Initial Environmental Examination

June 2014

CAM: Rural Roads Improvement Project II

Prepared by the Ministry of Rural Development for the Asian Development Bank.

ABBREVIATIONS

ADB	Asian Development Bank
APL	Angkor Protected Landscape
APSARA	Authority for Protection and Management of Angkor and the Region of Siem Reap
BOD	biological oxygen demand
DBST	double bituminous surface treatment
EIA	environmental impact assessment
EMP	environmental management plan
GoC	Government of Cambodia
GPS	global positioning system
GRM	grievance redress mechanism
IEE	initial environmental examination
HIV/AIDS	human immunodeficiency virus/acquired immune deficiency syndrome
MCFA	Ministry of Culture and Fine Arts
MT	motorized transport
MOE	Ministry of Environment
MRD	Ministry of Rural Development
NTFP	non-timber forest products
PDRD	Provincial Department of Rural Development
PDE	Provincial Department of Environment
ROW	right of way
SEO	Social and Environmental Office (in MRD)
SPS	ADB's Safeguard Policy Statement (2009)
TA	technical assistance
TSBR	Tonle Sap Biosphere Reserve
UNESCO	United Nations Educational Scientific and Cultural Organization
WB	World Bank

WEIGHTS AND MEASURES

°C	degree Celsius
cm	centimeter
dB(A)	decibel (with A scale weighting)
ha	hectare
hrs	hours
km	kilometer
km^2	square kilometer
mm	millimeter
m	meters
m/s	meter per second

NOTE:

In this report, "$" refers to US dollars. unless otherwise stated.

Contents

APPENDICES

FIGURES

TABLES

I. EXECUTIVE SUMMARY

1. The Cambodia Rural Road Improvement Project is classified as Environmental Category B and an Initial Environmental Examination (IEE) has been conducted as part of project preparation in accordance with the Safeguard Policy Statement (2009) of the Asian Development Bank (ADB).

2. The Project proposes upgrading of about 729 km of existing rural roads from gravelled roads to permanently paved roads with double bituminous surface treatment or concrete roads. There will be 39 roads located in nine provinces which will pass through 33 districts and 93 communes of Cambodia. These roads serve primarily rural communities and comprise a mix of well established and frequently trafficked road links and a number of links that are currently being or have been recently improved to gravel road standard. As the Project will only upgrade roads within existing widths, no land or other physical assets need to be acquired and hence there are no resettlement issues.

3. On 11 August 1999 a Sub-decree (No: 72 ANRK.BK) on environmental impact assessment (EIA) processes was promulgated requiring submission of an initial environmental impact assessment (IEIA) or an EIA for selected projects listed in the sub-decree annex to be submitted by project owners – public or private – to the Ministry of Environment (MOE) for review. For transport infrastructure projects, an environmental assessment is only required for construction of bridges with a capacity equal to or in excess of 30 tons or national roads involving construction or rehabilitation in excess of 100 kilometers in length. The individual roads vary in length from about 4.1 km to 43.0 km. There are no major bridges. As these criteria do not apply to this project, approval from MOE is not required.

4. In 2008 the Kingdom of Cambodia introduced its Protected Area Law (No. NS/RKM/0208/007), which explicitly defines protected areas.

5. Six of the roads proposed for improvement under this Project are located in the transition zone of the Tonle Sap Biosphere Reserve (TLSBR). As the road upgrading is in keeping with activities permitted in the Transition Zone, these works will not have adverse impacts on the TLSBR. Notwithstanding this, an environmental assessment has been prepared in accordance with ADB SPS 2009 and the TLSBR Management Authority have been contacted to confirm that they have no objection.

6. Another output has been added to the original design which is the Mekong River Island Connectivity Output. Though not originally planned during the design of Loan 2670, MRD subsequently requested ADB to rehabilitate roads and jetties within a Mekong River island cluster (part of mainland Kampong Cham Province) in order to improve climate resilient access and connectivity. Geographically located in the Mekong River but 11 km away from the mainland these 5 remote islands are highly vulnerable to flooding with no organized access either from the mainland or inter-island. Due to recent increasing calamities caused by climate changes, lack of access to emergency facilities have resulted in annual casualties of about 10 island residents. Based on the aforementioned rationale, this fifth output, improving climate resilient access, will incorporate climate change adaptation measures for the design and rehabilitation of 50 km rural roads as well as 11 jetties. This output will be piloted for the Mekong River island cluster of Kampong Cham Province, and replicated in other similar areas while strengthening associated policy approaches.

7. Although no formal approvals are required from the relevant ministries and

organizations it is still the policy of MRD and DDIS Consultants to inform other such organizations of the planned activities and they are consulted at all stages of the project.

8. Cambodia's climate is dominated by the monsoon which causes distinct wet and dry season. The southwest monsoon typically brings the rainy season from May to October. The northeast monsoon brings drier and cooler air from early November to March and then hotter air prevails in April and May. The southern part of the country typically has generally a 6-month dry season and the northern part of the country also a 6-month dry period although with climate change such generalizations need to be made with caution.

9. Vegetation cover along the project roads largely consists of agricultural crops such as rice, while some sections traverse areas covered with shrubs, grasses and sparse trees. No extensive removal of vegetation or tree cover is anticipated.

10. Condition surveys have been carried out of every road. Environmentally sensitive items such as schools, pagodas, clinics, utilities, water courses and trees etc. have been identified and the chainage given for each location. (See Appendix 1) These items will be drawn to the attention of the contractor and extra care demanded of the contractor when they are operating in these vicinities.

11. Only minor environmental impacts are anticipated during construction and these are considered temporary. To avoid or mitigate negative impacts arising from the Project, an environmental management plan (EMP) detailing mitigation measures and monitoring activities has been prepared as part of the IEE. Proper and timely implementation of EMP provisions will avoid or minimize environmental impacts concerning location of project roads and construction facilities, safety risks due to potential presence of unexploded ordnance (UXO), potential encroachment to culturally protected areas, disruption and damage to community facilities, dust and noise emission, damage to vegetation and loss of wildlife, soil erosion, waste disposal and other issues associated with construction works. During operation phase, the Project will have over-all positive impacts such as on the quality of life because the permanently paved roads will result in significant reductions in dust levels. A few potential adverse impacts during operation are also addressed in the EMP, such as those pertaining to traffic noise and road safety from increased traffic volume. These impacts can be mitigated through implementation of the EMP.

12. Public consultations involving affected people and local officials have been conducted through focus group discussions and individual interviews in all nine provinces during the preparation of the IEE in compliance with ADB's information disclosure and consultation requirements. No major issues have been identified.

13. A grievance redress mechanism will be established by MRD prior to start of site works to ensure that affected people's concerns, complaints, and grievances about the Project's environmental performance are promptly addressed. To ensure that Project is carried out consistent with the EMP requirements, MRD specifies in the tender documents and civil works contracts that implementation of the EMP is compulsory. MRD is assisted by the detailed design and implementation supervision (DDIS) consultant in monitoring the environmental performance of contractors. The DDIS consultant will also continue environmental management capacity building of the Social and Environmental Office established within MRD during Project implementation.

14. The project is confirmed as Category B in accordance with ADB SPS 2009. There are no overriding environmental reasons why the project should not proceed.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

15. After the formation of the new Royal Government of Cambodia following UN supervised elections that heralded the beginning of the end of internecine conflict over three decades in Cambodia, in 1993 a new Constitution was written and for the first time environmental considerations were included. Specifically Article 36 of the Law on Protected Areas regarding the imposing of ban on any developments in the core areas of the protected area, Article 44 of the Law which requires the social-environmental impact assessment to be conducted in regard to the development projects in the community and sustainable use areas and Article 59 *inter alia* states: t*he State shall protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rock and sand, gems, forests and forestry products, wildlife, fish and aquatic resources* and it was within this constitutional context that the Ministry of Environment (MOE) was established. The mission of the MOE is *inter alia* to: promote environmental protection and conservation of natural resources through the Kingdom thus contributing to improving environmental quality, public welfare, national culture and the economy. This has to be seen in the context of the Royal Government of Cambodia's three pillars of development, one of the three pillars being the sustainable use of natural resources and sound environmental management to reduce poverty and improve the livelihoods of all Cambodians. Concurrently, the project owner should follow; (i) -the Land Law, (ii) - Law on the Management of Aquatic Resources of the Kingdom of Cambodia, (iii) -Sub-Decree on the Water Pollution Control, (iv) -Sub-Decree on Solid Waste Management and (v) - Sub-Decree on the Control of Air and Noise Pollution as the environmental statndard relating to the development project.

16. Cambodia has entered into the following international agreements on Environment:

- International Conventions and Agreements Kyoto Protocol ratified - 2002
- United Nations Framework Convention on Climate Change (UNFCCC) ratified - 1995; Initial National Communication - 2000; Second National Communication (2012)
- Convention on Biological Diversity (CBD)- 1995
- Cartagena Protocol on Biosafety - 2003
- UN Convention to Combat Desertification (UNCCD) ratified – 1997
- CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) – 1997
- World Heritage Convention - 1991
- ASEAN Heritage Convention (National Parks: Bokor and Virakchey) (regional) - 2003
- Convention on the Prevention of Marine Pollution from Ships -1994
- Measures on prevention of climate change, ozone depletion, on freshwater resource protection and on sustainable forest ASEAN -1999
- Convention on Wetlands of International Importance (RAMSAR) - 1999
- Basel Convention on Control, Transport and Disposal of Trans-boundary Hazardous Waste- 2001
- Stockholm Convention on Persistent Organic Pollutants - 2001
- Vienna Convention and Montreal Protocol on Substances that Deplete Ozone Layer- 2001

17. In 1996 the Law on Environmental Protection and Natural Resource Management (No:NS/RKM/1296/36) came into force and it requires the government to prepare national and regional environmental plans and sub-decrees concerning a wide range of environmental issues, including EIAs, pollution prevention and control, public participation and access to

information. Other ministries that were explicitly mentioned at the time included the Ministry of Water Resources, Hydrology and Meteorology and Ministry of Land Use Management, Urbanization and Construction but by the end of the 1990s the list had been expanded to include the Ministry of Public Works and Transport, Ministry of Agriculture, Forestry and Fisheries, Ministry of Rural Development, Ministry of Health and Ministry of Tourism. On 11 August 1999 a Sub-decree (No: 72 ANRK.BK) on EIA Processes was promulgated requiring submission of an initial EIA (IEIA) or EIA for selected projects listed in the sub-decree annex to be submitted by project owners – public or private – to the MOE for review. For transport infrastructure projects, an environmental assessment is only required for construction of bridges with a capacity equal to or in excess of 30 tons or national roads involving construction or rehabilitation in excess of 100 kilometers in length. These categories do not apply to this project.

18. In 2008 the Kingdom of Cambodia introduced its Protected Area Law (No. NS/RKM/0208/007), which defines protected areas as (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.

19. Six of the existing roads proposed for improvement under this Project traverse the transition zone of the Tonle Sap Biosphere Reserve and it is within this legal context that MRD is required to undertake an environmental impact assessment. However, an environmental assessment is not required of rural roads, provided these are not located in abovementioned protected areas, irrespective of their length which legally would exempt the MRD from undertaking any type of environmental examination for some of the project roads.

III. DESCRIPTION OF THE PROJECT

A. Type and Category of Project

20. The Project will assist the Government of Cambodia to improve its rural road network by rehabilitating about 729 km of unpaved rural roads to paved condition. There will be 39 roads improved in nine provinces passing through 33 districts. Upgrading to a paved road standard will be undertaken without widening or realignment. The Project is classified as environment category B and an initial environmental examination (IEE) was conducted as part of project feasibility study in accordance with ADB Safeguard Policy Statement of 2009 (ADB SPS).

B. Need for the Project

21. By the early 1990s, the years of civil war had left the country's road network severely deteriorated. Since 1992, with assistance from the Asian Development Bank (ADB), the World Bank, Korea EXIM Bank and others, the Government focused on rehabilitating core infrastructure to support sustainable economic development. These efforts have brought the paved national road network to about 2,700 km in length, about 25% of the total national and provincial road network. However, with rural economy becoming increasingly dependent on the improved national road network, the rural road network continues to deteriorate due to rapidly growing traffic, lack of maintenance financing, poor road maintenance standards, inadequate institutional capacity in road maintenance and management, lack of private contractor capacity, and shortcomings in design and construction methods.

22. The proposed project aims to continue and expand the initiatives of Loan 2670 by rehabilitating about 729 km of rural roads in the 7 original project provinces and 2 additional provinces. As one activity of implementation supervision consulting services under Loan 2670, it was planned to design the proposed project to enhance ownership and capacity development of MRD, to build upon lessons learned in all outputs, and for a seamless continuation of initiatives between the two projects. The ongoing Loan 2670 has supported MRD's capacity development in applying road selection criteria, minimizing resettlement impacts, improving procurement efficiency, and strengthening project management.

23. **The project outputs.** There are five key outputs in this project: (i) rural road improvements; (ii) rural road asset management; (iii) rural road safety and community awareness program; (iv) project management support; and (v) connectivity improvements for Mekong River Islands. The first output is rural road improvements, to improve about 729 km of rural roads to climate resilient paved condition. This output also includes green planting and design and implementation supervision consulting services.

24. The second output of the project will improve rural road asset management in a sustainable manner through a strong capacity-building program. This program will continue the interventions initiated in Loan 2670, including the overloading prevention program for rural roads to efficiently manage the road assets.

25. The third output will increase the awareness and application of road safety and safeguards by (i) further expanding the pilot community-based road safety awareness program, initiated in Loan 2670, including education program for schools, drivers, road users, and the community that also incorporates road safety provisions in road design; (ii) further strengthening the capacity of the social and environment office in MRD established in 2012; (iii) implementing an HIV/AIDS and human trafficking prevention; and (iv) conducting a sex disaggregated baseline socioeconomic survey of project beneficiaries.

26. The fourth output is to strengthen the capacity of MRD to provide efficient project management support for project implementation. The project will also promote substantial positive employment and gender impacts in the rural communities under most of all outputs. The Gender Action Plan (GAP) will incorporate all the labor and gender mainstreaming in all 5 project outputs. Through lessons learned from ongoing Loan 2670, the project will strengthen MRD's focus more on all outputs equally as the tendency has been somewhat inclined towards road improvement activities. This will be achieved through increased MRD staff resources in social, gender, and safeguards areas.

27. The fifth output has two sub-outputs: (i) to rehabilitate roads and jetties within a 5-island cluster in the Mekong River (Koh Mitt, Koh Pir, Koh Samrorng, Koh Soutin, and Koh Thmei) in order to improve climate resilient access and connectivity. The civil works contract for rehabilitating roads and jetties also includes provisions for small-scale levees and water management interventions to minimize flooding; and (ii) to develop a climate change adaptation framework and its associated investments of minor activities of multisector nature (agriculture, renewable energy, tourism, water supply, etc.) that will be designed and implemented during the proposed project, include a community-based emergency management system. Although this output will be piloted for the Mekong River Island cluster, it may be replicated in other similar areas with remote access.

28. A full review of the environmental aspects of Connectivity Improvement of Mekong River Islands is given in Appendix 1 and Appendix 2.

29. The Project will provide improved access for beneficiaries to markets, employment opportunities, and social services in the project provinces. The expected outcome of the Project is safe, cost effective, all-year road access provided in the rural areas of the project provinces where most of Cambodia's rural poor live.

C. Project Location

30. The project roads are located in nine provinces of Cambodia as given in Figure III-1. Six of these provinces are in the Tonle Sap basin, namely Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap, and Kampong Thom. The remaining three provinces are Kampong Cham, Takeo and Kampong Speu. The project roads traverse 33 districts serving about 617,586 beneficiaries. The location of connectivity improvement for Mekong River Islands is given in Figure III-2.

D. Current Condition of Project Roads

31. The existing condition of the project roads is variable, ranging from those that have been re-gravelled recently and otherwise maintained to a good standard to roads that have not been maintained recently and are in a poor condition with a very high road roughness values with very little remaining laterite.

32. The individual roads vary in length from about 4.1 km to 43.0 km. The roads comprise a mix of well established and frequently trafficked road links and a number of links that are currently being or have been recently improved to gravel road standard. Some of these roads carry less traffic than others at present. However, they form important links from national roads or provincial roads to new or established community centers. MRD has invested recently to widen existing earth roads to 5.5 m or 6.0m and placed laterite on the top. On some project roads, upgrading works are ongoing, but these are expected to be completed before the implementation of the proposed project. Most of the project roads links to a national, provincial road or RRIP roads and provide access to the road network at large.

33. Some bridges in the project roads have been constructed with timber long time ago, which will be replaced by new bridges. There are a number of cross drainage structures such as box culverts and concrete pipe culverts. Some of them have been constructed new and in good conditions. But many of pipe culverts are needed to be replaced for efficient drainage during wet season and increasing discharge capacity against future climate change.

E. Current Traffic Condition

34. Nearly 80% of the traffic along the project roads consists of motorcycles ranging from about 160 to 3,000 per day. The roads are also used by light 4 wheeled vehicles and some small trucks. Heavy trucks transport rice crops at harvest season. It is also important to recognize the usage of these roads by non-motorized traffic, especially children and poorer people who are either pedestrians or use bicycles or where animal-powered transport is also in use.

Figure III-1 Location Map of Project Roads

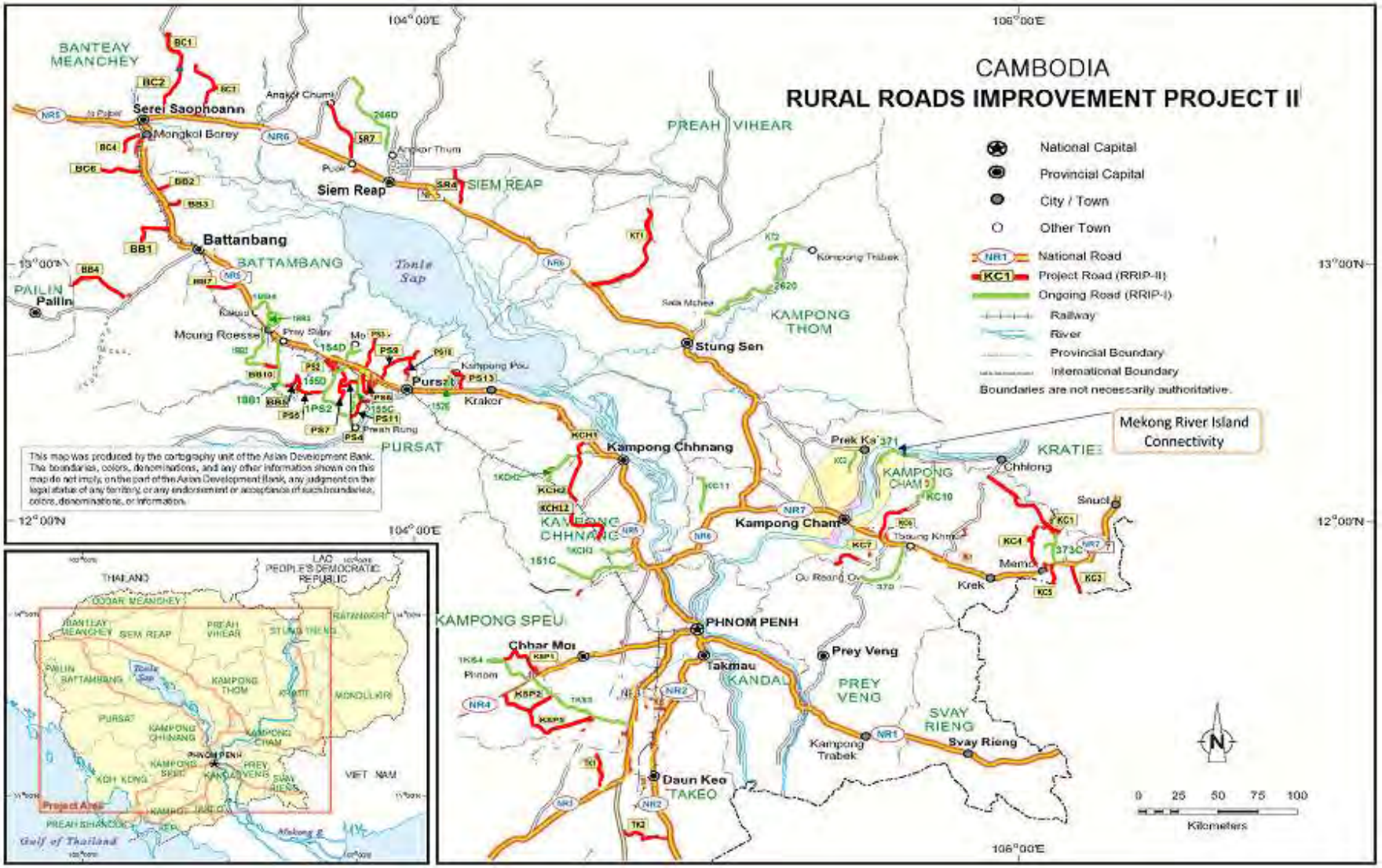
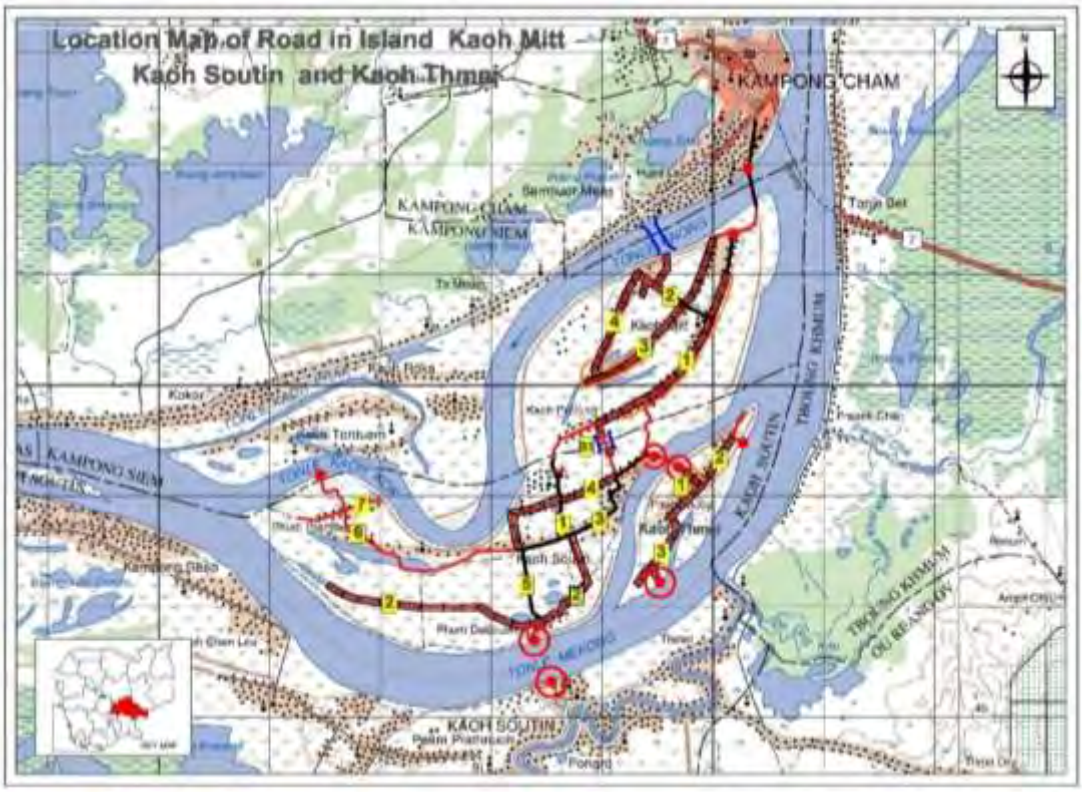


Figure III-2 Location Map of Mekong River Islands



Kaoh Mitt, Kaoh Soutin and Kaoh Thmei

Kaoh Samraong

Kaoh Pir

F. Proposed Works

35. The project proposed the upgrading of 729 km in 9 target provinces, 39 existing rural roads (679 km) and 50 km of Mekong River island roads in Kampong Cham province. The list of project road is given in Table III.1. The location maps of project roads by province are shown in Appendix 3.

Table III-1 List of Project Roads

Province	Road No.	Road Name	District	Length (km)
Kampong Cham	KC1	Veal Toch-Kabas	Dambe and Memot	43.0
	KC3	Khlong Tboung-Beung Chroung	Memot	13.0
	KC4	Phlak Samraong-Teuk Tum	Memot	24.8
	KC5	Memot-Doun Roath	Memot	9.8
	KC6	Mream Teak-Trapeang Rusey	Tboung Khmum	25.2
	KC7	Phsa Torsu-Chroy Sosit	Ou Reang Ov and Kaoh Soutin	17.2
			Subtotal (6 roads)	**133.0**
Takeo	TK1	Tram Kok-Mungkol Meanlech	Tram Kok	16.5
	TK2	Pich Sar-Sobin	Kirivong	18.3
			Subtotal (2 roads)	**34.8**
Kampong Speu	KSP1	Kraing Khcheay-Kandal	Phnum Sruoch	18.6
	KSP2	Talat-Kandal	Phnum Sruoch	23.1
	KSP5	Phsa Slab Leng-Sala	Basedth and Phnum Sruoch	33.5
			Subtotal (3 roads)	**75.2**
Kampong Chhnang	KCH1	Chheu Neak-Preal	Rolea Bier	4.1
	KCH2	Thmar Reab- Veal Sbov	Rolea Bier/Tuek Phos	22.9
	KCH12	Thnal-Alaing Ke	Teuk Phos-Samaki Meanchey	11.5
			Subtotal (3 roads)	**38.5**
Pursat	PS2	O Tapoang-Rum Lech	Bakan	8.6
	PS3	Trapeang Chorng-Beung Botkandal	Bakan	16.1
	PS4	Trapeang Chorng-Khna Toteung	Bakan	5.1
	PS5	Talo-Prahal	Bakan	13.1
	PS6	Trapeang Chorng-Snam Preah	Bakan	14.3
	PS7	Beung Khnar-Phteas Rong	Bakan-Phnum Kravanh	21.9
	PS9	Phteas Prei-Sre Sdok	Pursat Town-Kandieng	18.0
	PS10	Kandieng-Sre Sdok	Kandieng	12.0
	PS11	Bak Chinchean-Phteas Rong	Phnum Kravanh	8.2
	PS13	O Sandan-Kampong Po	Krakor	8.2
			Subtotal (10 roads)	**125.5**
Battambang	BB1	Ou Ta Ki-Ta Kream	Thmor Kol / Banan	19.6
	BB2	Chroy Sdao-Nikom	Thmor Kol	6.0
	BB3	Ta Meun-Taa Poung	Thmor Kol	8.7
	BB4	Sdao-O Khum	Rattana Mondol	29.2
	BB5	Sdok Pravoeuk-Svay Yor	Rokkha Kiri	14.6
	BB7	Kampong Preang-Svay Cheat	Sang Ke	11.6
	BB10	Preaek Chik-Prey Tralach	Rokkha Kiri	5.5

Province	Road No.	Road Name	District	Length (km)
			Subtotal (7 roads)	**94.8**
Banteay Meanchey	BC1	Thmaor Pourp-Pheas Thbaung	Thmor Pourk/Svay Chek	27.2
	BC2	Sala Krav-Pheas Thbaung	Preah Netrpreah/Svay Chek	17.4
	BC3	Chup Vary-Ponley	Preah Netrpreah/Phnom Srok	27.0
	BC4	Prek Chik-Thnal Bot	Mongkol Borei	9.1
	BC6	Or Nhor-Ta Sol	Mongkol Borei	10.0
			Subtotal (5 roads)	**90.7**
Siem Reap	SR4	Khchas -Chan Sar	Sutr Nikom	17.0
	SR7	Angkor Chum-Puok	Puok	29.5
			Subtotal (2 roads)	**46.5**
Kampong Thom	KT1	Thnort-Ou Angkor	Stoung and Prasat Balangk	40.0
			Subtotal (1 road)	**40.0**
			Total 9 Provinces (39 roads)	**679.0**
Mekong River Island Roads				**50.0**
Total Project Roads				**729.0**

Source: Feasibility Study Report of DDIS consultants, 2014

36. All project roads have been surveyed for environmental impacts and no significant adverse environmental impacts are associated with these roads. The roads will be upgraded from laterite surface to a paved condition by double bituminous surface treatment (DBST), and concrete roads for Mekong River island roads. The provision of a durable paved road with a structural design life of 15 years will improve accessibility and riding quality, thereby reducing road maintenance costs and road user costs. Although it will be more costly to construct paved roads, the whole life costs of the road will be lower. During the design life the road will require resealing to maintain the integrity and waterproofing function of the bituminous seal. The Project will include placement as necessary of sub-base and road base, using unbound natural aggregate materials for the road pavement. The works also involves replacement or repair of existing bridges and cross drainage structures such as box culverts and concrete pipe culverts. It also involves slope protection and installation of necessary road furniture for safety of vehicle and pedestrians. The existing road width will be maintained without widening to avoid resettlement impact. The condition survey results and photos are shown in Appendix 4 and Appendix 5.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

37. Cambodia lies in the southwestern part of the Southeast Asian peninsula and has a land area of 181,035 km^2. International borders are shared with Thailand to the west, the Lao People's Democratic Republic to the north, and the Socialist Republic of Vietnam on the east and southeast. The country is bounded on the southwest by the Gulf of Thailand and has a coastline of 440 km.

38. **Climate.** Cambodia's climate is dominated by the monsoon which causes distinct wet and dry seasons. The southwest monsoon typically brings the rainy season from May to October. The northeast monsoon brings drier and cooler air from early November to March, then hotter air prevails in April and early May. The southern part of the country typically has a

two-month dry season whereas the northern areas have a four-month dry season although weather patterns have been changing and what is typical is now increasingly problematic.

39. The annual mean rainfall is 1,400 mm in the central lowland regions and can reach 5,000 mm in coastal areas. However, there are really no reliable rainfall databases for the Project zones and rainfall can vary from a low of less than 1,000 mm to a high of 2,000 mm. The existing pools or ponds which are located close to the rural roads under the development and are key sources of water for regular consumption of the people (from example, in Kampong Speu Province). The relative humidity is high throughout the year, usually exceeding 90%, and even in the dry season rarely falls below 50%.

40. Temperatures are fairly uniform throughout the country, with only small variations from the average annual temperature of around 28°C. January is the coldest month where temperatures as low as 12°C have been recorded and April is the warmest where temperatures reach 42°C. Most of Cambodia's regions have an average wind velocity of less than 3 m/s. Maximum wind speeds can reach in excess of 20 m/s during the wet season. During the dry season the maximum wind velocities are lower and are commonly in the range of 6 - 8 m/s.

41. **Topography.** Cambodia is divided into three distinct topographic regions: the central plains, the flat coastal areas, and the mountain ranges with high plateaus. The central plains form 75% of the country and consist of the alluvial plains of the Mekong River and the Tonle Sap basin where the project roads are located. These are Cambodia's two dominant topographical features and this is where over 90% of the population resides. The road sections are generally in flat terrain.

42. **Air Quality and Noise.** The Project roads traverse primarily agricultural areas and villages/residential areas in rural settings with no industrial development. Currently, main sources of air pollution are dust emission due to passage of vehicles along the unpaved project roads. Sources of noise are community activities (especially near markets) and the existing traffic largely composed of motorcycles.

43. **Surface Water.** The Project roads cross a number of rivers, streams and irrigation canals. Within the Project area, surface run-off on exposed soil and erosion of river embankments cause turbidity in some of the watercourses. Surface water pollution from domestic sewage along sections where densely populated villages are found as well as run-off from surrounding agricultural fields may also be expected.

44. **Flooding.** Several of the project roads are in areas known to be prone to flooding. According to Provincial Department of Rural Development (PDRD), recent agricultural developments have changed the patterns of water movements such that culverts at new locations are required. Coordination with the ongoing Climate Change Adaptation Output will continue and Vulnerability Maps produced under that Output will be used to identify areas likely to be vulnerable to flooding in the future due to climate change induced higher flood levels.

B. Ecological Resources

45. **Flora**[1]**.** Forests make up a major part of the country's natural resources. Hill evergreen, tropical rain and dry land evergreen forests are found in the humid coastal ranges, humid northeastern uplands, and the very humid to sub-humid low altitude areas. Freshwater

[1] Cambodia Journal of Natural history, ISSN 2226-969, August 2013 Vol 2013 No.1 Centre for Biodivertcity Conservation, Royal University of Phnom Penh and Fauna and Flora International

inundated forests are found in the Tonle Sap Lake and in areas of the Mekong River. Mangrove forests are found along the coasts of Kaput and Kohl Kong provinces. In 1960 Cambodia's forests covered 73% of the total land area of the country. By 1998 the forest cover had decreased to 58% and at least until the mid-2000s it was estimated that Cambodia was losing forest cover at the rate of 2% per annum. The reduction has been attributed mainly to commercial logging, illegal logging (both large and small scale), large scale agricultural concessions, fuel wood collection, non-traditional shifting cultivation and the settlement of new villages. Secondary measures include forest fires and infrastructure development. Nevertheless, Cambodia still has substantial forest cover in comparison with other GMS countries with the exception of the Lao PDR.

46. In the Project provinces, there are some protected forest areas and indigenous tree species (e.g. the *Diptherocarpus* species) that are protected by Cambodia's Forestry Law of 1995. However, as the primary land use along the Project roads is agricultural and residential, these forests are not located in the vicinity of the roads proposed for upgrading. Concession forests may be harvested for sale but there are no longer such concessions in the Project zone. Community forests are managed by local residents who must abide by a management plan that is supervised by the Forestry Department. The community has access to the forest and may remove forest products and cut trees for their own use but they are prohibited from selling the trees. Timber harvesting for sale is only allowed from forest concessions. There are also non- timber forest products (NTFPs) that poorer households rely on such as bamboo, resins, wild fruits and vegetables, honey bees and other insects, and larger wildlife, although the collection of some NTFPs for commercial purposes are circumscribed by Cambodian laws. The Project Excuting Agency (MRD) should properly conduct annual review and revision according to the Forest Laws.

47. Vegetation cover along the project roads largely consists of agricultural crops such as rice, while some sections traverse areas covered with shrubs, grasses and sparse trees. The Project roads are located within or in close proximity to three of Cambodia's agro-ecological zones, which are based on a study of available data, including soil maps, topographic maps and land use maps. In all three zones lowland rice cropping is the main activity but other crops grown include soybean, cassava, and cashew. Fruit and vegetables crop are also cultivated although primarily for domestic consumption. Large and small livestock are raised and some households during the early dry season once the rice harvest is completed travel to flood recessed areas of the Tonle Sap to cultivate flood recessed rice and fish.

48. **Fauna[2].** Cambodia has a rich biodiversity. The forests, wetlands and other habitats support many species of flora and fauna, including 212 species of mammals, 536 species of birds, 240 reptile species, 850 freshwater and 436 marine fish species and more than 2,300 plants (800 of these plants are used in for the local manufacture of traditional Khmer medicine).

49. **Fishery[3].** Fish is the most important source of animal protein in the diet of all Cambodians, constituting upwards of 75% of total animal protein input. Fish are also an important source of calcium and Vitamin A, especially for the rural poor. On average the countrywide consumption rate is 65.5 kg/capita/year. Each year, Cambodia's combination of subsistence,

[2] Cambodia Journal of Natural history, ISSN 2226-969, August 2013 Vol 2013 No.1 Centre for Biodivertcity Conservation, Royal University of Phnom Penh and Fauna and Flora International

[3] Integrated Analysis of Data from MRC Fisheries Monitoring programmes in the Lower Mekong Basin, ISSN: 1683-1489, Mekong River Commision, MRC Technical Paper No.33 August 2013

middle-scale and large- scale commercial fishing harvests produce 300,000 to 430,000 tonnes of freshwater fish. This production ranks fourth in the world and is worth approximately US$300 million. However, there have been incremental declines in fish catches and it is now estimated that less than 250,000 tonnes of fish is being caught, consisting of approximately 105,000 tonnes of household fisheries, 75,000 tonnes of rice field fisheries and 68,000 tonnes of middle and large-scale fisheries (marine fisheries production account for an additional estimated 55,000 tonnes).

50. **Ecologically Protected Areas.** The National Environmental Action Plan 1998 specifies four types of protected areas. These are national park, wildlife sanctuary, protected landscape and multiple-use management area.

51. The Tonle Sap is the largest freshwater lake in the Greater Mekong Sub-Region with an area of 2,500-3,000 km^2 in the dry season and 10,000 – 15,000 km^2 in the wet season with water depths ranging from 1 meter in the dry season to 10 meters in the wet season and home to nearly one-third of Cambodia's population. In 1997 it was nominated as a Biosphere Reserve under the Man and the Biosphere Reserve Program of United Nations Education and Scientific Cooperation Organization (UNESCO). Biosphere reserves are nominated by governments and remain under their jurisdiction. Reserves are intended to fulfil three complementary functions: (i) a conservation function; (ii) a development function; and (iii) a logistic function. The Tonle Sap Biosphere Reserve (TSBR) has the following zones:

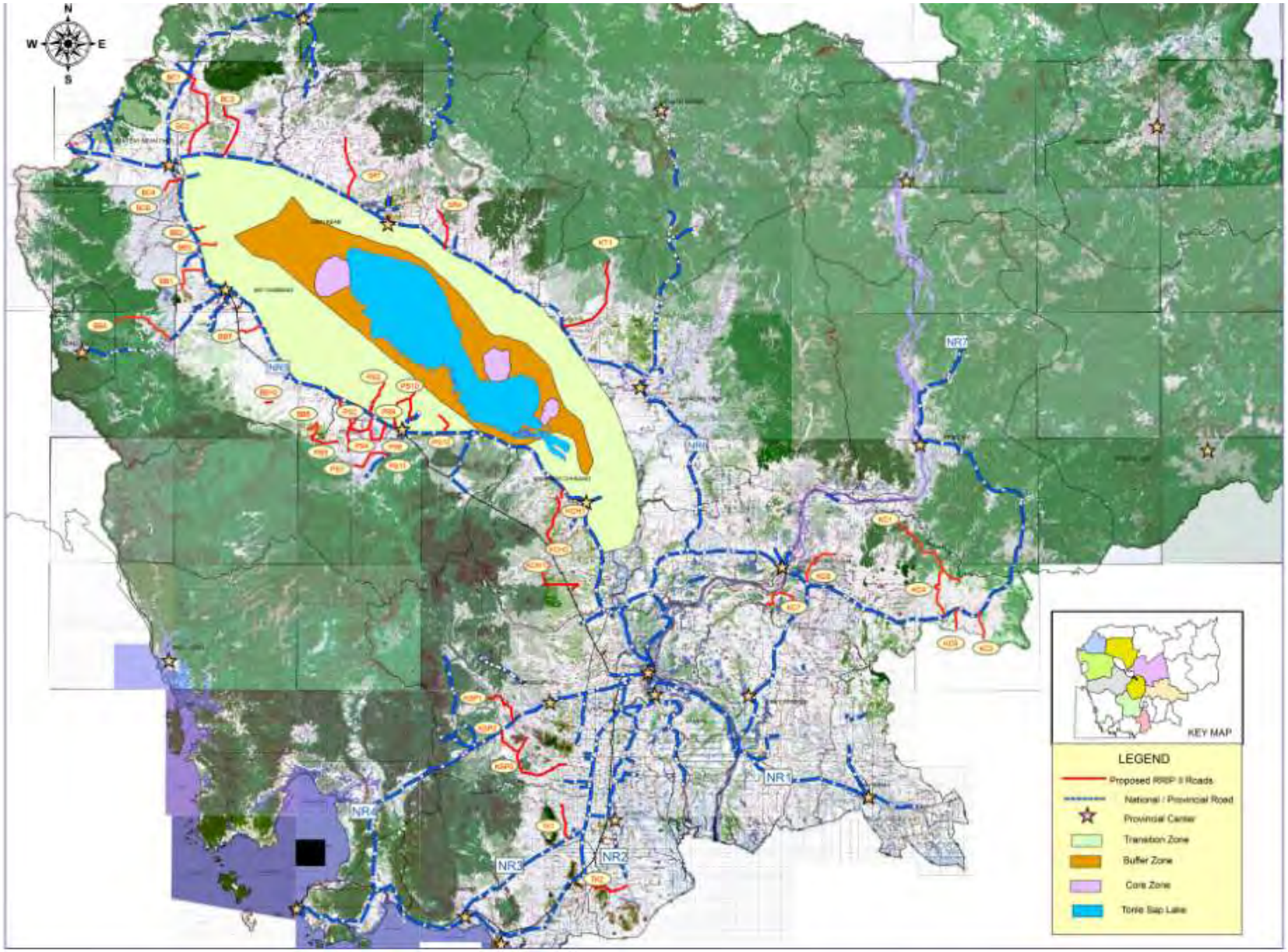
(i) *Core areas* are securely protected sites for conserving biodiversity, monitoring minimally disturbed ecosystems, and undertaking research and other low-impact uses such as education. The TSBR core areas cover a total of about 43,000 ha which are characterized by a flooded forest, streams and water bodies, and rich biodiversity. Nearly 100 water bird species are found there, a dozen of which are of global significance. The areas are also known for their fish, mammals, and reptiles. The three core area of TSBR are as follows:

a. Prek Toal Core Area located in Koh Chiveang Commune, Ek Phnom District, Battambang province (21,342 ha)
b. Boeng Tonle Chhmar Core Area located in Peam Bang Commune, Stong District, Kampong Thom province (14,560 ha)
c. Stoeng Sen Core Area located in Phat Sanday Commune, Kampong Svay District, Kampong Thom Province (6,355 ha)

(ii) The *buffer zone* covers about 541,482 ha and is used for cooperative activities compatible with sound ecological practices, including environmental education, recreation, ecotourism, and research. Its boundary corresponds to the outer boundary of the Tonle Sap Multiple-Use Area. The TSBR buffer zone surrounds the core areas up to the outer limit of the flooded forest.

(iii) The *transition area* is the outer zone which covers 899,600 ha. It is intended to be flexible and allows development in keeping with the needs of the local population. The transition area forms the interface between the TSBR and common land. The southern edge of TSBR transition zone forms a boundary with national road NR5. These boundaries are shown in **Figure IV-1**. The flexible transition area is the integrated economic zone, which is managed for the sustainable agriculture, human settlement and land uses, without having adverse effects on the flooded forest, water quality and soils of the region around the Tonle Sap Lake.

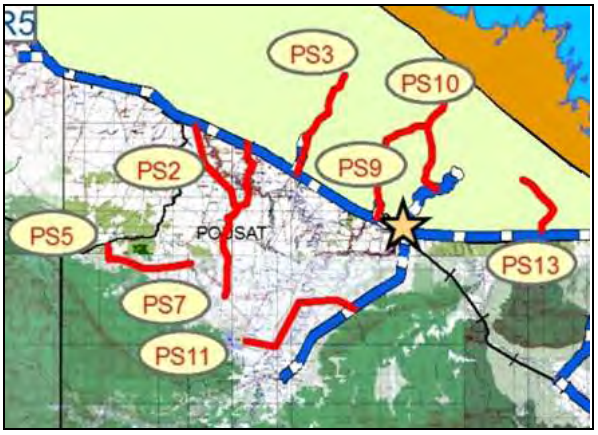
Figure IV-1 Location of Project Roads with respect to boundary of Tonle Sap Biosphere Reserve



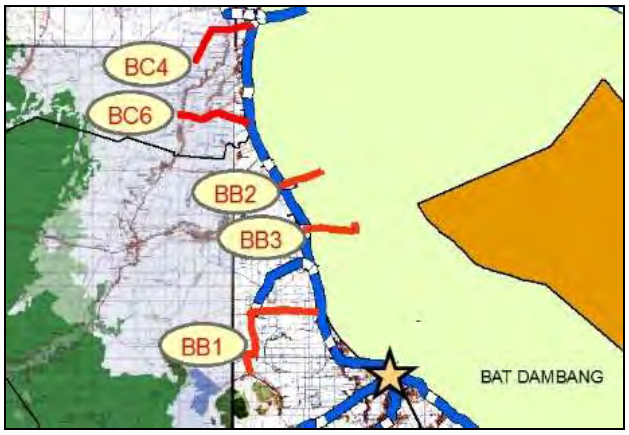
52. None of the project roads are located within the core and buffer zones of TSBR. But, 7 project roads in 3 provinces around the Tonle Sap Lake are located within the transition zone of TSBR where human settlements are found and agricultural cropping and livestock are the main livelihood activities. The roads inside the transition zone are listed below and the Figure IV-2 shown the locations of the roads by each province.

(a) PS3, PS10, PS9 and PS13 in Pursat Province
(b) BB2, BB3 in Battambang Province

Figure IV-2 Locations of Project Roads in the Transition Zone of TSBR



Pursat Province



Battambang Province

53. As stated all of the roads are in the Transition Zone and not in the Buffer Zone. The distance from each road to the Buffer Zone at the nearest point is shown in Table III-I below.

54. The proposed works under this project are totally in keeping with the requirements of the transition zone as stipulated by the Tonle Sap Biosphere Reserve Secretariat. No impacts will occur in the Buffer Zone and no adverse impacts will occur in the Transition Zone.

Table III-1 Proximity of Project Roads to Tonle Sap Buffer Zone

Name of Road inside Transition Zone	Province	Distance from end of road to Tonle Sap Buffer Zone
PS3	Pursat	11.70kms
PS10	Pursat	8.20kms
PS13	Pursat	6.75kms
BB2	Battambang	15.00kms
BB3	Battambang	8.70kms

55. All roads to be improved are existing roads. No new roads will be constructed. The

closest that any of the roads approach to the Buffer Zone is 6.75 km in Pursat Province.

C. Culturally Protected Areas

56. The famous Angkor Protected Landscape (APL) covers about 401 km^2 and was declared a UNESCO World Heritage site in 1992. The different zones of this protected landscape[3] are as follows:

(i) *Zone 1*- Monumental site. This zone is the core zone, monumental sites and protected archaeological reserves. It has the most significant archaeological features and the highest level of protection;
(ii) *Zone 2* - Protected archaeological reserves. This zone acts as buffer zone, around the monumental sites;
(iii) *Zone 3* - Protected cultural landscapes. Preserved for their distinctive traditional physical and cultural features, including historic buildings and land use practices;
(iv) *Zone 4* - Sites of archaeological, anthropological or historic interest. This zone is of less significance than the zone 1 and 2, but requires protection for research, education and tourism; and
(v) *Zone 5* - The socio-economic and cultural development zone of the Siem Reap-Angkor region. This zone covers the whole of Siem Reap province and broadly corresponds to the catchment area of greater metropolitan Angkor. This zone is to be managed as a multiple-use area with an emphasis on economic and social development through sustainable natural resource use and cultural tourism.

57. There is no project road within this culturally protected area.

D. Social and Economic Development

58. Most people in the Project zone are ethnic Khmer and largely Buddhist although there are a few Christian households largely as a result of some NGOs with programs in rural areas. Literacy and numeracy rates for males over 18 ranges from a high of 78.2% in Kampong Cham (68.2% for females) to a low of 69.5% in Kampong Thom (59% for females), according to the social impact study undertaken as part of activities associated with this Project. Completion of primary schooling ranges from a high of 73.5% in Battambang (68.5% for females) to a low of 60% in Kampong Thom (58.2% for females). Males who have completed higher and further education range from a high of 1.6% in Kampong Cham (1.1% for females) to a low of 0.8% in Kampong Speu (0.9% for females) according to recent surveys[4]. Somewhat higher literacy and numeracy rates are reported for the ethnic Cham, the only significant ethnic minority group living along several of the Project roads in Kampong Cham and Pursat. These ethnic Cham are Muslim but consider and are considered to be Cambodians and are very well integrated with the majority ethnic Khmer population.

59. Housing construction materials range from the use of NTFPs typically belonging to the poorest and most vulnerable households to houses constructed using permanent building materials such as wood, concrete, steel and iron that belong to better off households. Very few households have access to sanitary toilets and access to water within 150 meters of the house

[4] DDIS Consultants Socio-economic Study for RRIP II, April 2013

ranges from a high of 91.2% in Kampong Chhnang to a low of 71% in Battambang and there are serious seasonal water shortages in four of the Project zones (Siem Reap, Kampong Speu, Pursat and Battambang). Most of the major diseases are waterborne such as diarrhea although other diseases include malaria, tuberculosis and upper respiratory infections. HIV/AIDS rates appear to be quite low but there is a reluctance to report on people living with AIDS. There are local health centers in each of the communes but service provision is problematic and many people prefer to use private clinics than such centers. Use of these centers by women giving birth is very low.

60. Most people derive their livelihoods from some type of agriculture, most notably the cultivation of wet season rice (although poorer households rely on common property resources in forestry and fishing to a greater extent than better off households) but over the past decade a significant number of younger people, especially females from the Project zone have secured employment in the garment-assembly industry although as Cambodia faces strong competition from other lower cost producers of garments there may no longer be the same number of off-farm waged employment opportunities available. For households able to derive a portion of their incomes from off-farm or non-farm based income generation opportunities (e.g. owning or managing small grocery shops, tailoring and dress-making, wood-working, vehicle repair, provision of beauty services, managing cultural and religious festivities and producing handicrafts) there are generally greater opportunities to increase incomes and reduce exposure to seasonal vulnerabilities such as food shortages. This has reduced their reliance on natural resources.

61. Food poverty rates vary from a low of 12.5% in Kampong Cham to a high of 53.4% in Kampong Speu but three provinces (Kampong Speu, Siem Reap and Kampong Thom) have poverty rates well in excess of the national poverty rate of 36.1% in 2008. Major causes range from land shortages in Kampong Cham, Siem Reap and Battambang to lack of non-farm income generation activities in Kampong Thom, poor transport links in Kampong Speu and Pursat and lack of access to credit in Kampong Chhnang but in actuality there are multiple causes, including especially high expenditures on healthcare, right throughout the Project zones. The most vulnerable households are those with less than 0.5 hectares of productive agricultural land ranging from 39.5% of all households surveyed living along the Project roads in Kampong Cham (although fertile land used for vegetable cultivation is a mitigating factor) to 14.8% in Kampong Thom (but here low rice yields during the wet season and lack of dry season cropping opportunities are major causative factors). These households are often female-headed households but not exclusively so because there are also physically impaired people with a high dependency ratio that are also very vulnerable.

62. Cambodia has 27 different soil types but the main ones in the Project zone are either soils developed on the old alluvial terraces of the colluvial-alluvial plains. Four types – Prey Khmer, Prateah Lang, Bakan and Tuol Samroung – are where most of the agricultural production occurs although just one, the Toul Samroung, which occupies just 10% of the rice area is really suited to high yielding rice production. Soils developed on the active flood plains – Kabal Po and Krakor – are also highly suited for rice production and occupy approximately 30% of soils where rice production takes place in the Project zone. Such soils respond well to improved ditch and drainage irrigation and judicious application of fertilizers if there is also a timely available of suitable seed varieties, which unfortunately is not always so in Cambodia. However, yields have increased incrementally over the past two decades with wet season yields averaging 2.4 tonnes per hectare and dry season yields (only 15% of rice produced) averaging almost 3.7 tonnes per hectare. These are below regional averages but the labor intensive system is currently recording average yields of 3.6 tonnes per hectare in the wet season. In 2008, Cambodia produced a surplus of 3 million tonnes although there are still food security problems for

rice deficit households.

63. Cambodia's natural mineral resources include gem stones such as sapphires, ruby and zircon; coal, offshore gas and oil; basalt, granite, limestone, dolomite, quartzite; and phosphate deposits. There are no major mineral resources in the vicinity of the project roads, although in close proximity to project roads in Kampong Cham and Kampong Chhnang there are white clay and clay for cement non-metallic deposits.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES 300

A. Pre-construction Phase

1. Unexploded Ordnance

64. A land mine or unexploded ordnance (UXO) risk is widespread in Cambodia including the provinces in which the proposed project will be conducted. The works are to upgrade existing roads without widening. Nevertheless, a risk remains since there may be deep seated anti-tank mines that could be exploded by heavy construction equipment and shallow ordnance may be uncovered during the works. For replacement of bridges and drainage structures, these treats are increasing as many of UXO are moved along rivers and streams during flooding time. The detailed design and implementation supervision consultant (DDIS) shall engage a UXO specialist to determine the level of risk of each of all project roads and advise on the need for clearance. Any clearance that is required will be undertaken through the civil works contracts, by the engagement of qualified local UXO clearance firms. The contractor shall only commence site works after the UXO clearance firm has certified that areas are already cleared.

2. Grievance Redress Mechanism

65. During site preparation and construction phases, there may be complaints related to the environmental performance of the project. To ensure that there will be a mechanism to resolve such complaints, MRD shall undertake the following prior to start of site works:

i) establish a grievance redress mechanism (GRM)
ii) make public the existence of the GRM through public awareness campaigns
iii) ensure that names and contact numbers of representatives of MRD and contractors are placed on the notice boards outside the construction site and at local government offices (e.g., provincial and commune levels)

More details are given in Section VII.

3. Climate Change and Hydrological Impacts

66. A rapid climate change assessment of adaptation needs was undertaken for the Project in October 2009. Findings showed that existing climate change projections supported by field observations highlight two major concerns related to current and future climate changes. Specifically, there appears to be an overall increase in average total annual rainfall and, this increase is poorly distributed over seasons, resulting in increased floods during the rainy season as well as increased drought incidence during the dry season. Droughts are significant especially for unpaved roads as dust levels increase and reduce visibility and create poor local air quality. Flooding and soil moisture content is a primary concern for protecting investments in roadworks and will be addressed as a priority in the climate change adaptation strategy to be implemented under the Project. The strategy will seek to strengthen the overall objective of the Project to improve rural road mobility. It will do so by:

i) Protecting the road infrastructure from the impacts of climate change and,
ii) Ensuring that the road infrastructure does not increase the vulnerability of the surrounding area to climate change.

67. To address hydrological impacts, the project shall provide for appropriate design of roadside and cross drainage systems, where necessary, to avoid flooding on project roads as well as in areas surrounding the road embankment. The road embankment, bridges and drainage facilities shall be designed based on the historical flood data and flood forecasting. Erosion control and slope stabilization measures shall be included in the design, as appropriate, such as side ditches, berms, stone ripraps, and gabions along the road, tree planting in areas of high erosion risk, cross drainage to accommodate floodwater/run-off in case road sections are on elevated fills that will obstruct natural drainage.

4. Encroachment on Historical/Cultural Areas

68. The Project involves the permanent sealing of existing alignments and on none of the project roads will any of the alignments be widened or adjusted. Therefore, impacts to cultural relics are not anticipated.

5. Disruption to Community Utilities

69. Although the project will not require road widening, some of the site works may require relocation of some utilities. To ensure that there will only be minimal interruptions to affected utilities, the contractor shall re-provision water supply pipelines, irrigation canals and other facilities prior to commencement of site works. This will be done in agreement with the local community and the utility management authorities / company.

6. Impacts on the People's Plants

70. The Project should also highlight the impacts taht may have on the people's to be be cut down together with the corresponding mitigation measures in place.

B. Construction Phase

1. Encroachment/Damage to Culturally Significant Areas

71. The Project will involve improvements to existing roads by paving with DBST without widening or realignment. To ensure that site works and other project-related activities shall not adversely affect culturally significant sites:

(i) All project-related activities shall be implemented consistent with the policies, rules and regulations governing APL
(ii) The contractor shall ensure that project activities shall not cause damage to any archaeological relics within APL.

72. In the event of any construction work uncovering or revealing archaeological relics these shall be deemed a “chance find” and reported as such to the Ministry of Culture and Fine

Arts or APSARA. All work on the site must stop until MoCFA or APSARA issue a statement that work may be resumed.

2. Air Quality Impacts

73. Dust from the currently unpaved project roads is a major nuisance for roadside residents, especially those in built-up areas. However, during construction the dust nuisance is likely to be greater and people who suffer from upper respiratory illnesses in settlements contiguous to the project roads are likely to experience greater levels of discomfort than would normally be the case during the hot, dusty times of the year. However, this impact is considered temporary and the project will have positive impacts on the quality of life of roadside residents as it will result to significant reduction in dust after completion of the project. During construction, air pollution sources are dust due to earthworks and stockpiling, extraction of fill materials and transport of construction materials such as earth, stone, gravel, sand, and cement; as well as gaseous emissions from construction equipment, vehicles and asphalt mixing plants; extraction of fill materials; etc. These impacts, however, are considered temporary and localized. Improved air quality due to considerable reduction of dust levels during operation phase is anticipated. The following mitigation measures shall be implemented by the contractors to minimize impacts to air quality:

(i) Construction equipment will be maintained to a good standard. Immediate repairs of any malfunctioning construction vehicles and equipment shall be undertaken.
(ii) Equipment and vehicles not in use shall be switched off.
(iii) Machinery and vehicles causing excessive pollution (e.g., visible smoke) will be banned from construction sites.
(iv) All construction equipment and vehicles shall have valid certifications indicating compliance to vehicle emission standards.
(v) Siting of bitumen plants, concrete mixing plants, crushing plants and other facilities that cause high dust and/or gaseous emissions should be at least 500 m from settlements and other sensitive receptors (schools, hospitals, etc.)
(vi) Necessary environmental clearance/approval shall be obtained prior to establishment and operation of asphalt mixing plants, crushing plants and other facilities.
(vii) On rainless day undertake watering, at least twice per day, on dusty and exposed areas at construction yards, materials stockpile, construction sites, access roads, quarry areas, borrow sites and other project areas where residential sites and other sensitive receptors are located nearby.
(viii) Tightly cover trucks transporting construction materials (sand, soil, cement, gravel, etc.) to avoid spills and dust emission.
(ix) Impose speed limits on construction vehicles to minimize dust emission along areas where sensitive receptors are located (houses, schools, hospitals, temples, etc.).
(x) Position any stationary emission sources (e.g., portable diesel generators, compressors, etc.) as far as is practical from sensitive receptors;
(xi) Burning of wastes generated at the construction sites, work camps and other project- related activities shall be strictly prohibited.
(xii) Provide temporary covers (e.g., tarpaulins, grass, etc.) on long term materials and spoils stockpiles.
(xiii) Clean road surfaces of debris/spills from construction equipment and vehicles.
(xiv) Install temporary fencing or barriers around particularly dusty activities in vicinity of

sensitive receivers.

(xv) Locations for stockpiling spoils, fill and other materials with high dust content shall be at least 500 m from the nearest residential areas and other sensitive receivers.

3. Noise and Vibration Impacts

74. Elevated noise and vibration levels are likely to be experienced during construction phase due to site works and operation of various equipment and vehicles. To minimize noise and vibration impacts, the following measures shall be implemented by the contractor:

(i) No noisy construction-related activities (e.g., transport of materials along residential areas and other sensitive receptors, piling, use of jackhammer, etc.) will be carried out from (2100 hrs to 0600 hrs) along residential areas, hospitals and other sensitive receptors.

(ii) Noisy construction activities will be avoided during religious or cultural events in close proximity to the roadside such as Friday prayers attended by Muslim Cham, when ethnic Khmer are attending temple festivals or holding weddings, etc.

(iii) All construction equipment and vehicles shall be well maintained, regularly inspected for noise emissions, and shall be fitted with effective muffler and other appropriate noise suppression equipment consistent with applicable national and local regulations.

(iv) Use only vehicles and equipment that are registered and have necessary permits. Truck drivers and equipment operators shall avoid, as much as possible, the use of horns in densely populated areas and where there other sensitive receptors are found such as schools, temples, hospital, etc. are located.

(v) Impose speed limits on construction vehicles to minimize noise emission along areas where sensitive receptors are located (houses, schools, temples, hospitals, etc.).

(vi) Provide temporary noise barriers (3-5 meter high barrier can reduce 5-10 dB(A)), as necessary, if site works will generate high noise levels that could disturb nearby households, hospital, school and other sensitive receptors.

(vii) Avoid noisy construction activities in vicinity of sensitive receivers during night time or other sensitive periods (e.g. during school hours in vicinity of schools)

(viii) Truck drivers and equipment operators shall avoid, the use of horns

(ix) Restrict use of vibrating rollers and operation of heavy equipment near vibration sensitive structures

4. Construction and Domestic Waste

75. Various construction activities and operation of workers camps will generate solid wastes. Poor waste management could cause odor and vermin problems, pollution and flow obstruction of nearby watercourses and could negatively impact the landscape. The following mitigation measures to minimize impacts due to waste generation shall be implemented by the contractor:

(i) Segregate and regularly collect wastes at worker camps and offices.

(ii) Construction/workers' camps shall be provided with garbage bins with covers..

(iii) Prohibit disposal of solid wastes into canals, rivers, other watercourses, agricultural field and public areas.

(iv) There will be no site-specific landfills established by the contractors. All solid

waste will be regularly collected and removed from the work camps and disposed to areas approved by local authorities.

(v) Prohibit burning of construction and domestic wastes.
(vi) Recyclables shall be recovered and sold to recyclers.
(vii) Residual and hazardous wastes shall be disposed of in disposal sites approved by local authorities.
(viii) Ensure that wastes are not haphazardly dumped within the project site and adjacent areas

5. Establishment and Operation of Construction and Workers Camps

76. There will be a need to establish workers camps during construction. The operation of these facilities will generate wastes and if improperly handled, these could cause health problems and pollution. The following mitigation measures shall be implemented by the contractor to minimize impacts that may arise from operation of construction/workers camps:

(i) Workers camp location and facilities shall be located at least 500 m from settlements and agreed with local communities and local officials.
(ii) Drainage shall be provided to facilitate the rapid removal of surface water from all areas and prevent flooding and accumulation of stagnant water.
(iii) Provide adequate housing for all workers at the construction camps and establish clean canteen/eating and cooking areas.
(iv) Portable lavatories (or at least pit latrines in remote areas) shall be installed and open defecation shall be prohibited and prevented by cleaning lavatories daily and by keeping lavatory facilities clean at all times.
(v) Provide separate hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers.
(vi) Wastewater effluents from contractors' workshops and equipment washing-yards will be passed through gravel/sand beds and all oil/grease contaminants will be removed before wastewater is discharged. Oil and grease residues shall be stored in tightly covered drums. Such wastes shall be disposed consistent with national and local regulations.
(vii) Construction/workers camps shall be cleaned up after use to the satisfaction of MRD/SEO/DDIS and local community. All waste materials shall be removed and disposed to disposal sites approved by local authorities.
(viii) Land used for campsites shall be restored to the original condition as far as practicable and the area shall be planted with appropriate trees/shrubs as soon as practicable after it is vacated and cleaned.

6. Quarry and Borrow Sites

77. The following measures shall be implemented at quarry and borrow sites to minimize impacts on water quality, reduce dust emission during transport, minimize erosion and siltation of nearby water courses and avoid damage to productive land and ecologically sensitive areas:

(i) Sourcing of quarry and borrow materials from existing sites shall be preferred over establishment of new sites, as much as possible.
(ii) Quarries and borrow pits shall not be established in national, provincial, district and village conservation forests and other ecologically sensitive and protected

areas.

(iii) Borrow/quarry sites shall not be located in productive land.

(iv) In case the Project will involve new quarry/borrow sites, necessary approvals from environmental authorities shall be obtained prior to operation of such sites. Such sites shall be located over 500 m away from residential, school, hospital and other sensitive receptors.

(v) Prior to extraction, topsoil (about 15 cm) shall be stockpiled, preserved and then refilled after completion of quarry/borrow pit operation for rehabilitation purposes after excavation is over.

(vi) Dust control during excavation and transport (e.g., water spraying on access roads and provision of truck cover) shall be undertaken in areas where there are sensitive receptors such as residential areas, school, hospital, etc.

(vii) Long-term material stockpiles shall be covered to prevent wind erosion.

(viii) During quarry and borrow site operation, provide adequate drainage to avoid accumulation of stagnant water.

(ix) The use of river bed sources shall be avoided, as much as possible, however if this is unavoidable the contractor shall minimize use of river bed for construction materials and sources of fill and quarry materials lying on small rivers and streams shall be avoided. Alluvial terraces or alluvial deposits which lie on the river beds but not covered by water in normal hydrological conditions shall be preferred.

(x) Confine winning river bed materials to less than 20% of river width in any location and keep away from river banks.

(xi) Protect and reinstate river banks if unexpected erosion occurs.

(xii) Quarry and borrow sites must be selected amongst those offering the highest ratio between extractive capacity (both in terms of quality) and loss of natural state.

(xiii) Quarry and borrow sites lying close to the alignment, with a high level of accessibility and with a low hill gradient, are preferred.

(xiv) Upon completion of extraction activities, re-contour borrow/quarry pit wall or fill-up when there are available and suitable materials such as excavation spoils, replace topsoil, and re-vegetate with native species such as grasses and fast-growing shrubs and trees.

(xv) Upon completion of extraction activities, borrow pits shall be dewatered and fences shall be installed, as appropriate, to minimize health and safety risks.

(xvi) In quarries in mountainous or hilly areas, or wherever slopes are important, terraces shall be cut after extraction, drainage system and vegetation cover shall be provided for rehabilitation to enhance slope stability.

(xvii) Implement compensatory planting (at least one is to one ratio) if trees will have to be removed at quarry and borrow sites.

(xviii) Borrow pits will be left in a tidy state with stable side slopes and proper drainage in order to minimize soil erosion, siltation of nearby bodies of water and to avoid creation of water bodies favorable for mosquito breeding.

(xix) To avoid drowning when pits become water-filled, measures such as fencing, providing flotation devices such as a buoy tied to a rope, etc. shall be implemented.

(xx) It is possible that villagers may request borrow pits to be left excavated so that they may be used as water reservoirs or fishponds. If this were to be agreed between the contractors and the villagers, all the full safety measures detailed above must be observed. Such agreements would be formalized in writing between the contractors and the villagers after full discussion with all concerned parties.

7. Use of Hazardous Substances

78. Pollution and safety risks due to use of hazardous materials and disposal of hazardous wastes shall be prevented through implementation of the following mitigation measures by the contractor:

(i) Store fuel and hazardous substances and wastes in paved areas with roof and embankment. If spills or leaks do occur, undertake immediate clean up.
(ii) Train relevant construction personnel in handling of fuels and other hazardous substances as well as spill control procedures.
(iii) Ensure availability of spill clean up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored.
(iv) Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national and local regulations.
(v) Store waste oil, lubricant and other hazardous materials and wastes in tightly sealed containers to avoid contamination of soil and water resources.
(vi) Ensure all storage containers of hazardous substances and wastes are in good condition with proper labeling.
(vii) Regularly check containers for leakage and undertake necessary repair or replacement.
(viii) Store hazardous materials above flood level.
(ix) Storage areas for fuel, oil, lubricant, bitumen and other hazardous substance will be located at least 100 m away from any watercourses.
(x) Storage areas will be bunded and provided with interceptor traps so that accidental spills do not contaminate the environment.
(xi) Storage, transport and disposal of hazardous wastes, including spill wastes, shall be consistent with national and local regulations.
(xii) Wherever possible, refueling will be carried out at a fuel storage area.
(xiii) Refuelling shall not be permitted within or adjacent to watercourses.
(xiv) Where significant amount of oily wastewater or spill/leakage of oil and grease may occur (e.g., equipment maintenance areas), drainage leading to an oil-water separator shall be provided for treatment of wastewater. The oil-water separator shall be regularly skimmed of oil and maintained to ensure efficiency.
(xv) Vehicle maintenance and refueling will be confined to areas in construction sites designed to contain spilled lubricants and fuel.
(xvi) Bitumen shall not be allowed to enter either running or dry streambeds and nor will be disposed of in ditches or small waste disposal sites prepared by the contractor.
(xvii) Bitumen storage and mixing areas as well as storage areas for other petroleum products used in the preparation of the bitumen mixture shall be protected against spills and all contaminated soil must be properly handled according to national and local regulations. As a minimum, these areas must be provided with concrete flooring and surrounded by an embankment to readily contain and clean-up spills.
(xviii) Adequate precaution will be taken to prevent oil/lubricant/hydrocarbon contamination of channel beds. Spillage if any will be immediately cleared with utmost caution to leave no traces.
(xix) All areas intended for storage of hazardous materials will be quarantined

and provided with adequate facilities (e.g., fire fighting equipment, sorbent pads, etc.) to combat emergency situations complying with all the applicable statutory stipulation.

8. Blasting

79. Blasting is not anticipated to be undertaken for the project. However, in case this becomes necessary, the following measures shall be implemented by the contractor to ensure safety of workers and the public:

(i) Blasting will be carried out only with permission of the concerned authority, using a pre-established schedule.
(ii) All the statutory laws, regulation, rules etc., pertaining to acquisition, transport, storage, handling and use of explosives will be strictly followed.
(iii) The timing will be made available to the local people within 500 m of the blasting site in all directions, depending on the total charge used.
(iv) Blasting will be held only during day time. Under no circumstance will blasting be undertaken at night.
(v) Where possible blasting mats will be used to reduce flying rock.
(vi) No blasting will take place without a condition survey of any buildings within 500 m and permission and monitoring by the DDIS.
(vii) People living near blasting sites will be informed of blasting times prior to the blasting.
(viii) Warning sirens will be sounded before blasting.
(ix) Pre-splitting shall be undertaken.
(x) Where the vibration from blasting is exceeding the maximum permissible level, or damage occurs to local property information from the blasting shall be used to modify blasting patterns and calculate a reduced charge for future blasts
(xi) Blasting shall be under careful and strict management/supervision of properly trained and licensed personnel. Workers at blasting sites will be trained prior to blast operations and provided with safety equipment and earplugs.
(xii) Observe proper warning and precautionary measures to ensure safety of residents, pedestrians, motorists and structures during blasting.
(xiii) All expenses/costs to address injuries, damage to properties, accidents, etc. due to blasting shall be assigned to the contractor.

9. Excavation Spoils

80. Improper spoils disposal could cause deterioration of water quality and flow obstruction of water courses. The following measures shall be implemented by the contractor to avoid or minimize such impacts.

(i) Provide grass cover and other suitable slope stabilization measures on road embankment slopes and on long term stockpile of spoils.
(ii) Spoil disposal shall not cause sedimentation and obstruction of flow of watercourses, damage to agricultural land and densely vegetated areas. As several of the roads pass very close to rice padi, and in fact the road shoulder is contiguous with the rice fields, excess spoil shall not be dumped on rice production land, either temporarily or permanently. If temporary storage space is needed then

work should take place alternately on opposite traffic lanes.

(iii) The spoils disposal site shall be located at least 50 m from surface water courses and shall be protected from erosion by avoiding formation of steep slopes, provisions of adequate drainage and grassing.

(iv) Spoils shall only be disposed to areas approved by local authority.

(v) Water courses (rivers, canals, etc.) shall be kept free of excavation spoil and construction debris, floating and submerged.

(vi) Spoil and construction materials stockpile area shall be located away from water stagnation and under no circumstances will these materials be dumped into watercourses.

(vii) Dredged and excavated materials shall be reused or provided to local residents as soon as possible, if they require such materials, for land reclamation. The remaining spoils can be disposed into low elevation sites for road construction.

10. Bridge Works

81. The following measures shall be undertaken by the contractor during bridge repair or replacement to protect water quality and river/stream flow:

i) Rocks, stones, soil and other materials shall not be dumped onto rivers and streams.

ii) Ensure bridge works shall not cause obstruction of river flow and flooding of adjacent area.

iii) At bridge repair and demolition sites, the bridge structure will not be dropped into the river but alternative means will be used to avoid "dropping the bridge" into rivers/streams. This shall be done by "sawing" appropriate sections of the bridge and using cranes to lift these sections away or alternatively by construction of a platform onto which the bridge could be lowered.

iv) Cofferdams, silt fences, sediment barriers or other devices will be used as appropriate based on the design to prevent migration of silt during excavation and boring operations within streams. If cofferdams are used, these will be dewatered and cleaned to prevent siltation by pumping from cofferdams to a settling basin or a containment unit.

v) Exposed surfaces shall be provided with native grasses and creepers to reduce runoff as early as possible in construction.

11. Damage to Community Facilities

82. Transport of materials and spoils, operation of construction equipment and various construction activities may damage community utilities. The contractor shall implement the following measures to address this impact:

i) The contractor shall not allow overloading of trucks used for all project-related activities.

ii) The contractor shall immediately repair any damage caused by the Project to community facilities such as water supply, power supply, irrigation canals, drainage and the like. Adequate compensation shall be paid to affected parties, as necessary.

iii) Access roads damaged during transport of construction materials and other project- related activities shall be reinstated upon completion of construction works

12. Water Quality and Drainage

83. Bridge works, stockpiling of construction materials and spoils, use of hazardous materials and earthworks if not properly managed are likely to cause deterioration of surface water quality, flooding and flow obstruction of watercourses. These impacts shall be minimized through implementation by the contractor of the following measures:

(i) Firmly consolidate river banks using stones, concrete and other suitable retaining measures at each bridge construction site and ensure that water courses (rivers, canals, etc.) shall be kept free of excavation spoil and construction debris, floating and submerged.
(ii) Spoils, construction wastes and construction materials stockpile area shall be located away from water bodies and under no circumstances will these materials be dumped into watercourses.
(iii) Do not fill up canals and creeks at the construction site. In case filling of local drainage system is necessary, consultation with local authorities shall be undertaken and their permission obtained beforehand. An alternative drainage shall be established before the existing canal is filled-up.
(iv) Prohibit placement of construction materials, waste storage areas or equipment in or near drainage channels and water courses.
(v) Discharge of oily wastewater, fuel, hazardous substances and wastes, and untreated sewage to watercourses/canals and on the ground/soil shall be prohibited.
(vi) Provide adequate drainage at the construction sites and other project areas to avoid flooding of surrounding areas and minimize flow obstruction of existing watercourses.
(vii) Regularly inspect and maintain all drainage channels to keep these free of obstructions.
(viii) Slope stabilization measures (e.g., planting of fast growing native species of grass and shrubs, etc.) shall be implemented on exposed surfaces along river embankments to reduce material wash-away.
(ix) Construct retaining structures such as gabion baskets, rip-rap, etc. for river bank protection.

13. Traffic Disruption and Access Obstruction

84. Road construction works are expected to cause traffic disruption and congestion and obstruction of access to roadside properties and establishments. Lack of proper traffic warning signs and other safety measures (e.g., sufficient lighting at night at construction sites, etc.) could cause accidents. The following measures shall be implemented by the contractor to minimize such impacts:

(i) In cooperation with the local traffic authorities, properly organize transport of materials for the project to avoid congestion.
(ii) Set up clear traffic signal boards and traffic advisory signs at the roads going in and out the road and bridge construction sites to minimize traffic build-up.
(iii) Regularly monitor traffic conditions along access and Project roads to ensure that project vehicles are not causing congestion.
(iv) Provide sufficient lighting at night within and in the vicinity of construction sites.

(v) Implement suitable safety measures to minimize risk of adverse interactions between construction works and traffic flows through provision of temporary signals or flag controls, adequate lighting, fencing, signage and road diversions.
(vi) Provide temporary accesses to properties and establishments affected by disruption to their permanent accesses.
(vii) Reinstate good quality permanent accesses following completion of construction.
(viii) Provide safe vehicle and pedestrian access around construction areas.
(ix) Provide adequate signage, barriers and flag persons for traffic control.
(x) If necessary, traffic will be diverted for safe and smooth movement of vehicles to ensure smooth traffic flow and minimize accidents, traffic hold ups and congestion.
(xi) The diversion signs would be bold and clearly visible particularly at night.
(xii) Temporary bypasses will be constructed and maintained (including dust control) during the construction period particularly at bridge crossings. Location of temporary bypasses shall be agreed with local authorities and such sites shall be reinstated upon completion of works.

14. Soil Erosion

85. The following measures shall be implemented by the contractor to minimize soil erosion that could eventually cause damage to road embankments and deterioration of water quality of nearby river and streams:

(i) On hill slopes and other potentially erodible places along the roadside, appropriate native vegetation that retards erosion will be planted.
(ii) As much as possible, construction activities in hilly areas are to be undertaken during dry season only.
(iii) Road embankments and slopes shall be monitored during construction for signs of erosion, vegetative cover shall be provided on slopes by planting native grass and creepers on erosion prone sections.
(iv) Long-term material stockpiles will be covered with native species of grass or other suitable materials to prevent wind erosion.
(v) Use appropriate erosion control and stabilizing measures such as benching, geotextiles, mats, fiber rolls, soil binders, etc. that are not toxic to the environment, or vegetation measures/temporary landscaping in disturbed areas and on graded slopes.

15. Flora and Fauna

86. As the Project will not involve road widening, only minimal vegetation clearing is expected. However, operation of construction equipment and vehicles as well as improper disposal of spoils may cause damage to existing vegetation. Hunting of wildlife and cutting of trees for fuel may not be undertaken by workers and strict prohibitions should be imposed by the contractor.

(i) Spoils and all types of wastes shall not be dumped into forested areas, agricultural land, densely vegetated areas, and water courses.
(ii) Workers shall be prohibited from collecting firewood and construction materials from surrounding forests, and from hunting wild animals.
(iii) As the project will not require road widening, ensure that construction works

are carried out without unnecessary clearing of roadside vegetation.

(iv) The contractor shall prohibit cutting of trees for firewood and for use in for construction-related activities

(v) Construction vehicles will operate within the corridor of impact, i.e., approximately within ROW, to avoid damaging soil and vegetation. It will be most important to avoid soil compaction around trees. Generally the rule will be to avoid driving heavy equipment or trucks anywhere into the 'drip-line' of a tree (defined as imaginary line around a tree where rainwater falls freely to ground unimpeded by the tree's foliage).

(vi) The contractor will not use or permit the use of wood as a fuel for the execution of any part of the Works, including but not limited to the heating of bitumen and bitumen mixtures, and to the extent practicable shall ensure that fuels other than wood are used for cooking, and water heating in all his camps and living accommodations.

(vii) Contractor shall not buy or use wood from the illegal sources (that come from the illegal logging)

(viii) Construction camps, asphalt mixing plants, material storage sites and other project facilities shall not be located in the forest areas and other densely vegetated sites.

(ix) Contractor will take all precautions necessary to ensure that damage to vegetation is avoided due to fires resulting from execution of the works. The Contractor will immediately suppress the fire, if it occurs, and shall undertake replanting to replace damaged vegetation.

(x) As much as possible, bridge works will be scheduled in dry season to minimize adverse impacts to fishery, river water quality and other aquatic resources.

16. Health and Safety

87. The main risks during the construction stage may arise from: (a) inadequate sanitation facilities in work camps; (b) failure to implement measures to avoid accidents and injuries involving workers and the public; (c) introduction of sexually transmitted or other diseases by non-local workers, and; (d) outbreaks of diseases such as malaria, diarrhea, etc. in the labor force. In order to minimize these risks, the following measures shall be implemented by the contractor:

(i) Conduct orientation for construction workers regarding emergency response procedures and equipment in case of accidents (e.g., head injury from falling, burns from hot bitumen, spills of hazardous substances, etc.), fire, etc.; health and safety measures, such as on the use of hot bitumen products for paving of project roads, etc.; prevention of HIV/AIDS, malaria, diarrhea, and other related diseases.

(ii) Provide drainage at construction sites and workers camps to prevent water logging/accumulation of stagnant water and formation of breeding sites for mosquitoes.

(iii) Provide fire extinguish equipment and appropriate emergency response equipment (based on on-going construction activities) at the work areas and at construction and workers camps.

(iv) Provide first aid kits at each camps and working sites that are readily accessible by workers.

(v) At the workers camps, provide adequate housing for all workers at the construction camps, provide reliable supply of potable water, install separate

hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers and establish clean eating areas and kitchen.

(vi) Provide workers with appropriate safety equipment/devices (such as dust mask, safety helmets, safety shoes or boots, goggles, ear plugs, etc.) and strictly require them to use these as necessary.

(vii) Install sign boards, lighting system at the construction sites, borrow pits, or places which may cause accidents for vehicle, people and workers

(viii) Strictly impose speed limits on construction vehicles along residential areas and where other sensitive receptors such as schools, pagodas, hospitals, and other populated areas are located.

(ix) Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials by providing covers over transporting dump trucks.

(x) Barriers (e.g., temporary fence) shall be installed at construction areas to deter pedestrian access to these areas except at designated crossing points.

(xi) Sufficient lighting at night as well as warning signs shall be provided in the periphery of the construction site.

(xii) The general public/local residents shall not be allowed in high-risk areas, e.g., excavation sites and areas where heavy equipment is in operation.

(xiii) Ensure proper collection and disposal of solid wastes within the construction camps consistent with local regulations.

(xiv) Provide fencing on all areas of excavation greater than 2 m deep.

(xv) Ensure reversing signals are installed on all construction vehicles.

(xvi) Measures to prevent malaria shall be implemented (e.g., provision of insecticide treated mosquito nets to workers, spraying of insecticides, installation of proper drainage to avoid formation of stagnant water, etc.).

(xvii) Discharge of untreated sewage shall be prohibited.

17. Social Conflicts

88. The presence of workers could cause conflicts with local communities. These will be avoided by implementing the following measures:

(i) Regularly inform in advance the local officials and local residents on the location and schedule of construction activities which may cause impacts on the environment and life of people (e.g., road sections to be constructed; roads used for transport, locations of worker camps etc.)

(ii) Locate construction camps away from communities (at least 500 m away) in order to avoid social conflict in using resources and basic amenities such as water supply.

(iii) Maximize number of local people employed in construction works.

(iv) Maximize goods and services sourced from local commercial enterprises.

18. Mitigation Measures at Completion Stage

89. The project executing agency will cooperate with the contractor(s) taking in to the following:

(i) Preparation for cleaning at each site comprise of the management of general wases and construction debris etc.

(ii) Management of dug dirt and rock fragments scattered along the roads already

built.

C. Operation Phase

1. Air Quality and Noise

90. Dust from the currently unpaved project roads is a major nuisance for roadside residents, especially those in built-up areas. The Project will have positive impacts on the quality of life of roadside residents as it will result in a significant reduction in dust and to a lesser extent noise. Measures such as providing signs prohibiting drivers from blowing horns alongside schools, hospitals and other areas with sensitive receptors will help minimize noise from vehicles. Imposition of speed limits in such areas would further reduce noise levels.

2. Road Safety

91. Increased traffic speeds resulting from improved paved road surfaces, can also impose considerable safety risks to rural communities. The project includes a community-based road safety program to increase safety awareness. The program includes education program for schools, drivers, road users, and the community. During operation, traffic signs, markings and other devices used to regulate traffic at appropriate places shall be properly maintained.

VI. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

92. MRD invited the Provincial Departments of Rural Development (PDRD) in each of the project provinces to identify the rural roads to be prioritized for improvement of pavement. PDRD consulted with both district level officials and elected members of Commune Councils in those districts selected to be included in this project. Commune Council members who also have links with village leaders informed the PDRDs and sought their opinions, which in most instances were relayed to both district level officials and PDRD. During the feasibility study by the DDIS consultants, the consultants also disclosed to local people identified to be interviewed on a household basis or invited to participate in focus group discussions (FGD) what the Project would entail and sought their opinion as to whether they would support the Project or not. This information disclosure took place along all of the project roads that were surveyed.

93. Public consultations were undertaken from 25 March to 2 May 2013 during which 1,300 respondents and households were interviewed. The discussions were semi structured and open ended. Respondents were invited to express their opinions on the following topics:

- Are you aware that the road in your commune/village will be improved?
- Are you in favor of the rural roads improvement project?
- what POSITIVE IMPACTS or benefits will the people/commune get from having improved roads?
- What do you think of women working in road construction?
- Is Dust during road construction an issue ?
- Is Noise caused by machines/ equipment (i.e., buldozzers, etc.) an issue ?
- Is an increase in road accidents in road sections without road signs/lights an issue ?

In general the opinions expressed were consistent across all provinces :

- Noise is a problem during construction but if work at night is avoided and all reasonable efforts are made to control it, then given that the construction is temporary, noise is not a nuisance.
- Vibration was not seen as an issue.
- Dust during construction in the dry season is a problem. More water sprays are an effective control measure.
- Dust on roads in the wet season becomes mud and heavy contractors vehicles break up the road surface and worsen the situation. Construction in the wet season should be avoided.
- Dust after the road is finished is not an issue as the DBST reduces dust generation
- After the road is finished speeds increase and local residents are concerned about traffic accidents.

94. More details are given in Appendix 6 - Socio-economic Data.

VII. GRIEVANCE REDRESS MECHANISM

95. Through a Grievance Redress Committee (GRC), MRD shall promptly address affected people's concerns, complaints, and grievances about the Project's environmental performance at no costs to the complainant and without fear of retribution. The GRC, which shall be established before commencement of site works, shall be chaired by PMU to be assisted by the SEO. The GRC shall have members from the PDRD, commune councils, local NGO, and women's organization. Grievances can be filed in writing or verbally with any member of the GRC. The committee will have 15 days to respond with a resolution. If unsatisfied with the decision, the existence of the GRC shall not impede the complainant's access to the Government's judicial or administrative remedies.

96. PMU, through the PDRDs, shall make public the existence of this grievance redress mechanism through public awareness campaigns. PMU shall also set-up a hotline for complaints and the hotline shall be publicized through the media and numbers placed on the notice boards outside the construction site and at local government offices (e.g., provincial, district, commune levels). Locally affected people will still be able to express grievances through the commune councils and these would be referred to PMU through the usual channels in those committees.

97. The GRC, through the SEO, will receive, follow-up and prepare monthly reports regarding all complaints, disputes or questions received about the Project and corresponding actions taken to resolve the issues. The SEO will develop and maintain a database of complaints received related to the Project. The GRC will also use the punitive clauses of the 1996 Law on Environmental Protection and Natural Resources Management in conjunction with MOE to prosecute any offending parties.

98. The contractor will be encouraged to establish discussions with the village representatives before works commence and maintain these discussions as an ongoing activity through the life of the project.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

99. This EMP has been prepared to deal with the set of mitigation and management measures to be taken during Project implementation to avoid, reduce, and mitigate for adverse environmental impacts identified as part of this IEE.

A. Mitigation

100. **Table VIII.1** presents the environmental impacts and corresponding mitigation measures discussed in Chapter V. The table also shows responsibilities for implementation of mitigation measures and monitoring. MRD shall ensure that the EMP is included in the tender and contract documents for civil works. The conformity of contractors with environmental contract procedures and specifications shall be regularly monitored by the project management unit (PMU) through the Social and Environmental Office (SEO) which is already established in MRD.

101. PMU/SEO shall be assisted by the detailed design and implementation supervision consultant (DDIS) to undertake EMP monitoring and to prepare corresponding semi-annual monitoring reports for submission to ADB and the Ministry of Environment for review and comments.

Table VIII.1. Environmental Impacts and Mitigation Measures

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
Pre-construction						
Location of Project roads	Safety risks due to presence of unexploded ordnance (UXO)	The detailed design and implementation supervision consultant (DDIS) shall engage a UXO specialist to determine the level of risk of the project roads and advise on the need for clearance.	All project roads	Part of project cost	DDIS	MRD/PMU
		Any clearance that is required will be undertaken through the civil works contracts, by the engagement of qualified local UXO clearance firms.	All project roads	Part of project cost	Contractor	DDIS, MRD/ PMU/SEO
		The contractor shall only commence site works after the UXO clearance firm has certified that areas are already cleared.	All project roads	Part of project cost	Contractor	DDIS, MRD/ PMU/SEO
	Lack of mechanism to address environmental complaints	Establish a grievance redress mechanism (GRM), as described in Chapter VII.	All project roads	No additional cost	MRD/PMU	DDIS
		Make public the existence of the GRM through public awareness campaigns.	All project roads	No additional cost	MRD/PMU	DDIS
		Ensure that names and contact numbers of representatives of MRD and contractors are placed on the notice boards outside the construction site and at local government offices (e.g., provincial and commune levels)	All project roads	No additional cost	MRD/PMU	DDIS
Location of quarry and borrow areas	Siting of quarry and borrow areas could cause damage to ecologically sensitive sites, productive land and nuisance to sensitive receptors (residential areas, schools, etc.)	Sourcing of quarry and borrow materials from existing sites shall be preferred over establishment of new sites, as much as possible.	Quarry and borrow sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Quarries and borrow pits shall not be established in national, provincial, district and village conservation forests and other ecologically sensitive and protected areas.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Borrow/quarry sites shall not be located in productive land.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		In case the Project will involve new quarry/borrow sites, necessary approvals from environmental authorities shall be obtained prior to operation of such sites. Such sites shall be located over 500 m away from residential, school, hospital and other sensitive receptors.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
Location of construction camps/workers camps and other project facilities	Siting of various project facilities could adversely affect sensitive receptors (residential areas, etc.) due to dust emission, wastewater generation, etc.	Workers camp location and facilities shall be located at least 500 m from settlements and agreed with local communities and local officials.	All project roads	No additional cost	Contractor	DDIS, PMU/SEO
		Siting of asphalt plants, concrete mixing plants, crushing plants and other facilities that cause high dust and/or gaseous emissions will be at least 500 m from settlements and other sensitive receptors (schools, hospitals, etc.)	All project roads	No additional cost	Contractor	DDIS, PMU/SEO
		Necessary environmental clearance/approval shall be obtained prior to establishment and operation of asphalt mixing plants, crushing plants and other facilities.	All project roads	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
Project design	Climate change and hydrological impacts	Incorporate in the project design the measures that have been developed under the Climate Change Adaptation Component of the Project (e.g., ecosystem-based adaptation measures).	All project roads	Part of project cost	DDIS	MRD/PMU
		Provide for appropriate design of roadside and cross drainage systems, where necessary, to avoid flooding on project roads as well as in areas surrounding the project roads, especially at sections where road embankments will be raised to prevent flooding of roadways.	All project roads	Part of project cost	DDIS	MRD/PMU
		The road embankment, bridges and drainage facilities shall be designed based on the historical flood data and flood forecasting.	All project roads	Part of project cost	DDIS	MRD/PMU
		Erosion control and slope stabilization measures shall be included in the design, as appropriate, such as side ditches and berms, rock lining and slope walls along the road, shrub buffer strips sites in areas of high erosion risk, cross drainage to accommodate floodwater/run-off in case road sections are on elevated fills that will obstruct natural drainage.	All project roads	Part of project cost	DDIS	MRD/PMU
Site preparation	Disruption to community utilities	Prior to commencement of site works, relocate or re-provision water supply pipelines, irrigation canals and other facilities that may be affected by construction works This will be done in agreement with the local community and the utility company.	All project roads	Part of contractor's bid cost	Contractor	DDIS, MRD/PMU
Construction						

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
Operation of construction equipment excavation works, spoils and waste disposal, transport of construction materials	Encroachment/ damage to historically/culturally significant areas such as Angkor Protected Landscape (APL), and other areas.	All project-related activities shall be implemented consistent with the policies, rules and regulations governing APL.	Roads SR2, SR 7	No additional cost	Contractor	DDIS, PMU/SEO, APSARA, MCFA
		The contractor shall ensure that Project activities shall not cause damage to any archaeological relics. In the event of any construction work uncovering or revealing archaeological relics these shall be deemed a "chance find" and reported as such to the Ministry of Culture and Fine Arts or APSARA.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO, APSARA, MCFA
		The following 'chance-find' principles will be implemented by the contractor for all Project roads to account for any undiscovered items identified during construction: a. In coordination with APSARA and MCFA, workers will be provided orientation in the location of cultural/heritage zones within the construction area and in the identification of potential items of cultural/heritage significance. b. Upon discovery of any objects of possible archaeological significance that may be uncovered during construction, the site supervisor shall immediately suspend construction activities affecting the area and shall alert APSARA, MCFA or its provincial or district offices to inspect the site. c. Work will remain suspended until a site assessment has been made by the concerned authority (APSARA, MCFA, etc.), an agreement has been reached as to any required mitigation measures (which may include excavation and recovery of the item), and the contractor has been given permission by the concerned authority to proceed with the concerned authority to proceed with the construction activities.	All project roads	No additional cost	Contractor	DDIS, PMU/SEO, APSARA, MCFA
Earthworks, excavation activities, transport of materials, operation of construction equipment,	Air pollution due to elevated levels of dust and gaseous emissions	Construction equipment will be maintained to a good standard. Immediate repairs of any malfunctioning construction vehicles and equipment shall be undertaken.	All project roads	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Equipment and vehicles not in use shall be switched off.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Machinery and vehicles causing excessive pollution (e.g., visible smoke) will be banned from construction sites.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		All construction equipment and vehicles shall have valid certifications indicating compliance to vehicle emission standards.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
Earthworks, transport of materials, operation of construction equipment and vehicles	Elevated noise and vibration levels that could cause nuisance and damage to properties	No noisy construction-related activities (e.g., transport of materials along residential areas and other sensitive receptors, piling, use of jackhammer, etc.) will be carried out from 2100 hrs to 0600 hrs along residential areas, hospitals and other sensitive receptors.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		Noisy construction activities will be avoided during religious or cultural events in close proximity to the roadside such as Friday prayers attended by Muslim Cham, when ethnic Khmer are attending temple festivals or holding weddings, etc.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		All construction equipment and vehicles shall be well maintained, regularly inspected for noise emissions, and shall be fitted with effective muffler and other appropriate noise suppression equipment consistent with applicable national and local regulations.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Use only vehicles and equipment that are registered and have necessary permits.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEU
		Truck drivers and equipment operators shall avoid, as much as possible, the use of horns in densely populated areas and where there other sensitive receptors are found such as schools, temples, hospital, etc. are located.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Impose speed limits on construction vehicles to minimize noise emission along areas where sensitive receptors are located (houses, schools, temples, hospitals, etc.).	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Provide temporary noise barriers (3-5 meter high barrier can reduce 5-10 dB(A), as necessary, if site works will generate high noise levels that could disturb nearby households, hospital, school and other sensitive receptors	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Avoid noisy construction activities in vicinity of sensitive receivers during night time or other sensitive periods (e.g. during school hours in vicinity of schools)	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Truck drivers and equipment operators shall avoid, the use of horns	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Restrict use of vibrating rollers and operation of heavy equipment near vibration sensitive structures	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
Various construction activities, operation of construction and workers camps	Improper handling and disposal of wastes could cause odor and vermin problems, pollution and flow obstruction of nearby watercourses and could negatively impact the landscape.	Prohibit disposal of solid wastes into canals, rivers, other watercourses, agricultural field and public areas.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		There will be no site-specific landfills established by the contractors. All solid waste will be regularly collected and removed from the work camps and disposed to areas approved by local authorities.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Prohibit burning of construction and domestic wastes.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Recyclables shall be recovered and sold to recyclers.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Residual and hazardous wastes shall be disposed of in disposal sites approved by local authorities.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Ensure that wastes are not haphazardly dumped within the project site and adjacent areas	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Segregate and regularly collect wastes at worker camps and offices.	Construction and workers camps	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Construction/workers' camps shall be provided with garbage bins.	Construction and workers camps	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
Establishment and operation of construction and workers camps	Operation of these facilities will generate solid and liquid wastes and if improperly handled, these could cause health problems and pollution.	Drainage shall be provided to facilitate the rapid removal of surface water from all areas and prevent flooding and accumulation of stagnant water.	Construction/ Workers camps	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Provide adequate housing for all workers at the construction camps and establish clean canteen/eating and cooking areas.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Portable lavatories (or at least pit latrines in remote areas) shall be installed and open defecation shall be prohibited and prevented by cleaning lavatories daily and by keeping lavatory facilities clean at all times.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEU
		Provide separate hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concer	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Wastewater effluents from contractors' workshops and equipment washing- yards will be passed through gravel/sand beds and all oil/grease contaminants will be removed before wastewater is discharged. Oil and grease residues shall be stored in tightly covered drums. Such wastes shall be disposed consistent with national and local regulations.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Construction/workers camps shall be cleaned up after use to the satisfaction of MRD/SEO/DDIS and local community. All waste materials shall be removed and disposed to disposal sites approved by local authorities.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Land used for campsites shall be restored to the original condition as far as practicable and the area shall be planted with appropriate trees/shrubs as soon as practicable after it is vacated and cleaned.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
Quarry and borrow site operation	Operation of quarry and borrow sites could cause adverse impacts to surface water quality, elevated dust emission during excavation siltation of nearby water courses, damage to productive land and ecologically sensitive areas and pose health and safety risks.	Prior to extraction, topsoil (about 15 cm) shall be stockpiled, preserved and then refilled after completion of quarry/borrow pit operation for rehabilitation purposes after excavation is over.	All quarries and borrow areas operated for the project	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Dust control during transport (e.g., water spraying on access roads and provision of truck cover) and excavation shall be undertaken in areas where there are sensitive receptors such as residential areas, school, hospital, etc.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Long-term material stockpiles shall be covered to prevent wind erosion.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		During quarry and borrow site operation, provide adequate drainage to avoid accumulation of stagnant water.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		The use of river bed sources shall be avoided, as much as possible, however if this is unavoidable the contractor shall minimize use of river bed for construction materials and sources of fill and quarry materials lying on small rivers and streams shall be avoided. Alluvial terraces or alluvial deposits which lie on the river beds but not covered by water in normal hydrological conditions shall be preferred.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Confine winning river bed materials to less than 20% of river width in any location and keep away from river banks.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Protect and reinstate river banks if unexpected erosion occurs.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Quarry and borrow sites must be selected amongst those offering the highest ratio between extractive capacity (both in terms of quality) and loss of natural state.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Quarry and borrow sites lying close to the alignment, with a high level of accessibility and with a low hill gradient, are preferred.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Upon completion of extraction activities, re-contour borrow/quarry pit wall or fill-up when there are available and suitable materials such as excavation spoils, replace topsoil, and re-vegetate with native species such as grasses and fast- growing shrubs and trees.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Upon completion of extraction activities, borrow pits shall be dewatered and fences and warning signs shall be installed, as appropriate, to minimize health and safety risks.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		In quarries in mountainous or hilly areas, or wherever slopes are important, terraces shall be cut after extraction, drainage system and vegetation cover shall be provided for rehabilitation to enhance slope stability	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Implement compensatory planting (at least one is to one ratio) if trees will have to be removed at quarry and borrow sites.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Borrow pits will be left in a tidy state with stable side slopes and proper drainage in order to minimize soil erosion, siltation of nearby bodies of water and to avoid creation of water bodies favorable for mosquito breeding.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		To avoid drowning when pits become water-filled, measures such as fencing, providing flotation devices such as a buoy tied to a rope, etc. shall be implemented.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		It is possible that villagers may request borrow pits to be left excavated so that they may be used as water reservoirs or fishponds. If this were to be agreed between the contractors and the villagers, all the full safety measures detailed above must be observed. Such agreements would be formalized in writing between the contractors and the villagers after full discussion with all concerned parties.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
Use of hazardous substances such as fuel, oil, bitumen, etc.	Pollution and safety risks due to use of hazardous materials and disposal of hazardous wastes	Store fuel and hazardous substances and wastes in paved areas with roof and embankment. If spills or leaks do occur, undertake immediate clean up.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Train relevant construction personnel in handling of fuels and other hazardous substances as well as spill control procedures.	All project roads	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Ensure availability of spill clean up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national and local regulations.	Designated storage sites	No additional cost	Contractor	DDIS, PMU/SEO
		Store waste oil, lubricant and other hazardous materials and wastes in tightly sealed containers to avoid contamination of soil and water resources.	Designated storage sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Ensure all storage containers of hazardous substances and wastes are in good condition with proper labeling.	Designated storage sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Regularly check containers for leakage and undertake necessary repair or replacement.	Designated storage sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Store hazardous materials above flood level.	Designated storage sites	No additional cost	Contractor	DDIS, PMU/SEO
		Storage areas for fuel, oil, lubricant, bitumen and other hazardous substance will be located at least 100 m away from any watercourses.	Designated storage sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Storage areas will be bunded and provided with interceptor traps so that accidental spills do not contaminate the environment.	Designated storage sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Storage, transport and disposal of hazardous wastes, including spill wastes, shall be consistent with national and local regulations.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Wherever possible, refueling will be carried out at a fuel storage area.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		Refuelling shall not be permitted within or adjacent to watercourses.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		Where significant amount of oily wastewater or spill/leakage of oil and grease may occur (e.g., equipment maintenance areas), drainage leading to an oil-water separator shall be provided for treatment of wastewater. The oil- water separator shall be regularly skimmed of oil and maintained to ensure efficiency. Discharge of oil-contaminated	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Vehicle maintenance and refueling will be confined to areas in construction sites designed to contain spilled lubricants and fuel.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Bitumen shall not be allowed to enter either running or dry streambeds and nor will be disposed of in ditches or small waste disposal sites prepared by the contractor.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Bitumen storage and mixing areas as well as storage areas for other petroleum products used in the preparation of the bitumen mixture shall be protected against spills and all contaminated soil must be properly handled according to national and local regulations. As a minimum, these areas must be provided with concrete flooring and surrounded by an embankment to readily contain and clean-up spills.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Adequate precaution will be taken to prevent oil/lubricant/ hydrocarbon contamination of channel beds. Spillage if any will be immediately cleared with utmost caution to leave no traces.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities (e.g., fire fighting equipment, sorbent pads, etc.) to combat emergency situations complying with all the applicable statutory stipulation.	Designated storage sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
Blasting	Safety risks to workers and the public	Blasting will be carried out only with permission of the concerned authority, using a pre-established schedule.	All areas where blasting will occur	No additional cost	Contractor	DDIS, PMU/SEO
		All the statutory laws, regulation, rules etc., pertaining to acquisition, transport, storage, handling and use of explosives	Throughout project sites	Part of contractor's	Contractor	DDIS, PMU/SEO
		The timing will be made available to the local people within 500 m of the blasting site in all directions, depending on the total charge used.	All areas where blasting will be undertaken	No additional cost	Contractor	DDIS, PMU/SEO
		Blasting will be held only during day time and shall be carried out not using high powered explosives. Under no circumstance will blasting be undertaken at night.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Where possible blasting mats will be used to reduce noise levels when blasting is carried out to reduce flying rock.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		No blasting will take place without condition survey of the buildings within 500 m and permission and monitoring by the DDIS	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		People living near blasting sites will be informed of blasting times prior to the blasting.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Warning sirens will be sounded before blasting.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Pre-splitting shall be undertaken.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Where the vibration from blasting is exceeding the maximum permissible level, or damage occurs to local property information from the blasting shall be used to modify blasting patterns and calculate a reduced charge for future blasts	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Blasting shall be under careful and strict management/ supervision of properly trained and licensed personnel. Workers at blasting sites will be trained prior to blast operations and provided with safety equipment and earplugs.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Observe proper warning and precautionary measures to ensure safety of residents, pedestrians, motorists and structures during blasting.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		All expenses/costs to address injuries, damage to properties, accidents, etc. due to blasting shall be shouldered by the contractor.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
Earthworks/ excavation	Improper spoils disposal could cause deterioration of water quality, damage to productive land and flow obstruction of water courses.	Provide grass cover and other suitable slope stabilization measures on road embankment slopes and on long term stockpile of spoils.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Spoil disposal shall not cause sedimentation and obstruction of flow of watercourses, damage to agricultural land and densely vegetated areas. (ii) Spoil disposal shall not cause sedimentation and obstruction of flow of watercourses, damage to agricultural land and densely vegetated areas. As several of the roads pass very close to rice padi, and in fact the road shoulder is contiguous with the rice fields, excess spoil shall not be dumped on rice production land, either temporarily or permanently. If temporary storage space is needed then work should take place alternately on opposite traffic lanes.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		The spoils disposal site shall be located at least 50 m from surface water courses and shall be protected from erosion by avoiding formation of steep slopes, provisions of adequate drainage and grassing.	*ditto*	Part of	Contractor	DDIS, PMU/SEO MOE/PDE

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Spoils shall only be disposed to areas approved by local authority.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Water courses (rivers, canals, etc.) shall be kept free of excavation spoil and construction debris, floating and submerged.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Spoil and construction materials stockpile area shall be located away from waterbodies and under no circumstances will these materials be dumped into watercourses.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Dredged and excavated materials shall be reused or provided to local residents as soon as possible, if they require such materials, for land reclamation. The remaining spoils can be disposed into low elevation sites for road construction.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
Bridge works	Bridge repair and replacement could cause obstruction of river flow and deterioration of water quality due to siltation	Rocks, stones, soil and other materials shall not be dumped onto rivers and streams.	All bridge reoair and replacement sites	No additional cost	Contractor	DDIS, PMU/SEO/PDRD
		Ensure bridge works shall not cause obstruction of river flow and flooding of adjacent area.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		At bridge repair and demolition sites, the bridge structure will not be dropped into the river but alternative means will be used to avoid "dropping the bridge" into rivers/streams. This shall be done by "sawing" appropriate sections of the bridge and using cranes to lift these sections away or alternatively by construction of a platform onto which the bridge could be lowered.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Cofferdams, silt fences, sediment barriers or other devices will be used as appropriate based on the design to prevent migration of silt during excavation and boring operations within streams. If cofferdams are used, these will be dewatered and cleaned to prevent siltation by pumping from cofferdams to a settling basin or a containment unit.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Exposed surfaces shall be provided with native grasses and creepers to reduce runoff as early as possible in construction.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
Transport of materials and spoils, operation of construction equipment and various construction activities	Damage to community utilities such as water supply pipes, irrigation canals, drainage, etc. may occur during construction activities.	The contractor shall not allow overloading of trucks used for all project- related activities.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		The contractor shall immediately repair any damage caused by the Project to community facilities such as water supply, power supply, irrigation canals, drainage and the like. Adequate compensation shall be paid to affected parties, as necessary.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Access roads damaged during transport of construction materials and other project-related activities shall be reinstated upon completion of construction works.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
Bridge works, stockpiling of constructio n materials and spoils, use of hazardous materials and earthworks	Deterioration of surface water quality, flooding and flow obstruction of watercourses	Firmly consolidate river banks using stones, concrete and other suitable retaining measures at each bridge construction site and ensure that water courses (rivers, canals, etc.) shall be kept free of excavation spoil and construction debris, floating and submerged.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Spoils, construction wastes and construction materials stockpile area shall be located away from water bodies and under no circumstances will these materials be dumped into watercourses.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		Do not fill up canals and creeks at the construction site. In case filling of local drainage system is extremely necessary, consultation with local authorities shall be undertaken and their permission obtained beforehand. An alternative drainage shall be established before the existing canal is filled-up.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		Prohibit placement of construction materials, waste storage areas or equipment in or near drainage channels and water courses.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		Discharge of oily wastewater, fuel, hazardous substances and wastes, and untreated sewage to watercourses/canals and on the ground/soil shall be prohibited.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		Provide adequate drainage at the construction sites and other project areas to avoid flooding of surrounding areas and minimize flow obstruction of existing watercourses.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Regularly inspect and maintain all drainage channels to keep these free of obstructions.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Slope stabilization measures (e.g., planting of fast growing native species of grass and shrubs, etc.) shall be implemented on exposed surfaces along river embankments to reduce material wash-away.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Construct retaining structures such as gabion baskets, rip-rap, etc. for river bank protection.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
Road and bridge works	Traffic disruption and obstruction of access to roadside properties	In cooperation with the local traffic authorities, properly organize transport of materials for the project to avoid congestion.	All project roads and access roads	No additional cost	Contractor	DDIS, PMU/SEO
		Set up clear traffic signal boards and traffic advisory signs at the roads going in and out the road and bridge construction sites to minimize traffic build-up.	Throughout project sites, where appropriate	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Regularly monitor traffic conditions along access and Project roads to ensure that project vehicles are not causing congestion.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO
		Provide sufficient lighting at night within and in the vicinity of construction sites.	Throughout project sites, where appropriate	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Implement suitable safety measures to minimize risk of adverse interactions between construction works and traffic flows through provision of temporary signals or flag controls, adequate lighting, fencing, signage and road diversions, as necessary.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Provide safe temporary accesses to properties and establishments affected by disruption to their permanent accesses.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Reinstate good quality permanent accesses following completion of construction.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Provide safe vehicle and pedestrian access around construction areas.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Provide adequate signage, barriers and flag persons for traffic control.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		If necessary, traffic will be diverted for safe and smooth movement of vehicles to ensure smooth traffic flow and minimize accidents, traffic hold ups and congestion.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		The diversion signs would be bold and clearly visible particularly at night.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Temporary bypasses will be constructed and maintained (including dust control) during the construction period particularly at bridge crossings. Location of temporary bypasses shall be agreed with local authorities and such sites shall reinstated upon completion of works.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
Earthworks, stockpiling and roadworks	Soil erosion	On hill slopes and other potentially erodible places along the roadside, appropriate native vegetation that retards erosion will be planted.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		As much as possible, construction activities in hilly areas are to be undertaken during dry season only.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO
		Road embankments and slopes shall be monitored during construction for signs of erosion, vegetative cover shall be provided on slopes by planting native grass and creepers on erosion prone sections.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Long-term material stockpiles will be covered with native species of grass or other suitable materials to prevent wind erosion.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO
		Use appropriate erosion control and stabilizing measures such as benching, geotextiles, mats, fiber rolls, soil binders, etc. that are not toxic to the environment, or vegetation measures/temporary landscaping in disturbed areas and on graded slopes.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO

Operation of construction equipment and vehicles, site works, spoils	Impacts to flora and fauna	Spoils and all types of wastes shall not be dumped into forested areas, agricultural land, densely vegetated areas, and water courses.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Workers shall be prohibited from collecting firewood and construction materials from surrounding forests, and from hunting wild animals.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO

Project Activity	Potential Environmental Impacts/Concern	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
disposal and presence of workers		As the project will not require road widening, ensure that construction works are carried out without unnecessary clearing of roadside vegetation.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		The contractor shall prohibit cutting of trees for firewood and for use in for construction-related activities	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Construction vehicles will operate within the corridor of impact, i.e., approximately within ROW, to avoid damaging soil and vegetation. It will be most important to avoid soil compaction around trees. Generally the rule will be to avoid driving heavy equipment or trucks anywhere into the 'drip-line' of a tree (defined as imaginary line around a tree where rainwater falls freely to ground unimpeded by the tree's foliage)	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		The contractor will not use or permit the use of wood as a fuel for the execution of any part of the Works, including but not limited to the heating of bitumen and bitumen mixtures, and to the extent practicable shall ensure that fuels other than wood are used for cooking, and water heating in all his camps and living accommodations.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Contractor shall not buy or use wood from the illegal sources (that come from the illegal logging)	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Construction camps, asphalt mixing plants, material storage sites and other project facilities shall not be located in the forest areas and other densely vegetated sites.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Contractor will take all precautions necessary to ensure that damage to vegetation is avoided due to fires resulting from execution of the works.	*ditto*	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		The Contractor will immediately suppress the fire, if it occurs, and shall undertake replanting to replace damaged vegetation.				DDIS, PMU/SEO MOE/PDE
		As much as possible, bridge works will be scheduled in dry season to minimize adverse impacts to fishery, river water quality and other aquatic resources.	*ditto*	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE

Project Activity	Potential Environmental Impacts/Concerns	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
Construction works, operation of workers camps	Health and safety risks to workers and the public	Conduct orientation for construction workers regarding emergency response procedures and equipment in case of accidents (e.g., burns from hot bitumen, spills of hazardous substances, etc.), fire, etc.; health and safety measures, such as on the use of hot bitumen products for paving of Project roads, etc.; prevention of HIV/AIDS, malaria, diarrhea, and other related diseases.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Provide drainage at construction sites and workers camps to prevent water logging/ accumulation of stagnant water and formation of breeding sites for mosquitoes.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Provide fire fighting equipment and appropriate emergency response equipment (based on on-going construction activities) at the work areas and at construction and workers camps.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Provide first aid facilities that are readily accessible by workers.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		At the workers camps, provide adequate housing for all workers at the construction camps, provide reliable supply of potable water, install separate hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers and establish clean eating areas and kitchen.	Workers camps	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Provide workers with appropriate safety equipment/devices (such as dust mask, hard hats, safety shoes, goggles, ear plugs, etc.) and strictly require them to use these as necessary.	Throughout project sites	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Install sign boards, lighting system at the construction sites, borrow pits, or places which may cause accidents for people and workers	Throughout project sites, where appropriate	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Strictly impose speed limits on construction vehicles along residential areas and where other sensitive receptors such as schools, hospitals, and other populated areas are located.	Throughout project sites, where appropriate	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE

Project Activity	Potential Environmental Impacts/Concerns	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Barriers (e.g., temporary fence) shall be installed at construction areas to deter pedestrian access to these areas except at designated crossing points.	Throughout project sites, where appropriate	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Sufficient lighting at night as well as warning signs shall be provided in the periphery of the construction site.	Throughout project sites, where appropriate	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		The general public/local residents shall not be allowed in high – risk areas, e.g., excavation sites and areas where heavy equipment is in operation.	Throughout project sites, where appropriate	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Ensure proper collection and disposal of solid wastes within the construction camps consistent with local regulations.	Construction/ workers camps	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Provide fencing on all areas of excavation greater than 2 m deep.	Throughout project sites, where appropriate	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Ensure reversing signals are installed on all construction vehicles.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Measures to prevent malaria shall be implemented (e.g., provision of insecticide treated mosquito nets to workers, spraying of insecticides, installation of proper drainage to avoid formation of stagnant water, etc.).	Construction/ workers camps	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE

Project Activity	Potential Environmental Impacts/Concerns	Proposed Mitigation Measures	Location	Estimated Cost	Responsibility	
					Implementation	Monitoring
		Discharge of untreated sewage shall be prohibited.	Construction/ workers camps	Part of contractor's bid cost	Contractor	DDIS, PMU/SEO MOE/PDE
Operation of construction/ workers camps	Social conflicts	Regularly inform in advance the local officials and local residents on the location and schedule of construction activities which may cause impacts on the environment and life of people (e.g., road sections to be constructed; roads used for transport, locations of worker camps etc.). The contractor will be encouraged to establish discussions with the village representatives before works commence and maintain these discussions as an ongoing activity through the life of the project.	Throughout project sites	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Locate construction camps away from communities (at least 500 m away) in order to avoid social conflict in using resources and basic amenities such as water supply.	Construction/ workers camps	No additional cost	Contractor	DDIS, PMU/SEO MOE/PDE
		Maximize number of local people employed in construction works.	Throughout project sites		Contractor	DDIS, PMU/SEO MOE/PDE
		Maximize goods and services sourced from local commercial enterprises.	Throughout project sites		Contractor	DDIS, PMU/SEO MOE/PDE
Operation						
Increased number of vehicles	Elevated noise levels	Along schools, hospitals, etc., provide traffic signs prohibiting blowing of horns and impose speed limits	All project roads	Part of project cost	PDRD, Local traffic authority	MRD/PMU
	Road safety risks	Implementation of a community-based road safety program under the Project to increase safety awareness. The program includes education program for schools, drivers, road users, and the community.	All project roads	Part of project cost	PDRD	MRD/PMU
		Proper maintenance of traffic signs, markings and other devices used to regulate traffic at appropriate places.	All project roads	Part of project cost	PDRD, Local traffic authority	MRD/PMU

B. Monitoring

102. **Table VIII.2** presents the environmental monitoring activities to be undertaken during various project phases. Monitoring of the contractor's environmental performance in terms of implementation of mitigation measures for pre-construction and construction phases shall be undertaken by the detailed design and implementation consultant (DDIS). The DDIS shall also conduct ambient measurements (dust, noise and surface water quality) and shall assist the MRD in preparing semi-annual environmental monitoring reports for submission to ADB and the Ministry of Environment. The monitoring reports shall describe progress with the implementation of the EMP and compliance issues and corrective actions, if any.

Table VIII.2 Environmental Monitoring Measures

Aspects/Parameters to be Monitored and Applicable Standards	Location	Means of Monitoring	Schedule/ Frequency	Responsible to Undertake Monitoring
Pre-construction				
1. Completion of detailed design in accordance with EMP requirements to address climate change and hydrological impacts (see IEE Table VIII.1)	Phnom Penh	Review of detailed design documentation	Prior to approval of detailed design	MRD/PMU
2. Implementation of all mitigation measures specified in IEE Table VIII.1 on the following:				
a. UXO clearing	All project roads	Confirm UXO removal certified by authorized UXO clearing firm	Prior to start of site works	DDIS, MRD/PMU
b. Establishment of grievance redress mechanism (GRM)	All project roads	Confirm GRM is established and disclosed to the public	Prior to start of site works	DDIS / SEO / PMU/ MRD
c. Siting of quarry and borrow areas consistent with EMP	All project roads	Check contractor's construction materials plans, site visit	Prior to establishment of quarry and borrow areas	DDIS, MRD/PMU
d. Siting of various project facilities (workers / construction camps, crushing plants, bitumen plants, etc.) consistent with EMP	All project roads	Check contractor's facilities location plans, site visit	Prior to establishment of contractor's facilities	DDIS, MRD/PMU
e. Relocation of community facilities (e.g., water supply pipelines, irrigation canal, etc.)	All project roads	Site visit, confirm with local officials	Prior to start of site works	DDIS, MRD/ PMU

Aspects/Parameters to be Monitored and Applicable Standards	Location	Means of Monitoring	Schedule/ Frequency	Responsible to Undertake Monitoring
3. Ambient surface water quality (fecal coliform, dissolved oxygen,pH, oil and grease, suspended solids, biological oxygen demand – 5 days or BOD5) to be compared to standards specified in Subdecree on Water Pollution Control, 1999 (No. 27 ANK.BK)	All project roads - on rivers or streams close to proposed sites for construction/ workers camps	Field sampling	Once, prior to establishment of workers/construction camps	DDIS
4. Noise in dB(A) and vibration compared to standards specified in Subdecree on the Control of Air Pollution and Noise Disturbance, 2000 (No. 42ANK.BK)	At least one sampling station on each project road (particulalry where sensitive receptors such as residential areas, school, medical facility, etc, are found) andother areas where project-related activities are undertaken	Noise and vibration measurement	Once, prior to start of site works	DDIS
5. Total suspended particulate/ dust compared to standard specified in Subdecree on the Control of Air Pollution and Noise Disturbance, 2000(No. 42 ANK.BK)	At least one sampling station on each project road (particulalry where sensitive receptors such as residential areas, school, medical facility, etc, are found) and other areas where project-related activities are undertaken	Field sampling	Once, prior to start of site works	DDIS
Construction				
6. Implementation of construction phase environmental mitigation measures specified in IEE Table VIII.1	Locations indicated in IEE Table VIII.1 for specific mitigation measures	Site visit, interviews with local residents, coordination with concerned agencies (e.g., local traffic authorities, etc.)	Monthly (on a regular basis) Random checks and to validate complaints	DDIS, MRD/PMU/SEU, PDRDs/MOE-PDE

Aspects/Parameters to be Monitored and Applicable Standards	Location	Means of Monitoring	Schedule/ Frequency	Responsible to Undertake Monitoring
7. Noise in dB(A) and vibration compared to standards specified in Subdecree on the Control of Air Pollution and Noise Disturbance, 2000 (No. 42 ANK.BK)	All project roads and other areas where project- related activities are undertaken	Noise and vibration measurement	In response to complaints	DDIS
8. Total suspended particulate/dust compared to standard specified in Subdecree on the Control of Air Pollution and Noise Disturbance, 2000 (No. 42 ANK.BK)	All project roads and other areas where project- related activities are undertaken	Field sampling	In response to complaints	DDIS
9. Ambient surface water quality (fecal coliform, dissolved oxygen,pH, oil and grease, BOD5)	Upstream, midstream and downstream of rivers and stream close to construction/ workers camps	Field sampling	Quarterly and in response to complaints / to validate and verify pollution events	DDIS
10. Other parameters to be sampled, as appropriate, to validate complaints and pollution event(s) due to project activities	Other locations to validate complaints or where pollution occurred due to the project (e.g., fuel spill)			

103. The estimated costs for implementing the EMP are provided in **Table VII.3** as follows:

Table VIII.3: Estimated Costs for EMP Implementation (4 years)

Item	Estimated Total Cost (USD)
1. Environmental monitoring to be undertaken by DDIS environment specialists	
a. International (1 person for 8 months USD20,000/month)	160,000
b. National (1 person for 8 months @ USD2,000/month)	16,000
2. Environmental management capacity building program/training to be undertaken by DDIS for SEO staff (estimates only, to be determined during Project implementation)	20,000
3. Environmental effects monitoring for noise, dust and surface water quality (allow USD 1,000/quarter)	16,000
4. Construction phase mitigation measures (included in project costs)	N/A
5 Transportation for environmental monitoring (@ USD1000/quarter for 4 years)	16,000
Sub-total	228,000
6. Contingency (10%)	22,800
Total	**250,800**

C. Implementation Arrangements

104. The table below shows the institutional responsibilities for implementation of the EMP.

Table VIII.4: Responsibilities for EMP Implementation

Agency	Responsibilities
Ministry of Rural Development (MRD)	• Executing agency, shall ensure that sufficient funds are available to properly implement the EMP • Ensure that all Project components, regardless of financing source, complies with the provisions of the EMP and ADB Safeguard Policy Statement 2009 (SPS) • Ensure that Project implementation complies with Government environmental policies and regulations • Ensure that tender and contract documents include the EMP • Develop further the capabilities of the Social and Environmental Office (SEO) during Project implementation • Submit semi-annual monitoring reports on EMP implementation
Project Management Unit (PMU)/ Social and Environmental Office (SEO)	• Responsible for overall project implementation, management and coordination; • Include the EMP in the tender and contract documents; • Ensure that EMP provisions are strictly implemented during various project phases (design/pre-construction, construction and operation) to mitigate environmental impacts to acceptable levels • Undertake monitoring of the implementation of the EMP (mitigation and monitoring measures) with assistance from DDIS. • With support from DDIS, prepare semi-annual environmental monitoring reports for submission to ADB. • Ensure that Project implementation complies with ADB's Safeguard Policy Statement (SPS) principles and requirements • Train and retain dedicated staff for the SEO to oversee EMP implementation • Ensure that environmental protection and mitigation measures in the EMP are incorporated in the detailed design • Obtain necessary approval(s) from MOE prior to award of civil works contracts • Prior to start of site works, establish an environmental grievance redress mechanism, as described in the IEE, to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the Project's environmental performance • With assistance from DDIS, prepare semi-annual environmental monitoring reports for submission to ADB • Based on the results of EMP monitoring, identify environmental corrective actions and prepare a corrective action plan, as necessary, for submission to ADB
Detailed Design and Implementation Supervision Consultant (DDIS)	• Incorporate into the project design the environmental protection and mitigation measures identified in the EMP for the design/pre- construction stage; • Assist PMU/SEO to ensure that all environmental requirements and mitigation measures from the IEE and EMP are incorporated in the bidding documents and

Agency	Responsibilities
	contracts • Prior to start of site works, assist MRD in establishing a grievance redress mechanism as described in the IEE, • Implement all mitigation and monitoring measures for various project phases specified as DDIS's tasks in the EMP • Undertake environmental management capacity building activities for SEO as required in the EMP • Undertake regular monitoring of the contractor's environmental performance as scheduled in the EMP • Conduct field measurements for surface water quality, dust and noise as required in the EMP
Contractor	• Provide sufficient funding and human resources for implementation of the EMP • Ensure proper and timely implementation of required pre-construction and construction mitigation measures in the EMP • Implement additional environmental mitigation measures, as necessary
PDRD	• Responsible for operation and maintenance of Project road
Ministry of Environment (MOE and PDE of 9 Provinces)	• Issue necessary approvals to the Project prior to implementation • Undertakeenvironment monitoring of the Project based on their mandate during construction

D. Capacity Building

105. There are currently 7 staffs within SEO : 1 Chief, 1 Vice chief, 1 Resettlement, 2 Environment and 2 Gender.

106. The staff of MRD assigned to the SEO requires practical training which will be provided both locally, regionally and internationally. Thus, study tours will be undertaken to develop the in-depth knowledge required to be able to function as an effective SEO for MRD. The SEO will then provide social and environmental safeguards training and pro-poor approaches on rural transport issues to each of the Provincial Departments of Rural Roads (PDRD). The provision of this capacity building support is included under this project. The tasks of the DDIS tasks will include:

i) Strengthen the capabilities of the staff in the SEO at MRD,
ii) Establish links and cooperation between the SEO and the Ministry of the Environment and other concerned agencies,
iii) Undertake study tours for the SEO staff: regionally and elsewhere,
iv) Prepare training materials and train SEO staff in the scope and detail of their responsibilities, and
v) Prepare the SEO staff so they can inform and train staff of other offices of MRD/ PDRDs

IX. CONCLUSION

107. Results of the initial environmental examination (IEE) show that only minor environmental impacts are anticipated. Such impacts will be experienced during site works mainly due to dust and noise emissions as well as potential occupational and community health and safety risks, but can be mitigated. None of the project roads traverses the buffer and core zones of ecologically protected areas.

108. The Project proposes upgrading of 39 existing rural roads from gravelled roads to permanently paved roads totaling 729 km. The roads are located in nine provinces and will pass through 33 districts of Cambodia. These roads serve primarily rural communities and comprise a mix of well established and frequently trafficked road links and a number of links that are currently being or have been recently improved to gravel road standard. As the Project will only upgrade roads within existing widths, no land or other physical assets need to be acquired and hence there are no resettlement issues.

109. Six of the roads proposed for improvement under this Project are located in the transition zone of the Tonle Sap Biosphere Reserve (TLSBR). As the road upgrading is in keeping with activities permitted in the Transition Zone, these works will not have adverse impacts on the TLSBR. Notwithstanding this, an environmental assessment has been prepared in accordance with ADB SPS 2009. This is to be submitted to TLSBR authority for their information.

110. One of the project roads (PS10) located in the Transition Zone of TLSBR has been shortened due to economic considerations and this has the environmental advantage of pulling them back further from the Buffer Zone. This action is supported.

111. Another output has been added to the original design which is the Mekong River Island Connectivity Output. Though not originally planned during the design of Loan 2670, MRD subsequently requested ADB to rehabilitate roads and jetties within a Mekong River island cluster (part of mainland Kampong Cham Province) in order to improve climate resilient access and connectivity. Geographically located in the Mekong River but 11 km away from the mainland these 5 remote islands are highly vulnerable to flooding with no organized access either from the mainland or inter-island. Due to recent increasing calamities caused by climate changes, lack of access to emergency facilities have resulted in annual casualties of about 10 island residents. Based on the aforementioned rationale, this fifth output, improving climate resilient access, will incorporate climate change adaptation measures for the design and rehabilitation of 50 km rural roads as well as 11 jetties. This output will be piloted for the Mekong River island cluster of Kampong Cham Province, and replicated in other similar areas while strengthening associated policy approaches.

112. Although no formal approvals are required from the relevant ministries and organizations it is still the policy of MRD and DDIS Consultants to inform other such organizations of the planned activities and they are consulted at all stages of the project. MRC and MoE have been approached and requested to provide letters confirming they have No Objection to these schemes.

113. Vegetation cover along the project roads largely consists of agricultural crops such as rice, while some sections traverse areas covered with shrubs, grasses and sparse trees. No extensive removal of vegetation or tree cover is anticipated.

114. Condition surveys have been carried out of every road. Environmentally sensitive items such as schools, pagodas, clinics, utilities, water courses and trees etc. have been identified and the chainage given for each location. (See Appendix 4 / 5 for results) These items will be drawn to the attention of the contractor and extra care demanded of the contractor when they are operating in these vicinities.

115. Only minor environmental impacts are anticipated during construction and these are considered temporary. To avoid or mitigate negative impacts arising from the Project, an environmental management plan (EMP) detailing mitigation measures and monitoring activities has been prepared as part of the IEE. Proper and timely implementation of EMP provisions will avoid or minimize environmental impacts concerning location of project roads and construction facilities, safety risks due to potential presence of unexploded ordnance (UXO), potential encroachment to culturally protected areas, disruption and damage to community facilities, dust and noise emission, damage to vegetation and loss of wildlife, soil erosion, waste disposal and other issues associated with construction works. During operation phase, the Project will have over-all positive impacts such as on the quality of life because the permanently paved roads will result in significant reductions in dust levels. A few potential adverse impacts during operation are also addressed in the EMP, such as those pertaining to traffic noise and road safety from increased traffic volume. These impacts can be mitigated through implementation of the EMP.

116. Public consultations involving affected people and local officials have been conducted through focus group discussions and individual interviews in all nine provinces during the preparation of the IEE in compliance with ADB's information disclosure and consultation requirements. No major issues have been identified.

117. A grievance redress mechanism will be established by MRD prior to start of site works to ensure that affected people's concerns, complaints, and grievances about the Project's environmental performance are promptly addressed. To ensure that Project is carried out consistent with the EMP requirements, MRD specifies in the tender documents and civil works contracts that implementation of the EMP is compulsory. MRD will be assisted by the detailed design and implementation supervision (DDIS) consultant in monitoring the environmental performance of contractors. The DDIS consultant will also continue environmental management capacity building of the Social and Environmental Office in MRD during implementation.

118. The project is confirmed as Category B in accordance with ADB SPS 2009. There are no overriding environmental reasons why the project should not proceed.

APPENDIX 1

Initial Environmental Examination

Connectivity Improvements for Mekong River Islands Output

July 2013

Cambodia : Mekong River Island Connectivity Output

ADB TA 8322-CAM

Prepared by Ministry of Rural Development, Cambodia for the Asian Development Bank.

CONTENTS

FIGURES

TABLES

I. EXECUTIVE SUMMARY

1 The Mekong River Island Connectivity Output (MICO) is consistent with and contributes to the goals of the Rural Road Policy and Strategy of the Ministry of Rural Development (MRD), in particular to improve connectivity between road and water transport.

2 The TA for MICO covers 5-island cluster in Mekong River consisting of 35 villages in three districts (i) Kampong Siem, (ii) Kaoh Soutin and (iii) Krouch Chhmar in Kampong Cham Province. The islands are: (i) Kaoh Mitt, (ii) Kaoh Soutin, (iii) Kaoh Thmei, (iv) Kaoh Samraong, and (v) Kaoh Pir with a total population of 29,868 or about 6,868 households.

3 On each of the islands the roads are a network from which the most important to provide better connectivity have been selected for improvement or rehabilitation. For Kaoh Mitt connectivity to the new Ministry of Public Works and Transport (MPWT) bridge which is under construction is the highest priority. This imminent permanent high quality and preferential link has been considered in deciding which roads on Kaoh Mitt, Kaoh Soutin and Kaoh Thmei have the highest priority for improvement. A concrete bridge has been proposed to connect Kaoh Mitt to Kaoh Soutin, as described below. For Kaoh Thmei connectivity by ferry boat is still required when water levels are high. Hand-built concrete roads similar to those that exist have been designed for improvement or rehabilitation. Most of the existing concrete roads will be retained because they are suitable and they represent the communities' investment in their own future. The inventory of existing roads has been prepared.

4 This project proposes the improvement of 50km of roads using hand-laid unreinforced concrete and the improvement of 11 jetties, 7 on the islands and 4 connecting jetties on the mainland. It also proposes the construction of a 350m concrete bridge between Kaoh Mitt and Kaoh Soutin as the only means of providing all year connectivity. Any other solution would mean that connectivity is loss for several months of the year.

5 The aesthetics and natural beauty of the islands will be preserved. No high embankments will be constructed except for a short length (1.3km) on Kaoh Samraong, through an area that is not populated. Other than minor adjustments, existing road levels have been retained. Nearly all existing cross drainage and all the existing small bridges require replacement. This is recommended for all roads on the islands, not only those that are on the roads that will be improved to ensure connectivity.

6 Natural and man-made drainage channels to reservoirs or other exits for water will be cleared or improved to reduce localized flooding in populated areas. Levees will be rehabilitated. Water pumping systems will be provided to provide water and remove excess water where possible.

7 Resettlement, other than some minor temporary losses, will not be required because the existing road widths are adequate.

8 Jetties that provide a vehicle service and are accessible all year will be rehabilitated and made permanent, durable and sustainable. They will have associated floating jetties for small boats that do not have loading ramps. Other jetties which can only serve connectivity across long stretches of exposed sandy soils by way of bamboo-mats have been avoided. These are likely to provide less than all-year service.

9 Except for Kaoh Samraong each island will have two designed and durable jetty connections, through to Kampong Cham City (KCC) or other major centre as is efficient for their needs. It is not possible to improve a second jetty on Samraong because of the shallow water and the presence of sand-bars on the west side of the island. Improved jetties should provide all-year good connectivity. The jetties will be suitable for boats with or without loading ramps.

10 Safety both at the jetties and during the water crossing is essential. Surveys have been undertaken which indicate the current situation and therefore what is required for improved and safer services in the future. A draft Memorandum of Understanding (MoU) will be prepared for consideration by MRD and the Governor's Office of Kampong Cham province.

11 Mains electricity supply will be available on Kaoh Mitt and Kaoh Soutin. Elsewhere diesel generators provide some electricity.

12 Water supplies are available from either private sources or deep or shallow wells. Arsenic in wells has previously been determined and the villagers are aware of this. They extract water and use it according to the level of arsenic contamination.

13 Environmental studies to provide the Initial Environmental Examination (IEE) and the Environmental Management Plan (EMP) have been completed. Field visits confirm that the Output is Category B, as indicated in the concept documents. The area of the Output is not within or near to any protected areas. There are no legally protected sites of special scientific or ecological interest. Equally, there are no protected cultural or national heritage structures within the area of the Output. Public consultations have been held with representatives and individual residents from each or the 5 islands in attendance. Studies have been undertaken to understand the extent of localized flooding in the populated areas and relate this to the levels of flood from the Mekong River and from the incidence and extent of rainfall using historical data.

14 The Output area is within the jurisdiction of both the Ministry of Environment (MOE) and the Ministry of Water Resources and Meteorology (MOWRAM), for the land and water areas, respectively. It is also of interest to the Mekong River Commission (MRC). Each have are being been consulted and informed as necessary and formal documents such as letters of no objection have been requested as appropriate. The Cambodian MRC has indicated that improvement of the jetties is considered a small area improvement that does not affect the Mekong River to any extent.

15 An environmental management plan (EMP) detailing mitigation measures and monitoring activities has been prepared as part of the IEE. Temporary environmental impacts caused by the civil works have been identified and mitigation measures are given in the EMP.

16 To ensure that the project is carried out in accordance with the EMP requirements, MRD will specify details of the implementation of the EMP in the tender documents and civil works contracts. The EMP (and EMMP) will form part of the tender documents which becomes legally binding on the selected contractor.

17 Only minor environmental impacts are anticipated. Such impacts will be experienced during site works mainly due to dust and noise emissions as well as potential occupational and community health and safety risks, but can be mitigated. Some minor mitigation measures will be specified but no major impacts have been identified.

18 The project is confirmed as being Category B according to ADB guidelines.

II. DESCRIPTION OF THE PROJECT

A. The Project Overview

1. Objective

1. The Government of Cambodia has requested an Asian Development Bank (ADB) project preparatory technical assistance (TA) to prepare the Mekong River Island Connectivity Output; this is one of the 5 outputs, under the proposed Rural Roads Improvement Project II (RRIP II). Meanwhile, the ongoing Loan 2670 will design the other 4 outputs of the proposed project in parallel with this TA implementation. This ongoing loan project is a priority in the Government's key infrastructure development agenda as it provides all-year access to rural agricultural communities of 9 provinces of Cambodia.

2. The objective of the TA is to design the Mekong River Connectivity Output. There are two key objectives of the proposed technical assistance (TA) :

- The first is to design interventions that would increase island connectivity of the villages of the 5-island cluster in Mekong River.
- The second is to establish strategic changes in multi-sector development of climate change studies and flood planning for enhanced access, eco-tourism, climate resilient tourism, and private sector participation in rural clean energy generation.

3. The impact of the TA is increased island connectivity of the villages of the 5-island cluster in Mekong River in Kampong Cham Province.

2. Rural Road Policy and Strategy

4. The MRD policy for rural roads is to provide all year access; that is access to basic needs, economic and social facilities, services and opportunities. The goal is to develop and manage sustainable road transport infrastructure, modes and services. It declares:

a) Rural access will be efficiently developed and managed to ensure optimal economic returns on investment; connectivity to higher order infrastructure; benefits to society and the use of local resources.

b) Rural access will be sustainable in economic, environmental and social terms.

c) Land and water rural infrastructure will be complementary to improve rural access for women and men.

d) Rural transport modes and services will be equitable, affordable, dependable and safe.

3. Island Infrastructure

5. Site visits were conducted to each of the islands by the consultants. The existing road network had been recorded using hand-held GPS units to obtain "tracks" indicating the start and end points of each road and the route along the road at frequent intervals. The location of intersections and other points of interest such as cross drainage structures, and importantly the locations of jetties were also recorded using GPS Way Points. These data were plotted on topographic maps to obtain an overview and understand the extent of the existing network. The locations of community services such as health centres, schools and commune centres and the approximate boundaries of the village were recorded. On the maps given below the roads are shown and jetties indicated by red-filled circles; those to be improved have an outer red circle.

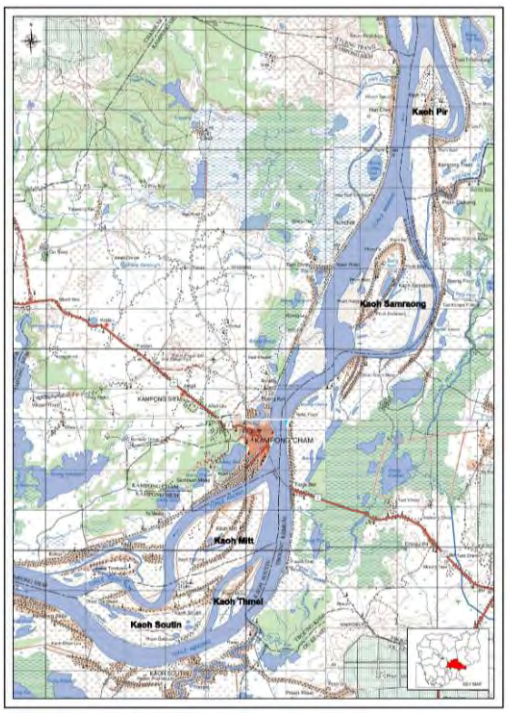


Figure 1: Map 1 Location of the 5 Islands

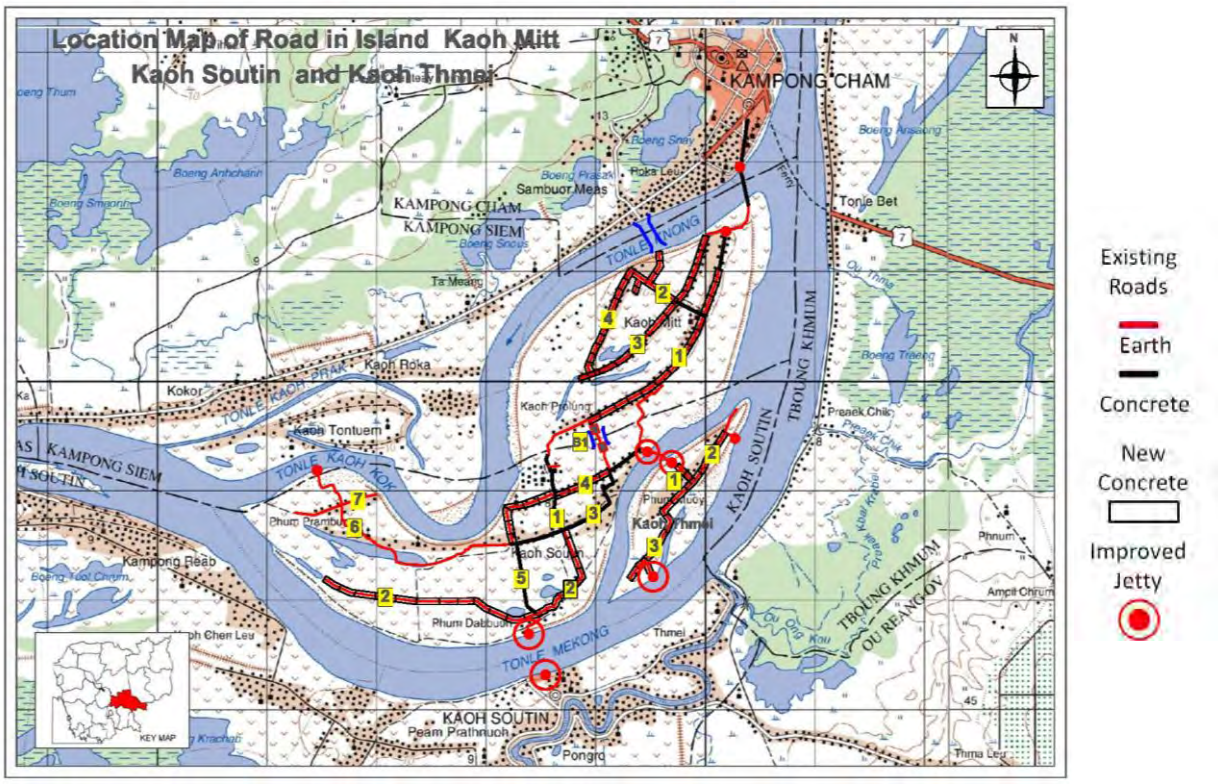


Figure 2: Map 2 Kaoh Mitt, Soutin and Thmei

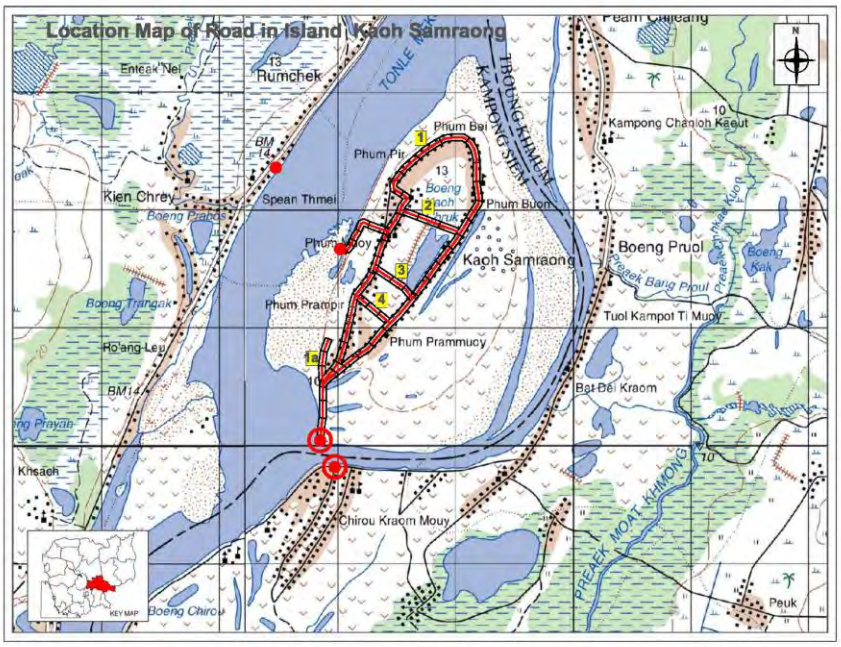


Figure 3: Map 3 Kaoh Samraong (Grid-2km square)

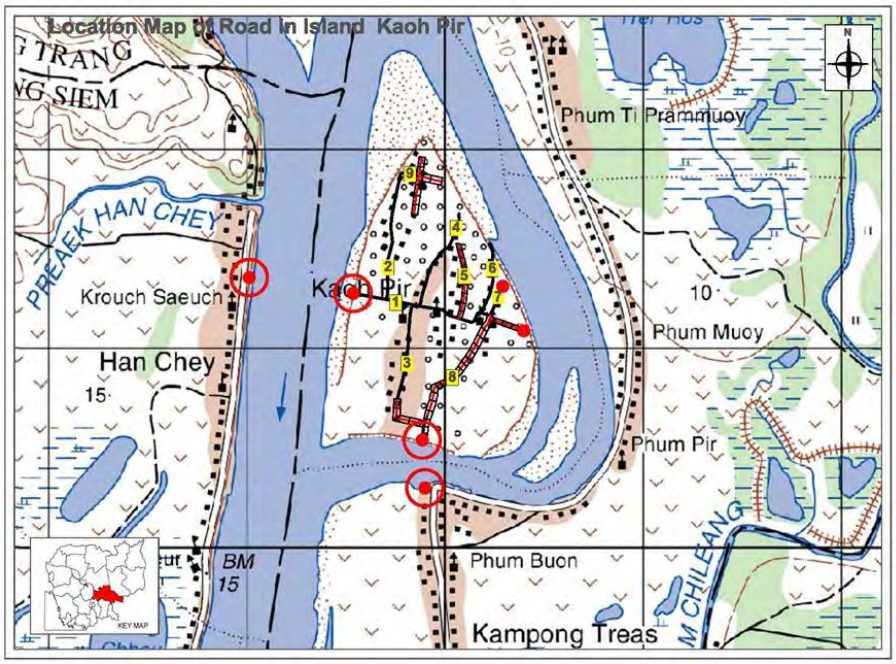


Figure 4: Map 4 Kaoh Pir (Grid=2km square)

An inventory of the existing network of roads and jetties has been obtained. This includes the identification of which roads are paved, and which are engineered earth roads and which are simple tracks. The inventory is shown in

Table II-1. The total estimated length of existing roads is 66.75km of which 13.7km has a concrete pavement.

Table II-1 Inventory of Existing Roads

Island		Road ID	Existing Road			Existing Structure		
			Length (km)	Surface (km)		Bridge	Box	Pipe
				Concrete	Soil +	Nos	Nos	Nos
1	Kaoh Mitt	1	5.90	0.50	5.40	1	-	-
		2	2.45	0.45	2.00	-	2	-
		3	4.80	-	4.80	1	1	-
		4	2.00	-	2.00	-	-	-
		Sub total	**15.15**	**0.95**	**14.20**	**2**	**3**	**0**
2	Kaoh Soutin	1	2.90	1.40	1.50	1	5	-
		2	6.80	0.10	6.70	1	-	-
		3	2.90	2.30	0.60	-	-	-
		4	3.50	0.80	2.70	1	-	-
		5	2.60	2.60	0.00	2	1	-
		6	1.70	-	1.70	-	-	-
		7	1.30	-	1.30	-	-	-
		Sub total	**21.70**	**7.20**	**14.50**	**5**	**6**	**0**
3	Kaoh Thmei	1	0.40	-	0.40	-	1	-
		2	2.10	-	2.10	-	-	-
		3	1.10	-	1.10	-	1	-
		Sub total	**3.60**	**0**	**3.60**	**0**	**2**	**0**
4	Kaoh Samraong	1	10.00	-	10.00	-	-	2
			2.00	-	2.00	1	-	-
			1.00	-	1.00	-	2	1
			0.85	-	0.85	-	1	-
		Sub total	**13.85**	**0**	**13.85**	**1**	**3**	**3**
5	Kaoh Pir	1	2.10	1.65	0.45	-	5	-
		2	1.50	1.50	0.00	-	1	1
		3	2.00	1.00	1.00	-	-	-
		4	1.10	-	1.10	-	-	-
		5	1.15	-	1.15	-	-	-
		6	0.80	0.80	-	-	-	-
		7	0.40	0.40	-	-	-	-
		8	1.50	-	1.50	-	1	-
		9	1.90	0.20	1.70	-	-	-
		Sub total	**12.45**	**5.55**	**6.90**	**0**	**7**	**1**
Total			**66.75**	**13.70**	**53.05**	**8**	**21**	**4**

Source: Consultant's road inventory studies

6. All the roads are managed by MRD, and all of them provide access from commune to village or village to village, or to a jetty and are therefore defined as Category 4 in the MRD administrative inventory (MRD, 2012). The data obtained from these surveys will be handed over to MRD to complement their road asset inventory.

7. The paved roads are all hand-laid cement concrete, in various conditions. Many are in good condition. For different roads their individual width varies from 2 to 5 metres. They have been constructed by-hand using natural gravels and sands as aggregates, both obtained from the Mekong River. They are suitable for the existing traffic on the island but they will not be durable if traffic loading increases significantly. The difficulty is that although concrete roads are stiff and strong in compression, they are brittle and can crack under even a single heavy traffic load, or if they are not supported sufficiently well from below.

8. Overall, cement concrete roads are a sensible technical solution for the development of roads on the islands, especially because the roads are expected to be subject to annual flooding. Although the Mekong River water level varies annually by approximately 12.5m and channels within and between the islands fill with river water, the villages are generally located on higher land and the source of the floods they experience can in some cases be caused by the accumulation of rain fall. (not Mekong River water). Generally, Flood waters subside after several days. Although flooding makes the construction of durable roads more difficult, it is part of the natural annual cycle and is an important source of water for agriculture and domestic use. Climate change is of course a major threat.

9. The extent of the paved network varies from island to island. Kaoh Soutin has the most extensive paved network with approximately 50% of the network paved with concrete. In contrast, Kaoh Samraong has no paved roads.

4. Existing Drainage Structures

10. The condition of the cross drainage structures including small bridges is generally bad. Two new box culverts are noted to be in good condition on Kaoh Thmei and those on Kaoh Pir are noted to be fair. With only two exceptions, box culverts have been used instead of pipe culverts. Box culverts have a high capacity relative to their overall dimensions and can be constructed in-place while pipe culverts are manufactured and transported to the work site, which would be more difficult on the islands. Thus, box culverts are generally suitable. Except those declared to be in a good condition, all the structures require replacement whether or not they are on the roads that are to be improved.

5. Ownership of the Roads

11. In general the roads are managed by MRD. However at one location the approach road to a jetty used during a site survey was said to a private road within a plantation. It has been important to establish that the roads and jetties are publicly owned.

6. Bridge Connectivity

12. Currently, Kaoh Mitt is served during the dry season by a long bamboo bridge, with an earth road approach on the mainland within Kampong Cham City. The bridge is capable of carrying heavy 4-wheel-drive cars and light trucks. It is mostly used by pedestrians and motor cycles. The traffic over the bridge is considerable and many people appear to be commuting to KCC. The bridge is removed for the wet season and replaced when the water levels recede. On the island the bridge connects to a long bamboo- mat road over the sands which are exposed when water levels are low.

13. Approximately 1km to the east of the bamboo bridge a new permanent bridge is under construction by MPWT to connect Kaoh Mitt to the mainland just south of KCC. The new bridge will be 9.5m wide and approximately 795m long. On the mainland the bridge connects to an existing road, but on Kaoh Mitt apart from a short (50m) widened bridge approach road of engineered earth, the bridge only connects to a little-used track which after a short distance connects to an earth road 5m wide. The bridge is expected to be completed in late 2014, or early 2015. The new MPWT bridge dominates the concepts of connectivity for Kaoh Mitt, and also for Kaoh Soutin and Kaoh Thmei. Access to the bridge on the Kaoh Mitt end must be improved. Some heavier truck traffic can be expected to use the bridge and this will generally beneficial to the island's population.

Figure 5 Bamboo Bridge and New Bridge under Construction on Kaoh Mitt
(Source: MICO Consultant)

7. Jetties

14. Each island has a number of jetties from where access is provided to the mainland either to the West or East bank of the Mekong River, or to another island. Some are for use during high or low water levels; a few are suitable for use during both seasons. The ferry operators move their services to different locations depending upon the water levels. The ferry boats vary considerably some are capable of carrying up to 4 heavy duty cars and therefore small trucks. They can carry numerous motor cycles or animals. Some ferries appear quite new being steel construction, others are older wooden construction. Those capable of carrying motor cycles or bigger vehicles have front loading ramps which can be raised during transit, or lowered for loading / unloading. These types of ferries require a firm approach ramp, not a floating jetty. A number of smaller boats without ramps are available to carry people to various destinations. These must land in deeper water because of the shape of their hull and require a floating jetty.

15. Where the jetties are located on steep river banks either on the islands or on the mainland the existing jetty is not sufficiently durable with only a steep, shaped earthen approach which is easily eroded and is slippery when wet and is damaged by the ferries. They can easily become unusable.

16. At many locations on the islands where the river is shallow during the dry season a long stretch of (usually) sandy riverbed is exposed and the ferries cannot reach the permanent river bank of the island. They offload at the water's edge and the vehicles and people have to traverse a long stretch of several hundred meters to reach higher ground. Sometimes bamboo-mats are provided to make these lengths passable. These lengths of riverbed make connectivity very tentative and impassable after rainstorms. The bamboo-mats are a simple construction, but quite durable, being a simple cross-matrix of sliced lengths of bamboo cut and made by-hand into a 3 metre square mat. It is light-weight and simply laid end-to-end on the sand. The mats are picked up and carried to a storage area as the river water levels rises, and are put back when it recedes.

17. There are therefore three situations for each jetty, as listed below.

i. Steep bank – with an all year navigable water approach for a ferry where a durable ramp can be constructed and the ferry can off-load whatever the water level, and for which is relatively simple to provide a durable design.

ii. Steep bank without all year navigable water where a long stretch of sand, or soil, has to be traversed either with or without a bamboo-mat. This is difficult to design and likely to be expensive to construct. The access is at risk over the exposed sands and soils from localized water ponding or flooding of the slightly undulating natural ground.

iii. Smaller ferry boats without loading ramps which use existing jetties of the two types given above or other convenient places for them in an ad-hoc manner. Provision of floating jetties at the locations of the major jetties may be needed to ensure embarkation and disembarkation of passengers can be safely and easily assured.

8. Jetty Ownership and Ferry Services

18. The jetties are publically owned and are under the management of the Governor of Kampong Cham Province. Ferry services are provided by private enterprises. They compete to provide the service and to maintain the existing jetties. The same system is used for provision of the bamboo-mat roads. A toll is charged for the bamboo bridge, bamboo-mat roads and the use of ferries or boats.

9. Private Sector Participation

19. Private sector participation in boat services will continue but will be regulated by MRD in concert with the provincial authorities including the Governor of Kampong Cham City. An MoU will be established with the Governor's Office to define the regulations and responsibilities. The private boat operators will need to improve their services, including charging reasonable fees, operational safety, and possibly operating to schedules for example. However, they will of course have to maintain operational efficiency consistent with the needs of the private sector. This will ensure sustainability of the newly provided infrastructure. Under the TA, consultations have been conducted with the boat operators to understand their requirements, in preparation for future consultations with the Governor's Office.

B. Improvement of Roads

1. Selected Roads

The information on connectivity including the locations of service centres and populations as well as the locations of jetties to be improved has been carefully reviewed and based on this the roads listed in **Table II-2** has been proposed. No significant movement of heavy vehicles is expected. This will allow other roads to be narrower and used more for residential, local and tourist use.

Table II-2 Roads Selected for Improvement

Island (Kaoh)	Road Number	Length (km)	Width (m)	Notes
Mitt	1	4.91	3 to 5	Partially paved, part is primary route from new bridge
	2	2.65	3 to 5	Includes access to new bridge
	3	4.80	3	To village
	4	2.42	3	To village
	Sub-total	**14.78**		
Soutin	1	2.2	5	Includes rehabilitation of "bad" concrete road
	2	7.0	3	As above, and important length to connect persons relocated from eroding areas of the island
	3	1.49	3	Partial paved with concrete
	4	3.63	5	Main road link to jetty
	5	1.2	3	
	Sub-total	**15.52**		
Thmei	1	0.2	3	Link to the school
	2	2.3	3	Main north –s south link
	3	0.9	3	Road to jetty
	Sub-total	**3.4**		
Samraong	1	9.8	3 to 5	Includes a 3m high embankment through low-land for approximately 1.3km of its length

Island (Kaoh)	Road Number	Length (km)	Width (m)	Notes
	2	0.75	3	Provides a short-cut from west to east of island
	3	1.0	3	Provides a short-cut from west to east of island
	Sub-total	**11.55**		
Pir	3	0.8	5	Links to southern Jetty
	5	1.15	3	
	8	1.5	5	
	9	1.3	3	Connects school and Pagoda
	Sub-total	**4.75**		
Total		**50.0**		

Source: Consultant's road design

2. Rehabilitation of Structures

20. Except for 2 box culverts on Kaoh Thmei which are in good condition and 7 culverts on Kaoh Pir which are in a fair condition the cross drainage structures including the bridges are in a bad condition. All of the structures that are not in a good or fair condition will be replaced. Those in a fair condition will be inspected during the surveys to determine if they should be replaced. There is only one drainage structure on Samraong which is likely to be insufficient and better drainage should be ensured. The majority of structures are along the roads that will be improved, but the others are also important because should they fail they will create a break in the connectivity that is to be achieved through this Output.

Table II-3 Summary of bridges and their condition

Island (Kaoh)	Road Number	Span (m)	Width (m)	Length (m)	Condition
Mitt	1	2	2.5	20	Bad
	3	2	3	15	Bad
Soutin	1	1	3.2	5	Bad
	2	1	2	5	Bad
	4	1	2.5	7	Bad
	5	1	3	5	Bad
	5	1	3	7	Bad
Thmei	-	-	-	-	-
Samraong	2	5	2	20	Bad
Pir	-	-	-	-	-
Total				**84**	

Source: Consultant's inventory

Table II-4 Summary of Culverts

Island (Kaoh)	Road Number	Cell (#)	Width (m)	Height (m)	Length (m)	Condition
Mitt	2	1	2.0	1.5	3	Bad
	2	1	3	1.5	3	Bad
	3	1	4	2	4	Bad
Soutin	1	1	1.5	1.5	4	Bad

Island (Kaoh)	Road Number	Cell (#)	Width (m)	Height (m)	Length (m)	Condition
	1	1	1.5	1.5	4	Bad
	1	1	2.0	3.0	3	Bad
	1	1	3	3.0	4	Bad
	1	1	3	1.5	4	Bad
	1	1	3	1.5	4	Bad
Thmei	1	1	3	3	6	Good
	3	1	3	3	6	Good
Samraong	1	1P		5		Bad
Pir	1	2	2	2	5	Fair
	1	1	2.5	2.5	5	Fair
	1	1	2	2	5	Fair
	1	1	3	3	5	Fair
	1	1	3	3	4	Fair
	2	1	3	3.5	4	Fair
	2	1P		4		Fair
	8	1	3	1.5	5	Fair
Total Number of Culvert locations = 21						

Source: Consultant's road inventory studies

C. Climate Change Adaptation for Roads

1. Climate Change Approach to Transport Planning

21. Designing infrastructure with future climate changes in mind requires rational methods for managing the risk and uncertainty which is inherent in climate change adaptation planning. While information regarding the hydrological patterns of the Mekong are improving, and climate change modelling in Southeast Asia is developing, a high degree of uncertainty remains, as with all attempts at developing future scenarios. The climate change modelling is meant to provide a range of potential futures rather than a single projected image of the future. In addition, a number of human interventions in particular upstream hydroelectric and irrigation activities will likely have a more significant effect on the flow of the Mekong than climate change itself.

22. The extreme situations of high and low water levels cause the greatest challenges for infrastructure planning. At one end are events that have a low probability of occurrence, such as superstorms, but that have a very high impact. On the other hand are events that have a high probably of occurrence and re-occurrence, such as seasonal rainy seasons, but the impacts are relatively less.

23. Current coping strategies developed by communities living on the islands already apply these principles or redundancy and flexibility. Communities switch regularly between land and water based transport, for example, depending on the seasons. The low-cost technologies used, such as bamboo bridges and crossings, are flexible and reversible.

24. Two climate change strategies are proposed:

- Ensuring access to critical services (clinics, schools, markets) during extreme events, particularly floods
- Using flexible and reversible cost effective technologies that can withstand both high and low water level extremes and can be incrementally adjusted as climate changes

2. CCAO Draft Road Design Considerations

25. The CCAO has prepared draft road design standards that are intended to counter the threat of climate change on rural road infrastructure. Drier conditions generally indicate stronger roads, but this is more than offset by greater risks of extreme weather events leading to a higher risk of flooding than before. The importance of adequate drainage infrastructure is apparent, and the threat to other aspects of road design must be also addressed. Some of the needs, concepts and scope under consideration by CCAO with respect to climate change and climate proofing are described below.

- Forecasting of the risks and effect of damage to identify the vulnerability of the road to flood.
- Finding out and analyzing the efforts of other Institutions to deal with this issue.
- Reviewing existing road design, ecosystem, weather forecasting system, geotechnical evaluation and botanical characters.
- Taking consideration of all the phases of infrastructure development or maintenance, namely design, construction, and maintenance while considering the effects of climate change.
- Recognizing that during preparatory and detailed design phases, studies are required to take account of climate change and that infrastructure itself will have an effect on the area.
- Obtain data on rainfall, intensity, duration and its effects including the velocity of water, high flood levels and to use these hydrological data for further designing purposes. Historical data is insufficient and predictions for the future must be made.
- The need to determine discharge and velocity of water from run-off factors from land and understand that they vary according to slope of the ground, topography and geology of the area and the coverage by vegetation of all forms, among other factors.
- The successful design of road drainage structures depends upon the opening dimensions, the height of the structure, its capacity, as well as the layout of the structures according to the flow of water including whether it is perpendicular or skewed to the road.
- The finished top of subgrade level should be 0.7m above the high flood level to prevent movement of moisture towards the road pavement, especially with clayey subgrade soils.
- Consider realignment of the road if it currently passes through flood-prone, swampy or low land. Otherwise, provide a means of lowering the capillary “draw-up” to the pavement by using sand drains or other means, when required.
- Ensure the geometric design of the road is correct by constructing the road cross-fall (camber) and longitudinal grade to quickly drain the water from the surface.
- Protect road slopes by turfing, sodding or other bio engineering techniques to stabilize the area and prevent erosion, land slips, or sliding. Use locally available and recommended grasses of the correct species which are themselves resilient to climate change. Do not use trees on side-slopes or very close to the road structure because they prevent the natural development of grasses which resist erosion and the roots of the tree damage the road structure.
- Construct road-side drains, intercepting drains, catch water drains, mitre drains, cut-off drains to effectively remove the surface water without causing erosion damage.
- Ensure weep holes are constructed at the correct spacings in retaining walls.

D. Improvement of Jetties, Bridges and Levees

1. Priorities for Improvement of Jetties

26. The criterion for the improvement of jetties has been prepared as shown below.

- The jetties will be rehabilitated such that they will not form a permanent structure in the Mekong River.

- The jetties on steep river banks and with permanent navigable water approaches, and that have vehicle ferries are the first priority. Reinforced Concrete approaches will be designed with drainage and adequate slope protection by conventional and bio (green) engineering solutions. They will be permanent and able to meet the needs of ferries. They will have a means of easily on or offloading pedestrians from boats without loading ramps, by using attached floating jetties to accommodate the changes in water height.

- Jetties with long (300m) sandy or soil approaches during the dry season and those that serve vehicle ferries are the next priority. Their design at the permanent river bank will be substantially the same as above. Temporary roads such as the use of bamboo-mats will be retained. A more durable design will be prepared to cope with the mid-season conditions when accessibility is more difficult or lost because of localized water levels or ponded water from recent rainfall.

2. Selected Jetties

27. By design two jetties have been sought for each island to provide an alternative exit point to cope with differing water conditions and water flows around the islands for safety reasons. The design also requires connectivity from an island to either the West or East banks of the Mekong River, such that boat or ferry services meet the requirements of the travelers. It also provides in many cases a shorter travelling time on the roads. Generally those jetties with long sandy or soil approaches have been avoided because they do not provide an assured high level of connectivity. Usually an alternative jetty has been found. The list of jetties to be improved is given in **Table II-5**.

28. There are two exceptions. The first is that on Kaoh Samraong it is not possible to provide two jetties because the shallow waters and the sand–bars on the approach to the island from the West. These seasonally shallow waters and the presence of sand-bars are a substantial impediment which cannot be resolved without major engineering in the Mekong River, which is far beyond the scope of this Output. The second exception is Kaoh Mitt, which is because the new MPWT bridge will provide the connectivity to the West bank.

Table II-5 List of Jetties to be Improved

Island (Kaoh)	Jetty Location		Provides connection to / from
	Island	Mainland	
Mitt	0	0	KCC connection via new MPWT bridge from Dec. 2014
	0	0	Kaoh Soutin via a new concrete bridge
Soutin	0	0	Kaoh Mitt via a new concrete bridge
	1	1	Kaoh Soutin District centre (KSDC)
	1		Kaoh Thmei
Thmei	1		Kaoh Soutin
	1		Via Kaoh Soutin or direct to KSDC or KCC
Samraong	1	1	Chiro on West bank
Pir	1	1	Kaoh Seuch (Han Chey) on west bank
	1	1	Kampong Treas on East bank
Total	**7**	**4**	

KCC=Kampong Cham City; KSDC= Kaoh Soutin District Centre [on mainland]

Source: Consultant's studies

3. Construction of Jetties

29. A typical existing jetty has a long (80m) ramp side-long to the river bank sloping downwards to the water and has an eroded river bank both above and below the ramp (**Figure 6**.) This photo was taken towards the end of the dry season when the depth of the water was at its lowest level. In the peak of the wet season nearly all the ramp and the river banks will be under water. Many other jetties have a similar side-long aspect to the river bank and others are perpendicular to the flow of the river. Some are considerably longer than the jetty shown.

Figure 6: View of an Existing Jetty

30. A diagram of a typical jetty is shown in **Figure 7**. The construction will have to be undertaken during the dry season when the Mekong water level is at its lowest. The ramp will be constructed from cement concrete with steel reinforcement to ensure strength and durability under arduous operating conditions. It will be well founded on a supporting durable stabilized sub-base which is resistant to erosion. It must also resist the forces from ferry boats abutting hard onto the jetty and the point loading from its ramp, especially when vehicles are being off-loaded.

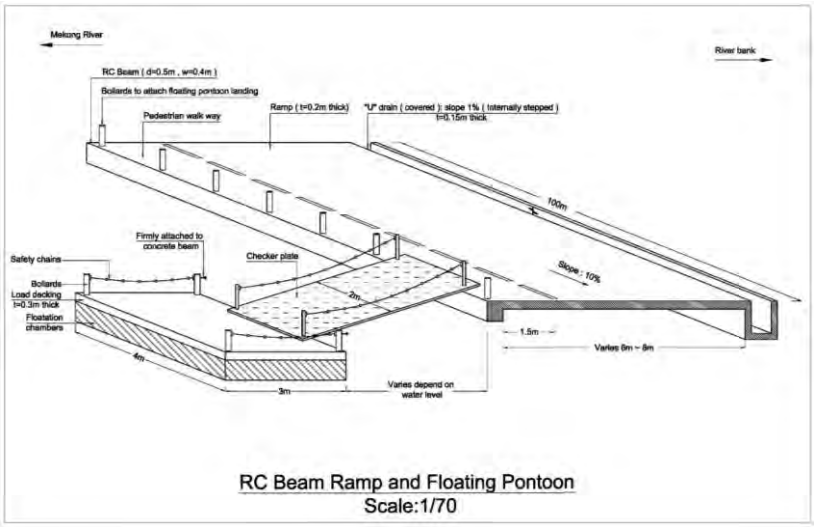


Figure 7 Typical Jetty Design

31. The river banks at the jetty must be durable. A strong facing stone or concrete fascia will be used at the levels below the ramp. Gabions and benching of the river banks will be used for the slope above the ramp. At either side of the jetty area it will be possible to use a bio-engineering approach and establish suitable grasses to resist erosion in the vicinity of the jetty.

32. A floating jetty for loading and off-loading from boats without loading ramps will be provided alongside the ramp in a manner such that it floats and slides along the ramp as the water level changes. Safety rails and bollards to tie-up the boats will also be provided as well as bright, overhead lighting for safe operations after dark. A pedestrian walkway will be delineated along one side of the ramp.

33. Drainage of the jetty area will be provided by a concrete lined drain set into the inner edge of the ramp and with the ramp sloping at 1% towards the drain. Scour checks will be used in the drain to reduce the speed of the water in the drain.

34. It is essential that the top of the jetty ramp is above the maximum flood level of the Mekong River so that flooding of the land above the ramp is not caused by the jetty itself. The land locally surrounding the top of the jetty will also need to be at, or above, the elevation of the jetty for the same reason. The minimum level if the top of the jetty is 15.2m above mean sea level.

35. The dimensions of typical ferries and boats without ramps have been estimated to ensure that both types can approach the ramp or the floating jetty as appropriate safely and with sufficient depth of water below the keel.

4. Rehabilitation of Levees and Avoidance of Flooding

36. Levees have been constructed in the past to contain surface runoff water or possibly on some islands to retain water from the Mekong River when it is in flood for use during the dry season. At the same time there should also be drainage channels to prevent overflowing of the storage areas in an uncontrolled fashion especially into populated areas. If this cannot lead to other storage ponds at a lower level then it should flow into the Mekong River. The cause of flooding in and around the populated areas is difficult to understand because the land in these areas is above the maximum flood levels of the Mekong River. It is quite possible that levees are poorly designed or are damaged or missing in populated areas. The TA recommends the rehabilitation and improvements of levees.

E. Labor Based Technology

37. MRD employs equipment based, machine intensive, labor-based and labor-intensive methods for road construction and maintenance. MRD's draft policy for rural roads commits MRD to encouraging the use of appropriate technologies for the development and maintenance of rural roads that favours the use of local labourers and materials but without undermining quality and cost aspects.

38. MICO will follow the Labor and Gender Action Plan (LGAP) established for the RRIP II. The requirements are:

- A labor force database will be available for contractors
- PDRDs will be able to track the use of local labor
- At least 50% of road maintenance workers will be women
- Child labor will not be employed for road maintenance

39. The existing concrete roads on the islands have been constructed by hand by local people. It is very likely that there are experienced and skilled persons on the islands. Kaoh Samraong may be an exception at the outset because there are no concrete roads on the island. Nevertheless the skills can be readily taught, as they have been on other islands and experienced workers are in the vicinity.

F. Project Environmental Classification

40. The Project is classified as environment category B and an initial environmental examination (IEE) has been conducted as part of project preparation in accordance with ADB Safeguard Policy Statement of 2009 (ADB SPS).

III. DESCRIPTION OF THE ENVIRONMENT

41. A full description is included in the main text. Only aspects relevant to MICO are discussed here.

A. Physical Resources

1. Air Quality and Noise

42. The islands are primarily agricultural areas and villages/residential areas in rural settings with no industrial development. Currently, main sources of air pollution are dust emission due to passage of vehicles along the unpaved roads. Sources of noise are community activities and the existing light traffic largely composed of motorcycles.

2. Surface Water

43. The islands have no major surface water courses, rivers or streams. Some large inundations exist which fill with water during the wet season and act as a local reservoirs during the dry season. Some small watercourses act as irrigations canals. These depend on rainfall or flooding to fill them with water. Irrigation of fields and crops is provided by pumping water from the Mekong river using diesel powered pumps. Within the Project area, surface run-off on exposed soil and erosion of river embankments cause turbidity in some of the watercourses. Surface water pollution from domestic sewage along sections where densely populated villages are found as well as run-off from surrounding agricultural fields may also be expected.

3. Groundwater

44. Ground water in the islands is extracted for domestic and agricultural uses by shallow and deep wells. In shallow wells water is extracted manually by means of a winch and bucket. The wells have wide diameter and open so allowing contamination. Deep wells have a sanitary seal and are operated by a lift pump handle. Some have down-the-hole pumps but these require electricity which is not available at all locations.

Figure 8 Typical Village Wells

4. Arsenic in Groundwater

45. Kampong Cham is one of six provinces considered to be at high-risk for arsenic contamination of groundwater in Cambodia. The islands in the Output area are of particular concern because of their location in the Mekong River.

46. It is believed that arsenic is carried in sediments flowing down the river from the Himalayas. Over hundreds of years, the sediments have been deposited downstream. As water starts to move down into the soil, it picks up the arsenic and carries it down into the aquifers. Bacteria in the soil are responsible for dissolving the arsenic into the water. This process takes place 2-3 metres below the surface and therefore both shallow and deeper wells are at risk (Fendord et al, 2009[1]). Villagers on the island are aware of the presence of arsenic and have adapted their daily practices to avoid adverse effects from arsenic poisoning.

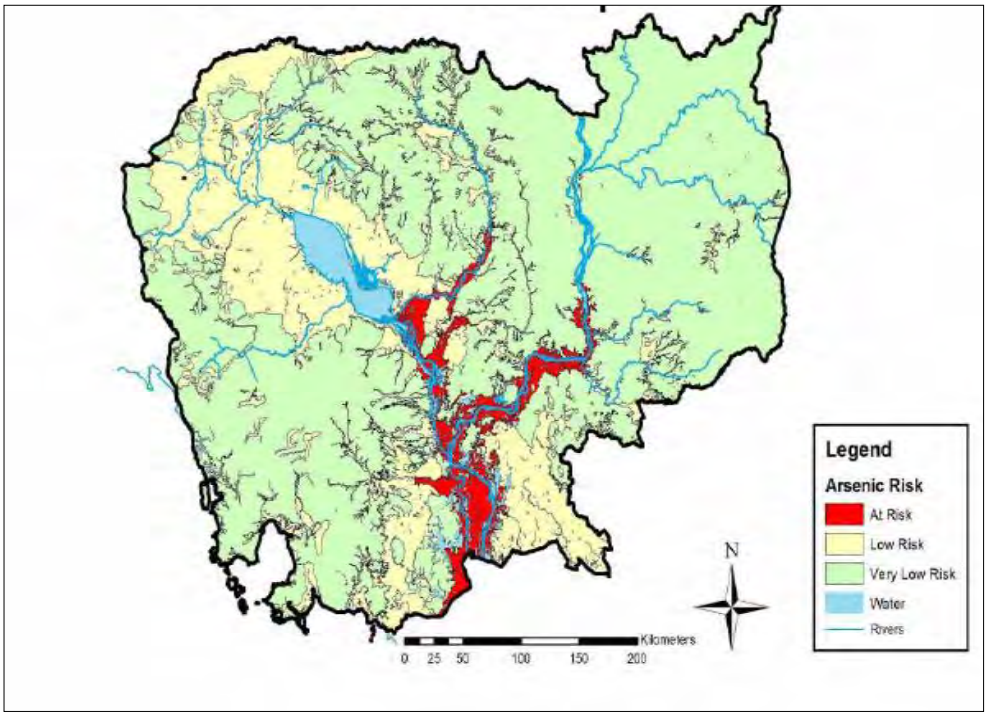


Figure 9 Arsenic Risk Map for Cambodia **(Source: Arsenic Inter-ministerial Sub Committee AISC)**

5. Drought

47. Drought is not a big issue in this area, because farming activities can take place in the dry season, and in the wet season before the flood occurs. For good crop growing conditions, during the dry season there must be rain 2 or 3 times in this area. If there is no rain in the whole dry season this adversely impacts dry farming crops. In 2012 because of no rain in the dry season, farming crop production decreased about 30% (chief of Kaoh Samraong commune so stated).

6. Flood Occurrences

48. Data was obtained relating to the height of water flowing in the Mekong River. To supplement this, rainfall data has also been obtained. This is analyzed below.

[1] http://news.stanford.edu/news/2009/april1/fendorf-arsenic-water-poison-asia-040109.html

49. The occurrences of floods can be visually represented by looking at the hydrographs for the gauge height in meters for the years 1994-2012 recorded on the Kampong Cham Staff-Gauge. The minimum and maximum levels are shown in **Figure 10** below.

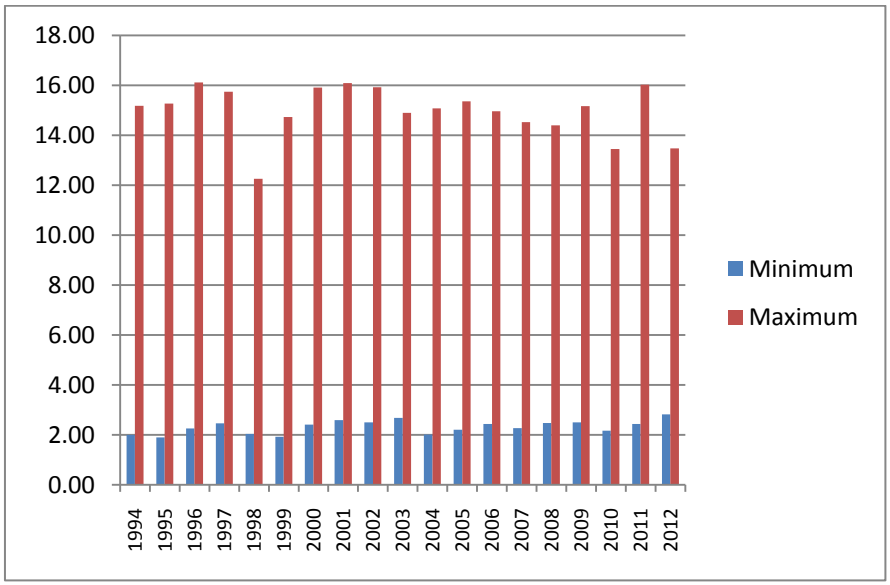


Figure 10 Minimum and Maximum Flood Levels Kg Cham in MASL 1994-2012
(Source: MICO consultants analysis)

50. The occurrence of floods in 1996, 2001 and 2011 can be clearly seen from these data.

51. One can also see that in the years 1998, 2010 and 2012 the highest recorded levels were low, around 12 metres.

7. Flooding in Kampong Cham

52. The embankment alongside the main river bank through Kampong Cham is located at an elevation of 16 metres above zero on the inclined staff gauge. (Zero on the gauge is -0.93m above Mean Sea Level (MSL).) When the river reaches this height the banks overflow and Kampong Cham becomes flooded. Because the town centre is mostly flat the flooding is extensive. This means the height of the flooding on the islands caused by the river cannot exceed a height of 16m. This can clearly be seen by examining the staining on the bridge pillars. The bridge pillar and the parapet are shown in **Figure 11**

Figure 11 Staining on Bridge Pillars and View of the Parapet
(Source: MICO Consultant studies)

53. The Height Gauge on the bridge shows that the parapet limits the flood level to 16 m as shown in **Figure 12**. This means the flood levels on the nearby islands also cannot exceed 16m due to flows in the Mekong.

Figure 12 Height Gauge on Bridge shows parapet limits flood to 16 m

8. Recurrence Interval of Flooding in Kampong Cham

54. According to the villagers the major natural disaster in these islands in the Mekong River is an "extreme flood". The "normal flood" is not a serious problem for this area, because they are used to live in inundated places within the Mekong Flood plain, and this provides them with natural water storage areas during the drought. A "*big flood*" is a significant problem for them.

55. Similarly the villagers rely on a "normal" flood to irrigate their crops and recharge their natural reservoirs on the islands. If a "small" flood occurs then they are short of water and experience a drought in the dry season.

56. Examination of the records shows that the occurrence of floods over the period 1994 to 2012 was as shown below in **Figure 13** and

57. **Figure 14**.

Year	Min (m)	Max (m)		
1994	2.01	15.18		
1995	1.90	15.27		
1996	2.26	16.11		
1997	2.47	15.74		
1998	2.04	12.26		
1999	1.93	14.73		
2000	2.42	15.91		
2001	2.60	16.09		
2002	2.50	15.92		
2003	2.68	14.89		
2004	2.02	15.07		
2005	2.21	15.35		
2006	2.44	14.96		
2007	2.27	14.52		
2008	2.48	14.39		
2009	2.50	15.16		
2010	2.17	13.44		
2011	2.44	16.02		
2012	2.82	13.47		
Max	m	16.11	Events	
0.90	90%-ile	16.03	3 times	Big
0.50	50%-ile	15.16		
Mean	m	14.97	13times	Normal
0.11	11%-ile	13.47	3 times	Small
Min	m	12.26		
STDEV	m	1.02		

Figure 13 Occurrences of Big, Normal and Small Floods

Source: MICO Consultant's analysis of MRC data

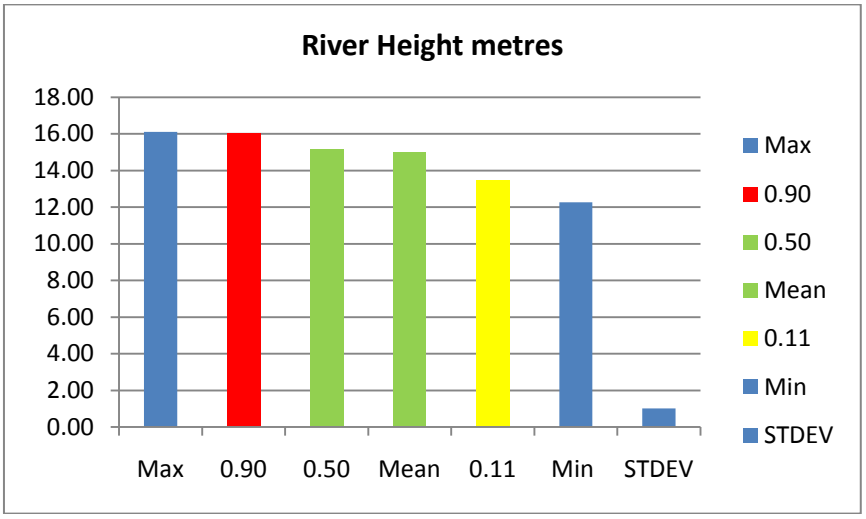


Figure 14 Flood Heights
(Source: MICO Consultant's analysis of MRC data)

58. The recurrence of a 16m flood over the period 1994 to 2012 was calculated to represent the 90th percentile. That is to say 10% of the floods exceeded 16m and 90% did not, over this time interval. The maximum level was 16.11m that is 0.11m above the parapet.

59. The Standard Deviation was 1.02m about a mean of 14.97m. Based on the data, the event frequency of the three types of flood over the 19 years period was:

Big - 3 events
Normal - 13 events
Small - 3 events

9. Localised Flooding on the Islands

60. Villager on the island at elevations greater than 16m flood level still report flooding. This is considered to be localised flooding due to heavy rainfall. Much of the central higher parts of the islands are covered over with impermeable concrete roads. Heavy rainfall on such impermeable surfaces would overwhelm the already inadequate drainage system leading to localised flooding.

Figure 15 Interview with Local Police Officer and Shop Owner who suffer Floods

61. In interviews the shop owner described how she receives a warning of an impending flood from the police officer and moves her products to the upper storey of her house, as shown in **Figure 16**. The ramp is used for moving motor cycles.

62. The villagers indicated the height of flooding on the pillars of the house as shown in **Figure 17**. The local school is inundated and has to be evacuated see **Figure 18**.

Figure 16 Shop Owners move Possessions into this House

Figure 17 Villager indicating Height of Flood

Figure 18 School which is Flooded and Graves indicating Height of Flood

63. Kaoh Pir school was reported to be flooded to a depth of 0.5 metres and needed to be evacuated.

64. Road side graves would suggest they are located above the expected limit of flooding due to the river see **Figure 18**.

65. In another location on Kaoh Pir villagers indicate high ground where animals are brought and a shelter where villagers stand guard over the animals, as shown in **Figure 19**.

Figure 19 Animal shelter and watch tower; villager indicating Height of Flood

10. Rainfall Data

66. Rainfall data was obtained for daily readings for every day since January 1994 until the present time. This was used to feed into the flood mapping exercise.

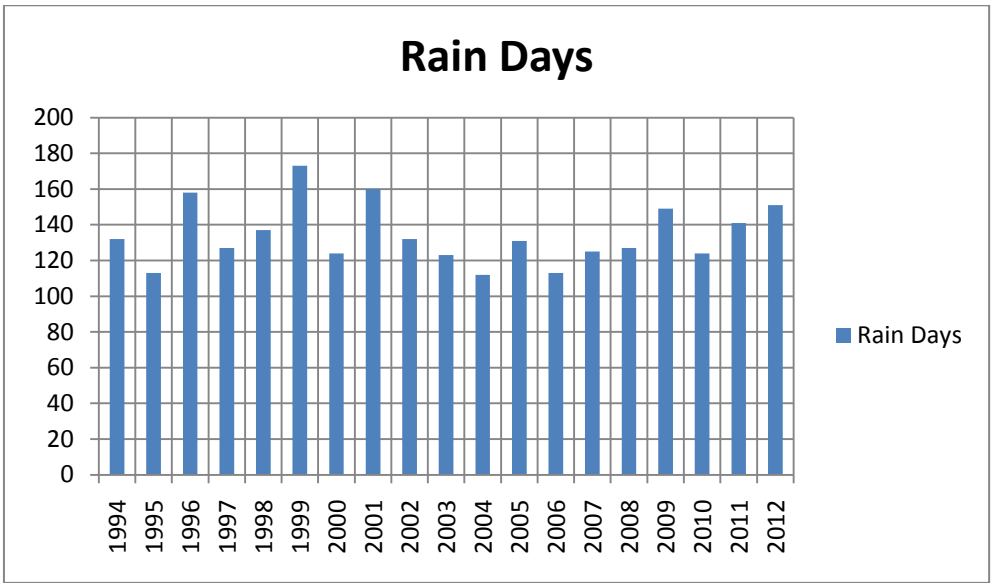


Figure 20 Number of Rain Days

67. The rain fall data shows higher occurrences of localized rain in the years 1996, 1999, 2001, 2009, 2011 and 2012. This correlates with the villagers' reports of bad floods in 1996, 2001 and 2011.

68. The flooding in the central part of the islands would appear to be driven by two parameters: height of the flow in the Mekong River and heavy local rainfall. The flood height and rainfall data indicates that flooding on the higher elevations of the islands is caused by rainfall and not by the river flooding.

69. For design purposes when considering flooding on the islands it is important to differentiate between flooding caused by high river flows and flooding caused by rain.

B. Ecological Resources

1. Flora

70. There are no data on forest cover and land use in these 5 Mekong River islands. The forest cover and other land use in whole Kampong Cham Province are presented in table below.

Table III-1 Forest Cover and Land Use in Kampong Cham Province

No.	Forest Types	Area (ha)	%
1	Evergreen Forest	22,406	2.4
2	Semi-evergreen Forest	7,863	0.8
3	Deciduous Forest	12,312	1.3
4	Wood Shrubland	881	0.1
5	Wood Shrubland Evergreen	3,029	0.3
6	Bamboo	6,085	0.6
7	Other Forest	112,812	11.9
8	Total Forest	165,388	17.4
9	Non-Forest	782,908	82.6

Source: Forestry Statistics of Cambodia. FA, 2009 (Non-Forest: this category includes agricultural areas, urban areas, water bodies, and grassland.)

2. Fauna

Cambodia has a rich biodiversity. Because of lack of natural forest resources on the islands almost no indigenous species are found, only common species such as common reptile, snakes and water bird were observed.

3. Fishery

Fish is the most important source of animal protein in the diet of all Cambodians, constituting upwards of 75% of total animal protein input. Fish are also an important source of calcium and Vitamin A, especially for the rural poor. On average the countrywide consumption rate is 65.5 kg/capita/year. No specific information was available for the islands.

4. Agriculture

71. Vegetation cover along the island roads largely consists of agricultural crops such as rice, while some sections traverse areas covered with shrubs, grasses and sparse trees. Lowland rice cropping is the main activity but other crops grown include soybean, cassava, and cashew. Fruit and vegetables crop are also cultivated although primarily for domestic consumption.

72. The island's economy is predominantly anchored in cash crop production of tobacco crops, corn, bamboo, and fruit production. Irrigation during the dry season is limited and two main barriers identified by commune leaders were the cost of diesel for pumping surface water from the Mekong River. Well water was used in some places though also limited by arsenic content in deeper wells.

5. Ecologically Protected Areas

73. There are no protected areas or conservation areas in and near the islands. The Tonle Sap Biosphere Reserve (TSBR) and the Snuol Wildlife Sanctuary are distant from these islands. There are no community conservation areas in these islands that belong to local communities.

C. Socio-Economic Resources

1. Population and Land Use

74. The following information is based on primary data stated by the residents during the Public Consultations.

Table III-2 Population and Land Use

Island-Commune Name	Number of Village	Number of Family	Population	Cultivated field (ha)	
				Rice field	Farm field
Koah Soutin District					
Kaoh Soutin island, Kaoh Soutin commune	14 villages	3173	12,562	124 ha	610 ha
Kaoh Thmei (village1), Kaoh Soutin commune	1 village	369	1,508	No	82 ha
Kampong Siem District					
Kaoh Mitt, Kaoh Mitt commune	9 villages	1656	7,610	365 ha	427 ha
Kaoh Samraong, Kaoh Samraong commune	8 village	1444	7,256	No	2542 ha
Krouch Chhmar District					
Kaoh Pir, Kaoh Pir commune	4 villages	593	2,432	150 ha	229 ha

Source: Public consultations with the residents of the islands

2. Employment and Income

75. Agriculture is a major component of the country's economy as well as for farmers in the five Mekong River Islands. The result of consultation with local authorities and communities regarding local employment and income of villagers in all islands gives similar results. Most of the people in this area are farmers and their income is based on agricultural products. First is farming products (bamboo, tobacco, kapok, sesame, red-corn, bean, and yam-bean) and second is dry rice product, except Kaoh Thmei village, Kaoh Soutin commune, and Kaoh Samraong commune which have no dry rice field. Other sources for local income are small businesses, small scale fishing (family fishing), and any vegetables or fruit trees.

76. Labor is a supplemental income for local people. Commune chiefs reported that most of the young people which is about 10-15% of the total population migrate to any towns or cities or other country to find jobs capable of supporting their families. In 2012 in Kaoh Samraong commune, 392 persons migrated to other cities and 98 persons migrated outside the country to find jobs. (Chief commune comment).

3. Poverty

77. The country's national poverty incidence in 2008 was 30.1% but rural areas have higher poverty rate of 34.7%. Cambodia ranked 33 in the "alarming" countries with high level of hunger and under nutrition, where 12% of the households were classified as food insecure due to increase in food prices.

78. The average poverty rate is shown below:

Table III-3 Average Poverty Rate

District	Commune	Poverty rate 2009
Kampong Siem		25.40%
	Kaoh Mitt	32.20%
	Kaoh Samraong	25.90%
Kaoh Soutin		24.70%
	Kaoh Soutin	23.90%
Krouch Chhmar		27.50%
	Kaoh Pir	21.60%

Note: No data is available for Kaoh Thmei, because Kaoh Thmei is one village in Kaoh Soutin Commune.

Source: Data Book, NCDD-MOI, 2009

4. Indigenous Peoples (IPs)

79. Initial data gathering shows that there are no Indigenous Peoples (IPs) in the Output area.

5. Gender and Child Mortality

80. Women account for 52% of the population. The country's child mortality rate in 2010 was 350 per 100,000 live births. Ii is noted that in Kaoh Pir, Kaoh Pir commune, Krouch Chhmar district there is no health center.

IV. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION

A. Potential Impacts due to Location

1. Existing Connectivity

81. Kaoh Mitt is currently connected to mainland Kampong Cham by a temporary bamboo bridge. This carries pedestrians, motorcycles and motor cars. It does not carry heavy goods vehicles. A toll is charged for usage.

82. Kaoh Soutin is actually contiguous with Kaoh Mitt and accessible by regular motorized transport during the dry season. Kaoh Thmei is also accessible during the dry season by a bamboo mat roadway linking it to Kaoh Soutin. Transportation by boat is necessary during in the wet season.

83. Kaoh Mitt is being connected to mainland Kampong Cham by a steel bailey bridge which is presently under construction. It is scheduled for completion in December 2014 and will be able to carry all types of vehicular traffic.

84. Kaoh Samraong is accessible by large and small ferries on the east and south banks. Kaoh Pir is accessible from the west by vehicle ferry, and by a small boat ferry (non-vehicle) from the east side.

2. Power Requirements

85. No islands currently have a mains grid electricity supply. On some islands private enterprises run diesel fueled generators and distribute single phase 240 volt electricity by overhead cables. Similar operators run diesel fueled generators to recharge 12 volt lead acid car batteries whose owners bring them for recharge.

86. The construction of the steel bailey bridge linking Kaoh Mitt to mainland Kampong Cham will allow connection of high voltage cables to Kaoh Mitt and concrete electricity posts are now being constructed in anticipation of a supply being connected. The other islands have no such planned mains electricity supply.

87. There are currently no sources of renewable energy on the islands although such equipment has been seen in Kampong Cham and is readily available in Phnom Penh.

3. Water Supplies

88. There are several main sources of water supply on the islands:

- Direct from Mekong River, which is often extracted by private companies and pumped around the islands through 100mm blue PVC piping. This is charged at Riels 4,000/ m^3.
- Direct from Mekong River but delivered in plastic containers by horse and cart. This is charged at Riels 15,000/ m^3.
- Shallow hand dug wells with concrete sleeve liners accessed by bucket and winch. These are open to the elements and can experience bacterial contamination.
- Deep wells with sanitary covers and hand pumps.
- Rain water collected from roof tops and stored in large earthen or concrete pots with open tops.
- Bottled water purchased commercially
- Natural ponds and depressions on the islands which fill with rain or river water and provide a water source during the dry season.

4. Potable Water Issues – Arsenic

89. A number of organizations are studying the problem in Cambodia including the World Health Organization (WHO), the United Nations Children's Fund (UNICEF [2]), Resource Development International (RDI), World Vision, the World Bank (Water and Sanitation Program), ADB (Tonle Sap Rural Water Supply and Sanitation Project) and MRD.

90. These processes have taken place for tens of thousands of years, depositing huge amounts of arsenic contaminated sediments. In regions where the groundwater conditions are just right, the arsenic is released from the sediments and dissolved into groundwater aquifers. In populated areas, these contaminated waters are pumped to the surface by wells and ingested by individuals, families, and communities (RDIC). Though arsenic has currently been found in deeper levels of the aquifer on the islands, shallow wells may draw arsenic from the deeper levels. Little is known of the hydrogeology on the islands and therefore shallow wells may present a risk as well.

91. The General Population Census of Cambodia in 2008 reported that more than 52% of rural people use groundwater, and close to 27% of drinking water sources are accessed by tube wells (National Institute of Statistics, 2009). In the Output area, x % of the population use groundwater as drinking water and x% use surface water (filtered, unfiltered), x % use purchased tank water.

92. Analysis by a joint MRD and IGES study of the results of the national tube well testing program suggested that the arsenic content in 23.2% of tested tube wells in high risk areas exceeded the recommended national level for drinking water (50µg/L), and that the arsenic content in 41.7% of tested tube wells exceeded the WHO's recommended levels (10µg/L).

93. In response to the arsenic-contaminated groundwater problem, the Royal Government of Cambodia, with support of UNICEF and others agencies, has taken various actions. Chief among these is the establishment of a national-level institution for policy making to cope with the arsenic issue and implementation of initial mitigation programmes (screening of tube wells, awareness-raising, provision of alternative safe water) in high-risk areas. A national well database for Cambodia has also been established (http://www.cambodiawellmap.com) by MRD.

94. A nation-wide rapid assessment of Drinking Water Quality was conducted jointly by the MRD and the Ministry of Industry, Mines and Energy (MIME) in 2001. A total of 1,607 villages in 318 communes in 49 districts within the 6 provinces of Kandal, Prey Veng, Kampong Cham, Kampong Chhnang, Kampong Thom and Kratie and peri-urban Phmon Penh, were estimated to be most at risk.

5. Arsenic Inter-ministerial Sub Committee (AISC)

95. AISC was established in 2002 to coordinate activities of the government across the various ministries in the area of water and health which are concerned with arsenic contamination. It is also tasked to develop document policy/guideline related to arsenic. The AISC consists of representatives from 5 ministries which have responsibilities for water: MRD, MOWRAM, MoH and MIME and MoE. This committee is chaired by MRD with a sub-secretariat team.

96. Most developed countries and the WHO have set drinking water quality standards for arsenic at 10 parts per billion (ppb). Many developing countries, including Cambodia, have set their standard at 50 ppb. However many deep wells, including those on the islands, have levels in the range 300-500 ppb.

97. Experience in Bangladesh has shown that arsenic contamination is generally associated with tube-wells. The same observation is true in Cambodia, only 10% of 1,420 open wells tested were contaminated, generally at lower concentrations with the maximum recorded arsenic value in open wells ranging from 20-30 µg/L (ppb)

[2] http://www.unicef.org/cambodia/As_Mitigation_in_Cambodia_2009.pdf

6. Arsenic in Kampong Cham Islands

98. It has been well established that deep water aquifers in the Kampong Cham region are contaminated with arsenic. This is carried down the Mekong River adsorbed on sediments with the arsenic originating in naturally occurring weathered rocks high in the upper reaches of the Mekong River.

99. Water samples are taken regularly from all sources and analyzed for arsenic content by MRD and the Red Cross. Villagers are aware of this contamination. They use deep aquifer water for washing clothes but not for irrigation or drinking. Shallow wells are used for crop irrigation and for animal husbandry. River water is boiled and used for drinking. Bottled water is used if affordable or for selling to tourists. Collected rain water is used for domestic vegetable irrigation. Shallow hand-dug wells with sanitary covers continue to be a preferable option for arsenic affected areas.

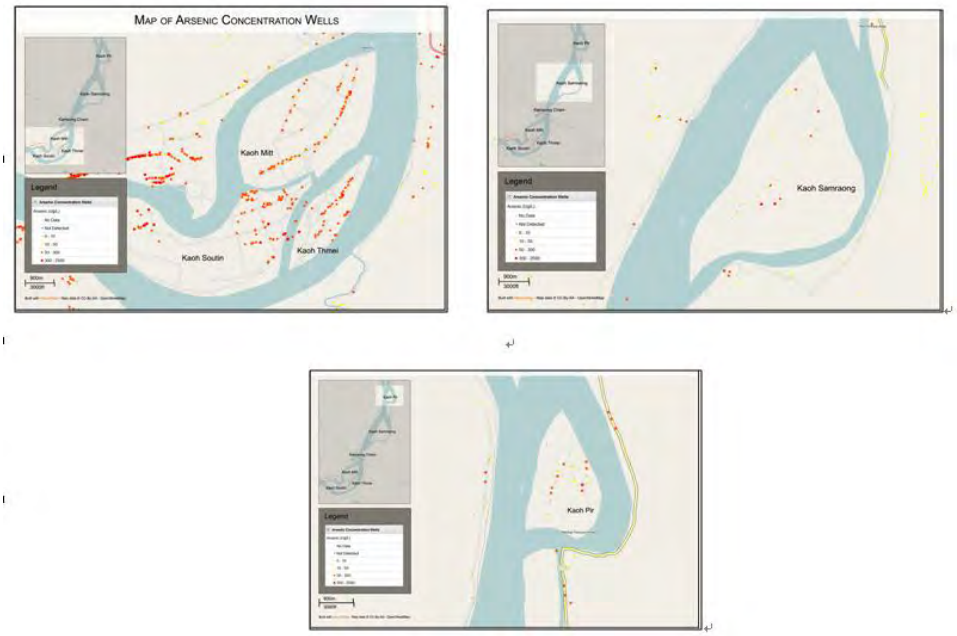


Figure 21 Arsenic Concentration in Wells
(Source AISC)

7. Arsenic Impacts on Islands Agriculture

100. A major cash crop on the islands is tobacco whose leaves are harvested for cigarettes. Tobacco plants are a known bio-accumulator of arsenic. The villagers are aware that irrigation with arsenic bearing water will kill the plants and so they irrigate with shallow well water or river water.

8. Removal of Arsenic from Water

101. Arsenic removal from water can be accomplished by several different technologies ranging from simple low-cost household filters to expensive large scale municipal facilities. This aspect will be investigated during the study. A key issue is whether waters supplies in the future should be sufficient only for the existing population or if encouragement of tourism will lead to a significant increase in potable water demand to WHO standards. This will have cost implications.

9. Meteorological Data Collection Liaison with MOWRAM -

102. MOWRAM maintain a meteorological station in Kampong Cham on the banks of the Mekong River approximately 1 km upstream from the main river crossing bridge on the right hand side

bank. They measure conventional parameters twice a day: max/ min temperature; wet/ dry bulb hygrometer readings; wind speed (high / low) and water depth.

103. Their site was visited and the monitoring equipment inspected. The staff gauge measuring river height is physically located on concrete steps leading down to below lowest water level. Readings are taken visually at 0700 and 1900 every day and the average level recorded.

104. The staff gauge is calibrated to a benchmark on the surface of the meteorological station site which is notated at 15.382 metres above Mean Sea Level (MSL). The lowest point of the staff gauge is -0.93 m relative to MSL.

Figure 22 MOWRAM MET Station Kampong Cham and Benchmark 15.382 AMSL.
(Source: CCAO Consultants)

Figure 23 Staff Gauge Mekong River Kampong Cham Lowest Point -0.93 AMSL
(Source CCAO Consultants)

105. A two day topographic survey was carried out over 9 to 10 July 2013. (See Annex 2 for full report) The reference level is the height of the Mekong River measured on the inclined staff gauge (ISG) at the Kampong Cham flood monitoring station. The water level at each of the islands was then measured at the start of the survey on each island. The elevations are the heights above the water level. They are not the elevations above Mean Sea Level (AMSL) although this can be determined.

106. Using the same basis for elevations as the reference level and the Mekong River Commission reports the flood warning level is 15.2m and the flooding level is 16.2m as measured on the ISG. The maximum possible height of water is between 16.0 and 16.2m which was reached on 3 occasions since 1994. The mean of the maximum flood level for the years from 1994 to 2012 is 15.16m. The range of the maximum flood level elevations is 12.26m to 16.11m.

107. Data was obtained for average daily readings on the Mekong River height at Kampong Cham for every day since January 1994 until the present time. The summary is shown below.

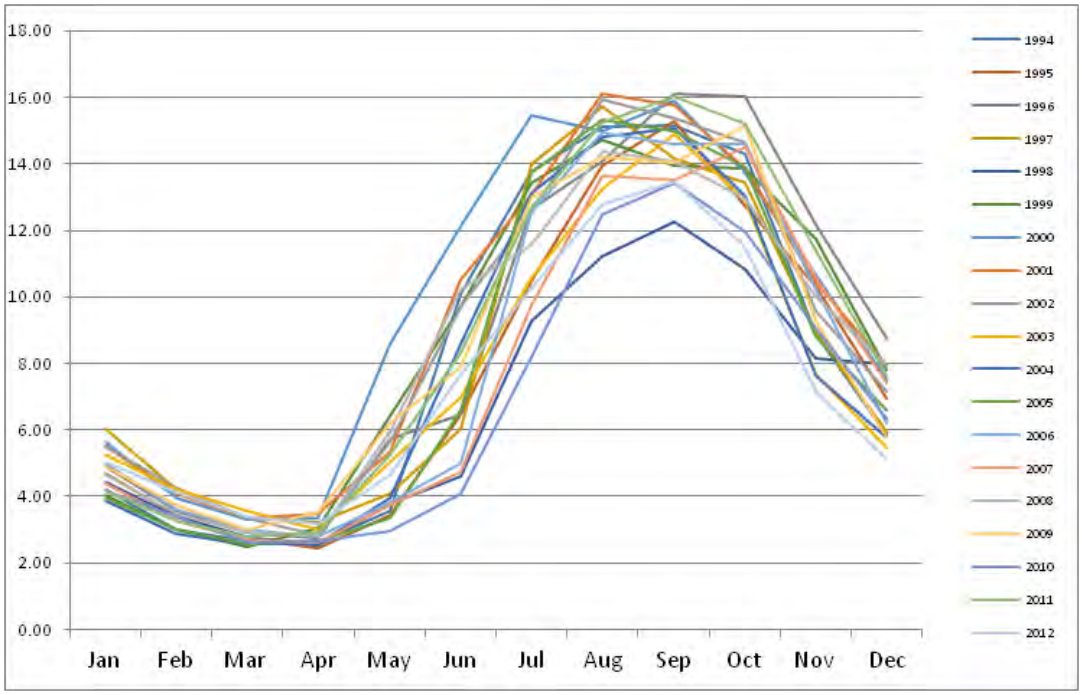


Figure 24 Height in Metres AMSL at Kampong Cham 1994-2012
Source: (MICO Consultants based on MOWRAM data)

10. Liaison with MRC

108. The MRC confirmed the benchmark of the Kampong Cham staff gauge. The lowest point of the staff gauge is -0.93 m relative to MSL. MRC publish daily recorded data and forecast data. A current example is shown below for Kampong Cham. The data below shows the water level over the last 7 days and 7 day forecast for 1 April 2013 to 16 April 2013. Such data is used in the vulnerability mapping.

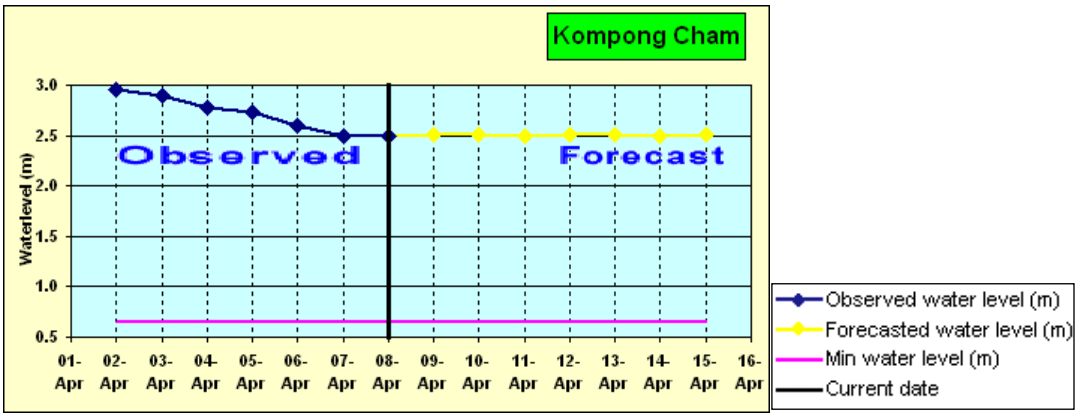
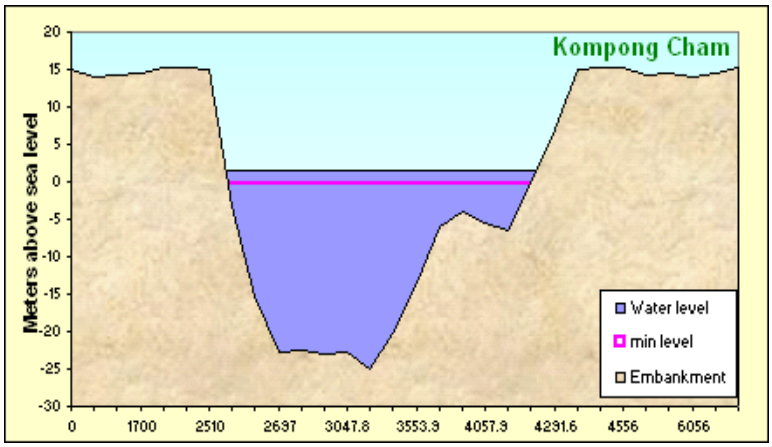


Figure 25 Observed and Forecast Water Levels at Kampong Cham
(Source: (Mekong River Commission Daily Reports)



- Water level on Monday, April 08, 2013 at 07:00 AM = 2.50 m
- Minimum level = 0.65 m
- All levels are above zero gauge
- Zero gauge Kampong Cham = -0.93 m above MSL

Figure 26 Schematic Cross Section with Actual Water Level at Kampong Cham (Source: (Mekong River Commission Daily Reports)

11. Flooding

109. Kaoh Mitt has the lowest elevations of all the 5-islands (14.6m approximately) compared with a mean of 15.16m given above), and therefore may be flooded by the Mekong River. Interviews with the Commune Chief indicated that only three of 15 villages were liable to flood annually. The maximum water depth was said to be 1m above the ground level. The period of flooding was about 15 days. This is consistent with the survey data which showed two of these villages are located in a low area (elevation of 12.062m).

110. The third village is also on lower ground on the approach to the preferred crossing to Kaoh Soutin. The flooding elsewhere and particularly near the commune centre at the intersection of Road 1 and Road 2 was said to occur infrequently. The elevation is 14.9m; and the depth of water was said

to be 0.3m. Again this is consistent with the mean of the maximum annual flooding elevations of 15.16m.

111. The survey indicated that Kaoh Soutin elevations were similar to Kaoh Mitt, so Kaoh Soutin could also be flooded by the Mekong River.

112. The elevation of Kaoh Thmei populated areas is higher than either Kaoh Mitt or Kaoh Soutin, at between 15.5m to 15.8m, approximately. It is unlikely to be flooded by the Mekong River unless it is a year with an extreme level of flooding such as 2011.

113. The lowlands on the approach to the jetty located on the south of the Kaoh Samraong are flooded by the Mekong River as expected. A high (3m) embankment with cross drainage is planned for this length.

114. The populated areas are much less likely to be flooded by the Mekong River because their elevation is 15.1m.

115. The flooding in the area of the Commune Centre has a higher elevation of 16.1m on the ground and 16.5m on the adjacent road. Frequent flooding is reported and it can only be caused by the accumulation of rain water and the overtopping of the two lakes located close to and on either side of the populated area. The new road to the south of the western lake area (Road 3) has been constructed with a box culvert south located close to the eastern length of Road 1 which could alleviate the problem by allowing the water to drain to the South, but with apparently insufficient lower ground at a level below the culvert this is unlikely to be effective. A drainage system needs to be constructed.

116. Kaoh Pir has the highest elevations, typically 15.4m along road one to the school and the Police station and it is reported to be frequently flooded. At the police station the ground elevation is 15.7m and the water mark on the wall indicating the flooding level is at 16.6m. This cannot be caused by the Mekong River which has not exceeded 16.2m since 1994, and cannot exceed this level because the water floods the mainland surrounding Kampong Cham City.

117. The flooding is caused by the accumulation of rain water and the overtopping of the reservoirs on either side of Road 1 for example on the approach to the school Commune centre and the Police station. A drainage system is required to alleviate this problem.

12. Climate Change and Hydrological Impacts

118. Existing climate change projections supported by field observations highlight two major concerns related to current and future climate changes. Specifically, there appears to be an overall increase in average total annual rainfall and, this increase is poorly distributed over seasons, resulting in increased floods during the rainy season and increased drought during the dry season. Droughts are significant especially for unpaved roads as dust levels increase and reduce visibility and create poor local air quality. Flooding and soil moisture content is a primary concern for protecting investments in roads and will be addressed as a priority in the climate change adaptation strategy to be implemented under the Output.

119. The strategy will seek to strengthen the overall objective of the Output to improve rural road mobility. It will do so by:

- Protecting the road infrastructure from the impacts of climate change
- Ensuring that the road infrastructure does not increase the vulnerability of the surrounding area to climate change.

120. For example placing the road on an embankment can lift the road above flood levels but can create a “dam” which causes localized flooding, where none occurred before.

13. Coordination with Climate Change Adaptation Output (CCAO)

121. CCAO is undertaking both climate change projections and hydrological modelling for the five islands included in this TA and should be used together. This data will provide valuable input into the location and design of transport infrastructure.

122. In Cambodia, there appears to be an overall increase in average total annual rainfall and, this increase is poorly distributed over seasons, resulting in increased floods during the rainy season as well as increased drought incidence during the dry season.

123. Some of the ways in which climate change can impact on road infrastructure is damage due to land-slides and mud-slides, increased moisture in the subsurface causing failure to the structure, increased erosion to unpaved shoulders from rapid water runoff, increased winds erosion of unpaved roads, and penetration of rainwater through poor surface treatment.

124. Increased wind and reduced moisture on dry unpaved roads can increase dust levels and reduce visibility. These issues are of concern to the infrastructure itself as well as pose a safety issues for drivers and other road and roadside users.

125. Flooding and soil moisture content is a primary concern for protecting investments in road works and will be addressed as a priority in the adaptation strategy of this output. There is no evidence of major landslides damaging the road in what is a relatively flat topography.

14. Current and Future Flood and Drought Risks

126. The CCAO is undertaking integrated climate change modelling to develop projections of flood patterns which is one of the inputs into the design of adaptation options for the five islands.

127. The objective of the modeling work is to support 5 Islands flood management and adaptation through provision of solid historical and future projection information on flooding. The objective is reached through historical hydrometeorological data analysis, geographical information systems (GIS) and mathematical modeling.

128. The Integrated Climate Change Modeling (ICM) work consists of four components :

- Historical Hydromet Data Analysis
- Climate Change Modeling
- Climate Change Impact Modeling
- Information synthesis and visualization utilizing Geographic Information System

129. Historical hydrometeorological data analysis collects existing data on precipitation, temperature, discharge and river water levels. Climate change modeling produces climate variability and climate projection information for the 5 Islands area. Climate change impact modeling produces quantitative climate impact information. The impact information consists of numerical flood depth, flood duration and flow velocity (shear stress) data. Integrated climate, hydrological and hydrodynamic modeling is utilized in the impact modeling. Information synthesis, visualization and GIS focus on creation of flood impact and vulnerability maps.

15. Historical Hydromet Data Analysis

130. Historical data is required for:

- historical flood analysis (river water levels)
- input for hydrological models that compute water levels and discharge (precipitation and temperature)
- comparison data for hydrological and hydrodynamic model calibration (river discharge and water levels)
- baseline data for statistical climate downscaling (precipitation and temperature)
- bias correction data for dynamic downscaling correction (precipitation and temperature).

131. Historical precipitation and temperature data is required for the whole Mekong River upstream of Kampong Cham. This is because Mekong River flow depends on the whole basin. The data is obtained from the MRC and Cambodian MOWRAM. Kampong Cham historical river water levels and discharge are obtained from MOWRAM. The obtained data is processed into a format that the Output modeling tools use and data analysis is performed.

16. Climate Change Modeling

132. Climate change modeling is based on results from Global Circulation Models (GCMs). These are numerical models describing movement of energy and water between land, atmosphere and oceans.

133. Because the resolution of the GCMs is in general poor, typically larger than 100 km, they have limited capacity to describe local and regional climate variability. The GCM results need to be downscaled to the local scale either dynamically (physical modeling) or statistically. Historical climate data is required in both cases either for bias correction or establishing linkage between large scale and local weather.

134. Specific climate change modeling tasks are:

- Identify best GCM datasets
- Extract weather information for the Mekong River basin from the large NetCDF-format global datasets
- Conduct statistical and dynamic downscaling; analyse and correct results for biases and errors; this includes statistical behaviour of the data such as frequency and intensity of extreme events (storms and droughts); dynamic downscaling is conditional on obtaining practical dynamic model such as PRECIS
- Conduct dynamic interpolation and statistical analysis of the downscaled data: generate analysis GIS grid for the Mekong River with appropriate resolution (e.g. 1 - 2 km), run climate simulation interpolating between downscaled data points on hourly or daily basis, collect and process statistics for each grid cell and produce data products such as dry and wet season average and maximum temperature and precipitation in baseline and future climate conditions

17. Climate Change Impact Modeling

135. The impact modeling steps are:

- Construct hydrological model for the whole Mekong River Basin - (i) collect necessary GIS-data for impact modelling (land use, soil and topography), (ii) collect historical hydromet data for the model, (iii) calibrate model based on observed discharge and water levels, (iv) process the climate modelling outputs for the Mekong River hydrological model to obtain future projected discharges and water levels.
- Construct GIS-based high resolution (50-100 m) impact model for the 5 Islands area
- Run the 5 Islands model with the historical water level data to establish historical flood depth, duration and frequency maps.
- Run the 5 Islands model with future projection data (Mekong River model water levels). Together with the historical model runs data will be used for impact and adaptation planning.
- Construct 3D hydrodynamic model for the 5 Islands area. Run the model for obtaining flow speeds and shear stresses for impact and adaptation planning.

18. Impact and Vulnerability Mapping

136. The impact and vulnerability maps are used for adaptation, contingency and infrastructure planning. Main target groups are bridge and road engineers, ferry and boat engineers, jetty planners and rescue and contingency planners. The GIS maps will unify physical flood information together with socio-economic data.

137. Following maps are examples of impact and vulnerability maps. They show maximal flood depth and duration in 1996 which was a maximal flood year and is often referred to in consultations as one of the worst flood years.

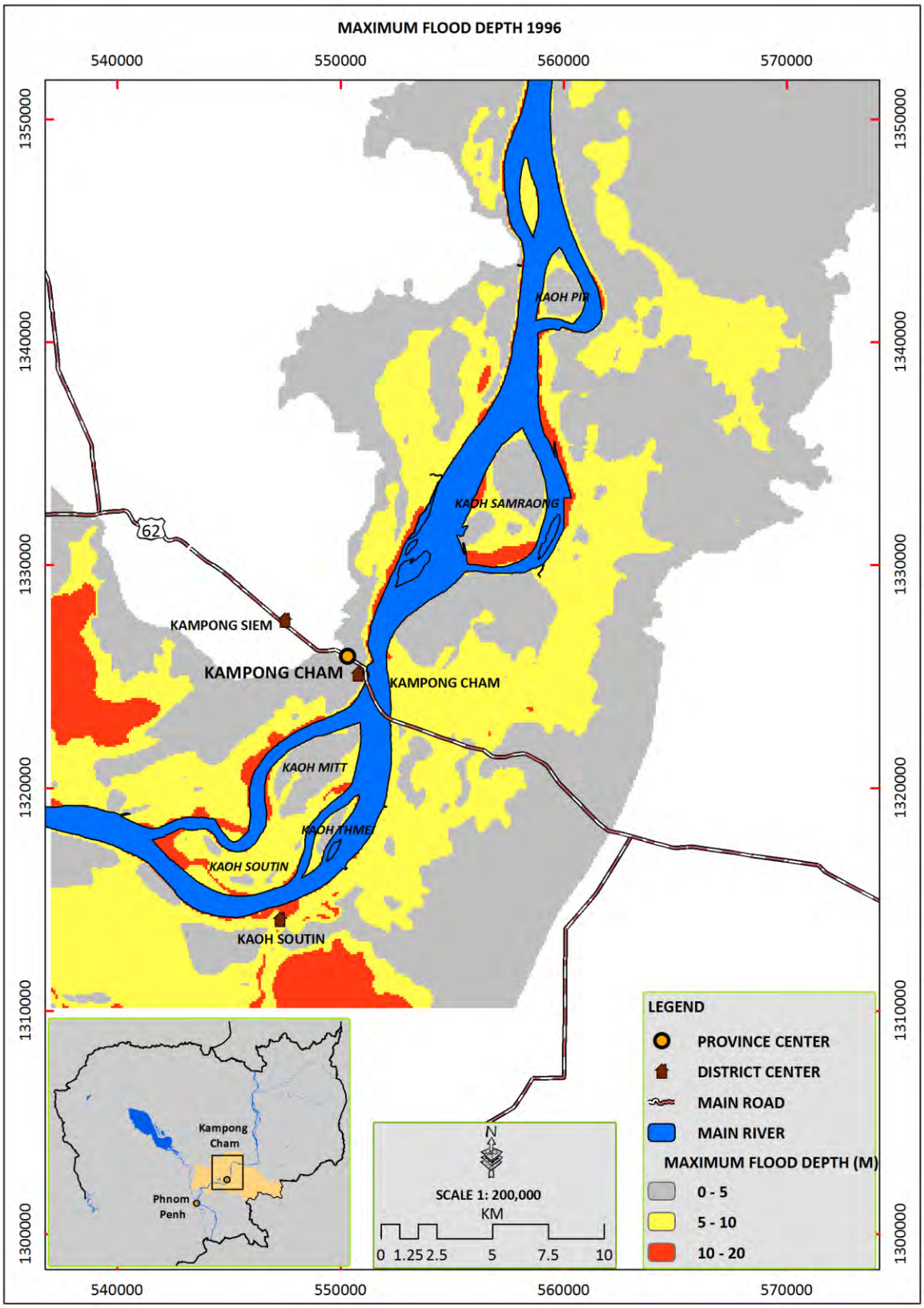


Figure 27 Simulated maximum flood depth during the record high 1996 flood
(Source: CCAO Consultants)

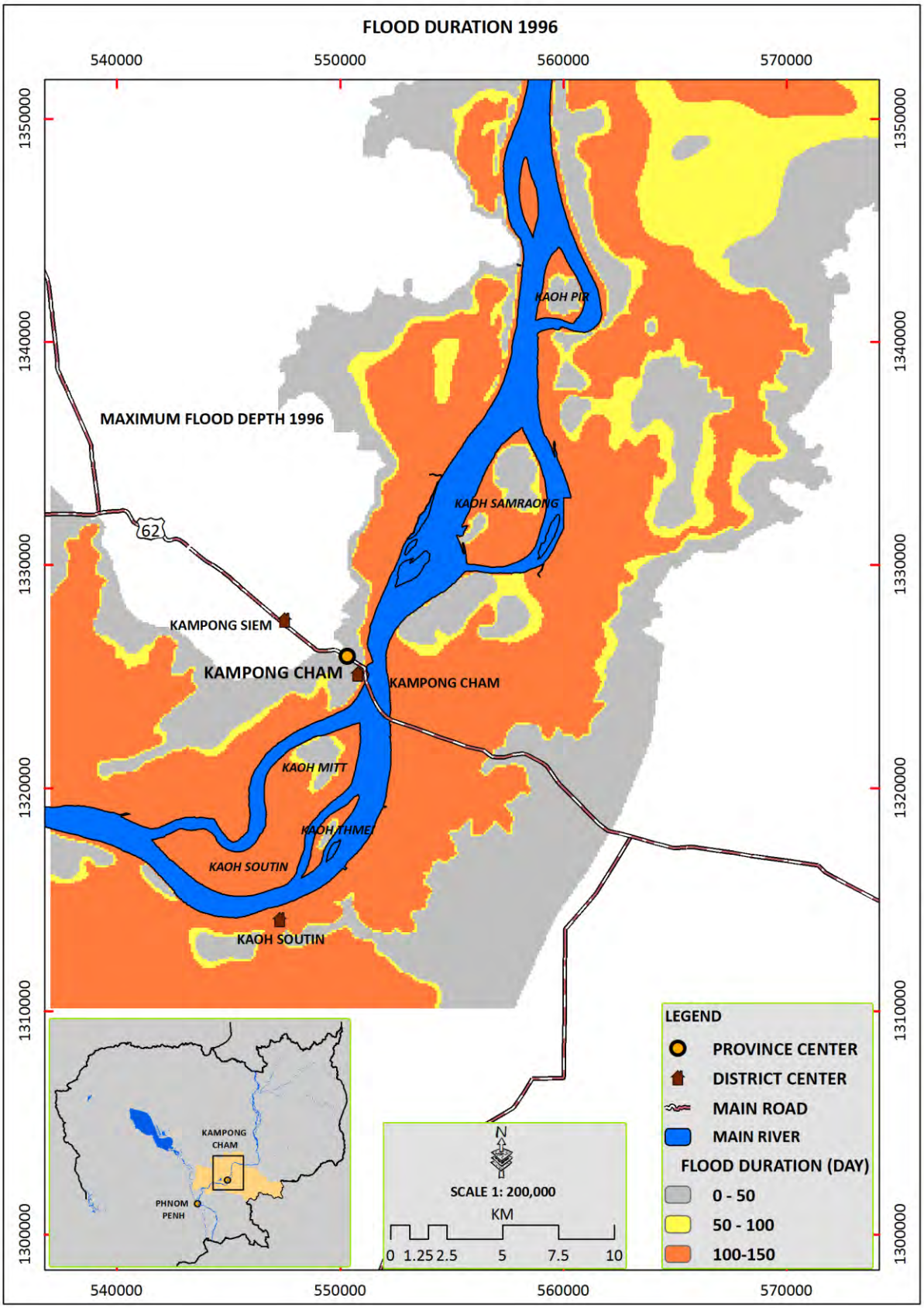


Figure 28 Simulated Flood Duration during the Record High 1996 Flood
(Source: CCAO Consultants)

B. Potential Impacts Due to Construction Works

1. Unexploded Ordnance

138. A land mine or unexploded ordnance (UXO) risk is widespread in Cambodia including the islands. The works are to upgrade existing roads without widening. Nevertheless, a risk remains since there may be deep seated mines that could be exploded by heavy construction equipment and shallow ordnance may be uncovered during the works. The detailed design and implementation supervision consultant (DDIS) shall engage a UXO specialist to determine the level of risk of all project roads and advise on the need for clearance. Any clearance that is required will be undertaken through the civil works contracts, by the engagement of qualified local UXO clearance firms. The contractor shall only commence site works after the UXO clearance firm has certified that areas are already cleared.

2. Potential Impacts from Operating Outside Agreed Areas

139. Contractors must be instructed as to where construction works, materials storage, workers camps, fabrication yards and borrow areas may be located. Operating outside these areas may intrude into private protected areas such as temples or lead to conflict with local residents. As it is intended to hire local labor who live at home, workers residential camps should not be necessary.

3. Borrow Areas

140. Widening and raising of embankments may use a variety of earth, laterite and rock materials. Soil will be obtained from borrow pits or excavated material taken from trenches running lateral to the road. Temporary roads may be needed to access borrow pits. After work is completed borrow areas (borrow pits and borrow roads) must be reinstated to their original condition.

4. Rock Extraction

141. Where rock extraction is by explosives, blasting noise and vibration impacts may occur. The blasting method statement must be submitted to the DDIS consultants in advance for approval. Any quarry supplying material to the contractors must have the relevant MoE environmental approvals.

5. Fabrication Sites

142. Construction of culverts will be by the use of pre-cast concrete structures, which will be transported to site and installed. The location of fabrication sites and their operation may have impacts on surrounding areas.

6. Transport of Construction Materials

143. Construction materials such as earth, gravel and rock will be hauled by trucks to the project sites. If contractors' haulage trucks exceed weight limits there may be damage to bridges.

7. Fuel and Oils

144. Vehicles will require fuel and lubrication oils which may leak into watercourses. Vehicle wash down water may cause contamination.

8. Bitumen Use for Asphalt

145. If Bitumen is used it will need a fuel source for heating. Wood should not be used as a fuel. Asphalt applied during rain can be washed into watercourses.

9. Noise and Vibration

146. During construction, noise and vibration may be generated by construction equipment, vehicles, or pile driving.

10. Dust

147. Dust from unpaved roads is a major nuisance for roadside residents, especially those in built-up areas. During construction, fabrication sites and access roads, material stockpiles, crushers and batching plants may generate dust.

11. Construction Waste Materials

148. It is noted that one jetty is in a poor condition and may need demolition and removal. Demolition of old structures may give rise to waste construction materials. These may comprise waste concrete rubble, wood, nails and old steel re-bars. These can be sharp and pose a threat to grazing animals.

12. Erosion and Sedimentation

149. Borrow pits, quarries, road embankments, culverts and bridge abutments and road diversions will expose bare soils where material can be eroded. Work within channels and dumping of excavated material into flowing channels can cause blockage of drainage channels.

13. Damage to Services

150. Services within the RoW may include electrical cable, fibre optic telephone cables, mobile telephone transmission towers and underground water pipelines. Damage to such utilities must be avoided.

14. Road Diversions

151. It may be necessary to divert traffic around certain areas. Drivers must be forewarned of changed road conditions. Old signage may be misleading if not removed.

15. Forest and Roadside Trees

152. In order to allow road widening roadside trees may be removed. These must be disposed of adequately. These are discussed in detail under “Mitigation”.

16. Discovery of Relics

153. No ancient monuments have been located, but contractors must exercise care as historic artifacts may be discovered during excavation.

17. Accidents and Injuries

154. The Contractor must have a stated policy and clear program for Occupational Health and Labor Safety. Trained first aid personnel and emergency response facilities are required.

C. Potential Impacts Due to Workers Camps

1. Location of Camps and Works

155. The conceptual layout of the construction camps, workers quarters and quarries has not yet been proposed. Their exact locations are not yet specified. More details will become available as the works progress.

2. Camp Amenities for Fixed Teams

156. Workers living in camps will need adequate facilities for food preparation and cooking facilities, laundry, personal hygiene and waste removal. Contractors must provide these to avoid unsanitary impacts on nearby residents.

3. Construction Camps for Mobile Teams

157. As works progress contractors may try to use temporary camps with containers for sleeping and temporary latrines on rented land. This is considered too disruptive to local villagers and renting houses as temporary quarters is preferred.

4. Stagnant Water Areas

158. Stagnant water can gather in borrow pits, discarded solid waste such as plastics, old tires and metal containers and provide temporary breeding habitats for mosquitoes. Malaria and dengue fever are prevalent. Contractors should provide preventive control measures.

5. Health and Safety

159. Risks may arise during the construction stage from (i) inadequate sanitation facilities in work camps (ii) lack of preparation for accidents and injuries (iii) introduction of contagious diseases by immigrant workers (iv) outbreaks of malaria in the labor force. Contractors must take steps to avoid these.

6. Social Issues - STIs

160. The introduction of sexually transmitted diseases or other infections by immigrant workers is a concern. These issues should be addressed.

7. Cleanup of the Construction Site

161. When construction is completed, the contractors must clean up the construction sites by removing all equipment and buildings and carrying out site remediation work.

D. Potential Impacts Due to Operation

1. Road Accidents

162. As a result of improved roads it will be possible for vehicle speeds to increase. This may increase road accidents. Traffic safety is an issue and a road safety program should be implemented.

2. Noise

163. Noise from road traffic is a nuisance for roadside residents. As traffic grows noise levels will increase. However smoother road surfaces can reduce road / wheel interaction noise.

3. Air Pollution

164. Air pollution from motor vehicle will increase. However, higher speeds give more engine efficiency which reduces air pollution.

4. Loss of Forests

165. Improved access to an area can sometimes result in accelerated loss of forests due to illegal logging. As access to the islands is difficult this is not considered to be problematical.

5. Loss of Wildlife

166. A concern with increased access is the possibility of an increase in illegal wildlife hunting and threats to endangered species. As stated above as access to the islands is difficult this is not considered to be problematical.

6. Social Impacts

167. The 5-island cluster in Mekong River consists of 35 villages in two districts (i) Kampong Siem and (ii) Krochmar in Kampong Cham Province. The islands are: (i) *Kaoh Mitt, (ii) Kaoh Soutin, (iii) Kaoh Thmei, (iv) Kaoh Samraong, and (v) Kaoh Pir* with a total population of 29,868 or about 6,868 households. Agriculture is the predominant livelihood of the households in the villages and the major crops planted by the farmers are cassava, corn, peanut, tobacco, fruits, and vegetables. With farming as the major source of income, the households are highly vulnerable to droughts and floods damaging their crops, and they have no savings to buffer against the adverse impacts of climate variability and change.

168. Access to basic social services and facilities (i.e., schools, hospitals, clinics, markets, etc.) is a major problem of the people in the identified island villages due to poor road conditions and landing areas that need rehabilitation. Connectivity to the mainland is critical and is solely by boat. Residents of these islands use small motor boats from several small landing areas, which are not properly built, to cross the Mekong River to the mainland Kampong Cham and its provincial town which is 11 km. away. Road access and boat landings have become increasingly hazardous, especially during the rainy season and monsoons, which have become increasingly intense in the area. Travel times during the rainy season have doubled, and this has placed additional burden and risks on villagers, with high fatality rate of patients being transported to the mainland during a serious illness or emergency.

7. Gender Impacts

169. A labor and gender action plan (LGAP) was prepared to serve as guide to ensure gender mainstreaming before and during project implementation. Gender impacts should be positive.

8. Positive Operational Impacts - Social Enhancement

170. Not all impacts are adverse. The project will have several positive benefits which include:

- Hiring of Local Communities for construction work
- Reduce Transport Costs
- Improved Public Access
- Improved Transport of Goods for Rural Communities
- Tourism Benefits

These will enhance the quality of life and living standards of the local population.

E. Mitigation of Impacts Due to Location

1. Avoidance of Impacts outside Agreed Areas

171. Contractors must follow instructions as to location of construction works, materials storage, workers camps, fabrication yards, and borrow areas. They must not work in protected reserves without prior permission from the relevant authorities.

2. Temples

172. There are several temples and pagodas adjacent to the Output roads. Care should be taken to avoid damage to perimeter walls. There are no ancient temples and no permissions are required from Ministry of Culture and Fine Arts.

3. Religious Edifices

173. There are no religious edifices in the immediate vicinity of the roads. There are several graves located near some of the roads. Contractors must employ normal care when working near these.

4. Avoidance of Flooding

174. The construction of concrete roads on the islands will extend the area of impermeable surfaces and so increase the possibility of localized flooding. Additional drainage must be included alongside the roads and this aspect should be included in Detailed Design.

F. Mitigation of Impacts Due to Construction Works

1. Intrusion into Protected Areas

175. All of the construction activities, including structural work and laydown yards, quarries, borrow pits, fabrication yards and workers camps must be located outside any protected areas.

2. Borrow Areas

176. The borrow areas are still to be identified and finalized. Details of location, excavation and rehabilitation are still to be decided. Often villagers wish borrow pits to be left open so that they could be used for water reservoirs. If this were to be agreed between the contractors and the villagers, all full safety measures must be observed to prevent drowning. Such agreements would be formalized in writing between the contractors and the villagers after full discussion with all concerned parties. As borrow areas will be subject to a private contract between the villagers and the contractor, the decision as to rehabilitation will be made on a case by case basis.

177. However, should the villagers specify rehabilitation the contractor must comply with this request. All borrow pits must be resurfaced after project completion with topsoil and revegetation, as indicated in a borrow pit excavation plan, to such a condition that they do not pose a hazard to local residents. Temporary roads may be needed to access borrow pits. After work is completed these must be removed. This includes breaking up compacted ground and reinstating the original ground surface.

3. Quarry Operation

178. If contractors use existing quarries they must check that the quarry operators have all necessary approvals from environmental authorities prior to obtaining materials from such sites. Dust control during excavation and transport e.g. water spraying on access roads and covering of truck loads with tarpaulins shall be undertaken in areas where there are sensitive receptors such as residential areas, school, hospital, etc. Long-term material stockpiles shall be

covered to prevent wind erosion. During quarry and borrow site operation, provide adequate drainage to avoid accumulation of stagnant water.

179. The use of river bed sources shall be avoided, as much as possible, however if this is unavoidable the contractor shall minimize use of river bed for construction materials and sources of fill and quarry materials lying on small rivers and streams shall be avoided. Alluvial terraces or alluvial deposits which lie on the river beds but are not covered by water in normal hydrological conditions shall be preferred.

4. Fabrication Sites

180. Concrete beams and culverts will be pre-cast in a fabrication yard and then transported to site and erected. Cement and aggregate must be kept on the yard and not transported to site.

5. Transport of Construction Materials

181. Materials such as earth, gravel and rock may be hauled by trucks to the project sites. If contractors' haulage trucks exceed weight limits there may be damage to bridges and road surfaces. Weight restrictions must be imposed on contractor's vehicles to prevent damage to structures. Wheel washing facilities must be provided at roadside camps to prevent mud being carried over onto roads.

6. Fuel Storage and Vehicle Maintenance

182. It is expected that vehicles will be stored at construction sites. Fuel stored on site must follow good industry practice. Fuel suppliers must provide skid mounted tanks with a metered off take and pump, mounted on a concrete hard standing. The concrete base must have a perimeter kerb to catch and retain any minor leaks or spills from the main tank manifold. Vehicle maintenance should take place at commercial garages. If maintenance takes place on site, measures must be implemented to control oily water runoff.

7. Waste Oil

183. Waste oil can be sold to local waste contractors. Any waste oil must be stored in drums which are clearly marked "waste material". The drums must be of sound structural integrity and not leak, or be covered on the outside with dirty oil.

184. Drums must be stored on a concrete hard standing with a perimeter kerb to catch and retain any minor leaks or spills from the drums. The base must be covered with a lightweight rain proof shelter. Simple inclined corrugated lightweight material is sufficient. This must stop rain falling on the drums. (See figure below)

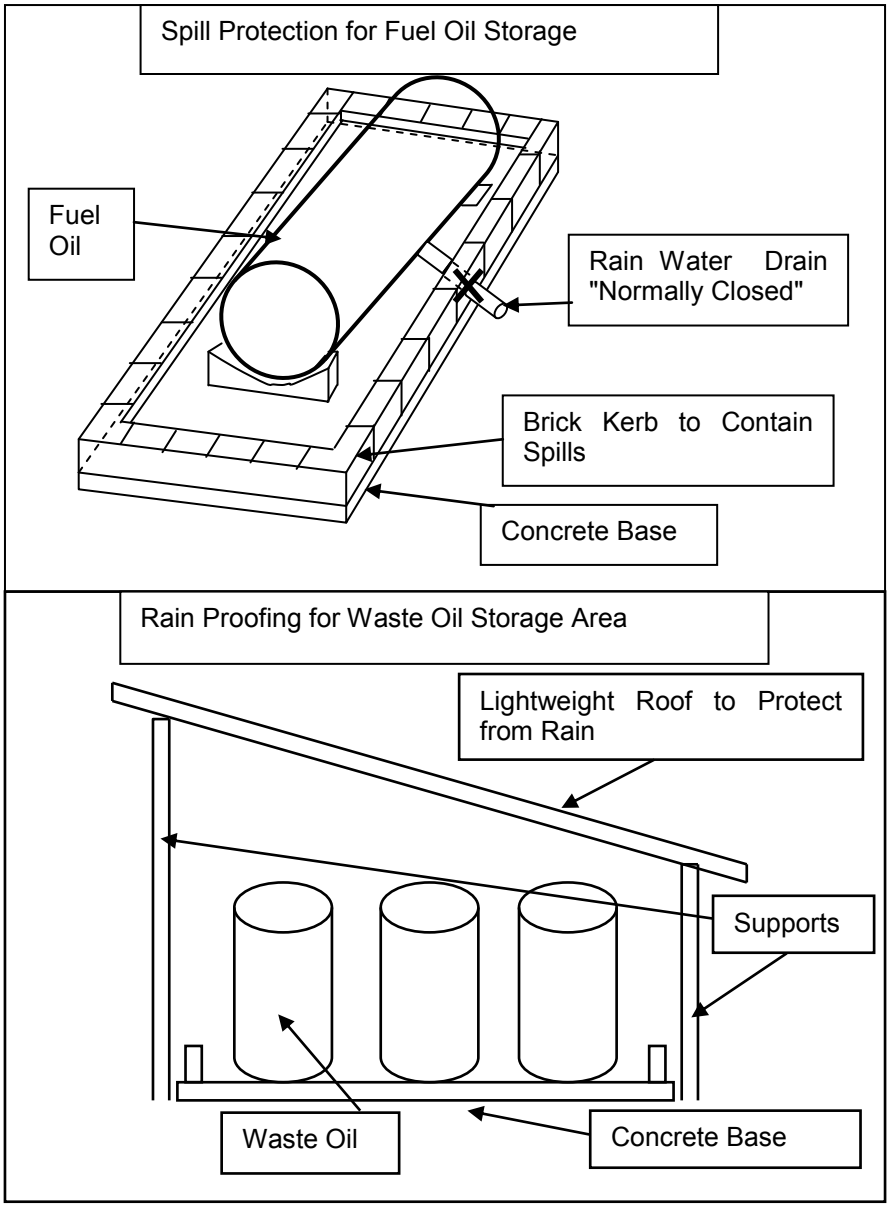


Figure IV-29 Spill Protection for Fuel Oil Storage / Rain Proofing for Waste Oil Storage

8. Bitumen Used for Asphalt

185. It is intended that the roads will be concrete and not bitumen. If bitumen is used it should be heated by kerosene or gas. Fuel wood must not be used or as an alternative cold mix bitumen can be employed. Asphalt must not be applied during rain so as to avoid it being washed into watercourses.

9. Noise Impacts

186. Pile driving, improper silencing of vehicles and equipment used on the road construction site may impact on communities. The Contractor must ensure that machinery is adequately silenced and operations are restricted to normal daylight hours.

10. Dust Impacts

187. The Contractor must maintain dust abatement procedures where roads, construction sites and access areas pass through villages and at sites where workers are employed. In rock quarries which are privately owned dust abatement will be owner's responsibility, unless the crusher, screens and storage are owned by the contractor. Abatement measures can include covering piles of raw

material with tarpaulins to prevent dust being blown away, and water spraying of roads and construction areas.

11. Construction Waste Materials

188. Demolition of old structures, such as collapsed jetty approaches, may give rise to waste construction materials. These may comprise waste concrete rubble, wood, nails and old steel re-bars. These can be sharp and pose a threat to grazing animals. They must be disposed of at an agreed location approved by the local authorities. This must be reported to the RE.

12. Erosion and Sedimentation

189. If bare soils are exposed material may be eroded. Areas must be re-vegetated as soon as possible after disturbance. Depending on the season this may require watering to ensure establishment of vegetation until the wet season arrives. Re-vegetation work may be carried out by affected people as a form of income generation. Re-vegetation specifications will be included in the Detailed Design. The contractor must take care to avoid unnecessary work within channels and avoid dumping of excavated material into flowing channels. If possible, work which could affect water channels must take place during the dry season, before heavy rainfall flows occur.

13. Damage to Services

190. The Contractor must liaise with the relevant utility companies to check location of services and avoid damage.

14. Road Diversions

191. It may be required to divert traffic around certain areas. Warning signs and flagging must displayed at the commencement of any road construction or diversion so as to forewarn drivers of changed road conditions. Old signage must be removed by the Contractor.

15. Forest and Roadside Trees

192. AS no road widening is anticipated no trees should be removed. If it is found necessary during detailed design to remove trees, the number of trees to be removed must be defined and replacement of trees considered.

16. “Chance Find” Discovery of Relics

193. If during excavation relics are discovered, under the Law on Cultural Heritage, 1996, the discovery must be reported to the responsible agency. Stop work may be required until the local authorities give permission to proceed.

17. Accidents and Injuries

194. The Contractor shall have a Safety Officer trained in first aid and the contractor must check the response time of emergency facilities such as fire and ambulance. All workers must be issued with PPE – Personal Protective Equipment – such as safety boots, helmets, goggles and gloves. Workers must be trained in their use and reminded daily at morning “Toolbox Briefings” when the day’s tasks are assigned. Records must be kept of accidents, lost time due to fatalities, injury or medical attention. Workers should be offered incentives to report “near misses” and correct carelessness. Extra efforts must be made to prevent children injuring themselves on site after working hours. Emergency telephone numbers must be displayed prominently on site.

18. Dislocation of People

195. Roads and jetties will be built within an established ROW or usage area but minor dislocations such as temporary bypasses around structures must be agreed by the contractor and local people.

G. Mitigation of Impacts Due to Workers Camps

1. Camp Amenities for Construction Teams

196. It is intended to recruit local labor as far as possible. If workers are brought in to the islands from the mainland proper facilities must be provided for the workers accommodation and subsistence.

197. Water must be supplied for cooking and washing but it is not intended for drinking. If wells are drilled on sites the supply must be 100 L / man / day. It must be stored in overhead storage tanks for gravity distribution. If no wells are planned water for personal washing, laundry, cooking and toilets must be supplied to the camp by road tanker. The supply must be 100 L / man / day.

2. Drinking Water

198. Adequate drinking water must be supplied. Between 1-4 litres per day bottled water must be supplied per worker.

3. Sanitation

199. Proper sanitation must be provided. Open defecation must not be allowed. If septic tanks are installed they must be covered with concrete slabs to control odour and must have vent pipes. Soakaways must be constructed below the ground surface to allow dissipation of liquid effluents and be subsurface. As an alternative pit latrines may be used. These must be covered after use.

4. Food and Cooking Facilities

200. Food must be prepared by offsite local contractors to provide 3 meals per day. Food waste must be collected daily and removed regularly to discourage vermin. If the labor force is not supplied with adequate rations they may exert demands on local supplies of fuelwood, fruit and wildlife. The Contractor must provide gas, kerosene or similar for cooking.

5. Washwater

201. Potable water must be used for personal hygiene washing, laundry and washing cooking utensils. Such wash waters must be kept in a separate waste stream and not mixed with sanitary waste. If discharged to water courses the waste water must first pass through a grease trap to retain detergents and oil / grease. This must be cleaned regularly and the grease waste buried.

6. Solid Waste Disposal

202. Biodegradable waste must be buried in pits and covered with soil on a daily basis. Non-biodegradable wastes such as paper, plastics, cans bottles and the like must be collected and removed from the site by a subcontractor.

7. Mobile Teams

203. Teams of workers may move around the islands as the works progress. The contractors should rent houses as temporary quarters, with full water supply, sanitation and cooking facilities for workers. This is preferable to short term camps. These locations must be determined through the approval of the Engineer.

8. Stagnant Water Areas

204. Contractors must check borrow pits, discarded plastic sacks, old tires and metal containers for stagnant water to avoid temporary breeding habitats for mosquitoes. This must be at least every 7 days to interrupt the breeding cycle of the mosquito which is 12 days. Contractors must implement regular pesticide sprays and provide mosquito nets for workers during sleeping.

9. Health and Safety

205. The contractors must implement a pre-employment health screening, employ a safety officer skilled in first aid, and carry out regular sanitary checks. They must also liaise with the local emergency services (fire, police, ambulance) to check the response time of emergency facilities.

10. Social Issues - STIs

206. Workers from outside the community must be given pre-employment HIV screening. Work camps should be sited away from local communities. An HIV/AIDS awareness program has been developed and should be implemented by a specialist subcontractor.

11. Cleanup of the Construction Site

207. When construction is completed, the contractors must clean up the construction sites by removing all equipment and buildings and carrying out site remediation work.

H. Mitigation of Impacts Due to Operation

1. Consultations and Liaison

208. The contractors must maintain contact on a working level with the local authorities :

- Provincial DoE
- Provincial DoCF
- Provincial DoAFF

209. In addition liaison with community heads, local village representatives, individual landowners and utility companies must be maintained.

2. Embankments

210. The raising of an embankment to a flood free height will avoid flooding of the road. It may also cause runoff to be held behind the embankment and so additional cross drainage must be included. Some roads on the south of Kaoh Samraong may require this.

3. Noise

211. Noise from road traffic can be a nuisance for roadside residents. The project will have positive impacts on the quality of life of roadside residents as paved roads will be less noisy, but as traffic grows noise levels will increase. The paved road will assist in reducing noise. Other controls include; prohibition on the use of air horns at night and fining drivers who operate vehicles without adequate silencers.

4. Air Pollution

212. The project will pave roads reducing dust which will have a major immediate beneficial impact on those people living alongside the roads. Provision of concrete roads will improve muddy conditions during rain and flooding.

5. Religious Edifices

213. There are no religious artifacts located near the roads. Graves will be avoided.

6. Road Accidents

214. Control of speeding and overloaded vehicles is the responsibility of the police. A community based road safety program will be implemented.

7. Loss of Forests

215. While the Output will improve access to the islands it is not expected to increase any forest loss.

8. Loss of Roadside Trees

216. No loss of roadside trees is anticipated.

9. Indigenous Peoples (IPs)

217. As there are no Indigenous Peoples (IPs) in the Output area an Indigenous Peoples Plan is not be necessary.

10. Loss of Wildlife

218. There are no wildlife-protected areas within the immediate Output area.

11. Future Tourism Development

219. The lack of utilities, amenities and connectivity are already an issue for existing residents. Tourists are already visiting the islands, often in organized special interest groups such as photography, looking for photogenic locations. If more tourists are to be accommodated in the future then the quantification of the increase in utilities (such as potable water supply) needs to be adjusted accordingly.

12. Emergency Response Plans

220. The police post on Kaoh Pir was visited and the police officer interviewed. He provided his full contact details. As part of his normal police procedure he has an emergency response plan to be followed in the event of a flood warning being received or flooding being imminent. He stated his immediate needs were lack of electricity, the need to replace an old, weak wireless set, replacement of an old computer and also the need for a boat with a powerful engine for rescuing persons stranded in a flood. He indicated that other islands are in a similar situation. He holds monthly meetings with residents to hear any complaints or respond to pertinent issues.

13. Existing Coping Strategies and Natural Disaster Response

221. The major natural disaster in these islands in the Mekong River is flood. The normal flood is not a serious problem for this area, because they are used to living in inundated places within the Mekong River Flood plain, but a big flood is a significant problem for them.

222. MOWRAM and the National Committee for Disaster Management (NCDM) through the provincial level issue an announcement to all districts and provinces along the Mekong River to prepare for floods and carry out emergency responses before the flood arrives. These measures include the following:

- Every authority from village, commune, and district level has established a committee for disaster management for response and management of any natural disaster in their areas.
- The commune authorities and Committee for Disaster Management in communes inform their people to prepare flood responses.
- They prepare boats for transporting animals and people to safe areas during floods.
- Some villagers who live in small-low houses are moved to safety in upland areas near the commune such as: pagoda, big and high houses, and schools. Some villagers move to safe upland areas in Kampong Siem and Tboung Khmum district.
- Some villagers build cow stables or horse stables higher than flood levels and temporarily keep their cows and horses there during the flood.
- Cambodia Red Cross (CRC) is collaborating with International Agencies and Red Cross/Red Crescent Action and local authorities to urgently distribute to affected people sanitation materials, plastic shelters, rice, and foods.

14. Gender Mainstreaming

223. To ensure effective gender mainstreaming, a LGAP will be prepared. Quarterly progress monitoring of the LGAP will be conducted and a report will be submitted by MRD to ADB. The national consultant will work closely with the DDIS social safeguards and development specialist, and MRD's Social and Environmental Office (SEO) in implementing gender and social safeguard measures based on the 2009 ADB Safeguard Policy Statement (SPS) and the LGAP that will be designed for the TA. The "no child labor policy" will be strictly enforced. Bidding documents and civil works contracts will require implementation of appropriate labor standards and basic occupational/health and safety measures. Civil works contracts will also require unskilled men and women to be given priority for

employment and no child labor or trafficked individuals to be hired for the construction or maintenance works.

15. HIV

224. Improved road connectivity from the mainland of Kampong Cham province to the MICO areas will promote eco-tourism and may result in an influx of tourists going to the islands to see its panoramic view. This may have an economic impact but it may also have potential risks to the local population (men and women) for possible spread of HIV/AIDS if no safeguard measures will be implemented, including promoting awareness on HIV/AIDS and Human Trafficking Prevention. An HIV/AIDS and Human Trafficking Prevention Program (HHTPP) will also be prepared to serve as guide for implementation prior to commencement of civil works and during project implementation. An NGO will implement the HHTPP awareness and prevention programs/activities. People interviewed mentioned that they heard or become aware of the HIV/AIDS only on television and in health centers.

16. Resettlement

225. The Output is Category C in accordance with ADB Guidelines, as upgrading of roads within the current pavement widths will not result in any land acquisition or resettlement but may have some temporary impacts, i.e., dust, noise, some stalls of fruits and vegetables located along the roads (in front of some houses) may require temporary movement) but there are no permanent structures along the road, etc. A Land Acquisition and Resettlement Framework (LARF) will be prepared to serve as guide for implementation. This function will be implemented in coordination with the MRD's Social and Environmental Office (SEO). Public consultations will be conducted prior to start of the Output to widely inform the people and local government officials.

17. Positive Operational Impacts - Social Enhancement

The project will have several positive benefits which will enhance the quality of life and living standards of the local population. No mitigation is required but efforts must be made to maximize these benefits.

226. Once the Output is completed, it will benefit the local population especially the women, farmers and other villagers whose main sources of income are selling agricultural products and at the same time people can buy food and other household needs. The Output is also favorable to children in going to school, either by foot or using bicycles, as the roads will be paved or improved. Access to health centers/hospitals by pregnant women who will undergo regular medical check-up; children, elderly and other sick household members would be faster and more convenient.

227. In addition to greater access to basic facilities, the Output is also expected to have positive gender impacts such as: (i) opportunity for unskilled women and men to work and earn income during civil works (i.e., road construction, planting trees and other climate change related activities); (ii) involve women in decision making; (iii) attend capacity building/training that will enhance the people's level of awareness especially the women on aspects related to the Output, labor-based appropriate technology (LBAT), climate change, early warning system and climate change adaptation interventions, gender awareness and HIV/AIDS and Human Trafficking Prevention

228. A long-term impact of the Output is possible improvement in the household's socio-economic condition which is expected to be achieved after Output completion and/or within the next 5 years or more.

V. ANALYSIS OF ALTERNATIVES

229. This project was originally classified as Category B and this has been confirmed by this IEE. No Analysis of Alternatives is required.

VI. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

A. Public Consultations

230. The public consultation and participation process is an essential requirement in the preparation of the IEE. It follows reconnaissance surveys of the Output sites and involves on-site consultation with local authorities, communities, and local NGOs who provide information on the natural and social resources and vulnerabilities to natural disasters. The main objectives of the public consultation are:

- Provide information on the Output activities and locations to local authorities and local communities
- Receive or collect information and data from local communities, affected communities and relevant agencies concerned with vulnerabilities on environmental and social resources
- Receive feedback and comments from stakeholders
- Address potential issues and concerns from participants

231. These public consultations have been carried out on one occasion (in three locations) as required by the ADB SPS 2009.

B. Flooding

232. The islands are located in the midstream of the Mekong river and experience the regular annual flooding cycle of the Mekong. Villagers refer to 3 types of flood :

- A “normal” flood which they welcome because it irrigates their crops, causes little damage and fills natural indentations with water which they can use in the dry season
- A “small” flood where insufficient water is received and crops suffer
- A “big” flood which inundates the islands and causes damage, and evacuation is needed

Both the “big” and “small” flood were of concern to the residents.

233. The flood is a major natural disaster in these islands. All most every year the Mekong River Flood occurs in these island areas, when Mekong Water is rising from August to September or October.

234. In year 2011, 2000, and 1996 during a big Mekong River Flood in Cambodia, the 5 islands of Kaoh Thmei, Kaoh Soutin, Kaoh Samraong, and Kaoh Pir were flooded and all island areas including farming fields, houses-villages, roads, and any structures were inundated. The flood impacted on infrastructure, agricultural crops, loss of human life and animals.

235. If the Mekong River water rises as normal, a “normal flood” is not a serious problem for this area, because the villagers are used to living in inundated places as a natural consequence of living in the Mekong Flood Plain. Mekong Flood waters provide sustainable top soil of good quality to farming fields and supplies enough water to retention reservoirs for irrigation of dry farm crops. During the wet season, if the Mekong Flood level is too low, the water flows cannot reach the retention reservoir and farmers suffer during the drought.

Table VI-1 Mekong River Flood year 1996, 2000, and 2011 in the 5 Islands

Year	Flooded island area	Time	Duration	Depth
2011	All villages area and structures	August to October	2.5 months	0.3 - 1.5m
2000	All villages area and structures	August to October	2.5 months	0.3 - 1.0m
1996	All villages area and structures	August to September	2 months	0.2 - 1.0m

Source: Consultant’s public consultations with the residents of the islands

236. The flood situation is similar for all 5 islands and these data are estimated from group consultations. The following information is based on primary data stated by the residents during the Public Consultations.

Table VI-2 Present Rural Road Condition

Island - Commune Name	Total road length (km)	Road type	Flood 2011	Deep (m)
Koah Soutin District				
Kaoh Soutin island, Kaoh Soutin commune	15 km	Earth	All	0.2 – 1.0m
Kaoh Thmei, Kaoh Soutin commune	4 km	Earth	All	0.3 - 1.0m
Kampong Siem District				
Kaoh Mitt, Kaoh Mitt commune	12 km	Earth-Concrete	All	0.2 - 0.8m
Kaoh Samraong, Kaoh Samraong commune	15 km	Earth	All	0.4 - 1.0m
Krouch Chhmar District				
Kaoh Pir, Kaoh Pir commune	About 11 km			
	6.5 km	Concrete	All	0.3 – 0.8m
	4.5 km	Earth	All	0.3 – 0.8m

Source: Public consultations with the residents of the islands

C. Consultation Meeting in Kampong Cham Province

237. Kampong Cham province is located some 125 km from Phnom Penh. Some of districts of Kampong Cham province are located in the Mekong River Basin and Mekong Flood Plain such as Kaoh Soutin, Kampong Siem, and Krouch Chhmar District. During the rainy season some land areas such as rice fields, farm field, villages and residential towns are regularly inundated by Mekong River flooding, when the Mekong River water levels rise significantly.

238. Field consultations and information disclosure meetings were conducted on five Mekong River Islands for four communes in three districts of Kampong Cham province namely: Kaoh Mitt commune and Kaoh Samraong commune, Kampong Siem district; Kaoh Soutin and Kaoh Thmei, Kaoh Soutin commune, Kaoh Soutin district; and Kaoh Pir commune, Krouch Chhmer district, Kampong Cham province. The local communities participating in the consultation meetings were represented by commune chiefs, village chiefs and representative of communities in these islands. Invitations were issued to all villagers or interested parties to attend.

239. Three consultation meetings were conducted in Kaoh Mitt Commune Office, Kaoh Samraong Commune office, Kampong Siem district and Kaoh Pir Commune Office, Krouch Chhmar district, Kampong Cham province on 28 and 29 March, 2013. The participants' names and agencies are given in Annex 1.

VII. GRIEVANCE REDRESS MECHANISM

A. Grievance Redress

240. During site preparation and construction phases, there may be complaints related to the environmental performance of the project. To ensure that there will be a mechanism to resolve such complaints, MRD will undertake the following prior to start of site works:

- establish a grievance redress mechanism (GRM)
- make public the existence of the GRM through public awareness campaigns
- ensure that names and contact numbers of representatives of MRD and contractors are placed on the notice boards outside any construction sites and at local government offices (e.g., provincial and commune levels)

241. Through a Grievance Redress Committee (GRC), MRD shall promptly address affected people's concerns, complaints, and grievances about the Project's environmental performance at no costs to the complainant and without retribution. The GRC, which shall be established before

commencement of site works, shall be chaired by PMU to be assisted by the SEO. The GRC shall have members from the PDRD, commune councils, local NGO, and women's organization. Grievances can be filed in writing or verbally with any member of the GRC. The committee will have 15 days to respond with a resolution. If unsatisfied with the decision, the existence of the GRC shall not impede the complainant's access to the Government's judicial or administrative remedies.

242. PMU, through the PDRDs, shall make public the existence of this grievance redress mechanism through public awareness campaigns. PMU shall also set-up a hotline for complaints and the hotline shall be publicized through the media and numbers placed on the notice boards outside the construction site and at local government offices (e.g., provincial, district, commune levels). Locally affected people will still be able to express grievances through the commune councils and these would be referred to PMU through the usual channels in those committees.

243. The GRC, through the SEO, will receive, follow-up and prepare monthly reports regarding all complaints, disputes or questions received about the Output and corresponding actions taken to resolve the issues. The SEO will develop and maintain a database of complaints received related to this. The GRC will also use the punitive clauses of the 1996 Law on Environmental Protection and Natural Resources Management in conjunction with MOE to prosecute any offending parties.

VIII. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

A. Environmental Management Plan

244. The Environmental Management Plan (EMP) gives guidance on how to mitigate the environmental concerns identified in connection with this Output. The EMP deals with mitigation and management measures to be taken during implementation to avoid, reduce, and mitigate adverse environmental impacts.

245. MRD will ensure that the EMP is included in the tender documents for civil works. It will form part of the contract between MRD and the selected contractor and the requirements of the EMP will be contractually binding on the contractor. The conformity of contractors with environmental contract procedures and specifications shall be regularly monitored by the project management unit (PMU) through the Social and Environmental Office (SEO) during implementation. PMU/SEO will be assisted by the detailed design and implementation supervision consultant (DDIS) to undertake EMP monitoring and to prepare corresponding semi-annual reports for submission to ADB.

B. Contractors Environmental Management Plan (CEMP)

246. After appointment and mobilization the contractor must prepare his own version of the EMP known as the Contractors EMP (CEMP). This must give specific details of locations of borrow areas, borrow roads, workers camps and other facilities. This must be submitted to the DDIS Consultant for their approval before works commence.

C. EMMP

247. The Environmental Monitoring Program is included in the Environmental Management Plan and so the EMP can be considered as an EMMP - Environmental Management and Monitoring Plan.

1. Environmental Monitoring

248. The essence of monitoring is to ensure Compliance with the EMP. The contractors have a duty to comply with this and the relevant legislation. The supervising consultant must check their activities and report to MRD. In the event of noncompliance MRD can exert pressure on the contractor to comply.

2. Measurements

249. It will be necessary to carry out measurements to establish if the regulations are being met. In fact, simple compliance with the standards is not necessarily the final objective. There is no harm in the contractor “going beyond compliance” and running an operation better than that required by the law. The measurements to be made and regulations / standards to be met are given below. There will be a “hierarchy” of monitoring and measurements. This would be based on :

- Contractors
- Consultants inspectors
- SEO environmental staff
- Ministry of Environment

250. Initially, contractors should check daily that all operations are being conducted correctly. In general “good housekeeping” must be employed and checked by visual inspection. Dust must be

controlled by covering of stockpiles and water sprays. Solid waste, engine oil and grease, must be taken away by waste removal contractors and records kept.

251. Construction supervision inspectors must make daily spot checks and weekly formal checks on site operations. They must cross check all of the above and view records for waste disposal. They must also investigate any pollution incidents or complaints. They must use checklists for record purposes and make sure that the complaint or incident is brought to the notice of the contractor immediately, verbally and with a follow up written notice. The checklists are given in Appendix 6 of the RRIP 2 IEE.

252. In addition SEO staff should make monthly visits to site to check the veracity of reporting. They should also review the reports submitted by the consultants to the MRD and report to the MRD PMU project manager.

3. Timing of Monitoring

253. The timing of the monitoring is important. The following list is for guidance and is indicative only.

- Liquid emissions from sites must be checked every three months or after heavy rain if overflowing is reported. Measurements in streams and water courses must be made.
- Dust emissions on site must be checked daily by visual inspection and monthly by examining records of water spraying. Ambient air quality must be checked over a 24 hour continuous period at sensitive receptors in the event of complaints.
- Noise and vibration must be checked at sensitive receptors in the event of complaint, at night as well as during the daytime. Noise should be checked at site perimeters quarterly
- Correct removal and disposal of food waste and waste engine oil and grease must be checked weekly by visual inspection of the camps and checking of records from the waste disposal contractors.
- Reinstatement of borrow pits and quarries must be checked after closure of the facility.

254. In addition to regular monitoring, unannounced spot checks may be made by SEO on contractors operations. All of the above procedures should be carried out by the site inspectors, in conjunction with SEO, and where appropriate MOE/ DOE. The results should be formally recorded every week and compiled into a monthly report. This should be submitted to the Engineer, the Chief Resident Engineer and discussed with SEO and the contractors as necessary but at a minimum on a monthly basis. Monthly reports should be compiled into quarterly and annual reports to be submitted to ADB.

Table VIII-1 Measurement of Environmental Parameters

Regulation	Environmental Issue	Parameter	Standard	Timing	Equipment	Institutional Responsibilities
Sub-decree on Water Pollution Control	Water Quality	BOD	< 50mg/L	every 3 months or after heavy rain	Water Sampler	Inspector, SEO
		SS	< 50mg/L			
		Temperature	<45^{0}C			
		pH	6-9			
		Oil & Grease	< 5mg/L			
		Dissolved Oxygen	> 4mg/L			
Sub-decree on Air and Noise Pollution Control	Air Quality	TSP	< 0.33 mg/m^3	24 hours	H.V.S + Lab	MoE
	Noise Quality	Leq	75dB(A)	(daytime 07-19) In response to complaint and	Noise Meter	SEO

				quarterly		
		Leq	65dB(A)	(nighttime, 19-07)		
No Regulation	Vibration	PPV	< 1mm/sec	During blasting or use of rotary compactors	Vibration meter	MoE
Sub-decree on Solid Waste Management	Solid Waste	Food Waste	Properly Removed	Daily	Visual Inspection	Contractor
	Liquid Waste	Waste Oil, Grease	Properly Controlled After Removed by Subcontractor	Weekly	Visual Inspection	Contractor
No Regulation	Septic Tank	Smell, Sewage	No Smell, No Overflowing	During Operation	Visual Inspection	Inspector
No Regulation	Borrow Pits	Condition of Borrow Pits	Filled after Project Completion, Topsoil resurfaced	After Closure	Visual Inspection	Inspector
No Regulation	Borrow Pits	Depth of Borrow pits	No Drowning Hazard	After Closure	Visual Inspection	Inspector
No Regulation	Borrow Road	Location for Borrow Road	Meet the Engineer Demands	After Closure	Visual Inspection	Inspector
No Regulation	Quarries	Condition of Quarries	Quarries reinstated	After Closure	Visual Inspection	Inspector
No Regulation	Tree if Cut	Tree	Tree Replanted	After Removal	Visual Inspection	Inspector

4. Review Procedures

255. Successful implementation of the CEMP will require combined efforts from contractors, consultants, and MRD. The CEMP is a dynamic document and may be subject to change by the contractor as the work progresses. Periodic reviews may be necessary and these should in fact be encouraged.

5. Staffing for Monitoring

256. The contractors should have an environmental specialist on their staff who will advise on implementing the CEMP. MRD will retain supervision consultants. They will maintain a Resident Engineer (RE) on site and a team of inspectors. The inspector's responsibilities will include environmental issues and they must check activities and progress against environmental checklists. The inspectors must report to the RE who in turn submits reports to the DDIS Consultants. Environmental results must be reported to the social and environment office (SEO). The results must also be incorporated in the progress reports submitted to ADB.

6. Response to Complaints

257. Villagers and APs are encouraged to voice complaints and these are to be duly investigated and reported through the contractor to SEO and so to MRD.

258. Response to complaints will be based on the following schedule:

- Complaint made to contractor or others
- Response by contractor or construction supervision consultants' inspectors.
- Weekly compiling of checklists by inspectors. Copies of checklists to be given to contractors as official notification of action being required, confirmation of receipt obtained by contractor signing copy, and joint inspection carried out if necessary.

- Monthly progress reports by inspectors by consolidating weekly reports.
- Corrective Action Reports (CARs) from contractors, as soon as action taken.
- Monthly progress meetings with contractors at which CARs from previous month examined and checked.
- Three monthly progress reports to ADB detailing problems and Corrective Actions taken.
- Regular checks by the Local Environmental Specialist and regular oversight checks by International Environmental Specialist.
- Checks with complainants that they are satisfied

Review of progress must be checked on a daily basis by the inspectors. Any urgent issues must be drawn to the contractors' attention immediately. Failure by the contractor to respond in a timely or adequate manner must be raised with them at the monthly progress meetings.

7. Costs for EMP

259. The estimated costs for implementing the EMP are provided below :

Table VIII-2 Estimated Costs for EMP Implementation (1 year)

Item	Estimated Total Cost (US$)
1. Environmental monitoring to be undertaken by DDIS environment specialists	
a. International (1 person for 1 month US$20,000/month)	20,000
b. National (1 person for 1 month US$2,500/month)	2,500
2. Environmental management capacity building program/training to be undertaken by DDIS for SEO staff (estimates only, to be determined during Project implementation)	10,000
3. Transportation for environmental monitoring (US$5,000 year for 1 year)	5,000
4. Construction phase mitigation measures (included in project costs)	N/A
Total	37,500

8. Table of Environmental Management Plan

The EMP is given in tabular form below.

Table VII.3: EMP GIVING POTENTIAL NEGATIVE IMPACTS, MITIGATION MEASURES AND RESPONSIBILITIES

Activities	Potential Negative Impacts	Mitigation Measures	Implementing Organisation	Supervising Organisation
Impacts and Mitigation – Location				
(a) Road alignment	Incursion into agricultural lands.	▪ Maintain existing alignment.	Consultant	MRD
(b) Raising Road Affecting Hydrology or Drainage.	Possible road failure due to impoundment of flood waters.	▪ Extra cross drainage to be provided. Included in detailed design.	Consultant	MRD
(c) Road Widening	Loss of infrastructure	▪ Minimal Impacts, road width to be maintained.	Consultant	N/A
(d) Need for fill material	Loss of Agricultural Land for Borrow Pits.	▪ Develop alternative uses for borrow pit areas with agreement of farmers and villagers. Some villagers request borrow pits to be left as water ponds for use by village. ▪ Do not use Mekong River sand	Contractor	SEO, MRD
(e) Cutting of roadside trees	Loss of roadside trees, loss of shade and utility.	▪ Compensation to be paid or trees replaced.	Consultant	MRD
(f) Cut faces and slopes near jetties	Erosion and instability of cut faces	▪ Design cut slope to minimize instability. ▪ Use stabilization measures such as vegetation retaining walls and gabions, if necessary. ▪ Vegetate slopes	Consultant	MRD
(g) More drainage structures	Localised flooding.	▪ Position drainage structures to ensure that runoff is conveyed into natural drainage lines at controlled velocities. ▪ If more concrete surface roads are provided include in Detailed Design more drainage	Consultant	MRD
Impacts and Mitigation – Construction				
(a) Mobilization of equipment and workforce	Accident risk from mobilizing construction equipment	▪ Minimize the mobilization of heavy equipment to nighttime. ▪ Control movement of heavy equipment on ferrries	Contractor, Police	SEO
(b) Mobilizing workforce	The introduction of an outside workforce can have a negative impact on the health and social well-being of local people	▪ Conduct special briefing or on-site training on environmental requirement of the project to workers. ▪ Strictly supervise workers not to interfere in local affairs or quarrel with local people. ▪ In case of complaints from local people on the	Contractor	SEO

		issues caused by workers, the complaints should be solved as soon as possible, by collaboration of contractor and village representatives.		
(c) Behaviour of workers	Impacts on local wildlife by workforce– in contravention of Joint Prakas of the Ministry of Environment and the Ministry of Agriculture on Prohibition of Hunting and Catching of Wildlife Animals (1996)	▪ Carry out awareness-raising campaigns on wildlife value for workers. ▪ Any worker conduct hunting, or buying wildlife from local people, will be dismissed from job. ▪ Supply workers with sufficient food from outside the project.	Contractor	SEO, MoE, MAFF
(d) Protecting workers safety	Accident risk from mobilizing	The following safety precautions should be provided to workers. ▪ Warning and/or Precaution Signs on safety. ▪ Provide full PPE; Helmets, boots, warning jackets etc. ▪ Instruction on health and safety. ▪ Establishment of all relevant safety measures required by law and good engineering practices. ▪ Explain use of life jackets if travelling on ferry	Contractor	SEO, MRD
(e) Health Aspects	Outbreak of disease	▪ The contractor shall have all his workers undergo a medical screening prior to their arrival on site, to check for HIV/AIDS, sexually transmitted diseases, and to provide an awareness program. Any workers screening positive for such diseases shall not be allow on the site. ▪ Site construction camps far away from local communities. ▪ Keep camps from becoming blight on the local environment. ▪ Provide enough water supplies for workers, and ensure sufficient sanitation for the camp: the proper location for solid waste disposal. ▪ Make medical treatment available for workers. Provide workers mosquito nets and malaria-prevention medication, if needed, spray around camp area with chemicals against mosquitoes.	Contractor	SEO, MoH
(f) Providing fuel for workers	Depletion of natural resources through demand for building	▪ Do not harvest wood resources within forests. ▪ Where local materials must be used, make	Contractor	SEO, MoE, FA

	materials, fuel and food for workers.	agreements with local communities about the areas or the volume that can be harvested without significant impact. ▪ Support community development by paying an adequate price for any local resources used. ▪ All supplies for building camps should be brought from outside area.		
Impacts and Mitigation – Workers Camps				
(a) Construction work area	Loss of water quality– in contravention of Sub-Decree on Water Quality	▪ Revegetation of construction area. This relates to grass seeding of slopes of new embankments for soil stabilisation and control of sediment run off.	Contractor	MRD
(b) Work in stream channels	Loss of water quality– in contravention of Sub-Decree on Water Quality	▪ Limit work in channels to low flows. Diversionary works to be completed in dry season.	Contractor	MRD
(c) Fuel, lubricants and asphalt	Loss of soil and water quality – in contravention of MOE Praka No. 992 on the Regulation of Industrial Solid and Liquid Waste Management (1994)	▪ Fuel storage in properly designed facilities, careful refueling systems	Contractor	MRD, DoE
(d) Solid waste disposal	Loss of soil and water quality– in contravention of Sub-Decree on Waste Management	▪ Solid waste management procedures	Contractor	MRD, DoE
(e) Dust impacts	Loss of quality of life values– in contravention of Draft Sub-Decree on Air Pollution Prevention	▪ Road watering, cover stock piles	Contractor	MRD
(f) Noise impacts	Loss of quality of life values– in contravention of Draft Sub-Decree on Noise Prevention	▪ Vehicle noise control, timing of work.	Contractor	MRD
(g) Vibration impacts	Loss of quality of life values– in contravention of Draft Sub-Decree on Noise Prevention	▪ Schedule work to minimize nuisance	Contractor	MRD
(h) Damage to services	Loss of services	▪ Contractor liaise with utility company on location of services and local electricity suppliers such as pagodas on islands.	Contractor	MRD
(i) Damage to bridges,	Loss of access	▪ Truck overloading must be controlled	Contractor	MRD/Police

pavements and ferries				
(j) Altered road conditions	Driver hazards	▪ Reduce waiting time delays; signage	Contractor	MRD/Police
(k) Inadequate sanitation	Increased disease– in contravention of Law on Environmental Protection and Natural Resource Management (1996)	▪ Temporary camps to be in rented accommodation with existing sanitation, and extra water provided by tanker if needed. ▪ Use local labor as first choice	Contractor	MRD
(l) Being ready for accidents and injuries	Slow response to injury, no treatment for illness	▪ Worker Health and Safety Plan, First Aid officer on site identifying nearest medical facilities.	Contractor	Contractor, Consultant, MRD
(m) Transmission of sexually communicable diseases	Spread of diseases to communities	▪ Pre-employment worker screening, Public education program.	Separate study and program implemented	MRD/ Contractor
(n) Stagnant water areas	Breeding habitats for mosquito vector	▪ Siting camps distant to communities. Removal of stagnant water areas.	Contractor	Consultant
(o) Discovery of artifacts and relics – "Chance Find"	Permanent loss of cultural items– in contravention of Law on Protection of Cultural and National Heritage (1996)	▪ Contractor awareness; inform MoCF	Contractor	MoCF
(p) Construction near riverside	Loss of riverside vegetation	▪ Avoid clearing riverside vegetation during road construction except where absolutely necessary. Revegetate riverbanks where clearing is unavoidable.	Contractor	SEO
(q) Construction of detour	Blocking access for villagers while road being repaired.	▪ Leave enough of a roadside edge for vehicle to pass on the other half of the roadway.	Contractor	SEO
(r) Construction near village water supplies	Encroachment on water supply systems from road construction activities	▪ Contractors should pay a fee to villagers for damage to water system, perhaps based on number of days without water until the system is fixed. Fees might be specifically targeted toward women's groups, since they are usually the ones who will have the main burden of carrying water when the system is down.	Contractor	SEO
(s) Construction Causing Air Pollution	Dust / Air pollution– in contravention of Draft Sub-Decree on Air Pollution Prevention	▪ Use water bowsers to water the road when dust occurs, particularly in the dry season. ▪ Maintain all construction vehicles to minimize vehicle emission.	Contractor	SEO, DoE
(t) Construction Causing Noise	Noise and Vibration– in contravention of Draft Sub-	▪ All road construction vehicles must have working mufflers and be properly maintained.	Contractor	SEO, DoE

	Decree on Noise Prevention	▪ Avoid working at night near settled areas		
(u) Excavation of Borrow pits	Creation of stagnant water bodies in borrow pits, quarries	▪ Incorporate adequate drainage and fill in borrow pits and quarries. ▪ Maintain borrow pits and quarries by landscaping and revegetating after operation.	Contractor	SEO
(v) Construction Camps Operation	Solid waste– in contravention of Draft Sub-Decree on Waste Management	▪ Provide garbage bins & sanitary facilities for workers. Waste in the bins should be cleared periodically. ▪ Special attention should be paid to the sanitary condition of camps.	Contractor	SEO
Impacts and Mitigation - Operation				
(a) Better quality road and higher speeds	Increase in road accidents to people and livestock	▪ Speed limits enforced. Driver and community awareness; road signs	Police	Police
(b) More traffic volume	Increased air pollution and noise – in contravention of Draft Sub-Decree on Noise and Air Pollution Prevention	▪ Control of vehicle air and noise emissions from vehicles. Paved road will decrease noise and dust.	DoE	MoE, Police
(c) Increased access	Accelerated Loss of Forests and Wildlifes	▪ Not anticipated as no wildlife conservation areas near to project roads.	DoE	MoE, MAFF
(d) Increased jetty traffic and tourism	More demand on water resources	▪ Support well-planned eco-tourism that involves solicitation of continuous feedback from both local residents and travelers. ▪ Support the development of additional village water resources ▪ Develop renewable energy to meet new demands ▪ If more ferries operate, ensure fuel storage facilities incorporate measures to prevent accidental spills entering river.	MRD	MOWRAM

IX. CONCLUSIONS

260. Flooding in the populated areas of the islands is a complex issue. Normal flooding of the fields on lower land is expected and necessary for agriculture. The residents indicate that flooding of the populated areas occurs to some extent in some years and the climate change studies indicate this also, but the environment studies and engineering studies indicate that the height of the Mekong does not experience levels that could cause flooding from that source for some islands.

261. It is likely that for some islands, it is the accumulation of rainfall from the intense storms that Cambodia endures. For some flooding events and location it could also be caused by overtopping of the river banks where these are locally at lower levels, and could even be from the jetties if these have lowered the river bank. Overflowing of water storage areas that are without adequately designed outlets, or have damaged levees are also a likely cause of localized flooding on the islands. Existing surface water drainage ponds and their levees are to be improved.

262. Each of the islands will have better connectivity and the economic analysis indicates that the economic benefits have been achieved.

263. Lack of electricity is an issue. All power on the islands is currently provided by diesel generators. The new steel bridge will permit grid electricity to be provided to Koh Mitt. Local distribution concrete poles are already being constructed. Other islands have no such option. Sometimes lighting is provided by oil lamps.

264. Water supply on the island is obtained direct from Mekong River by private companies and pumped around the island, or delivered in plastic containers by horse and cart. It is also obtained from shallow hand dug wells and deep wells with sanitary covers and hand pumps. Rain water is collected from roof tops and natural ponds and depressions on the islands fill with rain or river water and provide a water source during the dry season.

265. It has been well established that deep water aquifers in the Kampong Cham region are contaminated with arsenic. Villagers are aware of this contamination. They use deep aquifer water for washing clothes but not for irrigation or drinking. Shallow wells are used for crop irrigation and for animal husbandry. River water is boiled and used for drinking. Bottled water is used if affordable.

266. MOWRAM maintain a meteorological station in Kampong Cham on the banks of the Mekong River approximately 1 km upstream from the main river crossing bridge on the right hand side bank. Data was obtained for average daily readings for every day since January 1994 until the present time. Three years show extreme flooding : 1996, 2001 and 2011. On each of these occasions river heights exceeded 16 metres at the monitoring station.

267. Rainfall data was also obtained for daily readings for every day since January 1994 until the present time. These show that higher than usual rainfall occurred in 1996, 2001 and 2011.

268. The public consultation and participation process is an essential requirement in the preparation of the IEE. These public consultations have been carried out in 3 locations as required by the ADB SPS 2009.

269. According to the villagers the major natural disaster in these islands in the Mekong River is an “extreme flood”. The “normal flood” is not a serious problem for this area, because they are used to live in inundated places within the Mekong Flood plain, and this provides them with natural water storage areas during the drought. A “*big flood*” is a significant problem for them.

270. Similarly the villagers rely on a “normal” flood to irrigate their crops and recharge their natural reservoirs on the islands. If a “small” flood occurs then they are short of water and experience a drought in the dry season.

271. Ministry of Water Resources and Meteorology (MOWRAM) and National Committee for Disaster Management (NCDM) through the provincial level issue an announcement to all districts and

provinces along the Mekong River to prepare for floods and carry out emergency responses before a flood arrives.

272. The 5 islands have almost no natural resources such as forest and wildlife as most areas have been cultivated for dry rice fields and farming. Farm fields are used to grow tobacco, kapok, sesame, bamboo, corn, bean, yambean, and other fruit trees have been planted in village gardens. Because of lack of natural forest resources in these areas almost no indigenous species are found, only common species such as common reptile, snakes and water bird were observed. There are no data on forest cover and land use in these 5 Mekong islands.

273. The five islands under consideration are not located in any Sites of Special Scientific or Ecological Interest and there are no Protected Areas in close proximity to the sites.

274. There are no sites of Cultural and National Heritage existing on any of the islands under consideration.

275. An environmental management plan (EMP) detailing mitigation measures and monitoring activities has been prepared as part of the IEE. Temporary environmental impacts caused by the civil works have been identified and mitigation measures are given in the EMP.

276. To ensure that the project is carried out in accordance with the EMP requirements, MRD will specify details of the implementation of the EMP in the tender documents and civil works contracts. The EMP (and EMMP) will form part of the tender documents which becomes legally binding on the selected contractor.

277. Only minor environmental impacts are anticipated. Such impacts will be experienced during site works mainly due to dust and noise emissions as well as potential occupational and community health and safety risks, but can be mitigated. Some minor mitigation measures will be specified but no major impacts have been identified.

278. The project is confirmed as being Category B according to ADB guidelines.

X. ANNEX 1 PUBLIC CONSULTATIONS

List of Stakeholders Participated in Public Consultations

279. The first consultation meeting was conducted in Kaoh Mitt commune office, Kampong Siem district, Kampong Cham province on 28 March, 2013. The involved participants came from Kaoh Mitt commune, Kampong Siem district and Kaoh Soutin and Thmei (Village 1), Kaoh Soutin commune, Kaoh Soutin district, Kampong Cham province.

Table 3 List of Stakeholders in First Public Consultation

No	Name	Organization / commune	Position	Phone
1	Ms. Thu Deth	Kaoh Mitt	Villager	
2	Ms. Horn Hang	Kaoh Mitt	Villager	
3	Mr.Khy Pang Sim	Kaoh Mitt	Deputy chief village	
4	Mr. Long Kim Han	Kaoh Mitt	Deputy chief village	
5	Mr. Hak Lin Gnon	Kaoh Mitt	Deputy chief village	
6	Mr. Ouk Than	Kaoh Mitt	1st Deputy commune chief	017 597 718
7	Mr. Eim Aov	Kaoh Mitt	Chief village	088 556 2209
8	Mr. Veng Neang	Kaoh Mitt	Chief commune	012 981 426
9	Ms. Heng Sokheun	Kaoh Thmei, Kaoh Soutin commune	Villager	097 600 5095
10	Mr. Chhai Chhunseng	Kaoh Thmei	Deputy chief village	012 526 047
11	Mr. Sim Veng	Kaoh Thmei	Chief village 1	097 552 6716
12	Mr. Noa Sok	Kaoh Thmei	Villager	
13	Mr. Ly Hour	Kaoh Soutin	Chief village 14	097 594 3643
14	Ms. Yeun Meng Lay	Kaoh Soutin	Villager	017 291 008
15	Mr. No Lim	Kaoh Soutin	Chief village 13	012 451 610
16	Mr. Nam Leag Heng	Kaoh Soutin	Chief village 7	012 684 951
17	Mr. Chheag Sang	Kaoh Souting	Chief village 3	
18	Mr. Ros Koy	Kaoh Souting	Commune council	092 202 302
19	Mr. Chheag Sokheng	Kaoh Souting	Commune Clerk	012 315 211
20	Ms. Srey Samai	MRD	Gender Unit	012 774 312
21	Mr. Hang Sopolit	MRD	Resettlement Unit	012 756 559
22	Mr. Men Rithy	PDRD	Chief district office	092 906 761
23	Mr. Sok Vanna	Kaoh Mitt	Villager	
24	Mr. Heng Chantha	Kaoh Soutin	Villager	
25	Mao Vanchann	CCAO	Deputy Team Leader	
26	Yim Chamnan	CCAO	Vulnerability and Environment	
27	Chin Phaharath	CCAO	Road Engineer	
Source: Consultant's studies				

280. The second consultation meeting was conducted in Kaoh Pir commune office on 29 March, 2013. The involved participants came from Kaoh Pir communes of Krouch Chhmar district, Kampong Cham province.

Table 4 List of Stakeholders in Second Public Consultation

No	Name	Organization / commune	Position	Phone
1	Mr. Khov Our	Kaoh Pir	Chief commune	012 953 225
2	Mr. Long Sok	Kaoh Pir	1st Deputy commune chief	012 632 101
3	Mr. Ev Eang Seng	Kaoh Pir	Commune council	097 579 7169
4	Mr. Long Leun	Kaoh Pir	2nd deputy commune chief	
5	Mr. Ek Thon	Kaoh Pir	Commune council	
6	Mr. An Eath	Kaoh Pir	Chief village	
7	Mr. Net Meng Heag	Kaoh Pir	Deputy chief police	012 314 239
8	Mr. Hak Kim Chhay	Kaoh Pir	Director of primary school	012 415 483
9	Mr. Ro Chantha	Kaoh Pir	Deputy chief village	
10	Mr. Keat Say	Kaoh Pir	Chief village	012 162 3868
11	Ms. Sang Sokhon	Kaoh Pir	Gender member	
12	Ms. Chhav Chheng Aung	Kaoh Pir	Commune gender chief	042 650 1936
13	Ms. Meng Theara	Kaoh Pir	Villager	088 710 4940
14	Ms. Phloch Sren	Kaoh Pir	Villager	
15	Ms. Kay Sok	Kaoh Pir	Chief village	092 320 364
16	Mr. Yun Sag Heng	Kaoh Pir	Chief village	
17	Ms. Phan Sokhang	Kaoh Pir	Deputy chief village	
18	Mao Vanchann	CCAO	Deputy Team Leader	

No	Name	Organization / commune	Position	Phone
19	Yim Chamnan	CCAO	Vulnerability and Environment	
20	Chin Phaharath	CCAO	Road Engineer	
Source: Consultant's studies				

281. The third consultation meeting was conducted in Kaoh Samraong commune office on 29 March 2013. The involved participants came from Kaoh Samraong communes of Kampong Siem district, Kampong Cham province.

Table 5 List of Stakeholders in Third Public Consultation

No.	Name	Organization / commune	Position	Phone
1	Mr. San Sok	Kaoh Samraong	Chief commune	012 572 481
2	Mr. Sdeg Troap	Kaoh Samraong	Commune council	012 195 0576
3	Mr. Dy Kouch	Kaoh Samraong	Commune council	
4	Ms. Tit Vannak	Kaoh Samraong	Commune council	
5	Mr. Hinh Sameoun	Kaoh Samraong	Chief village 1	016 588 340
6	Mr. Hom Kang	Kaoh Samraong	Chief village 2	
7	Mr. keth Sam At	Kaoh Samraong	Chief village 5	097 798 6967
8	Mr. Sao Sameth	Kaoh Samraong	Deputy chief village 5	
9	Mr. Kong Sok	Kaoh Samraong	Teacher	
10	Mr. Meas Sambor	Kaoh Samraong	Villager	
11	Mr. Leag Heng	Kaoh Samraong	Villager	097 799 9125
12	Mr. Kear Sokhun Thear	Kaoh Samraong	Villager	
13	Mr. Lay Kim Sreag	Kaoh Samraong	Villager	
14	Mr. Som Sun Heng	Kaoh Samraong	Chief village 7	097 604 2735
15	Mr. Tin Yeoug	Kaoh Samraong	Chief village 6	012 212 043
16	Mr. On Chhey Leag	Kaoh Samraong	Chief village 8	092 605 512
17	Ms. Tit Vanak	Kaoh Samraong	Commune council	092 710 296
18	Mr. Orm Eng	Kaoh Samraong	Deputy chief village 2	
19	Mr. Van Va	Kaoh Samraong	Commune administration	012 495 976
20	Mao Vanchann	CCAO	Deputy Team Leader	
21	Yim Chamnan	CCAO	Vulnerability and Environment	
22	Chin Phaharath	CCAO	Road Engineer	

Source: Consultant's studies

Issues and Information

282. The feed-back and issues from consultation in Kaoh Mitt commune office, with Kaoh Mitt commune, Kampong Siem district and Kaoh Soutin and Thmei (Village 1), Kaoh Soutin commune, Kaoh Soutin district, Kampong Cham province are summarized below:

- Most rural roads are earth roads and flood when the Mekong River water rises during August to September or October. As a result transportation is the main problem for this area.
- In 2011, 2000, and 1996 during wet season all the village area in these 3 islands (Koah Mitt, Kaoh Soutin, and Kaoh Thmei) flooded for about 2.5 months.
- During the wet season transportation is the main issue in this area, the local people use their own boats for any human activities and transport of products.
- During floods it is difficult for children to go to school and to transport sick people and any emergency cases to hospital, because boats are small and limited facilities exist for travelling across such a big river.
- In Kaoh Mitt commune, the population is growing and farm land is limited (farm field is about 427 ha, dry rice field is about 365 ha), and there is not enough land for all the people. On these farms they can cultivate only in the dry season and early wet season from October to July.
- There is a lack of jobs in this commune, especially during flooded time. Most young people migrate to any towns to find suitable jobs in garment factories, as construction workers, and farming worker as hired out labor. (Chief commune commented).
- In Kaoh Thmei (Village1) they have no rice fields. The fields are used to plant Tobacco, Kapok Tree, Bamboo, and green beans. During the wet season they plant corn and sesame.
- The main problem is transportation
- Water supply is a problem because ground water quality is no good.

283. The feed-back and issues from consultation in Kaoh Pir commune office, with commune and village chiefs, and communities, Kaoh Pir, Krouch Chhmar district, Kampong Cham province are summarized below:

- The problem is transportation, especially during flooded season, to transport any products to markets and sick people to hospital. There is no Health Center/Health Care in this commune, because the population is lower than 5,000 persons.
- Some roads are earth roads and the commune fund is too small for improving rural road with concrete roads.
- There is inadequate water supply for households and drinking, especially for houses far from the river bank. Private companies bring water from the river by horse-cart and sell to villagers. They charge \$2.50-3.00 /m^3 for houses far from the river.
- There is a lack of electricity for household use in this island; the villagers use their own small generators, charged batteries, and oil lamps for lighting their houses.
- There are inadequate latrines and lack of sanitation on this island.

284. The feed-back and issues from consultation in Kaoh Saraong commune office, with commune and village chiefs, and communities, Kaoh Samraong commune, Kampong Siem district, Kampong Cham province are summarized below:

- The problems in the commune are related to the Mekong River Flood. The flood usually occurs from early August to early October, but if the Mekong River Flood comes early in July, some wet farm crops such as corn, red corn, and sesame will be damaged.
- Villagers like a ***normal flood*** (no flood in village area and flood only in agricultural field), because floods provide fertilizer to farm field, and provide water in natural streams. The stream is 3 km long and acts as a Retention Reservoir for holding back enough water to irrigate farm crops in dry season.
- The severe Mekong River Flood is the problem because it damages any vegetation in village gardens and any structures. Also the Low Mekong River Flow is a problem too, because it will impact soil quality through drought and there is not enough water in the retention reservoir for irrigating tobacco farms in dry season.
- The drought is a problem in this commune. Usually during dry season from November to April rain may occur 2-3 times, but in year 2012 there was a Low Mekong River Flow and no rain, so the farm crop production decreased by 20-30%.
- There is a health center, but it has limited materials and technical staff. The serious patients must be transported to a provincial hospital. The transport of patients is a problem and dangerous during flood season.
- There is a lack of water supply for households. They bring water from the river by pumping but this is difficult especially for houses far from the river bank.
- The lack of any jobs in this commune because of insufficient land area forces young people to migrate to Phnom Penh and outside Cambodia to find suitable jobs in garment factories, as construction workers and farm laborers. The out-migration in this island is about 15% of total people, (Chief commune comment).

Human life and Domestic Animals Affected by Disasters

285. These islands people have experience of life in flooded areas, so human and animal life being lost from floods are rare. Other natural disasters which have occurred in this area are thunder storms which caused damage or loss of human life. Some details are given below.

Kaoh Mitt Commune, Kampong Siem District

- Flood, 2011: 4 cows died
- Storm 2011-12: 1 person died and damaged 7 houses.

Kaoh Samraong Commune, Kampong Siem District

- Flood, 2011: 3 cows and 14 pigs died and 13 houses collapsed into river.

- Lightning, 2011-12: 2 persons died.

Kaoh Soutin commune, Kaoh Soutin District

- Flood, 2011: 3 persons died
- Thunder, 2012: 1 person died

Kaoh Pir Commune, Krouch Chhmar District

Flood, 2011: 1 person died

Requests for Assistance

286. During consultations with local authorities and communities of ***Kaoh Thmei*** and ***Kaoh Soutin***, Kaoh Souting district, ***Kaoh Mitt*** and ***Kaoh Samraong***, Kampong Siem district, and ***Kaoh Pir***, Krouch Chhmar, district, Kampong Cham province, the general requests or comments raised from participants were as quoted verbatim below:

Kaoh Thmei (Village1) and Kaoh Soutin, Kaoh Soutin Commune, Kaoh Soutin District

- The rural road is a problem for our people. The Output should improve earth roads to concrete roads in these 2 islands, because some time Mekong River Flood occurs in these islands. As in Kaoh Thmei village all roads are earth roads.
- Kaoh Thmei village is isolated from Kaoh Soutin on the Mekong River, so we need a health center in our island.
- For supporting health care of our people in Kaoh Thmei and Kaoh Soutin, government should provide high speed power boat (one per island) to transport emergency patients across the big river to district or provincial hospitals during flooded season.
- Government should provide water supply system for household use by pumping from river to water tank and supply to households, because ground water is polluted with Arsenic.

Kaoh Mitt and **Kaoh Samraong** Commune, Kampong Siem District

- Request to improve rural road to concrete road in these 2 islands, because when big Mekong River Flood arrives the roads will flood; we think concrete road is better for our islands. As for ***Kaoh Samraong*** commune all roads are earth roads.
- For supporting health care of our people in ***Kaoh Mitt*** and ***Kaoh Samraong*** commune, provide power boat (one per island) to transport emergency or serious patients to district or provincial hospitals during flooded season.
- Should provide water supply system for household use by pumping from river to water tank and supply to households, because ground water is polluted with Arsenic. Also could provide treatment tanks to households for drinking raw water.
- Sanitation latrines are needed for the people in Kaoh Samraong commune.
- Kaoh Saraong commune need one pumping machine to pump water from river to fill in Retention Reservoir to irrigate dry crop, when Mekong River Water is low and cannot flow into this reservoir.

Kaoh Pir Commune, Krouch Chhmar District

- Request to improve rural road to concrete road for some parts of roads are earth roads.
- Kaoh Pir is isolated from district area on the Mekong River, so we need a health center on our island despite having small population.
- Another way would be to provide one fast motor boat for our island to transport emergency patients across big river to district or provincial hospitals during flooded season.
- Our people need water supply system for household use by pumping from river to big water tank and supply to households, because most of houses are far from river bank and ground water is polluted with Arsenic.
- Could be provided small treatment tanks to households for drinking water, because almost people use to drink raw water.

287. The results of consultations show that the general requests are almost the same from the communities in all 5 islands as they are concerned with road improvement, provision of a health center or emergency transport of patients, water supply and the lack of local jobs in these islands. Agricultural technical support could consider agricultural extension, farm skills improvement, and local jobs improvement by providing out-of-farm jobs such as: bamboo handicraft (Kaoh Pir) and handicraft weaving (Kaoh Mitt), and other applicable jobs.

288. All consultations requested a boat for emergency water transport. It should be noted that all communes offered to cover fuel and maintenance costs from their own budgets.

Photographic Record of Consultations

289. The following figures show the attendance of the consultations.

Figure 30 Consultation in Kaoh Mitt commune office, Kampong Siem District (Source: MICO and CCAO Consultants)

Figure 31 Consultation in Kaoh Pir Commune Office, Krouch Chhmar District (Source: MICO and CCAO Consultants)

Figure 32 Consultation in Kaoh Samraong commune office, Kampong Siem District (Source MICO and CCAO Consultants)

APPENDIX 2

Mekong River Connectivity Output

Briefing on Flooding of the Islands

Ministry of Rural Development

Asian Development Bank

MINISTRY OF RURAL DEVELOPMENT
KINGDOM OF CAMBODIA

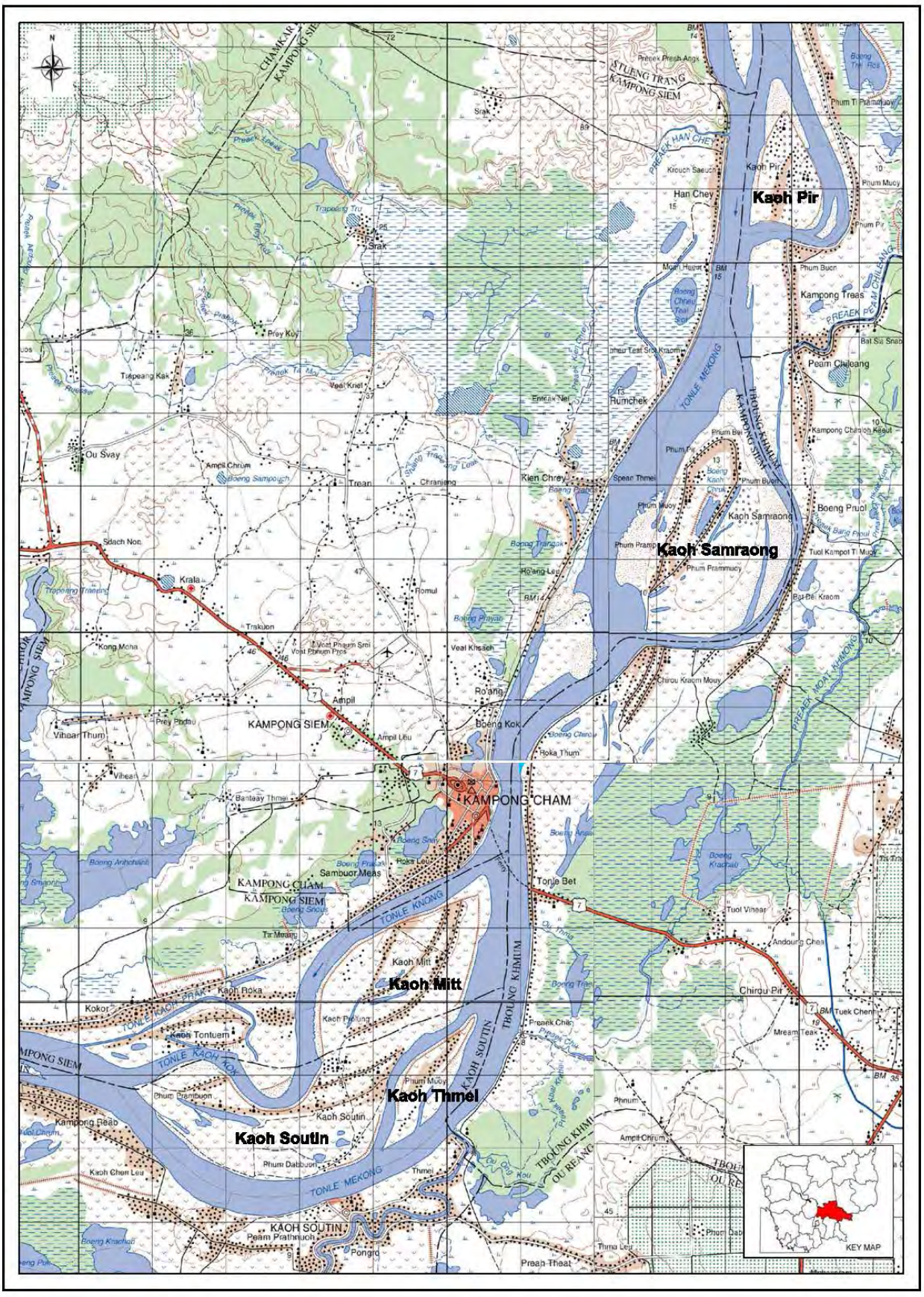
Asian Development Bank: TA 8322-CAM

Mekong River Island Connectivity Output

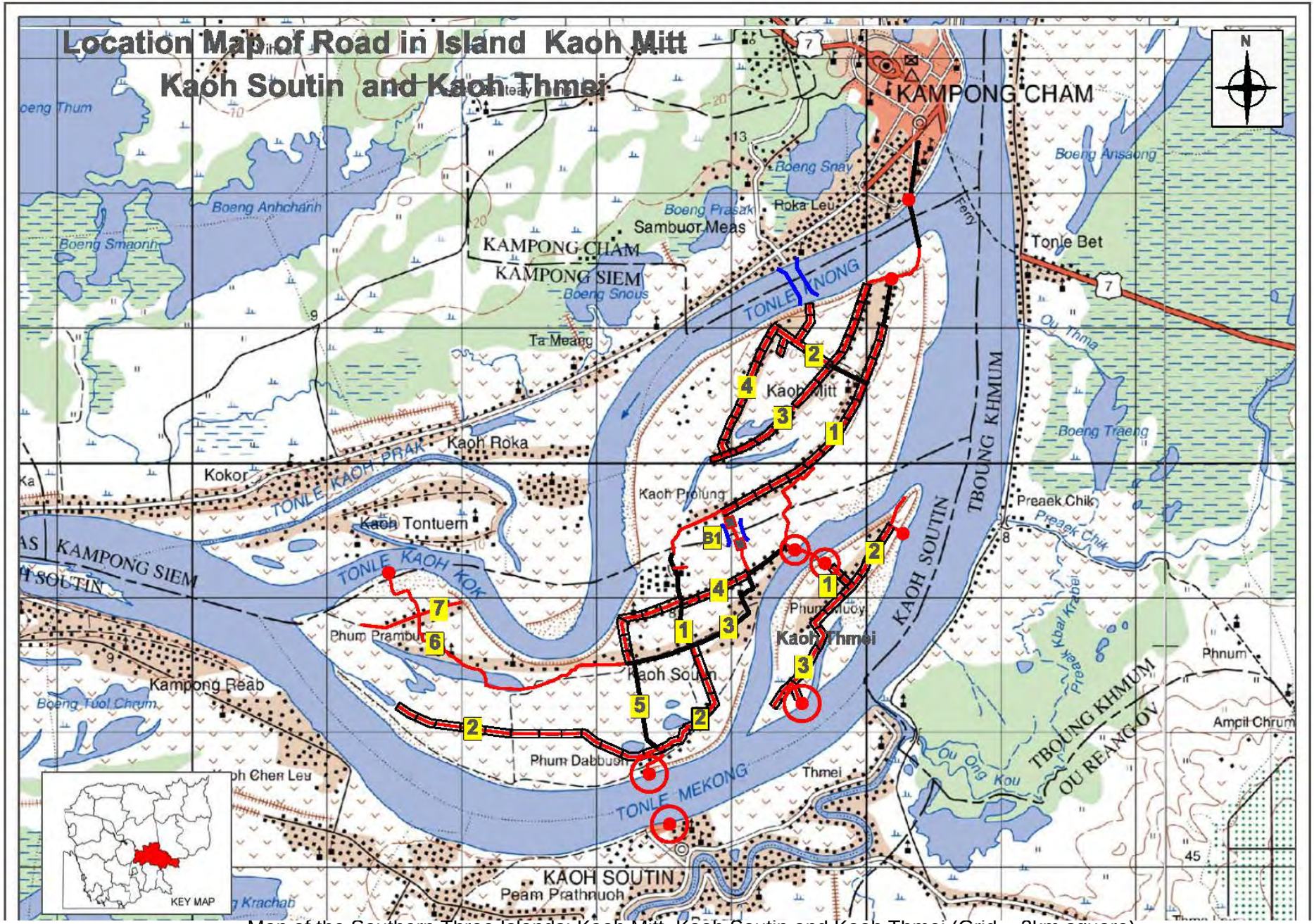
Brief on Flooding of the Islands

July 2013

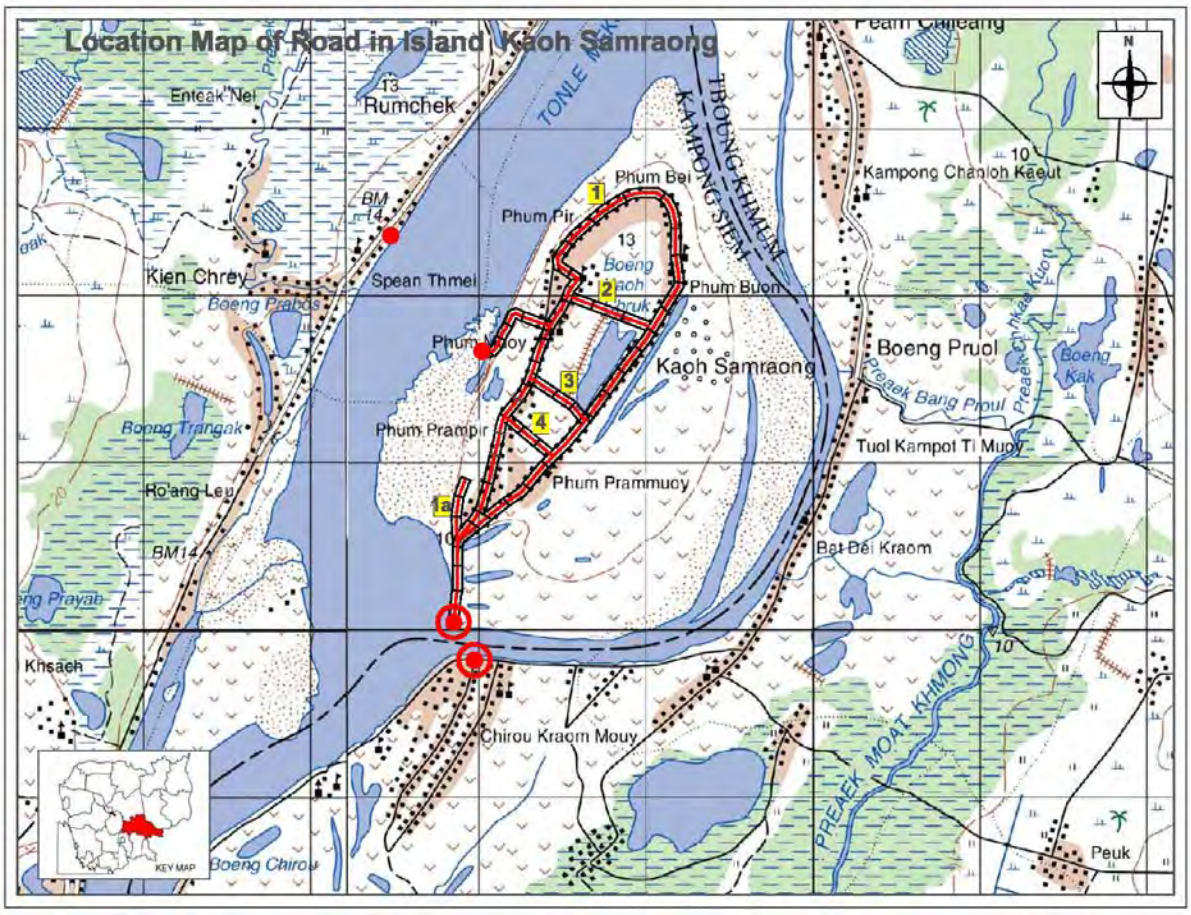
Korea Consultants International



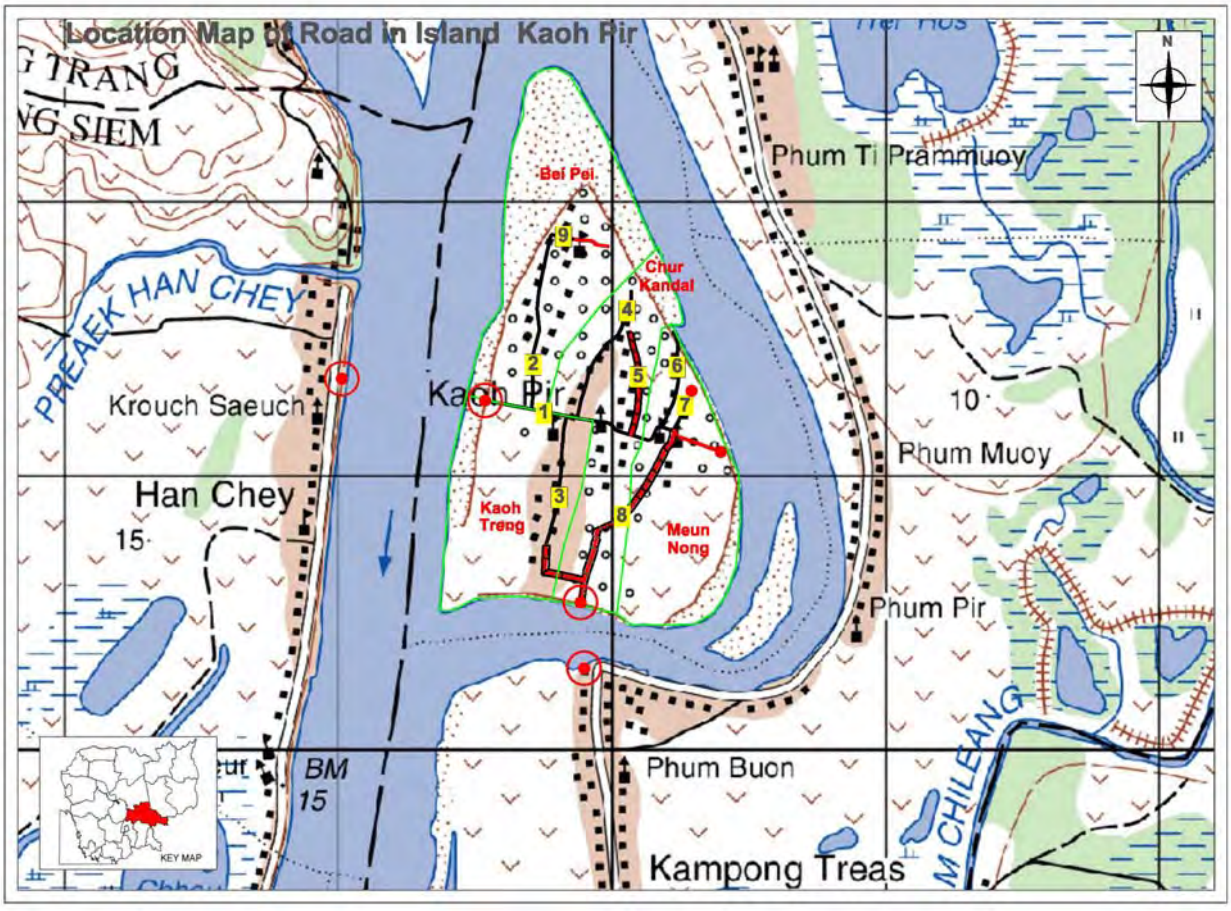
Map showing the 5 Islands



Map of the Southern Three Islands: Kaoh Mitt, Kaoh Soutin and Kaoh Thmei (Grid = 2km square)



Map of Kaoh Samraong (Grid-2km square)



Map of Kaoh Pir (Grid=2km square)

BRIEF ON FLOODING OF THE ISLANDS

Contents

MEKONG RIVER ISLAND CONNECTIVITY OUTPUT

BRIEF ON FLOODING OF THE ISLANDS

1 INTRODUCTION

1. The residents of the islands have reported flooding to various extents and frequencies. HPS Survey Company conducted a topographical survey (TS) of selected points on each island to understand whether the flooding was caused by rising water from the Mekong River overtopping the islands or whether flooding was caused by rainwater which was unable to drain. This report discusses the situation on each island and provides an initial analysis of the information available. The surveyors topographic and profile survey report is given in Appendix 1.

2 REFERENCE LEVEL

2. The reference level is the height of the Mekong River measured on the inclined staff gauge (ISG) at the Kampong Cham flood monitoring station on the two days of the topographic survey (9 to 10 July 2013). A daily report is provided by the Mekong River Commission, see Appendix 2. The water level at each of the islands was then measured at the start of the survey on each island. The elevations are the heights above the water level. They are not the elevations above Mean Sea Level (AMSL); although this can be determined it is not relevant for this report. All elevations in this report are referenced to the elevation of the ISG.

3. Using the same basis for elevations as the reference level and the Mekong River Commission reports the flood warning level is 15.2m and the flooding level is 16.2m as measured on the ISG mentioned above (see Appendix 2). The maximum possible height of water is between 16.0 and 16.2m which has been reached on 3 occasions since 1994. The mean of the maximum flood level for the years from 1994 to 2012 is 15.16m. The range of the maximum flood level elevations is 12.26m to 16.11m, respectively, as determined during the MICO environmental studies (see Appendix 3).

3 SELECTED SURVEY LOCATIONS

4. Survey locations were selected by the MICO team.

5. It must be noted that all the islands have extensive areas of lower ground which are farmed and are expected to flood. The concern is the populated areas which are located on higher ground. It is not possible to obtain sufficient data by topographic leveling surveys to map the islands. Survey locations are along roads, near population centers and at the top of jetties.

4 INTERPRETATION OF THE SURVEY DATA FOR EACH ISLAND

6. Interpretation of the TS data includes the use of other information collected during the field visits to the islands and interviews with the residents and their Chiefs and other MICO studies.

4.1 KAOH MITT

7. Kaoh Mitt has the lowest elevations of all the 5-islands (14.6m approximately) compared with a mean of 15.16m given above), and therefore may be flooded by the Mekong River.

8. Interviews with the Commune Chief indicated that only three of 15 villages were liable to flood annually. The maximum water depth was said to be 1m above the ground level. The period of flooding was about 15 days. This is consistent with the survey data which showed two of these villages are located in a low area (elevation of 12.062m). The third village is also on lower ground on the approach to the preferred crossing to Kaoh Soutin. (The TA has recommended a bridge for this crossing.)

9. The flooding elsewhere and particularly near the commune centre at the intersection of Road 1 and Road 2 was said to occur infrequently. The elevation is 14.9m; and the depth of water was said to be 0.3m. Again this is consistent with the mean of the maximum annual flooding elevations of 15.16m given in Appendix 3).

4.2 KAOH SOUTIN

10. The TS survey indicated that Kaoh Soutin elevations were similar to Kaoh Mitt, so Kaoh Soutin could also be flooded by the Mekong River.

4.3 KAOH THMEI

11. The elevation of Kaoh Thmei populated areas is higher than either Kaoh Mitt or Kaoh Soutin, at between 15.5m to 15.8m, approximately. It is unlikely to be flooded by the Mekong River unless it is a year with an extreme level of flooding such as 2011.

4.4 KAOH SAMRAONG

12. The lowlands on the approach to the jetty located on the south of the Kaoh Samraong are flooded by the Mekong River as expected. A high (3m) embankment with cross drainage is planned for this length.

13. The populated areas are much less likely to be flooded by the Mekong River because their elevation is 15.1m.

14. The flooding in the area of the Commune Centre has a higher elevation of 16.1m on the ground and 16.5m on the adjacent road. Frequent flooding is reported and it can only be caused by the accumulation of rain water and the overtopping of the two lakes located close to and on either side of the populated area (see map). The new road to the south of the western lake area (Road 3) has been constructed with a box culvert south located close to the eastern length of Road 1 which could alleviate the problem by allowing the water to drain to the South, but with apparently insufficient lower ground at a level below the culvert this is unlikely to be effective. A drainage system needs to be constructed.

4.5 KAOH PIR

15. Kaoh Pir has the highest elevations, typically 15.4m along road one to the school and the Police station. But it is reported to be frequently flooded. At the police station the ground elevation is 15.7m and the water mark on the wall indicating the flooding level is at 16.6m. This cannot be caused by the Mekong River which has not

exceeded 16.2m since 1994, and cannot exceed this level because the water floods the mainland surrounding Kampong Cham City.

16. The flooding is caused by the accumulation of rain water and the overtopping of the reservoirs on either side of Road 1 for example on the approach to the school Commune centre and the Police station. A drainage system is required to alleviate this problem.

5 ELEVATIONS OF THE JETTIES

17. The elevations of the top of the jetties are often lower than the elevations of populated areas. This is natural simply because they approach the Mekong River. However if the jetty locations have been chosen originally because they are on lower ground than the surrounding river banks they could easily provide a path for the Mekong River flood waters to “enter” the islands. The design for those to be improved needs to ensure that this is prevented.

18. Other jetties and other low points around the perimeter of each island need to be inspected and levees and drainage systems provided to limit the entry of Mekong River, otherwise any lower ground within the populated areas will become flooded.

6 IMPROVEMENT OF LEVEES AND FLOOD DEFENSES

19. Levees have been constructed in the past to contain surface runoff water or possibly inundation from the Mekong River for use during the dry season. At the same time there should also be drainage channels to prevent overflowing of the storage areas in an uncontrolled fashion especially into populated areas. If these cannot lead to other storage ponds at a lower elevation then they should flow into the Mekong River and flood defenses are required when the Mekong River is in flood. It is quite possible that water storage areas, levees and any existing drainage systems are poorly designed or damaged or they are missing. The effect of these deficiencies will be exacerbated by climate change and adaptation is required.

7 RECOMMENDATION

20. The TA recommends the rehabilitation and improvement of levees, other flood defenses and water storage areas through the implementation of civil works using improved designs to alleviate the effects of both flooding and drought on the islands enabling both the storage and release of flood water whether it originates from flooding of the Mekong River or the accumulation of rainfall. The islands require improved drainage and water storage systems which are separated for household and agriculture uses.

KINGDOM OF CAMBODIA

MINISTRY OF RURAL DEVELOPMENT

PROJECT: WATER LEVEL CHECKING

SURVEY REPORT

1	Topographic and Profile Survey

9~10-JULY- 2013

KOREA CONSULTANTS INTERNATIONAL

HPS SURVEY CONSTRUCTION GROUP

HPS SURVEY CONSTRUCTION GROUP CO.,LTD

SURVEY ENGINEERING SERVICES
DRAWING & DESIGN
Contact phone: 012 502 000
: 088 502 0000
Website: hpssurveytopo.com

ACTIVITIES PICTURES REPORT

LOCATION: KAMPONG CHAM PROVINCE

1. Pictures of Reference Station Level

Ref1- E= 551013 N= 1326001
BM Level= 16.313m

Ref2- E=551063 N= 1326010
Water Level= 6.50m

Ref3- E= 550676 N= 1325009
Water Level= 15.979 m

2. Work Activities Pictures at Kaoh Mitt

E=549604 N=1321663
Water Level= 15.132 m Ground Level= 14.889 m

E=547990 N=1320609
Ground Level= 12.062m

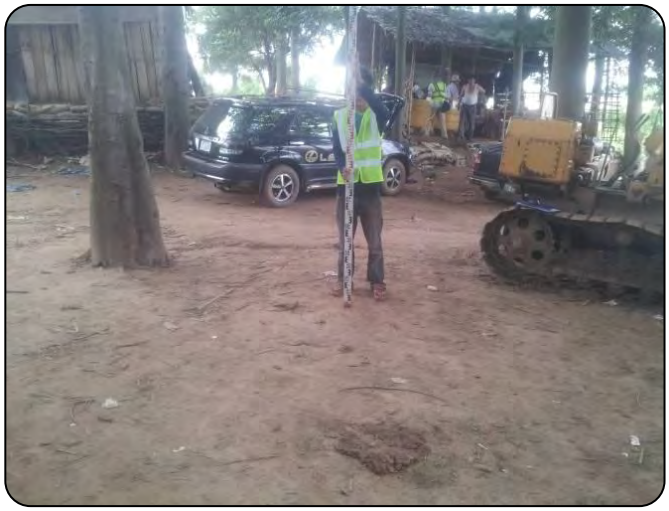
E=547666 N=1319027
Ground Level =14.62m

E=547685 N=1318930
Ground Level =10.375m

3. Work Activities Pictures at Kaoh Soutin

E=547806 N=1318617
Ground Level =15.094m

E=548460 N=1319032
Ground Level =12.909m



E=546314 N=1315699
Ground Level =14.00m

E=546320 N=1314848
Ground Level =16.05m

4. Work Activities Pictures at Kaoh Tmei

E=548998 N=1318773
Water Level=16.115m Ground Level =14.649m

E=549328 N=1318462
Ground Level =15.52 m

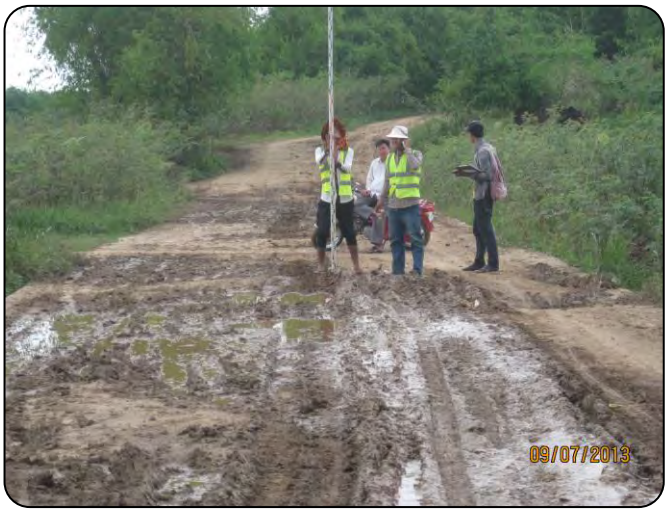
E=548567 N=1316771
Water Level=16.006 Ground Level =13.325

5. Work Activities Pictures at Kaoh Samraong

E=555340 N=1329964
Ground Level =15.812

E=555276 N=1330383
Ground Level =12.947

E=555305 N=1330932
Ground Level =11.556



E=555316 N=1331279
Ground Level =9.559

E=555386 N=1331449
Ground Level =15.074

E=556464 N=1332362
Ground Level =15.37

E=557443 N=1333458
Ground Level =16.467

E=557448 N=1333459
Ground Level =16.057

6. Work Activities Pictures at Kaoh Pir

E=557573 N=1342685
Ground Level =15.847

E=558647 N=1342722
Ground Level =15.601

E=559286 N=1342596
Water Level=16.602 Ground Level =15.602

E=559353 N=1341387
Ground Level =14.464

SUMMARY LIST GROUND LEVEL AND WATER LEVEL

			UTM		ACTUAL COORDINATE			
			Easting	Northing	Easting	Northing	Elevation	Note
	Ref1	BM20 at climate station K Cham City	551013	1326012	551013	1326001	16.313	Measure position on BM20
	Ref2	Inclined Staff gauge	551070	1326008				Measure water level
	Ref3	Scale on Kizuna bridge pillar	550676	1325015	550676	1325009	15.979	Record height of scale at 16 metre level
Island	Number	Description of Location	UTM		ACTUAL COORDINATE			
(Kaoh)			Easting	Northing	Easting	Northing	Elevation	Notes
Mitt	1	Intersection of Road 1 and Road 2 at CL and ground level	549603	1321668	549604	1321663	14.889	Intersection of Road 1 and Road 2 at CL
					549512	1321716	14.871	The ground level
	2	CL of road at Low point of Road 3 and the ground level	547986	1320607	547990	1320609	12.062	CL of road at Low point of Road 3
					548106	1320670	11.656	The ground level
	3	Intersection Road 2 with track to new MPWT Bridge	548902	1322907	548899	1322067	15.044	Bridge is under construction
	4	Intersection of Road 1 with track to Kaoh Soutin	547430	1319573	547431	1319570	14.596	
	5	Start of planned concrete bridge	547668	1319028	547666	1319027	14.62	
	6	Lowest point along track to Kaoh Soutin	547686	1318931	547685	1318930	10.375	
Soutin	7	Intersection Road 4 with Road 3	547805	1318604	547806	1318617	15.094	
	8	End of Road 4 at intersection with track to Kaoh Thmei	548484	1319037	548460	1319032	12.909	
	9	Top of Jetty to Kaoh Soutin District Centre on Mainland	546316	1315224				
					546314	1315699	14	Top of jetty on Island
					546320	1314848	16.05	Top of jetty on Mainland
Thmei	10	Top of Jetty on Thmei	549013	1318767	548998	1318773	14.649	
	11	intersection of Road 1 with Road 2 and Road 3	549359	1318488				on Thmei
					549328	1318462	15.52	intersection of Road 1 with Road 2
					548848	1317836	15.801	intersection of Road 2 with Road 3
	12	Top of Jetty on island	548563	1316785	548567	1316771	13.325	
Samraong	13	Top of Jetty on mainland	555349	1329973	555340	1329964	15.812	
	14	Top of jetty on Island	555277	1330382	555276	1330383	12.947	
	15	location of new pipe culvert	555306	1330908	555305	1330932	11.556	
	16	centre of road on causeway (broken concrete)	555315	1331241	555316	1331279	9.559	
	17	centre of road 1	555385	1331450	555386	1331449	15.074	obtain levels along road 1 to commune centre
	18	Road 1 Intersection with road to west	556463	1332366	556464	1332362	15.37	
	19	Road 1 Centreline at commune centre	557450	133503	557443	1333458	16.467	
	20	Ground level at Commune Centre			557448	1333459	16.057	Adjacent to the WP above

SUMMARY LIST GROUND LEVEL AND WATER LEVEL

			UTM		ACTUAL COORDINATE			
			Easting	Northing	Easting	Northing	Elevation	Note
Kaoh Pir	21	Top of jetty on Main land	557403	1342762	557573	1342685	15.847	
	22	Top of Jetty on Island	558516	1342750	558647	1342722	15.601	
	23	Series of CL levels along Road 1 to Police station	many measurments					measure along road CL
					1342709	558713	15.22	Along Road Cl at jetty to Height water of police
					1342693	558804	15.177	TP4 (CL)
					1342674	558892	15.113	TP5 : Intersection of Road 1 and Road 2
					1342651	559005	15.192	TP6(CL)
					1342625	559124	15.357	TP7(CL)
					1342600	559238	15.777	TP8(CL)
					1342568	559418	15.475	TP11(CL)
					1342584	559314	15.456	TP10(CL)
					1342552	559528	15.398	TP12(CL)
	24	Height of water mark on wall of Police station	559286	1342593	559286	1342596	16.602	
	25	Intersection of road 1 and Road 8	560079	1342441	560070	1342476	15.655	measure CL
	26	Top of Jetty on island	560462	1342284	559353	1341387	14.464	
	27	Top of Jetty Intersection of Road 3 and Road 8	559353	1341403	559353	1341387	14.464	

CL= Centreline of road

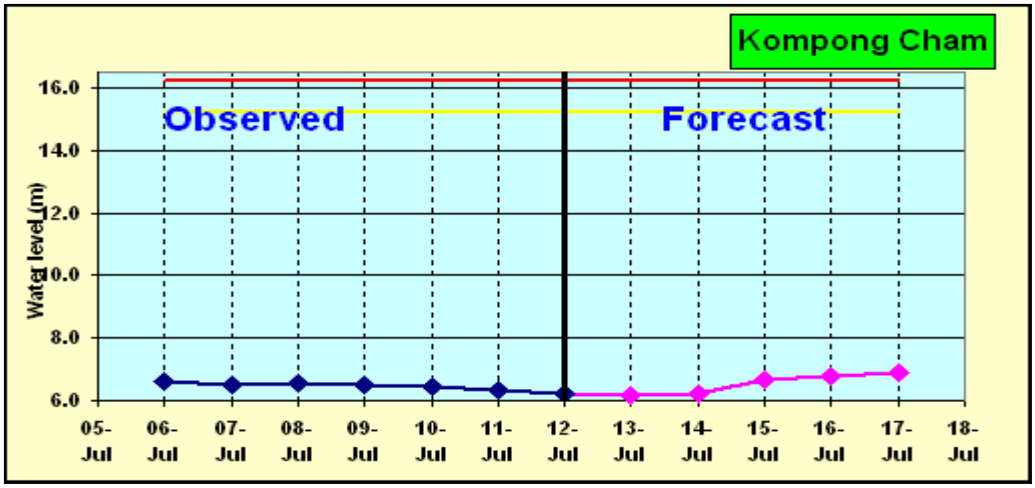
Mekong River Commission
For Sustainable Development
Flood Information

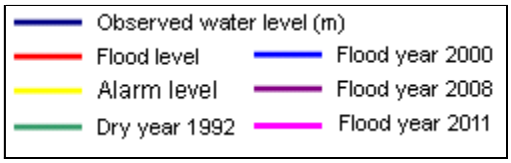
Actual water levels

Kompong Cham

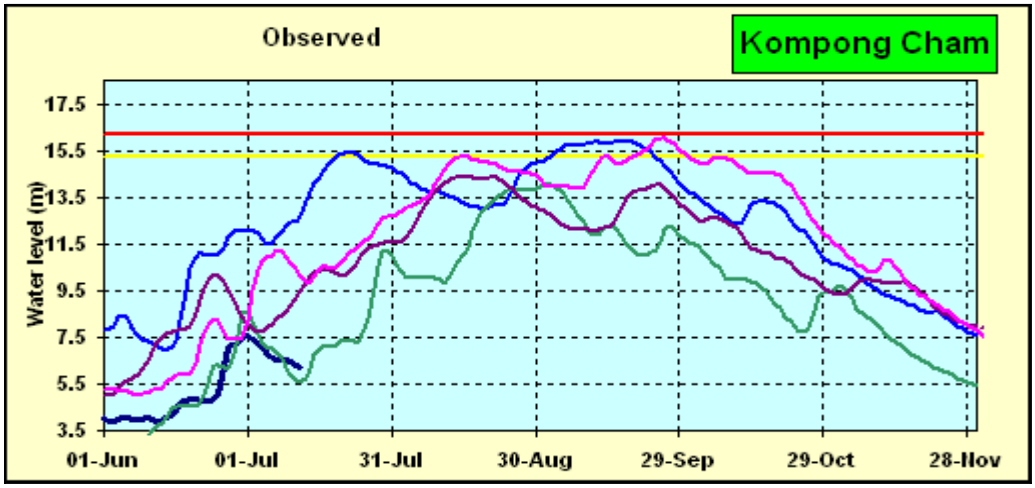
Water level on Friday, July 12, 2013 at 07:00 AM = 6.23 m
Forecast level on Saturday, July 13, 2013 = 6.17 m
Flood level = 16.20 m
Alarm level = 15.20 m
All levels are above zero gauge
(Zero gauge Kompong Cham = -0.93 m above MSL)

Water level over the last 7 days and 5 day forecast





Observed water level this season



1 FLOOD OCCURRENCES

1. Data was obtained relating to the height of water flowing in the Mekong River. To supplement this, rainfall data has also been obtained. This is analyzed below.

2. The occurrences of floods can be visually represented by looking at the hydrographs for the gauge height in meters for the years 1994-2012 recorded on the Kampong Cham Staff-Gauge. The minimum and maximum levels are shown in Figure 1 below.

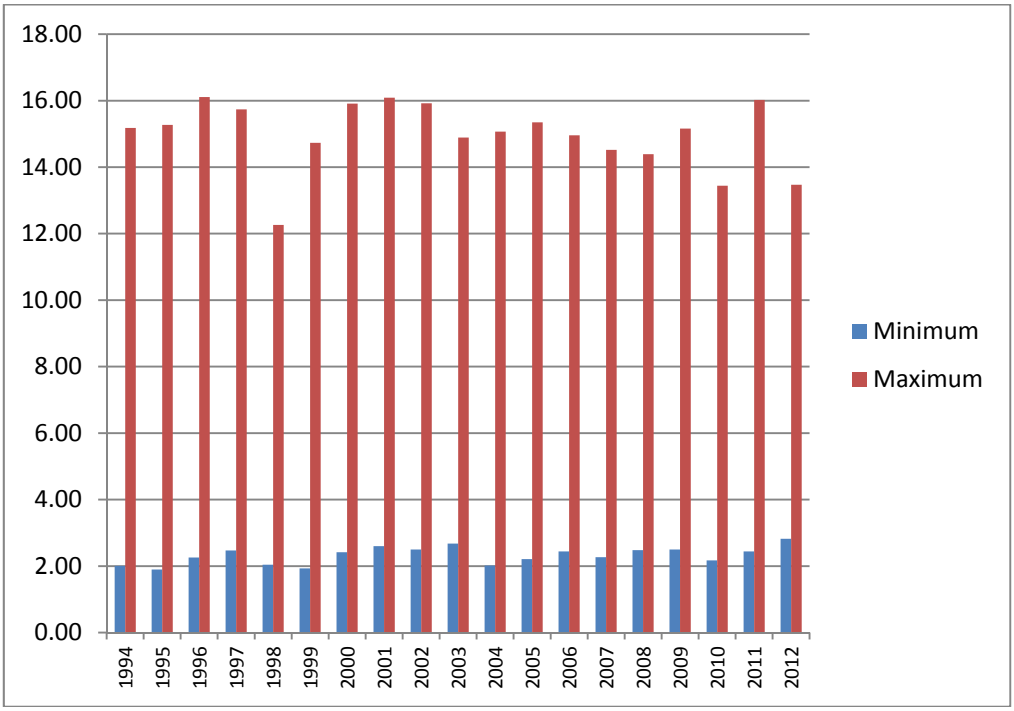


Figure 1 Minimum and Maximum Flood Levels Kampong Cham (Water Heights in metres 1994-2012)
(Source: MICO consultants analysis)

3. The occurrence of floods in 1996, 2001 and 2011 can be clearly seen from these data. One can also see that in the years 1998, 2010 and 2012 the highest recorded levels were low, around 12 metres.

2 FLOODING IN KAMPONG CHAM

4. The embankment alongside the main river bank through Kampong Cham is located at an water level elevation of 16 metres. When the river reaches this height the banks overflow and Kampong Cham becomes flooded. Because the town centre is mostly flat the flooding is extensive. This means the height of the flooding on the islands caused by the river cannot exceed a height of 16m. This can clearly be seen by examining the staining on the bridge pillars. The bridge pillar and the parapet are shown in Figure 2.

Figure 2 Staining on Bridge Pillars and View of the Parapet
(Source: MICO Consultant studies)

5. The Height Gauge on the bridge shows that the parapet limits the flood to 16 m as shown in Figure 3. This means the flood levels on the nearby islands cannot exceed a water height of 16m due to flows in the Mekong.

Figure 3 Height Gauge on Bridge shows parapet limits flood to 16 m

3 RECURRENCE INTERVAL OF FLOODING IN KAMPONG CHAM

6. According to the villagers the major natural disaster in these islands in the Mekong River is an “extreme flood”. The “normal flood” is not a serious problem for this area, because they are used to live in inundated places within the Mekong Flood plain, and this provides them with natural water storage areas during the drought. A “*big flood*” is a significant problem for them.

7. Similarly the villagers rely on a “normal” flood to irrigate their crops and recharge their natural reservoirs on the islands. If a “small” flood occurs then they are short of water and experience a drought in the dry season.

8. Examination of the records shows that the occurrence of floods over the period 1994 to 2012 was as shown below in Table 1 and Figure 4.

Table 1 Occurrences of Big, Normal and Small Floods

Year	Min (m)	Max (m)		
1994	2.01	15.18		
1995	1.90	15.27		
1996	2.26	16.11		
1997	2.47	15.74		
1998	2.04	12.26		
1999	1.93	14.73		
2000	2.42	15.91		
2001	2.60	16.09		
2002	2.50	15.92		
2003	2.68	14.89		
2004	2.02	15.07		
2005	2.21	15.35		
2006	2.44	14.96		
2007	2.27	14.52		
2008	2.48	14.39		
2009	2.50	15.16		
2010	2.17	13.44		
2011	2.44	16.02		
2012	2.82	13.47		
Max	m	16.11	Events	
0.90	90%-ile	16.03	3 times	Big
0.50	50%-ile	15.16		
Mean	m	14.97	13times	Normal
0.11	11%-ile	13.47	3 times	Small
Min	m	12.26		
STDEV	m	1.02		

Source: MICO Consultant's analysis of MRC data

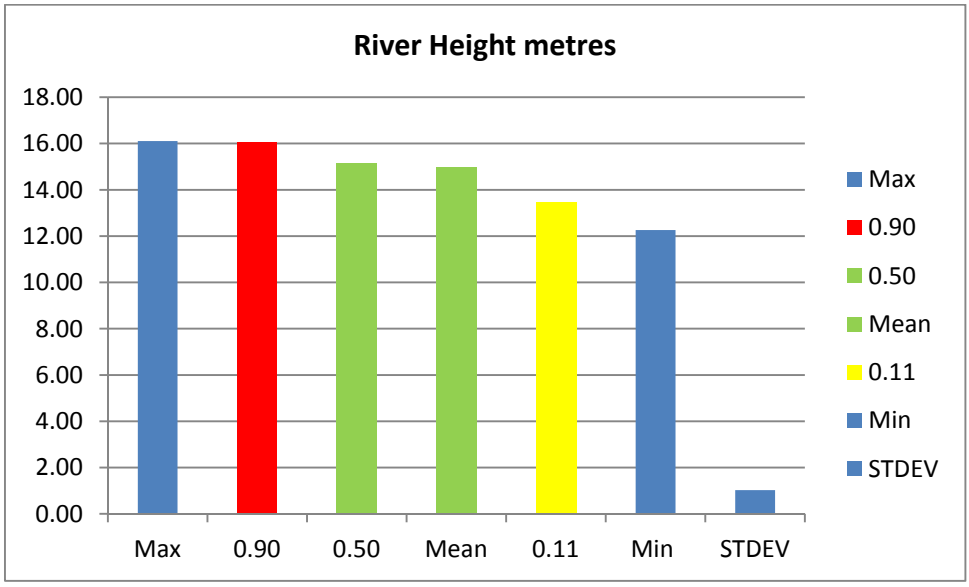


Figure 4 Flood Heights
(Source: MICO Consultant's analysis of MRC data)

9. The recurrence of a 16 m flood over the period 1994 to 2012 was calculated to represent the 90th percentile. That is to say 10% of the floods exceeded 16m and 90% did not, over this time interval. The maximum level was 16.11m that is 0.11m above the parapet.

10. The Standard Deviation was not large being 1.02m about a mean of 14.97m. In the MTE Seminar the question was asked about the recurrence interval of the three types of floods. Based on the data the event frequency of the three types of flood over the 19 years period was:

- Big - 3 events
- Normal - 13 events
- Small - 3 events

4 LOCALIZED FLOODING ON THE ISLANDS

11. Villager on the island at a water height elevation greater than 16m still report flooding. This is considered to be localized flooding due to heavy rainfall. Much of the central higher parts of the islands are covered over with impermeable concrete roads. Heavy rainfall on such impermeable surfaces would overwhelm the already inadequate drainage system leading to localized flooding.

Figure 5 Interview with Local Police Officer and Shop Owner who suffer Floods

12. In interviews the shop owner described how she receives a warning of an impending flood from the police officer and moves her products to the upper storey of her house, as shown in Figure 6. The ramp is used for moving motor cycles.

13. The villagers indicated the height of flooding on the pillars of the house as shown in Figure 7. The local school is inundated and has to be evacuated see Figure 8.

Figure 6 Shop Owners move Possessions into this House

Figure 7 Villager indicating Height of Flood

Figure 8 School which is Flooded and Graves indicating Height of Flood

14. Kaoh Pir school was reported to be flooded to a depth of 0.5 metres and needed to be evacuated.

15. Road side graves would suggest they are located above the expected limit of flooding due to the river see Figure 8.

16. In another location on Kaoh Pir villagers indicate high ground where animals are brought and a shelter where villagers stand guard over the animals, as shown in Figure 9.

Figure 9 Animal shelter and watch tower; villager indicating Height of Flood

5 RAINFALL DATA

17. Rainfall data was obtained for daily readings for every day since January 1994 until the present time. This was used to feed into the flood mapping exercise.

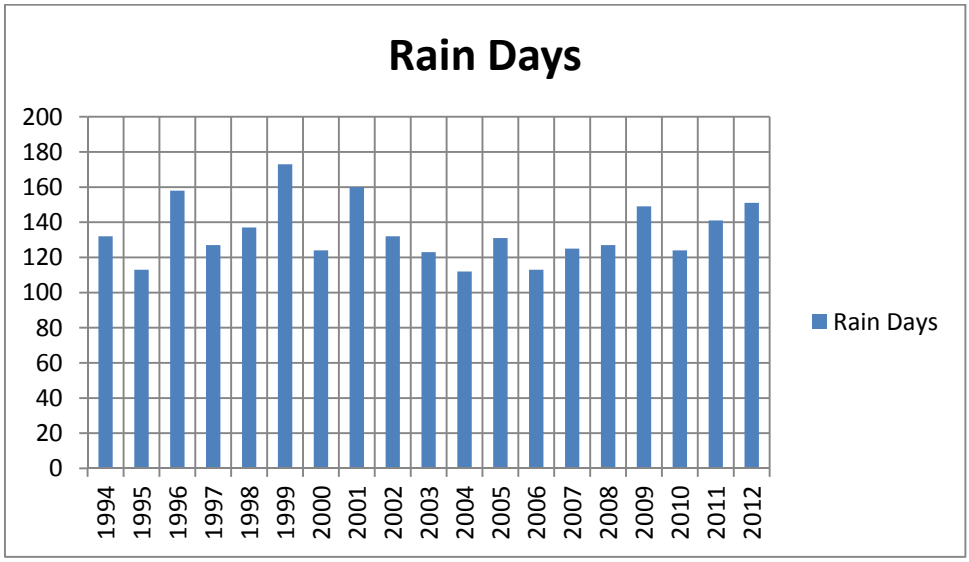


Figure 10 Number of Rain Days

18. The rain fall data shows higher occurrences of localized rain in the years 1996, 1999, 2001, 2009, 2011 and 2012. This correlates with the villagers' reports of bad floods in 1996, 2001 and 2011.

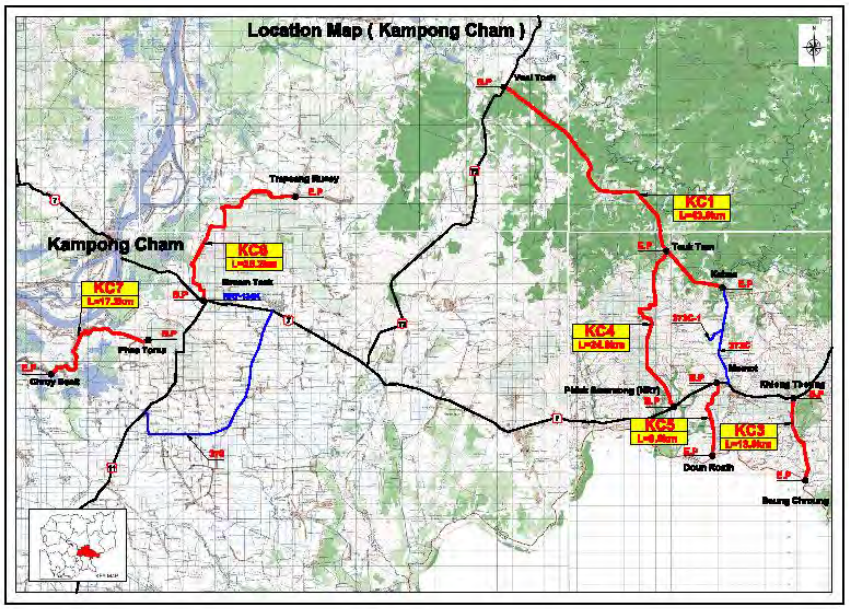
19. The flooding in the central part of the islands would appear to be driven by two parameters: height of the flow in the Mekong River and heavy local rainfall. The flood height and rainfall data indicates that flooding on the higher elevations of the islands is caused by rainfall, and not by the river flooding.

20. For design purposes when considering flooding on the islands it is important to differentiate between flooding caused by high river flows and flooding caused by rain.

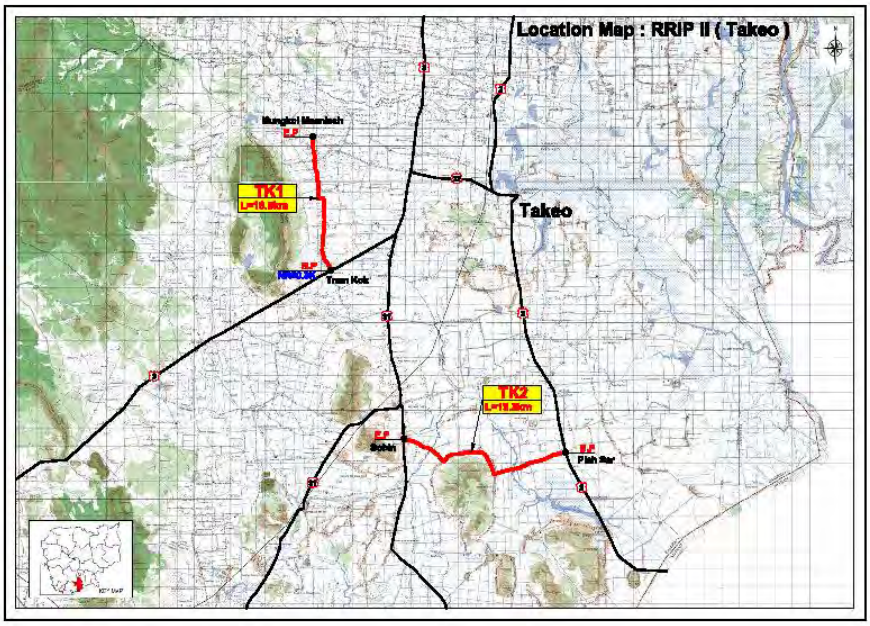
APPENDIX 3

Location Map of Project Roads by Province

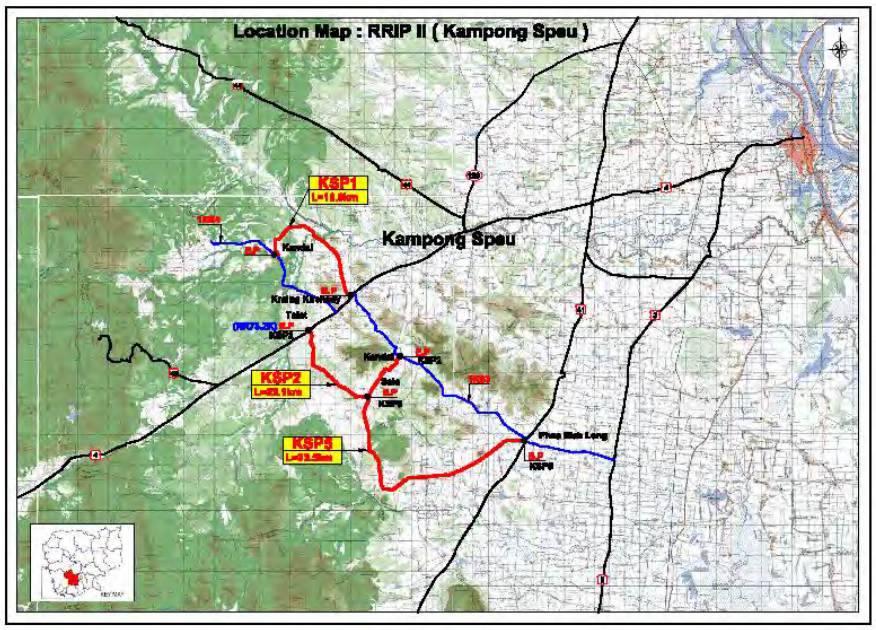
1. Kampong Cham Province - 6 roads



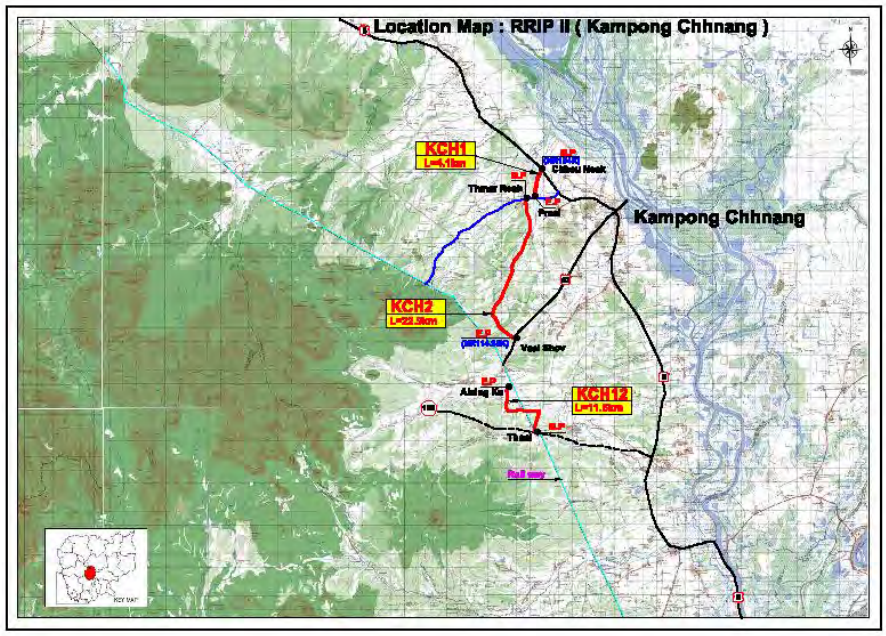
2. Takeo Province - 2 roads



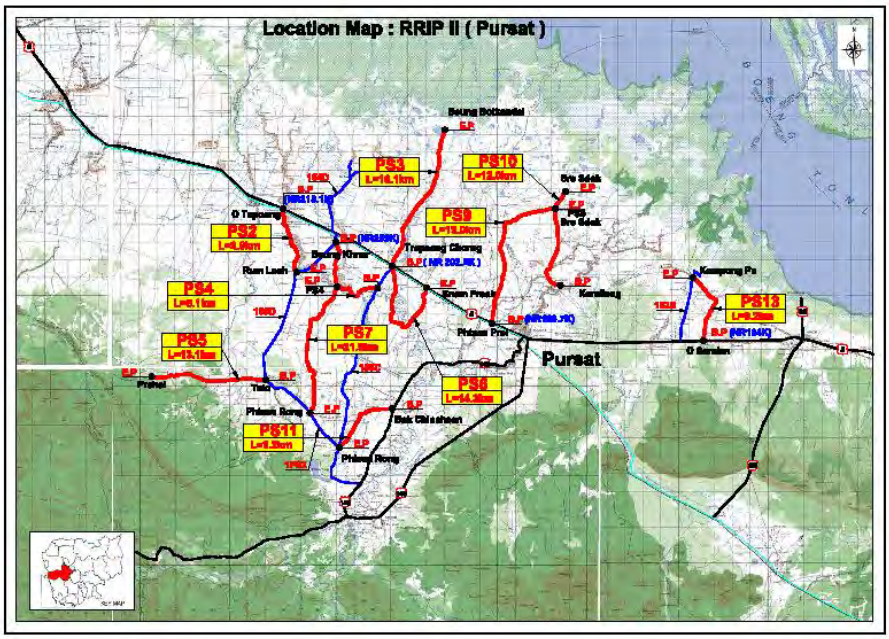
3. Kampong Speu Province - 3 roads



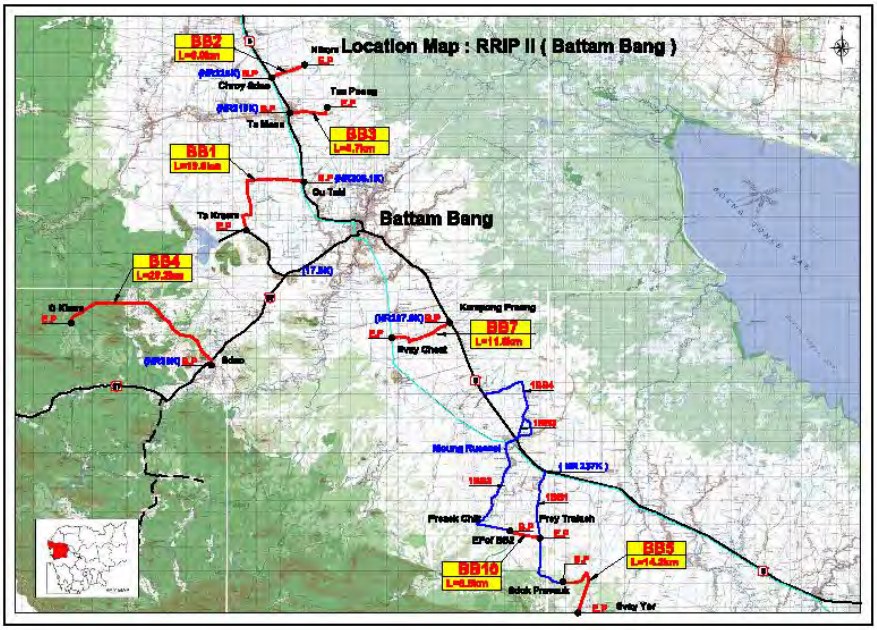
4. Kampong Chhnang Province - 3 roads



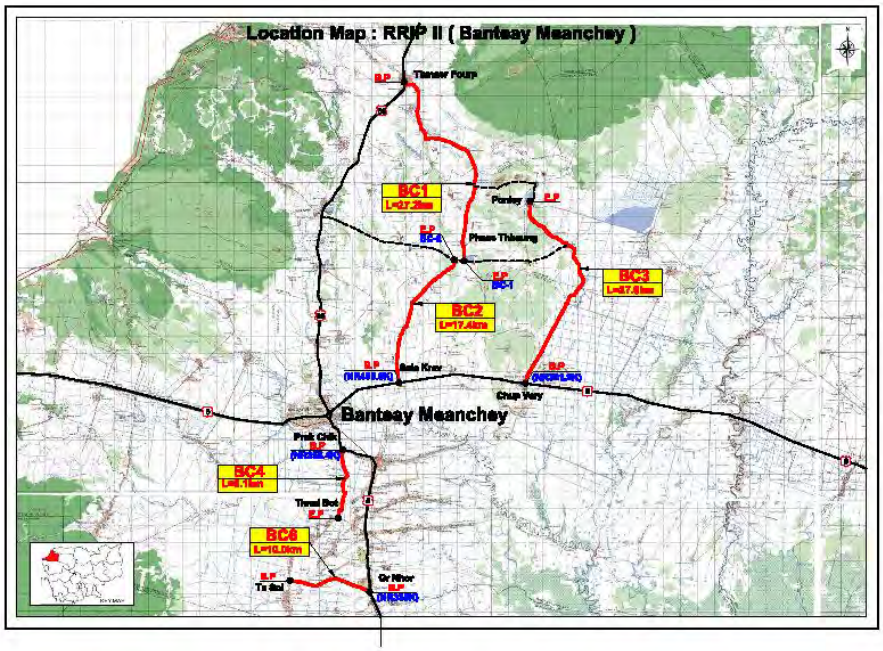
5. Pursat Province - 10 roads



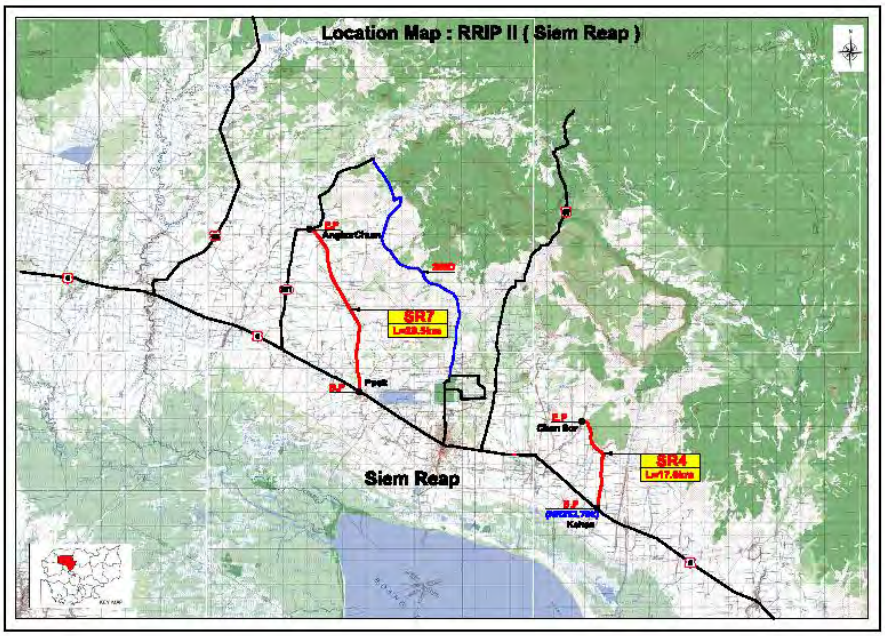
6. Battambang Province - 7 roads



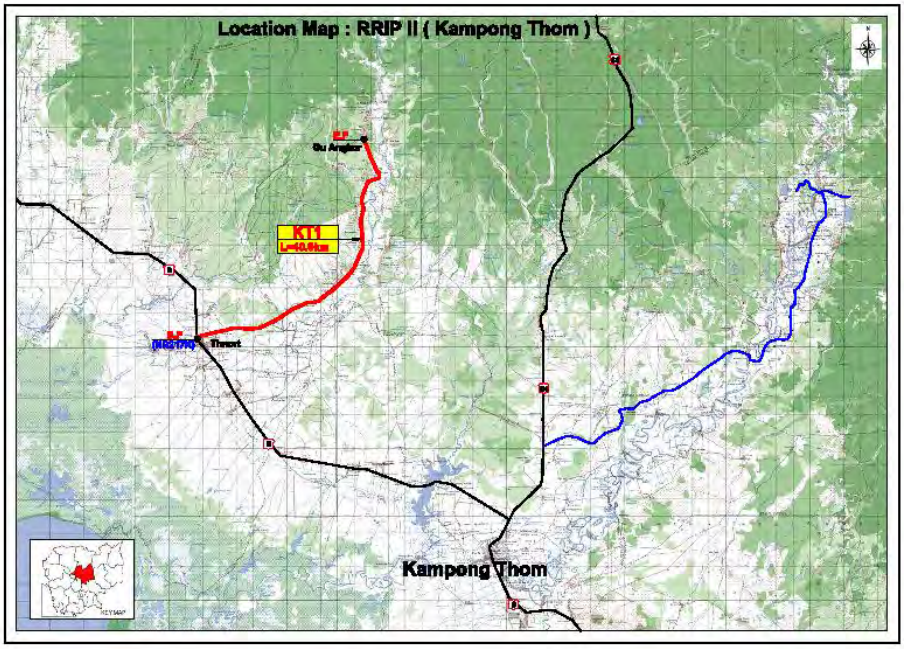
7. Banteay Meanchey Province - 5 roads



8. Siem Reap Province - 2 roads



9. Kampong Thom Province - 1 road



APPENDIX 4

Condition Survey Details

Inventory of Environment

Province	Kampong Cham	Date	17th 05, 2013
Road ID	KC1	Time	7:00 - 8:40
Length of Road	43.00 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / VC	√			
0.30	PS - SS / Village			√	
0.50	Orchard	√		√	
2.00	Pond			√	
2.50	Pagoda / PS	√			
5.00	Village / ST	√		√	
5.50	Islam Church			√	
7.50	PS			√	
8.10	Islam Church	√			
8.70	Rubber farm/ Village	√			
9.60	Islam Church	√			
10.00	Islam Church			√	
11.50	Islam Church			√	
11.80	Pagoda	√			
12.50	Islam Church			√	
12.60	VC / SS			√	
13.50	Orchard / Rubber	√		√	
14.00	Rubber Farm	√		√	
19.20	Pagoda / CC	√		√	
19.40	VC / PS			√	
19.50	Bridge				
19.50	HEC			√	
21.50	Rubber tree / Orchard	√		√	
23.40	Village	√		√	
23.70	Islam Church			√	
26.50	Pagoda	√			
26.80	VC	√		√	
27.30	Bridge				
27.40	PS			√	
30.40	Rubber Farm	√		√	
31.00	EC / VC / EC	√		√	
31.50	Rubber farm / Orchard	√		√	
35.50	PS			√	
37.00	Bridge				
40.10	Pagoda / Village	√			
41.50	EC / Village / EC	√		√	
41.90	Bridge				

Inventory of Environment

Province	Kampong Cham	**Date**	17th 05, 2013
Road ID	KC3	**Time**	9:15 - 9:50
Length of Road	13.00 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Rubber farm	√		√	
2.00	Antenna	√			
2.20	Rubber farm	√		√	
6.20	Village / PS			√	
6.30	Bridge				
6.50	Antenna / Rubber farm	√			
10.00	VC / Rubber farm				
11.80	Village	√		√	
12.30	VC / PS / Pagoda				
E.P (12.70)	Vietnam Border				

Inventory of Environment

Province	Kampong Cham	Date	17th 05, 2013
Road ID	KC4	Time	12:45 - 2:05
Length of Road	24.80 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / Market / EC	√		√	
0.20	OL				
0.60	Rubber farm	√		√	
4.00	EC / Village / OL	√		√	
4.60	SS / ST			√	
5.20	Rubber farm	√		√	
9.60	PS			√	
9.80	EC / VC / Rubber farm	√			
12.80	Bridge				
13.20	Pagoda / PS	√			
13.50	Village				
14.30	EC / VC	√			
14.60	PS	√			
15.00	Rubber farm	√		√	
17.90	PS / Village / EC	√		√	
18.20	EC / VC	√			
18.50	Rubber farm / Orchard	√		√	
21.70	Village / farm / EC			√	
24.20	Village				
24.50	PS	√			
24.60	Pagoda	√			
E.P (24.80)	VC	√		√	

Inventory of Environment

Province	Kampong Cham	**Date**	17th 05, 2013
Road ID	KC5	**Time**	10:30 - 11:00
Length of Road	9.8 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / VC / EC	√		√	
0.40	Pagoda			√	
0.50	Orchard / Rubber tree	√		√	
3.30	Village	√		√	
3.60	Antenna / OL			√	
4.00	EC	√		√	
7.30	Village				
9.30	OL				
9.60	OL				
9.70	Pagoda / PS	√			
E.P	VC / Vietnam Border				

Inventory of Environment

Province	Kampong Cham	Date	16th 05, 2013
Road ID	KC6	Time	1:20 - 2:30
Length of Road	25.20 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	VC / OL / EC / Village			√	
1.00	Orchard	√		√	
1.60	Grave	√			
1.80	Grave	√			
1.90	Village / PS			√	
2.00	Orchard (Rubber tree)	√		√	
3.20	Village / Orchard (Rubber)	√		√	
4.50	Village / Grave / Orchard			√	
5.00	Grave / Pond	√		√	
5.20	Pagoda / Grave	√		√	
5.30	PS				
5.60	Village				
6.40	Rubber / Lake	√		√	
6.60	Village				
7.00	Islam church			√	
7.20	Islam church / VC	√			
8.40	Pagoda / Grave	√		√	
8.50	Village / ST	√		√	
9.60	Grave			√	
9.90	Pagoda / VC	√			
10.20	Grave / Orchard	√		√	
10.60	Antenna / Village				
10.80	Islam church	√			
11.30	PS	√			
11.50	Rubber farm	√		√	
14.00	SS / Village				
14.20	VC / OL / EC			√	
14.60	Pagoda			√	
14.70	PS			√	
15.00	HEC / OL				

16.10	Church	√			
16.60	Pagoda gate / OL		√		
17.10	EC / PS / EC	√		√	
17.20	Pagoda			√	
17.50	Pond / Village			√	
17.80	OL / EC			√	
18.30	Grave			√	
19.00	Islam church			√	
19.10	OL / Islam church			√	
20.60	PS / Village	√			
21.20	EC / OL / Rubber farm	√			
21.90	Pagoda Gate / OL / EC		√	√	
22.00	VC				
22.30	Pagoda / PS	√		√	
22.90	Village				
23.00	EC / OL / EC	√		√	
23.50	Rubber farm				
24.00	EC / Village / EC	√		√	
E.P	VC / OL				

Inventory of Environment

Province	Kampong Cham	Date	17th 05, 2013
Road ID	KC7	Time	3:25 - 4:40
Length of Road	17.20 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / Gate / Village / EC	√	√	√	
0.30	OL				
0.80	Pagoda / VC				
0.90	OL				
1.20	SS	√			
1.40	Grave			√	
1.70	CC / HEC	√			
2.50	OL				
5.20	PS			√	
5.40	Pagoda			√	
5.60	OL				
5.80	Pagoda			√	
5.90	Bridge				
5.90	Pond	√			
6.00	VC / River			√	
6.50	PS	√			
6.80	Lake / Orchard	√		√	
7.60	SS-PS	√			
7.80	Pagoda / River	√		√	
8.00	River			√	
8.30	Bridge				
8.70	Market / OL / EC	√			
10.00	Village / PS / Orchard				
10.60	Grave	√			
11.20	Pagoda / PS	√			
13.30	Grave	√			
13.70	River		√		
14.00	Bridge				
14.40	VC				
14.70	PS				
14.80	Pagoda / River	√		√	
15.10	OL				
16.60	EC / VC	√			
E.P (16.80)	EC / Village				

Inventory of Environment

Province	Takeo	Date	3rd 05, 2013
Road ID	TK1	Time	1:37 - 2:26
Length of Road	16.5 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Market / EC / OL	√			
0.40	ST / Village				
0.90	Orchard			√	
1.00	Pond			√	
1.90	VC / ST				
2.60	Pagoda / VC	√			
3.00	Pond / ST	√			
3.80	Orchard	√		√	
4.80	Pond			√	
5.40	Antenna				
5.50	VC / Pagoda			√	
6.20	Antenna			√	
6.50	Grave			√	
7.60	Pagoda / PS	√		√	
8.70	Pond / Village	√			
9.10	Antenna	√			
10.40	Pond				
10.70	CC			√	
11.80	ST	√		√	
12.20	Pond	√			
12.50	VC	√		√	
12.70	PS			√	
13.40	VC / EC			√	
14.00	VC / Pagoda			√	
14.40	Grave	√			
14.45	PS / Pond	√			
15.20	ST	√		√	
E.P	VC / OL				

Inventory of Environment

Province	Takeo	**Date**	3rd 05, 2013
Road ID	TK2	**Time**	11:20 - 12:25
Length of Road	18.30 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / Gate pagoda / Village	√	√		
0.20	Antenna / ST			√	
0.60	ST	√		√	
2.80	Village	√		√	
2.90	Pagoda / ST	√			
4.10	Village				
4.85	OL / Pagoda / PS / Grave			√	
5.70	VC	√		√	
6.10	Bridge				
6.50	ST	√		√	
8.40	PS / Pagoda / Village			√	
9.00	VC / HS	√			
9.30	Grave			√	
9.60	Antenna / EC			√	
9.90	Antenna	√			
10.40	Grave / Pagoda	√		√	
11.50	VC	√		√	
12.20	VC / Pagoda / Antenna			√	
12.90	HEC	√			
14.80	CC				
15.80	PS / Pagoda	√			
16.70	Antenna / VC	√			
18.00	ST	√		√	
19.00	Lake	√		√	
19.80	Pagoda / Village	√			
20.10	ST				
22.10	Pagoda / PS / VC				
E.P (22.50)					

Inventory of Environment

Province	Kampong Speu	Date	29th 04, 2013
Road ID	KPS1	Time	10:37 - 11:30
Length of Road	18.6 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Village / Pagoda	√ (EC / OL)		OL	
0.35	Pagoda / PS	√			
3.60	Village				
5.00	Pagoda / Village	√			
	MT			√	
6.40	Pagoda			√	
6.60	Market	√		√	
7.50	Lake / Village			√	
8.50	Bridge				
9.90	Pagoda			√	
10.10	Bridge				
10.50	Lake			√	
12.10	Village	√		√	
16.30	Village	√		√	
EP	Village				

Inventory of Environment

Province	Kampong Speu	Date	29th 04, 2013
Road ID	KPS2	Time	12:35 - 1:15
Length of Road	23.1Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Market	OL		EC / OL	
0.30	EC	√			
0.60	HEC				
1.00	OL	√		√	
1.60	OL	√		√	
4.20	ST	√		√	
4.70	Orchard	√			
6.40	Pond	√			
6.40	Bridge				
8.00	Orchard			√	
11.00	Village	√		√	
12.10	SS / PS / CC	√		CC	
12.60	Market				
13.10	Tree			√	
13.50	Grave			√	
14.60	OL				
15.50	Village				
16.40	Orchard				
17.20	Bridge				
17.80	Forest	√		√	
18.00	Orchard	√			
20.00	Village	√		√	
20.40	Bridge				
21.00	ST / Orchard	√		√ (Orchard)	
21.80	Bridge				
21.70	Village	√		√	
EP	Village				

Inventory of Environment

Province	Kampong Speu	Date	29th 04, 2013
Road ID	KPS5	Time	1:45
Length of Road	33.5 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / Market	√		√	
0.1-0.8	Market				
0.30	OL				
1.60	OL / MT			√	
1.80	HS / CC			√	
2.30	Bridge				
2.40	Lake			√	
3.20	Village				
4.20	MT	√			
4.80	Lake / Village	√		√ (Lake)	
5.50	Pond	√			
6.10	PS / HEC	√ HEC		√ PS	
6.40	CC			√	
7.90	Village				
10.3-10.5	Market				
11.00	Bridge				
11.30	CC			√	
12.60	Village				
14.30	MT / Pagoda	√			
15.80	CC			√	
20.00	Village / Lake			√	
20.60	Pagoda	√			
21.40	VC				
22.40	Lake			√	
23.20	Village	√		√	
26.80	Village	√		√	
27.20	PS			√	
29.70	Bridge				
29.90	Orchard			√	
31.00	Orchard / Village	√			
EP	Village				

Inventory of Environment

Province	Kampong Chhnang	**Date**	7th 05, 2013
Road ID	KCH1	**Time**	3:05 - 3:20
Length of Road	4.1 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	VC / OL / EC			√	
0.01	Bridge				
2.55	VC / OL				
2.95	PS / Pagoda	√		√	
4.10	Bridge				
E.P	Village / EC			√	

Inventory of Environment

Province	Kampong Chhnang	Date	7th 05, 2013
Road ID	KCH2	Time	2:10 - 3:00
Length of Road	22.9 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	ST / Village				
0.50	ST	√		√	
1.20	Orchard	√		√	
1.60	Forest	√		√	
2.00	Bridge				
2.50	Orchard	√			
3.50	ST / Village	√		√	
4.00	ST	√		√	
4.30	OL				
6.40	PS			√	
7.00	ST	√		√	
9.50	Pagoda / Grave	√			
9.70	PS			√	
12.80	Village	√		√	
13.00	PS			√	
13.20	Pagoda / VC	√			
14.25	Church			√	
15.10	Village				
17.00	EC			√	
17.90	VC				
18.00	SS			√	
18.60	Antenna			√	
19.00	PS			√	
19.50	CC			√	
19.80	VC				
20.10	Bridge				
20.40	Bridge				
23.00	Bridge				
E.P (24.00)	VC	√		√	

Inventory of Environment

Province	Kampong Chhnang	Date	7th 05, 2013
Road ID	KCH12	Time	12:25 - 12:40
Length of Road	11.5 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Village	√		√	
0.40	Cross Railway		√		
3.50	Pagoda			√	
4.00	Village	√		√	
6.00	Village	√		√	
6.90	School	√			
7.10	Pagoda	√		√	
8.10	Lake				
9.00	Village	√			
11.00	Village	√		√	
11.30	School			√	
E.P	Pagoda		√		

Inventory of Environment

Province	Pursat	**Date**	9th May 2013
Road ID	PS2	**Time**	2:17 - 2:47
Length of Road	8.60 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / Market			√	
	Pond / OL / Grave	√			
	Grave			√	
	OL / Village				
	Village / ST				
	PS / ST			√	
	Pond			√	
	Pagoda / Pond	√		√	
	Grave	√		√	
	River		√		
	OL / VC				
	OL				
	OL				
	Lake	√		√	
	HEC / CC / PS	√		√	
	VC / OL / EC	√			
6.50	Bridge				

Inventory of Environment

Province	Pursat	**Date**	8th May 2013
Road ID	PS3	**Time**	9:40 - 10:40
Length of Road	16.10 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / Gate / VC	√	√		
0.70	Pond / Grave	√		√	
1.20	Grave	√			
1.70	Bridge				
1.80	ST	√		√	
2.70	Village / ST				
4.30	Pond	√			
5.00	Antenna				
5.40	VC				
5.70	PS / CC	√			
6.00	Antenna	√			
8.10	Pond / Village	√			
8.90	Pond	√			
10.40	VC / Antenna / Pogoda	√		√	
10.60	Bridge				
10.80	Grave	√			
11.80	Pond	√			
12.20	Grave / Village	√			
12.80	Bridge				
12.90	Pond / Antenna	√		√	
13.00	PS	√			
13.70	Antenna				
E.P (16.60)	Antenna				

Inventory of Environment

Province	Pursat	**Date**	8th May 2013
Road ID	PS4	**Time**	11:00-12:00
Length of Road	5.1 Km	**Width of Road**	5.5

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	B.P.		√		
0.70	Pond /ST			√	
1.80	ST		√		
3.20	Wooden bridge		√		
4.80	ST	√			
5.10	E.P.				

Inventory of Environment

Province	Pursat	**Date**	9th May 2013
Road ID	PS5	**Time**	1:08 - 1:36
Length of Road	13.13 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Market / EC / OL			√	
0.40	Bridge				
0.45	Pond			√	
0.80	Bridge				
1.50	Bridge				
2.40	Pond			√	
3.10	Grave / Pond	√		√	
4.70	Village	√		√	
6.00	Pagoda / Orchard			√	
6.50	Village / VC				
7.90	Orchard	√			
9.00	Village	√		√	
9.50	Bridge				
11.10	Village	√		√	
11.50	VC				
12.00	PS / Pagoda	√		√	
E.P (13.25)	Village / Orchard				

Inventory of Environment

Province	Pursat	Date	8th 05, 2013
Road ID	PS7	Time	11:13 - 12:50
Length of Road	21.90 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / VC	√			
0.20	Pagoda / PS / EC	√		√	
0.90	OL				
1.60	Village				
2.40	Pond			√	
3.30	Grave / Village	√			
4.00	PS / Grave	√		√	
4.20	VC / Pagoda			√	
4.40	CC			√	
4.60	HEC			√	
4.75	Pond / Grave	√		√	
5.60	VC / Antenna				
6.90	Village				
7.70	VC				
8.30	VC / ST				
8.90	PS / Pagoda / VC	√			
9.00	Pond			√	
9.70	Orchard			√	
10.10	Pond / Village			√	
10.40	Pond	√			
10.90	Grave	√			
11.30	Village / Pond			√	
12.70	Channel		√		
14.60	VC / PS			√	
14.70	Grave	√			
15.10	Pond			√	
15.70	Grave			√	
15.80	Grave / Village			√	
16.40	ST	√		√	
17.30	ST	√		√	

17.50	PS			√	
17.60	Pagoda	√			
17.70	VC / ST				
18.80	ST / Grave			√	
20.70	PS	√			
22.60	Pagoda / VC	√			

Inventory of Environment

Province	Pursat	Date	8th 05, 2013
Road ID	PS9	Time	1:28 - 2:15
Length of Road	18.00 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	OL / EC / Village			√	
0.10	Pond			√	
0.40	Antenna / OL / Orchard	√			
0.60	HEC	√			
0.70	PS	√			
0.80	Pond			√	
1.50	Village	√		√	
1.70	Bridge				
1.90	Bridge				
1.90	Lake / VC / PS / Pagoda			√	
3.10	Village / ST	√		√	
4.25	Grave			√	
4.60	Bridge				
4.60	Pond	√			
4.90	Pond / Pagoda / PS	√		√	
5.10	Bridge				
5.30	VC				
6.00	Grave			√	
9.70	Pond			√	
9.80	Village / ST	√		√	
10.30	Antenna / PS / VC			√	
10.90	Pagoda			√	
11.30	Antenna	√		√	
11.50	Bridge				
11.60	Bridge				
12.60	EC	√			
12.70	OL				
12.90	Village				
13.60	Bridge				
13.60	PS	√			

15.70	Bridge				
16.40	Village				
16.55	Pond			√	
16.70	VC				
16.90	Bridge				
17.00	Pagoda	√			
17.30	PS / VC	√			
17.40	Bridge				
17.70	Bridge				
18.00	Grave			√	
E.P (18.80)	VC / Pond	√			

Inventory of Environment

Province	Pursat	Date	9th 05, 2013
Road ID	PS10	Time	2:25
Length of Road	12.00 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Market / OL / EC / Village			√	
0.20	HS / ST			√	
1.40	OL / Pagoda / PS			√	
1.60	ST				
1.80	VC / OL				
2.90	OL				
3.30	OL				
3.50	Orchard			√	
3.80	VC / OL				
3.80	Bridge				
4.30	Bridge				
4.60	Bridge				
4.70	Bridge				
4.90	Grave			√	
5.90	Village				
6.60	Bridge				
6.60	Village / Pagoda			√	
6.90	Grave	√			
7.40	Bridge				
7.60	Bridge				
7.90	VC / PS			√	
8.50	Village / Pagoda			√	
9.90	Antenna / Village / ST	√			
10.40	OL / Antenna	√			
10.70	Market / PS			√	
10.80	Antenna / SS	√		√	
11.10	Bridge				
11.20	VC / Channel				
11.30	Pagoda			√	
E.P (12.90)	Pagoda				

Inventory of Environment

Province	Pursat	**Date**	9th 05, 2013
Road ID	PS11	**Time**	8:58
Length of Road	8.20 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	VC				
1.70	Village	√		√	
2.00	ST	√		√	
2.50	Pond	√			
3.00	VC	√		√	
3.40	Bridge				
3.80	Pond / HEC / PS / VC	√			
4.10	Pagoda	√			
6.20	SS			√	
6.30	Grave			√	
7.10	Grave			√	
7.70	Pond			√	
E.P (8.60)	OL / Market / Pagoda		√		

Inventory of Environment

Province	Pursat	Date	8th 05, 2013
Road ID	PS13	Time	11:50 - 12:10
Length of Road	8.20 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	VC / Gate / EC	√	√	√	
0.20	Bridge				
0.25	OL / ST / Village	√		√	
2.50	Village / ST	√		√	
3.00	Pagoda / OL / Pond	√		√	
3.20	PS	√			
3.40	Antenna			√	
5.20	EC / Village	√			
5.80	Islam church	√			
5.90	Pond			√	
6.25	PS	√			
7.00	Channel				
7.60	Village / ST				
E.P	Village / ST	√		√	

Inventory of Environment

Province	Battambang	Date	10th 05, 2013
Road ID	BB1	Time	9:38 - 10:13
Length of Road	19.61 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / Market / Channel	√		√	
0.30	Pond	√		√	
0.80	OL				
1.00	Orchard	√		√	
3.70	Village	√		√	
6.00	Village / ST	√		√	
7.00	ST	√		√	
7.90	Orchard			√	
8.70	CC / VC / HEC	√		√	
9.30	Church			√	
9.90	VC				
10.10	Pond			√	
10.25	Grave	√			
13.80	Village				
14.30	VC				
14.60	Bridge				
14.80	Orchard / River			√	
15.10	Pagoda	√			
16.30	Orchard / Village / ST	√		√	
16.80	PS	√			
19.00	Orchard / Village / ST	√		√	
19.42	Bridge				
E.P (20.20)	VC / OL / EC			√	

Inventory of Environment

Province	Battambang	Date	10th 05, 2013
Road ID	BB2	Time	8:13 - 8:29
Length of Road	6.00 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	OL / Gate / VC / EC			√	
0.20	Pond	√		√	
1.20	OL				
1.50	VC				
1.60	OL				
1.90	OL				
2.10	Grave	√			
2.50	Pagoda	√		√	
2.60	SS / PS	√			
3.30	OL				
3.70	ST	√			
5.20	Pagoda / PS	√		√	
E.P (6.10)	Village / Grave			√	

Inventory of Environment

Province	Battambang	Date	10th 05, 2013
Road ID	BB3	Time	8:45 - 9:10
Length of Road	8.70 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / VC				
0.10	ST / Pond			√	
0.90	Pagoda			√	
1.10	PS			√	
2.00	VC				
2.50	Grave	√			
3.00	HEC	√			
3.10	PS	√			
6.40	Pagoda			√	
7.10	Grave			√	
7.60	VC / PS			√	
7.80	ST	√		√	
8.35	Church	√			
8.60	Orchard / Village			√	
E.P	Grave			√	

Inventory of Environment

Province	Battambang	Date	10th 05, 2013
Road ID	BB4	Time	10:38 - 12:00
Length of Road	29.20 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	VC / EC				
0.70	Pond / ST	√		√	
1.80	Orchard	√		√	
5.80	Village	√		√	
6.00	PS				
7.60	Antenna			√	
9.30	PS / Pagoda / VC	√			
11.00	Pond			√	
11.80	SS / PS	√		√	
12.30	Orchard	√		√	
14.40	Village				
14.70	PS			√	
17.00	EC / VC	√			
17.20-17.40	Market				
17.70	EC / VC	√			
17.90	CC	√			
18.40	Pagoda / HEC / PS	√		√	
20.40	VC	√		√	
24.50	Village				
24.60	Church			√	
29.00	Pagoda	√			
E.P (30.40)	Orchard / River	√		√	

Inventory of Environment

Province	Battambang	Date	10th 05, 2013
Road ID	BB6	Time	3:00 - 3:54
Length of Road	25.40 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / Market	√			
0.40	Orchard / Village	√		√	
1.60	EC / VC / Pagoda	√			
1.70	CC / PS	√		√	
1.80	SS			√	
2.00	Orchard	√		√	
3.00	Village	√		√	
3.70	Church			√	
6.80	PS / Antenna / Village	√			
7.10	Bridge				
8.80	PS			√	
8.90	HEC			√	
11.70	Bridge				
12.40	Village	√		√	
13.00	Pond / Village	√			
14.00	Bridge				
15.00	Bridge				
17.60	Bridge				
18.20	ST / Forest	√		√	
18.70	Bridge				
18.90	OL / EC			√	
19.20	EC / OL / Village	√			
19.50	VC / Orchard / ST				
23.50	EC / VC / OL	√			
24.10	Bridge				
24.20	Pagoda	√			
24.50	EC	√		√	
25.30	HEC / SS				
E.P (25.50)	VC / OL / CC				

Inventory of Environment

Province	Battambang	**Date**	10th 05, 2013
Road ID	BB7	**Time**	4:55 - 5:31
Length of Road	11.60 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / Market / Village	√			
0.30	Pond	√			
0.40	Pond	√		√	
0.50	ST	√		√	
1.80	Orchard	√		√	
2.70	Pond / OL			√	
2.90	PS			√	
3.20	Grave			√	
4.00	OL				
5.10	Grave	√			
5.20	Pond / ST	√			
5.30	Grave			√	
5.60	Grave	√			
6.60	PS			√	
6.70	Antenna / OL	√			
7.20	Pagoda	√			
7.90	OL				
8.20	ST	√		√	
8.30	Bridge				
9.10	Pond / Village			√	
10.00	Pagoda	√			
10.40	VC				
10.70	Grave	√			
E.P (11.90)	PS / VC				

Inventory of Environment

Province	Battambang	Date	10th 05, 2013
Road ID	BB10	Time	3:30 - 4:00
Length of Road	5.50 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Channel			√	
1.25	Box Culvert		√		
1.90	Pipe Culvert		√		
3.50	Box Culvert		√		
4.50	Box Culvert		√		
5.30	Box Culvert				
E.P	Pond / Channel	√		√	

Inventory of Environment

Province	BTMC	**Date**	14th 05, 2013
Road ID	BC1	**Time**	7:30 - 8:20
Length of Road	27.20 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	VC / OL / EC			√	
0.10	EC / OL	√			
0.40	OL				
0.80	OL / Village				
1.30	Grave			√	
2.00	OL				
4.60	Pond / Village	√			
5.40	Pagoda			√	
5.50	PS			√	
5.80	EC			√	
6.50	SS			√	
6.70	PS	√			
6.80	OL / VC / EC			√	
7.50	Pagoda	√			
7.60	CC / HEC	√		√	
7.75	VC				
9.70	Pond			√	
11.90	HEC / CC	√			
12.00	SS	√			
12.40	Village / EC			√	
13.10	OL / VC				
13.50	Pagoda / Antenna / PS	√		√	
15.60	Antenna	√			
16.60	Bridge				
16.70	Village / Antenna			√	
17.00	HS				
17.40	PS / VC	√			
18.00	HEC / CC	√		√	
19.40	Bridge				
20.00	Village				

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
21.00	PS			√	
21.20	ST	√		√	
24.30	PS / Lake			√	
24.40	Pagoda / Village	√			
25.60	Antenna			√	
25.90	PS			√	
26.00	CC / HEC			√	
26.10	Antenna			√	
E.P (26.40)	VC / OL				

Inventory of Environment

Province	BTMC	**Date**	13th 05, 2013
Road ID	BC2	**Time**	3:30 - 4:15
Length of Road	17.40 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	VC / OL / ST				
1.40	Village / ST	√		√	
3.10	PS	√			
3.30	Pagoda	√			
4.00	Village / ST	√		√	
5.10	Pagoda			√	
5.20	PS			√	
5.30	Pond			√	
5.60	Pond / PS	√			
6.60	ST	√		√	
9.60	PS / ST / Village			√	
12.60	VC / PS / Pagoda			√	
13.00	Orchard / ST	√			
E.P (17.00)	EC / Village	√			

Inventory of Environment

Province	BTMC	Date	14th 05, 2013
Road ID	BC3	Time	9:15 - 10:10
Length of Road	27.00 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Market / OL / EC			√	
0.10	Pagoda			√	
1.00	HEC / CC	√			
1.20	ST	√		√	
3.10	Orchard	√		√	
4.10	PS / Pagoda	√		√	
9.90	Village				
10.10	PS	√			
11.00	Village				
11.10	Antenna			√	
11.80	Pond			√	
14.00	Village	√		√	
14.50	PS	√			
16.50	Village	√		√	
17.80	PS			√	
18.20	HEC	√			
18.70	VC / OL / EC			√	
19.00	PS	√			
19.10	OL / VC / EC	√			
23.00	Village	√		√	
24.70	Orchard			√	
25.00	Village / VC	√		√	
25.70	PS	√			
26.00	Antenna			√	
E.P	Village / Lake		√		

Inventory of Environment

Province	BTMC	Date	13th 05, 2013
Road ID	BC4	Time	1:58 - 2:21
Length of Road	9.10 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	EC / OL / VC	√			
0.10	Bridge				
0.10	Village / ST				
2.30	Pagoda / PS	√			
2.40	Bridge				
2.60	Grave	√			
2.90	SS				
3.30	Bridge				
3.30	OL				
3.40	CC				
3.60	HEC				
4.30	VC / OL / Pagoda			√	
4.90	Grave	√			
6.60	Pond / Pagoda			√	
6.70	OL				
7.10	ST				
7.20	Bridge				
7.20	VC	√		√	
7.60	OL				
7.70	Bridge				
7.80	Grave			√	
7.90	Pagoda				
E.P (8.70)	EC / OL / Market / River	√		River	

Inventory of Environment

Province	BTMC	Date	13th 05, 2013
Road ID	BC6	Time	1:25 - 1:45
Length of Road	10.00 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond
◦ Schools : Primary, Secondary, High (PS, SS, HS)
◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)
◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)
◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)
◦ Forest / Orchard / Street trees (ST)
◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	OL / Village / EC			√	
0.05	ST	√		√	
0.35	ST	√		√	
0.55	Village / Pagoda			√	
0.85	OL				
1.45	OL				
2.35	Orchard	√			
3.55	Village				
3.65	OL				
4.15	PS			√	
4.55	OL / Pagoda				
4.75	OL				
6.45	Pond			√	
6.85	PS			√	
E.P	OL / Village / Pagoda			√	

Inventory of Environment

Province	Siem Reap	**Date**	15th 05, 2013
Road ID	SR4	**Time**	9:00 - 9:45
Length of Road	17.00 Km	**Width of Road**	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	VC / ST / Village				
5.30	Pagoda	√			
6.70	PS	√			
8.20	Village	√		√	
11.10	HEC				
11.20	SS / Pagoda / CC / PS / VC	√		√	
12.40	Orchard / ST / Village	√		√	
14.70	PS / ST / Village	√			
16.00	Pond			√	
16.40	Pond			√	
E.P (16.80)	VC / Village	√		√	

Inventory of Environment

Province	Siem Reap	Date	15th 05, 2013
Road ID	SR7	Time	8:10 - 8:40
Length of Road	29.5	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	OL / EC / Village	√		√	
3.00	Pagoda	√			
5.00	River	√			
6.00	River	√			
7.30	Village	√		√	
10.00	Village	√		√	
11.30	School / Pagoda	√		√	
14.70	Pond	√			
14.80	School	√			
20.00	Village	√		√	
25.00	Pagoda	√			
25.10	Pond			√	
26.80	River	√	Bridge	√	
E.P	Village	√		√	

Inventory of Environment

Province	Kampong Thom	Date	15th 05, 2013
Road ID	KT1	Time	2:00 - 3:45
Length of Road	40.0 Km	Width of Road	

◦ Pagoda / Temple / Graves / River / Lake / Pond

◦ Schools : Primary, Secondary, High (PS, SS, HS)

◦ Village / Town / Market / Commune Center(CC) / Village Center(VC)

◦ Clinic Centers(CLC) / Health Centers(HEC) / Hospitals(H)

◦ Electricity Cables (EC) / Over Lines (OL) / Mobile Tower (MT) / Telephone Cable (TC)

◦ Forest / Orchard / Street trees (ST)

◦ Road Inventory : Bridges / Market

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
B.P (0.0)	Market / OL / EC			√	
0.50	Bridge				
1.30	Grave	√			
2.80	Grave	√			
3.30	PS / Village	√			
3.60	Pagoda	√			
5.00	Village				
5.70	PS / ST	√			
8.10	Village	√		√	
8.70	Antenna / OL / Pagoda			√	
8.80	Pond / PS / EC			√	
9.50	ST	√		√	
10.50	Pagoda			√	
11.30	Village	√		√	
11.40	PS	√			
14.00	Village / ST	√		√	
15.00	Antenna / PS /Pagoda				
16.20	Grave	√			
16.50	Village	√		√	
17.00	CC			√	
17.20	VC				
17.50	Grave / Village	√			
17.80	Bridge				
19.70	Village	√		√	
20.30	VC / Pagoda				
20.60	HEC	√			
20.70	Grave	√			
21.00	Village	√		√	
23.00	PS			√	
23.80	Pagoda	√			

PK	Inventory	Direction			Remarks
		LHS	Center	RHS	
25.50	Village				
26.40	PS			√	
26.70	village				
28.60	PS	√			
29.70	VC / Pagoda			√	
31.00	EC / OL / Lake	√			
31.30	Village				
32.00	OL				
33.10	Grave / EC			√	
33.20	Antenna	√		√	
33.50	PS			√	
33.60	CC / Antenna			√	
37.50	Village / ST				
38.40	Pagoda / PS	√		√	
38.50	Lake	√			
38.90	Antenna			√	
40.00	SS - PS	√			
E.P (40.00)					

APPENDIX 5

Condition Survey Photos

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Kampong Cham Province

	
KC1 : PK 0.0 (Electric cable)	KC1: PK 2.0 (Pond)
	
KC1: PK 2.5 (Pagoda)	KC1: PK 5.5 (Islam Church)
	
KC1: PK 10.0 (Islam Church)	KC1: PK 11.8 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Kampong Cham Province

	
KC3: PK 12.3 (Pagoda)	KC3: End Point (Vietnam Border)
	
KC4: PK 13.2 (Pagoda)	KC4: PK 24.6 (Pagoda)
	
KC5: PK 0.4 (Pagoda)	KC5: PK 9.7 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Road Inventory (Photograph)

Kampong Cham Province

	
KC6: PK 5.0 (Pond)	KC6: PK 16.6 (Pagoda)
	
KC6: PK 17.2 (Pagoda)	KC6: PK 17.5 (Pond)
	
KC6: PK 19.0 (Islam church)	KC6: PK 22.3 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Kampong Cham Province

	
KC7: PK 0.8 (Pagoda)	KC7: PK 5.4 (Pagoda)
	
KC7: PK 5.8 (Pagoda)	KC7: PK 5.9 (Pond)
	
KC7: PK 11.2 (Pagoda)	KC7: PK 14.8 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Takeo Province

	
TK1: PK 2.6 (Pagoda, Village Center)	TK1: PK 5.5 (Village center, Pagoda)
	
TK1: PK 7.6 (Primary school)	TK1: PK 12.2 (Pond)
	
TK1: PK 12.7 (Primary school)	TK2: PK 2.9 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Takeo Province

	
TK2: PK 4.85 (Pagoda)	TK2: PK 8.4 (Pagoda)
	
TK2: PK 10.4 (Pagoda)	TK2: PK 12.2 (Pagoda)
	
TK2: PK 19.0 (Lake)	

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Kampong Speu Province

	
KSP1: PK 0.35 (Pagoda)	KSP1: PK 5.0 (Pagoda)
	
KSP1: PK 7.5 (Lake)	KSP1: PK 9.9 (Pagoda)
	
KSP2: PK 6.4 (Pond)	KSP2: PK 13.1 (Street Tree)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Kampong Speu Province

	
KSP5: PK 2.4 (Lake)	KSP5: PK 4.8 (Lake)
	
KSP5: PK 14.3 (Pagoda)	KSP5: PK 20.0 (Lake)
	
KSP5: PK 20.6 (Pagoda)	KSP5: PK 22.4 (Lake)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Kampong Chhnang Province

	
KCH1: PK 2.95 (Pagoda)	KCH2: PK 13.2 (Pagoda)
	
KCH3: PK 9.1 (Pagoda)	KCH3: PK 16.7 (Pagoda)
	
KCH9: PK 3.82 (Pagoda)	KCH10: PK 7.1 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Kampong Chhnang Province

	
KCH10: PK 11.5 (Pagoda)	

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Pursat Province

	
PS3: PK 0.7 (Pond)	PS3: PK 4.3 (Pond)
	
PS3: PK 10.4 (Pagoda)	PS3: End Point (Tonle Sap)
	
PS5: PK 3.1 (Pond)	PS5: PK 6.0 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Pursat Province

	
PS5: PK 12.0 (Pagoda)	PS7: PK 0.2 (Pagoda)
	
PS7: PK 2.4 (Pond)	PS7: PK 10.4 (Pond)
	
PS7: PK 11.3 (Pond)	PS7: PK 17.6 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Pursat Province

	
PS9: PK 1.9 (Lake)	PS9: PK 4.9 (Pond)
	
PS9: PK 4.9 (Pagoda)	PS9: PK 16.55 (Pond)
	
PS10: PK 1.4 (Pagoda)	PS10: PK 6.6 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Pursat Province

	
PS10: PK 11.2 (Channel)	PS11: PK 2.5 (Pond)
	
PS11: PK 4.1 (Pagoda)	PS13: PK 3.0 (Pagoda)
	
PS13: PK 5.9 (Pond)	PS13: PK 7.0 (Channel)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Battambang Province

	
BB1: PK 14.8 (Orchard, River)	BB1: PK 15.1 (Pagoda)
	
BB2: PK 2.5 (Pagoda)	BB2: PK 5.2 (Pagoda)
	
BB3: PK 0.1 (Pond)	BB3: PK 0.9 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Battambang Province

	
BB3: PK 6.4 (Pagoda)	BB3: End Point (Orchard)
	
BB4: PK 0.7 (Pond)	BB4: PK 9.3 (Pagoda)
	
BB4: PK 18.4 (Pagoda)	BB7: PK 2.7 (Pond)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Battambang Province

	
BB7: PK 7.2 (Pagoda)	BB7: PK 10.0 (Pagoda)
	
BB10: PK 5.5 (Pond)	

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Banteay Mean Chey Province

	
BC1: PK 5.4 (Pagoda)	BC1: PK 7.5 (Pagoda)
	
BC1: PK 9.7 (Pond)	BC1: PK 13.5 (Pagoda)
	
BC1: PK 24.3 (Lake)	BC1: PK 24.4 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Banteay Mean Chey Province

	
BC2: PK 5.1 (Pagoda)	BC3: PK 0.1 (Pagoda)
	
BC3: PK 4.1 (Pagoda)	BC3: PK 11.8 (Pond)
	
BC3: End Point (Lake)	BC4: PK 4.3 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Banteay Mean Chey Province

	
BC4: PK 6.6 (Pond)	BC4: PK 7.9 (Pagoda)
	
BC4: End Point (Market)	BC6: PK 4.55 (Pagoda)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Siem Reap Province

	
SR4: PK 5.3 (Pagoda)	SR4: PK 11.2 (Pagoda)
	
SR4: PK 16.4 (Pond)	SR7 : PK 7.2 (Floodway)

Rural Roads Improvement Project (RRIP II)

Environment Inventory (Photograph)

Kampong Thom Province

	
KT1: PK 8.8 (Pond)	KT1: PK 15.0 (Pagoda)
	
KT1: PK 23.8 (Pagoda)	KT1: PK 31.0 (Lake)
	
KT1: PK 38.4 (Pagoda)	

APPENDIX 6

Socio-Economic Data from Public Consultations

APPENDIX 6

Socio-Economic Data from Public Consultations

1. The RRIP II has a total length of about 729 km with 39 road sections in 93 communes in 33 districts, and has the potential to benefit about 617,586 beneficiaries (154,000 households) in nine (9) provinces of Cambodia, namely: (i) Kampong Cham; (ii) Takeo, (iii) Kampong Speu, (iv) Kampong Chhnang, (v) Pursat, (vi) Battambang, (vii) Banteay Meanchey, (viii) Siem Reap, and (ix) Kampong Thom. The project will be funded by a loan from the Asian Development Bank (ADB) and Korea Eximbank (KEXIM), and will be implemented by the Ministry of Rural Development (MRD) as the Executing Agency (EA).

2. The road will provide an all-year road access from provincial towns and agricultural areas, and will provide greater accessibility to basic facilities and services. It will also strengthen the capacity of the MRD to plan, manage and monitor road maintenance operations and implementing the loan covenants and other conditions through the MRD's Project Management Unit/Social and Environmental Office (SEO) and the Provincial Department of Rural Roads (PDRD).

3. The RRIP II has five (5) key project outputs, namely: (i) rural road improvements; (ii) rural road asset management; (iii) rural road safety and community awareness program; (iv) project management support; and (v) connectivity improvements for Mekong River Islands. The Mekong Islands under the 5th output are located in Kampong Cham province, consisting 4 communes and 35 villages in the island-cluster located in the Mekong River.

4. Poverty is considered as a major problem in Cambodia, particularly in the rural areas where majority of the population lack access to basic facilities due to bad road condition, absence of electricity, inadequate irrigation structures, and limited access to safe drinking water and sanitary toilets in the rural areas. Based on ADB Cambodia Country Poverty Analysis report in December 2011, Cambodia's growth performance for 1998-2007 ranks sixth highest among the countries in the world, and it is one of the 46 countries that achieved 7% average annual growth for 14 years in a row (Guimbert 2010).

5. Rural poverty remains a challenge, with 90% of the poor residing in the countryside (in 2009) and about 80% in 2013. ADB stated that Cambodia's population living on less than $1.25 (PPP) a day was 18.6% in 2009, compared to 28.3% in 2008. In 2007, the population living below the national poverty line was 30.1%. The under – 5 mortality rate per 1,000 live births was 43 in 2011 and the population with access to improved drinking water sources was 64% in 2010 (ADB. 2013. Basic Statistics 2013. Manila; ADB & Cambodia Fact Sheet, 2012).

6. The CSES 2010 stated that there are many different factors that could prevent women from accessing health care for themselves such as not having money for treatment (65%); one-third of women reported problems in getting permission to go to a health center for treatment (33%); two in five (40%) did not want to go to the facility alone; *and 36% of women cited far distance to the health facility as a problem.* This is a problem experienced by most rural women due to far distance of health facilities; lack money especially by women in the lowest quintile; and added to these factors is unimproved road conditions in the rural areas especially during rainy season. Transportation is also a major problem as there are no regular public vehicles hat ply the routes in remote communes/districts.

7. Baseline socio-economic survey was conducted in the RRIP II areas in 9 provinces, utilizing a total of 1,230 respondents randomly selected from various communes/districts. The baseline survey was conducted in April to 1st week of May 2013. Data entry and processing started middle of May 2013, and data processing was completed in August 2013. Stakeholder consultations were also conducted in selected project areas.

8. Based on the baseline survey, the following are the positive impacts of the proposed project once completed: (i) easy to transport agricultural products to the markets; (ii) convenient for the children and/or easy to go to school; will motivate children to go to school thus, cases of school drop-outs will decline; (iii) faster travel in going to another place/district or province; (iv) greater access to health center and hospitals; (v) will provide jobs during the road construction for the local population, including the women; business investors will establish commercial establishments that could provide jobs to the local communities, and could prevent migration if there are jobs available in the project areas (vi) will increase the economic condition of the households as they could open shops along the road once completed; they plan to sell vegetables, fruits and other products.

9. The negative impacts of the project identified by the survey respondents include the following: (i) possible increase of road accidents as drivers will drive too fast; (ii) increase in drugs, and human trafficking cases (although this is not yet a problem as of now but could be a problem in the future); (iii) potential risks of HIV/AIDS and STIs especially in areas which are frequently visited by tourists, and in areas where truck drivers/road users stay overnight (in hotels/lodging houses, entertainment establishments, etc.); this is not yet considered as a major problem as of now but the respondents believed that this could be a major problem that the local communities may experience in the future; (iv) some trees will be affected during the road construction; and shops located along the road might be temporarily disrupted but they said, there is no problem as they could just move their shops during the road construction. Resettlement is considered not a major problem in the RRIP II as the road improvement will be done in the existing roads; and (v) environmental impacts (i.e. dust, noise and pollution) due to the contractors' equipment; these problems are considered temporary and could be mitigated.

10. The following safeguard measures will be implemented to address the concerns raised by the respondents and the people consulted: (i) prepare Gender Action Plan (GAP) to ensure gender mainstreaming; (ii) HIV/AIDS/STIs and Human Trafficking Prevention and Awareness Plan; (iii) Community-based Road Safety Program; (iv) environment and other social safeguard measures.

11. Overall, almost 100% of the people in the RRIP II areas are in favor of the proposed project. They identified positive impacts, as well as negative impacts. They believed that the negative impacts could be mitigated by social safeguard measures. The proposed project will provide greater benefits to the local communities and households.