Initial Environmental Examination

Project No. 42285
September 2014

CAM: Integrated Urban Environmental Management in the Tonle Sap Basin Project – Kampong Chhnang Urban Area Environment Improvements

Prepared by the Ministry of Public Works and Transport for the Asian Development Bank

Currency Equivalent
(Official exchange rate of the National Bank of Cambodia as of 26 March 2014)

Currency Unit	-	Riel (KHR)
USD 1.00	=	KHR 4,015
USD 0.000249	=	KHR 1.00

Abbreviations

ADB	Asian Development Bank
AP	affected person
C-EMP	Contractor's Environmental Management Plan
DPWT	Department of Public Works and Transport
EIA	environmental impact assessment
EIAR	environmental impact assessment report
EMP	environmental management plan
EMR	environmental monitoring report
ESS	environmental safeguard staff
GRM	grievance redress mechanism
IEC	information, education and communication
IEE	initial environmental examination
IEIA	initial environmental impact assessment
GoC	Government of Cambodia
HH/HHs	household/s
KHR	Cambodian Riel
MoE	Ministry of Environment
MPWT	Ministry of Public Works and Transport
MRC	Mekong River Commission
O&M	operation and maintenance
PDoE	Provincial Department of Environment
PMIS	project management and implementation support
PIU	project implementation unit
PMU	project management unit
PSC	project steering committee
USD	United States Dollar
WHO	World Health Organization

Weights and Measures

C	-	Celsius/centigrade
dBA	-	decibel audible
ha	-	hectare/s
km		kilometer/s
km^2		square kilometer/s
kph		kilometer/s per hour
m		meter/s
m^3		cubic meter/s
masl		meter/s above sea level
mg/l		milligram/s per liter
mm		millimeter/s
ppsk		person/s per square kilometer
tpd		tonnes per day

NOTES

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

This initial environmental examination (IEE) is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff and may be preliminary in nature. The IEE and its environmental management plans will be updated during project implementation.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

Table of Contents

I. EXECUTIVE SUMMARY

A. Purpose of the Report

1. This report gives an account of the initial environmental examination (IEE) of the proposed subprojects under the Kampong Chhnang Urban Area Environment Improvements Output of the Integrated Urban Environmental Management in the Tonle Sap Basin Project. The IEE was conducted as part of project preparation primarily to: (i) identify and assess potential impacts arising from the implementation of the proposed Kampong Chhnang subprojects on the physical, biological, socio-economic and physical cultural environment and resources; and (ii) recommend measures to avoid, mitigate, and compensate for adverse impacts. The IEE was carried out following the Safeguard Policy Statement (2009) of the Asian Development Bank and with reference to the Law on Environmental Protection and Natural Resource Management (1996), Sub-decree on EIA Process (1999) and Declaration on General Guideline for Initial Environmental Impact Assessment (IEIA) and Environmental Impact Assessment (EIA) Reports (2009) of the Government of Cambodia. Several relevant reports, documents, site reconnaissance, and consultations with communities and relevant government agencies have provided bases to this IEE.

B. Integrated Urban Environmental Management in the Tonle Sap Basin Project

2. The Integrated Urban Environmental Management in the Tonle Sap Basin Project (or, "Project") will contribute to the increased economic activities and environmental protection in towns around the Tonle Sap Basin. It responds to the need of the municipal governments for integrated urban environmental management in urban areas around the Tonle Sap. The project will improve urban services and enhance climate change resilience in Kampong Chhnang (KCH) and Pursat (PST) municipalities through urban area environmental improvements; community mobilization and environmental improvements; strengthened sector coordination and operations; and strengthened capacity for project implementation, and operations and maintenance (O&M).[1] The project follows the Tonle Sap Urban Areas Development Framework (TSUADF) and KCH and PST urban development strategies to 2030.[2]

3. It will have five outputs:
   - Output 1: Kampong Chhnang Urban Area Environment Improvements
   - Output 2: Pursat Urban Area Environment Improvements
   - Output 3: Community Mobilization and Environmental Improvements
   - Output 4: Strengthened Sector Coordination and Operations
   - Output 5: Strengthened Capacity for Project Implementation, Operation and Maintenance

4. The Ministry of Public Works and Transport (MPWT) is the executing agency of the Project. The Project Management Unit (PMU) of the MPWT will be the implementing agency. Project Implementation Units (PIUs) will be set up in each town to manage subproject implementation.

C. Kampong Chhnang Urban Area Environment Improvements

[1] The Asian Development Bank (ADB) provided project preparatory technical assistance. ADB. 2011. *Technical Assistance to the Kingdom of Cambodia for Preparing the Integrated Urban Environmental Management in the Tonle Sap Basin Project.* Manila. (TA 7986-CAM, $700,000, approved on 13 December 2011).

[2] An inter-ministerial prakas for the TSUADF is pending. Urban strategies approved on 31 July 2014 (MPWT Letter No. 009 PMU/MPWT/IEUMTB/14/30 July 2014 for KCH and No. 008 PMU/MPWT/IUEMTB/14/30 July 2014 for PST).

5. Kampong Chhnang Town will benefit from the proposed investment to deliver Outputs 1, 3, 4 and 5 above. The subprojects for Kampong Chhnang Urban Area Environment Improvements are the subject of this IEE:

- Flood protection through the upgrade of existing embankment and construction of new embankment with road, designed for a 50-year flood; and
- Solid waste management, involving: (i) stage 1 development of a controlled landfill adjacent to the site of a closed dumpsite; (ii) provision of collection and landfill equipment, and (iii) remediation of the closed and existing dumpsites.

D. Summary of Impacts and Mitigation Measures

6. **Positive Impacts and Environmental Benefits.** When completed, the subprojects will bring about the following benefits, impacts and outcome:

- Upgrading of existing embankment and construction of new embankment with road:
  - the benefits of improved protection from annual flooding from the Tonle Sap and safe perennial access for affected communities;
  - relief from flooding, reduced health and safety risks, and improved mobility as positive impacts; and
  - improved urban environment and safe, climate-change resilient communities/Town as outcomes.
- Solid waste management:
  - the benefits of improved solid waste collection and disposal;
  - reduced/eliminated open and indiscriminate dumping and burning of solid wastes and relief from its associated issues, e.g., fumes and uncontrolled gas emissions, odor, nuisance, contamination of water resources, and health and safety risks, as positive impacts; and
  - improved urban environment and safe communities/Town as the outcomes.

7. Overall, the subprojects will bring about improved urban environment and climate change-resilience, significantly contributing to a qualitative improvement in the lives of residents in Kampong Chhnang Town.

8. **Relative to Siting, Planning and Design.** The screening process revealed the following salient siting concerns: (i) the Tonle Sap River, adjacent to some 350m-stretch of the existing embankment, will be exposed to impacts during construction; (ii) the floodplain between the existing embankment and Tonle Sap River, which plays a crucial role during reverse flow of the Tonle Sap system and its size which needs to be reasonably sustained to cope with climate change impacts on flood level and intensity; (iii) streams (or drainage channels for stormwater runoff) crossing the existing embankment; (iv) dense urban development/settlement on both sides of the existing embankment at the town center; and (iv) abandoned waste cell adjacent to the proposed controlled landfill site.

9. Relative to design, the salient concern would be the inadequate consideration/ incorporation in the respective designs of the above mentioned siting concerns and the following:

- climate change impacts on the hydrology of the Tonle Sap system and crossing streams;
- concerns associated with the controlled landfill, such as climate change impacts on landfill operations, potential vulnerability of the soil and groundwater in the landfill site and its vicinity, closure/environmental restoration plan to at least mitigate the disturbance to, and blend with, the surrounding landscape, technical and financial capability of the operating institution to sustain an effective controlled landfill operations, and remediation plan for existing dumpsites.

- demand for, and availability of and sources for, fine and coarse aggregates; and
- vulnerability to damages during natural hazard events.

10. In the preparation of the feasibility study, resettlement plan and this IEE, some of the measures taken to minimize the subprojects' environmental and social impacts include, among others:

- The subprojects were prepared within a highly consultative and participatory process through workshops, socio-economic survey (SES) and focus group discussions.
- The IEE has incorporated the existing socio-economic and environmental conditions, issues and concerns raised in the SES.
- A resettlement plan has been formulated in a highly consultative, participatory manner.
- Preliminary design for the embankment has: (i) carefully studied and incorporated Tonle Sap system's hydrology and climate change-induced flood levels; (ii) specified protection against erosion; (iii) accommodated crossing streams with outlets and sluice gates; (iv) significantly mitigated involuntary resettlement by selecting to build a new embankment to the east of sections with, and bypassing the, dense settlements; and (v) significantly kept the floodplain between the existing embankment and Tonle Sap River.
- Preliminary design for the controlled landfill has: (i) included the appropriate leachate and gas management strategy and clay liner to protect groundwater and soil; (ii) recommended for a hydro-geological investigation during detailed design; (iii) considered climate change issues; (iv) proposed the greening of completed/capped waste cells and site; and (v) recommended the institutional set-up for operations and its training.
- The proposed remediation of open dumps have considered the protection of the groundwater and soil, climate change issues, greening of completed/capped waste cells; and dealing with existing fumes and open burning as a priority.

11. **During Construction.** The identified direct impacts with potential moderate to high significance during construction are: (i) dust and noise; (ii) potential contamination of the Tonle Sap River and groundwater resources; (iv) temporary disturbance to the landscape; (v) impacts on vegetation beyond the subprojects' footprints; (vi) risks to habitats in the Tonle Sap River and potentially in the surrounding hills of the controlled landfill site; (vii) impacts on the socio-economic environment and resources from traffic, blocked/constricted accesses, accidental damages of utility and damages from use of existing access roads; and (viii) health and safety hazards.

12. Indirect and induced impacts such as traffic/slower mobility in the town proper from embankment works and dust/suspended particles to potentially affect adjacent rice plants and yield, will be of moderate magnitude and low significance. Due to the subprojects planned in the town proper, cumulative impacts during the construction of the proposed embankment works are anticipated to yield almost all of the above mentioned direct impacts in high magnitude and significance.

13. A detailed set of mitigation measures are featured in the Environmental Management Plans (EMPs) in **Annexes E** and **F**). The effective conduct of the following are crucial mitigation measures as well: (i) construction management by the Contractor; (ii) supervision of Contractor's EMP (C-EMP) implementation by the Contractor's Environmental Management Engineer; (iii) construction supervision by the PMU; (iv) monitoring of C-EMP implementation by the PMU; (v) observance of the Grievance Redress Mechanism by all concerned parties; and (vi) community participation in C-EMP implementation monitoring. Coordination with relevant commune and village authorities and affected social service

institutions and business associations should enable further mitigation of indirect and induced impacts. To bring cumulative impacts down to acceptable levels, project implementers must agree on collaborative efforts to mitigate impacts through responsible implementation of respective EMPs. There must be adequate stakeholder consultations and coordination among project proponents/ implementers for a unified traffic management scheme and public information/disclosure.

14. **During Operation**. Direct impacts will mainly relate to the operation of the controlled landfill. In the operations of all subprojects, unsustained effectiveness of their services will result in case of inefficient operations, m**a**intenance and repair.

15. Potential impacts of high magnitude during the operation of the controlled landfill include: (i) air pollution from dust, gas, fumes and odor; (ii) ground water contamination from leachate and gas migration; (iii) soil contamination from leachate and gas migration; (iv) impact on the landscape; (v) pests/rodents/vermin, bird and stray animal attraction; (vi) wind-blown litter; (vii) fire/explosion; (viii) health and safety hazards of, and nuisance for, community along the access road; (ix) workers health and safety hazards; and (x) unsustained sanitary operations due to lack of technical and financial resources and capabilities.

16. The anticipated salient concerns from the operation of the improved waste collection fleet and equipment include: (i) leachate drippings during collection, temporary storage in hook lift bins and haulage; (ii) odor, flies and pests at hook lift bins and their stations, pushcarts, open tipping trucks from lack of keeping the premises and equipment clean; and (iii) mud spread with the movement of the fleet to and from the landfill. The embankment road will generate dust and noise from road users but at low to moderate magnitude. Remediated open dumps will generate almost the same impacts of an operational landfill; however, of lesser magnitude.

17. The magnitude of direct impacts arising from the operation of completed works will highly depend on the degree of environmental considerations made from the start of subproject development through to operation. Some basic measures are a: (i) effective supervision of detailed design and construction, and performance monitoring by the PMU; (ii) quality construction by the Contractors; (iii) sufficient provisions in the annual budget for operation, maintenance and repair, and for emergency response; (iv) undertaking the recommended environmental effects monitoring during operation; (v) prompt action to raised issues/concerns/grievances; (vi) Operators to engage/designate a staff to oversee EMP implementation and prepare the required environmental monitoring reports; and (vii) conduct of engineering investigation after every natural hazard event, and prompt action on damages. A detailed set of mitigation measures are featured in the EMPs in **Annexes E** and **F**.

18. There will be no significant adverse indirect, induced and cumulative impacts during operation. Growth in the annually flooded areas of Kampong Chhnang Town and in its economic activities will continue even without Project interventions, which will pose further environmental threats in the lives of the concerned communities. With a climate change-resilient embankment and improved solid waste collection and disposal, the Town will expect more positive than adverse indirect, induced and cumulative impacts. The upgraded and new embankment would open areas for flood-free development and use but controlled by the zoning specifications for development over the transition area of the Tonle Sap Biosphere Reserve. Where currently rice can only be grown during the dry season, these lands are now open for year-round rice production. The economic sectors – agriculture, fisheries, services and industry (particularly, tourism) are expected to reap positive benefits. Overall, indirect, induced and cumulative impacts will be more positive than adverse, and will be due to the improved urban environment.

E. Information Disclosure, Consultation and Participation

19. The process in engaging stakeholders and affected people involved workshops, household socio-economic survey and safeguards-specific consultations. Workshops, which had the active involvement of representatives from national ministries and agencies, the six provinces and six municipalities, were held in April and June 2013 to obtain stakeholders agreement/confirmation on several aspects of project preparation. A Socio-Economic Survey (SES) was conducted on 16-18 July 2013. Environmental safeguard-specific consultations included: (i) formal discussions/ meetings with relevant government institutions; (ii) some brief informal interviews with randomly picked relevant persons during site visits; and (iii) an environmental safeguard public meeting held on 25 October 2013 at the Aranh Pagoda, Kampong Chhnang Municipality. **Annex D**

20. Stakeholder consultations will continue through subprojects implementation and operation. The PMU, PIU Contractors and/or Operators will inform the public on matters concerning the progress of the subprojects, adverse impacts, mitigation measures and environmental monitoring and grievances. To date, the following information have been disclosed during the environmental safeguard public meeting held on 25 October 2013 at the Aranh Pagoda, Kampong Chhnang Municipality: (i) Subproject descriptions, locations and activities; (ii) environmental benefits, positive impacts and outcomes of subprojects; (iv) potential salient environmental impacts and mitigation measures, particularly during construction and operation; (v) environmental monitoring that is open to active community participation; (vi) general features of the proposed environmental grievance redress mechanism; and (vii) status of compliance with government and ADB safeguards requirements. The IEE (in both English and Khmer) and the MoE-approved IEIA/EIA Reports (in Khmer), will be available at the offices of the PMU and PIU for stakeholders. The IEE and environmental monitoring reports will be disclosed on the websites of the ADB and MPWT/PMU.

F. Grievance Redress Mechanism

21. The MPWT, as executing agency of the Project will establish the project-specific grievance redress mechanism (GRM). The GRM will accommodate both informally- and formally-lodged, but project-related, grievances. Informally, an affected person (AP) can lodge a complaint directly to the Contractor during construction or the Operator during operation. Formally, the AP can lodge a complaint with the PIU, village or sangkat resettlement sub-committee, or IRC working group. The formal GRM comprises of four stages. In the first stage, the complaint is dealt with at the subproject-level by the: (i) PIU for environmental complaints; or (ii) village or sangkat resettlement sub-committee or IRC working group for social complaints. In the second, third and fourth stages, complaints can be raised to the District Office, Provincial Grievance Redress Committee, and Provincial Court, respectively.

G. Environmental Management Plan

22. The EMPs for each subproject are featured herein as **Annexes E** and **F.** The EMPs will be updated by the PMU based on the detailed design, with technical assistance from the Environmental Specialists of the Project Management and Implementation Support (PMIS) Team that will be engaged under the Project's Output 5. EMPs will be implemented by the PMU, PIU, Detailed Design Consultants, Contractors for civil works, and the Operators of completed works. The marginal costs for implementing the EMPs are initially estimated to involve:

- USD 33,859 (KHR 136 million) of fixed costs to cover IEIA/EIA review and approvals, and environmental effects monitoring prior to, and during, construction; and
- USD 22,200 (or KHR 89.1 million) annually for environmental monitoring during operation and decommissioning.

23. The estimated costs: (i) include taxes and contingencies for deficiencies in assumed unit costs, but exclude inflation; (ii) exclude the salaries of the Environmental Safeguard Staff (ESS) as he/she will be existing MPWT staff seconded to the PMU; (iii) exclude the salary of the ESS counterpart in the PIU as he/she will be existing DPWT staff seconded to the PIU; and (iv) exclude the cost of USD 84,350 for technical assistance from, and "hands-on" training by, Environmental Specialists that will be engaged as part of the PMIS Team for both towns of Kampong Chhnang and Pursat.

H. Conclusion

24. The IEE concludes that the proposed subprojects in Kampong Chhnang Town are not environmentally critical. These are not within or adjacent to environmentally sensitive areas, except for the existing 350-m wall at embankment section C-D adjacent to the Tonle Sap River that will be raised to about 0.60 m (or 2 feet), an activity that will not be critically harmful to the health of the Tonle Sap River. With adequate mitigation measures in place, residual impacts are expected to have lower and acceptable significance.

25. The few impacts of high magnitude (without mitigation) will not be unprecedented and distinct. The extent of adverse impacts is expected to be local, confined within the subprojects' main areas of influence. With mitigation measures in place and ensuring that the bulk of works are completed (or at least almost complete) prior to the onset of the rainy season, the potential adverse impacts during construction would be highly/more site-specific.

26. The few adverse impacts of high significance during construction will be temporary and short-term. These will not be sufficient to threaten or weaken the surrounding resources. The preparation and full implementation of a C- EMP that would address as minimum the requirements of the SPS-compliant subproject EMP will mitigate the impacts and lower their residual significance to at least "moderate" levels. Simple/uncomplicated mitigation measures, basically integral to socially and environmentally responsible construction practices, are commonly used at construction sites and are known to Contractors. Hence, mitigation measures would not be difficult to design and institute.

27. Direct impacts during operation will mainly come from controlled landfill operations. Guided by an Operations Manual and strengthened by continuing capacity building program, controlled landfill operations is not expected to have long-term, persistent, permanent/irreversible adverse impact on human health and safety, air quality, water quality, soil quality, biodiversity, as well as the lifestyle and means of subsistence of nearest local communities.

28. Indirect, induced and cumulative impacts during operation will mainly arise from the upgraded embankment; and from the controlled landfill to a lesser extent. The upgraded embankment will create substantial flood free land east of the NR5. There is risk that this will encourage more urban development in the area, reducing the extensive stormwater retention area here at present. This area east of the NR5 and behind the upgraded embankment is within the "flexible transition area" of the Tonle Sap Biosphere Reserve. Some degree of urban development is allowed over the newly created flood-free land behind the upgraded embankment. The line ministries concerned with the management of the flexible transition area in coordination with the Tonle Sap Biosphere Reserve Secretariat should initiate without delay the update of the management plan through a highly

consultative and participatory process, in anticipation of growth over the newly created flood-free land and incorporating sufficient water retention areas for preservation. With proper development controls and other mitigation measures in place, the overall, indirect, induced and cumulative impacts during operation will be more positive than adverse due to improved urban environment.

29. The proposed subprojects will bring about the benefits of: (i) improved embankment protection from annual flooding from the Tonle Sap and safe perennial access for affected communities; and (ii) improved solid waste collection and disposal. Positive impacts include: (i) relief from flooding; (ii) improved mobility; (iii) reduced or eliminated indiscriminate dumping of solid wastes and its associated issues of odor, nuisance, contamination of water resources and clogging of drains; and (iv) reduced health and safety risks. Collectively, the two subprojects will bring about improved urban environment and climate-change resilience, significantly contributing to a qualitative improvement in the lives of residents in Kampong Chhnang Town.

30. Based on the above conclusions, although the subprojects may have some adverse environmental impacts, the preparation of an IEE would be sufficient to identify and address these impacts. No further special study or detailed EIA needs to be undertaken to comply with ADB's Safeguard Policy Statement. Under government policy, an IEIA Report for each subproject is required to start the environmental impact assessment process. The IEIA Report will be based on this IEE.

II. POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

A. Policy and Legal Framework

36. The overarching policy on the protection of the environment and balance of abundant natural resources is set out in the 1993 Constitution of the Kingdom of Cambodia. Proceeding from, and conformable to, the Constitution, the Government of Cambodia has enacted a series of environmental laws, regulations and standards. Among these, the basic laws/policies that provide the framework within which environmental assessment is carried out in Cambodia are the:

The Law on Environmental Protection and Natural Resource Management (Preah Reach Kram/NS-PKM-1296/36), enacted on 18 November 1996, requires the conduct of environmental impact assessment on every private and public project, existing or proposed. (Articles 6 and 7)

Sub-decree No. 72 ANRK.BK, dated 11 August 1999, the Sub-decree on EIA Process, provides the detailed guidelines for implementation of the EIA Process. Its Annex requires the conduct of IEIA/EIA on the following activities under the Project: (i) waste processing, burning activities, all sizes; (ii) wastewater treatment plants, all sizes; and (iii) drainage systems, >5,000 ha. The Sub-decree has no stipulations on environmental assessment requirements for flood protection dykes, riverbank protection and local roads.

Declaration on General Guideline for Preparing Initial Environmental Impact Assessment (IEIA) and EIA Reports, a declaration issued by the Ministry of Environment (MoE) in 2009, specifying the basic contents of IEIA/EIA Reports: (i) introduction; (ii) legal framework; (iii) project description; (iv) description of the existing environment; (v) public participation; (vi) assessment of, and mitigation measures for, significant environmental impacts; (vii) environmental management plan; (viii) cost-benefit analysis; and (ix) conclusion and recommendation.

Declaration on the Delegation of Power of Decision-Making on Project Development to the Provincial Department of Environment, 2005, providing for the PDoE to be the reviewing and approving authority of IEIA/EIA reports of projects costing below USD 2 Million.

Joint Declaration between the MEF) and the MoE on the Determination of Service Fee for EIA Reviewing and Monitoring, 2012, specifying five levels of fee with a minimum of USD 500 and a maximum of USD 1,750.

37. Other laws, regulations and guidelines that provide general context/guide in the environmental assessment of subprojects are given in Table II-1. The key environmental quality standards applied in this IEE are: (i) Ambient Air Quality Standard, 2000; (ii) Maximum Standard of Noise Level Allowable in the Public and Residential Areas, 2000; (iii) Water Quality Standards for Public Waters for the Purpose of Biodiversity Conservation, 1999; (iv) Water Quality Standards for Public Waters and Health, 1999; (v) Drinking Water Quality Standards, 2004; and (vi) Effluent Standard for Discharged Wastewater to Public Water Areas or Sewers, 1999, applicable to landfills. **Annex A**

Table II-1. Other Relevant Laws, Regulations and Guidelines in Cambodia

Law/Regulation/Guideline	Year	Brief Description
Royal Decree on the Protection of Natural Areas	1993	Has classified the 23 protected areas in Cambodia into four categories, namely: (i) natural parks; (ii) wildlife sanctuaries; (iii) protected landscapes; and (iv) multiple-use areas. Designated the Tonle Sap (316,250 ha) as a multiple-use area or area necessary for the stability of the water, forestry, wildlife and fishery resources, for entertainment/ tourism, and for conservation of long-term existing natural resources with a view to assure sustainable economic development.
Law on the Protection of Cultural Heritage (NS/RKM/0196/26)	1996	Regulates the protection of national cultural heritage and cultural property in general against illegal destruction, modification, alteration, excavation, alienation, exportation or importation. Its Article 37 stipulates that in case of chance find of a cultural property during construction, work should be stopped and the person who found the property should immediately make a declaration to the local police, who shall, in turn, transmit the property to the Provincial Governor without delay.
Sub-decree on Water Pollution Control (Sub-decree No. 27 ANRK/BK)	1999	Regulates activities that cause pollution in public water areas in order to sustain good water quality so that the protection of human health and the conservation of biodiversity are ensured. Annexes 2, 4 & 5 provide the industrial effluent standards, including effluent from wastewater stabilization ponds, water quality standards for public waters for the purpose of biodiversity conservation, and water quality standards for public waters and health, respectively.
Sub-decree on SW Management (Sub-decree No. 36 ANK/BK),	1999	Regulates solid waste management to ensure the protection of human health and the conservation of biodiversity.
Sub-decree on Control of Air Pollution and Noise Disturbance (Sub-decree No. 42 ANK/BK	2000	Regulates air and noise pollution from mobile and fixed sources through monitoring, curb and mitigation activities to protect the environmental quality and public health. It contains the following relevant standards: (i)) ambient air quality standard (Annex 1); and (ii) maximum allowable noise level in public and residential areas (Annex 6).
Law on Land	2001	Provides that: (i) unless it is in the public interest, no person may be deprived of ownership of his immovable property; and (ii) ownership deprivation shall be carried out according to legal forms and procedures and after an advanced payment of fair and just compensation. (Article 5)
Royal Decree on the Establishment & Management of TSBR (Royal	2001	Establishes the Tonle Sap Biosphere Reserve (TSBR) according to the statutory framework of the World Network of Biosphere

Law/Regulation/Guideline	Year	Brief Description
Decree NS/RKT/0401/070)		Reserves. The TSBR is divided into core areas, buffer zone & flexible transition zone.
Environmental Guidelines on Solid Waste Management	2006	Contains a Landfill Ordinance that regulates landfill requirements to: (i) reduce as far as possible the adverse effects of waste disposal on the environment; (ii) preserve groundwater, surface water & air quality & to reduce emissions of greenhouse gases (iii) ensure waste is not harmful to human, natural & animal health during operation & decommissioning; and (iv) provide information and technical recommendation on the construction, operation and closing/follow-up management of landfills to ensure public health and safety and environmental protection.
Law on Water Resources Management	2007	Requires license/permit/written authorization for the: (i) abstraction & use of water resources other than for domestic purposes, watering for animal husbandry, fishing & irrigation of domestic gardens and orchards; (ii) extraction of sand, soil & gravel from the beds & banks of water courses, lakes, canals & reservoirs; (iii) filling of river, tributary, stream, natural lakes, canal & reservoir; and (iv) discharge, disposal or deposit of polluting substances that are likely to deteriorate water quality and to endanger human, animal and plant health. (Articles 12 & 22) Its Article 24 stipulates that MOWRAM, in collaboration with other concerned agencies, may designate a floodplain area as flood retention area.
Protected Areas Law (Royal Decree No. NS/RKM/0208/007)	2008	Defines the framework of management, conservation & development of protected areas to ensure the conservation of biodiversity, & sustainable use of natural resources in protected areas. It divides the protected area into 4 zones namely, core zone, conservation zone, sustainable use zone & community zone. Article 36 strictly prohibits all types of public infrastructure in the Core Zone & Conservation Zone; & allows development of public infrastructures in the Sustainable Use Zone & Community Zone with approval from the Royal Government at MoE's request. Article 41 prohibits destructive/harmful practices in protected areas, e.g., destroying water quality, poisoning, using of chemical substances, disposing of solid and liquid wastes into water or on land.
Expropriation Law	2010	Defines the principles, mechanisms, and procedures of expropriation, and defining fair and just compensation for any construction, rehabilitation, and public physical infrastructure expansion project for the public and national interests and development of Cambodia.
Sub-Decree on Demarcation of 647,406 Hectare Flooded Forest Domain in Six Provinces adjacent to Tonle Sap Lake (Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap and Kampong Thom) (Sub-decree No. 197 ANKr/BK)	2011	Stipulates a zoning system for the area between the national highways and the Tonle Sap Lake system and the nature of agriculture activities that are permitted and banned in each zone.

B. Administrative Framework

38. The Ministry of Environment (MoE) through its EIA Department supervises over and regulates the EIA Process. The MoE is responsible for: (i) review and approval of EIA reports in collaboration with other concerned ministries and (ii) monitors the EMP implementation of Project Proponents/ Owners throughout the different project phases. MoE operates at the municipal and provincial levels through its Provincial Department of Environment (PDoE).

39. The Sub-Decree on EIA Process prescribes a period of 30 working days for review of IEIA report from the date of registration and another 30 working days for review of revised IEIA or EIA Report from receipt of report. If MoE fails to respond its findings and

recommendations within the prescribed periods, it will be assumed that the submitted report is compliant. By virtue of MoE's Declaration on the Decentralization for Provincial Department of Environment, 2005, projects with a capital investment cost below USD 2 Million shall be reviewed and approved by the PDoE. (Table II-2)

40. From consultation with the MoE through the Deputy Director of the EIA Department, on 26 June 2013, it was learned that:[3]

- For projects comprising of subprojects, such as the IUEMTSB Project: (i) subprojects that are mentioned in the Annex of Sub-decree No. 72 ANRK.BK, will require individual IEIA Reports; and (ii) subprojects that are not mentioned in the Annex of Sub-decree No. 72 ANRK.BK can be covered in one IEIA Report.
- The IEEs prepared by the ADB PPTA Team, following ADB's SPS 2009, can be accepted as IEIA Reports.

41. In another consultation with the MoE Deputy Director held on 17 October 2013[4], it was pointed out that the final completion report is needed before any conclusion on requirements can be made.

- Proponent is to undergo screening to determine the type of report to be prepared, an IEIA or EIA. Sufficient details on the subprojects will facilitate screening process. Depending on the screening results, MoE's EIA Department will: (i) recommend for individual report for each subproject or for some subprojects to be covered under one report; and (iii) determine IEIA or EIA requirement.
- For EIA Report, primary data for key receptors, social impact assessment, pre-FS Report will be required and should be in Khmer. This will be submitted by the MPWT as the official project proponent.
- Review process for IEIA is a maximum of 30 working days; for EIA, a maximum of 30 working days. However, the process could take almost a year for an EIA, including preparation, revision or additional requirements and review.

C. International Environmental Agreements

42. Cambodia is party to the following relevant international environmental agreements: (i) UNESCO World Heritage Convention, 1991; (ii) Convention on Biodiversity, 1995; (iii) UN Framework Convention on Climate Change, 1995; (iv) Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1997; (v) Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat, 1999; (vi) Basel Convention on the Control of Transboundary Movements of the Hazardous Wastes and Their Disposal, 2001; (vii) Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer, 2001, and all Amendments, 2007; and (viii) Climate Change Kyoto Protocol, 2002.

43. Cambodia joined the UNESCO Network of Biosphere Reserves in 1997. It is committed to the Millennium Development Goals, the seventh goal of which is to "ensure environmental sustainability". It is among the 168 Governments that adopted the Hyogo Framework for Action 2005-2015, a 10-year global footprint for disaster risk reduction efforts, in January 2005. At the regional level, it ratified the following ASEAN Agreements: (i) on Transboundary Haze Pollution in 2006; and (ii) on Disaster Management and Emergency Response (AADMER), which entered into force in 2009. At the sub-regional level, Cambodia, along with Lao PDR, Thailand and Viet Nam, signed the "Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin" (or the Mekong Agreement) in April 1995.

[3] Consultation of PPTA National Environmental Specialist with Mr. Danh Serei, Deputy Director, EIA-MoE, on 26 June 2013.
[4] Consultation of PPTA National Environmental Specialist and ADB Mission Member with Mr. Danh Serei, Deputy Director, EIA-MoE, on 17 October 2013.

Table II-2. The RGC Environmental Impact Assessment Report Preparation, Appraisal, Approval and Implementation Process *

Steps in the Process	Responsible Entity
Preparation of Environmental Examination Application (EEA) & Initial Environmental Impact Assessment (IEIA) Report, submission to MoE together with a Pre-Feasibility Study (PFS) Report.	Project Proponent
Review of IEIA Report ▪ Review period is a maximum of 30 working days, from date of registration of IEIA Report and PFS Report. If MoE fails to respond its findings and recommendations within the prescribed period, it will be assumed that the IEIA Report is compliant. ▪ Review conclusion could either be any of the following: A. IEIA Report is approved. B. IEIA needs revision. C. An EIA Report is required.	MoE
Revision of IEIA Report or preparation of EIA Report, submission to MoE along with a FS Report. ▪ During EIA preparation, public involvement typically occurs during scoping, may also occur at any other stage in the preparation.	Project Proponent
Review & Approval of Revised IEIA & EIA Reports ▪ Review period is a maximum of 30 working days from receipt of revised IEIA Report & Pre-FS Report or EIA Report and FS Report. If MoE fails to respond its findings and recommendations in prescribed period, it will be assumed that Revised IEIA Report or EIA Report is compliant. ▪ Public involvement occurs during review.	MoE
Acknowledgement of findings & recommendations of approved IEIA &/or EIA Reports before project implementation.	Project Proponent
Implementation of approved IEIA or EIA Reports & its EMP	Project Proponent
Monitoring of project implementation if compliant with the approved IEIA or EIA Reports & its EMP.	MoE and PDoE

***** Applicable to IUEMTSB Project

III. DESCRIPTION OF SUB-PROJECTS

A. Justification and Rationale

44. **Urbanization in Cambodia and in the Tonle Sap Basin**. Urbanization in Cambodia is taking place with minimal coordination and regulation, inadequate infrastructure and insufficient regard for the environmental impacts of development. The results include disorganized growth, inefficient land use, damage and loss of natural resources, and inadequate access to urban services. Problems are attributable to poor urban management, little strategic spatial planning, poor connectivity between urban planning and environmental management, and insufficient investment in infrastructure and community services. Urban planning and investments are needed to accommodate expanding urban populations, sustain economic growth in medium-sized cities that are moving up the value chain in terms of their production profiles and activities, and protect the environment.

45. The Tonle Sap Basin, including all its river catchments, covers about one third of the area of Cambodia. Within the Basin are six main urban centers, the capital towns of the six provinces around the Tonle Sap Lake namely, Kampong Chhnang, Pursat, Battambang, Serei Saophan, Siem Reap and Steung Saen. These urban centers are the focal points of economic growth in, and will be crucial to the development of, the Tonle Sap Basin as a whole. At the same time, they can have potentially adverse impacts on the Tonle Sap Lake

and the environment surrounding it. The Lake's abundant resources have supported large human settlements throughout history. The Tonle Sap Basin is an important region for socio-economic development in Cambodia, but urban growth and developments over past decades have caused rapid degradation of the natural resource base that is essential for livelihood support.

46. **Kampong Chhnang Town.** Kampong Chhnang Town was selected as one of the two towns that the proposed Project would focus interventions on. It is less than 1 km from the Tonle Sap water resource and by far, the closest. It is the only municipality that has the lake forming part of its boundary. Government agencies of Kampong Chhnang list poor environmental sanitation, i.e., a combination of flood, wastewater removal and solid waste management, as the Towns' biggest issue.

47. Flooding This proximity to the Tonle Sap has been a benefit in providing much of the economic base of the town as a port and fishing settlement. However, the annual cycle of the water level fluctuation in the Tonle Sap also often rises to such levels that the town is inundated. Flooding is also caused from runoff from the hills to the west of the town during heavy rainfall, and when this coincides with high water levels in the Tonle Sap, the town faces a major inundation problem. However, it is the Tonle Sap that invariably causes the most flooding.

48. The town is frequently inundated during the wet season with the last major flooding occurring in 2011, when the flood water rose to a level of 11.78 masl, which was 180 mm above the previous highest level in 2000, overtopped the existing embankment and flooded the town up to National Highway 5, and affecting around 55% of the population, 370 ha of urban land and over 1,200 ha of agricultural land. The annual hydrological cycle of the Tonle Sap is the main cause of flooding in Kampong Chhnang. Minor flooding, which can also be caused by run-off from the adjacent hills, is much less of an issue and is being addressed by the current JICA interventions. Dykes have been constructed in the past. However, these no longer fully protect the town from flooding. This flooding significantly constrains development on the eastern side of the urban area. Addressing the Tonle Sap flooding should thus be the main aim of any intervention in Kampong Chhnang. The Province and Municipality has proposed the raising of the level of the long embankment circling the town to the north and east to address the 1st priority issue of annual flooding from the Tonle Sap.

49. Solid Waste In Kampong Chhnang solid waste collection is limited and the method of final disposal is open dumping. Indiscriminately thrown solid wastes are common sights in open areas, drainage channels and water bodies. This situation has blocked the flows in the combined drainage system, thus contributing to flooding; and has led solid wastes to Tonle Sap River in addition to those directly dumped onto it, thus harming the water resource.

50. Accurate waste generation data in Cambodia is very limited. Based on PPTA Team's study, the Town is estimated to generate 0.51 kg/person/day or 22 tpd in 2014. Based on PPTA Team's inspection, the waste stream is composed of 50-65% organic matter of which 35% is green waste, 10-15% plastic, 4-6% glass, 2-6% metal, 2-4% textiles, 1-2% wood, and 10-15 others e.g., coconut husks, disposal napkins.

51. It is further estimated that only about 40% or 9 tpd is collected daily at present. There are three dump sites in Kampong Chhnang, i.e., a closed dump site at Phnum Touch Village the recently closed Traok dump site, and the currently active Kol Kup dumpsite. The Phnum Touch dump site was commissioned in 1998/99 and was abandoned in 2010, partly due to distance. The waste at depth has all been burnt, but there are some recent wastes from the nearby local (Pongro) market that is yet to fully burn. The site was smoking at the time of PPTA Team's inspection in the dry season. During the Team's site visit in the wet season,

the wastes were not burning or smoking but flies were in large populations. During the Mission's visit in September 2014, the Mission also observed that not all wastes had been burned, that recent wastes continue to be brought from the local market, and that burning continued. The recently closed Traok dump site is situated in private land and was accepting wastes based on a private treaty between the company providing the collection services and the private landowner. This was commissioned in 2010; and was operated till recently During the PPTA Team's site investigation in May, as reported, the water impounded in the currently operating pit appeared to be not obviously contaminated leachate and retained an oxic appearance, devoid of black coloration and gasification. During the site visit in the wet season, extensive leachate formation and expression was observed in the current operating pit. Impounded water was murky. During the Mission's visit in September 2014, almost all wastes had been burned and the previous site has been covered and is now the location of stone crushing machinery. A small amount of waste that has not been burned has been placed in another location within the stone crushing operation, and placed in a pit for burning during the dry season. The currently active Kol Kup dump site in Kol Kup Village, Srei Tmei Commune, Roleap Ear District is on 5 hectares of privately land owned. It is also the property of the owner of the stone crushing operation in Traok. Dumping started on March 2014 as the Traok dumpsite was closed. During the Mission's visit in September 2014, while there was no burning, the local authorities explained that wastes were burned on the site.

52. In addition to the obvious environmental damage caused by waste fires, uncontrolled burning represents a serious health and safety risk. Incomplete combustion of the various plastic types at the dump can result in the formation of carcinogenic by-products such as dioxins. These airborne pollutants are being breathed in by the truck drivers and waste pickers at the site, as well as by the farmers working in the adjacent rice fields. Odor, flies and sometimes litters from waste collection trucks are the complaints of households along the access roads. The Province, Municipality, as well as PDoE and DPWT, have expressed the priority need to improve solid waste management in the town. Augmenting the solid waste collection fleet and upgrading the method of final disposal should thus be another valuable intervention for improved urban environment in Kampong Chhnang.

53. **Integrated Urban Environmental Management in the Tonle Sap Basin Project**. By addressing the top two priority development issues and infrastructure needs of Kampong Chhnang Town and building the institutional capacity of local authorities, the Project will help to improve the climate change resilience of, and flood protection and environmental sanitation in, Kampong Chhnang. The Project will help develop the town to complement agricultural and industrial development and become a support center for the proliferation of the rural economy, trade, and industrial value chain development. It will promote sustainable urban development in the Tonle Sap Basin.

54. The subprojects proposed under the Project will deliver the following outputs:

55. **Output 1: Kampong Chhnang Urban Area Environment Improvements** includes: (i) upgrading of existing embankment and construction of new embankment with road; and (ii) solid waste management through the development of a controlled landfill, provision of collection and landfill equipment, and remediation of the closed and existing dump sites.

56. **Output 3: Community Mobilization and Environmental Improvements** includes improved household sanitation for IDPoor 1 and 2 in the current municipality area; climate change and hygiene awareness and action; and community small-scale infrastructure improvements in pre-identified poor and vulnerable areas in each municipality. Small-scale infrastructure improvements will be prioritized by the communities and financed by the project, national government, and community.

57. **Output 4: Strengthened Sector Coordination and Operations** supports MPWT to convene national urban development task force meetings (twice per year); strengthens climate change regulations focusing on improved building codes in provincial towns around the Tonle Sap, including appropriate sanitation; and supports the establishment of pilot USUs (or special operating agencies) for improved delivery and management of decentralized urban services.

58. **Output 5: Strengthened Capacity for Project Implementation, Operation and Maintenance** includes project implementation support services for the project management unit (PMU) and project implementation units (PIUs) in design and supervision, safeguards implementation and monitoring, gender mainstreaming, community development, accounting and financial management, procurement, disbursement, review and expansion of existing strategies (flood mitigation, stormwater drainage, SWM, and disaster risk management), and skills enhancement and on-the-job training in urban planning and development, solid waste management, and O&M.

B. Kampong Chhnang Urban Area Environment Improvements

59. The Kampong Chhnang Urban Area Environment Improvements is the subject of this IEE. The Community Mobilization and Environmental Improvements will be subject to IEE as its activities are proposed and developed.

60. **Flood protection.** The works proposed for the embankment will involve:

- reinforcing and raising the level of the existing embankment where required;
- rebuilding and raising existing embankment where it is damaged or construction is poor;
- building a new embankment in areas where there is no current embankment;
- building a new embankment in areas where raising existing embankment would severely impact on adjacent properties but where land is available adjacent to the settlement;
- building retaining walls to support the embankment in areas where raising existing embankment would severely impact on adjacent properties and where land is not available, and
- providing sluice gates to allow stormwater to flow to the Tonle Sap.

61. Construction of proposed embankment works can only take place during the dry season when there is access to the embankment base. This means that there is really only a five to seven month annual construction window, depending upon the Tonle Sap levels. Any section of the embankment will have to be constructed and protected within one dry season. Figures III-1 and III-2

62. **Solid Waste Management.** This subproject will: (i) develop Stage 1 of the proposed controlled landfill, (ii) provide waste collection and landfill equipment, and (iii) remediate the closed and existing dump sites.

63. The proposed controlled landfill will be developed in an abandoned dumpsite at Phnum Touch Village, Pongro Commune of Rolea B'ier District. The site, a public land controlled by the Province of Kampong Chhnang, is about 12 km from the town center and can be accessed from PR 53 through a 3.3-km long laterite public road. There is an area of previously deposited waste about 40 by 30 metres square, placed into an excavated pit of unknown depth but thought to be 3 metres deep from the top of the encircling bund.. The waste is approximately level with the top of the encircling bund, which is up to two metres above natural surface level. The waste at depth has all been burnt, but there is some recent waste from a local market which is yet to fully burn but was smoking at the time of inspection. There is also wind-blown litter over parts of the site.

64. The site is suitably distant from the nearest community. The water table is reportedly at least 50 m below ground surface. There is no surface water body within or in the vicinity of the site. Soil in the site and its vicinity is clayey. Overall, the site is considered suitable for a long-term controlled landfill.

65. The controlled landfill is proposed to be developed in four main stages, adopting a cell staging approach and staged development strategy (described in **Annex B**) that will attain a capacity sufficient for the landfill to operate for about 30 years. The four stages will occupy an area of 4.2 ha, excluding any allowance for some small buildings, roads, recycling put down area and any buffers around the waste mounds. The existing old waste cell will eventually form part of the landfill development sometime in 2027; in the interim, it will be remediated under the Subproject.

66. Under the Project, only Stage 1 (one of the four stages) will be developed, providing an air space of 77,600 m3, enough for about 5 years of operation, to include:

- a 100 m by 100 m Cell 1 of the proposed four cell system required for the 30-year development, including associated bulk earthworks and compacted clay liner system;
- the cell liner, costed as a compacted clay liner, with the clay to either be sourced on-site and reworked or imported from local clay pits;
- various buildings required, including a reception/gatekeepers hut, ablution blocks, meeting rooms, storage room, generator building, etc;
- access roads both internal and external to the site necessary to reach Cell 1
- areas to allow processing and stockpiling of recyclables;
- leachate pipe collection systems and pumping stations, together with re-injection and irrigation systems; (A leachate treatment plant is not required reducing both CAPEX and OPEX as well as operational complexity.)
- ground monitoring wells, 1 unit at each of 3 sides;
- stormwater drainage systems;
- potable and non-potable water supply; and
- ancillary works, such as landscaping, weighbridge, lighting and fencing.

67. Surface water management will include site's stormwater drainage system, ensuring effective slopes in waste cells, and providing sump pumps temporarily in the lower area of the cell to remove any impounded uncontaminated stormwater during significant rain event.

68. Leachate management will adopt the approach of minimizing generation and either re-injecting into the waste cell or irrigating/watering areas with clay liners. Leachate will be collected in the drains located in the bottom of the cells. From there, it will flow into a pumping station to allow the leachate to be returned to the top of the cell for reinjection or sprayed on the external batters (of waste cells) to encourage vegetation growth in dry weather. An area can be set aside in the site layout for future leachate treatment facilities. A leachate water balance has been completed to demonstrate that the expected leachate volume can be managed through reinjection and irrigation of previously worked cells, and future cell development areas if needed, without recourse to treatment and is presented in the Technical Feasibility of Kampong Chhnang Solid Waste Management. Considering climate change issues, Section 14 of the same report recommends the: (i) appropriate slopes for external batters, maintained vegetation on external batters, and appropriate sizes of peripheral drains to account for higher rainfall intensities; and (ii) a conscious plan to irrigate the vegetation on external batters during hotter and drier summers.

69. Groundwater quality will be monitored through monitoring wells that will be situated one at each of three sides, hydrogeologically upslope and downslope of the landfill cells. The volume of gas that will be produced during Stage 1, or even after the final overtopping following Cell 4 completion, is going to be too small. There is no need at this stage to make

a final decision on landfill gas management. (More details, including gas generation estimates, as well as recommended gas treatment and controls that can be implemented at a later date when necessary, are presented in the same Technical Appendices mentioned above.)

70. For Stage 1 landfill operations, some 12,000 m^3 of soil cover material will be needed. This will come from the balanced cut-to-fill excavation program during cell development as described in the cell staging and staged development strategy presented in **Annex B.** One unit each of dozer, excavator, dump truck and water tank with pump will be provided for the landfill operations.

71. The following collection equipment will be procured to address the current deficiencies in waste collection: (i) two units each of 20 m3 and 5 m3 compactor trucks; (ii) one unit of hook lift truck; (iii) thirty hook lift bins; (iv) one unit of 10-wheeler tipping dump truck; (v) two units of small motorized carts; and (vi) thirty units of pushcarts.

Figure III-1 Plan of Proposed Embankment Works

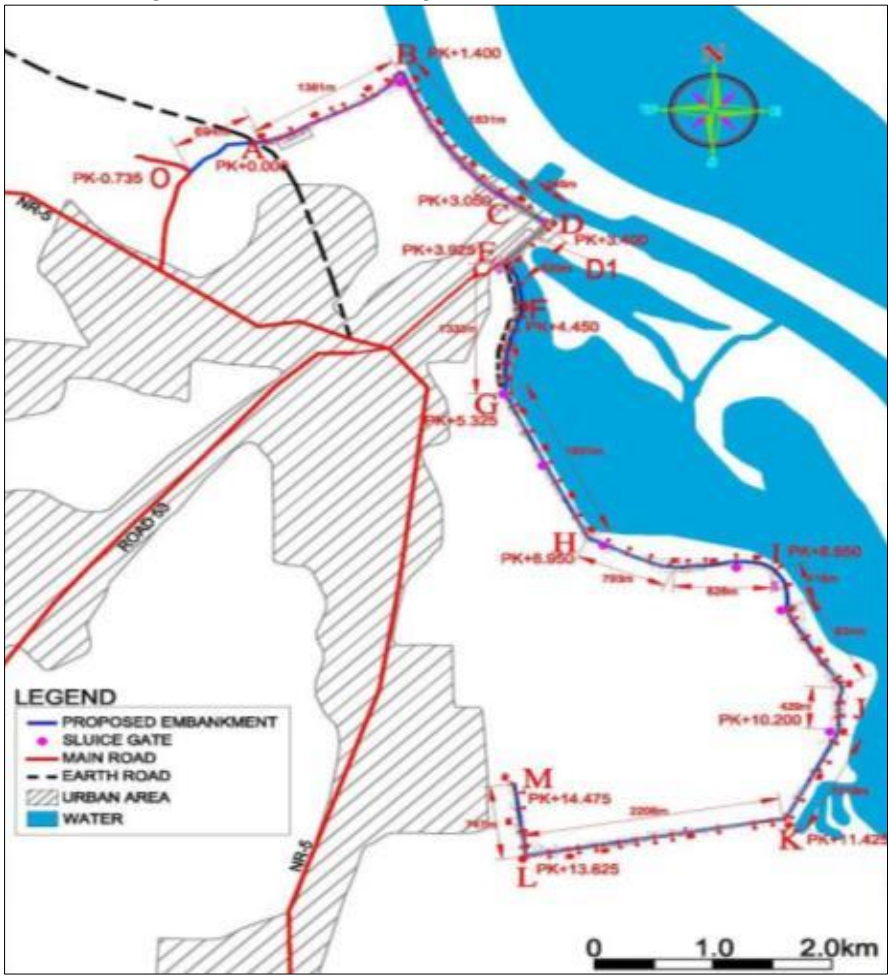


Figure III-2 Plan View of Proposed Embankment beside Existing Settlements


Settlement on existing embankment
Proposed alignment of new embankment

Figure III-3. Kampong Chhnang Controlled Landfill Location Plan and Layout

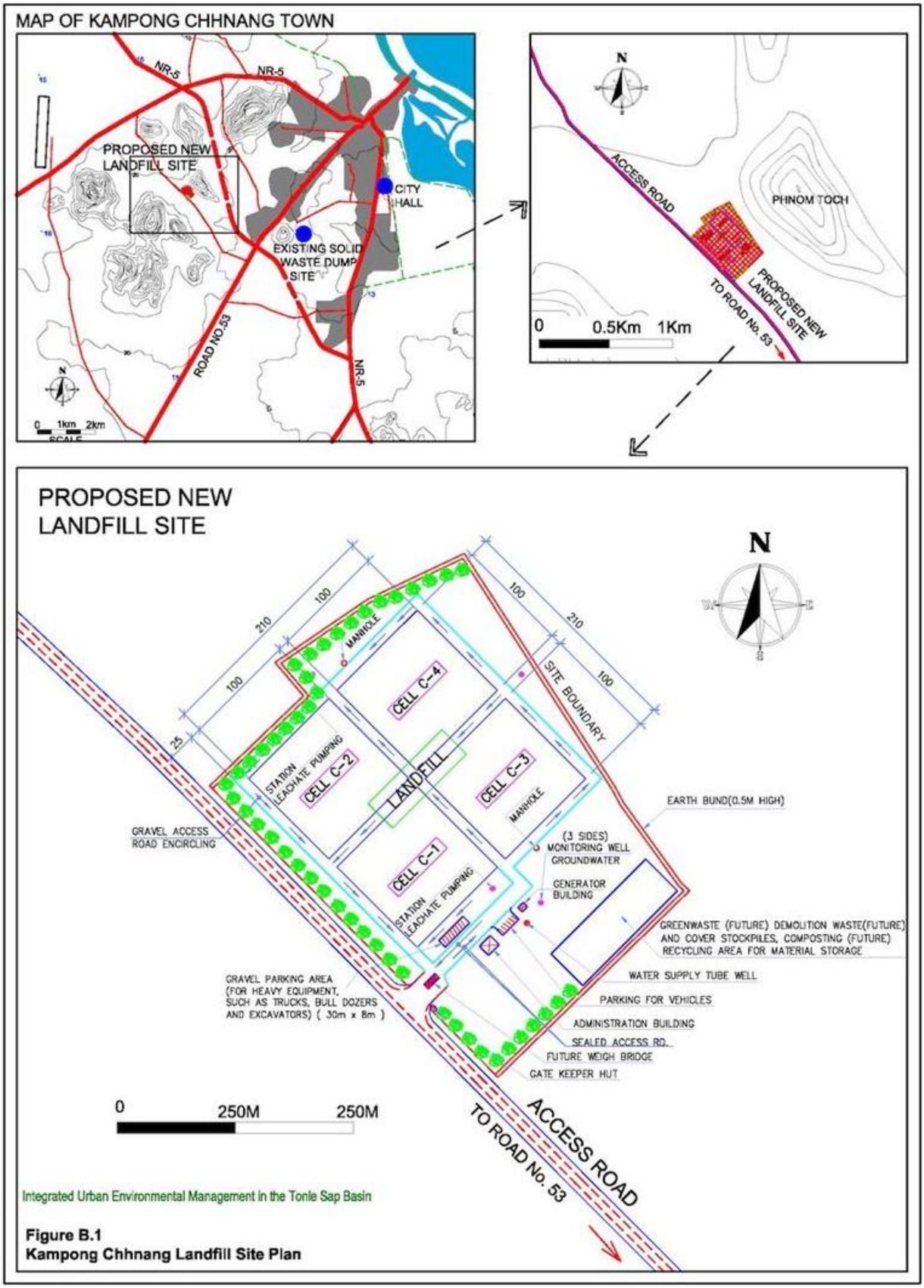
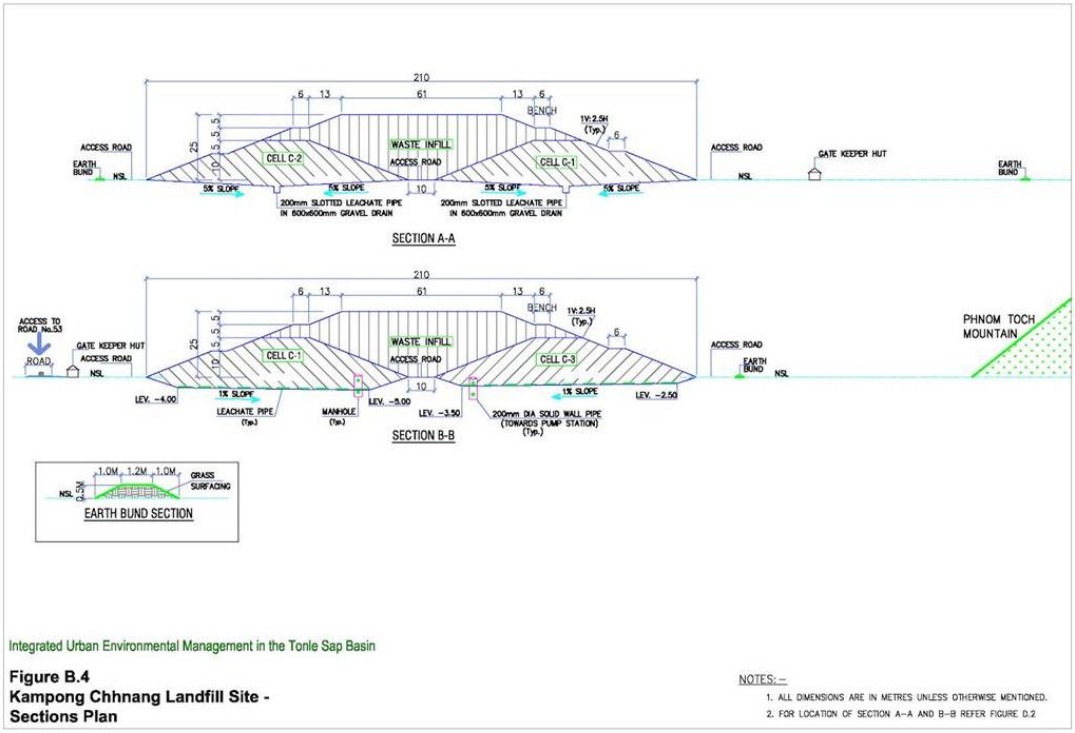


Figure III-4. Kampong Chhnang Controlled Landfill – Sections



72. The Phnum Touch (closed dump site near the site of the proposed controlled landfill) existing Traok and Kol Kup dump sites will be remediated on site, extinguishing the fire/s first before closure. Closing of the waste cell or dumping area will be as per normal landfill operating procedures:

- Push the previously (non-smoldering) deposited wastes to form a mound with reasonable slopes. Compact the wastes. Cap with soil.
- Compact waste properly by pushing up a slope and having at least 3 passes.
- Trim back the perimeter batters to a 1v:2.5h slope, if required. (Or, just develop the replaced, pushed and compacted waste into a 5% plateau, if no mounding is required.)
- Install final capping (600 mm of soil with low-permeability) in accordance with final mound or plateau profile and footprint.
- Instal at least two groundwater monitoring wells, strategically situated in such a way as to provide hydrogeologically appropriate upslope and downslope sampling locations for the final mound footprint. If sampling indicates that groundwater contamination is occurring, deleaching wells can be installed retrospectively within the waste mound.

73. Remediation works will be undertaken by the Government simultaneously with the construction of the controlled landfill. While remediation works is designed by project consultants, actions to arrest the intensification of present environmental issues/concerns and reduce remediation costs are in **Annex C**

C. Subprojects' Areas of Influence

74. The environments that will be potentially affected by the subprojects can be classified into: (i) "main project areas of influence", covering component sites (footprints) and areas within 200 m from their edges, considering the potential reach of noise, dust and socio-economic impacts; and (ii) "extended areas of influence" to include borrow areas/quarry sites, waste disposal sites, access routes to and from component sites and the resources in

close proximity to them, sources of water for construction use, workers campsites and their immediate surroundings, and sources of labor.

Table III-1. Potentially Affected Resource/s in Project's Area/s of Influence

Area of Influence	Potentially Affected Resources				
	Soil, Ground, Geology	Water Resources	Air	Land Use, Socio-econ. Resources	Other Ecological Resources[a]
1 Component sites & vicinities within at least 200 m from their edges [b]	■	■	■	■	-
2 Borrow areas/quarry sites & their areas of influence [c]	■	-	■	-	■
3 Waste disposal sites [c]	■	-	■	-	-
4 Access routes - To/from sources of chemicals for construction use & disposal sites [d]	■	■	■	■	-
- Used by construction-associated vehicles	-	-	■	■	-
5 Sources of water for use in construction & their downstream stretches	-	■	-	■	■
6 Workers' campsites & immediate surroundings (if outside 200 m from edges of component sites)[e]	■	■	■	■	-
7 Sources of labor for construction	-	-	-	■	-

[a] Areas of influence of borrow areas/quarry sites could have migratory species at certain periods of the year.

[b] As shown in Table V-4 (Section V), noise levels generated by construction equipment decrease at a rate of approximately six decibels (dB) per doubling of distance away from the source; (ii) the maximum noise level for receptors less than 5 m could be 93-95 dB; and (iii) within 200 m from a noise source, noise level exceeds WHO guideline of 50 dB.

[c] Expects that the following have no water resource to affect: (i) legally permitted borrow areas/quarry sites & Town's waste disposal sites; and (ii) potential Government project & other sites that would avail of the residual soil for filling.

[d] Water resources crossed by, adjacent to, or close to access routes (including effective downstream stretches). "Close to", say within 50 m without any form of physical barrier in between water resource and access route.

[e] From poor sanitation practices, additional demand for water within the community, use of stove for heating and cooking, and if applicable, transport to and from component sites.

75. Based on sites visit, review of satellite and land use maps, the potentially affected resources within the main areas of influence were identified. These include natural and artificial resources.

Table III-2. Identified Potentially Affected Resources in the Main Areas of Influence

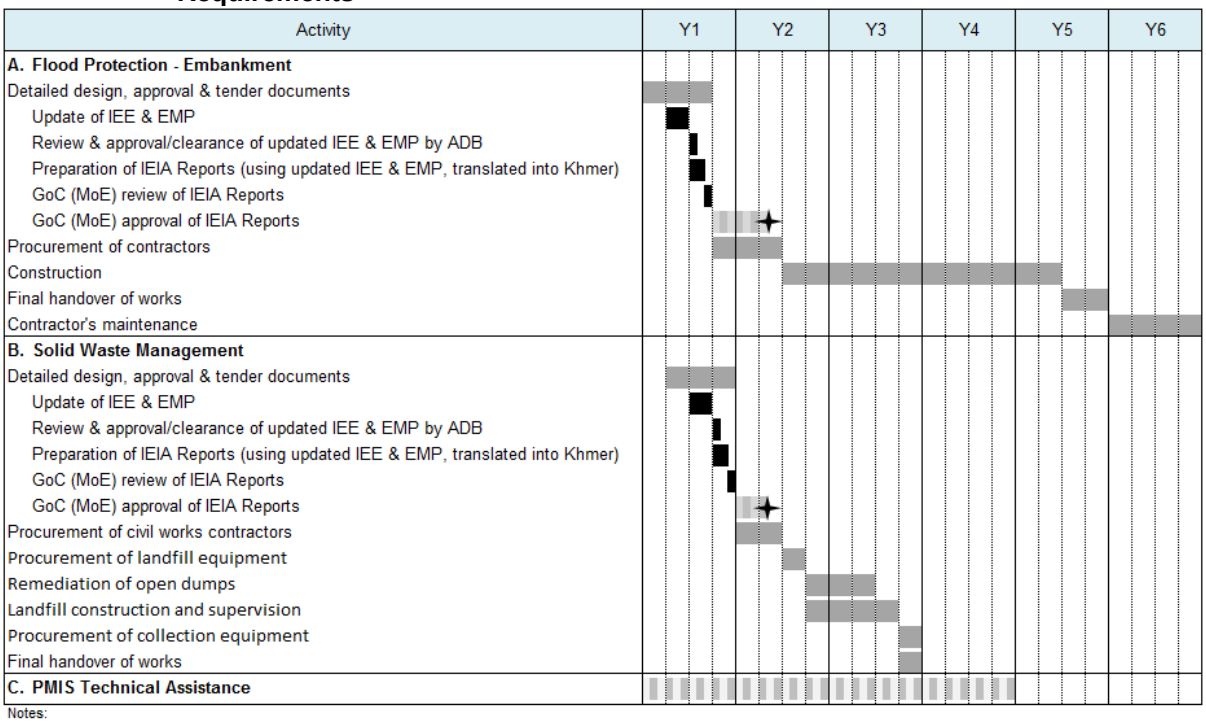
Flood Protection	Solid Waste Management
- Tonle Sap River - People – residents/passers-by/customers/workers - Rice lands, rice plants and other flora along side - Wat Sam Roang - Wat Yeary Tep - Masjid Kampong Chhnang - Sam Roang Primary School & another school - 2 water supply intakes - potential boreholes and open dug wells - Tourism, agricultural & fishing ports - Markets & other business establishments - Power supply poles - Access road	- Rice fields in the vicinity & the farmers - Access road - Residents along access road - Flora in immediate vicinity

D. Category and Requirements

76. Under ADB classification, the Project is a Category B undertaking and an initial environmental examination (IEE) is required.

77. Under GoC policy and from consultation with MoE:[5] (i) projects listed in the Annex of the Sub-decree on EIA Process require individual IEIA Reports; projects not listed may be combined under one IEIA Report; (ii) the ADB IEE Report may serve as the IEIA Report; and IEIA/EIA reports from the Project will be appraised and approved by the Ministry of Environment (MoE). Based on this discussion, MoE requires separate IEIA Reports for each of the subprojects in Kampong Chhnang, since "waste processing activities of all sizes" is listed in the Annex of the Sub-decree on EIA Process. The IEIA Report will be based on this IEE. (Table III-8)

Table III-3. Indicative Timeline for Compliance with RGC Environmental Assessment Requirements



Notes:
- Y1 is the start of Loan implementation, 1st activity being the preparation of the DEDs.
- Assumes environmental specialist is part of the DED Team; and therefore no independent procurement for such specialists.
- GoC appraisal period for IEIA report is 30 working days from receipt of application. Indicative timeline assumes no revision of IEIA Report required.
- Assumes current MoE review of summary IEEs prepared by the PPTA will conclude that no subproject will require the conduct of an EIA.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical/Chemical Environment

78. **Geographic Location.** Kampong Chhnang Town is the capital of Kampong Chhnang Province. The Province is located to the northwest of Phnom Penh, the country's capital and occupies the southeastern edge of the Tonle Sap Basin. It borders with Kampong Thom to the North, Kampong Cham to the East, Kampong Speu to the South and Pursat to the West. It is traversed by the National Highway 5 and the National Railway. Covering a land area of 45 km^2, Kampong Chhnang Town is situated at the center of Kampong Chhnang Province and lies west of the Tonle Sap River. It is accessible from Phnom Penh through the National Highway 5 in about 100 km.

[5] Consultation of PPTA National Environmental Specialist with Mr. Danh Serei, Deputy Director, EIA-MoE, on 26 June 2013.

79. **Climate.** Cambodia is situated in a tropical zone, between 10 and 14 degree latitude north of the equator. Its climate is influenced by the monsoon cycle and has two distinct seasons, the dry and rainy seasons. The northeast monsoon brings in the dry season from November to April. The dry season is cooler from November to January when cool air from Siberia flows in, and is dry and hot from February to April. The rainy season is experienced from May to October, as southwest monsoon brings in moisture and rains from the Indian Ocean. Average temperature has minimal variations regionally and seasonally. Weather is coolest in January and hottest in April. Relative humidity ranges between 65-70% in March and 85-90% in September. The rainy season accounts for about 80-90% of the annual rainfall, varying between 1,200 and 2,000 mm across the country. October is the wettest month; January/February, the driest or with the least rainfall. Mean wind speed in Cambodia is low at about 2 m/s. December is known as the month of strong steady wind from the north. Typhoons, which often devastate coastal Vietnam, rarely cause damage in Cambodia. Annual evaporation is from 2,000 to 2,200 mm, i.e., highest in March and April at 200 mm to 240 mm and lowest in September-October at 120 mm to 150 mm.[6]

80. Throughout the Tonle Sap Basin: (i) temperatures are fairly uniform; and (ii) annual rainfall varies between 800 and 2,000 mm. Records in the Kampong Chhnang Rainfall Station (Kampong Chhnang Town) for the five-year period of 2008-2012, show an average annual rainfall of 1,600 mm.

Table IV-1. Monthly and Annual Rainfall, Kampong Chhnang, 2008-2012

Year	Monthly Rainfall (mm)												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2008	0.0	11.0	2.6	25.0	259.3	97.1	170.6	92.0	326.0	169.2	267.0	0.0	1,419.8
2009	0.0	0.0	64.0	73.5	195.8	164.6	275.6	273.0	299.1	289.0	0.0	0.0	1,634.6
2010	26.2	22.1	148.6	40.5	191.6	80.8	126.5	147.4	147.4	236.8	51.7	0.0	1,219.6
2011	0.0	0.0	73.0	185.0	138.0	249.0	259.7	265.0	301.0	237.0	210.5	11.0	1,929.2
2012	94.0	17.0	24.0	96.0	135.4	187.5	318.1	293.5	180.5	269.5	212.3	3.3	1,831.1
												Average	1,606.9

Source: Provincial Department of Water Resources and Meteorology of Kampong Chhnang Province

81. **Climate Change.** In the past 40 years (1971 to 2010), the northwest provinces of Cambodia, which include Kampong Chhnang, had been experiencing: (i) increasing trend in drought frequency and duration; (ii) a steady heat level in the initial decade of 1971-1980, decreasing trend in heat in 1980 till 1990, and a rising heat thereafter; (iii) increasing trend in flood frequency and duration in the initial 35 years and a decreasing trend in the period 2005-2010; and; (iv) steady rise in rainfall frequency and intensity. Climate change projections indicate a rise in temperature of 0.3-0.6^{o}C by 2025, delayed onset of monsoon, increase of wet season rainfall, decrease of dry season rainfall and more intense flood pulses.[7]

82. **Topography, Geology and Soils**. The Tonle Sap Basin-Mekong Lowlands is the largest topographic region, covering about 75% of the country. It consists mainly of plains with generally less than 100 masl elevations. Terrain is rolling and dissected as elevation rises. Kampong Chhnang Town lies in the vast plain of this region at about 17 masl elevation. Underlain with rock of quaternary age, as most of Cambodia, Kampong Chhnang Town consists of water (Tonle Sap River and tributaries), floodplains and lake bed desposits bordering the Tonle Sap River, a small portion of granite on the NW, and pediments forming the SW boundary of the town. Soils consist of a mixture of often organic-rich silt, sand and clay, such as lacustrine alluvial soils and red-yellow podzols. The alluvial soils are fresh, deposited annually, relatively young/recent, highly fertile and largely grown with rice. The

[6] Cambodia Environment Outlook. Ministry of Environment and UNEP. 2009.

[7] Strategic Program for Climate Resilience in Cambodia. A presentation to the PPCR Sub-Committee by T. Chankresna (MEF), M. Sophal (MoE) and the Royal Government of Cambodia. Cape Town. 28 June 2011.

red-yellow podzols developed from chemical weathering/ decomposition of underlying parent material, generally have low fertility and are used for upland rice and non-rice crops.

83. **Surface Water**. Tonle Sap River flows through Kampong Chhnang Town in a N-SE or SE-N direction, (depending on the season) close to the Town's eastern boundary. The Tonle Sap River connects the Tonle Sap Lake to the Mekong River at the Chaktomuk confluence in Phnom Penh. The water flow of the Tonle Sap River and Lake is closely related to the hydrological performance of the Mekong River. In the wet season, about May to October, part of the Mekong River water flows into the Lake through the Tonle Sap River. In the dry season, about November to April, the flow changes its course from the Lake by flowing out to the Mekong River. Average annual flowOUT (flow from the Lake to the Mekong River) of Tonle Sap River between 1996 and 2009 was 69,826 MCM; average annual flowIN (flow from the Mekong River to the Lake) was 39,949 MCM.

84. The quality of water in the Tonle Sap specific to aquatic life, human impact and agricultural use of water, according to the assessment of MOWRAM's water quality data recorded over the period 1993-2008 at stations located in Figure IV-1 is presented in Table IV-2. The assessment shows the influence of human pressure on the quality of water upstream of, at and downstream of Kampong Chhnang. More recent water quality monitoring, i.e., during the wet months of 2011, with samples taken from the Phsar Kroam area (or embankment segment C-D in Figure III-1) revealed concentrations to be within standard limits for a limited set of parameters, as presented in Table IV-3.

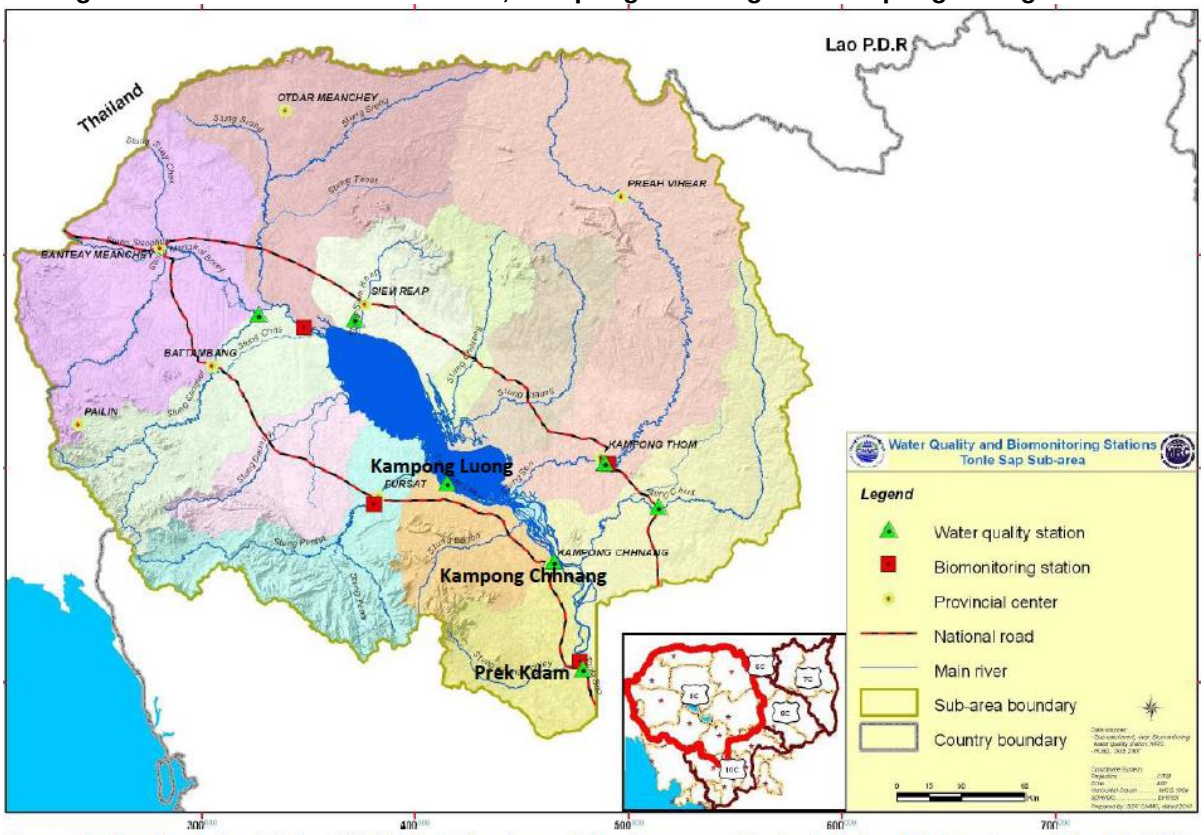
Table IV-2. Water Quality Indices for 3 Stations Located in Tonle Sap

Station Location	Water Quality Indices				
	Aquatic LIfe	Human Impact	Agricultural Use of Water		
			General Use	Irrigated Rice	Livestock
Prek Kdam	8.2 (moderate quality)	7.3 (impacted)	8.9 (can be used for general purpose)	9.9 (can be used without restrictions)	10.0 (can be used without restrictions)
Kampong Chhnang	8.0 (moderate quality)	7.0 (impacted)	8.7 (can be used for general purpose)	9.6 (can be used without restrictions)	10.0 (can be used without restrictions)
Kampong Luong	8.1 (moderate quality)	6.8 (severely impacted)	8.7 (can be used for general purpose)	9.6 (can be used without restrictions)	9.8 (can be used without restrictions)

Source: Profile of Tonle Sap Sub-Area (SA-9C). Basin Development Plan Programme. Cambodia National Mekong Committee. February 2012.

Showing influence of human pressure on water quality.

Figure IV-1. Location of Prek Kdam, Kampong Chhnang and Kampong Luong Stations



Source: Profile of Tonle Sap Sub-Area (SA-9C). Basin Development Plan Programme. Cambodia National Mekong Copmmittee. Feb 2012.

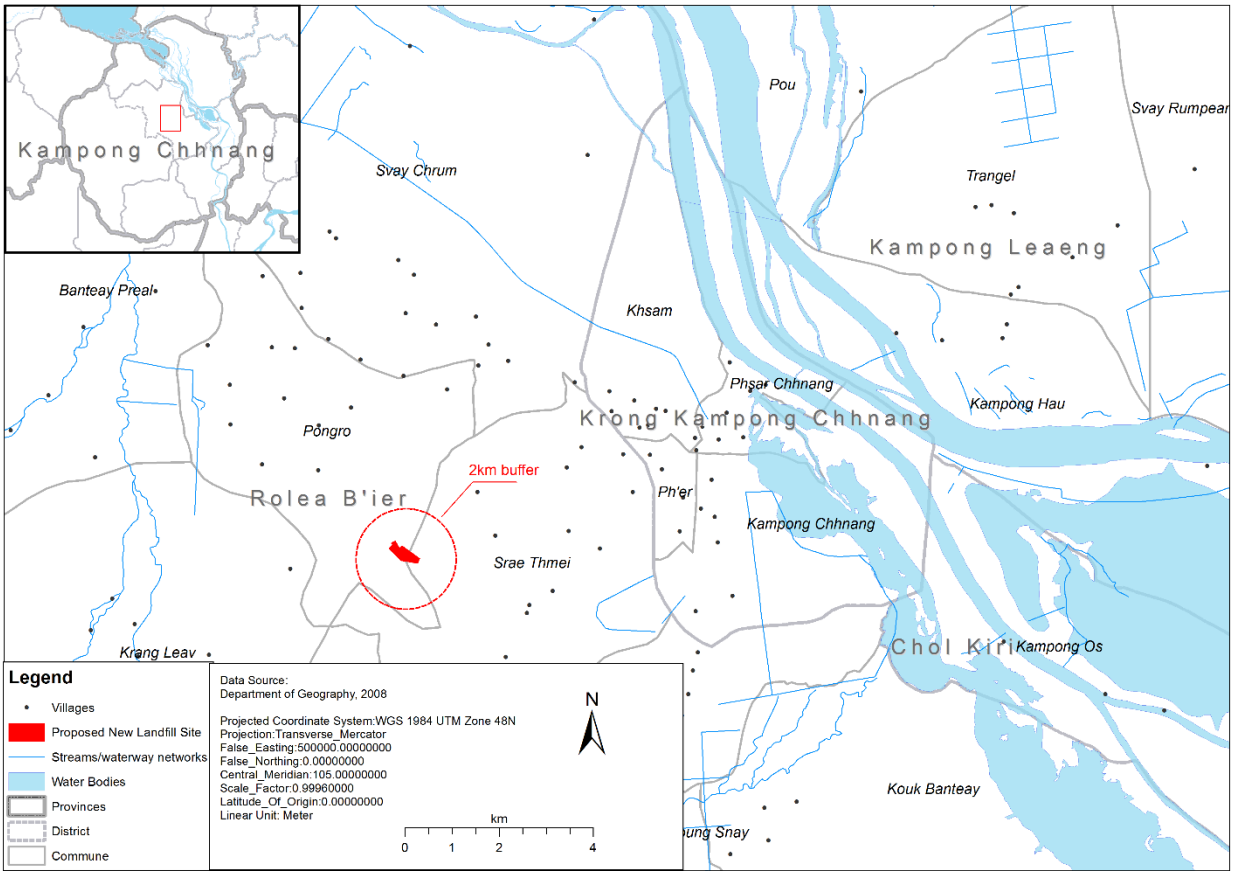
Table IV-3. Water Quality of Tonle Sap River, 2011 (at Phsar Kroam Area – Segment C-D)

No.	Parameter	Unit	Result				Standard*
			14 Jul 2011	10 Aug 2011	12 Sep 2011	12 Oct 2011	
1	pH	-	6.69	7.30	7.18	7.07	6.5-8.5
2	TSS	mg/l	90.00	62.00	66.00	94.00	25-100
3	BOD	mg/l	1.45	1.35	1.65	1.24	1-10
4	COD	mg/l	4.23	3.14	4.70	2.48	<8.0^
5	Cr^{6}	mg/l	ND<0.005	ND<0.005	0.005	ND< 0.005	<0.05
6	Total P	mg/l	0.06	0.03	0.007	0.01	0.005~0.05
7	Total N	mg/l	0.26	0.17	0.19	0.15	0.1~0.6

Source: Department of Pollution Control Laboratory Office. MoE.
* Annex 4 of Sub-decree on Water Pollution Control (No. 27/ANRK/BK of 06 April 1999).
^ MRC Guideline
Exceeded standard

85. There are no natural water bodies and stream networks within a 2-km radius from the proposed landfill site. There are only abandoned borrow pits and artificial drainage along the access road toward Phnum Touch village. The area is sandwiched between access roads to the West and South with foothills to the Northeast. Run-off from the foothills is collected through unevenly dug channels and ends at borrow pits.

Figure IV-2. Surface Water Networks and the Proposed Landfill Site



86. **Groundwater.** Groundwater depth in the Tonle Sap Basin varies considerably. The water table changes with rainfall, specific local geomorphologic conditions, and the distance to the permanent water of the Tonle Sap Lake. Based on a preliminary investigation on groundwater resources in the Tonle Sap Basin[8], overall, the Tonle Sap Basin presents high yield and quality water supply. Its exploitation is somewhat minimal, except in the Siem Reap area. The area around Kampong Chhnang consists of Saprolite aquifers, i.e., weathered bedrocks which take the form of fracture rock, gravel and sand and lies just above the fresh bedrocks. It grades upwards into clay. Water is trapped in the coarser grained materials below the clay and usually provides adequate amount of good quality drinking water for hand-pumped wells.

87. Based on an analysis of groundwater samples taken from tube wells throughout the four communes of Kampong Chhnang Municipality in August 2010, the general safety of deep aquifer groundwater is very good to excellent and the aesthetic quality of the water good to excellent (Table IV-4a). [9] Drinking water quality is also shown in Table IV-4b.

8 As subcomponent of the Tonle Sap Rural Water Supply and Sanitation Sector Project (ADB-Grant 0018-CAM-SF).

9 Groundwater Quality Analysis Reports for Kampong Chhnang-Kampong Chhnang-Phsar Chhnang, Kampong Chhnang, Ph'er and Khsar. Resource Development International – Cambodia (www.rdic.org). February 2011.

Table IV-4a. Rating of Groundwater Quality in Kampong Chhnang Municipality

Particulars		Commune			
		Phsar Chhnang	Kampong Chhnang	Ph'er	Khsam
Quality rating	General safety of deep aquifer groundwater	Very good	Excellent	Excellent	Very good
	Aesthetic quality of groundwater	Good	Excellent	Excellent	Very good

Source: Groundwater Quality Analysis Reports for Kampong Chhnang-Kampong Chhnang-Phsar Chhnang, Kampong Chhnang, Ph'er and Khsar. Resource Development International – Cambodia (www.rdic.org). February 2011.

Table IV-4b. Drinking Water Quality Index (DWQI) in Kampong Chhnang Municipality

Kampong Chhnang (No. of wells: 25)							
Parameters	**Iron, (mg/L)**	**As, ppb**	**Turbidity, ntu**	**NO_3, mg/L**	**Hardness, mg/L**	**pH**	**Mn, mg/L**
Max	1.94	10.00	8.90	55.48	432.00	7.07	2.11
Min	0.00	0.00	0.26	0.00	36.00	5.95	0.02
Median	0.23	0.00	0.91	0.84	197.00	6.59	0.13
Mean	0.35	1.20	2.45	5.72	222.44	6.60	0.24
Phsar Chhnang (No. of wells: 25)							
Max	2.05	100.00	8.89	119.11	1098.00	7.40	1.24
Min	0.02	0.00	0.27	0.00	90.00	6.64	0.01
Median	0.27	0.00	0.51	2.69	378.00	7.08	0.20
Mean	0.47	12.60	1.33	19.35	406.96	7.04	0.28
Khsam (No. of wells: 25)							
Max	4.35	0.00	24.70	51.53	738.00	7.15	0.62
Min	0.02	0.00	0.35	0.00	36.00	4.88	0.05
Median	0.17	0.00	1.42	2.81	251.00	6.50	0.16
Mean	0.49	0.00	2.93	9.24	304.76	6.50	0.21
Ph'er (No. of wells: 25)							
Max	1.78	0.00	174.00	15.02	630.00	7.59	0.55
Min	0.02	0.00	0.33	0.00	72.00	6.05	0.06
Median	0.39	0.00	1.18	0.12	251.00	6.89	0.14
Mean	0.49	0.00	11.51	1.73	280.24	6.85	0.18

Source: Drinking Water Quality Index (DWQI), Resource Development International – Cambodia, 2010

88. Elevated (or unacceptable) concentrations of Mn, NO_3, As, Fe, turbidity and hardness were observed in Kampong Chhnang Town. Exposure to elevated concentrations of: (i) Mn can cause neurological disorders, can cause water to be cloudy and unpleasant to drink, can cause discoloration; (ii) NO_3, even in the short-term, can cause blue-baby syndrome in infants; (iii) As can cause debilitating skin disease (arsenicosis), increased risks of contracting cancer, among others; (iv) Fe can cause water to be cloudy and unpleasant to drink, can cause discoloration, among others; (v) hardness can cause scaling of pipes and pans; and (v) turbidity can cause water to be cloudy and can likely cause unpleasant taste or odor. (Table IV-5)

Table IV-5 Contaminants of Potential Concern

Contaminants			Estimated Probability of Encountering Unacceptable Concentrations			
Of potential concern to		Unacceptable Concentration	Phsar Chhnang	Kampong Chhnang	Ph'er	Khsam
Health	Aesthetics					
Mn	Mn	>0.4 mg/l	25%	15%	2%	8%
NO_3	-	>50 mg/l	5%	1%	-	1%
As	-	>50 ppb	2%	-	-	-
-	Fe	>1 mg/l	11%	6%	14%	3%
-	Turbidity	>20 ntu	-	-	9%	2%
-	Hardness	>500 mg/l	28%	-	5%	13%

Source: Groundwater Quality Analysis Reports for Kampong Chhnang-Kampong Chhnang-Phsar Chhnang, Kampong Chhnang, Ph'er and Khsar. Resource Development International – Cambodia (www.rdic.org). February 2011.

89. **Air Quality.** Dust pollution is prevalent along unsurfaced access road towards Phnum Touch village. No major sources of pollution are found in the area. Ambient air quality can be described based on field observations on current sources of emissions, i.e., dust when strong winds blow over unsurfaced roads and when the low transport volume passes over unsurfaced roads during the dry season, dust and vehicle emissions from the quarry site and smoke emissions from domestic cooking and burning of wastes. . Ambient air quality and noise level are typical to low density secondary towns and concentration levels are assessed to be within the national standard limits. Baseline Ambient air quality (PM2.5, PM10, SO2, NO2) and Ambient noise levels (Lmax, Lmin, Leq) will be established by PMU as part of Environmental effects monitoring in Environmental Management Plan prior to construction phase.

90. **Natural Hazards**.[10] Cambodia is exposed to floods, drought, storms, earthquakes, landslides and forest fires. Flood and drought are the main physical hazards, their regular occurrence often within the same year. For the period 1987-2007, floods had been more destructive. Storms are occasional events; earthquakes are of low intensities; landslides are rain-triggered; and forest fires are not very common. Forest fires, however, could become a serious threat if current rate of forest degradation continues, coupled with increasing events of drought and hotter days. Flooding is also expected to increase in terms of frequency, severity and duration with climate change.

Table IV-6. Natural Hazards in Cambodia

Earthquake	Flood	Landslide	Drought	Storm / Typhoon	Volcano Eruption	Forest Fire	Tsunami
X	XXX	X	XX	X	-	X	-

Extracted from Table A.1.1. Disaster Matrix by Country (1970-2009). ASEAN: Advancing Disaster Risk Financing and Insurance in ASEAN Member States: Framework and Options for Implementation. Volume 2: technical Appendices. April 2012. World Bank, GFDRR, ISDR & ASEAN. Source of data is DRMI, 2010:59. Disaster incidence range from XXX 'high" to X 'low".

Table IV-7. Summary of Natural Disasters in Cambodia, 1987-2007

Natural Disaster		Number of Events	Persons				Cost ('000 USD)
			Killed	Injured	Homeless	Total Affected	
Flood	Total	12	1,125	53	275,805	9,514,614	327,100
	Average per event		94	4	22,984	792,885	27,258
Drought	Total	5	0	0	0	6,550,000	138,000
	Average per event		0	0	0	1,310,000	27,600

Lifted from Strategic National Action Plan for Disaster Risk Reduction, 2008-2013. National Committee for Disaster Management and Ministry of Planning. Source of data is EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be, Université Catholique de Louvain, Brussels (Belgium).

91. Floods. There are two major types of flood in Cambodia: (i) Mekong River flood and (ii) flash floods. Mekong River flood occurs with cumulative rainfall in the upper catchments throughout the rainy season, causing a slow but steady rise in water levels lasting for several days. This causes the Tonle Sap River to reverse its flow, expanding the Tonle Sap Lake to six times its dry season size. This event is worsened with heavy rains around the Tonle Sap

[10] Largely lifted from the Strategic National Action Plan for Disaster Risk Reduction, 2008-2013, National Committee for Disaster Management and Ministry of Planning.

Lake, affecting the provinces around the lake and the southern provinces. This event is most severe when heavy rains coincide with a tropical depression and storm.

92. Flash flood results with repeated heavy rainfall in the mountainous areas. Flash flood lasts for only a few days but often cause severe damages to crops and infrastructures, particularly in tributaries around the Tonle Sap Lake., Kampong Chhnang, is one of the Provinces that have been, and are prone to be, affected by flash floods. According to a map obtained from the Strategic National Action Plan for Disaster Risk Reduction, the communes in Kampong Chhnang Town are not among the priority flood-prone communes.

93. Drought. There are four characteristics of drought in the country (i) unpredictable delays in the onset of rainfall in the early part of the wet season; (ii) erratic variations in wet season rainfall onset, amount, and duration across different areas; (iii) early end of rainfall during the wet season; and (iv) occurrence of mini-droughts of three weeks or more during the wet season, which can damage or destroy rice crops without irrigation. Localized drought is also becoming increasingly apparent and significant in many areas, including areas that are also flood-affected. During the monsoon season of the year 2012, Cambodia experienced drought and flash flood. The drought affected 14 provinces. In Kampong Chhnang, less than 1,000 ha of rice field were adversely affected.[11] The Strategic National Action Plan for Disaster Risk Reduction, 2008-2013, shows that the communes of Kampong Chhnang Town are not among the priority drought-prone commune/s.

94. Storms. Sheltered by surrounding mountain ranges, storms or typhoons affect Cambodia occasionally. During storms, damages are largely caused by floods. Damage is most severe when storms come during September and October when seasonal discharge of the Mekong River is high and a second significant peak to annual flood is generated (MRC 2007).

95. Earthquake. Based on the Seismic Hazard Map of Southeast Asia, produced by the Seismic Hazard Assessment Program (GSHAP), 1999, Cambodia lies within the low seismic hazard zone, with peak ground acceleration of 0.2-0.4 m/s^2 (or 0.02-0.04 g), 10% chance of exceedance in 50 years. From a correlation with the modified Mercalli scale, intensity IV earthquake has a PGA range of 0.03 g and below. The Earthquake Intensity Risk Zones Map of the UN International Strategy for Disaster Reduction (ISDR) shows Cambodia to be within the earthquake intensity I-V zone. The observed effects of intensity V earthquake would include earthquake being felt by nearly everyone; some glasses/windows broken; unstable objects overturned; and pendulum clocks may stop.

B. Biological Environment

96. Cambodia has many diverse ecosystems, all supporting a variety of plants and animals. Its landscape includes extensive lowlands, including the alluvial plains surrounding the Tonle Sap Lake, where human population is largely rural and where most natural vegetation has been replaced by agricultural crops, particularly rice. Other major crops include maize, soybeans, mung beans, vegetables, groundnuts, and sesame. The Tonle Sap Lake and its wetlands and seasonally inundated forests, are part of the country's water systems that provide habitats harboring high levels of biodiversity. Protected areas found within Kampong Chhnang Province include: (i) Phnom Aural[12], a wildlife sanctuary which lies east of Cardamom Mountains; and (ii) Tonle Sap Biosphere Reserve (TSBR), consisting of the Tonle Sap Lake and its floodplain. Kampong Chhnang Town is away from the Phnom Aural. It is partly within the transition zone of the TSBR, where the construction of some

[11] Member Report, Cambodia. Forty-fifth Session of the ESCAP/WMO Typhoon Committee. 29 January-1 February 2013. Hong Kong, China.

[12] Names and designations used are based on Protected Area Law, 2008

physical infrastructure is allowed. The Tonle Sap River and its tributaries, rice fields and inundated grasslands are the wetlands within Kampong Chhnang Municipality. The protected area and type of wetland relative to the subproject sites are presented in Table IV-8. The subproject sites are not habitats of rare species of flora and fauna. However, according to the PDoE Director, in the vicinity of the abandoned Phnum Touch dumpsite, there have been reports of sightings of the Indochinese Spitting Cobra (*Naja siamensis*) and Burmese Python (*Python bivittatus*), which are both classified as vulnerable species in the IUCN Red List. Other fauna species reportedly found in the site are listed in Table IV-9. Among the vegetation found in the vicinity are shrubs such as Cassava or Tapioca (*Manihot esculenta*), small trees such as Calabur or Cherry Tree (*Muntingia calabura*) and tall trees such as Blue Gum Eucalyptus (*Eucalyptus globulus*). Eucalyptus would be good for the landfill for mosquito repellent and odor mitigation.

97. The area around the project site is predominantly agriculture lands. Landuse around the Phnom Touch dumpsite and proposed landfill site is characterized by shrublands and quaternary pediments.

Figure IV-3. Landuse near the Proposed Landfill Site

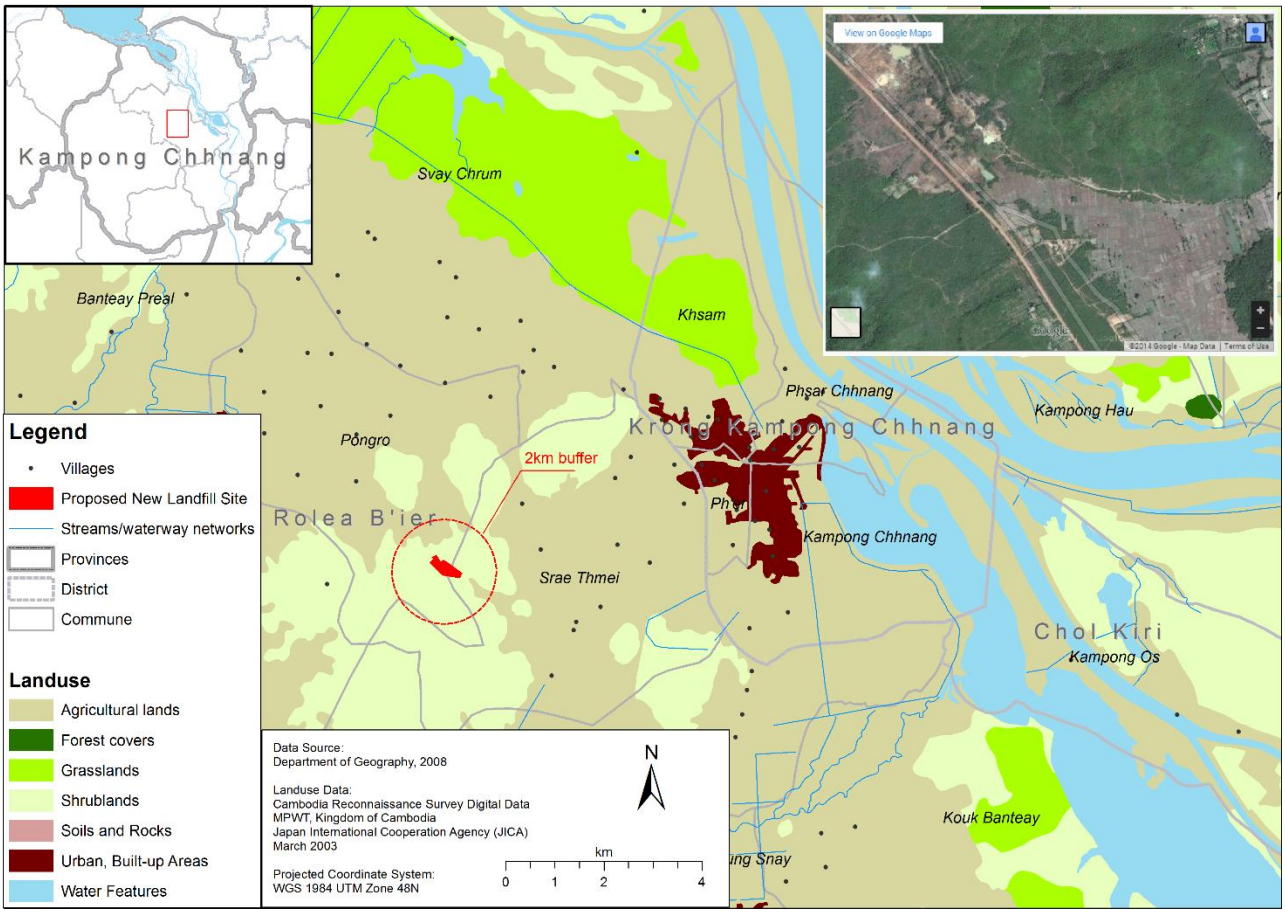


Table IV-8. Protected Area and Type of Wetland in Subproject Sites

Subproject	Protected Area	Wetland
Flood Protection		
Upgrading of existing embankment	Within the TSBR transition zone, where some physical infrastructure is allowed	Tonle Sap River & tributaries Rice fields
Construction of new embankment with road	Within the TSBR transition zone, where some physical infrastructure is allowed	Inundated grassland s Rice fields
Solid Waste Management		
Controlled landfill	-	-

Table IV-9. Fauna Species Reportedly Sighted in the Vicinity of Phnum Touch Dumpsite *

Common Name		Scientific Name	IUCN Red List Classification **
Local	English		
Mammals			
Kdan Nhaeng	Lesser Mouse-deer	*Tragulus javanicus*	DD
Tunsay Kul	Burmese Hare	*Lepus peguensis*	LC
Kanthuek	Northern Treeshrew	*Tupain belangeri*	LC
Kambrok Por	Variable Squirrel	*Callosciurus erythraeus*	LC
Sam Pouch Vor	Small Indian Civet	*Viverricula indica*	LC
Skar Touch	Small Asian Mongoose	*Herpestes javanicus*	LC
Chhlous	Red Muntjac	*Muntiacus muntjak*	LC
Chrouk Prey	Wild Pig	*Sus scrofa*	LC
Reptiles			
Pous Vek Dom Bouk	Indochinese Spitting Cobra	*Naja siamensis*	VU
Pous Vek Krobei	Monocled Cobra	*Naja kaouthia*	LC
Pous Thlan Touch	Burmese Python	*Python bivittatus*	VU
Pous Thlan Thom	Reticulate Python	*Python reticulatus*	NE

***** Obtained during meeting with Kampong Chhnang PDoE Director, Mr.Pov Bunthan, on 16 August 2013.

** Obtained from http://www.iucnredlist.org

C. Economic Environment

98. **Economy**[13] Most of the economic activities around the Tonle Sap are based on fisheries or agriculture. Fish processing is widespread, while agriculture focuses on rice production in most places. Infrastructure facilities are largely absent, particularly in the floating or stilted villages. The few access roads are mostly in poor condition. Ports and landing sites lack basic infrastructure; however, contribute effectively to livelihood generation. The lake is used for transportation of people and goods, including petroleum products and fish. Most of the people transported are foreign tourists. Low water levels in the dry season limit the size and traffic of boats. [14]

99. The capital of Kampong Chhnang Province, Kampong Chhnang Municipality serves as an administrative center and market town. It is a noted port. It is easily accessible from and to Phnom Penh via the National Road 5 and the national railway. It lies along the GMS Southern Corridor. Government has proposed for the development of the existing Kampong Chhnang Airport into an international airport. Kampong Chhnang is experiencing some 'overspill' from Phnom Penh, i.e., businesses that need access to the national road network but do not need to be located in the increasingly congested capital city. Town authority has reported recent industrial developments located on the outskirts of Kampong Chhnang Town. Agriculture and fisheries, services and small- and medium-scale businesses, and tourism and pottery craft (among the industries) make up the economic sector of the Municipality at present. Projects to upgrade National Road No.5 and the railway will further enhance the town's attractiveness for investors.

100. **Land Use and Urban Development**. In 2003, the general land use of Kampong Chhnang Municipality consists of water (largely the Tonle Sap River), agricultural land

[13] Kampong Chhnang Krong Data Book 2009. Kampong Chhnang Province. October 2009. National Committee for Sub-National Democratic Development (NCDD).

[14] Lifted from the Technical Note 10: Impacts on the Tonle Sap Ecosystem. Assessment of Basin-wide Development Scenarios. Basin development Plan Programme, Phase 2. Mekong River Commission. June 2010.

(mainly rice land), some grassland near the northwest boundary and urban/built up areas, which has intensified along the roads leading to Tonle Sap and has gone beyond the Municipal boundaries to the south/south west along the NR5 and west along the PR53. The existing embankment that will be upgraded and extended under the Project is within rice fields, urban built/up areas and flooded grasslands. The abandoned dumpsite that will be converted into a controlled landfill is within agricultural land and shrublands. Two (2) villages namely Trapeang S'bov and Phnom Touch which are respectively located in Srae Thmei and Pongro communes will be affected. The project area of influence is calculated to be 10 hectares including 200-meters buffer area from the edge of proposed landfill boundary.

101. **Infrastructure Development.** Roads and Transport The national and provincial roads within the Kampong Chhnang Municipality are all bitumen-surfaced; while the municipal roads are a combination of laterite or bitumen surfacing with many unformed roads. A by-pass of the National Road 5 (NR5) is proposed at around 5 km to the west of the town. Many roads lack roadside drains; while existing roadside drains are often silted up or blocked with solid waste. With relatively low traffic on municipal roads, in general, municipal road conditions are reasonable. Upgrading of roads is in the process. The main issue is flooding of the roads during the wet season and dust and mud on un-surfaced roads during the dry and wet seasons, respectively. There is no formal street sweeping; while streetlights are present only along the NR5. The national railway passes through Kampong Chhnang Province and is connected Kampong Chhnang Town through the Provincial Road 53. The Kampong Chhnang Airport has been proposed for expansion to become the new international airport of the country. Similar to Phnom Penh, local public transport mode is the tuk-tuk.

102. Water Supply The water supply system was originally built in 1939 and repaired in 1979, serving then only the town center offices and around 100 households. It was extended with Dutch (in 1997) and ADB (in 1998) assistance and now serves around 1,160 houses, or 23% of the population. The source is an intake on the Tonle Sap River close to the floating community area. Treatment is by a standard process of sedimentation and rapid sand filtration. The system is managed by the Department of Industry, Mining and Energy. The total length of the distribution system is 400 km.

103. In 2012, a private company, ANCO invested around USD 10 million in the town's water supply and plans to cover all the urban area including some areas outside municipal limits. ANCO's source is an intake further upstream on the Tonle Sap River and again treatment is by a standard process of sedimentation and rapid sand filter. Presently, there are 250 connections with new applications of around 20 per day. ANCO's connection charge is relatively high for many poor families to benefit from the system.

104. Drainage and Sanitation The existing combined system in the town center was built in the 1960s and extended in the 1980s. The system has multiple outlets that flow towards the Tonle Sap River and discharge untreated into drainage canals with much of the wastewater being used in the dry season for irrigation. The central market has its own sewer and outfall. The road inlets to the sewers are blocked with solid waste and there does not seem to be enough inlets to meet flood demands. The DPWT and Municipality have no exact number on the extent of coverage of the combined system; but estimate only 10 to 20% of the town as connected to the combined system. The Municipality estimates only around 50% of the town's households as having access to latrines making human waste disposal/sanitation a major issue. The town is frequently inundated during the wet season and various embankments have been constructed around the town at various periods. The major embankment forms the base of Provincial Road 53 that leads in an area with a large floating community. This embankment, however, was breached in 2011 causing major flooding and was raised and resurfaced in 2012.

105. The main cause of flooding in the town is from the Tonle Sap during the wet season. Flooding is also caused from runoff from the hills to the west of the town and when both of these flood events coincide, the town faces a major inundation problem. This occurred in 2011, when the existing embankment was overtopped and flooded up to the NR-5. Selected drains in the town are currently being rehabilitated under the assistance of the Japan International Cooperation Agency (JICA). Started in January 2013, it should be completed by the end of 2014.

106. Solid Waste Current waste collection is done by a fleet of three very old vehicles with capacity of 5, 6 and 10 m3. The two smaller vehicles haul 2 loads and the larger truck, one load, daily. Assuming the loads are 90% full, at a typical un-compacted raw waste density of 250-330 kg/m3, the total volume of solid waste hauled daily would be about 7 to 10 tpd. The current percentage of waste collection is estimated to be 40% of solid wastes generated in the town core. Collected solid wastes are presently disposed of at Traok dump site, an open dump located on private land in Srae Thmey Commune, Rolea B'ier District, under a treaty between the company providing the collection services and the private landowner. The property is less than one hectare in size and is beyond the Municipal boundaries, about 4 km from the town center. Disposal of solid wastes from the Municipality at this site was commissioned in 2010, as approved by the Provincial Governor.

D. Socio-economic Environment

107. **Population.** In the 2008 census, Kampong Chhnang Municipality registered a total population of 38,121 persons (7,415 families). With a land area of nearly 47 km^2, the Municipality had a gross population density of 817 persons per square kilometer (ppsk). By 2011, it was estimated that the Municipality had a population of 40,360 persons and a gross population density of 865 ppsk. Ph'er Commune had the highest population density at 2,653 ppsk, followed by Phsar Chhnang Commune at 1,649 ppsk. The existing embankment runs through communes with least population density (Kampong Chhnang and Khsam) and with the second highest population density (Phsar Chhnang). The abandoned dumpsite that is proposed for conversion into a controlled landfill is in a site that is suitably remote from human settlement.

108. **Ethnic Minorities.** The District Data Book 2009 reported that there was no family belonging to ethnic minority group present in Kampong Chhnang Municipality over the period 2006-2008. Of the 94 households surveyed in the PPTA's Socio-Economic Survey (SES), none belonged to indigenous minorities; 85% were Khmers and 15% were Chams. These households live in the village of Chong Kaoh next to the Tonle Sap River.

109. **Employment, Poverty and Vulnerable Households.** Of the respondents in the PPTA's SES, a majority or 77%, were self-employed. Employed respondents represented some 10%. About 3% of the respondents were without occupation; while 7% were retired. Based on the World Food Programme's identification of poor households survey in August 2012, poverty rates in the six municipalities around Tonle Sap Lake ranged from 22.6 to 31.8% in 2012. Kampong Chhnang Municipality had the higher percentage of poor families, 31.0%. Based on Ministry of Planning's poverty threshold for urban areas apart from Phnom Penh, i.e, 132,386 KHR monthly per capita (or approximately 661,930 KHR per household of 5 members), the majority (54.3%) of households surveyed in Kampong Chhnang are well above the poverty threshold. It should be noted, however, that around a quarter (25.6%) of the households are still below the poverty line, and 19.1% are just above the poverty threshold and could thus still be vulnerable to shocks.

110. Of the 94 households surveyed in the SES: (i) 20% were female-headed; (ii) 11% were headed by disabled persons; and (iii) 11% were headed by an elderly (over 65 years old).

111. **Security of Tenure and Housing.** According to the District Data Book 2009, in 2008: (i) of the total 7,415 families, 117 or nearly 2% were living on public land and 13 persons were without permanent housing; (ii) 58% of houses had zinc/fibro roof; and (iii) 70% of houses had electricity. Of the 94 households surveyed in the PPTA's SES: (i) 94% own the house they live in; (ii) 86% own the lot they occupy; and (iii) the rest are either renting or not renting the houses and/or lots they live in/occupy.

112. **Access to/Levels of Basic Services.** Education According to the District Data Book 2009, in 2008, the ratios of primary and total secondary students to class, classroom and teacher were lower than the national average ratios in the urban area. Based on the PPTA's SES, access to higher education among the heads of surveyed household appeared to have been fairly limited. The highest educational attainment of 23% of them was secondary level; of 22%, primary level; and of 21%, pre-school level. Most of the surveyed male household heads (28%) attained secondary level of education; while most of the surveyed female household heads attained only either pre-school level (30.0%) or primary level (30.0%).

113. Health Care Kampong Chhnang Province is divided into two health operational districts, one of which is based in Kampong Chhnang Municipality. A health operational district differs from administrative district boundaries. Hence, the Kampong Chhnang Health Operational District has operational jurisdiction beyond its administrative boundary. The Kampong Chhnang Operational District, according to the District Data Book 2009, had 1 referral hospital, 23 health centers and 3 health posts in 2008. Among these facilities, the referral hospital and 2 health centers can be found within the administrative boundary of Kampong Chhnang Municipality. The Operational District served a population of 282,930 persons in 2004 or 2005 with 4 doctors, 5 medical assistants, 117 nurses and 57 midwives. Ratios of persons: (i) to a doctor was 70,732; and (ii) to a nurse was 2,418. The referral hospital had 125 beds for patients with general diseases and 37 beds for patients with tuberculosis. Ratio of persons to a bed for general disease was 2,263.

114. Water Supply According to the District Data Book 2009, in 2008, only 21% of the total households in the Municipality had access to piped water supply. Pumped/mixed well was the source of potable water for 59%; ring wells and open dug wells by 6%; rivers, lake, natural pond and/or reservoirs by 12%; rain water and normal pond by the remaining 2%, of the total households. Of the 94 households surveyed in the SES, 38% sourced drinking water from boreholes; 19% from piped water supply connected to their houses; 14% from rivers/streams/springs; 10% from protected dug wells; 6.4% from piped water supply in their compounds. The rest reported as using rain water or purchasing water.

115. Sanitation According to the District Data Book 2009, in 2008, the ratio of people to latrine in Kampong Chhnang Municipality was 10.3.[15] By commune, the ratio ranged from 7.5 (in Ph'er) to 9.0 in Kampong Chhnang, 10.5 in Khsam, and 12.8 in Phsar Chhnang. Of the 94 households surveyed in the SES: (i) 66% had flush/pour flush toilets; (ii) 6.4% had pit latrines with septic tank; (iii) 7.4% had pit latrines without septic tank; (iv) 1% had dry pit latrines without slab; and (v) 14% had no latrines, were using other's latrine. The remaining 5% had other form of sanitation facility or disposal method.

116. Drainage Of the 94 households surveyed in the SES, 77% did not have access to drains; 18% had access to earth drains; and the remaining 5% had access to closed and cement-lined open drains. About 87% said their communes would flood during heavy rains and/or during river overflow. Of those served by drains, 12% reported drains to be too small; and about 10% reported their drains as clogged with sediments and/or solid wastes.

[15] Number of houses with latrines divided by the total population.

117. Solid Waste. According to the District Data Book 2009, in 2008, the percentage of households with access to solid waste collection by in the Municipality was 1.9%. By commune, it ranged from 0% in Ph'er to 0.6% in Phsar Chhnang, 0.9% in Kampong Chhnang, and 7.8% in Khsam.
Of the 94 households surveyed in the SES, 25% had access to solid waste collection services. Majority would burn their garbage. Some would bury their garbage, while some would throw their garbage anywhere.

118. Power Supply. In 2008, the number of households that were connected to the power supply grid was 3,236 (or nearly 44% of total households in the Municipality. (Total excludes homes powered by generators or batteries.) Electricity consumption per household in 2008 was 887 kWh.

E. Physical Cultural Environment

119. There are no physical cultural resources that will be affected by the proposed subprojects. According to the Municipality, no chance finds of archaeological/historical relics have yet been experienced or reported.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Positive Environmental Impacts and Benefits

120. The subprojects will bring about improved urban environment and climate change-resilience, significantly contributing to a qualitative improvement in the lives of residents in Kampong Chhnang Town. It will promote the implementation of the Tonle Sap Urban Areas Development Framework, and the Kampong Chhnang Town Development Strategy 2030 which will guide future urban development in the Tonle Sap Basin. Table V-1 presents the environmental benefits, positive impacts and outcome of the proposed subprojects.

Table V-1. Environmental Benefits, Positive Impacts & Outcomes

Aspect	Subprojects	
	Flood Protection	Solid Waste Management
Benefits	Improved protection from annual flooding from the Tonle Sap Safe perennial access	Improved SW collection & disposal
Positive impacts	Relief from flooding Reduced health and safety risks Improved mobility/access	Reduced/eliminated open & indiscriminate dumping & burning of solid wastes and relief from its associated issues --- fumes and uncontrolled gas emissions, odor & nuisance, contamination of water resources, health and safety risks, clogging of drains.
Outcome	Improved urban environment Safe, climate change resilient communities/ Town	Improved urban environment Safe communities and Town

B. Screening of Potential Impacts/Issues/Concerns

121. The screening process revealed the following salient siting concerns: (i) the Tonle Sap River, which is adjacent to some 350-m stretch of the existing embankment section to be upgraded and will be exposed to impacts during construction; (ii) the floodplain between the existing embankment and Tonle Sap River, which plays a crucial role during reverse flow of the Tonle Sap system and its size which needs to be reasonably sustained to cope with

climate change impacts on flood level and intensity; (iii) streams (or drainage channels for Town's stormwater runoff) crossing the existing embankment; (iv) dense urban development/ settlement on both sides of the existing embankment at the town center; and (iv) abandoned waste cell at the controlled landfill site that would pose health and safety hazard to construction workers.

122. Relative to design, the salient concerns would be the inadequate consideration/ incorporation in the respective designs of the above mentioned siting concerns and the following:

- climate change impacts on the hydrology of the Tonle Sap and crossing streams;
- concerns associated with the controlled landfill, such as; (i) climate change impacts on landfill operations; (ii) potential vulnerability of the soil and groundwater in the landfill site and its vicinity; (iii) closure/environmental restoration plan to at least mitigate the disturbance to, and blend with, the surrounding landscape; (iv) technical and financial capability of the operating institution to sustain an effective controlled landfill operations; and (v) remediation plan for the existing dumpsites that the controlled landfill will replace.

123. The identified direct impacts with potential moderate to high significance during construction are: (i) dust and noise; (ii) potential contamination of the Tonle Sap River and groundwater resources from construction sediments, waste and hazardous substances; (iii) potential soil erosion during embankment works; (iv) temporary disturbance to the landscape with parked vehicles/equipment, stockpiles, storage structures, sanitation facilities, pits, among others; (v) impacts on vegetation beyond the subproject footprints; (vi) risks to habitats in the Tonle Sap River and potentially in the surrounding hills of the controlled landfill site; (vii) impacts on the socio-economic environment and resources from traffic, blocked/constricted accesses, accidental damages of utility and damages from use of existing access roads; and (viii) public and workers' health and safety hazards.

124. From the screening process, indirect and induced impacts during construction namely, traffic/slower mobility in the town proper from embankment works and dust/suspended particles to potentially affect adjacent rice plants and yields, will potentially be of moderate magnitude and low significance. The screening of cumulative impacts during construction resulted to almost all of the screened impacts against the proposed embankment works of high magnitude and high significance, mainly due to the number of projects planned in the town proper.

125. During operation, main potential environmental impacts relate to the operation of the controlled landfill and improved collection fleet and equipment, and the embankment, to a lesser extent. Leachate and air emissions arising from, and inefficient operation and maintenance of, new solid waste management facilities are the major concerns.

C. Impacts/Issues/Concerns and Mitigation Measures Relative to Siting, Planning and Design

126. In the preparation of the feasibility study, resettlement plan and this IEE, measures were taken to minimize some of the aforementioned siting and design issues and concerns and the subprojects' other potential environmental and social impacts:

- The subprojects have been prepared within a highly consultative and participatory process through workshops, socio-economic survey (SES) and community focus group discussions to: (i) inform stakeholders about the proposed Project; (ii) obtain the priority needs and concerns; and (iii) agree on the subprojects.
- The alignment of the proposed embankment works have taken into careful consideration the existing settlement conditions and have optimally

avoided/minimized displacement and involuntary resettlement.

- All proposed works estimated the spoils that will be generated and to be managed. The excavated soils from drainage works will be reused as compacted backfill. The controlled landfill will use excavated soils as soil cover material for the entire life of Cell (Stage) 1.

Table V-2. Spoils Management

Spoil	Embankment		
	Cut/Excavated	Used as Backfill	Residual
Soil	150,000	100,000	50,000
Excavated rock	0	0	0
Removed refuse (if any)	0	0	0
Demolition waste (if any)	0	0	0
Other (if any)	0	0	0
Location/s of temporary storage	As fill in low-lying areas across the river		
Final disposal site/s	As fill in low-lying areas across the river		

Obtained from PPTA engineers.

- The IEE has incorporated the existing socio-economic and environmental conditions, issues and concerns raised in the SES.
- A resettlement plan has been formulated in a highly consultative, participatory manner.
- An environmental safeguard public meeting was held to present/disclose the IEE and existence of EMPs for implementation.
- In project preparation and IEE, other planned projects were taken into account.
- Preliminary design for the embankment has: (i) carefully studied and incorporated Tonle Sap system's hydrology and climate change-induced flood levels, applied a 50-year return period; (ii) specified protection against erosion during annual water levels change in the Tonle Sap and from heavy rainfall; (iii) accommodated crossing streams carrying stormwater flow from the Town to the Tonle Sap River by including outlets and, to avoid backflow, sluice gates; (iv) significantly mitigated involuntary resettlement by selecting to build a new embankment to the east of Sections E-F and F-G, bypassing the dense settlements, population, temples and school along the Sections; and (v) significantly kept the floodplain between the existing embankment and Tonle Sap River by shifting to the alignment to the east of Sections E-F and F-G at the barest minimum distance that would allow construction without adversely affecting the settlements.
- Preliminary design for the controlled landfill has: (i) included the appropriate leachate and gas management strategy, proposed groundwater monitoring wells and clay liner to protect groundwater and soil; (ii) recommended for a hydro-geological investigation during detailed design; (iii) carefully considered climate change issues; (iv) proposed for the greening of completed/capped waste cells and landscaping of the site; and v) recommended the institutional set-up for operations and its training.
- The proposed remediation of open dumps have considered the protection of the groundwater and soil, climate change issues, greening of completed/capped waste cells; and dealing with existing fumes and open burning as a priority.

127. During detailed design, the above initial mitigation measures will be carried on and/or validated. Consultations will be held and feedback should be taken into account. The potential impacts, issues and concerns that could arise during construction and operation can be avoided or, at least, mitigated with sufficient incorporation/consideration of the following during the detailed design stage:

- The demand for, and availability of and sources for, fine and coarse aggregates to be assessed carefully during detailed design not only to mitigate delays in construction progress and avoid prolonged exposure of open or disturbed

surfaces but also to avoid haphazard (and illegal) extraction of these materials. An Aggregates Management Plan (AMP) to be prepared during detailed design will serve as framework for the preparation of Contractor Aggregates Management Plan in the Contractor's EMP (C-EMP).

- Town's vulnerability to damages from other natural hazard events, existing utility infrastructures in the sites, relevant feedback/suggestions obtained during stakeholder consultations, and adaptation measures for other integral components of the controlled landfill, such as access and internal roads (flexible pavement, granular protection/bedding, optimum compaction, appropriate gradient), water supply (collect and store rainwater), buffer area/landscaping (use submergence and drought tolerant plants).
- Construction schedules and, if relevant, designs of other ongoing and planned projects in Kampong Chhnang Town to mitigate cumulative impacts.
- Appropriate environmental mitigation and monitoring measures are included in the EMP. The SPS-compliant EMP will be part of the bidding document. Selected Contractor will be required to prepare a detailed C-EMP that will address as minimum the requirements of the EMP. The C-EMP will be quantitatively and qualitatively evaluated against the EMP by the PMU and cleared by the ADB prior to the commencement of any work on site. The Contract for civil works will explicitly stipulate the obligation of Contractor (and his/her Sub-contractors) to institute the mitigation measures properly and carry out environmental monitoring according to the ADB-cleared C-EMP. The Contract for civil works will stipulate some tie-up of progress payment and collection of performance bond with the performance in C-EMP implementation.

D. Impacts and Mitigation Measures during Construction

128. **Impacts on Air Quality**. Dust and noise will be salient during construction. Moderate increase of sulphur oxides and nitrogen oxides levels in the ambient air quality will be expected intermittently, such as when VOC-emitting activities are undertaken and when there is peak movement/operation of construction vehicles and equipment. Unmitigated vibration could lead to health consequences and permanent damages of sensitive structures. These issues/impacts will be temporary but, if not mitigated, will have potentials to result in long-term consequences in the health of the affected communities and the construction workers. Some measures to mitigate are: (i) apply segmentation of works; (ii) water stockpiles & exposed surfaces at least twice a day, or as necessary; (iii) enforce slower maximum speed (40 kph) en route to sites & (30 kph) in subproject access roads and sites; (iv) minimize drop heights & spray water when loading/unloading aggregates; (v) ensure trucks hauling cement, aggregates and spoils to have cover and maintain a minimum of 2 ft freeboard; (vi) locate VOC-emitting processes away from receptors, (vii) undertake prompt maintenance of vehicles/equipment; (viii) encase generators and locate them away from receptors; (ix) limit noisy operations at daytime; and use least noisy and least vibrating equipment and tools.

129. **Impacts on Water Resources**. Tonle Sap River, the crossing streams and the groundwater resource (through existing boreholes and open dug wells in the vicinity) will be at risk of pollution from the proposed embankment works caused by: (i) poorly managed construction sediments, wastes and hazardous substances; and (ii) poor sanitation practices of construction workers. Polluted streams and Tonle Sap River will be detrimental to the rich and diverse aquatic resources of the Tonle Sap ecosystem, as well as to the health of people relying mainly on the river and streams as sources of water for domestic uses. Polluted groundwater will pose health risks to the groundwater-reliant households. Crossing streams will be vulnerable to being filled with sediments and wastes.

130. There is no surface water body in or near to the controlled landfill site. Groundwater table is reportedly at 50 m below the ground surface and soil at the landfill site is clayey, indicating slow permeability rate. Hydrogeological and soil investigations during the detailed design stage will have confirmed the groundwater and soil conditions.

131. Some mitigation measures: (i) use sediment traps, fences, nets and/or earth berms;; (ii) store aggregates, spoils and wastes away from water bodies and surface drainage routes; (iii) dispose of spoils and wastes promptly; (iv) provide adequate sanitation facilities at work sites; (iv) enforce upon workers good sanitation practices; (v) implement proper solid and hazardous waste management; and (vi) complete embankment works prior to the onset of the rainy season.

132. **Impacts on Soil**. Soil erosion, of moderate significance, may be caused on the existing embankment by construction works and/or vibration from movement and operation of construction vehicles/equipment near the slopes. Soil removed by erosion may become airborne, creating dust, and/or be transported away by water into water bodies and pollute them. With guided land disturbance and coordinated work program (if Contractor and sub-contractors will be working on a section at the same period), ensuring that the programmed embankment works are done prior to the onset of the rainy season and avoiding the disturbance of more slopes than necessary, soil erosion will be mitigated.

133. The concern for possible indiscriminate borrow operations for aggregate materials is considered to be minimal. However, as preventive measure, the magnitude of this concern will be confirmed during detailed design and carefully addressed through the formulation of an Aggregates Management Plan as framework for the Contractor's EMP and requiring Contractor's to obtain aggregates only from sources with environmental clearance and license to operate and that still have high ratio of extraction capacity over loss of natural state.

134. **Impact on the Landscape**. The proposed embankment works will be implemented in the dry season. During this time, the landscape at a longer length of the embankment will be a play of rice fields, shrubs and some trees. In the vicinity of the landfill site, the abandoned open dump (naturally burning during the dry season) is in the midst of rice fields and shrub lands surrounded by forested hills. Excavations, indiscriminately parked construction vehicles and equipment, stockpiles of aggregates, storage structures, sanitation facilities, pits and construction supplies/materials will disturb the landscape. This could be mitigated with planned and enforced orderly placement of construction amenities and stockpiles and observance of vehicle and equipment parking.

135. **Impacts on the Biological Environment**. The proposed subproject sites are not in any protected area. The existing embankment that will be upgraded and extended is within the almost 900,000-ha flexible transition zone of the Tonle Sap Biosphere Reserve (TSBR), where some types of infrastructure and development are allowed with approval, particularly an approved IEIA/EIA Report. Compliance with the conditions set out in approved IEIA/EIA report, implementation of the EMP (mitigation and monitoring) will prevent and minimize impacts..

136. The proposed embankment works will mainly upgrade the existing embankment. About 20 percent of the total length will be extending the existing embankment in the north and in the south along the unprotected settlements. A 350-m long section of the proposed embankment works is close to the Tonle Sap River. Tonle Sap ecosystem is rich in biodiversity and Tonle Sap contributes over half of the fish produced in the country. The impacts on Tonle Sap River is unlikely to be adverse inasmuch as works will involve only raising the existing wall to some 0.60 m (or 2 ft). The risks of adverse impacts on its flora and fauna species can be mitigated through the proper management of sediments, wastes

and hazardous materials and the enforcement of the observance of proper sanitation practices by construction.

137. Shrubs, trees within subprojects' footprints will be largely, if not all, removed. A plan to replace the removed trees can be one of the detailed design outputs. Vegetation outside the footprints, particularly at the embankment sites, will be potentially subject to trampling or hit by construction vehicles/equipment, structures, stockpiles of aggregates, excavated and residual soils, storage structures and workers. This can be mitigated through the: (i) determination during detailed design of the land required for work easement; (ii) inclusion of this required land in the resettlement plan as temporary disturbance/loss, as appropriate; (iii) installation of adequate physical demarcation during construction mobilization to ensure confinement of construction activities within the subproject footprint and work easement area.

138. **Impacts on the Socio-Economic Environment**. Traffic volume in Kampong Chhnang Town is currently low. The embankment road will be largely closed to vehicular traffic. Economic establishments in the main area of influence, including the three ports and the markets, will be highly affected. Delivery of goods, people and services will experience longer travel time. Road users and the clients/patrons of the businesses and market and port operations will be exposed to more road safety hazards. With mitigation measures in place, segmentation of works, prior consultation/ coordination/collaboration with concerned local authorities, temporary transfer (when appropriate) of port and market operations, and adequate prior public information, traffic impacts would be moderated.

139. Due to the restricted space, blocking of accesses to houses, properties, businesses, ports, markets and social institutions, as well as to construction sites cannot be avoided. Excavations, installations, loading and unloading, stockpiles of wastes and aggregates, storage of other construction materials, and potential indiscriminate parking of construction vehicles/equipment will create obstructions to accesses, gives inconvenience and nuisance, disrupt daily domestic and economic activities including port and public transportation operations, and pose safety hazards. To mitigate: (i) agree on safe accesses to provide with affected households and local authorities; (ii) post clear signage (reflectorized) at active junctions/sections; and (iii) provide adequate lighting at active works sites and provide safe accesses.

140. Some permanent power supply poles and those informal ones are potentially subject to relocation. Those that will be retained will be exposed to accidental damage during construction. During their relocation and when they are accidentally damaged, service interruptions will be experienced and domestic, social and economic activities will be disrupted. Access roads to the sites will be subject to pressures from the movements of construction-associated vehicles and equipment, resulting to road ruts in those that do not have sufficient capacity to accommodate the volume of construction vehicles to and from the sites. To mitigate impacts: (i) during mobilization, contractor should consult/coordinate with relevant utility companies on/for the exact locations, planned relocation & set contact arrangements in case of damage/s; (ii) consult/coordinate with local road authorities regarding proposed actions to take in case of damaged roads; (iii) in case of accidental damage, immediately inform the concerned company and/or the PIU and PMU; (iv) give at least 1 week prior notice on planned service interruption due to relocation of power supply poles; and (v) plan to provide interim services/actions for damaged utilities/community infrastructures, e.g., scheduled power supply using generators, for street lighting, interim re-surfacing of damaged access roads.

141. The health and safety of the community/public and construction workers will be at high risk during construction. These people will be directly and indirectly exposed to crosscutting threats from construction's impacts on air quality and water resources; noise and vibration,

traffic; blocked accesses to home, work, markets and social services, among others; open excavations; poorly managed construction wastes, wastewater and spoils; indiscriminate stockpiles of aggregates; hazardous substances transported to and stored on site; accidental spills of hazardous substances; reckless drivers of construction-associated vehicles; potential fire and explosion; and lack of awareness on the hazards posed by subproject implementation on health and safety. Communicable and transmittable diseases may potentially be brought into the community by construction workers; and/or construction workers may also be potentially exposed to communicable and transmittable diseases in the community and in the workforce. The adequate conduct of community IEC and pre-mobilization orientation for workers will raise the awareness and prepare both stakeholders of the health and safety risks during construction. Responsible C-EMP/EMP implementation by contractors will mitigate the cross-cutting threats during construction. Contractors shall set up a first-response team linked to an ultimate-emergency response team.

142. Inadequate supply of safe/potable water in construction sites; inadequate sanitation facilities; poor sanitation practices on site; poor housing conditions; the handling and operation of construction equipment; handling of hazardous substances; exposure to extreme weather and non-observance of health and safety measures, pose additional threats to the health and safety of construction workers. The Contractors shall ensure: (i) accommodations for workers are safe and adequate and sufficiently supported with basic services; (ii) workers are provided with protective wears and observe the enforced use of these during work.

143. **Impacts on the Sustainability of Works**. During construction, seismic or extreme weather event may occur, causing damage or movement to unsettled/unfinished/uncured structures and affecting their structural integrity. After every event, conduct an engineering investigation of built structures & implement the necessary corrective measures without delay. Prepare written report on the investigation findings & if applicable, the planned or implemented corrective measures.

144. **Assessment Summary**. Impacts during construction will be temporary and are expected to be local, confined within the active work sites and their immediate vicinities. Except during windy days, heavy rainfall and/or extreme weather event, dust, odor, fine aggregates, sediments and wastes would not be the transported beyond these sites. With proper mitigation measures in place, such as: (i) special care taken at sensitive locations, e.g., embankment section beside the Tonle Sap River, mosque along the new section to the north, streams crossing the embankment, sections close to settlements; and (ii) ensuring that, when practicable, works are properly phased, segmented and organized so that the bulk of works are completed (or at least almost complete) prior to the commencement of another phase/segment, the potential adverse impacts during construction would be minimized and kept highly site-specific. These impacts will not be sufficient to threaten or weaken the surrounding resources.

145. Measures to keep construction impacts to the minimum or acceptable levels are mostly good engineering and construction practices. A detailed set of mitigation measures are featured in the EMPs (**Annexes E** and **F**). The effective conduct of the following are crucial mitigation measures as well: (i) construction management by the Contractor; (ii) supervision of C-EMP implementation by the Contractor's Environmental Management Engineer; (iii) construction supervision by the PMU; (iv) monitoring of C-EMP implementation by the PMU; (v) observance of the Grievance Redress Mechanism by all concerned parties; and (vi) the participation of concerned communities in the monitoring of C-EMP implementation.

146. In case of chance find of buried physical cultural resource: (i) construction work or any activity should stop immediately; (ii) finder should make a declaration to the local police, who shall communicate it to the Provincial Governor at once; (iii) Governor shall in turn inform the

competent authority and ensure protection of the found object/s and the site; (iv) competent authority shall, within 30 days from date of declaration, announce temporary suspension of works and the safeguarding measures to take; and (v) if no such measures are announced within 30 days, temporary suspension shall no longer apply and the competent authority shall decide on the permanent measures to take.

147. In case of chance find of UXO during construction: (i) Construction work should be immediately stopped and area, immediately secured. (ii) The local police should be immediately contacted for ensured security of the area and for them to communicate with the Cambodian Mine Action and Victim Assistance Authority (CMAA). (iii) PIU should immediately inform the PMU, which being based in Phnom Penh, could also coordinate the matter with the CMAA.

E. Impacts and Mitigation Measures during Operation

148. During operation, the main potential direct impacts relate to the operations of the controlled landfill. In all three operations, in case of inefficient operations, maintenance and repair, unsustained effectiveness of their operations and services will result.

149. **Controlled Landfill**. The impacts associated with the operation of the controlled landfill include: (i) air pollution from dust, gas, fumes and odor; (ii) ground water contamination; (iii) soil contamination from leachate and gas migration; (iv) impact on the landscape from fumes, open mounds of waste, scattered wastes and wind-blown litters; (v) pests/rodents/vermin, bird & stray animal attraction; (vi) wind-blown litters; (vii) fire/explosion; (viii) health and safety hazards of, & nuisance for, community along the access road; and (ix) workers' health and safety hazards.

150. Some mitigation measures include the: (i) application of soil cover; (ii) watering of access and internal roads and stockpiles of soil cover material; (iii) monitoring of groundwater and gas migration; (iv) implementation of the gas collection and flaring as soon as necessary; (v) recovering of recyclable materials that will emit volatile organics; (vi) leachate monitoring and maintenance of the leachate re-circulating system; (vii) using of litter fence around tipping area; (viii) open garbage trucks to have tarpaulin cover over hauled waste and to maintain 1.5 ft freeboard; (ix) setting up of a first-response team; (x) enforcing upon workers the use of protective wears provided them; (xi) conduct of regular training of landfill staff; (xii) timely provision of adequate budget for landfill operation and maintenance; and (xiii) the conduct of engineering investigation after every seismic or extreme weather event & implementation of the necessary corrective measures without delay.

151. **Improved Waste Collection Fleet and Equipment**. The anticipated concerns include: (i) leachate drippings during collection, temporary storage in hook lift bins and haulage; (ii) odor, flies and pests at hook lift bins and their stations, pushcarts, open tipping trucks from lack of keeping the premises and equipment clean; (iii) mud spread with the movement of the fleet to and from the landfill; and (iv) health and safety hazards of, & nuisance for, community along the access road and households near to the bin stations. The main measures to mitigate these concerns/impacts are ensuring cleanliness and technical maintenance of equipment and cleanliness of their parking/garage/station areas, as well as wetting or cleaning of tires prior to leaving the landfill particularly during the rainy season.

152. **Upgraded Embankment**. The embankment road will generate dust and noise from road users but expected to be low magnitude. Safety risks include overtopping of the embankment, failure of the embankment, and potential increased flooding behind the embankment. Preliminary engineering studies, however, has evaluated the probability of

these risks as low to very low, particularly that preliminary design has considered adequate factors of safety, and which should be kept incorporated during detailed design. Unauthorized entry into (or unauthorized use of) embankment road prior to full stabilization will expose its structural integrity to risk. Physical barriers with legible warning signs should be displayed at strategic locations. Coordination with the village and commune officials on this concern and in disseminating the warning would mitigate the risk.

153. The Provincial Disaster Management Committee (DMC), chaired by the Deputy Provincial Governor in charge of Environment, should develop a contingency plan to deal with the unlikely, yet potentially disastrous, overtopping of the embankment. As operator of the embankment, the Provincial Department of Water Resources and Meteorology (PDWRaM), should have an emergency response plan and set up its Safety Team as initial responder of emergency, linked to an External Emergency Response Team) (EERT) as ultimate responder.

154. **Mitigating Impacts during Operation**. The magnitude of direct impacts arising from the operation of completed works will highly depend on the degree of environmental considerations made from the start of subproject development through to operation. Some basic measures are as follows: (i) effective supervision of detailed design and construction, and performance monitoring by the PMU; (ii) quality construction by the Contractors; (iii) sufficient provisions in the annual budget for operation, maintenance and repair, as well as for emergency response; (iv) undertaking the recommended environmental effects monitoring during operation; (v) prompt action to raised issues/concerns/grievances; (vi) Operators to engage/designate a staff to oversee EMP implementation and prepare the required environmental monitoring reports; and (vii) conduct of engineering investigation after every natural hazard event, and prompt action on damages. A detailed set of mitigation measures are featured in the EMPs (**Annexes E** and **F**).

Table V-3 Safety Risks during Operation of Upgraded Embankment

Risk	Probability	Impact	Mitigation Measures
Overtopping of embankment	Very Low	Very damaging	Design – includes factor of safety. Operations – need to ensure all sluice gates are closed when necessary.
Failure of embankment	Low	Very damaging	Design – Includes strong embankment protection to increase resilience and minimize maintenance. Construction – Ensure adequate supervision of contractor Operation – Annual maintenance and inspection required.
Flooding behind the embankment increases	Medium	Medium	There are adequate retention areas behind the embankment at present. If these areas are urbanized, then pumps may have to be installed. The design allows for this.
Climate change accelerates the rising level of the Tonle Sap	Medium	Medium	Design – accommodates climate change in factor of safety and the design allows for be further raising of the embankment.

Source: PPTA Engineers

F. Impacts and Mitigation Measures during Decommissioning of Open Dumps

155. The salient impacts from remediated dumps are leachate and gas. Soil cover and capping, peripheral drains, adequate side slopes of mounds, groundwater quality monitoring and vigilance on gas migration and prompt actions on groundwater contamination and gas migration are the main mitigation measures.

G. Indirect, Induced and Cumulative Impacts

156. **During Construction.** The proposed embankment works will be the main generator of indirect and induced impacts; the controlled landfill works to a lesser extent. The volume of vehicle movements that will be generated from the almost simultaneous construction of the two subprojects and the likely closure/blocking of some roads/lanes leading to the construction sites will cause traffic build-up and choke points, particularly in the town center along PR 53 east of the NR 5 and at the junction of PR53 with NR 5. In the town proper, there will be slower mobility, longer travel time; slower delivery of goods, people and services than usual. A greater number of people will be exposed to safety hazards from traffic and constricted road space. Coupled with disruption of economic activities and social services from interrupted power supply due to relocation of power poles and/or accidental damages, production outputs will suffer some slowdown. Severe dust falling on rice plants would have some effect on the rice fields' yields. Apart from the applicable mitigation measures for direct impacts during construction, the coordination with the relevant commune and village authorities, social service institutions and business associations should enable further mitigation of indirect and induced the impacts.

157. Based on the screening of cumulative impacts, the construction of the controlled landfill will not generate, if at all will generate least, cumulative impacts. The cumulative impacts of proposed embankment works will be due to the possibility of its simultaneous construction with at least 4 planned projects east of the NR 5, namely: (i) Kampong Chhnang-Kampong Thom Bridge taking off from the end of PR 53 at the embankment at the ports area; (ii) two access roads starting from the embankment road; (iii) new wastewater treatment plant between NR 5 and embankment road; and (iv) improvements of the tourism, agricultural and fish ports at the end of PR 53 at the embankment road. The ongoing JICA drainage and sewerage project is expected to be in its defects liability period during the construction of the proposed embankment works. Immediately west of the NR 5 at the junction with PR 53, main drains are proposed to be installed.

158. As such, the proposed embankment works will generate cumulative impacts of high magnitude and significance in terms of dust, noise, water resources contamination, soil contamination, impact on aquatic habitats in the Tonle Sap River, traffic, blocking of accesses, health and safety hazards and disruption to social services and economic activities. To bring cumulative impacts down to acceptable levels:

- Project proponents/implementers must agree on a collaborative efforts to mitigate impacts through responsible implementation of their respective EMPs;
- There must be adequate consultations with stakeholders and local traffic authorities and coordination among project proponents/implementers for a unified traffic management scheme and public information/disclosure.
- Provide temporary bypass routes in consultation with affected stakeholders and local authorities. This route must first be prepared (e.g., conditioned to accept the traffic spill, installed with signage) and maintained regularly as agreed on by the concerned projects.
- The grievance redress mechanism should be disclosed (through public meetings, display at strategic places and media) to the communities affected by the cumulative impacts.

159. **During Operation**. Indirect, induced and cumulative impacts will be mainly generated from the operation of the completed embankment; while from the controlled landfill, to a lesser extent.

160. Growth in the annually flooded areas of Kampong Chhnang Town will continue even without the IUEMTSP interventions, which will pose further environmental threats and damages in the lives of the concerned communities and the Town as a whole. With a climate change-resilient embankment and improved solid waste collection and disposal, the Town will expect overall positive benefits, impacts and outcome to lead the Town to sustainable development. At the same time, however, the completed works also pose risk and adverse impacts.

161. The upgraded embankment will create substantial flood free land east of the NR 5. There is a risk that this will encourage more urban development in the area, reducing the stromwater retention area. However, a new by-pass road is proposed to be built about 5 km to the west of the town center. This should pull future growth of the town away from the Tonle Sap towards the west of the Town, particularly for industrial development. Yet, the development of better access to the port on the Tonle Sap, together with the completion of the proposed Kampong Chhnang- Kampong Thom Bridge from PR 53 and all currently planned projects, could cumulatively encourage more development in the newly created flood-free land, particularly if many of the boat population decide to relocate to permanent structures but maintain fishing as their main source of income.

162. The area east of the NR5 is within the "flexible transition area" of the Tonle Sap Biosphere Reserve, defined under the Decree on the Establishment and Management of the Tonle Sap Biosphere Reserve as "*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*". This means that some degree of urban development is allowed over the newly created flood-free land behind the upgraded embankment. The line ministries concerned with the management of the flexible transition area in coordination with the TSBR Secretariat should initiate an update of the management plan through a highly consultative and participatory process, in anticipation of growth over the newly created flood-free land and ensuring sufficient allocation of retention areas and their preservation.

163. With proper development controls, the overall, indirect, induced and cumulative impacts will be more positive than adverse, and will be due to improved urban environment.

H. Unanticipated Impacts during Construction and Operation

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

VI. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

165. Stakeholder consultation and participation was an essential process in project preparation. The process in engaging stakeholders and affected people involved workshops, household socio-economic survey and safeguards-specific consultations.

166. Workshops, which had the active involvement of representatives from national ministries and agencies, the six provinces and six municipalities, were held to obtain stakeholders agreement/ confirmation on several aspects of project preparation, including the set of criteria for town prioritization and the selection of priority towns and subprojects. The Inception Workshop of 25 April 2013 resulted, among others, in: (i) a stakeholders' agreement to focus current investments on two towns; (ii) the incorporation of stakeholder's feedback on the set of criteria for town prioritization; and (iii) arriving at the selection of Kampong Chhnang and Pursat for the current project preparation, based on the town prioritization scoring exercise and recommendation of the executing agency. In the Interim Workshop of 24 June 2013, the stakeholders, among others: (i) confirmed the proposed subprojects for further design and feasibility; and (ii) provided their capacity development needs.

167. A Socio-Economic Survey (SES) was conducted on 16-18 July 2013. It has incorporated environmental queries recommended by the Environmental Specialists of the PPTA, such as those concerning access to and satisfaction/problems with the existing basic services, experiences with natural hazards, priority environmental issues, and perceived benefits from and adverse impacts of the Project. The survey covered 94 households, representing 5% of the total households in villages in which the proposed subprojects will be implemented. Most findings from the survey are presented in the description of socio-economic environment (Section IV-D); others are presented in **Annex D**.

168. Environmental safeguard-specific consultations included: (i) formal discussions/meetings with relevant government institutions; (ii) some brief informal interviews with randomly picked relevant persons during site visits; and (iii) an environmental safeguard public meeting. **Annex D** presents the topics discussed with consulted government institutions and notes of the brief interviews with randomly picked relevant persons.

169. In the environmental safeguard public meeting held on 25 October 2013 at the Aranh Pagoda, Kampong Chhnang Municipality, attended by 24 persons representing the population in the subproject sites, the following were presented: (i) general overview of the subprojects; (ii) subproject benefits, positive impacts and outcomes; (iii) potential salient environmental impacts from the subprojects; (iv) proposed measures to mitigate them; (v) existence & implementation of environmental management plans (EMPs) that include environmental mitigation and monitoring; (vi) existence and observance of a grievance redress mechanism during project implementation; and (vii) compliance with Government and ADB environmental safeguard policies. No question, issue or concern was raised during the public meeting.

Table VI-1 Environmental Safeguard Public Meeting

Date	Consultation Venue	Consulted Group	No. of Participants			Issues raised / Discussions / Responses / Outcomes
			Total	M	F	
25 Oct 2013	Aranh Pagoda, Kampong Chhnang Municipality	Representatives from Subprojects' villages	24	17	7	No question, issue, concern raised.

170. Stakeholder consultations will continue through subprojects implementation and operation. All stakeholders must be invited and encouraged to participate in community consultations. To facilitate the engagement of stakeholders, the PMU and PIU will maintain good communication and collaboration with Commune Councils and Village Leaders. The PMU, PIU Contractors and/or Operators will be open to contact by the public on matters concerning the progress of the subprojects, adverse impacts, mitigation measures and environmental monitoring and grievances. Future stakeholder consultations will include the following:

- During detailed design, if update of the IEE is warranted, it would be appropriate to disclose the updated IEE to the affected communities and solicit feedback.
- Prior to construction, the PMU will conduct an intensive information, education and communication (IEC) campaign to ensure sufficient level of awareness/information among the affected communities regarding the upcoming construction, its anticipated impacts, the grievance redress mechanism, contact details and location of the PMU and PIU, and status of compliance with Government's environmental safeguard requirements, among others, are attained/provided. Billboards about the subproject, implementation schedule and contact details of the executing agency, PMU, PIU and Contractors will have been set up at strategic locations within the subprojects' main areas of influence. The grievance redress procedure and details will have been posted at the offices of the PMU, PIU, Municipality and concerned Commune Councils and at the residences of concerned Village Leaders.
- During construction, regular random interviews will be conducted by the PIU to monitor environmental concerns of subproject communities.
- During operation and for a certain period during decommissioning of open dumps, periodic random interviews to be conducted by the PIU and Operators to monitor the environmental concerns of communities.

171. To date, the following information have been disclosed during an environmental safeguard public meeting held on 25 October 2013 at Aranh Pagoda, Kampong Chhnang Municipality: (i) Sub-project/sub-component descriptions, locations and activities; (ii) environmental benefits, positive impacts and outcomes of the subprojects; (iv) potential salient environmental impacts and mitigation measures, particularly during construction and operation; (v) environmental monitoring that is open to active community participation; (vi) general features of the proposed environmental grievance redress mechanism; and (vii) status of compliance with GoC and ADB safeguards requirements.

172. The IEE (in both English and Khmer), as well as the MoE-approved IEIA/EIA Reports (in Khmer), will be available at the offices of the PMU and PIU for consultation by stakeholders. Copies may be made available upon request. The IEE and environmental monitoring reports will be disclosed on the website of the ADB and MPWT/PMU.

VII. GRIEVANCE REDRESS MECHANISM

A. Proposed Set-Up

173. The MPWT, as executing agency of the IUEMTSBP will establish the GRM, and its support system, including the setting up of the Grievance Redress Committee (GRC) at the subproject (provincial) level. The GRC will comprise of local sangkat or village leaders, representatives of the Municipality (involved in social and environmental concerns), and PIU social and environmental safeguard counterparts. The PMU's social and environmental safeguard staff will oversee the GRM implementation. Their counterparts in the PIUs will ensure the GRM implementation at the town level and will be responsible for keeping the PMU informed. Contractors and Operators will be required to designate their respective counterpart GRM staff. The village leaders, sangkat leaders and social and environmental

safeguard staff of the Municipality will serve as grievance access points for APs preferring to approach their local leaders/government.

174. The GRM will accommodate both informally- and formally-lodged, but Project-related, valid grievances. The PMU, PIU and GRC will maintain records of all grievances received, whether informally- or formally-lodged, valid or invalid, and appealed. The PIU will immediately inform the PMU, as necessary, particularly when APs resort to appeal. The PMU will in turn immediately inform the ADB of the same. GRM implementation will be reported by the: (i) PIU in the Subproject's monthly progress reports, semi-annual monitoring reports during construction and annual monitoring reports during operation; and (ii) PMU in the Project's monthly progress report, semi-annual monitoring reports during construction and annual monitoring during operation.

175. Sufficient support system, including well GRM-oriented staff of Contractors and Operators, access point persons at the Municipality, villages and sangkats, communication facilities, documentation/recording, and reporting system, funds, posters declaring contact details and displayed at strategic locations, among others, will be in place to sustain the effective implementation of the mechanism.

B. Access to the Mechanism

176. Any person who has environmental concerns/issues pertaining to the subprojects during detailed design, construction and operation phases will have access to the mechanism free of charge. The PMU, through its social and environmental safeguard staffs and their counterparts in the PIUs, will ensure that:

- the public, especially the residents and regular passers-by, in the main areas of influence of the subprojects, are aware of their rights to access, and will have access to, the GRM free of administrative and legal charges; and
- the GRM is fully disclosed prior to construction: (a) in public consultations and IECs or social/community preparations, (b) through posters displayed in the offices of the PMU, PIU, Municipality and concerned Villages/Sangkats and at strategic places within the main areas of influence of subprojects (posters to include names and contact details of the head and social and environmental safeguard staffs of the PMU and PIU.

C. GRM Steps and Timeframe

177. **Informal Approach.** Informally, an affected person (AP) can lodge complaint directly to the Contractor during construction or Operator during operation. Contractor/Operator will immediately document and screen the complaint. If screening reveals the complaint as Project-related and valid, the Contractor/Operator will act within three days from receipt of complaint. Otherwise, the Contractor/ Operator will direct the AP with non-Project-related and/or invalid complaint to the PIU for the formal approach. The Contractor/Operator will secure a confirmation of completion of action from the AP. For at least a week after confirmation of completion, the PIU will monitor the effectiveness of the action/resolution taken. After which, PIU will secure a written confirmation of satisfaction from the AP. The Contractor/Operator shall report to the PIU all complaints received, eligible or ineligible, actions agreed on and taken, and confirmation of completed action.

178. **Formal Approach.** If informally lodged complaint is valid but is not acted on within three days from receipt of complaint, or if AP is not satisfied with the resolution undertaken by the Contractor/Operator, AP can access the formal mechanism, which comprises of four stages.

First Stage. (Day 1) Complaint is filed at the subproject (town) level, verbally or in writing, with the PIU, village or sangkat resettlement sub-committee, or IRC working group. Complaint is screened if project-related and valid, and AP is immediately informed of the screening results. An AP with complaint screened as non-Project-related and/or invalid will be advised that he/she can raise his/her complaint to the second stage; and receiving agent will formally forward the complaint to the District Office. Project-related and valid will be attended to as follows:

- For social complaints, by the village or sangkat resettlement sub-committee or IRC working group. (Presented in the Resettlement Plan Kampong Chhnang.)
- For environmental complaint, by the PIU; and the steps and timeframe involved in addressing environmental complaint at the first stage are presented below.

Step 1	Investigation, Discussion and Agreement (Day1/Day2)
PIU, together with the Contractor/Operator and AP, will investigate and discuss the complaint at the site within 2 days from filing of complaint. Agreement on actions and measures and time involved will be made with the AP. Agreement will be properly documented and filed; PIU, AP, Contractor/Operator will have copies.	
Step 2	Implementing the Agreed-on Resolution
- If required action is minor, i.e., not requiring further investigation and would be quick and easy to implement, the Contractor/Operator will immediately implement the agreed action. (starting Day2/Day3) - If required action is major, i.e., requiring further investigation and/or procurement of supplies/parts, the Contractor/Operator will: (i) immediately provide the most suitable interim measure to reduce the magnitude of the impact (starting Day 2/Day 3); and (ii) start work on the major action within 5 days from discussion (or not later than Day 8 since receipt of complaint). AP will be advised by the PIU that his/her complaint may be raised to the second level of the GRM, if he/she so prefers when: (i) minor action is not implemented within 2 days from discussion; (ii) interim measure prior to major action is not implemented within 2 days from discussion; or (iii) major action is not started within 5 days from discussion.	
Step 3	Confirmation of Completed Action
	Contractor/Operator will secure a written confirmation of completed action from the AP and furnish the PIU a copy.
Step 4	Confirmation of Satisfaction (1 week after confirmation of completed action)
	The PIU will monitor the effectiveness of the resolution for at least a week after receipt of confirmation of completed action from the Contractor/Operator. After which, PIU will secure a written confirmation of satisfaction from the AP.

Second Stage. For actions not taken within the agreed timeframe and when AP is dissatisfied with the action taken at the First Stage, AP can raise his/her complaint to the District Office. The District Office has 15 days within which to resolve the complaint to the satisfaction of all concerned. If the complaint cannot be solved at this stage, the District Office will bring the case to the Provincial Grievance Redress Committee.

Third Stage. The Provincial Grievance Redress Committee meets with the aggrieved party and tries to resolve the complaint. The Committee may ask for a review by an external monitor (EMO). Within 30 days of the submission of the grievance, the Committee must make a written decision and submit copies to the MPWT, EMO, PRS/IRC and the AP.

Fourth Stage. If the aggrieved AP does not hear from the Provincial Grievance Redress Committee or is not satisfied with the decision, he/she can bring the case to Provincial Court. This is the final stage for adjudicating complaints. The Court will make a written decision and submit copies to MPWT, EMA, PRS/IRC and the AP. If any party is still unsatisfied with the Provincial Court judgment, he/she can bring the case to a higher-level court. The RGC will implement the decision of the Court.

179. The Project's GRM should not impede access to the country's jurisdiction or administrative remedies. Accessing to both of the country's legal system and GRM can be done at the same time. If efforts to resolve disputes using the grievance procedures remain

unresolved or unsatisfactory, AP has the right to directly discuss his/her concern/complaint with the ADB's Urban Development and Water Division, Southeast Asia Department through the ADB Cambodia Resident Mission (CARM). If AP is still not satisfied with the responses of CARM, he/she can directly contact the ADB Office of the Special Project Facilitator. The Office of the Special Project Facilitator procedure can carry on based on the accountability mechanism in parallel with the project implementation.

180. The PMU, PIU and GRC will keep records of all lodged and documented/referenced complaints, actions/resolutions taken, AP's written confirmations of completed action and satisfaction, complaints raised to higher levels, lessons learned. The number of grievances recorded and resolved and the outcomes will be displayed at the offices of PIU, PMU and Municipality and reported in the monthly progress reports, semi-annual monitoring reports during construction and annual monitoring reports during operation, submitted to ADB.

181. The PMU will do periodic review of the effectiveness of the GRM in each town and record information on the effectiveness of the mechanism, especially on the project's ability to prevent and address complaints. All costs involved in resolving complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the PMU. In cases where AP does not have the writing skills or are unable to express their grievances verbally, he//she may seek third-party assistance of his/her choice.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Mitigation

182. The recommended mitigation measures consist of actions, activities, plans and documents (including resettlement/compensation plan, environmental approval documents, Contractor's EMP) that need to be undertaken, observed, obtained, prepared to prevent, mitigate, or compensate for, the adverse impacts. The broad measures are outlined below; while the specific measures are presented in the Environmental Mitigation Plans (**Annexes E** and **F**):

- Ensuring incorporation in detailed design of adequate considerations and conditions relative climate change to sustain the structural integrity and effective operations of completed works.
- Ensuring the engagement of an environment-responsible Contractor by incorporating the SPS-compliant EMPs into the respective bidding documents, for use as basis in the preparation of the Contractor's EMP (C-EMP) by the selected Contractor, addressing as minimum the requirements of the EMP. C-EMP to be quantitatively and qualitatively evaluated against the EMP by the PMU and cleared by ADB prior to the commencement of any work on site. The contract for civil works to explicitly stipulate the obligation to institute the mitigation measures properly and carry out environmental monitoring according to the C-EMP. The Contract to stipulate some tie-up of progress payment and collection of performance bond with the performance in C-EMP implementation.
- A C-EMP that ensures environment-friendly engineering practices that avoid first, and (if unavoidable) mitigate, adverse impacts; and commitment from Contractor to fully implement the C-EMP.
- Quality construction supervision and environmental monitoring by the PMU.
- Conduct of engineering investigations of built structures after every seismic and extreme weather events during construction and operation. Disclose investigation reports.
- Sufficient funds for sustained quality of operation and maintenance.
- Observance of the GRM and prompt action/resolution of lodged grievances.

183. The Environmental Mitigation Plan attempts to be comprehensive to, among others: (i) point out that most measures are the usual good engineering practices and are, therefore, not difficult to institute; and (ii) facilitate monitoring/random inspection by the PMU/PIU and relevant institutions.

B. Monitoring and Reporting

184. Environmental monitoring will consist of environmental effects monitoring; and performance monitoring. Performance monitoring will monitor and evaluate the performance of the Design Consultant, Contractor, Operator, PMU and PIU in complying with, or adhering to, the C-EMP/EMP. The Environmental Monitoring Plans are presented as **Annexes E** and **F**

185. Environmental monitoring activities and findings shall be documented for purposes of reporting, recording, verifying, referring on and evaluating the environmental performance of the Subproject. The documentation shall also be used as basis in correcting and enhancing further environmental mitigation and monitoring.

186. Environmental Monitoring Reports (EMRs) shall be prepared as follows:

- Monthly, by the Contractor during construction and by the Operator during operation, to be submitted to the PIU. The 3rd, 6th, 9th and 12th Monthly EMRs to incorporate the quarterly and, if applicable, semi-annual reports on environmental quality monitoring.
- Monthly, by the PIU, incorporating the monthly reports of Contractors/Operators into the overall monthly progress report of Kampong Chhnang Town Subprojects, to be submitted to the PMU.
- Quarterly, by Contractor and Operator, or if applicable, by an engaged licensed laboratory, reporting on the results of environmental quality monitoring, as specified in the EMP. The 3rd, 6th, 9th and 12th Monthly EMRs to incorporate these quarterly and, if applicable, semi-annual reports on environmental quality monitoring.
- Semi-annually during construction and annually during operation until loan closure or as agreed, by the PMU to be submitted to the ADB to fulfill the environmental agreement in the loan.

187. A draft outline for the Semi-Annual and Annual EMR is presented as **Annex G.** The monthly EMRs by the Contractor, Operator and PIU may adopt the outline, as applicable, to facilitate the preparation of the Semi-Annual and Annual EMRs.

C. Implementation Arrangements

188. **Implementation Schedule.** Environmental management will be implemented from the detailed design phase through to procurement, construction and operation. Table VIII-1 presents the indicative time frame of key EMP activities in relation to Subproject implementation schedule.

Table VIII-1 Environmental Management Implementation Schedule

A. Flood Protection - Embankment

Activity	Indicative Time Frame
SUBPROJECT IMPLEMENTATION	
Detailed Design & Bidding Documents	Q1 Y1 – Q3 Y1
Procurement	Q4 Y1 – Q2 Y2
Construction	Q3 Y2 – Q2 Y5
Final handover	Q3 Y5 – Q4 Y5
Contractor's maintenance	Q1-Q4 Y6
ENVIRONMENTAL MANAGEMENT	
Overall	
1. Project Management and Implementation Support (PMIS)- Engagement of Envi'l Specialist	Starting Q1 Y1 (for 4 yrs of intermittent inputs)
2. PMU's submission of Environmental Monitoring Report (EMR)	
- Quarterly EMR for Subproject's Quarterly Progress Report	- 15th day after effective month
- Semi-Annual EMR during construction for submission to ADB	- 15th day after effective 6-mo. Period
- Annual EMR during operation for submission to ADB	- 15th day after effective year
Prior to Construction Mobilization	
1. Finalization of EMP, (if applicable) revision of IEE	Q2 Y1
2. ADB review & approval of revised IEE & EMP.	Q3 Y1
3. Obtaining IEIA Report approval	Q2 Y2 (at least 1 mo. prior to award of civil works contract)
4. Community preparation (include disclosure of Final IEE & EMP)	Q2 Y2 (2nd month)
5. Establishment of baseline data (as set out in the EMP)	Q2 Y2 (shall have been done prior to award of contract)
6. Preparation of C-EMP by selected Contractor, review of C-EMP against SPS-compliant EMP.	Q2 Y2, before start of works on site or establishment of construction-related facilities.
Construction Period	
Mobilization to Demobilization	
1. Implementation of mitigation measures and conduct of environmental effects monitoring following the C-EMP.	Q3 Y2 – Q2 Y5
2. Submission of Environmental Monitoring Report (EMR)	Q3 Y2 – Q2 Y5
- Monthly, by Contractor	5th day of the month following the effective month
- Quarterly, by Contractor or by Licensed Laboratory	3rd day of the month following the effective quarter
Operation Period (potentially could start even before DLP is over)	
1. Implementation of mitigation measures & monitoring activities as specified in the EMP	Starting Q1 Y6
2. Submission of EMR	Starting Q1 Y6
- Monthly, by Operator	5th day of the month following the effective month
- Quarterly, by Operator or by Licensed Laboratory	3rd day of the month following the effective quarter

B. Solid Waste Management

Activity	Indicative Time Frame
SUBPROJECT IMPLEMENTATION	
Detailed Design & Bidding Documents	Q2 Y1 – Q4 Y1
Procurement for civil works	Q1-Q2 Y2
Procurement for landfill equipment	Q3 Y2
Remediation of open dumps	Q4 Y2 – Q2 Y3
Construction of landfill	Q4 Y2 – Q3 Y3
Procurement of collection equipment	Q4 Y3
Final handover of works	Q4 Y3
ENVIRONMENTAL MANAGEMENT	
Overall	
1. Project Management and Implementation Support (PMIS)- Engagement of Envi'l Specialist	Q1 Y1 (for 3-4 yrs of intermittent inputs)

Activity	Indicative Time Frame
2. PMU's submission of Environmental Monitoring Report (EMR)	
-Quarterly EMR for Subproject's Quarterly Progress Report	- 15th day after effective month
- Semi-Annual EMR during construction for submission to ADB	- 15th day after effective 6-mo. - period
- Annual EMR during operation for submission to ADB	- 15th day after effective year
Prior to Construction Mobilization	
1. Finalization of EMP, (if applicable) revision of IEE	Q3 Y1
2. ADB review & approval of revised IEE & EMP.	Q4 Y1
3. Obtaining IEIA/EIA Report approval	Q2 Y2 (at least one month prior to award of civil works contract)
4. Community preparation (include disclosure of Final IEE & EMP)	Q2 Y2 (2nd month)
5. Establishment of baseline data (as set out in the EMP)	Q2 Y2 (shall have been done prior to award of contract)
6. Compensation/replacements due to land/ ROW acquisition	c/o Resettlement Plan
7. Preparation of C-EMP by selected Contractor, review of C-EMP against SPS-compliant EMP.	Q3 Y2, before start of works on site or establishment of construction-related facilities.
Construction Period	
Mobilization to Demobilization	
1. Implementation of mitigation measures and conduct of environmental effects monitoring following the C-EMP.	Q4 Y2 – Q3 Y3
2. Submission of Environmental Monitoring Report (EMR)	Q4 Y2 – Q3 Y3
- Monthly, by Contractor	5th day of the month following the effective month
- Quarterly, by Contractor or by Licensed Laboratory	3rd day of the month following the effective quarter
Operation Period (potentially could start even before DLP is over)	
1. Implementation of mitigation measures & monitoring activities as specified in the EMP	Starting Q1 Y4
2. Submission of EMR	Starting Q1 Y4
- Monthly, by Operator	5th day of the month following the effective month
- Quarterly, by Operator or by Licensed Laboratory	3rd day of the month following the effective quarter

189. **Institutional Responsibilities.** The institutions that will have major and minor roles in environmental management include the Ministry of Public Works and Transport (MPWT), Department of Public Works and Transport (DPWT), Project Steering Committee (PSC), Project Management Unit (PMU), Project Implementation Unit (PIU), Project Management and Implementation Support (PMIS) Team's Environmental Specialists; the ADB, Design Consultant, Contractor, Operator, (if applicable) Licensed Laboratory, MoE/PDoE, Municipality of Kampong Chhnang and the relevant Commune Councils. As executing agency, the MPWT will assign a qualified staff to the PMU to serve as full time Environmental Officer. The PMU Environmental Officer will assist each PIU. The PSC, headed by the MPWT, will be responsible for deciding on environmental management matters that will require action from the senior-management level. The PMU will manage the day-to-day activities of the Subproject. Its PMU Environmental Officer will oversee and monitor the implementation of EMP. The PIU will provide technical support to the PMU Environmental Officer in carrying out the environmental management responsibilities at the town level. The PMIS Team will include an International and National Environmental Specialists, who will impart technical advice, guidance, support and "hands-on training" to the PMU and PIU in subproject environmental management, at least in the first two-three years of implementation. The ADB will undertake reviews of relevant environmental documents for clearance purposes, and carry out periodic environmental review missions.

190. More specific responsibilities are presented in Table VIII-2. "Prior to construction" period covers the detailed design period until prior to awarding of civil works contract.

Construction period covers the period after obtaining ADB's clearance for the C-EMP until commissioning for operation. Operation period commences at commissioning of the completed Subproject.

191. **Capacity Development.** Considering the limited capability of the Project's key players in environmental management, technical assistance from environmental specialists and capacity development during loan implementation will be needed. Capacity development will consist of hands-on training in implementing the responsibilities in EMP (as well as CMEI-EARF) implementation, complemented with a short-term series of lectures/seminars on relevant topics. It will be carried out through the PMIS environmental specialists. (**Annex H**)

192. While carrying out technical assistance, the environmental specialists will ensure that the EMP and CMEI-EARF implementation proceeds as a "hands-on" training for the PMU, particularly its environmental safeguard staff, as well as the PIUs, and will conduct training relevant to EMP and EARF implementation..

193. **Preliminary Costs.** The marginal costs for implementing the EMPs are initially estimated to involve: Table VIII-4

- USD 33,859 (KHR 136 million) of fixed costs to cover IEIA/EIA review and approvals, and environmental effects monitoring prior to, and during, construction; and
- USD 22,200 (or KHR 89.1 million) annually for environmental monitoring during operation and decommissioning.

194. The estimated costs: (i) include taxes and contingencies for deficiencies in assumed unit costs, but exclude inflation; (ii) exclude the salaries of the ESS and his/her counterpart in the PIU, as they will be existing MPWT and DPWT staff seconded to the PMU and PIU, respectively; and (iv) exclude the cost of USD 84,350 for technical assistance from, and "hands-on" training" by, Environmental Specialists of the PMIS Team for the both of Kampong Chhnang and Pursat.

D. Performance Indicators

195. The preliminary set of environmental performance indicators is meant to evaluate the effect of Subproject implementation on the environment, i.e., whether or not the Subproject is enhancing, sustaining or deteriorating the state of the environment. The indicators are directed on two environmental areas that will be impacted by Subproject implementation: (i) the natural resources and (ii) health and safety of the concerned people. The selected indicators are limited to only those that can be measured/gauged from activities during subproject implementation and that can be tracked over a defined period. (Table VIII-5)

IX. CONCLUSION AND RECOMMENDATION

196. The IEE concludes that:

- The proposed subprojects in Kampong Chhnang are not environmentally critical.
- The proposed subprojects are not within or adjacent to environmentally sensitive areas, except for the 350m-long Section C-D of the existing embankment that is adjacent to the Tonle Sap River. Section C-D is where the existing tourism, agricultural and fish ports are located. Proposed works in the section will be mainly raising the height of the existing wall to about 0.60 m (or 2 feet), an activity that will not be critically harmful to the health of the Tonle Sap River. With adequate mitigation measures in place, residual impacts are expected to have lower and acceptable significance.

- The few impacts of high magnitude (without mitigation) will not be unprecedented and distinct. The proposed 15.1-km embankment works will be segmented (or implemented by sections) as works can only take place during the dry season when there is access to the embankment base. Construction and protection, therefore, will have to be completed within one dry season. Based on the recommended implementation schedule, less than 4 km of works will be implemented at a time. Comparable length of embankment works would have been implemented when the existing 10 km embankment was built originally.
- The extent of adverse impacts is expected to be local, confined within the subprojects' main areas of influence, quarry sites, waste disposal sites, and the routes to and from these sites. Except during windy days, heavy rainfall and extreme weather event, fugitive dust, fine aggregates, sediments and/or wastes would not be the transported beyond the aforementioned sites. With mitigation measures in place and ensuring that the bulk of works are completed (or at least almost complete) prior to the onset of the rainy season, the potential adverse impacts during construction would be highly/more site-specific.
- The few adverse impacts of high significance during construction will be temporary and short-term (i.e., most likely to occur only during peak construction period). These will not be sufficient to threaten or weaken the surrounding resources. The preparation and implementation of a Contractor's EMP that would address as minimum the requirements of the SPS-compliant Subproject EMP will mitigate the impacts and lower their residual significance to at least "moderate" levels. . Simple/uncomplicated mitigation measures, basically integral to socially and environmentally responsible construction practices, are commonly used at construction sites in urban settings and are known to Contractors. Hence, mitigation measures would not be difficult to design and institute.

  The proposed embankment and controlled landfill will be engineered to avoid and/or minimize adverse impacts. As of preliminary design/feasibility study stage, measures have been respectively incorporated to initiate mitigation.
- Direct impacts during operation will mainly come from controlled landfill operations. Guided by an Operations Manual and strengthened by continuing capacity building program, controlled landfill operations is not expected to have long-term, persistent, permanent/irreversible adverse impact on human health and safety, air quality, water quality, soil quality, biodiversity, as well as the lifestyle and means of subsistence of nearest local communities.
- Indirect, induced and cumulative impacts during operation will mainly arise from the upgraded embankment; from the controlled landfill, to a lesser extent. The upgraded embankment will create substantial flood free land east of the NR 5. There is a risk that this will encourage urban development in the area, reducing the stormwater retention services that this area is currently serving. However, a new by-pass road is proposed to be built about 5 km to the west of the town center. This should pull future growth of the town away from the Tonle Sap towards the west of the Town, particularly for industrial development. Yet, the development of better access to the port on the Tonle Sap, together with the completion of the proposed Kampong Chhnang-Kampong Thom Bridge from PR53 and all currently planned projects, could cumulatively encourage development in the newly created flood-free land, particularly if many of the boat population decide to relocate to permanent structures but maintain fishing as their main source of income.

  The area east of the NR5 and behind the upgraded embankment is still within the "flexible transition area" of the Tonle Sap Biosphere Reserve, defined under the Decree on the Establishment and Management of the Tonle Sap Biosphere Reserve as "*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". This means that some degree of urban development is allowed over the newly created flood-free land behind the upgraded embankment. The line ministries concerned with the management of the flexible transition area in coordination with the Tonle Sap Biosphere Secretariat should initiate without delay the update of the management plan through a highly consultative and participatory process, in anticipation of growth over the newly created flood-free land and incorporating sufficient water retention areas for preservation.

- With proper development controls and other mitigation measures in place, the overall, indirect, induced and cumulative impacts during operation will be more positive than adverse due to improved urban environment.
- The proposed embankment works will bring about the benefits of improved protection from annual flooding from the Tonle Sap and safe perennial access for affected communities; the positive impacts of reduced flood damages to lives and properties, reduced health and safety risks, and improved mobility; and as outcomes, improved urban environment and safe, climate-change resilient communities/Town.
- The proposed controlled landfill and provision of waste collection fleet and equipment will bring about the benefits of improved solid waste collection and disposal; the positive impacts of reduced/controlled indiscriminate dumping of solid wastes, reduced odor and nuisance from indiscriminately dumped solid wastes, reduced contamination of water resources, contribution to reduced greenhouse gas emissions, and reduced health and safety risk; and as outcomes, improved urban environment and safe communities.
- Overall, the subprojects will bring about improved urban environment and climate change-resilience, significantly contributing to a qualitative improvement in the lives of residents in Kampong Chhnang Town.

197. Based on the above conclusions, although the Subproject may have some adverse environmental impacts, the preparation of an IEE would be sufficient to identify and address these impacts. No further special study or detailed EIA needs to be undertaken to comply with the Safeguard Policy Statement of the ADB. Under GoC policy, an IEIA Report for each subproject is required to start the environmental impact assessment process. The IEIA Report will be based on this IEE.

Table VIII-2 Institutional Responsibilities

Institution	Prior to Construction	During Construction	During Operation and Decommissioning
MPWT	▪ Firm up the necessary collaboration with the MoE for the Subproject's compliance with GoC's environmental safeguard requirements on IEIA/EIA and EMP implementation.		
DPWT	▪ Firm up the necessary collaboration with PDoE & relevant provincial agencies on matters concerning the environmental management of the Subproject.		
PSC	▪ Decide on environmental management matters that will require action from the senior-management level. ▪ Ensure the allocation and timely disbursement of adequate resources for the conduct of environmental quality monitoring activities by the PMU prior to construction as required in the Environmental Monitoring Plan.	▪ Decide on environmental management matters that will require action from the senior-management level.	▪ Decide on environmental management matters that will require action from the senior-management level.
PMU	▪ Update IEE & EMP, as necessary. ▪ Coordinate with Design Consultant to ensure the incorporation of updated findings & mitigation measures in design & bidding documents. ▪ Ensure EMP is part of the bidding documents, EMP clauses are incorporated in bidding documents, contracts. ▪ Ensure MoE approval of IEIA/EIA Report has been secured prior to awarding of civil works. ▪ Review Contractor's EMP (C-EMP) against EMP.	▪ Conduct inspections and spot checks to monitor the performance of the Contractor in implementing the C-EMP/EMP ▪ Review Monthly EMRs of Contractor. ▪ Prepare the Project's Semi-Annual EMRs for submission to ADB.	▪ Conduct inspections and spot checks to monitor the performance of the Operator in implementing the EMP. ▪ Review Monthly & Annual EMRs of Operator. ▪ Prepare the Project's Annual EMR for submission to ADB, until loan closure or as agreed.
PIU	▪ Coordinate and collaborate relevant provincial agencies, as necessary. ▪ Conduct IEC, disclose updated IEE and EMP. ▪ Establish the baseline environmental quality through the conduct (by itself or by an engaged licensed laboratory) of the environmental quality monitoring as prescribed in the EMP ▪ Establish health & safety baseline conditions in affected villages. ▪ Prepare draft Semi-Annual EMR. Submit to PMU for finalization for Project's EMR.	▪ Collate and review monthly EMRs of Contractor, and submit to the PMU. ▪ If a licensed laboratory will be engaged to do independent environmental quality monitoring, oversee & manage the quarterly conduct of the environmental effects monitoring . Review results. ▪ Prepare the draft Semi-Annual EMR and submit to the PMU for finalization and incorporation to the Project's Semi-Annual EMR. ▪ Ensure/manage the observance of the GRM	▪ Collate and review monthly EMRs of Operator, and submit to the PMU. ▪ Prepare the draft Annual EMR and submit to the PMU for finalization and incorporation to the Project's Annual EMR. ▪ Ensure/manage the observance of the GRM

Institution	Prior to Construction	During Construction	During Operation and Decommissioning
PMIS	▪ Provide technical advice/assistance, IEE update ▪ Review bidding documents, review C-EMP against the EMP; confirm subproject readiness. ▪ Conduct lectures for capacity development.	▪ Provide technical advice/assistance,, e.g, preparation of Semi-Annual EMR for ADB, review of results of environmental effects monitoring.	
ADB	▪ Review and clear updated IEE/EMP ▪ Review bidding documents, clear C-EMP, confirm readiness of subproject.	▪ Review Semi-Annual EMR. ▪ Carry out review missions. .	▪ Review Annual EMR. ▪ Carry out review missions. .
Design Consultant	▪ Incorporate mitigation measures in design & bidding documents. ▪ Incorporate EMP as part of bidding documents, EMP clauses in bidding documents, contracts.		
Contractor	▪ Prepare a Contractor's EMP that addresses as minimum the requirements of the EMP.	▪ Implement mitigation measures & conduct internal EMP implementation monitoring. ▪ Conduct environmental quality monitoring as prescribed in SPS-compliant EMP. (If an independent Licensed Laboratory will not be engaged.) ▪ Prepare Monthly EMRs.	
Operator			▪ Implement mitigation measures & conduct internal EMP implementation monitoring. ▪ Prepare Monthly and Annual EMRs.
Licensed Lab (An option)	▪ Conduct baseline environmental quality monitoring as prescribed in the EMP.	▪ Conduct quarterly environmental effects monitoring & report results to the PMU/PIU accordingly.	
MoE/PDoE	▪ Review & approve IEIA/EIA Report.	▪ Monitor compliance with approved IEIA/EIA & EMP.	▪ Monitor compliance with approved IEIA/EIA & EMP.
Municipality	▪ Facilitate obtaining the necessary inputs from, and/or participation/cooperation of, concerned communes and villages through collaboration with their Commune Councils.	▪ Participate in the monitoring of the performance of Contractor in EMP implementation. ▪ Review EMRs & results of environmental effects monitoring. ▪ Assist in ensuring the observance of the GRM.	▪ Participate in the monitoring of the performance of Operator in EMP implementation. ▪ Review EMRs. ▪ Assist in ensuring the observance of the GRM.
Commune Councils	▪ Facilitate (& participate in) public consultation & disclosure, IEC, establishment of baseline community health & safety statistics.	▪ Participate in the monitoring of the performance of Contractor in EMP implementation. ▪ Review EMRs & results of environmental effects monitoring. ▪ Assist in ensuring the observance of the GRM.	▪ Participate in the monitoring of the performance of Operator in EMP implementation. ▪ Review EMRs. ▪ Assist in ensuring the observance of the GRM.

Table VIII-3 Proposed Topics and Estimated Cost for Capacity Development/Training in Environmental Safeguards

Topic	Target Participants	Timing	Duration	Estimated Cost (US$)	
				Lecturer	Venue & Attendance
1. By PMIS Environmental Specialists					
1.1 Legal Framework ▪ Relevant national laws, regulations & standards on environmental assessment & management ▪ ADB SPS 2009 ▪ Environmental assessment & review procedure under the CMEI-EARF 1.2 Environmental Assessment ▪ Rapid environmental assessment ▪ Initial environmental examination 1.3 Some Aspects of EA Process & Environmental Management ▪ Meaningful consultation & info disclosure ▪ Grievance redress mechanism ▪ Environmentally responsible procurement ▪ Occupational & community health and safety	PMU, PIUs PDoE, others Interested (min 4, max 10)	Early stage of PMIS	1 day	c/o PMIS	* 1,600
1.4 EMP Implementation, part 1 ▪ Institution arrangements & responsibilities ▪ Environmental quality monitoring ▪ Emergency response 1.5 EMP Implementation, part 2 ▪ Performance monitoring & indicators ▪ Environmental monitoring report	PMU, PIUs, PDoE, others interested (min 4, max 10)	Early stage of PMIS	1 day	c/o PMIS	* 1,600
1.6 Other relevant topics, such as: A Good engineering and construction practices as mitigation measures B Climate change adaptation (applicable to eligible activities/works under the Project) B.1 Climate change impacts on infrastructure B.2 CC-proofing of infrastructures C Other relevant topics that may be requested by the the MPWT/PMU/PIUs	MPWT, DPWT, PIUs, PMU Others Interested (max 30)	During Project Implementation	2-3 days	^ 1,500	** 14,000
			Sub-Total	1,500	17,200
			Grand Total	**18,700**	

* Estimated max. $150 per participant, to cover: (i) $100 for venue & meals; (ii) $60 for --- $30 per diem, $20 allowance for attendance, and 2-way share taxi transport --- participants coming from outside the venue city/town; and (iii) $20 allowance for attendance of participants from the venue city/town. Assumes at least 2 participants from venue city/town.

** Assumes at least 10 participants or one-third of max. no. of participants are from the venue city/town.

^ Includes fee, per diem and transport

Table VIII-4. Preliminary Costs for EMP Implementation

Activity			Fixed Cost		Recurrent (Annual) Cost	
			Amount	Source of Fund	Amount	Source of Fund
Project Readiness						
A.	Preparation of GOC's EA documents, appraisal/approval					
1	Preparation of GoC EA documents		c/o detailed engineering design		-	
2	IEIA/EIA Report review and approval		4,025.00	PMU counterpart	-	
Sub-Total		USD	4,025.00		-	
	(thousand)	KHR	16,160,375.00		-	
Environmental Effects Monitoring						
A.	Upgrading of Embankment and Construction of New Embankment wih Road					
1	Pre-Construction *		2,745.00	PMU counterpart	-	
2	Construction		10,962.00	Civil works contract	-	
3	Operation		-		3,960.00	Operator's budget
Sub-Total		USD	13,707.00		3,960.00	
	(thousand)	KHR	55,033,605.00		15,899,400.00	
B.	Solid Waste Management					
1	Pre-Construction *		5,496.00	PMU counterpart	-	
2	Construction		10,631.00	Civil works contract	-	
3	Operation **		-		12,318.00	Operator's budget
4	Decommissioning of remediated dumps		-		5,914.00	Operator's budget
Sub-Total		USD	16,127.00		18,232.00	
	(thousand)	KHR	64,749,905.00		73,201,480.00	
Performance Monitoring						
A.	Environmental Safeguards Staff & his/her counterpart in the PIU ^		-		-	
TOTAL		USD	33,859.00		22,192.00	
	(thousand)	KHR	135,943,885.00		89,100,880.00	
Project Implementation Support Technical Assistance						
	Environmental Specialists ^^		84,350.00	Output 5	-	-

* For establishing baseline prior to mobilization of civil works

** No decommissioning applicable as Cell 1 will be overtopped when Cell 2 is completed..

^ It is expected that an Environmental Safeguards Staff (ESS) will be MPWT staff seconded/assigned to the PMU; and his/her counterpart in the PIU will be DPWT staff seconded to the PIU.

^^ Covers PMIS TA on EMP implementation in both Kampong Chhnang and Pursat.

Table VIII-5. Performance Indicators

A. Flood Protection

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
During Construction 1 Air emissions Ambient concentrations of dust/ particulates (PM_{10}, $PM_{2.5}$), SO_2, NO_2	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of air quality monitoring during construction - Results of pre-construction air quality monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction ambient level/s.	
		- No complaint lodged regarding health impact or nuisance	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance	- Grievance Redress Mechanism records/ report
2 Noise	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- % of excess over the more stringent limit between national standard & WHO Guidelines	- Results of noise monitoring during construction - Results of pre-construction noise monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- % of excess over the less stringent limit between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- % of excess over pre-construction ambient level	
		- No complaint lodged regarding health impact or nuisance from noise.	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance due to severe noise	- Grievance Redress Mechanism records/ report
3 Water resource problem 3.1 Concentrations of pollutants in groundwater resources	- Pre-construction concentration does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of groundwater quality monitoring during construction - Results of pre-construction ground-water quality monitoring
	- Pre-construction concentration does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction level/s.	
		- No complaint lodged regarding health impact due to deteriorating ground-water quality.	- % of total HHs downstream that that lodged complaint on health impact &/or nuisance due to groundwater quality.	- Grievance Redress Mechanism records/ report
3.2 Concentrations of pollutants in surface water in the vicinity	- Pre-construction concentration does not exceed the limit set in the national standard.	- Level should be equal or less than the limit set in the national standard.	- No. of parameters that exceeded, & % of excess/es of each over, the limits set in the national standard.	- Results of surface water quality monitoring during construction - Results of pre-construction surface water quality monitoring
	- Pre-construction ambient level exceeds the limit set in the national standard.	- Level should not exceed the pre-construction level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction level/s.	
		- No complaint lodged regarding health impact, &/or impacts on fish resources due to river water pollution.	- % of the total HHs downstream of construction site that lodged complaint on health impact &/or impacts on fish resources due to river water pollution.	- Grievance Redress Mechanism records/ report
4 Generation of construction-related traffic, especially of big trucks - Public safety hazard/risks		- None or 0% of construction days with road accidents involving construction vehicles.	- % of total construction days with road accidents involving construction vehicles.	- Contractor's & PMU's EMRs - Contractor's Safety Team's records - Grievance Redress Mechanism records/ report - Records/reports of district/municipality police/traffic authorities
		- No accident should result in long-term or permanent injury or fatality.	- % of total construction days with accident that caused serious injuries &/or fatalities	
During Operation				
5 Flooding from the Tonle Sap due to overtopping		- No overtopping should occur.	- Frequency, say once in 5, 10...years	- Reports of local authorities - Field reconnaissance during flooding
		- No damage to, &/or loss of human life should result.	- Number of people injured and dead.	- Grievance Redress Mechanism records/ report
6 Embankment failure		- No embankment failure should occur.	- Frequency	- Reports of local authorities - Field reconnaissance during flooding
		- No damage to, &/or loss of human life should result.	- Number of people injured and dead.	Grievance Redress Mechanism records/ - report
7 Flooding behind the embankment due to reduced retention areas	-	- No such flooding should occur.	- Frequency and number days flooded.	- Reports of local authorities - Field reconnaissance during flooding - Grievance Redress Mechanism records/ report
		- No damage to, &/or loss of human life should result.	- Number of people injured and dead.	

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
8 Air emissions Ambient concentrations of dust/ particulates (PM_{10}, $PM_{2.5}$), SO_2, NO_2	- Pre-construction or pre-operation ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of air quality monitoring during operation - Results of pre-construction or pre-operation air quality monitoring
	- Pre-construction or pre-operation ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction or pre-operation ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction or pre-operation ambient level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction or pre-operation ambient level/s.	
		- No complaint lodged regarding health impact or nuisance	- % of the total HHs that lodged complaint on health impact &/or nuisance from air emissions from road users.	- Grievance Redress Mechanism records/ report
9 Noise from road users	- Pre-construction or pre-operation ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- % of excess over the more stringent limit between national standard & WHO Guidelines	- Results of noise monitoring during operation - Results of pre-construction or pre-operation noise monitoring
	- Pre-construction or pre-operation ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- % of excess over the less stringent limit between national standard & WHO Guidelines	
	- Pre-construction or pre-operation ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction or pre-operation ambient level.	- % of excess over pre-construction or pre-operation ambient level	
		- No complaint lodged regarding health impact or nuisance from noise.	- % of the total HHs that lodged complaint on health impact &/or nuisance due to noise from road users.	- Grievance Redress Mechanism records/ report

B. Solid Waste Management

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
During Construction				
1 Air emissions Concentrations of dust/ particulates (PM_{10}, $PM_{2.5}$), SO_2, NO_2 Concentrations of landfill gas, CH_4, CO_2, O_2, H_2S, CO	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of air quality monitoring during construction - Results of pre-construction air quality monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction ambient level/s.	
		- No complaint lodged regarding health impact or nuisance from severe dust.	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance due to severe dust	- Grievance Redress Mechanism records/ report
2 Noise	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- % of excess over the more stringent limit between national standard & WHO Guidelines	- Results of noise monitoring during construction - Results of pre-construction noise monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- % of excess over the less stringent limit between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- % of excess over pre-construction ambient level	
		- No complaint lodged regarding health impact or nuisance from noise.	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance due to severe noise	- Grievance Redress Mechanism records/ report
3 Groundwater resource problem	- Pre-construction concentration does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of groundwater quality monitoring during construction - Results of pre-construction ground-water quality monitoring
	- Pre-construction concentration does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction level/s.	
		- No complaint lodged regarding health impact due to deteriorating ground-water quality. water quality.	- % of total HHs downstream that that lodged complaint on health impact &/or nuisance due to groundwater quality. nuisance due to deteriorating groundwater quality.	- Grievance Redress Mechanism records/ report
4 Generation of construction-related traffic, especially of big trucks - Public safety hazard/risks		- None or 0% of construction days with road accidents involving construction vehicles.	- % of total construction days with road accidents involving construction vehicles.	- Contractor's & PMU's EMRs - Contractor's Safety Team's records - Grievance Redress Mechanism records/ report - Records/reports of district/municipality police/traffic authorities
		- No accident should result in long-term or permanent injury or fatality.	- % of total construction days with accident that caused serious injuries &/or fatalities	
During Operation of Controlled Landfill (1) and During Decommissioning of Remediated Dumps				
5 Air emissions				
5.1 Concentrations of landfill gas, CH_4, CO_2, O_2, H_2S, CO	- Pre-construction/pre-operation level at landfill site as baseline	- Level should not exceed the pre-operation level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-operation level/s.	- Results of landfill gas monitoring during operation - Results of pre-construction/ pre-operation landfill gas monitoring
		- No worker should get sick due to landfill gas.	- No. or workers that got sick from landfill gas.	- Clinical report/s.
		- No complaint lodged regarding impacts on health, plants, animals from landfill gas migration.	- % of the total HHs in influence area that lodged complaint on health impacts &/or nuisance due to gas migration.	- Grievance Redress Mechanism records/ report
5.2 Ambient air concentrations $PM_{2.5}$, PM_{10}, SO_2, NO_2	- Pre-construction or pre-operation ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of air quality monitoring during operation - Results of pre-construction or pre-operation air quality monitoring
	- Pre-construction or pre-operation ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction or pre-operation ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction or pre-operation ambient level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction or pre-operation ambient level/s.	
		- No complaint lodged regarding health impact or nuisance from severe dust.	- % of the total HHs that lodged complaint on health impact or nuisance.	- Grievance Redress Mechanism records/ report

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
6 Groundwater resource problem	- Pre-construction concentration does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of groundwater quality monitoring during construction - Results of pre-construction ground-water quality monitoring
	- Pre-construction concentration does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction level/s.	
		- No complaint lodged regarding health impact due to deteriorating ground-water quality.	- % of total HHs downstream that that lodged complaint on health impact &/or nuisance due to groundwater quality.	- Grievance Redress Mechanism records/ report
7 Fire & explosion		- No such incidence.	- % of days in a year when fire &/or explosion occurred due to landfill gas.	- Hospital records - Village/Commune/Municipality report/s
		- None or 0% of workers injured or lost life.	- % of total workers that encountered injury/fatality from fire/explosion due to landfill gas.	- Report of City Fire Department - Report of Operator's Safety Team/ Landfill Management
8 Population of pests, insects, rodents vermin) Health & safety hazard		- No community complaint lodged on health impact or nuisance from pests, insects, rodents from the landfill.	- % of the total HHs in landfill influence area that lodged complaint on health impacts & nuisance from pests, insects, rodents proven to have been introduced to community after landfill started operation.	- Grievance Redress Mechanism records & report
9 Damage during earthquake or extreme weather event		- No such incidence.	- No. of days of disruption in disposal services due to damage.	- Operator's field investigation report - Field spot checks & random interviews by PMU/PIU

Sources of Information

Documents

Cambodia Environment Outlook. Ministry of Environment and UNEP. 2009.

Cambodia Tropical Forestry and Biodiversity (118/119) Asessment. February 2011. USAID-Cambodia.

Climate Change Impacts and Vulnerability. A presentation in Siem Reap on 01 August 2012 by K. Keo. Environment and Energy Unit. UNDP Cambodia.

Construction Equipment Noise Ranges. Noise from Construction Equipment and Operations, Building Equipment and Home Appliances. US-EPA. 31 December 1971.

EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be, Université Catholique de Louvain, Brussels (Belgium).

Disaster Matrix by Country (1970-2009). ASEAN: Advancing Disaster Risk Financing and Insurance in ASEAN Member States: Framework and Options for Implementation. Volume 2: technical Appendices. April 2012. World Bank, GFDRR, ISDR & ASEAN.

Groundwater Quality Analysis Reports for Kampong Chhnang-Kampong Chhnang-Phsar Chhnang, Kampong Chhnang, Ph'er and Khsar. Resource Development International – Cambodia. February 2011.

Identification of Poor Households. World Food Programme. August 2012.

Initial Environmental Examination of the Proposed Logistics Development Project. Mongolia. 2011.

JICA GIS Data Set, 2003

Kampong Chhnang Krong Data Book 2009. Kampong Chhnang Province. October 2009. National Committee for Sub-National Democratic Development (NCDD).

Law on Environmental Protection and Natural Resource Management (Preah Reach Kram/NS-PKM-1296/36). 18 November 1996.

Member Report, Cambodia. Forty-fifth Session of the ESCAP/WMO Typhoon Committee. 29 January-1 February 2013. Hong Kong, China.

Profile of Tonle Sap Sub-Area (SA-9C). Basin Development Plan Programme. Cambodia National Mekong Committee. February 2012.

Strategic Program for Climate Resilience in Cambodia. A presentation to the PPCR Sub-Committee by T. Chankresna (MEF), M. Sophal (MoE) and the Royal Government of Cambodia. Cape Town. 28 June 2011.

Strategic National Action Plan for Disaster Risk Reduction, 2008-2013. National Committee for Disaster Management and Ministry of Planning.

Sub-decree on EIA Process (Sub-decree No. 72 ANRK.BK). 11 August 1999.

Technical Note 10: Impacts on the Tonle Sap Ecosystem. Assessment of Basin-wide Development Scenarios. Basin development Plan Programme, Phase 2. Mekong River Commission. June 2010

The Earthquake Intensity Risk Zone Map. 10 April 2008. UN/ISDR.

The Seismic Hazard Map of Southeast Asia . GSHAP 1999. UN/International Decade of Natural Disaster Reduction.

UNDP Climate Change Country Profile – Cambodia

- McSweeney, C., New, M. & Lizcano, G. 2010. UNDP Climate Change Country Profiles: Cambodia. Available: http://country-profiles.geog.ox.ac.uk/ [Accessed 30 June 2013].
- McSweeney, C., New, M., Lizcano, G. & Lu, X. 2010. The UNDP Climate Change Country Profiles Improving the Accessibility of Observed and Projected Climate Information for Studies of Climate Change in Developing Countries. Bulletin of the American Meteorological Society, 91, 157-166

Institutions and Organizations

Conservation International Cambodia. 2008.
Department of Pollution Control Laboratory Office. MoE.
Department of Public Works and Transport – Kampong Chhnang
Indigenous Community Support Organisation
Kampong Chhnang Municipality
Provincial Department of Planning
Provincial Department of Water Resources and Meteorology of Kampong Chhnang Province
UN Office for the Coordination of Humanitarian Affairs

Websites

www.cambodia.climatemps.com
www.preventionweb.net

Annex A. Environmental Quality Standards Applied in the IEE

(Note: International Guidelines are presented, where applicable, to show comparison and will be useful if evaluation of quality monitoring results include checking of how subproject's environmental performance fare with international standards.)

A.1 Ambient Air Quality Standards

Parameter	Averaging Period	Cambodia's Ambient Air Quality Standard (mg/m^3) *	WHO Air Quality Guidelines (mg/m^3)	
			Global Update 2005	1999
CO	8-hour	20	-	10
	1-hour	40	-	30
	30-minute	-	-	60
	15-minute	-	-	100
NO_2	1-year	-	0.04	-
	24-hour	0.1	-	-
	1-hour	0.3	0.2	-
SO_2	1-year	0.1	-	
	24-hour	0.3	0.02	-
	1-hour	0.5	-	-
	10-minute	-	0.5	-
TSP	1-year	0.1	-	-
	24-hour	0.33	-	-
PM_{10}	1-year	-	0.02	-
	24-hour	-	0.05	-
$PM_{2.5}$	1-year	-	0.01	-
	24-hour	-	0.025	-
O_3	8-hour daily max.	-	0.1	-
	1-hour	0.2	-	-
Pb	1-year	-	-	0.0005
	24-hour	0.005	-	-

* Annex 1 of Sub-decree on Control of Air Pollution and Noise Disturbance (No. 42/ANK/BK of 10 July 2000)

A.2 Noise Level Standards

Receptor	Cambodia's Max. Standard of Noise Level Allowable in Public and Residential Areas (dB(A)) *		WHO Guidelines for Community Noise (dB(A))	
Quiet areas: (hospital, library, school, kindergarten)	06:00 - 18:00	45	07:00 - 22:00	55
	18:00 - 22:00	40		
	22:00 - 06:00	35	22:00 - 07:00	45
Residential areas: (hotel, administrative office, villa, flat)	06:00 - 18:00	60	07:00 - 22:00	55
	18:00 - 22:00	50		
	22:00 - 06:00	45	22:00 - 07:00	45
Commercial/service areas & areas of multiple business	06:00 - 18:00	70	07:00 - 22:00	70
	18:00 - 22:00	65		
	22:00 - 06:00	50	22:00 - 07:00	70
Small industrial factories mingling in residential area	06:00 - 18:00	75	07:00 - 22:00	70
	18:00 - 22:00	70		
	22:00 - 06:00	50	22:00 - 07:00	70

* Annex 6 of Sub-decree on Control of Air Pollution and Noise Disturbance (No. 42/ANK/BK of 10 July 2000)

A.3 Surface Water Quality Standards for Biodiversity Conservation

Parameter	Unit	Cambodia's Standard Value *		MRC Guidelines
		River	Lake & Reservoir	
pH	-	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
BOD_5	mg/l	1 - 10	-	-
COD	mg/l	-	1 - 8	< 4
SS	mg/l	25 - 100	1 - 15	-
DO	mg/l	2.0 - 7.5	2.0 - 7.5	> 5.0
Total N	mg/l	-	0.1 - 0.6	< 0.7
Total P	mg/l	-	0.005 - 0.05	0.13
Coliform	MPN/100 ml	< 5000	< 1000	-

* Annex 4 of Sub-decree on Water Pollution Control (No. 27/ANRK/BK of 06 April 1999)

A.4 Surface Water Quality Standards for Public Health Protection

Parameter	Unit	Cambodia's Standard Value *
Carbon tetrachloride	µg/l	< 12
Hexachloro benzene	µg/l	< 0.03
DDT	µg/l	< 10
Endrin	µg/l	< 0.01
Dieldrin	µg/l	< 0.01
Aldrin	µg/l	< 0.005
Isodrin	µg/l	< 0.005
Perchloro ethylene	µg/l	< 10
Hexachloro butadiene	µg/l	< 0.1
Chloroform	µg/l	< 12
1.2 Trichloroethylene	µg/l	< 10
Trichloro ethylene	µg/l	< 10
Trichloro benzene	µg/l	0.4
Hexachloroethylene	µg/l	< 0.05
Benzene	µg/l	< 10
Tetrachloroethylene	µg/l	< 10
Cd	µg/l	< 1
Total Hg	µg/l	< 0.5
Organic Hg	µg/l	0
Pb	µg/l	< 10
Cr^{+6}	µg/l	< 50
As	µg/l	< 10
Se	µg/l	< 10
Polychlorobiohenyl	µg/l	0
CN	µg/l	< 0.005

* Annex 5 of Sub-decree on Water Pollution Control (No. 27/ANRK/BK of 06 April 1999)

A.5 Groundwater Quality Standards

Parameter	Cambodia's Drinking Water Quality Standards, 2004		WHO Guidelines for Drinking-water Quality *	
	Unit	Maximum Value	Unit	Guideline Value
Physical/chemical				
Taste	-	Acceptable	-	-
Odor	-	Acceptable	-	-
Color	TCU	5	-	-
Turbidity	NTU	5	-	-
Residual Cl	mg/l	0.2 - 0.5	mg/l	0.2 (min. residual)
pH	-	6.5 - 8.5	-	None established
Al	mg/l	0.2	-	None established
NH_3	mg/l	1.5	-	None established
Chloride	mg/l	250	-	None established
Cu	mg/l	I	mg/l	2
Hardness ($CaCO_3$)	mg/l	300	-	None established
H_2S	mg/l	0.05	-	None established
Fe	mg/l	0.3	-	None established
Mn	mg/l	0.1	-	None established
Na	mg/l	200	-	None established
SO_4	mg/l	250	-	None established
TDS **	mg/l	800	-	None established
Zn	mg/l	3	-	None established
Inorganic constituents				
As	mg/l	0.05	mg/l	0.01
Ba	mg/l	0.7	mg/l	0.7
Cd	mg/l	0.003	mg/l	0.003
Cr	mg/l	0.05	mg/l	0.05
CN	mg/l	0.07	-	None established
Fe	mg/l	1.5	-	None established
Pb	mg/l	0.01	mg/l	0.01
Hg	mg/l	0.001	mg/l	0.006
Ni	mg/l	0.02	mg/l	0.07
NO_3	mg/l	50	mg/l	50
NO_2	mg/l	3	mg/l	3
Se	mg/l	0.01	mg/l	0.04
Bacteriological				
Thermotolerant (Fecal Coliform or E. Coli	MPN/100 ml	0	MPN/100 ml	Must not be detectable in any 100 ml sample.
Total coliform	MPN/100 ml	0	MPN/100 ml	

* Fourth Edition, 2011

* Conductivity (µS/cm) can aldo be measured and is roughly equivalent to twice the TDS value.

A.6 Effluent Quality Standards

Parameter	Unit	Cambodia's Allowable Limits for Pollutant Substance Discharge	
		To Protected Public Water Area	To Public Water Area & Sewer
Temperature	°C	< 45	< 45
pH	-	6 - 9	5 - 9
BOD_5 (at 200 °C)	mg/l	< 30	< 80
COD	mg/l	< 50	< 100
TSS	mg/l	< 50	< 80
TDS	mg/l	< 1000	< 2000
Grease and Oil	mg/l	< 5.0	< 15
Detergents	mg/l	< 5.0	< 15
Phenols	mg/l	< 0.1	< 1.2
NO_3	mg/l	< 10	< 20
Cl (free)	mg/l	< 1.0	< 2.0
Cl^-	mg/l	< 500	< 700
SO_4	mg/l	< 300	< 500
Sulphide (as Sulphur)	mg/l	< 0.2	< 1.0
PO_4	mg/l	< 3.0	< 6.0
CN	mg/l	< 0.2	< 1.5
Ba	mg/l	< 4.0	< 7.0
As	mg/l	< 0.10	< 1.0
Sn	mg/l	< 2.0	< 8.0
Fe	mg/l	< 1.0	< 20
B	mg/l	< 1.0	< 5.0
Mn	mg/l	< 1.0	< 5.0
Cd	mg/l	< 0.1	< 0.5
Cr^{-3}	mg/l	< 0.2	< 1.0
Cr^{+6}	mg/l	< 0.05	< 0.5
Cu	mg/l	< 0.2	< 1.0
Pb	mg/l	< 0.1	< 1.0
Hg	mg/l	< 0.002	< 0.05
Ni	mg/l	< 0.2	< 1.0
Se	mg/l	< 0.05	< 0.5
Ag	mg/l	< 0.1	< 0.5
Zn	mg/l	< 1.0	< 3.0
Mo	mg/l	< 0.1	< 1.0
NH_3	mg/l	< 5.0	< 7.0
DO	mg/l	> 2.0	> 1.0
Polychlorinated Byphemyl	mg/l	< 0.003	< 0.003
Ca	mg/l	< 150	< 200
Mg	mg/l	< 150	< 200
Carbon tetrachloride	mg/l	< 3	< 3
Hexachloro benzene	mg/l	< 2	< 2
DTT	mg/l	< 1.3	< 1.3
Endrin	mg/l	< 0.01	< 0.01
Dieldrin	mg/l	< 0.01	< 0.01
Aldrin	mg/l	< 0.01	< 0.01
Isodrin	mg/l	< 0.01	< 0.01
Perchloro ethylene	mg/l	< 2.5	< 2.5
Hexachloro butadiene	mg/l	< 3	< 3
Chloroform	mg/l	< 1	< 1
1.2 Dichloro ethylene	mg/l	< 2.5	< 2.5
Trichloro ethylene	mg/l	< 1	< 1
Trichloro benzene	mg/l	< 2	< 2
Hexaxhloro cyclohexene	mg/l	< 2	< 2

* Annex 2 of Sub-decree on Water Pollution Control (No. 27/ANRK/BK of 06 April 1999)

Annex B. Solid Waste Generation/Quantity Projections, Cell Staging and Staged Development Strategy

B.1 Population, Waste Mass and Controlled Landfill Volume Projections

YEAR	Province TOTAL	Provincial Annual Growth Rate	Urban Growth Rate	Projected Population	Rate of Waste Generation post HH Recycling	Daily Waste Generated	Percent Collected	Daily Waste Collected	Annual Waste Collected	Cumulative Waste Collected	Cumulative Airspace Consumed in Landfill	Landfill Capacity	YEAR
	2008 Census	2008 Census	2008 Census		kg/person.day (0.50 increasing to 0.65 over 30 years)	Tonnes/day		Tonnes /day	Tonnes/ year	Tonnes	Cubic Metres (Waste density at 600kg/m3; 15% cover volume; 15% recycling at landfill on average over time)	Cubic Metres (Stage 1 and Ultimate)	
2008	410,706												2008
2009	415,684	1.21											2009
2010	420,620	1.19											2010
2011	425,673	1.2	2.24	40,360									2011
2012	430,990	1.25	2.24	41,700									2012
2013	436,541	1.29	2.24	43,000	0.5								2013
2014	442,293	1.32	2.24	48,250	0.51								2014
2015	448,221	1.34	2.24	62,100	0.51								2015
2016	454,395	1.38	2.04	55,700	0.52								2016
2017	460,872	1.43	2.04	56,900	0.52								2017
2018	467,602	1.46	2.04	58,000	0.53								2018
2019	474,534	1.48	2.04	59,200	0.53	31	20	6	2,300	2,300	3,800		2019
2020	481,613	1.49	2.04	60,300	0.54	32	25	8	3,000	5,300	8,700		2020
2021	488,836	1.5	1.77	62,400	0.54	33	30	10	3,700	9,000	14,700		2021
2022	496,201	1.51	1.77	64,400	0.55	34	35	12	4,400	13,400	21,900		2022
2023	503,674	1.51	1.77	66,500	0.55	35	40	14	5,200	18,600	30,400		2023
2024	511,229	1.5	1.77	68,500	0.56	36	50	18	6,600	25,200	41,100		2024
2025	518,839	1.49	1.77	70,500	0.56	37	60	22	8,100	33,300	54,300		2025
2026	526,503	1.48	1.5	71,600	0.57	38	70	27	9,700	43,000	70,100	77,600	2026
2027	534,392	1.5	1.5	72,700	0.57	39	70	27	10,000	53,000	86,400		2027
2028	542,076	1.44	1.5	73,800	0.58	40	70	28	10,300	63,300	103,200		2028
2029	550,036	1.47	1.5	74,900	0.58	41	70	29	10,500	73,800	120,300		2029
2030	558,124	1.47	1.5	80,800	0.59	47	70	33	12,100	85,900	140,000		2030
2031		1.47	1.3	81,900	0.59	48	80	39	14,200	100,100	163,100		2031
2032		1.47	1.3	83,000	0.60	49	80	39	14,500	114,600	186,800		2032
2033		1.47	1.3	84,000	0.60	50	80	40	14,800	129,400	210,900		2033
2034		1.47	1.3	85,100	0.61	51	80	41	15,100	144,500	235,500		2034
2035		1.47	1.3	86,200	0.61	53	80	42	15,400	159,900	260,600		2035
2036		1.47	1.1	87,200	0.62	54	85	46	16,700	176,600	287,800		2036
2037		1.47	1.1	88,100	0.62	55	85	46	17,000	193,600	315,500		2037
2038		1.47	1.1	89,100	0.63	56	85	47	17,300	210,900	343,600		2038
2039		1.47	1.1	90,100	0.63	57	85	48	17,700	228,600	372,500		2039
2040		1.47	1.1	91,100	0.64	58	85	49	18,000	246,600	401,800		2040
2041		1.47	1	92,000	0.64	59	85	50	18,300	264,900	431,600		2041
2042		1.47	1	92,900	0.65	60	85	51	18,600	283,500	461,900		2042
2043		1.47	1	93,800	0.65	61	85	52	19,000	302,500	492,900		2043
2044		1.47	1	94,800	0.66	62	85	53	19,300	321,800	524,300		2044
2045		1.47	1	95,700	0.66	63	85	54	19,600	341,400	556,200		2045
2046		1.47	1	96,700	0.67	64	85	55	20,000	361,400	588,800	677,900	2046

B.2 Cell Staging

1. The first cell airspace is 77,600 cubic metres which is enough for about 5 years of operation. The second cell in isolation will provide a similar number of years of operation.

2. The next stage of landfilling will be over-topping both the first and second cells to develop a unified single cell which will provide a total of about 12 years capacity, going to a maximum height of approximately 25 metres above the base.

3. The excavation depths for the first cell were based on a number of factors;
   - the desire to maximize the separation between the base of the controlled landfill and the water table thereby requiring the excavation depths to be minimized
   - the need to provide a balanced cut to fill design such that there would not be excess soil at the completion of Cell 1 nor would there be a need for significant importation of cover material

4. In the end, the adopted excavation depth was approximately 1.2 metres on average. This will provide some 12,000 cubic metres of soil which can be used for cover material for the life of Cell 1.

5. After some 10 years of operation, the excavation levels can then be decided for Cells 3 and 4 to provide the right amount of soil cover based on operational experience to date, as well as protecting the ground water table. This decision does not have to be made until better information is available on actual waste generation rates and local hydrogeology.

6. The capacity of the completed controlled landfill incorporating over-topping of all four cells is some 677,900 cubic metres. This will be sufficient capacity for about 30 years of operation. The total mass taken to the site is expected to increase from an estimated 16 tonnes per day in 2016 to over 53 tons per day 30 years later.

7. This cell staging approach is appropriate as most controlled landfills develop the first cells to provide about 5 years of operation and the ultimate site to provide at least 30 years capacity.

B.3 Staged Development Strategy

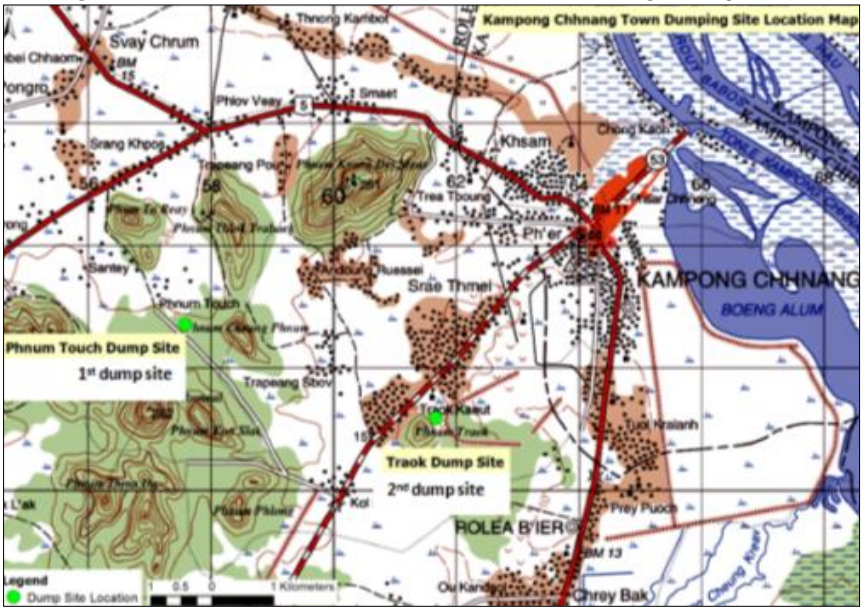
1. A possible staged excavation and filling program would be as follows;
   - excavate and prepare Stage 1 for filling.
   - fill Stage 1 to the levels shown, while excavating and preparing Stage 2 for filling.
   - fill Stage 2 to the levels shown
   - fill the infill area above Cells 1 and 2 while excavating and preparing Stage 3 for filling.
   - fill Stage 3 to the levels shown.
   - fill the infill area above Cells 1, 2 and 3 while excavating and preparing Stage 4 for filling.
   - fill Stage 4 to the levels shown
   - fill the final infill areas to levels shown on as the final landform

2. The design balances the need for cover material over the life of the landfill with approximately 15% of the airspace consumed as cover. The volume of cover available may be increased or decreased by several means:
   - raising or lowering the base of the future landfill cell areas.
   - varying the slope of the base between a minimum of 1 per cent and a maximum of 10 per cent.
   - varying the thickness of daily cover between 100mm and 150mm depending upon the effectiveness/performance of the waste compaction operation.
   - winning cover from previously placed temporary (internal) batters when placing new waste against them.

Annex C. Environmental Audit Report – Open Dumpsites

1. The ADB SPS 2009 provides that when the project involves existing activities or facilities, environmental audits will be performed to determine the existence of any areas where the project may cause or is causing environmental risks or impacts. In proposing for the development of a controlled landfill, the associated facilities that will pose environmental risks are the: (i) "closed" dumpsite in Phnum Touch Village and (ii) in Traok Kaeut Village; and the existing open dumpsite in Kul Kop Village.

Figure 1. Locations of the Closed and Existing Dump Sites



Site Audit/Due Diligence Approach

2. The site audit/due diligence was carried out using information obtained from (i) key informant interviews; (ii) few brief random interviews; (iii) site visit by the PPTA Environmental Specialists, and (iv) largely from site investigation by the PPTA Solid Waste Specialists.

3. Key informant interviews were conducted during meetings of the Solid Waste Specialists (in May) and Environmental Specialists (in August) with the Municipality and Provincial Department of Environment (PDoE). Brief random interviews were conducted by the Environmental Specialists with: (i) a female farmer who was seen passing through the Phnum Touch Dump Site to visit her rice field (the lone person seen at the dumpsite during the site visit); and (ii) the nearest household to the existing Traok Dump Site. Site visit was conducted by the Environmental Specialists in August during the rainy season; site investigation by the Solid Waste Specialists in May during the dry season.

4. The main limitations of the audit/due diligence are the: (i) absence of environmental quality monitoring information that would have supported the findings and observations of the site visit and investigation; (ii) absence of a site plan showing the extent, dimensions and locations of areas with waste deposits that would have provided basis for estimating remediation costs; and (iii) lack of opportunity to go back to the sites, local authorities, and land owner, for discussion and obtain feedback on the findings and areas of concern and recommended actions for remediation.

5. The audit/due diligence assumes that even though the waste disposal operations in the existing dump site is on private land, the Municipality, Provincial Government and the PDoE have some responsibility over the environmental risks involved in such operations, considering that:

- It is the Municipality that benefits from the operations, i.e., its wastes being collected, hauled and disposed of.
- The Sub-decree on Solid Waste Management rests the responsibility of: (i) establishing guidelines on, and monitoring of, solid waste management on the MoE; and (ii) collecting, transporting, storing, recycling, minimizing and dumping of wastes upon the local administrative authorities --- with the objective of ensuring the protection of human health and the conservation of biodiversity.

Applicable Laws, Regulations and Standards

6. The national laws, regulations, standards, policy and guideline that are applicable and/or relevant to solid waste management are briefly discussed below.

Table 1. National Laws, Regulation, Standards Relevant to Solid Waste Management

Law on Environmental Protection and Natural Resource Management (Preah Reach Kram/NS-RKM-1296/36) 1996	MoE to collaborate with concerned ministries to establish an inventory list indicating: (i) sources, types & quantities of pollutants & wastes that are imported, generated, transported, recycled, treated, stored, disposed, or released into the airspace, water, land or on land surface; (ii) sources, types & quantities of all toxic & hazardous substances that are imported, produced, transported, stored, used, generated, treated, recycled, disposed, or released into airspace, water, land or on land surface; & (iii) sources, types & extent of disturbances by noise & vibrations. (Article 12)
Sub-decree on EIA Proces (Sub-decree No. 72 ANRK.BK) 1999	The detailed guidelines for implementation of the EIA Process. Its Annex requires the conduct of IEIA/EIA on "waste processing, burning activities of all sizes".
Sub-decree on Solid Waste Management (Sub-decree No. 36 ANRK/BK) 1999	This Sub-decree applies to all activities related to disposal, storage, collection, transportation, recycling, dumping of garbage & hazardous waste. Article 4 - (i) MoE to establish guidelines on disposal, collection, transport, storage, recycling, minimizing & dumping of HH wastes in provincial & city areas in order to ensure that HH wastes are managed in a safe manner; & on which (ii) cities & provinces are to formulate their waste management plans for implementation in the short, medium & long-terms . Article 5 – Responsibility of collection, transport, storage, recycling, minimizing & dumping of wastes rests on provincial & city authorities. Article 6 - MoE to monitor the disposal, collection, transport, storage, recycling of household wastes. Article 7 – strictly prohibits waste disposal in public areas or any unauthorized site.
Sub-decree on The Joint Declaration Min. of Interior and Min. of Environment on Solid Wastes & Litter Management in Cambodia	Provides a mechanism for joint cooperation & responsibility among relevant agencies to effectively manage solid wastes & litter at provincial & municipal levels aimed at protecting public health, environmental quality & biodiversity. Specifies penalties of between USD2.5 & USD25 for illegal disposal.
Environmental Guidelines on Solid Waste Management, 2006	Applies to all activities related to discarding, storage, collection, transport, recycling, treatment, composting & disposal of all kinds of solid waste. Contains: (i) guideline in the formulation of a solid waste management plan; (ii) a landfill ordinance; (iii) composting ordinance; (iv) guideline in medical waste management; & (v) guideline on environmental education. Landfill Ordinance requires landfills to: (i) reduce as far as possible the adverse effects of waste disposal on the environment; (ii) preserve groundwater, surface water & air quality & to reduce emissions of GHGs (iii) ensure waste is not harmful to human, natural & animal health during operation & decommissioning; & (iv) provide information & technical recommendation on the construction, operation & closing/follow-up management of landfills.
Sub-decree on Water Pollution Control (Sub-decree No. 27 ANRK/BK), 1999	Regulates activities that cause pollution in public water areas in order to sustain good water quality so that the protection of human health and the conservation of biodiversity are ensured. Article 2 – Sub-decree applies to all sources of pollution & all activities that cause pollution of the public water areas. Article 8 - strictly prohibits disposal of solid waste or any

	garbage or hazardous substances into public water areas or into a public drainage system; & storage or disposal of solid waste or any garbage & hazardous substances leading to pollution water of the public waters. Annexes 2, 4 & 5 provide the standards for industrial effluent applicable to effluent from leachate treatment facilities, water quality for public waters for biodiversity conservation, & water quality for public waters & health, respectively.
Sub-decree on Control of Air Pollution and Noise Disturbance (Sub-decree No. 42 ANK/BK, 2000	Regulates ambient air quality (Annex 1), hazardous substances in the air (Annex 2), pollution substances in ambient air from stationary sources (Annex 3), gas emissions from mobile sources (Annex 4), noise emission from vehicles on public roads (Annex 5), noise emission in public and residential areas (Annex 6), & noise control at workplaces (Annex 7). Annexes 1, 2, 3 & 7 are relevant to landfill operations. Annexes 4, 5 & 6 are relevant to waste collection operations.
The National 3R Strategy in Cambodia	Intends to establish an efficient solid waste management system to build on the 3Rs giving jobs, incomes to people, reducing waste amount at dumpsites, without causing severe risks & hazards to the environment, biodiversity & public health. The Strategy states two target years, 2015 & 2020, for the country's 3R achievement.

7. The environmental quality standards applicable to the remediation of the dumps are the: (i) Ambient Air Quality Standard, 2000; (ii) Maximum Standard of Noise Level Allowable in the Public and Residential Areas, 2000; (iii) Drinking Water Quality Standards, 2004; and (vi) Effluent Standard for Discharged Wastewater to Public Water Areas or Sewers, 1999, applicable to landfills.

Description of the Existing Open Dumps

8. **Phnum Touch Dump Site.** The "closed" dump site, is referred to as the Phnum Touch Dump Site. It is situated in Phnum Touch Village, Pongro Commune, Rolea B'ier District, about 12 km southwest of the Town center. This was commissioned in 1998/99 and was abandoned in 2010. The site is public land controlled by the Provincial Government. According to the Municipality, the then small group of service provider collected wastes only from the market. However, households near the market were depositing their garbage in the market area; hence, these household wastes were included in the collection. The activity had no economic benefit for the small group of service provider, or with one provider, because the site was too far. Hence, the site was abandoned in favor of a nearer site in Traok Kaeut Village, the existing dump site.

9. The waste cell in Phnum Touch Dump Site is roughly 40 by 30 m^2, placed into an excavated pit of unknown depth but thought to be 3 m deep from the top of the encircling bund. The waste is approximately level with the top of the encircling bund, which is up to 2 m above natural surface level. The waste at depth has all been burnt, but there is some recent waste from the nearby local market (Pongro Market)[16] that is yet to fully burn but was smoking at the time of inspection in the dry season. There is also wind-blown litter over parts of the site. During site visit in the wet season, the wastes were not burning or smoking but flies were in large populations.

10. The site is suitably distant from the nearest community, about 600-700 m away. The water table is reportedly at least 50 m below ground surface. There is no natural water course within or in the vicinity of the site. The existence of a water pond in the site was noted. Cracking of surface soils was observed in a number of locations during the site investigation in the dry season by the Solid Waste Specialists, which indicates significant plasticity and obviously, clay content in the soil. This site of the Phnum Touch Dump Site is also the site of the proposed controlled landfill.

[16] According to the Municipality, the local people in the village complained about the operation of the dumpsite. However, after explanations from the Municipality, they understood but wanted the wastes from their market to be disposed of at the site.

Photo 1. Phnum Touch Dump Site

Smoking in the dry season

Weeds growing in between deposited wastes in the rainy season

11. **Traok Dump Site**. The closed dump site, is referred to as the Traok Dump Site. It is situated in Traok Kaeut Village, Srae Thmei Commune, Rolea B'ier District, about 5 km southwest of the Town center. This disposal facility is on private land and is accepting waste based on a private treaty between the company providing the collection services and the private landowner. Disposal of solid wastes from the Municipality at this site was commissioned in 2010, with the approval of the Provincial Governor. The Traok Dump Site, therefore, is in operation for about three years now.

12. The property is less than one hectare in size and is outside the Municipality's administrative boundaries. From the Town center, it is accessed through Provincial Road 53 (of bitumen) and then through a very poor dirt road. There is no natural water course in or near to the site. The site is said to be a former borrow area; hence, it has a series of pits, some being impounded with water, about 2 to 3 m deep. One pit, roughly 70 m x 30 m in size, has been filled with waste to natural surface level. The current working face, of about the same size, is about 10 percent filled with waste. Both cells/pits have not been profiled, compacted or covered with soil in any way. Both have remained open with patches on fire or burnt. The site is leached silty sand for the top 2 m, then transitioning into siltstone outcrops. The soil does not appear to have significant clay content based on the non-cohesive nature of the soil structure and the lack of cracking in areas of dry soil.

13. During the site investigation in May, as reported, the water impounded in the current operating pit appeared to be not obviously contaminated with leachate and retained an oxic appearance, devoid of black colouration and gasification. During the site visit in the wet season, extensive leachate formation and expression was observed in the current operating pit. Impounded water was murky, as shown in Photo 3. The adjacent pit appeared not obviously contaminated with the leachate as impounded water appears mainly turbid, of lighter than medium brown color. No medical waste was observed. Cullet of larger quantities than normal and intact bottles of significant number were observed.

14. The Municipality thinks there is no regular waste picker or scavenger at this site. During the visit of the PPTA Environmental Specialists in the wet season, no scavenger was seen at the site; the site was not smoking; but flies were swarming.

15. During the site visit in September 2014, the Traok dump site had been covered and heavy stone crushing machinery are now operated over the covered site. It was explained to the Mission that the solid waste was moved to the boundary of the property and burned in batches. The small amount of solid waste that has not yet been burned has been placed in a pit and the water impounded in the pit is turbid of light to medium brown color.

Photo 2. The Traok Dump Site

Photo 3: Previous Dumpsite now covered, and remaining solid waste

16. **Kul Kop Dump Site**. The existing dump site, is referred to as the Kul Kop Dump Site. It is situated in Kol Kup Village, Srei Tmei Commune, Roleap Ear District, about X km of the Town center. This disposal facility is on private land and it is owned by the same owner as the Traok Dump Site and it is assumed to be accepting waste based on a private treaty between the company providing the collection services and the private landowner. Disposal of solid wastes from the Municipality at this site started in March 2014.

17. The property is about 5 hectares in size and is outside the Municipality's administrative boundaries. There are no natural water courses in or near the site. The property has been roughly levelled and waste sits on levelled earth. The adjacent property is also being levelled.

18. During the site visit in September 2014, much of the solid waste seems recently dumped. No medical waste was observed. No water impounding was observed.

19. There appears waste pickers or scavengers at this site as evidenced by a temporary roofed structure and bicycles on the site. The site was not smoking; but there were flies and birds.

Photo 4. Kul Kop Dump Site

Findings and Areas of Concern

20. The salient areas of concern include uncontrolled waste fires and smoke particularly in the dry season; unmanaged leachate; and populations of vermin, flies and birds particularly in the wet season. The following discussion is part of Appendix 27b – Solid Waste Management of the Draft Final Report and is based on site investigation conducted by the Solid Waste Specialists in May 2013 (at the end of the dry season). Findings from the sites visit of the Environmental Specialists in the wet season are added in (*in italics*).

21. **Existing Fires.** In addition to the obvious environmental damage caused by waste fires, they also present a serious health and safety risk. Incomplete combustion of the various plastic types at the dump site can result in the formation of carcinogenic by-products such as dioxins. These airborne pollutants are being breathed in by waste truck drivers, dump site staff, waste pickers at the site and farmers of adjacent/nearby rice fields. There are also many safety issues associated with such fires at the disposal site. There may be pressure vessels (gas tanks, pressure cans, etc.) deposited at the site which can explode at the elevated temperatures associated with combustion. Any heavy smoke also presents a major safety problem by severely limiting sight distances. As a result, there is a much greater risk of collisions between vehicles or vehicles and people. The presence of the fire, and also the associated intensity of smoke generation, appears to have been accepted by the local community as a normal aspect of waste management. This is not the case and urgent effort will be required to address this perception problem prior to attempting to remediate the site.

22. In summary, urgent action is required to prevent new fires from starting and to stop ongoing fires. The surface fires should be extinguished and then deeper fires progressively excavated and extinguished as part of the initial activities leading to eventual full remediation.

23. *During the site visit in August in the rainy season, there was no waste fire or smoke. The seasonal occurrence of waste fire and smoke should not be a reason to defer action to prevent waste fire and smoke and to continue exposing dump site workers, waste haulers, waste pickers and farmers of adjacent rice fields to the associated health and safety hazards.*

24. **Existing Leachate.** A number of drains and contiguous water courses were inspected in and around the dumping site. While there was some obvious leachate contamination of the water courses and impoundments, the visual extent of the leachate contamination appeared only minor. The water courses were not black and anaerobic with gasification occurring, but rather just showed some colouration of the water column. Some of the nearby water ponds appeared aerobic/oxic and were visually uncontaminated by

leachate. As it was the end of the dry season at the time of inspection, leachate migration from the waste piles would be minimal unless the mound was fully saturated. It is also noted that most of the organics at the site have either degraded due to natural decomposition processes or been incinerated. Therefore there is very little organic material in the refuse mounds to produce a high biological strength leachate. Whilst the leachate may be weak organically, it may still of course contain inorganics such as heavy metals and biocides. In general, the amount of leachate flow and peripheral contamination was apparently low for such uncontrolled facilities but this is no reason to accept this ongoing pollution.

25. *The pictures in Photo 3 were taken in August in the rainy season. It shows: (i) the amount of leachate contained in Pit "A"; and (ii) the adjacent Pit "B" appears not to have been contaminated yet, indicating the high containment capability of the pot wall. However, during heavy rains, particularly during continuous heavy rains, Pit "A" would be overtopped easily, spreading leachate onto the access road and adjacent lands. This mainly* supports *the statement above that there is no reason to accept the ongoing pollution from leachate.*

26. **Other Existing Environmental Issues**. Very few vermin were observed on the sites, probably because of the extent and intensity of the fires. There were a number of birds present, but the infestation was not of grave concern. Flies were generally at fairly low densities for such uncontrolled dumping, again due to the burning of putrescible organics such as food scraps.

27. *In the random interview with the household nearest to the existing dumpsite, she mentioned having noticed some increase of presence of flies in their vicinity intermittently, which she thought could have come along with the waste trucks. During the site visit in August, the level of odor was not disturbing. Vermin was not in large population to be noticed easily. The presence of birds did not raise grave concern. But flies were swarming.*

Summary

28. Based on these various impacts, as well as the aesthetic and public health issues, the dump sites require either in-situ (on-site) remediation or hauling to the proposed controlled landfill site.

Photo 5. Observations Regarding Leachate at Traok Dump Site

Pit A is almost filled up with leachate. Pit B is turbid (could be largely due to suspended clay particles) but not murky, indicating Pit A leachate did not permeate or has not yet permeated through the pit walls.

Pit "A" almost filled up with murky stormwater or leachate.

Remediation Plan

29. The following discussion is part of Solid Waste Management of the Final Report and is based on site investigation conducted by the Solid Waste Specialists in May 2013 (at end of dry season).

30. **Recommended Management Options.** There are two options for managing the dump sites:

- One option is through on-site remediation by pushing the previously deposited wastes into a suitable mounded shape, compacting the waste and then covering it with soil, applicable to dumping areas that are small and remote from sensitive areas such as water courses.
- The other option is by excavating and extinguishing the waste, loading it onto trucks and hauling it to the controlled landfill once it is operational, applicable to dumping areas with significant amount of waste and that are potentially environmentally and socially damaging.

31. For the three Dump Sites, on-site remediation is recommended due to the following reasons, opportunities and/or constraints:

- The distance from the Traok Dump Site and Kul Kop to the controlled landfill site is significant. The Phnum Touch Dump Site requires remediation where the remaining wastes had been moved.
- The volumes of waste are relatively small. Albeit the Phnum Touch Dump Site served as disposal site for the Municipality's wastes for 12 years, it received only the Town market's wastes and the household wastes from around the market. Thereafter, it has been receiving only the wastes from the local market nearby. Traok Dump Site is relatively small, having started operation in 2010 and estimated to have been receiving only 40% of the total waste generated daily in the Municipality. The Kul Kop Dump Site is new not having received one years worth of garbage.
- The wastes have been burnt so the leachate will be of lower strength organically, particularly those of Phnum Touch Dump Site.
- There is no hazardous industry in the Municipality, which would result in heavy metals and biocides in the waste, leading to a hazardous leachate potential.
- The soil profile contains some clay, thus limiting leachate migration and providing attachment sites for any heavy metals in the leachate.
- Rainwater infiltration leading to leachate generation could be mitigated by pushing the wastes to suitable mounded shape, compacting the wastes and covering it with soil.
- The sites are flood free.

32. **On-Site Remediation.** The proposed Solid Waste Management Subproject has included the remediation of old dump sites in the scope of physical works to be designed in detail and constructed. It has indicated the remediation works to be simultaneously undertaken with the construction of the controlled landfill. The most recent proposed arrangement is that the dump sites will be closed by the government landfill. It will be overseen by the PMU and PIU. The Government and private land owner of the existing dump site have signified in their intention for the closure of the dump sites through a letter sent to the PPTA Team. The subsequent discussions refer to the option of on-site remediation of existing waste deposits.

33. Closure Protocols In most cases unless the waste pile is extensive and causing local environmental, social or aesthetic concern, it should just be shaped, compacted and covered with soil as per normal landfill operating procedures. A key factor in limiting on-going leachate generation from any remediated secondary dumping sites will be providing reasonable slopes for the final mound shape. The external batters should be graded at the usual 1V:2.5H and the crown should still have a minimum of 5% slope. This is to allow for differential settlement throughout the waste mass over time which can result in ponding of rain water in settled areas if the surface is flat, resulting in excessive infiltration and subsequent leachate formation. Applying cover material is essential. The decision on whether to remediate on site or haul the waste to the landfill will be decided on a case by case basis.

34. Landfill Gas Systems Most remediated dumps just allow landfill gas to escape passively through the cap. This is a very common approach and has few drawbacks in terms of safety or environment. This does not present a safety risk as methane concentrations are minimal in the open atmosphere even relatively close to the final cap. Landfill gas is toxic to tree growth. If vegetation, such as large trees, has roots penetrating through the cover material into the waste mass, then they will be stunted or die. A common alternative to a gas interception system is to provide an extra depth of soil over the impermeable layer for any locations where large trees are proposed.

35. One option for gas management includes installing a rubble layer on the top 1/3 of the final mound surface to facilitate landfill gas migration to passive vents. The gas would then be freely vented to atmosphere through a number of six metre high passive stacks. This system facilitates a path for methane rich landfill gas to vent to atmosphere, which has climate change considerations. However most of the organics in the landfill have already been removed by fire so the quantities of landfill gas to be emitted will not be large.

36. Overall, the inclusion of a gas blanket is not considered necessary as:

- The site is very small
- The gas quantities will be relatively small because of the fires on site to date have removed most of the historically-deposited waste organics;
- There will not be any buildings with basements constructed on the site which could lead to explosive gas pockets forming, and
- Growing media plus clay cap will give sufficient root depth for grasses and small shrubs to survive. If larger trees are to be planted, a localised thickening of the surface growth media will provide sufficient root protection against landfill gas impacts on tree vitality.

37. Leachate Management The proposed final cover design and batter slopes will minimise rainfall infiltration and therefore leachate generation. Given that the soil has extensive clay content, and the dumping site is very small, it is considered appropriate not to require the installation of a liner under the entire waste mound. Retrospectively installing such a liner would require that all waste is removed and then replaced. This will be a huge cost for what is considered to be of little environmental benefit. To minimise the amount of leachate entering the water table under the site, it is important to minimise the leachate forming within the mound. This is firstly done by profiling the mound and providing suitable final cover, which minimises the volume of leachate generated.

38. An option for further reducing the leachate head would be to provide a peripheral leachate interceptor drain. However this would usually only be required for large dumps and not the locally small size. The interceptor would usually consist of a gravel filled drain under the toe of the final cover. Within the gravel drain would be a 200mm diameter slotted pipe laid at grade. The pipe may be encased with geotextile to limit the intrusion of silt. The pipe would drain to one or more leachate pumping stations. The leachate pumping stations would lift the leachate to irrigate newly planted areas in the dry weather encouraging vegetation cover. This would involve running a permanent pipe to the top of the mound and then having a relocatable pipe attached to this outlet. The relocatable pipe would be moved around the areas to be irrigated as required.

39. Escaping landfill gas is fully saturated and this also passively removes leachate.
Given the relatively small size of the sites, it is recommended that compaction, shaping and application of soil cover should be sufficient without the need for leachate interceptors and pumping stations. The waste site will be incorporated into the new controlled landfill in the future in any case.

40. Fire Control. Fires at waste disposal sites are extremely hard to manage. Small areas of surface combustion can be controlled with water and subsequent application of the soil cover material. However, areas that are smoking due to underground combustion cannot be extinguished just by applying water at the location of smoke egress. Landfills are anisotropic and the smoke plumes resulting from fires at depth often surface some distance laterally from the actual subsurface fire source. Therefore no matter how much water is applied at the point of smoke emission, there is no guarantee that this water will reach the combustion source. The only way to extinguish subsurface fires is to excavate until the

combustion source is reached. The combusting material can then be removed, spread and watered until the fire is extinguished, and the waste then returned to the cell only once it has returned to ambient temperature. Even for small spot fires, this can be a very time consuming and expensive activity.

41. This fire control program will also need to include an education component to remove any belief that merely applying soil as final cover will extinguish all fires in the long term, especially in the upper parts of the waste piles. Any new fires starting in the fresh waste piles, or restarting in the previously worked areas, should be immediately and fully extinguished as the highest priority. This may require the preparation of a temporary cleared area or intermediately covered existing waste area for placement and management of excavated burning waste.

42. Environmental Management. To support such a remediation scheme for a large closure activity, it will usually be necessary to install a number of groundwater monitoring wells. Such wells may have to be installed for the existing sites but this is unlikely given the small size of the dumping sites. They would be located in such a way as to provide hydrogeologically appropriate upslope and downslope sampling locations for the final mound footprint. If the sampling indicates that groundwater contamination is occurring, then deleaching wells can be installed retrospectively within the waste mound. Groundwater contamination is considered extremely unlikely if the waste is placed correctly, compacted, shaped appropriately, covered and equipped with leachate interceptors systems, in accordance with the general specifications above.

43. Climate Change Issues The climate change predictions for, and the criteria used in conceptualizing the climate resilience measures for other infrastructure investments in, Cambodia were considered. Locally, the main effect of climate change on solid waste management will be hotter drier summers and more intense rainfall events in the wet season. The hotter and drier summers means that grass and other vegetation planted on waste mounds die due to lack of water and heat stress. This will be overcome by a conscious plan to irrigate the greens. The more extreme wet weather events will be managed by ensuring that the: (i) external batters are protected against erosion resulting from the higher rainfall intensities, e.g., through vegetation, sufficient compaction and slope; and (ii) top of the mound or the plateau area has sufficient grade to lead stormwater away from it. As appropriate, peripheral drainage infrastructure may have to be provided to account for higher rain fall intensities to collect the stormwater runoff on mound sides and divert it away.

Immediate Actions Required

44. Extinguish ongoing fires immediately. (i) For small area of surface combustion, through watering and subsequent soil cover. (ii) For sub-surface combustion, progressively excavate until the combustion source is reached. Cart the combusting material to a prepared area and spread, water to extinguish the fire. Once it has returned to ambient temperature, reload the waste to the cell or transfer it to the active cell and then apply intermediate cover soil to prevent it from re-igniting. (iii) Remove and extinguish any burning tyre or other large items on fire.

45. Do not allow new fires to start. Compact the wastes (at least 3 passes) in all previously worked areas which are not smoking or burning. Then, apply intermediate cover soil (300mm thick) over the compacted waste.

46. Close the waste cell or dumping area as per normal landfill operating procedures. Once waste cell is no longer burning or smoking, close the cell: (i) Push the previously (non-smouldering) deposited wastes to form a mound with reasonable slopes. (ii) Compact the

wastes properly by pushing up a slope and having at least 3 passes. (iii) Trim back the perimeter batters to a 1v:2.5h slope, if required. Or, develop the replaced, pushed and compacted waste into a 5% plateau, if no mounding is required. (iv) Cap with 600 mm of soil with low-permeability in accordance with final mound or plateau profile and footprint.

47. Planning of Immediate Actions The Province and Municipality, with technical assistance from the PDoE, should sit down with the dump site operators at the soonest possible to plan the implementation of required immediate action and agree on areas/aspects where the assistance of local authorities would be needed. Local authorities could provide the operators with some soil cover material, spreading equipment, water truck, excavator and/or dozer.

48. **Remediation of Phnum Touch and Traok Dump Site**. With some pre-planning and agreement between local authorities and land owners, the site could be progressively remediated and closed within the current operating budget of the Muncipality. The current working face, may commence application of soil cover in its operations.

49. **Remediation of Kul Kop Dump Site**. The Kul Kop dumping site should be closed following procedures above as soon as the controlled landfill site is operational. A plan for improved operations will be prepared by the environmental consultants for implementation by the government.

Annex D. Notes of Consultations

Information not for disclosure

Annex EEnvironmental Management Plan – Flood Protection

A. Prior to Construction Phase

A.1 Detailed Engineering Design

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Supervise & monitor
1 Unsustained effectiveness of service of completed works due to inadequate consideration during design of (any one or combination of) the following: - climate change & the hydrology of the Tonle Sap River/Lake system - stormwater runoff from Town to the Tonle Sap River through the crossing drainage channels - significance of keeping the floodplain - scale of settlement and urban development along the section near the town proper - vulnerability to other natural hazards - relevant feedback from stakeholders - design adaptation options for integral components, such as slopes, road & crossing drainage channels	1.1 Few design adaptation options for flood and drought. - For slopes: appropriate gradient, landscape with plant species that are both flood- and drought-tolerant, e.g., growing vetiver plant, optimum degree of compaction. - For road: optimum degree of compaction, use flexible pavement - For crossing streams: increasing size of outlets (with gates and pumps, as necessary) 1.2 Incorporate in design climate change impacts to the hydrology of Tonle Sap system and crossing streams. 1.3 While intending to protect existing settlements before the existing embankment, re-aligning the embankment to the east must be kept at the minimum technically feasible distance. 1.4 Design to seismic design criteria as regulated in Cambodia or 1.5 Design to incorporate relevant issues, concerns & experience of local residents pertaining to existing embankment's coping with climate change events as raised during consultations.	Not applicable	-	Design Consultant	PMU & PMIS Envi Sp/ ADB*
2 Unsustainable supply of gravel, stone, rock, sand, soil, or unsustainable extraction of these materials to meet construction demand	2.1 Prepare an Aggregates Mgnt Plan (AMP): ▪ confirming location of legal sources for required aggregates ▪ estimating the demand for, & supply from confirmed sources of, aggregates ▪ specifying measures to effectively minimize potential risks of aggregates extraction, transport, loading & unloading ▪ specifying environmental requirements should Contractor opt to operate its own borrow area to serve as basis for Contractor's AMP. 2.2 Specify in bidding documents & contract Contractor's obligation to obtain aggregates only from quarries still operating within allowed extraction threshold according to their environmental clearances & permits to operate.	Not applicable	-	Design Consultant	PMU & PMIS Envi Sp/ ADB*

A.2 Obtaining Approvals, and Community Preparation

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Monitor
3 Displacement of HHs & losses	3.1	Finalize Resettlement/Compensation Plan, after Det. Measurement Surveys, through highly consultative & participatory process.	All affected villages	c/o detailed design cost	Det. Design Resettlement Sp	PMU/PIU & PMIS Resettlement Sp
	3.2	At least 30 days before awarding of contract for civil works, losses shall have been fully compensated for, & the required relocation of affected HHs & services, accomplished, according to the approved resettlement & compensation plan.	All affected villages	c/o resettlement cost	PMU/PIU	
4 Overall environmental concerns/impacts of the Subproject	4.1	Obtain IEIA/EIA approval for the Subproject.	Not applicable	c/o PMU's counterpart budget	PMU/PIU	PMIS Envi Sp/ ADB*
5 Potential communicable/transmittable diseases brought with entry of workers & overall health & safety hazards during construction.	5.1	Intensive awareness program on communicable/transmittable diseases, e.g., SARS, H1N1, STD, HIV/AIDS, tuberculosis, and diseases that may be brought with entry of workers & on the health and safety hazards during construction.	All affected villages	c/o PMU's counterpart budget	PMU/PIU with health & village officials	

A.3 Procurement & Prior to Mobilization

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Review & Evaluate
6 Engagement of environmentally irresponsible contractor for civil works	6.1	A SPS-compliant EMP, as part of bidding documents.	Not applicable	-	PMU/PIU	PMIS Envi Sp/ ADB*
	6.2	EMP to be appended to the Contract for basis of preparation of Contractor's EMP (C-EMP) & for compliance.				
	6.3	Contract to require Contractor's submission of monthly environmental monitoring report, outline appended in Contract.				
	6.4	Contract to also stipulate some tie up of progress payment & collection of performance bond with the performance in C-EMP/ EMP implementation.				
	6.5	Selected Contractor to prepare detailed C-EMP that addresses as minimum the requirements of the SPS-compliant EMP.				
	6.6	C-EMP to be quantitatively & qualitatively evaluated against the EMP.				
	6.7	ADB to clear C-EMP before start of any work on site or establishment of construction-related facilities.				
6a UXO "chance find"	6a.1	Workers' pre-orientation workshop to include procedures to follow in case of UXO "chance find". First-response team to coordinate & undergo orientation on management of UXO "chance find" event.	Not applicable	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*

B. Construction Phase

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Monitor
PHYSICAL / CHEMICAL ENVIRONMENT 7 Dust/suspended particles from: - earthworks - dry exposed surfaces - stockpile of dry soils, sand, cement - transport of aggregates, cement, residual soil for disposal & wastes - loading/unloading of fine aggregates, cement and other materials - movements of construction vehicles/ equipment	7.1	Implement segmentation/sectioning of works, as appropriate.	Entire alignment	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	7.2	Water dry unpaved/exposed surfaces, stockpiles of sand & excavated materials , at least twice daily, or as necessary.	Active work segment	c/o Construction running, set up costs (preliminaries)		
	7.3	Protect stockpiles of soil/sand with a wind barrier/screen. Or, confine stockpiles well within the sites with hoarding.				
	7.4	Wash/wet tires prior to exiting construction sites to remove mud/ dirt. Provide wetting facilities at exit.				
	7.5	Provide hoarding around active sites, where applicable, of not less than 2 m high from ground level, & to extend at least 10 m from edges of segment.	Active work segment, close to settlements			
	7.6	Cover trucks securely, especially those carrying aggregates & cement, with tarpaulin. Trucks to maintain min. 2 feet freeboard.	At entire hauling route	c/o Supplier's cost		
	7.7	Limit speed of all construction-related vehicles in access road to, and in, site to maximum of 30 kph.	Access road to, and in, construction site	-		
	7.8	Minimize drop heights when loading/unloading soil onto trucks/ ground. Spray water on soil being loaded/unloaded.	At the site			
8 Noise generated by/from, among others: - the operation of equipment, movement of vehicles (especially those diesel-fed & without effective mufflers) - such processes as drilling/excavation, pavement breaking, concrete mixing, earthmoving, unloading of aggregates, rock crushing	8.1	Use only equipment that emit least noise, e.g. electrically powered equipment, hydraulic tools, those with efficient mufflers. Allow only well-maintained equipment/vehicles	At the site	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	8.2	Set up noise barriers, e.g.: - hoarding around active site, min. 2 m high from ground level; - sound-absorbing enclosure around generator sets; - consider locating site office &/or storage structures such that these can act as noise barriers.				
	8.3	Restrict use of noisy equipment from 8AM-5PM. Overtime work should: not go beyond 9PM, observe regulated noise level, not use noisy equipment, be coordinated with village/commune, & be announced to affected communities at least 5 days in advance.	At the site	-		
	8.4	Strictly enforce upon workers compliance with wearing of ear mufflers, especially those operating the equipment.				
	8.5	Locate noisy generators at max. distance from nearest receptors.				
	8.6	Limit engine idling to a max. of 5 minutes.				
	8.7	Minimize drop heights when loading/unloading coarse aggregates.				
	8.8	Spread out schedule of material, spoil & waste transport, in the day (off-peak traffic hours), or early evening.				

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Review & Evaluate
9 Deterioration of surface & ground water resources from improper/inadequate management of the following in workers: camp & subproject sites: - sewage/wastewater - solid & hazardous wastes - sediments, silts - hazardous construction materials	9.1 Provide adequate sanitation facilities, adequate water supply. Strictly enforce observance of sanitation practices. 9.2 Implement an eco-friendly solid/hazardous waste management: - practices waste minimization, reuse and segregation - has adequate covered storage bins/containers, color-coded clearly marked to avoid mixing, especially hazardous wastes - has separate enclosed storage areas for solid & hazardous wastes, that can contain spills, clearly marked/labelled - networks with private individuals/entities that are into waste recovery & recycling to reduce wastes brought to landfills - implements prompt disposal at the Municipality's landfill - coordinates with PDoE the disposal of hazardous waste - workers & hazardous waste contractors to observe safety measures/system when handling hazardous wastes	Active work segment, field offices &, if applicable, workers camp	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	9.3 Implement measures to mitigate sedimentation/siltation. - stockpile on flat grounds & away from, not obstructing, main surface drainage routes, limit to max height of 2 m. - dispose of unsuitable & excess soils as soon as possible - avoid stockpiling more aggregates than needed - use any combination of silt fences, sediment basins/traps, sandbags, barrier nets, earth berm/bund, perimeter dike, speed stilling humps, seeding, mulching, establishing general vegetation, whichever would be appropriate.	At all sites, most especially at Section C-D & near to crossing with drainage channels			
	9.4 Manage the use and storage of hazardous substances: - install visible caution signage at storage areas , secure them from unauthorized entry or use. Must be able to contain spillage. - locate stationary ground storage at least 30 m away from water bodies or groundwater well. Raise to min 1 foot above highest flood level. Or, use mobile storage. - have equipment clearly leaking oil repaired off-site at once. - no vehicle maintenance & refuelling to be allowed at the site. - use less hazardous substances. - store no more hazardous substances on site than needed. - have spill clean up materials for all types of hazardous substances readily available on site.	At the site			

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Review & Evaluate
10 Soil erosion due to: - movement & vibration from works & vehicles	10.1 Coordinate work program & ins and outs of vehicles. 10.2 Implement measures to mitigate vibration: - During mobilization, identify vibration-sensitive areas &/or structures in the main influence area to plan for the appropriate technology, equipment/ tools & procedure level to apply or use. - Schedule separately ground-impacting activities in a site as much as possible to reduce the intensity of impact. - Limit engine idling to a max. of 5 minutes. - Limit speed to max. 40 kph en route to sites, 30 kph in access road to, & in, site.	Active work segment	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	- Use available equipment & tools that emit least vibrations (as per manufacturer's specifications), or equipped with shock absorber. - Maintain equipment/tools according to specifications.	Active work segment	c/o Construction mobiliz'n & running costs (prelim)		
11 Impact on the landscape from disorderly parking of vehicles/equipment, stockpiling, siting of storage structures & sanitation facilities, borrowing; from litters & poor solid waste management; from removal of trees and shrubs, etc.	11.1 Stockpile materials and spoils and park construction vehicles/ equipment only in designated areas (with least or no vegetation as much as possible).	Active work segment	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	11.2 Organize placement of field structures. Implement proper solid waste management and keeping of premises. 11.3 Plant trees to replace removed trees as coordinated with concerned commune.		c/o Construction mobiliz'n & running costs (preliminaries)		
BIOLOGICAL ENVIRONMENT 12 Impairment of aquatic life in Tonle Sap River (along Section C-D)	12.1 Implement the appropriate recommended measures to mitigate the deterioration of surface & groundwater resources. 12.2 Install clear signage at strategic location along the Tonle Sap River to remind workers of the significance of the River.	Section C-D.	c/o Construction (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
13 Loss of vegetation within & beyond Subproject footprints, from: - un-guided works un-directed movement of equipment - haphazard stockpiling of materials - haphazard parking of equipment	13.1 During detailed design, determine the required temporary access roads and work easements for temporary disturbance. Include, as appropriate, in the resettlement plan for the rightful compensation.	Not applicable	-		
	13.2 Prior to clearing & grubbing, physically mark limits for construction footprints, including work easements & if applicable, the required temporary access roads 13.3 Install reflectorized guides, signage &/or markers to direct vehicular/ equipment traffic, storage, stockpiles, parking and works.	At active work segment & the required temporary access roads	c/o Construction mobiliz'n cost (preliminaries)		
	13.4 Stockpile materials/spoils & park construction vehicles/equipment only in designated areas (with least or no vegetation, as possible)	At active work segment	-		

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Review & Evaluate
SOCIO-ECONOMIC ENVIRONMENT					
14 Traffic & road lane blocking, due to: - movements of construction vehicles/ equipment in & out of the main area of influence - roadside parking of construction vehicles & equipment - stockpiling of aggregates, excavated soils, spoils within access road ROW	14.1 Coordinate with village/commune/municipal traffic authorities for: - a scheme to jointly manage the junctions & mitigate impact on main roads; - parking of construction trucks & equipment - stockpiling of aggregates and construction spoils - safe access of private vehicles and pedestrians.	Main influence area	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	14.2 Spread out schedule for materials delivery in non-peak hours.	Active work segment			
	14.3 Park construction vehicles & equipment & stockpile construction aggregates & spoils according to approved/coordinated scheme.				
	14.4 Stockpile no more aggregates than needed in the short term.				
	14.5 Dispose of spoils away from active work face at end of day's work.				
	14.6 Post traffic (flag) persons at effective junctions during entire working hours.	Effective junctions	c/o Construction running & mobiliz'n costs (preliminaries)		
	14.7 Post billboards on road/lane closure, traffic rerouting plan at strategic places, min. 1 week prior to effectivity.	Strategically in main influence area			
15 Blocked accesses to properties, social services, economic activities & sources of livelihood, by: - active work segment - parked construction vehicles/equipment - stockpile of aggregates & spoils	15.1 In coordination with village/commune authorities, conduct information campaign during mobilization -- on work phasing & schedules, anticipated access blocking, & provisions for safe access & temporary car parking for blocked garages/driveways.	Affected communities	-	Contractor & PMU/PIU	PMIS Envi Sp/ ADB*
	15.2 At least one week prior to actual access blocking, notify the affected properties. Work together/agree with property owners & concerned villages for the alternative accesses and parking areas.				
	15.3 Park construction vehicles & equipment & stockpile construction aggregates & spoils according to approved/coordinated scheme.	Active work segment		Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	15.4 Stockpile no more aggregates than needed in the short term.				
	15.5 Store spoils away from accesses. Dispose of them away from active work face at the end of each day's work.				
	15.6 Provide safe access to blocked properties/assets, e.g., steel planks of adequate grade, width and length, &, if needed, with guide rail & adequate signage and lighting.	Affected properties	c/o Construction running cost (preliminaries)		

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Review & Evaluate
16 Accidental damage to power supply poles, damages to access roads, causing disruptions in socio-economic services & activities.	16.1 During mobilization: - coordinate work activities & schedule with power supply company, set contact arrangements in case of damage & unavoidable relocation; - coordinate & agree with the Municipality/Province regarding road ruts caused by construction vehicle movements; and - post work activities & schedules at strategic places in the main influence area. 16.2 In case of accidental damage, advise concerned utility company at once. Facilitate quick restoration by clearing obstructions & lending assistance (workers, equipment, tools) in the repair. 16.3 Give at least 1 week prior notice on planned service interruption due to relocation of existing utilities. power supply poles,	Main influence area	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
17 Community health & safety hazards from, among others: - dust, noise, gas emissions, odor, vibration - affected water resources - inadequate waste/wastewater mgnt - spillage of hazardous substances - fire, explosions, collapse of work structures - blocked accesses to properties, social services, economic activities & sources of livelihoods - open excavations/disturbed areas - movement of construction-associated vehicles/equipment - rise of communicable/transmittable diseases with entry of workers	17.1 Implement recommended measures to mitigate: - dust, gas emission, odor, noise, vibration - deterioration of surface & groundwater resources & adverse impacts of wastes & hazardous substances - traffic, road blocking 17.2 Emergency response preparedness (procedures, trained staff, equipment, tools & supplies, good link to ultimate responders). 17.3 Provide safe accesses to blocked properties, social services, economic activities & sources of livelihood. 17.4 Install adequate/appropriate lighting & clear signage/warning at, & reflector barrier/hoarding around, active work face/disturbed areas.	Active work segment	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	17.5 Implement work segmentation to minimize disturbing more areas than could be worked at & restored in a day or in short periods. 17.6 Enforce upon drivers of construction-associated vehicles & equipment to implement safe/defensive driving & operation. 17.7 In case of "chance find" of UXO, immediately stop work, implement evacuation procedures, secure area. Contact local police to ensure security of the area involved & to communicate the Cambodian Mine Action and Victim Assistance Authority.	Entire subproject footprint	-		
	17.8 Remind construction workers regarding responsible practices for health and safety of community.	Not applicable			

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Review & Evaluate
18 Workers' health & safety hazards from: - dust, noise, gas emissions, vibration - inadequate waste/wastewater management - exposure to hazardous substances - exposure to the weather - poor sanitation practices - open pits, disturbed areas - operating equipment, handling tools - movement of construction-associated vehicles/equipment - rise of communicable/transmittable diseases in subproject communities - fire, explosion, collapse of disturbed soils & worked-on structures	18.1	Conduct workers' orientation, prior construction, on occupational health & safety hazards, strict observance of safety measures, emergency response procedures, & use/handling of hazardous substances and noisy & vibrating equipment.	Not applicable	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	18.2	Implement recommended measures to mitigate dust, gas emission, noise, vibration; and to manage wastes & hazardous substances	Active work segment			
	18.3	Provide protective wears, e.g., eye & nose masks, ear mufflers, helmets, gloves, footwear, etc. Enforce their use by workers at work.				
	18.4	Install adequate lighting, safe accesses to & from active work areas.				
	18.5	Minimize impact from operating noisy/vibrating equipment/tools by ensuring workers' daily exposure value (ELV) is kept within the standard limit, as specified by manufacturer, through shifts to allow breaks from continuous use of equipment by individual worker.	Active work segment	-		
	18.6	Provide safe accommodations.	Workers camp	c/o Construction mobiliz'n & running costs (preliminaries)		
	18.7	Provide adequate water for washing & safe drinking, and adequate sanitation and waste management facilities. Enforce observance of good hygiene, sanitation & waste management practices.	Workers camp & active work segment			
	18.8	Set up emergency response team, equipped with adequate staff, equipment, tools & supplies, linked to ultimate responders.	Field office			
	18.9	Arrange with nearest primary & tertiary health institutions for health & emergency care of workers.	Not applicable	-		
	18.10	Enforce upon drivers/operators of construction-associated vehicles & equipment to implement safe/defensive driving & operation.	In & outside construction sites			
	18.11	In case of "chance find" of UXO, immediately stop work, implement evacuation procedures, secure area. Contact local police to ensure security of the area involved & to communicate the Cambodian Mine Action and Victim Assistance Authority.	Active work segment			
PHYSICAL CULTURAL ENVIRONMENT 19 Damage to physical cultural resource in case of chance find	19.1	Stop work & secure site immediately. Make a declaration to local police. Resume work only when told so by the authority mandated under the Law on the Protection of Cultural Heritage.	Controlled landfill			
SUSTAINABILITY OF WORK 20 Damage during seismic or extreme weather event	20.1	After every seismic or extreme weather event, conduct engineering investigation of built structures & implement corrective measures without delay.	Entire subproject footprint	c/o Construction contingency cost	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
Sub-Total (Prior to Construction and During Construction)			USD	-		

C. Operation Phase

Potential Environmental Impacts	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
				Pre-Operation Phases			Operation Phase	
				Det. Design Consultant	PMU/PIU	PMIS Envi Sp / ADB*	Operator	PMU/PIU & ADB*
21 Dust & noise from use of road	21.1 Implement environmental effects monitoring as prescribed in the EMP. 21.2 When exceedance against pre-operation level merits an investigation of the road surface, this should be conducted immediately for corrective action.	As prescribed in EMP.	c/o Operations running cost	-	-	-	Implement	Monitor
22 Safety risks from overtopping & structural failure	22.1 Conduct regular inspection and prompt maintenance & repair. 22.2 Operator must have an Emergency Action Plan, which should be drafted together with village/commune/municipal officials for collaborative action in case of emergency. Participation of community volunteers must be encouraged. 22.3 Operator must set up its team for initial emergency response that is linked with an ultimate response team.	Entire embankment	c/o Operations running cost	-	-	-	Implement	Monitor
23 Unauthorized entry of vehicles/ use of road embankment by public prior to full stabilization.	23.1 Provide physical barriers with legible warning sign against entry until such time when dyke has fully stabilized (at all possible entry points). 23.2 Coordinate with village authorities, nearest residents &/or farmers regarding vigilance on unauthorized entry/use.	All possible entry points. Affected villages	c/o Operations running cost -	-	-	-	Implement	Monitor
24 Unsustained effectiveness of services due to inefficient operation, maintenance & repair	24.1 Sufficient budget and technical capacity for operation, maintenance and repair.	Not applicable	c/o Operations running cost	-	-	-	Implement	Monitor
25 Damages during seismic or extreme weather events	25.1 After every seismic or extreme weather event, conduct engineering investigation of built structures & implement corrective measures without delay.	All sites	c/o Operations emergency or contingency cost	-	-	-	Implement	Monitor
Sub-Total (During Operation)		USD	-					
TOTAL		USD	-					

Environmental Monitoring Plan

I. ENVIRONMENTAL EFFECTS MONITORING

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
A.	**Prior to Construction Phase** During procurement prior to awarding of contract for civil works						
1	**Ambient air quality** $PM_{2.5}$, PM_{10}, SO_2, NO_2 *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines. Results as baseline data before mobilization.*	1 in Section B-C 1 in Section D-E 1 in Section F-G	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once	1,785.00	PMU/ (Licensed Lab)	PMISEnvi Sp/ ADB*
2	**Ambient noise levels** Lmax, Lmin, Leq *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise. Results as baseline data before mobilization.*	1 in Section B-C 1 in Section D-E 1 in Section F-G	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once	195.00		
3	**Groundwater quality** pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011. Results as baseline data before mobilization.*	1 in Section B-C 1 in Section D-E 1 in Section F-G	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once	261.00		
4	**Surface water quality** Temp, pH, conductivity, TSS, alkalinity, Total N, NO_2, NO_3, Cl, SO_4, PO_4, NH_4, Mg, Ca. K. Na, DO COD, Total P, Al, Si Fe, BOD, E-coli, coliform *Review results against Annex 5 of Sub-decree No.27/ANRK/BK (1999). Results as baseline data before mobilization.*	Tonle Sap River 1 upstream & 1 downstream of Section C-D	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once	504.00		
5	**Community health & safety conditions** - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accidents (vehicular, fire, etc) & crime *Information as baseline data before mobilization.*	Commune/s of active section	Information from Commune Council, relevant commune health center, Mun. Health Department, Mun. Government	Once			
	Sub-Total (Prior to Construction for baseline data)				2,745.00		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring		Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
B.	**Construction Phase**						
6	**Ambient air quality** $PM_{2.5}$, PM_{10}, SO_2, NO_2 *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	Active section	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once quarterly	8,330.00	Contractor (Licensed Lab)	PMISEnvi Sp/ ADB*
7	**Ambient noise levels** Lmax, Lmin, Leq *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise.*	Active section	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once quarterly	910.00		
8	**Groundwater quality** pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011. Results as baseline data before mobilization.*	Active section	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once, quarterly	1,218.00		
9	**Surface water quality** Temp, pH, conductivity, TSS, alkalinity, Total N, NO_2, NO_3, Cl, SO_4, PO_4, NH_4, Mg, Ca. K. Na, DO COD, Total P, Al, Si Fe, BOD, E-coli, coliform *Review results against Annex 5 of Sub-decree No.27/ANRK/BK (1999). Results as baseline data before mobilization.*	Active section	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, quarterly	504.00		
10	**Community health & safety** - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accident, fire & crime	Commune/s of active section	Information from, & close coordination with, Commune Council, relevant commune health center, Mun. Health Department, Mun. Government	Once, quarterly	-		
11	**Workers' health & safety** - Incidences of illness due to work - Incidences of work-related accident, injuries/deaths to emergencies, crime involving workers	Work site	Records of Safety Engineer	Once, quarterly	-		
	Sub-Total (Construction)				10,962.00		
	Sub-Total (Prior to Construction and During Construction)				13,707.00		

Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Annual Cost (USD)	Responsibility	
					Implement	Compliance Monitoring
C. Operation Phase						
12 Ambient air quality $PM_{2.5}$, PM_{10}, SO_2, NO_2 *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	1 in Section B-C ` 1 in Section F-G	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, semi-annually	3,570.00	Operator/ (Licensed Lab)	PMISEnvi Sp/ ADB*
13 Ambient noise levels Lmax, Lmin, Leq *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise.*	1 in Section B-C 1 in Section D-E 1 in Section F-G	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, semi-annually	390.00		
Total Annual Cost (Operation)				3,960.00		

II. PERFORMANCE MONITORING

Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
				Implement	Compliance Monitoring	
A. Prior to Construction Phase						
A.1 Detailed Design Preparation						
1 Completion of detailed design & O&M Manual incorporates EMP requirements.	Not applicable	Review of detailed design documents.	Once, prior to finalization Once, prior to approval	Design Consultant	PMU & PMIS Envi Sp/ADB*	-
A.2 Obtaining Environmental Clearance						
2 IEIA/EIA Report approval obtained	Not applicable	IEIA/EIAR approval document from MoE.	Once, at least 30 days prior to contract award	PMU	PMIS Envi Sp/ ADB*	
3 Intensive awareness program on health and safety hazards, communicable/transmittable diseases, on the grievance redress mechanism	All communes along the alignment	Review of relevant report of the PMU's Social, Environmental & Communication Teams.	Once, at least 30 days prior to contract award			
A.3 Procurement						
4 Procurement process complied with EMP requirements: SPS-compliant EMP part of bidding documents.	Not applicable	Verifying if EMP among bidding documents.	Once, prior to procurement			
C-EMP/EMP compliance stipulated in Contract Contract stipulates some tie up of progress payment & collection of performance bond with performance in C-EMP/EMP implementation.	Not applicable	Review of Draft & Final Contract.	Once, during draft Once, prior to signing			

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
	A.4 Post-Procurement Prior to Mobilization						
5	Preparation by selected Contractor its C-EMP, addressing Subproj. EMP requirements as minimum, & includes (but not limited to) plans for: aggregates mgnt; excavation mgnt (linked to removed soil mgnt); dust, noise & vibration controls; gas emission mitigation; sedimentation controls; solid & hazardous waste mgnt; traffic mgnt (to be coordinated with authorities); occupational health & safety; grievance redress; emergency response; environmental monitoring & reporting.	Not applicable	Verifying existence of C-EMP. Evaluating C-EMP against Subproj EMP.	Once prior to mobilization	Contractor	PMU/PIU PMIS Envi Sp/ ADB*	-
6	Have C-EMP cleared by ADB.	Not applicable	Verifying existence of ADB clearance.	Once prior to mobilization			
7	Environmental quality monitoring for baseline data according to the EMP.	1 in Section B-C 1 in Section D-E 1 in Section F-G	As prescribed in the Environmental effects Monitoring (Part I-A) of this Environmental Monitoring Plan.	Once prior to mobilization			
	B. Construction Phase						
8	Environmental mitigation implemented according to the C-EMP/EMP.	Active section	Site inspections, random spot checks.	Regular & random	Contractor	PMU/PIU PMIS Envi Sp/ ADB*	-
			Consulting affected residents.	Random			
			Review of lodged grievances.	Monthly			
			Review of records of workers accidents & sick leave.	Monthly			
			Consult relevant commune health center.	Monthly			
			Consult Mun. Health Department.	Monthly			
9	Environmental effects monitoring conducted according to the EMP.	Active section	As prescribed in the Environmental effects Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-A of this Environmental Monitoring Plan.	Contractor (Licensed Lab)		
10	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	All sections	Review of lodged grievances.	Regular and random	Contractor		
			Consulting village/commune authorities.	Monthly			
11	UXO "chance find" dealt with properly and encountered no injury and/or fatality.	All sections	Review Monthly EMR.	Monthly			
12	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	All sections	Review of investigation & remediation works report.	Latest, 1 week after each event			
13	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
14	Quarterly EMR on effects monitoring submitted promptly.	Not applicable	Review of Quarterly EMR on effects monitoring.	Quarterly	Contractor (Licensed Lab)		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
15	Semi-annual EMR submitted promptly following prescribed outline.	Not applicable	Review of the Semi-annual EMR.	Semi-annually	Contractor & PMU	PMIS Envi Sp/ADB	-
C.	**Operation Phase**						
16	Measures to mitigate non-sustainability of operation instituted, i.e., allocating adequate budget for proper maintenance & repair & environmental effects monitoring.	Not applicable	Site inspections, random spot checks, verifying promptness in maintenance & repair, & environmental effects monitoring.	Regular & random	Operator	PMU/PIU PMIS Envi Sp/ ADB*	-
17	Environmental effects monitoring conducted according to the EMP.	1 in Section B-C 1 in Section D-E 1 in Section F-G	As prescribed in the Environmental effects Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-A of this Environmental Monitoring Plan.	Operator (Licensed Lab)		
18	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	All sections	Review of lodged grievances. Consulting village authorities.	Regular and random Quarterly	Operator		
19	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	All sections	Review of investigation & remediation works report.	Latest, 1 week after each event			
20	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
21	Semi-annual EMR on effects monitoring submitted promptly.	Not applicable	Review of Semi-annual EMR on effects monitoring.	Semi-annually	Operator (Licensed Lab)		
22	Annual EMR submitted promptly using prescribed outline.	Not applicable	Review of the Annual EMR.	Annually	Operator, PMU	PMIS Envi Sp/ ADB*	
TOTAL COST							-

Annex F. Environmental Management Plan – Solid Waste Management

A. Prior to Construction Phase

A.1 Detailed Engineering Design

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Supervise & monitor
1 Unsustained effectiveness of service of completed works due to inadequate consideration during design of (any one or combination of) the following: - climate change & its impacts on waste disposal operations - vulnerability of site to seismic event - design adaptation options for integral components, such as road & water supply, buffer/landscaping/tree screen stormwater management, among others - technical & financial capacity of the operator to sustain controlled landfill operations	1.1 Few design options to consider to adapt to both increased and reduced rainfall: - For roads: flexible pavement, optimum degree of compaction - For landscaping/greening: combine drought- & submergence-tolerant plants, - For water supply: collect and store rainwater - For waste mound: appropriate gradient, drought & flood tolerant groundcover - For soil cover: optimum degree of compaction, appropriate gradient, appropriate soil type that could seal off rain water & at the same time is less plastic when dry 1.2 Apply seismic design criteria as regulated in Cambodia. 1.3 Design of stormwater management to ensure as much stormwater as possible is kept away from contact with waste cell. 1.4 Prepare O&M Manual and implement continuing capacity development. O&M Manual to include the required annual budget to guide Municipality on, & allocate for promptly, the amount needed to sustain effective operations.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp/ ADB*
2 Inadequate consideration of the following during design: - vulnerability of the soil & groundwater resource to waste disposal operations - reducing disturbance of waste disposal operations to the landscape - impact of the operations on the access road and the community along the access road - impacts of the hook lift bins on the communities where these will be stationed.	2.1 Consult proper authorities (&/or relevant university department or experts) on the hydro-geological & soil conditions in the area. 2.2 Ensure detailed design incoporates the groundwater monitoring well proposed in the preliminary design. 2.3 Incorporate at least 2 groundwater monitoring wells in the design for remediation of open dumps. 2.4 Allocate green buffer or introduce tree screens along the perimeter of the landfill to mitigate disturbance of waste operations to the existing landscape. 2.5 Consult the communities along the access road and communities near to hook lift bin stations Relevant feedback to be considered.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp/ ADB*
3 Unsustainable supply of gravel, stone, rock, sand, soil, clay or unsustainable extraction of these materials to meet construction demand & soil cover to meet operational demand.	3.1 Prepare an Aggregates Mgnt Plan (AMP) linked to the staged development (cut-to-fill) strategy proposed for the development of the controlled landfill: ▪ confirming location of legal sources for required aggregates ▪ estimating the demand for, & supply from confirmed sources of, aggregates	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp/ ADB*

4. Risks brought by continued operation of uncontrolled dumpsites	4.1 Prepare a final remediation and closure plan for the three dumps sites based on directions in Annex C. 4.2 Complete remediation and closure of Phnum Touch and Traok dumpsites before contract award for the controlled dump site and complete remediation and closure of Kul Kop dump site after the controlled landfill is operational	Phnum Touch, Traok, and Kul Kop dump sites	c/o government/ Municipality	Consultant for finalizing plans Government/Municipality for implementing plans	PMU & PMIS Env Sp ADB*

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Supervise & monitor
	▪ specifying measures to effectively minimize potential risks of aggregates extraction, transport, loading & unloading ▪ specifying environmental requirements should Contractor opt to operate its own borrow area to serve as basis for Contractor's AMP. 3.2 Specify in bidding documents & contract Contractor's obligation to obtain aggregates only from quarries still operating within allowed extraction threshold according to their environmental clearances & permits to operate.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp/ ADB*

A.2 Obtaining Approvals, and Community Preparation

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
4 Overall environmental concerns/impacts of the Subproject	4.1 Obtain IEIA/EIA approval for the Subproject.	Not applicable	c/o PMU's counterpart budget	PMU/PIU	PMIS Envi Sp/ ADB*
5 Potential communicable/transmittable diseases brought with entry of workers & overall health & safety hazards during construction.	5.1 Intensive awareness program on communicable/transmittable diseases, e.g., SARS, H1N1, STD, HIV/AIDS, tuberculosis, and diseases that may be brought with entry of workers & on the health and safety hazards during construction.	All affected villages	c/o PMU's counterpart budget	PMU/PIU with health & village officials	

A.3 Procurement & Prior to Mobilization

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Review & Evaluate
6 Engagement of environmentally irresponsible contractor for civil works	6.1 A SPS-compliant EMP, as part of bidding documents. 6.2 EMP to be appended to the Contract for basis of preparation of Contractor's EMP (C-EMP) & for compliance. 6.3 Contract to require Contractor's submission of monthly environmental monitoring report, outline appended in Contract. 6.4 Contract to also stipulate some tie up of progress payment & collection of performance bond with the performance in C-EMP/ EMP implementation. 6.5 Selected Contractor to prepare detailed C-EMP that addresses as minimum the requirements of the SPS-compliant EMP. 6.6 C-EMP to be quantitatively & qualitatively evaluated against the EMP. 6.7 ADB to clear C-EMP before start of any work on site or establishment of construction-related facilities.	Not applicable	-	PMU/PIU	PMIS Envi Sp/ ADB*
6a UXO "chance find"	6a.1 Workers' pre-orientation workshop to include procedures to follow in case of UXO "chance find". First-response team to coordinate & undergo orientation on management of UXO "chance find" event.	Not applicable	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU PMIS Envi Sp/ ADB*

B. Construction Phase

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Monitor
PHYSICAL / CHEMICAL ENVIRONMENT						
7 Dust/suspended particles from: - earthworks - dry exposed surfaces - stockpile of dry soils, sand, cement - transport of aggregates, cement residual soil for disposal & wastes - loading/unloading of fine aggregates, cement and other materials - movements of construction vehicles/ equipment	7.1	Confine clearing, grubbing & excavation according to the Staking Plan & Excavation Phasing Plan &/or Staged Development Strategy.	Landfill site	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	7.2	Water dry unpaved/exposed surfaces, stockpiles of sand & excavated materials , at least twice daily, or as necessary.		c/o Construction running, set up costs (preliminaries)		
	7.3	Protect stockpiles of soil/sand with a wind barrier/screen.				
	7.4	Wash/wet tires prior to exiting construction sites to remove mud/ dirt. Provide wetting facilities at exit.				
	7.5	Cover trucks securely, especially those carrying aggregates & cement, with tarpaulin. Trucks to maintain min. 2 feet freeboard.	At entire hauling route	c/o Supplier's cost	Supplier	
	7.6	Limit speed of all construction-related vehicles in access road to, and in, site to maximum of 30 kph.	Access road to, and within, landfill	-	Contractor	
	7.7	Minimize drop heights when loading/unloading soil onto trucks/ ground. Spray water on soil being loaded/unloaded.	Landfill			
8 Noise generated by/from, among others: - the operation of equipment, movement of vehicles (especially those diesel-fed & without effective mufflers) - such processes as drilling/excavation, earthmoving, unloading of aggregates, rock crushing, cement mixing	8.1	Use only equipment that emit least noise, e.g. electrically powered equipment, hydraulic tools, those with efficient mufflers. Allow only well-maintained equipment/vehicles	At the site	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	8.2	Sound-absorbing enclosure around generator set/s.				
	8.3	Locate noisy generators at max. distance from workers.		-		
	8.4	Strictly enforce upon workers compliance with wearing of ear mufflers, especially those operating the equipment.				
	8.5	Limit engine idling to a max. of 5 minutes.				
	8.3	Minimize drop heights when loading/unloading coarse aggregates.				
BIOLOGICAL ENVIRONMENT						
9 Impact on fauna habitats in vicinity.	9.1	Implement the appropriate recommended measures to mitigate the dust, noise.	Landfill	c/o Construction (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	9.2	Implement proper management of waste & hazardous substances.				
SOCIO-ECONOMIC & CULTURAL ENVIRONMENT						
10 Damage to access road from the many construction vehicles passing over daily during the construction period	10.1	During mobilization: - coordinate & agree with the Municipality/Province regarding road ruts caused by construction vehicle movements; and	Not applicable	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
		- post work activities & schedules at strategic places along the access road.	Access road	c/o Construction mobiliz'n cost		
11 Health & safety hazards of (& nuisance for) community along access road & the few farmers working at the adjacent rice fields, from: dust, noise, movement of vehicles and equipment, rise of communicable/	11.1	If dust level is high (during dry season), water adequate portions of the access road with residence/s along it.	Access road	c/o Construction running costs	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	11.2	Limit speed to 30 kph along access road.	Access road	-		
	11.3	Enforce upon drivers of construction-associated vehicles & equipment to implement safe/defensive driving & operation.				

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Monitor
transmittable diseases with the entry of workers	11.4	Adequate IEC prior to mobilization for community preparedness. IEC to include potential rise of communicable/transmittable diseases with entry of workers.	Phnum Touch Village	c/o PMU's counterpart budget	PMU/PIU	PMIS Envi Sp/ ADB*
12 Workers' health & safety hazards from any combination of the following: - dust, noise, gas emissions, fumes, odor - leachate from existing waste cell - exposure to wastes & hazardous substances - exposure to the weather - poor sanitation practices - open pits, disturbed areas - operating equipment & handling of tools - movement of construction-associated vehicles/equipment - rise of communicable/transmittable diseases in the village - fire, explosion, collapse of disturbed grounds, or worked-on cell	12.1	Conduct workers' orientation, prior construction, on occupational health & safety hazards, strict observance of safety measures, emergency response procedures, & use/handling of hazardous substances and noisy & vibrating equipment.	Not applicable	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	12.2	Implement recommended measures to mitigate dust, gas emission, noise, vibration; and to manage wastes & hazardous substances	Landfill			
	12.3	Provide protective wears, e.g., eye & nose masks, ear mufflers, helmets, gloves, appropriate footwear, etc. Enforce their use by workers while at work.				
	12.4	Install adequate lighting, safe accesses to & from active work areas.				
	12.5	Minimize impact from operating noisy/vibrating equipment/tools by ensuring workers' daily exposure value (ELV) is kept within the standard limit, as specified by manufacturer, through shifts to allow breaks from continuous use of equipment by individual worker.	Landfill	-		
	12.6	Provide safe accommodations.	Workers camp	c/o Construction mobiliz'n & running costs (preliminaries)		
	12.7	Provide adequate water for washing & safe drinking, and adequate sanitation and waste management facilities. Enforce observance of good hygiene, sanitation & waste management practices.	Workers camp & Landfill			
	12.8	Set up emergency response team, equipped with adequate staff, equipment, tools & supplies, and with good link to ultimate responders.	Landfill			
	12.9	Arrange with nearest primary & tertiary health institutions for health & emergency care of workers.	Not applicable	-		
	12.10	Enforce upon drivers/operators of construction-associated vehicles & equipment to implement safe/defensive driving & operation.	In & outside construction sites			
	12.11	In case of "chance find" of UXO, immediately stop work, implement evacuation procedures, secure area. Contact local police to ensure security of the area involved & to communicate the Cambodian Mine Action and Victim Assistance Authority.	Landfill			
PHYSICAL CULTURAL ENVIRONMENT 13 Damage to physical cultural resource in case of chance find	13.1	Stop work & secure site immediately. Make a declaration to local police. Resume work only when told so by the authority mandated under the Law on the Protection of Cultural Heritage.	Controlled landfill			
SUSTAINABILITY OF WORKS 14 Damage during seismic or extreme weather event	14.1	After every seismic or extreme weather event, conduct engineering investigation of waste cell, built structures & facilities and implement corrective measures without delay.	Landfill	c/o Construction contingency cost	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
Sub-Total (Prior to Construction and During Construction)			USD	-		

C. Operation Phase

Potential Environmental Impacts	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
				Pre-Operation Phases			Operation Phase	
				Det. Design Consultant	PMU/PIU	PMIS Envi Sp / ADB*	Operator	PMU/PIU & ADB*
15 Dust - in dry season & on windy days - from trucks entering/leaving especially from tipping face - from loading/unloading of soil cover, unloading of wastes - from soil covering activity - from borrowing activity - from wind-blown stockpile of soil cover material	15.1 During dry season, water access & internal roads, stockpile of soil cover, twice a day or more as necessary.	Landfill	c/o Operations running & safety costs	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
	15.2 Spraying water when spreading soil cover.							
	15.3 Seeding of exposed areas as soon as possible							
	15.4 Protect stockpile soil cover with a wind break/shield (artificial or natural or combination).	Borrow/stockpile area						
	15.5 Enforce on all open trucks hauling garbage, aggregates, soil cover & similar materials to have proper cover & maintain min. 2 feet freeboard.	To, from landfill	c/o respective Operations Costs					
	15.6 Limit vehicle speed inside facility to maximum of 30 kph.	Landfill	-					
	15.7 Minimize drop heights when loading/unloading soil onto trucks/waste cell and when unloading wastes.							
16 Production of landfill gas, gas migration, potential explosion & loss of deep-rooted vegetation	16.1 Provide gas collection & vents.	Landfill	c/o Project cost	Include in design	Implement	Supervise & monitor	-	-
	16.2 Install appropriate bottom liner, sides liner.							
	16.3 Apply soil/alternative cover daily.	Landfill	c/o Operations running cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
	16.4 Initially, vent gas. Flaring may be done occasionally, as necessary, but process to be kept simple.							
	16.5 Implement landfill gas monitoring per EMP. Use result to evaluate effectiveness of system. (Gas is expected to be generated after 5 years from start of operation.)							
	16.6 In case landfill gas monitoring reveals high content of hazardous compounds, e.g., halogenated compound: - filter gas, prior to flaring; the filtered should not be burned, but should be handled carefully & disposed of properly. - implement separation of cells for organic & other wastes - implement use of collected gas suitable for each cell							
	16.7 In case of gas migration: - establish a buffer area; create an impermeable wall between buffer area and waste cell - set up monitoring well within buffer area after the wall & implement continuous monitoring.							
17 Odor, vermin/pests/ insects/rodents, bird & animal attraction	17.1 Apply soil/alternative cover daily.	Landfill	c/o Operations running cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
	17.2 Pest control, as necessary, but should use non-persistent one							
	17.3 Rodent/vermin controls, as necessary, e.g., bait stations							
	17.4 Movable perimeter (litter) fence around active cell to prevent stray animals from feeding on wastes prior to soil cover.							

Potential Environmental Impacts		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
						Pre-Operation Phases			Operation Phase	
						Det. Design Consultant	PMU/PIU	PMIS Envi Sp / ADB*	Operator	PMU/PIU & ADB*
		17.5	Landscaping, perimeter greening, creating a buffer area, planted with trees & shrubs that repel insects, e.g., eucalyptus, citronella (Pelargonium citrosum), neem (Azadirachta indica); trees and shrubs that bear sweet smelling flowers, e.g., ylang-ylang (Cananga odorata), champaca (Michelia champaca), sampaguita (Jasminum sambac), champasak. (Plumeria rubra or Plumeria alba), among others.	Landfill	c/o Operations running cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
		17.6	Perimeter fencing at least around landfill area.	Landfill	c/o Project cost	Include in design	Implement	Supervise & monitor	-	-
18	Noise from truck movements/ equipment operation could pose hazard to workers	18.1	Limit speed inside facility to maximum of 30 kph.	Landfill	-	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
		18.2	Spread out arrivals of trucks.							
		18.3	No blowing of horn inside the facility.							
		18.4	Workers to wear ear mufflers.	Landfill	c/o Operations running cost					
		18.5	Use low-noise landfill equipment & to be turned off when idle.							
		18.6	Borrowing only as programmed. Use low-noise equipment, with muffler, well maintained, for borrowing & hauling.	Borrow area						
19	Wind-blown litters	19.1	Provide movable litter fence around tipping area & active waste cell.	Landfill	c/o Operations running cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
		19.2	Open garbage trucks (dump trucks) will be required to maintain at least 2 feet freeboard and provide tarpaulin cover	To, from Landfill	respective Operations Costs					
20	Mud spread	20.1	Trucks to have washed/wet tires prior to leaving Landfill.	Landfill	-	Include in wash facility in design.	Implement	Supervise & monitor	Implement	Monitor
21	Groundwater contamination from leachate & gas migration	21.1	Install /provide the following: - appropriate bottom & sides liners - perimeter surface runoff drains - leachate management system - groundwater monitoring wells	Landfill	c/o Project Cost	Include in design	Implement	Supervise & monitor	-	-
		21.2	Apply soil/alternate cover daily.	Landfill	c/o Operations running cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
		21.3	Apply capping to completed cells.							
		21.4	Undertake monitoring of leachate & groundwater as prescribed in the EMP.							
22	Leachate drippings from trucks hauling wastes, odor & litters from open garbage trucks	22.1	Require waste trucks to ensure no leachate drippings during transport.	To, from Landfill	-	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
		22.1	Require open waste trucks to maintain min. 2 feet freeboard & provide the appropriate cover.							
		22.3	Require trucks to wash body & tires prior to exit from landfill.	Landfill/Landfill						

Potential Environmental Impacts		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
						Pre-Operation Phases			Operation Phase	
						Det. Design Consultant	PMU/PIU	PMIS Envi Sp / ADB*	Operator	PMU/PIU & ADB*
23	Fire/explosion from gas build build up, heat, etc.	23.1	Equip Landfill with adequate/appropriate fire-fighting equipment.	Landfill	c/o Project cost & Operations running cost	Include in design & O&M Manual	Implement	Supervise & monitor	Implement	Monitor
		23.2	Set up trained Safety Team (as initial responders) linked to the fire department & other ultimate responders.							
		23.3	Install gas collection & treatment. Monitor landfill gas.							
		23.5	Conduct regular fire/explosion/emergency drills	Landfill	-					
		23.6	Enforce a "No Smoking" Policy within the Landfill premises.							
24	Community health & safety hazard, nuisance (from waste collection trucks along access road - leachate drippings, dust litters from open litter dump truck	24.1	Conduct IEC regarding the hazards & risks of completed/ operated sub-components.	Phnum Touch Village	c/o Operations safety cost'	Include in O&M Manual	-	Implement	-	-
		24.2	Perimeter fencing around Landfill, or at least around the landfill.	Landfill	c/o Project cost & Operations running cost	Include in design & O&M Manual	Implement	Supervise & monitor		
		24.3	Install sufficient warning signs against unauthorized entry							
		24.4	Implement measures to mitigate dust, gas, leachate, pests/ insects/rodents, incidence of fire/explosion.							
		24.5	Secure premises against unauthorized entry by public.	Landfill	c/o Operations running cost'	-	-	-	Implement	Monitor
		24.6	Collaborate with Village officials for community safety	Phnum Touch Village	-					
25	Workers' health & safety hazard	25.1	Conduct a comprehensive orientation on the O&M Manual, to include health and safety risks & mitigation measures.	Not applicable	c/o Operations running cost	-	-	-	Implement	Monitor
		25.2	Set up emergency response mechanism & train workers of their roles & responsibilities in the mechanism.							
		25.3	Workers to undergo semi-annual physical examinations & be provided with appropriate vaccinations. Establish & update workers' health baseline data.	Not applicable	c/o Operations social/safety cost					
		25.4	Provision of required protective wear, i.e., clothing, cap, hand glove, ear muffler, nose/mouth mask, eye wear, footwear (boots) for workers' compliance.							
		25.5	Access to adequate sanitation facilities and potable water.	Landfill	-					
		25.6	Observance of good sanitation practices.							
26	Unsustained sanitary operations due to insufficient operational & financial capabilities.	26.1	O&M Manual to specify capacity development, budget requirements for O&M.	Not applicable	c/o Design cost	Include in design	-	Supervise & monitor	-	-
		26.2	Implement regular/continuing capacity development.	Not applicable	c/o Operations running cost	-	-	-	Implement	Monitor
27	Damages during seismic or extreme weather events	27.1	After every seismic or extreme weather event, conduct engineering investigation of built cells, structures & facilities and implement corrective measures without delay.	Landfill	c/o Operations safety cost	-	Implement	Supervise & monitor	Implement	Monitor
Sub-Total (During Operation)				USD	-					
TOTAL				USD	-					

Environmental Monitoring Plan

I. ENVIRONMENTAL EFFECTS MONITORING

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
A.	**Prior to Construction Phase** During procurement prior to awarding of contract for civil works						
1	**Ambient air quality** $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO_2, O_2, CH_4 *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines. Results as baseline data before mobilization.*	Within site & outside site (controlled landfill & dump sites)	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once	4,600.00	PMU/ (Licensed Lab)	PMISEnvi Sp/ ADB*
2	**Ambient noise levels** Lmax, Lmin, Leq *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise. Results as baseline data before mobilization.*	Within site & outside site (controlled landfill & dump sites)	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once	260.00		
3	**Groundwater quality** pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, Pb, Cu, Cd, Cr(-3), Cr(+6) *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011. Results as baseline data before mobilization.*	Within site & outside site (controlled landfill & dump sites)	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once	636.00		
4	**Community health & safety conditions** - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accidents (vehicular, fire, etc) & crime *Information as baseline data before mobilization.*	Phnum Touch Village	Information from Commune Council, relevant health center, Mun./Prov'l Health Department, Municipality	Once	-		
	Sub-Total (Prior to Construction for baseline data)				5,496.00		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring		Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
B.	**Construction Phase**						
5	Ambient air quality a) $PM_{2.5}$, PM_{10}, SO_2, NO_2 b) $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO_2, O_2, CH_4 *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	Within site & outside site Within site and outside site (controlled landfill & dump sites)	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	a) Once, semi-annually b) Once, semi-annually	2,380.00 6,900.00	Contractor (Licensed Lab)	PMU/PIU/ PMISEnvi Sp/ ADB*
6	Ambient noise levels Lmax, Lmin, Leq *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise.*	Within site & outside site (controlled landfill & dump sites)	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, quarterly	715.00		
7	Groundwater quality pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, Pb, Cu, Cd, Cr(-3), Cr(+6) *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011.*	Within site & outside site (dump sites)	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once, quarterly	636.00		
8	Community health & safety - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accident, fire & crime	Phnum Touch Village	Information from, & close coordination with, Commune Council, relevant health center, Mun./Prov'l Health Department, Municipality	Once, quarterly	-		
9	Workers' health & safety - Incidences of illness due to work - Incidences of work-related accident, injuries/deaths to emergencies, crime involving workers	Workers' camp & work site	Records of Safety Engineer	Once, quarterly	-		
	Sub-Total (Construction)				10,631.00		
	Sub-Total (Prior to Construction and During Construction)				16,127.00		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Annual Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
C.	**Operation Phase**						
10	Ambient air quality $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO_2, O_2, CH_4 *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	Within site & outside site	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, quarterly	9,200.00	Operator/ (Licensed Lab)	PMU / PMISEnvi Sp/ ADB*
11	Leachate Quality pH, Al, NH_3, Cl, SO_4, NO_3, NO_2, Cu, Pb, H_2S, Fe, Mn, Na, TDS, Zn, As, Ba, Cd, CN, Hg, Ni, Cr^{-3} Cr^{6+} *Review results against Annex 2 of Sub-decree No.27/ANRK/BK (1999).* *Review results also against Cambodia's Drinking Water Quality Standards (2004) to check magnitudes of exceedance, as groundwater is the resource to protect at the site.*	2 at sump at lower end of waste cells (Where leachate gathers at pump area)	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, annually	490.00		
12	Groundwater quality pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, Pb, Cu, Cd, Cr(-3), Cr(+6) *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011.*	2 within site and 1 outside site	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once, quarterly	2,628.00		
13	Community health & safety - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accident, fire.	Phnum Touch Village	Information from, & close coordination with, Commune Council, relevant commune health center, Mun. Health Department, Mun. Government	Once semi-annually	-		
14	Workers' health & safety - Incidences of illness due to work - Incidences of work-related accident, injuries/deaths to emergencies, crime involving workers	Landfill site	Records of Safety Officer.	Once semi-annually	-		
	Total Annual Cost (Operation)				12,318.00		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Annual Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
D. Decommissioning Phase of Remediated Dumps							
15	Ambient air quality $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO_2, O_2, CH_4 *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	Within site & outside site	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, semi-annually	4,600.00	Operator/ (Licensed Lab)	PMU / PMISEnvi Sp/ ADB*
16	Groundwater quality pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, Pb, Cu, Cd, Cr(-3), Cr(+6) *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011.*	2 within site and 1 outside site	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once, semi-annually	1,314.00		
17	Community health & safety - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accident, fire & crime	Phnum Touch Village	Information from, & close coordination with, Commune Council, relevant commune health center, Mun. Health Department, Mun. Government	Once semi-annually (at least for 1st 5 yrs., may be reduced thereafter depending on conditions)	-		
	Total Annual Cost (Decommissioning)				5,914.00		

II. PERFORMANCE MONITORING

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
A. Prior to Construction Phase							
	A.1 Detailed Design Preparation						
1	Completion of detailed design & O&M Manual incorporates EMP requirements.	Not applicable	Review of detailed design documents.	Once, prior to finalization Once, prior to approval	Design Consultant	PMU & PMIS Envi Sp/ADB*	-
	A.2 Obtaining Environmental Clearance						
2	IEIA/EIA Report approval obtained	Not applicable	IEIA/EIAR approval document from MoE.	Once, at least 30 days prior to contract award	PMU	PMISEnvi Sp/ ADB*	
3	Intensive awareness program on health and safety hazards, communicable/transmittable diseases, on the grievance redress mechanism	Phnum Touch Village	Review of relevant report of the PMU's Social, Environmental & Communication Teams.	Once, at least 30 days prior to contract award			

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
	A.3 Procurement						
4	Procurement process complied with EMP requirements: SPS-compliant EMP part of bidding documents.	Not applicable	Verifying inclusion of EMP in bidding documents.	Once, prior to procurement	PMU	PMISEnvi Sp/ ADB*	-
	C-EMP/EMP compliance stipulated in Contract	Not applicable	Review of Draft & Final Contract.	Once, during draft Once, prior to signing			
	Contract stipulates some tie up of progress payment & collection of performance bond with performance in C-EMP/EMP implementation.						
	A.4 Post-Procurement Prior to Mobilization						
5	Preparation by selected Contractor its C-EMP, addressing Subproj. EMP requirements as minimum, & includes (but not limited to) plans for: aggregates mgnt; excavation mgnt (linked to removed soil mgnt); dust, noise & vibration controls; gas emission mitigation; sedimentation controls; solid & hazardous waste mgnt; traffic mgnt (to be coordinated with authorities); occupational health & safety; grievance redress; emergency response; environmental monitoring & reporting.	Not applicable	Verifying existence of C-EMP. Evaluating C-EMP against Subproj EMP.	Once prior to mobilization			
6	Have C-EMP cleared by ADB.	Not applicable	Verifying existence of ADB clearance.	Once prior to mobilization			
7	Environmental quality monitoring for baseline data conducted according to the EMP.	Landfill site & vicinity	As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	Once prior to mobilization			
	B. Construction Phase						
8	Environmental mitigation implemented according to the C-EMP/EMP.	Landfill site	Site inspections, random spot checks.	Regular & random	Contractor	PMU / PMISEnvi Sp/ ADB*	-
			Consulting affected residents.	Random			
			Review of lodged grievances.	Monthly			
			Review of records of workers accidents & sick leave.	Monthly			
			Consult relevant commune health center.	Monthly			
			Consult Mun. Health Department.	Monthly			
9	Environmental effects monitoring conducted according to the C-EMP/EMP.	Landfill site & vicinity	As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-Bof this Environmental Monitoring Plan.	Contractor (Licensed Lab)		
10	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	Not applicable	Review of GRM records.	Regular and random	Contractor		
			Consulting village/commune authorities.	Monthly			
11	UXO "chance find" dealt with properly and encountered no injury and/or fatality.	Controlled landfill & dump sites & their vicinities	Review Monthly EMR.	Monthly			

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
12	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	Landfill site	Review of investigation & remediation works report.	Latest, 1 week after each event	Contractor	PMU / PMISEnvi Sp/ ADB*	-
13	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
14	Quarterly EMR on effects monitoring submitted promptly.	Not applicable	Review of Quarterly EMR on effects monitoring.	Quarterly	Contractor (Licensed Lab)		
15	Semi-annual EMR submitted promptly following prescribed outline.	Not applicable	Review of the Semi-annual EMR.	Semi-annually	Contractor & PMU	PMISEnvi Sp/ ADB*	
C.	**Operation Phase**						
16	Operation following the O&M Manual & EMP	Landfill site	Site inspections, random spot checks.	Regular & random	Operator	PMU, PMISEnvi Sp/ ADB*	-
			Consulting affected residents.	Random			
			Review of lodged grievances.	Quarterly			
			Review of records of workers accidents & sick leave.	Quarterly			
			Consulting relevant commune health center.	Quarterly			
			Consulting Mun. Health Department.	Quarterly			
17	Measures to mitigate non-sustainability of operation instituted, i.e., allocating adequate budget for proper sanitary landfill operations, maintenance & repair, & environmental effects monitoring.	Operator's Office	Site inspections, random spot checks, verifying promptness in maintenance & repair, & environmental impacts monitoring.	Regular & random			
18	Environmental effects monitoring conducted according to the EMP.	Landfill site & vicinity	As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-C of this Environmental Monitoring Plan.	Operator (Licensed Lab)		
19	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	Not applicable	Review of GRM records.	Regular and random			
			Consulting village authorities.	Quarterly			
20	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	Landfill site	Review of investigation & remediation works report.	Latest, 1 week after each event			
21	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
22	Quarterly EMR on effects monitoring submitted promptly.	Not applicable	Review of Quarterly EMR on effects monitoring.	Quarterly	Operator (Licensed Lab)		
23	Annual EMR submitted promptly using prescribed outline.	Not applicable	Review of the Annual EMR.	Annually	Operator & PMU	PMISEnvi Sp/ ADB*	

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
C.	**Decommissioning Phase of Remediated Dumps**						
24	Environmental effects monitoring conducted according to the EMP.	Remediated dump sites & vicinities	As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-C of this Environmental Monitoring Plan.	Operator (Licensed Lab) or Mun. Govt)	PMU/PIU, PMISEnvi Sp/ ADB*	-
25	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	Not applicable	Review of GRM records.	Regular and random	Operator of Mun. Govt.		
			Consulting village authorities.	Quarterly			
26	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	Remediated dump sites	Review of investigation & remediation works report.	Latest, 1 week after each event			
27	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
28	Quarterly EMR on effects monitoring submitted promptly.	Not applicable	Review of Quarterly EMR on effects monitoring.	Quarterly	Operator (Licensed Lab)		
29	Annual EMR submitted promptly using prescribed outline.	Not applicable	Review of the Annual EMR.	Annually	Operator, PMU	PMIS Envi Sp/ ADB*	
TOTAL COST							-

Annex G. Draft Outline for the PMU's Environmental Monitoring Report

This outline and the performance assessment and rating are mainly suggested and will be finalized according to applicability during the detailed design stage. The level of detail and comprehensiveness would depend on the degree of complexity of social and environmental impacts.

1. Introduction
- 1.1 Purpose of the Report
- 1.2 Project Overview
- 1.3 Physical Progress of the Project

2. Environmental Requirements in Project Loan and Grant Agreements and Subproject Contractual Arrangements

3. Conformance to the EARF
(This section reports on CMEI Output's conformance to the EARF.)

4. Environmental Mitigation [a]
(This section reports on the implementation of the Environmental Mitigation Plan.)

5. Environmental Monitoring [b]
(This section reports on the implementation of the Environmental Monitoring Plan.)
- 5.1 Environmental Impacts Monitoring
- 5.2 Environmental Performance Monitoring

6. Grievance Redress [c]
(This section reports on the number of grievances received and acted on, and the performance in observing the GRM.)

7. Emergency Response [d]
(This section reports on the incidence of emergency situation, emergency response level, and, if applicable, the casualties encountered.)

8. Preparation and Submission of EMRs [e]
(This section reports on the performance in reporting by respective parties.)

9. Overall Environmental Performance [f]

10. Summary of Key Issues, Actions and Lessons Learned
- 10.1 Key Issues Identified
- 10.2 Actions Taken/To be Taken
- 10.3 Lesson Learned

11. Conclusion & Recommendations

Annexes
- A Environmental Impacts Monitoring Results
- B Performance Monitoring/Inspection Reports
  (To include regular site monitoring/inspection and unannounced spot check reports, random informal public consultations on site, photographs)
- C Other supporting documents/information

---

[a] Assessment of/rating for:

(i) performance in mitigation measures implementation

5	Very good	100% of required mitigation carried out
4	Good	76-99% of required mitigation carried out
3	Fair	51-75% of mitigations carried out
2	Poor	26-50% of mitigations carried out
1	Very poor	0-25% of mitigations carried out

(ii) effectiveness of implemented mitigation *

5	Very good	100% effective
4	Good	76-99% effective
3	Fair	51-75% effective
2	Poor	26-50% effective
1	Very poor	0-25% effective

* Use state of received grievances, findings from regular monitoring/inspections, unannounced spot checks, informal random public consultations on site, state of workers health and safety, and (every quarter) the results of environmental impacts monitoring --- as bases for assessing effectiveness.

b

Assessment of/rating for:

(i) performance in environmental impacts monitoring

5	Very good	100% of required environmental impacts monitoring carried out
4	Good	76-99% of required environmental impacts monitoring carried out
3	Fair	51-75% of environmental impacts monitoring carried out
2	Poor	26-50% of environmental impacts monitoring carried out
1	Very poor	0-25% of environmental impacts monitoring carried out

(ii) results environmental impacts monitoring

5	Very good	within the more stringent value between international and national standards
4	Good	within the less stringent value between international and national standards
3	Fair	in excess of the less stringent value between international and national standards, but equal or less than the baseline value
2	Poor	1-3% in excess of the baseline value
1	Very poor	>3% in excess of the baseline value

(iii) performance monitoring

5	Very good	All target regular site monitoring/inspections, unannounced spot checks, informal public consultations carried out
3	Fair	Not all target regular site monitoring/inspections, unannounced spot checks, informal public consultations carried out
1	Very poor	No regular site monitoring/inspections, unannounced spot checks, informal public consultations carried out

c

Assessment of/rating for:

(i) performance in grievance redress

5	Very good	100% closed promptly
4	Good	76-99% closed promptly
3	Fair	51-75% closed promptly, no appeal
2	Poor	26-50% closed promptly, 1-3 appeals
1	Very poor	0-25% closed promptly, >3 appeals

(ii) number of grievances received

5	Very good	0 or no valid grievance received
4	Good	1-3 valid grievance/s received
3	Fair	4-5 valid grievances received
2	Poor	6-10 valid grievances received
1	Very poor	>10 valid grievances received

d

Assessment of/rating for emergency response:

5	Very good	no emergency case, no emergency response necessary
4	Good	1st response, no injury, no casualty
3	Fair	1st response/ultimate response, 1-3 injured
2	Poor	1st response/ultimate response, >3 injured, no casualty
1	Very poor	1st response/ultimate response, with casualty

e

Assessment of/rating for EMR preparation/submission:

5	Very good	submitted promptly on prescribed deadline
3	Fair	submitted after prescribed deadline, but before overall Project Progress Report submission
1	Very poor	not submitted and therefore not incorporated in Project Progress Report

f

Overall performance could be described in qualitative terms by subproject, city and Project. Or, rating system could be applied. This would require weights to be assigned to each indicator, each subproject and each city to arrive at the overall Project performance.

Annex H.
Terms of Reference for PMIS Environmental Specialists (International and National Consultants)

Person & Task	Person-Months	Minimum Qualifications	Minimum Work Experience
International Environment Specialist	4	Masters Degree in environmental science, engineering, planning or equivalent	10 years' experience in environmental management & assessment in developing countries. Experience in south east Asia and of urban development or related projects financed by multilateral development funding agencies is required.
Environment Specialist	12	Degree in environmental science, engineering, planning or a related discipline	5 years of experience in environmental management, safeguards or environmental impact assessments. Experience on urban development or related assignments funded by multilateral development financing institutions would be beneficial. Fluency in written and spoken English is required

Environment Specialist (International, 4 person months)

- Assist the PMU in the conduct of the following for proposed Community Mobilization and Environmental Improvements (CMEI) subprojects, to include the: (i) review, finalization and confirmation of the results of the rapid environmental assessment (REA) and categorization; and (ii) basic environmental assessment and preparation of report for compliance with EARF and RGC requirements.
- Ensure ADB Environment safeguard category remains B.
- Assist the PMU in ensuring the incorporation of relevant mitigation measures in the detailed designs, coordinated public consultations and disclosure/information dissemination with the social/resettlement team, and that the RGC's environmental assessment requirements will not cause delay in the commencement of the construction phase.
- Finalize and update the IEEs and EMPs, as necessary, based on the detailed engineering designs, and ensure consistency, where applicable, with other safeguard plans.
- In coordination with the Solid Waste Management Specialist, finalize remediation and closure plans for all three dumpsites in coordination with the government/Municipality and monitor implementation. Assist the PMU in preparing for procurement by: (i) ensuring that the SPS-compliant EMP is part of the tender documents and civil works contracts; and (ii) establishing and incorporating environmental criteria, scoring and weight in the evaluation of bids in coordination and agreement with the procurement committee.
- Assist the PMU in ensuring that contractors prepare their respective contractor's EMP (C-EMP) based on the SPS-compliant EMP and actual site conditions and in evaluating the contractor's EMPs (C-EMPs).
- Assist the PMU in preparing for the activation of the grievance redress mechanism, undertaking pre-construction environmental quality monitoring as recommended in the EMP, and reviewing/evaluating Contractor's EMPs to ensure they are fully responsive to the SPS-compliant EMPs.
- Design a tool or system to facilitate effective consultations, monitoring/inspection and reporting by the PMU.
- Coordinate with the MOE and TSA on regulatory compliance issues—for water quality in the the Tonle Sap, noise and dust from construction sites, sanitation in workers campsite, etc.

- Provide training lectures/seminars on the EMP and its implementation.
- During construction and operation, guide the PMU in supervising, monitoring, and reporting EMP implementation.
- Assess the operation/observance of the grievance redress mechanism, and recommend improvements.
- Review the results of the environmental effects monitoring. Recommend investigations and recommend corrective actions, as necessary
- Assist the PMU and PIUs in follow up consultations.
- Conduct visits to work sites to provide guidance to, and advise the PIUs and operators on environmental management concerns arising during project construction and operation, respectively, and recommend corrective measures.
- Prepare the necessary status reports for compliance with the conditions set out in approved Royal Government of Cambodia's IEE/IEIA Reports.
- Assist in the preparation of semi-annual environmental monitoring reports (EMRs) and finalize the monthly EMRs for input to the PMU's semi-annual safeguards monitoring report for submission to the ADB.
- Recommend measures to ensure effective EARF and EMP compliance/ implementation, as necessary.
- Ensure that capacity development in environmental managemnt is carried out through "hands on" training during the implementation of the EARF and EMPs.

Environment Specialist (National, 12 person months)

The national consultant will support the international consultant in carrying out the tasks below:

- Support the PMU in the conduct of the following for proposed Community Mobilization and Envrionmental Improvements (CMEI) subprojects, to include the: (i) review, finalization and confirmation of the results of the rapid enviornmental assessment (REA) and categorization; and (ii) basic environmental assessment and preparation of report for compliance with EARF and RGC requirements.
- Support the PMU in ensuring the incorporation of relevant mitigation measures in the detailed designs, coordinated public consultations and disclosure/information dissemination with the social/resettlement team, and that the RGC's environmental assessment requirements will not cause delay in the commencement of the construction phase.
- Finalize and update the IEEs and EMPs, as necessary, based on the detailed engineering designs, and ensure consistency, where applicable, with other safeguard plans.
- With the international specialist, finalize remediation and closure plans for all three dumpsites in coordination with the government/Municipality and monitor implementation
- Support the PMU in preparing for procurement by: (i) ensuring that the SPS-compliant EMP is part of the tender documents and civil works contracts; and (ii) establishing and incorporating environmental criteria, scoring and weight in the evaluation of bids in coordination and agreement with the procurement committee.
- Support the PMU in ensuring that contractors prepare their respective contractor's EMP (C-EMP) based on the SPS-compliant EMP and actual site conditions and in evaluating the contractor's EMPs (C-EMPs).
- Support the PMU in preparing for the activation of the grievance redress mechanism, undertaking pre-construction environmental quality monitoring as recommended in the EMP, and reviewing/evaluating Contractor's EMPs to ensure they are fully responsive to the SPS-compliant EMPs.
- Design a tool or system to facilitate effective consultations, monitoring/inspection and reporting by the PMU.

- Coordinate with the MOE and TSA on regulatory compliance issues—for water quality in the the Tonle Sap, noise and dust from construction sites, sanitation in workers campsite, etc.
- Provide training lectures/seminars on the EMP and its implementation.
- During construction and operation, guide the PMU in supervising, monitoring, and reporting EMP implementation.
- Assess the operation/observance of the grievance redress mechanism, and recommend improvements.
- Review the results of the environmental effects monitoring. Recommend investigations and recommend corrective actions, as necessary
- Support the PMU and PIUs in follow up consultations.
- Conduct visits to work sites to provide guidance to, and advise the PIUs and operators on environmental management concerns arising during project construction and operation, respectively, and recommend corrective measures.
- Prepare the necessary status reports for compliance with the conditions set out in approved Royal Government of Cambodia's IEE/IEIA Reports.
- Assist in the preparation of semi-annual environmental monitoring reports (EMRs) and finalize the monthly EMRs for input to the PMU's semi-annual safeguards monitoring report for submission to the ADB.
- Ensure that ADB's environment safeguard categorization remains B. Recommend measures to ensure effective EARF and EMP compliance/ implementation, as necessary.
- Ensure that capacity development in environmental managemnt is carried out through "hands on" training during the implementation of the EARF and EMPs.

-