# Initial Environmental Examination

June 2012

## CAM: Greater Mekong Subregion Corridor Towns Development Project

## Subprojects of Battambang, Bavet, Neak Loeung, and Poipet

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

## CURRENCY EQUIVALENTS

(as of 2 June 2012)

| | | |
|---|---|---|
| Currency Unit | – | riel (KR) |
| KR1.00 | = | $0.00024 |
| $1.00 | = | KR4,166 |

## ABBREVIATIONS

| | | |
|---|---|---|
| ADB | – | Asian Development Bank |
| CIEE | – | consolidated initial environmental examination |
| CTDP | – | corridor towns development project |
| EWEC | – | East-West Economic Corridor |
| EA | – | executing agency |
| EIA | – | environmental impact assessment |
| EMO | – | external monitoring organization |
| EMP | – | environment management plan |
| GMS | – | Greater Mekong Subregion |
| GoC | – | Government of Cambodia |
| IA | – | implementing agency |
| IEE | – | initial environmental examination |
| MAFF | – | Ministry of Agriculture, Forestry and Fisheries |
| MIME | – | Ministry of Industry, Mines and Energy |
| MPWT | – | Ministry of Public Works and Transport |
| MRF | – | materials recovery facility |
| MoE | – | Ministry of Environment |
| NCCC | – | The National Climate Change Committee |
| PDE | – | Provincial Department of Environment |
| PDPWT | – | Provincial Department of Public Works and Transport |
| PDWRM | – | Provincial Department of Water Resources and Meteorology |
| PDLMUC | – | Provincial Department of Land Management, Urbanization & Construction |
| PISC | – | project implementation and supervision consultant |
| PIU | – | project implementation nit |
| PPCC | – | provincial project coordination committee |
| PPTA | – | project preparatory technical assistance |
| PMU | – | project management unit |
| PPMU | – | provincial project management unit |
| REA | – | rapid environmental assessment |
| RF | – | resettlement framework |
| SEC | – | Southern Economic Corridor |
| SLEDP | – | strategic local economic development plan |
| SWM | – | solid waste management |
| USD | – | United States dollar |
| WWTP | – | wastewater treatment plant |

## WEIGHTS AND MEASURES

| | | |
|---|---|---|
| km | – | kilometer |
| kg | – | kilogram |

| | | |
|---|---|---|
| ha | – | hectare |
| mm | – | millimeter |

**NOTE**

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

**CONTENTS**


| | | | |
|---|---|---|---|
| I. | EXECUTIVE SUMMARY | | 1 |
| | A. | Project Summary | 1 |
| | B. | Potential Impacts | 2 |
| | C. | Conclusions | 3 |
| II. | INTRODUCTION | | 4 |
| | A. | Background to Project and IEE | 4 |
| | B. | Assessment Context | 5 |
| | C. | Consolidated IEE | 6 |
| III. | POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK | | 6 |
| | A. | ADB Safeguard Policy | 6 |
| | B. | National Environmental Assessment Protocol | 6 |
| | C. | National Environmental Law and Policy | 6 |
| | D. | Responsible Agencies for Environmental Assessment and Management | 7 |
| IV. | DESCRIPTION OF SUBPROJECTS | | 8 |
| | A. | Bavet Subproject | 8 |
| | B. | Battambang Subproject | 18 |
| | C. | Neak Loeung Subproject | 25 |
| | D. | Poipet Subproject | 27 |
| V. | DESCRIPTION OF AFFECTED ENVIRONMENTS | | 39 |
| | A. | Common Environmental Features of the Towns | 39 |
| | B. | Bavet Town | 39 |
| | C. | Battambang Town | 43 |
| | D. | Neak Loeung Town | 47 |
| | E. | Poipet Town | 50 |
| VI. | PUBLIC CONSULTATION | | 53 |
| | A. | Identification of Stakeholders | 53 |
| | B. | Summary of Public Consultation and Project Response | 54 |
| VII. | POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES | | 58 |
| | A. | Subproject Benefits | 58 |
| | B. | Subproject Impacts and Mitigations | 59 |
| VIII. | ANALYSIS OF ALTERNATIVES | | 67 |
| | A. | Solid Waste Management in Poipet | 67 |
| IX. | INFORMATION DISCLOSURE AND PUBLIC GRIEVANCE MECHANISM | | 74 |
| X. | ENVIRONMENTAL MANAGEMENT PLANS | | 75 |
| XI. | CONCLUSIONS AND RECOMMENDATION | | 76 |
| XII. | REFERENCES CITED | | 77 |
| XIII. | APPENDIX A. ENVIRONMENTAL STANDARDS FOR CAMBODIA | | 78 |

Figure 1. Location of four corridor towns of CTDP in Cambodia. ..... 5
Figure 2. Location of wastewater treatment facilities in Bavet. ..... 10
Figure 3. Plan of wastewater treatment plant in Bavet ..... 11
Figure 4. Cross-section of upgraded road in Bavet ..... 14
Figure 5. Proposed layout of MRF in Bavet ..... 17
Figure 6. Proposed location of MRF in Bavet ..... 17
Figure 7. Location of planned wastewater and drainage system in Battambang ..... 19
Figure 8. Plan of wastewater treatment plant in Battambang ..... 20
Figure 9. Cross section of typical wastewater and storm drain in Battambang ..... 20
Figure 10. Location of flood control structures along Sangke river, Battambang ..... 22
Figure 11. Proposed layout of MRF in Battambang ..... 23
Figure 12. Location of MRF in Battambang ..... 25
Figure 13. Location of flood protection area in Neak Loeung ..... 26
Figure 14. Location of sub-project components in Poipet ..... 30
Figure 15. Plan of wastewater treatment plant in Poipet ..... 31
Figure 16. Planned storm water drainage and sewage network in Poipet. ..... 32
Figure 17. Proposed landfill site in Poipet ..... 35
Figure 18. Proposed layout of MRF at Poipet ..... 36
Figure 19. Location of MRF in Poipet ..... 38
Figure 20. Land zoning in Bavet ..... 41
Figure 21. Land zones in Battambang ..... 45
Figure 22. Preliminary location of dike & access road in Neak Loeung ..... 47
Figure 23. Land zones in Neak Loeung ..... 49
Figure 24. Land use in Poipet ..... 51

Table 1. Example road safety issues and solutions in Bavet ..... 13
Table 2. Features of Bavet MRF ..... 16
Table 3. Features of Battambang MRF ..... 24
Table 4. Components of wastewater treatment system ..... 28
Table 5: Water quality limits for discharged water in Cambodia ..... 29
Table 6. Features of MRF in Poipet ..... 37
Table 7. Land use in Bavet ..... 40
Table 8. Land use in Battambang ..... 44
Table 9. Land use in Neak Loeung ..... 49
Table 10. Existing land use in Poipet ..... 51
Table 11. Summary of stakeholder views of road development in Bavet ..... 55
Table 12. Summary stakeholder views of WWTPs in Bavet, Battambang, and Poipet ..... 56
Table 13. Summary of stakeholder views of sanitary landfill in Poipet ..... 56
Table 14. Summary stakeholder views flood protection in Neak Loeung ..... 57
Table 15. Alternatives to subprojects in Bavet, Battambang, and Neak Loeung ..... 67
Table 16. Advantages & disadvantages of sanitary landfills ..... 69
Table 17. Incineration issues ..... 69
Table 18: Composting issues ..... 70
Table 19. Central sorting issues ..... 71
Table 20. Comparison of solid waste management techniques ..... 71
Table 21. Compliance with disposal site location criteria ..... 72

# I. EXECUTIVE SUMMARY

1. The towns of Bavet, Battambang, Neak Loeung, and Poipet are the locations of the four subprojects of the Corridor Towns Development Project (CTDP) in Cambodia. Cambodia together with Laos and Viet Nam form the three target countries of the parent GMS Corridor Towns Development Project (ADB TA 7644-REG). Through infrastructure developments in the four towns the goal of the CTDP is to develop the existing South Economic Corridor (SEC) in Cambodia from a transportation corridor into an economic corridor as part of the overall economic development of the Greater Mekong Sub-region.

2. The initial environmental examination (IEE) of the CTDP in Cambodia presented herein consolidates the initial four IEEs that were prepared for each subproject town. The consolidated IEE (CIEE) has been re-formatted and edited pursuant to the requirements of ADB's SPS (2009).

## A. Project Summary

3. The CTDP in Cambodia is an ADB Category B project at the feasibility design phase, and is defined by the following four subprojects and ten infrastructure component developments:

| **Subproject** | **Infrastructure Component Developments** |
|---|---|
| A) Bavet Town: | 1) Improved wastewater treatment<br>2) Urban road improvement & drainage<br>3) Materials recovery facility |
| B) Battambang Town: | 4) Improved wastewater treatment<br>5) Urban flood control<br>6) Materials recovery facility |
| C) Neak Loeung Town: | 7) Urban flood control & land reclamation |
| D) Poipet Town: | 8) Improved wastewater treatment<br>9) Sanitary landfill<br>10) Materials recovery facility |

4. The proposed new wastewater treatment plants (WWTP) in Bavet, Battambang, and Poipet will provide primary treatment of domestic and industrial wastewater that is conveyed to the WWTPs through new dedicated pipelines. The wastewater treatment process will end in anaerobic treatment lagoons before the treated effluent is discharged to the environment. Waste treatment sludge will either be disposed in a landfill or to agricultural lands. The quality of the treated effluent and waste sludge at disposal has not been finalized.

5. The upgrade to the urban road and drainage in Bavet will occur to a section of the national highway that passes through the town. The road will be widened to four lanes with a lighted, treed median with drainage ditches on either side. Two sections of dikes will be constructed alongside the Sangke river in Battambang to prevent chronic flooding events in the town. The dikes will be constructed as municipal roads.

6. The proposed sanitary landfill in Poipet will receive solid waste from the municipality. It will likely contain a liner of clay depending on soil permeability and the sensitivity of groundwater

which needs to be clarified. An adjacent leachate treatment facility is planned. The quality of treated leachate and the receiving environment for disposal has not been finalized.

7. The three material recovery facilities (MRF) will provide organized and safe environments for the current livelihood of solid waste recycling in the three towns. The MRFs will be contained in specially designed buildings that provide central solid waste depot sites.

**B. Potential Impacts**

8. In general the examination of the pre-construction, construction, and operational phases of the four subprojects, which included input from community stakeholder meetings, indicates that the potential environmental impacts of the CTDP in Cambodia will be short-term civil construction-related which can be mitigated. The construction impacts of elevated dust, noise, traffic disruptions, erosion and sedimentation, liquid and solid waste, erosion, and public and worker safety can be mitigated and managed effectively with good construction management practices.

9. The stakeholder meetings conducted in the four subproject towns underscored the need for effective management of noise, dust, traffic disruptions, and traffic safety during the construction phase. The concerns of stakeholder included the increased truck and automobile traffic that is anticipated as a result of the operation of the completed subproject components.

10. Potential long-term environmental impacts of the infrastructure developments concern the operation of the three waste water treatment plants (WWTP) and single sanitary landfill. The potential impacts arise from uncertainties with the sensitivity of receiving environments including groundwater, and uncertainties with the feasibility stage designs of the subprojects.

11. Two of the three proposed receiving environments for the three WWTPs affect downstream surface waters that are used for domestic purposes such as washing and drinking water. The sensitivity of local groundwater to the lagoons of the WWTPs is not well understood. The quality and disposal procedures the waste sludge from the WWTPs also not finalized.

12. Similarly, the sensitivity of groundwater and downstream surface waters & land to the sanitary landfill in Poipet needs to be investigated and clarified, especially during the rainy season. Similar to sludge from the WWTPs, the quality of planned treated leachate that will collected from the landfill needs to be determined, and the treated leachate disposal procedures finalized.

13. The potential impacts of the WWTPs and sanitary landfill on groundwater, surface water, and land use can be addressed at the detailed design stages of the subprojects with supplementary investigation. Of particular need is re-examination of proposed receiving environments for the treated WWTP effluent, and the sensitivity of local groundwater. The design specifications for treated effluent and leachate quality, and the assimilative capacity of receiving environments require further clarification.

14. Available data and information indicate an absence of critical wildlife habitat, rare or endangered species, ecological protected areas, and cultural property & values at the four subproject sites. However, because the sites of subprojects components are not finalized a re-review of local sensitive ecological resources should occur at detailed design stage.

15. Potential induced environmental impacts of the four subprojects are increased natural resource consumption and environmental degradation which could stem from the planned impact of the CTDP of socioeconomic development in the four towns. These induced environmental impacts would potentially accumulate regionally along and adjacent to the SEC.

16. The infrastructures of the CTDP are being developed in view of potential effects global climate change such as frequency of severe rainfall events, as well to reduce the contribution of the CTDP to climate change where possible.

## C. Conclusions

17. The consolidated IEE concludes that the description of the feasibility design of the project combined with available information on the affected environments is sufficient to identify the scope of potential environmental impacts of the project. However, clarification of the affected environments is needed which can occur during the detailed designs of the subprojects.

18. Individual Environmental Management Plans (EMP) for the subprojects are found under separate cover. The EMPs provide detailed impacts mitigation and environmental monitoring plans, and the institutional responsibilities and capacity needs for the environmental management of the subprojects. The EMPs will need to be updated to meet the detailed designs of the subprojects.

# II. INTRODUCTION

## A. Background to Project and IEE

19. The Corridor Towns Development Project (CTDP) will facilitate transformation of existing transport corridors in the Greater Mekong Subregion[1] (GMS) into economic corridors through priority infrastructure investments and capacity building support in select corridor towns. The expected impact of the CTDP is corridor towns becoming the nucleus of economic activities, thereby contributing to the emergence of economic growth centers along the transport corridors in the GMS. The outcomes of the CTDP will lead to provision of adequate urban and infrastructure and essential services to facilitate growth and increase urbanization.

20. The more than 300 million people in the GMS which are spread across diverse social and economic terrain share common endeavors to improve their living standards. Corridor town development is a new approach to maximize the economic benefits of increased trade and traffic flows along existing major transport corridors in the GMS. Several corridor towns are located so strategically that they can boost investment and economic activity. With the necessary enabling environment in place - such as adequate infrastructure and public services, proper strategic economic development plans, and institutional capacity to guide and manage future development and investment - corridor towns can successfully attract private sector investments for economic infrastructure such as market centers, agro-business, agricultural processing zones, industrial parks, transport terminals, and logistics facilities.

21. Corridor town developments will occur in Cambodia, PDR Laos, and Viet Nam. In Cambodia the target towns for infrastructure development are Bavet, Battambang, Neak Loeung, and Poipet. The four towns are located along the southern economic corridor (SEC) of Cambodia defined by the CTDP (Figure 1).

22. Poipet is the northern-most town along the SEC at the border with Thailand in the province of Banteay Mean Cheay. Bavet is in the south at the border with Viet Nam in the province of Svaay Rieng with Battambang and Neak Loeung lying between close to Tonle Sap and Phnom Penh, respectively. Planned infrastructure developments in each subproject town are summarized briefly below:

| | |
|---|---|
| A) Bavet Town: | 1) Wastewater treatment<br>2) Urban road improvement & improved drainage<br>3) Materials recovery facility |
| B) Battambang Town: | 4) Wastewater treatment<br>5) Urban flood control<br>6) Materials recovery facility |
| C) Neak Loeung Town: | 7) Urban flood control & land reclamation |
| D) Poipet Town: | 8) Wastewater treatment<br>9) Sanitary landfill<br>10) Materials recovery facility |

[1] The GMS is defined by China, Burma, Thailand, Laos Cambodia, and Viet Nam in basin of Mekong river.

**Figure 1. Location of four corridor towns of CTDP in Cambodia.**


From Norconsult 2012.

## B. Assessment Context

23. The CTDP was assigned Environmental Category B which requires an initial environmental examination (IEE) pursuant to the ADB's safeguard policy[2], and environmental assessment guidelines[3]. A category B project will have potential adverse impacts that are less adverse than those of category A project, are site-specific, largely reversible, and can be mitigated with an environmental management plan[4]. The government of Cambodia (GoC) requires that an initial environmental impact assessment (IEIA) be conducted for the ten subprojects.

24. The detailed designs for the ten infrastructure developments in the four towns have not been prepared. The IEE and EMPs were prepared based on the information on the construction and operational phase activities of the town subprojects available at the feasibility stage of the CTDP. The IEE was prepared using available data and information on sensitive ecological and cultural receptors that exist at the different town sites. The four EMPs will be updated where necessary to meet the future detailed designs of the four corridor town subprojects.

[2] ADB, 2009. Safeguard Policy Statement, ADB Policy Paper.
[3] ADB, 2003, Environmental Assessment Guidelines.
[4] Footnote 2, pg 19.

## C. Consolidated IEE

25. The IEE presented here integrates the original four IEEs that were prepared for the four town subprojects. The four IEEs were consolidated to simply the environmental safeguard documentation for the CTDP by reducing duplication of information. Similarly, the original ten environmental management plans (EMP) that were prepared for each infrastructure development were consolidated into four single EMPs for each town subproject. The four stand-alone EMPs are found under separate cover.

# III. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

## A. ADB Safeguard Policy

26. The ADB Safeguard Policy Statement (ADB 2009) clarifies the rationale, scope and content of an EA and is supported by technical guidelines (e.g., Environmental Assessment Guidelines 2003). Projects are initially screened to determine the level of assessment that is required according to the following three environmental categories: Category A for projects that normally cause significant or major environmental impacts that are irreversible, diverse or unprecedented such as hydroelectric dams (an Environmental Impact Assessment is required); Category B projects which have potential adverse impacts that are less adverse than those of category A, which are site-specific, largely reversible, and for which mitigation measures can be designed more readily than for category A projects (an Initial Environmental Examination is required); and Category C projects that are likely to have minimal or no negative environmental impacts. An environmental assessment for Category C projects is not required but environmental implications need to be reviewed.

## B. National Environmental Assessment Protocol

27. Environmental impact assessment in Cambodia is prescribed by the RGC sub-decree on EIA, No 72 ANRK.BK produced by the Ministry of Environment (MOE, 2009), and the Prakas Guideline on Initial Environmental Impact Assessment (IEIA) and full EIA. The Prakas Guideline was prepared by the MOE and promulgated on March 9, 2000.

28. In compliance with the sub-decree on EIA, all individuals, private companies, joint-venture companies, public companies, ministries and government agencies are obliged to conduct an environmental impact assessment for proposed projects or activities, which must be submitted for approval by the MoE. The decree provides a list of project types that proponents use to screen projects for requiring either an IEIA or full EIA. In consultation with MOE the CTDP requires an IEIA.

## C. National Environmental Law and Policy

29. The Government of Cambodia has established laws and regulations for forests, protected areas, and land management to ensure sustainable development. The key elements of the legal & policy framework include the following:

- *Law on Forest (2002)* produced by the Ministry of Agriculture, Forestry and Fishery (MAFF)

- *Law on Land (2001)* establishes a framework for the recognition of land and property rights in Cambodia.
- *Law on Protected Areas (2008)* produced by MOE
- *Law on Water Resource Management* produced by Ministry of Water Resources and Meteorology.

30. Key environmental regulations include:

- Sub-decree on Solid Waste Management (1999); and
- Sub-decree on Water Pollution Control (1999):
  Annex 2: Industrial effluent standards (including WWTPs);
  Annex 4: Water quality standards for public water & biodiversity; and
  Annex 5: Water quality standards for public waters and health.

31. The GoC standards for industrial effluent discharge, ambient surface & coastal water quality, and public waters and health of Annexes 2 - 5 of Subdecree on Water Pollution Control (1999) are reproduced in Appendix A of IEE.

32. For all other applicable environmental standards and criteria such as ambient air quality, vibration, noise, contaminated soil, and workplace & community safety the standards and protocols of the Environment, Health & Safety Guidelines of the World Bank (2007) will apply.

## D. Responsible Agencies for Environmental Assessment and Management

33. Agencies in Cambodia that oversee environment & natural resources management are:

- Ministry of Environment (MoE);
- Ministry of Agriculture, Forestry and Fisheries (MAFF);
- Ministry of Water Resources and Meteorology (MOWRAM);
- Ministry of Industry, Mines and Energy (MIME); and
- National Climate Change Committee (NCCC); a cross-ministerial policy making body.

34. The EIA Department of the Ministry of Environment (MoE) oversees and regulates EIA, and coordinates the implementation of projects in collaboration with project executive agencies (EA) and concerned ministries. The MoE has the following responsibilities:

1) Review, evaluate, and approve submitted environmental impact assessments in collaboration with other concerned ministries; and

2) Monitor to ensure a Project Owner (PO) satisfactorily implements the Environmental Management Plan (EMP) throughout pre-construction, construction, and operation phases of project.

35. The ministries are represented and supported at the provincial, town, and district/commune levels by counterpart line departments, agencies, and sub-offices. The counterparts are responsible to extend and implement the mandate of their parent ministries to the commune level.

36. The Ministry of Public Works and Transports (MPWT) will be the executing agency (EA) with overall responsibility for successful execution of the subprojects in all four towns. As the EA

the MPWT will coordinate with concerned ministries and line agencies of all jurisdictions to ensure all affected policy and regulations are met.

37. The EA will assign a technical working group at the national level as the Project Management Unit (PMU) which will be led by a director assigned by the EA. The PMU will hold overall accountability of the implementation and operation of the four town subprojects on behalf of the EA and act as the national project agency. The provincial Department of Public Works and Transport (PDPWT) will be assigned as the Implementing Agency (IA) at the town level as Provincial Project Coordinating Committee (PPCC).

38. With assistance from a Detailed Design & Supervision Consultant (DDSC) [5] the PMU will update the four EMPs that will be prepared for the town-subprojects to meet the requirements of the detailed subproject designs.

## IV. DESCRIPTION OF SUBPROJECTS

### A. Bavet Subproject

39. The subproject in Bavet consists of:

a) Improved wastewater treatment & drainage structures;
b) Upgraded urban road and drainage; and
c) Materials recovery facility

#### 1. Wastewater Treatment and Drainage Structures

##### a. Current Situation

40. Toilets in Bavet consist of the pour/flush with soak-aways, pit latrines, or basic single vault pits with about 47% of the population have access to sanitary toilets. The existing wastewater canals and sewerage pipes in Bavet were constructed more than 10 years ago and are poorly designed. With the rapidly growing number of households, an expanding urban area, and increasing number of commercial establishments, the current storm drainage and sewerage system have become very inadequate to meet the local demands and requirements. These canals and pipes are installed only in some sections of the town centre due to limited budget and funding support from the provincial and national government.

41. The existing wastewater canals and pipes are in poor condition, are inadequate in capacity &, unsanitary, and provide no connections to a proper system in the urban areas. The existing system does not uniformly cover the main urban area. The existing sewerage system is 1,012 m in length with pipes of varying diameter, and mostly installed in the areas to support the larger hotels. The total length of open canals conveying wastewater is about 25 km so which means most untreated wastewater is carried in open channels rather than through a dedicated sewerage system.

42. The wastewater treatment plant (WWTP) development in Bavet will mitigate contamination of the local environment and reduce health risks of the urban population. It aims

[5] It is anticipated that a single Detailed Design and Supervision Consultant will be appointed for four subprojects.

to improve the living conditions of the majority of the local population and to contribute to making Bavet a clean and attractive town. The separation of wastewater from storm water is crucial to reducing pollution of the open areas and to mitigate health related problems.

### b. Subproject objectives & components

43. The objectives of subproject are:

1. Drain wastewater from households and commercial establishments to the WWTP;
2. Mitigate health related problems and adverse negative environmental conditions brought about by the absence of wastewater management system; and
3. Attract private sector investments.

44. The subproject components include the following:

1. Construction of separate sewage interceptors, and piping system;
2. Upgrading of existing storm water drainage canals, and
3. Construction of new wastewater treatment plant in the southern part of the town.

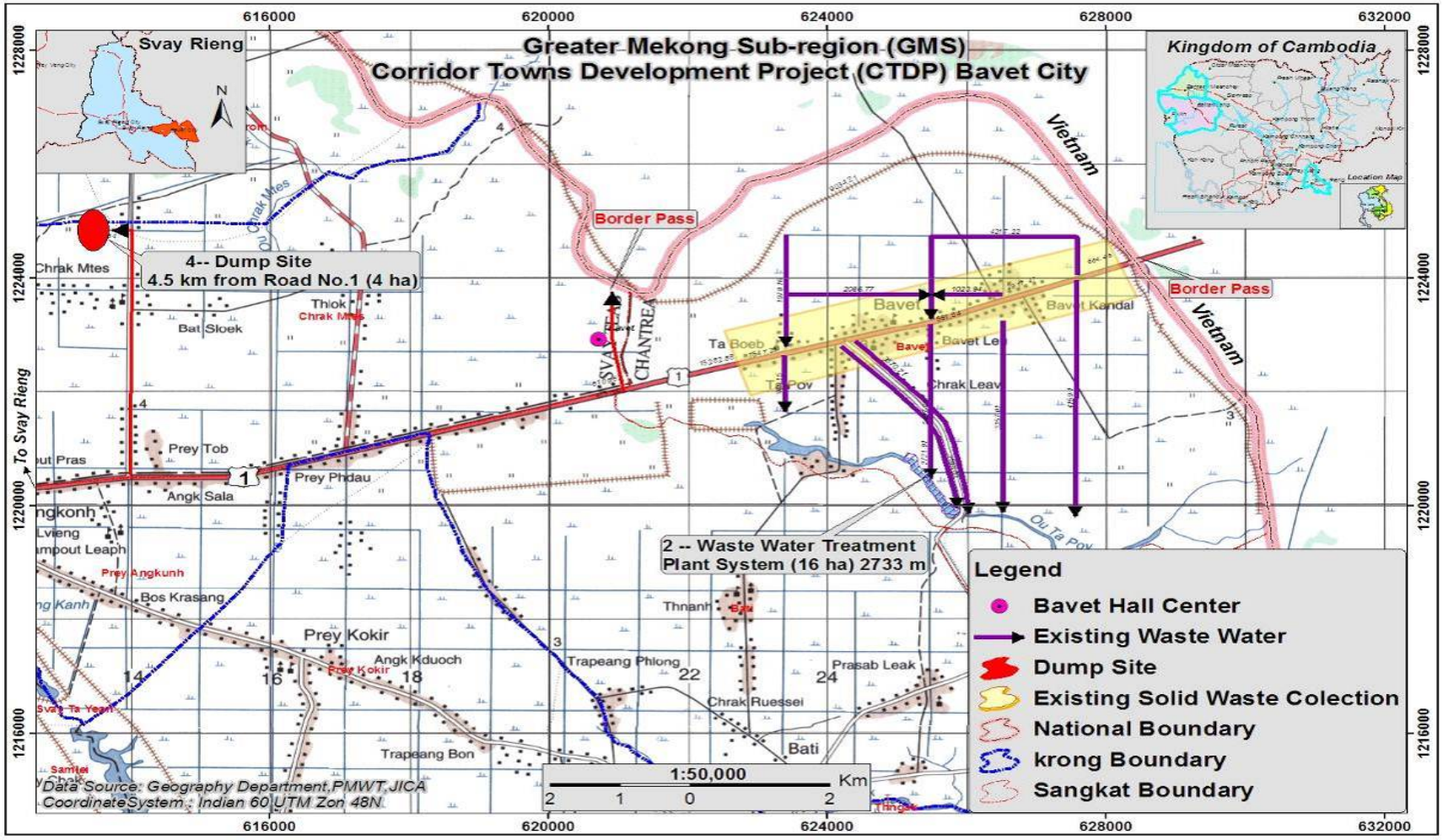
45. Civil works will involve construction of 3,180 m of concrete canals and a bottom width of 1.5 m of storm water drainage canals from the town centre to the WWTP. New sewage pipelines (6,360m) will be installed along the storm drainage canals in order to intercept household wastes and effluent discharged from commercial and business establishments. The subproject will also upgrade 3.1 km of access road with three box culverts installed in three strategic road sections. The new WWTP will be constructed on 8 hectares of public land designated by the municipal government of Bavet.

46. The subproject is considered a resilient adaptation to adverse impacts of climate change risk through the construction and rehabilitation of storm drains leading to the river adjacent to the WWTP. The sewerage systems facilities, storm drainage canals and WWTP, and related structures for protection against flooding will in general be designed according to a 50 year return period.

47. Figures 2 & 3 outline the location of the main elements the wastewater treatment system of the subproject, and the plan of the main components of the treatment plant.

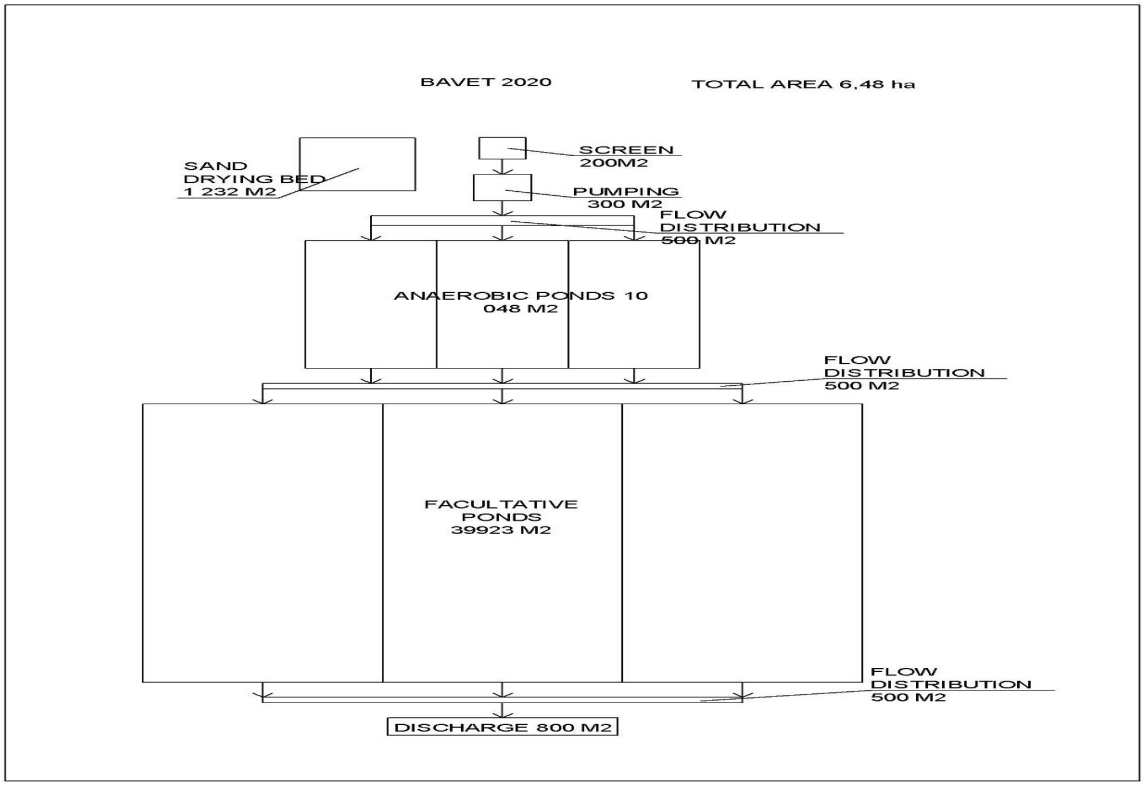
48. The proposed location of WWTP is beside a stream (Figure 2) approximately 5 km from the town center. The treated effluent and presumably WWTP sludge will be discharged into the Ta Pov stream. The stream, which is dry during periods of the dry season, is used for irrigation. Thus, the treated effluent also will be used for irrigation. The planned discharge stream is tributary to downstream surface waters and natural areas.

**Figure 2. Location of wastewater treatment facilities in Bavet.**




From Norconsult 2012

**Figure 3. Plan of wastewater treatment plant in Bavet**




From Norconsult 2012

## 2. Improvement of Urban Road and Drainage

### a. Current Situation

49. National Road #1 runs through Svay Teab District to Bavet. There are approximately 2,000 houses and commercial establishments along the road which account for approximately 30% of the town's population. The existing road is 10.5 m in width and provides two unmarked lanes.

50. There is no formally designated shoulder with the edge of the pavement being eroded and damaged in many places. Moreover, the road is too narrow to accommodate the increasing number of small, medium and large vehicles that use the road. A daily average of 160 large vehicles and heavy container trucks travel along the road. In some instances these trucks are park along the side of road due to limited space at the border/port area.

51. The number of trucks and motor vehicles is expected to continue to increase because of the growing number of industry locators and commuting workers in the dry ports. Based on the traffic count undertaken for the FS, due to the traffic type and volume the road is classified as a type I road, which requires four lanes.

52. The right-of-way for the road does not provide drainage on either side of the road and as a consequence is flooded during rainfall events. Exacerbating this situation are the residential and commercial establishments which have installed their own ad hoc drainage structures which discharge to the road thereby aggravating the flooding problems.

53. Over the last three years, an annual average of 50 road accidents occurred in the town of Bavet due to poor road conditions and bad driving (speed). As a consequence national road #1 needs to be upgraded.

### b. Subproject objectives and components

54. The objectives of the road improvements are:

1. Ease of traffic flow through town along the main road and minimize road accidents;
2. Improve the existing core urban road network of the town;
3. Reduce flooding of main road and adjacent houses and commercial establishments through the construction of drainage structures on both sides of the road;
4. Improve traffic flow and access in order to encourage private sector investments; and
5. Beautify the main road by planting trees along shoulders & on new median, and installing street furniture and lighting.

55. The improvement of the road will involve civil works, installation of structures and facilities and the essential elements for operation and maintenance of the road and related structures. The components of the road upgrades include the following:

a. Civil works to widen the 10 km section of road from 10 m to 22 m with expansion from 2 to 4 lanes with upgraded paved surface;
b. Construction of a lighted median to be planted with trees and ornamentals;
c. Construction of drainage structures on both sides of the road; and
d. Capacity building for operation and maintenance of the completed road & facilities.

56. The upgrades to the road will pose only minor resettlement problems since there will be no displacement of residential houses and commercial establishments. A 30-meter easement has been adhered to by residents and commercial establishment owners who are anticipating and supporting the improvements to the road. However, a formal resettlement plan has been prepared for the CTDP which is under separate cover.

### c. Road Safety Considerations

57. The high density of urban area along the road combined with the high volume of 2 and 3-wheel traffic necessitates a wide auxiliary lane. Segregation of vehicles from motorbikes has been studied. The use of light pedestrian overhead bridge crossings in selected places through urban or suburban areas has also been considered.

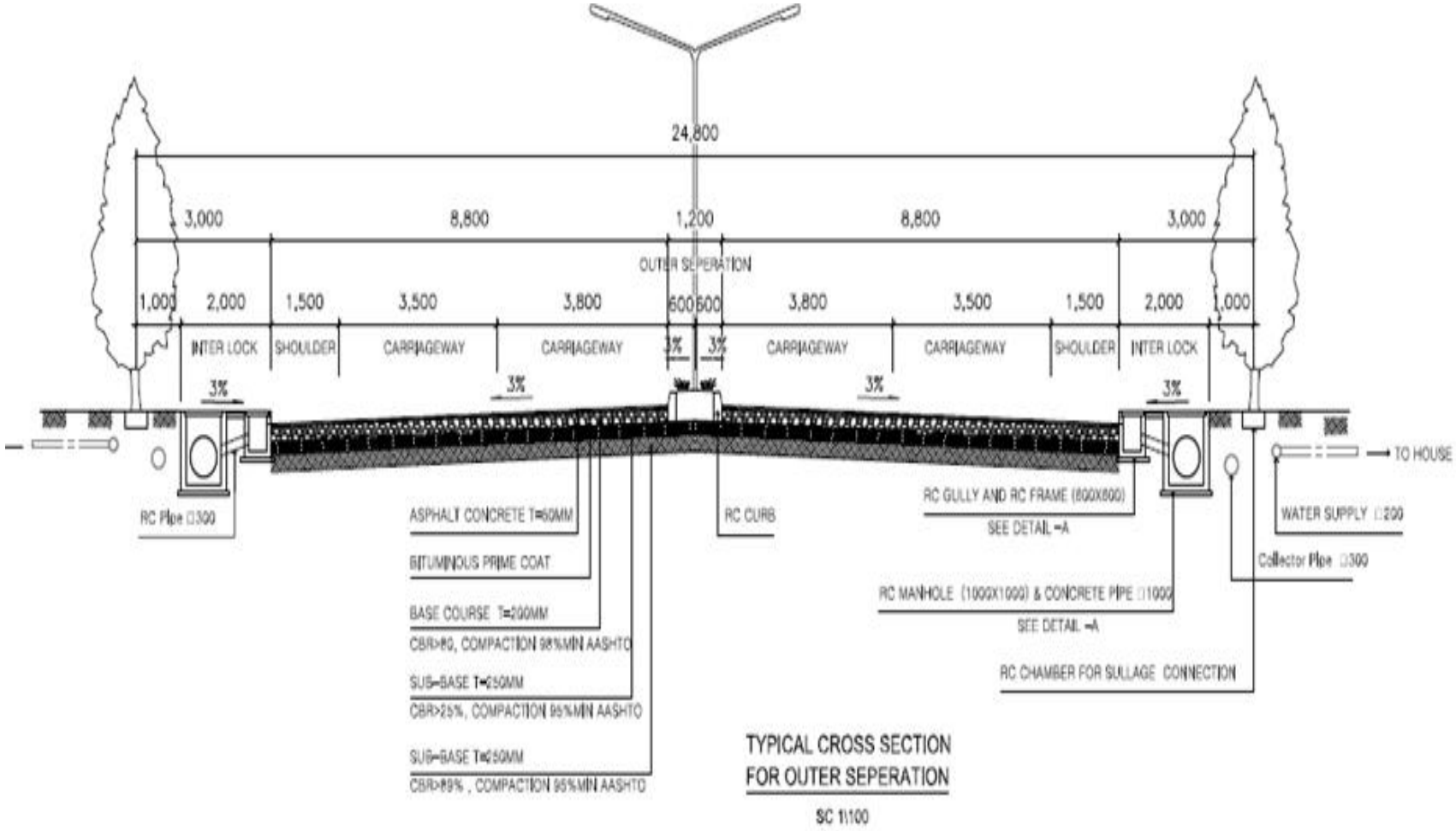
58. Other safety factors considered include traffic signals, the design of the median in the case of the dual carriageway sections, minor road intersections, parking lanes in urban areas, bus stops, road markings, safety barriers, delineators, shoulders versus verges and pedestrian walkways. Table 1 summarizes road design features considered to improve safety. Figure 4 shows cross section of upgraded road with all facilities.

**Table 1. Example road safety issues and solutions in Bavet**

| Problem Identified | Recommended Improvement |
|---|---|
| Lack of facilities for non-motorized vehicles | Provide dedicated lanes for non-motorized vehicles, |
| Unsafe night driving. | New signs, road markings, studs and marker posts to be provided with light-reflective materials to assist night use of road |
| Road surface, geometry, & signage not supportive of high speeds. | Upgraded road to include redesigned surface, curves, adequate signage and lighting. |
| No protection provided to users at structures | Guard-rail & diversions to be provided on the approaches to new box culvert, reducing the risk of vehicle impact with bridge parapets. |
| Varying standards of road alignment and ride quality. | Uniformity of design standards applied along entire road. Adequate signage will be provided to warn users of changes to roadway. |
| Inadequate facilities for public service vehicles which currently are required to stop on main on main road. | Provide bus lay-bys to permit public service vehicles to pull out of main. |

Modified from Norconsult 2012

**Figure 4. Cross-section of upgraded road in Bavet**




From Norconsult 2012.

## 3. Materials Recovery Facility

### a. Current situation

59. Solid waste collection at Bavet is undertaken by Sokkheng Company, a Vietnamese company which undertakes collection at the urban sangkat of the district, eight casinos and one factory at the special economic zone. Seven factories which are not covered by collection, reportedly burn their respective wastes. The rest of the four rural sangkats is not covered by the collection system.

60. Sokkheng Company uses three trucks each with an approximate capacity of 5 tons to collect mixed waste at a daily rate of 20 tons. The collected waste is disposed by the same company at a 4-hectare open dump located about 15 kilometers northwest of the center of the district. Waste is burned at the dumpsite to recover the metal component of the dumped materials.

61. The sidewalks and vacant lots of even the urban sangkat are littered with waste and uncollected waste bags which reflect the inadequacy of the current collection system. Waste picking at bins is not allowed in Bavet. Waste picking is done only at the dumpsite by a team of 12 pickers contracted by Sokkheng Company to recover the recyclables. The recyclables are temporarily stored at the junkshop of the waste collection company. Buyers from nearby Vietnam buy the recyclables stored in the said junkshop. There is no designated person or agency that is responsible for solid waste management in Bavet municipality.

62. Although recovery of a significant percentage of recyclables is already done at source, unsanitary picking of mixed waste continue to take place at the existing open dump. This practice by the contractual pickers exposes them to health hazards aside from painting a negative aesthetic image of the district. The MRF together with the passage of the necessary district declarations on waste segregation at source, segregated waste collection and IEC on SWM will provide a sanitary and efficient system and facility for the recovery of the recyclables.

63. The proposed MRF aims to establish a sanitary and centralized method for the recovery of recyclable materials as part of the promotion of the principles of the 3 Rs namely reduction, recycle and reuse. Its establishment will be supported by a parallel government program which will involve the passage and strict implementation of waste segregation at source, segregated waste collection and sustained conduct of information and education campaign on proper solid waste management and practices. Table 2 presents features of the proposed Bavet MRF. Figure 5 shows the proposed MRF layout.

64. The MRF Subproject site is located within a flat, 6.5 -hectare lot adjacent to the existing Bavet dumpsite (Figure 6). The lot was purchased by the Cambodia Red Cross for the development of a sanitary landfill and shall be donated to the District of Bavet. The proposed MRF site is directly accessible via the National Highway 1 and a 3-kilometer all weather road.

**Table 2. Features of Bavet MRF**

| | | |
|---|---|---|
| Objective | : | Recovery of recyclable materials from municipal solid waste generated at Bavet and improvement of the solid waste management system |
| Technology | : | Fully manual sorting aided by payloader for movement of waste and recyclables and by a baler for compaction of the recovered materials |
| Capacity | : | The facility can receive and manually process at least 30 $m^3$ of dry, source segregated non-biodegradable waste and truck sorted recyclable materials per day using a team of 8 pickers. |
| Operating Schedule | : | The facility shall operate from 7:30 AM to 4:30 PM from Monday to Saturday. |
| Target Inputs | : | 1. The primary inputs correspond to dry, source segregated non-biodegradable waste from casinos, households and factories of the special economic zone and truck sorted recyclable materials.<br>2. Secondary inputs correspond to segregated recyclables to be purchased directly from households and other establishments |
| Target outputs | : | Recyclable materials which include plastic bottles, tin cans, metal containers, carton and white paper, metal |
| Design Features | : | A 800 $m^2$ fully enclosed building with paved flooring and designated areas for receiving and sorting waste, storage areas for recyclable materials and residual materials, office, area for equipment and toilet and wash areas for pickers and facility supervisor/staff. Facility equipped with a payloader, baler, weighing scales, bins and a small power generating set. A main front door and 2 side doors and enclosed by a perimeter fence with a brick r base and an upper chain link section. |
| General Process Flow | : | Waste will be inspected then unloaded into the receiving/sorting area. Recyclables will be segregated from the waste pile and stored in designated temporary storage areas. Biodegradable and residual materials will be moved by the payloader into the nearby sanitary landfill cell. Recovered recyclable materials will be weighed, baled or packed and/or sold to large junkshops or recycling facilities. |
| Management and Operational Arrangements | : | 1. The facility will be managed under a public – private partnership. The Red Cross and Bavet District will engage Sokkheng Company which collects the waste of Bavet.<br>2. A technical supervisor and one (1) staff shall oversee the day to day operations of the facility. A minimum of eight (8) waste pickers shall undertake the segregation of the recyclable components. The pickers shall be compensated in accordance with the amount of valuable materials recovered. Aside from assisting the facility supervisor, he shall also operate the baler and payloader.<br>3. Recovered recyclables sold to recycling centers in province or Vietnam |
| Key project stakeholders | : | Waste pickers at dumpsite, waste collection crew, Sokkheng Company, Bavet District, and Cambodia Red Cross. |
| Requirements for sustained operation | : | 1. Passage and implementation of a decree which requires 2-level waste segregation at source into wet biodegradables and dry non-biodegradables<br>2. Passage and implementation of a decree requiring segregated waste collection. Non-segregated or mixed waste shall not be collected.<br>3. Passage and implementation of a decree which provides the MRF operator priority in the purchase of segregated dry non-biodegradables from locators, factories, and establishments within the current Bavet special economic zones<br>4. Capacity building for MRF supervisor and staff |

**Figure 5. Proposed layout of MRF in Bavet**

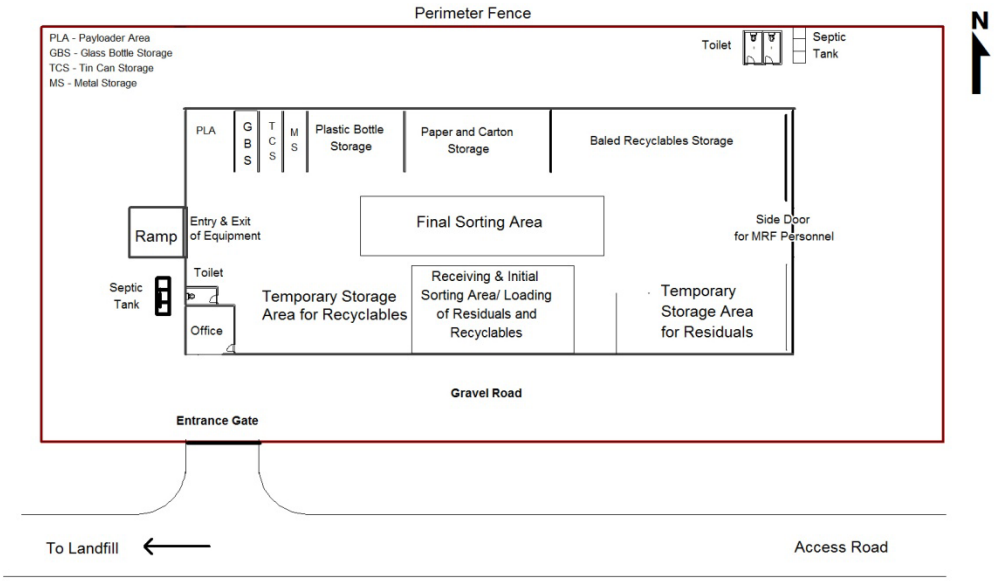
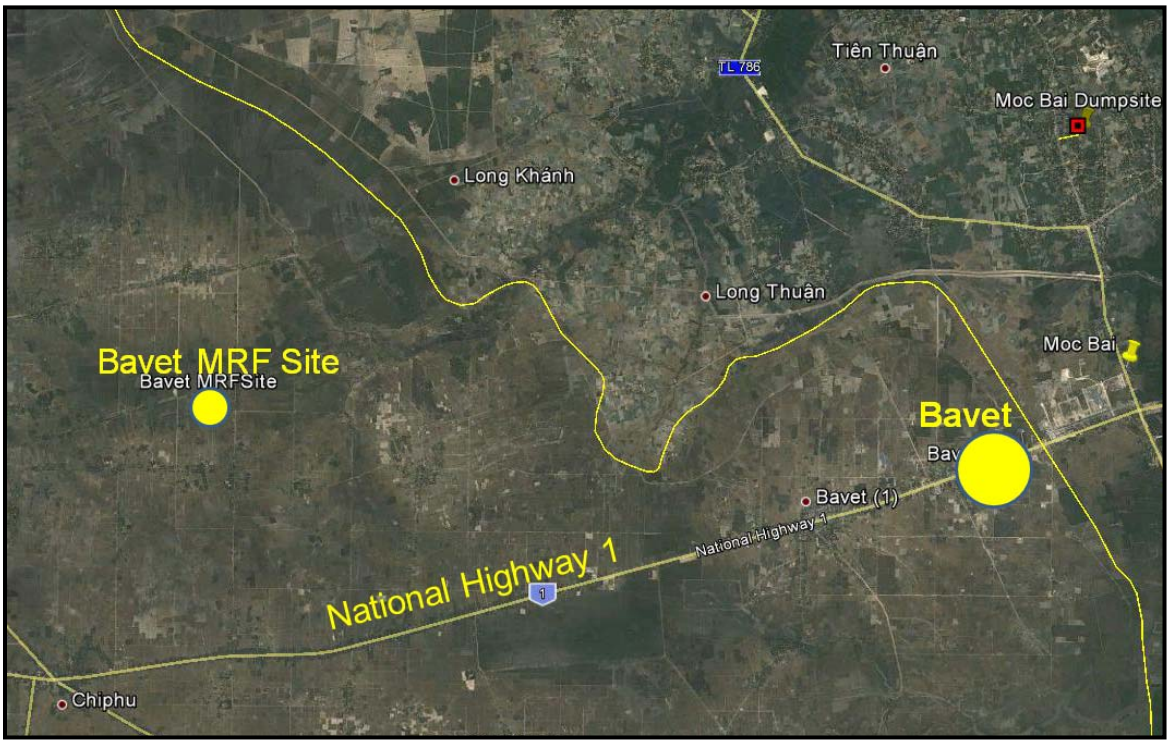



**Figure 6. Proposed location of MRF in Bavet**



## B. Battambang Subproject

65. The subproject in Battambang consists of:

a) Improved wastewater treatment & drainage structures,
b) Flood control structures along Sangke river; and
c) Materials recovery facility

### 1. Wastewater Treatment and Drainage Structures

#### a. Current Situation

66. The existing wastewater treatment plant in Chamkar Samraong Sangkat (western side of the Sangke River) is currently not functioning as intended. To restore full capacity and to ensure a more efficient treatment process the treatment plant needs to be rehabilitated. However, at this time only upgrades to the new inlet pump station, and rehabilitation of existing ponds and dikes is proposed. A small laboratory to control the quality of the inlet and the effluent is also proposed.

67. Presently, there are no treatment facilities on the eastern side of Sangke River including Rottanak and Preak Preah Sdach Sangkats. There exist combined canals for wastewater and storm water but the water is drained to adjacent rice fields without treatment. Thus, the project recommends separation of sewage from storm water, and the construction a new wastewater treatment plant in Rangkat Sangkat.

68. Due to severe flooding problems in Sangkat Rottanak and Preak Preah Sdach the subproject also includes a new and separate storm water drainage system for the two Sangkats.

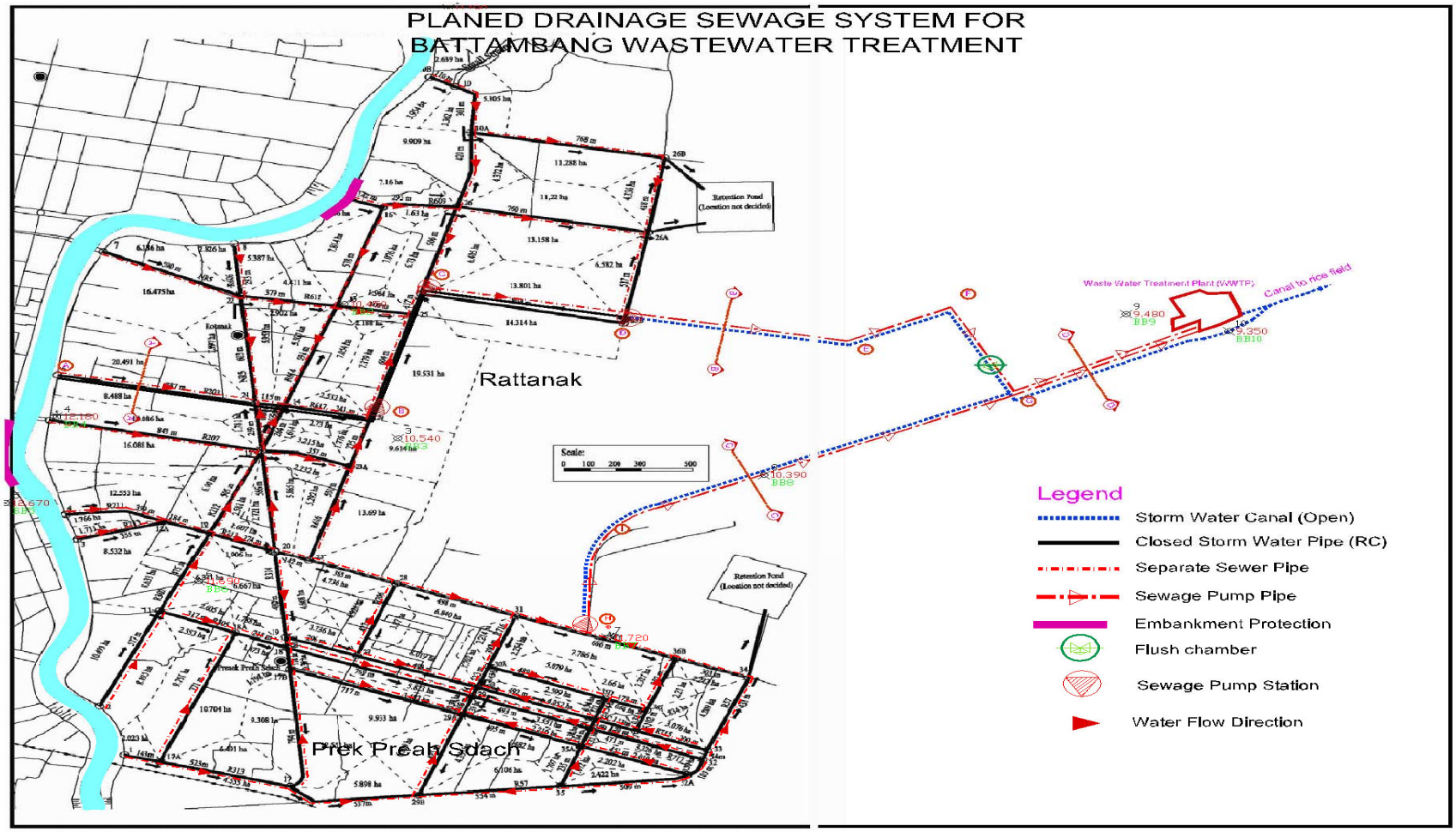
#### b. Subproject components

69. Construction will include a separate system for sewage and drainage for the wastewater treatment including wastewater treatment plant located in Rangkat Sangkat , 23.6 km of drainage pipes in Rottanak Sangkat, 25.7 km of sewage pipes in Rottanak Sangkat, 36.7 km of drainage pipes in Preak Preah Sdach Sangkat, 36.7 km of sewage pipes in Preak Preah Sdach Sangkat.

70. The treatment plant can easily be expanded to accommodate the future increased wastewater treatment demand. Only about 30% of the acquired land will initially be used for the WWTP. Figures 7 & 8 outline the location and plan and of the wastewater treatment plant. Figure 9 outlines the cross section of a wastewater and storm drainage system.

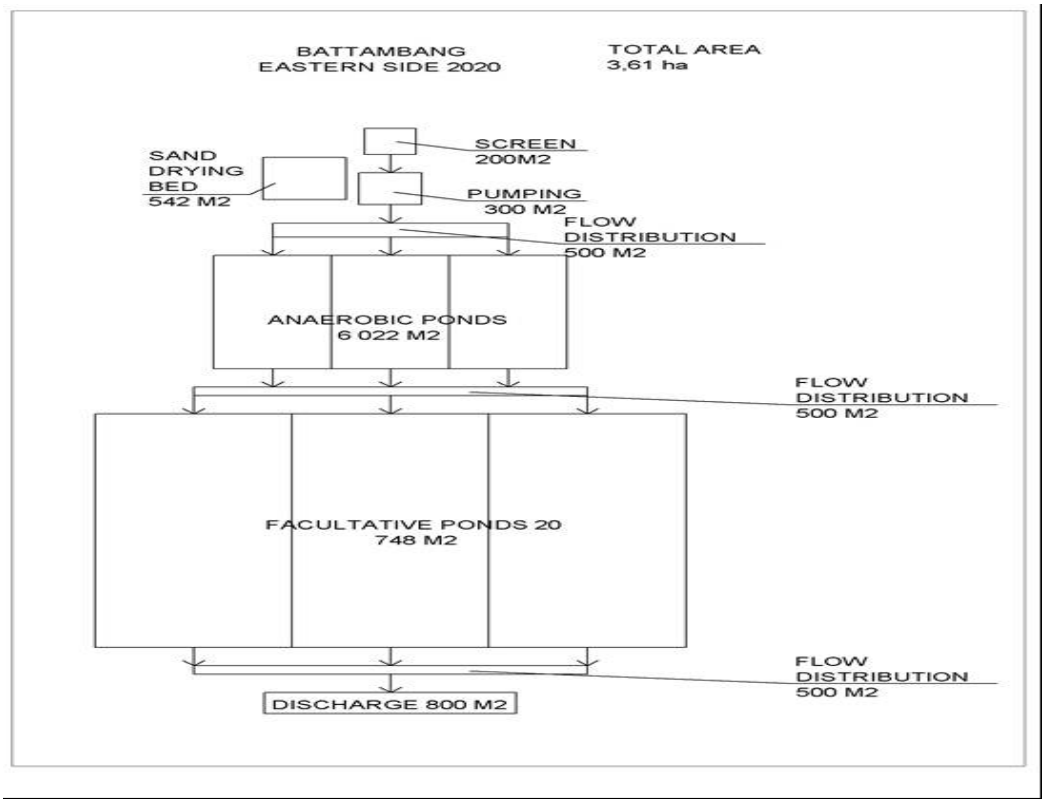
71. The proposed location for the new WWTP is approximately 4 km from the Sangke river in a rice field. The treated effluent will be discharged to a canal which will flows into the Steung Chas stream 2km downstream of WWTP. The stream is used for local domestic uses (e.g., drinking and washing). The main water source of the Steung Chas stream is the Sangke river and rain. The stream eventually flows into Tonle Sap Lake.

**Figure 7. Location of planned wastewater and drainage system in Battambang**



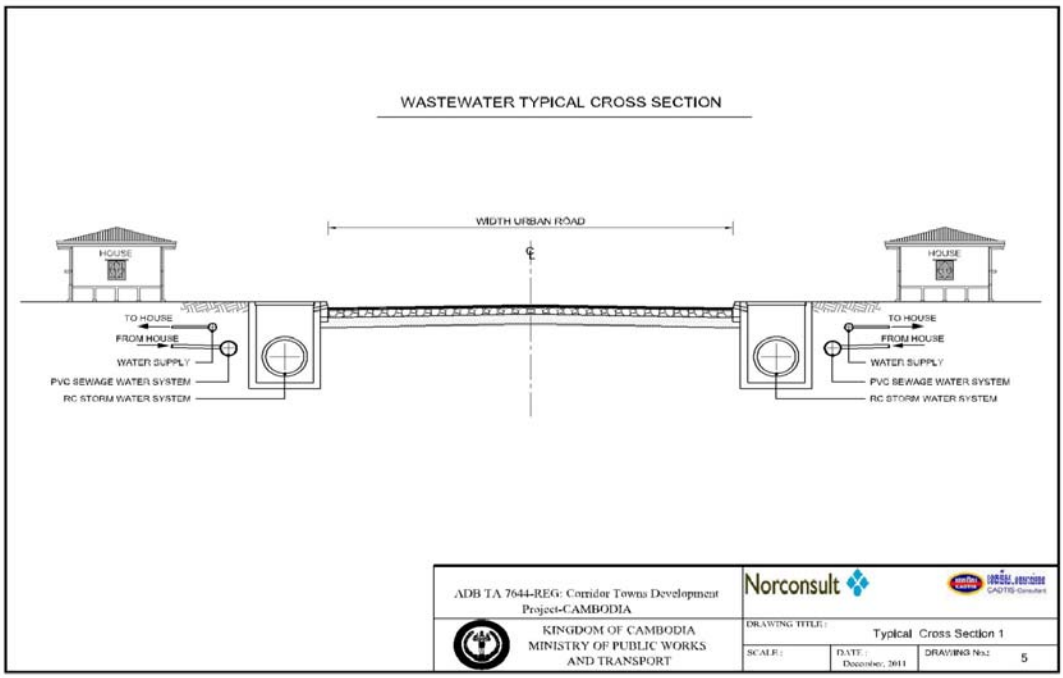

From Norconsult 2012

**Figure 8. Plan of wastewater treatment plant in Battambang**




From Norconsult 2012.

**Figure 9. Cross section of typical wastewater and storm drain in Battambang**



## 2. Flood Control along Sangke river

### a. Current situation

72. The flood control component is intended to reduce flooding of residential and commercial establishments from flood waters of the Sangke river on the eastern side of the town. Indirectly, flood control is meant improve the attractiveness and competitiveness of Battambang for public and private sector investments.

73. Civil works will involve the construction of flood control structures located at Wat Sophy in the Sophy village in Rottanak Sangkat. It will include embankment protection and erosion control structures located at Apsara Market in Kamkor village in Svay Por Sangkat.

74. The existing 2000 m of river embankment protection from the highway bridge to H.E Sor Kheng bridge was constructed in 2007 from funds from the Provincial Government of Battambang. Due to strong currents during the rainy season and the erosion 170 meters of slope protection structures have been severely damaged. The embankment in the eastern portion of the Sangke river has been eroded and has resulted in the periodic flooding of the commercial and residential areas of Rottanak and Prey Sdach districts.

75. The state of existing embankment structures in Battambang varies from good condition to totally damaged. A number of 16 sites were identified for repair and reconstruction and construction of new embankment structures in order to avoid erosion and flooding.

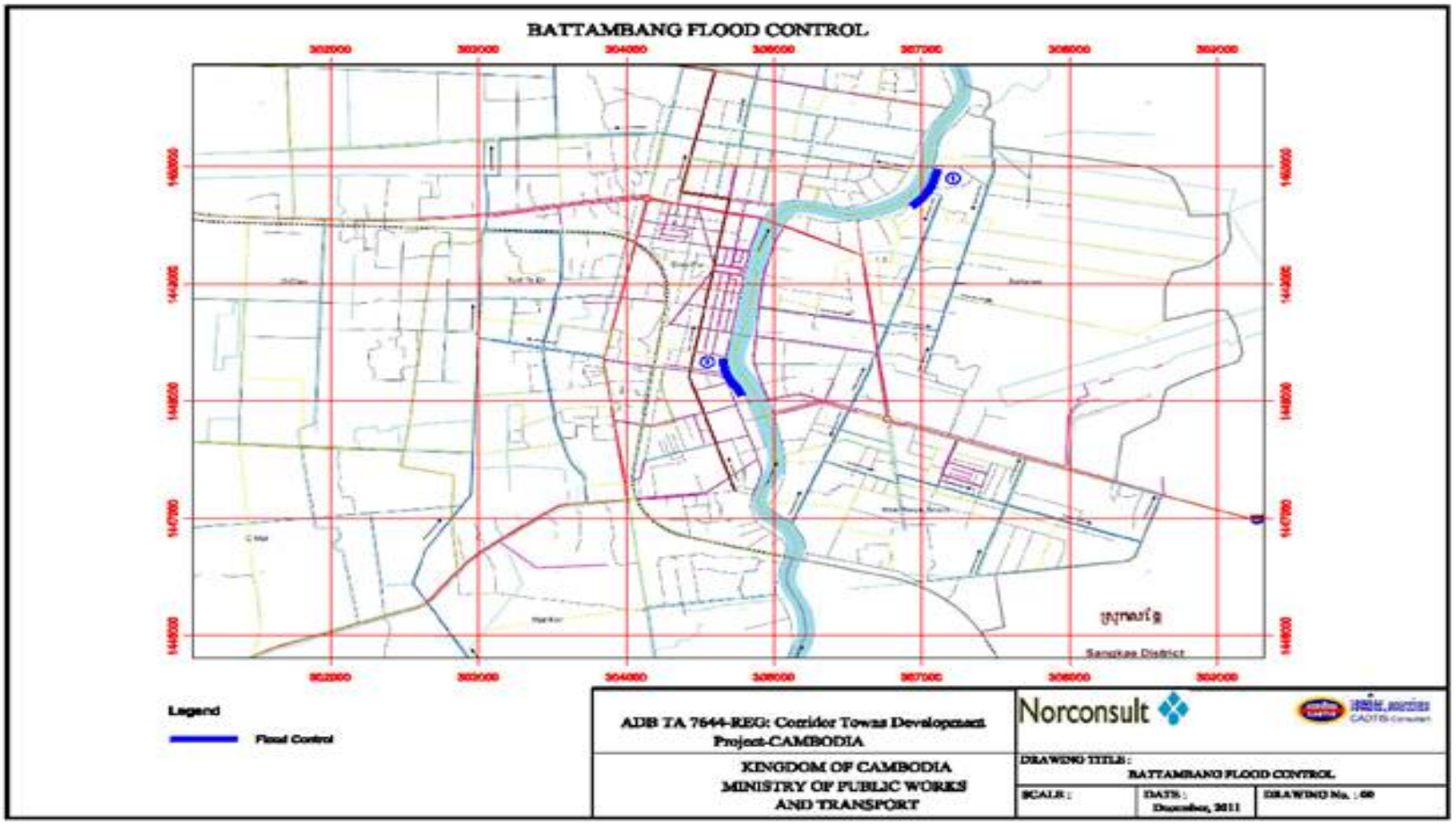
### b. Subproject components

The subproject components consist of the following structures and mitigation measures:

1. River embankment protection – repair 1 location = 200m
2. River embankment protection – new construction 11 locations = 1,120m
3. Flood dike protection – new 3 location = 800m

The locations along the Sangke river where flood control structures will be placed are shown in Figure 10.

**Figure 10. Location of flood control structures along Sangke river, Battambang**



## 3. Materials Recovery Facility

### a. Current Situation

76. Solid waste collection at Battambang is undertaken by CINTRI (CAMBODIA) Ltd. via a long term contract with the provincial government. Collection covers is done daily and covers the urban sector of the town,

77. The waste collector uses seven trucks to collect mixed waste at a daily rate of 60 tons. The collected waste is disposed at a 2-hectare open dump located about 5 kilometers northwest of the center of the district. Waste is burned at the dumpsite to recover the metal component of the dumped materials.

78. Waste picking is done at bins by an estimated 50 pickers, at waste collection trucks by the crew of Cintri Ltd. and at the dumpsite by 30 pickers all of whom belong to the informal sector. Results of the end of the pipe waste characterization study indicate that the bulk of the recyclables are recovered at source.

79. Although recovery of a significant percentage of recyclables is already done at source, unsanitary picking of mixed waste continue to take place at bins, waste collection vehicles and at the existing open dump. This practice by the pickers exposes them to health hazards aside from painting a negative aesthetic image of the district. The MRF together with the passage of the necessary district declarations on waste segregation at source, segregated waste collection and IEC on SWM will provide a sanitary and efficient system and facility for the recovery of the recyclables.

80. The proposed MRF subproject aims to establish a sanitary and centralized method for the recovery of recyclable materials as part of the promotion of the principles of the 3 Rs namely reduction, recycle and reuse. Its establishment will be supported by a parallel government program which will involve the passage and strict implementation of waste segregation at source, segregated waste collection and sustained conduct of information and education campaign on proper solid waste management and practices. Table 3 presents the features of the proposed Battambang MRF. Figure 11 shows the proposed MRF layout.

**Figure 11. Proposed layout of MRF in Battambang**

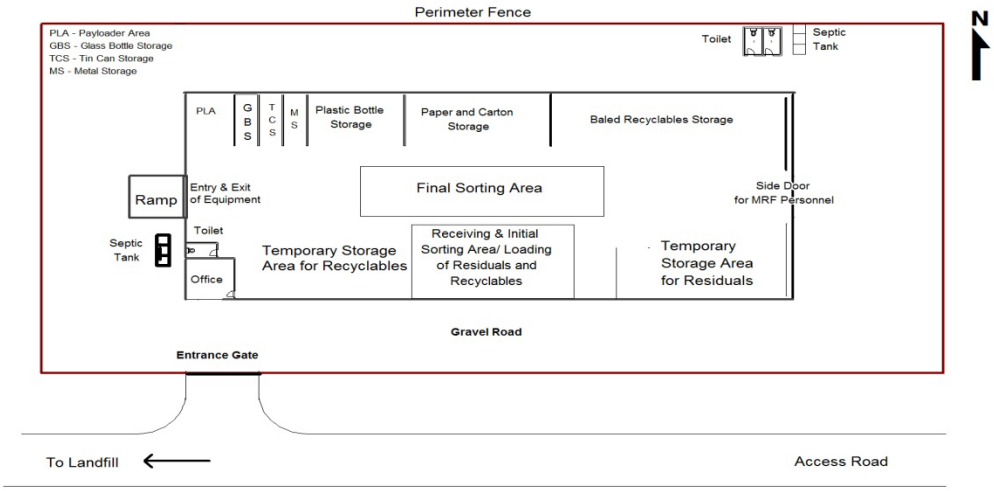
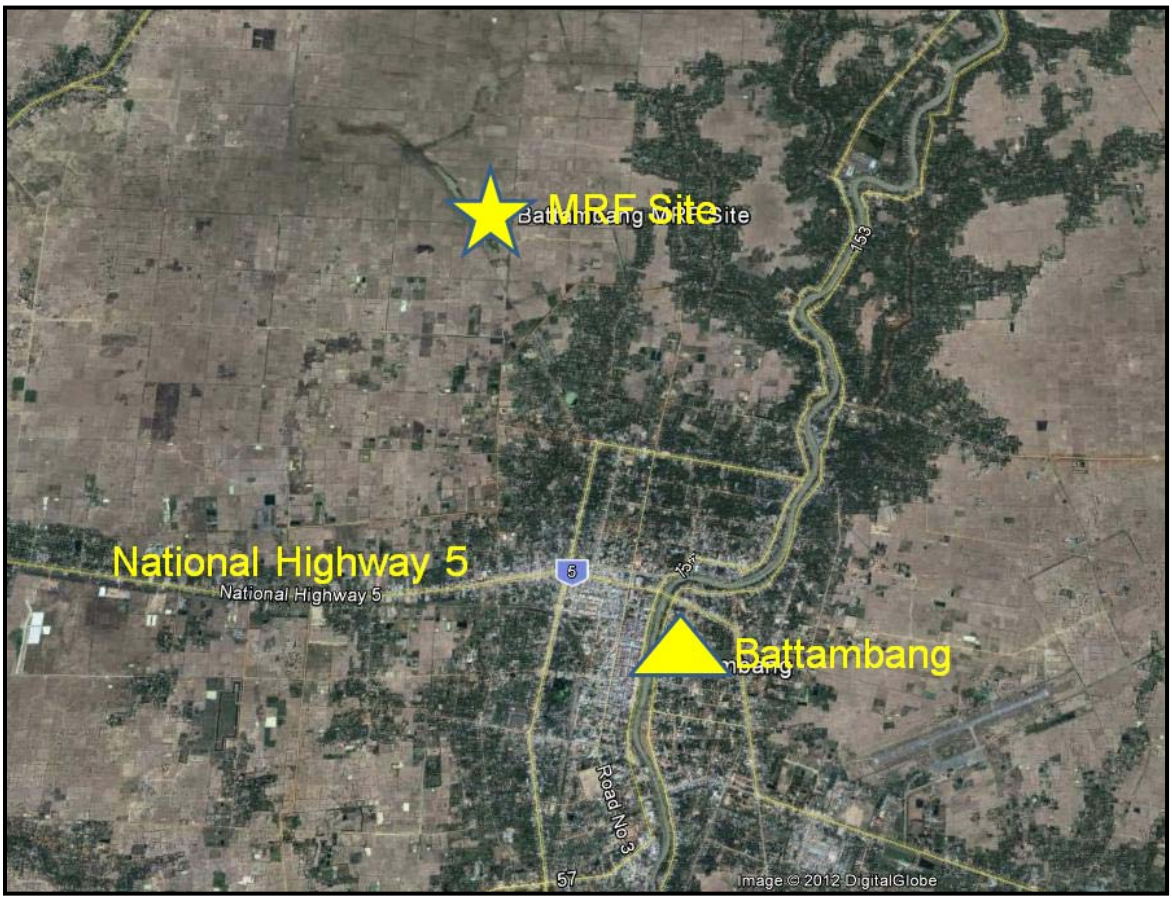


**Table 3. Features of Battambang MRF**

| | | |
|---|---|---|
| Technology | : | Fully manual sorting aided by payloader for movement of waste and recyclables and by a baler for compaction of the recovered materials |
| Capacity | : | The facility can receive and manually process at least 30 cubic meters of dry, source segregated non-biodegradable waste and truck sorted recyclable materials using a team of eight pickers. |
| Target Inputs | : | 1. The primary inputs correspond to dry, source segregated non-biodegradable waste from households, hotel and other commercial establishments and truck sorted recyclable materials.<br>2. Secondary inputs correspond to segregated recyclables to be purchased directly from households and other establishments |
| Target outputs | : | Recyclable materials which include plastic bottles, tin cans, metal containers, carton and white paper, metal |
| Design Features | : | A 600 $m^2$ fully enclosed building with paved flooring and designated areas for receiving and sorting of waste, storage areas for recyclable materials and residual materials, office, area for equipment and toilet and wash areas for pickers and facility supervisor/staff. Facility equipped with a payloader, baler, weighing scales, bins and a small power generating set. A main front door and 2 side doors and will be enclosed by a perimeter fence with a brick lower base and an upper chain link section. |
| General Process Flow | : | Waste will be inspected then unloaded into the receiving/sorting area. Recyclables will be segregated from the waste pile and stored in designated temporary storage areas. Biodegradable and residual materials will be moved by the payloader into the nearby sanitary landfill cell.<br>Recovered recyclable materials will be weighed, baled or packed and/or sold to large junkshops or recycling facilities. |
| Management and Operational Arrangements | : | 3. The facility will be managed under a public – private partnership. The province of Banteay Meanchey and Battambang District will engage the private company which collects the waste of Battambang.<br>4. A technical supervisor and one staff shall oversee daily operations of the facility. Eight waste pickers shall undertake the segregation of the recyclable components. Pickers shall be compensated in accordance with the amount of valuable materials recovered. Aside from assisting the facility supervisor, he shall also operate the baler and payloader. Recovered recyclables sold to recycling centers in province or Thailand |
| Key project stakeholders | : | Waste pickers at dumpsite and urban sector of Battambang, small buyers of recyclable materials, waste collection crew, private waste collection company, Battambang District, junkshop operators |
| Requirements for sustained operation | : | 5. Passage and implementation of a decree which requires 2-level waste segregation at source into wet biodegradables and dry non-biodegradables<br>6. Passage and implementation of a decree requiring segregated waste collection. Non-segregated or mixed waste shall not be collected.<br>7. Passage and implementation of a decree which provides the MRF operator priority in the purchase of segregated dry non-biodegradables from locators, factories, and establishments within the current and future special economic zones<br>8. Capacity building for MRF supervisor and staff |

81. The MRF site is located within a flat, 6 hectare lot adjacent to the existing Battambang dumpsite (Figure 12). The lot will be purchased by the Battambang District government for the development of a sanitary landfill. The proposed MRF site is directly accessible from the National Highway through 3-kilometer all weather road.

**Figure 12. Location of MRF in Battambang**




## C. Neak Loeung Subproject

82. The subproject in Neak Loeung consists of:

a. Construction of 4,500m of flood protection dikes on the eastern part of the town to a height of 6m;
b. Construction of access road on top of the flood protection dikes including box culverts serving as water gates with control valves;
c. Installation of pump stations to pump storm water from the enclosed area to the natural stream outside the protection dikes; and
d. Capacity building for operation and maintenance of flood protection dikes.

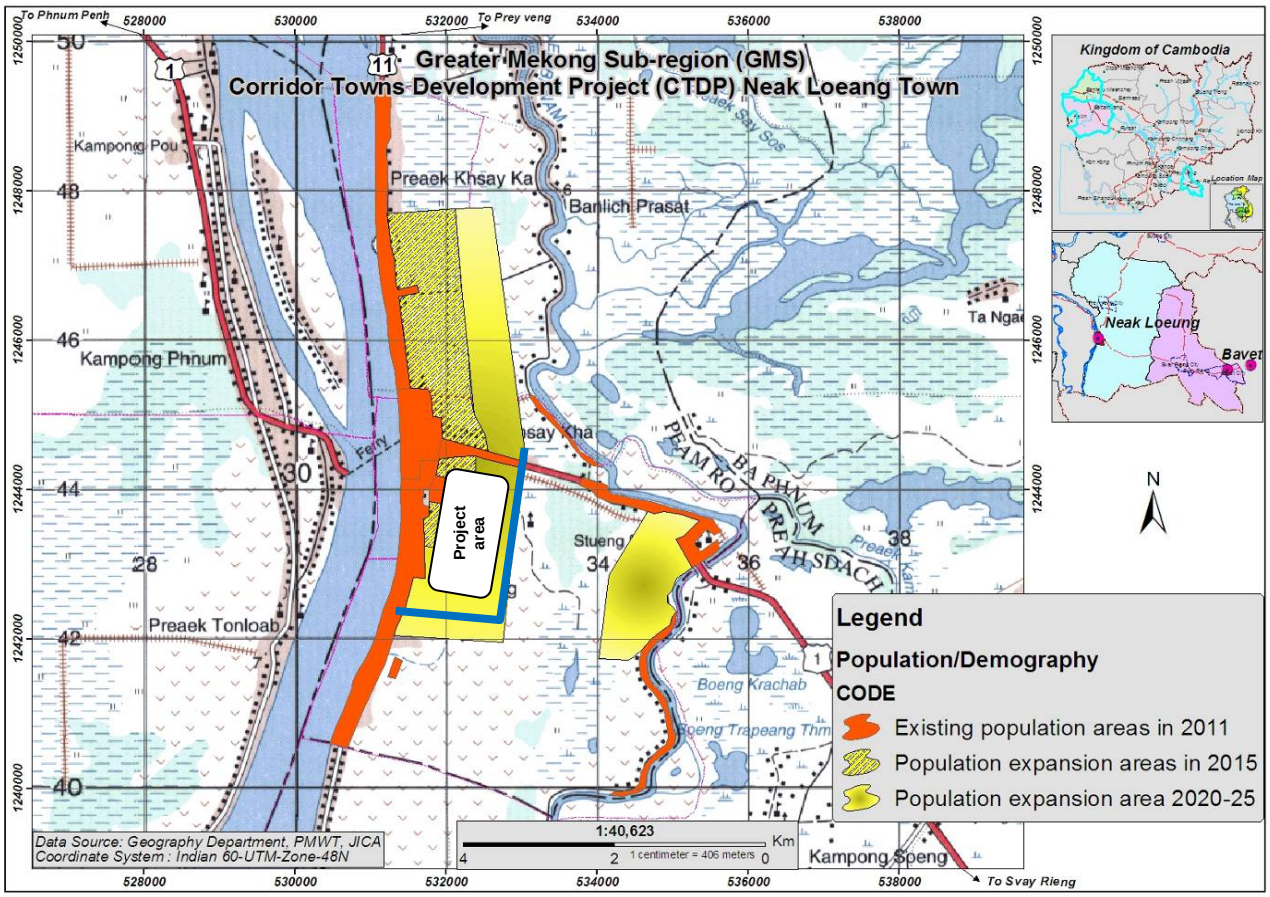
## 1. Flood Control

### a. Current Situation

83. The town of Neak Loeung currently does not have flood protection structures that can mitigate the annual flooding of the town center. During the peak rainy season about 90% of the land area of the town center is flooded for several days. Flood waters are gradually drained into the small natural streams that flow to the Mekong River on the western side of town and to the open agricultural areas in the eastern side. The absence of protection barriers allows the annual flooding of the town and resulting in the disruption of socio-economic activities among the local residents and business establishments.

84. The 4.5 kilometers of flood protection dikes will protect an area of 363 hectares which will soon emerge as the new urban center (Figure 13). The subproject is envisioned to provide the urban infrastructure that would stimulate economic activities and improve trade and investments. The protection dikes will also serve as access road for the local residents particularly during the rainy season. The proposed flood protection dikes will be constructed along the planned roads and will eventually be part of the permanent road system in Neak Loeung. This area is to include commercial and business establishments and well as residential houses.

**Figure 13. Location of flood protection area in Neak Loeung**




From Norconsult 2012

85. The enclosed areas will be exposed to stormwater during the rainy season and consequently will require pumping of the stormwater to the natural stream Preak Ta Sa outside the protection dikes. A water gate will control the flooding and be kept open during the dry season. It is also assumed that any development of the enclosed area should require earth filling works at ground level equal to the level of the dikes that also serve as access roads.

## D. Poipet Subproject

86. The subproject in Poipet consists of:

1) Improved wastewater treatment;
2) Improved solid waste management and sanitary landfill; and
3) Materials recovery facility

### 1. Wastewater Treatment Plant

#### a. Existing Conditions and Need for the Subproject

87. The high population growth rate and the rapid expansion of the urban areas of Poipet have been placing increasing pressure on local authorities to provide adequate urban infrastructure and services. The municipal government of Poipet has prepared a development master plan that incorporates essential urban infrastructure to stimulate local economic development activities and investments. With the expanding residential and commercial zones in both the town center and suburban areas, the wastewater management system in the town has become inadequate to handle both wastewater and storm-water runoff. Such inadequacy is adversely affecting the economic and environmental conditions of the local population and is considered to be a disincentive to the private sector to invest in Poipet.

88. The existing wastewater system in Poipet covers only a small proportion of the town area and consists of a combination of pipes and open canals which convey both sewage and storm-water, there are existing treatment facilities. During peak storm-water flow this combined sewerage and storm-water system overflows and contaminates the recipient and the local environment. Poipet town generates 3,000 $m^3$ of wastewater/day which flows to a small piped system eventually draining to an open canal and stream along the border between Cambodia and Thailand.

89. Due to the inadequacy of the wastewater system, households and commercial establishments are obliged to construct their own open drain and small canals where their wastewater drains to natural streams and open agricultural areas. The open canals are inappropriately designed and poorly maintained resulting in unsanitary conditions in the surrounding areas. This situation is further compounded by the absence of a wastewater treatment plant (WWTP) in Poipet.

90. The municipal government has identified as its top priority the improvement of the wastewater system in response to the demands and persistence of the local population. A modern and more effective sewerage system is based on the separation of effluent and storm-water in a closed system collecting sewage from households and commercial establishments in sewage pipes which convey the sewage to a WWTP while storm-water is collected in drains or channels and conveyed to the nearest river, stream or watercourse. This priority urban environment infrastructure will contribute to promoting Poipet as a clean and live-able border town.

### b. Components of the Sub-project

91. The subproject includes implementation of a separate wastewater system for collecting sewage from the town including separate storm-water pipes and canals. Two main alignments are proposed to intercept sewage from the town center and bring it to the proposed treatment plant.

92. The following design parameters have been applied: (i) water consumption of 150 l/c*d (the additional component for institutional buildings, industry, hotels etc. will be determined during preparation of design criteria in the initial phase of the project); (ii) the wastewater transfer system is designed for wastewater production of 120 l/c*d (80% of water consumption); (iii) storm water drainage system is designed for the 1 in 10 year flood event with pipes/culverts installed at a minimum slope of 0.5% for gravity transfer.

93. The improvement of the wastewater system will involve civil works, installation of structures and facilities and the essential elements for operation and maintenance of the wastewater systems and wastewater treatment plant, and related structures, including upgrading of the access road. The WWTP will consist of four anaerobic ponds in parallel. The anaerobic ponds will be the primary pollutant removal mechanism for BOD, SS and grit. The proposed depth of the anaerobic ponds is 3 m, and based on the projected 2020 population will have a design capacity of 20,152 m3. Gradually, over a period of time, the settled solids in the anaerobic ponds will build up and reduce the treatment efficiency of the ponds.

94. To restore the treatment efficiency, periodic de-sludging of the pond system will be required. To facilitate de-sludging, the design of the ponds incorporates: (i) concrete lined pond bottom to prevent possible damage to the pond floor and to prevent flotation of the pond structure during de-sludging; (ii) an access ramp to allow vehicle access; and (iii) a valve and piping arrangement to allow for the isolation and bypassing of the flow during de-sludging operations. The components of this urban environment infrastructure are summarized in Table 4:

**Table 4. Components of wastewater treatment system**

| Component | Description |
|---|---|
| Sewerage network 300mm | Sewage pipeline on both sides of the road. |
| Rehabilitation of earth drainage canal | Canals for storm water drainage. |
| Storm water pipes | Storm water pipes both side of the road |
| Box culverts | Box culverts crossing roads |
| Open and closed storm water canals/ pipes | |
| Wastewater treatment plant | Including screens, flow distribution, anaerobic pond and facultative pond. |
| Outlet pipe from WWTP | |

95. The proposed location of WWTP is approximately 6 km from the municipal center of Poipet (Figure 14). The treated effluent will be discharged into an Ou Chrav Stream (Kai Don). This stream is also utilized by local people for drinking, washing and vegetation activities.

96. Treated effluent from the all three WTTPs will conform to the Sub-decree on Water Pollution Control, issued by the Royal Government of the Kingdom of Cambodia 6 April 1999, which forms the basis of the choice of treatment process, as the project outcome must adopt the present discharge limitations.

97. The Sub-decree has presented an "effluent standard for pollution sources discharging wastewater to public water areas or sewer access". For Poipet, the recipient is characterized as "Public water area and sewer", and the limits for discharged water from the wastewater treatment plant for relevant parameters are presented in Table 10.

**Table 5: Water quality limits for discharged water in Cambodia**

| Parameter | Unit | Limit |
|---|---|---|
| pH | - | 5-9 |
| $BOD_5$ | mg O/l | < 80 |
| DO | mg/l | > 1 |

Source: Annex 2, Sub-decree on Water Pollution Control (see Appendix A)

98. It is assumed that wastewater from industrial processes are pre-treated before these are discharged to the municipal sewerage network. The quality requirement shall be in accordance with regulations of the government where no industrial waste shall be discharge to the public sewage system.

**Figure 14. Location of sub-project components in Poipet**

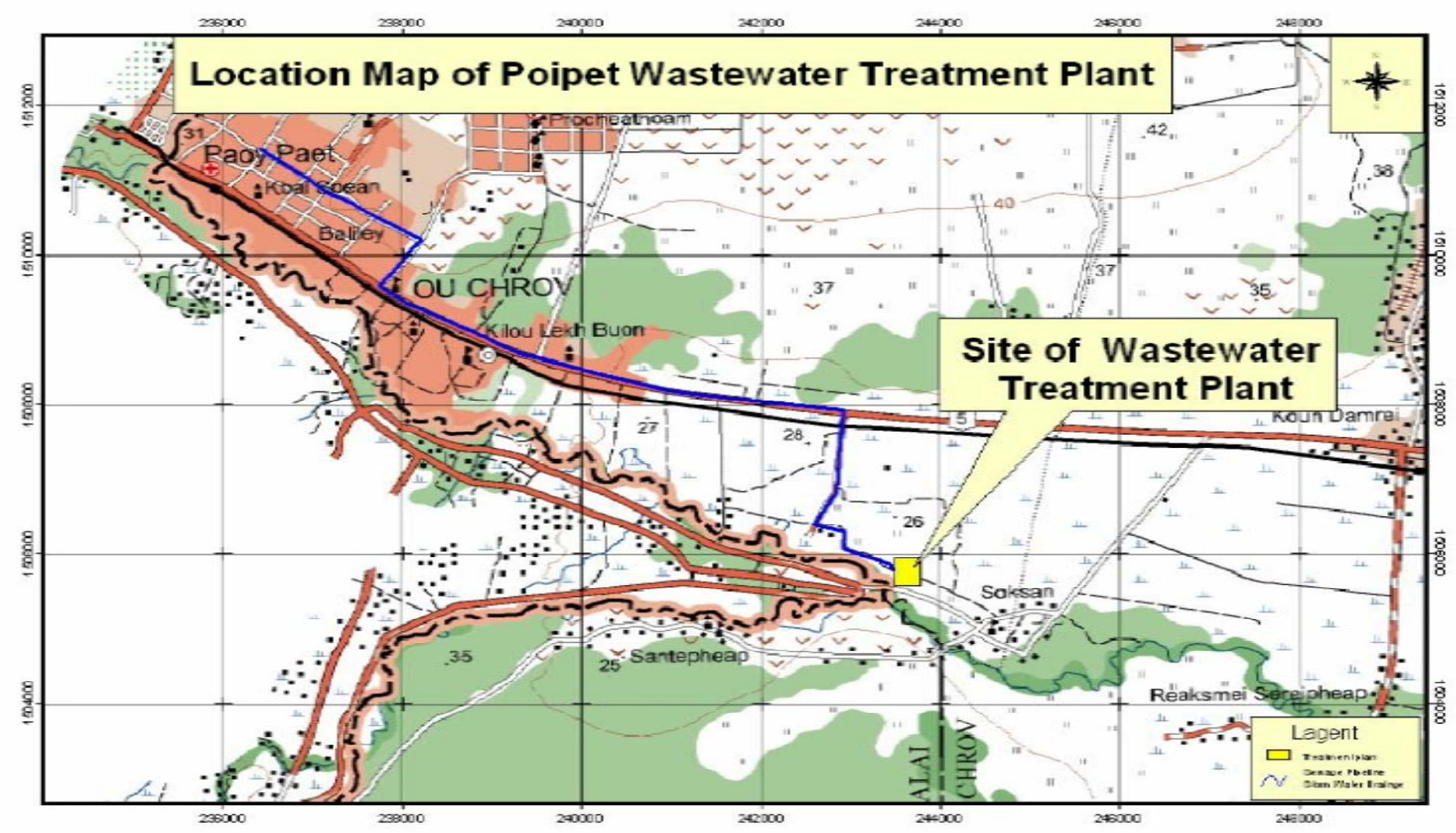


**Figure 15. Plan of wastewater treatment plant in Poipet**

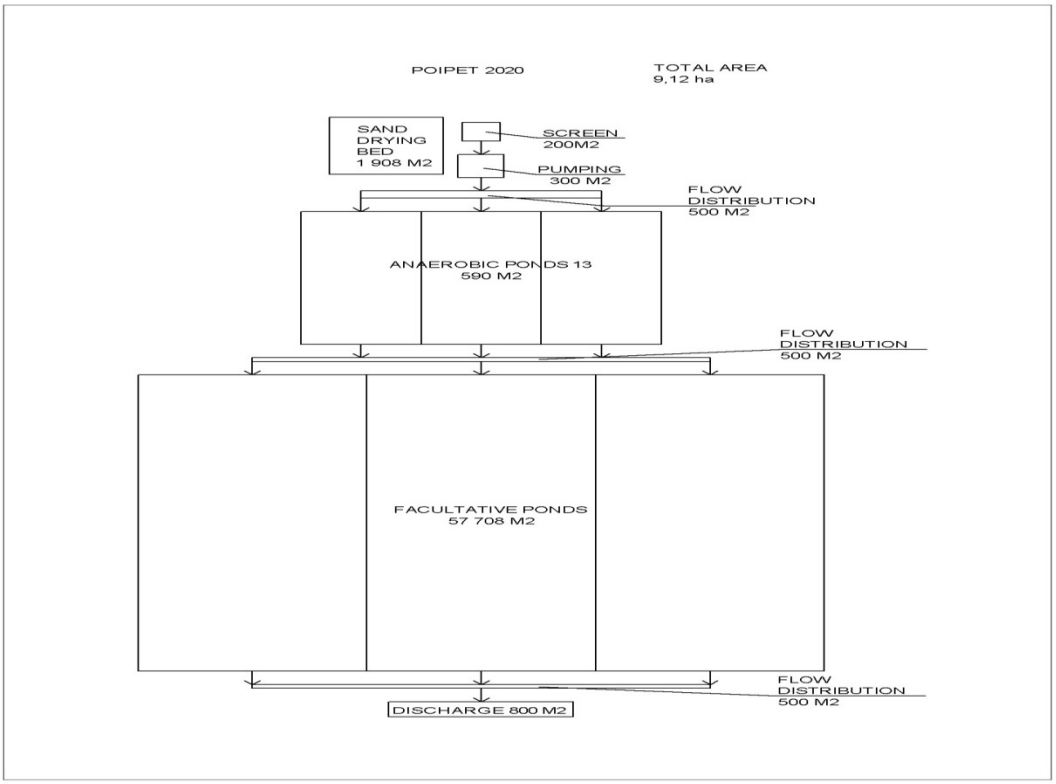
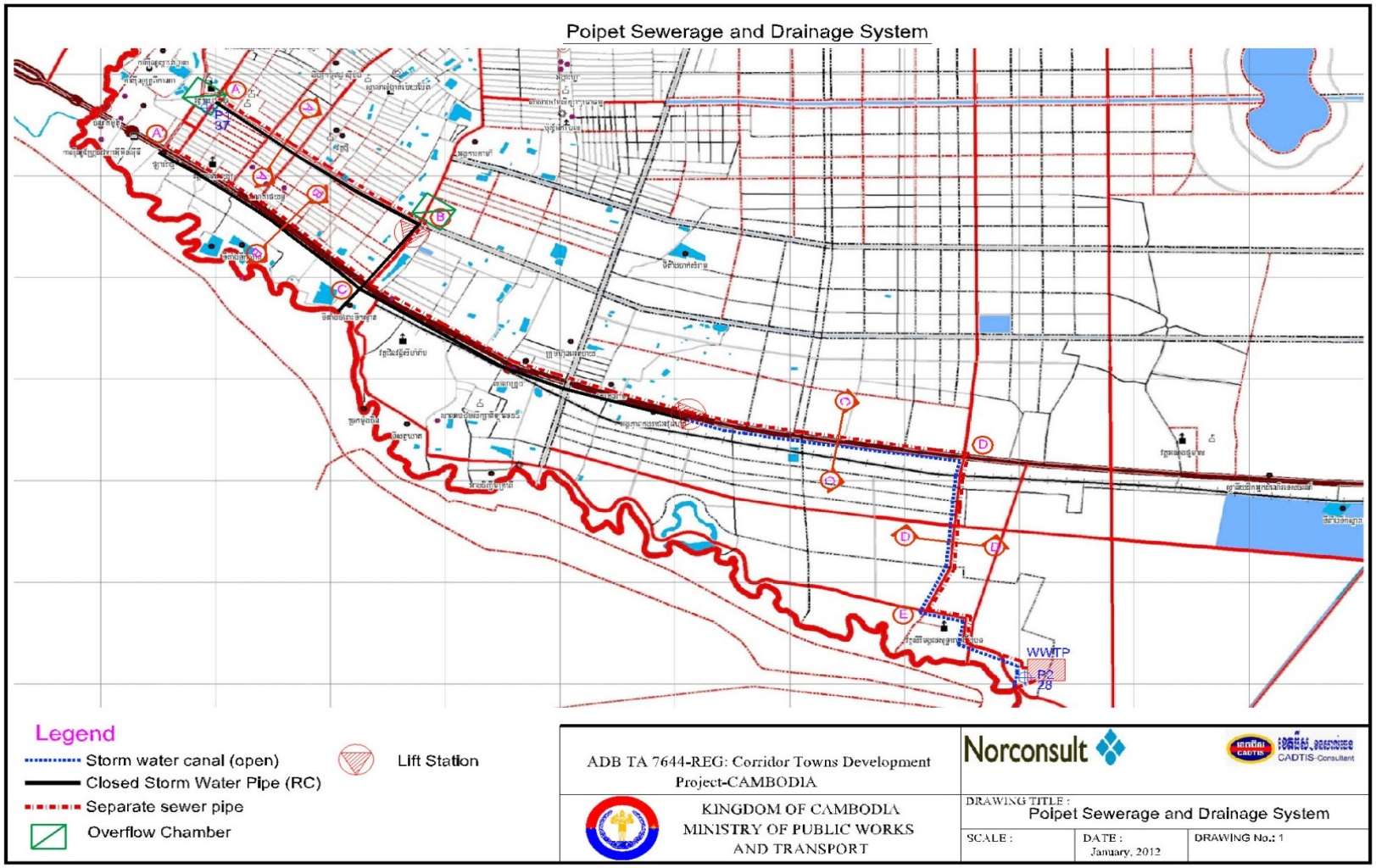


**Figure 16. Planned storm water drainage and sewage network in Poipet.**



## 2. Improved Solid Waste Management

### a. Existing Conditions and Need for Subproject

99. Poipet does not have a designated area where it can dispose of its hazardous, industrial, agricultural, and other toxic waste which may pose a danger to the environment. There is a lack of local regulation regarding the handling/disposal of hazardous waste materials in the city, the municipality should enforce the sub-decree on Solid Waste Management (April 1999) which establishes the legal basis for solid waste management together with hazardous wastes. The main purpose of this sub-decree is to regulate the solid waste management sector with technical standards for waste disposal to ensure the protection of human and environmental health. This sub-decree applies to all activities related to disposal, storage, collection, transportation, recycling, dumping of municipal and hazardous waste.

100. The town's waste stream comprises two-thirds domestic waste and remaining third is waste generated by sources such as institutions, markets, commercial and industrial enterprises. Current domestic waste generation is approximately 16,000 tons/year (43 tons/day) and is expected to increase to 173,000 tons/year (173 tons/day) by 2030. Other municipal waste collected, treated and/or disposed is expected to increase from 3,700 tons/year to 55,000 tons/year by 2030. Estimates of waste generation indicate that people in the urban areas of Poipet generate 0.55 kg of waste per day with rural areas producing less.

101. Much of the waste is collected loose and not containerized in bags, bins, or baskets and creates health and environmental problems and also makes the collection extremely inefficient. A large portion of the solid waste is also left uncollected, resulting in a number of small and illegal dump-sites throughout the town.

102. The waste contractor has a total of six collection trucks which collect 1.5 tons/day per truck, this is a very low collection rate which in a well-managed system should be in the order of 5 -10 tons/day per truck. The existing service coverage for waste collection services is approximately 20%.

### b. Subproject components

103. The goal of the subproject is to establish a modern solid waste management system in Poipet. The specific objectives of this subproject include the following:

(i) establish a sanitary landfill for proper disposal of solid waste;
(ii) install a material recovery facility (MRF)[6] for proper waste segregation and recycling;
(iii) procure additional equipment and facilities for improved waste collection;
(iv) procure additional equipment for improved operation at the disposal site;
(v) introduce recycling of food and green waste through pilot composting; and,
(vi) implement public education & and awareness campaigns to support the improved solid waste management system; and (vi) promote public private partnership in the operation and maintenance of the sanitary landfill and material recovery facility.

[6] The MRF is to be fully designed in a later stage of the project as part of the UFPF component.

104. The following design principles will be applied to the subproject:

The collection service should be expanded to cover 90% of the urban areas and 70% of the rural area by 2030;

Collection should be carried out at a minimum of twice per week with different levels of collection service (house collection areas paying higher fees, and centralised collection points in low-income areas paying lower fees);

The collection equipment, routes and schemes should be optimised in the subsequent project implementation phase and be flexible enough to be adapted to waste segregation schemes in the future;

Only containerised waste should be collected, and the city should supply appropriate, low-tech and low-cost containers (drums, baskets, bags, steel containers etc.);

The receptacle/storage system must be compatible with the collection and transportation system. Many types of waste containers are designed specifically for a particular hoist or truck type;

Collection trucks with a minimum 5 ton capacity should be selected based on an agreed municipal strategy catering for the future collection system and have appropriate loading height. Collection from small street-side bins may require smaller trucks; and

The use of compacting trucks should be encouraged as they offer improved loading and consequently collection efficiency as well as enclose the waste which improves transportation of the waste and working conditions.

105. Assumed to be a modern sanitary landfill the upgraded site will have the following technical components:

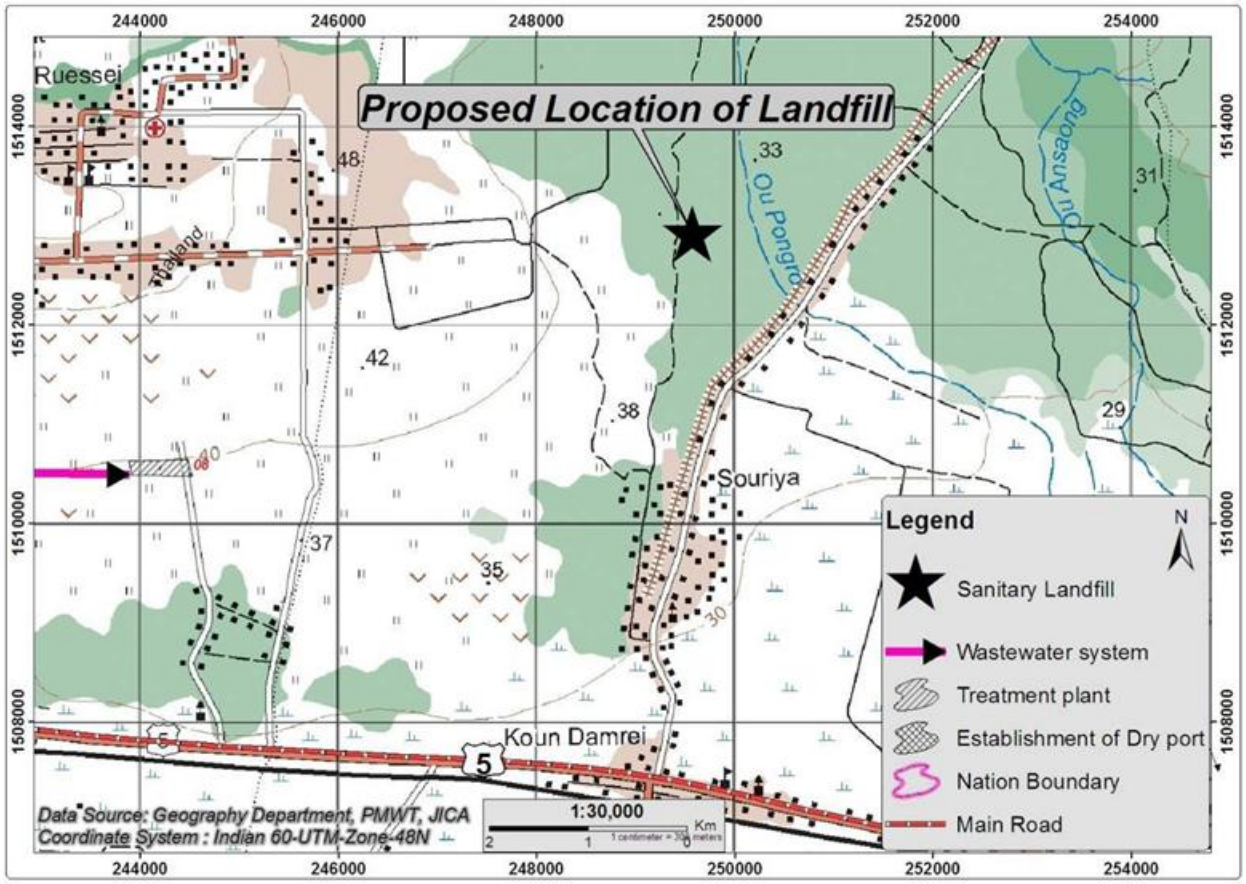
- Access road, paved - design is 2 lanes each 3 m wide and a total width including shoulders of 7 m. The alignment mostly follows existing roads of low standard and is indicated in drawing no. 6 in annex 5.
- If applicable : Guard and recorder house - this is recommended in Poipet
- If applicable : Weighing bridge - this is recommended in Poipet
- Administrative building (office, wardrobes, showers, toilets
- Additional service building with storage etc.
- Landfill equipment depot with simple workshop.
- If applicable: Gas extraction and most preferably utilization.
- Proper internal road system (all – weather surface with laterite).
- Surrounding upstream run–off ditches or dikes cutting off surface water.
- Liner if local soil conditions cause risk of leakage and groundwater contamination.
- Bottom leachate drainage system of sand or gravel with central drainage pipelines.
- Leachate transport system
- Leachate treatment plant (based on biological treatment).
- Proper fences
- guiding signs and if applicable operational lighting at tipping area.
- Reception station for hazardous waste
- Ground water monitoring well(s) downstream the landfill

106. Relevant operational equipment for solid waste handling and landfilling operation:

- Front loader for internal transport, including servicing the composting plant
- Bulldozer with flexible bucket for spreading and compacting solid waste and for handling and spreading cover material
- Truck.
- backhoe tractor for multi-purpose use

107. The proposed site (Figure 17) is slightly elevated and therefore not subject to flooding. It will require upgrading and paving of nearly 3 km of access road. All of the required waste management facilities will be developed and accommodated within the site. Assuming the landfill will be 8 m - 10 m in height, the landfill itself will require an area of between 40,000 $m^2$ – 55,000 $m^2$ to the year 2030. The proposed site is not near any surface waters. The depth of the water table and location of aquifers need to be verified.

**Figure 17. Proposed landfill site in Poipet**



## 3. Materials Recovery Facility

### a. Current situation

108. Solid waste management in Poipet is undertaken by Poipet Cleaners Co. Ltd. which undertakes waste collection and street sweeping at the urban sectors of 2 sangkats of the district. The collected waste is disposed by the same company at an open dump located about five kilometers northeast of the center of the district. The open dump is about 5 ha but only 10 %of area is used for waste. Burning of solid waste is a common practice at the dumpsite.

109. Waste collection covers only an estimated 20 to 25 % of the daily waste of 50 to 60 tons. This condition is reflected in the piles of uncollected waste and litter along the road and vacant lots and complaints of local residents on the service provided by Poipet Cleaners Co. Ltd. Waste generators include households, market, commercial establishments, institutions and casinos. Recovery of recyclable materials for reuse and recycling occurs at varying levels. Unsanitary picking of waste is done at the bins, waste collection trucks and the dumpsite.

110. Although recovery of a significant percentage of recyclables is already done at source, unsanitary picking of mixed waste continue undertaken by the informal sector at bins, waste collection trucks and the existing open dump. This practice exposes the pickers to health hazards aside from painting a negative aesthetic image of the district. The MRF will provide a sanitary and efficient system and facility for the recovery of the recyclables that can be recovered at bins, waste trucks and dumpsite.

111. The proposed MRF (Figure 18) will establish a sanitary and centralized recovery of recyclable materials promoting the principles of the 3 Rs (reduction, recycle & reuse). It will be supported by a parallel government program involving passage and strict implementation of waste segregation at source, segregated waste collection and sustained conduct of information and education campaign on proper solid waste management and practices.

**Figure 18. Proposed layout of MRF at Poipet**

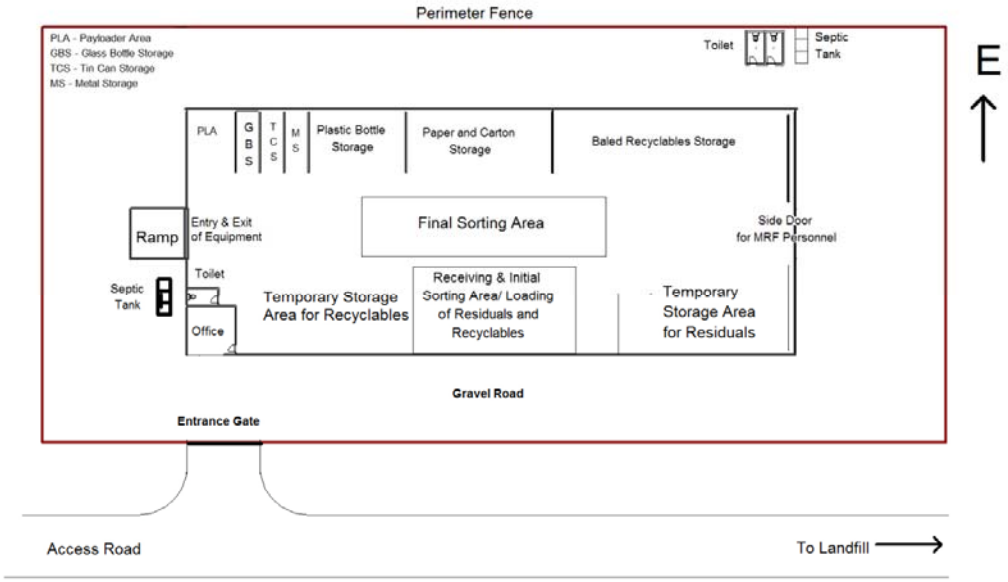


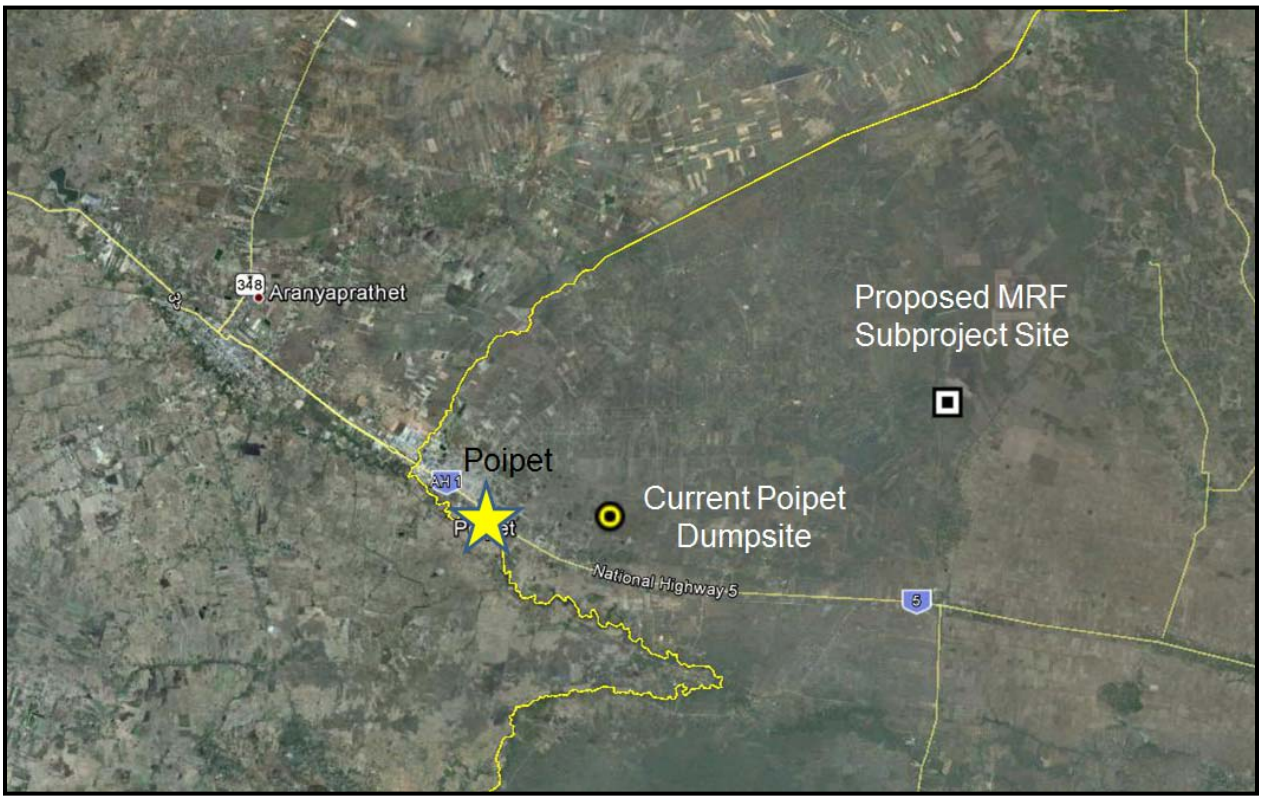
**Table 6. Features of MRF in Poipet**

| | | |
|---|---|---|
| Objective | : | Recovery of recyclable materials from municipal solid waste generated at Poipet and improvement of the solid waste management system |
| Technology | : | Fully manual sorting aided by payloader for movement of waste and recyclables and by a baler for compaction of the recovered materials |
| Capacity | : | The facility can receive and manually process at least 30 cubic meters of dry, source segregated non-biodegradable waste and truck sorted recyclable materials using a team of eight (8) pickers. |
| Operating Schedule | : | The facility shall operate from 7:30 AM to 4:30 PM from Monday to Saturday. |
| Target Inputs | : | 1. The primary inputs correspond to dry, source segregated non-biodegradable waste from casinos and truck sorted recyclable materials.<br>2. Secondary inputs correspond to segregated recyclables to be purchased directly from households and other establishments |
| Target outputs | : | Recyclable materials which include plastic bottles, tin cans, metal containers, carton and white paper, metal |
| Design Features | : | MRF corresponds to a 800 $m^2$ fully enclosed building with paved flooring and designated areas for receiving and sorting of waste, storage areas for recyclable materials and residual materials, office, area for equipment and toilet and wash areas for pickers and facility supervisor/staff. The facility will be equipped with a payloader, baler, weighing scales, bins and a small power generating set. It shall have a main front door and 2 side doors and will be enclosed by a perimeter fence with a brick lower base and an upper chain link section. |
| General Process Flow | : | Waste will be inspected then unloaded into the receiving/sorting area. Recyclables will be segregated from the waste pile and stored in designated temporary storage areas. Biodegradable and residual materials will be moved by the payloader into the nearby sanitary landfill cell.<br>Recovered recyclable materials will be weighed, baled or packed and/or sold to large junkshops or recycling facilities. |
| Management and Operational Arrangements | : | 3. The facility will be managed under a public – private partnership. The province of Banteay Meanchey and Poipet District will engage the private company which collects the waste of Poipet.<br>4. A technical supervisor and one (1) staff shall oversee the day to day operations of the facility. Eight (8) waste pickers shall undertake the segregation of the recyclable components. The pickers shall be compensated in accordance with the amount of valuable materials recovered. Aside from assisting the facility supervisor, he shall also operate the baler and payloader.<br>5. Recovered recyclables shall be sold to recycling centers in the province or Thailand |
| Key project stakeholders | : | Waste pickers at dumpsite and urban sector of Poipet, small buyers of recyclables, waste collection crew, private waste collection company, Poipet District, junkshop operators |
| Requirements for sustained operation | : | 6. Passage and implementation of a decree which requires 2-level waste segregation at source into wet biodegradables and dry non-biodegradables<br>7. Passage and implementation of a decree requiring segregated waste collection. Non-segregated or mixed waste shall not be collected.<br>8. Passage and implementation of a decree which provides the MRF operator priority in the purchase of segregated dry non-biodegradables from locators, factories, and establishments within the current and future special economic zones<br>9. Capacity building for MRF supervisor and staff |

.

112. The MRF site is located within a flat, 10-hectare lot allocated by the Poipet District Government for its sanitary landfill (Figure 19). Current access to the site from the center of the Poipet is through Highway 5 thence though an all-weather road which extends northward for about 5 km until about 400 m from western edge of the 10-hectare lot. The construction of the 400-meter long access road will be undertaken during the construction of the sanitary landfill.

**Figure 19. Location of MRF in Poipet**



# V. DESCRIPTION OF AFFECTED ENVIRONMENTS

113. The description of the affected environments focuses on the environmental features that could possibly be affected by the subprojects, or could possibly influence the implementation and successful operation of the subprojects.

## A. Common Environmental Features of the Towns

### 1. Climate

114. The climate of the region is a tropical monsoon climate and is influenced by various factors, including its location in the Inter-Tropical Convergence Zone and the monsoon.

115. There are two distinct seasons: (i) the dry season from November to April associated with the northeast monsoon, which sends drier and cooler air, and with February being the driest month; (ii) the wet season from May to October, in which rainfall is largely derived from the southwest monsoon drawn inland from the Indian Ocean; the rainfall pattern is bi-modal in this season with peaks in June and September/October.

116. The average rainfall in the four towns ranges from 1280mm to 1700mm with peak rainfall occurring in September/October and the lowest rainfall in February. The temperature is lowest in January and highest in April with an average of 29 - 34$^{o}$C.

#### a. Air Quality and Noise

117. Air quality and noise data are not available for the four towns. The main sources of noise and air pollutants are from vehicle traffic and dust from unpaved roads, burning of solid waste, gases from untreated wastewater and smog from vehicles.

### 2. Geology

118. The geology of all towns is dominated by young alluvium soils made up of sediment deposits from rivers and streams. These are mainly finer sediments, thus a high concentration of silt and clay is found in the ground. Alluvial deposits normally result in fertile land.

## B. Bavet Town

119. The topography around Bavet is characterized by flat, low lying land, ranging up to 10 m above sea level. Many of the surrounding water bodies vary in extent with seasonal precipitation.

### 1. Bio-physical Features

120. The immediate surroundings of Bavet are dominated by agricultural lands, with sparse and scattered grassland and shrubland in few places. No forest is within the Project area, as shown from the map of forest distribution in Cambodia.

121. Bavet Municipality is planning to conserve an area approximately 5 km downstream from the proposed WWTP, near the Vietnam Border. It is reported there are still a lot of bird species

in the proposed conservation area. The map of important bird areas (IBA[7]) has been reviewed and no vulnerable areas have been identified within proximity to the Project sites. No rare or endangered terrestrial flora or fauna are recorded from the Project area.

### 2. Aquatic Ecology

122. Through field observations and meetings with the town officials, the ecology of the Tapov stream has been discussed. Some fish species such as catfish, hermibagrus (Chhlang), mystus rhegma (Kagnchos), Kragn, and other small fish are present in the stream. The water quality of the stream tends to be poor especially in times of low water flow. No rare or endangered species of aquatic flora or fauna are recorded from the project area.

### 3. Land Use and Zoning

123. Bavet town has an existing land use (Table 12) and zoning map (Figure 20), indicating the agricultural, industrial, commercial, residential zones and the a direction of the short-term development for the town. This is intended to guide the local officials, the investors and its constituents in urbanization.

124. The total area of Bavet town is 20,669 hectares which consists of residential land (21%), agricultural area accounting for 75%, with forest and unused (future residential) land accounting each for 2% of the total area. Bavet is confronted with the shortage of land for farming and housing which resulted to an increasing number of informal settlers who were encroaching on the right of ways, natural ponds, streams, canals, forest and the like, in order to have a place to stay.

125. It is reported that many rice fields are available for sale or awaiting for investors to develop the land for industrial and enterprise purposes.

**Table 7. Land use in Bavet**

| Land use | Existing | |
|---|---|---|
| | Area (ha) | % |
| Residential | 4,310 | 20.9 |
| Agriculture | 15,539 | 75.2 |
| Forest | 404 | 2.0 |
| Unused (future residential) | 416 | 2.0 |
| Total | 20,669 | 100.0 |

Source: MLMUPC Master Plan (2011)

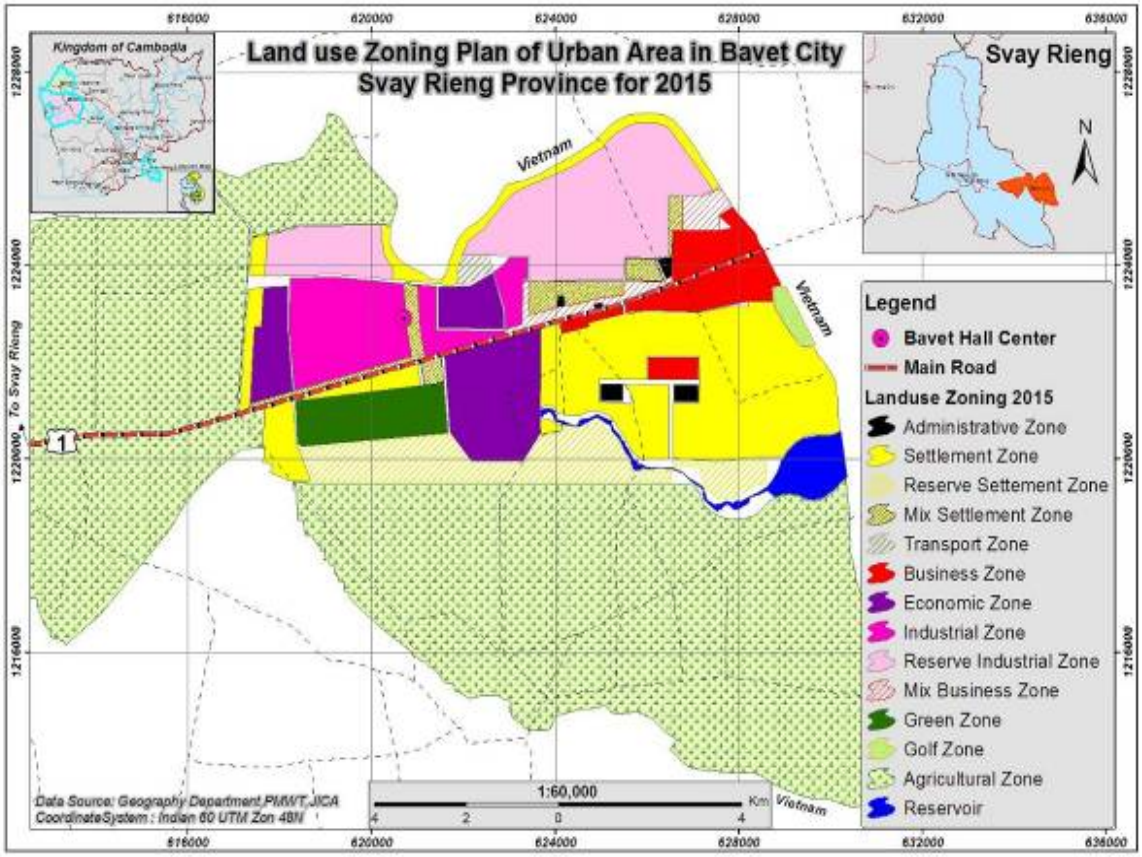
126. Within the town, Bavet Sangkat is considered as the core urban area. The development along NR 1 mainly consists of new buildings such as restaurants, guest-houses, casinos and hotels, beer gardens, shops/stalls and shops-houses. The ROW has largely been left clear, and most encroachment within the ROW is by temporary stalls which have been given permission to locate there until the road is improved.

127. While the land use plan is meant guide the development of the town, there is also ad hoc development by casino and hotel owners building dormitories for their staff/employees, usually

[7] http://birdlifeindochina.org/datazone/14

within the sites of buildings, but there are increasing numbers of temporary shelters being built to serve workers.

**Figure 20. Land zoning in Bavet**




## 4. Location of Subproject Components

### a. WWTP

128. The proposed location of new WWTP is beside Ta Pov stream (Figure 2) approximately 5 km from the town center. The treated effluent and presumably WWTP sludge will be discharged into the stream which is dry during periods of the dry season, and used for irrigation. Thus, the treated effluent also will be used for irrigation. The planned discharge stream is tributary to downstream surface waters and natural areas.

### b. Urban Road Upgrades

129. The stretch of urban road to be upgraded is part of National Road #1 which runs through Svay Teab District to Bavet. There are approximately 2,000 houses and commercial establishments along the road which account for approximately 30% of the town's population.

### c. MRF

130. The MRF Subproject site is located within a flat, 6.5 -hectare lot adjacent to the existing Bavet dumpsite (Figure 6). The lot was purchased by the Cambodia Red Cross for the development of a sanitary landfill and shall be donated to the District of Bavet.

## 5. Relevant Existing Services and Infrastructure Provision

### a. Urban Water Supply and Wastewater

131. There are two water supply companies operating in the town; one in Bavet Sangkat operated by Khun AKPIWAT Co. Ltd. that serves up to 724 households in the core urban area, and Chi-Phou Urban Water Supply Company which serves the Chi-Phou community with 152 household connections. The water is supplied from boreholes with tanks and electric pumps reticulating the water through a network of pipes.

132. It has been noted in the Master Plan that Bavet needs to expand its water supply capacity to better meet the needs of the growing town population. Khun AKPIWAT Co. Ltd is seeking for external resources to support expansion of its system

### b. Urban Roads and Drainage

133. The road network in Bavet includes NR 1 with a length of 22 km (including a 7 km section which traverses the centre of the town), asphalt roads with a length of 6 km connecting NR 1 to Chantrea district, gravel roads with a total length of 29.1 km, and earth roads with a total length of 26.7 km. Included in the road network are two reinforced concrete bridges and 105 culverts.

134. As indicated above most of the urban roads in Bavet are either gravel or earth surface, and become muddy and slippery during the rain. During wet conditions these roads are barely trafficable for four-wheel vehicles and motorbikes. This is not considered an acceptable situation for a developing town aiming to improve living conditions for the population.

135. The municipality has a transportation plan for its urban area which plans to upgrade gravel and earth roads and improve NR 1 along a 10 km section (including providing four lanes and central median strip). This latter proposal is being undertaken as a subproject under CTDP.

136. Drainage system consists of the open drains converted from natural ditches/canals. The Governor is planning to have the existing canals dredged in order to discharge the flood and waste water from the town. The majority of the town is still without working drainage. The Governor has indicated in the map that there will be a retention stream (partition half from natural stream) to the south-west of the town so that it also acts as a primary treatment facility. Of the total 20,669 $km^2$ land area of the municipality, approximately 90% of the land is affected by flooding during the rainy season. The rainy season starts from June to November but the peak of water flooding is from September to mid-October.

137. As a response from the Bavet municipal working group, the urban land area of the municipality which is located in the whole Sangkat Bavet covering about 4,804 ha of which 80% gets flooded every year. As for the core areas of the municipality, about 35% gets flooded,

especially during rainy season. In general, the drainage at the urban areas directly flows with wastewater into the existing canals and piped systems into the wetland areas.

## C. Battambang Town

### 1. Biophysical Features

138. The topography around Battambang is characterized by flat, low lying land, ranging between 10 and 20 metres above sea level. Many of the surrounding water bodies vary in extent as the level rises significantly with varying seasonal precipitation. A major feature of Battambang is the Sangke River which flows through the town centre.

139. The subprojects are located in Battambang town with exception of the proposed site for the new wastewater treatment plant which is located in Sangke District east of Battambang town.

140. The immediate surroundings of Battambang are dominated by agricultural lands, which stretch 5-10 km on both sides of the Southern Economic Corridor road, from Phnom Penh to the southeast to Poipet in the north-west. Towards the northeast, the agriculture changes to grass and shrub lands and 25-30 km to the east-southeast the land is covered with forest.

### 2. Wildlife Features

141. The greater Tonle Sap ecosystem, within which Battambang sits, is home to some of the world's rarest and endangered bird species including Pelicanus philippensis (Spot-billed pelican), Leptoptilos dubius (Greater adjutant stork), Cairina scutulata (White-winged duck), Mycteria cinerea (Milky stork) and Leptoptilos javanicus (Lesser adjutant stork). It shelters some of the last viable populations of bird species thought to be extinct elsewhere. The flooded forest hosts the largest breeding water bird colony anywhere in Southeast Asia covering an estimated 875 ha in Battambang province.

142. However, the map of important bird areas[8] (IBA) in Cambodia has been reviewed and no vulnerable areas have been identified within close proximity to the project sites.

143. A search of the IUCN redlist[9] of terrestrial and aquatic species in Cambodia with habitats in grassland, shrubland and wetlands (the ecosystem types surrounding the project sites when not agriculture) show that 5 species are endangered and 6 species are vulnerable. Of these, 7 are threatened by "human intrusions and disturbance" and/or "residential and commercial development". These 7 include: Asian Small-clawed Otter (Aonyx cinerea), Hog Deer (Axis porcinus), Indian Water Buffalo (Bubalus arnee), Hairy-nosed Otter (Lutra sumatrana), Smooth-coated Otter (Lutrogale perspicillata), Fishing Cat (Prionailurus viverrinus) and Eld's Deer (Rucervus eldii). However, none of these species have been reported from the Project area.

144. The Project area is highly disturbed by urban and agricultural development and does not include any sensitive habitats or support any rare or endangered species of flora or fauna.

[8] http://birdlifeindochina.org/datazone/14

[9] IUCN 2011. IUCN Red List of Threatened Species. Version 2011.1. <www.iucnredlist.org>. Downloaded on 01 November 2011.

## 3. Aquatic Ecology

145. The Sangke River and its tributaries belong to the greater ecosystems of Mekong, more precisely the part connected to Tonle Sap. Of all the vertebrates of the Tonle Sap ecosystem, fishes are undoubtedly the largest group, both in number of species as well as in biomass. The precise number of species in the Mekong is not known; the total number recorded or inferred from the known zoogeography of the region includes about 1 200 species, but up to 1900 species could be expected.

146. For Cambodia in particular, 500 species have been described (including the Tonle Sap ecosystem) but the real number is higher. The lack of a practical, comprehensive fish species identification guide for use in the field by local data collectors, and the fact that local names of fish species usually cover more than one species, contributes to some uncertainty about the actual species richness. Some of the species found in the Tonle Sap remain there permanently, while many other species use the lake and the floodplain only temporarily and migrate back and forth to the main stretch of the Mekong River. [10]

147. Amphibians and reptiles are common in the ecosystem, even though larger species like turtles have become rare or have disappeared altogether as the result of excessive hunting etc. Aquatic snakes are very common, as are toads and frogs.

148. However, the Project area does not include any sensitive habitats or support any rare or endangered species of aquatic flora or fauna.

## 4. Land Use and Zoning

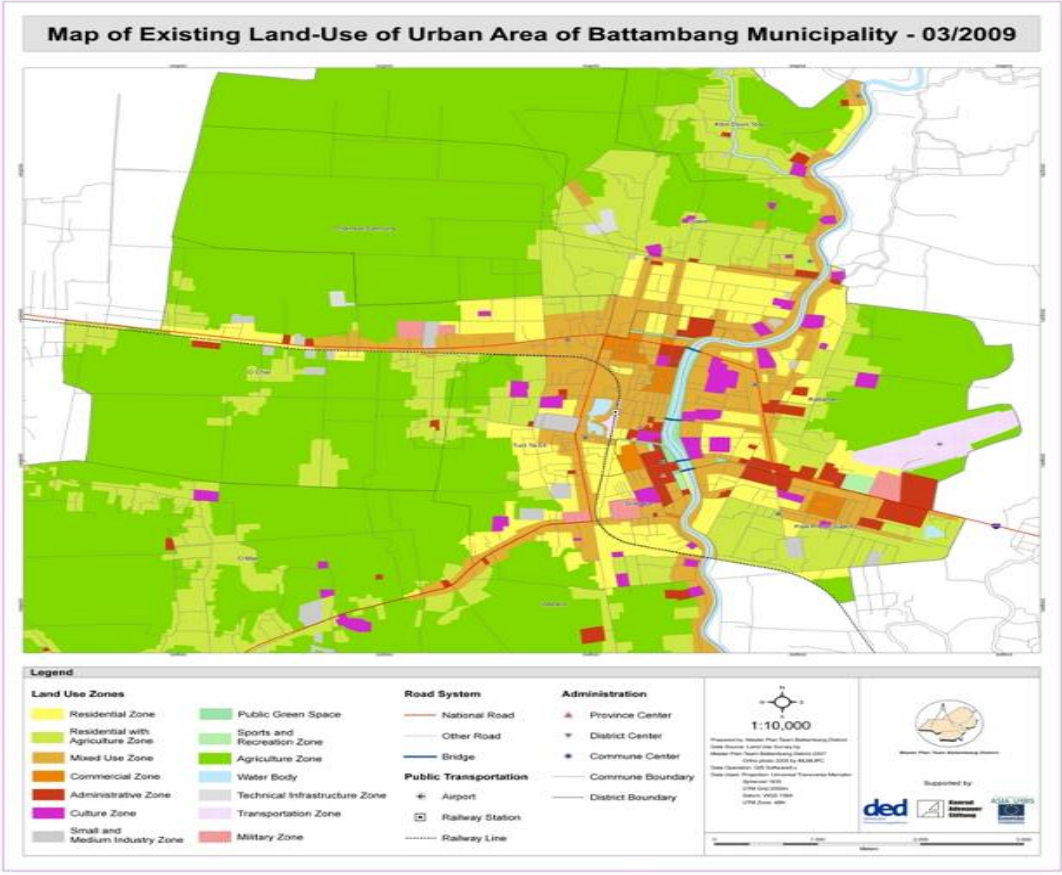
149. The land use pattern of the municipality is based on the zones (Figure 21) generally indicated in the land use plan (Table 13). The major land use category is the agriculture zone which occupies 8,558 ha or three-quarters of the total area.

**Table 8. Land use in Battambang**

| Land Use Category | Area (ha) | % of municipality | % of settlement area |
|---|---|---|---|
| | | | |
| Residential zone | 456.7 | 4.02 | 15.8 |
| Residential with agriculture zone | 1,379.6 | 12.16 | 47.6 |
| Mixed use zone | 584.5 | 5.15 | 20.2 |
| Commercial zone | 42.1 | 0.37 | 1.5 |
| Administration zone | 132.6 | 1.17 | 4.6 |
| Culture zone | 104.4 | 0.92 | 3.6 |
| Small and medium industry zone | 65.5 | 0.58 | 2.3 |
| Public green space | 17.6 | 0.16 | 0.6 |
| Sports and recreation zone | 9.1 | 0.08 | 0.3 |
| Agriculture zone | 8,557.5 | 75.40 | - |
| Total | 11,349.6 | | |

[10] Lamberts, D. 2001. *Tonle Sap fisheries: a case study on floodplain gillnet fisheries in Siem Reap, Cambodia*. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2001/11, 133 p. ftp://ftp.fao.org/docrep/fao/004/ab561e/ab561e.pdf

**Figure 21. Land zones in Battambang**




Source: Technical Report on the Land-Use Plan for Battambang Municipality (March 2009)

## 5. Location of Subproject Components

### a. WWTP

150. The proposed location for the new WWTP is approximately 4 km from the Sangke river in a rice field. The treated effluent will be discharged to a canal which will flows into the Steung Chas stream 2km downstream of WWTP. The stream is used for local domestic uses (e.g., drinking and washing). The main water source of the Steung Chas stream is the Sangke river and rain. The stream eventually flows into Tonle Sap Lake.

### b. Flood Control Structures

151. The flood control structures will be situated alongside the Sangke river in Battambang (Figure 10).

### c. MRF

152. The MRF Subproject site is located within a flat, 6 hectare lot adjacent to the existing Battambang dumpsite (Figure 12). The lot will be purchased by the Battambang District government for the development of a sanitary landfill.

## 6. Residential & Agricultural Areas

153. The residential zone and residential areas with agricultural zone together account for more than 1,800 ha or almost 16%. The residential areas are concentrated along arterial and main roads. The residential with agriculture areas are situated towards the outskirts of the city in the peri-urban areas. The mixed-use zones which include all urban, sub-urban and rural areas covers a total area of 584 ha accounting for 5% of the municipal land area. These zones exist along the national roads and main road networks surrounding the commercial center. The small and medium industry zones consist of a mix of small-scale enterprises for vehicle repair shops, construction companies, and small-scale factories.

154. The town center or core urban area of the municipal are several commercial establishments such as markets, shopping stalls, hotels and restaurants including financial facilities such as banks and money changers. As the educational and cultural center of the province, Battambang has several universities, colleges and vocational training centers, monuments, Buddhist temples and pagodas, a sports centre, museum and an exhibition hall to showcase the historical and cultural heritage of what was once the center of the Golden Era of Cambodia. The town center is also the seat of municipal government and comprises administration buildings, district offices of provincial and district level departments, court houses and other public offices.

155. Battambang has 24 informal settlements mainly scattered across the inner city. Some communities have been residing on public land (e.g. on canals, road corridors, pagodas grounds and along the railway) for many years. The settlements are characterized by insecure land tenure, inadequate and unhealthy living conditions and insufficient basic amenities such as water supply, electricity and safe sanitation.

## D. Neak Loeung Town

### 1. Biophysical Features

156. The topography around project area is about 8.5 meters above sea level on the west bank and approximately 8.8 meters above sea level on the east bank. The elevation of residential area reclaimed from natural flooding is approximately 6 to 7 meters. Many of the surrounding water bodies vary in extent with varying seasonal precipitation. The project site is located in floodplain areas between Mekong River and Stueng Slout. The land area of Neak Loeung is approximately 2,918 hectares.

### 2. Ecological Characteristics

157. The project area is mostly dominated by agricultural lands (paddy and orchard) and the rest is scattered as grassland and shrub land. There is no forest or flooded forest within the study area. However, a few bamboo have been naturally growing which is suitable habitat for water bird breeding.

158. The Eastern Mekong floodplain around Neak Loeung has several habitats for reptile species even though some lands are influenced by human activities such as the cultivation of rice and other vegetables. However, no rare or endangered species are now recorded as being present in the Project area.

159. The fish species recorded from the Project area during the wet season have a wide distribution and are not rare or endangered.

### 3. Location of Subproject Component

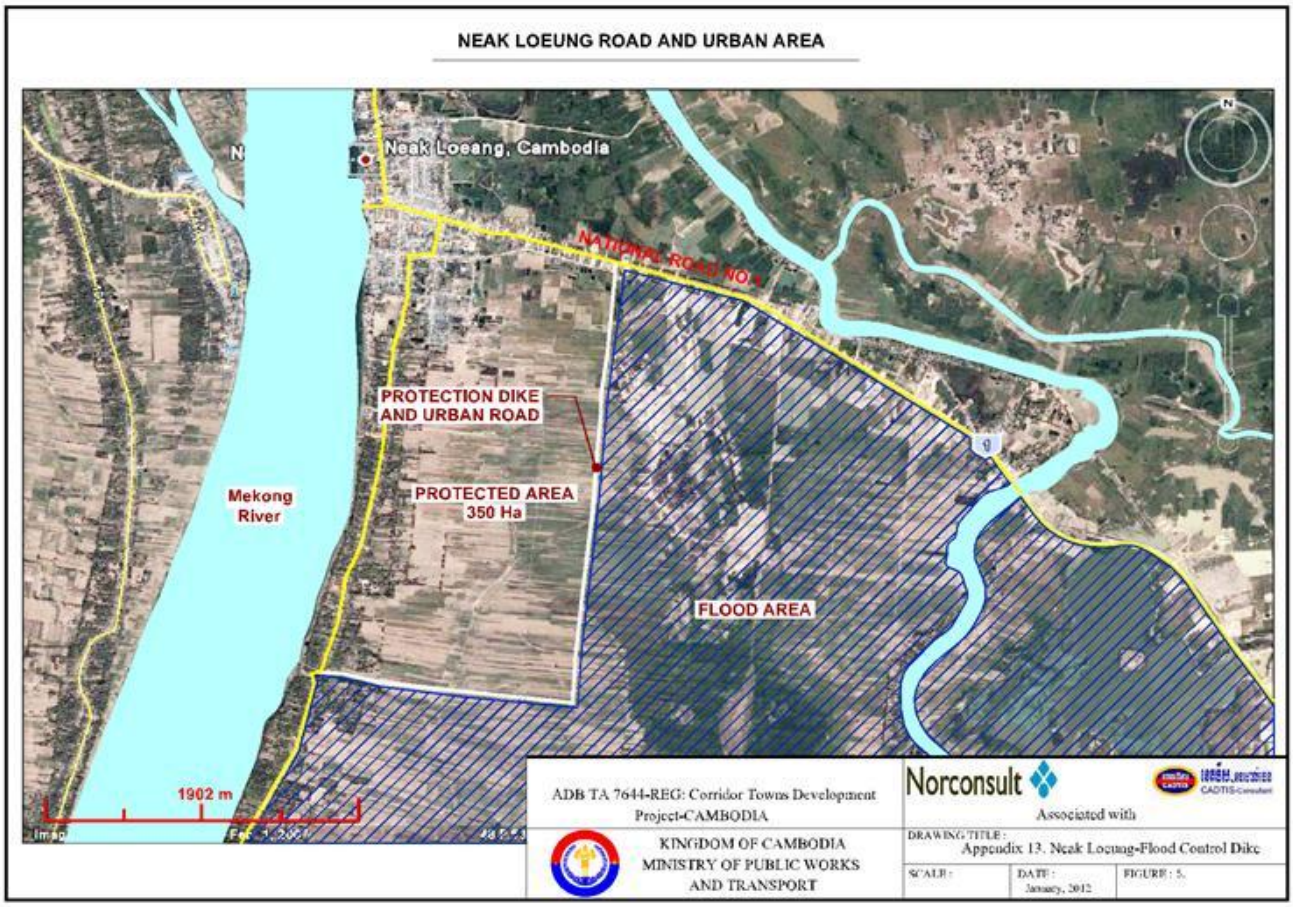
160. Most of the project site becomes flooded during the wet season. The flooding is caused by the river Preak Banam that flows to the east of the project site. There is a small stream south of the project area, namely Preaek Ta Sa Stream. During rainy season, water from Mekong flows into the sub-project area via Preaek Ta Sa stream.

161. The sub-project site is mostly flat but there is a hill inside the sub-project area (Neak Loeung Pagoda) along Mekong River. Soil has a high content of silt and clay with organic content and yellow/brown colour. Soil is very suitable for rice farming and vegetation. Some clay quarries for brick construction are located east of the sub-project area.

162. Because of old villages, there is existing infrastructure such as village roads, wood bridges, local market, school, and paddy fields around villages (Neak Loeung and Preaek Ta Sa villages).

163. Ecological resources are limited in the project area due to previous exploitation. Local communities have recently converted shrub forest land into agricultural land.

**Figure 22. Preliminary location of dike & access road in Neak Loeung**




Area now expanded to 363 ha

164. According to local authorities, paddy turtles or endangered turtle species were previously found in and around the project site before the area was turned into an agricultural area. Natural flooding has facilitated in breeding and feeding of some fish species in the project site. Thus, local villagers have carried out household fishing for their daily livelihoods.

165. There are some water birds in the project area such as parrot, pigeon, grey heron, little egret, lesser whistling duck, and mynah. Scattered bamboos are found inside the project area, making a suitable habitat for water birds. The map of important bird areas[11] (IBAs) has been reviewed and no vulnerable areas have been identified directly at the project site though there is one in the proximity.

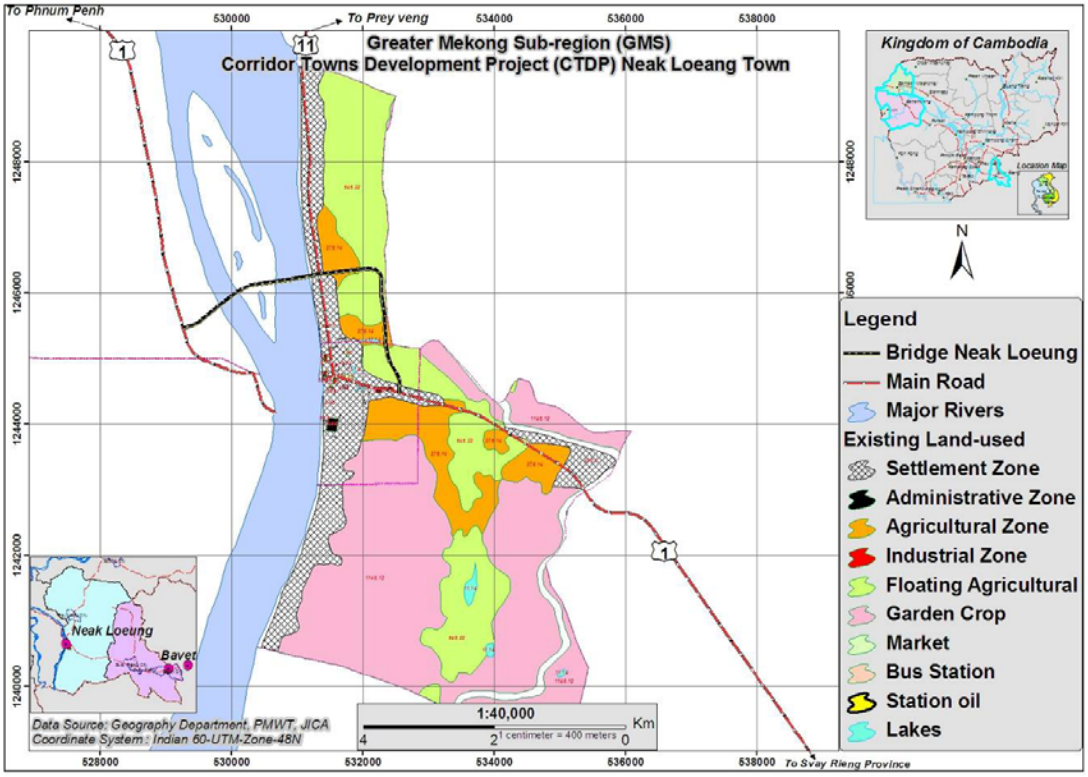
[11] http://birdlifeindochina.org/datazone/14

## 4. Land Use

166. According to the District Data Book, the total area of Peam Ro district is 30,390 ha. Approximately half the land is cultivated. The total forest area is 800 ha, which is less than 3% of the total land area.

167. Neak Loeung has prepared the land use (Table 14) and zoning map (Figure 23) indicating the residential, residential, commercial, industrial, administration, social facilities, public utilities, services, agricultural and common properties zones.

**Figure 23. Land zones in Neak Loeung**




**Source: Ministry Of Land Management Urban Planning and Construction, 2010**

**Table 9. Land use in Neak Loeung**

| | Land area (ha) |
|---|---|
| Total Land Area | 30,390 |
| Total Forest Area<br>Flooded Forest Area | 798<br>798 |
| Cultivated land | 14300 |
| Construction land | 2846 |
| Other land area | 2446 |

## E. Poipet Town

### 1. Biophysical Features

168. The topography around Poipet is characterized by extensive lowlands, with only a few higher areas to the north and east, ranging between 30 and 80 meters above sea level. The highest point is a hill formation right north of town and the stream south of town is finding its way along the lowest elevations. The main river is the Mongkol Borei River.

169. The immediate surroundings of Poipet are dominated by agriculture, forest and grassland. The natural ecosystem type inherent to the surroundings of Poipet is characterized as deciduous dipterocarp forest, which is tree vegetation typically with an open canopy combined with a grassy ground layer. However, as seen on the map below which illustrates the forest cover across Cambodia in 2006, not much forest is left around Poipet. Given extensive deforestation and expansion of agricultural activities, there is no forest vegetation in the subproject areas.

### 2. Wildlife Resources

170. The Poipet Project Working Group states that rabbit, deer, and wild pig are present in the open areas but no rare or endangered species are recorded from recent times. A small number of bird species are identified, including the white heron, dove, wood-sparrow and house sparrow. There are no areas under protection or conservation around the proposed Project area. Some trees of economic value (e.g. banana, papaya, mango and coconut) are found.

171. The map of important bird areas[12] (IBA) has been reviewed and no vulnerable areas have been identified within close proximity to the project sites.

### 3. Aquatic Ecology

172. In the Poipet, the main drainage feature is the stream, which flows along the border with Thailand. Some fish species ( catfish, hermibagrus (Chhlang), mystus rhegma (Kagnchos), micronema cheveyi (Kampliev), and Chhlogn) are present in the stream and in the rice fields during flooding. The few families who engage in fishing are active during the rainy season by the stream and in flooded areas. No rare or endangered species of aquatic flora or fauna are recorded from the Project area.

[12] http://birdlifeindochina.org/datazone/14

## 4. Land Use and Zoning

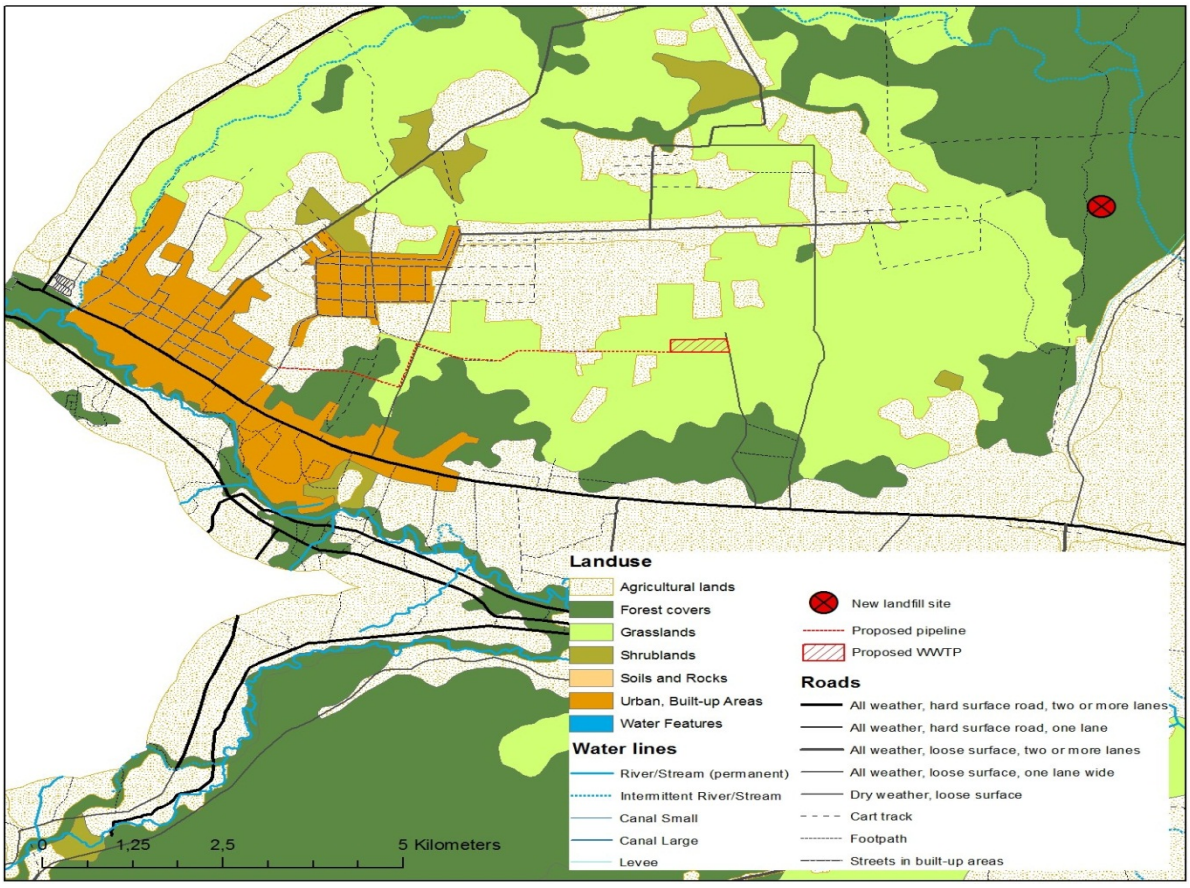
173. The municipality of Poipet has prepared a land use (Table 15) and zoning plan (Figure 24) with the assistance of the MLMUPC. The plan delineates the land use categories into zones for industrial, commercial, residential, social, open space and infrastructure purposes.

**Table 10. Existing land use in Poipet**

| Land use by type | Area (ha) | % |
|---|---|---|
| Agricultural | 18,314 | 67.1 |
| Residential | 4,570 | 16.7 |
| Infrastructure | 1,748 | 6.4 |
| Social facilities | 360 | 1.3 |
| Recreational/open space | 841 | 3.1 |
| Industrial/commercial | 1445 | 5.3 |
| Unused | 23 | 0.1 |
| Total | 27,301 | 100.0 |

Source: Poipet Land Use and Master Plan (2011)

**Figure 24. Land use in Poipet**



174. The existing land use as described in the master plan. The largest proportion of land (two-thirds of the total area) is dedicated to agriculture, followed by the area designated for residential development (17%).

175. The town of Poipet has its share of informal and ad hoc settlements on the urban fringe where slum dwellers and squatters have located. Based on 2008 Census there were 1,302 households (6%) residing on public land with limited access to public utilities.

## 5. Services and Infrastructure

176. The wastewater system in Poipet is made up of open canals (10 km) which were constructed through the cost and in-kind contributions from local residents and approximately 38.6 km of pipe/culvert also provided through contributions from residents. As noted in Section 3.1, the town generates about 3,000 m3 of wastewater daily.

177. Local authorities have included the improvement of the wastewater system and the installation of a WWTP as a high priority urban infrastructure to address the needs and requirements of the expanding urban center in Poipet. An area of 16 ha in the eastern part of the town center has been designated for the construction of a retention pond and a wastewater treatment facility. The District Department (DDPWT) is providing technical assistance in the preparation of the master plan and design layout of the proposed wastewater system improvement and the installation of the WWTP.

178. In the town center households generally have pour-flush, pit or basic single vault latrines. In the case of hotels, casinos and other larger buildings, there is a national standard for septic tank design requiring connection to the main drainage/sewerage system. Household waste and those from the commercial centers are also discharged through collection and haulage to the north eastern part of the town.

179. The collection and haulage of solid waste in Poipet has been managed and operated by a private contractor - Poipet Cleaners - since 2008. This arrangement is covered by a contract of services with municipality and the province Banteay Meanchey. Under the contract, Poipet Cleaners undertake two main services; (i) waste collection from households, shops, guesthouses, hotels and restaurants; (ii) waste sweeping and haulage along main roads and commercial areas; and; (iii) operation of exiting dumpsite. The private contractor has 50 staff personnel where 24 of them are employed as waste collectors while 14 are engaged for sweeping the public areas. The contractor has a total of six waste collection trucks operating in the town.

180. With the increasing urban population and expanding urban area, solid waste collection coverage has become limited to about 16%-20% with the total waste generation in the Poipet being approximately 43 tons/day and the volume collected being about 10 tons/day. The waste is transported and disposed into the existing open dump site which is located approximately 7 kilometers from the town centre. The size of the open dump is about 5 hectares but only 10 percent of the area is being used for dumping waste. Burning of solid waste is a common practice at the dumpsite.

### 6. Location Subproject Components

#### a. WWTP

181. The proposed location of WWTP is approximately 6 km from the municipal center of Poipet (Figure 14). The treated effluent will be discharged into an Ou Chrav Stream (Kai Don). This stream is also utilized by local people for drinking, washing and vegetation activities.

#### b. Sanitary Landfill

182. The proposed site (Figure 17) is slightly elevated and therefore not subject to flooding. The proposed site is not near any surface waters. The depth of the water table and location of aquifers need to be verified. All of the required waste management facilities will be developed and accommodated within the site.

#### c. MRF

183. The MRF site is located within a flat, 10-hectare lot allocated to the sanitary landfill (Figure 19). The construction of a 400-meter long access road will be undertaken during the construction of the sanitary landfill.

## VI. PUBLIC CONSULTATION

184. A stakeholder communication strategy was prepared for the CTDP. The strategy is based on the principles of meaningful engagement, transparency, participation, and inclusiveness to ensure that vulnerable and/or marginalized groups such as women, the poor, and unemployed, have been given equal opportunities to participate in the design of the project. The strategy also provides the means and opportunities for stakeholders to continue to be engaged during project implementation.

185. Consultation of affected stakeholders of the four subproject towns was conducted with the following formats: 1) discussions with government officials and private sector representatives; and 2) interviews with village leaders, focus discussion groups & household interviews/surveys.

### A. Identification of Stakeholders

186. Stakeholders were identified in a participatory and flexible manner. Stakeholder communication to date has focused on institutional stakeholders, communities within the town areas, and persons directly affected by proposed project interventions. The stakeholders of the design and successful implementation of the CTDP include:

- Institutional stakeholders including the (i) EAs and IAs and other relevant government agencies responsible for the design, management and implementation of the Project; (ii) state institutions which share an interest in the Project; Private sector institutions, particularly Chambers of Commerce and potential participants in private public partnership (PPP) subprojects and those who share an interest in the outcomes of the Project;

- Non-governmental organizations (NGOs) and community-based organizations (CBOs) which have provided information that has been incorporated into the design of the various Project interventions, and which might participate in implementation of measures and interventions;

- Communities living along the corridors who will benefit from the project, and who have an interest in identifying measures to enhance or maximize the benefits, communities within the subproject areas who may be directly and/or adversely affected, and who have an interest in the identification and implementation of measures to avoid or minimize negative impacts;

- As a sub-group of the above, vulnerable and/or marginalized groups who have an interest in the identification and implementation of measures that support and promote their involvement and participation in the project; and

- Other institutions or individuals with a vested interest in the outcomes and/or impacts of the project.

## B. Summary of Public Consultation and Project Response

187. The results of the public consultations conducted as part of the IEE showed an overwhelming positive support for the CTDP at all four subproject towns. Tables 16 - 19 summarize the comments from different stakeholders of the 5 main infrastructure developments. The negative response to the different infrastructure developments are bolded italics in the Tables.

## Table 11. Summary of stakeholder views of road development in Bavet

| Stakeholder | Views of Subproject Component |
|---|---|
| Road users, members of households in catchment of National Road #1 | Improved access to markets, key social services (health and education services) and urban employment opportunities;<br>Reduced local flooding from improved drainage (household and public health);<br>Small household retail businesses will become more profitable as traffic volumes and local incomes rise;<br>Potentially increased incentives to produce higher value agricultural products as transport to markets improve;<br>Increased incomes from produce and cash crop marketing will allow families to invest in better housing and healthcare which will improve wellbeing and living standards;<br>Increased access to vocational education, training and employment opportunities among youth;<br>***Concerns regarding safety and accidents need to be addressed*** |
| Transport operators | Increased business opportunities to carry passengers and goods;<br>New services/routes can open up;<br>School and tourist bus and taxi services will improve;<br>***Need for awareness raising with drivers in respect of speed and safe driving*** |
| Street vendors and markets along the roads | ***Temporary impacts during construction will need to be addressed;***<br>Improved access and increased traffic and passenger flow can increase volume of sales;<br>Access and mobility improved (convenience, comfort and ease of travel) |
| Health and Education personnel | Services in schools and the health centre disrupted during rainy season flooding can resume without interruption;<br>There will be easier access to the clinics for mobile health teams from District hospital and for patients travelling to town clinics/ District hospital;<br>***Need to work with Police and transport operators to ensure road safety (reduced road accidents and injury)*** |
| Police/traffic police | Improved security (including street lighting) deterrent for petty and local criminals;<br>Civil defence capability of local area improved;<br>***Need to enforce existing road rules;***<br>***Involved in delivery of road safety campaign*** |
| Businesses, agricultural product processors and exporters | Assuming other constraints to the sector/industry are overcome, production in the area will increase, diversify and modernize as it becomes easier to get products to market;<br>Improved access will encourage further investors in the special economic zones |
| Municipality | As major stakeholder in infrastructure and service provision;<br>Potential to levy higher fees/taxes with improved services;<br>Can encourage additional investors to area as services expanded to cover wider area |
| Merchants | Improved access and increased traffic and passenger flow can increase volume of sales to small businesses and households |

**Negative responses to subproject component highlighted in bold**

**Table 12. Summary stakeholder views of WWTPs in Bavet, Battambang, and Poipet**

| Stakeholder | Views of Subproject Component |
|---|---|
| Households in beneficiary area | Improved and regular wastewater collection and treatment reduces localized pollution;<br>Improved public health status and living conditions in immediate area (adjacent to existing open channels and sewers);<br>Improved environment and reduced nuisance (smell and flies) for households;<br>Potential increase in land values as result of foregoing;<br>Opportunities to participate in environmental health and hygiene awareness raising campaign |
| Private investors and business operators | Induced business opportunities from incremental improvements in urban environment and improved services and infrastructure;<br>Do not have to install individual WWTPs or sewerage connections |
| Municipality | As major stakeholder in infrastructure and service provision;<br>Potential to levy higher fees/taxes with improved services;<br>Can encourage additional investors to area as services expanded to cover wider area |
| Wider community | Improved public health status and living conditions (reduced flooding, reduced nuisance - smell and flies);<br>Opportunities to participate in environmental health and hygiene awareness raising campaign |

**Table 13. Summary of stakeholder views of sanitary landfill in Poipet**

| Stakeholder | Views of Subproject Component |
|---|---|
| Households in beneficiary area | Improved and regular waste collection and management reduces localized pollution from informal and illegal rubbish dumping;<br>Improved public health status and living conditions in immediate area;<br>Improved environment and reduced nuisance (smell and flies) for households currently adjacent to, close proximity of, existing dump-site;<br>Opportunities to earn additional income from 'recyclables';<br>Opportunities to participate in recycling, environmental health and hygiene awareness raising campaign |
| Private contractors | Increased business opportunities in offering regular and reliable waste collection services |
| People trading in waste products;<br>Waste pickers | MRF can formalize recycling and trade in waste;<br>Provides opportunity for income generation through sale of waste collected from town or sorted at landfill;<br>Opportunities to participate in recycling, environmental health and hygiene awareness raising campaign |
| Wider community | Improved public health status and living conditions (reduced nuisance - smell and flies);<br>Opportunities to earn additional income from 'recyclables';<br>Opportunities to participate in recycling, environmental health and hygiene awareness raising campaign |

**Table 14. Summary stakeholder views flood protection in Neak Loeung**

| Stakeholder | Views of Subproject Component |
|---|---|
| flood control users, members of households within the 363 hectare protected area | Improved access to markets, key social services (health and education services) and urban employment opportunities;<br>Reduced local flooding from improved flood control and Watergate and drainage (household and public health);<br>Small household retail businesses will become more profitable as traffic volumes and local incomes rise;<br>Potentially increased incentives to produce higher value agricultural products as transport to markets improve;<br>Increased incomes from produce and cash crop marketing will allow families to invest in better housing and healthcare which will improve wellbeing and living standards;<br>Increased access to vocational education, training and employment opportunities among youth;<br>***Concerns regarding safety and accidents need to be addressed*** |
| Transport operators | Increased business opportunities to change agriculture production and goods;<br>New services/routes can open up;<br>***Need for awareness raising with drivers in respect of speed and safe driving*** |
| street vendors, and markets along the roads | ***Temporary impacts during construction will need to be addressed;***<br>Improved access and increased traffic and passenger flow can increase volume of sales;<br>Access and mobility improved (convenience, comfort and ease of travel) |
| Health and Education personnel | Services in schools and the health centre disrupted during rainy season flooding can resume without interruption;<br>There will be easier access to the clinics for mobile health teams from District hospital and for patients travelling to town clinics/ District hospital; province and overseas.<br>***Need to work with Police and transport operators to ensure flood road safety (reduced road accidents and injury)*** |
| Police/traffic police | Improved security (including street lighting) deterrent for petty and local criminals;<br>Civil defence capability of local area improved;<br>Involved in delivery of flood safety campaign |
| Businesses, agricultural product processors and exporters | Assuming other constraints to the sectors are overcome, production in the area will increase, diversify and modernize as it becomes easier to get agriculture products to market; |
| Municipality/ District | As major stakeholder in infrastructure and service provision;<br>Potential to levy higher fees/taxes with improved services;<br>Can encourage additional investors to area as services expanded to cover wider area |
| Farmer | Improved access and increased passenger flow can increase volume of sales to small businesses and households |

**Negative responses to subproject component highlighted in bold**

## 1. Project Response

188. Tables 16-19 indicate that negative stakeholder views of the subprojects are limited to concerns of traffic safety during construction and operation phases of the new urban road in Bavet, traffic safety issues and general disturbances during construction phase in Neak Loeung, and general issues of disturbance during construction of both subprojects. These issues will be addressed by specific mitigation sub-plans of the EMPs for the subprojects.

# VII. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

189. The assessment of potential impacts of the CTDP is structured by the five primary types of infrastructure developments at the four subproject towns which are defined by:

a) WWTPs & facilities;
b) urban road & drainage;
c) flood control structures & dikes;
d) sanitary landfill; and
e) MRFs.

190. The assessment was stratified by infrastructure type and not by subproject town because the potential impacts of the different infrastructure types are generally similar, and town-specific impacts of common infrastructures can be highlighted with minimal repetition of the assessment.

## A. Subproject Benefits

### 1. Wastewater Treatment

191. The construction new wastewater treatment plants in Bavet, Battambang, and Poipet will stop the current diffuse discharge of untreated sewage into surface waters, canals, and on land. By collecting and treating the discharges the treatment plants will reduce the widespread environmental contamination and reduce health risks of the urban population. The broadly discharged raw domestic and industrial waste will be given primary treatment with more localized and controlled discharge of the treated effluent. The separation of sewage from stormwater will improve the quality of the aquatic and terrestrial environments. Living conditions of the majority of the local populations will be improved while the towns become more clean and attractive. The benefits of wastewater treatment in the eyes of the community are summarized in Table 17.

### 2. Urban Road Upgrade & Drainage

192. The widening with central median, and overall upgrade of the section of national road #1 main through Bavet will greatly ease traffic congestion, and support the increasing volume of transport and container truck traffic along the SEC. The upgrades which include a lighted, treed median, proper shoulders, signage, and speed limits will also greatly increase safety of local vehicle and pedestrian traffic. The improvements to national road #1 are needed to support development along the SEC.

### 3. Flood Control

193. The construction of the flood control structures and dike-roadways in Battambang and Neak Loeung will significantly improve the quality of life in the town by expanding the area that is not flood prone during the rainy season. The expanded urban core that will be created will have direct positive socioeconomic benefits for the town, and to development along the SEC. The flood protection dikes will minimize physical damages to the households, and reduce exposure of women and children to water borne illness from the over-flow of open drainage canals and leaking of sewerage pipes which often carry storm water run-offs and wastewater.

### 4. Sanitary Landfill & Support Facilities

194. The sanitary landfill in Poipet will provide the much needed facility to organize the collection, transport, and disposal of domestic, hazardous, industrial, and agricultural waste which currently poses a danger to the local environment. The landfill and associated MRF will make solid waste collection and management more efficient, safe and environmental friendly. The current use of local contractors will for solid waste collection and disposal will be enhanced through the development and promulgation of solid waste management procedures. The sanitary landfill and associated facilities will act to assist with the implementation of the sub-decree on Solid Waste Management (April 1999). The sub-decree provides technical standards for all activities related to disposal, storage, collection, transportation, recycling, dumping of municipal and hazardous waste.

### 5. Materials Recovery Facilities

195. The MRFs planned for Bavet, Battambang, and Poipet will organize and make safer and more efficient the current practice of solid waste recycling that is occurring in the three towns. Currently the sidewalks and vacant lots of the urban areas are littered with waste and uncollected waste bags which reflect the inadequacy of the current ad hoc systems. The practice of the 3 Rs namely reduction, recycle and reuse will be enhanced. Although recovery of recyclables is already done at source in the towns, unsanitary picking of mixed waste continue to take place at the existing open dumps. The MRFs together with necessary local declarations on waste segregation at source and by collection will provide sanitary facilities for the recovery of the recyclables.

## B. Subproject Impacts and Mitigations

196. The assessment of potential negative impacts of the five primary infrastructure developments is structured chronologically according to subproject implementation starting with the pre-construction preparation phase, followed by the construction phase, and ending with the post-construction operation phase of the commissioned infrastructure developments. This assessment structure is carried forward and shapes the four environmental management plans for each of the four subprojects.

### 1. Pre-construction Phase

197. Negative impacts associated with the pre-construction phases of the five primary types infrastructure developments concern land acquisition and resettlement. At the feasibility design stage the need for local resettlement is expected for the development of the flood control dikes in Neak Loeung & Battambang, and the WWTP developments in Poipet & Battambang. These impacts and management actions are addressed in the Resettlement Action Plan (RAP) for the subprojects under separate cover.

198. Key impact mitigation measures of the pre-construction phase are:

1) initiation of the RAP for the CTDP;
2) completion of detailed designs of the four town subprojects; and
3) updating and initiation the four EMPs.

The EMPs will need to be reviewed and updated where necessary during pre-construction phase to address the detailed designs of the subproject components to ensure that additional or changes to impacts identified in IEE are addressed by the EMPs.

199. Updating the EMPs involves finalization of sub-plans to manage potential impact nodes such erosion, sedimentation of surface waters, noise, dust and air quality, spoil disposal, traffic, and worker and public safety at the project sites. Details of the mitigations of the pre-construction phase are detailed in the EMPs (see section X).

### 2. Construction Phase

#### a. Common potential impacts of infrastructure developments

200. The potential environmental impacts of the CTDP are dominated by the construction phase of the individual subprojects. Common impacts of construction will arise from civil construction works which will consist of for example, reduced and/or blocked public access, disrupted business and recreation, noise, dust and air pollution from NOx, SOx, & CO caused by increased truck traffic and heavy equipment use, soil and surface water pollution caused by equipment operation and maintenance, public and worker accidents, increased traffic accidents, land erosion and surface water sedimentation, drainage and flooding problems, solid waste and domestic pollution from worker camps, social disease and community problems caused by migrant workers. These short-term impacts will occur at different levels of magnitude depending on the activity at all construction areas of the infrastructure developments of the four subprojects.

##### i. Common mitigation measures

201. Management measures to mitigate potential common impacts associated with the construction phase of the infrastructure developments are exemplified below. The mitigation measures are detailed further in the EMPs.

1) Care must be taken to ensure that sites for earthworks (e.g., excavations, trenches) that are suspected to have unexploded ordnance should be surveyed by the GoC prior to construction. If such ordnance is detected clearing work will need to be commissioned prior to undertaking civil works.
2) Open excavations should be fenced, and trenches covered where public walkways or vehicles must cross.
3) A chance find management plan must be in place for cultural artifacts and property.
4) Regular use of wetting agents should be employed at construction sites to minimize dust.
5) All construction vehicles and equipment should be maintained in proper working order, and not operated at night if possible to minimize noise.
6) Speed limits should be posted and adhered to by construction vehicles.
7) Where possible construction vehicles should use different roads or dedicated lanes of roads shared by the public.
8) Trees and other vegetation at all construction sites and along road corridors should be protected.

9) Present and past land use should be reviewed to assess whether excavated soils are contaminated spoil. Contaminated spoil should be disposed at a landfill or a location approved by MoE.

10) Berms and/or silt curtains should be constructed around all excavation/trench sites and along all surface waters to prevent soil erosion and surface water sedimentation.

11) Local workers should be used as much as possible to prevent or minimize influx of migrant workers, and incidence of social disease and community unrest.

12) Worker camps must have adequate domestic waste collection facilities and sufficient pit latrines that are located away from public areas and surface waters.

13) Dedicated fuel storage areas must be established away from public areas and marked clearly.

14) To minimize the impact of construction on the public, and workers the World Bank Environment, Health, and Safety Guidelines (2007) that govern the safe and orderly operation of civil works should be followed.

15) Aggregates (e.g., sand, gravel, rock) that are transported by truck should be covered.

16) Prolonged use of temporary storage piles of file should be avoided, or covered, or wetted regularly to prevent dust and erosion.

17) Sand extraction in rivers for road embankment fill should be done at licensed areas only.

18) Storage of bulk fuel should be on covered concrete pads away from the public and worker camp. Fuel storage areas and tanks must be clearly marked, protected and lighted. Contractors should be required to have an emergency plan to handle fuel and oil spillage.

### b. Infrastructure-specific Construction Impacts & Mitigations

202. Potential construction impacts specific to an infrastructure type in a subproject town are identified below. The potential impacts elaborate important common impacts identified above.

#### i. WWTPs & pipelines

Traffic disruption

203. The construction of sewer lines on either side of the main roads in Battambang and Poipet could disrupt traffic and increase risk of traffic accidents on road. Care should be taken to ensure heavy excavation equipment does not block traffic flow, and special slow speed limits be assigned to all construction vehicles.

Penetration of water table

204. The excavation of the treatment ponds for the WWTPs could penetrate or become too close to the water table. A review of the depth of the water tables, soil permeability, and subsurface flow of local aquifers must be conducted during the pre-construction phase. This study should be coordinated with the same study required for the sanitary landfill in Poipet (see below). The detailed designs of the WWTPs need to confirm whether local groundwater and surface waters are vulnerable to possible leakage from treatment lagoons, and whether lagoons need clay or concrete linings.

### ii. Flood control

Surface water quality

205. The construction of planned embankments next to the Sangke river in Battambang will easily cause extensive siltation to the river which would degrade water quality and local uses of the river. Aquatic biota of the river would also be negatively affected. Construction waste can also end up in the river. Extra care should be taken to construct adequate berms, or placement of silt curtains well above and below actual construction sites to protect the river.

206. Construction of the embankments should occur during the dry season thereby maximizing the distance between the river and construction area. Well declared rules for not disposing construction waste should be enforced by contractors.

207. Similarly, construction of the dike-roads in Neak Loeung should occur during the dry season to siltation of the outside flood area, and also to ensure that the presence of aquatic biota in the flood prone area to be claimed for urban development will be minimal.

### iii. Sanitation landfill

Groundwater and surface water

208. Similar to the treatment lagoons of the WWTPs the excavations for the landfill site could penetrate or become too close to the local water table. The hydrogeology in the area of the proposed landfill site has not been adequately documented. Table 21 indicates that the underlying soils are impermeable, and together with an undefined impervious landfill liner that groundwater will be protected. However, understanding of the hydrogeology of the site needs to be improved in parallel with the completion of the detailed designs of the landfill.

209. The proposed landfill site reportedly is not near surface waters. However, as part of the review of sensitivity of groundwater, a review of the sensitivity of local surface waters downstream of the proposed site to runoff from the landfill during rainy season conditions should be conducted.

### iv. All infrastructure components

Terrestrial & Aquatic Resources, and Cultural Property & Values

210. There are no reported rare or endangered animals and plants in the affected subproject areas, or cultural property and values that will be affected by the infrastructure developments. However, because the final locations of facilities & components of the infrastructure developments will only be determined at the detailed design phase of the subprojects, the potential exists for valued ecological and cultural resources to be negatively affected.

211. Thus, as part of the detailed design stage when siting is finalized, and when the EMPs are updated, a review of the proximity and sensitivity of all valued eco-cultural resources of the subproject areas (e.g., Tapov Stream, Bavet, southern reaches of Tone Sap ecosystem in Battambang, and the flood plain to be claimed in Neak Loeung) in relation to finalized infrastructure developments should be undertaken.

### 3. Operation Phase

#### a. WWTP & Pipelines

Contamination of environment & community impact

212. The waste treatment plants in the three subproject towns will collect and treat the presently diffusely discharged raw wastewater, and then discharge the treated effluent to single point(s) in the receiving environment.

213. The proposed receiving environments for the treated effluents from the WWTPs consist of the: **a)** *Ta Pov stream* in Bavet which is used for irrigation, and is a tributary of downstream surface waters; **b)** a canal that flows into the *Steung Chas stream* in Battambang which is used for domestic purposes (e.g., washing drinking water) which ultimately empties into Tonle Sap; and **c)** and the *Ou Chrav Stream* in Poipet which is also used for domestic washing and drinking water.

214. Thus, the obvious risk is contamination of current human and ecological uses of the proposed receiving environments for the WWTP effluents. This could occur if the effluent is not treated to specification, or the receiving environment cannot assimilate (i.e., dilution & bioaccumulation) the effluent thereby creating a pollution problem. Therefore, existing uses and sensitivity of the proposed receiving environments for the effluent and waste sludge of the WWTPs need to be reviewed during the detailed design phase.

Negative Aesthetics & Community Safety

215. The other potential risk is the operation of the WWTP and pipelines will negatively affect local communities. Potential environmental impacts of the operation of the WWTPs and pipeline networks are summarized below.

1. Change to the community landscape of the nearby homesteads due to noise, odour, and overall negative aesthetics of the WWTP;

2. Increased traffic in area, and traffic accidents caused by staff and plant operations;

3. Increased air pollution and noise from increased vehicle traffic;

4. Contamination of shallow groundwater from treatment lagoons;

5. Pollution of land, local surface waters, or groundwater from discharged treated effluent that does not meet effluent quality design standards;

6. Contamination of domestic uses of the receiving environments;

7. Contamination of land and groundwater from discharged treatment process sludge;

8. Contamination of land surface water, or groundwater from spills or uncontrolled discharge of untreated and treated wastewater due to pipeline or equipment failure;

9. Increased incidence of vector carried disease arising from standing water; and

10. Increased injury people in nearby community from exposure to WWTP or pipeline operations.

### i. Mitigations

216. Most of the required mitigations for the potential impacts listed above will be addressed directly by the detailed engineering design specifications for the siting, operation, and management of the WWTP and pipelines.

217. However, at the time of writing the detailed designs of the WWTPs and pipelines were not completed. In particular, not finalized are:

1) specifications for the treated effluent quality other than the declaration that effluents will meet GoC industrial discharge standards (see Appendix A);
2) final locations of the effluent discharge sites; and
3) design & operation specifications for treatment lagoons and management of waste sludge to ensure soil, groundwater and surface waters are not negatively affected.

218. Clarification of depth and sensitivity of local water tables and aquifers to treatment lagoons and sludge management is required. The detailed engineering designs of the WWTPs needed to be completed to be able to specify the engineering process-mitigations to manage the impacts above identified.

219. Furthermore, the basic water quality of the final receiving environments, and ultimate surface waters that will receive treated effluent from the WWTPs directly or via wastewater canals needs to be determined. The update to the environmental baseline will be done during the pre-construction phase along with the updates to the EMPs.

220. The composite impact mitigation for the wastewater treatment systems consists of:

a) sustained safe collection and transport wastewater to the WWTPs;
b) consistent treatment of wastewater to effluent quality design specifications;
c) the ability of the receiving environments to assimilate the treated effluent at all times of year;
d) the ability of the WWTP to manage and dispose safely treatment byproducts such as sludge; and
e) the ability of the WWTP to not intrude into normal community life through negative aesthetics.

221. Specific mitigations for the potential impacts of the operation of the WWTP and pipeline networks are provided below. The mitigations are detailed in the EMPs.

1. A five metre treed perimeter berm built around each WWTP facility including the treatment lagoons to isolate the WWTP facility from the nearby community to reduce noise odour and overall negative aesthetics of the WWTP;

2. Enforced well marked speed limits will be posted on roads used by WWTP staff, with WWTP vehicles kept in good working order;

3. A carefully designed system of treatment lagoons that does not contaminate groundwater and land;

4. A regular effluent and sludge quality testing protocol;

5. All equipment and processes maintained in good working order with back-up equipment and processes in place in critical areas;

6. Engineering and management systems in place to prevent and address emergency spill and discharge situations;

7. All staff properly trained with regular refresher courses;

8. Adequate domestic waste management procedures; and

9. All standing water and wastewater covered as much as possible;

### b. Urban road and dike roads (flood control)

Increased traffic accidents

222. Speed limits should be clearly posted and enforced. Roads should be well lighted at night. Signage for road conditions should be well placed.

Increased air pollution

223. As much as possible all vehicles must be kept in good working order, and inspected regularly by authorities.

### c. Sanitation landfill

Contamination of groundwater, surface waters, and land

224. Similar to WWTPs the landfill and leachate treatment facility could contaminate groundwater and possibly downstream surface waters depending on natural surface drainage and subsurface flow. The sensitivity of groundwater and surface waters downstream of the final landfill and leachate treatment facility site during the rainy and dry season conditions need to be reviewed.

225. The detailed designs of the landfill need to be completed in view of potential impacts on groundwater, and surface waters & land with specific focus on the required liner, the surface drainage diversion channels around the landfill, leachate collection & treatment specifications, treated leachate disposal, management of truck traffic in/out of landfill, and expected lifespan of the landfill. A groundwater quality monitoring program is required (see EMP).

Negative Aesthetics & Community Health

A landfill can create conditions for odour, disease vector habitat, vermin, and risk of injury to local community from unrestricted access to landfill site. Mitigations for the potential impacts of the operation of a landfill on the community are included in standard international operations guidelines (e.g., O&M) for landfills. Example key mitigations for potential community impacts are as follows:

1. Locate landfill far away from residential and urban areas;
2. Install a tall perimeter fence that ideally is also treed around entire landfill property;
3. Install sufficient signage along perimeter warning the public to stay away from landfill;

4. Post a fulltime guard at landfill who monitors the perimeter by vehicle;
5. Grade and cover solid waste with appropriate thickness of soil/aggregate to minimize exposure of waste to open air, disease vectors, and vermin;
5. All loaded solid waste trucks on route to landfill must be covered, and solid waste trucks should be rinsed and kept clean daily.

Traffic disruption and road accidents

226. Speed limits along road to landfill should be clearly posted and enforced. Roads should be well lighted at night. Signage for road conditions should be well placed.

Increased air pollution
227. As much as possible all vehicles and trucks that travel to and from the landfill must be kept in good working order, and inspected regularly by authorities.

### d. Materials recovery facilities

Traffic disruption and road accidents

228. Speed limits on road to MRF should be clearly posted and enforced. Roads should be well lighted at night. Signage for road conditions should be well placed.

Increased air pollution
229. As much as possible all vehicles and trucks that travel to and from MRFs must be kept in good working order, and inspected regularly by authorities.

## 4. Induced and Cumulative Impacts

230. Complementing the planned impact of the CTDP of socioeconomic development at each subproject town and along the SEC are the potential negative impacts of increased urban development which would occur at different spatial scales. An immediate potential impact of urban development is increased traffic-related accidents, and air pollution.

231. At the town level the new and upgraded infrastructure will create immigration to the towns. Potential induced impacts will be increased land development and pressure on existing infrastructure not developed by the CTDP. New zones for housing and commercial development could follow to support and be supported by the expanding populations of the towns.

232. Socioeconomic development from the CTDP could cause increased consumption of natural resources, and pollution along and adjacent to the SEC. Regional economic development commonly is linked to environmental degradation and natural resource consumption. Socioeconomic development of a region is normally manifest by population growth and the increase in living standards which lead directly to increased individual and family consumption leading directly and indirectly to increased natural resource consumption, and waste production, and environmental pollution.

## 5. Climate Change

233. As indicated in original IEEs, the designs of the infrastructure developments at feasibility stage are climate change resilient. For example Pacific regional climate models project an increase in extreme rainfall events as a result of climate change.

234. Consideration of climate change includes consideration of measures to reduce the contribution of the project to greenhouse gas production. Effort needs to be taken to reduce the carbon footprint of the project by ensuring for example that speed limits along the new roads are enforced, and that effort is taken to encourage residents and users of the new roads also ensure their vehicles are in good working condition. The lighting of the new road in Battambang and dike roads in Neak Loeung should use light bulbs that are energy efficient.

## VIII. ANALYSIS OF ALTERNATIVES

235. The analysis of alternatives to the subprojects focused primarily on subproject component locations. In the case of the Poipet subproject alternate techniques for solid waste management were assessed. Table 15 summarizes the assessment of alternatives for Bavet, Battambang, and Neak Loeung. The analysis of alternate ways to improve solid waste management in Poipet is summarized following Table 15.

**Table 15. Alternatives to subprojects in Bavet, Battambang, and Neak Loeung**

| Subproject | Infrastructure Component | Alternatives assessed, and selected alternative | Environmental or Social Significance |
|---|---|---|---|
| Bavet | Urban road | Option 1: 22.8m alignment – *selected*<br>Option 2: 25.6m alignment | Reduced resettlement |
| | Wastewater treatment | Two sites 100m part on same side of Ta Pov river – *selected site has land title* | None |
| | MRF | No alternatives identified | n/a |
| Battambang | Flood control | According to Development Masterplan | n/a |
| | Wastewater treatment | According to Development Masterplan | n/a |
| | MRF | According to Development Masterplan | n/a |
| Neak Loeung | Flood control | According to Development Masterplan, and elevations where flood dikes will be most effective | None |
| Poipet | Wastewater treatment | Option 1: Combined sewage & stormwater system<br>Option 2: Separate systems – *selected* | No exposure of environment to raw sewage during storm events |

### A. Solid Waste Management in Poipet

236. An analysis of methods to improve collection & disposal of solid waste was conducted with the following objective considerations:

- Select the least cost solutions compatible with what is considered appropriate technology under current economic and development conditions in Cambodia.

- Collect and dispose of solid waste through solutions creating a minimum of damage and inconvenience for humans and the environment, while at the same time causing a minimum of demand on natural resources.

- Plan all technical facilities at the same environmental standard; small treatment and disposal facilities with less stringent environmental and operating requirements should be discouraged.

- All solutions must take into consideration the particular local conditions.

- All existing national environmental standards should be applied.

237. The following treatment and disposal methods are internationally recognized as pertinent for municipal solid waste (MSW) and potentially being applicable in a Cambodia context:

- Incineration of most of the waste stream, or alternatively incinerate selected, high calorific waste categories.

- Composting of waste with high organic content.

- Centralized sorting of mixed MSW or selected waste streams.

- Sanitary landfilling with bio-gas collection and utilization.

238. It is an important condition that MSW treatment plants have a clear economy-of-scale. Typically, the unit treatment cost (USD/ton) for a large treatment facility may be less than a third of a small facility.

239. Sanitary landfilling is still the most common treatment and disposal method in most industrialized countries. Properly designed and operated landfills have limited environmental impacts. Table 18 summarizes common advantages and disadvantages of sanitary landfills.

**Table 16. Advantages & disadvantages of sanitary landfills**

| Advantages | Disadvantages |
|---|---|
| • very flexible with regard to change in quantities and characteristics of MSW<br>• Landfill gas (LFG) extraction and utilization may provide a profitable resource recovery method<br>• low requirements for skilled/specialized workers<br>• low costs, both in investments and annual costs<br>• very flexible in combination with RRR activities and other treatment methods | • potential major negative environmental impacts if improperly designed and/or operated<br>• difficult to completely eliminate all environmental or social impacts<br>• very low resource recovery if LFG utilization is not introduced<br>• occupies and limits the use of large areas<br>• with a limited and dense populated area sites may be difficult to find and establish<br>• a larger portion of the country is on limestone and soil aquifer, requiring extra precautions against groundwater contamination |

240. A sanitary landfill provides the possibility of extracting and utilizing the energy-rich landfill gas (LFG). Incineration is a widespread treatment method in many western countries. Normally it is combined with utilization of the generated energy, preferably with the utilization of both electricity and surplus heat. Also, worldwide, this method is becoming more and more recognized; although the experience to date in many countries outside the most industrialized is not very encouraging, mostly because of very wet MSW and lack of operational and financial capacities. The costs per treated ton are very high and the net income of sale of (only) electricity is low. In addition the required operational skills are high, and the method should not be appropriate for the current conditions in Cambodia.

241. In Cambodia with a relatively low percentage of combustible components like paper, cardboard, plastics, textiles etc., the waste composition will normally not make incineration an acceptable nor sustainable solution. However, the method has been described and analyzed as an option, in order not to exclude any available method.

**Table 17. Incineration issues**

| Advantages | Disadvantages |
|---|---|
| • volume reduction | • very high costs, both investment and operation |
| • detoxification of hazardous waste | • technically sophisticated |
| • reduced leachate and landfill gas production at the landfills | • require highly skilled operators |
| • energy recovery | • secondary pollution impacts, particularly air pollution |
| • land stabilization | • adverse public sector reactions |

242. The warm and humid climate in Cambodia, as well as the high proportion of biodegradable, organic material is favorable conditions for composting. However, some sort of pre-treatment or separation schemes could preferably be included.

243. Based on an assessment of available composting technologies, it is recommended to base the composting solution on low-technology aerobic windrow composting with frequent mechanical mixing.

**Table 18: Composting issues**

| Advantages | Disadvantages |
|---|---|
| • low-tech solution (the proposed solution)<br>• reduces the quantities that need to be landfilled, and particular of components with potential environmental impacts<br>• properly prepared end-product is environmentally friendly and provide a high quality soil conditioner for municipal or agricultural use | • only suitable for a portion of the MSW, unless a large percentage of reject for disposal is accepted<br>• insufficient demand for compost at unsubsidized production cost. For most of The Philippines, soil conditioners are available in sufficient volumes<br>• rather high unit cost of production<br>• limited resource utilization of the total MSW stream<br>• may cause negative environmental impacts if not properly operated |

244. Composting is considered suitable only for waste with a high content of organic material, like market and yard waste, etc. For mixed MSW, the reject percentage could be high (40-50 percent) for production of compost of sufficiently high quality. In most developed countries, modern composting is mainly based on source-separated organic fractions of MSW.

245. Without quite extensive post-treatment, like sieving etc., compost based on MSW has a limited use. It is internationally accepted to see this compost as soil conditioner, not a fertilizer. In most western countries the compost is used by the municipality in parks, at road side slopes, as vegetation cover at landfills, etc.

246. Based on experience from elsewhere it is considered economic feasible to compost only about 20 percent of the total MSW stream. This percentage of the MSW may be achieved through rather low-cost and simple pre-sorting separation schemes. A higher percentage of composting may require extensive and expensive additional source separation schemes.

247. Small scale, manual back yard composting of garden waste and possibly vegetable waste from households should be strongly encouraged and stimulated in medium and high income areas, with large plot sizes, and in rural communities.

248. Central sorting of mixed MSW may be done in plants with different complexities, from very simple plants with mechanical sorting of more bulky components (cardboard, plastics, metals, etc.,) to more complex plants with mechanical pre-sorting, conditioner and a main sorting line where these components of items that have an economic value are manually picked and sorted.

**Table 19. Central sorting issues**

| Advantages | Disadvantages |
|---|---|
| • high yield resource recovery (material recycling)<br>• limited impact on the environment (enclosed plants) | • can only receive a portion of the MSW (normally not mixed/wet household waste)<br>• can be complex and expensive to operate<br>• sophisticated facilities: high initial investment and operating costs<br>• very limited domestic market for the potential materials and varying international markets with large price fluctuations |

Table 20 compares solid waste management techniques as applied to Poipet.

**Table 20. Comparison of solid waste management techniques**

| **Aspects** | | **Sanitary Landfilling** | **Incineration** | **Composting** | **Low-tech Central Sorting** |
|---|---|---|---|---|---|
| Environmental impact | | Acceptable | Good to very good | Acceptable to good | Good to very good (high % rejects) |
| Resource recovery | | Acceptable (LFG) | Good to very good | Barely acceptable | Good |
| Local operation and maintenance capability (appropriateness) | | Good to very good | Not Acceptable | Good (low-tech solutions) | Acceptable |
| Need/market for end-product | | Good to very good | Very good (electricity) | Acceptable to good | Good to very good (difficult market for recycled materials) |
| Efficiency (% of total MSW stream handled) | | Very good (~ 100%) | Good (~ 70-80%) | Acceptable (10-30%) | Good (30-40%) |
| Treatment (O&M) Costs Unit Price USD/tonne | Small size plant 50 t/d | 20 | 142 | 32 | 32 |
| | Medium size plant 100 t/d | 13 | 108 | 25 | 22 |

### 1. Selected option for solid waste management

249. The sanitary landfill was selected as the most appropriate method. After selection of the method, a siting analysis was performed for the proposed new sanitary landfill. The following site screening criteria were adopted:

- Minimal distance from town center. (reduced transport costs)
- Minimum volume requirement: min. 20 years of operation, preferably more.
- Little or no insight. (sheltering topography or vegetation)
- No inhabitants at the area and no neighbours within min. 300 m
- Favourable soil/ground conditions. (highly recommended; impermeable soils) and no underlying or adjacent potential or existing groundwater or surface water sources
- Good and adjacent availability of cover material.
- Suitable recipient for leachate.
- No flooding at the site
- Uncomplicated ownership of area.
- Limited or no ambient area use and interests.
- Available existing infrastructure.
- No other environmental constraints (protected natural areas etc)
- No (or limited) other political constraints.

250. Several sites were proposed in the planning process and assessed by the local authorities, and the proposed site was recommended primarily because of land suitability and availability. A land title exists for the proposed site, which is approx. 250 x 400 m (10 ha) and will require approx. 2.5 - 3 km access road.

251. The analysis concluded that the site is in accordance with national and professional requirements as presented in the following table and thus could be utilized in the future SWM system. The compliance with various criteria has been assessed as good, medium or poor; no criteria are assessed as poor.

**Table 21. Compliance with disposal site location criteria**

| Criteria | Compliance with criteria | Comments |
|---|---|---|
| Minimal distance from town center. (Reduced transport costs) | Good | As close as realistically possible when following the master plan development in the next 15-20 years. The site also has a good location for optimized access road. |
| Minimum volume requirement: min. 20 years of operation, preferably more. | Good/ medium | Available volumes for min. 20 years of operation. Adjacent land is available and idle and over time the site should be extended. |
| Little or no insight. (sheltering topography or vegetation) | Medium | Very difficult to achieve in Poipet due to the flat terrain with very limited high vegetation and trees. However, the site is adequate distance from other activities. |
| No inhabitants in area and no neighbours within 300 m | Good | Nearest house (only a few) 1 km away |
| Favourable soil/ground conditions. (highly recommended; impermeable | Good/ medium | Soils: Old alluvium. Most probably the soils have limited permeability due to the fact that there are paddy fields in parts of the site. The use of additional |

| Criteria | Compliance with criteria | Comments |
|---|---|---|
| soils) and no underlying or adjacent potential or existing groundwater or surface water sources | | liner has been included (local suitable clay) in the feasibility assessment. No stability problems are expected under the local soil conditions and landfill design. No groundwater interests or wells in the neighbourhood. |
| Good and adjacent availability of cover material. | Good/ Medium | Most of the cover material may be provided through initial 1-2 m excavation of the site. |
| Suitable recipient for leachate. | Medium | The leachate will be treated before discharge to the rice fields. |
| No flooding at the site | Good | The flood situation is important, and consultations with the local EA and residents have been carried out on this, concluding that the site is not a flood prone area. |
| Uncomplicated ownership of area. | Good | A land title has been provided and the site is readily available. |
| Limited or no ambient area use and interests. | Good | The area has no land use except for agriculture within a wide distance from the site. |
| Available existing infrastructure. | Medium | Since the site has a beneficial isolated location with very limited adjacent activity, electricity lines, water supply wells and access road must be constructed, but at a moderate extent. |
| No other environmental constraints (protected natural areas etc) | Good | The site is not in wetlands or in an area with valuable fauna/flora importance. It is an elevated dry land with limited vegetation. |
| None (or limited) other political constraints,. | Good | No other plans in the adjacent area. Site readily available and provided by the Governor. |
| No other natural conditions concerns | | Not subject to earthquakes or similar. |

## IX. INFORMATION DISCLOSURE AND PUBLIC GRIEVANCE MECHANISM

252. As indicated above information on the subproject components was provided to stakeholders. A verbal and written presentation of the project was provided to the all participants.

253. The formal disclosure of information to affected persons and stakeholders during the IEE is meant to form the beginning of continued information disclosure and stakeholder involvement as the project is implemented. As part of the stakeholder communication strategy regular information exchange meetings with stakeholders are strongly encouraged throughout implementation of the subprojects.

254. A well-defined grievance redress and resolution mechanism will be established to address APs grievances and complaints regarding land acquisition, compensation and resettlement in a timely and satisfactory manner. All APs will be made fully aware of their rights, and the detailed procedures for filing grievances and an appeal process will be published through an effective public information campaign. The grievance redress mechanism and appeal procedures will also be explained in the project information booklet (PIB) that will be distributed to all APs.

255. APs are entitled to lodge complaints regarding any aspect of the land acquisition and resettlement requirements such as, entitlements, rates and payment and procedures for resettlement and income restoration programs. APs complaints can be made verbally or in written form. In the case of verbal complaints, the committee on grievance will be responsible to make a written record during the first meeting with the APs.

256. A Grievance Committee will be organized in local communes comprising of local leaders designated for such tasks by the IRC. The designated commune officials shall exercise all efforts to settle APs issues at the commune level through appropriate community consultation. All meetings shall be recorded by the grievance committee and copies shall be provided to APs. A copy of the minutes of meetings and actions undertaken shall be provided to PMU and ADB upon request.

257. The procedures for grievance redress are set out below. The procedure described below is consistent with the legal process for resolution of disputes in Cambodia.

i) Stage 1: Complaints from APs for the first time shall be lodged verbally or in written form with the village chief or commune chief. The complaints shall be discussed with the APs and the designated Head of Grievance Committee or members of the committee. It will be the responsibility of the Head of Grievance Committee to resolve the issue within 15 days from the date the complaint is received. All meetings shall be recorded and copies of the minutes of meetings will be provided to APs.

ii) Stage 2: If no understanding or amicable solution can be reached or if no response is received from the grievance committee within 15 days from filing the complaint, the APs can elevate the case to the District Grievance Committee. The District Grievance Committee is expected to respond within 15 days upon receiving the APs appeal.

iii) Stage 3: If the AP is not satisfied with the decision of the District Office, or in the absence of any response, the APs can appeal to the Provincial Grievance Committee (PGC). The PGC will review and issue a decision on the appeal within 30 days from the day the complaint is received.

iv) Stage 4: If the AP is still not satisfied with the decision of the PGC or in the absence of any response within the stipulated time, the APs, as a last resort may submit his/her case to the provincial court. The court will address the appeal by written decision and submit copies to the respective entities which include the IRC, PRS/IRC and the APs. If however, the AP is still not satisfied the court's decision, the case may be elevated to the provincial court. If however, the decision of the provincial court is still unsatisfactory to the APs, the APs may bring the complaints to the Higher Court.

258. The External Monitoring Organization (EMO) will be responsible for checking the procedures and resolutions of grievances and complaints. The EMO may recommend further measures to be taken to redress unresolved grievances. The Project Supervising Consultants will provide the necessary training to improve grievance procedures and strategy for the grievance committee members when required.

259. The executing agency will shoulder all administrative and legal fees that will be incurred in the resolution of grievances and complaints if the APs win their case. Other costs incurred by legitimate complaints will also be refunded by the project if the APs win their case.

260. In cases where APs do not have the writing skills or are unable to express their grievances verbally, APs are encouraged to seek assistance from the recognized local groups or NGO or other family members, village heads or community chiefs to have their grievances recorded in writing and to have access to the DMS or other documentation, and to any survey or valuation of assets, to ensure that where disputes do occur, all the details have been recorded accurately enabling all parties to be treated fairly. Throughout the grievance redress process, the responsible committee will ensure that the concerned APs are provided with copies of complaints and decisions or resolutions reached.

261. If efforts to resolve disputes using the grievance procedures remain unresolved or unsatisfactory, APs have the right to directly discuss their concerns or problems with the ADB Social Sectors Division (RSES), Southeast Asia Department through the ADB Cambodia Resident Mission (CARM). If APs are still not satisfied with the responses of CARM, they can directly contact the ADB Office of the Special Project Facilitator (OSPF).

## X. ENVIRONMENTAL MANAGEMENT PLANS

262. Environmental management plans for each subproject town have been developed, and are found under separate cover.

# XI. CONCLUSIONS AND RECOMMENDATION

263. The examination of the four subprojects of the CTDP in Cambodia indicates that potential environmental impacts are restricted to the construction phase of the subproject components. Potential operational impacts of the WWTPs and sanitary landfill need to be addressed at the detailed design stage of the CTDP.

264. The public meetings underscored the need for effective management of noise, dust, traffic disruptions, and safety during the construction phase of the project. Follow-up meetings with the consulted stakeholders to address any construction-related issues are required.

265. The civil construction impacts of elevated dust, noise, traffic disruptions, erosion and sedimentation, and public and worker safety can be managed effectively with standard construction practices (e.g., World Bank 2007).

266. The reported absence of critical habitats, rare or endangered species, biodiversity values, ecological protected areas, or affected cultural or heritage structures focuses potential impacts on the local community and worker population.

267. However, in parallel with preparation of the detailed designs a select re-review of the existence and sensitivity of valued ecological and cultural resources including groundwater is needed to clarify potential impacts of the detailed designs. It is recommended that as part of the update of the EMPs at the detailed design stage, that supplementary data/information be reviewed.

268. The IEE concludes that the description of the feasibility design of the project combined with available information on the affected environment is sufficient to identify the scope of potential environmental impacts of the project. Providing that significant changes do not occur to the design of one or more of the project components, and that the supplementary sensitive receptor data, and final design information identified above is provided, that further detailed environmental impact assessment (EIA) of the project is not required.

269. The separate EMPs developed for the subprojects provide impacts mitigation plans, environmental monitoring plans, and specify the institutional responsibilities and capacity needs for the environmental management of the subprojects. The IEE recommends that the EMPs be reviewed and updated at the detailed design phase to ensure that they addresses fully the final project designs.

## XII. REFERENCES CITED

ADB, 2009. Safeguard Policy Statement, ADB Policy Paper.

ADB, 2003, Environmental Assessment Guidelines of the Asian Development Bank.

Kingdom of Cambodia, 1999. Subdecree on Water Pollution Control, N0. 27, ANkr-BK, Eight chapters + 5 Annexes.

Kingdom of Cambodia, Subdecree on Solid Waste Management, No. 36 ANKr-BK, Six chapters + Annex.

Lamberts, D. 2001. *Tonle Sap fisheries: a case study on floodplain gillnet fisheries in Siem Reap, Cambodia*. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2001/11, 133 p

IUCN 2011. IUCN Red List of Threatened Species. Version 2011.1. <www.iucnredlist.org>. Downloaded on 01 November 2011.

World Bank Group, 2007. Environmental, Health, and Safety Guidelines. Washington DC., 96 pgs.

# XIII. APPENDIX A. ENVIRONMENTAL STANDARDS FOR CAMBODIA

From GoC Subdecree on Water Pollution Control (1999)

Annex 2
Effluent standard for pollution sources
discharging wastewater to public water areas or sewer

| Nº | Parameters | Unit | Allowable limits for pollutant substance discharging to | |
|---|---|---|---|---|
| | | | Protected public water area | Public water area and sewer |
| 1 | Temperature | $^0$C | < 45 | < 45 |
| 2 | pH | | 6 – 9 | 5 - 9 |
| 3 | $BOD_5$ ( 5 days at 200 C ) | mg/l | < 30 | < 80 |
| 4 | COD | mg/l | < 50 | < 100 |
| 5 | Total Suspended Solids | mg/l | < 50 | < 80 |
| 6 | Total Dissolved Solids | mg/l | < 1000 | < 2000 |
| 7 | Grease and Oil | mg/l | < 5.0 | < 15 |
| 8 | Detergents | mg/l | < 5.0 | < 15 |
| 9 | Phenols | mg/l | < 0.1 | < 1.2 |
| 10 | Nitrate ($NO_3$ ) | mg/l | < 10 | < 20 |
| 11 | Chlorine ( free ) | mg/l | < 1.0 | < 2.0 |
| 12 | Chloride ( ion ) | mg/l | < 500 | < 700 |
| 13 | Sulphate ( as $SO_4$ ) | mg/l | < 300 | < 500 |
| 14 | Sulphide ( as Sulphur ) | mg/l | < 0.2 | < 1.0 |
| 15 | Phosphate ( $PO_4$ ) | mg/l | < 3.0 | < 6.0 |
| 16 | Cyanide ( CN ) | mg/l | < 0.2 | < 1.5 |
| 17 | Barium ( Ba ) | mg/l | < 4.0 | < 7.0 |
| 18 | Arsenic ( As ) | mg/l | < 0.10 | < 1.0 |
| 19 | Tin ( Sn ) | mg/l | < 2.0 | < 8.0 |

| | | | | |
|---|---|---|---|---|
| 20 | Iron ( Fe ) | mg/l | < 1.0 | < 20 |
| 21 | Boron ( B ) | mg/l | < 1.0 | < 5.0 |
| 22 | Manganese ( Mn ) | mg/l | < 1.0 | < 5.0 |
| 23 | Cadmium ( Cd ) | mg/l | < 0.1 | < 0.5 |
| 24 | Chromium ( Cr )$^{+3}$ | mg/l | < 0.2 | < 1.0 |
| 25 | Chromium ( Cr )$^{+6}$ | mg/l | < 0.05 | < 0.5 |
| 26 | Copper ( Cu ) | mg/l | < 0.2 | < 1.0 |
| 27 | Lead ( Pb ) | mg/l | < 0.1 | < 1.0 |
| 28 | Mercury (Hg ) | mg/l | < 0.002 | < 0.05 |
| 29 | Nickel ( Ni ) | mg/l | < 0.2 | < 1.0 |
| 30 | Selenium ( Se ) | mg/l | < 0.05 | < 0.5 |
| 31 | Silver ( Ag ) | mg/l | < 0.1 | < 0.5 |
| 32 | Zinc ( Zn ) | mg/l | < 1.0 | < 3.0 |
| 33 | Molybdenum ( Mo ) | mg/l | < 0.1 | < 1.0 |
| 34 | Ammonia ( $NH_3$ ) | mg/l | < 5.0 | < 7.0 |
| 35 | DO | mg/l | >2.0 | >1.0 |
| 36 | Polychlorinated Byphemyl | mg/l | <0.003 | <0.003 |
| 37 | Calcium | mg/l | <150 | <200 |
| 38 | Magnesium | mg/l | <150 | <200 |
| 39 | Carbon tetrachloride | mg/l | <3 | <3 |
| 40 | Hexachloro benzene | mg/l | <2 | <2 |
| 41 | DTT | mg/l | <1.3 | <1.3 |
| 42 | Endrin | mg/l | <0.01 | <0.01 |
| 43 | Dieldrin | mg/l | <0.01 | <0.01 |
| 44 | Aldrin | mg/l | <0.01 | <0.01 |
| 45 | Isodrin | mg/l | <0.01 | <0.01 |
| 46 | Perchloro ethylene | mg/l | <2.5 | <2.5 |
| 47 | Hexachloro butadiene | mg/l | <3 | <3 |
| 48 | Chloroform | mg/l | <1 | <1 |
| 49 | 1,2 Dichloro ethylene | mg/l | <2.5 | <2.5 |

**Annex 4**
**Water Quality Standard in public water areas for bio-diversity conservation**

***1- River***

| No | Parameter | Unit | Standard Value |
|---|---|---|---|
| 1 | pH | mg/l | 6.5 – 8.5 |
| 2 | $BOD_5$ | mg/l | 1 – 10 |
| 3 | Suspended Solid | mg/l | 25 – 100 |
| 4 | Dissolved Oxygen | mg/l | 2.0 - 7.5 |
| 5 | Coliform | MPN/100ml | < 5000 |

***2- Lakes and Reservoirs***

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

***3- Coastal water***

| No | Parameter | Unit | Standard Value |
|---|---|---|---|
| 1 | pH | mg/l | 7.0 – 8.3 |
| 2 | COD | mg/l | 2 – 8 |
| 4 | Dissolved Oxygen | mg/l | 2 - 7.5 |
| 5 | Coliform | MPN/100ml | < 1000 |
| 5 | Oil content | mg/l | 0 |
| 6 | Total Nitrogen | mg/l | 1– 1.0 |
| 7 | Total Phosphorus | mg/l | 0.02 – 0.09 |

**Annex 5**

Water Quality Standard in public water areas
for public health protection

-

| No | Parameter | Unit | Standard Value |
|---|---|---|---|
| 1 | Carbon tetrachloride | µg/l | < 12 |
| 2 | Hexachloro-benzene | µg/l | < 0.03 |
| 3 | DDT | µg/l | < 10 |
| 4 | Endrin | µg/l | < 0.01 |
| 5 | Diedrin | µg/l | < 0.01 |
| 6 | Aldrin | µg/l | < 0.005 |
| 7 | Isodrin | µg/l | < 0.005 |
| 8 | Perchloroethylene | µg/l | < 10 |
| 9 | Hexachlorobutadiene | µg/l | < 0.1 |
| 10 | Chloroform | µg/l | < 12 |
| 11 | 1,2 Trichloroethylene | µg/l | < 10 |
| 12 | Trichloroethylene | µg/l | < 10 |
| 13 | Trichlorobenzene | µg/l | < 0.4 |
| 14 | Hexachloroethylene | µg/l | < 0.05 |
| 15 | Benzene | µg/l | < 10 |
| 16 | Tetrachloroethylene | µg/l | < 10 |
| 17 | Cadmium | µg/l | < 1 |
| 18 | Total mercury | µg/l | < 0.5 |
| 19 | Organic mercury | µg/l | 0 |
| 20 | Lead | µg/l | < 10 |
| 21 | Chromium, valent 6 | µg/l | < 50 |
| 22 | Arsenic | µg/l | < 10 |
| 23 | Selenium | µg/l | < 10 |
| 24 | Polychlorobiohenyl | µg/l | 0 |
| 25 | Cyanide | µg/l | < 0.005 |