Initial Environmental Examination

Project Number: 53199-001
September 2021

Cambodia: Livable Cities Investment Project Bavet

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

CURRENCY EQUIVALENTS

(as of 2 September 2021)

Currency unit	–	riel (KR)
KR1.00	=	$0.00024
$1.00	=	KR4,086

ABBREVIATIONS

ADB	–	Asian Development Bank
AP	–	Affected Person
ASP-EA	–	Activated Sludge Process with Extended Aeration
CCCSP	–	Cambodia Climate Change Strategic Plan
CCS		Comprehensive City Survey
CEMP	–	Construction Environmental Management Plan
CF	–	Community Forestry
CMAC	–	Cambodian Mine Action Centre
CMIP	–	Climate Model Intercomparison Project
CSIRO	–	Commonwealth Scientific and Industrial Research Organisation
CTOP	–	Comprehensive Technical Options
DCSC	–	Design and Construction Supervision Consultant
DED	–	Detailed Engineering Design
DOC	–	Department of Construction
EA	–	Executing Agency
EHS	–	Environment, Health, and Safety
EIA	–	Environmental Impact Assessment
EIS	–	Environmental Impact Statement
EMMP	–	Environmental Management and Monitoring Plan
EMP	–	Environmental Management Plan
EMoP	–	Environmental Monitoring Plan
ESO	–	Environment and Social Officer
ESSF	–	Environmental and Social Safeguards Framework
ESSP	–	Environmental and Social Safeguards Policy
FGD	–	Focal Group Discussion
FHH	–	Female Headed Household
FS	–	Feasibility Study
GCM	–	Global Climate Model
GDSWM	–	General Directorate of Sewerage and Wastewater Management
GHG	–	Greenhouse Gas
GMS 1	–	Greater Mekong Subregion Southern Economic Corridor Towns Development Project
GMS 2	–	Second Greater Mekong Subregion Corridor Towns Development Project
GRM	–	Grievance Redress Mechanism
HH	–	Household
IA	–	Implementing Agency
IBAT	–	Integrated Biodiversity Assessment Tool
IEE	–	Initial Environmental Examination
IEIA	–	Initial Environmental Impact Assessment
ILO	–	International Labor Organization

IPCC	–	Intergovernmental Panel on Climate Change
IUCN	–	International Union for Conservation of Nature
KII	–	Key Informant Interviews
KNMI	–	Royal Netherlands Meteorological Institute
LCIP	–	Livable Cities Investment Project
LFG	–	Landfill Gas
MA	–	Municipal Administration
MAFF	–	Ministry of Agriculture Forestry, and Fisheries
MEF	–	Ministry of Economy and Finance
MISTI	–	Ministry of Industry, Science, Technology and Innovation
MIH	–	Ministry of Industry and Handicrafts
MLMUPC	–	Ministry of Land Management Urban Planning and Construction
MP	–	Master Plan
MPWT	–	Ministry of Public Works and Transport
MOWRAM	–	Ministry of Water Resources and Meteorology
MOE	–	Ministry of Environment
MOI	–	Ministry of Interior
MSW	–	Municipal Solid Waste
NFP	–	National Forest Programme
O&M	–	Operation and Maintenance
OHS	–	Occupational Health and Safety
PA	–	Provincial Administration
PDLMUPC	–	Provincial Department of Land Management, Urban Planning and Construction
PDAFF	–	Provincial Department of Agriculture, Forest and Fisheries
PDOE	–	Provincial Department of Environment
PDPWT	–	Provincial Department of Public Works and Transport
PIU	–	Project Implementing Unit
PIU-EO	–	PIU Environmental Officer
PIU-SO	–	PIU Social Officer
PMU	–	Project Management Unit
PMU-EOs	–	PMU Environmental Officer
PMU-SO	–	PMU Social Officer
PRIP	–	Provincial Road Improvement Province
PS	–	Pumping Station
PWTESPO	–	Public Works & Transport, Environmental, Sanitation, and Public Order Office
RCP	–	Representative Concentration Pathway
REA	–	Rapid Environmental Assessment
RGC	–	Royal Government of Cambodia
SCF	–	Strategic Climate Fund
SEZ	–	Special Economic Zone
SOP	–	Standard Operating Procedure
SPS	–	Safeguard Policy Statement
SRES	–	Special Report on Emissions Scenarios
SSP	–	Shared Socioeconomic Pathways
SURF	–	Southeast Asia Urban Services Facility
SW		Stormwater
SWM	–	Solid Waste Management
TA	–	Technical Assistance

ToR	–	Terms of Reference
TRTA	–	Transaction Technical Assistance
UDS	–	Urban Development Strategy
USD	–	United States Dollar
UXO	–	Unexploded Ordnance
WEEE	–	Waste Electrical And Electronic Equipment
WHO	–	World Health Organization
WSP	–	Waste Stabilization Ponds
WW	–	Wastewater
WWTP	–	Wastewater Treatment Plant
VAT	–	Value Added Tax

NOTE

In this report, "$" refers to United States dollars.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

1. Introduction

1. At the request of the Kingdom of Cambodia, the Asian Development Bank (ADB) is developing the Livable Cities Investment Project (LCIP) to improve the environment of several secondary cities in Cambodia including Bavet, Poipet, and Kampot.

2. Project outputs include: (i) Output 1: policy and regulatory environment improved, (ii) Output 2: urban infrastructure improved, and (iii) Output 3: institutional effectiveness and governance improved.

3. The scope of this Feasibility Stage Borrower Initial Environmental Examination (IEE) and Environmental Management Plan (EMP) concerns sub-project under Output 2 only.

4. For the priority area in the short term (2025), the identified subprojects in Bavet under LCIP Output 2 are as follows:
   (i) Improved wastewater management systems (pumping stations, network and treatment plant);
   (ii) Improved drainage systems to manage stormwater flows, and;
   (iii) Improved solid waste management (SWM) systems (including landfill, waste collection and recycling, and transportation vehicles, an upgrade of environmental protection measures and activities to promote waste reduction. The closure of the existing dumpsite is not within the project scope.

5. The IEE identifies and assesses potential impacts and risks arising from the implementation of the proposed project on the physical, biological, physical cultural and socioeconomic environment; and recommends measures to avoid, mitigate, and compensate for adverse impacts, while enhancing positive impacts. The EMP describes the project requirements and methods for environmental mitigation measures, monitoring, reporting, roles and responsibilities, budget, and the grievance redress mechanism (GRM). The EMP will be the key guiding document for environmental-related issues for project construction and operation.

6. The IEE and EMP will be updated at Detailed Engineering Design (DED) stage, and the updated DED stage EMP will form part of the bidding documents. The Project also requires the completion of two domestic Initial Environmental Impact Assessments for national regulatory compliance.

2. Description of the Environment (Baseline)

7. **Location, Geography and Topography.** The municipality of Bavet is located in Svay Rieng Province (South-East part of Cambodia), and represents an international border gate between Cambodia and Vietnam. The close surroundings of Bavet are a flat, low lying land (up to 10 m above sea level), dominated by agricultural lands, with sparse and scattered grassland and shrub land (the proposed wastewater treatment plant (WWTP) site of 20 hectares (ha) forms part of the Community Forest “Chamkar Konkoki” (CFCK), where it is a lowland and flooded plain area in the rainy season, with high acidity soil which is fully dominated of growing of *Melaleuca quinquenervia* (Smach - Khmer name). Acacia (plantation by community in 1994) and *Melaleuca leucadendra* are commonly found in the

area). Seasonal precipitation affects the extension of many surrounding water bodies and can cause flooding in 17 urban areas of Bavet municipality.

8. **Geology and Soils.** The geology of Bavet as a part of the Svay Rieng province is characterized by young alluvium soils made up by 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, as observed around Bavet. Bavet soil is considered to have a very high runoff potential. Soil sampling was realized during field survey. Based on laboratory results, soil can be classified as clay loam at the landfill site and sandy loam at the Wastewater Treatment Plant (WWTP) site.

9. **Climate and Climate Change.** The tropical monsoon climate of Cambodia has two distinct seasons: (i) the dry season, which lasts approximately from November to April; (ii) the wet season, lasting from May to October. The mean maximum temperature is 28°C and the mean minimum temperature is 22°C. In lowland areas, annual rainfall ranges from 1,000 mm to 1,700 mm. Due to climate change, the number of days above 35°C is projected to increase from 25-30 days per year to over 50 days per year under Representative Concentration Pathway (RCP) 8.5. The projected change in rainfall from climate models, is much more variable than it is for temperature, some models project a decrease and others an increase. Climate models mostly project future decrease in tropical cyclone numbers and increase in the intensities of the strongest storms.

10. **Hydrology, Water Resources and Quality.** Bavet is located in the floodplain of the Mekong River. The extensive network of tributaries (*preaek*) and streams are governed by the rise and fall of the Mekong during the annual cycle of rainy and dry season. The main water body for the local hydrological context is Ta Pov Stream. The level of water in Ta Pov Stream rises during rainy season when the channel bordering Vietnam is flooded and becomes shallow during dry season. Ta Pov water is locally used for irrigation and animal feeding only. 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 Ta Pov Stream tends to be poor, especially in times of low water flow. The results of the baseline survey indicated that surface water quality in the vicinity of the proposed treatment plant, landfill, and adjacent areas does not meet standards for biological parameters, particularly total coliforms. Groundwater at the proposed landfill seems to have been polluted by leachate from the existing dumpsite.

11. **Ecology, Wilderness Values and Protected Areas.** Integrated Biodiversity Assessment Tool (IBAT) analysis report confirms that neither protected areas nor key biodiversity areas or forests are in the vicinity in Svay Rieng province. Dominating landscape in Bavet area is urban, accompanied by an agricultural land use (rice). Among the 175 species listed in this IBAT report, belonging to the International Union for Conservation of Nature (IUCN) Red List, 22 are identified as Critically Endangered and 33 as Endangered. No endangered or threatened species are recorded in the studied area, according to IUCN available data. However, during field survey, one Near Threatened bird species (Painted Stork, *Mycteria leucocephale*) was reported to be present in the projected landfill site. Also, two Near Threatened species (i.e. Eurasian Curlew *Numenius arquata* and Painted Stork *Mycteria leucocephala*) and one Endangered species (i.e. Milky Stork *Mycteria cinerea*) are reported to be present on the projected WWTP site. Moreover, the dense vegetation area, where the projected WWTP will be located, was created by the Ministry of Agriculture Forestry, and Fisheries (MAFF), and contains a dense *Acacia auriculiformis Muell* plantation (Chamkar Korki Community Forestry). The aim of this establishment is to conserve the biodiversity and

manage the traditional use of forest products and non-timber forest products, The final goal being for the local community livelihood, tradition and religious believes to align with the poverty reduction policy of the Royal Government of Cambodia. Local people used to contribute to its creation by planting several tree species (*Acacia auriculiformis Muell., Melaleuca quinquenervia*., Hopea *odorata Roxb, Dipterocarpus alatus Roxb).* One of these trees was identified as a sacred tree for local communities during field survey.

12. **Human and Socio-Economic Context.** At the time of the population census of 2018, 42,546 people lived in Bavet. In 2018, 54.69% of the population, aged from 18 to 60 were employed: 81% in the industry sector, 14% in the agricultural sector and 5% in the service sector. In 2018, agriculture land use represented the biggest portion of the city at 75.18%. Due to its strategic location close to the Vietnamese border, Bavet was designated by the national government as a Special Economic Zone (SEZ) for small and medium manufacturing industries. In 2019, 10 SEZs were established and are in operation. In 2018, the Bavet border checkpoint recorded 534,660 international tourists, which represent approximately 8.62% of the total international tourists (6,201,077) entering Cambodia.

13. **Social and Transport Infrastructures.** There is only one Health Center in Bavet municipality. Concerning educational facilities, in 2018 there were 17 state primary schools, 3 state secondary schools and 2 public high schools but no university in Bavet. The city's green open spaces are very limited and poorly landscaped as only 1 urban forest is found in Chomka Konkoki Community Forest and one potential green space area at Road 316D in Tapov Village, *Sangkat* Bavet. Bavet is accessible by road through the National Road (NR) 1: this is a main road crossing between Cambodia and Vietnam, that connects to Bangkok, Phnom Penh and Ho Chi Minh City. Terminals of private bus operators are found along NR 1.

14. **Cultural Heritage and Physical Cultural Resources.** Few cultural monuments are found in the municipality of Bavet and cultural heritage is mostly represented by mosques and pagodas. During the field survey, a shrine place was observed in the sector of the WWTP projected location. The shrine place (620749 E, 1220827 N) is located in the Acacia forest (low land), 100 m from the WWTP project boundary (short term investment configuration). This area is covered by several big trees surrounding by the water. A sacred tree for local communities was also identified in the same sector.

15. **Noise.** In the outskirts of the city the acoustic ambiance is relatively calm: the suburbs east of the city center are dominated by agricultural fields. The heart of the city provides a noisier background, with its urban-life and construction activities, markets, as well as the traffic of NR 1 and the 10 SEZs located along the national road. During field survey, noise level measurement has been conducted at the landfill site (31 to 59 dB(A)) and 3 houses close to it (50 to 65 dB(A)); at the WWTP site (43 to 53 dB(A)) and 3 houses close to it (45 to 60 dB(A)); at the pumping station, and at the main pumping station (34 to 65 dB(A)).

16. **Air Quality.** In general, the air quality in rural areas is still good. However, the increase in socioeconomic development along new road corridors will bring air pollution from vehicle traffic and industrialization. This might be particularly the case for Bavet, where it is strategically located at the Cambodia-Vietnam border in the inland. Moreover, local air quality at the projected SWM site is already affected by the existing dumpsite (waste burning, odors, etc.). Other sources of air pollutant are waste burning from households and agricultural activities, and gases from untreated wastewater. During field survey, the air quality has been measured at the landfill site. The result of air quality measurement

conducted at the landfill site indicates that all the parameters are below the standard of Ministry of Environment (MoE). Hydrogen sulfite and ammonia were not detected.

17. **Water Supply.** The piped water supply is available for 30% of the population, but only 10% is connected to it, mainly for economic reasons (cost of water), only 2% use it as a main source of drinking water. 95% of the population has its own borehole and 50% use the water from it as a main source of drinking water. The accessibility of bottled drinking water is good in Poipet.

18. **Wastewater Management.** It is estimated that 74% of the excreta generated in Bavet is not safely managed. 95% of the population in Bavet has onsite sanitation containment, which are mostly semi-impermeable with an open bottom. Only 5% of the population ever emptied its sanitation containment, because of a wide use of chemicals (from Vietnam) to fluidize the excreta, which then percolates into the surrounding soil through the open bottom or the side wall holes. There is only one emptying business that provides services in Bavet: their main clients are SEZs and casinos. As there is no WWTP, the faecal sludge is disposed of at the local dumpsite, although the dumping location remains unknown.

19. **Urban Drainage.** The majority of the total land area of Bavet is affected by intermittent flooding during the rainy season. Households and commercial establishments drain their wastewater and stormwater through small canals and natural streams (e.g., Ta Pov River) into the open agricultural areas and rice fields. Bavet has more than 20 km of open channel network. The open channel network is now considered as the main drainage infrastructure. The water quality in it is poor, especially during dry periods of the year when the effluent becomes pure sewage. The network outlets are Ta Pov River, open spaces and agricultural lands. The existing drainage system in Bavet is a combined wastewater and stormwater scheme that was constructed more than 10 years ago. The canals and pipes have been installed only in some sections of the town center and mainly in the touristic areas. Recurrent floods are reported by inhabitants and local authorities. Main stormwater channels are operating properly but their capacity is not sufficient to ensure proper drainage of the city center.

20. **Solid Waste Management.** The collection and disposal of domestic solid waste is provided by a private company, HYBRID Garbage Co. The collection coverage is very limited (14% of the urban area). Solid waste is transported to a dumpsite (4 ha) located at 5 km from the city center. A new Material Recovery Facility (MRF) has been built by the Greater Mekong Subregion Southern Economic Corridor Towns Development Project (GMS1)[1]. Buyers from nearby Vietnam are actively involved in the recyclables trade in Bavet.

3. Anticipated Environmental Impacts

21. The sensitive receptors within the project area of influence were identified in order to determine positive and negative impacts and associated measures. The following paragraphs present the main impacts identified for the project.

[1] ADB. Greater Mekong Subregion Southern Economic Corridor towns Development Project (GMS1). https://www.adb.org/projects/43319-033/main#project-pds

3.1. Positive Impacts and Environmental Benefits

22. Women are likely to benefit more from improved water and sewer services as primary users of these facilities. A specific Gender Equality and Social Inclusion Action Plan (GESIAP) has been developed which considers this social issue during the project implementation. Additionally, employment and increased education opportunities may provide more gender equality.

23. **Wastewater Management.** The wastewater pipe network will improve the quality of life, by reducing odor nuisances due to the practice of emptying sanitation containments directly into the environment. Furthermore, the amount of untreated wastewater directly rejected into the environment will be minimized. Collection and treatment of wastewater is also a matter of public health, as it will diminish the incidence of water borne infections and diseases, associated with inadequate sanitation. On-site septage collection for co-treatment in the WWTP will also improve the quality of life in rural areas. Finally, operation, monitoring and maintenance of the new pumping stations and WWTP will enable the creation of employment opportunities for the population.

24. **Stormwater Drainage.** Improving the drainage capacity of the city will reduce risks of flooding and consequent scattering of waste material in the streets. Thus, it will prevent economic loss due to damage to property. It will also enhance tourist and commercial development of Bavet, by attracting private sector investments. Furthermore, the bank erosion due to the absence of concrete material lining in the currently used canals will be avoided by the projected piped network in urban areas. Functional and separated drainage and sewage systems will help reduce diseases from infection and mitigate health related problems in the population.

25. **Solid Waste Management.** The new landfill will prevent contamination of local groundwater and related diseases with its leachate management. It will improve efficiency and long term sustainability of urban drainage due to reduced waste disposal in drains. The closure of the existing dumpsite will avoid groundwater pollution due to the infiltration of rainwater across the waste mass. It will also help to minimize the practice of waste burning and waste disposal into water bodies and other natural habitats, reduce air, water and soil pollution and improving living standards for the population. Pre-sorting activities will increase the recovery rate of solid waste materials, diverting from landfilling and consequently saving agricultural land areas. Composting will reduce greenhouse gas emission, extend the landfill life by diverting the incoming waste flows and the produced compost will be reused in agriculture. The proposed area for the new landfill is close to the current dumpsite, which may improve acceptability from the population. Ultimately, the project will improve working conditions for waste pickers and create new employment opportunities for the local population.

26. The waste management project components, including composting of organic waste; controlled wastewater treatment; Greenhouse Gas (GHG) capture; recycling and waste minimization are greenhouse gas emission reduction strategies. In particular, emissions of the more potent greenhouse gases of methane (CH_4) and nitrous oxide (N_2O) from anaerobic decomposition will be captured and converted to CO_2, thanks to a landfill gas (LFG) collection system and a gas flare unit.

3.2. Biodiversity Conservation and Sustainable Natural Resource Management

27. **Natural habitat and flora.** In case of **land acquisition**, the size of the areas concerned will be reduced as much as possible.

28. The WWTP site (20 ha) is located on public land owned by Svay Rieng province, at the edge of the 304 ha of MAFF/Chamkar Konkoki Community Forest. This land is a mix between a regrowing natural forest (*Melaleuca quinquenervia*) and acacia plantations as Chamkar/farm, resembling a natural land reserve or ephemeral wetland. Mitigation measures to preserve the area surrounding the project site will include the establishment of buffer zones, avoiding unnecessary earth movement and removal of vegetation, management plans and protection/conservation strategies, temporary fences. The site does not require any resettlement as there is no permanent households within a 100 m buffer zone. The new controlled landfill, the sorting plant and the composting plant will be created in the vicinity of the existing dumpsite. No land acquisition is required. Additionally, the collection points will be located in public areas.

29. In urban areas, sewerage and urban drainage projects will be associated to a temporary impact due to the construction of underground network. This impact will be limited in time and space, and mainly related to impeded access to houses and to public and commercial facilities. No land acquisition is necessary, but an official authorization for works will be required. In rural areas, drainage network will consist of open channels. Their construction would cause a permanent impact on adjacent parcels in terms of exploitable surface loss for agriculture or other private uses. The property owners impacted by the construction will receive an economical compensation and/or will be assisted for the resettlement on a parcel with equivalent characteristics.

30. **Fauna.** At the WWTP site, works may disturb nearby breeding waterbirds in the forest (acacia plantation). The WWTP works will also require the removal of 20 ha of a planted forest (which is fired every year by local communities). Two Near Threatened species (i.e. Eurasian Curlew *Numenius arquata* and Painted Stork *Mycteria leucocephala*) and one Endangered species (i.e. Milky Stork *Mycteria cinerea*) in the IUCN red list are reported by field survey. Milky Storks may be disturbed by WWTP construction and temporarily abandon the site. They are expected to repopulate the area during operation phase. Moreover, due to recurrent fires in this forest, local birds are already obliged to leave the area periodically. As the burnt zones of the forest grow back, birds repopulate them. Also, during field survey, one Near Threatened bird species (Painted Stork, *Mycteria leucocephale*) was reported to be present in the projected landfill site. Mitigation measures include minimizing impacts on adjacent vegetation, for instance with physical barriers, and carrying out unavoidable tree removal individually, after careful inspection and with subsequent soil stabilization, more surveys should be done during the national IEIA report, as suggested during consultations with two local bird specialists.[2] The specialists confirmed that best timing for starting works is just after (up to 4 months) the annual fire of the forest carried out by the local community. For the WWTP site, the Project's compensation planting for Chamkar Konkoki Community Forest will include the funding of 69,000 trees which will be planted under the Cambodian National Forest Programme. The exact location of the replanting will be advised by MAFF/Provincial Department of Agriculture Forest and Fisheries (PDAFF) at the time of implementation, under the National Forest Programme and will ideally be replanted in the

[2] Mr. Hong Chamnan Freelance biodiversity consultant and Mr. Bou Vorsak previously of BirdLife International.

local area, depending on NFP requirements. The tree species will be driven by the National Forest Programme. For the landfill, compensation trees will be planted along roads and canals (public land) in the local area, by the project, as per Bavet Municipality demands. The compensation cost for replanting tree/acacia will be provided in the updated DED stage EMP (budget has been set aside by the project).

31. Based on the effective implementation of these measures, ecological-related construction risks are considered to be very low.

3.3. Pollution Prevention and Abatement

32. Excavation for the landfill and WWTP construction will generate more than 350,000m^3 of materials that will firstly be used for embankment construction on site, stockpiled along the project boundaries, protecting sites from flooding and potential pollution, and remaining materials will be removed towards the numerous works in the urban zone of the city.
33. Improved sanitation and solid waste management will reduce the volume of sewage and solid waste entering local water bodies and particularly Ta Pov River. The treated effluent from the **WWTP** will be released into an existing canal, which merges with the main irrigation canal network within the catchments of Ta Pov River and Stueng Me Sar Thngak (final natural receiving water bodies). WWTP effluent will be treated before release (70-90% design removal rate for COD, BOD and TSS; 50-70% for TN and TP). Thus, the water quality of the receiving bodies will not be significantly altered.

34. At the outfalls of the **drainage system**, it is expected that the water flow and quality of the receiving bodies will not be significantly altered, since the current combined drainage system is already being discharged into local water bodies (Ta Pov River and its tributaries). Moreover, the Northern outlet of the drainage system is located by an agricultural land, which is bordered by a newly built ring road (1.5m above the ground level). Thus, in case of intense rainfall events, the overflow will be managed in that area (for a rain event up to one in five years), without impacts on the land beside this road.

35. The main potential impact on **soil contamination** is related to infiltration of leachate in the subsoil. The landfill site will include a low permeability base liner to prevent infiltration. The majority of the leachate will be collected and recirculated into the waste mass, with the excess being tankered for treatment at the WWTP. The landfill cells liner will be made of a geomembrane liner of 2mm thick high-density polyethylene (HDPE) fusion-welded geomembrane. The HDPE geomembrane will be protected by a non-woven geotextile fabric.

36. The SWM project includes provision of equipment for landfill gas collection, which is then routed to a flare stack for burning. The equipment will be installed by the operator at an appropriate time during site operation.

3.4. Health and Safety

37. Environmental specialists will be assigned to ensure full and effective EMP implementation and health and safety compliance. Contractors will develop a site EMP, based on the EMP, assign at least one person responsible for Environment, Health, and Safety (EHS) and establish grievance register and incident register and comply with labor law of Cambodia and core labor standards of the International Labor Organization.

38. Recruitment of construction workers will prioritize local residents to reduce the number of migrant workers. Construction workers will be exposed to pollution emissions, noises, vibrations, construction-generated wastes and wastewater, hazardous substances, social conflicts with communities, transmittable diseases in the community, presence of unexploded ordnances (UXO), large moving and operating construction vehicles and equipment, and pits and excavations. Contractors' environmental and occupational health and safety plans will provide mitigation measures. The construction of temporary workers camps may affect the local community and environment. COVID-19 specific measures will also be implemented in contractors' health and safety plans.

39. Noise impacts will be mainly restricted to construction phase and will not have any consequences on population health.

3.5. Physical Cultural Resources

40. A shrine place and a sacred tree were observed in this sector during field survey, about 200m outside of the boundaries of WWTP short term investment project area. For long term investment, the construction of Waste Stabilization Ponds is expected to generate an extension of the WWTP boundaries towards that area. To preserve the value of these elements in terms of cultural heritage, the long term project location will be adapted in order not to affect them. An effective barrier (fence) will be installed during construction phase to protect the shrine and sacred tree area. The access to the shrine place and the sacred tree will be maintained in its current configuration during construction and operation phases.

3.6. Climate Change and Natural Hazards

41. In case of severe meteorological events due to Climate Change effects, the main impacts on the project components are identified as follows: (i) erosion caused by increased water flow in earth open channels for the drainage system, (ii) flooding affecting project sites, (iii) increased volumes of water to be managed by project components. Therefore, project components design has taken into account the flooding hazard by raising the level of WWTP platform (higher embankments), bordering the landfill with perimeter barrier / topographic constraints (at least 2m-high), and increase the designed capacity of the stormwater drainage line.

4. Consultation, Participation and Disclosure

42. Consultations were undertaken during the preparation of the IEE. This included interviews with a range of expert stakeholders and affected people, and completion of a questionnaire form on social and environmental factors. The views of stakeholders are integrated into the EMP where appropriate. A Public Consultation and Participation Plan is included in the EMP to outline the plans for future stakeholder engagement.

43. Information Disclosure will be maintained during project design and implementation. All stakeholders will be provided with information on the subproject component including the Grievance Redress Mechanism. Local disclosure and disclosure on ADB's website is outlined in the EMP.

5. Grievance Redress Mechanism

44. A project grievance redress mechanism (GRM) has been developed in compliance with ADB's SPS (2009) requirement to address environmental, health, safety, and social concerns associated with project construction and operation. Resettlement issues are dealt with through a separate mechanism.

45. The GRM is accessible to all members of the community, including women, youth, remote farmers and communities, and residents in poverty. Multiple points of entry are available, including face-to-face meetings, written complaints, telephone conversations, e-mail, and social media. It includes clear timescales and steps for rectifying issues arising and will provide clear and open channels of communication for affected people.

6. Environmental Management Plan

46. As part of this IEE, a project EMP has been prepared. It describes the project requirements and methods for environmental mitigation measures, monitoring, reporting, roles and responsibilities, budget, and the GRM. The EMP will be the key guiding document for environmental-related issues for project construction and operation.

7. Conclusion and Recommendations

47. Assuming full and effective implementation of the EMP, potential adverse environmental impacts are expected to be minimized and/or mitigated to an acceptable level in accordance with the standards applied in this IEE.

I. INTRODUCTION

1. Project Description

1. At the request of the Kingdom of Cambodia, the Asian Development Bank (ADB) is developing the Livable Cities Investment Project (LCIP) to facilitate long-term sustainable and economic growth. The project is aligned with the Government's policies and national strategies, in particular, the Government's Rectangular Strategy – Phase IV[3] and ADB Strategy 2030.[4]

2. The project will concentrate on the secondary cities of Bavet, Poipet, and Kampot, due to their economic potential and location at key trade and tourism zones. The project will focus on enhancing urban planning, building community resilience, and providing infrastructure. Project outputs include: (i) output 1: policy and regulatory environment improved, (ii) output 2: urban infrastructure improved, and (iii) output 3: institutional effectiveness and governance improved.

3. As a result of recent population growth, these cities have identified that the limited infrastructure is restricting their development potential. Existing services are no longer operating optimally and incapable of servicing demands. The LCIP proposes to adopt a holistic methodology, comprising of an integrated urban development approach, to ensure interventions consider land use, long term city needs, asset management, and asset financing for sustainable operations.

4. To ensure climate resilient and sustainable development of participating cities, the project adopts a climate-centric city development approach. Appropriate structural and non-structural measures are incorporated to ensure climate change risks is appropriately mitigated to avoid future cost associated to the climate change impact.

2. Project Components and Proposed Infrastructure

5. The scope of this Initial Environmental Examination (IEE) concerns output 2 only. The project components under output 2 are:

(i) Improved wastewater management systems (pumping stations, network and treatment plant);
(ii) Improved drainage systems to manage stormwater flows, and;
(iii) Improved SWM systems (including landfill, waste collection & recycling, and transportation vehicles, an upgrade of environmental protection measures and activities to promote waste reduction). The closure of the existing dumpsite is out of the project scope.

[3] Rectangular strategy for growth, employment, equity and efficiency: building the foundation toward realizing the Cambodia vision 2050 phase IV of the Royal Government of Cambodia of the sixth legislature of the national assembly. Phnom Penh http://cnv.org.kh/wp-content/uploads/2012/10/Rectangular-Strategy-Phase-IV-of-the-Royal-Government-of-Cambodia-of-the-Sixth-Legislature-of-the-National-Assembly-2018-2023.pdf

[4] Strategy 2030, Achieving a Prosperous, Inclusive, Resilient, and Sustainable Asia and the Pacific. ADB, July 2018 https://www.adb.org/sites/default/files/institutional-document/435391/strategy-2030-main-document.pdf

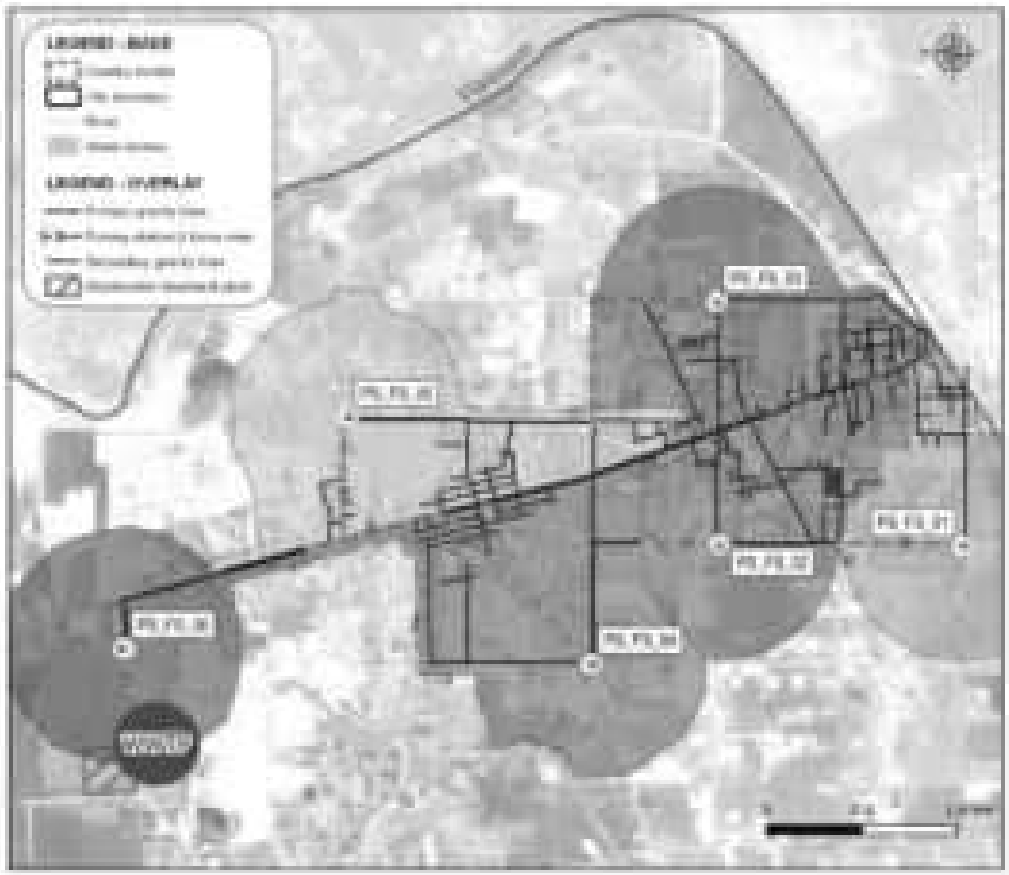
2.1. Wastewater

6. There is, at present, no sewer network and no WWTP. The assessment of the fecal and non-fecal waste disposal chain, both in rural and urban areas, suggests that 74% of fecal waste is not managed safely. Within the town center, wastewater is not being adequately evacuated from urban areas and remains stagnant.

7. A master plan was prepared which assessed various technical scenarios; in discussions with the Ministry of Public Works and Transport (MPWT), provincial government, and municipal administration, the scenario involving the construction of a centralized WWTP to serve the built-up area of Bavet and its extension in the medium and long term horizon was selected. Under LCIP, providing sewerage and connections to the existing population will be the priority but with the expected capacity required for the long term. To encourage households to connect to the sewerage system, the cost of connection will be subsidized by the project. It is proposed to start the implementation with:

(i) Construction of a WWTP for the initially connected population;
(ii) Construction of pumping stations to create a transfer chain to the WWTP; and
(iii) Construction of sewer pipes designed primarily for the selected existing built-up areas with some capacity for extensions for future growth.

Figure 1: Proposed Service Areas (wastewater)



Source: Egis, 2021

8. The Project focuses on the sewerage system for the areas delineated by the zoning 2025 (short term area) but provides infrastructure designed for future needs.

Table 1: Wastewater – investment horizon and Design Capacity

item	LCIP – investment horizon	Design Capacity
Sewer Network	2025 – short term or priority area	2040
Pumping Stations & Force mains		Equipment 2030 Civil works 2040
WWTP		2030

Source: Egis, 2021

Table 2: Summary table of investment in Bavet (wastewater)

Investment Area	Components
Pumping stations	6 PS
Networks	66 km of gravity lines, 9.5 km of force mains
Wastewater Treatment Plant	Waste Stabilization ponds

Source: Egis, 2021.

2.1.1. Wastewater treatment plant

9. The WWTP is designed for the medium term (2030) maximum capacity of 3,930 m^3/day as describe in the Master Plan and if the extensions described in the sector master plan strategy is implemented. These extensions will require additional investments. Therefore, the volume of wastewater and septage collected by the sewer system will be limited by the infrastructure proposed in the LCIP investment (designed as part of the current feasibility study) and the increase in population until 2040 in the collection service area.

Table 3: Wastewater and septage flow projection

item	unit	2025	2030	2040
Domestic population	Inhabitant	9,948	13,133	53,779
SEZ population	Inhabitant	39,306	39,306	39,306
TOTAL population connected	Inhabitant	49,254	52,439	93,085
TOTAL wastewater volume generated	**m^3/d**	2,909	3,376	7,960
TOTAL Septage volume generated	**m^3/d**	**21.1**	**21.8**	**24.3**

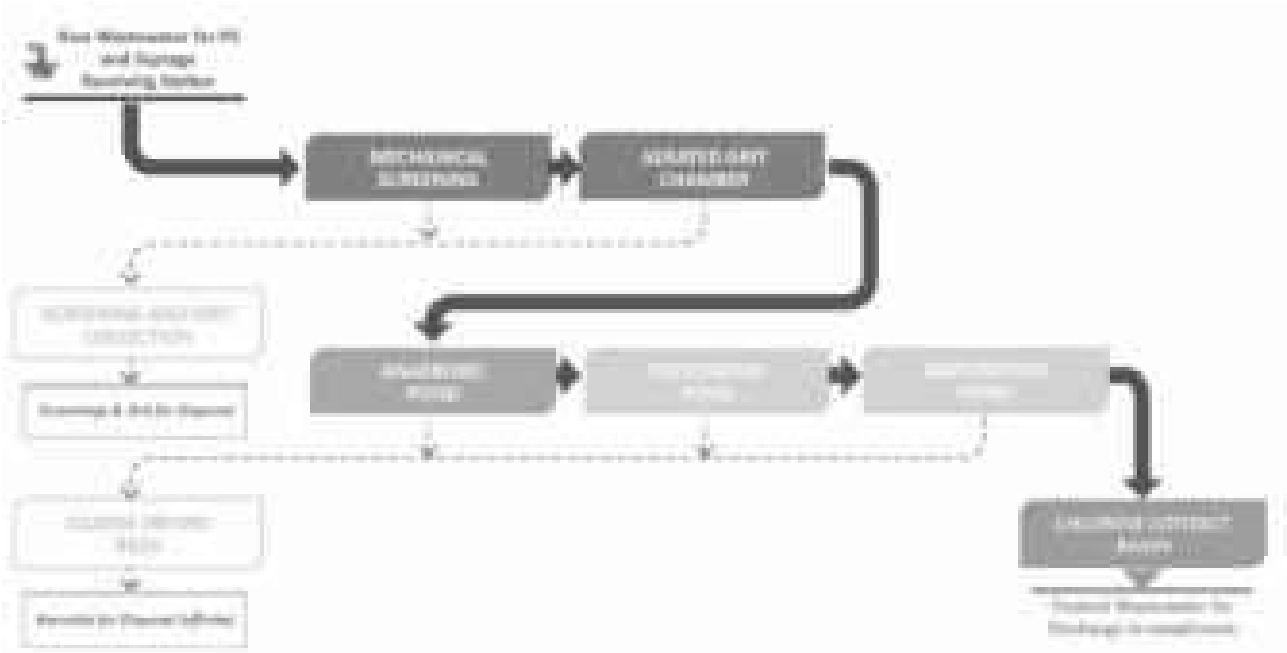
Source: Egis, 2021.

10. The WWTP site is located on 23ha of the public land, which is part of the 304 ha of Chamkar Konkoki Community Forest. It was provided by MAFF (letter No.2949, April 2017) to Svay Rieng provincial governor to construct the WWTP (Appendix 1), adjacent to the existing Materials Recovery Facility (MRF) constructed in 2018 by GMS1 project. The proposed site is a portion of land that is a mix between a regrowing natural forest and acacia plantation. The footprint of the WWTP under the loan is expected to be 20 ha.

11. The WWTP Site is accessed by a 1.5 km long dirt road connecting to National Road (NR). 1. Consequently, no new access road is required for the site location, with only minimal annual maintenance of the access road required each year. The closest electrical grid is along the NR. 1 (1.5 km from the proposed site). Service water network availability close to site location for serving the domestic needs of WWTP will be assessed during the detailed design phase.

12. As the **Waste Stabilization Pond (WSP)** is a typical treatment process well used in Cambodia and mainly for capacity building and operation costs reasons, this treatment process has been assessed and is preferred. The following Figure shows the related process flow diagram.

Figure 2: Process Flow Diagram – Waste Stabilization Ponds (WSP)



Source: Egis, 2021.

13. The dominant biological reactions that occur in the projected Waste Stabilization Pond system are listed below:

(i) **Anaerobic Ponds**: Anaerobic conditions prevail throughout the entire pond depth. The whole pond depth will be lacking oxygen except at a thin layer at the surface and rely totally on anaerobic digestion to achieve organic removal. Waste conversion is performed by a combination of precipitation and anaerobic metabolism of organic wastes to carbon dioxide, methane and other gases, acids, and cells. Typical BOD reduction of 40% will be achieved in anaerobic ponds. Influent waste settles to the bottom, and partially clarified effluent is discharged to downstream treatment.

(iv) **Facultative Ponds**: These ponds typically range from three (3) to eight (8) feet in depth. They contain a supernatant (upper) layer that is aerobic, and lower layers that are anaerobic. The key to facultative operation is oxygen production by photosynthetic algae. The oxygen is utilized by the aerobic bacteria in stabilizing the organic material in the upper layer.

(v) **Maturation Ponds**: This type of pond is also known as a polishing pond, for polishing effluent from other biological processes. Dissolved oxygen is furnished through photosynthesis. These ponds provide some additional organic removal but are important for pathogen reduction.

14. There is no rotating equipment in the WSP system.

Figure 3: WWTP layout

Source: Egis, 2021.

15. The WWTP process has been design using proven technology both in western countries and in Cambodia. Hence, sizing parameters used for this project are COD, BOD, TSS, total nitrogen and total phosphorus only.

16. The following table summarizes the treatment efficiency with the technology selected for the project.

Table 4: Treated Wastewater Concentrations – Waste Stabilization Pond Technology

Parameters	Expected Concentrations (mg/l)	Theoretical Treatment Efficiency (%)
COD	125	75
BOD	30-40	80-90
TSS	40-100	70
Total Nitrogen (TN)	15-20	50-70
Total Phosphorus	5-10	50-70

Source: Egis, 2021.

17. **Septage management.** In the urban areas, it is estimated that 75% of the population will have access to the sewer system. The remaining portion (remote households too far in rural areas for any connection) will have, therefore, on-site sanitation. The septage management can be described through this sanitation chain:

(iv) Septage collection. Based on the Comprehensive City Survey (CCS), most of the existing domestic septic tanks are unlined or inaccessible. A campaign for the rehabilitation/replacement of septic tanks not connected to the proposed centralized sewerage system is recommended, but no provision of new septic tanks is included in this project;
(v) Septage transportation: Mechanical desludging (vacuum truck);
(vi) Septage treatment: co-treatment at the wastewater treatment plant.

18. **Septage Co-treatment.** A receiving septage station is constructed in the WWTP site, and the septage is added at the plant headworks, between the screening stage and the grit chamber. Septage collection service and treatment will be designed for:

(i) Households in urban areas that are not connected to the sewer system (25% of the urban population);
(ii) New households in rural areas that follow the construction permit;
(iii) Institutions and Commerce that are not connected to the sewer system.

19. An initial step for raw septage screen will be implemented to remove coarse material from it to avoid damages and efficiency loss during the next treatment stages. The waste retained by the screen is evacuated to a screw compactor to reduce their volume. Compacted wastes are stored in containers before final disposal to the project landfill.

20. Raw septage is transferred after screening into a control tank, wherein the operator can observe the appearance of the load and lead to further action in case of illegal waste (e.g. hazardous or toxic sludge from industrial WWTP).

21. As for the mixed storage tank, its capacity is sufficient to ensure a buffer volume of raw septage to feed with a constant flow rate the WWTP. The control and storage tanks will be designed as follows:

(i) Capacity of the control tank: 10 m^3;
(ii) Capacity of the storage tank (2 days retention time): 40 m^3.

22. **Tertiary Treatment.** The effluent from the maturation pond needs to be disinfected as a back-up for achieving the required of pathogen removal (E.coli) consistently. For this purpose, the project design includes chlorine contact basins with an approximate retention time of 15 minutes considering maximum peak dry weather flow.

23. **Discharge point**. The WWTP treated effluent will be discharge to an existing canal that is heading southward for 1.3 km through agricultural area. The canal merges with the main irrigation canal network.

24. **Sludge Treatment**. For the purposes of design, a conservative approach of de-sludging from ponds at least once in 6 months has been considered and the sizing of sludge drying beds are estimated accordingly. Practically, de-sludging is expected to be necessary every two or three years, as long as there is no abnormal sludge blanket increase in the ponds.

25. Sludge drying beds are proposed for the purpose of dewatering sludge and are designed with adequate solids loading to ensure the solids accumulated over a period of time are handled properly before being discharged. At this stage, it is assumed that the dried solids will be disposed-off site and will be taken to the projected composting plant for further treatment. Laboratory test will be realized systematically to confirm that the sludge is suitable for composting before each transfer. Otherwise, it will be landfilled with common wastes.

2.1.2. Sewer and pumping stations

26. The drone topography survey conducted in January 2019 shows that the available slopes are not enough to convey wastewater to the WWTP by gravity.

27. Due to the remoteness of the WWTP and to the flatness of the city, pumping stations will be required to drain the wastewater to the treatment plant. The pumping station capacity is designed to receive the wastewater flow at the horizon 2040 according to the expected future extension of the urban area.

28. With the NR1 being a crest line of the city, gravity sewers are proposed to drain the sewage flow out of the urban built-up area. When the maximal depth is reached (i.e. 6 m), a pumping station will intercept the wastewater and convey it to the WWTP. The Figure 1: Proposed Service Areas (wastewater) presents the areas that allow reaching each pumping station by gravity while complying with the requirements of the sewer.

29. The network designed to carry wastewater flows has been split into six zones called “service areas”. Each service area corresponds to the whole gravity network connected to one pumping station.

30. **Gravity Network**. The following technical options are selected for the project:
(i) Maximal depth: 6m.
(ii) Pipe material: uPVC

31. Sewer lines are expected to follow existing and projected road alignments. This aims to avoid land acquisition or resettlement.

32. Several connection points are anticipated in the design. The purpose of these connection points is to allow future connections of the additional catchment that will be developed at mid-term and long-term strategy.

33. **Force Mains and Pumping Stations**. The following technical options are selected for the project:
(i) Maximal length for force mains: 3km.

(ii) Pipe material: HDPE.

34. The location of the convey chain offers the following advantages:

(i) Optimize the use of gravity lines to drain the sewerage network out of the current built-up area;
(ii) Enable the connection to the sewerage network for future urban growth, including the fast-growing casino area; and
(iii) Limit the force mains length alternating force mains and gravity mains along the convey chain.

35. As a first approach, a surface of 20m x 20m (surface of 400m²) is considered for the implementation of pumping stations. The sites are all located near existing roads. Figure 1: Proposed Service Areas (wastewater) presents the location of each pumping station. The location of pumping stations is preferred close to natural water bodies or planned drainage networks to control better overflows in the event of a failure.

36. **Maintenance.** As the network will be new, the breakage rate is expected to remain low for the network. No maintenance is scheduled for the concrete structures. However, equipment such as trucks and pumps will require preventing maintenance (on a regular basis) and a reactive maintenance will be performed in case of failure.

2.1.1. Equipment

37. In total, 3 vacuum trucks are needed for septage collection. Based on the total number of trucks available in the city (1 from the private sector), it is suggested that only 2 additional vehicles to be purchased as part of the project. In addition to those vacuum trucks, 1 additional vacuum truck is required for maintenance purposes on the sewer network. (assuming 1 vacuum truck can clean up to 3 km/day, 15% of the overall network length should be cleaned each year). In total 3 vacuum trucks are required.

38. Two pick-up cars and one utility truck are also considered for the daily needs of the staff.

2.2. Stormwater drainage

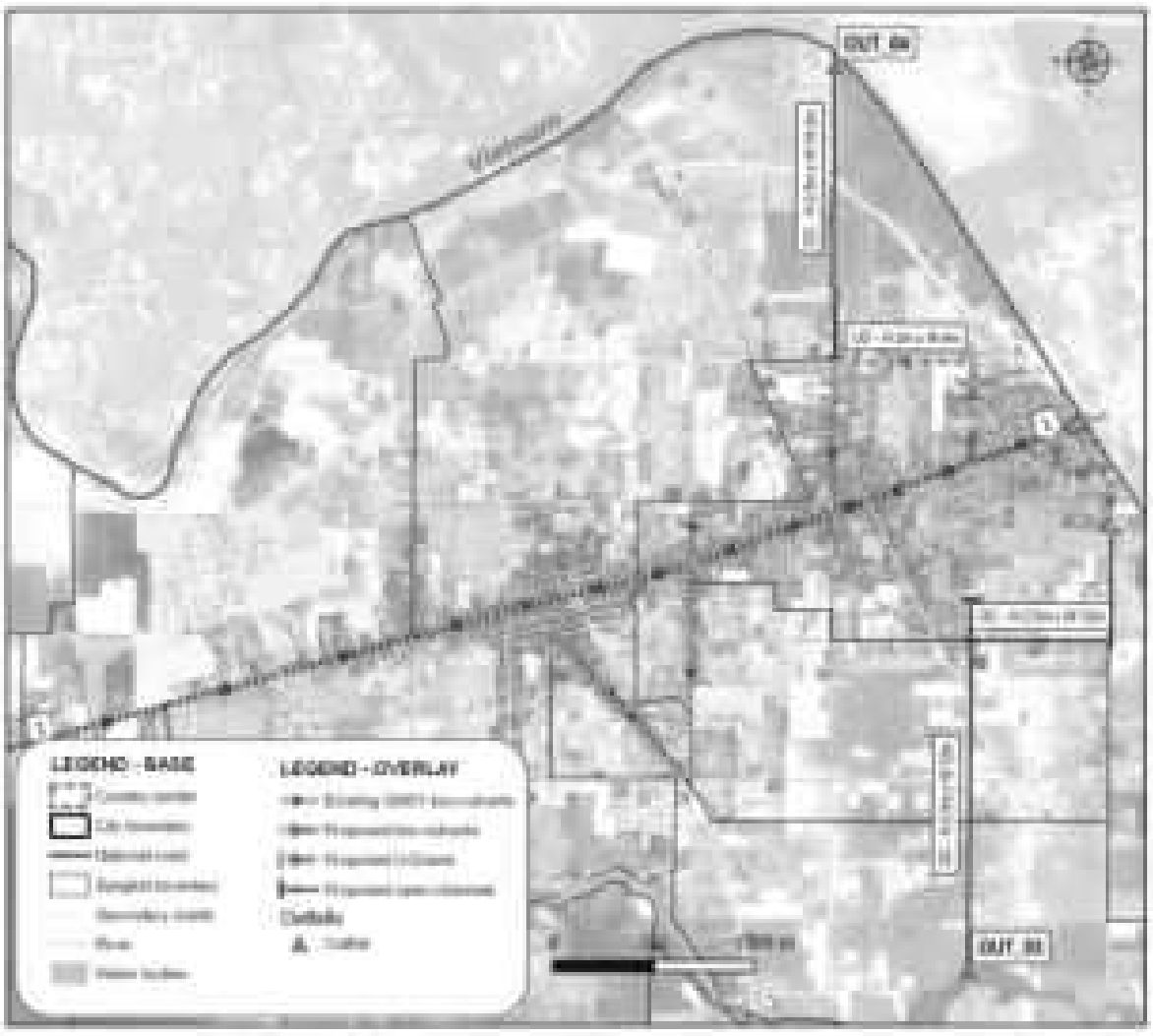
39. Bavet has more than 20 km of open channel network. The size of those channels varies between 2 and 4 meters and depth from 1 meter to 3 meters. The open channel network is now considered as the main drainage infrastructure. This network is the outfall of some drainage/sewerage pipes.

40. Except for the area covered by GMS 1 (refer to footnote 1), there is currently no existing overall strategy and roadmap for the sector. The implementation of the new drainage section does not seem to follow an overall strategy but a patching logic based on the urban development.

41. Recurrent floods are reported by inhabitants and local authorities. Main stormwater channels are operating properly but their capacity is not sufficient to ensure proper drainage of the city center.

42. The proposed drainage network follows the natural topography and discharges at low points of the road. As much as possible, the few existing cross-drains will be reused to limit the cost of road cutting and reinstatement.

Figure 4: Proposed Service Areas (stormwater)



Source: Egis, 2021.

Table 5: Summary table of investment in Bavet (stormwater)

Investment Area	Components
Box culvert	1.9 km
Open channel	6.8 km
U-drains	1.0 km
Outfalls	2

Source: Egis, 2021.

43. **Urban Drainage with Capacity for 1 in 5 Years Storm Runoff.** Following the guidelines of the MPWT,[5] the selected maximal rainfall is a 1-in-5 year return period rainfall.

[5] MPWT. 2003. Road Design Standard. Part 3. Drainage (CAM PW.03.103.99).

This intensity is based on rainfall Intensity, Duration and Frequency (RDF/IDF) curve for Svay Rieng station, Svay Rieng province.

44. The system is designed for a rainfall cumulated height of 75 mm (max. intensity = 218.5mm/h).

45. **In urban areas**, to minimize the risk of blockage by solid waste and problems related to resettlement, underground network (box-culvert) will be prioritized. This choice will limit urban development constraints on the surface. The depth and width of the proposed box culvert will allow storage and a slow drainage.

46. The following equipment will be implemented for each line:
    (i) New side-catch basins will be installed every 50 m length to ensure runoff flows to the new drainage channels, and to facilitate maintenance and silt removal. They will be equipped with metal grates.
    (ii) Manholes. To allow inspection of buried box-culverts, manholes will be disposed every 100m.
    (iii) Concrete rectangular box-culvert will be laid in open-trench and buried. Typical cross-section dimension: 3 m width box-culvert for 6 m width road, 6 m width double box-culvert for 8 m width road.

47. **In rural areas**, the irrigation canal system is well developed in Bavet. It is proposed to enlarge those existing trapezoidal earthen open-channels. This drainage solution fits with the actual land use. In the future and as the urban development will grow, it might be needed to replace it with box culvert lines. The maintenance will have to be increased to clean mud deposit and ensure the drainages lines capacity. In Bavet, part of the open-channels were proposed to be rehabilitated, according to the following process:
    (i) Creation of a drying area. This area will be used to store and dry naturally (infiltration and evaporation) the wet-material recently excavated before transportation;
    (ii) Tree and bush cutting and removal on the drainage network width;
    (iii) Excavation of dry materials (located above the open-channel water level);
    (iv) Once the water surface is reached, excavation of wet material is done (located below the open-channel water). Wet materials are disposed on a drying platform before being transported.

48. The existing secondary drainage network needs to be re-connected to the proposed drainage lines to get a consistent strategy for the whole drainage network. Secondary network connections will be studied during the detailed engineering design based on a detailed topographical survey.

49. **The catchment n°03** is located in the Southern part of NR1. The overall size of the catchment is 490 ha, with a densely built-up area in the upper part. The remaining land cover is mainly paddy rice field. The outlet of the proposed drainage lines is Ta Pov River. The maximal flow at the discharge point is estimated at 27.1 m^3/s, according to 2040 expected operation conditions (whole upstream catchment connected).

50. The stormwater flow is then drained into trapezoidal open canals. A field mission combined with the drone imagery allowed estimating the size of the existing channel at the same location as the proposed ones.

51. **The catchment n°04** is located in the Northern part of the NR1. The overall size of the catchment is 301 ha, with a densely built-up area in its upstream part. The remaining land cover is mainly paddy rice field. To reduce the cost of implementation, a U-drain line is proposed to replace the box culvert line in the not yet built-up area.

52. A wide-open channel will collect the stormwater out of the u-drain line and box culverts to drain it further North and reach the outfall n°4. An existing wide canal will be enlarged and strengthened to ensure that the runoff will be drained.

53. The outlet of the proposed drainage lines is a large existing canal near the Cambodia/Vietnam boarder. A Vietnamese solar farm is located on the other side of the border. Both side of the canal are actually wet land. The canal is currently 16m width and gets to a dead end on one side of a secondary street. A low water flow reaches the opposite side through two existing concrete pipes. The existing network continues toward a receiving water body located about 350m north within the Vietnamese territory.

54. In case of intense rainfall events that would fill up the canal, the overflow can be managed by flooding the side agricultural lands. This land is bordered on the south part by the newly built ring road. This road is elevated 1.5m above the ground level of the agricultural land. The impact due to eventual flooding in the proposed land would not impact the land beside this road.

Table 6: Drainage Lines Summary

Catchment n°	Trapezoidal open channel length [m]	Trapezoidal open channel slope [%]	Box culvert length [m]	Box culvert slope [%]	U-Drains length [m]	U-Drains slope [%]
03	4,633	0.04%	1,117	0.08%	-	-
04	2,200	0.008%	746	0.24%	1,029	0.05%
TOTAL	**6,834**	**-**	**1,863**	**-**	**1,029**	**-**

Source: Egis, 2021.

55. The operations and maintenance for drainage network will focus on: (i) keeping the drainage systems free from any obstruction (inside and outside the box culvert and at outlets); and (ii) controlling illegal sewerage connections to the drainage system.

2.3. Solid Waste Management

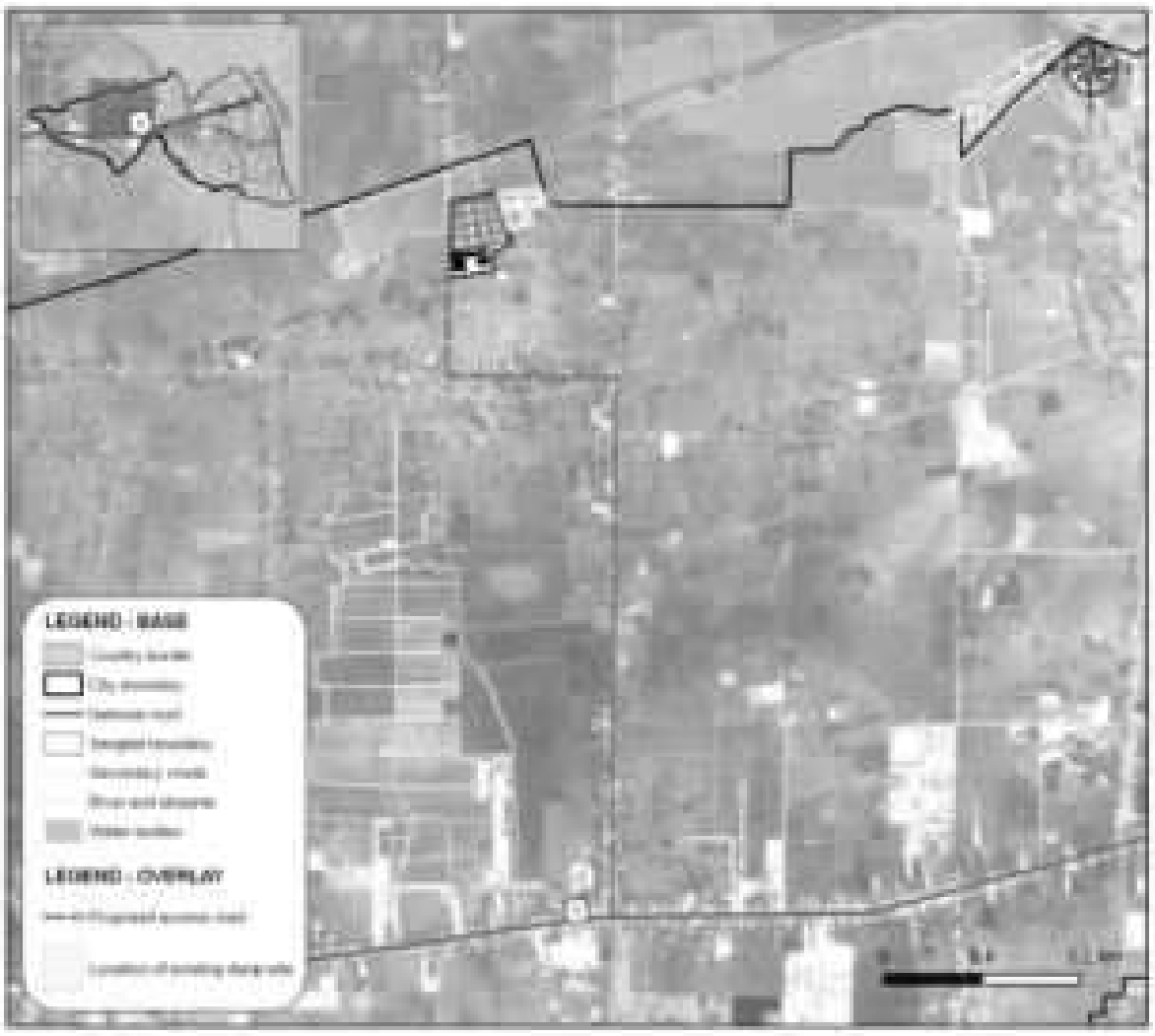
56. Based on the situation assessment of Bavet, it is estimated that 85% of the solid waste generated is unsafely managed. The household collection coverage is only approximately 14%. A large portion of the Municipal Solid Waste (MSW) is also left uncollected and is dumped directly in the nearby environment and/or burnt. It is necessary to improve the collection for the whole city.

57. In terms of collection, door to door collection is preferred in the city center while a centralized collection is suggested in rural areas until these areas are sufficiently developed to allow door-to-door collection. Source segregation at markets, with a dedicated centralized collection point, would be an opportunity to increase the sorting of bio-waste and, therefore, the potential for compost production. A total of 16 compacting trucks need to be acquired through LCIP to improve the collection. Regardless of the institutional arrangements that will be adopted

during implementation (i.e. service is outsourced), at this stage, it is assumed that the truck fleet will need to be acquired by the project to provide the service.

58. In terms of treatment, a sorting plant (capacity 53,041 tpy) and a composting plant (capacity 3,379 tpy) have been identified as the most appropriate technologies: (i) to reduce the amount of waste to be landfilled; (ii) to control part of the market for recyclables to increase revenue potential; and (iii) to contribute to climate change mitigation. Finally, a controlled landfill is proposed as the most appropriate disposal system for the city to avoid the harmful dumping and burning of waste. The design of the landfill has been based on 20-year design life, comprising of 16 cells. In the first phase, 8 cells will be constructed. Total design capacity is 1,032,609 m^3 but only capacity 516,305 m^3 will be delivered as part of LCIP (site: 20 ha – to be acquired). The proposed landfill site location was visited and approved by MoE through the letter No. 1555, dated 23 November 2020.

Figure 5: Proposed landfill and composting plant location (SWM)



Source: Egis, 2021.

Table 7: Summary table of investment in Bavet (SWM)

Investment Area	Components
Collection	16 collection trucks (compacting trucks)
Treatment	1 sorting-plant (capacity 53,041 tpy) and 1 composting plant (capacity 3,379 tpy)
Disposal	1 controlled landfill (capacity 516,305 m^3)

Source: Egis, 2021.

Table 8: Solid Waste Management Sub-Components

Sub-component	Options	Design Capacity
Collection		
Rural area collection	Centralized collection points	
Urban area collection	Door to door collection	
Market biowaste collection	Centralized collection points with segregation at source	
Treatment		
Sorting plant	Sheltered sorting line, managed as an additional flow of the MRF	Designed for 2040
Composting plant	Windrow composting process	Designed for 2040
Landfill	Leachate management: combination of leachate recirculation and off-site treatment at WWTP LFG treatment: flare stack	Designed for 2030

Source: Egis, 2021.

59. **Waste Collection.** In the city center, door-to-door collection will be provided. In the dense urban area, where households are very close one to another, the door-to-door collection is a high service standard. Wastes are collected at each property limit. It is admitted that all the SEZ are within urban areas so collected with the door-to-door system.

60. **Biowaste collection from markets**. Tapao, International, Night market and Chiphu. Market sellers will manage the segregation at source and bring the biowaste to the collection point. It is assumed that 80% of the market biowaste could be recovered by implementing such a dedicated collection system. Biowaste should be collected in waste containers of 660L located at markets in a 15 m^2 storage area. One compacting truck of 5t capacity will be required to collect biowaste in each market.

61. **Hazardous household waste**. This waste category includes waste motor oils, car batteries, batteries, paint, solvents, etc. which will be deposited at a centralized collection point at the material recovery facility (MRF), built as part of GMS 1. There are currently no available facilities for recycling of hazardous waste within an economically-viable distance of Bavet. Waste motor oil could be transported to Kampot, for refining and reuse, but the relatively small quantities that would be collected cannot be transported economically. It is proposed that waste motor oils, batteries, car batteries, and household hazardous waste be temporarily stored at a storage platform to be created at the controlled landfill until an economically viable quantity can be collected for shipment to treatment and elimination facilities in Phnom Penh or elsewhere.

The storage area will be created on embankments. The hazardous waste can be stored in dedicated container by waste type within lockable standard 20 or 40 foot shipping containers. Within the shipping containers, the hazardous wastes will be stored in dedicated and suitable containers by waste type. Every 1-3 months the hazardous waste will be transported for disposal in a permitted industrial landfill in outskirt of Phnom Penh. However, each SEZ will be responsible for hazardous waste generated by its commercial activities including proper storage and transportation of the hazardous waste.

62. **In rural areas**, households are relatively scattered and/or with poor road access (most of the roads in rural areas are not asphalted). Therefore, centralized collection points are preferred to door-to-door to limit the collection cost. The centralized collection points are designed with 10 to 20 plastic containers of 660L capacity. The containers are housed in open shelters (20 m^2), with access to the containers from the sides of the shelter. There are 8 proposed locations in the rural sangkats at the junction of major roads. These points would be located along the main roads (which are mostly asphalted).

63. Collection improvement will also include accompanying measures, including raising public awareness on managing their waste properly (at schools, etc.) thus raising the general willingness to pay for a better service.

64. **Sorting Plant**. The aim of the sorting plant is to sort the following fractions: valuable plastics, including PET bottles, plastic glasses and plastic bags; cans and metals; and the fraction of green waste >80 mm for composting. The existing MRF will keep its duty aiming to receive and transfer recyclable wastes collected by waste pickers and hazardous waste brought in by households.

65. The sorting line process is as follows:
    (i) Reception area. Collection trucks discharge in this area. A wheel loader or a crane with a grab will grab the waste and feeds the sorting line.
    (ii) Sorting line. The sorting line will be built in a concrete-floored, open-plan hanger-type building (1,350 m^2, 90x15m).

66. The sorting line refusals are transferred to the nearby landfill.

67. **Green waste recovered** from the sorting line are transferred to the nearby composting plant. The capacity of the composting facility comprises 70% of biowaste from markets and 30% of green waste from the sorting plant. The composting facility can also treat sewage sludge from the municipal WWTP (in this case, the moisture content of the sludge should be lower than 80%).

68. The composting facility roof will consist of a 12 m high and 15 m wide steel frame building. This design will allow for better control of moisture management and thus reduce leachate production.

69. In preparation of the composting process, green waste from parks and gardens are shredded and mixed up with the biowaste from the markets. The green waste provides carbon and confers a suitable structure to the mixture, creating porosity in the mixture that will improve the oxygen supply to the composting bacteria. The biowaste from the markets brings both nitrogen and water, enhancing bacterial growth. This mixing process is important in the success of the subsequent composting process.

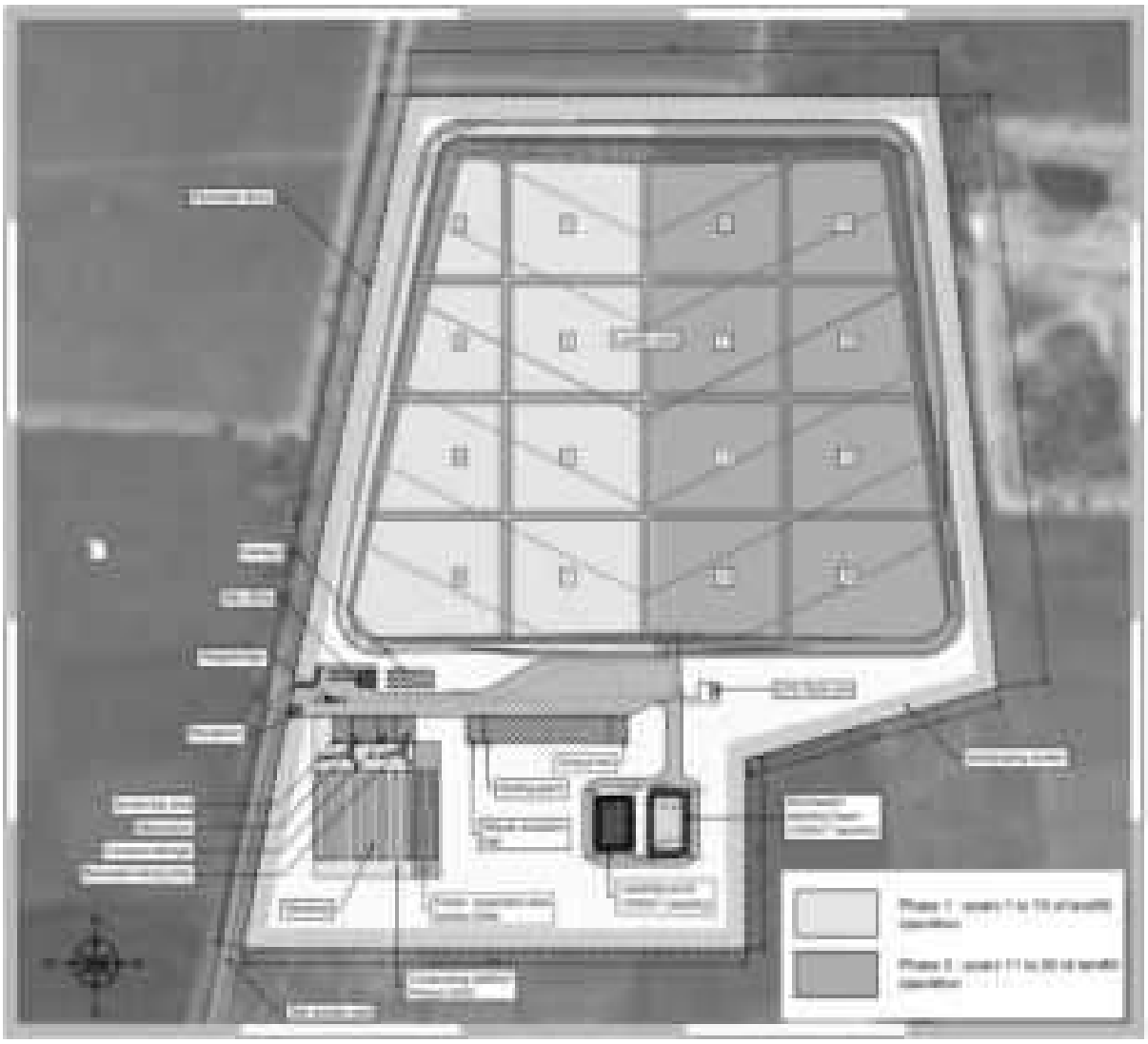
70. Then, the biowaste is placed in windrows on the composting platform, with a typical size of 50m length, 4m width, and 3m spacing between the windrows (7 windrows and 2,940m² are required for the project). Each day of the two month process, the windrows are turned with a windrow turning machine on a tractor. The tractor can also carry a water tank in order to add water into the windrow when the moisture content is too low. In the rainy season, windrows are covered from rainwater with a plastic cover system in order to reduce leachate production. After two months the fresh compost is screened before being moved to the maturation area. The screen size is 20mm. The overflow material is mixed with the fresh waste to improve the structure and starting conditions of the composting process.

71. The compost is ready to use after a final maturation process. The maturation area is a bay, sized for 1 month storage. It is divided into two separate bays i.e. surrounded by 3 concrete walls. In 2040, the compost production will be approximately 1,132 tons per year. The compost can be sold in bulk and in bags. The expected compost production by horizon is

(i) In 2025: 772 tons/year;
(ii) In 2030: 1,014 tons/year;
(iii) In 2040: 1,132 tons/year.

72. **The New Controlled Landfill** (land to be acquired) will be created close to the current dumpsite. The access road for the controlled landfill will need to be paved over 5km.

Figure 6: Landfill general layout



Source: Egis, 2021.

73. In accordance with the “Integrated Solid Waste Management for Local Governments, A Practical Guide” (ADB, 2017), the purpose of the landfill facilities is to receive residual waste that cannot be recovered, re-used or recycled; in particular, the landfilling of easily biodegradable wastes should be avoided as these have the greatest potential for environmental impacts such as odors, vermin, disease, and impact to groundwater. Some waste types are explicitly excluded from the landfill: (i) all types of hazardous waste; (ii) liquid wastes.

74. The void space that will be required in the landfill is estimated as 1,032,609m^3. The landfill cells will cover a total area of 8.4 ha, and will be subdivided into 16 cells of approx. 4,800m² each, to be filled sequentially over the course of the 20 year design life. The maximum height of waste within the cells will be 16m above existing ground level, with a maximum waste depth of 20m.

75. The landfill cells will be created by excavating to an average depth of 5m below existing ground level: the excavated soils will be used for the perimeter bund, as daily cover, and for the

final cover at the end of filling. The base of the landfill cells will be reworked, graded and compacted to ensure a uniform and firm base for the landfill.

76. The landfilling of the waste will be done sequentially, cell-by-cell and in a series of vertical lifts. The aim is to limit the extent of the working landfill face to reduce windblown waste and reduce the vertical infiltration of rainwater into the waste (producing leachate). The waste will be covered periodically with an intermediate or daily cover of soil taken from the on-site stockpile.

77. A final cover layer will be placed progressively over the waste mass during the course of the landfilling. Before the installation of the final cover layer, the surface of the waste mass may need to be re-modelled to provide a uniform final site profile to ensure adequate surface run-off and allow for long-term settlement of the waste. The final cover will comprise at least 0.5m of fine-graded soil, preferably silt or clay. The profile of the final cover system will have a slope of 4 to 6 % to ensure adequate surface run-off and allow for long-term settlement. The final cover will be grassed to ensure the integration of the closed site with its surroundings.

78. The landfill will share common facilities with the composting and sorting plants, such as the site management offices, worker sanitary facilities, a garage for plant maintenance.

79. The landfill cells will have a low permeability liner with a permeability less than $1x10^{-9}$ m/s, comprising a geomembrane liner of 2mm thick high-density polyethylene (HDPE) fusion-welded geomembrane. The HDPE geomembrane will be protected by a non-woven geotextile fabric.

80. **Leachate Drainage and Treatment**. The basal liner (HDPE geomembrane) will be overlain by a leachate drainage layer consisting of 0,5m of soils of permeability greater than or equal to 10^{-4} m/s (e.g. clean well-graded sands or gravels). The leachate will be drained by gravity towards the collection well at the low point and then, still by gravity, to the leachate storage lagoon, which has a capacity of 1,000m^3 capacity – 400m^3 for the run-off from the composting platform (20-hour duration for 10-year rainfall event) and 600m^3 for leachate.

81. It is proposed to use a combination of leachate recirculation and off-site treatment at WWTP. The majority of the leachate will be recirculated back into the landfill mass, with the excess being tankered for treatment at the WWTP. The recirculation uses a pump in the leachate pond, with pressure lines leading from the leachate pond up to the landfill surface, where the leachate enters the waste mass via infiltration drains or wells.

82. **Landfill Gas (LFG) Extraction and Treatment**. The LFG is assured by vertical wells at a density of 2 – 3 wells per cell. The LFG extraction system (collection and treatment) is funded by the project and will be later installed during the landfilling operations. It takes approximately. 3-5 years before LFG will be generated. The LFG wells are vented by a blower, applying a negative pressure to the waste mass and extracting the LFG, which is then combusted in a flare stack. Such a system can work full-time or intermittently, depending upon the rate of production of LFG, but does require a LFG that is sufficiently rich in methane. The estimation of LFG production indicates that a LFG-to-energy plant would not be a cost-effective solution for the site conditions.

83. Landfill gas is a natural byproduct of the decomposition of organic material in landfills. LFG is composed of roughly 50 percent methane (the primary component of natural gas), 50 percent carbon dioxide (CO_2) and a small amount of non-methane organic compounds (NMOC).

84. **Management of Stormwater Run-off**. The cells that are yet to be filled will be kept hydraulically separate from the operating cells to avoid mixing clean rainwater with leachate. Any clean rainwater that accumulates in the unused cells can be pumped out by portable pump towards the surface run-off ditches. The storm-water run-off from the on-site road and hard standing areas will be collected in the run-off ditches and then to the settlement lagoon before discharge to the water course.

85. The rainwater run-off on the hard-standing surfaced areas of the site will be collected by surface water ditches and then drained to a retention and settlement lagoon situated at the southern of the site before discharge to the nearest water course. The stormwater retention lagoon has a storage capacity 1,200 m^3 capacity, designed for the hard standing areas of the site on the basis of 20 hour duration for a 10-year rainfall event. The storm-water settlement lagoon will also serve as a reserve of water for fire-fighting purposes.

86. **Groundwater Monitoring**. The landfill will be provided with three groundwater monitoring wells, one up-gradient and two down gradient of the site. The sampling of the groundwater wells will be done on a six-monthly basis.

3. Rationale for an Environmental Assessment or Environmental Impact Assessment

3.1. Cambodian Background

87. In 1996, the Law on Environmental Protection and Natural Resources Management (NS/RKM/1296/36) came into force. The law requires the government to prepare national and regional environmental plans and sub-decrees concerning a wide range of environmental issues, including environmental impact assessments (EIAs), pollution prevention and control, public participation, and access to information. The Law on Environmental Protection and Natural Resource Management (1996) is the enabling legislation which allows the Ministry of Environment (MOE) to pass sub-decrees and regulations to protect the environment. Several sub-decrees are already laws while there are sub-decrees which have been drafted and are expected to become law in the near future.

88. Environmental impact assessment in Cambodia is guided by the Royal Government of Cambodia Sub-decree No. 72 ANRK.BK on EIA, and the classification of EIA study level under the Prakas No.21, 2020 on Environmental Impact Assessment Classification for Development Projects. In compliance with the regulation in Cambodia, 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.

89. The Annex of the decree No.72 provides a list of project types that proponents use to screen projects for requiring either an Environmental Impact Assessment (EIA) or initial EIA (IEIA). As project owner, the MPWT will have to prepare an IEIA for drainage, wastewater system, and landfill in separately report, according to the Prakas No.21, 2020 on Environmental Impact Assessment Classification for Development Projects, item 143 (drainage), 187 (Natural WWTP and sewer system) and 188 (landfill) of this Prakas. However, following consultation with

EIA department[6], MOE indicated that drainage and sewerage system could be combined in one IEIA report.

90. Since the project will involve rehabilitation, extension, or creation of new public facilities, IEIAs will be required (one for wastewater / stormwater and one for solid waste).

91. IEIA and EIA are not necessary for the project preparation and loan signature but will be required prior to the implementation of the sub-project components.

3.2. ADB background

92. Approved by ADB's Board of Directors in July 2009, the Safeguard Policy Statement (SPS) builds upon the three previous safeguard policies on the environment, involuntary resettlement, and indigenous peoples, and brings them into a consolidated policy framework that enhances effectiveness and relevance. The SPS applies to all ADB-supported projects reviewed by ADB's management after 20 January 2010.

93. ADB will not finance projects that do not comply with its safeguard policy statement, nor will it finance projects that do not comply with the host country's social and environmental laws and regulations, including those laws implementing host country obligations under international law. In addition, ADB will not finance activities on the prohibited investment activities list.

94. The project screening and categorization at the earliest stage of project preparation has identified LCIP as "Environment" Category B. Therefore, an Initial Environmental Examination (IEE) is required. Further details on ADB's SPS is described in Section IV.

[6] Meeting with Dep. of EIA of MoE, Mr. Doung Samkeat deputy director, dates September 2020.

II. INSTITUTIONAL ARRANGEMENTS

1. Agencies/Organizations Involved

95. The national agencies that oversee environment and natural resources management are listed below.

(i) Ministry of Environment (MoE);
(ii) Ministry of Agriculture, Forestry and Fisheries (MAFF);
(iii) Ministry of Water Resources and Meteorology (MOWRAM);
(iv) Ministry of Mines and Energy (MIME);
(v) Ministry of Industry Technology Science and Innovation (MISTI);
(vi) Ministry of Land Management Urban Planning and Construction (MLMUPC);
(vii) Ministry of Public Works and Transport (MPWT);
(viii) National Climate Change Committee (NCCC).

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

97. The MoE is the primary agency mandated to implement Article 50 of the 1993 Constitution. The MoE is tasked to promote environmental protection and conservation of natural resources, thus, contributing to improvement of environmental quality, public welfare, national culture and the economy. This is embodied in the three pillars of development of the Royal Government of Cambodia. One of the three pillars is the sustainable use of natural resources and sound environmental management to reduce poverty and improve the livelihood of all Cambodians.

98. The EIA Department of the MoE oversees and regulates EIA and coordinates the implementation of projects in collaboration with project executive agencies and concerned ministries. The MoE has the following responsibilities:

(i) Review, evaluate, and approve submitted environmental impact assessments in collaboration with other concerned ministries; and
(ii) Monitor to ensure a project owner (the executing agency of the project) satisfactorily implements the EMP throughout pre-construction, construction and operational phases of the projects.

99. The MAFF is responsible for the management and protection of coastal mangrove forests, forest, and wildlife and fisheries. In Bavet the Prey Konkoki Community and Department of Agricultural Forestry and Fisheries in Svay Rieng province will be responsible for monitoring the impact on community forest, aquatic wildlife and territorial fauna and flora in the project area, especially Prey Konkoki Community Forest and will be consulted during any works on the community forest and compensation planting.

100. The MPWT developed an Environmental and Social Safeguards Policy (ESSP) for the Road Asset Management Project in 2008 to ensure that the rehabilitation of roads meets the social and environmental safeguard requirements of the MoE and donors such as the ADB and International Development Assistance. The ESSP is supported by an implementation framework (ESSF). The ESSF is applied to projects funded by all donors which includes a screening process for general environment, protected areas, resettlement, and ethnic minorities. Specific technical environmental guidelines have been prepared to ensure proper environmental management of activities within protected areas.

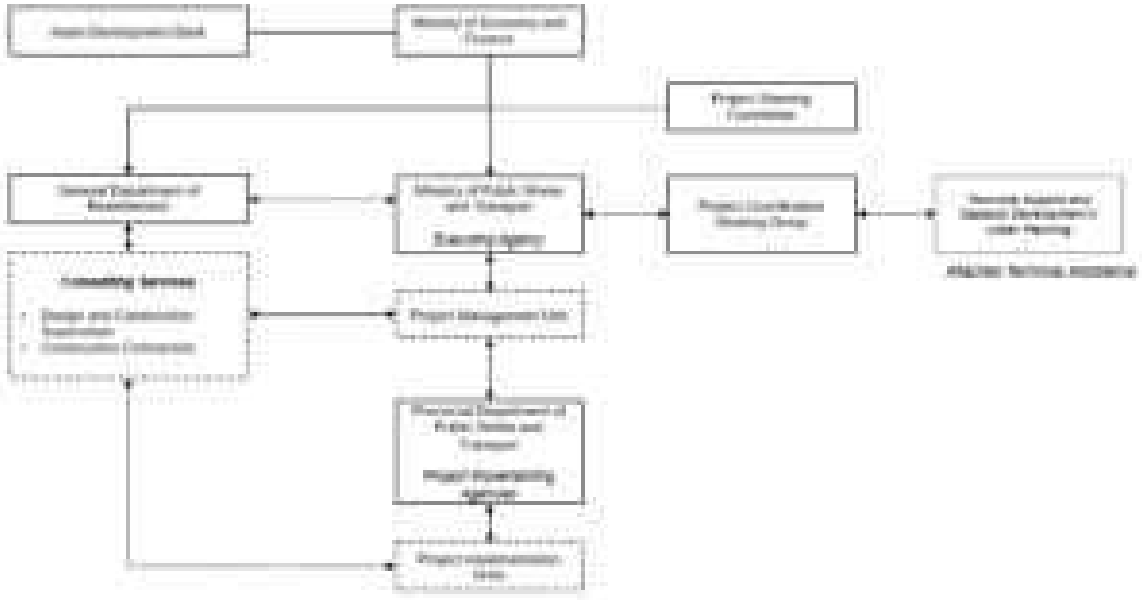
101. As the Executive Agency (EA) and Project Implementing Agency (PIA) are both under the umbrella of MPWT, MPWT ensures EMP implementation across all the project stages (pre-construction, construction, and operation and maintenance) as stated in IEIA/EIA (under national law) which is to be written in Khmer and should be carried out during the detailed engineering design (DED) phase of the project.

102. The local authorities including police force will be responsible for facilitation, controlling, and solving of any social conflicts that may happen in the project area. They will also assist the project executive agency to prevent illegal activities in the project area. So MPWT will work closely with them to ensure the project will be implemented smoothly.

2. Organizational Procedures

103. The proposed institutional arrangements during the project implementation are presented in the following **Figure 7**.

Figure 7: Relations between the different stakeholders for the project implementation



104. **Borrower**. As Borrower of the loan, the MEF has overall responsibility for the effective management and administration of public investment projects in Cambodia. It has a wide range of responsibilities which are described in its Standard Operating Procedure (SOP).[7]

105. **Executing Agency**. The MPWT has been designated by the MEF to be the EA for all Project sub-components. A PMU will be set up at the EA level. The PMU will be held accountable for the implementation and operation of the subproject on behalf of the EA and will work as a national subproject agency. The PMU will be led by a project director, who will be supported by deputy project directors, project managers, engineers/technical officers, safeguard

[7] MEF, December 2019. Standard Operating Procedure on Project Management for all Externally Financed Projects/ Programs in Cambodia.

specialists, procurement and financial specialists and administration support. It is recommended that at least one senior staff from the General Department of Sewerage and Wastewater Management (GDSWM) be part of the PMU to ensure an effective transition between the implementation hase and the future monitoring of the infrastructure.[8]

106. A PIA will be established to supervise and coordinate the implementation of the subproject investments. It will be responsible for coordinating with participating agencies and institutions to ensure broad participation in subproject related activities and to further enhance subproject ownership. A Project Implementation Unit (PIU) will be set up under the PIA, to coordinate the day-to-day implementation of the subproject. The PIU should include representatives of the municipal administration (MA), and the key departments such as the director/deputy director of the Provincial Department of Public Works and Transport (PDPWT), technical staff of the Provincial Department of Environment (PDOE), a technical staff of the Provincial Department of Land Management Urban Planning and Construction (PDLMUPC), and environment officer (PIU-EO) and social officer (PIU-SO). The MA, either through the participation of the Municipal Council members or technical staff of the Office of Public Works, Transport, Environment, Sanitation and Public Order Office (PWTESPO), should be closely associated with the PIU.

107. **Consulting support**. In addition, it is recommended that a Design and Construction Supervision Consultant (DCSC) be engaged, by the EA, which will include project management and capacity building services.

108. The DCSC will provide: (i) technical support, including the preparation of detailed engineering designs, technical specifications and bidding documents; (ii) construction supervision and contract administration; (iii) compliance with government and national policies and regulations, ADB's procurement policies and guidelines, Safeguards Policy statement, Gender and Development Policy, and Guidelines for Gender Mainstreaming Categories of ADB Projects; (iv) institutional capacity development; and (v) stakeholder engagement, awareness and communication activities.

109. The DCSC will also provide technical support to the PMU and PIAs concerning project management, financial, monitoring, evaluation procedures: (i) ensure that periodic project reviews are carried out; (ii) coordinate the reporting activities of the PMU, (iii) monitor and coordinate project-related procurement to ensure compliance with safeguard requirements; (iv) and support the PMU in implementation of the procedures required for land acquisition, including conducting and documenting consultations and the Grievance Redress Mechanism (GRM). The DCSC will also ensure that capacity within the PMU is built regarding ADB social safeguards requirements using both workshops and on-the-job training. The scope of the DSCS will also include conducting a behavior change analysis and awareness campaign and developing a communication strategy on wastewater and solid waste management to support the project in its social components.

3. Composition and functions of the Project Steering Committee

110. As indicated in paragraph 62 of the MEF SOP, a Steering Committee is recommended when more than one line ministry or agency is involved in implementing the Project.

[8] In December 2019, through sub-decree 220 ANKR BK, the Government established the General Directorate of Sewerage and Wastewater Management under the supervision of MPWT.

111. Although not mandatory, a project steering committee is suggested, given the scale of the project and the fact that it will involve a number of different line ministries, in particular, the MoE on environmental approvals, and MLMUPC on land use and spatial planning.

112. It is proposed for the LCIP Project Steering Committee (PSC) to have the following responsibilities:

(i) Provide guidance and policy direction to facilitate project implementation
(ii) Facilitate interagency and inter-ministerial coordination; and
(iii) Coordination of discussion among central level agencies.

113. The members of the Project Steering Committee should include (at least) the following representatives:

(i)	MPWT	Chair
(ii)	MPWT/GDSWM	member
(iii)	MEF	member
(iv)	MoE	member
(v)	MOI	member
(vi)	MISTI	member
(vii)	MLMUPC	member

114. To be official, the Project Steering Committee should be installed through a Prakas, and the members nominated through their positions – and not their names. Having the representatives mobilized based on their functions allows saving time, should the staff at the function changed.

115. The Steering committee will liaise with and be supported by other sub-committees, including:

(i) The existing Inter-ministerial Sub-Committee on Cost Recovery and Tariff Setting, chaired by MEF;
(ii) The existing Technical Sub-Working Group on Wastewater Management Chaired by MPWT.

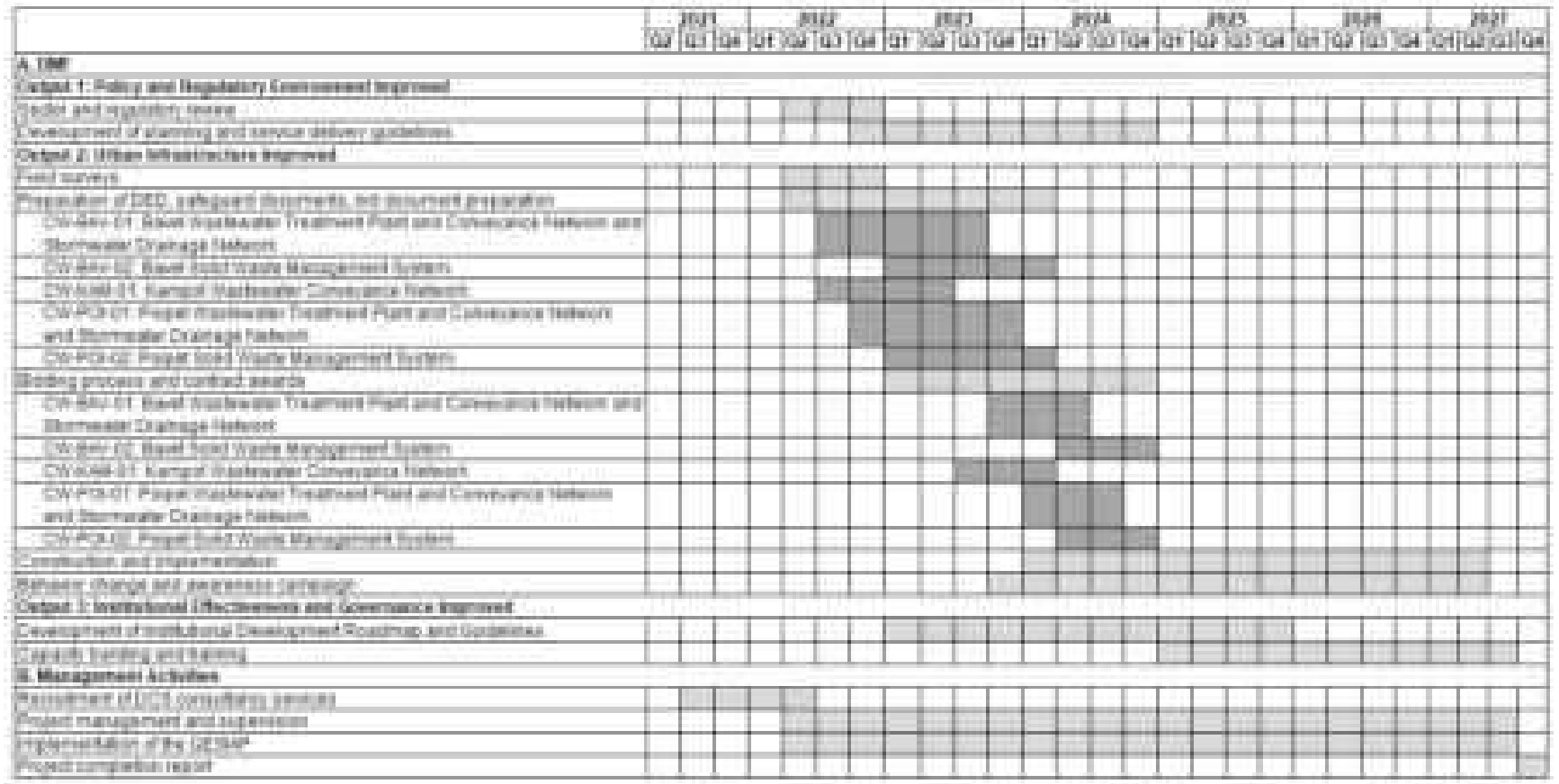
4. Implementation Plan and Schedule

116. The project is expected to be implemented over a 75-month period from August 2021 to December 2027 as shown in Figure 8.

117. This tentative implementation schedule is developed in conjunction with the Strategic Procurement Planning which assumes a DCSC will service the entire project. Within the DCSC, multiple design teams will therefore be required to carry out the study and supervision of the different components in parallel in order to achieve the project objectives.

118. The IEE report and its associated EMP will be updated at DED stage, and the updated DED stage EMP will part of the bidding documents. At this stage, both the updated IEE and EMP at DED stage will be re-disclosed, and updated stakeholder consultations may be needed. If any variation orders take place under project implementation it shall be assessed by ADB if the environmental due diligence will need to be further update and re-disclosed.

Figure 8: Tentative Project Implementation Schedule



DCS = design and construction supervision consultants; DED = detailed engineering design; GESIAP = gender equality and social inclusion action plan; Q = quarter.
Source: Egis.

5. Implementation Process

119. **Institutional Strengthening.** (a) The EA will assign one qualified environment officer (PMU-EO) and one social officer (PMU-SO) who will be the key focal point responsible for overall coordination, monitoring, and safeguard reporting for the project environmental and social safeguards. These officers will work closely with the PIU; and (b) the PIU will include one environment safeguard specialist (PIU-EO) and one social specialist (PIU-SO) (externally recruited experts), who will be responsible for coordination and daily implementation of the EMP and social safeguards. The specialists will work closely with the other PMU officers to ensure full and effective EMP implementation.

120. **Training in Environmental Management.** The PIU-EO, with the support of the EA, PIA and the consulting teams (DCSC), will provide training in implementation and supervision of environmental mitigation measures to contractors.

121. **Grievance Redress Mechanism (GRM).** The PMU/PIU will implement the project GRM at least two months before the start of construction, to ensure that the project communities are well informed and have an opportunity to discuss any concerns. This is further to the public consultations already conducted during project preparation (Section VIII).

122. **Bidding Documents and Contract Documents.** The EMP will be included in the bidding documents and contracts for procurement of civil works, goods and services. All contractors and subcontractors will be required to comply with the EMP and other safeguard documents to be included in the tender documents.

123. **Contractor Obligations.** Contractors, in their bids, will respond to the environmental clauses in the bidding documents for EMP requirements. Prior to construction, each contractor will develop its own construction environmental management plan (CEMP), based on the EMP and specific for each site, and assign at least one person responsible for Environment, Health, and Safety (EHS). Each CEMP shall include the following: (a) surface water protection (especially, to avoid or minimize impacts to water bodies); (b) spill control and management; (c) site drainage and soil erosion protection; (d) health and safety taking into account COVID-19 national guidance and international guidance;[9] (e) temporary traffic management; (f) construction site access control. CEMP will be submitted to the PMU for review (with consultant team review support) and endorsement and its implementation will be reported monthly to the PIU. Each contractor will establish grievance register and incident register and comply with labor law of Cambodia and core labor standards of International Labor Organization (ILO).

124. **Consultations and Disclosures.** Consultations and disclosure activities will be maintained with affected people and other involved stakeholders to ensure continued communication, including, for example: works schedule, details of activities including those that result in nuisances and disturbances, the status of claims, and other aspects.

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[9] See e.g.: World Health Organization. 2020. Considerations for public health and social measures in the workplace in the context of COVID-19. Geneva. Available here: https://www.who.int/publications-detail/considerations-for-public-health-and-social-measures-in-the-workplace-in-the-context-of-covid-19; HM Government. 2020. Working safely during COVID-19 in construction and other outdoor work. Guidance for employers, employees and the self-employed. Available here: https://assets.publishing.service.gov.uk/media/5eb961bfe90e070834b6675f/working-safely-during-covid-19-construction-outdoors-110520.pdf. The Canadian Construction Association. 2020. COVID 19 Standard Protocols. Available here: https://www.cca-acc.com/wp-content/uploads/2020/04/CCA-COVID-19-Standardized-Protocols-for-All-Canadian-Construction-Sites-04-16-20.pdf.

III. OBJECTIVES AND POLICY FRAMEWORK

1. Objective of the Environmental Assessment

125. The IEE and EMP have been prepared in accordance with the Safeguard Policy Statement (SPS, June 2009) of the Asian Development Bank (ADB), and the Law on Environmental Protection and Natural Resources Management, enacted by National Assembly (1996) of Cambodia and Sub-decree No. 72 ANRK.BK on EIA, its implementing guidelines. These IEE and EMP: (i) identify and assess potential impacts and risks arising from the implementation of the proposed project on the physical, biological, physical cultural and socioeconomic environment; and (ii) recommend measures to avoid, mitigate, and compensate for adverse impacts, and enhance positive impacts.

126. The IEE is based on site reconnaissance, relevant reports and documents (inception reports, sector master plans, urban development scenarios, and environmental and social baseline survey reports prepared by the TRTA[10] (Transaction Technical Assistance) of the three target cities), consultations with communities, and meetings and discussions with the government agencies.

2. Relevant Laws and Regulations

2.1. International Regulations, Conventions and Treaties

127. Cambodia is signatory to many international environmental treaties and conventions which provide a comprehensive legal framework. These include: Association of South East Asian Nations (1999), Biodiversity Convention (1994), Convention on International Trade in Endangered Species of Fauna and Flora (CITES) (1997), Ramsar Convention (1999) and Climate Change Convention (1995) (MoE 2006); Paris Agreement on Climate Change (2016); and Sendai Framework for Disaster Risk Reduction 2015-2030.

128. The Royal Government of Cambodia promulgated the Cambodia Climate Change Strategic Plan 2014–2023 (CCCSP) in response to the country's commitment to the United Nations Framework Convention on Climate Change. The CCCSP was prepared following the guidelines of the Council of Ministers and consultations stakeholders. The CCCSP is designed to address a wide range of climate change issues concerning adaptation, greenhouse gas (GHG) mitigation, and low-carbon development.[11] The MPWT's Climate Change Action Plan for Transport Sector 2014–2018 identified priority climate adaptation actions that include: (i) develop national road construction and maintenance design standards for national roads, taking into account climate change impact; (ii) repair and rehabilitate existing road infrastructure taking into account climate change impact and various other actions in relation to raising capacity and public awareness of climate change impacts; and (iii) capacity building and institutional strengthening for addressing climate change impacts.

129. The Royal Government of Cambodia is one of the pilot countries participating in the Pilot Program for Climate Resilience (PPCR) – one of the three sub-programs of the Strategic Climate Fund (SCF). The PPCR provides incentives for scaled-up action and transformational change in integrating consideration of climate risks and resilience in national development planning, consistent with poverty reduction and sustainable development goals. The priority sectors for PPCR in Cambodia include water resources,

[10] TA 9554-REG:Southeast Asia Urban Services Facility.
[11] Cambodia Climate Change Strategic Plan 2014-2023. www.bb.undp.org. 6 February 2017.

agriculture and infrastructure. In June 2011, the PPCR sub-committee endorsed Cambodia's Strategic Program for Climate Resilience with a funding envelope of up to $86 million ($50 million in grants and up to $36 million in concessional credit). Of this, an allocation of $17 million ($10 million loan and $7 million grant) was endorsed for "Climate-proofing of Roads in Prey Veng, Svay Rieng, Kampong Chhnang and Kampong Speu Provinces" as part of the ADB-funded PRIP. The PRIP includes piloting of approaches to strengthen civil works design and planning, as well as to reduce risks of damages resulting from climate change impacts through implementing ecosystem-based adaptation measures and emergency management responses.[12]

130. For all other applicable environmental standards and criteria such as ambient air quality, water quality, vibration, noise, contaminated soil, and workplace and community safety, the standards and protocols of the World Bank Group EHS (2007) will apply particularly for standards which impose stricter limits such as noise in the immediate vicinity of residential and commercial areas.

2.2. National Laws and Regulations

131. The hierarchy of legislation in Cambodia is:

(i) Royal Decree signed by the King;
(ii) Sub-decree signed by the Prime Minister;
(iii) Ministerial Decision / PRAKAS signed by a Minister;
(iv) Regulation issued by a Ministry.

132. The major legislation in Cambodia is the Royal Decree which ratifies laws passed by parliament. These can be supplemented by "PRAKAS" or ministerial decisions. These laws allow sub-decrees and regulations to be passed which can stipulate procedures and standards to be met in order to ensure compliance with the law. Many of these sub-decrees and standards have been drafted but have not yet been ratified by parliament.

133. In 1993, the Royal Government of Cambodia confirmed a new Constitution in which environmental considerations were included for the first time. Specifically, Article 59 requires the State to protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rock and sand, gems, forests and forestry products, wildlife, fish and aquatic resources and it was within this constitutional context that the Ministry of Environment (MoE) was established.

134. The Government of Cambodia has established specific laws and regulations for forests, protected areas, and land management to ensure sustainable development. The key elements of the legal and policy framework on environment that are applicable to the project include the following:

Table 9: Key elements of the legal and policy framework on environment that are applicable to the project

Law/Circular	Date	Key elements

[12] PRIP Climate change outputs include Climate Modeling Report, Flood Risk Management Interface Manual v10, Infrastructure Rehabilitation for Climate Resilience, Knowledge Management Report, Non mandatory guidelines for FPR v1,6, Reinforcing community flood resilience, Road Design Standard v6-hun-1 and Vulnerability Report v5. (http://prip.mpwt.gov.kh/documentation).

Law/Circular	Date	Key elements
Law on Environmental Protection and Natural Resources Management	1996	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM-1296/36
Law on Natural Protected Areas	2008	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0208/007
Law on Fisheries Management and Administration	1989	-
Law on Forest	2002	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0802/016
Law on Land	2001	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0801/14
Law on Water Resource Management	2007	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0607/16

Source: Egis, 2021.

135. Key directives in support of the Law on Environmental Protection and Natural Resources Management include:

Table 10: Key directives in support of the Law on Environmental Protection and Natural Resources Management

Law/Sub-decree	Date
Law on Protection of Natural Areas	2008
Sub-decree No. 72 on EIA process	1999
Sub-decree on Water Pollution Control • Annex 2: Effluent standards for pollution sources discharging to public water area or sewer system • Annex 4: Water quality standards for public water and biodiversity • Annex 5: Water quality standards for public waters and health	1999
Sub-decree on Air Pollution Control and Noise Disturbance • Annex 1: Ambient air quality standard • Annex 6: Maximum permitted noise level in public and residential area (dB(A))	2000
Sub-decree on Solid Waste Management • Annex: Type of the hazardous waste	1999
Sub-decree on River Basin Management	2015
The sub-decree No.113 on delegates the management of waste to municipal and district administrations with a differentiation made between urban solid waste and garbage and set outs responsibilities for separation of recyclable materials.	2015

Source: Egis, 2021.

136. The Forestry Law defines the framework for management, harvesting, use, development and conservation of the forests in the Kingdom of Cambodia. The objective of the law is to ensure the sustainable management of these forests for their social, economic

and environmental benefits, including conservation of biological diversity and cultural heritage (Article 1). The law prescribes areas in the forestlands to be reforested. It also enjoins the citizens of Cambodia to plant trees and development of tree plantations, through the Arbor Day, for example.

137. The National Forest Programme (NFP) 2010-2029 aims to achieve sustainable forest management and alleviate poverty in Cambodia. Specifically, it identifies objectives and goals in developing and managing forests to improve livelihoods, environmental services and overall economic development. More importantly, it aims to ensure that the management and exploitation of forests generates benefits for government entities, local communities, the private sector and individuals. The NFP prioritizes six programmatic areas that will be emphasized over the next two decades in order to achieve several objectives: (i) forest demarcation; (ii) classification and registration; (iii) forest conservation and development of forest resource and biodiversity; (iv) forest law enforcement and governance programme; (v) capacity and research development; (vi) sustainable forest financing; and (vii) Community Forestry (CF).

138. The NFP aims to increase the current level of forest cover to 60% of the total land area as its strategic indicators. It also sets a target of 500,000 hectares of high value commercial plantation established and 10 million tree seedlings distributed per year and two million hectares of forest land allocated for Community Forestry (approximately 1,000 CF).

139. Other pertinent regulations, policy, or guidelines for the project are as follows:

Table 11: Other pertinent regulations, policy, or guidelines for the project

Regulation	Date	Key elements
Prime Ministerial Edict. entitled "Measures to Eliminate Anarchical Land Grabbing"	1999	Declares public land on the verge of roads and railways must not be occupied. For NR1, the road reserve is 30 m from centerline and for NR6 it is 25 m from centerline
Directive on Managing Health Wastes in the Kingdom of Cambodia	2008	Ministry of Health
Preach Reach Kept on Creation of Fisheries Communities	2005	-
Anukret on establishment of protected forests, natural resources conservations, wildlife protection areas, protected forest for biodiversity conservation	2002 and 2004	-

Source: Egis, 2021.

140. **Wildlife.** The Joint Prakas of MoE and Ministry of Agriculture, Forestry, and Fisheries on Prohibition of Hunting and Catching Wildlife (1996) specifically bans hunting of wild animals and birds for food, including all species of mammals, reptiles, amphibians, insects, other invertebrates, and their eggs or offspring.[13]

141. The Law on Forestry Management prohibits the hunting of wildlife within protected areas. Aside from maintaining check points and providing rangers, the MoE has an active community education program to promote environmental awareness especially within the rural communities.

[13] http://www.cambodiainvestment.gov.kh/.6 February 2017.

142. **Natural Areas.** Cambodia has a network of 23 natural protected areas managed through the MoE. These areas cover 2.2 million hectares or 18% of Cambodia's land area and include most of its important habitats. The Forest Administration has also designated protected forests (from cancelled logging concessions) bringing the total area under protection to around 25% which is more than twice the global average. Protected Areas are sites which are protected by Royal Decrees, laws and regulations. Such mandatory stipulations are promulgated in Khmer language. The Khmer version takes precedence over the translated version.

143. In 2008, Cambodia introduced the Protected Area Law (No. NS/RKM/0208/007) which defines (i) national parks, (ii) wildlife sanctuaries, (iii) protected landscapes, (iv) multiple use areas, (v) Ramsar sites, (vi) biosphere reserves, (vii) natural heritage sites, and (viii) marine parks.

144. These have been referenced to the International Union for Conservation of Nature (IUCN) Categorization list:

(i) National Parks (IUCN Category II) – Natural and scenic area of significance for their scientific, educational, and recreational values.

(ii) Wildlife Sanctuaries (IUCN Category IV) – Natural area where nationally significant species of flora or fauna, natural communities, or physical features require specific intervention for their perpetuation.

(iii) Protected Landscapes (IUCN Category V) – Nationally significant natural and semi-natural landscapes that must be maintained to provide opportunities for recreation.

(iv) Multiple-Use Areas (IUCN Category VIII) – Areas that provide for the sustainable use of water resources, timber, wildlife, fish, pasture, and recreation with the conservation of nature primarily oriented to support these economic activities.

(v) Ramsar Sites – There are two sites in the IUCN Categories IV and VIII above and one site in the middle stretches of the Mekong River between Stung Treng and the border with Laos.

(vi) Biosphere Reserve – The Tonle Sap Multiple-Use Area was nominated as Cambodia's first Biosphere Reserve in 1997. The Boeung Chmar portion of Tonle Sap Multiple-Use area (28,000 hectares) is designated as a Ramsar site.

145. Under Article 11 of the law, each protected area is divided into four management zoning systems as follows:

(i) **Core Zone:** management area(s) of high conservation values containing threatened and critically endangered species and fragile ecosystems. Access to the zone is prohibited except the Nature Conservation and Protection Administration's officials and researchers who, with prior permission from the Ministry of Environment, conduct nature and scientific studies for the purpose of preservation and protection of biological resources and natural environment with the exception of national security and defense sectors.

(ii) **Conservation Zone:** management area(s) of high conservation values containing natural resources, ecosystems, watershed areas, and natural landscape located adjacent to the core zone. Access to the zone is allowed only with prior consent of the Nature Conservation and Protection Administration at the area with the exception of national security and defense sectors. Small-scale community uses of non-timber forest products (NTFPs) to support local ethnic minorities' livelihood may be allowed under strict control, provided that they do not present serious adverse impacts on biodiversity within the zone.

(iii) **Sustainable Use Zone:** management area(s) of high economic values for national economic development and management, and conservation of the protected area(s) itself thus contributing to the local community, and indigenous ethnic minorities' livelihood improvement. After consulting with relevant ministries and institutions, local authorities and local communities in accordance with relevant laws and procedures, the Royal Government of Cambodia may permit development and investment activities in this zone in accordance with the request from the Ministry of Environment.

(iv) **Community Zone**: management area(s) for socio-economic development of the local communities and indigenous ethnic minorities and may contain existing residential lands, paddy field and field garden or swidden (Chamkar[14]) or farming. Issuing of land title or permission to use land in this zone shall have prior agreement from the Ministry of Environment in accordance with the Land Law. This management area does not cover the APSARA (Authority for the Protection and Management of Angkor and the Region of Siem Reap) authorities and other authorities designated and management area(s) to which the Royal Government has allocated the tasks.

146. **Historical Monuments and Cultural Heritage.** The Law on Protection of Cultural and National Heritage (1996) is the general law in Cambodia which covers all national monuments. This is supplemented by the "Decision on the Definition of Three Zones to Protect Temple and Surrounding Areas in all Provinces and Municipalities except Angkor Wat" (1996). These laws protect small temples or ancient structures.

147. **Solid Waste Management.** The Sub-decree on Solid Waste Management No.36 ANRK/BK (1999) regulates the collection, storage, disposal, dumping, recycling of solid domestic and industrial, commercial, hospital and other asserted waste in order to prevent any ecological damage to the ecosystem and avoiding pollution of both soil and water. The sub-decree No.113 ANRK/BK (2015) delegates the management of waste to municipal and district administrations with a differentiation made between urban solid waste and garbage and set outs responsibilities for separation of recyclable materials.

148. **Technical Guideline on Urban Solid Waste Management, MoE 2016**. Criteria for selection of the landfill site are listed below.

Table 12: Criteria for selection of the landfill site Criteria

	Description
1.	1km from national road, residential property, and public drainage
2.	3km from any school, health center, natural water source (lake, river, stream, sea/shoreline)
3.	5km from any place of tourism resort, worship (pagoda, religion temple) and natural conservation area
4.	8km from an airport
5.	10-50km from urban area
6.	15km from any heritage site and historical resort
7.	Not in a flooded area and year-round access road
8.	At low economic value and unfertile soil for agricultural crop

Source: MoE, 2016.

149. **National Occupational Health and Safety Standards.** Occupational and Community Safety and Health (OHS) guidelines for Government follow the recent OHS

[14] Swidden or Chamkar is also known as slash and burn or shifting cultivation.

Programme for Cambodia (2010-2013) that was developed by the ILO. The guidelines provide the framework for instituting OHS at the workplace and in the community.

2.3. National and International Environmental Standards

150. Cambodia has national standards for a range of environmental parameters. Standards that were applied for the IEE are: (i) water quality standards (Sub-decree No27 ANRK/BK, 1999, updated by the Prakas No.120, 11 April 2018, MoE); (ii) ambient air quality and Noise disturbance level standards (Anukret No42 ANK/BK, 2000); and (iii) occupational health and safety standard (OHS Program for Cambodia, 2010-2013). Comparison with the World Bank Group's Environmental, Health and Safety (EHS) Guidelines is given below.

151. **Water Quality.** The following tables summarize Cambodian water quality standards and international standards: Cambodian standards are more stringent than international ones, when they exist, except for the TSS parameter.

Table 13: Parameters and standards for surface water quality

No	Parameter	Unit	National Standard for rivers[15]	National Standard for lakes and reservoirs[15]
1	pH	-	6.5 - 8.5	6.5 - 8.5
2	Total Dissolved Solid (TDS)	mg/L	< 1,000	< 1,000
3	Total Suspended Solid (TSS)	mg/L	25 - 100	1 - 15
4	Dissolved Oxygen (DO)	mg/L	2.0 - 7.5	2.0 - 7.5
5	Biochemical Oxygen Demand (BOD_5)	mg/L	1 - 10	< 30
6	Chemical Oxygen Demand (COD)	mg/L	< 50	1 - 8
7	Oil and grease		< 5	< 5
8	Detergent	mg/L	< 5	< 5
9	Sulphate (SO_4)	mg/L	< 300	< 300
10	Total Nitrogen (TN)	mg/L	0.1 – 0.6	0.1 – 0.6
11	Total Phosphorus (TP)	mg/L	0.005 – 0.5	0.005 – 0.5
12	Lead (Pb)	mg/L	< 0.01	< 0.01
13	Arsenic (As)	mg/L	< 0.01	< 0.01
14	Cadmium (Cd)	mg/L	< 0.001	< 0.001
15	Iron (Fe)	mg/L	< 1	< 1
16	Mercury (Hg)	mg/L	< 0.0005	< 0.0005
17	Total Coliform	MPN/100mL	< 5,000	< 1,000

Source: Table 4 of the Prakas No.120 on launching the use of ToR for infrastructure development and tourism projects, 11 April 2018, MoE.

Table 14: Parameters and standards for groundwater quality

No	Parameter	Unit	National Standard[16]
1	pH	-	6.5 – 8.5
2	Turbidity	NTU	5
3	Electrical Conductivity (EC)	ms/cm	-
4	Total Dissolved Solid (TDS)	mg/L	800
5	Total Hardness (as $CaCO_3$)	mg/L	300
6	Chloride (Cl)	mg/L	250
7	Fluoride (F)	mg/L	1.5
8	Nitrate (NO_3)	mg/L	50
9	Sulphate (SO_4)	mg/L	250
10	Iron (Fe)	mg/L	0.3
11	Arsenic (As)	mg/L	0.05
12	Mercury (Hg)	mg/L	0.001
13	Chromium (Cr)	mg/L	0.05
14	Manganese	mg/L	0.1
15	Aluminum (Al)	mg/L	0.2
16	Benzene (C_6H_6)	mg/L	0.01
17	Dichloromethane (CH_2Cl_2)	mg/L	-
18	Cadmium (Cd)	mg/L	0.003
19	Total Coliform	MPN/100mL	0
20	E.coli	MPN/100mL	0

[15] Sub-Decree No. 27, updated by the Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE.
[16] Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE.

Source: Table 6 of the Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE.

Table 15: Water Quality Standard in Public Water Areas for Public Health Protection

No	Parameter	Unit	National Standard[17]	WHO/EHS Standard
1	Carbon tetrachloride	µg/L	< 12	-
2	Hexachloro-benzene	µg/L	< 0.03	-
3	DDT	µg/L	< 10	-
4	Endrin	µg/L	< 0.01	0.6
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	10
16	Tetrachloroethylene	µg/L	< 10	-
17	Cadmium	µg/L	< 1	3
18	Total mercury	µg/L	< 0.5	6
19	Organic mercury	µg/L	0	-
20	Lead	µg/L	< 10	10
21	Chromium, valent 6	µg/L	< 50	50
22	Arsenic	µg/L	< 10	10
23	Selenium	µg/L	< 10	40
24	Polychlorobiphenyl	µg/L	0	-
25	Cyanide	µg/L	< 0.005	-
26	Barium	mg/L	-	1.3
27	Boron	mg/L	-	2.4
28	Copper	mg/L	-	2
30	Sodium	mg/L	-	50
31	Fluoride	mg/L	-	1.5
32	pH	-	-	6.5 - 8.5

Source: The item 1 to 25 is extracted from annex 5 of sub-decree no.27, and the item 26-32 is international standards.

152. Table 16 provides the local standards for allowable limits for pollutants in effluent as indicated in Sub-Decree 27, Annex 2. For the project, the values listed in the column "Effluent standard for pollution sources discharging to water areas or public sewers" apply to this project.

Table 16: Effluent Standard for Pollution Sources Discharging Wastewater to Public Areas or Sewer

No	Parameter	Unit	Allowable limits for pollutant substance discharging to[18]	WHO/EHS Standard

[17] Annex 5, Sub-Decree No. 27.
[18] Annex 2, Sub-Decree No. 27.

			Protected public water area	Public water area and sewer	
1	Temperature	°C	< 45	< 45	-
2	pH		6 – 9	5 - 9	6-9
3	BOD5 (5 days at 200 C)	mg/L	< 30	< 80	30
4	COD	mg/L	< 50	< 100	125
5	Total Suspended Solids	mg/L	< 60	< 120	50
6	Total Dissolved Solids	mg/L	< 1000	< 2000	-
	Total Coliform Bacteria	MPN/100mL	-	-	400
7	Grease and Oil	mg/L	< 5.0	< 15	10
8	Detergents	mg/L	< 5.0	< 15	-
9	Phenols	mg/L	< 0.1	< 1.2	-
10	Nitrate (NO3)	mg/L	< 10	< 20	-
	Total Nitrogen	mg/L	-	-	10
11	Chlorine (free)	mg/L	< 1.0	< 2.0	-
12	Chloride (ion)	mg/L	< 500	< 700	-
13	Sulphate (as SO4)	mg/L	< 300	< 500	-
14	Sulphide (as Sulphur)	mg/L	< 0.2	< 1.0	-
15	Phosphate (PO4)	mg/L	< 3.0	< 6.0	-
	Total Phosphorus	mg/L	-	-	2
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 (NH3)	mg/L	< 5.0	< 7.0	-
35	DO	mg/L	> 2.0	> 1.0	-
36	Polychlorinated Biphenyl	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 Dichloroethylene	mg/L	< 2.5	< 2.5	-
50	Trichloro ethylene	mg/L	< 1	< 1	-

No	Parameter	Unit	Allowable limits for pollutant substance discharging to[18]		WHO/EHS Standard
			Protected public water area	Public water area and sewer	
51	Trichloro benzene	mg/L	< 2	< 2	-
52	Hexachlorocyclohexane	mg/L	< 2	< 2	-

Source: Column 2-4 is from Annex 2 of the sub-decree No.27, April 1999.

153. **Air Quality.** The ambient air quality standards for Cambodia (Anukret No42 ANK/BK, 2000) and the World Health Organization (WHO) (identical to EHS standards) are below.

Pollutant	Averaging period	National Standard (mg/m^3)	EHS/WHO[5] (µg/m^3)
Carbone Monoxide (CO)	1 hour	40	-
	8 hours	20	-
Nitrogen Dioxide (NO2)	1 hour	0,3	0,2
	24 hours	0,1	0,04
Sulphur Dioxide (SO2)	1 hour	0,5	-
	24 hours	0,3	20
Ozone (O3)	1 hour	0,2	-
	8 hours	-	160
Lead (Pb)	24 hours	0,005	-
Total suspended particulate (TSP)	24 hours	0,33	-
	Annual	0,10	-

Source: Annex 1 of the Sub-Decree on Air Pollution, 1999

154. **Noise.** Cambodian National Standard for Ambient Noise sets an allowable limit for noise in daytime at 60 dB (45 dB(A) in quiet areas), and night at 45 dB (35 dB(A) in quiet areas), with night being 10 pm-6 am according to the Anukret on the control of air pollution and disturbance. Comparison made with World Bank EHS standards shows that the EHS standards are less stringent than the national standard during the day.

Table 17: Cambodian National Standard for Ambient Noise

Standard	Maximum allowable noise limit, 1 hr LAeq in dBA		
	Day (6:00 – 18:00)	Mid (18:00 - 22:00)	Night (22:00 – 06:00)
WB/IFC Guideline			
Industrial/commercial	70	-	70
Residential/Institutional/Educational	55	-	45
Cambodian National Standard			
Quiet areas (hospital, libraries, school, kindergarten)	45	40	35
Residential areas (hotels, administrative offices, villas, flats)	60	50	45
Commercial and Service Areas and Area of multiple business	70	65	50
Small industrial factories mingling in residential area	75	70	50

Source: Annex 6 of the Sub-Decree on Air Pollution, 1999.

3. ADB Safeguards Policy Statement

155. **ADB's SPS (2009)** provides the joint basis for this IEE. All projects funded by ADB must comply with the SPS. The purpose of the SPS is to ensure that projects are environmentally sound, designed to operate in line with applicable regulatory requirements,

and are not likely to cause significant environment, biology, health, or safety hazards. The SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas: (i) environmental safeguards; (ii) involuntary resettlement safeguards; and, (iii) indigenous Peoples safeguards. The policies seek to avoid, minimize, or mitigate adverse environmental and social impacts, including protecting the rights of those likely to be affected or marginalized by the development process. The objectives of ADB's safeguards are to: (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and, (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks. The SPS is underpinned by the ADB Operations Manual for the SPS (OM Section F1, 2010), and guidance is provided by the ADB Environmental Safeguards - A Good Practice Sourcebook (2012).

156. The SPS also promotes the use of international standards, including the World Bank Group's EHS Guidelines. EHS guidelines relevant to the project include environment protection, water conservation, hazardous materials, waste management, noise control, sanitation, and community and occupational health and safety. Where EHS standards are higher than national standards, efforts are made for ADB-funded projects to target the EHS standards. The standards applied to this project are based on comparison of national and EHS thresholds; in cases where no EHS thresholds are available, or the Cambodian standards are identical to or higher than the EHS standards, the national standards are applied. In general, several Cambodian standards are equal to, or higher than, the EHS standards.

157. Compared with the Cambodian EIA requirements, the SPS emphasizes additional requirements, including: (i) a project grievance redress mechanism; (ii) definition of the project area of influence; (iii) due diligence of associated facilities; (iv) climate change mitigation and adaptation; (v) impacts on livelihoods through environmental media; and (vi) biodiversity conservation.

158. At an early stage in the project cycle, typically the project identification stage, ADB screens and categorizes proposed projects based on the significance of potential project impacts and risks. A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Project screening and categorization are undertaken to: (i) reflect the significance of the project's potential environmental impacts; (ii) identify the type and level of environmental assessment and institutional resources required for the safeguard measures proportionate to the nature, scale, magnitude and sensitivity of the proposed project's potential impacts; and (iii) determine consultation and disclosure requirements.

159. **SPS and protected areas.** The SPS requires that project activities will not be implemented in areas of critical habitat which includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic, or cultural importance to local communities.

160. SPS requires to identify measures to avoid, minimize, or mitigate potentially adverse impacts and risks on biodiversity and natural resource and, as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of the affected biodiversity. In areas where the natural habitat has apparently been altered, any

further conversion or degradation of such habitat have to be minimized, and opportunities to enhance habitat and protect and conserve biodiversity as part of project operations have to be identified.

161. ADB assigns a proposed project to one of the following categories based on the potential environmental impacts:

(i) **Category A.** Proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale EIA including an EMP, is required.

(ii) **Category B.** Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An IEE, including an EMP, is required.

(iii) **Category C.** Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.

162. **This project is categorized by ADB as category B for environment**. This IEE and EMP was prepared by the TRTA consultant on behalf of the MPWT, the executing agency.

163. **Climate Risk and Vulnerability Assessment**. The ADB also requires the identification of climate change risks to proposed project early in the project cycle and to identify actions to screen projects for climate risks, assess these risks, and address them in the project design. Technical guidelines have been developed by the ADB to aid in the climate risk and vulnerability assessment.[19] Likewise, the Guidelines on Climate Proofing Investment in the Water Sector: Water Supply and Sanitation[20] was issued to present a step-by-step methodology to help project teams incorporate climate adaptation into water supply and sanitation sector investment projects.

4. Gap Analysis

164. Regarding the national regulation and international standards (such as WHO/EHS), numerous standards exist. Comparison with the World Bank Group's Environmental, Health and Safety (EHS) Guidelines has been carried out: where national and international thresholds differ, the most stringent value is preferred.

[19] https://www.adb.org/sites/default/files/publication/148796/climate-risk-management-adb-projects.pdf
[20] https://www.adb.org/sites/default/files/institutional-document/32772/files/guidelines-climate-proofing-water.pdf

IV. DESCRIPTION OF THE ENVIRONMENT

1. Location, Geography and Topography

165. Cambodia lies in the southwestern part of the Southeast Asian peninsula. International borders are shared with Thailand to the west, the Lao People's Democratic Republic to the north, and the Socialist Republic of Vietnam on the east and southeast. The country is bounded to the southwest by the Gulf of Thailand.

166. The topography of Cambodia is described as “bowl shaped” and expands about 181,035km^2. The central plains form 75% of the country and consist of the alluvial plains of the Mekong River and the Tonle Sap basin.

167. The central region of the country is represented by Tonle Sap Lake and surrounding floodplain. The floodplain of Tonle Sap merges with the floodplain of the Mekong River to the southeast of Cambodia which forms the Cambodian plain covering 25,069 km^2. This means that the whole of northwest Cambodia acts as a catchment area draining ultimately into Tonle Sap.

168. The municipality of Bavet (current permanent population 109,583) is a flourishing border city located in the Southeast of Cambodia, around 150 km from Phnom Penh. It was established as a city in December 2008. It is strategically at the main international border crossing with Vietnam (70 km from Ho Chi Minh city). It is the first town in Cambodia along the National Road 1 (NR 1) when travelling form the border of Viet Nam.

169. In Bavet, urban development is observed along NR 1 with urban growth emanating from *Sangkat* Bavet and continued along the National Road westward of Svay Rieng Province.

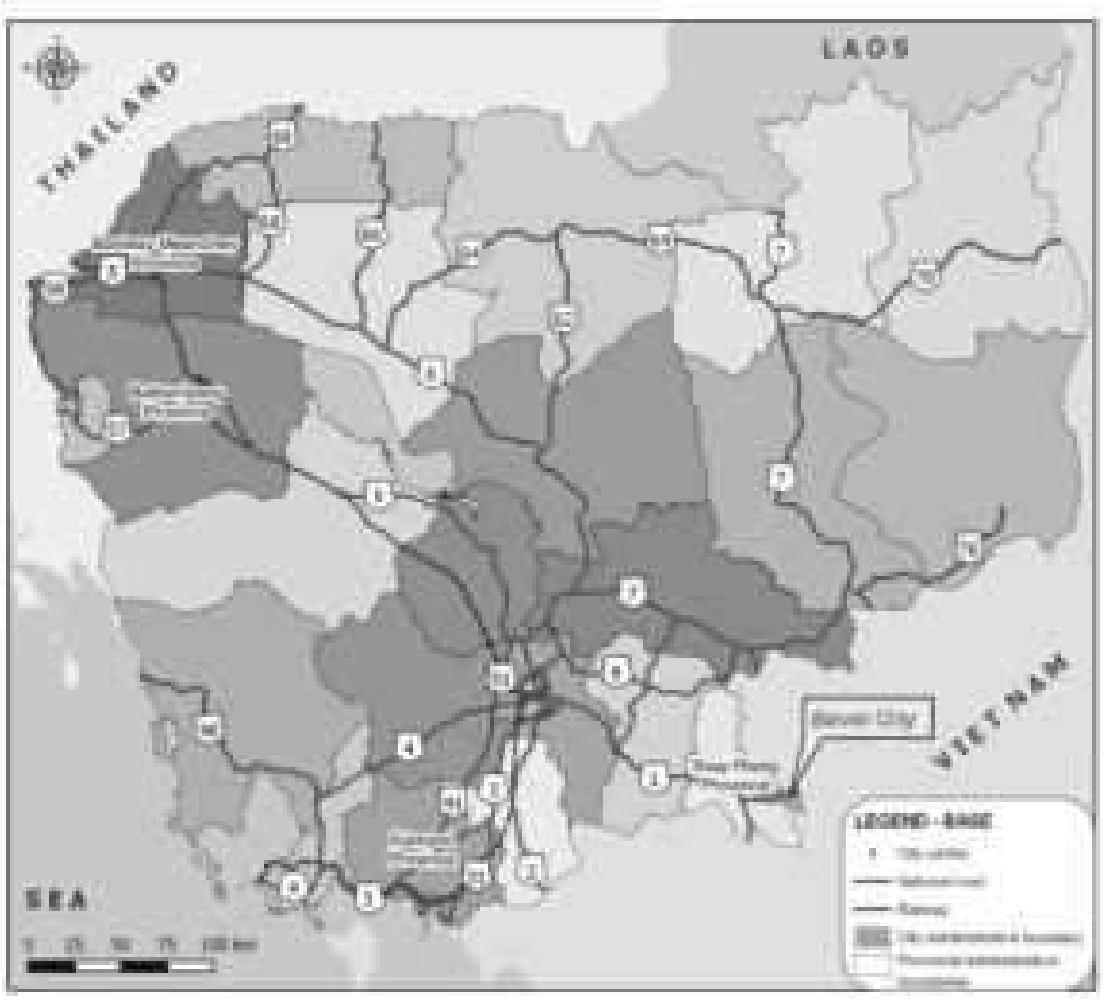
170. Bavet is an emerging trading and manufacturing center in the province of Svay Rieng. Main economic drivers in the city are industries and casinos. The city is hosting dynamic textile, electronic, plastic industries in the Special Economic Zones (SEZ), employing nearly half of the population of the city.

171. The surrounding area is a flat, low lying land (up to 10 m above sea level), dominated by agricultural lands, with sparse and scattered grassland and shrub land (no forest). Seasonal precipitation affects the extent of many surrounding water bodies and can cause flooding in 17 urban areas of Bavet municipality.

172. Bavet has a total land area of 206.69km² and consists of 5 quarters (Sangkats):

(i) Sangkat Bavet, composed of 5 villages (Phum);
(ii) Sangkat Prey Angkunh - 8 villages;
(iii) Sangkat Prasat - 2 villages;
(iv) Sangkat Bati - 5 villages;
(v) Sangkat Chrak Mtes - 15 villages.

Figure 9: Bavet City location

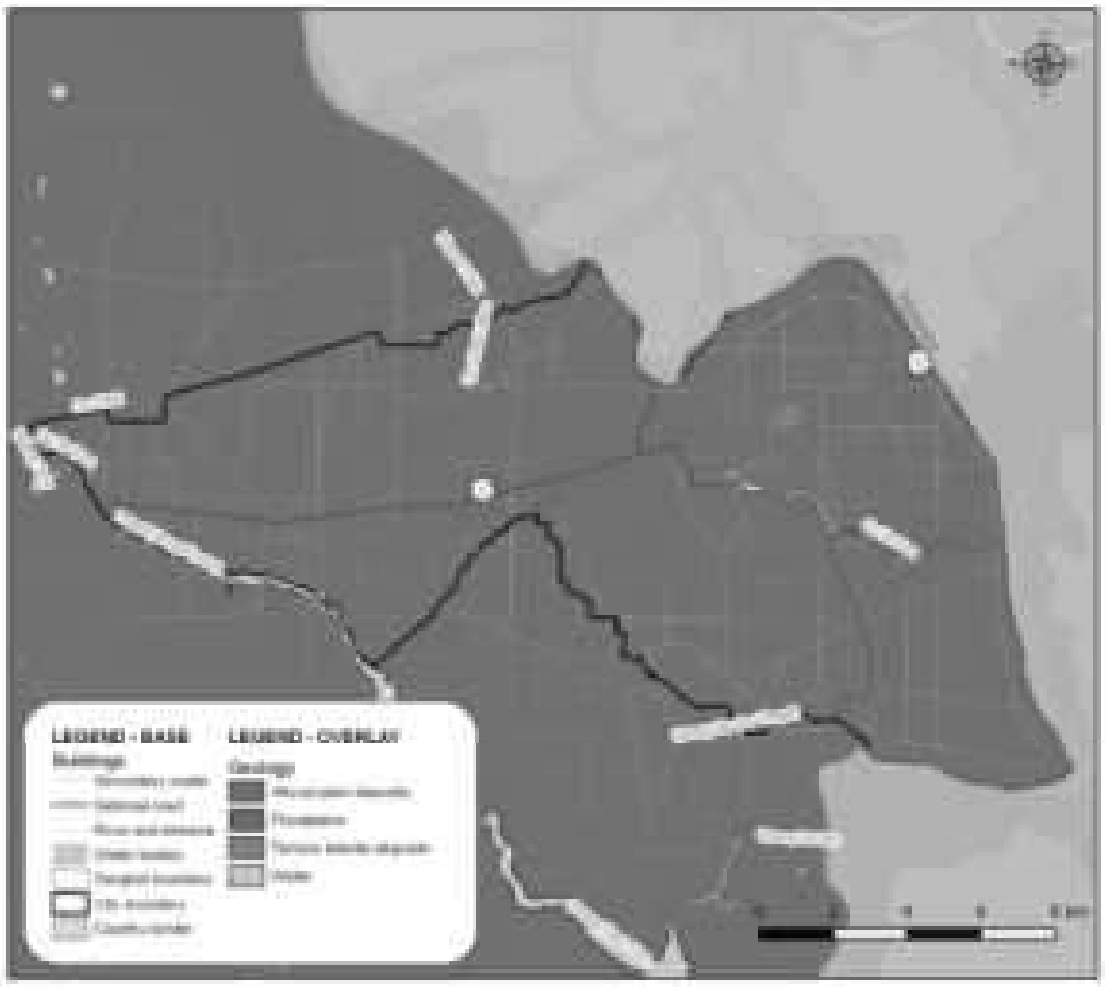


Source: Egis, 2021.

2. Geology and Soils

173. The geology of Bavet is characterized by young alluvium soils made up by 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, as observed around Bavet. A geological map covering the city extend is shown below:

Figure 10 Geological map - Bavet city



Source: Egis, 2021.

174. Soil sampling was realized during field survey at the WWTP site (620759 E, 1220818 N) and landfill site (613126 E, 1225274 N). Based on laboratory results, soil can be classified as clay loam at the landfill site and sandy loam at the WWTP site.

3. Climate, Hydrology, Water Resources and Water Quality

3.1. Climate

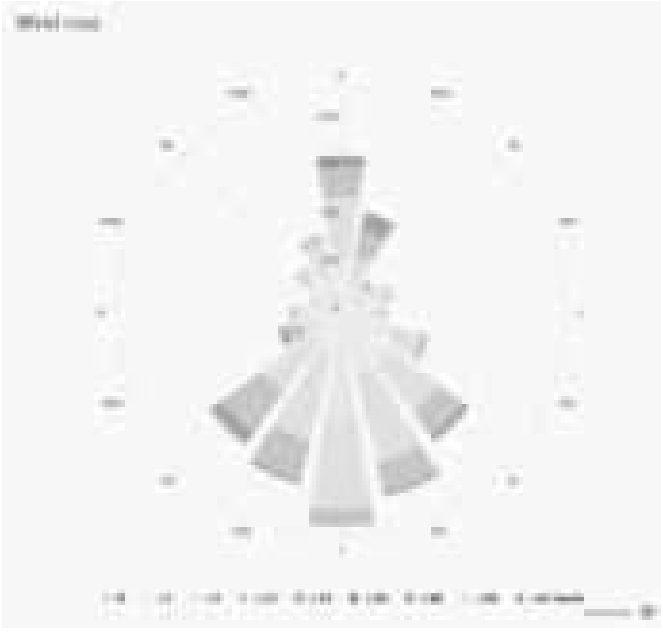
175. The climate of Cambodia is dominated by the tropical monsoon, which governs the wet and dry seasons. The rainy season occurs from May to early October and it accounts for 90% of annual precipitation. The dry season occurs from November to April. The monsoon air-flow is caused by seasonally alternating high and low pressures over central Asia. In summer moisture-laden air of the southwest monsoon is drawn landward from the Indian Ocean. The flow is reversed during the winter by the northeast monsoon of dry air.

176. Temperatures are fairly uniform throughout the country. The mean maximum temperature is 28°C and the mean minimum temperature is 22°C. Maximum temperatures in excess of 32°C are common before the start of the rainy season and may exceed 38°C. This occurs because SW monsoon winds bring hotter air in April and early May, while during the dry season, from November to March, NE winds bring drier and cooler air.

177. Most of Cambodia's regions have an average wind velocity of less than 3 meters per second (m/s). Maximum wind speeds can reach in excess of 20m/s during the wet season. During the dry season, the maximum wind speed velocities are lower and are commonly in the range of 6m/s–8 m/s.

178. The following wind rose for Bavet shows how many hours per year the wind blows from the indicated direction. It appears that the most frequent winds blow from South to North (more than 1,000 hours per year) and from North to South (more than 750h/y). The strongest wind speed is around 30km/h, blowing from North/North-East to South/South-West, for more than 500h/y.

Figure 11: Wind Rose for Bavet



Source: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/bavet_cambodia_1829516

179. The average annual rainfall from 1994 to 2004 varied between 1,400mm and 1,970mm. Annual rainfall varies considerably across the country. In lowland areas, annual rainfall ranges from 1,000mm to 1,700mm, while in the highlands it ranges from 1,000mm to 2,700mm, and in coastal areas from 1,000mm to 3,000mm.[21]

180. The heaviest rainfalls occur in the mountains along the coast in the southwest. As this area drains mostly to the sea, only a small quantity goes into the rivers flowing into the basin. Tropical cyclones that often devastate coastal Vietnam rarely cause damage in Cambodia but can form tropical depressions that result in extreme rainfall events for a 3–4 day period.

181. Relative humidity is high year-round which usually exceeds 90%. During the dry season, daytime humidity averages 50% climbing to about 90% during the rainy season (Cambodia Climate and Weather, 2015).

[21] GSSD 2015. Cambodia's Second National Communication Under the United Nations Framework Convention on Climate Change. General Secretariat, National Council for Sustainable Development/Ministry of Environment, Kingdom of Cambodia, Phnom Penh.

182. **Flooding.** Flooding in central Cambodia occurs due to increased water levels in the Mekong River and Tonle Sap Lake between early July and early October. Almost 62% of the losses in agricultural production over the last 20 years were due to flooding. There has been an increase in the frequency of severe floods in recent years. Severe floods also occurred in 1991, 1996, 2000, 2001, 2002 and 2011 with the 2000 floods considered to be the worst to hit Cambodia in 70 years.[22]

183. Flat areas of Bavet municipality are recurrently exposed to flooding events.

184. **Strong Winds.** Recent research has strengthened the understanding of the links between climate and tropical cyclones (typhoons) and climate models mostly continue to project future decrease in tropical cyclone numbers, increase in the intensities of the strongest storms and in rainfall rates. Studies of the northwest Pacific region off the coast of Vietnam project an increase in typhoon strength of around 5% by 2050[23]. This increased strength will also occur for the tropical depressions that form from the degrading typhoons over Cambodia.

3.2. Climate Change

185. Generally, climate modeling has been based on older generations of climate models released under the third Climate Model Intercomparison Project (CMIP3) and using the third Intergovernmental Panel on Climate Change (IPCC3) Special Report on Emissions Scenarios (SRES) CO_2 scenarios. Climate change modeling reports that present data for Cambodia are summarized in Table 18. The Second National Communication released in 2015, did not provide any recent modeling results and relied on projections from earlier reports. The Climate Futures program of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) funded by Ausaid used 6 CMIP5 Global Climate Model (GCM) models and Representative Concentration Pathways (RCP) to create climate projections for Cambodia and Vietnam. The study produced downscaled projections from a Regional Climate Model with a resolution of 10 km, with six model runs based on inputs from each of the 6 GCMs. The CSIRO reports present maps of the average value of the projections from the six Regional Climate Model (RCM). Because of the higher resolution of the CSIRO RCM, where possible the results of the for RCP8.5 for the 20 year period centered on 2055 are used for projections presented below. Those projections are used for the design of the proposed infrastructure.

186. To provide more information on the range of individual GCM projections, results from the Royal Netherlands Meteorological Institute (KNMI) Climate Explorer Website are also presented. The Climate Explorer Website supported by the World Meteorological Organization, presents data from the latest CMIP6 models. The data consists of projections from a 13 ensemble of GCMs and is at the resolution of the original models with no downscaling (2.5° x 2.5° grid). Data was downloaded and compared to baseline of 2000 – 2020.

187. A discussion of the selection of projections to use for the design of project infrastructure is presented in section IV. 6 below.

[22] NCDM, 2011. Summary Annual Report on Disaster Events in Cambodia from 2000-2010. National Committee for Disaster Management. Phnom Penh.

[23] For detailed review see Walsh et al. (2016) Tropical cyclones and climate change. Wiley Interdisciplinary Reviews-Climate Change, 7 (1), pp. 65 – 89.

Table 18: Climate Change modeling discussed in this report.

Report	Year Released	Model generation	No. Models	CO2 future Scenario	Baseline
Second National Communication	2015	CMIP3	2	SRES A2	2002
Climate Futures Program, CSIRO (Ausaid)	2013	CMIP5	6	RPC8.5	1975-2005
KNMI. Climate Explorer (www.climexp.knmi.nl).	2021	CMIP6	13	SSP2 RCP4.5 SSP5 RCP8.5	2000-2020

SRES = CO_2 scenarios developed for the IPCC3 Special Report on Emissions Scenarios
RCP = CO_2 Representative Concentration Pathways developed for IPCC5
SSP = Shared Socioeconomic Pathways
CMIP = Climate Model Intercomparison Project carried out for IPCC3, IPCC5 or IPCC6

Source: Egis, 2021.

3.2.1. Temperature

188. Climate change models are consistent in projecting an increase in temperature across Cambodia in the future. The projected temperature change for Bavet from CMIP6 GCMs is shown in Table 19. The table shows the median and range of a 13 ensemble of GCM's projections of mean annual temperature anomalies relative to the mean climate of 2000-2020 under the two scenarios for three 20year time periods. Average annual temperature for Bavet is projected to increase by 0.5 °C by 2030, by 1.3 °C by 2050 and by 3.1°C by the end of the century under RCP8.5. Projections for 2050 under RCP 4.5 are slightly less out to 2050, but the difference is larger by the end of the century.

Table 19: Range of Projected Mean Annual Temperature Change (°C) for the 2.5° x 2.5° cell containing Bavet Compared to the 2000-2020 model average under the SSP2 RCP4.5 and SSP5 RCP8.5 Scenarios from 13 Model Ensemble.

20 yr period	2030			2050			2090		
Scenario	Min	Av	Max	Min	Av	Max	Min	Av	Max
SSP2 RCP4.5	0.2	0.5	0.8	0.5	1.0	1.5	-0.3	1.6	2.6
SSP5 RCP8.5	-0.7	0.5	0.9	-0.2	1.3	2.2	1.2	3.1	4.5

Source. KNMI. Climate Explorer (www.climexp.knmi.nl).

189. The projected change in seasonal temperature for Bavet from the CSIRO RCM downscaling for the period centered on 2055 compared to the period 1975-2005 under RCP8.5 is shown in Table 20. Temperature changes are projected to be greater at the start of the dry season and least at the later part of the wet season.

Table 20: Projected seasonal temperature change (°C) for Bavet for the period centered on 2055 under RCP 8.5 compared to the period 1975-2005.

Parameter	Value
Mean Annual Temperature (°C)	1.9
April-May Temperature (°C)	1.6

Parameter	Value
June-September Temperature (°C)	1.8
October-November Temperature (°C)	2
December-March Temperature (°C)	1.8

Source. Katzfey, J., Jiao, X., Suppiah, R., Hoffmann, P., Nguyen, K. C. and Poun, S, Climate change projections for Mondulkiri and Koh Kong Provinces in Cambodia, 2013.

190. **Number of Hot Days.** Modeling carried out by the CSIRO presents projections of the number of days above 35°C which is a measure of potential heat stress conditions. The CSIRO modeling indicates that the number of days above 35°C is projected to change from 0-2 to 7-9.

3.2.2. Rainfall

191. The projected change in rainfall from climate models is more variable than it is for temperature. The Second National Communication states that under the A2 scenario, annual rainfall for Cambodia in 2100 would increase between 3% and 35% from current rainfall (2015), depending on location, while under SRES B1 the increase would be smaller. The projected annual rainfall change for Bavet from an ensemble of 10 CMIP6 GCMs is shown in Table 21. The average projection for annual rainfall from the GCMs used in this study is for little change into the future. With regards to the range of outputs, some models project a decrease, -4% by 2030, -5% for 2050 and -14% for 2090, while others project an increase of up to 14% by the end of the century. The results for RCP4.5 are similar out to 2050, but while the mean projection for the two scenarios is similar, the projections for RCP8.5 show a much wider range.

Table 21: Range of Projected Mean Annual Precipitation Change (%) for the 2.5° x 2.5° cell containing Bavet Compared to the 2000-2020 average under different Scenarios from 10 Model Ensemble.

Year	Scenario	Min	25th	Av	75th	Max
2030	SSP2 RCP4.5	-5	0	3	6	10
	SSP5 RCP8.5	-4	0	3	7	9
2050	SSP2 RCP4.5	-3	-2	1	3	8
	SSP5 RCP8.5	-5	1	3	4	10
2090	SSP2 RCP4.5	-4	-3	1	4	9
	SSP5 RCP8.5	-14	-2	1	5	14

Source. KNMI. Climate Explorer (www.climexp.knmi.nl).

3.2.3. Extreme weather events and flooding/storm surge

192. Typhoons making landfall on the coast of Vietnam often impact Cambodia as a tropical depression and can bring widespread heavy rainfall and subsequent flooding. There is a growing level of consistency between global climate models that on a global basis the frequency of tropical cyclones is likely to decrease by the end of the 21st century. A CSIRO report found that the majority of GCMs project that there will be a decrease in tropical

cyclone formation off the coast of Vietnam. This is consistent with a previous study by Chand et al 2016.[24] There is also a general agreement between models that the trade off to the decrease in frequency is an increase in intensity of wind speeds of 1.3 m/s [25], and an increase in rainfall rates of the order of 20% within 100 km of the cyclone center [26]. This indicates that extreme rainfall events that result from tropical depressions crossing Cambodia will decrease in frequency, but each event will bring more rain.

193. Table 22 shows the projected increase in extreme rainfall events from two sources; the KNMI website, and the CSIRO study. Both results are based on outputs from CMIP5 GCM data. The KNMI website presents GCM data in 2.5° x 2.5° pixels. The CSIRO study used CMIP5 models as an input to a 10 km x 10km pixel Regional Climate Model. Both studies found that 1 day extreme events are projected to increase in the future. The KNMI GCM data showed that climate models produced a wide range of projected changes. The average of the ensemble used in the CSIRO study is slightly lower than the KNMI data. For the 5 day extreme events, the CSIRO study projected an increase in 5 day events of 17.5mm. These projections are consistent with the projected changes in rainfall that will result from tropical depressions crossing into Cambodia from typhoons landing in Vietnam. Because Bavet is on the border, extreme rainfall would be expected to show the projected increase. The CSIRO study found a 60% agreement in the direction of the change between the models.[27]

Table 22: Projected change in extreme rainfall parameters (mm) for Bavet for the period centered on 2055 compared to the period 1975-2005.

Parameter	Value			
	BL	25th	Av	75th
Maximum 1-day rainfall (mm), KNMI, RCP4.5	140 mm	-56	2 (1.4%)	47
Maximum 1-day rainfall (mm), KNMI, RCP8.5	140 mm	-23	14 (10%)	45
Maximum 1-day rainfall (mm), CSIRO, RCP8.5	160 mm		12.5 (8%)	
Maximum 5-day rainfall (mm), CSIRO, RCP8.5	225 mm		17.5 (8%)	

NOTES: Both are based on CMIP5 models. The KNMI website presents GCM data in 2.5° x 2.5° pixels
The CSIRO study used CMIP5 models as an input to a 10 km x 10km pixel Regional Climate Model.
BL = Average of the model outputs for the baseline runs (1975-2005).

Source: KNMI. Climate Explorer (www.climexp.knmi.nl) and Katzfey, J. et al, Climate change projections for Mondulkiri and Koh Kong Provinces in Cambodia, 2013.

194. The MRC State of the Basin Report found no clear trend in the extent of flooding across the Mekong River Basin over the last ten years. However, the economic costs of flooding have shown an increase. The report also found no increasing or decreasing trend in the number of tropical storms over the same period.[28] The MRC basin-wide assessments of

[24] Chand, S.; Tory, K.; Ye, H. & Walsh, K. (2016), 'Projected increase in El Niño-driven tropical cyclone frequency in the Pacific', Nature Climate Change 7.
[25] Kang, N.-Y., and J.B. Elsner. 2015. Trade-off between intensity and frequency of global tropical cyclones. Nature Climate Change.
[26] Knutson, T.R., McBride, J.L., Chan, J., Emanuel, K., Holland, G., Landsea, C., Held, I., Kossin, J.P., Srivastava, A.K., and Sugi, M., (2010), Tropical cyclones and climate change: Nature Geoscience, v. 3, p. 157-163.
[27] Katzfey, JJ, McGregor, JL and Suppiah, R (2014). High-Resolution Climate Projections for Vietnam: Technical Report. CSIRO, Australia.
[28] The Mekong River Commission 2019. State of the Basin Report 2018. The Mekong River Commission, Vientiane Lao PDR.

climate impact on flood behavior suggests that flooded areas might increase by between 4.6% and 27.3% by 2060 for floods of all return intervals.

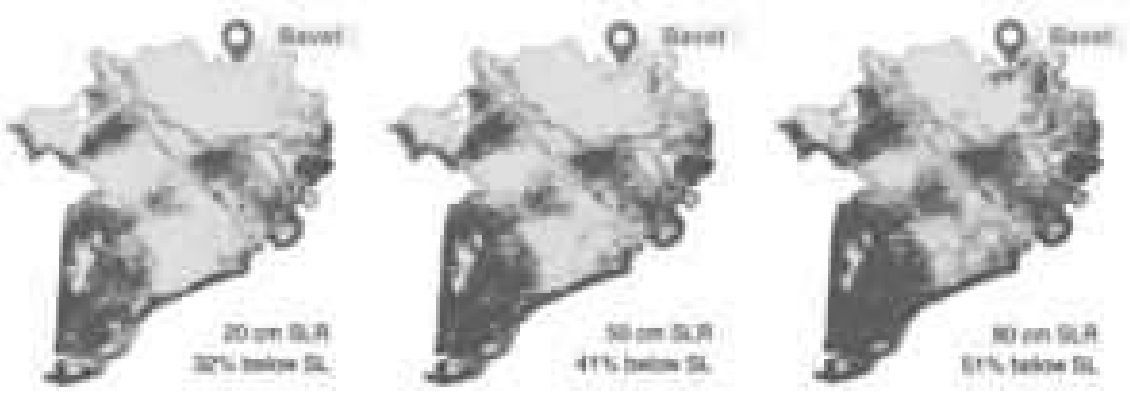
3.2.4. Droughts and land degradation/salinity hazard susceptibility

195. The Mekong River Commission state of the Basin Report concluded that a drought could potentially increase across the Basin in the future due to the projected increase in temperatures and changes in rainfall patterns.[29] The CSIRO modeling showed no change in the projected average duration of drought for the 20 year period centered on 2055 under RCP 8.5[30]. Additionally, their modeling projected only a small decrease in the frequency of short 3 month long agricultural droughts which affect rice cultivation in Cambodia.

3.2.5. Sea-level change

196.1 Recent research into the impacts of sea-level rise using updated Digital Elevation Models (DEMs) in the Mekong Delta indicates that the areas of Vietnam that surround Svay Rieng, like much of the rest of the delta, could be exposed to sea level inundation with a rise of 0.8m above current sea level.[31]

Figure 12: Sea level impact in Mekong Delta



Source: Minderhoud, P. S. J.; Coumou, L.; Erkens, G.; Middelkoop, H. & Stouthamer, E. (2019), 'Mekong delta much lower than previously assumed in sea-level rise impact assessments', Nature Communications 10(1), 3847.

197. It is not likely that a sea-level increase of this magnitude will occur during the next 20 years.[32] However, increased sea level downstream could lead to prolonged flooding as drainage will be impeded. It is difficult to make a quantitative assessment of the extent of this impact, so the potential impact of sea-level rise is included in the vulnerability assessment of the impacts of increased flood levels due to larger rainfall events.

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[29] *29* The Mekong River Commission 2019. State of the Basin Report 2018. The Mekong River Commission, Vientiane Lao PDR.

[30] Katzfey, J.; Jiao, X.; Suppiah, R.; Hoffmann, P.; Nguyen, K. C. & Poun, S. (2013), 'Climate change projections for Mondulkiri and Koh Kong Provinces in Cambodia', Technical report, CSIRO, Australia.

[31] Minderhoud, P. S. J.; Coumou, L.; Erkens, G.; Middelkoop, H. & Stouthamer, E. (2019), 'Mekong delta much lower than previously assumed in sea-level rise impact assessments', Nature Communications 10(1), 3847.

[32] Katzfey, J.; Jiao, X.; Suppiah, R.; Hoffmann, P.; Nguyen, K. C. & Poun, S. (2013), 'Climate change projections for Mondulkiri and Koh Kong Provinces in Cambodia', Technical report, CSIRO, Australia.

3.2.6. Selection of Projections of Extreme Rainfall Event Increase for Design of Climate Proof Project Infrastructure

198. In designing drainage for a city that is located on very flat terrain, one difficulty is allowing for enough fall to generate gravity flow and developing adequate drainage cross sectional area to cater to projected water volumes. During the Master Plan phase, a number of scenarios that considered the merits of designing the stormwater system for Bavet using a 1 in 2-year return frequency compared to a 1 in 5 year return period have been presented. The design storm intensity based on a 1 in 5-year return period is equivalent to a total rainfall of 121mm in one day. The one-day total rainfall for a 1 in 2-year event is 17% lower (101 mm). The comparison found a considerable difference in costs for infrastructure depending on which scenario was used. An additional impact is that as the size of the cross-sectional area increases, the amount of space required for the infrastructure also expands.

199. As there has been no clear trend in the number of storms or the size of extreme rainfall in recent decades across the Mekong River basin, it does not appear to be likely that there will be a large change in extreme event size in the next 10 to 20 years. Analysis of rainfall data from 1985-2019 indicates a (not statistically significant) decreasing trend of 6.3 mm per decade the in maximum yearly rainfall. Projections for increases in typhoon intensity in the future are for an increase of 20% by the end of the century and this indicates that extreme rainfall events will increase in the future. The median projections from the modeling are for an increase of 9% between the baseline (1975 - 2005) and the modeled period (2045 - 2065) under the RCP8.5. Under RCP4.5, the mean model projection is for a small change of less than 2%.

200. To determine a suitable projected increase for the time between the period used to generate the current IDF tables (1985-2018) and the time frame for the revision of the urban infrastructure plan 2030-2040, the average projected extreme event size from the CSIRO modeling was moderated to 5%. It is recommended that each component of rainfall Intensity, Duration and Frequency (IDF) tables can be adjusted by the projected change as a percentage, i.e. 5% to determine projected rainfall conditions in 2050. The lack of detailed climate change information makes it difficult to provide enough information to devise climate change parameters for different future CO_2 scenarios.

201. Figure 13 shows critical open channel drainage infrastructure in Bavet with the corridor of impact. The available space provided by the road reserve and along the existing canal will be completely taken up by the recommended design (1 in 5-year event size 5% larger due to climate change). The design of the project has been carried out in an effort to reduce the displacement of landowners, under the proposed design, across Bavet there is no need for households to be relocated or have primary structures impacted, but 5 households will lose a proportion of their privately owned residential land. Using the median projected increase due to climate change means that it is still economically feasible to develop a climate change proof design based on a 1 in 5-year event.

Figure 13: detail of available road reserve for stormwater infrastructure in urban areas

Source: Egis, 2021

3.3. Hydrology

202. The hydrologic setting of Cambodia is dominated by the Mekong River and Tonle Sap Lake system, which are connected by the Tonle Sap River. The Mekong River enters Cambodia from the north from Lao PDR and flows southeast to the border with Vietnam, i.e. Bavet area.

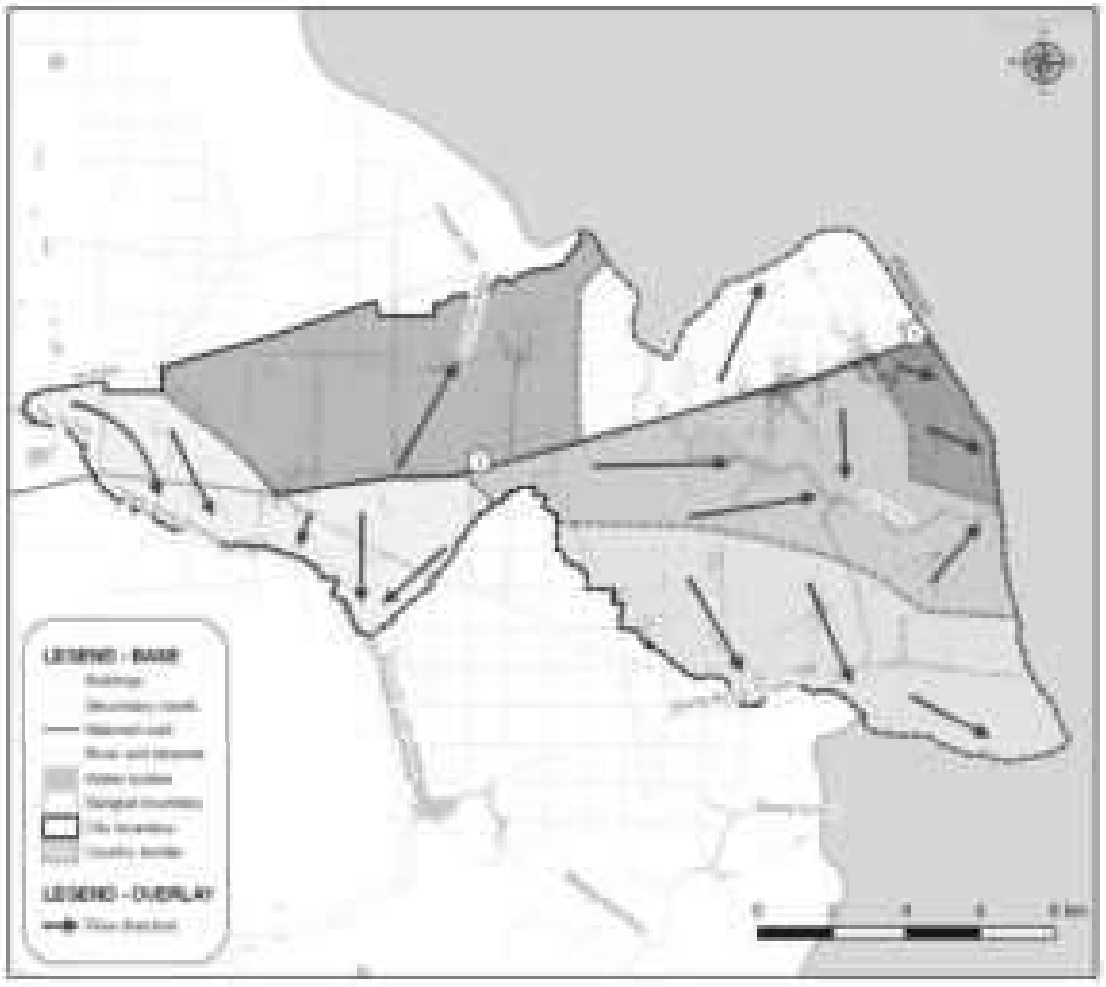
203. The Tonle Sap is uniquely important in Cambodia because of its characteristic of having two distinct annual water flow regimes. During the dry season, the Tonle Sap River flows downstream, to provide aquatic habitat in the low Mekong River, and local water supply. Monsoon floods in the Mekong make the Tonle Sap River to change its direction in May: so it flows upstream towards Tonle Sap Lake during the rainy season (until September/October), regulating floods in the downstream Mekong Delta.

204. Bavet is located in the floodplain of the Mekong River. The extensive network of tributaries (*preaek*) and streams are governed by the rise and fall of the Mekong during the annual cycle of rainy and dry season.

205. The main water bodies for the local hydrological context are:

(i) Ou Ta Pov;
(ii) Stueng Me Sar Thngak;
(iii) Ou Chrak Mtes / Preaek Chik;
(iv) Ou Ta Trav;
(v) Ou Chek; and
(vi) Preaek Bong Khvang.

Figure 14: Natural Catchments of the Main Rivers in Bavet



Source: Egis, 2021.

206. In general, stormwater from the upper half part of Bavet discharge to the channel bordering Vietnam to the north. From the northern part of the town, the stormwater drains to the open channels then to the main channel that crosses NR 1. The flow combines with the stormwater collected downstream and ultimately outfalls to Ta Pov River, which is situated in Sangkat Bavet, Sangkat Baty Sangkat Prasat and until Vietnam border.

207. Ta Pov River flows eastwards until it splits into two streams, flowing north and south along the Cambodia side of the border with Vietnam. The area between the two streams appears as a wetland with agricultural fields, and it is identified as “Reservoir” on Bavet Land Use Plan for 2030.

208. The level of water in Ta Pov River rises during rainy season when the channel bordering Vietnam is flooded and becomes shallow during dry season. Water uses of Preak Tapov are for irrigation and animal feeding only. The communities that are far from the town use water coming from wells; irrigation water extracted from Tapov stream is used for rice growing during dry season.

209. Evaporative losses account for 20%–30% of the rainfall occurring in Cambodia.

3.4. Water Quality

210. The Ministry of Water Resources & Meteorology (MOWRAM) and the Mekong River Commission (MRC) conduct regular water quality monitoring at designated sampling points in the Mekong River, Tonle Sap River, and Bassac River. There is a scarcity of available water quality data in Svay Rieng province, where Bavet is located.

211. The closest river with available quality data is Prek Trabaek River, a close tributary of the Mekong River, located in Kampong Trabaek district (Prey Veng province). The water quality of Prek Trabaek River is comparatively good, and only affected by local agricultural activities (Kampong Trabaek River Flood Control Project, MOWRAM, 2009).

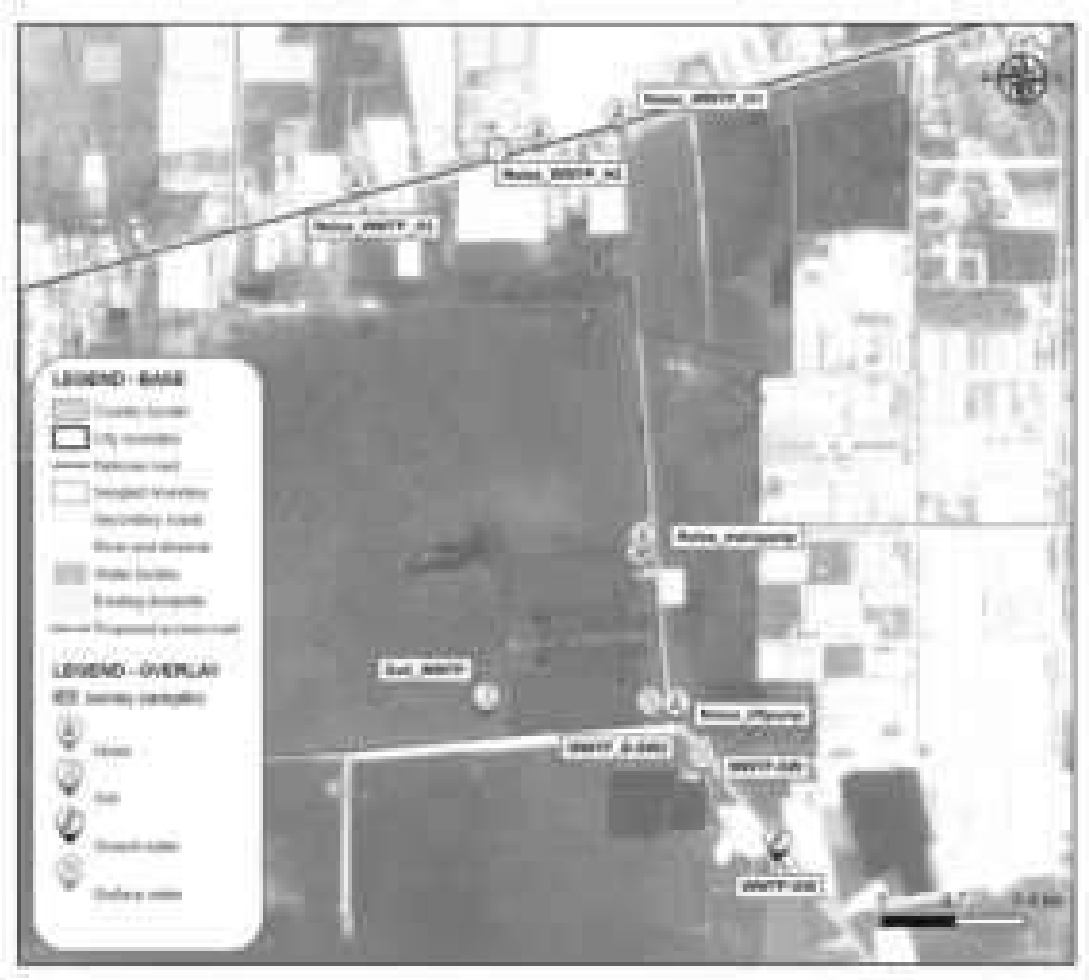
212. In Bavet municipality, multiple private boreholes are reported to be exploiting underground water resource without monitoring.

213. A specific survey of surface and groundwater has been carried out in September 2020 in water bodies in the vicinity of studied areas (i.e. WWTP and landfill). The following maps summarize the locations of the samples made. All of them are located around the future WWTP and Landfill proposed sites. The groundwater samples were taken from a borehole well (30-35m depth), and the ground water table was between 6-8m from natural ground (source: Baseline Environmental Survey Report - Jan.2021).

Figure 15 Localization of samples around the landfill

Source: Egis, 2021.

Figure 16 Localization of samples around the WWTP



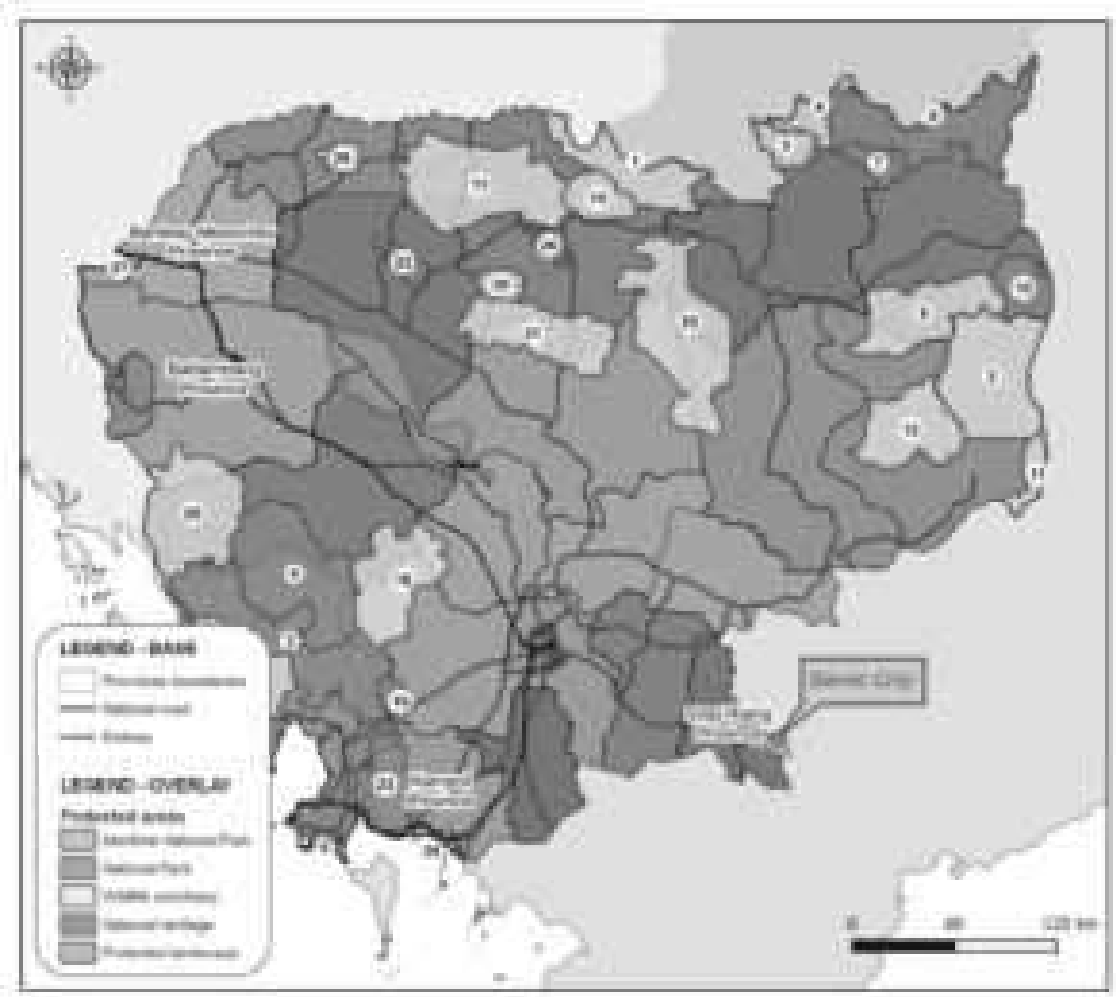
Source: Egis, 2021

214. Measured parameters are: pH, Electrode conductivity (EC), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Oil and Grease, Total Nitrogen (TN), Total Phosphorus (TP), Arsenic (As), Cadmium (Cd), Total Coliform, E.Coli, Na+, K+, Ca++, Mg++, Fe+, Fe++, Cl-, SO4-, NO2-, CO3-, and HCO3-. Results show that surface waters are affected by anthropogenic pollution sources (oil and grease). Iron concentration of the groundwater is slightly high compared to the national standards. The pollution source has not been identified at the WWTP area, whereas, in the future landfill area, the exiting dumpsite might be the main factor contributing to pollution of the groundwater. The total coliforms are higher than national standard of the public water area of Cambodia, and traces of E. Coli have been measured. The main source of total coliform and E. coli are faecalis of humans and animals. This result might cause the environment surrounding water sources such as the existing dumpsite with high organic waste to contribute to water quality. The wetland forest and agricultural field might also contribute to the increasing bacteria in the water.

4. Ecology, Wilderness Values and Protected Areas

215. Results of the proximity report from the IBAT data analysis (see appendices) confirms that neither protected areas nor key biodiversity areas are in the vicinity of the study area. There are also no protected areas or forest in Svay Rieng province. Dominating landscape in Bavet area is urban, accompanied by an agricultural land use (rice cultivation).

Figure 17 National parks and wildlife sanctuaries of Cambodia



Source: Egis, 2021.

216. Ecosystem types in Bavet area are grassland, shrub land and wetlands due to perennial flooding that occur from the swelling of Mekong River. Among the 175 species listed in the IBAT analysis report, belonging to the IUCN Red List, 22 are identified as Critically Endangered and 33 as Endangered. Although this data source is useful, precautions should be taken: among the species listed are marine species (pelagic thresher, Great Hammerhead, Bottlenose Wedgefish, …) that may not be present in the project study area. Furthermore, according to IUCN available data[33] no endangered or threatened species of flora or fauna are detected in this area.

217. The WWTP projected site land is a mix between a regrowing forest and acacia plantation within the Chamkar Konkoki Community Forest without any ecological value. The 2030 land use planned this site is listed as “Forest Area”. According to data collected during field survey, this forest is seasonally subject to fires, which accentuate its degradation. Moreover, these recurrent fires oblige local birds to leave the area periodically. As the burnt zones of the forest grow back, birds repopulate them.

[33] IUCN Red List of Threatened Species. www.iucnredlist.org.

218. Bavet Municipality is planning to conserve an area near the Vietnam Border. The area is assumed relatively rich on bird species and aquatic life, including turtles.

219. **Landfill Site.** Regarding local flora, field survey in September 2020 identified 15 different species, and 12 families in the area of the projected landfill site. They are mostly common species in the local status. Only 5 species are classified in least concern (LC) list by IUCN 2020: *Garcinia schefferi, Pierre*, *Cratoxylum formosum Melaleuca quinquenervia, Acacia auriculiformis Muell.,* and *Calamus salicifolius.*

220. **Mammals and Birds:** Surveyors recorded 18 bird species at the landfill site. One bird species (Painted Stork, *Mycteria leucocephale*) that is listed as Near Threatened in the IUCN red list, was reported to be seen by a resident during field interview, but not directly observed by surveyors. A large mammal (Red muntjac *Muntiacus muntjak*) was observed in this area.

221. **Amphibian and Reptile:** The total of 12 herpetofaunal species was confirmed by the comprehensive herpetological field survey. Findings show:

(i) *Xenochrophis flavipunctatus,* which is likely to live in open area of rice paddle fields (frogs are their main preys).

(ii) *Sphenomorphus maculatus,* which is likely to live in shrub, agricultural land, and also near human settlements.

222. Most amphibian species are common to shrub land, agricultural areas, and ponds around villages: *Duttaphrynus melanostictus, Microhyla fissipes, Microhyla pulchra, Fejervarya limnocharis, Hoplobatrachus rugulosus*. These species population are in stable status except for:

(i) *Hoplobatrachus rugulosus* which is hunted by local people for food and selling;

(ii) *Occidozyga lima* which is likely to live in paddy fields and puddles, but their status remains in good condition;

(iii) *Kaloula pulchra* which lives underground and only emerge during heavy rain or very wet ground for foraging and breeding. This species is also hunted by people, which lead locally to population decrease.

223. **Bat:** Small number of bats are present in the proposed landfill site.

224. In conclusion, the field survey (September 2020) shows that in the studied area and its vicinity, there is a significant number of fauna species.

(i) One Near Threatened bird species, the Painted Stork;

(ii) Small number of mammals and birds in less concern (LC) category of IUCN list, no Endangered (EN); Vulnerable (VU); Near threatened (NT);

(iii) Small number of amphibians and reptiles in less concern (LC) category of IUCN list;

(iv) Small number of bats are present in the proposed site.

225. **WWTP Site.** Regarding local flora, field survey identified 11 different species, and 7 genus in the area of the projected WWTP site. They are mostly common species with a local status. Only 2 species are classified in least concern (LC) list by IUCN 2020: *Melaleuca quinquenervia* and *Syzygium cumini*. The *Melaleuca quinquenervia* is the dominant species in this area. Other species recorded are: *Dioscorea oryzetorum, Cassytha filiformis, Litsca glutinosa, Cinnamomum litsacfolium, Thw., Orophea polycarpa, Heterosmilax paniculate, Eurycoma longiflia, Melastoma saigonense. Dipterocarpus alatus Roxb* was observed during field survey. It is identified as sacred tree for local communities. Note that in this forest, this tree species is relatively common, but no one has been observed in the projected WWTP area.

226. The vegetation where the WWTP will be located, was created by the MAFF with a dense *Acacia auriculiformis Muell* plantation (Chamkar Korki Community Forestry). The aim of this establishment is to conserve the biodiversity, manage the traditional use of forest products and non-timber forest products for the local community livelihood, tradition and religious believes to align with poverty reduction policy of the Royal Government of Cambodia. Local peoples contributes to its regeneration by planting several tree species (*Acacia auriculiformis Muell., Melaleuca quinquenervia*., *Hopea odorata Roxb, Dipterocarpus alatus Roxb).* One of these trees was identified as a sacred tree for local communities during field survey, at 200 m from the projected WWTP site (WGS84 coordinates N 11.041824, E 106.105408).

227. **Mammals and Birds:** Surveyors recorded 23 bird species at the WWTP site. Two Near Threatened species (i.e. Eurasian Curlew *Numenius arquata* and Painted Stork *Mycteria leucocephala*) and one Endangered species (i.e. Milky Stork *Mycteria cinerea*) in the IUCN red list were reported to be seen by a resident during field interview, but not directly observed by surveyors. Only small mammals are reported in the studied area.

228. **Amphibian and Reptile:** The total of 11 herpetofaunal species was confirmed by the comprehensive herpetological field survey. Findings show:

(i) One frog species *Hylarana erythraea,* which is likely to live on the forest edge;
(ii) *Sphenomorphus maculatus,* which is like to live in shrub, agricultural land, and also near human settlements.

229. Most amphibian species are common to shrub lands, agricultural areas, and ponds around villages: *Microhyla fissipes, Microhyla pulchra, Fejervarya limnocharis, Hoplobatrachus rugulosus.* These species population are in stable status except for:

(i) *Hoplobatrachus rugulosus* which is hunted by local people for food and selling;
(ii) *Occidozyga* lima which is likely to live in paddy field and puddles but their status remains in good condition;
(iii) *Kalophrynus interlineatus* which has very wide range of distribution in many countries of Southeast Asia but they are not commonly seen due to their shyness.

230. **Bat:** Small number of bats are present in the proposed WWTP site.

231. To summarize, the field survey showed that in this area and its vicinity, there is a significant number of waterbird species. Two Near Threatened species (i.e. Eurasian Curlew *Numenius arquata* and Painted Stork *Mycteria leucocephala*) and one Endangered species (i.e. Milky Stork *Mycteria cinerea*) in the IUCN red list are reported to be present. Only small mammals are reported to be present in the study area.

232. **Ecology of the Ta Pov Stream.** Some fish species such as catfish, hermibagrus (Chhlang), mystus rhegma (Kagnchos), Kragn, and other small fishes are present in the channel surrounding the project area.

5. Human and Socio-Economic Context

5.1. Population of the City

233. At the time of the population census of 2018, 42,546 people lived in Bavet. This corresponds to a population growth of 38% over of a period of 20 year, based on the comparison of the censuses of 1998 and 2018.

5.2. Poverty Impact and Social Dimensions

234. Between 21 December 2019 and 15 January 2020, a Comprehensive City Survey (CCS) was carried out in Bavet. 658 Households were surveyed and this sample size guarantees a minimum of 95% confidence level with 5% margin of error.

235. The households present the following socio-economic status:

(i) 69% of the household heads are males;
(ii) 66% of the Survey respondents are women;
(iii) 98% are married or widow/er;
(iv) The households are in average constituted of 4 persons;
(v) The average monthly income of the household is $486, the median in $390;
(vi) 13% of the respondents did not attempt primary school. 14% continued in High School or further; and
(vii) 17% of the families have lived in their house for less than 10 years.

236. The temporary or informal housing / shelters seem to be mainly in urban areas. Low income and disadvantaged people may need special assistance to benefit equitably from new infrastructure.

5.3. Gender and Development

237. Women generally have a higher health risk exposure from sanitation and sewage, as the primary contributors toward household and community sanitation tasks.

238. Women are the main users of water in the households, and are also primarily responsible for the solid waste, liquid waste and wastewater management on the household level. Water shortages also significantly increase the time needed for cooking, cleaning and caring for both children, the sick and disabled members. In addition, women who work in kindergarten, schools and hospitals bear the responsibility to fetch water and clean the toilets. A lack or low quality of the potable water and sanitation also increase the incidences of water-borne diseases and thus households' expenditures on medicine and doctors' fees.

5.4. City Economic Conditions

239. **Employment.** In 2018, 54.69% of the City population aged from 18 to 60 were employed. The employed population with a main occupation[34] increased by 14% from 2010 to 2016, but this declined from 21,387 in 2016 to 19,638 in 2018. In 2018, 14% of the population was working in the agricultural sector, 81% in the industry sector and 5% in the service sector.

240. **Agriculture.** Agriculture is an important source of income for the population, occupying a total of 155.39 km^2 or 75.18% of Bavet's total land area.

241. **Industries.** Due to its strategic location, Bavet was designated by the national government as a SEZ for small and medium manufacturing industries. In the economic zone there are mostly industries engaged in the manufacture of garments, shoes, bicycles and computer chips. In 2019, these SEZs have been established and are in operation:

(i) 3 SEZs in *Sangkat* Bavet: Manhattan SEZ, Tai Seng SEZ, D&M SEZ;
(ii) Intervia Auto-mobile Industry Complex in Prey Phdau;

[34] Principal work or means of earning a living as defined in the yearly City Socio-Economic Status report.

(iii) NLC SEZ in Thlok;
(iv) Dragon King SEZ and PIC SEZ in Prey Tob;
(v) Shandong Sunshell Svay Rieng SEZ in Chrey Thum, Angkunh;
(vi) Hi-Park SEZ in Toul Ampil;
(vii) Neakareach SEZ in Thnal Cheat; and
(viii) Svay Rieng GIGA Resource SEZ.

242. The local authorities are expecting additional industry locators to expand the existing and develop new SEZs.

243. **Service Sectors and Tourism.** The opening of the cross-border trade in 1991 has enabled the growth of trade activities and a growing influx of migrant workers into the area. There are bus terminal facilities operating in Bavet that provide services to local, provincial and international tourist buses (from Viet Nam). Between 2017 and 2018, the number of provincial tourists arriving into the area increased from 705,798 to 736,633.[35] In 2018, the Bavet border checkpoint recorded 534,660 international tourists, which represent approximately 8.62% of the total international tourists (6,201,077) entering Cambodia.[36] Cross-border activity has made Bavet grow larger than its provincial capital, Svay Rieng City in terms of number of visitors and population. Along NR1, Bavet city center hosts large hotels, buildings and commercial establishments that serve as casinos for gaming and as recreational centers. Close to the border gate is a commercial market operated by the private sector. The Bavet public and private markets which cater to the small and medium entrepreneurs, market vendors and traders are situated in the city center, Sangkat sub-centers and in the middle of residential and commercial establishments.

244. Bavet is strategically located at the Cambodia-Vietnam border. Its Land Use Plan Vision 2030 envisions Bavet to become “a commercial, industrial and modern tourism sustainable and inclusive city”. This vision has been developed from the strategic planning workshop undertaken on 6 November 2019.

5.5. Social Infrastructure

245. **Health.** There is only one Health Center in Bavet municipality. To meet its social development objective in health sector, the City targets for 2015-2019 were defined as follows: i) provide water supply access to 50% of total households and electricity access by 95%; and ii) promote health, hygiene and care by 99% of the total households.

246. **Education.** In 2018, there were 17 state primary schools. Given 5,333 students and 149 teachers in the state primary schools, the ratio of students to teachers was 36:1. There were also 3 state secondary schools with 16 classrooms in Bavet. With 748 students and 35 teachers in the state secondary schools, the ratio of students to teachers was 22:1. In 2 public high schools with 34 rooms, there were 84 teachers for 2,066 students, corresponding to a 25:1 ratio. These student-teacher ratios are below the international average ratio of 1 teacher for 23 students, except for secondary school level.[37] There is no university in the city.

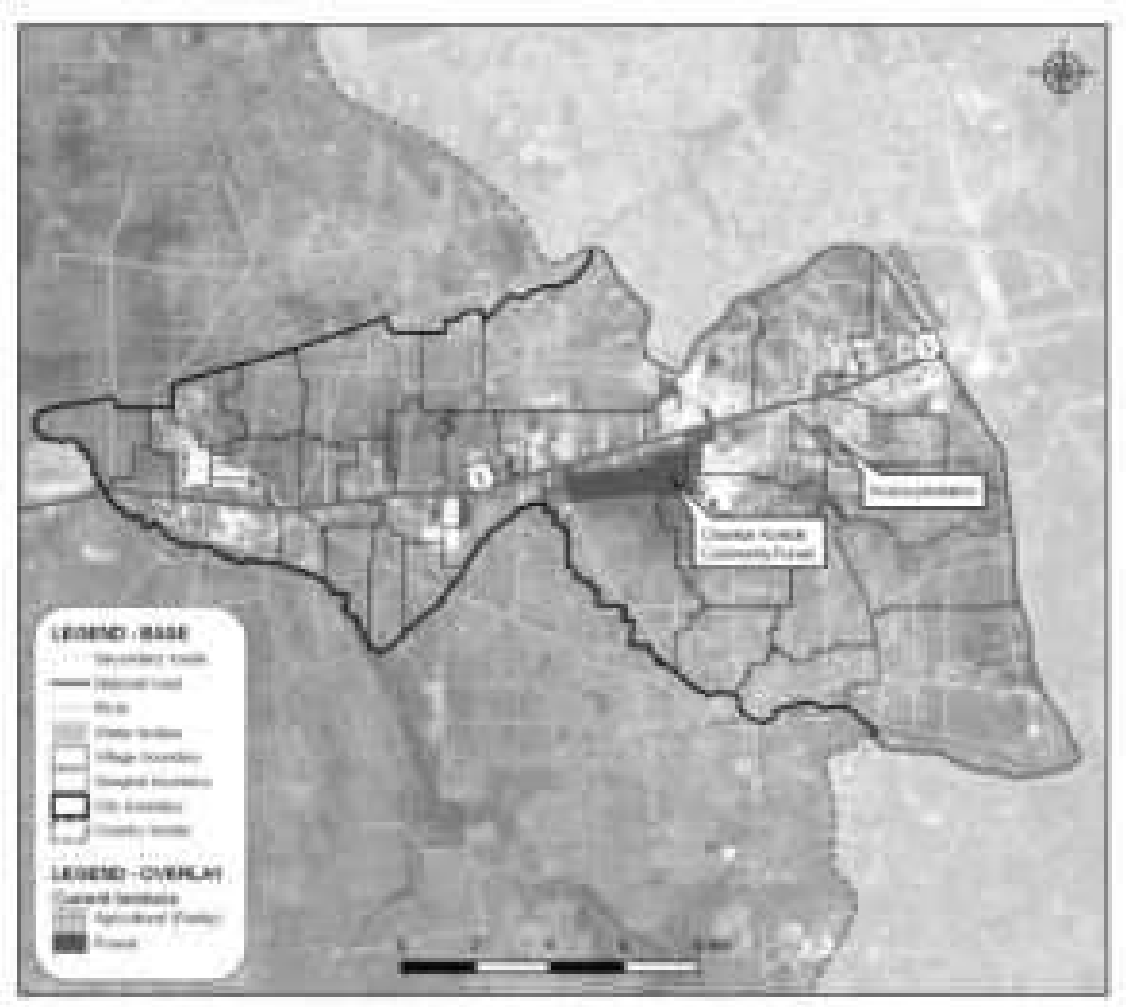
247. **Social Welfare and Vulnerable Persons.** In 2018, there were 243 vulnerable people in the city (0.75% of the population). In 2018, there were 91 orphans (85 orphans with guardian, 3 orphans without guardian, and 3 orphans living by themselves), 199

[35] Department of Tourism, 2019. Tourism Statistics.
[36] Government of Cambodia, 2017. Annual Tourism Statistics Report. Phnom Penh.
[37] https://data.worldbank.org/indicator/. Retrieved on 18/12/2019.

persons with disability aged over 18 years old (of whom 75 had no income), 4 homeless, and 8 defenseless elderly persons.

248. **Public Open Space and Recreational Facilities.** There is very limited and poorly landscaped green open space in Bavet. Only 1 urban forest is found in Chamkar Konkoki Community Forest and a potential green space area at Road 316D in Tapov Village, *Sangkat* Bavet. The map below shows the location of these 2 green spaces:

Figure 18 Location of green spaces - Bavet



Source: Egis, 2021.

5.6. Governance

249. Articles 145 and 146 in the Constitution, promulgated in 1993 (as amended), stipulated the territorial divisions of the local administration in Cambodia. Article 145 stipulates that the Cambodian territory is divided into provinces and municipalities. Below, that provinces are divided into districts and districts are divided into communes, whereas the municipalities are divided into khans and the khans are divided into sangkats. Article 146 provides that provinces/municipalities, districts/khans, and communes/sangkats shall be governed by the provisions of the 2008 organic law.

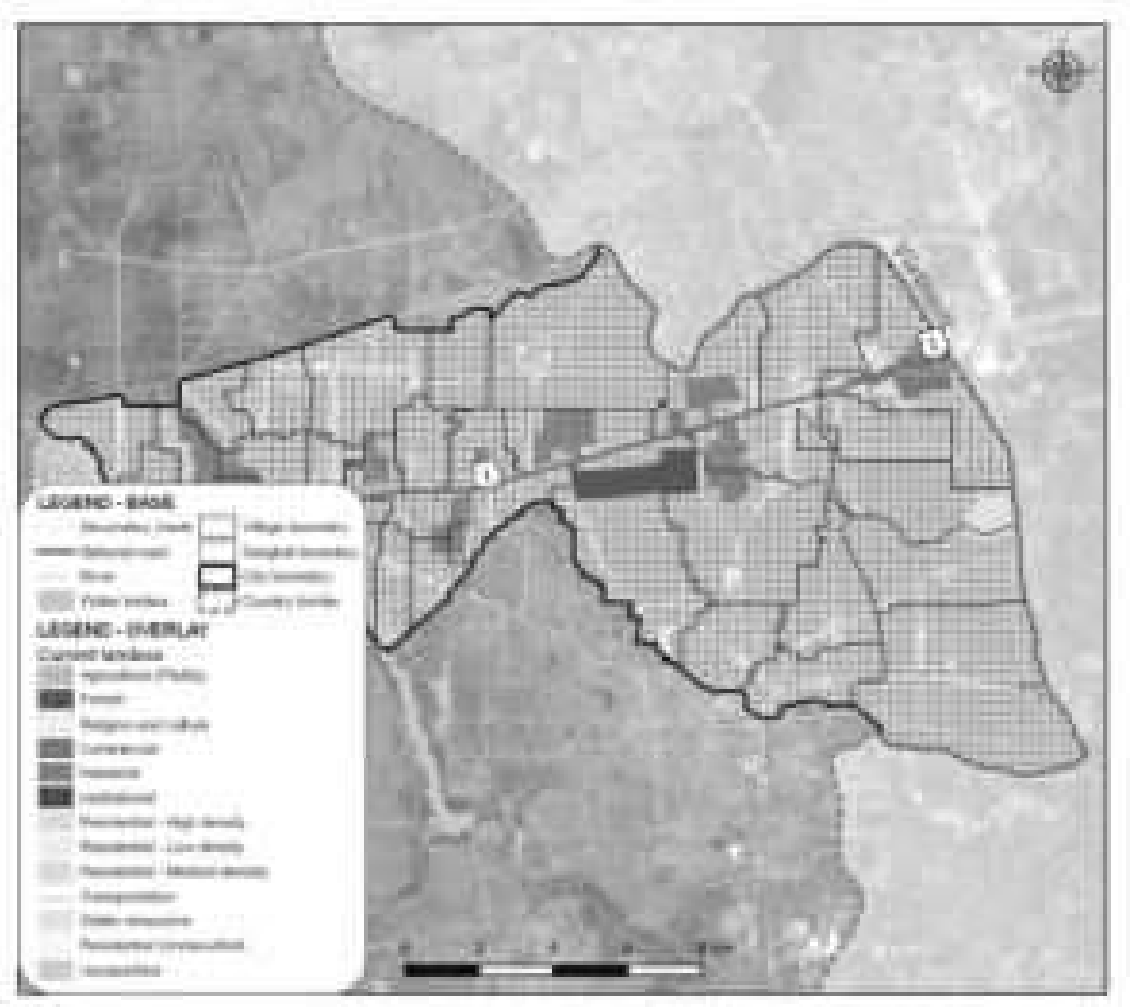
5.7. Land Use

250. Agriculture land use represents the biggest portion of the city at 80.63%; followed by urban use at 14.91% (of which residential represents 8%, industrial, 5%; commercial, 1% and transport, 3%), water, 1%, natural forest, 1.47% and open space 0.07%.

2 A significant land use conversion from agricultural to residential is proposed[38] for Bavet for 2030 and it is estimated to be 61.11 km^2.

251. Along the access road to WWTP Site-1 there are some signs of future construction sites with construction materials, concrete poles and subdivision boundaries. There is one Vietnamese fisherman habitation located on the access road canal.

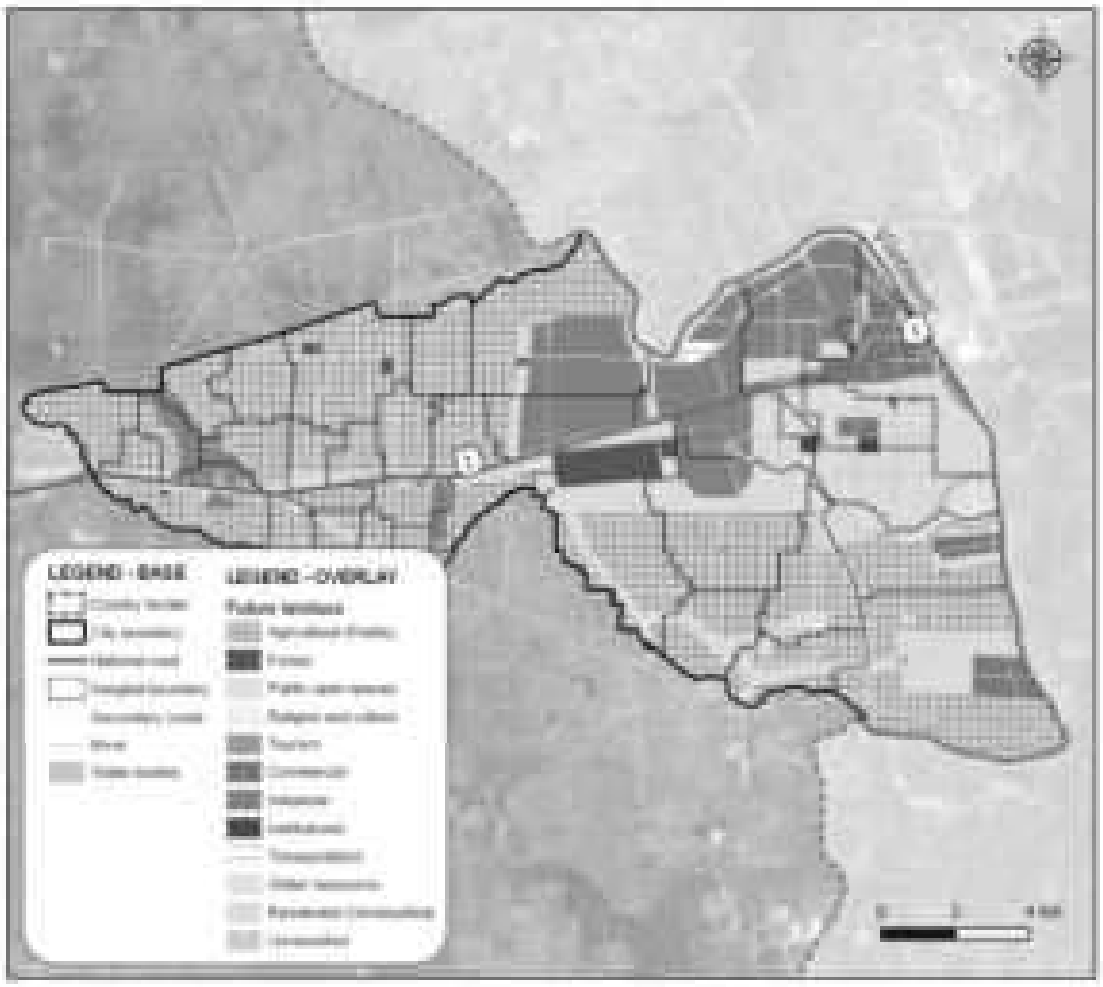
Figure 19: Current land use in Bavet City area



Source: Egis, 2021.

[38] Department of Land Management, Urban Planning and Construction, December 2019. Approved Master Land Use Plan.

Figure 20: Projected land use - horizon 2030, Bavet



Source: Egis, 2021.

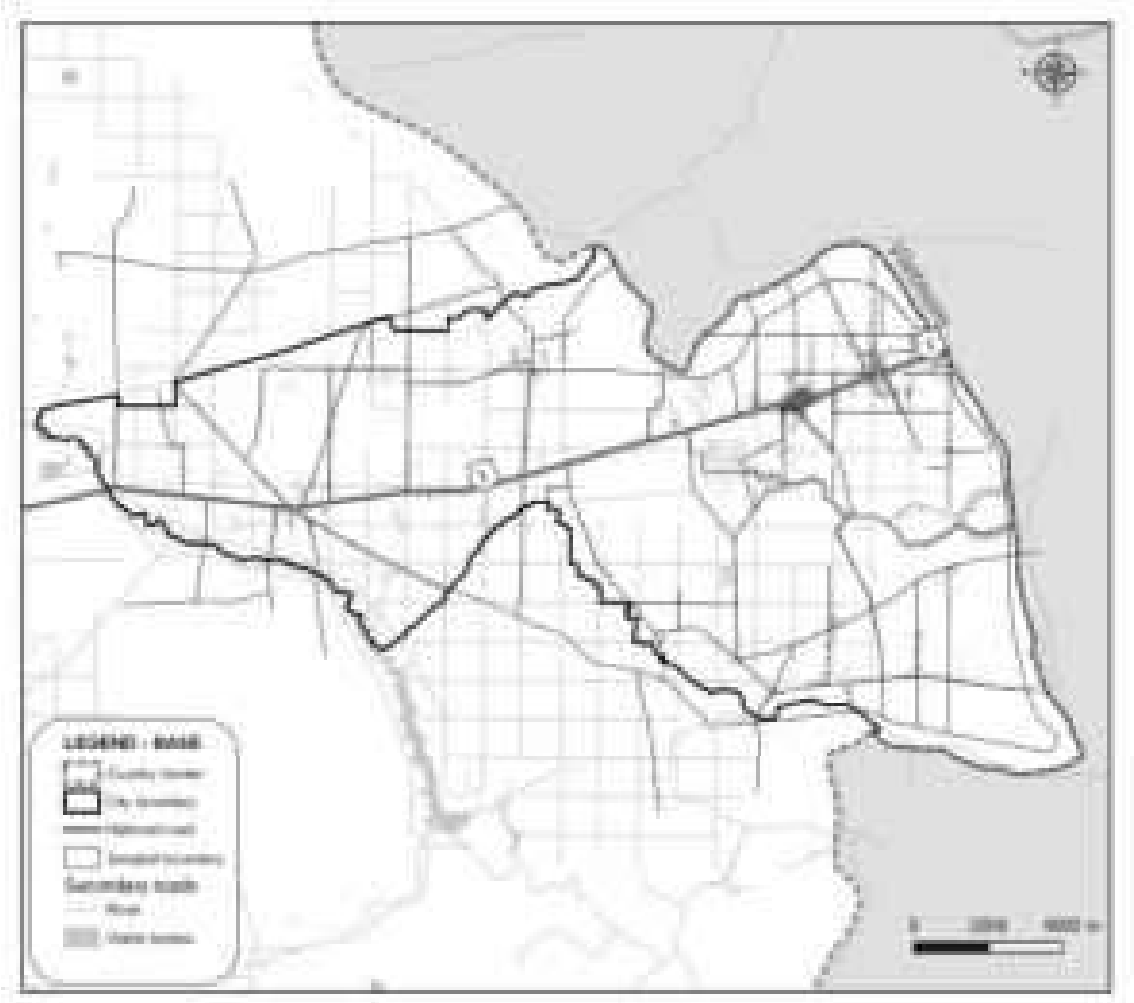
5.8. Transport Infrastructures

252. **Providers.** The MPWT is the main responsible agency for provision of roads and transport infrastructure.

253. **Access to Services.** Bavet is located on the NR 1 which cuts across the city. In December 2019, the road network in Bavet has a total length of 155.35 km and 44.62 km local earth road (ADT <500 vpd)[39] needed to be improved. Sangkat Bavet 181 m of concrete road is under construction in 2019. Most of the urban roads in Bavet are composed of laterite or earth surface. During rainy conditions these roads are barely passable for even four-wheel vehicles and motorbikes. Part of the proposals for upgrading these roads are currently being undertaken under the GMS 1 project. The map below shows the current transportation network available on Bavet city:

[39] Average Daily Traffic (ADT) vehicle per day (VPD).

Figure 21: Available transportation network - Bavet city



254. **Service Quality and Consistency.** Traffic loads are high along NR 1, since this is a main road crossing between Cambodia and Vietnam. The NR 1 connects to Bangkok, Phnom Penh and Ho Chi Minh City. It is accessible to vehicular traffic with varied time of congestion. Terminals of private bus operators are found along NR 1.

255. **Institutional Arrangements**. National roads are under the MPWT, while roads within the city and whole province are under Provincial Department of Public Works and Transport (PDPWT).

256. **Financial Status.** The service is financed by the public sector through national budget allocations (at the provincial or municipal level) or by financial and technical partners of Cambodia through specific projects.

6. Cultural Heritage and Physical Cultural Resources

257. Siem Reap province is one of the rich archaeological and cultural heritage areas in Cambodia. This area is located at 450 km distance from Bavet. The closest physical cultural resources named “Prasat/Temple Bassac” and “Popel Temple situated in Sray Chrum district” and Rumdul district, Sray Rieng province, are at about 60km and 40km distance from Bavet city.

258. Few cultural monuments are found in the municipality of Bavet and cultural heritage is mostly represented by mosques and pagodas.

259. During field surveys carried out in September 2020, a shrine place was observed near the vicinity of the WWTP projected location. It (620749 E, 1220827 N) is located in the ephemeral wetland forest, at 200 m distance from the WWTP project boundary. This area is covered by several big trees surrounding by the water. A sacred tree for local communities was also identified in the same sector. Its access is via a narrow footbridge crosses the canal bordering the forest to the south. The following map show the location of the shrine place identified:

Figure 22: Location of the shrine place identified and wastewater treatment plant project

Source: Egis, 2021.

7. Noise

260. In the outskirts of the city the acoustic ambiance is relatively calm: the suburban areas northwest and southeast of the city center are dominated by agricultural fields. The heart of the city provides a noisier background, with its urban-life and construction activities, markets, as well as the traffic of NR 1 and the 10 SEZs located along the national road.

261. During field surveys conducted in September 2020, noise level measurement were measured at the landfill site and 3 houses close to it; at the WWTP site and 3 houses close to it; at the pumping station, and at the main pumping station.

262. The landfill site's noise level is a maximum of 59 dB(A) between 11.00 and 12.00 and a minimum of 31 dB(A) between 7.00 and 8.00. The noise disturbance standard issued by MoE is 70 dB(A). The noise disturbance might be caused by transportation to the existing dumpsite, human activities, or natural noise sources (local fauna, wind effect, etc.). There is no significant impact from noise disturbance at the landfill area in its current configuration.

263. The average noise level in one hour of the three houses close to the landfill is 50 dB(A). The maximum is around 65 dB(A). There is no concern about the noise disturbance around the landfill area in its current configuration.

264. The WWTP site's noise level is a maximum of 53 dB(A) between 11.00 and 13.00 and a minimum of 43 dB(A) between 9.00 and 10.00. The noise disturbance might be caused by the vehicles, human activities, or natural noise sources. There is no significant impact from noise disturbance at the WWTP area in its current configuration.

265. The average noise level in one hour of the three houses close to the WWTP is 45 dB(A). The maximum is around 60 dB(A) There is no concern about the noise disturbance around the WWTP area in its current configuration.

266. The average noise levels in one hour of the lift pump station and the main pumping station have been measured. The average of noise level at the lift pumping station is 45.1 d(B)A, with a maximum of 58.3 dB(A) and a minimum of 34.2 dB(A). The average of noise level at the main pumping station is 43 d(B)A, with a maximum of 65.3 dB(A) and a minimum of 34.4 dB(A). The standard of noise disturbance is 70 dB(A), issued by MoE to define the commercial and service areas and multiple businesses' areas. There is no concern about the noise disturbance at the lift pumping station and main pumping station in their current configuration.

8. Air Quality

267. There is growing concern regarding increasingly poor air quality in urban areas of Cambodia. Air pollution is being linked to increases in the number of vehicles, industrial development, and overall urbanization that is occurring. The general lack of air quality data outside of major centers such as Phnom Penh is because air pollution in the rural areas is relatively low.[40]

268. In general, in rural areas air quality is still good. However, the increases in socioeconomic development along new road corridors will bring air pollution from vehicle traffic and industrialization. This might be particularly the case for Bavet, as it is strategically located at the Cambodia-Vietnam border in the inland. In Bavet, commercial and industrial sectors are developing, as well as national and international tourism. Consequently, the

[40] Communication from EIA Head of MOE, 2016 conducted by TA consultants of Second RAMP

traffic on NR1 is increasing along with the emissions from moving vehicles. Both in urban and rural areas air quality is also impacted by dust from unpaved roads. Moreover, local air quality at the projected SWM site is already affected by the existing dumpsite (waste burning, odors, etc.). Other sources of air pollutant are waste burning from households and agricultural activities, and gases from untreated wastewater.

269. During field survey (September 2020), the air quality has been measured at the landfill site (0612784 E, 1225002 N) as described in the following table. The result of air quality measurement conducted at the landfill site indicates that all the parameters are below the standard of MoE. Hydrogen sulfite and ammonia were not detected.

Table 23: Air quality at the landfill site

No	Parameters	Unit	Result	Standard
1	Carbon Monoxide (CO)	mg/m^3	0.86	<20 (8 hours)
2	Nitrogen Dioxide (NO2)	mg/m^3	0.016	<0.1 (24 hours)
3	Sulfur Dioxide (SO2)	mg/m^3	0.024	<0.3 (24 hours)
4	Total Suspended Particles (TSP)	mg/m^3	0.049	0.33 (24 hours)
5	PM10	mg/m^3	0.027	<0.05 (24 hours)
6	Hydrogen Sulfite (H2S)	mg/m^3	ND	<0.001
7	Ammonia (NH3)	mg/m^3	ND	<0.2

9. Water Supply

270. **Providers.** The Bavet water supply is managed by several operators: the Khun Development Company, a private company with authorization license from the Ministry of Industry and Handicraft (MIH) (from 2017, until 2022); the Sim Pheakdey Company, another private company; and by SEZ operators for their own needs.

271. **Water Resource.** Bavet is serviced by ground water, from deep wells / boreholes (200 m^3/h) for Khun area. For Sim Pheakdey and the SEZ, the number of boreholes in exploitation was not confirmed.

272. **Access to Services.** The piped water supply is available for 30% of the population, but due to economic reasons, only 10% is connected to it[41]. The cost for the piped water supply is \$0.5/m^3 Due to the cost of water, only 2% use it as a main source of drinking water. Within the 10% connected to the population, some prefer to use their own borehole and use the piped water supply only during electricity cuts[42]. The connected houses are mainly along the NR 1.[42] The average consumption is 5m^3/month. The survey respondents are mainly satisfied by the water supply network, 55% have not reported any complaint. Some customers complained about the price deemed too expensive (49%), the poor quality of the drinking water (35%), the poor service water pressure (21%), the lack of customer services (3%).

273. 95% of the population has its own borehole, and 50% uses the water from it as a main source of drinking water. When used to drink, the borehole water is always treated: 94% of the population treat it daily, 4% weekly and 2% monthly. 84% of the population boils the water before drinking it, 12% uses a filter and 4% drinks it after flocculation and settling.

[41] Comprehensive City Survey, Egis 21th of December 2019 and the 15th of January 2020
[42] Focus Groups in Kampout Pras, Chrey Thum, Kampout Chruk, Kouk Lvieng, Ta pov, Bavet Lau, Ta Boeb and Prasab Laek Villages

274. The accessibility of bottled drinking water is good in Bavet. Even in remote villages, 20L bottles can be found in small grocery shops.

275. The respondents of the Focus Groups indicated that the depth of their water intake (well) ranges from 22 to 43 m. In 1964, the USAID drilled 155 wells in Svay Rieng province to monitor the ground characteristics. The ground water table has been measured between 20 and 60 m below the land surface (USAID 1970, p46).

276. **Water Treatment Plant (WTP).** At least two plants operate on different private sites in Bavet Municipality. The average current operation rate shows a total of 10,470 m^3/day (city+SEZs+Casino), for a built capacity of at least 1,580 m^3/day (city only). The treatment process consists of an oxidation / flocculation/ decantation / filtration / chlorine disinfection stage & inletting to the underground tanks (240 m^3).

277. The current way of sourcing additional water in Bavet is to drill a borehole each time it is needed and pump in the aquifer the required amount of water. This however is clearly not a reliable and resilient way to look at things, even if this aquifer has the capacity to supply water to Bavet City, hotels, and SEZs. As no analysis has been carried out to confirm, it cannot be considered as a sustainable way to proceed. The fast growing water demand of Bavet, the types of uses, deserve a much more thoughtful and methodical approach.

278. Water resource used to supply Bavet City is entirely underground water. No consistent data concerning this aquifer has been gathered yet. The water is supplied from deep wells (boreholes) of announcing depth ranging from 40 meters and up to 120 meters.

279. Four existing units are under Khun Development exploitation (2 x 60 m^3/h and 2 x 40 m^3/h), operated “randomly” with auto switch control and in direct relationship with the treated water underground tank level, on the way out of the WTP.

280. It should be noted that the boreholes are already surrounded by development as a result of urban growth. The rate of urban expansion in Bavet, is likely to place its location (and operations) at risk.

281. Three of these boreholes are directed towards the oxidation tank at the WTP inlet, while the last one seems to be directly sent to the treated water underground tank. At this stage of the project, there is not available document to confirm that the raw water quality complies with water distribution standards.

282. The existing WTP operated by the Khun Development Company is approximately 1,200 m^3/day capacity.

(i) The treatment consists mainly of four successive stages:
(i) Oxidation stage: aeration cascade and pre-chlorine injection;
(ii) Flocculation / decantation stage;
(iii) Filtration stage: sand filter;
(iv) Disinfection stage: final chlorine injection (before inletting to the underground tank).

283. The operator is also injecting alum but, only when the turbidity is too high. High turbidity levels appeared to affect the water quality when the 4th borehole became operational. It was also noted that lime is added during the disinfection stage. The lime and alum injections occur at the final (iv) stage, just before storage of the treated water. This kind of processing is not common nor conventional. A more common practice would be injection at the coagulation stage (before stage ii).

284. It was observed that the operating mode of chemicals preparation (dosage) and injection is completely manual, and hence empirical. Further, the age of the WTP is unknown at this stage of the project.

285. **Distribution Network.** The distribution network was 97 km long in 2019 (Ø 50 to 160 mm), mainly in HDPE. The global coverage was 23% in 2018 - 2,380 households (HH) connections. Non-revenue water (NRW) was 21% in 2018. The domestic water needs ratio cannot be estimated (no distinction between household consumption and other consumption). The global use is around 600 l/day/connection and does not include casinos and SEZ factories needs.

286. **Quality.** There is currently no data on the raw water. Considering treated water quality, 3 among the 6 parameters tested in October 2019 were not compliant (exceedances on low pH, color, and too low remaining chlorine), questioning the efficacy of the WTP process.

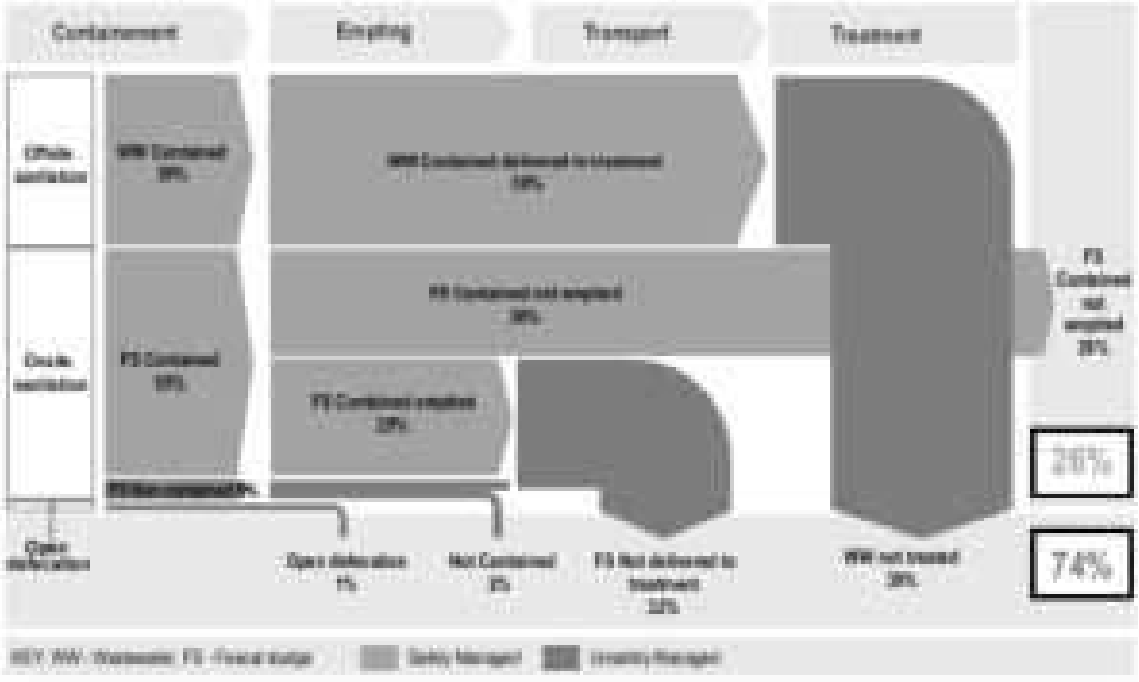
287. **Institutional Arrangements.** The Ministry of Industry, Science, Technology and Innovation (MISTI) plays an important role in: i) preparing policies, strategies, guidelines and regulations related to potable water sector; ii) developing technical standards or norms for potable water production and supply.

288. **Financial Status.** The water supply service is financed by a user-pay arrangement. Billings are issued and collected by private companies Khun, Sim Pheakdey, and SEZs operators directly to end users. The tariff guidelines are in the contract and approved by the government MIH (≈2,000 Riel / m^3 for Khun area). Khun and Sim Pheakdey, with its own technical and financial resources, handles construction and O&M.

10. Wastewater Management

289. Based on the assessment of access to both onsite sanitation facilities and sewerage system, it is estimated that 74% of the excreta generated in Bavet is not safely managed.

Figure 23: Excreta Flow Diagram



Source: Egis, 2021

290. **Toilets.** Different types of toilets are used in Bavet. The flush toilets are only used along the main road with houses connected to the city water system. The major toilet facility type used in Bavet is the pour flush toilet. In 2018, 9,227 (89.40%) households had access to a toilet.[43] In 2020, this number has reached 95%3 of the surveyed population.

291. This survey showed that 2% of the population are still practicing open defecation and this number raises to 5% in some of the remote villages. In the city, the main practice is to defecate into a plastic bag or bucket while the paddy fields are preferred in the rural areas. The hotels and restaurants located along the NR 1 have mostly flush toilets.

292. The same survey also indicated that 3% of the population share sanitation facilities with their neighbors. This matter is also important to consider, given the negative impacts on dignity, privacy and personal safety, especially for women and girls (JMP, 2018).

293. **Containment.** 95% of the population surveyed in Bavet City has an onsite sanitation containment. The most common type is a tank made of cylindrical concrete rings stacked one of top of the other. The rings used are 0.5 m high and 1 m of diameter.[44] 95% of the containment (i.e. 83% of the population) are considered semi-impermeable with an open bottom.

294. 30% of the surveyed population has a “Fully lined tank (sealed) to soak pit.”

295. 65% of the surveyed population has “Lined pit with semi-permeable walls and open bottom” containment, which are then considered as “semi-permeable” solution. It is common (80% of the “semi-permeable” tank) to find semi-permeable tank connected to a soak away tank (i.e. 46% of the population).

296. Hotels and casinos use the same system (i.e. cylinder lined ring) with deeper containments.

297. In rural areas, 3% of the containment or soak away tanks has overflow pipes that discharge into to paddy rice field. Along the main road in Chiphu, 5% of the containment have overflow pipes connected to the box drainage on the side road. In Bavet City Center, 60% of the overflow pipes are connected the side road drainage. In many cases, as the drainage network is either nonexistent or non-functional, the wastewater ponds along the road.

298. Wastewater flows directly to the environment through combined sewers and road drains, or indirectly via a canal into the open water. Most of the existing drainage lines are filled with wastewater and raw black water. The wastewater flows generated are not routed properly toward the outlets and may flood the city.

299. **Septages Emptying and Transport.** 5% of the population has emptied its sanitation containment and 3% hired a pump truck to empty and transport the fecal sludge, while the remaining did it manually. There are two main reasons for the low percentage of emptying the containment unit. The first is the wide use of chemicals (from Vietnam) to fluidize the excreta. By using it, a major proportion of fecal sludge is turned into supernatant, which then percolates into the surrounding soil through the open bottom or the side wall holes. Another reason is the long time to be filled up with fecal sludge. For a proper designed tank, it takes

[43] Department of Planning, 2018. Socio-Economic Situation Report.
[44] Focus Groups Discussions

in average three to five years to fill it up (WaterAid, 2018). This duration is increased with the use of chemicals.

300. In some rural areas, it is more profitable for households to bury the full sanitation containment and to build a new one than emptying it.

301. There is only one emptying business that provides services in Bavet. They own one vacuum truck which has a capacity of 3 m3. Their main clients are the SEZs and the casinos. During the high season, they empty an average of two tanks per week. The cost to empty one ring (diameter of 1 m) for households is between $10 and $15. For the casinos and SEZs, the average cost to empty is around $100 per emptying. While access to a hygienic toilet facility is essential for reducing the transmission of pathogens, it is equally important to ensure safe treatment and disposal of the excreta produced (JMP, 2018).

302. There is no septage treatment facility available for Bavet city.

303. According to the CCS, approximately one-third of the fecal sludge is sold to farmers. The remaining part is dumped in unknown locations.

304. **Treatment.** While access to a hygienic toilet facility is essential for reducing the transmission of pathogens, it is equally important to ensure safe treatment and disposal of the excreta produced (JMP, 2018).

305. There is no WWTP in Bavet. The fecal sludge is disposed at the local dumpsite. It costs $10 to empty a full truck. However, the owner of the emptying truck prefers to sell the waste to farmers (around $10 for the whole truck), meaning the sludge is then mostly disposed onto paddy fields.

306. **Groundwater contamination.** 50% of the population surveyed uses a private borehole as their main source of drinking water and 47% buy it from water venders. The remaining 3% use the water from the city's water supply network. Even the households that are connected to the drinking water network prefer to use their own borehole for economic reasons. The average water consumption is approximately 5 m^3/month. The cost for the installation of the bores, including the pump is around $100. The respondents of the Focus Groups indicated that the depth of their water intake ranges from 22 to 43 m. In 1964, the USAID drilled 155 wells in Svay Rieng province to monitor the ground characteristics. The ground water table has been measured between 20 and 60 m bellow the land surface[45]. As the depth is more than 10 m, the risk of groundwater contamination can be estimated as a "low risk."[46]

307. Based on this, fecal sludge not emptied from the containment systems could be considered as "treated in-situ" posing a low risk to contamination.

308. **SEZ Sanitation Assessment.** There are ten SEZs in Bavet. The toilet systems utilized in the SEZs are either flush or pour flush. The containment type used in the SEZ are rectangular tanks and circular lined tank with sealed bottom (i.e. High Park). Sandong Sanshell SEZ for example utilizes a rectangular lined tank with a capacity of 180m^3 for the 10,000 people working there. The effluent is released into water bodies[47], without any treatment to manage the effluent water quality.

[45] USAID, 1970. Water Resources in Cambodia
[46] SFD PI, 2018
[47] KIIs – Tay Seng and High Parks SEZ Interviews

309. Once the containment systems are full, a private company is hired to empty it. The dumping location remains unknown for most of the SEZs.

310. Manhattan SEZ, Tay Seng, SEZ, Sandong Sanshell SEZ have their own WWTP for the domestic wastewater. The technology used is unknown. The capacity of treatment is questioned in an article of the Phnom Penh Post in 2016.[48]

311. For Tay Seng SEZ, the WWTP lagoons outlet is to a lake, which is connected to existing irrigation network.

312. The SEZs contributes a significant proportion (39%) of the unsafely managed excreta. It could be opportunistic to connect SEZs to any future public service.

11. Stormwater Drainage

313. **Natural Transport.** The majority of the total land area of Bavet is affected by intermittent flooding during the rainy season (June to November, with peaks during September to October). The natural drainage of Bavet is governed by its topography which is relatively flat and it is influenced by the open earthen channels.

314. Households and commercial establishments drain their wastewater and stormwater through small canals and natural streams (e.g., Ta Pov River) into the open agricultural areas and rice fields. The rice paddies in turn drain into the border areas with Vietnam and the stream south of Ta Pov River about 2 km from the NR 1. Water level of Ta Pov Stream increases during rainy season and goes down during dry season.

315. Bavet has more than 20 km of open channel network. The size of those channels varies between 2 and 4 meters and a depth from 1 meter to 3 meters. The open channel network is now considered as the main drainage infrastructure. This network is the outfall of some drainage/sewerage pipes.

[48] https://www.phnompenhpost.com/national/officials-look-bavet-sezs-wastewater

Figure 24 Existing storm-water drainage system in Bavet

Source: Egis, 2021

316. Some key canals are totally blocked, leading to an incapacity to drain the collected water from secondary network. This is notably the case at the cross points under NR 1.

317. None of the canals is lined with concrete material. At some locations, this leads to an important bank erosion.

318. Due to the low flow in the canals, especially during dry season, plants and algae overgrow the banks. This leads to a reduction of the flow capacity.

319. The water quality in those open channels is poor, especially during dry periods of the year when the wastewater becomes pure sewage.

320. The collected flow in the canals is then leaded to the following outlets:

(i) Ta Pov River. Located in the south of Bavet, this stream is the main collector of all the canals situated south of NR 1. The upstream of this stream is treated wastewater coming out from Manhattan SEZ.

(ii) Open spaces and agricultural areas. Open channels are also a used for irrigation purposes. Some of them are then entirely discharging into agricultural lands.

321. Some primary channels are clogged (garbage or construction materials), with no other possible release point that the surrounding area, leading to flooding area in the city.

322. **Urban Drainage.** Recurrent floods are reported by inhabitants and local authorities. Main stormwater channels are operating properly but their capacity is not sufficient to ensure proper drainage of the city center.

323. The existing drainage system in Bavet is a combined wastewater and stormwater scheme that was constructed more than 10 years ago.

324. The canals and pipes have been installed only in some sections of the town center due to limited budget and funding support, and mainly in the areas where big hotels are located. However, residential and commercial establishments have installed their own ad hoc drainage structures, which discharge to the road thereby aggravating the flooding problems in those areas.

325. The urban drainage network in Bavet has been developed by four main actors, following the urban development:

(i) Communal Party, who started to develop the drainage network in 2018 in the city center. The constructed network has a total length of 1.6 km and the total planning length is 1.9 km at the horizon 2020.
(ii) ADB, that developed the drainage network though the GMS1 project.
(iii) Private Property Developers, that developed their own network in the private residential areas.
(iv) Individual Houses along roads out of the project's scope.

326. Except for the area covered by those actors, there is currently no existing overall strategy and roadmap for the sector.

327. The main common issues identified in the urban area are the following:

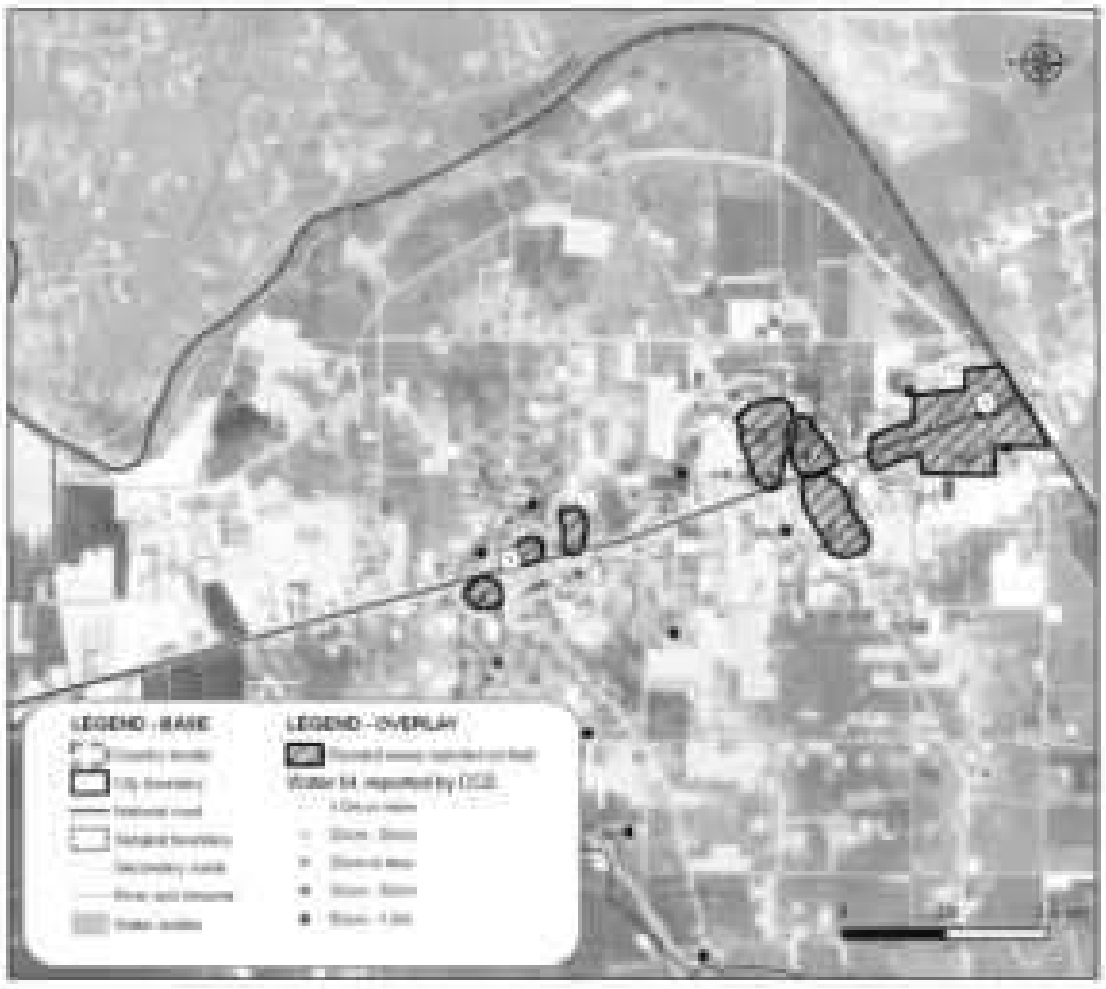
(i) Some key canals are totally blocked, leading to an incapacity to drain the collected water from secondary network. This is notably the case at the cross points under National Road n°1.
(ii) None of the canals is lined with concrete material. At some locations, this leads to an important bank erosion.
(iii) Due to the low flow in the canals, especially during dry season, plants and algae overgrow the banks. This leads to a reduction of the flow capacity.
(iv) The water quality in those open channels is poor, especially during dry periods of the year when the wastewater becomes pure sewage.
(v) Wrong connections of drainage network (some new lines constructed are not appropriately connected).
(vi) The primary drainage system is not properly used (secondary drains are not always connected to it).
(vii) Outlets of drainage system are sometimes obstructed by new constructions (or construction materials).
(viii) Catch pits grids are too small to carry properly the stormwater runoff.
(ix) Uncontrolled development of casinos and hotels close to the border crossing checkpoint leads to flooding issues. This area is identified as critical for secondary drainage networks.

328. It has been estimated by the CCS that 28% of the population experiences flooding in their village, and 37% in their house at every intense rainfall events. 18% of the population

experiences average flood depth between 20 and 30 cm, and 24% between 30 and 50 cm. For the average flooding event, the village is impacted during one day (14%) or more (43%).

329. For Bavet, the area located close to the border has been highlighted as critical.

Figure 25: Flood Prone Areas Locations in Bavet



Source: Egis, 2021

12. Solid Waste Management

330. **Providers.** The collection and disposal of domestic solid waste is provided by a private company, HYBRID Co. It is a garbage company holding a permit letter, released by the MoE on December 28th 2015, to provide service on urban waste management in Svay Rieng province.

331. The current generation of MSW in Bavet is estimated at 131 tons per day (tpd), equivalent to 47,690 tons per year (tpy), of which 95 tpd is collected by the official collection operator, 13 tpd is collected by waste pickers, and 23 tpd is not collected.

332. A solid waste characterization survey was carried out by the TRTA between the 10th and 16th of January 2020. The survey was conducted at the dumpsite on fresh MSW before any recyclables were removed by waste pickers. It was observed that 60% of the MSW composition is organic fraction (biowaste), followed by plastic bags at 10.6% (by weight).

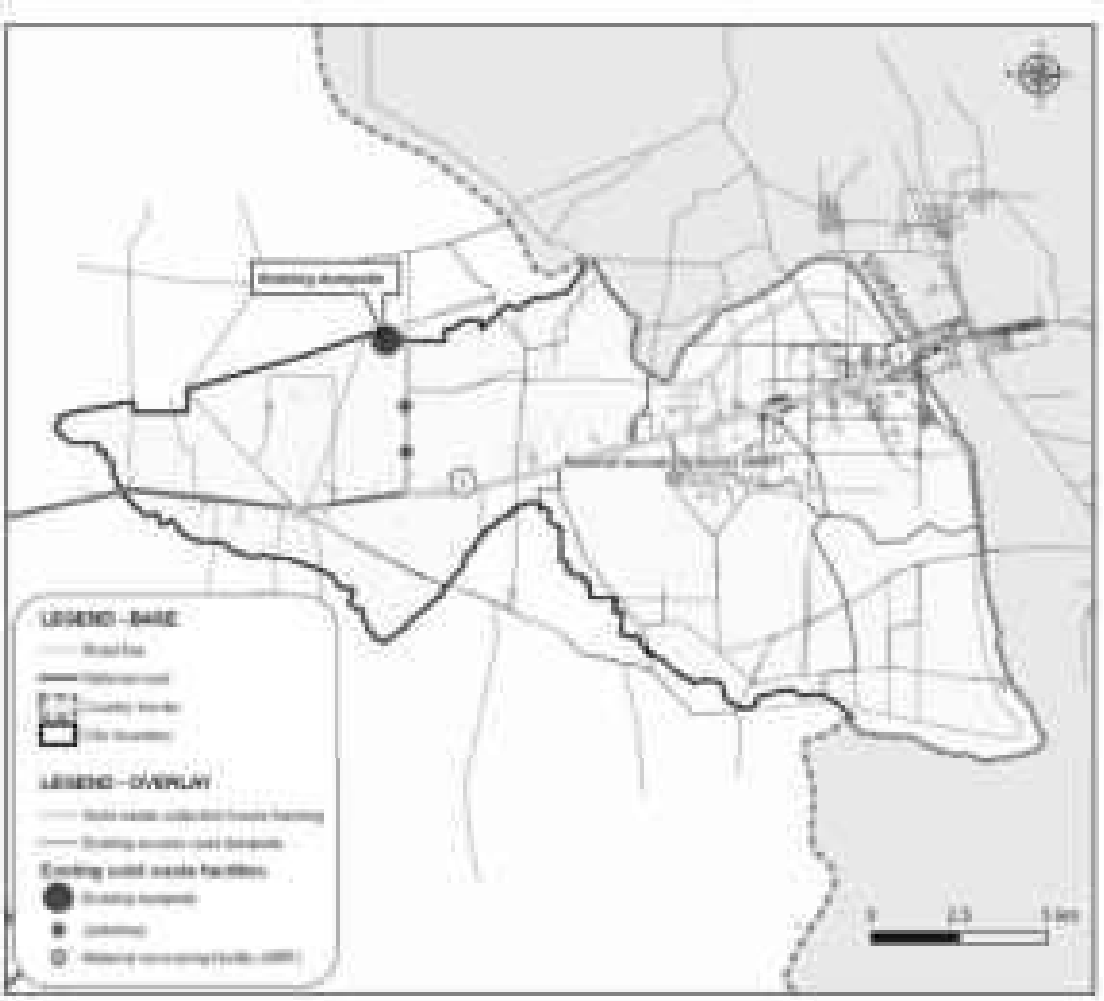
333. **Access to service**. The collection coverage ratio is relatively efficient considering the generated waste tonnages, reaching 83%[49] of the total waste generated; the main private producers, SEZ and casinos are well covered with a service. However only 14%[50] of households are covered by the service, meaning that 86% of households burn their waste or dispose of it on open land.

334. **Collection frequency**. Solid waste is collected on a daily basis according to 73%[51] of households (HHs) having access to the service.

335. **Collection coverage**. The current collection area mostly covers Bavet Sangkat (50%), and part of Chrak Mtes (5%), Bati (5%) and Prey Angkunh (10%). Sangkat Prasat is not covered. The following map shows the collection coverage based on the truck tracking survey in February 2020.

[49] Solid waste characterization survey, Egis 2020.
[50] Municipal database, 2019.
[51] Comprehensive City Survey, Egis 21th of December 2019 and the 15th of January 2020.

Figure 26 Solid waste - current collection coverage



Source: Egis, 2021.

336. **Recovery of recyclables.** Three wholesale junkshops in Bavet are collecting recyclables waste from informal collectors, waste pickers and scavengers which represent approximately 15% of the total MSW generated.

337. The recovered recyclables include the following: aluminum cans, iron, plastic bottles (PET), polypropylene (PP) containers, HDPE (high-density polyethylene) bottles, plastic bags, paper, and cardboard. Tetra-packs, glass, and polystyrene packaging are not recovered.

338. The three junkshops interviewed in June 2020 are registered companies. Each is equipped with a storage building, and two of them also provide recyclables packing (using a baling machine) and transportation services. Only one of them is equipped with a weighbridge, used to weigh the trucks. The destinations of the recyclables are mainly Cambodia, Thailand and Vietnam. Buyers from nearby Vietnam are actively involved in the recyclables trade in Bavet.

339. As a result of the coronavirus pandemic (COVID-19), the market price of recyclables in Bavet and Phnom Penh has dropped.[52] Most of the recyclables are transported to Vietnam and, with the border closed, there are few remaining buyers. Furthermore, the parallel drop in the price of oil during the pandemic also caused a drop in the market prices for recyclable plastics, the price of which is typically indexed to the oil market. The impact of the pandemic demonstrates that the recyclables market in Bavet is highly dependent on Vietnamese dealers. Additionally, it is worth noting that regional bans on waste imports in Vietnam, Thailand and Malaysia will further restrict recyclables sales and potentially impact on the sustainability of the sorted waste part of the project.

340. **Disposal arrangements**. All the MSW collected by HYBRID is transported to a dumpsite situated 15 km from the city center, where it is disposed of, with some recovery of recyclables by scavengers and burning of wastes. Waste pickers at the dumpsite work in poor conditions; health risk and safety are the main issues. During a site visit it was estimated that around 10% are children.

341. **Septage sludge**. Septage sludge from septic tanks is discharged directly in the environment. Desludging of septic tanks is actually not a common practice in Bavet so the volumes concerned are low.

342. **Bulky waste**. No specific collection is organized for bulky wastes. It seems that bulky wastes are reused, repaired locally as no bulky waste was observed in the streets or in the environment. It can be assumed that the bulky waste flow is negligible.

343. No data is available concerning generation of hazardous MSW, since no separate collection or disposal is carried out for this waste stream. In a situation where no hazardous waste management exists at all locally, it is difficult to estimate figures based on the available MSW composition data, and a dedicated survey would be required. More realistically, if based on experience figures from several studies and surveys in developing and developed countries, as an assumption, hazardous waste typically represents around 1% of the total MSW flow. Based on this assumption, it is considered that the order of 500 tpy of hazardous waste is being generated with the MSW in Bavet.

344. Currently, there is no facility available in Bavet city as well as in Svay Rieng province for receiving and treating hazardous waste. Only the industrial waste landfill in Sangkat Kambol, Khan Kambol, Phnom Penh Capital is receiving and treating hazardous waste in Cambodia.

345. **Hazardous waste** principally comprises used engine oils, accumulator batteries, car batteries, fluorescent lamps, small containers of miscellaneous products: paint, solvents, etc.

346. **Medical wastes**. The hazardous medical waste is to burn at the hospital. No hazardous medical wastes were found at dumpsite during the survey, only laboratory waste and bottles.

347. **Waste electrical and electronic equipment** (WEEE). No data is available at Province or City level concerning the generation of WEEE. In principle, WEEE should be managed by retailers, who should provide collection points. However, repairing WEEE or

[52] https://www.voacambodia.com/amp/with-no-buyers-phnom-penh-waste-pickers-are-helpless/5404314.html?fbclid=IwAR36X_FYhRv0Yz3MY698SjDbq3MN2aSkMESzJVK8oXBv1bRNjvYPaZ1l8uQ.

metal recovery activities are common in Cambodia, so it can be assumed that the electronic waste flow is negligible. No WEEE were observed at the dumpsite.

348. At present Bavet does not have a designated area where it can dispose of potentially hazardous agricultural and industrial wastes.

349. Construction and demolition waste is collected by informal operators. It is quite difficult to obtain information on these wastes as there are no proper control. However, it is probable that reuse of construction and demolition wastes is quite a common practice: the region is generally low-lying, and construction and demolition wastes are used as backfill to level sites.

350. In the SEZ, the household and industrial wastes are segregated. The industrial waste is collected by local contractors “Sok Racine” and treated by private operators which have an agreement from the MoE. However, the absence of the application of local policies and procedures for proper handling of hazardous waste is a source of risk for Bavet residents. For example, the industrial waste collection and disposal contractors are not properly checked with respect to their capability to handle and dispose of the industrial waste and to the municipality cannot be assured that the contractors follow environmentally sound disposal practices. Currently, there is no facility available in the region for receiving and treating industrial hazardous waste.

13. Other Environment-Related Issues

351. While the land use plan is meant to guide the development of the town, there is also ad hoc development by casino and hotel owners building dormitories for their staff/employees, usually within the sites of buildings, and there are an increasing number of temporary shelters being built to serve workers. This has encouraged informal settlers to proliferate including an entire community comprised of recent immigrants from Vietnam. Moreover, temporary shop/stalls are setting up along the NR 1; they have been given permission to locate there until the road is improved.

V. ANTICIPATED ENVIRONMENTAL IMPACTS

352. The impact assessment for this project includes consideration of: (i) delineation of the project area of influence and sensitive receptors; (ii) assessment of project benefits; (iii) factors required for pre-construction readiness for environmental safeguards; (iii) potential construction-phase impacts; (iv) potential operation-phase impacts; and (v) factors related to climate change and greenhouse gas emissions. The impact assessment also considered the specific context of each subproject i.e. ecological values, water resources, and social, economic, cultural, and tourism values; relevant national laws and regulations; and, ADB's SPS requirements in relation to projects within protected areas.

1. Project Areas of Influence and Sensitive Receptors

353. To define the geographic scope of the impact assessment, the "project areas of influence" and "sensitive receptors" were identified. The project areas of influence for project components were defined as the total areas which might be subject to direct/indirect adverse impacts. They were based on the locations of sensitive receptors, defined as settlements and/or environmental values that might be affected by the project component construction and/or operation phases. For this impact assessment, the project areas of influence and sensitive receptors were largely defined by the planned infrastructure.

354. The following variables and distances were applied to identify the sensitive receptors: (i) for impacts to soil and/or geology – area of impact usually localized and restricted to the immediate construction site, immediate surroundings, and potential borrow areas; (ii) for construction and/or operational noise – all residences, and/or other permanent or seasonal settlements located within 80 m of the noise-generating source; (iii) for construction-related air quality impacts – all residences, agricultural fields, and/or other permanent or seasonal settlements within 100 m of the emission source; (iv) for impacts to the water quality main rivers or watercourses, all construction works within at least 200 m of the water bodies (based on the shortest distance between project components and water bodies); and/or (v) for impacts to ecological values, all vegetation communities, fauna habitats, and permanent or seasonal food and/or breeding resources within or adjacent to the project construction sites. The approximate distances encompassed by these variables, combined with the direct construction sites, were assumed to encompass the total project area of influence. Potential sensitive receptors within the project area of influence were identified through field surveys, topographic maps, and satellite imagery.

355. Based on these definitions, sensitive receptors within the project area of influence were identified as follows (Table 24).

Table 24: Sensitive receptors to proposed construction activities

Project components	Sensitive receptors	Distance
Wastewater		
WWTP	Existing MRF	< 10 m
	"Forest Area" – public parkland	< 10 m
	Temporary house	> 900 m
	Shrine place / sacred tree	< 200 m
	Abandoned borrow pits (used for fishing, etc.)	< 150 m
	Manhattan SEZ	> 250 m
6 pumping stations	Urban areas	< 300 m
	Houses / farms	< 20 m
	Temporary house	< 20 m
	Ongoing urban development	< 50 m
	Surface water (ponds / rivers / channels)	< 10 m
	Dense vegetation areas/ Ephemeral wetland with no specific ecological value	< 10 m
	Agricultural land	< 10 m

Project components	Sensitive receptors	Distance
	Religious sites	< 250 m
	Manhattan SEZ	> 400 m
Effluent discharge point(s)	Agricultural canal network	0 m
	Agricultural land	< 10 m
Sewer network	Urban areas	< 10 m
	Ongoing urban development	< 10 m
	Agricultural land (considered as future urban areas)	< 10 m
Stormwater drainage		
Discharge point(s)	Agricultural canal network	0 m
	Surface water	0 m
	Solar farm	> 200 m
Solid waste management		
Controlled landfill	grassed trenches and grass strips	< 10 m
	Agricultural land	< 10 m
	Remote houses (with pond)	> 400 m
	Houses along the NR1	> 800 m
	Religious site	> 1300 m
	Surface water (Ou Chek river)	< 250 m
Road access to the landfill	grassed trenches	< 10 m
	Houses along the NR1	< 10 m
10 centralized collection points of ≈ 20 m2	Urban areas	> 1000 m
	Industrial and commercial areas	< 100 m
	Houses / farms along main roads	< 10 m
	Wetlands	< 800 m
	Surface water (ponds / rivers / channels)	< 400 m
	Dense vegetation areas	< 50 m
	grassed trenches and grass strips	< 10 m
	Agricultural land	< 20 m
	Religious sites	> 300 m
	Schools	> 300 m
	SEZs	> 300 m
	Health Center	< 150 m
Pre-sorting plant	grassed trenches and grass strips	< 10 m
	Agricultural land	< 10 m
	Remote houses	> 600 m
	Houses along the NR1	> 700 m
	Religious sites	>1000m
	Surface water	> 450 m
Composting plant	grassed trenches and grass strips	< 10 m
	Agricultural land	< 10 m
	Remote houses	> 600 m
	Houses along the NR1	> 700 m
	Religious sites	> 1000 m
	Surface water	> 500 m

Source: Egis, 2021.

356. The sites for **the 6 pumping stations** are scattered across the city, from the city center to the peri-urban areas west and south of the city center. Considering their relatively small size and low inconvenience with intermittent operating conditions, their impacts will be limited in time and space. Sensitive receptors will include houses at the edges of the of the urban area, which are situated close to the PS sites.

357. **The sewerage network** for the wastewater treatment will connect the pumping stations to the WWTP located south-west of *Sangkat* Bavet. Sensitive receptors will include buildings (houses, stores, farms, workshops etc.) located along the network lines.

358. **The primary network for the urban drainage** will be set across the city and its outfalls will enable discharge into existing rivers or existing irrigation canal network. Therefore, similarly to the primary network designed for wastewater treatment, sensitive receptors will include buildings located along the network lines and the rivers.

359. The proposed site for the **controlled landfill** is close to the existing dumpsite. Pre-sorting and composting treatment plants will also be located in the same area. No new access road is required; only minimal maintenance of the access road will be required annually, with a very limited impact on the surrounding receptors. Sensitive receptors will include buildings close to the sites.

360. Other receptors that will be considered are the houses located along the proposed routes of the solid waste collection trucks.

361. The existing **MRF** would maintain its original location and functions. Therefore, the new additional impacts from the WWTP project will be limited.

362. No new access road is required for the **WWTP**, because the site is accessed by a 1.5 km long dirt road connecting to National Road No. 1. Only minimal maintenance of the access road will be required annually, with a very limited impact on the surrounding receptors.

2. Positive Impacts and Environmental Benefits

2.1. Environmental Benefits

363. **Wastewater.** The project will improve wastewater disposal not only in urban areas, but also in rural and remote locations. It aims to minimize on-site production of fecal and nonfecal wastewaters, by connecting build-up area (projected land use 2030) to the off-site system following the urban and population growth.

364. The WWTP and its associated collection network will improve the quality of the effluents discharges and, thus, the quality of the natural receptors (water bodies), thanks to the removal of raw water discharges.

365. Sludge produced by the treatment process will be dewatered in Sludge Drying Beds, before being transferred to the new composting plant (if moisture < 80%). Thus, sludge spreading is not planned, avoiding any risk of pathogens transfer to agricultural lands, food or crops.

366. On-site septage collection will be provided by trucking for residential areas too far to connect or rural areas. Septic waste will be collected by vacuum trucks and brought to the closest pumping station or to the inlet of the WWTP for co-treatment. Septage co-treatment at the WWTP is the most viable option among the treatment alternatives, in comparison with a dedicated treatment.

367. Access to the wastewater treatment network will also restrain the current practice of the population of burying sanitation containments once they are full.

368. **Stormwater Drainage.** The project consists of a network of channels, culverts and pipes, designed to minimize street flooding during a 1 in 5 year rainfall event, and discharging stormwater to existing water bodies north and south of the built-up area.

369. None of the canals currently used for urban drainage is lined with concrete material. At some locations, this leads to an important bank erosion. This effect will be avoided by the projected piped network for urban area.

370. **Solid Waste Management.** The high standards of solid waste management implemented by this project will put an end to waste burning that is regularly practiced with the current dumpsite.

371. The project provides a higher recovery rate, diverting from landfilling and consequently saving agricultural land areas.

372. It will also minimize practice of waste disposal into water bodies and other natural habitats. This will help reducing air, water and soil pollution, with a big improvement in biological and chemical quality of local water bodies. GHG emissions from solid waste disposal operations will be controlled and managed. The landfill gas will be collected and routed to a flare stack, which will be designed at a later stage of the project – detailed design phase.

373. The new landfill with leachate collection will prevent contamination of local groundwater. After treatment, the majority of leachate is recirculated back into landfill mass. The residual leachate is transported by tankered to the WWTP and follows the complete wastewater treatment process.

374. Composting will reduce greenhouse gas emission, extend the landfill's life by diverting the incoming waste flows and the produced compost will be reused in agriculture.

375. **Greenhouse Gas Emission.** The waste management project components, including composting of organic waste; controlled wastewater treatment; GHG capture; recycling and waste minimization are greenhouse gas emission reduction strategies. In particular, emissions of the more potent greenhouse gases Methane (CH_4) and Nitrous oxide (N_2O) from anaerobic decomposition will be captured and converted to CO_2, via a landfill gas (LFG) collection system and a gas flare unit (to be installed during operation). Additionally, emissions of CO_2 and pollutants from burning waste will also be reduced.

376. The Cambodian Government has a number of national strategies to reduce greenhouse gas emissions, and where possible these will be incorporated into the project. The CCCSP has a strategic objective to promote low-carbon planning and technologies to support sustainable development. General mitigation strategies will be used as part of the overall project strategy where possible such as the use of biofuels, light vehicle technologies, electric vehicles. The project will contribute to mitigation by promoting the use of solar operation at the infrastructure site.

2.2. Socio-Economic Benefits

377. Women may benefit more from improved waste, water and sewer services as they generally have a higher risk to health from exposure to pathogens as the primary contributors towards household and community sanitation tasks. A specific Gender Action Plan (GAP) is carried out in order to include this social issue in the project implementation.

378. Additionally, employment increase and education opportunities may be able to provide more gender equality.

379. During works, all sub-projects will generate employment and local employees will be preferred:

Table 25: Employment generated by the project

Sub-project name	Component	Quantity	Construction schedule	Number of staff and workers
Wastewater	Sewers	66km	24 months	90-150 persons
	PS	6 stations		
	FM	9.5km		
	WWTP (WSP)	20ha		
Storm Drainage	Box culvert	1.9km	12 months	40-60 persons
	Open channel	6.8km		
	U drain	1km		
	Outfall	2 places		
Solid Waste	Controlled Landfill	20ha	18 months	40-50 persons
	Access road	5km		

Source: Egis, 2021

380. **Wastewater.** The short-term investment for year 2025 will provide service first to the existing major built up area. Extensions will be built in future years to service growth areas as they develop. By 2040, the project aims for 100% of excreta safely managed at the end of the sanitation chain, with 68% of the households connected to the sewer network (including population growth).

381. In rural areas on-site septage collection will be provided by vacuum trucks. Septic waste will be brought by trucking to the WWTP for co-treatment. This will minimize waste disposals to ground in agricultural fields or along the roads.

382. Collection and treatment of wastewater is a matter of public health, as it will diminish the incidence of water borne infections and diseases, associated with inadequate sanitation.

383. The quality of life will also be improved with the reduction of odor nuisances which can occur due to the practice of emptying the untreated contents of sanitation containments directly into the environment. The urban environment for residents and visitors will therefore be improved.

384. Operation, monitoring and maintenance of the new pumping stations and WWTP will enable the creation of employment opportunities for local population.

385. **Stormwater Drainage.** Currently, only 1.9 km of urban drainage is being constructed under the GMS1 project in Bavet. By 2025, 17% of the population will live in a drained area. This proportion will extend through the network development and will reach 86% by 2040. In the short term, 79% of the hotels, 67% of the markets and supermarkets, 14% of the institutions and 12% of the SEZs will already have access to the drainage network in 2025. By 2040, the urban drainage network will deserve 89% of the hotels, 100% of the markets and supermarkets, 76% of the institutions and 75% of the SEZs.

386. The project will service the existing major built up area in Bavet by 2025. The medium term (2030) solution will expand to include the built-up area of Chipu. More extensions to the drainage network can be built in future years to service growth areas as they develop, helping minimizing flooding in growing urban sectors. The reduction of flooding events will also avoid economic loss due to damage to property.

387. Functional and separated drainage and sewage systems will help reducing diseases from infection and mitigate health related problems in the population.
388. The absence of untreated sewage and flooding in the streets will enhance the touristic and commercial development of Bavet municipality, attracting private sector investments.

389. Considering climate change, increased rainfall may increase the number of flooding and pipe surcharge events. By improving the capacity of the drainage system, the vulnerability of the population to these consequences of climate change will be reduced, as the excess of water would be more easily evacuated.

390. **Solid Waste Management.** The project will minimize waste disposal and waste burning in the surroundings of the urban area, improving living standards for the population in Bavet municipality.

391. Current working conditions of scavengers including children working in the dumpsite are two major issues to address by implementing the new SWM strategy. The project address waste picker livelihoods through strategies such as integration into the formal system, as well as the provision of safe working conditions, social safety nets, and child labor restrictions. It will create around 129 jobs by 2040, mostly manual sorting operators in the sorting lines of the pre-sorting plant, addressed in particular to waste pickers and scavengers, then most of the present waste pickers (115 persons) will work at the sorting plant. This facility will provide better working conditions for these workers and maintain their revenues and their working location (new landfill location adjacent to the current dumpsite). In addition, the following measure will be implemented by SW collection contractors to guarantee the correct integration of waste pickers / scavengers in the project: provide training to the current informal workers in solid waste management (e.g. waste pickers/ scavengers could be trained as drivers for the collecting trucks) and provide them with formal jobs in priority.

392. Composting is a relatively efficient solution for diversion from landfill. Even with a relatively small composting plant, the actual landfill diversion rate is quite high, thus extending the landfill capacity by more than a year. The produced compost will be reused in agriculture.
393. The proposed area for the new landfill is close to the current dumpsite, which may improve acceptability from the population.

394. At the same time, with the new access road the number of households impacted by the waste trucks moving will be lower than in the current configuration, because there is no buildings on the road connecting the NR 1 to the pre-sorting and composting plants and to the new landfill.

395. For rural areas, the project does not include door-to-door waste collection in order to reduce the fees for the served population. It will include centralized “bring-to” collection points instead, where waste will be delivered from each household. This may improve acceptability from the population and thus increase the number of households using this service. Consequently, waste burning practice in local population could be minimized.

396. Groundwater is used for household water supply and private vegetable gardens watering. Leachate collection will prevent groundwater pollution. This will help in reducing health impacts in local population due to consumption of poor quality water.

3. Biodiversity Conservation and Sustainable Natural Resource Management

397. The clearing of vegetation, scouring, stripping, earthworks and the leveling of work areas is limited strictly to as little as necessary.

3.1. Construction Phase

(i) Hydrology and Water Availability

398. The project does not involve any works that would affect lake and river hydrology. Construction works will require water for the mixing of materials, wash-down of equipment, and drinking water for workers. This will be pumped directly into a water truck and transported to the work sites.

399. *Measures.* Pumping will occur at irrigation channels, only at sites with existing road and jetty access. No works or machine wash-down will be conducted at the pumping site. Contractors should ensure that the use of irrigation water or any water bodies complies with the EMP of the approved IEIA report and permit is obtained as needed.

(ii) Ecological and Wilderness Values

400. Clearing the WWTP site will lead to loss or damage of trees and vegetation. Construction will cause short-term noise and visual disturbance which may disrupt breeding or foraging by resident or migratory fauna. At the WWTP site, works may disturb nearby breeding waterbirds in the forest. The WWTP works will also require the removal of 20 ha of individuals of regrowing-forest and acacia-plantation in a partial of the Chamkar Konkoki Community Forest of 304 ha, a widespread and abundant species in this forest (plantation). This removal represents around 5 % of the total tree number of the forest. There are no known rare wildlife species or critical habitats in the immediate environment of the project components. However, two Near Threatened species (i.e. Eurasian Curlew *Numenius arquata* and Painted Stork *Mycteria leucocephala*) and one Endangered species (i.e. Milky Stork, *Mycteria cinerea*) in the IUCN red list are reported by a field interview with local people. Milky Storks may be disturbed by WWTP construction and temporarily abandon the site. They're expected to repopulate the area during operation phase, as the characteristics of the ephemeral wetland will not be globally altered by the WWTP presence. Moreover, due to recurrent fires in this forest, local birds are already obliged to leave the area periodically. As the burnt zones of the forest grow back, birds repopulate them.

401. During the ecological survey in September 2020, one Near Threatened bird species (Painted Stork, *Mycteria leucocephale*) was reported to be present in the projected landfill site.

402. *Measures.* These risks have been minimized as follows:

a) Careful designs to minimize the need for safeguard measures and impact to adjacent vegetation;
b) Setting up protective physical barriers around vegetation that does not have to be removed. If the removal of vegetation cannot be avoided and does not concern public lands, private owners of the concerned vegetation will be provided a compensation;
c) The best timing for starting works is just after the annual fire of the forest carried out by the Chamkar Korki Community Forest, up to four months;
d) Pre-inspection of each tree to be removed, to ensure that no nesting fauna are present;
e) Individual removal of each tree (rather than bulldozing) to minimize impacts to surrounding trees;

f) Soil stabilization after tree removal, to avoid local erosion that would contaminate surface water bodies;
g) For WWTP: The Project's compensation planting will include the funding of 69,000 trees which will be planted under the Cambodian National Forest Programme. The exact location of the replanting will be advised by MAFF/PDAFF at the time of implementation, under the NFP and will ideally be replanted in the local area, depending on NFP requirements. The tree species will be driven by the NFP, depending on the type of forest the NFP needs support with at the time (e.g. may include Community Forest, or native forest rehabilitation, conservation and biodiversity improvement);
h) For landfill: Planting local tree species into the remaining part of the Chamkar Konkoki community forest which are degraded, public park/garden, and along the Bavet municipality roads. The planting will be done during project implementation;
i) Strict speed limits (maximum 40 km/h) for work vehicles around construction sites to minimize the risk of collisions with fauna, livestock, or people;
j) Restriction on any construction activity and project vehicle activity between 6:00pm and 6:00am to minimize the risk of collisions with fauna at night (when some mammals are more active).

403. Site decommissioning and rehabilitation will be progressive and take place upon completion of the construction phase. All construction materials and residual solid waste will be removed. Local labor will be engaged in priority to take up decommissioning works. Plantations would be carried out by local communities.

404. The new landfill site will be rehabilitated after closure and the final cover will be grassed to ensure the integration of the closed site with its surroundings.

405. Based on the effective implementation of these measures, ecological-related construction risks are considered to be very low.

3.2. Operational Phase

(i) Ecological and Wilderness Values

406. The WWTP will be built on the boundaries of an area at the edge of the 304 ha of Chamkar Konkoki Community Forest, that is a mix of regrowing natural forest and acacia plantation. Human activity and equipment noise can generate disturbance which may disrupt breeding or foraging by resident or migratory fauna, i.e. breeding waterbirds in the forest.

407. An impact on aquatic life may be generated in case water quality is altered by effluents discharge (effluent leakage, pipe rupture) in receiving water bodies. However, the WWTP and landfill facilities are designed to reduce water pollution by using treatment systems adapted to the local context.

408. *Measures.* These risks have been minimized as follows:
a) Facility areas enclosed by 1.8m-high fences, avoiding any impacts to adjacent vegetation and fauna;
b) Adapt the maintenance activities as far as possible to nesting or reproduction periods, to avoid fauna disturbance (e.g. tree pruning operations). Landscaping of the landfill design will be minimalist (peripheral shrub hedge for example), in order to ensure limited maintenance and will not attract fauna e.g. birds to the site;
c) Strict speed limits (maximum 40 km/h) for work vehicles around the project sites during operation to minimize the risk of collisions with fauna, livestock, or people;

d) Restriction on vehicle circulation between 6:00pm and 6:00am to minimize the risk of collisions with fauna at night (when some mammals are more active);
e) Regular control and maintenance of equipment and installations;
f) For the WWTP and sewers, ensure maintenance of the network and maintain, education and communication for householders on what to dispose of in a sewer.
g) For the landfill, pests/rodents/vermin, birds and stray animals are likely to be attracted by the waste. This effect can be minimized with some operating procedures, such as minimizing exposed tipping areas, and prompt waste covering upon waste dumping in normal operation of the landfill.
h) In order to mitigate impacts of O&M on ecological issues by dedicated measures, a detailed training programme for operators will be required in the DED stage, with the PMU approval for scope and budget.

409. Based on the effective implementation of these measures, ecological-related impacts are considered to be low.

4. Pollution Prevention and Abatement

4.1. Construction phase

(i) Geology and Soil

410. Raw materials for concrete infrastructures will be selected from existing quarries or concrete plants to avoid the excavation of borrow pits and quarries, which may be a threat to the environment when left uncared for: frequent sliding, loss of ecosystem, groundwater pollution and loss of arable land. No new natural material extraction site will be created for this project.

411. Preparation of concrete mix, asphalt, and other materials. Due to the rapid urban development of Bavet, asphalt and concrete plants or material preparation sites already exist in vicinity of project sites. They will supply the project works as necessary, without creating additional impacts compared to the present situation.

412. *Measures.* Manufactured materials and products will also be prepared in Bavet and transported, given the relatively short distance.

413. **Earthworks.** The works for the road access upgrades/creation of the landfill will require approximately 5,000 m^3 of materials for grading (access road of the WWTP already exists).

414. Extracted volumes are estimated to be around 65,000m^3 for the WWTP and 135,000m^3 for the bulk excavation of the landfill. The stormwater works will generate 101,000m^3 of soft materials and 16,900m^3 of hard rocks. Topsoil stripping consists in a 1m-thick layer removed and stockpiled around the WWTP (20,000m^3) and landfill areas (16,000m^3). All materials will be reused on sites: on the WWTP site, soils will be layered for landscaping; on the landfill site, soils will be used for covering cells at the end of their filling. All excess of extracted materials will be easily dispatched to the numerous works in the city, as there is a lack of backfill materials.

415. The concrete infrastructures such as WWTP, platforms, etc. will not require the use of borrow materials as they will only require limited excavation and grading, which may generate a small surplus of approximately 5,000 m^3 of spoil.

416. *Measures for spoils.* This spoil will be utilized for the road works. The additional borrow materials required for the road access upgrading (landfill) will be sourced from existing borrow sites identified in Bavet surroundings. These sites are approved by the local

and national administration for the provision of spoil for construction works and are confirmed to have sufficient capacity for the project requirements.

417. Spoils requiring removal and disposal will be taken to a predetermined and approved location, such as the existing landfill of Bavet. These spoil disposal sites will be located far from water bodies, so that spoils will not interfere with the flow of the surface water runoff to side drains and do not block the side drains themselves.

418. **Soil Contamination.** Potential impacts include soil contamination which may be caused by: (i) improper transport, storage, handling and/or disposal of solid wastes, septic wastes, hazardous wastes and hazardous substances, such as petroleum products from equipment operation and maintenance, lubricants, paints, chemicals, curing compounds, asphalt products, among others; and (ii) accidental spills or leaks of hazardous wastes and substances.

419. *General measures.* These risks will be managed through strict on-site measures including: stabilization of exposed surfaces and spoil piles with ditches and/or sheeting; minimizing the duration that surfaces are exposed for; timing works for dry seasons, when rains are minimal and the ground is firm (to minimize infiltration of any contaminants); and, management of site stockpiles and storage sites for fuels and machinery. Pending effective management of the EMP, these risks are considered manageable.

420. *Specific measures.* To reduce the risk of soil contamination from construction machinery, contractors will do the following: (i) store petroleum products, hazardous materials and wastes on impermeable surfaces in secured and covered areas, provided with bunds; (ii) remove all construction wastes from the work sites to approved waste disposal sites; (iii) establish emergency preparedness and response actions; (iv) provide spill cleanup measures and equipment at each construction site; and (v) train contractors and crews in emergency spill response procedures.

421. **Water Quality and Wastewater Management.** Earthworks, excavation, and/or inappropriate storage and handling of fuel, accidental spills, domestic wastewater discharge from construction camps (clean water/sanitation, offices, refectory), and wash-down water for machinery and vehicles, could contaminate soil or surface waterways. Construction wastewater will come from washing aggregates, pouring and curing concrete, cleaning of construction machineries and vehicles, and human wastes. Surface water bodies that could be potentially affected by project works are: (i) existing agricultural channels / drainage network (200 m from the future landfill) discharging 3 km eastward to the connection point between Ou Chrak Mtes and Preaek Chik; (ii) existing agricultural channels / drainage network (<50 m from the future WWTP) discharging 1.3 km southward into existing agricultural channel network; and (iii) 2 water bodies receiving the collected urban waters (Ta Pov River and existing agricultural channels network towards Vietnamese border).

422. Pumping stations and collections points in agricultural areas will be built very close to surface water bodies (channels). Construction may cause a temporary impact on these receptors when adjacent to the project sites, mainly due to dust and waste production. Local water quality could be altered.

423. *Measures.* The following measures will be implemented to minimize water pollution:

a) Timing of construction to avoid peak rainfall during the rainy season (from May to October). Construction during other months imparts much lower construction risk as the ground is hard, infiltration is limited, and there will be limited runoff from work sites;
b) Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next; and, minimize open excavation areas;

c) Construct intercepting channels and drains to prevent runoff entering construction sites and to divert runoff from sites to existing drainage or open ground;
d) Contractors will develop actions to control oil and other dangerous substances as part of their site Contractor-EMPs;
e) All sites for washing of construction equipment will be equipped with water collection basins and sediment traps;
f) Fuel storage, machinery maintenance workshop and vehicle cleaning areas will be stationed at least 100m from the natural water bodies and 20m from channels;
g) Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces and provided with bunds and cleanup installations;
h) Contractors' fuel suppliers must be properly licensed and will follow established protocol for transferring fuel;
i) Portable toilets and on-site wastewater pre-treatment systems will be installed at construction camps (if camps are required) along with proper maintenance protocols.

424. **Air Quality.** Air pollution sources include: (i) dust from earth excavation, backfilling, road breaking, loading, hauling, bare earth surfaces, uncovered construction areas, and vehicle movements on unpaved roads, especially in windy days; (ii) aggregate preparation and concrete-mixing; (iii) vehicle and machinery emissions (gaseous CO, SO_x and NO_x). No asphalt heating and mixing processes are expected during these works. The exhaust emissions generated can cause respiratory issues for the residents living close to the construction sites and along the collection pipe network works both in urban (streets) and agricultural areas, especially for the vulnerable population including the elderly and the very young. Asphalt materials for road reinstatement will be provided ready to use by a local supplier.

425. *Measures.* Mitigation measures to reduce impacts on air quality are as follows:
a) Spraying water on exposed construction sites where fugitive dust is being generated. Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion;
b) Storing petroleum or other harmful materials in appropriate places and covering to minimize fugitive dust and emission;
c) Covering materials during truck transportation, in particular, fine material, to avoid spillage or dust generation;
d) Regulation by speed limits in the streets;
e) Regulation by speed limits of access roads to the construction sites;
f) Maintenance of project vehicles to minimize greenhouse gas emissions;
g) Turning off equipment/ vehicle when not in use; limiting engine idling to a max. of 5 minutes;
h) For odor: disinfection/deodorization/sanitizing affected latrines prior to clearing; provision of adequate sanitation facilities; and, strict enforcement of sanitation practices; prompt dispose of, organic and hazardous wastes; and, timely community consultations to ensure awareness of the risk of odors prior to landfill works;
i) Prohibit burning of wastes;
j) Timely monitoring of air quality and inspections during construction.

426. Moreover, a particular attention will be paid to limiting dust production when work is carried out near sensitive receptors e.g. schools, hospitals, residential areas.

427. Overall, risk of air pollution and disturbance to residents related to air quality is low, because: (i) the relatively small scope of project works; (ii) the wide distance from WWTP and landfill sites to the nearest residences (> 400 m).

428. **Solid Waste.** Solid waste will comprise domestic solid waste from workers and construction waste materials.

429. *Measures.* Covered garbage bins will be installed at each site of works. The construction contractors will be responsible to transport the containers and dispose them at the existing dumpsite, as the existing waste collection services are not adequate to address the project needs. Waste collection and disposal methods will follow strict procedures to ensure that only non-hazardous waste is disposed and that recyclable wastes are separated, (as a minimum plastic bottles). Hazardous wastes (paint containers, batteries) will be stored in sealed drums/container and transported to the official hazardous waste treatment facility in accordance with national regulations, e.g. industrial waste landfill in Sangkat Kambol, Khan Kambol, Phnom Penh Capital which is the only one permitted to accept hazardous waste in Cambodia at the present. Waste burning will be forbidden.

4.2. Operational Phase

(i) Geology and Soil

430. **Soil Contamination.** Soil contamination from spills or uncontrolled discharge of untreated or treated water can occur due to faulty pipeline or equipment of the wastewater treatment and stormwater drainage systems. The soil can also be contaminated by flooding due to clogging of the drainage system or by leachate streams from the landfill or the composting plant.

431. *Measures.* To reduce the risk of soil contamination, all equipment and processes will be maintained in good working order, with back-up material in critical areas. Engineering and management systems will be set up to prevent and handle emergency situations. The landfill site will include a low permeability base liner to avoid infiltration of leachate in the subsoil, and the composting plant will include an impermeable concrete platform bordered by a sealed ditch. Additionally, a budget is allocated for testing, training and maintain the composting machinery to ensure a good quality of the outputs.

432. **Water Quality and Wastewater Management.** Improved sanitation and solid waste management will reduce the volume of sewage and solid waste entering local water bodies and particularly Ta Pov River.

433. The **WWTP** treated effluent will be released into an existing channel that is currently obstructed by earthworks in some locations. The channel merges with the main agricultural channel network that is located in the catchments of Ta Pov River and Stueng Me Sar Thngak (final natural receiving water bodies).

434. WWTP effluents will be treated before release (70-90% design removal rate for COD, BOD and TSS; 50-70% for TN and TP). Thus, the water quality of the receiving bodies will not be significantly altered.

435. As per sub-decree No. 27 (26th of April 1999), the project includes the installation of an equipment for measurements of flow, concentration and amount of pollutants contained in the WWTP effluent. In order to confirm the theoretical design removal rates expected for the project, results will be compared to national standards listed in this sub-decree (these standards are more restrictive than international standards). These data will be recorded and kept available for consultation.

436. For the **drainage system**, it is expected that the water quality of the receiving water bodies will not be significantly altered, since the current combined drainage system is already being discharged into the same water bodies.

437. Surface water or groundwater contamination from spills or uncontrolled discharge of untreated or treated water can occur due to faulty pipeline or equipment of the wastewater treatment system of the landfill and the WWTP, and stormwater drainage systems.

438. Accidental leakage from the wastewater treatment or stormwater drainage systems may impact surface water quality, and also groundwater quality, depending on local groundwater depth. This impact might be increased in case of flooding.

439. *Measures for water contamination due to the wastewater treatment and stormwater drainage systems.* To reduce the risk of surface water and groundwater contamination, all equipment and processes will be maintained in good working order, with back-up material in critical areas. Engineering and management systems will be set up to prevent and handle emergency situations. Operators will schedule drain clearing maintenance program in order to ensure design flow is maintained for sewer and drainage networks. As mentioned above, a monitoring of the quality of the wastewater effluents will be set up to ensure they meet design criteria and can assimilate the treated effluent year-round.

440. Potential impacts related to the **controlled landfill** operations include: (i) surface water run-on, (ii) site water runoff, (iii) waste mass inundation, and (iv) leachate emissions.

441. Leachate generated within the waste mass can migrate through the sidewalls and base and cause contamination of groundwater. Note that the leachate migration is not controlled or monitored at the existing dumpsite, which is likely to have degraded the local groundwater quality to some extent.

442. During the landfill operational phase, damage to the impermeable layer could result to failure in the integrity of the leachate collection system, resulting in subsurface contamination.

443. *Measures.* Surface water run-on and runoff will be mitigated through the provision of perimeter drains and additional collector drains within the landfill area. The potential for waste mass inundation from precipitation will be mitigated through the provision of cover materials over waste mass surfaces, coupled with the drainage of these covered areas through the contouring of surfaces and installation of surface drains. Completed waste mass surfaces can also be vegetated to reduce cover material erosion.

444. In the new landfill, leachate will not be disposed but will be recirculated into the landfill mass. Residual leachate will be treated at the WWTP: Leachate quality will be tested before disposal at WWTP in order to ensure that it will not affect the WWTP effluent quality.

445. As part of the groundwater study for the new landfill, monitoring boreholes should be drilled downslope below the existing dumpsite to determine extent of leachate contamination of groundwater, and to track groundwater quality following landfill closure. The impacts of the solid waste management project on surface water and groundwater need to be monitored by installing monitoring wells at the up-gradient and down-gradient for the new landfill site.

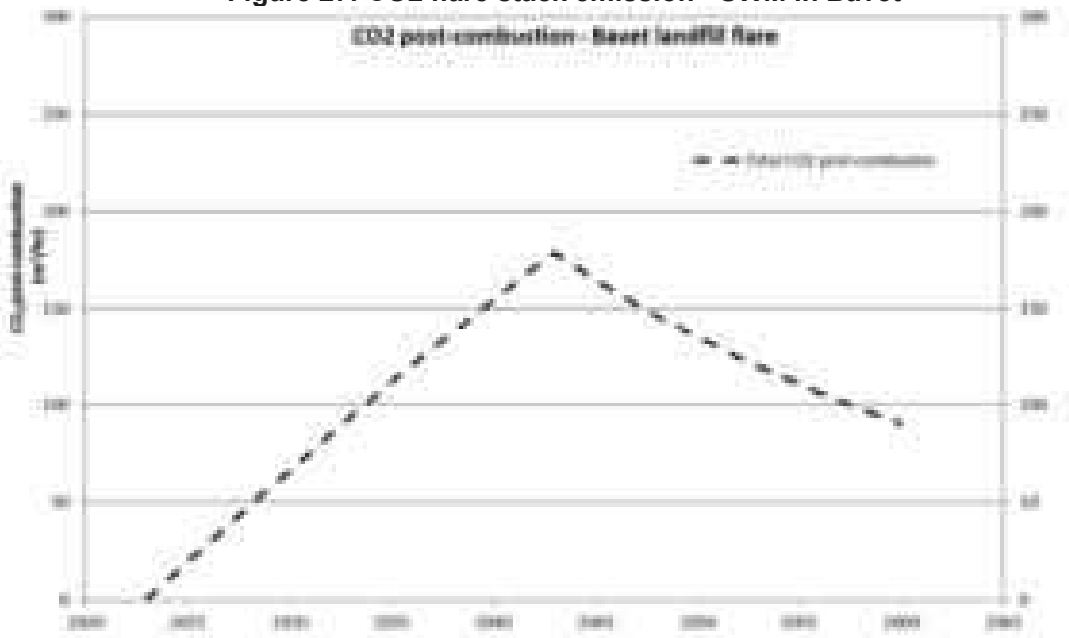
446. The depth of water table, and quality of groundwater below and downslope of the new landfill site will be conducted along with a soil permeability analysis during the detailed design phase, to be able to complete the design of landfill and required leachate management system to prevent contamination of local groundwater.

447. Potential damage to the impermeable layer of the landfill cells will be mitigated through: (i) O&M procedures and operator's training programme to ensure that the facilities operate as intended over the long term, (ii) continuous monitoring of groundwater quality to detect and mitigate any subsurface spill.

448. **Air Quality.** During its operation, the controlled landfill will generate landfill gas, such as carbon dioxide, methane and nitrous oxide. These gases are formed through organic waste decomposition process, accelerated by the saturation of waste due to rainwater and surface waters infiltration into the waste mass. The project transition from the current dumpsite to controlled landfilling will however minimize this effect as a result of reduced water penetration due to surface cover (capping) system.

449. As the landfill will receive only a relatively small waste volume (less than 100 tons/day for the medium term and less than 200 tons/day in the long term), the facility will only generate limited amounts of landfill gas (LFG). The LFG will be routed to a flare stack (details to be defined at the detailed design stage) for installation and use during operation, but funded by the Project. The following figure show the estimated CO2 emission. The operator will implement its O&M requirements to ensure that the landfill operates as intended over a long time.

Figure 27: CO2 flare stack emission - SWM in Bavet



Source: Egis, 2021.

450. Waste trucks (up to 19 in 2040) circulating on unpaved roads around landfill site, pre-sorting and composting plants, and collection points is likely to generate dust both in urban and agricultural areas. This will not differ significantly from the existing situation. The collection points will be located along existing roads, mostly unpaved in rural areas, but waste trucks are not expected to deteriorate local air quality, as these roads are currently used for vehicles circulation.

451. Moreover, collection points are mainly located in rural residential areas where air quality is expected to be relatively good. Trucks emissions around those areas may impact local air quality.

452. *Measures.* Mitigation measures to reduce impacts of dust and trucks emissions on air quality are as follows:

a) Proper cover on trucks / compactor vehicles;
b) Pavement of the landfill access road over 5km;
c) Regulation by speed limits in the streets;
d) Regulation by speed limits and speed bumps on access roads to project sites;
e) Maintenance of project vehicles to minimize greenhouse gas emissions;
f) Turning off equipment/vehicle when not in use; limiting engine idling to a max. of 5 minutes.

453. **Solid Waste.** Wind-blown waste from the landfill may be dispersed into the surrounding environment.

454. Accidental waste or leachate dumping on streets or into the natural environment can also occur during waste or septage transport or around collection points, causing nuisance for the surrounding residential or commercial areas.

455. Some solid wastes are transported by wastewater pipes to the WWTP.

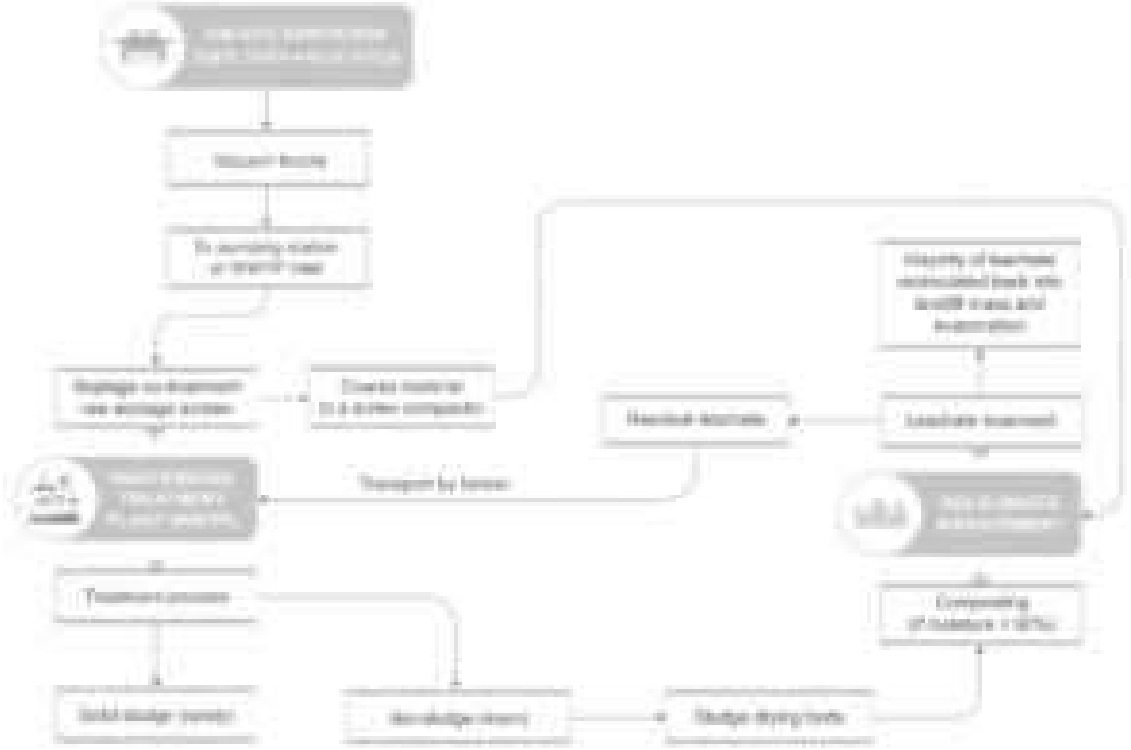
456. *Measures.* Waste dispersion will be reduced as follows: (i) minimizing exposed tipping areas, (ii) installing a 1.80m-high fence on landfill boundary (2,200m), (iii) daily compaction of the new waste deposits, and (iv) prompt waste covering upon waste dumping in normal operation of the landfill. The DSC consultant requirements include two positions (architect and landscaper), who will take into account this issue in the design; landscaping of the landfill design will include a peripheral shrub hedge. During the operational phase, the earthen bunds resulting from the opening of the pits will also serve as visual barriers.

457. Effects of waste or leachate dumping can be mitigated through structural design and operating procedures, including (i) waste encapsulation in trucks while in transit, and (ii) washing vehicles on facility exit. For collection points, operating procedures shall include (i) cleaning and maintenance of temporary storage areas, (ii) waste sorting skips with retention system to avoid leachate dispersion.

458. In the WWTP site, collected solid waste are evacuated by trucks and transported to the landfill.

459. The following figure describes the septage and sludge management with the project.

Figure 28: Septage and sludge management – SWM and WWTP in Bavet



Source: Egis, 2021

460. The quality of the sludge will have to be guaranteed to ensure the good functioning of the septage and sludge management system. Therefore, laboratory tests will be planned on a regular basis:

(i) on WWTP sludge after treatment on the Sludge Drying Beds, to verify their suitability for composting;

(ii) on Residual Leachate from the landfill, before being routed to the WWTP for treatment.

5. Health and Safety (Occupational Health and Safety; Community Health and Safety)

5.1. Construction Phase

(i) Geology and Soil

461. **UXO.** Construction sites may be concerned by unexploded ordnance (UXO), which can be uncovered by earthworks.

462. *Measures.* Sites for earthworks that are suspected to have UXO should be declared free of UXO by the CMAC (Cambodian Mine Action Centre) or by the Government[53] prior to construction (confirmation in writing will be required). Should an ordnance be detected, clearing work will be commissioned prior to undertaking earthworks. Basic training on UXO will be provided to contractor engineers/construction workers by demining organization such as CMAC. Training will focus on actions to take if UXO is identified during excavations / earth moving and how to report to CMAC.

[53] The government should provide certificate on free of UXO in case the area has been identified in the CMAC map as “no risk of mines.”

463. **Noise.** Construction works may cause neighboring disturbance, mainly in the urban areas. They will involve excavators, bulldozers, scrapers, dredgers, concrete-mixer, trucks and other heavy machinery. Noise emissions will not include rock-crushing, as any rock materials will be obtained and prepared at the borrow sites and transported to the sites. Noise will be temporary and localized. Construction materials, surplus spoil and construction wastes will be transported to and from the construction sites during an average 8-hour work-day for the construction seasons of about 8-10 months per year (depending on annual weather condition) for about one year (storm drainage), 1.5 year (landfill) and 2 years (WWTP). Noise levels of representative construction equipment (Table 26: Construction Equipment Noise) indicate that: (i) noise levels generated by a punctual source (construction equipment) decrease at a rate of approximately 6 decibels (dB(A)) per doubling of distance away from the source; (ii) the maximum noise level for receptors less than 5 m could be 93-95 dB(A); and (iii) within 150 m from a noise source, noise level exceeds WHO guidelines of 55 dB(A) and national standards of 60 dB(A) (45 dB(A) in quiet areas) during the day (no works are expected during the evening and the night).

Table 26: Construction Equipment Noise

Equipment	Noise emission level (dB(A)) at distances (m) from equipment										
	5	10	15*	20	40	60	80	100	150	200	300
Bulldozer	86	80		74	68	64.5	62	60	56.5	54	50.5
Excavator	84	78		72	66	62.5	60	58	54.5	52	48.8
Loader	90	84		78	72	68.5	66	64	60.5	58	54.5
Land scraper	90	84		78	72	68.5	66	64	60.5	58	54.5
Mixing Equipment	87	81		75	69	65.5	63	61	57.5	55	51.5
Roller	87	81		75	69	65.5	63	61	57.5	55	51.5
Vibrator road roller	86	80		74	68	64.5	62	60	56.5	54	50.5
Backhoe			81								
Compactor			82								
Concrete mixer			85								
Crane (mobile)			83								
Generator			81								
Jack hammer			88								
Paver			89								
Pneumatic tool			85								
Pump			76								
Shovel			82								
Truck			88								

Source: ADB. 2011. Initial Environmental Examination of the Proposed Logistics development Project. Ulaanbaatar; and, US EPA. 1971. Construction Equipment Noise Ranges. A blank field indicates no data available.

464. *Measures.* The following mitigation measures will be implemented to comply with EHS standards:

a) Ensure communications to inform affected people in advance of noisy activities and the duration e.g. excavation/road breaking;
b) Properly maintain construction vehicles and machineries to minimize noise;
c) Apply noise reduction devices and methods for high noise equipment operating within 150 m of the sensitive sites i.e. schools, health centers, and religious sites;
d) Prohibit operation of high-noise machinery, and movement of heavy vehicles along urban and village roads, between 6.00 pm and 8.00 am;

e) Place temporary hoardings or noise barriers around noise sources during construction;
f) Monitor noise at sensitive areas at regular intervals. If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation;
g) Conduct regular interviews with residents/villagers adjacent to construction sites to identify noise disturbance. Community feedback will be used to adjust work hours of noisy machinery.

465. **Vibration.** Vibration impacts will arise from movement and/or operation of vehicles and equipment, earthworks, drilling, and excavation. Mechanical vibration may be sudden and discontinuous, which can cause stress among workers and communities. Vibration levels for machinery can be high and could affect buildings and infrastructure.

466. *Measures.* To address these issues: (i) high vibration activities, such as compaction operations will be prohibited at night from 6.00 pm to 8.00 am; (ii) Building owners and communities will be consulted prior to large earthworks to ensure they are informed, and, to avoid sensitive timing e.g. exams at nearby schools or festivals, (iii) contractors will organize photograph surveys of state of buildings within 20m of any site works. Vibration impacts are not considered as a key risk due to the relatively limited scope of works and the distance (over 400 m) of the nearest residents to main works areas (WWTP and landfill sites).

467. **Social Issues.** Network works may cause temporary disruptions to vehicle access; traffic flow will be temporarily impeded and parking space in front of the residents' houses will be reduced. Additionally, access to public facilities such as schools and health centers/hospitals may be disturbed and submitted to safety risks.

468. The project includes some construction sites that are close to markets areas. These markets are busy areas from morning to early evening with people coming for shopping and social gathering. Moreover, day-time vendors block the road entirely for their commercial activity and permanent shops extent to the sidewalks for outdoor display of their goods.

469. The project involves temporary and permanent land acquisition but no house demolition.

470. *Measures.* These impacts will be minimized as follows:
a) To limit inconveniences, construction vehicles should use different roads or dedicated lanes and the implementation of wastewater and drainage networks will be undertaken on one side of the road at a time;
b) Preparation and implementation of a traffic management plan, and coordination with local authorities and communities;
c) Works must be implemented during night time in areas close to markets, and construction contractor will have to prepare noise reduction and mitigation plan and implement dedicated measures for noise disturbance reduction and safe conditions for workers and neighboring population during works as well as during non-active periods. Additionally, a preliminary public information will be necessary before starting construction works;
d) Information disclosure: villagers, residents, public facilities (schools, health centers/hospitals, …) and businesses will be informed in advance through media and information boards at construction sites of the construction activities, given the dates and duration of expected disruption;
e) Public consultations on work phasing and schedules, anticipated access blocking, provisions for temporary and safe access for blocked properties and temporary parking for blocked garages/driveways;

f) Contractors will have to prepare as necessary an access plan which must be submitted to managers of public facilities in order to avoid any disruption of public service. Special attention will be paid to the surroundings of schools and health care buildings. This plan will be validated by the Municipality;
g) Posting of billboards on road/lane closure, traffic rerouting plan at strategic places, at least 1 week prior to works;
h) Posting of traffic (flag) persons during entire working hours if necessary;
i) Spreading out the schedule for materials delivery in non-peak hours as far as possible;
j) Efficient management of truck arrival/departure;
k) Provision of safe access, if needed, to blocked properties, e.g., steel planks of adequate grade, width and length, and if necessary, with guide rail;
l) A close coordination with utility companies will prevent the disruption of utility services such as water and electricity supply due to damaged lines.

471. **Network Disruption**. At the beginning of the design phase, it is recommended that a detailed ground topography study be conducted to identify all existing network. During construction phase, existing pipes and cables (piped water, fiber cables, power supply) could be temporarily impacted with potential disruption of the service. The duration of the service disruption will be reduced as much as possible and contractors will have to contact and make arrangements with all the utilities suppliers in order to minimize the impacts.

472. **Hiring of Workers.** Recruitment of construction workers will prioritize local residents to reduce the number of migrant workers. Thus, construction camps with overnight accommodation will not be necessary. In case of external workers needing accommodation, local guest houses will be selected. On site construction camps will only provide daytime facilities for workers needs during working hours (clean water/sanitation, offices, refectory).

473. **Community and Occupational Health and Safety.**
For the community: Traffic congestion and risk of accidents may increase with construction traffic, causing temporary inconvenience to traffic, residents, commercial operations, and institutions.

474. *Measures*. For the communities where excavation in the street is required, the following measures will be implemented: (i) night lighting/reflectors around excavations, (ii) barrier/safety fencing installation along the construction site/trench, and (iii) access to properties will be maintained safely, particularly allowing older people safe access to their homes across any excavations.

475. **For construction workers**: Construction workers will be exposed to social conflicts with communities, transmittable diseases in the community, presence of unexploded ordnances (UXO), large moving and operating construction vehicles and equipment, and pits and excavations associated with construction sites.

476. The construction industry is also considered to be one of the most hazardous industries. Use of heavy construction machinery, tools, and materials present physical hazards including noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards, and chemical hazards such as toxic fumes and vapors.

477. *Measures.* The proposed mitigation measures are the following:
a) Contractor compliance with environmental and occupational health and safety guidelines, and also with international guidance (ILO) on worker housing to address quality of for example, accommodation, sanitation, facilitation, fire equipment;
b) CEMPs will include health and safety plans;

c) Provision of Personal Protective Equipment (PPE) for workers;
d) Contractors will organize an initial Environmental, Health and Safety training for their workers, and short but regular reminder meetings will be organized (biweekly);
e) Adequate work site lighting, water supply, sanitation facilities and safe access;
f) Establishment of a first-response team comprising trained staff, equipment, tools, supplies, and an adequate office/clinic. The first response team will be linked to ultimate responders;
g) Appointment of a qualified Environmental, Health and Safety Officer;
h) Contractors will comply with local statutory requirements for use of construction equipment.

478. Additionally, each project contractor will prepare an environmental, health and safety management plan, which will include the following:

a) Construction site protection: clear signs will be placed at construction sites in view of the public, informing people about the project's GRM, and warning people against potential dangers such as moving vehicles, hazardous materials, and excavations, and raising awareness on safety issues. Heavy machinery will not be used at night. All sites will be secured, disabling access by the public through appropriate fencing whenever appropriate;
b) Provide a clean and sufficient supply of fresh water for construction sites;
c) Provide adequate number of latrines at construction sites and ensure that they are cleaned and maintained in a hygienic state;
d) Garbage receptacles at construction sites will be set up, which will be periodically cleared to prevent outbreak of diseases;
e) Provide personal protection equipment e.g. safety boots, helmets, gloves, protective clothing, goggles, ear plugs;
f) Emergency preparedness and response plan for accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events. These plans will be submitted to the local authorities for review and approval. Emergency phone link with the health center/hospital of Bavet will be established. Each site of works will have basic first aid kits;
g) A records management system that will store and maintain easily retrievable records against loss or damage will be established. It will include documenting and reporting of occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits;
h) Occupational health and safety matters will be given a high degree of publicity to all work personnel and posters will be displayed prominently at construction sites;
i) All workers will be given basic training in sanitation, general health and safety matters, and work hazards. An awareness program for HIV/AIDS and other communicable diseases will be implemented for workers and the local communities;
j) Core labor standards will be implemented. Civil works contracts will stipulate priorities to: (i) employ local people for works; (ii) ensure equal opportunities for women and men; (iii) pay equal wages for work of equal value and pay women's wages directly to them; and (iv) not employ child or forced labor. Specific targets for employment have been included in the project gender action plan.

479. Moreover, at the end of the construction phase, the following measures (minimum requirements) will be implemented to ensure site clean up to an appropriate standard on completion of construction works:

a) Surplus materials evacuation,
b) Decommissioning of construction camp facilities and equipment,
c) Waste removal,

d) Contaminated soil removal/treatment, and
e) Leveling of soil.

480. **COVID-19 Specific measures**. To protect the health and safety of workers as well as communities potentially affected by ADB-financed and/or administered projects, contractors are required to conduct a COVID-19 risk assessment and to incorporate COVID-19 health risks as part of their environmental, health and safety (EHS) plans, which will form part of the CEMP. These EHS plans should be aligned with any government regulations and guidelines on COVID-19 prevention and control, or in the absence thereof, with international good practice guidelines as they may be updated from time to time. The plans need to include sensitization measures to ensure proper briefings and education / capacity development materials and proper signage for the workers. The contractors' EHS plans should be reviewed and cleared by the Engineer or supervision consultant in consultation with public health inspectors of the area, local medical officers and other relevant health specialists.

481. The Engineer (or supervision consultant) shall be adequately staffed to undertake professional review and make recommendations to the EA and monitor the contractors' EHS plans. The TOR of the Engineer (or supervision consultant) reflects the need to supervise and report on the contractors' EHS plans, including COVID-19 risk management. The CEMP, including the EHS plan, shall be cleared by the Engineer (or supervision consultant) prior to mobilization of construction workers.

482. For all works contracts, contract provision on EHS shall include the requirement to submit a specific COVID-19 risk management plan (as part of the EHS plan) showing what type of arrangements the contractor will take to address this risk.

483. Quarterly project progress reports and the semi-annual environment monitoring reports shall report on the findings of the project-level COVID-19 risk assessment and risk mitigation measures, shall confirm that such mitigation measures have been incorporated in all the contractors' EHS plans before works resumed/commenced at the site; and shall report on EHS plan implementation progress.

5.2. Operational Phase

484. **Air Quality.** Odor nuisance may be generated during waste dumping in normal operation of the landfill, as well as accidental dumping during waste transport or temporary storage in the collection points. Odor effects can be mitigated through structural design and operating procedures.

485. Odor will be an issue / risk for communal collection points 1) if collections are missed or sporadic 2) during emptying of the container. The latter could also cause dust/litter depending on contractors' processes for emptying. These can be mitigated with regular collections, efficient (quick) transfer, cleaning the containers, cleaning spills, disinfection schedule, replace broken containers etc.

486. *Measures for the landfill:* Odor at the Landfill site will be primarily controlled through good housekeeping and operational procedures, which will include: (i) operator competence training, (ii) frequent cover, compaction, progressive capping to reduce odor, (iii) interviews with local community e.g. to get feedbacks that may state particular time of day when the odor is worse, etc.; (iv) implementation of additional measures based on such feedbacks.

487. The WWTP is likely to develop an impact on air quality in terms of odor, even if project options have been selected for minimizing this impact.

488. The discharge of septic sewage can be a significant source of odors at the discharge point, whether to an intermediate pumping station or to the inlet of WWTP. The odor threshold level of hydrogen sulfide measured in a laboratory is about 0.5 parts per billion (ppb). The level above which odor problems can occur is typically ten times this value.

489. *Measures for the wastewater system and network.* The following guidelines should be given proper attention in the design of the sewer network:

a) Maintaining self-cleaning velocities;
b) Minimizing turbulence wherever there is a hydraulic fall of sewer line;
c) Ventilation of (gravity) sewers by proper venting arrangement;
d) Design to ensure prevention of accumulation of grits/debris in sewer;
e) Routing maintenance shall consider using chemicals application in main pumping stations & sewer lines close to populated neighborhoods for controlling septicity.

490. Clogging of the stormwater drainage system may generate odor nuisances due to an accumulation of solid waste.

491. *Measures for the stormwater drainage.* The drains will be kept clear and in good working conditions by regular maintenance operations.

492. **Noise.** Noise and vibration sources related to the project during daily operation will be: WWTP, pumping stations, waste transportation and pre-sorting equipment. All these sources but two pumping stations are located far (> 150m) from sensitive receptors such as schools, religious sites, health centers, etc.

493. In the buffer zone of the 6 projected pumping stations (300 meters), the field surveys did not identify significant sensitivity for socio-economic and environmental context. However, motorized parts of the pumping stations will be sound-insulated.

494. *Measures.* The following mitigation measures will be implemented:

a) Modern and well-maintained equipment, meeting international standards, to minimize nuisance;
b) Apply noise reduction devices and methods for equipment operating within 150 m of schools and religious sites in rural areas located in the southeast area of Bavet municipality (pumping stations in Prasab Leak, Thnal Keang);
c) Truck traffic will be allowed during daylight hours as far as possible;
d) Conduct regular interviews with sensitive areas residents/users to identify noise disturbance. Community feedback will be used to implement new mitigation measures if deemed necessary;
e) A contact number will be displayed on the station entrances and the WWTP administration phone number will be public.

495. **Waste Transportation**. The collection and transport of solid waste will become regular activities that will use existing roads and infrastructures. Up to 20 trips/day to the landfill during the operational phase (from households and from collection points), which is considered as not significant compared to the existing traffic conditions. Frequent movement of waste trucks will cause nuisance to villagers living along the access road to the landfill and to the collection points.

496. *Measures.* These impacts will be minimized as follows:

a) Preparation and implementation of a waste trucks circulation management plan, and coordination with local authorities and communities;
b) Truck circulation plan shall give priority to routing trucks away from traffic dense roads;
c) Schedule planning for waste transportation in non-peak hours as much as possible.

497. **Landscape Modification and Visual Impact** associated to the new project facilities are very limited. Bavet is located in a flat, low lying land, and the project components are not *located* on prominent areas that could be easily noticed from distance. The new landfill will be adjacent to the existing dumpsite, with improved design and operating procedures that will provide a better appearance to the facility. The WWTP location is adjacent to a natural dense area, but also to the existing MRF and in front of an industrial area (Manhattan SEZ). The existing forest of acacia plantation will hide the WWTP to the sight from the northwest and particularly for the NR 1. Thus, other mitigation measures are not deemed necessary at this stage of the project.

498. *Measures.* Allocate time in the DED and during the supervision for an Architect/Landscaper (international/national pair) to enhance facility design and landscaping for screening.

499. **Community and Occupational Health and Safety.** Working conditions in the WWTP, landfill, pre-sorting and composting plant could potentially deteriorate over time if no monitoring is carried out to ensure the workers' health and safety conditions. Additionally, new projects have to include COVID-19 measures.

500. Public safety may be impacted by the implementation of the projects. For instance accidents may occur on the access roads and exposure to the treatment pond operations of the WWTP could result in injuries or diseases.

501. *Measures for occupational H&S.* The working conditions in the WWTP, landfill, pre-sorting and composting plants will be reviewed regularly to maintain adequate health and safety conditions for the workers, including COVID-19 national guidance (if it does not exist, international guidance will be used). All workers will be trained with regular refresher courses. H&S will be embedded in operational manuals/procedures for each site; it concerns handling of waste and chemicals, waste sorting, safety risk situations of on-site workers, traffic risk situations for drivers, etc.

502. *Measures for community H&S.* Posted speed limits along the access roads will be enforced and the perimeter of the WWTP and of the landfill will be fenced off to prevent public from entering the facilities. Access to facilities will be restricted to authorized employees.

6. Physical Cultural Resources

6.1. Pre-Construction Phase

(i) Land Acquisition

503. **WWTP** site is located on public parkland owned by Bavet government that is adjacent to the existing Materials Recovery Facility (MRF) constructed in 2018. This land is a mix between a dense forest and ephemeral wetlands (acacia plantation – Community Forest). The 2030 land use planning for Bavet categories the land use at this site as "Forest Area". The footprint of the WWTP under the loan is expected to be 20 ha. The WWTP Site-1 is accessed by a 1.5 km long laterite road connecting to NR 1. Consequently, no new access road is required for the site location, with only minimal annual maintenance of the access road required each year.

504. *Mitigation measures* to preserve the area surrounding the project site will include: (i) Establishment of buffer zones inside the site with vegetation along the fences; (ii) Avoidance of unnecessary earth movement and removal of vegetation; (iii) Management plans and

protection/conservation strategies; (iv) Temporary high-visibility fences around the work area, in order to avoid any access into or outside the buffer by wild fauna and workers (permanent 1.8m fences during the operation phase).

505. A shrine place and a sacred tree were observed in the vicinity during field survey, located at 50 m distance from the southwest edge of the acacia plantation, and about 200m outside of the boundaries of WWTP short term investment project area. For long term investment, the construction of Waste Stabilization Ponds is expected to generate an extension of the WWTP boundaries towards that area. To preserve the value of these elements in terms of cultural heritage, the long-term project location will be adapted in order not to affect them. An effective barrier (fence) will be installed along the western WWTP boundary during construction phase to protect this sacred area, and its access will be maintained in its current configuration and upgraded during construction and operation phases.

506. *Mitigation measures.* During consultation with representatives of the Chamkar Konkoki Community Forest, in September 2020, it was agreed that a wooden bridge will be installed to give access to the shrine area, beside the compensation budget for replanting trees.

507. **Pumping stations.** In rural areas, the construction of collection points and pumping stations along channels as a part of project components will subtract surface area from adjacent agricultural parcels. The surface will be 140m^2 for each main pumping station (4 stations for short term investment) and 60 m^2 for each secondary station (2 stations). The property owners impacted by the construction will receive an economical compensation and/or will be assisted for the resettlement.

508. **Networks.** In urban areas, sewerage and urban drainage projects will be associated to a temporary impact due to the construction of underground network. This impact will be limited in time and space, and will mainly related to impeded access to houses and to public and commercial facilities. No land acquisition is necessary.

509. In rural areas, drainage network will consist of open channels. Their construction will cause a permanent impact on adjacent parcels in terms of exploitable surface loss for agriculture or other private uses. The property owners impacted by the construction will receive an economical compensation and/or will be assisted for the resettlement.

510. **Waste management.** The new controlled landfill, the sorting plant and the composting plant will be created in the vicinity of the existing dumpsite. A land acquisition is required. Additionally, the collection points will be located in public areas.

511. In case of land acquisition, the size of the areas concerned will be reduced as much as possible but will, nevertheless, also be considering the long-term needs (2040).

6.2. Construction Phase

512. Any local cultural site will be protected from disturbances from construction activities and their access will not be impeded. If the surroundings of the cultural sites are affected by construction works, they will be restored to their initial conditions.

513. Chance-find procedures are included in the EMP. In the event that any artifacts are found, works in the site will cease immediately, the site cordoned off, the municipal administration, provincial government, EA, and Ministry of Culture will be notified.

6.3. Operational Phase

514. Any local cultural site will be remote from disturbances due to the project operation and their access will not be impeded. Hence, no specific mitigation measure is proposed.

7. Climate Change and Natural Hazards

7.1. Construction Phase

515. **Erosion.** Potential impacts include poorly planned excavation or disposal from borrow and spoil disposal sites, causing erosion induced by rainfall events, of which the intensity could increase due to the climate change.

516. Erosion may be caused by rainwater flows and compounded by construction works and/or vibration from movement and operation of construction vehicles/equipment near slopes, particularly at unprotected banks of gullies, creeks, and moderately sloping terrain. Erosion could also occur after completion of construction where site restoration is inadequate. Works may also raise dust, which may reduce photosynthesis processes of natural vegetation by deposits on plant leaves which could lead to lowered productivity and damage biodiversity on adjacent natural habitats (i.e. WWTP site).

517. *General measures.* These risks will be managed through strict on-site measures including: stabilization of exposed surfaces and spoil piles with ditches and/or sheeting; minimizing the duration that surfaces are exposed for; timing works for dry seasons, when rains are minimal and the ground is firm (to minimize infiltration of any contaminants); and, management of site stockpiles and storage sites for fuels and machinery. Pending effective management of the EMP, these risks are considered manageable.

518. *Specific measures.* Earthworks will be carried out during dry periods as much as possible to avoid erosion and sediment transport. Before construction, contractors will include site-specific drainage and soil erosion control measures as part of their site-specific EMPs, which will include and be modeled on the following actions:

a) Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next;
b) Minimize open excavation areas;
c) Construct intercepting channels and drains to prevent runoff entering construction sites and to divert runoff from sites to existing drainage or open ground;
d) Stabilize all cut slopes, embankments, and other erosion-prone working areas;
e) Stabilize all earthwork disturbance areas within 15 days after earthworks are completed;
f) Provide temporary detention ponds or containment to control silt runoff;
g) Strip and stockpile topsoil, and cover (by geotechnical cloth) or seed temporary soil stockpiles;
h) Limit construction and material handling during periods of rains and high winds;
i) Properly slope or re-vegetate disturbed surfaces e.g. pipeline trenches and cut banks;
j) Landscaping will only use native plant species;
k) Storage areas will be located to minimize land area required.

7.2. Operational Phase

519. **Erosion.** Erosion may be caused by water flow in earth open channels as a part of the stormwater drainage network. This effect may be increased in case of severe meteorological events as a consequence of climate change. Concrete box-culverts in urban areas will avoid this impact.

520. Measures for soil erosion control:
   a) Properly slope or re-vegetate surfaces;
   b) Stabilize all cut slopes and embankments: their design should consider climate change effects;
   c) Landscaping will only use native plant species.

521. For the landfill construction, topsoil stripping (to 50 cm depth) will be realized on the total landfill cells area (8.4 ha). For the short term horizon, bulk excavation expected volume is 135,000 m^3. This volume will be temporarily stocked on site. It will then be reused for intermediate and final cells cover.

522. *Measures.* Topsoil will be separated and placed in dedicated stocks (max 2 m height). It will be reused for final cover of the landfill cells, in order to preserve the agronomic quality of the site. Soils from bulk excavation will be used to create a barrier on the site perimeter, aiming to minimize visual and dust impact on the surrounding environment.

8. Indirect, Induced and Cumulative Impacts

523. **Indirect impacts** are adverse and/or beneficial environmental impacts which cannot be immediately traced to a project activity but can be causally linked. **Induced impacts** are adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project which may occur later or at a different location. **Cumulative impacts** are the combination of multiple impacts from existing projects, the proposed project, and anticipated future projects that may result in significant adverse and/or beneficial impacts that would not be expected in case of a stand-alone project.[54]

524. **Indirect and induced impacts.** The project is expected to result in a few indirect or induced impacts, such as increased urban development in areas where service facilities are improved, which are not consistent with the existing land use plan of the municipality. Such in-migration and additional stress on resource needs should be further related to the assimilative capacity of Bavet.

525. **Cumulative impacts.** During construction period, other infrastructure projects, such as road repair or road widening activities, may be implemented at the same time as the proposed subprojects. As such, potential localized impacts may be felt to a greater extent in the project influence areas (i.e., additional dust generation from road construction). To minimize these impacts, the following measures can be implemented: (i) communications/consultation/collaboration with other major project construction teams; (ii) co-ordination between project owners.

[54] ADB. 2011. Sourcebook for Safeguard Requirement 1: Environment. ADB, Manila.

VI. ANALYSIS OF ALTERNATIVES

526. An urban development scenarios (UDS) analysis was conducted in 2019 (culminating in a final report prepared in February 2020) to identify urban trends, the population projection for the next 20-years, and future infrastructure needs.[55]

527. Based on this assessment, sector master plans were produced. For each component, several infrastructure scenarios were proposed to address the identified gaps.
3 For the selected scenario,[56] a Comprehensive Technical Options (CTOP) was used to develop alternatives to address the short term horizon (up to 2025).[57]

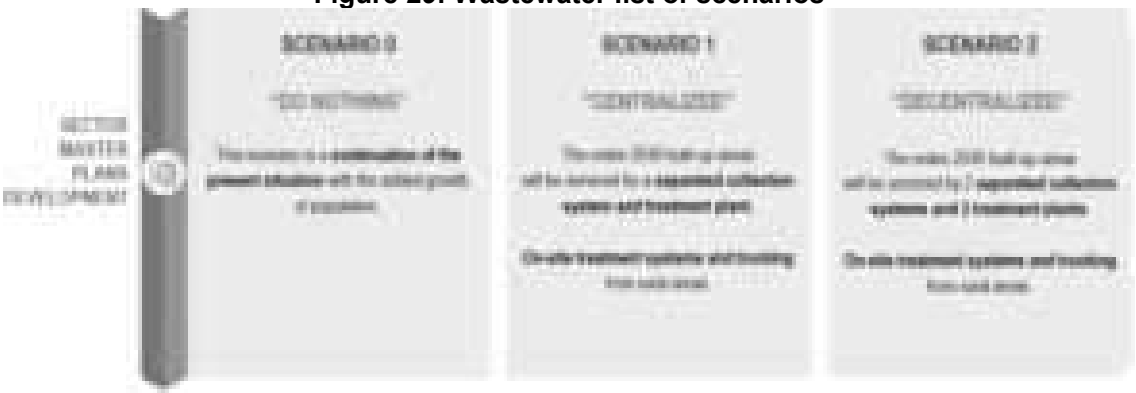
528. This section examines alternatives to the proposed project site, technology, design, and operation—including the no project alternative—in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. It also states the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.

1. Wastewater

1.1. Master Plan

529. Three scenarios were considered at the master plan phase: Scenario 0 – do nothing; Scenario 1 – fully centralized; and Scenario 2 – decentralized.

Figure 29: Wastewater list of scenarios



Source: Egis, 2021.

530. **Scenario 0**. The “Do nothing” scenario is a continuation of the current situation with the added growth of population, commercial and industrial buildings in the built-up area. There is no public wastewater treatment plant or piped collection system.

[55] Workshop held in Phnom Penh on 12 December 2019 with the MEF, MPWT, the Provincial Government, and the Municipal Administration to present the city needs assessment and roadmap.
[56] Workshop at Phnom Penh on 22 April 2020 with the MPWT, the Provincial Government, and the Municipal Administration where the preferred scenario was agreed.
[57] Workshop held in Provincial Hall, Svay Rieng province, Cambodia on 29th Sep.2020 with the MPWT, the Provincial Government, and the Municipal Administration to confirm the technical options for the short-term horizon.

531. SEZs are reported to provide partial treatment, but probably insufficient in some cases (as reported in the media): it is not clear whether dyes and other strong chemicals are used, and how they are treated and disposed.

532. As this scenario does not propose any treatment facility for fecal sludge, the “unsafely managed sanitation practices” proportion will raise to 78% in 2040, including 30% off-site sanitation provided by the SEZs (WW not treated/not sufficiently treated). The 22% of “safely managed sanitation practices” corresponds to households connected to the current sewerage network.

533. **Scenario1.** The “Centralized” scenario proposes for the whole built-up areas of Bavet (based on the projected land use 2030) to be serviced by a centralized wastewater treatment plant, with all wastewater is collected by pipe and transported to the treatment plant. Trucking from rural areas will continue for the remaining on-site area. A connection point is indicated for SEZs to allow connection (after pre-treatment) in areas where the sewer network passes.

534. **Scenario 2**. In the “Decentralized” scenario, most built-up areas will be serviced by a piped collection system and treatment plant, and on-site treatment systems will be promoted in areas too far to connect. Septic tanks and ground infiltration will be promoted along with community on-site systems appropriate, economical and meeting standards. Rural areas will continue to use present or improved on-site systems. A connection point is indicated for SEZs to allow connection to the sewerage network (after pre-treatment).

535. This scenario includes centralized collection and treatment only in Bavet centre and Chiphu centre. All other built-up areas and rural areas served by decentralized systems.

536. **Scenario analysis**. For the long-term horizon, the difference between the two scenarios is about 28% of the population that will have a connection to an off-site sanitation system. Based on the ability of the new WWTP to treat septic sludge, the percentage of excreta “safely managed” will be 100% for both scenario, even considering less connections to the sewerage network. Both scenarios would connect 89% of the hotels, 100% of commerce.

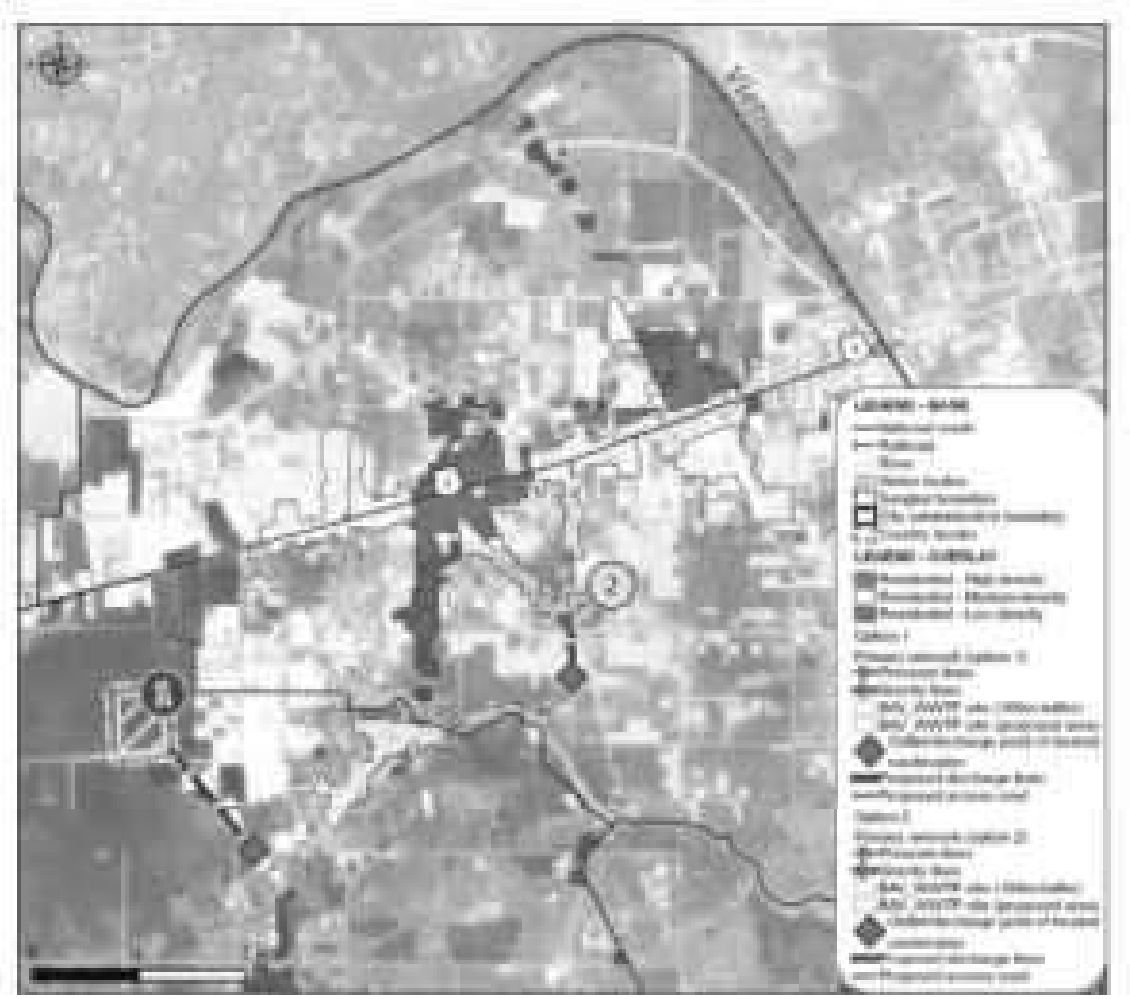
537. However, under Scenario 2, the OPEX economy would not be large enough compared to the additional investments required for a second WWTP to service the Chiphu area. Therefore, Scenario 1 – centralized wastewater treatment with sewerage in built up areas was recommended.

1.2. Site Alternatives

538. An initial assessment of WWTP sites in Bavet was carried out in November 2019 and presented during the UDS workshop in December 2019.

539. Two sites for the WWTP were identified, based on discussions between the MPWT, the Municipal Administration, and the TRTA consultants.

Figure 30: WWTP - site alternatives



Source: Egis, 2021.

540. **Site 1**. WWTP Site No. 1 (Site-1) is located on public parkland owned by Bavet government that is adjacent to the existing MRF, which was constructed in 2018. The WWTP site land is a mix between a regrowing forest and acacia plantation – Community Forest. The 2030 land use planning for Bavet categories the land use of this site as "Forest Area."

541. There are two drainage canals (options 1 and 2) along the WWTP Site-1 access road.

542. The WWTP Site-1 is accessed by a 1.5 km long dirt road connecting to National Road No. 1. Consequently, no new access road is required for the site location, with only minimal annual maintenance of the access road require each year.

543. Along the access road to WWTP Site-1 there are some signs of future construction sites with construction materials, concrete poles and subdivision boundaries. There is one Vietnamese fisherman habitation located on the access road canal. The WWTP Site-1 Location and Buffer Areas are shown in Figure 30.

544. WWTP Site-1 does not appear to require any resettlement as the site is public parkland and there are no permanent households within a 100m buffer zone. The effluent discharge would be to canal where the terminus is to agricultural land.

545. **Site 2**. The alternative site for the WWTP is located 3.8 km Easter than the selected one. The 2030 land use for this site is “mixed use residential”. The site is accessed by an existing 1.5 km of urban road that connects directly to NR 1. No new access road is required, only minimal annual road maintenance.

546. Four existing houses are in a 100 m buffer zone. Three development areas (residential under construction) are nearby but outside a buffer zone, and a small portion of another development area of the same kind is inside the buffer zone.

547. This site does not appear to require any resettlement; however, since it is a private land, it would need to be purchased.

548. From the WWTP site -2, the effluent can be transported to an existing canal, via a 1000 mm diameter pipe along the road. This pipe has been designed to collect the drainage water from the urban developing area. The pipe outlet is to an existing canal that is 530 m long discharging to a river that forms a small lake at the canal outlet location. It extends eastward for 7 km until it splits into two canals, flowing north and south along the Cambodia side of the border with Vietnam.

Table 27 Site Assessment Summary

Criteria	Site 1	Site 2
Area available	20 ha	1 to 10 ha
Owner	Public	Private
Site description	Acacia plantation	Dry sandy clay soil with moderately dense forest
Distance from city center	5 km	1.6 km
Distance from closest residential area	300 m	40 m
Access road	1 km to National Road No.1 Public road	1.6 km to National Road No.1
Effluent discharge location	Existing canal requires rehabilitation.	The 1st 530m has a concrete pipe (D:1m to collect combined WW from house development) then remaining 530m canal discharges to the main river
Environmental	Max floods 0.5m upper the natural ground surface	No flooding

Source: Egis, 2021

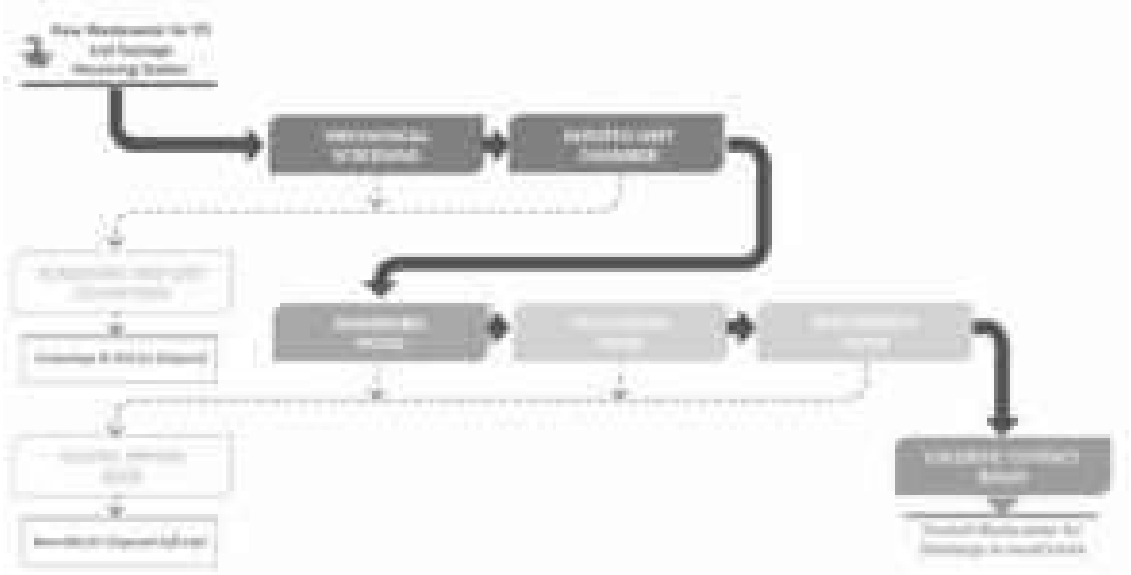
549. **Site analysis**. Land acquisition and costs as well as planned land use around and within the WWTP buffer zone, led to site 2 being discarded as an option. Site 1 was selected during the workshop held in Phnom Penh on December 12, 2019.

1.2.1. Wastewater Treatment Plant

4 Two processes were compared:

(i) Waste Stabilization Pond (WSP).

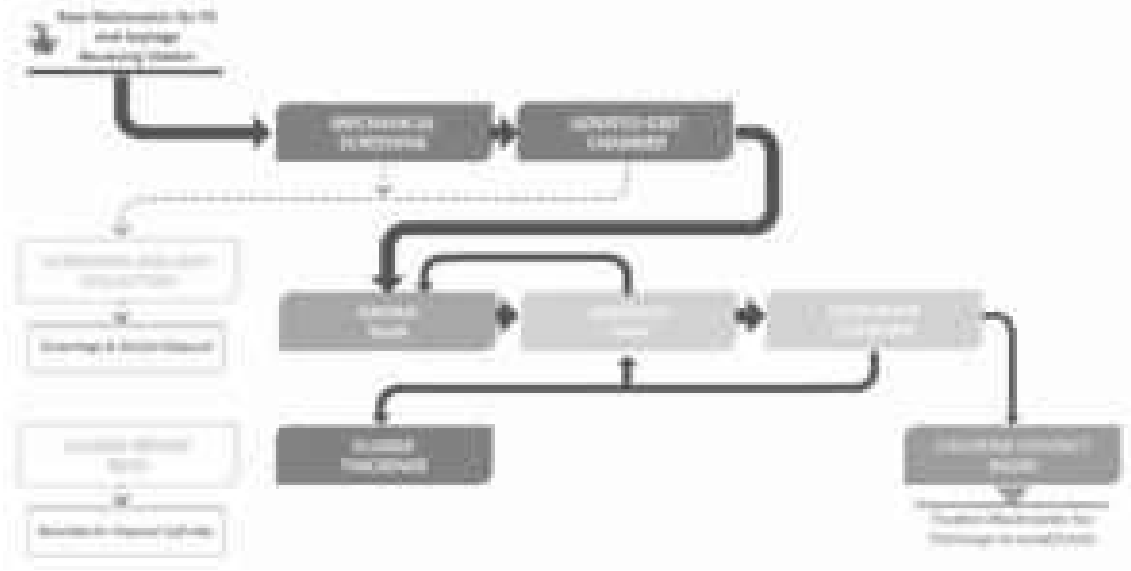
Figure 31: Process Flow Diagram – Waste Stabilization Ponds (WSP)



Source: Egis, 2021

(ii) Conventional Activated Sludge process - Extended Aeration (ASP-EA).

Figure 32: Process Flow Diagram – Activated sludge with extended aeration process (ASP-EA)



Source: Egis, 2021

550. **Option comparison - regarding pollution removal.** The following table makes the comparison between the two options considered. The option comparison is based on the treatment efficiency toward the pollutant removal targets specified in local standards (Sub-

decree 27, Annex 2 Effluent standard for pollution sources discharging wastewater to public water areas or sewer).

Table 28: Treated Wastewater Standards – comparison between two options

Parameters	Treatment Efficiency	
	WSP- Base option	**ASP-EA - Alternate option**
BOD	No concerns	No concerns
COD	COD < 50 mg/l may not be possible consistently since some amount of non-biodegradable particulate COD may get carried over along with algal mass.	COD < 50 mg/l possible consistently provided the total non-biodegradable COD in the raw wastewater is not more than 20% of total COD of influent.
TSS	TSS < 80 mg/l is possible most of the time. However occasional slippage may be possible during heavy algal accumulation leading to carry over in the effluent.	No concerns
Total Nitrogen (TN)	No concerns	No concerns
Total Phosphorus	No concerns	No concerns
E.Coli	No concerns	No concerns with tertiary step comprising separate chlorine disinfection

Source: Egis, 2021

551. The following table shows the comparison between the option selected for the project and the proposed alternative. The statement frames in red are considered to be critical and determinant for option selection.

Table 29: Treatment Process – comparison between two options

Description	Waste Stabilization Process	Activated Sludge Process – Extended Aeration
Pre-treatment	Screening, Grit Removal	Screening, Grit Removal
Equalization	Not required	Recommended
Aeration requirement	Oxygen supply through Photosynthesis of Algae in a facultative pond	Mechanical equipment - blowers or surface aerators or other aeration devices required
Clarifier / Settling Tanks	Not required, settling takes place by unmixed zones in the bottom layer of ponds	Required to separate treated effluent from bio-mass
Tertiary Treatment	Not required, in some cases, rock filters are used to prevent algal carry over in treated effluent	Required for fine polishing of treated effluent from the secondary treatment stage to comply with discharge standards
Disinfection	Not required generally, recommended as a back-up in case of any non-compliance for E.coli count in the treated effluent	Required to have chlorine or other sorts of disinfection such as UV or Ozone to achieve required E.coli levels in effluent
Footprint required	Very large when compared to other technologies 2030: 20 ha 2040: 54 ha	Very less, maybe less than one-third of the footprint required for WSP 2040: 6ha
Susceptibility to load variations	Very good	Very good

Description	Waste Stabilization Process	Activated Sludge Process – Extended Aeration
Energy Requirement	Practically no energy consumption except for pre-treatment works, pumping if any for transfer of sewage into the plant & effluent discharge from the plant (this is more related to hydraulics rather than the technology adopted)	Considerably high energy consumption when compared with WSP. The major energy component is for aeration supply besides pumping energy for sludge recirculation, sludge treatment & tertiary treatment
Sludge handling	May be required once in a year (very conservative) or even much later –after many years	Sludge handling & treatment to be operational on a routine basis
Aesthetic concerns	Possible insect breeding, flies, vegetation growth are quite possible	No such concerns
Environmental concerns	Odor nuisance is a common problem, buffer zone to be considered to mitigate odor levels reaching the nearest neighborhood	Very little odor and hence is not a major concern. Being completely aerobic, sludge produced is almost stabilized thereby minimizing the odor levels within the plant.
Operational reliability	Fairly good even without operator intervention	Very good in case of proper supervision. Lots of technical resources available to quickly troubleshoot any plant upsets owing to so many installations across the world with this scheme
Nutrient removal	Consistent removal of Total Nitrogen & Total Phosphorus possible.	Consistent removal of Total Nitrogen & Total Phosphorus possible.
Coliform removal	Very good efficiency	Fairly good, however, required discharge limits shall be achieved by disinfection step after secondary treatment
BOD removal efficiency	Very good	Very good
CAPEX & OPEX	Low construction cost & very low operational cost	High construction cost & operational cost

5

552. **Waste Stabilization Ponds** have proven to be a commonly adopted scheme in Cambodia. Apart from the initial capital cost for huge land use that would be required for the WSP scheme, the overall benefit of very low OPEX and sustainable operations without any major need for revamping/rehabilitation makes it the best fit solution in this particular case.

553. As stated earlier, a proper balance has to be maintained to choose a particular option concerning the project requirements such as financial infrastructure, capability building & other socio-economic factors.

554. On consideration of the above factors and based on the factors listed in the previous comparison table, **WSP was recommended as the preferred option**.

555. The plant will be designed to remove carbonaceous matter and to provide partial nitrification as a first stage, using a wastewater treatment technology already developed in the country. **In the medium, the treatment units will need to be upgraded to increase the capacity of the WWTP or to improve the treatment efficiency of the treatment if the standard changes.**

556. **Septage treatment**, dispersal, reuse, and recycling of the by-products and residuals of the treatment process. Two options are usually considered:

(i) A specific treatment: septage treatment plant;
(ii) A co-treatment at the wastewater treatment plant.

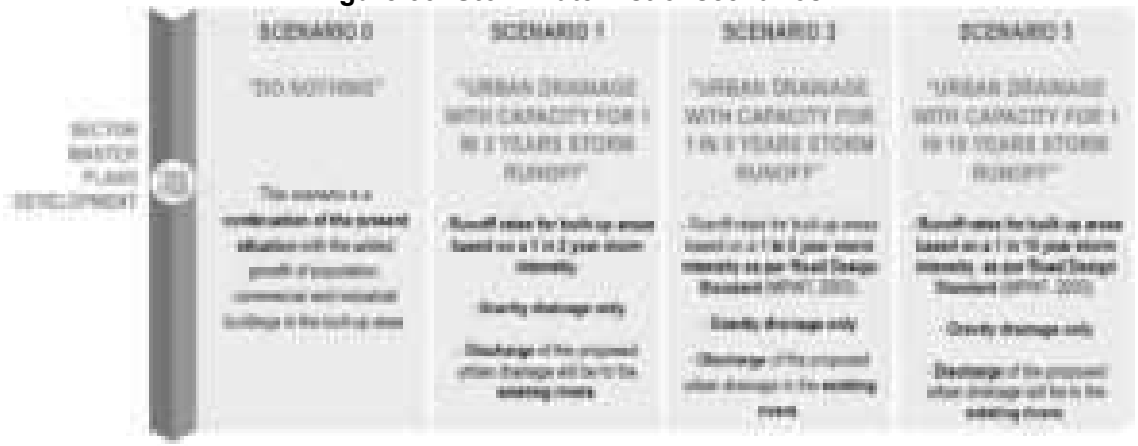
557. Septage co-treatment at the WWTP is probably the most viable and economical option among the treatment alternatives, in comparison with a dedicated treatment.

2. Stormwater Drainage

2.1. Master Plan

558. Four scenarios were assessed during the master plan stage, as indicated in the figure below.

Figure 33: Stormwater list of scenarios



Source: Egis, 2021

559. **Scenario 0**. This scenario is a continuation of the present situation with the added growth of population, commercial and industrial buildings in the built-up area.

560. Construction of new buildings such as hotels, shopping malls, casinos and parking areas will continue to cover the natural land with concrete, steel and asphalt structures. Runoff rates will increase from these impermeable surfaces and cause more localized flooding on streets and around buildings in low-lying areas.

561. Natural slopes of the land and the small-scale existing drainage will continue to cause flooding along roads and ditches in adjacent residential areas north and south of the national highway. In some cases, flooding will mix with sewage and create odors, increase risk and exposure to human contact and potential health hazards. The financial cost of flooding is not estimated.

562. **Scenario 1**. This scenario has been assessed based on rates for built-up areas for a 1 in 2 year storm intensity. Less intense and more frequent storms were accommodated in the model. More intense and less frequent storms to be expected every few years will still cause occasional street flooding and damages to buildings and contents.

563. The system is designed for a cumulated rainfall height of 63mm (max. intensity: 185mm/h).

564. **Scenario 2**. This scenario has been assessed based on rates for built-up areas for a 1 in 5 year storm intensity. Less frequent flooding during intense rainfall will occur as the infrastructure proposed will provide for a higher level of service (compared to a 1 in 2 year storm). However, this scenario will also require higher construction costs.

565. The system is designed for a cumulated rainfall height of 75mm (max intensity: 218.5 mm/h).

566. **Scenario 3.** This scenario has been assessed based on runoff rates for built-up areas for a 1 in 10 year storm intensity. Less frequent flooding during intense rainfall will occur as the infrastructure proposed will provide for a higher level of service. Similar to the 1 in 5 year scenario 2, this will incur a higher construction const.

567. The system is designed for a cumulated rainfall height of 111mm (max. intensity: 242.6mm/h).

568. **Scenario analysis**. In terms of people, institutions, SEZ, etc. connected, the last three scenarios have the same impact but with a different level of service: 1 in 2 year return period, 1 in 5 year, and 1 in 10 year.

569. The financial assessment found that the 1 in 2 year drainage design will be approximately 11% less expensive than the 1 in 5 year design. Operations costs are estimated to be identical.

570. Comparison of protection from 1 in 2 year return period urban drainage design and 1 in 5 year design for a 2.7 km^2 urban area in Italy showed that the additional annualized costs of 1.5 million Euros (15%) to provide 1 in 5 year storm protection over the 1 in 2 year protection resulted in $6 million less flood damage costs[58]. In many cities the higher standard for urban drainage pipes and channels of 1 in 5 year design is now used and it is considered an affordable balance between drainage infrastructure costs and reduced flood damage.

571. Therefore and as recommended in the national Road Design Standard (MPWT, 2003), it is agreed to design the urban drainage of the city for a capacity for 1 in 5 years storm runoff.

2.2. Site Alternatives

572. Urban drainage is limited to drainage of existing concrete roads.

573. Drainage is normally implemented on both side of the road, where many buildings are present in existing areas and developing elsewhere. Some of these constructions are clearly encroaching on the road right of way, as a temporary facility (equipment stored at night time such as tables / chairs).

574. A basic topographical survey of the road centre line has been completed in the coverage area. The proposed drainage network follows the natural topography and discharges at low points of the road. As far as possible, the few existing cross-drains will be reused to limit the cost of road cutting and reinstatement.

[58] Selection of the Optimal Design Rainfall Return Period of Urban Drainage Systems, A. Fortunatoa,*, E. Oliveria , M. R. Mazzolaa, 2014

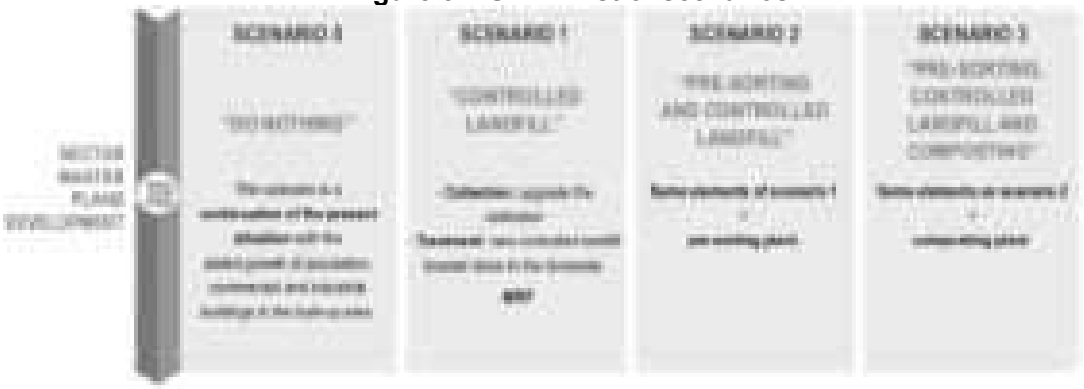
575. Discharge of the proposed urban drainage will be to the existing rivers, and special outfall structures, energy reduction and dispersal is required to avoid erosion along the river from the concentration of discharge.
576. Choices on drainage network location aim at limiting nuisance to agricultural land use as well as to residential and commercial areas.

3. Solid Waste

3.1. Master Plan

577. The following solid waste treatment scenarios were assessed as part of the master plan:

Figure 34: SWM - list of scenarios



Source: Egis, 2021

578. **Scenario 0**. The impacts of the 'Do Nothing' Scenario include the decrease of recovery rate and collection rate with population and urban growth.

579. Moreover, the environmental impact of the dumpsite is the main issue, particularly in terms of groundwater pollution and greenhouse gas (GHG) emissions, as well as atmospheric pollution from waste burning. Furthermore, in terms of working conditions, the waste discharging process from trucks is not safe as it is done manually by collection operators. Scavengers at dumpsite will still work in poor conditions, and health risk and safety are the main issues (children are also part of the scavengers, estimated at 10% during the site visit).

580. **Scenario 1**. In terms of household waste collection coverage, this scenario proposes an improvements in terms of: 50% in 2025, 75% in 2030 and 85% in 2040 by developing:

(i) **The door to door collection** in the dense urban area, where every households are very close one to another, the door to door collection is a high service standard. Waste are collected at each property limit. It is already functional nowadays. It is admitted that all the SEZ are within urban areas so collected with the door to door system.
(ii) **The centralized collection points**. To limit the cost of collection, centralized collection points are preferred to door-to-door collection due to the fact that households are relatively scattered and road access is poor (most of the roads in rural areas are not asphalted). With this system, the households transport their waste to centralized.

581. **Disposal/Treatment.** A controlled landfill to be built in Chrak Mtes Sangkat by 2025. The existing MRF would maintain its current purpose, packing the recyclables extracted from

the waste stream. The following table shows an estimate of the landfill volume and area required.

582. **Scenario 2**. In this scenario, the collection, transport, treatment and disposal are the same as scenario 1. The existing MRF would maintain its original purpose, packaging recyclables collected by the waste pickers. A pre-sorting plant, located near the new landfill site, is proposed and will allow to manage the dry recyclable.

583. **Scenario 3**. In addition to the scenario 2, a composting plant is proposed in this scenario with the goal to reduce landfilling. Compost is an opportunity to reduce greenhouse gas emission compared to landfilling, as soils store the compost carbon. The biowastes considered for composting are:

(i) Biowaste from markets, assuming an 80% source-sorted collection rate, based on successful experience in Battambang.
(ii) Biowaste picked up manually at the pre-sorting plant, mainly green waste. It is assumed that 5% will be recovered from the biowaste flow. In the long term, the recovery rate could be improved.

584. **Scenario analysis**. Based on the impact assessment, Scenario 3 was recommended for the following reasons:

(i) It provides the highest diversion rate from landfilling, 32% compared to 25% without composting and 17% without composting and pre-sorting plant.
(ii) Even if the composting plant costs are not recovered by the compost selling revenues due to low market maturity, long term benefits should be considered such as lower landfill footprint and economic benefits for farmers.
(iii) In the long term, jobs creation would reach around 130 jobs, including 15 jobs for the composting plant. Most of the jobs would be accessible by the poor and not qualified employees such as actual waste pickers and scavengers.

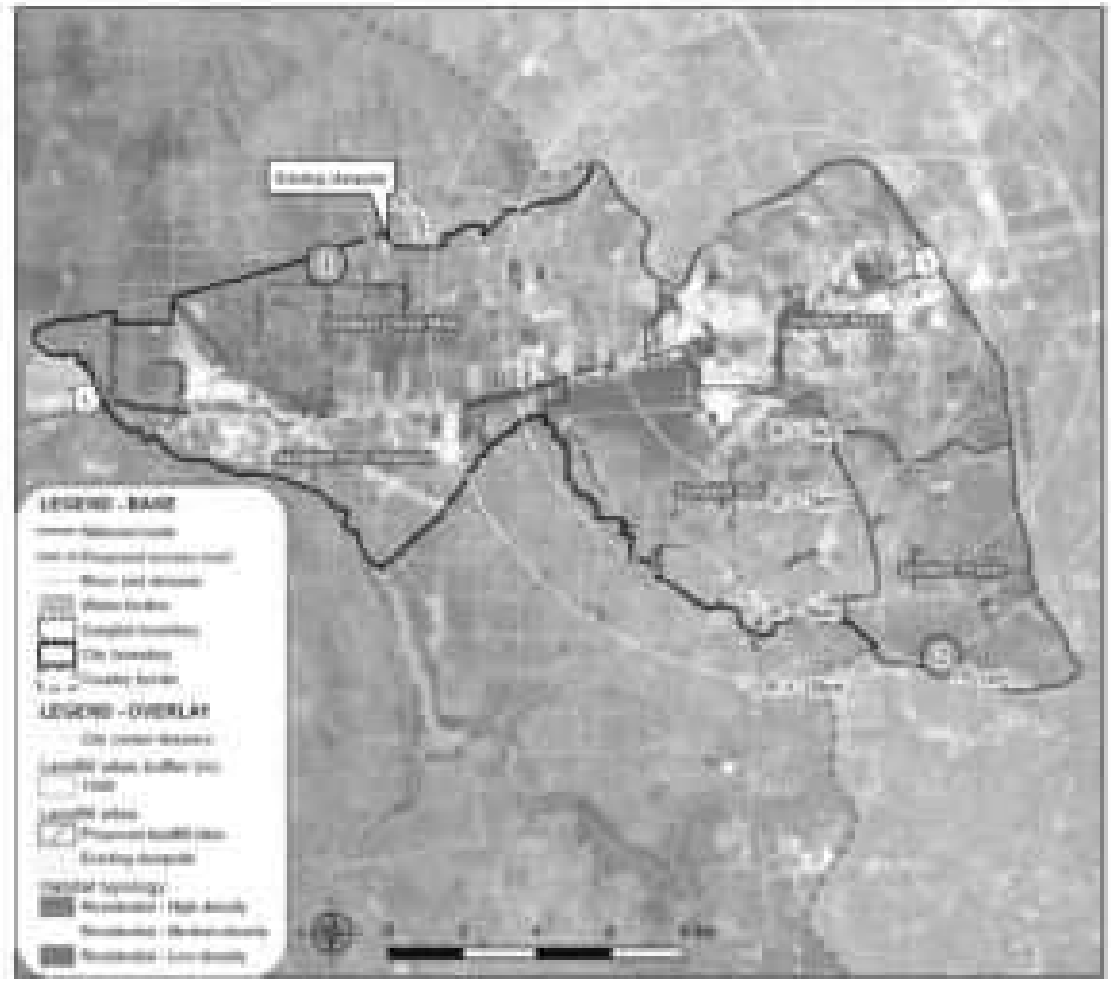
585. Under scenario 2 and 3, revenues from recyclables recovered at the pre-sorting plant are equivalent or higher than total scenario OPEX. Therefore, controlling part of the recyclables economy would improve the economic sustainability of the solid waste management in Bavet. It would also trigger social and environmental benefits.

3.2. Site Alternatives

586. An initial assessment of landfill sites in Bavet was carried out in November 2019 and presented during the UDS workshop in December 2019. The criteria for selecting a new landfill site was based on the criteria outlined in the “Technical Guidelines on Urban Solid Waste Management” (MoE, 2016), as listed in **Error! Reference source not found.** of this I EE.

587. Two sites were selected based on discussions between the MPWT, the Municipal Administration, and the TRTA consultants.

Figure 35: SWM - Site alternatives



Source: Egis, 2021

588. **Site 1** is close to the existing dump site and also the cheapest regarding the cost per capita. This site itself is in compliance with the criteria from the technical guideline on urban solid waste management of MoE 2016; such as more than 10km from the Bavet downtown, 4km from NR 1, more than 5km from the tourism site/religion site, more than 60km from the national heritage, more than 100km from the airport, year round access road, and no flooding. This site had been approved by the MoE, letter No.1555 dated Nov.23, 2020 (Appendix 2).

589. **Site 2** is located 15 km southeast of the city center. The location is mostly agricultural with paddy rice field. Based on testimonies, the water level in the fields is around 40 cm during the rainy season.

590. The table below summarizes the site assessment.

Table 30: Summary of landfill site assessments

Criteria	Site 1	Site 2
Area available	10 to 20 ha	10 to 20 ha
Owner	Private	Private
Site description	Agricultural land and rice fields, close to existing dump site	Agricultural land and rice fields

Distance from city center	12 km	10 km
Distance from the closest residential area	More than 300 m	More than 300 m but close to the Viet Nam border
Access road	Work to be done along 5 km (revetment, drainage)	Work to be done along 15 km (revetment, drainage)
Environmental	No flooding. No special ecosystem	Annual flooding, around 40 cm. No special ecosystem

Source: Egis, 2021

591. To avoid any additional environmental impact compared to the existing situation and to avoid occupying a new location, **Site** 1 was selected during the workshop held in Phnom Penh on December 12, 2019.

3.3. Technical Options

3.3.1. Waste Collection Options

592. The table below summarizes several criteria comparing the project options regarding waste collection:

Table 31: Technical options for collection in rural areas

Criteria	Centralized collection point	Door-to-door collection
Service standard to users	Medium service standard, people have to bring their waste to the collection point.	High service standard.
Logistic	Logistic is optimized, less trucks and drivers required and less fuel consumption.	Access to rural households is difficult due to lack of asphalted roads. Collection during rainy season may be interrupted. Risk of trucks damages.
Social	People behavior has to change as they have to bring their waste to the collection point instead of burning it or disposing it of in the environment.	People are encouraged to dispose of their waste in the street instead of burning it or disposing it of in the environment.
OPEX	Low cost.	Medium cost.

Source: Egis, 2021.

593. A mixed solution is selected for the project to better serve different areas of Bavet Municipality: centralized collection points for the rural areas and door-to-door collection in the urban area, and segregated-collection of biowaste at the market.

3.3.2. Options for Sorting Plant

594. The overall goal of the sorting plant is to reduce the proportion of MSW going to landfill and improve the working conditions of the waste pickers. The aim of the plant is to sort the following fractions: valuable plastics, including PET bottles, plastic glasses and plastic bags; cans and metals; and the fraction of green waste >80 mm for composting.

595. The sorting line refusals are transferred to the nearby landfill. When a container is full, it is taken for tipping and directly replaced by an empty container, ensuring the continuity of the sorting process operation.

3.3.3. Options for Composting Plant

596. The composting process are different due to the aeration mode: forced or natural. The following table summarizes the advantages and disadvantages of the silo process compared to the windrow process.

Table 32: Technical options for composting

Criteria	Silo composting	Windrow composting
Composting duration	4 weeks.	8 weeks.
Area required	Low.	High – 3 times higher than a silo composting process.
Maintenance requirement	High. Need of Maintenance for electromechanical equipments such as blowers.	Medium.
Leachate production	Leachate quantity is minimized as the process is totally sheltered.	The composting process is not sheltered, a windrow cover is provided to protect the windrows from rainfall limiting leachate production.

Source: Egis, 2021

597. Investment in a **windrow composting process** is cheaper as it requires less civil work than a silo composting process. In the silo composting process, electro-mechanical blowers are required. The electricity costs are higher and it requires also an adequate maintenance. Windrow composting is a robust system which is easier to operate and maintain than silo composting.

3.3.4. Landfill Options

598. Two solutions for final disposal of residual waste were proposed:
(i) controlled landfills; and
(ii) sanitary landfills.

599. According to ADB guidelines, a controlled landfill is usually the most appropriate disposal system for most small to midsize municipalities. A sanitary landfill is generally too expensive and too complex for small to midsize municipalities to operate sustainably without ongoing external technical support or funding. Also, the additional operating costs for items like the leachate treatment plant are significant but yield little or no environmental gain at this scale given their demonstrated unreliability. Furthermore, the required removal of all waste scavenging from the site could have significant social impacts and increase airspace consumption.

600. The selected solution for final disposal is controlled landfill. Within this overall definition, consideration must be given to the different technical options for the landfill, focused on three principal elements:

- The basal lining system
- The leachate treatment system
- The landfill gas treatment system

601. The following tables show the options for lining, leachate treatment and landfill gas treatment.

602. It is necessary for the landfill cells to have a low permeability basal liner, with a permeability less than $1x10^{-9}$ m/s, for which there are two options:

Table 33: Technical options for the basal liner

Criteria	HDPE geomembrane	Mineral clay liner
Availability of materials	Easily available on the market.	No source identified.
Ease of installation	Requires trained installation contractor (of which there are many).	Requires appropriate plant (sheepsfoot roller) and expertise.
Need for controls during construction	An installation QA/AC scheme is necessary.	An installation QA/AC scheme is necessary.
Degree of protection	High.	Good.
Permeability	$<1x10^{-12}$ m/s	$<1x10^{-11}$ m/s
Long-term durability	Good.	Excellent.
Cost	High.	High.

Source: Egis, 2021.

603. **Choice of base liner option** In view of the above analysis, it is recommended that a geomembrane basal liner be used. This is principally because of the doubts on the availability of clay (in-situ or off-site) for a mineral liner; this point may be verified at DED stage, based upon the findings of the site investigation.

604. The leachate will be drained by gravity towards the collection well at the low point and then, still by gravity, to a leachate storage lagoon. There are then three options for the treatment of the leachate, as follows:

Table 34: Technical options for the leachate treatment system

Criteria	Off-site treatment	On-site treatment	Recirculation
Technical complexity	High, depending upon the technology used.	None (on-site).	Low. The only operating plant is the pumping station.
Investment cost	High, depending upon the technology selected.	None.	Moderate. The recirculation system requires a small pump, distribution pipework and infiltration drains or wells.
Operating cost	The operating costs per m^3 treated are high for a small leachate treatment plant, requiring manpower, reagents, and electricity.	Moderate. There are two costs - the transport cost by tankered, and the cost charged by the WWTP for treating the leachate.	Low. Only costs are pump maintenance and electricity.
Environmental impact	Dependent upon the degree of treatment applied – for high-tech solutions, such as reverse osmosis, the discharge is very clean.	The transport of the leachate to the WWTP has an impact (GHG emissions, traffic circulation). Otherwise, the impact of the discharge is dependent upon the quality of treatment at the WWTP.	The recirculation of the leachate into the waste mass does promote the degradation of the waste and, thus, LFG emissions. It requires an effective operation of the site and good LFG measures.

Source: Egis, 2021.

605. **Choice of leachate treatment option.** It is proposed to use a combination of leachate recirculation and off-site treatment at WWTP. This solution is chosen because it avoids expensive and complex on-site treatment, whilst, at the same time, providing a flexible means of managing the leachate as its quantity and quality varies over time. The use of leachate recirculation is a tried and tested technique, which, although it does need to be properly managed, does not require expensive reagents and technical expertise to

implement. The majority of the leachate will be recirculated back into the landfill mass, with the excess being tankered off-site for treatment at the WWTP. The recirculation uses a pump in the leachate pond, with pressure lines leading from the leachate pond up to the landfill surface, where the leachate enters the waste mass via infiltration drains or wells.

606. There are three options for the treatment of the LFG:

Table 35: Technical options for the landfill gas treatment system

Criteria	Passive venting	Active venting with a flare stack	Active venting with electricity generation
Technical complexity	Simple.	Moderate.	High.
Operational requirements	Almost none.	Simple maintenance & monitoring.	Moderately difficult maintenance & monitoring.
Reduction of greenhouse gas emissions	None.	Good.	Good.
Capital costs	Low.	Moderate.	High.
Operating costs	Very low.	Low.	Moderate to high but balanced by value of electricity produced.

Source: Egis, 2021.

607. **Choice of LFG treatment system**. Based upon the above comparative analysis, the most suitable technical option is considered to be the flare stack. This is a relatively cost-effective solution, easy to maintain, which also meets the environmental requirements such as reduction of GHG emissions, limiting of odors, etc. that a passive system would not provide. The use of LFG flare stacks is an extensively used technology in similar countries and is does not need a high degree of technical supervision or expertise. Furthermore, the estimation of LFG production indicates that a LFG-to-energy plant would not be a cost-effective solution for the site conditions.

VII. CONSULTATION AND PARTICIPATION

1. Consultations undertaken

608. As a first step in preparing LCIP, a stakeholder analysis was completed to identify the key actors, their interests, and strategies to maximize their participation in the project. Information was gathered from (i) the different government organizations that will be involved in project implementation, (ii) civil society, (iii) public and private actors in the water and waste management sectors, and (iv) community members living in the project area.

609. In developing the project, a series of stakeholder consultations and workshops were carried out by the technical assistance team comprising international and national specialists with representatives at Sangkat, Municipality, Province, and Ministry levels, with community members and with private companies. In particular, detailed environmental consultations were undertaken as part of the social consultation in September 2020 (see Appendix 5 for details).

610. As summarized in Table 36, consultations comprise interviews with stakeholders and completion of a questionnaire form. The consultations focused on: (i) current household livelihoods and living conditions (income, water and electricity supply, sanitation and waste disposal); (ii) community observations and concerns on current environmental and climate changes; (iii) social and gender issues (gender division of labor and decision-making, opportunities for poor and disabled persons); and (iv) existing needs and priority actions required for improvement of the livability of the city and for its sustainability.

Table 36: Consultations undertaken in Bavet

No.	Name of the meeting	Date	Location	Total Participants	Female (Person)
A	**The General Consultations**				
1	In an Urban area	03/09/2020	Bavet General Knowledge and Technical High School	51	33
2	In a Rural area	03/09/2020	Ampor Woin Pagoda, Chrok Mates Village, Bavet Town, Svay Rieng Province	54	35
B	**Focus Group Discussions (FGD)**				
3	FGD 1 ID Poor	03/09/2020	Ampor Woin Pagoda, Chrok Mates Village, Bavet Town, Svay Rieng Province	9	8
4	FGD 2 FHHs	04/09/2020	Bavet General Knowledge and Technical High School	10	10
5	FGD 3 Elders	03/09/2020		11	6
6	FGD 4 Disable people	04/09/2020		9	4
7	FGD 5 Youth (12-15 years old at high school)	03/09/2020		16	5
8	FGD 6 IPs (Vietnam)	03/09/2020		7	4
9	FGD 7 informal Workers in Solid Waste Management	04/09/2020		10	6
10	FGD 8 Local Authorities/ key informants	02/09/2020	Headquarter Chrok Leav Village, Sangkat Bavet, Bavet Town, Svay Rieng Province	16	1
C	**Consult Key CBOs/NGO**				
11	Santi Sena Organization	03/09/2020	By Phone Call	1	
12	Union of Youth Federation of Cambodia	03/09/2020	Government Hill Bavet	2	1

Source: Egis/KCC, 2020 - Social Survey for Bavet City.

611. Individual consultations with key persons such as biodiversity and bird specialists, community forest members were also carried out to obtain contributive ideas on prevention and mitigation measures for valuable species conservation. For instance, during the consultation with Chamkar Konkoki Community Forest representative (baseline survey in September 2020), it was requested by the representative that the project implementation agency provides by compensation planting the trees damaged/destroyed by the project

activities. Besides the compensation for damaged trees, he also requested that a wooden bridge for the shrine area should be provided. This is now included in the project.

612. During the consultation with freelance biodiversity consultant and bird expert Mr. Hong Chamnang and Mr. Bou Vorsak, both suggested that an additional bird study should be done during DED stage. Although the WWTP and the landfill site are not located in a protected area or a special ecosystem / bird-habitat, there are still two species of bird (Painted Stork, and *Mycteria leucocephale*), classified as near threatened bird species by the IUCN list, that were observed on the proposed sites by the local people.

2. Results of consultations

613. Consultations provided input on the design of the project, it helped determine project priorities, socio-economic objectives, and confirm linkages with local development plans and aspirations. The information and recommendations gathered from the various stakeholder consultations has been incorporated into the design of the project to ensure that the investments align with local priorities and development plans, and that they will deliver equitable socio-economic benefits to the whole population, including women, the poor and vulnerable.

614. The results of the pre-implementation consultations are summarized in Appendix 5 There is broad community support for the project's approach to combine urban infrastructure development with capacity building to improve waste and water governance and management, improve urban sanitation and increase the city attractiveness.

615. In COVID-19 context, measures to minimize health risks during gathering meetings with community, including FGD, and HH survey, were applied in two ways:

(i) In communities with no presence of COVID-19 detected, face to face meeting could be organized but with respect to the following rules:
    a. prevention methods should be applied, such as, wearing masks, washing hands, and respecting social distances of at least 1.5m between each participant.
    b. the number of participants shall not exceed more than 50 persons.
    c. The meeting must take place in open spaces, without air conditioning.

(ii) In communities where the presence of COVID-19 has been detected, only the online method should be used for both FGD and the HH survey.

3. Roles of stakeholders in planning, design, and implementation

616. ADB is committed to put meaningful consultation processes into practice. Meaningful consultation is a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

617. ADB requires borrowers/clients to engage with communities, groups, or people affected by proposed projects, and with civil society through information disclosure, consultation, and informed participation in a commensurate manner about the risks and impacts on affected communities. Enhancing stakeholder participation has also been shown

to build understanding and support among diverse groups, which can improve project design and impacts.

618. Consistent with these efforts, the objectives of the consultation, participation plan, and related stakeholder communication strategy are to: (i) fully disclose information on the proposed project, its components, and its activities with the beneficiary communities and stakeholders, (ii) obtain information about the opinions, needs and priorities of beneficiary communities and stakeholders; social input and feedbacks e.g. on the quality and affordability of services, (iii) encourage the participation of beneficiary communities and stakeholders in project activities such as the payment for connection or services, changes in waste management practices, change in the extend and quality of services delivered, participation to O&M, awareness raising activities, capacity building, enforcement of local regulations and monitoring; (iv) obtain the cooperation of beneficiary communities and stakeholders for activities required to be undertaken as part of project planning and operation, (v) establish clear monitoring and effective grievance redress mechanism; and (vi) ensure transparency in all project activities.

4. Stakeholder consultation plan

619. The public consultation plan is described in the Environmental Management Plan. In general, regular information exchange meetings with stakeholders are recommended throughout the implementation of the subprojects.

620. More specifically, stakeholders who may be affected by a subproject, or concerned about its environmental impacts, are entitled to lodge complaints regarding any aspect of the subproject, from its preparation to its implementation. In this regard, the grievance redress mechanism (see page 123) aims to resolve complaints promptly and locally, through a conciliation process; and, as a last resort, to provide clear and transparent procedures for appeal.

621. Household connections are vital to the operation of the proposed wastewater management strategy, and therefore to achieve environmentally beneficial outcomes. To encourage households to connect to the sewerage system, the cost of connection will be subsidized by the project.

5. Next public consultations

622. An additional public consultation campaign should be organized prior to DED phase completion in order to accommodate any project changes and schedule adjustments. Any future consultations will be required to follow national guidance from the Ministry of Health regarding COVID-19 protection for all participants.

VIII. INFORMATION DISCLOSURE

623. All stakeholders will be provided with information on the subproject component, comprising: (i) description of project components; (ii) site locations; (iii) proposed construction measures; (iv) environmental impact assessment procedures; (v) avenues for public feedback; (vi) contact details of the executing and implementing agencies; and (vii) procedures and scope of the EIS. This IEE and corresponding EMP as well as the updated versions at detailed engineering design stage, and Semi-Annual Environmental Monitoring reports for the Project will be submitted to ADB and disclosed on their website when the documents are cleared.

624. The domestic disclosure will be conducted by the posting of information on government websites and on public notice boards in the city halls, and by distributing information booklets.

625. Once more advanced preparations of the project designs are undertaken, a second round of information will be conducted to seek public feedback on the findings, including potential impacts, mitigation measures, and consultations with communities and businesses in and near project sites.

IX. GRIEVANCE REDRESS MECHANISM

626. The grievance redress mechanism (GRM) is described in more detail in the chapter X.9.Grievance Redress Mechanism. A summary is provided below.

627. A GRM is developed in compliance with ADB's SPS (2009) requirement to address environmental, health, safety, and social concerns associated with project construction and operation. The GRM is designed to achieve the following objectives: (i) provide channels of communication for local communities to raise concerns about environment- and social-related grievances which might result from the project; (ii) prevent and mitigate adverse environmental and social impacts to communities caused by project construction and operation; (iii) improve mutual trust and respect and promote productive relationships between the project agencies and local communities; and (iv) build community acceptance of the project. The GRM is accessible to all members of the community, including women, youth, remote farmers and communities and poverty-stricken residents. Multiple points of entry are available, including face-to-face meetings, written complaints, telephone conversations, e-mail, and social media.

628. Public grievances to be addressed by the GRM are most likely to involve disturbance from construction dust, noise, traffic, soil erosion, interruption of public services, inappropriate disposal of construction materials, and safety for the general public and construction workers. It could also concern odors (landfill, WWTP, collection points) and waste dispersions by the wind during the operational phase.

629. Currently in Cambodia, there is no legally established system to resolve environmental grievances and complaints. The MPWT as the EA of the LCIP, establishes the GRM before the start of the construction phase and counts members from the PMU, the district authority, and the commune government within its ranks (here, commune councils). The PMU's Environment Officer (PMU-EO), as the focal point, will supervise the mechanism's implementation with technical support from the PMU's environmental safeguard consultants and will be responsible for updating the PMU. The Project Implementing Unit's environmental officer (PIU-EO) will be accountable for guaranteeing the implementation of the GRM at the subproject level, in collaboration with the PIU Social Officer (PIU-SO).

630. The PMU is assigned the role of ensuring the awareness of the public and stakeholders of their rights to access the GRM without administrative or legal charges. The existence of the GRM will be fully disseminated before construction works begin, through an effective public information campaign (public consultations, posters, distribution of information booklets), in an effort to inform the stakeholders concerning their rights and the procedures for filing grievances and understanding the GRM access points available to them.

X. ENVIRONMENTAL MANAGEMENT PLAN

1. Overview

631. The Environmental Management Plan (EMP) presents the mitigation and enhancement principles, practices, and technologies aimed at minimizing and/or eliminating the potential impacts of the project to its surrounding environment. The EMP is a dynamic document that may be updated any time during project implementation if it is found inadequate. Corrective actions or additional mitigation measures may be included.

2. Objective and Scope

632. This EMP is for the Bavet subprojects of the Livable Cities Investment Project - LCIP (hereafter referred to as the project). The EMP is to be implemented in all phases of each subproject – design, pre-construction, construction, and operation. The EMP is to ensure project compliance with Cambodia's environmental laws and the Safeguard Policy Statement (SPS, 2009) of the Asian Development Bank (ADB).

633. During the preparation of the detailed engineering design (DED), the PIU, acting on behalf of the EA and PIA, will pass this EMP to the engineering design team for the incorporation of the mitigation measures into the detailed designs.

634. The EMP will be updated at DED stage to be aligned to the updated design and any MoE requirements and conditions in the domestic environmental assessment shall be incorporated into the respective IEEs and corresponding EMPs, ideally before bidding, and latest before works commence.

635. The updated DED stage EMP will be as part of the bidding documents. This updated bidding-ready version of the EMP (and updated IEE) shall be shared with ADB for clearance and disclosure on the ADB website.

636. To ensure that bidders will respond to the EMP's provisions, the PIU will prepare and provide the following specification clauses for incorporation into the bidding documents:

(i) a list of environmental management requirements to be budgeted by the bidders in their proposals;
(ii) environmental clauses for contractual terms and conditions; and
(iii) the updated EMP, for compliance.

637. If any variation orders take place under project implementation it shall be assessed by ADB if the environmental due diligence will need to be further update and re-disclosed.

3. Structure of the EMP

638. The EMP describes the roles and responsibilities of relevant institutions for EMP implementation; potential impacts and the measures to mitigate them; environmental monitoring and inspection; institutional strengthening and training; inspection, monitoring, reporting arrangements, and EMP's implementation costs; grievance redress mechanism (GRM); and future public consultation.

4. Implementation Arrangements

4.1. Roles and Responsibilities

639. The institutional management framework supervising EMP consists of:

a) The MPWT, as the EA of all subprojects;

b) A PMU, created within the EA, whose role is to supervise the implementation of all subprojects. A Social and Environmental Monitoring Unit (ESMU) already exists in the MPWT and activities of the officers should be coordinated with this unit during implementation. The PMU will be held accountable for the implementation and operation of the subproject on behalf of the EA and will work as a national subproject agency;
c) The PDPWT as the chairman of the PIA of all subprojects in each province; and
d) A PIU who will assist the PMU and coordinate the day-to-day implementation of the subprojects.

640. **PMU**: An environment officer (PMU-EO) and a social/resettlement officer (PMU-SO) will be assigned at the PMU.

641. **PIU**: An externally recruited Environmental officer (PIU-EO) and a Social/resettlement officer (PIU-SO) will be assigned at the PIU. The PIU will ensure adequate working relations with local actors engaged by the PMU e.g. contractors, suppliers and service providers.

642. **Design and Construction Supervision Consultant**: Advisory services will be provided to the PMU and PIU by the Design and Construction Supervision Consultant (DCSC). The DCSC will engage one suitably qualified national environmental safeguards consultant and one international environmental safeguards consultant.

643. Project management services will be provided under the DCSC contract, concerning project management, financial and procurement methods, monitoring and evaluation procedures, and operation and maintenance works. The EMP and IEE updates required for the Project will be implemented by the PMU with support of the DCSC Environmental Safeguards specialists.

Table 37: Institutional responsibilities for EMP implementation

Institution	Prior to Construction including Detailed Engineering Design	During Construction	During Operation and Decommissioning
Executing Agency	MPWT is responsible for ensuring the implementation of the mitigation measures in the EMP and in ensuring compliance with loan covenants Collaborate with the MoE for the subprojects' compliance with the Government's environmental safeguard requirements on IEIA and EMP implementation Coordinate with implementing agencies, other stakeholders, and ADB the efficient project implementation activities, including the EMP Chairs the project steering committee Co-signs approval for withdrawal applications from project advance account (with Ministry of Finance) Accountability and responsibility for project planning, management, and implementation Timely and effective execution of loan agreement		
Implementing Agency	The Provincial Department of MPWT oversees implementation in conformity with the Project's development objectives and scope; Assist the coordination among government agencies involved in subprojects' implementation, including PDOE; Ensure coordinated and efficient project implementation activities including EMP.		
PMU	Hold overall accountability of the subproject implementation and operation on behalf of the EA and work as national subproject agency Review any new proposals involving projects and/or safeguards Facilitate timely allocation and disbursement of required counterpart financing and/or internal government budget ceilings, to enable the project to achieve		

Institution	Prior to Construction including Detailed Engineering Design	During Construction	During Operation and Decommissioning
	annual disbursement targets Ensure sufficient domestic financial and technical resources are allocated for the project EMP Review and formally approve (in writing) the submitted CEMPs Procure and manage DCSC (including PMC) for subproject implementation		
	Update IEE and EMP Coordinate with DCSC to ensure the incorporation of updated findings & mitigation measures in the design & bidding documents Ensure EMP is part of the bidding documents, EMP clauses are incorporated in bidding documents, contracts Ensure MoE approval of IEIA Report has been secured prior to awarding of civil works Conduct affect people consultation Establish and disseminate GRM	Formally approve CEMP Conduct inspections and spot checks to monitor the performance of the contractor in implementing the CEMP/EMP Prepare the Project's semi-annual EMR for submission to ADB EMP implementation site visits Implement the GRM for environmental Issues Conduct appropriate consultation and monitoring of effect of construction on effect people Participate in training	Review relevant operator monitoring report Prepare the Project's semi-annual EMR for submission to ADB, until loan closure or as agreed Ensure all GRM complaints are closed out to affected person's satisfaction
PIU-EO	Represents the executing and implementing agencies for implementation – planning, coordination, guidance, procurement, supervision, monitoring, reporting Central office (at MPWT in Phnom Penh) and field offices in Bavet Supervise and manage EMP implementation Manage and monitor contractors and suppliers Coordinate with PMU on progress and monitoring		
	Submit bidding documents, bid evaluation reports and other documents to ADB for necessary approval Coordinate and collaborate with relevant provincial agencies, as necessary Support PMU-EO Conduct affected people consultation Establish health and safety baseline conditions in affected villages Establish GRM for environmental Issues Conduct trainings in	Collate monthly EMR of contractor, and submit to the PMU Oversee the conduct of the environmental effects monitoring to be managed by the contractor and testing to be conducted by MoE Laboratory Implement the GRM for environmental issue Conduct consultation and monitoring of construction impacts on people Conduct training in collaboration with DCSC Verify EMP	Support reporting requirements of PMU Ensure all GRM complaints are closed out to affect person's satisfaction

Institution	Prior to Construction including Detailed Engineering Design	During Construction	During Operation and Decommissioning
	collaboration with DCSC	implementation and report on it	
ADB	Clear and disclose updated IEE/EMP, review bidding documents, confirm readiness of subproject Undertake periodic loan review missions to check EMP compliance	Undertake loan review missions to check EMP compliance Clear and disclose semi-annual EMR	
Contractor	Prepare a CEMP that addresses as minimum the requirements of the EMP Engage EHS specialist for construction site(s)	Implement mitigation measures & conduct internal EMP implementation monitoring Conduct environmental quality monitoring of the EMP. (If an independent licensed laboratory will not be engaged) Prepare Monthly and semi-annual EMRs	
Operator	Ensure budget for O&M to ensure design standard of operation		Implement mitigation measures & conduct internal EMP implementation monitoring Prepare Monthly and Annual EMRs
MoE / PDOE	Review, comment on approve EIA/IEIA Report.	Monitor compliance with approved EIA/IEIA & EMP	Monitor compliance with environmental standards
Municipality	Facilitate obtaining the necessary inputs from and/or participation/ cooperation of, concerned communes and villages through collaboration with their Commune Councils Facilitate (& participate in) GRM dissemination and implementation	Participate in monitoring of the performance of contractor with the CEMP implementation Facilitate & participate in GRM dissemination and implementation	
Commune Councils	Facilitate and participate in GRM dissemination and implementation	Participate in monitoring of the performance of contractor in EMP implementation Facilitate and participate in GRM dissemination and implementation	

ADB = Asian Development Bank, CEMP = Construction Environmental Management Plan, RM = grievance redress mechanism, MPWT = Ministry of Public Works and Transport, PIU = project implementation unit, EIA: Environmental Impact Assessment; IEIA: Initial Environmental Impact Assessment.
Sources: Egis, 2021.

4.2. Training and Awareness

644. MPWT, local administrations and provincial government have some experience with ADB-funded projects, through the implementation of GMS-1. However, none of these agencies have experience of a multiple subproject loan and associated safeguard management. To ensure effective implementation of the EMP, a capacity building program will be implemented on the EMP, including the mitigation measures, monitoring, and reporting.

645. Training will be conducted by PIU-EO, with facilitation and support from the DCSC. Trainees will include MPWT, the IAs, contractors, and local environment, water, and forestry officials. The training shall include, but not be limited to: (i) ADB Safeguards and EMP implementation (ii) EMP monitoring and reporting (iii) establishment and implementation of the GRM (iv) waste management (v) occupational health and safety measures during work and emergency preparedness in case of incidents, (vi) Consultation during implementation. Also, operational training is aimed at specific infrastructure operators.

Table 38: Project Environment Training Program

Training program	Scope of Training	Trainer	Trainee	Days	Persons
ADB Safeguards and SPS 2009	ADB requirements Project Cycle Role of Safeguards CEMP Development	PIU-EO/DCSC	PIU, MPWT/PMU	1	10
EMP Implementation, Monitoring and Reporting (Project Requirements including Consultation)	Roles, responsibilities, monitoring, inspection, reporting in EMP Environment monitoring program including Consultations Mitigation measures Public consultation and participation GRM implementation, coordination, reporting, working with the public Environment, health and safety during project construction and operation for workers and the community Prevention and control of transmissible diseases, COVID and HIV/AIDS	PIU-EO and PIU-SO and DCSC	PIU, MPWT/PMU local and provincial administration officers, Contractor	2	25
GRM Procedures	Establishing and implementing GRM GRM recording and process for resolution Affected People follow up	PIU-EO and PIU-SO and DCSC	PIU, MPWT/PMU local and provincial administration GRM Access Points	1	10
Occupational Health and Safety	EMP requirements Response and planning for incident management	PIU-EO and PIU-SO and DCSC	PMU, MPWT, Contractor	1	10
Solid waste management	Organizational arrangements and responsibilities SWM principles and hierarchy Waste streams, types and sources	PIU-EO and DCSC	PIU, local and provincial administration officers,	3	25

Training program	Scope of Training	Trainer	Trainee	Days	Persons
	SWM facilities Management procedures (collection, recovery, recycling and disposal) and support documents Hazardous waste management Health and waste management		operator staff and informal waste collectors		
Sanitation management	Wastewater (WW) collection management WWTP management (WW disposal registering procedure, interrelations with truck drivers, treatment process and maintenance, output sludge transportation towards landfill)	PIU-EO and DCSC	PIU, local and provincial administration officers, operators and WW truck drivers	2	20
Stormwater management	Organizational arrangements and responsibilities Stormwater Management	PIU-EO and DCSC	PIU, local and provincial administration officers	2	15

LASI = local agency for specialized inspection.
Source: Egis, 2021

4.3. Budget

Table 39: Estimated Costs for trainings of the Project Environment Management Plan

Parameter	Estimated Cost ($)
TRAINING	
Training Delivery	16,800
Travel costs	2,000.00
Equipment (room rental, printing, …)	3,000.00
TOTAL	**21,800.00**

Source: Egis, 2021

5. Documentation and Record Keeping

5.1. Record Keeping

646. The contractor shall appoint a qualified Environmental Health and Safety (EHS) staff member to be responsible for environmental management and monitoring plans (EMMP) implementation and reporting.

647. The EMMP should be either in electronic or paper form and has to be controlled to ensure that current versions are approved before distributed and obsolete versions are removed from the system. The changes to versions are identified, that the current versions are available at points of use, that they are legible, identifiable, and that obsolete ones are so noted to avoid unintended use.

648. Records, which are produced to evaluate the EMMP compliance and performance, are expected to exist and be maintained; records should be identifiable, retrievable, safely stored, and legible, retained as appropriate, and traceable. The EMMP applies from the handover date to the end of the first year of the operational phase for each project, and will be reviewed and adapted as often as needed in between. But, as the construction phase will not start before 2022, the EMMP will have to progressively be implemented during the consolidation phase in order to establish and put into action all the necessary organization

and documentation. It should be plainly effective at the going-live phase or the beginning of the construction works, whichever is the sooner.

5.2. Reporting

649. All reporting requirements are listed in the following table:

Table 40: Reporting Requirements

No.	Report	Frequency	Purpose	From	To
1	Monthly Construction Progress Report	Monthly	Ensure the effective implementation of the EMMPs Progress against performance indicators	Contractor	PMU / PIU / DCSC (+ Municipality and Commune Councils)
2	EMP Verification and consultation report	Monthly	Checking EMP measures and impacts on stakeholders	PIU /DCSC	PMU
3	Environmental Monitoring Reports (EMR)	Semi-annual	Monitoring all EMP measures and performance	PMU/PIUs	MPWT (EA) and ADB
4	Contractors' Environmental Management Plans (CEMP)	One time, Preparatory phase of the works	Addresses the EMP implementation and monitoring requirements	Contractor	PMU / DCSC
5	Operator EMRs	Determined by Permit / MoE	EMP implementation monitoring	Operator	MoE as required
6	Bidding documents, Bid Evaluation Reports	Bidding Phase	Support in bidding phase	PIU	ADB

Source: Egis, 2021

5.3. Review

650. In addition to reporting, a review process will include wider stakeholders as follows:

Table 41: Review Process

Institution	Prior to Construction including Detailed Engineering Design	During Construction
MoE / PDOE	Review, comment on approve IEIA Report	Review and Monitor compliance with approved IEIA & EMP & Environmental Standards
Municipality		Participate in monitoring of the performance of contractor with the CEMP implementation Review EMRs & results of environmental effects monitoring
Commune Councils	-	Review EMRs and results of environmental effects monitoring Participate in monitoring of the performance of contractor in

Institution	Prior to Construction including Detailed Engineering Design	During Construction
		EMP implementation

Source: Egis, 2021

6. Management of Change

651. Based on the established project environmental monitoring and reporting systems, the EA, IAs, and PIU shall assess whether further mitigation measures are required as corrective actions, and/or whether improvement in environmental management practices are required, and health and safety risks are controlled throughout the entire project cycle.

652. The effectiveness of mitigation measures and monitoring plans will be evaluated by a feedback reporting system. The PIU will play a critical role in the feedback and adjustment mechanism. If the PIU identifies a substantial deviation from the EMP, or if any changes are made to the scope of the subprojects that may cause significant adverse environmental impacts or increase the number of affected people, then the PIU shall immediately consult MPWT and ADB for feedback and/or approval to update the EMP. If necessary, further public consultations will be undertaken.

7. Consultation and Participation

653. Public consultations were conducted during project preparation and will continue throughout the project implementation. The public consultations will raise awareness of project activities, especially those which may impact the public such as noise, air and water quality, as well as access. A public consultation plan is in the following table. This includes public participation in evaluating environmental benefits and impacts. The PIU-EO and PIU-SO are responsible for facilitating the public consultations, with support from all project agencies.

Table 42: Public Consultation and Participation Plan for Environment Safeguards

Organizer	Approach	Times/Frequency	Subjects	Participants
Construction				
PIU	Questionnaire survey, site visits, and/or informal interviews	At least monthly during peak construction	Construction impacts; adjusting mitigation measures if necessary; feedback	Workers, residents in construction areas
	Public workshops	At least twice per year during peak construction	EMP implementation progress; construction impacts; adjusting mitigation measures if necessary; feedback	Residents, affected persons, social sectors
Operation				
PIU, operators of project facilities	Public consultation and site visits	At least once in first year of operation	Effects of mitigation measures, impacts of operation, feedback	Residents, affected persons adjacent to project facilities
	Public workshop	As needed based on public consultation	Effects of mitigation measures, impacts of operation, feedback	Residents, affected persons, social sectors
	Public satisfaction survey	At least once after one year of operation	Comments and suggestions	Project beneficiaries

EMP = environment management plan, PIU = project implementing unit.
Source: Egis, 2021.

8. Information Disclosure

654. Information disclosure and public consultation will continue throughout project implementation. Further information disclosure will be as follows.

(i) Copies of the domestic environmental impact assessments in Cambodian language, completed for all the subprojects in Bavet, are available on request at: MPWT in Phnom Penh; the Province's office and the Bavet's Municipality offices.
(ii) This IEE and corresponding EMP are disclosed on the ADB public website on behalf of the borrower and at detailed engineering design stage (DED) updated versions to reflect DED and any further changes will be disclosed.

655. The project environment monitoring reports will be prepared on a semi-annual basis and disclosed on the ADB public website.

656. Future public consultations will be facilitated by the PIU environment and social officers and will involve the Bavet's municipal administration, provincial government, and work contractors. All agencies will work together with the PIU to provide timely communications and consultations with stakeholders. Prior to works, the PIU will lead disclosure and consultation with local communities, and other relevant stakeholders, on the scope and planned dates for works, potential issues (e.g. noise, dust, temporary traffic and residential/economic activities access disturbance), and the planned mitigation measures. This will include, but not be limited to, public notices and meetings. Information on the GRM will be highlighted through these approaches. During construction, the PIU (with representatives from the MA) will conduct frequent consultations to identify any public concerns and respond to them promptly. These approaches will be continued for at least one year after the completion works (i.e. up to a maximum of one year after completion of the overall project) by the MA to identify any concerns with the completed works.

9. Grievance Redress Mechanism

9.1. Objective of the Grievance Redress Mechanism

657. A grievance redress mechanism (GRM), consistent with the requirements of the ADB Safeguard Policy Statement (2009) will be established to prevent and address community concerns, reduce risks, and assist the project to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the GRM has been designed to help achieve the following objectives: (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project; (ii) demonstrate concerns about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations. The GRM is accessible to all members of the community.

658. This project GRM is separated from the GRM system managed by the General Department of Resettlement (for resettlement issue only) and described in the Land Acquisition and Involuntary Resettlement - Standard Operating Procedures for Externally Financed Projects in Cambodia (RGC, 2018).

9.2. Proposed GRM System

659. In Cambodia, there is currently no existing legally established system to resolve environmental concerns and complaints. The MPWT, as the EA of the LCIP, establishes the GRM before commencement of site works and have members from the PMU, the district authority, and the commune councils. Grievances can be filed in writing or verbally with any

entry point of the GRM. PMU-EO will oversee the implementation of the mechanism with technical support from the PMU engaged Project Management Consultants as needed and will be responsible for keeping the PMU informed. The PIU-EO, in collaboration with the PIU-SO will be responsible for ensuring GRM implementation at the subproject level and report on the observance/implementation of the GRM in the monthly progress reports and in the periodic Environmental Monitoring Report that will be submitted to the PMU. Examples of a GRM register and GRM complaint form can be found in appendix 7 and 8.

660. The GRM will accommodate both informally and formally lodged eligible, grievances. The GRM aims to solve any complaints/disputes prior to using the Cambodian judicial system but shall not impede access to it. Access to the Cambodian judicial system and the GRM may be simultaneous. However, all cost associated to the project GRM are borne by the PMU.

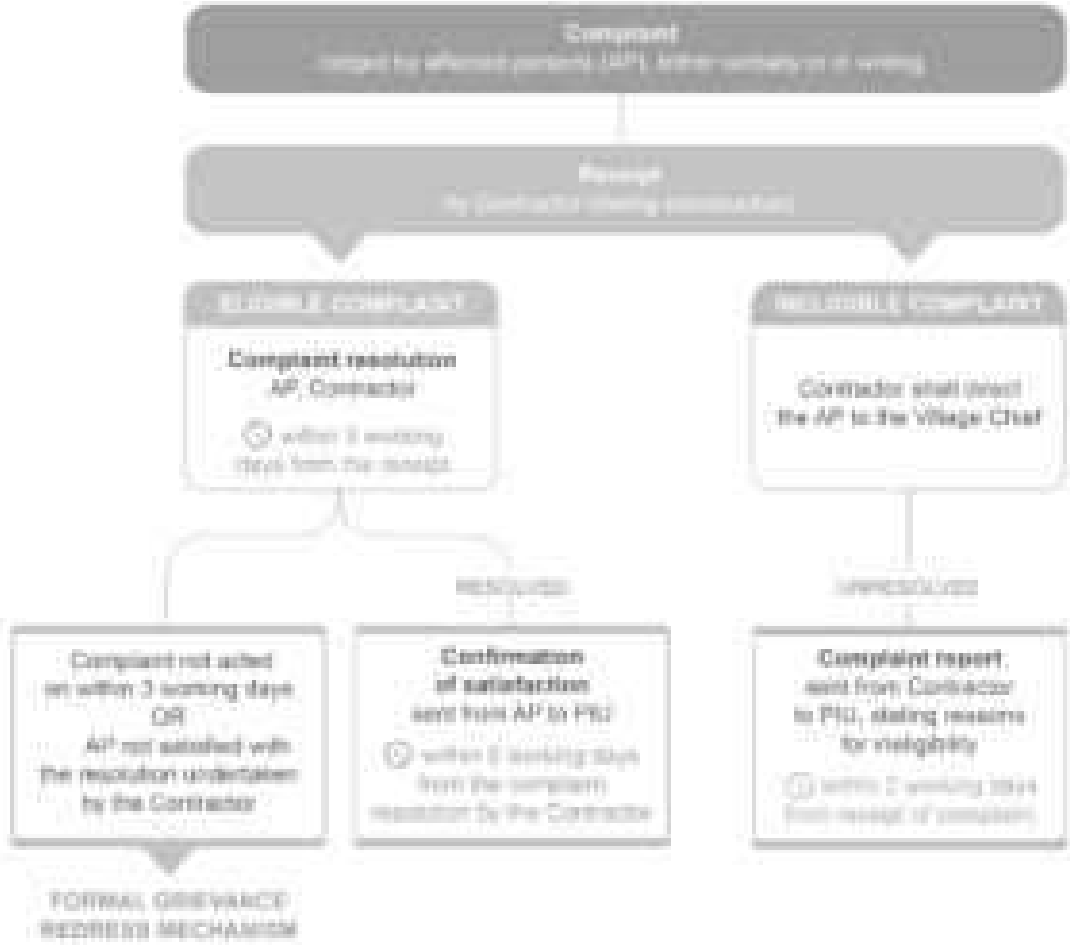
9.3. Access to the Mechanism

661. Grievances raised on environmental impacts are critical to the health and safety of Affected Persons (AP). Hence, the proposed mechanism intends to be easily accessible, free of charge, and promptly responsive to APs' complaints.

662. A grievance redress and resolution mechanism has been established to resolve grievances and complaints in all subprojects of GMS-1, and it can also be replicated for LCIP. The PMU, through its PMU-EO or PIU-EO will ensure that the public and all stakeholders are aware of their rights to access, and will have access to the GRM free of administrative and legal charges. The GRM is fully disclosed prior to construction during public consultations and through posters displayed in the commune office (posters to include names and contact details of the PIU).

663. **Informal process.** Informally, APs can lodge complaints directly to the contractor during construction. PMU to provide contractor with GRM contact details which the contractor will use to print 'GRM Contact Cards' for its staff to hand to complainants and will keep cards with all vehicles, machinery and site managers/foremen.

Figure 36: GRM - informal process



Source: Egis, 2021

664. The contractor shall raise awareness of all workers on how to respond when an AP or member of the public has a complaint i.e. direct the person to the most senior site manager present at the time and/or Contractor GRM focal point and prepare a 'GRM Contact Card.'

665. The contractor shall document and assess the complaint immediately, in consultation with the PIU-EO. If assessment validates the complaint as within the scope of the GRM/eligible, the contractor shall act on the complaint within three days from receipt of complaint. PIU shall obtain a written confirmation of satisfaction from the AP after 5 working days from completion of resolution by the contractor.

666. If assessment invalidates the complaint (i.e., reveals the complaint as ineligible or not associated with the project's environmental performance), the contractor shall direct the AP to the Village chief and shall report the complaint to PIU within 2 working days from receipt of complaint, stating reasons for ineligibility.

667. **Formal process.** If complaint is eligible but is not acted on within three days from receipt of complaint, or if AP is not satisfied with the resolution undertaken by the contractor, he/she can access the formal mechanism. The grievance redress process includes four steps before complaints may be elevated to the ADB as a last resort, as follows:

(i) **First step (Village/Sangkat level):** 5 working days - Complaints and grievances are reported verbally or submitted in writing to the Village chief or Sangkat chief or to contractor. The receiving agent will provide immediate written confirmation of the receipt of the complaint. If after 5 days the complainant does not hear from the contractor, Village or Sangkat chief or if the complainant is not satisfied with the decision taken in the first step, the complaint may be brought to the Municipal Office or Project Implementation Unit (PIU).

(ii) **Second step (Municipal level):** 10 working days - The Municipal Office or the PIU have 10 days within which to resolve the complaint to the satisfaction of all concerned. If the complaint cannot be solved at this stage, the Municipal Office or the PIU will bring the case to the Provincial Administration (PA) - Provincial Grievance Redress Committee (PGRC) or to the Project Management Unit (PMU) which will then inform the complainant.

(iii) **Third step (Provincial level):** 10 working days - The PGRC or the PMU have 10 days within which to resolve the complaint to the satisfaction of all concerned. If the complaint cannot be solved at this stage, the PGRC or the PMU will bring the case to the national level (line-ministries concerned by the issue), which will then inform the complainant.

(iv) **Fourth step (National level):** 20 working days - The representative of the concerned line Ministry or the Project Management Unit (PMU) meets with the aggrieved party to resolve the complaint/issue. Within 20 days of the submission of the grievance, the Committee or the PMU will make a written decision and submit a copy to the ADB. If the complaint cannot be solved at this stage, the MEF or EA or the PMU will bring the case to ADB.

(v) **Fifth step (ADB):** ADB has developed an Accountability Mechanism[59] to address the grievances of people adversely affected by ADB-assisted projects and ensure compliance with ADB operational policies and procedures. The mechanism is described on the ADB website.

[59] https://www.adb.org/who-we-are/accountability-mechanism/main.

Figure 37: Grievance Redress Mechanism Chart

Source: Egis, 2021

10. Environmental Management Plan

668. The following tables summarize the potential impacts of the subprojects during project preparation, design, construction and operation, and the mitigation measures. They include: (i) anticipated significant adverse environmental impacts and risks; (ii) mitigation measure with technical details, including the type of impact to which it relates and the conditions under which it is required; (iii) links to any other mitigation plans required for the project; and (iv) roles and responsibilities for implementing the mitigation measure.

669. These EMP requirements will be incorporated into bidding documents, construction contracts and operational management manuals, during detailed design and contractors during construction, under the supervision of the PIU and DCSC. The effectiveness of the measures will be evaluated based on environmental inspections and monitoring to determine whether they should be continued, improved or adjusted.

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Table 43: Environmental Management Plan for Solid Waste Subproject

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
Design and Pre-construction				
Land and geology	Creation of a new landfill site	Extension of the existing site.	Operator	PMU, PIU, IA
Land and geology	The collection points and the landfill project components take land from adjacent agricultural parcels	The property owners impacted by the construction will receive an economical compensation and/or will be assisted for the resettlement.	PIU	PMU, IA, Municipality, Commune council
Ecology and biodiversity	Project area located on a sub-natural zone (ancient agricultural area), 5,600 trees within 2ha were cutting in proposed landfill site	Clearing of vegetation, scouring, stripping, earthworks and the leveling of work areas is limited to strictly as necessary. Plantation of comparable area of removed trees in public property within Bavet; Plantation of local tree species into the remaining part of the community forest which are degraded, public park/garden, and along the municipality roads. The compensation cost (trees plantation and 2-years maintenance) is included in EMP Implementation Budget.	Contractor	PIU, PDAFF and Community Forest
Water resources	Decrease of water quality, which is used by households and agricultural activities	Impermeable disposal cells, process waters are treated.	Designer	PMU, PIU, IA
Air quality	GHG emissions	Good composting practice reduces methane emissions GHG emissions from solid waste disposal operations will be controlled and managed. The landfill gas will be collected and routed to a flare stack.	Designer	PMU, PIU, IA
Noise and vibration	Noise emissions which should cause neighboring disturbance	Project designs defined to mitigate noise emissions as far as possible.	Operator	PMU, PIU, IA
Materials and waste	Common practice of waste disposal into water bodies and other natural habitats	High recovery rate of waste collection.	Operator	PMU, PIU, IA
Materials and waste	Use of materials and waste production	Design and daily processes have been defined to limit material needs and waste production.	Designer	PMU, PIU, IA

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
Archeology and cultural heritage	No significant impact	-	-	-
Occupational health and safety	Stop the informal waste-pickers activity of the existing dumpsite	Training and official employment of waste-pickers on the projected solid waste platform (e.g. pre-sorting plant, drivers).	Operator	PIU, Municipality, Commune council
Socio-economic and community health and safety	-	Compost will be reused in agriculture.	Operator	IA
Construction				
Land and geology	Excavation of borrow pits and quarries may be a threat to the environment when left in poor condition, loss of ecosystem services or arable land	No new natural material extraction site will be created for this project; Manufactured materials and products will also be prepared in Bavet and transported, given the relatively short distance; Spoils will be utilized for the road works.	Contractor	PIU, PMU
Land and geology	Spoils require a removal and disposal in a predetermined and approved location	Spoil disposal sites will be located far from water bodies, so that spoils will not interfere with the flow of the surface water runoff to side drains and do not block the side drains themselves.	Contractor	PIU
Land and geology	Soil contamination: (i) improper transport, storage, handling and/or disposal of solid wastes, septic wastes, hazardous wastes and hazardous substances, such as petroleum products from equipment operation and maintenance, lubricants, paints, chemicals, curing compounds, asphalt products, and (ii) accidental spills or leaks of hazardous wastes and substances	Stabilization of exposed surfaces and spoil piles with ditches and/or sheeting; Minimize the duration that surfaces are exposed for; Timing works for dry seasons, when rains are minimal and the ground is firm (to minimize infiltration of any contaminants); Management of site stockpiles and storage sites for fuels and machinery; Store petroleum products, hazardous materials and wastes on impermeable surfaces in secured and covered areas; Remove all construction wastes from the work sites to approved waste disposal sites;	Contractor	PIU, PMU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		Establish emergency preparedness and response actions; Provide spill cleanup measures and equipment at each construction site; Train contractors and crews in emergency spill response procedures.		
Ecology and biodiversity	Potential disturbance of fauna and collision	Temporary fences around WWTP boundary; Restriction on any construction activity and project vehicle activity between 6:00pm and 6:00am to minimize the risk of collisions with fauna at night.	Contractor	PIU
Water resources	Construction works will require water for the mixing of materials, wash-down of equipment, and drinking water for workers.	Pumping will occur at irrigation channels, only at sites with existing road and jetty access; No works or machine wash-down will be conducted at the pumping site; Contractors should ensure that the use of irrigation water or any water bodies complies with the EMP domestic environmental assessment and permit is obtained as needed.	Contractor	PIU, Municipality, Commune council
Water resources	Surface water bodies could be potentially affected by construction wastewater (from washing aggregates, pouring and curing concrete, cleaning of construction machineries and vehicles, and human wastes)	Timing of construction to avoid peak rainfall during the rainy season (from May to October) and to limit runoff from work sites; Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next; and, minimize open excavation areas; Construct intercepting channels and drains to prevent runoff entering construction sites and to divert runoff from sites to existing drainage or open ground; Contractors will develop actions for control of oil and other dangerous substances as part of their site Contractor-EMPs; All sites for washing of construction equipment will be equipped with water collection basins and sediment traps; Fuel storage, machinery maintenance workshop and vehicle cleaning areas will be stationed at least 100m from	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		the natural water bodies and 20m from channels; Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces and provided with bunds and cleanup installations; Contractors' fuel suppliers must be properly licensed and will follow established protocol for transferring fuel; Portable toilets and on-site wastewater pre-treatment systems will be installed at construction camps along with proper maintenance protocols.		
Air quality	Dust emissions, air pollution from aggregate preparation and concrete-mixing, air pollution from vehicle and machinery emissions	Spraying water on exposed construction site where fugitive dust is being generated; Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion; Storing petroleum or other harmful materials in appropriate places and covering to minimize fugitive dust and emission; Covering materials during truck transportation, in particular, fine material, to avoid spillage or dust generation; Regulation by speed limits of access roads to the construction site; Maintenance of project vehicles to minimize greenhouse gas emissions; Turning off equipment/ vehicle when not in use; limiting engine idling to a max. of 5 minutes; For odor: disinfection/ deodorization/ sanitizing affected latrines prior to clearing; provision of adequate sanitation facilities; and, strict enforcement of sanitation practices; prompt dispose of, organic and hazardous wastes; and, timely community consultations to ensure awareness of the risk of odors prior to landfill works; Prohibit burning of wastes; Timely monitoring of air quality and inspections during	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		construction.		
Noise and vibration	Construction noise disturbance, mainly in the urban areas	Properly maintain construction vehicles and machineries to minimize noise; Apply noise reduction devices and methods for high noise equipment operating within 150 m of the sensitive sites i.e. schools, health centers, and religious sites; Prohibit operation of high-noise machinery, and movement of heavy vehicles along urban and village roads, between 6.00 pm and 8.00 am; Place temporary hoardings or noise barriers around noise sources during construction; Monitor noise at sensitive areas at regular intervals. If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation; Conduct regular interviews with residents/villagers adjacent to construction sites to identify noise disturbance. Community feedback will be used to adjust work hours of noisy machinery.	Contractor	PIU, Municipality, Commune council
Noise and vibration	Construction works may cause neighboring vibration disturbance, mainly in the urban areas	High vibration activities, such as compaction operations, will be prohibited at night from 6.00 pm to 8.00 am; Communities will be consulted prior to large earthworks to ensure they are informed, and to avoid sensitive timing.	Contractor	PIU, Municipality, Commune council
Materials and waste	Domestic solid waste from workers and construction waste materials	Covered garbage bins will be installed at each site of works; The contractors will be responsible to transport the containers and dispose them at the existing dumpsite; Waste collection and disposal methods will follow strict procedures to ensure that only non-hazardous waste is disposed; Hazardous wastes (discarded fuel, oil, spills) will be stored in sealed drums and transported to the official landfill site in accordance with national regulations;	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		Waste burning will be forbidden.		
Archeology and cultural heritage	No significant impact	-	-	-
Socio-economic and community health and safety	Job creation during works	Local people employment and women employment.	Contractor	PIU, Municipality, Commune council
Community health and safety	Deliberate or accidental access to construction site works	Construction site protection will include clear signs placed at construction sites in view of the public, informing people about the project's GRM, and warning people against potential dangers such as moving vehicles, hazardous materials, and excavations, and raising awareness on safety issues; Heavy machinery will not be used at night. All sites will be secured, disabling access by the public through appropriate fencing whenever appropriate.	Contractor	PIU Municipality, Commune council
Socio-economic and community health and safety	Network works may cause temporary disruptions to vehicle access; traffic flow will be temporarily impeded and parking space in front of the residents' houses will be reduced.	Construction vehicles should use different roads or dedicated lanes and the implementation of wastewater and drainage networks will be undertaken on one side of the road at a time; Preparation and implementation of a traffic management plan, and coordination with local authorities and communities; Information disclosure: villagers, residents, public facilities (e. g. schools, health centers/hospitals) and businesses will be informed in advance through media and information boards at construction sites of the construction activities, given the dates and duration of expected disruption; Public consultations on work phasing and schedules, anticipated access blocking, provisions for temporary and safe access for blocked properties and temporary parking for blocked garages/driveways; Contractors will have to prepare as necessary an access	Contractor	PIU Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		plan which must be submitted to managers of public facilities in order to avoid any disruption of public service. Special attention will be paid to the surroundings of schools and health care buildings. This plan will be validated by the Municipality; Posting of billboards on road/lane closure, traffic rerouting plan at strategic places, at least 1 week prior to works; Posting of traffic (flag) persons during entire working hours if necessary; Spreading out the schedule for materials delivery in non-peak hours as far as possible; Efficient management of truck arrival/departure; Provision of safe access, if needed, to blocked properties, e.g., steel planks of adequate grade, width and length, and if necessary, with guide rail; A close coordination with utility companies will prevent the disruption of utility services such as water and electricity supply due to damaged lines.		
Occupational health and safety	Construction workers will be exposed to the presence of unexploded ordnances (UXO)	Sites for earthworks that are suspected to have UXO should be surveyed by the Government prior to construction. Should an ordnance be detected, clearing work will be commissioned prior to undertaking earthworks.	Government of Cambodia	PMU, PIU Municipality, Commune council
Occupational health and safety	Risk to workers from construction site activities and working in/ around high traffic areas	Appointment of an Environmental, Health and Safety Officer; Contractor compliance with environmental and occupational health and safety guidelines; CEMPs will include health and safety plans; Contractors will organize an initial Environmental, Health and Safety training for their workers, and short but regular reminder meetings will be organized (biweekly); Provision of Personal Protective Equipment (PPE) for workers; Adequate work site lighting, water supply, sanitation facilities and safe access;	Contractor	PIU, Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		Establishment of a first-response team comprising trained staff, equipment, tools, supplies, and an adequate office/clinic. The first response team will be linked to ultimate responders; Contractors will comply with local statutory requirements for use of construction equipment. Provide a clean and sufficient supply of fresh water for construction sites; Provide adequate number of latrines at construction sites and ensure that they are cleaned and maintained in a hygienic state; Garbage receptacles at construction sites will be set up, which will be periodically cleared to prevent outbreak of diseases; Provide personal protection equipment e.g. safety boots, helmets, gloves, protective clothing, goggles, ear plugs; Emergency preparedness and response plan for accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events. These plans will be submitted to the local authorities for review and approval. Emergency phone link with the health center/hospital of Bavet will be established. Each site of works will have basic first aid kits; A records management system that will store and maintain easily retrievable records against loss or damage will be established. It will include documenting and reporting of occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits; Occupational health and safety matters will be given a high degree of publicity to all work personnel and posters will be displayed prominently at construction sites; All workers will be given basic training in sanitation, general health and safety matters, and work hazards. An		

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		awareness program for HIV/AIDS and other communicable diseases will be implemented for workers and the local communities; Core labor standards will be implemented. Civil works contracts will stipulate priorities to: (i) employ local people for works; (ii) ensure equal opportunities for women and men; (iii) pay equal wages for work of equal value and pay women's wages directly to them; and (iv) not employ child or forced labor. Specific targets for employment have been included in the project gender action plan.		
Occupational health and safety	Workers as well as communities may potentially be affected by COVID-19	Conduct a COVID-19 risk assessment and to incorporate COVID-19 health risks as part of their environmental and occupational health and safety (EHS) plans, which are part of their site-specific contractor EMP (CEMP).	Contractor	PIU
Operation				
Land and geology	Soil contamination (from spills or uncontrolled discharge of untreated or treated water) can occur due to faulty pipeline or equipment of the leachate treatment and stormwater drainage systems. The soil can also be contaminated by flooding due to clogging of the drainage system or by leachate streams from the landfill or the composting plant.	All equipment and processes will be maintained in good working order, with back-up material in critical areas; Engineering and management systems will be set up to prevent and handle emergency situations; The landfill site will include a low permeability base liner to avoid infiltration of leachate in the subsoil, and the composting plant will include an impermeable concrete platform.	Operator	PDPWT/ PDOE PMU, PIU PMU, PIU
Land and geology	Soil stripping will be temporarily stockpiled on the landfill site. It will then be reused for intermediate and final cells cover	Topsoil will be separated and placed in dedicated stocks (max 2 m height); It will be reused for final cover of the landfill cells, in order to preserve the agronomic quality of the site; Soils from bulk excavation will be used to create a barrier on the site perimeter, aiming to minimize visual and dust	Operator	PMU, PIU, PDPWT/ PDOE

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		impact on the surrounding environment.		
Ecology and biodiversity	Pests/rodents/vermin, birds and stray animals are likely to be attracted by the landfill solid waste	Minimize exposed tipping areas, and prompt waste covering upon waste dumping in normal operation of the landfill.	Operator	PMU, PIU
Water resources	Surface water or groundwater contamination from surface water run-on, site water runoff, waste mass inundation, and leachate emissions.	Provision of perimeter drains and additional collector drains within the landfill area; Provision of cover materials over waste mass surfaces, coupled with the drainage of these covered areas through the contouring of surfaces and installation of surface drains; Vegetate the completed waste mass surfaces	Operator	PMU, PIU
Water resources	Leachate generated within the waste mass can migrate through the sidewalls and base and cause contamination of groundwater.	Leachate will be recirculated into the landfill mass; Residual leachate will be treated at the WWTP; Leachate quality will be tested before disposal at WWTP in order to ensure that it will not affect the WWTP effluent quality.	Operator	PMU, PIU
Water resources	Damage to the impermeable layer could result to failure in the integrity of the leachate collection system, resulting in subsurface contamination.	O&M procedures to ensure that the facilities operate as intended over the long term; Continuous monitoring of groundwater quality to detect and mitigate any subsurface spill.	Operator	PMU, PIU
Air quality	The landfill will generate gas, such as carbon dioxide, methane and nitrous oxide	Landfill gas will be routed to a flare stack.	Operator	PMU, PIU, MoE
Air quality	Vehicle gas emissions and dust emissions	Compliance with speed limits in the streets and on access road using speed bumps; Turning off equipment/vehicle when not in use; limiting engine idling to a max. of 5 minutes; Maintenance of vehicles to minimize greenhouse gas emissions.	Operator	PMU, PIU PDPWT/

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
				PDOE
Air quality	Odor nuisance may be generated during waste dumping in normal operation of the landfill, as well as accidental dumping during waste transport or temporary storage in the collection points	Adapted operating procedures.	Operator	PDPWT/ PDOE
Noise and vibration	Noise emissions which should cause neighboring disturbance	Modern and well-maintained equipment, meeting international standards, to minimize nuisance; Apply noise reduction devices and methods for equipment operating within 150 m of schools and religious sites in rural areas located in the southeast area of Bavet municipality (pumping stations in Prasab Leak, Thnal Keang); Truck traffic will be allowed to move only during daylight hours as far as possible; Conduct regular interviews with sensitive areas residents/users to identify noise disturbance. Community feedback will be used to implement new mitigation measures if deemed necessary.	Operator	PDPWT/ PDOE
Materials and waste	Wind-blown waste from the landfill may be dispersed into the surrounding environment.	Minimize exposed tipping areas; Install a 1.80m-high fence on landfill boundary; Prompt waste covering upon waste dumping in normal operation; Daily compaction of the new waste deposits.	Operator	PMU, PIU PDPWT/ PDOE
Materials and waste	Accidental waste or leachate dumping on streets or into the natural environment can occur during waste or septage transport or around collection points, causing nuisance for the surrounding	Waste encapsulation in trucks while in transit; Wash vehicles on facility exit. For collection points: Cleaning and maintenance of temporary storage areas; Waste sorting skips with retention system to avoid leachate dispersion.	Operator	PDPWT/ PDOE

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	residential or commercial areas.			
Archeology and cultural heritage	No significant impact	-	-	-
Community health and safety	Frequent movement of waste trucks will cause nuisance to villagers living along the access road to the landfill and to the collection points.	Preparation and implementation of a waste trucks circulation management plan, and coordination with local authorities and communities; Truck circulation plan shall give priority to routing trucks away from traffic dense roads; Schedule planning for waste transportation in non-peak hours as much as possible.	Operator	PMU, PIU, PDPWT/ PDOE
Occupational health and safety	Working conditions in the landfill, pre-sorting and composting plant could potentially deteriorate over time if no monitoring is carried out to ensure the workers' health and safety conditions. Additionally, new projects have to include COVID-19 measures.	The working conditions in the landfill, pre-sorting and composting plants will be reviewed regularly to maintain adequate health and safety conditions for the workers, including COVID-19 national guidance (if it does not exist, international guidance will be used); All workers will be trained with regular refresher courses.	Operator	PDPWT
Community health and safety	Public safety may be impacted by the implementation of the projects. For instance accidents may occur on the access roads.	Posted speed limits along the access roads will be enforced and the perimeter of the landfill will be fenced off; Access to facilities will be restricted to authorized employees.	Operator	PMU, PIU

Table 44: Environmental Management Plan for Wastewater Subproject

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
Design and Pre-construction				
Land and geology	WWTP located on a public parkland	Establishment of buffer zones inside each site with vegetation along the fences; Avoidance of unnecessary earth movement and removal of vegetation; Management plans and protection/conservation strategies	Operator	PMU, PIU, IA
Land and geology	Wastewater collection network and pumping stations along channels as a part of project components will subtract surface area from adjacent agricultural parcels	The property owners impacted by the construction will receive an economical compensation and/or will be assisted for the resettlement.	PIU	PMU, IA, Municipality, Commune council
Ecology and biodiversity	Removal of 69,000 trees/acacia within 20ha of a forest belonging to the MAFF/Chamkar Konkoki Community Forest, due to the proposed WWTP site requirement	Compensate by replanting 69,000 trees under national forest programme; The compensation cost (trees plantation and 2-years maintenance) is included in EMP Implementation Budget.	Local forest community / PDAFF	PMU, PIU, PDAFF, MAFF and Community Forest
Ecology and biodiversity	Vegetation destruction	Clearing of vegetation, scouring, stripping, earthworks and the leveling of work areas is limited to strictly as necessary; Pre-inspection of each tree to be removed, to ensure that no nesting fauna are present; Individual removal of each tree (rather than bulldozing) to minimize impacts to surrounding trees; Soil stabilization after tree removal, to avoid local erosion that would contaminate surface water bodies.	Contractor	PIU
Water resources	Removal of polluted waters into existing water bodies; decrease of water quality, which is used by households and agricultural activities	Design of a high-performance WWTP.	Designer	PMU, PIU, IA
Air quality	Potential reduction of air quality, and increase of odors	Design of a high-performance WWTP.	Designer	PMU, PIU, IA
Noise and vibration	Noise emissions which should cause	Project designs of the WWTP and PS defined to mitigate	Designer	PMU, PIU, IA

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	neighboring disturbance	noise emissions as far as possible.		
Materials and waste	The project should need the use of materials and generate waste	Design and daily processes have been defined to limit material needs and waste production.	Designer	PMU, PIU, IA
Archeology and cultural heritage	A shrine place and a sacred tree are close to the WWTP area (50m)	The long term project location will be adapted in order not to affect them. An effective barrier (fence) will be installed along the western WWTP boundary during construction phase, and the shrine place access will be maintained in its current configuration and upgraded during construction and operation phases.	Designer	PIU, Municipality, Commune council
Community health and safety	Removal of raw water discharges	Design of a high-performance WWTP and its associated collection network.	Designer	PMU, PIU, IA
Construction				
Land and geology	Excavation of borrow pits and quarries may be a threat to the environment when left in poor condition, loss of ecosystem services or arable land	No new natural material extraction site will be created for this project; Manufactured materials and products will also be prepared in Bavet and transported, given the relatively short distance.	Contractor	PIU, PMU
Land and geology	Spoils require a removal and disposal in a predetermined and approved location	Spoil disposal sites will be located far from water bodies, so that spoils will not interfere with the flow of the surface water runoff to side drains and do not block the side drains themselves.	Contractor	PIU
Land and geology	Soil contamination: (i) improper transport, storage, handling and/or disposal of solid wastes, septic wastes, hazardous wastes and hazardous substances, such as petroleum products from equipment operation and maintenance, lubricants, paints, chemicals, curing compounds, asphalt products, among others; and (ii) accidental spills or	Stabilization of exposed surfaces and spoil piles with ditches and/or sheeting; Minimize the duration that surfaces are exposed for; Timing works for dry seasons, when rains are minimal, and the ground is firm (to minimize infiltration of any contaminants); Management of site stockpiles and storage sites for fuels and machinery; Store petroleum products, hazardous materials and wastes on impermeable surfaces in secured and covered areas;	Contractor	PIU, PMU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	leaks of hazardous wastes and substances	Remove all construction wastes from the work sites to approved waste disposal sites; Establish emergency preparedness and response actions; Provide spill cleanup measures and equipment at each construction site; Train contractors and crews in emergency spill response procedures.		
Ecology and biodiversity	Potential disturbance of fauna and collision	Temporary fences around WWTP boundary; Restriction on any construction activity and project vehicle activity between 6:00pm and 6:00am to minimize the risk of collisions with fauna at night.	Contractor	PIU
Water resources	Construction works will require water for the mixing of materials, wash-down of equipment, and drinking water for workers.	Pumping will occur at irrigation channels, only at sites with existing road and jetty access. No works or machine wash-down will be conducted at the pumping site. Contractors should ensure that the use of irrigation water or any water bodies complies with the EMP of the approved IEIA report and permit is obtained as needed.	Contractor	PIU, Municipality, Commune council
Water resources	Surface water bodies could be potentially affected by construction wastewater (from washing aggregates, pouring and curing concrete, cleaning of construction machineries and vehicles, and human wastes)	Timing of construction to avoid peak rainfall during the rainy season (from May to October). Construction in other months imparts much lower construction risk as the ground is hard, infiltration is limited, and there will be limited runoff from work sites; Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next; and, minimize open excavation areas; Construct intercepting channels and drains to prevent runoff entering construction sites and to divert runoff from sites to existing drainage or open ground; Contractors will develop actions for control of oil and other dangerous substances as part of their site Contractor-EMPs; All sites for washing of construction equipment will be equipped with water collection basins and sediment traps; Fuel storage, machinery maintenance workshop and vehicle cleaning areas will be stationed at least 100m from the	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		natural water bodies and 20m from channels; Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces and provided with bunds and cleanup installations; Contractors' fuel suppliers must be properly licensed and will follow established protocol for transferring fuel; Portable toilets and on-site wastewater pre-treatment systems will be installed at construction camps along with proper maintenance protocols.		
Air quality	Dust emissions, air pollution from aggregate preparation and concrete-mixing, air pollution from vehicle and machinery emissions	Spraying water on exposed construction sites where fugitive dust is being generated. Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion; Storing petroleum or other harmful materials in appropriate places and covering to minimize fugitive dust and emission; Covering materials during truck transportation, in particular, fine material, to avoid spillage or dust generation; Regulation by speed limits in the streets; Regulation by speed limits of access roads to the construction sites; Maintenance of project vehicles to minimize greenhouse gas emissions; Turning off equipment/ vehicle when not in use; limiting engine idling to a max. of 5 minutes; For odor: disinfection/ deodorization/ sanitizing affected latrines prior to clearing; provision of adequate sanitation facilities; and, strict enforcement of sanitation practices; prompt dispose of, organic and hazardous wastes; and, timely community consultations to ensure awareness of the risk of odors prior to landfill works; Prohibit burning of wastes; Timely monitoring of air quality and inspections during construction. A particular attention will be paid to limiting dust production when work is carried out near sensitive receptors e.g.	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		schools, hospitals, residential areas.		
Noise and vibration	Construction works may cause neighboring noise disturbance, mainly in the urban areas	Prior to commencement of physical works: The contractor will undertake a Site Condition survey which will include a description and photograph of buildings within 20m of the works site. Properly maintain construction vehicles and machineries to minimize noise; Apply noise reduction devices and methods for high noise equipment operating within 150 m of the sensitive sites i.e. schools, health centers, and religious sites; Prohibit operation of high-noise machinery, and movement of heavy vehicles along urban and village roads, between 6.00 pm and 8.00 am (with a possible exception for market areas); Place temporary hoardings or noise barriers around noise sources during construction; Monitor noise at sensitive areas at regular intervals. If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation; Conduct regular interviews with residents/villagers adjacent to construction sites to identify noise disturbance. Community feedback will be used to adjust work hours of noisy machinery.	Contractor	PIU, Municipality, Commune council
Noise and vibration	Construction works may cause neighboring vibration disturbance, mainly in the urban areas	High vibration activities, such as compaction operations, will be prohibited at night from 6.00 pm to 8.00 am (with a possible exception for market areas); Communities will be consulted prior to large earthworks to ensure they are informed, and, to avoid sensitive timing e.g. exams at nearby schools or festivals.	Contractor	PIU, Municipality, Commune council
Materials and waste	Domestic solid waste from workers and construction waste materials	Covered garbage bins will be installed at each site of works; The contractors will be responsible to transport the containers and dispose them at the existing dumpsite; Waste collection and disposal methods will follow strict	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		procedures to ensure that only non-hazardous waste is disposed; Hazardous wastes (discarded fuel, oil, spills) will be stored in sealed drums and transported to the official landfill site in accordance with national regulations; Waste burning will be forbidden.		
Archeology and cultural heritage	No significant impact	-	-	-
Socio-economic and community health and safety context	Job creation during works	Local people employment and women employment.	Contractor	PIU, Municipality, Commune council
Socio-economic and community health and safety context	Market areas: street vendors selling goods along the streets around the market will be temporarily affected during construction (economic losses).	Works will be implemented during night time in areas close to markets. Construction contractor will have to prepare noise reduction and mitigation plan and implement dedicated measures for noise disturbance reduction and safe conditions for workers and neighboring population during works as well as during non active periods; Preliminary public information will be necessary before starting construction works.	Contractor	PIU, Municipality, Commune council
Community health and safety	Deliberate or accidental access to construction site works	Construction site protection will include clear signs placed at construction sites in view of the public, informing people about the project's GRM, and warning people against potential dangers such as moving vehicles, hazardous materials, and excavations, and raising awareness on safety issues; Heavy machinery will not be used at night; All sites will be secured, disabling access by the public through appropriate fencing whenever appropriate.	Contractor	PIU Municipality, Commune council
Community health and safety	Network works may cause temporary disruptions to vehicle access; traffic flow will be temporarily impeded and	Construction vehicles should use different roads or dedicated lanes and the implementation of wastewater and drainage networks will be undertaken on one side of the road	Contractor	PIU Municipality, Commune

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	parking space in front of the residents' houses will be reduced.	at a time; Preparation and implementation of a traffic management plan, and coordination with local authorities and communities; Information disclosure: villagers, residents and businesses will be informed in advance through media and information boards at construction sites of the construction activities, given the dates and duration of expected disruption; Public consultations on work phasing and schedules, anticipated access blocking, provisions for temporary and safe access for blocked properties and temporary parking for blocked garages/driveways; Posting of billboards on road/lane closure, traffic rerouting plan at strategic places, at least 1 week prior to works; Posting of traffic (flag) persons during entire working hours if necessary; Spreading out the schedule for materials delivery in non-peak hours as far as possible; Efficient management of truck arrival/departure; Provision of safe access, if needed, to blocked properties, e.g., steel planks of adequate grade, width and length, and if necessary, with guide rail; A close coordination with utility companies will prevent the disruption of utility services such as water and electricity supply due to damaged lines.		council
Community Health and safety	Sites left in unsafe conditions	Surplus materials removed from site; Decommissioning of construction camp facilities and equipment; Waste removal; Contaminated soil removal/treatment; Leveling of soil and returning to prior condition as per contract requirements.		
Occupational health and safety	Construction workers will be exposed to the presence of unexploded	Sites for earthworks that are suspected to have UXO should be surveyed by the Government prior to construction;	Government of Cambodia	PMU, PIU Municipality,

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	ordnances (UXO)	Should an ordnance be detected, clearing work will be commissioned prior to undertaking earthworks.		Commune council
Occupational health and safety	Risk to workers from construction site activities and working in/ around high traffic areas	Appointment of an Environmental, Health and Safety Officer; Contractor compliance with environmental and occupational health and safety guidelines; CEMPs will include health and safety plans; Provide a clean and sufficient supply of fresh water for construction sites; Provide adequate number of latrines at construction sites and ensure that they are cleaned and maintained in a hygienic state; Garbage receptacles at construction sites will be set up, and regularly emptied; Provide personal protection equipment e.g. safety boots, helmets, gloves, protective clothing, goggles, ear plugs; Emergency preparedness and response plan for accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events. These plans will be submitted to the local authorities for review and approval. Emergency phone link with the health center/hospital of Bavet will be established. Each site of works will have basic first aid kits; A records management system that will store and maintain easily retrievable records against loss or damage will be established. It will include documenting and reporting of occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits; Occupational health and safety matters will be given a high degree of publicity to all work personnel and posters will be displayed prominently at construction sites; Contractors will organize an initial Environmental, Health and Safety training for their workers, and short but regular reminder meetings will be organized (biweekly); An awareness program for HIV/AIDS and other communicable diseases will be implemented for workers and	Contractor	PIU, Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		the local communities; Core labor standards will be implemented. Civil works contracts will stipulate priorities to: (i) employ local people for works; (ii) ensure equal opportunities for women and men; (iii) pay equal wages for work of equal value and pay women's wages directly to them; and (iv) not employ child or forced labor. Specific targets for employment have been included in the project gender action plan.		
Occupational health and safety	Workers as well as communities may potentially be affected by COVID-19	Conduct a COVID-19 risk assessment and to incorporate COVID-19 health risks as part of their environmental and occupational health and safety (EHS) plans, which are part of their site-specific contractor EMP (CEMP).	Contractor	PIU
Operation				
Land and geology	Soil contamination - from spills / accidents or uncontrolled discharge due to clogging of untreated water or leachate and stormwater	All equipment and processes will be maintained in good working order, with back-up material in critical areas; Engineering and management systems will be set up to prevent and handle emergency situations.	Operator	PDPWT/ PDOE PMU, PIU
Ecology and biodiversity	WWTP will be built on the boundaries of a dense vegetation area. Human activity and equipment noise can generate disturbance which may disrupt breeding or foraging by resident or migratory fauna, i.e. breeding waterbirds in the forest.	Project areas enclosed by 1.8m-high fences, avoiding any impacts to adjacent vegetation and fauna; Adapt the maintenance activities to nesting or reproduction periods, to avoid fauna disturbance; Strict speed limits (maximum 50 km/h) for work vehicles around the project sites to minimize the risk of collisions with fauna, livestock, or people; Restriction on project vehicle circulation between 6:00pm and 6:00am to minimize the risk of collisions with fauna at night (when some mammals are more active).	Operator	PMU, PIU PDPWT/ PDOE
Water resources	Removal of polluted waters into existing water bodies	Implement a daily efficient monitoring; On-site septage collection will be provided by trucking for	Operator	PMU, PIU, MoE,

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		residential areas too far to connect or rural areas.		PDPWT/ PDOE
Water resources	Surface water or groundwater contamination from spills or uncontrolled discharge of untreated or treated water can occur due to faulty pipeline or equipment Accidental leakage from the wastewater treatment or stormwater drainage systems may impact surface water quality, and also groundwater quality, depending on local groundwater depth. This impact might be increased in case of flooding.	All equipment and processes will be maintained in good working order, with back-up material in critical areas; Engineering and management systems will be set up to prevent and handle emergency situations; Monitoring of the quality of the wastewater effluents will be set up to ensure they meet design criteria and can assimilate the treated effluent year-round.	Operator	PDPWT/ PDOE PMU, PIU PMU, PIU
Air quality	Vehicle gas emissions and dust emissions	Follow speed limits in the streets and access roads to project sites; Maintenance of project vehicles to minimize greenhouse gas emissions; Turning off equipment/vehicle when not in use; limiting engine idling to a max. of 5 minutes.	Operator	PMU, PIU PDPWT/ PDOE
Air quality	WWTP is likely to develop an impact on air quality in terms of odor	Maintain self-cleaning velocities into pipelines; Minimize turbulence wherever there is a hydraulic fall of sewer line; Ventilation of (gravity) sewers by proper venting arrangement; Design to ensure prevention of accumulation of grits/debris in sewer; Route maintenance shall consider using chemicals application in main pumping stations & sewer lines close to populated neighborhoods for controlling septicity.	Operator	PDPWT/ PDOE
Noise and vibration	Noise emissions which should cause	Modern and well-maintained equipment, meeting	Operator	PDPWT/

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	neighboring disturbance	international standards, to minimize nuisance; Apply noise reduction devices and methods for equipment operating within 150 m of schools and religious sites in rural areas located in the southeast area of Bavet municipality (pumping stations in Prasab Leak, Thnal Keang); Truck traffic movements will be allowed during daylight hours as far as possible; Conduct regular interviews with sensitive areas residents/users to identify noise disturbance. Community feedback will be used to implement new mitigation measures if deemed necessary; A contact number will be displayed on the station entrances and the WWTP administration phone number will be public.		PDOE
Materials and waste	Solid waste are often illegally disposed of in drains	Solid waste are collected by trucks and transported to the landfill.	Operator	PDPWT/ PDOE
Materials and waste	Pollution by WWTP sludge	Laboratory tests on sludge will be planned yearly: - on WWTP sludge after treatment on the Sludge Drying Beds, to verify their suitability for composting; - on Residual Leachate from the landfill, before being routed to the WWTP for treatment.	WWTP and landfill operators	PDPWT/ PDOE
Archeology and cultural heritage	No significant impact	-	-	-
Community health and safety	Risk of pathogens transfer to agricultural lands, food crops, etc.	No sludge spreading.	Operator	PDPWT/ PDOE
Occupational health and safety	Working conditions in the WWTP could potentially deteriorate over time if no monitoring is carried out to ensure the workers' health and safety conditions. Additionally, new projects have to include COVID-19 measures.	The working conditions in the WWTP, landfill, pre-sorting and composting plants will be reviewed regularly to maintain adequate health and safety conditions for the workers, including COVID-19 national guidance issued by Ministry of Health; All workers will be trained with regular refresher courses.	Operator	PDPWT
Community health and safety	Public safety may be impacted by the implementation of the projects. For	Posted speed limits along the access roads will be enforced and the perimeter of the WWTP will be fenced off;	Operator	PMU, PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	instance accidents may occur on the access roads and exposure to the treatment pond operations of the WWTP could result in injuries or health diseases.	Access to facilities will be restricted to authorized employees.		

Table 45: Environmental Management Plan for Stormwater Drainage Subproject

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
Design and Pre-construction				
Land and geology	Storm drainage network will subtract surface area from adjacent agricultural parcels	The property owners impacted by the construction will receive an economical compensation and/or will be assisted for the resettlement.	PIU	PMU, IA, Municipality, Commune council
Land and geology	Bank erosion of canals for urban drainage	Projected piped network with concrete materials for urban area.	Contractor	PIU
Ecology and biodiversity	No significant impact	-	-	-
Water resources	No significant impact	-	-	-
Air quality	No significant impact	-	-	-
Noise and vibration	No significant impact	-	-	-
Materials and waste	The project should need the use of materials and generate waste	Design and daily processes have been defined to limit material needs and waste production.	Designer, Operator	PMU, PIU, IA
Archeology and cultural heritage	No significant impact	-	-	-
Socio-economic and community health and safety	Street flooding	Network of channels, culverts and pipes, designed to minimize street flooding during a 1 in 5 year rainfall event.	Designer	PMU, PIU, IA
Construction				
Land and geology	Spoils require a removal and disposal in a predetermined and approved location	Spoil disposal sites will be located far from water bodies, so that spoils will not interfere with the flow of the surface water runoff to side drains and do not block the side drains themselves.	Contractor	PIU
Land and geology	Soil contamination: (i) improper transport, storage, handling and/or disposal of solid wastes, septic wastes, hazardous wastes and hazardous substances, such as petroleum products from equipment	Stabilization of exposed surfaces and spoil piles with ditches and/or sheeting; Minimize the duration that surfaces are exposed for; Timing works for dry seasons, when rains are minimal, and the ground is firm (to minimize infiltration of any contaminants);	Contractor, PIU	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	operation and maintenance, lubricants, paints, chemicals, curing compounds, asphalt products, among others; and (ii) accidental spills or leaks of hazardous wastes and substances	Management of site stockpiles and storage sites for fuels and machinery; Store petroleum products, hazardous materials and wastes on impermeable surfaces in secured and covered areas; Remove all construction wastes from the work sites to approved waste disposal sites; Establish emergency preparedness and response actions; Provide spill cleanup measures and equipment at each construction site; Train contractors and crews in emergency spill response procedures.		
Ecology and biodiversity	Vegetation destruction	If the removal of vegetation cannot be avoided and does not concern public lands, private owners of the concerned vegetation will be provided a compensation.	Contractor	PIU
Ecology and biodiversity	Potential disturbance of fauna and collision	Restriction on any construction activity and project vehicle activity between 6:00pm and 6:00am to minimize the risk of collisions with fauna at night.	Contractor	PIU
Water resources	Construction works will require water for the mixing of materials, wash-down of equipment, and drinking water for workers.	Pumping will occur at irrigation channels, only at sites with existing road and jetty access. No works or machine wash-down will be conducted at the pumping site. Contractors should ensure that the use of irrigation water or any water bodies complies with the EMP of the approved IEIA report and permit is obtained as needed.	Contractor	PIU, Municipality, Commune council
Water resources	Surface water bodies could be potentially affected by construction wastewater (from washing aggregates, pouring and curing concrete, cleaning of construction machineries and vehicles, and human wastes)	Timing of construction to avoid peak rainfall during the rainy season (from May to October). Construction in other months imparts much lower construction risk as the ground is hard, infiltration is limited, and there will be limited runoff from work sites; Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next; and, minimize open excavation areas; Construct intercepting channels and drains to prevent runoff entering construction sites and to divert runoff from sites to	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		existing drainage or open ground; Contractors will develop actions for control of oil and other dangerous substances as part of their site Contractor-EMPs; All sites for washing of construction equipment will be equipped with water collection basins and sediment traps; Fuel storage, machinery maintenance workshop and vehicle cleaning areas will be stationed at least 100m from the natural water bodies and 20m from channels; Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces and provided with bunds and cleanup installations; Contractors' fuel suppliers must be properly licensed and will follow established protocol for transferring fuel; Portable toilets and on-site wastewater pre-treatment systems will be installed at construction camps along with proper maintenance protocols.		
Air quality	Dust emissions, air pollution from aggregate preparation and concrete-mixing, air pollution from vehicle and machinery emissions	Spraying water on exposed construction sites where fugitive dust is being generated. Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion; Storing petroleum or other harmful materials in appropriate places and covering to minimize fugitive dust and emission; Covering materials during truck transportation, in particular, fine material, to avoid spillage or dust generation; Follow speed limits in the streets and on access roads Maintenance of project vehicles to minimize greenhouse gas emissions; Turning off equipment/ vehicle when not in use; limiting engine idling to a max. of 5 minutes; For odor: disinfection/ deodorization/ sanitizing affected latrines prior to clearing; provision of adequate sanitation facilities; and, strict enforcement of sanitation practices; prompt dispose of, organic and hazardous wastes; and, timely community consultations to ensure awareness of the risk of odors prior to landfill works;	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		Prohibit burning of wastes; Timely monitoring of air quality and inspections during construction. A particular attention will be paid to limiting dust production when work is carried out near sensitive receptors e.g. schools, hospitals, residential areas.		
Noise and vibration	Construction works may cause neighboring noise disturbance, mainly in the urban areas	Properly maintain construction vehicles and machineries to minimize noise; Apply noise reduction devices and methods for high noise equipment operating within 150 m of the sensitive sites i.e. schools, health centers, and religious sites; Prohibit operation of high-noise machinery, and movement of heavy vehicles along urban and village roads, between 6.00 pm and 8.00 am (with a possible exception for market areas); Place temporary hoardings or noise barriers around noise sources during construction; Monitor noise at sensitive areas at regular intervals. If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation; Conduct regular interviews with residents/villagers adjacent to construction sites to identify noise disturbance. Community feedback will be used to adjust work hours of noisy machinery.	Contractor	PIU, Municipality, Commune council
Noise and vibration	Construction works may cause neighboring vibration disturbance, mainly in the urban areas	High vibration activities, such as compaction operations, will be prohibited at night from 6.00 pm to 8.00 am (with a possible exception for market areas); Communities will be consulted prior to large earthworks to ensure they are informed, and, to avoid sensitive timing e.g. exams at nearby schools or festivals.	Contractor	PIU, Municipality, Commune council
Materials and waste	Domestic solid waste from workers and construction waste materials	Covered garbage bins will be installed at each site of works; The contractors will be responsible to transport the containers and dispose them at the existing dumpsite;	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		Waste collection and disposal methods will follow strict procedures to ensure that only non-hazardous waste is disposed; Hazardous wastes (discarded fuel, oil, spills) will be stored in sealed drums and transported to the official landfill site in accordance with national regulations; Waste burning will be forbidden.		
Archeology and cultural heritage	No significant impact	-	-	-
Socio-economic and community health and safety	Job creation during works	Local people employment and women employment.	Contractor	PIU, Municipality, Commune council
Socio-economic and community health and safety context	Market areas: street vendors selling goods along the streets around the market will be temporarily affected during construction (economic losses).	Works must be implemented during night time in areas close to markets; construction contractor will prepare noise reduction and mitigation plan and implement dedicated measures for noise disturbance reduction and safe conditions for workers and neighboring population during works as well as during non active periods; Preliminary public information will be necessary before starting construction works.	Contractor	PIU, Municipality, Commune council
Community health and safety	Deliberate or accidental access to construction site works	Construction site protection will include clear signs placed at construction sites in view of the public, informing people about the project's GRM, and warning people against potential dangers such as moving vehicles, hazardous materials, and excavations, and raising awareness on safety issues; Heavy machinery will not be used at night; All sites will be secured, disabling access by the public through appropriate fencing whenever appropriate.	Contractor	PIU Municipality, Commune council
community health and safety	Works may cause temporary disruptions to vehicle access; traffic	Construction vehicles should use different roads or dedicated lanes and the implementation of wastewater and	Contractor	PIU, Municipality,

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	flow will be temporarily impeded and parking space in front of the residents' houses will be reduced.	drainage networks will be undertaken on one side of the road at a time; Preparation and implementation of a traffic management plan, and coordination with local authorities and communities; Information disclosure: villagers, residents and businesses will be informed in advance through media and information boards at construction sites of the construction activities, given the dates and duration of expected disruption; Public consultations on work phasing and schedules, anticipated access blocking, provisions for temporary and safe access for blocked properties and temporary parking for blocked garages/driveways; Posting of billboards on road/lane closure, traffic rerouting plan at strategic places, at least 1 week prior to works; Posting of traffic (flag) persons during entire working hours if necessary; Spreading out the schedule for materials delivery in non-peak hours as far as possible; Efficient management of truck arrival/departure; Provision of safe access, if needed, to blocked properties, e.g., steel planks of adequate grade, width and length, and if necessary, with guide rail; A close coordination with utility companies will prevent the disruption of utility services such as water and electricity supply due to damaged lines.		Commune council
Community Health and safety	Sites left in unsafe conditions	Surplus materials removed from site; Decommissioning of construction camp facilities and equipment; Waste removal; Contaminated soil removal/treatment; Leveling of soil and returning to prior condition as per contract requirements.	Contractor	PIU, Municipality, Commune council
Community and	Workers as well as communities may	Conduct a COVID-19 risk assessment and to incorporate	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
Occupational health and safety	potentially be affected by COVID-19	COVID-19 health risks as part of their environmental and occupational health and safety (EHS) plans, which are part of their site-specific contractor EMP (CEMP).		
Occupational health and safety	Construction workers will be exposed to the presence of unexploded ordnances (UXO)	Sites for earthworks that are suspected to have UXO should be surveyed by the Government prior to construction. Should an ordnance be detected, clearing work will be commissioned prior to undertaking earthworks.	Government of Cambodia	PMU, PIU Municipality, Commune council
Occupational health and safety	Risk to workers from construction site activities and working in/ around high traffic areas	Provide a clean and sufficient supply of fresh water for construction sites; Preparation and implementation of a traffic management plan, and coordination with local authorities and communities; Provide personal protection equipment e.g. safety boots, helmets, gloves, protective clothing, goggles, ear plugs; Emergency preparedness and response plan for accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events. These plans will be submitted to the local authorities for review and approval. Emergency phone link with the health center/hospital of Bavet will be established. Each site of works will have basic first aid kits; A records management system that will store and maintain easily retrievable records against loss or damage will be established. It will include documenting and reporting of occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits; Occupational health and safety matters will be given a high degree of publicity to all work personnel and posters will be displayed prominently at construction sites; Contractors will organize an initial Environmental, Health and Safety training for their workers, and short but regular reminder meetings will be organized (biweekly); An awareness program for HIV/AIDS and other communicable diseases will be implemented for workers and	Contractor	PIU Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		the local communities; Core labor standards will be implemented. Civil works contracts will stipulate priorities to: (i) employ local people for works; (ii) ensure equal opportunities for women and men; (iii) pay equal wages for work of equal value and pay women's wages directly to them; and (iv) not employ child or forced labor. Specific targets for employment have been included in the project gender action plan.		
Operation				
Land and geology	Soil contamination (from spills or uncontrolled discharge of untreated or treated water) can occur due to faulty pipeline or equipment of the wastewater treatment and stormwater drainage systems. The soil can also be contaminated by flooding due to clogging of the drainage system	All equipment and processes will be maintained in good working order, with back-up material in critical areas; Engineering and management systems will be set up to prevent and handle emergency situations.	Operator	PDPWT/ PDOE PMU, PIU
Land and geology	Erosion may be caused by water flow in earth open channels	Properly slope or re-vegetate surfaces; Stabilize all cut slopes and embankments: their design should consider climate change effects; Landscaping will only use native plant species.	Operator	PMU, PIU
Ecology and biodiversity	No significant impact	-	-	-
Water resources	Surface water or groundwater contamination from spills or uncontrolled discharge of untreated or treated water can occur due to faulty pipeline or equipment Accidental leakage from the wastewater treatment or stormwater drainage systems may impact surface water quality, and also groundwater quality, depending on local	All equipment and processes will be maintained in good working order, with back-up material in critical areas; Engineering and management systems will be set up to prevent and handle emergency situations;. Monitoring of the quality of the wastewater effluents will be set up to ensure they meet design criteria and can assimilate the treated effluent year-round.	Operator	PDPWT/ PDOE

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	groundwater depth. This impact might be increased in case of flooding.			
Air quality	Clogging of the stormwater drainage system may generate odor nuisances due to an accumulation of solid waste	Regular maintenance operations.	Operator	PDPWT/ PDOE
Noise and vibration	No significant impact	-	-	-
Materials and waste	No significant impact	-	-	-
Archeology and cultural heritage	No significant impact	-	-	-

Source: Egis, 2021

11. Environmental Monitoring Plan

670. The Environmental Monitoring Plan (EMoP) presents environmental parameters that will allow the Proponent to ensure environmental compliance and sustainability of the project operations. The EMoP defines monitoring, verification, and performance requirements. Information obtained during the EMoP implementation can be used in examining the short- and long-term effects of the project's environmental aspects, from which future strategies on environmental enhancement measures can be formulated.

671. The following table presents the proposed EMoP that will be implemented by the Proponent. Its shows concerns, parameters to be monitored, as well as the corresponding sampling and measurement plan (method, frequency, location), responsible party, and estimated budget.

Table 46: Environmental Impact Monitoring for Solid Waste Subproject

Concern	Parameter	Means of verification	Location	Standard	Frequency	Responsibility	Cost estimation (US$)
Design and Pre-construction Phase							
Ambient air quality	SO_2, NO_2, CO, TSP	Baseline measurement survey	1 in front of the closest houses near the site 1 on site	Results are compared against the most restrictive standard between national (Sub-decree No27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Before works' start	Implementation: Contractor Supervision: PIU, MoE	1,200
Ambient noise levels	Noise level during works (Leq, 1hour during the activities)	Baseline measurement survey	1 in front of the closest houses near the site 1 on site	Anukret No42 ANK/BK, 2000	Before works' start	Implementation: Contractor Supervision: PIU, MoE	450
Water Quality	pH, COD, BOD_5, total P, total N, coliform	Baseline measurement survey	1 Surface water near project site water outlet 3 on-site piezometers/boreholes	Groundwater: WHO Guidelines for Drinking-water Quality Surface water: Sub-decree No27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Baseline before works' start	Implementation: Contractor Supervision: PIU, MoE	540
Water quality	Surface water and groundwater	Visual inspections of	Work site and	-	Before works'	Implementation:	None

	protections	water management on site	access road		start	Contractor Supervision: PIU, MoE	
Biodiversity	Incidence of project-related injuries to wildlife e.g. collisions Hunting or fishing by project workers	Visual inspections of temporary fences	Site boundaries and access road	-	Before works' start	Implementation: Contractor Supervision: PIU, MoE	None
Community and worker health and safety	unexploded ordnances (UXO) risks for workers	UXO survey/clearance 20ha	Site and access boundaries	-	Before works' start	Implementation: Consultant Supervision: PIU, MoE	80,000
Socio-economic	Current informal waste-pickers employment	Conversion training	Landfill site	-	Before the existing dumpsite decommissioning	Implementation: Contractor Supervision: PIU, MoE	2,000
Construction Phase							
Ambient air quality	SO_2, NO_2, CO, TSP	Measurement survey	1 in front of the closest houses near the site 1 on site	Results are compared against the most restrictive standard between national (Sub-decree No27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Once biannual	Implementation: Contractor Supervision: PIU, MoE	3,510
Ambient noise levels	Noise level during works (Leq, 1hour during the activities)	Measurement survey	1 in front of the closest houses near the site 1 on site	Sub-decree No42 ANK/BK, 2000	Once biannual	Implementation: Contractor Supervision: PIU, MoE	1,350
Groundwater quality	pH, COD, BOD_5, total P, total N, coliform, E-Coli	Measurement survey	3 On-site piezometers/boreholes: upstream, downstream and laterally from the landfill	WHO Guidelines for Drinking-water Quality	2/year of works (dry and wet seasons)	Implementation: Contractor Supervision: PIU, MoE	1,620
Surface water quality	Siltation of nearby surface water (TSS)	Measurement survey	Surface water upstream and	Sub-decree No27 ANRK/BK, 1999	Once quarterly	Implementation: Contractor	160

			downstream near project site outlet	(Effluent standard for pollution sources discharging wastewater to public water areas or sewer)		Supervision: PIU, MoE	
Community and worker health and safety	Incidences of illness due to project Incidences of work-related accident, injuries/deaths, illness	Logbook/ database registration of the contractor	Contractor office	-	Once /month	Implementation: Contractor Supervision: PIU, MoE	1,200
Employment	Number of locally employed personnel	Logbook/ database registration of the contractor	Contractor office	-	Once/year	Implementation: Contractor Supervision: PIU, MoE	None
Construction waste	Presence/absence of illegal waste Environment safeguards at landfills	Visual inspection	Construction sites, waste disposal site	-	Once quarterly	Implementation: Contractor Supervision: PIU, MoE	None
Biodiversity	Incidence of project-related injuries to wildlife e.g. collisions Hunting or fishing by project workers	Visual inspections and interviews of workers	Works site boundaries and access road		Ongoing	Implementation: Contractor Supervision: PIU, MoE	None
Operation Phase							
Ambient air quality	SO_2, NO_2, CO, TSP	Measurement survey	1 in front of the closest houses near the site	Results are compared against the most restrictive standard between national (Sub-decree No27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Once /year	Implementation: Operator Supervision: PIU, MoE	
Ambient noise levels	Noise level during activities (Leq, 1hour)	Measurement survey	1 in front of the closest houses near the site 1 on site	Anukret No42 ANK/BK, 2000	Once/year	Implementation: Operator Supervision: PIU, MoE	The operator will be in charge of these costs
Groundwater quality	pH, COD, BOD_5, total P, total N, coliform	Measurement survey	3 On-site piezometers/boreholes: upstream, downstream	WHO Guidelines for Drinking-water Quality	2/year (dry and wet seasons)	Implementation: Operator Supervision: PIU, MoE	

			and laterally from the landfill				
Surface water quality	pH, COD, BOD_5, total P, total N, coliform, E-Coli	Measurement survey	Surface water body upstream and downstream near landfill site outlet	Sub-decree No27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Once quarterly	Implementation: Operator Supervision: PIU, MoE	
Community and worker health and safety	Incidences of illness due to project Incidences of work-related accident, injuries/deaths, illness	Logbook/ database registration of the operator	Landfill office	-	Once /year	Implementation: Operator Supervision: PIU, MoE	
Employment	Number of locally employed personnel	Logbook/ database registration of the operator	Landfill office	-	Once /year	Implementation: Operator Supervision: PIU, MoE	

Note: for all parameters, the responsibility for implementation will be a licensed laboratory (recruited by the contractor); and responsibility for supervision is the PIU.
Source: Egis, 2021

Table 47: Environmental Impact Monitoring for Wastewater Subproject

Concern	Parameter	Means of verification	Location	Standard	Frequency	Responsibility	Cost estimation (US$)
Design and Pre-construction Phase							
Ambient air quality	SO_2, NO_2, CO, TSP	Baseline measurement survey	1 WWTP on site	Results are compared against the most restrictive standard between national (Sub-decree No27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Before works' start	Implementation: Contractor Supervision: PIU, MoE	840
Ambient noise levels	Noise level during works (Leq, 1hour during the activities)	Baseline measurement survey	1 on WWTP site 2 urban PS 2 in front of the closest houses near the PS sites	Anukret No42 ANK/BK, 2000	Before works' start	Implementation: Contractor Supervision: PIU, MoE	450
Water Quality	pH, COD, BOD_5, total P, total N, coliform, E-Coli	Baseline measurement survey	1 Surface water near project site water outlet 1 on-site piezometer/borehole	Groundwater: WHO Guidelines for Drinking-water Quality Surface water: Sub-decree No27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Baseline before works' start	Implementation: Contractor Supervision: PIU, MoE	500
Water quality	Surface water and groundwater protections	Visual inspections of water management on site	Work site and access road	-	Before works' start	Implementation: Contractor Supervision: PIU, MoE	None
Biodiversity	Incidence of project-related injuries to wildlife e.g. collisions Hunting or fishing by project workers	Visual inspections of temporary fences	Site boundaries and access road	-	Before starting works	Implementation: Contractor Supervision: PIU, MoE	None
Archeology and cultural heritage	Shrine area protection	Visual inspections of temporary fences	Site boundaries	-	Before starting works	Implementation: Contractor	None

Community and worker health and safety	unexploded ordnances (UXO) risks for workers	UXO survey	Site boundaries	-	Before starting works	Implementation: Consultant Supervision: PIU, MoE	80,000
Construction Phase							
Ambient air quality	SO_2, NO_2, CO, TSP	Measurement survey	1 on site	Results are compared against the most restrictive standard between national (Sub-decree No27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Once biannual	Implementation: Contractor Supervision: PIU, MoE	3,360
Ambient noise levels	Noise level during works (Leq, 1hour during the activities)	Measurement survey	1 on WWTP site 2 urban PS 2 in front of the closest houses near the PS sites	Anukret No42 ANK/BK, 2000	Once biannual	Implementation: Contractor	1,800
Groundwater quality	pH, COD, BOD_5, total P, total N, coliform	Measurement survey	1 On-site piezometer/borehole	WHO Guidelines for Drinking-water Quality	2/year of works (dry and wet seasons)	Supervision: PIU, MoE	1,620
Surface water quality	Siltation of nearby surface water (TSS)	Measurement survey	Surface water upstream and downstream near project site outlet	Sub-decree No27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Once quarterly	Implementation: Contractor	160
Community and worker health and safety	Incidences of illness due to project Incidences of work-related accident, injuries/deaths, illness	Logbook/ database registration of the contractor	Contractor office	-	Once /month	Supervision: PIU, MoE	1,200
Employment	Number of locally employed personnel	Logbook/ database registration of the contractor	Contractor office			Implementation: Contractor	
Construction waste	Presence/absence of illegal waste	Visual inspection	Construction sites	-	Once quarterly	Supervision: PIU, MoE	

	Environment safeguards at landfills						
Biodiversity	Incidence of project-related injuries to wildlife e.g. collisions Hunting or fishing by project workers	Visual inspections and interviews of workers	Works site boundaries		Ongoing	Implementation: Contractor	
Operation Phase							
Ambient air quality	SO_2, NO_2, CO, TSP	Measurement survey	1 on site	Results are compared against the most restrictive standard between national (Sub-decree No27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Once /year	Implementation: Operator Supervision: PIU, MoE	The operator will be in charge of these costs
Ambient noise levels	Noise level during activities (Leq, 1hour)	Measurement survey	1 on WWTP site 2 urban PS 2 in front of the closest houses near the PS sites	Anukret No42 ANK/BK, 2000	Once/year	Implementation: Operator Supervision: PIU, MoE	
Groundwater quality	pH, COD, BOD_5, total P, total N, coliform	Measurement survey	1 On-site piezometer/borehole	WHO Guidelines for Drinking-water Quality	2/year (dry and wet seasons)	Implementation: Operator Supervision: PIU, MoE	
Surface water quality	pH, COD, BOD_5, total P, total N, coliform	Measurement survey	Surface water upstream and downstream near project site outlet	Sub-decree No27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Once quarterly	Implementation: Operator Supervision: PIU, MoE	
Community and worker health and safety	Incidences of illness due to project Incidences of work-related accident, injuries/deaths, illness	Logbook/ database registration of the operator	WWTP office	-	Once /year	Implementation: Operator	
Employment	Number of locally employed personnel	Logbook/ database registration of the	WWTP office		Once /year	Supervision: PIU, MoE	

		operator					

Note: for all parameters, the responsibility for implementation will be a licensed laboratory (recruited by the contractor); and responsibility for supervision is the PIU.
Source: Egis, 2021

Table 48: Environmental Impact Monitoring for Stormwater Subproject

Concern	Parameter	Means of verification	Location	Standard	Frequency	Responsibility	Cost estimation (US$)
Design and Pre-construction Phase							
Water quality	Surface water and groundwater protections	Visual inspections of water management on site	Work site and access road	-	Before works' start	Contractor, PIU	None
Biodiversity	Incidence of project-related injuries to wildlife e.g. collisions Hunting or fishing by project workers	Visual inspections of temporary fences	Works' boundaries	-	Before starting works	Contractor, PIU	None
Community and worker health and safety	unexploded ordnances (UXO) risks for workers	UXO survey/clearance	Works' boundaries	-	Before starting works	Consultant, PIU	50,000
Construction Phase							
Community and worker health and safety	Incidences of illness due to project Incidences of work-related accident, injuries/deaths, illness	Logbook/ database registration of the contractor	Contractor office	-	Once /month	Contractor, PIU, MoE	1,800
Employment	Number of locally employed personnel	Logbook/ database registration of the contractor	Contractor office			Contractor, PIU, MoE	
Construction waste	Presence/absence of illegal waste Environment safeguards at landfills	Visual inspection	Construction sites	-	Once quarterly	Contractor, PIU, MoE	
Biodiversity	Incidence of project-related injuries to wildlife e.g. collisions Hunting or fishing by project workers	Visual inspections and interviews of workers	Works site boundaries		Ongoing	Contractor, PIU, MoE	
Operation Phase							
Community and worker health and safety	Incidences of illness due to project Incidences of work-related accident, injuries/deaths, illness	Logbook/ database registration of the operator	Operator office	-	Once /year	Operator and PIU records	The operator will be in charge of these costs
Employment	Number of locally employed	Logbook/ database	Operator office		Once /year	Operator	

	personnel	registration of the operator					

Note: for all parameters, the responsibility for implementation will be a licensed laboratory (recruited by the contractor); and responsibility for supervision is the PIU.

12. Construction Environmental Monitoring

672. The **construction environmental management plan (CEMP)** shall be prepared by all contractors before the start of the construction works and shall be approved by PIU and the PMU. This requirement shall be included in the construction contracts.

673. The purpose of a CEMP is to outline how a construction project will avoid, minimize or mitigate effects on the environment and surrounding area.

674. The CEMP details the implementation of measures in accordance with environmental commitments outlined in; an Environmental Statement, an environmental policy or environmental plan, requirements of planning conditions, agreements or other legislative requirements. They are 'live' documents that are reviewed and updated at regular intervals throughout the project life cycle.

675. The purpose of the CEMP is to:

(i) Highlight stakeholder requirements;
(ii) Ensure that the development is compliant with current Cambodian environmental legislation and international standards (WHO, IFC, …);
(iii) Outline Environmental Management Systems e.g. ISO 14001;
(iv) Detail the mitigation committed to within the Environmental Statement and how it will be implemented on site;
(v) Ensure that any adverse effects are minimized during construction;
(vi) Describe any site-specific method statements required.

676. The basic scope of the CEMP shall consider the following subject areas, as applicable to the individual projects: soil, water quality and drainage, noise and air quality disturbances, nature conservation (biodiversity), archaeology and cultural heritage, people and communities, waste management, energy consumption, transport and materials.

677. **The CEMP** shall be structured as follows:

(i) Introduction – General purpose, scope, and structure of the document;
(ii) Scope of work and project description – Information about the development;
(iii) Environmental requirements and controls –
    a. environmental impacts and risks;
    b. Mitigation measures (minimum as set out in this EMP) and pollution control measures (air, noise, surface water, and groundwater quality);
    c. Monitoring procedures for monitoring construction processes against requirements (minimum as set out in this EMP).
(iv) Roles and responsibilities;
(v) Consents, commitments, and permissions;
    a. Appropriate environmental legislation, planning conditions, and any other consents or licensing.
(vi) Management plans – Specific management plans such as ecology, noise, dust, waste, traffic disturbance, access disturbance;
(vii) Emergency response plan;
(viii) Communication – External and internal consultations.

678. CEMP should also include an Environmental and occupational health and safety plan, including COVID-19 measures, which should be defined according national guidance from Ministry of health with consideration of ADB COVID-19 guidance: https://www.adb.org/publications/safety-well-being-workers-communities-covid-19.

13. Cost of EMP Implementation

679. This section provides an estimate of the cost of EMP implementation. The cost comprises three categories: mitigation measures, monitoring, and travel costs (Table EMP-6). Costs are for the construction phase of two years and the first year of operation, i.e. a total of three years. The costs do not include: (i) detailed design revisions and adjustments; and (ii) salaries of government and PIU staff. Costs are based on the experience of the TRTA team from other projects in Cambodia and in other countries. The total estimated cost is $236,100 (including surveys, travels, sampling analyses) for the construction phase (excluding the operator's charges). Additionally, the total UXO surveys are $210,000. The EMP costs have been incorporated into the overall project budget.

680. The cost for the domestic environmental clearances is included in a separate project budget.

Table 49: Estimated Costs for Implementation of the Project Environment Management Plan[60]

	Solid waste management	Wastewater management	Stormwater drainage
Parameter	**Estimated Cost ($)**	**Estimated Cost ($)**	**Estimated Cost ($)**
A. PRE-CONSTRUCTION and CONSTRUCTION PHASE			
Ambient air quality SO_2, NO_2, CO, TSP	$1,200 baseline $3,500 works (1 on site + 1 household)	$840 baseline $3,360 works (1 on site)	-
Ambient noise levels	$450 baseline $1,350 works (1 on site + 1 household)	$450 baseline $1,800 works (1 WWTP site + 2 urban PS + 2 household)	-
Groundwater quality pH, COD, BOD5, total P, total N, coliform, E-Coli	$1,200/piezometer (x3) $250 baseline $1,620 works	$1,200/piezo (x1) $250 baseline $1,620 works	-
Surface water quality pH, COD, BOD5, total P, total N, coliform, E-Coli, TSS	$250 baseline $160 works (TSS only)	$250 baseline $160 works (TSS only)	-
Compensation Planting	$11,200	$138,680	
Community and worker health and safety Incidences of work-related accident, injuries, illnesses	$1,200	$1,200	$1,800
UXO Clearance	$80,000	$80,000	50,000
Sub-Total A	**$104,370.00**	**$229,810.00**	**$51,800**
B. OPERATION PHASE (in charge of the operator)			
Ambient air quality SO_2, NO_2, CO, TSP	$1,200 / year	$840 / year	
Ambient noise levels	$450 / year	$450 / year	
Groundwater quality	$1,620 / year	$1,620 / year	

[60] Estimated costs for health and safety includes the costs of material compensation and health costs (medical consultation, medication, costs related to staff absence, …)

pH, COD, BOD5, total P, total N, coliform, E-Coli			
Surface water quality (downstream and upstream from the outlet) pH, COD, BOD5, total P, total N, coliform, E-Coli	$1,620 / year	$1,620 / year	
Worker health and safety Incidences of work-related accident, injuries, illnesses	Routine inspection	Routine inspection	
Community health and safety Incidence of accidents (e.g. vehicle damage, fire)	-	-	
Sub-Total B	**$4,890.00**	**$4,530.00**	
TOTAL (A+B)	**$109,260.00**	**$234,340.00**	
Travel cost (surveys)	$200.00 (x1 – pre-construction) $ 200.00 (x6 - construction) +$200.00 (x3 - =operation) **$2,000**		

Note:
Solid waste management – 18 months construction
Wastewater - 24 months construction
Storm drainage - 18 months construction
Source: Egis, 2021

XI. CONCLUSION AND RECOMMENDATIONS

681. An IEE is deemed sufficient for the LCIP given its categorization as Category B for Environment and Category B for Involuntary Resettlement and Category C for Indigenous Peoples as per ADB SPS 2009.

682. During construction, anticipated project impacts on noise, dust, traffic, health, and safety will be localized, temporary, intermittent in nature and can be readily addressed through implementation of the measures outlined in the EMP. Land clearing and grading will be limited to areas where necessary. A detailed tree inventory and survey will be undertaken as part of the tree cutting permit application in coordination with the concerned MoE office and the Municipality of Bavet.

683. During operation, the project is expected to have positive social impacts in terms of generation of local benefits. It is expected to generate/contribute additional local employment and livelihood opportunities and local government revenues.

684. The Proponent is fully committed to its environmental and social responsibilities, including compliance with national environmental, health, and safety regulations and ADB SPS requirements.

685. Should there be changes in the project scope or location of the facilities that would result to significant impacts not included in this assessment, an updated or a new Borrower IEE Report will be prepared.

686. This is a feasibility study phase IEE; an updated Borrower IEE and standalone bidding ready EMP and domestic IEIAs in Khmer will be prepared during the detailed design phase. The domestic IEIAs for all sub-projects will be submitted to the MoE, in accordance with national legislation.

XII. APPENDICES

1. Letter of MAFF No.2949, April 2017, on provision land 23ha to Svay Rieng provincial governor to construct the WWTP.

The Kingdom of Cambodia

Nation, Religion, King

Ministry of Agriculture, Forestry and Fisheries **Phhom Penh, 04 April 2017**

No. 2949

TO

H.E Governor of the Board of Governors of Svay Rieng Province

Subject: Case of Requesting for 23-hectare of Chomka Kon Korki Community Forestry, in Trapaing Plong village, Bati commune, Bavet city, Svay Rieng province.

Reference: Letter 037/17, dated 08 February 2017, of Svay Rieng Provincial Administration.

Following the above objectives, I would like to inform Your Excellency Governor of the Board of Governors that requesting for 23-hectare of Chomka Kon Korki Community Forestry, in Trapaing Plong village, Bati commune, Bavet city, Svay Rieng province, in purpose of developing Wastewater Treatment Plant of the provincial administration; The Ministry of Agriculture Forestry and Fisheries has agreed but have to follow the recommendations of the committee of Community forestry management and provide compensation to the Forest Communities before implementing the project, as well as mitigate environmental impact during the implementation project.

Accordingly, as mentioned above, the Governor of the Board of Governors is aware and appropriate measures are being followed.

Your Excellency the Governor of the Board of Governors, please receive my sincerity.

cc to:

- The Council of Ministers
- Ministry of Interior
- Ministry of Land Management, Urban Planning and Construction

* To notify *

General Department

- The Department of Planning and Statistics
- Department of Financial Accounting

Department of Agriculture, Forestry and Fisheries of Svay Rieng Province

* To notify *

- Chronological documents

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ជាតិ សាសនា ព្រះមហាក្សត្រ

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ដំណឹង

ស្តីពី

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សូមជូនពរឱ្យលោកទទួលបានសេចក្តីសុខ។

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រដ្ឋមន្ត្រី

ប៉ាន សោរិទ្ធ

2. Letter of MoE No. 1555, 23 November 2020, on approving location for the new landfill construction

Kingdom of Cambodia

National Religion King

Ministry of Environment

No 1555

To

HE Senior Minister, Minister of Public Works, and Transport

Subject: The Case approve the request for positioning (1) sub-project construction new landfill for Bavet city, and (2). Sub-project construction wastewater treatment plant for Bavet city in the Svay Rieng Province of the Livable Cities Investment Project of Ministry of Public Works and Transport

References:

- Reach Kram No. NS / RKM / 1296 / 36 dated 24 December 1996 promulgating the Law on the protection and management of natural resources
- Sub Decree No.72 dated 11 August 1999 on the assessment process, environmental impact
- Letter No. 32 Dated September 21, 2020 of the Ministry of Public Works and Transport
- Report dated 01 November 2020 of the department of environmental impact assessment of the Ministry of Environment

As mentioned in the above objective I have the honor to inform the Senior Minister that the Ministry of Environment approved the selection location for the (1) Sub project construction a new landfill, and (2). Sub-project wastewater treatment plant in Bavet city which located in the administrative boundary of the Bavet city, Svay Rieng Province of the Livable Cities Investment Project (LCIP) of Ministry of Public Works and Transport (Owner) and Asian Development Bank (ADB) loan agreement.

Meanwhile, the Ministry of Public Works and Transport should cooperation with the registered consultants in the Ministry of Environment to prepare the environmental impact assessment and social (IESIA) report for sub-projects of the Livable cities Investment Project before starting the project construction activities.

As described above, H.E. Senior Minister aware and manage with favor.

Please H.E. Senior Minister accept my salute.

Phnom Penh, November 23, 2020

For Minister of MPWT

Secretary of State

H.E. Chay Samit

Copy
- Office of the Council of Ministers
- Ministry of Economy and Finance
- Ministry of Land Management, Urban Planning and Construction
- Svay Rieng Provincial Administration
- Department of Environment of Svay Rieng
- Chronological documents

3. Environmental baseline survey report

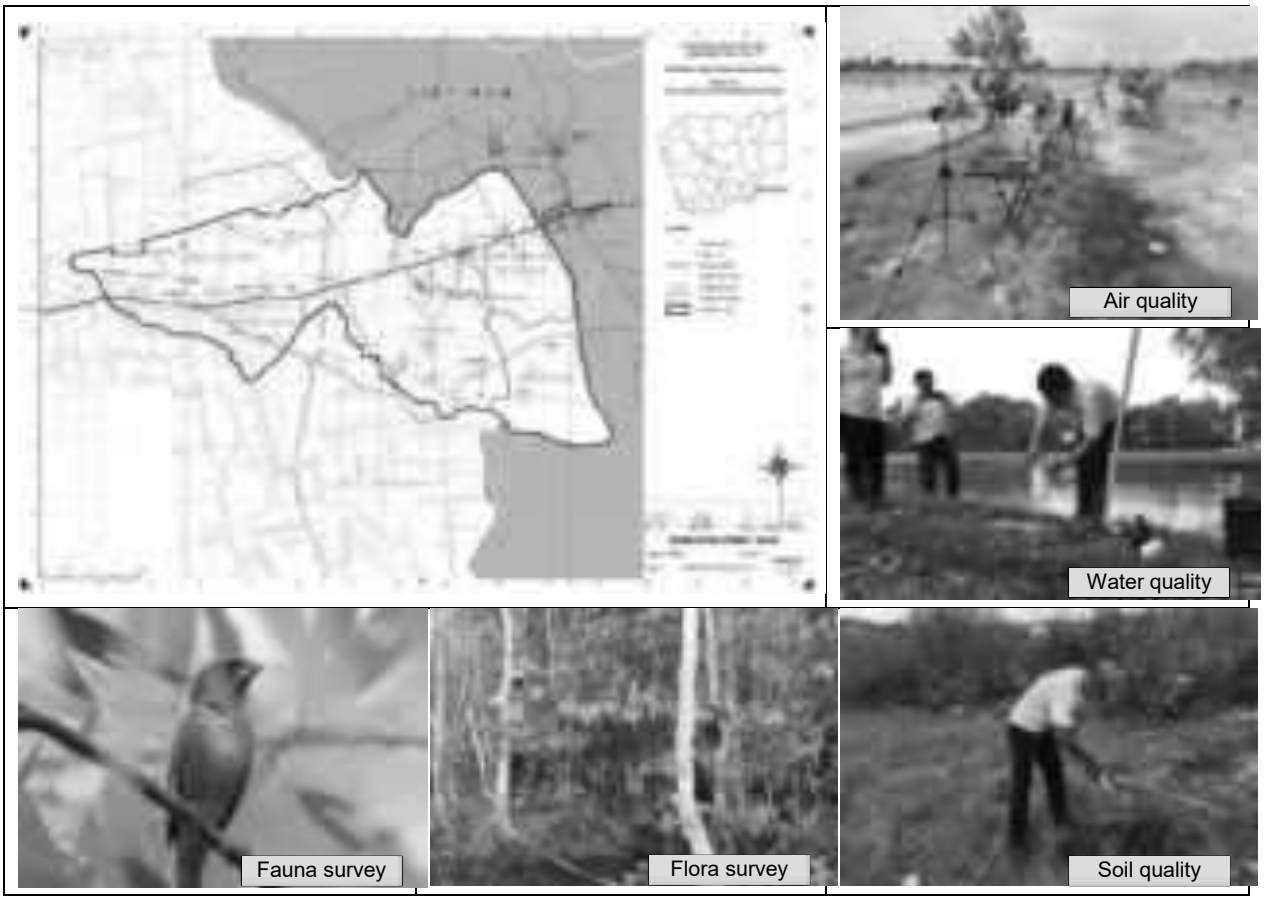
ASIAN DEVELOPMENT BANK

TA-9554 – REG: SOUTHEAST ASIA URBAN SERVICES FACILITY

CONTRACT NO: 143221-S53314

CAM: LIVABLE CITIES INVESTMENT PROJECT

Baseline Environmental Survey for Bavet City



Prepared by

BKK CONSULTANTS (CAMBODIA)

January 2021

CONTENTS

LIST OF ANNEX

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATION

AASHTO	: American Association of State Highway and Transportation Officials
ADB	: The Asian Development Bank
CFCK	: Community Forestry “Chamkar Konkoki”
DPWT	: Department of Public Works and Transport
EA	: Executing Agency
EIA	: Environmental Impact Assessment
EMP	: Environment Management Plan
FS	: Feasibility Study
GPS	: Global Positioning System
GRC	: Royal Government of Cambodia
GMS	: Greater Mekong Subregion
IEE	: Initial Environmental Examination
IEIA	: Initial Environmental Impact Assessment
KCC	: Key Consultants (CAMBODIA)
MAFF	: Ministry of Agriculture, Forestry, and Fisheries
MEF	: Ministry of Economy and Finance
MOE	: Ministry of Environment
MPWT	: Ministry of Public Works and Transport
MRC	: Mekong River Commission
MRF	: Materials Recovery Facility
PIC	: Project Implementation Consultant
PIU	: Project Implementation Unit
PMU	: Project Management Unit
SURF	: The Southeast Asia Urban Services Facility
USDA	: United States Department of Agriculture
UTM	: Universal Transverse Mercator
WWTP	: Wastewater Treatment Plant

1. INTRODUCTION AND BACKGROUND

1.1 Background

At the request of the Kingdom of Cambodia, the Asian Development Bank is developing a project to improve the environment of secondary cities in Cambodia. There are three targeted cities include Bavet, Kampot, and Poipet city.

The Southeast Asia Urban Services Facility (SURF), a transaction technical assistance facility led by EGIS EAU, will support the project preparation and conduct technical, financial, economic, institutional, sector policy, legal, regulatory, poverty, social, gender, and safeguard assessments. The purpose of Egis Eau's service is to provide assistance to government authorities to prepare the project in compliance with the ADB requirements.

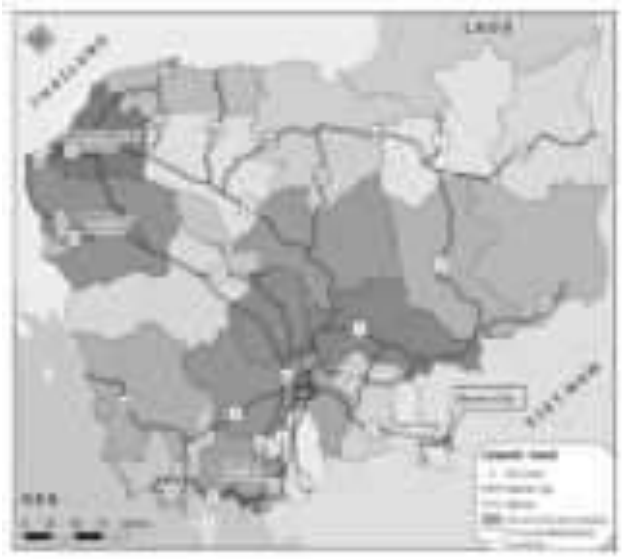
The project stage is in the Feasibility Study (FS) with a period of approximately 3 months (Sept.-Nov.2020). The social survey was awarded to Key Consultants (CAMBODIA) KCC to carry out, and Egis Eau provides ToR for the baseline survey according to the requirement of ADB.

This report is focused only on the subprojects in Bavet city, which include (i) wastewater collection and treatment plant, (ii) storm drainage, and (iii) solid waste management.

1.2 Study Area

The Bavet land is used to envision the city is becoming a commercial, industrial, and modern tourism for sustainable development. Bavet is a corridor city on the Cambodia border with Vietnam country. The Bavet city has a total land area of 206.69 km2, and it far from Phnom Penh capital city of 160 km. The Bavet city was established as a city in 2008, located in the southeast part of Cambodia, at the main international border crossing with Vietnam. It is the first city in Cambodia along the National Road 1 (NR 1) when traveling from the border of Vietnam. It is an emerging trading and manufacturing center in the Svay Rieng province. The Bavet city consists of 5 quarters (Sangkat), such as Sangkat Bavet, which comprises five villages, Sangkat Prey Angkunh of 8 villages, Sangkat Prasat of 2 villages, Sankat Bati of 5 villages, and Sangkat Chrak Mtes is composed of 15 villages.

Figure 1.2-1: The location map of the Bavet city



Source: Egis FS Report

1.3 Survey Objective

The overall survey objective is to describe the surrounding environment of each proposed project sites in the Bavet city include (i) WWTP and associated outfall and Pumping Stations (PS) along with the networks; (ii) Stormwater network and associated outfalls; and (iii) Landfill, sorting plant and composting area.

To describe the surrounding environment, additional data are required through monitoring or field observations and sampling on the following aspects:

(i) Soil quality ;
(ii) Water quality ;
(iii) Ground Water Quality;
(iv) Bacteriology ;
(v) Flora ;
(vi) Fauna ;
(vii) Cultural Heritage;
(viii) Noise;
(ix) Air quality.

The data, analysis, and reports from the Survey will assist and inform the preparation of the Initial Environmental Examination (IEE) report for the Cambodia Livable Cities Investment Project. The IEE report comprises baseline data on the existing condition of the physical and biological environment, the anticipated environmental impacts, and proposed mitigation measures.

1.4 Methodology

The baseline survey will be used three main methodologies: (i) Collect legislation and regulation on environmental resources in Cambodia, and internationally/regionally if any, (ii) Extraction key information from previous report study concerning the project area, and (iii) Conduct filed observation and measurement the natural physical resources in according to the ToR.

- Collect legislation and regulation on environmental resources- National and regional/international legislation and regulation will be collected such as law, sub-decree, Prakas/declaration, etc.
- Extraction key information/event on natural resources from any reported study which are concerned with the project target area, Bavet city.
- Field observation and measuring of the real condition of the environmental resources including physical (soil, air, water, hydrology, etc.), biological resources (forest, wildlife, and its habitat), and cultural resources (archeological site, artifact, religion site, etc.). The observation will also describe the present condition of the public service facility, such as water supply and sanitation systems, electricity, public health facility, education facility, and transportation facility within 300m buffer area to the project site.

1.5 Survey Team Member

There are 5 environmental survey team members and 7 fauna and flora survey team members, which include the team leader, co-team leader, engineers, and field assistant, see table 1.3-1.

Table 1.3-1: List of the team members of the environment study

No.	Description	Position	Responsible
I.	**Environmental Survey Team**		
1	Miss. Chhun Sokhom	Team Leader	Coordinate with the local authority, Field investigation, and reporting
2	Mr. Ang Sovanna	Co- team leader	Field investigation and reporting
3	Mr. Eng Diamant	Member	Field investigation and compiling data
4	Mr. Kol Ponlok	Member	Field investigation and compiling data
5	Mr. Chan Thanin	Member	GIS mapping
II.	**Fauna and Flora Survey Team**		
1	Mr. Toem Yean	Team Leader	Coordinate with the local authority, Field survey and reporting on flora
2	Mr. Hun Seiha	Co-Team Leader	Coordinate with the local authority, Field survey and reporting on amphibian and reptile
3	Mr. ITH Saveng	Member	Field survey and reporting on the bat
4	Mr. Pin Chanratana	Member	Field survey and report on bird and mammal
5	Mr. Noun Situn	Member	Field survey on flora and compile data
6	Mr. Yim Raksmey	Member	Field survey fauna and compile data
7	Mr. Phoen Bora	Member	Field survey fauna and compile data

2 ENVIRONMENTAL LEGISLATION

Some important laws, sub-decrees, and guidelines that concerned with the project location and the project nature are listed in the table below:

Level or legislation	Dated of launching to use	Key Concerned to the project
Constitution	Sept. 21, 1993.	- State property notably comprises land, mineral resources, mountain, sea, underwater, continental shelf, coastline, airspace, islands, rivers, canals, streams, lakes, forests, natural resources, economic and cultural centres, bases for national defence, and other facilities determined as State property. - The state shall protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rocks and sand, gems, forests, and forestry product, wildlife, fish, and aquatic resources.
Law		
Law on Environmental Protection and Natural Resources Management	Dec. 24, 1996.	- To protect and promote environmental quality and public health through prevention, reduction, and control of pollution. - To assess the environmental impacts of all proposed projects prior to the issuance of a decision by the Royal Government. - To ensure the rational and sustainable conservation, development, management, and use of the natural

		resources of the Kingdom of Cambodia. - To encourage and provide the possibility for the public to participate in the protection of the environment and the management of natural resources. - To suppress any acts that cause harm to the environment. - Under this law, developers need to prepare an IEIA report or EIA report for their proposed or existing development projects
Land Law	Jul. 20, 2001	- All persons shall respect the property of the State and legally acquired private property. The management of the cadastral administration of immovable property belonging to the State and the competence to issue titles related to immovable property throughout the Kingdom of Cambodia is under the authority of the Ministry of Land Management Urban Planning and Construction (MLMUPC). - Only natural persons or legal entities of Khmer nationality have the right to ownership of land in the Kingdom of Cambodia. - Any person who, for no less than five years prior to the promulgation of this law, enjoyed peaceful, uncontested possession of immovable property that can lawfully be privately possessed has the right to request a definitive title of ownership.
Law of Water Resources Management	May 22, 2007	- Filling of the river, tributary, stream, natural lakes, canal, and reservoirs should subject to license or permitted letter. - The discharge, disposal, or deposit of polluting substances that are likely to deteriorate the quality of water or to endanger human, animal, and plant health into the water, the soil, or the subsoil shall be subject to a license or permission form will be stated in Sub-decree.
Law on Protected Areas	Jan. 4, 2008	- This law defines the framework of management, conservation, and development of protected areas. The objectives of this law are to ensure the management, conservation of biodiversity, and sustainable use of natural resources in protected areas. - The establishment or modification of any protected area shall be based on the results of research studies, criteria, management objectives, and access rights to

		resource use, land titles, and other relevant aspects. - Each protected area shall be divided into four (4) management zoning systems as the following: 1. ***Core zone***: management area(s) of high conservation values containing threatened and critically endangered species and fragile ecosystems. Access to the zone is prohibited except the Nature Conservation and Protection Administration's officials and researchers who, with prior permission from the Ministry of Environment, conduct nature and scientific studies for the purpose of preservation and protection of biological resources and natural environment with the exception of national security and defense sectors. 2. ***Conservation zone***: management area(s) of high conservation values containing natural resources, ecosystems, watershed areas, and natural landscape located adjacent to the core zone. Access to the zone is allowed only with the prior consent of the Nature Conservation and Protection Administration at the area, with the exception of national security and defense sectors. The small-scale community uses of non-timber forest products (NTFPs) to support local ethnic minorities' livelihood may be allowed under strict control, provided that they do not present serious adverse impacts on biodiversity within the zone. 3. ***Sustainable use zone***: management area(s) of high economic values for national economic development and management, and conservation of the protected area(s) itself, thus contributing to the local community and indigenous ethnic minorities' livelihood improvement. After consulting with relevant ministries and institutions, local authorities, and local communities in accordance with relevant laws and procedures, the Royal Government of Cambodia may permit development and investment activities in this zone following the request from the Ministry of Environment. 4. ***Community zone***: management area(s) for socio-economic development of the local communities and indigenous ethnic minorities and may contain existing residential lands, paddy fields, and field gardens or swidden (Chamkar).
Expropriation Law	Dec. 29, 2009	- The main purposes of the law are: (i) ensure in right withdrawal on private properties in fairly, and justice, (ii) ensure in prior compensation fairly, and justice (iii) serve to public and nation benefit, and (iv) develop public physical infrastructures. - The compensation rate should provide fixed asset owners in compliance with a real market rate or subsidy cost in the dateline of the declaration on expropriation. Market rate and subsidy cost were arranged by committee or independent agency through a selection of expropriation committee
Law on Forest	Aug. 2002	- The objective of this law is to ensure the sustainable management of these forests for their social, economic, and environmental benefits, including conservation of biological diversity and cultural heritage. - This law shall be implemented to ensure public participation in

		any government decision that has the potential for heavy impact on concerned general citizens, livelihoods of local communities, and forest resources of the Kingdom of Cambodia. - Any individual who has committed a forestry offense harming the forest ecosystem shall be liable for payment in order to restore or repair the forest ecosystem to its original condition.
Sub-Decree		
Sub-decree No.72 on the EIA Process	Aug. 11, 1999.	- The EIA shall be done on every project and activity, private or public, and shall be reviewed by the MoE before being submitted to the RGC for decision. - The MoE shall: (i) evaluate and review the EIA report in collaboration with other Governmental Institutions and (ii) take appropriate administrative, conduct surveillance and monitor to ensure that the EMP during project construction, operation, and closure, which contained in an approved EIA report. - Prior to implementing the proposed project, the project owner must receive consent from the MoE in advance on the report of IEIA or EIA.
Sub-Decree No. 27 on Water Pollution Control	Apr. 06, 1999	- The purpose of this sub-decree is to regulate the water pollution control in order to prevent and reduce the water pollution of the public water areas so that the protection of human health and the conservation of biodiversity should be ensured. - This sub-decree applies to all sources of pollution and all activities that cause pollution of the public water areas.

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

№	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 20 ^{0} C)	mg/l	< 30	< 80
4	COD	mg/l	< 50	< 100
5	Total Suspended Solids	mg/l	< 60	< 120
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
50	Trichloro ethylene	mg/l	<1	<1
51	Trichloro benzene	mg/l	<2	<2
52	Hexaxhloro cyclohexene	mg/l	<2	<2

Annex 4

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

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

<table>
<tr>
<td>Sub-Decree No.42 on Air Pollution and Noise Disturbance Control</td>
<td>Jul. 10, 2000</td>
<td>
- The purpose of this sub-decree is to protect the quality of the environment quality and public health from air pollutants and noise disturbance through monitoring, curbing, and mitigating activities
- Ambient Air Quality Standards
<table>
<tr><th>Parameter</th><th>1 Hour Average mg/m^3</th><th>8 Hours Average mg/m^3</th><th>24 Hours Average mg/m^3</th><th>1 Year Average mg/m^3</th></tr>
<tr><td>Carbon Monoxide (CO)</td><td>40</td><td>20</td><td>-</td><td>-</td></tr>
<tr><td>Nitrogen Dioxide (NO_2)</td><td>0.3</td><td>-</td><td>0.1</td><td>-</td></tr>
<tr><td>Sulfur dioxide (SO_2)</td><td>0.5</td><td>-</td><td>0.3</td><td>0.1</td></tr>
<tr><td>O Zone (O_3)</td><td>0.2</td><td>-</td><td></td><td>-</td></tr>
<tr><td>Lead (Pb)</td><td>-</td><td>-</td><td>0.005</td><td>-</td></tr>
<tr><td>Total Suspended particulate (TSP)</td><td>-</td><td>-</td><td>0.33</td><td>0.1</td></tr>
</table>
- Maximum Standard of Noise Level Allowable in the Public and Residential Areas (dB(A))
<table>
<tr><th rowspan="2">Area</th><th colspan="3">Period of Time</th></tr>
<tr><th>From 6 am to 18 pm</th><th>From 18 pm to 22 pm</th><th>From 22 pm to 6 am</th></tr>
<tr><td>Quiet Areas
Hospital
Library
School
Kindergarten</td><td>45</td><td>40</td><td>35</td></tr>
<tr><td>Residential Areas
Hotel
Administrative office
House</td><td>60</td><td>50</td><td>45</td></tr>
<tr><td>Commercial and service areas and area of multiple businesses</td><td>70</td><td>65</td><td>50</td></tr>
<tr><td>Small industrial factories mingling in residential area</td><td>75</td><td>70</td><td>50</td></tr>
</table>
</td>
</tr>
<tr>
<td>Sub-Decree No.36 on Solid Waste Management</td>
<td>Apr. 27, 1999</td>
<td>
- The purpose of this sub-decree is to regulate solid waste management in a proper technical manner and safe way in order to ensure the protection of human health and the conservation of biodiversity.
- This sub-decree applies to all activities related to disposal, storage, collection, transport, recycling, dumping of garbage, and hazardous waste.
- The collection, transport, storage, recycling, minimizing, and dumping of waste in the provinces and cities are the responsibility of the authorities of provinces and cities.
</td>
</tr>
<tr>
<td>Sub-decree No.113 on the Management of Urban Solid Waste</td>
<td>Aug. 27, 2015</td>
<td>
- The goal of this sub-decree is to enhance the management of garbage and solid waste of downtowns with effectiveness, transparency, and accountability, referring to ensure aesthetics, public health, and environmental protection.
- The followings are objectives of this sub-decree are (i) Strengthen responsibilities of ministry, institution, skilled unit, sub-national administration and other relevant stakeholders for
</td>
</tr>
</table>

		the management of garbage and urban solid waste; (ii) Entrust function of the management of urban solid waste of municipal, city and district administrations and delegate function of the management of urban solid waste from municipal administration to khan administration; (iii) Determine necessary measures to improve efficiency and safety in the management of urban solid waste, and (iv) Promote public education and citizens 'participation in preparing and implementing measures relating to the management of urban solid waste.
Sub-decree No.189 on Establishment of Enterprise for Managing Transfer Station and Landfill of Solid Waste	Nov. 16, 2020	- Establishment of Enterprise for Managing of Transfer Station and Landfill of Solid Waste (EML) under the governance of MoE for technical aspect and MEF for the financial aspect. - EML is a public enterprise in the form of a state company that contect of a trading enterprise and fully autonomous in leading and management. - EML had priority resources from: • Initial capital from the national budget for investment and operation service • Income from using landfill service fee • Income from the management of integrated infrastructures • Subsidise from the sub-national and national administration • Gift and endowment • Other income from legal sources
Sub-decree No.235 on Management of Drainage and Wastewater Treatment System	Dec. 25, 2017	- Prepare, revise, and enhance the responsibility of Ministries, Institutions, Specialist Units, sub-national administrations, and concerned stakeholders on the improvement of drainage and wastewater treatment system; - Transfer of functions on operation and maintenance of drainage and wastewater treatment system to capital, municipal, district, and khan administrations; - Encourage the participation of development partners, private sectors to develop or to invest in construction, operation, and maintenance of drainage and wastewater treatment system. - Provincial administration shall fulfill its role to support and promote on operation and maintenance of drainage and wastewater treatment system within its jurisdiction and duties as the following: • Cooperate to prepare a master plan for development and management of drainage and wastewater treatment system in towns, districts; • Prepare the key standard specifications and procedures to guide the implementation of concerned laws and legal documents related to the management of drainage and wastewater treatment system; • Facilitate the arrangement of drainage and wastewater treatment system services; • Promote on concerning law and legal documents enforcement related to the management of drainage and wastewater treatment system and penalize on violations; • Conduct and facilitate monitoring and evaluating regarding the management of drainage and wastewater treatment

system;
  - Mobilize funds from development partners, donors, and private sectors to develop a drainage system and wastewater treatment system in towns, districts.
- Usage Services of Sewerage and Wastewater Treatment System: (i) Municipal, District, Khan Administrations shall responsible for managing and providing the services of sewerage system within their jurisdiction area with efficiency, transparency, accountability, and environmental safeguard, (ii) Municipal, District, Khan Administrations can delegate the rights of service providing on sewerage system services to any specialized agencies or private companies, and (iii) The delegation of the rights of services providing on sewerage service to the private company must be strictly carried out in accordance with the procurement procedures.
- Measures on the management of wastewater, drainage, and wastewater treatment system.

Annex 1: Effluent Discharge Standard from Commercial Building, Borey, Satellite City, and Resort or Recreation Center to the Drainage/Sewerage System connected to Centralized WWTP

No.	Parameters	Units	Permissible Standard, Pollutant level that permitted to discharge into the public sewer
1	pH	-	5 - 9
2	TSS	mg/l	< 150
3	Oil and Grease	mg/l	< 20
4	BOD_5	mg/l	< 80
5	COD	mg/l	< 120
6	Detergents- LAS	mg/l	< 15
7	Total Nitrogen (T-N)	mg/l	< 10
8	Total Phosphorus (T-P)	mg/l	< 1
9	Ammonia NH_3	mg/l	< 8
10	Coliform	MPN/100ml	-

Annex 2: Effluent Discharge Standard from Commercial Building, Borey, Satellite City and Resort or Recreation Center Discharges Directly to the Public Waterbody or Drainage/Sewerage System

No.	Parameters	Units	Permissible Standard, Pollutant level allows for discharging into public water
1	pH	-	6 - 8
2	TSS	mg/l	< 80
3	Oil and Grease	mg/l	< 5
4	BOD_5	mg/l	< 30
5	COD	mg/l	< 50
6	Detergents- LAS	mg/l	< 7
7	Tot. Nitrogen (T-N)	mg/l	< 6
8	Tot. Phosphorus (T-P)	mg/l	< 0,5
9	Ammonia NH_3	mg/l	< 5
10	Coliform	MPN/100ml	500 – 2,500

Guideline and design standard		
Technical Guideline on Urban Solid	2016	- The technical guideline is aimed to provide the basic technical standards to sub-national administrations and all stakeholders concerning urban solid waste management in order to ensure

Waste Management		effective protection of public health, the environment, and the conservation of biodiversity. - Managing solid waste in safety to the environment must be considered from the start of the waste generation process until the final storage in the landfill. This management cycle starts with the waste generation stage, temporary storage, cleaning, collection and transportation, recycling, processing, and final storage at the landfill. - Criteria in the selection of landfill site: Some geographical features that require basic considerations for selecting a site for construction landfill are: • Must be at least 10 km from urban are and not far than 50 km; • Must be at least 1 km from the national road, housing, public drainage; • Must be at least 3 km away from school, health center, natural water source (lake, river, beach, Praek, stung); • Must be at least 5 km from the tourist sites, religion site (pagodas, religious temple, ...), and natural resources conservation area; • Must be at least 15 km away from National Heritage sites and historical resort (natural and cultural); • Must be at least 8 km from the airport; • Do not be located in the flooded area and year-round access road to the site; and • Low economic value area and low fertile soil for agricultural crops (priority target). Depending on the current situation in Cambodia, the design of solid waste landfills can be classified into three different categories

3 PROJECT DESCRIPTION

The project aims to improve the population's access to urban infrastructure through three components:

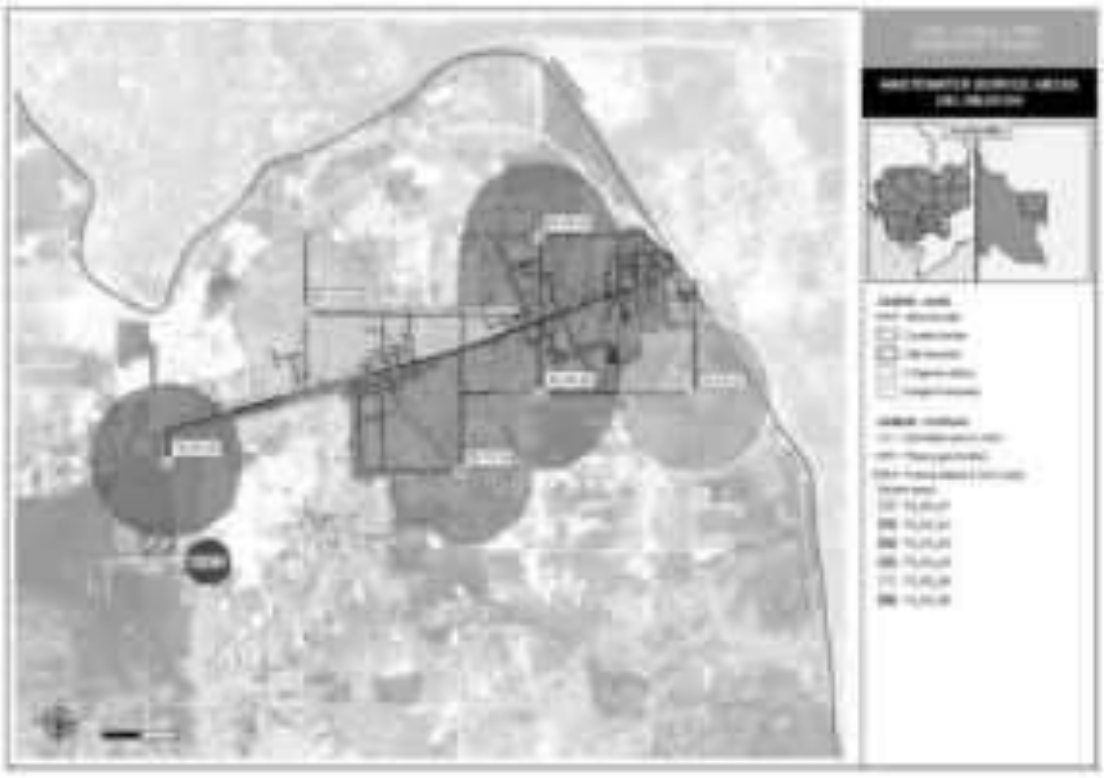
(i) Improved wastewater management systems (pumping stations, network and treatment plants),
(ii) Improved drainage systems to manage stormwater flows, and
(iii) Improved Solid Waste Management systems (including landfill, waste collection & recycling, and transportation vehicles).

The sub-project component for Bavet city are the following:

3.1 Wastewater

- 67km of network
- 6 pumping stations
- 15km of force main
- 1 Wastewater Treatment Plant

Figure 3.1-1: Wastewater collection and treatment subproject in Bavet city



(Source: Egis Oct. 2020)

3.2 Stormwater drainage

- 20km of network
- 2 outfalls

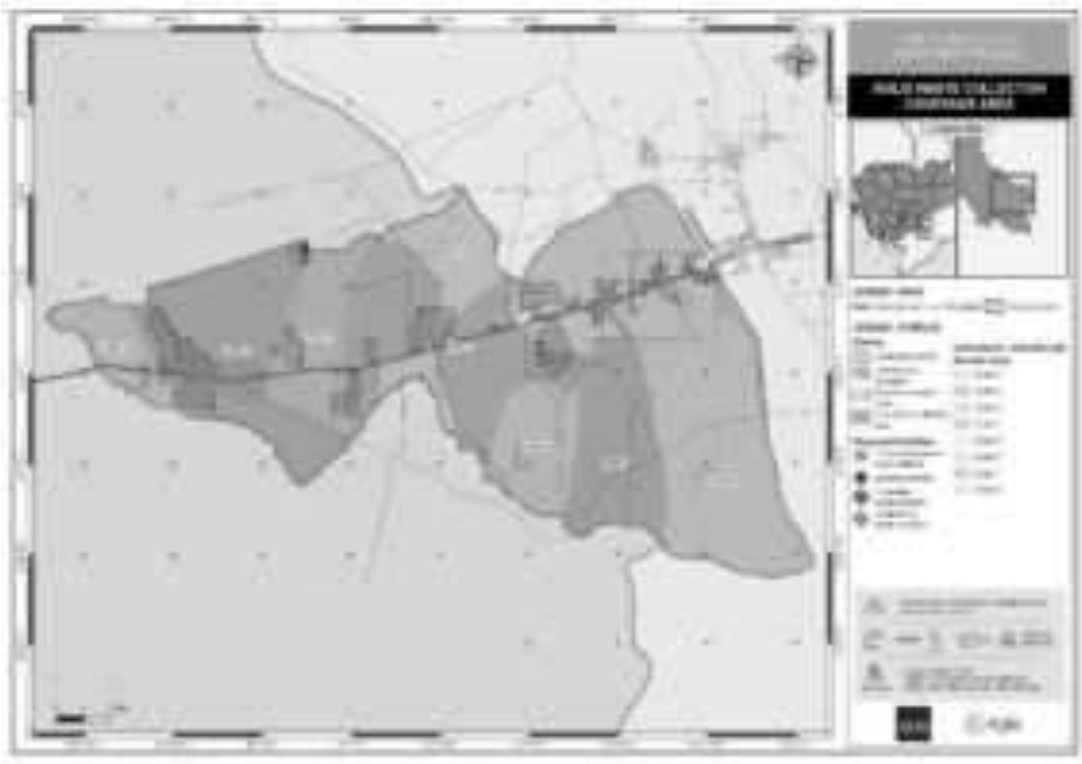
Figure 3.2-1: Stormwater drainage subproject in Bavet city

(Source: Egis Oct. 2020)

3.3 Solid Waste Management Facilities

- At the same location: 1 landfill + 1 sorting plant + 1 composting plant
- 8 centralized collection points

Figure 3.3-1: Solid waste management subproject in Bavet city



(Source: Egis Oct. 2020)

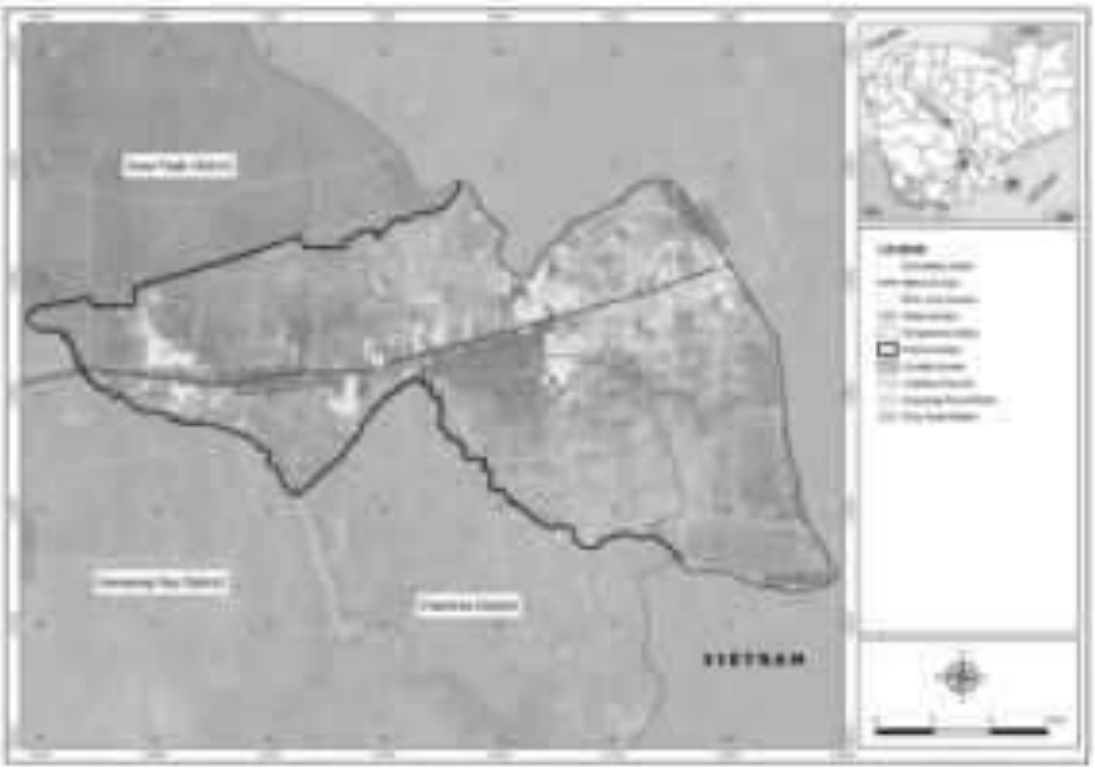
4 BASELINE SURVEY RESULTS

4.1 Overall environmental aspect

4.1.1 Geographical of Bavet city

Bavet city is the second city of Svay Rieng province, located at the south-east of Cambodia and reaching by National Road No.1 with about 160km from Phnom Penh Capital. Bavet city consisted of five sangkat/commune (Bavet, Bati, Chrok Mtes, Prasat, and Prey Ankunh) and had to border with Svay Teab district at west and northwest, Chantrea district at south district, Kapong Ro district at the southwest of Svay Rieng province, and Vietnam at east and northeast, Figure 4.1.1-1. It was the first city to connect from Vietnam by National Road No.1 and a southern corridor between Bangkok and Hochiminh city.

Figure 4.1.1-1: Map of Bavet city



(Source: KCC Nov.2020)

4.1.2 Land use

Bavet city is dominant of agricultural land with about 90% of the total area, follow by an industrial area. The residential and commercial area is a small portion comparing to the agricultural area; however, there are many SEZs running in this city with a huge number of workers (second range of Cambodia), Figure 4.1.2-1.

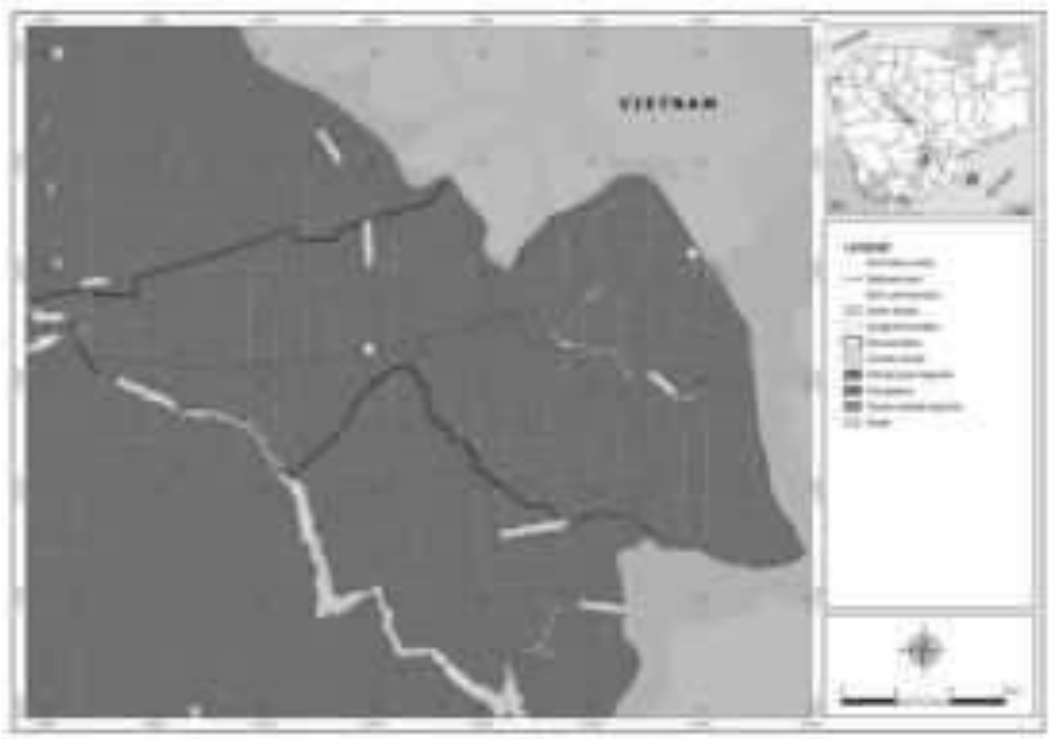
Figure 4.1.2-1: Present Landuse Map of Bavet city

(Source: LCIP Sector Master Plan, Egis June 2020)

4.1.3 Geology and Soil

The geology of Bavet is characterized by young alluvium soils made up of sediment deposits from rivers and streams, Figure 4.1.3-1. These are mainly finer sediments; thus, a high concentration of silt and clay is found in the ground. Clay soils with a very low infiltration rate of this soil (USAID, 1977).

Figure 4.1.3-1: Geological map of the project area



(Source: KCC Nov.2020)

Based on the distribution of the soil type in Cambodia, Crocker, C.D. (1962), the general map of the Kingdom of Cambodia and the exploratory survey of the soils of Cambodia, and Save Cambodia's Wildlife. "Agriculture." Atlas of Cambodia: maps on socio-economic development and environment. Seconded. Phnom Penh, 2014. Alluvial deposits normally result from infertile land, as observed around Bavet.

Figure 4.1.3-1: Soil type of the project area

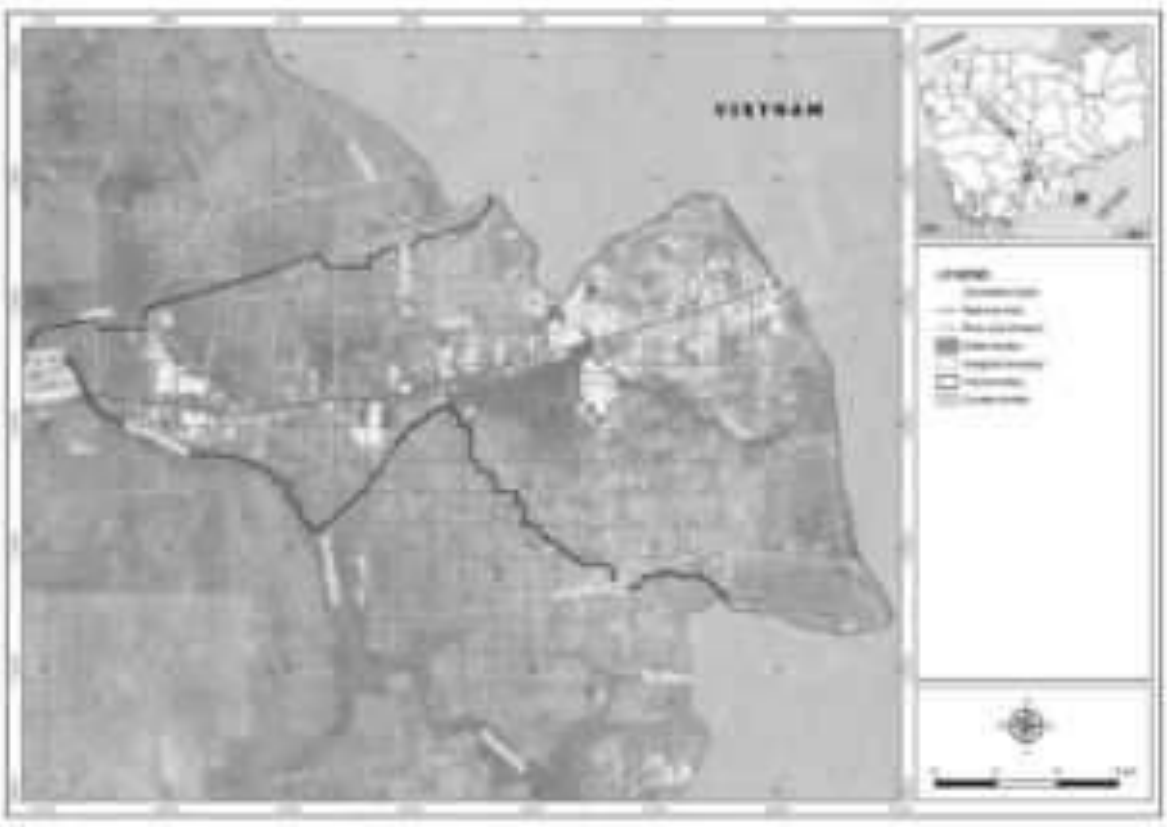
(Source: KCC Nov.2020)

4.1.4 Hydrology

The hydrologic setting of Cambodia is dominated by the Mekong River and Tonle Sap Lake system, which are connected by the Tonle Sap River. The Mekong River enters Cambodia from the north of Lao PDR and flows southeast to the border with Vietnam.

Bavet is located in the floodplain of the Mekong River. The extensive network of tributaries (preaek) and streams are governed by the rise and fall of the Mekong during the annual cycle of the rainy and dry season. The water bodies in the project area include Ou Ta Pov, Stueng Me Sar Thngak, Ou Chrak Mtes / Preaek Chik, Ou Ta Trav, Ou Chek; and Preaek Bong Khvang (Figure 4.1.4-1).

Figure 4.1.4-1: Map of water bodies in the project area



(Source: KCC Nov.2020)

4.1.5 Protection area

Law on Natural Protected Areas, 2008, was enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0208/007. In this law had been categorized the protected areas as following: (1) National Park, (2) Wildlife sanctuary, (3) Protected landscape, (4) Multiple use area, (5) Ramsar site, (6) Biosphere reserve, (7) Natural heritage site, and (8) Marine park. The list name of the national protected areas, as shown in Table 4.1.5-1, and Figure 4.1.5-1.

Table 4.1.5-1: List of protected areas in Cambodia

Kind of Protected Areas	Name of Protected Areas	Location of Protected Areas	Size (Hectare)
1. National Park	1. Preah Soramrith Kosomak “Kirirom.”	Kampong Speu & Kohg Kong	35
	2. Preah Monivong “Bokor.”	Kamport, Kampong Speu, Koh Kong & Krong Preah Sihanouk	140
	3. Preah Sihanouk “Ream	“Krong Preah Sihanouk”	21
	4. Preah Chey Varaman-Norodom “Phnom Kulen”	Siem Reap	37.5
	5. Virakchey	Rottanak Kiri & Stung Treng	332.5
	6. Kep	Krong Kep	5
	7. Botum-Sakor	Koh Kong	171.25
2. wildlife sanctuary	1. Phnom Aural	Kampong Speu, Pursat, & Kampong Chhnang	253.75
	2. Phnom Samkos	Pursat, Battambang, & Koh Kong	333.75
	3. Lompart	Rottanak Kiri & Mondul Kiri	250
	4. Phnom Prich	Mondul Kiri	222.5
	5. Snuol	Kratie & Mondul Kiri	75

	6. Boeng Per	Kampong Thom, Preah Vihear, Siem Reap	242.5
	7. Peam Krosop	Koh Kong	23.75
	8. Roniem Daun Sam	Battambang & Banteay Meanchey	40.021
	9. Kulen-Prum Tep	Preah Vihear, Siem Reap, & Oddar Meanchey	402.5
	10. Phnom Narm Lear	Mondul Kiri	47.5
3. Protected Landscape	1. Angkor	Siem Reap	10.8
	2. Preah Vihear	Preah Vihear	5
	3. Banteay Chhmar	Bantey Meanchey & Oddar Meanchey	81.2
4. Multiple Use Site	1. Dong Peng	Koh Kong	27.7
	2. Samlaut	Pailin & Battambang	60
	3. Boeng Tonle Sap	Kampong Chhnang, Kampong Thom, Siem Reap, Battambang & Pursat	316. 250
5. Tonle Sap Biosphere Reserve	Core zone:		
	-Preak Torl	Battambang	
	-Boeng Tonle Chhmar	Kampong Thom	
	-Stung Sen	Kampong Thom	
6. Ramsar Site	1. Stung Treng	Stung Treng	14.6
	2. Boeng Tonle Chhmar	Kampong Thom	
	3. Koh Karpi	Koh Kong	
7. Heritage Site	1. Phnom Aural	Kampong Speu, Kampong Chhnang & Pursat	
	2. Phnom Samkos	Pursat, Battambang & Koh Kong	
8. Marine Park	1. Koh Ses	Krong Preah Sihanouk	
	2. Koh Thmeiy	Krong Preah Sihanouk	

Source: Annex of Law on Natural Protected Areas, 2008

Figure 4.1.5-1: Map of protected area in Cambodia

(Data source MoE, 2008, and prepared map by KCC Nov.2020)

4.1.6 Climate Change

The average annual temperature is projected to increase by 0.6°C by 2030, by 2.1°C by 2050, and by 3.3°C by the end of the century. The number of days above 35°C is projected to increase from 2-3 days per year to 7-8 days per year. With regards to the projected change in rainfall, some climate models project a decrease, -12% by 2030, -19% for 2060, and -17% for 2090, while others project an increase of up to 30% by the end of the century. Moreover, there is a growing level of consistency between global climate models that, on a global basis, the frequency of tropical cyclones is likely to decrease by the end of the 21st century, but each event will bring more rain. Extreme rainfall will result from tropical depressions crossing into Cambodia from typhoons landing in Vietnam. Studies of the North West Pacific region off the coast of Vietnam project an increase in typhoon strength of around 5% by 2050. This increased strength will also occur for the tropical depressions that form from the degrading typhoons over Cambodia. Because Bavet is on the border, extreme rainfall would be expected to increase (increase in 5-day events of 14 mm - 17.5 mm by 2050). For the long-term horizon (2040), the maximum one-day rainfall intensity is predicted to be larger. An increase of 5% has been applied to all the rainfall intensities.

Svay Rieng is downstream of all other weather influences and, because of the extremely flat terrain, can flood over exceptionally large distances. As a result, widespread flooding from typhoons and other large tropical storm systems occurs across the Province in the wet season. However, the major cause of flooding around Bavet is thought to be due to no natural drainage combined with inadequate drainage that is unable to deal with intense rainfall events exacerbated by obstruction of flows due to poor road design or other anthropogenic activities and interventions.

4.1.7 Existing Network Facilities

- **Road network**

The road network in Bavet had a total length of 165 km includes asphalt/DBST (Double Bituminous Surface Treatment) roads NR No. 1 with a length of 22.7 kilometers, with a 7-kilometer section crossing the town center. The other roads are concrete, laterite roads, or earth roads. The road network also has two reinforced concrete bridges and 105 drainage culverts. High traffic loads are along with NR No.1 since this is the main road crossing between Cambodia and Viet Nam and as ASIAN highway No.1 to connect Bangkok, Phnom Penh, and Ho Chi Minh city.

NR No1 is also an Asian Highway No.1 (AH1) too and connected from Bangkok (Thailand) to Hochiminh city (Vietnam). The bypass of AH1 had been constructed. The upgrade NR No.1 with 4 lanes with a total length of 8km (from International Gate, Mocbai of Vietnam border) ongoing construction by ADB fund (GMS1), Figure 4.2.7-1, and expected completed construction the end of 2020.

Anyway, in Sangkat Chrak Mtes, there are 14.5 km is a sharp road (as a part NR. No1 and provincial road), 0.2 km of concrete road, 23.18 km of laterite road, and earth road 1.55 km, according to the commune database 2019.

Figure 4.2.7-1: The road network in Bavet city

National Road No1 in Bavet city (MGS1-ADB)

Bypass road

Concrete road

Laterite/earth road

- **Electricity network**

The main source of energy of the province is from Vietnam and the hydropower plant, which is managed by Electricite du Cambodge (EDC). Bavet's electricity comes from 14 independent power producers. In 2018, 7,469 households in the city (61%) used electricity, and 467 households (3.81%) used batteries.

As a Cambodian national utility company, it is responsible for operating and managing the power distribution system in the Province of Svay Rieng. EDC is implementing an $84.5 million project, partially funded by the Chinese government, connecting Bavet with the national power grid of Cambodia. A Singapore-based renewable energy company, Sunseap Group Pte Ltd., is implementing a 10 MW solar farm in Bavet.

- **Water supply**

Several operators manage water supply in Bavet city: the Khun Development Company, Figure 4.2.1.6-3, a private company with authorization license from the Ministry of Industry and Handicraft (MIH) (from 2017, until 2022); the Sim Pheakdey Company, another private company; and by SEZ operators for their own needs. The groundwater is the main source of water consumption in Bavet city. Groundwater from deep wells/boreholes (200 m^3/h) for Khun Development Company. For Sim Pheakdey and the SEZ, the number of boreholes in exploitation was not confirmed. About 1,400 households out of 4,000 in Sangkat Bavet receive piped water from two private water suppliers (1,030 with Khun Development and 402 with Sim Pheakdey).

The piped water supply is available for 30% of the population, but due to economic reasons, only 10% is connected to the system. The cost of pipe water is $0.5/$m^3$. Due to water cost, only 2% use it as the main source of drinking water. Within 10% of the population, they use the piped water supply only during electricity cuts and prefer to use their own borehole for main water consumption. The connected houses are mainly along the NR 1 at downtown only.

95% of the population has their own borehole, and 50% uses the water from it as the main source of drinking water. For drinking, the borehole water is always treated, boiled, or filtrated. A comprehensive city survey for this project indicates that 94% of the population treat it daily, 4% weekly, and 2% monthly. 84% of the population boils the water before drinking, 12% use a filter, and 4% drink it after flocculation and settling. The accessibility of bottled drinking water is good in Bavet. Even in remote villages, 20L bottles can be found in small grocery shops.

Figure 4.2.1.6-3: Bavet Water Supply facilities

Khun Development Company

Chiphu Water Supply

- **Solid waste management**

A private company, HYBRID Co, provides the collection and disposal of domestic waste. It is a solid waste company holding a permit letter, released by the MOE on December 28th, 2015, to provide urban waste management service in Svay Rieng province.

The current generation of solid waste in Bavet is estimated at 131 tons per day (tpd), equivalent to 47,690 tons per year (tpy), of which the official collection operator collects 95 tpd, waste pickers collect 13 tpd, and 23 tpd is not collected. The remaining waste was disposed of/burn separately. All the solid waste collected by HYBRID is transported to an existing dumpsite situated 15 km from the city center, where it is disposed of, with some recyclables by scavengers and the burning of wastes. Scavengers at dumpsite work in poor conditions; health risk and safety are the main issues. Base on the truck tracking survey in February 2020, the collection area mostly covers Sangkat Bavet (50%) and part of Chrak Mtes (5%), Bati (5%), and Prey Angkunh (10%). Sangkat Prasat is not covered.

Therefore, only 14% of households are covered by the service, meaning that 86% of households burn their waste or dispose of it on open land. Hotels and households along the

main roads have access to the solid waste collection service. In 2019, the collection service area represented 16% of the urban area. Solid wastes are transported to a dumpsite located 5 km from the city center, and the surface is 4 ha.

Figure 4.2.1.6-4: The truck for solid waster transportation

- **Education facilities**

According to Commune Database (CDB) 2018, there were 17 primary schools, given 5,333 students and 149 teachers in the primary schools, the ratio of students to teachers was 36:1. There were also three secondary schools with 16 classrooms in Bavet. With 748 students and 35 teachers in the secondary schools, the students' ratio to teachers was 22:1. In 2 public high schools with 34 rooms, there were 84 teachers for 2,066 students, corresponding to a 25:1 ratio. These student-teacher ratios are below the international average ratio of 23:1, except for the secondary school level. There is no university in Bavet city.

- **Health facilities**

There is only one referral hospital, two health centers, and three private hospitals to provide medical and health services in Bavet city. The total staff in health centers is 16 persons consist of 6 beds only. One referral hospital and three private hospitals will provide 90 beds to patients. The key health strategy in the City 5-Year Development Plan pertains to access to clean water and sanitation, citing that not all families have access to clean water supply systems and sanitary toilets.

4.2 Characteristic of the project area

4.2.1 Landfill

The baseline survey for environmental resources (physical and biological) will be the focus on the proposed landfill site within a 300m buffer area; see Figure 4.2.1-1. While the baseline survey for social resources (village structure, land use, hydrology, and existing public facilities) and protected area) will expanse to the whole territory of sangkat or the city its shelf. The characteristic in/adjaction of the proposed landfill site is described in the following points.

Figure 4.2.1-1: Map of the landfill site with 300m buffer

(Source: KCC Nov.2020)

4.2.1.1 Location of the landfill site

The proposed landfill site for Bavet city is located in Chrak Mtes village, Sangkat Chrak Mtes, Bavet City, Svay Rieng province, about 10 km from the city center, and 4.8 km from the NR No.1 and start from the entrance gate of Chrak Mtes pagoda. It was next door to the existing dumpsite. See Figure 4.2.1.1-1.

Figure 4.2.1.1-1: Lacation map of proposed landfill site

(Source: KCC Nov.2020)

4.2.1.2 Community structure/type of building

Commonly the Cambodian people prefer to settle their village along the river or road network, which is very easy for supporting their daily livelihood concerning the water supply source, agricultural works, and transportation activities. In Sangkat Crak Mtes the villages scattered along with NR No.1 and along the community roads, Figure 4.2.1.1-1. Houses along the NR No1 are built from brick and wood with tile or zinc roof, while the houses along the community road/small road are built from wood with zinc or tacht roof.

Anyway, within 300m from the landfill site no house, only two cottages of the waste picker at the existing dumpsite, 4.2.1.2-1. The Chrak Mtes village is located in the southern part of 500 meters from the proposed landfill.

Figure 4.2.1.2-1: Map of the closest village to the landfill site

4.2.1.3 Access road

The access road to the proposed landfill site is about 5 km long from NR No.1. The first section is the concrete road with 5m width and 380m length, the second section is laterite road 5m width and 3km length and poor condition, the third section is earth road 4m width and 1km length and the last section is earth road for oxcart using with 3m width and 600m length (Figure 4.2.1.3-1). The last section of the access road needs to rehabilitate. According to the feasibility study reported: a part of the access road to the proposed landfill site has been included in the project's cost.

Figure 4.2.1.3-1: Present condition of the access road

1st section: Concrete road

2nd section: laterite road, but dirty by installing drainage

3rd section: laterite road

Last section to landfill site: earth road

(Source: KCC field survey Sept.2020)

4.2.1.4 Land use/Type of land

There are three types of land use found in the proposed site: agricultural, grassland/bush, and residential area. The land use in Sangkat Crark Mtes indicated that the agricultural land is 68%, residential land is 29%, and the other (forest, lake, etc.) 0nly 3%. However, the land use in and surround the proposed landfill is dominated by agricultural land up to 85%, residential land about 14%, and the shrub/grassland and water body is about 1%.

The agricultural here is 99% is a rice field, and the other 1% is farmland. Only one cultivating rice has been practice (rainy season) here due to the no water in the dry season.
The proposed landfill area for the Bavet city with an approximate area of 20ha, where is unfertile soil or low production of agricultural product. It was covered by small useless trees with a very low-density coverage (shrub) area of 2ha, and the remaining is mainly grassland with small vegetation. In general, the proposed landfill site looks like an abandoned rice field, Figure 4.2.1.4-1a, and Figure 4.2.1.4-1b.

The existing dumpsite is next door to the proposed landfill. All the domestic waste from the Bavet city is dumped here by a private collector called Hybrid Garbage company. This dumpsite seems overcapacity at the moment, and the waste pile is spreading around. The wastewater discharge from the existing dumpsite during the rainy season was found during the survey. Figure 4.2.1.4-2a and Figure 4.2.1.4-2b showed the present condition of the existing dumpsite.

Figure 4.2.1.4-1a: Front view of the proposed landfill site

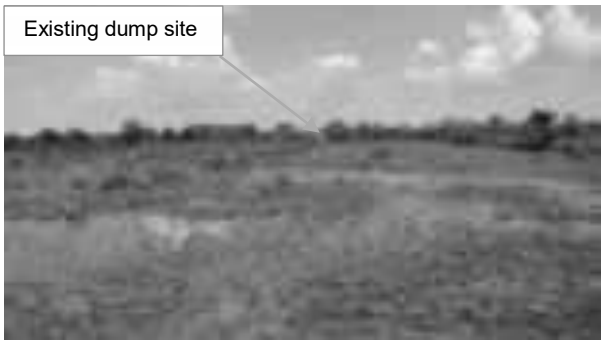


Figure 4.2.1.4-1b: Left-hand side view of the proposed landfill

Figure 4.2.1.4-2a: Front view of the proposed landfill site

Figure 4.2.1.4-2b: Left-hand side view of the proposed landfill

4.2.1.5 Hydrology/river system

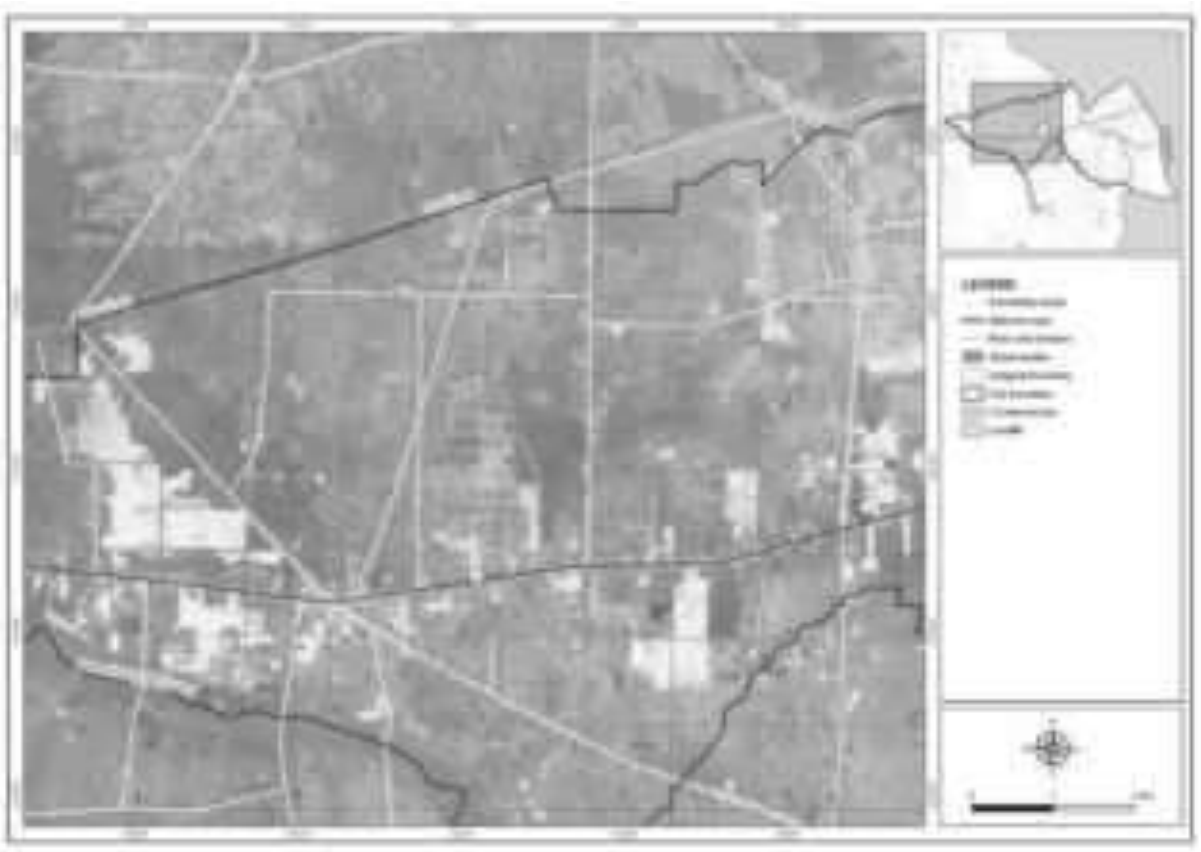
The water bodies within 300m from the proposed landfill site include Ou Chek and agricultural canals. The closest water body to the landfill site is Ou Check, about 250m Figure 4.2.1.5-1. Most of the agricultural canals are drained into the natural stream like Ou Chek and Ou Chrak Mtes. All of the agricultural canals were dried off in the dry season, Figure 4.2.1.5-2.
Preak Chik and Ou Chrak Mtes located at northeast and east of the landfill site with a distance of 3km and 2.5km, Figure 4.2.1.5-3. Man-made ponds for storing rainwater were found in some villager's lot or behind their house.

Figure 4.2.1.5-1: Ou Check-in wet season, Sept.2020

Figure 4.2.1.5-2: Agricultural canal next door to the landfill site

(Source: KCC, Taken in Sept. 2020)

Figure 4.2.1.5-3: Water bodies adjacent to the project site



(Source: KCC Nov.2020)

4.2.1.6 Access to Service Facilities

- **Access to the electricity network**

The electricity pole is available at the Monorrom village 900 meters at the entrance of the existing dumpsite, and the other one in the Chrak Mtes village with about 950m from the proposed landfill, Figure 4.2.1.6-1. Both villages Monorom and Chrak Mtes are access to the electrical power that supply by the DEC branch in Bavet. The existing dumpsite where next door to the proposed landfill also accesses this electrical power system.

Figure 4.2.1.6-1: Electricity power network closest to the proposed landfill

At conner entrance to an existing dumpsite, in village Monorom, 900m from Proposed landfill

In village Chrak Mtes, 950m from Proposed landfill

- **Access to water supply network**

As the location of the proposed landfill site for Bavet is about 10 km from the city center and 4.8 km from NR No.1 where is far away from the small capacity of the existing water supply system, Khun Development as well as Chiphu water supply. However, the groundwater source is available in the whole of Bavet city.

The main water supply source for the community near the landfill in Monorom and Chrak Mtes village is groundwater. Most of the households had their own borehole well, see Figure 4.2.1.6-2. Based on the field survey in Sept. 2020 found that some households have their own man-made pond for storing rainwater for domestic use and feeding cattle and vegetable orchards. All households have at least a few concrete jars/basins to harvest rainwater during the rainy season.

Figure 4.2.1.6-2: Water supply in Monorom and Chrak Mtes village

Borehole well

Man-made pond

- **Solid waste management**

A private company, HYBRID Co, provides the collection and disposal of domestic waste in Bavet city. It is a solid waste company holding a permit letter, released by the MOE on December 28th, 2015, to provide urban waste management service in Svay Rieng province. However, the community nearby the landfill, in Monorom and Chrak Mtes village, is not access to the system. The people use to burn or bury their domestic waste in their land lot.

According to the commune database, there are only 2 households in the whole Sangkat Chrak Mtes that have access to the solid waste collection service. Normally the waste collector company collects only along the main road downtown.

- **Education facilities**

In Sangkat Chrak Mtes, five primary schools were given 1,883 students (931 students are female) and one high school (Chiphu high school) for 1,660 students with 25 classrooms. Chrak Mtes primary school and Prey Tob primary school are located at 1.3km and 1.1km, respectively, from the landfill site, Figure 4.2.1.6-3.

There are no education facilities settled within the buffer zone 300 meters of the proposed landfill site, either the closest village Monorom and Chrak Mtes.

Figure 4.2.1.6-3: The closest schools to a landfill site

(Source: KCC Nov.2020)

- **Health facilities**

In Sangkat Chrak Mtes there is only one clinic and one pharmacy, according to the commune database. The referral hospital and health center are located downtown in Sangkat Prey Angkunh and Sangkat Bavet, about 5 and 11 km from the proposed landfill site.

There are no health facilities settled within the buffer zone 300 meters of the proposed landfill site, either the closest village Monorom and Chrak Mtes.

4.2.1.7 Ecosystem/Protected area

Based on the geographical location of the Bavet city is lying on the flooded plains of the Mekong catchment, were so far away from the protected area in the country, Figure 4.2.1.7-1. Ecosystem types in the Bavet area are grassland, shrubland, and wetlands due to perennial flooding that occurs from the swelling of the Mekong River.

The proposed landfill is commonly covered grassland as abandoned rice filed. Shrub and unvalued trees (Acacia) were found on the small dike of paddy field as well as along the embankment of agricultural canals, Figure 4.2.1.7-2. The bamboo and small trees are found on both sides of the Ou Chek (Figure 4.2.1.5-1) and a partial area at the right side corner of the proposed landfill, Figure 4.2.1.7-3.

No community forest and no fishing ground/lot in/adjacent to the proposed landfill site. Normally the local people collect the bumboo and unvalued trees for constructing the chicken/duck cage or for firewood. The fishing activities have been done in the rice field, agricultural canals, and Ou Chek.

Figure 4.2.1.7-1: Map of project area concerned to the protected area

(Source: KCC Nov.2020)

Figure 4.2.1.7-2: Acassia trees on the dike of the agricultural canal

Figure 4.2.1.7-3: Bumboo and small trees at the corner of the proposed landfill

(Source: KCC field survey in Sept.2020)

4.2.2 The Wastewater Treatment Plant (WWTP)

The baseline survey for environmental resources (physical and biological) will be the focus on the proposed WWTP site within a 300m buffer area. See Figure 4.2.2-1. While the baseline survey for social resources (village structure, land use, hydrology, and existing public facilities) and protected area) will expanse to the whole territory of sangkat or the city its shelf. The characteristic in/adjaction of the proposed landfill site is described in the following points.

Figure 4.2.2-1: Map of the WWTP site with 300m buffer

(Source: KCC Nov.2020)

4.2.2.1 Location

The proposed WWTP site for Bavet city is located in Trapang Thlong village, Sangkat Bati, Bavet City, 5 km from the city center, Figure 2.2.2.1-1. It is located on public land owned by the Bavet Municipality that is adjacent to the existing Materials Recovery Facility (MRF) of the MGS1 project.

It is a part of the Community Forest Chamkar Konkoki under the management of MAFF, and in 2018 the MAFF had given 23 ha to Svay Rieng Provincial Administration to use for constructing WWTP, Annex 1. This site is about 1.5 km from the NR No.1.

Figure 2.2.2.1-1: Location map of the WWTP site

(Source: KCC Nov.2020)

4.2.2.2 Community structure/type of building

Commonly the Cambodian people prefer to settle their village along the river or road network, which is very easy for supporting their daily livelihood concerning the water supply source, agricultural works, and transportation activities. In Sangkat Bati, the villages are scattered along with NR No.1 and along the community roads, Figure 4.2.2.1-1. Houses along the NR No1 are built from brick and wood with tile or zinc roof, while the houses along the community road/small road are built from wood with zinc or tacht roof. Commercial buildings are also found along with NR No.1.

There are three houses in Trapain Phlong village is located in the southern part of 500 meters from the proposed WWTP site. Anyway, within 300m from the landfill site, no house or existing settlement, but a big special economic zone (SEZ) named Manhattan is appearing in the buffer area, 4.2.2.1-1.

In the northern part adjacent to the project location, the ADB-GMS1 project constructed the Materials Recovery Facility (MRF) in 2018, but it was not functional yet, Figure 4.2.2.2-1.

Figure 4.2.2.2-1: MRF building of ADB-GMS1 project

4.2.2.3 Access road

The access road to WWTP is a laterite road connecting from NR 1 with 8 meters wide and 1.5 km length. This road is mubby during the wet season, Figure 4.2.2.3-1. The dry season is dusty, reported by the local people.

Figure 4.2.2.3-1: Access road to WWTP site

4.2.2.4 Land use/Type of land

The land use around the proposed WWTP site is dominated by agricultural land and community forest (Prey Konkoki community forest), the special economic zone in the eastern part, including the land development into urbanization in the short future. Commercial and residential areas are presented along the main road. Anyway, a SEZ (Manhattan) with an area of more than 100ha is located eastern of the proposed WWTP site, Figure 4.2.2.4-1.

The agricultural land (paddy field) is cultivated rice in the wet season and does nothing in the dry season. Anyway, the residential/land development project was found in front of the proposed WWTP site.

Figure 4.2.2.4-1: Landuse of the proposed WWTP

4.2.2.5 Hydrology/river system

Ou Tapov is the mainstream/river closest to the WWTP site; besides that, there are many agricultural canals which was built during the Khmer Rouge regime (1975-1979). The other stream is named Steung Masar Thngak at 8 km southern of the WWTP site, Figure 4.2.2.5-1.

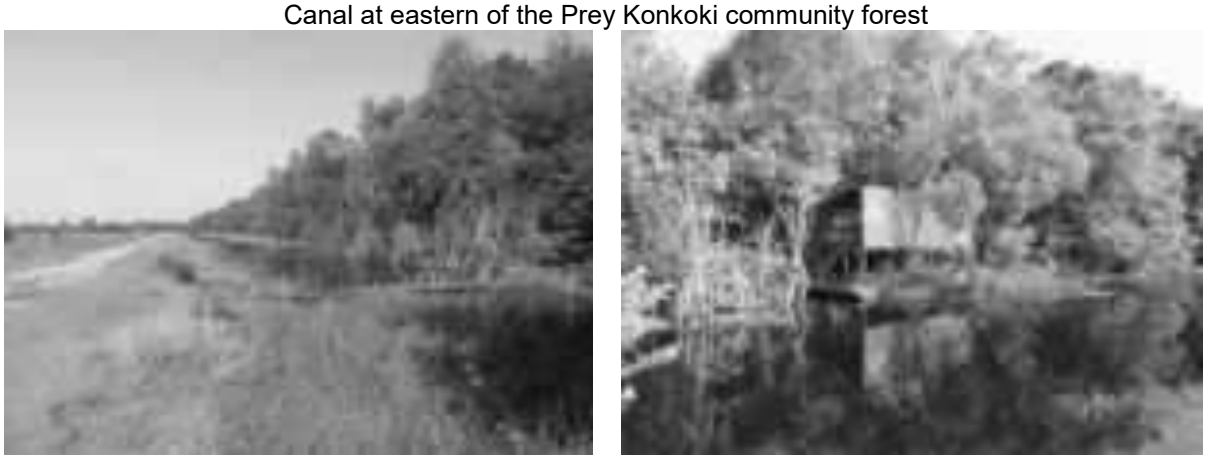
The water bodies within 300m from the proposed WWTP site include agricultural canals in the eastern and southern of the WWTP site and canal surrounding the Prey Konkoki community forest itshelf, Figure 4.2.2.5-2. The canal surrounding this community forest is used to maintain water for agricultural cultivating and protecting the community forest from fire during the dry season.

Figure 4.2.2.5-1: Water bodies within the project area

(Source: KCC Nov.2020)

Figure 4.2.2.5-2: The canal surrounding the Prey Konkoki community forest

Canal at eastern of the Prey Konkoki community forest



Canal at southern of the Prey Konkoki community forest

4.2.2.6 Access to Service Facilities

- **Access to Electricity network**

According to the information condition on social economic of the Sangkat Bati indicated that only 42.8% of the Trapaing Phlong village and 19.6% of Thnal Kaing access to electrical power service system (EDC), and the other three villages are not accessible to the electrical power.

As the WWTP site is located in the Trapaing Phlong village and not so far from the NR No.1, then easy to access the electrical power system. During the field observation in Sept. 2020, found the available electrical pole was installed in front of the WWTP site lot, see Figure 4.2.2.6-1.

Figure 4.2.2.6-1: Electrical pole in front of the WWTP site

- **Access to Water supply network**

Within the 300m buffer to the WWTP site no water supply system. The water supply system is available in the community settled along with NR No.1, which about 1.5 km from the WWTP site.

Based on the field survey in Sept. 2020 found that some households have their own borehole well, due to the water supply in Bavet town is limited in proving service to the dwellers, only in downtown is acceptable to the water supply system.

- **Solid waste management**

A private company, HYBRID Co, provides the collection and disposal of domestic waste. It is a solid waste company holding a permit letter, released by the MOE on December 28th, 2015, to provide urban waste management service in Svay Rieng province. However, this company is limited to providing service. For instance, there are only 37 households in Trapaing Phlong village od Sangkat Bati that access to the waste collection service.

Based on field observation in Sept. 2020 found that the people use to burn or bury their domestic waste in their land lot, and some plastic waste was spread in ope space in the community and in the agricultural canal.

- **Education facilities**

In Sangkat Bati, there are four primary schools with 24 rooms with 325 students and 17 teachers, and one secondary school with 5 rooms with 34 students and 6 teachers. However, all of these schools are far away from the proposed WWTP site (2.2 to 4.5km), Figure 4.2.2.6-2.

There are no education facilities settled within the buffer zone 300 meters of the proposed WWTP site.

Figure 4.2.2.6-2: Map of distance from schools to WWTP

(Source: KCC Nov.2020)

- **Health facilities**

There is only one pharmacy in Sangkat Bati; no health center is settled in the Sangkat administration. The health center is located in the Sangkat Bavet, where is about 2.5 km from the WWTP site, Figure 4.2.2.6-2. There are no health facilities settled within the buffer zone 300 meters of the proposed landfill site.

4.2.2.7 Ecosystem/Protected area

Based on the geographical location of the Bavet city is lying on the flooded plains of the Mekong catchment, were so far away from the protected area in the country, Figure 4.2.1.7-1. Ecosystem types in the Bavet area are grassland, shrubland, and wetlands due to perennial flooding that occurs from the swelling of the Mekong River.

The proposed WWTP site is covered by a regrowing forest of the Community Forest “Chamkar Konkoki”(CFCK). The total area of the CFCK is 404 ha under the management of MAFF, and the whole area is flooded in the wet season; Acacia and Melaleuca leucadendra (Smach) are commonly found in the area, Figure 4.2.2.7-1. Shrub and unvalued trees (Acacia) were found along both sides of the access road as well as along the canals at the boundary line of the proposed WWTP site, Figure 4.2.2.7-2.

There is a shrine located about 100 meters from the project boundary line, Figure 4.2.2.7-3. This is a religious area for the local people to celebrate every year to pray in healthy/peaceful/prosperous and ask for rainfall, etc.

Figure 4.2.2.7-1: Forestry in the proposed WWTP site

Regrowing forest in Community Forest “Chamkar Konkoki”

Melaleuca leucadendra trees (Smach)

Figure 4.2.2.7-2: A shrine named Bos-Mei

(Source: KCC field survey in Sept.2020)

4.2.2.8 Other features

A new laterite road at the northern of the WWTP site is ongoing construction, Figure 2.2.8-1. The MA staff reported that this road to divide the proposed WWTP site 20ha from the Prey Konkoki community forest, and also to be used as an access road to 3ha of arm force base of Bavet administration.

The existing canal 1.3 km, seems to be the best option to collect the WWTP effluents. The canal is connected to Ou Ta-Pov as the final discharging point. However, some sections should be improved due to fillup soil at some point in front of the land lot, Figure 4.2.2.8-2.

Figure 4.2.2.8-1: The new access road at northern of WWTP site

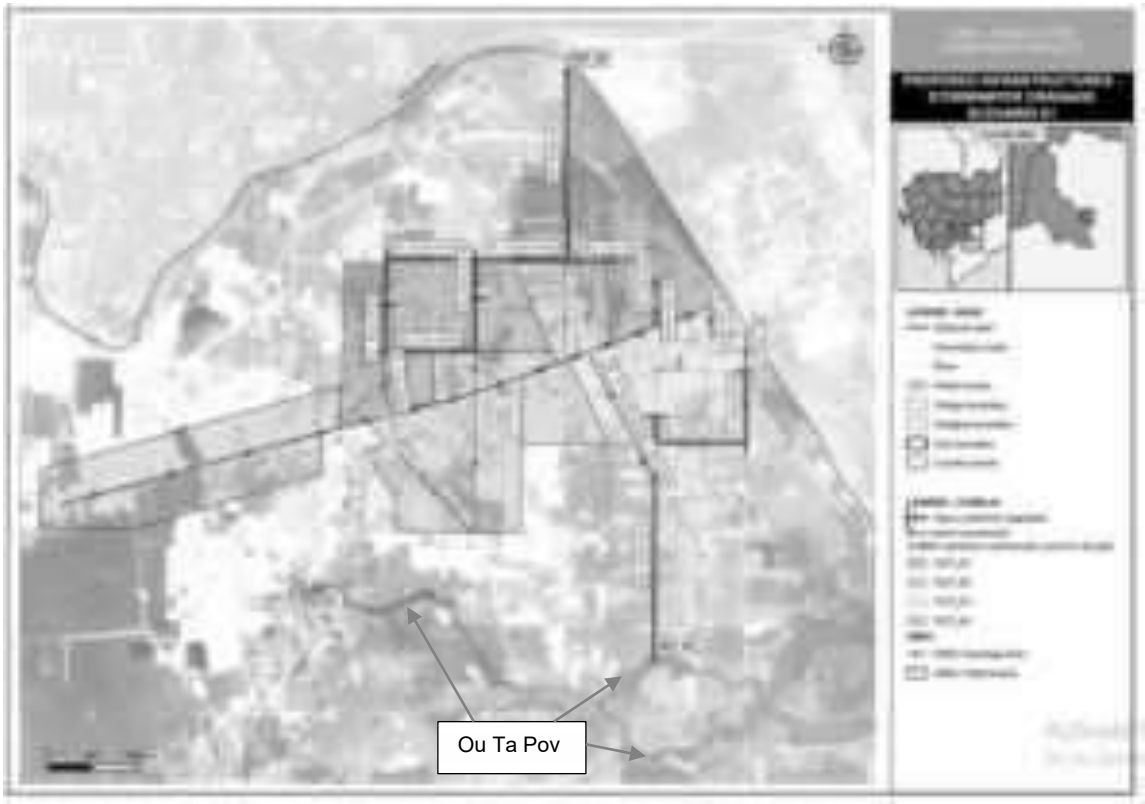
Figure 4.2.2.8-2: The canal to be used for outfall from WWTP

4.2.3 Storm Drainage Outfall

The baseline survey for environmental resources (physical and biological) will be the focus on the proposed storm drainage outfall sites within a 300m buffer area, see Figure 4.2.3-1. While the baseline survey for social resources (village structure, land use, hydrology, and existing public facilities) and protected area) will expanse to the whole territory of Sangkat or the city itself.

Two storm drainage outfalls (Out_03 and Out_04, Figure 4.2.3-1) have been proposed for solving significant floods in Bavet city. The storm drainage subproject is mostly covered the built-up area and the potential development activities in Bavet town. One (Out_04) is in the northern part of the city will discharge to a small canal in Vietnam. The other (Out_03) is in the southern part of the city and will discharge to the Ou Ta-Pov, Figure 4.2.3-1.

Figure 4.2.3-1: Map of the proposed outfall for stormwater drainage with 300m buffer



(Source: Egis FS, Oct.2020)

4.2.3.1 Outfall No.3 (Out_03)

- **Location:** The Out_03 is located (627136 E, 1220517 N) in Chrak Leav village, Sangkat Bavet, Bavet City, Svay Rieng province, about 3.5 km from the NR No.1. It was directly connected to the Ou Ta-Pov, Figure 4.2.3.1-1.

Figure 4.2.3.1-1: The location of the proposed outfall for stormwater drainage

(Source: KCC Nov.2020)

- **Community structure:** As the Out_04 is located far away from the village center, where only rice field is presented, so no settlement is presented within 300m buffer area as well as 1km from the outfall point. The duck farm was found in the wetland close to the outfall point, Figure 4.2.3.1-2. No water and electricity supply within the outfall area, even some village 2km from there. The school, hospital, and heritage place were not found in the buffer zone of 300 meters. The area is dominant of rice field and grassland, but many borrow pits were appeared between 350-500m from the outfall point, Figure 4.2.3.1-1.

Figure 4.2.3.1-2: A duck farm adjacent to the outfall No.3

(Source: KCC Sep.2020)

- **Access road:** The access road to the proposed Out_03 is about 3.5 km long from NR No.1. The first section is 2 km of laterite road with 8m width. The second section to the outfall site is earth road with 5m width as an embankment of the existing canal, poor conditions, and cannot travel during the rainy season.

Figure 4.2.3.1-3: Present condition of the access road

First section: Laterite road

Second section: Earth road

(Source: KCC Sep.2020)

- **Land use:** This outfall area is surrounding by agricultural land and no land development activities, Figure 4.2.3.1-4. Many borrow pits were found not so far away from the outfall point. The outfall site is almost the wetland of the Ou Ta-Pov. Note that the borrow pits here have been used to support the land development in Bavet city.

Figure 4.2.3.1-4: Land use in/adjaction of Out_03

(Source: KCC Sep.2020)

- **Hydrology:** Bavet is located in the floodplain of the Mekong River. The existing open canal connected from the drainage system will discharge into the small river downstream called Ou Ta-Pov, Figure 4.2.3-1. It flows eastwards until it splits into two streams, flowing north and south along the Cambodia side of the border with Vietnam. The area between the two streams appears as a wetland with agricultural fields, and it is identified as a “Reservoir” on Bavet Land Use Plan for 2030.

  The level of water in Ou Ta-Pov rises during the rainy season when the channel bordering Vietnam is flooded and becomes shallow during the dry season. However, the area is the face in flooded back from the Preaek Tapov river during heavy rain. Water

uses of Ou Ta-Pov are for irrigation and animal feeding only. The communities that are far from the city use water coming from wells; irrigation water extracted from Ou Ta-Pov is used for rice growing during the dry season.

Figure 4.2.3.1-5: The water bodies adjacent to the outfall_03

The open canal for a storm drainage system

Ou Ta-Pov

(Source: KCC Sep.2020)

- **Ecosystem/Projected area:** There is no protected areas or forest in Bavet city as well as in the Out_03 area. The dominating landscape in the Bavet area is an agricultural area (rice cultivation), mostly rice fields, an urban area settled along with the NR No.1. The ecosystem in/adjacent to the Out_03 is rice fields and grassland. Shrubland and wetlands are commonly presented in an area along both sides of Ou Ta-Pov.

4.2.3.2 Outfall No.4 (Out_04)

- **Location:** The Outfall No.4 is located (626126 E, 1227269 N) in Ta Boeb village, Sangkat Bavet, Bavet City, Svay Rieng province. It was about 3.4 km from the NR No.1 and very close to the Vietnam borderline, Figure 4.2.3.2-1.

Figure 4.2.3.2-1: Location map of outfall No.4

(Source: KCC Sep.2020)

- **Community structure:** A few residents of Ta Boeb village were found about 1.3km from the Out_04 pint, Figure 4.2.3.2-1. As the rural area, the houses in this village are commonly made of wood with a zinc roof, but within 300m buffer area of the Out_04 no house. No water and electricity supply system within 300m this area. The school, hospital, and heritage place did not found even 1km from the outfall point**.** On the Vietnam side, no settlement near the border, too; only a rice field was found.

- **Access road:** The ring road of Bavet City is located about 800 meters from the Out_04. The access road to Out_04 is the embankment of the existing canal (built by MoWRAM) with a total length of 800m and 8 widths, and it is connected to the ring road. However, it might not travel in the rainy season, muddy and sliddy.

Figure 4.2.3.2-2: Present condition of the access road

The embankment of the existing canal

The ring road of Bavet city

(Source: KCC Sep.2020)

- **Land use:** The area surrounds the Out_04 is agricultural land (rice paddy field), and no settlement at all, Figure 4.2.3.2-1. Grassland was found in the abundant rice field. There is a solar panel park located in the buffer zone of 300m. However, it was situated on the Vietnam side, Figure 4.2.3.2-2.

Figure 4.2.3.2-2: Land use in/adjunction of Out_04

The solar park situated on the Vietnam side

Grassland around Out_04

(Source: KCC Sep.2020)

- **Hydrology/Stream:** The water bodies within the 300m buffer area of the Out_04 are existing canal with 3m and 8m width on the Cambodia side. In Vietnam side has some agricultural canals too. The water flows direction of existing open canal from Cambodia to the Vietnam side across the borderline, Figure 4.2.3.2-3(a). This existing canal is in very good shape and good function (left picture); however, this canal is connected to the narrow stream/canal that needs rehabilitation (right picture) before discharging to the canal in the Vietnam side, Figure 4.2.3.2-3(b).

Figure 4.2.3.2-3: The existing canal at the Out_04

(a) The main canal connects from the ring road to Out_04

(b) A small canal connected from outlet to other canals at the Vietnam side

(Source: KCC Sep.2020)

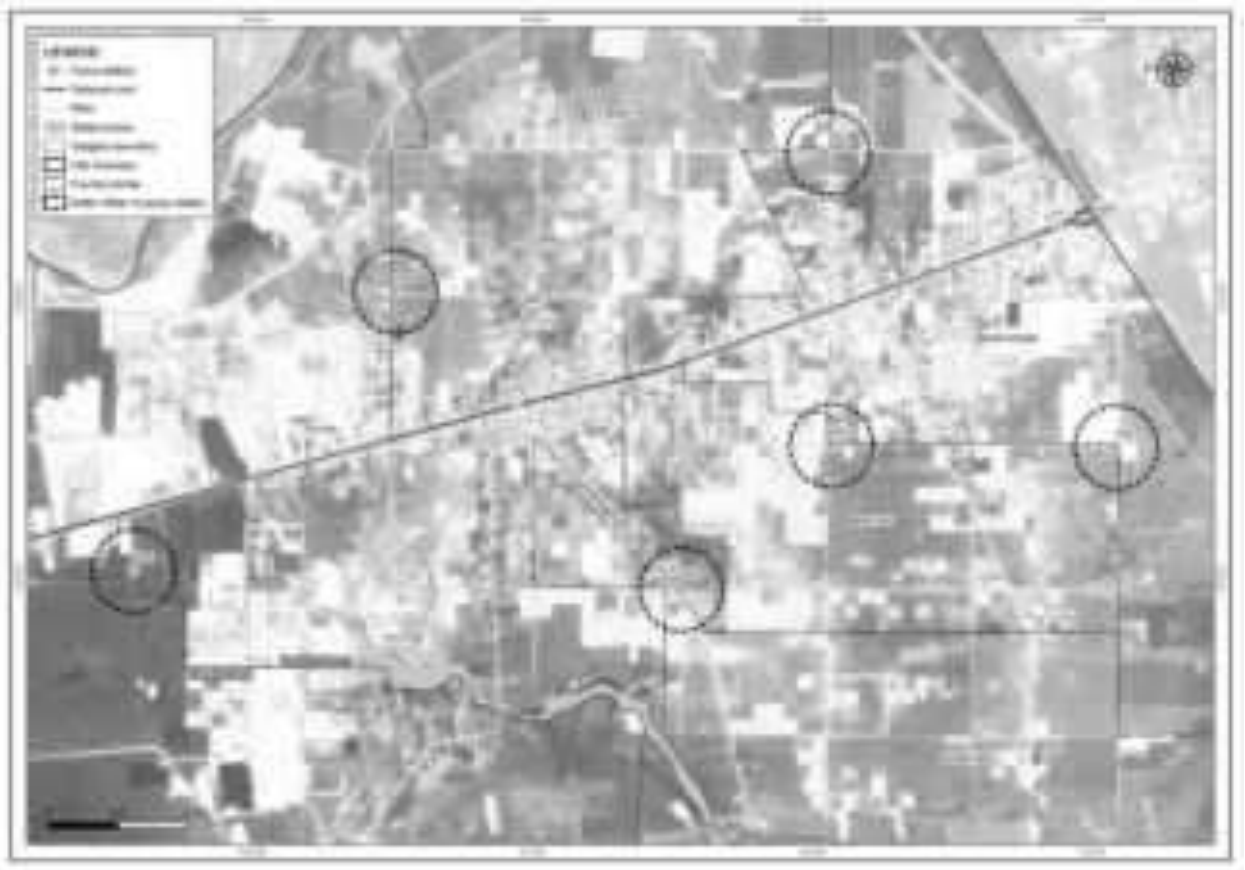
- **Ecosystem/Projected area:** Same as Out_03 area, there are no protected areas or forest in Bavet city as well as in 300m buffer of the Out-04. The dominating landscape in the Bavet area is the agricultural area (rice cultivation). The acacia trees were found on the embankment of the existing canal and ring road, Figure 4.2.3.2-2 and Figure 4.2.3.2-3. However, in Vietnam side has never known so far.

4.2.4 The Pumping Station

The baseline survey for environmental resources (physical and biological) will be the focus on the proposed pumping stations within a 300m buffer area. See Figure 4.2.4-1. While the baseline survey for social resources (village structure, land use, hydrology, and existing public facilities) and protected area) will expanse to the whole territory of Sangkat or the city itself.

The wastewater system in Bavet city has been proposed for six pumping stations to collect wastewater from each catchment or block and send it to treatment in a WWTP where located in Trapaing Phlong village as described in section 4.2.2.

Figure 4.2.4-1: Map of the proposed outlet for stormwater drainage with 300m buffer



(Source: KCC Sep.2020)

4.2.4.1 Pumping Station No.1 (PS_01)

- **Location:** The PS_01 is located in Bavet Kandal village, Sangkat Bavet, Bavet City, Svay Rieng province with coordinate 628190E, 1222964N (Figure 4.2.4-1). It is in the southern part of NR No. 1 and about 2km from NR No.1. It will collect all wastewaters from residential and commercial in the area and convey the wastewater to PS_02.

- **Community structure/type of building:** Commonly, the Cambodians prefer to settle their village along with the road network due to the ease of supporting their daily livelihood, concerning the water supply, electricity supply, agricultural activities, and transportation. Sangkat Bavet is an urban area, and the house was commonly built from brick and wood with tile or zinc roof. In the buffer zone of PS_01, we found one house has been built from brick with two floors. It far around 100m from the proposed site. One temporary cottage was found at the right of way adjacent to the PS.

Figure 4.2.4.1-1: Settles in the buffer zone of PS_01

A house is settled in the eastern part of the PS site (628174E, 1222914N)

A cottage situated on the PS site (628174E, 1222940N)

(Source: KCC Sep.2020)

- **Access road:** The access road to the proposed PS_01 is about 2km long from NR No.01. The first section is 900m of the concrete road with 8m width. The second section of the site is a laterite road of 1.1 km with 8m width. The concrete road is constructing adjacent to the proposed PS site is an alternative for the access road.

Figure 4.2.4.1-2: Present condition of the access road

First section: concrete road

Second section: laterite road

The concrete road adjacent to the pumping station

(Source: KCC Sep.2020)

- **Land use**: The proposed site for PS_01 is surrounded by land development activities, but no buildings yet. The land adjacent to the pumping station will be developed a casino, besides that is agricultural land (rice filed), Figure 4.2.4.1-3.

Figure 4.2.4.1-3: The view of land use within 300m buffer area of PS_01

- **Access to services facilities:**
  - **Electricity Network:** The electricity pole is available around 10 meters from the proposed PS site. The electrical power supply by the EDC branch in Bavet.
  - **Water Supply:** Khun Development and Chiphu water supply serve water supply in Bavet city. The piped water supply is available for 30% of the population, but only 10% is connected to the system. The groundwater source is available in the whole of Bavet city, and most of the households had their borehole well. The accessibility of bottled drinking water is good in Bavet. The pipe water supply is available at the proposed PS_01 site.
  - **Solid Waste Management:** A private company, HYBRID Co, provide the collection and disposal of domestic waste in Bavet city. In Sangkat Bavet, the household waste collected around 50%, meaning a waste of households burn their waste or dispose of it on open land. Waste collection has been served at the PS_01 area.
  - **Drainage Network:** At present, the wastewater flowed through the existing canal along the roadway. The existing open canal is the drainage system.
  - The school, hospital, and heritage place did not found in the buffer zone of 300 meters. There is no significant affected on the socio-economic and environment in this place.

Figure 4.2.4.1-4: The view of PS_FS_01

The existing open canal

The land development next to the PS site

Electricity pole

(Source: KCC Sep.2020)

4.2.4.2 Pumping Station No.2 (PS_02)

- **Location:** The PS_02 is located in Bavet Leu village, Sangkat Bavet, Bavet City, Svay Rieng province with coordinate 626104 E, 1222980 N (Figure 4.2.4-1). It is in the southern part of NR No.1 and about 900m from NR No.1. It uses for collecting wastewater from residential and commercial nearby and receiving wastewater from PS_01.

- **Community structure/type of building:** Commonly, the Cambodians prefer to settle their village along with the road network due to the ease of supporting their daily livelihood, concerning the water supply, electricity supply, agricultural activities, and transportation. Sangkat Bavet is an urban area, and the house was commonly built from brick and wood with tile or zinc roof. The flat house is commonly used in the urban area. In the buffer zone of PS_02, we found flat houses that have been built from brick with two floors. It far around 20m from the proposed site (Figure 4.2.4.2-1).

Figure 4.2.4.2-1: Residents in the buffer zone 300m from PS_02

Flat house situated in the buffer zone of PS_FS_02 (626077E, 1222946N)
(Source: KCC Sep.2020)

- **Access road:** The access road to the proposed PS_02 is about 900m long from NR No.1. The access road of 900m to the proposed PS_02 is an earth road with poor conditions (Figure 4.2.4.2-2).

Figure 4.2.4.2-2: Present condition of the access road

(Source: KCC Sep.2020)

- **Land use**: The proposed site for PS_02 is an urban area. The land adjacent to the station might be developing a settlement area. The area surrounding the PS_02 is an urban built-up area and new house development project, Figure 4.2.4.2-3.

Figure 4.2.4.2-3: The view of land use within 300m buffer area of PS_02

- **Access to services facilities**
  - **Electricity Network:** The electricity pole is available around 10 meters from the proposed PS site. The electrical power supply by the EDC branch in Bavet.
  - **Water Supply:** Khun Development and Chiphu water supply serve water supply in Bavet city. The piped water supply is available for 30% of the population, but only 10% is connected to the system. The groundwater source is available in the whole of Bavet city, and most of the households had their borehole well. The accessibility of bottled drinking water is good in Bavet. The pipe water supply is available at the proposed PS_02 site.
  - **Solid Waste Management:** A private company, HYBRID Co, provides the collection and disposal of domestic waste in Bavet city. In Sangkat Bavet, the household waste collected around 50%, meaning a waste of households burn their waste or dispose of it on open land. The proposed PS_02 area has been served for waste collection.
  - **Drainage Network:** At present, the wastewater flowed through the existing canal along the roadway. The existing open canal is the drainage system.
  - The school, hospital, and heritage place did not found in the buffer zone of 300 meters. There is no significant affected on socio-economic and environment in place

Figure 4.2.4.2-3: The view of PS_02 site

Land development

The existing open canal

Electricity pole

(Source: KCC Sep.2020)

4.2.4.3 Pumping Station No.3 (PS_03)

- **Location:** The PS_03 is located in Ta Boeb village, Sangkat Bavet, Bavet City, Svay Rieng province with coordinate 626122 E, 1225066 N (Figure 4.2.4-1). It is in the northern part of NR No.1 and about 1.2km from NR No. 1. It uses for collecting wastewater from residential and commercial nearby.

- **Community structure/type of building:** Commonly, the Cambodians prefer to settle their village along with the road network due to the ease of supporting their daily livelihood, concerning the water supply, electricity supply, agricultural activities, and transportation. Sangkat Bavet is an urban area, and the house was commonly built from brick and wood with tile or zinc roof. The flat house is commonly presented in the urban area. In the buffer zone of PS_03, we found two houses which have been built from brick and wood with tile roof. One house (626154 E, 1225039 N) is around 40m from the proposed site, Figure 4.2.4.3-1(A). Another house (626063 E, 1225189 N) is about 140m from the proposed site, Figure 4.2.4.3-1(B). A pagoda name Wat Ta Lok (626070 E, 1225302 N) is situated about 250 meters from the PS site, Figure 4.2.4.3-1(C).

Figure 4.2.4.3-1: Houses and pagoda preset in the 300m buffer zone of PS_03

The houses situated in the buffer zone The pagoda situated in the buffer zone

(Source: KCC Sep.2020)

- **Access road:** The access road to the proposed PS_03 is about 1,120m long and connected from NR No.1. The first section is a concrete road with 6m width and 800m length, started from NR No.1. The second section is the earth road with 6m width and 320m length.

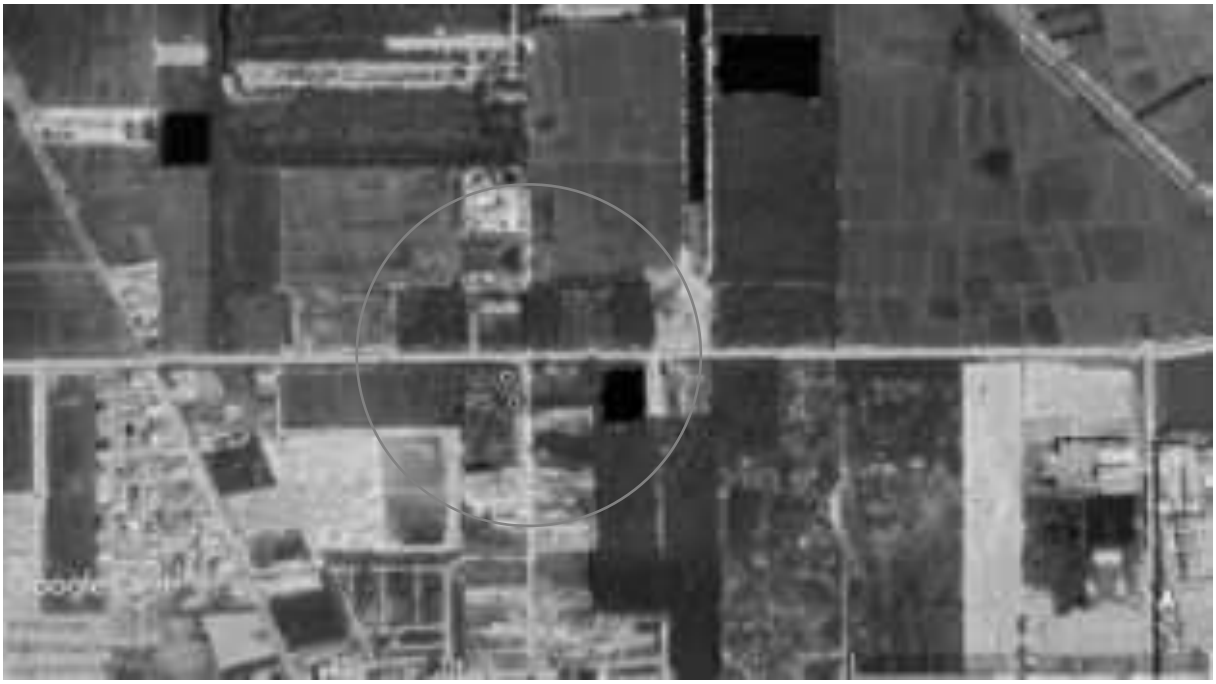
Figure 4.2.4.3-2: Present condition of the access road

The concrete road in the first section The earth road in the second section

(Source: KCC Sep.2020)

- **Land use:** The proposed site for PS_03 is an urban area. However, the area is not much development activities. There are few houses in a big land lot with a large orchard, and acacia trees are in some lot situated within 300m buffer area. It looks like a mixed urban and rural area.

Figure 4.2.4.3-3: The view of land use within 300m buffer area of PS_03



- **Access to services facilities**
  - **Electricity Network:** The electricity pole is stood about 10 meters from the proposed PS. The electrical power supply by the EDC branch in Bavet.
  - **Water Supply:** Khun Development and Chiphu water supply serve water supply in Bavet city. The piped water supply is available for 30% of the population, but only 10% is connected to the system. The groundwater source is available in the whole of Bavet city, and most of the households had their borehole well. The accessibility of bottled drinking water is good in Bavet. The pipe water supply is available at the proposed PS_03 site.
  - **Solid Waste Management:** A private company, HYBRID Co, provides the collection and disposal of domestic waste in Bavet city. As mention in section 3.3, the collection area in Bavet city is limited, so some households burn and bury their waste or dispose of it on open land. However, the 300m resident from the PS_03 site has been accessing to waste collection.
  - **Drainage Network:** At present, the wastewater flowed through the existing drainage system, which has been built by the GMS project.
  - The school, hospital, and heritage place did not found in the buffer zone of 300 meters. There is no significant affected on the socio-economic and environment in place.

Figure 4.2.4.3-4: The view of urban facilities nearby PS_03

The electricity pole

Existing storm drainage of GMS1 project

(Source: KCC Sep.2020)

4.2.4.4 Pumping Station No.4 (PS_04)

- **Location:** The PS_04 is located in public land in Bavet Leu village, Sangkat Bavet, Bavet City, Svay Rieng province with coordinates (625051E and 1221936 N), Figure 4.2.4-1. It is in the southern part of NR No.1 and about 1.7km from NR No.01. It uses for collecting wastewater from residential and commercial nearby.

- **Community structure/type of building:** Commonly, the Cambodians prefer to settle their village along with the road network due to the ease of supporting their daily livelihood, concerning the water supply, electricity supply, agricultural activities, and transportation. Sangkat Bavet is an urban area, and the house was commonly built from brick and wood with tile or zinc roof. The flat house is commonly used in the urban area. In the buffer zone of PS_04, a few houses were found in this area. There are two land lots available for constructing the pumping station PS_FS4. The proposed pumping station is already acquired by MEF/MPWT during the GMS1 feasibility study in the northern site. The southern site as triangle shape is the public land as a right of the way of the road and canal.

Figure 4.2.4.4-1: Residents in the buffer zone of PS_04

A house far around 100m from PS site (624955E, 1221943N)

A house far around 130 from PS site (625021E, 1222042N)

(Source: KCC Sep.2020)

Figure 4.2.4.4-2: The reservation land for PS_04

Triangle shape is the public land

The land was acquired by MEF/MPWT during the GMS1 project

(Source: KCC Sep.2020)

- **Access road:** The access road to the proposed PS_04 is about 1.7km long from NR No.1. This access road is earth road 8m in width and poor condition. Along this road found the drainage system of the GMS1 project under construction, Figure 4.2.4.4-3.

Figure 4.2.4.4-3: Access road and box culvert of GMS1 project

- **Land use:** The proposed site for PS_04 is mixed with urban-rural areas. However, the area is not much residential area, but two land development projects were appeared within 300m buffer area, Figure 4.2.4.4-4. The residential and agricultural area was found in the area; the agricultural land mostly rices field and acasia plantation.

Figure 4.2.4.4-4: The view of land use within 300m buffer area of PS_04

The plantation trees (Acasia)
(Source: KCC Sep.2020)

- **Access to services facilities**
  - **Electricity Network:** The electricity pole is stood about 30 meters from the proposed PS. The electrical power supply by the EDC branch in Bavet.
  - **Water Supply:** Khun Development and Chiphu water supply serve water supply in Bavet city. The piped water supply is available for 30% of the population, but only 10% is connected to the system. The groundwater source is available in the whole of Bavet city, and most of the households had their borehole well. The accessibility of bottled drinking water is good in Bavet. The pipe water supply is available at the proposed PS_04 site.
  - **Solid Waste Management:** A private company, HYBRID Co, provides the collection and disposal of domestic waste in Bavet city. In Sangkat Bavet, the household waste collected around 50%, meaning a waste of households burn their waste or dispose of it on open land. The proposed PS_04 area has been served for waste collection.
  - **Drainage Network:** At present, the wastewater flowed through the existing canal along the roadway. The existing open canal is the drainage system. The precast concrete drain box is found along the access road, and it will be used for the drainage system in Bavet city, which has been built by the GMS project.
  - The school, hospital, and heritage place did not found in the buffer zone of 300 meters. There is no significant affected on the socio-economic and environment in place.

4.2.4.5 Pumping Station No.5 (PS_05)

- **Location:** The PS_05 is located in Ta Pov village, Sangkat Bavet, Bavet City, Svay Rieng province with coordinate (623000 E, 1224015 N), Figure 4.2.4-1. It is in the northern part of NR No.1 and about 1.3km from NR No. 1. It uses for collecting wastewater from residential and commercial nearby, and it conveys the wastewater to PS_06.

- **Community structure/type of building:** Commonly, the Cambodians prefer to settle their village along with the road network due to the ease of supporting their daily livelihood, concerning the water supply, electricity supply, agricultural activities, and transportation. Sangkat Bavet is an urban area, and the house was commonly built from brick and wood with tile or zinc roof. The flat house is commonly used in the urban area. In the buffer zone of PS_05, and few houses settled not so far. There is a concrete mixer plant (Hak Meng Sreng Concrete Company) opposite the proposed PS. According to the site observation, the size of the right of way is unknown, and the canal is too narrow adjacent to the paddy field. The land for installing PS is needed.

Figure 4.2.4.5-1: House/building/structures in the buffer zone of PS_05

	
A concrete mixer plant (622938E, 1224038N)	A house far 200m from the proposed site (623021E, 1223845N)
	
A house far around 110m from the proposed PS site (623022E, 1223932N)	A house far 80m from the proposed PS site (623016E, 1223963N)

(Source: KCC Sep.2020)

- **Access road:** The access road to the proposed PS_05 is about 1.3km long from NR No.1. This access road is a laterite road with 8m width, but poor condition.

Figure 4.2.4.5-2: Present condition of the access road

(Source: KCC Sep.2020)

- **Land use:** The proposed PS site is the agricultural area at present. However, it could transform into urbanization in 20years later, according to the land-use master plan of Bavet. It was rice fields commonly within the 300m buffer area of the PS_05. The tree plantation (Acasia) was found in one lot in the southern area.

Figure 4.2.4.5-3: The view of land use within 300m buffer area of PS_05

- **Access to services facilities:**
  - **Electricity Network:** The electricity pole is not available at this proposed site. However, the electricity is connected from NR No.01 that supply by the EDC branch in Bavet.
  - **Water Supply:** Khun Development and Chiphu water supply serve water supply in Bavet city. The piped water supply is available for 30% of the population, but only 10% is connected to the system. The groundwater source is available in the whole of Bavet city, and most of the households had their borehole well. The accessibility of bottled drinking water is good in Bavet. The pipe water supply is not available at the proposed PS_05 site.

- **Solid Waste Management:** A private company, HYBRID Co, provides the collection and disposal of domestic waste in Bavet city. In Sangkat Bavet, the household waste collected around 50%, meaning a waste of households burn their waste or dispose of it on open land. The proposed PS_05 area has been served for waste collection.
- **Drainage Network:** At present, the wastewater flowed through the existing canal along the roadway. The existing open canal is the drainage system.
- The school, hospital, and heritage place did not found in the buffer zone of 300 meters. There is no significant affected on the socio-economic and environment in place.

Figure 4.2.4.5-4: The existing open canal

(Source: KCC Sep.2020)

4.2.4.6 Pumping Station No.6 (PS_06)

- **Location:** The PS_06 is located in Trapeang Phlong village, Sangkat Bati, Bavet City, Svay Rieng province with coordinate (621149 E, 1222094 N), Figure 4.2.4-1. It is on private land with unknow the landowner, and the land required for this PS is needed. It is in the southern part of NR No.1 and about 400m from NR No.1. It uses for collecting wastewater from residential and commercial nearby, and it conveys the wastewater to the WWTP. It is the main pumping station that collects all wastewater for the whole city and sends it to WWTP.

Figure 4.2.4.6-1: The private land of PS_06

(Source: KCC Sep.2020)

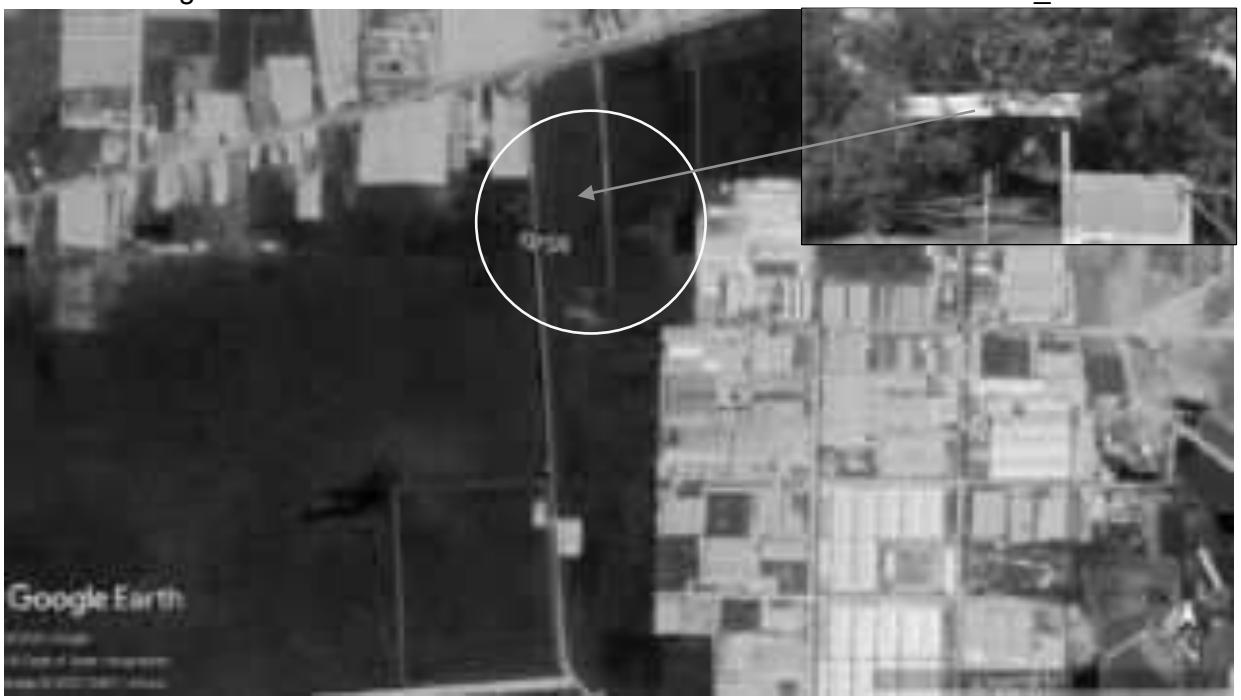
- **Community structure/type of building:** Commonly, the Cambodians prefer to settle their village along with the road network due to the ease of supporting their daily livelihood, concerning the water supply, electricity supply, agricultural activities, and transportation. Houses along the NR No1 are built from brick and wood with tile or zinc roof, while the houses along the community road/small road are built from wood with zinc or thatch roof. There was very far from the settlement area, and It settled adjacent to the Svay Reing Forestry Administration station (Chamka Prey Koki), were about 700m from the WWTP site.

- **Access road:** The access road to the proposed PS_06 is about 400m long from NR No.1. This access road is the laterite road with 8m width, but dusty in the dry season and muddy in the wet season.

Figure 4.2.4.6-2: The facilities of PS_06

- **Land use:** The land use in the Trapaing Phlong village is mixed of urban and agricultural area, however within 300m buffer area of proposed PS_06 is an agricultural area mostly. About 60m from the PS site is the community forest “Chamkar Konkoki” office/station, and close to NR No.1 found a land development lot. All the dack blue area is the community forest “Chamkar Konkoki.”

Figure 4.2.4.6-3: The view of landuse within 300m buffer area of PS_06



- **Access to services facilities:**
  - **Electricity Network:** The electrical pole was installed along the roadway in front of the PS and hope the area will have an electricity connection soon.
  - **Water Supply:** Khun Development and Chiphu water supply serve water supply in Bavet city. The piped water supply is available for 30% of the population, but only 10% is connected to the system. The groundwater source is available in the whole of Bavet city, and most of the households had their borehole well. The accessibility of bottled drinking water is good in Bavet. The pipe water supply is not available at the proposed PS_06 site.
  - **Solid Waste Management:** A private company, HYBRID Co, provides the collection and disposal of domestic waste in Bavet city. In Sangkat Bati, the household waste collected around 5%, meaning a waste of households burn their waste or dispose of it on open land. The proposed PS_06 area has not been served for waste collection.
  - **Drainage Network:** At present, the wastewater flowed through the existing canal along the roadway. The existing open canal is the drainage system.

Figure 4.2.4.6-4: The existing open canal

The existing open canal for storm drainage

The available electricity pole

(Source: KCC Sep.2020)

4.3 Soil quality

4.3.1 Methodology

Soil sampling was taken to analyze for both chemical and physical. There are two samples taken, according to the ToR, one sample at proposed landfill sites (612563 E, 1224870 N) and the other one at proposed WWTP (620759 E, 1220818 N). The location map of soil sampling is showed in Figure 4.3.1-1 and Figured 4.3.1-2.

Sampling method: Remove surface debris (such as plant residues, mulch, or turf thatch) from the surface. The upper topsoil (0-20cm) is also not taken. The soil sample was taken 30cm to 40cm depth and keep it's in plastic bags to maintain the moisture. The activities of soil sampling in both sites are shoed in Figure 4.3.1-3 and Figure 4.3.1-4.

Measurement method: The soil quality analysis following the measurement method that applied in the laboratory. The sieve analysis was conducted to identify the soil particle. The analysis of chemical concentration in the soil has been used as the laboratory's technical method as the descript Table 4.3.1-1.

Figure 4.3.1-1: The location of the sampling point in/adjacent to the landfill site

(Source: KCC Sep.2020)

Figure 4.3.1-2: The location of the sampling point in/adjacent to the WWTP site

(Source: KCC Sep.2020)

Table 4.3.1-1: The method for soil quality analysis in the laboratory

No	Parameter	Unit	Reference Method
1	pH	-	Method 1:5 Soil Water
2	Arsenic (As)	mg/kg-dry	Method 3500-As D, (HNO3,HCl digestion)
3	Cadmium (Cd)	mg/kg-dry	Method 3500-Cd C, (HNO3,HCl digestion)
4	Chromium (Cr-total)	mg/kg-dry	Method 3500-Cr C, (HNO3, HCl digestion)
5	Copper(Cu)	mg/kg-dry	Method 3500-Cu C, (HNO3,HCl digestion)
6	Lead (Pb)	mg/kg-dry	Method 3500-Pb C, (HNO3,HCl digestion)
7	Mercury (Hg)	mg/kg-dry	Method 3500-Hg B, (HNO3,HCl digestion)
8	Nickel(Ni)	mg/kg-dry	Method 3500-Ni C, (HNO3,HCl digestion)
9	Zinc(Zn)	mg/kg-dry	Method 3500-Zn C, (HNO3,HCl digestion)

Figure 4.3.1-3: Soil sampling at the landfill site

Figure 4.3.1-4: Soil sampling at the WWTP site

4.3.2 Finding

4.3.2.1 The Landfill

The soil quality was taken samples, and analyzed in September 2020 and following the ToR provided by the TA consultants. The soil quality at the landfill site was analyzed for both physical (soil particle) and chemical (trace element) characteristics, and the result is showed in Table 4.3.2.1-1 and Table 4.3.2.1-2. The detailed lab sheets are enclosed in Annex 2.

According to the mechanical sieve analysis (Pipette method), the soil particle at the landfill site contained clay 24.30%, fine silt 19.35%, coarse silt 16.36%, fine sand 34.29%, and coarse sand 4.43%. The Soil texture triangle showing the USDA (United States Department of Agriculture) classification system based on the grain size of clay, silt, and sand indicates that the soil at the landfill site is loamy. It is however based on the field visual shown in Figure 4.3.1-3, the clay present in a deeper layer >0.5m.

Table 4.3.2.1-1: The physical characteristic of soil

No.	Soil particle (Size)	Unit	Results
1	Clay (<0.002mm)	%	24.30
2	Fine Silt (0.002-0.02mm)	%	19.35
3	Coarse Silt (0.02-0.05mm)	%	16.36
4	Fine Sand (0.05-0.2mm)	%	34.29
5	Coarse Sand (0.2-2.0mm)	%	4.43

The soil quality in the proposed landfill indicated that the pH characteristic is acid (pH=3.5). Natural soil pH depends on the rock from which the soil was formed (parent material) and the weathering processes that acted on it—for example, climate, vegetation, topography, and time. These processes tend to cause a lowering of pH (increase in acidity) over time.

The other chemical parameters of the soil at the landfill site showed that most of the parameters below the standards, except zinc, are high value than the standards. However, the soil sampling about 200 m from the existing landfill and the soil quality may be polluted from the existing landfill.

Table 4.3.2.1-2: Chemical characteristic of the soil

No	Parameters	Unit	Standards*	Results
1	pH	-	-	3.50
2	Arsenic (As)	mg/kg-dry	<15	ND
3	Cadmium (Cd)	mg/kg-dry	<0.8	0.04
4	Chromium (Cr-total)	mg/kg-dry	<100 (Cr+6)	ND
5	Copper (Cu)	mg/kg-dry	<125	31.18
6	Lead (Pb)	mg/kg-dry	<85	26.42
7	Mercury (Hg)	mg/kg-dry	<0.3	0.17
8	Nickel (Ni)	mg/kg-dry	<35	ND
9	Zinc (Zn)	mg/kg-dry	<140	1864.74

Note: * Prakas on launching of standards of the quantity of toxins or hazardous substances allowed to be disposed of, No. 387 Br.K.B.Sth of MoE, September, (Annex 2: Standards of the quantity of toxic chemicals or hazardous substances allowed in soils) 30, 2015).

4.3.2.2 The WWTP

The soil quality at the WWTP site was analyzed both physical (soil particle) and chemical (trace element) characteristics, and the result is showed in Table 4.3.2.2-1 and Table 4.3.2.2-2. The detailed lab sheets are enclosed in Annex 2.

According to the mechanical sieve analysis (Pipette method), the soil particle at the WWTP site contained clay 12.05%, fine silt 13.15%, coarse silt 17.56%, fine sand 38.73%, and coarse sand 16.96%. The Soil texture triangle showing the USDA classification system based on the grain size of clay, silt, and sand indicates that the soil at WWTP is the loam. However, based on the field visual, Figure 4.3.1-4, the clay present in a deeper layer >0.5m.

Table 4.3.2.2-1: The physical characteristic of the soil

No.	Soil particle (Size)	Unit	Results
1	Clay (<0.002mm)	%	12.05
2	Fine Silt (0.002-0.02mm)	%	13.15
3	Coarse Silt (0.02-0.05mm)	%	17.56
4	Fine Sand (0.05-0.2mm)	%	38.73
5	Coarse Sand (0.2-2.0mm)	%	16.96

The soil quality in the proposed WWTP indicated that the pH characteristic is acid (pH=4.00). Arsenic (As), Chromium (Cr), and Nickel (Ni) concentration in the soil is not presented in the proposed WWTP. So all the parameters are met the standards for toxic chemicals or hazardous substances that can be allowed to exist in the soil. It can say that the soil quality in the proposed WWTP is good.

Table 4.3.2.2-2: Chemical characteristic of the soil

No	Parameters	Unit	Standards*	Results
1	pH	-	-	4.00
2	Arsenic (As)	mg/kg-dry	<15	ND
3	Cadmium (Cd)	mg/kg-dry	<0.8	0.10
4	Chromium (Cr-total)	mg/kg-dry	<100 (Cr+6)	ND
5	Copper (Cu)	mg/kg-dry	<125	10.00
6	Lead (Pb)	mg/kg-dry	<85	24.42
7	Mercury (Hg)	mg/kg-dry	<0.3	0.08
8	Nickel (Ni)	mg/kg-dry	<35	ND
9	Zinc (Zn)	mg/kg-dry	<140	26.14

Note: * Prakas on launching of standards of the quantity of toxins or hazardous substances allowed to be disposed of, No. 387 Br.K.B.Sth of MoE, September, (Annex 2: Standards of the quantity of toxic chemicals or hazardous substances allowed in soils) 30, 2015).

4.3.2.3 Discussion

The soil particle analysis is clay loam at the landfill site and sandy loam at the WWTP site. The soil mixture contains more clay than other types of rock or minerals at the landfill site, and the sand contains more than other minerals at the WWTP site. The soi particle analysis should conduct more points and more depth at the landfill and the WWTP site to understand the soil layer for analyzing the permeability conductivity to protect the groundwater pollution.

Soil quality monitoring at the proposed Landfill and the WWTP indicated that the soil quality was not polluted yet. However, the landfill site is a high-level concentration of the Zinc in the soil has unpredictable and perhaps pollutefrom the existing dumpsite. Acid pH can significantly affect the soil's toxic element levels in the soil, especially the Zinc concentration. Treating an excess of zinc in the soil can also be rather complicated; primarily, we need to focus on treating deficiencies in other elements. Firstly, soil pH should be monitored to ensure it doesn't drop too low. The soil pH very low at the landfill site might consequence from leachate the existing landfill.

4.4 Water quality

4.4.1 Methodology

4.4.1.1 Surface water and groundwater

The water samples were taken from locations representing the water source include stream, canal, and pond, which is closest to the project sites. The location of sampling points and the number of the sample are shown in Table 4.4.1.1-1, Figure 4.3.1-1, and Figure 4.3.1-2. Groundwater samples were taken from the tube/borehole well nearest to the project site. At least 10 minutes of pump out to get a good representative sample from the well was applied, and the storage and taking sample procedure is the same way as the surface water sampling.

Two different types of sample bottles (glass and polypropylene) have been used: 1000ml of polypropylene bottles for physical and chemical parameters, 500ml of polypropylene bottles for biological parameters, and 200ml of glass bottles for biological parameters. For the physical and chemical parameters, the sample fully filled with the water, but for the biological parameters, the sample water was keep some freeboard to allow some air for the microorganism alive. All samples were keeped in an ice box to maintain temperature <5°C after taking. The activities of water sampling are shown in Figure 4.4.1.1-1 and Figure 4.4.1.1-2.

The parameters and measurement methods for surface water and groundwater are listed in Table 4.4.1.1-2. Note that the methodology for water quality measurement is followed the MoE's lab standard.

Table 4.1.1-1: The location of the water sampling points

Sample code	Water sources	Location Description	coordinate
Landfill			
LF_SW	Surface water	The pond behind the house close to the existing dumpsite	613330 E, 1225220 N
LF_GW1	Groundwater	Tube well (35m depth) far 500m from the Landfill	613533 E, 1225367 N
LF_GW2	Groundwater	Tube well (30m depth) near the existing dumpsite	613406 E, 1225145 N
WWTP			
WWTP_SW	Surface water	At borrow pit near the outfall of WWTP	621359 E, 1220649 N
WWTP_GW	Groundwater	Tube well (30m depth)	621568 E, 1220418 N

Table 4.4.1.1-2: The method for water quality analysis in the laboratory

No	Parameters	Unit	Method (*)
1	pH	-	4500-H+/SM
2	Electrical Conductivity (EC)	µS/cm	2510-Ec/SM
3	Dissolved Oxygen (DO)	mg/l	4500-O/SM
4	Biochemical Oxygen demand (BOD_5)	mg/l	5210-BOD/SM
5	Chemical Oxygen demand (COD)	mg/l	5220-COD/SM
6	Carbonate (CO3)	mg/l	2320-A/SM
7	Bicarbonate (HCO3)	mg/l	2320-A/SM
8	Calcium (Ca)	mg/l	3500-Ca-B/SM
9	Magnesium (Mg)	mg/l	3500-Mg-B/SM
10	Sulphate (SO4)	mg/l	4500-SO4/SM

11	Chloride (Cl)	mg/l	4500-Cl/SM
12	Sodium (Na)	mg/l	3500-Na-B/SM
13	Potassium (K)	mg/l	3500-K-B/SM
14	Nitrite (NO2)	mg/l	4500-NO2-3/SM
15	Total Nitrite (TN)	mg/l	4500-N/SM
16	Total Phosphorus (TP)	mg/l	4500-P/SM
17	Iron (Fe2+)	mg/l	3500-Fe/SM
18	Iron (Fe3+)	mg/l	3500-Fe/SM
19	Oil & Grease	mg/l	3500-Grease/SM
20	Cadmium (Cd)	mg/l	3500-Cd/SM
21	Arsenic (As)	mg/l	3500-As/SM
22	Total Coliform	MPN/100ml	3500-coliform/SM
23	E . Coli	MPN/100ml	3500-coli/SM

Note: (*) MoE's lab standard of measurement, Sept. 2020

Figure 4.4.1.1-1: Water quality sampling at the landfill area

Surface water sampling

Groundwater sampling

Figure 4.4.1.1-2: Water quality sampling at the WWTP area

Surface water sampling

Groundwater sampling

4.4.1.2 Bacteriology

The bacterial in the surface water is known as infectious disease-related to fecal contamination. Total coliforms and Escherichia coli (*E. coli*) have been recognized as a suitable microbial indicator of drinking-water quality, primarily because they are easy to detect and enumerate in water. The time between sample collection and analysis should, in general, not exceed 24 hours, and samples are immediately placed in a light-proof insulated and cool box containing melting ice or icepacks with water to ensure rapid cooling. Membrane-filtration (MF) method has been applied for counting the number of total *E. coli,* which quantifies the number of *E. coli* indicators in the lab. Two samples were taken from each proposed site for Landfill and WWTP, and the detailed location description is listed in Table 4.4.1.2-1 and showed in Fig. 4.3.1-1 and Fig. 4.3.1-2.

Table 4.4.1.2-1: Sampling site description

Sample code	Water sources	Location Description	coordinate
Landfill			
LF_SW1	Surface water (Pond)	The pond behind the house close to the existing dumpsite	613330 E, 1225220 N
LF_SW2	Surface water (Stream/Creek)	A stream/creek near the landfill site called Ou Chrak Mtes	613551 E, 1225726 N
WWTP			
WWTP_SW1	Surface water (Borrow pit)	At borrow pit near the outfall of WWTP)	621359 E, 1220649 N
WWTP_SW2	Surface water (Existing canal)	A canal at the boundary line of the proposed WWTP site	621212 E, 1220805 N

Figure 4.4.1.2-1: Water sampling activities for bacteriology indicators at landfill area

Figure 4.4.1.2-2: Water sampling activities for bacteriology indicators at WWTP area

(Source: KCC Sep.2020)

4.4.2 Finding

4.4.2.1 The Surface water and groundwater

The water quality was taken samples, and analyzed in September 2020 and following the ToR provided by the TA consultants. The result of water quality (WQ) analysis, both surface water, and groundwater area showed in Table 4.4.2.1-1 and Table 4.4.2.1-2. These WQ results are presented the baseline water quality in/adjacent to the project area. The detailed lab sheets are enclosed in Annex 3.

Table 4.4.2.1-1 indicated that the parameter oil and grease value of both samples (WWTP_SW, and LF-SW) is higher than the standard (<5mg/l), while the Total Nitrogen of the sample LF_SW is also higher than the standard (0.1-0.6mg/l) too. With the results of the other parameters are meet the standards, and it could be concluded that the physical and chemical water quality in and adjacent to the proposed WWTP and Landfill site is good quality.

Table 4.4.2.1-1: The result of surface water analysis

No	Parameters	Unit	Guideline*	WWTP_SW	LF_SW
1	pH	-	6.5-8.5	7.22	7.09
2	Electrical Conductivity (EC)	us/cm	-	18.8	518.0
3	Dissolved Oxygen (DO)	mg/l	7.5-2	5.1	5.2
4	Biochemical Oxygen demand (BOD_5)	mg/l	<30	4.86	6.15
5	Chemical Oxygen demand (COD)	mg/l	1-8	6.70	10.90
6	Carbonate (CO3)	mg/l	-	0.00	0.00
7	Bicarbonate (HCO3)	mg/l	-	30.82	270.50
8	Calcium (Ca)	mg/l	-	4.89	33.53
9	Magnesium (Mg)	mg/l	-	7.14	49.43
10	Sulphate (SO4)	mg/l	<300	4.28	6.49
11	Chloride (Cl)	mg/l	-	3.83	90.67
12	Sodium (Na)	mg/l	-	4.74	6.21
13	Potassium (K)	mg/l	-	1.11	2.04
14	Nitrite (NO2)	mg/l	-	0.002	0.007
15	Total Nitrite (TN)	mg/l	0.1-0.6	0.412	1.221
16	Total Phosphorus (TP)	mg/l	0.005-0.05	0.012	0.056
17	Iron (Fe2+)	mg/l	-	0.00	0.00
18	Iron (Fe3+)	mg/l	-	0.015	0.019
19	Oil & Grease	mg/l	<5	15.6	9.8
20	Cadmium (Cd)	mg/l	<0.01	0.002	0.004
21	Arsenic (As)	mg/l	<0.001	0.001	0.000

Note: * The Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE, for surface water quality standards (lake and reservoir).

Table 4.4.2.1-2 indicated that the result of measurement on groundwater quality for all three samples has pH value slightly lower than the standard of surface water, which means that the groundwater here is slightly acidity. While the iron (Fe) also value slightly higher than the standard (0.3mg/l) too. Besides pH and Fe parameters, the Total Coliform of the sample LF_GW2 appeared that 68 MPN/100ml, which mean it was polluted by biological contamination; note the location of the borehole-well is close to the dumpsite, so it can be polluted by leachate or dirty environmental surrounding.

Anyway, the results of the other parameters have met the standards for groundwater quality. So it could conclude that the groundwater quality in/adjacent to the proposed WWTP and Landfill site is slightly polluted pH and Fe. The Total Coliform in groundwater in borehole well close to Landfill site also polluted, maybe the leachate from the existing dumpsite or bad environment in place.

Table 4.4.2.1-2: The result of groundwater analysis

No	Parameters	Unit	Guideline*	WWTP_GW	LF_GW1	LF_GW2
1	pH	-	6.5-8.5	6.27	6.14	6.31
2	Electrical Conductivity (EC)	ms/cm	-	89.9	11.5	15.7
3	Total Dissolved Solid (TDS)	mg/l	800	44.8	5.7	7.8
4	Chemical Oxygen demand (COD)	mg/l	-	1.1	1.3	2.2
5	Carbonate (CO3)	mg/l	-	0.0	0.0	0.0
6	Bicarbonate (HCO3)	mg/l	-	25.50	12.46	13.55
7	Calcium (Ca)	mg/l	-	3.15	6.41	6.94
8	Magnesium (Mg)	mg/l	-	9.12	5.03	5.63
9	Sulphate (SO4)	mg/l	250	6.05	3.60	4.66
10	Chloride (Cl)	mg/l	250	5.08	5.11	1.29
11	Sodium (Na)	mg/l	-	8.13	5.89	5.75
12	Potassium (K)	mg/l	-	2.65	2.62	2.19
13	Nitrate (NO3)	mg/l	50	0.004	0.006	0.002
14	Ammonia (NH3)	mg/l	-	0.013	0.011	0.028
15	Total Nitrite (TN)	mg/l	-	0.021	0.019	0.065
16	Total Phosphorus (TP)	mg/l	-	0.011	0.012	0.012
17	Iron (Fe)	mg/l	0.3	0.955	0.377	0.637
18	Mercury (Hg)	mg/l	0.001	0	0	0
19	Manganese (Mn)	mg/l	0.1	0.025	0.054	0.044
20	Chromium (Cr)	mg/l	0.05	0	0.001	0
21	Arsenic (As)	mg/l	0.05	0	0	0
22	Total Coliform	MPN/ 100ml	0	0	0	68
23	E . Coli	MPN/ 100ml	0	0	0	0

Note: * The Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE, for surface water quality standards (lake and reservoir).

4.4.2.2 Bacteriological

- **Landfill**

The WQ sampling date for Landfill, during the rainy season in September 2020, and following the ToR provided by the TA consultants. The *Total Coliform* from the watercourse near the landfill site is 22,000 MPN/100ml and 9,300 MPN/100ml, Table 4.4.2.2-1. The standard of total coliform of public water areas for protecting human health and conserving biodiversity is <5000 MPN/100ml for the river and <1000 MPN/100ml for lake and reservoir.

The high value of the total coliform might come from a polluted source and none pollution source in and adjacent to the sampling site, especially the existing dumpsite. It could be said that the watercourse in the area was polluted by animal manure and the leachate/wash out by rainfall from the existing dumpsite. The bacteriology indicator results indicate that the total coliform is higher at the landfill site compared to the WWTP.

Table 4.4.2.2-1: The result of bacteriological analysis

No	Parameters	Unit	Standards (**)		LF_SW1	LF_SW2
			River	lake and reservoir		
1	*Total Coliform*	MPN/100ml	<5000	<1000	22,000.00	9,300.00
2	*E. Coli*	MPN/100ml	-	-	92.00	50.00

Note: (**) The Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE, for surface water quality standards.

- **WWTP**

The results of the baseline survey in Sept.2020 indicated that the *Total Coliform* value is 6,800 MPN/100ml and 4,700 MPN/100ml, it slightly higher than the water quality standards for the lake and reservoir for sample SW1, Table 4.2.2.2-2. At the same time, the WQ of the sample SW2 is met the value of the standard.

Table 4.2.2.2-2: The result of bacteriological analysis

No	Parameters	Unit	Standards (**)		WWTP_SW1	WWTP_SW2
			River	lake and reservoir		
1	*Total Coliform*	MPN/100ml	<5000	<1000	6,800.00	4,700.00
2	*E. Coli*	MPN/100ml	-	-	40.00	20.00

Note: (**) The Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE, for surface water quality standards (lake and reservoir).

4.5 Flora and Fauna

4.5.1 Objective

The objectives of the flora and fauna survey are to document baseline information, status, and distribution of biodiversity and access its conservation and economic values within the project site and its adjacent areas. The information will help to minimize the negative impact of the development project on biodiversity.

The specific objective, as describes in the following:

- To checklist of tree species in the project area and adjacent.
- To document the endanger species list by IUCN red list and providing recommendations to policymakers for decision making on the negative impact of the development project.

4.5.2 Scope of the study

The flora and fauna survey here is required to determine the species of trees/vegetation, mammal, bird, reptile, amphibian, and bat in the project WWTP and Landfill site in the rainy season were covered in the survey period.

The results of the survey will report in term of present condition on the above resources and listing as local/English name, species name, family, and status in conservation value (common, rare, critical, vulnerable, endanger), and focus on the impact on the biodiversity that will be caused by the (1) the Landfill site is located in the Chrok Mtes village, Sangkat Chrak Mtes, and (2) Wastewater Treatment Plant site in the part of Chamkar Korki Community Forestry (CFCK) in Trapeang Phlong village, Sangkat Bati, Bavet City, Svay Rieng province, see Figure 4.5.2-1.

Figure 4.5.2-1: Location map of the landfill and WWTP site

Landfill site

WWTP site

4.5.3 Methodology

There are two main methodologies to be applied for the study: literature review and field survey in the project area.

4.5.3.1 Literature review

Previous study/research reports on flora and fauna concerning the proposed project sites will be reviewed and abstracted to use in the survey report according to the ToR for the survey.

4.5.3.2 Field Survey

4.5.3.2.1 Flora

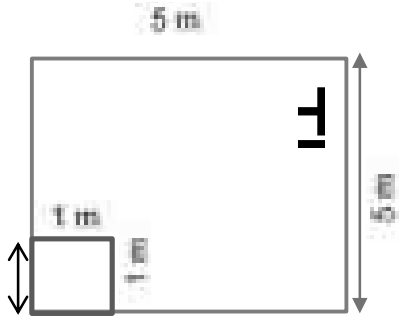
A. Plot design

We were undertaken basic inventories, using quadrate (5 m × 5 m) methodologies, of 2-3 plots to encounter rate, each botanical plot that is divided into two sub-plots within the project site (Figure 4.5.3.2.1-1). Plots were marked using a compass and measuring tape, with each plot divided into 5 m x 5 m quadrats marked using tape. Within each quadrat, all trees with a diameter at breath height (dbh, *c.* 1.3 m) equal to or more than 5 cm were measured (dbh recorded) and identified to species. We have recorded vegetation understory within each plot (sub-plot 2).

In accordance with National Forest Inventory (NFI) 2014 recommendations, rectangular plots were established for increases the accuracy of sampling intensity, especially for recording

larger trees, and ensures the more efficient use of time (Vesa et al. 2014). Under this structure, we use square plots, which are divided into two levels of sub-plots in each plot, including (1) a sub-plot for measuring encountering trees, and small tree (DBH>5cm.); (2) a sub-plot for encountering seedlings, climbers and shrubs (DBH <5 cm.) see Table 4.5.3.2.1-2.

Figure 4.5.3.2.1-1: Plots and sub-plots inventory quadrilateral



There are two and three inventory plots for the Landfill site and WWTP site, and the geographical location was described in Table 4.5.3.2.1-1 and showed in Figure 4.5.3.2.1-2: and 4.5.3.2.1-3.

Table 4.5.3.2.1-1: Field inventory plot locations

Landfill site			**WWTP site**		
Plot No.	**X**	**Y**	**Plot No.**	**X**	**Y**
Plot1	613047	1225310	Plot1	620858	1220831
Plot2	612600	1224908	Plot2	621093	1221190
			Plot3	620950	1220918

Table 4.5.3.2.1-2: Plot design and sub-plot specifications.

Plot & Sub-plots	**Dimensions**	**Area (m^2)**	**Sizes of Trees to be Counted and/or Measured**
Subplot 1: Trees, small tree	5 m × 5 m	25	DBH>5cm.
Subplot 2: Seedlings, vines /climbers	1 m × 1 m	1	DBH <5cm.

Source: Vesa et al., (2014).

Figure 4.5.3.2.1-2: Inventory plots for flora survey for Landfill

(Source: FF survey team, Sept.2020)

Figure 4.5.3.2.1-3: Inventory plots for flora survey for WWTP site (23ha)

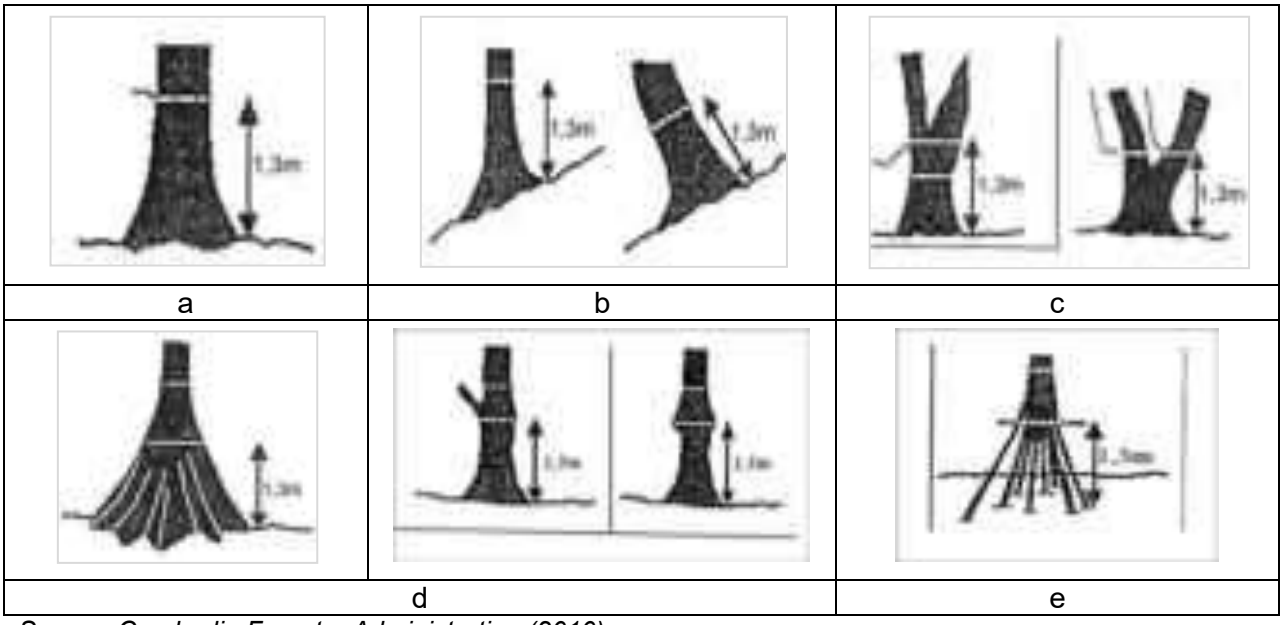
(Source: FF survey team, Sept.2020)

The Wastewater Treatment Plant (WWTP) site (Figure 4.5.3.2.1-3) is covered 23 hectares cut-off from Community Forestry Chamkar Konkorki (CFCK) 404 hectares where locates in southeastern of Bavet city hall.

B. Measuring techniques

The local and scientific names of every tree species were recorded. If a species was unknown, a photograph was taken and shown to local plant 'experts' and/or villagers to enlist their assistance in naming the unknown species. The DBH of every tree with DBH ≥ 5cm was measured with a measuring tape at the height of 1.3 m above the ground using a 1.3 m long stick. The DBH of every tree was measured twice to ensure accuracy.

Figure 4.5.3.2.1-4 (a, b, c,..): Illustrate the applications of measurement techniques



Source: Cambodia Forestry Administration (2010).

If a fork of a tree originated at the height of 1.3 m or more above the ground, the tree was considered to be a single tree, and its DBH was measured below the fork (Figure 4.5.3.2.1-4). If a fork originated below 1.3 m, each trunk was considered to be a single tree, and its DBH was measured at the height of 1.3 m above the ground (e). If a tree had an irregular shape at the height of 1.3 m above the ground because of bulges, wounds, hollowed-out trunks, or branches, its DBH was measured above the deformation (e) (FA, 2010; Vesa et al., 2014).

C. Equipment Tools

- GPS (Garmin; GPSMap 64sc) for marking plot sites.
- Vertex laser is measuring tree height.
- Datasheet; for record species have been Date, time (start and end), Name team leader and members, Plot code (Plot ID), Location name, Plot size in meter, Scale factor, GPS coordinates of the plot, local name, Quality of the tree, diameter at breast height (DBH) in cm, Tree height (H1) in meter and total height.
- Map of Landfill and WWTP site.
- Measuring tapes for measuring the diameter of each tree of breath height (cycle).
- Measuring tapes for measuring each plot's size.

- Compass; for navigation of plot measuring (North)

D. Data analysis

The principal/purpose of this study was to checklist vegetation species that present in landfills and WWTP sites. All vegetation species were entered into Excel Excel and R program (Pin et al., 2013; M. Rejou-Mechain et al., 2017). We also provided local status (Cambodia) and international status by International Union Conservation for Nature (IUCN red list).

4.5.3.2.2 Fauna

4.5.3.2.2.1 Mammal and bird

A. Line transect surveys

There are 3 line transects ranging in Landfill and WWTP site with the average 250-300m per line (Figure 4.5.3.2.2-1 and 4.5.3.2.2-2) were randomly placed in the study area to record the number of large mammals (i.e., red muntjac, wild pig, etc.) and bird species within the study area following the method used to estimate large density ungulates and tropical forest bird community (Gray et al. 2012, Gale et al. 2009).

Two teams of three-four surveyors have walked the transects and conducted the point transect one time a day (start at 06:00 AM in the morning or 16:00 PM in the late afternoon) to record data of mammals and bird species. Handheld GPS devices, compass, and ranger finders were used to measure the UTM of sighting animals, the angle from surveyors to the animal, and to measure the distance to the animals, respectively.

Figure 4.5.3.2.2-1: Map of the line-transects survey of the proposed landfill

(Source: FF survey team, Sept.2020)

Figure 4.5.3.2.2-2: Map of the line-transects survey of proposed WWTP

(Source: FF survey team, Sept.2020)

B. Interviews with Local People

In addition to the standard method we use to survey wildlife above, we will also collect information about wildlife within the study area and its adjacent areas from the opportunistic interview. We conducted a flash interview with local people such as the elderly regarding species that believe to be present in the area and collect documentation of historical records of wildlife species.

4.5.3.2.2.2 Amphibian and Reptile

Due to the proposed landfill is rice fields were presented of water during the period of survey (September 2020), so some reptile and amphibians are active during the day and some action at night then the group of three researchers has been done during the daytime and at night after rain.

The search was mostly along rice puddle field boundaries (small dike) with some vegetation and scattered trees, which are potential for finding reptiles and amphibians. Opportunistic searches for amphibians and reptiles were undertaken by slow-walking searching on the ground, grasses, vegetation, and visual/watch on the trees.

Most species that we found were caught, photographed, and released unharmed. Amphibians and reptiles were identified by using field guides to amphibians of Cambodia (Neang & Holden, 2008), the reptiles of Southeast Asia (Das, 2015).

4.5.3.2.2.3 Bat

A. Live Sampling

The bat survey was basically depending on suitable places of potential to capture bats. The sampling was comprised of 6 mist nets. However, in a given area, there is a relatively open space with shrub and farmland. The survey was conducted during the whole night time in the rainy season (September 5, 2020).

Different species of bats are evolved to adapt to different environmental factors, therefore equip with different senses and skills for researching food, escaping predators, mating, etc. Hence, using an mist net and harp traps are more effective in capturing different species of bats in an open area (Francis 1989, Berry et al. 2004). Mist nets were opened from 5:30—22:00 pm.

All captured bats were measured, photographed, recorded echolocation calls, and identified into species in the field using a field guide and series of published papers (e.g., Francis 2008, Kruskop 2013).

B. Interviews with Local People

Interviews with local people were conducted to determine whether there are any significant bat colonies roosting near the project site.

All measured data were analyzed and used to verify species identification. The conservation status of all recorded bat species during the research survey was determined using IUCN (2017) with additional publication from the region.

4.5.4 Finding

4.5.4.1 Flora

4.5.4.1.1 Literature Review

Landfill site

The landfill site is located in Sangkat Chrak Mtes of Bavet city were lies on downstream flat Mekong Delta (MRC, 2005), but not directly with the Mekong flooding. There are several species that form woody lianas under more favorable conditions, maintain a shrubby growth form in flooded habitat. The surrounding of the proposed landfill is dominated by agricultural lands, with sparse and scattered grassland and shrubland in few places (ADB, 2012).

The flooded area was providing the common (stunted) tree, and shrub species are *Barringtonia acutangula, Bridelia cambodiana (Euphorbiaceae), Brownlowia paludosa (*Tiliaceae*), Capparis micrantha (*Capparaceae*), Crataeva nurvala, C. roxburghii, Coccoceras anispodum, Croton mekongensis (*Euphorbiaceae*), Cudrania cambodiana, Dalbergia entadoides, Dalbergia pinnata (*Papilionoidae*), Ficus heterophylla, Gardenia cambodiana (Rubiaceae), Gmelina asiatica, Hymenocardia wallichii, Phyllanthus taxodiifolia (*Euphorbiaceae*), Powpowia diospyrifolia (*Annonaceae*), Terminalia cambodiana (*Combretaceae*) and Vitex holoadenon* (Colin P. *et al*., 2006).

WWTP site

Surround the proposed WWTP site; many industrial activities have been increased, from four factories in 2006 and special economic zones, dry ports are operated which started operations. Furthermore, there have been private lands and characterized by grassland, sediment deposits

from rivers and streams (ADB, 2019). The proposed WWTP site 20 ha is a part of Community Forest “Chamkar Konkoki” (CFCK), where is lowland and flooded plain area in the rainy season, and height acid which was fully providing of dominance flooded species of Melaleuca quinquenervia and tree plantation. Acacia and Melaleuca leucadendra (Smach) are commonly found in the area.

The Community Forestry “Chamkar Konkoki” (CFCK) had a total area of 404 ha and established by declaration No 605/15 Dec 2009 of Ministry of Agriculture, Forestry Fishery (MAFF) with the objectives of protection, sustainable use by the community, biodiversity conservation, and sustainable development, and traditional use of non-timber forest products by community living in a remote area.

Since 1994, the Forest Department of MAFF was celebrated National Tree Plantation with *Acacia auriculiformis Muell* species in 20 ha area. The local peoples were inserting tree species include *Acacia auriculiformis Muell, Melaleuca quinquenervia*, *Hopea odorata Roxb, Dipterocarpus alatus Roxb, in 264 hactares* (Chhem et al., 2000).

4.5.4.1.2 Field Inventory

Landfill site

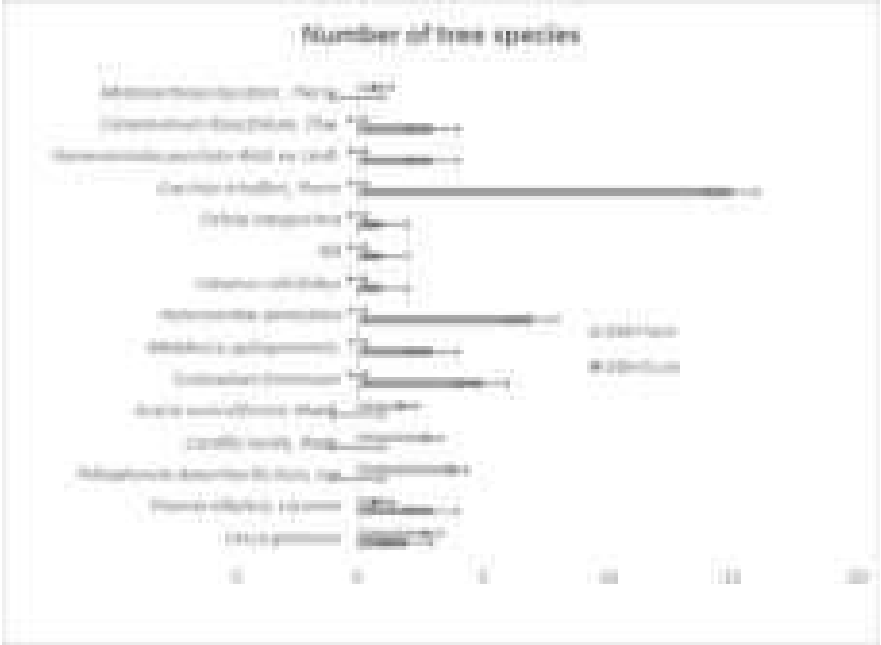
Based on the field survey on 2 plots and 4 subplots that selected for the tree/vegetation inventory in the proposed landfill site and adjacent site, was found 15 different species and 12 families who are common species in the local status, except 5 species such as *Garcinia schefferi, Pierre*, *Cratoxylum formosum Melaleuca quinquenervia, Acacia auriculiformis Muell.,* and *Calamus salicifolius* were classed in least concern (LC) that list by IUCN 2020.

Our result showed that a number of *Garcinia schefferi, Pierre* is dominant species which was a total number of 15 stems (Dbh<5cm), and second *Heterosmilax paniculate* 7 stems (Dbh<5cm) (Figure. Therefore, we also recorded *Cratoxylum formosum*, *Peltophorum dasyrrhachis Kurz.var, Payena elliptica Lecomte., Carallia lucida, Roxb., Melaleuca quinquenervia, Hymenocardia punctata Wall. ex Lindl., Acacia auriculiformis Muell., Litsca glutinosa, Cinnamomum litsacfolium, Thw., Calamus salicifolius, Ochna integerrima,* and *Melanorrihoea laccifera, Pierre (*Table 4.5.4.1.2-1) and (Figure 4.5.4.1.2-1). Table 4.5.4.1.2-1 listed the tree species with local grade and status in IUCN red-list. Some pictures are enclosed in Annex 4.

Table 4.5.4.1.2-1: List of tree/vegetation species of two plots in the proposed landfill site

N	Scientific_name	Family	# of trees		Local Grade	IUCN
			Dbh>5cm	Dbh<5		
1	*Melanorrihoea laccifera, Pierre.*	Anacardiaceae	1		Luxury	
2	*Peltophorum dasyrrhachis Kurz, var*	Caesalpiniaceae	4		1	
3	*Payena elliptica, Lecomte*	Sapotaceae	1	3	2	
4	*Carallia lucida, Roxb.*	Rhizophoraceae	3		3	
5	*Cratoxylum formosum*	Hypericaceae		5	3	LC
6	*Melaleuca quinquenervia*	Mytaceae		3	3	LC
7	*Hymenocardia punctata Wall. ex Lindl.*	Smilacaceae		3	3	
8	*Acacia auriculiformis Muell.*	Mimosaceae	2		nc	LC
9	*Ochna integerrima*	Ochnaceae		1	nc	
10	*Heterosmilax paniculata*	Smilacaceae		7	Climber	
11	*Garcinia schefferi, Pierre*	Guttiferae		15	NTFPs	LC
12	*Calamus salicifolius*	Palmae		1	NTFPs	LC
13	*Litsca glutinosa*	Lauraceae	3	2	Medical Plants	
14	*Cinnamomum litsacfolium, Thw.*	Lauraceae		3	Medical Plants	
15	*NA*	NA		1	NA	
	Total		14	44		

Figure 4.5.4.1.2-1: Number of vegetation species grey color (dbh >5 cm) and yellow color (dbh<5cm) with standard error (dark grey)



WWTP site

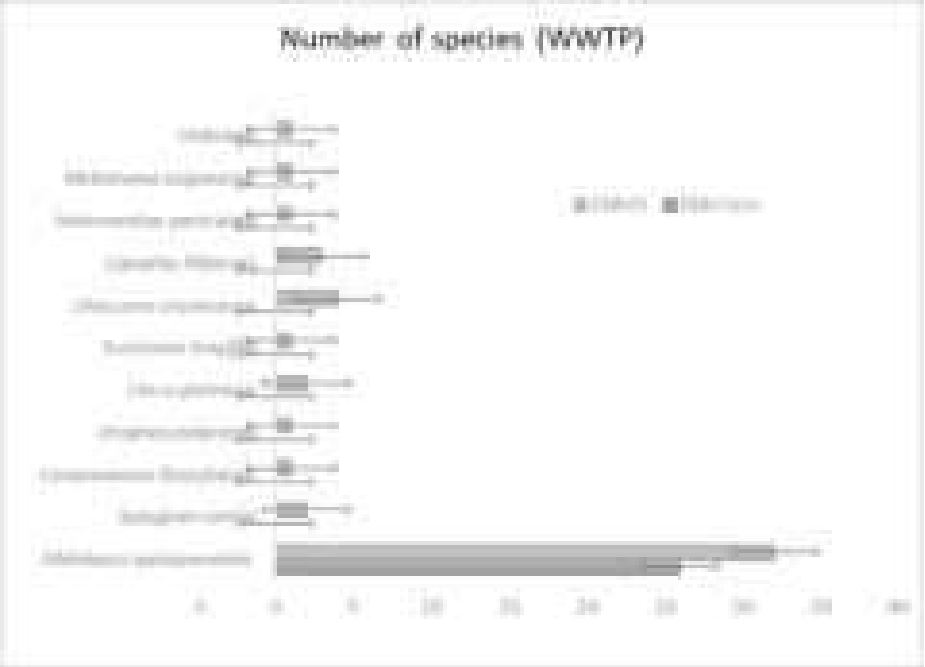
Based on the 3 plots and 6 subplots that selected for the tree/vegetation inventory in the project area (WWTP) of approximately 20 ha, was found 11 different species and 7 genera which mostly are common species in the local status, except 2 species such as; *Melaleuca quinquenervia Syzygium cumini* were classed in the least concern (LC) that list by IUCN 2020.

Our result suggested that a number of *Melaleuca quinquenervia* is the dominant species, which was a total number of 74 vegetations such as 26 stems (Dbh>5cm), and 48 seedlings (Dbh<5cm). Therefore, we were also recorded *Dioscorea oryzetorum, Cassytha filiformis, Syzygium cumini, Litsca glutinosa, Cinnamomum litsacfolium, Thw., Orophea polycarpa, Heterosmilax paniculate, Eurycoma longiflia, Melastoma saigonense (*Table 4.5.4.1.2-2) and Figure 4.5.4.1.2-2. In Table 4.5.4.1.2-2 listed the tree species with local grade (MAFF) and status in IUCN red-list. Some pictures are enclosed in Annex 4.

Table 4.5.4.1.2-2: List of tree/vegetation species of three plots in the proposed WWTP site

N	Scientific_name	Family	# of tree		Local Grade	IUCN
			Dbh>5cm	Dbh<5		
1	*Melaleuca quinquenervia*	Mytaceae	26	32	3	LC
2	*Syzygium cumini*	Myrtaceae		2	3	LC
3	*Cinnamomum litsacfolium, Thw.*	Lauraceae		1	3	
4	*Orophea polycarpa*	Annonaceae		1	nc	
5	*Unknown*	Unknown		1	Climber	
6	*Cassytha filiformis*	Lauraceae		3	Climber	
7	*Heterosmilax paniculata*	Smilacaceae		1	Climber	
8	*Dioscorea oryzetorum*	Dioscoreaceae		4	Climber and NTFPs	
9	*Eurycoma longiflia*	Simaroubaceae		1	Medical Plants	
10	*Litsca glutinosa*	Lauraceae		2	Medical Plants	
11	*Melastoma saigonense*	Melastomaceae		1	shrub	
	Total		26	48		

Figure 4.5.4.1.2-2: Diagram show number of tree/vegetation species in all plots dbh<5 cm dark yellow, and dbh>5 cm blue with standard error grey color



4.5.4.1.3 The estimation of vegetations

Landfill site

Based on the two plots survey, it can estimate the total number of the tree, diameter > 5cm, will be cut in the proposed landfill area of 20ha. In Table 4.5.4.1.3-1 is showed that the vegetation estimation with Dbh>5 cm in average number of 2,800 (±1,600) stems/ha with volume 148 (±35.26) m^3/ha, within 4,400 stems/ha (plot_1), 1,200 stems/ha (plot_2). However, the proposed landfill site is forest/vegetation cover about 10% of the total area of only 2ha (Figure 4.5.4.1.3-1).

Therefore, the total tree numbers will be cut in the whole proposed landfill area is 2,800 stems/ha multiply 2ha equal **5.600 steams**. According to the previous projects such as Sesan Hydropower, Nation Raod No 48, the MAFF forestry conservation team indicated that anyone who cut 1 tree needs to replant 1 tree. The new development landfill here will require to compensate as replanting trees with a total number of **5,600 trees.**

Table 4.5.4.1.3-1: The vegetation estimation per hectare with standard errored (SE±)

Plots	Dbh>5cm in all plots		Dbh>5cm/ha	
	# Stems	Volume (m^3)	# Stems/ha	Volume (m^3/ha)
Plot_1	11	0.46	4,400	183.25
Plot_2	3	0.28	1,200	112.72
Total	14	0.740	5,600	295.97
Mean/Average			**2,800**	**148.00**
SE±			**1,600**	**35.26**

Figure 4.5.4.1.3-1: Forest coverage in the proposed landfill site

(Source: FF survey team, Sept.2020)

WWTP site

Based on the three plots survey, it can estimate the total number of the tree, diameter > 5cm, will be cut in the WWTP site of 20ha. From Table 4.5.4.1.3-2 is showed that the vegetation estimation with Dbh>5 cm in average number of number which was totally 3,467 (±2,469) stems/ha (*Melaleuca quinquenervia*[1] is dominant species) with volume 516.70 (±126.06) m^3/ha, within 8,400 stems/ha (plot_1), 800 stems/ha (plot_2), and 1,200 stems/ha (plot_3). As known, the WWTP site with a total area of 20ha is located in a part of Community Forestry Chamkar Korki (CFCK) in Sangkat Bati of Bavet City where replated trees since 1994 and dominant of Melaleuca trees (Figure 4.5.4.1.3-2).

However, the forestry conservation team of MAFF indicated that anyone who cut 1 tree needs to replant 1 tree. According to the law on forestry in article 11, "The Permanent Forest Estates shall be managed with the objective to increase to the maximum extent the social, economic, environmental, and cultural heritage benefits for the Kingdom of Cambodia and its people according to the principle of sustainable forest management." So the new development landfill here will require to compensate as replanting trees with a total number of **69,340 trees.**

Table 4.5.4.1.3-2: The vegetation estimation per hectare with standard errored (SE±)

Plots	Dbh>5cm in all plots		Dbh>5cm/ha	
	# Stems	Volume (m^3)	# Stems/ha	Volume (m^3/ha)
Plot_1	21	1.06	8,400	423.71
Plot_2	2	0.08	800	30.96
Plot_3	3	0.16	1,200	62.03
Total	26	1.292	10,400	516.70
Mean/Average			**3,467**	**172.23**
SE±			**2,469**	**126.06**

[1] *Melaleuca quinquenervia* that classed in third grade by MAFF

Figure 4.5.4.1.3-2: Forest coverage in the proposed WWTP site

(Source: FF survey team, Sept.2020)

4.5.4.2 Fauna

4.5.4.2.1 Mammal and Bird

A. Line transects survey

Landfill site

The results of 3 transects survey with a total length of 750 m, Figure 4.5.3.2.2-1, were recorded 18 bird species, and 16 of them are listed as Least Concern in the IUCN Red listed species, Table 4.5.4.2.1-1. During the survey period, we recorded a total of over 300 birds. The activities of the line transect survey are shown in Figure 4.5.4.2.1-1.

Table 4.5.4.2.1-1: Species and the number of individuals recorded in the landfill site

No.	Common name	*Scientific name*	Number	Local Status	IUCN
Transect 1					
1	Common Myna	*Acridotheres tristis*	60-70	R	LC
2	House Swift	*Apus nipalensis*	1	R	LC
3	Paddyfield Pipit	*Anthus rufulus*	1	R	LC
4	Asian Green Bee-eater	*Merops orientalis*	3	R	LC
5	Common Myna	*Acridotheres tristis*	1	R	LC
6	Scaly-breasted Munia	*Lonchura punctulata*	1	R	LC
7	Blue-tailed Bee-eater	*Merops philippinus*	1	R	LC

Transect 2					
1	Eastern Spotted Dove	*Spilopelia chinensis*	5	R	LC
2	Black Drongo	*Dicrurus macrocercus*	1	R	LC
3	Common Myna	*Acridotheres tristis*	17	R	LC
4	House Swift	*Apus nipalensis*	4	R	LC
5	Red Turtle-dove	*Streptopelia tranquebarica*	3	R	LC
6	Red Turtle-dove	*Streptopelia tranquebarica*	4	R	LC
7	Ashy Bulbul	*Hemixos flavala*	2		
8	Asian Green Bee-eater	*Merops orientalis*	1	R	LC
9	Chinese Pond-heron	*Ardeola bacchus*	1	R	LC
Transect 3					
1	Rock Dove	*Columba livia*	7		LC
2	Eastern Spotted Dove	*Spilopelia chinensis*	23	R	LC
3	Greater Coucal	*Centropus sinensis*	1	R	LC
4	Asian Green Bee-eater	*Merops orientalis*	6	R	LC
5	House Swift	*Apus nipalensis*	12	R	LC
6	Paddyfield Pipit	*Anthus rufulus*	14	R	LC
7	Red Turtle-dove	*Streptopelia tranquebarica*	9	R	LC
8	Common Myna	*Acridotheres tristis*	91	R	LC
9	Common Tailorbird	*Orthotomus sutorius*	1	R	LC
10	Scaly-breasted Munia	*Lonchura punctulata*	25	R	LC
11	Eurasian Tree Sparrow	*Passer montanus*	10	R	LC
12	House Sparrow	*Passer domesticus*	3	R	
13	Rat		1		

Note: **IUCN classification:**Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).

Cambodia Status (local status for bird species)**:** Exting in Cambodia (e); Uncommon (r); Common everywhere (R); Rare (v); Rarely present in dry season (w); Commonly present in dry season (W); Common for mammals species (C).

Figure 4.5.4.2.1-1: Line transect survey activities at the proposed landfill site

(Source: FF survey team, Sept.2020)

WWTP site

The results of 3 transects survey with a total length of 850 m, Figure 4.5.3.2.2-2, were recorded 23 bird species, and 19 of them are listed as Least Concern in the IUCN Red listed species, see Table 4.5.4.2.1-2. There are over260 birds counted during this survey period. The activities of the line transect survey are showed in Figure 4.5.4.2.1-2. Some pictures are enclosed in Annex 4.

Table 4.5.4.2.1-2: Species and the number of individuals recorded in the WWTP site

No.	Common name	*Scientific name*	Number	Local sratus	IUCN
Transect 1					
1	Asian Green Bee-eater	*Merops orientalis*	8	r	LC
2	Cattle Egret	*Bubulcus ibis*	15	R	LC
3	Common Myna	*Acridotheres tristis*	2	R	LC
4	Crested Treeswift	*Hemiprocne coronata*	55	r	LC
5	Intermediate Egret	*Ardea intermedia*	7	r	LC
6	Lesser Whistling-duck	*Dendrocygna javanica*	5	R	LC
7	Little Cormorant	*Microcarbo niger*	2	r	LC
8	Little Egret	*Egretta garzetta*	3		LC
9	Oriental Magpie-robin	*Copsychus saularis*	1	R	
10	Oriental Turtle-dove	*Streptopelia orientalis*	9	r	LC
11	Red Turtle-dove	*Streptopelia tranquebarica*	1	r	LC
12	Rufescent Prinia	*Prinia rufescens*	4	r	LC
13	Sooty-headed Bulbul	*Pycnonotus aurigaster*	5	r	
14	Yellow-bellied Prinia	*Prinia flaviventris*	2	R	
15	Yellow-vented Bulbul	*Pycnonotus goiavier*	6	R	LC
Transect 2					
1	Asian Green Bee-eater	*Merops orientalis*	4	r	LC
2	Black-collared Starling	*Gracupica nigricollis*	2	R	LC
3	Common Tailorbird	*Orthotomus sutorius*	1	R	LC
4	Crested Treeswift	*Hemiprocne coronata*	1	r	LC
5	Great White Egret	*Ardea alba*	35	R	LC
6	Intermediate Egret	*Ardea intermedia*	5	r	LC
7	Javan Pond-heron	*Ardeola speciosa*	1	R	LC
8	Oriental Turtle-dove	*Streptopelia orientalis*	12	r	LC
9	Rufescent Prinia	*Prinia rufescens*	1	r	LC
10	Sooty-headed Bulbul	*Pycnonotus aurigaster*	7	r	
11	White-rumped Munia	*Lonchura striata*	22	r	LC
12	Yellow Bittern	*Ixobrychus sinensis*	1	r	LC
Transect 3					
1	Asian Green Bee-eater	*Merops orientalis*	2	r	LC
2	Black-collared Starling	*Gracupica nigricollis*	3	R	LC
3	Common Kingfisher	*Alcedo atthis*	3	R	
4	Common Tailorbird	*Orthotomus sutorius*	3	R	LC
5	Crested Treeswift	*Hemiprocne coronata*	2	r	LC
6	Little Cormorant	*Microcarbo niger*	1	r	LC
7	Little Egret	*Egretta garzetta*	1	R	LC
8	Oriental Magpie-robin	*Copsychus saularis*	3	R	
9	Oriental Turtle-dove	*Streptopelia orientalis*	3	r	LC
10	Pied Kingfisher	*Ceryle rudis*	1	r	LC
11	Rufescent Prinia	*Prinia rufescens*	4	r	LC
12	Sooty-headed Bulbul	*Pycnonotus aurigaster*	8	r	
13	Stork-billed Kingfisher	*Pelargopsis capensis*	1	r	LC
14	White-rumped Munia	*Lonchura striata*	25	r	LC

Note: **IUCN classification:**Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).

Cambodia Status (local status for bird species)**:** Exting in Cambodia (e); Uncommon (r); Common everywhere (R); Rare (v); Rarely present in dry season (w); Commonly present in dry season (W); Common for mammals species (C).

Figure 4.5.4.2.1-2: Line transect survey activities at WWTP site

(Source: FF survey team, Sept.2020)

B. Interviews with Local People

Landfill site

The results of the interview with the villager, a 37-year-olds woman a resident near the study area reported that in/vicinity of the proposed landfill site had 46 species of wildlife, including five mammals (four listed as Least Concern LC in the IUCN Red List), and 41 birds species (29 species are Least Concern, and one species is Near Threaten NT), see Table 4.5.4.2.1-3.

Table 4.5.4.2.1-3: Species list of wild animals presented in/adjacent to the landfill site

No.	Common name	*Scientific name*	Local status	IUCN
Mammals				
1	Burmese hare	*Lepus peguensis*	C	LC
2	Small Indian civet	*Viverricula indica*	C	LC
3	Red muntjac	*Muntiacus muntjak*	C	LC
4	Small Asian Mongoose	*Herpestes javanicus*	C	LC
5	Rat			
Bird				
1	Cattle Egret	*Bubulcus ibis*	R	LC
2	Grey Heron	*Ardea cinerea*	R	
3	Asian Blue Quail	*Synoicus chinensis*	R	LC
4	Eastern Spotted Dove	*Spilopelia chinensis*	R	LC
5	Rock Dove	*Columba livia*		LC
6	Black-winged Kite	*Elanus caeruleus*	R	LC
7	Black Baza	*Aviceda leuphotes*	R	LC
8	Ashy Drongo	*Dicrurus leucophaeus*	R	
9	Western Koel	*Eudynamys scolopaceus*	R	LC
10	Greater Coucal	*Centropus sinensis*	R	LC
11	Asian Green Bee-eater	*Merops orientalis*	R	LC
12	House Swift	*Apus nipalensis*	R	LC
13	Paddyfield Pipit	*Anthus rufulus*	R	LC
14	Indian Nightjar	*Caprimulgus asiaticus*	R	LC
15	Red-whiskered Bulbul	*Pycnonotus jocosus*	R	LC
16	Striated Grassbird	*Megalurus palustris*	R	LC
17	Yellow-vented Flowerpecker	*Dicaeum chrysorrheum*	R	LC
18	Common Myna	*Acridotheres tristis*	R	LC
19	Scarlet-backed Flowerpecker	*Dicaeum cruentatum*	R	LC
20	Black-collared Starling	*Gracupica nigricollis*	R	
21	White-rumped Munia	*Lonchura striata*	R	LC
22	Eurasian Tree Sparrow	*Passer montanus*	R	LC
23	House Sparrow	*Passer domesticus*	R	

24	Eurasian Tree Sparrow	*Passer montanus*	R	LC
25	Little Cormorant	*Microcarbo niger*	R	LC
26	Grey Heron	*Ardea cinerea*	r	
27	Painted Stork	*Mycteria leucocephala*	r	NT
28	Intermediate Egret	*Ardea intermedia*	r	LC
29	Javan Pond-heron	*Ardeola speciosa*	R	LC
30	Cattle Egret	*Bubulcus ibis*	R	
31	Javan Pond-heron	*Ardeola speciosa*	R	LC
32	Black-crowned Night-heron	*Nycticorax nycticorax*	R	LC
33	Purple Heron	*Ardea purpurea*	R	
34	Cinnamon Bittern	*Ixobrychus cinnamomeus*	R	LC
35	Lesser Whistling-duck	*Dendrocygna javanica*	R	LC
36	Black-winged Stilt	*Himantopus himantopus*	r	
37	Brown Shrike	*Lanius cristatus*	W	
38	Paddyfield Pipit	*Anthus rufulus*	R	LC
39	Bluethroat	*Cyanecula svecica*	w	
40	Crested Treeswift	*Hemiprocne coronata*	r	LC
41	Savanna Nightjar	*Caprimulgus affinis*	R	

Note: **IUCN classification:**Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).

Cambodia Status (local status for bird species)**:** Exting in Cambodia (e); Uncommon (r); Common everywhere (R); Rare (v); Rarely present in dry season (w); Commonly present in dry season (W); Common for mammals species (C).

Figure 4.5.4.2.1-3: Activities of interviewing with local people at the proposed landfill site

(Source: FF survey team, Sept.2020)

WWTP site

The results of the interview with a villager, a 47-year-olds man, resident near the study area reported that in/vicinity of the proposed WWTP site had 53 species of wildlife, including six mammals (listed as Least Concern LC in the IUCN Red List), and 47 birds species (two species are Near Threaten NT, and one species is Endangered EN), see Table 4.5.4.2.1-4.

Table 4.5.4.2.1-4: Species list of wild animals presented in/adjacent to the WWTP site

No.	**Common name**	***Scientific Name***	**Local status**	**IUCN**
Mammals				
1	Yellow-troated Marten	*Martes flavigula*	C	LC
2	Small Asian Mongoose	*Herpestes javanicus*	C	LC
3	Crab-eating Mongoose	*Herpestes urva*	C	LC
4	Berdmore's Squirrel	*Menetes berdmorei*	C	LC

5	Rat	*Rattus Rattus*	-	LC
6	Burmese hare	*Lepus peguensis*	C	LC
Birds				
7	Red-collared Dove	*Streptopelia tranquebarica*	r	LC
8	Barn owl	*Tyto alba*	R	LC
9	Black-shouldered Kite	*Elanus axillaris*	w	LC
10	Shikra	*Accipiter badius*	R	LC
11	Little Bronze-cuckoo	*Chalcites minutillus*	R	LC
12	Greater Coucal	*Centropus sinensis*	R	LC
13	House Swallow	*Hirundo javanica*	R	
14	Plain-backed Sparrow	*Passer flaveolus*	R	LC
15	Yellow-vented Bulbul	*Pycnonotus goiavier*	R	LC
16	Brown Shrike	*Lanius cristatus*	W	
17	Common Myna	*Acridotheres tristis*	R	LC
18	Black-collared Starling	*Gracupica nigricollis*	R	LC
19	Common Starling	*Sturnus vulgaris*	V	LC
20	Common Tailorbird	*Orthotomus sutorius*	R	LC
21	Yellow-bellied Prinia	*Prinia flaviventris*	R	
22	House Sparrow	*Passer domesticus*	r?	
23	Little Cormorant	*Microcarbo niger*	r	LC
24	Lesser Whistling-duck	*Dendrocygna javanica*	R	LC
25	Grey Heron	*Ardea cinerea*	R	LC
26	Great-billed Heron	*Ardea sumatrana*	r	LC
27	Great White Egret	*Ardea alba*	R	LC
28	Little Egret	*Egretta garzetta*	R	LC
29	Javan Pond-heron	*Ardeola speciosa*	R	LC
30	Cattle Egret	*Bubulcus ibis*	R	LC
31	Black-crowned Night-heron	*Nycticorax nycticorax*	R	LC
32	Yellow Bittern	*Ixobrychus sinensis*	r	LC
33	Painted Stork	*Mycteria leucocephala*	r	NT
34	Milky Stork	*Mycteria cinerea*	r	EN
35	Lesser Whistling-duck	*Dendrocygna javanica*	R	LC
36	Tufted Duck	*Aythya fuligula*	w	LC
37	White-breasted Waterhen	*Amaurornis phoenicurus*	R	LC
38	Watercock	*Gallicrex cinerea*	r, w	LC
39	Black-winged Stilt	*Himantopus himantopus*	r	
40	Red-wattled Lapwing	*Vanellus indicus*	R	
41	Eurasian Curlew	*Numenius arquata*	w	NT
42	Black-capped Kingfisher	*Halcyon pileata*	w	LC
43	Stork-billed Kingfisher	*Pelargopsis capensis*	r	LC
44	White-breasted Kingfisher	*Halcyon smyrnensis*	R	LC
45	Brown Shrike	*Lanius cristatus*	W	
46	White-browed Shrike-babbler	*Pteruthius aeralatus*	-	
47	Yellow-vented Bulbul	*Pycnonotus goiavier*	R	
48	Crested Treeswift	*Hemiprocne coronata*	r	LC
49	Brown Boobook	*Ninox scutulata*	R	LC
50	Rufous Woodpecker	*Micropternus brachyurus*	r	
51	Stripe-throated Bulbul	*Pycnonotus finlaysoni*	r	LC
52	Rufescent Prinia	*Prinia rufescens*	r	LC
53	Asian Green Bee-eater	*Merops orientalis*	r	LC

Note: **IUCN classification:**Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).

Cambodia Status (local status for bird species)**:** Exting in Cambodia (e); Uncommon (r); Common everywhere (R); Rare (v); Rarely present in dry season (w); Commonly present in dry season (W); Common for mammals species (C).

Figure 4.5.4.2.1-4: Activities of interviewing with local people at the proposed WWTP site

(Source: FF survey team, Sept.2020)

4.5.4.2.2 Amphibian and Reptile

Landfill site

A total of 14 herpetofauna, comprising 8 amphibians (arranged by four families and seven genera) and 4 reptiles (arranged by three families and four genera) were recorded from the survey area Table 4.5.4.2.2-1). In this result, there are 8 toad and frogs 1 skink, 2 geckos, and 1 snake, Figures 4.5.4.2.2-1 and 4.5.4.2.2-2. This result shows a very low diversity of herpetofauna due to it is a shrub not far from human settlements.

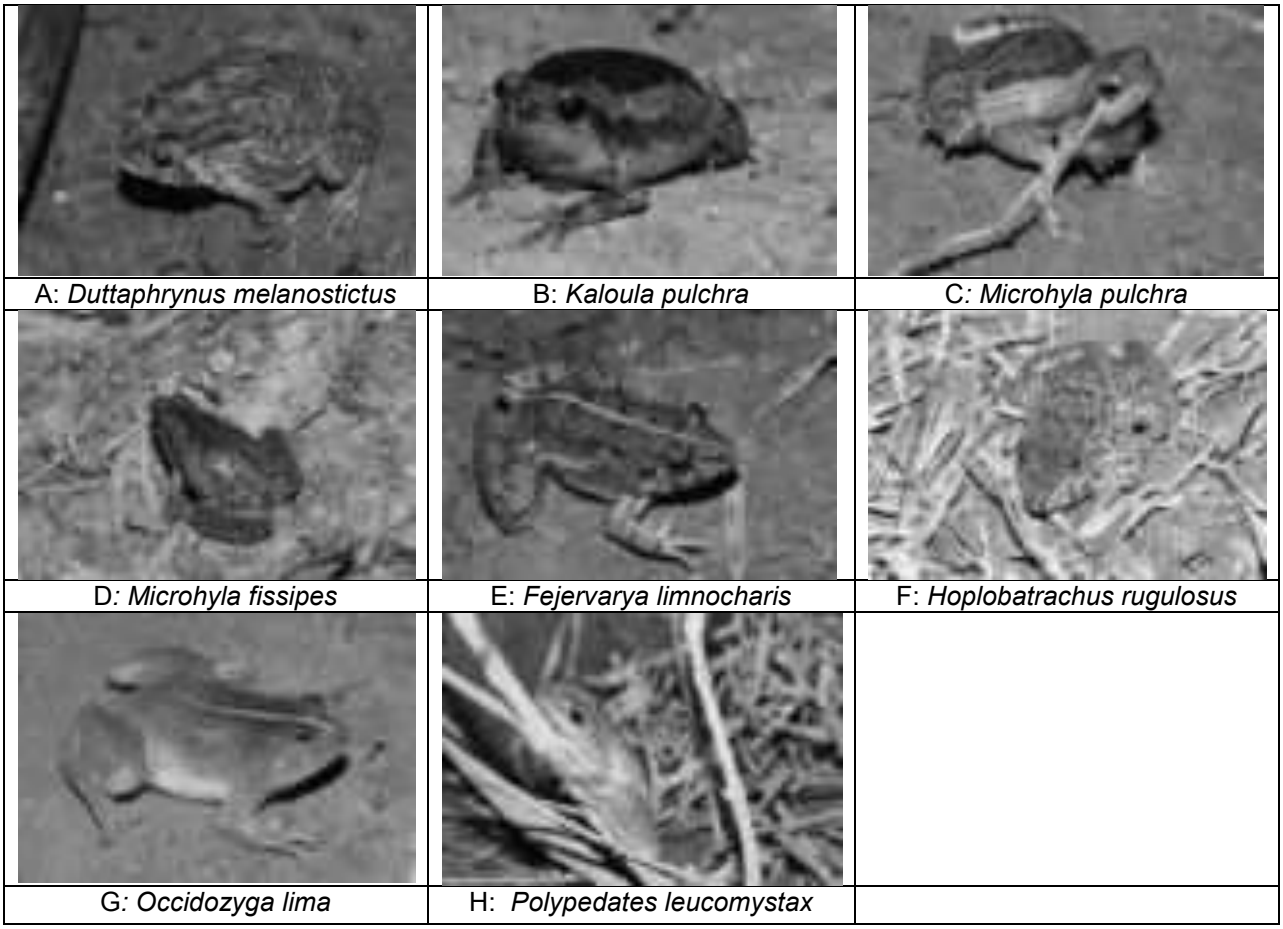
From the survey, there are 8 amphibian species which are commonly seen most part of the country and region. All of them are listed as Least Concern by IUCN (2020). A common treefrog (Polypedates leucomystax) is a wide range species that we can find in mountainous areas of evergreen forest, limestone karsts, agricultural land, and even in households. There are 4 reptile species, including snakes, geckos, skink, and lizard. All of them are listed as Not Evaluated and Least Concern.

Table 4.5.4.2.2-1: Herpetofauna species presenting in the landfill site

No.	Common name	Scientific names	Number	Local Status	IUCN status
	Amphibians				
1	Common Asian toad	*Duttaphrynus melanostictus*	2	NA	LC
2	Common Asian bullfrog	*Kaloula pulchra*	3	NA	LC
3	Ornate narrow-mouth frog	*Microhyla fissipes*	3	NA	LC
4	Beautiful narrow-mouth frog	*Microhyla pulchra*	6	NA	LC
5	Paddy frog	*Fejervarya limnocharis*	15	NA	LC
6	Rugulose bullfrog	*Hoplobatrachus rugulosus*	8	NA	LC
7	Green floating frog	*Occidozyga lima*	25	NA	LC
8	Common treefrog	*Polypedates leucomystax*	5	NA	LC
	Reptiles				
9	Siamese gecko	*Dixonius siamensis*	3	C	LC
10	Plat tailed gecko	*Hemiphyllodactylus sp.*	3	NA	DD
11	Stream skink	*Sphenomorphus maculatus*	2	C	DD
12	Chequerred keeled back snake	*Xenochrophis flavipunctatus*	1	NA	LC

Note: **IUCN classification:**Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).
Cambodia Status: Common for mammals species (C); Not available (NA).

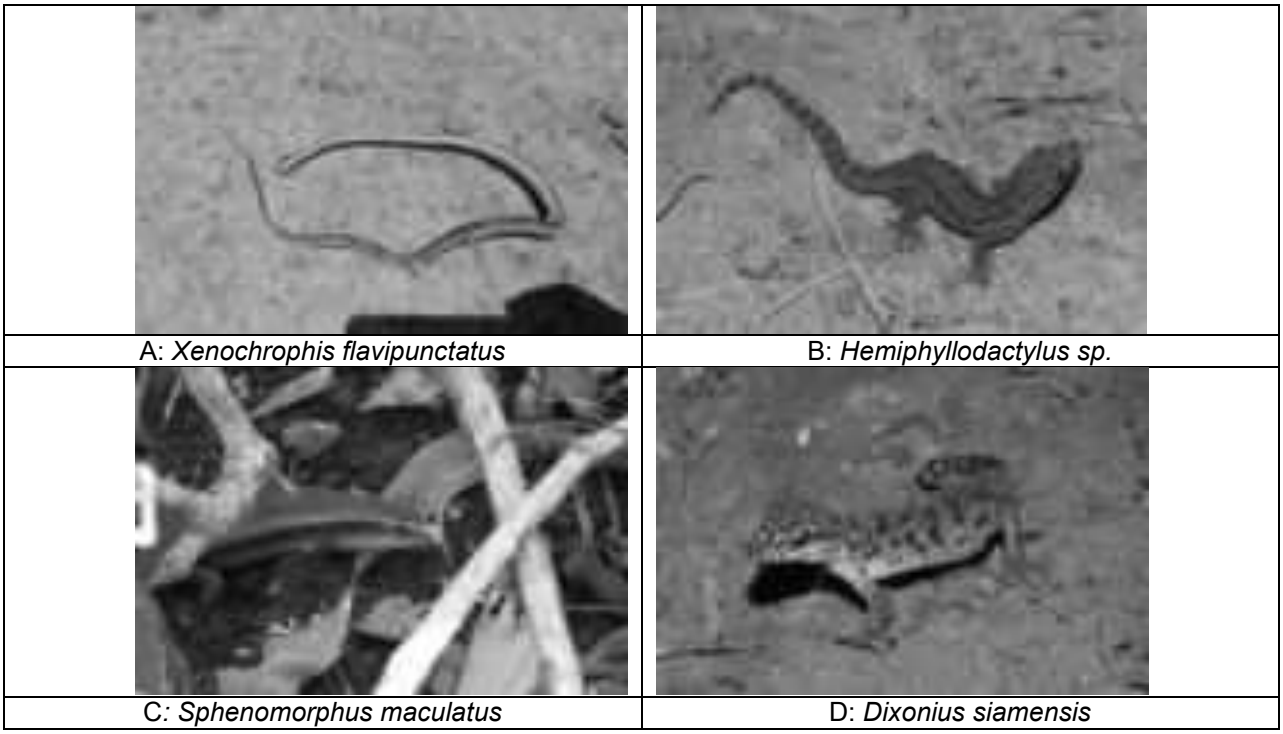
Figure 4.5.4.2.2-1: Recorded amphibians from the survey at the landfill site



A: *Duttaphrynus melanostictus*	B: *Kaloula pulchra*	C*: Microhyla pulchra*
D*: Microhyla fissipes*	E: *Fejervarya limnocharis*	F: *Hoplobatrachus rugulosus*
G*: Occidozyga lima*	H: *Polypedates leucomystax*	

(Source: FF survey, Sept.2020)

Figure 4.5.4.2.2-2: Recorded reptiles from the survey at the landfill site



A: *Xenochrophis flavipunctatus*	B: *Hemiphyllodactylus sp.*
C*: Sphenomorphus maculatus*	D: *Dixonius siamensis*

(Source: FF survey, Sept.2020)

WWTP site

A total of 11 herpetofauna, comprising 9 amphibians (arranged by four families and seven genera) and 2 reptiles (arranged by two families and two genera) were recorded from the survey area. In this result, there are 8 toad and frogs 1 skink, 1 gecko, and 1 Stream-side skink (Table 4.5.4.2.2-2) and Figure 4.5.4.2.2-3 and 4.5.4.2.2-4. This result shows a very low diversity of herpetofauna due to its a flooded secondary forest.

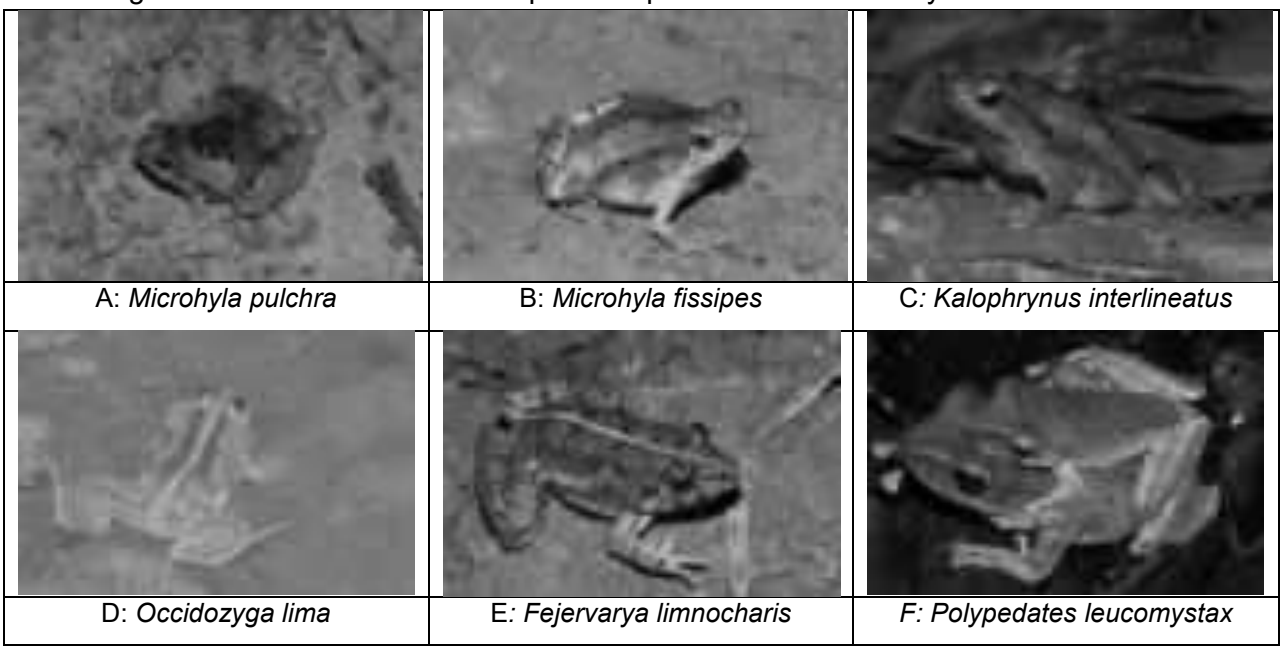
From the survey, there are 9 amphibian species which are commonly seen most part of the country and region. All of them are listed as Least Concern by IUCN (2020). A common treefrog (Polypedates leucomystax) is a wide range species that we can find in mountainous areas of evergreen forest, limestone karsts, agricultural land, and even in households. The common green frog (Hylarana erythraea) like a forest edge with water availability with some vegetation for the frog to hide. There are 2 reptile species, including a gecko and a Stream-side skink. All of them are listed as Not evaluated.

Table 4.5.4.2.2-2: Herpetofauna species presented in the WWTP site

No	Common name	Scientific names	Number	Locacl status	IUCN status
	Amphibians				
1	Common Asian toad	*Duttaphrynus melanostictus*	1	NA	LC
2	Striped sticky frog	*Kalophrynus interlineatus*	1	NA	LC
3	Ornate narrow-mouth frog	*Microhyla fissipes*	1	NA	LC
4	Beautiful narrow-mouth frog	*Microhyla pulchra*	2	NA	LC
5	Red-eye frog	*Hylarana erythraea*	1	NA	LC
6	Paddy frog	*Fejervarya limnocharis*	10	NA	LC
7	Rugulose bullfrog	*Hoplobatrachus rugulosus*	4	NA	LC
8	Green floating frog	*Occidozyga lima*	30	NA	LC
9	Common treefrog	*Polypedates leucomystax*	3	NA	LC
	Reptiles				
10	Plat tailed gecko	*Hemiphyllodactylus sp.*	2	NA	DD
11	Stream-side skink	*Sphenomorphus maculatus*	2	C	DD

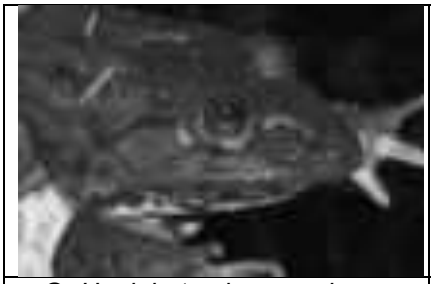
Note: **IUCN classification:**Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).
Cambodia Status: Common for mammals species (C); Not available (NA).

Figure 4.5.4.2.2-3: Recorded amphibian species from the survey at the WWTP site



A: *Microhyla pulchra* | B: *Microhyla fissipes* | C*: Kalophrynus interlineatus*

D: *Occidozyga lima* | E*: Fejervarya limnocharis* | *F: Polypedates leucomystax*




G: *Hoplobatrachus rugulosus* H: *Hylarana erythraea*

(Source: FF survey, Sept.2020)

Figure 4.5.4.2.2-4: Recorded reptile species from the survey at the WWTP site


A: *Hemiphyllodactylus sp.* B: *Sphenomophus maculatus.*

(Source: FF survey, Sept.2020)

4.5.4.2.3 Bat

A. Field survey

During the rainy season survey, a total of 1,102 mist net-hours sampling were achieved at sampling locations. The sampling areas are located at a low altitude of less than 10m in a low land area surrounded by rice paddy fields and villages. Most habitats are shrub-covered by short vegetation near the stream. Trees are short, ranging from approximately 1-4 meters in height.
The weather is hot during the daytime, smoke from nearby burning, and there was some rain at the end of survey time.
A. Live Sampling

Landfill site

Over the sampling period, five bats representing three species from three families were recorded (Table 4.5.4.2.3-1) and Figure 4.5.4.2.3-1 A, B, C). Even though a low capture result, may not reflect the true species diversity and abundance of the bat within the project area, while some bat species are likely to fly high above. This low capture rate would relate to the natural habitat of the area condition open space and smoke that would lead to scarce of insects which is least prefer by bat species and the limitation of the trapping capacity in each sampling site.

Table 4.5.4.2.3-1: Bat species and number of individuals captured at the Landfill site

Family	Scientific Name	Sex	Sex status	Capture time
Vespertilionidae	*Scotophilus kuhlii*	M & F	Mature	6:30
Emballonuridae	*Taphozous longimanus*	M	Mature	10:30
Pteropodidae	*Cynopterus brachyotis*	M	Juvenile	10:30

Figure 4.5.4.2.3-1: Species captured in the survey at the landfill site

Note:

A: Scotophilus kuhlii, three individuals (one female, Parous; and two males, mature),
B: Taphozous longimanus, one mature and
C: Cynopterus brachyotis, one juvenile

WWTP site

Over the sampling period, there was no bat captured even we saw some bat flight at an open canal outside the project boundary. Due to the area was flooded with dense vegetation, insects not many, and bats seem to avoid that area. The bats that were flying in open water was *Myotis hasseltii*; they are specialized in hunting small fish on the water surface.

B. Interviews

Landfill site

As there were not many local people available for interviews within the study area, the interviews were undertaken with four people only. Among the four people that we interviewed, two of them reported that there is one bat roost on the palm tree but about 3 kilometers away from the project site. Anyways, they also said local people hunt them for food either and don't how many would leave.

WWTP site

As there were not many local people available for interviews within the study area, the interviews were undertaken with two people who are temporarily stay near there. Among them, no one knows any presence of bat roost around the site.

C. Conservation Significance

Landfill site

All the species captured during sampling (Table 4.5.4.2.3- 1) are evaluated as Least Concern on the IUCN Red List of Threatened Species. *S. kuhlii* is known to widely distribute in mainland Southeast Asia including Bangladesh, India, Indonesia, Malaysia, Pakistan, the Philippines, Sri Lanka, and Taiwan (*Srinivasulu & Srinivasulu, 2019b)*. *T. longimanus* is known from Southeast Asia, including Bangladesh, Cambodia, India, Indonesia, Malaysia, Myanmar, Singapore, Sri Lanka, and Thailand (*Srinivasulu & Srinivasulu, 2019a)*. *C. brachyotis* is known Sri Lanka, southwest and northeast India, Bangladesh, Andaman, and Nicobar Islands, southern China,

southern Burma, Indochina, Thailand, the Malay Peninsula, Sumatra, Java, Bali, Sulawesi, the Philippines and also on the Lesser Sunda Islands. They are found from sea level up to 1600 m in Borneo (Peterson & Heaney, 1993).

WWTP site

The detected species from observation was *Myotis hasseltii,* which is known as Cambodia, India, Indonesia, Malaysia, Myanmar, Sri Lanka, Thailand, and Vietnam; they are listed as Least Concern in the IUCN Redlist (Bates at al., 2020).

4.5.5 Discussion

4.5.5.1 Flora

Landfill site

Landfill species are located of flood-plain extension (MRC, 2005) where were diversity of flooded-forest. But during the conducted survey were recorded 15 species in plot inventory and 12 families. Furthermore, our result showed that the dominant species of *Garcinia schefferi.* Therefore, we also recorded any species are including; *Heterosmilax paniculate, Cratoxylum formosum*, *Peltophorum dasyrrhachis Kurz.var, Payena elliptica Lecomte., Carallia lucida, Roxb., Melaleuca quinquenervia, Hymenocardia punctata Wall. ex Lindl., Acacia auriculiformis Muell., Litsca glutinosa, Cinnamomum litsacfolium, Thw., Calamus salicifolius, Ochna integerrima,* and *Melanorrihoea laccifera, Pierre.*

WWTP site

WWTP species is a location in the CFCK where *Acacia* cultivation mostly, but *Acacia auriculiformis Muell* were not recorded in plot survey. During the walking plots survey, we noticed that *Acacia auriculiformis Muell* was cleared in the dry season. Therefore, our result showed that the *Melaleuca quinquenervia* species was the similarity of the historical of Chhem et al., (2000), which was documenting of these dominant species in flooded plain forest that growing in height acid condition.

Even though, historical of CFCK were planting of any species such as *Hopea odorata Roxb, Dipterocarpus alatus Roxb* in the area. Our result was not recorded on the WWTP site. However during the survey has been noticed *Dipterocarpus alatus Roxb* where is the faith tree of communities in UTM 620749 E, 1220827 N, nearest the WWTP site, Figure 4.5.5.1-1 . Acacia and Melaleuca leucadendra (Smach) are commonly found in the area.

Figure 4.5.5.1-1: Some *Acacia auriculiformis Muell* tree was cutting before the survey date

4.5.5.2 Fauna

Landfill site

The landfill site is located in a flood-plain extension (MRC, 2005) were there was the diversity of the flooded forest. The result from our study showed that in the project area and the vicinity of the project, there is a significant number of bird species present in the area. At least one globally threatened bird species, the Painted Stork (Near Threatened) is reported to be present there.

- A small number of mammals and birds in less concern (LC) of IUCN status, no Endangered (EN); Vulnerable (VU); Near threatened (NT) are presented in the proposed site
- A small number of amphibian and reptile with less concern (LC) are presented in the proposed site
- A small number of bat are presented in the proposed site

WWTP site

Historical of CPK is located in lowland and flood plain areas in the rainy season that support the number of waterbird species. The aim of this establishment is to conserve biodiversity, manage the traditional use of forest products and non-timber forest products for the local community's livelihood, tradition, and religious beliefs align with the poverty reduction policy of the Royal Government of Cambodia. The result from our study showed that in the project area and the vicinity of the project, there is a significant number of waterbird species present in the area. At least three globally threatened bird species, including two Near Threatened species (i.e., Eurasian Curlew *Numenius arquata* and Painted Stork *Mycteria leucocephala*) and one Endangered species (i.e., Milky Stork *Mycteria cinerea*) are reported to be present there. Only small mammals are reported to be present in the study area.

We hope that the report on wildlife studies from the project area has contributed to the decisions regarding the implementation of the project, which will minimize the impact of this Landfill and WWTP site. In this regard, we would like to propose to the owners of this Landfill project, as well as its stakeholders, to protect the wildlife present in the area to the extent possible that it contributes to wildlife conservation in Cambodia.

4.6 Cultural Heritage

4.6.1 Methodology

To observe cultural heritage places in/adjacent to the project sites (WWTP, Landfill, Stormwater drainage outfall). The consultation with the village/Sangkat chief and locale people (elderly) as well as the representative of the Community Forest in place, who well known the heritage in the area (temples, pagodas, ancient pond, ancient gave area, archeological site, etc.) and within 300 meters from the project sites. Observation is one of the founding principles of the scientific method, and it can be a very effective tool for studying human-environment interactions around the project area.

4.6.2 Finding

According to the observation, we found only one shrine place (620749 E,1220827 N) located western of the WWTP site. This area is approximate 400m^2 and cover by a few big trees surrounding the open canal and a narrow open space under the big tree shadow, Figure 4.6.2-

1. It was flooded during the wet season and had a poor condition wooden bridge connected from the community road.

In the consultation with CFCK and village chief members in Sept. and Oct. 2020, Figure 4.6.2-2. The key results of the discussion meeting with stakeholders show in Table 4.6.2-1. The attendance lists eclose in annex 7.

Figure 4.6.2-1: The location of shrine place close to the WWTP site

Figure 4.6.2-2: Activities of consultation with CFCK member

Field survey on Sep 2020 Discussion meeting on Oct 2020

Figure 4.6.2-3: Activities of consultation with stakeholder at the landfill site

(source: KCC, Sep 2020)

Table 4.6.2-1: Key discussion meeting with stakeholders at the community level

N.o	Name	Date	Suggesetion/Comment/Opinion
The landfill			
1	Mr. Phoak Sophat (Village chief of Chrak Mtes)	02-Sep-2020	He said that there is no heritage in the area (temples, pagodas, ancient pond, ancient gave area, the archeological site within 300 meters from the proposed landfill site.
The WWTP			
1	Mr. Men Tith (Chief of CFCK)	01-Sep-2020	He said that the Community Forest "Chamkar Konkoki"(CFCK) is a total area of about 404 ha under the management of MAFF, and the whole area is flooded in the wet season; Acacia and Melaleuca leucadendra (Smach) are commonly found in the area. Only one shrine place located in this forest. Since the French colonial period (1910-1920), the forest had been re-planted, and the shrine place has been believed and worshiped by the people ever since. The people of about five villages around the CFCK have a strong belief in this shrine and have annual ceremonies as well. This is a religious area for the local people to celebrate every year to pray in healthy/peaceful/prosperous and ask for rainfall, etc.
2	Mr. Thoeun Setha, (Representative of the CFCK)	09-Oct-2020	He reported that the forest had been re-planted since 1990. A shrine place situated about 100m outside the proposed WWTP site's perimeter was worshiped by the villagers. He requested the study team to build a bridge across the canal to the shrine and build strong fences to prevent deforestation in the shrine area. The old bridge is a dilapidated wooden bridge that is difficult for people to reach to the worship place for celebrating various ceremonies.

4.7 Noise

4.7.1 Methodology

The noise survey has been conducted at the site by an expert at MoE's lab. The measurement conducted at the site of 1.2 meters above the ground is far within 2 meters from the walls and trees. To avoid any noise sources (dogs, bus/taxi station) have not been conducted. 1 sample for Landfill and WWTP, and 3 houses adjacent to each site, according to the ToR provided by the TA consultant. The map location of sampling points is shown in Figure 4.3.1-1 and Figure 4.3.1-2.

Noise is also the factor that impacts the environment, so studying the area's existing noise level is very important. Noise may affect the people living in the area, and the standard of noise and vibration varies from one country to another country; and Cambodia also has its own standard, which is described in section 2 of this report. The measurement of noise is in DeciBels (dB(A). According to sub-decree No 42 on the Control of Air Pollution and Noise Disturbances (2000) the permission noise level was classified according to the time period and specific area, Table 4.7.1-1.

Table 4.7.1-1: The maximum standard of noise level, in dB(A)

No.	Location	Period of Times		
		06:00-18:00	18:00-22:00	22:00-06:00
1	Quiet Areas Hospitals Libraries School Kindergarten	45	40	35
2	Residential Areas Hotels Administrative office Villa, flat	60	50	45
3	Commercial and Service Areas and Area of multiple businesses	70	65	50
4	Small industrial factories mingling in the residential area	75	70	50

4.7.2 Finding

The noise level measurement was conducted on September 13, 2020. Different places of the project sites were selected following the ToR from TA Consultant, and four samples for each the landfill and WWTP, and one sample for lift pumping station and one sample for the main pumping station, Table 4.7.2-1.

The eight hours measurement for landfill site and WWTP site and one hour measurement for 3 adjacent houses to the landfill site and the WWTP site, and one hour measurement for lift pumping station and main pumping station. The field measurement of the noise level in each sample site was shown in Figure 4.7.2-1, Figure 4.7.2-2, and 4.7.2-3.

Table 4.7.2-1: Noise sampling dated and location

No.	**Date of sampling**	**Description of sample location**	
		Location	Coordinate, UTM 48P
1	13 Sept. 2020	At Landfill site	612784 E, 1225002 N
2		Near house # 1	613585 E, 1225675 N
3		Near house # 2	613569 E, 1225155 N
4		Near house # 3	613583 E, 1224899 N
5		WWTP site	621188 E, 1221230 N
6		Near house # 1	621127 E, 1222454 N
7		Near house # 2	620906 E, 1222400 N
8		Near house # 3	620396 E, 1222264 N
9		Lift pumping station	621288 E, 1220809 N
10		Main pumping station	621196 E, 1221273 N

Figure 4.7.2-1: The noise measurements in and adjacent to the landfill site


At Landfill site


Near house #1


Near house #2


Near house #3

Figure 4.7.2-2: The noise measurement in and adjacent to the WWTP site


At WWTP site


Near house #1


Near house #2


Near house #3

Figure 4.7.2-3: The noise measurement at the lift and main pumping station

Lift pumping station

Main pumping station

The results of the noise measurement were described in the following table below, and the .

Table 4.7.2-2: Noise level measurement at the landfill site, Sept. 2020

Location	Survey period	Noise Level dB(A)			
		LAeq	**Standard [i] (Leq)**	**Lmax**	**Lmin**
Landfill site	7:00-8:00	45.6	60-70	58.9	31.3
	8:00-9:00	39.6		47.9	34.0
	9:00-10:00	39.4		48.4	39.0
	10:00-11:00	43.3		58.2	40.5
	11:00-12:00	46.6		59.3	38.2
	12:00-13:00	43.3		56.9	41.6
	13:00-14:00	47.9		59.4	39.2
	14:00-15:00	43.0		56.4	38.6
Average of 8 hours		**43.6**		**55.7**	**37.8**

Note: [i] 60 dB(A) for residential areas, hotels, administrative office, and villa/flat, day time (6:00-18:00)
70 dB(A) for commercial, service areas, and area of multiple businesses, day time (6:00-18:00)

Table 4.7.2-3: Noise level measurement at the houses close to the landfill site, Sept. 2020

Location	Survey period	Noise Level dB(A)			
		LAeq	Standard (Leq)	Lmax	Lmin
Near house # 1	7:00 - 8:00	42.3	60	54.7	32.2
Near house # 2	8:00 - 9:00	43.2	60	54.1	33.2
Near house # 3	9:00 - 10:00	43.2	60	58.2	36.2

Note: [i] 60 dB(A) for residential areas, hotels, administrative office, and villa/flat, day time (6:00-18:00)

The results of noise level measurement at landfill site during day time is between 48-59 dB(A) for the maximum level and 39-47 dB(A) for average level, Table 4.7.2-2. It means that the baseline noise level in the landfill area is met the Cambodian standard for mixing areas of residential, commercial, hotel, service area, office, and multiples business area 60-70 dB(A). While the maximum noise level in one hour of the three houses close to the landfill is 54-58 dB(A), and the average is 42-43 dB(A) only, Table 4.7.2-3. It seems a calm place in isresidential area nearby the Landfill site.

Table 4.7.2-4: Noise level measurement at the WWTP site, Sept. 2020

Location	Survey period	Noise Level dB(A)			
		LAeq	Standard[(i)] (Leq)	Lmax	Lmin
WWTP site	10:00 - 11:00	46.8	60-70	56.8	35.5
	11:00 - 12:00	43.8		60.8	30.4
	12:00 - 13:00	40.4		59.7	34.8
	13:00 - 14:00	38.2		58.2	23.8
	14:00 - 15:00	45.5		59.4	33.2
	15:00 - 16:00	44.3		61.0	33.3
	16:00 - 17:00	44.6		60.6	33.3
	14:00 - 15:00	48.4		58.4	34.0
Average of 8 hours		**44.0**		**59.4**	**32.3**

Note: [(i)] 60 dB(A) for residential areas, hotels, administrative office, and villa/flat, day time (6:00-18:00)
70 dB(A) for commercial, service areas, and area of multiple businesses, day time (6:00-18:00)

Table 4.7.2-5: Noise level measurement at the houses close to the WWTP site

Location	Survey period	Noise Level dB(A)			
		LAeq	Standard [(i)] (Leq)	Lmax	Lmin
Near house # 1	11:00 - 12:00	45.1	60	58.3	34.2
Near house # 2	12:00 - 13:00	43.0	60	65.3	34.4
Near house # 3	13:00 - 14:00	44.4	60	62.4	33.5

Note: [(i)] 60 dB(A) for residential areas, hotels, administrative office, and villa/flat, day time (6:00-18:00)

The results of noise level measurement at the WWTP site during day time is between 56-61 dB(A) for the maximum level and **43-45 dB(A) for average level**, Table 4.7.2-4. It means that the baseline noise level in the WWTP area is met the Cambodian standard for mixing areas of residential, commercial, hotel, service area, office, and multiples business area 60-70 dB(A). While the maximum noise level in one hour of the three houses close to the WWTP site is 58-65 dB(A), and the **average level is 43-45 dB(A) only**, Table 4.7.2-5. It meant that the present condition of the noise level in the WWTP site and nearby the residential area is good.

Table 4.7.2-6: Noise level measurement at the lift pumping station and main pumping station

Location	Survey period	Noise Level dB(A)			
		LAeq	**Standard[(i)] (Leq)**	**Lmax**	**Lmin**
Lift pumping station	15:00 - 16:00	42.1	70	55.2	32.2
Main pumping station	16:00 - 17:00	42.4	70	54.3	35.2

Note: [(i)] 70 dB(A) for commercial, service areas, and area of multiple businesses, day time (6:00-18:00)

The results of the noise level in one hour of the three houses close to the lift and main pumping station **is 42.1 and 42.4 dB(A),** but the Cambodian noise level standard for commercial, service areas and area of multiple businesses during day time is 70 dB(A). It seems a calm place in isresidential area near both pumping stations.

4.8 Air quality

4.8.1 Methodology

Conducting the baseline survey of air quality in proposed project sites is to support as baseline data for the initial environmental examination study. The air quality measurement has been conducted the same date as the noise measurement, September 13, 2020. There is the only sample that was selected in the proposed landfill site as respectively to the ToR given by the TA consultant.

8 to 24 hours for the field measurement were applied based on the requirement of the Cambodian standard. The field measurement was conducted by air quality experts and specific equipment of the Ministry of Environment (MoE), Figure 4.8.1-1. The air quality examination method has been done and analyzed according to the MoE lab procedure, Table 4.8.1-1.

Table 4.8.1-1: The method for air quality measurement

No	Parameters	Unit	Standard	Method
1	Carbon Monoxide (CO)	mg/m^3	<20 (8 hours)	Carbon Monoxide Passive Dositube
2	Nitrogen Dioxide (NO2)	mg/m^3	<0.1 (24 hours)	Saltzman [ISO 6768:1998 (E)]
3	Sulfur Dioxide (SO2)	mg/m^3	<0.3 (24 hours)	Pararosanilne [ISO 6767:1990 (E)]
4	Total Suspended Particles (TSP)	mg/m^3	0.33 (24 hours)	Weight Concentration Measuring
5	PM10	mg/m^3	<0.05 (24 hours)	Weight Concentration Measuring
6	Hydrogen Sulfite (H2S)	mg/m^3	<0.001	Portable Gas Detector H2S
7	Ammonia (NH3)	mg/m^3	<0.2	Portable Gas Detector H2S

Figure 4.8.1-1: The air quality measurement at the proposed landfill site

(Source: Air quality survey team, Sept. 2020)

4.8.2 Finding

The air quality has been conducted at the landfill site (0612784 E, 1225002 N) as the description in Table 4.7.2-1 and shows in Figure 4.3.1-1. The result of air quality measurement at the landfill site indicates that all the parameters below the air quality standard of Cambodia (sub-decree No.42 on Air Pollution Control and Noise Disturbance (Jul.2000), and Prakas No.120 on Stimulation of Term of Reference for Infrastructure and Tourism Project Development Sector (Apr.2018)), Table 4.8.2-1. The lab's sheets of air quality examination are enclosed in Annex 6.

It means that the ambient air quality in the proposed landfill site is very good.

Table 4.8.2-1: The results of air quality at the landfill site of the Bavet city

No	Parameters	Unit	Result	Standard
1	Carbon Monoxide (CO)	mg/m^3	0.86	<20 (8 hours)
2	Nitrogen Dioxide (NO2)	mg/m^3	0.016	<0.1 (24 hours)
3	Sulfur Dioxide (SO2)	mg/m^3	0.024	<0.3 (24 hours)
4	Total Suspended Particles (TSP)	mg/m^3	0.049	0.33 (24 hours)
5	PM10	mg/m^3	0.027	<0.05 (24 hours)
6	Hydrogen Sulfite (H2S)	mg/m^3	ND	<0.001
7	Ammonia (NH3)	mg/m^3	ND	<0.2

5. CONCLUSIONS

5.1 Environmental Regulation

There are some laws, sub-decrees, prakas, and guidelines relevant to environmental protection and monitoring to prevent the natural and social resources in good mainer and sustainable development. The detailed objective and aim of these regulations are described in section 2 of this report.

5.2 Project Decription

Three subprojects were proposed for Bavet city, according to the project component in the LCIP. Those subprojects include Wastewater, Storm Drainage, and Solid Waste Management. The detailed subproject component was described in section 3 of this report.

5.3 Baseline survey

5.3.1 Overall environmental aspect

Bavet city is the second city of Svay Rieng province and the first city connect to Vietnam by National Road No.1 as the southern corridor between Bangkok and Hochiminh city. It dominates agricultural land with about 90% of the total area, and residential as well as commercial area settled mostly along with the NR#1. However, there are many SEZs are running in this city with a huge number of workers (second range of Cambodia).

Bavet is located in the floodplain of the Mekong River. The extensive network of tributaries (preaek) and streams are governed by the rise and fall of the Mekong during the annual cycle of the rainy and dry season. Therefore young alluvium soils are made up of sediment deposits from rivers and streams. No protected area located nearby the city and no special ecosystem too, normally the area abundance of rice field and mix of grass land. However, the area is face with climate change include temperature increase by 2.1°C by 2050, precipitation increase of 5% by 2050. However, the city is a shortage of urban infrastructures due to it just classified as a city in 2008.

5.3.2 Characteristic of the project area

The proposed landfill site for Bavet city is located in an abandoned rice field (unfertile soil) in Chrak Mtes village, Sangkat Chrak Mtes, Bavet City, Svay Rieng province, where is about 10 km from the city center, 5 km from the NR No.1, no school and health center within 1km, no house within 300m from the landfill site. The access road can be used year-round even the last part (500m) is earth road. Surround the landfill area is presented the agricultural canal. Based on the above mention, the project area is much to respond to the criteria of national and international guidelines for landfill development. The landfill itself is next door to the existing dumpsite, which is a good location for the people's perception, already family with dumpsite.

While the WWTP site is located in available public land 20ha as a part of Community Forest “Chamkar Konkoki,” which is given by MAFF to Svay Rieng authority for building WWTP, it is located about 5 km from the city center, 1.5 km from the NR No.1, no school and health center within 1km, no house within 300m from the WWTP site. However, there is a land development project that appeared in front of the proposed site. Easy access road with about 10m wide as laterite road. Agricultural land with sufficient open canal for supported rice cultivation activities.

5.3.3 Soil quality

The soil particle analysis is loam at the landfill site and loamy clay at the WWTP site. But in the visual clay layer are presented in-depth more than 0.5m. pH at both sites (landfill and WWTP) is acidity.

The soil quality at the proposed landfill site and the WWTP site indicate that all parameters are under the standard value of MoE. The soil quality of both sites is not polluted yet. However, the Zinc concentration in the soil at the landfill site is 12 times higher than the standard of MoE has unpredictable and perhaps pollute from the existing dumpsite.

The soil analysis's physical and chemical characteristics should conduct more points and more depth at both the proposed landfill and the WWTP site to understand the soil layer for analyzing the permeability conductivity to protect the groundwater pollution.

5.3.4 Water quality

The surface water quality indicator in the Bavet city indicates that surface water does not affect the water body's pollution sources. The water quality in the surface water is under the standard of MoE. This result indicated that the surface water quality still has no polluted impacts yet.

The groundwater at the proposed landfill site and the WWTP site indicate that all parameters are under the standard value of MoE, except the iron concentration is higher than the drinking standards of MoE. The Iron concentration in groundwater is three times at the WWTP area and two times at the landfill area higher than the standard. It might cause soil quality in the groundwater layer also the contribution of water quality in the ground. The main water consumption of Bavet city is underground water.

The bacteria in surface water indicate that the *E. coli* concentration is under the standard value of Cambodia determined by MoE. However, the *Total Coliform* concentration is about 2 times higher than the standard. This result might cause the environment surrounding water sources such as the existing dumpsite with high organic waste to contribute to water quality. The wetland forest and agricultural field might also contribute to the increasing battery in the water.

5.3.5 Flora

Landfill site

Vegetation: Our study was found 15 different species and 12 families which mostly are common species in the local status, except 5 species such as; *Garcinia schefferi, Pierre*, *Cratoxylum formosum Melaleuca quinquenervia, Acacia auriculiformis Muell.,* and *Calamus salicifolius* were classed in the least concern (LC) that list by IUCN 2020.

the total tree numbers will be cut in the whole proposed landfill area is 2,800 stems/ha, and the forest coverage around 10% of the total area equal 2ha. The new development landfill here will require to compensate as replant trees with a total number of **5,600 trees,** according to the forestry law of Cambodia.

WWTP site

Vegetation: Our result indicated approximately 23 ha, was found 11 different species, and 7 genus which mostly are common species in the local status, except 2 species such as; *Melaleuca quinquenervia Syzygium cumini* were classed in the least concern (LC) by IUCN

2020. The *Melaleuca quinquenervia* is dominant species, and we also recorded *Dioscorea oryzetorum, Cassytha filiformis, Syzygium cumini, Litsca glutinosa, Cinnamomum litsacfolium, Thw., Orophea polycarpa, Heterosmilax paniculate, Eurycoma longiflia, Melastoma saigonense.*

The vegetation estimation with Dbh>5 cm in an average number of number which was totally 3,467 (±2,469) stems/ha. As known, the WWTP site with a total area of 20ha is located in a part of Chamkar Korki Community Forestry (CFCK) in Sangkat Bati of Bavet City where replated trees since 1994 and dominant of Melaleuca trees. However, forestry law clearly indicated that anyone who cut 1 tree needs to replant 1 tree, so the new development landfill here will require to compensate as replant trees with a total number of **69,340 trees.**

Trees should be replanted at least at the perimeter site of the proposed main pumping station, landfill, and WWTP to protect the odor, noise, and nature-based. Also, it is important to compensate as replant the trees for sustainable development. The replanted should be local trees or Melaleuca tree that available in the market. However, the existing flora can be replanted; it is the priority to consider. The available land, such as in public gardens, along the road, green space as reserves by the city administration should replant the trees to compensate for the project development.

5.3.6 Fauna

Landfill site

Mammals and Birds: During our line-transect surveys and interviewing local people, we documented one bird species (Painted Stork *Mycteria leucocephale*) that listed as Near Threatened in the IUCN red list. We also recorded one large mammal (Red muntjac *Muntiacus muntjak*) during the survey period.

Amphibian and Reptile: The total of 12 herpetofaunal species is confirmed for the first time from the field comprehensive herpetological field survey of the survey site. This finding shows that one species of snake Xenochrophis flavipunctatus is likely to live in an open area of rice paddle field, which is available for frogs. Frogs are their main preys. Sphenomorphus maculatus is like to live in a shrub, agricultural land, and also near human settlements. Other reptile species are not much different from above; they can live in varied habitats to keep their population is stable.

Most amphibian species are common to shrubland, agricultural areas, and ponds around the village. Most of them including Duttaphrynus melanostictus, Microhyla fissipes, Microhyla pulchra, Fejervarya limnocharis, Hoplobatrachus rugulosus. These species populations are in stable status except Hoplobatrachus rugulosus, which is hunted by local people for food and selling. Occidozyga lima which is likely to live in paddy field and puddles but their status remains in good condition. Kaloula pulchra is a shy species that live underground and only emerges during heavy rain or very wet ground for foraging and breeding. This species is also hunted by people and led to a population decrease locally too. None of the species that occur in the area are listed as threatened species.

Bat: Due to some part of the area still covers by shrubs with a nearby stream, insects would still have some to attract some bats to the area, but not many. The site also relatively open, which is hard to capture bats while they can fly in any direction.

WWTP site

Mammals and Birds: At least three globally threatened bird species, including two Near

Threatened species (i.e., Eurasian Curlew *Numenius arquata* and Painted Stork *Mycteria leucocephala*) and one Endangered species (i.e., Milky Stork *Mycteria cinerea*) are reported to be present there. Only small mammals are reported to be present in the study area.

Amphibian and Reptile: The total of 11 herpetofaunal species is confirmed for the first time from the field comprehensive herpetological field survey of the survey site. This finding shows that one frog species *Hylarana erythraea* is likely to live on forest edge with enough vegetation for them to escape and camouflage themselves and availability of water. Frogs are their main preys. *Sphenomorphus* maculatus is like to live in a shrub, agricultural land, and also near human settlements. The gecko is not much different, while they can live in varied habitats to keep their population is stable.

Most amphibian species are common to shrubland, agricultural areas, and ponds around village. Most of them including *Microhyla fissipes, Microhyla pulchra, Fejervarya limnocharis, Hoplobatrachus rugulosus.* These species populations are in stable status except *Hoplobatrachus rugulosus,* which is hunted by local people for food and selling. *Occidozyga* lima which is likely to live in paddy field and puddles but their status remains in good condition. *Kalophrynus interlineatus* has a very wide range of distribution in many countries of Southeast Asia, but they are not commonly seen due to their shyness. Due to none of the species that occur in the area are listed as threatened species

Bat: This location is very low in bat diversity due to the flooded area, probably scarce of insect prey that lead to least favor by bat species.

5.3.7 Cultural Heritage

A shrine 400m^2 area with few big trees surrounding open canal presented at 100m from the borderline of 20ha for WWTP site. It was worshiped by the villagers in the dry season, but it was flooded during the wet season. The WWTP does not cause any significant impacts and concerns to the shrine area. However, the WWTP layout should be considered to avoid the bad smell to the shrine area.

5.3.8 Noise

The result of the noise disturbance measurement in all sites indicated is below the Cambodia standard as well as the international standard. The noise level measurement might be fluctuating depending on the human/transportation activities only. By the way, the location of the landfill site, WWTP site, and pump stations area calm place no settlement nearby, like rural area respectively.

5.3.9 Air quality

Same as noise measurement, due to most of the station are calm areas less of settlement and have not industrial or transportation activities, so the baseline results of air quality are lower than the Cambodian standard. It meant that all the subprojects area of the CLIP project sites in Bavet city is a good quality of air at the present time.

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ANNEX1: Permission letter from MAFF for WWTP site 23ha

The Kingdom of Cambodia

Nation, Religion, King

Ministry of Agriculture, Forestry and Fisheries Phhom Penh, 04 April 2017

No. 2949

TO

H.E Governor of the Board of Governors of Svay Rieng Province

Subject: Case of Requesting for 23-hectare of Chomka Kon Korki Community Forestry, in Trapaing Plong village, Bati commune, Bavet city, Svay Rieng province.

Reference: Letter 037/17, dated 08 February 2017, of Svay Rieng Provincial Administration.

Following the above objectives, I would like to inform Your Excellency Governor of the Board of Governors that requesting for 23-hectare of Chomka Kon Korki Community Forestry, in Trapaing Plong village, Bati commune, Bavet city, Svay Rieng province, in purpose of developing Wastewater Treatment Plant of the provincial administration; The Ministry of Agriculture Forestry and Fisheries has agreed but have to follow the recommendations of the committee of Community forestry management and provide compensation to the Forest Communities before implementing the project, as well as mitigate environmental impact during the implementation project.

Accordingly, as mentioned above, the Governor of the Board of Governors is aware and appropriate measures are being followed.

Your Excellency the Governor of the Board of Governors, please receive my sincerity.

cc to:

- The Council of Ministers
- Ministry of Interior
- Ministry of Land Management, Urban Planning and Construction

* To notify *

General Department

- The Department of Planning and Statistics
- Department of Financial Accounting

Department of Agriculture, Forestry and Fisheries of Svay Rieng Province

* To notify *

- Chronological documents

ANNEX 2: Lab sheets of soil quality examination

A. Soil Particle

[illegible]

Soil Analysis Results

[illegible] Company Name: KCC
[illegible] Address:
[illegible] 14/09/20 , NAL : 120-475/ 5 89-20

Lab. ID: 89/20		Lab No.	1	2	3	4
Description Parameter		Field ID:	Land fill Poipet	Land fill Bavet	WWTP Bavet	WWTP Poipet
Particle Size (Pipette Method)	(< 0.002mm) [illegible], Clay %		24.18	24.28	12.89	33.65
	(0.002-0.02 mm) [illegible], Fine Silt, %		6.35	19.25	13.15	12.55
	(0.02-0.05mm) [illegible], Coarse Silt, %		6.63	16.26	17.56	4.89
	(0.05-0.2mm) [illegible], Fine Sand,%		37.01	34.29	38.75	30.08
	(0.02-2mm) [illegible], Coarse Sand,%		25.91	4.43	16.96	14.49

[illegible] Note: This report only valid for sample examined.

1

B. Chemical parameters

LABORATORY

ANALYSIS REPORT

Sample Source: Key Consultants (Cambodia)
Date: September 05, 2023
Sample Type: [illegible] Bavet Landfill, [illegible] City Investment [illegible] Asian Development Bank [illegible] Village, Sang Kat Chrak Mtes, Bavet Town, Svay Rieng Province. UTM 48 P [illegible]

No	Parameter	Unit	Result	Standard	Reference Method
1	pH	-	5.90	-	Method 1:5 Soil Water
2	Arsenic (As)	mg/kg dry	ND	≤15	Method 3500-As C. (HNO3/HCl digestion)
3	Cadmium (Cd)	mg/kg dry	0.04	≤0.8	Method 3500-Cd C. (HNO3/HCl digestion)
4	Chromium (Cr total)	mg/kg dry	ND	≤400 (CrVI)	Method 3500-Cr C. (HNO3/HCl digestion)
5	Copper (Cu)	mg/kg dry	31.18	≤105	Method 3500-Cu C. (HNO3/HCl digestion)
6	Lead (Pb)	mg/kg dry	26.40	≤85	Method 3500-Pb C. (HNO3/HCl digestion)
7	Mercury (Hg)	mg/kg dry	0.17	≤0.3	Method 3500-Hg B. (HNO3/HCl digestion)
8	Nickel (Ni)	mg/kg dry	ND	≤35	Method 3500-Ni C. (HNO3/HCl digestion)
9	Zinc (Zn)	mg/kg dry	1884.74	≤140	Method 3500-Zn C. (HNO3/HCl digestion)

3- ND Mean Not Detected (Lower than LDL), NV Mean No Value

Date of Issue
Director

Analyst

LABORATORY

ANALYSIS REPORT

No	Parameter	Unit	Result	Standards	Reference Method
1	pH	-	4.03	-	Method 19 ISO Water
2	Arsenic (As)	mg/kg-dry	ND	≤20	Method 3500-As D. (HNO3/HCl digestion)
3	Cadmium (Cd)	mg/kg-dry	0.23	≤0.8	Method 3500-Cd C. (HNO3/HCl digestion)
4	Chromium (Cr+6)	mg/kg-dry	ND	≤100 (Cr+6)	Method 3500-Cr C. (HNO3/HCl digestion)
5	Copper (Cu)	mg/kg-dry	20.00	≤210	Method 3500-Cu C. (HNO3/HCl digestion)
6	Lead (Pb)	mg/kg-dry	24.42	≤400	Method 3500-Pb C. (HNO3/HCl digestion)
7	Mercury (Hg)	mg/kg-dry	0.08	≤0.3	Method 3500-Hg B. (HNO3/HCl digestion)
8	Nickel (Ni)	mg/kg-dry	ND	≤56	Method 3500-Ni C. (HNO3/HCl digestion)
9	Zinc (Zn)	mg/kg-dry	29.24	≤360	Method 3500-Zn C. (HNO3/HCl digestion)

1. ND Mean Not Detected (Lower than LOL), NV Mean No Value

ANNEX 3: Lab sheets of water quality examination

A. Surface Water Quality

Ministry of Water Resources and Meteorology
Department of Hydrology and River Works
Water Quality Analysis Office

Nation Religion King

Sampling Owner: KCC
Sampling Location: Bavet
Sampling Source: Surface Water
Sampling Date: 01 September 2020
Analysis Date: 01-07 September 2020

Water Quality Laboratory
QA & QC
Dep. Hydrology & River works
MOWRAM

Water Quality Result

I. Physical and Chemical Test

N°	Item	Unit	Method	Guideline		WWTP-SW1	LF-SW1
				River	Lake		
1	pH	pH unit	4500-H+/SM	6.5-8.5	6.5-8.5	7.22	7.09
2	Electrical Conductivity (EC)	mS/m	2510-Ec/SM			1.88	51.80
3	Dissolved Oxygen (DO)	mg/l	4500-O/SM	7.5-2.0	7.5-2.0	5.1	5.2
4	Biochemical Oxygen Demand (BOD5)	mg/l	5210-BOD5/SM	<10	<10	4.80	4.15
5	Chemical Oxygen Demand (COD-K)	mg/l	5220-COD/SM	<50		6.70	10.90
6	Carbonate (CO3)	mg/l	2320-A/SM			0.00	0.00
7	Bicarbonate (HCO3)	mg/l	2320-A/SM			30.82	270.50
8	Calcium (Ca)	mg/l	3500-Ca-B/SM			4.09	31.51
9	Magnesium (Mg)	mg/l	3500-Mg-B/SM			7.14	44.63
10	Sulphate (SO4)	mg/l	4500-SO4/SM	<500	<300	4.28	6.49
11	Chloride (Cl)	mg/l	4500-Cl/SM			3.81	90.67
12	Sodium (Na)	mg/l	3500-Na-B/SM			4.74	6.21
13	Potassium (K)	mg/l	3500-K-B/SM			1.11	2.04
14	Nitrite (NO2)	mg/l	4500-NO2-/SM			0.002	0.007
15	Total Nitrogen (TN)	mg/l	4500-N/SM	0.1-0.6	0.1-0.6	0.412	3.221
16	Total Phosphorus (TP)	mg/l	4500-P/SM	0.005-0.05	<0.005	0.012	0.050
17	Iron (Fe2+)	mg/l	3500-Fe/SM			0.00	0.00
18	Iron (Fe3+)	mg/l	3500-Fe/SM			0.015	0.019
19	Oil & Grease	mg/l	5520-Grease/SM	<5	<5	11.6	9.8
20	Cadmium (Cd)	mg/l	3500-Cd/SM			0.0021	0.0043
21	Arsenic (As)	mg/l	3500-As/SM	<0.01	<0.01	0.00114	0.00
22	Tot. Coliform	MPN in 100 ml	9221-Coliform/SM	<5000	<5000	6,200.00	23,000.00
23	E.Coli	MPN in 100 ml	9221-Coli/SM			40.00	93.00

Note* Guideline for Cambodia Public Water

WWTP-SW1 [illegible]

LF-SW1 [illegible]

Phnom Penh, Date 15 September 2020

Water Quality Analysis Office

Chief

CHEA VANNARA

B. Groundwater quality

Ministry of Water Resources and Meteorology
Department of Hydrology and River Works
Water Quality Analysis Office

Nation Religion King

Sampling Owner: KEC
Sampling Location : Bavet
Sampling Source : Ground Water
Sampling Date : 10 September 2020
Analysis Date: 01-07 September 2020

Water Quality Laboratory
QA & QC
Dep. Hydrology & River works
MOWRAM

Water Quality Result

N°	Item	Unit	Method	Guideline	WWTP-GW	LF-GW1	LF-GW2
1	pH	pH unit		6.5-8.5	6.25	6.14	6.31
2	Electrical Conductivity (EC)	mS/cm			8.04	1.13	1.57
3	Total Dissolved Solid (TDS)	mg/l			44.8	57	78
4	Chemical Oxygen Demand (COD/dichromate)	mg/l		<50	1.1	1.1	2.2
5	Carbonate (CO3)	mg/l			0.0	0.0	0.0
6	Bicarbonate (HCO3)	mg/l			23.50	12.80	13.50
7	Calcium (Ca)	mg/l			5.15	5.41	6.94
8	Magnesium (Mg)	mg/l			0.12	5.03	5.63
9	Sulphate (SO4)	mg/l		<400	6.01	3.03	6.66
10	Chloride (Cl)	mg/l			5.08	5.11	1.29
11	Sodium (Na)	mg/l			8.11	5.89	5.75
12	Potassium (K)	mg/l			2.65	2.62	2.34
13	Nitrate (NO3)	mg/l			0.004	0.006	0.003
14	Ammonia(NH3)	mg/l			0.011	0.011	0.029
15	Total Nitrogen (TN)	mg/l		0.1-0.8	0.021	0.019	0.005
16	Total Phosphorus (TP)	mg/l		0.005-0.05	0.011	0.012	0.012
17	Iron (Fe)	mg/l			0.051	0.277	0.637
18	Mercury (Hg)	mg/l			0	0	0
19	Manganese (Mn)	mg/l		<0	0.0254	0.0147	0.0486
20	Chromium(Cr)	mg/l			0	0.0018	0
21	Arsenic (As)	mg/l		<0.01	0	0	0
22	Tot. Coliform	MPN in 100 ml		<3000	0.0	0.0	68.0
23	E.Coli	MPN in 100 ml			0.0	0.0	0.0

Note* Guideline for Cambodia Public Water

WWTP-GW 621564E,1220418N

LF-GW1 619559E,1225367N

LF-GW2 619406E,1225145N

Phnom Penh, Date 15 September 2020

Water Quality Analysis Office

Chief

CHEA VANNARA

C. Bacteriology

Ministry of Water Resources and Meteorology
Department of Hydrology and River Works
Water Quality Analysis Office

Nation Religion King

Sampling Owner: KCC
Sampling Location: Bavet
Sampling Source: Ground Water
Sampling Date: 01 September 2020
Analysis Date: 01-07 September 2020

Water Quality Laboratory
QA & QC
Dep. Hydrology & River works
MOWRAM

Water Quality Result

N°	Item	Unit	Method	Guideline	WWTP-GW	LF-GW1	LF-GW2
1	pH	pH unit	4500-H+ B	6.5-8.5	6.27	6.14	6.31
2	Electrical Conductivity (EC)	mS/cm	2510-B		0.99	1.15	1.37
3	Total Dissolved Solid (TDS)	mg/l	2540-TDS/105		663	757	748
4	Chemical Oxygen Demand (COD)Mn	mg/l	5220-COD/150	<10	1.1	1.3	2.2
5	Carbonate (CO3)	mg/l	2320-A/NM		0.0	0.0	0.0
6	Bicarbonate (HCO3)	mg/l	2320-A/NM		35.50	12.46	13.55
7	Calcium (Ca)	mg/l	3500-Ca-B/NM		3.15	6.41	0.04
8	Magnesium (Mg)	mg/l	3500-Mg-B/NM		0.12	5.01	5.63
9	Sulphate (SO4)	mg/l	4500-SO4/NM	<300	6.05	3.60	4.66
10	Chloride (Cl)	mg/l	4500-Cl/NM		5.08	5.11	1.29
11	Sodium (Na)	mg/l	3500-Na-B/NM		8.13	5.89	5.75
12	Potassium (K)	mg/l	3500-K-B/NM		2.65	2.62	2.19
13	Nitrate (NO3)	mg/l	4500-NO3-E/NM		0.004	0.006	0.002
14	Ammonia(NH3)	mg/l	4500-NH3/NM		0.013	0.011	0.038
15	Total Nitrogen (TN)	mg/l	4500-N/NM	0.1-0.6	0.021	0.019	0.063
16	Total Phosphorus (TP)	mg/l	4500-P/NM	0.005-0.03	0.011	0.012	0.012
17	Iron (Fe)	mg/l	3500-Fe/NM		0.008	0.377	0.457
18	Mercury (Hg)	mg/l	3500-Hg/NM		0	0	0
19	Manganese (Mn)	mg/l	3500-Mn/NM	<5	0.0754	0.0947	0.1440
20	Chromium(Cr)	mg/l	3500-Cr/NM		0	0.0018	0
21	Arsenic (As)	mg/l	3500-As/NM	<0.01	0	0	0
22	Tot. Coliform	MPN in 100 ml	9500-Coliform/NM	<3000	0.0	0.0	68.0
23	E.Coli	MPN in 100 ml	9500-Coli/NM		0.0	0.0	0.0

Note* Guideline for Cambodia Public Water
WWTP-GW:E215668,1220418N
-LF-GW1:E135338,1221367N
-LF-GW2:E134068,1219145N

Phnom Penh, Date 15 September 2020
Water Quality Analysis Office
Chief

CHEA VANNARA

ANNEX4: Flora and fauna in project sites

A. Flora survey

Activities of tree measurement at Landfill suite

Measuring of *Litsca glutinosa DBH (cycle)* in Plot1

Melanorrihoea laccifera, Pierre. plot 2

Acacia auriculiformis Muell. plot 2

Picture of vegetation species in Landfill site

Melaleuca quinquenervia in plot1

Ochna integerrima in plot1

Leaf of Cratoxylum formosum in plot1

Activities of tree measurement at WWTP site

	
Vegetation species recorded in Plot1	Meet with member of the Chamkar Korki Community Forestry

Picture of vegetation species in WWTP site

		
Eurycoma longiflia in plot1	Cinnamomum litsacfolium, Thw. in plot1	*Syzygium cumini in plot 1*
		
Melastoma saigonense in plot2	*Melaleuca quinquenervia in Plot3*	*Tree condition at border of the WWTP*

B. Fauna Survey

Picture of bird species in the Landfill site

Bird species recorded during the line transect surveys; Paddyfield Pipit (top left), Blue-tailed Bee-eater (bottom left), Brown Prinia (Top right), and Common myna (bottom right)

Pictures of bird Species in WWTP site

Bird species recorded during the line transect surveys; Cattle Egret (top left), Common Myna (top right), Scaly-breasted Munia (middle left), Lesser Whistling-duck (middle right), Brown Prinia (bottom left), and Yellow-vented Bulbul (bottom right).

ANNEX5: Lab sheets of noise measurement

LABORATORY

ANALYSIS REPORT

Sampling Period: [illegible]

Time	Survey Period	Noise Level [illegible]				Remarks
		[illegible]	[illegible]	Lmax	Lmin	
[illegible]	7:00 - 8:00	[illegible]	[illegible]	[illegible]	[illegible]	
	8:00 - 9:00	[illegible]		[illegible]	[illegible]	
	9:00 - 10:00	[illegible]		[illegible]	[illegible]	
	10:00 - 11:00	[illegible]		[illegible]	[illegible]	
	11:00 - 12:00	[illegible]		[illegible]	[illegible]	
	12:00 - 13:00	[illegible]		[illegible]	[illegible]	
	13:00 - 14:00	[illegible]		[illegible]	[illegible]	
	14:00 - 15:00	[illegible]		[illegible]	[illegible]	
8 Hours Average		[illegible]		[illegible]	[illegible]	

LABORATORY

ANALYSIS REPORT

Time	Survey Period	Noise Level (dB(A))				Remarks
		LAeq	Standard LAeq	LAmax	LAmin	
[illegible]	7:00 - 8:00	40.0		54.7	32.2	[illegible]
[illegible]	8:01 - 9:00	40.0		54.1	33.2	[illegible]
[illegible]	9:01 - 10:00	40.0		56.2	38.2	[illegible]

Director General

Analyst

ANALYSIS REPORT

Time	Survey Period	Noise Level dB(A)				Remarks
		Leq	Standard Leq	Lmax	Lmin	
Day	10:00 - 11:00	46.6	70	58.8	35.5	
	11:00 - 12:00	43.8		60.0	30.4	
	12:00 - 13:00	45.4		60.7	34.8	
	13:00 - 14:00	38.2		59.2	33.8	
	14:00 - 15:00	40.8		59.4	33.2	
	15:00 - 16:00	44.3		61.2	35.3	
	16:00 - 17:00	44.6		60.8	33.3	
	18:00 - 19:00	46.4		59.4	34.0	
Hourly Average		44.0		59.4	33.8	

LABORATORY

ANALYSIS REPORT

Sample Source: Key Consultants (Cambodia)

Survey Point: [illegible]

Sampling date: September [illegible], 2020

Sampling Period: 11:00 AM to 17:00 PM

Time	Survey Period	Noise Level dB(A)				Remarks
		Leq	Standard	Lmax	Lmin	
[illegible]	11:00 - 12:00	45.1		55.3	34.1	[illegible]
[illegible]	12:00 - 13:00	46.8		55.1	34.4	[illegible]
[illegible]	13:00 - 14:00	44.4		53.4	33.9	[illegible]
[illegible]	15:00 - 16:00	40.1		55.2	32.2	[illegible]
[illegible]	16:00 - 17:00	41.6		54.2	33.2	[illegible]

[illegible]

ANNEX 6: Lab sheets of air quality examination

LABORATORY

ANALYSIS REPORT

Sample Source: Key Consultants (Cambodia)
Survey Point: [illegible]
Sampling date: September 13, 2020
Sampling Period: 07:00 AM to 07:00 AM Next Day

No.	Parameter	Unit	Result	Standard	Reference Method
1	Carbon Monoxide (CO)	mg/m³	[illegible]	[illegible]	[illegible]
2	Nitrogen Dioxide (NO2)	mg/m³	[illegible]	<0.1 (24 Hour)	Method Saltzman (ISO 6768:1998 E)
3	Sulfur Dioxide (SO2)	mg/m³	0.024	<0.3 (24 Hour)	Method Pararosaniline (ISO 6767:1990 E)
4	Total Suspended Particulate (TSP)	mg/m³	[illegible]	[illegible]	Method Weight Concentration Measuring
5	PM10	mg/m³	[illegible]	[illegible]	Method Weight Concentration Measuring
6	Hydrogen Sulfide (H2S)	mg/m³	ND	[illegible]	Method Portable Gas Detector [illegible]
7	Ammonia (NH3)	mg/m³	ND	[illegible]	Method Portable Gas Detector [illegible]

Date of Issue

Director

Analyzer

Annex 7: The attendance list with local meeting

THE ATTENDENCE LIST

Name of meeting : [illegible]
Date : [illegible]
Location : [illegible]

No	Name	Gender	Position	Organization	Contact Number	Signature
1	[illegible]	[illegible]	PIU	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	KCC	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	KCC	[illegible]	[illegible]

THE ATTENDENCE LIST

Name of meeting : Preliminary Environmental survey of landfill site
Date : 02/07/2010
Location : Bavet

ល.រ No	ឈ្មោះ Name	ភេទ Gender	តួនាទី Position	អង្គភាព Organization	លេខទូរស័ព្ទ Contact Number	ហត្ថលេខា Signature
1	[illegible]	[illegible]	[illegible]	HCC	[illegible]	
2	[illegible]	[illegible]	PIU	[illegible]	[illegible]	
3	[illegible]	[illegible]	PIU	[illegible]	[illegible]	
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
5	[illegible]	[illegible]	[illegible]	HCC	[illegible]	

4. Integrated Biodiversity Assessment Tool (IBAT) Report

Proximity Report
BAVET

Country: Cambodia

Location: [11.1, 106.1]

Date of analysis: 01 December 2020 (GMT)

Size of site: 171 km^2

Buffers applied: 1 km

Generated by: Jean-Louis Malfere

Organisation: ADB

Overlaps with:

Protected Areas	0
Key Biodiversity Areas	0
IUCN Red List	175

Displaying project location and buffers: 1 km

About this report

This report presents the results of [5956-12636] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 1 km.

This report is one part of a package generated by IBAT on 01 December 2020 (GMT) that includes full list of all species, protected areas, Key Biodiversity Areas in CSV format, maps showing the area of interest in relation to these features, and a 'How to read IBAT reports' document.

Data used to generate this report

- UNEP-WCMC and IUCN, 2020. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net - December 2020.
- BirdLife International (on behalf of the KBA Partnership), 2020. Key Biodiversity Areas - October 2020.
- IUCN, 2020. IUCN Red List of Threatened Species - July 2020.

Protected Areas

The following protected areas are found within 1 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

No protected areas within buffer distance

Key Biodiversity Areas

The following key biodiversity areas are found within 1 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

No KBAs within buffer distance

IUCN Red List of Threatened Species

The following threatened species are potentially found within 50km of the area of interest.

For the full IUCN Red List please refer to the associated csv in the report folder.

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Crocodylus siamensis	Siamese Crocodile	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
Indotestudo elongata	Elongated Tortoise	REPTILIA	CR	Decreasing	Terrestrial
Manis javanica	Sunda Pangolin	MAMMALIA	CR	Decreasing	Terrestrial
Pangasianodon gigas	Mekong Giant Catfish	ACTINOPTERYGII	CR	Decreasing	Freshwater
Pangasius sanitwongsei	Giant Pangasius	ACTINOPTERYGII	CR	Decreasing	Freshwater
Sphyrna lewini	Scalloped Hammerhead	CHONDRICHTHYES	CR	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Sphyrna mokarran	Great Hammerhead	CHONDRICHTHYES	CR	Decreasing	Marine
Pristis zijsron	Green Sawfish	CHONDRICHTHYES	CR	Decreasing	Marine
Pygathrix nigripes	Black-shanked Douc Langur	MAMMALIA	CR	Decreasing	Terrestrial
Rhina ancylostoma	Bowmouth Guitarfish	CHONDRICHTHYES	CR	Decreasing	Marine
Rhynchobatus australiae	Bottlenose Wedgefish	CHONDRICHTHYES	CR	Decreasing	Marine
Batagur affinis	Southern River Terrapin	REPTILIA	CR	Decreasing	Terrestrial, Marine, Freshwater
Catlocarpio siamensis	Giant Carp	ACTINOPTERYGII	CR	Decreasing	Freshwater
Datnioides pulcher	Siamese Tiger Perch	ACTINOPTERYGII	CR	Decreasing	Freshwater
Calidris pygmaea	Spoon-billed Sandpiper	AVES	CR	Decreasing	Terrestrial, Marine, Freshwater
Gyps bengalensis	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
Sarcogyps calvus	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial
Pseudibis davisoni	White-shouldered Ibis	AVES	CR	Decreasing	Terrestrial, Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Emberiza aureola	Yellow-breasted Bunting	AVES	CR	Decreasing	Terrestrial, Freshwater
Gyps tenuirostris	Slender-billed Vulture	AVES	CR	Decreasing	Terrestrial
Cyrtodactylus nigriocularis		REPTILIA	CR	Unknown	Terrestrial
Panthera pardus ssp. delacouri	Indochinese Leopard	MAMMALIA	CR	Decreasing	Terrestrial
Laubuka caeruleostigmata	Flying Minnow	ACTINOPTERYGII	EN	Decreasing	Freshwater
Cuora amboinensis	Southeast Asian Box Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Lutra sumatrana	Hairy-nosed Otter	MAMMALIA	EN	Decreasing	Terrestrial, Marine, Freshwater
Nycticebus pygmaeus	Pygmy Slow Loris	MAMMALIA	EN	Decreasing	Terrestrial
Rhincodon typus	Whale Shark	CHONDRICHTHYES	EN	Decreasing	Marine
Dipterocarpus dyeri		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Anisoptera costata		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Dipterocarpus intricatus		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Vatica philastraena		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Trachypithecus germaini	Indochinese Silvered Langur	MAMMALIA	EN	Decreasing	Terrestrial
Viverra megaspila	Large-spotted Civet	MAMMALIA	EN	Decreasing	Terrestrial
Stegostoma tigrinum	Zebra Shark	CHONDRICHTHYES	EN	Decreasing	Marine
Fluvitrygon oxyrhyncha	Longnose Marbled Whipray	CHONDRICHTHYES	EN	Unknown	Freshwater
Aetomylaeus maculatus	Mottled Eagle Ray	CHONDRICHTHYES	EN	Decreasing	Marine
Aetomylaeus vespertilio	Ornate Eagle Ray	CHONDRICHTHYES	EN	Decreasing	Marine
Mobula thurstoni	Bentfin Devilray	CHONDRICHTHYES	EN	Decreasing	Marine
Alopias pelagicus	Pelagic Thresher	CHONDRICHTHYES	EN	Decreasing	Marine
Gekko badenii		REPTILIA	EN	Decreasing	Terrestrial
Holothuria scabra	Golden Sandfish	HOLOTHUROIDEA	EN	Decreasing	Marine
Holothuria lessoni	Golden Sandfish	HOLOTHUROIDEA	EN	Decreasing	Marine
Pangasianodon hypophthalmus	Striped Catfish	ACTINOPTERYGII	EN	Decreasing	Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Poropuntius deauratus	Yellow Tail Brook Barb	ACTINOPTERYGII	EN	Decreasing	Freshwater
Urogymnus polylepis		CHONDRICHTHYES	EN	Decreasing	Marine, Freshwater
Pavo muticus	Green Peafowl	AVES	EN	Decreasing	Terrestrial
Sterna acuticauda	Black-bellied Tern	AVES	EN	Decreasing	Terrestrial, Freshwater
Platalea minor	Black-faced Spoonbill	AVES	EN	Increasing	Marine, Freshwater
Leptoptilos dubius	Greater Adjutant	AVES	EN	Decreasing	Terrestrial, Freshwater
Lonchura oryzivora	Java Sparrow	AVES	EN	Decreasing	Terrestrial
Magnolia cattienensis		MAGNOLIOPSIDA	EN	Unknown	Terrestrial
Mobula mobular	Spinetail Devil Ray	CHONDRICHTHYES	EN	Decreasing	Marine
Calostoma insigne		AGARICOMYCETES	EN	Decreasing	Terrestrial
Nomascus gabriellae	Red-cheeked Gibbon	MAMMALIA	EN	Decreasing	Terrestrial
Scleropages formosus		ACTINOPTERYGII	EN	Decreasing	Freshwater
Bos gaurus	Gaur	MAMMALIA	VU	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Carcharhinus plumbeus	Sandbar Shark	CHONDRICHTHYES	VU	Decreasing	Marine
Carcharias taurus	Sand Tiger Shark	CHONDRICHTHYES	VU	Unknown	Marine
Caretta caretta	Loggerhead Turtle	REPTILIA	VU	Decreasing	Terrestrial, Marine
Dermochelys coriacea	Leatherback	REPTILIA	VU	Decreasing	Terrestrial, Marine
Dugong dugon	Dugong	MAMMALIA	VU	Decreasing	Marine
Helarctos malayanus	Sun Bear	MAMMALIA	VU	Decreasing	Terrestrial
Hippocampus histrix	Thorny Seahorse	ACTINOPTERYGII	VU	Decreasing	Marine
Lepidochelys olivacea	Olive Ridley	REPTILIA	VU	Decreasing	Terrestrial, Marine
Lutrogale perspicillata	Smooth-coated Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
Macaca fascicularis	Nicobar Crab-eating Macaque	MAMMALIA	VU	Decreasing	Terrestrial
Panthera pardus	Leopard	MAMMALIA	VU	Decreasing	Terrestrial
Tenualosa thibaudeaui	Mekong herring	ACTINOPTERYGII	VU	Decreasing	Freshwater
Ursus thibetanus	Asiatic Black Bear	MAMMALIA	VU	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Hopea odorata		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Dipterocarpus alatus		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Dipterocarpus baudii		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Dipterocarpus costatus		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Dipterocarpus turbinatus		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Shorea roxburghii	White Meranti	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Shorea thorelii		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Carcharhinus falciformis	Silky Shark	CHONDRICHTHYES	VU	Decreasing	Marine
Urogymnus asperrimus	Porcupine Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Macaca leonina	Northern Pig-tailed Macaque	MAMMALIA	VU	Decreasing	Terrestrial
Hippocampus kelloggi	Great Seahorse	ACTINOPTERYGII	VU	Decreasing	Marine
Arctictis binturong	Binturong	MAMMALIA	VU	Decreasing	Terrestrial
Rusa unicolor	Sambar	MAMMALIA	VU	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Nebrius ferrugineus	Tawny Nurse Shark	CHONDRICHTHYES	VU	Decreasing	Marine
Hemipristis elongata	Snaggletooth Shark	CHONDRICHTHYES	VU	Decreasing	Marine
Aonyx cinereus	Asian Small-clawed Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
Rhinoptera javanica	Javanese Cownose Ray	CHONDRICHTHYES	VU	Unknown	Marine
Taeniurops meyeni	Blotched Fantail Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Montipora angulata		ANTHOZOA	VU	Decreasing	Marine
Pavona venosa		ANTHOZOA	VU	Unknown	Marine
Catalaphyllia jardinei		ANTHOZOA	VU	Unknown	Marine
Pectinia lactuca	Lettuce Coral	ANTHOZOA	VU	Unknown	Marine
Acropora willisae		ANTHOZOA	VU	Decreasing	Marine
Acropora acuminata		ANTHOZOA	VU	Decreasing	Marine
Pectinia alcicornis		ANTHOZOA	VU	Unknown	Marine
Acropora listeri		ANTHOZOA	VU	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Acropora paniculata		ANTHOZOA	VU	Decreasing	Marine
Goniopora planulata		ANTHOZOA	VU	Unknown	Marine
Acropora vaughani		ANTHOZOA	VU	Decreasing	Marine
Porites nigrescens		ANTHOZOA	VU	Unknown	Marine
Pavona decussata	Cactus Coral	ANTHOZOA	VU	Unknown	Marine
Astreopora cucullata		ANTHOZOA	VU	Decreasing	Marine
Porites sillimaniana		ANTHOZOA	VU	Unknown	Marine
Montipora friabilis		ANTHOZOA	VU	Decreasing	Marine
Leptoseris yabei		ANTHOZOA	VU	Unknown	Marine
Alveopora verrilliana		ANTHOZOA	VU	Unknown	Marine
Isopora brueggemanni		ANTHOZOA	VU	Decreasing	Marine
Heliopora coerulea	Blue Coral	ANTHOZOA	VU	Decreasing	Marine
Montipora caliculata		ANTHOZOA	VU	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Acropora donei		ANTHOZOA	VU	Decreasing	Marine
Leptoria irregularis		ANTHOZOA	VU	Decreasing	Marine
Acropora horrida		ANTHOZOA	VU	Decreasing	Marine
Acropora dendrum		ANTHOZOA	VU	Decreasing	Marine
Alveopora allingi		ANTHOZOA	VU	Unknown	Marine
Galaxea astreata		ANTHOZOA	VU	Unknown	Marine
Acropora microclados		ANTHOZOA	VU	Decreasing	Marine
Pavona bipartita		ANTHOZOA	VU	Unknown	Marine
Montipora corbettensis		ANTHOZOA	VU	Decreasing	Marine
Barabattoia laddi		ANTHOZOA	VU	Decreasing	Marine
Acropora globiceps		ANTHOZOA	VU	Decreasing	Marine
Turbinaria stellulata		ANTHOZOA	VU	Unknown	Marine
Montipora crassituberculata		ANTHOZOA	VU	Decreasing	Marine
Pachyseris rugosa		ANTHOZOA	VU	Unknown	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Physogyra lichtensteini		ANTHOZOA	VU	Unknown	Marine
Acropora aculeus		ANTHOZOA	VU	Decreasing	Marine
Turbinaria peltata		ANTHOZOA	VU	Unknown	Marine
Acropora anthocercis		ANTHOZOA	VU	Decreasing	Marine
Acropora palmerae		ANTHOZOA	VU	Decreasing	Marine
Acropora verweyi		ANTHOZOA	VU	Decreasing	Marine
Acanthastrea brevis		ANTHOZOA	VU	Unknown	Marine
Pavona cactus		ANTHOZOA	VU	Unknown	Marine
Favites spinosa		ANTHOZOA	VU	Decreasing	Marine
Euphyllia cristata		ANTHOZOA	VU	Stable	Marine
Lobophyllia diminuta		ANTHOZOA	VU	Unknown	Marine
Cyphastrea agassizi		ANTHOZOA	VU	Decreasing	Marine
Turbinaria mesenterina		ANTHOZOA	VU	Unknown	Marine
Acanthastrea hemprichii		ANTHOZOA	VU	Unknown	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Acropora polystoma		ANTHOZOA	VU	Decreasing	Marine
Isopora cuneata		ANTHOZOA	VU	Decreasing	Marine
Turbinaria reniformis		ANTHOZOA	VU	Unknown	Marine
Himantura uarnak	Reticulate Whipray	CHONDRICHTHYES	VU	Decreasing	Marine
Wallago attu		ACTINOPTERYGII	VU	Decreasing	Freshwater
Bagarius yarrelli		ACTINOPTERYGII	VU	Decreasing	Freshwater
Osphronemus exodon	Elephant Ear Gourami	ACTINOPTERYGII	VU	Decreasing	Freshwater
Oxygaster pointoni		ACTINOPTERYGII	VU	Decreasing	Freshwater
Epalzeorhynchos munense	Red Fin Shark	ACTINOPTERYGII	VU	Decreasing	Freshwater
Naja siamensis	Black And White Spitting Cobra	REPTILIA	VU	Decreasing	Terrestrial
Ophiophagus hannah	King Cobra	REPTILIA	VU	Decreasing	Terrestrial
Stichopus herrmanni	Curryfish	HOLOTHUROIDEA	VU	Decreasing	Marine
Actinopyga miliaris	Harry Blackfish	HOLOTHUROIDEA	VU	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Actinopyga mauritiana	Surf Redfish	HOLOTHUROIDEA	VU	Decreasing	Marine
Actinopyga echinites	Deep Water Redfish	HOLOTHUROIDEA	VU	Decreasing	Marine
Datnioides undecimradiatus		ACTINOPTERYGII	VU	Decreasing	Freshwater
Cirrhinus microlepis	Small Scaled Mud Carp	ACTINOPTERYGII	VU	Decreasing	Freshwater
Labeo pierrei		ACTINOPTERYGII	VU	Decreasing	Freshwater
Pangasius krempfi		ACTINOPTERYGII	VU	Decreasing	Marine, Freshwater
Python bivittatus	Burmese Python	REPTILIA	VU	Decreasing	Terrestrial
Mobula alfredi	Reef Manta Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Mobula birostris	Giant Manta Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Holothuria fuscogilva		HOLOTHUROIDEA	VU	Decreasing	Marine
Mulleripicus pulverulentus	Great Slaty Woodpecker	AVES	VU	Decreasing	Terrestrial
Buceros bicornis	Great Hornbill	AVES	VU	Decreasing	Terrestrial
Rhyticeros undulatus	Wreathed Hornbill	AVES	VU	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Carpococcyx renauldi	Coral-billed Ground-cuckoo	AVES	VU	Decreasing	Terrestrial
Grus antigone	Sarus Crane	AVES	VU	Decreasing	Terrestrial, Freshwater
Rynchops albicollis	Indian Skimmer	AVES	VU	Decreasing	Terrestrial, Freshwater
Clanga clanga	Greater Spotted Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Leptoptilos javanicus	Lesser Adjutant	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Ciconia episcopus	Asian Woollyneck	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Acrocephalus tangorum	White-browed Reed-warbler	AVES	VU	Decreasing	Terrestrial, Freshwater
Aetobatus ocellatus	Spotted Eagle Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Cyrtodactylus badenensis		REPTILIA	VU	Unknown	Terrestrial
Oxymonacanthus longirostris	Harlequin Filefish	ACTINOPTERYGII	VU	Decreasing	Marine
Arctonyx collaris	Greater Hog Badger	MAMMALIA	VU	Decreasing	Terrestrial
Aetomylaeus nichofii	Banded Eagle Ray	CHONDRICHTHYES	VU	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Cyrtodactylus thuongae		REPTILIA	VU	Unknown	Terrestrial

Recommended citation

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How to use this report

This report provides an indication of the potential biodiversity-related features - protected areas, key biodiversity areas and species - close to the specified location. It provides an early indication of potential biodiversity concerns, and can provide valuable guidance in making decisions. For example, this information can be helpful when assessing the potential environmental risk and impact of a site, categorising investments/projects, preparing the terms of reference for an impact assessment, focusing attention on key species of conservation concern and sites of known conservation value, and reviewing the results of an impact assessment.

The report does not provide details of potential indirect, downstream or cumulative impacts. Furthermore, the report should be regarded as a "first-step", providing a set of conservation values sourced from global data sets, and is not a substitute for further investigation and due diligence, especially concerning national and/or local conservation priorities.

5. Summary of the Public Consultations in Bavet City

5. Summary of the Public Consultations in Bavet City

5.1 Summary public consultation results

In developing the project, a series of stakeholder consultations and workshops were carried out preparatory by the technical assistance team comprising international and national specialists with representatives at Sangkat, Municipality, Province, and Ministry levels, with community members and with private companies. In particular, detailed environmental consultations were undertaken as part of the social consultation in September 2020.

Following COVID-19 procedures of the National Government and the RGC, the Ministry of Health of Cambodia, and WHO guidelines, the public consultations for LCIP have been carried out with a limited number of participants, no more than 50 persons per section. Mask wearing, use of hand sanitizer, and personal distancing were the measures applied.

The consultation is described in table below:

14 public consultations and Focus Group discussions (FGD) were undertaken in Bavet city at different Sangkat locations and dates, as described in tables below:

Table 1: Summary of the dates and locations of the public consultations in Bavet city

No.	Name of the different group of meeting	Date	Location	Total participant (persons)	Female (Person)
1	The dwellers in urban area	03/09/2020	Bavet General Knowledge and Technical High School	51	33
2	The dwellers in rural area	03/09/2020	Ampor Woin Pagoda, Chrok Mates Village, Bavet Town, Svay Rieng Province	54	35
3	ID Poor group	03/09/2020	Ampor Woin Pagoda, Chrok Mates Village, Bavet Town, Svay Rieng Province	9	8
4	FHHs group	04/09/2020	Bavet General Knowledge and Technical High School	10	10
5	Elders group	03/09/2020		11	6
6	Disable people group	04/09/2020		9	4
7	Youth (12-15 years old at high school) group	03/09/2020		16	5
8	Indigenous People group	03/09/2020		7	4
9	Informal Workers in Solid Waste Management	04/09/2020		10	6
10	Local authorities (chief of Sangkat/village)	02/09/2020	Headquarter Chrok Leav Village, Sangkat Bavet, Bavet City, Svay Rieng Province	16	1
11	Santi Sena Organization (NGO)	03/09/2020	By Phone Call	1	
12	Union of Youth Federation of Cambodia (NGO)	03/09/2020	Government Hill Bavet	2	1
13	Chamkar Konkoki Community Forest	28/09/2020	Bavet city hall	1	0
14	Biodiversity/birds freelance consultants	07/4/2021	By Phone call	2	0
	Total:			**199**	**113**

Table 2: Summary results of the public consultations in Bavet city

No.	Name of the different group of meeting	Perception to the project	Suggestions and Recommendations
1	The dwellers in Bavet city both urban and rural area	All of them understand the project, which will provide many benefits to the whole people in Bavet City and contribute to the provincial as well as national economic development through various activities, especially tourism. All participants in the different PCs welcome and 100% support the project.	- The project LCIP should provide the improvement on solid waste management to all level including the waste separation by type from each household. - The project should recruit local workforces as much as possible to provide job opportunities for local people. - The project DED team should cooperation with the Electricity/water supply authority to avoid damage facilities under ground during construction; - Working closely with concerning departments is recommended.
2	ID Poor group		- Suggested to disclosure project information to the local people and authority for getting good collaborate. - Should provide the priority recruitment for the local workforces as much as possible. - Suggested discount/low price or free for connection and using the sanitation system for ID poor Group.
3	FHHs group		- Suggested to LCIP to provide more bins in a public place. - Requested to solid waste company service should improve collection frequency and regularly. - Requested to the project implementing agency to provide the available entrance for residents/shop during the construction phase.
4	Elders group		- Suggest to LCIP project to provide training on solid waste separation as reduce, reuse, and recycle to the villagers. - Improvement of solid waste collection system should be considered. - During the construction phase, the contractor should follow the working time and install the traffic sign, barrier, and detour road.
5	Disable people group		- Suggested to provide vocational training for disable people to support their livelihood. - Requested to solid waste company service as well as the future SWM agency should improve collection frequency and regularly

			- The construction activities should be done in the dry season. - Low/discount connection cost and service fee should be considered for disabled people/family.
6	Youth (12-15 years old at high school) group		- A traffic facilitator at the entrance of their school should provide during construction activities in place. - Suggested to LCIP to improve the solid waste collection service and encourage to use the collection system. - The project implementing agency should provide any workshops or awareness campaigns on disadvantage and advantage of the burning, properly sorting, and storage solid waste. - Should disseminate the benefits of using sanitation system to the people to understand and corporate/support in O&M.
7	Indigenous People group		- Suggested to improve the solid waste service in whole Bavet city - The project should provide training on solid waste sorting/reduction/recycle to villagers. - Awareness campaigning on the benefit of the wastewater management system and health affected is recommended. - The project should provide the training on hygiene/sanitation to the local people. - At the operation phase, the technical team of sewerage implementing agency should be come in time when the HH facilities are disconnected.
8	Informal solid waste management		- Suggested to project to provide safety equipment or PPE during their working time. - The project implementing agency/owner should provide more training which is related to 3Rs and how to manage solid waste at HH to local people. - The informal workers in solid are working in Hybrid company, requested to company allow them to sale the collection waste to other buyer with good market price.
9	Local authorities (chief of Sangkat/village)		- The difficulties of the vulnerable group to achieve the project benefit due to the limitation of knowledge and poverty. - The current situation on solid waste service is limited, 60% of HH are buried and burn, and some HHs are not proper packing, so

			improvement of the SW collection system is needed. - Requested to the project to provide sorting and disposing waste within higher technique, and then would reduce the impact on the vulnerable group who are working as a waste picker in the landfill. - Suggested to project to create a more centralized collection point in the public area, Market. - Should provide sufficient garbage bins in the public area.
10	Santi Sena Organization	Welcome the project, and the activities of our organization mainly concerned to (i) organized a radio program, (ii) Children's Environmental Rights Campaign, (iii) Agricultural communities, and (iv) integrated farming systems and markets.	Our organization has the potential to provide service to the proposed project as campaigning program through radio
11	Union of Youth Federation of Cambodia in Bavet (UYFC)	Welcome the project, and the activities of our organization mainly concerned to (i) help poor families and homeless people, (ii) enhancing Hygiene, Sanitation and Environmental, and (iii) Traffic Law Training	Our organization could support the project on providing Hygiene, Sanitation and Environmental to the community

Individual consultations with key persons such as biodiversity specialist, community forest member, and BirdLife staff were also carried out for contributions on impact prevention and mitigation measures to valuable species in term of conservation aspect.

The summary results are stated below:

- For Chamkar Konkoki Community Forest representative requested to the project implementation agency (i) to provide compensation for replanting of the damaged trees, and (ii) to provide wooden bridge to the shrine where about area 100m from the project site.
- The biodiversity consultant and former BirdLife International staff, Mr. Hong Chamnan and Mr. Bou Vorsak, both are suggested more bird studies should be done during DED stage,

even though the WWTP site and the landfill site are not located in the protected area or special ecosystem, in order to make sure the proposed project implementation will be not affect the near-threatened bird species as reported from the local people.

5.2 Attendant list

5.2.1 General consultation in an urban area

THE ATTENDENCE LIST OF THE MEETING

Name of meeting: URBAN GENERAL MEETING
Date:
Location:
Total Participants: 18 (Male) Female: 13

No	Name	Gender	Position	Organization	Contact Number	Signature
1						
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THE ATTENDENCE LIST OF THE MEETING

Name of meeting: URBAN GENERAL MEETING
Date: 02 09 2020
Location: [illegible]
Total Participants: ______ (Male= ______ Female= ______)

ល.រ. No	ឈ្មោះ Name	ភេទ Gender	មុខងារ Position	ស្ថាប័ន Organization	ទូរស័ព្ទ Contact Number	ហត្ថលេខា Signature
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]		
26	[illegible]	[illegible]	[illegible]	[illegible]		
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
31	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
32	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
33	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
34	[illegible]	[illegible]	-	[illegible]		[illegible]
35	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
36	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
37	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
38	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

THE ATTENDENCE LIST OF THE MEETING

Name of meeting : URBAN GENERAL MEETING
Date : 03.04.20
Location : [illegible] School
Total Participants : ______ (Male= ______ Female= ______)

No	Name	Gender	Position	Organization	Contact Number	Signature
39	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
40	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
41	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
42	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
43	[illegible]	[illegible]		[illegible]		[illegible]
44	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
45	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
46	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
47	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
48	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
49	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
50	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
51	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

5.2.2 Attendant list of general consultation in a rural area

THE ATTENDENCE LIST OF THE MEETING

Name of meeting
Date
Location
Total Participants (Male= Female=)

No	Name	Gender	Position	Organization	Contact Number	Signature
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THE ATTENDENCE LIST OF THE MEETING

Group [illegible]

Name of meeting : [illegible] Meeting (Rural)
Date : 03/[illegible]
Location : [illegible]
Total Participants : ______ (Male= [illegible] Female= [illegible])

[illegible] No.	[illegible] Name	[illegible] Gender	[illegible] Position	[illegible] Organization	[illegible] Contact Number	[illegible] Signature
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
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[illegible]	[illegible]	[illegible]				[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

5.2.3 Attendant list of FGD 1 ID Poor

THE ATTENDENCE LIST OF THE MEETING

Name of meeting: meeting with ID poor

Date: 03/09/2018

Location: [illegible]

Total Participants: 9 (Male= 1, Female= 8)

ល.រ No	ឈ្មោះ Name	ភេទ Gender	តួនាទី Position	ស្ថាប័ន Organization	ទូរស័ព្ទ Contact Number	ហត្ថលេខា Signature
1	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

5.2.4 Attendant list of FGD 2 FHHs

THE ATTENDENCE LIST OF THE MEETING

Name of meeting : FGD – FHHs
Date : [illegible]
Location : [illegible]
Total Participants : ...... (Male: ...... Female: ......)

[illegible] No	[illegible] Name	[illegible] Gender	[illegible] Position	[illegible] Organization	[illegible] Contact Number	[illegible] Signature
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
2	[illegible]	[illegible]	-	-	[illegible]	
3	[illegible]	[illegible]	-	[illegible]		
4	[illegible]	[illegible]	-	[illegible]	[illegible]	
5	[illegible]	[illegible]	-	[illegible]		
6	[illegible]	[illegible]	-	[illegible]		
7	[illegible]	[illegible]	-	[illegible]		
8	[illegible]	[illegible]	-	[illegible]		
9	[illegible]	[illegible]	-	-		
10	[illegible]	-	-	[illegible]		

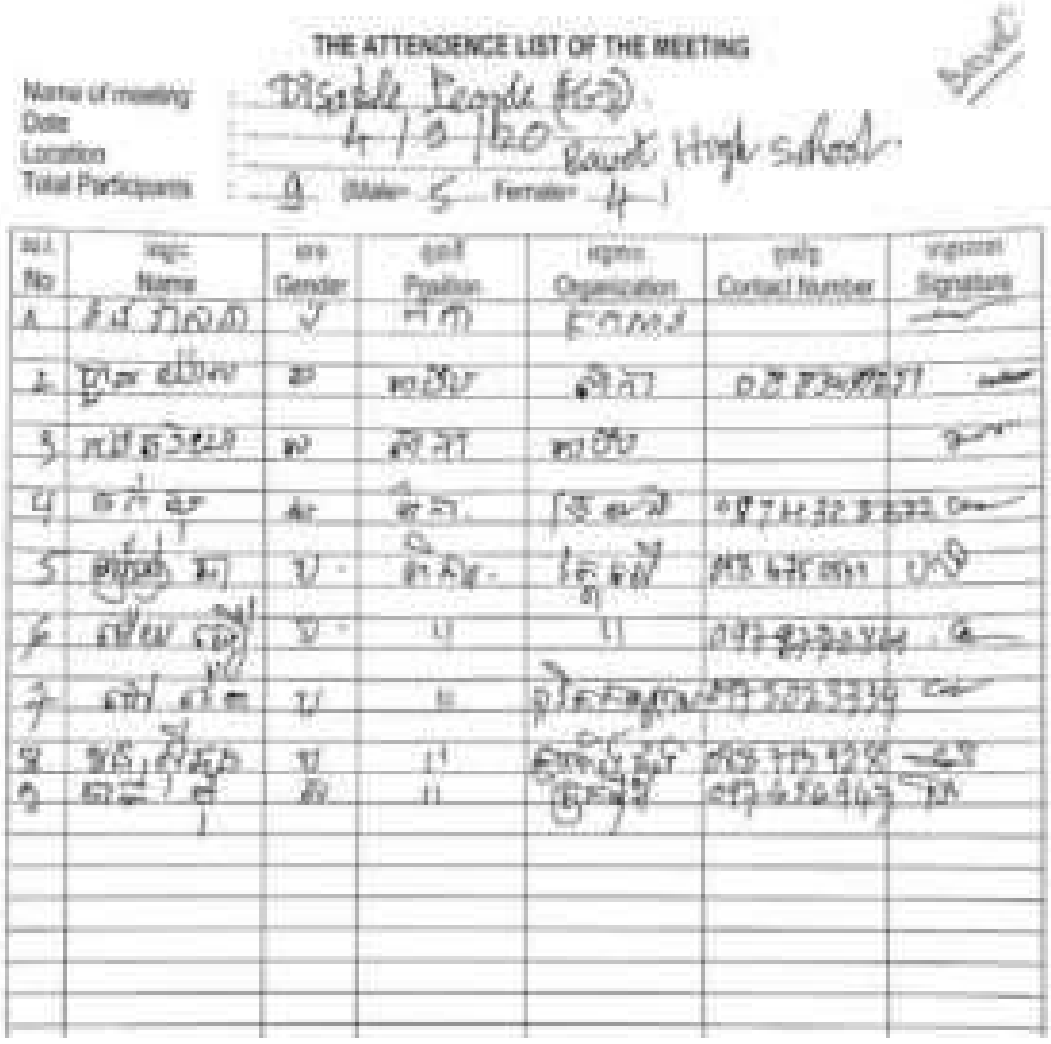
5.2.5 Attendant list of FGD 3 Elders People

THE ATTENDENCE LIST OF THE MEETING

Name of meeting : Elders (FGD)
Date : 03/04/20
Location : Pasuk High school
Total Participants : 11 (Male: 5 Female: 6)

No.	Name	Gender	Position	Organization	Contact Number	Signature
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						

5.2.6 Attendant list of FGD 4 Disabled People



THE ATTENDENCE LIST OF THE MEETING

Name of meeting: Disable People FGD
Date: 4/9/20
Loration: Bawdi High School
Total Participants: 9 (Male= 5 Female= 4)

No	Name	Gender	Position	Organization	Contact Number	Signature
1		√				
2						
3						
4						
5						
6						
7						
8						
9						

5.2.7 Attendant list of FGD 5 Youth 12-15 Highschool

THE ATTENDENCE LIST OF THE MEETING

Name of meeting : FGD - Youth (12-15)
Date : 04-05-2020
Location :
Total Participants : 16 (Male= 11 Female= 5)

No	Name	Gender	Position	Organization	Contact Number	Signature
1	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5.2.8 Attendant list of FGD 6 Indigenous People

THE ATTENDENCE LIST OF THE MEETING

Name of meeting: FGD- Indigenous people
Date: 03/09/2020
Location: [illegible]
Total Participants: 7 (Male= 4 Female= 3)

No.	Name	Gender	Position	Organization	Contact Number	Signature
1	[illegible]	[illegible]	[illegible]	[illegible]		
2	[illegible]	[illegible]	-	-		
3	[illegible]	[illegible]	-	[illegible]		
4	[illegible]	[illegible]	[illegible]	[illegible]		
5	[illegible]	[illegible]	[illegible]	[illegible]		
6	[illegible]	[illegible]	[illegible]	[illegible]		
7	[illegible]	[illegible]	[illegible]	[illegible]		

5.2.9 Attendant list of FGD 7 Informal Workers in Solid Waste Management

THE ATTENDENCE LIST OF THE MEETING

Name of meeting: FGD - Workers in Solid Waste [illegible]

Date: [illegible]

Location: [illegible]

Total Participants: 10 (Male: 4 Female: 6)

S.L. No	Name	Gender	Position	Organization	Contact Number	Signature
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]		[illegible]			[illegible]
4	[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]			[illegible]
7	[illegible]	[illegible]	—	—	[illegible]	[illegible]
8	[illegible]	[illegible]	—	—	—	[illegible]
9	[illegible]	[illegible]	—	—	[illegible]	[illegible]
10	[illegible]	[illegible]	—	—	—	[illegible]

5.2.10 Attendant list of FGD 8 Local Authorities

THE ATTENDENCE LIST OF THE MEETING

Name of meeting: Local Authority
Date: 02-09-2020
Location: [illegible]
Total Participants: 16 Male: 15 Female: 1

No.	Name	Gender	Position	Organization	Contact Number	Signature
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	KCC	[illegible]	[illegible]

5.2.11 Attendant list of Consult key NGOs/CBO

THE ATTENDENCE LIST OF THE MEETING

Name of meeting : CBO / NGO Meeting

Date : 03/08/2017

Location : Environmental Hill / Bavet

Total Participants : 7 (Male= 5 Female= 2)

No	Name	Gender	Position	Organization	Contact Number	Signature
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]		KCC	[illegible]	[illegible]
4	[illegible]	[illegible]		KCC	[illegible]	[illegible]
5	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	RH	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]		KCC	[illegible]	[illegible]

TABMA- QUESTIONNAIRE & GUIDELINES FOR THE SOCIAL SURVEY-LCIP _ Bavet / Kampot and Poipet Cities _ Attendance List

5.3 Activities of Public Consultation

5.3.1 Activities of the general consultation

The General consultation in an urban area

The General consultation in a rural area

5.3.2 Activity of the FGD 1 ID Poor

5.3.3 Activities of the FGD 2 Female Household

5.3.4 Activities of the FGD 3 Elders people

5.3 5 Activities of FGD 4 Disable people

5.3.6 Activities of FDG 5 Youth

5.3.7 Activities of FGD 6 indigenous people

5.3.8 Activities of FGD 7 formal workers in solid waste management

5.3.9 Activities of FGD 8 local authorities

5.3.10 Activities of Consult key with UYFC

6. Safeguards Monitoring Report Template

Semi-Annual Environmental Monitoring Report

COUNTRY [complete]

Ministry of [complete]

[Project Number/Name]

Reporting Period: *[date covered by this report]*

Date*: [date of issue of this report]*

SEMR Report Number: *[1, 2 or 3 ... – depending on how many SEMRs issued before]*

Contents

Tables

Annexes

Notes on this template:

[**Advice**: text in red} - this gives the PMU help on what information to add into the sections of the report. **Delete** the red text when the report is complete.

[text in yellow] - delete this text and add the relevant answer. **Delete** the text in yellow when the answers are completed.

1 ENVIRONMENTAL SAFEGUARDS SUMMARY

[**Advice:** Complete this summary under each heading. This summary can be copied directly into the main report to support with the Main Report preparation]

1. The [1st,2nd, 3rd etc] Semi-annual Environment Monitoring Report (SEMR) covers the period of [start month – end month and year] for [Project Name]. The SEMR has been prepared to fulfil the safeguard policy requirement of ADB.
2. The SEMR is prepared by [name of organisation and function e.g External Monitoring Consultant or Support Consultant] and checked by [PMU or Ministry].

1.1 Summary of Project Progress

[**Advice:** Complete the summary table below. Section 2 gives more detail Project Progress]

3. The following table gives a brief summary of the project progress for contract award, construction and key activities in this reporting period:

Table 1 Project Progress Summary

Safeguards Category	Environment	B	
Reporting Period:	[Months/ Year]	**Date Last Report Issued:**	[Month/ Year]
Contracts Awarded to Date:	[Advice: For each Civil Works Contract to be awarded, give progress to date] CW1 [contractor name, award date, subproject] CW2 [contractor name, award date, subproject]		
Construction Progress to Date:	[Advice: For each Civil Works Contract to be awarded, at END of Reporting Period] As of [Month/Year of this reporting period] the physical construction progress is as follows: CW1 [x %] construction completed CW2 [x %] construction completed		
Key Sub-project Activities in this Reporting Period:	[Advice: For each Civil Works (CW) Contract, write the key activities that have taken place on construction sites during the 6 months covered in this report] Construction Activities CW1 [e.g. ground clearance and preparation, excavation of site] CW2 [e.g. ground clearance and preparation, excavation of site] [Advice: Include any consents or permissions in this section such as UXO clearance, EIA Approval, Waste disposal permission – include any issued during the 6 months covered in this report] Permits or Consents Issued: Permit / Consent for [activity] issued by [Authority] on [date]		

1.2 Summary of EMP Implementation

[**Advice:** This section gives a high level summary of how the progress on implementing the EMP and the mitigation measures is progressing, in this reporting period. Consider any main issues – the detail will be in the EMP Implementation section of the main report]

4. EMP implementation is summarised in the following points, for this reporting period:

- [mitigation measures in use]
- [overall progress and performance of contractors]
- [other issues affecting project environmental performance?]

1.3 Summary of EMP Monitoring

[**Advice:** This section gives a high level summary of how the EMP has been monitored in this reporting period. This includes site visits by PIU, PMU, Construction Supervision Contractor, Independent Monitoring Organisation. The EMP will say who should be monitoring and when. Detail will be in the EMP Monitoring section of the main report]

5. EMP monitoring is summarised in the following points, for this reporting period:

- Number of Monitoring Visits to Construction Site and wider area:
  - [Number of] visits by PMU/PIU
  - [Number of] visits by [others e.g. Independent Monitoring Organisation, MoE, CSC]
- Number of Environmental Samples Tested:
  - [Number of] water quality samples tested
  - [Number of] air quality samples tested
  - [Number of] water quality samples tested

1.4 Summary of Complaints, Issues and Corrective Action

[**Advice:** This section informs the Project and ADB of any potential problems that have been addressed or need to be addressed. It can include formal complaints through project Grievance Redress Mechanism. This is main issues only – the detail will be in the Corrective Actions/GRM part of the main report]

6. Any complaints, issues and corrective action that has been identified or implement is summarised in the following points, for this reporting period:

- Issues Raised: [issues on construction sites e.g. dust, noise, traffic]
- Grievances Raised with GRM: [Number of] grievances
- Corrective Action issued by project to Contractor:
  - [problem that needed corrective action]
  - problem that needed corrective action]

2 SAFEGUARDS STAFF, TRAINING AND DOCUMENTATION

2.1 Implementation Arrangements

[**Advice:** This section confirms if all roles have staff allocated, or if there are more people to recruit. It confirms if there are resources available for the project for Environmental Safeguards. If resources are not available e.g. cannot find the skills, or people have no time, say so here]

7. The EMP defines the Environmental Safeguards roles and responsibilities. The roles are required to be filled in order to meet the EMP requirements. The following table gives the status of the key roles for EMP implementation:

Table 2. Status of Environmental Safeguard Roles

Safeguards Role	**Status & Comment**			
[**see EMP for list of roles required** e.g. Project Consultant Environmental Specialist]	**Date Started:**	[date]	Full Time/ Part Time	[FT/PT]
	Comment	[Person Identified? Problems identifying person? No time available?]		
[e.g. PMU- Environmental Control Officer (ECO)]	**Date Started:**	[date]	Full Time/ Part Time	[FT/PT]
	Comment	[Person Identified? Problems identifying person? No time available?]		
[e.g. PIU Environmental And Social Safeguards Staff]	**Date Started:**	[date]	Full Time/ Part Time	[FT/PT]
	Comment	[Person Identified? Problems identifying person? No time available?]		
[e.g. PIU GRM Focal Point]	**Date Started:**	[date]	Full Time/ Part Time	[FT/PT]
	Comment	[Person Identified? Problems identifying person? No time available?]		
[e.g. CSC]	**Date Started:**	[date]	Full Time/ Part Time	[FT/PT]
	Comment	[Person Identified? Problems identifying person? No time available?]		
[e.g. Environmental Monitoring Consultant (EMC)]	**Date Started:**	[date]	Full Time/ Part Time	[FT/PT]

	Comment	[Person Identified? Problems identifying person? No time available?]		
[e.g. Contractor Environment Health & safety Staff]	**Date Started:**	[date]	Full Time/ Part Time	[FT/PT]
	Comment	[Person Identified? Problems identifying person? No time available?]		
[others? E.g Contractor GRM Person]	**Date Started:**	[date]	Full Time/ Part Time	[FT/PT]
	Comment	[Person Identified? Problems identifying person? No time available?]		

8. The project concludes that the environmental safeguards roles are [conclusion – enough people? Enough budget for staff? Other conclusion or comment?]

2.2 Training & Capacity Building

[see EMP for list of training required]

9. The following table gives the environmental safeguards training courses that have been completed during this reporting period and the planned training courses for the next six months:

Table 3. Environmental Safeguards Training Provided and Planned

Training Course Title	**Training Date**	**Participants**	**Training Provider**
[E.g CEMP /EMP preparation]	[date – completed or future]	[e.g. No. of PIU/PMU, Contractors]	[e.g. Support consultants, MoE, Independent trainer]

2.3 ADB Clearances

[**Advice**: This section updates ADB with the current progress on the EMP and IEE for the project. Ensure the up to date documents are available and it is clear which is the latest version of each document]

10. The following table gives information on the status of the safeguards documents.

Table 4. Status of Environmental Safeguard Documents

Safeguards Documents	Update Issued (Latest Version)	Submitted to MoE	Submitted to ADB
[e.g. IEE]	[date]	[date or Not Applicable]	[date]
[e.g. EMP subproject 1]	[date]	[date or Not Applicable]	[date]
[e.g. EMP Subproject 2]	[date]	[date or Not Applicable]	[date]
[e.g. EMP Subproject 3]	[date]	[date or Not Applicable]	[date]

2.4 National Approvals

[**Advice**: This section updates ADB with the current progress on any national approvals and/or certifications needed such as final Environmental Impact Assessment (EIA), IEIA, ECC, Environmental Protections Contract, etc. (varies from country to country) or EMP approvals from the relevant Ministry. If there is no change between this reporting period and the last, the table in the previous report can be used here]

11. The following table gives an update on the necessary national approvals required for the project to proceed.

Table 5. Status of National Approvals for Environmental Documents

Documents	Submitted to MoE	Approved By MoE:	Status – if not approved	Comment
[e.g. EIA]	[date or Not Applicable]	[date]	[e.g on going, expected July 2020]	[add any further comment/ suggestion here]
[e.g. EMP subproject 1]	[date or Not Applicable]	[date]	[e.g on going, expected July 2020]	
[e.g. EMP Subproject 2]	[date or Not Applicable]	[date]	[e.g on going, expected July 2020]	
[e.g. EMP Subproject 3]	[date or Not Applicable]	[date]	[e.g on going, expected July	

			2020]	

2.5 Construction Environmental Management Plan (CEMP) Approvals

[**Advice**: This section updates ADB on whether the contractor's have submitted the CEMP for each civil works package, and if the quality of the CEMP is suitable. *ADB would also need assurance that the CEMPs have updated health and safety plans in line with national legislation and any WHO best practices to ensure the necessary COVID-19 mitigation and safety measures are in place to ensure workers health and safety.*]

12. The following table confirms the status of the Construction Environmental Management Plan (CEMP) for each CW package:

Table 6. Status of CEMP Approvals

Civil Works Package/ Subproject	CEMP Given to PMU	Approved By PMU:	Comment:
[e.g. CW01 Wastewater]	[date]	[Yes & Date or No]	[E.g. quality of CEMP? Good quality? Easy to monitor, generally complies with ADB?]
[e.g. CW02 Landfill]	[date]	[Yes & Date or No]	
[e.g. CW03 Drainage]	[date]	[Yes & Date or No]	

3 EMP IMPLEMENTATION

3.1 Environmental Performance

[**Advice**: This is the most important table showing if the Safeguard requirements are being followed. This section is summarised for Section 1: Summary. The summary will be included in the main 6 monthly report for the entire project. Use all the monthly reports from PIU, PMU, GRM, Contractor, construction supervision consultant etc to complete this table.]

13. The following table gives the environmental impact mitigation measures in the Borrower (Project) EMP and the corresponding CEMP and how the project is progressing with implementing the mitigation measures, for each subproject.

14. The evidence for the compliance is through a combination of:

- Site visits to observe site practices;
- Consultation with affected people;
- Regular environmental reporting from [CSC, Contractor, others, according to EMP requirements].

[**Advice**: This table needs to be repeated for each sub-project. Each subproject can EMP has different Mitigation Measures & progress to report on. **Health & safety** Mitigation measures are reported separately]

Table 7. Status of EMP Compliance [subproject]

	EMP Requirement (Mitigation Measure)	**Compliance & Description (Yes, No, Partial)**	**Comment or Further Explanation if Needed**	**Reasons for Not Full Compliance**
1	Example 1. Worker Camp Sanitation	**Yes**	Camp includes septic tank which is installed	-
2	Example 2. Noise and Dust Management	**Partial**	Contractor given corrective action issued **21-07-19:** -Spray 3x daily -Start work 7am	-Water is not sprayed 2x daily; -Working outside allowed hours, starting at 6:30am
1	[mitigation measure]	[Yes/No/Partial]	[comment on evidence of compliance if needed – any additional information]	[give reason/evidence for non-compliance]
2				
3				
4				
5				
6	[continue]			

15. For all 'Partial' or 'No' compliance issues in the table above, the actions needed to solve the compliance issues are in the table below:

[**Advice**: For any Partial or Not Compliance issues in the table above, the table below shows ADB what actions will be taken to ensure compliance]

Table 8. EMP– Actions Needed for Compliance [subproject]

	EMP Requirement	**Further Action to Take**	**Date for Action**	**Who will Implement Action**
02	Noise and dust management	Contractor should not start work before 7am Contractor should spray water minimum 3x daily	End of Sep. 2020	Contractor
	[requirement from table above for non-compliant issues]	[action needed to make issue compliant]	[deadline for action]	[who implements action]

16. The following table gives information on environmental performance issues from previous Environmental Monitoring Reports. This table confirms that the action was completed or that the action is outstanding.

[Advice: This table shows the result/outcome of Actions needed to be taken in the previous report (this means follow up Table 8, above, of previous EMR]

Table 9. EMP Compliance Outstanding Issues from Previous Report(s) [subproject]

EMP Requirement	**Further Action to Take**	**Responsibility and Timing**	**Resolution**	**Required Action**
Example 1. Water pollution from sediment	**Change construction drainage**	Contractor – by 2 April 2020	**Completed** – Action was taken and confirmed by PIU visit 4th April 2020	None

[complete for each issue]				

3.2 Health and Safety Performance

[**Advice**: This reports on any health and safety requirements for the project that the contractor needs to fulfil. This can be combined for all subprojects with similar H&S requirements. *Due to the COVID-19 reporting on specific measures that are in place in line with national legislation and requirements for the pandemic need to be included. ADB would also need assurance that the CEMPs have updated health and safety plans in line with national legislation and any WHO best practices to ensure the necessary COVID-19 mitigation and safety measures are in place.]*

17. The following table gives the Health and Safety impact mitigation measures in the Borrower EMP and how the project is progressing with implementing the mitigation measures, for all subprojects.

Table 10. Status of Health and Safety Compliance - ALL subprojects

	Health and Safety Requirement	**Compliance & Description (Yes, No, Partial)**	**Comment or Further Explanation if Needed**	**Reasons for Not Full Compliance**
1	Example 1. Workers Need to wear protective clothing	**Partial**	**Subproject: Landfill** Workers are not all wearing hard hats and high visibility Workers seen without safety boots	- Re-issue safety clothing to those without -Training on staff to remind them to wear it 18th August 2020
2	Example 2. First Aid kit needed on site	**Yes**	**Subproject: All** First Aid Kit available in site offices	None
	[complete for each issue]			

18. For all 'Partial' or 'No' compliance issues in the table above, the actions needed to solve the compliance issues are in the table below:

[**Advice**: For any Partial or Not Compliance issues in the table above, the table below shows ADB what actions will be taken to ensure compliance]

Table 11. Status of Health and Safety Actions Needed for Compliance - ALL subprojects

	Health and Safety Requirement	Further Action to Take	Date for Action	Who will Implement Action
1	Example 1. Workers Need to wear protective clothing	All workers to be given and wear safety clothing	**25th August 2020**	Contractor
	[complete for each issue]			

19. The following table follows up on Health and Safety performance issues from previous Environmental Monitoring Reports for this subproject. This table confirms that the action was completed or that the action is outstanding.

[Advice: This table shows the result/outcome of Actions needed to be taken in the previous report (this means follow up Table 11, above, of previous EMR]

Table 12. EMP Compliance Outstanding Issues from Previous Report(s) – ALL subrojects

Issue	Required Action	Responsibility and Timing	Resolution	Required Action
Example 1. Water pollution from sediment	**Change construction drainage**	Contractor – by 2 September 2020	Completed – Action was taken and confirmed by PIU visit 4th April 2020	None

4 EMP MONITORING

[Advice: This section should show the progress made against the monitoring that is required in the EMP for each subproject. This is a combination of environmental quality monitoring (e.g. taking samples or water, noise measurements) and monitoring the EMP performance by consulting affected people.]

4.1 Environmental Quality Monitoring

20. Environmental quality monitoring requirements are defined in the Monitoring Plan section of the EMP. The following table gives a summary of the environmental quality monitoring requirements for each subproject

Table 13. EMP Environmental Quality Monitoring Requirements

Subproject	Environmental Issue Monitored	Location	Parameters	Responsible Organisation	Frequency
[use EMP to complete this table e.g Subproject 1]	[noise]	[primary school]	[DbA]	[Contractor]	[every 3 months]
[Subproject 1]	[water]	[stream]	[chemicals/temp]	[Contractor]	[every 3 months]
[Subproject 2]	[noise]	[hospital]	[DbA]	[Contractor]	[every 3 months]

21. The following table gives information on the environmental quality monitoring implemented, during this reporting period. Detailed results compared to relevant national / international standards are in Annex 1.

Table 14. EMP Environmental Quality Monitoring implemented

Subproject	Environmental Issue Monitored	Location	Monitoring Date
[Subproject 1]	[Noise]		
[Subproject 1]	[Surface Water Quality]		
[Subproject 1]	[Groundwater Quality]		

22. **Summary of Results – Noise.** [one paragraph summary on the results – eg. do they meet national standards, international standards? Does it show a good quality or poor quality environment?].

23. **Summary of Results – Surface Water quality**. [one paragraph summary on the results – eg. do they meet national standards, international standards? Does it show a good quality or poor quality environment?].
24. **Summary of Results – Groundwater quality**. [one paragraph summary on the results – eg. do they meet national standards, international standards? Does it show a good quality or poor quality environment?].
25. **Summary of Results – Air quality**. [one paragraph summary on the results – eg. do they meet national standards, international standards? Does it show a good quality or poor quality environment?].

4.2 Construction Phase Affected People Consultation

[Advice: Complete the table below with the consultations undertaken during construction site monitoring. This is usually undertaken by project staff e.g. PIU or PMU]

26. During the construction phase, the following table gives information on the consultations that were undertaken in order to understand the impact of the project on Affected People and how effective the EMP Mitigation measures are for residents, businesses and other affected people around the construction sites.

Table 15. Construction Phase Affected People Consultation

Subproject	Consultation Date	Person Consulted / Location	Outcome / Issues	Corrective Action Needed	Action Implemented by (person/date)
[Subproject 1]	[date]	[e.g. group of 5 residents, outside commune office]	[Issues raised or General comment from person on project]	[Describe how this issue will be solved]	[e.g Contractor, by June 14 2020]

5 COMPLAINTS, ISSUES, CORRECTIVE ACTION

5.1 Information Disclosure

[**Advice**: In this section, provide information on any public meetings, dissemination of information that has taken place to give information to the public. Some of this will take place in the 'before construction' phase, when the project is being prepared. For the FIRST SEMR, include information on pre-construction disclosure activities such as GRM dissemination.]

27. The following table gives information on any information disclosure activities undertaken;:

Table 16. Information Disclosure

Topic / Reason for Information	Disclosure Date	Method of Disclosure	Outcome / Results
[e.g. new project schedule, update on GRM, change to construction plans]	[date]	[e.g. information board, meeting, leaflet]	[Issues raised or outcome of meeting]

5.2 Grievance Redress Mechanism

[**Advice**: In this section include any complaints made through the GRM INCLUDING those made during any consultation with Affected People – such as issued raised in Table 15 . Include any complaints made that have already been resolved e.g. resolved during time of consultation]

28. The following table gives information on complaints about the project the Project Team is aware of, during this reporting period. The table includes:
    - Complaints made thorough GRM entry points
    - Issues raised in consultation;
    - Issues raised any other way that the project team is aware of.
29. For issues that have already been solved, this is confirmed in the final column of the table. Where possible the project tries to solve all issues as quickly as possible through informal discussions between the affected people and the contractor.

Table 17. Project Complaints or Issues

Details of Complaint / Issue Raised	Detail of Person (Date, Name, Contact Details)	Action Needed & Date	Comment / Resolved?
[e.g. noise/dust, poor access to house, affected water supply]	[date , Name of Person, Phone number/village location]	[e.g. contractor to reinstate water supply by 19th June 2020]	[Issue solved. Action has been taken and Affected Person is satisfied. PIU followed up.]

30. The following table gives information on all issues raised in previous SEMRs which are not yet resolved:

Table 18. Project Complaints or Issues – Not resolved from previous reports

Details of Complaint	Detail of Person (Date, Name, Contact Details)	Action Needed & Date	Reason this is still not resolved
[e.g noise/dust, poor access to house, affected water supply]	[date , Name of Person, Phone number/village location]	[e.g. contractor to reinstate water supply by 19th June 2020]	[explain why the problem continues.]

5.3 Corrective Action

[**Advice**: In this section, provide information on any formal corrective action that had to be issued to change practices on the construction site] being

31. The following table gives information on any formal corrective action that has been issued to the contractor in order to improve environmental performance:

Table 19. Corrective Action Issued

Reason for Corrective Action	Date Issued	Outcome	Comment / Follow Up
[e.g water supply damaged to village]	[date]	[e.g. Contractor formally requested to repair water supply and compensate people. This was undertaken.]	[PIU will monitor the water supply monthly]

6 CONCLUSION & RECOMMENDATION

[**Advice**: Summarise if the EMP is being followed and if the Environmental Safeguards are adequate. Make recommendations on what will happen to improve the project environmental performance in the next reporting period]

32. Conclusion: [on general environmental progress]
33. Recommendations: [on next steps and actions to take to make improvements in environmental performance of the project]

Annex 1 Environmental Quality Monitoring Results

[Insert Table of results and relevant national/international standard]

Annex 2 Photo Record – Visits, Monitoring, Consultation

Photographs of Site Visits

Photographs of Environmental Quality Monitoring

Photographs of Consultation

7. GRM Complaint Form

Grievance ID:

The _____ Project welcomes complaints, suggestions, queries, and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name.

Thank you.

Date	**Place where grievance is filed:**				
Contact Information/Personal Details					
Name		**Gender**	* Male * Female	**Age**	
Home Address					
Place					
Phone No.					
E-mail					
Complaint/Suggestion/Comment/Question details (who, what, where, and how) of your grievance below:					
How do you want us to reach you for feedback or update on your comment/grievance?					
If included as attachment/note/letter, please stick here:					

8. GRM Register