

**THE PEOPLE'S COMMITTEE OF HO CHI MINH CITY
ENVIRONMENT SANITATION PROJECT
INVESTMENT MANAGEMENT AGENCY**

**EXECUTIVE SUMMARY
ENVIRONMENTAL IMPACT ASSESSMENT**

**HO CHI MINH CITY ENVIRONMENTAL
SANITATION – PHASE 2**

July 17, 2014

TABLE OF CONTENTS

TABLE OF CONTENTS	2
ABBREVIATION	3
I. INTRODUCTION	4
II. PROJECT DESCRIPTION.....	4
III. DESCRIPTION OF THE ENVIRONMENT	8
A. Physical Environment	8
B. Biological Environmental.....	9
C. Socio Environment.....	9
IV. PROJECT ALTERNATIVES	10
V. POTENTIAL NEGATIVE ENVIRONMENT AND SOCIAL IMPACTS, AND MITIGATION MEASURES	12
A. Physical Environment	12
B. Biological Environment.....	14
C. Social Impacts and Mitigation Measures	15
D. Cumulative Impacts.....	16
VI. ECONOMIC ASSESSMENT	16
VII. ENVIRONMENTAL MANAGEMENT PLAN	16
VIII. PUBLIC CONSULTATION	18
IX. CONCLUSION	19
Annex 1: Environmental Management Plan	20
Annex 2: National Technical Regulation on Surface Water Quality	25

ABBREVIATION

ADB	Asian Development Bank
AS	Activated Sludge
BOD	Biochemical Oxygen Demand
CAS	Conventional Activated Sludge
CDM	Clean Development Mechanism
CESPIMA	City Environmental Sanitation Project Investment Management Agency
COD	Chemical Oxygen Demand
D.2	District 2
dBA	Decibel
DONRE	Department Of Natural Resources and Environment
EIA	Environmental Impact Assessment
EPC	Engineering Procurement Construction
FCC	Flood Control Center
GHG	Green House Gas
GIS	Geographic Information System
HCMC	Ho Chi Minh City
HCMCES	Ho Chi Minh City Environmental Sanitation Project
HCMCES 2	Ho Chi Minh City Environmental Sanitation Project – Phase 2
MONRE	Ministry of Natural Resources and Environment
NLTN	Nhieu Loc-Thi Nghe
ODA	Official Development Assistance
PC	People's Committee
PPTAF	Project Prepare Technical Assistance Facility
RAP	Resettlement Action Plan
RC	Reinforced concrete
SA	Social Assessment
SBR	Sequencing Batch Reactor
SCFC	Steering Center for Urban Flood Control Program
SS	Suspended Solid
TLBC	Tham Luong Ben Cat
TN	Total Nitrogen
TP	Total Phosphorus
UDC	Urban Drainage Company
USD	United States Dollar
UV	Ultra Violet
VAT	Value added tax
VND	Vietnam Dong
WB	World Bank
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

I. INTRODUCTION

1. The City Environmental Sanitation Project Investment Management Agency (CESPIMA) has prepared the environmental impact assessment (EIA) report for the project “Ho Chi Minh City Environmental Sanitation - Phase2” in cooperation with the Meinhardt (Singapore) Ltd.. The EIA report was prepared based on existing statistical data of the meteorology, hydrology, and socioeconomic conditions in the project area. Additional environmental data on air, noise, and water quality were collected from the project area and analyzed by the Institute for Environment and Resources, National University of Ho Chi Minh City. Technical manuals on process engineering, pollution control technologies (including wastewater, air emission, and solid waste) and environmental rapid assessment manuals were used in the analysis. Pollution factors estimated by the World Health Organization (WHO) and other popular methods.
2. The proposed project is classified in line with the World Bank operational policy on Environmental assessment (OP 4.01) as category A project, since it is a project with significant potential impacts given the construction and operation of the WWTP and affiliated infrastructure in HCMC financed by this project. The original EIA reports on which the current document has been based on are available in both Vietnamese and English for public information. Their content has been discussed separately in a public meeting held in HCMC on April 24, 2014.
3. The EIA report was prepared pursuant to Vietnam’s Decree No. 29/2011/ND-CP dated April 18, 2011 on strategy Environment Assessment, Environmental Impact Assessment and Environment Protection Commitment. The structure of the report followed Circular No. 26/2011/TT-BTNMT. The EIA report is also prepared taking all applicable World Bank environmental and social safeguard policies and guidelines into consideration.

II. PROJECT DESCRIPTION

4. The proposed Ho Chi Minh City Environmental Sanitation Project – Phase 2 (HCMC ESP2) is a continuation of the Bank’s HCMC ESP1, which closed on June 30, 2012. Under the first project, through the construction of an interceptor and rehabilitation of the drainage system, wastewater from the NLTN basin is transferred to a pumping station. The pumping station is now operational and the untreated wastewater is pumped under the Saigon River to a shaft on the East Bank in District 2 from where it is currently discharged into the Saigon River. Under the Phase 2 project, the large volume of untreated wastewater currently discharged into the Saigon river will be treated through the newly planned WWTP and discharged at a new location into the Dong Nai river; this will improve the environmental condition in the city.
5. According to the Law on Environment Protection dated November 29, 2005 of the National Assembly which came into effect from July 1, 2006 and the Decree No. 29/2011/ND-CP dated April 18, 2011 issued by the Government on strategic environment assessment, environmental impact assessment and environment protection commitment the City environment sanitation project investment management agency (CESPIMA) has to prepare and submit an EIA report of the HCM ESP 2 to the Department of Natural Resources and Environment of Ho Chi Minh City for review and appraisal.
6. The national environmental requirements and procedures for the HCMC ESP2 are described in the Circular No. 26/2011/TT-BTNMT issued by MONRE on detailing some articles of Decree No. 29/2011/ND-CP dated April 18, 2011 of the Government on strategic environmental assessment, environmental impact assessment, and environment protection commitment.
7. In line with the World Bank Group operational policies, the HCMC ESP2 investments

trigger the following five safeguard policies: (a) OP4.01: Environmental Assessment; (b) OP4.04: Natural Habitats; (c) 4.11: Physical Cultural Resources; (d) OP4.12: Involuntary Resettlement; and (e) OP7.50: International Waterways. OP4.01 and OP7.50 are discussed below and the other three policies triggered are discussed in the relevant sections later in this document.

8. **Environmental Assessment (OP4.01).** The project triggers the Bank safeguard policy on Environmental Assessment (OP 4.01). The project will improve the environment of HCMC by collection and treatment of wastewater from the Nhieu Loc-Thi Nghe basin and parts of District 2 and water quality modelling carried out for the project illustrates that the quality of the Saigon River will improve due to project interventions (as the current practice of discharging untreated wastewater to the Saigon river would cease, reducing the pollution discharged to the river). However, there will be minor and temporary site-specific environmental impacts primarily during the construction period (due to dust pollution, noise and vibration due to the operation of heavy equipment, waste generation at the construction site, and traffic interferences). Also, due to the construction activities, local vegetation and landscape will be affected (e.g., vegetation at the site of the WWTP will be removed and also a creek that is located at the site will be diverted to another location within the site). The main impacts would be: permanent loss of agricultural land (about 74% of the land is agricultural), movement of four graves, and removal of two temporary shelters. The relocation of the creek (about 150 m within the site) will be done in line with the overall flood control measures that are being considered for the site. The negative impacts will be mitigated through the application of mitigation measures outlined in the Environmental Management Plan (EMP) which will include a monitoring plan and through the application of health and safety requirements of workers that would be involved in the construction. Implementation of the EMP will be a requirement for contractors under the project.
9. **OP7.50 on International Waterways is triggered.** The project will finance a WWTP discharging into Dong Nai River, a tributary of Saigon River, which is in turn an international waterway rising from Cambodia. The policy OP 7.50 is triggered since the project will take place on an international river (Saigon River) and since the wastewater will be discharged to the Dong Nai River which is a tributary of an international river (Saigon River) [paras. 1(a) and 1(b) of the policy].
10. The HCMC ESP2 has five components which are summarized below (costs shown exclude VAT):
 - *Component 1: Construction of Interceptor (Cost: US\$65 million):* The sewage interceptor total length of 8 km and diameter of 3.2m will be constructed to connect sewage from East Bank Shaft to the wastewater treatment plant at Thanh My Loi ward, District 2. It will convey sewage from NLTN to the Pumping Station at the entrance of the WWTP. The construction of the interceptor will prevent the discharge of untreated wastewater to the Saigon River.
 - *Component 2: Construction of Wastewater Treatment Plant (Cost: US\$261 million):* The WWTP will treat the wastewater collected in the NLTN basin and in the D2 area. The WWTP is being designed for a capacity of 480,000 m³/day and will be constructed through a Design Build and Operate contract where the same private company will carry out these three stages. The WWTP will be located near the confluence of the Saigon and Dong Nai rivers, and the treated wastewater will be discharged to the Dong Nai River. The site is prone to flooding and, as a result, flood protection measures are included in the project design.
 - *Component 3: Construction of Sewerage Network in the District 2 area (Cost: US\$52 million):* The project will invest in drainage level 2 and level 3 in District 2. Investment objective of the drainage in District 2 is to maximize the wastewater collection to improve the environmental conditions in the project areas where untreated wastewater is discharged to water bodies. In addition, households in the project area

will be connected, if they are not currently connected to the combined or separated system. The wastewater collected from the District 2 area will be transferred to the interceptor that also will convey wastewater to the wastewater treatment plant (being constructed under this project) from the Nhieu Loc-Thi Nghe (NLTN) area.

- *Component 4: Project Implementation (Cost: US\$32 million):* This component has two parts: (a) Component 4a: Construction Supervision will support hiring of consultants to supervise construction during project implementation; and (b) Component 4b: Improving Sanitation Management and Project Implementation will provide technical assistance including implementation support and capacity building for key project entities (e.g. CESPIMA). In addition, support will be provided to the CESPIMA to enhance sanitation management in HCMC.
 - *Component 5: Land Acquisition and Operating Cost of Implementation Management Agency (Cost US\$40 million):* CESPIMA coordinates with the People's Committee of District 2 to setup the general plan for the compensation assistance and resettlement. District 2 People's Committee is responsible for the establishment of a committee for the compensation assistance and resettlement as prescribed. The committee for the compensation assistance and resettlement will setup the land acquisition plan, documents and decisions for households, individuals, and organizations (if any) under the provisions and give land hand-over decision for CESPIMA. Component 5a: Resettlement and Land Acquisition will include costs (borne solely by HCMC) to compensate people that currently own the land where the WWTP would be constructed. Component 5b: Operating Cost of the Implementation Management Agency includes salaries, fees and other costs (all borne by HCMC) for the eight years of the project implementation period.
11. Under HCMC ESP2 the wastewater will be conveyed from the East Bank shaft and District 2 to a proposed new wastewater treatment plant via a 3.2m diameter and 8 km long interceptor (See Figure 1). The proposed routing of the interceptor will also take into account the plans for sewerage and drainage investments necessary for the development of District 2 and the capacity of the interceptor would be sufficient to also eventually transfer the wastewater from District 2 once the area will be developed in the future. The sewerage and drainage investments' locations in District 2 are being identified now and relevant detailed designs would be completed after the proposed approval of the project by the Bank. As most of the sewer and drainage infrastructure in the District 2 area are expected to be installed under existing roads, the environmental and social impacts are not expected to be substantial. A separate Environmental and Social Management Framework (ESMF) has been prepared for these investments. The ESMF outlines the process that will be carried out to address environmental and social considerations that may come up during the construction phase once the location of the investments is known.

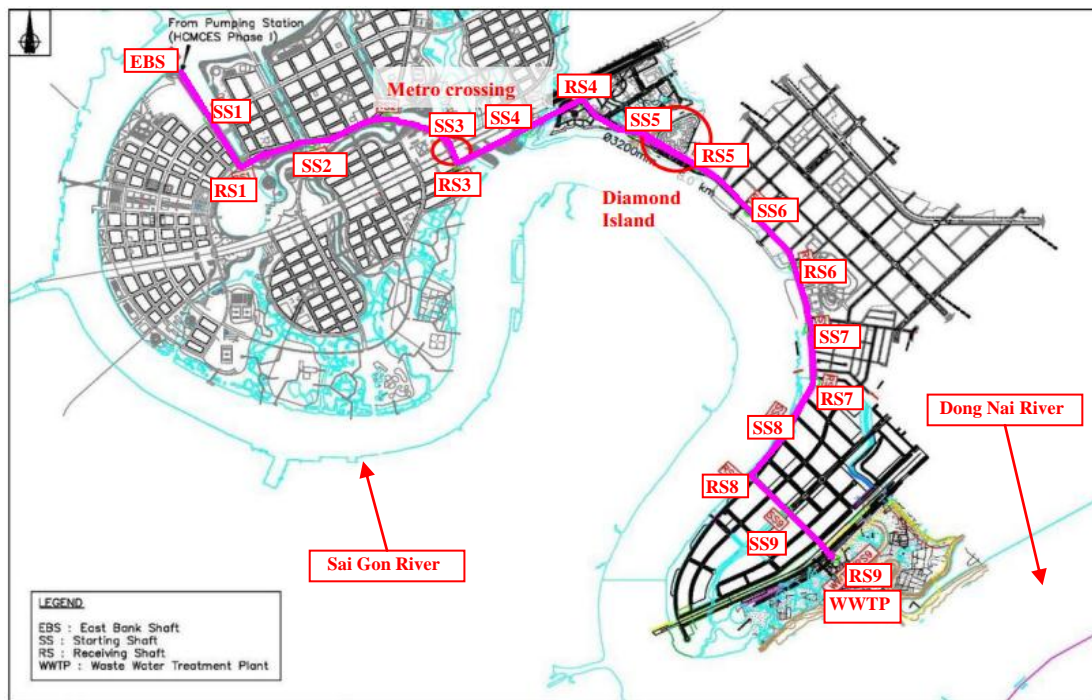


Figure 1. Interceptor route

12. A Wastewater Treatment Plant with a capacity of 480,000 m³/day by 2020 will be built at Thanh My Loi Ward, District 2 (See Figure 2). The proposed WWTP is located at the confluence of the national Dong Nai River and the international Saigon River. The outlet of WWTP will be located in the Dong Nai River, which is a national river that originates in Vietnam and flows to the East Sea. The area assigned for the WWTP construction requires 38.47 hectares used in the past (more than 5 years ago) primarily for agricultural and residential purposes. Currently, this area is covered by randomly grown vegetation (e.g., shrubs, small bushes, nipa); three creeks and ditches, all of which give the area the characteristics of shrub swamp conditions. The overall area is flat but partially flooded during high tide.
13. The wastewater treatment standard for the future WWTP is regulated in line with QCVN 14:2008/BTNMT¹ for domestic wastewater, column A² in 2020 as decided by the People Committee of HCMC. Furthermore, based on the Feasibility Study prepared in May 2014, four treatment technologies were considered and the bidder will have the option to bid on any one of these 4 technologies or other feasible alternatives. The technology with the lowest life-cycle cost taken in consideration socio-economic and environmental aspects would be selected. .

¹ QCVN14 is the national technical regulation on domestic wastewater

² Column A regulates the value of parameters for wastewater discharging into water bodies, which is used for water supply purposes

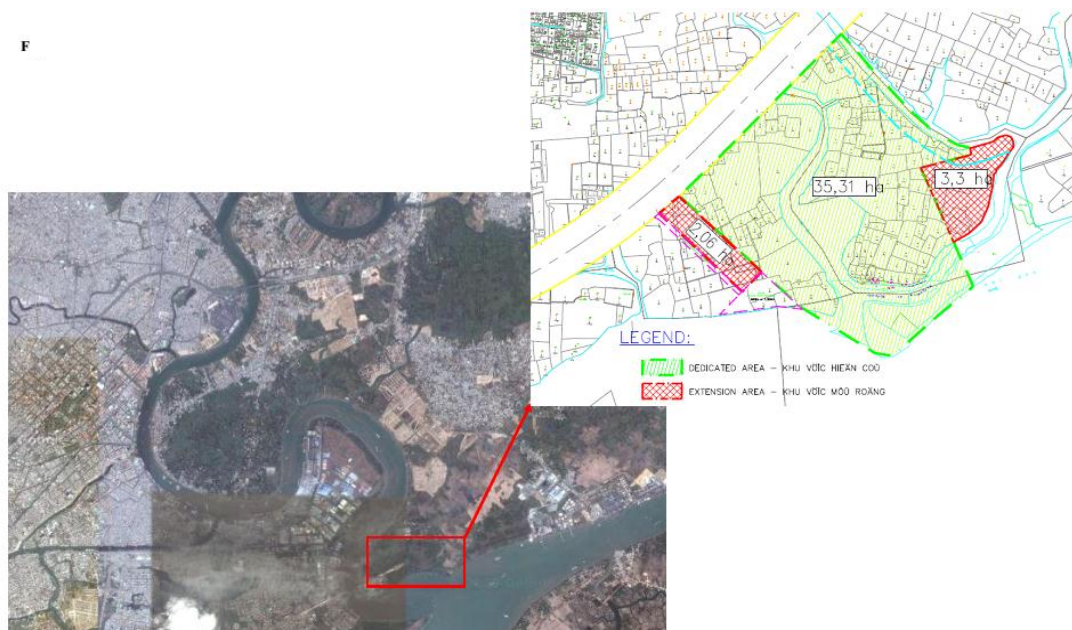


Figure 2. Location of wards along the interceptor and WWTP

14. The same entity that worked with the World Bank on the first phase project (HCMC ES1) would also implement the second phase project, as the staff is familiar with the World Bank procedures. The project will provide financing for institutional strengthening of the key project entities (e.g. CESPIMA), which will consist of implementation support and capacity building including safeguard management. for key project entities. Under the project, consultants would be in place to support the implementing agency. The environmental monitoring program proposed for implementation during the WWTP operation will ensure the treated wastewater meets the effluent standard and any possible impacts downstream are managed and reduced. It would be important for HCMC to have the necessary resources to ensure that the investments are carried out in a proper way and that wastewater and sanitation management in the city is sustainable from environment and financial standpoints. Semi-annual environmental and social audits would be carried out to ensure that proper procedures are being followed.

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Environment

1). Atmospheric Conditions

15. Data provided by the meteorological stations of Tan Son Hoa Station during 2005-2012 years show the annual average, maximum, and minimum temperatures are 28.16°C, 34.2°C (year of 2000), 20.8°C (year of 2000), respectively. The average maximum temperature occurs in April and the minimum in January. Average annual rainfall of the city varies from 1,742.8 to 2,340.2 mm/year. The West - Southwest wind from the Indian Ocean blows into the rainy season, from June to October, with average speed about 2.4 m/s. By while, the North - Northeast wind from the East Sea blows into the dry season, from November to February, with average speed of about 2,4 m/s.
16. Throughout the project area air samples were taken, with the result that the concentrations of dust, sulfur dioxide, nitrogen dioxide, carbon monoxide and volatile organic constituents in the ambient air are within the limits of the Vietnamese technical environmental regulations for ambient air quality (QCVN 05:2013/BTNMT and QCVN 06:2009/BTNMT). The noise levels in the project area are within the limits of the National Technical Regulations on Noise (QCVN 26:2010/BTNMT).

2). Hydrological Conditions

17. Ho Chi Minh City, located in the downstream of the Dong Nai river basin system, has an interlinked rivers and canals network. The Dong Nai River has many tributaries such as the La Nga River, the Nha Be River with average flow of 980 m³/s and the highest flow of 10,000m³/s during floods. The international waterway Saigon River originates from the Hon Quan district (near to the border between Cambodia and Vietnam), Binh Phuoc Province, flows through Thu Dau Mot to the HCMC with a length of about 200 km (80 kilometers in the city). The width of the Saigon River in the city ranges from 225m to 370m and its depth is 20 meters. The hydrological conditions of the rivers in Ho Chi Minh City area are influenced by semi-diurnal variation of tidal of the East Sea. Monitoring results measured at Phu An station in 2010, showed that the highest of average tide level in the Saigon River is 1.385 m. The highest water level is registered in November (1.55 m) and the lowest in July (-2.22 m) The average flow of the Saigon and Dong Nai rivers near the project site are 93 and 980 m³/s, respectively.
18. The results of surface water samples analysis showed that at the present the water quality in the Sai Gon and Dong Nai rivers in the project's area are within limits of QCVN 08:2008/BTNMT, Column B2. The BOD and ammonia concentrations in some locations are exceeding the QCVN 08:2008/BTNMT, column A2.³ Groundwater in Ho Chi Minh City is quite abundant. According to geological survey, an average depth of groundwater is equivalent to sea level and directly affected by tides. Groundwater in project area appears in the inner aquifer (layer 2, 5, and 6a) with a small reserve. The result of underground water analysis at the 05 drilled wells of 40 m depth in the project area indicates that the groundwater quality is good.

3). Geological Condition

19. The topography of District 2 is low lying and flat, therefore, District 2 may have problem with flooding, especially when climate change and sea level rise are considered as well. Because of its low terrain, the ground level of District 2 needs to be raised from +2.5m to +3.0m above the sea level to prevent flooding. Based on the original terrain, the survey region is the type of the coastal plain, formed by the sediment originated from rivers and sea. According to geo-technical works and analysis in the laboratory from drilling samples, the geological strata of the region is divided into 6 soil layers from top to bottom, which permit construction of WWTP of the planned size. The WWTP itself will also be protected against flooding through measures taken under the project.

B. Biological Environmental

20. The analysis of the phytoplankton, zooplankton, and macro invertebrates' samples collected at 5 sample sites within the project area in Saigon River shown that there are 72 species of the phytoplankton and 39 species of zooplankton. However, there are no endangered species found in the project area. Further, the area of the future WWTP is characterized by shrubs swamp, which is not a natural habitat for migratory birds or any protected species. Common vegetation seen at the site includes shrubs and nipa without any mangrove species.

C. Socio Environment

21. The construction of the wastewater treatment plant will require 38.47 ha of land, of which the public land (creeks and ditches) is 7.7 ha, accounting for 20%, and the privately owned land is 30.77 ha. This land is agricultural in nature (former paddy fields) and is

³ Column A2 and Column B2 - please see Annex 2, which shows the referenced document (QCVN 08:2008/BTNMT). See column labels to find "A2."

held by private individuals. One fish pond area and two thatch houses are currently observed in this area. These houses were temporary built by two households for the purpose of attending their crops. Also, four graves have been noted in the area. A Resettlement Action Plan has been developed to address any social impacts due to the project.

22. The area where the interceptor will be laid (Thu Thiem, An Loi Dong, Binh Khanh, An Khanh and Binh Trung Tay Wards) will also be impacted by the project during construction period and in areas where land will have to be acquired for the man-holes (which will also be the area where shafts would be used to build the interceptor). However, the interceptor is expected to be constructed through a pipe jacking method that uses only partial length of the pipe under the ground reducing the impact of the project during the construction period. These concerns are addressed through the Resettlement Policy Framework and the ESMF that have been prepared for the project.

IV. PROJECT ALTERNATIVES

23. In the HCMC ESP1, waste water is collected and discharged to the East Bank Shaft of the Saigon River without treatment (“Zero” alternative). In the HCMC ESP2, waste water will be collected and treated at a WWTP before final discharge in Dong Nai River. There were three alternative locations in District 2 proposed for the construction of the NLTN WWTP, including Thu Thiem (location 1), Nha Be (location 3) and Cat Lai (location 2) (See Figure 3). After consideration and discussions with HCMC authorities, the site in Cat Lai was selected for the following reasons: The site is located closer to the existing discharge point of untreated wastewater in the Saigon river than Nha Be site; Thu Thiem site will be designated in the future as business center area and not appropriate for WWTP construction. Also, the Cat Lai site is close to the Dong Nai River which has a higher flow than the Saigon River which will allow greater dispersion of the treated wastewater after it comes out of the treatment plant. Given these considerations, HCMC PC approved the decision to build the WWTP, in Cat Lai site located in Thanh My Loi Ward. The choice of this site is also in line with earlier approval of the People's Committee of Ho Chi Minh City. .

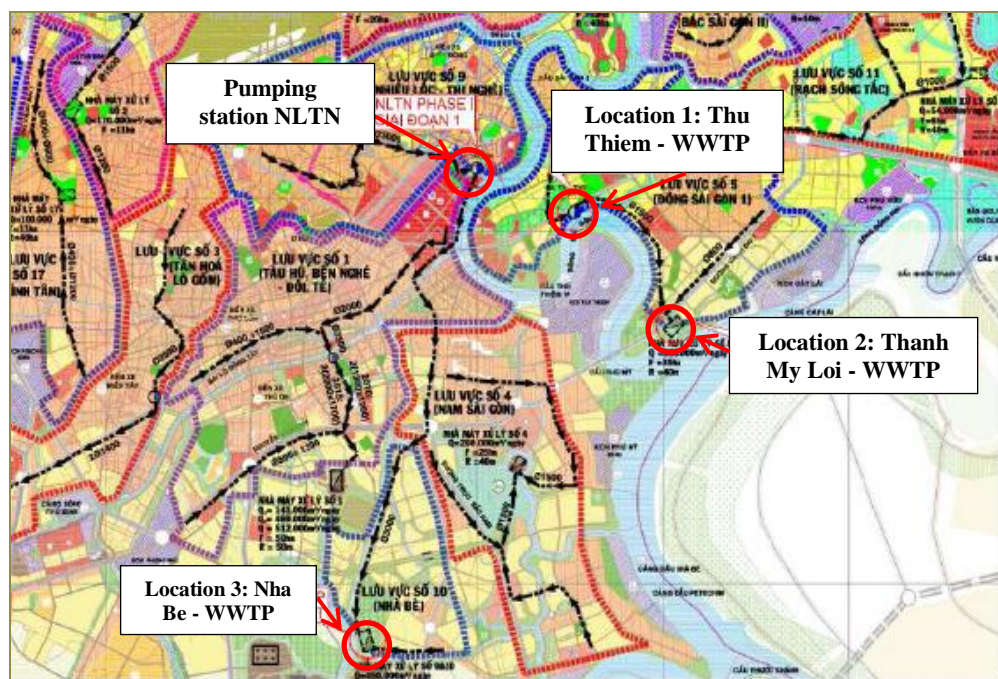


Figure 3. Locations of proposed WWTPs

24. There were three alternative routes proposed for the interceptor sewer construction (See

Figure 4). The location P03 is the proposed site of the treatment plant; and the location EBS is where the wastewater is currently being discharged in the Saigon River. The first alternative of A2 - PO1 -PO3 route was rejected as most of this route passes under a main road beneath which several public services are located (including a 2.2 meter tunnel). Furthermore, this route would cross a high density area which would make the construction more complicated. The second alternative was the A1 - PO1 route but that also was not retained as construction would have to take place through densely populated areas. The third option, which is the route EBS - A3 - A31 - A34 - PO3 has been selected because it is the shortest; there are no major issues of crossing utility lines; and part of the route is under green undeveloped areas.

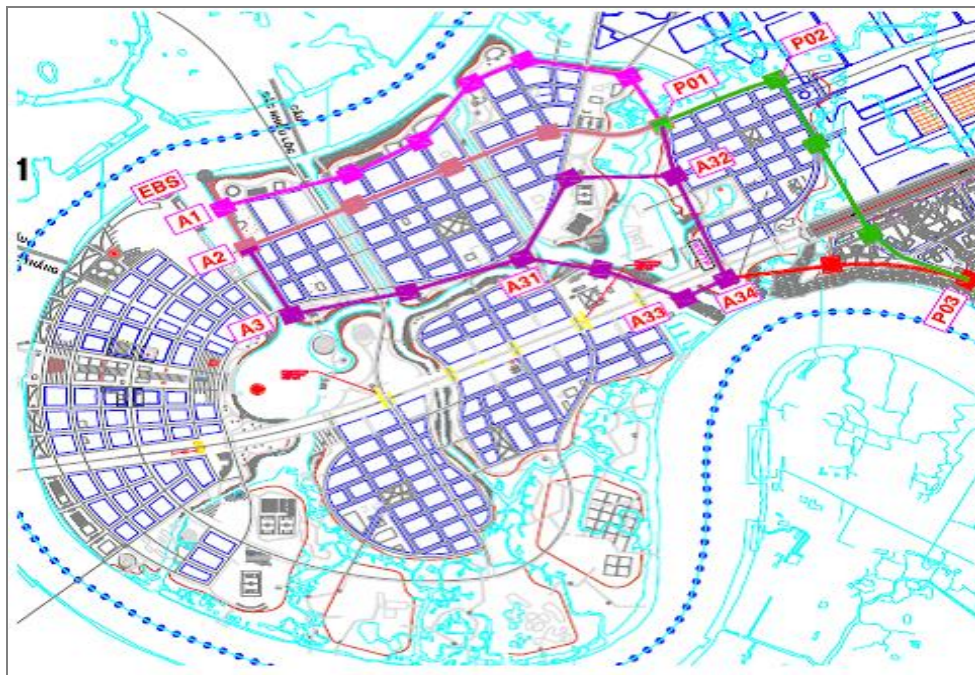


Figure 4. Location of selected interceptor route

25. Furthermore, there were three alternative locations proposed for the WWTP outlet, including Ky Ha Canal, Ngon Ngay Canal and Dong Nai River. Based on screening criteria, the position on the Dong Nai River is the most suitable option because the dilution at this position is higher compared to the other 2 locations, reducing any possible impacts of the project. In addition, according to the survey of social consultation, mainly from Nhon Trach side, on the opposite side of WWTP, there are few aquaculture households of communes Phu Huu, Phuoc Khanh, Dai Phuoc; thus the choice of the location at the lower part away from these areas will reduce any possible impacts on these areas.
26. In the framework of HCMCES 2 Feasibility Study, there are 4 WWT technologies considered for NLTN WWTP, as follows: (1) Conventional Activated Sludge (CAS), (2) Sequencing Batch Reactor (SBR) (3) Bio-filtration (BF) and (4) Trickling filter. All four processes are considered fully suitable to NLTN WWTP constraints and meet the environmental regulation QCVN 14:2008/BTNMT (Column A). Bidders will have the option to bid on one of the 4 alternatives. The technology that has the lowest life cycle cost (CAPEX plus discounted OPEX) and the least environmental and social impact will be chosen.

V. POTENTIAL NEGATIVE ENVIRONMENT AND SOCIAL IMPACTS, AND MITIGATION MEASURES

A. Physical Environment

1). During pre-construction and construction phases

27. The construction equipment and transport vehicles will emit exhausts such as nitrogen oxides, SO₂, CO, carbon dioxide, and hydrocarbons and generate noise. The activities involving heavy vehicles will be particularly intense during site preparation and construction. The level of emissions from these vehicles will be managed through an appropriate maintenance schedule for all vehicles, correct engine tuning, and a reduction in the numbers of diesel driven equipment. Dust pollution can be managed by regularly spraying the site with water (particularly during the dry season), washing down vehicles as they leave the site and sealing surface as soon as practical to minimize the dust exposure.
28. At the wastewater treatment plant area there are 3 creeks namely, (i) Phu My (4.5 m deep and 50 m wide; (ii) Ngon Ngay (1 m deep and 20 m wide), and (iii) Ky Ha (5.5 m deep and 50 m wide) as presented in Figure 5. Based on the latest Feasibility Study information, there is a proposal to divert the Phu My creek (about 150 m in the WWTP area) to the Ngon Ngay creek in order to create space for the WWTP. However, this proposal is subject to change as it would need to be considered in conjunction with the plans to construct the treatment plant and flood protection measures that are planned at the site. A preliminary survey and the basic design of the creek diversion concluded that a final design would need to take in consideration the additional flow, which would call for an increased depth and proper embankment of the Ngon Ngay creek. Potential impacts of the creek diversion include erosion and sedimentation along the Ngon Ngay creek due to higher flows from the Phu My creek; and impacts due to diversion of water away from the Phu My creek within the WWTP.



Figure 5. Creeks (including the diversion creek) located at WWTP site

29. Domestic wastewater discharged during the construction phase by workers contains suspended solid, organic matter (BOD, COD), nutrients (N, P) and *E.coli* which is higher

than the permissible values set by the relevant technical regulations (QCVN 14:2008/BTNMT, column A). This can be controlled by arranging the mobile toilets to serve workers' personal hygiene needs; and signing a contract with Urban Environment Management Company of Ho Chi Minh City for periodic collection and treatment to avoid further pollution. During the construction period, the Contractor has to install the necessary mobile toilets close to the project area.

30. Reclamation activities will generate waste such as vegetation, unused materials, sand, soil, gravel and waste oil. These materials could be washed away into the water sources without proper cover. Reducing waste during construction, planning specific items for construction, and quantifying materials are needed for construction work. Garbage and other construction waste will be collected separately in assigned temporary storage, and then transported to Go Cat landfill.

2). During operation phases

31. *Water quality.* "Without project" scenario: The entire effluent from NL-TN canal is discharged into the Sai Gon River through NL-TN pumping station at Nguyen Huu Canh Street in HCMC. Currently, the concentration of pollution parameters in Saigon river water is affected by untreated waste waters discharged directly into the river. Model results simulating current situation show main values (BOD, COD, TSS, NH_4^+) of the Sai Gon River water quality exceeding the QCVN 08:2008/BTNMT column B1 standards, especially at the discharge location. In the Dong Nai and Nha Be river segments (where the new wastewater treatment plant will be located) concentrations of pollutants are reduced because of dilution ability and high flow of the national river. The model simulated water quality parameters that showed achieving the standards of QCVN 08:2008/BTNMT, column B1 at these locations.
32. In the rainy season, the concentrations of pollutants in the river water are slightly decreased comparing to those in the dry season, except for the TSS concentration. The model simulated values that are slightly increased comparing with the current state of the water quality because of the high water flow in both rainy and dry seasons and strong dilution ability of the Sai Gon-Dong Nai Rivers. The calculated results shown that, in this scenario, wastewater from the NL-TN Basin is directly discharged into the Sai Gon River, which cause strong impact on the Sai Gon river water quality. Additionally, other loads of pollutants from urban, residential, sand exploiting, industrial sources etc. in the upstream area may generate cumulative impact on the Sai Gon River water quality as well as on the Nha Be river water quality in the downstream in the future.
33. In "with-project" scenario, the model simulated concentrations of pollutants in the Sai Gon River that notably decreased, especially at the pump station location. In this position, BOD, COD, NH_4^+ , TSS concentrations decreased based on model results. The Sai Gon River water quality showed simulated levels that meet QCVN 08:2008/BTNMT, column B1, while value BOD met QCVN 08:2008/BTNMT, column A2. The Dong Nai River water quality at the discharge location of the wastewater treatment plant showed slightly increased values. In particular, concentrations of BOD, COD, NH_4^+ , TSS increased by 1.8, 0.6, 0.06, 3mg/l, respectively. The concentrations of the pollutants meet QCVN 08:2008/BTNMT, column B1. Further, the Nha Be River water quality concentration was found to slightly decrease. Concentrations of BOD, COD, NH_4^+ , TSS are decreased by 1.0, 1.5, 0.005, 1.4 mg/l, respectively. It is believed that with the influence of the tide, the water quality along the Saigon River, Dong Nai and Nha change calculated results showed that in this scenario, the Sai Gon river water quality will be improved overall. In addition, the construction of wastewater treatment systems and wastewater collection line will bring benefits for the protection of the environment as well as reduce the pollution loads to the Sai Gon-Dong Nai Rivers.

34. Sludge quantity generated from WWTP depends on the choice of technological processes. Total amount of sludge estimated for SBR technology as reference option is about 1,100 m³/day (from the settling tank); 100 m³/day dewatered and thickened sludge; 37 m³/day (from screening) in 2045; 37 m³/day from grit removal tank (2045). The sludge is expected to be transferred by land way to Da Phuoc landfill, located about 25 km from WWTP. The potential environmental issues caused by the sludge transportation and overall management are dust, odors, noise, waste water leakage, traffic incidents etc. The quantity of hazardous wastes, including packaging and chemical containers, oil and grease generated from the maintenance and repair of operation machines in the WWTP are insignificant, which should be separately collected and stored in warehouses, then disposed in the planned area.
35. *Da Phuoc landfill area.* Once the WWTP is operational, sludge from the treatment plant is expected to be transported and disposed at the Da Phuoc landfill area (located in Da Phuoc commune, Binh Chanh District). The details of sludge disposal will be confirmed at project appraisal. This landfill is currently used by HCMC for disposal of sludge generated from other WWTPs and other wastews generated in HCMC. About 47 ha of the landfill will be used to take the sludge from the WWTP and the development of the landfill is considered an ancillary activity under the HCMC ES2 project. As confirmed by the Binh Chanh Resettlement Committee, Da Phuoc commune, and the project implementing agency, the land acquisition and compensation for the 47 ha was completed and the land is ready for HCMC ES2 use. Households consulted (in 2012) indicated their livelihoods were fully restored.
36. A number of the risks and accidents may be caused by the project interventions during the construction and operation phases including traffic incidents during transportation of construction materials by water or land ways, the flooding due to heavy rains and climate change impacts. Also, there may be a number of other incidents occurred such as equipment damage, clogged pipes, temporary improper operation of WWTP; spillage of sludge, the chemical leakage, explosion/fire incidents, working accidents etc.

B. Biological Environment

1). During pre-construction and construction phases

37. In the project area, it is necessary to reclaim and level land to prepare building construction. To build the WWTP requires an area of 38.47m². That land area is primarily (74%; 28.47 ha) agricultural and crop land, with 62 land owners. The needed land area is primarily privately owned (80%; 30.77ha [including 0.04 hectares of residential land, accounting for 0.10%], with public land (creeks and ditches) accounting for 20% (7.7ha). The area includes some trees of nipa (*Nypa fruticans*) and swamp land, and rice paddy field. The owners of the land will sell their land to HCMC for the construction of the wastewater treatment plant and they shall be compensated as per the procedures used in Vietnam and in line with the World Bank's resettlement policies. In addition, there are four graves and two temporary houses that would be impacted, and compensation would be made. The land acquisition at the proposed site of WWTP would not result in the physical resettlement of the affected households since no households are living in the proposed site for the WWTP. Especially, in the WWTP area, some mangroves, coconuts, other trees will be cut down. Since the damaged area is very small, it does not affect the aquatic species. Nevertheless, the contractor must ensure to eliminate trees when necessary, and in line with approved construction plan based on the detailed design.
38. The interceptor line will be installed below the urban space, and a pipe jacking method is being considered for the interceptor construction where the pipe would be pushed under the ground through shafts which would minimize open excavation causing less inconvenience for the citizens. The areas where the vertical shafts would be installed would need to be acquired permanently. About 17 such locations have been identified.

39. **Natural Habitats (OP4.04).** This policy is being triggered as the location of the wastewater treatment plant is in a swamp area and is near a natural reserve area in Can Gio (20 to 30 km downstream). Site survey conducted during the preparation of the EIA did not indicate that there are any endangered species in the location of the treatment plant. However, this policy is being triggered in case during the design and construction period it is seen that natural habitat of a species would be affected. In such a case, appropriate mitigation measures would be considered and reflected in the site specific EMP.

2). During operation phases

40. Since the treated effluent discharged from WWTP will meet the regulation QCVN 14:2008/BTNMT, column A, therefore, the effluent will not affect the ecological environment in the surrounding area. However, some specific environmental protection measures will be monitored including satisfactory treatment of wastewater before discharging into receiving source; regular environmental monitoring and WWTP operation training will be duly implemented.

C. Social Impacts and Mitigation Measures

41. **Social Assessment (SA).** An SA exercise was initiated in 2010. It was updated in subsequent years – from 2011 to 2014, to reflect the development of the project activities and environmental assessment results as the project preparation evolves. The purpose of the SA is two-fold: a) examine the potential impacts of the project –positive and negative (on the basis of planned project activities), and b) inform the design of mitigation measures that address identified potential adverse impact and propose other community development activities (i.e. behavior change communication) to enhance project's development effectiveness. The SA confirms that the overall social impact of the project is positive - because the project will improve the environmental sanitation for the two target catchment areas - Nhieu Loc – Thi Nghe area (Phase 1) and District 2 area (Phase 2).
42. **Involuntary Resettlement (OP 4.12).** Because land acquisition is required to construct the WWTP, and some temporary land acquisition may be required for the installation of the Interceptor and the sewerage in the District 2 area, the World Bank's OP 4.12 on Involuntary Resettlement is triggered. A Resettlement Policy Framework (RPF) has been prepared in accordance with the World Bank's OP 4.12 to guide the preparation of Resettlement Action Plan (RAP) for any site-specific civil works under the project that requires land acquisition. The RPF specifies steps to be taken for preparation, review, and clearance of a RAP when required during project implementation. It also specifies how compensation would be made to local people who are affected with loss of land, structures, crops, businesses during project implementation, and how livelihood restoration of local people will be supported, and monitored. In addition to RPF, an Environmental Social Management Framework (ESMF) has been prepared in accordance with the World Bank's OP 4.01 (Environmental Assessment), and OP 4.12 (Involuntary Resettlement). The ESMF provides guidance on how environmental and social impact will be addressed in an integrated manner.
43. **Physical Cultural Resources (OP 4.11).** The Bank's policy on Physical Cultural Resources (OP 4.11) is triggered as the land acquisition for the construction of the WWTP (in Thanh My Loi ward) will require the relocation of four graves of local people. These graves would be removed in accordance with Bank policy and local procedures which would include consultation with the affected group and compensation for relocating the grave site. No major impacts on other physical cultural resources (PCR) are expected during Project implementation. However, the provisions of the EMP will apply to minimize the impact of the project on other PCR that may be located near the site (monuments,

religious buildings etc.). The works contracts will also have provisions to address chance finds in case such instances come up during the construction phase.

44. **Social safeguards implementation:** HCMC People's Committee (HCMC PC) is primarily responsible for the implementation of the RAP(s) to be carried out under this project. The costs for compensation payment/livelihood restoration will be financed by HCMC People's Committee. During project implementation, IMA, as assigned by HCMC PC, will do the day-to-day RAP implementation in collaboration with District 2 People's Committee, and other relevant governmental agencies. A social staff will be appointed at IMA to provide technical support to relevant government agencies to ensure the RAP is implemented in accordance with the RPF. An independent price appraisal and a monitoring agency will be engaged by IMA to assist in carrying out necessary tasks to ensure the compensation payment is made at the replacement costs and that the compensation payment and livelihood restoration are monitored appropriately in line with the objectives of the RPF.
45. **Disclosure of social safeguards documents.** Prior to appraisal, the social safeguard documents, including SA, RPF, and the RAP will be disclosed in Vietnamese at the Vietnam Development Information Center in Hanoi, and locally at the office of District 2 People's Committee, and on the website of the IMA. The English version of the above documents will also be disclosed at Bank's Info Shop.

D. Cumulative Impacts

46. Overall, the project will have a positive cumulative impact, as water quality of the Saigon River will improve based on water quality modeling, as noted earlier. Also, the wastewater collected in the D2 area, where they do not have sewers, would now be treated before release, and this would also have a positive impact. Sludge generated by the WWTP would be properly handled. The positive effects are mostly from improving water quality of Sai Gon - Dong Nai River and reducing wastewater treatment costs for companies, thereby raising awareness of environmental protection of the people. However, there would be some negative impacts on the environment mainly from the clearing and reclamation process; construction activities; sludge production from the plant operation.

VI. ECONOMIC ASSESSMENT

47. The investment cost is US\$495 million. Apart from the investment cost, HCMC has budgeted US\$29 million for operating costs to pay the DBO (Design Build and Operate) contractor during the first five years of the operational phase of the project. The investment cost depends on the choice of technology process. Total cost, including the operation of the wastewater treatment plant for 5 years, is thus estimated to be US\$524 million (including the cost for preparation phase, cost for implementation phase, and contingencies and VAT). The project will be financed by a Bank loan of US\$250 million (IBRD) and an IDA credit of US\$200 million. HCMC will provide the remaining financing of US\$74 million (US\$45 million for investments plus US\$29 million for operations).

VII. ENVIRONMENTAL MANAGEMENT PLAN

48. Environmental Management Plan (EMP) consists of the set of mitigation, monitoring, and institutional measures to be undertaken during project implementation and operation, in order to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. EMP also includes the actions needed to implement these measures. The full EMP, which is presented in chapter 8 of the EIA report, would be attached to the contract of the DBO operator and revised if necessary before works may commence.

49. The Environmental Management Plan (EMP) consists of a set of mitigation, monitoring, and institutional measures to be taken during the project's implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The plan also includes specific actions needed to implement these measures and assigned responsibilities. In summary, the EMP address a range of issues, such as air pollution, dust generation, drainage and sedimentation control, solid waste management, etc. that could be encountered during pre-construction or construction phase; as well as impacts that could occur during the operations phase, such as effluent standards not being met, operational problems, odors, and waste from the operations. In addition, the DBO contractor would also prepare and utilize site-specific EMPs. See Annex 1 for the matrix presenting the EMP issues, actions and responsibilities. The EMP would also be attached to the contract of the DBO operator that will design build and operate the plant. The environmental management entities consist of MONRE, People Committee of HCMC, DONRE of HCMC, and the CESPIMA. The environmental audit is to be carried out by an environmental consultant employed by the CESPIMA. The environmental auditor is responsible for assessment of the environmental performance of the construction contractor, the facility operator construction monitoring consultant and the CESPIMA. The audits will be carried out at agreed period of intervals in line with the recommendation in the Project Environmental Performance Reporting System (PEPRS) Manual.

50. The structure of the environmental management of the project is shown below (Figure 7).

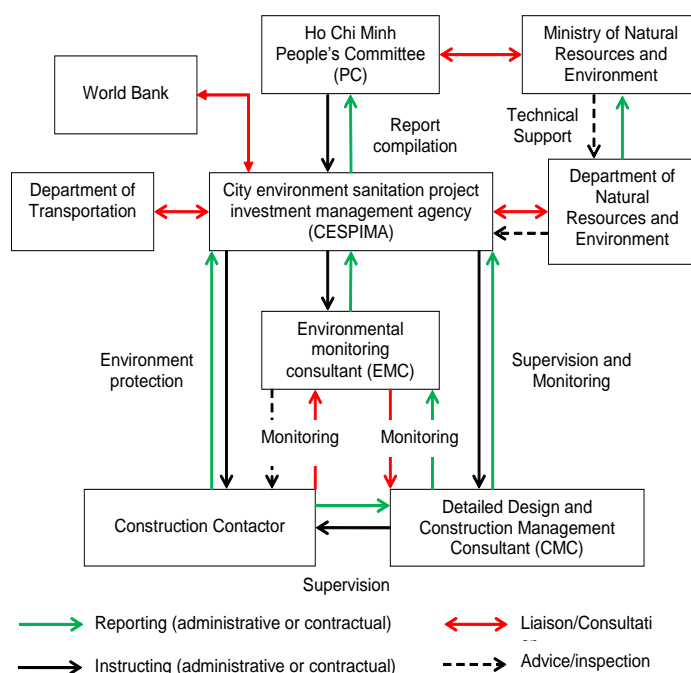


Figure 6. The structure of the project environmental management

51. A training program will be designed for the construction and operation phases since gaps in environmental protection and occupational safety management aspects have been proposed. Specifically, knowledge about labor safety, collection and treatment of waste and environmental protection is essential. The training programs for workers should be conducted by contractors according to construction contracts between the CESPIMA and contractors. Public information program and community relation will be developed during the preconstruction, construction and operation phases. Public, and especially media, reaction has been excessively and increasingly negative towards infrastructure projects meant for public services. This is because public agencies in Vietnam are generally not well acquainted with implementing large-scale urban infrastructure projects, especially on public consultation mechanisms.

52. Site-specific Environmental Management Plan (SEMP) will be developed by construction contractor prior to the start of any pre-construction and construction activities following to the measures specified in the project EMP and with modifications in line with the detailed design. These included mitigation measures for negative impacts caused by the construction of the interceptor sewer and WWTP, including measures for health, safety, environmental pollution, and traffic management.
53. The project owner will carry out periodic visits to implement the project environmental monitoring program in line with national legislation and requirements. Environmental Audit Quarterly Reports conducted by Auditing Consultant every 3 months will be attached as an annex to the Progress Report prepared by the CESPIMA for the World Bank. Environmental Quality Monitoring Reports conducted by construction monitoring consultant during construction phase and the first year of operation (2 times/year) will be submitted to CESPIMA, then to DONRE of Ho Chi Minh City and the World Bank. A Final Report at the end of the construction phase will summarize the environmental auditing completed and provides recommendations for continued auditing in operation phase.

VIII. PUBLIC CONSULTATION

54. The public consultation held during the preparation process of the EIA report for the HCMC ESP2 is regulated in Article 14 of the Circular and the WB's safeguard policy OP 4.01. For category A project, proposed for IBRD or IDA financing, during the EA process, the borrower consults project-affected groups and local non-governmental organizations (NGOs) about the project's environmental aspects and takes their views into account as early as possible in the EA process. For Category A projects, the borrower consults these groups at least twice: (a) shortly after environmental screening and before the terms of reference for the EA are finalized; and (b) once a draft EA report is prepared. In addition, the borrower consults with such groups throughout project implementation as necessary to address EA-related issues that affect them.
55. The EIA Consultant carried out the survey of affected area at upstream, middle stream and downstream of WWTP discharged point.
 - The 1st public consultation was held during first phase of EIA preparation. The information was disseminated in two rounds in the proposed project area as follows: (i) Round 1 was run from December 24th, 2010 to December 26th, 2010. The implementation contents during this phase included project information dissemination, questionnaire-based interviews with a sample of approx. 10% households living in the proposed project area – Thanh My Loi ward. (ii) Round 2 took place from December 20th, 2011 to December 23th, 2011. Consultants organized additional meetings to seek opinions of local authorities and residents in wards/communes where are affected by WWTP discharged point. The 2nd public consultation was performed after the draft EIA report preparation.
 - The 2nd public consultation was implemented from February 9th, 2012 to February 24th, 2012 with the objective to present the main findings of EIA reports and to get feedback from affected household (PAHs). In addition, to comply with Circular 26/2011/BTNMT and Decree 29/2011/ND-CP, consultation was undertaken to collect opinion from leaders (People's Committee, Fatherland Front's Committee) of Wards and Communes, of representative of affected people.
 - The final public consultation was held on 24 April 2014 by CESPIMA and Meinhardt Vietnam before completion of the EIA report and ESMF for the sewer investment project in D2. The consultation results show that the participants support the Project investments. They acknowledge that their living conditions will improve due to the project. They requested that appropriate measures

should be taken by the local authorities to keep the environment clean; and they also wanted to be informed about the developments regarding the project and the area. Minutes are attached in the main report.

IX. CONCLUSION

56. The discharge of untreated waste waters to the Saigon River will be eliminated due to the project, since the interceptor will take the waste waters from the East bank shaft and sewerage lines will be laid in the D2 area, where also untreated wastewater is currently being discharged to the Saigon River. This project combined with other similar projects will improve the environment in HCMC.
57. During pre-construction, construction, and operation, the CESPIMA commits to apply the measures for mitigation of negative impacts in order to address environmental or social impacts in accordance with Vietnamese and World Bank regulations. Workers shall be trained to enhance managerial capabilities, ensure operational safety and effectively, and control environmental pollution.
58. The CESPIMA will coordinate with authorities during the pre-construction, construction and operation stages of the project to fully implement pollution control and harmful environmental impacts mitigation measures, and to prevent environmental incidents.

Annex 1: Environmental Management Plan

Issues	Mitigation measures	Vietnamese code/regulation	Execution	Supervision
Pre-construction and construction phase				
Air pollution	<ul style="list-style-type: none"> - Construction vehicles must undergo a regular emissions check and get certified named: "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT; - Maintain vehicles and equipment daily and every 6 months (or 8.000 km on the road); - Do not burn waste on site; - All vehicles must comply with Vietnamese regulations controlling allowable emission limits of exhaust gases. 	<ul style="list-style-type: none"> - TCVN 6438-2005: Road vehicles. Maximum permitted emission limits of exhaust gas; - Decision No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection; - QCVN 05:2013/BTNMT: National technical regulation on ambient air quality. 	Contractors	CESPIMA+ HCM DONRE
Dust generation	<ul style="list-style-type: none"> - Removing waste out of construction site as soon as possible; - Cover the transport means to avoid dust, soil and building materials scattering during transportation; - The Contractor shall implement dust suppression measures (e.g. use water spraying vehicles to water roads, covering of material stockpiles, etc.) as required. 	QCVN 05: 2013/BTNMT: National technical regulation on ambient air quality	Contractors	CESPIMA + HCM DONRE
Disruption of vegetative cover and ecological resources	<ul style="list-style-type: none"> - When needed, erect temporary protective fencing to protect trees before commencement of any works within the site or planting trees in buffer zone of the construction site; - The Clearance Plan shall be approved by CESPIMA and followed strictly by contractor. Areas to be cleared should be minimized as much as possible; - The application of chemicals for vegetation clearing is not permitted; - Prohibit cutting of any tree unless explicitly authorized in the vegetation clearing plan; - No area of potential importance as an ecological resource should be disturbed unless there is prior authorization from local government. This could include areas of breeding or feeding of 	Law on Environment protection No. 52/2005/QH11	Contractors	CESPIMA + HCM DONRE

	birds or animals, fish spawning areas, or any area that is protected as a green space.			
Domestic wastewater workers	<ul style="list-style-type: none"> - Build portable or use temporary toilets in construction site; - Clean toilet every day; - Construct septic tank and withdraw the wastewater and sewage when the construction finishes; - Wastewater over permissible values set by relevant Vietnamese technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors. - Workers working in pumping station to be equipped with earplugs, head phone to reduce noise. 	QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater	Contractors	CESPIMA + HCM DONRE
Drainage and sedimentation control	<ul style="list-style-type: none"> - Periodic dredging of sewers; - Ensure drainage system is always maintained and cleared of mud and other obstructions; and periodically check the status of the drainage system; - Prevent discharge of garbage into drains; - Site de-watering and water diversions: In the case that construction activities require that work be carried out within the watercourse (e.g. retaining wall construction, erosion protection works), the work area must be dewatered to provide for construction in dry conditions. The sediment laden water pumped from the work area must be discharged to an appropriate sediment control measure for treatment before re-release to the stream; - Stream diversions or construction of cofferdams would require site-specific mitigation measures in the EMP; - The Investor shall follow the detailed drainage design included in the construction plans, intended to prevent storm water from causing local flooding or scouring slopes and areas of unprotected soil resulting in heavy sediment loads affecting local watercourses. 	<p>TCVN 4447:1987: Earth works-Codes for construction;</p> <p>Decree No. 22/2010/TT-BXD on regulation of construction safety;</p> <p>QCVN 08:2008/BTNMT – National technical regulation on quality of surface water.</p>	Contractors	CESPIMA + HCM DONRE
Solid Waste Management	- Before construction, a solid waste control procedure must be prepared by the Contractors and it must be carefully followed	Decree No. 59/2007/ND-CP on solid waste management	Contractors	CESPIMA + HCM DONRE

	<p>during construction activities.</p> <ul style="list-style-type: none"> - Use excavated materials for land leveling; - Remove waste on construction site within 24h; - Collect sand stone and materials from digging and clean construction sites every day. Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc shall be collected and separated on-site from other waste sources for reuse, for use as fill, or for sale; - Before construction, all necessary waste disposal permits or licenses must be obtained; - Measures shall be taken to reduce the potential for litter and negligent behavior with regard to the disposal of all refuse. At all places of work, the Investor shall provide litter bins, containers and refuse collection facilities; - Solid waste may be temporarily stored on site in a designated area approved by the local Government to collection and disposal through a licensed waste collector. In case, if not removed off site, solid waste or construction debris shall be disposed of only at sites identified and approved by the Government and included in the solid waste plan. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas, such as in areas of natural habitants or in watercourses; - Waste storage containers shall be securely covered at all times; - No burning, on-site burying or dumping of solid waste shall occur; - Residual sludge from WWTP : proposed contract in place with the Da Phuoc complex solid waste treatment area to send biological sludge from WWTP to this area following current regulations; - Residual sludge from interceptor: periodically dredged every 3 months, and dredged mud proposed to be transported to Da Phuoc solid waste treatment complex area. 			
--	---	--	--	--

Chemical hazardous wastes	<ul style="list-style-type: none"> - Chemical waste shall be disposed at an approved appropriate landfill site and in accordance with local legislative requirements; - Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery shall be collected in holding tanks and removed from site by a specialized oil recycling company for disposal at an approved hazardous waste site; - Relevant agencies (DONRE, environmental police office) shall be promptly informed of any accidental spill or incident. Initiate a remedial action plan following any spill or incident. In such as case, the contractor shall provide a report covering the reasons for the spill remedial actions taken, consequences/damage from the spill, and proposed corrective actions; - Training programs to prepare workers to recognize and respond to workplace chemical hazards. 	Circular No. 12/2011/TT-BTNMT on management of hazardous substance	Contractors	CESPIMA + HCM DONRE
Operation phase				
Outlet discharge	<ul style="list-style-type: none"> - Regular monitoring of the effluent and river quality at the outlet discharge; - Installing warning signs "DISCHARGE LOCATION OF WWTP" at suitable locations; - Eliminating the discharge of untreated wastewater. 	QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater	WWTP Operation Unit	HCM DONRE
Groundwater contamination	<ul style="list-style-type: none"> - Monitoring and controlling the groundwater quality in the area; - Preventing leakage at connections in the wastewater pipe. 	QCVN 09:2008/BTNMT – National technical regulation on quality of ground water	WWTP Operation Unit	HCM DONRE
Operational problems	<ul style="list-style-type: none"> - Monitoring of water quality to evaluate the efficiency of the WWTP operation; - Installing signs to warn people about on the risks of contacting untreated wastewater; - Maintain and submit daily working records and effluent discharge reports to the environmental supervising agency; - Have back-up systems if possible in case of accidents or operation failure. 	QCVN 08:2008/BTNMT – National technical regulation on quality of surface water.	WWTP Operation Unit	HCM DONRE
Odors	<ul style="list-style-type: none"> - Ensuring a suitable radius of buffer zone based on local regulations; 	QCVN 06:2009/BTNMT: National technical regulation	WWTP Operation	HCM DONRE

	<ul style="list-style-type: none"> - Planting trees in the buffer zone to block the view of the treatment plant; - Regular maintenance of treatment units; - Odor control equipment installed in the plant. ; 	on organic pollutant in the ambient air .	Unit	
Waste from the operation	<ul style="list-style-type: none"> - A good plan of collection and treatment; - WWTP to be equipped with waste storage tanks; - Regular collection of sludge; - Hazardous waste properly handled; - - Keeping a good personal hygiene. 	Circular No. 12/2011/TT-BTNMT on management of hazardous substance	WWTP Operation Unit	HCM DONRE

Annex 2: National Technical Regulation on Surface Water Quality

Surface water

The national technical regulation on surface water quality **QCVN 08:2008/BTNMT** is applied for evaluation of monitored results, including:

- Column A1 – Suitable for domestic water supply purposes and for other purposes such as A2, B1 and B2;
- Column A2 - Suitable for domestic water supply purposes after applying the appropriate treatment technologies, as well as suitable for purposes of conservation of aquatic plants or other purposes such as B1 and B2;
- Column B1 – Suitable for the irrigation purpose or other purposes with requirement of the similar water quality or other purposes such as B2;
- Column B2 – Suitable for waterway transportation and other purposes with the requirement of low quality water.

Table 1. The limit value of surface water quality parameters according to QCVN 08:2008/BTNMT

No.	Parameter	Unit	Limit Value			
			A		B	
			A1	A2	B1	B2
1	pH		6-8.5	6-8.5	5.5-9	5.5-9
2	DO	mg/l	≥ 6	≥ 5	≥ 4	≥ 2
3	TSS	mg/l	20	30	50	100
4	COD	mg/l	10	15	30	50
5	BOD ₅ (20°C)	mg/l	4	6	15	25
6	Amoni (NH ₄ ⁺) (N)	mg/l	0.1	0.2	0.5	1
7	Clorua (Cl ⁻)	mg/l	250	400	600	-
8	Florua (F ⁻)	mg/l	1	1.5	1.5	2
9	Nitrite (NO ₂ ⁻) (N)	mg/l	0.01	0.02	0.04	0.05
10	Nitrate (NO ₃ ⁻) (N)	mg/l	2	5	10	15
11	Phosphate (PO ₄ ³⁻) (P)	mg/l	0.1	0.2	0.3	0.5
12	Xianua (CN ⁻)	mg/l	0.005	0.01	0.02	0.02
13	Asen (As)	mg/l	0.01	0.02	0.05	0.1
14	Cadimi (Cd)	mg/l	0.005	0.005	0.01	0.01
15	Chì (Pb)	mg/l	0.02	0.02	0.05	0.05
16	Crom III (Cr ³⁺)	mg/l	0.05	0.1	0.5	1
17	Crom VI (Cr ⁶⁺)	mg/l	0.01	0.02	0.04	0.05
18	Cu	mg/l	0.1	0.2	0.5	1
19	Zn	mg/l	0.5	1.0	1.5	2
20	Niken (Ni)	mg/l	0.1	0.1	0.1	0.1
21	Fe	mg/l	0.5	1	1.5	2
22	Hg	mg/l	0.001	0.001	0.001	0.002
24	Oils & grease	mg/l	0.01	0.02	0.1	0.3
31	E. Coli	MPN/100ml	20	50	100	200
32	Coliform	MPN/100ml	2,500	5,000	7,500	10,000