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PEOPLE'S COMMITTEE OF HO CHI MINH CITY

URBAN-CIVIL WORKS CONSTRUCTION INVESTMENT MANAGEMENT AUTHORITY OF HO CHI MINH CITY

ENVIRONMENTAL IMPACT ASSESSMENT OF HO CHI MINH CITY GREEN TRANSPORT DEVELOPMENT PROJECT

(FINAL REPORT)

Ho Chi Minh City

December 2014

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ENVIRONMENTAL IMPACT ASSESSMENT

(FINAL REPORT)

PROJECT OWNER

URBAN-CIVIL WORKS CONSTRUCTION INVESTMENT MANAGEMENT AUTHORITY OF HO CHI MINH CITY

ON BEHALF OF THE ASSOCIATION

CENTER FOR ASSISTING COMMUNITY SUSTAINABLE DEVELOPMENT (CDS) - TRANSPORT ENGINEERING DESIGN INCORPORATION (TEDI)

HCMC, December 2014

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LIST OF ABBREVIATIONS

CC	Climate Change
PM	Project Management
DONRE	Ministry of Natural Resources and Environment
BRT	Bus Rapid Transit
BOD	Biochemical Oxygen Demand
CNG	Compressed Natural Gas
CSD-TEDI	Center for Assisting Community Sustainable Development (CDS) - Transport Engineering Design Incorporation (TEDI)
COD	Chemical Oxygen Demand
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EO	Environmental Officer
EURO	Europe
ES	Environmental Supervisor
Depot	Technical Facility
DO	Dissolved Oxygen
FS	Feasibility Study
HGTP	Ho Chi Minh City Green Transport Development Project
ITS	Intelligent Transport Systems
IEMC	Independent environmental monitoring consultant
MCT	Mai Chi Tho Boulevard
MRT	Metro Rapid Transit
ODA	Official Development Assistance
GHG_S	Greenhouse Gases
QCVN	Vietnam technical regulations
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
TP HCM	Ho Chi Minh City
TT	Circular
TTg	Prime Minister
UBND	People's Committee
UCCI	Urban-Civil Works Construction Investment Management Authority of Ho Chi Minh City
USD	US Dollar
VND	Vietnam Dong
VVK	Vo Van Kiet Boulevard
WB	World Bank

SUMMARY OF ENVIRONMENTAL IMPACT ASSESSMENT REPORT

A. SUMMARY OF PROJECT COMPONENTS

The Ho Chi Minh City Green Transport Development Project has two main components:

A.1. Component 01: Development of Bus Rapid Transit (BRT) corridor

This component includes construction of BRT line 1 along Vo Van Kiet – Mai Chi Tho Boulevard (23.0 km), starting from An Lac Turnaround to Vo Van Kiet – Mai Chi Tho Boulevard and ending at Cat Lai T-junction. There are, moreover, other supporting facilities for this BRT line, including bus stations, Terminal, Technical Facility, Modern Management System, and CNG buses. These will be developed in this component.

a) BRT line 1 and location of BRT lanes

- Total length of BRT line 1: 23.0 km
- Route: An Lac Turnaround (for turning) – Vo Van Kiet Boulevard – Mai Chi Tho Boulevard – Cat Lai T-junction (Rach Chiec Terminal)
- Scope of the study: 100 m wide along the BRT corridor
- BRT lane:
  + Using 2 central lanes of the existing road – completely separated with other types of vehicle;
  + The segment passing through Thu Thiem Tunnel is not separated.

b) Rach Chiec Terminal

- The Terminal serves for turning around BRT buses, for picking up and dropping off passengers, also serving as trans-shipment to the MRT1 and other conventional bus routes along the Hanoi Highway.
- This Terminal is constructed in Rach Chiec Sport Complex, within an area of 0.58 ha. It includes the following facilities: (a) a station building that has 3 floors to be built on an area of 310 m^2 (with a total ground floor area of 1,100 m^2), connecting not only to the BRT buses but also to normal buses and allowing trans-shipping with MRT1; (b) a BRT parking area that allows 15 BRT buses parking at the same time; and (c) a green space and internal traffic.

c) Thu Thiem Technical Facility

- This Technical Facility serves for parking, daily technical testing (maintenance, brake testing, fuel re-charging, cleaning etc.) before the rapid transit buses can operate on the route.
- The Technical Facility is located in an area planned for the Thu Thiem Railway Station, with an area of 1.77 ha, of which 1.0 ha will be used for functional areas, with the remaining used for a 120 m access road from Mai Chi Tho Boulevard.
- The Technical Facility includes the following: (a) a five-storey office building built on an area of 1,345 m^2, with its two highest floors used for the BRT operating area and the ITS operation system; (b) warehouse, and technical and environmental supporting area; (c) vehicle washing area; (d) maintenance area; (e) CNG station; and (f) an internal traffic and parking area.

d) An Lac turnaround

- The An Lac Turnaround is used for turning of RT buses in the first phase of the project when the start and end terminals of the new Mien Tay Terminal are yet to be constructed.

e) BRT bus stations

- There are 28 BRT bus stations along the whole route, located on the separator of existing roads. Bus stations are environmentally designed using solar power and incorporate green spaces.
- Each station is designed with: (a) an access area; (b) ticket control area; (c) platform/ waiting area; and (d) auxiliary area with rest rooms and power generation, and for expansion of the bus stop for future 18 m long RT buses.

f) Access to BRT bus stations

There are two ways for accessing BRT bus stations:

a. Using pedestrian flyovers

- A total of 17 pedestrian flyovers will be improved from existing flyovers on Vo Van Kiet Boulevard or construction of new pedestrian flyovers, including: construction of 10 new pedestrian flyovers (at BRT 05, BRT 15 on Vo Van Kiet Boulevard, and at BRT 20, 21, 22, 23, 24, 25, 26, 28 – on Mai Chi Tho Boulevard); one new bridge at BRT 17; and 6 pedestrian flyovers to be improved (at BRT 04, 06, 08, 09, 11 and 14).
- Pedestrian flyovers at BRT 11, 14 and 17 will have elevators for supporting people with disabilities.

b. Using traffic lights

- All other stations are designed with traffic lights for passengers accessing the bus stations.

g) Parking areas

- There are a total of nine parking areas for passengers along the BRT route, with a total area of 7,879 m^2. Each parking area covers from 250 to 1,250 m^2 depending on specific free land near each station .
- Parking area locations include BRT 02 (2 parking areas), 03 (2 parking areas), 07, 12, 14, 16 and 18.

h) BRT bus using CNG fuel

- Bus B80 will be used for this project. Its carrying capacity is 80 to 85 passengers per time and it consumes compressed natural gas as fuel.
- There will be 30 buses used from 2018 to 2025, increasing to 48 buses from 2025 to 2030, and 56 buses after 2030.

i) Intelligent transport systems (ITS)

- The ITS utilizes high-tech applications in electronics, information technology and telecommunications to operate and manage city wide transport systems and in particular the BRT corridor.

A.2. Component 02: Institutional Strengthening

This component includes technical support and capacity building for state management staff and public transport system operation staff (including subway, BRT and buses); integrated

planning for land use and transport planning; intelligent ticketing system and integrated traffic control center.

A.3. Total investment of project

This is an ODA project supported by a loan from the International Bank of Reconstruction and Development (IBRD) of the World Bank (WB), with a total investment for BRT line1 of 175,310,500 USD, of which the counterpart budget is 33,026,700 (18.84%) USD, and WB loan from IBRD of 142,283,800 USD (81.16%).

B. SUMMARY OF ENVIRONMENTAL AND SOCIO-ECONOMIC BASELINE CONDITIONS

The environmental and socio-economic baseline of project areas is summarized as follows.

Table A.1 Summary of environmental and socio-economic baseline of the project areas

Ambient air quality	Ambient air quality in project areas are good. Monitored values of all indicators - CO_2, SO_2, NO_2 - were lower than permissible values as stated in QCVN 05:2013/BTNMT - Vietnam National Technical Regulation for Ambient Air Quality.
Surface water quality	Analyses of surface water quality indicated low DO and high coliform levels. Some samples, collected during ebbing tide, were not contaminated by coliforms, whereas all others had higher than permissible values, ranging from 2 to 40 times greater than that stipulated in QCVN 08:2008/BTNMT (Category B) - Vietnam National Technical Regulation for Surface Water Quality.
Underground water quality	Indicator values for groundwater quality were within permissible values as stated in QCVN 09:2008/BTNMT - Vietnam National Technical Regulation for Ground Water Quality, excluding samples taken at Commune 7 (NN3) and Commune 10 (NN5) of District 6, which presented coliform levels 9 times higher than the permitted value.
Existing waste management	Currently, Ho Chi Minh City has both public and private waste collection systems which respond to solid waste collection in the whole City. For wastewater, the Vo Van Kiet – Mai Chi Tho corridor is currently discharging wastewater to urban drainage systems, as well as to natural channels along the project corridor.
Protected and/or reserved area(s)	There are no areas to be protected or reserved in project areas.
Biodiversity	Project areas lack forest, and there are no preserved areas with fauna and flora that require protection.
Climate change impacts	According to previous studies, all modes of transport in Ho Chi Minh City will be impacted by climate change (by 2050), especially by flooding. BRT 1 is projected to be located in impacted areas, especially in areas of District 2.
Economic and	Living conditions of HHs in project areas are much higher than average, of which

social conditions	approximately 30% of people are considered wealthy, 50% well off, 18% middle class, and 2% poor. Most people living next to Vo Van Kiet – Mai Chi Tho Boulevard operate commercial businesses given the advantage of their location. The average income of people in project areas ranges from 2 to 10 million VND/ person/ month.
Basic infrastructure for electricity, water supply, education and health care	*Electricity*: The electrical supply is in good condition, with 100% of households connected to the grid. *Water supply*: All residents along Vo Van Kiet – Mai Chi Tho Boulevard have access to water, supplied by SAWACO, and additionally supported by groundwater and rainwater sources. *Health care*: Each commune has its own health care center, and there are several hospitals to support communities. *Education*: Almost all communes have their own kindergarten, primary school and high school.
Historical and cultural value(s)	Along the project corridor, there are historical and cultural sites such as the Traditional Hall of Commune 1 of District 5 and Giuse Cathedral in Commune 5 of District 5. However, these will not be impacted by project activities.

C. SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS

Assessment of environmental impacts will help the project management unit select appropriate alternatives to protect the environment during project implementation.

A summary of potential environmental impacts caused by project activities during the pre-construction phase is shown in the following:

Table 2 Potential environmental impacts caused by the project during its pre-construction phase

Activities	Potential Impacts	Significance of Impacts
1. Selection of design alternatives 2. Land acquisition 3. Preparation of construction 4. Moving of existing	The project will acquire 2.35 ha of land of which 1.77 ha will be used for the Technical Facility at Thu Thiem and 0.58 ha for Rach Chiec Terminal. Approximately 95% of acquired land will be agricultural, and other parts residential and commercial. However, agricultural activities as well as business activities do not currently exist in these areas, so land acquisition should have limited social impact. All other project activities are located on public land at Vo Van Kiet – Mai Chi Tho, thus no land acquisition is required in these cases.	Minor negative long-term
	Impact on households: - The Technical Facility at Thu Thiem will impact on 12 households but only on agricultural land.	Minor negative long-term

Activities	Potential Impacts	Significance of Impacts
infrastructure 5. UXO removal	- Rach Chiec Terminal at Rach Chiec Sport Complex will impact on three households and two companies. - No households will be significantly impacted;	
	Pollution by way of gases, waste, noise and vibration could result from demolition of existing infrastructure. However, areas for developing the Rach Chiec Terminal and Technical Facility at Thu Thiem are free land that belong to other planned development projects of Ho Chi Minh City. Therefore, project land acquisition will not have significant impacts on households, and acquisition activities will not be implemented during the pre-construction phase (these areas are vacant land).	Insignificant
	Underground infrastructure: During the pre-construction phase, project activities could temporarily impact on underground facilities in the project area.	Minor negative and short-term
	Environmental landscape: The environmental landscape is considered in the pre-construction phase where appropriate design and selection of alternatives are important. This aspect is very important and needs to be carefully considered to avoid long-term and irreversible impacts.	Moderate negative and long-term without careful consideration
	Removal of unexploded ordnance (UXO): The project area was bombed during the war so that there is high potential risk of finding UXO. For the safety of workers and the local community, the area needs to be examined for and cleared of UXO.	Moderate negative without completing UXO removal
	Appropriate design of project: It is very important to ensure: i) all objectives of the project are addressed; ii) social safety and acceptance; iii) sustainable operation of project activities; iv) establishing the project as a successful case study of BRT to be scaled-up; v) saving costs during construction and operation; vi) responding to potential future climate change impacts; and vii) ease to access for all.	Moderate and long-term negative if without carefully considering appropriate project design

A summary of potential impacts caused by project activities during construction phase is shown in Table A3:

Table A 3 Summary of potential environmental impacts caused by the project during its construction phase.

Activities	Potential Impacts	Level of Impacts
1. Earthwork	**Impact on air quality from dust and gas emissions**	Moderate

Activities	Potential Impacts	Level of Impacts
activities at working site 2. Storing and handling of materials 3. Construction of workers' camps; concentration of workers 4. Transporting of materials and wastes 5. Construction of main components of project 6. Installation of electrical equipment, and telecommunications 7. Activities of workers on working site	- The total amount of soil requiring excavation is 29,629 m^3 and filled soil is 58,457m^3. The total estimated amount of dust emissions from excavation, operation of construction equipment, transportation etc. is 1.68 kg per day. - Emission loads arising from daily construction machinery and transportation is estimated at 0.5g dust, 21g SO_2, 15.3g NOx, 51.8 g CO, and 5g VOC. - Secondary dust will be generated from movement of construction vehicles and workers at the construction site. Emissions are estimated to exceed Vietnam National Technical Regulation for Ambient Air Quality QCVN 05:2013/BTNMT within a distance of 5 to 10 m from the edge of the construction site for the Technical Facility component, while within permission standards at other construction sites. However, at the smaller construction sites, secondary dust and gas emissions will be an important source. The project area is in an urbanized area with high population density and traffic volume, and vulnerable to dust and gas emissions.	negative but temporary and local
	Waste generated by the project could include: construction waste, 18,190 m^3; domestic waste, 6,570 kg; hazardous waste, 48 kg; and oil contaminated waste of 485 litters for the whole construction phase. These wastes should be collected and treated appropriately to avoid any negative impacts on soil, water, air quality, and to ensure sanitation.	Moderate negative but temporary and local
Main activities during construction 1. Upgrade of road surface 2. Upgrade and construction of bus stops, pedestrian bridges 3. Construction of Terminal and Technical Facility	**Noise and vibration** generated from operation of construction machinery and equipment. Machinery noise at source varies from 90-105 dBA, but is within the regulated level at a distance of 32m. Vulnerable groups are residential and commercial areas located along the project corridor, and impacted only during the construction phase.	Moderate negative but temporary and local
	Impact on water quality - Wastewater to be generated from daily activities of workers is estimated as approximately 1.8 – 2.4 m^3 per day per lodge. - Run-off water from construction sites could contain suspended matter, and other pollutants which could lead to increase of pollutants in water quality in project area; - Wastewater from maintenance activities of construction machinery and equipment contains organic substances, oils and treated matter which may potentially cause water pollution. Wastewater without appropriately management could impact on the surrounding aquatic environment.	Minor negative because channels are not used for productive and recreational purposes, and are currently polluted.
	Occupational safety risks during construction may potentially result from UXO; electricity grid; conflict between construction equipment and traffic vehicles enroute to and from project sites;	Moderate negative

Activities	Potential Impacts	Level of Impacts
	and accidents with workers travelling to and from construction sites.	
	Ecosystem impacts The project area is characterized as an urban ecosystem within which several areas have experienced rapid urbanization and canal development. The urban landscape has experienced rapid change, and it is anticipated that project activities during construction phase will not significantly impact on the urban ecosystem.	Insignificance
	Flooding during construction Most construction sites within the project are not located in flood prone areas, and the project activities will not likely be heavily impacted by flooding during construction. However, existing flood prone areas at An Duong Vuong Street (Binh Tan District) and Nguyen Thi Dinh Street could impact on construction activities.	Minor negative but temporary and locally
	Traffic safety and congestion With a daily traffic volume of 2,676 cars, 2,287 buses, 221 trucks and 46,629 motorcycles, and many road intersections, there is potential for traffic congestion and accidents, including during the construction phase.	Minor negative but temporary and locally
	Encroachment and degradation of local infrastructures Operation of transportation vehicles could impact on daily activities of the local communities.	Minor negative
	Socioeconomic disturbance - Large numbers of workers onsite could create social conflict with local communities. - The potential spread of disease could put pressure on local health care services. - Higher traffic load may potentially increase traffic accidents.	Minor negative
	Impacts on physical cultural resources Historical and cultural infrastructure in project areas are located away from and will not to be affected by project activities.	Insignificance

A summary of potential impacts caused by project activities during the operational phase is shown in Table A4 below.

Table A4 Summary of potential environmental impacts caused during the operational phase.

Activities	Potential Impacts	Level of Impacts
1. Vehicle operation and increase of	**Impact on air quality** Air quality may be impacted from dust and gases generated from vehicle activities. Based on experiences from other cities around the	Insignificant

Activities	Potential Impacts	Level of Impacts
traffic volume enroute 2. Operation of Technical Facility, Terminal; bus stations; and buses	world and emission calculations, the project will contribute to reduced greenhouse gas and other pollutant emissions (i.e. CO_2, SO_3, NO_2 and dust). Based on calculations, air pollutant concentrations from vehicles within the project corridor will increase, but will remain under the regulated permissible level.	
	Impacts of noise and vibration The use of CNG fuel will contribute to sustainable transport development. Past experience indicates that noise generated by CNG vehicles is much lower than diesel vehicles: 37% lower outside and 65% lower inside vehicles. The project is therefore expected to contribute to reduced noise pollution in the project corridor.	Insignificant
	Solid and hazardous waste Solid waste will be generated at bus stop stations, the Terminal and Technical Facility. The amount of waste generated is estimated to be about 949.135 kg per day from the stations and Terminal, and 11.5 kg per day at the Technical Facility by 2025. Hazardous waste will also be generated during maintenance and from repair of vehicles, such as batteries, tires, and clothing. This waste should be collected to protect human and environment.	Moderate negative
	Impact of wastewater Sources of wastewater include: domestic wastewater from BRT passengers and staff working at stations, the Terminal and Technical Facility; and industrial wastewater from BRT-bus washing and vehicle maintenance. The amount of water used is estimated as 145 m^3 per day by 2025 and 155 m^3 per day by 2030. Rainwater runoff at the Rach Chiec Terminal and Technical Facility will contaminant sediment, and pollutants will enter the drainage system. Wastewater should be collected and treated appropriately to avoid pollution of surrounding areas.	Moderate negative
	Traffic accidents and congestion Traffic accidents and congestion may results from: i) narrowing the traffic lanes; ii) prioritizing right of way for BRT buses; iii) increased traffic volume at the entry to Thu Thiem Technical Facility and Rach Chiec Terminal; iv) increased use of private vehicles; and v) low awareness of traffic users along the corridor.	Moderate negative and long-term
	Sanitation and hygiene in public areas At BRT stations and the Terminal where many people will congregate each day, there potentially could be issues with sanitation and hygiene.	Moderate negative and long-term

Activities	Potential Impacts	Level of Impacts
	Security Homeless people may congregate in public areas including stations, pedestrian bridges, and Terminal, and may pose a security risk it is not properly managed.	Moderate negative and long-term
	Risk related to compressed gases and CNG equipment Safety processes need to be enforced to ensure safety of the fuel supply system at the Technical Facility, as well as functioning of related equipment for using CNG. There is increased risk if safety processes are not followed.	Moderate negative and long-term

D. SUMMARY OF MITIGATION MEASURES TO NEGATIVE IMPACTS

Depending on the particular type of environmental impact identified, relevant mitigation measures to address potential negative impacts will be implemented. Mitigation measures related to construction activities will be included in contracts with construction contractors and monitored by relevant stakeholders and authorities. In addition, monitoring and reporting requirements are also fully mentioned in the Environmental Management Plan (EMP) to ensure that mitigation measures are implemented and reported to authorities.

Table A5 Summary of preventive and mitigation measures addressing potential negative impacts

Measures	Fund	Time	Responsibilities	Monitoring of Responsibilities
Pre-construction phase				
Follow guidelines of the Resettlement Policy Framework and Resettlement Action Plan (RPF & RAP) of the project, as approved by WB and HCMC People's Committee.	RAP cost	Before starting project construction	Committee of land acquisition of District 2	UCCI and independent monitoring consultant for resettlement
Move infrastructure before starting construction. Cooperate with organizations to ensure functioning of electricity, water supply as well as telecommunications	-as above-	-as above-	-as above-	-as above-
Cooperate with the authorized organization for UXO clearance in the	-as above-	-as above-	-as above-	-as above-

Measures	Fund	Time	Responsibilities	Monitoring of Responsibilities
project areas, and ensure budget for implementation and complete before starting construction.				
No existing houses in project construction areas, thus land acquisition will have less impact on local communities.	-as above-	-as above-	-as above-	-as above-
Design phase should consider sustainable principles to ensure achieving objectives of the project as well as effective operation. Attention should be paid to specific problems such as pedestrian flyovers, flooding, road narrowing, disabled access, structures, safety of fuel, materials, as well as the environmental management plan (EMP).	Include in basic design and detailed design of project	Before starting construction	FS consultant; Detailed design consultant	UCCI & Design Monitoring Agency (if any)
Construction phase of project				
Air Quality				
- Spraying water, moistening surface of excavated soil at least two times on dry days at sensitive places. - Fencing of construction sites, with fences of 2 m height at sensitive places. - Daily cleaning of areas close to construction sites. - Using vehicles that meet emission standards, . - Regular maintenance of construction equipment as well as vehicles. - Monitoring of air quality.	Included in budget of contractors. Monitoring budget of UCCI	24 months of construction	Contractor, and will be required by contract.	UCCI, IEMC, HCMC DONRE
- Trucks transporting materials and/or waste to be covered, of appropriate size, and not overloaded. - Washing areas provided for trucks at construction site gates at the Rach Chiec Terminal and Technical Facility at Thu Thiem, and trucks washed before leaving construction sites.	Included in budget of contractors. Monitoring budget of UCCI	24 months of construction	-as above-	-as above-

Measures	Fund	Time	Responsibilities	Monitoring of Responsibilities
- Waste and material generated during transportation to be cleaned immediately. - Regular emissions testing of vehicles.				
- Concrete mixing plants (if any) to be located far from any water sources and residential areas. - Cleaning activities at stations to be done at least once per day during the rainy season and twice per day during the dry season. - In case concrete for project construction will be purchased from commercial stations, environmental evidences of these stations should be provided.	Included in budget of contractors. Monitoring budget of UCCI.	24 months of construction	Contractor, and will be required in contract.	UCCI, IEMC, HCMC DONRE
Reduce impacts of noise and vibration				
- *Appropriate planning of construction activities.* Turn off machinery when not in use. Do not operate machinery and/or equipment which generate noise levels above 55dBA at night and nearby sensitive areas. Equip PPE to employees operating noisy machinery. - *Selection of machine and equipment:* Prioritize use of low-noise machinery and/or equipment, and regularly maintain to mitigate noise levels. - Transport of materials and waste at night in the residential areas (9 pm – 6 am) will not be allowed.	Included in budget of contractors. Monitoring budget of UCCI.	24 months of construction	Contractor, and will be required in contract	UCCI, IEMC, HCMC DONRE
Solid waste management				
- Construction waste need to be temporarily handled at construction sites and transported to the agreed disposal site at Da Phuoc Landfill. - Locate appropriate waste containers at construction sites. and provision of appropriate waste collection (daily), transportation, and treatment as per	Included in budget of contractors. Monitoring budget of UCCI.	24 months of construction	Contractor, and will be required in contract.	UCCI, IEMC, HCMC DONRE

Measures	Fund	Time	Responsibilities	Monitoring of Responsibilities
regulations. - Provide dustbins and mobility septic tanks at work sites. - Disposal of solid wastes into canals, streams or other watercourses, agricultural fields and public areas shall be prohibited. - Toxic waste to be collected, transported and treated according to Circular 12/2011-BTNMT dated on 14/04/2011 of MONRE.				
Mitigate impacts on water quality				
- Excavation activities must be scheduled outside of the rainy season. - Worksites, material storage areas and load/unload construction activities must be located far from watercourses to ensure that materials do not enter water bodies. - Provision of manhole grid covers at Vo Van Kiet and Mai Chi Tho Streets to prevent solid waste from entering the drainage system. - Construction sites designed to prevent rainwater runoff into surface waters. - All construction machinery and/or equipment regularly maintained to ensure efficient operation. - Fuel and other hazardous substances to be stored in roofed areas. - Material storage areas to be protected from rainfall. Temporary storage of construction and domestic waste on sites limited to 24 hours maximum. - The placement of washing instruments/vehicles next to any water body will not be allowed.	Included in budget of contractors. Monitoring budget of UCCI.	24 months of construction.	Contractor, and will be required in contract.	UCCI, IEMC, HCMC DONRE
Occupational and community safety				

Measures	Fund	Time	Responsibilities	Monitoring of Responsibilities
- Implement safety measures as required by law. - Workers shall be provided with appropriate personal protective equipment (PPE). - Provision of fences at construction sites, and require contractors ensure occupational and community safety. - Supply of safe potable/drinking water for all workers. - Construction sites to ensure sanitary lodges and kitchens for workers. - The contractor must always maintain security fences and provision of lighting during nightime; - Regular check of worker occupational health at least every 6 months.	Included in budget of contractors. Monitoring budget of UCCI.	24 months of construction.	Contractor, and will be required in contract.	UCCI, IEMC, HCMC DONRE
Traffic safety and congestion				
- Cooperate with Traffic Police on Vo Van Kiet – Mai Chi Tho Boulevard to moderate and manage traffic along project corridors. - Construction activities should be completed section by section. - Provision of traffic warning signs on route. - Loading and unloading activities on Vo Van Kiet – Mai Chi Tho Boulevard should avoid rush hours. - Schedule low noise and low vibration activities during nighttime. - Provision of a security guard at construction site gates at Rach Chiec Terminal and Thu Thiem Technical Facility.	Included in budget of contractors. Monitoring budget of UCCI.	24 months of construction.	Contractor, and will be required in contract.	UCCI, IEMC, HCMC DONRE
- All construction activities only allowed within acquired land areas. - Before completion of construction activities, contractors to carry out site clearance and environmental	Included in budget of contractors. Monitoring budget of	24 months of construction.	Contractor, and will be required in contract.	UCCI, IEMC, HCMC DONRE

Measures	Fund	Time	Responsibilities	Monitoring of Responsibilities
recovery, such as: + transport of all unused materials; + removal of all construction machinery and equipment, temporary facilities; ; + site environmental recovery such as provision of trees and grass. +	UCCI.			
Managing impacts to public facilities				
During the construction phase, roads require regular maintenance to ensure safety for local communities. All public facilities should be fully compensated as its origin after completion of construction works and agreed by local authorities. Contact organizations responsible for electricity and water supplies to ensure service provision during the construction phase.	Included in budget of contractors. Monitoring budget of UCCI.	24 months of construction.	Contractor, and will be required in contract.	UCCI, IEMC, HCMC DONRE
Social disturbance management				
- Regular health check for workers. - Construction workers who are not locally resident, must register as temporary residents and obtain a temporary residential certificate from the local authority. - Cooperate with local government to manage risks of communicable diseases and social disturbance. - Prioritize employing local workforce. - Ensure safety for local communities.	Included in budget of contractors. Monitoring budget of UCCI.	24 months of construction.	Contractor, and will be required in contract.	UCCI, IEMC, HCMC DONRE
Mitigate impacts on local cultural beliefs				
During the construction phase, if a tomb is discovered, the following process to be implemented: - halting of construction activities and protection of the site; - coordination with local authorities to	Included in budget of contractors. Monitoring budget of UCCI.	24 months of construction.	Contractor, and will be required in contract.	UCCI, IEMC, HCMC DONRE

Measures	Fund	Time	Responsibilities	Monitoring of Responsibilities
arrange for relocation; and - mapping of grave site before and after relocation.				
OPERATIONAL PHASE				
Mitigate impacts of dust and pollution gases				
To control emissions from BRT buses, requires meeting inspection, safety and environmental emission standards. Regular cleaning operations at Rach Chiec Terminal and Technical Facility at Thu Thiem, to ensure sanitation and mitigate secondary dust. Planting trees to create green spaces at BRT bus stations, pedestrian flyovers, parking areas, and the Rach Chiec Terminal and Technical Facility at Thu Thiem.	Included in operational budget of project.	During operational phase of project.	Management Unit.	HCMC Transport Dept. HCMC DONRE
Solid waste management				
Domestic solid waste - Garbage bins to meet requirements of the Ministry of Construction QCVN 07:2010/BXD and cleaned daily. - Waste trolleys to meet requirements concerning their vollume (250-660 litre) and material (heavy metal or composite). - Waste transport and treatment requires signing contract with local CITENCO for transporting and treating solid waste. - Profesional staffs to be assigned to ensure sanitary conditions. - The budget for these activities need to ensure for running the system *Hazardous waste management* - Store hazardous waste temporarily in separate areas. - Make record of hazardous waste generation on weekly basis. - Signing of contract with authorized	Included in operational budget of project.	During operational phase of project.	Management Unit.	HCMC Transport Dept. HCMC DONRE

Measures	Fund	Time	Responsibilities	Monitoring of Responsibilities
agencies for hazardous waste collection and treatment ;				
Management of wastewater				
- 1: Storm water runoff is regulated as clean water flow and could discharge directly to drainage system. - 2: Domestic wastewater to be treated in septic tanks before discharge to drainage system. - 3: Wastewater from cleaning, and maintenance activities to be treated before discharge to drainage system.	Included in operational budget of project.	During operational phase of project.	Management Unit.	HCMC Transport Dept. HCMC DONRE
Ensure environmental sanitation and hygiene				
- Regular collection and transport of solid waste for treatment at local facilities. - Regular cleaning of facilities at least twice per day. - Regular cleaning, once per month, of all facilities.	Included in operational budget of project.	During operational phase of project.	Management Unit	HCMC Transport Dept. HCMC DONRE
Traffic safety and congestion				
- Provision of traffic warning signs at intersections and BRT bus station. - Prioritize and ensure traffic lights and signals are functioning. - Cooperate with traffic police to control traffic volume in rush hours. - Design traffic signals that meet national standards. - Cooperate with local government to raise awareness for local road users.	Included in operational budget of project.	During operational phase of project.	Management Unit	HCMC Transport Dept. HCMC DONRE
Public security				
- Provision of security guards to ensure security at public places, such as the BRT station, Terminal and Technical Facility. - Raise awareness of staff and BRT passengers of their social	Included in operational budget of project.	During operational phase of project.	Management Unit	HCMC Transport Dept. HCMC DONRE

Measures	Fund	Time	Responsibilities	Monitoring of Responsibilities
responsibilities. - Training of BRT drivers and staff concerning appropriate customer service, and social responsibilities of drivers.				

E. SUMMARY OF ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAM

To recognize potential environmental impacts, as well as to evaluate the effectiveness of environmental mitigation measures developed for the project, it is neccesary to establish and implement an Environmental Management and Monitoring Program.

Environmental Management Program (EMP)

The project EMP was established to propose an action plan for implementing proposed mitigation measures, as approved by the environmental authority, and integrated into the bidding and contractual documents of the project. In addition, the EMP is also institutionalized implementation of the environmental mitigation measures; managing and identifying any additional environmental problems to have appropriate responding measures.

Responsibilities of related parties are indicated as follows:

- The World Bank (WB) to monitor and supervise compliance of environmental, social safeguard policies through regular project implementation support missions.
- The Project Owner – UCCI – GTP PMU to ensure the operational budget for implementing mitigation and monitoring measures, monitor related parties in implementing their environmental responsibilities, and respond appropriately to arising problems.
- The organization approving the EIA Report – HCMC DONRE to provide guidance for state environmental management at the provincial level and will inspect EIA compliance during construction and operational phases of the project.
- The Construction Supervisor Consultant (CSC) to ensure satisfactory implementation of mitigation measures by contractors as required by the EMP, and to monitor and assess new environmental problems, and propose appropriate mitigation measures.
- The Independent Environmental Monitoring Consultant (IEMC) to monitor implementation of environmental safeguard policies, procedures of related parties, regularly monitor compliance of environmental protection measures on the field, and consult to deal with occurring environmental problems.
- Construction Contractor(s) to implement environmental mitigation measures, which are approved in the EIA Report, EMP and site specific EMP.

- Local communities to monitor and inform the Project Owner and local authorities of environmental problems caused by project construction activities and impacts on their communities.

Environmental Monitoring Program

Contents of the Environmental Monitoring Program include:

- Monitoring compliance of contractor(s) in implementing environmental mitigation measures.
- Monitoring of environmental quality:
  - Air quality - PM_{10} and Total Suspended Particulate (TSP) at six points along project corridor.
  - Noise and Vibration - L_{eq}, *speed and acceleration* of noise and vibration at five points (which are the same with air quality monitoring).
  - Surface water quality - temperature, pH, turbidity, DO, COD, BOD_5, TSS, E.coli and other coliforms at five points along project corridor.
- Monitor waste discharges at worker camps and concrete mixing stations (if any).
- Monitor environmental risks to identify environmental risk during implementation of the project. This activity will focus on localized flooding and traffic incidents.
- The environmental monitoring program will be implemented countinually during the two year construction phase, and subsequently for one year during its operation phase.

Capacity Building

A training program will be implemented for raising awareness of responsibilities, and knowledge and competency in implementing related environmental issues during the construction phase. The training program targets Environmental Officers of the PMU, Safety and Environmental Officers of the Contractors, the Construction Supervisor Consultant/Environmental Supervisor, and the Independent Environmental Monitoring Consultant. The training program will be designed according to user needs and responsibilities of related parties responsible for environmental management.

Estimated Budget for the Environmental Monitoring Program

Table A 6 Summary of the budget for the environmental monitoring program

No.	Contents	Budget
1	Budget for Independent Environmental Monitoring Consultant (VNĐ)	377,800,000
2	Budget for implementing Environmental Monitoring Program (VNĐ)	959,271,312
3	Budget for implementing training program for improvement of competency (VNĐ)	116,000,000
	Total (1 – 3) (VNĐ)	**1,453,071,312**
4	Provisional budget (10%) (VNĐ)	145,307,131
	Total budget (1 – 4) (VNĐ)	**1,598,378,444**

Total budget (1 – 4) in USD	**75,006**

INTRODUCTION

1. PROJECT BACKGROUND

The Prime Minister issued Decision No 568/QĐ-TTg on April 8, 2013, approving adjustment of the master plan for transportation development of Ho Chi Minh to 2020 with a vision to and beyond 2030. The development visions include that transport development will integrate with national, regional and HCMC economic development plans. Transport development will reflect the city's advantages of geographical location and natural environment. Sustainable road transport development is directed towards modernization, meeting the travel needs of people, and also responding to climate change and resulting sea level rise. Improvement of transport service quality will focus on mass transit; public transport modes; environmental pollution reduction and energy saving by applying advanced transport technologies, especially multimodal transportation and logistics; as well as reserving adequate land area for transport corridor development.

Decision No 568/QĐ-TTg establishes development objectives where public transport modes (including bus, MRT, BRT, and taxi) will share 20 to 25% of total travel demand by 2020, 35 to 45% of total travel demand by 2030, and 50 to 60% of total demand after 2030. To achieve these objectives, the city government plans to invest in six BRT corridors, with the BRT No. 1 route running along Vo Van Kiet and Mai Chi Tho.

The Green Transport Development Project of Ho Chi Minh City, which was approved by the Prime Minister under Decision No. 2235/QĐ-TTg, dated 19/11/2013, on Approval of the Green Transport Development Project of Ho Chi Minh City, is funded by the World Bank (WB). The World Bank will allocate 142,284 million USD and the Vietnam Government 33,027 million USD from HCMC's state budget. The project includes two components:

> **Component 1** - *Development of the bus rapid transit (BRT) along corridor of Vo Van Kiet – Mai Chi Tho Boulevard* (VVK-MCT is also called the East-West Boulevard) corridor (total length of BRT is about 23.0 km) supporting infrastructure such as bus stations, terminals, Technical Facility Center and a modern management system. This component will also include investment and operation of BRT buses, using compressed natural gas (CNG) as fuel.
>
> **Component 2** - *institutional capacity building.* This component includes technical assistance and capacity building for state managers and staff who operate the public transportation system (including subway, BRT, buses), as well as integrated planning of land use and transport planning.

The main objective of the Project

The BRT pilot investment of the VVK-MCT route is an important step in the direction of prioritizing public transport development, especially bus services in HCMC. The completed VVK-MCT BRT route will help resolve some basic problems of city public transportation, urban development and environment protection.

General objectives

- To improve service efficiency and development of public passenger transportation system for the city:

  -The HCMC-GTP contributes to existing bus services of the city, coordinating with the metro network, to form a mass rapid transit system which plays an important role in creating favorable conditions for economic and social growth of HCMC.

  - The BRT provides a safer, more convenient and more effective public transport system, integrating with land use plans. With the first VVK-MCT route and other routes to follow, the BRT will attract more people to public transportation, and reduce the number of personal vehicles on the roads and associated traffic congestion.

- Contributing to urban development, renovation, environmental protection and quality of life for city's population.

  - The operation of HCMC-GTP contributes on reorganizing the urban face along the line by applying the transport oriented planning solution to achieve the objective of rehabilitation of urban along the BRT.

  - The usage of compressed natural gas (CNG) buses contributes to reducing exhaust emissions from vehicles, especially motorcycles, are the main cause of air and noise pollution in Ho Chi Minh City. Currently, the use of two-wheel vehicles is still popular. The personal vehicles continue to increase, with the increase rate of 6-7%. These traffic related factors generate a large amount of NO2, CO2 and hydrocarbons emissions.

  - The project "HCM City Green Transport Development Project" creates favorable conditions to attract passengers to the BRT Line. Thus the personal transportation will also decrease, suitable for carbon emissions reduction aims in the city by enhancing the methods in public transport services and reduce personal transport as well as develop sustainably in Ho Chi Minh City.

  - The project creates good conditions for the city such as: the building of infrastructure can give an impulse to the country demand; and the development of some related industries; connect functional areas, resident areas and remote areas in the city, improve operating effectiveness of the transport system; impulse the economic development by rapid, convenient transport service; enhance investment environment.

Specific objectives

- When completed, the HCMC-GTP will provide the city with a new form of public passenger transport - the BRT route along Vo Van Kiet – Mai Chi Tho corridor – offering shorter travel times, and a more convenient and safer service. Implementation of the BRT, as well as development works along the route, will also contribute to urban renovation, environmental protection and improved quality of life for residents.

- Implementation of Component 2 shall contribute on fully completing institutional framework, operating and managing model of the city public transport system, training for strengthening capacity of concerned agencies, and implement study to create premise to develop other BRT routes and contribute on development of intelligent, integrated public transport systems for the entire city in the next time.

The scope of this Environmental Impact Assessment (EIA) report includes development of BRT line 1 and supporting technical facilities such as the Technical Facility at Thu Thiem, Rach Chiec Terminal, BRT stations and pedestrian flyovers. The report provides an executive summary of the project information, and then provides an account of environmental impacts, both positive and negative, addressing project development during pre-construction, construction and operational phases of project. Environmental mitigation measures are proposed to protect the environment from potential negative impacts from project development activities.

2. LEGAL BASIS FOR ENVIRONMENTAL IMPACT ASSESSMENT

2.1. Vietnam legal framework

The Vietnam legal framework comprises the following items:

- The Law on Environmental Protection approved by the National Assembly of the Socialist Republic of Vietnam dated 29th November, 2005.
- Law on Water resources approved on June 21st, 2012, by the 13th National Assembly of the Socialist Republic of Vietnam at its 3rd session.
- The Law on Land approved by National Assembly of the Socialist Republic of Vietnam dated 29/11/2013.
- Decree No. 201/2013/NĐ-CP of Government on Specific regulations of Water Resources Law dated 27th November, 2013.
- Decree No.43/2014/NĐ-CP of Government on Specific regulations of Land Law 2013 dated 15th May, 2014.
- Decree No.44/2014/NĐ-CP of Government on Specific regulations of Land price dated 15th May, 2014.
- Decree No.47/2014/NĐ-CP of Government on Specific regulations of compensation, support and resettlement when being government acquired land dated 15th May, 2014.
- Decree No. 21/2008/NĐ-CP, dated 28th February 2008 of the Government amending and supplementing a number of articles of the Government's Decree No. 80/2006/ND-CP dated 9 th August, 2006, detailing and guiding the implementation of a number of articles of the Law on environmental protection.
- Decree No. 29/2011/NĐ-CP of Government on strategic environmental assessment, environmental impact assessment and environmental protection commitment; dated 18th April, 2011.
- Decree No. 59/2007/NĐ-CP of Government, dated this 9th April, 2007, on solid waste management.
- Decree No.38/2013/NĐ-CP, issued 23rd April 2013, of Government on Management and using Fund of Official Development Assistance (ODA) and loan.

- Decree No. 117/2009/NĐ-CP of Government, dated 31st December 2009, on the handling of law violations in the domain of environmental protection.
- Circular No. 36/2014/TT-BTNMT, issued 30th June 2014, of MONRE on the method to determine land price, establish and change land price, and determine land price specifically and consultation on determination of land price.
- Circular No. 37/2014/TT-BTNMT issued 30th June 2014 of MONRE on specific regulations of compensation, support and resettlement following land acquisition by government.
- Circular No. 12/2011/TT-BTNMT, dated April 14th 2011, of the Ministry Of Natural Resources and Environment stipulating hazardous waste management.
- Circular No.26/2011/TT-BTNMT, dated 18th July, 2011, of the Ministry of Natural Resources and Environment, detailing a number of articles of the Government's Decree No. 29/2011/NĐ-CP, issued 18th April, 2011, on strategic environmental assessment, environmental impact assessment and environmental protection commitment.
- Circular 06/2007/TT-BTNMT, dated 15 June 2007, of the Ministry of Natural Resources and Environment guidelines to executing Decree 84 of the Government on supplementary regulations on granting land use certificates, orders and procedures for compensation, assistance and resettlement when the State acquires land, and settling complaints on land.
- Circular No. 09/2010/BGTVT, dated 6th April 2010, of the Ministry of Transport on Regulation environmental protection requirement in transport infrastructure development.
- Circular No. 28/2011/TT-BTNMT, dated 1st August, /2011, of the Ministry of Natural Resources and Environment on regulating monitoring techniques and procedures for ambient air quality and noise.
- Circular No. 29/2011/TT-BTNMT, dated 1st August,2011, of the Ministry of Natural Resources and Environment on regulating monitoring techniques and procedures for inland surface water quality.
- Circular No. 30/2011/TT-BTNMT, dated 1st August, /2011, of the Ministry of Natural Resources and Environment on regulating monitoring techniques and procedures on underground water quality.
- Circular No.33/2011/TT-BTNMT, issued 1st August 2011, of MONRE on Technical regulations for soil quality monitoring.
- Circular No.47/2011/TT-BTNMT, issued 28th December 2011, of MONRE on Technical regulations for industrial wastewater.
- Circular No.32/2013/TT-BTNMT, issued 25th October 2013, of MONRE on Technical regulations for ambient air quality.
- Decision No.12/2008/QĐ-BCT, issued 17th June 2008, of Ministry of Industry and Trade on technical regulation of electrical safety.
- Decision No.68/2008/QĐ-BLĐTBXH, issued 28th December 2008, of Ministry of Labor – Invalids and Social on List of equipment, personal protective equipment for workers, who are working in or related to risk and/or hazardous aspects.

Project investment legal documents:

- Law on Construction no. 16/2003/QH11, dated 26/11/2003.
- Decree No. 12/2009/NĐ-CP, dated on 10/2/2009, of the Government on construction investment management and Decree No. 83/2009/NĐ-CP, dated15/10/2009, of Government on stipulating some of the content of the Decree No. 12/2009/ND-CP, dated on 10/2/2009.
- Decree No. 112/2009/NĐ-CP, dated 14/12/2009, of Government on management of work construction investment expenses.
- Decree No. 15/NĐ-CP, dated 6/2/2013, of Government on quality management of construction works.

Project-related legal documents:

- Document No. 2293/UBND-DTMT, dated 20/May/2011, issued by the HCMC People's Committee on assigning project management tasks related to BRT construction of VVK-MCT Boulevard to UCCI.
- Memorandum, dated 1-3/Oct/2012, of the World Bank (WB) Missions and the HCMC People's Committee on preparing Green Transport Development Project of Ho Chi Minh City.
- Decision No. 2885/QD-BQLGTDT-KTCL. dated 29/Nov/2012. of UCCI on approval of the procurement plan of the project HCMC-GTP, Pre-FS phase.
- Decision No. 1088/QĐ-BKHĐT, dated 14/08/2013, of Ministry of Investment and Planning on approval of TA sub-project documents for Green Transport Development Project of Ho Chi Minh City from PPTAF of the World Bank (WB).
- Decision No. 2235/QĐ-TTg, dated 19/11/2013, by Prime Minister on Approval of Green Transport Development Project of Ho Chi Minh City funded by the World Bank (WB).
- Document No. 5084/UBND-QLDA, dated 24/09/2013, of HCMC PC on Loan agreement for TA sub-project for Green Transport Development Project of Ho Chi Minh City from PPTAF of the World Bank (WB).
- Decision No. 6295/QĐ-UBND, dated 29/11/2013, of HCMC PC on approval of TA sub-project for Green Transport Development Project of Ho Chi Minh City from PPTAF of the World Bank (WB).
- Decision No. 568/QĐ-TTg, dated 08/04/2013, of Prime Minister Approving the Adjustment of Transportation Development Planning of Ho Chi Minh by 2020 with a vision after 2030.

2.2. The Vietnamese environmental standards and regulations

Indicator	Technical standards
Ambient air quality	- QCVN 05:2013/BTNMT - National technical regulation for ambient air quality. - TCVN 5970:1995 - Planning of ambient air quality monitoring program.
Noise and vibration	- QCVN 26:2010/BTNMT - National technical regulation on noise. - QCVN 27:2010/BTNMT- National technical regulation on vibration.

Water quality	- QCVN 08:2008/BTNMT – National technical regulation on surface water quality. - QCVN 09:2008/BTNMT – National technical regulation on underground water quality. - QCVN 14:2008/BTNMT – National technical regulation on domestic wastewater quality. - QCVN 40:2011/BTNMT - National technical regulation on industrial wastewater quality.
Solid waste	- TCVN 6696:2000 Solid Waste - Sanitary Landfill. General requirements for environmental protection. - QCVN 07:2009/BTNMT – National technical regulation on threshold levels for hazardous waste.

2.3. Safety, Environmental and Social policies of The World bank

The World Bank's Safeguard policies triggered include:

- Environmental Assessment (OP/BP 4.01).
- Involuntary resettlement (OP/BP 4.12).
- The World Bank Group Guidelines on Environment, Safety and Health (EHS) of WB.

During the project's concept stage, the WB had not decided as to whether project activities might negatively impact on cultural, historical and religious heritage, thus it was proposed that the Bank's policy on Physical Cultural Resources (OP/BP 4.11) be assessed during project preparation. During EIA report preparation, it became evident that project activities would not negatively impact archeological, paleontological, historical, architectural, religious, aesthetic or other cultural types, and the policy was therefore not triggered.

Environmental and social screening results during the project's concept stage showed that it would be categorized as 'B' for environment, in line with the WB's environmental safeguard policy. The identification and analysis the project's potential environmental and social impacts during EIA preparation confirmed this categorization.

3. ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGIES AND APPROACHES

3.1. Social surveys, interviews and statistical methods

- Collecting information on social and economic statistical data including population, household, poverty rate, ethnic groups, living standards in the 7 districts and 21 wards/communes in the project areas.
- Interviewing local people, households, and bus passengers in the project areas using questionnaires.
- Collecting information on relevant development plans and other projects in the project areas.
- Conducting sample monitoring on ambient environmental quality in proposed project areas.

3.2. Baseline Ambient Environmental Quality Monitoring

- *Surface and underground water quality*: Samples were taken and analysed, complying with the Vietnam standards, and results compared with National Technical Regulation on Surface Water Quality - QCVN 08/2008/BTNMT and National Technical Regulation on Underground Water Quality - 09/2008/BTNMT.
- *Ambient air quality*: Samples were taken and analysed, complying with the Vietnam standards, and results compared to QCVN 05:2013/BTNMT– National Technical Regulation on ambient air quality.
- *Noise and vibration*: Samples were taken and analysed, complying with the Vietnam standards, and the results compared to QCVN 26:2010/BTNMT- National technical regulation on noise and QCVN 27:2010/BTNMT- National technical regulation on vibration.

3.3. Conduct of site surveys

- Investigation of natural environment, hydrography, weather conditions, and fauna and flora in project areas.
- Completion of the rapid environmental impact screening form.
- Survey of land use, ecological systems, and vegetation cover in project areas.

3.4. Environmental assessment and analyses

a. *Comparison method*

Measurements and analyses were conducted against environmental standards to assess the status and trends of changes in environmental quality in project areas.

b. *Geographic Information Systems (GIS)*

The method is useful for studying encroachment of the project, land use, landscapes, and protected areas. It helps to examine dynamic aspects of landscapes.

c. *Cumulative impact assessment*

This method is considered as very useful for assessing long-term and multiple impacts.

d. Modeling

Mathematical procedures are applied to estimate ambient air, ground and surface water quality entities (i.e., concentrations, deposition, exceedance). In general terms, a distinction between process-oriented models and statistical models can be made. Process oriented models are based on the description of physical/chemical processes - starting with emissions, atmospheric advection and dispersion, chemical transformation and deposition are calculated. In this report, the MUAIR model was applied to estimate distributions of PM_{10}, SO_2, CO, and NO_2.

e. Expert interview

Expert interview was used to systematically identify negative and positive impacts of the project to the environment through sending questionnaires to environmental experts, and also seeking their feedback and contributions to the report.

3.5. Monitoring equipment

– Air quality measurement equipment includes:

- POCKET WEATHER TRACKER 4500, produced by Kestrel firm (America), to measure temperature, humidity, pressure, wind velocity and direction.
- MULTI-GAS MONITOR IBRID MX6, made in Japan, to measure hazardous substances including CO, NO2, and SO2.
- EPAM 5000 (America) to measure concentrations of dust, TSP and PM10.

– Noise and vibration measurement equipment includes:

- INTEGRATING SOUND LEVEL METER TYPE 6226, produced by ACO Co. Ltd (Japan), to measure noise parameter (Leq).
- VIBRATION LEVEL METER VM-1220E, produced by IMV Corporation (Japan) to measure vibration parameter (acceleration).

– Surface water and underground water quality monitoring procedures include:

- Surface water sampling by America equipment. Sample reservation according to TCVN 6663–14:2000, ISO 5667–14:1998.
- Other indicators: temperature, pH, turbidity, DO will be measured onsite using WATER QUALITY CHECKER MODEL WQC-22A, produced by DKK-TOA CORPORATION (Japan).

- GPS equipment
- Computers, photographic and other protective equipment.

4. ORGANIZATION OF ENVIRONMENTAL IMPACT ASSESSMENT

Project approval: Ho Chi Minh City People's Committee

- Adress: 86 Le Thanh Ton, Ben Nghe ward, District 1, Ho Chi Minh City
- Telephone: (08)38296052, (08)38295026.
- Fax: (08)38295675
- Representative: Nguyen Huu Tin Position: Vice Chairman

Project Owner: Urban-Civil Works Construction Investment Management Authority of Ho Chi Minh City (UCCI)

- Adress: 03, Nguyen Thi Dieu St., Ward 6, Dist.3, HCMC
- Telephone: (+84) 839300530 Fax: (+84) 839306638
- Representative: Nguyen Minh Phuc Position: General Director

The consultant: Association between Center for Assisting Community Sustainable Development (CSD) and Transport Engineering Design Inc (TEDI)

- Adress: No. 5, Nguyen Viet Xuan , Thanh Xuan District, Ha Noi.
- Telephone : 04- 38523090 Fax : 04- 35655800
- Representative: Ho Ngoc Hai Position: Director

List of EIA team members of Ho Chi Minh City Green Transport Development Project

No	Name	Company/ Organization	Expertise
1	Mr. Luong Minh Phuc	UCCI	General Director of UCCI
2	Mr. Tran Quan	UCCI	Deputy Director of Project Management, Ho Chi Minh City Green Transport Development Project
3	Dr. Ho Ngoc Hai	CSD	General Director of CSD, Doctor of Psychology
4	Mrs. Trinh Thi Bich Thuy	CSD	Master of Environmental Science Team leader
5	Mr. Nguyen Thanh Chinh	TEDI	Master of Environmental Science
6	Dr. Ho Ly Giang	CSD	Doctor of Anthropology
7	Ms. Tran Thi Thanh Binh	CSD	Bachelor of Journalism
8	Mr. Hoang Bao Phu	CSD	Master of Environmental Science
9	Mrs. Lam Vu Thanh Noi	CSD	Master of Environmental Science
10	Mr. Nguyen Huy Tien	CSD	Master of Environmental Chemistry
11	Mr. Pham The Giang	TEDI	Hydrology Engineering
12	Ms. Ho Thu Thuy	TEDI	Bachelor of Environmental Science
13	Mr. Bui Nguyen Pho	TEDI	Environmental Science
14	Mrs. Nguyen Hong Van	TEDI	Bachelor of Economic
15	Mr. Nguyen Dinh	TEDI	Master of Environmental Science
16	Mr. Pham Thanh Hao	TEDI	Bachelor of Environmental Economic
17	Mr. Pham Manh Tien	TEDI	Environmental Engineering

CHAPTER I: PROJECT DESCRIPTION

1.1. PROJECT NAME

Name: Ho Chi Minh City Green Transport Development Project

Approval project Authority: Ho Chi Minh City Peoples Committee

- Address: 86 Le Thanh Ton, Ben Nghe Ward, District 1, Ho Chi Minh City
- Phone number: (08)38296052, (08)38295026
- Fax: (08)38295675
- Representative: Nguyen Huu Tin. Position: Vice president of Ho Chi Minh City PC

Project Owner: Urban Civil Works Construction Investment Management Authority – City Urban - Ho Chi Minh City Peoples Committee

- Adress: No.3 Nguyen Thi Dieu, Ward 6, District 3, Ho Chi Minh City
- Phone number: (+84) 839300530 Fax:
- Representative: Mr. Luong Minh Phuc Position: Head Department

1.2. PROJECT LOCATION

The BRT 1 project is a pilot project of the BRT in HCMC that was designed with a length of 23.0 km along the Vo Van Kiet and Mai Chi Tho Boulevard. In the first period of the project, when the Mien Tay Bus Terminal was still not constructed and functioning, the route of BRT line No. 1 included: Cat Lai Junction – Mai Chi Tho Boulevard – Vo Van Kiet Boulevard – An Lac turnaround. Route details are as follows:

- Main route along the Vo Van Kiet and Mai Chi Tho Boulevard
  - Turning point: intersection of An Lac turnaround (Binh Tan District)
  - Ending point: intersection of Cat Lai Junction (District 2)
  - Length of route: 23.0 km
  - Scope of study: 100 m width along the BRT corridor
- 28 stations along route (including An Lac U-turn and integrated with MRT 1 at Rach Chiec Station) will be located along the central separator of the Vo Van Kiet-Mai Chi Tho route.
- Technical Facility at Thu Thiem railway station.
- Rach Chiec Terminal Station at Rach Chiec Sports Complex.
- The An Lac turning point will be one of two ending points of BRT line 1 in the first period of the project. This is only for turning and is not a bus terminal or technical facilities (Figure 1.4).
- Besides enhancing the effectiveness and connectivity of BRT route No. 1 and public transport in general, the BRT 1 will be designed to connect to the Ben Thanh area and other BRT routes in the future. However, these activities are not included in the current EIA report.

Furthermore, the proposal of another ending point is located at the new Mien Tay bus station. However, given the Mien Tay bus station has not been constructed, the An Lac turnaround will be chosen as the U-turn point (10°43' North, 106°36' East). After completion of the Mien Tay bus station, the start terminal will be constructed. However, this report will not consider the location of new Mien Tay bus station; it only considers the identified existing routes, which are from An Lac turnaround to Rach Chiec junction. With the length and layout as mentioned, the project BRT line No. 1 will pass through 20 communes of 7 districts including:

- District1 - Communes of Cau Kho, Cau Ong Lanh, Co Giang and Nguyen Thai Binh. District 2 - Communes of An Loi Dong, An Phu, Binh Khanh and Thu Thiem.
- District 5 - Communes of 1, 5, 6, 10 và 13.
- District 6 - Communes of 1, 3, 7 và 10.
- District 8 - Commune of 16.
- Binh Tan District - Commune of An Lạc.
- Binh Chanh District - Commune of Tan Kien.

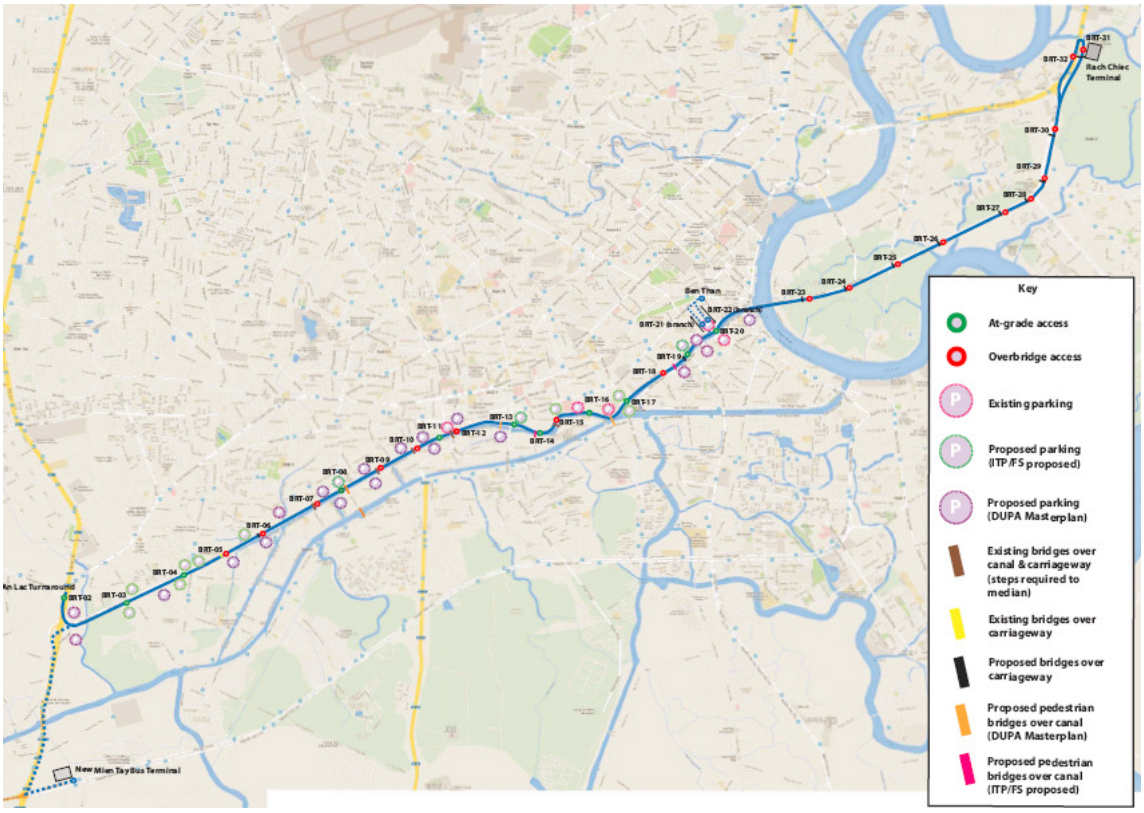


Figure 1. 1 BRT 1 line and station locations along the corridor

1.3. MAIN PROJECT COMPONENTS

The BRT line No. 1 project includes two main components. Component 1 involves construction of the Bus Rapid Transit (BRT) along Vo Van Kiet and Mai Chi Tho Boulevard comprising a length of 23.0 km and supporting infrastructures. Component 2 includes technical assistance and capacity building for state managers and staff who operate public transportation systems. The main infrastructure of the project will be constructed in component 1.

1.3.1. Component 1: Development of the Bus Rapid Transit (BRT) along the corridor of Vo Van Kiet – Mai Chi Tho Boulevard

Component 1 involves construction of Bus Rapid Transit (BRT) line along Vo Van Kiet – Mai Chi Tho Boulevard (VVK-MCT, also called the East-West Boulevard), for a length of about 23.0 km, from An Lac U-turn to Vo Van Kiet- Mai Chi Tho Boulevard and ending at Rach Chiec Terminal at Cat Lai T-junction. Additionally, component 1 includes supporting infrastructure such as 28 bus stations, the Terminal at Rach Chiec junction, and a modern management system. This component also includes investment and operation of BRT, which was proposed to initially use compressed natural gas (CNG), and installation of intelligent transport systems (ITS). The main items are presented in Table 1:

Table 1. 1 Main items of BRT 1 project

No	Items	quantity	Scope	Note
1	**Rach Chiec Terminal - terminus**	1	**5600 m^2**	
	Green space (trees)	1	990 m^2	
	Internal roads & car park	1	4300 m^2	capacity: 15 buses
	Terminal	1	310 m^2-3 floors	Terminal (310 m^2), second floor (310 m^2), & ground floor (1100 m^2)
2	**Thu Thiem Technical Facility**		**10,000 m^2**	
	Maintenance station , car washing , refueling	1	1760 m^2	
	Office, operator house, warehouse, technical area and environmental facility areas.	1	1800 m^2	5 floors
	Car parking, transportation operation	1	3360 m^2	
	Green space		1830 m^2	
	Transportation area	1	1250 m^2	
	Connecting route between MCT and the depot	1	7700 m^2	
3	**Bus station**	28	**153 m^2/ station**	Not including bus stop areas at stations
4	**BRT corridor**	1	**23.0 km**	
6	**Bus**	30 - 50	**12 m/bus**	Before 2025 there will be 26 buses (with an

No	Items	quantity	Scope	Note
				additional 4 buses reserved). Number of buses will increase to 50 by 2030. Bus fuel is CNG
7	Pedestrian flyovers	17	-	5 existing pedestrian flyovers and Cha Va bridge will be improved on Vo Van Kiet. 2 new pedestrian flyovers and 1 bridge will be constructed on Vo Van Kiet. 8 steel pedestrian flyovers will be newly constructed on Mai Chi Tho.
8	Parking areas	9	**7879 m^2**	Free land near bus stations will be used.
9	Intelligent Transport Systems **(ITS)**	1	-	This is a section in the Thu Thiem Depot.

1.3.1.1 Rach Chiec Terminal

This station will be one of the largest infrastructure developments of this project, allowing buses to return as well as pick up passengers. In addition, the BRT terminal acts as a hub linking bus routes going into the center of Ho Chi Minh City and Suoi Tien, Bien Hoa, as well as connecting to BRT 1.

As per the functions described above, the design of BRT Rach Chiec is described below.

- ***Location and area:*** the total area of Rach Chiec Terminal is about 5800 m^2 0.58 ha in with 0.56 ha 5600 m2 of land will be constructed infrastructures and located at the Rach Chiec Sports Complex.
- The Rach Chiec Sports Complex is located at 10°81'16" N, 106°75'76" E, adjacent to the Rach Chiec canal to the north, Hanoi Expressway and Nguyen Thi Dinh Street to the west, and vacant agricultural land and low density population areas to the southeast.

(a) The operational station covers an area of 310 m^2, comprising three floors, a main staircase, and emergency staircase exit.

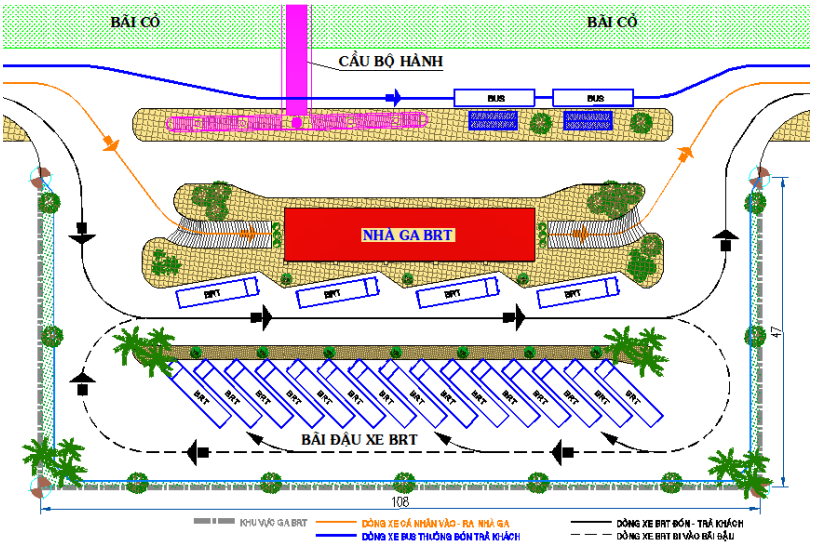
- The ground floor of the station is used for passengers transiting between BRT No. 1 and normal buses. There is a lounge area, a prepaid area with capacity of 4 BRT buses (12 m - 18 m), and an area free of charge for normal buses offering a capacity of 2 buses (12 m). The background for BRT access with height of 61cm, and the background for normal bus access with height of 25cm. Inside the station will be waiting area for passengers, as well as information and other services.

- The first floor connects via a pedestrian bridge to Metro No. 1 serving transit passengers between different transport modes. the working area of the terminal
- Car parking and depot areas with ventilation systems will be located in the basement (area of 1100 m^2). Ventilation systems will help remove CO gas emitted from motorcycles. There are also water storage tanks for firefighting and water supply, and the technical facility located at ground level.

(b) Parking sufficient for 20 BRT buses

(c) Tree and internal transportation areas in the terminal.

Typical layout of Rach Chiec terminal is presented in Table 1.1 and Figure 1.2:



(a) Typical layout of Rach Chiec terminal

(b) Rach Chiec terminal

(c) Location at Cat Lai T-junction

Figure 1. 2 (a) Layout and (b) concept design of Rach Chiec terminal and location at Cat Lai T-junction

1.3.1.2. Thu Thiem Technical Facility

The Technical Facility area provides vehicle parking, daily vehicle examination, maintenance, brake testing, CNG refueling, washing facilities, and a small repair shop, rescue

and technical support. The Thu Thiem Technical Facility for BRT 1 is designed as described below.

- ***Location & total area***

- The total area of the technical facility is 17,700 m^2, of which the technical facility area is 10,000 m^2. In addition, an access road will also built which comprises an area of about 7,700 m^2.
- The technical facility is located in the planned area of Thu Thiem railway station, District 2. However, the area is still vacant land. The technical facility is located at 10°78'89 N, 106°74'52 E.
- The project site is near the intersection of Dong Van Cong and Mai Chi Tho Streets to the northwest, Binh Khanh residential area to the north, a distance of 120 m from Mai Chi Tho Street to the south (the distance from MCT to the technical facility), and vacant areas lie to the west (towards Ca Tre canal) and east (towards to ACG international School).

- ***Functional areas***

- The *operating office building* was designed with five floors with a total area of 1,345 m^2, situated to the northern part of the Thu Thiem Technical Facility. Its two top floors house the operation control center for BRT No. 1 with its ITS control system. Offices are located on other floors.
- *Warehouse and technical facility area*s. The warehouse is located next to maintenance areas for storing maintenance equipment, engines, electrical equipment, compressors etc., as well as functioning as office space for employees working there. Technical facility area functions include wastewater treatment, electrical support, water supply and hygiene. The office building, warehouse and technical facility areas of Thu Thiem Technical Facility extend over an area of 1,800 m^2.
- *Internal transportation areas and car parking* share 60% of the total area of the Technical Facility (3400 m^2). The floor surface is concreted and drainage connected to the storm water drainage system. Power lines, water and sanitation, and communication infrastructure will be installed in the lower zone traffic and parking spaces, ensure adequate slots for the construction of tanks or settling tanks and sludge tanks and other necessary protection items.
- *Vechicle washing area*. There is one car washing lane outside, one lane inside and one fixed bridge to support washing activities, such as washing the body of buses, mirrors, and tires. This area covers 300 m^2 and is built with a steel frame.
- *Maintenance area*. There are five maintenance parks and drains for wastewater collection, oil; one area for painting, and one area for repair of buses. An adjacent area of the building stores equipment, paint, engine parts, electronic components, and includes a compressor room, welding room, service areas and administration office. This area covers 940 m^2 and is built with a steel frame.
- *CNG refueling areas* are designed to supply CNG for four buses at any given time. There is a control room monitoring CNG tanks, as well as equipment and structures needed to control leakage, gas storage and the CNG pump system. The CNG fueling station was

designed by the agency and follow fire safety standards of Vietnam and New Zealand. This area covers 520 m^2 and is built by steel frame.

- *Route accessing Thu Thiem Technical Facility.* The location of Thu Thiem Technical Facility will be constructed in an area currently without road access, and the project will proceed to construct an access road with a length of 120 m. The road will be designed as a common road with asphalt layer, similar to bus stations with the standard A1, and a design speed of 40 km/h for BRT buses; the technical facility does not require high speed access for BRT buses.

Typical layout of Thu Thiem Technical Facility is presented in Table 1.1 and Figure 1.3.

Layout of office, warehouse and technical facility areas

Figure 1. 3 Typical layout of Thu Thiem Technical Facility

1.3.1.3. An Lạc Turn-around

In the first phase, BRT No. 1 will end at An Lac instead of the new Western (Mien Tay) bus terminal, the new station is identified in the process of location determination. . This facility (at An Lac roundabout) will not be a terminal and buses will not lay over here. The An Lac Turnaround will be located within the existing median. Figure 1.4 shows the indicative arrangements of the vehicle turnaround:

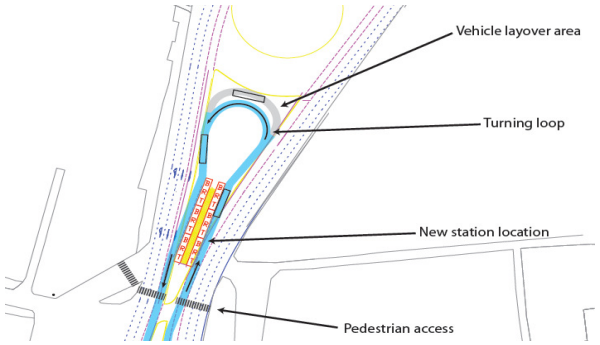
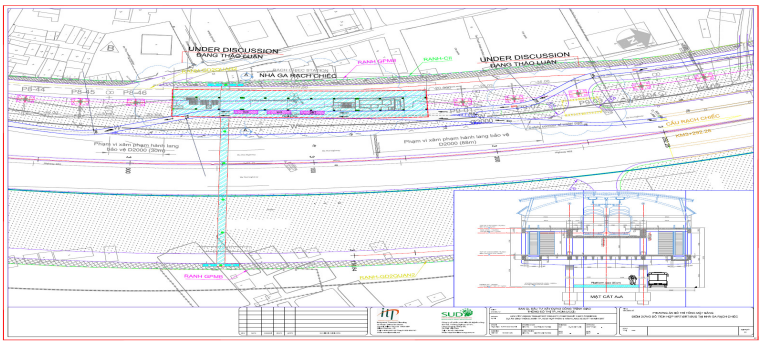


Figure 1. 4 An Lac turnaround arrangements

1.3.1.4. Rach Chiec MRT Terminal:

Rach Chiec Terminal will be located at the positive site of designed MRT terminal (opposite Rach Chiec station), which will permit drop off of passengers at the proposed station plaza south of Hanoi Highway and pick up of passengers at the MRT Rach Chiec Station, north of Hanoi Highway. As designed, the BRT station is able to be located under the MRT station with access between two stations via escalators and lifts. Figure 1.5 shows layout of the BRT and MRT routes and stations.

(a) MRT station arrangements



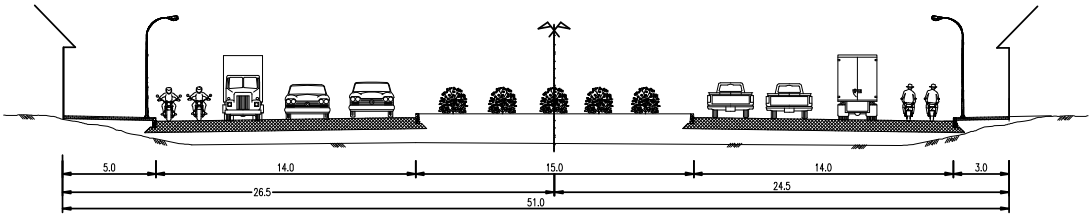
(b) MRT – BRT inter-relationship indicative arrangement

Figure 1. 5 (a) Location and (b) MRT – BRT inter-relationship indicative arrangement

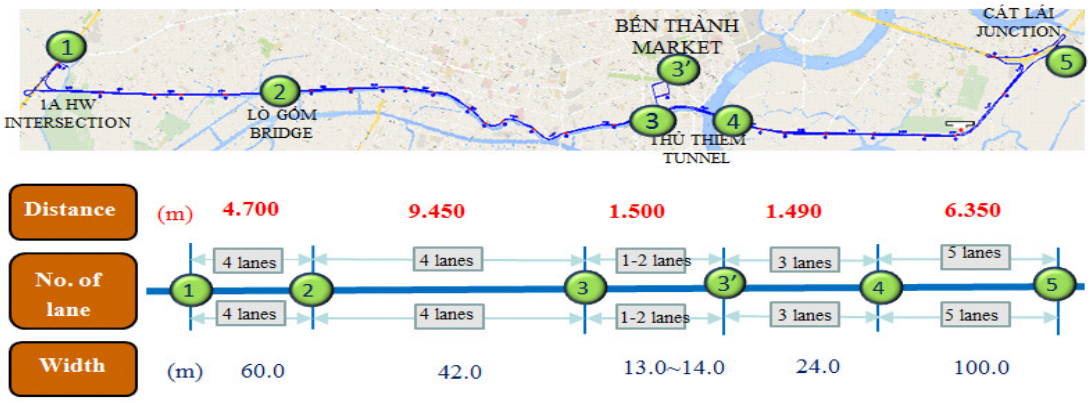
1.3.1.5. BRT lanes

The BRT No.1 lanes can be located either in the two middle lanes or in two lanes at the same side of the road or in two lanes at two sides of the East-West Boulevard. The BRT lanes should be located where they offer the least conflict with other traffic users, especially taking into consideration the direction changes of vehicles. In most cases, BRT lanes located in the central road separator will create fewer conflicts with other vehicles compared to road side lanes, e.g., as vehicles can turn into other roads or parking lanes. Furthermore, delivery vehicles, taxis, motorcycles often require access to the kerbside, and as such a centrally located BRT lane should not interfere with them. However, the BRT 1 section running through Thu Thiem Tunnel will not be separated from other types of vehicle, and stages connected to Ben Thanh will use the current road system. The typical layout of the BRT lane is based on specific characteristics of each segment on the East-West Boulevard.

The corridor of BRT line No. 1 can be described in two parts. The first part is from An Lac turnaround to the intersection of National Highway 1A and Vo Van Kiet Boulevard. The second part is along the East-West Boulevard, which can be divided to four segments: segment 1 from National Highway 1A intersection to Lo Gom bridge; segment 2 from Lo Gom bridge to Thu Thiem tunnel; segment 3 through Thu Thiem tunnel; and segment 4 from Saigon River Tunnel to Catlai Junction. Figure 1.6 presents the main segments of the East-West Boulevard.



(a) Current arrangement of road from An Lac turnaround to intersection of National highway 1A and Vo Van Kiet boulevard

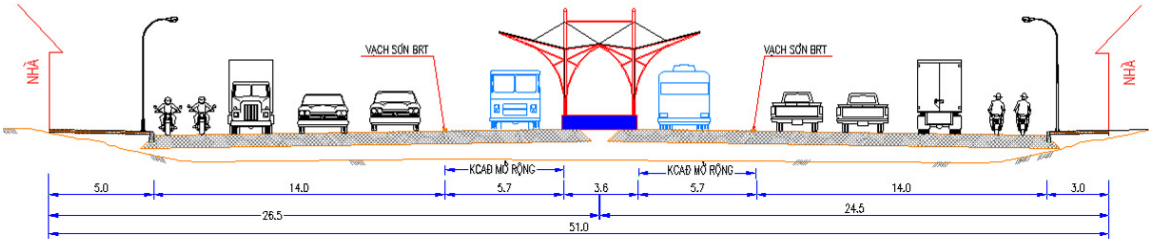


(b) Current width and arrangement of Vo Van Kiet and Mai Chi Tho Boulevard

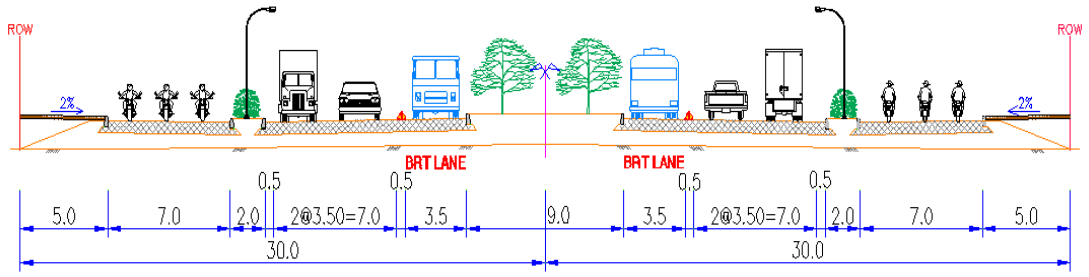
Figure 1. 6 Current width of road of development of BRT

The distance from An Lac turnaround to the intersection of National highway 1A and Vo Van Kiet Boulevard is 800 m, with variable width to a maximum of 100 m. The BRT lanes will be 15 m wide along the middle of the road, which includes 3.5 m for separator and bus station, and 11.5 m width for the two BRT lanes (as in Figure 1.7a).

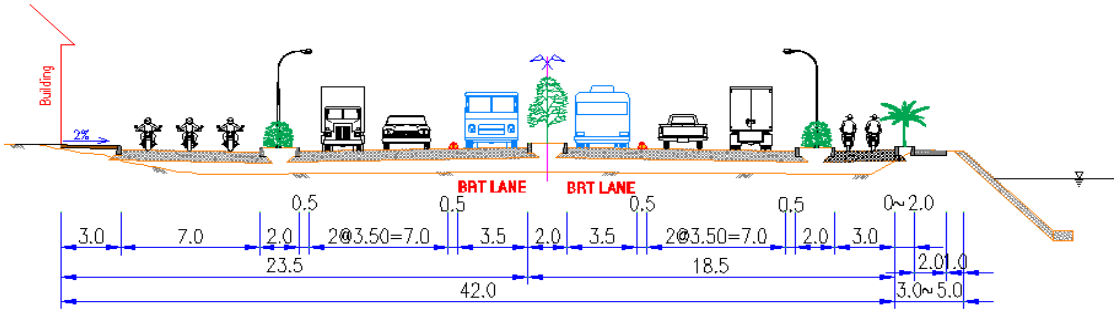
The route along Highway 1A intersection to Lo Gom Bridge has four lanes in each direction, of which there are three lanes for cars, and the central lane used for BRT vehicles; a median width of 9 m ensures sufficient space for station construction. The second segment from Lo Gom Bridge to Thu Thiem tunnel has four lanes, but given the existing median width of 2 m is insufficient for a bus station, the median will be expanded to 3.5 m.



(a) Typical layout for BRT line 1 from An Lac turnaround to intersection of National highway 1A and Vo Van Kiet boulevard



(b) Typical layout plan for BRT 1 of Segment 1



(c) Typical layout plan for BRT station of Segment 2

Figure 1. 7 Typical layout plan for BRT station of (a) segment from An Lac turnaround to intersection of National highway 1A and Vo Van Kiet boulevard (b) Segment 1 and (c) Segment 2

Segment 3- Saigon River Tunnel (Thu Thiem Tunnel). The width of segment 3 is 11.5 m, which is the maximum width of Thu Thiem Tunnel. Two BRT lanes are located along the median and mix with other traffic lanes. The typical layout of segment 3 is presented in Figure 1.8.

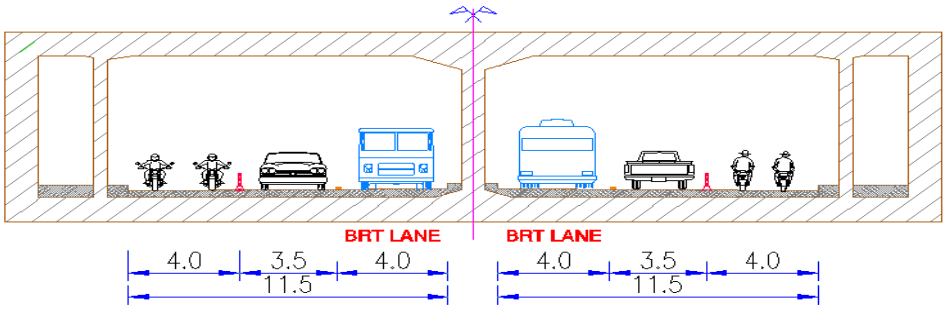


Figure 1. 8 BRT traffic organization inside Saigon River Tunnel

Segment 4 runs from the Saigon River Tunnel to Cat Lai Junction (Mai Chi Tho Boulevard), MCT was designed with 20 if width, 4 car lanes in each direction, 2 BRT lanes are also aligned closing to the median separator. The median separator (20 m wide) will be improved to construct BRT station (Figure 1.9).

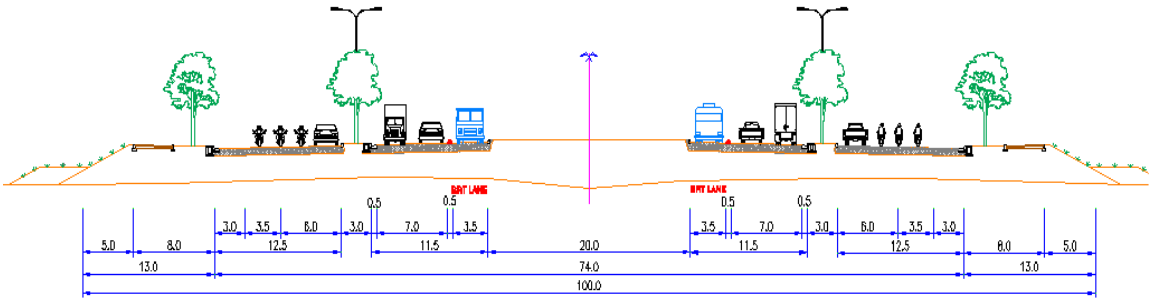


Figure 1. 9 Layout and BRT lane of segment 4: Thu Thiem Tunnel – Cat Lai Junction

Pavement of road.

Given BRT buses often run at high speed along fixed lanes, the pavement layer should be guaranteed against incidents such as plastic extrusion and rutting, and using conventional asphalt concrete, especially at stations. The project will only improve surface road structure at BRT stations and junctions, where vehicle idling agitates road surfaces; the top 5 cm of the road surface will be replaced. Surface replacement will commence at some locations prior to 2025 and be completed between 2015 to 2040; the surface material to be replaced is asphalt polymer. Renovation will take place before and after siting of bus station 30 m; and before intersection 50 m that ensure BRT bus could be stopped on place.

Figure 1. 10 Current road surface structure of East-West Boulevard

Segregation barrier

Excluding the Thu Thiem Tunnel segment, the BRT will be operated separately from other vehicle lanes, and segregated using either median separators or a separation barrier. This design ensures that buses can move across lanes to give priority to vehicles such as ambulances, fire, and police in an emergency. Separators are made of reinforced concrete, and beveled on two sides to ensure vehicles can cross when necessary. Prefabricated separators are 1 m and each module installed on the road, the tissue module 0,2 m apart to ensure horizontal drainage pavement as in Figure 1.11.

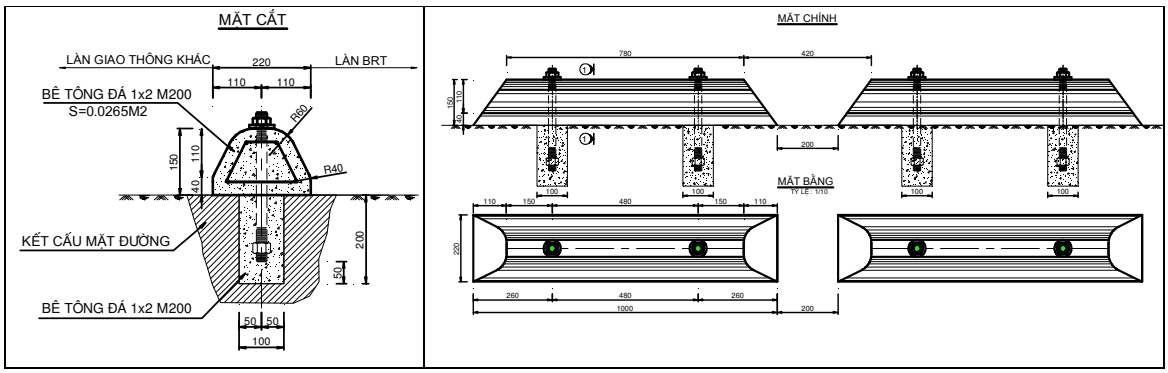


Figure 1. 11 Layout of segregation barrier and other lanes

Group of pavement and segregation

Those items are designed of East-West Boulevard and Based on the detailed shape of the sidewalk HCMC Department of Transport issued with 1762/QD-SGTVT decision of June 18, 2009, promulgating the Regulation on the implementation of the construction, renovation, upgrading and refurbishment, pavement management and increased green space, street trees in the city of Ho Chi Minh.

Pavement structure

For the pavement structure in the shelter on separate blocks, approaches to shelters follows shaped pavement structure of the Department of Transportation. Pavement height is reduced to allow easy access by pedestrians.

1.3.1.6. BRT bus stations

BRT stations will have a uniform, friendly environment, with a wall decorated with greenery, include a solar energy collection system, a steel design, and constructed on median separators along Vo Van Kiet - Mai Chi Tho Boulevard.

The project has 28 stations, located as shown in Table 1.2.

Table 1. 2 List of BRT station and terminals of BRT 1

No	Station	Location
1	BRT 01	KM 0+00
2	BRT 02	KM 1+655
3	BRT 03	KM 2+760
4	BRT 04	KM 3+240
5	BRT 05	KM 4+080
6	BRT 06	KM 5+200
7	BRT 07	KM 5+780
8	BRT 08	KM 6+560
9	BRT 09	KM 7+160
10	BRT 10	KM 7+600
11	BRT 11	KM 7+940
12	BRT 12	KM 8+900
13	BRT 13	KM 9+360
14	BRT 14	KM 9+800
15	BRT 15	KM 10+400
16	BRT 16	KM 11+140
17	BRT 17	KM 12+100
18	BRT 18	KM 12+560
19	BRT 19	KM 13+070
20	BRT 20	KM 15+100
21	BRT 21	KM 15+780
22	BRT 22	KM 16+360
23	BRT 23	KM 17+420
24	BRT 24	KM 18+700
25	BRT 25	KM 19+960
26	BRT 26	KM 20+580
27	BRT 27	KM 21+500
28	BRT 28	Front of Caltavil building

Station design

Bus stops include: (a) an access area connecting to crossings or pedestrian overpasses determined by the characteristics of each stop; (b) payment area with ticketing staff, a queuing area, and revolving door; (c) a waiting area (control area) sufficient to serve

passengers from two buses (maximum), and provide trip information and seats for the elderly and disabled; and (d) expand the area is arranged to expand the platform to offer more interior space and other space for a car park or service using 18 m articulated vehicles.

Station capacity

The internal space of each station is enough to serve passenger demand during peak hours. The highest demand will be expected at BRT station No. 19 located in district 1 with 867 passengers/hour.

Station accessibility

Stations are located far from the intersection around 50 m (including deceleration and turn lanes passage) to ensure that the lengths of the car lanes are enough for BRT transfer station.

Given bus stations will be located along the median separator, the project will ensure accessibility to BRT passengers through construction of new pedestrian flyovers, improvement of existing pedestrian flyovers, and use of traffic lights at intersections. Pedestrian flyovers will be constructed from concrete, with a width of 3.6 m along Vo Van Kiet Boulevard and 3.0 m along Mai Chi Tho Boulevard.

Specific layout in Table 1.3 below:

Table 1. 3 Arrangement of pedestrian flyovers for BRT station accessibility in BRT 1

Items	Location –BRT station	Total	Note
New pedestrian flyovers	BRT 05, 15, 20, 21, 22, 23, 24, 25, 26, and 28	10	
Location of canal pedestrian flyovers	BRT 17	01	Including elevator designed for the disabled.
Improvement of existing pedestrian flyovers	BRT 04, 06, 08. 09, 11, and 14	06	BRT 08 & 14 including elevator designed for the disabled.
Car parking for passengers	BRT 02 (2 locations), 03 (2 locations), 07, 12, 14, 16, and 18	09	Total area of 7,879 m^2

Car parking for BRT passengers

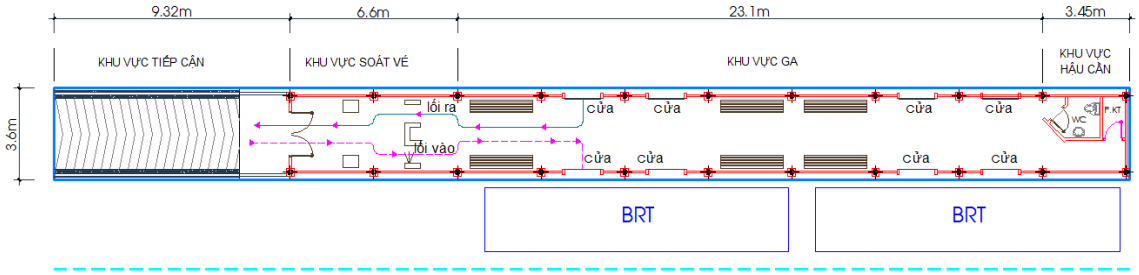
For convenience and increasing use of BRT, several stations will have car parking (bicycles and motorcycles) for passengers. Parking will be located on vacant land near BRT stations. The BRT 1 route will have nine parking areas, mostly located at Vo Van Kiet Boulevard, with a total area about 7879 m^2, with an area of 250 to 1250 m^2 for each car park depending on each specific site. Car parks are designed in modules, where the capacity of a standard car park is 80 cars/300 m^2. According to this standard, a total area of 7,879 m^2 can accommodate up to 2000 cars at any given time. Details of car parks are shown in Table 1.4 below:

Table 1. 1 – Detail location and design of car parking areas

No	BRT	Route	Car parking	Capacity	Note

	station		area	(car)	
1	BRT 02	KM 1+655	1250 m^2	320	Ho Ngoc Lam – Vo Van Kiet
		KM 1+655	1250 m^2	320	Green area
2	BRT 03	KM 2+760	1250 m^2	320	An Duong Vuong – Vo Van Kiet
		KM 2+760	1250 m^2	320	Green area
4	BRT 07	KM 5+780	375 m^2	80	Binh Tien – Vo Van Kiet
5	BRT 12	KM 8+900	1200 m^2	320	Pavement of Nguyen Tri Phuong Street, District 5
6	BRT 14	KM 9+800	314 m^2	80	Near Hoa Binh market
7	BRT 16	KM 11+140	690 m^2	160	Under Nguyen Van Cu Bridge Nguyen Van Cu Bridge
8	BRT 18	KM 12+560	300 m^2	80	De Tham – Vo Van Kiet Street
	Total		**7879 m^2**	**2000**	

Design of stations is presented in Figure 1.12.



(a) Typical layout of BRT station

(b) BRT stations in Vo Van Kiet – Mai Chi Tho Boulevard

Figure 1. 12 (a) Layout of station và (b) Perspective view of bus station along BRT1 route

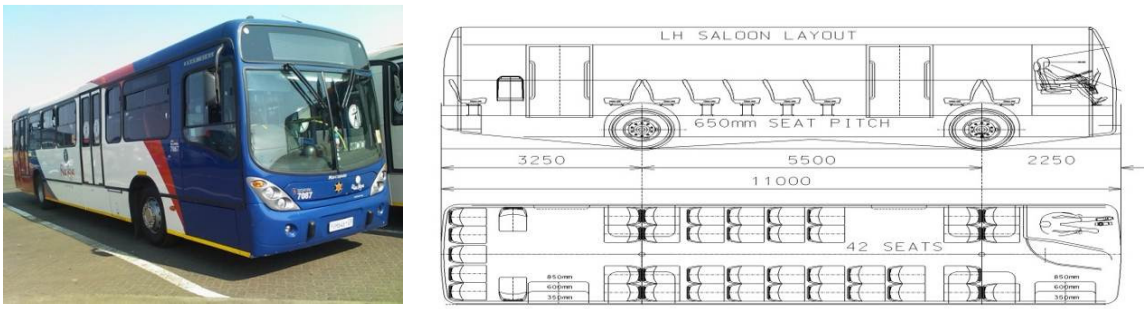
1.3.1.7. CNG Buses for BRT 1

One of the objectives of the HCMC Green Transport Project project is to use alternative fuel with lower emission of greenhouse gases (GHGs), high capacity for passenger carrying buses, and convenient and modern to encourage people to use public transport, instead of personal vehicles. Use of CNG will contribute to reducing GHG emissions. Based on travel demand estimated for BRT lane No.1, CNG vehicles (B80) with 80 to 85 seats are proposed. CNG fuel is proposed as an alternative fuel to conventional fossil fuels (gasoline and diesel). The safety gas tank of B80 vehicles will contain CNG fuel. A CNG supply station will be provided at the Thu Thiem Technical Facility (refer to Item 1.3.1.2)

BRT vehicles will operate in accordance with legal provisions on transport safety and environmental protection, as regulated by the Ministry of Transportation in QCVN 09:2011/BGTVT (technical quality, safety and environmental protection for cars), QCVN 10:2011/BGTVT (technical quality, safety and environmental protection for roadway motored vehicles – city passenger cars), and TCVN 6724:2000 (for general structure of approved car styles).

This project uses buses capable of carrying 80 to 85 passengers/(B80), and fueled by compressed natural gas (CNG) according to Euro 4 discharge standards. In the first phase of the project (up to 2020), 26 buses will be used (4 spare), increasing to 42 buses by 2025 (4 spare), and 50 buses after 2030 (4 spare) to meet predicted passenger demand. Buses are designed with four doors which open inwards and a floor height of 61cm which is adjustable to accommodate the disabled. The bus is 11 to 12 m in length, with a maximum width of 2.5 m and maximum height of 3.2 m.

Bus design is presented in Figure 1.13:



(a) BRT buses

(b) Supporting disabled passengers

Figure 1. 13 (a) B80 bus (b) Bus designed to support the disabled

1.3.1.8. Intelligent Transport Systems (ITS)

The ITS uses a communication transmission system, supports traffic signal connectivity, connects to and helps manage bus teams, provides information to passengers, and incorporates camera and CCT monitoring. The physical structure of the communication system is presented in Figure 1.14.

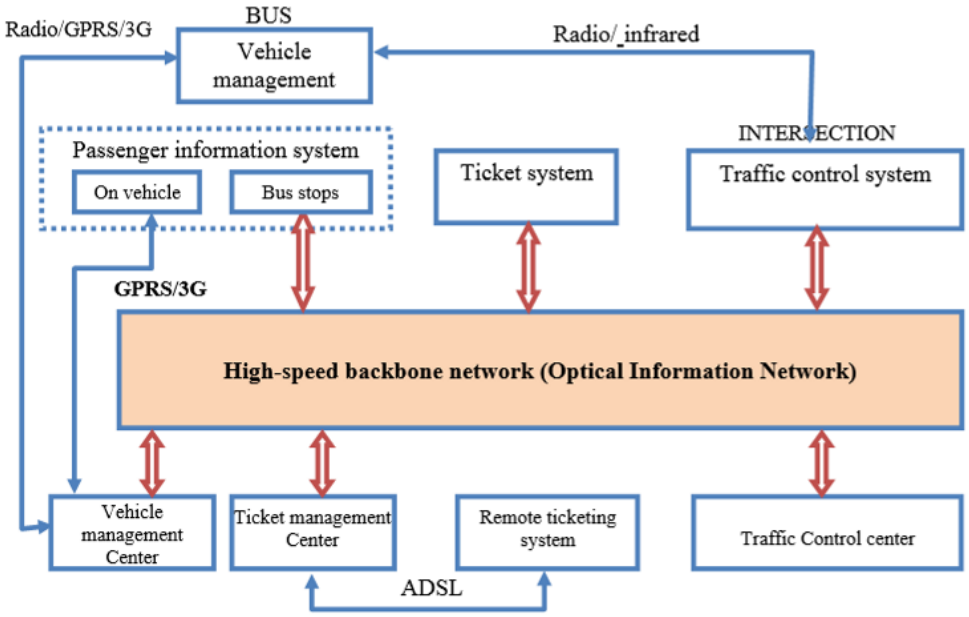


Figure 1. 14 The physical structure of the communication system

1.3.1.9. Other supporting systems of the Technical Facility and Rach Chiec Terminal

Lightning protection systems

Construction of lightning protection systems requires that they are checked for grounding resistance, and if not meeting design values, the project is required to add additional piles and earthing wire.

Power & lighting system

- Main lines will be installed in the cable tray or rack, and their cover decorated with refractory materials. The line to other power consumptions will be covered by fire resistant plastic tube underground (install tube first and reeve line after), branch lines will be installed with junction box and dominoes.
- Electrical cabinets are MSB (Main Switch Board) and extra switchboards are at the first floor, SMB (Sub Main Board). Electrical cabinets distribute DB (Distribution Board).
- Backup generators 3P - 4W, 380V / 220V. Use adapter ATS (Auto Transfer Switch) in the main electrical cabinet MSB for precautions.
- Lighting equipment uses fluorescent lamps for the operational phase, installed with 2-3 lamps, combined with reflective lights, halogen lamps, wall lamps and other decorative lighting.

Water supply and drainage system

- In the terminal and Technical Facility, water supply systems and the firefighting water roof tank will use iron or PPR technology pipes. Water supply and drainage will use PVC pipes. Reinforced concrete pipes will be used outside buildings for sewage and wastewater.
- Rainwater and wastewater after septic tank treatment is collected into manholes, drainage and discharge to the common drainage systems through BRT route. Wastewater from kitchens is treated before discharging to the drainage system.
- The central building will be designed with a firefighting system (PCCC) comprising an automatic fire alarm system, induction heating equipment, water pipes in each floor, and other equipment. The central building will be installed with air conditioning to ensure a comfortable working environment for staff and passengers.

1.3.2. Component 2: Institutional Strengthening

This component will finance institutional strengthening and capacity building activities essential to the successful implementation of the BRT line, and more broadly to improve transport and urban development planning in HCMC.

This component includes technical assistance and capacity building for state managers and staff who will operate the public transportation system (including subway, BRT, and bus), as well as integrated land use and transport planning.

The pilot investment project for BRT along Vo Van Kiet – Mai Chi Tho corridor is an important step in prioritizing public transport development, and especially for buses in Ho Chi Minh City.

The objectives of the pilot BRT corridor are described as follows:

- BRT runs on dedicated lanes to avoid traffic congestion and thus allows fast and reliable transportation services throughout the day. This is a key benefit to passengers that makes BRT an attractive alternative means for personal transportation.

- The attractiveness of BRT is reinforced by modern bus stations and stops in locations that appeal to passengers, advanced fee collection and operations control, and accurate information support systems.

- High service quality, speed and reliability are the important guarantees to increase and maintain large volumes of BRT passengers, help BRT operate with higher performance, and lowers operating costs and reduced need for state subsidies.

- In the medium term, a backbone network for overall mass BRT system will be established.

1.4. ESTIMATION OF WATER DEMAND IN OPERATION PHASE OF PROJECT

Water demand from project infrastructure during the operational phase includes:

- 28 BRT stations and railway Rach Chiec Terminal (clean water for passengers and staff - up to 256 staffs including 206 station staff and 50 supervisors).
- Thu Thiem Technical Facility (clean water for 20 to 25 staff and washing of BRT vehicles).

1.4.1. Water supply sources

Saigon Water Corporation (SAWACO), and other companies under SAWACO's management, supply water to all project areas. As demand for water is not considered high based on the number of staff/workers and other water users, the project will use SAWACO's services; detailed water use volumes are estimated in section 1.4.2.

1.4.2. Water use volume

Based on the water use standard stated in TCVN 33:2006/BXD (concerning water supply – pipe networks and construction design standards), the standard for domestic water use in HCMC (project areas) is 300 – 400 liters/ person/day; and the water use for other economic activities may be applied to similar conditions. Water demand is estimated based on the number of staff, passengers and time spent on project activities. The calculation is as follows.

Table 1. 2 Estimation of water use for project activities during the operation phase

No	Location	Activities	Water use volume	Note
1	28 bus stations		2 – 3 m^3/station/day	
2	Rach Chiec Terminal	Domestic water supply	5 – 6 m^3/day	
3	Thu Thiem Technical	Domestic water supply	2.5 – 3.3 m^3/day	
		Water for washing	135 - 155 m^3/day	Based on the

Facility	buses		number of buses
	Total	200 – 250 m^3/day	

1.5. PROJECT IMPLEMENTATION

1.5.1. Road surface construction

The project will be implemented along the existing East-West corridor and its road surface improved before construction of stations and junctions. The road connecting Thu Thiem Technical Facility and MCT will also be constructed. Additionally, other construction activities include leveling for Rach Chiec Terminal, Thu Thiem Technical Facility and other stations. The detailed volumes of excavation and backfill are shown in Table 1.4.

Table 1. 4 Volumes of excavation and backfill

Items	Excavation m^3	Backfill m^3	Total m^3
Technical Facility Thu Thiem	18353.9	42973.6	61327.5
Rach Chiec Terminal	11038.0	15389.0	26427.0
Each bus station (a bus-stop)	237	94	331
Each pedestrian flyover	2059.5	1441.7	3501.2

Source: FS report, 2014

1.5.2. Materials and construction methods

a. Material

Construction materials including stone, sand, cement, steel and existing structures are expected to be purchased from stores in the region; the project will not exploit the materials. Concrete will be purchased at local concrete mixing plants, such as Holocim Concrete Batching Plant.

Table 1. 5 Location and capacity of concrete mixing plants close to the BRT 1 route

Location	Capacity
Concrete mixing plant at Km 7 Nguyen Thi Dinh, Thach My Loi ward, district.2	240 m^3/h
Concrete mixing plant at Hoang Huu Nam, Long My Thanh ward, district 9	100 m^3/h
Concrete mixing plant at1498A, Nguyen Van Linh, district 8	240 m^3/h
Concrete mixing plant at 1, Vinh Loc residential, Binh Tan district	100 m^3/h

Figure 1. 15 Location of concrete mixing plants

b. Construction methods

Traffic Safety: Construction will take place along Vo Van Kiet - Mai Chi Tho Boulevard, and near the Thu Thiem Technical Facility and Rach Chiec terminal. Traffic safety measures include onsite fencing, traffic signals, warning signs, and coordination with traffic police.

Workers: Construction requires mobilizing workers, with construction implemented section by section with an expected 3- to 50 workers at each location, and construction of terminals and the Technical Facility requiring 60-80 workers.

Machines and equipment: Transportation of materials and equipment depends on the specific requirements of each construction phase of the project. Trucks and excavators will often be used during construction of road (excavation and backfill) and for other infrastructure construction. The construction phase will employ a variety of equipment such as rollers, stoning vehicles, asphalt coat sprayers, and asphalt cooking equipment. The amount of equipment mobilized will depend on detailed construction activities and construction methods.

Table 1. 6 Summary of construction-related machinery and equipment

Machine	Unit	Technical Facility	Rach Chiec terminal
Excavation machine <=3.6m3	Shift	21	12
Bulldozer <=110CV	shift	76	29
Compacter/ leveling machine 16T	shift	133	48
Spray machine XM	shift	1126	434
Mortar mixer XM 1600L	shift	1126	434
Mortar mixer XM 1150L	shift	1126	434
Mortar pump XM 32-50m^3/h	shift	1126	434
Generator	shift	1126	434
Truck 10 tons	shift	135	68

Source: FS report, 2014

Construction waste discharge:

Construction waste will be disposed of at Da Phuoc landfill, Binh Chanh district, HCMC, in line with the requirements of the following documents:

- Document No. 6420 / UBND-DTMT, dated 28/9/2007, issued by the HCMC People's Committee about discharge mud of ODA project in HCMC.
- Minutes of the 15 / TNDT-QLDA.TN, dated 26/02/2008, issued by the Urban Drainage Company - The Department of Transportation Company regarding authority of sludge disposal for PMU of HCMC environment and, sanitation project, and PMU of East-West Boulevard project.

1.5. LAND ACQUISITION AND RESETTLEMENT

The project will be constructed along Vo Van Kiet - Mai Chi Tho Boulevard, ending with the terminal at Rach Chiet Sport Complex, Technical Facility at Thu Thiem and other facilities. A preliminary assessment has been made of the extent of land acquisition for *BRT Corridor Development*. Based on the technical information currently available, it is anticipated that *BRT Corridor Development* will only have a small impact on land and properties in the project areas, and that the number of affected households will be limited.

Key project activities that are likely to require permanent or temporary land acquisition are:

- The rehabilitation and improvement of road infrastructure on the Vo Van Kiet Boulevard to support BRT operations. All civil works will be within the right of way (RoW) of Vo Van Kiet Boulevard. No land acquisition required
- Complementary non-motorized transport infrastructures to facilitate access to BRT services, such as 28 stations, parking areas, pedestrian flyovers and/or sidewalk improvements, as well as public spaces like parks and plazas, and landscaped areas. All these types of infrastructure will be constructed within the RoW of Vo Van Kiet Boulevard. No land acquisition required.
- The construction of complementary BRT infrastructure, such as the Technical Facility and terminals which located within two planned projects including: 0.5800 ha of Rach Chiec Sport Complex Project and 1.77 ha of Thu Thiem Railway Station Project in District 2.

A summary of the abovementioned structures and associated scope of land acquisition is shown in Table 1.7.

Table 1. 7 Scope of land acquisition

No.	District	Components	Volume	Acquired land (ha)
1	Binh Tan	Station	3	Within the RoW, no land acquisition
		Parking	1	
2	8	Station	1	
3	6	Station	4	
		Parking	1	
4	5	Station	6	
		Parking	4	
5	1	Station	5	

No.	District	Components	Volume	Acquired land (ha)
		Parking	1	
6	2	Station	1	1.77
		Road connects VVK and Thu Thiem Technical Facility	1	
		Rach Chiec Terminal Station	1	0.58
		Station	9	Within the RoW, no land acquisition

According to the latest information concerning technical design provided by the PMU, only two structures will need land acquisition:

- Thu Thiem Technical Facility: The technical facility for BRT line No. 1 is proposed to be located at Thu Thiem Railway Station, where the High-speed Railway HCMC-Nha Trang project is also planned. An area of 17,700 m^2 will be used to build the Terminal Station of BRT. The Technical Facility will acquire 17,300 m^2 of agricultural land and impact on the livelihood of 12 households, though not considered significant. Additionally, 1026 trees will be removed and cultivation of on 158 m^2 of cropland will be affected.
- Rach Chiec Terminal: Construction of this station will require 5800 m^2 of land. Development of this area is planned for the Rach Chiec Sport Complex Project and is in progress of acquisition, compensation and resettlement according to requirements as per Letter No. 519/ TB-UBND-TNMT approved by HCM DONRE. This land acquisition consists of 95% (5600 m^2) agricultural land and 221 m^2 of residential land located along Nguyen Thi Dinh Street. The acquisition will affect three households and two companies (considered as no significant impact).
- Land acquisition and clearance will be conducted before the construction phase, as per compliance with the Resettlement Policy and framework as well as the project resettlement plan under which approval by Vietnam and the donor (WB).

Based on the above information, the project will acquire land from two communes of District 2 as detailed below:

- The Technical Facility will acquire 17,300 m^2 of agricultural land which will affect the three households and two companies, but without significant impact. Furthermore, 1206 trees will be cut down and cultivation of 158 m^2 cropland affected.
- Rach Chiec Terminal will impact mainly agricultural land (5,800 m^2 or 95%) and 221 m^2 of residential land. It will affect 12 households

1.6. PREPARATION FOR CONSTRUCTION AND LAND ACQUISITION

The project site is located in six urban districts and one semi-urban district, but the project areas will not encroach upon residential land. . Characteristics of project land are detailed as follows.

Table 1. 8 Characteristics of project land

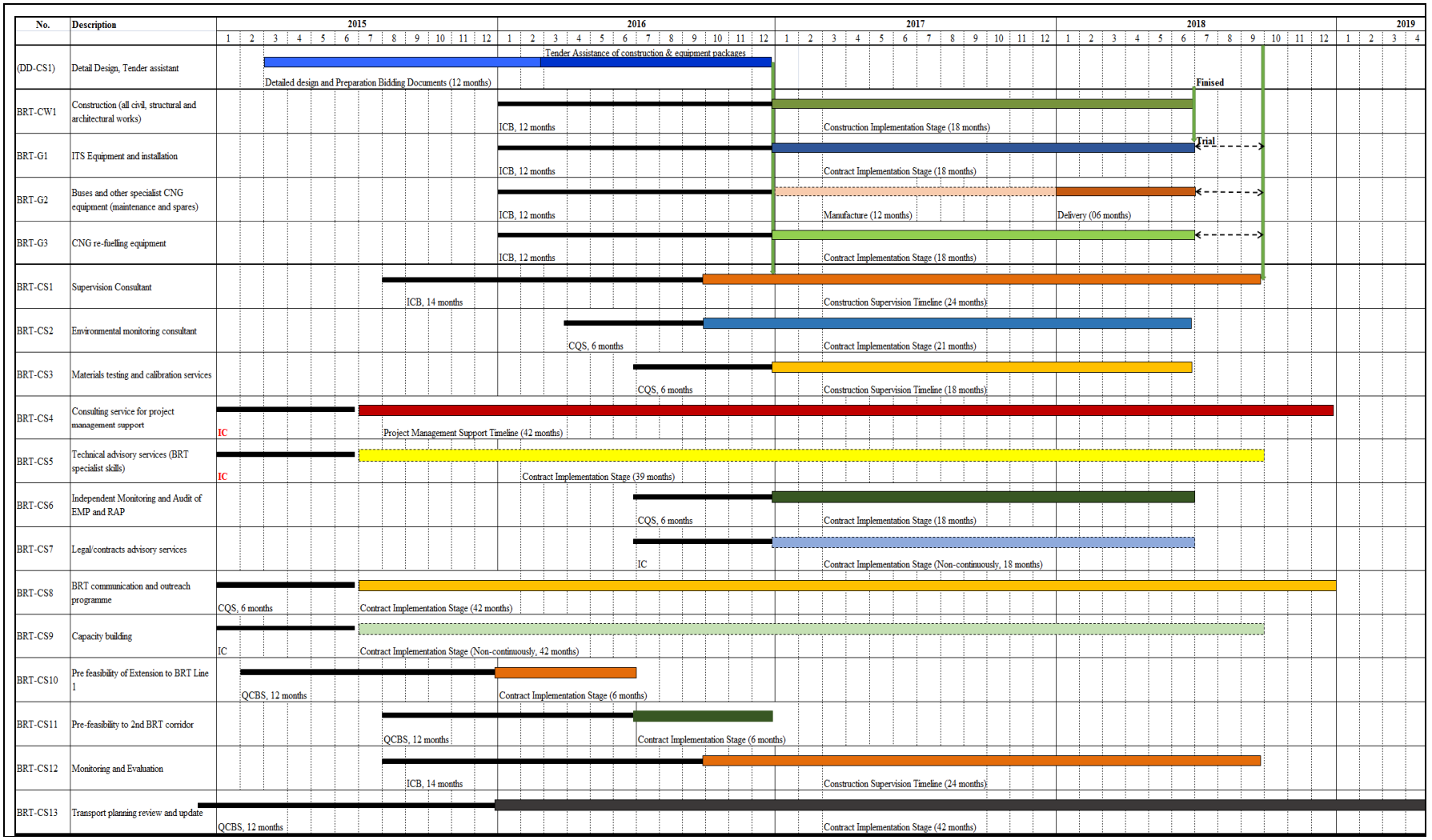
Items	Unit	Affected area	Note
Station	m^2	5292	East-West Boulevard

BRT lane	m^2	164500 m^2	East-West Boulevard, 23.0 km
Rach Chiec Terminal	m^2	5800 m^2	Rach Chiec Sports Complex
Technical Facility Thu Thiem	m^2	8500 m^2	Thu Thiem
Connecting road between VVK and Technical Facility	m^2	7700 m^2	Thu Thiem
Car parking for passengers	m^2	7879 m^2	Station

1.7. PROJECT IMPLEMENTAITON SCHEDULE

Following completion of the feasibility study - "Ho Chi Minh city Green Transport Development Project" - the detailed design stage will be implemented from 2/2015 to 2/2016 and civil construction work from early 2017. The BRT operational phase will commence at the end of 2018. The detailed implementation schedule is presented in Table 1.9.

Table 1. 9 Project Implementation Schedule



1.8. TOTAL FUNDING AND INVESTMENT

ODA-funded project is from IBRD, World Bank (WB) with total investment (for BRT 1 with the length of 23.0 km) are approximately $ 175,310,500, in which the counterpart funds is $ 33,026,700 (18.84%) and the ODA (from IBRD) is $ 142,283,800 USD (81.16%).

1.9. DUE DILIGENCE ASSESSMENT OF EAST-WEST BOULEVARD PROJECT

The BRT lane No. 1 of HCMC Green Transport Development Project will use existing roads, which are VVK and MCT (East-West Boulevard). Its total length is 20.5 km (length of East – West Boulevard in Decision 568/QĐ-TTg), passing through District 1, District 2, District 4, District 5, District 6, District 8, Binh Tan District, and Binh Chanh District. The East - West Boulevard starting point is at 1A Highway (Binh Chanh District), and its ending point, which is connected to the Hanoi Highway, at Cat Lai T-junction (District 2).

The East-West Boulevard Project was implemented with funding from the Japanese government through the Japanese Bank for International Cooperation (JBIC) in the form of ODA (Official Development Assistance). Project preparation work was completed in 1999, and active compensation and resettlement started in 2002 and ended in 2007. At the start of the the project, Japan International Cooperation Agency (JICA) required the JICA-funded projects must comply with the policy of Vietnam government on compensation and resettlement assistance.

According to the requirements of the WB's safeguard policy, the project have has to review and assess the compliance of social and environment policy of the connection segment (length 20.5 km) belong to East-West Boulevard, HCMC.

The objectives of due diligence include: i) to review and assess preparation and implementation of environmental protection measures (on highway roads funded by JICA) according to both Vietnamese laws and policies as well as HCMC policies (a commitment made between Vietnamese and Japanese governments); ii) to assess that environmental management has met objectives of the WB Involuntary Resettlement Policy (OP / BP 4.12) and Environmental Assessment Policy (OP/ BP 4.01); iii) to propose resolving remaining environmental issues and existing projects if necessary, and conduct the lessons learnt for green transportation projects funded by World Bank. The review of social compliance is addressed in a separate report.

Methodology

Document review	*This is one of the most important methods for assessing compliance. All the documents related to environmental protection requirements, and implementation responsibilities were identified, reviewed and analysed.*
Sample survey	*Based on interviews with key informants/stakeholders to assess social changes of local communities in project areas.*
Field observation	*This method helps to obtain timely and useful information to the collected data, the method helps to understand the context which was mentioned in the data and explained the survey results.*

Assessment results/findings:

Implementation of environmental requirements during project preparation

The EIA of *the East-West Boulevard* project was developed and approved by the Ministry of Science, Technology and Environment, as per Decision No. 1852 /QD-BKHCNMT on 25 October 1999. The EIA report was prepared to meet all requirements of Vietnamese laws and the social and environmental policies of JICA. An EMP was developed to integrate into the EIA report. A training program was developed for both parties to improve capacity for implementing the environmental management plan, as well as to minimize negative environmental impacts.

Stakeholder consultations and identification of potential negative impacts were addressed during preparation of the EIA report. Consultation involved meeting all stakeholders for information disclosure, communicating with local authorities (via written documents, reports and interviews), and publication of information as requested by the Vietnamese government.

Implementation of environmental requirements during project construction

According to review and analysis of document results, all environmental reports and progress reports were completed and archived. This project is divided into three construction packages. Package 1 involves construction of the west road and its extension along the canal. Package 2 entails construction of the Saigon River Tunnel (Thu Thiem tunnel). Package 3 comprises procurement and installation of mechanical and electrical equipment for the Thu Thiem tunnel, charging station and operation and maintenance equipment. For civil construction packages 1 and 2, a review of results shows that project met all environmental requirements during its construction phase.

All reports were prepared, submitted and stored as required, including a total of 60 to 68 monthly environmental reports/packages. Environmental monitoring reports (every 3 months) were implemented to monitor environmental quality in project areas.

Implementation of environmental requirements during project operation

The completed project was transferred to management and operation departments, and the Center for Sai Gon River Tunnel Operation Management assigned to manage operation of the East West Boulevard from March of 2013. The Center has responsibilities to carry out periodic maintenance, cleaning and other environmental management activities. As observation, the Center has been fully responding for their responsibilities in maintain the road quality, environmental beautiful landscape. Ambient environmental quality monitoring was carried out during the first two years of operation by environmental monitoring consultants. Subsequently, environmental monitoring became the responsibility of the Ho Chi Minh MONRE. The Center for Sai Gon River Tunnel Operation Management maintains continuous operation of several automatic air and noise monitoring stations in the tunnel.

Conclusion

Environmental responsibility is good and meet all the environmental requirements, environmental landscape along East-West Boulevard has been significantly improving and community quality life is improving.

Thoughout preparation, construction, and operational phases of the project, the owner has fully complied with all environmental protection and social requirements of the Vietnamese government and JICA.

There are no outstanding or remaining environmental issues identified in project areas, and thus it is not necessary to propose environmental improvement measures for the East-West Boulevard Project.

CHAPTER II

CURRENT NATURAL ENVIRONMENT AND SOCIO-ECONOMIC BASELINES

Ho Chi Minh City, located at 10°38' to 11°10'N and 106°22' to 106°55'E, has an extended shape from northwest to southeast. Ho Chi Minh City is bounded to the north by Tay Ninh and Binh Duong provinces, east by Dong Nai province and the East Sea, and southwest by Long An province. The length of the city is 150 km extending from Cu Chi district to Can Gio district; and its width is 50 km from Thu Duc to Binh Chanh district.

The project area passes through the region connecting the west and east of the city, passing through Binh Chanh district, Binh Tan district, and District 5, 6, 8, 1 and 2 of the city, along the Vo Van Kiet - Mai Chi Tho Boulevard (or West - East Boulevard). The current location of the project is determined extending from 10° 43' to 10°48' N and from 106°36' - 106°45' E or from the crossroad of the 1 A Highway and the Vo Van Kiet Boulevard to the Rach Chiec U-turn.

2.1. CURRENT STATE OF NATURAL ENVIRONMENT

The project's area is located in Ho Chi Minh City and therefore exhibits features of its topographical condition, geology and hydrological climate.

2.1.1. Topography, geomorphology and geology

Geology

Geological characteristics of Ho Chi Minh City include Pleistocene and Holocene sediments exposed at the surface. Pleistocene sediments occupy a large of area of the north, northwest and northeast of the city. The layer of ancient alluvial sediment forms a distinctive soil type - "gray soil" - covering more than 45,000 ha (23.4% of area of the city). In this area, there are three types of gray soil, which are high gray soil, gray soil with yellow red motley horizon and gley soil.

Holocene sediment is formed from a variety of origins including from the sea, gulf, river and floodplain, with different soil groups: marine alluvial soil, alum earth and alkaline soil. In addition, there is an area of coastal sand dunes and eroded brownish yellow feralite in the city's elevated regions.

Topography

Ho Chi Minh City is located in the transition zone between the southeast zone and the Mekong Delta with lower terrain from north to south and from west to east. Uplands in the north-northeast and northwestern have an average elevation of 10 to 25 m, interspersed with hills of up to 32 m. Areas to the south-southwest and southeast of the city have an average elevation of 1 m, with the lowest point at 0.5 m. The downtown area has an average elevation of 5 to 10 m. The topography of project area is relative flat, which can be divided into two

different areas. The first area including District Numbers 1, 4, 5, 6 and Binh Chanh are located at a higher elevation and not affected by flooding and tide. District No. 2, located along the Saigon River, is low-lying and significantly affected by flooding; however, the project route located within Mai Chi Tho Street is higher than surrounding areas and not flood prone. Thu Thiem depot and Rach Chiec terminal are located in low-lying areas, and could be affected by flooding and tide in the future.

Land

According to environmental survey results of 23 communes in the project area (4 communes of District 1; 4 communes of District 2; 3 communes in Binh Chanh district; 1 commune of District 8; 6 communes in District 5; and 5 communes in District 6), results show specialized land represents 60% of the total land area (higher than the nationwide of 4.33%). Residential categorized land is approximately 30 % (higher than the national rate of 1.85%). Agricultural categorized land represents 5% of the total land area (much lower than the proportion of nationwide agricultural land of 28.49%), and unused land represents 5% (lower than the proportion of nationwide unused land of 15.45%).

Among the 23 surveyed communes, Commune 1 of District 5 had the highest share of vacant land, accounting for 8.93% of total land. Three communes of Binh Chanh district had a high share of agricultural land amounting to 61 to 67% of the total land area. All communes of District 1 and An Phu commune of District 2 had a high share of residential and specialized land accounting for 90% of the total land area.

2.1.2. Hydro-meteorology

2.1.2.1. Meteorology

a. Temperature:

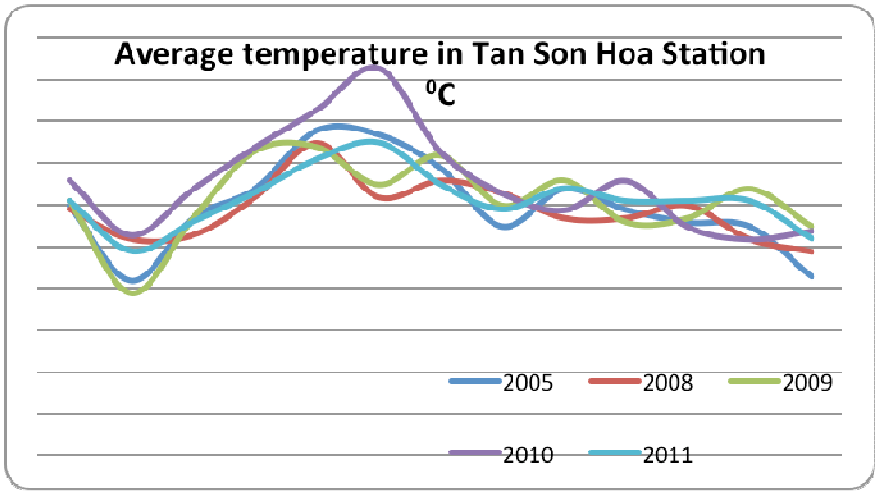
The annually average temperature in Ho Chi Minh City is approximately 28.14°C, with the monthly highest in June at 29.44°C. The temperature was over 31°C for a few years (in December 6th 2010). The monthly lowest average temperature is in January at 26.7 °C, and the lowest temperature had been recorded at 25.9°C in the year (in January 2009). The temperature amplitude between day and night can reach 10°C, and is therefore hot during the daytime and with chance for fog to form during cooler periods. The average annual daily air temperature in Ho Chi Minh City is higher than other places in the southern region from 1.0 to 1.5°C. Temperature sequence in Ho Chi Minh City in Tan Son Hoa station is shown in Table 2.1 and Figure 2.1:

Table 2. 1 Average temperature in Ho Chi Minh City - Tan Son Hoa station

Month	Year (^{0}C)				
	2005	**2008**	**2009**	**2010**	**2011**
12 month period	28.00	27.90	28.10	28.60	28.10
1	26.20	27.20	25.90	27.30	26.90
2	27.70	27.30	27.70	28.40	27.60
3	28.40	28.20	29.30	29.40	28.30
4	29.80	29.50	29.40	30.30	29.10

Month	Year (^{0}C)				
5	29,70	28.20	28.50	31.30	29.50
6	28.90	28.60	29.20	29.30	28.50
7	27.50	28.30	28.00	28.30	27.90
8	28.40	27.70	28.60	27.90	28.40
9	27.90	27.70	27.60	28.60	28.10
10	27.60	28.00	27.70	27.50	28.10
11	27.50	27.20	28.40	27.20	28.10
12	26.30	26.90	27.50	27.40	27.20

Source: Ho Chi Minh City Statistical Yearbook, 2012



Source: Ho Chi Minh City Statistical Yearbook, 2012

Figure 2. 1 Average temperature in Ho Chi Minh City – Tan Son Hoa station

b. Rainfall

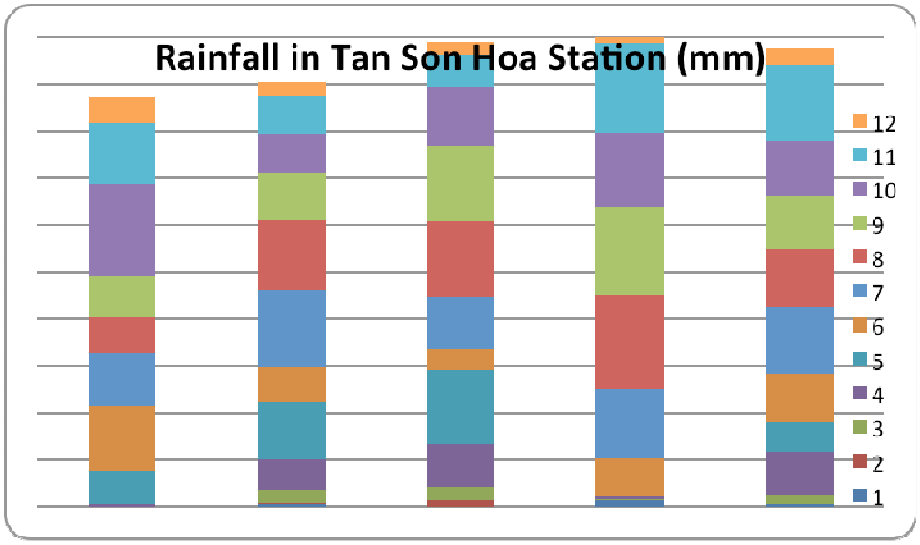
The annual rainy season in Ho Chi Minh City usually occurs from May to November every year and the dry season from December to April. Yearly average rainfall in Ho Chi Minh City is at about 1900 mm. During the rainy season rainfall represents from 86.5% to 99% of the total annual, with heaviest rain occurring in July, August, September, October and November, characterized by up to 400 mm (in August 2010). In the dry season, rainfall is very low, especially in January to March, when there is very little rain.

Table 2. 2 Rainfall at Tan Son Hoa station

Month	**Year** (mm)				
	2005	**2008**	**2009**	**2010**	**2011**
1	0.00	9.50	0.30	23.00	9.40
2	0.00	1.50	21.40	0.00	0.00
3	0.00	58.90	57.80	3.90	40.30
4	9.60	127.00	187.00	9.90	181.90
5	143.60	246.90	318.50	8.80	124.40
6	273.90	147.20	83.20	160.00	213.10

Month	**Year** (mm)				
7	228.00	331.20	223.00	294.30	281.50
8	146.30	297.80	323.90	400.60	244.40
9	182.90	202.60	325.00	373.70	232.10
10	388.80	165.60	249.00	321.80	232.60
11	264.50	167.10	141.20	379.90	321.10
12	105.40	57.80	49.50	40.30	73.00

Source: Ho Chi Minh City Statistical Yearbook , 2012



Source: Ho Chi Minh City Statistical Yearbook in 2012

Figure 2. 2 Rainfall at Tan Son Hoa station

Rainfall in Ho Chi Minh City is typically intense lasting no more than three hours. Prolonged heavy rain causes flooding in low-lying area with poor drainage, accumulating to a depth of 20 to 80 cm.

c. Humidity

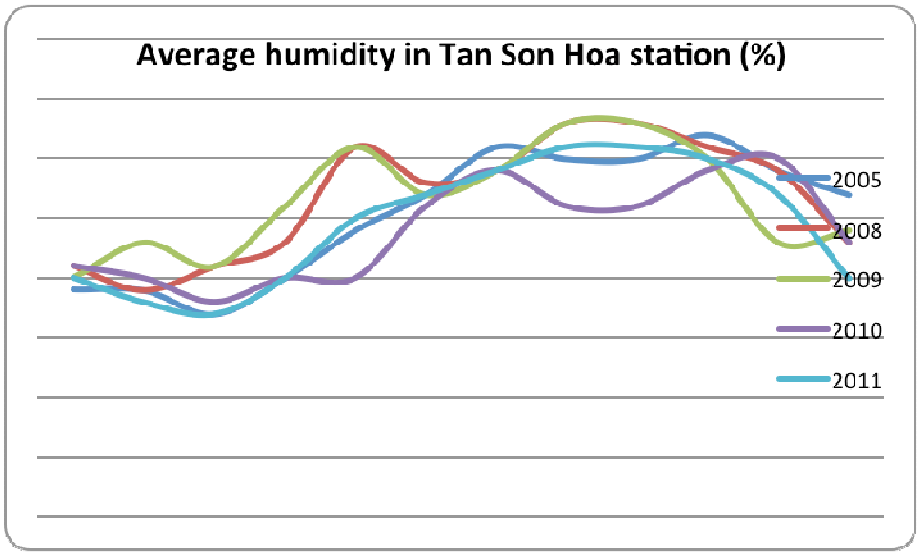
The average humidity in Ho Chi Minh City is approximately 75%, but depends on the month. Humidity is higher during the rainy season (Figure 3.3) with average humidity of about 80%, and can peak at 83% (in August). The dry season has lower humidity, average humidity at approximately 70%, falling to less than 67% (in March 2011). Average air humidity in Ho Chi Minh City is shown in Table 2.3 and Figure 2.3.

Table 2. 3 Humidity at Tan Son Hoa station

Humidity (%)					
Month	**Year**				
	2005	**2008**	**2009**	**2010**	**2011**
1	69.0	71.0	70.0	71.0	70.0
2	69.0	69.0	73.0	70.0	68.0
3	67.0	71.0	71.0	68.0	67.0
4	70.0	73.0	76.0	70.0	70.0

Humidity (%)					
Month	**Year**				
	2005	**2008**	**2009**	**2010**	**2011**
5	74.0	81.0	81.0	70.0	75.0
6	77.0	78.0	77.0	76.0	77.0
7	81.0	79.0	79.0	79.0	79.0
8	80.0	83.0	83.0	76.0	81.0
9	80.0	83.0	83.0	76.0	81.0
10	82.0	81.0	80.0	79.0	80.0
11	79.0	79.0	73.0	80.0	77.0
12	77.0	73.0	74.0	73.0	70.0
%					

Source: Ho Chi Minh City Statistical Yearbook, 2012



Source: Ho Chi Minh City Statistical Yearbook, 2012

Figure 2. 3 The graph of humidity at Tan Son Hoa station

d. Characteristics of wind and storm

Ho Chi Minh City experiences two main wind directions during the year: east-southeast in the dry season (also called "chuong" wind); and west-southwest in the rainy season, with average wind speeds of 3-4 m/s, with strongest winds often occurring at noon/afternoon. Strong winds affect tidal levels (a few centimeters) and increase saltwater intrusion in Ho Chi Minh City.

Storms rarely happen in HCMC, the weather only affected by tropical depression or storms in the central region causing heavy rainfall in Ho Chi Minh City.

e. Thermal radiation:

The total daily average solar radiation in Ho Chi Minh City is 365.5 calories/cm^2 during the year. In the dry season, the total amount of radiation is higher than in the rainy season at

nearly 100 calories/cm^2/day and maximum radiation intensity during the day is about 0.8 - 10 calories/m^2/min from 10 am to 2 pm.

f. Number of sunshine hours

The total number of hours of sunshine in recent years has tended to decrease. Last year Ho Chi Minh City received 1892.9 hours of sunshine, which was 200 hours less than 2011 and 110 hours less than 2008 and 2009. December and January receive the least sunshine, where the lowest number of sunshine hours was recorded as 9.5 hours (in December 2005) and most recently is 116.9 hours (in September 2009) and 120.1 hours (in January/2011).

Monthly sunshine hours in Ho Chi Minh City are detailed in Table 2.4.

Table 2. 4 Total sunshine hours in Tan Son Hoa station

Month	**Year** (hrs.)				
	2005	**2008**	**2009**	**2010**	**2011**
1	164.8	156.3	174.4	157.1	120.1
2	215.3	135.6	168.1	245.3	188.9
3	252.9	216.7	236.9	239.6	157.8
4	225.6	188.3	186.7	240.8	187.0
5	200.4	165.7	155.9	210.4	165.0
6	185.6	172.8	191.6	177.0	163.6
7	153.1	218.7	149.2	150.0	162.6
8	178.1	161.0	155.7	141.2	198.1
9	142.2	142.6	116.9	155.2	144.8
10	138.8	152.4	132.3	102.7	154.3
11	124.6	145.4	146.7	130.6	141.0
12	90.5	134.1	187.6	123.8	109.7
Total	**2071.9**	**1989.6**	**2002.0**	**2073.7**	**1892.9**

Source: Ho Chi Minh City Statistical Yearbook , 2012

2.1.2.2. Hydrological conditions:

Canal and river systems

Ho Chi Minh City has two main river systems, the Saigon River and the Dong Nai River, both of which provide water supplies to Ho Chi Minh City, as well as receiving rainwater and sewage from the City.

Dong Nai River is the largest river in the southeast region, goes to Ho Chi Minh City from Dong Nai bridge to the mouth of the Soai Rap River. The section running through the City is 90 km in length with average width of 500 to 800 m and 10 to 15 m depth at Nha Be area. The section of Dong Nai River which is runs through the city is influenced by tides. The water of Dong Nai river flows with the higher tide and is more faster flowing than the Saigon River with a flow rate of 600m^3/s. Dong Nai River provides water supply and drainage for a large basin in the southeast with around 23,000 km^2, including Ho Chi Minh City. Water flow in the dry season is about 75-200 m^3/s and lower after opening of the Tri An Reservoir.

The Saigon River is a large river of the southeast region, is derived from Loc Ninh to Ho Chi Minh City at Ben Suc, confluence with the Dong Nai River at the mouth of Cat Lai, this confluence is known as Nha Be river flowing directly into the sea with a length of about 70 km and a width of 300-400 m with 570 km^2 basin. The section which flows through Ho Chi Minh City has a width of 225 to 370 m and depth of 20 m; the section which flows through Binh Thanh district has a depth of 10-15 m. The Saigon River flow rate is about 59.4 m^3/s in Binh Duong province and about 84 m^3/s in Binh My-Ho Chi Minh City.

The Sai Gon - Dong Nai River system is a source of alluvium and nutrients for aquatic life. However, the Saigon River is affected by salinity and reduced annual alluvium after construction of Dau Tieng and Tri An reservoirs. Specifically flood occurs in around September each year, before constructing reservoirs operation system, freshwater is available in areas of Binh Chanh district and Nha Be district, but now the flood season in September, freshwater is only available in area of Binh Thanh basin. And the impact of flood tide is increasing in river segments of Ho Chi Minh City.

Network of canals in Ho Chi Minh City is characterized by Southern region, it is very dense and tangled, if only partial canals in the inner area of the City holds the main task of urban drainage, currently there are 5 main systems with a total length of the main canals is 55,585 m and tributary length of 36,436 m and density is 4 m/ha. Main canal systems include:

- *Nhieu Loc - Thi Nghe canal* (length of 9,035 m) connecting with Cong Ba Xep, Bung Binh, Mieu, Ong Tieu, Mieu Noi, Bui Huu Nghia, Cau Bong, Cau Son, Pham Van Han, and Van Thanh channels.
- *Tau Hu canal - Doi canal - Te Canal* (length of 19,500 m) connecting with Hang Bang, U Cay, 1 horizontal, 2 horizontal, 3 horizontal, Ong Nho, Xom Cui, and Ba Tang channels.
- *Ben Nghe channel* (length of 5,900 m) connecting with Cau Chong and Cau Dua channels.
- *Tan Hoa – Ong Buong – Lo Gom channel* (length of 7,240 m) connecting with Ben Trau, Ba Lai, Cau Sat and Ruot Ngua channels.
- *Tham Luong – Ben Cat – Vam Thuan canal* (length of 14,040 m) connecting with Dua, Ong Bang, Lang, Ben Cat, Ong Tong , Dinh An Nhon, Ba Mien, Cau Mot, Rong Voi and Sen channels.

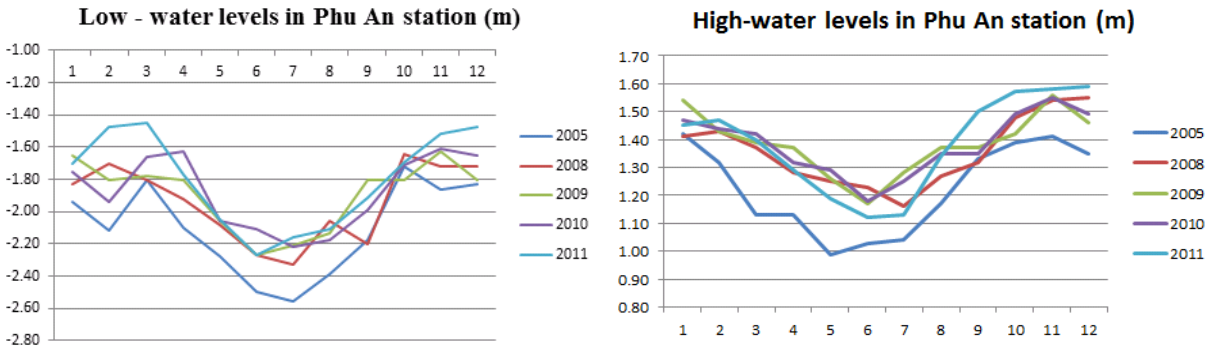
Hydrological conditions of Tan Hoa, Doi, Teand Ben Nghe canals depend directly on the hydrological regimes of the Saigon River, with their water level 5 to 10 cm lower than the Saigon River.

Table 2. 5 Saigon River water level – Phu An station

(a)	**The lowest water level**						**The highest water level**				
Month	**Year**					**Month**	**Year**				
	2005	**2008**	**2009**	**2010**	**2011**		**2005**	**2008**	**2009**	**2010**	**2011**
1	-1.94	-1.83	-1.65	-1.75	-1.70	**1**	1.42	1.41	1.54	1.47	1.45
2	-2.12	-1.70	-1.80	-1.94	-1.47	**2**	1.32	1.43	1.43	1.44	1.47
3	-1.80	-1.80	-1.78	-1.66	-1.45	**3**	1.13	1.37	1.39	1.42	1.40

(a)	The lowest water level						The highest water level				
Month	Year					Month	Year				
	2005	**2008**	**2009**	**2010**	**2011**		**2005**	**2008**	**2009**	**2010**	**2011**
4	-2.10	-1.92	-1.80	-1.63	-1.77	**4**	1.13	1.28	1.37	1.32	1.29
5	-2.28	-2.08	-2.06	-2.06	-2.05	**5**	0.99	1.25	1.26	1.29	1.19
6	-2.50	-2.27	-2.27	-2.11	-2.27	**6**	1.03	1.23	1.17	1.18	1.12
7	-2.56	-2.33	-2.21	-2.22	-2.16	**7**	1.04	1.16	1.28	1.25	1.13
8	-2.39	-2.06	-2.13	-2.18	-2.11	**8**	1.17	1.27	1.37	1.35	1.34
9	-2.18	-2.20	-1.80	-1.99	-1.91	**9**	1.33	1.32	1.37	1.35	1.50
10	-1.72	-1.64	-1.80	-1.71	-1.69	**10**	1.39	1.48	1.42	1.49	1.57
11	-1.86	-1.72	-1.63	-1.61	-1.52	**11**	1.41	1.54	1.56	1.55	1.58
12	-1.83	-1.72	-1.80	-1.65	-1.47	**12**	1.35	1.55	1.46	1.49	1.59
											Unit: meter

Source: Ho Chi Minh City Statistical Yearbook, 2012



Lowest water level

Highest water levels

Source: Ho Chi Minh City Statistical Yearbook, 2012

Figure 2. 4 Graph of water levels of the Saigon River at Phu An station

The project corridor has a high river network density. The BRT line from An Lac turnaround to Rach Chiec Terminal is parallel and/or crosses many canals. Details of the river network in the project corridor is shown in Table 2.6 below.

Table 2. 6 Statistics of river network along project corridor

No.	River/canal	Location	Description
1	Nuoc Len Canal	Parallel with BRT route from An Lạc intersection to Nuoc Len bridge.	Average cross section is 35 m, length of 850 m, distance from left hand side of Vo Van Kiet street is 3-5m.
2	Nuoc Len	Nuoc Len Bridge, crossing	Average width of 35 m.

No.	River/canal	Location	Description
	Canal	BRT line.	
3	Rach Cay Canal	Rach Cay Bridge, crossing BRT line.	Average width of 30 m.
4	Ruot Ngua Canal	Parallel with BRT line from Rach Cay bridge to Lo Gom bridge.	Average width of 30 m, length of 850 m, and distance of 12 m from Vo Van Kiet boulevard
5	Lo Gom Channel	Crossing BRT line at Lo Gom Bridge.	Average width of 70 m.
6	Ben Nghe – Tau Hu – Lo Gom Channels	Parallel with BRT line from Lo Gom Bridge to Thu Thiem Tunnel.	Average width of 45m, length of 9.5 km, and distance of 5 to 10 m from Vo Van Kiet Boulevard.
7	Sai Gon River	At Thu Thiem Tunnel.	Average width of 275 m.
8	Ca Tre Canal	Parallel with BRT line from Thu Thiem Tunnel to Kenh 2 Bridge	Average width of 30m, distance of 150 to 200 m from Mai Chi Tho Boulevard
9	Kenh 2 Canal	Crossing BRT line at Kenh 2 Bridge.	Average width of 50 m.
10	Ca Tre Nho Canal	Crossing BRT line at Ca Tre Nho Bridge.	Average width of 30 m.
11	Rach Chiec Canal	Distance 180 m from Terminal.	Average width of 6 m.

The statistic of river network in the project corridor can support for environmental impact assessment of project on surface water quality, especially at sensitive places where BRT line 1 crossing or parallel with river/ channel or canal. Water quality in the project area will be assessed and proposed mitigation measures.

2.1.3. Biological Resource and Biodiversity

Ho Chi Minh City consists of 24 districts with a total area of 2,095,01 km^2 and is divided into three zones: (1) hilly ecological zone - suburban district of Cu Chi, undulating hills, ancient alluvial soil, undeveloped industry, population density is moderate with low urbanization; (2) urban center ecological zone - urban and suburban districts, occupy about 46% of the city area but occupied by 94% of its total population and most of the industrial facilities in the city; and (3) the mangrove ecosystem – Can Gio district, 40-50 km far from center of the city, coastal estuary, where topography is the lowest in the City (0.5 - 1 m) and most of the area is flooded, with 23.055 ha of mangrove forest land of which 6,161 ha of natural forest and 16,894 ha of planted forest.

Currently, Ho Chi Minh City has 555 species of lower plants (algae) and more than 1,000 species of higher plants including coastal aquatic plants (448 species) and higher plants (572 species). Ho Chi Minh City also features a variety of animals, including invertebrates (654 species), fish (171 species), amphibians (14 species), reptiles (60 species), birds (140 species) and mammals (41 species). These species of organisms are abundant in Ho Chi Minh City, however, many groups of organisms, which are important in terms of medicine, and agriculture have not been studied and replenished, such as protozoa, fungi, mosses, lichens and insects. Biodiversity characteristics of the canal systems in the project area include 212 species, and about 207 species had been named of 65 families, and 18 orders. The most diversity specie is Perciformes which has 76 species (account for 35.35%), Siluriformes which has 38 species, Cypriniformes which has 37 species.

Coastal ecosystems – Can Gio mangrove forest is an area of major biodiversity in Ho Chi Minh City. in which fauna of aquatic invertebrates have more than 700 species belonging among 44 families, 19 classes, 5 branches; the system has over 137 species belonging among 39 families and 13 orders; fauna of vertebrates have 9 amphibians, 31 reptiles, 4 mammals. Including 11 species of reptiles are listed in Vietnam's Red Book; and 130 avifauna with 47 families, 17 orders, including 51 species of waterfowl and 79 other species.

Changes in biodiversity tends to worsen as the economic value species are being used indiscriminately in Ho Chi Minh City; habitats of the organism are being contaminated excessively and uncontrolled and the most serious pollutions are water, soil and air; Rapid urbanization causes loss of land and biodiversity in Ho Chi Minh City.

BRT Line 1 will be constructed along Vo Van Kiet – Mai Chi Tho corridor, and other supporting facilities will be located in specific places along this corridor. The Technical Facility will cover 1.0 ha with 0.77 ha of connecting road, and Rach Chiec Terminal will cover 0.58 ha. However, these areas (2.35 ha) represent vacant land, dominanted by grasses. The project will not significantly impact on biodiversity of this corridor.

2.1.4. Climate change, natural disasters

Climate change information used in this section are derived from research results of climate change impacts and adaptation measures by Department of Natural Resources and Environment of Ho Chi Minh City in collaboration with the Asian Development Bank (ADB) in 2009.

2.1.4.1 Current weather conditions and forecasts to 2050

As mentioned above, Ho Chi Minh City is located in the tropical monsoon region, the climate is divided into two seasons, the dry season and the rainy season. In addition, Ho Chi Minh City also has a low position on the terrain elevation, therefore a part of the city is frequently flooded by tides, waves, construction activities. Flood areas are changing due to rapid urbanization and other activities. Ho Chi Minh City regularly suffers huge floods during the rainy season and high tide periods (from September to January).

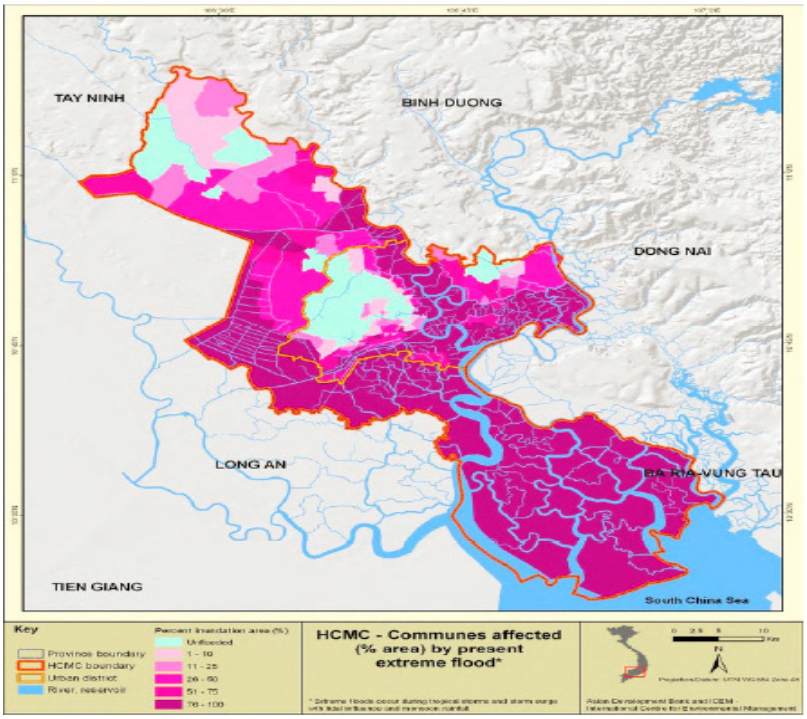
Vietnam's southern region is not affected frequently by tropical storms but can be affected by tropical depressions and storms in the central region that is the cause of heavy rains and

cumulative impacts on flooding by flood tide. Over the past century, the number of hurricanes affecting Ho Chi Minh City is only 10% of the total number of hurricanes affecting the territory of Ho Chi Minh City is 1 – 1.2 m that could cause flooding in the City.

Asian Development Bank (ADB, 2009) conducted a study on the impact of climate change on Ho Chi Minh City as well as climate change adaptation measures for the city by 2050. Two climate change scenarios A2 and B2 of the Intergovernmental Panel on Climate Change (IPCC, 2007) were modeled for the climate and hydrology in HCMC. According to the result of the model, by 2050 the climate and hydrology situation will be extremely serious with adverse trends . High tide and tidal flooding are determined as the major causes of adverse effects and affected by climate change factors in HCMC.

According to the research results of climate change forecasting, the forecasts of the average and maximum values for the weather by 2050 (rainfall and temperature), which has a huge difference between two scenarios A2 (high emissions and less actions in improving the situation) and B2 (medium emissions and application of mitigation measures). The predicted results under the B2 scenario are not much different when compare with the the current conditions. However, the predicted results based on A2 scenario have a great change.

According to the forecasts of ADB study, heavy rain will be much higher than the current rainfall under the A2 scenario.In more detail, the number of rainy days such as 1, 3 and 5 days will increase by 20% in the future. Whereas under the B2 scenario, there is almost no difference to the number of rainy days from 3 and 5 consecutive days, and the number of rainy days of one consecutive day will reduce by 25% compared to the present. Increased rainfall will impact on flooding causes. In addition, the average daily temperature is forecasted to increase by $1,4^0$C when compare with the current average daily temperature in Ho Chi Minh City.



Source: *ADB & HCM DONRE, 2009*

Figure 2. 5 Map of current affecting extreme flooding in Ho Chi Minh City

According to forecasts, by 2050 the City will have additional 3% of flooded area when occurring extreme situations, 7% frequently flooded areas, compared to the current flooded areas under the A2 scenario. As of 2009, there were 154 (48%) communes/wards are frequently affected flooding and according to forecasting by 2050, these figures will increase to 177 (55%) of the communes/wards and account for 61% of the city areas. In cases of extreme disaster due to storms, Ho Chi Minh City will have additional 30 communes/wards which will be affected by 2050 and 71% of the city areas will be affected by the great storms.

Table 2. 7 Comparing current flood situation andclimate change with the A2 scenario by 2050

Type	Present		2050	
	Normal flooding	Extreme flooding	Normal flooding	Extreme flooding
Number of communes/wards is affected (total of 322)	154	235	177	265
Affected area (ha)	10830.9	13552.6	12315.2	14188.5
Rate of affected area (%)	54%	68%	61%	71%

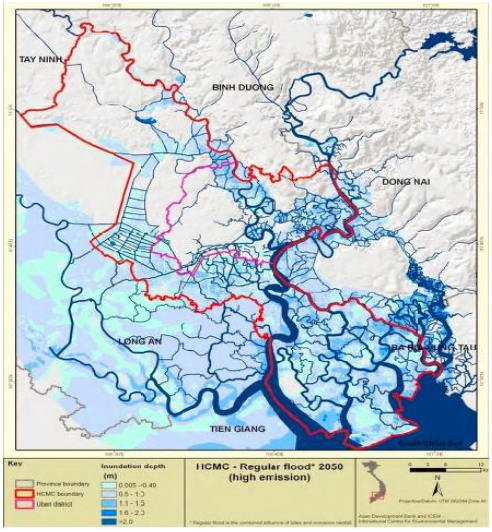
Source: *ADB & HCM DONRE, 2009*

Forecasting by 2050, the flooding in Ho Chi Minh City will be increased, including inundation depth and duration of flooding exceeding the current level of extreme catastrophes. The average flooding level will increase 40% for the extreme catastrophes, and 21% for normal flooding. Average duration of high flooding level will increase 12% in the cases of extreme catastrophes, and 22% compared to normal flooding cases.

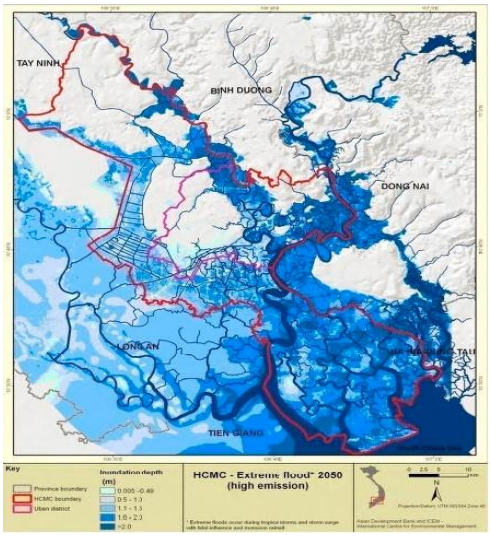
In addition, the study results also showed that the sea surface temperatures of the East Sea

region will be heated up leading hazard of cause of hurricanes and impact on Ho Chi Minh City, and frequencies of tropical storms and cyclones will increase in the East Sea and coast of Ho Chi Minh City. In addition, sea levels are expected to increase to 26 cm for the A2 scenario, and 24 cm for the B2 scenario that will affect resonantly on trend of current tidal flooding in the City. Only a small area of the city will be flooded everlastingly with scenario of sea level rising 26 cm by 2050. The eastern region is the area which is the most vulnerable under the impact of climate change.

Forecasting impacts of flooding by climate change in Ho Chi Minh City is shown in Figure 1.6 as following:



(a) Forecasting flooding with normal flooding in 2050



(b) Forecasting flooding with extreme catastrophes flooding in 2050

Figure 2. 6 The A2 flooding scenario by climate change by 2050 in HCMC

2.1.4.2. Current flood situation in BRT 1 corridor

According to statistics from the Steering Center of the Urban Flood Control Program (SCFC) in 2006-2009 (SCFC, 2010), the western region of the City including segment from Western Bus Station to An Lac Roundabout is one of the typical flood areas which should be monitored. Flooding figures and causes of flooding are summarized in the following Table 2.7:

Table 2. 8 Current flooding situation in area of Western bus station – An Lac roundabout

2008					**2009**				
Average rainfall intensity (mm/h)	Number of flooding	Height (m)	Area (m^2)	T (flood-ing period) (minute)	**Averag e** rainfall intensit y (mm/h)	Number of flooding	H (m)	Area (m^2)	T (min.)
20	11	0.21	3282	106	24	13	0.27	6135	197
Causes of	- Due to heavy rainfall, sunken terrain								

flooding	- high tide

Source: SCFC, 2010

According to the research results of Center for Flooding Prevention (2010) and the study of ADB and Ho Chi Minh DONRE (2009), the project areas in particular and in Ho Chi Minh city in general will be strongly affected by climate change, specially the project area in District 2.

In addition, according to the survey and community consultation results showed that flooding prone areas, which is located at the crossroads of Ho Ngoc Lam Street and Vo Van Kiet Boulevard. The segment through An Lac Commune is often flooded during raining time with considerable frequency of flooding; cause of localized flooding was considered that due to rain and flood tide from channel system with the low road surface.

Figure 2. 7 Current situation of flooding at crossroads on An Duong Vuong street in normal weather condition

Flooding situation in the District 2 in the project area

Saigon River region and canals through District 2 are suffered overall influence of high tide causing flooding in many locations as peaked tide. The segments of the project area along the route of East - West Boulevard are not directly affected by flooding due to terrain higher than surrounding areas. However, the routes connecting with the East - West Boulevard such as segment of Luong Dinh Cua Street and Tran Nao Street (Binh Khanh ward & An Khanh ward, District 2), these areas are located closely to the banks of canals the connecting Saigon River in District 2, are flooded during rainy season.

Figure 2. 8 Flooding on Luong Dinh Cua street, District 2

(Source: Tuoi Tre Online on December 4th 2013)

2.1.4.2. Impact assessment and vulnerability analysis of climate change impacts:

In assessment of climate change damage, transportation is one of the sector that should be considered that high vulnerable to climate change. In Ho Chi Minh City, network of transportation is considered as a strategic infrastructure, a large part of the transport system can be deactivated by impacts of flooding and economic activities . Business of citizen and freight from the port to the industrial zone will be influenced by flooded transport system. As prediction, all current types of roads of the city will be affected by flooding due to climate change by 2050 including links horizontal axis, ring roads, expressways, national highways and provincial roads (ADB and Ho Chi Minh MONRE, 2009). Link roads and ring roads will be protected in some measures by flood control system while expressways, national highways and provincial roads will not much be influenced by this system.

2.2. SOCIO-ECONOMIC SITUATION IN THE PROJECT AREA

The BRT 1 is through several districts in Ho Chi Minh City, connecting to different socio-economic characteristics in the areas.

2.2.1. Population, labor, employment and poverty

Ho Chi Minh City is the most populous city in the country (as of 2012, according to the General Statistics Office) with rapid population growth due to the urbanization process. Only from 1995 to 2012, Ho Chi Minh City has increased around 3 million people (from 4.6404 million in 1995) with a average population growth rate is 3.01% /year. The trend of urbanization has been taking place is expected to increase the population of the city. The population will be strongly increased at semi-urban districts, which currently has a low population density and vacant land in HCMC.

As the information above, in the project areas, the central districts such as District 1, 5, 6, and a part of District 8 and Binh Tan district are urban districts, and the rest will be converted from semi-urban to urban areas in the future.

Table 2. 9 Demographic characteristics and population density in the areas belong to the project

Nº	District	Population	Area	Density
		person	*km²*	*persons/km²*
1	Binh Chanh District	465,248	252.69	1,841
2	Binh Tan District	430,350	22.38	19,229
3	District 8	421,547	19.18	21,978
4	District 6	251,902	7.19	35,035
5	District 5	175,217	4.27	41,034
6	District 1	185,715	7.73	24,025
7	District 2	136,497	49.74	2,744
8	Whole the City	7,521,138	2,095.01	3,590

Source: Ho Chi Minh City Statistical Yearbook in 2012

According to the results of environment surveys, population density in the region is about 2,195 persons/km^2, 8.5 times higher than the average population density of the country (257 persons/km^2) and lower than the average population density in Ho Chi Minh City (3,401 person/km^2). In the wards/communes in project areas, a family has average 4 persons/ household. Average rate of female population is about 52%, higher than average rate of national female (50.84%); average rate of natural population growth is 0.6%.

Living standard of residents in wards/communes belong to the project areas are rather good with 30% wealthy households, 50% prosperous households, 18% middle households, and 2% poor households. The residents are living along the project take advantage of houses closing at the road for trade and services. Average income is about 2-10 millions vnd/month/person.

Based on 50 household questionnaires, most of them are resident live through many generations at the project areas. Average number of a household are 4 or 5 persons, in which, most are in the labor age (80%). Living condition of these households is rather good, 100% household use electricity, tap water, and toilet meet standard. Structure of house is strong and they are the multistory houses.

2.2.2. Basic technical infrastructure: electricity, water supply, education and healthcare

Health care: All of wards/communes belong to the project area have medical aid stations, specially some wards have hospital to care health for residents. Rate of heath care facilities per 1,000 people of wards/communes in the project area is 0.05, lower than the national rate (0.16).

Education facilities: Most of wards/communes in the project areas have kindergarten, primary school, secondary school, high school; percentage of school per 1,000 people in wards/ communes is 0.2 – 0.5%, which is lower than national percentage (0.47%).

Table 2.10 below provides information of historical and cultural infrastructures as well as educational and health care centers in the project corridor:

Table 2. 10 List of schools, hospitals, and cultural belief infrastructures in project corridor

Type	Infrastructures	Description
School	Primary school of Kim Dong (Commune 3, District 6) Kindergarten of Rang Dong (Commune 1, District 6) Hong Ban International University (Commune 6, District 5) Primary school of Ham Tu (Commune 1, District 5) Primary school of Chuong Duong (Commune Cau Kho, District 1) Australia International School AIS (District.2) International School ACG Vietnam (District.2)	Located closely to Vo Van Kiet – Mai Chi Tho Boulevard from 50 – 100 m
Hospital	Nhiet Doi Hospital Tam Than Hospital Saigon-ITO hospital District 4 Hospital	Located closely to Vo Van Kiet – Mai Chi Tho Boulevard from 30-70m
Cultural value	Thien Hau Temple (Cau Ong Lanh Commune, District 1) Minh Dang Quang Temple (Cat Lai T-junction)	Located closely to Vo Van Kiet – Mai Chi Tho Boulevard from 30-100m
	Dai The Gioi Water Park	Located closely to Vo Van Kiet – Mai Chi Tho Boulevard around 50m

Power supply: Current ssituation of power supply in the project area is well done, 100% of households are using electricity which is supplied by Ho Chi Minh City Power Corporation.

Water supply: 100% of people are full of water supply, which is supplied by SAWACO, wells and rainwater.

2.2.3. Current traffic situation

Traffic load on Vo Van Kiet – Mai Chi Tho Boulevard

According to traffic survey data , traffic volume on Vo Van Kiet – Mai Chi Tho Boulevard is high, in which motorcycle is dominated mode. Traffic congestion temporary occurs at intersections during rush hours. There are 21 graded intersections, 2 interchanges and 3 interchanges will be formed in the future on Vo Van Kiet – Mai Chi Tho Boulevard.

Table 2. 11 Traffic load on on Vo Van Kiet – Mai Chi Tho Boulevard

Route	**Car**	**Truck with 2 axes & bus under 25 seats**	**Truck with 3 axes & bus over 25 seats**	**Heavy Truck**	**Moto-bicycle**	**Bicycle**	**Total**
Vo Van Kiet Boulevard							
- Toward Mai Chi Tho	1286	1275	96	1	23053	172	25883
- Toward National Highway 1A	1390	1012	125	1	23576	88	26192
Mai Chi Tho Boulevard							

- Toward Vo Van Kiet	1213	1073	146	186	16411	29	19058
- Toward Hanoi Highway	1650	933	129	202	20662	19	23594

Traffic accidents

Traffic police, who responsible for rail and road traffic of Ho Chi Minh City, has provided traffic accident data along Vo Van Kiet – Mai Chi Tho corridor in Table 2.12. In which the number of accident has been slightly increased with 6 cases was in 2010, 12 cases in 2011, 20 cases in 2012 and 40 cases in 2013.

Table 2. 12: Accident Rate along the Corridor

Kind of Lost	Year			
	2010	2011	2012	2013
Total of accidents	6	12	20	40
Injury cases	6	22	6	13
Death cases	3	12	15	30
Accident probability per million vehicle travel (km)	0.006	0.012	0.020	0.040
Death probability per million vehicle travel (km)	0.009	0.034	0.021	0.043

Source: Traffic safety data of Traffic Police Office of Ho Chi Minh City, 2013

Public Transportation

There is only public bus route 39 currently operating on this corridor. The bus No.39 goes from Mien Tay Terminal to Ben Thanh and vice versa every 15 minutes.

By investigation of 150 questionnaires for bus passengers at stations along the alignment, it is showed that number of persons knowabout the Bus Rapid Transship (BRT) is quite small, only above 20% of respondents. However, 100% interviewees agree and choose this service when they know that BRT1 will be operated soon. Assessments about the existing bus service showed that they select to use the service due to low ticket price, safety and convenience.

2.2.4. The economic structure of the Project area

Main occupation is commercial and service (70%), public servant and freelance (15%), traditional production (10%), agriculture (5%) (in District 8 and Binh Chanh district). People living in these wards/*communes* take advantage of houses near the road, or near the market, companies or enterprise, etc. many types of commerce are concentrated in the central squares as District 1, 5 and 6. Average income of people in the wards/communes is about 2,500,000 VND/month/person.

2.2.5. Economic conditions along route of the project

Economical features along route of the project ares multiform, including many occupations as business, freelance, civil servant, etc. *Business* is main focus (80%), with many types as restaurants, hotel, inn, cafe shops, groceries, building material shop, and telephone repairing shop, etc. These households have high income, approximate from 5 to 10 million VND/month.

2.2.6. The historical monuments, cultural heritage

Along the route of the project, there are cultural and historical monuments such as Traditional House of Ward 1, (district 5), Saint Giuse Church in Ward 5, District 5. However, these historical monuments will be unaffected by the construction activities. The rehabilitation of existing roads, constructing flyovers can be generated dust and noise but it is far from the location of cultural monuments, therefore these traditional houses will not be affected and damaged by the project activities.

2.2.7. Related projects are implementing in the project area

Projects of constructing commercial districts, offices and residential quarters: feature of the project area through on the right side of Vo Van Kiet street (direction from national highway 1 - Thu Thiem) are Tau Hu - Ben Nghe canal system, and passing canal in District 8. On the left side of route of the East - West boulevard, segment of Vo Van Kiet boulevard are areas of Binh Tan District, District 6, District 5, District 1 and Binh Chanh District. Along this route is developed residential areas, administrative offices and business households, therefore construction projects on this segment are office buildings, residential areas, housing and business, etc.

The Project of improvement of surface water quality: current segment of Lo Gom Bridge to Tau Hu region is implementing one of project items to rehabilitate the water environment in HCMC.

The project develops along Mai Chi Tho Boulevard: segment of the Thu Thiem tunnel to Cat Lai area in District 2, is in the development stage with a series of building projects residential areas and administrative areas. And intersection with the East - West route also has Long Thanh - Dau Giay expressway project is under construction.

2.2.8. Development planning in the project area

The East-West Boulevard is a arterial road in Ho Chi Minh City. In the future, the first point of the East - West boulevard (Binh Chanh District) will be connected with the Ho Chi Minh City - Trung Luong expressway. According to HCMC transportation planning, the end region of East-West expressway (District 2) will be connected to the Ho Chi Minh City - Long Thanh - Dau Giay expressway, thereby it helps promote trade from the Mekong Delta provinces, Southeast region and Central provinces, Northern region and contributes to the economic development of Ho Chi Minh City. At the same time, when the Long Thanh International Airport will be constructed (located in Dong Nai Province, about 40 km far from the Ho Chi Minh City), Ho Chi Minh City and the South East region will be connected to the Long Thanh international airport by the East-West route.

BRT 1 as well as East-West Boulevard will pave the way for slackening density of urban residents to the East and the South particularly contributes importantly to develop a new commercial center in Thu Thiem, District 2. Thu Thiem new urban area is about 300m far to the Thu Thiem tunnel and 200 meters to Mai Chi Tho street, this is a new urban area with 8 functional areas which are divided to the specific characteristics of complex used function,

separate building density, the public spaces and landmark building. Thu Thiem has a total population of 145,400 residents, 219,200 regular working people, and 1 million nonresidents.

In addition, two sides of the Vo Van Kiet – Mai Chi Tho route are still devoted to planning development and expansion of schools, hospitals, public buildings and residential areas. According to the planning by 2020 with a vision to 2050, which is recently published by the Ministry of Construction, industrial parks will not be established in the central area of radius 30 km in Ho Chi Minh City (Website: HCMC Department of Planning - Architecture, 2014), and current industrial parks will be converted into the high-tech parks, green industrial parks, thereby industrial parks will not be developed on both of two sides of the Vo Van Kiet – Mai Chi Tho route.

2.3. CURRENT SITUATION OF ENVIRONMENTAL COMPONENTS IN THE PROJECT AREA

2.3.1 Air quality

- *Sources of pollution*
  - Traffic activities;
  - Decomposition waste along the Tau Hu - Ben Nghe canal;
  - Activities of residential areas along the route of East – West boulevard;
  - Activities of cottage industries and handicrafts factories.
- *Air Sampling*

To assess the current situation of air environment in the project area, groups have conducted measuring samples from June 04th 2014 until June 9th 2014 at typical locations in the project areas such as:

- *Terminal region of the beginning and the end of the route, which are expected to build functional facilities:* KK1, KK6; R1, R6.
- *Residential area*s: KK2, KK4; R2; R4.
- *The areas near the hospital, schools:* KK3, KK5; R3, R5.

Locations of sampling air environment are presented in Table 2.13 and Figure 2.9:

Table 2. 13 Locations of sampling air environment in the project area

No	Sign	Current location	Coordinate	Socio-economic creatures of sampling area
1	KK1	Mien Tay Moi bus station area	10°41'22.93"N, 106°35'43.54"E	Along QL1, there are small traders, and other services as vehicle workshops. Vehicle density is high.
2	KK2	Resident area of Ward 3 (Cross between 2 streets: Vo Van Kiet and Pham Phu Thu)	10°44'28.72"N, 106°38'43.94"E	Residential density is high, trade and service types are abundant. Vehicle volume is high, without heavy truck.
3	KK3	Hospital for tropical diseases – Vo Van Kiet	10°45'8.04"N, 106°40'40.08"E	
4	KK4	Residential area near Ong Lanh Bridge	10°45'45.85"N, 106°41'49.53"E	
5	KK5	AIS International School	10°47'14.50"N,	Construction activities on both sides of

No	Sign	Current location	Coordinate	Socio-economic creatures of sampling area
		Vietnam – Mai Chi Tho	106°44'57.24"E	road. Vehicle density is normal, with many vehicle types.
6	KK6	End point of the Project, near Rach Chiec Bridge	10°48'7.95"N, 106°45'14.02"E	

- *The parameters of air quality assessment*

Indicators of air pollution are monitored the basic parameters of the ambient air environment, including:

- Temperature, humidity, wind velocity, wind direction, air pressure;
- Dust PM10, TSP, CO, NO_2, SO_2;

- *Method of measurement, sampling and analysis of air indicators*

Methods of measurement, sampling and analysis of air pollution indicators was conducted based on Vietnam standard. Air quality indicator is measured twelve consecutive times in one day, every two hours /measurements, and every thirty minutes for each measurement.

Equipment for measuring sample are shown in Table 2.14 as below:

Table 2. 14 Equipments for measuring air environmental quality in the project area

Nº	Parameter	Equipment and methods
1	Temperature, humidity, wind velocity, wind direction, pressure	POCKET WEATHER TRACKER 4500
2	Dust and PM10	EMPAM 5000
3	CO, NO_2, SO_2	MULTI - GAS MONITOR IBRID MX6

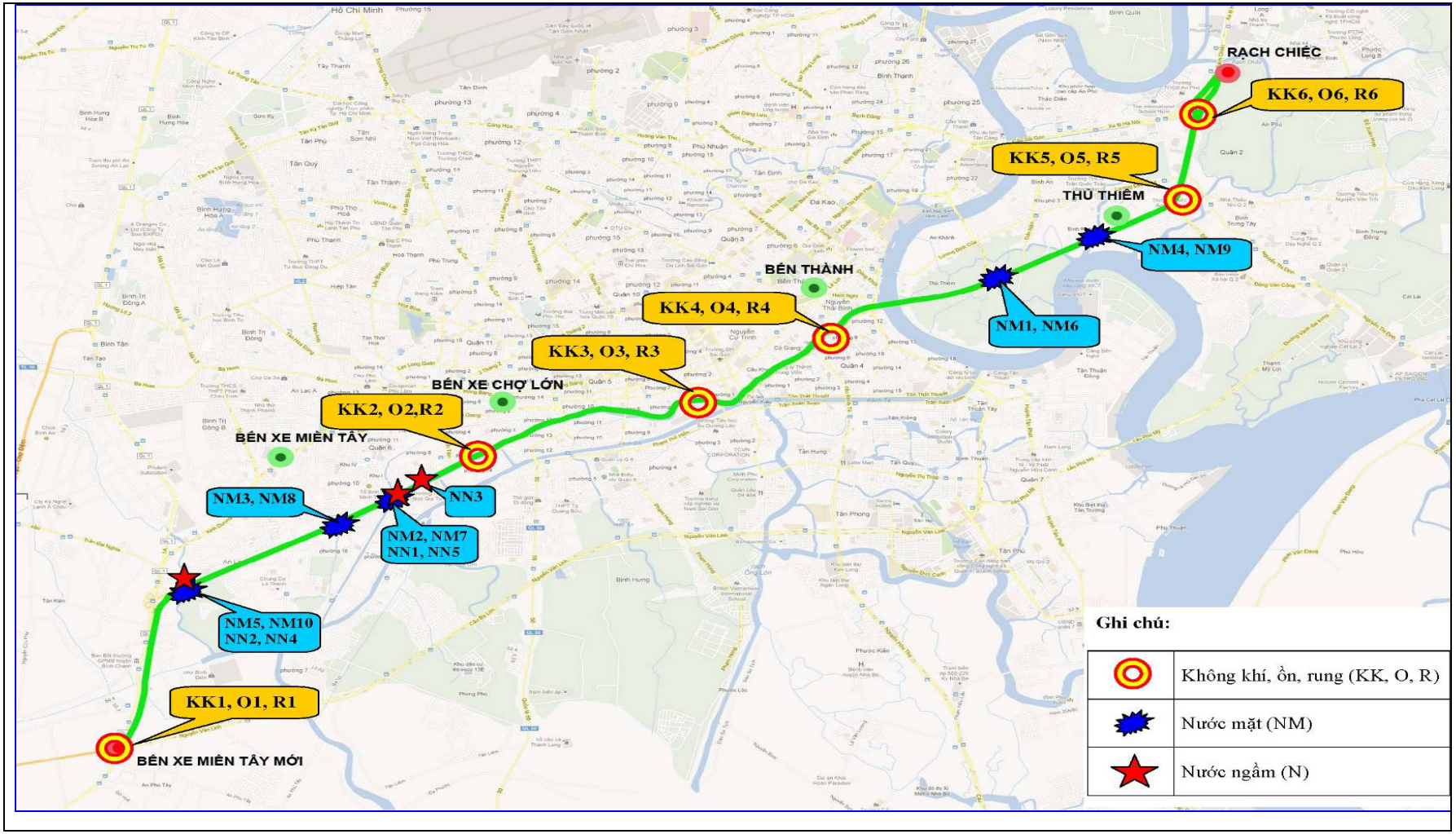


Figure 2. 9 Sampling maps for environmental baseline assessment

- *Measurement result and assessment*

Current air quality is presented in Table 2.15 as below:

Table 2. 15 Results of measuring indicators of microclimate and ambient air

No	Sample/ Location	Time	Temp	Humidity	Wind velocity	Pressure	PM10	TSP	CO	NO_2	SO_2
			°C	%	m/s	hPa	mg/m3				
1	KK1	1h	37.0	89.9	2.2	1007.6	0.139	0.142	2.070	0.034	0.061
		24h	31.1	77.3	1.1	1004.9	0.094	0.101	1.157	0.024	0.034
2	KK2	1h	35.3	72.4	1.7	1006.2	0.156	0.180	1.980	0.028	0.042
		24h	31.2	70.2	1.2	1004.6	0.089	0.111	1.377	0.018	0.026
3	KK3	1h	35.4	71.1	2.0	1006.0	0.098	0.140	1.752	0.026	0.021
		24h	32.4	66.5	1.0	1005.0	0.072	0.089	1.010	0.014	0.012
4	KK4	1h	35.8	74.1	1.6	1006.3	0.126	0.200	1.245	0.018	0.019
		24h	32.4	65.3	1.1	1005.1	0.080	0.102	0.976	0.012	0.013
5	KK5	1h	34.7	85.6	2.1	1008.8	0.118	0.157	1.003	0.026	0.019
		24h	31.1	76.9	1.2	1004.7	0.079	0.103	0.885	0.015	0.011
6	KK6	1h	35.9	79.8	2.0	1006.2	0.092	0.106	1.120	0.029	0.027
		24h	31.1	73.8	1.2	1003.9	0.055	0.069	0.944	0.019	0.016
QCVN 05:2013/BTNMT		**1h**	**-**	**-**	**-**	**-**	**-**	**-**	**0.,3**	**30**	**0.2**
		24h	**-**	**-**	**-**	**-**	**-**	**0.15**	**0.2**	**-**	**0.1**

Comments: By comparison with the National Technical Regulation on Ambient Air Quality - QCVN 05:2013/BTNMT, the analysis results of air environmental indicators such as CO, SO_2, NO_2 are within allowable limits and much lower than QCVN 05:2013/BTNMT. It shows that the quality of air environment is still good condition in the project areas. The parameters of noise and vibration are evaluated sin Section 2.3.2.

2.3.2. Current situation of noise, vibration

- *Sources of noise and vibration pollution*: sources causing noise and vibration pollution are mainly from transportation and construction activities along the route.
- *Network of sampling noise and vibration:* Network of sampling noise and vibration are located as follows:

- *Terminal region of the beginning and the end of the route, which are expected to build functional facilities:* O1, O6.
- *Residential area*: O2, O4.
- *The areas near hospitals, schools:* O3, O5.

Table 2. 16 Locations of sampling noise and vibration environment in the project area

No	Code	Current location	Coordinate	Socio-economic creatures of sampling area
1	O1, R1	Mien Tay Moi bus station area	10°41'22.93"N, 106°35'43.54"E	Along NH1, there are small traders, and other services as vehicle workshops. Vehicle density is rather high.
2	O2, R2	Resident area of Ward 3	10°44'28.72"N,	Residential density high,

No	Code	Current location	Coordinate	Socio-economic creatures of sampling area
		(Cross between 2 streets: Vo Van Kiet and Pham Phu Thu)	106°38'43.94"E	trade and service types are abundant. Vehicle volume is much, without heavy truck.
3	O3, R3	Hospital for tropical diseases – Vo Van Kiet	10°45'8.04"N, 106°40'40.08"E	
4	O4, R4	Residential area near Ong Lanh Bridge	10°45'45.85"N, 106°41'49.53"E	
5	O5, R5	AIS International School Vietnam – Mai Chi Tho	10°47'14.50"N, 106°44'57.24"E	Construction activities on both sides of road. Vehicle density is normal, with many vehicle types.
6	O6, R6	End point of the Project, near Rach Chiec Bridge	10°48'7.95"N, 106°45'14.02"E	

- **Method of measurement, sampling and analysis of noise and air parameters**

Method of measurement, sampling and analysis of noise and vibration indicators was conducted under Vietnam standard. Noise and vibration indicators were measured 16 consecutive times in one day, from 06am to 22pm, and every 5 – 10 minutes for each measurement.

Equipment for measuring sample are shown in Table 2.17 as below:

Table 2. 17 Equipments for measuring noise and vibration environmental quality in the project area

Nº	Parameter	Equipment and method
1	Noise	INTEGRATING SOUND LEVEL METER TYPE 6226
2	Vibration	VIBRATION LEVEL METER VM-1220

Current situation of noise *and vibration level***:**

Summary, results of measurement were presented in Table 2.18. Compared to the National Technical Regulations on Noise & Vibration – QCVN 26:2010/BTNMT and QCVN 27: 2010 / BTNMT, it is found that measured noise and vibration levels in the project area are lower than allowable limit.

Table 2. 18 Result of measuring noise and vibration in the project area

Nº	Sample/Location	Time	Noise	Vibration
			Leq (dBA)	
1	O1, R1	Average 6-21h for noise & 6-22h for vibration	66.1	54.6
2	O2, R2		67.3	51.8
3	O3, R3		68.0	52.5
4	O4, R4		68.5	53.1
5	O5, R5		64.9	55.2
6	O6, R6		67.7	57.7
QCVN 26:2010 BTMT		Average 6-21h	**70.0**	**-**
QCVN 27:2010/BTNMT		Average 6-22h	-	**70,0**

Comments: By comparison with the National Technical Regulation on noise - QCVN 26:2010/BTNMT and National Technical Regulation on Vibration QCVN 27:2010/BTNMT threshold, the analysis results of noise and vibration on the route of the project are within allowable limits. However, the average value of the noise level are approximately allowable limits, but in fact, in the rush hour traffic, the local noise level exceeded the above threshold.

2.3.3. Surface water quality

- *Source of pollution***:**

.The BRT bus route number 1 runs parallel to the Tau Hu - Ben Nghe canal system and crosses the Saigon River received wastewater from households as well as other sources the project area. The project area is located in the lower basin of the Saigon River and is affected by ebb and flow of tide.

- *Network of surface water sampling*

To assess the current status of surface water quality in the project area, a study team conducted site survey which includes taking sample, analysis water quality along project route from June 5th 2014 – June 12th 2014.

Hydrological and hydro meteorological at the time of sampling: Samples of surface water are taken 2 times per day (at the time of ebb and flow). The time of sampling is on June 2014, in the dry season.

- Sampling areas at Rach Kenh 2 canal, Rach Nuoc Len canal: influenced by the East Sea tide, tidal amplitude is quite large, about 2.5 ÷3.5m. Maximum tide water levels from 0.96 ÷ 1.28m and minimum tide water levels from -2.11 to 1.22m; Flow rate is influenced by the tide in the dry season: v = 0.75 ÷ 1.0km/h; samples were taken between the water flow, about 15 ÷ 17 m from banks.
- Sampling areas at Lo Gom, Ruot Ngua canal: the hydrological regime of the river and canal depends on two main factors, which are semi-diurnal of Saigon River and rainfall regimes. The average tidal levels from 1.0 ÷ 1.1 m, the highest tide level from 0.3m to 1.6m; The flow rate is low; Samples were taken between the water flow, about 15 ÷ 17m from canal banks

Network of sampling as follows:

- *Sampling at the time of high tide:* 05 samples NM1, NM2, NM3, NM4, NM5*;*
- *Sampling at the time of ebb tide:* 05 samples NM6, NM7, NM8, NM9, NM10.

Table 2. 19 Locations of sampling surface water environment in the project area

N^{o}	Sign	Current location	Coordinate	Note
1	NM1	Kenh 2 channel	10°46'26.10"N: 106°43'28.90"E	High tide
2	NM6			Ebb tide
3	NM2	Lo Gom channel	10°44'3.48"N; 106°38'3.76"E	High tide
4	NM7			Ebb tide
5	NM3	Ruot Ngua channel	10°43'48.65"N;	High tide

6	NM8		106°37'39.03"E	Ebb tide
7	NM4	Ca Tre Nho channel	10°46'51.53"N; 106°44'17.55"E	High tide
8	NM9			Ebb tide
9	NM5	Nuoc Len channel	10°43'7.03"N; 106°36'15.01"E	High tide
10	NM10			Ebb tide

- *The parameters of surface water quality assessment*

Indicators of surface water environment assessment include TSS, COD, BOD_5, total oil and parameters such as: temperature, pH, turbidity, conductivity, DO.

- *Method of measurement, sampling and analysis of surface water indicators*

Methods of sampling, measurement and analysis were conducted in accordance with the regulations and guidelines, the methods for collecting and analyzing samples are shown in Table 2.20 as below:

Table 2. 20 Methods and equipments for measuring and analysing surface water quality

STT Nº	Parameter	Equipment/Method
1	pH, temperature, conductivity, turbidity, DO	TOA WQC-22A/ Direct measurement
2	TSS	TCVN 6625:2000
3	COD	SMEWW 5220 C:2012
4	BOD_5	TCVN 6001-1:2008
5	Total oil	SMEWW 5220 B:2012
6	E.coli, Coliforms	TCVN 6187-2:1996

- *Measurement result and assessment*

Current surface water environmental quality in the project area is presented in Table 2.21 as below:

Table 2. 21 Result of measuring surface water environmental quality in the project area

Nº	Sign	T°C	pH	Conductivity	Turbidity	DO	TSS	COD	BOD_5	Oil	Coliforms	E.Coli
		°C	-	*s/m*	*BTU*			*mg/l*			*MNP/100 ml*	
1	NM1	30.3	6.5	0.045	30	3.4	45	18	10	0.01	$1.5x10^3$	$4.6x10^2$
2	NM2	31.1	6.8	0.179	40	0.2	43	18	9	0.02	$4.6x10^4$	$2.4x10^4$
3	NM3	31.1	6.9	0.177	42	0.4	10	14	6	KPH	$2.4x10^4$	$9.3x10^3$
4	NM4	31.3	6.8	0.031	44	3.2	10	16	7	KPH	$1.1x10^3$	$2.4x10^2$
5	NM5	31.2	7.0	0.196	36	4.2	91	20	11	0.03	$1.1x10^3$	$4.3x10^1$
6	NM6	30.6	6.6	0.049	36	3.4	38	15	5	0.01	$1.5x10^2$	$4.3x10^1$
7	NM7	30.8	6.9	0.169	46	0.3	40	16	6	0.01	$4.6x10^2$	$4.3x10^1$
8	NM8	30,3	7.0	0.148	58	0.6	9	12	6	KPH	$2.4x10^4$	$9.3x10^3$

9	NM9	31.2	6.9	0.062	50	3.4	11	12	5	KPH	$4.3x10^1$	$2.3x10^1$
10	NM10	30.1	7.0	0.18	55	4.5	78	17	9	0.02	$1.1x10^1$	$4.6x10^3$
QCVN 38:2011/BTNMT		-	**6.5-8.5**	**-**	**-**	**>=4**	**>=100**	**-**	**-**	**-**	**-**	**-**
QCVN 08:2008/BTNMT - B1		-	**5.5-9.0**	**-**	**-**	**>=4**	**>=50**	**30**	**15**	**0,1**	**7500**	**100**
QCVN 08:2008/BTNMT – B2		-	**5.5-9.0**	**-**	**-**	**>=2**	**>=100**	**50**	**25**	**0.3**	**10000**	**200**

Note:

- KPH: Undetected
- QCVN 38:2011/BTNMT - National technical regulation on surface water quality for protection of aquatic lives.
- QCVN 08:2008/BTNMT - National technical regulation on surface water quality. B1 column – Using for irrigation and other purposes with similar requirements for the water quality or purposes of type B2. B2 column – Waterway traffic and other purposes with low requirements on the water quality.

Comments: The analysis of surface water results show that the project area is being polluted surface water on indicators such as dissolved oxygen (DO), and especially microbiology. There is only a number of samples analyzed at ebb tide had microbiology content within allowable limit, the remainder is over threshold from 2-40 times under columns B in QCVN 08: 2008 / BTNMT.

2.3.4. Ground water environmental quality

- *Network of ground water sampling:* Network of sampling as follows:

05 samples are taken along the project area: areas of Lo Gom channel; Nuoc Len channel; Ward 7, District 6; An Lac Ward - Binh Tan District; Ward 10 - District 6.

Locations of sampling groundwater environmental quality are described in Table 2.22 as below:

Table 2. 22 Locations of sampling ground water quality in the project area

Nº	Sign	Current location	Coordinate	Note
1	NN1	Lo Gom channel	10°44'3.48"N; 106°38'3.76"E	
2	NN2	Nuoc Len channel	10°43'7.03"N; 106°36'15.01"E	
3	NN3	Ward 7, District 6	10°52'19"N; 107°39'9"E	
4	NN4	An Lac ward, Binh Tan District	10°50'47"N; 107°40'12"E	
5	NN5	Ward 10, District 6	10°52'19"N; 107°39'9"E	

- *The parameters of ground water quality assessment*

Groundwater quality were be assessed by the following parameters: temperature, pH, conductivity, turbidity, salinity, DO, hardness, total solids (TS), COD, total iron and arsenic; and coliforms, E.Coli.

- *Method of measurement, sampling and analysis of ground water indicators*

Measurement, sampling and analysis were conducted under the testing standards. In particular, parameters such as pH, conductivity, turbidity, salinity, DO were measured directly sampling; while the remaining parameters were tested in the laboratory. Details are shown in Table 2.23 as below:

Table 2. 23 Methods and equipments for measuring and analysing ground water quality

№	Parameter	Equipment/Method
1	pH, temperature, conductivity, turbidity, salinity, DO	TOA WQC-22A/ Direct measurement
2	Hardness ($CaCO_3$)	TCVN 6624:1996
3	Total solids (TS)	SMEWW 3540 B:2012
4	COD ($KMnO_4$)	TCVN 6186:1996
5	Total iron	SMEWW 3500 Fe,B:2012
6	Arsenic	SMEWW 3500 As,B:2012
7	Coliforms, E.Coli	TCVN 6187-2:1996

- *Measurement result and assessment*

Current ground water environmental quality in the project area is presented in Table 2.24.

Table 2. 24 Result of measuring ground water environmental quality in the project area

Sign	T°C	pH	Conductivity	Turbidity	Salinity	DO	Hardness	TS	COD	T-Fe	T-As	Coliforms	E.Coli
	°C	-	s/m	BTU	%			mg/l				MNP/100 ml	
NN1	21.5	6.4	0.045	46	0.016	4.5	36	396	1.2	3.975	KPH	KPH	KPH
NN2	22.7	6.9	0.003	14	0.05	3.9	146	102	0.6	0.088	KPH	KPH	KPH
NN3	23.5	6.1	0.004	16	0.02	3.8	58	85	0.5	0.041	KPH	$2.4x10^3$	$2,4x10^2$
NN4	22.3	6.1	0.065	2	0.033	4.2	62	81	0.5	0.064	KPH	KPH	KPH
NN5	23	7.2	0.045	35	0.025	4.5	79	63	0.7	0.055	KPH	$2.4x10^2$	$2,3x10^1$
QCVN 09:2008/BTNMT		**5.5-8.5**	**-**	**-**	**-**	**-**	**500**	**1500**	**4**	**5**	**0.05**	**3**	**KPH**

Note:

- QCVN 09:2008/BTNMT: National technical regulation on ground water quality
- KPH: Undetected

Comments: By comparison with the National technical regulation on ground water quality - QCVN 09:2008/BTNMT, most indicators are shown current situation of groundwater quality in the project area were within allowable limits, but ground water in areas of ward 7 (NN3) and ward 10 (NN5) in District 6 are infected microbiology over threshold many times under QCVN 09:2008/BTNMT.

2.3.5. Current situation of waste management

Currently, there are two collection system of domestic garbage that are public collection system and private collection system, in Ho Chi Minh City.

The public garbage collection system consists of public service companies in the project areas, this system undertakes sweeping the entire street cleaning, garbage collection at markets, agencies and public works, and performs domestic garbage collection for approximately 30% of households in the project area and then brings to transfer stations or directly to landfills. .

Private garbage collection system consists of individual waste collectors, collectors unions and environment sanitation cooperatives. Private collectors collect garbage primarily (contractual agreements under the management of the Ward People's Committee) of approximately 70% of households and the family firms in the project areas. Private garbage collection system is responsible for cleaning up garbage in the alley, then gathering trash along the way to pick-up location or feeder trash and garbage transfer for transporting garbage units.

For public garbage collection system, the collection is stable. The system will be responsible for maintaining activities of garbage collection in public areas, street sweeping.

Regarding domestic wastewater in the area, according to the Ho Chi Minh City Steering Center of the Urban Flood Control Program (2013), under the drainage master plan in Ho Chi Minh City, target of domestic drainage for citizen is up to 315 liters/person/day in 2020. Ho Chi Minh City is considered a pioneer in domestic wastewater treatment, there is a wastewater treatment plant in the project area, which has the capacity to treat up to 141,000 m3 wastewater/day in phase 1 in Binh Chanh District. Wastewater in District 1, 5, 8, located in Tau Hu - Ben Nghe – Kenh Doi - Te canal basin, will be collected by a distinct wastewater collection drain system. The system will be separated with current rainwater drainage systems and connect to waste water treatment plant. However, currently according to the Ho Chi Minh City Steering Center of the Urban Flood Control Program, treated wastewater in Ho Chi Minh City reached only about 1/10 total amount of daily wastewater. Wastewater in BRT route 1 (outside of District 1, 5, 8) is discharged into drainage systems and canals of the city.

2.3.6. Description of the current situation of the sensitive objects

Because of the characteristics of the project area is urban ecology, and none of natural conservation sites, so sensitive points were identified as areas potentially crowded residents; or cultural values of belief; ecosystems and surface water (canals) can be easily affected by the activities of the project

The dominated ecosystem in the project area is urban ecology, which have experienced rapid urbanization process, there are no natural reservation areas or high ecology value area have been found in the project area. Thus, the sensitive objects are residential areas, schools, hospitals, cultural/historical subjects, or canals which could be sensitive with project’s negative impacts.

To the Technical Facility area: it is the planned area of Thu Thiem railway station, which has not yet constructed. Existing land is covered by green vegetation layer, and besides the residential areas, offices, schools are being built under the planning;

The Rach Chiec end terminal station - Using land of the Rach Chiec Sports Complex, opposite to Cat Lai T-junction at intersection with the Hanoi Highway and Rach Chiec Bridge; ahead of Rach Chiec canal. On the side of the terminal area, residential areas are not allowed development such as opposite to the Hanoi Highway, but there are still some residential areas nearby.

The list of detailed description, location map of sensitive locations is presented in Figure 2.10 as below and in annex 1:

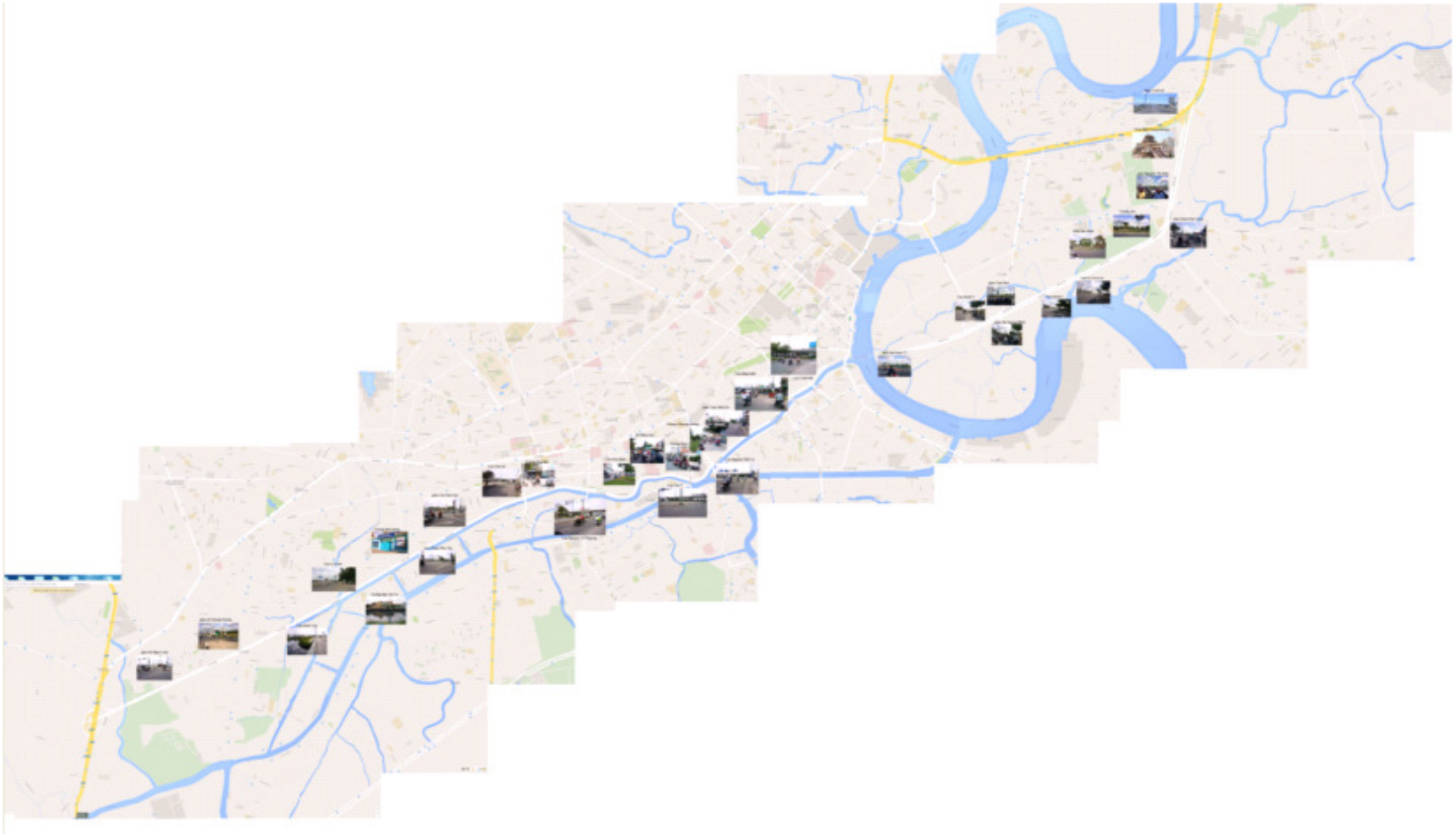


Figure 2. 10 Sensitive objects located long the BRT route

CHAPTER III
ASSESSMENT OF IMPACTS

3.1. INTRODUCTION

The project aims to improve the quality of environment and transportation for the city. This chapter focuses on potential environmental impacts including both positive and negative impacts as well as short and long-term impacts. The analyses were based on the components of the project that will be implemented, and environmental impacts were assessed according to the project implementation phases including i) pre-construction phase; ii) construction phase; and Operation phase.

Environmental impacts were all considered with regard to the policy framework of World Bank (WB) as well as Vietnam national regulations. The negative impacts will be controlled and mitigated while the positive impacts will be enhanced.

The Green Transportation Project (GTP) includes construction of a BRT line along the current Boulevards of Vo Van Kiet and Mai Chi Tho, connecting with new residential areas and planned areas of residential development in the future. The project area is characterized as low biodiversity without any protected species. The main characteristics of this urban ecosystem are unused land, land under construction, and polluted surface water in channels with low biodiversity.

Land acquisition caused by the GTP will be limited because almost all construction activities will be undertaken within the existing boundaries of Vo Van Kiet – Mai Chi Tho Boulevards. Land acquisitions include: i) Thu Thiem Technical Facility to be located at Thu Thiem railway station with an area of 1.0 ha and 0.77 ha for its connection road; ii) Rach Chiec Terminal, with an area of 0.58 ha,to be located at Rach Chiec Sport Complex which is identified in the city development plan. The rapid environmental assessment indicated that no environmental, social or culturally sensitive areas will be significantly impacted along BRT line 1.

Almost all environmental impacts will occur during construction and operational phases of the project. Those impacts will be quantified and pollutant concentrations monitored. Generally, activities of the project will not significantly impact on the environment and society.

3.2. ANALYZING IMPACTS OF ALTERNATIVES

3.2.1 Assessing“with project” and “without project” alternatives

This section will analyze two alternatives that include WITHOUT PROJECT as Alternative 1, and WITH PROJECT as Alternative 2.

- Alternative 1: (WITHOUT PROJECT) will analyze travel demand along Vo Van Kiet – Mai Chi Tho Boulevards in the next 10 – 20 years without the proposed project.
- Alternative 2: (WITH PROJECT) will analyze travel demand along Vo Van Kiet – Mai Chi Tho Boulevards in next 10 – 20 years with implementation of the project.

Results of the analyses are shown as follows.

Table 3. 1 Analyses of alternatives – WITHOUT PROJECT and WITH PROJECT

Main environmental and social issues	WITHOUT PROJECT	WITH PROJECT
Air pollution and Greenhouse Gas (GHG) emissions	Degraded air quality Increasing use of personal transportation resulting from: • Development of new urban areas of Thu Thiem. • Population growth along Vo Van Kiet Boulevard (with growth rate of 1%). • Operation of new Mien Tay Passenger Terminal and increasing travel demand. • Development of new residential areas around An Lac intersection. • Inefficient existing buses that do not meet EURO II standard Population growth along Vo Van Kiet – Mai Chi Tho Boulevards from migration could result in increasing travel demand, greater use of personal vehicles, and hence more air pollution. The application of emission standards for road vehicles, both assembled and imported, need to follow Decree 49/2011 of the Prime Minister, which states: - two wheel vehicles need achieve Euro 3 standard from 01/01/2017; - automobiles need to achieve Euro 4 standard from 01/01/2017 and Euro 5 standard from 01/01/2022. Management of vehicle emissions at the local level, following the Decree 909/2009 of Government, states: - From 2010 – 2013: 20% of motorcycles in Hanoi and Ho Chi Minh cities must be inspected as well as maintained to meet emission standards. - From 2013 – 2015: 80 - 90% of motorcycles in Hanoi and Ho Chi Minh cities and 60% of motorcycles in other urban areas, categories 1 and 2, must meet emission standards.	Air quality will not be degraded Travel demand along Vo Van Kiet – Mai Chi Tho Boulevards will increase, with 76.6 thousand trips per day (2013), of which 6% will use bus, and this number will increase on average 3% per year. According to the survey, if the quality of bus services increased, such as offered by the BRT, demand for using public transportation would increase by approximately 33 to 66%. Development of public transportation is the main solution to reduce private vehicle use, fuel consumption, and reduce emissions in urban areas. BRT line 1 intends to use cleaner fuel or compressed natural gas (CNG), hence contributing to reductions of ambient air pollutants. According to the project's pre-feasibility, results from a pilot of 30 CNG buses, shows a reduction of GHG emissions: - reduction of 20% of CO2, 75% of NOx, 63.5% of CO and 63% of HC. - Saving of 30% - 40% fuel cost. Hence, development of this project will improve air quality along Vo Van Kiet – Mai Chi Tho Boulevards with high environmental and social benefits.

	However, the effectiveness of these policies requires implementation by the government, and it is still predicted that private vehicles will be the main source of pollution in urban areas.	
Noise pollution	Increased noise Increased noise along Vo Van Kiet – Mai Chi Tho Boulevards from increasing numbers of private vehicles. The area has a high population and density of offices, schools and medical centers, which could be significantly impacted by increasing noise levels.	Noise level reduction: Although the project will not meet all travel demands, by converting 66% of travel demand from private to public transport could potentially reduce noise level along the project corridor.
Traffic congestion	Increased traffic congestion Increased traffic congestion is expected from increasing numbers of vehicles, especially with the current trend of replacing motorcycles with automobiles. In 2013 The number of journeys on Mai Chi Tho Boulevard was 76.6 thousand trips per day, of which approximately 94% was from private vehicle use. The number of journeys on Vo Van Kiet Boulevard was 959.3 thousand trips per day, of which approximately 94% used private vehicles. By 2020 The number of journeys on Mai Chi Tho Boulevard is projected to rise to 384.8 thousand trips per day, and 1030.4 thousand trips per day on Vo Van Kiet Boulevard. If 94% use private vehicles and only 6% public transportation, then there will be 361.7 trips per day on Mai Chi Tho Boulevard and 968.6 trips per day on Vo Van Kiet Boulevard by private vehicle usage. By 2030: After development of Thu Thiem, operation of Mien Tay Terminal, and expected population growth along Vo Van Kiet – Mai Chi Tho Boulevards, travel demand on the Boulevards will significantly increase. In addition, the increasing of quality of life could also result in increasing of number of automobile. Furthermore, there are multiple intersections along these	Reduced traffic congestion As people turn to use the BRT, transportation along this route could be less congested due to reduced numbers of private vehicles. According to the assessment of service quality, the number of people preferring to use BRT could increase 10% by 2017, and in the case of Ho Chi Minh City could be higher because of higher dependence on motorcycles. By 2020, when the BRT line has been in operation for a while, it could respond to 12% to 15% of travel demand along this route, which could significantly mitigate traffic congestion. However, traffic congestion could reduce comparing without BRT alternative only if other solutions on this route are integrated such as consideration of design of bus station, connection between passengers and bus station, traffic lights etc.

	Boulevards. All these characteristics could potentially increase traffic congestion.	
Traffic accidents	Greater potential for traffic accidents Traffic accidents are more likely due to the increased number of vehicles along this route. According to the above analyses, travel demand, as well as the number of traffic vehicles on this route, will increase in the future and lead to a higher risk of traffic accidents.	Contribution to traffic accident control The operation of BRT attracts people to using public transport, reducing private vehicle usage, and thus risk of traffic congestion and accidents. However, potential for accidents could increase without appropriate design of connectivity between passengers, bus stations and the separated BRT lanes.
Travel time	Travel time will increase because of increasing demand and number of vehicles. The current average speed of automobiles and motorcycles traveling this route are the same, approximately of 32 to 36 km/hr. The average speed of buses, along all routes, is relatively lower at 11 to 24 km/hr. The current bus route No. 39, via Vo Van Kiet – Mai Chi Tho Boulevards, has the highest average speed of 25 to 26 km/hr. According to the assessment, many parts of Vo Van Kiet – Mai Chi Tho Boulevards are currently congested during rush hours. With trends of increasing travel demand and traffic vehicle usage, traffic congestion will be negatively impacted and result in longer travel times along this route.	Operation of BRT line 1 could remain travel speed of people using BRT as well as mitigate pressure of congestion on this route. BRT line 1 should ensure rapid, reliable, appropriate and convenient transportation, helping passengers reduce their commute time along this route. The average speed of BRT will be 22 – 25 km/hr. However, this speed will be remained on the corridor that helps passengers manage their commute time better.

3.2.2. Analysis of alternatives to BRT - 1 components

This section will summarize and analyze alternatives of the project to ensure that selected options are most appropriate. Four sets of alternatives are considered: i) location of BRT lanes, and BRT bus stop/station locations; ii) access to BRT bus stations; iii) types of vehicles; and iv) separating BRT bus lanes from other traffic.

a) Alternatives of BRT lanes, and bus stop/ station locations

There are three proposals regarding BRT lanes and bus stop/station locations, including two lanes in the middle of road; two lanes on pavements; and two lanes on the channel site. The aim is to select a location that avoids conflict with other lanes, especially at intersections. Advantages and disadvantages of proposals are summarized in Table 3.2.

- Alternative 1: Two lanes in the middle
- Alternative 2: Two lanes on pavements

- Alternative 3: Two lanes on channel side.

Table 3. 2 Analyses of alternatives for locating BRT lanes and bus stop/stations

	Alternative 1	Alternative 2	Alternative 3
Advantages	Less conflict with vehicles needing to turn or station on route; Only need one bus stop station for both directions. Ensure steady travelling speed of travel of BRT and other vehicles. Reduced pollution as BRT lines in separate lanes that are easier to manage. Reduced traffic accidents. Should not impact on businesse activities along corridor. This is the low investment option given that the BRT road surface only needs improvement at limited points. There will be less impact on current infrastructure along the corridor.	Use current lanes of Vo Van Kiet – Mai Chi Tho Boulevards. Easy to separate BRT lanes and others.	Separate BRT lanes from other traffic. Only one bus station for both directions; Should not impact on local business activities. Reduce conflict with other vehicles that need to turn. Ensure steady travelling speed of BRT as well as other vehicles.
Disadvantages	Difficult for passengers connecting to bus stations, requiring technical solutions to ensure passenger safety. Unsafe for passengers if connection to BRT is at junction with traffic lights. Pedestrian flyovers and BRT bus stations in crowded areas could be unsafe if not properly managed.	Potential conflict with vehicles that turn into Vo Van Kiet at intersections; and with vehicles want to station at corridor; Potential of accidents at sensitive areas such as high density residential areas, schools and hospitals. Impacts on speed of vehicles and increased traffic congestion.; High investment because of doubling of bus stations compared with other alternatives. There will be a more impacts on infrastructure in the corridor.	One side of the corridor is adjacent ot a canal making it more difficult to approach the BRT. Associated safety issues need resolving. Unsafe for walking pedestrians when approaching to BRT if use traffic lights; Pedestrian flyovers and BRT bus stations in crowded areas need to address public health and safety. Potential impacts on infrastructure along corridor when constructing bus stations.

Evaluation	The optimal solution.	The least optimal solution.	The medium alternative.

b) Alternatives for accessing BRT bus stations

Alternatives for accessing BRT bus stations were analysed with respect to centrally locating BRT lanes (the optimal solution selected above). Two accessibility alternatives were considered, including:

- Alternative 1: Provision of pedestrian flyovers to access BRT bus stations;
- Alternative 2: Provision of traffic lights and pedestrian crossings to access BRT bus stations.

This section will analyze both alternatives according to their advantages and disadvantages, however, the choice of alternative depends on the characteristics of any particular bus stop. The details of selection are shown in Table 3.3.

Table 3. 3 Analysis of alternatives for accessing BRT bus stations

	Alternative 1	**Alternative 2**
Advantage	Ensure safety for both BRT passengers as well as other vehicles in the corridor. Limit conflict between BRT buses and other vehicles that result in traffic congestion, and also reduce traffic pressure at the access location. Ensure traffic runs smoothly on this route reducing travelling time. Expend accessibility to other areas of District 4, District, isolated by the canal. It will create public space along the corridor with beautiful, modern and green designs.	Low cost alternative given current availability of traffic lights in this corridor. Low cost of maintenance. Reduce time for passengers accessing BRT bus stations. There will be less impact on underground infrastructure in the corridor.
Disadvantages	Costly alternative in both construction and operation. Could negatively effect business activities at pedestrian flyover locations. Could impact on underground infrastructure during the construction phase. Potential public safety at pedestrian flyovers and BRT bus stations.	Higher potential of traffic accident between BRT passengers and other vehicles in corridor. Potential for greater traffic congestion and increased travel time for other vehicles due to BRT crossing points. Low awareness and compliance in using crossings by passengers causing traffic accidents. Citizens of District 4 and District 8 will not have access to BRT 1 due to canal's location. Limit business activities at pedestrian flyovers locations.
Evaluation	Although with higher costs of construction and operation, this option	Lower cost alternative but with greater risk to the public.

	offers higher social and environmental benefits and should be considered in the long-term. The construction cost could be reduced if pedestrian flyovers are located at necessary locations, and use current pedestrian flyovers that currently exist on the corridor.	In the early phase of the project, this option could be used. However, in the long-term, this option is considered inappropriate given projected traffic volume increases in the corridor.

c) Bus and fuel alternatives

Objectives of the Green Transportation Project require consideration of the type of bus and fuel that will be used for operation toand reducing GHGs and other pollutant emissions. Given liquefied petroleum gas (LPG) is not available in this region, it is not considered here. The B80 bus with carrying capacity of 80 to 85 passengers is the vehicle option, but with two fuel alternatives:

- Alternative 1: Bus using diesel fuel;
- Alternative 2: Bus using compressed natural gas (CNG)

Table 3. 4 Analysis of alternatives of using fuel

	Alternative 1	**Alternative 2**
Advantages	Investment cost is about 20% lower alternative 2. Diesel fuel that meet Euro IV (emission standard of gas) is the lowest risk alternative only if the Euro IV diesel will be available by 2018. However, with no strong commitment of development that fuel in Vietnam by 2018 leading to high risk and uncertainty for the project objectives.	Investment cost is higher but operation cost is lower because of lower price and higher efficiency of CNG compared with diesel. This alternative could save 20% - 22% of fuel cost. Low air pollutant emissions and GHGs than diesel alternative, as well as reduce noise, vibration and more luxuriate. It will improve environment (ambient air) that could enhance social benefits such as less health care cost and longer life for citizens as well as reduce cost for climate change adaptation.
Disadvantages	Higher air pollutant and GHG emissions. Operational cost is higher by about 20% compared with alternative 2. Risks of fuel recharge if project considers using diesel that meets Euro IV emission standard. Increasing of exploitation and consumption of fossil fuel.	High investment cost. Risk of emergencies during operation if CNG safety standards will not be strictly implemented as per technical standards and regulations.
Evaluation	Applications of low emission vehicles as well as low emission fuel are considered as important solution to improve urban environment. However, because of inconsistency of development, this alternative is inappropriate in Ho Chi Minh City and	Appropriate with project's objective as improving air quality in Ho Chi Minh city. Appropriate with global norms of using cleaner energy and low emission. Appropriate with other objectives of

	in this project also.	project.

d) Alternatives for separating BRT lanes from other traffic

The separation could vary depending on the particular situation. However, separation needs to consider design selection. Those considerations are drainage, flood and cleaning as well as isolated with other vehicles to ensure smoothly operated but could respond appropriately in emergencies. There are two alternatives described as following:

- Alternative 1: Using small and discontinuous concrete that are sloped both of two sides to separate BRT lanes with others. This is popular application with discontinuous places that allow drainage of storm water;
- Alternative 2: Using guardrail (or fence).

Table 3. 5 Analysis of alternatives of GPC between BRT lanes and other traffic

	Alternative 1	Alternative 2
Advantages	Low cost alternative. Observe easily in operation and be familiar in urban transportation Do not cause feelings of limited space of road; Easy for drainage if create disconnection places. Could allow others use this lane in cases of emergency such as ambulance, firefighting.	Observe easily traffic situation on route and stormwater could easily pass through. Could recognize location of seperator hence BRT bus can keep functioning, Many BRT systems in Chinese have applied this selection especially for streets that do not regulate the size of lanes. Perfectly isolate other vehicles that could enter in BRT lane hence ensure safety for BRT and its passengers as well as its operational speed.
Disadvantages	Difficult to recognize GPC when road be flooded. Cannot absolutely isolate other vehicles enter the BRT lane that could cause accidents and delay travel time.	High investment cost. Make the feeling that should reconstruct other lanes to ensure safety width of lanes.
Evaluation	This alternative could be optimal with high awareness people who travel on this corridor, so the lower investment cost will not equal to the social risks.	This BRT line is the first application and people with low-awareness in public transportation that is optimal alternative.

3.3. GENERAL IMPACT ASSESSMENT

Environmental impact screening was conducted for the project, based on screening sensitive objects along the BRT 1 and other construction works, community consultation and group discussions. The results of the environmental impact screening are as follows.

Main project activities	Environmental aspects																		
	Physical								Ecology		Socio-Economic								
	Quality of surface water	River flow	Quality of underground water	Sediment quality	Gas emissions	Noise/ vibration	Dust	Inundation	Aquatic ecosystems	Terrestrial ecosystems	Community health	Land use	Transportation	Income	Waste management	Construction of houses	Historical/ cultural infrastructure	Entertainment	Commercial activities
PRE-CONSTRUCTION PHASE																			
Land acquisition	NL	-				NL	NL	-	-	-	-	NM	NL	NL	NL	NL	-	-	NL
Relocate undergound infrastructure	-	-	-	-	-	-	-	-	-	-	-	-	NL	-	-	-	-	-	NL
Residue of booms and demining of booms	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSTRUCTION PHASE																			
Excavation/ backfill activities	NL	-	-	-	NL	NM	NM	NL	NL	NL	NL	-	NM	NL	NM	-	-	NL	NL
Material transportation and waste disposal	-	-	-	-	NL	NL	NL	-	-	-	NM	-	NM	-	-	NH	-	-	-
Contruction of all items for the BRT 1 line	NL	-	-	NL	NL	NL	NL	-	NL	-	NL	-	NM	NL	NL	-	NL	-	-
Contruction of bus stations, terminal/ terminus	NL	-	-	-	NL	NM	NM	-	NL	NL	NL	NL	NM	-	NL	-	-	NL	NL
Construction of technical facility	NL	NL	-	-	NL	Nl	NM	NL	NL	NL	-	-	NL	-	NM	-	NL	-	NL
Workers' camps	NM	-	-	-	NL	-	-	-	NL	-	NM	-	-	-	NL	-	-	NL	-
OPERATION PHASE																			
Vehical operation along the BRT 1 line	NL	-	-	-	NL	NL	NL	-	-	-	NL	-	-	-	-	-	NL	NL	-

Main project activities	Environmental aspects																		
	Physical								Ecology		Socio-Economic								
	Quality of surface water	River flow	Quality of underground water	Sediment quality	Gas emissions	Noise/ vibration	Dust	Inundation	Aquatic ecosystems	Terrestrial ecosystems	Community health	Land use	Transportation	Income	Waste management	Construction of houses	Historical/ cultural infrastructure	Entertainment	Commercial activities
Operation of terminal, terminus, bus stations	NM	-	-	-	NL	NM	NL	NL	NL	NL	NM	NL	NM	-	NM	-	-	-	-
Operation of pedestrian flyovers	-	-	-	-	-	-	NL	-	-	-	NL	-	NM	-	NM	-	-	-	-
Operation of technical facility	NL	-	-	-	NM	NL	NM	NL	-	-	NM	NM	NM	-	NL	-	-	-	-

Note

No Negative impact	-
Negative impact (low)	NL
Negative impact (Medium)	NM
Negative impact (Hight)	NH

3.3.1. Positive impacts

Overall, this project will prove beneficial include improving public transportation of Ho Chi Minh City; controlling the increase of private vehicles; improving urban environment; improving quality of lives for the people living along project corridor. The positive impacts of project could be summarized as follows.

- The objectivities of the project will support the national transportation sector as well as city development targets.
  - Green growth strategy that includes: i) Reduction of GHG emissions; ii) change the fuel structure in industry and transportation; iii) sustainable urban development.
  - National strategy of climate change adaptation and mitigation focused on application of low carbon fuel, toward using CNG, LPG for public buses and taxi with targets of 20% by 2020 and 80% by 2050.
  - National program of energy saving and energy efficiency.
  - Ministry of Transportation Sustainable Development Action Plan also set up a target to development low carbon bus systems in urban areas
  - The Ho Chi Minh City transport development plan to 2020 and oriented to 2030 also set targets to develop mass transit transportation and improve public transportation quality.
- Separate public transport from other mixed transport lane to increase and manage travel time, enhance reliability of public services which will help bus systems operate more efficiently, low cost, less waiting time and reduce subsidies.
- Ensure that public transportation will serve rapid, reliable and appropriate services at all places on the corridor with modern BRT buses, e-ticket and modern control system that people prefer as better alternative rather than using private vehicles.
- The BRT system could be more preferred than motorcycle for people living in this corridor. This will help reduce pollutant emissions . Moreover, low emission BRT buses could reduce air pollution, increase environment quality, improve living standards of communities along the corridor, and reduce social cost related to air quality. High quality BRT buses will support increase of environmental quality along the corridor
- Develop and provide an environmental friendly bus system with cleaner vehicles, 'green designed' bus stop stations (solar energy) and terminal on the corridor .
- Contribute to reduced traffic conflict and accident in the corridor.

3.3.2. Negative impacts

- Could narrow existing road surface in case that BRT and its services will not attract enough passengers moving from private vehicles, the traffic congestion and traffic conflict could be worse on this corridor.
- Potentially increase traffic accidents, especially at existing intersections, BRT bus stations and access locations.

- Operational safety for compressed gas both in BRT buses and fuel supply station. Any risk from this system could have adverse impacts on public safety and environment.
- Potential increase of environmental issues such as waste generation and social disturbance at BRT bus stations, pedestrian flyovers, terminal and parking areas.
- Potential of increased social disturbance and security in public areas in case of appropriate management plan, specifically on bridges and in waiting areas.
- Temporary generation of pollutants such as solid wastes, hazardous wastes, wastewater and air pollution during construction phase

3.4. IMPACT ASSESSMENT DURING PRE-CONSTRUCTION PHASE

3.4.1. Impact assessment of land acquisition

The following activities or components of the project could relate to temporary and (or) permanent land acquisition:

- Project will improve and upgrade infrastructure on Vo Van Kiet Boulevard. All construction activities to be conducted within the corridor of Boulevard, provision of new non-motorized infrastructure to support BRT accessibility, such as pedestrian flyovers, bicycle lanes, pavement improvement and landscape creation, but all construction works are located within the Vo Van Kiet – Mai Chi Tho corridor, thus no land acquisition is required.
- Construct new infrastructures such as Rach Chiec Terminal, Thu Thiem Technical Facility and parking areas. Land acquisitions are shown below.

Table 3. 6 Land acquisition of project

No.	District	Infrastructure	Amount	Required land (ha)
1	Binh Tan	BRT bus station	3	In corridor area, without land acquisition
		Vehicle parking areas	1	
2	8	BRT bus station	1	
3	6	BRT bus station	4	
		Vehicle parking areas	1	
4	5	BRT bus station	6	
		Vehicle parking areas	4	
5	1	BRT bus station	3	
		Vehicle parking areas	1	
6	2	Thu Thiem Technical Facility	1	1.77 ha
		Connection road to Thu Thiem Technical Facility	1	
		Rach Chiec Terminal	1	0.58
		BRT bus station	9	In corridor area, without land acquisition

The project will not require a large area of land. According to Resettlement Action Plan (RAP) of the project, land acquisition will be required in An Phu and Binh Khanh communes of District 2, which is reserved for Thu Thiem Technical Facility, and access road from Mai Chi Tho Boulevard to Thu Thiem Technical Facility. Other project's infrastructure items will

not require land acquisition because their locations on existing Vo Van Kiet – Mai Chi Tho Boulevards, or in Rach Chiec Sport Complex that are already completed land acquisition by city authorities.

Land acquisition for Rach Chiec Terminal development will affect 12 households . Affected land is mainly agricultural (5800 m^2, comprising 95% of the total affected area) and only 221 m^2 of residential land. No household will be severely affected or vulnerable.
Land acquisition for Thu Thiem Technical Facility construction is mainly agricultural land, which will affect three households, two companies. No households will be severely affected or vulnerable. Currently, the land is not cultivated or used in business activities, so the impact will be minor.

Conclusions

Land acquisition of this project is considered to have a MINOR NEGATIVE IMPACT. However. to optimize the objectives of the project, the project must comply with resettlement policies of the World Bank and Vietnam government, and approval of RAP as well.

3.4.2. Impact assessment of underground infrastructure

Underground technical infrastructure in corridor could be impacted, such as telecommunication cables, drainage pipelines, water supply pipelines and electrical cables. According to the project design, almost all project activities will be located on the centerline of existing roads, thus the construction activities will not create significant effect on underground technical infrastructure. Impacts may occur on pavement area where implementing construction of pedestrian flyovers, or Rach Chiec Terminal and Thu Thiem Technical Facility development areas. However, all underground facilitates on East - West Boulevard was located on the technical hole, thus the impacts would be insignificant. The impacts could be listed for new constructions of Thu Thiem Technical Facility and Rach Chiec Terminal but excavated volume and activities on these areas is quite small, thus the impacts also very minor.

However, in case the project has been identified that could create negative impact on underground technical infrastructures, the relocation of affected items need to be completed before construction activities started to ensure the continuous of public services provision along the corridor .

Conclusions

The impact on underground technical infrastructure caused by project, is considered as having a MINOR NEGATIVE IMPACT. However, the status of underground facilitates need to be carefully considered before conducting excavation/backfill activities, consulting with relevant stakeholders, and complying with any relocation matters before starting construction.

3.4.3. Impact assessment of urban landscape

One of the main objectives of the project is improvement of urban public space. However, if inadequate consideration of project's architecture and existing urban landscape could lead to high risks of urban landscape broken down, environmental quality degradation, social and safety issues. Specific components that need to be considered include structural and architectural aspects of BRT bus stations, pedestrian flyovers, Rach Chiec Terminal and Thu Thiem Technical Facility. Especially the two later places should also consider development plan of surrounding areas to ensure overall consistency.

Conclusions

Impacts on the urban landscape caused by the project during this phase are considered as having MODERATE NEGATIVE IMPACTS over the long-term, and requires that all designs are considered carefully to ensure conformity and consistency of development along the corridor.

3.4.4. Impact assessment of dust, gaseous emissions and solid waste generation

Currently the areas proposed for Thu Thiem Technical Facility and Rach Chiec Terminal that have land acquisition activities, are inhabited and under development plans of city, as discussed in Section 3.4.1. These conditions make project having small land clearance activities that lead to less emission of dust, gases as well as solid waste during this pre-construction phase.

Conclusions

Impacts of pollution caused by the project during the construction phase should lead to NO NEGATIVE IMPACT, because the project requires little land acquisition or clearance.

3.4.5. Impact assessment of UXO

Because Ho Chi Minh City was bombed heavily during the war period, UXO removal is important so as to avoid any potential threat to works and safety for local people and workers. For all project items, located on the East - West corridor, construction sites are free from UXO. For construction sites at Thu Thiem Technical Facility and Rach Chiec Terminal, which are new construction areas, UXO needs to be carefully considered and removed before construction activities can commence.

Conclusions

The impacts of UXO in the project area represent SIGNIFICANT NEGATIVE IMPACTS if mitigation measures are not applied, with high risk to human health, life, and also infrastructure. UXO removal must be completed before starting civil works.

3.4.6. Impact assessment of appropriate technical design

Appropriate selection of technical designs is very important to ensure sustainable operation of the project and wide social acceptance. The main technical items, which need to be considered during the design phase include design of BRT bus stations; accessibility to BRT bus stations; selection of BRT bus vehicles; and selection of operational methods. These are necessary in order to achieve: i) objectives of this project; ii) social acceptance; iii) sustainable operation; iv) demonstration as successful pilot for other BRT projects; v) cost savings for both construction and operation phases; vi) adapting and mitigating climate change impacts; vii) accessibility for all social groups, and viii) complementing existing urban landscape.

Conclusions

Considered as having a HIGH POSITIVE IMPACT and could result in higher efficiency for the operational phase. Thus, the appropriate design of the whole project and each technical item needs to be carefully considered during the design phase.

3.5. IMPACT ASSESSMENT DURING CONSTRUCTION PHASE

The construction phase was considered as having a high impact on the environment along the corridor. Potential impacts could be generated from main construction activities such as i) improvement of road surfaces and construction of new access roads to Thu Thiem Technical Facility; ii) construction of pedestrian flyovers and BRT bus stations; iii) construction of Rach Chiec Terminal and Thu Thiem Technical Facility; iv) large population of workers on the construction sites; v) transportation of wastes and materials; and v) wastewater treatment.

Key sources of environmental and social impacts during the construction phase are listed in the Table below.

Table 3. 7 Potential pollution sources during construction phase of project

No.	Activities generating waste	Types of waste
1	*Construction & improvement of BRT lanes and connection roads* - Improvement of road surfaces - Upgrading road surfaces at selected sections - Completion	Dust, Air pollution Construction wastes Solid waste
2	*Construction of bus stations and pedestrian flyovers* - Construction of foundations - Construction of infrastructure	Dust Construction wastes
3	*Construction of Rach Chiec Terminal & Thu Thiem Technical Facility* - Construction of foundations - Construction of operational buildings - Construction of internal roads & acecss roads to Thu Thiem Technical Facility - Construction of drainage systems - Construction of fences	Dust Air pollution Construction wastes Solid waste & hazardous waste Wastewater
3	*Working onsite*	

	- Operation of mixing conrete and storage material for concrete mixing - Operation of equipment and machinery - Operation of workers	Dus Air pollution Waste water Solid waste & hazardous waste
4	*Transportation of materials and wastes*	Dust Air pollution emission
No.	**Activities related to waste**	**Types of impact**
1	*Construction of roads and improvement of road surfaces*	Noise, vibration, construction and traffic safety and traffic congestion
2	*Construction of BRT bus stations and pedestrian flyovers*	Noise, vibration, construction and traffic safety, traffic congestion and safety for people travelling in corridor.
	Construction of Rach Chiec Terminal & Thu Thiem Technical Facility	Noise, vibration, construction and traffic safety, traffic congestion and social conflicts with local communities.
4	*Working onsite* - Shelters - Equipements & machinery	Noise, vibration, construction safety and social conflicts between workers and local communities.
5	*Transportation of materials and wastes*	Noise, vibration and potential damage existing road.

3.5.1. Impact assessment of dust and gaseous emissions

a) Emission sources

Impacts on air quality in the project area associated with the construction stage will include a) dust due to the leveling of ground, excavation activities, transporting of construction materials such as earth, stone, cement, sand, gravel; b) emissions from equipment using gasoline, diesel, kerosene (e.g., NOx, CO, SO2, VOC); and iii) gases emitted from concrete mixing stations (if any).

b) Quantification of impacts

Dust emitted from excavation and leveling activities

The amount of dust emitted from these activities depends on volume of material excavated, soil leveling, and also depends on the number of machines and trucks working onsite. However, construction activities for the BRT project are not too much and concentrated on contructions of pedestrian flyovers s, bus stations and two biggest construction fields at Rach Chiec Terminal and Thu Thiem Technical Facility so that the amount volume of excavation/ backfill and dust emitted will not too much.

Table 3. 8 Emission coefficientfrom construction

Unit: g/m^3

No.	Pollution source	Emission coefficient
1	Dust from soil excavation and leveling activites	1 - 100

2	Dust from material (sand, rock, etc.) handling in construction	0.1 - 1
3	Dust from transportation of materials	0.1 - 1

Source: WHO, 1993

Most soil excavation and leveling activities will be concentrated at construction sites of Thu Thiem Technical Facility, Rach Chiec Terminal and BRT bus stations. Therefore, the calculation of emission only is focused on these areas. According to volumes of soil excavation and leveling from the construction sites, dust emission could be quantified as in the following table.

Table 3. 9 Caculation of dust load from soil excavation and leveling activities

Component	Excavated volume (m^3)	Leveling volume (m^3)	Total (m^3)	Total dust emitted (g)	Load (mg/s)
Thu Thiem Depot	18354	42974	61328	61328 - 6132800	0.002025 - 0.202573
Rach Chiec Terminal	11038	15389	26427	26427 - 2642700	0.000873 -0.087291
Average for each bus stop station	237	94	331	331 - 33100	0.000512 -0.051080

According to the number of the construction machines that need to be mobilized on the construction site and based on fuel consumption norms stated in the Circular 06/2010 of Ministry of Construction, dated 26/5/2010, fuel demand could be calculated. With the assumption that the fuel used is diesel, emission factors per ton of fuel from internal combustion engines are as follows: CO (28 kg); SO_2 (40 kg), NO_2 (55kg), HC (12 kg) and dust (0.12 kg) (WHO).

Table 3. 10 Emission of pollutants from operation of internal combustion engines

Component	Fuel consumption		Emission of pollutants (kg)				
	litter	Kg	CO	SO_2	NO_2	HC	Dust
Thu Thiem Depot	231155	198794	5566,2	7952	10933.7	2385.5	23.9
Rach Chiec Terminal	89420	76901	2153.2	3076	4229.6	922.8	9.3
Average per bus station	123	106	2.9626	4.232	5.8	1.3	0.013

According to total dust and gas emitted from soil excavation and leveling activities, and from operation of above machinery, the average pollution load can be calculated for any place using the Sutton Model (based on Gausses theory for point source of pollution) to calculate pollutant concentration. Results from the equation are considered as continuous emission and infinity; wind direction is perpendicular to pollution concentration line caused by operation of construction machines.

The concentration of pollutant at distance x from pollution source and in downstream of wind direction can be calculated as:

$$\mathbf{C_{(x)} = 0,8.E}\,(e^{\left[-(z+h)^2/2\sigma_z^2\right]} + e^{\left[-(z-h)^2/2\sigma_z^2\right]})/\sigma_z u \quad (2)$$

Where :

E: Loading of pollutant during specific period (mg/m.s), E in table 3.9 & 3.10

σ: Diffuse coefficient in direction z (m) is fuction of x under wind direction. While σ is identified by Slade fomula with the stable atmosphere at level B that is:σ= 0,53.x0,73

x: distance from source to calculated point, follow wind direction;

u: Wind speed (m/s), this area has average wind speed of 3 m/s;

z: Elevation of calculated point (m), in this is 0,5 m.

h: Elevation of construction site compared with surrounding areas (m), considered in this calculation is: h = 0 m.

Table 3. 11 Categorization of atmospheric stability by Pasquill-Gifford (*Turner, 1970*)

Wind speed at elevation of 10m (m/s)	**Radiation intensity at daytime**			**Cloud cover at night**	
	Summer radiation with angle >60°	Summer radiation with angle 30°÷60°	Fall radiation with angle 15°÷35°	Cloud cover ≤ 4/8	Cloud cover ≤ 3/8
<2	A	A-B	B	E	F
2-3	A - B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	D	D	D	D	D

In which

- *level A = Very unstable*
- *level B = Unstable*
- *level C = Slightly unstable*
- *level D = Moderate*
- *level E = Slightly stable*
- *level F = Stable*
- *level A-B or C-D is average of both of them*

Assuming that air pollution from other sources and the effect of terrain in this corridor are ignored, calculated results of dust and gas emissions from soil excavation and leveling activites and machine operation from construction site are as follows.

- *Concentration of dust from construction sites downwind*

Table 3. 12 Deposition of dust on surrounding areas

Unit: mg/m^3

Component	**Distance from boundary of construction site (m)**						**QCVN05 :2013/DONRE**
	5	**10**	**15**	**20**	**25**	**50**	
Thu Thiem Technical Facilitates	**0.2233**	**0.2144**	0.1539	0.0978	0.0478	0.0022	0.2*
Rach Chiec Terminal	0.1718	0.1650	0.1184	0.0752	0.0368	0.0017	
Average per bus station	0.0859	0.0825	0.0592	0.0376	0.0184	0.0009	

Conclusions

Results indicate that dust concentrations are maximal at a distance of 5 to 10 m away from

emission sources on the Thu Thiem Technical Facility construction site, which is higher than permitted values as stated in QCVN 05:2013/BTNMT - national technical regulations for ambient air quality. However, dust concentrations are within permitted standards from 15 m on the Thu Thiem construction site, and other construction sites are within standard.

- Downwind pollutant concentrations from construction machinery on construction sites

Table 3. 13 Air pollutant dispersal from construction sites

Indicator	Thu Thiem Technical Facilitates			Rach Chiec Terminal			Average per bus station			QCVN05: 2013/DONRE
	5m	10m	20m	5m	10m	20m	5m	10m	20m	
CO	0015	0.015	0.012	0.0066	0.0066	0.0053	0.0037	0.0037	0.0030	-
SO_2	0.003	0.003	0.003	0.0014	0.0014	0.0011	0.0008	0.0008	0.0006	0.125
NOx	0.005	0.005	0.004	0.0023	0.0023	0.0019	0.0013	0.0013	0.0011	0.1
Dust	0.000	0.000	0.000	0.0001	0.0001	-	-	-	-	0.2
HC	0.001	0.001	0.001	0.0007	0.0006	0.0006	0.0004	0.0004	0.0003	1.5*

Conclusions

Compared to standards defined in QCVN 05:2013/BTNMT, operation of machinery on all construction sites will not generate pollutant levels that exceed permitted standards. Thus, it construction machinery should not create negative effects on ambient air quality in the project area.

However, calculated results did not include secondary dust, as generated from soil and material caused by vehicles operating along existing roads. This kind of dust is quite important at the main gates of construction sites, for the small and separated construction sites, these dust sources could be considered as main issues on the sites.

Operation of concrete mixing station

Currently, the project has not set plan to provide concrete mixing stations at construction sites. The concrete could come from two main sources: i) purchased from nearby commercial concrete stations (as identified in Section 1.4.2) and ii) use of a concrete mixing station on onsite. In the case of the latter, it is estimated that there will be two stations at a Rach Chiec Terminal construction site and at Thu Thiem construction site. The small bus stop station on Mai Chi Tho and Vo Van Kiet mostly use steel assembled structures and will not require a high volume of concrete. The environmental issues around concrete mixing station depend on location, operation and capacity of the station. Within the project activities, the $30m^3/h$ station is proposed on the construction site, and operation of the station mostly mix the construction material to formulate concrete, there will be no material produce activities on the stations. Based on experience, the main impacts of a $30m^3/h$ concrete mixing station could be listed as below:

- Dust generation exceeding permitted standard in QCVN 05: 2013/BTNMT at a distance of 20 m from station when operating;
- Noise generation could exceed the permitted standard at a distance 45m during

station at daytime and 90 m during nighttime;

- Discharge wastewater - for small concrete mixing station, washing material activities at the site are quite limited, and the contractor may purchase clean material due to small volume.

c) Sensitive receptors

The scope of impacts depends on the sensitivity of potential recipients. According to assessments in the corridor, impacts caused by dust and gas emissions are moderate and can be controlled.

- Rach Chiec Terminal located in area of Rach Chiec Sport Complex project, which is almost completed resettlement activities. There are no sensitive subjects such as schools, hospitals and residential areas, thus impacts from dust and gas emissions caused by this construction site are quite insignificant. The pollution sources, that need to be managed are from transportation of materials and waste.
- The construction site at Thu Thiem Technical Facility, located within the Thu Thiem New Urban Development Project, is surrounded by mostly vacant land, and therefore, no sensitive receptors are located in the affected areas around construction site.
- The construction sites for BRT pedestrian flyovers will not create significant impact on Mai Chi Tho Boulevard because low population density along the new street. The construction activities on Vo Van Kiet Boulevard, however, will create potential negative impacts on several nearby households, but these impacts will also be minor due to limited scope of work and no resettlement activities.
- The activities of road surface improvement and bus station construction will also emit dust and air pollutants. However, there is only 5 cm of road surface in thickness, 100 m in length at bus stations and 50 m in length at intersections for road surface improvement, which need to be upgraded. Moreover, many intervention activities on high traffic volume of Vo Van Kiet street need to take place during night time that could help to reduce impacts on recipients;
- Transportation activities: There will be several material or waste transport routes that pass through high traffic volume and densely populated urban areas, which may be potentially affected by dust generated from these activities.

Table 3. 14 Sensitive receptor sites along project corridor during construction phase

Category	Sensitive receptor locations	Description
Residential area	Residential area closes to An Lac People Committee (PC) Residential area of Karina close to Rach Cay canal Residential area of Phuc Thinh, Cho Quan Residential area of Cau Kho Residential area of An Phu & Petrovietnam	These residential areas are located next to VVK & MCT Boulevards, with high density of people The residential areas in Binh Tan and District 2 are being developed and will be more crowded Residential areas in District 1, 5, 6 and 8 are already settled with both residential and commercial activities;

	Residential area of The Vista.	Development of BRT could impact on these areas with traffic safety and congestion as well as environmental pollution. However, those people are likely potential users of the BRT.
School	Primary school of Kim Dong (District.6) Kindergarten Rang Dong (D.6); International University of Hong Bang (D.5) Secondary School of Dang Tran Con (D.8) Primary School of Ham Tu (D.5); Primary school of Chuong Duong (D.1) Australia International School AIS (D.2) Vietnam International School ACG (D.2)	Except Hong Ban University, located a distance of 100 m from VVK boulevard, all others are much closer to VVK & MCT Boulevards (less than 50 m). The times when students go to school and back home, are very crowded. The rush hours related to education activities are 6:30 am – 7:30 am and 4 pm – 5 pm daily; Project could affect traffic safety and congestion to student in these areas, as well as effect on environment. However, these subjects could also effect on project activities.
Market	Hoa Binh Market; Cau Ong Lanh Market	The market located next to Vo Van Kiet Boulevard (on walk side) and at intersections; Highly attract surrounding residents in early morning and later afternoon, which could make difficulty for ones who want to access VVK boulevard from city center. These subjects could also effect on project activities
Hospital	Nhiet Doi hospital Tam Than hospital Saigon-ITO hospital	Except Saigon – ITO hospital distances 100 m from VVK boulevard, all others are in front of VVK boulevard. These hospitals are closer together in high density of transportation; Working 24 hrs. per day.
Public area	Water park	Located at intersection of Nguyen Tri Phuong bridge and Vo Van Kiet Boulevard, this is an entertainment area; There is a park in front, offering a green space on Vo Van Kiet Boulevard.

Source: Rapid environmental condition assessment of GTP, 2014

Conclusions

The impacts of dust and gas emissions during the construction phase are considered as having MODERATE NEGATIVE IMPACTS because there are some sensitive subjects along the corridor. The project must strictly comply with mitigation measures to manage and reduce those impacts during the construction phase.

3.5.2. Impact assessment of noise and vibration

a) Source generation

Noise is generated from the construction activities due to operation of equipment, machines as well as transportation vehicles. The main construction machinery and equipment to be mobilized include excavator, dozer, tamping machine, bucket excavator, concrete mixing machinery, and trucks. The level of noise depends on the kinds machinery and particular construction activities on the sites.

Table 3. 15 Noise level generation from construction machinery at a distance of 8 m

Unit: dBA

Clearing	***Digging and transfering of land***	***Construction of bridge and pedestrian flyovers s***
Bulldozer 80	Bulldozer 80	Crane 75 ÷ 77
Forklift 72 ÷ 84	Grab machine 72 ÷ 93	Welder 71 ÷ 82
Truck 83 ÷ 94	Truck 83 ÷ 94	Concrete mixer 74 ÷ 88
Ground leveling and compaction	Excavator 80 ÷ 93	Concrete pump 81÷ 84
Leveling machine 80 ÷ 93	***Clearing***	Concrete rammer 76
Roller 73 ÷ 75	Bulldozer 80	Compressor 74 ÷ 87
Completing road	Grab machine 72 ÷ 93	Bulldozer 80
Spreader 86 ÷ 88	Truck 83 ÷ 94	Truck 83 ÷ 94
Truck 83 ÷ 94	Speader 86 ÷ 88	Bore machine 87
Compactor 74 ÷ 77		

Source: USA EP, noise levels of construction machines, p. 300, 1, 1971

b) Quantification of impacts

In fact, mobilization of noise generation equipment will deeply rely on the construction activities undertaken on the site, which mean that above equipment will not be mobilised at the same time. Results from baseline monitoring show that ambient noise levels were higher than permitted levels as stated in QCVN 26 – national technical regulation for noise pollution. Therefore, impacts of noise from construction activities should take into account the resonant from different sources

Noise generated from machines working independently are listed in Table 3.15. However, noise levels at construction sites are usually generated at least from two types of equipment operating at the same time. The noise level is identified as following:

$$L_{\sum} = 10 \lg \sum_{i}^{n} 10^{0,1.Li}$$

In which:

- L_{Σ} *total noise level from sources*
- *Li noise level i*
- *N total noise sources.*

Source: Pham Ngoc Dang, 2003. Air enviornment

To calculate noise level that is reduced by distance:

$$\Delta L = 10\lg(\frac{r_2}{r_1})^{1+a}(dB)$$

In which: ΔL : reduction of noise at distance r_2 compared with source r_1; distance for noise source normally considered as r_1= 8 m; a: noise absorbtion of area

Source: Pham Ngoc Dang, 2003. Air enviornment.

However, given the number of machines mobilised at the same time will be limited, calculated results of noise during construction phase are shown in Table 3.16:

Table 3. 16 Estimation of noise levels caused by construction at different distances

Unit: dBA

Component	Noise level at source	Noise level at varying distances			
		32 m	64 m	128 m	256 m
Thu Thiem Technical Facility	73.8÷84.2	71.9÷82.3	62.6÷ 73	59.2÷76.6	57.9÷67.3
Rach Chiec Terminal	73.8÷84.2	70.1÷81.7	66.8÷78.4	62.4÷75.0	58.1 ÷69.7
Average per bus station	73.8÷84.2	62.9÷65.2	60.6÷72.9	57.2÷69.5	53.9 ÷66.2
Technical regulation QCVN 26:2010 of MONRE: From 6 am – 9 pm noise permitted in special areas is 55 dBA and in common areas is 70 dBA *From 9 pm – 6 am noise permitted in special areas is 45 dBA and common areas is 55 dBA*					

There is a notification that with a construction item which generates high noise level, if undertaking nearby the residential, commercial and industrial areas during daytime will be generated noise level within permission standard (QCVN 26: BTNMT) at the distance of 64m and during nighttime, the distance will be 32m .

The noise level generated from project activities will not create significant negative impact to local people during daytime, but during nighttime need to consider appropriate working schedules and mitigation measures. It is noted that, the baseline monitoring results indicated that noise level exceeded permission standards during rush hours in some crowded areas on the corridor (Section 3.2.3), thus the construction activities at these locations need to consider to avoid resonated impacts.

c) Sensitive receptors

Sensitive locations along project corridor could be impacted by noise generated from construction sites (bus stations and pedestrian flyovers etc.) include residential areas on Vo Van Kiet Boulevard, especially construction activities during nighttime;

Road users on this corridor could also be impacted by noise if travelling by motorcycle, bicycle and walking. However, the construction activities in this project are limited and mostly concentrated on centerline of existing street which could help to limit the impacts on road users on this corridor.

The main noise generation sources are in Rach Chiec and Thu Thiem construction sites but depending on allocation of materials, equipment as well as construction methods. However, there are no highly sensitive subjects that could be impacted by noise and vibration located nearby to the construction sites of Rach Chiec Terminal and Thu Thiem Technical Facility so that this impact on these sites are not significant. However, there are residential and school areas located close with construction activities on access road to Thu Thiem Technical Facility, which need to consider several noise mitigation measures to control noise generation, especially from transport vehicles.

Conclusions

The impacts of noise caused by construction of the project are considered as MODERATE NEGATIVE IMPACTS. Given there are still some sensitive subjects in this corridor, there is need to strictly comply with proposed mitigation measures during the construction phase.

3.5.3. Impact assessment on surface water quality

a) Pollution sources

The following activities could directly or indirectly affect surface water during construction phase:

- Storm water runoff through construction sites could contaminate surface water by suspended matters and damaged drainage systems.
- Grease and oil leaking from construction equipment, cleaning equipment and from maintenance work.
- Uncontrolled wastewater generated from workers.

b) Quantification of impacts

Wastewater from operation and maintenance of construction equipment and machinery

This kind of wastewater contains organic substances, oil, and suspended solids. The wastewater, generated from regular maintenance, inlude: i) machine maintenance (about 2 m^3/day); ii) machine cleaning (about 5 m^3/day); iii) machine cooling (about 4 m^3/day). However, the volume of water supply required for this purpose on the site is heavily dependent on the complying and intention of the contractors.

Table 3. 17 Pollutants generated from maintenance and cooling machinery

Wastewater source	Volume (m^3/day)	Concentration of pollutant		
		COD (mg/l)	Oil (mg/l)	SS (mg/l)
Maintenance	2	20-30	-	50-80
Cleaning	5	50-80	1 – 2	150-200
Cooling	4	10-20	0.5 - 1	10-50
QCVN 08: 2008 of MONRE (A)		10-15	0.1-0.2	20-30
QCVN 08: 2008 of MONRE (B)		30-50	0.1-0.3	50-100

Water runoff from construction sites

Storm water passing through construction sites could spread pollutants to the surface water environment. Runoff of materials, sand and rock into water is as the main cause of pollution and increasing of water turbidity. If the excavating and leveling volume is about 101,091 m^3, and the assumption of 0.4% of such volume will be washed by storm water into surrounding water bodies, the total amount will be 404 m^3. Additionally, runoff water is also contaminated by leakage of oil and lubrication from machine with low concentration. The study by *WHO*[1] showed that SS, COD and oil contaminate in runoff water are about 0.5 - 1.5 mg N/l ; 0.004 - 0.03 mg P/l; 10 - 20 mg COD/l and 10-20 mg TSS/l. However, the extent of impacts depends on collection and drainage systems at construction sites.

Wastewater from worker facilities

Wastewater from worker facilities contains organic substances that are easily degradable. However, if this kind of wastewater is discharged directly to water bodies it could create significant contaminate surface waters. According to project designs there will be at least three worker camps established on the sites located on the BRT route, Thu Thiem Technical Facility and Rach Chiec Terminal. The average number of workers per camp is about 30 – 50 people. With average consumption of 70 – 100 liters/person/day and assume that almost such amount will be turn into wastewater, the average wastewater discharge in one camp will be 2.1 – 5.0 m^3/day. This kind of wastewater usually contains suspended solids (SS), organic substances (BOD, COD), nitrogen and phosphorus-containing substances, as well as microorganisms that need to be controlled and treated before discharge to environment.

c) Impact assessment

The main recipients are water bodies located along the project corridor, however, according to observations the impacts will be insignificant as described as follows:

- Construction of BRT lanes and BRT bus stations. Tau Hu – Thi Nghe canal, which is on one side of Vo Van Kiet Boulevard, could be impacted by the construction activities. However, there are several reasons that will mitigate impacts on canal including: i) almost all construction activities will take place in the centerline of road so that storm water passing through the construction sites will be trapped by drainage system; ii) construction activities on sidewalks are limited; and iii) the water in this canal is currently polluted.
- Drainage systems on Vo Van Kiet and Mai Chi Tho Boulevards could be damaged by inappropriate handling of materials.
- Though location of Rach Chiec Terminal is a low-lying area and sensitive subjects to wastewater impacts, wastewater still need to be managed;
- The area of Thu Thiem Technical Facility is flat and connected with Canal 2, however this canal is quite some distance to the construction site.

Table 3. 18 Summary of sites sensitive to wastewater impacts

No.	Watershed	Location	Description	Current water quality
From An Lac to Rac Chiec				

[1] WHO, 1993 – Guidance for Environmental rapid assessment, Volume 2, part 1

No.	Watershed	Location	Description	Current water quality
1	Nuoc Len canal	Running parallel to National Highway 1A from An Lac to Nuoc Len bridge.	Average cross section is 35 m, length is 850 m. Keep distance 3-5m away from left hand side of Vo Van Kiet street	Polluted by organic substances and microorganisms; COD, BOD, Total N, NH_{4+} and Total P, Coliforms are higher than threshold of technical regulation many times.
2	Nuoc Len canal	Nuoc Len bridge, crossing Vo Van Kiet Boulevard.	Average cross section is 35 m .	Polluted by organic substances and microorganisms. COD, BOD, Total N, NH_{4+} and total P, coliforms are higher than threshold of technical regulations.
3	Rach Cay canal	Rach Cay bridge, crossing Vo Van Kiet Boulevard	Average cross section is 35 m and length is 850 ml; Keep distance 12m away from left hand side of Vo Van Kiet street	Polluted by organic substances and microorganisms.
4	Ruot Ngua canal	Running parallel with Vo Van Kiet Boulevard from Rach Cay bridge to Lo Gom bridge	Average cross section is 30 m and length is 850 m; distance 12 m from Vo Van Kiet Boulevard	Polluted by organic substances.
5	Lo Gom canal	Crossing Vo Van Kiet Boulevard at Lo Gom bridge.	Average cross section is70 m.	Polluted by organic substances and microorganisms.
6	Ben Nghe – Tau Hu – Lo Gom	Running parallel with Vo Van Kiet Boulevard from Lo Gom bridge to Thu Thiem tunnel.	Average cross section is 45 m and length is 9500 m, distance 5 – 10 m from Vo Van Kiet Boulevard	Polluted by organic substances and microorganisms nesr Lo Gom bridge.
7	Sai Gon river	Thu Thiem tunnel	Average cross section is 2 75 m.	Still not be polluted
8	Ca Tre canal	Running parallel with Mai Chi Tho Boulevard From Thu Thiem tunnel to Canal 2 bridge	Average cross section is 30 m; and distance 150 – 200 m from Mai Chi Tho Boulevard.	Still not be polluted.
9	Kenh 2 canal	Cross Mai Chi Tho Boulevard at Canal 2 bridge	Average cross section is 50 m.	Still not be polluted.
10	Ca Tre Nho canal	Cross Mai Chi Tho Boulevard at Small Ca Tre bridge	Average cross section is 30 m.	Still not be polluted.
Rach Chiec Terminal and Thu Thiem Depot				

No.	Watershed	Location	Description	Current water quality
11	Rach Chiec river	Distance 180 m from Rach Chiec terminal.	Average cross section is 60 m.	Still not be polluted

Conclusions

Considered as a MINOR NEGATIVE IMPACT due to current low quality of surface waters in the corridor and the water resources are used mainly for transportation rather than domestic consumption and irrigation. However, project activities must strictly comply with proposed mitigation measures to ensure that construction activities do not additionally reduce water quality.

3.5.4. Impact assessment of solid and hazardous waste generation

a) Waste sources

- Construction-generated solid waste

Solid wastes are generated from construction activities include sand, rock and concrete from excavation, which will be utilized for ground leveling other components within project and then disposed at Da Phuoc Landfill, with an estimated volume of around 18,190 m^3 . These are non-hazardous wastes but need to be handled to avoid impacts on air and water qualities.

- Domestic-generated solid waste

Domestic solid waste generated from workers' facilities contains organic wastes such as paper, plastics, cartons, food waste. Average generation of domestic solid waste is about 0.4 – 1.0 kg/person/day depending on particular lifestyle (*Vietnam National Environment Report 2011 – Solid waste*). If there are three worker camps with average 30 – 50 workers/camp, the daily solid waste generation caused by this project during construction phase is 12 - 50 kg/day/camp.

- Hazardous waste

Hazardous wastes are mostly oil contaminated materials. As regulated in the Circular No.12/2011-BTNMT issued on 14/04/2011 of MONRE, they include boxes, cans, asphalt, petrol, fuels, paints etc. The volume of hazardous waste depends on the number of mobilized equipment/machinery and based from monitoring experiences from many construction sites showed that only small amount of hazardous waste is generated. .

Other kinds of hazardous waste include batteries, wastes contaminated by printing inks etc. with small amount (from 2 – 3 kg/month), however, these are not be generated on construction sites but in operational offices and maintenance areas.

Discharged oil and oily contaminated waste from regular maintenance also identified as hazardous wastes. The amount of generation is estimated that: i) the amount of oil discharged each time is 07 litters; and ii) frequency of maintenance is 117 work shifts.

All the hazardous wastes must be collected, stored as regulated and only authorized organizations permitted transport and treatment.

Table 3. 19 Summary of solid and hazardous wastes generated from construction activities

No.	Activities	Waste generation				
		Type	Volume	Contents	Location	Duration
1	Surface excavation	Construction solid waste	18,190 m^3	Non-hazardous solid waste	Construction sites	24months
2	Operation of worker camps	Domestic solid waste	6,570 kg	Degradable, organic solid waste content	3 camps	24 months
3	Maintenance and others	Hazardous waste	48 kg	Discharged oil, paint boxes; battery etc.	Construction sites & offices	24 months
4	Discharged oil	Hazardous waste	485 liters	Discharged oil		

b) Impact assessment:

Inappropriate management of solid and hazardous waste could contribute to an unhealthy environment or act as source of disease. especially vector borne. as well as pollute air and water environments. Therefore, the project needs to manage generated waste appropriately.

As designed, total excavated soil volume is 18,190 m^3, which could be utilized for ground leveling or disposeof at Da Phuoc landfill site as agreed.

Domestic solid waste which will be managed appropriately. Itis strongly suggested that this kind of waste be collected, transported and treated through existing solid waste management systems.

Hazardous waste of small volume, but could create serious negative impacts on environment, will be collected, transported and treated by a licensed agency.

Conclusions

The impacts of domestic and construction solid waste, and hazardous waste, represent MODERATE NEGATIVE IMPACTS during the construction phase of the project. It requires the project to implement mitigation measures to reduce negative impacts during the construction phase.

3.5.5. Occupational Safety

Construction activities of this project will not use heavy machinery, however, risk of occupational accidents still be potential in construction sites and cause to injuries and even lives of employees. The following sources could create high risk of accident: UXO at construction sites; conflict between construction equipment and transport vehicles on the road, which also could be considered high risk due to high volume of traffic on Vo Van Kien and Mai Chi Tho street.

There may be risk of electric shock and electrocution while conducting excavations such as from encountering power cables.

In addition, workers may get sick because of unsafe living conditios, unsafe food and inappropriate personal protection equipment (PPC).

Conclusions

Impacts caused by unsafe working conditions are considered as MODERATE NEGATIVE IMPACTS during the construction phase. It is important to implement mitigation measures to ensure safety for all workers, local communities and ensure planning of emergency responses if accidents happen.

3.5.6. Traffic safety

Project construction activities will be take place at the centerline of Vo Van Kiet and Mai Chi Tho Boulevards, which experience high traffic volume. Construction activities will add to the road construction materials, machinery, equipment and workers during the construction period, occupy road surface which could increase high risk of traffic conflict for both workers and road users.

Table 3. 20 Average daily traffic volume along corridor

Route	Car	Truck with 2 axles & bus ≤ 25 pax.	Truck with 3 axles & bus > 25 pax.	Semi-trailer	Motor-cycle	Bicycle	Total
Vo Van Kiet Boulevard							
- Toward Mai Chi Tho	1286	1275	96	1	23053	172	25883
- Toward National Highway1A	1390	1012	125	1	23576	88	26192
Mai Chi Tho Boulevard							
- Toward Vo Van Kiet	1213	1073	146	186	16411	29	19058
- Toward Ha Noi Boulevard	1650	933	129	202	20662	19	23594

Source: Traffic observation report of the project, 2013

Furthermore, there are many important intersections on this corridor with high potential for traffic accidents. It requires that project has to plan schedule for construction activities as well as safety measures at intersections including: Ho Ngoc Lam, An Duong Vuong, Pham Phu Thu, Cao Van Lau, Tung Thien Vuong, Hai Thuong Lan Ong, Nguyen Tri Phuong, An Binh, Huynh Man Dat, Nguyen Bieu, Nguyen Van Cu, Tran Dinh Xu, Nguyen Thai Hoc, Tran Van Khe, Tran Nao, Dong Van Cong, Luong Dinh Cua etc.

In addition, inappropriate management of materials, machinery and equipment, organizing employees and managing shelters as well as inappropriate working plan could also cause to risk for people travelling on corridor, workers and local communities.

Table 3. 21 Areas of potential high risk to traffic congestion and accident

No.	Sensitive areas	Description

No.	Sensitive areas	Description
1	An Lac intersection with National highway 1A & Kinh Duong Vuong street	Important intersection with high traffic density. This intersection connect to Mien Tay Terminal by Kinh Duong Vuong (2,7 km). In front of intersection is commercial center of Big-C supper market.
2	Intersections between National highway 1A and Vo Van Kiet Boulevard	This intersection allows vehicle turn from national highway toward Vo Van Kiet Boulevard and vice versa.
3	Cat Lai intersection between Mai Chi Tho & Ha Noi Boulevards	This intersection allows vehicles turning from Dong Nai – Ho Chi Minh toward Mai Chi Tho Boulevard and vice versa and toward Long Thanh – Dau Giay.
4	Other intersections: Vo Van Kiet & Ho Ngoc Lam Vo Van Kiet & An Duong Vuong Vo Van Kiet & Pham Phu Thu Vo Van Kiet & Cao Van Lau Vo Van Kiet & Hai Thuong Lan Ong Vo Van Kiet & Nguyen Tri Phuong Vo Van Kiet & An Binh Vo Van Kiet & Huynh Man Dat Vo Van Kiet & Tran Dinh Xu Vo Van Kiet & Nguyen Thai Hoc Vo Van Kiet & Ky Con Mai Chi Tho & Tran Van Khe Mai Chi Tho & Tran Nao Mai Chi Tho & Dong Van Cong Mai Chi Tho & Luong Dinh Cua	These intersections connect people in other places to Vo Van Kiet & Mai Chi Tho Boulevard that help them easily travel to the western (Binh Chanh & National highway 1A) and (or) to the eastern (Cat Lai, Dong Nai, Vung Tau). These intersections also connect areas of District 4 and District 8 to City center. Residential, commercial as well as official areas are highly concentrated on District 1, 5, 6 and Binh Tan that are along Vo Van Kiet Boulevard. New residential and commercial areas are in construction toward Binh Chanh district (Vo Van Kiet Boulevard) and toward District 2 (Mai Chi Tho Boulevard). Population density is lower in Mai Chi Tho Boulevard than Vo Van Kiet Boulevard.
Crowded areas (market, school, residential areas and hospitals)		
5	Residential areas along corridor in District 1, District 5, District 6 and District 8	The residential areas in Binh Tan and District 2 are being developed and will be more crowded; Residential areas in District 1, 5, 6 and 8 are already settled with both residential and commercial activities.
6	Primary school of Kim Dong (District 6) Kindergarten of Rang Dong (District 6) University of Hong Bang (District 5) Primary school of Ham Tu (District 5) Primary school of Chuong Duong (District 1) Australia International School AIS (District 2) International school of ACG (District 2)	The rush hours related to education activities are 6:30 am – 7:30 am and 4 pm – 5 pm daily. The kindergarten and primary schools requires parents take children to and leave school.
7	Hoa Binh market Cau Ong Lanh market	These market located next to Vo Van Kiet Boulevard (on pavement side) and at intersections;

No.	Sensitive areas	Description
		Highly attract surrounding residents in early morning and later afternoon.
8	Nhiet Doi hospital Tam Than hospital Saigon-ITO hospital	These hospitals are close together in high density area of transportation; Working 24 hrs. per day.

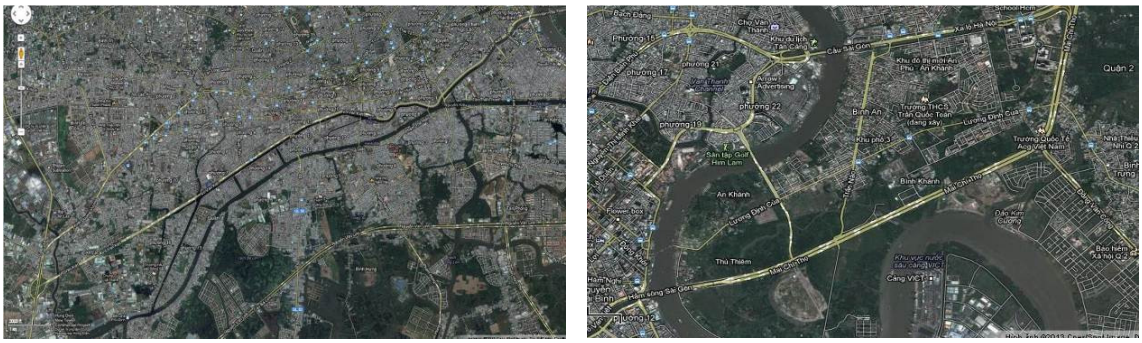
Source: Rapid environmental condition assessment of GTP, 2014

Conclusions

Traffic safety is considered as a MODERATE NEGATIVE IMPACT during the construction phase of project, due to potential impacts on workers and people travelling along the corridor. The project must implement mitigation measures to control traffic congestion, avoid traffic accidents, as well respond quickly to any emergency.

3.5.7. Ecosystem impact assessment

This project is developed along the existing Boulevards of Vo Van Kiet and Mai Chi Tho and impacts on ecosystems are likely negligible. The characteristics of ecosystems in this corridor is urban ecosystem with areas (Binh Tan district and District 2) have been experiencing rapid urbanization process and density water surface network (river, canals). The natural environment of the corridor has rapidly changed due to a number of new development projects which have been implementing. The impact of changing environmental landscape caused by this project will be insignificant with the positive trend.



Landscape on Vo Van Kiet corridor Landscape on Mai Chi Tho Corridor

Figure 3. 1 Existing landuse and lanscape on Vo Van Kiet – Mai Chi Tho corridor

Conclusions

There will likely be NO NEGATIVE IMPACT on the urban ecosystem caused by project activities during the construction phase. However, the project needs to implement measures to avoid unnecessary impacts on areas outside of construction sites.

3.5.8. Degradation of public facilities

Local public infrastructure could be impacted due to operation of transport vehicles (material, waste and mixing concrete transportation) which could degrade facilities and create

additional impacts on local daily activities. However, due to the small scale, widely dispersed construction, low transportation demand, and most of the transport routes are urban transport with good quality, therefore the impacts will not high, but to ensure control over the types of impacts, the mitigation measures need to be proposed and complied during construction time. If degradation of local infrastructure results from this project, contractors and PMU are to compensate and restore facilities to their condition prior to project commencement.

Conclusions

It is considered that there will be a MINOR NEGATIVE IMPACT on local facilities, because of limited excavation and transportation of materials and waste. Mitigation measures are required to ensure responsibilities of Project Owner as well as contractors to local communities.

3.5.9. Social impact assessment

a) Source of impacts

It is estimated that there will be three worker camps established with 60 – 80 workers each during the peak periods. The activities of construction equipment, machinery, open holes, transport vehicles could lead to social disturbance, risks and noise during nighttime.

b) Impact assessment

The main social problems could be listed as the below:

- Potential impact of spreading infectious disease from employees to local communities and vice versa.
- Potential impact of prostitution, drugs and gambling.
- Potential conflict between workers and local communities because of differences of culture, behavior.
- Potential impacts on local businesses, for example restaurants, shops etc. could be temporary closed or disadvantaged because of project activities and pollution, especially at pedestrian flyovers sites.
- Cultural values could be potentially impacted but because all these values are distanced from project construction areas hence will not be significantly impacted. However, the concentration of huge amount of employees could potentially undesirable conflict with local communities including cultural values;
- Communities could be at risk if they travel around or are close to the construction sites and potentially exposed to accidents.

Conclusions

It is considered that there will be MINOR NEGATIVE IMPACTS to local communities. However, the project requires appropropriate management at construction sites to avoid undesirable impacts.

3.5.10. Assessment of impacts on historical and cultural heritage

There are no important historical and cultural sites identified ta project construction sites of project or within affected areas of project activities. There are two sites, a church and monastery, built during the colonial French period, at a distance of 70 m from Mai Chi Tho Boulevard at Thu Thiem ward – district 3. However, the monastery and the church is in the process of preparing to move to develop the Thu Thiem New Urban Area, the impact of the project on the two works is so impacts caused by project are negligible.

In addition, the area close to Canal 2 that used to be planned as reserved historical area of Vie Nam War, however, the plan is still unclear and many other projects have been developed in that area.

In project area, a bridge has been built since 1940s and is currently improved but this project only implement small improvement activities in the segment of the BRT 1 with the bridge on Vo Van Kiet road, less impact on the surroundings, so the project will not have an impact on the old bridge.

Almost all components of project are developed on existing Vo Van Kiet and Mai Chi Tho Boulevards but Rach Chiec Terminal and Thu Thiem Technical Facility are new constructions. There are no any grave or underground archaeological sites discovered in those new construction areas. However, any new discovery that occurs during the construction phase will be informed to authorities for further advice.

Conclusions

There is likely NO NEGATIVE IMPACT on historical and cultural heritage during the construction phase of the project. However, discovery of any artefact of historical or cultural interest must be informed to relevant authorities to request specific guidance on how to proceed.

3.5.11. Flooding and climate change-related impacts

Construction activities could create localized flooding through blocking water flow. However, almost construction activities of the project are not in floodplain or in important area of water flow, hence it will not significantly impact on natural flood. However, the impacts of drainage system caused , for example materials corrupt drainage system, could result in localized flooding.

According to rapid environmental assessment on the corridor, the localized flooding in the corridor could impact on project activities and vice versa but are considered insignificant:

- The intersection of An Duong Vuong street & Vo Van Kiet Boulevard is usually flooded because of combination impacts of heavy rain and high tide that requires to be considered during the construction phase.
- The area of Thu Thiem Technical Facility is located in low-lying area of Saigon river basin. The surrounding area usually flooded that requires considerations during the construction period.

Conclusions

According to such assessments, climate change and flood will affect on project activities, while project also effect on current existing flood issues. However, those are MINOR NEGATIVE IMPACT.

3.5.12. Environmental risks and emergencies

Residue of UXO

There is possibility of residue from UXO remaining from the Viet Nam War that pose a risk of explosion during excavation. The consequences are significantly adverse that could cause to injuries, disabilities and human losses of affected people and infrastructures in the project area. Demining activities should be conducted by authorities of Ministry of Defense and take place during the pre-construction phase of project.

Fire and explosive emergencies

Emergencies of fire and explosion could be occurred at storing fuel, unsafe in using electric . The consequences are extremely adverse that could cause to injuries, disabilities and human losses. The reasons of fire and explosion are as following:

- Unsafe or inappropriate firefighting systems and management at fuel storage areas on construction sites could result in fire and explosion.
- Electric generator supplying energy for machineey, equipment could cause electrical incidents resulting in fires;
- Using of heating equipment could cause to fire or occupational accident such as burn.

Because these emergencies could occur any time thus it requires a specific Emergency preparedness and response plan at the construction site as well as appropriate equipment to minimize probability of these emergencies.

Flood emergency

The frequency of tropical storms that reach Ho Chi Minh City is $1/10^2$ compared to other coastal areas. Tropical storms could cause to many consequences and adversely increase floods that are currently impacts on its citizens as well as the project corridor.

Conclusions

The emergencies are MODERATE NEGATIVE IMPACT because low frequency occurs then its impacts is not serious, however, if risk happens during construction phase could create significantly impact on people and properties. It requires that an appropriate rapid responding plan need to prepare for ensure management of emergencies .

3.6. IMPACT ASSESSMENT DURING OPERATION PHASE

3.6.1. Impact assessment of dust and gas emissions

Dust and gas emissions from transportation:

Dust and gas emissions are the main pollutants from transportation activities especially in urban areas. This section will focus on calculation of GHGs emissions as well as other pollutants from the project .

Dust and gas emissions are calculated for two different scenarios - assessing emissions of BRT Line 1 in comparison with scenario without the BRT.

According to Technical Report of Internal Energy Agency (2010) – Contribution of CNG in sustainable transportation development:

Using CNG could reduce average of 25% of GHGs emissions compared with same capacity of vehicles using gasoline. For diesel fuel, the average reduction is higher but specific amount of reduction depends on particular type of vehicle.

In addition, using CNG could also improve environmental quality because of reduction of emissions from CNG vehicles rather than other diesel vehicles emit. The gases could be less emitted including CO_2, NO_x, and PM.

Furthermore, the using of CNG could have lower impact of noise up to 66% inside vehicle and 33% outside vehicle, depending on type of vehicle.

Emission from operation of BRT buses on route

According to feasibility study of project, the technical specifications for project in the operation phase are calculated as follows.

Table 3. 22 Technical specifications in operation phase

Specifications	Units	Year		
		2018	2020	2030
Number of vehicle	Car	26	26	50
Number of trip per day	Trip	260	348	744
Total travel distance per day	Km	7774	7899	12,675
Operational speed	Km/hr	25	25	25
Fuel		CNG	CNG	CNG
Fuel consumption factor	litters/100 km	39.56	39.56	39.56
Trip generation factor	Trips/day	2.5	2.5	2.5
Trips on track	%	15	15	15
Shifting from private vehicles to BRT	%	15	15	15

Source: Feasibility study of GTP, 2014

The number of trips generation and the modal share of in the corridor are calculated in feasibility study report (2014) as follows:

Table 3.23 Total trips predicted for each vehicle

Vehicle	Total trip generation [trips]			
	2013	2020	2025	2030
Taxi	166,982	214,140	250,623	282,870
MC	5,469,406	6,021,781	6,235,867	6,308,370
Car	230,849	314,939	363,133	406,561
Coach	224,724	332,302	365,049	398,580
Bus & BRT (PuT)	137,049	210,395	283,383	292,027

Source: Feasibility study of GTP, 2014

GHG emissions are calculated as $CO_{2equivalent}$ (CO_{2e}) for two scenarios: i) without BRT development (BAU); ii) with BRT development.

Inputs for formula are identified as following:

- Using the traffic accounting data to identify the traffic flow by vehicle types on route.
- Forecast transport data on corridor by apply the default factors such as additional trip generation, trip generation share by vehicle types, and fuel consumption factor extracted from EFFECT[2] model in Vietnam Low Carbon Option Assessment of the WB report for urban area.
- Using emission factor of IPPC 2006 for CO_{2e} for three types of fuels that commonly used in transportation including CNG, diesel and gasoline.

Table 3. 24 Emission factors of GHGs according to IPCC 2006

Type of fuel	Emission kg CO_{2e} /unit	unit
CNG	0.0545	Sct (short ton)
Gasoline	8.78	gallons
Diesel	10.21	gallons

Source: IPCC guideline, Volume 2 – Mobile Combustion, 2006

- Using coefficient of average travel distance of vehicle according to HOUSTRAN[3] to calculate VKT (Vehicle – km travel).

- Calculation of emission according to IPCC guideline, 2006, Calculation method TIER 1[4]

Table 3.25 GHG emissions from different development scenarios[5]

Development scenario	Total GHGs emission in project corridor (tons)			
	Base year (2013)	2018	2020	2030
Without BRT (BAU)	15,765	175,142	270,950	402,278
With BRT	15,765	132,757	204,760	307,603

In addition, many other assessments have concluded that using CNG could help to reduce pollutant emissions to air environment,

Table 3, 26 CNG and diesel: comparison of GHG emissions

Fuel	CO	NOx	PM
Diesel	2.4 g/km	21 g/km	0.38 g/km
CNG	0.4 g/km	8.9 g/km	0.012 g/km
% of reduction	**84**	**58**	**97**

Note: Medium-duty diesel bus, central business district test cycle,

[2] Emission coefficients from EFFECT model, calculated for Vietnam urban context;
[3] From 20.000 surveys of questionnaires in HOUSTRAN project, assume that these coefficients are constant;
[4] Calculation method TIER 1 in guideline of IPCC is used for calculation GHGs emissions depending on Carbon containing in fuel, usually applied in developing countries and in developed countries where still do not have national emission coefficients;
[5] Calculated results do not consider competition from operation of BRT.

Source: Frailey and others, 2000,

Apply theory of MUAIR model, which is developed by Dr. Kim Oanh based on theory of Hanna (1971) and Berkowicz R, (2000) to calculate concentration distribution of pollutant along the project corridor with the scenario of BRT development. Assume that climate conditions in this area are constants, the improvements of technology, fuel quality as well as maintenance activities will not affect to emission on the corridor, In addition, the existing of high-rise building will not be considered in this model.

$$C_{ij} = \frac{(2/\pi)^{1/2}\,(x/2)^{(1-b)}}{u \cdot a \cdot (1-b)} \left\{ Q_{ij} + \sum_{k=i+1}^{N} Q_i \left[(2i+1)^{(1-b)} - (2i-1)^{(1-b)} \right] \right\}$$

In which:

*Qij= Qp*Wij*

U = wind speed, 0-9999 (but not equal 0)

Cij: Concentration of pollutant i at location j (µg/m3)

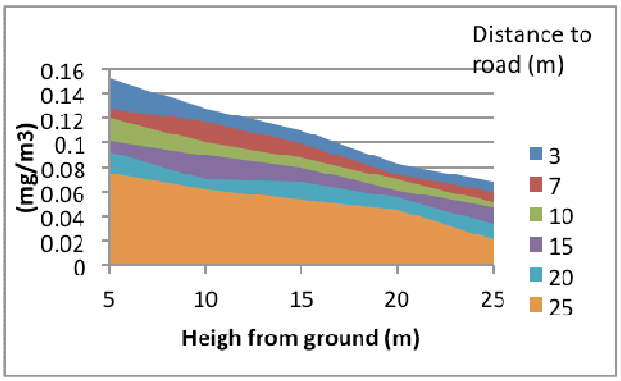
Qij: Pollution load of pollutant I at location j (g/s,m2)

Qp: Total emission of pollutant on route,

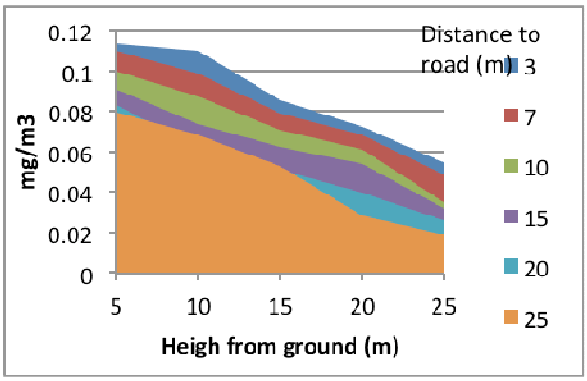
Wij: Travel demand in future on route

The calculated results of pollutant concentration are shown below:

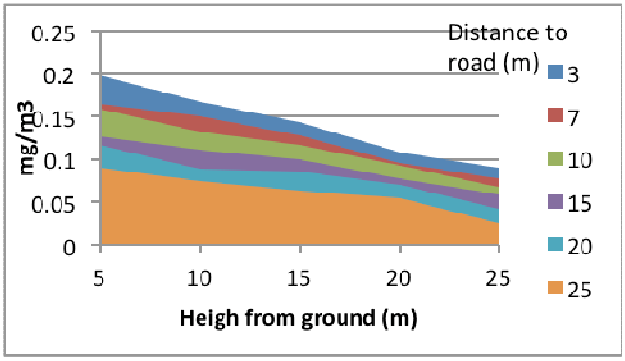
- *Distribution of PM_{10} on project corridor*

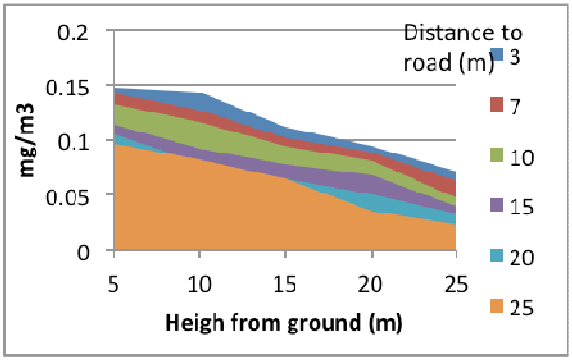


Distribution of PM_{10} on Vo Van Kiet Boulevard by 2020



Distribution of PM_{10} on Mai Chi Tho Boulevard by 2020



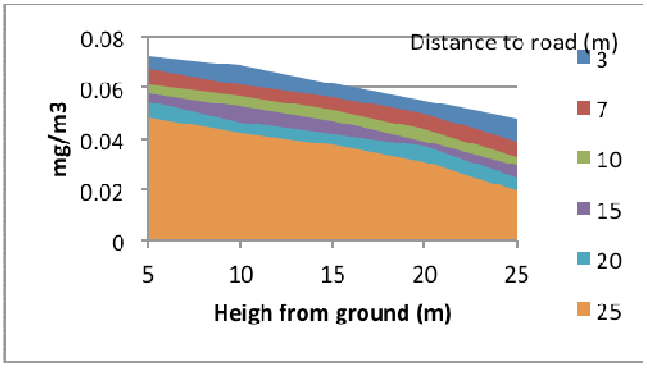


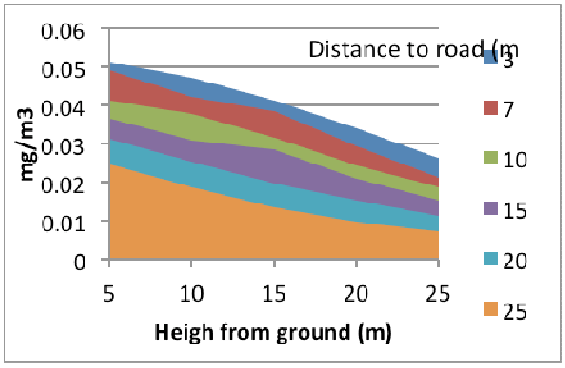
Distribution of PM_{10} on Vo Van Kiet Boulevard by 2030

Distribution of PM_{10} on Mai Chi Tho Boulevard by 2030

Figure 3.2 Distribution of PM_{10} on Vo Van Kiet and Mai Chi Tho Boulevards by 2020 and 2030

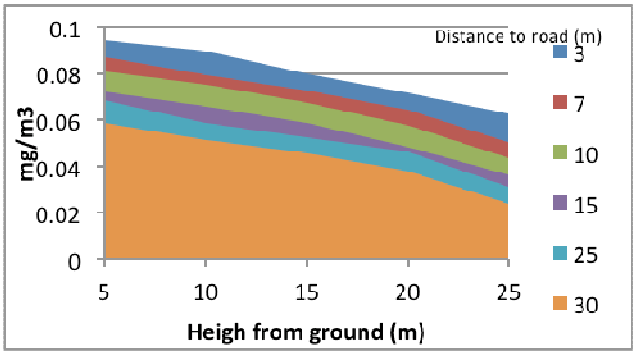
- *Distribution of NO_x along project corridor*

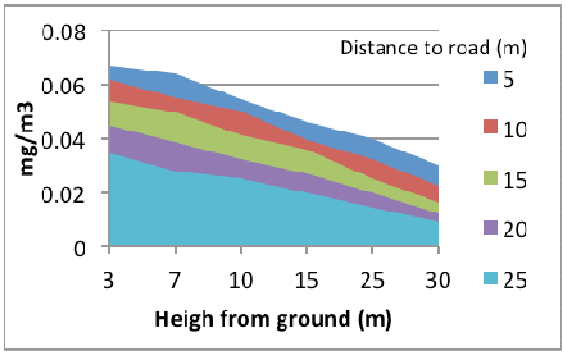




Distribution of NOx on Vo Van Kiet Boulevard by 2020

Distribution of NOx on Mai Chi Tho Boulevard by 2020



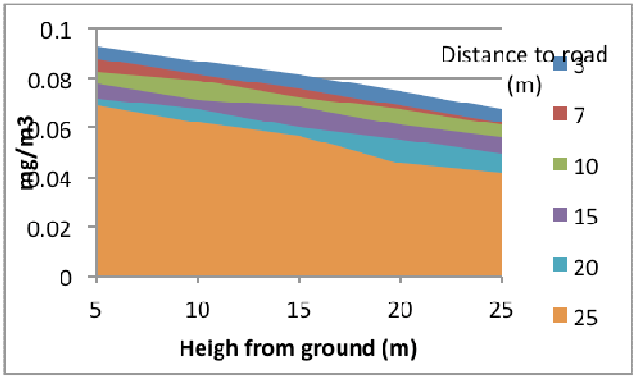


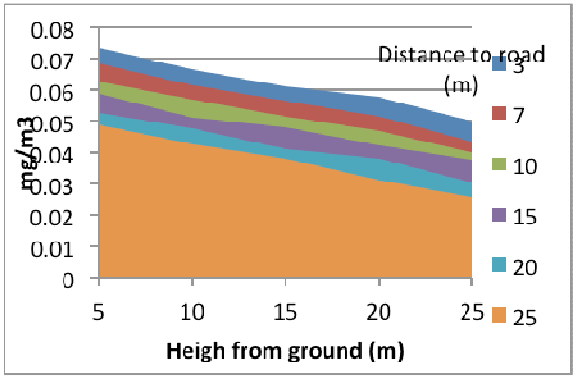
Distribution of NOx on Vo Van Kiet Boulevard by 2030

Distribution of NOx on Mai Chi Tho Boulevard by 2030

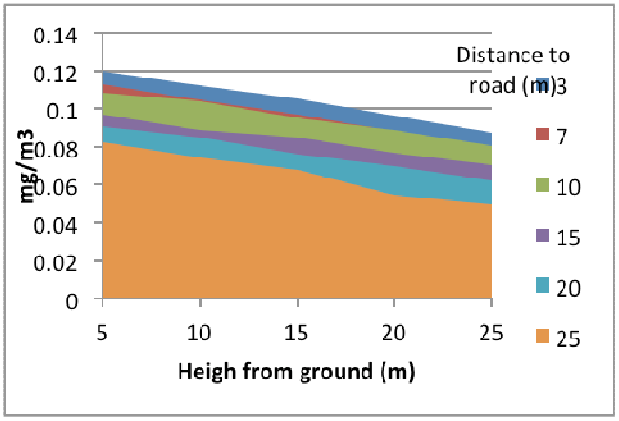
Figure 3.3 Distribution of NO_x on Vo Van Kiet and Mai Chi Tho Boulevards by 2020 and 2030

- *Distribution of SO_2 on project corridor*

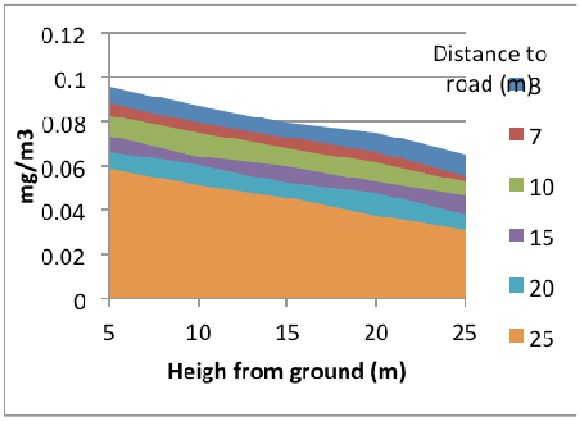




Distribution of SO_2 on Vo Van Kiet Boulevard by 2020



Distribution of SO_2 on Mai Chi Tho Boulevard by 2020

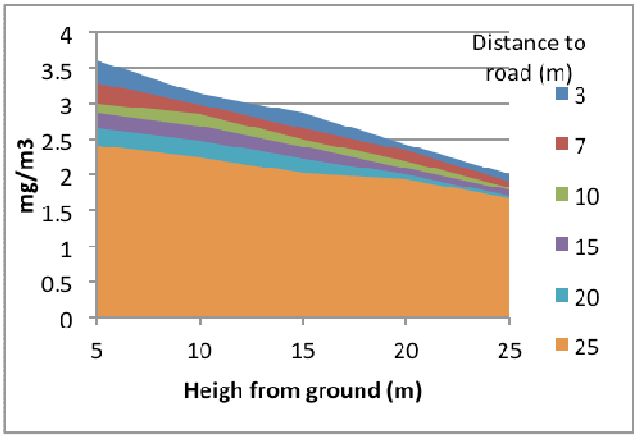


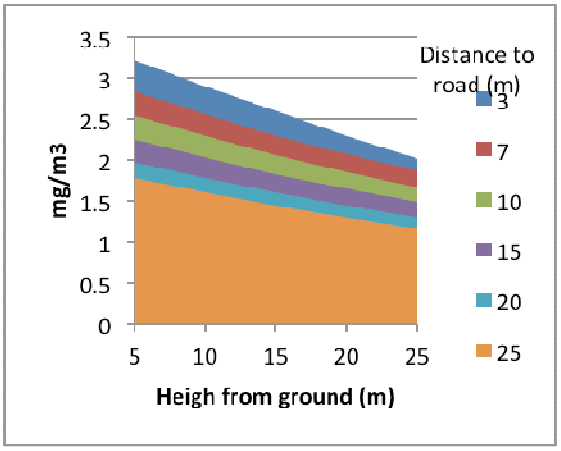
Distribution of SO_2 on Vo Van Kiet Boulevard by 2030

Distribution of SO_2 on Mai Chi Tho Boulevard by 2030

Figure 3.4 Distribution of SO_2 on Vo Van Kiet and Mai Chi Tho Boulevards by 2020 and 2030

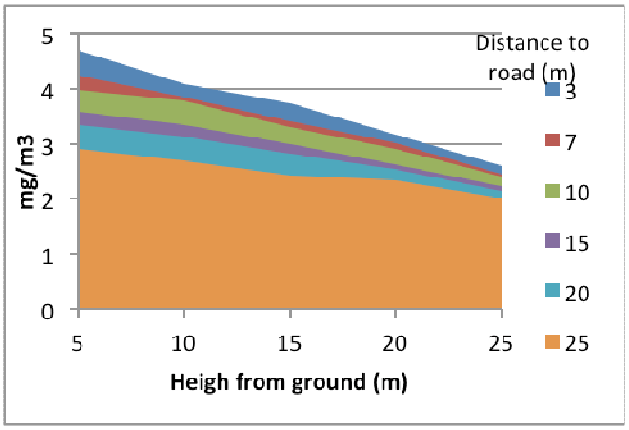
- *Distribution of CO on project corridor*

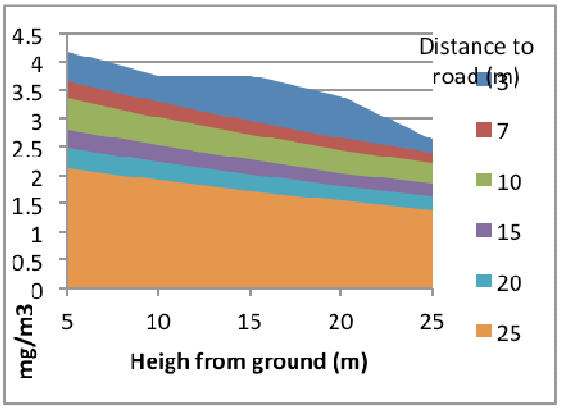




Distribution of CO on Vo Van Kiet Boulevard by 2020

CO Distribution on MaiChiTho Boulevard, 2020





CO Distribution on Vo Van Kiet Boulevard by 2030 CO Distribution on MaiChiTho Boulevard, 2030

Figure 3.5 Distribution of CO on Vo Van Kiet and Mai Chi Tho Boulevards by 2020 and 2030

According to such results, the development of BRT on this corridor could increase pollutant concentrations, however, it will still be under thresholds of technical regulations.

However, according to the results of the survey and forecast traffic demand by consulting feasibility study report showed that the percentage of people are going to switch from conventional buses to the BRT bus is about 14%, the percentage of switching from motorbike riders to BRT is over 6%. With the share of generation trips on the route to be converted from diesel fuel and gasoline buses (with high emissions of pollutants) to CNG cleaner BRT bus (gas compressed natural) will contribute to reducing air pollutants emission and GHGs along the BRT 1, improve air quality when compared to conditions without BRT line.

Dust and gas emissions from operation of power generators (standbys)

The 300 kVA power generators will be provided at the Rach Chiec terminal and Thu Thiem Technical Facility to ensure power supply for cases that electricity could be off from national grid. Power generators will use DO as fuel. The operation of power generators could create dust and air pollutants, however, power generators will only operate since any electricity problem occur, thus the impacts will be minor. The total dust and air pollutant volume generate from power generators will base on fuel economy factor, operation capacity and type of fuel consumption.

The emission coefficients of power generators, which use DO fuel is in the below table:

Table 3, 27 Emission coefficient of power generators (DO fuel, 0.5%S)

No,	Air pollutant	Emission coefficient (kg/ton fuel consumed)
1	Dust	0.71
2	SO_2	1.00
3	CO	2.19
4	NO_x	9.62
5	THC	0.79

Source: *Rapid assessment of pollutant volume, WHO, 1993*

Usually, when DO fuel is combusted at temperature of 200^0C, total generated pollutant per 1 kg of DO will be 38,6 m^3. With average fuel consumption factor is 35 kg/hour, the total volume of generated pollutant will be 1351 m^3/hour. The air pollutants from power generation could be estimated as below table:

Table 3, 28 Volume and concentration of air pollutants generated from power generators

No.	Pollutant	Emission coefficient (kg/ton fuel)	Pollutant volume		Pollutant concentration under normal conditions (mg/m^3)	Pollutant concentration under standard conditions (mg/Nm^3) *	QCVN 19:2009/BTNMT
			Kg/h	g/s			
1	Dust	0,71	0.025	0.007	18.39	31.88	120
2	SO_2	1	0.035	0.010	25.91	44.90	300
3	CO	2,19	0.077	0.021	56.74	98.32	600
4	NO_x	9,62	0.337	0.094	249.22	431.90	600
5	THC	0,79	0.028	0.008	20.47	35.47	-

Note:

- QCVN 19:2009/BTNMT National standard on industrial dust and air pollutant concentration, category B which will be applied from 1/1/2015. The calculation factor Kp=1 and Kv=0.6
- (*) standard condition is 25^0C, 1 atm.

Air pollutant concentration generate from power generators will not exceed permission level regulated in QCVN 19:2009/BTNMT, thus a small chimney will be provided to manage impacts of these pollutants.

Conclusions

Dust and gas emissions caused by operation of BRT buses during the operational phase of project are considered as representing a NONE NEGATIVE IMPACT. The main objective of the project is to encourage reduced use of private vehicles and increase consumption of clean fuel instead of fossil fuel to reduce pollutant emissions. It is a positive impact of the project, and one of the long-term goals of the project is the development of public transport, limiting personal vehicles, while using clean fuel, which will lead to reduce air pollutants emission, The operation of power generation is MINOR NEGATIVE IMPACT, which is within limitation of National technical regulation,

3.6.2. Noise and vibration impact assessment

The development of a modern BRT system will encourage people to use public BRT buses instead of private vehicles. This will help reduce traffic congestion and indirectly reduce noise pollution. In addition, the project also contributes to noise reduction by:

- Replacing 2 – 3 buses by bigger one.
- Selected BRT buses are less noise generation vehicles.
- Apply noise reduction equipment.
- Motivate people using public buses instead of private vehicles.

According to project design, the BRT will be in operation from 2018 as follows:

Table 3, 29 Number of trips per hour

No	Year	No. of BRT return trips (return trips/day)
1	2018	260
2	2020	348
3	2030	744

According to average noise emissions caused by transportation in standard conditions, noise level caused by BRT bus is about 68 dBA. However, this noise is caused all vehicles on road for example car, truck and motorcycle. Moreover, the air quality monitoring on June/2014 showed that noise in this corridor are below threshold of National technical regulations for residential area.

Table 3, 30 Average noise level from transportation under standard conditions (LA7)

Traffic flow (veh/h)	40	50	60	80	100	150	200	300	400	500
Noise level L_{A7}, (dBA)	68	68.5	69	69.5	70	71	72	73	73.5	74
Traffic flow (veh/h)	**700**	**900**	**1000**	**1500**	**2000**	**3000**	**4000**		**5000**	**10000**
Noise level L_{A7},[6] (dBA)	75	75.5	76	77	77.5	78.5	79		80	81

Source: TDS Integrated environmental issues in Transpiration Plan, 2005

Because transportation on this corridor by 2020 and 2030 will still be mixed transportation that results in difficulties in quantifying noise level caused by specific type of vehicle. However, noise reduction is benefit from using CNG buses, which is 37% of reduction inside vehicle and 65% of reduction in outside vehicle compared with diesel consumption buses[7].

Conclusions

Noise pollution is considered as having NO NEGATIVE IMPACT. A key benefit of the BRT vehicle is noise generation reduction during vehicle operation (inside and outside).

3.6.3. Impact assessment of solid waste and hazardous waste generation

a) Domestic solid waste

Waste sources are from passengers and employees at bus stations, Rach Chiec Terminal and employees at Thu Thiem Technical Facility. The amount of waste generated at bus stations depends on number of passenger and employees. Passengers will not wait long time in bus stations but the combination of services in these areas will contribute to domestic solid waste generation.

Although this is non-hazardous waste and mainly contains organic substances, it needs to be managed to mitigate environmental issues and disease. The calculation of waste generation, with average of 0.015 kg per passenger per trip is as following:

[7] See more at: http://www.civitas.eu/content/cng-buses-public-transport#sthash.zeVE4A13.dpuf

Table 3.31 Estimation of domestic solid waste generation at 28 BRT bus stations

BRT station	Location	Waste generation (kg/day)	
		2020	2025
An Lac	An Lac intersection	1,969	9,427
BRT-02	VVK	1,76	10,252
BRT-03	VVK	2,343	17,545
BRT-04	VVK	1,727	23,463
BRT-05	VVK	3,575	17,215
BRT-06	VVK	4,466	35,794
BRT-07	VVK	3,542	44,638
BRT-08	VVK	4,686	35,387
BRT-09	VVK	5,544	46,871
BRT-10	VVK	3,828	55,429
BRT-11	VVK	4,774	38,258
BRT-12	VVK	3,124	47,751
BRT-13	VVK	2,145	31,196
BRT-14	VVK	2,893	21,428
BRT-15	VVK	2,156	28,875
BRT-16	VVK	2,871	21,593
BRT-17	VVK	1,342	28,71
BRT-18	VVK	2,123	13,365
BRT-19	VVK	5,522	21,197
BRT-20	MCT	2,398	55,253
BRT-21	MCT	2,915	31,031
BRT-22	MCT	1,804	29,183
BRT-23	MCT	1,232	18,04
BRT-24	MCT	2,783	12,331
BRT-25	MCT	2,486	27,808
BRT-26	MCT	4,092	24,827
BRT-27 (Rach Chiec)	Cat Lai junction	0	6,699
BRT-27 (Rach Chiec)	Cat Lai junction	7,04	0
BRT-28	Cat Lai junction – Ha Noi Avenue	1,969	70,345
TỔNG		**94,919**	**949,135**

In addition, Thu Thiem Technical Facility will be operational center, fuel recharge station, parking and washing areas. The operation of Thu Thiem Technical Facility will generate

certain amount of domestic solid waste that need to be collected and treated. The estimation of 0.5 kg of solid waste generation per person per day, the solid waste generated at Thu Thiem Technical Facility is as following table:

Table 3.32 Estimation of domestic solid waste generation at Thu Thiem Technical Facility

Activities & waste generation	Unit	Volume
Maintenance	People	14
Management of maintenance	People	1
Office	People	8
Amount of waste generated	Kg/day	11.5

b) Hazardous waste

Hazardous waste from the operational phase of this project is generated mainly in Thu Thiem Technical Facility from operational and maintaining activities of BRT buses, including waste batteries, tires, oily waste. These hazardous wastes need to be separated, collected, transferred and treated properly to avoid negative impacts on environment as well as public health. The estimation of hazardous waste generated at Thu Thiem Technical Facility is in Table 3.31:

Table 3.33 Estimation of hazardous waste generation at Thu Thiem Technical Facility

Type of waste	Hazardous code	EC code	Unit	Volume		
				2018	2020	2030
Tires	15 01	16 01	Pair	310	358	410
Battery	19 06	16 06	One	53	61	70
Oily waste	18 02 01	15 02 02	Kg	100	128	152
Electric lights	16 01 06	20 01 21	Kg	10	12	15

The generated solid and hazardous waste in public area, and maintenance activities if not collected appropriately, will generate the sanitation problem, increase the generation of disease as well as impact to public health and reduced passenger in public transport.

Conclusions

Domestic solid waste and hazardous waste generation during the operational phase of project are considered as having a MODERATE NEGATIVE IMPACT, requiring appropriate management to ensure acceptable environmental quality.

3.6.4. Impact assessment of wastewater generation

Based on water-related activities which stated in item 1,4, the total daily water demand is estimated about 200 – 250 m^3 which will be mostly used for domestic purposes at bus stop stations and terminal. The volume water for washing vehicles will be high in Thu Thiem

Technical Facilitate, The following wastewater need to be managed during the operational phase:

Domestic wastewater generated from bus stop stations, terminals, with volume is 2 – 3 m^3/,day in each bus stop stations and 5 – 6 m^3/day in Rach Chiec Terminal. This type of water mostly contain food refuse, undissolved substances, organic maters, BOD, COD, Total Nitro, Total Phosphorous, P and virus (WHO, 1993).

Domestic wastewater generated from Thu Thiem Technical Facility, according to feasibility study, there will be 20 – 25 people working at Technical Facility, the wastewater estimated about 2,5 – 3,3 m^3/per day. According to WHO 1993 calculation for developing countries, the pollutant loads in domestic wastewater are in Table 3.33 as following:

Table 3.34 Pollutants in domestic wastewater

No,	Pollutant	Load (g/person/day)
1	BOD_5	45-54
2	COD	72-102
3	SS	70-145
4	Oil	10-30
5	N total	6-12
6	NH_4^+	2.4-4.8
7	P total	0.8-4.0
8	Total Coliform	10^6-10^9

Source: WHO (2003)[8]

Pollution in cases with and without septic tanks are as follows.

Table 3.35 Concentration of pollutants in domestic wastewater

No,	Pollutants	Concentration (mg / l)		QCVN 14: 2008 of MONRE *(mg/l)*	
		Without septic tank *(mg/l)*	With septic tank *(mg/l)*	A	B
1	BOD_5	533 ÷ 619	106.6 ÷ 247.6	30	50
2	COD (dichromate)	1020 ÷ 1028,5	204 ÷ 411.4	-	-
3	SS	1000 ÷ 1450	200 ÷ 580	50	100
4	N total	85÷120	17 ÷ 48	-	-
5	Ammonia (N-NH_4)	33,3 ÷ 46,7	6.6 ÷ 18.6	5	10
6	P total (PO_4^{3-})	14,2 ÷ 40	2.84 ÷ 16	6	10
7	Total coliforms (MNP/100ml)	1,.4 10^8 ÷ 1.4 10^{10}	-		

Source: WHO (2003)[9]

Such results indicate that the effluent from septic tank is still polluted by BOD, COD etc, compared with national technical regulations of QCVN 14:2008 of MONRE. Therefore, it needs to be treated before discharging to drainage system.

[8] (WHO) 2003; Assessment of Sources of Air, water and Land Pollution
[9] (WHO) 2003; Assessment of Sources of Air, water and Land Pollution

Wastewater from washing BRT buses: This type of wastewater contains organic substances, oil and suspended solids that require treatment before discharge. The water demand for washing BRT buses is estimated about 5 m^3/day/bus, the total wastewater generated from washing could be estimated as following:

Table 3.36 Estimation of wastewater generated from bus washing at Thu Thiem Technical Facility

	Unit	2018	2020	2030
Number of vehicle	vehicle	24	24	46
Wastewater	m^3/day	120	120	230

Wastewater from washing vehicles could contain high concentrations of contaminants (e.g., soap, oil and grease, SS) that need to be treated before discharge into the drainage system.

Table 3.37 Contamination of wastewater from vehicle washing activities

	pH	COD (mg/l)	TS (mg/l)	TSS (mg/l)	Oil (mg/l)
Heavy vehicle	6.4-7.0	255-445	1200-6000	400-2000	400-800
Light vehicle	7.1-7.6	227-378	800-1500	600-750	150-700
Composite part	6.4-6.6	280-360	1800-2500	1500-2000	300-700

Source: EIA report – Sustainable Development project of Da Nang City

Water runoff

This kind of wastewater is generated from storm water at Thu Thiem Technical Facility and Rach Chiec Terminal. The main content of this wastewater is suspended solids. Solid contaminants need to be removed by traps before discharge to the drainage system.

Volume of runoff water: According to Le Van Nai (1999), volume of runoff water could be estimated as bellowing:

$$Q = 0{,}278 * K * I * F$$

Where:

K: surface runoff volume (K=0,6);

I: average rainfall volume, (average rainfall in Ho Chi Minh City, 2011, is 162,8 mm);

F: area of catchment

At Rach Chiec Terminal: Average run off volume is 157,6 m^3/month or 5,3 m^3/day,

Thu Thiem Technical Facility: Average run off volume is 484,1 m^3/month or 16,1 m^3/day,

Conclusions

Wastewater from the operation phase are considered as having a MODERATE NEGATIVE IMPACT, requiring integrated management measures to ensure an acceptable environment at project sites and public places.

3.6.5. Impact assessment of traffic safety and congestion

The potential for traffic accidents and congestion could occur due to following reasons:

- The narrowing of road on Vo Van Kiet – Mai Chi Tho corridor since the two center lanes will be prioritized for BRT buses. The traffic demand on this corridor is estimated to increase which create high potential of traffic congestion and accident.
- At intersections: with a total existing 21 intersections, 2 interchanges and 3 planned intersections, operation of BRT with prioritized traffic lights could cause congestion at such intersections.
- Safety for passengers: the unsafe impacts or traffic accidents could be risk for BRT passengers when they access to BRT bus station at the traffic light location.
- Traffic accident and congestion at the Rach Chiec Terminal Gate and Thu Thiem Technical Facility Entrance could be worse due to increasing traffic volume in rush hours.

Conclusions

Traffic accident and congestion during the operational phase are considered as having a MEDIUM NEGATIVE IMPACT. Operation of the BRT route should help by reducing private vehicle use in this corridor.

3.6.6. Impact assessment of environmental sanitation in stations and terminal

Environment sanitation at BRT bus stations and terminals will likely be a significant issue given large numbers of passengers. Moreover several service types will also provide there such as ticket, drinking shops, waiting area and other environmental facilitates . Environmental issues could arise due to inappropriate solid waste management, wastewater collection, and inadequate cleaning activities. Low awareness from passengers could create negative environmental impacts and insanitation condition at the stations and terminal.

The insanitation condition at bus stations and terminal could create impacts on urban aesthetics, diseases disperse for passengers and employees as well as communities along the corridor and result in reducing the attractive of BRT vehicle.

Conclusions

MODERATE NEGATIVE IMPACTS are considered likely during the operational phase, requiring appropriate management systems at each station.

3.6.7. Impact assessment of security and social disturbance in project corridor

Public areas at BRT bus stations could be good place for homeless, unemployment peoples led to and increase the social evils as robbery, prostitution and drugs which will result in high social risk for local people and nearby communities.

According to project design, there will be nine parking areas for passengers at BRT stations number 02 (station number 2 will be provide 02 parking areas), 03 (station number 3 will be p02 parking areas), 07, 12, 14, 16 and 18 with total area of 10250 m^2, this also should be considered about security and social evils arising in these areas.

Conclusions

MODERATE NEGATIVE IMPACTS are considered likeluy during the operational phase, requires integrated measures of management to ensure security and safety at public places.

3.6.8. Risk of fire and explosion

Fire and explosion risks could occur at stop stations, terminals, technical facility area and on the vehicles, which could lead to fire risk in these areas, especially due to electrical problems. Fire and explosion risks could create serious impacts on property, human health, lives and environment if an appropriate management measures and rapidly responding mechanisms have not planned and implemented during operation phase. The fire and explosion risks become quite importance in public areas such as bus station, terminal.

Conclusions

Considered as a MODERATE NEGATIVE IMPACT given low likelihood of occurrence, but still with potential to create a serious impact and long-term consequences which need to be addressed to ensure sustainability of the project. Risks caused by using and operating CNG will be assessed in the Section 3.6.9

3.6.9. Impact assessment of emergencies arising from CNG and CNG supply

Ensure safety of filling at fuel supply station and using CNG on vehicles is one of the most importance concern of the project, ensure safety of CNG storage, supply and consumption is also necessary for success and sustainability, enhancement of passenger believes on BRT transport mode and avoid impacts on properties.

The emergencies from CNG system could cause adversely impacts on properties, environment and even human lives, hence it requires highly and carefully considerations of safety during design, material selection, and building up the maintaining system.

In America, using of CNG has probability of incidents of fire and explosive is higher than using diesel about 2.5 times, The reasons, cause to these incidents, are from failing of equipment at fuel station, leakage of gases, accident with other vehicles, fire but not from CNG as well as mistake from operators including drivers, In which the incidents caused by failing of equipment is highest (38%) then followed by accident with other vehicle (21%), Leakage of CNG counted for 12% of incidents,

Conclusions

Potential emergencies from using CNG in the operational phase are MODERATE NEGATIVE IMPACTS, the occurrence of the risk is low, but when happen the risk will

affect many people including operators, passengers and the surrounding buildings. The operation of CNG requires highly concerns to ensure safety during operational phase.

3.7. ASSESSMENT OF CUMULATIVE IMPACTS

The accumulating impact assessment considers impacts that accumulated with time or space. There are many methods for assessing accumulated impacts, particular methods will be decided by authors.

Principles of cumulative impact assessment
- *Accumulating impact assessment should be carried out synchronously and be a part of environmental impact assessment of program, development plan or development policy;* - *Emphasis on integrated assessment of direct and indirect, short-term or long-term impacts on ecosystem, human as well as natural resources;* - *Cumulative impacts should be assessed as distribution areas of impacted factors such as ecology, society and natural resources instead of administrative boundaries;* - *Impacts from other developments should also considered and analysed fully in assessment of cumulative impacts;* - *Have to assess the contribution of different developments;* - *Risks should be considered and analysed fully in risk assessment;*

The assessment methodology will selected based on available information of relevant development projects and plans, strategy in the project area, the following methods are proposed to assess the cumulative impacts of the project as following:

Method	Descriptions
Statistic	Impacts of different projects, programs as well as different sectors which are taken place at same place will be listed. This method is effective in identifying potential cumulative impacts as well as any change could be fully considered;
Systematic analysis and tracing impacts	This method depends on principle of impact chain and casual relations to identify cumulative impacts. This method is effective in identifying complex impacts that caused by various activities, programs as well as different sectors, or the potential impacts in long-term;
Modelling	Modelling is a mathematic tool help to estimate and quantify impacts;
Trend analysis	This method emphasize on analyses of impacts as time change, Historical data is important to predict future trend. Trend analysis is very important because almost cumulative impacts occur after certain period and change with time;
Expert consultation	Experiences and knowledge of experts in their professional could significant contribute to identification and quantifying cumulative impacts.

Cumulative impacts caused by the project are considered with development plans, development projects in its corridor as following:

Land use Plan on Vo Van Kiet Boulevard:

- **District 4:** The areas are next to Sai Gon River have been planned for high rise buildings. There are several schools that are alreadly located or will be constructed by 2015 and 2020.
- **District 6:** The areas along Vo Van Kiet Boulevard trend to be areas for high rise buildings and commercial areas where are still free land at 1. 3 and 7 wards.
- **District 5:** Mixed land use area and are many high rise buildings next to Cho Lon Market.
- **District 8** (Communes 8 & 16): Almost for the residential purposes.

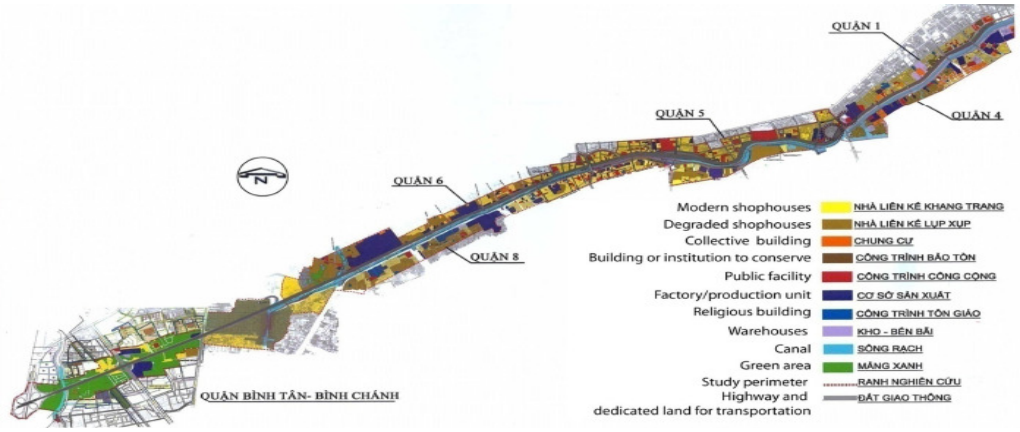


Figure 3, 6 Landuse plan along Vo Van Kiet corridor

Development plan of District 2

New urban development of Thu Thiem: this urban area is located in Thu Thiem peninsula including commnues of An Khanh, An Loi Dong, Binh An, Binh Khanh of District 2 and opposite with urban center by Saigon River. The area of new urban is 737 ha that includes 657 ha of new construction and 80 ha of existing urban area that will be improvement. The new urban of Thu Thiem will be divided by 5 areas: central business area that will be financial, commercial as well as service fuctions; the north residential area; the multi-functional area of East – West Boulevard; the east residential areas; the ecological area in the south that is for environment, entertainment and services. There is an estimation of 160,000 people will live and 450,000 people will work in office in the new urban area of Thu Thiem. In addition, there will be huge number of visitors and tourists comes to this area especially in festivals or events.

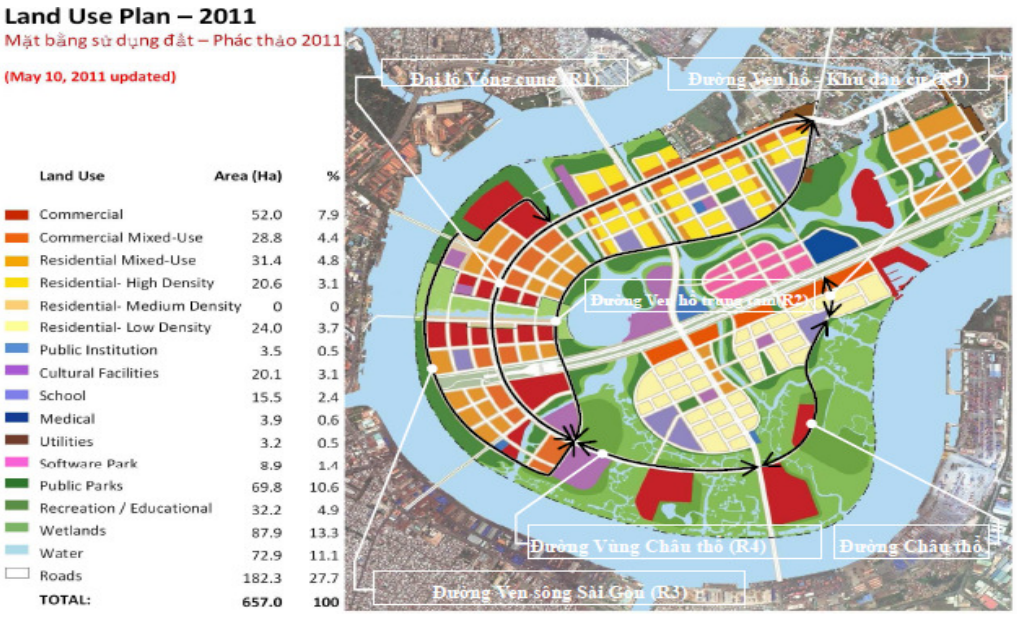


Figure 3, 7 Land use plan of new Thu Thiem urban area

Traffic activities on East – West Boulevard: The Boulevard is connected with Trung Luong highway in the west while connected with Long Thanh – Dau Giay highway in the east, These connections could make convenience for travelling among areas of Mekong basin area, the East-South region as well as regions in the Central and the North. Furthermore, the development of Long Thanh International Airport in Dong Nai which will connect to Ho Chi Minh by Long Thanh – Dau Giay highway which could increase connection functions of East – West Boulevard.

Results of cumulative impacts of the project in the general context of the project area can be summarized as follow.

Impacts	Type of impact	Duration	Scope assessment
Impact during construction	Not significant accumulation but could negatively degrade local environment	Short time	Impact locally within scope of project
Air pollution	Will not degrade urban air quality but contribute to improve it	Long time	Consider of GHGs and air pollutant emissions on the corridor
Noise pollution	Will not increase noise level in this area but positively contribute to reduce it	Long time	Contribute to reducing the impact caused by passengers who use BRT system
Public health	Public place could spread out diseases, however the available of BRT could improve public health along corridor because pollution reduction	Long time	BRT passengers, communities along the corridor and people travelling along the corridor
Social security	Potentially increase problems of	Long time	BRT passengers, communities along the

Impacts	Type of impact	Duration	Scope assessment
	social security in public places; Potential convenience for urban crime travelling and escape,		corridor
Traffic safety	Improvement of travel condition on the corridor; High risk of traffic safety if access method to BRT stations does not appropriate design and meet the urban development demand	Long time	Communities and people travelling along the corridor, passengers from MRT
Ecosystem changes	Motivate urbanization process in the District 2 and change urban ecosystem	Short time and could be balanced by ecosystem itself	Ecosystem along the corridor
Environment and hygiene	Degrade environmental and hygiene conditions in the public places	Long time	Areas of the BRT bus station and terminal
Urban landscape	Improvement urban landscape	Long time	Along the corridor
Accessibility and social equity	Increase accessibility of communities to public transports	Long time	Along the corridor

3.8. ASSESSMENT OF DETAIL AND RELIABILITY OF ABOVE ASSESSMENTS

Statistical and comparative methods: In completing Environmental impact assessment (EIA) Environment Team has taken many observation, data collection in project corridor, Those data has been updated and for series of years. Therefore, such methods could give reliable and accurate results.

Field observation, measurement and sampling, sample analysis in laboratory and social survey are methods used in this EIA, People, who are trained, experienced, and working in such technique for years, conducted those activities. The data from such methods could ensure accurately and reliability about environmental quality.

Environmental rapid assessment method: the application follows guideline of WHO in quantifying pollutions that depends on pollution coefficients. This method could quickly give outputs that are used for other assessments.

Integrated analysis and assessment methods: this method used to synthesize environmental impacts caused by project then propose the mitigation measures. Though these methods are subjective assessments it is still reliable if it is done by environmental experts who experience with those impacts. The impacts will be assessed depending on realities of local contexts as well as project designs before propose mitigation measures that should be appropriate and feasible.

In general, the applied methods in this EIA have been used for many studies as well as recommended by various agencies including Vietnam Ministry of Natural Resources and Environment (MONRE), these methods are reliable.

3.8.1. Guidelines for environmental impact assessments

The characteristics of impacts were identified according to experiences of experts, secondary data as well as quantification of impacts that are caused by project activities. The impacts were quantified through used materials, emission coefficients from reliable sources such as Assessment of Sources of Air, Water and Land pollution by WHO (1993), Environmental Impact Assessment by Larry W. Canter (1997).

Determining the spatial scale and time scale of impacts carried based on expert consultation method, analyzing the current characteristics in terms of scale, scope and construction plans in considerations of local climate conditions, infrastructures as well as environmental management regulations.

Impacts assessments considered to the scale of impacts, spatial scale, time scale as well as sensitivity of recipients. The actual experiences are very important in assessing the impacts and proposed the mitigation measures. It requires understanding local social and environmental context as well as local environmental regulations.

The assessments were details enough that allow proposing mitigation measures, in later section, to mitigate negative impacts as well as have feasible preparedness and response plans for emergencies.

3.8.2. Reliability of assessments

All impact assessments were conducted by experienced experts as well as useful tools that give reliable and accurate results. Impacts type and impacts scope were assessed for different phases of project implementation so that they reflect reality. Therefore, investor has committed to mitigate negative impacts as well as pollution control, which are detailed in later sections. .

The quantifying pollutions assessed based on the fuel consumption and emission norms documents. For example, the application of emission norms of vehicle WHO 1993; or calculation of noise level applied guideline of Pham Ngoc Dang 1997; or air pollution distribution calculated by MUAIR model.

The assessments were analyzed by experts who experience in practices and scientific researches as well as participate in many EIAs therefore their opinions or analyses and solutions that are determined.

CHAPTER 4: NEGATIVE IMPACT PREVENTION AND MITIGATION MEASURES

This section focuses on prosing appropriate mitigation measures in order to prevent, avoid or mitigate the negative impacts on human and natural environment in the project areas. However, mitigation measures need to be included in the environmental management plan and in appropriate environmental clauses in the tender documents for Contractors during project implementation phase.

Based on the impacts identified and analyzed in Chapter 3, the mitigation measures have been proposed for three phases of project implementation such as: i) Pre construction phase; ii) Construction phase and iii) Operation phase.

Four step approaches have been selected during setting priorities and proposing the mitigation measures. Those steps include: 1) *Avoid*: analysis the alternative options to select optimization options and methods to minimize negative impacts on the social and natural environment; 2) Apply *advantage technique* during design and construction; 3) *Integrated and appropriate mitigation plan*: a detail EMP will be developed based on the main findings and recommendation from this EIA; 4*) Adequate Environmental Monitoring Plan*: to ensure the compliance with EMP and EIA during project implementation.

4.1. PRE-CONSTRUCTION PHASE

4.1.1. Land acquisition and resettlement

Land acquisition and resettlement will be compliance with the approved Resettlement Policy Framework (RPF), which was prepared in order to establish the resettlement principles, eligibility requirements for compensation, valuation methods, describe the legal and institutional framework, organizational arrangements, funding mechanisms, and community consultation and participation, and grievance redress mechanism to be applied to the project during the project implementation. Resettlement Action Plan (RAP) will be prepared in compliance with the approval RPF and submitted to the World Bank for approval before construction activities will be started.

The RPF has been prepared in compliance with the World Bank's Operational Policy on Involuntary Resettlement (OP 4,12) and the Vietnam's laws and regulations. The RPF will be applied to all components of the Ho Chi Minh Green Transport Development Project that result in involuntary resettlement, regardless of the finance source. It also applies to other activities resulting in involuntary resettlement that are:

- Directly and significantly related to the World Bank-funded Ho Chi Minh Green Transport Development Project;
- Necessary to achieve its objectives as set forth in the project documents; and
- Carried out, or planned to be carried out, contemporaneously with the Ho Chi Minh Green Transport Development Project;

After getting no objection from the World Bank and approval by the HCMC People's Committee, the RPF shall be used as a guidance for preparation of a Resettlement Action Plan for any site-specific civil works under the Ho Chi Minh City Green Transport Development Project that require acquisition of land.

This Resettlement Policy Framework is consistent with the various laws, decrees and circulars regulating on land acquisition, compensation and resettlement in Vietnam, and World Bank's Operational Policy on Involuntary Resettlement.

The Vietnam government regulations have been applied as following:

- The Land Law 2013, which has been effective since July 1, 2014;
- Decree No.43/2014/ND-CP guiding in detail some articles of Land Law 2013
- Decree No.44/2014/ND-CP provides on method to determine land price; make, adjust land price brackets, land price board; valuate specific land price and land price consultancy activities,
- Decree No. 47/2014/ND-CP providing compensation, support, resettlement when land is recovered by the State
- Decree No. 38/2013/ND-CP of 23 April 2013, on management and use of official development assistance (ODA) and concessional loans of donors,
- Circular No. 36/2014 / TT-BTNMT dated 30 June 2014, regulating method of valuation of land; construction, land price adjustment; specific land valuation and land valuation advisory
- Circular No. 37/2014/TT-BTNMT dated 30 June 2014, regulating compensation, assistance and resettlement when the State acquires land,
- Decision No. 1956/2009/QD-TTg dated November 17 2009, by the Prime Minister approving the Master Plan on vocational training for rural labors by 2020;
- Decision No. 52/2012/QD-TTg dated November 16 2012, on the support policies on employment and vocational training to farmers whose agricultural land has been recovered by the State.

In-effect decisions of HCMC's People Committee (HCMC PC) on resettlement and compensation, land price includes:

- Decision No. 35/2010/QĐ-UBND dated 28 May 2010 issued by HCMC PC on compensation, assistances and resettlement
- Decision No. 66/2012/QĐ-UBND dated 28 December 2012, issues the rates of physical structures and houses.

The Bank's Resettlement Policy OP 4.12. includes safeguards to address and mitigate the economic, social, and environmental risks arising from involuntary resettlement.

The basic guiding principles of the World Bank's resettlement policy are:

(i) Involuntary resettlement should be avoided where feasible, or minimized after exploring all viable alternatives in project design;

(ii) Where resettlement cannot be avoided, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment

resources to enable the people affected by the Project to share in benefits. Affected Persons should be meaningful consulted and should have opportunities to participate in planning and implementing resettlement programs.

(iii) Affected Persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-project levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

4.1.2. Relocation of underground infrastructure

To minimize any interruption in the services provision and impacts on social ecomonic condition of local people, the PMU commit to strickly apply the proposed mitigation measure which stated in this section, as detail:

- Closely cooperation with the in-line management agencies during impact identifying, relocation, conpensation and technical assisstance plan preparation. The workers need to be trained with electric safety skills since they involve the relocation activities;
- Strickly following technical guidance and design specification: underground infrastructure relocation activites (such as electricity lines, drainage pipes or water supply system), if any, need to completed before starting construction activites . The relocation need to followthe technical guidance as: i) maintain the existing infrastrucutre to ensure continuos provision of services; ii) construct new infrastructure and iii) remove the service provision from old to new infrastructure; iv) destruct old infrastrucure and hand over the site .
- Adequate resources alocation: the cost for underground infrastrucutre relocation and service reprovision, if any, will be been included in the total investment cost of the project. PMU will contact to all relevant authorities to ensure the relocation activities will be taken place as it is designed.

4.1.3. Unexploded ordnance removal

Unexploded ordnance remove will be carried out in the Thu Thiem Technical Facility and Rach Chiec Terminal. The UXO remove activities need to complete before starting construction activities, the several step should follow during UXO remove:

- Coordinate with the appropriate agencies at the design stage to identify if UXO is a potential threat to works;
- Based on the findings, PMU will sign contact with an authorized agency for removing UXO;
- Ensure that the civil work activities on the site will be started since PMU get an certified that the project areas are already been cleared.

4.1.4. Environmental considerations in design phase

To pursue environmental friendly development, climate change adaptive capacity as well as ensure the achievement of the project's goals, several principal should take into account during the design phase

- Minimize land acquisition;
- Minimize encroachment on ecosystem and natural resources;
- Advantage technology application: such as alternative fuel application, renewable energy utilization;
- GHG reduction and urban air quality improvement;
- Community living quality improvement;
- Private vehicle use reduction and traffic congestion improvement;
- Wide social acceptance;
- Public transport service enhancement.

The main technical parts/items need to careful consider during the design phase to ensure that sustainable operation of the project as:

a) Pedestrian flyovers

The location and design of pedestrian flyovers need to consider the accessibility of local communities, such as:

- To utilize several the existing pedestrian flyovers , some upgrade, and adjustments should be made to enhance the accessibility of the people;
- To attract local people which are located on other site of Tau Hu canal (District 8), the pedestrian flyovers connect to these areas need to be considered, which could be planned for short term or long-term investment. The results from public consultation meetings show that local people living in other site of Tau Hu canal could be high potential passenger for public transport long this corridor;
- To manage the traffic congestion and conflict, using the signal light to access the bus top stations need to be carefully considered due to low awareness of public passengers as well as road users.
- .

b) Flooding and climate change

Flooding and climate change will create negative impacts on BRT vehicle operation and its service provision. In the context of climate change and sea level rising, HCM city has been considered as high climate change vulnerable , therefore, a number of variable climate such as rainfall, temperature, natural disasters, tidal regime…, need to take into account with difference climate change scenarios for HCMC during the design phase. The height of bus lanes, Thu Thiem Technical Facility and bus stop station, terminal need to evaluate according to climate change scenarios for HCMC, the B2 scenarios is recommended for the time frame of 50 years.

c) Narrow street lanes

The BRT lane will utilize a center lane of exiting street which leading to narrow the road surface. Although, almost sections on Vo Van Kiet and Mai Chi Tho are suitable for project development, there are several sections on Vo Van Kiet street that have two lane only (section from Lo Gom bridge to Thu Thiem Tunnel), could affect to the traffic flow movement in the future. For these sections, the intervention is widening the existing lanes to 6,5m and remove the existing motorcycle lane.

d) Main gates of Thu Thiem Technical Facility and Rach Chiec Terminal

Currently the location of both Thu Thiem Technical Facility and Rach Chiec terminal are in the vacant land areas. However, these areas are planned to be urban and commercial areas in the future, therefore the design specification of main gates for these infrastructures need to take into account the safety, accessibility and traffic conflict.

e) Accessibility for disabled and elderly

Consideration of the invalid and old accessbility will create high social benefits, and which also become the important requirements for new construction transport infrastructure. Transport accessibility need to comply with Circular No. 39/2012/TT-BGTVT dated 24/09/2012 of Ministry of Transport on Guidance on implementation of national accessibility standard in transport infrastructure development and other priority tools, policies to support invalid and old access to public transport. The main items need to be taken into account in the projects are i) accessibility infrastructure; ii) accessibility vehicles and iii) accessibility policies.

f) Terminal design

Design of the terminal needs to comply with QCVN 45:2012/BGTVT National standard on Passenger terminal. Other consideration should also take into account during the design phase to enhance the effectiveness during the operation phase such as utilization of natural light, energy saving and renewable energy application in the context that HCMC have high potential application of solar energy.

g) Vehicle parking areas along route

Nice vehicle parking areas are designed along the corridor to enhance the accessibility of the BRT, however, selection of location, design and operation of parking areas need to consider to minimize the encroachment of public open space, walking facilitates, and suitable with the surrounding landscape and security during the operation phase.

h) Fuel usage

CNG will be applied in the project, thus the safety for NCG storage tanks on vehicles and supply system need to develop in comply with international and national technical standards to ensure absolute safety during the operation phase, which includes:

- QCVN 09:2011/BGTVT – National standard on technical safety and environmental protection for automobiles issued in circular No. 56/2011/TT-BGTVT date 17/11/2011 of Ministry of Transport;

- QCVN 10:2011/BGTVT National standard on technical safety and environmental protection for city buses issued by Ministry of Transport;

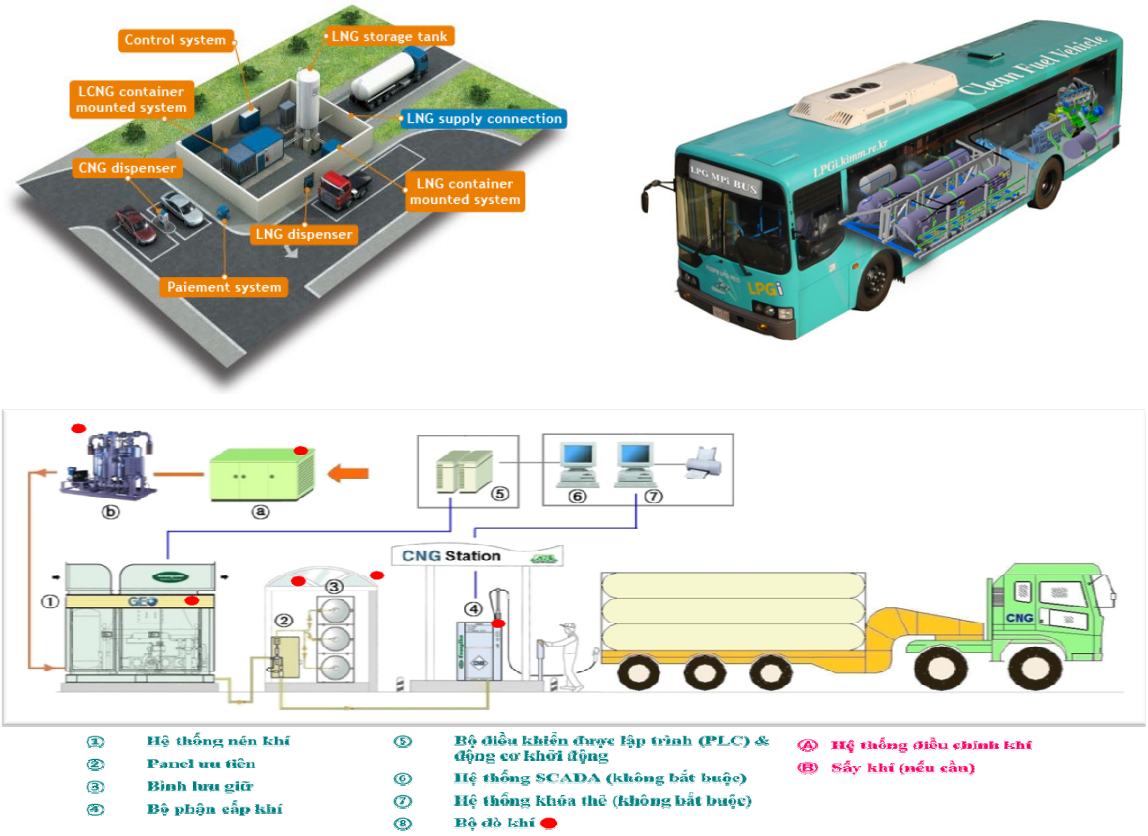


Figure 4, 1 CNG buses and Supply system

l) Sustainable construction materials

Selection of sustainable construction materials will be take important role in ensure the sustainable operation of project in context of climate change.

m) Solid waste management system in public space: The solid waste management in Rach Chiec terminal, Technical Facility and stop stations need to be carefully considered the following parameters:

- *Garbage bin*: Need to comlied with the requirement of Ministry of Construction in QCVN 07:2010/BXD, detail as: i) Vollume is from 100 liter and not exceed 1m^3; ii) location distance is every 100 m;
- *Garbage trolley*: folling the detail requirements as: i) vollume varies from 250-660 litter; ii) made by composite;
- *Temporary garbage storage* : i) the location of temporary garbage storage need to keep distance with passenger waiting areas and office building; ii) faciliate with cover, concered ground, water supply for clean activites, drainage pipes and suistable gate for truck operation;

- *Garbage transportation and treatment*: garbage transportation and treatment maners need to consider in term of feasibility, economic and sanitation condition.

h) Wastwater treament facilitate at Thu Thiem Depot

Wastewater treatment system at Thu Thiem Depot need to design separately for each type of waste water, the appropriate wastewater treament design during this phase will hepl to reduce the operation cost and other environmental issues. There are three main wastewater need to be considered as bellow:

- *Runoff water (rainy water):* could directly discharge into general drainage system, place grid for prevention of wastes from entering the drains at the mainholes;
- *Domestic wastewater:* this kind of wastewater must discharge into septic tank before discharging into general drainage system;
- *Vehicle maintain and clean wastewater*: this kind of wastewater need to primary treatment includes depositing unresolved maters and collecting oil spill before discharging into general drainage system and the wastewater quality need to meet the requirements on QCVN 40: 2011/BTNMT – National standard for industrial wastewater.

g) Environmetnal pollution control infrastructure and environmental accident response

The appropriate design and operation of environmetnal polution control infrastructure and environmetnal risk responding plan are very importance factors to ensure the sanitation conditions in the public spaces. These infrastructure need to evaluate base on the demand forescast and quality of provided services. The folowing items could be considered as:

- Appropriate water supply system;
- Adequate drainage system and waste water treatment for repair activities, domestic activities;
- Solid waste management system;
- Fire prevention and protection system
- Warning system on CNG relative facilitates
- …

4.1.5. Environmental management plan

Appropriate environmental management plan for construction activities need to be prepared in accordance with the civil activities in order to make sure that all environmental issues have been taken into account, the appropriate mitigation measure have been proposed and planed, the resource has been allocated and tasks have been assigned. The following items need to prepare management plan before starting construction activities as:

- Environmental capacity building plan;
- Traffic and traffic safety management plan;

- Pollution management plans: dust control plan, noise control plan and wastewater management plan;
- Solid waste and hazardous waste management plan
- Hazardous substance using management plan
- Construction material management plan;
- Waste disposal management plan;
- Worker camps management plan;
- …,

4.2. MITIGATION MEASURES DURING CONSTRUCTION PHASE

General principle: in order to enhance the effectiveness of mitigation measure and minimize the negative impacts on environment, the mitigation measure will be proposed based on the following principles:

- Setting more priority on avoiding and preventing negative impacts than solving environmental pollution issues;
- High feasibility in term of: i) implementing techniques; ii) time frame; iii) financial capacity; iv) impact reduction effectiveness; and v) controllable and manageable;
- Proposed mitigation measure need to include into biding documents and being an required clause in the civil work contracts;
- Base on the proposed mitigation measures, the civil work contractors need to prepare Site EMP (SEMP) which consist to scope, site activities and specific requirement on the site. The SEMP need to submit to PMU and supervisor consultants for approval before implementing;
- Moreover, requirements on the sites and environmental risk analyzing, the contractors need to prepare the environmental risk and accident responding plan to ensure the capacity and resource to manage environmental risk and accident during the construction phase;
- Information disclosure and availability for local authorities to promote for the public monitoring mechanism on the construction sites.

4.2.1. Dust and exhaust mitigation measures

Description of mitigation measures

The main objectives are negative impact control on ambient air quality from dust and exhaust generated from civil construction activities as: i) leveling of ground, excavation activities; ii) emissions from equipment using gasoline, diesel, kerosene, etc,; iii) transport of construction materials and waste.

a)For ground levelling , excavation activities

- Spraying water to maintain certain moisture levels, and to prevent or minimize dust dispersion. The watering activities is proposed at least one a day during rainy

season and twice a day during dry season. The high dust generation areas are proposed as below:

- At new construction or improvement sites of pedestrian flyovers , on District No1. district No. 5 and An Loi Dong ward in district No. 2;
- Road surface improvement of at bus stops;
- Construction of bus stop station;
- Access roads construction sites on Thu Thiem Technical Facility and Rach Chiec terminal.

- Storing the eexcavated soil storage areas must be placed in the designed areas far from any residential area, keeping a distant to the surrounding sensitive receptors and not allow to stay on site over 24 hours;
- Covering the construction site (it could be use fence or canvas) to avoid the release of dust , the height of fence must be at least 2 m, specialy the section on:
  - Construction of bus stop station;
  - Improvement of road surface at bus stops;
  - Thu Thiem Technical Facility at area which is close to Viet – Uc international School;
  - Rach Chiec terminal at area which is close to Hanoi Freeway;
  - Pedestrian flyover new construction or improvement locations
- Setting up appropriate schedule of material mobilization to the site to avoid material obstruct ;
- Cleaning the nearby areas daily by road cleaning vehicles on BRT routes construction to reduce secondary dust generation from traffic flows.

b) Equipment emissions

- The construction machinery/ equipment and heavy vehicles have to comply with the Decision No. 249/2005/QĐ-TTg of the Prime Minister, Regulation on Emission Roadmap dated 10 October 2005 for road transportation vehicles;
- Regular maintenance and clean construction machineries/ equipment;
- Construction machinery/ equipment will not allow to place out of the ROW.

c) Transport of construction materials and waste

- Trucks carrying materialwastes materials must be covered. All trucks should not be overloaded and fix with its body;
- Provision of wheel-wash stations at the ingress/ egress points on Thu Thiem and Rach Chiec construction sites to clean construction vehicles which is moving out of the construction site from depositing soil dust on public road;
- Soil scattered on the paved road and public road due to over fill or fallout from the trucks should be removed immediately;

- Loading and unloading construction materials, waste need to schedule to avoid the rush hours and forbit during the nightime (from 22 pm – 6 am) at the section nearby the hospitals and residential areas.

d) Concrete mixing stations

- The location of concrete mixing plant on the site must be away from any watercourses and residential areas as well as sensitive objects;
- The watering activities have been proposed at least once per day during the rainy season and twice a day during the dry season in the concrete mixing plants;
- Operation schedule of the plan must be carefully considered to avoid rest times of local people;
- In case that, the project will purchase the hot concrete from nearby mixing stations, the contractors and PMU need to check the environmental permission certificates of these stations.

Location and time frame: At high air pollutant and dust sensitive recipients around the construction site as stated above for specific mitigation measures, during the construction phase.

Remarks: Above proposed mitigation measures to control dust and exhaust generation impacts on ambient air quality is practicable, suitable to project's resources and implementing capacity of the Vietnam's contractors. Controlling the dust generation from sources will result in reducing dust release from the construction sites and transport vehicles. Since all proposed mitigation measures are fully complied, the dust concentration could minimize to within the permission level regulated on QCVN 05/2013-BTNMT is 0.2mg/m^3,

All proposed mitigation measures need to include into biding documents and will be an environmental clause on civil work contracts to ensure the strictly compliance of contractors. The effectiveness of mitigation measures is strongly relied on the compliance level of contractors on the sites. Thus the impacts on ambient air quality is still high priority during the project implementation. Additional mitigation should proposed for any outstanding issues to maintain ambient air quality in the project area. Moreover, public monitoring mechanism also needs to promote through public consultation meetings, interview… to seek for strictly compliances of contractors and identify any outstanding issues.

4.2.2. Noise and vibration

Description of mitigation measures

According to monitoring results in Chapter II, the noise and vibration level in the project area are within the permission standard. However, the noise generated from construction equipment could be higher than standard, the following measures are proposed to control noise and vibration from construction activities:

a) Setting up appropriate operational schedule of noise generate equipment

- Use modern and new construction machineries and equipment which generate lower

noise level and strickly carry out equipment maintenance as regulated by the Government;

- Turn off the interrupted machines wherever possible to avoid resonant frequency,
- Usage of machines generate noise level over >55 dBA at night (from 22:00 to 6:00) is strictly prohibited at the location nearby residential area, hospital in District 1, District 2 and District 6;
- Heavy truck transportation, loading/unloading shall not allow to operate at night (from 22:00 to 6:00);
- Provision noise protection equipment for worker;

b) Usage of lower noise generating equipment

- Selecting the lower noise generate equipment which could be result in noise level reduction from 6 dBA to 12 dBA.

c) Limit concurrent usage of multiple noise generating equipment

- Limit concurrent usage of several noise generate equipment apply for construction activities near by the noise and vibration sensitive receptors.

Location: Location shall be based on the noise level allowed around the noise and vibration sensitive receptors.

Remarks: All proposed mitigation measures need to include into the biding documents and will be an environmental clause on civil work contracts to ensure the strictly compliance of contractors. The mitigation measures are proposed to manage the noise from generating sources. The effectiveness of mitigation measures is strongly relied on the compliance level of contractors on the sites. Additional mitigation should proposed for any outstanding issues to control noise and vibration in the project area. Moreover, public monitoring mechanism also needs to promote through public consultation meetings, interview… to seek for strictly compliances of contractors and identify any outstanding issues.

4.2.3. Water pollution management

Description of mitigation measures

- Undertake earthworks where possible during dry season, to reduce the run off water from the construction site which lead to increase content of SS and pollutants in surrouding water bodies;
- Water run off in the construction site need to flow to manholes to deposit dediment before discharging into environment;
- Provision of gird to prevent waste entering the drainage system on the construction areas of road surface improvement and bus stop station on Vo Van Kiet and Mai Chi Tho streets to prevent the solid waste from entering into water flow;
- Construction sites of Thu Thiem Technical Facility and Rach Chiec terminal shall be designed to ensure that surface run-off from the construction site does not flow directly into surrounding water bodies;

- All equipment shall be kept in good working order and serviced regularly. Leaking equipment shall be removed immediately from site and repaired;
- The workshop shall have impermeable floor which is bounded and sloped towards an oil trap to contain any spillages. When servicing equipment, drip trays shall be used to collect the waste oil and other lubricants;
- Provide the facilities in the site including latrines, holding areas, garbage bins. Waste from latrines will be collected and treated properly through an economic contract with local environmental companies;
- Covering material storage areas should be implemented during rainy times, Temporary storage of construction waste on the sites will be no longer than 24 hours and it must be covered;
- Washing instruments/vehicles next to the water bodies is forbidden to avoid leaching of waste, sludge, soil, oil contaminated water.

Location: every the construction site, special which is located nearby the water bodies, and construction site on the Vo Van Kiet, Mai Chi Tho street.

Remarks: The proposed mitigation measures are practicable, suitable to project's resources and implementing capacity of the Vietnam's contractors. Strictly, compliance with above measure could help to manage water pollution from the project activities. They need to include into biding documents and will be an environmental clause on civil work contracts.

The effectiveness of mitigation measures strongly relies on the compliance level of contractors on the sites. Thus from the result of environmental supervision activities, additional mitigation should proposed for any outstanding issues to manage impacts on water quality in the project area. Moreover, public monitoring mechanism also needs to promote through public consultation meetings, interview… to seek for strictly compliances of contractors and identify any outstanding issues.

4.2.4. Solid waste management

Description of mitigation measures

a) Garbage

- Domestic waste generated on the site shall be managed as the following steps: i) provide dustbins at work site; ii) waste category for reuse; iii) domestic waste and garbage from worker camps need to be collected by hygienic manner through service provision of local companies.
- Garbage bins: need to meet the requirement of Ministry of Construction QCVN 07:2010/BXD as detail: i) vollume of garbage bin will be 100 litters and no exceed $1m^3$; ii) garbage bin with coverage; iii) location of garbage bins will be every 100 meters; iv) waste standing on garbage bin will not allow to over 24h; v) daily clean the bins is required.

- Provide dustbins and mobile septic tanks at work site, which is estimated that about 4-6 dustbins will be provided for each construction sites. The temporary areas, if any, will provide the mobility dustbins;
- Disposal of solid wastes into canals, stream, other watercourses, agricultural field and public areas is prohibited.

b) *Construction waste*

- Wherever possible, materials used or generated by construction shall be recycled such as excavated soil could be reused for levelling purpose on the sites.
- Construction waste will be temporary storage on the site before transporting to waste disposal, the contractors must ensure the following i) must keep the safety distance of 250m from any irrigation canals, water bodies; ii) must keep the safety distance (200 m) from any sensitive residential areas; iii) located within the RoW of the project; iv) covering storage areas during rainy times and v) ttemporary storage on the sites will be no longer than 48 hours.
- Construction wastes will be disposed at Da Phuoc area where are approved in the letter No. 6420/UBND-DTMT dated 28/09/2007 of HCMC PC on the disposal construction waster from ODA project in HCMC;
- Waste transport vehicle also need to comply with mitigation measures for transport vehicles stated in Item of Dust and exhaust generation.

d) Hazardous waste

They are included boxes, cans contain asphalt, petrol, fuels, paints etc. These types of waste need to be Collected transported and treated by a company, which has a work permit to treat hazardous waste according to MONRE's Circular No. 12/2011/TT-BTNMT dated 14 April 2011, the detail requires as bellowing:

- The storage area for all hazardous substances is located away from any water bodies such as Tau Hu canal, Ca Tre Lon canal, Ca Tre Be canal…;
- Storage of hazardous substances must in the places, which are facilitated with: i) roof; ii) concrete ground and water resistant; iii) edge around the storage areas; iv) away from water bodies and high fire risk areas;
- Weekly records on volume of generated hazardous substances;
- Sign contact with company which has a work permit to treat hazardous waste according to MONRE's Circular No. 12/2011/TT-BTNMT dated 14 April 2011 for transport and treatment.

Location: on the construction sites, worker camps, waste storage areas on the sites.

Remarks: The proposed solid waste management manners follow the regulation on Decree No. 59/2007/NĐ-CP on solid waste management and Circular No. 12/2011/TT-BTNMT on stipulating hazardous waste management. The feasibility of the mitigation measures rely on the capacity of local waste service companies and the compliance of contractors, They need to include into biding documents and will be an environmental clause on civil work contracts.

4.2.5. Occupational safety and health for worker

Description of mitigation measure

- Establish safety measures as required by law and by good engineering practice, provide first aid facilities that are readily accessible by workers;
- Workers shall be provided with appropriate personal protective equipment (PPE) such as safety shoes, hard hats, safety glasses, ear plugs, gloves, etc, at no cost to the employee;
- The Contractor shall ensure safety for people who are permitted to enter the site. The construction sites shall be kept clean and tidy to avoid dangers caused to these people;
- Contractors ensure to provide safe drinking water to workers for daily uses;
- Construction site shall be provided with toilet/sanitation facilities/cooking areas and clean camps;
- Contractor shall readily provide and maintain lights, protection fences, signboards and wardens where necessary to prevent local people access the sites;
- Provision periodic health care check for worker (every 6 months as regulated);

Location: every construction sites

Remarks:

The effectiveness of mitigation measures strongly relies on the compliance level of contractors and awareness of workers on the sites; They need to include into biding documents and will be an environmental clause on civil work contracts ;

4.2.6. Risk of traffic congestion and accidents

Description of mitigation measures

- Coordinate with traffic polices on moderate the traffic flow during rush hours, there are three traffic police groups in the areas, include i) Ben Thanh group; ii) Cai Lai group and iii) Tin Hieu group;
- Construction activities on the surface of Vo Van Kiet and Mai Chi Tho street should implement section by section to reduce temporary encroachment of road surface;
- Place sign boards near construction sites to direct traffic means to slow down;
- Loading and unloading activities on Vo Van Kiet and Mai Chi Tho streets must be scheduled to avoid rush hours;
- Provide lighting at construction site at night;
- Provision a security guard staff at the entering gates of construction sites of Thu Thiem Technical Facility and Rach Chiec terminal to moderate vehicle go out and in the construction site.

Remark: The effectiveness of mitigation measures strongly relies on the compliance level of contractors and awareness of workers on the sites. They need to include into biding documents and will be an environmental clause on civil work contracts. The supervision consultant needs to supervise the compliances of contractors and enhance the cooperation among relevant agencies in traffic management.

Table 4.1 Intersection and traffic situation along the road which need to implement traffic management measures

Section	Length	Intersection	Traffic situation
QL1A – Lo Gom	4,5km	Ho Hoc Lam An Duong Vuong	Dual carriageway for motorized vehicles: 21m Median separator: 9m Separator between motorized and non-motorized vehicles Two directions of non-motorized vehicles: 14m
Along Ben Nghe canal from Lo Gom bridge to Thu Thiem tunnel	9,45km	Highway 1A intersection (elevated) Pham Phu Thu Cao Van Lau Tung Thien Vuong (Cha Va bridge) Hai Thuong Lan Ong Nguyen Tri Phuong (NTP bridge) Huynh Man Đat Nguyen Bieu (Y bridge) Nguyen Van Cu (NVC bridge) Tran Đinh Xu Nguyen Thai Học (Ong Lanh bridge) Ki Con Calmette (Calmette bridge)	Dual carriageway for motorized vehicles 21m Median separator: 2m Separator between motorized and non-motorized vehicles Two directions of non-motorized vehicles: 10m Sidewalks both sides: 3m
The segment from Thu Thiem tunnel to Hanoi Highway intersection	6,35km	Tran Van Khe Tran Nao Dong Van Cong Luong Dinh Cua Hanoi Highway intersection (elevated)	Dual carriageway for motorized vehicles : 28m Median separator: 25m Separator between motorized and non-motorized vehicles : 6m Two directions of non-motorized vehicles: 18.5 m Sidewalks both sides:16m
Rach Chiec Terminal		Connect with existing high traffic volume road	
Thu Thiem Technical Facility		Connect with existing high traffic volume road	No access road

4.2.7. Ecosystem impact management

Description of mitigation measures

- All activities on the site are only allowed within the acquired land areas and ensure that construction material and waste will not fall into the surrounding areas;
- Forbid to discharged construction waste, domestic waste, waste water and runoff water into the surrounding areas as well as cut the trees outside the project's RoW
- Before the construction activities completed, contractors have to carry out site clearance and environmental recovery such as:
    - Transporting all unused materials from the construction site;
    - Removing all construction machineries and equipment, temporary facilities, worksite, etc….
    - Recovering environmentat the site .
    - Monitoring the survive of the trees.

Location: All construction sites

Remarks: They need to include into biding documents and will be an environmental clause on civil work contracts for compliance by contractors.

4.2.8. Public infrastructure encroachment

Description of mitigation measures

- Obtain the approval from local authorities on the transportation routes or any public facilitates during the construction phases;
- Periodic maintenance the road or public facilitates to ensure the movement and usage of local people;
- Reinstatement of any affected roads and public facilitates before construction activities completed;
- Contact with local authorities for water and power supply on the construction sites.

Location: Any public facilitates need to use during construction phase.

Remarks: They need to include into biding documents and will be an environmental clause on the civil work contracts for complied by and social responsibility of contractors . The PMU needs to monitor the contractor's performance and seeking for feedbacks from local people for further improvement and effectiveness.

4.2.9. Social disturbance

Description of mitigation measures

- Severely affected and vulnerable households will be prioritized for hiring for the site works;

- Barriers will be installed (temporary fence) at construction areas to deter people from entering the site;
- The local residents shall not be allowed in high-risk areas (excavation sites and areas where heavy equipment is in operation and such sites have a watchman to keep public out;
- The lighting will be provided at the construction site at night;
- Borrow areas will be backfilled or fenced upon completion of construction works, ;
- Construction workers who are not local people must register temporary residents and obtain temporary residential certificate from local authority;
- Workers will be educated on appropriate behavior for interactions with local community and risks of communicable diseases.

Location: All construction sites

Remark: The proposed mitigation measures will not require high technical skills and suitable with Vietnam's condition, thus all mitigation must be implemented by constrictors to minimize the social risks.

4.2.10. Cultural and social impacts

Description of mitigation measures

When grave or cultural objects are found during the construction phase, the PMU need to coordinate with local authorities to arrange the relocation and mapping the location of the graves before and after relocation.

If the Contractor discovers archeological/historical sites, monuments and objects, including graveyards and / or individual graves unearthed during construction, the contractor will be responsible for:

- Stoping the construction activities in the chance find area;
- Delineating the location or found area;
- Protecting the area to prevent the object from being damage and lost. For artifacts or remains, the night guard will be allocated directly until the local government has the responsibility or the Department of Culture and Information takeover;
- Informing the Investor to notify for the local government or the nations undertaking the cultural heritage of Viet Nam (within 24 hours).

Relevant local/central authorities will be responsible for the area protection and conservation before providing the decision on the later appropriate procedures. Then they will implement the preliminary evaluation on the excavated findings. The significance and importance of these findings should be evaluated according to various criteria relevant to cultural heritage, including aesthetic value, historical or scientific research, economic and social values;

The decision of findings treatment will be made by the responsible agency. This decision covers the layout (such as in case of detecting the rest of the cultural or archeological importance cannot be moved) conservation, preservation, restoration and salvage.

Location: where ever the cultural objects are found.

Remarks: The proposed mitigation measure are suitable with Vietnamese believes.

4.2.11. Flooding and climate change

Description of mitigation measures

- Appropriate arrange of construction site to ensure the height and distance from high flooding risk areas;
- Consider the flooding history in the project area to schedule excavation works avoiding rainy season and flooding and flood-tide from July to October;
- At the excavation section, provision the vegetable as soon as practicable after excavating;
- Build and maintain temporary drainage ditches within and surrounding construction sites to ensure surface runoff is drained efficiently;
- Prevent the material storage at the high potential flooding, especially at the intersection between Vo Van Kiet and An Duong Vuong street.

4.2.11. Environmental accident management

Description of mitigation measures

- Providing of the fire and explosion prevention and management on the construction sites;
- Applying the fire and explosion prevention and management standards in constructing temporary sites, storage areas on the sites…;
- Facilitating the fire and explosion prevention equipment on the site and providing training for workers on fire and explosion prevention and management.

+ Provision with personal protective equipment for worker

- Workers shall be provided with appropriate personal protective equipment (PPE) such as safety shoes, hard hats, safety glasses, ear plugs, gloves, etc, at no cost to the employee;
- Ensure the safety of electricity supply at the construction sites…;
- Educating the workers on personal protective equipment users, and imposing strictly penalization for the violence;
- Providing periodic health carry checking for workers, every 6 months and complying with any labor duties such as health care insurance, social insurance and body insurance…;

+ Emergency rapid response plan;

The contractors must prepare an emergency rapid response plan in case of accidents, work collapse, hazardous substance/ waste leak out to surrounding areas…

Location: in all construction sites;

Remarks:

The proposed mitigation measures will not require high technology, but could help to set up

an emergency rapid response to curb with any arising accidents on the site thus also could help to reduce the risk and social cost burden. The contractors must strictly comply with the approval plan, and the requirement need to include into biding documents and will be an environmental clause on civil work contracts. PMU needs to monitor the performance of contractors and seeking for feedbacks from local people for further improvement and effectiveness.

4.3. OPERATION PHASE

4.3.1. Ambient air quality and exhaust gases

a) Managing the emission from vehicle operation

Controling the emission from vehicles need to comply with active regulations and standards such as:

- Decision No. 49/2011/QD-TTg date 01/09/2011 of Prime Minister on providing the roadmap for application of exhaust emission standards to manufactured, assembled and imported brand-new cars and motorbikes, detail road map as i) apply UERO 4 standard from 01/01/2017 and ii) apply EURO 5 standard from 01/01/2022, include BRT vehicles;
- Checking the vehicle quality according to Circular No. 56/2012/TT-BGTVT dated 27/12/2012 of Ministry of Transport on providing technical safety and environmental protection verification of road motor vehicles;
- Circular No, 10/2009/TT-BGTVT dated 24/06/2009 of Ministry of Transport on technical safety and environmental protection inspection of road motor vehicles;
- Circular No, 10/2014/TT-BGTVT of Ministry of Transport on revising the Circular No, 56/2012/TT-BGTVT on providing technical safety and environmental protection verification of road motor vehicles and Circular No. 10/2009/TT-BGTVT on technical safety and environmental protection inspection of road motor vehicles;
- Circular No. 31/2011/TT-BGTVT dated 15/4/2011 of Ministry of Transport on Regulating on providing technical safety and environmental protection verification for imported automobile;
- Circular No. 31/2011/TT-BGTVT dated 15/4/2011 of Ministry of Transport on Regulating the inspection of quality on technical safety and environmental protection for imported motor vehicles.

b) Controlling the secondary dust release from surface

- Periodically carrying out surface cleaning at Rach Chiec terminal and Thu Thiem Technical Facility to control secondary dust release. Moreover, the appropriate maintenance of road surface could increase lifetime of the infrastructure;
- Tree should be planted to prevention of dust dispersion and landscape creation on bus stop stations, pedestrian flyovers, parking areas, Rach Chiec terminal and Thu Thiem Technical Facility.

c) Controlling dust and pollutant from power generators:

According to volume and concentration of dust and pollutants are estimated in the Chapter 3, operation of power generators will not create dust and pollutants over permission standard thus the technical measure will be not considered, only a height of chimney need to be assessed to minimize pollutants releases

The height of chimney is estimated as the following factors: i) chimney diameters(0.3 m); ii) average pollutant volume (0.375 m^3/s); ii) average wind speed in Ho Chi Minh city (from 1.5 – 3.0 m/s, applied data is 2,0 m/s); iv) temperature at chimney outlet (473^{0}K) 200^{0}C); v) average ambient temperature (25 – 28 ^{0}C, applied data is 26,5^{0}C).

According to Brayant – Davidson, effectiveness height of chimney could be calculated:

$$H = h + \Delta h \ (m)$$

$$\Delta h = D\left(\frac{\omega}{u}\right)^{1.4}\left(1+\frac{\Delta T}{T_{khoi}}\right), m$$

$$\omega = \frac{L}{S}$$

Where:

- H effectiveness height of chimney (m); h height of chimney in practice (m);
- D chimney diameter (m);
- **ω** speed of pollutant at outlet of chimney (m/s);
- L Pollutant volume (m^3/s); S are of chimney (m^2)
- u wind speed (m/s);
- Tkhoi – temperature at chimney outlet (K);
- ΔT – different temperature value between pollutant at chimney outlet and ambient environment;

  - Height Δh = 1,6 m;
  - Effective height of chimney Rạch Chiec Terminal is 13.6 m and Thu Thiem Technical Facility is 26.6 m,

- Thus, estimate height of chimney is 13.6 m at Rach Chiec terminal and over 26.6 m at Thu Thiem Technical Facility.

4.3.2. Solid waste management

4.3.2.1. Domestic solid waste: which is generated from staffs, workers and passengers

a) At bus stop station:

- Porivding 40 litter domestic dustbins at wating areas and in the toilets;
- Domestic dustbins will be provide with diffence color (yellow for organic waste and green for organic waste);
- Number of dustbins will be 8 for each station;

- Dustbins with coverage and garbage standing on the bin will not longer than 20 hours;
- Garbage will be daily collected, transported and treated by CITENCO through the contracts.

b) Rach Chiec Terminal

- Porivding 40 litter domestic dustbins (material by heavy metal or compozit) at the main gates, wating areas and in toilets, 20 litter dustbins at underground area and 250 – 660 litter dustbins at garbage storage areas in the Terminal;
- Domestic dustbins will be provide with diffence color (yellow for inorganic waste and green for organic waste);
- Number of dustbins will be: 40 litter dustbins: 08; 20 litter dustbins: 2 and 250 – 660 litter dustbins: 2;
- Dustbinswith coverage and waste standing on the bin will not longer than 20 hours;
- Assigning staffs to collect waste indise terminal;
- Garbage will be collect from small dustbins and temporaty storage on the 250 – 660 litter dustbins then daily collected, transported and treated by CITENCO through the economic contract.

c) Thu Thiem Technical Facility

Porivding 5 litter domestic dustbins in all working rooms, 2 bins per room.

Porivding 100 litter domestic dustbins material made by compozit at the temporary storage area;

- Assigning staffs to collect waste indise terminal;
- Daily collected, transported and treated by CITENCO through economic contract.

4.3.2.2, Hazardous waste

As calculated in the Chapter 3, hazardous waste could on generate at Thu Thiem Technical Facility, thus the mitigation measure only focus on this area. The main mitigation measures are proposed as bellowing:

- Implementing hazardous waste generator register as regulation;
- Separating waste at sources: separating domestic and hazardous waste at sources as regulation in Circular No. 12-2011/TT-BTNMT;
- Storing: hazardous waste will be storage at red bins, providing at least 04 bins at maintenance areas and 03 bin at store areas;
- Storage of hazardous substances must in the places, which facilitated with: i) roof; ii) concrete ground and water resistant; iii) edge around the storage areas; iv) away from water bodies and high fire risk areas;

- Labeling the toxic symbol on the bins;
- Signing contact with company, which has a work permit to treat hazardous waste according to MONRE's Circular 12/2011/TT-BTNMT, dated 14 April 2011 for transportation and treatment.

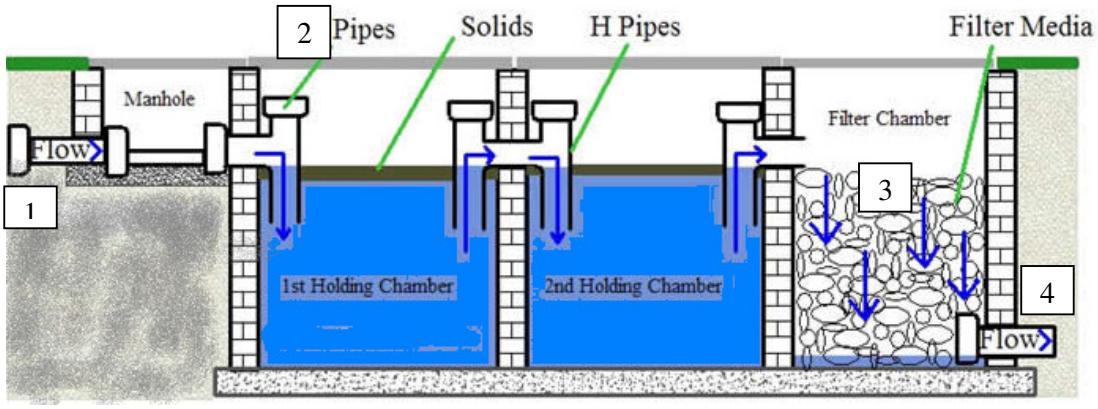
4.3.3. Waste water management

The wastewater generate from the operation phase includes runoff water; domestic water in BRT bus stations and Rach Chiec Terminal, and industrial wastewater in Thu Thiem Technical Facility. The mitigation measures to manage these types of wastewater are proposed as below:

4.3.3.1, Management of wastewater at BRT stop station:

Main wastewater types are runoff and domestic wastewater from staffs and passengers:

- Runoff wastewater: will be collect and discharge into available general system along corridor;
- Domestic wastewater: with average volume is 2 – 3 m3/ day will be treated by three part septic tank before discharging to general system;
- The main function of septic tanks are precipitating and degrading organic matters. The effectiveness of septic tank will treat up to 50 – 70 % of TSS and 25 – 45% of BOD and COD, while sludge will be kept from 6 – 8 months for bio-degradation. Wastewater will be kept in the tanks for long period to ensure effectiveness of precipitation process, and then it will move to filtering tank before discharging to local drainage system. Each tank will be set a pole tube to emit gases, which are produced from anaerobic treatment process.



1 – Wastewater influent; 2 – pole tube; 3 – Filter materials; 4 – Effluent
Figure 4, 2 Layout of septic tank (3 tanks) with filtering tank

Calculating volume of septic tank for each station**:**

Volume of septic tank = Volume of water (Wn) + Volume of sludge (Wb)

- Volume of water :

$$Wn = N*T = 3*2 = 6\ m^3$$

Where: N daily average wastewater volume of station (3 m^3); T storage period of wastewater (2 days),

- Volume of sludge:

$$Wb = \frac{a * N * t * (100 - P1) * 0,7 * 1,2}{(100 - P2) * 1000}$$

Where:

+ an average sludge volume of 1 person: 0,4 – 0,5 l/person/day;
+ N number of person who use septic tank – estimate average 20 time/day – *According to American restroom association, the rate of public passenger who using toilet in public transport area is 1/100 passengers – 1/500 passengers,*
+ t period of sludge storage (6 months or 180 days);
+ 0,7 disintegrate factor is 30%; 1,2 calculation factor up to 20% of total sludge storage in the tanks;
+ P1 moisture of sludge (P1 = 95%); P2 moisture of sludge in tank (P2 = 90%);

Wb = 0,5*20*180*(100 -95)*0,7*1,2/(100 – 90)/1000 ≈ 0,8 m^3

- **Total volume of septic tank for each stations W = 6 + 0,8 ≈ 7 m^3**, (3,3 m x 1,5m x 1,5 m)

***4.3.3.2. Management of wastewater at Rach Chiec Terminal*:** There are two kinds of wastewater in Rach Chiec Terminal including runoff water and domestic wastewater, which is discharged from project employees and BRT passengers. The management of wastewater has been proposed as following:

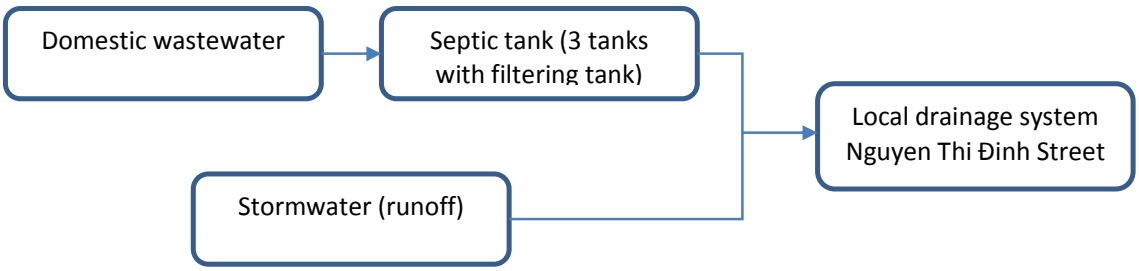


Figure 4, 3 Management of wastewater in Rach Chiec Terminal

- Storm water is identified as non-polluted water and will be directly discharged to local drainage system in Nguyen Thi Dinh Street. Solid waste on the ground will be regularly cleaned to prevent pollutants from running into the drainage system and potentially cause water pollution.

- Domestic wastewater from Rach Chiec Terminal will be treated by septic tank (Figure 4.2), based in the volume of wastewater at stations, the tank capacity is calculated as follow:
  + Volume of water = 6 m^3/day * 2 day of storage = 12 m^3;
  + Volume of sludge, average of 60 people/day, storage during 6 months;

    Volume of sludge ≈ 2.3 m^3
  + **Total volume of septic tank = 12 m^3 + 2.3 m^3 = 14.3 m^3,** size could be 6.5m x 1.5m x 1.5m,

***4.3.3.3. Management of wastewater at Thu Thiem Technical Facility*:** Wastewater from Technical Facility includes : storm-water runoff; domestic wastewater discharged by employees and staffs ; and industrial wastewater from washing BRT vehicles. Those wastewaters will be managed as following:

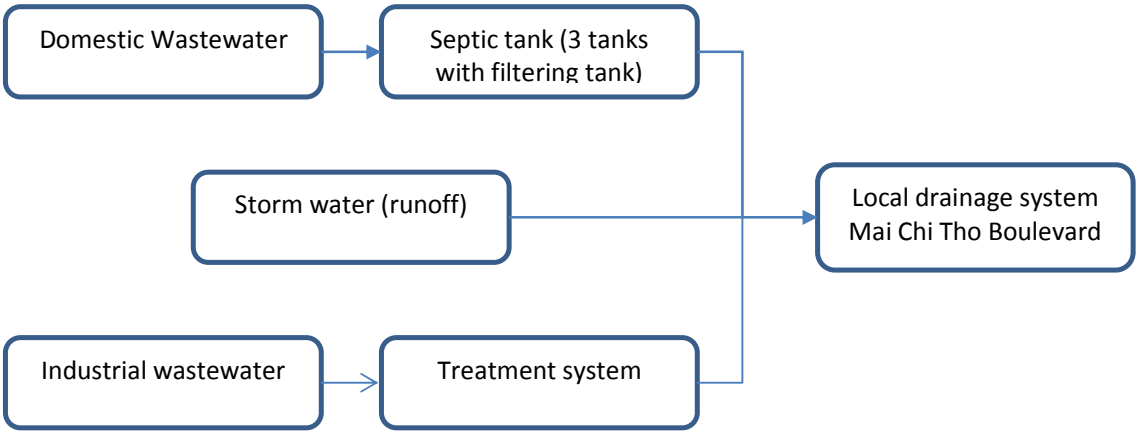


Figure 4, 4 Management of wastewater in Thu Thiem Technical Facility

- Storm water is identified as non-polluted water and will be directly discharged to local drainage system in Mai Chi Tho Boulevard. Solid waste on the ground of Terminal will be regularly cleaned to prevent pollutants from running into the drainage system and potentially cause water pollution;
- Domestic wastewater from Thu Thiem Technical Facility will be treated by septic tank (Figure 4,2), based in the volume of wastewater at stations, the tank capacity is calculated as follow:
  + Volume of water = 3;3 m^3/day * 2 day of storage = 6;6 m^3;
  + Volume of sludge, average of 25 people/day, storage during 6 months

    Volume of sludge ≈ 0;95 m^3
  + **Total volume of septic tank = 6;6 m^3 + 0;95 m^3 = 7;55 m^3,** (could be sized of 3;6m x 1;5m x 1;5m),

- **Industrial wastewater from washing BRT buses**: This kind of wastewater contains special pollutants, which require to be treated before discharging to environment. There will be maximum of 155 m^3 per day . The treatment process has been described as following:

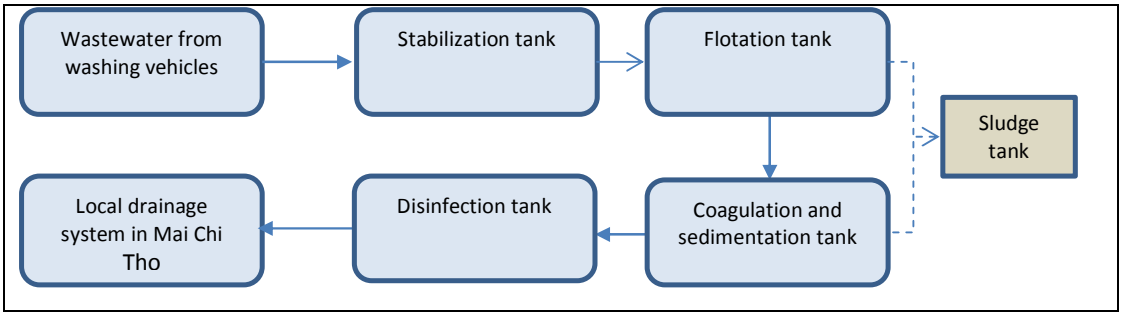


Figure 4, 5 Wastewater treatment process for wastewater from washing BRT buses

Description:

Wastewater from washing BRT buses will be collected and screened the solid wastes, before moving to stabilization tank. Then wastewater will be stabilized including wastewater quantity (Q), pH, and concentration (C) of pollutants. After that wastewater go into flotation tank, where separates oil and suspended solids out of wastewater flow before processing into coagulation and sedimentation tank with supporting of coagulating chemicals. The wastewater needs to be disinfected before discharged to drainage system.

+ **Capacity of wastewater treatment system**: 155 m^3/day or 6.5 m^3/hr,

+ **Stabilization:** collecting and stabilize wastewater from washing BRT buses. Because the discharge volume of wastewater is different depending on working hours, therefore, this tank is very important in manage quantity and concentration of following treatment steps. At the stabilization tank, chemicals could be added to ensure pH level;

+ **Flotation tank** will separate oil and suspended solids in wastewater by creating small bubbles. . Suspended solids and oil will stick on bubbles and gathered on surface of tank as sludge. This sludge will be removed to sludge tank.

+ **Coagulation and sedimentation tank**: In this tank, coagulating reaction (with coagulating chemicals such as PAC) and sedimentation process will remove substances by gravity.

+ **Disinfection tank**: This step ensures wastewater does not contain microorganism before discharge to environment. Chlorine could be used as normal disinfection chemical.

+ **Sludge tank**: sludge from flotation tank and coagulation, sedimentation tank will be collected and compared with QCVN 07:2009/BTNMT (National Technical Regulation of MONRE) for hazardous waste threshold. It will be managed as hazardous waste if the analyzed results are above thresholds, otherwise it will be

disposed as non-hazardous solid waste.

The effluent of domestic wastewater after treatment is compared to QCVN 14:2008/BTNMT (National Technical Regulation of MONRE) for domestic wastewater, while the technical regulation for effluent of industrial wastewater is QCVN 40:2011/BTNMT, type B.

During operational period of wastewater treatment systems, it need to:

- Regularly clean sludge from tanks to ensure treatment functions;
- Regularly clean drainage systems to ensure drainage functions;
- Appropriately allocate budget for wastewater treatment processes.

4.3.4. Environmental sanitation management

- Provision of the environmental station regulation broads on the bus stop stations and other public space along the BRT route;
- Establishment of environmental sanitation management group which assign the specific tasks to ensure appropriate management of environmental and sanitation condition in the public areas along the BRT route;
- Appropriate operation of solid waste collection, transportation and treatment system at the bus stop station, pedestrian flyovers, Rach Chiec terminal and Thu Thiem Technical Facility;
- Carry out daily clean at least twice a day at bus stop station, pedestrian flyovers, Rach Chiec terminal and Thu Thiem Technical Facility,
- Carry out general clean (every month); including glass clean, tree decorates, drainage clean, and mud suck….

4.3.5. Traffic safety

- Place signal boards near by the intersections and at bus stop stations;
- Appropriately operation of priority signal lights and traffic signal lights to ensure the traffic flow operation as designed;
- Coordinate with traffic polite groups along the BRT route in traffic managing during rush hours;
- Place signal boards near by the entering gates of Rach Chiec terminal and Thu Thiem Technical Facility;
- Coordinate with local authorities, NGOs to mobilize the resources to undertake road safety awareness campaigns or local residents and other road users.

4.3.6. Social safeguard

- Provision of camera at the bus stop station to supervise any social safety issues and social evils;
- Assigning the safeguards to ensure the social security on the public areas, especially at of Rach Chiec terminal and Thu Thiem Technical Facility;

- Coordinate with local authorities in control social evils at the public areas such as: bus stop station, pedestrian flyovers, Rach Chiec terminal and Thu Thiem Technical Facility;
- Awareness raising on social responsibility at the public areas by provision the panel advertisement and regulation boards at the stations and on the BRT vehicles,
- Training for driver to have good behavior with passenger and increase safety driving skills and social responsibilities through periodic driving skill examination, or annual operation evaluation.

4.3.7. Prevention of fire, explosion and response

Fire and explosion prevention and fight need following tasks:

- Availability of fire preventing and fighting equipment
    - Providing fire preventing and fighting equipment on BRT vehicles, BRT stop stations;
    - Providing handling fire preventing and fighting equipment and setting up fire preventing and fighting system at Rach Chiec terminal and Thu Thiem Technical Facility as regulated;
    - Providing the water holes at BRT stations, Rach Chiec Terminal and Thu Thiem Technical Facility as regulated in Fire Preventing and Fighting Regulations;
    - Ensuring water storage for firefighting Facility according to regulations in TCVN 33:2006/BXD (National Technical Regulation of Ministry of Construction)at Rach Chiec Terminal and Thu Thiem Technical .
- Training for fire preventing and fighting skill:
    - Having emergency response team;
    - Regularly training to ensure responses;
- Collaborate with local authorities (firefighting department and hospitals) in responding to firefighting and emergencies,

4,3,8, Safety management for CNG system

Safety requirements

- New installed equipment must comply with the national and international technical standards and its operation designs,
- CNG storage and filling station have to made by standard material which suitable with the CNG condition, the following national standard which need to comply since apply CNG fuel, include:
    - TCVN 6156:1996: Pressure vessels - Safety engineering requirements of erection, use, repair, Testing method.
    - TCVN 6292:1997: Gas cylinders - Refillable welded steel gas cylinders;
    - TCVN 6294-1997: Gas cylinders – Welded carbon steel gas cylinders – Periodic inspection and testing;

  - TCVN 6295-1997: Gas cylinders - Seamless gas cylinders - Safety and performance criteria;
  - TCVN 6008-2010: Pressure equipment - Welds - Technical requirements and testing methods;
  - TCVN 7472-2005: Welding - Fusion - welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels.

- The maintenance and repair of equipment need to be carefully planned and strictly following during the operation phase, which also need to be taken by a professional staffs, The maintenance process need to be strictly monitored and the maintained equipment need to test before completion.

Equipment operation and management

- Deeply understanding the operation condition of equipment such as temperature, pressures, operation time, operation period…;
- Deeply understanding the safety limitations of pressure relative equipment on the BRT vehicles and in the fuel filling station or others …;
- Preparing the safety operation and risk management process for each equipment or for whole system;
- Providing adequate trainings on technical skill, risk management, operation process for staffs who are working with pressure relative equipment.

Maintenance of warning equipment

- Warning equipment such as safety valves, pressure clocks, smoke and fire tracking equipment need to be always under good condition;
- Periodic testing, verification the warning equipment to ensure good operation condition and comply with national technical requirements;
- The automatic deflation equipment such as safety valves, explosion prevention equipment (on tank truck) need to install exhaust pipe to safety areas;

Maintenance of gas storage equipment

- Preparing the appropriate maintenance plans for whole system and for each pressure items of the system, The maintenance plans need to consider the typical characteristics such as: lifetime, operation condition, and operation environment….
- Attention on the unusual performance of gas entering and outlet system, The safety staffs need to check the operation condition for gas storage equipment on BRT vehicles and in the Thu Thiem Technical Facility weakly.
- Before carrying out the gas storage equipment need to deflate all gas on the equipment, cleaning, fill Nitro….
- Strictly compliance with safety process in maintenance equipment.

Education and training

- Provision adequate education and training for staffs who will be in charge of operation, maintenance, repair of all pressure equipment and who is new;
- The training will be repeated in the following cases:
    - Change in works
    - Change in operation process
    - After longtime stop working or move to other departments,
    - Annually training program.

Periodic verification activities: as regulated, the equipment needs to follow periodic verification such as: i) Pressure vase; ii) safety valve and iii) pressure-gauge.

CHAPTER 5: ENVIRONMENTAL MANAGEMENT PLAN AND ENVIRONMENTAL MONITORING PLAN

5.1. ENVIRONMENTAL MANAGEMENT PLAN

5.1.1. Objectives

The main objectives of the Environmental Management Plan (EMP) are detailed as below:

- To prepare implementation documents of approved mitigation measures and ECOP in the project technical notes.
- Specifing commitments and obligations, documenting responsibilities, and timing of implementation.
- Ensuring appropriate management of environmental impact sources and negative environmental impacts, and preparedness for rapidly responding to environmental risk and accidents.
- Recording and reporting on variations in ambient environmental quality indexes, and identify any outstanding issues and propose additional measures or retrofitting actions for improvement.
- Disclosing the project information to local communities to promote the community bases monitoring and enhance the compliance responsibility of relevant stakeholders.

Data and information collected and evaluated from environmental management and monitoring must include the following characteristics:

- Accuracy of the datae – collection and evaluation data must be homogeneous with what performance on the sites;
- Typification of data: collected and evaluated data must be representative for a certain areas on the site.
- Similarity of the data: collected and evaluated data at different times must be comparable.
- Continuous collection of data: collected and evaluated data must be implemented as requested in the approved EoMP and EMP, which could be monitored for a long time during project construction and operation;

5.1.2. Summary of mitigation measures and implementing responsibilities

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
I	**Pre-construction phase**						
-	Land acquisition and resetlement	Permanent acquisition 1.77 ha at Thu Thiem depot and 0.58 ha at Rach Chiec terminal Impacts on 03 HHs and 02 business shops at Thu Thien Technical Facility And 12 households at Rach Chiec terminal	Land acquisition and resetlement will be compliance with approval Resettlement Policy Framework (RPF) and Resettlement Action Plan (RAP)	Including in RAP	Before construction started	Land acquisition and compensation committee of District 2	UCCI and Independent resetlement monitoring consultant
-	Underground facilities relocation	Underground facilities relocation could be include: Water supply; Drainage system; Power supply system Information system	Contact with all relevant local authorities for service provision of power, water supply, drainages… Prepare utility relocation plan and inform for local commune and affected people;	Including in RAP	Before construction started	Land acquisition and compensation committee of District 2	UCCI and Independent resetlement monitoring consultant
-	Unexploded Ordnance remove	Project located in the high potential UXO which could threat to worker which could create accidents due to UXO	Coordinate with the appropriate agencies at the design stage to identify if UXO is a potential threat to works Ensure that the contractors shall only commence site works after the project areas are already been cleared	Including in RAP	Before construction started	Land acquisition and compensation committee of District 2	UCCI and Independent resetlement monitoring consultant
-	Project design	Appropriate environmental friendly consideration in design such as bus stop station, access options to	Several principals need to consider during the design phase the maximize the benefits of the project, such as: Minimize land acquisition;	Includes in design cost	Before construction phase	Design consultant	UCCI and Design supervision consultant (if

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
		stop station, vehicle selection, fuel application and operation option to reduce the O&M cost and ensure the sustainable operation of the project	Minimize the encroachment of ecosystem and natural resources; Advantage technology application: such as alternative fuel, renewable energy utilization; GHG reduction and urban air quality improvement; Community living quality improvement Private vehicle use control and traffic congestion improvement Wide social acceptance; Public service enhancement Some detail suggested consideration for project include: pedestrian flyovers, accessibility, architecture options, safety for CNG fuel application, construction material and environmental management plans				any)
II	**Construction phase**						
1	***Ambient air quality***						
-	Earthworks and excavation activities at bus stop station, pedestrian flyovers construction/ Improvement, Rach Chiec	Dust generated from earthworks and excavation activities could create impacts on sensitive air receptors along or nearby the construction sites in bus stop station, pedestrian flyovers improvement, Rach Chiec terminal and Thu Thiem Technical Facility and its access road	Watering at least one a day during rainy season and twice a day during dry season at the high dust generation locations are determined as below: • At pedestrian flyover new construction or improvement locations, especially on District No1, district No, 5 and An Loi Dong ward in district No, 2; road • Improvement of rad surface at bus stops • Construction of bus stop station, • Access road to Thu Thiem Technical Facility and	Include in civil work contracts Supervision and	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
	terminal and Thu Thiem Technical Facility and its access road	Other activities could also generate secondary dust and disperse to ambient environment	Rach Chiec terminal • Excavated soil storage sites must be placed in the designed areas far from any residential area and covered Covering the construction site with 2m height fence at location of: Construction of bus stop station; Improvement of road surface at bus stops; Thu Thiem Technical Facility on side close with Viet – Uc international School and Mai Chi Tho street; Rach Chiec terminal on side close with Hanoi Freeway; Pedestrian flyover new construction or improvement locations Daily clean the nearby areas by road cleaning vehicles on BRT routes construction to reduce secondary dust generation from traffic flows The construction machinery/ equipment and heavy vehicles have to comply with emission standards Regular maintenance and clean the machinery/ equipment , Construction machinery/ equipment will not allow to place out of the ROW Monitoring the ambient air quality on the construction site	monitoring include in contracts with CSC and IEMC			
-	Transport of construction materials and waste	Along the transportation road	Trucks carrying granular/wastes materials must be covered, All trucks should not be overloaded and fix with its body Provision of wheel-wash stations at the ingress/ egress points on Thu Thiem and Rach Chiec construction sites to clean construction vehicles moving out of the construction site from depositing soil dust on public road Soil scattered on the paved road and public road due to over fill or fallout from the trucks should be removed immediately	Include in civil work contracts Supervision and monitoring include in contracts with CSC and	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
				IEMC			
	Concrete mixing stations (if any)	Dust generated could create impact to sensitive receptors at distance of 25m	The location of concrete mixing plant on the site must be away from any watercourses and residential areas as well as sensitive objects ; The watering activities have been proposed at least once per day during the rainy season and twice a day during the dry season in the concrete mixing plants; Operation schedule of the plan must be carefully considered to avoid rest times of local people In case that, the project will purchase the hot concrete from nearby mixing stations, the contractors and PMU need to check the environmental permission certificates of these stations	Include in civil work contracts Supervision and monitoring include in contracts with CSC and IEMC	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE
2	**Noise and Vibration**						
-	Operation of construction equipment machineries and transport vehicles	Operation of noise and vibration generated equipment machineries and transport vehicles could create impacts on noise sensitive receptors location along or nearby the construction sites	*Setting up appropriate operation schedule of noise generate equipment:* Turn off the interrupted machines wherever possible , Usage of machines generate noise level over >55 dBA at night (from 22:00 to 6:00) is strictly prohibited at the location nearby residential area, hospital, Provision noise protection equipment for worker; *Usage of lower noise generate equipment:* Selecting the lower noise generate equipment , appropriate maintenance equipment and vehicles Heavy truck transportation, loading/unloading shall not allow to operate at night (from 22:00 to 6:00) at residential areas	Include in civil work contracts Supervision and monitoring include in contracts with CSC and IEMC	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
3	**Solid waste management**						
	Earthworks and excavation activities, worker camp establishment Equipment maintenance and other activities	Soil from earthworks and excavation activities Domestic waste is 21-30kg/day Hazardous include oil waste and batteries …59,4 kg Create insanitation environment and impacts on surrounding water bodies, and waste disposal areas…	Wherever possible, materials used or generated by construction shall be recycled such as excavated soil could be reused for leveling propose on the sites Construction waste will be temporary storage on the site and will be disposed at Da Phuoc disposal site where are approved in letter 6420/UBND-DTMT dated 28/09/2007 of HCMC PC on the disposal construction waster from ODA project in HCMC Provide dustbins and mobile septic tanks at work site and need to be collected by hygienic manner through service provision of local URENCO, Provide the facilities in the site including latrines, holding areas, garbage bins, Disposal of solid wastes into canals, stream, other watercourses, agricultural field and public areas is prohibited Hazardous waste need to be Collected, transported and treated by company which has a work permit to treat hazardous waste according to MONRE's Circular 12/2011/TT-BTNMT dated 14 April 2011	Include in civil work contracts Supervision and monitoring include in contracts with CSC and IEMC	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE
4	***Surface water quality management***						
	Earthworks and excavation activities, worker camp establishment	High potential pollute the nearby water Untreated waste water from worker camps create high risk of sanitation condition and disease dispersion in the	Undertake earthworks where possible during dry season , Undertake earthworks where possible during dry season Provision of gird to prevent waste entering the drainage system on road surface improvement and bus stop station building on Vo Van Kiet and Mai Chi Tho streets,	Include in civil work contracts Supervision	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
	Equipment maintenance and other activities	project area; Temporary impacts on drainage in Vo Van kiet and Mai Chi Tho streets	Construction sites of Thu Thiem Technical Facility and Rach Chiec terminal Site plan shall be designed to ensure that surface run-off from the construction site does not flow directly into surrounding water bodies, All equipment shall be kept in good working order and serviced regularly, Leaking equipment shall be removed immediately from site and repaired, The workshop shall have impermeable floor which is bounded and sloped towards an oil trap to contain any spillages, When servicing equipment, drip trays shall be used to collect the waste oil and other lubricants, Provide the facilities in the site including latrines, holding areas, garbage bins, Waste from latrines will be collected and treated properly through an economic contract with local companies Covering material storage areas during rainy times, Temporary storage of construction waste on the sites will be no longer than 24 hours and it must be covered Washing instruments/vehicles next to the water bodies is forbidden to avoid leaching of waste, sludge, soil, oil contaminated water	and monitoring include in contracts with CSC and IEMC			
	Occupational safety and health for worker						
	Worker camp establishment and operation of construction equipment	Occupational safety and health for worker	Establish safety measures as required by law and by good engineering practice and provide first aid facilities that are readily accessible by workers, Workers shall be provided with appropriate personal protective equipment (PPE) such as safety shoes, hard hats, safety glasses, ear plugs, gloves, etc, at no cost to the employee,,	Include in civil work contracts Supervision and	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
			The Contractor shall ensure safety for people who are permitted to enter the Site, The construction sites shall be kept clean and tidy to avoid dangers caused to these people, Contractors ensure to provide safe drinking water to workers for daily uses, Construction site shall be provided with toilet/sanitation facilities/cooking areas and clean camps Contractor shall readily provide and maintain lights, protection fences, signboards and wardens where necessary to prevent local people access the sites Provision periodic health care check for worker (every 6 months as regulated)	monitoring include in contracts with CSC and IEMC			
	Traffic congestion and accident risks						
	Earthworks and excavation activities, worker camp establishment Equipment, vehicles operation	Encroachment of road surface Traffic conflict between construction equipment, vehicles and road users High risk of traffic congestion and accident at the intersections	Coordinate with traffic polices on moderate traffic flow during rush hours, there are three traffic polices group in the areas, include i) Ben Thanh group; ii) Cai Lai group and iii) Tin Hieu group, Construction activities on the surface of Vo Van Kiet and Mai Chi Tho street should implement section by section to reduce temporary encroachment of road surface; Place sign boards near construction sites to direct traffic means to slow down Loading and unloading activities on Vo Van Kiet and Mai Chi Tho streets must be scheduled to avoid rush hours; Provide lighting at construction site at nigh Provision a security guard staff at the entering gates of construction sites of Thu Thiem Technical Facility and Rach	Include in civil work contracts Supervision and monitoring include in contracts with CSC and IEMC	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
			Chiec terminal to moderate vehicle go out and in the construction site,				
	Ecosystem impact management						
	Land acquisition, and discharge pollutants to environment	Loss living environment Degradation of living environment and ecosystem However, the project area located under rapidly urbanization process thus the impacts on ecosystem is minor	All activities of contractor are only allowed within the acquired land areas and ensure that construction material and waste will not fall into the surrounding areas; Forbid to discharged construction waste, domestic waste, waste water as well as runoff water into surrounding areas and cutting the trees outside the project's RoW Before the construction activities completed, contractors have to carry out site clearance and environmental recovery such as: Transport of all unused materials from construction site; Remove all construction machineries and equipment, temporary facilities, worksite, etc… Environmental recovery at the site such as planting of trees, Monitoring the survive of the trees	Include in civil work contracts Supervision and monitoring include in contracts with CSC and IEMC	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE
	Public infrastructure encroachment						
	Transport vehicle operation Construction site establishment	Degradation of public infrastructure which used during construction phase	Obtain the approval from local authorities on the transportation routes or any public facilitates during construction phases Periodic maintenance the road or public facilitates to ensure the movement and usage of local people; Reinstatement of any affected roads and clearance public facilitates before construction activities completed	Include in civil work contracts Supervision and monitoring	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
			Contact with local authorities for water and power supply on the construction sites	include in contracts with CSC and IEMC			
	Social disturbance						
	Construction machinery mobilization at the site, concentration of workers	Disease spreading and increasing in social evils as prostitution, HIV/AID, drugs…); Conflict between workers and local people Safety for communities	Install barriers (temporary fence) at the construction areas to deter people from entering the site, The local residents shall not be allowed in high-risk areas (excavation sites and areas where heavy equipment is in operation and such sites have a watchman to keep public out Provide lighting at construction site at night, Upon completion of construction works, borrow areas will be backfilled or fenced Construction workers who are not local people must register temporary residents and obtain temporary residential certificate from local authority, Educate workers on appropriate behavior for interactions with local community and risks of communicable diseases Maximize employment of local people as construction workers,	Include in civil work contracts Supervision and monitoring include in contracts with CSC and IEMC	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE
	Cultural impacts						
	Earthworks and excavation activities	Relic and grave items were found during construction	When grave or cultural objects are found during construction, coordinate with local authorities to arrange the relocation and mapping the location of the graves before and after relocation, Halt construction activities, protect the site and inform construction supervision for guidance	Include in civil work contracts Supervision and	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
				monitoring include in contracts with CSC and IEMC			
	Flooding and climate change						
	Earthworks and excavation activities and construction site establishment	High risk of localized flooding due to material and waste obstructed on the site Block of any water flows Natural disaster during construction phase	Appropriate arrange of the construction sites to ensure the height and distance from high flooding risk areas; Review the flooding history in the project area to schedule excavation works avoiding rainy season and flooding and flood-tide from ; At the excavation section, provision the vegetable as soon as practicable after excavating, Build and maintain temporary drainage ditches within and surrounding construction sites to ensure surface runoff is drained efficiently; Prevent the material storage at the high potential flooding, especially at the intersection between Vo Van Kiet and An Duong Vuong street	Include in civil work contracts Supervision and monitoring include in contracts with CSC and IEMC	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE
	Environmental recovery responsibility						
	Earthworks and excavation activities and construction site establishment	Risk for local communities, create insanitation condition, environmental pollution	Site clearance at construction site i) Transport of all unused materials from construction site; ii) Remove all construction machineries and equipment, temporary facilities, ; iii) leveling the surface; iv) planting of trees; At the waste disposal location: leveling the surface and provision with vegetable cover,	Include in civil work contracts Supervision and monitoring	During construction time (24 months)	Contractors as regulated on civil contracts	UCCI, CSC, IEMC, Ho Chi Minh City DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
				include in contracts with CSC and IEMC			
III	Operation stage						
	Dust and exhaust gases						
	Operation of vehicles	Create impacts on public health of nearby households, sensitive receptors	Management emission from vehicles need to complied with relevant regulations and standards Periodically carrying out surface cleaning at Rach Chiec terminal and Thu Thiem Technical Facility to control secondary dust release. Tree should be planted to prevention of dust dispersion and landscape creation on bus stop stations, pedestrian flyovers, parking areas, Rach Chiec terminal and Thu Thiem Technical Facility	Include in O&M cost	During operation phase	Management unit	HCM city PDOT and DONRE
	Solid waste management						
	Passenger discharge Vehicle operation and Terminal and bus stop station operation	High risk of surface water pollution and soil pollution Odor generation, and sanitation condition to surrounding areas	Solid waste management Garbage bin: need to meet the requirements of Ministry of Construction QCVN 07:2010/BXD and daily clean; Waste trolley: will also meet the requirements of: i) the vollume will be 250-660 litre; ii) material by heavy metal or compozit; Waste transport and treatment: the university should sign contract with local URENCO for transporting and treating the solidwaste, Assign staffs: the profesional staffs need to be assigned to ensure the sanitation condition ;	Include in O&M cost	During operation phase	Management unit	HCM city PDOT and DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
			Budget: the budget for this activities need to ensure for running the system Hazardous substances Storage of hazardous substances must in the places which facilitated with: i) roof; ii) concrete ground and water resistant;; iii) edge around the storage areas; iv) away from water bodies and high fire risk areas, Weekly records on volume of generated hazardous substances; Sign contact with company which has a work permit to treat hazardous waste according to MONRE's Circular 12/2011/TT-BTNMT dated 14 April 2011 for transport and treatment				
	Waste water management						
	Operation of Rach Chiec terminal, Thu Thiem Technical Facility and bus stop stations	High risk of surface water pollution and soil pollution and underground pollution Odor generation, and sanitation condition to surrounding areas	+ *Flow 1: Runoff water (rainy water):* this kind of wastewater is considered as nonpolluted and could directly discharge into general drainage system, place grid for prevention of wastes from entering drains + *Flow 2: Domestic wastewater:* this kind of wastewater must discharge into septic tank before discharging into general drainage system of Thu Thiem Technical Facility and Rach Chiec Terminal, The quality of wastewater from this flow need to meet the requirements on QCVN 14 : 2008/BTNMT – National standard for domestic wastewater; + Flow 3: Vehicle maintain and clean wastewater: this kind of wastewater must collect into a technical hole (pond) for primary treatment includes depositing unresolved maters and collecting oil spill before discharging into general drainage	Include in O&M cost	During operation phase	Management unit	HCM city PDOT and DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
			system of Thu Thiem Technical Facility and Rach Chiec Terminal, The quality of wastewater from this flow need to meet the requirements on QCVN 40: 2011/BTNMT – National standard for industrial wastewater *For operation the system* Regularly remove the sludge from septic tank and manholes; Regularly carry out the cleaning the drainage to ensure water flow , Allocating adequate budget for this activities need to ensure for running the system				
	Environmental sanitation management						
	Operation of Rach Chiec terminal, Thu Thiem Technical Facility and bus stop stations	High risk of surface water pollution and soil pollution and underground pollution Odor generation, and sanitation condition to surrounding areas	Appropriate operation of solid waste collection, transportation and treatment system at the bus stop station, pedestrian flyovers, Rach Chiec terminal and Thu Thiem Technical Facility; Carry out daily clean at least twice a day at bus stop station, pedestrian flyovers, Rach Chiec terminal and Thu Thiem Technical Facility, Carry out general clean (every month); including glass clean, tree decorates, drainage clean, and mud suck…,,	Include in O&M cost	During operation phase	Management unit	HCM city PDOT and DONRE
	Traffic safety						
	Operation of vehicles	Traffic congestion and accident on the main gates and intersections	Place signal boards near by the intersections and at bus stop stations; Appropriately operation of priority signal lights and traffic signal light to ensure the traffic flow operation as designed Coordinate with traffic polite groups along the BRT route in	Include in O&M cost	During operation phase	Management unit	HCM city PDOT and DONRE

No,	Project activities	Potential environmental impacts	Mitigation measure	Implementing cost	Time frame	Implementing Responsibility	Supervision Responsibility
			traffic managing during rush hours; Place signal boards near by the entering gates of Rach Chiec terminal and Thu Thiem Technical Facility; Coordinate with local authorities, NGOs to mobilize the resources to undertake road safety awareness campaigns or local residents and other road users				
	Social safeguard						
-	Vehicle operation Passengers and drivers	Social evils at the public areas	Assigning the safeguards to ensure the social security on the public areas, especially at of Rach Chiec terminal and Thu Thiem Technical Facility; Coordinate with local authorities in control social evils, issues at the public areas such as: bus stop station, pedestrian flyovers, Rach Chiec terminal and Thu Thiem Technical Facility; Awareness raising on social responsibility at the public areas by provision the panel advertisement and regulation boards at the bus stations and on the BRT vehicles, Training for driver to have good behavior with passenger and increase safety driving skills and social responsibilities through periodic driving skill examination, or annual operation evaluation;	Include in O&M cost	During operation phase	Management unit	HCM city PDOT and DONRE

5.1.3. Institutional arrangement

EMP implementation will involve relevant agencies, organizations and stakeholders with deferent roles and responsibility, such as:

- The World Bank (WB): Donor
- Project Owner: Urban-Civil Works Construction Investment Management Authority of Ho Chi Minh City (UCCI)/Ho Chi Minh City Green Transport Development Project PMU (GTP PMU)
- EIA report approval: Ho Chi Minh Department of Natural Resource and Environment
- Construction Supervisor Consultant (CSC)/ Environmental Supervisor (ES)
- Independent environmental monitoring consultant (IEMC)
- Civil work contractors
- Local communities

The relationship between different stakeholders during the construction phase can be summarized in the figure below.

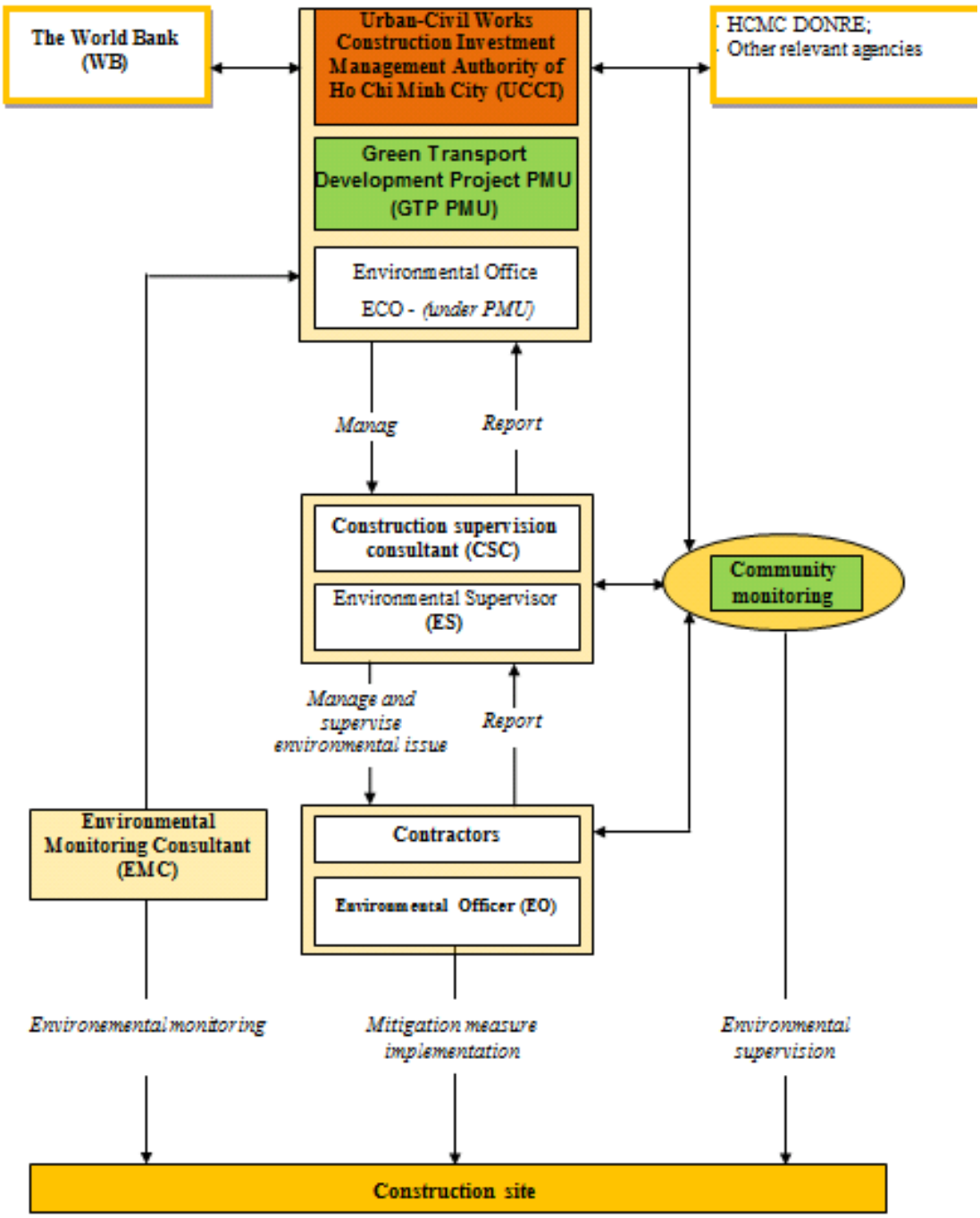


Figure 5. 1 Diagram of Environmental Management System

Detailed responsibilities of relevant stakeholders are summarized in the table below.

Table 5. 1 Responsibilities for Environmental Management

Agencies/actors	Environment management responsibility
Project Owner: Urban-Civil Works Construction Investment Management Authority of Ho Chi Minh City (UCCI)/Ho Chi Minh City Green Transport Development Project PMU (GTP PMU);	The UCCI will be the implementing agency, general manage and monitor project, GTP PMU is representative of UCCI, general co-ordinate the project, manage and monitor project EMP implementation, the ensure active of project environmental management system stated in figure 5.1
Environmental Operator/Officer ECO - (GTP PMU);	GTP PMU assigns a qualification office to in charge of environmental management for whole project, ECO will be responsible for monitoring the implementation of WB's environmental safeguard policies and Vietnam regulation in all stages and process of the project The EOC will also advise The GTP PMU's leaders on environmental issues to ensure that the project implementation meets all requirements of WB's environmental safeguard policies and Vietnam regulation.
Construction supervision consultant (CSC/environmental supervisor (ES)	The Construction supervision consultant (CSC) will be responsible for supervising and monitoring all construction activities and ensuring that Contractors comply with the requirements stated on technical notes, The CSC shall engage environmental staff (ES) to monitoring performance of Contractor and ensuring that contractor comply with approval EMP and EIA. Periodical report on EMP compliance of contractors to GTP PMU.
Independent Environmental Monitoring consultant(IEMC)	Assist the PMU in building up the EMS (environmental management system) and also assist PMU in preparing periodic environmental monitoring and supervision report; Supervision the compliance performances on the sites of relevant parties; Conduct the environmental monitoring activities Provide the technical assistance in environmental impact mitigation, Periodical implementation of environmental monitoring Implement additional environmental monitoring if requested
Contractors	Based on the approved EMP, the Contractor will be responsible for preparing site EMP (SEMP) for its civil contract, SEMP is submitted to GTP PMU for review and approval before commencing construction, Fulfill compliance with approval EIA and implementing impact avoid and mitigation measure during construction phase Monitored by environmental staffs/consultant and they could requested to implement/cut out additional measure, if needed
Ho Chi Minh City PC	Coordinate with or assign to functional department to i) check, certificate environmental protection performances for operation phase; ii) Regular check the environmental compliance status of relevant stakeholder during

	project preparation and implementation phases, if needed, ,
Ho Chi Minh city DONRE	With the role of state management in the environmental field, DONRE will be responsible for: - Enforce the environmental law, regulations, standards; - Coordinate with relevant agencies in promoting environmental protection enforcement - Inspecting the construction, completion and operation of environmental infrastructures
Ho Chi Minh City DOT	Taking place as public authority in state management of transport related issues in Ho Chi Minh city (road and inland water way) and other urban infrastructures (such as parking, lighting, urban bus…), Ho Chi Minh city DOT as a member in Project management broad, which will be responsibility for: - Coordinate with donor, relevant agencies in project implementation; - Monitoring, inspection project implementation and assist in remove barriers and difficulties; - Managing and instruct to implement professional tasks
Local communities (Authorities, NGOs…)	Community based monitoring is a kind of voluntary monitoring of local people, authorities in the project area, which stated in Decision No, 80/2005/QĐ-TTg and other legal documents, in order to: - Monitoring and assessment the compliance with public investment policies of management agencies and others such as investment decision makers, investors, PMU, contractors (include environmental aspect); - Find out and recommend to administrative management agencies in any incompliance cases on public investment policies (include environmental aspect) for rapidly responding and preventing the violation, national budget loss or community interest encroachment,

During the operational phase, environmental management responsibilities are summarized as below:

BRT operation management unit - the Management Operation Center of Public Transport ensures relevant regulations on environmental issue management are addressed, establish the EMS, and assign the staff and resources to run the EMS.

BRT business unit – the business unit has four main functions, including BRT operational, infrastructure, commercial, and marketing management. The BRT unit will ensure the appropriate operation of EMS and management of all environmental issues on the BRT route.

Saigon Bus Company – the bus company is proposed as BRT operation at the early state of project operation phase. Its main responsibilities include active involvement in the detailed design of the BRT system, selection and purchase of BRT buses, establishment of the operation system and implementation of BRT operations.

District Environmental and Natural Resource Division and Ho Chi Minh DONRE have responsibilities for management, monitoring and inspection of environmental issues along the BRT route.

5.1.4. Environmental Compliance Framework

Environmental responsibility of the Contractor

The Contractor shall firstly adhere to and aim to minimize the impacts that may result from project construction activities, and secondly the mitigation measures set down in these EMP to prevent harm and nuisance to local communities, impacts in construction and operation on the environment.

Remedial actions which cannot be effectively carried out during construction should be carried out on completion of the work (and before issuance of the acceptance of completion of work).

The duties of the Contractor and his Sub-Contractors include, but are not limited to:

- Compliance with relevant legislative requirements governing the environment, public health and safety.
- Work within the scope of contractual requirements and other tender conditions.
- Organize representatives of the construction team to participate in the joint site inspections undertaken by the ES.
- Carry out any corrective actions instructed by the ECO or the ES.
- In case of non-compliances/discrepancies, carry out investigation and submit proposals on mitigation measures, and implement remedial measures to reduce environmental impact.
- Stop construction activities which generate adverse impacts upon receiving instructions from the ECO or the ES. Propose and carry out corrective actions and implement alternative construction methods, if required, in order to minimize environmental impacts. Major non-compliance by the Contractor will be cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of the ECO and ES.

Contractor's Environment Officer (EO)

The Contractor shall be required to appoint a competent individual as the Contractor‘s on-site Environment Officer (EO). The EO must be appropriately trained in environmental management and must possess the skills necessary to transfer environmental management knowledge to all personnel involved in the contract. The EO will be responsible for monitoring the Contractor‘s compliance with the EMP requirements and the environmental specifications, The duties of the EO shall include but not be limited to the following:

- Carry out environmental site inspections to assess and audit the Contractors' site practice, equipment and work methodologies with respect to pollution control and adequacy of environmental mitigation measures implemented.
- Monitor compliance with environmental protection measures, pollution prevention and control measures and contractual requirements.
- Monitor the implementation of environmental mitigation measures.
- Prepare audit reports for the environmental monitoring data and site environmental conditions.

- Investigate complaints and recommend any required corrective measures;
- Advise the Contractor on environment improvement, awareness and proactive pollution prevention measures.
- Follow the procedures in the EMP and recommend suitable mitigation measures to the Contractor in the case of non-compliance. Carry out additional monitoring of non-compliance within the specified timeframe instructed by the ECO/ES.
- Liaison with the Contractor and ECO/ES on all environmental performance matters; and Contractor's submission of EMP Implementation Plan reports to the ECO/ES, and relevant administrative authorities, if required.
- Keep detailed records of all site activities that may pertain to the environment.

Independent Environmental Monitoring Consultant (IEMC)

In order to minimize the environmental impacts during construction of the project, the Project Owner shall ensure that project-specific monitoring and audit requirements are established for the project. The monitoring and audit shall be carried out by an Independent Environmental Monitoring Consultant (IEMC) appointed by GTP PMU, the main responsibilities of IEMC will include:

- Assist the PMU, Construction Supervision Consultant (CSC) and contractors in performing their environmental duties on the site, including provision of technical advisories and guidance documents.
- Periodic site supervision to check compliance performance on relevant environmental policies, mitigation measures of relevant stakeholders which include the environment procedures, report system, resource allocation, training activities, and onsite environmental management practice.
- Monitoring environmental conflicts on the site, developing additional mitigation measures, and responding plans if needed.

IEMC will be responsible for carrying out environmental sampling and monitoring in all project implementation phases. IEMC will be submitted periodic environmental monitoring reports to GTP PMU (every quarter report during construction phase and semi report during operation phase). IEMC will also provide specialized assistance to GTP PMU and ECO in environmental matters.

Environmental Supervision during Construction

During construction, environmental supervision shall be carried out by a qualified Construction Supervision Consultant (CSC) reporting to the PMU. The CSC is responsible for inspecting, and supervising all construction activities to ensure that mitigation measures adopted in the EMP are properly implemented, and that the negative environmental impacts of the project are minimized. The CSC shall engage a sufficient number of qualified staff (Environmental Supervisor - ES) with adequate knowledge on environmental protection and construction project management to perform the required duties and to supervise the Contractor's performance. The ES shall:

- Review and assess on behalf of the PMU whether the construction design meets the requirements of the mitigation and management measures of the EIA and

EMP.

- Supervise site environmental management system of Contractors including their performance, experience and handling of site environmental issues, and provide corrective instructions.
- Review the EMP implementation by Contractors and Sub-Contractors, verify and confirm environmental supervision procedures, parameters, monitoring locations, equipment and results.
- Report EMP implementation status to GTP PMU and prepare the environmental supervision statement during the construction period.
- Approve invoices or payments.

Compliance with Legal and Contractual Requirements

Construction activities shall comply not only with contractual environmental protection and pollution control requirements but also with environmental protection and pollution control laws of the Socialist Republic of Viet Nam.

All the works method statements submitted by the Contractor to the ECO for approval shall also be sent to the ES to see whether sufficient environmental protection and pollution control measures have been included.

The ES shall also review the progress and program of the works to check that relevant environmental laws have not been violated, and that any foreseeable potential for violating the laws can be prevented,

The Contractor(s) shall regularly copy relevant documents to the SEO and the ES. The document shall at least include the updated Work Progress Reports, the updated Works Program, and the application letters for different license/permits under the environmental protection laws, and all the valid license/permit, SEO and ES shall also have access, upon request, to the Site Log-Book.

After reviewing the documents, the EO and ES shall advise the ECO and the Contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the EO and ES conclude that the current status on license/permit application and any environmental protection and pollution control preparation works may not comply with the works program or may result in potential violation of environmental protection and pollution control requirements by the works in due course, they shall advise the Contractor and the ECO accordingly.

Compliance and Compliance Address, Penalty System

A compliance framework, based on the environmental requirements established by the EMP and Environmental Specifications included in bidding documents, will be strictly enforced by supervision engineers found any incompliance cases on environmental protection, the 2% of total next payment will be delayed. The contractors will provide an extension for recover and repair the effects, if they could be completed within the extension time, the penalty will not applied. If the contractors could not compensate the impacts, they have to pay for the third parties for impact compensation implementation.

5.2. ENVIRONMENTAL MONITORING PLAN

5.2.1. Objectives

The main objectives of EMoP are to ensure that all identified environmental impacts stated in Chapter 3 and other arising impacts during project implementation will be appropriately managed, performance of the project works will be enhanced, and complaints appropriately addressed. The environmental monitoring program should have the following objectives:

- Determine the actual extent of the impacts and propose additional adjustment if needed.
- Check and supervise implementation of proposed mitigation measures during project implementation and manage their effectiveness.
- Identify any outstanding environmental issues.
- Recommend additional mitigation measures.

5.2.2. Basic documents for environmental monitoring

Ambient environmental monitoring programs will be designed based on Vietnamese regulations and other technical documents of the project:

- Law on Environmental Protection 2005, and other EIA relevant legal documents of the project.
- Circular No. 28/2011/TT-BTNTM, dated 01/08/2011, of MONRE regulating ambient air quality and noise monitoring technical process.
- Circular 29/2011/TT-BTNMT, dated 01/08/2011, of MONRE regulating inland surface water quality monitoring technical process.
- Environmental impacts analyzed in EIA report.
- Environmental quality status in the project area.

5.2.3. Monitoring content

The environmental monitoring program will include:

- Monitoring the level of compliance with mitigation measures and monitoring actual performance of mitigation measures on site.
- Environmental risk monitoring such as soil erosion, localized flooding, traffic safety.
- Discharge monitoring - monitoring the discharge of project activities to environment.
- Ambient environmental quality monitoring - monitoring the typical environmental pollution index of the project.

a) Monitoring compliance with mitigation measures

In order to supervise environmental compliance performance of project activities with

relevant regulations, standards, and technical guidance, the main objectives of compliance monitoring is to ensure that all proposed mitigation will be complied with during project implementation, identify arising environmental issues and propose additional mitigation measures. The EO and ES will assist the GTP PMU in implementing compliance monitoring, verification indicators, time frame, location. Responsibilities are included in Table 5.1. of this report.

b) Environmental risk monitoring

Environmental risk will be monitored during project implementation, The project area is located in rapidly urbanizing areas and environmental risk monitoring will focus on localized flooding and traffic conflict.

c) Discharge monitoring

Any discharges into the surrounding environment from construction sites will be monitored. The main focus will be on worker camps and concrete mixing station (if any). The exact location will be identified on the site following civil works commencement. Discharge monitoring will be implemented daily by the ES under CSC and every six months by the IEMC.

d) Ambient environmental quality monitoring

Ambient environmental quality monitoring will be carried out during two stages of project implementation: construction phase and operation phase (two first years), implemented by the IEMC.

+ Construction phase

- Ambient air quality monitoring
    - Objectives - to observe and identify any changes in ambient air quality around the construction site and to monitor the impacts of project activities on environment.
    - Monitoring indicators - TSP and PM_{10} were selected based on the scope and characteristics of the project.
    - Monitoring locations - six locations along the project area include i) intersection of HN1A; ii) residential area of Ward 3; iii) Tropical Hospital; iv) residential area at Ong Lanh bridge; v) International School ASG Vietnam; vi) intersection between Hanoi Expressway Mai Chi Tho Street – nearby Rach Chiec bridge.
    - Monitoring methods - following the regulations in circular No, 28/2011/TT-BTNMT on technical procedures on ambient air quality, noise, and vibration monitoring.
    - Monitoring frequency - every 6 months
    - Comparison standards - QCVN 05:2013/BTNMT – national standard on ambient air quality;
- Noise and vibration monitoring

- Objectives - to observe and identify any changes in noise and vibration levels around the construction site and to monitor impacts of project activities on the environment.
- Monitoring indicators - noise (Leq) and vibration (Laeq)
- Monitoring locations same are for air quality monitoring.
- Monitoring methods - following the regulation in circular No. 28/2011/TT-BTNMT on technical procedure for ambient air quality, noise and vibration monitoring.
- Monitoring frequency - every 6 months
- Comparison standards -
  - QCVN 26:2010/BTNMT - national standard on noise.
  - QCVN 27:2010/BTNMT - national standard on vibration.

- Surface water quality monitoring
  - Objectives - to observe and identify any changes in surface water quality around the construction site and to monitor impacts of project activities on environment.
  - Monitoring indicators - T, pH, SS, DO, COD, BOD_5, TSS, *E.coli* and coliforms.
  - Monitoring locations - five locations along the project area including Nuoc Len canal, Ruot Ngua canal, Lo Gom canal, Kenh 2 canal, and Ca Tre Nho canal.
  - Monitoring methods - following regulations in circular No. 29/2011/TT-BTNMT on technical procedures for inland water monitoring.
  - Monitoring frequency - every 6 months
  - Comparison standard - QCVN 08:2008/BTNMT- national standard on surface water quality.

+ Operation phase:

- Ambient air quality
  - Objectives - to monitor impacts of project activities on ambient air quality during the operation phase.
  - Monitoring indicators - TSP and $PM_{10,}$ NO_x, SO_2, and CO.
  - Monitoring locations: eight locations along the project area including i) intersection of HN1A; ii) residential area of Ward 3; iii) Tropical Hospital; iv) residential area at Ong Lanh bridge; v) international School ASG Vietnam; vi) intersection between Hanoi Expressway Mai Chi Tho street – nearby Rach Chiec bridge; vii) main gate of Rach Chiec Terminal; and viii) main gate of Thu Thien Technical Facility.
  - Monitoring methods - following the regulations in circular No, 28/2011/TT-BTNMT on technical procedures for ambient air quality, noise, and vibration monitoring.

- Monitoring frequency - every 6 months.
- Comparison standard - QCVN 05:2013/BTNMT – national standard on ambient air quality.

- Noise and vibration monitoring
  - Objectives - to identify any impacts of project activities on the environment.
  - Monitoring indicator - noise (Leq) and vibration (Laeq).
  - Monitoring locations: same as for air quality monitoring;
  - Monitoring methods – following regulations in circular No, 28/2011/TT-BTNMT on technical procedures for ambient air quality, noise, and vibration monitoring.
  - Monitoring frequency - every 6 months
  - Comparison standards:
    - QCVN 26:2010/BTNMT - national standard on noise.
    - QCVN 27:2010/BTNMT- national standard on vibration.

- Industrial wastewater monitoring
  - Objectives - to assess and monitor impacts of discharge activities from project activities on the ambient environment.
  - Monitoring indicator - pH, COD, BOD_5, TSS, grease and oil
  - Monitoring location: one location before water entering into treatment system and one location at discharging point into receptors.
  - Monitoring methods - following regulations in circular No. 29/2011/TT-BTNMT on technical procedures for inland water monitoring.
  - Monitoring frequency - every 6 months
  - Comparison standards - QCVN 40:2011/BTNMT– national standard on industrial wastewater quality.

- Domestic wastewater quality monitoring
  - Objectives - to assess and monitor impacts of discharge activities from project activities on the ambient environment.Monitoring indicator - pH, BOD_5, TSS, TS, $N\text{-}NH_4^+$, total P (PO_4^{3-}), total coliforms
  -
  - Monitoring location - one at discharge point at Rach Chiec Terminal and one location at discharge point at Thu Thiem Technical Facility.
  - Monitoring methods - following regulations in circular No. 29/2011/TT-BTNMT on technical procedures for inland water monitoring.
  - Monitoring frequency - every 6 months.
  - Comparison standards - QCVN 14:2008/BTNMT– national standard on domestic wastewater quality.

Monitoring indicators and their locations are indicated in the following table.

Table 5.2 Ambient environmental monitoring locations

No.	Location	Code	Construction stage	Operation stage	
I	**Air quality, noise and vibration**		**6 location**	**6 location**	
1	Intersection of HN1A	KK1, O1, R1	x	x	10°43'9.46"N 106°36'2.79"E
2	Residential area of Ward 3	KK2, O2, R2	x	x	10°44'28.72"N; 106°38'43.94"E
3	Tropical Hospital	KK3, O3, R3	x	x	10°45'8.04"N; 106°40'40.08"E
4	Residential area at Ong Lanh Bridge	KK4, O4, R4	x	x	10°45'45.85"N; 106°41'49.53"E
5	International School ASG Vietnam	KK5, O5, R5	x	x	10°47'14.50"N; 106°44'57.24"E
6	Intersection between Hanoi Expressway Mai Chi Tho street – nearby Rach Chiec Bridge	KK6, O6, R6	x	x	10°48'7.95"N; 106°45'14.02"E
7	Main gate of Rach Chiec Terminal	KK7, O7, R7		x	$10^0$78'89 N. $106^0$74'52 E
8	Main gate of Thu Thien Technical Facility	KK8, O8, R8		x	$10^0$81'16" N. $106^0$75'76" E
II	**Surface water quality**		**5 location**		
1	Nuoc Len canal	Nm1	x		10°43'7.03"N; 106°36'15.01"E
2	Ruot Ngua canal	Nm2	x		10°43'48.65"N; 106°37'39.03"E
3	Lo Gom canal	Nm3	x		10°44'3.48"N; 106°38'3.76"E
4	Kenh 2 canal	Nm4	x		10°46'43.19"N 106°44'1.82"E
5	Ca Tre Nho canal	Nm5	x		10°46'51.53"N; 106°44'17.55"E
III	Industrial wastewater monitoring			02 location	
	Before water entering treatment system	Ntcn1		x	
	At discharging point into receptors	Ntcn2		x	
IV	Domestic wastewater monitoring			02 location	
	At discharge point in Rach Chiec terminal	x			
	At discharge point in Thu Thiem Technical Facility	x			

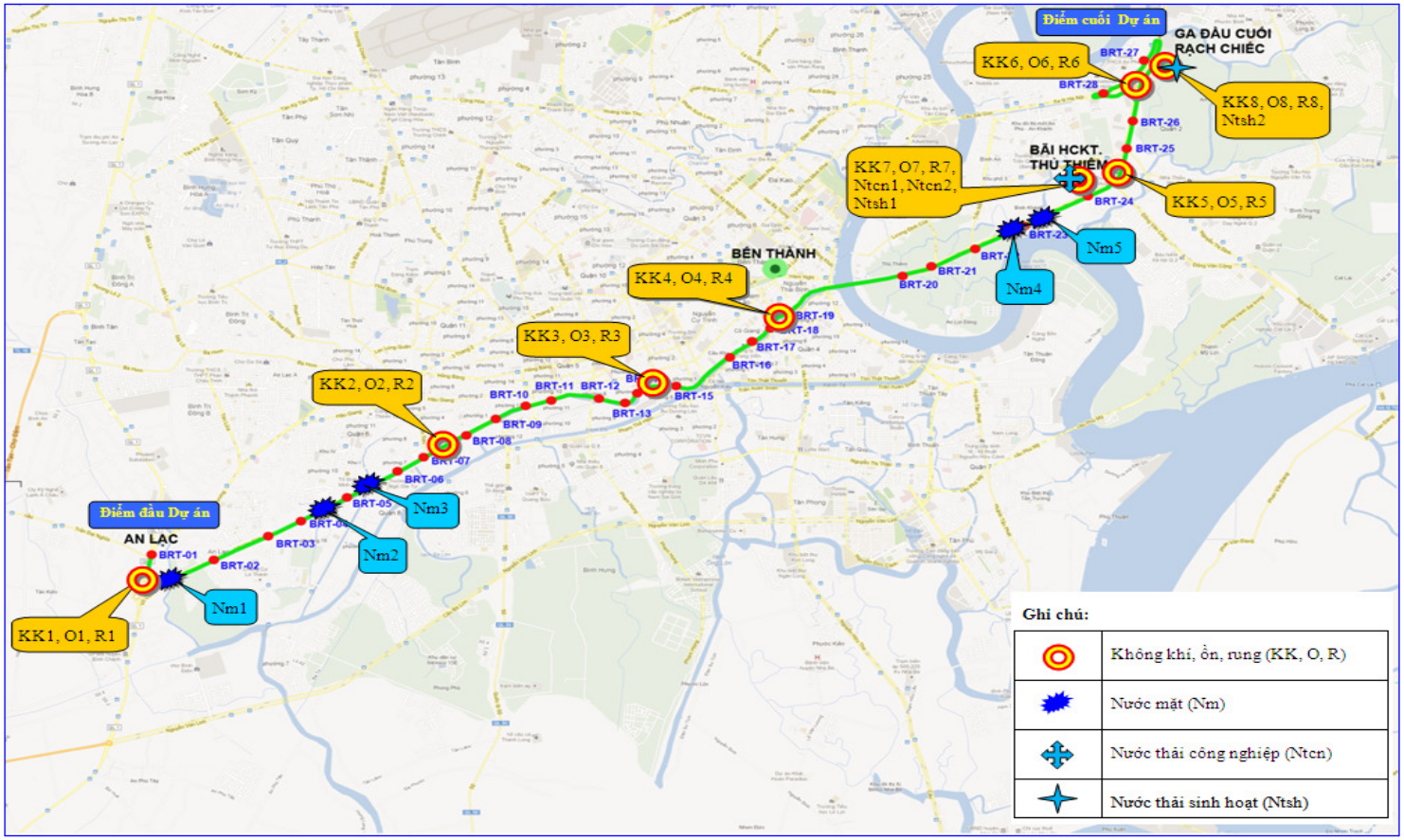


Figure 5, 2 Proposed monitoring locations

Table 5.3 Ambient environmental quality monitoring requirements

No.	Items	Implementing stage	
		Construction	**Operation**
I	**Ambient air quality**		
	Monitoring parameters	TSP, PM10	TSP, PM10, CO, SO_2, NO_2
2	Monitoring frequency	Every 6 months, taking 8 samples/location/day	
3	Frequency of taking samples	6 locations x 8 samples/location x 4 times (2 years of construction)	8 locations x 8 samples/location x 1 year x 2 times
	Standard for comparison	QCVN 05:2013/ BTNMT	
II	**Monitoring noise and vibration**		
1	Monitoring parameters	Noise (Leq), vibration (Laeq)	
2	Monitoring frequency	Every 6 months, 1 location/day, 15 times/day, 3 samples/time	
3	Frequency of taking samples	6 locations x 15 times/day x 3 samples/time x 4 time (2 years of construction)	8 locations x 15 times/day x 3 samples/time x 1 year x 2 times
4	Standard for comparison	QCVN 26:2010/ BTNMT (Noise) and QCVN 27:2010/BTNMT (vibration)	
III	**Surface water quality monitoring**		
1	Monitoring parameters	temperature, pH, Turbidity, DO, COD, BOD_5, TSS, E.coli and coliforms,	
2	Monitoring frequency	Every 6 months; 1 sample/location 1 time/day	
3	Frequency of taking samples	5 locations x 01 sample x 2 times (2 years of construction)	
4	Standard for comparison	QCVN 08:2008/ BTNMT	
IV	**Industrial wastewater quality**		
	Monitoring parameters		pH, COD, BOD_5, TSS, grease and oil
	Monitoring frequency		Every 6 months; 1 sample/location 1 time/day
	Frequency of taking samples		1 location x 1 sample xyear x 2 times
	Standard for comparison		QCVN 40:2011/ BTNMT
V	**Domestic wastewater quality**		
	Monitoring parameters		pH, BOD_5, TSS, TS, $N\text{-}NH_4^+$, total P (PO_4^{3-}), total coliforms
	Monitoring frequency		Every 6 months; 1 sample/location 1 time/day
	Frequency of taking samples		1 locations x 1 sample x 1 year x 2 times
	Standard for comparison		QCVN 14:2008/ BTNMT

5.2.4. Monitoring Report System

In order to exchange information, establish a database for monitoring implementation of mitigation measures, and effectively implement the EMP, it is essential to adopt a system for reporting to all levels of management (as shown in the table below).

Table 5.4 System for environmental monitoring reporting

No,	Issues to be reported	Monitoring at 1st level	Monitoring at 2nd level (one duplicate must be sent to HCMC DONRE)	Monitoring at 3rd level
	Construction stage			
1	Implement approval of mitigation measures onsite	**Implemented by:** Contractor **Frequency of report submission:** Monthly **Report sent to:** PMU	**Implemented by:** Environmental Supervisor **Frequency of report submission:** Quarterly **Report sent to:** PMU	**Implemented by:** PMU **Frequency of report submission:** Quarterly **Report sent to:** WB
2	Monitoring compliance with EMP and contractor clauses	**Implemented by:** Environmental Supervisor **Frequency of report submission:** Quarterly **Report sent to:** PMU	**Implemented by:** PMU **Frequency of report submission:** Quarterly **Report sent to:** WB	
3	Independent environmental monitoring consultant	**Implemented by:** IEMC **Frequency of report submission:** Quarterly **Report sent to:** PMU	**Implemented by:** PMU **Frequency of report submission:** Quarterly **Report sent to:** WB	
4	Community-based monitoring on EMP implementation	**Implemented by:** Community Monitoring Group **Frequency of report submission:** In cases of reflection/complaints, **Report sent to:** Local authority	**Implemented by:** In cases of reflection/complaints **Frequency of report submission:** In cases of reflection/complaints, **Report sent to:** PMU and other relevent agencies,	
	Operation stage (two first years of warranty)			
1	Ambient environmental quality monitoring		**Implemented by:** IEMC **Frequency of report submission:** Quarterly **Report sent to:** PMU	
2	Monitoring compliance with EMP and contractor clauses	**Implemented by:** Environmental Supervisor **Frequency of report submission:** every six months **Report sent to:** PMU		
3	Community-based monitoring	**Implemented by:** community authorities **Frequency of report submission:** every six months **Report sent to:** district authorities	**Implemented by:** district authorities **Frequency of report submission:** every six months **Report sent to:** DONRE	**Implemented by:** DONRE **Frequency of report submission:** annualy **Report sent to:** HCM

5.3. CAPACITY BUILDING AND TRAINING PROGRAM

Success of the EMP will heavily rely on implementing capacities, awareness of relevant actors, by providing capacity building and training programs could heip to enhance the skill, understanding of all involvement stakeholders such as: PMU's ECO, Contractor (***EO)***. Construction supervision consultant (ES) and IEMC. All relevant actors will be appropriately trained to understand their responsibilities, inplementing skills, and environmental awareness in all activities of the project.

Training documents will be available at sites for reference including: trainees, time frame, trainer, and training contents which aim at provising enough information for aditing, and inspecting.

The training program will be developed for relevant stakeholders as detailed below.

*- **GTP PMU** - Project Owner*

The EOC under PMU will be trained to improve their environmental qualifications and gain experience in the environmental sector. Depending on his/her skills and assignment, the EOC will be provide technical guidance and resources. The resources could be allocated from the overall environmental management of the project, or others. The detailed training contents are suggested as below:

- Environmental impact principals and relevant process.
- Environmental management principles
- Supervision, monitoring and recording skills.
- Environmental auditing.
- Social assessment and public consultation.
- Environmental management process in project implementation as well as its implementing methodologies (from bidding document preparation, bid evaluation, contract signing, monitoring implementation and acceptance works, etc,)
- Skill and knowledge in environmental management systems.
- Understanding of EMS roles.
- Understanding on relevant legal documents.
- Improving skills in proposing additional mitigation measure on sites when needed.

- Construction supervision consultant/environmental supervisor (ES) and independent environmental monitoring consultant (IEMC)

Environmental supervisors of CSC and IEMC also need to be trained to have enough capacity and skills in monitoring EMP compliances of relevant stakeholders. Training documents will be available at sites and include content for trainees, trainer, and information for auditing, and site inspection. The detailed training contents are suggested as below:

- Environmental impact principals and relevant process.
- Environmental management principles.
- Site inspecting and monitoring EMP compliance.
- Site monitoring process on SEMP implementation.
- Supervision, monitoring and recording skills.
- Urgent environmental accident responding skills.

- Technique skills on environmental monitoring sampling.
- Construction performance supervision on environmental aspects…

- Community based monitoring committee

- Training on community monitoring skills.
- Training on simple monitoring methods, tools which will be applied.
- Public awareness raising on EMP in general and potential environmental impacts.
- Information disclosures on project and impacts, the main contacts on EMP implementation system.

- Civil Contractors

Civil contractors will assign an SEO to manage environmental issues on the site. The SEO will be trained to fully understand all requirements in the EMP and its compliance requests. The training documents will be available at sites including content for trainees, trainer, and enough information for auditing, and inspecting. Detailed training content are suggested as below:

- Relevant legal environmental documents which focus on responsibilities of civil contractors, local authorities and community monitoring.
- Understanding of the EMP implementation process and requirements of WB safeguard policies (such as the involvement of the IEMC, and HSET implementation process).
- Understanding of environmental processes before and after construction activities started.

5.4. ENVIRONMENTAL MANAGEMENT BUDGET

5.4.1. Budget for implementing mitigation measures by contractors

Following regulations of Vietnamese laws, the Contractor must adhere to the following four HSET criteria: Health for Community (Health); Site Safety (Safety); Environmental Sanitation (Environment); and Transport Management (Transportation).

The cost for organization, training, dissemination, procurement, operation of equipment, and manpower for implementation of mitigation measures in and out of the site in accordance with HSET requirements are integrated in the construction package (regulated at item 3,1, article 3 clause 6 in circular: No. 04/2010/TT-BXD, dated 26/5/2010 of MOC). The Contractors will be responsible to study, prepare alternatives and offer cost estimation for these activities. It is considered as one of the criteria for assessing the capability of the Contractor in the future and compliance level of the Contractor.

5.4.2. Budget for supervising compliance of EMP by contractors

Monitoring or supervision of EMP implementation (monitoring of EMP compliance and mitigation measure implementation) of contractors will be carried out by ES. This budget will be included in civil work packages. Contractors will be responsible to study the environmental requirement in the approval EMP and EIA, prepare and offer cost estimation

for monitoring EMP compliance during the construction phase. It is considered as one of the criteria for assessing the capability of the ES in the future and compliance level of EMP implementation monitoring.

Table 5.5 Cost Estimate for EMP implementation monitoring (VN)

No,	Items	Unit	Volume	Rate	Cost
I	**Construction phase**				**137,600,000**
1	Environmental Supervisor (3 persons, in 24 months, mobilized 1 month in every three month)	month	2	31,500,000	63,000,000
2	Other cost				74,600,000
II	**Operation phase**				**68,800,000**
1	Environmental Supervisor (1 person, in 12 months, mobilized 2 months in every six)	month	1	31,500,000	31,500,000
2	Other costs				37,300,000
	Total				**377,800,000**

Note:

- *Other costs includes: reporting, travel, hotel, printing, and VAT.*
- *EMP compliance monitoring will be allocated from project budgets as regulated in item 3,5, article 3 clause 4 of Circular: 04/2010/TT-BXD, dated 26/5/2010 of MOC.*

5.4.3. Ambient environmental monitoring cost estimation (prepared by IEMC)

The GTP PMU will mobilize an independent environmental monitoring consultant to conduct ambient environmental quality monitoring for three phases of project implementation.

Based on the design of the ambient environmental quality monitoring program, the cost estimation for implementing is shown in the table below.

Table 5.6 Budget estimation for EoMP

Unit: VND

N,	Item	Construction phase (24 month)		Operation phase (12 months)		Total cost
		Location	Cost	Location	Cost	
1	Air	6	53,760,000	8	86,912,000	140,672,000
2	Noise	6	80,640,000	8	53,760,000	134,400,000
3	Vibration	6	75,600,000	8	50,400,000	126,000,000
4	Surface water	5	17,160,000			17,160,000
	Industrial wastewater quality			2	3,872,000	3,872,000
	Domestic wastewater quality			2	2,984,000	2,984,000
5	Others		325,492,227		208,691,085	534,183,312
	Total		**552,652,227**		**406,619,085**	**959,271,312**

Other cost includes: income advantage tax, and VAT……

5.4.4. Cost estimation for capacity building and training program

The budget for the capacity building and training program during project implementation are summarized in the table below.

Table 5.7 Breakdown of budget for capacity building and training program

No,	Trainee	Number of Trainee	Cost estimate	Cost allocated sources
1	ECO - (Under GTP PMU)	4 person x 4 times	4 x 4 time x 1,000,000VND /person = 16,000,000 VND	Project Owner (GTP PMU)
2	ES and IEMC	2 person x 4 times	2 x 4 times x 1,000,000VND / person = 8,000,000 VND	Project Owner (GTP PMU) Including in contact with ES and IEMC
3	Community-based monitoring committee	1 person/ ward x 26 ward x 4 times)	1 x 26 x 4 times x 1,000,000VND /person = 104,000,000 VND	Project Owner (GTP PMU) Including in contact with IEMC
	Total (1-3)		**= 128,000,000 VND**	
4	SEO of Contractors	5 person x 4 times	5 x 4 times x 1,000,000VND /person = 20,000,000 VND	Contractors Including in civil work package
	Total (1-4)		**= 148,000,000 VND**	

5.4.5. Total budget for EMP implementation

The total budget for EMP implementation is estimated in the table below, which does not include other costs stated in civil work packages and others.

Table 5.8 Total budget for EMP implementation

Unit: VND

No,	Items	Cost
1	Ambient environmental quality monitoring	377,800,000
2	EMP implementation compliance supervision	959,271,312
3	Capacity building and training program	116,000,000
	Total (1 – 3)	**1,453,071,312**
4	Contingency cost (10%)	145,307,131
	Total (1 – 4)	**1,598,378,444**
	Grand total (1 – 4) in USD	**75,006**

Note: Exchange rate on 12/9/2014 of Vietin bank: 1 USD = 21,230 VND

Total budget for the EMP implementation is **1,598,378,444 VND (75,006 USD)**

This budget is estimated based on current prices, thus it is strongly suggested that an amount for discount rate should be taken into account,

CHAPTER 6
PUBLIC CONSULTATION & ENVIRONMENTAL INFORMATION DISCLOSURE

The environmental impact assessment (EIA) regulation of Vietnam (in Circular No. 26/2011 of MONRE) and operational policy of World Bank (OP 4.01) requires that: the local people/authorities, non-organization(s) that are impacted by project activities need to be informed and consulted during EIA preparation. Public consultation and disclosure of environmental information were conducted by: i) organizing meetings and discussion with local organizations, local authorities and local people; ii) submission of project documents to People Committees of impacted communities for official comment; and iii) surveying households resident along the corridor to collect information.

6.1. PUBLIC ENVIRONMENTAL CONSULTATION AS REQUIRED BY THE WORLD BANK

The operational policies of The World Bank (WB) for Environmental Assessment (OP 4.01) requires that development projects funded by or borrowing IBRD funds need to conduct an environmental consultation during the EA process. The Project Owner has to consult affected groups about environmental aspects and take their views into account.

The public environmental consultation according to WB OP 4.01 was conducted for the HCMC Green Transport Development Project as follows.

6.1.1.Content, method and time

- *Purpose:*
  - to inform about project information.
  - to inform about potential environmental impacts to local communities as well as organizations.
  - to collect environmental information for the EIA report and project.
  - to identify potential environmental issues that could be impacted by project activities.
- *Method*:
  - meetings with relevant stakeholders.
- *Participants*:
  - representatives from local authorities, People Committees, communities, social organizations, etc.
  - people living along the project corridor.
- *Time*:
  - the public environmental consultation was held from 14/7/2014 – 27/09/2014, as listed in Table 6.1.

Table 6.1 Time table of environmental consultation for GTP as required by WB operational policy

Time	Place	No, of Participants	Notes
Monday 14/7/2014			

Afternoon	14 – 15:30 pm	Thu Thiem People Committee (PC), District 2 (D.2)	7	
Tuesday 15/7/2014				
Morning	9 – 10:30 am	Binh Khanh PC, D. 2	12	
Afternoon	14 – 15:00 pm	An Loi Dong PC, D.2	7	
	15:30 – 16:30 pm	Saigon Water Supply Company - SAWACO	6	
Wednesday 16/7/2014				
Morning	9 – 10:30 am	Nhiet Doi hospital	5	
Afternoon	15 – 16:30 pm	Ho Chi Minh City Urban drainage company - UDC	3	
Thursday 5 17/7/2014				
Morning	9 – 10:30 am	PC of D. 6	26	Communes of 7, 3, 1
Afternoon	14 – 15:30 pm	Ho Chi Minh City Traffic Police Department	11	
Friday 18/7/2014				
Morning	9:30 – 10:30 am	Vietnam Electric Company - EVN	10	
Afternoon	14 -15:00 pm	An Lac PC, Binh Tan District	28	
	15 – 16:30 pm	Meeting room - Commune 6, D.5	50	
Saturday 19/7/2014				
Morning	8 – 10 am	PC of D.8	32	Commune 7 & Commune 16,
Monday 21/7/2014				
Afternoon	14 – 15 pm	Tan Kien PC, Binh Chanh District	17	
Friday 15/8/2014				
Morning	8 – 9 am	PC of D.1	14	
Saturday 27/9/2014				
Morning	8:30 – 10:30 am	An Phu PC, D.2	20	An Phu & Binh Khanh communes
	Total		**258**	

6.1.2.Results

Details of the public environmental consultation are shown in Table 6.2, and summarized as follows.

Opinions from governmental organizations

All impacted local governmental organizations agreed with the objectives of projects, but reminded about environmental projections as well as traffic safety during the construction and operation phases of project.

Opinions from potential impacted citizens

Representatives from communities and community social organizations raised their concerns about existing environmental issues as well as potential impacts from project activities. There was high concern in accessing BRT bus stations that could cause traffic accidents to passengers and other vehicles, but communities were strong agreed on the benefits from the project.

Opinions of potential impacted organizations

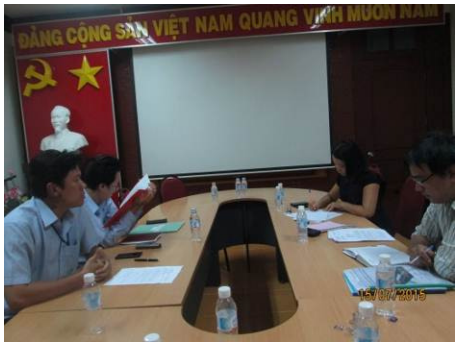
The activities of this project will impact on the operation of organizations, including traffic polices along the East–West corridor, electrical system (EVN – HCM), water supply network (SAWACO), and water drainage system (UDC). All consulted organizations agreed with project development and were willing to cooperate with the project related to infrastructure and traffic safety along the corridor.

Response and commitments of project representative to local communities and organizations

Project representatives explained objectives and components as well as advantages and disadvantages of project components to participants. Public opinion will be considered during the design phase. Finally, representatives of the project committed themselves to complying with environmental protection regulations to mitigate negative impacts and protect the environment during construction and operation of the project.

Table 6. 2 Results of public environmental consultation of GTP

Place Consulted organizations	Context	Public opinions	Feedbacks
Electrical company - EVN HCM 	EVN is responsible for the entire city's electricity including the East–West Boulevard. Electrical system on East–West Boulevard is responsibility of electrical departments from Binh Chanh to Thu Thiem, and is an underground system.	Electric infrastructure is underground so the excavation on the middle lanes needs considering impacts on this system; The electrical system at Thu Thiem tunnel is on walk side; Agree with this project & will cooperate with project if it is necessary; Project needs to consider records of East – West Project to understand all underground infrastructures on the corridor.	Project will refers records of East – West Project; and will send detailed designs to ENV for further recommendations.
Nhiet Doi Hospital 	Nhiet Doi Hospital is one of biggest and oldest hospitals in Ho Chi Minh City. It is located between D.1 & D.5 and responsible for infectious diseases and infection. This hospital has 900 employees working as three shifts. Hospital capacity is for treatment of 1200 – 1500 people per day with 550 inpatients per day.	Operation of the BRT will not affect to hospital ; Noise levels at gates of hospital are over the permision of technical regulation of Ministry of Health (MOH).	Will consider recommendations of the hospital.
Drainage company - UDC	Used to be Urban Lights Company (1980), respond for urban drainage systems in whole Ho Chi Minh City ;	Drainage systems in the project corridor are managed by UDC ; Willing to assist for any relocation activities of drainage (if any) .	Recommend UDC check and provide the further information on water drainage

Place Consulted organizations	Context	Public opinions	Feedbacks
	Relate to project corridor, UDC currently responds for operation of domestic wastewater treatment systems of 141,000 m^3/day, which is in Improvement of Water Environment Project.	If there are some drainage sections which need to be relocated , Flood Prevention Department will work with project in determining impacts and implementing relocation measures; ; If flood occurs during the construction phase, the temporary drains on the construction sites will be provided to connect to drainage systems.	systems could be impacted by the project; Project will contact to Department of Flood Prevention for further information .
Water supply company SAWACO 	SAWACO was found in 1880s and responsibility for urban water supply ; Currently SAWACO is multifunctional company with businesses related to water supply and water services; On the East – West corridor, the following companies are managed by seveal enterprise under SAWACO : Water transmission enterprise, Thu Duc water company; Ben Thanh Water supply company.	Location of the BRT Line 1 does not impact on main pipeline of water system, except at Cat Lai junction there is 2 water pipeline networks D1500 of Thu Duc Water company , and D800 of SAWACO. Construction of the project could corrupt, as broken pipelines or need to relocate; SAWACO will cooperate with PMU during the construction phase to manage undesirable impacts on water network; However, cost for relocation and repair are responsibility of the project; The relocation and repair methods will be proposed by SAWACO depending on particular situation	Project PMU will cooperate with SAWACO to ensure operation of water supply network in this corridor,

Place Consulted organizations	Context	Public opinions	Feedbacks
Traffic polices 	Traffic police office responds for all traffic safety in Ho Chi Minh City including the East – West corridor.	Need to consider the BRT lanes locations, especially in the middle lanes and its occupation areas on the existing road surface. The sections Ben Thanh – Thu Thiem tunnel has only 3 lanes in one direction thus the BRT it could result in significant traffic congestion; Additional, bus stations in middle of road could create high potential risk of traffic accidents, thus pedestrian flyovers need to be constructed at all stations to ensure safety for passengers; The low awareness of people could result in inefficiency of using pedestrian flyovers; Potential impacts of traffic congestion at intersections that use traffic priority lights Need to separate BRT lanes with others.	Will consider all suggestion during the project designs phase.
Public opinions (Representatives of local governments and communities)			
Thu Thiem Commune, District 2 	This commune is in District 2 and in planning to be part of new urban area. It is close to Saigon River in the west; Many planned areas are still not implemented and inhabitants located next to the river bank.	Project is located in the planned area thus will not create impacts on households ; Currently the project will not impact on local environment. Local people will get benefits from the project, however, there are several resettlement areas which are located far from project corridor (such as Thanh My is far 3,5 km to BRT Line), people of these areas will not get benefits from project if connection manner will not be provided .	

Place Consulted organizations	Context	Public opinions	Feedbacks
		Subsidies of ticket price for vulnerable people such as poor and students should be considered.	
An Loi Dong Commune, D,2	This commune is in District 2 and in planning to be part of new urban area. It is close to Saigon River in the south and in the east and located within under construction areas.	Project is located in the planned area thus will not create impacts on households ; Currently the project will not impact on local environment;	

Place Consulted organizations	Context	Public opinions	Feedbacks
Binh Khanh Commune, D,2 	Binh Khanh commune is located in District 2, and close to An Loi Dong commune. . It is rapidly development area and no households is living in both sides of Mai Chi Tho Boulevard.	Project will not create impacts on historical and cultural values. The t benefits from the project could maximized since these area become more crowded in the future; The distance from Commune PC to Mai Chi Tho is lower than 1 km, so people in the commune could get a lot of benefits from the project; Government and communities agree with and support for project development, however, the project need to ensure management of environmental issues especially solid waste management at bus stations to control impacts on; Ca Tre Lon and Ca Tre Nho canals; The project need to ensure the social safety which could be raised for drivers, employees at bus station and street vendors during the operation phase; Increase connection with other streets.	

Place Consulted organizations	Context	Public opinions	Feedbacks
District 1	Is is Centre business district of Ho Chi Minh City with a long history of development and high traffic density.	The BRT will not create potential impacts on land acquisition in this district area The construction activities could impact on local businesses, environment and traffic accident, such as construction of pedestrian flyovers and stop stations; The attention need to be paid for the location of stop stations which is located on the middle lane; The ticket price need to be considered to attract more passenger, and the awareness of people should also be improved.	Basic design of the project will not lead to land acquisition, the connection to Ben Thanh will be consider for longtime plan; Environmental and safety issues will be considered during the construction and operation.
PC of District 6 	District 6 is located in the West South of the city and close to District 11,Tan Binh District and Lo Gom canal; close to District 5; to District 8 in Vo Van Kiet Boulevard and Ben Nghe canal; and close to Binh Tan District; There are many historical and cultural values in district center; The district develops commercial, service and industrial economies.	The ticket price and connection need to be considered to attract more passenger ; All construction activities need to be Implemented as scheduled to mitigate impacts on local residents; Traffic congestion happen on the motorcycle lane in Vo Van Kiet Boulevard , the construction need to considered to minimize the impacts ; Construction of pedestrian flyovers could impact on local households.	Explained the design of the project and the BRT route as well as the implementing schedule; The project will consider public suggestion into design, construction and operation of the project,

Place Consulted organizations	Context	Public opinions	Feedbacks
PC of District 8 	District 8 is isolated with City center. It is close to District 5 and District 6 in the north by Tau Hu and Ruot Ngua canals; close to District 4 and District 7 in the east; and close to Binh Chanh District in the south-west; This district characterizes with complex surface water network, that affected by tide; This district develops commercial, service and agricultural economies,	Location of bus stations in the middle lanes of road need to consider about parking areas for passengers; it could create the traffic congestion; Ensure safety and security at bus stations are important because it could be potential place for homeless, unemployed that could resulted in many environmental issues; The project will not impact on residential areas of District 8. However potential pollutions caused by the project could impact on water environment as well as social impacts because of social evils concentrated at bus stations; There is Police station of District 8 could support in managing social security; Consideration of efficiency of the BRT line due to existing Bus route 39 is ineffectiveness; Consider location of bus stop stations because road narrow on the corridor; Intersections An Duong Vuong and Ho Ngoc Lam usually have accidents and flash floods caused by high tide; Current pedestrian flyovers are not effective because awareness of people;	

Place Consulted organizations	Context	Public opinions	Feedbacks
PC of District 5 	District 5 is an central district of Ho Chi Minh City with a long historical development; The area has several main t roads such as North – South and East – West corridors. The District is crowded areas and develops commercial and service economies.	The project should consider elevation of Nguyen Tri Phuong bridge ; The road section, which is crossing Commune 10, is very narrow, thus construction of pedestrian flyovers is a challenge and could impact on local households; The project need to consider to public environment and security at bus stop stations; The project need to consider bus station designs and awareness of bus drivers; Impacts of social evils at bus stations along the corridor also need to be carefully considered; The section in Cha Va bridge and Nguyen Tri Phuong bridge has high noise level and also high risk of accidents, which need to take into account during the construction phase.	The project will consider accessibility of pedestrian flyovers at bus stations; Project will not acquire land in this area; Social security and safety at bus stations as well as training BRT employees will be considered in the project development.
PC of Tan Kien Commune, Binh Chanh District	The commune has important location of transportation that is intersection of National highway 1A and starting of East –West Boulevard as well as New Mien Tay terminal; The area is high transport density of .	Should consider distance from bus stations that allow people easy connect to; and easy to interchange with other route at intersections; Should consider effectiveness that is lacking in existing bus route 39; Intersection areas of National highway and Vo Van Kiet Boulevard has weak geology and vibrated with high density of traffic; Construction of project could impacts on	Consider public opinions and transfer to related sections; Commit to comply environmental regulations and measures to mitigate negative impacts to local communities;

Place Consulted organizations	Context	Public opinions	Feedbacks
		residential infrastructures.	
PC of An Lac Commune, Binh Tan District	An Lac intersection is very important in transportation currently; it is intersection of National highway 1A & Kinh Duong Vuong street that toward current Mien Tay Terminal; High density of transportation; The areas in this commune that Vo Van Kiet corridor passing through is in development and planned for residential purposes.	Should consider operational speed, ticket price as well as efficiency of BRT; Vo Van Kiet Boulevard passing An Lac commune usually flooded with heavy rain and require appropriate measures; Pedestrian flyovers for all will be better alternative to avoid traffic accident.	Will consider opinions in project;
PC of An Phu Commune 	An Phu and Binh Khanh Communes will be impacted that caused by land acquisition for Thu Thiem Technical Facility; High density of transportation & planned to be new urban area of Thu Thiem in future.	The surrounding areas of project are in development with many other construction sites that could generate cumulative impacts on environment and society; Several areas are flooded during heavy rain or high tide that could impact on accessibility to BRT services; Employees of project during construction phase have to be informed to local authorities for management social impacts; Should use local workforce for project; Investor should responsible for and degradations of infrastructures caused by project.	Will comply environmental regulations as well as regulations in managing employees;

6.2. PUBLIC ENVIRONMENTAL CONSULTATION ACCORDING TO ENVIRONMENTAL REQUIREMENTS OF VIETNAM GOVERNMENT

6.2.1. Environmental consultation by project documents

The requirements of environmental consultation during EIA implementation of a new development project are stated in Decree No. 29/2011 of Government and Circular No. 26/2011 of DONRE. The project owner is required to consult affected local governments (at commune level) and affected communities in the project areas.

The environmental consultation according to Vietnam environmental regulations was conducted as follows.

6.2.1.1. Content, method and time

a. *Objectives*

Officials to inform affected stakeholders about assessed environmental impacts and environmental management and monitoring programs. This also requires official recommendations and/or feedback from local authorities about environmental impacts caused by the project and proposed mitigation measures.

a. *Participants and method*

Urban-Civil Works Construction Investment Management Authority of Ho Chi Minh City (UCCI) submitted document No. 2091/BQLGTĐT-GTX comprising the EIA project and summary reports to affected communes, and requested relevant communes to give their official response to environmental impacts caused by this project.

b. *Time:*

The EIA summary report was sent to relevant communes between 9/10/2014 and 13/10/2014 and received feedback up to 31/10/2014.

6.3.2. Results

Results of the second public environmental consultation are shown in Table 6.4 and in the Appendix. In general, all communes agreed with development of the project and contribute to mitigate environmental impacts on their own boundaries as well as for whole corridor also.

Table 6.3 Results of environmental consultation as required by the Vietnam government

No,	Commune	Public opinion		
		About environmental impacts	About mitigation measures	Recommendations
1	**District 2**			
	Binh Khanh	Agreed with environmental impacts & mitigation measures proposed by the EIA report. However, the project should consider solutions to eliminate impacts of air pollution and noise during the construction phase, especially from activities of material transportation and storage, as well as gases from using machinery. The impact of land erosion should also be considered given the area's higher elevation. The project should inform local authorities with information related to workers who are working in the construction phase as required for management. The project should also cooperate with local authorities in responding to emergencies.		
	Thu Thiem	Agreed with proposed assessments and mitigations caused by project.		Project Owner needs to consider affected

				communities as well as monitor compliance with environmental regulations.
	An Loi Dong	Construction of project will pollute local environment (including wastewater, air pollutants and dust). Mai Chi Tho Boulevard will be narrowed causing congestion, accidents and social disturbance.	Should reduce waste generation during the construction phase, and use good vehicles to reduce noise and pollutant emissions. Should ensure environment and hygiene.	Project should be completed as soon as possible given its positive objectives, as well as meeting travel demands of local citizens.
	An Phu	Location of project is partly in an existing residential area, with many high rise buildings. Transporting of materials and wastes could affect daily activities of local residents.	The BRT station should locate garbage containers and should be roof-covered to ensure environment and safety for passengers.	The project owner should prepare for emergencies to ensure immediate response.
2	**District 1**			
	Nguyen Thai Binh	- Need to comply with environmental law in all phases of the project to mitigate negative impacts. - Manage environmental issues, especially at residential areas. - Ensure traffic safety and social security in project areas. - Need to consider effectiveness and need to cooperate with agencies in monitoring compliance and response to emergencies.		
	Cau Ong Lanh			
	Co Giang	Agreed with EIA.	Agreed with EIA, but project should focus more on control of air pollution during construction phase.	Should ensure social safeguards.
	Cau Kho	The project could impact on local citizens mentally as well as environmentally.	Should mitigate impacts of traffic congestion and air pollution caused by project activities.	Should minimize impacts on daily activities of local residents. Regularly monitor negative impacts on environment.
3	**District 5**			
	Commune 1			
	Commune 5	Agreed with impact assessments and mitigation measures.		Could not discharge wastewater directly to Tau Hu canal
	Commune 6			
	Commune 10	Agree with assessments and proposed mitigation measures of project		Should cooperate with local government in managing environmental issues.
	Commune 13			
4	**District 6**			
	Commune 1	Agree with EIA	Should comply with all mitigations proposed in EIA.	
	Commune 3			
	Commune 7	Agreed with impact assessments and mitigation measures presented by project's owner.		
	Commune 10	Agreed with impact assessments and mitigation measures presented by project's		

		owner.	
5	**District** 8		
	Commune 16		
6	**Binh Tan District**		
	An Lac	Agreed with proposals of project EIA.	Should consult more with DONRE of District.
7	**Binh Chanh District**		
	Tan Kien	Agreed with impacts and mitigation measures of project.	

6.2.2.Results of household survey

The Project Owner conducted a survey of households living along the project corridor. The survey interviewed households in District 1, 2, 5, 6, 8, Binh Tan and Binh Chanh.

The objective of this survey was to inform communities about project development and consult on environmental aspects that need to be considered and supplemented in the EIA report, as well as collect recommendations from affected households.

According to the results, almost all respondents agreed with project development, and other results can be summarized as follows:

- A high proportion of respondents already knew about project development (86.2%) from various information sources such as public media and local government. Some 74.1% of respondents agreed with project development and there was not any objection.
- Many ideas concerned about environmental and safety impacts, in which they recommended that communities be widely informed about project construction.
- The project owner and contractors should implement measures to ensure traffic safety as well as reduce occurrence of traffic congestion.
- Ensure public environment and hygiene at construction sites to eliminate and reduce spreading of disease.
- Ensure timely implementation of project schedule to reduce environmental impacts to communities.
- Ensure environmental qality at public space during the operational phase of project;
- Cooperate with local governments to ensure security at public spaces.

Table 6.4 Summary of survey results

No.	**Concerns**	**Environmental issues**	**Feedback**	
			Amount	**Percentage (%)**
1	Existing environmental pollution	Pollution	10	17.2
		Flood	5	8.6
		Dust & noise	39	67.2
		Others	13	22.4
2	Already informed about GTP	Yes	50	86.2

No.	Concerns	Environmental issues	Feedback	
			Amount	Percentage (%)
		No	8	13.8
3	Source of information	Public media	16	27.6
		Local government	6	10.3
		Others	28	48.3
4	Comments on project development	Agree	43	74.1
		Disagree	15	25.9
		No comment	0	0.0
5	Environmental issues caused by project	Air pollution	5	8.6
		Flood	2	3.4
		Noise & vibration	8	13.8
		Traffic safety	17	29.3
		Traffic congestion	23	39.7
		Water pollution	1	1.7

6.3. ENVIRONMENTAL INFORMATION DISCLOSURE

UCCI submitted letter No. 2235/BQLGTĐT-GTX, issued on 22/10/2014, enclosing two other project documents including the Report of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP). These documents contain information regarding potential environmental impacts caused by the project and an action plan to mitigate impacts, as disclosed to affected communes, districts and related organizations.

The project environmental information disclosure to local people, authorities and other relevant organizations was implemented from 23/10/2014 to 27/10/2014.
The Environmental Management Plan (EMP) was disclosed at the Vietnam Development Information Center at 63 Ly Thai To Street, Ha Noi on 22nd October, 2014. The official document of the EMP will be published on the WB website and other sites after approval by a Committee of the WB.

Table 6.5 Summary of publishing environmental information of GTP

No,	Organizations		Time of publishing
A	**7 Districts**		
1	PC of District 1		24/10/2014
2	PC of District 2		24/10/2014
3	PC of District 5		24/10/2014
4	PC of District 6		27/10/2014
5	PC of District 8		27/10/2014
6	PC of Binh Tan District		27/10/2014
7	PC of Binh Chanh District		27/10/2014
B	**20 Communes**		
1	Cau Kho	District 1	24/10/2014
2	Cau Ong Lanh		27/10/2014

No,	Organizations		Time of publishing
3	Co Giang		24/10/2014
4	Nguyen Thai Binh		27/10/2014
5	An Loi Dong	District 2	27/10/2014
6	An Phu		24/10/2014
7	Binh Khanh		27/10/2014
8	Thu Thiem		27/10/2014
9	Commune 1	District 5	24/10/2014
10	Commune 5		24/10/2014
11	Commune 6		24/10/2014
12	Commune 10		27/10/2014
13	Commune 13		27/10/2014
14	Commune 1	District 6	24/10/2014
15	Commune 3		27/10/2014
16	Commune 7		27/10/2014
17	Commune 10		27/10/2014
18	Commune 16	District 8	27/10/2014
19	An Lac	Binh Tan District	27/10/2014
20	Tan Kien	Binh Chanh District	27/10/2014
C	**11 Governmental Organization**		
1	Transportation Department		23/10/2014
2	Planning Department		23/10/2014
3	Planning and Investment Department		23/10/2014
4	Construction Department		23/10/2014
5	Office of Transportation Police of HCMC		23/10/2014
6	Office of Environmental Criminal Prevention Police – PC49 - HCMC		23/10/2014
	Center of Operation and management public transportation		23/10/2014
	Center of management of Sai Gon tunnel		27/10/2014
9	Saigon Bus Company		27/10/2014
10	Petrogas South		24/10/2014
11	HCMC DONRE		23/10/2014

6.4. OPINION AND FEEDBACK FROM PROJECT OWNER

To ensure protection of environmental qualities related to land, air and water, the UCCI will require that the Contractor comply with Environmental Protection Laws as well as national

and local technical regulations on environmental quality; UCCI will monitor these activities. The Urban-Civil Works Construction Investment Management Authority of Ho Chi Minh City (UCCI) commits that all proposed mitigation measures, as mentioned in Chapter 4 of this report, will be complied with.

The UCCI consulted with affected communes about environmental impacts as well as proposed mitigation measures of this project. Feedback from local governments is highly consistent with project development, with the recommendation that the project should be implemented on time. Public opinions were considered and updated in the EIA report (Chapters 3, 4 and 6).

The Urban-Civil Works Construction Investment Management Authority of Ho Chi Minh City (UCCI) commits that the project will implement mitigation measures to ensure environmental quality as follows:

- *Environmental hygiene and public health* - UCCI commits that the project will comply with proposed mitigation measures in this EIA report, and cooperate with local authorities to inform them about activities, environmental impacts and mitigation measures of this project relevant to communities.
- *Traffic safety and occupational safety* - UCCI commits that these issues will be added to construction contracts, and strictly implement appropriate traffic management during the construction phase to reduce traffic congestion.
- *Social security* - UCCI will consider all recommendations and add to contracts signed with contractors requiring registration of employees at local authorities, and cooperate with local authorities in managing social issues with specific mitigation measures as stated in Chapter 4.
- *Reinstate damaged road* - UCCI commits that any damaged road caused by project activities will be compensated for.

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

The Ho Chi Minh City Green Transport Development Project will be invested with the Project Development Objective (PDO) to increase accessibility to job opportunities and urban services for citizens residing in the southwestern side of the city and other adjacent areas to the project corridor, by providing an alternative that is safer, more secure, more efficient, integrated with land development along the corridor and integrated with the proposed metro lines, and generates fewer emissions. The project includes two components: i) Component 1 - Development BRT along Vo Van Kiet – Mai Chi Tho corridor; and ii) Component 2 - Institutional Strengthening.

The environmental impact assessment of the project only focuses on the implementation of Component 1 - Development BRT along Vo Van Kiet – Mai Chi Tho corridor. The EIA report has been prepared based on the WB's safeguard policies and Vietnamese relevant regulations. Impacts of the project were considered for all three phases of project implementation (pre-construction, construction and operational phases) with the aim of minimizing negative impacts on the environment and maximizing social and environmental benefits.

Negative impacts of the project can be summarized as below:

- Given most investment items of the project will be located along the existing West – East Corridor, impacts of land acquisition, resettlement, and relocation during the pre-construction phase will be insignificant.
- During the construction stage, almost all construction items will be small-scale and separated, and negative impacts could be considered as not quite significant and controllable. Main impacts are dust generation, wastewater from construction sites, solid waste generation, traffic congestion and safety.
- During the operation stage, the project has been assessed as bringing big positive benefits such as public service improvement, urban air quality improvement, and GHG emission reduction, however, high risk of fire and explosion of CNG equipment, safety for passengers and drivers, sanitation in public areas were also identified.

Based on the main findings from impact identification and assessment, mitigation measures have been proposed to manage negative impacts, including:

- During the pre-construction phase, mitigation measure focus on compliance with approved RPF and RAP, consideration of appropriate technical specifications during design phases, and preparation of EMPs for construction and operation phases.
- During the operation phase, mitigation measure focus on controlling dust generation and release, solid waste management, waste water management, traffic safety, and occupational safety for workers, and social disturbance management.

- During the operation phase, mitigation measures focus on inspection and verification of CNG relative equipment, solid waste management, sanitation at public areas, and social safety.

RECOMMENDATIONS

The EIA and EMP report were prepared and are appropriate for all project items. However, to appropriately implement proposed mitigation measures, collaboration among all relevant stakeholders is needed. Environmental considerations have to take place in all stages of project implementation, from bidding document preparation, bid evaluation, and to environmental clauses included in civil work contracts, to ensure that adequate resources for implementing all environmental requirements shall be allocated. Moreover, all relevant periodic monitoring reports shall also be prepared.

Collaboration among relevant local authorities such as HCMC DONRE, People's Committee of all Districts and Communes within the project area also place much importance on monitoring the efficiency of all proposed mitigation measures at all sites and report any emerging environmental issues for further management.

COMMITMENT OF PROJECT OWNER

The Urban-Civil Works Construction Investment Management Authority of Ho Chi Minh City (UCCI) commits that the project will comply with all proposed mitigation measures as stated in the EIA and EMP reports which were approved by HCMC DONRE and No Objected by the WB, as follows:

a. The UCCI shall implement and supervise strictly all mitigation measures and pollution control plans as proposed according to the Vietnam Law on Environmental Protection and WB's Safeguard Policies.
b. Implement all noise and vibration management measures.
c. Implement all mitigation measures to ensure safety of workers during the project implementation phase.
d. Collaborate with local authorities and traffic police to moderate traffic flow, control traffic accidents, and manage security in project areas.
e. Implement fire and explosive prevention measures.
f. Implement resettlement policies (collaborate with District No 2 PC).
g. Comply with all environmental regulations, educate and raise awareness of staff regarding environmental protection.
h. The UCCI commits that it will address any complaints from communities regarding project-related environmental issues according complaints, denounces and compensation which regulated on Chapter XIV of Vietnam Law on Environmental Protection 2005.
i. The UCCI commits that it will comply with all relevant national technical standards as follows -
    - QCVN 05:2013/BTNMT National technical regulation for ambient air quality.

- QCVN 06:2009/BTNMT - National technical regulation for hazardous substance on ambient air quality.
- QCVN 26:2010/BTNMT: National technical regulation on noise.
- QCVN 27:2010/BTNMT: National technical regulation on vibration.
- QCVN 08:2008/BTNMT - National technical regulation on surface water quality.
- QCVN 14:2008/BTNMT - National technical regulation on domestic wastewater quality.
- QCVN 40:2011/BTNMT - National technical regulation on industrial wastewater quality.

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