CAN THO URBAN DEVELOPMENT AND RESILIENCE PROJECT

SFG1540 V1

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

November/2015

PEOPLE COMMITTEE OF CAN THO CITY

ODA PROJECT MANAGEMENT UNIT, CAN THO CITY

CAN THO URBAN DEVELOPMENT AND RESILIENCE PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

PROJECT OWNER
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CONSULTANT
JOINT VENTURE OF IAC VIETNAM AND SINH THAI CICE

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ABBREVIATIONS

Ahs	Affected Households
CC	Climate change
AC	Asphalt concrete
CeC	Cement concrete
CMC	Construction monitoring consultant
CTUDR	Can Tho Urban Development and Resilience Enhancement Project
DED	Detailed engineering design
DOC	Department of Construction
DOF	Department of Finance
DONRE	Department of Natural Resources and Environment
DOT	Department of Transport
DPI	Department of Planning and Investment
MKD	Mekong detal
EIA	Environmental impact assessment
ESIA	Environment and Social Impact Assessment
ECOP	Environmental Code of Practice
EMC	External Monitoring Consultant
EMP	Environmental Management Plan
EMS	Environmental monitoring system
FS	Feasibility study
LIA	Low-income area
MOC	Ministry of Construction
MUDP	Management of Urban Development under Urban Development Agency
NUUP	National urban upgrading program
ODA	Official Development Assistance
PPMU	Project Management Unit
PPU	Project Preparation Unit
PSC	Project Steering Committee
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
RP	Resettlement Plan
P/CPC	Provincial/City People’s Committee
UDA	Urban Development Agency
URENCO	Urban Environment Company
WB	World Bank

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EXECUTIVE SUMMARY

I. INTRODUCTION AND PROJECT DESCRIPTION

1.1. Background

Vietnam is among the countries most seriously affected by climate change and sea level rise. Can Tho city in particular, and the Mekong Delta region in general, are forecastto be most affected by the negative impacts of climate change. According to the Mekong Delta Plan – Long-term vision (Netherlands – Vietnam in November 2013), sea level in the Delta will rise from 57 to 73cm (average scenario) and from 78 to 95cm (high scenario) by 2100.

The proposed Can Tho Urban Development and Resilience Enhancement Project (CTURP) will enhance climate change resilience and promote sustainable city development for Can Tho city through: (i) both physical and non-structural investments for flood risk management; (ii) investments in ensuring safety and accessibility, and provision of public transport activities through an integrated corridor management approach; and (iii) enhancement of financial management capacity and integrating transport with land use.

A full Environmental and Social Impact Assessment (ESIA) report, a detailed resettlement and compensation plan report, and a development plan report for ethnic minorities have been prepared to ensure the project will be implemented in accordance with the requirements of the World Bank (WB) and applicable national legislation and regulations of Vietnam. The Environmental and Social Impact Assessment provides an overview of the environmental and social baseline conditions on the direct impacted areas, summarizes the potential impacts associated with the proposed project and includes an Environmental and Social Management Plan (ESMP) which sets out the management measures required to mitigate any potential impacts. The ESMP is to be utilized by the contractor to be commissioned by ODA PROJECT MANAGEMENT UNIT, CANTHO CITY and will form the basis of site-specific management plans that will be prepared by the contractor and sub-contractors as part of their construction methodology prior to works commencing. These ESMPs will be approved and disclosed by the World Bank and the relevant Vietnamese authorities prior to the start of civil works.

1.2. Basis of Law, Legislation and Regulation

The project is required to comply with the prevailing environmental laws in Vietnam, which include the Law on environmental protection Law on Environmental Protection No. 55/2014/QH13 passed by the National Assembly on 23 June 2014 and took effect since 01 January 2015; , Decrees, Circulars, Decisions, standards and regulations of Vietnam on Environment; Circular No. 27/2015/TT-BTNMT of 29 May 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plans and guidelines for prepare World Bank environmental and social policies as summarized in Table 1 below.

Environmental assessment OP/BP 4.01

Physical Cultural Resources (BP/OP 4.11)

Involuntary Ressetlment (OP/BP 4.12)

Indigenous Peoples (OP/BP 4.10)

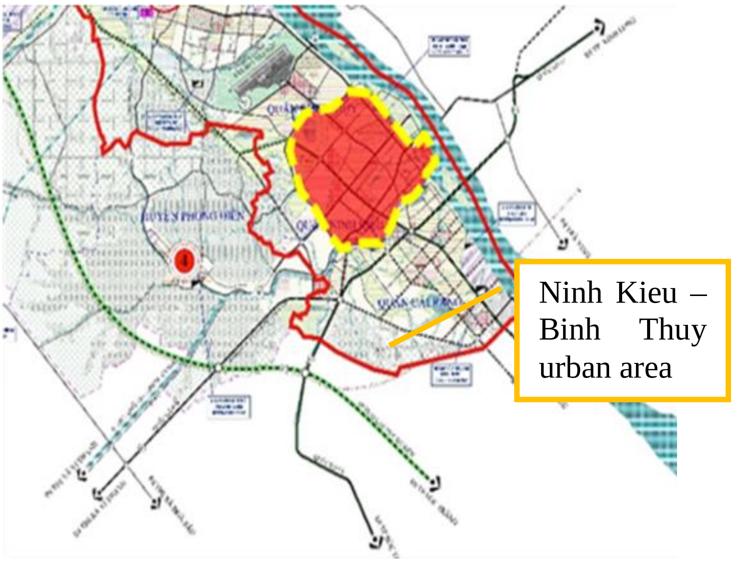
Natural Habitats (OP/ BP 4.04)

Projects on International Waterways (OP/BP 7.50)

The ESIA will also apply WBG Environmental, Health, and Safety Guidelines known as the "EHS Guidelines". The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).

1.3. Project Description

The Project will be located in 20 wards in four inner districts -Ninh Kieu, Cai Rang, O Mon and Binh Thuy- in Can Tho city.



Critical flood control and urban development works will take place in the Ninh Kieu – Binh Thuy traditional urban area, located in center of Can Tho city, adjacent to intersection of Hau river and Can Tho, and bordering Can Tho airport to the North.

The proposed Project components and main investment items are described in tables 1 and 2 below:

Table 1: Components of the CTUDR

Components	**Activities**	**Investment cost (US.$ million)**
Component 1	Flood control and environmental sanitation - Sub-component 1.1: Flood control system - Subcomponent 1.2: Environmental sanitation	131.74
Component 2	Urban corridor development	97.74
Component 3	Strengthening urban management for climate change resilience	14.14

Table 2: The main investment items of the project

No.	Item	Detailed description
1	Component 1	Component 1: Flood control and environmental sanitation with the total investment is USD 131.74 million. This component will support Can Tho city to implement the structure and non-structure measures to control flood and ensure environmental sanitation for the core urban area.
1.1	Proposed flood control systems	
	1. Can Tho river embankment (section from Ngo Duc Ke to Cai Son ditch)	Embankment at the right bank within Ninh Kieu district with the length of 5.5km, and height from 2.8- 3m. Type of embankment: gravity concrete embankment wall + reinforcing embankment roof by pre-cast concrete
	2. Construction road and park behind embankment	- Building green park, square, art lighting system. Arranging tourism areas interlaced on embankment, such as tourism area - food court - local trading center - recreation area - festival area. - Building road behine embankment with roadbase section of 23m throughout the route with road pavement of 15m and 6m sidewalk near households. Sidewalk in the side of embankment will

No.	Item	Detailed description
		combine with green park behind embankment in minimum of 2m width + The start point of route Km0+00 at interchange between Ngo Duc Ke road and Hai Ba Trung road (in the area of the Guest House No.2) of Ninh Kieu District, Can Tho City. The ending point: Km 5 + 604.68 at interchange between the motorway after the park of river embankment under studying and the planned Hau Giang road (now local road) in Ninh Kieu District, Can Tho City. + Alignment: The road is upgraded based on the existing and newly-built routes in the region with the width of 4-6m, including Hai Ba Trung, Nguyen Thi Minh Khai, Tam Vu and local earth roads. Pavements of road have been degraded and most of road has no infrastructure in two sides.
	3. Develop sluice gates and shiplocks for core urban area	a) Cai Khe sluice gates: Cai Khe sluice gates is located in Cai Khe ditch between Ninh Kieu bridge and pedestrian bridge. Culvert width of B=40m (nozzle of 2x20m). Width of dock of B=10.5m (classified according to grade of waterway). b) Dau Sau sluice gates: Located in Dau Sau ditch, 200m far away Dau Sau ditch to the side of Can Tho river. Culvert width of B=20m (one nozzle of 20m). Width of dock of B=10.5m (classified according to grade of waterway). c) Ship locks on flood control corridor: Building uncomplicated, no need electricity, control water level at a certain elevation. Width of valve gate varies from 5 to 20m.
	4. Improvement of watercourses in the central area, dredging, upgrading protective embankments, roads, relocation of encroached canals	a) Cai Son ditch anti-landslide embankment: Located in Cai Son ditch to Ninh Kieu district side; Length of L=1,6km and 2,1km: Elevation of embankment coping: suitable with flood control and higher than highest water level, with P=1%. Type of embankment: Gravity concrete embankment wall + reinforcing embankment roof by precast concrete Auxiliary works include protective handrail and road behind embankment: - Section 1 from 923 to Cai Son bridge (Nguyen Van Cu): road pavement of 4m built by cement concrete M300. - Section 2 from Cai Son bridge to road CMT8: Road pavement of 7m built by asphalt concrete.
	5. Renovation of canals/ditchs in the core urban area	- 13 canals will be improved which include: Đầu Sấu canal, Ngã Bát canal, Mương Củi canal, Xẻo Nhum canal, Mương Lộ canal, Hàng Bàng canal, Tư Hổ canal, Sao canal, Bà Bộ canal, Lễ canal, Xẻo Lá canal, Ngỗng canal, Ông Tà canal. - Soft embankment: Reinforce foundation by cajeput pile with a density of 16 piles / m2, each pile is driven 4m deeply. The top of pile is concreted with pillar of 0.8x0.4m. From reinforcement of +1.00 and up, retaining current reinforcement and supplement some green trees to create surrounding landscaping and trees to keep soil and embankment.

No.	Item	Detailed description
	6. Develop regulatory lake, water in urban core areas	a) *Regulation Lake of University Campus:* locates at Long Tuyen ward, Binh Thuy district, expansition of existing canal and ditch for building ecological lake, planting trees at the center of the university. Dredging lake with an area of 10.57 ha. Dredged depth from 2 m; total volume of 256,000 m^3 dredged materials; Soft embankment; Water surface area: 51.931 m; Green and landscape area: 37,771 m^2, area of playground and walkway: 8167 m^2; Area of service land: 4.261 m^2, providing road protected embankment with width of 2.0 m. Waste water collection system to be invested with University Campus planning. The land area for renovating ecological lake, planting trees: 223.412m^2 *b) Long Hoa regulation reservoir:* Locates at Long Hoa ward, Binh Thuy district. The land for building ecological lake, trees plating by expanding existing canals, ditches such as Muong Khai ditch, Cai Son ditch, Hang Bang ditch, Pho Tho ditch and Nuoc Lanh ditch, etc. Dredging lake with an area of 17.53 ha. Dredged depth from 2 m; total sludge volume of 93,000 m3 of dredged materials. Soft embankment; water surface area: 67,774 m^2; Green and landscape area: 142,049 m^2; Area of playground and walkway: 13,589 m^2; construction of providing road protected embankment with width of 2.0 m. The land area for renovating canals, ditches for building ecological lake, planting trees: 102,130m^2. - Waste water collection system to be invested with Xuan Lan resident area in the future
1.2.	Environmental sanitation improvement works:	
	1. Improving drainage system for routes in the center of Ninh Kieu district;	a) Improving Hoang Quoc Viet road infrastructure The road has starting point at the provincial road 923 passing through the intersection with Nguyen Van Cu road and ends at Nguyen Van Linh road with a total length of 3.3km. Currently, the road width is small (4m) by asphalted macadam road and has no technical infrastructure, b) Renovating drainage system in the center of Ninh Kieu district: Minimum culvert diameter is 300mm for wastewater culvert and 400m for stormwater culvert.
	2. Equipement	Equipment attached to buildings and equipment to support the management and operation of regulatory monitoring drainage system, dredging of drains, canals, pumping stations, reservoir, and damper.
2	Component 2	Urban corridor development to connect backbones of the town, promote connectivity among new and existing residential areas in the city center, enhance connectivity among inter-regional urbans and public transport options of Can Tho city. The total investment is USD 97.74 million.

No.	Item	Detailed description
2.1	Quang Trung bridge (modul 2):	Construction of Quang Trung bridge with total length of bridge and connecting road is by 689m., bridge with length of 481m, width B = 11m. Renovation of existing bridge: To ensure aeration and increase aesthetics for the works, excavating soil at section of high backfilling, install additional access spans similar to Structure alternative 2 and expanding 3 spans of 3x33m to the side of Cai Rang and 2 spans of 2x33mm to the side of Ninh Kieu.
2.2	Road and bridge of Tran Hoang Na	Length of total line is about 3,794km in which Section from Nguyen Van Cu to residential area 91B: road base of 20m (carriage way of 2x3,5m= 7m, combine vehicle way = 2x2,5m= 5m, sidewalk in two side: 2x4m= 8m) Section from residential area to NH 1A: Roade base of 28m (carriage way of 2x2x3,5m= 14m, combined vehicle way of 2x1x2,25= 4,5m, median strip of 1x0,5m= 0,5m, safety lane of 2x1x0,5m= 1m, sidewalk of 2x4m= 8m). There are 2 bridges: Dau Sau 1 and Dau Sau 2 on the route: Dau Sau 1: 24,53+24,54+24,537, L= 74,613m, scale of 15,6m (carriage way of 2x6m= 12m, sidewalk of 2x1,5m, handrail of 2x0,3m = 0,6) Dau Sau 2: 1x24,54m, length of L= 25,44m, scale of 15,6m (carriage way of 2x6m= 12m, sidewalk of 2x1,5m, handrail of 2x0,3m = 0,6) Tran Hoang Na Bridge with total length of bridge, L = 576,56m (to edge behine abutment wall). Main span is structured with arch for vehicles running below: Span diagram: 39,1m + 4x40m + 39,1m + 99m + 39,1m + 4x40m + 39,1m Bridge surface: 23m (carriage way of 2x2x3,5m= 14m, combined vehicle way of 2x1x2,25m= 4,5m, median strip of 1x0,5= 0,5m, safety lane of 2x1x0,5m = 1m, pedestrian way handrail 2x1,5m = 3m)
2.3	Building the road connecting the August revolution road to provincial road 918	The starting point begins at the August Revolution road intersecting with Alley 91 and ends at the provincial road 918 near Can Tho prison with total length of about 5km
2.4.	Building residential areas for resettlement	Building the resettlement site in Ninh Kieu district with an area of about 40ha is suitable with the planning with technical and social infrastructure as stipulated to ensure living conditions for local people.

No.	Item	Detailed description
2.5	Equipment	Equipment attached to the works and serving for the management and operation includes: (a) establishment of GIS center; (b) equipment for the street and bus stop.
3	Component 3	Strengthening urban management for climate change resilience with the objectives of (1) Management for risks of natural disaters and climate change resilience; (2) Management of transportation and urban development; (3) Financial plan of the city and (4) Application of information technology in urban administration management The total investment is USD 14.14million.

2. BASELINE CONDITIONS

2.1. Geographical and Natural Conditions

Can Tho, located at the center of the Mekong delta region is a gateway city to the lower reaches of the Mekong river. It is an industrial, commercial-service, education and training, technological center, health and cultural center; serveds as an importanttransport center; , and holds a key strategic position in the fields of national defense and security Can Tho City is slightly inclined topography with the land of river systems, canals interlacing and common ground elevation of 0.8 - 1.0m above the sea level. The annual average water level fluctuates from 39-51cm, the highest water level from 193-200cm and the lowest water level from (-140) - (-121cm). The rainy season lasts from May to October. Total annual average rainfall is about 1,247.7mm. Although the project area is not affected by flooding from upstream, high rainfall combined with high tide could cause local flooding with the level ranging from 20-50cm. In the rainy season, prolonged thunderstorms lead to flooding in urban areas.

2.2. Environmental Baseline

There are few incidences of air pollution exceeding emission standards (only 1/35 taken samples is over the permissible standard located in Under Bridge 3 on Nguyen Van Linh road). The surveys show that the dust and noise levels are permissible under Vietnamese standards Analysis results of sludge samples dredged canals shows heavy metal concentration in was much smaller than thosepermitted under Vietnamese standards.

With regard to surface water, the analytical results show that analytical indicators of most of samples are within the permitted limit. However, samples taken at some creeks (Dau Sau, Hang Bang, Ngong, Ba Bo, Tu Ho, Ong Ta, Muong Khai) showed signs of pollution by solid waste and sewage emanating from residential areas, For the underground water, analytical results show that most of analytical indicators pass permitted limits Particularly, Coliform and E.Coli indicators exceed permitted limits many times. It means that underground water here is unusable for domestic purpose unless underground water is treated. Using untreated underground water will cause digestion diseases.

In addition, the analysis results of phytoplankton composition in the project area in March 2015 have recorded that there was 60 species belonging to 24 families, 16 orders, and 4 branches.

2.3. Socio-economic Conditions

In 2009, the total population of Can Tho city was 1,189,555 people, of which urban population was 783,104 people (65.8%); rural population was 406,451 (34.2%). The population density is 8,416 person per km2 in Ninh Kieu, 1,026 person per km2 in O Mon, 1,567 person per km2 in Binh Thuy and 1,251 person per km2 in Cai Rang. The Kinh ethnic makes the majority of 96.74%, while the rest is Chinese (1.27%), Khmer (1.95%) and other ethnics (0.04%). Average income per capita reached $1,749 (2009). The poverty rate is about 4.67%. The labours in agriculture, forestry and aquaculture were 49%, industry and construction about 18.27%, and trade and services about 32.73%. The number of un-employees was 4.84% (36,735 people).

Can Tho is a city of cultural diversity. Religious elements and religious institutions are also very rich with temples, pagodas and churches scattered everywhere. There are 15 religious institutions that may be affected during the project construction.

3. ALTERNATIVE ANALYSIS

Due to the investment items of the project, there are various technical options. Proposed design alternatives are analyzed based on their advantages and disadvantages of technical, economic, social and environmental aspects to choose the best option.

"Without project": In the absence of the Project, flooding and tidal surges will continue unabated. There will e deterioration of environmental sanitation conditions: air pollution, solid waste, accretion of sludge, and other negative environmental impacts, that would have detrimental effects on the welfare of the citizens of Can Tho.

3.1. For the "With project":

Analysis of the 5 proposed flood control options was undertaken. : Multi Criteria Analysis (MCA) considered technical, economical, environmental, social, and resettlement aspects and cost-effectiveness analysis at a preliminary level to select a feasible option.

3.2. Alternatives for Flood Control System

Under component 1, the alternatives for flood control system have also been analyzed:

- Alternatives for selecting engineering and technology options for Can Tho embankment; and Alternatives for selecting engineering and technology options for construction road and park behind embankment and: Option 1 was selected for economic and technical reasons, and to enhance urban aesthetics as it will be constructed in line with the prior embankment system and can increase elevation, lessing flood risk in the future. The road will connect with other areas of the City.
- Alternatives for selecting engineering and technology options for Dau Sau and Cai Khe tide sluice gate: The most environmentally friendly and aesthetically pleasing option was selected.
- Alternatives for selecting engineering and technology options for five ship locks: Option 1 has been selected due to as it was judged to have the greatest impact on water pollution and odour control.

3.3. Alternatives for Environmental Sanitation

Four alternatives have been taken into consideration namely: (1) Alternative 1: Continue to build separated drainage system to drain 100% of storm water; (2) Alternative 2: Construction of separately drainage system. Rehabilitation of the existing drainage system to ensure the capacity of 30% storm water and newly construction of storm water drainage system, ensure to drain 70% remaining storm water; (3) Alternative 3: basically, Alternative 3 is similar to Alternative 2, drainage direction and receiving sources for the catchments:; (4) Alternative 4: Storm water is collected maximally to Xang Thoi Lake, only small volume near Cai Khe Canal (Route of Mau Than, Tran Hung Dao, Xo Viet Nghe Tinh, Nguyen Trai) drain to Cai Khe Canal.

Alternative No 4 has been selected due to lowest possibility of flood risk and the creation of an improved environment and landscaping around the drainage system

3.4. Alternatives Of Investment Scale For Urban Corridor Development

Alternative for Quang Trung Bridge: To ensure the connection between the old bridge and the new bridge, creating a focal point for the southern gate of the city of Can Tho. Alternative 2 has been selected due to its having the shortest construction perios, therefore t negative impacts are reduced.

Alternative for – the connecting road to the August Revolution road to provincial road 918: Two options have been analyzed. Option 2 has been selected due lower costs and reduced impacts of site clearance.

4. SUMMARY OF ASSESSMENT OF IMPACTS

When the project is completed, the overall impact will be positive. Nevertheless, the project will cause some negative impacts (temporarily or permanently) on the local environment and the local population. Therefore, effective implementation of mitigation measures will be necessary.

4.1. Positive Impact

Positive impacts which are expected to be generated by the project during the operational phase include: (i) Improved public health and living conditions in the project area, especially for encroachment living households, pollution of Can Tho Riverhouseholds in areas adjacent to existing open channels and drains and lakes in heavy pollution; (ii) Minimized flooding for households and commercial areas along two Can Tho riversides; (iii) Safety issues along two river banks is secured; (iv) Increased income in the construction phase (thanks to thesale of and enhanced income by protecting assets and commercial goods, and the continuity of business operations during the flood season; (v) increased opportunities for commerce, tourism, local recreation and exercise; (vii) Improved access to markets and primary social services (health, education) and urban employment opportunities (viii) Reduced flooding because the drainage system is improved (personal and public health protection); (ix) Increased income from production and marketing of agricultural products (x) Increased efficiency of production and consumption of goods due to better marketaccessibilities (xi) The flooding, inundation and bad smell will disappear in the city through flood control works, drainage systems under the project. The project works are expected to be built to adapt to climate change and reduce inland saltwater intrusion in Can Tho city.

4.2. Negative Impact:

Pre-construction phase impacts include the activities of land acquisition and rehabilitation; reclamation, cleanrance, preparation process of prior-embanking. Work sites and worker camps would generate dust from the process of clearing, grading; Emissions generated from construction vehicles; Solid waste generated from the reclamation; Noise, vibration from machinery; Impact on vegetation area, impact on regional ecosystems.

Construction phase: the activities in construction phase includes: Embanking, Pipeline construction. Worker activities would generate Dust, emissions from material transportation and machinery. Work camp management, if improperly maintained, to improper disposal of solid waste, waste water, diseases and social problems caused by the concentrated workers. A key environmental impact is thedisposal of sludge coming from dredging process.

Operation phase: the environmental and social impacts during the operational phase are largely positive. However, the negative impact would occur if the Operation and maintaince would not be well implemented: (i) Flooding caused by failure to maintain the drainage and canal system; (ii) Odor: drainage system for roads in Ninh Kieu could cause odor in local area. However, the level of impact will not be significant and easily managed by the proper operation and maintenance of the Can Tho City; (iii) Salinization: Inadequate management and operation of tide sluice gate cause salinization; (iv) Disruption to the activity of inland waterway:

Inadequate management and operation of tide sluice gate cause disruption to the activity of inland waterway.

4.3 Socio-economic Impacts

Land Acquisition and Resettlement

Land acquisition and resettlement are the main social impacts for the project. According to the Inventory of Loss (IOL) conducted, the implementation of the 2 components of the project will affect 4.539 households, of which 1,814 will be relocated, 634 severely affected households (losing more than 20% of productive land, 10% for vulnerable HH) and 709 households with small business affected. 35 companies (mainly construction material companies) will also be affected as well as 2 markets (see Table 1).

The total acquired land for the project is 1,354,055 m^2, of which Residential land represents 361,936 m^2 (26.8%); Agricultural land: 735,736 m^2 (54.4%), non- agricultural land: 27,917 m^2 (2%), public land (35.909 m^2 (2.6%) and other land (transportation, rivers, canals, cemeteries) 192,557 m^2 (14.2%).

444 vulnerable HH including 349 female head of HH with dependents, 35 poor HH and 11 HH belonging to an ethnic minority groups will also be affected. They are however fully integrated with the Kinh majority. 222 HH are encroaching on the River and canals banks without right or claim on land. They will all be relocated in a serviced resettlement site.

A resettlement plan (RP) will be prepared in compliance with World Bank policy for involuntary resettlement and regulations of Vietnam to mitigate impact on the affected households. An Income Restoration Program (IRP) for severely affected HH, relocated HH and HH losing business will also be prepared as part of the RP. Due to the relocation of 1,814 HH several km from their former location, preparation of the IRP, in close collaboration with HH losing their livelihood, will be a key issue for the Project.

Table 1: Information about the land acquisition of 02 project components

Kinds of affected assets		Unit	Total		Component 1		Component 2	
			Quantity	AH/ Companies	Quantity	AH/ Agencies	Quantity	AH/ Agencies
Land								
Non-agriculture	Residential	m²	361,936	3,598	215,280	2,357	146,656	1,241
	Non- agriculture	m²	27,917	35 Companies	27,797	35 Companies	120	2 Companies
	Public land	m²	35,909	8WPCs	30,015	6WPCs	5,894	5WPCs
	Other land (cemetery, trans-portation, canals)	m²	192,557	10 Agencies 11WPCs	146,184	10 Agencies 10WPCs	46,373	7WPCs
Agriculture	Annual crops	m²	31,539	64	14,673	38	16,866	26
	Perennial trees	m²	704,197	1,024	170,085	524	534,112	500
Total affected land			**1,354,055**		**604,034**		**750,021**	
Totally affected houses		**m²**	115,226	1,625	77,723	1,145	37,503	480
Partly affected houses		**m²**	26,069	856	15,620	580	10,449	276
Total of AHs								
	Total AHs	HH	4,539		2,858		1,681	
	DHs	HH	1,814		1,271		543	
	No of HHs have productive lands	HH	826		347		479	
	No of HHs have their business stores affected	HH	709		472		237	
Vulnerable HHs			**444**		**200**		**244**	
	Women headed with dependents	HH	349		150		199	
	Minority HHs	HH	11		6		5	
	Disabled headed HHs	HH	6		4		2	
	poor HHs	HH	35		22		13	
	Elderly headed HHs	HH	10		5		5	
	HHs under supported by social policies	HH	33		13		20	

Other social impacts

Other potential social impacts on local communities include road and public safety during construction, spreading of HIV/AIDS during the construction period and disruption of communities and livelihoods during site clearance and construction. A Social Action Plan (SAP) to mitigate impacts and to maximize benefits on the affected communities; this SAP also includes a gender action plan.

4.4 Potential Impacts To Sensitive Facilities

The project does not have any direct impacts to historical and cultural monuments, religious, school and health facilities during land acquisition process. However, in the construction phase, construction material transportation and construction activities can affectaccess to, pagodas, churches and schools; which could also be affected by dust and noise during construction phase and facing some difficulties of get in/out the structures. Most of sensitive areas are a part from more than 10 m to construction sites. These are: Preventive

Medicine Center, guest house No. 2 (Km0); 2 markets of Tan An (Km0+220) and An Lac (Km0+710) located near river banks, Cathedral (Km0+480); Ninh Kieu Methadone treatment facility (Km0+850) ; The Military Court of Region 9 (Km0+860); Nguyen Hien primary school (Km2+780), Inland Waterways Management and Maintenance Joint Stock Company No. 12 (Km3+620); Ong church (Km5+000); An Binh market (Km5+700). Giác Thiền pagoda at Km0+230;

4.5. Cumulative Impact Assessment

The ESIA conducted a thorough review of relatedother, large recently completed and, ongoing or planned investments in the project cities to identify possible linkages and potential cumulative impacts. Details of these key linked and associated subprojects, including ancillary aspects of the projects, are shown below. Based on the assessment and due diligence review, negative cumulative impacts from these linked and associated projects are deemed be limited insignificant because most of them are either existing or will be completed by the time the CUTDR project will commence implementation, and several projects will have a postive cumulative impact on the CTUDR by reducing the pollution load on waterways, through treating sanitation, which will allow the drainage and sanitation components of the CTUDR to operate more efficiently. , while a few are unlikely to be implemented during the CTUDR implementation because financing for these projects have not been secured yet.”

Over the past years, Can Tho city, with the support of the Vietnamese Government, donors and international funding institutions, has been implementing various development programs and projects for the Mekong River Delta region in general and Can Tho city in particular. Key infrastrcucture, including a number of typical projects are as follows:

- Can Tho drainage and wastewater treatment project (financed by KfW)
- Cai Sau sludge landfill project financed by (Cai Rang district)
- Mekong Delta Transport Infrastructure Development Project (financed by the WB5)
- Mekong Delta Water Resources Management for Rural Development project (financed by the (WB6)
- Can Tho Upgrading project (VUUP1) from 2002-2014,(financed with IDA’s preferential fund)
- Mekong Delta Urban Upgrading project (MDR-UUP) from 2012 - 2017 (VUUP2) (financed by the WB). The potential cumulative impacts caused by simultaneous construction, can be managed with coordination of schedules at the city level, and good construction management during implementation.

In summary, most considerable information is available on possibly linked projects. Most of the potential linkages are likely to have largely positive impacts, through improving water treatment, solid waste management, and drainage along major roads, reducing water and air pollution, and improving the urban environment as well as performing vital flood control functions such as new WWTPs receiving and treating wastewater flows form this project. The CTUDR itself has largely positive impacts, as there is no net abstraction from the river, therefore preserving riverine ecological integrity. The wastewater treatment measures lessen the pollutant load in the waterways.

5. PROPOSED MITIGATION MEASURE

The mitigation measures proposed on the project include:

- Preconstruction phase: (1) Land Acquisition and Resettlement: The RPF has been prepared in compliance with the World Bank’s Operational Policy on Involuntary Resettlement (OP 4,12) and Vietnam’s laws and regulations. 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; (ii) (3) Unexploded ordnance removal: will be carried out in the Can Tho embankment; Cai Son cannal; Long Tuyen and Long Hoa regulatory lake.; (iii) Air pollution: The vehicles must have canvas cover crate and must not drop the rock, materials in order to minimize dust emissions the environment; the maximum velocity of the vehicles traffic on the dirt road near the project area is 5 km/h, watering regularly in the construction area, especially in the construction site on the route,

- Construction phase: (i) Noise and Vibration: 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; 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; Heavy truck transportation, loading/unloading shall not allow to operate at night (from 22:00 to 6:00); (ii) Air pollution: Spraying water to maintain certain moisture levels, and to prevent or minimize dust dispersion. The watering activities are proposed at least one a day during rainy season and twice a day during dry season. Storing the excavated 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; (iii) Domestic waste: 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. (4) Construction-generated solid waste: Wherever possible, materials used or generated by construction shall be recycled such as excavated soil for regulatory lake, embankment, pipeline installation could be reused for levelling purpose on the sites, Construction wastes will be disposed at area where are approved Can Tho' PC on the disposal construction waster; Dredged sludge will be transported to Cai Sau sludge landfill. According to PPMU, The location to construct Cai Sau landfill has enough land for disposal of dredging sludge and material of CTUDR project.

- Operation phase: To reduce risks of flooding, odor, salinization and disruption to the activity of inland waterway: Ensure implemention of anadequate operation and management plan budget allocated ; Ensure that traffic safety provisions, including signs, lights, and pavement markings, that were installed during construction are permanently and effectively maintained, and renewed as necessary, Ensure the city's operations and maintenance plan, and related budget, includes the work and resources required to maintain the road in its as-completed condition; Ensure, with the assistance of the traffic control authority, that overloaded vehicles do not use the road.

6. ENVIORNMENTAL AND SOCIAL MANAGEMENT PLAN

Prepared as a part of the ESIA, an Environmental and Social Management Plan (ESMP) is a safeguards instrument that is typically used in many projects. It consists of information on, and guidance for, the process of mitigating and managing adverse environmental impacts throughout project implementation. Typically in Vietnam, an EMP comprises a list of typical mitigation measures to be carried out by contractors and others, an environmental monitoring program, capacity building, organizational arrangements and responsibilities, and the estimated cost of EMP implementation and monitoring.

There is a comprehensive regulatory framework in Vietnam related to EIA preparation, environmental standards, protection and management of forests and cultural property, and other aspects related to construction and operation of facilities and infrastructures in Vietnam. This ESMP in consistent with these regulations.

To facilitate effective implementation of the ESMP, the PMU will: (a) Establish an Environment and Social Unit (ESU) responsible for ensuring timely implementation of the

EMP, including monitoring, reporting, and capacity building related to safeguards; (b) Assign the Construction Supervision Consultant (CSC) to also be responsible for supervision of the contractor's safeguard performance as part of the construction contract and this requirement will be included in the CSC's terms of reference; and (c) Hire qualified national consultants as the Independent Environmental Monitoring Consultant (IEMC) to assist the ESU in performing its task.

6.1. Environment Monitoring Program

Objective and Approach

Main objective of the Environment Monitoring program is to ensure that (a) the potential negative impacts of the project are minimized; (b) the EMP is effectively implemented; and (c) the EMP is adequate to mitigate the potential negative impacts. Given that monitoring the implementation of the RP will be conducted separately, the environmental monitoring program will comprise (a) monitoring the safeguard performance of the contractor during site clearance and construction, (b) environmental quality monitoring, (c) monitoring effectiveness of the ESMP.

6.2. Capacity Building Program

6.2.1. Technical Assistance support for the implementation of safeguards

The scope of the technical assistance would cover support from experts and training that would cover both the knowledge on safeguards requirements and procedures for the project as well as training that covers both specific knowledge on safeguard procedures and requirement for the project staff, consultants, and national contractor would be important. This would include, for example, assistance in the preparation of documents and implementation of training program on environmental management and environmental monitoring for contractors, CSC and relevant staffs of PMU (environmental staffs and coordinators of packages) to do their tasks. It would also include assisting the PMU's environmental staffs with the review of contract documents on the bidding packages for construction items of the project to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements as well as provide general environmental guidance as requested by the PMU to enhance overall project implementation and performance.

Given the nature, locations, and scale of construction, it is anticipated that the safeguard technical assistance support and training will be provided at least during the first 3 years of the project implementation. The WB safeguard specialists will participate in the capacity building in particular in the training activities as appropriate.

7. PUPLIC CONSULTATION AND INFORMATION DISCLOSURE

7.1 Objectives of Public Consultation

The consultation with the participation of local authorities and local people in the project site during the preparation and implementation of EMP and ESIA is to provide essential information for further understanding about the project, impacts of the project implementation and potential mitigation measures for the project.

7.2. Implementation Methods

This is a Category A project, thus public consultation were carried out twice during the ESIA process.

To implement the EIA report of the CTUDR, the ODA-PMU organized consultation meetings with the People's Committees and Vietnam Fatherland Front of 20 wards in 4 districts of Ninh Kieu, Binh Thuy, Cai Rang and O Mon.

Before consulting at wards, the ODA-PMU held general meetings at each district to introduce about the project and collect opinions for the project, including the meeting at office of Ninh Kieu DPC on 01 June 2015, the meeting at office of Binh Thuy DPC on 02 June 2015, the meeting at office of O Mon DPC on 03 June 2015 and the meeting at office of Cai Rang DPC on 08 June 2015. The participants at these meetings consist of representatives of DPC, WPC and some divisions.

After holding the general meetings at districts, the ODA-PMU carried out consultation at each ward to introduce about the project, identify the zone/population group in the project area, collect information about the status of environmental sanitation at the locality, discuss potential environmental impacts and mitigation measures as well as coordinate with the local authorites in holding public consultation in the project area. Simultaneously, the ODA-PMU also sent the dispatches for applying for consultation for the relevant agencies.

Generally, through the public consultations at the project area, the authorities and local people supported for the project and desired the project to be implemented early. All local people agreed with the project implementation, however, they requested that the construction tbe carried out rapidly, and that environmental management and regular environmental monitoring be undertaken, as well as that labor, community, and traffic safety measures be followed.

The local people requested the local authorities and the project to make proper compensation and arrange resettlement for them at their expectation.

The People's Committees and Vietnam Fatherland Front as well as representatives of people in the project will jointly discuss and solve issued raised during the project implementation.

8. CONCLUSIONS, RECOMMENDATIONS

On the basis of analysis and assessment on existing environment, environmental and socio-economic impacts in the project area, the report presents the following conclusions.

The construction of flood control infrastructure will enhance drainage capacity, improve living conditions and sanitation conditions, and enhance the quality of life for city residents. Also, the urban transport infrastructure development will enhance the inter-regional transport links in order to facilitate socio-economic development and increase the accessibility of residents in low-income areas to social infrastructure services of the city.

The project will help improve urban integrated management capacity (technical infrastructure and operational units , strengthen the planning , scheduling , coordination mechanisms , management of natural disaster risks, urban management and financial management of the city) to ensure high efficiency in urban integrated management and ensuring the sustainable development of Can Tho city.

The the measures of prevention, control and handling of environmental pollution are taken.

During the operation of the Project, there will be some adverse environmental and socio-economic impacts but these will be mitigated and are considered to be manageable in comparsion to the environmental and social benefits that the Project brings.

CHAPTER 1. INTRODUCTION AND PROJECT DESCRIPTION

1.1. BACKGROUND AND OBJECTIVES OF PROJECT

1.1.1. General Background of the Project

Can Tho is the largest city of the Mekong Delta and the 4th largest city in Vietnam. This is a major economic exchange point in the dynamic quadrilateral Can Tho - Ca Mau - An Giang - Kien Giang and the regional center for industry - agriculture, trade - service, finance - banking, science - technology and vocational training, center for health, culture and tourism. Can Tho city is an important clue in regional and international transport, technical logistics, plays a role as a center for socio-economic of the Mekong Delta region. The development objective of Can Tho city in the period of 2020 - 2030 is to continue to further improve this important role. Can Tho city is a source of promoting economic, cultural, scientific and engineering development for the entire region. Over the past 10 years, Can Tho city has carried out economic restructuring from traditional agriculture into industry, trade, services, tourism and agricultural production economy. Can Tho is forecasted to become the regional center for high-tech agricultural production and aquaculture, processing exporting food, thereby become a major factor in ensuring food security in the Mekong Delta region. Can Tho city is also an international and domestic transport hub, playing an important role in the regional transport system, supporting the regional links and providing essential infrastructure for the entire region, like telecommunication and utility networks.

According to WB's assessment, Vietnam is one of 05 countries around the world seriously affected by climate change and sea level rise, of which Can Tho city in particular and the Mekong Delta region in general are forecasted to be most affected due to negative impacts of climate change. In the fact, flooding is a current pressing issue. Flooding caused by rains, tide and inundation or soil subsidence has been occurring regularly in Can Tho city, which leads to increase in risks of landslides and spread of many epidemics. Those will have significant influences to life of residents and damage to infrastructure. In Can Tho city, there are many rivers, canals, so in case of heavy rains in combination of tide, the city will be flooded rapidly in a longer period. According to the Mekong Delta Plan – Long-term vision (Netherlands – Vietnam in November 2013), the sea level will rise from 57 to 73cm (average scenario) and from 78 to 95cm (high scenario) up to 2100. As a result, GDP of the country will be lost about 10% and 90% of the Mekong delta region's area is almost completely submerged, of which Can Tho city will suffer great pressure from future flooding and urbanization under impacts of climate change.

The spontaneous and uncontrolled urbanization and immigration in Can Tho city lead to several households' illegal encroachment of canals/ditches for living places. In addition, the disorder waste discharge and sedimentation narrowed flow and reduce drainage capacity of canals/ditches, leading to environmental pollution and affected urban aesthetics while putting pressure on the infrastructure in the city. Those impacts associated with sea level rise, unusually heavy rains and soil subsidence makes flooding more severe in Can Tho city. Furthermore, according to the population census 2009 (WB's calculations based on consumption-based approach), the poor households make up 12% of Can Tho city population while low-income population makes up 31%. The poor and households living near rivers, canals, and ditches are likely vulnerable due to natural disasters and changes in economic conditions. On the other hand, the development of industrial, commercial and services sectors will require a huge demand for laborers, cause increased vehicle flow, especially in traffic routes linking industrial parks and major ports, traffic routes connecting surrounding provinces to the central area where several service facilities are located, leading to overload of the existing transport infrastructure.

Accompanying with Can Tho city, the Government of Vietnam and international credit instutions, international and national donors have been financing the technical infrastructure upgrading projects, typically the Urban upgrading projects funded by WB, the Wastewater Drainage and Treatment Project funded by GIZ and KfW and Can Tho River South Bank Embankment Project and so on. These projects have been contributing to the sustainable development of Can Tho city. The two urban upgrading projects funded by WB and being implemented in Can Tho city have been improving and upgrading some canals and lakes in the urban. However, some canals need to be invested in improvement and upgrading. Beside finding “soft” solutions to adapt to climate change and live with flooding for socio-economic development, there should be infrastructure solutions for fighting and minimizing possible future negative impacts due to climate change, helping the poor households in case of climate change.

However, in the present context, the State budget must be allocated for other purposes of economic development and social security, borrowing of ODA loan for investment in the Mekong Delta region in general and Can Tho city in particular for urban and infrastructure upgrading and development for climate change resilience with the aims of economic growth, improved quality of human resources, improved quality of life and sustainable poverty reduction is very necessary and urgent.

To support the Government of Vietnam in proactive adaption to the impacts of climate change –sea level rise, currently World Bank is coordinating with the Vietnam authorities to build the project: "Adaption to Climate Change and sustainable livelihoods in Mekong River Delta "(WB9). The project is considered as Phase 1 in long-term program of World Bank in MRD in order to strengthen the capacity of development and management on climate change adaptation among different industries and of various institutions. In particular the project will support of information systems, institutional arrangements and schedule to build capacity for provincial and regional planning for the sustainable development of the whole MRD. Besides, the project will also consider investment opportunities "low regret" and scale up investments for the long-term development plans should be more funding for future periods. The project will also include the work and non- work that WB will finance technical assistance to build resilience capacity in MRD.

The completed Project will meet WB’s compulsory criteria on poverty reduction, improved living conditions for the low-income areas and the GoV’s comprehensive strategy on growth and poverty reduction. Simultaneously, the project outcome is one of important activities identified for Can Tho city and Me-Kong delta region for climate change resilience.

Pursuant to the Law on Environmental Protection and the Government’s Decree No. 18/2015/ND-CP dated 14 February 2015 on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plans, environmental impact assessment will be conducted for the works under Component 1 and Component 2 of the Project as stipulated in Annex II of Decree No. 18/2015/ND-CP and submitted to the DoNRE of Can Tho city and Can Tho CPC for appraisal and approval.

1.1.2. Objectives of the Project

❖ *Long-term Objectives*

- The objectives of the project are to reduce damages caused by flooding in center of Can Tho city and improvement of accessibility to public traffic along the corridor towns and contributing to socio-economic development of the city. These objectives will be achieved through: (i) investments in structure and non-structure measures for flood risk management; (ii) investments in ensuring safety and accessibility, public transport activities through integrated corridor management approach; and (iii) enhancement of financial and accounting management capacity integrating transport with land use.

❖ *Specific Objectives*

- Promoting the growth in sustainable, fair and social participatory manner.
- Building anti-flooding infrastructure, enhancing drainage capacity, improving living standards and environmental conditions to eliminate poverty in urban areas.
- Developing modern urban transport infrastructure, enhancing inter-regional transport connectivity and connectivity among urban areas to facilitate socio-economic development and enhance accessibility of people in low-income areas to social infrastructure services of the city.
- Improving urban management capacity (technical infrastructure and operating units, enhancing the planning, plan preparation, coordination mechanism, flood risk management, urban management and financial management of the city) to bring high efficiency in urban management and ensuring sustainable development of the city.

1.2. BASIC OF LAWS, LEGISLATIONS AND REGULATIONS

The Project complies with the Vietnam's and Donor's applicable legal regulations on environmental protection, including:

1.2.1. Technical Basic

- Resolution No. 45-NQ/TW dated 17 February 2005 of the Ministry of Politics on construction and development of Can Tho city in the period of 2009 – 2015;
- Resolution No. 57/NQ-CP dated 04 May 2013 of the Government on land use planning up to 2020 and land use plan for 5 early years (2011-2015) of Can Tho city;
- Decision No. 1721/QD-BNN-TCTL dated 20 July 2012 of the MARD on approving water resources planning against flooding for Can Tho city;
- Decision No. 1533/QD-TTg dated 30 August 2013 of the Prime Minister on approving the master plan on socio-economic development of Can Tho city up to 2020 and vision to 2030;
- Dispatch No. 6148/UBND-XDDT dated 17 December 2013 of Can Tho CPC on proposing to implement the priority infrastructure development projects, urban upgrading and climate change resilience projects for Can Tho city and the Mekong delta region (now known as CTUDP);
- Dispatch No. 10816/VPCP-QHQT dated 24 December 2013 of the Government Office conveying opinions of the Deputy Prime Minister, Hoang Trung Hai on proposing the implementation of WB-funded project of Can Tho CPC;
- Dispatch No. 42/UBND-XDDT dated 03 January 2014 of Can Tho CPC on proposing support from WB for the pirority infrastructure development project, urban upgrading and climate change resilience for Can Tho city and the Mekong delta region;
- WB's letter dated 24 January 2014 sent to Can Tho CPC on financial support from WB for Can Tho city and Mekong detla priority infrastructure development project;
- WB's letter dated 04 July 2014 sent to Can Tho city People's Committee on conducting Workshop hold from 16 to 20 June 2014 for studying Can Tho city's advantages;
- Dispatch No. 3127/UBND-XDDT dated 27 June 2014 of Can Tho city People's Committee on preparation of the Can Tho city and Mekong delta region Development, Upgrading and Climate Change Resilience Project (now known as Can Tho Urban Development and Resilience Enhancement Project);
- Decision No. 3488/QD-UBND dated 25 November 2014 of the Chairman of Can Tho city People's Committee on supplement of investment preparation fund, advance payment of basic construction for the projects funded by State budget in 2014;

- Dispatch No. 1007/UBND-XDDT dated 10 March 2015 of Can Tho city People's Committee on assignment of the task of project preparation and implementing procedures related to selection of bidders for Can Tho Urban Development and Resilience Enhancement Project.

1.2.2. Laws, Decrees, Circulars, and Regulations/Standards Vietnam

1) Legal Framework on Environmental Impact Assessment

- Law on Environmental Protection No. 55/2014/QH13 passed by the National Assembly on 23 June 2014 and took effect since 01 January 2015;
- Law on Water Resources No. 17/2012/QH13 passed by the National Assembly on 21 June 2012;
- Land Law No. 45/2013/QH13 passed by the National Assembly of the Socialist Republic of Vietnam on 29 November 2013 and took effect since 01 July 2014;
- Construction Law No. 50/2014/QH13 issued on 18 June 2014 and took effect since 01 January 2015;
- Law No. 27/2001/QH10 on fire protection and prevention dated 29 June 2001 of the National Assembly;
- Decree No. 18/2015/ND-CP of 14 February 2015 of the Government on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plans;
- Decree No.19/2015/ND-CP of 14 February 2015 of the Government detailing the implementation of a number of articles of the Law on Environmental Protection;
- Decree No. 25/2013/ND-CP of 29 March 2013 of the Government on environmental protection charges for wastewater;
- Decree No. 174/2007/ND-CP of 29 November 2007 on environmental protection charges for solid waste;
- Decree No. 88/2007/ND-CP of 28 May 2007 of the Government on urban and industrial park water drainage;
- Decree No. 179/2013/ND-CP of 14 November 2013 on sanction of administrative violations in the domain of environmental protection;
- Decree No. 43/2014/ND-CP of 15 May 2014 of the Government detailing the implementation of a number of articles of the Land Law;
- Decree No. 140/2006/ND-CP of the Government dated 22 November 2006 on regulations for establishment, appraisal, approval and organization of implementing of strategies, planning, plans, programmes and development projects;
- Decree No. 38/2015/ND-CP of 24 April 2015 of the Government on management of waste and discarded materials;
- Decree No. 80/2014/ND-CP of 06 August 2014 of the Government on drainage, and wastewater treatment and took effect since 01 January 2015;
- Decree No. 59/2015/ND-CP of 18 June 2015 of the Government on management of construction investment projects;
- Decree No. 83/2009/ND-CP of 15 October 2009 of the Government on amending and supplementing a number of articles of Decree No. 12/2009/ND-CP of the Government on management of investment projects on the construction of works;
- Circular No. 27/2015/TT-BTNMT of 29 May 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plans;

- Circular No. 22/2010/TT-BXD of 03 December 2010 of the Ministry of Construction on labor safety in work construction;
- Circular No. 09/2009/TT-BXD of 21 May 2009 of the Ministry of Construction detailing the implementation of a number of articles of Decree No. 88/2007/ND-CP of 28 May 2007 of the Government on urban and industrial park water drainage;
- Circular No. 36/2015/TT-BTNMT of 30 June 2015 on hazardous waste management;
- Circular No. 19/2011/TT - BYT of 06 June 2011 of the Minsitry of Health guiding labor hygiene, laborers' health and occupational diseases;
- Circular No. 16/2009/TT-BTNMT and 25/2009/BTNMT of the Ministry of Natural Resources and Environment on the issuance of National technical regulations on environment;
- Circular No. 32/2013/TT-BTNMT of 25 October 2013 of the Ministry of Natural Resources and Envrionment on the issuance of national technical regulations on environment;
- Circular No. 10/2007/TT-BTNMT of 22 October 2007 on guiding quality assurance and control in environmental monitoring;
- Decision No. 02/2009/TT-BTNMT dated 19 March 2009 of the Ministry of Natural Resources and Environment on the assessment of capacity to receive wastewater of water sources;
- Decision No. 16/2008/QD-BTNMT dated 31 December 2008 of the Ministry of Natural Resources and Environment on the issuance of national technical regulations on environment;
- Decision No. 22/2006/QD-BTNMT dated 18 December 2006 of the Ministry of Natural Resources and Envrionment on compulsory application of Vietnam's standards on environment;

2) Applicable Vietnam's Standards and Regulations

During the preparation of this environmental and social impact assessment, some following Vietnam's regulations are applied:

❖ *Water quality:*

- QCVN 01:2009/BYT - National technical regulation on drinking 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.
- QCVN 40:2011/BTNMT - National technical regulation on industrial wastewater.
- QCVN 25:2009/BTNMT - National technical regulation on wastewater of the landfill sites: Permitted maximum concentration of pollution parameters in wastewater of the solid waste landfill sites when discharging into receiving sources.

❖ *Air quality:*

- QCVN 05:2013/BTNMT – Air quality – National technical regulation on ambient air quality.
- QCVN 06:2009/BTNMT – Air quality – Permitted maximum concentration of hazardous substances in ambient air.
- TCVN 6438:2001 - Road traffic means - Permitted maximum level of exhaust gas.

❖ *Quality of soil and sediment:*

- QCVN 03:2008/BTNMT – Soil quality - National technical regulation on the allowable limits of heavy metals in the soils.
- QCVN 15:2008/BTNMT - Soil quality - National technical regulation on the pesticide residues in the soils.
- QCVN 43:2012/BTNMT - National technical regulation on sediment quality in fresh water areas.

❖ *Noise and vibration:*

- QCVN 26:2010/BTNMT - National technical regulation on noise.
- TCVN 5948:1999 - Acoustic - Noise emitted by accelerating road vehicles - Permitted maximum noise level.
- QCVN 27:2010/BTNMT - National technical regulation on vibration.

❖ *Water supply and drainage:*

- TCVN 7957:2008 - Drainage and sewerage - External Networks and Facilities - Design Standard
- TCXDVN 33:2006 - Water Supply - Distribution System and Facilities. Design Standard.

❖ *Labor safety and health:*

- Decision No. 3733/2002/QĐ-BYT dated 10 October 2002 on application of 21 standards on safety and health.

1.2.3. Environmental Safeguards Policies of WB

A study and assessment of environmental impacts is carried out to evaluate the compliance with WB's policies and guidelines on environmental and social issues.

According to the guidelines on implementing policy OP4.01 (http://go.worldbank.org/OSARUT0MP0), the project is categorized as a category A project and requires the completion of ESIA report in details. A detailed and comprehensive ESIA, including an assessment of cumulative impacts, is always required for projects that are in this category. A Category A project has environmental impacts that are expected to be 'adverse, sensitive, irreversible and diverse – and that may include attributes such as pollutant discharges large enough to cause degradation of air, water, or soil; large-scale physical disturbance of the site or surroundings; extraction, consumption or conversion of substantial amounts of forests and other natural resources; measurable modification of hydrological cycles; use of hazardous materials in more than incidental quantities; and involuntary displacement of people and other significant social impacts.

However, most environmental impacts caused by the project are expected to be temporary and mainly occur during the construction (due to pollution of dust, noise, vibration from operations of heavy devices, generation of waste and exhaust sludge at the construction site and trafic disruption, etc.). Also, due to the construction activities, the trees and the local landscape are also affected. The negative impacts will be mitigated through the synchronous application of mitigation measures as outlined in the Environmental and Social Management Plan (ESMP) for the project, including monitoring plan and through the application of the health and safety requirements for construction workers. The implementation of the ESMP will be a requirement for the construction contractors involved in the project. The following Bank policies are triggered for the proposed Project: The following Bank policies are triggered for the proposed Project:

- Environmental Assessment (OP/BP 4.01)
- Involuntary Resettlement (OP/BP 4.12)

- Natural Habitats (OP/ BP 4.04)
- Physical Cultural Resources (BP/OP 4.11)
- Indigenous Peoples (OP/BP 4.10)
- Projects on International Waterways (OP/BP 7.50)

A complete description of the World Bank safeguards and their triggers for applicability can be found on the World Bank's official web site www.worldbank.org and are summarized in this chapter.

❖ ***Environmental Assessment (OP4.01, BP 4.01)***

Environmental Assessment (OP4.01) - WB's policy on Environmental Assessment. This policy requires an Environmental Assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. The EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed investment. The EA process takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and cultural property) and transboundary and global environmental aspects

The Project has numerous positive environmental and social impacts. It will (under all technical scenarios) reduce flooding in Can Tho's urban core and drainage and sanitation works, in addition to reducing drain overflows, will improve public health, improve the aesthetics of the city, and enhance the welfare of the Project Affected Persons who will be relocated to new sites with improved amenities, while retaining access to their livelihoods. Nevertheless, there are potential significant adverse impacts during the project construction and operation phases – key among which will be changes in the hydrology of the Can Tho and Hau rivers, although since there will be no net abstraction of water from the rivers, there will be no negative impacts of environmental flow.

OP/BP 4.01 is triggered and the project is classified as a category A due to the significant and potentially irreversible environmental and social impacts associated with the flood control measures.. The Project will contribute to promoting sustainable urban development, minimizing damages due to flood, improving environmental sanitation, improving connectivity between the city center and newly-developed areas, and enhancing climate change resilience for Can Tho city, promoting Can Tho city to become a socio-economic centrer and dynamics of Mekong delta region.

The EA should establish a mechanism to determine and assess future potential environmental and social impacts during project implementation, and then to set out mitigation, monitoring and institutional measures to be taken during operations of these activities, to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

Operational Policy 4.01 further requires that the EA must be disclosed as a separate and stand alone document by the Government of Vietnam and the World Bank as a condition for World Bank appraisal. The disclosure should be both in Vietnam where it can be accessed by the general public and local communities and at the InfoShop of the World Bank and the date for disclosure must precede the date for appraisal of the program.

❖ ***OP 4.12 - Involuntary Resettlement***

The objective of this policy to avoid where feasible, or minimize, exploring all viable alternative project designs, to avoid resettlement. This policy is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts.

This policy covers direct economic and social impacts that both result from Bank-assisted investment projects, and are caused by (a) the involuntary taking of land resulting in (i) relocation or loss of shelter; (ii) loss of assets or access to assets, or (iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or (b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to project appraisal of proposed projects. The objective of this policy to avoid where feasible, or minimize, exploring all viable alternative project designs, to avoid resettlement.

The policy requires the displaced persons and their communities, and any host communities receiving them, are provided timely and relevant information, consulted on resettlement options, and offered opportunities to participate in planning, implementing, and monitoring resettlement. Appropriate and accessible grievance mechanisms are established for these groups. In new resettlement sites or host communities, infrastructure and public services are provided as necessary to improve, restore, or maintain accessibility and levels of service for the displaced persons and host communities.

This policy is triggered because the Project activities will lead to the involuntary taking of land and other assets resulting in:

- Relocation or loss of shelter,
- Loss of assets or access to assets,
- Loss of income sources or means of livelihood, whether or not the affected persons must move to another location,
- Loss of land.

❖ ***OP/BP 4.04 Natural Habitats***

This policy supports the conservation of natural habitats and the maintenance of ecological functions as a basis for sustainable development. The objective of the policy is to promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions. The World Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

The policy calls for the avoidance of significant conversion or degradation of critical natural habitats, including those habitats that are (a) legally protected, (b) officially proposed for protection, (c) identified by authoritative sources for their high conservation value, or (d) recognized as protected by traditional local communities. Where projects adversely affect non-critical natural habitats, the project should proceed only if viable alternatives are not available, and if appropriate conservation and mitigation measures, including those required to maintain ecological services they provide, are in place.

The project should include mitigation measures that minimize habitat loss and establish and maintain an ecologically similar protected area. Whenever feasible, preference is given to siting projects on lands already converted. The policy requires that the Project consult key stakeholders, including local nongovernmental organizations and local communities, and involve such people in design, implementation, monitoring, and evaluation of projects, including mitigation planning.

❖ ***OP 4.10 - Indigenous Peoples***

Indigenous peoples in particular geographical areas are identified by having: a close attachment to ancestral territories and to the natural resources in these areas; self-identification and identification by others as members of a distinct cultural group; an indigenous language, often different from the natural language; presence of customary social and political institutions; and primarily subsistence-oriented production.

The Bank's objective is to ensure that indigenous peoples do not suffer adverse effects from Bank financed projects and that they receive culturally compatible social and economic benefits. Effectively the World Bank requires a project to develop a program for addressing issues based on the informed participation of the indigenous people themselves. Any project that affects indigenous peoples is expected to include components or provisions that incorporate an "Indigenous Peoples Plan.

❖ ***OP/ BP 4.11 Physical Cultural Resources***

The objective of this policy is to assist in preserving physical cultural resources (PCR) and avoiding their destruction or damage. PCR includes archaeological, paleontological, architecturally significant, and religious sites including graveyards, burial sites, and sites of unique natural value. Initial indications are that no observed physical or cultural resources will be affected by the project. Nevertheless, the Contractor is responsible for familiarizing themselves with the following "Chance Finds Procedures", in case culturally valuable materials are uncovered during excavation, including:

Stop work immediately following the discovery of any materials with possible archeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;

Protect artifacts as well as possible using plastic covers, and implement measures to stabilize the area, if necessary, to properly protect artifacts

Prevent and penalize any unauthorized access to the artifacts

Restart construction works only upon the authorization of the relevant authorities

All contracts should include a Chance Finds Procedure clause

❖ ***OP/BP 7.50 – International Waterways***

This policy applies to the following types of international waterways:

- Any river, canal, lake, or similar body of water that forms a boundary between, or any river or body of surface water that flows through, two or more states, whether Bank members or not;
- Any tributary or other body of surface water that is a component of any waterway described in (a) above; and
- Any bay, gulf, strait, or channel bounded by two or more states or, if within one state, recognized as a necessary channel of communication between the open sea and other states--and any river flowing into such waters.

This policy applies to the following types of projects:

- Hydroelectric, irrigation, flood control, navigation, drainage, water and sewerage, industrial, and similar projects that involve the use or potential pollution of international waterways as described in para. 1 above; and
- Detailed design and engineering studies of projects under para. 2(a) above, including those to be carried out by the Bank as executing agency or in any other capacity

For this project, OP 7.50 is applicable since under Component 1.2, the rehabilitation and improvement of canal, drainage and sanitation infrastructure. Although environmental impacts would be moderate, there is a possibility that dredging of the canals in the urban core, could potentially pollute the Song Hau River, an international waterway.

Table 1.1. World Bank Policies triggered by the project

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment (OP/BP 4.01)	X	
Natural Habitats (OP/BP 4.04)	X	
Pest Management (OP 4.09)		X
Physical Cultural Resources (OP/BP 4.11)	X	
Involuntary Resettlement (OP/BP 4.12)	X	
Indigenous Peoples (OP/BP 4.10)	X	
Forests (OP/BP 4.36)		X
Safety of Dams (OP/BP 4.37)		X
Projects in Disputed Areas (OP/BP 7.60)		X
Projects on International Waterways (OP/BP 7.50)	X	

Detailed requirements for the methodology of assessment and generic impacts on the urban drainage works and water resources development as outlined in the WB's environmental assessment document (*No. 140, Volume II – Sector Guidelines, Washington D.C, 1991*). More guidance can be found on the webpage <www.ifc.org/ehsguidelines> , which contains the most updated versions of the World Bank Group Environmental, Health, and Safety Guidelines (known as the "EHS Guidelines"). The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The World Bank group uses the EHS Guidelines as a technical source of information during project appraisal activities.

Table 1.2. Compliance with World Bank Safeguards Policies

Policy	Name	Application scope
OP/BP 4.01	Environmental assessment	The project is classified as A-project, therefore a full environmental and social impact assessment (ESIA) report has been prepared
OP/BP 4.12	Involuntary Resettlement	The detailed resettlement and compensation plan report has been made because project has relocated peoples and will establish a new resettlement area for them.
OP 4.10	Indigenous People	Development plan report of ethnic minority has been made to ensure rights of ethnic minority. Simultaneously, the project is designed to improve residential areas of ethnic minority without affecting on their land and homes
OP/ BP 4.04	Natural Habitats	Screening and mitigation measure will be proposed and included in ESIA. The Project consult key stakeholders, including local nongovernmental organizations and local communities, and involve such people in design, implementation, monitoring, and evaluation of projects, including mitigation planning
OP/ BP 4.11	Physical Cultural Resources	Screening of PCR has been done during the process of ESIA. PCR includes archaeological, paleontological, architecturally significant, and religious sites including graveyards, burial sites, and sites of unique natural value.

Policy	Name	Application scope
		Initial screenings identify no observed physical or cultural resources will be affected by the project. Nevertheless, the Contractor is responsible for familiarizing themselves with the following “Chance Finds Procedures”
OP/BP 7.50	Projects on International Waterways	Upgrading of drainage and wastewater systems will affect volumes and quality of discharges into some tributaries of the Mekong River, an international waterway. However, the exception under sub-paragraph 7.(c) of the policy applies, as the tributaries concerned run exclusively in one state, i.e. Vietnam, and Vietnam (Can Tho) is the lowest downstream riparian state. Therefore OP 7.50 is not considered to be triggered.

In addition, ESIA complies with the International Conventions of which Vietnam is a member (i.e: International water resources and climate change, etc.).

Furthermore, the environment, health and safety specialist team of the World Bank has guided information throughout the project on environmental, social, health and safety issues related to investment sector. The environmental guidelines related to ESIA report include emissions, ambient air quality, noise, waste water, hazardous waste, sewage sludge / sediment and water quality, etc.

1.3. PROJECT DESCRIPTION

1.3.1. Project Location and Affected Area

Can Tho city is located in the downstream of Mekong river and in the center of Mekong delta region. It is 169km from Ho Chi Minh City, over 150km from Ca Mau city, approximate 120km from Rach Gia city and over 80km from the sea towards the Southern Hau river road (National Highway 91C).

The geographical coordinates of Can Tho are as follows: $105^0$13'38" - $105^0$50'35" East Longitude and $9^0$55'08" - $10^0$19'38" North Latitude, stretching over 60 km along the Western bank of Hau river. It borders An Giang province to the north, Dong Thap and Vinh Long provinces to the East, Kien Giang province to the West and Hai Giang province to the South. Can Tho city has a total natural area of 1,409.0 km², accounting for 3.49% of the area of entire region. The peri-urban area is 53 km².

The proposed works in components are expected to be implemented in 20 wards of 04 districts of Ninh Kieu, Binh Thuy, O Mon and Cai Rang in Can Tho city.

For the flood control works focusing on the urban areas to control small areas where important works of the city are concentrated from the perspective of urban development and flood control. Ninh Kieu – Binh Thuy traditional urban area, located in center of Can Tho city, adjacent to intersection of Hau river and Can Tho and borders Can Tho airport to the North.

For the CTUDR project in Can Tho city, the affected area is whole construction scope of proposed works under Components 1 and 2 of the Project and areas surrounding such works, especially sensitive works in 20 wards of 4 districts. In addition, roads of transporting materials for construction of works and transporting waste raised from the project to the landfill, residential areas, and offices surrounding the roads are located in the affected area of the project. The forecasted population up to 2020 is about 420,000 people (urban area construction land is 5,710 ha), and population up to 2030 is about 500,000 people (urban area construction land is 8,100 ha). This is center urban area concentrated with history of establishment and development of Can Tho city. It is also a place to locate politic-administrative centers of the city, highway, waterway and airway distribution center, city-level and regional sports center, regional education and training center, city-level and regional polyclinic and special medical centers, city-level and regional trade and services and financial center, combined residential areas, justification residential areas and centralized residential areas.

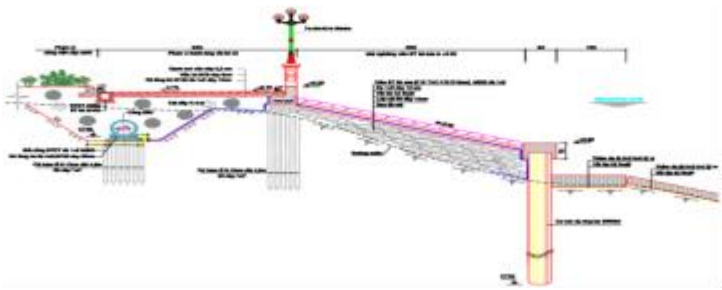
According to the master plan of the city and the urban development program, Ninh Kieu – Binh Thuy traditional urban area is core of center urban where is concentrated with history of establishment and development of the Western Capital – Can Tho city. This is concentrated with several works and key residential areas, production and business areas of the city.

Simultaneously, due to low terrain and near big river mouth, this area is often affected by tide and sea level rise. Therefore, Ninh Kieu – Binh Thuy core urban area is main area in need of zoning for protection and prioritizing investment in infrastructure projects (bridges, roads, etc.), social infrastructure, urban upgrading, and protection of landscape, environment and water sources

1.3.2. Project Components

The project includes three main components: (i) Component 1: Flood control and environmental sanitation; (ii) Component 2: Urban corridor development; (iii) Component 3: Urban management strengthening for climate change resilience. Component 1 and component 2 will implement engineering measures with aim at flood control, sanitation and enhance urban transport connections.

Table 1.3. The main investment items of the project

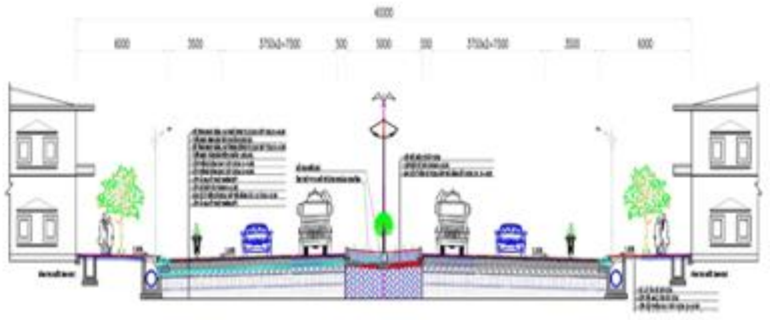
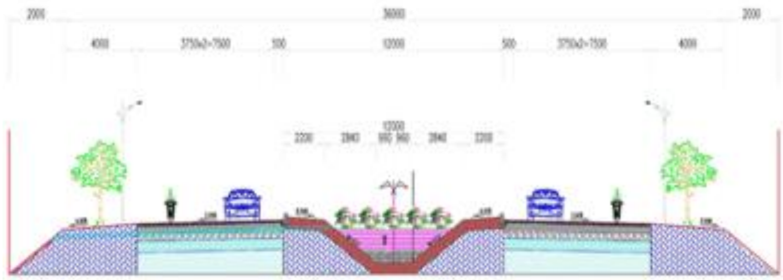
No	Item	Detailed description
1	**Component 1**	**Component 1: Flood control and environmental sanitation** with the total investment is USD 131.74 million. This component will support Can Tho city to implement the structure and non-structure measures to control flood and ensure environmental sanitation for the core urban area.
1.1	***Proposed flood control systems***	
	1. Can Tho river embankment (section from Ngo Duc Ke to Cai Son ditch)	Embankment at the right bank of Can Tho river with total length of 5.5 km and the height from 2.8-3.0 m, type of embankment: Gravity concrete embankment wall + roof reinforcing embankment with precast concrete. It í divided into 3 following sections: - <u>Section 1:</u> The start point begins from Cai Son bridge pier to the end point at Dau Sau ditch. Total length of P1 section is 908m. - <u>Section 2</u>: Located in the upstream of Dau Sau ditch with total length of 3,092m. The start point of the embankment is located in Dau Sau food processing factory and the end point is the pumping station. - <u>Section 3:</u> Start point connects with embankment of Can Tho city Military Base and the end point connects with protective embankment for Guest House No.2. Total length of section 3 is 1,490m.  **Cross Section of Can Tho River Embankment**
	*2. Construction road and park behind **e**mbankment*	- Building green park, square, art lighting system. Arranging tourism areas interlaced on embankment, such as tourism area - food court - local trading center - recreation area - festival area. - Building road behine embankment with roadbase section of 23m throughout the route with road pavement of 15m and 6m sidewalk near households. Sidewalk in the side of embankment will combine with green park behind embankment in minimum of 2m width. - Expansion principle will be calculated from boundary of household inside embankment to green park. + The start point of route Km0+00 at interchange between Ngo Duc Ke road and Hai Ba Trung road (in the area of the Guest House No.2) of Ninh Kieu District, Can Tho City. The ending point: Km 5 + 604.68 at interchange between the motorway after the park of river embankment under studying and the planned Hau Giang road (now local road) in Ninh Kieu District, Can Tho City.

No	Item	Detailed description
		+ Alignment: The road is upgraded based on the existing and newly-built routes in the region with the width of 4-6m, including Hai Ba Trung, Nguyen Thi Minh Khai, Tam Vu and local earth roads. Pavements of road have been degraded and most of road has no infrastructure in two sides. - Works on the route: The route consists of 6 pipe culverts and 4 bridges crossing over medium and small canals such as Tham Tuong ditch, Ba Le ditch (iron bridge), Kinh bridge.  **General layout of embankment and park behind embankment**
	3. 02 Tidal Sluice Gates and 05 shiplocks for core urban area	<u>*a) Cai Khe tidal sluice gate:*</u> Cai Khe tidal sluice gate is located in Cai Khe ditch between Ninh Kieu bridge and pedestrian bridge. Culvert width of B=40m (nozzle of 2x20m). Width of tidal sluice gate of B=10.5m (classified according to grade of waterway). <u>*b) Dau Sau tidal sluice gate:*</u> Located in Dau Sau ditch, 200m far away Dau Sau ditch to the side of Can Tho river. Culvert width of B=20m (one nozzle of 20m). Width of dock of B=10.5m (classified according to grade of waterway). <u>*c) Shiplocks on flood control corridor:*</u> Building uncomplicated, no need electricity, control water level at a certain elevation. Width of valve gate varies from 5 to 20m.
	4. Improvement of watercourses in the central area, dredging, upgrading protective embankments, roads, relocation of encroached canals	<u>a) Cai Son ditch anti-landslide embankment:</u> - Located in Cai Son ditch to Ninh Kieu district side - Length of L=1,6km and 2,1km. - Elevation of embankment coping: suitable with flood control and higher than highest water level, with P=1%. - Structure: M250 reinforced concrete wall, roof coefficient of m=3.00, paved with hexagonal concrete with thickness of 16cm. Type of embankment: Gravity concrete embankment wall + reinforcing embankment roof by precast concrete Auxiliary works include protective handrail and road behind embankment: - Section 1 from 923 to Cai Son bridge (Nguyen Van Cu): road pavement of 4m built by cement concrete M300. - Section 2 from Cai Son bridge to road CMT8: Road pavement of 7m built by asphalt concrete.

No	Item	Detailed description
	5. Renovation of canals/ditchs in the core urban area	- 13 canals will be improved which include: Đầu Sấu canal, Ngã Bát canal, Mương Củi canal, Xẻo Nhum canal, Mương Lộ canal, Hàng Bàng canal, Tư Hổ canal, Sao canal, Bà Bộ canal, Lễ canal, Xẻo Lá canal, Ngỗng canal, Ông Tà canal. - Solution for dredging: Depending on the section and bottom elevation of each canal, the dredging will be conducted at depth from 0.5 to 1.5m. The main construction method is using small sized excavators and by manual method to ensure not cause erosion to the center area. - Soft embankment: Reinforce foundation by cajeput pile with a density of 16 piles / m^2, each pile is driven 4m deeply. The top of pile is concreted with pillar of 0.8x0.4m. From reinforcement of +1.00 and up, retaining current reinforcement and supplement some green trees to create surrounding landscaping and trees to keep soil and embankment. - Vertial embankment with rubble stone: Consolidate foundation by cajeput pile with a density of 16 piles/m2. The body of embankment is built with rubble stone and concreted in-cast at the reinforcement of +1.00 with dimension of 0.8x0.4m. From reinforcement +1.00 and up is backfilled with sand sacks and planted with trees for keeping shore and create landscape.
	6. Develop regulatory lake, water in urban core areas	a) *Regulation Lake of University Campus:*locates at Long Tuyen ward, Binh Thuy district, expansition of existing canal and ditch for building ecological lake, planting trees at the center of the university. Dredging lake with an area of 10.57 ha. Dredged depth from 2 m; total volume of 256,000 m^3 dredged materials; Soft embankment; Water surface area: 51.931 m; Green and landscape area: 37,771 m^2, area of playground and walkway: 8167 m^2; Area of service land: 4.261 m^2, providing road protected embankment with width of 2.0 m. Waste water collection system to be invested with University Campus planning. The land area for renovating ecological lake, planting trees: 223.412m^2 *b) Long Hoa regulation reservoir:* Locates at Long Hoa ward, Binh Thuy district. The land for building ecological lake, trees plating by expanding existing canals, ditches such as Muong Khai ditch, Cai Son ditch, Hang Bang ditch, Pho Tho ditch and Nuoc Lanh ditch, etc. Dredging lake with an area of 17.53 ha. Dredged depth from 2 m; total sludge volume of 93,000 m3 of dredged materials. Soft embankment; water surface area: 67,774 m^2; Green and landscape area: 142,049 m^2; Area of playground and walkway: 13,589 m^2; construction of providing road protected embankment with width of

No	Item	Detailed description
		2.0 m. The land area for renovating canals, ditches for building ecological lake, planting trees: 102,130m^2. - Waste water collection system to be invested with Xuan Lan resident area in the future.  **Typcial layout of Regulation lake** b) Long Hoa regulation reservoir: - Location: At location of expanding canals for building ecological lake, planting trees in the planning of residential areas in Long Hoa ward, Binh Thuy district, Can - The land of green trees for building Long Hoa 1 ecological lake located in the planning of Long Hoa residential area is a green area with a number of relatively large canals, ditches such as Ba Bo ditch, Ba Thay Son ditch, Suc ditch, etc. The land area for renovating canals, ditches for building ecological lake, planting trees: 102.130m2.  **Typical layout of Long Hoa regulation lake**
1.2.	***Environmental sanitation improvement works:***	
	1. Improving drainage system for routes in the center of Ninh Kieu district;	*a) Improving Hoang Quoc Viet road infrastructure* The road has starting point at the provincial road 923 passing through the intersection with Nguyen Van Cu road and ends at Nguyen Van Linh road with a total length of 3.3km. Currently, the road width is small (4m) by asphalted macadam road and has no technical infrastructure,

No	Item	Detailed description
		- Section 1: From the provincial road 923 to Nguyen Van Cu road: 1,2km, 4 lanes, 30,0 m of safety corridor - Section 2: From Nguyen Van Cu road to Nguyen Van Linh road: 1,2km, 2 lanes, 30,0 m safety corridor *b) Renovating drainage system in the center of Ninh Kieu district:* Minimum culvert diameter is 300mm for wastewater culvert and 400m for stormwater culvert. c)
	2. Equipment	Equipment attached to buildings and equipment to support the management and operation of regulatory monitoring drainage system, dredging of drains, canals, pumping stations, reservoir, and damper.
2	**Component 2**	**Urban corridor development** to connect backbones of the town, promote connectivity among new and existing residential areas in the city center, enhance connectivity among inter-regional urbans and public transport options of Can Tho city. The total investment is USD 97.74 million.
2.1	***Quang Trung bridge (modul 2):***	Construction of Quang Trung bridge with total length of bridge and connecting road is by 689m., bridge with length of 481m, width B = 11m. Position of bridge: Arrange Quang Trung bridge – Bay 2 on the left of existing bridge – toward Cai Rang to Ninh Kieu. Distance between two birdge edges is 3m, meeting above-mentioned criteria. No need site clearance in the side of Ninh Kieu, consistent with the cross section planning of Quang Trung – Cai Cui road and ensure safety during the construction  **Proposed position of Quang Trung Bridge (modul 2)**
2.2	***Road and bridge of Tran Hoang Na***	Length of total line is about 3,794km in which - Road: rehabilitation and upgrade of road with length of 1,6km building line of 20m and 28m; construction of length about 1,6km building line of 20m and 28m; - Bridge: length of 594m, width of 21m across Can Tho river;

No	Item	Detailed description
2.3	***Building the road connecting the August revolution road to provincial road 918***	The starting point begins at the August Revolution road intersecting with Alley 91 and ends at the provincial road 918 near Can Tho prison with total length of about 5. - Type of road: Urban main road. - Design speed: 60 km/h .  **Cross section of Section 1 (CMT8 Road to Vo Van Kiet Road)** Section 1 : From August revolution road to Vo Van Kiet road, road base width of 40m, including pavement width of 23m.  **Cross section of Section 2 (Vo Van Kiet Road to PR 918)** Section 2: Vo Van Kiet road to the provincial road 918 with total roadbed width of 36 m, including 16 m wide pavement. + Vo Van Kiet road interchange: Design bracelet interchange in combination with traffic lights at rush hour, the island diameter of 60m, roadway width of 16.5m, arrange navigation islands around the island in combination with directional markings. Road base width of 40m, including pavement width of 23 m. + Nguyen Van Linh interchange: Design interchange regulated by traffic lights and roundabout island combined with signal lights with a diameter of 60 m. Roadway width of 16.5 m, arrange navigation islands around the island in combination with directional markings.
2.4.	***Building residential areas for resettlement***	Building the resettlement site in Ninh Kieu district with an area of about 40ha is suitable with the planning with technical and social infrastructure as stipulated to ensure living conditions for local people.
2.5	Equipment	Equipment attached to the works and serving for the management and operation includes: (a) establishment of GIS center; (b) equipment for the street and bus stop.

No	Item	Detailed description
3	**Component 3**	**Strengthening urban management for climate change resilience** with the objectives of (1) Management for risks of natural disaters and climate change resilience; (2) Management of transportation and urban development ; (3) Financial plan of the city and (4) Application of information technology in urban administration management The main activities would include: (1)Management for risks of natural disaters and climate change resilience; (2)Management of transportation and urban development; (3)Financial plan of the city: (4)Application of technologies in urban management; (5)Transport and Urban Development;(6) Application of information technologies to management activities The total investment is USD 14.14million.

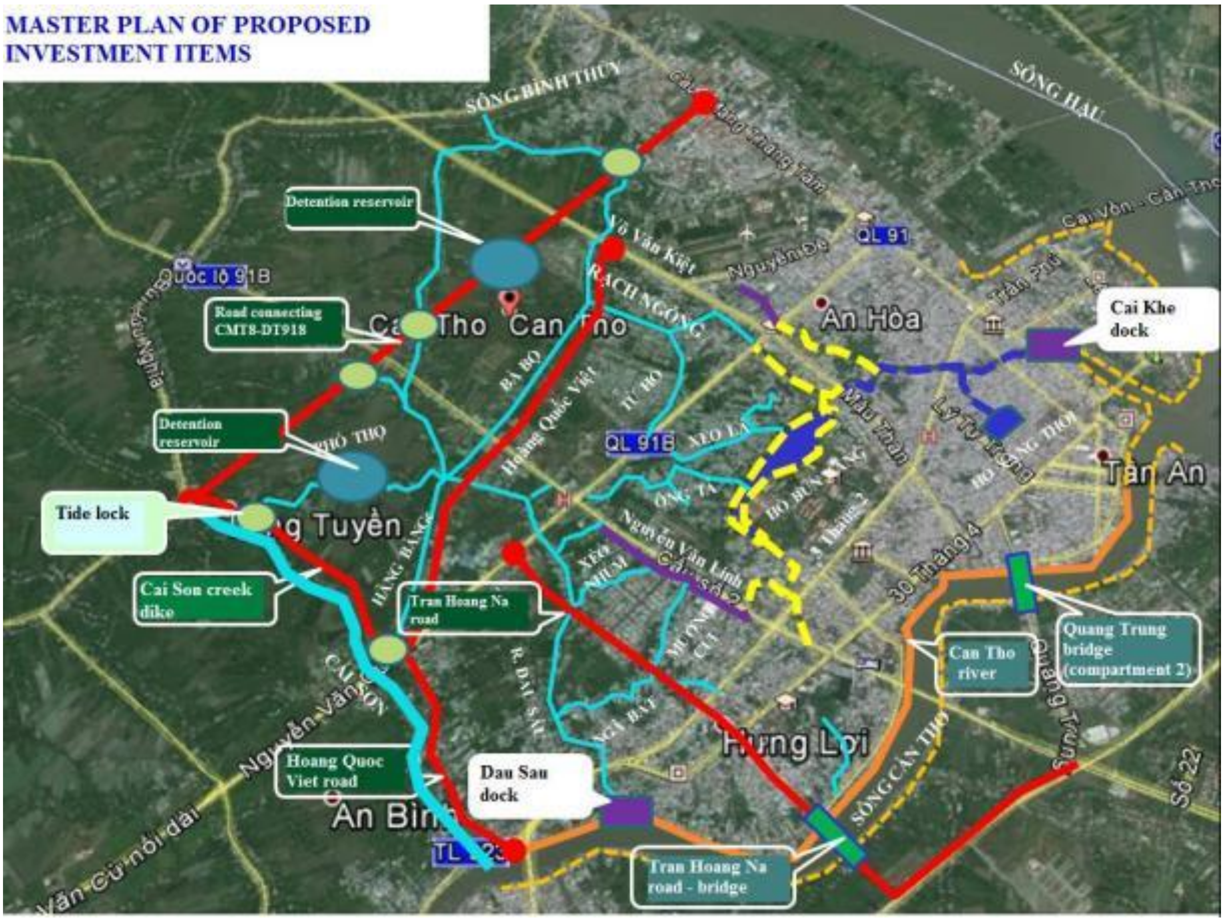


Figure 1.1. Master Plan of Proposed Investment Items

1.3.3. Construction Materials And Waste Spoil Disposal Sites

Materials such as sand, stone, gravel: purchased at Can Tho or from neighboring provinces like Hau Giang, An Giang.

Steel, Cement: Steel is purchased at factories in Can Tho, Ho Chi Minh City. Cement is purchased at factories in Kien Giang, Can Tho.

Hollow brick, solid brick, pavement tiles and glazed brick: Bought in HCM City, Long An, Dong Nai, Binh Duong

Table 1.4. Locations of Potential Stone and Sand Sources

Item	Sand sources		Stone sources	Cement
	Sand mine	Sand mines	Granit Quarry	
Location	Tien and Hau river	Along Hau from Cai Rang river to Thot Not district	Trà Sư, Két, Bà Đội (Tịnh Biên), Sập, Ba Thê nhỏ, Tượng, Chóc, Trọi (Thoại Sơn) mountain	An Giang, Kien Giang
Km to sub-projects	10-60	10-60	150	150
Capacity (m^3)	191,831,924	25,000,000	11,000,000	Adequate
Environmental permit	Obtained by supplier	Obtained by supplier	Obtained by supplier	Obtained by supplier

❖ ***Conditions for supplying engery***

Main power supply source is from national grid. Building transmission line and 120kVA transformer substation powered from 22kV medium-voltage grid in the region, low-voltage 4kV for serving the construction and operation management in the future.

In addition, arrange more backup 33kVA generators for ensure smooth construction and operation in case of power failure.

Water for construction: Water can be used directly from domestic water sources of residents or bored wells.

❖ ***Waste spoil disposal sites***

Waste spoils disposal sites will be surveyed for capacity, distance to project area and achieved agreement with local authorities. However, the constractor could select other disposal sites which must agree with local authories to ensure the most economical way**.** The possible spoil disposal sites will be mentioned in Bidding document. The estimated amout of excavated soil in the project (lake construction, road behind the embankment, pipeline construction) is approximately 592, 000 m^3. These are non-contaminated soil and will be used for levelling at needed places or to be levelling at Cai Sau disposal site. The domestic waste during construction period of total 20 tons (about 80kg/d) will be treated at the O Mon waste treatment area. The dredged sewage sludge from canal dredging (about 322,000 m3), which is organic contaminated will be disposed at Cai Sau sewage sludge disposal site.

Acording to FS Consutants, the estimated amount of sludge is about 350,000 m^3. Based on discussion with Can Tho city, sewage sludge from CTUDR project will be transported by land ways and disposed in Cai Sau sewage sludge disposal site and at O Mon Solid Waste Treatment Area.

Cai Sau sewage sludge disposal site. The Cai Sau Sewage Sludge disposal site is located at Phu Thu ward, Cai Rang district, Can Tho city, about 15 km from the city urban core area. The disposal site, which is located within the planning area of Cai Sau Waste Water Treatment Plan with a total area of 6 ha. It has been assigned by Can Tho'People Committee to receive the sludge generated from projects in Can Tho since 2011 (No.1980/UBND-KT dated on May, 30, 2011). An Environmental Protection Commitment was prepared and approved by Cai Răng district's People Pommittee. The Cai Sau land fill is currently under operation and managed by Can Tho Water and Drainage Company.

Cai Sau landfill currently received the sludge from canal and drainage from Can Tho city. The existing operated area of the landfill are about 2000 m3 of total 5000 m2. The remaining area of the landfill is adequate to receive the sludge generated from the CTUDR project as well as other ongoing projects.

Based on the testing, these sludge are defined as contaminated sluge, which have high level organic pollutants, but it is not hazardous sludge.

Design

The design of the landfill meets current technical standard for treating contaminated sludge. The Cai Sau landfill has total 8 cells for sludge storage, each of which has a total of 240 m2 (60x4m) and 2 m depth. The cell is excavated to the depth of 1m. The excavated soil is used to embank surrounding the cell at the level of 1 m higher than the existing ground. The cell is lined with impermeable layer (HDPE).

Sewage Sluge Treatment Process

Before sewage sludge is dumped in to yard, garbage is removed by using B40 iron net. Garbage is collected and treated by Can Tho URENCO. Sewage sludge without garbage will be dumped into the disposal cell, spray daily with biological products and sprinkle with lime to prevent odor. When the cell is full, it will be covered with a layer of sand (20) cm to avoid odors. After 2-3 month, the dry sludge from the cell will be excavated to be used for leveling of surrounding area within the landfill area.

Wastewater includes leakage water from sewage sludge and floor-washed water will be collected by an open concrete canal (128m length, 2 m width) and flows into 02 leachate collection hole (200 m^3 each). When the

The leachate from each cell will be pumped into the sewer system of Hung Phu Industrial Zone 1 (IZ) and treated by the wastewater treatment plant of IZ

Internal transport systems

Investment firms build up the temporary internal roads adjacent from the main axis of industrial zones (existing road of Hung Phu industrial zone 2 connect from the south of Hau river to Nam Viet petrochemical refinery factory) to discharge point: 30m long x 4m wide, convenient transportation system for specialized vehicles and trucks carrying sewage sludge. The 4m wide of internal road will be tarring to ensure the operation of motor vehicles. Progress of transporation ensured requirements about environmental protection, avoid sludge leakages. Trucks carrying sewage sludge must be covered. All trucks should not be overloaded.

O Mon Solid Waste Treatment Area

O Mon solid waste treatment area located in Phước Thới and Thới An wards, O Mon district, is 17 km distant from Can Tho city. The current area is about 04 ha. The waste treatment area is manged by Vietnam Ecotech Company, with the current capacity for municipal solid waste is 350 tons per day using incinator for combustible waste and partly of the non-combustible is dump at the landfill. Environmental Assessment for the O Mon was developed and approved by the local authority.

According to the City Planing on Solid Waste TReatment, the disposal site will be expanded to 47 ha and a Solid Waste Treatment Complex will be constructed (Decision No. 280/QD-UBND on 19 January 2015).

As in 2017, the project should be started works, Cai Rang sewage sludge and O Mon Solid Waste Treatment capacity shall be sufficient to receive sludge from drainage system, channel dredging and other sources.

1.3.4. Investment Fund And Implementation Progress Of The Project

❖ ***Project investment fund***

Total investment fund of the project is US.$ 322.5 million (equivalent to VND 6,807,974 million), of which:

- ODA fund**:** US.$ 260.14 million (equivalent to VND 5,491,644 million), accounting for 81% of total investment fund.
- Counterpart fund: US.$ 62.36 million (equivalent to VND 1,316,330 million), accounting for 19% of total investment fund.

❖ ***Project implementation schedule***

Estimated implementing time: From 2017 to 2020. The construction of culverts (Cai Khe, Dau Sau, Rach Suc, etc.) will be affected by semi-diurnal conditions. The construction will encounter several difficulties with narrow enclosure framework; therefore, it requires suitable construction method. The works are estimated to be implemented in the period 2016 – 2017 (within 14 months).

1.4. METHODS APPLIED IN THE ESIA

During the study, investigation and preparation of ESIA report, the Consulting firm used a combination of following study methods:

1.4.1. Methods of ESIA

❖ ***Rapid assessment method***

The Rapid Assessment Method was issued by the World Health Organization (WHO) in 1993. Basis of this method is nature of materials, technologies and rules of natural processes as well as experiences in rating pollution load.

In Vietnam, this method is introduced and applied in many ESIA studies, performing the relatively accurate calculation of the pollution load in the context of limited measurement and analysis instruments. In this report, the pollution load coefficients are taken under the EIA guidelines of the World Bank *(Environmental Assessment Sourcebook, Volume II, Sectoral Guidelines, Environment, World Bank, Washington D.C 8/1991)* and *Handbook of Emission, Non-Industrial and Industrial source, Netherlands).*

❖ ***Impact matrix method***

Building correlation between effects of each project activity to each issue and environmental composition as shown in the impact matrix. On such basis, to orientate detailed contents to be studied with impacts.

❖ ***Environmental modeling method***

This method is applied to calculate and simulate by Mathematical Equations for the process of spreading exhaust gas, wastewater generated from the project to ambient environment.

❖ ***Comparison method***

The comparison method is to assess the environmental quality, effluent quality, pollution load, etc. On the basis of comparison with the concerning environment norms and standards, the regulations of the Ministry of Health as well as the related researches and experiments.

❖ ***Identification method***

This method is applied through the following specific steps:

- Describe the environment system.
- Identify the project components that affect the environment.
- Identify the full range of related waste streams, environmental issues to serve the detailed evaluation.

❖ ***Listing method***

It is used quite common (since the establishment of the National Environmental Protection Agencies in some countries - NEPA) and bring positive results thank to many advantages as clear approach, systematic provision during system analysis and evaluation. It includes 2 main categories:

- *The description listing table*: This method lists the environment components in need of research in addition to the information on the measurement, prediction and evaluation.
- *Simple checklist:* This method will list environmental components to be studied and likely to be affected.

❖ ***System analyzing method***

This method is popular in environment. An advantage of this method is comprehensive assessment of impacts and effectiveness in identification of impacts and sources of waste.

This method is applied on the basis of considerations of waste sources, sources of impacts, affected objects and environment components as elements with intimate relationship in the system, thereby determining, analyzing and assessing impacts.

1.4.2. Other Methods

❖ ***Method of Public Consultation***

This method is applied during the interview with local authorities' leaders and people at the project area to collect essential information for EISA/EIA of the project. Particularly, the public consultation will introduce about project benefits and possible negative impacts on environment and their life. Whereby, summarize feedbacks and expectations of local people to the project.

On the other hand, discussions and direct interviews with local officials and local people on the local socio-economic development.

❖ ***Method of information and data inheritance, summary and analysis***

This method is to identify and assess natural conditions and socio-economic conditions of the project area through data and information collected from various sources such as the statistic yearbook, regional socio-economic profile report, regional baseline environment and relevant studies.

At the same time, the inheritance of the available studies and reports is really essential to use up available findingds and further develop limitations.

❖ ***Field survey method***

Field survey is compulsory for ESIA/EIA to identify the status of the project area, relevant surrounding objects to select sampling position, survey of status of water supply, drainage and power supply.

The consultancy firm carried out the geographical and topographical surveys, collecting of meteorology-hydrology materials for designing in accordance with Vietnam's applicable standards. These survey results will be used for assessment of natural conditions of the project area.

❖ ***Consensus method***

Based on knowledge and experiences in environmental science of EIA specialists of the consultancy unit and and other scientific research units.

❖ ***Sampling and analyzing methods in laboratory***

Sampling and analyzing samples of environmental components (soil, water, air) are integral to identify and evaluate status of baseline environment quality in the project area.

After the field survey, the sampling and analyzing program will be developed with some main contents, including: position of sampling, measurement parameters, analysis, human source, required equipment and tools, time, sample preservation plan, analysis plan and so on.

For this project, the consultant coordinated with Ho Chi Minh city Center for Analysis and Environment to conducting the monitoring, sampling and analyzing of air, water, soil, sediment and aquatic organism in the project area in accordance with Vietnam's applicable standards.

- *For ambient air*

Height of sampling point from ground is 1.5m. Air sample is collected on imperger pipe by pump Sampler (America) Model: 224.PCXR8. Dust sample is collected by air collector pump KIMOTO (Japan).

Dust: Sampling and analyzing according to TCVN 5067:1995, sampling equipment: KIMMOTO, weighing on analytical scale: Sartorius BP 211D, sensitivity 1x 10^{-5}gr (German).

SO_2: Collecting sample from Kimmoto Handy Sample HS-7- Japan, according to TCVN 5971:1995. Sample analyzer by colorimeter on UV spectrum -1691 PC…

CO: Sampling and analyzing according to standard HD.5.7-13.

- *For analyzing samples of water, soil and sediment*

Vietnam's standard TCVN 6663-6:2008: Guidance on sampling of rivers and streams. TCVN 5999:1995: Guidance on sampling of wastewater. TCVN 6663-11:2011: Guidance on sampling of ground water. TCVN 7176:2002 – Methods of biological sampling. TCVN 6663-3:2000: Guidance on sampling of sewage sludge and sediment. TCVN 6663-3:2008: Guidance on preservation and handling of samples.

Parameter analyzing methods according to Vietnam's standards and ISO, including:

1- pH: Directly measured by digital meter - Wagtech, according to TCVN 6492:2011.

2- DO: Directly measured by digitial meter - Wagtech, TCVN 7325:2004.

3- Total suspended solid (TSS): Weight method, TCVN 6625:2000.

4- BOD_5: BOD Track analyzer, according to TCVN 6001-1:2008.

5- COD: COD analyzer brand HACH, includes colorimeter DR/890, sample destroying stove according to SMEWW 5220 D:2012.

6- Hardness: Analyze on two-channel ion chromatography LC-0ADVP, Detector CDD according to TCVN 6224-1996.

7- NH_4^+-N: UV-VIS Spectrophotometer Model Shimazu UV - 1691 PC theo SMEWW 4500-NH_3 F:2012.

8- NO_3^--N: Analyze on UV-VIS Spectrophotometer Model Shimazu UV - 1691 PC according to EPA 352.1.

9- PO_4^3: Analyze on two-channel ion chromatography LC-0ADVP, Detector CDD or UV-VIS Spectrophotometer Model Shimazu UV - 1691 PC according to TCVN 6202:2008.

10- SO_4^2: Analyze on two-channel ion chromatography LC-0ADVP, Detector CDD or UV-VIS Spectrophotometer Model Shimazu UV - 1691 PC according to SMEWW 4500 SO_4^{2-} E:2012

11- Cd, Zn, Fe, Pb, Cu, Cd…: Analyze according to SMEWW 3113B:2012, As according to TCVN 6626:2000, Hg according to TCVN 7877:2008, on atomic absorption spectrum Model AAS-800.

12- Mineral oil: Weight method, TCVN 5070:1995.

13- Coliform: Pipe method, TCVN 6187-2:1996.

14- Clorua: Two-channel ion chromatography analysis equipment LC-0ADVP, Detector CDD according to Vietnam’s standard TCVN 6494-1:2011.

CHAPTER 2. BASELINE NATURAL, ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS OF THE PROJECT AREA

2.1. PHYSICAL CONDITIONS

2.1.1. Geographical Conditions

Can Tho city is located on the western bank of Hau River - center of the Mekong Delta (MD), its geographical location ranges from 105 ° 20 'to 105 ° 70' East longitude and from 9 ° 80 'to 10 ° 30' North latitude. The city is 75km far from the East sea, 1,877km from Hanoi capital and 169km from Ho Chi Minh City. Can Tho city was reset in January 2004 and recognized as a Class I urban directly under the Central government on 24 June 2009. The administrative boundary of the city is identified as follows. It borders: An Giang province to the Northwest, Hau Giang province to the South, Kien Giang province to the Southwest, Dong Thap and Vinh Long provinces to the Northeast.

Total natural area of the city is 140,895 ha (in 2010) with 9 administrative units, including 5 urban districts of Ninh Kieu, Binh Thuy, O Mon, Thot Not, Cai Rang and 4 rural districts of Vinh Thanh, Co Do, Thoi Lai and Phong Dien. With the location at center of the Mekong delta region, being a gateway city of the downstream of Mekong river, an industrial, commercial-service, education and training, technological center, health and cultural center, an important node in field of transport of Mekong delta region and international multimodal, a key locality with strategic position in fields of national defense, security and the Mekong delta region and country.

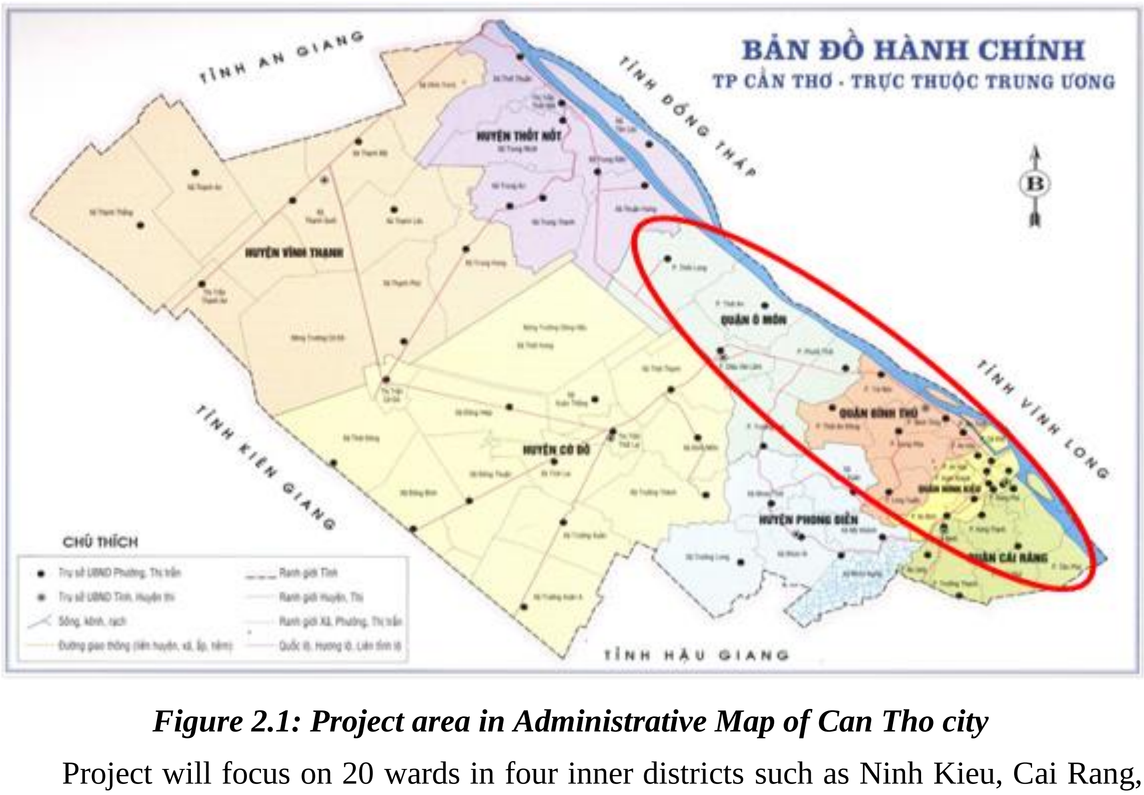


Figure 2.1: Project area in Administrative Map of Can Tho city

Project will focus on 20 wards in four inner districts such as Ninh Kieu, Cai Rang, O Mon and Binh Thuy in Can Tho city. (Figure 2.1).

2.1.2. Topography – Geomorphology Conditions

Located in the coastal delta region, Can Tho city's terrain is generally quite flat with elevation ranging from 0.5 - 1.8 m, popular from 0,8-1,2m and tends to tilt slightly from Northwest to Southeast towards the Hau river flows and from Northeast to Southwest in the direction of crossing the Hau river. Overall, the topography of the city is divided into two areas as follows:

- The high ground located along the Hau river with elevation of 1.0 -1,5m, lower toward the infield. The area along Cai San avenue has elevation around 0.8m, descending to the region between Thot Not and O Mon (Song Hau farm) with the elevation of only 0.5m.
- The low-lying area is located adjacent to Kien Giang in Vinh Thanh, Co Do, Thoi Lai districts and a part of the Southeast of Cai Rang and Phong Dien districts with the popular elevation ranging from 0.5- 0.8m.

Table 2.1: Natural area of Can Tho city per topography

Items	Area (ha)	Percent (%)
Total natural area	**140.096**	**100,00**
1. Land area	**133.065**	**94,98**
- High	7.579	5,41
- High medium	25.409	18,14
- Medium	56.076	40,03
- Low	38.809	27,70
- Low medium	5.192	3,71
2. Area of canals and creeks	**7.031**	**5,02**

Source: Sub-National Institute of Agricultural Planning and Projection, 2009.

In details, in term of topography, most of the land area of Can Tho city is distributed on 3 types of terrain, including medium, high medium and low medium with an area of 133,065 ha (accounting for 85.87% compared with the total natural area), while medium terrain of 56,076 ha (accounting for 40.03%), low medium terrain of 38,809 ha (accounting for 27.70 %) and high medium terrain of 25,409 ha (accounting for 18.14%), high terrain of 7,579 ha (accounting for 5.41%) and in low-lying terrain of 5,192 ha (accounting for 3.71%).

2.1.3. Geological and Tectonic Characteristics

The Mekong Delta in general and Can Tho city in particular is formed by types of sediment located on the Mezoic bedrock which appeared at the depth near the ground in the northern plains to 1,000 m near the coast. The types of sediments can be divided into the following main strata: Holocene strata (Q_{IV}) on the surface are young sediments, including clay and sand. The grain ranged from fine to medium. The Pleistocene strata (Q_{I-III}): contains sand, gravel and clay, mud and marine sediments. The Pliocene strata (N_2): contains clay and medium grain sand. The Miocene strata (N_1): contains clay and medium grain sand. The irrigation works and infrastructure are mostly built on the Holocene strata where the sediments are soft. This strata has a high content of clay and organic impurities, often in the water saturated state so its load-bearing capacity is poor.

2.1.4. Conditions of Climate And, Hydrology And Oceanography

❖ ***Climate***

Can Tho is located in a tropical climate – monsoon area. It has a pleasant climate with few storms, is hot and humid all year round and cold season does not exist. The rainy season lasts from May to November, the dry season from December to April of the following year.

- Temperature: the average annual temperature is high, varying from 26,5-27,30C (average 27.00 C). The average monthly temperature varies from 25.0-28.50C. April is the hottest month with the average temperature ranging 27.6 – 28.40C. January is the coldest month with the average temperature ranging 24.9 – 25.20C.

The average number of sunshine hours is high, the annual average is 7.2 hours/day. Months February-April have the highest number of sunshine hours (average 8-10 hours/day), August-October have the lowest average sunshine hours from 5-6 hours/day.

- Humidity: the average annual relative humidity ranges 82-85%. The average relative in September and October is highest (85-90%), lowest in January and February (79-82%). The difference between the highest average humidity month and lowest month is 13%, the humidity increases from the sea to the mainland.

- Wind: Can Tho city is influenced by monsoon regime; there are 2 monsoons in a year: the Northeast (from November to April) coinciding with the dry season and the Southwest (from May to October), which coincides with the rainy season.

The Northeast monsoon is mainly the East wind, accounting for 50-70% of all occurrences in a month, the highest average monthly wind speed is 3.0m/s (in February), the highest instantaneous wind speed is 21.0 m/s;

The Southwest monsoon is mainly the West wind, accounting for 40-50% of all occurrences in a month. The highest average monthly wind speed is 1.8 m/s, the highest instantaneous wind speed is 24.0 m/s.

- Rain: Can Tho city has a high rainfall in the Mekong Delta with average annual rainfall measured of 1,566mm. The rainy season starts from May to November, coinciding with the period of the southwest monsoon, the rainfall in the rainy season takes more than 90% of the annual rainfall with the average number of rainy days in the season is 124 days.

During the rainy season, average rainfall increases from May (around 200mm, with more than 10 rainy days), from July-October, the rainfall is largest (of which, September and October has more rainfall, by around 300mm with the number of rainy days ranged from 19-20 days). Passing November, the average rainfall decreases, which generally remains around 150mm with the number of rainy days ranged 11-15 days.

Table 2.2: Rainfall in months in Can Tho city

No.	2005	2006	2007	2008	2009	2010	2011	2012	2013
Whole year	*1.731,90*	*1.642,2*	*1.501,1*	*1.509,7*	*1.247,7*	*1.310*	*1.495,5*	*1.226,9*	*1.339,7*
January	-	9,5	18,6	17,8	-	14,7	1,8	1,2	15,1
February	-	11,1	-	8	31,3	-	-	8,6	3,7
March	4,8	98,8	79,7	-	55,6	0,6	103,9	141,6	-
April	0,5	116,3	18,7	128,4	2,9	1,1	1,1	111,5	54,5
May	93,7	207,6	272,6	173,2	76	66,5	155,7	71,6	169,1
June	197,8	138,7	174,1	159,5	136,6	195,9	181,1	136,5	255,2
July	254,6	175,8	102,8	119,8	116	143,8	384,5	133,1	156,8
August	108,8	148,1	230,4	216,5	200,6	214,5	167,7	90,7	112,6
September	307,4	307,3	187,6	254,5	122,5	120,9	152,2	299,7	336,7
October	311,5	295,4	347,2	223,1	133,8	265,4	101,3	200,6	138,9
November	315,5	61,4	67,4	147,6	209,5	204,0	191,1	15,8	94,6
December	137,7	72,2	2	61,3	138,8	82,4	55,1	16	2,5

Source: Statistical Yearbook 2013 of Can Tho city

❖ ***Hydrological regime***

The flow regime in the rivers, canals and creeks of the city is dominated by the flow of Mekong river, Eastern sea tide, local rains and infrastructure with the strongest domination by interference between flow regime in the upstream of the Mekong river and the tidal regime in the Eastern sea.

- The city is located in the area affected by the irregular semi-diurnal of the Eastern sea over the Hau river, Can Tho river and canals with the relatively strong amplitude and tide peak ranging from +107 ÷ +173 cm compared to the common field surface elevation ranging from 100-120 cm. It is possible to take advantage of tide for gravity irrigation for crops, water supply for aquaculture almost entire area of the region. However, at the end of the dry season when irrigation water is required, tide peak is low (+119 ÷ +129 cm). In order to expand area of gravity irrigation, it is required to regularly clear canals in combination with pumping and irrigation in areas with high terrain. Conversely, during the rainy season, especially in September to November, tide peak reaches the highest level (+ 163 ÷ + 173 cm) and heavy infield rains, flooding from upstream, slightly inclined topography surface from the river banks into infield, resulting in difficulty in water drainage, leading to fairly deep inundation in low-lying areas.

- The dry season begins from December to next May when the flows on the rivers decrease (accounting for 10-15% of total water volume all year). However, due to strong impact by tide, the river water level in these months increases, especially in January and February, the tide peak on the Hau river is generally 20- 30 cm higher than the field surface. Conversely, the flood season begins from June to November when the flows on the rivers increase (accounting for 85-90 % of total water volume all year) with the highest water level in September to October. The water level in the Hau river is from 30- 60 cm higher than field surface and lower from November onwards.

Table 2.3: Tide water level in months at Can Tho substation

(Unit: cm)

Water level	**Months of year**											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1. Medium highest, lowest in several years												
H max	138	130	119	113	108	107	129	146	164	173	163	148
H min	-91	-	-	-	-	-	-	-68	-42	-1	-34	-64
2. Absolute highest, lowest in several years												
H max	149	134	130	124	129	134	153	159	179	179	184	164
H min	-	-	-	-	-	-	-	-92	-74	-45	-63	-76

** Source: Can Tho City Centre for Hydro-Meteorological Forecast*

❖ ***<u>The network of rivers, canals and creeks</u>***

Can Tho city has a relatively dense network of rivers, canals and creeks which can be preliminarily divided into the following groups:

- Natural rivers:

+ Hau river: is the northeast boundary of the city. The river section in Can Tho city is nearly 60km long, the river is average 1,500 to 2,000m wide and 14 - 18m deep. Hau river is the main drainage axis, responsible for drainage of rainwater and flood for the city. Flood flow in the river ranges 1,800 to 2,000 m^3/s; the lowest flow in dry months is about 300-400 m3 / s.

+ Can Tho river is located in the southern of Can Tho city, it plays very important role in conducting the water as well as being the waterway to remote and far areas from Hau river.

+ Natural large creeks formed by the movement of rainwater, floods and tides connected with Hau River include: creeks of Binh Thuy, Tra Noc, O Mon, Cai Cui, Cai Dau; These creeks are 50 to 300m wide with bottom elevation ranged -4.0 to -10,0m; total length of natural rivers and canals in the area is about 310km. Together with Hau river, these creeks form a vital network for distribution, supply/drainage of water as well as transportation in the province.

-Network of axis canals/primary canals:

The axis canal network is distributed evenly in Can Tho city, about every 4-5km there is one canal. These canals have a length of between 30 and 60 km, width from 10 to 30m, bottom depth ranging from -2.0 to -5,0m. Each canal has dozens of branches connected. The total length of the canal network is more than 300km.

The primary canal network is connected to the 60 main existing canals with a total length of about 350km.

- Secondary canal network:

Can Tho city has around 800 km of secondary canals, the average density is about 11m/ha. The surface of secondary canals are often 6 to 8 meters wide with bottom elevation ranged from 0.0 - 2.0m. The length of each canal is 1.5 to 5 km;

- Tertiary canal network:

This network of canals is associated with rice fields. The people themselves perform the maintenance and dredging annually. The entire province has about 750 tertiary canals, with a length of about 1000km, the average density of about 8m/ha. The canals are 2-3m wide wit bottom elevation ranged 0.0 to -0,5m.

❖ ***Infield flooding situation***

Every year, from the late July to the late August, water level on canals in the region rapidly increases due to flooding from the Long Xuyen Quadrilateral region crossing National Highway 80 and flows from the Hau river to National Highway 91 and in combination with heavy infield rains, leading to massive flooding.

Table 2.4: Average monthly water level at Can Tho and Tan Hiep Substations

(Elevation: Hon Dau; Unit: m)

Position	**Months in year**											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Can Tho	0,49	0,35	0,25	0,13	0,07	0,10	0,30	0,49	0,71	0,91	0,85	0,66
Tan Hiep (Kien Giang)	0,27	0,14	0,09	0,03	0,06	0,19	0,37	0,56	0,88	1,24	1,11	0,66

** Source: Water resource management planning in river basins in Can Tho city*

Flood peak often appears in the late September to the end of October, with the decreasing time in the direction from North to South. Approximately 88.7% of the area is located in the shallow flooded areas and flood controlled actively all year round. Only 11.3% of the area is flooded deeply and located in the flood control area. Flood is functioned to provide alluvial and antidotal for the environment. However, flood is also costly for construction of the residential areas, industrial parks and infrastructure. The heaviest flood -historical flood (in 2000) affected quite badly to the autumn-winter rice production, fruit gardens and aquaculture.

2.1.5. Natural Resources

❖ ***Soil***

Generally, land within Can Tho city is fairly good with the following groups and categories: alluvial soil, banked soil, alkaline soil, banked alkaline soil, potential alkaline soil. Compared with the total natural area, alluvial soil and banked soil account for 71.14% (99,675 ha); alkaline soil and banked alkaline soil account for 18.43% (25,811 ha), in which the potential alkaline soil and agricultural activities accounted for only 3.71% (5,192 ha).

❖ ***Water resources***

Surface water resource

In addition to rainwater, main source to supply water for Can Tho city is from the Hau river through axis canals such as Rach Gia – Long Xuyen, Tron, Cai San (in Long Xuyen quadrilateral region), Thot Not, Thom Rom, KH 2, KH 7, O Mon, Xa No (in the West of the Hau river). In comparison with other provinces of the Mekong delta region, Can Tho is one of localities having convenient freshwater supply source with abundant water sources, good quality and gravity irrigation which can be used in several areas.

Ground water

Ground water in the city is quite abundant with 4 hydrological complexes containing different water levels:

- Complex containing Holoxen sediment water is a complex containing groundwater with free surface and sediment thickness varying from 40- 70 m, small reserve, unqualified quality according to domestic water standards in terms of microbiology.

- Complex containing Pleistocene sediment porous aquifer: is a complex containing porous-type water in depth from 80 to 150 m, water reserves varying among regions with total reserves of approximately 716,440 m3/day and good water quality. This is the layer with highest reserves of water but unevenly distributed, therefore, it is only suitable for small-scale mining and requires thorough investigation before exploitation.

- Complex containing Plioxen sediment porous stratal water: the sediment thickness varies from 130 to 180 m, water reserves are abundant with a total reserves of approximately 361,300 m3/day. However, due to high degree of mineralization (1,28- 9.40 mg/l), sometimes up to 21.56 mg/l, it can’t meet domestic water standards to supply to the city.

- Complex containing Mioxen sediment porous stratal water: The sediment thickness varies from 450 to 500 m with total water reserves of about 273,600 m3/day. This is water layer with strong pressure and high degree of mineralization (1.49 – 3.92 mg/l), high temperature (39 – 40^0C) and potential for exploiting mineral water.

Currently, residents in most of localities in the city are exploiting groundwater for domestic purpose.

❖ ***Forest resources***

Compared with the coastal provinces of the Mekong Delta region, the forest resources of Can Tho city are not much. According to the results of land inventory in 2010, the city only has 227 hectares of plantations with the majority of eucalyptus trees. Currently, this entire area has been planned to be transformed into other agricultural land in order to improve efficiency of use.

❖ ***Mineral Resources***

Minerals serving the socio-economic development in Can Tho city consist of peat, brick and tile clay, construction sand, of which:

- Brick and tile clay is scattered in the districts with the layer thickness from 1.5 to 2.0 m and able to be exploited for manufacturing bricks and tiles. However, it is required to pay attention to treatment of aluminous status in some areas.

- Peat has a reserves of about 30-50 thousand of tons, concentrated in Vinh Thanh and Co Do with limited mining capacity.

- River sand has a reserves of about 70 million cubic meters, currently being exploited and able to meet needs of construction sand of Can Tho city but unable to meet needs of other provinces in the Mekong delta region.

2.2. CURRENT SITUATION OF ENVIRONMENTAL QUALITY IN PROJECT AREA

To evaluate the quality of environmental components at the project area, the Client and Consultants coordinated with Ho Chi Minh Centre for Analysis and Environment to carry out the survey, measurement and sampling of environment components in accordance with Vietnam standards and analyzing in the laboratory, as well as collecting relevant information and data. For detailed results of each analyzed sample, refer to the Annexes. The methods of measurement and sampling, storage, transportation, treatment and analyzing of samples in laboratory are carried out in compliance with regulations of Vietnam's applicable standards.

2.2.1. Air Quality

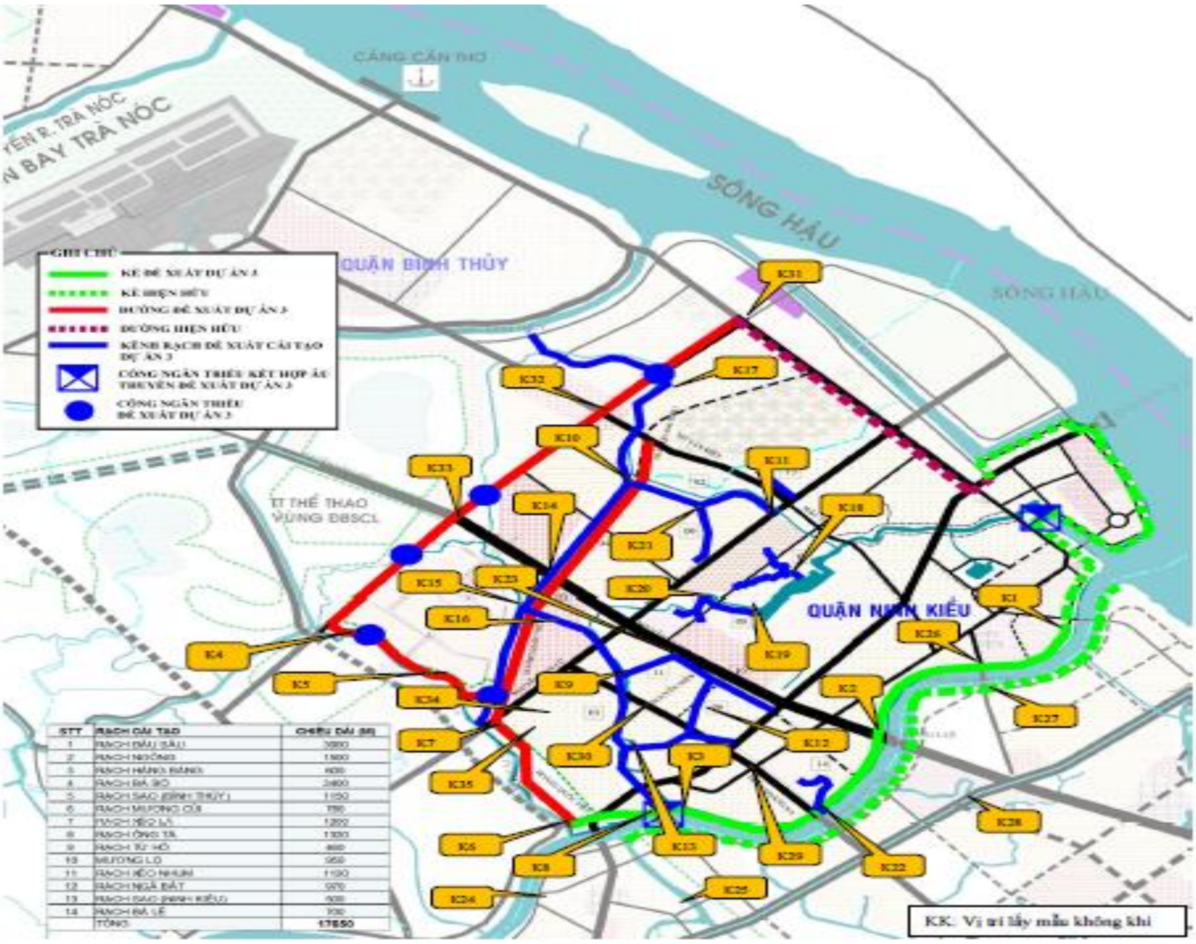


Figure 2.2: Air sampling position map

❖ ***Time of sampling:***

Dates of sampling are 26, 27, 28 May 2015

Weather condition: It is sunny, slightly windy and temperature varying from 29-34^{0}C; Humidity: 60-80%

Table 2.5: Analytical Results Of Ambient Air Samples

No.	Code	Sampling position	Sampling coordinates	Measurement and Analysis Indicators						
				Dust (*)[1]	NO_2 (*)	SO_2 (*)	CO	Noise (*)	Vibration	
									Velocity of vibration	Acceleration of vibration
				µg/m^3	µg/m^3	µg/m^3	µg/m^3	dBA	mm/s	m/s^2
1	K1	Ngo Duc Ke road intersecting with Hai Ba Trung road	X= 0586130 (m) Y= 1108925 (m)	230	63	71	1354	66.4	0.1	0.00
2	K2	Hung Loi bridge pier crossing Ninh Kieu	X= 0584314 (m) Y= 1107555 (m)	275	67	74	1750	67.5	0.2	0.01
3	K3	End of Tam Vu road	X= 0582790 (m) Y= 1106700 (m)	207	65	72	1285	63.8	0.1	0.00
4	K4	Nga Cai creek intersection with Muong Khai creek	X= 0579910 (m) Y= 1108842 (m)	125	55	63	1076	54.7	0.0	0.00
5	K5	Bend corner of Muong Khai near Gua creek intersection	X= 0580564 (m) Y= 1108251 (m)	116	54	60	1109	56.5	0.0	0.00
6	K6	Cai Son bridge pier on Lo Vong Cung road	X= 0581732 (m) Y= 1106428 (m)	124	59	62	985	56.4	0.0	0.00
7	K7	Under Cai Son bridge pier on Nguyen Van Cu road	X= 0581171 (m) Y= 1107641 (m)	196	67	73	1450	55.8	0.0	0.00
8	K8	End of Dau Sau creek intersecting with Can Tho river	X= 0582578 (m) Y= 1106736 (m)	148	65	67	1262	68.4	0.0	0.00
9	K9	Intersection of Xeo Nhum and Dau Sau creeks	X= 0582332 (m) Y= 1108344 (m)	127	58	62	1055	54.1	0.0	0.00
10	K10	Intersection of Ngong and Ba Bo creeks	X= 0582383 (m) Y= 1110755 (m)	93	54	57	860	52.8	0.0	0.00

[1] (*): *Criterion recognized by VILAS*

No.	Code	Sampling position	Sampling coordinates	Measurement and Analysis Indicators						
				Dust (*)[1]	NO_2 (*)	SO_2 (*)	CO	Noise (*)	Vibration	
									Velocity of vibration	Acceleration of vibration
				µg/m³	µg/m³	µg/m³	µg/m³	dBA	mm/s	m/s²
11	K11	Rach Ngong 2 bridge on Nguyen Van Cu road	X= 0583473 (m) Y= 1110325 (m)	247	71	78	1770	65.7	0.1	0.00
12	K12	In middle of Muong Cui creek	X= 0582897 (m) Y= 1107911 (m)	164	62	70	1450	65.3	0.0	0.00
13	K13	Intersecting point between Dau Sau and Nga Bat creeks	X= 0582349 (m) Y= 1107435 (m)	120	57	63	1230	62.5	0.0	0.00
14	K14	Ba Bo bridge on Nguyen Van Linh road	X= 0581571 (m) Y= 1109574 (m)	216	67	74	1870	66.8	0.1	0.01
15	K15	Intersection of Ba Bo and Phu Tho creeks	X= 0581237 (m) Y= 1109161 (m)	152	63	69	1550	67.9	0.0	0.00
16	K16	Concrete bridge between Hang Bang creek - section between Ba Bo and Dau Sau creeks	X= 0581813 (m) Y= 1109099 (m)	180	60	65	1172	58.2	0.0	0.00
17	K17	Van bridge on Tran Quang Dieu road	X= 0582696 (m) Y= 1112004 (m)	192	65	73	1590	67.0	0.1	0.00
18	K18	Xeo La bridge on Xeo La creek	X= 0583632 (m) Y= 1109601 (m)	122	54	63	1065	60.5	0.0	0.00
19	K19	Ong Ta bridge on Ong Ta creek	X= 0583387 (m) Y= 1109169 (m)	145	52	64	1280	56.8	0.0	0.00
20	K20	Concrete bridge to inter-group 8-7-6 alleys on Ong Ta creek	X= 0583016 (m) Y= 1109272 (m)	105	55	57	917	58.9	0.0	0.00
21	K21	Intersection of Tu Ho and Ngong creeks	X= 0582924 (m) Y= 1110414 (m)	163	64	69	1525	63.5	0.0	0.00
22	K22	Iron bridge on Tam Vu road crossing Ba Le creek	X= 0583994 (m) Y= 1106758 (m)	142	58	65	1235	64.7	0.0	0.00

No.	Code	Sampling position	Sampling coordinates	Measurement and Analysis Indicators						
				Dust (*)[1]	NO_2 (*)	SO_2 (*)	CO	Noise (*)	Vibration	
									Velocity of vibration	Acceleration of vibration
				µg/m^3	µg/m^3	µg/m^3	µg/m^3	dBA	mm/s	m/s^2
23	K23	Under Bridge 3 on Nguyen Van Linh road	X= 0582728 (m) Y= 1108611 (m)	226	68	75	2100	**71.4**	0.3	0.02
24	K24	Ranh creek in section intersecting with alley road 5	X= 0581573 (m) Y= 1105640 (m)	270	65	78	1920	67.5	0.1	0.00
25	K25	Concrete bridge at the end of Thuy Loi canal adjacent to Cai Rang Be river	X= 0582754 (m) Y= 1105466 (m)	140	57	61	1050	61.0	0.0	0.00
26	K26	Quang Trung bridge on side of Ninh Kieu district	X= 0585366(m) Y= 1108476 (m)	160	65	68	1350	69.5	0.2	0.00
27	K27	Quang Trung bridge on side of Cai Rang district	X= 0585375 (m) Y= 1108200 (m)	168	63	69	1176	68.5	0.1	0.00
28	K28	Cai Da bridge pier on Road IC3	X= 0584820 (m) Y= 1106683 (m)	210	70	84	1875	68.7	0.3	0.01
29	K29	Road 30/4 intersecting with Tran Hoang Na road	X= 0583353 (m) Y= 1107204 (m)	224	67	72	1360	67.5	0.2	0.01
30	K30	Nguyen Hien and A3 Cross-road	X= 0582571 (m) Y= 1107976 (m)	189	66	76	1640	61.4	0.1	0.00
31	K31	Alley 91 intersecting with August Revolution road	X= 0583184 (m) Y= 1112750 (m)	246	71	78	1850	68.9	0.4	0.02
32	K32	On Vo Van Kiet road, 400m from Ba Bo bridge	X= 0582149 (m) Y= 1111525 (m)	207	65	72	1580	62.3	0.1	0.00
33	K33	Pho Tho creek	X= 0581009 (m) Y= 1110291 (m)	232	72	78	2040	67.5	0.5	0.02
34	K34	End of Road 4 in Hong Lac residential area	X= 0581810 (m) Y= 1108117 (m)	150	55	63	1130	55.8	0.0	0.00

No.	Code	Sampling position	Sampling coordinates	Measurement and Analysis Indicators						
									Vibration	
				Dust (*)[1]	**NO_2** (*)	**SO_2** (*)	**CO**	**Noise** (*)	Velocity of vibration	Acceleration of vibration
				µg/m³	µg/m³	µg/m³	µg/m³	dBA	mm/s	m/s^2
35	K35	End of alleys 234	X= 0581638 (m) Y= 1107868 (m)	143	58	61	1074	56.3	0.0	0.00
Test method				*TCVN 5067-1995*	*TCVN 6137-2009*	*TCVN 5971-1995*	*HD03-PT-CO*	TCVN 7878/2-2010	TCVN 6963:2001 *(EL - CALC version 1.1.08)*	
QCVN 05:2013/BTNMT (1 hour)				**300**	**200**	**350**	**30.000**			
QCVN 26:2010/BNTNMT								**70**		
QCVN 27:2010/BNTNMT									**-**	**0,03**

The measurement results show that analysis indicators are within permitted limits of QCVN 05:2013/BTNMT, within one hour. Measurement result of noise level at K23 exceeds permissible noise standards by 0.02% QCVN 26:2010/BTNMT. It might be because of high traffic volume area, near Can Tho Hospital, residential area 91b and 91B bus terminal.

2.2.2. Surface Water Quality

The results show that analytical indicators of most of samples are within the permitted limits of national standard for the water used for waterway transportation (QCVN 08: 2008/BTNMT Column B) (Table 2.8). However, the indicators of NH4+, NO_2^- of most samples are higher than the thresholds of the national standard. Concretely, NH_4^+ indicator exceed national stardard by 1.15 to 26 times and NO_2^- indicators also exceed standard by 1.4 to 46 times. Indicators on BOD_5, COD, and coliform exceed national standard for waterway transportation respectively by 2 times, 6 times, and 2.5 times.

The high level of pollutans in the surface water can be explained by the direct discharge of waste water and garbage throwing from households along the canals/river. The magnitudes of pollution are varied. It is observed that the surface water in primary canals i.e Can Tho river (sample NM1-4); Muong Khai creek (NM5), Cai Son creek (NM6) are less polluted than those from the secondary canals as Dau Sau (NM8) and Ngong (NM9). The tertiary canals – the creeks in the urban core areas (NM10-30) showed the highest level of pollution. The result could be explained by the fact that, velocity and volume of primary canals are highest, thus, the pollutant are diluted. In contrast, the velocity and flow of the 3rd canals are lowest, in many cases, they are stuck, leading to very high level of pollutants.

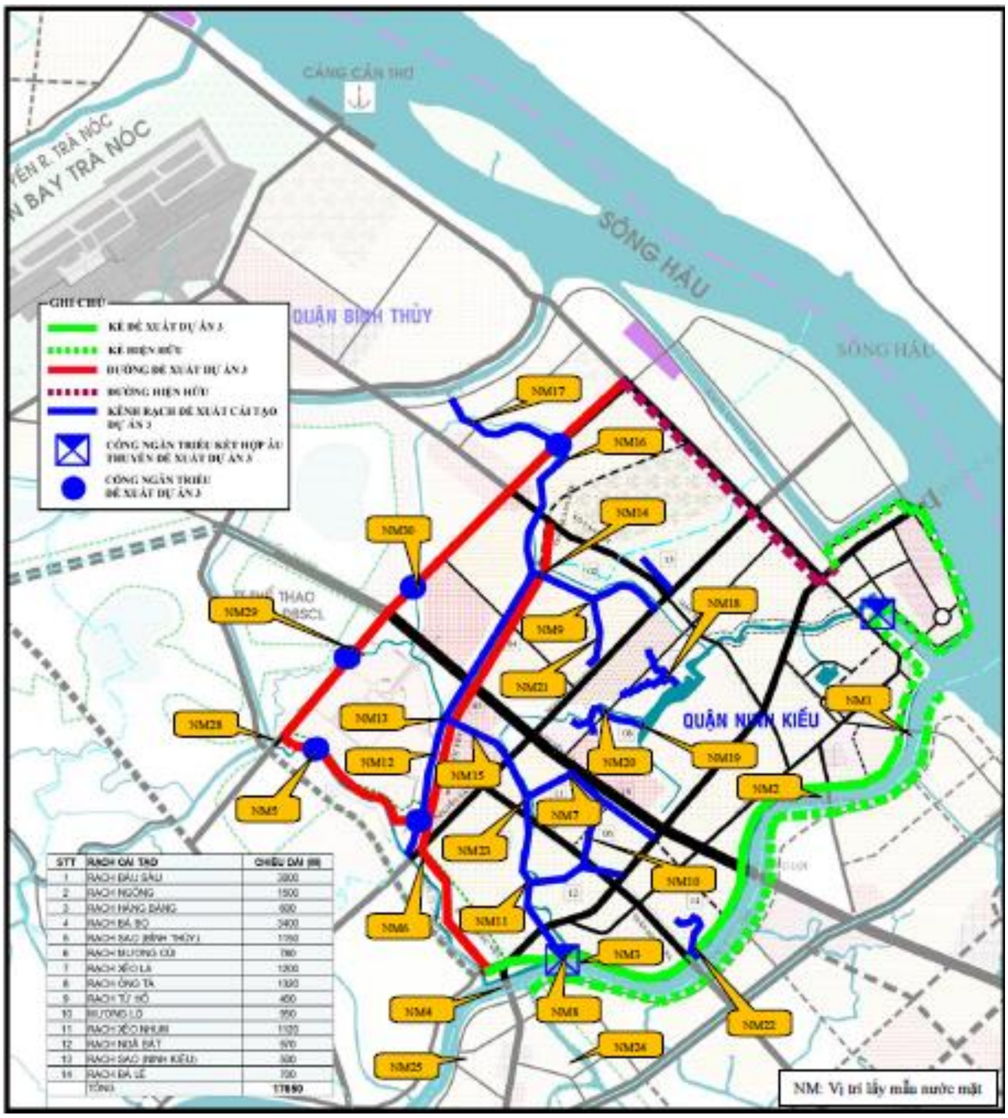


Figure 2.3: Location map of sampling surface water

Table 2.6: Position of Sampling Surface Water

Code	Position	Coordinates	Code	Position	Coordinates	Code	Position	Coordinates
NM1	Embankment of Ngo Duc Ke road intersecting with Hai Ba Trung road	X= 0586170 (m) Y= 1108928 (m)	NM11	Intersection of Dau Sau and Nga Bat creeks	X= 0582397 (m) Y= 1107439 (m)	NM21	Bridge pier crossing Tu Ho creek on Nguyen Tri Phuong road	X= 0582945 (m) Y= 1109827 (m)
NM2	Quang Trung bridge on side of Cai Rang district	X= 0585395 (m) Y= 1108200 (m)	NM12	Hang Bang creek opposite to Nam Hieu ecotourism destination	X= 0581024 (m) Y= 1108123 (m)	NM22	Iron bridge on Tam Vu road crossing Ba Le creek	X= 0583996 (m) Y= 1106766 (m)
NM3	Can Tho river bank at the end of Tam Vu road	X= 0584026 (m) Y= 1106699 (m)	NM13	Intersection of Ba Bo and Phu Tho creeks	X= 0581258 (m) Y= 1109176 (m)	NM23	Intersection of Xeo Nhum and Dau Sau creeks	X= 0582332 (m) Y= 1108344 (m)
NM4	Can Tho river bank crossing Cai Rang bridge	X= 0581528 (m) Y= 1106420 (m)	NM14	Intersection of Ngong and Ba Bo creeks	X= 0582383 (m) Y= 1110755 (m)	NM24	Rang creek section adjacent to Cai Rang river	X= 0581476 (m) Y= 1105640 (m)
NM5	Nga Cai creek intersection with Muong Khai creek	X= 0579933 (m) Y= 1108847 (m)	NM15	Concrete bridge between Hang Bang creek - section between Ba Bo and Dau Sau creeks	X= 0581813 (m) Y= 1109099 (m)	NM25	Concrete bridge at the end of Thuy Loi canal adjacent to Cai Rang Be river	X= 0582750 (m) Y= 1105486 (m)
NM6	Under Cai Son bridge pier on Nguyen Van Cu road	X= 0581171 (m) Y= 1107641 (m)	NM16	Van bridge crossing Sao creek (Binh Thuy) on Tran Quang Dieu road	X= 0582696 (m) Y= 1112004 (m)	NM26	O Mon bridge pier	X= 0569342 (m) Y= 1117903 (m)
NM7	Bridge No.3 on Nguyen Van Linh road crossing Xeo Nhum creek	X= 0582728 (m) Y= 1108611 (m)	NM17	Iron bridge at the end of Sao creek intersecting with Suc creek	X= 0581760 (m) Y= 1112333 (m)	NM27	Ba Rich bridge pier	X= 0570167 (m) Y= 1119272 (m)
NM8	End of Dau Sau creek intersecting with Can Tho river	X= 0582483 (m) Y= 1106850 (m)	NM18	Xeo La bridge on Xeo La creek	X= 0583622 (m) Y= 1109593 (m)	NM28	Intersection of Muong Khai creek and Pho Tho creek	X= 0579449 (m) Y= 1109003 (m)
NM9	Tu Ho intersecting with Ngong creek	X= 0582932 (m) Y= 1110469 (m)	NM19	Ong Ta bridge on Ong Ta creek	X= 0583379 (m) Y= 1109155 (m)	NM29	Phu Tho canal is about 300m from Ba Bo bridge on Nguyen Van Linh road	X= 0580744 (m) Y= 1110352 (m)
NM10	Concrete bridge in middle of Muong Cui creek	X= 0582897 (m) Y= 1107911 (m)	NM20	Concrete bridge to inter-group 8-7-6 alleys on Ong Ta creek	X= 0583007 (m) Y= 1109271 (m)	NM30	Suc creek is about 400m from Ba Bo bridge on Nguyen Van Linh road	X= 0581277 (m) Y= 1110343 (m)

Table 2.7: Analytical results of surface water samples

No.	Code	Measurement and analysis indicators												
		pH (*)[2]	**DO**	**TSS (*)**	**COD** (*)	**BOD_5 (*)**	**$P\text{-}PO_4^{3-}$ (*)**	**$N\text{-}NH_4^{+}$** (*)	**$N\text{-}NO_2^{-}$** (*)	**$N\text{-}NO_3^{-}$**	**Cl^{-}**	**Fe**	**Total grease**	**Total Coliform**
		-	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	MPN/100ml
1	**NM1**	6.84	6.0	12	12	6	0.07	**1.69**	0.07	**0.15**	39.0	0.08	0.03	$91*10^{1}$
2	**NM2**	6.32	5.8	25	14	8	0.10	**1.70**	0.08	**0.13**	41.7	0.10	KPH	$15*10^{2}$
3	**NM3**	6.41	6.0	10	12	5	0.06	**1.15**	**0.12**	**1.06**	38.6	0.07	0.03	$93*10^{1}$
4	**NM4**	6.32	5.8	16	10	5	0.06	**4.90**	**0.08**	**1.05**	40.0	0.12	KPH	$11*10^{2}$
5	**NM5**	6.87	5.3	27	28	16	**1.06**	**7.00**	**1.24**	**0.08**	41.9	0.20	KPH	$15*10^{2}$
6	**NM6**	6.51	5.8	20	28	14	**0.94**	**9.56**	**1.02**	**0.07**	37.5	0.18	0.03	$43*10^{2}$
7	**NM7**	6.39	**3.4**	46	63	**30**	1.75	**20.04**	**1.40**	**0.09**	57.5	0.27	0.02	$25*10^{3}$
8	**NM8**	6.70	5.7	22	18	10	**2.02**	**12.41**	**1.52**	**0.19**	42.0	0.30	KPH	$61*10^{2}$
9	**NM9**	6.55	4.3	31	**50**	**27**	**1.67**	**8.02**	**0.18**	**0.07**	45.0	0.10	KPH	$25*10^{2}$
10	**NM10**	7.20	**3.8**	53	**76**	41	**2.21**	**26.60**	**2.30**	**0.10**	52.5	0.26	0.04	$16*10^{3}$
11	**NM11**	6.89	4.2	24	**66**	**35**	**1.54**	**16.33**	**0.86**	**0.15**	41.0	0.25	0.03	$11*10^{3}$
12	**NM12**	7.00	6.0	18	7	4	0.04	**5.27**	**2.15**	**0.31**	37.8	0.17	KPH	$24*10^{2}$
13	**NM13**	7.03	6.2	40	38	17	1.25	**8.60**	**1.20**	**0.42**	49.0	0.26	0.06	$36*10^{2}$
14	**NM14**	6.57	4.9	42	45	24	**2.30**	**5.17**	**1.60**	**0.21**	42.7	0.19	0.03	$13*10^{2}$
15	**NM15**	6.54	5.0	34	32	15	**2.05**	**9.34**	**0.67**	**0.25**	38.0	0.20	0.02	$29*10^{2}$
16	**NM16**	7.01	**3.2**	45	**87**	**46**	**2.50**	**26.20**	**1.56**	**0.77**	72.5	0.17	0.04	$21*10^{3}$
17	**NM17**	6.56	5.8	19	20	10	**1.36**	**7.65**	**0.88**	**0.32**	65.0	0.10	0.02	$36*10^{2}$
18	**NM18**	7.20	4.7	28	30	16	**1.78**	**20.51**	**1.85**	**0.09**	57.5	0.16	0.04	$95*10^{2}$
19	**NM19**	6.59	4.5	28	34	18	**2.55**	**12.43**	**0.60**	**0.19**	42.1	0.20	0.05	$75*10^{2}$
20	**NM20**	7.04	**3.8**	46	**68**	**37**	**1.82**	**18.50**	**1.89**	**0.20**	40.6	0.22	0.03	$19*10^{3}$
21	**NM21**	7.01	4.7	49	47	21	**2.00**	**14.64**	**2.15**	**0.06**	40.1	0.17	KPH	$27*10^{2}$

[2](*): *Criterion recognized by VILAS*

No.	Code	Measurement and analysis indicators												
		pH (*)2	**DO**	**TSS (*)**	**COD** (*)	**BOD$_5$ (*)**	**P-PO$_4^{3-}$ (*)**	**N-NH$_4^+$** (*)	**N-NO$_2^-$** (*)	**N-NO$_3^-$**	**Cl$^-$**	**Fe**	**Total grease**	**Total Coliform**
		-	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	MPN/100ml
22	**NM22**	7.30	4.2	48	46	**27**	**2.25**	**18.76**	**1.40**	**0.12**	51.3	0.20	0.05	$12*10^3$
23	**NM23**	7.12	**3.5**	36	**55**	**32**	**2.86**	**17.90**	**1.39**	**0.17**	46.6	0.25	0.03	**$95*10^2$**
24	**NM24**	7.22	5.0	32	31	17	**2.00**	**12.60**	**0.84**	**0.21**	34.4	0.12	0.02	**$75*10^2$**
25	**NM25**	6.59	4.9	20	**54**	**29**	**1.56**	**19.08**	**1.49**	**0.06**	57.5	0.16	KPH	**$15*10^3$**
26	**NM26**	6.80	6.1	27	15	7	0.10	**2.20**	**2.16**	**0.09**	40.6	0.12	KPH	**$11*10^2$**
27	**NM27**	6.73	6.3	34	16	8	0.19	**1.63**	**1.17**	**0.11**	39.7	0.06	KPH	930
28	**NM28**	6.71	6.2	39	19	10	**0.98**	**5.50**	**0.20**	**0.12**	31.8	0.21	0.04	$21*10^2$
29	**NM29**	6.39	5.0	42	32	17	**1.05**	**7.60**	**0.26**	**0.10**	37.5	0.09	0.02	$72*10^2$
30	**NM30**	6.52	5.8	31	13	8	**0.54**	**4.54**	**0.22**	**0.14**	42.5	0.10	0.03	$16*10^2$
Test method		TCVN 6492: 2011	TCVN 7325: 2004	SMEWW 2540D-2012	SMEWW 5220C -2012	SMEWW 5210B-2012	SMEWW 4500 P. D -2012	SMEWW 4500.NH_3 .C:2012	SMEWW 4500.NO_2 .B:2012	TCVN 6180:1996	SMEWW 4500.Cl .B:2012	SMEWW 3500.Fe .B:2012	SMEWW 5520C:2012	TCVN 6187-2:1996
QCVN 08: 2008/BTNMT Column B	**B1**	**5.5-9**	**≥ 4**	**50**	**30**	**15**	**0.3**	**0.5**	**0.04**	**10**	**600**	**1.5**	**0.1**	**7.500**
	B2	**5.5-9**	**≥ 2**	**100**	**50**	**25**	**0.5**	**1**	**0.05**	**15**	**-**	**2**	**0.3**	**10.000**

Note: KPH: Not detect LOD: Detection threshold; QCVN 08: 2008/BTNMT: National technical regulation on quality of surface water.

Column B1: surface water quality used for irrigation purpose

Column B2: surface water quality used for inland waterway purpose

2.2.3. Underground Water Quality

Table 2.8, 2.9 present position of sampling underground water and analytical results of underground water quality .Analytical results show that most of analytical indicators pass permitted limits according to QCVN 09:2008/BTNMT (national technical regulation on surface water). However, Coliform and E.Coli indicators exceed permitted limits many times. It is because the positions of ground water samples are near some local market, the drainage system of local people here is self-absorbed and the wells are not kept in a good condition. It means that underground water here is unusable for domestic purpose unless underground water is treated. Using untreated underground water will cause digestion diseases..

Table 2.8: Positions of Sampling Underground Water

Code	Sampling positions	Coordinates
NN1	Lam Van Mung, No. 1C, Quang Trung road, Xuan Khanh ward, Ninh Kieu district, Can Tho city, well is about 80m deep (Can Tho embankment).	X = 0585330 (m) Y = 1108497 (m)
NN2	Le Cong Binh, No. 205/5, Nguyen Loi A, An Binh ward, Ninh Kieu district, Can Tho city, well is about 70m deep (Can Tho embankment).	X = 0581735 (m) Y = 1106435 (m)
NN3	Pham Kim Phong, No. 217, Binh Pho B, Long Tuyen ward, Binh Thuy district, Can Tho city. Well is about 80m deep (Muong Khai creek).	X = 0581022 (m) Y = 1108145 (m)
NN4	Do Van Viet, No. 220, Binh Pho B zone, Long Tuyen ward, Binh Thuy district, Can Tho city. Well is 100m deep (Ba Bo creek).	X = 0581087 (m) Y = 1108364 (m)
NN5	Diep Kien Xon, No. 238/4, Zone 4, An Binh ward, Ninh Kieu, Can Tho city. Well is about 80m deep (Cai Son creek).	X = 0581658 (m) Y = 1106586 (m)
NN6	Phan Thanh Phong, No. 315/9, Zone 4, An Binh ward, Ninh Kieu, Can Tho city. Well is about 120m deep (Cai Son creek).	X = 0581524 (m) Y = 1107534(m)
NN7	Le Thi Truc Mai, No. 34/1, Zone 1, An Binh ward, Ninh Kieu, Can Tho city. Well is about 120m deep (Dau Sau creek).	X = 0582535 (m) Y = 1106686 (m)
NN8	Nguyen Quoc Vy, No. 346A/2, Zone 6, An Khanh ward, Ninh Kieu district, Can Tho city. Well is about 104m deep (Dau Sau creek).	X= 0582332 (m) Y= 1108344 (m)
NN9	Ho Thi Hai, No. 2/34, Road 3/2, Hung Loi ward, Ninh Kieu district, Can Tho city. Well is about 80m deep (Nga Bat creek).	X = 0582231 (m) Y = 1107210 (m)
NN10	Le Thi Cuu, No. 127/8D, Vo Van Kiet road, An Hoa ward, Ninh Kieu district, Can Tho city. Well is about 60m deep (Ngong creek).	X= 0582932 (m) Y= 1110489 (m)
NN11	Tran Tuan Sang, No. 108/77, Tran Quang Dieu road, An Thoi ward, Binh Thuy district, Can Tho city. Well is about 100m deep (Ngong creek).	X= 0582383 (m) Y= 1110755 (m)
NN12	Nguyen Thi Hong, No. 299A, Group 4, Zone 4, An Khanh ward, Ninh Kieu district, Can Tho city. Well is about 90m deep (Hang Bang creek).	X = 0581650 (m) Y = 1109642 (m)
NN13	Vo Van Tao, No. 298, group 4, zone 4, An Khanh ward, Ninh Kieu district, Can Tho city. Well is about 120m deep (Ba Bo creek).	X = 0581653 (m) Y = 1109649 (m)
NN14	Nguyen Van Dom, No. 303/12, Binh Nhut A zone, Long Hoa ward, Ninh Kieu district, Can Tho city. Well is about 120m deep (Sao creek – Binh Thuy).	X= 0582696 (m) Y= 1112004 (m)
NN15	Vo Thi Yen, No. 174, Long Hoa ward, Binh Thuy district, Can Tho city. Well is about 80m deep (Sao creek – Binh Thuy).	X= 0581760 (m) Y= 1112333 (m)

Code	Sampling positions	Coordinates
NN16	Cao Thi Ba, No. 42/2, Zone 3, An Khanh ward, Ninh Kieu district, Can Tho city. Well is about 70m deep (Xeo La creek).	X = 0583339 (m) Y = 1109096 (m)
NN17	Nguyen Van Hoa, No. 31A/2, group 6, zone 2, An Khanh ward, Ninh Kieu district, Can Tho city. Well is about 100m deep (Ong Ta creek).	X = 0583203 (m) Y = 1109214 (m)
NN18	Pham Van Chinh, No. 166/9, zone 4, An Khanh ward, Ninh Kieu district, Can Tho city. Well is about 260m deep (Tu Ho creek).	X = 0582945 (m) Y = 1109827(m)
NN19	Tran Thi Luom, No. 162, Tam Vu road, zone 2, Hung Loi ward, Ninh Kieu district, Can Tho city. Well is about 80m deep (Ba Le creek).	X = 0584003 (m) Y = 1106782 (m)
NN20	Chau Thi Que, No. 329 C/11, Nguyen Van Linh road, Zone 3, An Khanh ward, Ninh Kieu district, Can Tho city. Well is about 180m deep (Xeo Nhum).	X= 0582728 (m) Y= 1108611 (m)
NN21	Tran Thi Kim Anh, No. 179, Yen Ha hamlet, Yen Trang zone, Le Binh ward, Cai Rang district, Can Tho city. Well is about 90m deep (Thuy Loi canal).	X = 0582607 (m) Y = 1105343 (m)
NN22	Tieu Tuan Xuan, No. 180/7, An Hoa zone, Thai Hoa ward, O Mon district, Can Tho city. Well is about 80m deep (O Mon embankment).	X= 0570167 (m) Y= 1119272 (m)
NN23	Nguyen Kim Thanh, No. 10, group 70, Hung Phu ward, Cai Rang district, Can Tho city. Well is about 80m deep (Quang Trung bridge).	X = 0584809 (m) Y = 1108074 (m)
NN24	Nguyen Van Toan, No. 1B/151, Alley 17, Tran Hoang Na road, Hung Loi ward, Ninh Kieu district, Can Tho city. Well is about 90m deep (Tran Hoang Na road).	X = 0583385 (m) Y = 1107040 (m)
NN25	Lam Hoang Dung, No. 545/21, group 9, Binh An zone, Dong Hoa ward, Binh Thuy district, Can Tho city. Well is about 100m deep (August Revolution road).	X= 0581277 (m) Y= 1110343 (m)

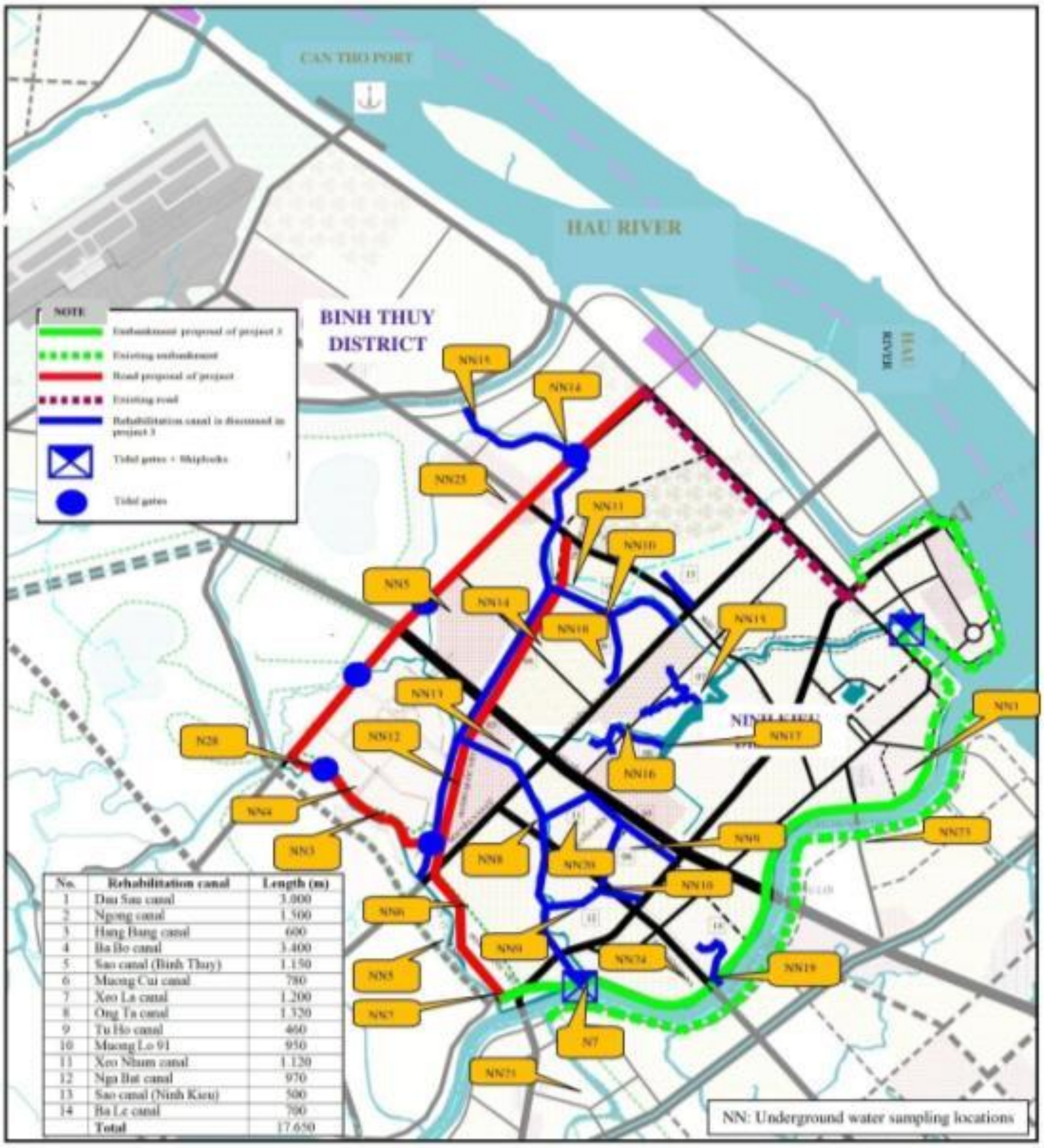


Figure 2.4: Location Map Of Sampling Underground Water

Table 2.9: Analytical Results Of Underground Water Quality

TT	Code	Measurement and analysis indicators											
		pH *(*[3])*	**Cl^-**	**$N\text{-}NH_4^+$** *(*)*	**$N\text{-}NO_2^-$** **(*)**	**$N\text{-}NO_3^-$**	**SO_4^{2-}**	**Hardness**	**As**	**Fe**	**Mn**	**Total Coliform**	**E.Coli**
		-	mg/l	mg/l	mg/l	mg/l	mg/l	mg $CaCO_3$/l	mg/l	mg/l	mg/l	MPN/100ml	MPN/100 ml
1	**NN1**	6.71	14	KPH	0.12	2.53	76.1	460	0.003	0.92	KPH	93	36
2	**NN2**	6.55	25	KPH LOD=0.02	0.34	1.47	85.9	412	0.002	3.61	0.03	110	62
3	**NN3**	6.64	21	KPH LOD=0.02	0.25	1.17	68.3	167	KPH LOD=0.001	2.64	0.02	92	40
4	**NN4**	6.43	27	KPH LOD=0.02	0.78	0.07	100.5	406	KPH LOD=0.001	2.63	KPH LOD=0.01	36	12
5	**NN5**	6.56	24	KPH	0.09	1.58	154.1	262	0.002	1.54	0.03	42	9
6	**NN6**	6.80	26	0.04	0.52	0.19	91.0	372	KPH LOD=0.001	1.20	KPH	11	KPH LOD=3
7	**NN7**	6.74	25	KPH	0.30	0.08	69.4	202	KPH LOD=0.001	0.52	KPH LOD=0.01	19	6
8	**NN8**	6.78	106	KPH	0.47	0.10	97.1	412	KPH	2.77	KPH	26	9
9	**NN9**	6.54	12	KPH LOD=0.02	0.07	2.06	67.9	99	0.002	0.16	KPH	120	36
10	**NN10**	6.61	19	0.04	0.22	0.87	81.5	215	0.003	1.24	0.02	200	95
11	**NN11**	6.36	18	KPH LOD=0.02	0.19	0.73	62.8	195	KPH LOD=0.001	0.63	KPH LOD=0.01	39	11
12	**NN12**	6.39	16	KPH LOD=0.02	0.11	1.06	86.2	205	KPH LOD=0.001	0.45	KPH LOD=0.01	26	KPH LOD=3

[3] (*): *Criterion recognized by VILAS*

TT	Code	Measurement and analysis indicators											
		pH (*3)	**Cl^-**	**$N-NH_4^+$ (*)**	**$N-NO_2^-$ (*)**	**$N-NO_3^-$**	**SO_4^{2-}**	**Hardness**	**As**	**Fe**	**Mn**	**Total Coliform**	**E.Coli**
		-	mg/l	mg/l	mg/l	mg/l	mg/l	mg $CaCO_3$/l	mg/l	mg/l	mg/l	MPN/100ml	MPN/100 ml
13	**NN13**	7.02	23	0.03	0.64	0.09	82.7	331	KPH LOD=0.001	0.38	KPH LOD=0.01	**13**	KPH LOD=3
14	**NN14**	6.84	22	KPH LOD=0.02	0.35	0.72	83.8	250	KPH LOD=0.001	0.20	KPH LOD=0.01	**21**	**9**
15	**NN15**	6.71	200	KPH LOD=0.02	0.91	0.04	185.6	478	0.002	0.51	0.03	**61**	**19**
16	**NN16**	6.21	24	KPH LOD=0.02	0.47	0.15	72.7	315	0.003	0.43	0.02	**95**	**44**
17	**NN17**	6.80	20	KPH LOD=0.02	0.30	0.17	69.6	299	KPH LOD=0.001	1.66	KPH LOD=0.01	**75**	**24**
18	**NN18**	6.76	16	KPH LOD=0.02	0.20	0.47	81.5	230	KPH LOD=0.001	1.49	KPH LOD=0.01	**9**	KPH LOD=3
19	**NN19**	6.89	25	KPH LOD=0.02	0.17	0.52	64.2	215	KPH LOD=0.001	2.71	KPH LOD=0.01	**29**	**9**
20	**NN20**	6.75	26	KPH LOD=0.02	0.07	0.73	91.6	287	KPH LOD=0.001	1.29	KPH LOD=0.01	**12**	**3**
21	**NN21**	7.00	12	KPH LOD=0.02	0.31	0.06	47.3	101	0.002	1.20	0.02	**24**	**16**
22	**NN22**	6.62	38	KPH LOD=0.02	0.24	0.05	59.9	150	KPH LOD=0.001	0.95	KPH LOD=0.01	**19**	**6**
23	**NN23**	6.49	27	KPH LOD=0.02	0.18	0.95	86.3	419	KPH LOD=0.001	1.71	0.02	**15**	KPH LOD=3
24	**NN24**	6.66	28	KPH LOD=0.02	0.17	1.12	76.5	372	KPH LOD=0.001	2.18	KPH LOD=0.01	**93**	**35**
25	**NN25**	6.72	35	KPH LOD=0.02	0.41	0.10	78.0	291	KPH LOD=0.001	0.65	KPH LOD=0.01	**29**	**13**
Test method		TCVN 6492:2011	SMEWW	SMEWW 4500.NH_3.F:2012	SMEWW	TCVN 6180:1996	SMEWW 4500.SO_4.E:2012	SMEWW	SMEWW 3113B-2012	SMEWW	SMEWW 3111B - 2012	TCVN 6187/2:1996	TCVN 6187/2:1996

TT	Code	Measurement and analysis indicators											
		pH ***(*3)***	**Cl^-**	**$N\text{-}NH_4^+$** ***(*)***	**$N\text{-}NO_2^-$** ***(*)***	**$N\text{-}NO_3^-$**	**SO_4^{2-}**	**Hardness**	**As**	**Fe**	**Mn**	**Total Coliform**	**E.Coli**
		-	mg/l	mg/l	mg/l	mg/l	mg/l	mg $CaCO_3$/l	mg/l	mg/l	mg/l	MPN/100ml	MPN/100 ml
			4500.Cl.B: 2012		4500-NO_2-B-2012			2340 C - 2012		3500.Fe. B:2012			
QCVN 09: 2008/BTNMT		**5.5 - 8.5**	**250**	**0.1**	**1.0**	**15**	**400**	**500**	**0.05**	**5**	**0.5**	**3**	**KPH**

Note: *KPH: Not detect LOD: Detection threshold;* *QCVN 09:2008/BTNMT: National technical regulation on quality of underground water.*

2.2.4. Domestic Wastewater Quality

Table 2.10, 2.11 present position and analytical results of sampling domestic waste water.Analytical results show that some analytical parameters are within permitted limits on national technical regulation on domestic waste water quality (QCVN 14:2008/BTNMT). However, most of the water samples were polluted as total Coliform, COD and $N\text{-}NH_4^+$ exceed permitted limits many times. The reasons for some indicators such as: BOD_5, $N\text{-}NH_4$, Coliform exceed the limitation are: the wastewater comes from market, daily wastewater or near hospital (Can Tho Hospital).

Table 2.10: Positions of Sampling Domestic Wastewater

Code	Sampling positions	Coordinates
NT1	Outlet of the fruits and vegetables market to Cai Khe creek	X= 0585465 (m) Y= 1110444 (m)
NT2	Outlet at Quang Trung bridge pier (Can Tho embankment)	X= 0585375 (m) Y= 1108200 (m)
NT3	Outlet at Tam Vu iron bridge pier (Ba Le creek)	X= 0583987 (m) Y= 1106766 (m)
NT4	Outlet at the end of Tam Vu road (Can Tho embankment)	X= 0582790 (m) Y= 1106700 (m)
NT5	Outlet at Muong Khai creek, near Gua creek intersection (Muong Khai creek)	X= 0580754 (m) Y= 1107938 (m)
NT6	Outlet at Muong Khai creek, about 300m from Pho Tho market (Muong Khai creek)	X= 0580562 (m) Y= 1108250 (m)
NT7	Outlet at Dau Sau bridge pier on Nguyen Van Cu road	X= 0582131 (m) Y= 1108746 (m)
NT8	Outlet at Dau Sau bridge pier on Road 3/2	X= 0582515 (m) Y= 1106999 (m)
NT9	Outlet at Rach Ngong 2 bridge on Nguyen Van Cu road	X= 0582131 (m) Y= 1108746 (m)
NT10	Outlet in middle of Muong Cui creek	X= 0582876 (m) Y= 1107841 (m)
NT11	Outlet is about 40m from intersection of Nga Bat creek and Dau Sau creek	X= 0582518 (m) Y= 1107460 (m)
NT12	Outlet is about 100m from Ba Bo bridge on Nguyen Van Linh road toward Vo Van Kiet road (Ba Bo creek)	X= 0581595 (m) Y= 1109598 (m)
NT13	Outlet under Ba Bo bridge on Nguyen Van Linh road (Ba Bo creek)	X= 0581572 (m) Y= 1109564 (m)
NT14	Outlet under Can bridge crossing Sao creek (Binh Thuy) on Tran Quang Dieu road	X= 0582696 (m) Y= 1112004 (m)
NT15	Outlet near Xeo La bridge, Xeo La creek	X= 0583631 (m) Y= 1109628 (m)
NT16	Outlet near Ong Ta bridge (Ong Ta creek)	X= 0583232 (m) Y= 1109192 (m)
NT17	Outlet between Ong Ta bridge and concrete bridge on Ong Ta creek	X= 0583168 (m) Y= 1109201 (m)
NT18	Outlet in the middle of concrete bridge on Ong Ta creek	X= 0583012 (m) Y= 1109268 (m)
NT19	Outlet under concrete bridge on Tu Ho creek, on Nguyen Tri Phuong road.	X= 0582945 (m) Y= 1109827 (m)
NT20	Outlet under concrete bridge near intersection of Tu Ho and Ngong creeks	X= 0582932 (m) Y= 1110469 (m)

Code	Sampling positions	Coordinates
NT21	Outlet under bridge No.3 on Xeo Nhum creek on Nguyen Van Linh road	X= 0582332 (m) Y= 1108344 (m)
NT22	Outlet on Ranh creek, near alley road 5 (Ranh creek)	X= 0581569 (m) Y= 1105647 (m)
NT23	Outlet under O Mon bridge	X= 0569342 (m) Y= 1117903 (m)
NT24	Outlet on Suc creek, about 400m from Ba Bo bridge on Nguyen Van Linh road.	X= 0581277 (m) Y= 1110343 (m)
NT25	Outlet on Pho Tho creek, near Pho Tho market (road connecting August Revolution road to Provincial road 918)	X= 0579423 (m) Y= 1109015 (m)

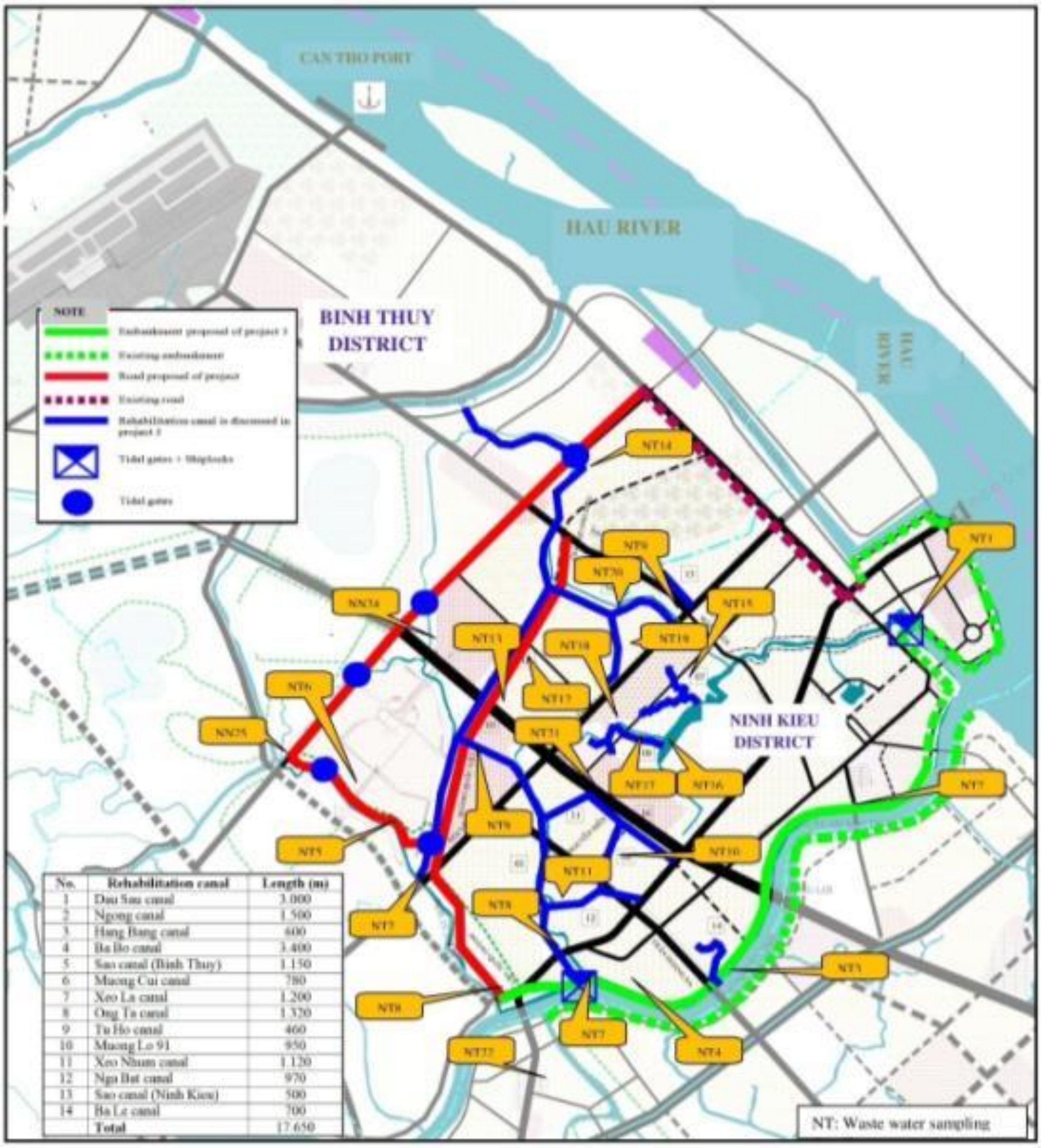


Figure 2.5: Location map of sampling domestic wastewater

Table 2.11: Analytical Results Of Domestic Wastewater Quality

No.	Code	Measurement and analysis indicators									
		pH (*)	**TSS (*)**	**COD** (*)	**BOD_5 (*)**	**$P-PO_4^{3-}$ (*)**	**$N-NH_4^+$** (*)	**S^{2-} (per H_2S)**	**$N-NO_3^-$**	**Grease Unit**	**Total Coliform**
		-	mg/l	mg/l	mg/l	mg/l	mg/l	mg $CaCO_3$/l	mg/l	mg/l	mg/l
1	**NT1**	6.50	40	119	**64**	3.44	**23.24**	0.59	0.31	0.42	$34*10^3$
2	**NT2**	6.71	28	21	11	1.42	3.36	0.05	0.17	0.03	**$28*10^4$**
3	**NT3**	7.15	50	56	32	2.47	**20.20**	0.16	0.85	0.07	$19*10^3$
4	**NT4**	6.86	28	39	23	1.10	**10.32**	0.11	1.60	0.11	**$61*10^5$**
5	**NT5**	6.45	17	12	7	0.18	4.40	0.04	0.34	KPH	$11*10^2$
6	**NT6**	6.95	32	36	20	2.70	6.32	0.05	0.12	0.15	$29*10^2$
7	**NT7**	7.12	39	75	42	2.14	**26.88**	0.12	0.10	0.09	**$15*10^4$**
8	**NT8**	6.75	41	80	45	1.43	**22.04**	0.15	0.38	0.14	**$61*10^4$**
9	**NT9**	6.90	47	127	**73**	3.19	**19.50**	0.23	1.35	0.45	**$43*10^4$**
10	**NT10**	6.93	49	36	19	0.37	**17.82**	0.06	0.16	0.17	$91*10^2$
11	**NT11**	6.94	25	72	39	0.94	**15.12**	0.32	0.27	0.13	$15*10^3$
12	**NT12**	6.70	15	14	5	0.23	3.36	0.09	0.24	KPH	$11*10^2$
13	**NT13**	6.80	34	26	17	0.33	**16.24**	0.08	0.58	0.09	$25*10^2$
14	**NT14**	6.96	19	69	39	2.90	**32.12**	0.29	0.35	0.17	**$27*10^4$**
15	**NT15**	6.82	17	22	10	0.81	8.60	0.08	0.71	0.03	$27*10^2$
16	**NT16**	7.01	47	90	52	1.47	**14.70**	0.23	0.16	0.86	**$16*10^4$**
17	**NT17**	6.80	68	186	**107**	0.95	**47.32**	0.26	0.64	1.05	**$19*10^5$**
18	**NT18**	7.15	45	60	33	1.08	**22.60**	0.07	0.18	0.61	$39*10^2$
19	**NT19**	7.23	67	66	39	2.85	**20.40**	0.15	0.20	0.09	$53*10^3$
20	**NT20**	7.13	68	166	**94**	1.90	**18.90**	0.11	0.42	0.91	$15*10^3$
21	**NT21**	6.88	37	66	32	1.72	**25.60**	0.27	0.18	0.08	$28*10^3$
22	**NT22**	6.73	31	78	41	1.40	**10.70**	0.11	0.24	0.14	$43*10^3$
23	**NT23**	6.90	12	21	11	0.25	3.20	0.14	1.40	0.01	$29*10^2$
24	**NT24**	6.57	30	17	9	0.97	6.32	0.09	1.10	0.01	$21*10^2$

No.	Code	Measurement and analysis indicators									
		pH **(*)**	**TSS** **(*)**	**COD** (*)	**BOD_5** **(*)**	**$P\text{-}PO_4^{3-}$** **(*)**	**$N\text{-}NH_4^+$** (*)	**S^{2-}** **(per H_2S)**	**$N\text{-}NO_3^-$**	**Grease Unit**	**Total Coliform**
		-	mg/l	mg/l	mg/l	mg/l	mg/l	mg $CaCO_3$/l	mg/l	mg/l	mg/l
25	**NT25**	6.89	32	40	23	0.11	**44.90**	0.07	0.23	0.05	$28*10^3$
Test method		TCVN 6492-2011	SMEWW 2540D-2012	SMEWW 5220B-2012	SMEWW 5210B-2012	SMEWW 4500 P –D -2012	SMEWW 4500 C-2012	SMEWW 4500 D-2012	*TCVN 6180:1996*	SMEWW *5520B:2012*	*TCVN 6187-2:1996*
QCVN 14:2008/BTNMT (Column A)		**5-9**	**50**	**-**	**30**	**6**	**5**	**1**	**30**	**10**	**3.000**
QCVN 14:2008/BTNMT (Column B)		**5-9**	**100**	**-**	**50**	**10**	**10**	**4**	**50**	**20**	**50.000**

<u>Note:</u> *QCVN 14: 2008/BTNMT: National technical regulation on quality of domestic wastewater*

(*): *Criterion recognized by VILAS*

KPH: Not detect LOD: Detection threshold

2.2.5. Soil quality

Analytical results show that quality of soil is good. Analytical indicators meet permitted standards. Positions of sampling soil are shown in the table bellowed:

Table 2.12: Analytical Results Of Soil Quality

No.	Code	Sampling positions	Coordinates	Measurement and analytical indicators				
				As	Cd	Zn	Cu	Pb
				mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK
1	D1	Hung Loi bridge pier on side of Ninh Kieu district	X= 0584314 (m) Y= 1107555 (m)	0.71	0.43	146.30	18.13	1.60
2	D2	Can Tho river bank crossing Cai Rang bridge	X= 0581528 (m) Y= 1106420 (m)	0.80	0.021	106.0	32.65	6.43
3	D3	Intersection of Nga Cai – Muong Khai creeks	X= 0579910 (m) Y= 1108842 (m)	0.93	0.019	97.0	39.22	7.54
4	D4	Under Cai Son bridge pier on Nguyen Van Cu road	X= 0581171 (m) Y= 1107641 (m)	0.94	0.017	102.1	24.31	7.62
5	D5	Under Bridge 3 on Nguyen Van Linh road	X= 0582728 (m) Y= 1108611 (m)	0.71	KPH	137.50	6.45	1.88
6	D6	In middle of Muong Cui creek	X= 0582897 (m) Y= 1107911 (m)	0.32	0.017	70.84	11.51	2.60
7	D7	Near intersecting point between Dau Sau and Nga Bat creeks	X= 0582349 (m) Y= 1107435 (m)	0.50	KPH LOD=0.003	25.60	16.30	1.36
8	D8	Intersection of Ngong and Ba Bo creeks	X= 0582383 (m) Y= 1110755 (m)	0.23	KPH LOD=0.003	29.70	15.11	1.94
9	D9	Near Ba Bo bridge on Nguyen Van Linh road	X= 0581571 (m) Y= 1109574 (m)	0.42	0.026	72.40	9.68	2.80
10	D10	Van bridge on Tran Quang Dieu road	X= 0582696 (m) Y= 1112004 (m)	0.37	0.021	69.60	6.50	2.42
11	D11	Near Xeo La bridge on Xeo La creek	X= 0583632 (m) Y= 1109601 (m)	0.30	KPH LOD=0.003	160.20	3.12	1.50
12	D12	Concrete bridge to inter-group 8-7-6 alleys on Ong Ta creek	X= 0583016 (m) Y= 1109272 (m)	0.73	0.023	77.10	11.50	2.34
13	D13	Intersection of Tu Ho and Ngong creeks	X= 0582924 (m) Y= 1110414 (m)	0.67	0.021	75.30	8.34	2.80

No.	Code	Sampling positions	Coordinates	Measurement and analytical indicators				
				As	Cd	Zn	Cu	Pb
				mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK
14	D14	Ranh creek in section intersecting with alley road 5	X= 0581573 (m) Y= 1105640 (m)	0.35	0.015	68.74	10.08	3.25
15	D15	Concrete bridge at the end of Thuy Loi canal adjacent to Cai Rang Be river	X= 0582754 (m) Y= 1105466 (m)	0.50	KPH LOD=0.003	21.40	12.60	1.20
16	D16	O Mon bridge pier	X= 0569342 (m) Y= 1117903 (m)	0.93	KPH LOD=0.003	144.50	7.22	1.90
17	D17	Quang Trung bridge on side of Ninh Kieu district	X= 0585366(m) Y= 1108476 (m)	0.26	0.031	92.33	27.03	3.72
18	D18	Nguyen Hien and A3 Cross-road	X= 0582571 (m) Y= 1107976 (m)	0.34	0.035	85.41	36.16	3.65
19	D19	Pho Tho creek	X= 0581009 (m) Y= 1110291 (m)	0.72	KPH LOD=0.003	150.32	16.10	1.70
20	D20	End of alleys 234	X= 0581638 (m) Y= 1107868 (m)	0.60	0.410	53.80	8.17	2.20
Test method				TCVN 6649:2000 TCVN 8467:2010	TCVN 6649:2000 TCVN 6496:2009	TCVN6649:2000 TCVN6496:2009	TCVN6649:2000 TCVN6496:2009	TCVN6649:2000 TCVN6496:2009
QCVN 03:2008/BTNMT				**12**	**5**	**200**	**70**	**120**

(*): QCVN 03:2008/BTNMT: National technical regulation on the allowable limits of heavy metals in the soils

Criterion recognized by VILAS; KPH: Not detect; LOD: Detection threshold

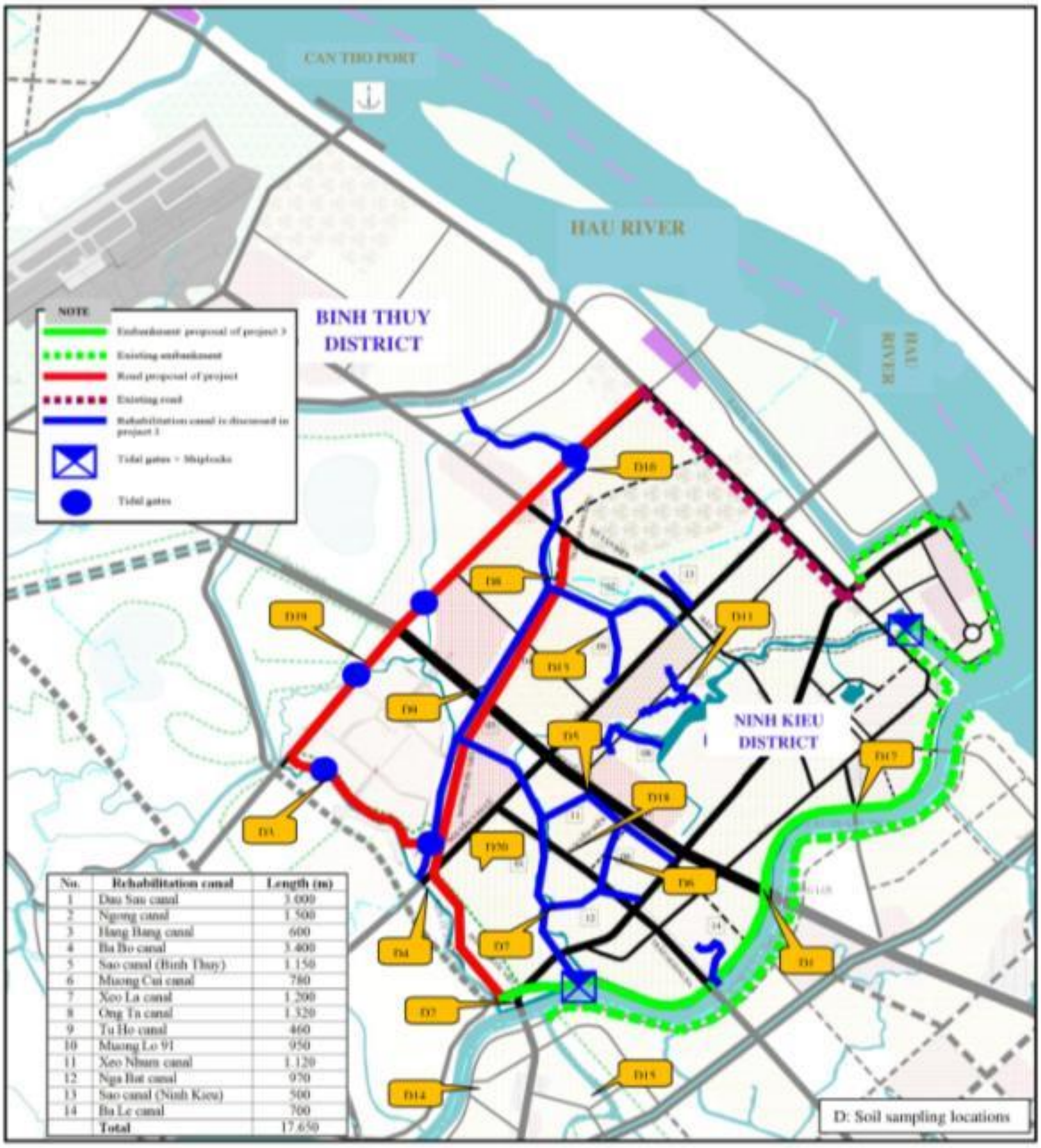


Figure 2.6: Location map of sampling soil

2.2.6. Sediment Quality

The results showed that most analysed indicators (As, Cd, Cu, and Pb) are below the thresholds as defined by the national technical regulations on sediment quality (QCVN43:2012/BTNMT).

However, many samples (B14, B16-18) show high concentration of Zn, which is above the allowable limit of sediment quality for purpose of aquatic life protection. The concentration of Zn in these samples are also higher than the allowable limits of soil used for landfilling (QCVN 03:2008/BTNMT); therefore they can not be used for landfilling and shall be disposed at the landfill. On the other hand, the concentration of Zn in these samples are lower than the limits national technical standard on hazardous waste (QCVN 07:2009/BTNMT), thus these sludge could be disposed at land fill for normal waste.

Table 2.13: Analytical Results Of Sediment Quality

No.	**Code**	**Sampling positions**	**Coordinates**	**Measurement and analytical indicators**				
				As	**Cd**	**Zn**	**Cu**	**Pb**
				mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK
1	B1	Embankment on Ngo Ke Duc intersecting with Hai Ba Trung road	X= 0586170 (m) Y= 1108928 (m)	0.70	0.50	211.24	7.61	1.87
2	B2	Quang Trung bridge on side of Cai Rang district	X= 0585395 (m) Y= 1108200 (m)	0.60	KPH LOD=0.003	150.13	9.53	0.94
3	B3	Can Tho river bank at the end of Tam Vu road	X= 0584026 (m) Y= 1106699 (m)	KPH LOD=0.17	KPH LOD=0.003	170.46	14.17	1.80
4	B4	Can Tho river bank crossing Cai Rang bridge	X= 0581528 (m) Y= 1106420 (m)	1.11	KPH LOD=0.003	204.74	11.55	0.71
5	B5	Nga Cai creek intersection with Muong Khai creek	X= 0579933 (m) Y= 1108847 (m)	0.60	KPH LOD=0.003	**438.62**	27.60	3.10
6	B6	Under Cai Son bridge pier on Nguyen Van Cu road	X= 0581171 (m) Y= 1107641 (m)	KPH LOD=0.17	KPH LOD=0.003	270.55	31.42	2.30
7	B7	Bridge No.3 on Nguyen Van Linh road crossing Xeo Nhum creek	X= 0582728 (m) Y= 1108611 (m)	1.40	1.10	**972.37**	20.92	1.70
8	B8	End of Dau Sau creek intersecting with Can Tho river	X= 0582483 (m) Y= 1106850 (m)	1.91	0.60	211.68	9.37	2.9
9	B9	Tu Ho intersecting with Ngong creek	X= 0582932 (m) Y= 1110469 (m)	KPH LOD=0.17	KPH LOD=0.003	175.42	11.62	1.13

No.	Code	Sampling positions	Coordinates	Measurement and analytical indicators				
				As	Cd	Zn	Cu	Pb
				mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK
10	B10	Concrete bridge in middle of Muong Cui creek	X= 0582897 (m) Y= 1107911 (m)	KPH LOD=0.17	KPH LOD=0.003	163.36	14.71	1.40
11	B11	Intersection of Dau Sau and Nga Bat creeks	X= 0582397 (m) Y= 1107439 (m)	KPH LOD=0.17	KPH LOD=0.003	140.28	15.14	1.30
12	B12	Hang Bang creek opposite to Nam Hieu ecotourism destination	X= 0581024 (m) Y= 1108123 (m)	KPH LOD=0.17	0.70	98.57	22.63	1.74
13	B13	Intersection of Ba Bo and Phu Tho creeks	X= 0581258 (m) Y= 1109176 (m)	KPH LOD=0.17	0.90	106.34	24.70	1.50
14	B14	Intersection of Ngong and Ba Bo creeks	X= 0582383 (m) Y= 1110755 (m)	KPH LOD=0.17	KPH LOD=0.003	**761.26**	10.42	1.06
15	B15	Concrete bridge between Hang Bang creek – section between Ba Bo creek and Dau Sau creek	X= 0581813 (m) Y= 1109099 (m)	KPH LOD=0.17	0.70	110.79	25.48	1.70
16	B16	Van bridge crossing Sao creek (Binh Thuy) on Tran Quang Dieu road	X= 0582696 (m) Y= 1112004 (m)	1.41	KPH LOD=0.003	**428.24**	21.14	3.80
17	B17	Iron bridge at the end of Sao creek intersecting with Suc creek	X= 0581760 (m) Y= 1112333 (m)	0.78	KPH LOD=0.003	**360.33**	18.30	2.20
18	B18	Xeo La bridge on Xeo La creek	X= 0583622 (m) Y= 1109593 (m)	KPH LOD=0.17	KPH LOD=0.003	**357.46**	17.80	1.60
19	B19	Ong Ta bridge on Ong Ta creek	X= 0583379 (m) Y= 1109155 (m)	KPH LOD=0.17	KPH LOD=0.003	**343.81**	14.90	2.94
20	B20	Concrete bridge to inter-group 8-7-6 alleys on Ong Ta creek	X= 0583007 (m) Y= 1109271 (m)	KPH LOD=0.17	KPH LOD=0.003	256.80	11.23	2.33
21	B21	Bridge pier crossing Tu Ho creek on Nguyen Tri Phuong road	X= 0582945 (m) Y= 1109827 (m)	KPH LOD=0.17	KPH LOD=0.003	195.46	42.81	2.86
22	B22	Iron bridge on Tam Vu road crossing Ba Le creek	X= 0583996 (m) Y= 1106766 (m)	KPH LOD=0.17	KPH LOD=0.003	247.43	29.69	1.60
23	B23	Intersection of Xeo Nhum and Dau Sau creeks	X= 0582332 (m) Y= 1108344 (m)	1.80	0.76	**770.50**	19.52	2.30

No.	Code	Sampling positions	Coordinates	Measurement and analytical indicators				
				As	**Cd**	**Zn**	**Cu**	**Pb**
				mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK
24	B24	Rang creek section adjacent to Cai Rang river	X= 0581476 (m) Y= 1105640 (m)	KPH LOD=0.17	KPH LOD=0.003	91.22	11.20	1.90
25	B25	Concrete bridge at the end of Thuy Loi canal adjacent to Cai Rang Be river	X= 0582750 (m) Y= 1105486 (m)	KPH LOD=0.17	KPH LOD=0.003	80.36	5.40	1.50
26	B26	O Mon bridge pier	X= 0569342 (m) Y= 1117903 (m)	KPH LOD=0.17	KPH LOD=0.003	67.71	3.70	4.15
27	B27	Ba Rich bridge pier	X= 0570167 (m) Y= 1119272 (m)	0.93	KPH LOD=0.003	**318.91**	17.43	2.70
28	B28	Intersection of Muong Khai and Pho Tho creeks	X= 0579449 (m) Y= 1109003 (m)	1.15	KPH LOD=0.003	**320.84**	23.25	2.11
29	B29	Phu Tho canal is about 300 from Ba Bo bridge on Nguyen Van Linh road about 300m	X= 0580744 (m) Y= 1110352 (m)	1.64	KPH LOD=0.003	301.65	16.17	1.90
30	B30	Suc creek is 400m from Ba Bo bridge on Nguyen Van Linh road	X= 0581277 (m) Y= 1110343 (m)	1,32	KPH LOD=0,003	190,28	18,13	2,41
Test method				TCVN 6649:2000 TCVN 8467:2010	TCVN 6649:2000 TCVN 6496:2009	TCVN6649:2000 TCVN6496:2009	TCVN6649:2000 TCVN6496:2009	TCVN6649:2000 TCVN6496:2009
QCVN 43:2012 /BTNMT				**17**	**3.5**	**315**	**197**	**91.3**
QCVN 03:2008/BTNMT				**12**	**10**	**300**	**100**	**300**

QCVN43:2012/BTNMT: National technical standard for sediment used for protecting aquatic life

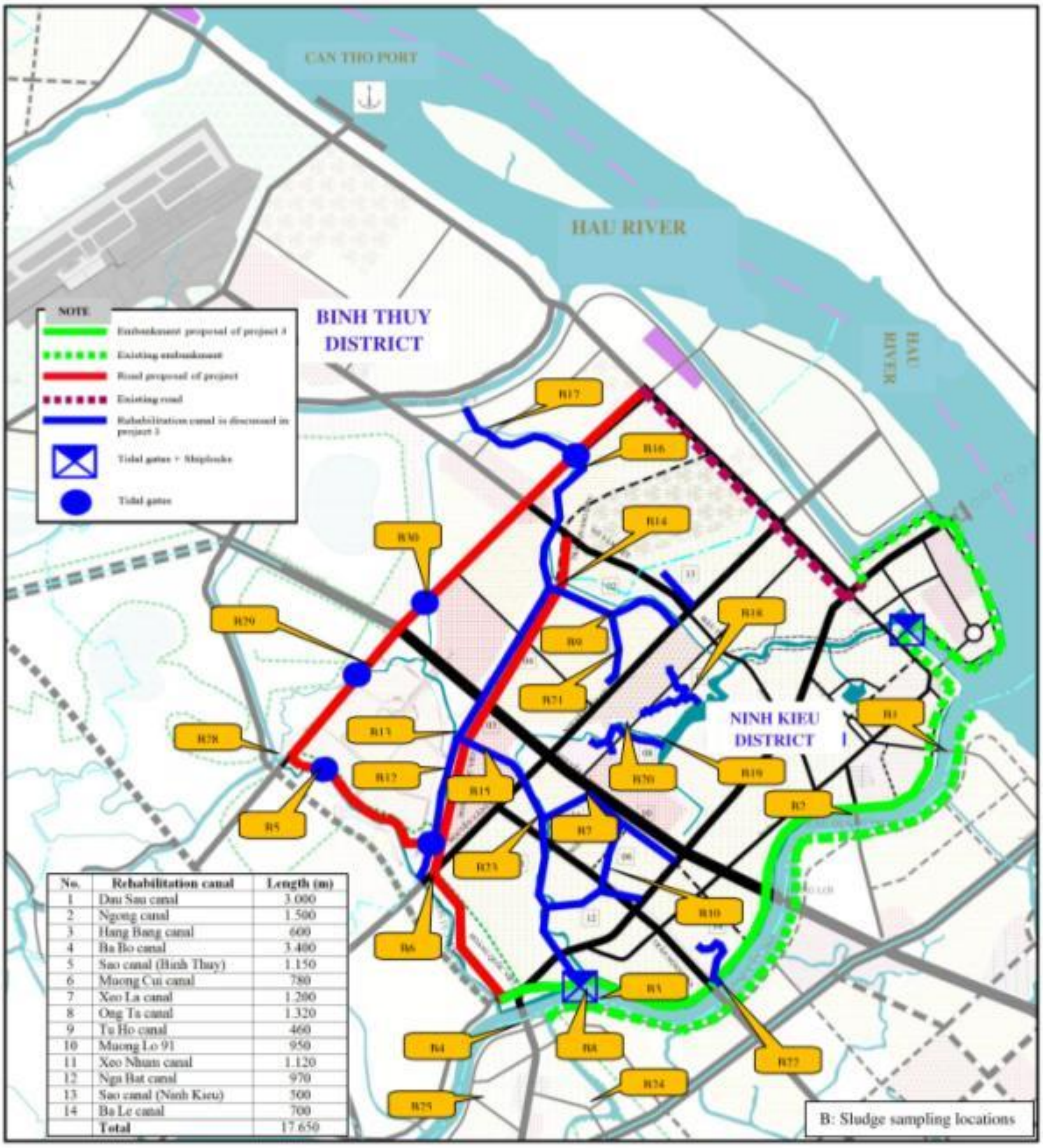
QCVN03:2008/BTNMT; National technical standard for soil quality

Table 2.14: Converting concentration of sediment followed Hazardous Waste Thresholds

Code	**Concentration**					**Equivalent value to absolute content of parameters**					**Limitation of absolute content according to QCVN 07: 2009**			
	As	**Cd**	**Zn**	**Cu**	**Pb**	**As**	**Cd**	**Zn**	**Cu**	**Pb**	**As**	**Cd**	**Zn**	**Pb**
	mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
B1	0.7	0.5	211.24	7.61	1.87	0.21	0.15	63.37	2.28	0.56	13.40	3.35	1675	100.50
B2	0.6	KPH	150.13	9.53	0.94	0.16	KPH	40.54	2.57	0.25	12.26	3.07	1532.5	91.95
B3	KPH	KPH	170.46	14.17	1.80	KPH	KPH	52.84	4.39	0.56	13.78	3.45	1722.5	103.35
B4	1.11	KPH	204.74	11.55	0.71	0.39	KPH	71.66	4.04	0.25	15.30	3.83	1912.5	114.75
B5	0.6	KPH	**438.62**	27.60	3.10	0.19	KPH	140.36	8.83	0.99	14.16	3.54	1770	106.20
B6	KPH	KPH	270.55	31.42	2.30	KPH	KPH	94.69	11.00	0.81	15.30	3.83	1912.5	114.75
B7	1.4	1.1	**972.37**	20.92	1.70	0.42	0.33	291.71	6.28	0.51	13.40	3.35	1675	100.50
B8	1.91	0.6	211.68	9.37	2.90	0.55	0.17	61.39	2.72	0.84	13.02	3.26	1627.5	97.65
B9	KPH	KPH	175.42	11.62	1.13	KPH	KPH	57.89	3.83	0.37	14.54	3.64	1817.5	109.05
B10	KPH	KPH	163.36	14.71	1.40	KPH	KPH	47.37	4.27	0.41	13.02	3.26	1627.5	97.65
B11	KPH	KPH	140.28	15.14	1.30	KPH	KPH	42.08	4.54	0.39	13.40	3.35	1675	100.50
B12	KPH	0.7	98.57	22.63	1.74	KPH	0.21	29.57	6.79	0.52	13.40	3.35	1675	100.50
B13	KPH	0.9	106.34	24.70	1.50	KPH	0.28	32.97	7.66	0.47	13.78	3.45	1722.5	103.35
B14	KPH	KPH	**761.26**	10.42	1.06	KPH	KPH	243.60	3.33	0.34	14.16	3.54	1770	106.20
B15	KPH	0.7	110.79	25.48	1.70	KPH	0.25	38.78	8.92	0.60	15.30	3.83	1912.5	114.75
B16	1.41	KPH	**428.24**	21.14	3.80	0.48	KPH	145.60	7.19	1.29	14.92	3.73	1865	111.90
B17	0.78	KPH	**360.33**	18.30	2.20	0.23	KPH	108.10	5.49	0.66	13.40	3.35	1675	100.50
B18	KPH	KPH	**357.46**	17.80	1.60	KPH	KPH	107.24	5.34	0.48	13.40	3.35	1675	100.50
B19	KPH	KPH	**343.81**	14.90	2.94	KPH	KPH	106.58	4.62	0.91	13.78	3.45	1722.5	103.35
B20	KPH	KPH	256.80	11.23	2.33	KPH	KPH	74.47	3.26	0.68	13.02	3.26	1627.5	97.65
B21	KPH	KPH	195.46	42.81	2.86	KPH	KPH	68.41	14.98	1.00	15.30	3.83	1912.5	114.75
B22	KPH	KPH	247.43	29.69	1.60	KPH	KPH	89.07	10.69	0.58	15.68	3.92	1960	117.60
B23	1.8	0.76	**770.50**	19.52	2.30	0.54	0.23	231.15	5.86	0.69	13.40	3.35	1675	100.50

Code	Concentration					Equivalent value to absolute content of parameters					Limitation of absolute content according to QCVN 07: 2009			
	As	**Cd**	**Zn**	**Cu**	**Pb**	**As**	**Cd**	**Zn**	**Cu**	**Pb**	**As**	**Cd**	**Zn**	**Pb**
	mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK	mg/kg TLK	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
B24	KPH	KPH	91.22	11.20	1.90	KPH	KPH	31.01	3.81	0.65	14.92	3.73	1865	111.90
B25	KPH	KPH	80.36	5.40	1.50	KPH	KPH	24.91	1.67	0.47	13.78	3.45	1722.5	103.35
B26	KPH	KPH	67.71	3.70	4.15	KPH	KPH	20.31	1.11	1.25	13.40	3.35	1675	100.50
B27	0.93	KPH	**318.91**	17.43	2.70	0.27	KPH	92.48	5.05	0.78	13.02	3.26	1627.5	97.65
B28	1.15	KPH	**320.84**	23.25	2.11	0.37	KPH	102.67	7.44	0.68	14.16	3.54	1770	106.20
B29	1.64	KPH	301.65	16.17	1.90	0.57	KPH	105.58	5.66	0.67	15.30	3.83	1912.5	114.75
B30	1.32	KPH	190.28	18.13	2.41	0.48	KPH	68.50	6.53	0.87	15.68	3.92	1960	117.60

Conclusion: Concentration of sediment in project area is under Limitation of absolute content according to QCVN: 07/2009.



No.	Rehabilitation canal	Length (m)
1	Dau Sau canal	3.000
2	Ngong canal	1.500
3	Hang Bang canal	600
4	Ba Bo canal	3.400
5	Sao canal (Binh Thuy)	1.150
6	Muong Cui canal	780
7	Xeo La canal	1.200
8	Ong Ta canal	1.320
9	Tu Ho canal	460
10	Muong Lo 91	950
11	Xeo Nhum canal	1.120
12	Nga Bat canal	970
13	Sao canal (Ninh Kieu)	500
14	Ba Le canal	700
	Total	17.650

Figure 2.7: Location map of sampling sediment

2.2.7. Aquatic Environment

The survey and analysis results identified the quantity of plankton species as follows:

Table 2.15: Composition and Quantity Of Plankton Species In Rivers And Canals In Can Tho City

Science name	**Sample symbol**																							
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**	**P16**	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**
PROTOZOA																								
Arcellidae																								
Arcella sp.											+						+							
Paramoecidae																								
Paramecium sp.							31				6					7				17	19			
COELENTERATA																								
Hydridae																								
Hydra sp.	+	1	+																					
ROTATORIA																								
Philodinidae																								
Philodina roseola (Ehrenberg)	2	1	2	2	1			3	36	17	3	2	4	12	4	4		1	8	38	31		7	14
Rotaria rotaria (Pallas)							2	+	9	11			8	7	6				14	23	27	1	2	8
Rotaria neptunia (Ehrenberg)									11	1	4	1						2		14	12		4	6
Trichocercidae																								
Trichocerca (T.) capucina Wiersejski & Zacharias										1	1													
Trichocerca (T.) rattus (Muller)				1			1																	
Synchaetidae																								
Polyarthra vulgaris Carlin													12	28			2							
Asplanchnidae																								

Science name	Sample symbol																							
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**	**P16**	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**
Asplanchna sieboldi (Leydig)		1																						
Lecanidae																								
Lecane luna (Muller)						+	2																	
Monostyla bulla (Gosse)							1																	
Brachionidae																								
Brachionus angularis Gosse									470	7	17	7	21	18					3		18			
Brachionus calyciflorus Pallas							1		183	8		18	127	92	38		2			32	13			
Brachionus urceus (Linnaeus)																								
Anuraeopsis fissa (Gosse)							1														4		+	
Flosculariidae																								
Sinantheria socialis (Linnaeus)	+	+								+		+					+							
Conochilidae																								
Conochiloides dossuaris (Hudson)	+							+																
Filiniidae																								
Filina longiseta (Ehrenberg)						+	1		115	6	11		242	175	62					18	8		2	
Tetramastix opoliensis Zacharias									28												2			
CLADOCERA																								
Bosminidae																								
Bosmina longirostris (O.F. Muller)	1																2							
Bosminopsis deitersi Richard								1			+													
Sididae																								

Science name	**Sample symbol**																							
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**	**P16**	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**
Diaphanosoma excisum Sars			+			+					1		2		3			+				+		
Diaphanosoma leuchtenbergianum Fischer											1													
Latonopsis australis Sars																		+			+			
Macrothricidae																								
Ilyocryptus halyi Brady																		1						
Daphniidae																								
Moina dubia de Guerne et Richard			1			2							2	1	1	1		2	+			1		+
Moinodaphnia macleayii (King)										1		1	3											
Ceriodaphnia rigaudi Richard	+					+																1		
Chydoridae																								
Euryalona orientalis (Dalay)																						1		
Alona davidi Richard																						1		
COPEPODA																								
Diaptomidae																								
Eodiaptomus draconisignivomi Brehm			+			1																		
Neodiaptomus malaindosinensis Lai and Fernando															1									
Pseudodiaptomidae																								
Pseudodiaptomus beieri Brehm	1				+																			
Schmackeria bulbosa Shen and Tai	2		3	+	1	1				1		1					1							

Science name	**Sample symbol**																							
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**	**P16**	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**
Cyclopidae																								
Microcyclops varicans (Sars)																								
Mesocyclops leuckarti (Claus)					+					1	1		1	1	1	+			2	1				
Thermocyclops hyalinus (Rehberg)			1	2	2	2	2	+	+	2	1	2	7	8	2	2	3		+	2	1		+	1
Canthocamptidae																								
Elaphpoidella javaensis (Chappuis)													+											
OSTRACODA																								
Cypridae																								
Cypris subglobosa Sowerby			1					+		+		+											+	
Heterocypris anomala Klie		1			1			+	2		3		3	2	7		1	6	25	6	3		11	
Stenocypris derupta Varra		1																						
OLIGOCHAETA																								
Naididae																								
Pristina longiseta Ehrenberg	1	2			1	1	1				1			2			+	2	2	2			+	5
Stylaria fossularis Leidy					+															+				
LARVA																								
Nauplius copepoda	5	6	11	8	16	3	7	4	39	6	12	9	44	52	26		6	3	5	11	2	3	1	4
Polychaeta	1		1			2	1																	
Coninae	1		1	4	1			1		1	14	1		+			1						+	
Bivalvia	1		+	+							+						5						+	
Chironomidae		+				+	+								+			+						
Baetis sp.																								+

Science name	Sample symbol																							
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**	**P16**	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**
Quantity of species in the sample	13	9	12	7	10	12	13	9	10	15	17	11	14	13	12	5	12	10	9	12	13	7	12	8
Number of individuals/m^3	2800	2200	3300	2400	3300	2400	6400	1800	90300	7800	9300	5300	49000	41100	16300	1900	3500	2700	6800	17600	15300	1500	3900	4600

Table 2.16: Quantity of Phytoplankton In Rivers And Canals In Can Tho City

Sample name	**Quantity** (individuals/litre)	**Dominant species**	**The number of dominant species** (individuals/litre)
P1	1134	*Oscillatoria acuta*	202
P2	1382	*Coscinodiscus subtilis*	518
P3	1605	*Oscillatoria brevis*	320
P4	1404	*Oscillatoria brevis*	286
P5	1584	*Thalassiosira subtilis*	528
P6	1568	*Oscillatoria brevis*	352
P7	2116	*Oscillatoria acuta*	1065
P8	2554	*Thalassiosira subtilis*	605
P9	48650	*Thalassiosira subtilis*	46368
P10	2610	*Oscillatoria formosa*	820
P11	2636	*Oscillatoria brevis*	726
P12	15784	*Thalassiosira subtilis*	14386
P13	6858	*Thalassiosira subtilis*	3672
P14	6972	*Thalassiosira subtilis*	1356
P15	1245	*Oscillatoria brevis*	238
P16	1378	*Planktolyngbya* sp.	538
P17	1725	*Planktolyngbya* sp.	422
P18	4810	*Oscillatoria formosa*	1778
P19	5162	*Thalassiosira subtilis*	2819

Sample name	**Quantity** (individuals/litre)	**Dominant species**	**The number of dominant species** (individuals/litre)
P20	7374	*Thalassiosira subtilis*	5216
P21	1469	*Coscinodiscus subtilis*	317
P22	3413	*Oscillatoria brevis*	1555
P23	4061	*Oscillatoria brevis*	1903
P24	1186	*Oscillatoria brevis*	307
P25	2288	*Oscillatoria acuta*	942
P26	1579	*Lyngbya limnetica*	414
P27	3995	*Oscillatoria acuta*	810
P28	1920	*Thalassiosira subtilis*	313
P29	7916	*Oscillatoria brevis*	3326
P30	1555	*Oscillatoria acuta*	653

Figure 2.8: Location Map Of Sampling Phytoplankton

2.2.8. Biological Resources

In Can Tho, biological resources are divided into two types of natural ecosystems and agro-ecosystems:

Natural ecosystems

- fauna include birds, fishes, reptiles, amphibians and insects
- flora include grasses and small trees are typical systems in Can Tho and the Mekong delta

Agro-ecosystems:

- animal and husbandry system include cattle, cow, chicken, duck, and fish is raised in fond
- rice cropping systems are dominated
- fruits garden and yards are also dominated with longan, tangerine, mango, and other fruits

❖ ***Aquatic ecosystems***

- In the river systems in Can Tho, there are 69 species of plankton plants, 72 animal species and 33 plankton benthic (data of the Institute of Ecology and Biological Resources)
- For aquatic plants, two major species of green algae and diatoms dominated than other algae. Amongst these mentioned species, there are many other species like mesosapbrobic, Melosira granulata, Fragillaria capucina, Microcystis aeruginosa…that are represented in the enriched environment with nutrient levels and medium level of contamination.
- The surveyed zooplankton included different genus such as protozoa, Mollusca, Nemathelminthes, Arthrapoda, Annelida, are considered having the freshwater origin species such as Bosmina, Bosminopsis, Chydorus, Arcella. The other species are adapted with contaminated environment (acidic) like Asplanchna, Brachionus, Keratella.
- Benthos: Different species in the class of Gastropoda, Bivalvia, Oligochaeta và Polychaeta, aquatic earthworm like Oligochaeta Limnodrilus hoffmeisteri, represented for family live in eutrophication environment (enriched nutrients). Other 3 species of oysters: C. leviuscula, C. Bocourti, C. Baudoni are represented for high mud environment.
- Fisheries: typical and representative families are known as Cyprinidae with 84 species (such as carp (Cyprinus carpio), bream fish, and ***Henicorhynchus***; Gobidae with 14 species of gobies; Cralidae (catfish), Siluridae with 51 species of sheatfishes or Wallago attu; Schibeidae with 13 species of alike catfish and pangasius. The aquaculture sector prefer to raise catfish, basa fish (Pangasius bocourti) and hybrid catfish. However, aquaculture system had contaminated river system and is significantly brought negative impacts to natural resources.

In order to assess the phytoplankton in project area, the consultants was conducted samplings at representative main river, primary and secondary canals. The results were analyzed (table 2.15), recorded on 60 species of 24 families, 16 orders and four phylum. Amongst that, diatom algae (*Bacilliariophyta)* consist of the most abundant composition, with 25 species and accounted for 41.7% of total recorded species. The next dominates are *Cyanophyta* and *Chlorophyta* with 16 species and accounted for 26.7% of total records. The lowest dominate is *Euglenophyta* with 3 species and accounted for 5.0%.

Cyanophyta was found at all surveyed sites with high frequency of detection and represented for *different genus like Microcystis, Oscillatoria, Planktothrix.* These genuses are considered as toxic algae and highly adaptive in the high nutrient environment and potentially harm to other aquatic animals. The diatoms was relatively high detection during the monitoring. These diatoms plays very important role in aquatic ecosystems, as they are feed for aquatic animals such as shrimps larvae and fishes.

Chlorophyta is representative freshwater algae, lower detection level was recorded during monitoring work. Like other algae, *Chlorophyta* includes nutrient-enriched species, they serve as primary food source for aquatic fauna and therefore, they play also important role in aquatic ecosystem.

The detection frequency of Phacus sp. was low during this monitoring survey. These species are represented for freshwater environment and adaptive distribution in contaminated environment and therefore, importantly use in waste-water treatment.

In each sampling site in Can Tho area, the number of sampled species ranged from 13-30 species/site. The highest number of species distributed in Can Tho river with 30 species/site, followed by Omon river with 29 species/site. The lowest species were sampled at the Hau river and the number ranged from 13-14 species/site. The rest of sites have number of species sampled relatively high at 18-26 species/site.

Distribution of plankton is relatively high and ranged from 1 175-34 243 cells/ L. The highest density of cells in the Can Tho River and the lowest found in the Hau river. The other sites had density of cell are also high at the range of 1 855- 13 508 cells/ L.

At the time of surveying in Can Tho in Agust 2015, the dominated and represented species were freshwater species, few of species were capable to adapt with brackish environment and widely distribution. *Cyanophyta* was highly dominated at 40-98.7% and mostly are toxic algae, highly adapted in high nutrient environment. This finding indicated that surface water in studied area was polluted in the large scale. The unbalanced development of plankton flora have been recorded.

In the project area, no rare specie plants were protected as it is mainly in urban area and agricultural land was used for resettlement purposes (planning for resettlement), there was no natural conservation area. Therefore, project implementation and operation will bring no impact to wildlife and natural ecosystems.

2.3. SOCIO-ECONOMIC CONDITIONS

2.3.1. Economic Development Situation

For economic growth, in the period of 2004 - 2013, Can Tho GDP increased in average of 14.5%/year; the city' GDP reached 11.67% in 2013, the total value added of this year reached 62,600 billion, up 3.5 times compared to 2004. The value of industry in 2013 reached nearly 87,000 billion, up 7.5 times compared to 2004; total retail sales of merchandise and service revenues this year is to reach 62,000 billion, the highest in the MDR. Highlight of Can Tho is revenues in 2013 which reached nearly 11,000 billion VND, exceeded the plan 24.5%. (Source: Report of the first nine months, 2014, Can Tho DPI). Figure 2.1 presents the economic structure in Can Tho.

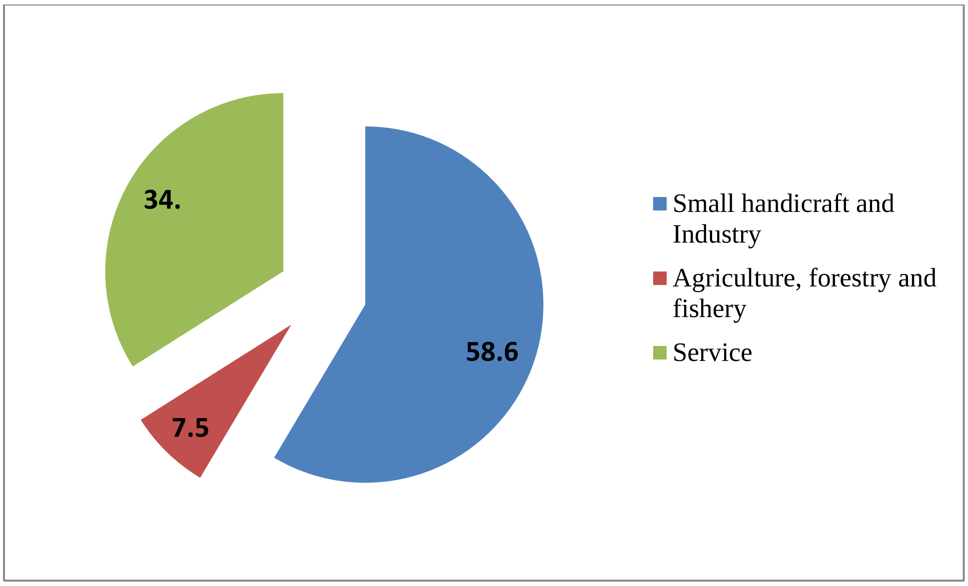


Figure 2.1. Structure of economic development in Can Tho. In 2014

(Source: Statistic Year Book, 2014)

2.3.2. Social Situation

Can Tho city has a total of 09 administrative units, including 5 urban districts of Ninh Kieu, O Mon, Binh Thuy, Cai Rang and Thot Not and 04 rural districts including Vinh Thanh, Co Do, Phong Dien and Thoi Lai. Scale, area and population of these districts are shown in the table 2.18. The average population density of Can Tho city was 875 people/km2. The highest population density is about 8,737 persons/km2 (Ninh Kieu district) and the lowest population density is about 389 persons/km2 (Vinh Thanh district). The project area focus on four inner districts as Ninh Kieu, O Mon, Binh Thuy and Cai Rang.

Table 2.17: Scale, Area, Population And Population Density Of Can Tho City

No.	Districts	Area (km^2)	Average population (people)	Population density (person/km^2)
1	Ninh Kieu	29.27	1,232,260	875
2	O Mon	132.22	133,630	1,018
3	Binh Thuy	70.68	119,158	1,686
4	Cai Rang	68.33	91,000	1,332
5	Thot Not	118.01	164,980	1,398
6	Vinh Thanh	298.23	116,110	389
7	Co Do	311.15	126,069	405
8	Phong Dien	125.26	101,120	807
9	Thoi Lai	255.81	123,505	483
Total		**1.408**	**1.232.260**	**875**

(Source: Statistic Year Book of Can Tho city - 2013)

Population in project area is approximately 32 6926 pepole, in which female represents 51.6% of the total population. Total households are 74398 and average people per households are 4.44. Can Tho city has several ethnic communities living as same as other multi-ethnic integration areas. According to statistic data to the end of 2009, major ethnic group living in the city is Kinh with 1,153,341 people, accounting for 96.96%, Hoa Kieu ethnic group accounts for 1.19%, Khmer ethnic group accounts for 1.8% and other ethnic groups account for 0.05%. In the project area, Kinh group has a biggest population, account for 96.3%. Population of other ethnic minorities such as Hoa Kieu and Khmer account for 2.6%, 1% respectively. Besides, the number of households is ethnic Tay, Indian, Thai, Cham, Muong, Ede also in the project are, and then this ratio does not account for much. (Social Impact Assesment Report, 6/2015).

Table 2.18: Average Population Size By Ethnic Groups

No	District	Population		Ethnic minority													
		No of household	No of population	Khmer		Hoa		Chăm		Tày		Nùng		Other		Total HH	Total population
				No of HH	No of population	No of HH	No of population	No of HH	No of population	No of HH	No of population	No of HH	No of population	No of HH	No of population		
1	Ninh Kieu	56,041	199,534	434	2,222	1,353	6,892	6	32	5	16	7	23	4	23	1,809	9,208
2	O Mon	1708	7064	23	101	18	87	0	0	0	0	2	8	6	25	49	221
3	Binh Thuy	12682	48927	84	215	39	112	0	0	0	0	0	0	12	21	135	348
4	Cai Rang	15614	63095	71	271	353	481	3	10	0	0	0	0	0	0	427	2067
	Total	86,045	318,620	612	2,809	1,763	7,572	9	42	5	16	9	31	22	69	2,420	11,844
	Percent %		3.7	0.71		2.05		0.01		0.01		0.01		0.03		2.81	3.72

(Source: ODA PMU, 2014)

Table 2.19: Vulnerable households

Content	Unit	District			Total
		Binh Thuy	Ninh Kieu	Cai Rang	
Household under preferential treatment policy	Quantity	41	162	31	234
	Rate (%)	7.0%	7.9%	4.0%	6.8%
Poor household	Quantity	5	53	23	81
	Rate (%)	.8%	2.6%	2.9%	2.4%
Household with disabled people	Quantity	30	50	10	90
	Rate (%)	5.1%	2.4%	1.3%	2.6%
Near-poor household	Quantity	22	133	43	198
	Rate (%)	3.7%	6.5%	5.5%	5.8%
Women-headed household	Quantity	56	311	98	465
	Rate (%)	9.6%	15.1%	12.6%	13.6%

(Source: Socio-Economic Survey, June 2015)

Vulnerable groups in the project area include: (i) ethnic minorities (mainly Khmer); (ii) a group of single women with dependents, (iii) Disabled HH and iv) poor and near poor HH;

- *Ethnic minorities:* In 03 project districts, there are no community cluster of ethnic minorities living separately, only 11 households P groups are urbanized and integrated into the urban mainstream way of life. Hence there is no need for action plans specific to this group.
- *Group of single women with dependents*: 490 women head of households have principal income from hired labor, their income is not stable, although local authorities had them attended the primary class profession (nail, makeup, hairdressing) in counties with funding to support of 10,000 VND/session/trainee with 45-60 days training period. However, practical skills from this training and the ability to find a job from the job were also limited. Therefore, effectiveness of those training programs is very low. Propose to build small credit program suitably for this group may develop household economy.
- *Disabled persons:* The project area has a number of households affected with Agent Orange and now enjoying the social benefits, also some women with disabilities ar present and currently doing the basic work at home (embroidery, garments). However the number of HH is not significant, so there is no need to prepare an action plan to intervene. The impacts will be covered under the RP.
- *Poverty issues:* Poor and near poor HH represents respectively 2.4% and 5.8% of surveyed HH.Poor HH are often landless, encroaching on river/canals banks. They will be allocated a plot of land in a serviced resettlement sites and will receive special assistance under the RP.

Table 2.20: Table on poverty (poor and near poor) by district and commune

No.	Districts	No. of near-poor HHs			Near-poor ethnic minority HHs									
								Divided by ethnicity						
								Khmer			Chinese			Others
		Total population of city	No. of poor HHs	Rate	Ethnic minority HHs*	Near-poor ethnic minority HHs	Rate %	Total HHs	Near-poor HHs	Rate/ Khmer HH	Total HHs	Near-poor HHs	Rate/ Chinese HH	
1	Ninh Kieu	64,553	551	0.85	2.518	47	1.87	530	25	4.72	1802	21	1.17	1
2	O Mon	33,086	1413	4.27	1.272	104	8.18	1134	103	9.08	384	1	0.26	0
3	Binh Thuy	31,112	497	1.6	466	13	2.79	156	9	5.77	159	4	2.52	0
4	Cai Rang	23,564	566	2.4	530	32	6.04	152	26	17.11	397	5	1.26	1
5	Thot Not	39,322	966	2.53	348	14	4.02	111	13	11.71	271	1	0.37	0
6	Vinh Thanh	27,429	1389	5.06	365	95	26.3	209	94	44.98	12	1	8.33	0
7	Co Do	29,518	1911	6.47	2.18	352	16.2	1999	351	17.56	128	1	0.78	0
8	Phong Dien	25,035	972	3.88	349	27	7.74	206	27	13.11	130	0	-	0
9	Thoi Lai	29,890	1554	5.2	934	91	9.74	997	89	8.93	74	1	1.35	1
CAN THO CITY		**30,3509**	**9,819**	**3.6**	**2,998**	**775**	**9.2**	**5,494**	**737**	**14.8**	**3,357**	**35**	**2**	**3**

(Source: ODA PMU, 2014)

❖ ***Labor and Occupation***

Total number of workers in Can Tho city is gradually increasing year to year. The rate of labor increases from 1.53 to 1.93% compared with the previous year. The rate of agricultural labor is from 39.4 to 46.5% higher than the rate of non-agricultural labor. The labor forceaccounts for approximately 540,994 people, accounting for 71.3% and 217,524 persons not in the labor force (housewives, students, persons who cannot work, unemployed and people no need to work), accounting for 28.7%. The number of laborers working in agriculture - forestry and aquaculture account for 49%. The number of laborers working in industrial sector (mining, processing, production of electricity and water) and construction accounts for 18.27%. The number of laborers working in trading and service sectors (businesses, hotels, restaurants, transport, warehouse, communications and other sectors) accounts for 32.73%. The number of unemployees in 2009 was 36,735 people, accounting for 4.84%. The project area located in the urban core area. Economic structure of districts trends to service and trade sector and its accout for 71.2%, agricultural, industrial other sector cover 15,4%; 13,4% respectively.

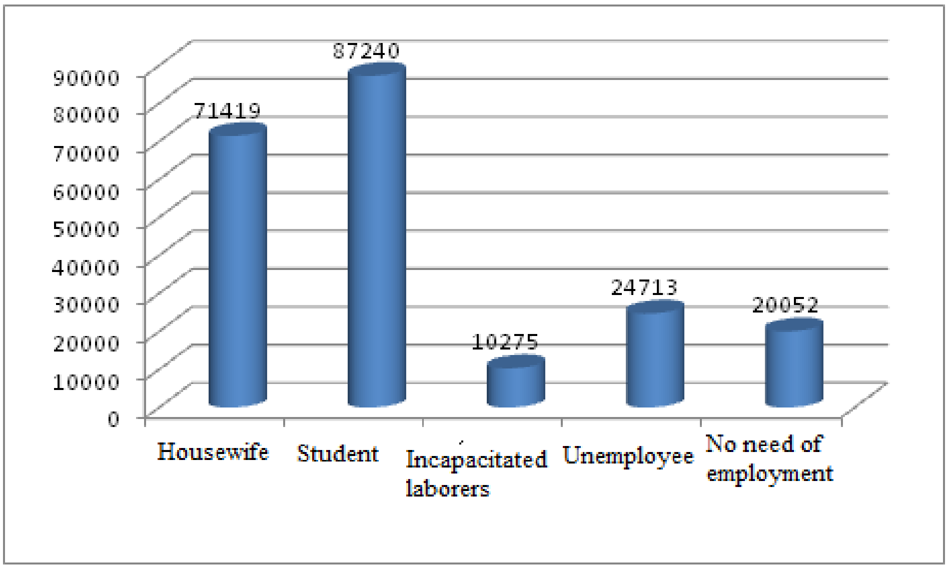


Figure 2.9 : Standby labor structure in Can Tho city

❖ ***Living standards***

The living standards and average incomes of the city's people are being improved significantly. According to Social Assessment Impact (6/2015), average income per households in wards in the project area is 43, 3 millions/people/year.

Poverty in Can Tho city: according to the report of the first 9 months of 2015 done by the city DOLISA, it shows poverty rates and near-poor rates to gradually reduce annually. In 2012, the city had 19,530 poor households, accounting for 6.62% and 15,921 near-poor households with 5.39%. These numbers have declined over the years and by 2014, the number of poor households citywide remains 11,867 HHs (3.95%) and near poor households is 11,692 HHs (3.89%), which decreases by 50% over 3 consecutive years of 2012 to 2014 (Table 2.21).

Table 2.21: Poverty rate of Can Tho city

No	Year	Poverty rate		Percentage Near Poor	
		HHs	Percentage %	HHs	Percentage %
1	2012	19.530	6,62	15.921	5,39
2	2013	15.465	5,19	14.282	4,79
3	2014	11.867	3,95	11.692	3,89

(Source: Department of Labour, Invalids, Social of Can Tho city - September 2015)

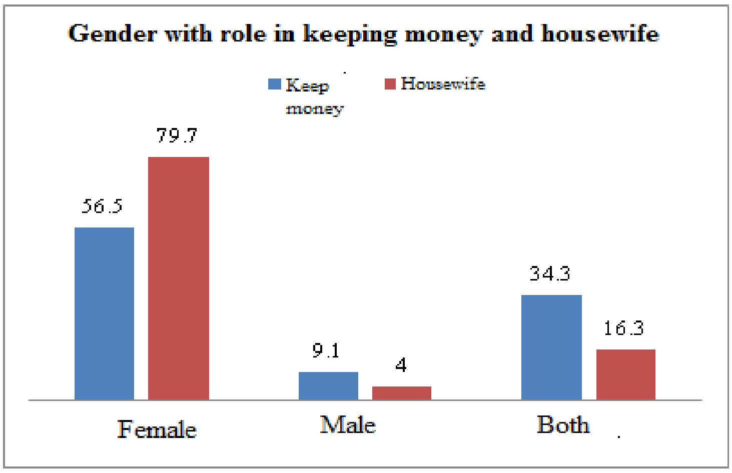
Table 2.22: Incidence of Poverty

No	District/ Ward	Total surveyed HH		Poor		Near-Poor	
		HH	%	HH	%	HH	%
I	**Ninh Kieu**						
1.1	An Binh	124		6	4.8	21	16.9
1.2	An Hoa	196		3	1.5	8	4.1
1.3	An Khanh	191		1	0.5	12	6.2
1.4	An Lac	57		2	3.5	3	5.2
1.5	Hung Loi	120		1	0.8	6	6.5
1.6	Tan An	100		0		2	0.2
1.7	Xuan Khanh	180		11	6.1	28	15.6
II	**Binh Thuy**						
2.1	An Thoi	199		1	**0.05**	2	0.1
2.2	Long Hoa	200		2	**1**	6	3
2.3	Long Tuyen	152		1	**0.6**	11	6.7
III	**Cai Rang**						
3.1	Hung Phu	145		4	**2.8**	6	**4.1**
3.2	Hung Thanh	161		2	**1.2**	3	**1.9**
IV	**O Mon**						
V	**Can Tho City**			**11.867**	**3.95**	**11.692**	**3.89**
Total							

(source DOLISA)

2.3.3. Gender

The survey results showed that. 56.5% of respondents stated that women is responsible to manage money in the HHand 79.7% of respondents stated that women are responsible for daily household tasks.



Some family issues are decided by both male and female. 70.2% of households stated that both wife and husband jointly decide on buying vehicles or houses. 72.4% of spouse decide on borrowing bank's loan or investment, business. 73% of spouses decide on studying and occupation of their children.

Most of the Land Use Right Certificate (LURC) (58.2% of households) are under the name ofboth wife and husband. 22.1% under husband name only and 19.7% under wife name onlye. The survey results also that 60.2% of respondents stated that both wife and husband own family assets. However, the proportion of male owning assets is 24.1%, which is higher than the proportion of female, 15.7%. Namely:

Table 2.23: Name on LYRC and ownership of assets

Items	**Gender**	**Unit**	**Districts**			**Total**
			Binh Thuy	**Ninh Kieu**	**Cai Rang**	
Name on Land Use Right Certificate	Wife	Quantity	66	399	167	632
		Rate (%)	13,7%	20,4%	21,4%	19,7%
	Husband	Quantity	129	351	232	712
		Rate (%)	26,7%	18,0%	29,7%	22,1%
	Both	Quantity	288	1202	382	1872
		Rate (%)	59,6%	61,6%	48,9%	58,2%
Ownership of assets	Female	Quantity	49	338	117	504
		Rate (%)	10,1%	17,3%	15,0%	15,7%
	Male	Quantity	145	415	215	775
		Rate (%)	30,0%	21,3%	27,5%	24,1%
	Both	Quantity	289	1199	449	1937
		Rate (%)	59,8%	61,4%	57,5%	60,2%

(Source: Socio-economic survey, June 2015)

The participation in community activities and local organizations show that there is gender difference. Male often participates in both activities more than female. 54% of respondents stated that males play main role in community activities while the proportion of females is 21.6%. Similarly, the proportion of males participating in local organizations is 54.7% and the proportion of females is 23.4%.

Table 2.24: Gender and participation in activities

Items	Gender	Unit	Districts			Total
			Binh Thuy	Ninh Kieu	Cai Rang	
Participation in community activities: community meetings	Female	Quantity	83	498	114	695
		Rate (%)	17,2%	25,5%	14,6%	21,6%
	Male	Quantity	268	1030	438	1736
		Rate (%)	55,5%	52,8%	56,1%	54,0%
	Both	Quantity	132	422	229	783
		Rate (%)	27,3%	21,6%	29,3%	24,4%
Participation in local organizations	Female	Quantity	85	538	131	754
		Rate (%)	17,6%	27,6%	16,8%	23,4%
	Male	Quantity	297	1028	434	1759
		Rate (%)	61,5%	52,7%	55,6%	54,7%
	Both	Quantity	101	386	216	703
		Rate (%)	20,9%	19,8%	27,7%	21,9%

(Source: Socio-economic survey, June 2015)

The survey results by questionnaire with households and community also showed that there is no significant gap between male and female in education, income and health.

2.4. . INFRASTRUCTURE CONDITION

2.4.1. Transport Connectivity

❖ ***Road network***

The city now has 116km highway crossing (including National Highway 1A, 80, 91 and 91B). The section of National Highway 1A (12km long) and National Highway 91 (51.14km long) crossing Can Tho city’s center has been upgraded and expanded with the width of pavement, bridge and culvert from 12 to 24m (grade III delta road).

The provincial roads including 917, 918, 919, 920, 920B, 920C, 921, 922, 923, 926, 932 have a total length of 183.859 km.

The city-level roads are almost paved with asphalt. There is only about 25% of aggregate roads and 18% of red roads.

The intercommunal roads in the suburb districts and a part of urban area are 426km long, mainly being aggregate and red roads.

Some provincial roads and almost district roads have several culverts, therefore, 4-wheel trucks are not allowed.

The urban road network of Can Tho city is mainly concentrated in the urban areas of the old towns (Can Tho city, Thot Not, O Mon, Cai Rang towns). The main roads in the center of Can Tho city have been renovated and expanded, including Tran Phu, Tran Hung Dao, road 3-2, Hoa Binh, road 30-4 and Mau Than roads.

According to the field survey, the tertiary traffic systems in 4 districts of Ninh Kieu, Binh Thuy, Cai Rang and O Mon are now degraded and should be upgraded to create better living conditions and incomes for the residents here.

❖ ***Waterways***

Can Tho city has an abundant network of rivers – canals – creeks with a total length of 3,405km, of which the waterway network from grade I to VI has a total length of about 345.5km spread out on the city, which is very favorable for the development of waterway traffic.

❖ ***Airway***

Can Tho international airport (also known as Tra Noc airport) was renovated and upgraded with runways, taxiways and aircraft parking area with a runway of 2,400m length, 45m width and 5 taxiways in dimension of 114.5 x 15.0 m. It is expected to expand the runway to 3,000 m x 45 m, synchronously upgrade taxiway, parking area, flight control system, passenger terminal and other flight services facilities to receive kinds of mid-range aircraft as A320, B767 with domestic and international flightpaths.

2.4.2. Water Supply

The proportion of households is supplied with clean water in Ninh Kieu, Binh Thuy, Cai Rang, O Mon district is quite high about 98 %, 95%, 90%, 90%, respectively. The rest of households buy water and use water from other sources like rainwater and river water, etc. These households are mainly those living near the canals and creeks.

2.4.3. Power Supply / Electricity

Can Tho city is energized from Can Tho thermal power plant and national grid.

- Can Tho 1 thermal power plant has a suspended thermal generating set with capacity of 33MW, 4 F6 gas turbine units with capacity of 3.7 MW each. In 2008, O Mon 1 thermal power plant with capacity of 300MW was put into operation, increased significantly power supply source for subloads in the city as well as entire national grid.
- Tra Noc 220kV substation has 4 outgoing feeders to supply power for eight 110kV transformer substations in the city, including Can Tho, Long Hoa, Hung Phu industrial park, Can Tho industrial park, Southern broadcasting station, Thot Not, Thoi Thuan and Binh Thuy.

In 4 districts in the project area, 100% of wards have had electricity. Regarding lighting system, 100% of primary and secondary infrastructure of Can Tho city is powered lighting. However, in alleys belong to tertiary infrastructure, public lighting ratio is quite low. The rate of alleys lighted in Ninh Kieu is 50%, 10% in Binh Thuy, 7% and 5% in Cai Rang and O Mon.

2.4.4. Drainage and Wastewater Treatment

Currently, wastewater in Ninh Kieu and Binh Thuy districst has not been collected and treated separately; there are not any wastewater treatment plants. Percentage of roads, alleys has drainage system in Ninh Kieu about 40% while it is only 5% in Binh Thuy, Cai Rang, O Mon.

The drainage capacity of existing lakes and canals is very poor because of narrowed flows or block with garbage and encroachment of households. Many places were flooded from 0.3 to 0.4m height in several hours; especially Lias belonged to Ninh Kieu and Binh Thuy districts.

2.4.5. Archaeological and Historical Treasures

No archaeological or historical treasures are known to occur anywhere within the project RoWs.

2.4.6. Flooding

By analyzing the actual flood statistics from 2002 - 2014, it is shown that in previous years (before 2008), inundation in Can Tho city was caused by floods and tides. From 2009 to present, inundation in Can Tho city has still been affected by the floods, tides, of which tides is the main factor. The causes of inundation in the city can be summarized as follows:

❖ ***Causes from natural factors***

- Flooding caused by low-lying terrain from the rivers into the infields and new urban areas developed on the low elevation areas in the districts of Vinh Thanh, Co Do, Phong Dien, Thot Not, O Mon. More than 99.6% of city land has the elevation level of below ≤2m. Low-lying areas are directly flooded or indirectly affected by floods.

- Flooding resulted from unfavorable hydrological characteristics, affected by upstream floods and the increase in top level of high tides on major rivers in recent years causing the increase in the flooding level and scope.

- Flooding caused by rains tend to rise resulting in the overload of drainage sewers. The annual rainfall of Can Tho city is not large (1,636mm) but heavy rains of more than 50mm or even more than 100mm of rainfall often occur.

- Flooding due to the effects of climate change - sea level rise:

Over the last 30 years, the highest water level measured at Can Tho station has increased by nearly 50cm, particularly the lowest water level has also increased by nearly 40cm, causing difficulty for the drainage. In 2011, the peak water level of Hau river, measured at Can Tho station increased unusually if compared with that measured at Tân Châu and Châu Đốc stations and with the highest flood level measured in 2000. In 2000, the flood peak measured at Tân Châu was 506cm, and at Châu Đốc 490cm. At Can Tho station, it was measured 173cm. However, the 2011 flood peak at Tân Châu was 486cm, Châu Đốc 425 cm while at Can Tho, it was 215 cm, almost highest in the history, 42 cm higher than the peak level in 2000. After considering these factors, it can be concluded that the high level of water in 2011 in Can Tho was resulted from the combination of high tides and sea level rise.

❖ ***Causes resulted from technical factors, works***

- Flooding due to lack of drainage works such as: canals, regulating lakes (insufficient quantity and scale), and the increase of urbanization.

- Flooding due to the degradation of the existing drainage system, inadequate capacity to drain the water for the City with the current development situation, or due to improper construction from the original designs or due to being leveled by other works.

❖ ***Organizational and management causes***

- Difficulties in managing the city development plan on a low-lying resulted in improper leveling and filling, loss of the water regulation areas and drainage canals.

- Decentralization for management, maintenance and repair of drainage system in the city is insufficient;

- The people's awareness to protect the drainage system is poor, for example uncontrolled littering, blocking the water collection system from roads down to manholes and the urban drainage pipelines...

CHAPTER 3. ANALYSIS OF ALTERNATVIES

3.1. ASSESSING "WITHOUT PROJECT" AND "WITH PROJECT"

This section analyses alternatives -"without project" and "with project"- in term of environmental, social issues.

- "Without project": When the project will not be implemented. In the case of not doing this project, it is obvious that drawbacks still arise in the current condition as flooding, tidal surges; deterioration of environmental sanitation conditions; air pollution, solid waste, accretion of sludge, and other negative environmental impacts,that would have detrimental effects on the welfare of the citizens of Can Tho.
- "With project": When the project will be implemented 03 components: Flood control and environmental sanitation; urban corridor development and Strengthening urban management for climate change resilience.

Results of the analyses are shown as follows.

Table 3.1: Analyses of alternatives – WITHOUT PROJECT and WITH PROJECT

The major environmental and social issues	WITHOUT PROJECT	WITH PROJECT
Environmental Issues		
Flooding and tidal surges	Key urban area keeps on being flooded by upstream flooding, tiding and high rainfall intensity. Flooding occurs regularly in project area, there will be 55% of flooded households during the rainy season with flooding frequency of 0.25 times / month, after flooded average of 0,32m and the average submerged time of 2.45 days / was flooded; Using hydraulic model simulating to the current status including of drainage system as at present, the project works VUUP1, VUUP2 was built. With the estimated frequency of 10%, the flooded area of 1542 hectares is occupied 57.7% of the total area of the zone.	After construction of works under the project- due to tidal control and improve drainage capacity of the drainage system that flooded urban area declines, by using hydraulic model, flooded area declines to 1080-984 ha area, accounting for 34.5-34.4% of the whole area.
Air pollution	Odor pollution causing by garbage, stagnant waste water from canals	Resolving odor pollution due to garbage, stagnant waste collection

The major environmental and social issues	WITHOUT PROJECT	WITH PROJECT
		Air pollution in construction period due to construction activities as material transport activities, excavation…
Improving surface water quality in canals	Surface water quality in canals has been polluted by directly receiving wastewater and household waste in the region but scattered form.	Improving surface water quality in canals by replacing households living along the canals, upgrading and collection of wastewater, canal dredging
Landslide	Increasing of landslide due to rainy season, the effects of climate change and sea level rise	Reducing of landslide by flooding control options such as embankment
Social Issues		
Land Acquisition and Resettlement	Not affected by land acquisition and resettlement	The project is expected to have 4,539 affected households, of which 1,814 resettled households, 634 vulnerable affected households and 709 households with small business affected.
Disruption to living activities of Can Tho residents	No impact on the livelihood and activities of Can Tho residents and community relationship	Impact on the livelihood and activities of Can Tho residents and community relationship by construction activities and resettlement for PAHs
Accessibility to Road and inland Waterway	Traffic jams often occur due to flooding and storm surges.	Road, Inland waterway activities will more convenient due to prevention of flooding and tide occurred in core urban are; improvement of channel and canal by dredging and embanking.
Increase of land value	Low land values	When embankment is constructed to create landscape of river, body of embankment will be taken advantages of brand advertising, land on embankments will be used as parking lots, amusement parks and restaurants. Therefore, the land around the embankment will promote efficiency and bring more value
Sanitation condition and public health	Deterioration of environmental sanitation condition Illness arising caused by flooding and water resources: 25.6% of household common related to scabies diseases, 23.5% of households related to	Improving sanitation condition and public health by improving drainage capacity, controlling tide and improving regulating reservoirs therefore diseases arising from flooding will be reduced. Sanitation and public heath will be improved, especially for residents living along the canals / docks.

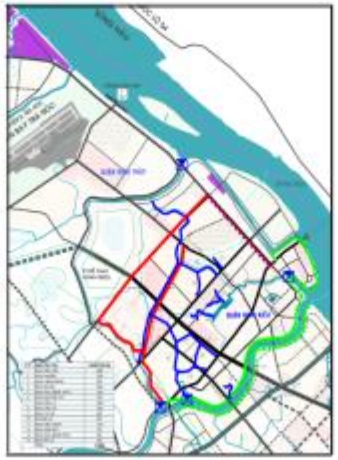
The major environmental and social issues	WITHOUT PROJECT	WITH PROJECT
	dengue, 17.9% of households related to dysentery and 2% of households related to typhoid;	
Urban Landscape	Declining urban landscape	*Improving urban landscape:* the project will remove households on encroachment for channel and canal; create open space along two river banks with riverside landscape architecture organization such as improving public spaces, embellishing the traditional architecture, tree planting….
Beneficiary	None	Direct beneficiaries of the project are the residents living in the project area in Ninh Kieu and Binh Thuy wards. In addition, households who are living on river banks and coastal areas - in the project area will have a stable and safe dwelling. 966 000 people will be protected against flooding on high tide day, of which there will be around 24,000 (1.9%) ethnic people (mainly Khmer people).

3.2. ANALYSIS “WITH PROJECT” ALTERNATIVES

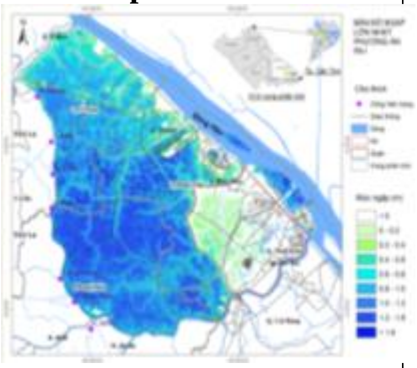
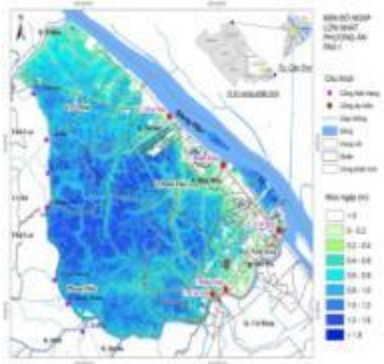
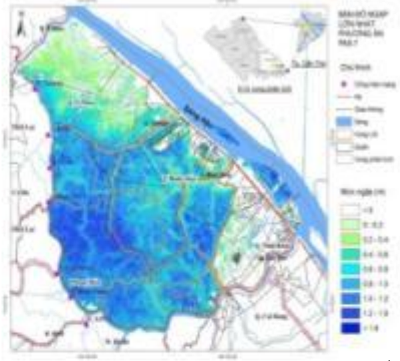
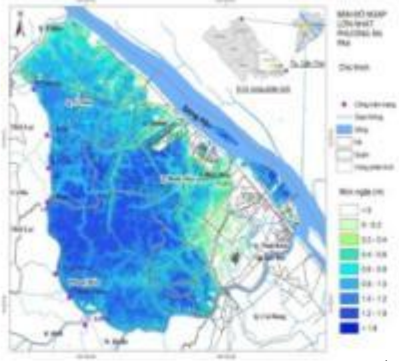
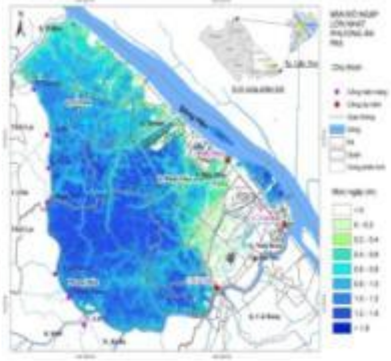
To protect Ninh Kieu and Binh Thuy district, the feasibility study prepared under the project has studied five flood control options. Results of the analyses are shown as follows.

Table 3.2: Analysis of the 5 Proposed Flood Control Options

NO	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5
1	**Description of the option:** This option allow flood control through a closed protection system including embankments for urban landscaping along Can Tho river, and road along Cai Son, Muong Khai and Binh Thuy rivers, and NH91. Tidal gates/valves on primary canals to control tide level. Rehabilitation and upgrade of canals in the center and construction of water drainage system.	**Description of the option:** Option 2 is not a closed protection system. Instead, 3 tidal sluice gates combine with ship lock in Tra Noc, Binh Thuy and Cai Son rivers will be constructed. Can Tho river embankment will be constructed. Rehabilitation and upgrade of canals in the center and construction of water drainage system.	**Description of the option:** Option 3 is a closed protection system, like option 1, but at a smaller scale. Flood control system includes Can Tho river embankment, road system along Cai Son and Hang Bang rivers connecting to NH91. Rehabilitation and upgrade of canals in the center and construction of water drainage system.	**Description of the option:** Option 3 is a closed protection system, like option 1, but at a smaller scale. Flood control system includes Can Tho river embankment, road system along Cai Son and Mương Khai rivers, link between CMT8 (NH91) to PR918 (in component 2). Rehabilitation and upgrade of canals in the center and construction of water drainage system.	**Description of the option:** Option 5 is actually option 4 and adding 2 sluice gates + ship lock in Binh Thuy and Cai Son. Other items remain the same as option 4.
2	**Core area protected: 3,600 ha**	**Core area protected: 3,600 ha**	**Core area protected: 2,477 ha**	**Core area protected: 2,675 ha**	**Core area protected: 2,675 ha**

NO	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5
					
3	**Description of structural solutions of the option:** - Constructing Can Tho river embankment with length of 5.5km with tidal protection elevation, combining with urban landscaping. - Constructing 2 tidal sluice gates combining with ship lock at Cai Khe and Dau Sau canals on Can Tho river. - Constructing 6 tidal sluice gates/valves at the beginning of primary canals on Cai Son, Muong Khai and Binh Thuy rivers. - Upgrade and habilitation of roads along Binh Thuy,	**Description of structural solutions of the option:** - Constructing Can Tho river embankment with length of 5.5km with tidal protection elevation, combining with urban landscaping. - Constructing 2 tidal sluice gates combining with ship lock at Cai Khe and Dau Sau canals on Can Tho river. - Constructing 3 tidal sluice gates combining with ship lock on Tra Noc, Binh Thuy and Cai Son rivers.	**Description of structural solutions of the option:** - Constructing Can Tho river embankment with length of 5.5km with tidal protection elevation, combining with urban landscaping. - Constructing 2 tidal sluice gates combining with ship lock at Cai Khe and Dau Sau canals on Can Tho river. - Constructing tidal sluice gates/valves along Cai Son and Hang Bang rivers to close the system.	**Description of structural solutions of the option:** **- Constructing Can Tho river embankment with length of 5.5km with tidal protection elevation, combining with urban landscaping.** **- Constructing 2 tidal sluice gates combining with ship lock at Cai Khe and Dau Sau canals on Can Tho river.** **- Constructing tidal sluice gates/valves along Cai Son, Muong Khai and link between CMT8 (NH91)**	**Description of structural solutions of the option:** - Constructing Can Tho river embankment with length of 5.5km with tidal protection elevation, combining with urban landscaping. - Constructing 2 tidal sluice gates combining with ship lock at Cai Khe and Dau Sau canals on Can Tho river. - Constructing tidal sluice gates + ship lock on Binh Thuy and Cai Son rivers to control water river during high tides with heavy rain. Water level control on these 2 rivers allows reduction of the

NO	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5
	Muong Khai and Cai Son rivers to flood protection elevation. - Upgrade and rehabilitation of 17 primary canals to improve drainage capacity, storage volume during heavy rain and high tide, improve sanitation. Especially to promote effectiveness and connecting to structures in VUUP 1 and 2 projects. - Rehabilitation of the drainage system in Ninh Kieu urban center, in total 27 proposed roads with length of about 11km in Ninh Kieu core area and about 10km in the remaining areas of the catchment. - Constructing 3 regulation and water retention lakes with area of 86ha	- Upgrade and rehabilitation of 17 primary canals to improve drainage capacity, storage volume during heavy rain and high tide, improve sanitation. Especially to promote effectiveness and connecting to structures in VUUP 1 and 2 projects. - Rehabilitation of the drainage system in Ninh Kieu urban center, in total 27 proposed roads with length of about 11km in Ninh Kieu core area and about 10km in the remaining areas of the catchment.	- Upgrade and rehabilitation of 17 primary canals to improve drainage capacity, storage volume during heavy rain and high tide, improve sanitation. Especially to promote effectiveness and connecting to structures in VUUP 1 and 2 projects. - Rehabilitation of the drainage system in Ninh Kieu urban center, in total 27 proposed roads with length of about 11km in Ninh Kieu core area and about 10km in the remaining areas of the catchment.	**and PR918 to close the system.** **- Upgrade and rehabilitation of 17 primary canals to improve drainage capacity, storage volume during heavy rain and high tide, improve sanitation. Especially to promote effectiveness and connecting to structures in VUUP 1 and 2 projects.** **- Rehabilitation of the drainage system in Ninh Kieu urban center, in total 27 proposed roads with length of about 11km in Ninh Kieu core area and about 10km in the remaining areas of the catchment.** **- Constructing 2 regulation and water retention lakes with area of 12ha**	water levels in areas surrounding the urban core. - Upgrade and rehabilitation of 17 primary canals to improve drainage capacity, storage volume during heavy rain and high tide, improve sanitation. Especially to promote effectiveness and connecting to structures in VUUP 1 and 2 projects. - Rehabilitation of the drainage system in Ninh Kieu urban center, in total 27 proposed roads with length of about 11km in Ninh Kieu core area and about 10km in the remaining areas of the catchment. - Constructing 2 regulation and water retention lakes wit area of 21ha.

NO	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5
4	**Flood map** 	**Flood map** 	**Flood map** 	**Flood map** 	**Flood map** 
5	**Flood reduction impacts** - Most of urban areas are not flooded. - Flooding area (530 ha) during heavy rain and high tide mainly in the area between Hang Bang and Binh Thuy/Muong Khai canals in the low elevation areas, and low-lying areas to be used for temporary retention. - Average flooding time reduced from 3-4 h to 1-2 h. - Protected area is 3,600 ha, with elevation above +1.05m will not be flooded, population in the protected	**Flood reduction impacts** - Floodings in a large area of the urban areas are significantly reduced. - Flooding area during heavy rain and high tide is still large (1.870 ha) with average flood depth from 0.6 – 1.0m, mainly in low-lying areas, including retention areas and near the center area. - Average flooding time reduced from 3-4 h to 2-3 h. - Protected area is 3,600 ha with elevation above +1.70m will not be flooded, population in the protected	**Flood reduction impacts** - Most of urban areas are not flooded. - Flooding area reduced to about 270 ha, scattered in low-lying areas, lakes and ponds, places used for temporary retention during heavy rain combining with high tide. - Average flooding time reduced from 3-4 h to 1 h. - Protected area is 2,477 ha with elevation above +0.85m will not be flooded, population in the protected	**Flood reduction impacts** **- Most of urban areas are not flooded.** **- Flooding area reduced to about 360 ha, scattered in low-lying areas, lakes and ponds, places used for temporary retention during heavy rain combining with high tide.** **- Average flooding time reduced from 3-4 h to 1 h.** **- Protected area is 2,675 ha with elevation above +0.78m will not be flooded, population in the protected**	**Flood reduction impacts** - Most of urban areas are not flooded. - Flooding area reduced to about 290 ha, scattered in low-lying areas, lakes and ponds, places used for temporary retention during heavy rain combining with high tide. - Average flooding time reduced from 3-4 h to 1 h. - Protected area is 2,675 ha with elevation above +0.71m will not be flooded, population in the protected area is about 423,400 in

NO	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5
	area is about 439,400 in which permanent population (local population, students, immigrant workers) is about 407,600 people and unpermanent population (tourists, people coming for healthcare) is about 31,800 people. - Uncomplicated operation and maintenance of the flood control system. - Water level rising impacts in surrounding areas: insignificant.	area is about 439,400 in which permanent population (local population, students, immigrant workers) is about 407,600 people and unpermanent population (tourists, people coming for healthcare) is about 31,800 people. - Water level rising impacts in surrounding areas: reduced water level. - Benefited area (flood reduction) of this option is bigger than the core area.	area is about 423,400 in which permanent population (local population, students, immigrant workers) is about 391,600 people and unpermanent population (tourists, people coming for healthcare) is about 31,800 people. - Water level rising impacts in surrounding areas: no rising water level.	**area is about 439,400 in which permanent population (local population, students, immigrant workers) is about 391,600 people and unpermanent population (tourists, people coming for healthcare) is about 31,800 people.** **- Water level rising impacts in surrounding areas: no rising water level.**	which permanent population (local population, students, immigrant workers) is about 391,600 people and unpermanent population (tourists, people coming for healthcare) is about 31,800 people. - Water level rising impacts in surrounding areas: no rising water level.
6	**Social impacts and resettlement** - Number of affected households: 4,447 - Number of resettled households: 1,115	**Social impacts and resettlement** - Number of affected households: 2,996 - Number of resettled households: 876	**Social impacts and resettlement** - Number of affected households: 3,599 - Number of resettled households: 1,032	**Social impacts and resettlement** **- Number of affected households: 3,805** **- Number of resettled households: 1,073**	**Social impacts and resettlement** - Number of affected households: 3,805 - Number of resettled households: 1,073
7	**Environmental impacts** - Improved environmental conditions and public health. - Upgrade essential sanitation	**Environmental impacts** - Improved environmental conditions and public health. - Upgrade essential	**Environmental impacts** - Improved environmental conditions and public health. - Upgrade essential	**Environmental impacts** **- Improved environmental conditions and public**	**Environmental impacts** - Improved environmental conditions and public health. - Upgrade essential sanitation

NO	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5
	infrastructure for Can Tho city. - Insignificant impacts to land and water ecosystems. - Impacts during construction phase such as noise, vibration, dusts, water pollution need to be controlled and mitigated.	sanitation infrastructure for Can Tho city. - Insignificant impacts to land and water ecosystems. - Impacts on waterway transport need to be further studied in FS. - Impacts such as erosion, changing flows/beds at tidal sluice gates/ship locks need to be further studied in FS. - Impacts during construction phase such as noise, vibration, dusts, water pollution need to be controlled and mitigated.	sanitation infrastructure for Can Tho city. - Insignificant impacts to land and water ecosystems. - Impacts during construction phase such as noise, vibration, dusts, water pollution need to be controlled and mitigated.	**health.** **- Upgrade essential sanitation infrastructure for Can Tho city.** **- Insignificant impacts to land and water ecosystems.** **- Impacts during construction phase such as noise, vibration, dusts, water pollution need to be controlled and mitigated.**	infrastructure for Can Tho city. - Insignificant impacts to land and water ecosystems. - Impacts on waterway transport need to be further studied in FS. - Impacts such as erosion, changing flows/beds at tidal sluice gates/ship locks need to be further studied in FS. - Impacts during construction phase such as noise, vibration, dusts, water pollution need to be controlled and mitigated.
	Total investments (for flood control sub-component) Estimates: 3,566.95 billion VND (168.97 million USD)	**Total investments (for flood control sub-component)** Estimates: 2,785.587 billion VND (131.96 million USD)	**Total investments (for flood control sub-component)** Estimates: 2,136.63 billion VND (101.21 million USD)	**Total investments (for flood control sub-component)** **Estimates: 2,781.122 billion VND (131.74 million USD)**	**Total investments (for flood control sub-component)** Estimates: 3,134.306 billion VND (148.47 million USD)

According to the Table 3.1, the option 1, the investment cost and affected households are highest, thus, it is not considered. The option 2 is not selected as the protected area is not closed, thus it is hard to control the flood risk. Option 33 has lowest investment, number of resettled people are lowest. However, this option is not in accordance with the city planning and the total protected area is lowest. Therefore, it is also not selected.

However, the option 4 and 5 are short-listed as they are effective in control flood risk of the urban core area. In addition, they also create land fund for urban development along the road connecting CMT8 and provincial road; which is a part of the flood control work.

In the comparison between two short-listed options 4 and 5; the environmental and social impacts are mostly the same. However, the investment cost for option 5 are higher as they include the construction of two sluice gates at Binh Thuy and Cai Son rivers but effectiveness of flooding reduction is not higher than option 4. In addition, the management of waterway is easier in option 3. In consideration of all aspects, option 4 is selected.

3.3. ALTERNATIVES ON TECHNOLOGY FOR FLOOD CONTROL SYSTEM

Investment items of components include Can Tho river embankment, construction road and park behind embankment, Dau Sau and Cai Khe tide sluice gates and tide locks; Cai Son ditch anti-landslide embankment, renovation of canals/ditches in the core urban area; two regulatory lakes.

3.3.1. Alternatives for Selecting Engineering And Technology Options For Can Tho Embankment

Analysis of selection of embankment structure: proposed technical options to compare are the typical embankment structures, which are being used in Mekong River Delta are and in other provinces in Vietnam.

Table 3.3: Comparison of Engineering And Technology Options For Can Tho Embankment

Items	**Alternative 1:**	**Alternative 2**	**Alternative 3**
Technology	Gravity concrete embankment wall + roof reinforcing embankment with precast concrete	Wall prestressed concrete embankment + reinforced by gabion wall	Wall concrete piles prestressed + slanted roof with precast concrete
Advantage	Commonly applied in coast protection works in the project area and the Mekong Delta. Together with existing Can Tho River Embankment from Cai Khe to Ngo Duc Ke. A pile construction method in the country is relatively common in Vietnam. Having the lowest value in the options	Suitable for building location with limited construction space. Simple construction methods can be applied in the deep position	Suitable for building location with spacious work site. Simple construction methods can be applied in the deep position
Disadvantage	Big pile depth due to dig on good soil. Construction of embankment base depends on tide making working time may be extended. Need to organize temporary road for construction and transport materials	The size and length wall piles often large, deep so investment cost would be higher, construction time could be reduced. Need road construction transportable wall piles and construction equipment, volume of super-sized and super-weighted. No matching old embankment sections in term of connectivity	The size and length wall piles often large, deep so investment cost would be higher. Construction depends on the tides, so construction time can be reduced. Need road construction transportable wall piles and construction equipment, the volume shipped super, super important. . No matching old embankment sections in term of connectivity

Items		Alternative 1:	Alternative 2	Alternative 3
Evaluation	Social Aspect	None	None	None
	Environmental Aspect	Ensuring urban landscape beacause of matching with old embankment system and increasing elevation in the future and ensure beautiful, durable and modern	Not ensuring urban landscape due to not matching old embankment sections	Not ensuring urban landscape due to not matching old embankment sections
	Economic Aspect	The lowest economic cost	The economic cost is higher than alternative 1	The economic cost is higher than alternative 1
Conclusion		Selected	Not selected	Not selected

In the comparison among three alternatives in term of social, economic and environmental espect, alternative 1 is seclected due to ensuring urban landscape and the lowest enconomic cost.

3.3.2. Alternatives for Selecting Engineering And Technology Options For Cai Son Cannal

Situation of river erosion in areas along Cai Son canal become more severe in recent years. In the rainy season and flooding season, the travel of local people is difficult. The construction of Cai Son canal embankment is to limit erosion is an urgent job to help protect the safety of people living in the area

Table 3.4: Comparison of Engineering And Technology Options For Cai Sơn Cannal Embankment

Items	Alternative 1	Alternative 2
Technology	Gravity concrete embankment wall + roof reinforcing embankment with precast concrete	Wall prestressed concrete embankment + reinforced by gabion wall.
Advantage	Commonly applied in coast protection works in the project area and the Mekong Delta. Together with existing O Mon River on Chau Van Liem side which has been invested by Investment bond. Pile construction methods in the country is relatively common in Vietnam. Having the lowest value in the options.	Suitable for building location with limited construction space. Simple construction methods can be applied in the deep position

	Elevation increase in the future is easier.	
Disadvantage	Big pile depth due to dig on good soil. Construction of embankment base depends on tide making working time may be extended. Need to organize temporary road for construction and transport materials	The size and length wall piles often large, deep so investment cost would be higher, construction time could be reduced. Need road construction transportable wall piles and construction equipment, volume of super-sized and super-weighted.
Social Aspect	None	None
Environment	Ensuring urban landscape as it is synchronous with the Can Tho embankment	No matching old embankment sections so that do not ensure urban landscape.
	The lowest economic cost	The economic cost is higher than alternative 1
Conclusion	**Selected**	**Not selected**

In the comparison between two alternatives in term of social, economic and environmental espect, alternative 1 is seclected due to ensuring urban landscape due to connecting with old embankment system and increasing elevation in the future is easier, and the lowest enconomic cost.

3.3.3. Alternatives for Selecting Engineering And Technology Options For Construction Road And Park Behind Embankment

Table 3.5: Comparison of Engineering And Technology Options For Construction Road And Park Behind Embankment

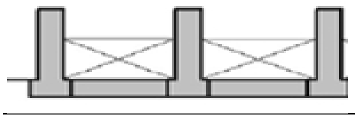
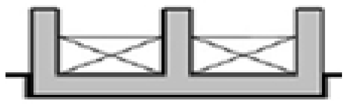
Item	Alternative 1	Alternative 2
Investment scale	Scale of road cross section follows the Area IV planning and planning of Ninh Kieu district, approved in 2007 : - Section from intersection of Ngo Duc Ke to the end of Nguyen Thi Minh Khai, 18m-wide (road surface 10m-wide, pavement of 4m/side) - Section from Nguyen Thi Minh Khai to the end of Tam Vu in accordance with 25m planning (road surface 12m, pavement 6.5m/side) - Principle of expansion expanding is calculated from the boundaries of the house inside the embankment to the park.	Scale of road cross proposed for Project with development objectives and suitable with current traffic flow. - Construction of cross section of 23m wide along the route with road surface of 15m, pavement is 6m/side. - Principle of expansion expanding is calculated from the boundaries of the house inside the embankment to the park.

Item	Alternative 1	Alternative 2
Advantage	- Consistent with the approved planning. - Reduce partial compensation for the section from Ngo Duc Ke to end of Nguyen Thi Minh Khai - Take the advantage of the existing road base. Reduce investment cost.	- Consistent with the need for vehicle moving in the future. - To facilitate smooth travel connections with existing roads. - Combined with the park and the Can Tho River embankment forming a beautiful landscape and a highlight for Can Tho City
Disadvantage	- Sections of route are difference, causing it difficult for moving - Cannot combine with the park at the rear of embankment	- Increase the land clearance area - Cannot take the maximum advantage of existing road base.
Social	Less impacts caused by site clearance	More impacts caused by the site clearance area
Environment	Not Ensuring urban landscape	Ensuring urban landscape
Economic	The lowest investment cost	The investment cost is higher than alter 1
Conclusion	**Not selected**	**Selected**

Compared to the option 1, option 2 has higher cost and require more land acquisition. However, it is better as it ensure urban landscape and create public services. Therefore, it is selected after consideration of all aspects.

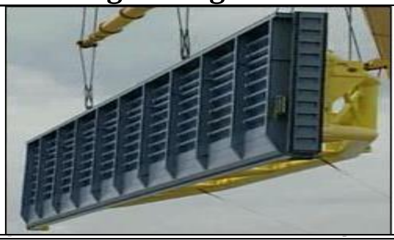
3.3.4. Alternatives for Selecting Engineering And Technology Options For Dau Sau And Cai Khe Tide Sluice Gate

Table 3.6: presents comparison of structure options, valve gate

	Alternative 1: Abutment option	**Alternative 2: Tradition option**
Illustrating image		
Advantage	Use enclosure frame for construction, without digging canal. Operation in combination with dock and upper way relatively easily Easily combined with other works to create a beautiful landscape for project Will arise foundation treatment for the abutment	This is the traditional option which has been widely applied in the works in the delta, for the docks that have small apertures. Simple foundation treatment
Disadvantage	This is new option that requires new construction technologies; however, it was applied for the flood prevention project in Ho Chi Minh City. Time of construction period is less than alternative 2	Must embankment upstream and downstream rotary, and canals flow. Due to the nature of the permanent and fixed shape, forming aesthetic, landscaping will be limited. Operation in combination with more sophisticated dock.
Social	None	None
Environment	Less negative impacts in construction phase because time of construction period is less than Alter 2 Creating urban landscape, the highlight for the city	More negative impacts during construction phase because time of construction phase is more than Alter 1. Limited aesthetic, landscaping
Economic	None	None
Conclusion	Selected	Not selected

Selection of Alter1 because structure with abutment option will less environmental impacts in construction phase and creat the hgihligh for Can Tho city as well as ensure urban landscape.

Table 3.7: Comparison of Valve Gate

Items	**Alternative 1**	**Alternative 1**
Technology	**Standing valve gate**	**Lower axis**
Illustrating image		
Advantage	Operation and maintenance is relatively simple. Installation is relatively simple.	No need to build towers to operate the gate, the system operator can put on the gate pillar. Gate is invisible when not in use. When maintenance of the gate, it will be pulled up entirely No interaction with the surrounding architecture. Bearing capacity of the structure is relatively large.
Disadvantage	Need to build towers to operate the valve. Doors will be pulled up when not in use, interact with the surrounding architecture major. Large gate structure Bearing capacity of the structure is medium.	Installation of the gate is relatively complicated. Gate structure scale is medium
Social aspect	None	None
	More environmental impacts during construction, operation phase due to building of towers to operate the valve. Not ensure aesthetic and urban landscape	Less environmental impacts during construction, operation phase due to no building of towers to operate the valve. Ensure aesthetic and urban landscape
	None	None
Conclusion	**Not selected**	**Selected**

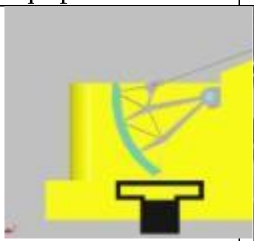
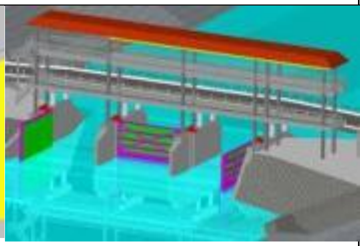
Selection of Alter2 because valve gate with lower axis will less environmental impacts in construction phase and creat the hgihligh for Can Tho city as well as ensure urban landscape.

3.3.5. Alternatives for Selecting Engineering And Technology Options For Five Ship Locks

The proposed option will have 5 ship locks which are proposed for the controlling corridor positions intersect with canals, including: Sao Canal, Ba Bo Canal, Suc Canal, Pho

Tho Canal and Hang Bang Canal. The comparison options will focus on valve gates and key equipment of the flood control.

Table 3.8: Comparison of Ship Locks Options

Items		Alternative 1	Alternative 2	Alternative 3
Technology		ship locks with hydraulic lifting equipment	: Automatic ship locks	Clape type ship locks
Illustrating image				
Advantage		Gate operation is simple. Construction is not complicated. No need electricity.	Self-operated gate Construction is not complicated No need electricity.	Self-operated gate Direct coupling which is not complicated Consuming additional installation fee Able to control river tide
Disadvantage		Controlling the water level at a certain level. Valve door width 5-20m Inland Waterway is limited	Uncontrolled high water levels in certain elevation. Gate will drain all water. If channel bottom is not deep the channel bottom will visible. Valve door width 5-20m Inland Waterway is limited	Only one way flow out so mainly wastewater and storm water that causing pollution and odor. Able to get stuck in the dry season when there is no large flow
Evaluation	Social Aspect	None	None	None
	Environmental Aspect	Not causing water pollution and odor	Not causing water pollution and odor	Causing water pollution and odor
	Economic Aspect	None	None	None
Conclusion		**Selected**	**Not selected**	**Not selected**

In the comparison among three alternatives in term of social, economic, environmental and technology espect, alternative 1 is seclected due to not causing water pollution and ordor and has modern technology and widely use in other similar projects.

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3.4. ALTERNATIVE FOR EVIRONMENTAL SANITATION

Component includes: improving drainage system for routes in the centre of Ninh Kieu district**.**

❖ ***Alternative 1: Continue to build separated drainage system to drain 100% of storm water.***

The first drainage option is follow the principle of drainage water into receiving sources by the fastest way, minimize length of drainage. Main receiving source is Can Tho River.

Catchment 1: Include Tan An Ward, An Lac, Xuan Khanh, draine to the Can Tho River.

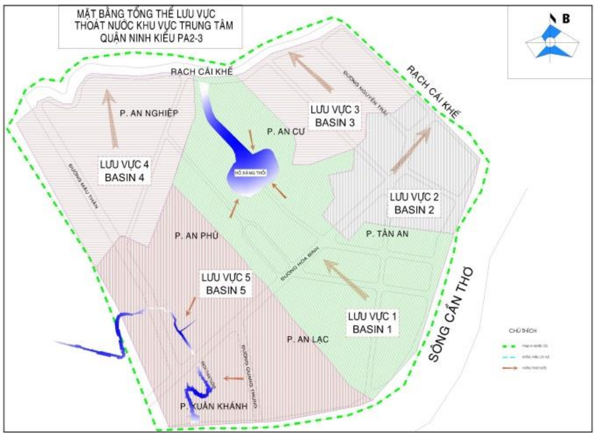


Figure 3.1: General drainage map of option 2 -3

Catchment 2: Include An Hoi Ward and part of An Cu Ward and drain to Cai Khe Canal.

Catchment 3: Area around Xang Thoi Lake, drain to Xang Thoi Lake

Catchment 4: An Nghiep Ward and Part of An Phu Ward, drain to Cai Khe Canal.

Catchment 5: Part of An Phu Ward and Xuan Khanh Ward drain to the Tham Tuong Canal.

❖ ***Alternative 2: Construction of separately drainage system. Rehabilitation of the existing drainage system to ensure the capacity of 30% storm water and newly construction of storm water drainage system, ensure to drain 70% remaining storm water***

Main drainage direction: toward Cai Khe canal and Xang Thoi lake.

Catchment 1: Include part of Tan An ward and An Lac towards the Xang Thoi lake

Catchment 2: Include part of An Hoi ward, Tan An ward and Can Tho City PC drain to Cai Khe Canal.

Catchment 3: part of An Hoi ward, area of Nguyen Trai Road and Xo Viet Nghe Tinh road, drain to Cai Khe Canal.

Catchment 4: An Nghiep Ward and Part of An Phu Ward, drain to Cai Khe Canal.

Catchment 5: Part of An Phu Ward and Xuan Khanh ward, drain to Tham Tuong Canal.

Direction of the construction of sewer line: Ngo Duc Ke – Dien Bien Phu – Nguyen Thai Hoc – De Tham and drain to Xang Thoi Lake (In here could install drainage pump)

Construction of the pumping station to control flood at Xang Thoi Lake

❖ ***Alternative 3:***

Basically, Alternative 3 is similar to Alternative 2, drainage direction and receiving sources for the catchments:

However, Option 3 build 02 main sew line to collect water for Xang Thoi Lake : (1) Route of Ngo Duc Ke – Dien Bien Phu – Nguyen An Ninh – Ly Tu Trong (Luu Huu Phuoc park) – Truong Dinh – Xang Thoi Lake; (2) Nguyen Thai Hoc – De Tham – Xang Thoi Lake.

❖ ***Alternative 4:***

Storm water is collected maximally to Xang Thoi Lake, only small volume near Cai Khe Canal (Route of Mau Than, Tran Hung Dao, Xo Viet Nghe Tinh, Nguyen Trai) drain to Cai Khe Canal.

Lengthening of Xang Thoi Lake by ditch section with zero slope on De Tham Road (Section from Hoa Binh Avenue to Xang Thoi Lake). Hydraulic slope will be generated by flood control pumping station located at Xang Thoi Lake. The storm water drainage lines flow to this sewer line including: (1) Route of Phan Dinh Phung – Nguyen Thai Hoc – De Tham , (2) Hoa Binh Revenue (From Quang Trung bridge) – De Tham, (3) Hoa Binh Revenue (from Xo Viet Nghe Tinh) – De Tham, (4) Vo Thi Sau – Nguyen Khuyen system for Ninh Kieu district center:

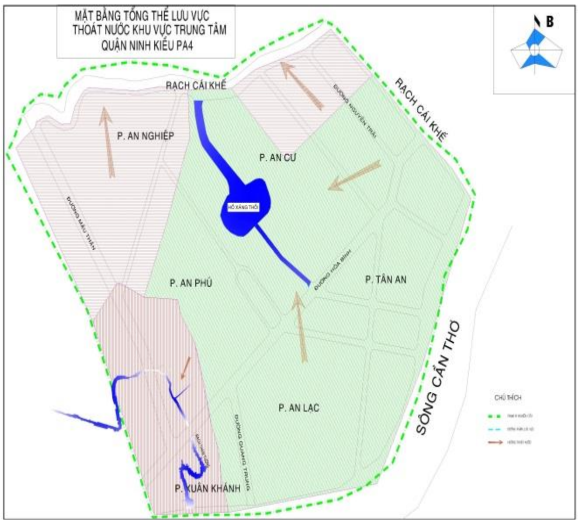


Figure 1: General drainage map of option 4

Table 3.9: Comparison of Drainage Technical Alternatives

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Drainage direction	Principle of the nearest drainage, shortest route.	Mainly flow to Xang Thoi Lake and Cai Khe Canal	Mainly flow to Xang Thoi Lake and Cai Khe Canal	Mainly flow to Xang Thoi Lake
Main drainage route	Small catchments have not created, limited water gathering.	Ngo Duc Ke – Dien Bien Phu – Nguyen Thai Hoc – De Tham and drainage to Xang Thoi Lake.	(1) Route of Ngo Duc Ke – Dien Bien phu – Nguyen An Ninh – Ly Tu Trong (Luu Huu Phuoc Park) – Truong Dinh – Xang Thoi Lake (2) Route of Nguyen Thai Hoc – De Tham – Xang Thoi Lake	(1) Route of Phan Dinh Phung – Nguyen Thai Hoc – De Tham (2) Hoa Binh Avenue (From Quang Trung Bridge) – De Tham (3) Hoa Binh Avenue (from Xo Viet Nghe Tinh) – De Tham. (4) Vo Thi Sau – Nguyen Khuyen – De Tham
Construction of drainage pumping station	NO	Construction at Xang Thoi Lake	Construction at Xang Thoi Lake	Construction at Xang Thoi Lake
Advantage	Fastest drainage time, gathering time in sewer is short	Ensure drainage of central Ninh Kieu District. Keeping much existing construction	Ensure the faster drainage than alternative 2, Reduce the diameter and the depth of sewer placement of main sewer line (1) similar to alternative 2.	There is strong connectivity with receiving sources which have been controlled water level. Better drainage, faster drainage than alternative 1 and alternative 2. Ensure the drainage of area of Can Tho Riverbank when the river water level rising, tide sluice gates closing.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Disadvantage	When the tide level rising, the valve gate of Can Tho river is closed. Water cannot flow out, flood risk is high	The connection with the controlled water area is not good enough Construction of large sewer line, depth of sewer line placement is high	Good connectivity with alternative 1, however, there is no closed linking. depth of main sewer line placement is high	Need to invest in many large sewer lines
Social Aspect	Stabilize for local residents	Stabilize for local residents	Stabilize for local residents	Stabilize for local residents
Environmental Aspect	Causing high risk flood Improving environment and landscape surrounding drainage system; Minimize diseases, create clean environment, facilitate transportation Reduce flooding and inundations during high tide and heavy rain.	Causing high risk flood Improving environment and landscape surrounding drainage system; Minimize diseases, create clean environment, facilitatetranspo rtation.	Causing high risk flood Improving environment and landscape surrounding drainage system; Minimize diseases, create clean environment, and facilitate transportation.	Not causing high risk flood Improving environment and landscape surrounding drainage system; Minimize diseases, create clean environment, and facilitate transportation.
Economic Aspect	None	None	None	None
Conclusion	**Not selected**	**Not selected**	**Not selected**	**Selected**

In the comparison among four alternatives, alternative 4 is seclected basing on environmental and social espects.

3.5. ALTERNATIVE OF INVESTMENT SCALE FOR URBAN CORRIDOR DEVELOPMENT

3.5.1. Alternative for Quang Trung Bridge

To ensure the connection between the old bridge and the new bridge, creating a focal point for the southern gate of the city of Can Tho, Quang Trung Bridge will be evaluated and considered as a whole aesthetic and technical and finance. The alternatives are compared as follows:

Table 3.10: Comparison of technical alternatives of Quang Trung Bridge

Item	Alternative 1	Alternative 2	Alternative 3
Technical options	Bridge structure for Quang Trung - Unit 2: using structural alternatives 1 - keep the same length of the existing bridge; Bridge structure for Quang Trung - Unit 1: use the option (a) - Keep the length of the existing bridge, road bridge editing suitable new premises, near the abutments remain talus, only reinforced by concrete retaining wall at repair section	Bridge structure for Quang Trung - Unit 2: use structural plans 2 - Length of the new bridge is longer than the existing bridge, the shore for more than 3 beat Cai Rang and shore 3x33m longer Ninh Kieu 2 rhythm 2x33m; Bridge structure for Quang Trung - Unit 1: using alternatives (b) - Rhythm guide shore Cai Rang extended 3 beat 3x33m and shore Ninh Kieu 2 rhythm 2x33m extended.	Alternative III is a compromise between the two solutions I and II, in terms of limit cost: Bridge structure for Quang Trung - Unit 2: use structural plans 2 - Length of the new bridge is longer than the existing bridge, the shore for more than 3 span at Cai Rang and shore 3x33m longer at Ninh Kieu 2 at span 2x33m; Bridge structure for Quang Trung - Unit 1: use the option (a) - Keep the existing road bridge, near the abutments remain talus, only reinforced concrete walls line tuning segment.
Advantage	Alternative I has the lowest expense The time of construction period is highest.	Alternative II has the advantage of fine art works, construction conditions, favorable exploitation and faster construction time. Regarding the construction period: embankment is lower, processing volume is not much so should be able to shorten the construction period of about 6 to 8 months compared to Option I. The bridge is located on Quang Trung - Cai Cui which is an important gateway to the southern city; Quang Trung bridge and along with Southern Cultural Center, ecological corridors and the other surrounding buildings make up the architectural highlights typical river for Mekong Delta region in general and Tay Do in	Regarding the construction period: embankment is lower, processing volume is not much so should be able to shorten the construction period of about 6 to 8 months compared to **Alternative** I.

Item	Alternative 1	Alternative 2	Alternative 3
		particularly, so factors of landscape is critical	
Disadvantage	The option I have the height up to 7 m high bridge road, handling complex construction expensive, hard to avoid affecting existing bridges are being exploited, affecting homes and structures resulting from either side subsidence, cracking the road-use solution even handle advanced soft ground. Maintenance work costlier. With a height of 7m embankment while the two sides only path 8m, two blocks from the bridge facade feels like for a breakwater before the house, the living walking difficulties.	Alternative II has the highest construction cost.	For **Alternative** III, work handling simple as **Alternative** II, but there is no synchronization between the new bridge and the existing bridge, the lower labor demand needs new path obscured by the current bridge organic inadvertently forming a "cavity" enabling components operation of social evils, causing difficulties in management. Alternative III is only higher than I about 9%.
Social Aspect	Affecting homes and structures resulting from either side subsidence.	None	Operation of social evils.
Environmental Aspect	The construction period is highest so that negative impacts causing in this period is higher than other alternatives.	The construction period is shorter than alternative 1 (about 6 to 8 months) so that negative impacts causing in this period is lower than other alternatives. Make up the architectural highlights typical river for Mekong Delta region in general and Tay Do in particular.	There is no synchronization between the new bridge and the existing bridge The construction period is shorter than alternative 1 (about 6 to 8 months) so that negative impacts causing in this period is lower than other alternatives.
Economic Aspect	Lowest construction cost	Highest construction cost	Alternative III is only higher than I about 9%.
Conclusion	Not selected	Selected	Not selected

Option 2 is seclected based on environmental and social espects athough Option 2 is highest construction cost.

3.5.2. Alternative for - THE ROAD CONNECTING THE AUGUST REVOLUTION ROAD TO PROVINCIAL ROAD 918

The alternatives are compared as follows:

Table 3.11: Comparison of Technical Alternatives Of The Road Connecting The August Revolution Road To Provincial Road 918

Item	Alternative 1	Alternative 2
Investment scale	Investment of the entire route with the planned scale of 40m. in which : - Road surface: 2x11.5m. - Median strip: 5m. - Pavement: 2x6m.	Investment stage by the sections : - Section 1 is invested by planning with scale of 40m : + Road surface: 2x11.5m. + Median strip: 5m. + Pavement: 2x6m. - Section 2 is stage investment. Still clear 40m but invest with scale of 36m including : + Road surface: 2x7.5m. + Safety strip: 2x0.5m. + Median strip combine with biological ditch 12m + Soil edge for trees: 2x4m. + Redline: 2x2m.
Advantage	In accordance with the approved planning. Create a smooth, completion route.	In accordance with the demand for vehicle traffic moving in the future and infrastructure conditions in the region. The advantage of connecting with regional planning in the future. Investment costs conform to the conditions of the city.
Disadvantage	Increasing the clearance area Not suitable for the current state of the technical infrastructure of the region. High investment costs.	Different sections, making it difficult for travel.
Social Aspect	More impacts caused by site clearance	Less impacts caused by site clearance
Environmental Aspect	May reduce traffic safety in operation phase	May reduce traffic safety in operation phase
Economic Aspect	Cost of investment is higher than alternative 1	Cost of investment is lower than alternative 1. Investment costs conform to the conditions of the city.
Conclusion	Not selected	Selected

Alter 2 is seclected based on advanatages of economic, environmental and social espects.

CHAPTER 4. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

The potential positive and negative impacts are assessed in details in Chapter 4 of the Environmental and Social Impact Assessment Report.

When the project is completed, the overall impact will be positive.The total number of direct beneficiaries from the project is the population in 20 ward 4 districts of Can tho city. Nevertheless, the project will cause some negative impacts (temporarily or permanently) on the local environment and the local population. Therefore, effective implementation of mitigation measures will be necessary.

The potential negative impacts of the project's subcomponent on the physical, biological, and socio-economic environments are identified using the checklist method, including assessment of the levels of impacts during the preconstruction, construction, and operation phases. Potential negative cumulative and social and impacts on physical cultural resources (PCR) have been identified separately.

4.1. EXPECTED POSITIVE IMPACTS

❖ ***On the Socio-Economic***

Component 1. Flood Control & Environmental Sanitation

- Improve public health, living conditions in the project area, especially for encroachment living households, reducing pollution of Can Tho River in areas adjacent to existing open channels and drains and lakes in heavy pollution;
- Improve the environment and reduce nuisance (odor and flies) for households living along the canal route / locks;
- Minimize flooding for households and commercial areas along two Can Tho riversides;
- Safety issues along two river banks is secured;
- It is potential that the local people can increase the income in the construction phase (thanks to the sale of goods) and have a chance to enhance their income by protecting assets and commercial goods, and the continuity of business operations during the flood season;
- Increase the area for opening food and beverage stores and promote tourism development;
- Open space along the 2 waterfronts for local recreation and exercise;
- The opportunity to participate in the project category as workers, odds, etc

Component 2.Urban corridor development

- Access to markets,primary social services (health, education) and urban employment opportunities are improved;
- Reduce flooding because the drainage system is improved (personal and public health protection);
- Increase income from production and marketing of agricultural products trade, help households invest more for housing and health care, thereby improving the living standards of the people.;
- Small business of households bring higher profits due to traffic and local income increase;
- Increase ability to access vocational training and employment opportunities for young workers;

- The transport system connecting the inner city to the suburbs of Can Tho city, and urban infrastructure to be upgraded to modern condition will bring the efficiency of production and consumption of goods due to better markets accessibilities as well as real estate prices in the suburbs will improve.
- Improve the environment and reduce nuisance (odor and flies) for households living along the canal route / locks;

❖ ***On the Environment***

The flooding, inundation and bad odors will be significantly reduced in the city through flood control works, drainage systems under the project. The project investments will achieve Vietnams goal of an environmentally friendly, sustainable, and aesthetically pleasing environment.The project works are expected to be built to adapt to climate change and anti-saltinity due to inland saltwater intrusion in Can Tho city, the center of Mekong region where is expected to seriously be affected by climate change

4.2. POTENTIAL NEGATIVE IMPACTS

4.2.1. Type and Scale of Project Impacts

Based on the analysis of baseline data, field visits, and discussion with key officials and stakeholders, the potential negative impacts on the physical, biological, and socio-economic environment caused by the project have been identified.

The type and scale of potential negative impacts by components of Can Tho project are summarized in Table 4-1 below. The level of impacts are assigned as follows: None (N) –no impact; Low (L) – Small works, minor impacts, localized, reversible, temporary; Medium (M) –Small works in urban/sensitive areas, medium scale works with moderate impacts of which most are reversible, reducible and manageable, localized, temporary; High (H) –Medium scale works in small urban /sensitive area, large scale works with significant impacts (socially and/or environmentally) of which some are irreversible and require compensation. The residual impacts of the project, after implementation of mitigation measures discussed in Chapter 4, are mostly negligible.

Table 4.1: Level of Potential Negative Impacts of Project

Components	**Physical**			**Biological**		**Socio**				**Others**		**Remarks**
	Air, noise, vibration	***Land, soil, water***	***Solid waste, Sludge***	***Forest, natural habitats***	***Fish, aquatic life***	***Land acquisition, resettlement***	***Indigenous peoples***	***PCR***	***Livelihood, community disturbance***	***Local flood, traffic, safety***	***Off-site impacts***	
Component 1: Flood control and environmental sanitation*: [Resettlement impacts on 2,858 PAH in which* 1,271 Replaced Households, 200 Vulnerable Households and 347 Severely Affected Households, *Land Acquisition : 698,205 m^2, [Total cost: 131,74 million USD)*												
Sub-component 1.1 : Flood control system -*construction of Can Tho river embankment system (section from Ngo Duc Ke to Cai Son canal) is long 5,5km; Construction of roads and parks behind the embankment; Activities will be carried out in core urban area, highly populated lived along river embankment at several sections (Km0 – Km1+420; Km2+080 – Km4+830; Km4+970 – Km5+270; Km5+270 – Km5+870;* *Sensitive locations includes:* Preventive Medicine Center, guest house No. 2 (Km0); 2 markets of Tan An (Km0+220) and An Lac (Km0+710) located near river banks, Cathedral (Km0+480); Ninh Kieu Methadone treatment facility (Km0+850) ; The Military Court of Region 9 (Km0+860); Nguyen Hien primary school (Km2+780), Inland Waterways Management and Maintenance Joint Stock Company No. 12 (Km3+620); Ong church (Km5+000); An Binh market (Km5+700).*[resettlement impacts on 1345 PAH]*												
Pre-const.	L	M	L	L	L	H	N	L	M	L	L	Medium-scale construction impacts best addressed through ECOPs (see Note 2 below). -need to observe PCR during transportation; local flooding; disturbance to residents (quite populated, sensitive locations), - risk on soil erosion and land slide, embankment subsidence during the construction; - excavated about 100,000 m3 non-containminated soil from construction of road behind Can Tho embankment and drainage system along Can Tho embankment
Construction	M	M	M	L	L	N	N	L	M	M	M	

Components	**Physical**			**Biological**		**Socio**				**Others**		**Remarks**
	Air, noise, vibration	***Land, soil, water***	***Solid waste, Sludge***	***Forest, natural habitats***	***Fish, aquatic life***	***Land acquisition, resettlement***	***Indigenous peoples***	***PCR***	***Livelihood, community disturbance***	***Local flood, traffic, safety***	***Off-site impacts***	
Operation	L	L	L	N	N	N	N	L	L	L	L	-Need to address the risk due to inadequate O/M; livelihood restoration; and local flooding; risk on embankment subsidence and cracking
Sub-component 1.2: **Flood control system**–*Construction of Cai Khe and Dau Sau sluice gate and 05 ship locks for core urban area [Activities will be carried out in core urban area, No Land Acquisitions and No PAHs)*												
Pre-const.	L	N	L	L	L	N	N	N	L	L	L	Medium impacts best addressed through ECOPs (see Note 2 below). Landside and subsidence risk during construction, drainage issue and navigation due to the change of water course during construction, affect aquatic fauna, etc
Construction	M	MJ	M	M	M	N	N	L	L	M	L	
Operation	L	L	L	N	N	N	N	L	L	L	L	-Need to address the risk due to inadequate O/M; blockgage of the sluicegate and shiplock due to garbage throwing in the canal, etc
Sub-component 1.3 : **Flood control system-** *Improvement of* watercourses in the central area, dredging, upgrading protective embankments, roads, relocation of encroached canal *[Cai Sơn cannal (section:* **Can Tho river – Long Hoa prison)-** crowded population lived along the cannals at Km0 – Km0+100; Km0+100 – *Km1+080;* Km1+080 – Km1+460; Km3+320 – Km3+690; Km3+690 – Km3+890- sensitive location: Giác Thiền pagoda at Km0+230; *resettlement impacts on 525 PAH]*												
Pre-const.	L	M	L	L	L	H	N	L	M	L	L	Small to medium scale impacts best addressed through ECOPs (see Note 2 below). -issues may include the need for disposal of wet sludge; local flooding; disturbance
Construction	M	M	M	L	L	N	N	L	M	M	M	

Components	**Physical**			**Biological**		**Socio**				**Others**		**Remarks**
	Air, noise, vibration	***Land, soil, water***	***Solid waste, Sludge***	***Forest, natural habitats***	***Fish, aquatic life***	***Land acquisition, resettlement***	***Indigenous peoples***	***PCR***	***Livelihood, community disturbance***	***Local flood, traffic, safety***	***Off-site impacts***	
												to residents (quite populated, sensitive loccations); off-site impact. Disposal of 125,000m3 non-containminated soil from the river bank of Cai Sơn cannal.
Operation	L	L	L	N	N	N	N	L	L	L	M	-Need to address the risk due to inadequate O/M, livelihood restoration; and local flooding, disposal of solid waste and into the open channel, off-site impact
Sub-component 1.4: **Flood control system -**Develop regulatory lake, water in urban core areas by improving Long Tuyen (University village regulation lake) and Long Hoa regulation lake).[*resettlement impacts on 117AHs]*												
Pre-const.	L	M	L	L	L	M	N	L	M	L	L	Small-scale impacts best addressed through ECOPs (see Note 2 below). - Disposal of 349,169 m3 excavated materials, traffic disruption and congestion, local flooding, disturbance to residents (quite populated, sensitive locations).
Construction	M	M	M	L	L	N	N	L	M	H	M	
Operation	L	L	L	N	N	N	N	L	L	L	L	-Ensure effective O/M, livelihood restoration; and local flooding.
Sub-component 1.5: **Flood control system-** *Renovation of 13 canals/ditchs, in the core urban area, includes Đầu Sấu canal, Ngã Bát canal, Mương Củi canal, Xẻo Nhum canal, Mương Lộ canal, Hàng Bàng canal, Tư Hổ canal, Sao canal, Bà Bộ canal, Lễ canal, Xẻo Lá canal, Ngỗng canal, Ông Tà canal. Work include: dredging, soft/hard embankment; road extension along some creeks (selectively)* No *resettlement impacts*												
Pre-const.	L	M	L	L	L	N	N	L	M	L	L	-; issues may include the;

Components	Physical			Biological		Socio				Others		Remarks
	Air, noise, vibration	*Land, soil, water*	*Solid waste, Sludge*	*Forest, natural habitats*	*Fish, aquatic life*	*Land acquisition, resettlement*	*Indigenous peoples*	*PCR*	*Livelihood, community disturbance*	*Local flood, traffic, safety*	*Off-site impacts*	
Construction	M	M	M	L	L	N	N	L	M	M	M	Need to observe PCR during transportation; soil erosion and subsident risk of the embankment during construction Disturbance to residents (quite populated); local flooding. Disposal of organic contaminated dredged sludge: 53,895 m3
Operation	L	L	L	N	N	N	N	L	L	L	L	-Need to address the subsidence risk due to inadequate O/M
***Component 1.2: Environmental sanitation improvement work:** Improving the drainage system for the routes in the center of Ninh Kieu district center; [No land acquisition]. Work include installation of drainage pipeline connecting to KfW interceptor.*												
Pre-const.	L	L	L	N	N	N	N	N	N	N	N	-Apply good construction practices for small contracts
Construction	L	L	L	N	N	N	N	N	M	L	L	
Operation	L	L	L	N	N	N	N	N	N	N	N	---Ensuring effective O/M.
Component 2: ***Urban corridor development [Total cost:*** *97.74 million US.$] [Land Acquisition: 750.089 m^2, Resettlement impacts on 1.681 AHs, in which* 543 Replaced Households, 244 Vulnerable Households and 479, Severely Affected Households*]*												
Subcomponent 2.1: Quang Trung bridge (modul 2): construction of Quang Trung bridge (modul 2) with total length of bridge and connecting road is by 689m., bridge with length of 481m, width B = 11m.[*Resettlement impacts on 96 PAHs]*												
Pre-const.	M	M	M	N	L	M	N	N	M	M	M	Medium scale works whic impacts can be mitigated with ECOPs (see Note (2) below). Issues may include the need for filled soil from outside; local flooding; disturbance to residents (quite populated), impacts on
Construction	H	H	H	N	L	M	N	N	M	M	M	

Components	Physical			Biological		Socio				Others		Remarks
	Air, noise, vibration	*Land, soil, water*	*Solid waste, Sludge*	*Forest, natural habitats*	*Fish, aquatic life*	*Land acquisition, resettlement*	*Indigenous peoples*	*PCR*	*Livelihood, community disturbance*	*Local flood, traffic, safety*	*Off-site impacts*	
												water quality of Can Tho river and transportation, navigation during construction.
Operation	M	L	L	N	L	N	N	N	N	M	M	--to ensure effective O/M Traffic safety
Subcomponent 2.2: Road and bridge of Tran Hoang Na (rehabilitation and upgrade of road with length of 1,6km building line of 20m and 28m; construction of length about 1,6km building line of 20m and 28m; length of 594m, width of 21m across Can Tho river). In addition, investment in parallel road on National Highway 1 A (section from Tran Hoang Na to interchange IC3) with length of 1,6km, building line of 12m .[*Resettlement impacts on 548 AHs] [* The population is crowded in two sides at Km0+470 – Km0+700; Km0+700 – Km1+180; Km1+385 – Km2+880]												
Pre-const.	M	M	M	N	N	M	N	L	L	M	M	issues may include the need for filled soil from outside; disturbance to residents; impacts on water quality of Can Tho river and transportation, navigation during construction (quite populated and)
Construction	M	M	M	N	N	N	N	L	L	M	M	
Operation	L	L	L	N	N	N	N	N	L	L	L	-Traffic safety; local flooding, Need to ensure effective O/M .
Subcomponent 2.3: Connecting road August Revolution (Highway 91) - Provincial road DT918 scale length of about 5.3 km, width of 40m .[*Resettlement impacts on 456 AHs] [The population is crowded in two sides at km Km0 – Km0+615, Km0+615 – Km0+905. The route crossing over two irrigation canals of about 12m]*												
Pre-const.	M	M	M	L	L	H	N	L	M	M	M	- large amount of earth to be excavated and disposed off; off-site impacts; possible local floods.
Construction	M	M	M	L	L	N	N	L	L	M	M	
Operation	L	L	L	N	L	N	N	N	N	M	L	- to ensure effective O/M; possible local flood; traffic safety
Subcomponent 2.4: Construction serves residential resettlement in Ninh Kieu District, covering about 40 hectares, ensure appropriate planning with public utility, social infrastructure as required, ensuring conditions for the people .[Resettlement impacts on 581 PAHs]												
Pre-const.	M	M	M	N	L	H	N	M	M	M	M	Medium-scale impacts best addressed through ECOPs (see Note 2 below)
Construction	M	M	M	N	L	N	N	M	M	M	M	

Components	**Physical**			**Biological**		**Socio**				**Others**		**Remarks**
	Air, noise, vibration	***Land, soil, water***	***Solid waste, Sludge***	***Forest, natural habitats***	***Fish, aquatic life***	***Land acquisition, resettlement***	***Indigenous peoples***	***PCR***	***Livelihood, community disturbance***	***Local flood, traffic, safety***	***Off-site impacts***	
Operation	L	L	L	N	N	N	L	N	N	L	L	- ensure adequate O/M related to waste and waste water management; local floodingto ensure effective O/M

Notes: (1) The following criteria are used for the assessment of level of impacts: None (N) –no impact; Low (L) – Small works, minor impacts, localized, reversible, temporary; Medium (M) –Small works in urban/sensitive areas, medium scale works with moderate impacts of which most are reversible, reducible and manageable, localized, temporary; High (H) –Medium scale works in small urban /sensitive area, large scale works with significant impacts (socially and/or environmentally) of which many are irreversible and require compensation; Both M and H need monitoring and implementation of the mitigation measures as well as adequate institutional capacity on safeguard.

(2) Small and medium scale works, most impacts are localized, temporary, and can be mitigated through the application of good engineering and construction management practices and with close supervision and monitoring and close consultation with local communities.

Severely households: Severely households are the persons who loss are above 20% of total landholdings (equal or above 10% of productive land).

Displaced Person(s) (APs): Displaced Person(s) (APs) are the persons who are affected by involuntary taking of land, resulting in:

(a) Relocation or loss of shelter;

(b) Loss of assets or accessibility to assets;

(c) Loss of income sources or means of livelihood, regardless of relocation or not; and

Restriction of accessibility to legally designated parks or protected areas causing adverse impacts on their livelihoods.

Vulnerable Groups: Those who might suffer disproportionally from adverse project impacts and/or be less able to access the project benefits and compensation, including livelihood restoration and assets compensations, when compared to the rest of the PAPs. Vulnerable peoples include people who, by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage or social status may be more heavily affected by economic or physical displacement than others and who may be more limited than the population at large in their ability to claim or take advantage of resettlement assistance and related development benefits.

4.2.2. Socio-economic Impacts

❖ ***Land Acquisition and Resettlement***

Involuntary Resettlement is the inevitable relocation affects in the process of implementing the project, including affected people (PAP) to rebuild their homes, property and income restoration. The affected include those subject to compulsory land acquisition by the projects financed by the World Bank and lead to: Must relocate or be homeless; Lose assets or ability to access to assets; Lose income sources or means of livelihood, whether people affected should or not to move to another location; and be restricted access to the area is required by law or protected areas detrimental to the livelihoods of those affected.

According to the survey and initial assessment, the implementation of 02 components of the project is expected to have 4.539 affected households, of which (i) 826 HHs will be severely affected, in which 760 HHs have more than 20% and 66 HHs have more 10% (for the vulnerable) of their agricultural land including garden land being affected; (ii) 709 HHs whose business being affected, of which 580 HHs have business licences and the remaining 129HHs are not registered; (iii), 37 agencies/companies and 12 wards affected by the project and (iv) 444 vulnerable households out of 4,359 AHs, of which 349 female headed households with dependents and economic disadvantages, accounting for 78.6%, the remaining 21.4% including 06 with disabled headed HHs, 10 elderly HHs, 11 minority HHs; 35 poor HHs and 33 HHs under the social policies .

A resettlement plan (RP) will be prepared in compliance with World Bank policy for involuntary resettlement and regulations of Vietnam to mitigate impact on the affected households. An Income Restoration Program (IRP) for severely affected HH, relocated HH and HH losing business will also be prepared as part of the RP. Due to the relocation of 1,814 HH several km from their former location, preparation of the IRP, in close collaboration with HH losing their livelihood, will be a key issue for the Project.

Detailed information regarding the nature and scale of the impacts and proposed mitigation measures are provided in the RP report which was prepared separately.

Based on the RP report, the impacts due to land acquisition and resettlement include the following:

Table 4.2: Information about The Land Acquisition Of 02 Project Components

Kinds of affected assets		**Unit**	**Total**		**Component 1**		**Component 2**	
			Quantity	**AH/ Companies**	**Quantity**	**AH/ Agencies**	**Quantity**	**AH/ Agencies**
Land								
Non-agriculture	Residential	m²	361,936	3,598	215,280	2,357	146,656	1,241
	Non- agriculture	m²	27,917	35 Companies	27,797	35 Companies	120	2 Companies
	Public land	m²	35,909	8WPCs	30,015	6WPCs	5,894	5WPCs
	Other land (cemetery, transportation, canals)	m²	192,557	10 Agencies 11WPCs	146,184	10 Agencies 10WPCs	46,373	7WPCs
Agriculture	Annual crops	m²	31,539	64	14,673	38	16,866	26
	Perennial trees	m²	704,197	1,024	170,085	524	534,112	500
Total affected land			**1,354,055**		**604,034**		**750,021**	
Totally affected houses		**m²**	115,226	1,625	77,723	1,145	37,503	480
Partly affected houses		**m²**	26,069	856	15,620	580	10,449	276
Total of AHs								
	Total AHs	HH	4,539		2,858		1,681	
	DHs	HH	1,814		1,271		543	

Kinds of affected assets		Unit	Total		Component 1		Component 2	
			Quantity	AH/ Companies	Quantity	AH/ Agencies	Quantity	AH/ Agencies
	No of HHs have productive lands	HH	826		347		479	
	No of HHs have their business stores affected	HH	709		472		237	
Vulnerable HHs			**444**		**200**		**244**	
	Women headed with dependents	HH	349		150		199	
	Minority HHs	HH	11		6		5	
	Disabled headed HHs	HH	6		4		2	
	poor HHs	HH	35		22		13	
	Elderly headed HHs	HH	10		5		5	
	HHs under supported by social policies	HH	33		13		20	

HH: household; APs: Displaced Person(s); PPC: Province People Commitee

- ***Potential differential impacts on women and vulnerable in particular landless HH to be relocated***

No differential adverse impacts were identified on any vulnerable households. In almost all such cases there were other earning members in the households. However, with disabled persons the households face higher expenditures on medical treatment and loss of productive members. For single women with dependents tend to have unstable income from professions like making nail, selling lottery tickets, hairdressing and making-up, propose to building small credit program suitably for this group may develop household economy.

- ***Other social impacts***

Component 1. Flood Control & Environmental Sanitation

- Affect the movement of people during construction;
- The risk of impoverishment for occupied households living in the Can Tho canals and river embankments;
- The risk of accidents on workplace safety without adequate warning systems;
- Increase social ills without suitable livelihood recovery programs;
- Loss of family income for those traders who are selling at the market Binh, An Lac and Tan An, and some business households in Hung Loi Ward (expected to be Quang Trung bridge);
- The relocation of the former residence to the new place will affect people with incomes from motorcycle/car pacth, motorbikes, manicure, hairdressing, etc.

Component 2.Urban corridor development

- Affect the movement of people during construction;
- The risk of accidents on workplace safety without adequate warning systems;
- Increase social ills without suitable livelihood recovery programs;
- The relocation of the former residence to the new place will affect people with incomes from motorcycle/car patch, motorbikes, manicure, hairdressing, etc.
- An increased risk of traffic accidents when traffic flow moving from bridge/new lines formed without these programs providing skills training on road safety;
- Loss of family income for those traders who are selling at the ward Hưng Lợi (expected to be Quang Trung bridge)

Other potential social impacts on local communities are such as transportation, road safety or public safety, labor accidents, or disruptions of communities during site clearance, construction, and operation.

4.2.3. Potential Impacts To Sensitive Facilities

The project does not have any direct impacts to historical and cultural monuments, religious, school and health facilities during land acquisition process. However, in construction phase, construction material transportation and construction activities can affect to sensitive points.

There are number of temples, pagodas, churches and schools which could be affected by dust and noise during construction phase and facing some difficulties of get in/out the structures. Most of sensitive areas are a part from more than 10 m to construction sites. These are: Preventive Medicine Center, guest house No. 2 (Km0); 2 markets of Tan An (Km0+220) and An Lac (Km0+710) located near river banks, Cathedral (Km0+480); Ninh Kieu Methadone treatment facility (Km0+850); The Military Court of Region 9 (Km0+860); Nguyen Hien primary school (Km2+780), Inland Waterways Management and Maintenance Joint Stock Company No. 12 (Km3+620); Ong church (Km5+000); An Binh market (Km5+700). Giác Thiền pagoda at Km0+230;

Table 4.3: List of Sensitive Facilities In The Project Area

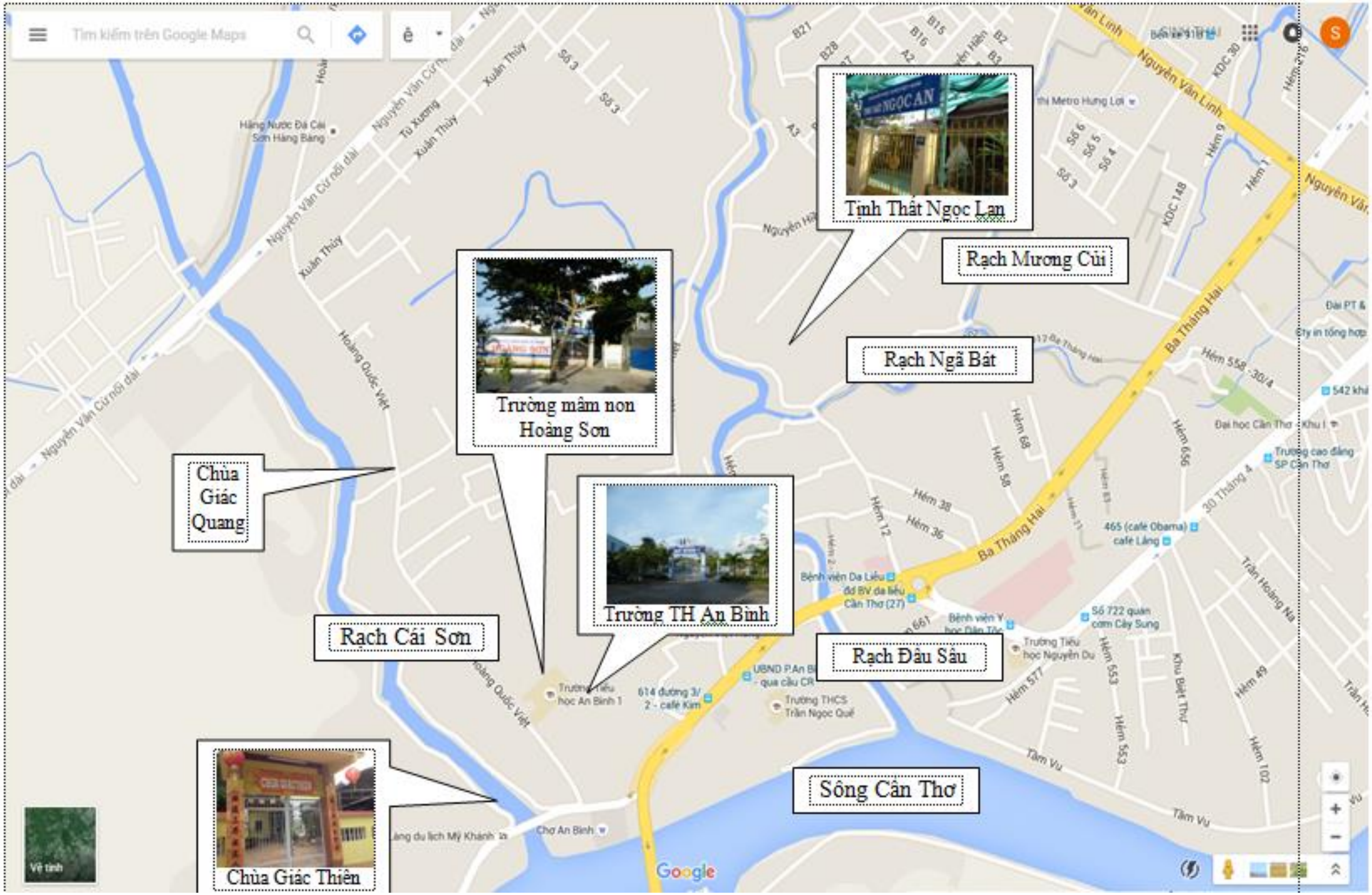
No.	Name/Picture	Location	Distance to Works (m)	Specific Discription
I.	**Pagoda, church, temple**			
1	Cathedral 	Can Tho Embankment, An Lac Ward, Ninh Kieu District	5	Located facing toward Nguyen Thi Minh Khai Street and overlooking to Can Tho River Bank, it is approximately 70m from the Can Tho River Bank, opposite to the residential area along the riverbank. There are populated density, high traffic flow in the central district area/zone.
2	Can Tho Diocesan Priests Retirement House	Can Tho Embankment, Xuan Khanh Ward, Ninh Kieu District	2	Located in Tam Vu and Tran Ngoc Que junction, facing toward Tam Vu street and Can Tho River, it is about 25 meters from the river bank.

No.	Name/Picture	Location	Distance to Works (m)	Specific Discription
				The Work is located on the cul-de-sac section of Tam Vu street where the traffic flow is restricted and there is no houses.
3	Quan Phong Monastery 	Can Tho Embankment, Hung Loi Ward, Ninh Kieu District	2	Located on the head of Tam Vu Street, facing toward Tam Vu street and Can Tho River Bank, it is approximately 10m from the river bank, there is no residential area along the river in the opposite side, with the low traffic density
4	Ong Vam Dau Sau Pagoda 	Embankment, An Binh Ward, Ninh Kieu District	20	Located in the dreads alley facing toward alley and Can Tho River bank, it is about 40m from Can Tho river bank, there are residential house along the river with crowded population in the opposite side, traffic density is relatively low.
5	Giac Thien Pagoda 	Cai Son Canal Embankment, An Binh Ward, Ninh Kieu District	5	Located on pair canals' dreads, facing toward Cai Son canal, it is about 10 meters from canal shore, with sparse population density and low traffic density.
6	Ngoc An Monastic 	Dau Sau Canal, An Khanh Ward, Ninh Kieu District	5	Located on the Dau Sau pair canals dreads, facing towards the Dau Sau canal, it is about 15 meters from the canal shore, with the sparse population density and the low traffic density.
	Giac Quang Pagoda	Rehabilitaion of Hoang Quoc Viet street, An Binh Ward, Ninh Kieu District	15	Located between Hoang Quoc Viet Street (far from street about 30m) and Cai Son canal (far from the canal about 40 meters), there are residential areas in the opposite side

No.	Name/Picture	Location	Distance to Works (m)	Specific Discription
				with crowded population density and high traffic density.
II.	**The public works**			
1	The Guest House No.2 	Can Tho Embankment, Tan An Ward, Ninh Kieu District	0	Located at the junction of Ngo Duc Ke street with Hai Ba Trung Street, opposite to Ngo Duc Ke Street on the river bank, back to the river side, next to the Ninh Kieu wharf. There are high residential density, with high traffic flow in the central of district area.
2	City Preventive Health Centre 	Can Tho Embankment, Tan An Ward, Ninh Kieu District	5	Located at the junction of Ngo Duc Ke Street with Hai Ba Trung street, on two streets, facing towards Can Tho river bank, it is approximately 40 meters from the bank, opposite to residental houses along Can Tho river bank. It is located at the central district near Ninh Kieu Wharf, Tan An Market.
2	Tan An Market 	Can Tho Embankment, Tan An Ward, Ninh Kieu District	0	Located between Vo Thi Sau street and Can Tho River. One side is facing towards Can Tho river and another facing toward Vo Thi Sau street. It is located in the central district area, with the crowded residential density and the high traffic flow. This will be relocated during construction period.
3	An Lac Market 	Can Tho Embankment, An Lac Ward, Ninh Kieu District	0	Located between Nguyen Thi Minh Khai Street and Can Tho River. It is the central district area with the crowded residential density and the high traffic flow. This will be relocated during construction period
4	Methadone Treatment Facility of Ninh Kieu District	Can Tho Embankment, An Lac Ward, Ninh Kieu District	0	Located between Nguyen Thi Minh Khai street and Can Tho bankriver, facing towards Nguyen Thi Minh Khai street. It is the central district

No.	Name/Picture	Location	Distance to Works (m)	Specific Discription
				area with the crowded residential density and high traffic flow.
5	Regional Military Court 9 	Can Tho Embankment, An Lac Ward, Ninh Kieu District	2	Located facing towards Nguyen Thi Minh Khai street and Can Tho river, it is about 80m from the river bank, with residential houses along Can Tho River Bank in the opposite side. There are crowded residential density and high traffic flow in the central district area.
6	Nguyen Hien Primary School 	Can Tho Embankment, Hung Loi Ward, Ninh Kieu District	5	Located on Tam Vu street, facing towards Tam Vu street and Can Tho River, it is about 20 meters from the riverbank, opposite to the residental houses along the river bank, with the quite high traffic density.
7	Tam Vu Market 	Can Tho Embankment, Hung Loi Ward, Ninh Kieu District	5	Located on Tam Vu street, facing towards Tam Vu street, it is about 35m from the riverbank, opposite to residential houses along river bank with the crowded traffic density.
8	Inland Waterway Maintainace Management JSC., No12 	Can Tho Embankment, Hung Loi Ward, Ninh Kieu District	0	Located between Tam Vu street and Can Tho river, opposite to the pair riverbanks, with the quite high trafic density.

No.	Name/Picture	Location	Distance to Works (m)	Specific Discription
9	An Binh Market 	Can Tho Embankment, An Binh Ward, Ninh Kieu District	0	Located between Lo Vong Cung street and Can Tho river, one facing towards the street and another facing towards Can Tho River, with crowded traffic density.
10	An Binh Primary School 	Rehabilitation of Hoang Quoc Viet street, An Binh Ward, Ninh Kieu District	15	Located on Hoang Quoc Viet Street, facing towards Cai Son canal, it is approximately 160m from canal shore, opposite to the residential areas with crowded population density and high traffic density.
11	Hoang Son Preschool 	Rehabilitation of Hoang Quoc Viet Street, An Binh Ward, Ninh Kieu District	10	Located in Hoang Quoc Viet street, facing towards the Cai Son canal, it is about 160m from canal shore, opposite to the residential areas with crowded population density and high traffic density.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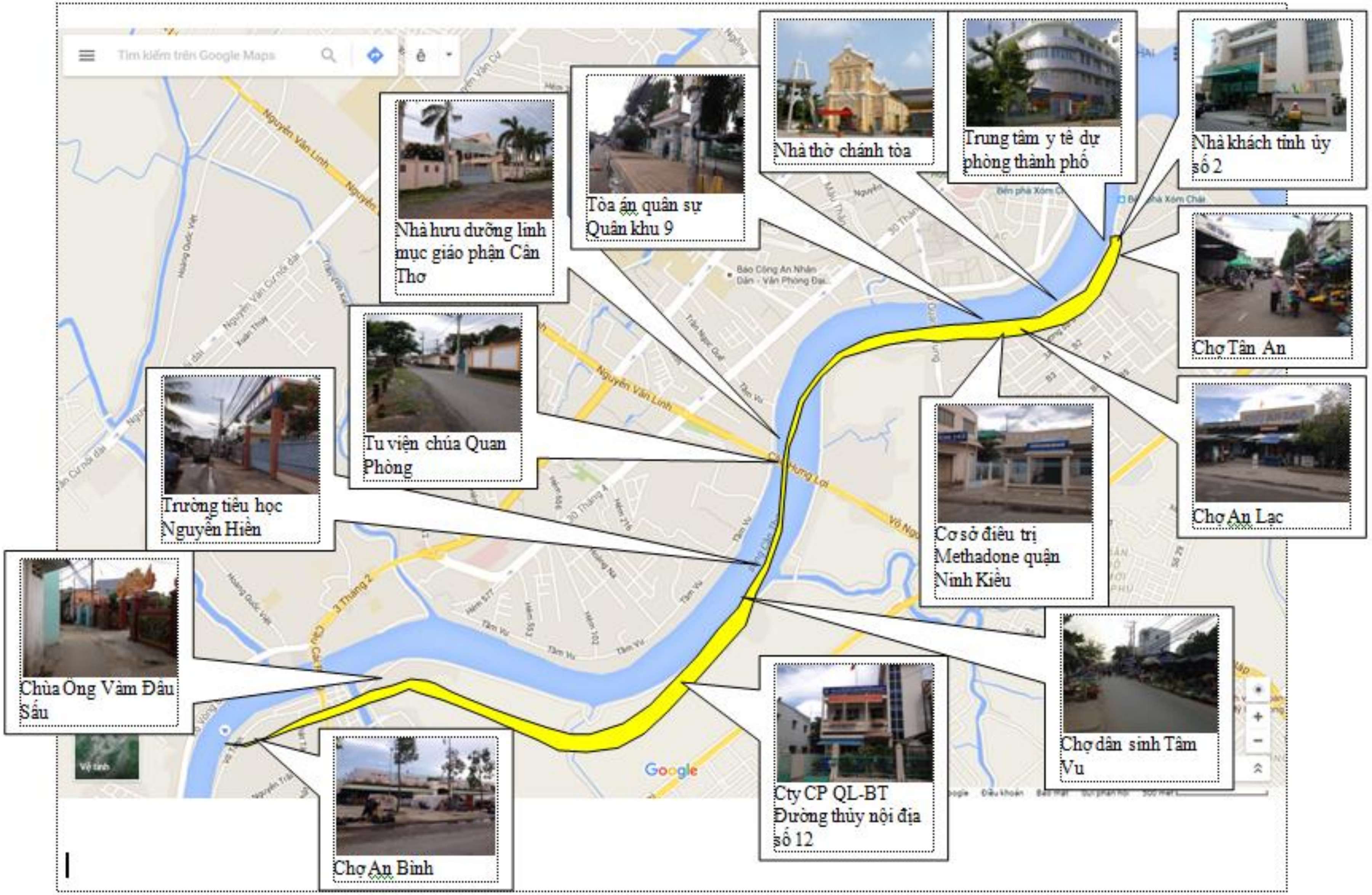
Rạch Cái Sơn
Rạch Đầu Sấu
Sông Cần Thơ
Chùa Giác Thiên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Nhà hưu dưỡng linh mục giáo phận Cần Thơ
Chợ Tân An
Tu viện chúa Quan Phòng
Trường tiểu học Nguyễn Hiền
Cơ sở điều trị Methadone quận Ninh Kiều
Chợ An Lạc
Chùa Ông Vàm Đầu Sấu
Chợ dân sinh Tầm Vu
Cty CP QL-BT Đường thủy nội địa số 12
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4.2.4. Cumulative Impact Assessment

The ESIA conducted a review of related large , recently completed and ongoing investments in the project cities to identify possible linkages and potential cumulative impacts. Details of these key linked and associated subprojects, including ancillary aspects of the projects, are shown below. Based on the assessment and due diligence review, negative cumulative impacts from these linked and associated projects are deemed be limited because most of them are either existing or will be completed by the time the CUTDR project will commence implementation, and several projects will have a postive cumulative impact on the CTUDR by reducing the pollution load on waterways, through treating sanitation, which will allow the drainage and sanitation components of the CTUDR to operate more efficiently. ,

Over the past years, Can Tho city, with the support of the Vietnamese Government, donors and international funding institutions, has been implementing various development programs and projects for the Mekong River Delta region in general and Can Tho city in particular. Key infrastrcucture projects are as follows:

- Can Tho drainage and wastewater treatment project (financed by KfW)
- Cai Sau sludge landfill project financed by (Cai Rang district)
- Mekong Delta Transport Infrastructure Development Project (financed by the WB)
- Mekong Delta Water Resources Management for Rural Development project (financed by the WB)
- Vietnam Urban Upgrading project (VUUP) from 2002-2014, (WB funded project).
- Mekong Delta Urban Upgrading project (MDR-UUP) from 2012 - 2017 (VUUP2) (financed by the WB)
- Mekong Delta Urban Upgrading project (MDR-UUP) from 2012 - 2017 (VUUP2)

Table 4.4: Summary Report Of Linked Projects Of Can Tho Urban Development And Resilience (CTUDR) Project

Project Name	Can Tho drainage and wastewater treatment project (KfW)
Description	The owner of Can Tho drainage and domestic wastewater treatment project (KfW) is Can Tho Water Drainage and Supply Company. The project is funded by German Agency for International Cooperation (GIZ) and German Development Bank (KfW) with the total investment of 18.723 million Euro focusing on the collection and treatment of wastewater in the central districts of Ninh Kieu and Cai Rang. - Content and scale of construction: • Construction of 11km of interceptor sewers. • Improvement of 3,000 m of existing sewers. • 07 stations (02 main pumping stations and 05 upgrading pumping stations). • 01 wastewater treatment plant with a capacity of 30,000m^3/day.night. - Construction location: • Rach Ngong pumping station: 1,600 m^2 in An Hoa Ward, Ninh Kieu District; • Wastewater collection sewers: in the area of Ninh Kieu District; • Sewers and pumping station for transferring wastewater to the treatment plant: in the area of Cai Rang District;

	• Wastewater treatment plant: 24.9 ha in the area of Thanh Thang, Phu Thu Ward, Cai Rang District. - Project category: Group B - Total investment: 494,277.87 million VND (18,723,000 Euro) - Funding source: loan from German's ODA and local budget - Duration of project: from 2003 to 2014 ***Relationship with CTUDR project:*** Wastewater from the beneficiary areas of the CTUDR project, especially Ninh Kieu District, will be collected and pumped to the KfW funded wastewater treatment plant for treatment. The drainage system in the central urban areas of Ninh Kieu District under the CTUDR project will be connected and linked to the drainage network of the KfW project. Wastewater from CTUDR project will not overburden the 30,000m^3/day.night capacity of the KfW treatment plant because this flow had been included in the design of the KfW project.
Current status	**The treatment plant and sewage collection system under the KfW project have been deployed since 2007, the plant construction phase has been completed and ready to put into test run. The system will operate officially at the end of 2015.**
Status of EIA	This project has been provided with an environmental impact assessment, which has been appraised by the DONRE of Can Tho City, approved by the People's Committee of the city, and evaluated and approved by environmental experts of the German government (KfW).
Detail of EMP	Proposed mitigation measures in the approved EIA report of the WWTP project follow as: Mitigation measures to treat generated sludge of the WWTP Generated sludge from WWTP processing will be treated as follows: Activated sludge → Sludge pump → Sludge conveyor, press → transport to Cai Sau landfill. To control the quality of the treated wastewater of the WWTP: According to the approved decision of the EIA report by Can Tho province People's Committee - Department of Natural Resources and Environment (DONRE), the effluent of the WWTP must meet standard of type A, TCVN 5945:2005 (now it is replaced by the QCVN 14:2008/BTNMT). Environmental management program has been proposed in the EIA report, has mentioned the roles and responsibilities of stakeholders in the implementation of the environmental management plans for the KFW project. Environmental monitoring program has been proposed in the EIA report, including monitoring indicators, locations, frequency and applicable standards. Monitoring frequency of environmental quality is 4 months per time during the construction period and 6 months per time in the first operation year.
Assessment of cumulative impact	It is expected that the KfW project will be fully functional at the end of 2015,. Therefore by the time he CTUDR project commences construction, the KfW project will already have helped to improve sanitation conditions of the city by the collection and treatment of wastewater. The negative cumulative impacts of MDR-UUP and the KFW project will only occur at the drainage systems of some Lias in

	Ninh Kieu district and Bun Xang lake. On the overall, impacts will be positive due to treatment of wastewater prior to discharge.
OP 4.12: Screening of linked project	The drainage system, of some areas in Ninh Kieu district, and Bun Xang lake area, to be funded by this Can Tho Urban Upgrading Sub-Project will have the connection and associated network with the City Drainage and Wastewater Treatment Project. Therefore, the related sewers (drainage culverts of North bank and South bank of Can Tho river) and WWTP activities are linked to MDR-UUP.
Due Diligence review	Land acquisition for the WWTP had been carried out since 2004 and completed in 2007. At present, there is not any claim of the affected households and the plant has been completed and put into test run. Some surveys showed that affected people have restored and stabilized their livelihoods. Upgrade and construction of drainage culverts of North bank and South bank of Can Tho river are conducted on the current road and sidewalk. Fences and courtyard of the households are only temporarily affected during construction of culverts and are fully compensated for the affected households.
Project Name	**Cai Sau sludge landfill (Cai Rang district)**
Description	Scope of work: Cai Sau sludge landfill has been designed to contain sludge of WWTP and dredged materials of MDR-UUP. Sediment from dredging activities of the MDR-UUP project in Can Tho city will be also transported and treated at this site. *Relationship with CTUDR project:* All dredged materials from MDR-UUP project in Can Tho city before and those of the coming CTUDR project will be disposed at this landfill. Source of finance: Local budget.
Current status	The area of this landfill is about 5-6 ha, invested by Can Tho City People's Committee, **which should be completed and ready when the CTUDR subproject commences implementation**.
Status of EIA	Environmental protection commitment of this project was certified by the People's Committee of Cai Rang district by document no. 25/GXN-UBND dated on July 13, 2011. Below is the summary of the impacts for each project item: The location to construct Cai Sau landfill has enough land for disposal of dredging sludge and material of CTUDR project. The distance from the landfill to residential areas is around 2 km radius. This is a reasonable distance to limit the direct impacts to residents (noise, dust, and odor...) by the waste transportation and treatment. The landfill location is at the end of the main wind direction.
Detail of EMP	- *Mitigation measures to treat leachate from landfill:* Landfill leachate will be collected by the pile HPHD D200 perforated tube and pumped to leachate treatment system. The quality of wastewater output has met standard of type A, QCVN 25:2009 / BTNMT. Landfill is lined with HDPE. - Mitigation measure to treat gas emission from the landfill: Gas emission is collected by vertical wells spaced. Pipe HDPE D200 collects gas from wells... - Mitigation measures to treat odor and pathogens microorganisms:

	Regular soil covering and spraying to prevent odor, especially after rain. Planting of trees adequately to create buffer from residential areas and construct walls (fences) around. Environmental monitoring program proposed including monitoring indicators, monitoring location, frequency and applicable standards. Monitoring frequency of environmental quality is 6 months per time in the construction period and 6 months per time in the operation period.
Assessment of cumulative impacts	The upgraded landfill has been designed and constructed following the national standards with sufficient technical facilities for solid waste treatment. The capacity of landfill is enough for the CTUDR project. Thus, the impacts generated from dumping of solid waste will be minimized within scale of landfill. Environmental impacts and other impacts of Cai Sau landfill were assessed and its mitigation measures were proposed to ensure that it could receive and treat all solid waste (sludge...) generated in the city. If best practice solid waste and leachate treatment measures are employed, the negative cumulative impact of this landfill on air and water quality can be controlled. The CTUDR project will monitor operation of this landfill to ensure that best practice solid waste and leachate treatment measures are employed to limit methane emissions and groundwater contamination.
Recommendation	The project will monitor operation of this landfill.
Due Diligence review	The Cai Sau sludge landfill is used to receive dredged sludge of drains. This sludge landfill locates on land of Cai Sau wastewater treatment plant, Phu Thu ward, Cai Rang district. Sludge from dredging activities of the CTUDR project will be transported and treated at this site. The land acquisition were completed in 2004-2005 by the local authority and now it is available to use, so that further land acquisition and resettlement is not required, that due diligence review is not needed in this case.
Project Name	**Mekong Delta Transport Infrastructure Development Project (WB5)**
Description	**** WB5 project in the area of Can Tho City:*** For Can Tho city, the WB5 project helps to construct a number of important transportation works such as Thoi Thuan - Thanh Loc road, Vam Cong bridge and Road QL91B…
Current status	By March of 2013, the Thoi Thuan - Thanh Loc road section (2.9km long in the area of Thot Not district), had been completed, including 3 packages, of construction of bridges, arranged with test pile driving and official pile driving for piers by the construction contractors. The remaining package of road construction was also completed by 2014
Status of EIA	This project has been provided with an environmental impact assessment report. The EIA report was approved by the MONRE under Document No. 896/BTNMT-TD dated 12/03/2007, and accepted by the World Bank in the letter dated 17/01/2007. The EIA for Thoi Thuan - Thanh Loc road subproject itself has been appraised by Can Tho city DONRE and approved by the People's Committee of the city and the World Bank.

	The EIAs for these sub-projects have been approved and disclosed by the World Bank
Assessment of cumulative impacts	Thoi Thuan - Thanh Loc road upon completion will contribute to the carriage of goods, socio-economic development for Vinh Thanh and Thot Not areas, thereby connecting to other routes including routes under the CTUDR project, creating a continuous transport network and smooth traffic flow in Can Tho city, enabling more efficient evacuation during natural disasters such as flooding. When the CTUDR project commences its construction, the completed Thoi Thuan - Thanh Loc road will lead to improve traffic flow in coordination with the road and bridge construction under CTUDR. Measures will taken to ensure adequate drainage along the Thoi Thuan-Thanh Loc road, so the cumulative impact of flooding should be lessened. The
OP 4.12: Screening of linked project and Due Diligence review	The compensation and clearance for construction have been carried out by the local authority. The RP has been prepared by the PMU and cleared by the WB. Based on the approved RP by the WB, the local authority has prepared the Compensation Plan and get it approved by the local authority. Both RP and compensation plan have been disclosed for comment and review from the affected household as required by the OP 4.12 of the WB. So far, the compensation expenses have been paid to 97/97 affected households, and the site clearance has been completed .As such,. a due diligence review at this time is not necessary.
Project Name	**Mekong Delta Water Resources Management for Rural Development project (WB6)**
Description	The project area will cover the western part of the Mekong Delta with 6 provinces (An Giang, Kien Giang, Ca Mau, Hau Giang, Bac Lieu and Soc Trang) and Can Tho city. - *Linked projects in the area of Can Tho city: O Mon - Xa No subproject* Can Tho city, in particular, covers an area of 19,024 ha of natural land under the project (of which 16,247 ha is the agricultural land) including part of Phong Dien, Co Do and O Mon districts in Can Tho city; objectives are to improve waterway and road transportation; establish residential area ground; improve the environment of the project area; serve the rural area with clean water to maintain benefits from agricultural production; enhance people's lives and help promote solutions and adapt to climate change. O Mon - Xa No subproject is invested into 2 phases: - Phase 1 (WB2): Implementation period from 2002 - 2008 **- Phase 2 (WB6): Implementation period from 2011 - 2016** - Scale of the subproject (Phase 2 WB6): + Subproject 1: Fully closing the dikes and culverts in O Mon - Xa No area in phase 1, under 3 project provinces (including 68 open culverts; 31 underground culverts; 18,223m of Xa No canal anti-landslide embankment with works completed in the WB2 project to control flood for 45,430 ha of natural land. + Subproject 6: Fully closing the dikes and culverts in O Mon - Xa No area in phase 2, under 3 project provinces (dredging 10.5 km of Tac Ong Thuc canal and 196.55 km of secondary canal).
Current Status	a) Subproject 1has been underway since December 2012, including 20 secondary culverts and 16 underground culverts, in which: + The area of Phong Dien district covered 22 culverts, including 10 underground culverts and 12 open culverts such as Muong Bo (adjacent to O Mon District), Ben

	Tranh, Tay Dinh,Tay Bien, Cau Van, Nha May, Rach Nhum C, Ba Tich, Ngon Muong Ngang, Muong Ngang, Rach Ban and Muong Dieu. + The area of O Mon district covered 10 culverts, including 6 underground culverts and 4 open culverts such as Ong Tanh, Nang Ut, Ca Ho and Rach Coc. + The area of Thoi Lai district covered 4 open culverts such as Vam Nhon, Tac Ca Di, Cau Nhiem D (Xeo Sao) and Xeo Chat. - Subproject 1 handed over to the locality: 16/16 underground culverts, 12 open secondary culverts. The 5 remaining open secondary culverts are under construction, 3 open secondary culverts are pending as Board 10 is waiting for the localities to hand over the ground for construction. b) For subproject 6: Not implemented yet as the WB has not arranged the funding.
Status of EIA	This project has been provided with an environmental impact assessment report. The general EIA report of the project has been approved by the MONRE, assessed, and appraised by WB's environmental experts. The separate EIA for works in the area of Can Tho city has been appraised by Can Tho city DONRE and approved by the People's Committee of the city. The EIAs for these projects have been approved and disclosed by the World Bank. .
Assessment of cumulative impact	When the works under O Mon - Xa No subproject are completed (dikes are reinforced with embankments for anti landslide; open sewers and underground sewers are built, canals and ditches are dredged, etc), they will help control floods, prevent saline intrusion, retain fresh water, collect alluvium and ensure irrigation for the project area. This project will not cause cumulative negative impacts to the CTUDR project but rather will have a positive impact through the improvement public water drainage conditions. This project operate simultaneously with the drainage works under the CTUDR project.
OP 4.12: Screening of linked project and Due Diligence review	The compensation and clearance for construction have been carried out by the local authority. The RP has been prepared by the PMU and cleared by the WB. Based on the approved RP by the WB, the PPMU has prepared the Compensation Plan and submitted to the local authority for approval. Both RP and compensation plan have been disclosed for comment and review from the affected household as required by the OP 4.12 of the WB. So far, the compensation expenses have been paid to affected households, and the site clearance has been completed .As such,. a due diligence review at this time is not necessary.
Project Name	**Vietnam Urban Upgrading Project (VUUP1) - Can Tho City Subproject**
Description	VUUP1 project was implemented from 2002 - 2014, with a preferential loan of 38.5 million USD from IDA. The project was carried out in the area of 11 wards in Ninh Kieu and Binh Thuy districts. - Owner of project: The People's Committee of Can Tho city - Client: Can Tho Urban Upgrading Project Management Unit - Sources of finance: Loan from WB and counterpart fund. - Scale of investment: the project has 6 main components *+ Component 1: Upgrading tertiary infrastructure* Lighting electricity: installing public lighting system for alleys. Alley roads: upgrading and coating alley roads

	Drainage system: building drainage systems at all alleys during the construction of alleys. Bridge upgrading: upgrading bridges in Areas 4 and 6 *+ Component 2: Upgrading related primary and secondary infrastructure* This component focuses on the upgrading of large primary and secondary infrastructure needed to maintain tertiary infrastructure investment. The investment may include the investment in roads; water supply and drainage systems, wastewater collection system... The investment prioritizing on large drainage and wastewater collection systems is one of the largest missing infrastructures in urban areas in general and in Can Tho city in particular. *+ Component 3: Resettlement for poor people* The upgrading of large infrastructure requires resettlement or compensation for affected households. Many households living in poor conditions along the wastewater drainage ditches are in need of resettlement to improve the living conditions for themselves and create space for the upgrading and renovation of infrastructure. This component includes the construction of houses for resettlement and compensation for the affected households. *+ Component 4: Housing and land management* This component aims to strengthen the capacity of the State agencies at the localities, upon the decentralization of responsibility to better manage the property assets in the city. This component focuses on the establishment of electronic information system for housing and land management; on updating and digitizing cadastral maps and simplifying processes/procedures for granting certificates of land use right. *+ Component 5: Revolving fund for house improvement* *+ Component 6: Technical support, design, supervision and training*
Current Status	Currently, the VUUP1 project - Can Tho city subproject is in the completion phase. Works having been done in the VUUP1 project will contribute greatly to the improvement of infrastructure of Can Tho city as well as paving the way for the implementation of similar projects. This project carried out the upgrading and renovation of the drainage system, internal roads, canals and ditches and urban drainage system that helps benefit about 450,000 people of the city.
Status of EIA	The project has been provided with an EIA report appraised by the DONRE of Can Tho city and approved by the People's Committee of the city as well as reviewed and evaluated by WB's environmental experts. The EIAs have been approved and disclosed by the World Bank.
Assessment of cumulative impact	The works of Can Tho subproject are in the closing stage and their commission will play an important role in improving the management of housing and land, improve infrastructure conditions, improve drainage and sanitation capacity for Can Tho city and simultaneously upgrade the living conditions of people in low-income residential areas. When the CTUDR project is carried out, works of this project will already be in operation and will work in synergy with the works under CTUDR to reduce pollution and flooding in the city of Can Tho.
OP 4.12: Screening of linked project and	The compensation and clearance for construction have been carried out by the local authority. The RP has been prepared by the PMU and cleared by the WB. Based on the approved RP by the WB, the PMU has prepared the Compensation Plan and submitted to the local authority for approval. Both RP and compensation plan have been disclosed for comment and review by the affected household as

Due Diligence review	required by the OP 4.12 of the WB. So far, the compensation expenses have been paid to 1,966 households that have to be relocated in An Khanh Ward, Ninh Kieu District, and the site clearance has been completed .As such, the due diligence review at this time is not necessary.
Project Name	**Mekong Delta Region Urban Upgrading Project (MDR-UUP) - Can Tho City Subproject**
Description	Mekong Delta Region Urban Upgrading Project (MDR-UUP) is carried out from 2012 - 2017 including 06 provinces, in which, the Can Tho city subproject is supported with 69.95 million USD from IDA to further investment for upgrading the urban. Information about the project is as follows: - The Client: The People's Committee of Can Tho city. - Donor: World Bank (WB). - Coordinating Agency: Urban Development Project Management Unit – Urban Development Agency – Ministry of Construction. - Representative of the Client: MDR-UUP Project Management Unit - Can Tho city subproject. - Project operating agencies: The People's Committee of Ninh Kieu, Cai Rang, Binh Thuy and O Mon wards and URENCO, Water supply and sewerage company. - This subproject will be invested for the construction of works to upgrade the infrastructure with the following components: + *Component 1:* Upgrading tertiary infrastructure in low income areas (LIAs) Upgrading and rehabilitation of infrastructure systems such as roads, water supply, sewerage, electricity and public lighting... for 31 LIAs in the area of 4 districts of Ninh Kieu, Binh Thuy, Cai Rang and O Mon. + *Component 2:* Primary and secondary support infrastructure Studying and rehabilitating primary and secondary roads such as roads in Le Binh Ward; canals, ditches and Bun Xang lake, Ngong ditch, Sao ditch...; drainage system for Bun Xang basin; and providing equipment for the management of sewers and sanitation. + *Component 3:* Resettlement Studying and building resettlement areas with complete technical infrastructure and social infrastructure to serve for the clearance, compensation and resettlement of the project. + *Component 4*: Project implementation and management Financing for the project preparation activities and works in phase 1. Providing technical assistance for the project start-up and implementation. Providing financial support for the task of building capacity for the management unit and organizing studying and training classes. + *Component 5*: Providing technical assistance to the Ministry of Construction for the implementation of the National Urban Upgrading Program and Project Coordination - This component will be under the management and performance of the Ministry of Construction. Thus, the component details will not be mentioned in this report.
Current Status	Currently, this project is in the construction progress and some sub-projects have been put into operation. It is expected to be completed in late 2017.

Status of EIA	The project has been provided with an EIA report appraised by the DONRE of Can Tho city and approved by the People's Committee of the city as well as reviewed and approved and disclosed by the World Bank .
Assessment of cumulative impact	The CTUDR project is implemented based on the background of the MDR-UUP project works that have been done; thus, the CTUDR works will merge with the MDR-UUP project, contributing to the improvement of urban infrastructure and environmental sanitation as well as the adaptation to climate change for Can Tho city.
OP 4.12: Screening of linked project and Due Diligence review	The compensation and clearance for construction have been carried out by the local authority. The RP has been prepared by the PPMU and cleared by the WB. Based on the approved RP by the WB, the PPMU has prepared the Compensation Plan and submitted to the local authority for approval. Both RP and compensation plan have been disclosed for comment and review by the affected household as required by the OP 4.12 of the WB. So far, the compensation expenses have been paid to affected households. As such, the due diligence review at this time is not necessary.

The potential cumulative impacts caused by simultaneous construction, can be managed with coordination of schedules at the city level, and good construction management during implementation.

In summary, most potential linkages are likely to have largely positive impacts,through improving water treatment, solid waste management, and drainage along major roads, reducing water and air pollution, and improving the urban environment as well as performing vital flood control functions. . The CTUDR itself has largely positive impacts, as there is no net abstraction from the river, therefore preserving riverine ecological integrity. The wastewater treatment measures lessen the pollutant load in the waterways.

Map 4.1and 4.2 illustrate the boundaries of the linked projects.

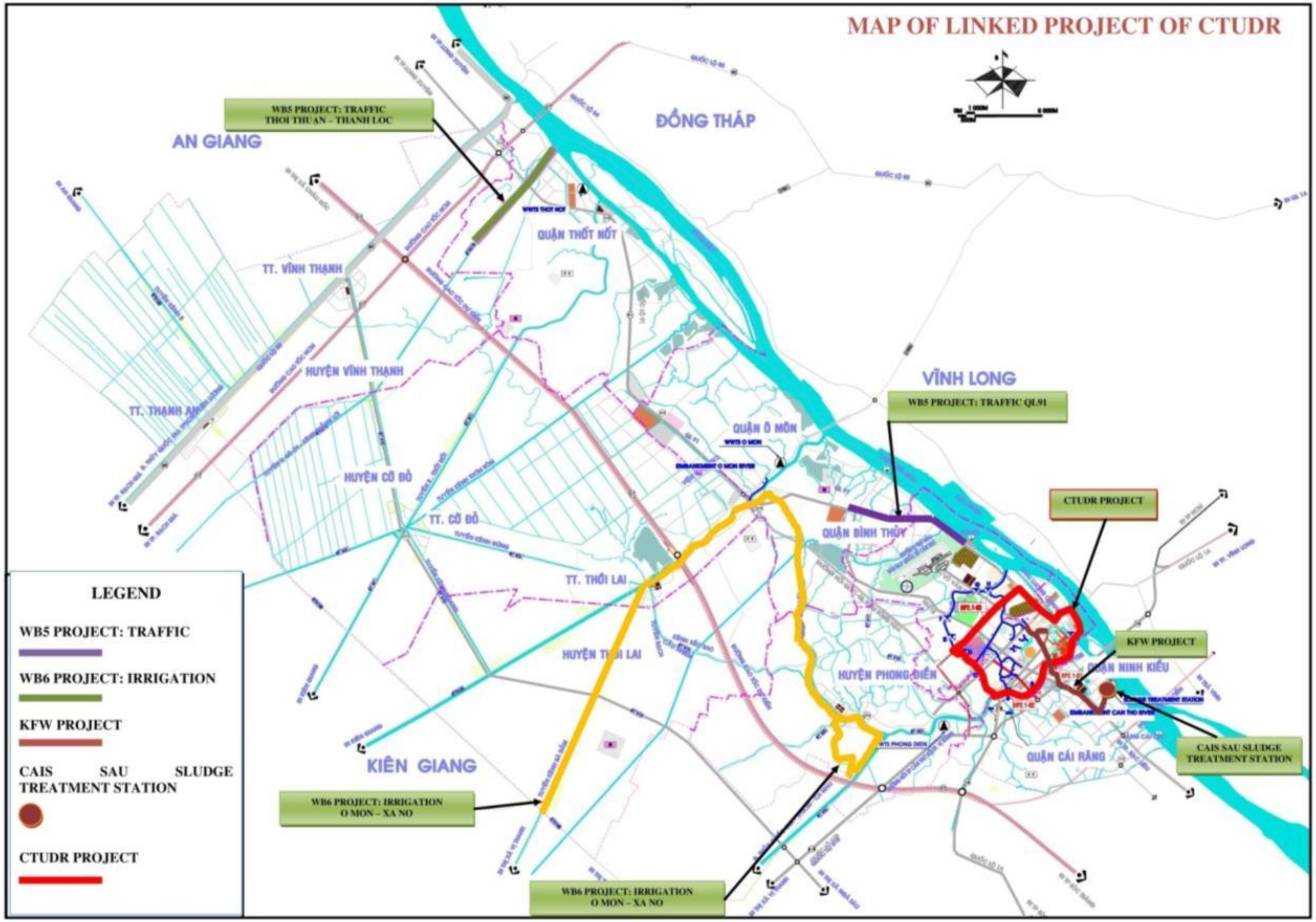


Figure 4.1: Map of Linked Project of CTUDR

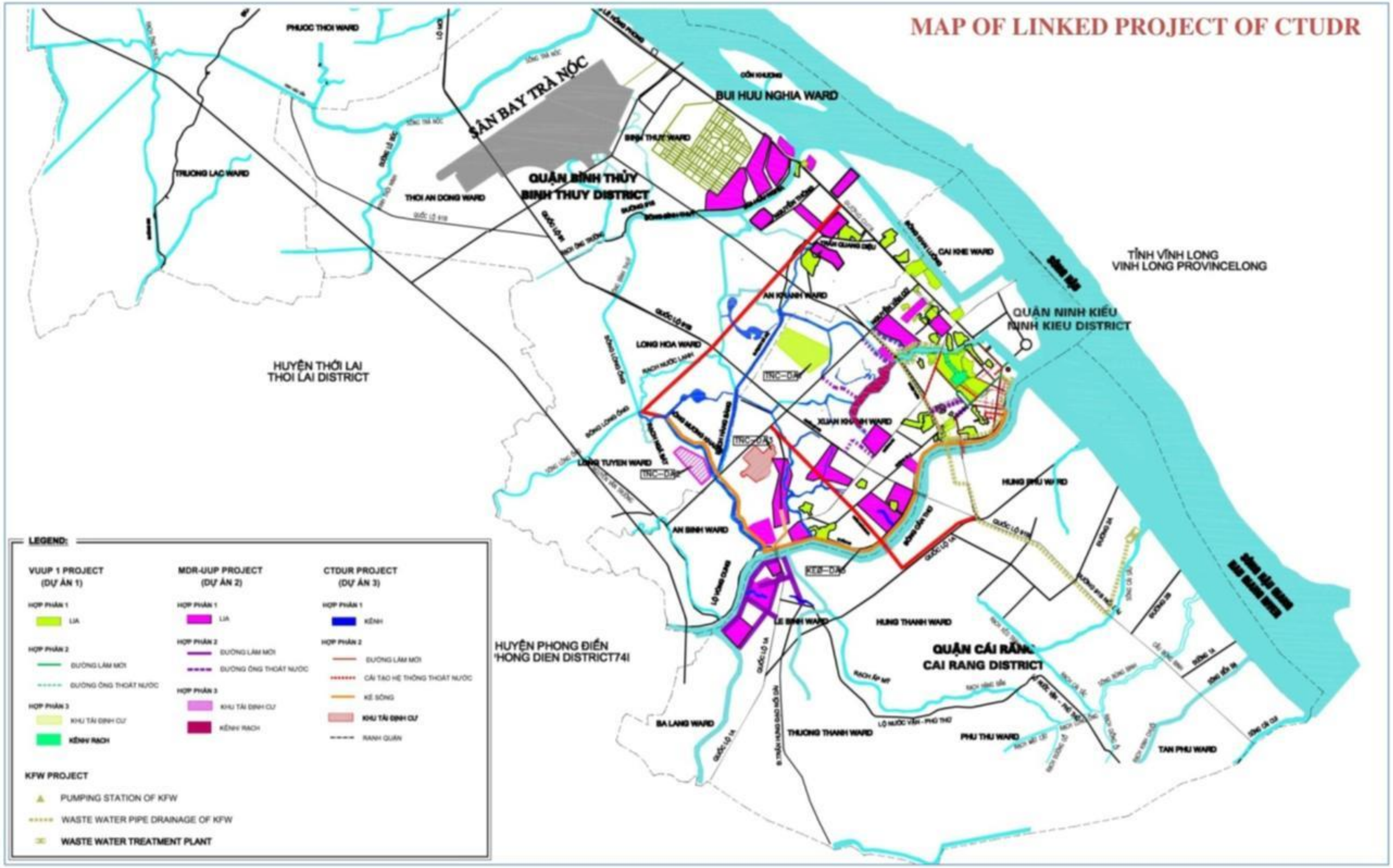


Figure 4.2: Map of Linked Project of CTUDR

4.3. IMPACT ASSESSMENT FOR FLOOD CONTROL WORKS

The Flood Control Works include the following items:

- Sloppy reinforced mbankment for Can Tho river (section from Ngo Duc Ke road to Cai Son cannal) with a length of about 5.5km. Relocation for households occupying and suffering pollution from Can Tho river
- upgrading and rehabilitation of road, construction of park behind embankment,
- *Construction of Cai Khe and Dau Sau sluice gate and ship locks for core urban area*
- *Improvement of* watercourses in the central area, dredging, upgrading protective embankments, roads, relocation of encroached canal *[Cai Sơn cannal section from* Can Tho river – Long Hoa prison**).**
- Develop regulatory lake, water in urban core areas by improving Long Tuyen (University village regulation lake) and Long Hoa regulation lake).
- Upgrading of 13 canal/ditchs in the urban core area, work includes dredging; embankement either using corase rock or soft embankment (the application of measures to restore the local plants (cypress, coconut, etc.) combined ground reinforcement;

4.3.1. Assessment of Environmental Impact During Pre-Construction Phase

4.3.1.1. Identifying Source Of Impacts

The activities in pre-construction phase includes: land acquisition, cleanrance, preparation process of prior-embanking; works site; worker camp.... The table below present source of impacts, impacts and scale of impact will occur in pre-contruction period basing on its activities.

Table 4.5: Impacts During The Pre-Construction Phase

No.	Source of impacts	Impacts	Scale of Impact
(i) Embankment for Can Tho river (section from Ngo Duc Ke road to Cai Son creek) with a length of about 5.5km; Relocation for households occupying and suffering pollution from Can Tho river, upgrading and rehabilitation of road behind embankment			
A - Impact sources related to waste			
1	Rehabilitation	▪ Waste generated from the rehabilitation process of near-riverbank households.	▪ Medium, short term, can be controlled
2	Cleanrance	▪ The dust generated from the process of clearing, grading. ▪ Emissions generated from construction vehicles. ▪ Solid waste generated from the reclamation.	▪ Low, temporal, can be controlled ▪ Low, temporal, can be controlled ▪ Low, temporal, can be controlled
3	The preparation process prior embanking.	▪ Dust, emissions from material transportation.	▪ Low, short term, can be controlled
4	Worker activities	▪ Domestic waste water ▪ Domestic solid waste	▪ Low, short term, can be controlled ▪ Low, short term, can be controlled
5	Maintenance of vehicle and machinery	▪ Waste oil	▪ Low, long term, can be controlled
B - Impact sources not-related to waste			

No.	Source of impacts	Impacts	Scale of Impact
1	Clearance	▪ Disruption of daily life, negative effects on local businesses ▪ Conflicts between people in the construction area and investors. ▪ Noise, vibration from machinery	▪ Medium, long term, can be controlled ▪ Low, long term, can be controlled ▪ Low, short term, can be controlled
2	Vehicles, machinery	▪ Noise and vibration from machinery, vehicles	▪ Low, short term, can be controlled
3	Concentrated workers at the project site	▪ Affect on local economic – social condition. ▪ The ability in generating a number of diseases and social problems caused by the concentrated workers.	▪ Low, long term, can be controlled ▪ Low, long term, can be controlled
4	Rehabilitation	▪ Disruption of daily life, negative effects on local businesses ▪ Affect on the lives of displaced people.	▪ Medium, long term, can be controlled ▪ Medium, long term, can be controlled
(ii) Construction of Cai Khe and Dau Sau sluice gates and 05 ship locks for the center area.			
A - Impact sources related to waste			
1	Worker activities	▪ Domestic waste water ▪ Domestic solid waste	▪ Low, short term, can be controlled ▪ Low, short term, can be controlled
2	Maintenance of of vehicle and machinery	▪ Waste oil	▪ Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Clearance	▪ Disruption of daily life, negative effects on local businesses ▪ Conflicts between people in the construction area and investors.	▪ Medium, short term, can be controlled ▪ Low, short term, can be controlled
2	Vehicles, machinery	▪ Noise and vibration from machinery, vehicles	▪ Low, short term, can be controlled
3	Concentrated workers at the project site	▪ Affect on local economic – social condition. ▪ The ability in generating a number of diseases and social problems caused by the concentrated workers.	▪ Low, short term, can be controlled ▪ Low, short term, can be controlled
4	Traffic	▪ Traffic congestion during the pre-construction phase	▪ Medium, short term, can be controlled
(iii) Rehabilitation of the main canals/ditches in the center area, dredging, upgrading and improvement of protective embankment, road, relocation of households occupying canals/ditches, supplement of reservoirs for rapid water regulation, anti-flooding in Binh Thuy district, supplement of synchronous connection of canals, creeks, lake for 2 urban upgrading projects which was implemented with new systems.			
A - Impact sources related to waste			
1	The preparation process prior embanking.	▪ Dust, emissions from material transportation.	▪ Low, short term, can be controlled

No.	Source of impacts	Impacts	Scale of Impact
2	Worker activities	▪ Domestic waste water ▪ Domestic solid waste	▪ Low, short term, can be controlled ▪ Low, short term, can be controlled
3	Maintenance vehicle and machinery	▪ Waste oil	▪ Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Clearance	▪ Disruption of daily life, negative effects on local businesses ▪ Conflicts between people in the construction area and investors.	▪ Medium, short term, can be controlled ▪ Low, short term, can be controlled
2	Vehicles, machinery	▪ Noise and vibration from machinery, vehicles	▪ Low, short term, can be controlled
3	Concentrated workers at the project site	▪ Affect on local socio- economic condition. ▪ The ability in generating a number of diseases and social problems caused by the concentrated workers.	▪ Low, short term, can be controlled ▪ Low, short term, can be controlled

❖ ***Impact sources not related to waste***

(1) Land Aquisition

Flood control works require acquisition of 698,205 m2 of land, in which there are 271.379 m2 of agriculture land; 222.830 m2 of residential land; 111,903 m2 of land for transport; 34,281 m2 of land for canals. There are 2,858 affected households in which 1,271 household of relocation resettlement; 347 households severely affected by the loss of productive land; 472 households affected their business. There are 200 vulnerable households: in which (150) female-headed households, (6) ethnic minority households; (4) disable-headed households; (22) poverty households; (5) elderly households; (13) social-policy households. The residential land acquisition and relocation of affected households cause more impacts on the physical and spiritual lives of the people, even to create social problems and prolonged litigation. The relocation to a new place also creates a strong impact on people and to emerge issues related to social living conditions of the resettled households will be changed dramatically, keep them away with the familiar relationship of the surrounding villages, social amenities and living conditions which they are enjoyed, even convenient business opportunities, they will take a long time to adapt to the new location.

(2) Impacts due to relocation of infrastructure

There will be relocated 350 electric poles; 8 sub-stations; 1,750m of power lines, 8 bus station and will affect to 1,384 m^2 of road.

Table 4.6: The Impacts Of Encroaching Traffic Infrastructure

Public properties	Quantity
Electric poles	350
Electrical Sub-stations	8
Power line	1,750
Road	1,384
Telephone lines	346
Bus stops	8

(3) Flooding

One of the main objectives of the project is improvement of flood risk management. However, if inadequate considerations of project's drainage design and existing situation of flooding could lead to high risks of flood, environmental quality degradation, social and safety issues. Specific components that need to be considered include capacity and design of regulation lakes and drainage systems, sluice gates, ship locks and cannals.

(4) UXO (Unexploded ordnance)

Because Can Tho 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 sub-components, UXO needs to be carefully considered and removed before construction activities can commence. 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.

❖ ***Impact sources related to waste***

(5) Air pollution

Air pollution from pre-construction activities/sites has many sources: (i) Emissions generated from transportation; (ii) Dust generated from ground clearance; (iii) Emission generated from machinery.

(i) Emissions generated from transportation: The dust and emission gas during the pre-construction phase is mainly generated from the machinery and materials transportation trucks and construction vehicles in the construction area. The impact of this process takes place in a short time, thus, it is not significant. Vehicles in use have the capacity from 3.5 to 16 tons with 10-hour continuous operation. Currently, there is no standardized data of emission sources caused by vehicles. Therefore, the method of rapid assessment of the World Health Organization (WHO) can be used to assess the impacts.

Table 4.7: Emission Factors Of Air Contaminants For Trucks

No.	Type of truck	Unit (U)	SO2 kg/U	NOx kg/U	CO kg/U	VOC kg/U
1	Gasoline truck (> 3.5 tons)	1000 km	4.50*S	4.50	70	7
		tn of Fuel	20*S	20	300	30
2	Diesel truck(< 3.5 tons)	1000 km	1.16*S	0.70	1	0.15
		tn of Fuel	20*S	12	18	2.60
3	Diesel truck (3.5 - 16 tons)	1000 km	4.29*S	11.80	6	2.60
		tn of Fuel	20*S	55	28	12
4	Diesel truck(>16 tons)	1000 km	7.26*S	18.20	7.30	5.80
		tn of Fuel	20*S	50	20	16

Source: WHO,1993

Note: S is the Sulfur content in diesel oil (S = 0.25%)

Properties for diesel vehicles are set with an average speed of 10 km/h, 3.5 ÷ 16 tons, the average distance of 1 km, exhaust pollution load for one (01) truck as follows:

Dust : 0.90 g/km

SO2 : 4.29*S g/km;

NOx : 11.80 g/km;

CO : 6.00 g/km;

VOC : 2.60 g/km.

The total length of riverbank which needs to be clenaed before carrying construction works is listed in Table 4-8 as follows:

Table 4.8: Advanced Workload For Each Item (River/Canal embankment)

No.	Construction sector	Unit	Amount	Note
1	Can Tho River (section from Ngo Duc Ke road to Cai Son creek)	m	5,600	Level 1st canal
2	Muong Khai Canal	m	360	Level 1st canal
3	Cai Son Canal	m	240	Level 1st canal
4	Dau Sau Canal	m	450	Level 2nd canal
5	Ngong Canal	m	225	Level 2nd canal
6	Muong Cui Canal	m	78	Level 3rd canal
7	Nga Bat Canal	m	97	Level 3rd canal
8	Ba Bo Canal	m	340	Level 3rd canal
9	Hang Bang Canal	m	60	Level 3rd canal
10	Sao Canal	m	115	Level 3rd canal
11	Xeo La Canal	m	120	Level 3rd canal
12	Ong Ta Canal (An Thoi)	m	132	Level 3rd canal
13	Tu Ho Canal	m	112	Level 3rd canal
14	Ba Le Canal	m	70	Level 3rd canal
15	Xeo Nhum	m	53	Level 3rd canal
16	Ranh Canal	m	42	Level 3rd canal
17	Thuy Loi Canal	m	160	Level 3rd canal
18	O Mon River	m	1,800	Level 1st canal
	Total	**m**	**10,054**	

Estimated width for ground clearance is 5.0 m on each side of river/canal and 0.2m depth. Therefore, the total volume of solid waste which is cleaned will be about 20,108 m^3. The volume of solid waste during the ground clearnance and rehabilitation process (including vegetation, debris, sediment, and some material of households) is estimated at 30,200 tons (the estimated proportion of soil: 1.5 ton/m^3), with the estimated ground clearance and rehabilitation time about 60 days in total (be done in form of "rolling"). The estimated total number of 10-tons vehicles for transporting solid waste is 5 vehicles/day, equivalent to 20 times/day (included turn in and out). With total of estimated trucks is 05 (load: 10-ton), equivalent to 20 times/day, average moving distance of about 20km/truck, the pollution load generated each day are listed in the Table 4-9 as follows:

Table 4.9: Emission Loads Of Air Pollutants During The Pre-Construction Phase

No.	Parameter	Pollution Load (kg/day)
1	Dust	0.9
2	SO_2	1.072
3	NO_x	11.8
4	CO	6.0
5	VOC	2.6

During this phase, along the river bank which be constructed with the embankment, load of pollutants coming from the transport do not focus in one point or same time. The pre-construction time of this process is very short and this work is done in the form of "rolling" - transit immediately to the next area after finishing the each construction work. This plan should be able to create local air pollution in a particular area which should happen in a short period and be insignificant. Besides, the investor will also take role to coordinate the transportation density and minimize the negative impacts on local people.

(ii) Dust generated from ground clearance and rehabilitation Factor of dust pollution (E) diffused from the reclamation phase is based on the following formula:

$$E = 0{,}0016\ \times k \times \frac{(\frac{U}{2{,}2})^{1{,}3}}{(\frac{M}{2})^{1{,}4}}$$

Among them:

E: Pollution factor (kg/ton)

k: Average grain structure value (0.35)

U: Average wind speed in construction area (3 m/sec)

M: Average soil moisture in dry season (58%)

Thus, 1 ton of solid waste coming from the reclamation makes 0.0047 kg of dust. With about 30,200 tons of sandy soil, the amount of dust which is generated during the reclamation phase is 141.94 kg. The reclamation time is estimated about 60 days which will generate average 2.37 kg of dust per day. The process of solid waste transporting coming from ground clearance and rehablitation will generate dust and increase the local dust concentration in the area. Radius of greatest impact of dust generating by this activity is around 300 m downwind. These impacts on the local environment are insignificant. For human health: dust may reduce respiratory function, makes skin diseases, eye diseases, etc. Workers are directly affected in the ground clearance and rehablitation area and also be the main target. For plants: The construction areas are located along the river bank. This area is surrounded by river/canal and some household living along the roads. Transport processes should generate a relatively dust to trees. Therefore, investors need to take some measures to cover the works to minimize the dust impact on people in the region.

(iii) Emission generated from machinery

The concentration of pollutants depends on the type of materials, operating status and longevity of the engine. The older machines are used, the higher concentration of pollutants is emitted, and therefore, machinery activities will affect physical environments in terms of noise, air pollution. The project will carry out ground clearance and rehablitation of 10.05 ha, the amount of fuel to clean is estimated at about 76 L/ha. Thus the total amount of oil needed is 763.8 kg ~ 611.04 liters of oil (the oil specific weight: 0.8 kg/L). According to NATZ, harmful emissions of construction machines, 1 ton of oil for the internal combustion engine (Table 4-7) is estimated the emission load in the local area during ground clearance and rehablitation within 60 days. Calculation results and forecast load due to emissions during the pre-construction phase are presented in Table 4-10.

Table 4.10: The Emission Factors

	Emission factor (kg/ton)		
Indicator	SO2	NO2	CO
Load (kg)	2.8	12.3	0.05

(Source: NATZ)

Table 4.11: Emission Loads Due To Clearnance Activities

Used oil (tons/day)	**Emission load (kg/day)**		
	SO2	**NO2**	**CO**
0.01273	0.035644	0.156579	0.000636

For the process of ground clearance and rehabilitation, emissions arise primarily from machinery and vehicles. The average daily emissions calculated as above is considered to have negligible impact on the air environment. Featuring the surrounding area is mainly covered by river and residential houses, therefore, the environmental background of project area should be impacted. On another hand, the spreading ability is strong in this area and the residential area locates about 300m far from the construction area, hence, the emission impacts are set at medium level. However, to ensure the best quality for the surrounding environment, the machinery and equipment have to be maintained regularly. For human health: Incidence of emissions is mainly on construction site and the emissions can strongly stimulate the respiratory and cause eye problems. Thus, workers need to comply with regulations on occupational safety, use personal protection equipment as prescribed.

(6) Domestic Wastewater

The amount of wastewater generated by the activities of workers in the area of construction is negligible and unregulated. Total number of worker who working for each item is estimated about 20 workers. Demand for water use of each worker's prescribed in QCXDVN 01:2008/BXD is about 45 liters/person/day including water for washing, cooking and personal hygiene. The amount of wastewater is calculated by 100% of water used daily. Thus, the amount of domestic wastewater generated at about 0.9 m^3/day/work. Ingredients of wastewater include suspended solids, oil, grease, high concentrations of organic matter, residue, dissolved organic matter (through the BOD_5, COD indicators), nutrients (Nitrogen, Phosphor) and microorganisms. According to the pollutants emission of the World Health Organization (WHO) for developing countries in Table 4-11, the estimated load and average concentration of pollutants in the domestic wastewater before treatment through septic tanks are listed as follows:

Table 4.12: Loads and Pollutants Concentration Of Domestic Wastewater (untreated)

No.	Pollutants	Pollution factor(*) (g/person. Day)	Load (kg/day)	Pollutant factor (mg/l)	
				Untreated	QCVN 14:2008 Column B
1	BOD_5	45 – 54	0.9 – 1.08	1000 - 1200	50
2	COD	72 – 102	1.44 – 2.40	1600 – 2666	-
3	TSS	70 – 145	1.40 – 2.90	1555 – 3222	100
4	Grease	10 – 30	0.20 – 0.60	222 - 666	20
5	Total Nitrogen	6 – 12	0.12 – 0.24	133 - 266	50
6	Ammonia (N-NH_4)	2.4 – 4.8	0.048 – 0.096	53 - 107	10
7	Phosphor	0.8 – 4.0	0.016 – 0.08	17.8–88.9	10
8	Total Coliforms	10^6 - 10^9	$20x10^3$ – $20x10^6$	$22x10^6$ – $22x10^9$	5000 (MNP/100ml)

(Source: WHO, 1993)

In the table above, the pollution load, number of workers and wastewater flow, calculate the pollutants concentration in wastewater by the following formula:

$$C = \frac{C_0 .}{Q}$$

In which:

C: Pollutant concentration, (mg/L)

C_0: Pollutant load, (g/day)

Q: Wastewater flow, (m^3/day)

Compare the pollutants concentration in untreated domestic wastewater with the QCVN 14:2008, Column B, most of the parameters are over the standards. To minimize the impact, the investor should require the contractor to hire houses which are near to the construction area or to build toilets inside the construction area to serve the needs of the labor activities. Therefore, the amount of domestic wastewater is collected and be treated by the local treatment system, hence, the impact is negligible.

(7) Domestic Solid waste

Solid waste coming from workers in pre-construction phase discharged about 0.35kg/person/day. With the number of workers is estimated about 20 people for each item, the amount of solid waste should generate around 7 kg/day. This solid waste contains 60-70% organic ingredient and 30-40% other substances, and may contains many bacteria, pathogens. These solid wastes would be collected and processed in order to limit the negative impact on human health and the local environment. The number of workers in the pre-construction phase is not too much, so the amount of solid waste generating from construction area is insignificant. However, investors should also take some measures to collect and ensure environmental hygiene of working areas.

(8) Waste oil

After operating, the machinery and construction vehicles using on site must be maintained to avoid damage and ensure the stable operation. This process will generate an amount of Waste oil from machinery and vehicles. The amount of oil for once change is estimated about 16 liters/truck. The changing cycle is about 3-6 months, depending on the working time of machinery. The amount of hazardous waste generated from cleaning rags, oil machinery, oil tanks, etc. in this phase is minimal. The estimated amount of Waste oil for once change is 10 liters. Hazardous wastes are collected and processed by specialized units according the provisions of the Hazardous Waste Management.

(9) Runoff rainwater

Rainwater is a clean water source once not exposing to pollution sources: wastewater, emission gas, contaminated land, etc. During pre-construction phase, the runoff rainwater on construction site can be swept with sand, garbage, waste and become pollution source for surface waters, underground soil and pollute the groundwater in this area. Total rainfall arising from the project area during construction is estimated by the following formula:

$$Q = \varphi \text{ x q x S}$$

In there:

S: area of construction;

φ : Coefficient of surface coverage = 0.95;

q : rainfall intensity = 166,7 x i (mm/minute), i is the highest water layer of this area in the wettest month (Hoang Hue, 1996). According to data from appendix of Chapter 2 in QCVN 02:2009/BXD on condition of natural materials used in construction, the precipitation of the wettest month of Can Tho City is 1,712 mm, and the wettest month with an average of 24rainy days,3 hours raining per day, inferred i = 0.38 mm/min

The flows of rainwater in the wettest month incurred in the project area are:

$$Q = 0.95 \text{ x } 166.7 \text{ x } 0.38 \text{ x } 100{,}540/\ 1{,}000/60 = 100.84 \text{ m3/s.}$$

Due to construction area along the riverbank and canal with a total construction area is not great at every moment, the amount of runoff rainwater through the construction area is quite reasonable. The runoff rainwater will directly flow into the river/canal. Therefore, there is no significant impact to the local environment. To minimize the impact, the investor will allocate the area by gathering machinery, materials, solid waste, avoiding the leaching of pollutants.

Table 4.13: Pollutants Concentration In Rainwater

No.	**Ingredient**	**Concentration (mg/L)**
1	Total Nitrogen	0.5 – 1.5
2	Total Phosphor	0.004 – 0.03
3	COD	10 – 20
4	TSS	10 – 20

(Source: Hoang Hue, 1996)

4.3.2. Assessment of Environmental Impact During Construction Phase

4.3.2.1. Identifying Source Of Impacts

The activities in construction phase includes: Embanking, Pipeline construction, Vehicles, machinery, Worker activities. The table below present source of impacts, impacts and Scale of impact will occur in contruction period basing on its activities.

Table 4.14: - Impacts During The Construction Phase

No.	Impact source	Impacts	Impact Scale
(i) Embankment for Can Tho river (section from Ngo Duc Ke road to Cai Son creek) with a length of about 5.5km and Relocation for households occupying and suffering pollution from Can Tho river, upgrading and rehabilitation of road behind embankment			
A - Impact sources related to waste			
1	Embanking Material transportatation	- Dust, emissions from embanking, material transportation and machinery.	- Medium, temporary, can be mitigated via good management and construction practices
2	Worker activities	- Domestic waste water - Domestic solid waste - Water pollution	- Low, temporary, can be mitigated via good management and construction practices - Moderate, can be mitigated by good construction practices.
3	Maintenance of vehicle and machinery	- Waste oil	- Low, termporary, can be controlled
B - Impact sources not-related to waste			
1	Vehicles, machinery	- Noise and vibration from machinery, vehicles	Low, temporary, can be mitigated via good management and construction practices
2	Concentrated workers at the project site	- Affect on local economic – social condition. - The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Low, short-term, can be controlled - Low, short-term, can be controlled
3	Construction activities	Disturbance to local people, impacts to sensitive points and adjacent PCR	- Moderate, short term, can be mitigated by coordination, management measures.
4	Embanking activities	Risk on soil erosion, land slide, embankment and	Short-term, can be mitigated by design solution and construction methods.
(ii) Construction of Cai Khe and Dau Sau Slui gates and ship locks for the center area.			
A - Impact sources related to waste			
1	Worker activities	- Domestic waste water - Domestic solid waste - Water pollution	- Low, short term, can be controlled - Low, short term, can be controlled - Moderate, can be mitigated by good construction practices
2	Pipeline construction	- Dust, emissions from material transportation and machinery.	- Medium, long term, can be controlled
2	Maintenance of vehicle and machinery	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Low, short term, can be controlled
2	Concentrated workers at the project site	- Affect on local economic – social condition.	- Low, short term, can be controlled

No.	Impact source	Impacts	Impact Scale
		- The ability in generating a number of diseases and social problems caused by the concentrated workers. - Disturbance to local people	- Low, short term, can be controlled
3	Drainage and traffic	- Drainage issue and navigation due to the change of water course during construction	- Medium, short term, can be controlled
4	Risks	Land slide,subsidence risk during construction period	-Medium, short-term, can be mitigated.
(iii) Rehabilitation of the main canals/ditches in the center area, dredging, upgrading and improvement of protective embankment, road, relocation of households occupying canals/ditches, supplement of reservoirs for rapid water regulation, anti-flooding in Binh Thuy district, supplement of synchronous connection of canals, creeks, lake for 2 urban upgrading projects which was implemented with new systems.			
A - Impact sources related to waste			
1	Embanking.	- Dust, emissions from material transportation.	- Medium, short term, can be controlled
2	Dredging	- Ordour	-Medium, short term, can be controll
3	Dredging and excating	- Excavated materials, sludge coming from dredging process. Total 592 665 m^3 of soil from dreding and excavating. The amount of contaminated sludge 322.169 m^3	- Medium, long term, can be controlled
4	Worker activities	- Domestic waste water - Domestic solid waste	- Low, short term, can be controlled - Low, short term, can be controlled
5	Maintenance of vehicle and machinery	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Medium, , short term, can be controlled
2	Concentrated workers at the project site	- Affect on local economic – social condition. - The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Low, short term, can be controlled - Low, shortg term, can be controlled
3	Traffic	Congestion and disruption due to lake construction activities	Medium,, short term, can be controlled
4	Risks	Local flooding	- Low, short term, can be controlled

4.3.2.2. Impact Assessment

❖ ***Impact sources not related to waste***

(1) Noise and vibration pollution

During construction phase, the following activities will cause noise, including: material transport, drilling and sewing machine; Asphalt sprinklers (sprinkler, compressor); Execution of works.

The level of noise coming from the transportation and construction are calculated by the following formula:

$$L_p(X) = L_p(X_0) + 20 \log_{10}(X_0/X)$$

In there:

$L_P(X_0)$: noise 1m far from source (dBA)

$L_P(X)$: Noise levels in the position to calculate

X: position to calculate

X_0 = 1m

Table 4.15: Noise Levels From Construction Vehicles

No.	Vehicles/Equipment	Noise from the source (dBA)							
		15m	25m	30m	45m	60m	90m	120m	150m
1	Trucks	88	84	82	78	76	72	70	68
2	Concrete mixers	85	81	79	75	73	69	67	65
3	Concrete pavers	76	72	70	66	64	60	58	56
4	Steel cutting	84	80	78	74	72	68	66	64
5	Concrete pump	82	78	76	72	70	66	64	62
6	Rollers	74	70	68	64	62	58	56	54
7	Land scrapers	80	76	74	70	68	64	62	60
8	Concrete drillings	98	94	92	88	86	82	80	78
9	Road pavings	89	85	83	79	77	73	71	69
10	Steel bending	84	80	78	74	72	68	66	64
11	Vertical drilling	88	84	82	78	76	72	70	68
12	Crane - crawler	88	84	82	78	76	72	70	68
QCVN 26:2010/BTNMT		70 dBA							

In the noise sources, the biggest noise source is drilling. Noise levels at a location 120 meters far from stationary sources are less than the limit, and it only arises in a short time so the impact is acceptable.

In the project, the road will be digged by machinery such as concrete drilling, land scrapers, trucks, etc. While performing the pavement, other machines will be used such as rollers, paving machines, pumps and concrete mixers, etc. In general, the noise level at location 50 meters far from stationary sources are within the permissible limits. Thus, the source of this pollution will affect mainly the people along the route of the drainage pipeline construction area. The people who are most affected are the people along the important roads in the densely populated areas.

Table 4.16: The Maximum Noise Resonance Level From Equipment

No.	Machinery/Equipment	Noise from the source (dBA)							
		15m	25m	30m	45m	60m	90m	120m	150m
1	The total noise level when performing excavation, installation	99.5	95	93	90	87	84	81	80
2	The total noise level in the area of re-establishing pavement	88	84	82	78	76	72	70	68

(2) Traffic congestion

Construction areas of project spread across Ninh Kieu - Binh Thuy area is the *urban core* with high density of traffic. Therefore, the increased circulation of trucks serving the transportation of materials, soil from the construction area should directly increase traffic density, jeopardize the safety of traffic to the local people. The estimated total number of 16-tons vehicles will be mobilized for transporting excavated soil, solid waste and sludge are about 382 turns per day.

(3) Economic and social conditions

During the construction process, the workers concentrated in one area would indirectly rise to social problems. Besides, the migrant workers appear in the construction sectors also affect the daily life of people. However, with the shortage of labor for the construction, local workers in the city will have the opportunity to participate in the construction. The vendors and supermarkets near the construction will also develop and expand during project implementation.

(4) Risk on soil erosion and landslide, embankment susdidence during the embankment and construction of sluice and tidal gate

Total length of embankment system of Can Tho River is about 5.5km. Some sections of Can Tho river which will be improved, are serious erosion. Because, those section are mostly built on the Holocene strata where the sediments are soft. This strata has a high content of clay and organic impurities, often in the water saturated state so its load-bearing capacity is poor. Therefore, when flood season comes, a big flood with high tide peak will cause riverside landslide, affect to the construction area. Hence, it is the safest when contractor constructs in dry season because the months in this dry season are especially little rainfall. In process of embankment construction, if not reinforce bank well, or construction time lasted to rain season, big water flow can cause land subsidence, dangerous for workers and affect construction process.

(5) Disruption of navigation (if there is) during the construction of tidal gate and canal

Inland water network/navigation is one of the strengths of Can Tho city with system of Can Tho river and Hau river contributed to create trading position in nation and the entire Mekong River Delta region. With cannal system from primary canals to tertiery cannals are equally distributed in Can Tho City and facilitated to inland waterway. Can Tho river, Hang Bang, Ngong, Muong Cui and Sao Cannal are the most heavy traffic cannal in Can Tho.

Therefore, construction phase, acitivies of digging and material transport by boats in their river and cannal can be disterupted inland waterway activities.

Because Cai Khe tidal gate is located in Cai Khe canal which is between Ninh Kieu Bridge and pedestrian bridge; Dau Sau tidal gate is placed in the Dau Sau Canal, away 200m to the Can Tho River; 5 tide sluice gates which are located Sao Canal, Ba Bo Canal, Suc Canal, Pho Tho Canal and Hang Bang Canal. Inland waterway activities in those cannals are quite crowded.

During the construction period, the water will be diverted so as to allow installation of stalling 02 tidal gates and 05 shiplocks, digging sedimention, sludge and installing valve gate. These activities will cause temporary disruption to the inland waterway.

Impact sources related to waste

(4) Air pollution

Air pollution from construction activities/sites has many sources: (i) Dust generated from construction of flood control works i.e.pipeline, embankment, road and excavated of regulation lakes; (ii) Emission generated from the material transportation and construction activities of flood control works; (iii) Odor from dredging process .

(i) Dust generated from construction of flood control works

Activities of construction of flood control works such as pipeline, embankment and road and excavated of regulation lakes:

<u>(a.) Embanking Can Tho river, Cai Son cannal and upgrading of road behind embankment</u>

FS consultants estimated that the total quantity of soils from digging/ecavating for Can Tho, Cai Son embankmet and road behind embanment, will be waste spoil to be disposed of at approved waste spoil disposal sites as flowing:

Soils from excavating of Can Tho embankment and road behind embankment: 100.000 m3. Soils form excavating and destroying of current culverts of Cai Son cannal: 125.496 m3

Total quantity of soil and rock for disposal will be 225,496 m^3; will be transported by 10-ton trucks. The process of excavating and transporting will generate dust in the construction area. The diffusion of dust from excavation based on dust pollution factor (E) as follows:

$$E = 0{,}0016 \times k \times \frac{(\frac{U}{2{,}2})^{1{,}3}}{(\frac{M}{2})^{1{,}4}}$$

In there:

- E: pollutants factor (kg/ton)
- k: grain structure with average values of 0.35
- U: average wind speed in the project area (3 m/s)
- 1M: average moisture of soil in dry season (~ 30%)

Therefore, an average of 1 ton of backfilling soil will generate about 0.0102 kg dust.

Calculate the volume of dust arising from excavation and backfilling for the construction items of the project according to the following formula:

$$W = E * Q * d$$

- W: The average amount of generated dust (kg);
- E: Pollution factor (kg of dust / ton of soil);
- Q: The amount of excavated soil (m3);

- d: Proportion of excavated soil (d = 1.5 ton/m3).

Thus, the total amount of dust in the air environment around 3444 kg. Total construction time is about 8 months; the estimated load of arising dust is about 0.4983 g/s.

According to the analysis of air quality in the project area, the highest concentration of dust was recorded at 270 µg/m3, equivalent 0.00027g/m3 air.. Therefore, the load of dust generating during the digging and soil transport should directly get the increase in the dust concentration of environmental quality in the region. However, due to the construction will be carried out in sequences, dust emission levels will be significantly reduced. Plans for transporting and disposing of this waste spoil will be carefully developed

<u>(b) Installing drainage pipeline system:</u>

According to table 4.28, the volume of digging soil for installation of drainage systemes is 29.906 m^3. After installing drainage pipeline system, about 40% of the total amount will be used for backfilling. The rest of digging soil, 17,944 m^3, will be transported by 10-ton trucks. The process of digging and transporting will generate dust in the construction area. The diffusion of dust from excavation based on dust pollution factor (E) as follows:

$$E = 0{,}0016 \times k \times \frac{\left(\frac{U}{2{,}2}\right)^{1{,}3}}{\left(\frac{M}{2}\right)^{1{,}4}}$$

In there:

- E: pollutants factor (kg/ton)
- k: grain structure with average values of 0.35
- U: average wind speed in the project area (3 m/s)
- 1M: average moisture of soil in dry season (~ 30%)

Therefore, an average of 1 ton of backfilling soil will generate about 0.0102 kg dust.

Calculate the volume of dust arising from excavation and backfilling for the construction items of the project according to the following formula:

W = E * Q * d

- W: The average amount of generated dust (kg);
- E: Pollution factor (kg of dust / ton of soil);
- Q: The amount of excavated soil (m3);
- d: Proportion of excavated soil (d = 1.5 ton/m3).

Thus, the total amount of dust in the air environment around 274 kg. Total construction time is about 8 months, the estimated load of arising dust is about 0.0397 g/s.

According to the analysis of air quality in the project area, the highest concentration of dust was recorded at 270 µg/m3, equivalent 0.00027g/m3 air. Therefore, the load of dust generating during the digging and soil transport should directly get the increase in the dust concentration of environmental quality in the region. However, due to the construction will be carried out in sequences, dust emission levels will be significantly reduced.

<u>c. Construction of Long Tuyen and Long Hoa regulatory lake construction</u>

Following the design specifications of the regulation ponds, the total digging soil required for construction of the lake is around ~349,169 m3. The total area for playgrounds and footpaths is about 2.2 ha, the volume of soil coming from the reclamation is around 11,000 m3. The process of digging and transporting will generate dust in the construction area. The diffusion of dust from excavation based on dust pollution factor (E) as follows:

$$E = 0{,}0016 \times k \times \frac{(\frac{U}{2{,}2})^{1{,}3}}{(\frac{M}{2})^{1{,}4}}$$

In which:

- E: pollutants factor (kg/ton)
- k: grain structure with average values of 0.35
- U: average wind speed in the project area (3 m/s)
- M: average moisture of soil in dry season (~ 30%)

Therefore, an average of 1 ton of backfilling soil will generate about 0.0102 kg dust.

Calculate the volume of dust arising from excavation and backfilling for the construction items of the project according to the following formula:

$$W = E * Q * d$$

- W: The average amount of generated dust (kg);
- E: Pollution factor (kg of dust / ton of soil);
- Q: The amount of excavated soil (m3);
- d: Density of excavated soil (d = 1.5 ton/m3).

Thus, the total amount of dust in the air environment around 5,501kg. Total construction time is about 9 months, the estimated load of arising dust is about 0.7074 g/s (8-hours day work). Regulation lake locates in the university village, with a large number of students, the soil transportation from the construction area will directly affect to life and health of local people. Investors should take measures such as using tarpaulin to spread on the truck, watering the soil on trucks before transporting to minimize dust emission.

(ii) Emission generated from generated from the material transportation and construction activities of flood control works

<u>(a.) Embanking Can Tho river, Cai Son cannal and upgrading of road behind embankment</u>

The volume of soil during the digging process (including vegetation, sediment and soil) is estimated 338,244 tons (the estimated proportion of soil: 1.5 ton/m3), with the estimated digging time about 8 months in total. The estimated total number of 16-tons vehicles for soil transportation is 88 vehicles/day. Distance to leveling park is estimated at around 30km.

Properties for diesel vehicles are set with an average speed of 10 km/h, 3.5 ÷ 16 tons, the average distance of 1 km, exhaust pollution load for one (01) truck as follows:

- Dust : 0.90 g/km
- SO2 : 4.29*S g/km;
- NOx : 11.80 g/km;
- CO : 6.00 g/km;
- VOC : 2.60 g/km.

The emissions coming from the vehicles during the digging process are listed in Table as follow:

Table 4.17: Emission Loads Of Air Pollutants

No.	Parameter	Pollution Load (kg/day)
1	Dust	47.52
2	SO2	113.27
3	NOx	623.04
4	CO	316.8
5	VOC	137.28

Note: %S = 0.5%

Following the results of the calculation, the process of soil transporting generates pollutants with the concentrations are pretty high. To minimize the impact on the environment and traffic conditions, this process should be operated at night.

The machines and vehicles as follow (Table 4-18):

Table 4.18: Demand for Diesel Oil Following Machinery And Vehicles

No.	Machinery	Amount	Fuel consumption (liter/shift)	Needed DO(liters)	Needed DO /day (kg/day)
1	Portable generators	2	75.62	151.24	127.80
2	Bulldozer	3	93.60	280.80	237.28
3	Land scraper	3	132.00	396.00	334.62
4	Paving machine	2	57.00	114.00	96.33
5	Crawler cranes10-ton lifting capacity	1	36.00	36.00	30.42
6	Car cranes - 16-ton lifting capacity	1	43.00	43.00	36.34
7	Portable compactors (80kg)	5	4.59	22.95	19.39
8	Wheel cranes	1	33.00	33.00	27.89
9	9-ton compactors	10	34.00	340.00	287.30
10	16-ton compactors	10	37.80	378.00	319.41
11	Asphalt sprinklers	2	57.00	114.00	96.33
12	Spreaders	2	30.20	60.40	51.04
13	Graders	3	38.80	116.40	98.36
14	Compressor	2	75.00	150.00	126.75
				Total	1,889.24

Note: Density of DO is 0,845 (kg/L)

Source: WHO, 1993

The calculation process with the assumption of operating machinery, concentration of pollution is defined in the construction area. Construction time is estimated at 8 hours/day. Pollution load and concentrations of pollutants in emissions when burning diesel oil is calculated as follows:

$$\text{Pollution load (g/s)} = \frac{\text{Pollution factor}\left(\frac{\text{g}}{\text{kgDO}}\right) \times \text{Needed DO}\left(\frac{\text{kgDO}}{\text{day}}\right) \times \frac{1}{3}}{3600}$$

The emission loads in the construction are depicted in the Table 4-20 as follows:

Table 4.19: Emission Loads Coming From The Use Of Oil For Machinery

No.	Pollutants	Pollution factor (g/kg DO)	Load (g/s)
1	Dust	0.28	0.049
2	SOx	20*S	0.875
3	NOx	2.84	0.497
4	CO	0.71	0.124
5	VOC	0.035	0.006

S=0.25%

Source: WHO, 1993

(b) Installing drainage pipeline system:

The volume of solid waste after the digging process is estimated at about 27,000 tons (the estimated proportion of soil: 1.5 ton/m^3). Time for the installation of drainage pipeline system process is estimated about 240 days in total (be done in form of "rolling"). The estimated total number of 10-tons vehicles for carrying solid waste is 11 vehicles/day, equivalent to 22 times/day (included turn in and out). The works of drainage pipeline construction include the machines and vehicles as follow (Table 4-20):

Table 4.20: Demand for Diesel Oil Following Machinery And Vehicles

No.	Machinery	Amount	Fuel consumption (liter/shift)	Needed DO(liters)	Needed DO needed/day (kgday)
1	Portable generators	2	75.62	75.62	63.90
2	Bulldozer	2	93.6	93.60	79.09
3	Land scraper	2	132	132.00	111.54
4	Paving machine	2	57	57.00	48.17
5	Crawler cranes10-ton lifting capacity	1	36	36.00	30.42
6	Car cranes - 16-ton lifting capacity	1	43	43.00	36.34
7	Car cranes - 25-ton lifting capacity	1	50	50.00	42.25
8	Portable compactors (80kg)	2	4.59	9.18	7.76
9	Wheel cranes	1	33	33.00	27.89
10	9-ton compactors	10	34	340.00	287.30
11	16-ton compactors	10	37.8	378.00	319.41
12	Asphalt sprinklers	2	57	114.00	96.33
13	Spreaders	2	30.2	60.40	51.04
14	Graders	2	38.8	77.60	65.57

No.	Machinery	Amount	Fuel consumption (liter/shift)	Needed DO(liters)	Needed DO needed/day (kgday)
15	Compressor	2	75	75	150.00
	Total				**1,696.44**

Source: WHO, 1993

Note: Density of DO is 0.845 (kg/L)

The calculation process with the assumption of operating machinery, concentration of pollution is defined in the construction area. Construction time is estimated at 8 hours/day.

Pollution load and concentrations of pollutants in emissions when burning diesel oil is calculated as follows:

$$Pollution\ load\ (g/s) = \frac{Pollution\ factor\ \left(\frac{g}{kgDO}\right) \times Needed\ DO\ \left(\frac{kgDO}{day}\right) \times \frac{1}{3}}{3600}$$

The emission loads in the construction are described in the Table 4-21 as follows:

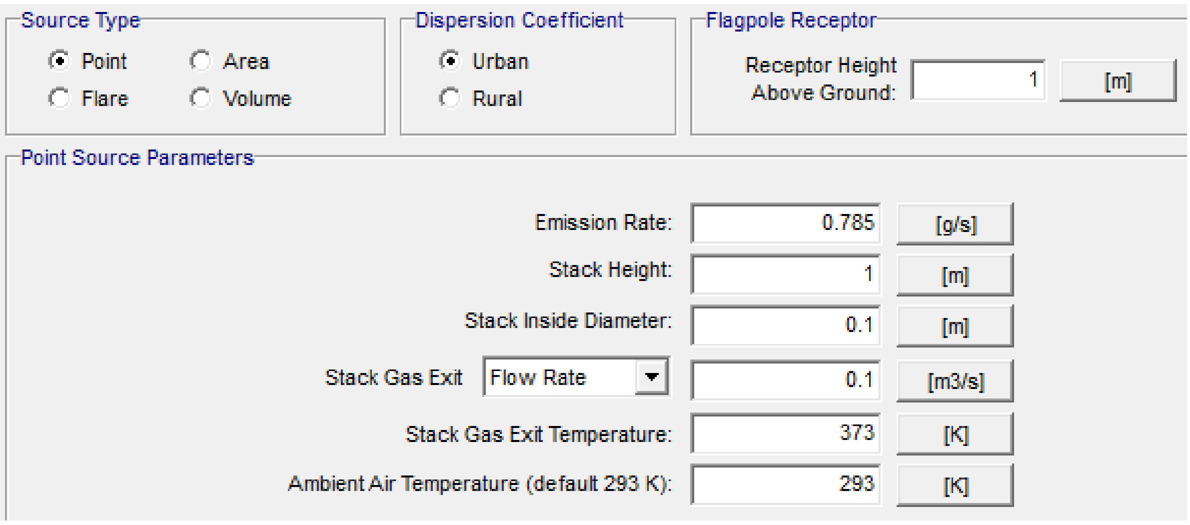
Table 4.21: Emission Loads Coming From The Use Of Oil For Machinery

No.	Pollutants	Pollution factor (g/kg DO)	Load (g/s)
1	Dust	0.28	0.044
2	SOx	20*S	0.785
3	NOx	2.84	0.446
4	CO	0.71	0.111
5	VOC	0.035	0.005

S=0.25%

Source: WHO, 1993

The emission loads generating in the construction area are quiet low. However, to assess the impact of emissions from the operation of machinery to the air environment, we used the Exhaust Emission Models - Screen View, select emission loads and highest emission levels as Sox with the input parameters as follows:



Modeling result is described in Figure 4-2 as follow:

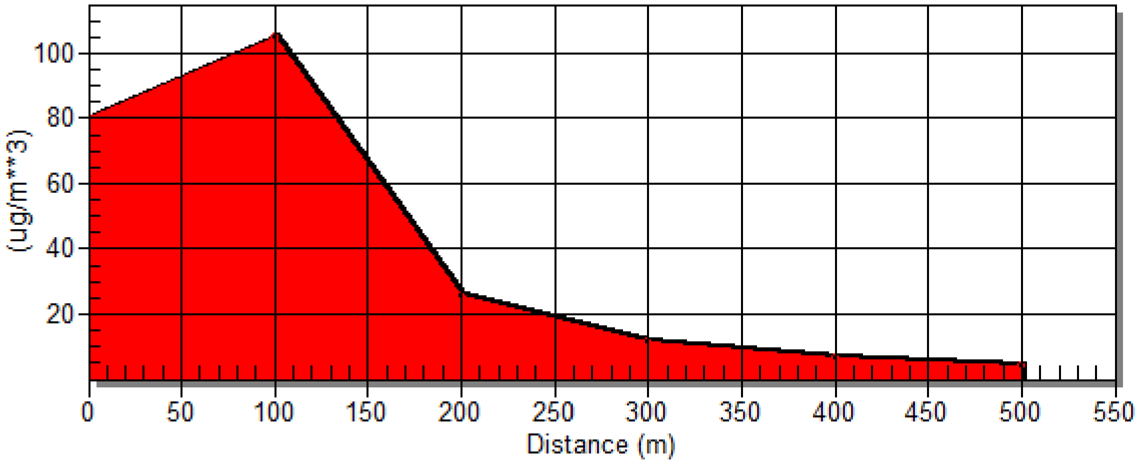


Figure 4.3: NOx Emissions From Machinery At Construction Site

With a distance of 100m around construction areas, concentrations of pollutants lightly increase and be reduced significantly at 200 m far. However, due to the items which will be constructed on the existing road, near residential areas, the impact of the generated emissions directly affects people living in the area of construction.

If the density of dredging sludge is 1,100 kg/m3, the total weight of dredging sludge will be about 354,525 tons. With the estimated weight of sludge and the dredging process lasted 8 months in total (be done in form of "rolling"). The estimated total number of 10-tons vehicles for dredging sludge is 92 vehicles/day, equivalent to 184 times/day (included turn in and out).

04 trucks with 16-ton load, equivalent to 184 times/day, average moving distance of about 20km/truck and the emission factor (Table 4-21), the pollution load generated each day are listed in the Table 4-22 as follows:

Table 4.22: Emission Factor

No.	Causes of pollution	Estimated emission factor
1	Dust generated by the process of excavation, leveling	1 ÷ 100 g/m3
2	Dust generated by the process of loading and unloading of materials (cement, soil, sand, stones ...), machinery and equipment	0.1 ÷ 1g/m3
3	Emission from vehicles, mechanical construction containing dust, CO, hydrocacbon, SO2, NOx,..(3,5÷16-ton truck running by DO with S=0,5%)	Dust: 4,3kg/ton DO; SO2: 0,1kg/ton DO; NOx: 55kg/ton DO; CO: 28kg/ton DO; VOC: 12kg/ton DO
4	Vehicles for sand transporting, soil dropping on the road	0,1 ÷ 1g/m3

Source: WHO, 1993

Table 4.23: Emission Load Of Air Pollutants During The Dredging Phase

No.	Parameter	Pollution Load(kg/day)
1	Dust	0.576
2	SO2	0.686
3	NOx	7.55
4	CO	3.84
5	VOC	1.66

(c) Emission from Long Tuyen and Long Hoa regulatory lake construction

The volume of soil during the digging process (including vegetation, sediment and soil) is estimated at 540,254 tons (the estimated proportion of soil: 1.5 ton/m3), with the estimated digging time about 9 months in total. The estimated total number of 16-tons vehicles for soil transportation is 125 vehicles/day, equivalent to 250 times/day (included turn in and out). Distance to leveling park is estimated at around 30km.

Properties for diesel vehicles are set with an average speed of 10 km/h, 3.5 ÷ 16 tons, the average distance of 1 km, exhaust pollution load for one (01) truck as follows:

Dust : 0.90 g/km

SO2 : 4.29*S g/km;

NOx : 11.80 g/km;

CO : 6.00 g/km;

VOC : 2.60 g/km.

The emissions coming from the vehicles during the digging process are listed in Table 4-24 as follow:

Table 4.24: Emission Loads Of Air Pollutants During The Digging Process

No.	Parameter	Pollution Load (kg/day)
1	Dust	7.56
2	SO2	18.02
3	NOx	99.12
4	CO	50.40
5	VOC	21.84

Note: %S = 0.5%

Following the results of the calculation, the process of soil transporting generates pollutants with the concentrations are pretty high. To minimize the impact on the environment and traffic conditions, this process should be operated at night.

The playground and footpath constructions include the machines and vehicles as follow (Table 4-25):

Table 4.25: Demand for Diesel Oil Following Machinery And Vehicles

No.	Machinery	Amount	Fuel consumption (liter/shift)	Needed DO(liters)	Needed DO /day (kg/day)
1	Portable generators	2	75.62	75.62	63.90
2	Bulldozer	2	93.6	93.60	79.09
3	Land scraper	2	132	132.00	111.54
4	Paving machine	2	57	57.00	48.17
5	Crawler cranes10-ton lifting capacity	1	36	36.00	30.42
6	Car cranes - 16-ton lifting capacity	1	43	43.00	36.34
7	Portable compactors (80kg)	2	4.59	9.18	7.76
8	Wheel cranes	1	33	33.00	27.89
9	9-ton compactors	10	34	340.00	287.30
10	16-ton compactors	10	37.8	378.00	319.41
11	Asphalt sprinklers	2	57	114.00	96.33
12	Spreaders	2	30.2	60.40	51.04
13	Graders	2	38.8	77.60	65.57
14	Compressor	2	75	75	150.00
				Total	1.374,76

Note: Density of DO is 0,845 (kg/L)

Source: WHO, 1993

The calculation process with the assumption of operating machinery, concentration of pollution is defined in the construction area. Construction time is estimated at 8 hours/day. Pollution load and concentrations of pollutants in emissions when burning diesel oil is calculated as follows:

$$\text{Pollution load (g/s)} = \frac{\text{Pollution factor}\left(\frac{\text{g}}{\text{kgDO}}\right) \times \text{Needed DO}\left(\frac{\text{kgDO}}{\text{day}}\right) \times \frac{1}{3}}{3600}$$

The emission loads in the construction are depicted in the Table 4-26 as follows:

Table 4.26: Emission Loads Coming From The Use Of Oil For Machinery

No.	Pollutants	Pollution factor (g/kg DO)	Load (g/s)
1	Dust	0.28	0.036
2	SOx	20*S	0.636
3	NOx	2.84	0.362
4	CO	0.71	0.090
5	VOC	0.035	0.004

S=0.25%

Source: WHO, 1993

The pollutant loads during this process are low. By the Screen View modeling, the change of contaminant concentration comparing the distance is shown in Figure 4-4 as follow:

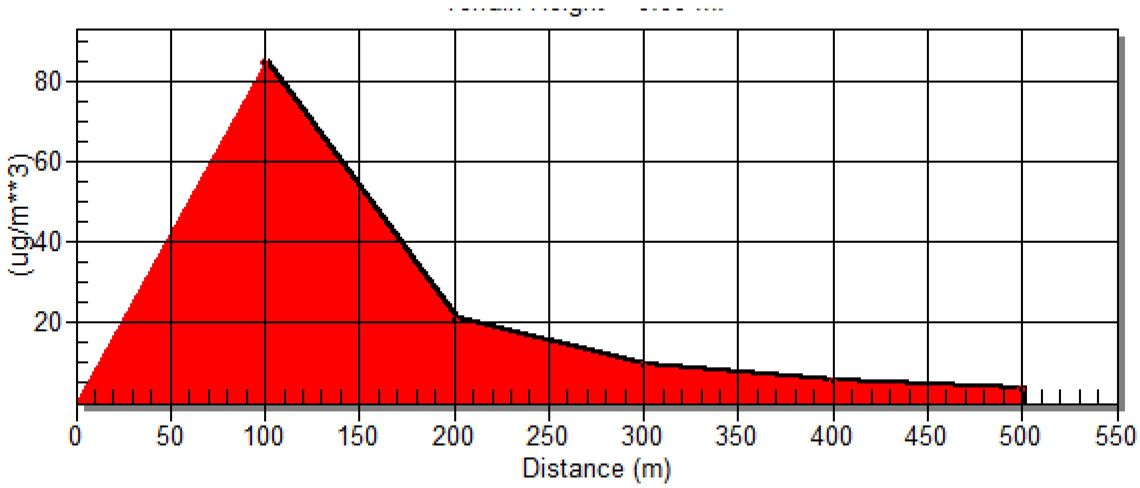


Figure 4.4: Emission of SOx Due To The Construction

Following the results of modeling, contaminant concentrations increased within 100m around the construction area and decreased rapidly in the range of 200m. Due to the location of the construction which is far from residential areas, there is no significant impact to the surrounding residents

Dust and exhaust emissions are a nuisance, may affect human. Thus, schools, residential and quiet areas (pagodas) areas are considered to be dust (and noise) sensitive. The table below present where careful attention needs to be paid to dust, noise and emissions.

Table 4.27: Sensitive Receptor Sites Along Project Corridor During Construction Phase

Sensitive receptor locations	Locations	Description	
I. Physical Culture Resources (Pagoda, Church and Temple)			
Embankment for Can Tho river (section from Ngo Duc Ke road to Cai Son creek)			
Ong Vam Dau Sau Pagoda	Km5+000	It is about 40m from Can Tho river bank, there are residential house along the river with crowded population in the opposite side, traffic density is relatively low.	The results of Ambient Air quality at locations belong Flood control woks show that indicators are within permitted limits of QCVN 05:2013/BTNMT, within one hour
Cai Son cannal			
Giác Thiền pagoda	Km0+230	it is about 10 meters from canal shore, with sparse population density and low traffic density	
II. The public works			
Embankment for Can Tho river (section from Ngo Duc Ke road to Cai Son creek)			
Preventive Medicine Center	Km 0+00	High residential density, with high traffic flow in the central of district area	
Guest house No. 2	Km 0+00	On the river bank,	
Tan An Market	Km0+220	Near river bank	
An Lac Market	Km0+710	Near river bank	
Ninh Kieu Methadone treatment facility	Km0+850	On the river bank, the crowded residential density and high traffic flow.	
The Military Court of Region 9	Km0+860	It is about 80m from the river bank, with residential houses along Can Tho River Bank in the opposite side.There are crowded residential density and high traffic flow in the central district area.	The results of Abient Air quality at locations belong Flood control woks show that indicators are within permitted limits of QCVN 05:2013/BTNMT, within one hour
Nguyen Hien primary school	Km2+780	It is about 20 meters from the riverbank, opposite to the residental houses along the river bank, with the quite high traffic density.	
Inland Waterways Management and Maintenance Joint Stock Company No. 12	Km3+620	Opposite to the pair riverbanks, with the quite high trafic density	
An Binh market	Km5+700	On the river bank	
II. Resident Area			
Embankment for Can Tho river (section from Ngo Duc Ke road to Cai Son creek)			

Resident area	Km0 +000–Km1+420	Crowed resident	
Resident area	Km2+080 – Km4+830	Crowed resident	
Resident area	Km4+970 – Km5+270	Crowed resident	
Resident area	Km5+270 – Km5+870	Crowed resident	
Cai Son cannal			
Resident area	Km0 +000–Km1+080	Crowed resident	
Resident area	Km1+080 – Km1+460	Crowed resident	
Resident area:	Km3+320 – Km3+690	Crowed resident	
Resident area:	Km3+690 – Km3+890	Crowed resident	
O mon river			
Resident area	Km 0 +00 to km0+560	Crowed resident	
Resident area	Km0+560-Km1+710	Crowed resident	

Athough, the results of Ambient Air quality at locations belong Flood control woks show that indicators are within permitted limits of QCVN 05:2013/BTNMT, within one hour. However, PMU should require constractor should follow enviromental protection regulations.

(iii) Odors from dredging process

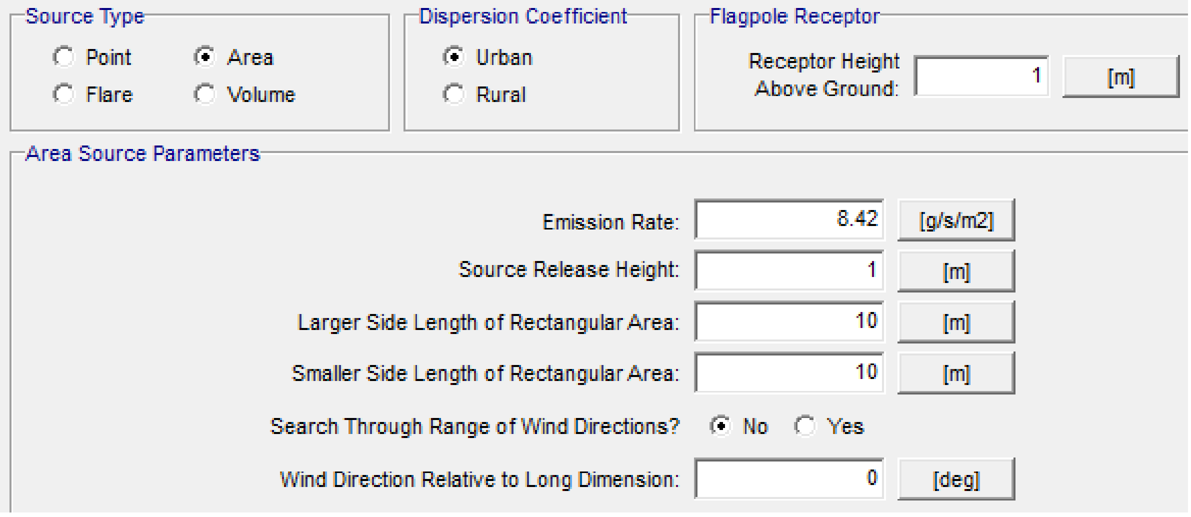
During the dredging process, sludge was destroyed the stable structures, the decomposed organic compounds continue to compose and the other organic compounds are volatile. Odors from dredging sludge affect to the communities because of organic compounds biodegraded in anaerobic conditions and released odors. Odorous gases created by anaerobic decomposition process including H2S, mercaptans, amins, organic acids, VOCs, etc.

According to research by the Environmental Organization of Cambridge, intense odor perception in humans as follows:

- Detecting odors: 1 Ou/m3
- Light odors: 5 Ou/m3
- Frowst odors: 10 Ou/m3

Because of the similarities of natural conditions between the project of dredging items with the dredging project of Ba Chiem - Ba Chua –Lap Dau canals, Nha Be district, Ho Chi Minh City, the dispersal ability smell was set at 8.42 Ou/s.m2.

Due to dredge each part of canal, the Screen View is set with the following parameters:



The impact of odors from the dredging process is shown in the graph below (Figure 4-4)

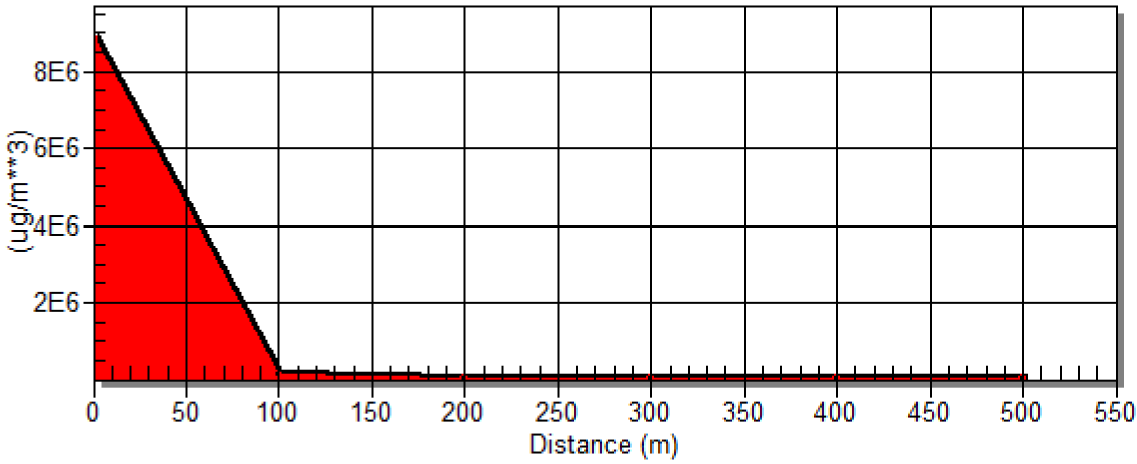


Figure 4.5: Emission of Odors Due To Dredging Process

Odors coming from the dredging activities will impact to the surrounding area. However, dredging activities take place in a short time, and follow the form of "rolling" so the direct impact in a small area is short.

(5) Domestic Solid waste

Solid domestic waste includes paper, cardboard, unused food, metal, wood, etc. A worker produces about 0.35 kg of waste per day . With the number of workers is estimated about 80 people for each item, the amount of solid waste should generate around 28 kg/day/work. This solid waste contains 60-70% organic ingredient and 30-40% other substances, and may contains many bacteria, pathogens. These solid wastes would be collected and processed in order to limit the negative impact on human health and the local environment. The number of workers in the construction phase is not too much, so the amount of solid waste generating from construction area is insignificant. However, investors should also take some measures to collect and ensure environmental hygiene of working areas. Inappropriate waste disposal can cause environmental impacts on hygiene, human health and aesthetic qualities as well as provide habitats for disease vectors. Quality of land, air and water can be adversely affected.

(6) Construction-generated solid waste

Construction-generated solid waste causing by drainage pipeline installation, dredging process. Total of construction –generated solid waste include 322,000 m3 dredged sludge and about 592, 000 m3 excavated soil. Estimated volume for each investment is as below:

Volume of - dredged sludge from 13 ditches: 322,295,5 m^3

Volume of- excavated soil by drainage pipeline installation: 17,944 m^3

Volume of- excavated soil by from construction of road behind Can Tho embankment and Cai Son canal: 225,496 m^3

Volume of excavated soil from the regulation lake: 349,000 m3The amounts of excavated soil for the installation of drainage systems construction are listed in the Table 4-28 as follow:

Table 4.28: Volume of Solid Waste during The Construction Of Drainage Pipeline Installation

No.	Construction Sector	Unit	Length	Width	Depth of ground clearance	Volume of digging soil (m3)	Volume of digging soil (m^3)
1	Drainage pipeline along the Can Tho River (section Ngo Duc Ke – Cai Son Canal)	m	5,600	1	1	5,600	3,360
2	Drainage pipeline along the Muong Khai Canal	m	2,400	1	1	2,400	1,440
3	Drainage pipeline along the Cai Son Canal	m	1,600	1	1	1,600	960
4	Drainage pipeline along the Dau Sau Canal	m	2,400	1	1	2,400	1,440
5	Drainage pipeline along the Ngong Canal	m	2,400	1	1	2,400	1,440
6	Drainage pipeline along the Muong Cui Canal	m	590	1	1	590	354
7	Drainage pipeline along the Nga Bat Canal	m	640	1	1	640	384
8	Drainage pipeline along the Ba Bo Canal	m	3,400	1	1	3,400	2,040
9	Drainage pipeline along the Hang Bang Canal	m	960	1	1	960	576
10	Drainage pipeline along the Sao Canal	m	920	1	1	920	552
11	Drainage pipeline along the Xeo La Canal	m	1,920	1	1	1,920	1,152
12	Drainage pipeline along the Ong Ta Canal	m	2,112	1	1	2,112	1,267
13	Drainage pipeline along the Tu Ho Canal	m	896	1	1	896	538
14	Drainage pipeline along the Ba Le Canal	m	560	1	1	560	336
15	Drainage pipeline along the Xeo Nhum Canal	m	848	1	1	848	509
16	Drainage pipeline along the Ranh Canal	m	100	1	1	100	60
17	Drainage pipeline along the Thuy Loi Canal	m	2,560	1	1	2,560	1,536
	Total	**-**	**-**	**-**	**-**	**29,906**	**17,944**

(b) Dredging process

The dredging process includes:

Table 4.29: Dredging Plans

No.	Canal/ Ditch	Section	Bottom level (m)	Embankment level (m)	Length (m)	Current width (m)	Dredging (m)
1	Dau Sau Ditch	From the Dau Sau Ditch to Dau Sau Bridge	-2.45	2.2	350	35	0
		From the Dau Sau Bridge to the TP3 Ditch	-2.27	2.2	650	45	0
		From the TP3 Ditch to Nguyen Van Cu Bridge	-2.45	2.2	1528	50	0
		From the Nguyen Van Cu Bridge to Rach Suc River	-2.27	2.2	838	21	0
2	Nga Bat Ditch	From the Dau Sau Ditch to DCII.140 point	-0.2	1.7	710	15	-0.5
		From DCII.140 point to 102 Alley, 3/2 Street	-0.67	1.7	260	8	-0.5
3	Muong Cui Ditch	From Nga Bat Ditch (DCII.07 to DCII.06)	-0.33	2.05	126	14	-0.5
		From DCII.06 to DCII.142	-0.5	1.75	340	14	-0.5
		From DCII.142 to DCII.144	-0.65	1.83	314	10	-0.5
4	Xeo Nhum Ditch	From Dau Sau Ditch to Nguyen Van Linh Street	-0.45	1.65	1120	17	-0.5
5	Muong Lo River	Along to Nguyen Van Linh Street	-0.3	2.2	950	3	0
6	Hang Bang Ditch	From Cai Son Ditch to Ba Bo Ditch	-3.28	1.85	1.400	37	0
		From Ba Bo Ditch to residential zone	-0.3	2.06	900	10	-0.5
7	Tu Ho Ditch	From the Ngong Ditch	-0.89	1.65	450	19	0
		Part of the People’s Committees of An Khanh Ward	-0.29	1.52	465	20	-0.5
8	Sao Ditch	The beginning of the ditch	-0.34	1.74	500	19	-0.5
		The end of the ditch (near the Ba Bo Ditch)	-0.26	1.65	615	19	-0.5
9	Ba Bo Ditch	Part near the Hang Bang	-0.35	2.11	440	23	-0.5
		Part from Nguyen Van linh street to Vo Van Kiet street	-0.91	2.11	1.400	23	0
		The end of the ditch	-0.23	1.55	1.600	20	-0.5
10	Ba Le Ditch	From the Can Tho River to the Television Broadcast’s lake	-0.4	1.65	700	16	-0.5
11	Xeo La 1 Ditch	From the 388 Alley to the end of canal	-0.4	1.55	500	15	-0.5
		From the Mo Mo Alley to the end of the canal	-0.11	1.34	700	14	-0.5
12	Ngong Ditch	Near the Ba Bo Ditch	-2.42	1.65	300	32	0
		The middle part	-2.89	1.85	400	32	0
		Near the Ngong II Ditch	-3.24	1.69	800	41	0
13	Ong Ta Ditch	From the Bun Lake to Nguyen Van Cu Bridge	-1.19	1.35	800	27	0

No.	Canal/ Ditch	Section	Bottom level (m)	Embankment level (m)	Length (m)	Current width (m)	Dredging (m)
		From the end of Bun Sang Lake to the Department of Environment Faculty of Can Tho University	-0.2	1.75	520	20	-0.5

The total volume of dredged slugde is calculated using the formula below:

V (m3) = Current width (m) * Length (m) * Dredging level (m)

The volumes of dredged sludge of each item are listed in the Table 4-30.

Table 4.30: Volume Of Dredged Sludge

No.	Canal/Ditch	Section	Volume of sludge (m3)
1	Dau Sau Ditch	From the Dau Sau Ditch to Rach Suc River	230,473
2	Nga Bat Ditch	From the Dau Sau Ditch to 102 Alley, 3/2 Street	11,565
3	Muong Cui Ditch	From Nga Bat Ditch (DCII.07 to DCII.144)	12,836.25
4	Xeo Nhung Ditch	From Dau Sau Ditch to Nguyen Van Linh Street	12,836.25
5	Tu Ho Ditch	From the Ngong Ditch. Part of the People's Committees of An Khanh Ward	3,825
6	Ba Bo Ditch	Part near the Hang Bang	21,191.25
		Part from Nguyen Van linh street to Vo Van Kiet street	
		The end of the ditch	
7	Ba Le Ditch	From the Can Tho River to the Television Broadcast's lake.	3,825
8	Xeo La 1 Ditch	From the 388 Alley to the end of canal	19,305
9	Ong Ta Ditch	From the Bun Lake to Nguyen Van Cu Bridge	6,438.75
		From the end of Bun Sang Lake to the Department of Environment Faculty of Can Tho University	
Total			**322,295.5**

Currently, the entire dredging sludge from the river/canals in Can Tho City will be transported to sludge treatment zone in the wastewater treatment station in Cai Rang District. Sludge should be put on deck, and will be buried when reaching to 75-80% moisture.

The estimated amout of excavated soil in the project (lake construction, road behind the embankment, pipeline construction) is approximately 592 000 m^3. These are non-contaminated soil and will be used for levelling at needed places or to be levelling at Cai Sau disposal site. The domestic waste during construction period (about 80kg/d) will be disposed at the O Mon landfill. The dredged sewage sludge from canal dredging (about 322,000 m3) is organic polluted and will be disposed at Cai Sau sewage sludge disposal site.

(7) Waste water from work camps and Drainage from equipment and truck maintenance

Demand for water use of each worker's prescribed in QCXDVN 01:2008/BXD is about 45 liters/person/day including water for washing, cooking and personal hygiene. The amount of wastewater is calculated by 100% of water used daily. Thus, the amount of domestic wastewater generated at about 3.6 m^3/day/work for 80 workers.

Ingredients of wastewater include suspended solids, oil, grease, high concentrations of organic matter, residue, dissolved organic matter (through the BOD5, COD indicators), nutrients (Nitrogen, Phosphor) and microorganisms. According to the World Health Organization (WHO), the pollutant emission for developing countries in Table 4-27, the estimated load and average concentration of pollutants in the domestic wastewater before treatment through septic tanks are listed as follows:

Table 4.31: Loads and Pollutants Concentration Of Domestic Wastewater (untreated)

No.	Pollutants	Pollution factor(g/person.day)	Load (kg/day)	Pollution concentration (mg/l)	
				Untreated	QCVN 14:2008 Column B
1	BOD5	45 – 54	3.6 – 4.32	4000 - 4800	50
2	COD	72 – 102	5.76 – 9.60	6400 – 10664	-
3	TSS	70 – 145	5.60 – 11.4	6220 – 12888	100
4	Grease	10 – 30	0.80 – 2.40	888 - 2664	20
5	Total Nitrogen	6 – 12	0.48 – 0.96	532 - 1064	50
6	Ammonia (N-NH4)	2.4 – 4.8	0.192 – 0.384	212 - 428	10
7	Phosphor	0.8 – 4.0	0.064 – 0.32	71.2–355.6	10
8	Total Coliforms	106 - 109	80x103 – 80x106	88x106 – 88x109	5000 (MNP/100ml)

Source: WHO, 1993

In the table above, the pollution load, number of workers and wastewater flow, we calculate the pollutants concentration in wastewater by the following formula:

$$C = \frac{C_0.}{Q}$$

In which:

- C: Pollutant concentration, (mg/L)
- C0: Pollutant load, (g/day)
- Q: Wastewater flow, (m3/day)

Compare the pollutants concentration in untreated domestic wastewater with the QCVN 14:2008, Column B, most of the parameters are over the standards. To minimize the impact, the investor should requires the contractor to hire houses which are near to the construction area or to build toilets inside the construction area to serve the needs of the labor activities.

Therefore, the amount of domestic wastewater is collected and be treated by the local treatment system, hence, the impact is negligible.

Drainage from equipment and truck maintenance in open areas contains oil, grease, suspended solids (SS) and other substances. To prevent drainage from reaching water bodies, equipment and truck maintenance areas will be covered.

This section from Ngo Duc Ke and Cai Son cannal, water sources of Can Tho River is contaminated by domestic wastewater from resident, concentration of NH4, NO2 is higher than permitted level in QCVN 08:2008 (at level B). Therefore, management of project activities which can pollute the water source is very necessary and must be reasonable, feasible in order to minimize diminishing quality of water source at upstream of river/streams because it can affect water source at downstream.

4.3.3. Assessment of Environmental Impacts During Operation Phase

This is an urban environmental improvement project, hence, the environmental and social impacts during the operational phase are largely positive.

(1) Flooding

The project have proposed flood control works to solve the problems in urban areas, in order to control the small areas where the concentration of important works of the city from the perspective of urban development and risk management of flooding. The project has selected option with protected area 2675 ha. However, according to the hydrological analysis, the level of water in Can Tho river and surrounding area utside the protected area will be enhances by only 3 mm compared to the existing situation. These are long-term and very small impact.

If the investments are not well maintained, there is a potential risk of negative impacts, such as flooding caused by failure to maintain the drainage and canal system (including ship locks and sluice gates).

Failure to maintain trees and/or vegetation on the soft embankments could result in soil erosion leading to collapse of the embankments, leading to increased flood risk.

Poor waste management behavior on the part of consumers and waste collectors could also result in blockage of the sewage and canal systems, again leading to flood risk, potential health impacts caused by increased pollution loads, and a decrease in aesthetic quality.

(2) Odor

Inadequate operation and maintenance of drainage system for roads in Ninh Kieu could cause odor in local area. However, the level of impact will not be significant and easily managed by the proper operation and maintenance of the Can Tho City

Ineffective operation of sewerage and wastewater collection facilities, especially for interceptors and pumping, if can create excessive odor, flooding in the area, and potentially serious health impacts. Blocking of garbage, soil, and other solid wastes could exacerbate the situation.

For the regulating lake if not managed properly water stagnation may also occur during the dry season due to lack of circulation while flooding can occur during the rainy season. Adequate control of land use around the lake will also be necessary.

(3) Disruption to the activity of inland waterway

Inadequate management and operation of tide sluice gate cause disruption to the activity of inland waterway.

Disruption to the activity of inland waterway: When boats want to pass through dock, they should wait at the waiting area at the downstream, at this time, the lock gate is closed, turn on the valve on the downstream gate to raise water level the water level in the lock chamber at the downstream lock gate to raise water level in the lock chamber equal to the downstream level, open the lock gate for boats coming into the lock then close the gate at downstream, and open the valve at the upstream lock gate to lower the water level in the lock chamber to the upstream level and open the gate for sailing out of the lock.

(4) Risk on embankment cracking and subsidence

For embanking Can Tho riverside, in construction process as well as operating this embankment system, this issues can be happened the incidents of cracking/breaking embankment as following:

- Heavy rain, big flood and weak foundation reinforcement will cause erosion of embankment, more seriously the incident of broke embankment
- Gathering overload of construction materials is the one of main reason causing embankment erosion.
- Cracking, breaking embankment in operation process are caused by natural factors or use exceeding the design parameters.

The incidents of broke embankment will directly affect the quality of works, reduce the capacities of flood prevention and disaster mitigation of embankment system. Incidents of embankment erosion also affect work quality and environmental landscape in area.

The incidents of broke embankment will directly affect the life of people living near the embankment system, affect the quality of houses, buildings and structures that located on protection range of embankment system

(5) Inadequate maintenance and garbage throwing causing blockage in the canals

Poor waste management behavior on the part of consumers and waste collectors could also result in blockage of the sewage and canal systems, again leading to flood risk, potential health impacts caused by increased pollution loads, and a decrease in aesthetic quality.

4.4. IMPACT ASSESSMENT FOR ENVIROMENTAL SANITATION WORKS

Environmental sanitation improvement works are proposed as follows:

- Rehabilitation and synchronous supplement of the drainage system for routs in the Ninh Kieu district (11 km length) and in the remaining area (10 km). The roads will be upgraged and separate waste water and storm water culverts will be installed. The wastewater culvert will be connect to the interceptor and KfW wastewater treatment plant.
- Equipment serving the works and equipment supporting the management and operation, regulating and monitoring of the drainage system, dredging of culverts, ditches, pumping stations, lakes and control valves.

4.4.1. Assessment of Environmental Impacts During Pre-Construction Phase

4.4.1.1. Identifying Source Of Impacts

Table 4.32: Impacts during the Pre-Construction Phase

No.	Impact source	Impact/Waste	Impact Scale
(i) Rehabilitation and synchronous supplement of the drainage system connecting the collection system in Ninh Kieu center area (length of about 11 km) and about 10km in the remaining areas			
A - Impact sources related to waste			
1	The preparation process prior construction.	- Dust, emissions from material transportation.	- Low, short term, can be controlled
2	Worker activities	- Domestic waste water - Domestic solid waste	- Low, short term, can be controlled - Low, short term, can be controlled
3	Maintenance of vehicle and machinery	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Low, short term, can be controlled
2	Concentrated workers at the project site	- Affect on local economic – social condition. - The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Low, short term, can be controlled - Low, short term, can be controlled
(i) Equipment serving the works and equipment supporting the management and operation, regulating and monitoring of the drainage system, dredging of culverts, ditches, pumping stations, lakes and control valves			
A - Impact sources related to waste			
There is no impact			
B - Impact sources not-related to waste			
There is no impact			

4.4.1.2. Impact Assessment

❖ ***<u>Impact sources related to waste</u>***

(1) Air pollution

Air pollution generated from transportation and clearance activities.

Emissions generated from transportation activities: The dust and emission gas during the pre-construction phase is mainly generated from the machinery and materials transportation by trucks and construction vehicles in the construction area. The impact of this process takes place in a short time, thus, it is not significant.

Dust generated from clearance activities: Properties for diesel vehicles are set with an average speed of 10 km/h, 3.5 ÷ 16 tons, the average distance of 1 km, exhaust pollution load for one (01) truck as follows:

- Dust : 0.90 g/km
- SO_2 : 4.29*S g/km;
- NO_x : 11.80 g/km;

- CO : 6.00 g/km;
- VOC : 2.60 g/km.

The construction vehicles in use should have the capacity from 3.5 to 16 tons with 8-hour continuous operation. Currently, there is no standardized data of emission sources caused by vehicles. Therefore, the method of rapid assessment of the World Health Organization (WHO) can be used to assess the impacts (Table 4-2, section 4.3.1.2)

During this phase, load of pollutants coming from the transport do not focus in one point or same time. The pre-construction time of this process is very short and this work is done in the form of "rolling" - transit immediately to the next area after finishing the each construction work. This plan should be able to create local air pollution in a particular area which should happen in a short period and be insignificant. Besides, the investor will also take role to coordinate the transportation density and minimize the negative impacts on local people.

(2) Domestic waste water

The amount of wastewater generated by the activities of workers in the area of construction is negligible and unregulated. Total number of worker who working for each item is estimated about 30 workers. Demand for water use of each worker's prescribed in QCXDVN 01:2008/BXD is about 45 liters/person/day including water for washing, cooking and personal hygiene. The amount of wastewater is calculated by 100% of water used daily. Thus, the amount of domestic wastewater generated about 1.35 m^3/day/work.

Ingredients of domestic wastewater include suspended solids, oil, grease, high concentrations of organic matter, residue, dissolved organic matter (through the BOD_5, COD indicators), nutrients (Nitrogen, Phosphor) and microorganisms. According to the pollutants emission of the World Health Organization (WHO) for developing countries in Table 4-7, the estimated load and average concentration of pollutants in the domestic wastewater before treatment through septic tanks are listed as follows:

Table 4.33: Loads and Pollutants Concentration Of Domestic Wastewater (untreated)

No.	Pollutants	Pollution factor(*) (g/person.day)	Load (kg/day)	Pollutant factor (mg/l)	
				Untreated	QCVN 14:2008/Column B
1	BOD_5	45 – 54	1.35 – 1.62	1500 - 1800	50
2	COD	72 – 102	2.16 – 3.60	2400 – 3999	-
3	TSS	70 – 145	2.10 – 4.35	2332 – 4833	100
4	Grease	10 – 30	0.30 – 0.90	333 - 999	20
5	Total Nitrogen	6 – 12	0.18 – 0.36	199 - 399	50
6	Ammonia ($N\text{-}NH_4$)	2.4 – 4.8	0.072 – 0.144	79 - 160	10
7	Phosphor	0.8 – 4.0	0.024 – 0.12	26.7–133.3	10
8	Total Coliforms	10^6 - 10^9	$30x10^3$ – $30x10^6$	$33x10^6$ – $33x10^9$	5000 (MNP/100ml)

Source: WHO, 1993

In the table above, the pollution load, number of workers and wastewater flow, the pollutants concentration in domestic wastewater calculated by the following formula:

$$C = \frac{C_0.}{Q}$$

In which:

- C: Pollutant concentration, (mg/L)
- C_0: Pollutant load, (g/day)
- Q: Wastewater flow, (m^3/day)

Compare the pollutants concentration in untreated domestic wastewater with the QCVN 14:2008, Column B, most of the parameters are over the standards. To minimize the impact, the investor should requires the contractor to hire houses which are near to the construction area or to build toilets inside the construction area to serve the needs of the labor activities. Therefore, the amount of domestic wastewater is collected and be treated by the local treatment system, hence, the impact is negligible.

(3) Domestic Solid waste

Solid waste coming from workers in pre-construction phase discharged about 0.35kg/person/day. With the number of workers is estimated about 30 people for each item, the amount of solid waste should generate around 10.5 kg/day. This solid waste contains 60-70% organic ingredient and 30-40% other substances, and may contains many bacteria, pathogens. These solid wastes would be collected and processed in order to limit the negative impact on human health and the local environment.

The number of workers in the pre-construction phase is not too much, so the amount of solid waste generating from construction area is insignificant. However, investors should also take some measures to collect and ensure environmental hygiene of working areas.

(4) Waste oil

After operating, the machinery and construction vehicles using on site must be maintained to avoid damage and ensure the stable operation. This process will generate an amount of Waste oil from machinery and vehicles. The amount of oil for once change is estimated about 16 liters/truck. The changing cycle is about 3-6 months, depending on the working time of machinery.

The amount of hazardous waste generated from cleaning rags, oil machinery, oil tanks, etc. in this phase is minimal. The estimated amount of Waste oil for once change is 160 liters. Hazardous wastes are collected and processed by specialized units according the provisions of the Hazardous Waste Management.

❖ ***Impact sources not related to waste***

Besides the impact of waste generated in the process of pre-construction, the project area also has other effects on the local environment and residents. These effects are described sequentially as follows:

(5) Noise and vibration pollution

Noise and vibration pollution during this phase are generated from vehicles and machinery. These activities will cause noise and vibration impacts on the surrounding environment, however, this effect is not significant due because of its short term affect.

Pre-construction before construction phase do not use machines, therefore, noise and vibration pollutions are not significant.

(6) Traffic congestion

The pre-construction phase will affect to traffic because of its location – on the main roads of Can Tho City. The barrier of construction areas will cause traffic jams during rush hours as well as affecting the daily activities of the people in the construction area.

(7) Economic – Social conditions

Vehicles, machinery during thepre-construction phase, workers gathering can affect the surrounding area. However, the construction phase of the project can create jobs and income for approximately 40 direct labors in each item. In addition, the drainage pipelines construction will affect the business of the household locating in the road. The concentration of labor in one area will indirectly cause the disorder of social problem in local area.

4.4.2. Assessment of Environmental Impacts during Construction Phase

4.4.2.1. Impact Sources

The impact sources during construction phase of ***Environmental Sanitation Works*** are listed in Table 4-34 as follow:

Table 4.34: Impacts during Construction Phase

No.	Impact source	Impact	Impact Scale
Rehabilitation and synchronous supplement of the drainage system connecting the collection system in Ninh Kieu center area (length of about 11 km) and about 10km in the remaining areas			
A - Impact sources related to waste			
1	Construction.	- Dust, emissions from soil transporting.	- Medium, temporary , can be controlled
2	Worker activities	- Domestic waste water - Domestic solid waste	- Low, temporary, can be controlled - Low, temporary, can be controlled
3	Maintenance	- Waste oil	- Low, temporoay, can be controlled
B - Impact sources not-related to waste			
1	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Low, temporary, can be controlled
2	Concentrated workers at the project site	- Affect on local economic – social condition. - The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Low, temporary, can be controlled - Low, temporary, can be controlled
(i) Equipment serving the works and equipment supporting the management and operation, regulating and monitoring of the drainage system, dredging of culverts, ditches, pumping stations, lakes and control valves			
A - Impact sources related to waste			
There is no impact			
B - Impact sources not-related to waste			
There is no impact			

4.4.2.2. Impact Assessment

4.4.3. Assessment of Environmental Impacts During Operation Phase

For construction of sludge treatment area, the operation phase will generate the following these impacts:

- Emissions from the decomposition of sludge in parking areas.

- Odors arising
- Business and living condition near the sludge treatment area

(1) Emissions from the decomposition of sludge in parking areas

With untreated sludge:

Dredging sludge contains the odors because of organic sediment or odor of H_2S releasing by the process of anaerobic decomposition in the water. When the sludge is moved to parking area, the biochemical reactions continue to occur with the product is water leakage and emission pollution. Part of the organic matter in the sludge occurring biodegradation process and creates CH_4, NH_3, CO_2, etc. Reactions of anaerobic decomposition of sludge in the parking area occur by the following equation:

$$Organics + H_2O \Rightarrow Decomposed\ Organic + CH_4 + NH_3 + CO_2 + other\ emission$$

Emissions generating from sludge parking area include: NH_3, CO_2, CO, H_2S, H_2, CH_4, N_2, O_2, etc. Sludge coming from canals contains mostly sand and soil with 70-90% of dry weight. Thus, the volume of dredged mud 53,896 m^3sludge with the humidity is 30%, organic content of the dredging sludge which able to biodegrade is estimated about 2,263 kg organic (from 2-6%).

In addition, according to the results of research on the process of anaerobic decomposition of sludge, the concentration of sludge natural decomposition element as follows:

Table 4.40: C, H, O, N, S Ingredients In Sludge

Elements	C	H	N	S	O
Ingredient percentage (%)	33.14	4.94	3.41	1.05	24.52
Mass of elements capable of decomposition	1,743.5	259.89	179.40	55.24	21,499.99
Mol	145.17	257.83	12.81	1.72	1,343.75
Mol ratio	11	20	1	0	105

Source: Leino Reinola, 2007

Therefore, general formula of organic substances in dredged sludge is: $C_{84}H_{150}O_{46}N_7$

Biodegradation equation:

$$C_{84}H_{150}O_{46}N_7 + 3.75\ H_2O \Rightarrow 6.125\ CH_4 + 4.875\ CO_2 + NH_3$$

The emission loads are list in Table 4-41 as follow:

Table 4.41: Emission Loads From The Sludge Decomposition Process

No.	Emission	Load arising from the decomposition (kg)	Emission load (g/s)
1	CH_4	901.66	0.058
2	CO_2	1973.53	0.127
3	NH_3	156.41	0.010

If the sludge drying area is 25 x 50 (m), wind speedin this area of 3m/s, concentrations of the emissions aredescribed as follows:

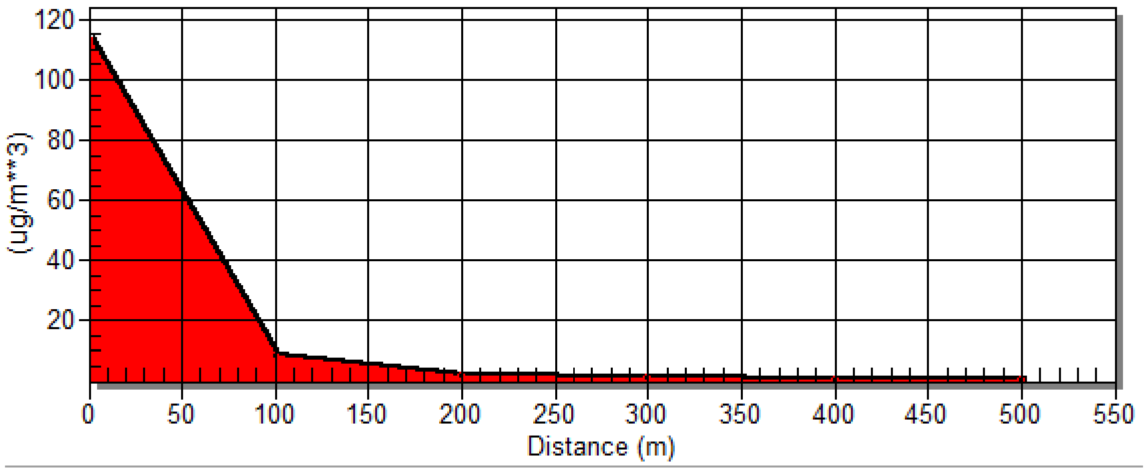


Figure 4.7: CH4 Emissions In Sludge Dryingarea

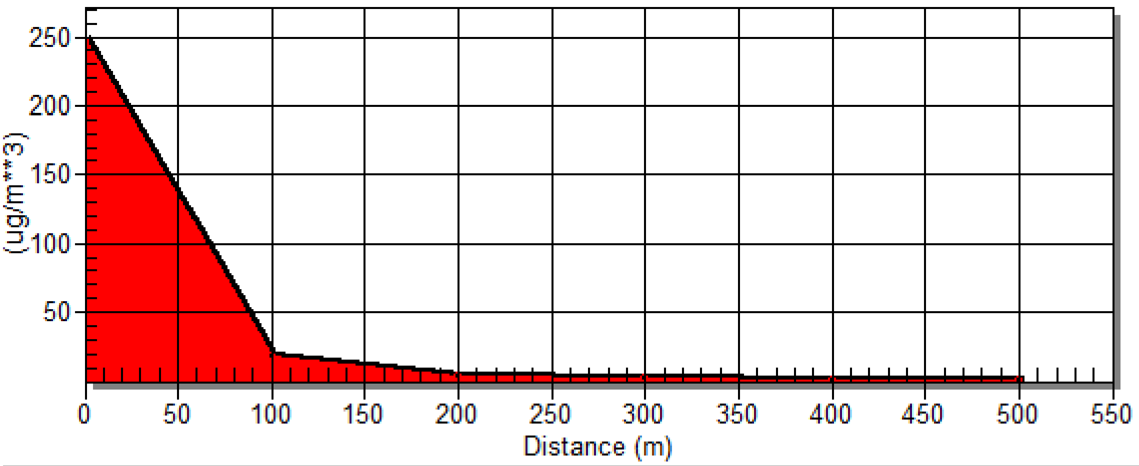


Figure 4.8: CO2 Emissions In Sludge Drying Area

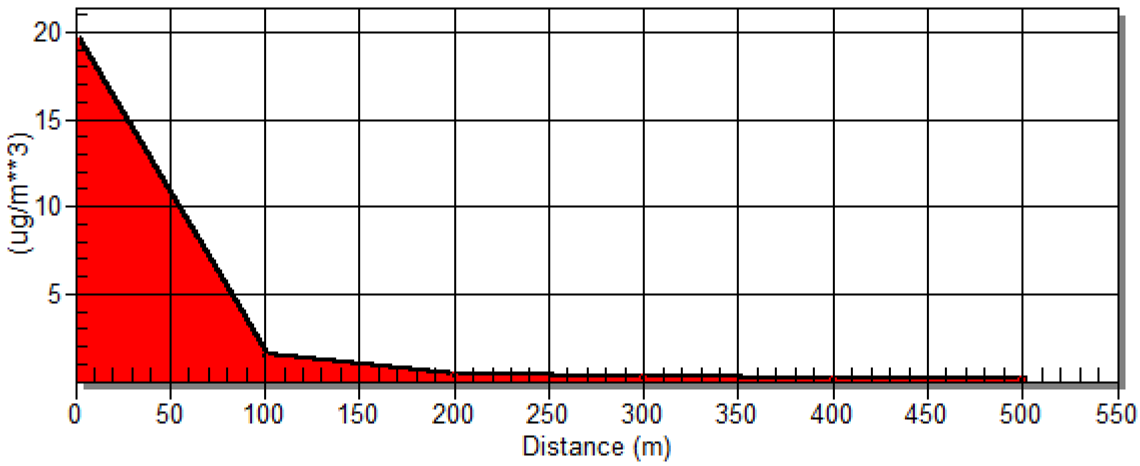


Figure 4.9: NH3 Emissions In Sludge Drying Area

With large sludge drying area, emissions in the local region is not high. Therefore, the effect of emissions to the surrounding area is not significant.

<u>With the amount of sludge is treated by the process</u>

Dredged sludge coming from the drainage system, canals will be transported to the sludge treatment area. Sludge is put into pools to separate the water containing in sludge and reduce the volume of sludge.The moisture of sludge after this process will reach 95-97% and be taken into methane tanks. Here, sludge anaerobic fermentation will occurs to break down organic material in the sludge by microorganisms. In the process of anaerobic digestion of microorganisms, methane can be used as fuel for power generation of treatment plant. Sludge after this process have removed 60-80% soluble organics and almost the helminth eggs, pathogenic bacteria and be put into the conveyor belt for sludge drying. Sludge after conveyor should be used to produce fertilizer.

Therefore, with the new sludge treatment technology instead of using sludge drying area as usual, the impact on the environment is minimized and do not affect the living environment of people around the treatment plant.

4.4.3.1. Impact Sources Not Related To Waste

Sludge receiving process generates odors, directly affect the living conditions to those households near the treatment plant. Besides, the number of trucks serving the carrier also affects traffic conditions in the local area and the business of households adjacent to the sludge treatment plant.

4.5. IMPACT ASSESSMENT FOR URBAN CORRIDOR DEVELOPMENT

This component shall support the city in carrying out the priority investment in transport as defined in the approved socio-economic development plan (2013), master plan for transportation of the city (2013). The investment in the transport infrastructure works shall connect the longitudinal artery of the city, promoting connections between new residential areas and the existing ones in the city center, strengthening the connection between inter-regional urban areas and developing public transport measures for Can Tho city.

- Construction of Quang Trung Bridge (2nd unit) from Ninh Kieu to Cai Rang with a total length of about 869m, the bridge with 481m long, 11m wide.
- Tran Hoang Na road and bridge: Total length of route of about 3,794km, of which:

+ Road: Improving and upgrading of road in length of about 1.6 km, with 20 m and 28 m lines; newly building of 1.6km length, 20m and 28m lines;

+ Bridge: Length of about 549 m, width of about 21 m crossing Can Tho River.

In addition, further investment in the parallel road in National Highway 1A (section from Tran Hoang Na to the intersection IC3) in length of about 1.6 km and 12 m line.

- Construction of Road connecting National Highway 1A (NH1A) and provincial road DT918, with a total of 5.3 km, building line of 40m.
- Construction of a resettlement area in Ninh Kieu district covering an area of about 40 hectares, ensuring appropriate planning of technical and social infrastructure and facilitate living conditions for local people.

4.5.1. Assessment of Environmental Impact During Pre-Constructoin Phase

4.5.1.1. Identifying Source Of Impacts

The activities in pre-construction phase includes: land acquisition; reclamation, clearance, preparation process of prior-embanking; works site; worker camp.. The table below present source of impacts, impacts and scale of impact will occur in pre-contruction period basing on its activities.

Table 4.42: Impacts during Pre-Construction Phase

No.	Source of Impacts	Impacts	Scale of Impacts
(i) Construction of Quang Trung bridge (sub-component 2) from Ninh Kieu to Cai Rang with a total length of about 869 m, the bridge is 481m long, 11 m wide.			
A - Impact sources related to waste			
1	The preparation process	- Dust, emissions from material transportation.	- Low, short term, can be controlled
2	Worker activities	- Domestic waste water - Domestic solid waste	- Low, temporary, can be controlled - Low, temporary, can be controlled
3	Maintenance of vehicle and machinery	- Waste oil	- Low, long term, can be controlled
B - Impact sources not-related to waste			
1	Land acquisition	Impacts on economic – social condition of APs, public infrastructure and	High, permanent
1	Clearance	- Disruption of daily life, negative effects on local businesses - Conflicts between people in the construction area and investors.	- low, temporaty, can be controlled - low, temporaty, can be controlled
3	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Low, temporary, can be controlled
4	Concentrated workers at the project site	- Affect on local economic – social condition. - The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Low, temporary, can be controlled - Low, long term, can be controlled
5	Traffic	- Traffic congesion during the pre-construction phase	- Medium, short term, can be controlled
6	Risk	- UXO	- Medium, long term, can be controlled
(i) Tran Hoang Na road and bridge: Total length of route of about 3,794km			
A - Impact sources related to waste			
1	Land acquisition	Impacts on economic – social condition of APs, public infrastructure and PCR (relocated grave)	High, permanent
2	The preparation process prior construction.	- Dust, emissions from material transportation.	- Low, short term, can be controlled
3	Worker activities	- Domestic waste water - Domestic solid waste	- Low, short term, can be controlled - Low, short term, can be controlled
4	Maintenance of vehice and machinery	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Clearance	- Disruption of daily life, negative effects on local businesses	- Medium,short term, can be controlled

No.	Source of Impacts	Impacts	Scale of Impacts
(i) Construction of Quang Trung bridge (sub-component 2) from Ninh Kieu to Cai Rang with a total length of about 869 m, the bridge is 481m long, 11 m wide.			
		- Conflicts between people in the construction area and investors.	- Low, short term, can be controlled
2	Reclamation	- Noise, vibration from machinery. - Impact on vegetation area, impact on regional ecosystems.	- Low, short term, can be controlled - Low, short term, can be controlled
3	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Low, short term, can be controlled
4	Concentrated workers at the project site	- Affect on local economic – social condition. - The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Low,short term, can be controlled - Low, short term, can be controlled
5	Traffic	- Traffic congesion during the pre-construction phase	- Medium, short term, can be controlled
(ii) Construction of Road connecting National Highway 1A (NH1A) and provincial road DT918, with a total of 5.3 km, building line of 40 m			
A - Impact sources related to waste			
1	The preparation process priorconstruction.	- Dust, emissions from material transportation.	- Low, short term, can be controlled
2	Worker activities	- Domestic waste water - Domestic solid waste	- Low, short term, can be controlled - Low, short term, can be controlled
3	Maintenance of vehice and machinery	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Land acquisition	Impacts on economic – social condition of APs, public infrastructure and PCR (relocated grave)	High, permanent
2	Clearance	- Disruption of daily life, negative effects on local businesses - Conflicts between people in the construction area and investors.	- Medium, short term, can be controlled - Low, short term, can be controlled
3	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Low, short term, can be controlled
4	Concentrated workers at the project site	- Affect on local economic – social condition. - The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Low, short term, can be controlled - Low, short term, can be controlled
5	Traffic	- Traffic congestion during the pre-construction phase	- Medium, short term, can be controlled
(iii) Construction of a resettlement area in Ninh Kieu district covering an area of about 40 hectares, ensuring appropriate planning of technical and social infrastructure and facilitate living conditions for local people.			
A - Impact sources related to waste			

No.	Source of Impacts	Impacts	Scale of Impacts
(i) Construction of Quang Trung bridge (sub-component 2) from Ninh Kieu to Cai Rang with a total length of about 869 m, the bridge is 481m long, 11 m wide.			
1	The preparation process prior construction.	- Dust, emissions from material transportation.	- Low, short term, can be controlled
2	Worker activities	- Domestic waste water - Domestic solid waste	- Low, short term, can be controlled - Low, short term, can be controlled
3	Maintenance of vehice and machinery	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Land acquisition	Impacts on economic – social condition of APs, public infrastructure and PCR (relocated grave)	High, permanent
2	Clearance	- Disruption of daily life, negative effects on local businesses - Conflicts between people in the construction area and investors.	- Medium, short term, can be controlled - Low, short term, can be controlled
3	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Medium, short term, can be controlled
4	Concentrated workers at the project site	- Effect on local economic – social condition. - The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Low, short term, can be controlled - Low, short term, can be controlled

4.5.1.2. Impact Assessment

❖ ***<u>Impact sources not-related to waste</u>***

(1) Land Acquisition:

Urban corridor development require an area of 750.089 m^2, in which there are 550.979 m^2 of land for agriculture; 146.686 m^2 of land for residence; 6.014 m^2 of non-agricultural land; 3.184 m^2 of cemetery land. There are totally 1.681 affected households in which 543 household of relocation resettlement. There are 479 households severely affected by the loss of productive land; 237 households affected their business. There are 244 damaged households: in which (199) female-headed households, (5) ethnic minority households; (2) disable-headed households; (13) poverty households; (5) elderly households; (20) social-policy households.

Land acquisition of this project is considered to have a high 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.

(2) Encroaching Infrastructruce

There will be relocated 125 electric poles; 4 electrical sub-stations; 6.250m of power lines, 8 bus stations.

Table 4.43: The Impacts Of Encroaching Infrastructure

Public properties	Quantity
Electric poles	125
Electrical sub-stations	4
Power line	6,250
Road	2,880
Telephone line	72
Bus stops	3

The impact on technical infrastructure caused by project, is considered as having a medium negative impact. Therefore, the status of 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) Impact on spirituality/PCR

This component will be relocated 84 tombs, including 75 built tombs and 9 earth covered tombs of 42 households who are living in An Binh, Hung Loi (Ninh Kieu), An Thoi and Long Hoai (Binh Thuy) and Hung Thanh (Cai Rang) Wards.

Works	Ward	Number of Tomb	Number of Household
Infrastructural for Resettlement Area	An Binh	37 (2 earth-covered tombs and 35 built tombs)	27
Bridge in Tran Hoang Na road	Hung Loi	17 (built tombs)	1
Connection Road CMT8 - Provincial Road 981 -	An Thoi	1 (earth-covered tomb)	1
Connection Road CMT8 - Provincial Road 981 -	Long Hoa	20 (6 earth-covered tombs and 14 built tombs)	11
Bridge in Tran Hoang Na Road - Concurrently -	Hung Thanh	9 (built tombs)	2
Total		**84**	**42**

The relocation of all tombs is very complex and costly. The cost for the relocation is not merely cost for demolition, digging, transportation and building new graves, but also the cost of worship, waiting for burial, in accordance with the spiritual life of each locality. Therefore, the resettlement committee needs to investigate the aspirations of the people and make the final appropriate decision of relocation tomb and consistent with regional customs.

(4) UXO (Unexploded ordnance)

Because Can Tho 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 sub-components, UXO needs to be carefully considered and removed before construction activities can commence. 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.

❖ ***Impact sources related to waste***

(5) Dust, gaseous emissions - Air pollution

Air pollution from pre-construction activities/sites has many sources as clearance of surface area in work bridge and road construction; emissions from machinery and vehicles.

Dust from clearance:

According to the FS Team, total of solid waste from cleanance process are listed in the Table 4-41: 67,850 (m^3).

Dust pollution factor (E) diffused from the reclamation phase is based on the following formula:

$$E = 0{,}0016 \times k \times \frac{(\frac{U}{2{,}2})^{1{,}3}}{(\frac{M}{2})^{1{,}4}}$$

In which:

- E: Pollution factor (kg/ton)
- k: Average grain structure value (0.35)
- U: Average wind speed in construction area (3 m/sec)
- M: Average soil moisture in dry season (58%)

Thus, 1 ton of solid waste coming from the reclamation makes 0.0047 kg of dust. With about 101,775 tons of soil, the amount of dust which is generated during the reclamation phase is 478.34 kg. The clearance time is estimated about 60 days which will generate average 7.9 kg of dust per day. The process of solid waste transporting coming from reclamation and clearance will generate dust and increase the local dust concentration in the area. Therefore, constractors need to take some measures to cover the works such as watering the road and construction area to minimize the dust impact on local people in the region.

Emission generated from clearance

Eexhausts pollution load for one (01) truck per one km (with diesell; an average speed of 10 km/h, 3.5 ÷ 16 tons as follows: Dust : 0.90 g/km; SO_2: 4.29*S g/km; NO_x : 11.80 g/km; CO : 6.00 g/km; VOC : 2.60 g/km. The volume of solid waste during the reclamation and clearance process (including vegetation, debris, sediment, and some material of households) is estimated at 101,775 tons (the estimated proportion of soil: 1.5 ton/m^3), with the estimated reclaiming time about 60 days in total (be done in form of “rolling”). The estimated total number of 10-tons vehicles for transporting solid waste is 20 vehicles/day, equivalent to 17 times/day (included turn in and out). Thefore, 20 truck (truck load of 10-ton), equivalent to 20 times/day, average distance of about 20km, the pollution load generated each day are listed in the Table 4-44 as follow:

Table 4.44: Emission Loads Of Air Pollutants During The Pre-Construction Phase

No.	Parameter	Pollution Load (kg/day)
1	Dust	6.12
2	SO_2	7.293
3	NO_x	80.24
4	CO	40.8
5	VOC	17.68

Load of pollutants from the transport do not focus in one point or same time. The pre-construction time of this process is very short and this work is done in the form of "rolling" - transit immediately to the next area after finishing the each construction work. This plan should be able to create local air pollution in a particular area which should happen in a short period and be insignificant.

(4) Domestic Wastewater

Total number of worker who working for each item is estimated about 20 workers. Demand for water use of each worker's prescribed in QCXDVN 01:2008/BXD is about 45 liters/person/day including water for washing, cooking and personal hygiene. The amount of wastewater is calculated by 100% of water used daily. Thus, the amount of domestic wastewater generated at about 0.9 m3/day/work. Ingredients of wastewater include suspended solids, oil, grease, high concentrations of organic matter, residue, dissolved organic matter (through the BOD5, COD indicators), nutrients (Nitrogen, Phosphor) and microorganisms. According to the pollutants emission of the World Health Organization (WHO) for developing countries in Table 4-45, the estimated load and average concentration of pollutants in the domestic wastewater before treatment through septic tanks are listed as follows:

Table 4.45: Loads And Pollutants Concentration Of Domestic Wastewater (untreated)

No.	Pollutants	Pollution factor(*) (g/person.day)	Load (kg/day)	Pollutant factor (mg/l)	
				Untreated	QCVN 14:2008 Column B
1	BOD_5	45 – 54	0.9 – 1.08	1000 - 1200	50
2	COD	72 – 102	1.44 – 2.40	1600 – 2666	-
3	TSS	70 – 145	1.40 – 2.90	1555 – 3222	100
4	Grease	10 – 30	0.20 – 0.60	222 - 666	20
5	Total Nitrogen	6 – 12	0.12 – 0.24	133 - 266	50
6	Ammonia ($N-NH_4$)	2.4 – 4.8	0.048 – 0.096	53 - 107	10
7	Phosphor	0.8 – 4.0	0.016 – 0.08	17.8–88.9	10
8	Total Coliforms	10^6 - 10^9	$20x10^3$ – $20x10^6$	$22x10^6$ – $22x10^9$	5000 (MNP/100ml)

Source: WHO, 1993

In the table above, the pollution load, number of workers and wastewater flow, we calculate the pollutants concentration in wastewater by the following formula:

$$C = \frac{C_0.}{Q}$$

In which:

- C: Pollutant concentration, (mg/L)
- C_0: Pollutant load, (g/day)
- Q: Wastewater flow, (m^3/day)

Compare the pollutants concentration in untreated domestic wastewater with the QCVN 14:2008, Column B, most of the parameters are over the standards. To minimize the impact, the investor should require the contractor to hire houses which are near to the construction area or to build toilets inside the construction area to serve the needs of the labor activities. Therefore, the amount of domestic wastewater is collected and be treated by the local treatment system, hence, the impact is negligible.

(6) Domestic Solid waste and construction solid waste

Domestic Solid waste

Solid waste coming from workers in pre-construction phase discharged about 0.35kg/person/day. With the number of workers is estimated about 20 people for each item, the amount of solid waste should generate around 7 kg/day. This solid waste contains 60-70% organic ingredient and 30-40% other substances, and may contains many bacteria, pathogens. These solid wastes would be collected and processed in order to limit the negative impact on human health and the local environment. The number of workers in the pre-construction phase is not too much, so the amount of solid waste generating from construction area is insignificant. However, investors should also take some measures to collect and ensure environmental hygiene of working areas.

Construction solid waste by cleanance process

Site clearance: Removal of vegetation and exposure of the ground to rain and wind sets up the conditions for increased runoff and erosion. Removal of mature trees contributes to this and can degrade the aesthetics of a locality. Also the surface soil may be usable elsewhere.

Demolition of existing structures: Materials in existing structures may inlude bricks, tiles, concrete waste, steel, soil, waste rock, wood, etc. The demolition process will create noise and dust. However, the volume of dust and waste and the period of demolition are very limited. Impacts will be localized and of small scale. Table below present the total of solid waste from the cleanance process.

Table 4.46: Total of Solid Waste From The Clearance Process

No.	Items	Unit	Amount	Estimated amount of solid waste (m^3)
1	Path road of Quang Trung Bridge (25 m x 388 m)	m^2	9,700	970
2	Part of Tran Hoang Na Str., 28 m width, 700 m long	m^2	19,600	1,960
3	Part of Tran Hoang Na Str., 20 m width, 900 m long	m^2	18,000	1,800
4	New road from THN to IC3, 12 m width, 1,600 m long	m^2	19,200	1,920
5	Connection road between CMT8 and 918 main road, 40 m width, 5,300 m long	m^2	212,000	21,200
6	Technical Infrastructure for the resettlement areas	ha	40	40,000
			Total:	**67,850**

(7) Waste oil

After operating, the machinery and construction vehicles using on site must be maintained to avoid damage and ensure the stable operation. This process will generate an amount of Waste oil from machinery and vehicles. The amount of oil for once change is estimated about 16 liters/truck. The changing cycle is about 3-6 months, depending on the working time of machinery. The amount of hazardous waste generated from cleaning rags, oil machinery, oil tanks, etc. in this phase is minimal. The estimated amount of Waste oil for once change is 10 liters. Hazardous wastes are collected and processed by specialized units according the provisions of the Hazardous Waste Management.

4.5.2. Assessment of Environmental Impact During Construction Phase

4.5.2.1. Identifying Source Of Impacts

The activities this phase include: operation of work camps; work sites and built structures (embankments & bridges); Maintenance of vehicles and equipment; ....The table below present source of impacts, impacts and scale of impact will occur in construction phase basing on its activities.

Table 4.47: Impacts During The Construction Phase

No.	Impact source	Impact/Waste	Impact Scale
(i) Construction of Quang Trung bridge (sub-component 2) from Ninh Kieu to Cai Rang with a total length of about 869 m, the bridge is 481m long, 11 m wide			
4.6. A - Impact sources related to waste			
4.7. 1	4.8. Construction.	4.9. - Dust, emissions from material transportation. - Emission from welding rod - Waste water from lighter	4.10. - Medium, short term, can be controlled -Medium , short term, can be controlled - Medium, short term, can be controlled
4.11. 2	4.12. Worker activities	4.13. - Domestic waste water - Domestic solid waste	4.14. - Medium, shortterm, can be controlled - Medium, short term, can be controlled
3	Construction activities	- Water pollution due to construction activities	Medium, short term, can be controlled
3	Maintenance of	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Medium, short term, can be controlled
2	Concentrated workers at the project site	- Affect on local economic – social condition. - Diseases and social problems caused by the concentrated workers.	- Medium, lshort term, can be controlled - Low, short term, can be controlled
3	Traffic	- Traffic congestion; disruption of waterway transportation	- Medium, short term, can be controlled
4	Risk	- Safety issues during bridge construction	- Medium, short term, can be controlled
Tran Hoang Na road and bridge: Total length of route of about 3,794km			
A - Impact sources related to waste			
1	Construction	- Dust, emissions from material transportation. - Emission from welding rod - Waste water	- Medium, short term, can be controlled - Medium, short term, can be controlled - Medium, short term, can be controlled
2	Worker activities	- Domestic waste water - Domestic solid waste	- Medium, short term, can be controlled - Medium, short term, can be controlled

No.	Impact source	Impact/Waste	Impact Scale
(i) Construction of Quang Trung bridge (sub-component 2) from Ninh Kieu to Cai Rang with a total length of about 869 m, the bridge is 481m long, 11 m wide			
3	Maintenance of Vehicles, machinery	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Medium, short term, can be controlled
2	Concentrated workers at the project site	- Effect on local economic – social condition. - Diseases and social problems caused by the concentrated workers.	- Medium , short term, can be controlled - Low, short term, can be controlled
3	Traffic	- Traffic congestion	- Medium, short term, can be controlled
4	Risk	- Safety issues during the bridge construction - Local flooding	- Medium, long term, can be controlled - Medium, long term, can be controlled
Construction of Road connecting National Highway 1A (NH1A) and provincial road DT918, with a total of 5.3 km, building line of 40 m			
A - Impact sources related to waste			
1	Construction.	- Dust, emissions from material transportation.	- Medium, short term, can be controlled
2	Worker activities	- Domestic waste water - Domestic solid waste	- Medium, short term, can be controlled - Medium, short term, can be controlled
3	Maintenance of	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Low, short term, can be controlled
2	Concentrated workers at the project site	- Effect on local economic – social condition. - Diseases and social problems caused by the concentrated workers.	- Low, short term, can be controlled - Low, short term, can be controlled
3	Traffic	- Traffic congestion	- Medium, short term, can be controlled
4	Risk	- Local flooding - Safety	- Low, short term, can be controlled
Construction of a resettlement area in Ninh Kieu district covering an area of about 40 hectares, ensuring appropriate planning of technical and social infrastructure and facilitate living conditions for local people.			
A - Impact sources related to waste			
1	Construction.	- Dust, emissions from material transportation.	- Medium, temporary can be controlled
2	Worker activities	- Domestic waste water - Domestic solid waste	- Medium, temporary, can be controlled - Medium, temporary, can be controlled

No.	Impact source	Impact/Waste	Impact Scale
(i) Construction of Quang Trung bridge (sub-component 2) from Ninh Kieu to Cai Rang with a total length of about 869 m, the bridge is 481m long, 11 m wide			
3	Maintenance of Vehicles, machinery	- Waste oil	- Low, short term, can be controlled
B - Impact sources not-related to waste			
1	Vehicles, machinery	- Noise and vibration from machinery, vehicles	-Medium, temporary, can be controlled
2	Concentrated workers at the project site	- Effect on local economic – social condition. - Ddiseases and social problems caused by the concentrated workers.	- Medium, temporary, can be controlled - Low, temporary, can be controlled
3	Traffic	- Traffic congestion	- Medium, short term, can be controlled
4	Risk	- Local flooding - safety issue	Medium, short term, can be controlled Medium, short term, can be controlled

4.14.1.1. Impact Assessment

❖ ***Impact sources not related to waste***

(1) Public safety and Traffic Management/ Traffic congestion:

Quang Trung Bridge plays important role in connecting the project area to the NH1 through Can Tho Bridge going to HCMC and to other provinces of Vinh Long, Soc Trang, Hau Giang. Tran Hoang Na road is considered an urban arterial road connecting to the city center. Their Road and Bridge go through the populated area. Thus, road and bridge construction activities will affect people's daily activities. Because, construction traffic will increase the number of vehicles on local roads and affect the normal traffic flow, may diminish or interrupt access to properties, and can increase the number of traffic accidents, incidents and congestion. Traffic issues tend to be the most serious around bridge and culvert construction sites, at major intersections...Overweight trucks and heavy equipment may damage roads leading to/from works areas.

(2) Safety precaution for the workers:

Accidental and risks in construction site would have ended up in the loss of a life for one of these workers. Some of the most common types of construction accidents include crane accidents, workers being run-over by operating equipment, explosions.

(3) 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.

(4) Social impact assessment

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.

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.
- 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.

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.

❖ ***Impact sources related to waste***

(5) Surface Water pollution

Water from construction activities/sites has many sources:

- Runoff from road and bridge construction sites
- Drainage from equipment and truck maintenance areas
- Wastewater from work camps
- *Waste water from barges*

Runoff from road and bridge construction sites

Runoff from road and bridge construction sites, waste spoil sites and borrow pits may erode the water bodies. Runoff typically contains a high concentration of mud and organic matter and may contain leaked engine oil and grease; from bridge construction sites it may contain concrete, cement, paint and steel and possibly spilled betonies. All of these substances may flow water bodies. The construction of bridges may also impact on water quality in other ways. Quang Trung Bridge (modul 2)/Tran Hoang Na will use bored piles. Drilling the holes for the piles will cause significant impacts on runoff and increase the turbidity in the affected river.

Material from the construction of bridge may reach the river over which it is built. Apart from the materials in river-banks and the constructed earth embankments, concrete, cement, paint, steel and other substances may get into water bodies. Surface water may be contaminated.

Bentonite is often used as a drilling mud to assist when drilling holes for bridge piles. Drilling mud is circulated in the drilling system and retained in tanks on the drill-rig. Most never reaches the ground surface. Bentonite is of very fine particles that act as a drilling lubricant, seal the hole and assist to maintain its integrity. Bentonite is benign, non-toxic, but the fine particles can coat a stream-bed and block oxygen interchange between the water and the bottom muds. This kills mud-dwelling organisms but their population quickly recovers.

Table 4.48: Bentonie Wastes Generated From Construction Activities

No	***Bridges***	***Bentonie waste (m^3)***
1	Quang Trung	4.080
2	Tran Hoang Na	2.400

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 m3/day); ii) machine cleaning (about 5 m3/day); iii) machine cooling (about 4 m3/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 4.49: 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

Wastewater from work camps

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 m3/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. In the absence of proper management, these substances may reduce environmental quality and impact human health.

Waste water from barges

The project also use barges to transport materials therefore surface water of Can Tho river can polluted by ballast water and sanitary water. Ballast water is used by the water from the river which is similar with surface water. Therefore, the impact of ballast water to the environment is negligible. For the sanitary water, wastewater coming from thebarges is estimated about 8 -10 m3/day (4 barges including 70T, 200T, 250T, 400T). Factors causing water pollution of waste water is grease, suspended solids, organic matter, nutrients (N, P) and microorganisms. Therefore, wastewater which is discharged directly to the river can cause water impacts on the project area. However, sanitation activities are irregular and this effect is temporary, and will end when construction of bridge girders.

According to the analytical result of surface water in Quang Trung Bridge, Tran Hoang Na in Cai Rang district showed that surface water is contaminated by domestic wastewater from residents; concentration of NH4, NO2 is higher than permitted level in QCVN 08:2008 (level B). Therefore, management of project activities which can pollute the water source is very necessary and must be reasonable, feasible in order to minimize diminishing quality of water source at upstream of river/streams because it can affect water source at downstream.

Table 4.50: Summary of Sites Sensitive To Wastewater Impacts

No.	River/Bridge	Location	Current water quality
1	Quang Trung Bridge	Quang Trung bridge on side of Cai Rang district	Most of indicators are within the permitted limits of QCVN 08: 2008/BTNMT Column B. concentration of NH4, NO2 is higher than permitted level in QCVN 08:2008 (level B)
2	Trần Hoang Na Bridge	Iron bridge on Tam Vu road crossing Ba Le creek	Most of indicators are within the permitted limits of QCVN 08: 2008/BTNMT Column B. concentration of NH4, NO2 is higher than permitted level in QCVN 08:2008 (level B)

(6) Soil erosion:

Bored piles will be used in the construction of Quang Trung / Tran Hoang Na Bridge. During the drilling and pile placement process water flow may be reduced. This can cause scouring of the river bottom and banks the severity depending upon the diameter of the pile and coffer dam (if used) and the distance that the pile is from the river bank. Bridge pile drilling sites on the banks of a river may cause localized buildup of drilling waste. Runoff and earth transport to a water body will affect water quality in the affected river.

(7) Air pollution

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).

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.

Dust and emission generated from road construction

After reclamation and clearance process, the smooth stone should be transported to the construction area before making the asphalt. Estimated total surface area is 278,500 m^2 (prefer to Table 4-36), thickness of smooth stone is 0.1m, the total volume of smooth stone have to be transported is about 27,850 m^3. If the density of smooth stone is 1.8 ton/m^3, the total volume will be about 50,130 tons. Properties for diesel vehicles are set with an average speed of 10 km/h, 3.5 ÷ 16 tons, the average distance of 1 km, exhaust pollution load for one (01) truck as follows:

- Dust : 0.90 g/km
- SO_2 : 4.29*S g/km;
- NO_x : 11.80 g/km;
- CO : 6.00 g/km;
- VOC : 2.60 g/km.

The estimated time for road construction is 6 months. The estimated total number of 10-tons vehicles for transporting smooth stone is 10 vehicles/day, equivalent to 5 times/day (included turn in and out). With an estimated total of 10 trucks with 10-ton load, equivalent to

5 times/day, average moving distance of about 20km/truck, the pollution load generated each day are listed in the Table 4-51 as belows:

Table 4.51: Emission Loads Of Air Pollutants During The Construction Phase

No.	Parameter	Pollution Load (kg/day)
1	Dust	0.90
2	SO_2	1.07
3	NO_x	11.80
4	CO	6.00
5	VOC	2.6

In general, levels of dust and pollutants arising from the stone transporting to the construction sector are not high. However, to minimize the impact on the environments and the lives of people close to the construction area, project proponent should schedule transportation activity at night time to minimize the impact.

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 and ii) use of a concrete mixing station on onsite. 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.

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.

Table 4.52: Sensitive Receptor Sites Along Project Corridor During Construction Phase

Category	Sensitive receptor locations	Distance to centreline
I. Tran Hoang Na Road and Bridge		
Resident area	km0+470 to km0+700	**10**
Resident area	Km 0+700 to Km1+180	**10**
Resident area	Km1+385 to Km2+880	**10**
II. Construction of Connecting road August Revolution (Highway 91) - Provincial road DT918		
Resident area	Km0 –Km0+615.	**10**
Resident area	Km0+615 to Km0+905.	**10**

The impacts of dust and gas emissions during the construction phase are considered as having moderate negative impact because there are some sensitive subjects along the corridor. Besides, The analytical results of indicators of ambient air are within permitted limits of QCVN

05:2013/BTNMT, within one hour. So that the project must strictly comply with mitigation measures to manage and reduce those impacts during the construction phase.

(8) Noise and vibration

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 4.53: Noise Level Generation From Construction Machinery At A Distance Of 8 M

(Unit: dBA)

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

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

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. The measurement results show that noise level is within permitted limits except for noise level at K23 (Under Bridge 3 on Nguyen Van Linh road) exceeds permissible noise standards by 0.02% QCVN 26:2010/BTNMT. It might be because of high traffic volume area, near Can Tho Hospital, residential area 91b and 91B bus terminal. However, 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:

- LΣ total noise level from sources
- Li noise level i
- N total noise sources.

(Source: Pham Ngoc Dang, 2003. Air environment)

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 r2 compared with source r1; distance for noise source normally considered as r1= 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 4-51:

Table 4.54: 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
Construction of Quang Trung Bridge (2nd unit)	73.8÷84.2	71.9÷82.3	62.6÷ 73	59.2÷76.6	57.9÷67.3
Tran Hoang Na road and bridge	73.8÷84.2	70.1÷81.7	66.8÷78.4	62.4÷75.0	58.1 ÷69.7
Construction of Road connecting National Highway 1A (NH1A) and provincial road DT918	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.

Sensitive locations along project corridor could be impacted by noise generated from construction sites include residential areas, especially construction activities during nighttime; road users on this corridor could also be impacted by noise if travelling by motorcycle, bicycle and walking. 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.

(8) Solid and hazardous waste generation

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 Cai Sau Landfill, with an estimated volume of around 3706 m3. 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.36/2015-BTNMT issued on 30/06/2015 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. 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.

Domestic solid waste which will be managed appropriately. It is 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. The impacts of domestic and construction solid waste, and hazardous waste, represent moderate negative impact during the construction phase of the project. It requires the project to implement mitigation measures to reduce negative impacts during the construction phase.

(10) 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 machinery, 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

This component will be affect by flooding causing by the storm, heavy rains and tide. Current situation of flooding in Can Tho city is more and more increasingly on both area and level. In 10-recent year, in the inner-city area of city' center, flooding situation happens to tidal time is more and more increasingly in both quanity of roadline and scope of flooding. Most of heavy floods on large-area are the same time to flooding level on river reaching highest flooding and tidal level in annual months of IX, X, XI. Therefore, the construction activities should arrange reasonable implementation period, especially active excavation and embankment, stripping surface coating not done in the rainy season to reduce erosion runoff. Before constrution period start, flood emergency pland should be submitted PMU and approved PUM to avoid the risks of flooding.

4.14.2. Assessment of Environmental Impact During Operation Phase

Road Safety, Air, Noise, and Vibration

- Road safety is likely to be the key impacts during operation of Quang Trung bridge/Road and bridge of Tran Hoang Na/Connecting Road August Revolution during the first few years with transportation of cars, motorcycles, trucks, etc.) and level of traffic accident would be increased. Experience in the country suggested that this condition can be managed however improving knowledge of local people on road use regulations and practices as well as monitoring and enforcement of driver speed and behavior can help mitigating the impacts.
- In a longer term when traffic volume is relative high, generation of dust, exhausted gases, noise, and vibration could be an additional issue but this could be mitigated through a long term planning.
- Inadequate operation and management of infrastructure as road drainage, sewerage collection system cause odor, flooding. Operation and maintenance program should be integrated in to the city's overall operations and maintenance program.

Social Aspect

- Given the different natural and social relationship in the new resettlement areas, at the beginning of resettlement, people will have to adjust to their new living conditions. Difficulties may arise from rural habits and ways of life that may not be appropriate for urban lifestyle. Since the urban area does not have enough space for such activities, this may pose a challenge and in terms of sanitation and health control as well; not to mention incompatibility with the city landscape. This issue will be mitigated through the RP implementation.
- Impacts on Water Environment Wastewater and rainwater drainage from Ninh Kieu Resettlement areas will be connected to the existing drainage system through drainage of the sub-area and will be discharging wastewater directly into the Can Tho river
- The amount of wastewater generation in the Ninh Kieu resettlement areas is estimated to be about 175 m3/day at each site. Government's regulation requires that waste from toilet will be pretreated via household's septic tank for each family before discharging into public drains. If this is the case, pollution loading after septic tank treatment should be further reduced by 30-40% BOD5/COD.

This amount of wastewater will be collected and treated by the wastewater treatment plant within the resettlement area, which is constructed under the project.

Generation of solid waste will be small and these amounts will be collected and managed by the city urban company (URENCO).

CHAPTER 5. PROPOSED MITIGATION MEASURES

There are several strategies (avoidance, minimization, rectification, and/or compensation) that have been applied to mitigate the potential negative impacts identified in Chapter 4. During the preparation of the project, effort has been made to avoid potential adverse impacts on resettlement and land acquisition by reducing scope and/or modification of the basic design of the project investment. In developing the mitigation measures the strategies to minimize and/or rectify the impacts have been applied and where appropriate compensation has been incorporated. The proposed mitigation measures to reduce the impacts due to land acquisition and resettlement are described in the RP and RPF.

This chapter identifies mitigation measures of the key project environmental and social impacts during the construction (which include site clearance, ground leveling, and construction) and operation phases. Given that most of the key impacts will occur due to civil works and transportation of construction/waste materials, many of the potential negative impacts on physical, biological, and social environment could be mitigated through a set of general measures that are typically applied to most of construction projects to minimize impacts such as noise, dust, water, waste, etc. As part of the Environmental and Social Management Plan (ESMP) for the project these general measures have been translated into a standard environmental specification to be incorporated into the bidding and contract documents. These are referred to as Environmental Codes of Practice (ECOPs) and it will be applied to mitigate typical impacts of the project's civil works. Section 6.1 briefly explains the scope and content of the ECOPs, which are presented in the next Chapter 6.

However, for the subprojects of CTUDR project there are site-specific impacts that require site-specific measures both during the construction and operation phases. Section 6.2 discusses site-specific measures during construction for the subcomponents that require mitigation measures beyond those identified in ECOPs. Section 6.3 describes site-specific measures to mitigate impacts of the key subcomponents during the operation phase.

5.1. MEASURES TO MITIGATE GENERIC IMPACTS DURING CONSTRUCTION PHASE

The ECOPs describe typical requirements to be undertaken by contractors and supervised by the construction supervision consultant during construction. The final ECOPs will be incorporated into the bidding and contract documents (BD/CD) during the detailed design stage. Scope and content of the ECOPs is as follows:

Scope: Construction activities for small works governed by these ECOPs are those whose impacts are of limited extent, temporary and reversible, and readily managed with good construction practices.

The measures identify typical mitigation measures for the following aspects:

- Dust generation
- Air pollution
- Impacts from noise and vibration
- Water pollution
- Drainage and sedimentation control
- Management of stockpiles, quarries, and borrow pits
- Solid waste
- Management of dredged materials
- Disruption of vegetative covers and ecological resources

- Traffic management
- Interruption of utility services
- Restoration of affected areas
- Worker and public safety
- Communication with local communities
- Chance findings

5.2. MEASURES TO MITIGATE SITE –SPECIFIC IMPACTS FOR FLOOD CONTROL WORK

5.2.1. Pre-Construction Phase

The major impacts of this phase include resettlement, public infrastructure encroachment, air pollution, generation of waste and waste incurred from the luminescence, the risks posed by explosive remnants, generation of waste oil and the pollution caused by stormwater runoff.

(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 CTUDR 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 CTUDR Project;
- Necessary to achieve its objectives as set forth in the project documents; and
- Carried out, or planned to be carried out, contemporaneously with CTUDR Project;

After getting no objection from the World Bank and approval by the Can Tho 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 CTUDR 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:

- Land Law 2013 which has been effective since July 1, 2014 Decree No. 45/2013 / QH13 dated November 29, 2013
- Decree No.43/2014/ND-CP dated May 15, 2014 of the Government providing guidance on detailed implementation of some articles from the Land Law 2013.
- Decree No. 44/2014/ND-CP dated 15 May 2014 of the Government providing regulations on land prices.

- Decree No. 47/2014/ND-CP dated 15 May 2014 of the Government on compensation, support, and resettlement when land acquisition is required by the State.
- Circular No. 36/2014 / TT-BTNMT dated 30 June 2014, specifying detailed methods of valuation of land prices, construction, adjustment of land prices; specific land prices valuation and land prices valuation consulting service.
- Circular No. 37/2014/TT-BTNMT dated 30 June 2014, providing detailed regulation 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.
- Document of Prime Minister No. 1665/TTg-CN, dated October 17, 2006, regarding management of clearance of site, mine and explosive ordnance for transport construction, and
- Other related regulations or administrative decisions applicable for the resettlement plan and implementation of the project including relevant decisions by Can Tho City's People Committee (CT-CPC) related to principles for compensation, assistance and resettlement in the event of land acquisition required by the State, and CT-CPC's decisions on compensation unit prices for land, crops, and affected assets due to land acquisition for the purpose of the Project.
- Decision No.15/2014/QĐ-PC, dated November 13, 2014 of CT-CPC regarding to compensation and assistance when the state acquired land in Can Tho city;
- Decision No.09/2015/QĐ-PC, dated March 5th, 2015 of CT-CPC regarding to stipulate for house price, structure, crops and pet in Can Tho city;

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:

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

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.

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.

(2) Relocation of public 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: infrastructure relocation activites (such as electricity lines, telephone line, bus stop..), 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.

(3) Measures to maximize benefits for women and vulnerable groups

- Work closely with the district women's unions, ward women's unions to mobilize the participation of women and vulnerable in all activities in the project preparation and implementation (public consultation through questionnaires, people’s meetings...).
- Strategy of disseminating Project’s information to the community, focusing on female headed households, poor and vulnerable.
- All public meetings must ensure at least 30% of the participants as women.
- Mobilize the participation of the women's unions in the Resettlement Process and in the Income Restoration Program to assist women and vulnerable groups;
- Detailed IRP will be set up based on demands of both male and female headed households and vulnerable through individual consultations with women and women's interest groups (such as women's unions).
- All statistics are disaggregated by gender for both men and women and vulnerable as a basis for the monitoring of gender/social indicators.

(4) Unexploded ordnance removal

Unexploded ordnance remove will be carried out in the Can Tho embankment; Cai Son cannal; Long Tuyen and Long Hoa regulatory lake and 13 ditchs - Đầu Sấu canal, Ngã Bát canal, Mương Củi canal, Xẻo Nhum canal, Mương Lộ canal, Hàng Bàng canal, Tư Hổ canal, Sao canal, Bà Bộ canal, Lễ canal, Xẻo Lá canal, Ngỗng canal, Ông Tà canal. 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.

(5) Air pollution

Although the impacts of air pollution in this phase was negligible. However, the mitigation measures during the clearance, transportation of emitted materials and emissions from the operation of the machines also need to be applied by bidders as follows:

+ For dust:

- The vehicles which transport materials, spoil must comply with the general traffic regulations: must to have canvas cover crate and must not drop the rock, materials in order to minimize dust emissions the environment.
- To ensure the safety of road traffic and vehicle speed, ensuring the needs of people traveling in this region: the transported vehicles are not overloaded weight allowed for each type of vehicle.
- In accordance with the characteristics of the transport system in the province the major vehicles using are the trucks with the loads of 5 to 10 tons; the maximum velocity of the vehicles traffic on the dirt road near the project area is 5 km/h, ensuring the safety of people and vehicles without swept dust.
- Implement of simply dust mitigation measure is watering regularly in the construction area, especially in the construction site on the route, with the frequency of watering is 02 times/day.

+ For gases emissions

In this phase the exhaust gas composition is quite simple and low toxicity, simple measures can be used to limit pollution. The treatment measures are as follows:

- Providing reasonable construction schedule, increasing the number of day shifts in order to reduce the density of construction vehicles in the same time.
- Using transportation vehicles with internal combustion engines with high performance, small footprint download. Machinery and equipment are regularly maintained, machinery and equipment are always operated in the best state, for limiting the flue gas.

(6) Waste

The volume of waste and rubbish arising from the activities emitting create space, demolishing existing buildings on Can Tho embankment, Cai Son canal ... must be gathered, collected and transported to the landfill project which is approved by local authorities. Representatives of investors and construction units must have a memorandum of understanding, closing cooperation in the process of transporting the waste from the project area to disposal.

(7) Domestic Wastewater

During this period, the amount of generated waste water is relatively low. However, according to the calculations, the concentration of pollutants in waste water untreated is exceeding standards (QCVN 14: 2008, Column B). Therefore, the contractor must be responsible for compliance with the relevant Vietnamese legislation relevant to wastewater discharges into watercourses.

- Portable or constructed toilets must be provided on site for construction workers. Wastewater from toilets as well as kitchens, showers, sinks, etc. shall be discharged into a conservancy tank for removal from the site or discharged into municipal sewerage systems; there should be no direct discharges to any waterbody.
- Wastewater over standards set by relevant Vietnam technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors.

- Make appropriate arrangements for collecting, diverting or intercepting wastewater from households to ensure minimal discharge or local clogging and flooding
- Before construction, all necessary wastewater disposal permits/licenses and/or wastewater disposal contract have been obtained
- At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed or effectively sealed off.

(8) Rainwater runoff

Minimize the risk of water pollution in the rivers due to rainwater runoff:

- Do not arrange the temporary dump in the area of land near the river and the canal, the area to gather material must be covered geotextile and using the temporary mud partitions if necessary to minimize sediment runoff into the river.

- Site Cleanup

- Installation of drainage pumps in case of incidents of heavy rain, local flooding;

- The curator must regularly monitor the progress and quality of works

(9) Noise and vibration

Sources of noise and vibrations in the Project preparation stage is mainly the operation of machinery when emotion of clearance space, demolition of existing buildings. Volume emotion, demolition are not great, so that the impacts from this activity is negligible. Measures to mitigate noise and vibration in the ground preparation phase will be implemented as follows:

- Use equipment with lower noise levels (in operation of emition create space, demolition, displacement power poles);
- Do not dismantled at night, from 22h-6 am the following day;
- Notification must be required to the residential sector affected.

(10). Waste oil

Waste oil must be collected and stored in areas with impermeable floors and are handled by the company who specializes in handling toxic waste. The collection, transportation and processing is done by the specializing company. These companies must be complied with requirements of Circular 36/2015 / TT-BTNMT (06/30/2015). Bidders must have a notebook of generated hazardous waste, handling and transportation of hazardous waste (handle by whom, be transported from / to, transportation date, liability).

(11) Flooding

During detailed design, PMU will ensure that detailed design will provide adequate tidal sluice gates, cannas, ship locks, adequate installation of temporary and permanent drainge to avoid potential flooding, disruption to the activity of inland waterway in Can Tho river during construction and operation.

5.2.2. Construction Phase

(1) Noise and Vibration

According to monitoring results in Chapter II, the noise and vibration level in the project area are within the permission standard except for noise level at K23 (Under Bridge 3 on Nguyen Van Linh road) exceeds permissible noise standards by 0.02% QCVN 26:2010/BTNMT. 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.

Can Tho river embankment system locations where careful attention needs to be paid to dust, noise and emissions include:

- Crowed resident area along river embankment at several sections at Km0 – Km1+420; Km2+080 – Km4+830; Km4+970 – Km5+270; Km5+270 – Km5+870;
- Sensitive locations includes Preventive Medicine Center, guest house No. 2 (Km0); 2 markets of Tan An (Km0+220) and An Lac (Km0+710) located near river banks, Cathedral (Km0+480); Ninh Kieu Methadone treatment facility (Km0+850) ; The Military Court of Region 9 (Km0+860); Nguyen Hien primary school (Km2+780), Inland Waterways Management and Maintenance Joint Stock Company No. 12 (Km3+620); Ong church (Km5+000); An Binh market (Km5+700).

Resident areas and sentive locations along the Cai Son cannal shoud be paid attention to reduce dust, noise and vibration:

- Resident area: Km0 – Km1+080; Km1+080 – Km1+460; Km3+320 – Km3+690; Km3+690 – Km3+890; Sensitive location: Giác Thiền pagoda at Km0+230
- 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.

(2) Traffic congestion and disruption of road/waterway transportation

A Draft Traffic Management Plan to maintain safety, to minimize disturbance to local traffic and pedestrians and to maintain public and private access throughout the works areas. The Plan will show routes provided to maintain access, e.g., a passing lane retained along the road during construction or temporary bypasses, or scheduled access times. The Plan will be presented to communities and officials before finalization and approval by the CSC/PCC and subsequent implementation by the Contractor

Contractor shoud provide lighting at construction site at night; a security guard staff at construction sites to moderate vehicle go out and in the construction site.

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.

- Coordinate with the local authority to inform local people on the construction plan prior to construction.

- Coordinate with the Department of Inland Waterway to reflag the signal system on the Can Tho section at the project construction area;

- To turn on the lights at night at connector (shelves) platform and abutment; the warning devices of construction site would be installed upstream and downstream of the expected bridge to sign to ship owners known.

- To minimize the construction equipment to encroach fairway;

- Limit the construction area. The construction activities are only taken in the area;

- Arranging 01 emergency department on the Can Tho River during construction

(3) Air pollution

The main objectives are negative impact control on ambient air quality from dust and exhaust generated from civil construction activities as (i) Dust and emission generated from drainage pipeline construction, embankment and regulatory lake; (iii) Emission generated from machinery; (iv) Dredging process; (v) Odor from dredging process.

a)Dust generated from drainage pipeline construction; embankment, regulatory lake construction (including excavation and ground leveling 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.
- Storing the excavated 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;
- Setting up appropriate schedule of material mobilization to the site to avoid material obstruct ;
- Cleaning the nearby areas daily by road cleaning vehicles on 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;
- 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 residential areas.

(4) Domestic waste

- The number of workers in the construction phase is not too much, so the amount of domestic waste is insignificant, approximately 28 kg/working day. 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

(5) Construction-generated solid waste

- Wherever possible, materials used or generated by construction shall be recycled such as excavated soil for regulatory lake, embankment, pipeline installation 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 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 area where are approved Can Tho' PC on the disposal construction waster.
- Dredged sludge will be transported to Cai Sau sludge landfill. According to PPMU, The location to construct Cai Sau landfill has enough land for disposal of dredging sludge and material of CTUDR project.
- Waste transport vehicle also need to comply with mitigation measures for transport vehicles stated in Item of Dust and exhaust generation.

(6) 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. 36/2015/TT-BTNMT dated 30 June 2015, the detail requires as bellowing:

- The storage area for all hazardous substances is located away from any water bodies such as Can Tho River and Cai Son cannal….
- 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. 36/20115/TT-BTNMT dated 30 June 2015 for transport and treatment.

(7)Waste water from work camps, drainage from equipment and truck maintenance and construction site

According to analysis results for samples taken at Can Tho river and some creeks (Dau Sau, Hang Bang, Ngong, Ba Bo, Tu Ho, Ong Ta, Muong Khai) in the project area showed that their locations had polluted by COD, BOD5, PO4, NH4, NO_2, Coliform because their locations receives daily wastewater from households along Can Tho river and Creeks. Therefore, construction activities should consider how to avoide the impacts on surface water at their locations. Specific measures shoud be implemented by constractors:

- Undertake excavation and ground leveling 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 the solid waste from entering into water flow;
- Construction sites 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;
- 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.

(8) Water pollution (due to the construction of embankment and shiplock

- Cai Khe tidal gate is located in Cai Khe canal which is between Ninh Kieu Bridge and pedestrian bridge; Dau Sau tidal gate is placed in the Dau Sau Canal, away 200m to the Can Tho River; 5 tide sluice gates which are located Sao Canal, Ba Bo Canal, Suc Canal, Pho Tho Canal and Hang Bang Canal.
- During the construction of embankment and shiplock, sluigate is near the waterway, ther fore there is potential risk on water runoff or spill overl of construction materials and oil/grease which could cause water pollution and affect ability of the drainage area.

(9) Management of dredged sludge/soil

Sewage sluge form from this component will be transported by land way and treated in Cai Sau. Sewage sludge collecting, treatment processs have been stated in Environmental Protection Commitment and approved by Cai Rang district'PC, presented as following:

- *Sewage Sludge Collecting Process:* Depend on terrain of the road, sewage sludge is collected by hand or machine. Mechanized method: sewage sludge is collected directly from manholes by pressure of specialized truck. Hand method: worker use specialized baskets to collect sewer sludge accumulation in the manholes and dump in to truck. Progress of transporation ensured requirements about environmental protection, avoid sludge leakages. Trucks carrying sewage sludge must be covered. All trucks should not be overloaded and fix with its body;

- *Sewage Sluge Treatment Process* in Cai Sau Landfill: Before sewage Sludge is dump in to yar, It is eliminated/excluded garbage by net framework made of B40 iron. Garbage is collected and treated by Can Tho URENCO. Sewage Sludge is excluded garbage will be treated as following:

  + Spraying biological product (Freshen Free) 02 times per day with 195 ml biological product diluted with 75 litters of water per time and then spraying evenly the suface of sewage sludge.

  + Using lime sprinkle the surface of sewage sludge: 02 times per day with 39 kg lime per time.

- After yard is full treated sewage sludge will be, will covered with a thick layer of sand 20 cm to avoid odors.

(10) Risk on soil erosion and land slide, embankment subsidence during the construction

Study on hydraulic, hydrology, geological surveys to ensure sustainable and stable designs.

Construction process:

- Reinforcement of piles in process of dredging, embanking along river
- No gathering material near river bank,
- Ensure flow circulation
- When carry out construction have to include safety measures for households and compensate the damages if any damage to buildings, roads, houses

5.2.3. Operation Phase

To reduce these risks of flooding, ordorcracking and subsidence; blockage of sluice gate, shiplok and rehabilitated cannals and disruption to the activity of inland waterway, the following measures will be carried out by the city.

Ensure implemention of anadequate operation and management plan for sub-components in Flood control works and budget allocated.

To avoid risk on embankment cracking and subsidence, in detailed design should be implemented draulic, hydrology, and geological surveys to ensure sustainable and stable designs and an O &M Plan as well as budget source should be approved and arranged by Can Tho City.

To reduce blockage of the sluice gate, shiplock and rehabilitated canal, public → awaress raising should be implemented and adequate 0&M budget should be prepared.

5.3. SITE-SPECIFIC MEASURES FOR ENVRIONMENTAL SANITATION WORKS

5.3.1. Pre-construction Phase

Environmental sanitation works include Rehabilitation and synchronous supplement of the drainage system for route in the Ninh Kieu district (11 km length) and in the remaining area (10 km). Environmental Sanitation works component requires no land acquisition and resettlement, as well as public infrastructure encroachment. Key environmental impacts in this phase includes air pollution/noise and vibration generating transportation, reclamation; domestic waste water; solid waste generating from workers and reclamtion activities. Site specific measures can be mitigated though the typical mitigation measures stated for Flood control works Because the drainage system for route in the Ninh Kieu district (11 km length) and in the remaining area (10 km) have been constructed and operated many years. This new system will be upgraded based on the existing alignment, therefore there is no potential risk on UXO as confirmed by FS consultant. In any case the drainage is installed in the area where UXO screening have not yet been conducted, it is requested that the investor to hire competent agency to carry out UXO screening to ensure safety.

5.3.2. Construction Phase

The subcomponent impacts are considered moderate, temporary, and localized and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site specific impact includes odor from digging sludge from drainage systems.

To mitigate the impacts the following measures will be carried out by PMU:

- Befor digging sludge from drainage system, contractors shoud be submit a detailed plan of construction time, construction method, traffic management plan and environment sanitation measures.
- Use measures to prevent landslides during dredging, avoid construction time at peak hours.
- Provide appropriate construction methods to accelerate and reduce to the minimum the impact on people living in the project area.

Aerosols and Odors (H2S, NH3, Amino acid and mercaptan) from manholes will be released when the dredging and repair are carried out. It can cause discomfort to local residents living in the radius of 10 m, but it is expected to cause harm to public health. The gas only affects the workers, who dredge manholes without preventive measures. Therefore, workers should be follows the safety regulations.

5.3.3. Operation phase

Key site specific impacts include emissions from **impacts rising from inadequate management and operation.**

(1) Inadequate management and operation activities

Inadequate management and operation activities cause the drainage systems blocked or broken down, overload wastewater in blocked or broken area will be affected surface water or contanminate soil. Therefore, the city should be allocated adequate budget for O &M for drainage system.

(2) Odor and Air pollution:

The risk of temporary odor emissions at the manhole at O &M of the manholes will realease toxic sustances and odors that cause discomport for people living around the project area. Thefore O &M process should be noticed for people living surrounding.

5.4. SITE-SPECIFIC MEASURES FOR URBAN CORRIDOR DEVELOPMENT

5.4.1. Pre-construction

Key potential impacts of the component are considered quite significant. Key site-specific impacts are mainly due to land aquisition and resettlement, demolition of existing structures, accidents due to UXO, domestic waste and garbage: generated from worker camps. Hazardous materials and waste include: oil, petrol, diesel, bitumen, paints, waste oil.

Specific measures for land acquisition and resettment, relocation of public infrastructure, unexploded removal, air pollution/noise/vibration, waste, domestic wasterwater, rainwater runoff impacts are the same activities in pre-construction of flood control works.

5.4.2. Construction

(1)Public safety and Traffic Management/ Traffic congestion

- Coordinate with traffic polices on moderate the traffic flow during rush hours in the areas includes Quang Trung (modul 1);
- Place sign boards near construction sites to direct traffic means to slow down;
- Provide lighting at construction site at night;
- Provision a security guard staff at the entering gates of construction sites of Quang Trung Bridge, Tran Hoang Na Bridge and the Road connecting the Agust Revolution t Provincial Road 918 to moderate vehicle go out and in the construction site.

(2) Safety precaution for the workers:

- 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…

(3) Degradation of public facilities

- 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.

(4) Social impact assessment

- 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.

(5) Water pollution

Minimize the risk of water pollution in the rivers and canals causing by solid arising due to erosion caused by earthworks and construction of road

- Adopt measures to minimize the impacts related to erosion and sedimentation include: finishing construction of road segments before periods of heavy rain;
- Do not arrange the temporary dump in the area of land near the rivers, streams, irrigation canals, and ponds; at the construction site of two bridgeheads' area material storage need covered geotextile and use the temporary mud partitions if necessary to limit sediment runoff into the river.

Minimize the risk of water pollution and sediment generated by mud during the construction of bored piers

- Execution of sequential pairs of symmetrical piers in the river flow. This couple piers construction must be finished before next following couple piers will be built. During construction of each pillar, each pile will be constructed sequentially. Construction of next pile will be continued after the before pile finished.

Minimize the risk of water pollution and sediment from operation and maintenance of facilities and equipment on the floating rigs involved construction of under bridge

- Wastewater generated from operating and maintenance areas of machinery and equipment is not discharged directly into the river, which is given through a partition system has to collect the oil scum before flowing down river .
- The partition made of geotextile layer which allow water through only and keep oil scum. Regular maintenance in order to operation of the partitions is effective.
- Oil scum collected store in drums for disposal according to Circular 36/2015 / TT-BTNMT

Reduce the risk of solid waste pollution from floating rigs in bridge construction

- No direct discharge of waste into the river flow, put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow.
- Arrange 2 different kinds of trash on each floating rigs for containing oil rags and other solid wastes.
- Oil debris will be collected and processed according to Circular 36/2015 / TT-BTNMT
- The different types of waste will be collected and treated as normal waste according to treatment contract with the local garbage disposal units.

Reduce the risk of river water pollution by solid waste spillage when construction on the bridge section

- Using the grid with geotextile liner made shield below the construction of the bridge. Grid helps retaining spillage during the construction materials on the bridge portion to avoid falling into river, even causing accidents for those activities on the river under the bridge. Grid and cover geotextile must be closed enough in order to retain falling objects can not slip through.

- Falling objects must be collected regularly, focused and sorted, the reusable component should be transferred out of the project area and handled according to regulations

Reduce the risk of river water pollution by solid waste not collected after bridge construction

The clearance work of the riverbed must be applied after construction. Contents of clearance work include:

- To remove all temporary works;
- Take away the spilled material;
- Stable bed, shore flow as the initial state.

Reduce the pollution risk of of irrigation water, pond water, small streams and rivers' water causing by stormwater runoff washed away the dirt from the surface of the site

- Limit the distance from the water source: Photomap construction site must be designed so that all temporary works serving construction, temporary material containing area, machinery area, equipment maintenance areas, and worker camps area must be far away from water sources, lakes, canals at least 150 meters.

Reduce pollution from excess bentonite

- For the bentonite waste generated during construction of bored piles and abutments mitigation measures should be conducted as follows:
- During pile construction, bentonite will be circulating in the isolation tank.
- Recirculation tank will be installed a sedimentation compartment to bentonite is not overflowing out of water pollution
- The amount of bentonite mixed soil from the pile will be transported by truck to the regulation landfill. Bentonite has the same characteristics of clay can be used for leveling material.

Reduce the risk of groundwater pollution in piles construction

- Restrictions additive penetration into the groundwater during construction pile: Compliance and completion according to schedule will limit the penetration of chemical liquid containing bentonite into groundwater.
- Prevent dirty surface water to penetrate into the drilling wall during construction pipe: When construction pipe in the location of Can Tho river's flow, watertight enclosure must be constructed higher than the surrounding water level and be constructed in due process to ensure restriction of dirty water penetrating into the drilling wall.

(6) Minimization of impacts due to encroachment safe corridor inland waterway

When construction of the piers of Quang Trung Bridge and Tran Hoang Na Bridge the following measures will be applied to prevent the occurrence of inland waterways accidents.

- Coordinate with the Department of Inland Waterway to reflag the buoys signal system on the Can Tho section at the project construction area;
- To turn on the lights at night at connector (shelves) platform and abutment; The warning devices of construction site would be installed upstream and downstream of the expected bridge to sign to ship owners known.
- To minimize the construction equipment to encroach fairway;
- Limit the construction area. The construction activities are only taken in the area;
- Arranging 01 emergency department on the Can Tho River during construction.

The impact due to water traffic corridors occupation causing by flow occupied serving to execute the pier:

Waterway activities running through Quang Trung Bridge is very busy. The process of piers construction in the Can Tho river bed will make estimated cross-sectional area of the river diminished, to narrow transport corridors as well as causing the risk of river traffic safety loss due to collision between transport vehicles with the construction machinery and equipment.

Due to the road and waterway axises in the project area are the main traffic routes, will be maintained throughout the construction period and are the routes of materials, waste projects transport, so these impacts will must be minimized.

The risk of transport safety loss occurs during the pier construction in the area of Can tho river flow and during the inter-communal and inter-village roads using to transport construction materials. First activity causes waterway safety loss; second activity causes road traffic safety loss.

(7) Air pollution

For excavation and material and waste transport vehicle:

The watering activities have been proposed at least a time per day during the rainy season and twice a day during the dry season in the working areas.

Using trucks with lids or canvas;

Minimizing dust from road leveling activities by watering every day

Clean wheels of vehicle before leaving construction site, dispose location and material quarries.

All material storage areas and material production areas shall be located at least 50 meters from any residence.

For activities of construction machineries:

- The construction machineries and equipment have to be complied with Decision No. 249/2005/QĐ-TTg dated 10/10/2005 of Prime minister, Regulation on Emission roadmap for road transportation vehicles.
- Regulatory maintenance of vehicles and equipment.
- Construction machineries and equipment will not allow moving out of worksite boundary (within the site clearance areas).
- Coordinated transport of materials, spoil and wastes

For activities of asphalt, hot mix plant:

- Check with environmental protection commitment of construction material suppliers, monitoring environmental control requirements compliances of suppliers if the contractor procure.
- The contractor will secure the required environmental approvals prior to establishment and operation of construction facilities and plants if asphalt hot mix, crushing and batching plants selected and proposed by him.
- Asphalt hot mix, crushing and batching plants shall not be located within 1000 m of settlements **(stated in table 4-48).**
- Use dust suppression measures and control activities.
- Asphalt plant conveyers and hoppers will be covered
- Timber and rubber are forbidden as a kind of fuel in the site.

(8) Noise and Vibration

For excavated disposal, waste and material transport:

- Trucks will be permitted to move through these sensitive areas between 8 a.m. and 5 p.m. and at speeds of no more than 30 km/hr maintained through urban areas.
- Truck drivers shall restrict horning in areas close to resident areas as mentioned in **table 4-48.**

For activities of construction machineries:

The Contractor needs to submit the Engineer documents proving that all construction vehicles, equipment, and machines are checked and meet requirements concerning noise and vibration generation of the current Vietnam standards as QCVN26:2010/BTNMT for noise level and QCVN27:2010/BTNMT for vibration emitted by construction works; Priority to mobilize lower noise machines and equipment or facilitating the noise reduction devices and properly maintenance of the equipment.

Turn off the idle machines wherever possible to avoid resonant frequency.

Use of machines generate noise level over >55 dBA at night (from 22:00 to 6:00) will be strictly forbidden and other noisy activities including heavy truck transportation, loading/unloading, beam lifting and stockpile of the materials will be carried out during the day time.

In case that, noise generation equipment need to run during night time nearby the resident areas, the detail schedule will be considered and approved by Consultant Supervision Engineer before could be applied and should be informed by local resident about coming works beforehand.

(9) Solid and hazardous waste generation

Solid waste generation:

For generated form workers 'camps:

- Domestic waste and garbage from worker camps need to be collected by hygienic manner.
- Set up dustbins and mobility septic tanks at work site.
- Domestic waste shall be transported and treated by local environmental companies/co-operatives through contracts
- Shall not be disposed to rivers/cannals and public areas.
- Burning of domestic wastes shall be prohibited
- Activities of construction road and bridges

For hazardous waste generation

- Waste to be collected, transported by adequate manners and treated in approval landfill sites by local authorities.
- Waste will be transported and treated by local environmental companies/co-operatives through contracts.
- Trucks carrying waste spoil will be covered. All trucks used should have well fitted bodies and not be over topped in loading.
- Before construction has completed, the contractor will move construction waste spoil and unused materials to approved disposal sites.

Athough hazardous waste of small volume but could create serious negative impacts on environment so that its must be collected, transported and treated by a licensed agency. Constractors must be followed the ways:

Follow environmental regulations in handling hazardous materials including appropriate storing of materials.

Fuels, oils storage sites and fuel filling activities shall be located away from water courses.

Use and maintain vehicle and machinery properly to avoid accident spills. Prepare emergency plans in case of accidental spills.

Collected, transported and treated under contract with company which has permit for treating hazardous waste disposal according to Circular 36/2015/TT-BTNMT on 30 June, 2015 of MONRE

5.4.3. MEASURES TO MITIGATE IMPACTS DURING THE OPERATION PHASE

For the Quang Trung Bridge, Tran Hoang Na

After construction is completed, there will be operations of various vehicles on the new bridge. Key short term impacts would include an increase in traffic and pedestrian accidents, due to higher standard road allowing more and faster traffic; premature failure of pavements, embankment or and drainage structures due to inadequate maintenance.

To mitigate these impacts the following measures will be carried out by the city road maintenance agency:

- Ensure that traffic safety provisions, including signs, lights, and pavement markings, that were installed during construction are permanently and effectively maintained, and renewed as necessary
- Ensure the city’s operations and maintenance plan, and related budget, includes the work and resources required to maintain the road in its as-completed condition;
- Ensure, with the assistance of the traffic control authority, that overloaded vehicles do not use the road.
- Ensure enough budget for road and bridge maintainace. In general, road and bridge maintenance activities can be classified into three categories: Routine maintenance: comprises a range of small scale and simple activities - usually carried out at least once a year - but usually widely dispersed. Typical activities include roadside verge clearing and cutting back encroaching vegetation, cleaning of silted ditches and culverts, patching and pothole repair, and light grading/reshaping of unsealed surfaces. Periodic maintenance: occurs less frequently - usually after a number of years. Works can include regravelling, resurfacing, resealing and repairs to structures.

For Resettlement in Ninh Kieu District

Wastewater and environmental hygiene: Rain drainage system and wastewater collection system are designed to discharge separately. Rain water is collected into pipe system and discharge directly to Ngon Dau Sau canal. Wastewater from households is collected and treated through septic tank then connected to general sewage of area, and connect to wastewater treatment plant of resettlement area. . Solid waste is collected and transported to the city’s landfill and treated as city’s public service.

To reduce the risk, it will be necessary for the sites to be fully integrated into the city’s overall operations and maintenance program.

CHAPTER 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

Based on the assessment of the potential negative impacts discussed in Chapter 4 and the mitigation measures proposed in the previous Chapter 5, this chapter presents the Environmental and Social Management Plan (ESMP) for subprojects of CTUDR project. The ESMP identifies actions to be carried out under the subproject including the environmental monitoring program and the implementation arrangements, taken into account the need to comply with the Government's EIA regulations and the World Bank (WB)'s safeguard policies, including those of the World Bank Group's Environmental, Health, and Safety Guidelines.

6.1. BASIC PRINCIPLES

As a part of the ESIA, an Environmental and Social Management Plan (ESMP) is a safeguards instrument that is typically used in many projects and which consists of information on and guidance for the process of mitigating and managing adverse environmental impacts throughout project implementation. Typically in Vietnam, an ESMP comprises a list of typical mitigation measures to be carried out by contractors, an environmental monitoring program, organization arrangements, and an estimated monitoring cost.

There is a comprehensive regulatory framework in Vietnam related to ESIA preparation, environmental standards, protection and management of forest and cultural property, and other aspects related to construction and operation of facilities and infrastructures in Vietnam. This ESMP in consistent with these regulations.

To facilitate effective implementation of the ESMP, the PMU will: (a) Establish an Environment and Social Unit (ESU) responsible for ensuring timely implementation of the ESMP, including monitoring, reporting, and capacity building related to safeguards; (b) Assign the Construction Supervision Consultant (CSC) to also be responsible for supervision of the contractor's safeguard performance as part of the construction contract and this requirement will be included in the CSC's terms of reference; and (c) Hire qualified national consultants as the Independent Environmental Monitoring Consultant (IEMC) to assist the ESU in performing its task.

The Can Tho City Water Supply Company, URENCO, and the Department of Transport will be responsible for implementation of the mitigation measures during the operation stage of the project and they will ensure that the mitigation measures are implemented and adequate budget is provided. The Provincial Steering Committee (PSC) chaired by the Chairman or Vice Chairman of the Provincial People's Committee (PCP) will provide the overall policy guidance and oversight of the project implementation. Roles and responsibilities of the specialized agencies and the Departments of Planning and Investment and Natural Resources and Environment (DONRE) will also be critical.

In terms of laying out the mitigation measures of the ESMP, there are two fundamental parts to this ESMP. Firstly, the City has developed and will use Urban Construction Environmental Codes of Practice (ECOPs). These ECOPs outline typical generic low-level impacts that can be expected to occur in a wide range of construction activites of the project. They include mitigation measures for these impacts and a process for including them in the construction contracts of contractors. During the detailed design of technical specifications for each contract, the technical design consultant will incorporate into the contract the parts of the ECOPs specific to that contract, as well as the specific measures identified in the ESMP.

Secondly, all site-specific impacts that are either not covered in the general ECOPs or which are of an order of magnitude that require mitigation measures not covered in the ECOPs, are described in more detail in the ESMP. The mitigation measures are derived from the more detailed analysis of the previous Chapter 3.

Activities to be carried out to mitigate impacts due to land acquisition and resettlement are presented separately (RP and RPF) and they will be carried out and monitored separately.

Some components of the project will finance environmental measures, above and beyond mitigation measures as described in the ESMP. This is the case for Component 4.1 which will finance the PMUs ESMP program, including safeguard training; and Component 4.2 which will finance environmental and resettlement monitoring.

6.2. KEY MITIGATION MEASURES

6.2.1. Urban Construction Environmental Codes of Practice (ECOPs)

Below are the mitigation measures themselves. Types of impacts covered in this document are:

- Dust generation
- Air pollution
- Impacts from noise and vibration
- Water pollution
- Drainage and sedimentation control
- Management of stockpiles, quarries, and borrow pits
- Solid waste
- Management of dredged materials
- Disruption of vegetative covers and ecological resources
- Traffic management
- Interruption of utility services
- Restoration of affected areas
- Worker and public safety
- Communication with local communities
- Chance findings

Table 6.1: Mitigation Measures Extracted From Urban Works ECOPs

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
1. Dust generation	• The Contractor is responsible for compliance with relevant Vietnamese legislation with respect to ambient air quality. • The Contractor shall ensure that the generation of dust is minimized and is not perceived as a nuisance by local residents and shall implement a dust control plan to maintain a safe working environment and minimize disturbances for surrounding residential areas/dwellings. • The Contractor shall implement dust suppression measures (e.g. use water spraying vehicles to water roads, covering of material stockpiles, etc.) as required. • Material loads shall be suitably covered and secured during transportation to prevent the scattering of soil, sand, materials, or dust. • Exposed soil and material stockpiles shall be protected against wind erosion and the location of stockpiles shall take into consideration the prevailing wind directions and locations of sensitive receptors. • Dust masks should be used by workers where dust levels are excessive	• QCVN **13: 2009/BTNMT**: *National technical regulation on ambient air quality*
2. Air pollution	• All vehicles must comply with Vietnamese regulations controlling allowable emission limits of exhaust gases. • Vehicles in Vietnam must undergo a regular emissions check and get certified named: "*Certificate of conformity from inspection of quality, technical safety and environmental protection"* following Decision No. 35/2005/QD-BGTVT; • There should be no burning of waste or construction materials (eg. Bitumen, etc.) on site. • Cement processing plants should be far from residential areas	• **TCVN 6438-2005:** *Road vehicles. Maximum permitted emission limits of exhaust gas.* • No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection; • QCVN 05:2013/BTNMT: *National technical regulation on ambient air quality*

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
3. Impacts from noise and vibration	• The contractor is responsible for compliance with the relevant Vietnamese legislation with respect to noise and vibration. • All vehicles must have appropriate "*Certificate of conformity from inspection of quality, technical safety and environmental protection"* following Decision No. 35/2005/QD-BGTVT; to avoid exceeding noise emission from poorly maintained machines. • When needed, measures to reduce noise to acceptable levels must be implemented and could include silencers, mufflers, acoustically dampened panels or placement of noisy machines in acoustically protected areas. • Avoiding or minimizing transportation through community areas and avoiding as well as material processing areas (such as cement mixing).	• **QCVN 26:2010/BTNMT:** ***National technical regulation on noise*** • **QCVN 27:2010/BTNMT:** ***National technical regulation on vibration***
4. Water pollution	• The Contractor must be responsible for compliance with the relevant Vietnamese legislation relevant to wastewater discharges into watercourses. • Portable or constructed toilets must be provided on site for construction workers. Wastewater from toilets as well as kitchens, showers, sinks, etc. shall be discharged into a conservancy tank for removal from the site or discharged into municipal sewerage systems; there should be no direct discharges to any waterbody. • Wastewater over standards set by relevant Vietnam technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors. • Make appropriate arrangements for collecting, diverting or intercepting wastewater from households to ensure minimal discharge or local clogging and flooding • Before construction, all necessary wastewater disposal permits/licenses and/or wastewater disposal contract have been obtained • At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed or effectively sealed off.	• QCVN 09:2008/BTNMT: National Technical Standard on underground water Quality • QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater; • QCVN 40: 2011/BTNMT: National technical regulation on industrial wastewater; • TCVN 7222: 2002: General requirements on centralized wastewater treatment plant;

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
		
5. Drainage and sedimentation control	• The Contractor shall follow the detailed drainage design included in the construction plans, intended to prevent storm water from causing local flooding or scouring slopes and areas of unprotected soil resulting in heavy sediment loads affecting local watercourses. • Ensure drainage system is always maintained cleared of mud and other obstructions. • Areas of the site not disturbed by construction activities shall be maintained in their existing conditions. • Earthworks, and fill slopes shall be properly maintained, in accordance with the construction specifications, including measures such as installation of drains, use of plant cover. • To avoid sediment-laded runoff that could adversely impact watercourses, install sediment control structures where needed to slow or redirect runoff and trap sediment until vegetation is established. Sediment control structures could include windrows of logging slash, rock berms, sediment catchment basins, straw bales, storm drain inlet protection systems, or brush fences. • The amount of excavated soil will be stored along the route at the locations agreed upon with the local authorities and people. At the same time, the contractor will not have construction plans, earthworks in the rainy season to avoid leaching, water pollution. In the	• TCVN 4447:1987: Earth works-Codes for construction • Decree No. 22/2010/TT-BXD on regulation of construction safety • QCVN 08:2008/BTNMT – National technical regulation on quality of surface water

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
	case of construction during the rainy season, the contractors should have appropriate construction methods to prevent local flooding as embankment, shielding excavated land by canvas, digging temporary drainage ditches and pumping for drying the construction site and limit flooding	
6. Management of stockpiles, quarries, and borrow pits	• Large scale borrow pits or stockpiles will need site-specific measures that go beyond those in these ECOPs. • All locations to be used must be previously identified in the approved construction specifications. Sensitive sites such as scenic spots, areas of natural habitat, areas near sensitive receptors, or areas near water should be avoided. • An open ditch shall be built around the stockpile site to intercept wastewater. • Stockpile topsoil when first opening a borrow pit and use it later to restore the area to near natural conditions. • If needed, disposal sites shall include a retaining wall. • If the need for new sites arises during construction, they must be pre-approved by the Construction Engineer. • If landowners are affected by use of their areas for stockpiles or borrow pits, they must be included in the project resettlement plan. • If access roads are needed, they must have been considered in the environmental assessment	
7. Solid waste	• Before construction, a solid waste control procedure (storage, provision of bins, site clean-up schedule, bin clean-out schedule, etc.) must be prepared by Contractors and it must be carefully followed during construction activities. • Before construction, all necessary waste disposal permits or licenses must be obtained. • Measures shall be taken to reduce the potential for litter and negligent behavior with regard to the disposal of all refuse. At all places of work, the Contractor shall provide litter bins, containers and refuse collection facilities.	• Decree No. 59/2007/ND-CP on solid waste management • Decision No. 23/2006/QD-BTNMT with list of hazardous substance • Circular No. 36/2015/TT-BTNMT on management of hazardous substance

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
	• Solid waste may be tESMPorarily stored on site in a designated area approved by the Construction Supervision Consultant and relevant local authorities prior to collection and disposal through a licensed waste collector, for example, URENCO. • Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. • No burning, on-site burying or dumping of solid waste shall occur. • Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc shall be collected and separated on-site from other waste sources for reuse, for use as fill, or for sale. • If not removed off site, solid waste or construction debris shall be disposed of only at sites identified and approved by the Construction Supervision Consultant and included in the solid waste plan. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas, such as in areas of natural habitat or in watercourses.	
8. Chemical or hazardous wastes	• Chemical waste of any kind shall be disposed of at an approved appropriate landfill site and in accordance with local legislative requirements. The Contractor shall obtain needed disposal certificates. • The removal of asbestos-containing materials or other toxic substances shall be performed and disposed of by specially trained and certified workers. • Used oil and grease shall be removed from site and sold to an approved used oil recycling company. • Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery shall be collected in holding tanks and removed from site by a specialized oil recycling company for disposal at an approved hazardous waste site. • Used oil or oil-contaminated materials that could potentially contain PCBs shall be securely stored to avoid any leakage or affecting workers. The Can Tho DONRE must be contacted for further guidance. • Unused or rejected tar or bituminous products shall be returned to the supplier’s production plant. • Relevant agencies shall be promptly informed of any accidental spill or incident.	• Circular No. 36/2015/TT-BTNMT on management of hazardous substance

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
	• Store chemicals appropriately and with appropriate labeling • Appropriate communication and training programs should be put in place to prepare workers to recognize and respond to workplace chemical hazards • Prepare and initiate a remedial action following any spill or incident. In this case, the contractor shall provide a report explaining the reasons for the spill or incident, remedial action taken, consequences/damage from the spill, and proposed corrective actions.	
9. Management of dredged materials	• Dredging plan should be established including time schedule, method statement to meet the requirements of traffic safety, public health, and environmental sanitation. In order to ensure dredging that is consistent with environmental regulations, key decision makers (local authority, DONRE, utility company, CSC, etc.) must be involved and concur in each key decision point in the process leading to preparation and implementation of a plan. • Characteristics of sludge/sediment should be determined by sampling and analysis if not already fully evaluated during the EIA. Sludge that is heavily contaminated would require measures that go beyond the scope of these ECOPs. • Ensure that dredged material management plans incorporate environmental considerations in the identification of short-term and long-term disposal alternatives, consider methods to reduce dredging, and maximize the beneficial use of dredged materials. • Lixiviate from dredged materials should not be allowed to enter watercourses without appropriate filtering or treatment. • Collected dredged materials have to be processed, as per Vietnamese regulations on waste collection, to ensure safe and environmentally secure transportation, storage, treatment and management • Those involved in handling of sludge should be specialized and have certification of sludge handling. Guidelines for certification of sludge handling is in the Circular No. 36/2015/TT-BTNMT on management of hazardous substance • Sanitary landfill site should meet technical requirements, based on level of potential contamination. In the case of disposal at a dumpsite, a hazardous cell may need to be constructed if sludge is contaminated by heavy metals.	• Decision No. 23/2006/QD-BTNMT with list of hazardous substance • Decree No. 59/2007/ND-CP dated 09 April 2007 on solid waste management • Decree No. 38/2015/ND-CP dated 24 April 2015 on management of waste and scrabs.

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
10. Disruption of vegetative cover and ecological resources	• The Contractor shall prepare a Clearance, Revegetation and Restoration Management Plan for prior approval by the Construction Engineer, following relevant regulations. The Clearance Plan shall be approved by Construction Supervision Consultant and followed strictly by contractor. Areas to be cleared should be minimized as much as possible. • Site clearance in a forested area is subject to permission from Department of Agriculture and Rural Development • The Contractor shall remove topsoil from all areas where topsoil will be impacted on by rehabilitation activities, including temporary activities such as storage and stockpiling, etc; the stripped topsoil shall be stockpiled in areas agreed with the Construction Supervision Consultant for later use in re-vegetation and shall be adequately protected. • The application of chemicals for vegetation clearing is not permitted. • Prohibit cutting of any tree unless explicitly authorized in the vegetation clearing plan. • When needed, erect temporary protective fencing to efficiently protect the preserved trees before commencement of any works within the site. • No area of potential importance as an ecological resource should be disturbed unless there is prior authorization from CSC, who should consult with PMUs, IEMC and the relevant local authorities. This could include areas of breeding or feeding of birds or animals, fish spawning areas, or any area that is protected as a green space. • The Contractor shall ensure that no hunting, trapping shooting, poisoning of fauna takes place.	• Law on Environment protection No. 55/2014/QH13
11. Traffic management	• Before construction, carry out consultations with local government and community and with traffic police. • Significant increases in number of vehicle trips must be covered in a construction plan previously approved. Routing, especially of heavy vehicles, needs to take into account sensitive sites such as schools, hospitals, and markets. • Installation of lighting at night must be done if this is necessary to ensure safe traffic circulation. • Place signs around the construction areas to facilitate traffic movement, provide directions to various components of the works, and provide safety advice and warning.	• Law on traffic and transportation No. 23/2008/QH12 • Law on construction No. 50/2014/QH13 • Circular No.22/2010/TT-BDX dated 03 Dec., 2010 on

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
	• ESMPloying safe traffic control measures, including road/rivers/canal signs and flag persons to warn of dangerous conditions. • Avoid material transportation for construction during rush hour. • Passageways for pedestrians and vehicles within and outside construction areas should be segregated and provide for easy, safe, and appropriate access. Signpost shall be installed appropriately in both water-ways and roads where necessary.	labor safety duringthe construction of civil works.
12. Interruption of utility services	• Planned and unplanned interruptions to water, gas, power, internet services: the Contractor must undertake prior consultation and contingency planning with local authorities about the consequences of a particular service failure or disconnection. • Coordinate with relevant utility providers to establish appropriate construction schedules. • Provide information to affected households on working schedules as well as planned disruptions (at least 5 days in advance). • Interruptions of water supply to agricultural areas must also be avoided. • The contractor should ensure alternative water supply to affected residents in the event of disruptions lasting more than one day. • Any damages to existing utility systems of cable shall be reported to authorities and repaired as soon as possible.	Decree No. 73/2010/ND-CP on administrative penalization security and society issues
13. Restoration of affected areas	• Cleared areas such as borrow pits which are no longer in use, disposal areas, site facilities, workers' camps, stockpiles areas, working platforms and any areas tESMPorarily occupied during construction of the project works shall be restored using landscaping, adequate drainage and revegetation. • Start revegetation at the earliest opportunity. Appropriate local native species of vegetation shall be selected for the planting and restoration of the natural landforms. • Spoil heaps and excavated slopes shall be re-profiled to stable batters, and grassed to prevent erosion; • All affected areas shall be landscaped and any necessary remedial works shall be undertaken without delay, including green-spacing, roads, bridges and other existing works	• Law on Environment protection No. 55/2014/QH13

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
	• Trees shall be planted at exposed land and on slopes to prevent or reduce land collapse and keep stability of slopes • Soil contaminated with chemicals or hazardous substances shall be removed and transported and buried in waste disposal areas. • Restore all damaged road and bridges caused by project activities.	
14. Worker and public Safety	• Contractor shall comply with all Vietnamese regulations regarding worker safety. • Prepare and implement action plan to cope with risk and emergency • Preparation of emergency aid service at construction site • Training workers on occupational safety regulations • If blasting is to be used, additional mitigation measures and safety precautions must be outlined in the ESMP. • Ensure that ear pieces are provided to and used by workers who must use noisy machines such as piling, explosion, mixing, etc., for noise control and workers protection. • During demolition of existing infrastructure, workers and the general public must be protected from falling debris by measures such as chutes, traffic control, and use of restricted access zones. • Install fences, barriers, dangerous warning/prohibition site around the construction area which showing potential danger to public people • The contractor shall provide safety measures as installation of fences, barriers warning signs, lighting system against traffic accidents as well as other risk to people and sensitive areas. • If previous assessments indicate there could be unexploded ordnance (UXO), clearance must be done by qualified personnel and as per detailed plans approved by the Construction Engineer. • Contractors' contracts to include conditions to ensure occupational health and safety; do not differentiate payment between women and men, and those who belong to local ethnic Khmer groups, for work of equal value; prevent use of child labor; and comply with the government's	• Circular No. 22/2010/TT-BXD dated 03 December 2010 on regulation of construction safety • Directive No. 02 /2008/CT-BXD on safety and sanitation issues in construction agencies • TCVN 5308-91: Technical regulation on safety in construction • Decision No. 96/2006/QD-TTg dated 04 May 2006 on management and implementation of bomb mine explosive material disposal.

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
	labor laws and related international treaty obligations ; • Maximize Employment of Women and poor HH during Construction •	
15. Communication with local communities	• Maintain open communications with the local government and concerned communities; the contractor shall coordinate with local authorities (leaders of local wards or communes, leader of villages) for agreed schedules of construction activities at areas nearby sensitive places or at sensitive times (e.g., religious festival days). • Copies in Vietnamese of these ECOPs and of other relevant environmental safeguard documents shall be made available to local communities and to workers at the site. • Reduced playground space, loss of playing fields and car parking: The loss of amenities during the construction process is often an unavoidable source of inconvenience to users in sensitive areas. However, early consultation with those affected, provides the opportunity to investigate and implement alternatives. • Disseminate project information to affected parties (for example local authority, enterprises and affected households, etc) through community meetings before construction commencementfocusing on female headed households, poor and vulnerable • Provide a community relations contact from whom interested parties can receive information on site activities, project status and project implementation results; • Provide all information, especially technical findings, in a language that is understandable to the general public and in a form of useful to interested citizens and elected officials through the preparation of fact sheets and news release, when major findings become available during project phase; • Monitor community concerns and information requirements as the project progresses; • Respond to telephone inquiries and written correspondence in a timely and accurate manner; • Inform local residents about construction and work schedules, interruption of services, traffic detour routes and provisional bus routes, blasting and demolition, as appropriate;	• Decree No. 73/2010/ND-CP on administrative penalization security and society issues

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
	• Provide technical documents and drawings to PC's community, especially a sketch of the construction area and the ESMP of the construction site; • Notification boards shall be erected at all construction sites providing information about the project, as well as contact information about the site managers, environmental staff, health and safety staff, telephone numbers and other contact information so that any affected people can have the channel to voice their concerns and suggestions.	
16. Chance find procedures	If the Contractor discovers archeological sites, historical sites, remains and objects, including graveyards and/or individual graves during excavation or construction, the Contractor shall: • Stop the construction activities in the area of the chance find; • Delineate the discovered site or area; • Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities or the Department of Culture, Sports and Tourism takes over; • Notify the Construction Supervision Consultant who in turn will notify responsible local or national authorities in charge of the Cultural Property of Viet Nam (within 24 hours or less); • Relevant local or national authorities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values; • Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage; • If the cultural sites and/or relics are of high value and site preservation is recommended by the professionals and required by the cultural relics authority, the Project's Owner will need to make necessary design changes to accommodate the request and preserve the site;	• Law on Cultural Heritage 32/2009/QH12 • Decree No. 98/2010/ND-CP dated 21/09/2010 of the Government on implementing a number of articles of Law on cultural heritage and Law on amendment and supplementation of a number of articles of Law on cultural heritage.

ENVIRONMENTAL – SOCIAL ISSUES	MITIGATION MEASURE	VIETNAM CODE/REGULATION
	• Decisions concerning the management of the finding shall be communicated in writing by relevant authorities; • Construction works could resume only after permission is granted from the responsible local authorities concerning safeguard of the heritage.	
17. Land Acquisition and Resettlement	• Prepare Resettlement Plans in accordance with WB Safeguard Policy. • As part of the RPs, income restoration programs (IRPs) will be prepared	
18. Gender	• Work closely with the district women's unions, ward women's unions to mobilize the participation of women and vulnerable in all activities in the project preparation and implementation (public consultation through questionnaires, people's meetings...). • • All public meetings must ensure at least 30% of the participants as women. • Mobilize the participation of the women's unions in the Resettlement Process and in the Income Restoration Program to assist women and vulnerable groups; • Detailed IRP will be set up based on demands of both male and female headed households and vulnerable through individual consultations with women and women's interest groups (such as women's unions).	
19. Risk of HIV/AIDS & Human Trafficking	• Prepare an HIV/AIDS and Human Trafficking Awareness and Prevention Program. • HIV/AIDS awareness and prevention measures to be included in the contractors' contracts	

6.2.2. Site-specific Impacts

Table 6.2 presents site-specific impacts and mitigation measures that are not fully addressed through the application of ECOPs. This may be because the impact is not a typical one and is not included in the ECOPs, because the severity of the impact goes beyond the scope of the mitigation measures in the ECOPs, or because simply of the very specific nature of the mitigation measure that is needed.

Table 6.2: Site Specific Impacts and Mitigation Measures

6.3. COMPONENT 1: FLOOD CONTROL WORKS	
6.4. C1.1: -Construction of polder system i.e. Can Tho river embankment system, rural road, upgrading (section from Ngo Duc Ke to Cai Son canal, 5.5 km long) ;	
6.5. Pre-Construction	
6.6. Impact:	Land acquisition and resettlement
6.7. Mitigation:	Implementation of approved RP in accordance with its provisions In ensuring the participation of woman and vulnerable groups in community consultation meetings/information disclosure to mobilize their active voice for selection of technical option as well as their demand for project implementation.
Implementation mechanisms:	Approved RP
Responsibility:	PMU
Fund source:	City
Monitoring:	Independent Monitoring Consultant
Construction	
Impacts	• Disruption to the market that operates along the banks of the upper section of the channel • Damage to partly completed works by flood • Noise from the extensive pile driving required by the design for the channel protection works • Water quality affected due to the activities of construction works and workers. • Disposal of 100,000 m3 non-contaminated excavated soil/at from the construction of road behind Can Tho embankment and sewer along Can Tho embankment. • Labor safety during construction • Landsile, soil erosion, risk of embankment subsidence
Mitigation:	• Ensure that the detailed design for the channel rehabilitation works explicitly provides for all aspects of the sludge management process: excavation, transport in leak proof and covered trucks, and deposit into suitably prepared sites • Ensure that the detailed design for the embankment include hydrological and geological surveys to ensure sustainable and stable of the embankment. Ensure the contract for the works requires the contractor to prepare a plan for working in the densely inhabited upstream section of the channel in particular, to include how he will organise the works to minimise disruption to the market

	• Ensure also that the contract requires the contractor, before he commences work, to provides a construction plan that sets out how he will maintain the flow in the channel and protect the works from flooding during construction • Ensure that pile driving work is carried out only during daylight hours, on normal working days. • The PMU should encourage the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Inadequate attention to drainage and waste management • Risk on embankment subsidence and cracking • Blockage of the rehabilitated channels, sluice gates, and ship locks due to garbage throwing in the canals.
Mitigation:	• Ensure that the site is included in the city's operations and maintenance plan and budget. • At each ward, a "self-manage" group will be established to manage and protect completed works under the project. Raise awareness of community of preserving, taking care and protecting works in the locality. • It is required to ensure gender equality in "self-manage" groups. In process of operation and maintenance of works, woman will be mobilized to participate in "self-manage" groups to ensure both their role and voice in community activities.
Implementation mechanisms:	City Operations and Maintenance Plan
Responsibility:	City
Fund source:	City
Monitoring:	City
C1.2: Flood control -Cai Khe and Dau Sau sluice gates and shiplocks	
Pre-Construction	
Impact:	None significant
Construction	
Impacts	• None beyond impacts defined in the ECOPs • Waterway traffic is disrupted • Natural waterways are blocked
Mitigation:	• Ensure that contractor prepares and implements a site specific environmental management plan (as required by the contract) for each aspect of the works – site clearance, earthworks, temporary and permanent drainage, pavement works, and traffic and site safety. Specifically, and addition to the general requirements set out in the ECOP: • Ensure that temporary culverts are installed in any natural waterways that are to be crossed by construction traffic

	• Ensure that equipment repair facilities, material stockpiles, and production equipment – batch plants, for example – are set up away from streams, residential areas, and other sensitive sites • The PMU should suggest the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Blockage of sluicegate and shiplock due to garbage throwing in the canal • Inadequate attention to OM causing to flood, odor and sanilization
Mitigation:	• Ensure that the site is included in the city's operations and maintenance plan and budget
Implementation mechanisms:	City Operations and Maintenance Plan
Responsibility:	City
Fund source:	City
Monitoring:	City
C1.3: Flood control- *Improvement of* watercourses in the central area, dredging, upgrading protective embankments, roads, relocation of encroached canal	
Pre-Construction	
Impact:	Land acquisition and resettlement
Mitigation:	Implementation of approved RP in accordance with its provisions
Implementation mechanisms:	Approved RP
Responsibility:	PMU
Fund source:	City
Monitoring:	Independent Monitoring Consultant
Construction	
Impacts	• 125,000 m^3 non-contaminated excavated soil from dredged activities during the construction of sewers along Cai Son cannal. • Landsile, soil erosion, risk of embankment subsidence
Mitigation:	Ensure that the detailed design for the channel rehabilitation works explicitly provides for all aspects of the sludge management process: excavation, transport in leak proof and covered trucks, and deposit into suitably prepared sites. • Ensure that the detailed design for the embankment include hydrological and geological surveys to ensure sustainable and stable of the embankment. • The PMU should suggest the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks.
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor/Detailed design consultant
Fund source:	IDA Credit

Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Odor, leakage of wastewater, adverse health impacts • Soil erosion and embankment subsidence
Mitigation:	• Ensure facilities are included in the city's operation and maintenance plan for schools, and that adequate budget is provided
Implementation mechanisms:	City Operations and Maintenance Plan
Responsibility:	City
Fund source:	City
Monitoring:	City
C1.4: FLOOD CONTROL- Upgrading of 13 canal/ditchs in the urban core area, work includes dredging; embankement either using corase rock or soft embankment (the application of measures to restore the local plants (cypress, coconut, etc.) combined ground reinforcement;	
Pre-Construction	
Impact:	Land acquisition and resettlement
Mitigation:	Implementation of approved RP in accordance with its provisions
Implementation mechanisms:	Approved RP
Responsibility:	PMU
Fund source:	City
Monitoring:	Independent Monitoring Consultant
Construction	
Impacts	• Ordor, disposal of 322,000 m3 organic polluted sludge from dredged ditchs. • Landsile, soil erosion, risk of embankment subsidence
Mitigation:	• Ensure that the detailed design for the channel rehabilitation works explicitly provides for all aspects of the sludge management process: excavation, transport in leak proof and covered trucks, and deposit into suitably prepared sites. Overall, sludge will be disposed at Cai Sau land fill. And the sludge disposal will be mananged carefully to ensure it will be disposed appropriately according to the sludge management plan. • Ensure that the detailed design for the embankment include hydrological and geological surveys to ensure sustainable and stable of the embankment. • The PMU should suggest the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks.
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor/Detailed design consultant
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Odor, leakage of wastewater, adverse health impacts • Soil erosion and embankment subsidence
Mitigation:	• Ensure facilities are included in the city's operation and maintenance plan for schools, and that adequate budget is provided. • At each ward, a "self-manage" group will be established to manage and protect completed works under the project. Raise awareness of

	community of preserving, taking care and protecting works in the locality. It is required to ensure gender equality in “self-manage” groups.(In process of operation and maintenance of works, woman will be mobilized to participate in “self-manage” groups to ensure both their role and voice in community activities.
Implementation mechanisms:	City Operations and Maintenance Plan
Responsibility:	City
Fund source:	City
Monitoring:	City
C1.5: Flood control- Flood control -Develop regulatory lake, water in urban core areas by improving Long Tuyen (University village regulation lake) and Long Hoa regulation lake)	
Pre-Construction	
Impact:	Land acquisition and resettlement
Mitigation:	Implementation of approved RP in accordance with its provisions
Implementation mechanisms:	Approved RP
Responsibility:	PMU
Fund source:	City
Monitoring:	Independent Monitoring Consultant
Construction	
Impacts	• None beyond those defined in the ECOPs
Mitigation:	• As set out in the ECOPs The PMU should suggest the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Odor, sedimentation
Mitigation:	• OM • At each ward, a “self-manage” group will be established to manage and protect completed works under the project. Raise awareness of community of preserving, taking care and protecting works in the locality. It is required to ensure gender equality in “self-manage” groups.(In process of operation and maintenance of works, woman will be mobilized to participate in “self-manage” groups to ensure both their role and voice in community activities.
Implementation mechanisms:	City Operations and Maintenance Plan
Responsibility:	City
Fund source:	City
Monitoring:	City
C2: ENVIRONMENT SANITATION: Improving the drainage system for the roads in Ninh Kieu district center	

Pre-Construction	
Impact:	None significant
Construction	
Impacts	• None beyond those defined in the ECOPs.
Mitigation:	• As set out in the ECOPs • The PMU should suggest the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Odor, leakage of wastewater, adverse health impacts
Mitigation:	• Ensure facilities are included in the city's operation and maintenance plan for schools, and that adequate budget is provided • At each ward, a "self-manage" group will be established to manage and protect completed works under the project. Raise awareness of community of preserving, taking care and protecting works in the locality. It is required to ensure gender equality in "self-manage" groups.(In process of operation and maintenance of works, woman will be mobilized to participate in "self-manage" groups to ensure both their role and voice in community activities
Implementation mechanisms:	City Operations and Maintenance Plan
Responsibility:	city
Fund source:	City
Monitoring:	City
COMPONENT 3: URBAN CORRIDOR DEVELOPMENT	
C3.1: Quang Trung bridge (modul 2): construction of Quang Trung bridge (modul 1) with total length of bridge and connecting road is by 689m., bridge with length of 481m, width B = 11m	
Pre-Construction	
Impact:	Land acquisition and resettlement
Mitigation:	Implementation of approved RP in accordance with its provisions In ensuring the participation of woman and vulnerable groups in community consultation meetings/information disclosure to mobilize their active voice for selection of technical option as well as their demand for project implementation.
Implementation mechanisms:	Approved RP
Responsibility:	PMU
Fund source:	City
Monitoring:	Independent Monitoring Consultant

Construction	
Impacts	• The extensive borrow material required to construct the road embankments –will come from borrow bits where localized impacts are possible • Natural waterways are blocked • Construction traffic causes danger within the construction site and also to residential and other areas outside the site • Vibration from construction equipment damages buildings in close proximity to the construction site • Batch plants, for concrete and asphalt (if erected on site), emit excessive polluted gases and water
Mitigation:	• In addition to the measures below, see all the Alignment Sheet in the following section which provides more information on measures to be taken at some specific areas along the alignment. • Ensure that contractor prepares and implements a site specific environmental management plan (as required by the contract) for each aspect of the works – site clearance, earthworks, temporary and permanent drainage, pavement works, and traffic and site safety. Specifically, and addition to the general requirements set out in the ECOP: – Ensure that there is no land clearance outside defined construction site boundaries – Ensure that, from the commencement of construction, site drainage is a priority activity, to include channels, silt traps, flow abatement structures, etc. – Ensure that borrow areas are developed, operated, closed, and restored in the same manner as earthworks sites for the project works, and that are subject to the same ESMP and other contractual requirements – Ensure that embankments are constructed in a systematic manner, without double handling of materials, and with constructed surfaces stabilized as soon as they are completed – Ensure that the earthworks protection measures defined in the contract, to include natural methods – grassing, shrub and tree planting for example – and artificial methods – stone and concrete surfacing, fiber or geotextile reinforcement, for example – are adapted to site conditions as work proceeds and is completed, and are fully implemented – Ensure that temporary culverts are installed in any natural waterways that are to be crossed by construction traffic – Ensure that equipment repair facilities, material stockpiles, and production equipment – batch plants, for example – are set up away from streams, residential areas, and other sensitive sites – Ensure that all drivers, equipment operators, etc, are qualified for their respective tasks and are trained in, and required to adhere to, the site's traffic management plan – Ensure that production equipment, batch plants for concrete and asphalt, are equipped with dust collection systems correctly operated and maintained, and are connected by pipes or channels to silt and contaminant traps for wastewater

	The PMU should suggest the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks
Implementation mechanisms:	Contract conditions, specifications, and the ECOP
Responsibility:	Contractor/detailed design consultant
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Increased traffic and pedestrian accidents, due to higher standard road allowing more and faster traffic • Premature failure of pavements, embankment slopes, and drainage structures due to inadequate maintenance • Failure of road pavements due to vehicle overloading
Mitigation:	• Ensure that traffic safety provisions, including signs, lights, and pavement markings, that were installed during construction are permanently and effectively maintained, and renewed as necessary • Ensure the city's operations and maintenance plan, and related budget, includes the work and resources required to maintain the road in its as-completed condition • Ensure, with the assistance of the traffic control authority, that overloaded vehicles do not use the road. • At each ward, a "self-manage" group will be established to manage and protect completed works under the project. Raise awareness of community of preserving, taking care and protecting works in the locality. It is required to ensure gender equality in "self-manage" groups.(In process of operation and maintenance of works, woman will be mobilized to participate in "self-manage" groups to ensure both their role and voice in community activities
Implementation mechanisms:	City Operations and Maintenance Plan
Responsibility:	City Drainage Company
Fund source:	City
Monitoring:	City
C3.2: Road and bridge of Tran Hoang Na	
Pre-Construction	
Impact:	• Land acquisition and resettlement
Mitigation:	• Implement approved RP in accordance with its provisions • In ensuring the participation of woman and vulnerable groups in community consultation meetings/information disclosure to mobilize their active voice for selection of technical option as well as their demand for project implementation.
Implementation mechanisms:	Approved RP
Responsibility:	PMU
Fund source:	City
Monitoring:	Independent Monitoring Consultant
Construction	

Impacts	• The extensive borrow material required to construct the road embankments –will come from borrow bits where localized impacts are possible • Natural waterways are blocked • Construction traffic causes danger within the construction site and also to residential and other areas outside the site • Vibration from construction equipment damages buildings in close proximity to the construction site • Batch plants, for concrete and asphalt (if erected on site), emit excessive polluted gases and water
Mitigation:	• In addition to the measures below, see all the Alignment Sheet in the following section which provides more information on measures to be taken at some specific areas along the alignment. • Ensure that contractor prepares and implements a site specific environmental management plan (as required by the contract) for each aspect of the works – site clearance, earthworks, temporary and permanent drainage, pavement works, and traffic and site safety. Specifically, and addition to the general requirements set out in the ECOP: – Ensure that there is no land clearance outside defined construction site boundaries – Ensure that, from the commencement of construction, site drainage is a priority activity, to include channels, silt traps, flow abatement structures, etc. – Ensure that borrow areas are developed, operated, closed, and restored in the same manner as earthworks sites for the project works, and that are subject to the same ESMP and other contractual requirements – Ensure that embankments are constructed in a systematic manner, without double handling of materials, and with constructed surfaces stabilized as soon as they are completed – Ensure that the earthworks protection measures defined in the contract, to include natural methods – grassing, shrub and tree planting for example – and artificial methods – stone and concrete surfacing, fiber or geotextile reinforcement, for example – are adapted to site conditions as work proceeds and is completed, and are fully implemented – Ensure that temporary culverts are installed in any natural waterways that are to be crossed by construction traffic – Ensure that equipment repair facilities, material stockpiles, and production equipment – batch plants, for example – are set up away from streams, residential areas, and other sensitive sites – Ensure that all drivers, equipment operators, etc, are qualified for their respective tasks and are trained in, and required to adhere to, the site's traffic management plan – Ensure that production equipment, batch plants for concrete and asphalt, are equipped with dust collection systems correctly operated and maintained, and are connected by pipes or channels to silt and contaminant traps for wastewater

	The PMU should suggest the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks
Implementation mechanisms:	Contract conditions, specifications supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Increased traffic and pedestrian accidents, due to higher standard road allowing more and faster traffic • Premature failure of pavements, embankment slopes, and drainage structures due to inadequate maintenance • Failure of road pavements due to vehicle overloading
Mitigation:	• Ensure that traffic safety provisions, including signs, lights, and pavement markings, that were installed during construction are permanently and effectively maintained, and renewed as necessary • Ensure the city's operations and maintenance plan, and related budget, includes the work and resources required to maintain the road in its as-completed condition • Ensure, with the assistance of the traffic control authority, that overloaded vehicles do not use the road. • At each ward, a "self-manage" group will be established to manage and protect completed works under the project. Raise awareness of community of preserving, taking care and protecting works in the locality. It is required to ensure gender equality in "self-manage" groups.(In process of operation and maintenance of works, woman will be mobilized to participate in "self-manage" groups to ensure both their role and voice in community activities
Implementation mechanisms:	City operations and maintenance plan
Responsibility:	City Road Maintenance Company
Fund source:	City
Monitoring:	City
C3.3: Connecting road August Revolution (Highway 91) - Provincial road DT918 scale length of about 5.3 km, width of 40m	
Pre-Construction	
Impact:	• Land acquisition and resettlement
Mitigation:	• Implement approved RP in accordance with its provisions • In ensuring the participation of woman and vulnerable groups in community consultation meetings/information disclosure to mobilize their active voice for selection of technical option as well as their demand for project implementation.
Implementation mechanisms:	Approved RP
Responsibility:	PMU
Fund source:	City

Monitoring:	Independent Monitoring Consultant
Construction	
Impacts	• Vegetation clearance, including trees and other vegetation, undertaken indiscriminately, without reference to construction site boundaries • The extensive borrow material required to construct the road embankments – will come from borrow bits where localized impacts are possible • Natural waterways are blocked • Construction traffic causes danger within the construction site and also to residential and other areas outside the site • Vibration from construction equipment damages buildings in close proximity to the construction site • Batch plants, for concrete and asphalt (if erected on site), emit excessive polluted gases and water
Mitigation:	• In addition to the measures below, see all the Alignment Sheet in the following section which provides more information on measures to be taken at some specific areas along the alignment. • Ensure that contractor prepares and implements a site specific environmental management plan (as required by the contract) for each aspect of the works – site clearance, earthworks, temporary and permanent drainage, pavement works, and traffic and site safety. Specifically, and addition to the general requirements set out in the ECOP: – Ensure that there is no land clearance outside defined construction site boundaries – Ensure that, from the commencement of construction, site drainage is a priority activity, to include channels, silt traps, flow abatement structures, etc. – Ensure that borrow areas are developed, operated, closed, and restored in the same manner as earthworks sites for the project works, and that are subject to the same ESMP and other contractual requirements – Ensure that embankments are constructed in a systematic manner, without double handling of materials, and with constructed surfaces stabilized as soon as they are completed – Ensure that the earthworks protection measures defined in the contract, to include natural methods – grassing, shrub and tree planting for example – and artificial methods – stone and concrete surfacing, fiber or geotextile reinforcement, for example – are adapted to site conditions as work proceeds and is completed, and are fully implemented – Ensure that temporary culverts are installed in any natural waterways that are to be crossed by construction traffic – Ensure that equipment repair facilities, material stockpiles, and production equipment – batch plants, for example – are set up away from streams, residential areas, and other sensitive sites – Ensure that all drivers, equipment operators, etc, are qualified for their respective tasks and are trained in, and required to adhere to, the site's traffic management plan

	– Ensure that production equipment, batch plants for concrete and asphalt, are equipped with dust collection systems correctly operated and maintained, and are connected by pipes or channels to silt and contaminant traps for wastewater The PMU should suggest the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks
Implementation mechanisms:	Contract conditions, specifications supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Increased traffic and pedestrian accidents, due to higher standard road allowing more and faster traffic • Premature failure of pavements, embankment slopes, and drainage structures due to inadequate maintenance • Failure of road pavements due to vehicle overloading
Mitigation:	• Ensure that traffic safety provisions, including signs, lights, and pavement markings, that were installed during construction are permanently and effectively maintained, and renewed as necessary • Ensure the city's operations and maintenance plan, and related budget, includes the work and resources required to maintain the road in its as-completed condition • Ensure, with the assistance of the traffic control authority, that overloaded vehicles do not use the road • At each ward, a "self-manage" group will be established to manage and protect completed works under the project. Raise awareness of community of preserving, taking care and protecting works in the locality. It is required to ensure gender equality in "self-manage" groups.(In process of operation and maintenance of works, woman will be mobilized to participate in "self-manage" groups to ensure both their role and voice in community activities
Implementation mechanisms:	City operations and maintenance plan
Responsibility:	City Road Maintenance Company
Fund source:	City
Monitoring:	City
C3.4: ***Construction serves residential resettlement in Ninh Kieu District, covering about 40 hectares, ensure appropriate planning with public utility, social infrastructure as required, ensuring conditions for the people***	
Pre-Construction	
Impact:	• Land acquisition and resettlement
Mitigation:	• Implement approved RP in accordance with its provisions In ensuring the participation of woman and vulnerable groups in community consultation meetings/information disclosure to mobilize their active voice for selection of technical option as well as their demand for project implementation.

Implementation mechanisms:	Approved RP
Responsibility:	PMU
Fund source:	City
Monitoring:	Independent Monitoring Consultant
Construction	
Impacts	• None beyond those defined in the ECOPs
Mitigation:	• As set out in the ECOPs • The PMU should suggest the Construction Contractors to use local laborers (both male and female and especially vulnerable groups) for simple and unskilled tasks
Implementation mechanisms:	Contract conditions, specifications supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Odour, wastewater, solid waste
Mitigation:	• OM • The detailed design shall ensure that the generated wastewater will be collected and treated by the wastewater treatment plant constructed within the resettlement area constructed under the project • At each ward, a "self-manage" group will be established to manage and protect completed works under the project. Raise awareness of community of preserving, taking care and protecting works in the locality. It is required to ensure gender equality in "self-manage" groups.(In process of operation and maintenance of works, woman will be mobilized to participate in "self-manage" groups to ensure both their role and voice in community activities)
Implementation mechanisms:	City/Detailed design
Responsibility:	City
Fund source:	City
Monitoring:	City

6.7.1. Management of Impacts on Physical Cultural Resources

Based on the ESIA study and the preparation of the RP, about 84 graves will be relocated for the project. Relocation of the 84 graves has been incorporated in the RP.

Based on the ESIA study and the preparation of the RP, non sensitive works, temples, historical sites, and natural conservation areas are affected by land acquisition.

If in the construction phase, specific procedures are to be applied in case of archeological artifact finds. The Figure 2 below identifies steps to be taken. The PMU will be responsible for the overall coordination and reporting. The chance find procedures will be included in all construction contracts and key staff and contractors will be trained on how to implement them.

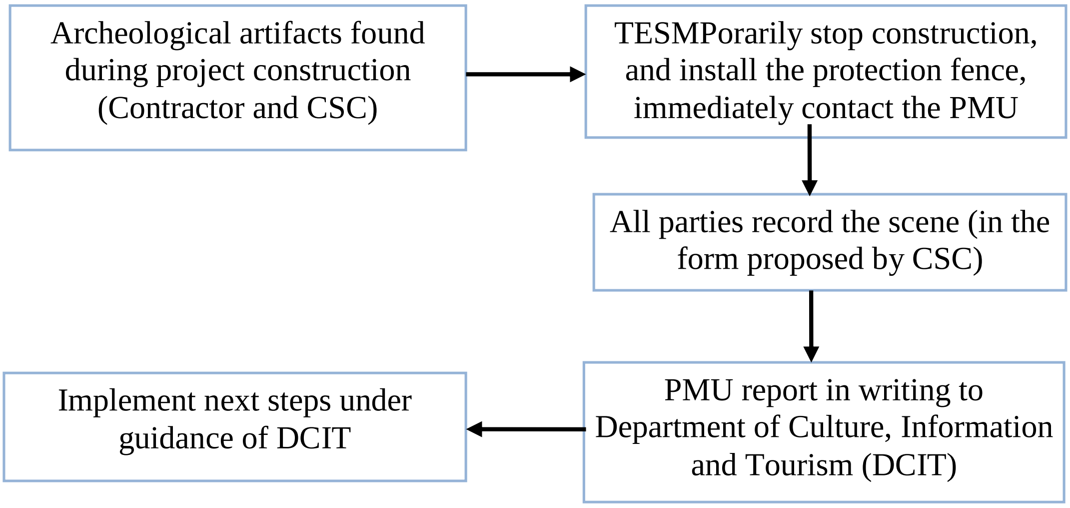


Figure 6.1: Chance-finds procedure to follow in case of archeological artifacts found during the project construction.

6.8. ENVIRONMENT MONITORING PROGRAM

Environmental Monitoring

It is essential to design the monitoring program and monitoring frequency appropriately to be able to record both the overall performance of the project works as well as the short-term impacts due to construction activities. The environmental monitoring program will be implemented during construction at three levels:

- *Monitoring the level of compliance with mitigation measures,*
- *Community-based Monitoring, and*
- *Monitoring the environmental parameters set out in the ESIAs for each of the works.*

6.8.1. Objective and Approach

Main objective of the Environment Monitoring program is to ensure that (a) the potential negative impacts of the project are minimized; (b) the ESMP is effectively implemented; and (c) the ESMP is adequate to mitigate the potential negative impacts. Given that monitoring the implementation of the RP will be conducted separately, the environmental monitoring program will comprise (a) monitoring the safeguard performance of the contractor during site clearance and construction, (b) environmental quality monitoring, (c) monitoring effectiveness of the ESMP.

6.8.2. Monitoring of Contractor's Safeguard Performance

Three levels of safeguard monitoring will be implemented: routine monitoring, periodic monitoring, and community monitoring as follows:

- Routine monitoring: The routine monitoring will be made by the Construction Supervision Consultant (CSC) as assigned by PMU. The CSC will include the monitoring results in the project progress reports.
- Periodic monitoring (every six months): As part of the overall monitoring of the ESMP, the ESU assisted by the Independent Environmental Monitoring Consultant (IEMC) will also monitor the contractor performance every 6 months and the results will be reported to the PMU and the WB.
- Community monitoring: Monitoring by local communities will be conducted following the Government practices with the technical and management support from the PMU.

6.8.3. Environmental Quality Monitoring

To ensure an acceptable level of environmental quality, monitoring of dust, noise, vibration, air quality, and water quality will be made at project specific locations that are likely to be significantly affected by the construction activities, or requested by local authorities and communities for specific purposes. ESU/IEMC will be responsible for the monitoring of the program.

Below is a list of the key issues and scope of monitoring that will be considered in the implementation of the monitoring program:

- Implementation of the Dredge Material Management Plan (DMMP) for all sludge and similar material excavated from the project work sites: Amount, level of heavy metals, locations and performance at disposal sites, and impacts on local residents will be monitored. Outline DMMPs will be prepared during detailed design, and will be used as the basis for contractors' dredged materials management plans.
- General Construction Impacts: To include local flooding; traffic management especially in residential areas; air, noise, and dust levels in residential areas; and water quality upstream and downstream of construction sites, with specific attention paod and impact on local residents;
- Others: As agreed with local agencies and communities during the preparation of the monitoring program.

Tables 6.3, 6.4, 4.7, and 4.8 provide general guidance on the monitoring program and estimated cost considering that the activities will be carried out before construction (project baseline environment), during construction (assumed 5 years), and during the first year of operation. Detailed monitoring programs will be prepared during the detailed design stage. An estimated cost for monitoring is incorporated into the ESMP cost (Section 6.6). Many of these measurements are required by Vietnamese regulations and would need to be done even if not directly related to expected project impacts.

Table 6.3: Scope of environmental monitoring during construction

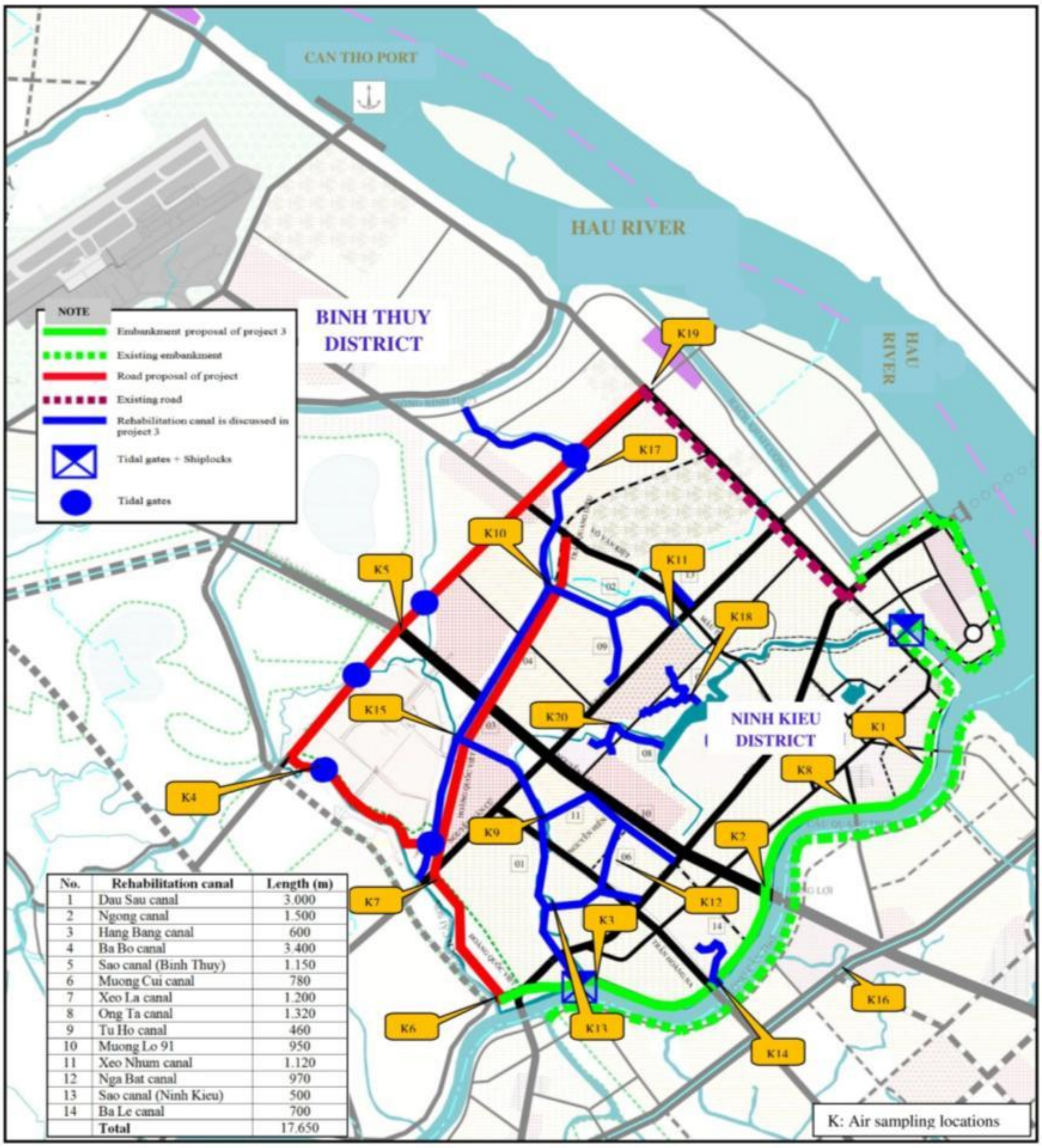
No.	Item	Pre-construction	Construction phase	Operation phase
I	**Environment checklist sheet for constructors**			
	1. Parameter	-	All mitigation measures at construction site	-
	2. Frequency	-	03 months/time	-
	3.Applied standard	-	According to ESMP document	-
	4. Monitoring position	-	At all construction sites	-
II	**Ambient air and noise/vibration monitoring**			
	1. Parameter	TSP, CO, NO_2, SO_2, L_{eq}, vibration	TSP, CO, NO_2, SO_2, L_{eq}, vibration	TSP, CO, NO_2, SO_2, L_{eq}, vibration
	2. Frequency	01 time before construction	06 months/time	Do not monitor
	3. Applied standard	QCVN 05:2013/BTNMT, QCVN 06:2009/BTNMT; QCVN 26:2010/BTNMT; QCVN 27:2010/BTNMT		
	4. Monitoring position	35 samples (Sampling locations are presented in Appendix)	20 samples (Figure 6.2)	
III	**Soil quality monitoring**			

	1. Parameter	As, Cd, Cu, Pb, Zn, Phá mẫu phân tích kim loại	As, Cd, Cu, Pb, Zn, Phá mẫu phân tích kim loại	As, Cd, Cu, Pb, Zn, Phá mẫu phân tích kim loại
	2. Frequency	01 time before construction	06 months/time (write report each 6 months/time)	Do not monitor
	3. Applied standard	QCVN 03:2008/BTNMT		
	4. Monitoring position	20 (Sampling locations are presented in Appendix)	10 samples (Figure 6.3)	-
IV	**Surface water quality monitoring**			
	1. Parameter	pH, DO, COD, BOD, N-NH4+, N-NO2-, N-NO3-, P-PO43-, oil & grease, Coliform, Cl-, Fe, TSS	pH, DO, COD, BOD, N-NH4+, N-NO2-, N-NO3-, P-PO43-, oi&grease, Coliform, Cl-, Fe, TSS	pH, DO, COD, BOD, N-NH4+, N-NO2-, N-NO3-, P-PO43-, oi&grease, Coliform, Cl-, Fe, TSS
	2. Frequency	01 time before construction	06 months/time	Do not monitor
	3. Applied standard	QCVN 08:2008-BTNMT		
	4. Monitoring position	30 samples (Sampling locations are presented in Appendix)	15 samples (Figure 6.4)	
V	**Groundwater quality monitoring**			
	1. Parameter	pH, hardness, Cl^-, Mn, F-, $N\text{-}NH_4$, $N\text{-}NO_2$, $N\text{-}NO_3$, SO42-, E-coli, Coliform, As, Fe	pH, hardness, Cl^-, Mn, F-, $N\text{-}NH_4$, $N\text{-}NO_2$, $N\text{-}NO_3$, SO42-, E-coli, Coliform, As, Fe	pH, hardness, Cl^-, Mn, F-, $N\text{-}NH_4$, $N\text{-}NO_2$, $N\text{-}NO_3$, SO42-, E-coli, Coliform, As, Fe
	2. Frequency	01 time before construction	06 months/time	Do not monitor
	3. Applied standard	QCVN 09:2008-BTNMT		
	4. Monitoring position	25 samples (Sampling locations are presented in Appendix)	10 samples (Figure 6.5)	
VI	**Wastewater quality monitoring**			
	1. Parameter	pH, BOD_5, COD, H2S, $N\text{-}NH_4$, $N\text{-}NO_3$, $P\text{-}PO_4$, oil & grease, Coliforms, TSS	pH, BOD_5, COD, H2S, $N\text{-}NH_4$, $N\text{-}NO_3$, $P\text{-}PO_4$, oil & grease, Coliforms, TSS	pH, BOD_5, COD, H2S, $N\text{-}NH_4$, $N\text{-}NO_3$, $P\text{-}PO_4$, oil & grease, Coliforms, TSS
	2. Frequency	01 time before construction	06 months/time	Do not monitor
	3. Applied standard	QCVN 14:2008/BTNMT		
	4. Monitoring position	25 samples (Sampling locations are presented in Appendix)	15 samples (Figure 6.6)	-
VII	**Sediment and sludge quality monitoring**			

	1. Parameter	As, Cd, Cu, Pb, Zn, Phá mẫu phân tích kim loại	As, Cd, Cu, Pb, Zn, Phá mẫu phân tích kim loại	As, Cd, Cu, Pb, Zn, Phá mẫu phân tích kim loại
	2. Frequency	01 time before construction	Do not monitor	Do not monitor
	3. Applied standard	QCVN 43:2012/BTNMT		
	4. Monitoring position	20 (Sampling locations are presented in Appendix)		
VIII	**Phytoplankton**			
	1. Parameter	Species composition and number of plant plankton cell	Species composition and number of plant plankton cell	Species composition and number of plant plankton cell
	2. Frequency	01 time before construction	06 months/time	Do not monitor
	3. Monitoring position	30 samples (Sampling locations are presented in Appendix)	15 samples (Figure 6.7)	

Maps of environmental monitoring locations in contruction phase and operation phase is presented in Figure 6.2 to 6.7.

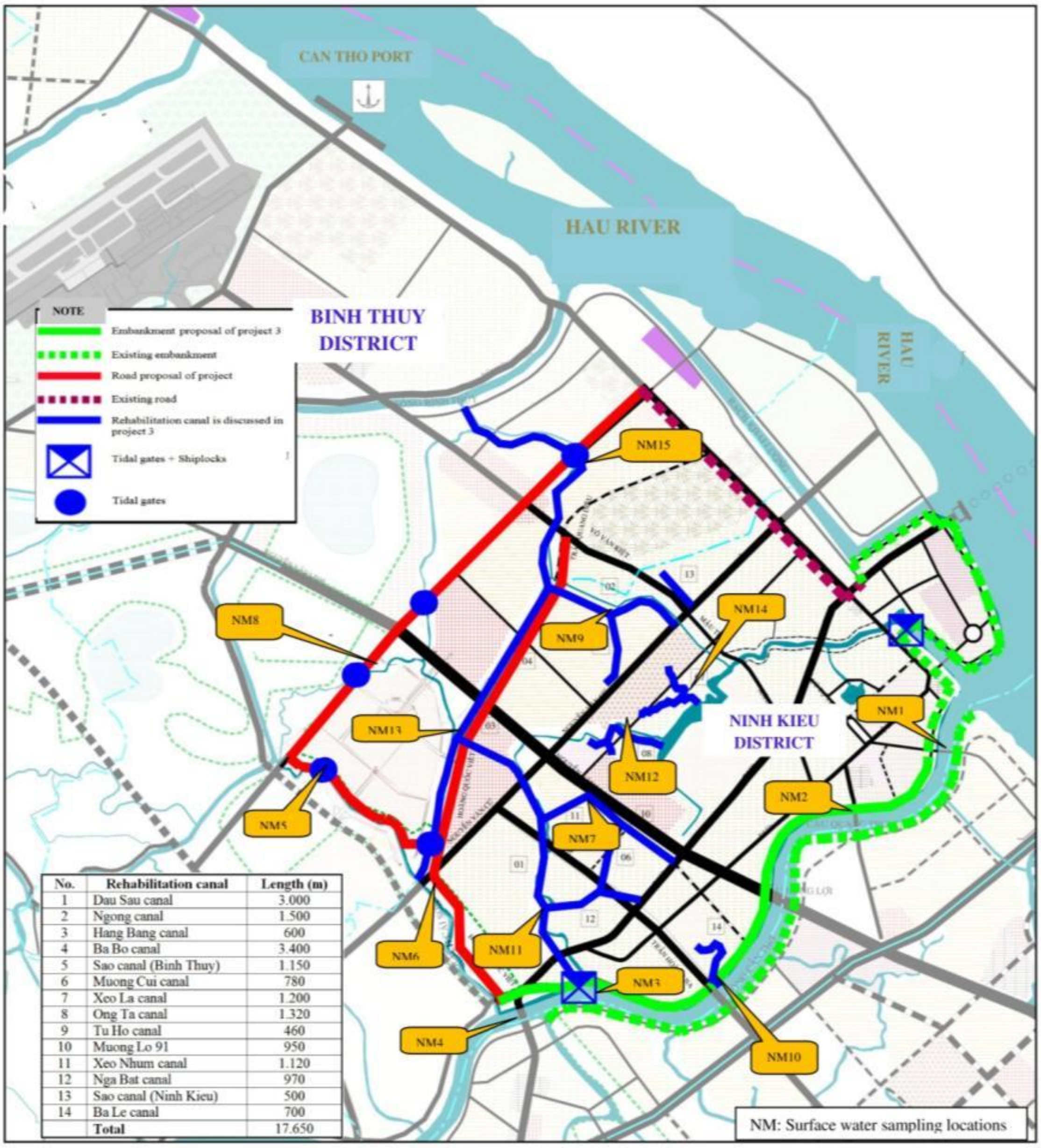
AIR SAMPLING LOCATIONS MAP
CAN THO URBAN DEVELOPMENT AND RESILIENCE PROJECT



No.	Rehabilitation canal	Length (m)
1	Dau Sau canal	3.000
2	Ngong canal	1.500
3	Hang Bang canal	600
4	Ba Bo canal	3.400
5	Sao canal (Binh Thuy)	1.150
6	Muong Cui canal	780
7	Xeo La canal	1.200
8	Ong Ta canal	1.320
9	Tu Ho canal	460
10	Muong Lo 91	950
11	Xeo Nhum canal	1.120
12	Nga Bat canal	970
13	Sao canal (Ninh Kieu)	500
14	Ba Le canal	700
	Total	17.650

Figure 6.2: Air sampling location map in construction phase and operation phase

SURFACE WATER SAMPLING LOCATIONS MAP
CAN THO URBAN DEVELOPMENT AND RESILIENCE PROJECT



No.	Rehabilitation canal	Length (m)
1	Dau Sau canal	3.000
2	Ngong canal	1.500
3	Hang Bang canal	600
4	Ba Bo canal	3.400
5	Sao canal (Binh Thuy)	1.150
6	Muong Cui canal	780
7	Xeo La canal	1.200
8	Ong Ta canal	1.320
9	Tu Ho canal	460
10	Muong Lo 91	950
11	Xeo Nhum canal	1.120
12	Nga Bat canal	970
13	Sao canal (Ninh Kieu)	500
14	Ba Le canal	700
	Total	17.650

Figure 6.3: Surface water sampling location map in construction phase and operation phase

UNDERGROUND WATER SAMPLING LOCATIONS MAP
CAN THO URBAN DEVELOPMENT AND RESILIENCE PROJECT

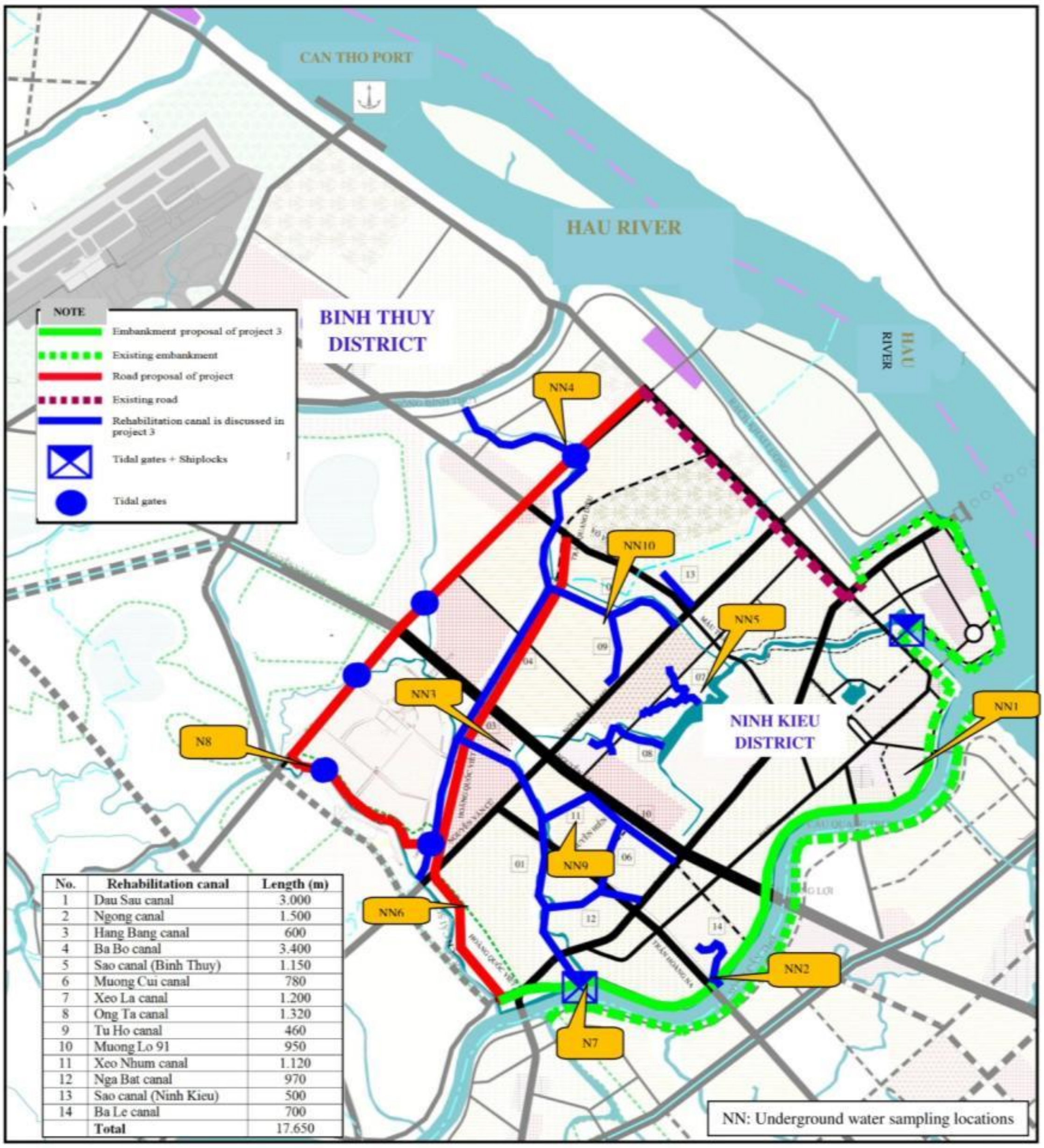


Figure 6.4: Underground water sampling location map in construction phase and operation phase

WASTE WATER SAMPLING LOCATIONS MAP
CAN THO URBAN DEVELOPMENT AND RESILIENCE PROJECT

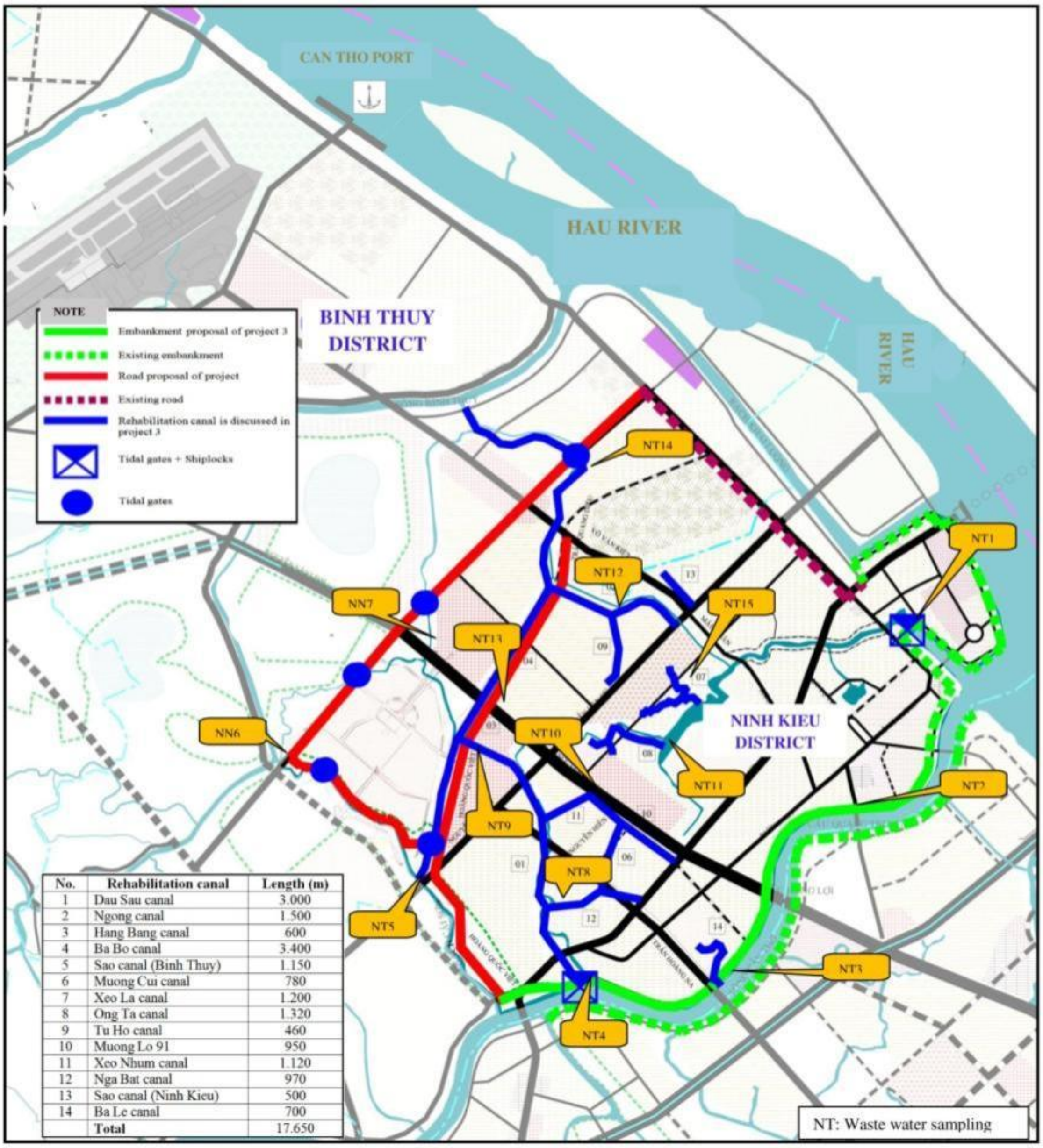
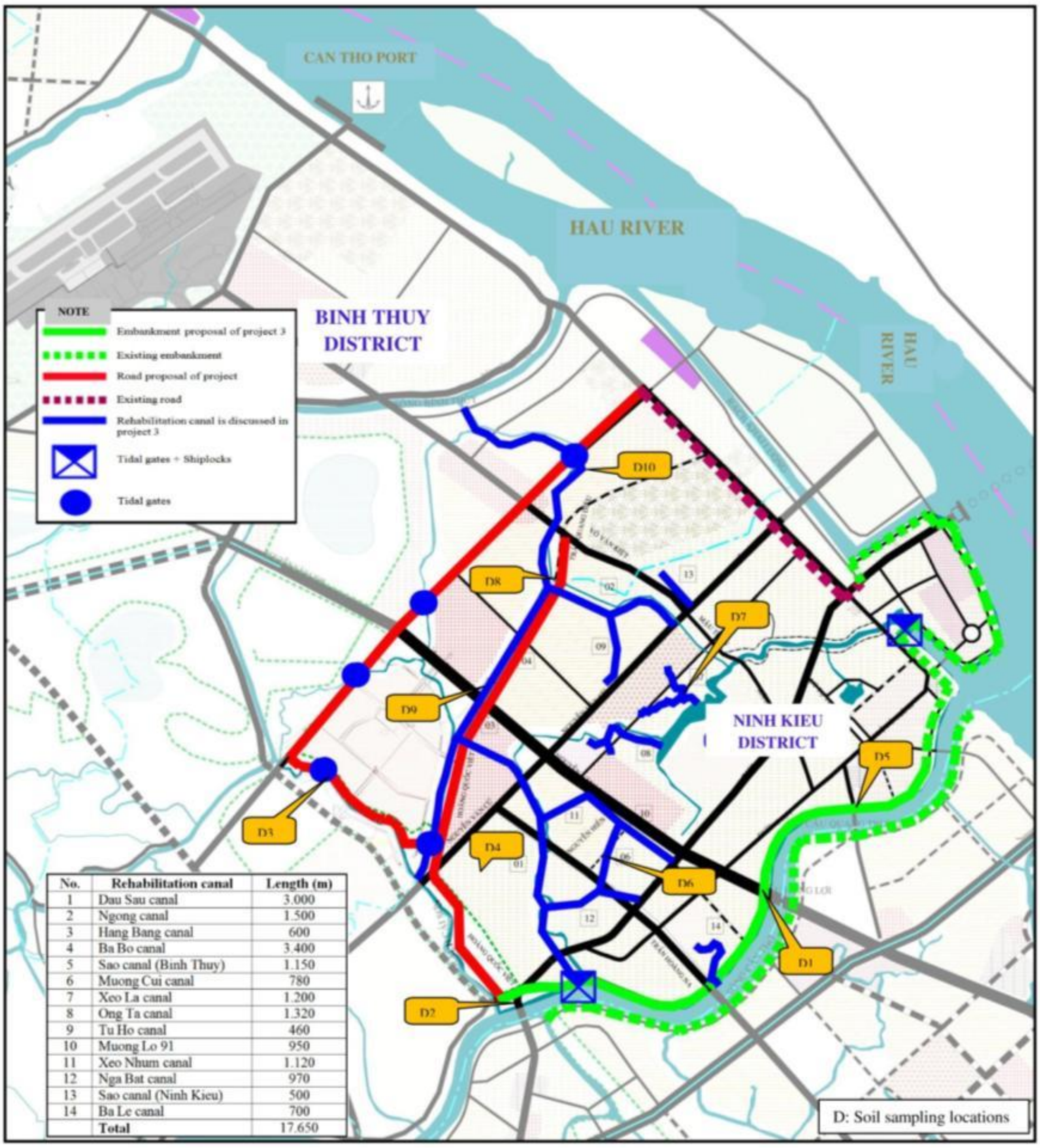


Figure 6.5: Waste water sampling location map in construction phase

SOIL SAMPLING LOCATIONS MAP
CAN THO URBAN DEVELOPMENT AND RESILIENCE PROJECT



No.	Rehabilitation canal	Length (m)
1	Dau Sau canal	3.000
2	Ngong canal	1.500
3	Hang Bang canal	600
4	Ba Bo canal	3.400
5	Sao canal (Binh Thuy)	1.150
6	Muong Cui canal	780
7	Xeo La canal	1.200
8	Ong Ta canal	1.320
9	Tu Ho canal	460
10	Muong Lo 91	950
11	Xeo Nhum canal	1.120
12	Nga Bat canal	970
13	Sao canal (Ninh Kieu)	500
14	Ba Le canal	700
	Total	17.650

Figure 6.6: Soil water sampling location map in construction phase

PLANKTON SAMPLING LOCATIONS MAP
CAN THO URBAN DEVELOPMENT AND RESILIENCE PROJECT

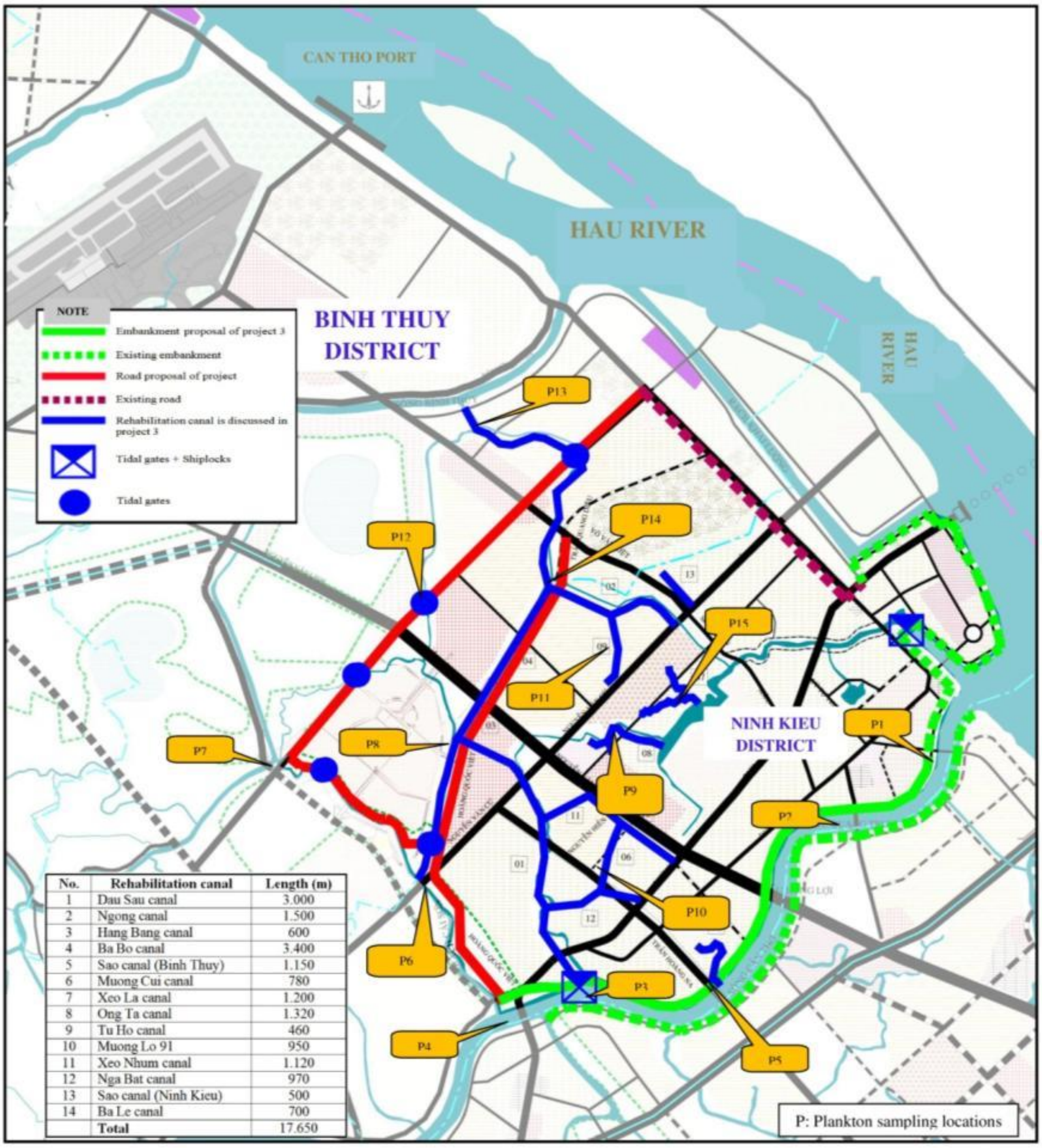


Figure 6.7: Plankton sampling location map in construction phase and operation phase

Table 6.4: Estimated cost for samples collection and analysis

(Exchange rate: 1 USD = 22,450 VND)

No.	Monitoring content	Frequency	Number of sample	Total of sample	Unit price (VND)	Amount (VND)	Amount (USD)
I	**Construction phase**						
	Frequency: 3 months/time: 12 times in Construction phase						
	Frequency: 6 months/time: 6 times in Construction phase						
1	Checklist /auditing at construction sites	Every month	12	144	150,000	21,600,000	962
2	Air quality, noise and vibration	Every 06 months	20	120	805,000	96,600,000	4,303
3	Soil	Every 06 months	10	60	850,000	51,000,000	2,272
4	Surface water	Every 06 months	15	90	1,794,000	161,460,000	7,192
5	Groundwater	Every 06 months	10	60	1,538,000	92,280,000	4,110
6	Wastewater	Every 06 months	15	90	1,460,000	131,400,000	5,853
7	Phytoplankton	Every 06 months	15	90	1,400,000	126,000,000	5,612
	Total					**680,340,000**	**30,305**

6.8.4. Monitoring Implementation Performance of DMMP

To ensure that dredging, transportation, and disposal activities will not create adverse impacts on local residents and environment, a guideline for preparation and monitoring of the DMMP is provided in box below. Accordingly, the detailed design will include a comprehensive testing program and the development of a DMMP, reflecting the guidelines below as appropriate.

A guideline for preparation and monitoring of a DMMP

Main environmental and social issues related to contaminated dredge materials are: (a) Pollution during the transport of the dredged soil from the dredging site to the disposal area; (b) Potential increase in turbidity and pollution of the water in the lakes/canals during dredging; (c) Odor and other disturbance to local residents; (d) and Potential misuse of the contaminated dredged materials for public infrastructure and households. To facilitate the preparation of a DMMP given that the activities will be carried out in an urban area and/or existing water body that may be used by other water users, the following aspects should also be considered:

- *Assessing the quality of the sediments.* The assessment will be carried out to confirm that the sediments will not include large amount of environmentally harmful materials such as heavy metals and/or other toxic substance. If these materials are found to be more than the thresholds stipulated by the national standards, a special disposal plan should be prepared with a monitoring plan. The special disposal plan should also set out a program to protect the nearby community residents from using the disposed dredged materials for house construction or gardening. The bottom sediment/sludge samples will be undertaken for analysis for key pollutants according to the national standards. The sampling and analytical methods should be in line with the Government regulations while the sampling locations will depend on the risk level for each specific site:

-

Volume of Spoils in cubic m	No of Sediment Samples
Up to 25,000	3
25,000 to 100,000	4-6
100,000 to 500,000	6-10
500,000 to 2,000,000	10-20
For each 1,000,000 above 2,000,000	Additional 10

- *Identifying the available land for disposing the dredged materials.* The plan should identify the landfill sites and/or land that could be appropriate for the disposal of dredged materials in line with the level of risk associated with it. Public land, land for construction of rural roads, public works, private land, etc. may be used, with an agreement with the project affected households. If the risk due to contamination of sludge is high the sludge materials will be disposed of at Nhi Phu sanitary landfill which has been in operation.
- *Preparing for a dredging and transportation plan.* Dredging procedures and transportation plan will be prepared outlining: (a) methods of dredging (pipeline, water pumping before digging, etc.) and uploading to the disposal area and/or transportation vehicles, and/or temporary storage site. If trucks are used, indicate proposed route of the transport from the dredged site to the disposal area, (b) time of operation, (c) type of vehicles/trucks and proposed measures to reduce the leakage of the dredged materials from the transport trucks, (d) contractors' responsibilities for cleaning the roads and carry out remedial works if necessary, and (e) a communication plan for the nearby communities including contact number for possible complaints.
- *Temporary storage/disposal for uncontaminated sediment/mud.* As the dredged materials are in the state of mud at first before settled for 24 to 48 hours. All drainage water from disposal land shall be driven to the drains and discharged back to the canal/lakes. For areas with highly contaminated with organic material and create odor, dredge material/sludge should be hauled by close tanker outside the construction site as soon as possible. For bottom sediment with low contamination of organic materials, the dredged sediment will be transported to a containing area which is appropriately located and properly design with an adequate size. A monitoring plan for tracking the disposal of high contaminated materials will also be prepared.
- *Identifying key area and/or receptacles (business, schools, public services, etc.) that are sensitive to dredging and transportation.* The DMMP shall carry out an inventory analysis on the possible affected local businesses, access to water, and transportation (mainly due to the dredging) and provide a plan to mitigate and/or compensate for the disturbances. The plan should include all measures necessary to avoid impacts on local transportation and water supply access to local residents as much as possible.
- *Identify other key water users.* If dredging occur in water bodies (such as lakes, rivers/stream) where there are potential other water users that may be affected by dredging, prepare a water quality monitoring plan with specific stations and parameters that could be used to monitor the potential impacts to the water users. Priority should be given to monitor the areas that are sensitive to change in water quality (high suspended solid (SS), low pH, high BOD or COD, high salinity, etc.) especially where the water is

used as a source of water supply for domestic and agricultural uses. In areas where dredging may cause negative impacts to these water users, respective subproject owner is required to inform/consult them and develop a series of actions to address their concerns, including conduct water quality monitoring in the DMMP.

6.8.5. Monitoring Effectiveness of the ESMP

The ESU assisted by IEMC will monitor performance of the ESMP implementation during the detailed design/bidding stage as well as during construction and first year operation of the facilities to ensure that (a) appropriate dredging and disposal of drainage sludge is properly carried out, in accordance with the DMMP, 9b) other impacts identified in the ESMP are effectively managed and mitigated; and (c) traffic management is adequate and the level of impacts are acceptable (no complaints or outstanding cases. Results/are to be properly kept in the project file for possible review by PMU and the WB. Cost for the monitoring will be part of the PMU cost.

6.9. ROLE AND RESPONSIBILITIES FOR ESMP IMPLEMENTATION

6.9.1. Organization Arrangement

The table 6.5 and figure 6.9 below summarizes roles and responsibilities of the key parties and their relationships regarding the implementation of the ESMP while those for the PMU, CSC, and IEMC are highlighted below while more details are provided in Section 4.4.2. Contractors are responsible for implementing mitigation measures. Measures will be included in bidding documents and costs are to be included in construction bids;

- CSC is responsible for monitoring the day-to-day implementation of mitigation measures. Cost included in CSC service contract;
- IEMC will be responsible for environmental monitoring which includes support to the PMU for implementing supervision and monitoring, and reporting on the implementation through monitoring reports.

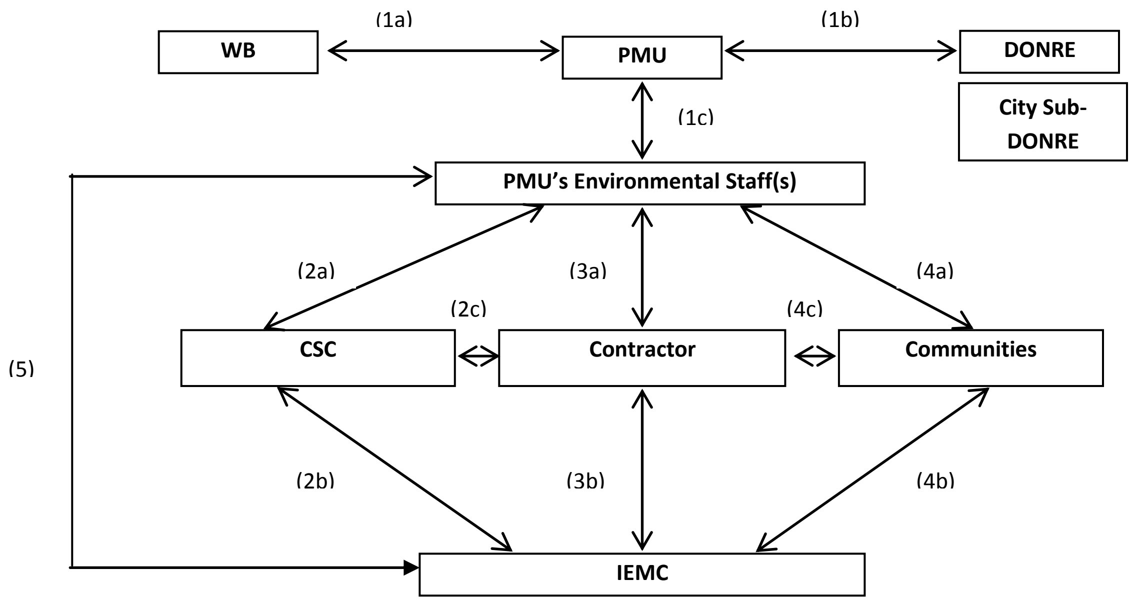


Figure 6.8: Organization Diagram for the ESMP Implementation

Table 6.5: Roles and responsibilities of key parties (Description referred to Figure 6.9)

Description	Roles/Responsibilities
(1a) (1b)	Based on quarterly reports of IEMC, PMU is responsible for preparing periodic reports to submit to WB and to the Provincial DONRE.
(1c)	PMU assigns the safeguard staff (ESU) to review and check the related sections in the Contract Documents on the bidding packages for construction items of the project to ensure compliance with ESMP PMU assigns the safeguard staff (ESU) to supervise, manage and carry out ESMP activities and also assigns CSC to closely supervise/monitor safeguard performance of the contractor, including undertaking the environmental monitoring program. PMU/ESU establishes a hotline communication with local community to be responsive to the complaints, comments, and/or recommendations from local people and/or the public throughout the site clearance and construction period.
(2a)	CSC submits periodic monitoring report of environmental mitigation measures to PMU; Recommends to the PMU to suspend in part or completely, construction works if it does not meet labor safety and environmental protection requirements of the contract. PMU reviews CSC's periodical reports to ensure compliance with mitigation measures.
(2b)	CSC: Support, collaborate with IEMC to establish, collect and point out information about essential environmental parameters in the field and information for construction implementation; IEMC: Monitor the implementation of the ESMP every 3 months including submission of the field report. Create database of results from environmental supervision and monitoring and train PMU in using such database Coordinate with CSC on monitoring and preparation of safeguard reports on ESMP performance; enhance capacity for CSC through a training program on environmental supervision
(3a)	Contractor: Before construction, with assistance from IEMC, prepare a site-specific environment management plan (S-ESMP) during site clearance and construction process as part of their construction method statement, then submit it to CSC and/or PMU for review and approval; During construction, the contractor has to submit a monthly report on safeguard issues, mitigation, and results throughout the construction period. In case of unexpected problem, the contractor will consult CSC/PMU. PMU/CSC: reviews the SESMP and can propose change as deemed necessary to be in line with the legal obligations as well as appropriate to each specific site. Daily supervision and monitoring of contractor's safeguard performance will be responsibility of the CSC.

(3b)	Contractor: Carry out the ESMP required during site clearance and construction, including conduct self-monitoring and submission of report. IEMC: periodically supervise and monitor the overall project ESMP implementation including provision of safeguard training to PMU/ESU staff, community, CSC, and contractors as needed. The training will be designed to enhance the effectiveness of the ESMP implementation and reporting.
(4a)	Community: According to Vietnamese practice, the community has the right and responsibility to routinely monitor environmental performance during construction to ensure that their rights and safety are adequately protected and that the mitigation measures are effectively implemented by contractors and/or PMU. In case of unexpected problems, they will report to CSC/PMU and/or call the hotline. PMU: Encourage, support and create good conditions for local community to participate in the environmental supervision and monitoring activities. PMU/CSC will review and response to the requests and/or recommendations made by community to ensure that the potential negative impacts are adequately mitigated.
(4b)	Community: Support and collaborate with IEMC during periodic monitoring and provide inputs to the overall safeguard issues that require attention and/or mitigation. IEMC: Strengthen local community's capacity and relevant agencies through preparation of relevant documents necessary for monitoring, supervision, and reporting including preparation of a database for the activities. IEMC: assist PMU and communities for the implementation of Information-Education-Communication (IEC) activities within Component 4 with regard to environmental hygiene, sanitation, road safety, etc.
(5)	IEMC supports PMU/ESU to implement the ESMP in line with Government's environmental regulations as well as the WB safeguard policies. In consultation with DONRE, IEMC will establish specific environmental monitoring program for the project to be implemented by CSC at key locations as shown in detailed design documents. PMU is responsible for preparation of the 6-month progress reports to be submitted to WB and DONRE, based on quarterly reports submitted by IEMC.

6.9.2. Specific Responsibilities of PMU, CSC, and IEMC

❖ ***Project Management Unit (PMU)***

PMU is responsible for implementing the ESMP during the detailed design and construction stages. ESMP implementation during operation stage is the responsibility of the facilities operators. PMU will set up an Environmental and Social Unit (ESU) to ensure timely and effective implementation of the ESMP, including preparation of reports on safeguard compliance as required by Government and WB.

PMU/ESU is responsible for ensuring that the related sections in the Contract Documents on the bidding packages for construction items of the project are in compliance with the ESMP.

PMU/ESU is responsible for communicating with relevant local, provincial and national departments; and with parties responsible for implementing and supervising ESMP, especially with the provincial Department of Natural Resources and Environment (DONRE) and the concerned wards/communes during planning, monitoring, operation, and management.

PMU/ESU will coordinate with community organizations to encourage them to actively participate in the planning, management, and implementation of the project, including monitoring of the contractor's performance.

To ensure effective monitoring and timely implementation of the ESMP, PMU/ESU will hire national environmental consultants to assist in carrying out and monitoring the ESMP implementation. Responsibilities of the Independent Environmental Monitoring Consultant (IEMC) will be described below.

For supervision and monitoring of contractor's performance, PMU will be responsible for: (a) Checking project implementation indicators relating to environment; (b) Unannounced inspections to ensure that mitigation measures are being implemented as presented in construction contract by contractor; (c) Reviewing periodic report of construction supervision consultant (CSC) to ensure compliance with mitigation measures; and (d) Based on the periodic reports by CSC and IEMC, PMU will prepare report on environmental compliance of subproject to submit to WB and DONRE (This is part of the submission of a 6-month progress report to WB).

PMU will coordinate closely with relevant enterprises on water supply, environmental sanitation, solid waste collection and to monitor operation and maintenance during project implementation.

❖ ***Independent Environmental Monitoring Consultant (IEMC)***

The IEMC will be responsible for assisting the PMU in ESMP implementation. This also includes advising the CSC, contractors and communities on environmental compliance, and carrying out the monitoring program in accordance with regulations and procedures of the Government and World Bank. Once the detailed operational implementation of the environmental monitoring program is discussed by PMU and World Bank, the IEMC will be responsible for quarterly checking, and supporting the PMU staff to supervise overall project activities to ensure that unified environmental protection policies of the Government and World Bank are applied and supervised during project implementation. The IEMC will be responsible to: (1) provide training and capacity building for construction management for PMU/ESU staff, including field engineers and/or consultants (CSC) in supervising the ESMP implementation of the contractor; (2) ensure active participation of the local communities and schools in the project areas, (3) monitor environmental parameters to assess the overall impacts of the project, and (4) establish environmental training program to be included in Component 4.

Specifically, the IEMC's responsibilities include:

- Ensuring that the approved ESMP and all project loan agreements related to environmental safeguards are fully applied and complied during project implementation.
- Assessing the effectiveness of mitigation measures which are provided by contractor and CSC in implementation process; providing proposals and recommendations to the PMU on necessary improvement and supplementation to meet the safeguard requirements.
- Reporting periodically (every 3 months) to the PMU on actual ESMP performance during project implementation.
- Establishing standard procedures, methods and forms to assist the PMU and CSC to assess contractors' progress in implementing required impact mitigation and monitoring measures.

- Assisting the PMU's environmental staff to review and check the related sections in the Contract Documents on the bidding packages for construction items of the project to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements.
- Measuring, taking samples and monitoring periodically environmental parameters (once per 3 months) during the time of environmental monitoring contract.
- Assistance in the preparation of documents and implementation of training program on environmental monitoring and supervision for contractors, CSC and relevant staffs of PMU (environmental staffs and coordinators of packages).
- Via PMU, discussing with relevant enterprises (if necessary) to find suitable solutions for unexpected risks relating to environmental sanitation.

❖ ***Construction Supervision Consultant (CSC)***

The CSC is responsible for monitoring the safeguard performance of the contractor during site clearance and construction, including oversight of the self monitoring to be conducted by contractor. With regard to safeguards, the CSC's main responsibility will include, but not be limited to, the following:

- Assist IEMC to establish, collect and provide information about both essential environmental indicators on-site and construction work.
- Ensure that construction work complies with approved ESMP, relevant indicators and standardized operation in documents for environmental impact mitigation and monitoring.
- Monitor the mitigation measure implementation of contractor, propose and deploy supplementary measures in time to complete mitigation measures and to meet the environmental management safety requirements of project.
- Make action plans/urgent solutions to cope with environmental problems, urgent situation and damages happening in construction
- Recommend PMU to suspend partially or completely construction work if labor safety and environmental protection requirements of the contract are not complied with.
- Organize regularly discussions with relevant enterprises and other stakeholders to provide information about implementation plans and necessary working program to enhance people's awareness of environmental protection during construction process.

❖ ***Construction Contractor***

The construction contractor's responsibilities in respects of all aspects of the works, including the environmental aspects, are set out in the contract between it and the PMU.

Construction contractors have their own responsibilities for both carrying out environmental impact mitigation measures and compliance with approved ESMP during assembling construction of project packages. In the preparation of technical method statement, contractor will study the project's approved EIA report and propose a construction method that includes environmental mitigation and protection measures that are aligned with the recommendations of the approved ESMP.

Contractor's method statement will be submitted to PMU and CSC for review, as well as to IEMC as deemed necessary. Changes, if there are any, will be evaluated for feasibility and for legal issues (laws, decrees, circulars and other regulations) before suitable adjustments are approved for specific cases on-site.

During construction work, construction contractor will be closely supervised by PMU, CSC, IEMC, environmental authorities and local community on ESMP observation.

6.9.3. Reporting Arrangements

The PMU will prepare reports twice per year for submission to the World Bank including the compliance with the ESMP. The report will contain the monitoring results and assessments of the IEMC that show project progress and the status of implementation of the ESMP. The reports will cover, among other matters as appropriate, the following:

- Contractor's compliance with mitigation measures
- Wastewater and environmental sanitation issues
- Existing flood situation where relevant
- Traffic and water supply conditions
- Quality of waste-water receiving water bodies
- Potential project-related risks and risk management issues
- Impacts on environmental conditions and performance of national heritage sites
- Water quality in Regulating Lake
- Status of measures to aid PAHs at new resettlement area on environmental aspects
- Consultation with local communities in key project areas

6.10. CAPACITY BUILDING PROGRAM

6.10.1. Technical Assistance support for the implementation of safeguards

An assessment of safeguards implementation capacity of existing PMU staff indicates that PMU staffs have limited knowledge on WB safeguard requirements as well as limited knowledge of environment and social issues. Such lack of capacity represents a risk to project implementation of safeguards requirements contained in the ESMP and, as required by the WB policy, is to be addressed through capacity building. Therefore it is proposed to provide capacity building through technical assistance that will support the PMU during the implementation of the safeguards requirements. The technical assistance will provide the necessary technical support the PMU in its work with contractors as well as other entities involved in the implementation of the ESMP.

The scope of the technical assistance would cover support from experts and training that would cover both the knowledge on safeguards requirements and procedures for the project as well as training that covers both specific knowledge on safeguard procedures and requirement for the project staff, consultants, and national contractor would be important. This would include, for example, assistance in the preparation of documents and implementation of training program on environmental management and environmental monitoring for contractors, CSC and relevant staffs of PMU (environmental staffs and coordinators of packages) to do their tasks. It would also include assisting the PMU's environmental staffs with the review of contract documents on the bidding packages for construction items of the project to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements as well as provide general environmental guidance as requested by the PMU to enhance overall project implementation and performance.

Given the nature, locations, and scale of construction, it is anticipated that the safeguard technical assistance support and training will be provided at least during the first 3 years of the project implementation. The WB safeguard specialists will participate in the capacity building in particular in the training activities as appropriate.

6.10.2. Training programs proposed

Table 6.6 below provides examples of the basic trainings for safeguards during project implementation. The training programs will be developed and delivered by the Technical

Assistance team for the implementation of safeguards for the PMU training. The PMU/IEMC with the support of the the Technical Assistance team for the implementation of safeguards will provide the training to contractors, CSC and other groups.

Other more specific and tailored training will be developed and agreed upon between PMU, IEMC and the Technical Assistance team for the implementation of safeguards during project implementation based upon a reassessment of needs and the status of safeguards implementation.

- *Target groups for the training:* include PMU staff, ESU staff, field engineers, CSC, construction contractors, local authorities and community representatives in the project area. Training of workers and drivers is the responsibility of the contractor.
- *Training schedule:* At least 1 month before the construction of the first contract. The training can be adjusted in line with the implementation schedule of the subproject/contracts.
- *Training frequency*: The basic training programs proposed in table 4.6 will take place every six months on a yearly basis and its content updated and adapted to implementation issues. Training frequency and content will be reassessed during implementation depending on needs. It is foreseen that the training program for PMU staff will continue until year three of implementation. Three days of training for CSC and contractors are also planned to take place twice a year on an annual basis for at least two years.

Table 6.6: Training Programs for Capacity Building on Environmental Supervision and Management

I. Objects	**PROJECT MANAGEMENT UNIT**
Training course	Environmental supervision, monitoring and reporting
Participators	Environmental staff and technical staff
Training Frequency	Soon after project effectiveness but at least 1 month before the construction of the first contract. The follow-up training will be scheduled as needed.
Time	Four days of training twice a year to be repeated on a yearly basis until year three of implementation.
Content	General environmental management relating to project including requirements of WB, DONRE, cooperating with relevant enterprises Requirements on environmental supervision; Supervision and implementation of mitigation measures; Community participation in environmental supervision. Guide and supervise contractor, CSC and community representatives in implementation of environmental supervision. Forms used in environmental supervision; Risk response and control; Other areas to be determined; Receiving approach and submit forms.
Responsibilities	PMU, IEMC with support of the Technical Assistance team for the implementation of safeguards.
II. Objects	**CSC, CONTRACTOR, COMMUNE/WARDS AUTHORITIES, COMMUNITY REPRESENTATIVES**
Training course	Implementation of mitigation measures
Participators	CSC; on-site construction management staff; environmental staff of contractor; commune/ward/group authorities.
Training frequency	After bidding, update based on requirements

Time	Three days of training for CSC and contractors and two days of training for other also to be repeated twice a year on an annual basis depending on needs
Content	Overview of environmental monitoring; Requirements of environmental monitoring; Role and responsibilities of contractors and CSC Content and methods of environmental monitoring; Response and risk control; Propagate monitoring forms and guide how to fill in the forms and risk report; Other areas to be determined; Preparation and submission of report.
Responsibilities	PMU, IEMC with support of the Technical Assistance team for the implementation of safeguards
III. Objects	**COMMUNITIES AND WORKERS**
Training course	Environmental sanitation and safety
Participators	Representatives of community and/or worker leaders (as appropriate)
Training frequency	As appropriate
Time	One-day presentation and one-day on-the job training twice a year to be repeated on a per needs basis
Content	Preliminary presentation on environmental protection and environmental overview Key issues that require community and workers attention to minimize safety risks (roads, waterways, equipment, machines, etc.) as well as reduce pollution (dust, fume gases, oil/grease spill, waste management, etc.) Management of environmental safety and sanitation in work sites and worker camps; Mitigation measures at construction site and work camps; Safety measures on electricity, mechanical, transportation, air pollution; Other areas to be determined; Procedures to deal with emergency situation.
Responsibilities	Contractor, PMU, with support from IEMC

6.11. ESTIMATED ESMP COST

Table 6.7 provides an estimated cost for ESMP implementation (excluding the resettlement cost and RP and EMDP independent monitoring). The ESMP cost will comprise (i) cost for implementation of the mitigation measures by contractor, (ii) cost for supervision by the CSC, (iii) cost for environmental monitoring consultant (IEMC); (iv) monitoring of environmental quality (v) PMU safeguard management costs, including technical assistance support for the implementation of safeguards and training. Costs for the implementation of the mitigation measures during construction will be part of the contract cost while cost for monitoring of SESMP by the CSC is provided for in the construction supervision contracts. Costs for PMU operations related to ESMP are provided for in the project management budget of the PMU, including basic safeguards training and allowances for people who participate in the monitoring program. After project completion, the cost for environmental monitoring of the constructed facilities will be funded by the cities' operations and maintenance budgets.

It is noted that the attendance of community representatives in ESMP implementation is voluntary, and without salary. Hence, to encourage the participation of community members, the cost for materials, equipment used for monitoring and rewards for people who are voted to implement monitoring are taken into account. Following decision No. 80/2005/QĐ-TTg dated 18/4/2005 of Prime Minister on regulations of community investment monitoring and joint circular for guidelines of decision implementation No. 80/2005/QĐ-TTg "cost for supporting the investment monitoring of community in commune/ward are calculated in cost estimation of commune/ward fatherland front and are guaranteed by commune/ward people's committee budget; cost for propagation, training courses, guiding, closing of community investment monitoring at district and provincial level are calculated in cost estimation of district/provincial Fatherland Front and are guaranteed by district/provincial people's committee budget".

Table 6.8 provides an estimated IEMC and environmental quality monitoring cost in line with the country practices for reference. However the final cost will be updated during the detailed design.

Table 6.7: Estimated Cost for ESMP implementation (million USD)

6.12.	**Cost (millions of $US)**	**Source of funds**
(a) Mitigation during construction	Part of contracts	WB
(b) Supervision of safeguards during construction	Part of CSC costs in Comp. 4	WB
(c) Environmental Safeguards unit (ESU) of PMU	Part of PMU costs in Comp. 4	WB
(d) Environmental quality monitoring	**0.03**	WB
(e) Independent Environmental Monitoring Consultant (IEMC)	**0.1**	WB
(f) Safeguards capacity building program	**0.02**	WB

Table 6.8: Estimated cost for the IEMC (Exchange rate: 1 USD = 22,450 VND)

No.	**Content**	**Unit**	**Quantity**	**Price (VND)**	**Total (VND)**	**Total (USD)**
1	Specialist salary (I)	Month	8	40,000,000	320,000,000	14,254
2	Specialist salary (II)	Month	24	30,000,000	720,000,000	32,071
3	Specialist salary (III)	Month	16	15,000,000	240,000,000	10,690
4	Local stays and allowance	Day	720	520,000	254,800,000	11,350
5	Traveling expenses	Turn-person	90	3,000,000	420,000,000	18,708
6	Training course	Overall	8	10,000,000	120,000,000	5,345
7	Office supply	Overall	18	12,000,000	120,000,000	5,345
8	Office and communication	Overall	18	5,000,000	50,000,000	2,227
	Total					**99,991**

CHAPTER 7. PUBLIC CONSULTATION & INFORMATION DISCLOSURE

7.1. OBJECTIVES AND BASIC PRINCIPLES

In the ESIA process, information disclosure and public consultation on environment ensures the acceptance of local authorities, local NGOs and local affected people in the project area. Public participation is one of basic conditions that ensure the local authority and community's support for project and take their view into account. Through public consultation, unidentified environmental adverse impacts and mitigation measures can be recognized and included in ESIA report. In fact, if community takes part early in the project preparation, the relationship between community and project officials becomes closer. Thereafter, the community can continue to contribute their feedback and any concerns they may have during project implementation.

7.1.1. Objectives of public consultation

- The consultation with the participation of local authorities and local people in the project site during the preparation and implementation of EMP and ESIA is to provide essential information for further understanding about the project, impacts of the project implementation and potential mitigation measures for the project;
- Clarify issues discussed in the beginning period of the project;
- Inform benefits achieved when the project is implemented;
- State responsibilities and awareness of stakeholders, beneficiary people in the project site during the project implementation;
- Encourage the community participation in determining the environmental impacts of the project.
- Collect information about demands as well as correspondences of local people and authorities in the construction and recommendation in order to mitigate environmental impacts or considering adjustment in the technical design stage.
- The World Bank's policy (OP/BP 4.01) on environmental impact assessment requires that the Project Affected People (PAPs) and local authorities to be provided with notification and consultation during the preparation of ESIA report.

Public consultation (in the preparation of ESIA report for the CTUDR project in Can Tho City) must comply with the requirements in the Government's Decree No. 18/2015/ND-CP dated 14 February 2015 on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plan, and Circular No. 27/2015/TT-BTNMT dated 29 May 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plan.

7.1.2. The basic principles of public consultation

Facilitate the participation of local people and authorities in project area as soon as possible;

For Category A project, the public consultation needs to be conducted with two rounds:

- The first round: As soon as environmental screening is completed and before TOR for ESIA report is finalized.
- Second round: After the first draft of EIA report is prepared.

7.2. IMPLEMENTATION METHODS

This is a Category A project, thus it was required by WB to carry out the public consultationtwice during the ESIA process. Technical consultants and environmental consultants collaborated closely with PMU, local authorities and community in affected areas to perform these two public consultations in order to meet the WB's requirement.

❖ ***1st public consultation at the project area***

To implement the EIA report of the CTUDR, the ODA-PMU organized consultation meetings with the People's Committees and Vietnam Fatherland Front of 20 wards in 4 districts of Ninh Kieu, Binh Thuy, Cai Rang and O Mon.

Before consulting at wards, the ODA-PMU held general meetings at each district to introducethe project and collect opinions for the project. These included the meeting at the office of Ninh Kieu DPC on 01 June 2015, the meeting at office of Binh Thuy DPC on 02 June 2015, the meeting at office of O Mon DPC on 03 June 2015 and the meeting at office of Cai Rang DPC on 08 June 2015. The participants at these meetings consist of representatives of DPC, WPC and some divisions.

After holding the general meetings at districts, the ODA-PMU carried out consultations at each ward to introduce the project, identify the zone/population group in the project area, collect information about the status of environmental sanitation at the locality, discuss potential environmental impacts and mitigation measures as well as coordinate with the local authorites in holding public consultation in the project area. Simultaneously, the ODA-PMU also sent the dispatches for applying for consultation for the relevant agencies.

The 1st public consultation schedule carried out is shown in the table bellowed:

Table 7.1: *The 1st public consultation about EIA*

No.	Time	Wards	Resquest Dispatch	Correspondence Dispatch from People's Committee	Correspondence Dispatch from Vietnam Fatherland Front
1	8/6/2015	Thoi Hoa	Dispatch 239/BQL-QLDT dated 8 June 2015	Dispatch 251/UBND dated 16 June 2015	Dispatch dated 12 June 2015
2		Long Tuyen	Dispatch 242/BQL-QLDT dated 8 June 2015	Dispatch 147/UBND dated 1 July 2015	Dispatch 01/CV-MTTQ dated 15 June 2015
3		An Thoi	Dispatch 241/BQL-QLDT dated 8 June 2015	Dispatch 162/UBND dated 1 July 2015	Dispatch 09/MTTQ-BTT dated 1 July 2015
4		Long Hoa	Dispatch 240/BQL-QLDT dated 8 June 2015	Dispatch 290/UBND dated 22 June 2015	Dispatch
5	9/6/2015	An Phu	Dispatch 257/BQL-QLDT dated 9 June 2015	Dispatch 28/UBND dated 17 June 2015	Dispatch
6		Phu Thu	Dispatch 246/BQL-QLDT dated 9 June 2015	Dispatch 70/UBND dated 17 June 2015	Dispatch 13/CV-MTTQ dated 17 June 2015
7		An Lac	Dispatch 255/BQL-QLDT dated 9 June 2015	Dispatch 97/UBND-HC dated 9 July 2015	Dispatch 07/MTP dated 9 July 2015

No.	Time	Wards	Resquest Dispatch	Correspondence Dispatch from People's Committee	Correspondence Dispatch from Vietnam Fatherland Front
8		An Khanh	Dispatch 254/BQL-QLDT dated 9 June 2015	Dispatch	Dispatch 07/CV-MTTQ dated 24 June 2015
9		An Binh	Dispatch 250/BQL-QLDT dated 9 June 2015	Dispatch 80/UBND-DT dated 15 June 2015	Dispatch 01/MTT-HC dated 15 June 2015
10	10/6/2015	An Hoa	Dispatch 252/BQL-QLDT dated 9 June 2015	Dispatch 174/UBND dated 25 June 2015	Dispatch 03/CV-MTP dated 25 June 2015
11		Xuan Khanh	Dispatch 260/BQL-QLDT dated 9 June 2015	Dispatch 125/UBND dated 15 June 2015	Dispatch 01/CV-MTP dated 1 July 2015
12		An Nghiep	Dispatch 256/BQL-QLDT dated 9 June 2015	Dispatch 218/UBND dated 7 July 2015	Dispatch 04/MTP dated 7 July 2015
13		Cai Khe	Dispatch 258/BQL-QLDT dated 9 June 2015	Dispatch 163/UBND dated 29 June 2015	Dispatch 01/UBMTTQ dated 29 June 2015
14		An Cu	Dispatch 251/BQL-QLDT dated 9 June 2015	Dispatch 229/UBND-HC dated 19 June 2015	Dispatch dated 25 June 2015
15	11/6/2015	Hung Thanh	Dispatch 247/BQL-QLDT dated 9 June 2015	Dispatch 138/UBND dated 10 June 2015	
16		An Hoi	Dispatch 253/BQL-QLDT dated 9 June 2015	Dispatch 74/UBND dated 18 June 2015	Dispatch 24/UBMTTQ dated 22 June 2015
17		Hung Phu	Dispatch 248/BQL-QLDT dated 9 June 2015	Dispatch 162/UBND dated 6 July 2015	Dispatch 29/MTTQ dated 6 July 2015
18		Tan An	Dispatch 261/BQL-QLDT dated 9 June 2015	Dispatch	Dispatch 08/CV-MTP dated 10 July 2015
19	12/06/2015	Hung Loi	Dispatch 259/BQL-QLDT dated 9 June 2015	Dispatch 157/UBND-HC dated 2 July 2015	Dispatch 29/CV-MTP dated 1 July 2015
20		Le Binh	Dispatch 249/BQL-QLDT dated 9 June 2015	Dispatch 221/UBND dated 25 June 2015	Dispatch 04/MTTQ dated 26 June 2015

❖ ***2nd public consultation at the project area***

The 2nd public consultation is conducted upon completion of the draft ESIA report. Thisconsultatiowas implemented from 19 October 2015 to 23 October 2015 in 17 wards under Ninh Kieu, Binh Thuy and Cai Rang districts. Non-governmental organizations in Can Tho city including Can Tho Women's Union, Can Tho Association of People with Disability, and Can Tho Climate Change were consulted on 2 November. These are organizations representing disadvantaged social groups affected by impacts of climate change. Consultation from these organizations is to define additional impacts as well as seek feedback on mitigation measures from them. In addition, the Can Tho ODA-PMU has also sent written requests for consultation to local authorities and non-governmental organizations about the ESIA report in line with the Government's Decree No. 18/2015/ND-CP dated 14 February 2015 on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plan and Circular No. 27/2015/TT-BTNMT of the MONRE on strategic environmental assessment, environmental impact assessment and environmental protection plan.

Content of the 2nd consultation includes a summary of ESIA report, main impacts and objects to be affected as well as mitigation measures to be implemented in each specific project ward so that the communities and representatives of local authorities, unions, and associations can provide feedback. Content, location, duration and participants in the consultation meeting are presented in Table 7.3 below.

7.3. PUBLIC CONSULTATION RESULTS

Through the consultations at the project wards/communes, the Consultant and PMU recognized opinions of communities when implementing the project. Main consultation opinions of communities and feedbacks of the Client are summarized belowed:

Table 7.2: Summary of opinions in the 1st public consultations

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
1	**Thoi Hoa**	Agree with the summary of the project's document - Impacts of the project on the natural environment and society: + The embankments will prevent landslides; create urban landscape, impulse the development of economy. However during the construction's process of traditional villages, enterprises will be affected by the process of goods transportation from O Mon river to manufacturing base. + Change the water flow - Feedback in the construction: + Have to ensure safety for residents, workers and vehicles on the river during construction. Shielding places where are under constructed, manholes, placing lights and signboards.	- Agree with the summary of the project's document - Actual status of environment on the ward: relatively guaranteed, however in rainy season some roads are flooded causes environmental pollution at minor level. - Impacts of the project on the natural environment and society: + The vehicles, machines in construction make noise, dust + The construction of the embankment provides a beautiful view for the city and impulse the development of local economy. - Feedback in the construction: + Have to ensure safety for residents, workers and vehicles on the river during construction. Shielding places where are under constructed, manholes, placing lights and signboards.
2	**Long Tuyen**	**Current status of environment on local:** + The rate of water supply: 85% of the population in ward have Clean Water, Nuoc Lanh canal doesn't have clean water (about 70 households), approximately 40 households in Nhum canal don't have clean water. Have the main water supply pipe but lack of branch pipes. + Drainage and inundation: Rainwater, wastewater follows natural terrain to canals. 918 road is frequently flooded, flooded level about 30cm at the time of September, October.	**Socio – environment impacts of project:** + Vietnam Fatherland Front Standing Committee noticed that CTUDR project overlaps the local planned expansion of 4m of Muong Khai of PPC's of Binh Thuy district, which is expected to be constructed in early 2016, that funding mechanism is that State funds is using for construction investment and local people donates land, structures and crops. According to the CTUDR preliminary design, the project will cause

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ Subsidence has taken place for a long time, there are about 200 households be affected in Binh Thuong A, Binh Duong, Binh Duong B, Binh Pho B. + The status of municipal waste collection: Urban Company only get garbage in the main route (Highway 91B, Bui Huu Nghia, Nguyen Van Truong street), alleys only have the Ward's collection teams. + Rach Hang Bang: mainly contaminated by waste water from households and facilities along Cai Son - Hang Bang street. **- Socio-environmental impacts of project:** + Summarizes report of the impact of the project on the environment fully measures to minimize the negative impacts to the natural environment and society. + Long Tuyen ward PPC agrees to the mitigation measures of environmental impacts mentioned in the summary, but would like a clearer statement of impacts **- Measures to minimize the environmental impacts of the project:** Long Tuyen ward PPC is agreeing to the mitigation measures of environmental impacts mentioned in the summary, and should state more clearly the measures. **- Recommendations:** + Reinforcing embankments and reconstruction road subsidence restrictions. + Dredging, widening canals. + Supporting project implementation fully + Suggest investor in the construction process to ensure labor safety, implement shielding works. Ensuring traffic safety during the transportation of construction materials to the construction	some environmental impacts such as dust, emissions, wastewater, waste and changing regional landscape. However, this effect is negligible, only occur locally, temporarily during construction. These impacts are identified, considered and put into project preparation/ implementation during preparation of ESIA. + Other concern raised by local people is that the project will impact to some houses and structures. It is recommended that the project should put into account all these mentioned matters, to ensure that the local people's livelihood and living condition will not be worse off due to the project implementation. + Because of the scale of the works, the impact on the environment (due to dust, noise, solid waste, traffic safety...) is great. On the other hand there will be a lot of affected households in the clearance process. Therefore the impact on daily life of people should be emphasized and clarified. **- Measures to minimize the environmental impacts of the project:** + Summarizes report of the impact of the project on the environment fully measures to minimize the negative impacts to the natural environment and society. + Long Tuyen ward PPC is agreeing to the mitigation measures of environmental impacts mentioned in the summary, and should state more clearly the measures. **- Recommendations:** + Reinforcing embankments and reconstruction road subsidence restrictions. + Dredging, widening canals. + Supporting project implementation fully + Suggest investor in the construction process to ensure labor safety, implement shielding works. Ensuring traffic safety during

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		sector, implementing and maintaining fire safety and security. + Suggest Client should pay attention to the environmental impact during the construction including workers' household waste, hazardous waste of the building under construction and treatment measures of smoke, dust, noise... + Suggest Client to comply with commitments of remedial measures to prevent and mitigate adverse environmental impacts.	the transportation of construction materials to the construction sector, implementing and maintaining fire safety and security. + Suggest Client should pay attention to the environmental impact during the construction including workers' household waste, hazardous waste of the building under construction and treatment measures of smoke, dust, noise... + Suggest Client to comply with commitments of remedial measures to prevent and mitigate adverse environmental impacts.
3	**An Thoi**	**- Environmental sanitation situation of An Thoi Ward:** + Household water use of 100%. Water quality is assured. + Drainage system is a general but not uniform, some roads have no drainage system such as 122 alley of Nguyen Thong, Nguyen Thong street... + Domestic waste is collected properly defined 100%, the small alley garbage was gathered before collecting by sanitation company. **- The impact of the project on the natural environment and social economy of local:** + The implementation project will cause some environmental impacts such as dust, sewage, garbage and change the landscape. However, this effect is negligible, only occur locally, temporarily during construction. + For the socio-economic impacts primarily arise in the course of construction activities influence, purchase of household -In within project influence. + An Thoi Ward People's Committee agreed with the impact of economic, social, environmental and raised. However the impact on the daily lives of the people should be emphasized and clarified	**- The status of environmental sanitation works on the ward:** + People using clean water reach 100%. The quality of water is guaranteed + The drainage system has general but not uniform. Nguyen Thong street, Tran Quang Dieu street, Cach Mang Thang 8 street, alley 22, Nguyen Thong street, KV1, small alleys of kV4, alley 108 TQD KV5, alley 69, alley 113, alley 179 VDPT KV5 has flooded and high tides if it rains heavily (month of July and August) about 2 hours. Binh Thuy bridge to Ong Pagoda road has landslide (about 50 households). + 100% of domestic waste is collected properly regulated. In the small alley, garbage trucks can not to reach to collect garbage so crowded alley will be prior to collect. **- Socio-environmental impacts of project in local** COMMITTEE OF THE VIETNAM FATHERLAND FRONT of An Thoi ward agree with stated environmental impacts. However, the direct impacts to people living conditions should be focused and clarified. - **On measures to minimize the environmental impact of the project:**

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		- Regarding measures to reduce the environmental impact of the project: + An Thoi Ward People's Committee agreed with the mitigation measures' Environmentalists have raised. **- Feedback on the construction:** + Suggest during construction works to ensure absolute safety, make the shield building, with remedies dust, hazardous waste collection in the construction process. + Ensures escape domestic wastewater, stormwater and tidal inundation avoid during construction. + Ensuring traffic safety during the transportation of construction materials to the area of work, implement fire protection and maintenance of security and order in the school. + Suggest Client to comply with commitments of remedial measures to prevent and mitigate the negative environmental impact	+ The report summarized project impacts also pointed out the minimizing measures for the negative impacts to natural and social conditions. + Committee of The Vietnam Fatherland Front of An Thoi agreed with the minimized measures of stated environmental impacts **- Construction works comments:** + Fully support on implementing the project. + Suggest investor in the construction process should ensure absolute safety, make the shielding works. Ensuring traffic safety during the transportation of construction materials to the work area, perform fire safety, traffic safety and preserve security in the building. + Ensures domestic wastewater drainage system, rainwater and tidal avoiding flood during construction. + Suggest Client should pay attention to the environmental impact during the construction on waste issues including household waste by workers, hazardous waste of the building under construction and dust handling measures. + Suggest investor implement commitments measures to prevent and mitigate adverse environmental impacts.
4	**Long Hoa**	**- Regarding the negative impact of the project to the natural environment and the socio-economy** + The environmental impacts arising from the implementation of the project include: the effect of waste water from the construction process as well as workers' living environment and ground water; Influence of construction of solid waste on the environment and living soil and water; impact of emissions, dust to arise from the means and machinery to air environment.	**- Regarding the negative impacts of the project to the natural environment, social-economic and public health:** + During the project implementation due to the scale of the work would generate environmental impacts such as impacts of dust and gases to the atmosphere and wastewater to the land and environment water, solid waste impacts of soil environment. However these effects were locally and only temporarily during construction. + The implementation project will have some impacts on the natural environment, economic - social and public health is

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ The impact on the social environment is determined primarily from the acquisition of land and clearance. + Long Hoa Ward People's Committee agreed with stated environmental impacts. **- On measures to minimize the environmental impact of the project:** +PPC of Long Hoa ward agreed with stated minimized measured the environmental impacts. **- Recommendations to the Project Owner:** + PPC encourages the project to renovate dredging canals to solve environmental pollution that exists in the canal. + Proposals put 6 mini water supply stations for water quality is not guaranteed. + Need more detailed construction information about Xuan Lan conditioning lake. + Suggest Client to comply with commitments of remedial measures to prevent and mitigate adverse environmental impacts.	negligible however, only take place during the project implementation. + Fatherland Front Committee of Long Hoa ward agreed with stated environmental impact. **- On measures to minimize the environmental impact of the project::** + Fatherland Front Committee of Long Hoa ward agreed with stated minimized measured the environmental impacts. **- Recommendations to the Project Owner:** + Fatherland Front Committee encourage to implement project. + Recommendations that eliminate 08 mini water supply stations due to water quality is not guaranteed.
5	**An Phu**	**- Regarding the negative impact of the project to the natural environment, socio-economy and public health:** + The impact on the social environment is determined primarily arising from the process of land acquisition and compensation. + The impact on the natural environment in the project area were identified, including: the impact of waste on the environment and landscape of the area of land; impacts from wastewater and stormwater runoff to soil and water and the impact on air quality of the environment. + Phu Ward People's Committee agreed with the negative impacts affecting the natural environment and the socio-economic environment has been stated in the report summary.	**- The status of environmental sanitation works on the ward:** + Locally, using 100% urban water supply, good quality water + There are drainage systems, drainage to the public, ensuring the drainage capacity, but flood situation is still there when heavy rain flooded (tide) at Ly Tu Trong Street, while flooding usually 1-2 hours. Garbage is collected 100%, Linh Linh company collected in the alley and Urban Construction company collected in way. Fees collected an average of 15,000 / month. 100% hygienic toilets is available. + Tham Tuong canal remain contaminated, black and smelly water.

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		- On measures to minimize the environmental impact of the project: + Summary report of the project has shown measures to mitigate the negative impacts to the natural environment and society, especially measures to minimize environmental impact of air, water environmental and land + Phu Ward People's Committee agreed with mentioned measures to minimize the environmental impact. **- Recommendations to the Project Owner:** + Upgrade the alley on the wards. + Investments to build kindergarten school. + Support for project implementation. + Suggest Client should pay attention to the environmental impact during the construction of waste including household waste by workers, hazardous waste of the building under construction and dust handling measures.	**- Regarding the negative impacts of the project to the natural environment, social-economic and public health:** + Projects are evaluated with the potential negative impact on soil, water and air. These effects can be minimized by precautions or appropriate measures. + The impact on the social environment is determined primarily arising from the process of land acquisition and compensation. + On the community health project at impact, but we still need to pay attention to these effects. **- Recommendations to the Project Owner:** + Upgrade the alley on the wards. + Investing in building kindergartens. + Suggest Client should pay attention to the environmental impact during the construction of waste including household waste by workers, hazardous waste of the building under construction and dust handling measures.
6	**Phu Thu**	**- Regarding the negative impact of the project on the nature, social-economic and public health.** + The implementation project will have some negative impacts on the environment Besides there are also some environmental impacts, social-economic and public health, these effects only occur locally, temporarily. And the People's Committee of Phu Thu ward also agreed with the above-mentioned environmental impacts **- Regarding measures to minimize the environmental impact of the project** + The People's Committee of Phu Thu agreed with the mitigation measures mentioned in the summary report of the Project. **- Proposals for project owners:**	**The status of environmental sanitation works on the ward:** + Water appears in newly invested urban such as 586. Rural water was supplied to about 1,000 households. The remaining households use water from canals, water from the depth of 100m. Areas such as Thanh Hung, Thanh Thang, Hung Khanh, Khanh Binh has not had clean water yet. + The new residential area constructions have drainage systems. The rest mostly drain naturally, self-absorbed into the rivers, Incision. + Waste is collected by the company Urban Construction in newly-invested residential construction. The rest mostly self-process by landfill, burn or thrown into the river.

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ Recommend Client to comply with commitments of remedial measures in order to mitigate adverse to environment.	+ Most toilets are clean, but a few are clean, others don`t have toilet + On the ward, there are some areas affected by dust from concrete mixing plant of construction project as well as odors and wastewater from farmer households. + Canal Cai Doi and Xeo Dung are extremely polluted while clean water has not yet been provided. **- Regarding the negative impacts of the project to the natural environment, social-economic and public health:** The process of implementation of the project will have some impacts on the environment, socio-economic and public health but not significantly, these effects only occur locally, temporarily. National Fatherland Front of Phu Thu ward agreed with the above-mentioned environmental impacts.
7	**An Lac**	**- Regarding the negative impacts of the project to the environment, social - economic and public health:** After considering the People Committee An Lac Ward agrees with the impacts of the project on the natural environment, social - economic and public health. However, the impacts on the activities in daily life of people need special attention. **- In terms of measures to reduce environmental impact of the project:** An Lac Ward People's Committee agreed with measures to minimize environmental impacts. - **Proposals for project owners:** + Build entertainment areas + Need resettlement areas for people. + Suggest investor in the construction process to ensure absolute safety, make the shielding works. Ensuring traffic safety during transport of construction materials to the construction sector,	**The status of environmental sanitation works on the ward:** + On the wards 100% clean water + Sewer system has not met requirement, around 30% households use sewer on the ground. Area 3 and Area 4 sewerage system is limited because people build encroached land for road, sewer... The Nguyen Thi Minh Khai and sections Quang Trung bridge are often flooded at high tide or heavy rain. + Garbage is collected on the main roads by Urban Construction company and alleys (with garbage collecting points in the alley). - **Regarding the negative impact of the project to the natural environment, social -economic and public health:** + In the course of the project will generate negative impacts on the natural environment, social-economic and community health. These impacts will affect to the natural environment, daily life activities of people as well as affecting the health of residents in the project

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		implement fire protection and maintenance of security in the working place. + Suggest Client should pay attention to the environmental impact during the construction of waste including household waste by workers, hazardous waste of the building under construction and available solution for dust processing.	area. However, this impact is only locally and occurred in a short time. + After reviewing the Fatherland Front Committee of An Lac Ward agrees with the impacts of the project on the natural environment, socio - economic and public health protection. However, the impacts on the activities, daily life of people need special attention. - **Recommendations to the Project Owner:** + Build entertainment areas. + Need resettlement areas for people. + To request Client to comply with commitments of remedial measures to prevent and mitigate adverse environmental impacts**.**
8	**An Khanh**	**The status of environmental sanitation works on the ward:** + On the ward, urban water reaches 98%, about 2% using well water. Drainage throw directly into canals. Water in canals are extremly polluted. + There are waste collecting areas. **- Regarding the negative impact of the project to the natural environment, socio-economic - social and public health:** + The negative impact on the natural environment in the area of social projects are identified including: the impact of waste gas, dust, noise, vibration impact on air environment; the impact of waste water from construction activities, wastewater from the process of living of workers and stormwater runoff to water and land; and the impact of solid waste arising from the process Construction and living of workers to the aquatic environment and landscape.	**- Regarding the negative impact of the project to the natural environment, socio-economic and public health:** + The negative impact on the natural environment in the area of projects are identified including: the impact of waste gas, dust, noise and vibration impacts on air environment; the impact of waste water from construction activities, wastewater from the process of living of workers and stormwater runoff to water and land; and the impact of solid waste arising from the construction and domestic workers to the aquatic environment and landscape. **- On measures to minimize the environmental impact of the project:** + The report, summarizing the project's impacts on the environment has indicated the measures to minimize the negative impacts to the natural environment and society. + An Khanh Ward Fatherland Front Committee agreed with the measures to reduce the mentioned environmental impact. **- Proposals for project owners:**

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ For the social environment, the affects mainly are identified arising in the preparatory period, from operational recovery and compensation. However, the impacts on the activities of people`s life need special attention. **- Regarding measures to minimize the environmental impact of the project:** An Khanh Ward People's Committee agreed with the measures to reduce the environmental impact. **- Proposals for project owners:** + Support project implementation. + Suggest investor in the construction process to ensure absolute safety, make the shielding works. Ensuring traffic safety during the transportation of construction materials to the construction sector, implement fire protection and maintenance of security in the working place.	Suggest an investor in the construction process to ensure the absolute safety of workers, make the shielding works. Ensuring traffic safety during the transportation of construction materials to the construction sector, implement fire protection and maintenance of security in working place. Recommend Client should pay attention to the environmental impact during the construction of waste including household waste by workers, hazardous waste of the building under construction and available solution for dust processing.
9	**An Binh**	**- Regarding the negative impact of the project to the natural environment and economy, society:** + The Client have predicted the negative environmental impacts of the construction phase and the period when project goes into operation. + The negative impacts on the environment has been presented by an investor through a detailed assessment. These are the inevitable impacts of the deployment and operation process of project. **- Regarding measures to minimize the environmental impact of the project:** Client have been presented measures to minimize and treat the negative environmental impacts of the project implementation phase. An Binh Ward People's Committee agreed with the solution proposed by the project owner.	**- On the negative impacts of the project "Developing Can Tho city and Enhancing the adaptability of the municipality" to the natural environment and the economy, society:** The negative impacts on the environment have been presented by project management committee in details, the Fatherland Front Committee of An Binh Ward agreed with these contents. **- Regarding measures to reduce the environmental impact of the project:** Project Management Board presented the measures to mitigate and overcome the negative impacts on the environment during the preparation, construction and operation of the project. Fatherland Front Committee of Binh ward unified with proposed solutions by the Client. **- Recommendations for ODA project management units:**

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		- Proposals for project owners: + Suggest investor implement mitigation measures seriously, minimizing the negative environmental impacts caused by the project operation. + Owner must regularly inform to public of progress of the project in details and coordinate with local authorities in the terms of implementing the project. + When a problem occurs, the investor must notify immediately to the local authorities to work together to overcome.	+ Suggest Project Management Board implemented measures to mitigate, minimize the negative impacts on the environment during the preparation, construction of project, which are caused in the project operation. + When occurring environmental incidents such as fires, explosions, the project manager must inform immediately to the local authorities to work together to overcome.
10	**An Hoa**	**The status of environmental sanitation works on the ward:** + 100% of the people using the water from sewerage company, water quality is relative, strength and weakness are depending on the moment. + For people living along the canal (especially 2 areas in the project) people discharge directly into canals. Sewer system is invested but in bad condition with bad drainage capacity, it is flooded when heavy rain and high tides. Routes are often flooded such as Rach Ngong, MauThan road because of the old drainage system, it is influenced by urban embankment upgrading projects in 2nd alley Mau Than coming in to mining. Thus, it still be flooded by sand filling. + Debris was collected by Ming Ling Co., Ltd. in the whole ward. 100% flush toilets. + There are some farm household with small scale causing environmental pollution, causing odor affecting the surrounding population. Water in Rach Sao and Rach Ngong is polluted. **- Regarding the negative impacts of the project to the natural environment, the economy - society:**	**- Regarding the negative impact of the project to the natural environment, the economy - society:** + The negative impact on the natural environment in the area of project are identified including: the curious effect gases, dust, noise, vibration impact on air environment; the impact of waste water from construction activities, wastewater from the process of living of workers and stormwater runoff to water and land; and the impact of solid waste arising from the construction and domestic workers to the aquatic environment and landscape. + During the project implementation also incurred some impacts on the economic socio-environment as well as the lives of the people in the region, however, these effects are only temporary, take place in time project implementation. **- Regarding measures to minimize the environmental impact of the project:** Hoa Ward Fatherland Front Committee agreed with the measures to reduce the environmental impacts which have proposed by Client. **- Recommendations to the Project Owner:** + Support for project implementation.

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ The negative impacts on the natural environment in the area of social projects are identified including: the impact of emissions, from dust, noise and vibration impacts on air environment; the impact of waste water from construction activities, wastewater from process workers' activities and stormwater runoff to water and land; and the impact of solid waste arising from the process of building and living of workers to the aquatic environment and landscape. + During the project implementation also incurred some impact on social and economic environment as well as the lives of the people in the region, however, these effects are only temporary, occurring only in time of project operation. **- Regarding measures to minimize the environmental impacts of the project:** + The report summarizes the impacts of the project on the environment, has shown these measures to minimize the negative impacts to the natural environment and society. + Hoa Ward People's Committee agreed with the mentioned mitigation measures the environmental impact. **- Recommendations to the Project Owner:** + Support for project implementation. + Suggest investor in the construction process to ensure timely and quality execution of absolute safety, make the shielding works. Ensure traffic safety during the transportation of construction materials to the construction sector, implement fire protection and maintenance of security in working place. Recommend Client should pay attention to the environmental impact during the construction of waste including household	+ Suggest investor in the construction process to ensure timely and quality execution of absolute safety, make the shielding works. Ensuring traffic safety during the transportation of construction materials to the construction sector, implement fire protection and maintenance of security in the working place. + Suggest Client should pay attention to the environmental impacts during the construction of waste including household waste by workers, hazardous waste of the building under construction and dust handling measures.

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		waste by workers, hazardous waste of the building under construction and available solution for dust processing.	
11	**Xuan Khanh**	**Xuan Khanh Ward People's Committee gives opinions on the content of the project as follows:** **1. Embankments System of Can Tho river (Xuan Khanh): being done on 03 areas: Area 1, Area 3 and Area 4 with length as follows:** + The area 1: 6.6031 ha, the number of households: 472 to 2621 inhabitants + The area 3: 4.1072 ha, the number of households: 312 to 2,225 inhabitants + The area 4: 22,1779ha, the number of households: 436 to 2,119 inhabitants Most people earn their living from services, small scale trading. Infrastructure is semi-permanent, often affected by storm surges, erosion and pollution. The implementation of the project is necessary, help to mitigate damage to property and lives of the people, social stability and contribute to local economic development. **2. Cau Quang Trung:** Being made on 02 areas: Area 1 and Area 2. This is the gateway to downtown Can Tho. But now, the traffic congestion and accidents are usually happened, the deep flooded situation in bridge links the two parties is usually happened and it influences the lives and business of the people. Thus, the implementation of the project is essential. The affecting scope of the project reaching to households living on Quang Trung street frontage, they live by small trading at home. It is needed to have soon solution.	**The status of environmental sanitation works on the ward:** + On the ward, there reaches 100% of urban water. + There are drainage systems to canals however, they don`t work well and frequently flood the whole ward, however flooding time is short, drainage quickly. The longest flood Tran Van Hoai is in about 45 minutes. The finished sewer system is waiting for operation, the connection to the system of water treatment plants Cai Sau. + Waste is collected primarily by the Minh Linh and Urban Construction companies also support a part. Collecting fee is about of vnd15,000 / month. + Approximately 98% of hygienic toilets, the rest areas are located in Can Tho riverbanks with no hygienic toilets. + Now on wards, there are 2 works as Vincom and cultural house are in the process of building causing the dust, noise and emissions. It affects a number of surrounding households. + Rach Ngong river is heavily polluted by household `s waste disposal into the canals. Ba Nga river is blocked due to the occupy of households. Rach Ban and Tham Tuong are being upgraded but have not been delivered. - Regarding the negative impact of the project to the natural environment, socio-economic and public health: + Fatherland Front Committee Xuan Khanh Ward agreed with the mentioned environmental impacts. However the impact on the daily lives of the people should be emphasized and clarified cuttings. - Regarding measures to minimize the environmental impact of the project:

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		3. Rehabilitation of sewer system. + Sewer system was invested so long, and now, it is to low, there is no slope, the size of tube is so small, clogged rain as heavy rains and storm surges rise. The water valve isnot functioned correspond with designed capacity, not connected with wastewater treatment systems. + The such places are often, frequently flooded on the ward: Tran Van Hoai, 30/4, path to Quang Trung bridge, Nguyen Van Troi street. + Recommendations to implement the project soon to overcome the flooding, congestion situation on the ward.	Agree with the mitigation measures outlined by Client - Proposals for project owners: + Need to upgrade and expand the alley, proposals to upgrade the alley 15th through 3/2 + Price survey, adjust appropriate compensation costs to support the resettlement of people. + Suggest Client to comply with commitments of remedial measures to prevent and mitigate adverse environmental impacts.
12	**An Nghiep**	- **Current status of environmental sanitation of constructions on district:** + water supply system: almost 100% households using tap-water. + sewage system and flooded state: sewage system on area is not good. Alley 149 along by Chanh irrigation ditch, people often drain off water directly into Khe irrigation ditch (about 100 households). Alley 138 (zone1), 218 Alley (zone 3) are not included in the project upgrading city, therefore they are not taken into consideration in improving that accounts for difficulties in drainage water. Several places are often flooded when there is heavy rain or flood-tie: Tran Hung Dao street, Mau Than (especially Cao Thang, Nguyen Cu Trinh, Nguyen Van Troi segment) is in bottom land resulting in flooding when it rains and ties heavily. It often takes 4 to 5 hours for water to drain. Several alleys such as alley 138 (getting out in direction of Tran Hung Dao), alley 218 (getting out in direction of Tran Hung Dao and Mau Than) is in low land so when occurring heavy rain or tie will lead to be flooded. Especially Tran Hung Dao street.	**Negative impacts of Project on natural environment, economy-society and communal health**. + In process of carrying out the Project, due to the project's sizable characteristics, It leads to arise negative impacts on natural environment. However, these impacts are only partial, provisional in construction time. +Project's Construction time will have some small impacts on eco-social environment, only occurring in construction time. +Vietnam Fatherland Front Committees of AN Nghiep District agree with all above environmental impacts. - **Mitigation measures of Project's enviromental impacts.** + Vietnam Fatherland Front Committees of AN Nghiep District agree with environmental impacts listed on Project's brief report. - **Recommendations to Project manager:** + upgrade 138 alley and 128 alley. + Upgrade and Construct clinics.

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ Rubbish: is collected 100% + Air pollution: only several bases arising noises and bad odor which affects surrounding people. + surface water pollution: segment from Chanh irrigation ditch to Khe irrigation ditch is contaminated because people exhaust sewage water directly into this irrigation ditch. **-Negative impacts of Project on natural enviroment, economy-society and communal health.** + In process of carrying out the Project, due to the project's sizable characteristics, It leads to negative impacts on natural environment. However, these impacts are only partial, provisional in construction time. +Project's Construction time will have some small impacts on eco-social environment, only occurring in construction time. +People Committee of AN Nghiep District agree with all above environmental impacts. - **Solutions minimizing Project's environmental impacts**. + Vietnam Fatherland Front Committees of AN Nghiep District agree with environmental impacts listed on Project's brief report. - **Recommendations to Project owner:** + upgrade 138 alley and 128 alley. + Upgrade and Construct clinics. + recommend Investor to execute probably commitments of solutions preventing and minimizing adverse impacts on environment.	+ recommend Investor to execute probably commitments of solutions preventing and minimizing bad impacts on environment.
13	**Cai Khe**	**- Current status of environmental sanitation in local** + In local area, over 90% of households using tap water. Only part of KV3 Hau River (<5%) still use river water, well water for bathing, washing.	Agree with mentioned recommendations of Cai Khe PPCs.

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ Drainage system is not good: KV1, some alley in KV3 is not improved. Tran Phu (KV1, KV3) have no major drainage system. + Ward has a contract with the construction company to collect trash urban localities. + There are 100% of hygienic toilets. + The quality of the surface water quality is not guaranteed, no one will use. + Beam breath polluted canal, because the incision is no longer used, the water is stagnant. Canal is approximately 500-700m with nearly 40 households living. During the execution of projects inevitably generate impacts on the environment and its impact on the environment smog air, waste water to the soil environment, soil and solid waste on the environment land. Cai Khe Ward People's Committee agreed with the environmental impact as well as measures to minimize the environmental impact of the projects outlined in the report summary. However the impact on the daily lives of the people should be emphasized and clarified. **- Recommendations to the Project Owner:** + Upgrade the alley (expand, improve pavement: KV1, KV5, KV6). + Upgrade the sewage systems and renovating Chum Hoi canal. + The project planning should be clearer about the area and the time taken.	
14	**An Cu**	In recent years, the current status of the drainage when heavy rain for 2 hours or more, was flooded from 0.2 - 0.4 meters including roads of Xo Viet Nghe Tinh Truong Dinh, Vo Thi Sau, De Tham, Huynh Cuong Hoang Van Thu, Ngo Quyen, Ly Tu Trong (section III Can Tho University area - Tran Hung Dao).	In the recent past, the current state of the drainage when heavy rain and high tides, was flooded from 0.2 - 0.4 meters including roads of Xo Viet Nghe Tinh, Truong Dinh, Vo Thi Sau, to participate, Huynh Cuong Hoang Van Thu, Ngo Quyen, Ly Tu Trong. Due to low altitude pavement, drainage system has roots, small beneath the water level, height of manhole connection between the road uneven,

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		The status of the tidal drainage, deep from 0.1 - 0.2 meters including roads Xo Viet Nghe Tinh Truong Dinh, Vo Thi Sau, Huynh Cuong, Hoang Van Thu, Ly Tu Trong (section III Tho University area - Tran Hung Dao). * Reason flooded: Road surface is low, the drainage system is old, small lies deep underground, height of manhole connection between the road uneven, differences together and not in sync with humor drains of the alley was done raising urban. Surveys suggest, specific measurements of each solution culverts to renovate and refresh the drainage system on the ward. Rach Con canal has yet to be renovated and upgraded, the previous channel section has a width of about 3met full length of about 370 meters, households were arbitrarily leveled occupied and used for so long, now moves turn wide watercourse Con average only about 0.5-l, 5 m, approximately 105 households living and along the canals, dredging proposal to upgrade, renovate and put new sewers. Xang Thoi Lake, where the water content of the concentrate contains Cu Ward, about 8 manhole of roads, alleys wastewater discharge into the lake, the lake dried up, the amount of sludge in the lake much, so far has not been scraped dredging, while shallow cause stench, pollution, dredging proposal lake dredging.	differences together and not synchronized with the drains of the alley was performed urban upgrading. Surveys suggest, specific measurements of each substrate solution culverts renovation, refreshing water drainage system on the ward. Xang Thoi Lake, where water content of concentrate contains Cu Ward, about 8 manhole of roads, alleys wastewater discharge into lakes, shallow reservoir, siltation in the lake much, so far not been dredging, while shallow cause stench, pollution. Propose dredging the lake. The upgrade route Ly Tu Trong inevitably reduce flooding when it rains, but flooded the alley connecting online with Ly Tu Trong Street, namely alley 2 Ly Tu Trong. As rain water flooded into houses causes many difficulties in life. Recommended for upgrading alley Ly Tu Trong.
15	**Hung Thanh**	**- Regarding the negative impact of the project to the natural environment and the socio-economy** Related to the work of clearance which affects to local community life: the investor have to fully implement the provisions of the compensation and resettlement policies to support people whose land is acquired for settle down soon.	Hung Thanh Fatherland Front Committee has same opinion in consultation with ward PPCs

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		Construction process to ensure order and safety and to register for temporary residence for workers as prescribed. Suggested priorities for day laborers, unskilled labor using local labor. **- On Measures to minimize the Environmental Impact of the project :** + Design of waste water treatment system before being put into the water to ensure no contamination being discharged into the environment + Installation of public toilets at construction workers and construction workers + There shielding measures during construction to avoid affecting farmland, people's activities + Create temporary road (bypass) when cross internal road system of wards. Set construction warning signs, traffic safety signs at construction site + Shielding the transportation of construction materials, avoid dropping off the roadway. - Recommendations to the Project Owner: + Investor frequent inspection and remedial as environmental incidents and committed to comply with regulations on environmental protection.	
16	**An Hoi**	In recent times, after prolonged rains in local area of An Hoi Ward, in the main roads often flooded, due to sewer system is limited. Especially drainage positions in Channel 53 Hoang Van Thu was so pressing people, households occupied by building sewage and rainwater do not escape it. Wiring the ward interlaced explosive. Green Leaf kindergarten currently degradation should be	An Hoi Fatherland Front Committee has same opinion in consultation with ward PPCs

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		constructed to serve the teaching and learning for children that communicate Ward People's Committee for inclusion in the project the following items: 1. System 53 channels Hoang Van Thu 2. Sewer whole ward 3. System power lines 4. Construction of new kindergarten Green Leaves	
17	**Hung Phu**	**The status of environmental sanitation works on the ward:** On wards for about 90% of urban household uses clean water, while 10% use river water (mainly Near Can Tho River). Drainage channel majorly is canal, well-drained condition, and infrequent inundation. Only 15-20 minute flooding occurs large tides. Ba Hom canal is contaminated, this water cannot be used. During implementation of the project will generate an environmental impact windows, after reviewing the summary report of the project, Hung Phu Ward People's Committee agreed with the environmental impacts and the mitigation measures outlined in a brief report. Also Hung Phu Ward Committee has several **Recommendations to the Project Owner:** Upgrading a book on regional route 11 is degraded. Recommend Client to comply with commitments of remedial measures to prevent and mitigate the negative environmental impact.	Hung Phu Fatherland Front Committee has same opinion in consultation with ward PPCs
18	**Tan An**	**The status of environmental sanitation works on the ward:**	Tan An Fatherland Front Committee has same opinion in consultation with ward PPCs

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		95% of people use tap water, only a small percentage of residents living near river banks still use river water for bathing (<5%). The drainage system is old, deteriorated as the route Hai Ba Trung, Thu Khoa Huan, Ly Thuong Kiet, Tan Trao, Dien Bien Phu, Ngo Duc Ke. One piece Ly Thuong Kiet (KV1) were sunken than the other segments when tide surges cause flooding (November October 9 submerged about 2 hours, flooding about 50cm). Also some other roads were flooded when the tide surges such as Ngo Quyen Thu Khoa Huan, Hai Ba Trung...We flooding phenomenon occurred many years ago and rising. 75% of the garbage is collected. However, due to some pretty small alleys, garbage trucks cannot entry. On the other hand, the collection did not come on time and fast garbage collection should be stagnant garbage alley first. 95% of household has sanitary toilet. A small fraction of people living along the river still defecate in the river. Some tofu production facilities in Tan An. Some areas café, bar noise. - Regarding the negative impact of the project to the natural environment, economic - social and public health: The project is estimated to have the potential negative impact on soil, water and air. These effects can be minimized by precautions or appropriate measures. The impact on the social environment is determined primarily arising from the process of land acquisition and compensation. - On Measures to minimize the Environmental Impact of the project :: People's Committee of Tan An ward support measures to minimize the environmental impact yet. - Recommendations to the Project Owner:	

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ Upgrade the drainage system. + Develop separate sewers to escape the rain the river straight. + Improve elevation embankment combined 1-way drain valve. Raise high the pavement some routes: Nguyen Trai, Ly Thuong Kiet,... ' Recommend Client to comply with commitments of remedial measures to prevent and mitigate adverse environmental impacts.	
19	**Hung Loi**	**- The status of environmental sanitation works on the ward:** + Most of people using tap water supplied by Can Tho water supply limited company, some households in Dau Sau canal, KV6 still use river water for washing. + Over 80% of sewer system has completed, the drainage system in the alley is mostly good, a number of household using drainage systems have not upgraded branches, small-diameter drainage pipe, degradation is not working. Formerly principal of sewer canal, after upgrading drainage into the main drainage system of the city. Heavy rain (except new main line upgrade) are flooded, especially Tam Vu Street. + Rach Ba Le, Nga Bat, Muong Cui canal: all are heavily polluted, can not use. Canal encroachment is occurring. - On the negative impacts and mitigation measures of the project on the natural environment, the economy - society: During implementation of the project will not avoid the impact of the project on the environment, Hung Loi Ward People's Committee agreed with the environmental impact as well as the mitigation measures outlined in the report summary. However the impact on the daily lives of the people should be emphasized and clarified. - Recommendations to the Project Owner:	**-Regarding the negative impacts and mitigation measures of the project to the natural environment, the economy - society:** During implementation of the project will not avoid the impact of the project on the environment, Hung Loi Ward Fatherland Front Committee agreed with the environmental impact as well as the mitigation measures outlined in the report summary. However the impact on the daily lives of the people should be emphasized and clarified. **- Recommendations to the Project Owner:** + Should be commercial areas, resettlement areas to create conditions for people living better lives, or resettlement in place. + Support for project implementation. • Recommend Client have to comply with commitments of remedial measures to prevent and mitigate adverse environmental impacts.

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ Should be commercial areas, resettlement areas to create conditions for displaced people to more than make up resettlement site. + The canals are planning to deploy the early implementation of dredging the canal to have a clean aesthetic.	
20	**Le Binh**	**I/ About the project's impact to the natural environment and socio-economy:** + Regarding the clearance work affects local communities: Investor should fully implement the provisions of the compensation and resettlement support policies for who have acquired land to households affected over the ground soon stabilize their life. + The construction must ensure order and safety and temporary residence registration for workers as prescribed. + Suggest priorities for day laborers, unskilled labor using local labor. **II. Measures to minimize environmental impact** + Design of sewage before it enters water sources ensure clean water before it is discharged into the environment all. + Installation of public toilets before the time when the construction works to ensure environmental sanitation around the workers involved in the construction. + Construction of shielding, for embankment sand to not slide into housing and land plots are also cultivated crops and affecting daily life of farmers. + Create a temporary road to cross internal road system of wards of the work items should install signs to guide traffic to ensure safety during operation.	Le Binh Ward Fatherland Front Committee has same opinion in consultation with the ward PPC.

No	Ward	Recommendation of wards' PPC	Recommendation of Fatherland Front Standing Committee
		+ Motor vehicles involving to building process must ensure shielding from material scattered on the road. **III / Recommendations for projects:** Client should regularly check and remedial environmental incidents and committed to comply with regulations on environmental protection.	

Generally, through the public consultations at the project area, the authorities and local people supported the project and desired the project to be implemented early. Some consultation opinions are summarized as follows:

- All local people agreed with the project implementation, however, they request the construction to be carried out rapidly, limitdelays and ensure environmental cleanliess as well as compliance with tasks and ensuring quality of works.
- To mitigate potential impacts on the community and living conditions of the local people, the project components must be implemented. The construction on main roads of the city must be carried out in a systematic manner, and ensure labor and traffic safety for local people.
- Request the contractor to comply with commitments to mitigating negative environmental impacts caused by the project.
- For impacts on land acquisition and resettlement, the project general principle is that design alternatives should be studied to avoid any resettlement impacts. If it is not avoidable, the project should put into good account of all resettlement and income rehabiliatation matters, to ensure that the local people's livelihood and living condition will be, at least restored, or improve to pre-project implementation. The local people also requested the local authorities and the project to make proper compensation and arrange resettlement for them in accordance with their expectations.
- In addition, the local people desired the PMU’s and local authorities’s support in vocational training and provision of preferential loan for them to recover their economic livelihood and living conditions in a timely mannerIn accordance with the correspondence dispatch and direct consultation with the People’s Committees and Vietnam Fatherland Front of wards/communes, some opinions are summarized as follows:
- People’s Committees and Vietnam Fatherland Front of communes enthusiastically supported the project implementation. When the project is completed, the local people will have great benefits on living places and fresh environment.
- The local authorities will facilitate and support for implementation of the project, especially issues related to the land acquisition for the project implementation through site clearance and construction of work items.
- People’s Committees and Vietnam Fatherland Front of communes agreed with contents of the EIA report. Negative environmental impacts caused by the project are minor; however, it is essential to take mitigation measures of adverse environmental impacts.
- Agree with the mitigation measures of environmental pollution as mentioned in the report;
- Request the Client to commit to strictly implementing the mitigation measures of potential negative impacts such as environmental management and environmental quality monitoring.
- People’s Committees and Vietnam Fatherland Front as well as representatives of people in the project will jointly discuss and solve issued raised during the project implementation.

Table 7.3: Summary of opinions in the 2nd public consultations

Ward	Time, number of participants	Participants	Comments of participants	Feedback from the Client and Consulting Unit
Long Tuyen	8h30 on 22 October 2015 (24 persons)	Representatives of local authorities, organizations and households	- Water to restrict dust generation - Disclose clear information about the project, provide proper policies - Minimize flooding and water logging - Desire to make use of sludge to fill the ditch behind the house - Build embankment on both sides to reduce landslide - Avoid driving piles at rest time - Examine means of transportation, prevent over-speed - Calculate sewerage system reasonably - Avoid gathering materials along roads, complete works in successive manner	- Shall comply with what has been committed - Shall consider dredged sludge for backfilling of people - Shall organize meetings and notify detailed information about the project to the people when the project is approved
An Thoi	8h30 on 23 October 2015 (27 persons)	Representatives of local authorities, organizations and households	- Expand road by existing central line - Carry out construction in concentrated manner, preventing prolonged construction period - Consider collection of sewerage from people's house - Notify people of compensation plan early - Find measures against flooding at alley head during construction, complete one side before proceeding with the other side - Water to restrict dust generation during construction - Build embankment on both sides to reduce landslide - Build drainage line on Cach Mang Thang 8 road for drainage at alley 91 - Organize traffic flow properly, build temporary local road - Supplement drainage work item across Tran Quang Dieu road and Sao creek	- Shall comply with what has been committed - Shall review comments of the people

Ward	Time, number of participants	Participants	Comments of participants	Feedback from the Client and Consulting Unit
Long Hoa	8h30 on 21 October 2015 (20 persons)	Representatives of local authorities, organizations and households	- Study road elevation well to avoid inundation - Find measures against flooding at alley head during construction, complete one side before proceeding with the other side - Arrange proper gathering of culverts and materials, avoiding long assembly at the people's house, hindering people's travel - Implement the project quickly - Compensation should be clear and implemented promptly to stabilize the lives of people. - While construction, keep water source clean; limit waste discharge at source	Comments of the people are noted; mitigation measures shall be implemented fully as committed
An Phu	14h00 on 20 October 2015 (18 persons)	Representatives of local authorities, organizations and households	- Improve water supply of canals for production - Avoid suspended planning, slow implementation of the project - Drain's elevation on Mau Than road is higher than road surface, water is drained without being collected, causing local inundation. People suggest consideration and handling. - On Le Lai – Phan Van Tri road: manholes are higher than road surface, thus stormwater cannot drain - Need measures to reduce inundation on Nguyen Viet Hong road - Affected persons must be provided with assistance and information - Trucks transporting materials must be covered to avoid material spillage, affecting environmental sanitation	Dust generation, gas emission issues have been included in the ESIA and mitigation measures will be applied
An Lac	13h30 on 22 October 2015 (25 persons)	Representatives of local authorities, organizations and households	- There should be assistance policy and information disclosure for the affected households while project construction prolongs. - Carry out construction in successive manner to avoid affecting daily life of the people - Trucks transporting materials must be covered to avoid material spillage, affecting environmental sanitation - Apply works under the ground to avoid unearthing road surface	- Shall disclose detailed implementation progress of project at each locality before construction - Comments will be included in ESIA report

Ward	Time, number of participants	Participants	Comments of participants	Feedback from the Client and Consulting Unit
			- Pay attention to pile driving, avoiding influence on people's life - Inspect, record circumstance of works before construction to form the basis for compensation - When relocation is required, arrange resettlement sites with adequate infrastructure to ensure daily life of the people	
An Khanh	14h00 on 21 October 2015 (41 persons)	Representatives of local authorities and households	- Muong Cui creek is incapable of bearing heavy load, it is suggested heavy-load vehicles not to transport materials here. - When dredging and breaking mosquito drives, it is required to have sanitation teams for preventing epidemic and spraying pesticide to minimize epidemics. - In dredging, keep environmental sanitation. - Pay attention to social security disorder at the locality. - Odor raised from sludge need measures to minimize and outbreak sterilizing measures. - During the construction, the project owner will disseminate information for the propaganda units in collaboration with the client to implement the project.	Comments will be included in ESIA report and construction package
An Binh	14h00 on 21 October 2015 (17 persons)	Representatives of local authorities and households	- Pay attention to driving of Cajeput piles. - Inspect and recognize the status of works before construction for avoiding influences - Give put the specific schedule and clear plan. - Strictly implement commitments. - Take measures to minimize impacts on business of local people. - Prefer to build on the left of Cai Son creek to avoid landslide or apply the barge methods to minimize landslide. - Support the upgrading of Hoang Quoc Viet road - Take measures to minimize odor from the dredging	Recognize comments of residents and commit to strictly and fully implementing mitigation measures.

Ward	Time, number of participants	Participants	Comments of participants	Feedback from the Client and Consulting Unit
An Hoa	8h30 on 10 October 2015 (23 persons)	Representatives of local authorities and households	- Heavy-load vehicles are not allowed to transport materials on Muong Cui creek. - Arrange sanitation teams for preventing epidemic and spraying pesticide to avoid epidemic spreading during the dredging. - Keep environmental sanitation, take the sterilizing methods for epidemics due to sludge gathering during the dredging. - Disseminate information for self-manage teams to propagandize and coordinate with the Client for implementing the project. - Implement the project early to reduce pollution at the locality.	Regarding procedures for construction, repairing houses, residents could contact the ward People's Committee for guidelines for procedures as stipulated.
Xuan Khanh	14h00 on 20 October 2015 (16 persons)	Representatives of local authorities and households	- Separate traffic appropriately and arrange staff for implementing. - Contractor should be qualified and arrange specific schedule to avoid influences on daily life of residents. - During the construction, it is required to pay attention to noise generated from machines, not work at relax time of residents. - Calculate synchronously good drainage capacity of the drainage systems. - Need specific planning to avoid repetition of road excavation. - When designing bridge, take measures to avoid significant influences on stable life of residents.	Recognize comments of residents and commit to strictly and fully implementing committed mitigation measures.
An Nghiep	8h30 on 19 October 2015 (17 persons)	Representatives of local authorities and households	- The Client should be present frequently to receive opinions and solve complains of residents. - The community monitoring committee should be provided with funding for implementing. - Measures of environmental sanitation and urban aesthetic protection. - Arrange temporary pathway for residents during the construction. - Provide assistances for residents during the construction due to impacts on their business activities.	Pay attention to comments of residents to take mitigation measures.

Ward	Time, number of participants	Participants	Comments of participants	Feedback from the Client and Consulting Unit
			- Provide information and training for the community to effectively monitor.	
Cai Khe	14h00 on 19 October 2015 (14 persons)	Representatives of local authorities and households	- Arrange waste gathering places at alleys on Tran Phu road due to residents' weak awareness of environmental sanitation. - Arrange public sanitary facilities to avoid disorder defecation. - Need close management for the construction contractors due to impacts on drainage for households. - Solve flooding situation on Tran Phu road since this road has no drainage system. - Improve Nong Suc creek because residents encroach and throw gabage into the creek, causing environmental pollution.	- The community monitoring committee regularly report, update situation for the site steering committee to timely solve site problems. - Commit to closely manage activities of the contractor to minimize influences on daily life of residents.
An Cu	14h00 on 19 October 2015 (9 persons)	Representatives of local authorities and households	- Apply successive construction method to avoid disturbance to the road, business activities, drainage of residents. - During the construction, pay attention to existing drainage situation of households, not let water run-off over the road, take temporary drainage methods for residents. - Replace drainage culverts of Xang Thoi lake. - Put signs and lights for warning residents of the on-going works and manholes. - Build fences for isolating the on-going works. - Drainage culverts of 1,200 diameter should be recommended. - Need consensus of project owner and residents when implementing the project.	- Agree on the successive construction method - Recognize comments of residents and commit to strictly and fully implementing mitigation measures.
Hung Thanh	14h00 on 22 October 2015 (8 persons)	Representatives of local authorities and households	- Roles of community monitoring and funding should be concerned to ensure effectiveness. - Disseminate information for ensuring working effectiveness of the community monitoring committee. - Arrange waste gathering places at alleys on Tran Phu road due to	- Comments will be included in ESIA report - Consider and seek for funding to implement the works which cause pressing for

Ward	Time, number of participants	Participants	Comments of participants	Feedback from the Client and Consulting Unit
			residents' weak awareness of environmental sanitation. - Arrange public sanitary facilities to avoid disorderly sanitary habits. . - Need close management for the construction contractors due to impacts on drainage for households. - Solve flooding situation on Tran Phu road since this road has no drainage system. - Improve Nong Suc creek because residents encroach and throw garbage into the creek, causing environmental pollution. - Arrange accommodation places for workers, collect garbage to avoid insanitation. - Control security when workers gather crowded. - Make use of unskilled laborers at the locality. - Arrange material gathering yards and ensure careful shielding of materials.	residents on environmental sanitation, for example Nong Suc creek. - Prefer to use local human resources
An Hoi	8h30 on 19 October 2015 (27 persons)	Representatives of local authorities and households	- Apply successive construction method. - Give put specific schedule for disseminating for residents. - Build hard embankments for Ba Le creek to minimize landslide. - Combine implemented and on-going projects to avoid overlap of projects - During the dredging, control methods of fly and mosquito should be taken.	- Comments will be included in ESIA report - Commit to strictly and fully implementing proposed mitigation measures
Tan An	14h00 on 22 October 2015 (16 persons)	Representatives of local authorities and households	- When driving piles, pay attention to avoiding influences on residents. - Arrange temporary road for residents' movement. - Give out suitable plans of water and electricity supply to avoid	The construction contractor should prepare specific methods in case of electricity, water cutting-off for serving

Ward	Time, number of participants	Participants	Comments of participants	Feedback from the Client and Consulting Unit
			sudden interruption, affecting life of residents.	the construction and broad inform residents at least 7 days before implementing.
Hung Loi	8h30 on 20 October 2015 (32 persons)	Representatives of local authorities and households	- Spraying odour minimizing substance on dredged sludge and transport dry sludge to avoid influences on residents living near the creek. - Avoid working at relax time of residents, minimize gathering of materials in front of households' houses and roads.	Recognize comments of residents and commit to strictly and fully implementing mitigation measures.
Hung Phu	8h00 on 23 October 2015 (15 persons)		- Pay attention to noise generated from machines, avoid working at relax time of residents surround the project area - Avoid extension of working hours, affecting life of residents. - Consider model of site clearance, adequate compensation, avoid site clearance of frontage land and houses.	Opinions should be mentioned in ESIA report

Generally, the community, local authorities and non-governmental organizations were aware of positive impacts that project brings and desired the project to be early implemented. However, the residents also desired that during the project implementation, especially the construction, the project owner and construction contractors should pay attention to following outstanding problems:

- Disseminate information about the progress at the locality for residents to arrange their works and daily life to minimize conveniences during the construction. An incremental construction method should be preferred to avoid spreading constructionacross the whole area, and to narrow radius of influence;
- The community monitoring committee should be provided with the training program to exactly understand their functions and tasks. At the same time, there should be funding for maintaining and supporting members of the Community Monitoring Committee in implementing tasks;
- Provide assistances for households doing business that directly faces or abuts during the construction;
- Minimize delay of construction progress to avoid direct impacts on income and daily life of households;
- Minimize dust and noise during the transportation of materials gathered in the construction site;
- Ensure existing drainage for residents during the improvement of drainage system, avoid water run-off over the road pavement, causing environmental pollution and urban unaesthetic;
- The returning of road pavement should ensures aesthetic as original status and minimize repetition of road excavation on a same route.
- The project owner will be present at the construction site to closely manage activities of the construction contractors and ensure focals so that residents can contact in case of emergency.

ESIA presentation at An Khanh ward

Local people is raising ideas

Consultation at An Hoa ward

Consultation at Long Tuyen ward

Consultation at An Binh ward

Consultation at Long Hoa ward

7.4. INFORMATION DISCLOSURE

Following requirements for information dissemination in OP/BP 4.01, the PMU shall be on behalf of the project owner, :

- Provide Vietnamese version of ESIA report and the summary report to the office of Can Tho City People's Committee and People's Committees of project wards/communes.
- ESIA report (Vietnamese version) will be sent to ODA-PMU and DONRE of Can Tho City.
- Disclose the summary of ESIA report of the Project at wards/communes in the project area and inform via mass media or the ward information board one month prior to dissemination of ESIA report and the summary report. The Community can review and contribute their opinions about the ESIA report by filling in the notebook within 1 month in working time at following places: 1) People's Committees of wards in the project area; and 2) ODA-PMU.

ESIA report (English version) will be submitted to the World Bank for disclosure at VDIC and InfoShop in accordance with regulations on information dissemination policies.

CHAPTER 8. CONCLUSIONS, RECOMMENDATIONS AND COMMITMENT

8.1. CONCLUSION

On the basis of analysis and assessment on existing environment, environmental and socio-economic impacts in the project area, the report presents some following conclusions.

The CTUDR project that Can Tho CPC is appointed to be the Project Owner, authorizing the ODA-PMU to manage.

Requirements of the EIA report comply with Decree No. 18/2005/ND-CP dated 14 February 2015; Circular No. 27/2015/TT-BTNMT dated 18 July 2015 of the Minister of Natural Resources and Environment, guiding the implementation of strategic environmental assessment, environmental impact assessment and environmental commitment, WB's policies on Environmental safeguard. EIA report identified and assessed all impacts of the project:

- After the project is completed, it will contribute to stabilizing the people's life, political security and social order in the project area in particular and Can Tho city in general.
- The construction of flood control infrastructure will enhance drainage capacity, improve living conditions , sanitation conditions and enhance the quality of life for city residents . Also, the urban transport infrastructure development will enhance the inter-regional transport links in order to facilitate socio-economic development and increase the accessibility of residents in low-income areas to social infrastructure services of the city.
- The project implemented will help improve urban integrated management capacity (technical infrastructure and operational units , strengthen the planning , scheduling , coordination mechanisms , management of natural disaster risks, urban management and financial management of the city) to ensure high efficiency in urban integrated management and ensuring the sustainable development of Can Tho city.
- The long-term construction and operation of the project will cause some negative environmental and socio-economic impacts unless the measures of prevention, control and handling of environmental pollution are not taken.
- During the operation of the Project, there will be some adverse impacts but cthese will be mitigated and are considered to be manageable in comparsion to the environmental and social benefits that the Project brings.
- Cumulative impacts of the project are postive, upon completion of project works. Riverine ecological integrity of the project will no be affected by the flood risk management measures, and the rehabiliation of the sewage treatment system and canals will have positive impacts for the urban environment.

Awareness of responsibilities for environmental protection, the Project will make sufficient investments in environmental protection and commit to strictly complying with the prevention, control and handling measures of environmental pollution as mentioned in EIA report to meet Vietnam environmental standards, including:

- Measure to control air pollution during the construction phase.
- Measure to control drainage of storm-water and wastewater, domestic wastewater treatment during the construction and operation phases.
- Measure to control solid waste pollution during the construction and operation phases.
- The PMU will coordinate with the functional agencies in the engineering designing and construction phases to timely adjust pollution level to meet environmental standards and prevent environmental incidents, if any.

The measures to control pollution and minimize adverse impacts on environment as mentioned in EIA report are feasible and meet Vietnam environmental standards issued.

The Project Owner shall be responsible toward the law for environmental issues of the project during the construction and operation.

8.2. RECOMMENDATIONS

To ensure the Project to be put into operation quickly, the Client suggests the WB to review and approve the report and Can Tho DONRE and the functional agencies to appraise and submit Can Tho CPC for approving ESIA report so that the Client can continue to implement next steps of the project and ensure investment progress of the project.

The Client suggests the functional agencies to coordinate with the Client to monitor and solve environmental issues arising during the construction and operation of the project to ensure environmental safeguard and promote economic benefits of the project.

The local authorities coordinate together in the propaganda and maneuver local people to support the project and raise community's awareness of environmental protection during the implementation and after the completion of the project.

8.3. COMMITMENTS

8.3.1. General Commitments

The Client and PMU commit to complying with Vietnam Laws on Environmental protection: Law on Environmental protection 2014, Laws and legal documents (Decree No. 18/2015/ND-CP dated 14 February 2015 of the Government on environmental protection assessment, strategic environmental assessment, environmental impact assessment and environmental protection plan; Decree No. 38/2015/ND-CP dated 24 April 2015 on management of waste and scrabs; Decree No. 88/2007/ND-CP dated 28 May 2007 of the Government on urban drainage and urban areas, etc.) and WB's safeguard policies during the project implementation.

The Client commits to complying with the mitigation measures of adverse impacts of the Project on environment during the construction preparation, construction and operation according to contents as mentioned in Chapter 6 of this Report.

Project's activities shall be under the inspection of the competent authorities in charge of environmental management of DONRE of Can Tho city, Can Tho CPC and relevant functional agencies to ensure the project development and environmental protection

The Client commits to disclose contents of approved ESIA report approved at the project locality to monitor the compliance with environmental protection commitments in the approved ESIA report.

8.3.2. Commitment To Complying With Environmental Standards And Regulations

The Client commits to complying strictly with environmental standards and regulations:

- *Exhaust gas*: In accordance with Vietnam standard QCVN 05:2013/BTNMT – National technical regulation on ambient air quality;
- Waste water: Commit to implementing mitigation measures and operation of waste water treatment system to ensure waste water treatment according to QCVN 14:2008/BTNMT (column B): National technical regulations on domestic waste water quality;
- Noise: Control noise in accordance with QCVN 26:2010/BTNMT – National technical regulation on noise.

- Solid waste: Solid waste will be collected and treated properly to ensure not drop down and exposure to ambient environment to ensure requirements for environmental sanitation and regulations in Decree No.59/2007/ND-CP dated 09 April 2007 of the Government on solid waste management.
- Hazardous waste: Commit to complying with Circular No. 12/2011/TT-BTNMT dated 14 April 2011 of MONRE on hazardous waste management.

8.3.3. Commitment To Management And Control Of Environmental Pollution

The environmental management and control of environmental pollution will be given top priority during the construction and operation;

The Client commits to coordinating with the functional agencies during designing, construction and operation of the treatment system and environmental protection;

During the operation, the Client commits to implementing the environmental pollution management and control program in the project area as mentioned in this report and periodically reporting to the DONRE of Can Tho city.

The Client commits for compensation and remedy of environmental pollution in case of environmental incidents and risks due to the project implementation;

The Client commits to completing planned works, especially completion of the environmental treatment works after the ESIA report is approved./.

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ANNEXS

Annex 1. List of Documents related to CTUDR Project

Annex 2: List of Proposed Investment Items and Resuls of Its Baseline Survey

Annex 3: Results of the Project Environment Monitoring

Annex 4: Proposed Location for Environment Monitoring during Construction and Operation Phase

Annex 5: Minutes of Public Consultation and Site Pictures

Annex 6: Social Assessment Report

VIETNAM

Sustainable Development

IAC Vietnam Co., Ltd
Văn phòng: 50 Ngõ Huyện,
Phường Hàng Trống, Quận Hoàn Kiếm, Hà Nội
Tel/Fax: (+844) 6251 0258
Email: info@iacvietnam.com