

**PRE-FEASIBILITY STUDY
CLIMATE CHANGE ADAPTATION MEASURES FOR FLOOD AND
HEAT WAVE RISKS IN CAN THO CITY, VIETNAM**

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List of Acronyms

AFD	French Development Agency
BEC	Bid Evaluation Committee
BER	Bid Evaluation Report
BMZ	German Ministry for Economic Cooperation and Development
CPC	City People's Committee
CPI	Consumer Price Index
CT-WSSC	Can Tho Water Supply and Sewerage Company
DWT	Deadweight tonnage
CCA	Climate Change Adaptation
CCCO	Climate Change Coordination Office
CRO	Climate Resilience Office
DARD	Department of Agriculture and Rural Development
DoC	Department of Construction
DoCST	Department of Culture, Sport and Tourism
DoF	Department of Finance
DoNRE	Department of Natural Resources and Environment
DoT	Department of Transportation
DPI	Department of Planning and Investment
ECA	Economics of Climate Adaptation
FDI	Foreign Direct Investment
GCM	Global Climate Models
GOV	Government of Vietnam
GRDP	Gross Domestic Product
GSO	General Statistics Office Vietnam
HCMC	Ho Chi Minh City

ha	hectares
IEC	Information - education - communication
ISF	InsuResilience Solutions Fund
IPCC	Intergovernmental Panel on Climate Change
JSC	Joint Stock Company
KfW	German Development Bank
Ltd. Co.	Limited Company
MOLISA	Ministry of Labour, Invalids and Social Affairs
MPI	Ministry of Planning and Investment
MW	Megawatt
ODA	Official Development Assistance
PIT	Personal Income Tax
PMU	Project Management Unit
SEADRIF	Southeast Asia Disaster Risk Insurance Facility
SECO	Swiss Economic Cooperation and Organisation
SOE	State-owned Enterprises
UNFPA	United Nations Population Fund
UNU-EHS	United Nations University – Institute for Environment and Human Security
USD	US Dollar
VND	Vietnamese Dong
WASSCO	Water Supply and Sewerage Company
WB	World Bank

I. Introduction of Can Tho City

Can Tho is a large city directly under the management of Central Government of Vietnam (GoV) and it is the face of Western Region of Vietnam. The outstanding features of Can Tho are the interlacing network of canals which are the parts of Mekong River. The canal and narrow rivers are also the “streets” of Can Tho. It brings beauty to a large urban area, as well-known as Western Capital (Tay Do). Can Tho has poetic beauty of river villages, densely populated and those are hiding under the shade of coconut trees.

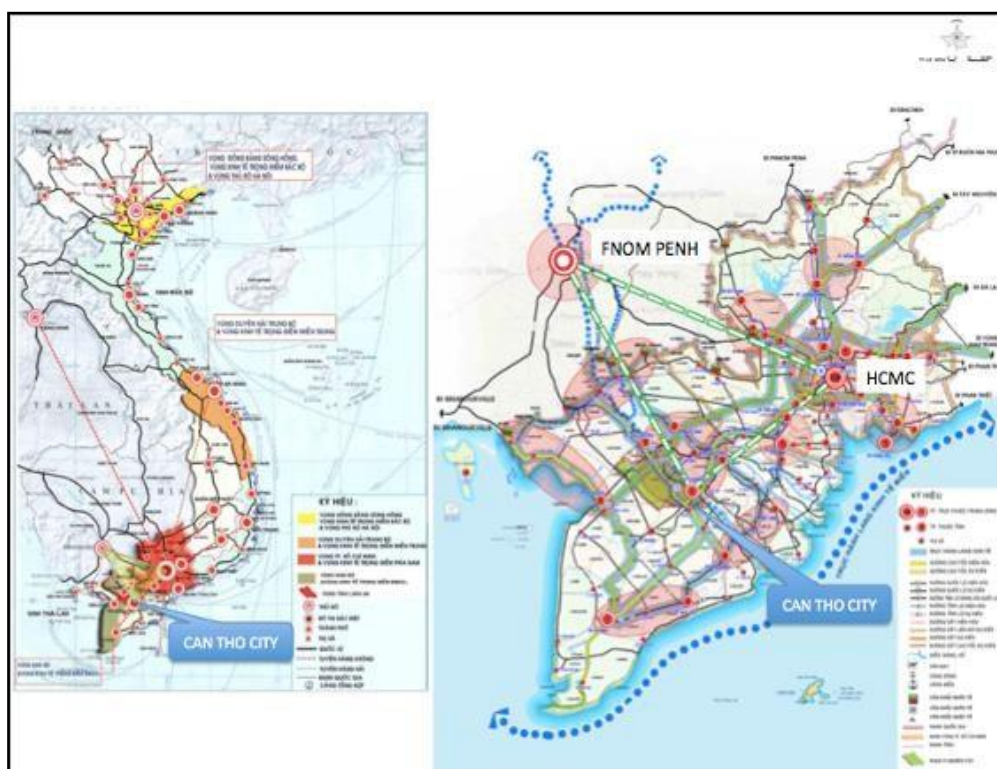


Figure 1: Map of Vietnam and Can Tho City

Previously, after reunification of Vietnam (1975), Can Tho Province (former Can Tho City) is under former Hau Giang Province, which included three administrative units of Can Tho City, Soc Trang Province, and Hau Giang Province¹. By the end of 1991, Hau Giang Province was divided into two provinces, Can Tho and Soc Trang. On 02 January, 2004, Can Tho Province was divided into Hau Giang Province and Can Tho City². Since 24 June 2009, Can Tho was under the direct management of Central Government of Vietnam³.

¹ Decree No.03/ND-76 dated 24 March 1976 of Government of Vietnam on merging Can Tho Province, Soc Trang Province and former Hau Giang Province into Hau Giang Province

² Meeting Section No.4 of National Assembly issued the Resolution No.22/2003 dated 26 November 2003 and Decree No.05 of Government of Vietnam, dated 02 January 2004

³ Decision No.889/QĐ-TTg of Prime Minister, dated 24 June 2009

Can Tho is a young city which was established later than other city of Vietnam. However, Can Tho has a history of formation and development over 130 years. During French Colonial Time, plantations, small industries, markets, hospitals and colleges were established in this region with good development. Nowadays, Can Tho has a strategic economic as well as military location and the focal point of land transportation and waterway of Southwest Delta of Vietnam at the centre of Mekong Delta Region.

Can Tho is the fourth largest populated city in Vietnam with a total area of 1,439.2 km² and a population of approximately 1.35 million people as of 2018 and consists of five urban districts (Ninh Kieu, Binh Thuy, Cai Rang, O Mon and Thot Not) and four rural districts (Phong Dien, Thoi Lai, Vinh Thanh and Co Do). The city is settled by some people groups as Kinh (96.7%), Chinese (1.2%), Khmer (1.8%) and other ethnic groups such as Cham.

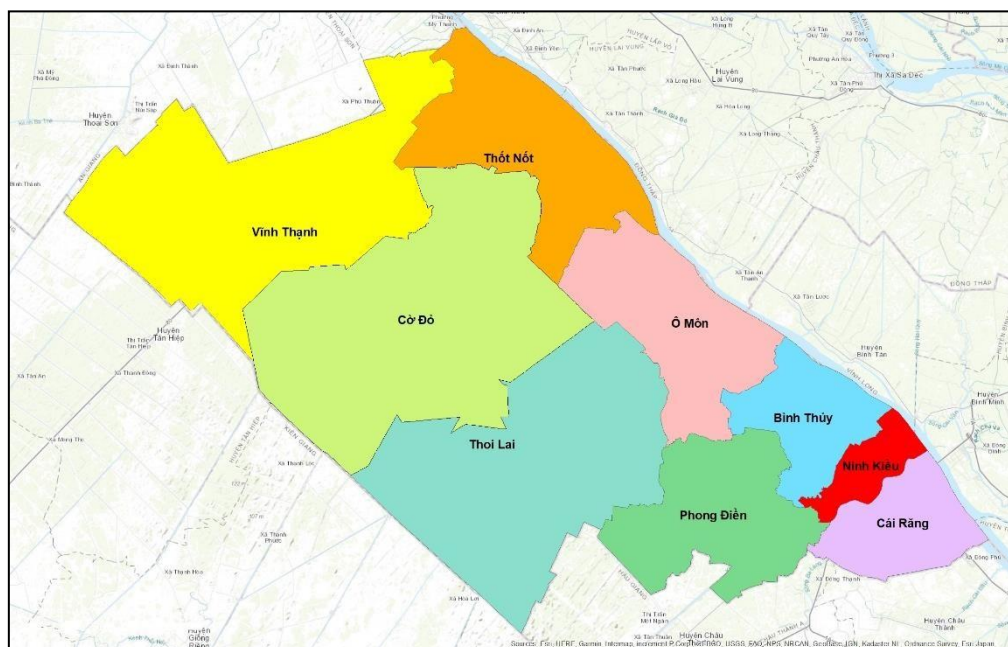


Figure 2: Map of Can Tho City, including district boundaries (own source)

Can Tho City is considered to be the centre of economy, culture, education and training of western provinces in the Southern region. The city is also the rice centre of the West of Southern Region, one of the main rice-producing and -exporting provinces in the whole country. In terms of industrial development, in recent years the city has focused on infrastructure development to attract domestic and foreign investors. High-tech industrial parks are Tra Noc in Binh Thuy District, Thot Not, Hung Phu and industrial park in O Mon district.

Located in the heart of the Mekong Delta, where the river system is intertwined, with vast orchards and fields, Can Tho is predicted to be a fast-growing city in all aspects.

II. Analysis of the Context

2.1 Institutional context

Can Tho has nine (9) districts with 83 administrative units, including five (5) town, 44 wards and 36 communes. The name of districts and communes was listed in the Annex 1 – Administrative Units of Can Tho City. Administrative units of the Socialist Republic of Vietnam (SRV) include: (i) province and cities directly under the Central Government (provincial level); (ii) urban and rural districts, township, provincial capital cities (district level); (iii) communes (for rural areas), wards (for urban areas) and townships (commune level); and (iv) special administrative and economic units. The SRV administrative units were also classified based on the criteria of population size, natural area, number of an affiliated administrative unit, level of socio-economic development and specific factors of each type of administrative unit in rural and urban areas and islands. The SRV administrative units include: (i) Hanoi and Hochiminh City were special provincial-level administrative units. The remaining provinces were classified into three categories: Type I, II, and III; (ii) district level were classified into three types: Type I, II and III; and (iii) commune level were classified into three types: Type I, II and III.

Can Tho City is the City Type I, under direct management of Central Government⁴. The local government of Can Tho City includes People's Council and People's Committee which were organised in all administrative units. Can Tho City's local government includes People's Councils and People's Committees at districts levels and commune/ward levels.

The People's Council of Can Tho City is an agency that represents the State's power and people at Can Tho City. Can Tho City People's Council consist of delegates who were elected by local electorate. The delegates of the People's Council are the representatives of Can Tho people. The People's Committee (PC) of Can Tho City was elected by the Can Tho People's Council. Can Tho CPC is the executive agency of Can Tho People's Council and it includes some specialized departments (e.g. DoC, DoF, DoNRE, etc.) that were organised to act as advisory bodies and assist the Can Tho CPC in performing the function of State management over the local sectors and fields, and carry out the tasks and duties in accordance with the authorization of Can Tho CPC. These specialized departments are under the direct management of Can Tho CPC.

The institutional structure of Can Tho Governmental Administration System will be summarized in the following figures:

⁴ According to Decree No. 899/QĐ-TTg of Prime Minister on 24 June 2009

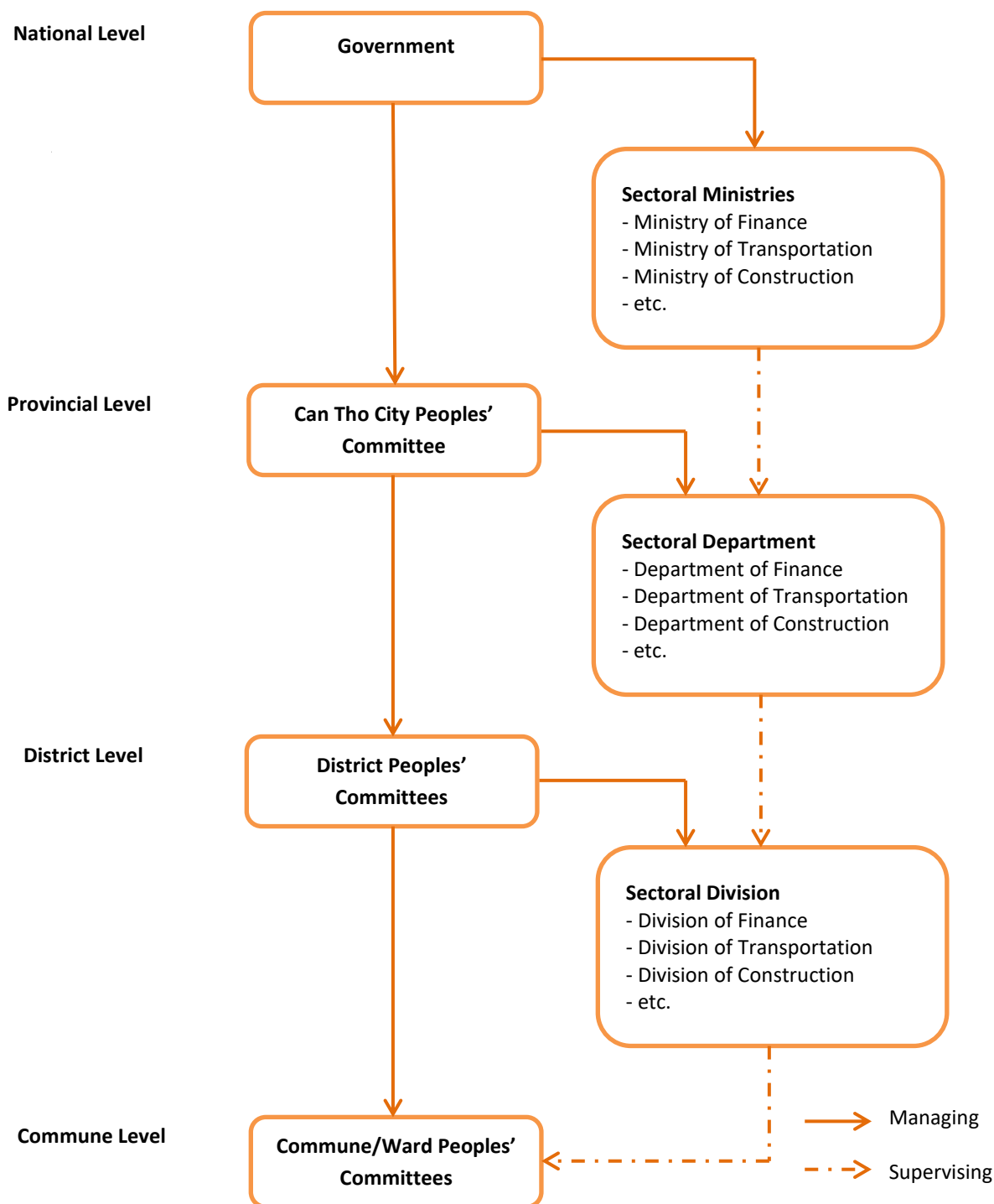


Figure 3: Institutional Structure of Can Tho City

People's Committees of both Can Tho City and its Districts have an essential role for the project implementation and management. Roles, functions and responsibilities will be described briefly for the implementation of proposed measures in Chapter VI – Proposed Executing Entity/Advisory Support Needed. Those executing entities will play an important role during

project consultation, formulation, implementation and then receiving hand-over the facilities after project completion.

For the implementation of proposed measures on flooding and heat wave, this part will describe institutional context of Can Tho City. Each measure will be involved a local governmental agencies/departments that link to each other and are under overall management of Can Tho CPC which is the highest governmental agency in a city. The involvement of them are diversified. Flooding control facilities of Measure 1: Mobile Flood Embankments will be handed over to City's Department of Agriculture and Rural Development (DARD) in accordance with its functions and responsibilities. **Rehabilitation of Existing Drainage System** of Measure 2 would be included the participation of DARD, City's Department of Construction (DoC) and Can Tho Water Supply and Sewerage JSC. (Can Tho WASSCO). The Measure 3: Detention Swales Along Roads can be implemented with the involvement of City's Department of Construction (DoC) and City's Department of Transportation (DoT). The Measure 4: Flood Awareness Campaign will need the participation of City's Department of Culture, Sport and Tourism (DoCST). And the last measure of Measure 5: Cooling Centres also need the DoCST as the location of those centres will be at existing public outdoor park and fountains of Can Tho City.

2.2 On-going projects and investment at Can Tho City

Mid-term public investment programmes and initiatives (2021 – 2025) was updated and submitted by Can Tho City People's Committee to the Can Tho People's Councils with total investment for all the projects in Can Tho City in the Second Regular Meeting of Can Tho City People's Councils. There are key projects added and supplemented to the list of needed project to be implemented soon in the 2021 – 2025 period. At this meeting, the delegates of Can Tho City People's Councils also vote to approve the Resolution of the Mid-term public investment plan for 2021 – 2025 period in Can Tho City.

Total investment during 2021 - 2025 is 31,313.75 billion VND⁵. In which:

- Investment capital by local budget is 21,574.6 billion VND, including domestic investment for basic construction, investment source from land use revenue, investment source from lottery revenue, investment source from local budget saving;
- Other mobilized sources except local budget is 2,000 billion VND, including local budget from land fund, increasing State budget revenue;
- Reserved budget from central State fund is 120 billion VND;
- Investment capital by allocated central State budget is 7,619.15 billion VND (national source of fund by each sector and fields and foreign capital).

⁵ Report No. 162/TTr-UBND of Can Tho PPC dated 23 August 2021

The added and supplemented list of projects that need to be implemented during this period in order to resolve:

- traffic jam situation at important intersections of Can Tho City;
- urban embellishment;
- construction of new office projects to relocated city's administrative agencies;
- exploiting land fund to generate revenue of State and local budget with the purpose of reinvestment as well as serving resettlement demands for the City during implementation of other projects.

The key projects will be implemented during 2021 – 2025 will be as follows:

- Project on rehabilitation of key traffic intersection of the City with total estimated investment cost of about 1,180 billion VND;
- Project on construction of the Office of National Assembly Delegation and People's Councils of Can Tho City with total estimated investment cost of 200 billion VND;
- Supplementing capital for Land Development Fund of 1,000 billion VND.

Besides, Can Tho City increased the total investment cost for 04 projects due to increased compensation and site clearance expenses during the implementation of these projects with a total amount of 1,305 billion VND. Including:

- Can Tho Urban Development and Resilience Project: increased total investment cost by 630.8 billion VND. This project has a total investment cost of over 7,843 billion VND, in which, WB ODA fund is 250 million USD, non-refundable source from Swiss Economic Cooperation and Organisation (SECO) is 10 million USD and remaining source of fund is from Vietnamese counterpart fund;
- Ninh Kieu Culture and Sport Centre Project: increased total investment cost by 106,050 billion VND. The total investment cost of this project was 586 million VND;
- Can Tho River Embankment – Can Tho Climate-change Adaptation Project: increased total investment cost by 284.619 billion VND. This project has a total investment cost of over 810 billion VND from AFD ODA fund and local counterpart fund, in which, AFD ODA fund is more than 462 billion VND, non-refundable source from AFD is 7.2 billion VND and local counterpart fund is over 341 billion VND.
- Tra Noc Erosion Prevention Embankment Project at Tra An Ward, Binh Thuy District (from Tra Noc Bridge to Xeo May Bridge): increased total investment cost by 283,711 billion VND. The total investment cost of this project was about 505 billion VND.

In addition, there are some other projects which are under implementation in the Annex 2 – List of on-going project.

III. Analysis of Beneficiaries

The beneficiaries of implementing measures by the project was analysed including both direct and indirect beneficiaries.

The direct beneficiaries are the local population of Can Tho City in the intervention area of Ninh Kieu, Binh Thuy and Cai Rang District. They also include institutions that could institutional strengthening and actively participate in the implementation of the proposed measures.

The indirect beneficiaries are total population of Can Tho City in general as well as local businesses and the main existing facilities and infrastructure.

3.1 Direct beneficiaries

For flooding measures, there is a fact that the direct beneficiaries are the people and their business will get some benefits from directly or participating in the project implementation and/or from investment for deploying facilities such as mobile flood embankment, detention swales along the roads, rehabilitation of existing drainage system, carrying flood awareness campaigns and cooling centres. The mitigation measures will bring directly some benefits to the beneficiaries who are living within the intervention area.

Total population of Can Tho City is 1,235,171 people, in which, there are 621,543 male, equivalent to 49.59% and 622,628 female, equivalent to 50.41%. The total population live in urban areas is 860,775 people, equivalent to 69.67% where are mostly in central districts of Can Tho (Ninh Kieu, Binh Thuy and Cai Rang Districts). Ninh Kieu is the densest district with a total population of 280,494 people, equivalent to 22.71% of the population of Can Tho City. In addition, the rate of permanent houses, structures and buildings in those districts is high. 100% of people live in the permanent houses at Ninh Kieu District and corresponding rates will be 97.5% and 96.2% for Binh Thuy and Cai Rang District.⁶

In these districts, the existing drainage system was old and downgraded. In the rainy season, 62 sections of the roads will be often flooded at Ninh Kieu District, 13 flooded sections at Binh Thuy District and 35 sections at Cai Rang District.⁷ The people, local businesses, shops, restaurants, buildings and infrastructure, etc. who are living and doing their business along these sections will be the direct beneficiaries from flooding measures once those measures were implemented within these areas. More details of direct beneficiaries will be analysed in the preparation of Feasibility Study phase when detailed location of each measure were selected. Site surveys and investigations should be implemented at these locations to define direct beneficiaries.

⁶ At 0:00 on 01 April 2019, in according to Census 2019

⁷ In according to the meeting with Mr. Tran Phong Nha, Vice Director of Can Tho Wastewater Division of Can Tho Water Supply and Wastewater Company

For cooling centres, direct beneficiaries, regardless of their gender, business and occupation will get equal benefit from the investment for implementing these heat wave measures. The direct beneficiaries of these measures related to using electric equipment to prevent them from heat waves, such as air conditioner.

Regarding using electricity in Can Tho City, there are 100% of households using grid electricity for indoor lighting⁸, however, there are only 24.8% of households having an air conditioner⁹. A low percentage of households are resistant to heat waves. In addition, the number of old people¹⁰ at Can Tho City are quite high. They is 147.915 people, including 62.035 male and 85.881 female. Those people are direct beneficiaries of cooling centres. They can come to relax at cooling centres that will be constructed by the project during hot weather days with heat waves.

Table 1: Population by Age

Age	Total	Male	Female
0-4	71,197	36,803	34,394
5-9	88,596	45,899	42,697
10-14	87,886	45,307	42,579
15-19	94,240	47,780	46,460
20-24	103,884	52,519	51,365
25-29	97,930	49,527	48,403
30-34	104,317	53,339	50,978
35-39	106,513	54,594	51,919
40-44	94,749	47,992	46,757
45-49	88,494	44,842	43,652
50-54	82,015	40,578	41,437
55-59	67,435	31,329	36,106
60-64	53,519	22,664	30,855
65-69	38,776	16,471	22,305
70-74	20,614	9,090	11,524
75-79	13,782	5,249	8,533
80-84	10,164	3,663	6,501
85+	11,060	4,897	6,163
Total	1,235,171	612,543	622,628

⁸ Census 2019, Rate of grid electricity using by households

⁹ Census 2019, Rate of equipment and furniture are using by household

¹⁰ Old people is the people over 60 years old, Elderly Law 2009

3.2 Indirect beneficiaries

Indirect beneficiaries of the project including the residents living in the project area as well as the whole city of Can Tho. Indirect beneficiaries are often, but not always, all those living within the zone of influence of the project. They are inhabitants and households who are living on riverbanks in the project area will have a stable and safe dwelling. The people will be protected against flooding on high tide days. Traffic congestion is reduced for the people living in the city and the surrounding areas. The businesses sector will benefit from the good circulation of goods and attracting investment. It is often only possible to make broad estimates of indirect beneficiaries because there is no clear distinction between the people who will be influenced by the project area under the measure which is physical construction such as embankment, rehabilitation work, detention swales and cooling centres and non-physical activities such as awareness campaigns.

Project on the implementation of flood and heat wave measures will strengthen the capacity for a number of Government agencies for sustainable urban development. Government agencies and related entities will benefit at the national, provincial, city level in training for capacity building and other technical assistance. Project implementation units will be enhanced about the management knowledge and reduced the cost due to traffic congestion, environmental pollution.

Effective exploitation of traffic corridor axis of urban is to solve traffic jam and urban development orientation; and development of land fund, increase of land value and revenue of the budget, then by increasing the regulation value to the centre; Embankment on river and lake can increase of land value: when embankment is constructed and installed to create a 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.

It also brings some advantages for waterway transport. The canals will be dredged and embanked to create large spaces for bottom of embankment and waterway on the canals to be favourable and faster. And it will increase waterway tourism increased because the features of Mekong River Delta are many channels and canals. Therefore, the tourism industry on river will be strong development if the city is invested in dredge and embanking for river and channels to surrounding landscape.

Indirect social benefits: It will create more stable jobs, reduce social evils, and ensure security for whole Can Tho City. Construction of major roads under the implementation of detention swales along roads will develop many services on two sides, such as, restaurants and hotels. Building the embankment will generate parkland behind the embankment with many entertainment activities, the yards of boats, attracting labour resources to drive the boat to

serve the needs of tourists. Attraction of workers for many areas will help reduce poverty, reduce social evils and ensure security and order.

Maintaining the activities of community service, health care and education for the whole region: when people have jobs with stable incomes mean life they raise, they will need to demand to serve themselves as care and health education; Create peace of mind for people and investors, improve the quality of serving the people: city development, people's lives will be improved to attract investors with new services, high quality changing the face of the city.

Stable life of people by non-flooding: there is no flooding where people's living is undisturbed and have not to find ways to live with dirty from floodwater, creating more advantages for people's business.

Settlements and permanent homes: no flooding, road and embankment system development, people have stable jobs. They will build and solidify homes, promote and take advantage of land resources.

Life safety due to non-flooding and depression on riverside: the riverside where is embanked by standard will reduce flooding and depression situation causing to loss of homes and property of people living around the river, canal.

Promotion to relevant industry development: the construction investment will promote the development of industries: tourism boats, trades on two roadsides, two sides of embankment.

Reduction of social cost caused by disease and traffic accidents: non-flooding will limit the source caused to spread diseases, reduction of traffic accidents by poor visibility will reduce the social costs for illness and accidents.

Environmental benefits: Pollution reduction on air, soil and water: no flooding will not pollute the soil and water environment in the process of sanitary living people. Contaminated and stagnant water will do fetid air pollution. Therefore, when there is no inundation would reduce environmental pollution. When developing a large road, no traffic congestion will reduce dust and noise from traffic vehicles. Fresh air and less dust & noise caused by reduction of traffic congestion. No stench rises due to flooding and poor sanitation.

Soil: it will reduce swampy conditions, did not disturb the soil microorganisms. Landscape, trees, water and green spaces create harmony between natural ecological environment and urban environment. The tree planting brings fresh atmosphere, fresh, oxygen-rich. City gives green environment - clean – beautiful

Water: water source is not stagnant, while rain or tide will flow faster, no flooding, no environmental influence of surface water, groundwater and aquatic ecosystems in the project area.

Reduction of disease: floodwater will make rapid water contamination due to process of people living with contaminated water from manholes reflux wastewater up. That is the source of infection and rapid spread of disease. Thus, if it is not flooding, it will reduce the disease to people.

Landscape: trees, water and green spaces create harmony between natural ecological environment and urban environment. The tree planting brings fresh atmosphere, fresh, oxygen-rich.

The project not only brings benefits to residents in the project area, but also contributes to promoting social and economic development for the Mekong Delta region. Being blessed with a strategic location in the heart of the Mekong Delta region, Can Tho is hub of trade exchange, receiving technology transfer, investment opportunities of the scientific and technical applications, health care, education and high-quality training of the Mekong Delta region from Ho Chi Minh City.

IV. Legal Basics

This part will provide existing law and regulation of Vietnam that must be followed by the project implementation.

4.1 Legal basics

- Procurement issues:
 - Consolidation Document No. 12/VBHN-VPQH dated July 04, 2019 of National Assembly on consolidation of Procurement Law 2013, Amended Procurement Law 2016, 2017, 2019;
 - Procurement Law 2019
 - Decree No. 63/2014/ND-CP of Government of Vietnam about guiding the Procurement Law on selection of contractor;
 - Decree No. 25/2020/ND-CP of Government of Vietnam about guiding the implementation of Procurement Law on selection of contractor (effective on April 20, 2020, replacing Decree 30/2015/ND-CP);
 - Circular 06/2020/TT-BKHDT of Ministry of Planning and Investment about guiding the implementation of Decree 25/2020/ND-CP;
 - Circular 10/2015/TT-BKHDT of Ministry of Planning and Investment about detailed plan on selection of contractor;
 - Circular 19/2015/TT-BKHDT of Ministry of Planning and Investment about detailed preparation of appraisal report during selection of contractor;
 - Circular 04/2019/TT-BKHDT of Ministry of Planning and Investment about guiding the training activities and testing for granting Procurement Certificate;
 - Circular 09/2019/TT-BKHDT of Ministry of Planning and Investment about amending Circular 04/2019/TT-BKHDT;
 - Circular 10/2016/TT-BKHDT of Ministry of Planning and Investment about detailed supervision, monitoring and inspection of procurement activities;
 - Circular 04/2017/TT-BKHDT of Ministry of Planning and Investment about detailed selection of contractor through the National Procurement Network;
 - Circular 05/2020/TT-BKHDT of Ministry of Planning and Investment about amending Circular 04/2017/TT-BKHDT (effective on September 01, 2020);
 - Circular 05/2018/TT-BKHDT of Ministry of Planning and Investment about guiding the preparation of Bid Evaluation Report of bid package selected via National Procurement Network.
- Construction issues:
 - Consolidation Document No. 02/VBHN-VPQH dated July 15, 2020 of National Assembly on issuance of Construction Law;
 - Construction Law 2019;

- Decree No. 15/2021/ND-CP of Government of Vietnam about guiding some contents on managing construction investment projects;
 - Consolidation Document No. 10/VBHN-BXD of Ministry of Construction about consolidation of guiding circular about the issuance of construction permits and management of foreign construction contractor in Vietnam.
- Management of investment for construction:
 - Decree No. 10/2021/ND-CP of Government of Vietnam about managing construction investment expense (effective on February 09, 2021);
 - Circular 11/2021/TT-BXD of Ministry of Construction about guiding the determination and management of construction investment expenses.
- Quality assurance and maintenance of construction works:
 - Decree 06/2021/ND-CP of Government of Vietnam about guiding the quality assurance, construction and maintenance of construction works;
 - Circular No. 06/2021/TT-BXD of Ministry of Construction about classifying construction works and guidance on the application in the management of construction works (effective on August 14, 2021).
- ODA Fund management:
 - Decree No. 56/2020/ND-CP of Government of Vietnam about management and use of ODA fund and concessional credit loan of international donors
- Environmental issues:
 - Environmental Protection Law No.72/2020/QH14 of National Assemble;
 - Decree No. 54/2021/ND-CP of Government of Vietnam about initial environmental assessment
- Flooding and head wave control:
 - Natural Disaster Prevention and Protection Law No. 33/2013/QH13 of National Assemble;
 - Amendment and Supplementation of some articles of Natural Disaster Prevention and Protection Law No. 33/2020/QH14 of National Assemble;
 - Decree No. 66/2021/ND-CP of Government of Vietnam about detailed guidance of the implementation of Natural Disaster Prevention and Protection Law.

4.2 Applied Technical Standard

Designing of the investment items of the project shall be based on GoV's related current active standards and codes. Below are the standards and codes to be applied or partly obeyed upon implementation of the project's work items.

- Hydraulic model and hydraulic structure construction calculation standards
 - QCVN 04 - 05: 2012/BNNPTNT of MOARD about National technical regulation - Hydraulic structure - Key design regulations;
 - TCVN 7957:2008 - Drainage and wastewater - External network and work - Design standards;
 - Decision No. 853/QĐ-BNN-KHCN of MOARD about technical standards applied in hydrological, hydraulic calculation for the "Flood-Control Hydraulic System in HCM City" Project.
 - QCVN 04-01: 2010/BNNPTNT of MOARD – National technical standards about composition, contents of Investment Report, FS Report and Economic – Technical Report of hydraulic structure projects;
 - TCVN 9362:2012 of Ministry of Composition about standards for design of foundation for buildings and structures;
 - TCVN 4253:2012 of Ministry of Science and Technology about Hydraulic structure - Foundation of hydraulic structures - Design requirements;
 - TCVN 9152:2012 of Ministry of Science and Technology about Hydraulic structure – Designing process for retaining wall of hydraulic structure;
 - QĐ1653/QĐ-BNN-KHCN of MOARD about technical standards applied for Sea Dyke Reinforcement, Protection and Upgrade Program;
 - TCXD 205-1998 of Ministry of Construction about Pile Foundation – Design standards;
 - TCVN 8419:2010 of Ministry of Science and Technology about Hydraulic structure - Design of river bank flood protection structures;
 - TCVN 8299:2009 of Ministry of Science and Technology about Hydraulic structure. Technical Requirements for Steel Gate and Groove Design;
 - TCVN 4116:1985 of Ministry of Construction about hydraulic concrete and reinforced concrete structure designing standards;
 - TCVN 8218:2009 of Ministry of Construction about hydraulic standards;
 - 22-TCN 207-92 of Ministry of Transport about harbour designing standards;
 - TCVN 9151:2012 of Ministry of Science and Technology about Hydraulic structures - Hydraulic calculation process of ground sluice;
 - TCVN 8421:2010 of Ministry of Science and Technology about load and impacts (of wave and ship/boat) on hydraulic structure.

- Transportation standard
 - TCVN 4054-05 - Highway designing standards. 22TCN 211-06 – Soft pavement designing process;
 - Vietnam construction codes - Ministry of Construction 1997. TCXD 104-2007 – Urban road, square designing regulations;
 - 22 TCN 262-2000 - Specifications for surveys and design of highway in soft soil areas. TCVN 2737:1995 – Load and design standards;
 - TCVN 6085:1995 - Technical drawings – Construction drawings - general principles for production of construction drawings for prefabricated structural components;
 - TCVN 4447: 1998 - Earth Works - Codes for Construction, Check and Acceptance. 22TCN-237- 01 – Regulations for road traffic signs;
 - TCXD 362:2005 - Greenery Planning for Public Utilities in Urban Areas - Design Standards;
 - Circular No. 20/2005/TT-BXD dated 20 December 2005 of Ministry of Construction about Urban Greenery Management Guidelines;
 - Decree No. 64/2010/ND-CP of Government about urban greenery management. Water supply standards;
- Vietnam construction standards and codes
 - Design standards: Water Supply - External Networks and Facilities (TCXD 33: 2006) HDPE pipe standards; ISO4427-1996; DIN8074; CS 155-63;
 - uPVC pipe standards; TCVN 6151, ASTM 2241 and AS 1477 Steel pipe standards: BS534:1981, BS3600:1976, BS3601:1987. Rubber gasket standards: ISO 4633-1983;
 - AWWA standards (valve): C500-93; C502-94; C509-94;
 - AWWA standards (pipe installation and pressure testing) C600-93. BS 4504 16bar; ANSI B16.5 class 150 standards for water meter.
- Drainage standards
 - Vietnamese Construction Codes 2008 – Volume I, II, III
 - TCVN 7957 – 2008 Drainage and Sewerage – External Networks and Facilities – Design standards.
 - TCVN 5945 – 2005 Industrial wastewater – design standards
 - TCVN 7382 – 2004 Water, hospital wastewater quality – discharge standards.
 - QCVN 07-2010- BXD about National Technical Codes about infrastructural structures TCXDVN 261-2001 – Landfill standards – Design standards
- Lighting power standards
 - 11 TCN 18:2006 - Electric equipment regulations – Part I: General regulations;
 - 11 TCN 19:2006 - Electric equipment regulations - Part II: Power transmission line system;

- 11 TCN 20:2006 - Electric equipment regulations - Part III: Protection and automatic;
 - 11 TCN 21: 2006 - Electric equipment regulations - Part IV: Distribution equipment and transformer station;
 - TCXDVN 253: 2001 - Lighting standards - Power supply designing - Science and Technics Publishing House;
 - Instructions for electrical designing and installation in compliance with IEC international standards of Science and Technics Publishing House (2006).
- Construction and structure standards
 - TCXDVN 356-2005: Concrete and reinforced concrete structures - Design standards. TCXDVN 372-2006: Sewerage reinforced concrete pipes;
 - 20TCN 104-83: Limit state-based bridge and culvert designing. TCXDVN 281-2004: Cultural house designing standards;
 - TCVN 2622-1995: Fire prevention and fighting design standards for buildings and structures;
 - TCVN 205-1998: Pile foundation design standards;
 - TCVN 5573-1991: Masonry and reinforced masonry structures - Design standards. TCVN 2737-1995: Load and impact design standards;

4.3 Consistency with existing plans of Can Tho City

- Master Plan on Socio-economic Development

In the Master Plan of Can Tho City on Socio-economic Development in Mekong River Delta to 2020 and Orientation to 2030, it mentioned the construction of Mekong River Delta to become a dynamic development region with a modern economic structure and synchronic infrastructure network. Can Tho City will implement flood control and environmental sanitation, urban corridor development, strengthening urban management to adapt to climate change.

- Construction planning

In the construction plan in Mekong River Delta to 2020 and Vision to 2050, it mentioned the Can Tho City will deal with the problems on flooding control and environmental sanitation, urban corridor development and strengthening on urban management for climate change resilience. It is completely consistent with construction planning in Mekong River Delta on the spatial structure to promote the role and position and potential of region in compliance with multipolar mode combined with an urban economic corridor in which Can Tho city is key- urban and centre of the region. It also forms a social infrastructure system with diversity and flexibility on the basis of the technical infrastructure system in companied with structure of the population, urban in the entire area, close control for the environment, waste treatment sources, cemeteries, lean

water source, and power, in combination with flooding control with mitigation measures to natural disasters for riverside and coastal urban areas.

- Can Tho City Drainage Planning

In the Can Tho City Drainage Planning to 2020 and Orientation to 2030, it will invest and create the drainage system in the city area more quantity and quality as well as the capacity of drainage of sewers in Can Tho city. It will contribute to a gradually complete objective as outlined to 2020 that thoroughly solves flood situations caused by heavy rain and flood tide.

Project's measures on flood and heat wave are fully in accordance with the law and regulations of Vietnam. In addition, the project's measures also consistent with existing plans that prepared by Can Tho City People's Committee. Its legal aspect is completely feasible.

V. Feasibility Analysis

5.1 Overview of existing conditions

5.1.1 Flooding

Can Tho City has a flat terrain with a dense network of rivers and canals which is advantageous for rapid drainage from urban areas to the receiving body. The high areas are favorable for construction; low-lying areas can be used for the construction of reservoirs, dams and drainage and combined with green trees to create a landscape. It is less affected by unusually severe weather phenomena like hurricanes, earthquake and tsunamis. The city belongs to the meteorological area, mild weather, the frequency and variable amplitude of these factors have less mutation that enables a reduction in the scale and nature of the drainage system.

The majority of Can Tho City's land has elevation below $\leq 2\text{m}$, low-lying terrain and in the direction from the river into the infield. The new urban areas are developed on the low areas in the districts of Vinh Thanh, Co Do and Phong Dien and O Mon and Thot Not which are directly or indirectly flooded low-lying areas affected by floods. And due to the dense network of rivers, it leads to large topographical division, poor engineering geology, soft ground, affecting the construction of technical infrastructure.

Due to unfavorable hydrological characteristics in Can Tho City along with upstream flood and the high tide rise in the major rivers in recent years, the extent and scope of flooding is also increased: (i) Focused rainfall with more than 80% of the average rainfall of 1.800mm fell down to the ground in the 6 months of the rainy season; (ii) The floodwater flow from the Mekong River upstream is 20 times higher than the flow in dry season; (iii) Sea level rise according to the average record is 3 mm/year over 30 years; and (iv) High tide has the difference between the tidal foot and tidal peak of over 3m in estuaries. At the lowest tide, the highest and lowest water level is about 3m, but at high tide, it is only from 0.8 to 1m.

Can Tho City is located in the most affected area by climate change and sea level rise with factors like temperature. The annual average temperature raises 1.6°C by 2070 and up to 2.6°C by 2100. Rainfall will increase by 10 - 20%, dry season rainfall falls down 30% whereas the rainfall in the wet season rises. The average sea level rise of 30cm by 2050, and the highest level is 86cm by 2100. One meter of sea level rise would inundate about 68% area of Can Tho City, 2m sea level rise causes inundation to 99% of area of Can Tho City. Severe weather increases the frequency and intensity of storms and hurricanes.

Flood depth is getting higher resulting from the combined effects of sea level rise, rainfall, high tide and ground deformation along with the loss of drainage or temporary water storage areas. The extreme weather phenomena will cause an increase in both intensity and frequency of presence. In addition, the river bank erosion is also caused by climate change.

Most existing irrigation and infrastructure works are built on the Holocene layer where soft sediments exist. This layer has a high clay content mixed with various organic impurities, usually in water saturation state which leads to a weak load-bearing capacity. There will be some challenges of Can Tho City on tidal, pluvial/fluvial impact. Being located on centre of Mekong River Delta and along Hau River, Can Tho City will share the risks of the delta. The city is very easy to be impacted and susceptible to flooding, many factors are contributing to the flooding of the city. Can Tho Topography is under eligible low and relatively flat. The average altitude variation is within +0.6 to + 0.8m. Can Tho City in shallow flooded areas of the Mekong River Delta.

Due to the natural geographical conditions, Can Tho City is divided into sections with different inundations. While the top (north) of the city is prone to flooding because the river bottom (South), including two core districts, Ninh Kieu and Binh Thuy, mainly affected by high tides and rain. Flooding in the two urban districts increased by stronger core by heavy rains, poor drainage system did not keep up the pace of development and urban development uncontrolled. Due to heavy intensity, extension and total high rainfall: according to statistics shows rainfall over shorter periods, the characteristics of rainfall in Can Tho usually rainstorm, rain lasting from 30 minutes to 180 minutes. In addition, Can Tho is under the "central" climates of the southern delta.

5.1.2 Heat waves

Heat wave is the hot weather days that exceeds human endurance will happen more in Can Tho City. A heat wave is an unusually high temperature wave that lasts for days or weeks and also affects a significant geographical part of Can Tho. There is no universal definition of heat wave that is suitable for the particular case of Vietnam. There is not so much information and data about heat wave in Can Tho City so it is difficult to specify about heat wave situation and issue in this City.

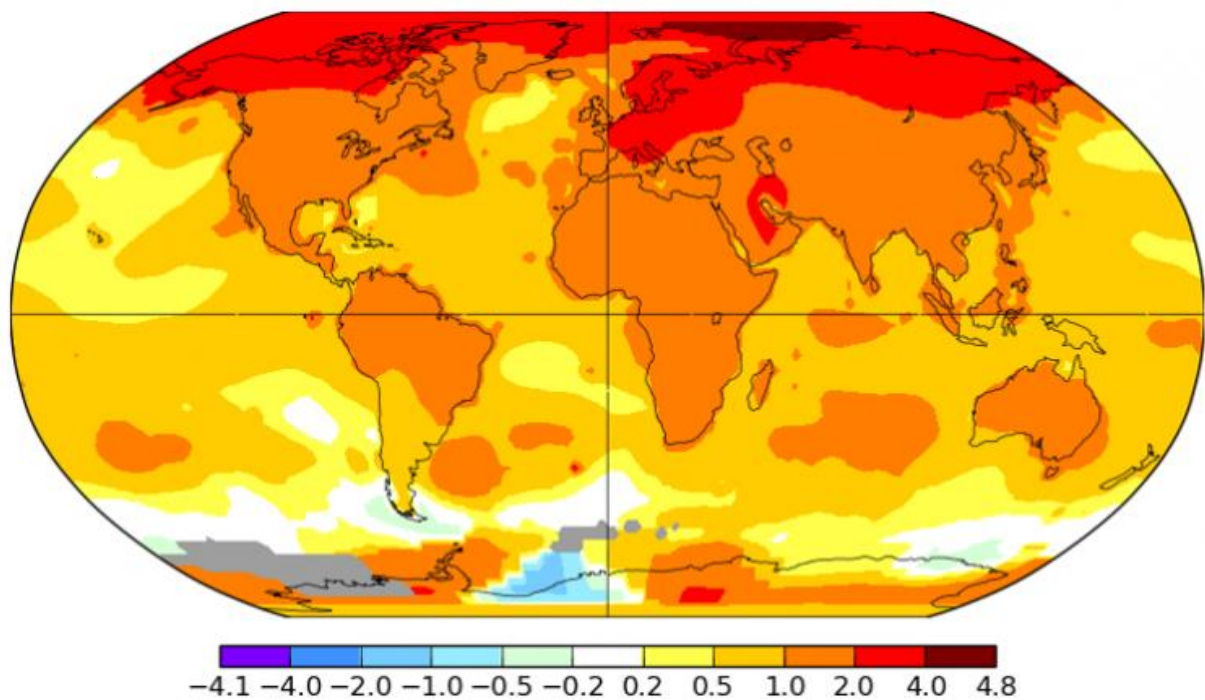


Figure 4: Global heat wave map 2019 (Source: NASA – GISS)

Usually, people believe that the first day of summer is the hottest day, this, however, is not always the case in Can Tho City. Even on the summer solstice day (June 22), the sunlight reaches the earth more directly but it is not the hottest day because water and earth are just beginning to absorb the heat. The temperature is more or less stable. After this day, sea water and earth will warm enough to start a hot period which may be more or less intense.

Heat wave is a natural phenomenon and there is no choice to change it, except trying to adapt as much as people can. Without taking any necessary measures, people can suffer their consequences. When it is extremely hot, if people do not take any right measures, people will have heat stroke or increased body temperature, particularly the youngest and/or oldest people as well as weak, very thin and/or very fat people. They are the most risky population groups in heat wave weather.

It is not only temperature increasing harmful to people. High temperature will be more dangerous when it combines with high humidity. People can live more easily under low temperature and low humidity. When the temperature is high, and surrounding atmosphere is so humid that sweating has no effect on cooling the body, human life could not suffer long under this high temperature and humidity. This situation will create some organ failure and people will be dead after some hours without any artificial cooling. The majority of deaths can be sourced from heat stroke, heart attack and dehydration from excessive sweating.

Heat wave will have different impacts on different community groups at Can Tho City depending on their living conditions. It is harder for the poor people to suffer from heat wave than the rich. In Can Tho City, cooling capacity of people could not follow the economic development. It shows a race between a warming microclimate and adaptation ability. During the hottest days, energy consumption spikes for using fan and/or air conditioner for cooling. This is also a problem because increasing energy consumption will increase expense for electricity and create power outages in many parts of Can Tho City or overload electric transmission systems.

When global warming climate, Can Tho City is located at a tropical region where already hot weather and high humidity is, this area will reach the deadly heat wave faster. Under this microclimate situation, shade has no effect because of high humidity and surrounding temperature is higher than human body temperature. In addition, this situation combines with low income of economic condition at Can Tho City. It will make the people have litter access to air condition due to their financial issues and low effectiveness of electricity system.

5.2 Proposed measures of flooding and heat wave mitigation

In the **Vulnerability Report**, the proposed measures of flooding and heat wave mitigation will be as follows:

Flooding:

- Measure 1: Mobile flood embankments
- Measure 2: Rehabilitation of existing drainage system
- Measure 3: Detention swales along roads
- Measure 4: Flood awareness campaign

Heat wave:

- Measure 5: Cooling centres

The following parts will provide generic feasibility analysis of each Measures in term of financial, technical, legal, institutional, social and environmental risks.

5.2.1 Measure 1 - Mobile Flood Embankment

The installation of mobile flood embankment is a traditional means of protecting low-lying communities and infrastructure against flooding during rainy season. This part will present an initial measures of new and remedial works for mobile embankment that can be referred as “mobile flood defence”. The mobile flood embankment can be easily deployed around an important building (e.g. office of local government, hospital, school), a historical place (e.g. temple, church), an infrastructure (e.g. a road), etc.

The mobile flood embankment systems consists of inflatable tube (hose) segments that are used to insulate/dam flood water. These robust flood protection segments are first inflated with air by a compressor, brought into position and then filled with water. While filling the segments with water, it is possible to take water from the raising water (flood) body for this purpose. After protection from the flood, the hose dams are dismantled, cleaned and stored again. The advantage of mobile flood embankment systems is their immediate use and protection. There is no need for (time-intensive) planning, approval and construction phases that often take years, as is the case with stationary flood protection measures (e.g. construction dikes, etc.).

A potential alternative or addition to mobile flood embankments are interventions with the use of flood shields. As embankment hoses, flood shields can be temporary installations placed on window or door/gate openings at buildings. Flood shields can be fitted to individual building characteristics and are deployed ahead of a potential flood event. In the absence of flooding, shields can be dismantled and stored in the buildings. Depending on the anticipated pressure from floods, flood shields consist of reinforced aluminium plates or steel. A flood shield is only as good as the wall it is attached to. Accordingly, a structural inspection and assessment should be carried out by experts before installation.

The potential risks of this measures will be analysed as follows:

- Financial Risk

This measure is high cost for investment. During preparation of this Pre-feasibility study, there is no local provider of mobile embankment available in Can Tho as well as Vietnam so that the mobile embankment can be imported from other countries. This means the project will pay high imported taxes, custom fees and other legal charges. It needs to consider carefully about these issues in during preparation of Feasibility Study.

- Technical Risk

There is no technical risk during implementation of this measures. The inflatable tube (hose) segments can be easily installed around targeted infrastructure once it was selected by Can Tho PPC. Mobile Flood Embankment can be implemented at some certain locations and places such as historical houses/relics, important Governmental buildings (Can Tho CPC), hospitals, beautiful hotels, etc. during flooding season in order to protect these buildings and keep them to operate regularly. This purpose, however, need to be considered very carefully in next phase of the project preparation (Feasibility Study). Because these tasks are very specific and precise in order to define necessary, demand and requirements of those buildings.

- Legal Risk

There is no legal basic available for designing - Vietnamese Standard for this mobile flood embankment. And Vietnamese construction sector are not familiar with this infrastructure. This

Measure is a new concept so that there is a need to introduce this concept to relevant stakeholders, particularly Can Tho PPC. Once they understand about this concept, implementation phase will be implemented easier.

- Institutional Risk

There is need of a cooperation between implementing company and beneficiary of this measure. Can Tho Water Supply and Sewerage Joint Stock Company will be selected as the implementer of this measure because it is in charge of wastewater management within urban area of Can Tho City. And the beneficiary will be a person or institute who is the owner of building or infrastructure that will be protected by mobile flood embankment during flooded duration. The cooperation should be a simple mechanism of how to implement the measure whenever it needed. Depending on the flood situation and level of water raise of river nearby, the mobile flood embankment can be deployed around the building or infrastructure.

Once this cooperation mechanism was developed, the mobile flood embankment will be implemented smoothly.

- Social Risk

Flooding season of Mekong River is a natural flood phenomenon in Mekong Delta of Vietnam. It usually starts from August to November every year. This is a typical phenomenon of Mekong River. It happens in Mekong Delta, Lower Mekong River and Tonle Sap Lake (Cambodia). Although this phenomenon is a flood, it is not considered as a natural disaster which can be harmful to local people. Farmers in Mekong Delta, including Can Tho City consider this flood season as a season of changing agricultural practices.



Picture 1: Fishery during flooding season at O Mon District (taken by Le Hoang)



Picture 2: Mekong Delta flooding area (source: Mekong Committee)



Picture 3: Flooding paddy field at Cai Rang District (taken by Le Hoang)

Instead of farming, local people switch to exploiting abundant aquatic resources, brought by immense flood phenomenon. The flood season creates conditions for agricultural land in lower Mekong River in Vietnam to be rest, wash away and kill pest and diseases for next agricultural crops. It also provide natural fertile alluvium for the soil, and also aquaculture resources (natural

fish, shrimp, etc.) for the lakes/pond in whole Mekong Delta free of charge. People usually consider the flood as a benefit for their life so that the deployment of mobile flood embankment could meet the derision of local people nearby.

- *Environmental Risk*

There is no severe environmental risk on this measure if the materials of mobile flood embankment from the manufacturers who produces mobile flood embankment in environmental-friendly methods. This risk can be fully controlled by existing environmental standards of original countries. So, it is no environmental risks for this measure.

5.2.2 Measure 2 - Rehabilitation of Existing Drainage System

Existing drainage system includes small rivers, channels, canals, opened ditches and regulation lakes (generally calls channels and lakes). Channels and lakes are very important elements of a drainage system. While the channels have function of transportation huge volume of storm water, the lakes will play a function of storing and regulating the storm water during the heavily showers. Channels and lakes help to reduce dimensions of the drainage system, including capacity of storm water pumping stations, while keeping the flood do not occur in the city or resident areas. The channels and lakes system, if it is properly operated and maintained, will improve the urban living environment and city landscape. In contrast, if it is poorly operated and maintained, the channels and lakes become most of polluted locations, containing all potential water-born disease.

The primary objective of rehabilitation of channels and lakes is to maintain the given functions of those facilities, including: (i) keeping the storm water flowing as necessary; (ii) maintaining the regulation capacity as needed; and (iii) maintaining the best environment and landscape conditions surrounding the channels and lakes. To achieve the objectives of rehabilitation of existing drainage system, the tasks will include the following sequence works: (i) inspection; (ii) cleaning; (iii) dredging; and (iv) repairing.

Inspection of existing drainage system by the following habitat parameters:

Table 2: Inspection of drainage channel and regulation lakes

Habitat Parameter	Status Category			
	Optimal	Sub-Optimal	Marginal	Poor
1. Sediment Deposition	Little or no enlargement of bars and less than 5% of the	Some new increase in bar formation, mostly from coarse	Moderate deposition of new gravel, coarse sand	Heavy deposits of fine material, increased bar

Habitat Parameter	Status Category			
	Optimal	Sub-Optimal	Marginal	Poor
	bottom affected by sediment deposition.	gravel; 5-30% of the bottom affected; slight deposition in pools.	on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition in pools prevalent.	development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
2. Channel Flow Status*	Water fills base flow channel; minimal amount of channel substrate exposed.	Water fills >75% of the base flow channel; <25% channel substrate exposed.	Water fills 25-75% of the base flow channel; riffle substrates mostly exposed.	Very little water in channel, and mostly present as standing pools.
3. Bank Stability Note: determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency and size of erosion areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of banks have erosion scars on side-slopes.
4. Bank Vegetation Protection (note: reduce scores for annual crops and weeds which do not hold soil well, e.g. knapweed)	Less than 50% of the channels and lakes bank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.	50-70% of the stream bank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	70-90% of the stream bank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	Over 90% of the stream bank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.

*A sectional hydraulic modelling for the drainage system could be considered to identify strongly degraded sections within the system with severe malfunctions regarding water discharge.



Picture 4: Inspecting the Existing Drainage System (flap gate and lake) (taken by Nguyen Hoang Long)

Cleaning existing drainage system includes removal of the nuisance vegetation growth from water body and removal of damped solid waste to the channels and lakes. This work could be done manually or mechanically. There are machines which cut and collect aquatic plants; remove them from the water; transport and dispose them in landfills, used as compost, or in some cases stockpiled to dry and then worked into the soil. In Can Tho City, most of the channels and lakes cleaning works are carried out manually. Sometimes, workers use boards to collect the floating aquatic plants and damped garbage to lakes and channels. Here, it should be mentioned that cleaning works, carried out manually, are often considered to be unpleasant and unattractive works. Hence, in future project planning phases, it should be considered to facilitate cleaning works with modern, and possibly automated tools and equipment, such as modern amphibious suction dredgers.



Picture 5: Cleaning the Existing Drainage System (taken by Le Xuan Hoang)

Dredging the existing drainage system includes removal or excavation, transport, and placement of dredged sediments are the primary components of the "dredging process". Each part of dredging process must be closely coordinated to ensure a successful dredging operation. The excavation process commonly referred to as "dredging" involves the removal of sediments recently deposited (maintenance) condition, either mechanically or hydraulically. After the sediment has been excavated, it is transported from the dredging site to the placement site or

disposal area. This transport operation, in many cases, is accomplished by the dredge itself or by using additional equipment such as barges, scows, and pipelines with booster pumps. Once the dredged material has been collected and transported, the final step in the dredging process is placement in either open-water, near-shore, or upland locations. The choice of management alternatives involves a variety of factors related to the dredging process including environmental acceptability, technical feasibility, and economic feasibility of the chosen alternative. Dredging is environmentally risk. So, as part of the preparation for the work, environment mitigation plan need to be prepared for all process, including dredging, transportation and disposal of the sludge.



Picture 6: Dredging the Existing Drainage System (taken by Nguyen Hoang Long)

Repairing the existing drainage system include the tasks (i) repairing existing embankment; (ii) repairing maintenance roads; and (iii) repairing the outlet structures.



Picture 7: Repairing the Existing Drainage System (taken by Nguyen Hoang Long)

The potential risks of this measures will be analysed as follows:

- Financial Risk

The rehabilitation of existing drainage system needs high cost due to high volume of works that need to be implemented. Existing conditions of drainage system at Can Tho City differ widely because of the varied nature of hydrologic condition. Site survey and investigation should be implemented during Feasibility Study phase in order to obtain important information of existing

condition of drainage system. Based on that detailed cost estimation can be prepared for the investment of rehabilitation.

- Technical Risk

The rehabilitation of the existing drainage system involve sequence works from survey to implementation phase. They can be done by a civil work company. In term of technical aspect, this work is many activities involved that are difficult to implement. This work also difficult to implement, mostly carry out by manual works in a long way construction site along the river, channels, opened ditches, etc. It is very hard work and needs carefully preparation, implementation, supervision and acceptance by relevant stakeholders.

However, the rehabilitation works were carried out in many time so that many contractors, workers, technicians and engineers involved are very familiar with these works.

- Legal Risk

There is a number of legal regulation, issued by Government of Vietnam and Ministry of Construction (MOC), particularly Decree No. 80/2014/ND-CP on drainage and wastewater treatment and Circular No. 07/2017/TT-BXD dated 02 April 2015 about guidance how to define and manage rehabilitation work of drainage system. Legally, there is no risk on this issue.

- Institutional Risk

There is no severe institutional risk in order to implement rehabilitation of existing drainage system. However, this work require a good cooperation and operation among stakeholder participated. In case, Can Tho Water Supply and Wastewater JSC. was assigned for this work. They should work together with many People's Committees of Wards, local communities and people who are living along the drainage system. This work requires a comprehensive effort to get it done.

- Social Risk

There is no social risk during implementing rehabilitation of existing drainage system. However, during rehabilitation, this work can create some disturbance and interruption of human activates nearby construction site.

- Environmental Risk

It is quite high environmental risk during rehabilitation of existing drainage system. Dredging sludge and sediment and removal of vegetation from existing drainage system will be harmful to the environment around if they were not transported in a proper way. In addition, disposal of high quantity of sludge, sediment and vegetation that removed from existing drainage system will create environment issues at dumpsite.

5.2.3 Measure 3 - Detention Swales Along Roads

Detention Swales Along Roads are on-site detention systems to provide temporary storage of storm water runoff from developments and restrict discharge. The main principles of this Measure are: (i) provide for the safety and welfare of the general and affected community, including protection from flooding, and the safe enjoyment of open space and other land adjacent to flooding protection infrastructure; (ii) achieve flood management targets as set by the Can Tho CPC; (iii) intergrade storm water drainage quality and flooding control; and (iv) manage flood protection, water quality and storm water harvesting and reuse schemes.

- Financial Risk

The implementation of detention swales along roads needs high cost due to high volume of works that need to be implemented. Existing conditions of roads at Can Tho City should be surveyed and investigated should be implemented during Feasibility Study phase in order to obtain important information of existing condition of the road. Based on that detailed cost estimation can be prepared for the investment of detention swales along the roads.

- Technical Risk

For the implementation of this Measure, a topographical and geographical survey is initially required. It is also a requirement of typical designs of road's structure. This engineering site survey will provide the basis for development of this Measure and consist of the following details:

- (i) contours and spot levels of proposed road, the contour interval shall not be greater than 0.2 m;
- (ii) all above and/or below ground existing features on the construction site, including houses, construction structures, fences, trees, etc.; existing underground infrastructure such as basement, electricity wires, cable, etc.;
- (iii) existing and proposed boundaries of houses and construction structures above and/or below ground;
- (iv) existing infrastructure and impervious area such as buildings, (including floor level), sheds, carports, and paved/hardstand area on the land; and
- (v) adjacent road, footpath, storm water pits and connecting pipes, downpipe connections, trees, verge and associated services. Can Tho City is at high ground water bed so that the site investigation should be carefully consider this factor.

Design drawings will be prepared base on site investigation and shall include sufficient details to access the suitability/capability of proposed Measure. There is a number of available roads with suitable width in order to implement this Measure 3 – Detention Swales Along Roads, provided in the Annex 4 of this Report. Selection of the road will be done during preparation phase of

Feasibility Study with the agreement of relevant project stakeholders. It is not difficult for the investment, legally. It can combine with annual infrastructure development plans, that are available at each district of Ninh Kieu, Binh Thuy and Cai Rang.



Picture 8: Detention swales along small alley (taken by Nguyen Hoang Long)

The designs must show the proposed Measures of managing flood with simple, safe, cost-effective maintenance and operation manners, are to include:

- (i) all above and/or below ground proposed features on the site, including any existing or proposed drainage reserves;
- (ii) contours or spot levels for proposed finished surface levels and expected drainage patterns (direction or flow); the contour interval must not be greater than 0.2 m;
- (iii) all previous and impervious area (buildings and covered/paved areas, paths and driveways with materials used, and any landscaping including plants, mulched area show schematically);
- (iv) proposed building finished flow level;
- (v) proposed earthworks (cut/fill line) and retaining walls on the site in association with the development; the top and bottom levels of the retaining wall are to be shown on the designs.

The potential risks of this measures will be analysed as follows:

- **Legal Risk**

There is a legal basic available for designing - Vietnamese Standard - TCVN 7957:2008 on Drainage and Sewerage – External Network and Facilities – Design Standard so that legal feasibility of this Measure is already available. And almost all construction works are familiar with construction sector. However, this Measure is still a new concept of flooding measure in the construction sector of Vietnam. There is a need to introduce this concept to relevant stakeholders. Once they understand about this concept, implementation phase will be implemented easier. Implementation of detention swales along road can combined with the construction development plan of district. This should be implemented during Feasibility Study phase.

- Institutional Risk

There is no severe institutional risk in order to implement rehabilitation of detention swales along road. Institutional framework for construction works is available in Can Tho City and relevant authorized agencies are familiar with working procedure.

- Social Risk

There are a few social risks during implementation of this measure. Some annoying for local people during construction phase will be happened. And some healthcare problem will be occurred in case the water was stored at detention swales along the road where can create a good condition of mosquito if this measure was not designed and constructed in proper way,

- Environmental Risk

This measure will face some environment issues in case of bad designs. Water will be stored at a place in long time can create good living conditions for mosquitos, flies and then leading to some annoying of local people on-site. But these issues can be resolved by designs with good slope.

5.2.4 Measure 4 - Flood Awareness Campaign

Measure 4 often begin with a lot of energy and enthusiasm and it is essential to draw attention of people. There are many ways and method to implement this measure, including everything from drawing contests for pupils at schools to public media advertisement. Depending on time, resources, stage of campaign, targeted groups, etc. this Measure will have very little risks in general.

An effective flood awareness campaign employs a variety of communication approaches and techniques to ensure that the key message is received and understood by a diverse audience. Different tools can be used to implement a flood awareness campaign, while their application to specific target group (i.e. informing, educating, motivating to an action, behaviour change, etc.):

- Media (local TV, radio, press)
- Public events
- Press conferences
- Workshops
- Exhibitions
- Brochures, posters

Before selecting the right tool, the target group should be defined among people are connected to the flood adaptation measure at Can Tho City. The targeted groups can be:

- Children
- Students
- Citizens
- Households
- Public sector



Picture 9: Public Awareness Campaigns (implemented by Nguyen Hoang Long)

There is a fact that the flood awareness campaign can be very diversified from very large scale to community of Can Tho City to small scale as a school. However, in any case, the risk of flood awareness campaign can be analysed as follows:

- Financial risk

Depending on the scale and type of campaign, the implementation cost of flood awareness campaign can be diversified from low to high. Total cost estimation of this measure should be define during Feasibility Study phase.

- Institutional risk

There is no specific institute/department who is responsible for implementation of the flood awareness campaign. Selection of this implementer can only be carried out via bidding process.

- Social risk

Campaign will be less effective if the targeted groups were selected wrong. The selection of targeted group should be implemented during Feasibility Study phase.

- Environmental risk

This Measure was defined that there is no risky factor in terms of environment

5.2.5 Measure 5 - Cooling centre

A cooling centre can be called as cooling shelter is a location, typically an air-conditioned or cooled building that has been designated as a site to provide respite and safety during extreme

heat wave days. It is a temporary indoor air-conditioned public space to deal with the health issues of people, particularly elder and ill people and during heat wave. People can go there, get cooling-down and medical treatment. It may be a government-own building such as office of local government (CPC, District PC), library or school, an existing community house, religious centre, or a private business such as shopping malls, big coffee shop, or even theatre. It may be a cooling sites, outdoor parks with water spray, public swimming-pools, public parks.

In Can Tho City, there are only a few number of buildings such as Governmental building (Office of Can Tho CPC), hospitals, supermarkets (Vincom Centre), etc. that are big enough for the purpose of converting into cooling centre. Other Governmental buildings (Office of District PCs) and Can Tho Library are quite small places for some certain amount of people.

However, we found out the fact that the change of other buildings into cooling centres come to institutional and social issues. No building can be converted into cooling centre without interruption of daily working of other people who are working in those buildings. Governmental servants have to work in Governmental buildings. Doctors and nurses have to work in the hospitals. Librarians have work in the libraries. And the owner will not allow people to get in his supermarket not for shopping but cooling-down. Even though the electricity, investment cost and other expenditures will be covered by the project. It, therefore, converting indoor public buildings to cooling centres is not feasible and the best way.

The more feasible way to implement cooling centres is to use available public parks. The public park can be converted into cooling centre by construction of some additional construction items such as (i) wet playground and (ii) fountain for people to come there and get cooling-down, and (iii) an air-conditioned administrative houses for some doctors or nurses to work within some heat wave days. The list of available public parks will be provided in the Annex 5.



Picture 10: Public Parks at Can Tho City (taken by Nguyen Quang Huy)

In order to implement this Measure, some risks concerning with technical aspects need to overcome. Selecting the location of cooling centres should be considered carefully so that the most vulnerable population can easily access to a safe and cool environment during heat wave time. The location should not be too far from poor area of Can Tho City or public bus system should be connected with those cooling centres. Some awareness campaigns should be

implemented in order to draw attention of people on heat-related health impacts and cooling centres. These campaigns can bring attention to decision-makers in order to prepare legal basics, regulation and technical standards on this issues. They will also bring awareness to legal entity such as City's Department of Culture, Sport and Tourism (DoCST) who is managing public parks at Can Tho City.

The potential risks of this measures will be analysed as follows:

- Financial Risk

The cooling centre needs high cost for investment. Site survey and investigation should be implemented during Feasibility Study phase in order to obtain important information to select the location of the cooling centre. Based on that detailed cost estimation can be prepared for the investment.

- Technical Risk

Investment of cooling centre is a kind of investment for construction so that the implementation of this measure should following the procedure as a construction project. In addition, cooling centre is a new concept so that there is no Vietnamese Technical Standard available. Location of cooling centres should be easy to access by vulnerable people who are mostly poor and elder people so that site survey and investigation should be carried out initially.

- Legal Risk

There is no legal basics, regulation and standards about cooling centre. Even though the cooling centre is a new concept, it can be easily applied relevant regulations and standards e.g. construction standards.

- Institutional Risk

As mentioned-about, cooling centre is a new concept so that there is no provincial institute/department in charge of managing and operating the cooling centre. This work should be assigned a new task to the Department of Culture, Sport and Tourism who is managing public parks where the cooling centre will be located on.

- Social Risk

There is almost no social risk when implementing the cooling centre. The cooling centre will be a convenient place for the people to prevent from heat waves so that it is a relax place where is always receive the support of people.

- Environmental Risk

There is no environmental risk during implementation of this measure.

5.3 Summary of Feasibility Analysis

There is a fact that it is very difficult to separate all kind of feasible aspects for proposed mitigation measure in this Pre-feasibility Study. Each measure will have advantage and disadvantage, benefits and risks,. All aspects are interdependent each other. In general, financial and institutional procedures of donor (KfW), Government of Vietnam, and Can Tho CPC such as approving procedures will take long time at all levels and reduce part of the project effectiveness. If the approval process is delayed, the project schedule and budget may have to be adjusted and it will increase delayed time of overall project implementation. Therefore, all relevant project stakeholder should resolve rapidly the works in term of processes on consideration and decision-making.

The project aims to minimize the additional works and the changes in scope of works. The changes in legal system such as laws, decrees, circulars which are guiding in investment sector and basic construction. Any change in taxes and other levy charges or large fluctuations of market prices may cause unforeseen delays and also will increase the costs during the project implementation phase. In general, in all of the Measure, financial issue is the most high risk of feasible implementation. No project activity or measure can be done without ensuring the financial sources from donors and Government of Vietnam. All possibilities in term of feasibility analysis, including financial, technical, institutional, environmental and social aspects of each measure will be mentioned and analysed in following parts. A summary of all feasible analysis for each measure will be provided in the following table.

Table 3: Summary of Feasible Analysis and Considerations

#	Measures	Financial Risk	Technical Risk	Legal Risk	Institutional Risk	Social Risk	Environmental Risk
1	Mobile Flood Embankment	<p>High</p> <ul style="list-style-type: none"> - High investment cost - High importing cost - High tax payment 	<p>Low</p> <ul style="list-style-type: none"> - Easy installation - Easy maintenance and operation - Difficult to install along the big river due to whole area will be flooded during rainy season 	<p>Medium</p> <ul style="list-style-type: none"> - Not so much materials/products available in Vietnam - Difficult custom, tax procedures 	<p>Medium</p> <ul style="list-style-type: none"> - Need a cooperation of wastewater company to store, operate and maintenance - Need certain places/locations to deploy 	<p>High</p> <ul style="list-style-type: none"> - Easy accept by local beneficiaries and authorities - Difficult accept by people because it will prevent natural fertilizer and other aquaculture resources (fish, shrimp, etc.) from the field/lake nearby 	<p>Low</p> <ul style="list-style-type: none"> - Low environmental risk if imported material following environmental standards
2	Rehabilitation of Existing Drainage System	<p>High</p> <ul style="list-style-type: none"> - High investment cost 	<p>High</p> <ul style="list-style-type: none"> - Difficult to implement, mostly manual works - Very hard works, needs carefully preparation, implementation, supervision, and acceptance 	<p>Low</p> <ul style="list-style-type: none"> - Easy to convince Vietnamese authorized agencies to implement because this Measure is familiar with them. 	<p>Low</p> <ul style="list-style-type: none"> - This work is very familiar with all authorized project stakeholders 	<p>Low</p> <ul style="list-style-type: none"> - Implementation of works can create disturbance and interruption of human activities nearby construction sites during implementation 	<p>High</p> <ul style="list-style-type: none"> - Dredging sludge/sediment and removal of vegetation from existing drainage system will be harmful to the environment - Disposal of high quantity of sludge, sediment, and vegetation will create environmental issues at dumpsite

3	Detention Swales Along Roads	<p>High</p> <ul style="list-style-type: none"> - High investment cost 	<p>Low</p> <ul style="list-style-type: none"> - Construction works are familiar by contractors, supervisors but need to introduce of new concept to relevant project stakeholders 	<p>Low</p> <ul style="list-style-type: none"> - Legal framework, regulations, standards, etc. available - Combination with district Infrastructure development plans 	<p>Low</p> <ul style="list-style-type: none"> - Institutional framework for construction works is available. - Relevant authorized agencies are familiar with working procedure 	<p>Low</p> <ul style="list-style-type: none"> - Some annoying for local people on-site 	<p>Low</p> <ul style="list-style-type: none"> - Environment for mosquitos in case of bad designs.
4	Flood Awareness Campaign	<p>High</p> <ul style="list-style-type: none"> - High investment cost - Implementation cost can be diversified from low to high, depending the type of public awareness campaign 	<p>No risk</p>	<p>No risk</p>	<p>No risk</p>	<p>Low</p> <ul style="list-style-type: none"> - Wasted implementation if wrong identification of targeted groups 	<p>No risk</p>
5	Cooling Centres	<p>High</p> <ul style="list-style-type: none"> - High investment cost 	<p>Medium</p> <ul style="list-style-type: none"> - Selecting the location of cooling centre may not be easily access by the most vulnerable people - No technical standard on this issue 	<p>Medium</p> <ul style="list-style-type: none"> - There is no legal basics, regulations and standards on cooling centres. 	<p>Medium</p> <ul style="list-style-type: none"> - Assigning new task for DoCST 	<p>Low</p> <ul style="list-style-type: none"> - Vulnerable people should be informed 	<p>No risk</p>

VI. Proposed Executing Entity/Advisory support needed

This part will present the functions and responsibility of provincial agencies who will involve in the implementation of above-mentioned measures. The selected measures can be grouped into one project, including five components with corresponding names of each measure.

6.1 People's Committees

6.1.1 Can Tho City People's Committee

Can Tho City People's Committee (CPC) is the owner of flooding control and prevention system and public parks, which are the infrastructure that were invested from State budget. It will receive the handing over from other business organisations and/or companies which developed new urban area and organisation and/or individuals invested capital for business and operation of infrastructure during certain time in urban areas within administrative boundaries of Can Tho City.

During formulation phase and initial implementation of all measures, Can Tho CPC will be the executing entity. Can Tho CPC will be an organisation who will approve the Project Proposal, Pre-Feasibility Study, Feasibility Study, Basic and Detailed Designs. After that, Can Tho CPC will establish a Project Management Unit (PMU) who will be in charge during implementation phase. Functions, duties and responsibility of PMU will be described more detail in Chapter VIII, Part 8.1 Proposed programme/project's structure.

After completion of implementing measure, mobile flood embankment will be handed over to the Can Tho Water Supply and Wastewater JSC. They are in charge of management and operation of drainage system in urban areas of Can Tho City. The construction items of Measure 3 – Detention swales along roads will be hand over the Provincial Department of Transportation (DoT) who is now managing all the roads in Can Tho City. And cooling centre will be handed over to DoCST who is responsibility for the public parks, where the cooling centre was proposed to locate in.

Can Tho CPC is the investment-deciding agency and must answer to Government about the Project. It is the competent level of Vietnam, which approves the Project and the related documents. The City PC is the competent level of Vietnam side on the implementation of the measure. The duties and responsibility of Can Tho CPC in this project will be as follows:

- Approving procurement plan, review reports of the Project, other Project-related documents under responsibilities of the Governing Body;
- Implementing procurement activities as per regulations of current procurement laws;
- Providing relevant information/documents for project preparation/implementation contractors and consultants; being responsible for legal bases and reliability of the

provided information, documents; keeping documents about the project as archives in accordance with related legal regulations;

- Fully and continuously responsible for managing utilization of investment funds since investment phase, during investment implementation and when the program, project has been introduced into exploitation for payback and paying ODA loan (for the case of on-lending);
- Supervising, assessing the project; managing exploitation of the project; fully responsible for derogations made during the project management course which cause negative consequences to socio-economic development, environment and national reputation;
- Holding legal responsibilities; may have to compensate for economic losses, or there may be need for Project owner replacement for delayed implementation or implementation not compliant with investment decision and technical assistance Project document approval decision, causing drain, waste and corruption, affecting the project's objectives and general efficiency;
- Other rights and responsibilities as per related legal regulations.
- Co-operating with Ministry of Planning and Investment, other ministries, sectors and related agencies to develop ODA appealing and utilization strategies and planning; Developing ODA utilization co-ordination and improvement policies/measures applied in the province/city/town;
- Co-operating with Ministry of Planning and Investment in submitting Government request for signing of International Treaty about ODA Fund for Programs/Projects;
- Ensuring utilization efficiency of ODA fund directly managed, implemented by the locality;
- Effectively organizing, steering implementation of the projects under the Program in the area as per the approved plan.
- Sufficiently and timely providing counterpart fund as set forth in the commitments with Government and Donor.

6.1.2 District People's Committees

District People's Committees are the owner of drainage systems at urban areas and craft village as well as concentrated rural residential area that were invested from State budget, handing over from business organisations and/or companies which developed new urban area and Organisation and/or individuals invested capital for business and operation of drainage system during certain time in urban areas within administrative boundaries of a District.

6.2 Departments of Can Tho CPC

6.2.1 Department of Construction (DoC)

Beside other tasks and responsibilities, functions and duties of Can Tho DoC in the project implementation will be briefly summarised as follows:

- Instructing and checking implementation of legal regulations about preparation, management and implementation of work construction investment projects, surveying, designing, construction activities, etc.
- Appraising Basic Design (providing comments about Basic Design) of Can Tho City Development Project and enhancing urban adaptation capacity;
- Instructing and checking project appraisal work, technical designs, working drawings and cost estimates according to work construction investment project management regulations;

6.2.2 Department of Planning and Investment (DPI)

Beside other tasks and responsibilities, functions and duties of Can Tho DPI in the project implementation will be briefly summarised as follows:

- Assessing project implementation results; Addressing, under its competence or according to recommendations of the City's PC Chairman, the counterpart fund provision/disbursement issues and difficulties; Periodically synthesizing reports about ODA fund utilization reality and efficiency of this Project.
- Instructing and checking the selection of construction contractors as per regulations of Construction Law and Procurement Law;
- Appraising and being responsible for the contents of documents submitted to the City PC about procurement plan, bidder selection results, bidding documents of the project or package under decision authority of the City PC Chairman; Appraising and submitting the procurement plan to the City PC for approval.
- Instructing, monitoring, supervising, inspecting, checking the implementation of legal procurement regulations and preparing general reports about project implementation, procurement plan and implementation already approved by the City PC.

6.2.3 Department of Finance (DoF)

Beside other tasks and responsibilities, functions and duties of Can Tho DoF in the project implementation will be briefly summarised as follows:

- Managing the funds authorized by Central Level for this project as per related legal regulations;
- Co-operating with Department of Planning and Investment and other related agencies in advising the City PC about utilization of the project's investment funds; Developing

policies and measures for co-coordinating and improving the utilization efficiency of the project's ODA funds;

- Co-operating with Department of Planning and Investment and other related agencies to prepare the project's annual basic construction investment fund allocation estimate and plan; submitting the project's phase-wise investment fund allocation decision to the City PC; Submitting the lists of project for counter-part fund allocation from the provincial budget under investment management regulations; Developing adjustment, justification plan for allocated fund for other investment projects also from the local budget; Co- operating with other related agencies to develop the proposal for allocation of other annual basic construction investment funds for this project and submit it to the City PC for approval;
- Providing comments on the project's investment, financial appraisal mechanism of the project; participating in bid assessment for the project's packages as requested by Client (if any);
- Instructing Client to prepare annual counterpart-fund plan in accordance with National Budget Law;
- Reporting the City PC for adjustment of the project's counterpart fund allocation plan when necessary.

6.2.4 Department of Natural Resources and Environment (DoNRE)

Beside other tasks and responsibilities, functions and duties of Can Tho DoNRE in the project implementation will be briefly summarised as follows:

- Instruct ODA PMU about EIA Report appraisal, approval legal procedures and process. Appraise EIA Report; Preparing report to be submitted to Can Tho City PC for approval.
- Instruct and supervising PMU, Construction Contractors in environmental supervision implementation during the construction and operation course.
- Co-operate with related agencies to address the Project's difficulties/issues.
- Advise the City PC about site clearance, resettlement and provision of land for the Project.

6.2.5 Department of Agriculture and Rural Development (DARD)

Beside other tasks and responsibilities, functions and duties of Can Tho DARD in the project implementation will be briefly summarised as follows:

- Guide and inspect the implementation of the CPC on decentralization of managing small and medium irrigation works and rural drainage project in the localities;
- Guide and inspect and take responsibility for the construction, exploitation, use and protection of small and medium irrigation works;

- Organise the implementation of approved programmes/projects for rural drainage;
- Implement all regulations on river management, exploitation, use and development of rivers in the city in accordance with master plans and detailed plans approved by competent authorities;
- Guide, inspect and take responsibility for the construction, exploitation and protection of dikes and embankments, and other facilities that protecting against floods;
- Prepare plans and measures, and organise to implement the prevention and control of floods, storm, drought, inundation, saltwater incursion, land slide along river in the city area;
- Guide the preparation of irrigation land use planning;
- Organise to mark the boundaries on-site and prepare the development plan and measures to relocate structures and house related to the protection area of dikes and embankment in accordance with existing laws and regulations;
- Guide and inspect the implementation of regulations on State management on exploitation and protection of irrigation facilities;
- Guide and inspect the implementation of regulations on State management on corridor of dike protection under Grade IV and V dikes;
- Guide and inspect the implementation of regulations on State management on decision about flood control to protect dikes within local area in accordance with existing laws and regulation.

6.2.6 Department of Transportation (DoT)

Beside other tasks and responsibilities, functions and duties of Can Tho DoT in the project implementation will be briefly summarised as follows:

- Advise and assist the Can Tho CPC in performing the State management of transportation, including road, inland waterways, transportation and traffic safety;
- Prepare decision, directives and other documents under promulgating competence of Can Tho CPC on transportation;
- Prepare long-term, mid-term, detailed plans, programmes and projects on transportation;
- Prepare measures on implementation of administrative reforms in transportation under State management works;
- Prepare and submit investment projects on transportation;
- Organise to implement legal documents, plans, programmes, projects, standards, technical document and economic – technical norms in transportation fields;
- Organise to perform the tasks and responsibilities of investment-decided agencies and to act as investor for investment projects on construction of traffic infrastructure in accordance with its functions;

- Provide opinions on construction projects on local waterways and routes that connect to local waterways;
- Issue construction permits on the roads that are under management of local authorities or authorized management by Central Government.

6.2.7 Can Tho City's State Treasury

Beside other tasks and responsibilities, functions and duties of Can Tho City's State Treasury in the project implementation will be briefly summarised as follows:

- Reviewing the documents being the bases for approval of Ministry of Finance and KfW;
- Instructing ODA PMU on counterpart fund disbursement and provision legal processes and procedures.

6.3 Can Tho Water Supply and Sewerage Joint Stock Company

According to the definition, the component of drainage system includes (i) Primary system: drainage system, canals, ditches, sewerage and storm water sewers of the area or basin to discharge directly into receiving body such as river, lake or wastewater treatment plant. Therefore, it should be considered an entity which is responsible for managing drainage system in order to implement the **Measure 2: Rehabilitation of existing drainage system**. Drainage system within a urban areas (Ninh Kieu, Binh Thuy and Cai Rang Districts) of Can Tho City includes sewerage system that is under management of Can Tho Water Supply and Sewerage Company. It is a necessity to look into this company in details of its function and duties.

Company's Official Name: Can Tho Water Supply - Sewerage Joint Stock Company (Can Tho WASSCO)

Address: 2A Nguyen Trai Street, An Hoi Ward, Ninh Kieu District, Can Tho City

On June 28, 2004 the People's Committee (PC) of Can Tho City issued, on proposal of the directors of the City Department of Construction and Department of Home Affairs, Decision No. 924/QD-CT-UB on converting the Can Tho Water Supply and Sewerage Company from the status of a State Owned Enterprise (SOE) into a Limited liability one member Company, called Can Tho Water Supply and Sewerage Company Ltd. (CT-WSSC). Then, CT-WSSC was changed into Can Tho Water Supply and Sewerage Joint Stock Company (Can Tho WASSCO) since July 01, 2015. The value of the Company at the time of its transformation was stated in the charter document as 280 billion VND with 28 million shares.

The mission of the Company, as stated in its establishment, respectively transformation deed, is:

- Production and sales of clean water

- Sewerage service and waste water treatment
- Construction of civil and specialized works
- Production and trade of water supply and sewerage equipment
- Consultancy, designing and supervisory services to water supply and sewerage projects

On 14 July 2014, Can Tho WASSCO established Wastewater and Construction Division which is taking the responsibility for sewerage and wastewater treatment at Can Tho City. The organizational structures of the Can Tho WASSCO and Wastewater and Construction Division were described in the Annex 6 - Organisational Structure of Can Tho Water Supply and Sewerage Joint Stock Company and Annex 7 - Organisational Structure of Can Tho Wastewater and Construction Division.

Can Tho WASSCO has strong relationship with local governmental agencies/institutions. Key agencies/institutions will be briefly described in the table below:

Table 4: Relationship among Can Tho WASSCO and other local governmental agencies/institutions

Agencies/Institutions	Relationship
Can Tho City People's Committee (CPC)	The Can Tho CPC promulgates Decrees and Decisions related to Can Tho WASSCO business policies and service provisions. The PC has the overall control and decision making power.
City Department of Construction (DoC)	The Can Tho DoC is responsible for cooperation on technical issues and the supervision of the volume and estimated works.
City Department of Finance (DoF)	The Can Tho DoF is responsible for co-operating on financial issues, such as the provision and approval of operational subsidies and investment capital. Can Tho DoF is responsible for carrying out financial audits and to guide the Company on financial management issues.
Department of Planning and Investment (DPI)	The Can Tho DPI assigns the annual capital plans of construction for the company, assists the company in looking for foreign investment partners and fulfils documents to suggest MPI the allocation of ODA loans for projects.

Sewerage system under the streets' names is managing by Can Tho WASSCO will be provided in the Annex 3.

6.4 Proposed local governmental agency for management of cooling centres - DoCST

In order to mitigate the impact of heat wave to the people, **Measure 5: Cooling centres** will be proposed to be implemented at Can Tho City. The best proposed place of cooling centres will be at the existing public outdoor parks which are under management of Department of Culture, Sport and Tourism (DoCST). The list of existing public outdoor parks and fountains will be provided in the Annex 5 of this Report. After completion of constructing cooling centre, they will

be handed over to the DoCST as an additional construction items of Public Park. Functions and duties of Can Tho DoCST in the project implementation will be briefly summarised as follows:

- Advise and assist Can Tho CPC in State management on culture, family and sport, including sport facilities at locality;
- Prepare plans, programmes on sport development;
- Guide and organise to implement master plans and plans on development of public sports in locality after approved;
- Assist the CPC in State management of sport in the City;
- Appraise and participate in the appraisal of investment of development project related to culture, sport and tourism in the City

VII. Implementation Budget

7.1 Project Budget

All the measure proposed in this Pre-Feasibility Study should be implemented in a project. The selected measures can be a components in this project. Project Budget will be provided in the following table:

Table 5: Project Budget

Unit: USD

Project component	Basic cost estimation
Measure 1 - Mobile Flood Embankment	2,877,037
Measure 2 - Rehabilitation of Existing Drainage System	4,012,547
Measure 3 - Detention Swales Along Roads	7,140,995
Measure 4 - Flood Awareness Campaign	986,000
Measure 5 - Cooling Centres	6,037,012
Total Investment Cost	21,053,591
Rounded number	21,100,000

Total cost estimation of all measure implementation (project) is 21.1 million USD.

The most expensive investment cost of the project implementation is the Measure 3 – Detention Swales Along Roads with total investment cost of 7.1 million USD. And the cheapest investment cost of the project implementation is Measure 4 – Flood Awareness Campaign. All above-mentioned figures is only rough calculation for the purpose of this Pre-feasibility Study. Some cost calculation on physical construction were based upon the Decision No.1821/QD-UBND dated 17 August 2021 of Can Tho CPC about issuance of cost norms and prices for construction work at Can Tho City. Some other cost was based upon experience of the consultant so that they are still a need to calculate and analysis in-deep with up-to-date quotation prices in the preparation phases of Feasibility Study, Design and Cost Estimation.

Detailed project/programme structure, funding mechanism, contribution proportion, rough cost estimation for each measure, etc. will be presented in the following parts.

VIII. Structure of the Programme/Project

8.1 Proposed programme/project's structure

Proposed programme/project's structure must be in accordance with Vietnamese legal framework on management and using fund of ODA Project from international donors, particularly Decree No. 56/2020/ND-CP dated 25 May 2020 of Government of Vietnam and its regulation

Proposed Organisational mechanism will be as the following figure:

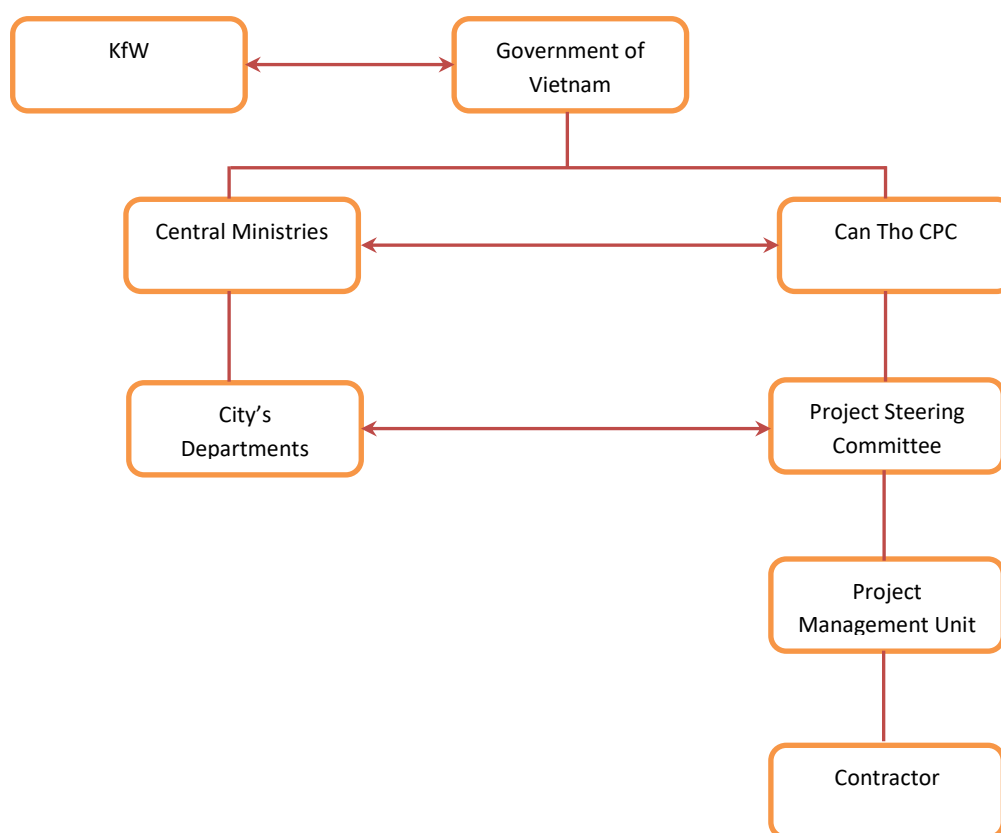


Figure 5: Proposed Organisational mechanism

Project will be an ODA project that a cooperation between KfW as donor and Government of Vietnam as beneficiary. From Vietnamese side, it will be some project's relevant agencies participating in the project Organisational mechanism such as central ministries and/or agencies. Governing body will be Can Tho City People's Committee (CPC). Project owner (client) will be ODA Project Management Unit (ODA PMU) of Can Tho CPC. Director of Can Tho ODA PMU will be a representative of Client. After the project portfolio is approved by the Prime Minister, the executive agency will assign the ODA PMU to act as the Project Owner. Activities

of the Project Owners will conform with above-mentioned Decree 56/2020/ND-CP. Functions of key project relevant stakeholders was described in Chapter VI.

Relationship between ODA PMU and other relevant stakeholders will be presented in the following figure:

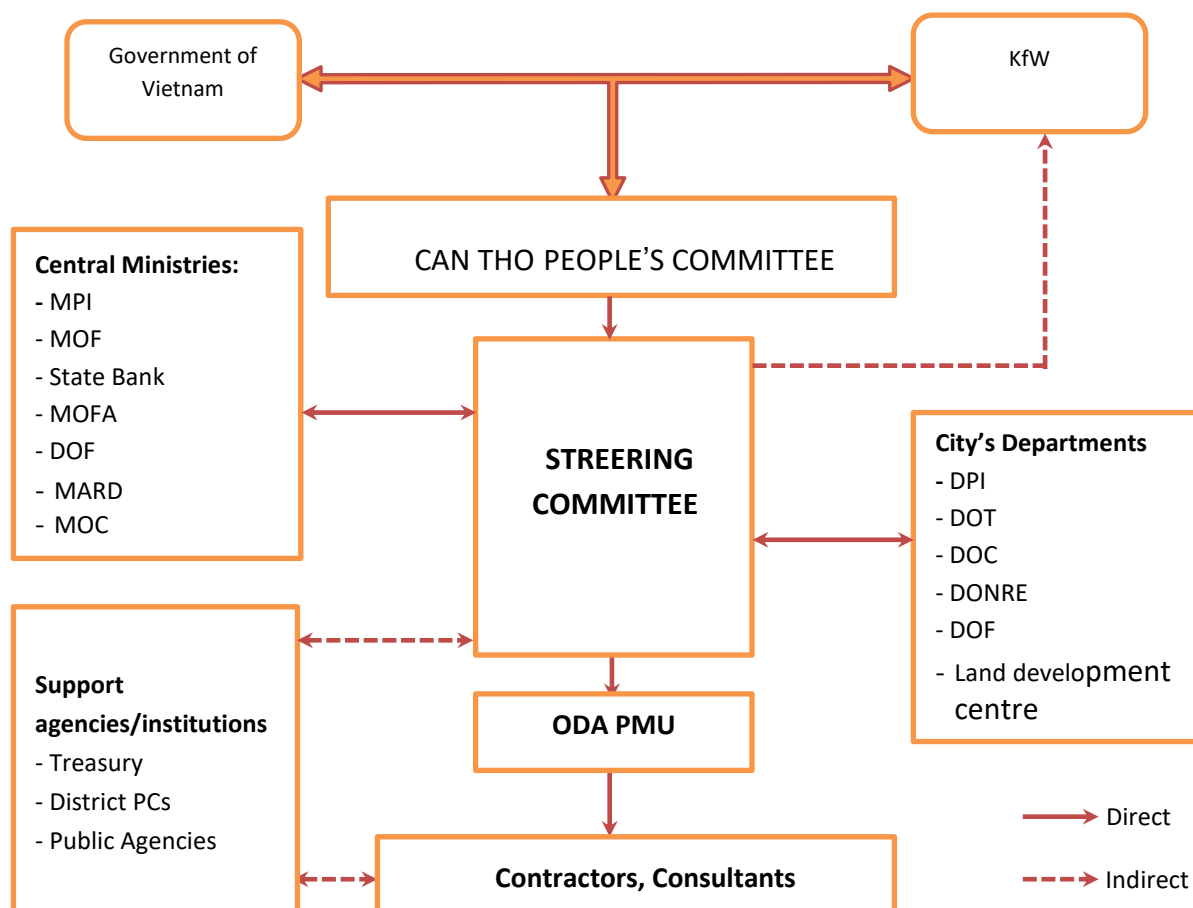


Figure 6: Relationship between ODA PMU and other relevant stakeholders

Duties and powers of ODA PMU is allocated by Can Tho CPC on the basis of competence and powers of the investor as defined in the legal documents of the Government of Vietnam.

The managing agency may authorize ODA PMU to decide or sign documents within their competence in the management process. This authorization shall be defined in Decision carried out by ODA Project Management Unit or at the specific written authorization of the managing agency.

ODA PMU are responsible for managing multiple programs and projects, which must be under in Can Tho City People's Committee approval and must ensure no interruption and in accordance with current provisions of law. In the absence of eligible capacity in some part of management

and supervision, PMU may hire consultants to perform this work with the approval of the managing agency.

Project Management Board has the following specific tasks:

- Organizing management chart and implementing programs and projects on the basis of the decision of the Governing body.
- Prepare and submit to the Governing body the approved overall plan to implement project; Approve the project implementation plans based on approved annual budget plan, allocated by the managing agency.
- Supporting the project management in the preparation and implementation the project; Develop work plans for each quarter; serve for the administration, monitoring and evaluation of programs and projects
- Appraise, approve technical designs and total cost estimates and estimates of construction items (for investment projects construction).
- Implementation of the tender prescribed by current laws on procurement and contract management;
- Negotiate, sign and monitor the implementation of the contract and handle contract violations.
- Coordinate with local authorities to organize the implementation of compensation, support and resettlement in accordance with the law, international agreements on ODA and preferential loans for programs and projects (for with an investment project for construction of works).
- Implement monitoring and evaluation of programs and projects to ensure that programs and projects implemented on schedule, with quality and achieve its objectives.
- Take responsibility for the loss, waste, corruption and irregularities within its authority in managing the organization and implementation of programs and projects of economic losses, social, environment, affecting objectives and overall effectiveness of programs and projects;
- The duties and powers as stipulated by law, the international treaties on ODA and preferential loans for programs and projects.

8.2 Funding mechanism and contribution

Funding mechanism of implementing measures is determined based on existing regulation of Government of Vietnam and financing principles of the donor (KfW) that will be specified as follows:

- (i) ODA loan from the KfW;
- (ii) Counterpart fund of the Government of Vietnam; and

(iii) Local counterpart fund of Can Tho CPC

Detailed proposal of percentage of funding mechanism will be as the following figure:

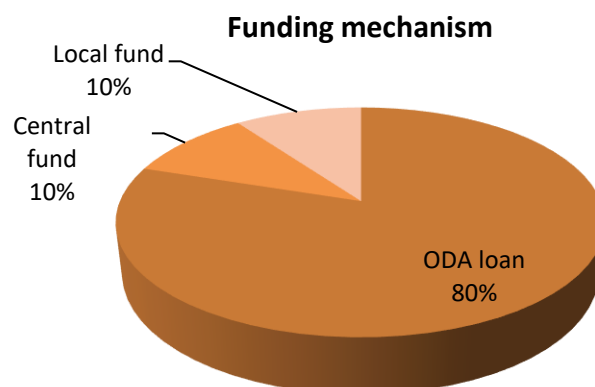


Figure 7: Proposed funding mechanism

A designated account of project implementation in EURO will be opened at a commercial bank under the term that approved by KfW. Funding for this project will be transferred directly from KfW to this account to perform payments for investment of the project after adaptation process of expenditure control of Can Tho City State Treasury. However, a specific disbursement procedure will be specified in a separate loan agreement to the loan agreement. Withdrawal forms and documents accompanied with application for money withdrawal of the project will be specified in the disbursement letter of KfW. The designated account will be maintained by Can Tho City State Treasury. In term of implementing the project, an VND account will be also opened by the project at Can Tho City State Treasury. The MPI will provide guidelines on determining and managing the project funding source under local and central budget flow.

Total project investment is: **21,100,000** USD. Funding contribution will be presented in the following table:

Table 6: Funding contribution among ODA, local and central Government funds

Unit: USD

Funding source	Total Investment	Percentage
ODA Fund from KfW	16,880,000	80%
Central Government Fund	2,110,000	10%
Local Fund	2,110,000	10%
TOTAL	21,100,000	

Table 7: Funding contribution between ODA and counterpart funds

Unit: USD

Funding source	Total Investment	Percentage
ODA Fund	16,880,000	80%
Total counterpart fund	4,220,000	20%
TOTAL	21,100,000	

Expected investment period is from 2022 – 2026 (see Section 9.2 – Project Schedule). The need of funding disbursement will be based on project progress. It is expected that a part of counterpart fund is used for project preparation activities and site clearance and compensation costs which will be happened for the most expenses from December 2022 to December 2023. The largest disbursement will be happened during the construction phase of the project (from January 2024 to January 2026) which can reach 80% of total project investment.

Detailed proposal of funding contribution will be as the following table:

Table 8: Proposed funding contribution in the project duration

Unit: USD

Funding source	2022	2023	2024	2025	2026	Total
ODA Fund from KfW	1,688,000	2,532,000	4,220,000	4,220,000	4,220,000	16,880,000
%	10%	15%	25%	25%	25%	100%
Central Government Fund	105,500	422,000	422,000	633,000	527,500	2,110,000
%	5%	20%	20%	30%	25%	100%
Local Fund	105,500	422,000	422,000	633,000	527,500	2,110,000
%	5%	20%	20%	30%	25%	100%
Total	1,899,000	3,376,000	5,064,000	5,486,000	5,275,000	21,100,000

IX. Implementation Structure

9.1 Work Structure and Cost Overview

9.1.1 Measure 1 - Mobile Flood Embankments

This measure introduces mobile flood embankment systems, consisting of inflatable tube (hose) segments that are used to insulate/dam flood water. These robust flood protection segments are first inflated with air by a compressor, brought into position and then filled with water. While filling the segments with water, it is possible to take water from the raising water (flood) body for this purpose. Compared to sand-based dams (e.g. made of sandbags), the construction time and complexity is much lower. It requires significantly fewer labour and there is no disposal of contaminated dam protection material, such as contaminated sandbags after their use. After protection from the flood, the hose dams are dismantled, cleaned and stored again. The advantage of mobile flood embankment systems is their immediate use and protection.

There is no need for (time-intensive) planning, approval and construction phases that often take years, as is the case with stationary flood protection measures (e.g. construction dikes, etc.). These mobile systems can protect roads, buildings and critical infrastructure from flood waters. The barriers are reusable, which make them a more sustainable and effective solution. Normally the hose dam segments can be combined to reach dam heights varying from 50 cm to 250 cm, if necessary. Also, based on a sleeve system, different segments can be combined to any length or height and suited to any topographical conditions or surface composition. The hose system adapts to changing substrates and bank shapes, whether concave, convex, linear or U-shaped. Kerb stones, height differences of up to 1 m, embedded rocks and curves pose no problem for rolling out, for stability and for sealing. In addition, the mobile dike can not only be built in the water, but can even be overflowed without losing its stability. Hose dam embankment systems can be built up for 40 -150 meters per hour. However, since the hose dam embankment systems are mainly used as mobile barriers against rising water levels in exposed areas, it also can be used as a temporary or permanent reservoir to store large amounts of water or contaminated liquids, e.g. during construction.

It is intended to introduce mobile flood embankment systems for a length of 3 km. For this, 30 hose modules with a diameter of 1.1 meter and length of 100 meters are bought. In total, the purchasing costs amount to USD 1.08 per m³, excluding maintenance. Depending on storage and maintenance, such an embankment system has a lifetime of around 30 years. Annual maintenance (storage and care) would amount to USD 20,924 (see Table below).

Table 9: Cost Estimation of Measure 1 – Mobile Flood Embankment

Unit: USD

<i>Feature</i>	<i>Unit</i>	<i>Quantity</i>
<i>Height (depth)</i>	meters	2
<i>Volume (all basins)</i>	m ³	502 172
<i>Area</i>	m ²	251 092
<i>Units</i>	pieces	30
<i>Cost/unit</i>	USD	1.08 (per m ³)
<i>Lifetime</i>	years	>30
<i>Total construction cost</i>	USD	1 360 047
<i>Maintenance cost per annum</i>	USD	20 924
<i>Maintenance cost (for 29 years)</i>	USD	1 516 990
<i>TOTAL (2050)</i>	USD	2 877 037

9.1.2 Measure 2 - Rehabilitation of Existing Drainage System

Storm water drainage systems in urban areas are a deterministic flood management system, especially in light of the current climate changes and intensified risks of severe floods. Irregular maintenance of urban drainage systems and canals may cause problems that reduce the efficient conveyance of water, especially the blockage or sedimentation of network pipes, which affects the efficiency of the network. To guarantee the efficient conveyance of dredging and canal systems, dredging can be a suitable rehabilitation method. The term dredging is routinely used to refer to the systematic removal of accumulated material from watercourses, canals, or drainage systems. In its most extreme form dredging may be used to re-align canalized watercourses. The term dredging covers a range of activities from the removal of sedimentation in open drainage canals or pipes, or the wholesale straightening (canalization) and/or deepening of watercourses. The main objective of this drainage rehabilitation method is to increase the cross-sectional area (and hence its volume), as well as a reduction in the roughness of the channel. These effects can increase the efficiency of the canal in moving water. Hence it will increase the conveyance of existing drainage system.

Generally, urban drainage systems are crucial to collect high quantities of water which accumulate in large amounts on the streets and passages. Many systems consist of reinforced concrete channels, mainly of trapezoidal shape or pipes of diameters with a diameter up to 120 cm. Sediment build-up in the drainage channels reduces their capacity and increases the potential for flooding. It also results in higher pollutant concentrations flushed out during large

flood events. Other problems that could reduce the conveyance capacity of the channels could be root intrusion from vegetation or simple debris and other blockages.

Generally, it is assumed that pipes of 1 m diameter are blocked by sediment up to 0.3 meters. This is equivalent to a reduction of the flow cross-section of the pipes of 25% (calculated by circle segment formulas). Therefore the sewer system capacity was reduced to $45 \times 0.75 = 33.75$ mm/h ~ 34 mm/h effective capacity, which was used in the simulations. The following collector systems are targeted to be improved and cleaned to ensure the drainage capacities (see the Tables below).

Table 10: Cost Estimation of Measure 2 – Rehabilitation of Existing Drainage System

Unit: USD

Feature / Districts	Binh Thuy	Ninh Kieu	Cai Rang	TOTAL
Length (m)	68,145	55,737	64,754	188,636
Capacity (m ³)	23,800	7,107	32,548	63,455
Cost/unit (USD/m ³) (Code: TNQN1.2111)	62.61	62.61	62.61	
Total cost (USD)	1,490,084	444,960	2,037,775	3,972,819
Maintenance cost per annum	14,901	4,450	20,378	39,728
TOTAL (all districts)	1,504,985	449,409	2,058,153	4,012,547

Table 11: Cost Summary of Measure 2 - Rehabilitation of Existing Drainage System

Unit: USD

#	Item	Unit	Quantity	Unit Cost	Total Cost
1	Rehabilitation of existing drainage system	m3	1.000	1,439,991	1,439,991
	Total in USD	USD/m3			62.61

Table 12: Detailed Cost of Measure 2 - Rehabilitation of Existing Drainage System

Unit: USD

Code	Material	Unit	Quantity	Unit Cost	Total Cost	Code	Explanation	Formula	Value
Note: Nominant lost of 100m ³ completed product						Rehabilitation of existing drainage system			
	Materials (VL)					TTK	Other direct expenses	$2.0\% \times (VL + NC + M)$	22,833
	Labour cost (NC)					T	Total direct cost	$VL + NC + M + TTK$	1,164,503
N1307	Labour rank 3.5/7 - Group 1	Day work	4.480	254,837	1,141,670	C	Overall cost	$5.5\% \times T$	64,048
						TL	Total income before tax	$5.5\% \times (T + C)$	67,570
						G	Total construction cost before tax	$T + C + TL$	1,296,121
						GTGT	Value added tax	$10\% \times (G)$	129,612
						Gxdl	Construction cost of temporary structures	$1\% \times (G + GTGT)$	14,257
	Total direct cost				1,141,670	Gxd	Construction cost after tax	$G + GTGT + Gxdnt$	1,439,991

9.1.3 Measure 3 - Detention Swales Along Roads

Vegetated swales are broad shallow channels topped with vegetation, also referred to as “bioswales”. Swales are designed to slow runoff, promote infiltration, and filter out pollutants and sediments. Vegetated swales are a ‘green’ alternative to conventional piping or drainage canal systems. Vegetated detention swales are linear grass-covered depressions that lead surface water overland from the drained surface to a storage or discharge system, typically using road verges. They are frequently used to convey runoff and disconnect impervious areas.

A detention swale is a broad, shallow, trapezoidal, or parabolic channel, densely planted with shrubs and grasses or with trees. It is designed to attenuate and in some cases infiltrate runoff volume from adjacent impervious surfaces, allowing some pollutants to settle out in the process. In steeper slope situations, check dams are used to further enhance attenuation and infiltration opportunities. A vegetated swale can enhance the aesthetic value of a site through the selection of appropriate native vegetation.

Swales may also discreetly blend in with landscaping features, especially when adjacent to roads. Swales avoid the need for expensive roadside curbs, gullies, and related maintenance. Some regular maintenance is required to keep a grass swale operating correctly, e.g. mowing during the growing season. The optimum grass length is around 150 mm. When properly designed, grassed swales result in a significant improvement over the traditional drainage ditch in both slowing and cleaning of water. Two types of vegetated swales exist, dry and wet swales. Wet swales mainly function as linear wetlands but also require more intense maintenance compared to dry swales, which are recommended for this measure. Dry swales are generally favoured for treating highway and residential road runoff because of their linear structure and inexpensive maintenance.

This measure proposes the establishment of dry grass swales of parabolic form to reduce runoff from roadways and/or sidewalks by allowing water to infiltrate. It is planned to establish swales of 1.5 meters depth and 2.5 meters width, representing 3,75 m³ per linear meter. It is important that swale depths and side slopes be shallow for safety and maintenance reasons. Annual operation and maintenance costs include debris removal, grass mowing, spot reseeding and sodding, weed control, swale inspection, and administration for inspections. It should be noted that swales are not practicable in areas with too steep grades or wet or poorly drained soils.

It is intended to establish grass swales along roads with up to 4 lanes and a maximum width of 12 meters. The following tables provide the cost estimation of the planned swales in Can Tho, stating their total length, water conveyance, and storage volume. It is noted that this cost estimation included the following works:

- construction site preparation;
- cutting down the trees and grass;

- reinforcement of erosion trenches by bamboo piles or sand bag (if any in some certain locations);
- row excavation for growing grass;
- growing grass with the distance of from 1 to 1,3m; space between each grass gourd from 0,1 to 0,15m; if height of slope $\leq 20\text{m}$, growing grass in accordance with contour line; if height of slope $> 20\text{m}$, growing grass in accordance with contour line with combination of diagonal line;
- watering, fertilizing, checking and replacing dead or week growth grass gourd within 06 months.

List of proposed roads and the width of the roads will be provided in the Annex 4.

Table 13: Cost Estimation of Measure 3 - Detention Swales Along Roads

Unit: USD

Feature / Districts	Binh Thuy	Ninh Kieu	Cai Rang
Depth (m)	1.5	1.5	1.5
Width (m)	2.5	2.5	2.5
Total length (m)	27,700	21,200	27,500
Total area (m ²)	69,250	53,000	68,750
Total Volume (m ³)	103,875	79,500	103,125
Cost/unit (USD/m ²)	33.76	33.76	33.76
Total construction cost (USD)	2,337,952	1,789,335	2,321,072
Ann. maintenance cost (USD)	8,666	6,625	8,593
Ann. maintenance cost for all districts until 2050 (USD)	251,314	192,125	249,197
TOTAL (each districts, until 2050)	2,589,266	1,981,460	2,570,269
TOTAL (all districts, until 2050)			7,140,995

Table 14: Cost Summary of Measure 3 - Detention Swales Along Roads

Unit: USD

#	Item	Unit	Formula	Quantity	Unit Cost	Total Cost
1	Excavation and backfilling by excavator $\leq 3,6\text{m}^3$, soil grade II - estimated by 20%	m3	$2,5\text{m} \times 1,5\text{m} / 2 \times 20\%$	0.300	18,208	5,463
2	Transportation by truck 7 tons, distance $\leq 1000\text{m}$, soil grade I	m3	$2,5\text{m} \times 1,5\text{m} / 2 \times 50\%$	0.300	21,678	6,503
3	Planting vetiver grass to reinforce slope	m2	$(2^2 + 1.5^2)^{0.5} \times 1 \times 2$	5.000	152,908	764,538
	TOTAL	m2				776,504
	Total in USD	USD/m				33.76

Table 15: Detailed Cost of Measure 3 - Detention Swales Along Roads – Item 1

Unit: USD

#	Material	Unit	Quantity	Unit Cost	Total Cost	Code	Explanation	Formula	Value
Item 1						Excavation and backfilling by excavator $\leq 3,6\text{m}^3$, soil grade II			
Note: Nominant lost of 100m^3 completed product									
1	Materials (VL)					TTK	Other direct expenses	$2.0\% \times (\text{VL} + \text{NC} + \text{M})$	28,872
2	Labour cost (NC)					T	Total direct cost	$\text{VL} + \text{NC} + \text{M} + \text{TTK}$	1,472,496
3	Labour rank 3,0/7 - Group 1	Day work	0.650	254,837	165,644	C	Overall cost	$5.5\% \times \text{T}$	80,987
4	Machinery (M)					TL	Total income before tax	$5.5\% \times (\text{T} + \text{C})$	85,442
5	Excavation $\leq 3,6\text{m}^3$	Day work	0.114	10,339,845	1,178,742	G	Total construction cost before tax	$\text{T} + \text{C} + \text{TL}$	1,638,925
6	Bulldozer $\leq 110\text{CV}$	Day work	0.039	2,544,542	99,237	GTGT	Value added tax	$10\% \times (\text{G})$	163,892
						Gxdlt	Construction cost of temporary structure	$1\% \times (\text{G} + \text{GTGT})$	18,028
	Total direct cost				1,443,624	Gxd	Construction cost after tax	$\text{G} + \text{GTGT} + \text{Gxdnt}$	1,820,846

Table 16: Detailed Cost of Measure 3 - Detention Swales Along Roads – Item 2

Unit: USD

#	Material	Unit	Quantity	Unit Cost	Total Cost	Code	Explanation	Formula	Value
Item 2						Excavation of foundation ≤ 6m by excavator ≤0,8m³, soil grade III			
Note: Nominant lost of 100m³ completed product									
1	Materials (VL)					TTK	Other direct expenses	$2.0\% \times (VL + NC + M)$	69,698
2	Labour cost (NC)					T	Total direct cost	$VL + NC + M + TTK$	3,554,582
3	Labour rank 3,0/7 - Group 1	Day work	7.480	254,837	1,906,181	C	Overall cost	$5.5\% \times T$	195,502
4	Machinery (M)					TL	Total income before tax	$5.5\% \times (T + C)$	206,255
5	Excavator ≤0,8m³	Day work	0.520	3,035,968	1,578,703	G	Total construction cost before tax	$T + C + TL$	3,956,338
						GTGT	Value added tax	$10\% \times (G)$	395,634
						Gxdlt	Construction cost of temporary structure	$1\% \times (G + GTGT)$	43,520
	Total direct cost				3,484,884	Gxd	Construction cost after tax	$G + GTGT + Gxdnt$	4,395,492

Table 17: Detailed Cost of Measure 3 - Detention Swales Along Roads – Item 3

Unit: USD

#	Material	Unit	Quantity	Unit Cost	Total Cost	Code	Explanation	Formula	Value
Item 3						Planting vetiver grass to reinforce slope			
Note: Nominant lost of 100m ³ completed product									
1	Materials (VL)					TTK	Other direct expenses	$2.5\% \times (VL + NC + M)$	298,765
2	Vetiver grass gourd	gourd	792.000	1,325	1,049,400	T	Total direct cost	$VL + NC + M + TTK$	12,249,348
3	Organic bio-chemical fertilizer priming	kg	150.000	670	100,500	C	Overall cost	$6.5\% \times T$	796,208
4	Foliar fertilizer	litter	0.930	2,500	2,325	TL	Total income before tax	$5.5\% \times (T + C)$	717,506
5	Other materials	%	5.000	11,522	57,611	G	Total construction cost before tax	$T + C + TL$	13,763,061
6	Labour cost (NC)					GTGT	Value added tax	$10\% \times (G)$	1,376,306
7	Labour rank 3,0/7 - Group 1	Day work	31.900	254,837	8,129,300	Gxdlt	Construction cost of temporary structures	$1\% \times (G + GTGT)$	151,394
8	Machinery (M)					Gxd	Construction cost after tax	$G + GTGT + Gxdnt$	15,290,761
9	Watering truck 5m ³	Day work	1.890	1,381,718	2,611,447				
Total direct cost					11,950,584				

9.1.4 Measure 4 - Flood Awareness Campaign

Due to the fact that the flood awareness campaign can be very diversified from very large scale all community of Can Tho City to small scale as a school. In this part, an awareness campaign will proposed to implement the campaign in a school that will be analysis. In case of widen activities and, it can be simply multiplied by arithmetic.

Objective of this awareness campaign will be:

- Capacity building for teachers in education and communication on flood awareness through active teaching methods
- Developing extracurricular on flood awareness and implementation plant of this extracurricular with active teaching method
- Raising awareness, changing behaviour on flood of pupils through this extracurricular, practise and activities in schools

Targeted group will be defined as follows:

- Teachers of a secondary school in Can Tho City (selected teachers of Biology Subject and Geography Subject)
- Pupils of the school (pupils of grade 6, 7 and 8)

Activities:

- Organising training for teacher in order to:
 - Building capacity of teachers in education and communication on flood awareness through active teaching method
 - Systematizing the knowledge on flood and active teaching method in school
 - Developing the content of curriculum on flood awareness for pupils
 - Developing the action plan on flood curriculum, extra activities (e.g. painting competition, theatre, cleaning activities of a small ditch, etc.)
- Implementing the education and communication activities following the action plan
 - Implementing the extracurricular
 - Implementing extra activities
- Organising a workshop to share lessons learned and replicate the education programme in other schools in cooperation with school's principal

Cost estimation of this Measure 4 – Flood Awareness Campaign at a secondary school will be provided in the Table 18. This Pre-Feasibility Study proposed to implement at 20 secondary schools at Can Tho City

Table 18: Cost Estimation of Measure 4 - Flood Awareness Campaign

Unit: USD

Cost estimation of a flood awareness campaign in Can Tho

Targeted group: pupils and teachers in secondary school

#	Activities	Unit	Total cost
1	Training for teacher, duration: two days		
1.1	Renting a meeting room	Day	300
1.2	Stationery	Lump sum	50
1.3	Hand out	Person	75
1.4	Print picture sheet	Sheet	150
1.5	Coffee break	Person x day	120
	Subtotal		695
2	Education campaign for pupil (class 6, 7 ,8)		
2.1	Stationery	Lump sum	50
2.1	Per diem for teachers	Person	120
2.3	Brochures	Sheet	210

Subtotal		380
3	Competition on flood awareness	
3.1	First prize	20
3.2	Second prize	30
3.3	Third prize	40
3.4	Consolation prize	40
Subtotal		130
4	<i>Workshop on lessons learned and replication</i>	
4.1	Renting a meeting room	day 300
4.2	Hand out	Person 75
4.3	Coffee break	Person 120
Subtotal		495
Total		1,700
Total cost for 20 secondary schools		34,000
TOTAL (until year 2050)		1 campaign/year 986,000

9.1.5 Measure 5 - Cooling centres

Cooling centres will be located at existing public outdoor parks and fountains. The cooling centre looks like a swimming pool but the depth of the pool in the cooling centre will be more shallow than a normal swimming pool.

The arrangement of an outdoor cooling centre will include: (i) a pool for children, (ii) a pool for adult people and (iii) a fountain. The standard area per person of this complex cooling centre will be 4.5 m²/person, including auxiliary works, administrative house, parking place, fence, green zone. The area of green zone will not be less than 30% of construction land. It is necessary to pay attention to avoid leaves falling into the pool when arranging green zone so that it should be selected the kind of trees which are less deciduous nor toxic resin. It will be arranged a type of green strips to prevent wind, dust, noise with the width over 5 m in case of the outdoor cooling centre next to normal roads and 10 m in case of high density roads.

General requirements of selecting outdoor cooling centres will be:

- The location must be approved in planning area;
- Having enough land for construction as well as development in future;
- Reasonable land use, do not take agricultural land for this purpose;
- Locating at high place, convenience for traffic and emergency cases;
- Convenient for power supply, water supply, drainage and communication

The dimension of pool for adult people will be 50 m in length, 26 m in width and average height will be at 0.2 m from ground level. The dimension of children playground will be 6 x 12.5 x 0.2 (m) with flexible design in accordance with actual demands. The design of cooling centres will be more flexible with surrounding landscape and panorama.

The cooling centres will be used by the people during heat wave days with the purpose to serve as much people as it can. Hence, the water used will not be affected to public health. The water must meet the following requirements:

- Automatic water temperature from 26 °C to 28 °C , the ideal for cooling purpose;
- Automatic circulating water filtration to bacteria, safe for showering;
- Proposed filtration process will be: Filter sand – pH adjustment – Chlorine dosing – Ozone steaming;
- Filtration capacity will be 4h – 6h for one cycle;
- Disinfection method will be selected from the following types: Ion disinfection, ozone disinfection, using chlorine from salt, UV (ultraviolet) disinfection; chlorine disinfection, etc.

Cost estimation of a cooling centre will be provided in the following tables. Proposed number of cooling centre with Can Tho City will be 03, with each one will be located at each district of Ninh

Kieu, Binh Thuy and Cai Rang. The list of proposed outdoor public parks will be provided in the Annex 5 of this report.

Table 19: Cost Estimation of Measure 5 – Cooling Centres

Unit: USD

Features	Quantity	Unit Cost	Total Cost
Pool for adult people	3	1,784,985	5,354,954
Children playground	3	59,519	178,557
Fountain	3	167,834	503,501
TOTAL (until 2050)			6,037,012

Table 20: Detailed Cost Estimation of the pool

Unit: USD

Feature	Adults	Children
Depth (m)	0.2	0.2
Width (m)	26	6
Total length (m)	50	12.5
Total area (m ²)	1300	75
Cost/unit (USD/m ²)	560.43	323.91
Total construction cost (USD)	728,565	24,293
Ann. maintenance cost (USD)	36,428	1,215
Ann. maintenance cost until 2050 (USD)	1,056,420	35,226
Sub-total	1,784,985	59,519
TOTAL (until 2050)		1,844,504

Table 21: Detailed Cost Estimation of the fountain

Unit: USD

Feature	Unit	Quantity
Depth	m	2.00
Diameter	m	30.00
Total area	m ²	706.86
Cost/unit	USD/m ²	184.06
Total construction cost (USD)	USD	130,103.63
Ann. maintenance cost (USD)	USD	1,301.04
Ann. maintenance cost until 2050 (USD)	USD	37,730.05
TOTAL (until 2050)	USD	167,833.68

9.2 Tentative Project Schedule

The following table will describe proposed Project Schedule which based on some assumption of the time line. The activities in this table will be interconnected and depended on each other. The preparation of Pre-feasibility Study and its submission to relevant project stakeholder will be at December of this year (2021). It is delayed, comparing with our proposed plan because social distance, curfews and look-downs in Vietnam, particularly at Mekong Delta, have been carrying out by Government of Vietnam.

From April 2021 to October 2021, Can Tho City was also look-downed several times. Even during the preparation phase of this Pre-feasibility Study report, the air line from Hanoi to Can Tho is still not yet opened. In addition, the ratio of vaccinate in Vietnamese people is still low, comparing with other countries so that there are some unforeseen conditions occurring whenever people come back to work. Hence, we could not anticipate when all the works will become “new” normal. Being under this circumstance, this Project Schedule was prepared with consideration of longer-time implementation.

After approving Pre-feasibility Study, further details should be investigated, including topographical and geographical surveys, advanced design studies for measures, detailed overviews of necessary components, and refined cost estimations.. In addition, a Bidding Document will be prepared and approved, by a Bid Evaluation Committee (BEC) who evaluate all the Tender Documents of Bidders in accordance with Vietnamese Laws and regulations as well as Guideline of KfW on selecting contractor. This bidding process will last about eight (8)

months, in which, there will be four (4) months to prepare and approve Bidding Documents, and four (4) months for bid evaluation and award construction contract to selected contractor.

On-site physical works and other project activities will be started at January 2024, after two-year preparation of all necessary project document. This project phase will last 24 months for construction, supervision, acceptance and handing-over of the Works.

Finally, a newly-invested facilities/works from this project will be accepted and put into operation after four 48 months of preparation and implementation. The following Gantt chart will provide the project activities during formulation phase.

It should be mentioned, that a funding source has not been identified yet for the planned measures outlined in this report.

Table 22: Project Schedule

#	Proposal activities during project formulation phase	2021												2022												2023												2024												2025	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2												
1	Preparation of Pre-Feasibility Study and submission to relevant agencies (KfW, Can Tho PPC for approval)																																																		
2	KfW's approval of the Pre-Feasibility Study																																																		
3	Can Tho PPC's approval of the Pre-Feasibility Study																																																		
4	Preparation of Feasibility Study, Topographical and Geographical Survey, Basic and Detail Design, Detailed Outlines and Components, Detail Cost Estimation																																																		
5	Approving Project Documents, signing Loan Agreement																																																		
6	Preparation of Bidding Document, organisation of bidding, selection of contractor, contract awarding																																																		
7	Project commencing																																																		
8	Project implementation																																																		

Project implementation will be from Jan 2024 to Jan 2026

X. Conclusions and Recommendation

10.1 Conclusions

The implementation of this project that will be potentially funded by KfW is highly feasible. The project implementation will bring socio-economic benefits and environment for people living in the project area in particular and whole people of Can Tho City in general.

The project will create incentives for sustainable economic development; resolving the employment and income stability for people. It is attractive and attract potential investors to secure financial investment business as improved by environment, especially overcome flooding, the negative impact from change climate, contributing to the economic growth and recovery after COVID-19 surge. The value of land in the area will be increased after the project is invested and put to use. It also saves cost for maintenance of technical infrastructure annually caused by flooding, to increase the use of budget savings in the demand for social welfare usefully.

The local people who are lived in stable environment without pollution because it is invested synchronic urban infrastructure, dealing with flooding and floodtide, having peace to live and work. The poor have opportunities to find jobs and stable income and gradually improve the urban life, security conditions, social security.

Flood and odour emission situation will be no longer in the city area by flood control works and drainage works which is invested by the project. Environmental conditions will be improved significantly to create criteria on green – clean – beautiful environment after the project is invested and put into use. The project works are constructed to correspond with climate change and prevent salinization caused by seawater carried inland.

The project will invest and improve living standards in the project area, tourism, and creating land fund for development of housing and public services in whole Can Tho City for full payback to pay loan to KfW.

10.2 Recommendation

This is a big project which will be implemented on a large project area in a long-run project implementation and it is related to economic, social, politic, technical and financial fields. It, therefore, requires a lot of attention, specific and regular directions of donor (KfW), Government of Vietnamese, many ministries and local government agencies (Can Tho CPC and relevant District People's Committees).

Financial investment is crucial factor to determine the project feasibility, including a counterpart fund which is a very important part of the success of project. It is highly recommended that the Government of Vietnam and Can Tho CPC should balance and promptly arrange funds for the project implementation.

Annexes

Annex 1: Administrative Units of Can Tho City

#	District	Ward/Communes
1.	1. Binh Thuy (8 wards)	An Thoi
2.		Binh Thuy
3.		Bui Huu Nghia
4.		Long Hoa
5.		Long Tuyen
6.		Thoi An Dong
7.		Tra An
8.		Tra Noc
9.	2. Cai Rang (7 wards)	Le Binh
10.		Hung Phu
11.		Hung Thanh
12.		Ba Lang
13.		Truong Thanh
14.		Phu Thu
15.		Tan Phu
16.	3. Ninh Kieu (11 wards)	Cai Khe
17.		An Hoa
18.		Thoi Binh
19.		An Nghiep

20.		An Cu
21.		Tan An
22.		An Phu
23.		Xuan Khanh
24.		Hung Loi
25.		An Khanh
26.		An Binh
27.	4. O Mon (7 wards)	Chau Van Liem
28.		Thoi Hoa
29.		Thoi Long
30.		Long Hung
31.		Thoi An
32.		Phuoc Thoi
33.		Truong Lac
34.	5. Thot Not (9 wards)	Thot Not
35.		Thoi Thuan
36.		Thuan An
37.		Tan Loc
38.		Trung Nhat
39.		Thanh Hoa
40.		Trung Kien
41.		Tan Hung
42.		Thuan Hung
43.	6. Co Do	Co Do Town

44.	(1 town and 9 communes)	Trung An
45.		Trung Thanh
46.		Thanh Phu
47.		Trung Hung
48.		Thoi Hung
49.		Dong Hiep
50.		Dong Thang
51.		Thoi Dong
52.		Thoi Xuan
53.	7. Phong Dien (1 town and 6 communes)	Phong Dien Town
54.		Nhon Ai
55.		Giai Xuan
56.		Tan Thoi
57.		Truong Long
58.		My Khanh
59.		Nhon Nghia
60.	8. Thoi Lai (1 town and 12 communes)	Thoi Lai Town
61.		Thoi Thanh
62.		Tan Thanh
63.		Xuan Thang
64.		Dong Binh
65.		Dong Thuan
66.		Thoi Tan
67.		Truong Thang

68.		Dinh Mon
69.		Truong Thanh
70.		Truong Xuan
71.		Truong Xuan A
72.		Truong Xuan B
73.	9. Vinh Thanh (2 towns and 9 communes)	Vinh Binh
74.		Thanh An Town
75.		Vinh Thanh Town
76.		Thanh My
77.		Vinh Trinh
78.		Thanh An
79.		Thanh Tien
80.		Thanh Thang
81.		Thanh Loi
82.		Thanh Quoi
83.		Thanh Loc

Annex 2: List of on-going projects

#	Project Name	Location	Estimated Land Area (ha)	Total Investment Cost (billions VND)	Total Investment Cost (millions USD)
1.	Development of High-tech Agriculture Station	Thanh Tien Communes, Vinh Thanh District	30.88	100	4.39
2.	Development of High-tech Agriculture Area and Eco-tourism	Thanh Tien Commune, Vinh Thanh District	26.66	80	3.51
3.	Construction of Infrastructure of Thot Not Industrial Zone, Phase 2	Thoi Quan Ward, Thot Not District	400	5,893	258.86
4.	Construction of Infrastructure of O Mon Industrial Zone – Area A	Thoi Quan Ward, O Mon District	256	8,352	366.88
5.	Construction of Infrastructure of O Mon Industrial Zone – Area B	Thoi Quan Ward, O Mon District	122	3,974	174.57
6.	Investment of Infrastructure Project of Phong Dien Industrial Cluster Zone	Nhon Nghia Commune, Phong Dien District	30	450	19.77
7.	Construction of Industrial – Handicraft Cluster Zone Project	Thoi Lai Town, Thoi Lai District	25	325	14.28
8.	Investment of Can Tho Centralized Informatics Centre	Hung Thanh Ward, Cai Rang District	20.03	depending on the calculation of investor(s)	
9.	Class II Logistics Centre for Mekong Delta Sub-region	Tan Phu Ward, Cai Rang District	242.2	4,166	183
10.	Aviation Logistics Centre	Vo Van Kiet Street, Binh Thuy District	27	400	17.57
11.	O Mon Thermal Plan III	Phuoc Thoi Ward, O Mon District	28.5	25,494	1,119.88
12.	O Mon Thermal Plan IV	Thoi Loi Ward, O Mon District	24.57	25,793.78	1,133.05
13.	Investment of Tan Loc Islet Eco-tourism	Tan Loc Islet, Thot Not District	41	915	40.19
14.	Investment of Phong Dien Eco-tourism	Nhon Ai Commue, Phong Dien District	40	890	39.1

15.	Cable Slings and Con Khuong Tourism Area	Binh Thuy and Ninh Kieu Districts	60	1,500	65.89
16.	Hau River Tourism Area	Cai Khe Ward, Ninh Kieu District	8.7	400	17.57
17.	Music Fountain and Multi-function service of Tay Do Culture Centre	Hung Thanh, Cai Rang	37	1,300	57.11
18.	Can Tho Amusement Park	Long Tuyen Ward, Binh Thuy District	75	1,000	43.93
19.	Work Items of Preservation and Development of Cai Rang Floating Market	Le Binh Ward, Cai Rang District	0.53	50	2.2
20.	Can Tho Multi-port (Passenger – Goods - Tourism)	Cai Khe Ward, Ninh Kieu District	3.5	266.36	11.7
21.	Urban, Eco-tourism, Amusement Cluster Area of Cai Rang District	Cai Rang District	1,226	depending on the calculation of investor(s)	
22.	Urban, Eco-tourism, Amusement Cluster Area of Phong Dien District	Phong Dien District	334.7		
23.	New Residential Area along Vo Van Kiet Street (Area 1) at Binh Thuy District	Vo Van Kiet Street, Binh Thuy District	82.7		
24.	New Residential Area along Vo Van Kiet Street (Area 2) at Binh Thuy District	Vo Van Kiet Street, Binh Thuy District	95.3		
25.	New Residential Area along Vo Van Kiet Street (Area 3) at Binh Thuy District	Vo Van Kiet Street, Binh Thuy District	72.3		
26.	New Residential Area along Vo Van Kiet Street (Area 5) at Binh Thuy District	Vo Van Kiet Street, Binh Thuy District	85.35		
27.	New Residential, Lot 1A, Southern Can Tho Urban Area	Hung Phu Ward, Cai Rang District	60.2		
28.	New Residential, Area 4, Lot 16B, Southern Can Tho Urban Area	Hung Phu Ward, Cai Rang District	21.96		
29.	New Urban Area 1	Chau Van Liem Ward, O Mon District	10.7		
30.	New Urban Area 2	Chau Van Liem Ward, O Mon District	22.6		
31.	New Urban Area at Southern National Road No. 91 (section from Ong	Chau Van Liem Ward, O Mon District	41.75		

	Tanh Channel to Tac Ong Thuc Channel)				
32.	Tourism Tower at Cai Khe Islet	Cai Khe Ward, Ninh Kieu District	2.38		
33.	Construction of Provincial Road No. 921 (section from Thot Not to Nga Tu Bridge)	Thot Not and Co Do Districts	31.12	998.89	43.88
34.	Construction of Provincial Road No.917	Binh Thuy, O Mon and Phong Dien Districts	33.8	1,109.62	48.74
35.	Construction of Provincial Road No. 918	Binh Thuy and Phong Dien Districts	28.9	1,316.3	57.82
36.	Construction of Connection Road from National Road No. 91 to Southern Hau River Road	O Mon, Binh Thuy, Phong Dien, Ninh Kieu, Cai Rang Districts	240	5,000	219.64
37.	Upgrading Provincial Road No. 923 (section from km 11+120 to km 25+380)	Phong Dien and O Mon Districts	33.6	1,057	46.44
38.	Phong Dien Bridge (Tay Do Bridge)	Phong Dien District	0.8	198	8.7
39.	Can Tho City Urban Railway Pre-feasibility Study	Can Tho City and connection to other neighbour provinces and region		15	0.66
40.	Can Tho Central Swimming-pool	Le Loi Street, Ninh Kieu District	1.8	167	7.34
41.	Cardiovascular Hospital ¹¹	Nguyen Van Cu Street, An Binh Ward, Ninh Kieu District	3	798	36.05

¹¹ This project is under lobbying to the Japanese ODA

Annex 3: List of sewerage under the streets and residential areas under management of Can Tho WASSCO

No.	Name of street
A. Ninh Kieu District	
1. An Hoi Ward	
1	Ngo Gia Tu
2	Hoa Binh
3	Nguyen Dinh Chieu
4	Xo Viet Nghe Tinh
5	Nguyen Trai
6	Truong Dinh
7	Ngo Huu Hanh
8	Hoang Van Thu
9	Alley 15 Hoang Van Thu - 18 Xo Viet Nghe Tinh
10	Alley 1 Hoang Van Thu
2. An Lac Ward	
11	Phan Dinh Phung
12	Nguyen Thi Minh Khai
13	Dien Bien Phu
14	Cao Ba Quat
15	Ngo Duc Ke
16	Dong Khoi
17	30/4 Road
18	Quang Trung
19	Alley 32 Nguyen Thi Minh Khai

3. An Cu Ward	
20	Hoa Binh
21	Ngo Quyen
22	Ly Tu Trong
23	Nguyen Than Hien
24	Tran Hung Dao
25	Truong Dinh
26	De Tham
27	Nguyen Khuyen
28	Vo Thi Sau
29	Hoang Van Thu
30	Mac Dinh Chi
31	Interceptor sewer line at Hoang Van Thu and Xang Thoi Lake
4. An Phu Ward	
32	30/4 Road
33	Ly Tu Trong
34	Phan Van Tri
35	Tran Hung Dao
36	Nguyen Viet Hong
37	Le Lai
38	Alley 227 Tran Binh Trong
39	Alley 1 Ly Tu Trong
5. An Hoa Ward	
40	Tran Viet Chau
41	Nguyen Van Cu

42	Mau Than
43	Pham Ngu Lao
44	Cach Mang Thang Tham
45	Vo Truong Toan (Alley 256 Nguyen Van Cu)
46	Alley 38 Tran Viet Chau
47	Vo Van Kiet
6. An Nghiep Ward	
48	Cao Thang
49	Nguyen Cu Trinh
50	Nguyen Van Troi
51	Huynh Thuc Khang
52	3/2 Road
53	Mau Than
7. An Binh Ward	
54	Nguyen Van Cu (from Cai Son Bridge to Rau Ram Bridge)
55	Hong Phat Residential Area – Cai Son – Hang Bang
56	Provincial Road No. 923
57	Nga Cay Residential Area
8. An Khanh Ward	
58	Nguyen Van Cu (extending section)
59	Alley 188 Nguyen Van Cu
60	Tran Bach Dang – Thoi Nhat Residential Area
61	Ap Thoi Nhut Residential Area
	Road No. 27; Road No. 15; Road No. 16; Road No. 17; Road No. 19; Road No. 18; Road No. 29; Road No. 6A; Road No. 24; Road No. 29; Road No. 21; Road No. 11A; Road No. 25; Road No. 26; Road No. 30; Road No. 20

62	Nguyen Thi Phuong - Ap Thoi Nhut Residential Area
63	Ngo Thi Nham - Ap Thoi Nhut Residential Area
64	Phan Huy Tru - Ap Thoi Nhut Residential Area
65	Nguyen Van Linh
66	Residential Area 91B
	Road No. 18; Road No. A2; Road No. A3; Road No. B2; Road No. B3; Road No. B4; Road No. B5; Road No. B8; Road No. B9; Road No. B10; Road No. B11; Road No. B12; Road No. B13; Road No. B14; Road No. B15; Road No. B16; Road No. B19; Road No. B21; Road No. B22; Road No. B24; Road No. B25; Road No. B27; Road No. B28; Road No. B30
9. Xuan Khanh Ward	
67	30/4 Road
68	Residential Area No. 5 - 30/4 Road
69	Residential Area No. 9 - 30/4 Road
70	Quang Trung
71	Tran Khanh Du
72	Tran Van Hoai
73	Tran Ngoc Que
74	Dinh Cong Trang
75	Nguyen Ngoc Trai
76	Nguyen Van Troi
77	3/2 Road
78	Mau Than
79	Alley 95 Mau Thanh
10. Hung Loi Ward	
80	30/4 Road
81	Residential Area No. 243 - 30/4 Road

82	Tran Hoang Na
83	Tran Ngoc Que
84	3/2 Road
85	Quan Trong Hoang (connection via House No. 310 at 30/4 Road)
86	Residential Area No. 178 - 3/2 Road
87	Cross sewer section at Tam Vu Road (Tam Vu Market)
88	Cross sewer section at Le Binh Road
89	Residential Area No. 148 - 3/2 Road
90	METRO Residential Area
91	Residential Area No. 91/23 - 30/4 Road
11. Thoi Binh Ward	
92	Hung Vuong
93	Phan Dang Luu
94	Ba Huyen Thanh Quan
95	Bui Thi Xuan
96	Ho Xuan Huong
97	Pham Ngu Lao
98	Dinh Tien Hoang
99	Rach Dinh Residential Area
100	Cach Mang Thang Tam
101	Alley 54 Hung Vuong
102	Alley 8 Hung Vuong
103	Alley 132/42 Hung Vuong
12. Tan An Ward	
104	Ngo Gia Tu

105	Phan Dinh Phung
106	Vo Van Tan
107	Nguyen Thai Hoc
108	Chau Van Liem
109	Nguyen An Ninh
110	Hai Ba Trung
111	Hoa Binh
112	Nam Ky Khoi Nghia
113	Ngo Duc Ke
114	Dong Khoi
115	Ngo Van So
116	Ly Thuong Kiet
117	Le Thanh Ton
118	Hai Thuong Lan Ong
119	Phan Boi Chau
120	Phan Chu Trinh
121	Tan Trao
122	Thu Khoa Huan
123	Tran Quoc Toan
124	Pham Hong Thai
125	Nguyen Du
126	Ba Trieu
127	Ngo Quyen
13. Cai Khe Ward	
128	Le Loi

129	Nguyen Binh
130	Tran Quang Khai (section 20 - 25)
131	Nguyen Trai
132	Linh Thanh Residential Area (Khuong Islet) (to Khai Luong Canal)
133	Tran Phu
134	Doan Thi Diem
135	Tran Dai Nghia - Mien Tay Residential Area
136	Luong Dinh Cua - Mien Tay Residential Area
137	Pham Ngoc Thach – Can Do Residential Area
138	Cai Khe Islet (Bai Cat)
139	Song Hau (East – North Section)
140	Tran Van Kheo
141	Tran Quang Khai
142	Ho Tung Mau (A1 Road) – Cai Khe Commercial Centre
143	Nguyen Duc Canh (Road A2) - Cai Khe Commercial Centre
144	Ung Van Khiem (Road B1) - Cai Khe Commercial Centre
145	Ly Hong Thanh (Road B2) - Cai Khe Commercial Centre
146	Nguyen Binh Khiem
147	Ton That Tung (Car Mechanism Alley)
148	Alley 118 – 112 Tran Phu
149	Hoan My Residential Area
	Branch Road No. 1; Branch Road No. 2; Branch Road No. 3; Phase 1A; Phase 1B
B. Binh Thuy District	
1. Tra Noc Ward	
150	Le Hong Phong

151	Nguyen Chi Thanh
152	Tra Noc Sewerage and Channel System
2. Tra An Ward	
153	Le Hong Phong
154	Nguyen Viet Xuan
155	Le Thi Hong Gam
156	Alley 28 Huynh Phan Ho
157	Vo Van Kiet
158	Tra An Ward Sewerage and Channel System
3. Binh Thuy Ward	
159	Nguyen Truyen Thanh (Alley 12 Le Hong Phong)
160	Alley 14 Le Hong Phong
161	Alley 10 Le Hong Phong
162	Vo Van Kiet
163	Binh Thuy Ward Sewerage and Channel System
4. An Thoi Ward	
164	Cach mang thang Tam
165	Alley 115 Cach mang thang Tam
166	Nguyen Viet Dung
167	Tran Quang Dieu
168	An Thoi Ward Sewerage and Channel System
5. Bui Huu Nghia Ward	
169	Cach mang thang Tam
170	Alley 116 Cach mang thang Tam
171	Alley 444 Cach mang thang Tam (Thu Khoa Tomb)

172	Huynh Man Dat
173	Bui Huu Nghia
174	Bui Huu Nghia Ward Sewerage and Channel System

Annex 4: List of Proposed Roads for Detention Swales Along Roads in Can Tho City

#	Road Name	District	Boundaries	Width
1	Hoa Binh Road	Ninh Kieu	All route	40m
2	April 30 Road	Ninh Kieu	All route	40m
3	Ly Tu Trong	Ninh Kieu	Tran Hung Dao - Luu Huu Phuoc Park - Hoa Binh – end of Luu Huu Phuoc Park	30m 23m
4	Phan Van Tri	Ninh Kieu	All route	23m
5	Chau Van Liem - Nguyen An Ninh	Ninh Kieu	All route	40m
6	Vo Van Tan - Nguyen Thai Hoc	Ninh Kieu	All route	35m
7	Tran Phu	Ninh Kieu	All route	40m
8	Hung Vuong	Ninh Kieu	- Bus Station Section - Dinh Tien Hoang - Dinh Tien Hoang - Nhi Kieu Bridge	42,7m 30m
9	Tran Hung Dao	Ninh Kieu	All route	30m

#	Road Name	District	Boundaries	Width
10	February 3 Road	Ninh Kieu	All route	40m
11	Cach mang thang Tam	Ninh Kieu Binh Thuy	New Bus Station - Nguyen Van Cu Nguyen Van Cu – Binh Thuy Bridge	Right side 26m; Left side 12m Right side 26m; Left side 14m (from middle of existing road)
12	Xo Viet Nghe Tinh	Ninh Kieu	Hoa Binh Road - Hung Vuong	20m
13	Le Hong Phong	Binh Thuy	All route	Right side 13m; Left side 27m (from middle of existing road)
14	Quang Trung	Ninh Kieu Cai Rang	- From April 30 Road - Quang Trung Bridge - From Quang Trung Bridge to ring road of Can Tho Bridge	40m 56m
15	Mau Than	Ninh Kieu	- April 30 Road - Tran Hung Dao - Tran Hung Dao - Nguyen Van Cu	30m 40m

#	Road Name	District	Boundaries	Width
16	Nguyen Van Cu	- Ninh Kieu - Ninh Kieu and Phong Dien	- Section from Cach mang thang Tam to Mau Than - Vo Van Kiet - Section from Mau Than - Vo Van Kiet to end of road	40m 34m
17	Hoang Quoc Viet (Cai Son – old Hang Bang)	Ninh Kieu	Nguyen Van Linh (National Road 91B) - Provincial Road 923	30m
18	Tran Van Kheo	Ninh Kieu	All route	28m
19	Le Loi	Ninh Kieu	All route	40m
20	Hai Ba Trung	Ninh Kieu	All route	20m
21	Ngo Quyen	Ninh Kieu	Hai Ba Trung - Mac Dinh Chi	19m
22	Nguyen Trai	Ninh Kieu	Hoa Binh Road – Cach mang thang Tam	21m
23	Phan Dinh Phung	Ninh Kieu	Hoa Binh Road - Nguyen Thi Minh Khai	17,50m
24	Nguyen Van Linh (old National Road 91B)	Ninh Kieu Binh Thuy	From Tam Vu Road (Ninh Kieu) – end of road at Phuoc Thoi Road (O Mon).	80m

#	Road Name	District	Boundaries	Width
25	Southern Road of Hau River	Cai Rang	Hung Loi Bridge – Cai Cui Port	80m
26	Vo Van Kiet (Mau Than – Can Tho International Airport)	Ninh Kieu Binh Thuy	Nguyen Van Cu - Can Tho International Airport	80m

Annex 5: List of proposed Public Parks for Cooling Centres in Can Tho City

District	Name of Public Park	Address
Ninh Kieu	Ninh Kieu Wharf	#38 Hai Ba Trung Street
	Mien Tay Culture	An Hoa Ward
	Hau River	Cai Khe Ward
	Luu Huu Phuoc	Hoa Binh Road
	Tao Dan	#3 Phan Dinh Phung Street
	An Khanh Residential Area	5A Road
	Walking Bridge	Tan An Ward
Binh Thuy	Zen Garden	Dang Van Day Road
	Binh Thuy	Binh Thuy Ward
	Green Stone Chair	Bui Huu Nghia Road
Cai Rang	Garden of Construction No. 8	Hung Phu Ward
	Nam Long	Hung Phu Ward
	Embankment of Residential Area No. 586	Mai Chi Tho Road
	Cai Nai Garden	Road Area 6

Annex 6: Organisational Structures of Can Tho WASSCO and its Division

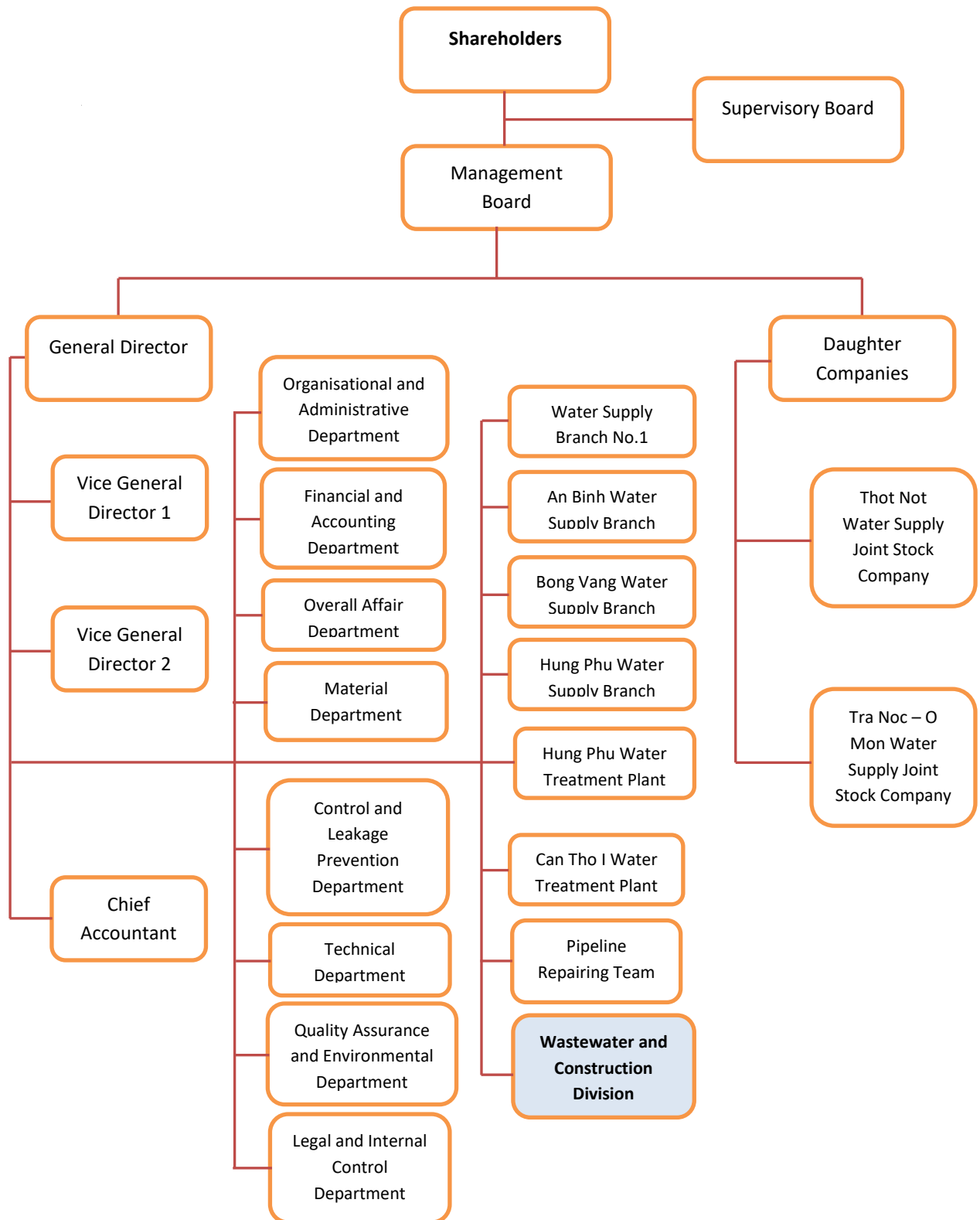


Figure 8: Organisational Structure of Can Tho Water Supply and Sewerage Joint Stock Company

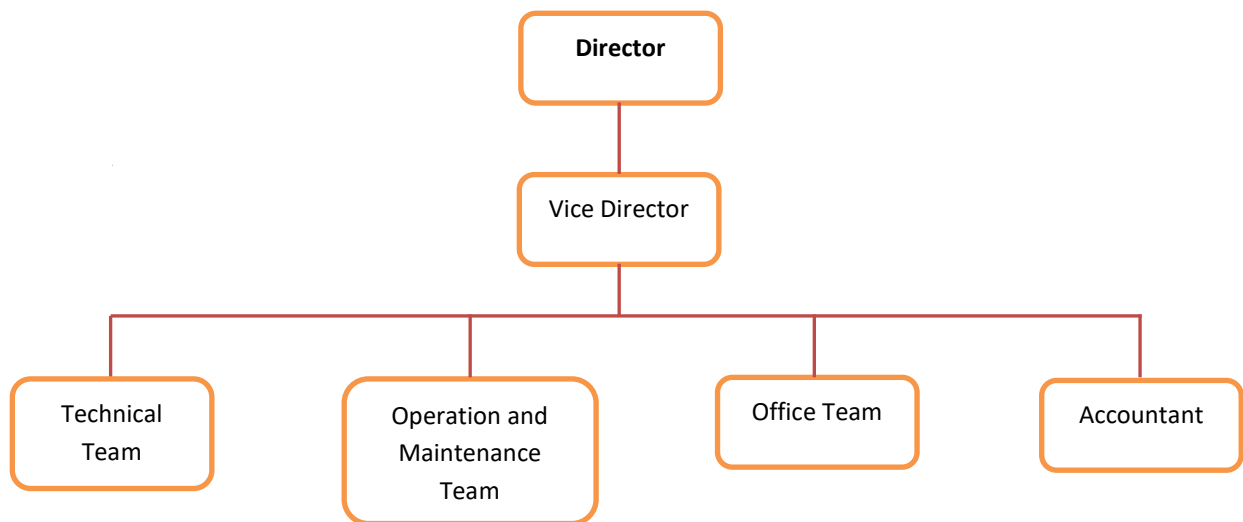


Figure 9: Organisational Structure of Can Tho Wastewater and Construction Division