MINISTRY OF TRANSPORT (MOT)
PROJECT MANAGEMENT UNIT – WATERWAYS (PMUW)
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PRELIMINARY ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT

(Draft)

Note: Some of the field level data are still being collected and this preliminary ESIA will be updated/revised accordingly

SOUTHERN WATERWAYS LOGISTIC CORRIDORS (SWLC) PROJECT

VIETNAM – JANUARY 2022

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ABBREVIATION

A4T	: Aus4Transport Program
CEDA	: Center of Environment Consultant and Development of Rural Areas
CESMP	: Contractor Environmental and Social Management Plan
CMTV	: Cai Mep – Thi Vai
CSC	: Construction Supervision Consultant
DEMP	: Dredging and Excavation Management Plan
DONRE	: Department of Natural Resources and Environment
EHS	: Environment, Health and Safety
EIA	: Environmental Impact Assessment
EMDP	: Ethnic Minority Development Plan
EMPF	: Ethnic Minority Policy Framework
ESCP	: Environmental and Social Commitment Plan
ESIA	: Environmental and Social Impact Assessment
ESMP	: Environmental and Social Management Plan
ESF	: Environmental and Social Framework
ESRC	: Environmental and Social Risk Classification
ESS	: Environmental and Social Standard
FS	: Feasibility Study
GBVAP	: Gender-Based Violence Action Plan
GoV	: Government of Vietnam)
GRM	: Grievance Redress Mechanism
HCMC	: Ho Chi Minh City
IBRD	: International Bank for Reconstruction and Development
IESMC	: Independent Environmental and Social Monitoring Consultant
ILO	: International Labor Organization
IWT	: Inland Waterway Transport
JICA	: Japan International Cooperation Agency
LMP	: Labor Management Procedures
MKD	: Mekong Delta
MONRE	: Ministry of Natural Resources and Environment
MOT	: Ministry of Transport
OHS	: Occupational Health and Safety
PDO	: Project Development Objectives
PMUW	: Project Management Unit - Waterways
RAP	: Resettlement Action Plans
RFP	: Resettlement Policy Framework
SEO	: Social and Environmental Officer
SEP	: Stakeholder Engagement Plan
SER	: Southeast Region
SSEO	: Safety, Social and Environmental Officer
SWLC	: Southern Waterways Logistics Corridors
TOR	: Term of Reference
VMD	: Vietnamese Mekong Delta
VTMS	: Vessel Traffic Management System
WB	: World Bank
WBG	: World Bank Group

EXECUTIVE SUMMARY

Project Background

The Mekong Delta is an important role in Vietnam's national economic development. To develop the economy of the Mekong Delta in the future, it is necessary to strengthen the transportation network, connecting the region with domestic and international markets. Since the Inland Waterway Transportation (IWT) network is already available, it should be exploited and made full use of its potential. Inland water transport has many advantages over road transport for safety reasons, less emissions, and lower transportation costs.

The project will be built on the basis of advanced transport technology to improve the quality of transportation, minimize the environmental impact through efficient energy use and accelerate the development of multilateral transport. Furthermore, in order to ensure the sustainability of investment, the waterway project will combine (i) development of other transport sectors, rural and urban transport networks in particular and (ii) rural development including irrigation and flood control to effectively adapt and address the problems of climate change and sea level rise.

The SWLC Project consists of three components as follows:

Components A: Upgrading East – West Corridor to meet the standard of grade II for inland waterways. East-West Corridor: waterway connecting Can Tho port to Ho Chi Minh city from: Hau river (Can Tho city) → Tra On river → Mang Thit river → Co Chien river → Cho Lach canal → Tien river → Rach Ky Hon; (via Cho Gao channel); Rach La → Vam Co river → Nuoc Man canal → Can Giuoc river → Soai Rap river (Ho Chi Minh City), the entire length of the East-West corridor is 197 km.

Component B: Renovating the North-South corridor to meet the standard of navigable channels and inland waterways. North - South Corridor: waterway connecting Dong Nai port to Cai Mep Thi Vai port cluster from: Dong Nai river (Dong Nai port) → Nha Be river → Long Tau river → Dong Tranh river → Tac Cua river → river Go Gia → Thi Vai river (Cai Mep-Thi Vai port cluster), the entire length of the North - South corridor is 82 km.

Component C: Consultancy services, including technical design and construction supervision.

The overall goal of the project is to improve the inland waterway infrastructure system; reduce waterway traffic congestion and accidents; reduce emissions contributing to environmental protection; reduce the transport distance and logistics costs; promote economic development, especially the Mekong Delta region; and increased connectivity for different types of transport. This goal will be realized by renovating and upgrading two transport corridors logistics transport connecting the Mekong Delta region with Ho Chi Minh City and linking the economic triangle area of Ho Chi Minh City-Dong Nai-Binh Duong with Cai Mep-Thi Vai port area, contributing socio-economic development, ensuring border security in localities in the Southeast and Mekong Delta.

Legal and technical basis for ESIA

The environmental assessment carried out during project preparation confirmed that the project's environmental risks were classified as Substantial. The World Bank environmental and social standards (ESS) applied to the project are as follows: ESS 1: Assessment and management of environmental and social risks and impacts; ESS10: Stakeholders engagement and information disclosure; ESS2: Labor and working conditions; ESS3: Resource Efficiency and Pollution Prevention and Management; ESS4: Community health and safety; ESS5: Land acquisition, restrictions on land use and involuntary resettlement; ESS6: Biodiversity conservation and sustainable management of living natural resources; ESS7: Indigenous

Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities *(equivalent to ethnic minority peoples in Viet Nam);* ESS8: Cultural heritage. The Environmental and Social Impact Assessment (ESIA) document is prepared according to the ESF and to Vietnamese legislation.

Project description

The SWLC project is expected to perform the following works: (i) Dredging and bend correction: reaching grade II inland waterways on routes: Mang Thit river (2,355,000m^3), Cho Lach canal (1,240,000 m^3), Ky Hon canal (50,000 m^3), Rach La canal (614,510 m^3) in the East-West corridor and Tac Cua river (256,000 m^3) in the North – South corridor; (ii) Embankment: Mang Thit river (13,154m), Cho Lach canal (8,770m) and Rach La canal (1,060 m) (on East-West corridor); (iii) Build one new Cho Lach bridge; (iv) Local roads: along Mang Thit river (4,566 m), along Cho Lach canal (1,496 m), along Rach La canal (1060 m) in the East-West corridor; (v) Irrigation and drainage outlets: 45 culverts in Mang Thit river, 29 culverts on Cho Lach canal, and 6 culverts in Rach La canal; Navigational aids: Install additional boys and signs to improve traffic safety in Tra On canal, Mang Thit river, Cho Lach canal, Nuoc Man – Can Giuoc canal.

Social and environmental baseline

In November 2021, 5 air samples, 10 surface water samples, and 2 biological samples were taken to evaluate the background environment quality in the project area. Results of field surveys and environmental monitoring show that the quality of the air, surface water is still quite good, except for several parameters including TSS, BOD_5, COD that exceed the permissible standards following National Regulation of Surface water quality QCVN 08-MT:2015/BTNMT (class B1 for irrigation and other uses). They are probably caused by the movement of inland waterway vessel together with the domestic activities of local people. The result of groundwater quality and sediment quality which are cited from the project ESIA in 2017 showed that all monitoring parameters meet the national permitted limits of QCVN 43:2012/BTNMT and QCVN 09-MT: 2015/BTNMT, respectively. The results of the survey and evaluation also show that, there are no national parks, nature reserves, and endangered terrestrial and aquatic species in the project area.

Within the Project affected river/canal network, there are no major cities, it contains mostly rural population and peri-urban areas (including 5 townships). The ethnic minority groups of Khmer people are identified in Tra On district, Vinh Long province. In the Mekong Delta (MKD) region, Khmer people are poorest compared with other EM people. Their livelihoods are mainly relied on farming such as rice cultivation and fishing.

The project works are built on the existing base, mainly located in residential areas. Some sensitive receptors consist of: (i) in Mang Thit river area: Phat Tanh pagoda, Tra On Protestant Church, Nhi My pagoda, Huong Duong Kindergarten, Tam Binh General hospital, Luu Van Liet primary school, Tam Binh market, Tuong Loc Church, Tuong Loc B primary school, Nhon Binh B primary school, Xuan Hiep A primary school, An Lac pagoda; (ii) in Cho Lach canal area: Khung Le Kindergarten, Cho Lach protestant church, Cho Lach cathedral, Cho Lach General Hospital, An Tiem Kao Dai church; in Rach La canal area: Linh Chieu pagoda. None physical cultural resources and intangible cultural resources are affected by the project implementation.

Environmental and Social Impacts and Risks

The ESIA identified the negative impacts and potential risks of the project. The most associated environmental risks and impacts are those common to construction activities and expected to be moderate, short-term, and localized with readily designed mitigation measures.

❖ ***General impacts***

Dust, exhaust gas, noise, vibration, wastewater, solid waste from construction activities and daily life of workers. These impacts can be considered as low to moderate for each work item and can be minimized.

The project is expected to have: i) direct pollutant discharges causing degradation of air, water or soil; ii) no extraction, consumption, or conversion of substantial amounts of forest, aquatic and terrestrial ecosystems and other natural resources; iii) impacts on fisheries and aquaculture, riverine ecosystem services; iv) moderate amounts of hazardous which are not be expected to result in significant impacts during construction, but with a moderate risk of fuel/oil leakage if accidents happen during construction and operation; and community and worker health and safety from construction and dredging activities.

The project also affects temporarily a wide array of waterway users and aquaculture households during the construction period. The construction workforce will include a relatively number of contract workers who may come from other provinces during the construction period. This may result in a range of social impacts and risks to local communities and other stakeholders (for example, gender-based violence (GBV), sexual exploitation and abuse (SEA) and sexual harassment (SH) related to labor influx and infection of COVID-19 and other communicable diseases).

❖ ***Specific impacts***

Land acquisition impact: Land acquisition will cause loss of assets attached to lands, such as houses/structures/graves, standing crops and trees, and loss of income generation opportunities from land-based livelihoods and nonagricultural businesses. Expectedly, the project will affect 1,068 households, of which 358 households will have to be resettled. Data on acquisition of land, on-land assets, crops and trees will be updated in the Project's Resettlement Action Plan..

Impacts at dredging disposal sites: The Project is expected to have substantial-scale physical disturbance of the site and surroundings due to excavation and dredging of about 4.5 million cubic meters of material during the construction phase resulting in substantial risks and impacts associated with excavation and disposal activities. It is estimated that the leachate will make up 20% of the total dredged sludge. However, the leachate will be channeled back to adjacent water bodies. According to the results of sediment monitoring in the project area from survey in 2018, there are no signs of heavy metal contamination. The sludge leachate contains high TSS content that affects aquatic species of receiving sources. In addition, the pipelines would be installed for transport the materials to the disposal sites, pose safety risks to local communities, due to failure or accidents. This impact is assessed to be substantial, but can be mitigated by appropriate mitigation measures.

Water runoff from the sedimentation pond in the disposal sites: At the disposal sites, water runoff from the sedimentation pond which impacts to water quality of local canals. However, this impact can be minimized by channeling the leaking back to adjacent water bodies on temporary drainage system associated with sedimentation tanks and through the embankment made of sand bags around the sites for wet dredging material. According to the results of sediment monitoring in the project area, there are no sign of heavy metal contamination. The dredging material contains high TSS likely to affect aquatic species of receiving sources. Impact is assessed to be low and mitigable.

Impacts to water quality. the project's works that cause impacts on the water environment include: dredging and excavation works in Mang Thit, Cho Lach, Rach La, Ky Hon, Tac Cua river/canal. Those activities will contribute to the increase of suspended solid wastes in the construction sites as well as in the downstream area. In addition, water runoff can transport materials (construction materials, soil, sand, grease and waste and so one) into aquatic areas,

causing water pollution. This impact is assessed at moderate level, temporary and can be mitigated.

Risks and incidents from dredged materials: When the dredging disposal sites are significantly higher than the surrounding ground, dredged material may spill downslope into the surrounding areas, filling up vacant or production land, cover vegetation or infrastructure, affecting people's livelihood and agricultural production activities. Rainwater runoff may erode this material and cause localized flooding, resulting in the impacts on aquatic species. This risk is assessed to be moderate and can be mitigated by relevant construction methods.

Impacts to sensitive structures: The Project implementation will affect 12 sensitive structures in Mang Thit river, 6 in Cho Lach canal and 1 in Rach La canal. Dust, noise, vibration, traffic accidents during the construction process will affect schooling. In addition, spiritual cultural activities of local people in the community hall, pagodas and cemeteries will be affected, especially the risk of conflict between workers and local residents. These impact are assessed to be low and mitigable.

Mitigation measures

Generic impacts

The detailed environmental and social mitigation measures for each impact source, respectively during project phases, include: (i) general impact mitigation measures (Environmental and social codes of practice - ESCOPs); (ii) site-specific impact mitigation measures; and (iii) measures to minimize impacts on sensitive receptors.

Site specific impacts

Social impacts: (i) Mitigation measures are taken for impacts from land acquisition in the Project area and shown in detail in the RAP; (ii) construction options which require the smallest land acquisition area are prioritized, and (iii) appropriate implementation of LMP.

Mitigation of impacts of dredged materials and at disposal sites: Dredging activities will be carried out in the dry season; Leachate from sediment must be directed to a sediment tank/trap before being discharged back the canals; Dredging materials must use specialized trucks with trunk; the dredging activities must not be carried out in during irrigation for agricultural production; a dredging materials management plan should be prepared before initiating construction.

Mitigation of impacts on water environment: the dredging activities must be carried out in the dry season; wastewater will be dumped into sediment pits before being discharged into the environment; waste disposal into rivers must be banned, construction materials must be covered with canvas and stored in the places far from water sources.

Minimize impacts on sensitive structures: Inform people of construction time; Do not transport, use high-noise machinery and build items that emit a lot of dust and noise through the Church area during major religious holidays; Installing fences and barriers for danger warning areas/restricted areas around construction areas with potential risks to the community; Requesting employees to strictly comply with the labor regulations; Recruit local labor.

Environmental and Social Management Plan (ESMP)

The SWLCP ESMP includes measures to minimize negative impacts, roles and responsibilities for ESMP implementation, supervisors, environmental compliance framework, reporting organization, and control program. environment, capacity building program and ESMP implementation costs. The estimated cost of the ESMP implementation is USD 144,829.

During the construction process, ESMP requires the participation of a number of stakeholders

and agencies, each with a unique role and responsibility, including the PMUW, Provincial Department of Natural Resources & Environment, Contractors, Construction supervision consultant (CSC), Independent environmental monitoring consultant (IESMC) and local community.

Public consultation and Information disclosure

Public consultation: Public consultation activities were conducted for the first round in 2017 and for the second round in December 2021 after the project restarted in the middle of 2021. The consultation was conducted with representatives of government agencies and union organizations. such as: Representatives of People's Committee, Vietnam Fatherland Front Committee, Women's Union, households affected by the project. The local authority and people in the commune/ward in the construction area are completely in agreement on the implementation of the project, which will bring about socio-economic and environmental benefits.

Information disclosure: The draft ESIA in Vietnamese was published at the offices of 29 wards/communes/towns and in the office of PMUW in Ho Chi Minh city in December 2021 to conduct public consultation. The final draft ESIA, together with RPF/RPs, EMDF/EMDPs, SEP, LMP, and ESCP will also be disclosed locally in an accessible place to project-affected parties and other interested parties as set out in ESS10, and the World Bank external website.

CHAPTER 1. INTRODUCTION, LEGAL FRAMEWORK

1.1. PROJECT ORIGIN

1.1.1. Investment necessity

The Mekong Delta is an important role in Vietnam's national economic development. To develop the economy of the Mekong Delta in the future, it is necessary to strengthen the transportation network, connecting the region with domestic and international markets. Since the Inland Waterway Transport (IWT) network is already available, it should be exploited and made full use of its potential. Inland water transport has many advantages over road transport for safety reasons, less emissions, and lower transportation costs.

The transport infrastructure system is the bottleneck in logistics services in Vietnam. Bulk transport from the Mekong Delta to Ho Chi Minh City (HCMC) must go through Cho Gao channel, Tien Giang, during peak season it can take up to 24-36 hours partly due to congestion due to poor sections of the route synchronous improvement; The current transport route passing through Tien River, Vam Nao River and Hau River is quite long, taking a long time to reach Can Tho Port. Roads connecting to ports in Ho Chi Minh City, especially Cat Lai port, are often congested during the peak export season, businesses have to reserve 1.5 times more transit time than usual to ensure that on-time delivery. While the ports in the HCMC area are being overloaded, the Cai Mep Thi Vai port area has not been utilized and exploited effectively over the years.

Multimodal transport in the Southeast (North-South corridor) is currently quite good with dense container traffic, but container transport in the Mekong Delta (East-West corridor) is still very modest (accounting for less 2% of transported cargo) due to the uneven clearance of bridges on the route and the non-synchronous channel.

The project area includes the Mekong Delta and the Southeast which are formed by two main river systems, the Dong Nai river system and the Mekong river system. The project includes many rivers with small, folding radius that do not ensure safety for navigation on Mang Thit river with 8 curved sections, Cho Lach canal with some narrow and shallow sections, Rach La canal with 4 curved sections, Dong Tranh River with 5 sharply curved and shallow sections which only allows ships to pass through during high water level, and Tac Cua River with 5 curved sections. Therefore, water transportation in the region is highly limited.

The project will invest in upgrading routes on the East-West Corridor to level II to ensure safe circulation of 3-class container ships, self-propelled vessel up to 1500T, gradually increasing the proportion of freight transport by container, reduce shipping cost. The project also connects port clusters in major economic centers, dry ports (ICD) to transport import and export goods. The project also promotes the potential and advantages of the Cai Mep-Thi Vai port cluster in the logistics chain in the South, contributing to promoting economic development in the region in particular and the country in general.

Thus, it can be seen that the main benefits of the project are due to the convenient transport distance, shortening the distance and time for ships and boats to transport goods from the Mekong Delta to the HCM city to major ports in the region (and vice versa) leads to lower transportation costs. Lower emissions and safer also thanks to shorter travel distances. The improved connectivity could lead to a shift in mode of transport in the future and enhance the competitive position of manufactured and processed goods along this new link, significantly contributing to poverty reduction, sustainable socio-economic development and reduction of environmental pollution, strengthening the connection of IWT and maritime transport, between the Mekong Delta and the Southeast to the Cai Mep - Thi Vai ports.

Through the above analysis, when the project is implemented, it will:

- Reduce water traffic congestion and accidents;
- Reduce transport distance and Logistics costs;
- Reduce emissions during circulation, contribute to environmental protection;
- Promote economic development; especially the Mekong Delta region;
- Increased connectivity for different types of transport.

Therefore, investment in SWLC project is significantly necessary.

1.1.2. Summarization of project preparation

1.1.2.1. Project proposal and approval

In 2018, the project only focused on research for the East-West corridor (through Hau river, Tra On river, Mang Thit river, Co Chien river, Cho Lach canal, Tien river, Ky Hon canal, Rach La canal, Vam Co river, Nuoc Man canal, Can Giuoc river, Soai Rap river, Long Tau river, Dong Tranh river, Tac Cua/Tac Bai river, Go Gia river, Thi Vai river) which would be renovated and upgraded to grade II technical inland waterway with a width of 55 m for the canal; 75 m for the river, 3.3 m deep for the navigation, at least 500 m bend radius for the canal and 700 m for the river so that it could be fit with self-propelled ships with a tonnage of up to 1,500 tons, fleet of barges 2x500 tons, 3-layer container ships for safe navigation.

The minimum recommended dimensions for waterways proposed in 2018 are shown in the following table.

Table 1.1. Minimum dimensions of East – West corridor proposed in 2018

Dimensions	Value (m)	Item	Value (m)
Canal			
Depth	3.3	Slope (V:H)	1:3
Width	55	Minimum bend radius	500
River			
Depth	3.3	Minimum bend radius	700
Width	75		

The volume of correction works on each canal route within the research scope (in the 2018 report) is detailed in the following table:

Table 1.2. Summary of correction works of the project proposed in 2018

No.	Waterways	Dredging [m^3]	Embankment [m]	Bridge [-]	Local road [m]	Landing stages [-]	Irrigation and drainage outlets [-]	Navigational aids [-]
1	*Tra On*	-	-	-	-	-	-	Yes
2	*Mang Thit*	3,115,862	14,938	2	5,057	10	44	Yes
3	*Cho Lach*	1,233,193	8,770	1	1,496	-	29	Yes
4	*Rach La*	1,081,675	3,873	-	1,536	06	11	Yes
5	*Ky Hon*	46,112	-	-	-	-	-	Yes
6	*Nuoc Man – Can Giuoc*	-	-	-	-	-	-	Yes
7	*Dong Tranh*	2,229,564	654	-	615	-	-	Yes
8	*Tac Cua*	294,113	-	-	-	-	-	Yes
9	Cho Gao phase 2	557,079	9,850	-	9,860	-	-	Yes
	Total	**8,557,608**	**38,085**	**3**	**18,564**	**16**	**84**	**-**

1.1.2.2. Completed items of the project

After the EIA report following Vietnamese regulation was approved in 2018 by MONRE following Decision No. 1328/QD-BTNMT dated 26 April 2018, and the final draft ESIA was submitted to WB for consideration and approval. However, due to the lack of investment capital according to the Law on Public Investment, the project has not yet commenced and no construction items have been completed.

According to National regulation, because the project has not implemented any items since 2018 (after the EIA report was approved by MONRE) until now (more than 24 months), and several project items have been adjusted resulting in the changes in the scope of the work volume, it is required to re-compile the EIA report as prescribed at Point a, Clause 1, Article 20 of the Law on Insurance Environmental Protection 2014, and Clause 6, Article 1 of Decree No. 40/2019/ND-CP dated May 13, 2019 of the Government amending and supplementing a number of articles of the Decree detailing and guiding the implementation Environmental Protection law.

1.1.2.3. Reasons for updating FS report

The SWLC Project was studied in 2018 with funding from the Project Preparation Technical Assistance Fund (PPTAF). However, because the project has been established for a long time, there are many fluctuations in the price level, so it is necessary to update the total investment of the project. In addition, some content has had significant changes such as:

- Cho Gao canal upgrading project (phase 2) has been built by the Government with the state budget capital.
- Mang Thit Bridge has been invested with JICA's funding, and Tra On Bridge is not rebuilt as mentioned above.
- Landing stages were not built due to switching from bend cutting to bend correction.
- The minimum bend radius in the 2021 PFS report is R_{min}=320m compared to R_{min}=500m in the 2017 FS. When applying R_{min}=320m, there will be no more bend cutting, but only bend correction at sharp curves, resulting in the decrease of works items and the scope of site clearance compared to the 2017 FS Report.
- When applying TCVN 12910:2020 and PIANC InCom WG Report n° 141 – 2019 to design, the navigational depth will be Hct = 1.3T and R_{min} = 3 to 4Lt. For ships designed on the East-West corridor with T = 2.7m and Lt = 80m, preliminary calculations show Hct = 3.5m and R_{min} = 320m.

Thus, the navigational depth of 3.5m is larger than LAD = 3.3m, but the dredging depth is smaller as shown in the 2017 FS and 2021 PFS report (dredging depth is 3.7m, including the preventive room between two maintenance periods). This results in less dredging of the channel compared to previous designs. Besides, updating the design water level according to the latest measurement data and adding the effects of climate change will change the design navigational water level and therefore the design channel bottom elevation is likely to be adjusted.

It should be emphasized that the adjustment of the channel route and the standard of the channel will lead to a large change in design volume and needs to be updated, for example: change in dredging design, design of embankment, local roads, irrigation culverts, landing stages, volume of site clearance, etc. As stated in the project objective, updating the FS report will not include the field survey. Therefore, the missing natural condition data will be supplemented in the next design step.

From the above reasons, it is necessary to adjust the project to submit to the competent authorities for approval.

1.1.2.4. The content to be updated in the 2021 FS

The report will update and address changing issues and socio-economic context in the project area, specifically as follows:

- The Ministry of Transport has decided to exclude about 12 km of the East-West waterway (the Cho Gao canal upgrade project phase 2 is approved for investment with the state budget) from the scope of the initial project. Mang Thit Bridge (funded by JICA) and Tra On Bridge are also excluded from the Project;
- The initial VTMS system is proposed to be piloted along the Ky Hon canal - Cho Gao - Rach La waterways, which will later be invested with other capital sources at an appropriate time;
- No new construction of the Tra On bridge is required because this bridge has only been put into use since 2010 and still meets the canal standard.
- No construction of ferry landing stages is needed due to the change from bends cutting at 3 locations on Mang Thit and Rach La canals to bend corrections.
- Project costs are updated according to the latest unit prices;
- The socio-economic context has changed and is expected to develop further according to the ongoing Mekong Delta Plan;
- The issue of climate change which has not been fully considered in the 2017 FS will be studied further;
- Adjustment of the design of the centerline and the flow norm in the 2021 PreFS Report.

The FS Report update will consider the following eight waterways: Tra On, Mang Thit, Cho Lach, Rach La, Ky Hon, Nuoc Man - Can Giuoc, Dong Tranh and Tac Cua. The work of updating FS Report within a period of 4 months includes the following main tasks:

- Revising data and information used and prepared in the 2017 FS and 2021 PFS;
- Collecting data on recent natural and waterway conditions, including accidents;
- Collecting data on rainfall in the target area for the past 10 years and evaluate the change of runoff over the years for the wet and dry seasons;
- Reviewing the FS prepared in the 2017 FS report and the 2021 PFS report;
- Updating traffic forecasts for target areas based on (i) current and forecast economic developments in the project area and (ii) a combination of current and forecast traffic volumes (road and waterway) under the “no project” scenario and the “with project” scenario;
- Updating investment costs and maintenance costs regularly based on updating current unit prices;
- Updating project benefits that can be quantified;
- Updating the economic efficiency of the project through updating the NPV, IRR and CBA values.

1.1.3. Relevant program, plans and development projects in the Project area

1.1.3.1. Master plan on development of Vietnam's Inland Waterway Transport to 2020 and orientation to 2030

The project investment is in line with the master plan on development of IWT transport in Vietnam to 2020 and orientation to 2030 according to Decision No. 1071/QD-BGTVT dated

April 24, 2013 of the Ministry of Transport. In particular, section 6 of the list of projects to be implemented in the period from 2016 to 2020 specified the improvement of waterway connecting Can Tho port with Cai Mep - Thi Vai port area (11th project – Upgrading the waterway transport route from Vung Tau – Thi Vai – Saigon – My Tho – Can Tho).

1.1.3.2. Resolution No. 120/NQ-CP dated November 17, 2017 on Sustainable and Climate-Resilient Development of the Mekong Delta

This SWLC project with embankments activities on the East – West and North – South corridors is in line with the main purpose to 2050 in the Resolution No. 120/NQ-CP dated November 17, 2017 on Sustainable and Climate-Resilient Development of the Mekong Delta.

A modern urban system is built and reasonably distributed in sub-regions. The road and waterway transport systems are developed synchronously, connecting within the region and inter-region, and must ensure a harmonious, unified, complementary, and non-conflicting combination with the irrigation and dike systems. Irrigation infrastructure is built synchronously in accordance with the model of transforming agricultural production to adapt to climate change in ecological sub-regions, and at the same time, there must be effective measures to prevent, combat and mitigate natural disasters and the impacts of climate change for people's livelihood and the economy when natural disasters occur, or become more frequent and intense due to climate impacts.

1.1.3.3. Decision No. 68/QĐ-TTg dated January 15, 2018 on the approval of adjustment to the Cuu Long river delta construction planning to 2030 and vision to 2050

This Decision specifies the development of inland waterways that are conveniently and synchronously connected with road traffic to enhance transport capacity throughout the region. The main transport routes cover main segments of SWLC project including IWT of special level and level II.

1.1.3.4. Upgrading Two Southern inland waterway routes and Can Tho port Project

The Southern Waterway Upgrading and Can Tho Port Project have scope spread across 14 provinces in the Mekong Delta and Ho Chi Minh City. The project has upgraded the waterways in the area to grade III of IWT technical, including:

- Dredging segment A: from Ho Chi Minh city to My Tho (69,5 km).
- Dredging segment B and C: from Sa Dec to Kien Luong (216,2 km) and section C extending Kien Luong - Ha Tien (19,9 km).
- Dredging segment D and F: from Cho Lach to Ca Mau (218,4 km), and section F extending Ca Mau - Nam Can (60,4 km), Luong The Tran - Ca Mau - Gia Rai (50 km).

In addition, the project has also constructed embankments for some segments, built 6 new bridges across the canal, and built 07 river ports (including Ca Mau (Ca Mau), Giao Long (Ben Tre), Long Duc (Tra Vinh), An Phuoc (Vinh Long), Sa Dec (Dong Thap), Binh Long (An Giang) and Tac Cau (Kien Giang).

The project started in 2002 and ended in March 2006 with a World Bank loan of 69 million USD and 240 billion VND from the state budget. The project has brought about clear results, improving cargo transportation capacity on the route.

After the dredging and renovation, the amount of goods in circulation has increased significantly, specifically, annually an average increase of 35% at Cho Gao station, 37% at Tan Hiep station, 21% at Vi Thanh station.

1.1.3.5. The Mekong Delta Transport Infrastructure Development Project (WB5)

The WB5 project is spread across 13 provinces and cities in the Mekong Delta. In addition to upgrading a number of national highways (53;54;91), provincial roads and local waterways, the project has upgraded two northern water corridors through Dong Thap Muoi - Tu Giac Long Xuyen and the southern coastal corridor reaches level III of IWT technique, including:

- A waterway corridor through Dong Thap Muoi, Long Xuyen quadrilateral 253 km long from Ho Chi Minh city across Ben Luc river, Thu Thua canal, Nguyen Van Tiep canal, Tri Ton canal (Hau Giang). On the construction route of Rach Chanh, to regulate fresh water, prevent salinity for Long Xuyen Quadrangle and Dong Thap Muoi.
- A 153km long southern coastal corridor passing through Soc Trang and Bac Lieu.

In addition, the project also will build new bridges on the route to ensure air clearance, navigation compartment, embankment, waterway signaling, upgrade a number of local waterways to grade IV technical IWT, road grade IV, delta grade V, prestressed reinforced concrete bridge.

The project started in the second quarter of 2008 and ended in the second quarter of 2016 using ODA capital of 404.57 million USD and 130.98 million USD from the state budget.

The completed project has improved the inland waterway and road network for the Mekong Delta, reduced the cost of inter-region transportation of the Mekong Delta connecting Ho Chi Minh City, facilitating the circulation of goods and movement of the people. The project will also contribute positively to the goal of poverty reduction, socio-economic development, and reducing the rate of accidents on roads and waterways.

1.1.3.6. Upgrading Cho Gao Canal Project - Phase 1

The problem of the erosion of the canal banks of Cho Gao canal is severe, and has already washed away the district road along the canal and the private property of several households (including garden land, residential land, auxiliary structures, and in one site a residential structure). There is significant support for the acceleration of the works on the Cho Gao canal due to the severe impacts of erosion.

Cho Gao canal with 28.6 km long, was dredged in the project of upgrading two southern waterways and Can Tho port. Because it is the artery route from Ho Chi Minh City to the Mekong Delta provinces, congestion and accidents have occurred due to increased socio-economic development, leading to the increase in the number of ships and boats since 2008. At the same time, it has seriously eroded the canal two banks. The project has been invested by the Ministry of Transport with a source of government bonds with Phase 1 cost of 786 billion VND, including extensive dredging and bend correction in Rach La (10.25km), Ky Hon (6.38 km) with 55m channel bottom wide. 10km-long segment of Cho Gao has only been constructed 7.2 km embankment in the North and 1.5 km embankment in the South. Phase 1 commenced in January 2013 and was completed in 2015. Combined with the dismantling of the old Cho Gao Bridge and the construction of the new Cho Gao Bridge, it has partly reduced congestion and water accidents in this canal.

The phase 1 of this project was completed and was not carried out or planned to be carried out contemporaneously with the SWLC project; it was constructed independently from the SWLC project via different source of capital and development plan.

1.1.3.7. Upgrading Cho Gao Canal Project - Phase 2

Ministry of Transport has issued decision No. 1782/QD-BGTVT dated September 14, 2020 approving further investment of Upgrading Cho Gao Canal project (phase 2) and this project is now being implemented for Cho Gao channel. This project includes dredging and widening of

Cho Gao channel length 9.85m to reach a width of B=55m, navigational depth 3.1m. This project also includes construction of 9.85 km bank protection, two bridges Binh Phan and Quon Long and local road type B along the channel, auxiliary works. After completion expected in 2023, the channel will reach grade II width inland waterway through the entire channel and erosion at Southern bank shall be completely resolved.

Upgrading embankments of Cho Gao canal both Phase 1 and 2 would need to take place urgently with the primary objective of public safety, due to severe and accelerating erosion of the canal banks and the instability of the bridge caused by heavy traffic. It has not been carried out contemporaneously with the World Bank's Southern Waterways Project (SWLC) and would have been completed regardless of this project. Therefore, Cho Gao canal project doesn't meet all the criteria for an associated facility as defined in the ESF.

The objective of the socializing Dong Tranh project is for dredging, maintaining and upgrading Dong Tranh waterways and Tat Ong Cu - Tat Bai, Tat Cua to Go Gia river using fund of the private sector. This project follows the "Beneficial uses of dredged materials as compensation for costs" model without using the state budget. This project will take place regardless of the World Bank's Southern Waterways Project, and therefore is not an associated facility.

Likewwise, all the remaining projects in Table 1.3 also don't meet all the criterial for associated facilities, as defined in the ESF, meaning facilities or activities that are not funded as part of the project and, in the judgment of the Bank, are: (a) directly and significantly related to the project; and (b) carried out, or planned to be carried out, contemporaneously with the project; and (c) necessary for the project to be viable and would not have been constructed, expanded or conducted if the project did not exist.

1.1.3.8. The socializing project of dredging, maintaining and upgrading Dong Tranh waterways and Tat Ong Cu - Tat Bai, Tat Cua to Go Gia river

There are two river sections coinciding with the SWLC project, Dong Tranh river and Tac Cua river. Vietnam Maritime Administration has issued decision No. 1026/QD-CHHVN dated October 24, 2014 regarding approval of Economic – Technical report on socialization of dredging and maintenance with following construction and investment scope:

- Dredging and establishment of channel with following parameters:

  + In Dong Tranh river, from Long Tau river crossover to Tac Cua crossover: length: 15.3 km for marine 5000DWT vessels 2 direction, navigational water level +0,0m (Chart datum) with bottom level: -7.4m (Chart datum), channel width: B= 130m; curve radius: Rc = 430m;

  + Tat Cua route: length: 6.4 km for marine 5000DWT vessel 1 direction, navigational water level +0.0m (Chart datum); bottom level: -7.4m (Chart datum); channel width: B= 70m; curve radius: Rc = 430m;

- Navigation aids system: 26 signal buoy sets with diameter Ø=2m.

A part of the project was implemented, then suspended from December 2016 until now. There has been no official announcement from MOT on the recommencement of this project. Currently, Vietnam Maritime Administration are preparing for further implementation of this project. Implementation of this socialization project of dredging, maintenance is under the method which used products shall be utilized to compensate for cost, State budget shall not be used in order to receive full-load SPV 3000 DWT and reduced-load SPV 5000 DWT in this channel. However, the scope and standard of this channel has not completely met the general standard for inland waterway, such as required curve radius of the Project must reach Rc = 450m. Therefore, extension dredging is required for this channel to bend correction and smooth

navigation for vessels.

All the related development projects in the project area are summarized in the table below:

Table 1.3. Summary of related projects in the area

No.	Projects	Spatial frame	Timeframe and budget	Associated facilities?		
				Criteria (a)[1]	Criteria (b)[2]	Criteria (c)[3]
1	Upgrading Two Southern inland waterway routes and Can Tho port Project	14 provinces in the Mekong Delta and Ho Chi Minh City	The project started in 2002 and ended in March 2006 with a World Bank loan of 69 million USD and 240 billion VND from the state budget.	No	No	No
2	The Mekong Delta Transport Infrastructure Development Project (WB5)	13 provinces and cities in the Mekong Delta. In which, two corridors were upgraded: - Waterway corridor through Dong Thap Muoi, Long Xuyen quadrilateral 253 km long from Ho Chi Minh city across Ben Luc river, Thu Thua canal, Nguyen Van Tiep canal, Tri Ton canal (Hau Giang). On the construction route of Rach Chanh, to regulate fresh water, prevent salinity for Long Xuyen Quadrangle and Dong Thap Muoi. - 153km long southern coastal corridor passing through Soc Trang and Bac Lieu.	The project started in the second quarter of 2008 and ended the second quarter of 2016 using ODA capital of 404,57 million USD and 130,98 million USD from the state budget.	No	No	No
3	Upgrading Cho Gao Canal Project - Phase 1	Dredging and bend correction in Rach La (10,25km), Ky Hon (6,38 km) with 55m channel bottom wide. 10km-long segment of Cho Gao has only been constructed 7.2 km	Phase 1 was commenced in January 2013 and completed in 2015.	Yes	No	No

[1] Directly and significantly related to the project.
[2] Carried out, or planned to be carried out, contemporaneously with the project.
[3] Necessary for the project to be viable and would not have been constructed, expanded or conducted if the project did not exist.

No.	Projects	Spatial frame	Timeframe and budget	Associated facilities?		
				Criteria (a)[1]	Criteria (b)[2]	Criteria (c)[3]
		embankment in the North and 1,5 km embankment in the South.				
4	Upgrading Cho Gao Canal Project - Phase 2	Cho Gao canal	From 2020 and is estimated to complete in 2023, using State budget.	Yes	Yes	No
5	The socializing project of dredging, maintaining and upgrading Dong Tranh waterways and Tat Ong Cu - Tat Bai, Tat Cua to Go Gia river	In Dong Tranh river, from Long Tau river crossover to Tac Cua crossover. In Tac Cua river, from Tat Ong Cu – Tat Bai, Tat Cua to Go Gia river	The project was implemented from 2014 and superseded in 2016. Currently, Vietnam Maritime Administration are preparing for further implementation of this project.	Yes	Yes	No

Based on the criteria (a), (b), (c), all the projects mentioned in the table above are not associated facilities under the definition of WB ESF. The potential cumulative impacts from the projects above together with SWLC project will be further identified and evaluated in Chapter 5.

1.2. LEGAL FRAMEWORK

1.2.1. National Legislation

1.2.1.1. Laws

This ESIA has been prepared in line with the following Laws sorted descending by time.

- The Law on Environmental Protection No. 72/2020/QH14

The Law on Environmental Protection No. 72/2020/QH14 was approved by the 14th National Assembly of the Socialist Republic of Vietnam on November 17, 2020 and will take effect from January 1, 2022; However, the Clause 3, Article 29 of this Law has taken effect from February 1, 2021. When it comes into effect, the Law on Environmental Protection No. 72/2020/QH14 will replace the Law on Environmental Protection No. 55/2014/ QH13.

The Law on Environmental Protection No. 72/2020/QH14 stipulates a number of new provisions, especially (i) environmental criteria to classify investment projects and (ii) regulations on preliminarily environmental impact assessment for investment projects, specifically as follows:

Article 28. Environmental criteria for classification of investment projects

Environmental criteria for classifying investment projects include: a) Scale, capacity, type of production, business and service; b) Land use area, land with water surface, sea area; scale of exploitation of natural resources; c) Environmentally sensitive factors, including concentrated residential areas; water sources used for domestic water supply purposes; nature reserves according to the provisions of the law on biodiversity and fisheries; types of forests according to the provisions of the law on forestry; tangible cultural heritage, other natural heritage; land for wet rice cultivation with 02 or more crops; important wetlands; requirements for relocation, resettlement and other sensitive environmental factors.

Based on environmental criteria, investment projects are classified into groups I, II, III and IV, specifically as follows:

Group I investment projects are projects posing high environmental risks, including: a) Projects of the type of production, business or service that are likely to cause significant environmental pollution; hazardous waste treatment projects; projects that import scrap from abroad as raw production materials; b) projects of the type of production, business or service with the risk of causing medium environmental pollution but having environmental sensitive factors; projects that are not of the type of production, business or service that are likely to cause significant environmental pollution but have environmental sensitive factors; c) Projects using land, land with water surface, sea area on a large scale or with medium scale but with sensitive environmental factors; d) projects involving extraction of minerals and water resources with large scale and capacity or with medium scale and capacity but having sensitive environmental factors; đ) projects require medium or higher scale of change in land use purpose but having environmental sensitive factors; e) projects that require large-scale relocation and resettlement.

Group II investment projects are projects that are likely to have adversely environmental impacts, including: a) Projects of the type of production, business or service that are likely to cause medium environmental pollution; b) Projects of the type of production, business and services that pose a risk of causing low environmental pollution but having sensitive environmental factors; projects that are not of the type of production, business or service with the risk of causing medium environmental pollution with medium scale and capacity but have environmental sensitive factors; c) Projects using land, land with water surface and sea areas with small scale and capacity but having sensitive environmental factors; d) Projects involving extraction of minerals and water resources with medium scale and capacity or with small scale

and capacity but having sensitive environmental factors; đ) Projects requiring small scale change of land use purpose but having environmental sensitive factors; e) projects requires medium-scale relocation and resettlement.

Group III investment projects are projects with low risk of causing adverse environmental impacts, including: a) Projects of the type of production, business or service that are likely to cause low environmental pollution; b) Projects that are not of the type of production, business or service that are at risk of causing environmental pollution, generate wastewater, dust, and exhaust gases that must be treated or generate hazardous wastes that must be managed according to waste management regulations.

Group IV investment projects are projects with no risk of adverse environmental impacts, including projects that do not fall into the categories of group I, II and III investment projects mentioned above.

The Government shall detail and promulgate the list of types of investment projects specified above. Thus, in the coming time, when the Government issues detailed regulations, IRDP Quang Nam Project will be classified according to environmental criteria, which is the basis for determining whether or not the project is subject to a preliminary environmental impact assessment.

Article 29. Preliminarily Environmental Impact Assessment

The projects subjected to preliminarily environmental impact assessment are Group I investment projects classified in accordance with the above-mentioned environmental criteria. The preliminarily environmental impact assessment is carried out during the pre-feasibility study of construction investment, proposal for investment policy, request for approval of investment policy for investment projects which are subjected to a need for decision or approval of investment policy in accordance with the provisions of the law on investment, public investment, investment in the form of public-private partnership, construction projects.

The preliminarily environmental impact assessment includes: a) Assessment on the suitability of the location of the investment project with the National Environmental Protection Strategy, the National Environmental Protection Master Plan, the project's content of environmental protection in relation with regional planning, provincial planning and other relevant planning; b) Identification and forecast of the main environmental impacts of an investment project on the basis of scale, production technology and location of project; c) Identification of environmentally sensitive factors on the basis of the project's implementation locations (if any); d) Analysis, assessment and selection of the plan on scale, production technology, waste treatment technology, project location and mitigation measures for environmental impacts; d) Identification of key environmental issues and scope of environmental impacts that need attention in the process of carrying out environmental impact assessment.

Agencies, organizations and individuals that propose investment projects in Group I according to the above-mentioned environmental criteria shall conduct a preliminarily environmental impact assessment. The content of the preliminarily environmental impact assessment shall be considered by the competent state agency at the same time as the application for decision or approval of the investment policy.

- The Labor Law No. 45/2019/QH13 adopted by the 14th National Assembly of Vietnam on Jan 1st, 2021 is the current legal document that defines labor standards; rights, obligations and responsibilities of employees, employers, representative of the employees at workplace, employers' representative organizations in labor relations and other relevant aspects directly related to labor relationship and state management of labor related issues;
- The Law on Denunciation No.25/2018/QH14, dated 12 June 2018;

- The Law on Irrigation No. 08/2017/QH14 adopted by the 14th National Assembly of the Socialist Republic of Vietnam on June 19, 2017 and effective on July 1, 2018;
- The Law on Children No. 102/2016/QH13 adopted by the 13th National Assembly of the Socialist Republic of Vietnam on April 5, 2016;
- The Law on Occupational Safety and Health No. 84/2015/QH13 issued on June 25, 2015;
- The Law No. 82/2015/QH13 on Marine and Island Resources and Environment was approved by the National Assembly Session 13th on June 25, 2015, effective since July 01, 2016. The Law's Article 24 stipulates Prohibited acts within coastal area protection corridors, including: (i) Mineral extraction unless otherwise as approved by the Prime Minister; (ii) Establish new constructions and expand construction works except the works used for protection of National defense and security, prevention and fighting against natural disaster and coastal landslides, coping with climate change, rising sea, preserving and bringing into play value of cultural heritages and other constructions serving interests of the nation, communities decided to invest by the National Assembly, Government, the Prime Minister, heads of ministries, central agencies, People's Council, People's committees of central-affiliated coastal cities and provinces; (iii) Construct cemeteries and landfills; (iv) Drilling, excavation, and backfilling within coastal area protection corridors except activities as prescribed in Article 25 of the Law; (v) Illegal transgression and use of coastal area protection corridors; (vi) Activities that cause coastal landslide, degrade ecosystem, value of service of ecosystem and natural landscapes.
- The Law on Construction No. 50/2014/QH13 adopted by the 13th National Assembly of the Socialist Republic of Vietnam on 18th June 2014 and effective from January 01st, 2015;
- The Revised Law on Inland Waterway Navigation No. 48/2014/QH13 adopted by the National Assembly of the Socialist Republic of Vietnam on June 24, 2014 amending and supplementing a number of articles in the Law on Inland Waterway Navigation;
- The Land Law No. 45/2013/QH13 adopted by the 13th National Assembly of the Socialist Republic of Vietnam on November 29, 2013 and effective from July 01, 2014;
- The Revised Law on Fire Prevention and Fighting No.40/2013/QH13 adopted by the 13th National Assembly of the Socialist Republic of Vietnam on November 22, 2013.
- The Law on Water Resources No. 17/2012/QH13 adopted by the 13th National Assembly of Vietnam, 3rd session on June 21, 2012;
- The Law on Complaints No.02/2011/QH13, dated 11 November 2011;
- The Revised Law on Cultural Heritages No. 32/2009/QH12 adopted by the 12th National Assembly of the Socialist Republic of Vietnam on June 18, 2009;
- The Law on Urban Planning No. 30/2009/QH12 adopted by the 12th National Assembly of the Socialist Republic of Vietnam on June 17, 2009;
- The Law on Road Transport No. 23/2008/QH12 adopted by the 12th National Assembly of the Socialist Republic of Vietnam on November 13, 2008;
- The Law on Biodiversity No. 20/2008/QH12 adopted by the 12th National Assembly of the Socialist Republic of Vietnam on November 13, 2008;
- The Law on Domestic Violence Prevention and Control No. 02/2007/QH12, dated 21 November 2007;
- The Law on Gender Equality No. 73/2006/QH11 dated November 29, 2006. This law provides for the principle of gender equality in all fields of social life and family, measures

to ensure gender equality and responsibilities of agencies, organizations, families and individuals in the implementation of equality gender;

- The Law on Inland Waterway Navigation No. 23/2004/QH11 adopted by the 11th National Assembly of the Socialist Republic of Vietnam on June 15, 2004;

1.2.1.2. Decrees and Directives

This ESIA has been prepared in line with the following Decrees sorted descending by time.

- Decree 08/2022/ND-CP dated January 10, 2022 by the Government on guiding the implementation of Environmental Protection Law;
- Decree No. 55/2021/ND-CP dated May 24, 2021 by the Government on amendment and supplement of a number of articles of the Government's Decree No. 155/2016/ND-CP dated November 18, 2016 on sanctioning of administrative violations in the field of environmental protection;
- Decree No. 54/2021/ND-CP dated May 21, 2021 by the Government on the premilitary assessment of environmental impacts;
- Decree No. 08/2021/ND-CP dated January 28, 2021 by the Government on management of inland waterways activities;
- Decree No. 06/2021/ND-CP dated January 26, 2021 by the Government on quality management of construction works;
- Decree No.117/2020/ND-CP dated September 28, 2020 of the Government on prescribing penalties for administrative violations in medical sector;
- Decree No. 56/2020/ND-CP dated May 25, 2020 by the Government on the management and use of official development assistance (ODA) and concessional loans from foreign donors;
- Decree No. 40/2019/ND-CP dated May 13, 2019 by the Government on amendments to decrees on guidelines for the law on environment protection;
- Decree No. 67/2018/ND-CP dated May 14, 2018 by the Government detailing a number of articles of the Law on Irrigation, effective from July 1, 2018;
- Decree No. 42/2017/ND-CP dated April 05, 2017 by the Government on amendment and supplement of a number of articles of the Government's Decree No. 59/2015/ND-CP dated June 18, 2015 on management of construction investment projects;
- Decree No. 155/2016/ND-CP dated November 18, 2016 by the Government on sanctioning of administrative violations in the field of environmental protection;
- Decree No. 59/2015/ND-CP dated June 18, 2015 by the Government on management of construction investment projects;
- Decree No. 38/2015/ND-CP dated April 24, 2015 by the Government on management of waste and discarded materials.
- Decree No. 19/2015/ND-CP dated February 14, 2015 by the Prime Minister detailing the implementation of a number of articles of the Law on Environmental Protection;
- Decree No. 18/2015/ND-CP dated February 14th, 2015 by the Government on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental management plan;
- Decree No. 80/2014/ND-CP dated August 06, 2014 by the Government on wastewater drainage and treatment;

- Decree No. 47/2014/ND-CP dated May 15, 2014 by the Government providing regulations on compensation, support and resettlement when the State recovers land.
- Decree No. 44/2014/ND-CP dated May 15, 2014 by the Government regulating land prices.
- Decree No. 43/2014/ND-CP dated May 15, 2014 by the Government detailing the implementation of some articles of the Land Law 2013.
- Decree No. 201/2013/ND-CP dated November 27, 2013 by the Government detailing implementation of a number of articles of the Law on Water Resources;
- Decree No. 75/2012/ND-CP dated October 3, 2012 by the Government detailing a number of articles of the Law on Complaints;
- Decree No. 113/2010/ND-CP dated December 03, 2010 by the Government stipulating determination of damages to the environment;
- Decree No. 98/2010/ND-CP dated September 21, 2010 by the Government guiding the Law and Revised Law of Cultural Heritage;
- Directive No.13/CT-TTG dated March 11, 2020 of the Prime Minister on Continuing to step up the prevention and control of COVID-19 epidemic in the new situation;
- Directive No.16/CT-TTG dated March 31, 2020 of the Prime Minister on Implementation of urgent measures for prevention and control of COVID-19;
- Directive No.19/CT-TTG dated April 24, 2020 of the Prime Minister on A new stage of prevention and control of COVID-19.

1.2.1.3. Circular

This ESIA has been prepared in line with the following Circulars sorted descending by time, then by Ministry of issuance.

- Circular No. 02/2022/TT-BTNMT dated January 10, 2022 by MONRE on detailing the implementation of some articles of the Environmental Protection Law;
- Circular No. 10/2021/TT-BTNMT dated June 30, 2021 by MONRE regulating monitoring techniques and management of environmental quality monitoring;
- Circular No. 25/2019/TT-BTNMT dated December 31, 2019 by MONRE on elaborating some articles of the Government's Decree No. 40/2019/ND-CP dated May 13, 2019 on amendments to decrees on guidelines for the Law on Environmental protection and providing for management of environmental monitoring services;
- Circular No. 36/2015/TT-BTNMT dated June 30, 2015 by MONRE on management of hazardous wastes;
- Circular No. 37/2014/TT-BTNMT dated June 30, 2014 by the Ministry of Natural Resources and Environment detailing compensation, support and resettlement when the State recovers land;
- Circular No. 30/2014/TT-BTNMT on land allocation, land lease, conversion of land use purpose and land acquisition;
- Circular No. 32/2013/TT-BTNMT dated October 25, 2013 by MONRE on promulgation of national technical regulations on environment;
- Circular No. 08/2017/TT-BXD dated May 16, 2017 by the Ministry of Construction stipulating regulations on construction solid waste management;
- Circular No. 04/2017/TT-BXD dated 30/3/2017 by the Ministry of Construction stipulating

regulation on occupational safety management in the construction of works;

- Circular No. 19/2016/TT-BYT dated June 30, 2016 by Ministry of Health on guidelines for occupational health and safety management;

1.2.1.4. Applied standards and regulations

This ESIA has referred to the following regulations (QCVN) and standards (TCVN) sorted ascendingly by code Number, then by Ministry of issuance.

- QCVN 03-MT:2015/BTNTM: National technical regulation on the allowable limits of heavy metals in the soils;
- QCVN 05:2013/BTNMT: National technical regulation on ambient air quality;
- QCVN 06:2009/BTNMT: National technical regulation on hazardous substances in ambient air;
- QCVN 07:2009/BTNM: National technical regulation on hazardous waste thresholds;
- QCVN 08-MT:2015/BTNMT: National technical regulation on surface water quality;
- QCVN 09-MT:2015/BTNMT: National technical regulation on ground water quality;
- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater;
- QCVN 15:2008/BTNMT: Soil quality - National technical regulation on the pesticide residues in the soils;
- QCVN 26:2010/BTNMT: National technical regulation on noise;
- QCVN 27:2010/BTNMT: National technical regulation on vibration;
- QCVN 38:2011/BTNMT: National technical regulation on Surface Water Quality for protection of aquatic lives;
- QCVN 39:2011/BTNMT: National technical regulation on Water Quality for irrigation;
- QCVN 43:2017/BTNTM: National technical regulation on sediment quality;
- QCVN 18:2014/BXD: National Technical Regulation on Safety in Construction;
- TCVN 6705:2009: Normal solid wastes - Classification;
- TCVN 6706:2009: Hazardous wastes - Classification.

1.2.1.5. Legal documents related to the project

- Decisions No. 355/QD-TTg dated February 25, 2013 of the Prime Minister approving the adjustment of Vietnam's transport development strategy to 2020, with a vision to 2030; No. 1071/QD-BGTVT dated April 24, 2013 of the Ministry of Transport approving the adjustment of the master plan on development of Vietnam's inland waterway transport to 2020 and orientation to 2030; No. 4360/QD-BGTVT dated December 10, 2015 of the Ministry of Transport approving the adjustment and supplementation of a number of detailed contents of the Master Plan on Development of Inland Waterway Transport in Vietnam up to 2020 and determining towards 2030;
- Decision No. 68/QD-TTg dated January 15, 2018 of the Prime Minister approving the adjustment of construction planning in the Mekong Delta to 2030 with a vision to 2050;
- Decision No. 1012/QD-TTg dated July 3, 2015 of the Prime Minister approving the master plan on development of logistics center system in the whole country to 2020, with orientation to 2030;
- Decision No. 1938/QD-BGTVT dated October 14, 2019 of the Ministry of Transport on

assigning tasks to the Project Management Unit - Waterway to organize the preparation of a pre-feasibility study report for an investment and development project and logistics corridors in the southern region expected in the medium-term public investment plan for the period 2021-2025;

- Decision No. 814/QD-BGTVT dated April 29, 2020 of the Ministry of Transport on the detailed assignment of the state budget investment plan in 2020 for projects using the reserve source of the medium-term public investment plan for the period 2016-2020;
- Decision No. 1015/QD-BGTVT dated May 25, 2020 of the Ministry of Transport on promulgating the Regulation on organization and operation of the Project Management Unit Waterways;
- Decision No. 1038/QD-BGTVT dated May 27, 2020 of the Ministry of Transport providing for decentralization and authorization in the management of construction investment projects using public investment capital managed by the Ministry of Transport; Document No. 10105/BGTVT-CQLXD dated October 8, 2020 guiding the implementation of some contents of Decision No. 1038/QD-BGTVT dated May 27, 2020 of the Ministry of Transport;
- Document No. 808/TTg-QHQT dated June 10, 2021 of the Prime Minister approving the proposal of "Vietnam Southern region Waterways and Transport Logistics" project, using loans from the World Bank and aid from the Australian Government;
- Notice No. 275/TB-BGTVT dated July 29, 2021 by Deputy Minister of Transport Le Anh Tuan at the meeting to report the pre-feasibility study of the project to develop waterways and logistics corridors in the southern region;
- Written recommendation from the Departments under the Ministry of Transport including Document No. 1607/CQLXD-DADT2 dated June 24, 2021 of the Department of Construction Management and Quality of Traffic Construction; Document No. 260/MT dated June 22, 2021 of the Department of Environment; Document No. 341/VT dated June 24, 2021 of the Department of Transport; Document No. 354/KCHT dated June 25, 2021 of the Department of Transport Infrastructure; Document No. 589/TC of Finance Department; Document No. 1439/CĐTND-KHTH dated July 2, 2021 of Vietnam Waterway Administration and Document No. 3028/CHHVN-KHDT dated July 27, 2021 of Vietnam Maritime Administration;
- Written recommendation from Local authorities including Document No. 3667/UBND-KTNV dated 9/7/2021 of Vinh Long Provincial People's Committee; Document No. 3674/UBND-KT dated June 30, 2021 of the People's Committee of Ben Tre province; Document No. 1412/SGTVT-KC dated June 29, 2021 of the Department of Transport of Tien Giang province; Document No. 3550/SGTVT dated 13/7/2021 of the Department of Transport of Long An province; Document No. 1250/UBND-TH dated 2/7/2021 of the People's Committee of Soc Trang province; Document No. 1026/SGTVT-KHTC dated 7/7/2021 of the Department of Transport of Dong Thap province; Document No. 1494/SGTVT-KHTC dated 9/7/2021 of the Department of Transport of An Giang province; Document No. 2573/UBND-KT dated 9/7/2021 of the People's Committee of Can Tho city; Document No. 2546/SGTVT-VTPTNL dated 15/7/2021 of Binh Duong Department of Transport; Document No. 3459/SGTVT-QLGT dated 23/7/2021 of the Department of Transport of Dong Nai province; Document No. 2415/SGTVT-KHTC dated August 6, 2021 of the Department of Transport of Ba Ria Vung Tau province;
- Minutes of cooperation agreement between the Ministry of Transport, Aus4Transport Program Management Consultant and the Australian Embassy in Hanoi; Letter from the Australian Embassy in Hanoi dated 11/2/2020 committing non-refundable funding for

updating the pre-feasibility study report, EIA and project technical design;

- Decision No. 46/QD-DT dated June 5, 2020 of the Project Management Unit Waterways approving the tasks and cost estimates for making pre-feasibility study reports for SWLC project;
- Decision No. 49/QD-DT dated June 12, 2020 of the Project Management Unit Waterways approving the contractor selection plan for the TV-TKT package: Consulting to prepare a pre-feasibility study report for the SWLC project;
- Contract No. TV-TKT dated June 30, 2020 Bidding package: Consulting for preparation of pre-feasibility study report, under the SWLC project between the Project Management Unit Waterway and VIPO Trading and Investment Consulting Joint Stock Company.

1.2.2. Relevant International Treaties and Agreements

Vietnam has signed a number of international agreements and conventions relating to environmental management, community rights and ethnic minorities. The international treaties are not always adopted to be national legislation. Some of the key agreements are listed in the following Table.

Table 1.4. International agreements relevant to environmental & social issues

Agreements/Conventions	Status	Objectives/Relevance
A. ENVIRONMENT		
United Nations Convention on Biological Diversity, 1992	Signed in May 1993	To promote development of national strategies for the conservation and sustainable use of biological diversity. Often seen as the key document regarding sustainable development.
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), 1982	Joined in 1989	The conservation and sustainable utilization of wetlands, i.e. to stem progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.
Paris Agreement	Joined in April 2016	Paris Agreement set a goal for not only the reduction of GHG emissions but also focus on Adaptation and finance flows that support developing countries to commit the agreement. The Paris Agreement aims to strengthen the global climate change response by increasing the ability of all to adapt to adverse impacts of climate change and foster climate resilience.
Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES), 1973	Joined in 1994	To ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33,000 species of animals and plants.
Stockholm Convention on Persistent Organic Pollutants, 2001	Signed in July 2002	UNEP calls for global action to be taken on POPs which is defined as chemical substances that persists in the environment, bio-accumulation in the food chain and cause adverse impact on human health.
B. SOCIAL AND CULTURAL		

Agreements/Conventions	Status	Objectives/Relevance
Protection of the World Cultural and UNESCO Convention Concerning the Natural Heritage, 1972 (World Heritage Convention)	Joined in 1987	To promote cooperation among nations to protect heritage from around the world that is of such outstanding universal value that its conservation is important for current and future generations.
Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) 1979	Signed in July 1980	The Convention defines what constitutes discrimination against women and mandates actions on a national level to put an end to discrimination.
International Covenant on Economic, Social and Cultural Rights (ICESCR)	Joined in 1982	This could protect the rights of minority ethnic groups

Vietnam has signed certain ILO Conventions, the details for which are provided in Table 1.5 below. Vietnam, which has now ratified 6 out of the 8 ILO Fundamental Conventions, becomes the 167th ILO Member State to ratify Convention No. 98 and the 20th State in the Asia and Pacific region to do so.

Table 1.5. Vietnam Ratification to ILO Conventions

Convention	Date	Status
C029 - Forced Labour Convention, 1930 (No. 29)	05 Mar 2007	In Force
C098 - Right to Organize and Collective Bargaining Convention, 1949 (No. 98)	05 Jul 2019	In Force
C100 - Equal Remuneration Convention, 1951 (No. 100)	07 Oct 1997	In Force
C111 - Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	07 Oct 1997	In Force
C138 - Minimum Age Convention, 1973 (No. 138) Minimum age specified: 15 years	24 Jun 2003	In Force
C182 - Worst Forms of Child Labour Convention, 1999 (No. 182)	19 Dec 2000	In Force

1.2.3. World Bank Environmental and Social Framework and Guidelines

The World Bank Environmental and Social Framework[4] (ESF), which became effective in October 1, 2018, sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards (ESSs) that are designed to support Borrowers' projects, with the aim of ending extreme poverty and promoting shared prosperity.

The Bank is committed to supporting Borrowers in the development and implementation of projects that are environmentally and socially sustainable, and to enhancing the capacity of Borrowers' environmental and social frameworks to assess and manage the environmental and social risks and impacts of projects. To this end, the Bank has defined ten specific Environmental and Social Standards (ESSs), which are designed to avoid, minimize, reduce or mitigate the adverse environmental and social risks and impacts of projects. The following ESSs

[4] https://www.worldbank.org/en/projects-operations/environmental-and-social-framework

are deemed relevant to the project:

ESS1. Assessment and Management of Environmental and Social Risks and Impacts

ESS1 requires the Borrower to be responsible for assessing, managing, and monitoring E&S risks and impacts associated with each stage of a project supported by WB toto achieve E&S outcomes consistent with the ESSs. This ESS is relevant to the project due to the environmental and social risks and impacts associated with implementation and operation of the investments under Component A and B, requiring assessment and management of the risks and impacts.

These include commonly known construction impacts and risks, such as: (i) (i) safety risks due to removal of unexploded ordnances (UXOs); (ii) water pollution and turbidity (e.g., dredging activities can cause an increase in suspended solids, including acid sulfate soil, and diffusion of pollutants to the surrounding water); (iii) changes in hydrologic regime due to bend corrections; (iv) impacts on aquatic life, riverine ecosystem services and water supply along the canals and rivers (e.g., aquatic fauna migrating out of dredging sites); (v) water and land pollution due to the disposal of dredged and excavated materials, and (vi) occupational and community health and safety risks. The main environmental adverse risks and impacts during operation would include: (i) impacts on water quality and aquatic life as a result of increased waterway traffic; (ii) waterway traffic congestion and safety risk; and (iii) oil leakage due to waterway traffic accidents.

During project preparation the MOT prepared an Environmental and Social Impact Assessment (ESIA) in accordance with ESS1. An Environmental and Social Management Plan (ESMP) has been prepared as an integral part of the ESIA. An Environmental Social Commitment Plan (ESCP) has also been prepared. The ESCP sets out the activities to be carried out by the Borrower during project implementation and could be adjusted during the project life keeping with the evolution of E&S risk and impacts.

ESS2. Labor and Working Conditions

The ESS2 recognizes the importance of employment creation and income generation in the pursuit of poverty reduction and inclusive economic growth. The Project owner can promote sound worker-management relationships and enhance the development benefits of a project by treating workers in the project fairly and providing safe, secure and healthy working conditions.

With the current design, it is expected that the workforce will include direct workers (directly employed by the PMUW), contracted workers (recruited by third parties such as contractors or consultants), and primary supply workers (workers engaged for essential construction materials to be purchased). The project is not likely to engage community workers, as civil works will be the responsibility of contractors. Most risks relate to occupational and community health and safety issues, including potential exposure to the COVID-19 virus, and other risks associated with the construction activities including OHS, GBV and to the operation of investments.

To be consistent with the ESS2 requirement, as part of the ESA process, Labor Management Procedures (LMP) have been prepared as a stand-alone document and referred in the E&S documents. The LMP sets out the way in which the project workers will be managed in accordance with requirements of national laws and ESS2, and also established a GRM for workers.

ESS3. Resource Efficiency and Pollution Prevention and Management

This ESS sets out the requirements to address resource efficiency and pollution prevention and management throughout the project lifecycle. The project is expected to use resources and materials for construction of canal and river embankment, reconstruction of a bridge, bend corrections at four canals and rivers, construction of access roads, and upgrading irrigation and drainage outlets.

Risks and impacts have been identified related to the release of pollutants, dredged materials, waste generation, the management of disposal materials and hazardous wastes, impacts on adjacent communities, and resource use efficiency. Given the type – dredging, bend cutting and correction, embankmen and scale – spread in the administration areas of 6 provinces/city - of the project, large amount of resources and materials are required and the adverse impacts on human health and environment are expected to be substantial. Assessment of the risks and impacts of the civil works and proposed mitigation measures related to relevant requirements of ESS3, including raw materials, water use, air pollution, hazardous materials, and hazardous waste has been addressed in the ESIA.

ESS4. Community Health and Safety

This ESS addresses the health, safety, and security risks and impacts on project-affected communities and the corresponding responsibility of the project owner to avoid or minimize such risks and impacts. The aspects of community health and safety that needs to be considered during the implementation include UXO safety risks due to the project's location within an area with history of war, traffic safety along transportation routes; community health issues and safety at the construction sites; and public safety including concerns on GBV/SEA related to the influx of workers and security personnel; and COVID-19 risks. Standard measures in the World Bank Group Environment, Health, and Safety Guidelines (EHSG) to ensure the health and safety of communities have been integrated, and referred to, directly in the ESIA, and implemented during the construction of and operation.

ESS5. Land Acquisition, Restrictions on Land Use and Involuntary Resettlement

This ESS recognizes adverse impact for project on local people, especially those considered to be vulnerable or disadvantageous. Involuntary resettlement should be avoided. Where involuntary resettlement is unavoidable, it will be minimized and appropriate measures to mitigate adverse impacts on displaced persons (and on host communities receiving displaced persons) will be carefully planned and implemented.

The project will require land acquisition and resettlement of the 1,068 affected households, resulting in temporary and permanent economic impacts, and restriction of access to livelihood activities. There are potential impacts by both permanent and temporary losses of informal urban small businesses, street trade, aquaculture, and fishing. The current project design proposals for embankments have considered the need to reduce land acquisition and resettlement in densely populated areas, proposing a vertical (as opposed to slope) design solution for embankments in residential and commercial areas. The resettlement and land acquisition impacts have been preliminarily assessed so that framework approach is applied, and a resettlement policy framework was prepared for the project. Site-specific resettlement plan (RP) for each project province which was prepared under OP4.12 will be updated when detailed design is available and complied with ESS5.

ESS6. Biodiversity Conservation and Sustainable Management of Living Natural Resources

ESS6 recognizes that protecting and conserving biodiversity and sustainably managing living natural resources are fundamental to sustainable development. It also recognizes the importance of maintaining core ecological functions of habitats, including forests, riverine, littoral, coastal and marine areas, and the biodiversity they support.

The project will be implemented within the existing waterways along the canals and rivers. The proposed project will not be located within any critical natural habitats and forests. All the canals and rivers are national maritime navigation channel with vessels and barges are frequently navigated through, don't directly of indirectly link to any important/critical habitat or ecosystem. The waterways and surrounding lands that would be within the project footprint have been anthropogenically converted decades ago. Nevertheless, The ESA process has

addressed the adverse impacts on aquatic ecosystems during construction and operation in the project area of influence. The ESIA includes appropriate measures to avoid, mitigate, minimize, or compensate for the disturbance or negative biological impacts through the siting of the works, engineering design or construction practices.

ESS7. Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities

This ESS aims to ensure that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of ethnic minorities (equivalent definition to Indigenous Peoples). ESS7 is also meant to avoid adverse impacts of projects, or when avoidance is not possible, to minimize, mitigate and/or compensate for such impacts.

The Khmer people are present in the project area, and have a long history of collective attachment to the land they occupy (along with a distinct identify, language, and socio-cultural institutions). The social impact assessment conducted for the project included a dedicated module on project impacts on the Khmer people. This module was based on, five consultation exercises, which were implemented in the communes where the Khmer people are residing in the project area. These consultation events formed the basis for the preparation of a project Ethnic Minority Planning Framework (EMPF), as well as site-specific Ethnic Minority Development Plan (EMDP) for province where EM people present. The EMPF has been prepared with the requirements of the World Bank's ESS7. The potential project impacts that may require FPIC include those impacts related to land acquisition and relocation of ethnic minority households, as well as impacts on cultural activities. Specific impacts and FPIC (if required) will be identified and included in the updated EMDP.

ESS8. Cultural Heritage

This ESS recognizes that cultural heritage provides continuity in tangible and intangible forms between the past, present and future. It sets out measures designed to protect cultural heritage throughout the project lifecycle.

The project is not expected to have the significant adverse impacts on important cultural heritage in the project area. The ESIA identifies some temples and pagodas located near the project sites. The ESA process has included survey and consultation with the local cultural and archeological authorities to identify the existence of tangible and intangible heritage within the area of influence of the Project; assessed the extent to which the project interventions may cause impacts to these cultural assets; and proposed appropriate mitigation measures to be included in ESMP for implementation.

ESS10. Stakeholder Engagement and Information Disclosure

This ESS recognizes the importance of open and transparent engagement between the project owner and project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.

Along with the project proponent, direct beneficiaries and project affected people, there are a number of interested parties identified as stakeholders in the analysis conducted as part of the social impact assessment. These include the Provincial People's Committees, District (and Town) People's Committees, Compensation Committees and Land Fund Development Branches of the Districts, Women's Unions and Ethnic Boards of the provinces, Political-Social Organizations (Fatherland Front, Women's Union, Farmers' Union, the Youth Union, the

Elderly Union) as well as Village and hamlet level decision making bodies. During the preparation of the project, stakeholder participation in the design of civil works contributed significantly in adjusting project design to minimize socio-economic impacts, identifying appropriate mitigation measures, and to secure social license to operate, as well as mitigating unexpected impacts caused by construction works to the life of people in the community, especially social and environmental impacts during construction and operation of construction works phases.

A stakeholder engagement plan (SEP) has been developed for the project to ensure transparency and meaningful consultation with the affected and interested parties. Stakeholder engagement and consultations will be conducted throughout the project cycle. The SEP, along with other social and environmental instruments, is subjected to public consultation and disclosure per the requirements of ESS10, and is to be treated as a live document, to be regularly updated during project implementation. The SEP includes a description of a GRM, guiding the reception, recording, handling, and reporting of complaints/grievances that may be encountered during project implementation.

World Bank Group Environmental, Health, and Safety Guidelines[5]

World Bank-financed projects should also take into account the World Bank Group Environmental, Health, and Safety Guidelines (known as the "EHS Guidelines"). The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice.

The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group and are generally considered to be achievable in new facilities at reasonable costs by existing technology. The environmental assessment process may recommend alternative (higher or lower) levels or measures, which, if acceptable to the World Bank, become project- or site-specific requirements. This project should conform to the EHS Guidelines.

1.2.4. Gap analysis between the Government of Vietnam and the WB's ESF

The application of environmental assessment policies in Vietnam, as well as various efforts directed to policy harmonization between the Vietnamese Government and donors, has gradually narrowed the gap between the two systems. However, significant differences remain between the Vietnamese Government's environmental policies and the ESF of the World Bank. These differences and proposed gap filling measures are described in Table 1.6 below.

Detailed gap analysis between the country safeguard framework and the WB ESF including the ESSs is presented in the Country Safeguard Framework Assessment[6] which can be accessed at https://pubdocs.worldbank.org/en/788801595006256885/VN-CSFA-Report-2019.pdf

[5] The EHS Guidelines can be accessed at www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines.
[6] https://pubdocs.worldbank.org/en/788801595006256885/VN-CSFA-Report-2019.pdf

Table 1.6. Summary of the World Bank (WB) ESA and National EIA Processes and proposed gap mitigation for the project

EA Stage	WB	Viet Nam	Gap Filling Measures
Objective	+ The Environmental and Social Framework (ESF) includes 10 Environmental and Social Standards (ESSs) which are designed to assess and manage negative environmental and social (E&S) risks and impacts of projects towards sustainable development.	Law on Environmental Protection and related laws, decrees, standards and regulations on environmental protection. This law is supplemented and supported by the legal system and legal documents related to natural resource management, labor, construction management …… The following comparison focuses on the Law on Environmental Protection (2015 and directives for implementation)	+ The Environmental and Social Framework (ESF) of the World Bank is applied to projects financed by WB
ESA instrument	Tools developed under the ESSs may include: ESMF, ESIA, ESMP, regional & local ESIA; SESA, SIA, RPF, EMPF, RAP, EMDP, LMP, SEP assessing a hazard or a risk; ES audit. + Based on information provided by the Borrower, the World Bank evaluates E&S instruments of proposed projects intended to be financed by WB + The Borrower prepares, submits and discloses the Environmental and Social Commitment Plan (ESCP) and the Stakeholder Engagement Plan (SEP) for the World Bank before appraisal.	+ Environmental and social assessment tools such as SEA, EIA or EPP are decided based on Appendices I and II of Decree 40/2019.	+ ESIA, ESMP, RPF/RPs, EMPF/EMDPs, ESCP, SEP, and LMP meet the ESSs 1, 2, 3, 4, 5, 6, 7, 8 and 10; EIA meets the requirements of the Government of Vietnam.
Scope and clearance	+ The Borrower conduct an Environment and Social Impact Assessment (ESIA) for the project. The level of assessment depends on the level of environmental and social risks of the Project. + If the Borrower and the World Bank propose to apply part or all of the country's environmental and social framework, the WB will evaluate that legal framework to ensure the Project meets the objectives under ESSs (paragraph 20, ESS1) + The Borrower manages environmental and social impacts and risks throughout the entire project cycle, from preparation to construction and operation. + WB reviews the socio-environmental documents before evaluating the project + Mitigation measures are considered in the steps of project	+ Usually, after consulting with the local DONRE or VEA, if the project is listed to require EIA report, the project owner will prepare the EIA report. + Submit preliminary EA with PFS and ESIA report and FS report + There are regulations on labor management and construction management in a number of relevant legal documents but there is no strict regulation on the management of environmental and social requirements in the bidding documents like the World Bank. + There are legal regulations on management of mines and borrow pits. Functional agencies will monitor and inspect environmental compliance (DONRE) and labor (Department of Labor, Invalids and Social Affairs)	+ Preparation of draft versions of the ESIA, RP, ESCP, SEP and LMP for the Project will be in accordance with the ESSs and submitted to the World Bank prior to project appraisal. + Programming and programming EIA DONRE / MONRE with PFS and FS. + Requirements for measures to minimize the

EA Stage	WB	Viet Nam	Gap Filling Measures
	location, design, construction and operation. Contractor and worker management requirements There are environmental and social assessment required for key suppliers		environmental impacts are included in the bidding documents. Supervised throughout the implementation
Public consultation, stakeholder engagement, and grievance redress mechanism (GRM)	+ The Borrower shall consult stakeholders of the project and the ones who are interested in the project. The Borrower shall prepare a Stakeholder Engagement Plan (SEP), including defining stakeholders, consultation, information disclosure, establishment and operations of a GRM. ESS2 also requires the preparation of the labor management procedures (LMP) and the establishment and operation of a GRM for project workers. If ethnic minority is presence and is adversely affected, free, prior, and informed consent (FPIC) is required. Consultation with affected people including vulnerable people throughout project implementation. For informed consents, the Borrower provides relevant project documents in a timely manner prior to consultation in a form and language that are understandable and accessible to the group being consulted. - Minutes of the public meetings are included in the reports.	The project owner consults with the People's Committees of communes, wards or townships (hereinafter referred to as communes) where the project is implemented, with organizations or communities who are directly affected by the project, and with stakeholders about the project's impacts and measures to mitigate the project's social and environmental negative impacts. + The project owner submits the EIA report to the communal People's Committee together with a written request for comments. Within 15 working days from the date of receipt of the EIA, the People's Committees of communes send their responses if they do not approve the project.	+ Consultation in accordance with ESSs. Consultation results shall be included in ESIA, RPF, EMPF, RPs, EMDPs, SEP, LMP and ESCP.
Disclosure	+ WB requires to disclose environmental and social documents at the local authority before project appraisal + WB will make the E&S documents of high-risk and substantial-risk projects available to the public before project appraisal.	+ After the EIA report is approved, the project owner proceeds with the necessary procedures to make the Environmental Management Plan (EMP) public available at the CPC / ward office in the project area, in which consultation of the community is made for people's information, examination and oversight. (Article 16, Decree 40/2019).	+ ESIA RPF, EMPF, RPs, EMDPs, ESCP, SEP, and LMP will be publicly disclosed as per requirements on the relevant ESSs and GoV.
Independent Expert	+ For high risk and complex project, the Borrower may be required to retain independent ESA experts not affiliated with the project to carry out ESA.	+ Project owner shall prepare or contract an institution meeting the conditions provided in Clause 1, Article 13 (Decree 18/2015) to prepare an EIA report. Project owner or consulting service provider must fully meet the following conditions: (i) Having staff members in charge of EIA obtaining at least Bachelor's	+ Risk of the proposed Project risk is substantial and dam safety will not be involved. The Project will not require any

EA Stage	WB	Viet Nam	Gap Filling Measures
		degrees and Certificate in EIA consultancy; (ii) Having specialist staff members related to the project obtaining at least Bachelor's degrees; (iii) Having physical-technical foundations and special-use devices for measuring, taking, processing, and analyzing environmental samples, which meet technical requirements. In case of unavailability of qualified special-use devices, a capable institution should be contracted.	independent experts.
Clearance procedure	World Bank screens and categorizes the project's risks and the documents are reviewed and approved at different levels	+ The Ministry of Natural Resources and Environment shall appraise and approve EIA reports for projects specified in Appendix III to this Decree, except for projects dealing with national defense and security. + Ministries and ministerial-level agencies shall appraise and approve EIA reports for projects falling under their investment approval competence, except for projects in Appendix III to the Decree; + Provincial People's Committees appraise and approve EIA reports for projects in the province, except for projects specified above.	+ WB reviews and clears ESIA, RPF, EMPF, ESCP, SEP and LMP before the project appraisal. In general, the document will be finalized before the end of appraisal. + GOV approves the EIA
Content of ESIA report	According to the ESS, due attention will be given address labor and working conditions as well as community health and safety	EA report should be in line with Circular 25/2019/TT-BTNMT.	+ Structure of the ESIA is consistent with requirement of both WB and GOV.
ESIA supervision	+ During project implementation, the World Bank supervises the implementation of environmental and social commitments in accordance with the approved documents.	The local DONRE is entrusted to supervise the environmental compliance of the project. - By the end of project construction stage, the Environmental Management Agencies will coordinate with Construction Management Agencies to supervise the compliance of environmental management activities stated in EIA.	+ Follow the ESCP and the approved ESIA, RPs, SEP, and LMP of the Project.

1.3. ESIA PREPARATION METHOD

The ESIA was prepared following the national regulations and ESS requirements by combination of the following methods:

Enumeration method: this method is a common method widely applied to determine the study area, sampling site, determine affected area, sensitive receptors that may be affected by project activities in the preparation and construction phases.

Rapid assessment method: Empirical emission factors and factors have been applied to calculate total suspended particles (TSP); predict noise and vibration dispersion over the nearest residential areas; greenhouse gas emissions; solid and toxic waste; For emissions, the Sutton model, was applied to model dust and exhaust emissions as a quick assessment of project activities. Furthermore, WHO rapid inventory sourcing techniques (1993), including the Environmental Assessment Book (Volume II, Sector Guide, Environment, World Bank, Washington DC 8/1991) and Emission handbook, Non-Industrial and Industrial Sources, The Netherlands) were deployed for rapid assessments.

Expert method: This method is developed with knowledge and experience of experts, related to site survey, socio-economic development situation, people's life, cultural and religious resources; natural environment (existing status of baseline environment in terms of air, water and soil quality); regional and local climatic features such as hydrometeorology, geology, geography, topology and landscape; and ecology (flora and fauna characteristics).

Matrix Method: This technique is applied to predict potential impacts caused by project activities. This matrix is established based on the sources of impacts and potential objects affected by the project.

Comparative method: The results of the survey on the natural environment and the laboratory analysis are compared with the national technical regulations on the components of the physical environment to assess the baseline environment in the project area.

GIS mapping method: Using GIS, in collaboration with available maps (such as topographic maps) and special software (such as MapInfo, AutoCAD) to create comprehensive maps for the ESMP process, including: maps of sampling locations to survey flora; map of sampling locations for air quality and surface water quality.

Survey and site visit: Based on existing environmental data and maps (topographic maps, existing land use maps of the project area, etc.), the implementation of on-site measurements, sample taking, surveys and site visits for analyzing the baseline condition (air, water, soil and flora) in the project area were conducted throughout the year in the dry and rainy seasons. The field surveys were conducted to collect primary data and information to meet ESF requirements that ES assessment is based on current information. In addition, “desk review” is also carried out to collect secondary data and information from relevant recent study about baseline conditions.

Sample analysis: All water, air and soil samples, and sediment collected in the field are stored and brought to the laboratory for analysis.

Public consultation: Public consultation is used to help identify opportunities and risks, improve project design and implementation, and increase project ownership and sustainability. Public consultation is specifically required by the World Bank Environmental and Social Framework. Informed consultation will be used. This is a two-way process in which beneficiaries provide advice and input on the design of the proposed project that affects their lives and environment, promoting communication between government, communities and implementing agencies to discuss all aspects of the proposed project. Feedback from the

consultation will be incorporated into the project's ESIA and design. The project's affected people include the displaced people and people in the neighboring communities affected by the project impacts, while the project's envisaged beneficiaries and groups key beneficiaries are local mass organizations, including women's unions, local and central governments, other donors and development agencies, and other stakeholders. Specially, stake-holder engagement was carried out during ES assessment to meet the requirements of ESS10.

Disclosure: Information disclosure including project ES instruments will allow the public to access information on the environmental and social aspects of the project. Information disclosure is mandated by the World Bank's policies and ESS requirements. The project ES instruments will be published nationally and in local languages and at the World Bank's website, which, like all consultations, is an ongoing process during the preparation and monitoring of the project.

Data processing and statistics: All statistical data and documents obtained from local level (Commune, Ward and City level), as well as on-site measurements have been processed and shown in tables, figures and charts for interpretation. This data is systematized over time, adjusted to serve the identification of the natural environment and socio-economic situation; and the analysis of environmental change trends in the project area. These data are very important as a basis for assessing and predicting environmental impacts when implementing the project, as well as recommending corrective measures.

Quantitative methods

The following quantitative methods are expected to be applied:

- **Socio-economic surveys (SES)**: Quantitative surveys are an important methodology will be applied to collect basic information about the socio-economic information at the household level. The information collected from quantitative surveys reflects the scale, frequency, extent, and trends of the phenomena / behavior of the objects that the survey targets. The quantitative survey was conducted by interviewing households using a structured questionnaire. This method requires a sampling strategy to carry out pre- and post-project evaluation of standards. Sample size for SES: The minimum of SES sample size is at least 10% of affected people and 20% of severely affected people.
- **Census and Inventory of lost (IOL)**: The consultant has conducted a census and survey of affected households and inventory of affected assets of 100% of households/organizations affected by land acquisition/land use restriction for project implementation. Collected data will be analyzed and used to update the RP for the provinces. To fully collect information and ensure high accuracy, the surveyors will work together with the affected households and the cadastral official to determine the affected boundary at site. The list of affected households and the scope of the impacts are established based on the overlapping of land acquisition boundaries (provided by the FS consultant) and the cadastral map of the project area provided by the locality. The form of questionnaire for IOL survey will be developed based on the type of the impacts on land acquisitions and affected assets on land.

Qualitative methods

Qualitative methods aim to find information that cannot be covered by the structured questionnaires. The information obtained from the qualitative survey aims to answer the questions: why, how? and delve into the explanation of the phenomena/behaviors that take place. In addition, qualitative information can further exploit the thoughts, opinions, and aspirations of the informants, especially sensitive issues. Qualitative methods to be applied include: (i) focus group discussions; and (ii) in-depth interviews.

- **Focus Group Discussions (FGD)**: The outputs from the FGDs will be collected during the preparation of E&S documents. The participants of the FGDs are representatives of various stakeholders (local authority, local mass organizations, different affected groups, etc.) and they are good information sources on the project's area. Please see more details about the participant and objectives of Focus Groups Discussions in the Table next page.
- **In-depth interviews** will be applied to the subjects who are representatives of the affected households and staff of local authority. The guidance for conducting the in-depth interviews will be developed to guide the discussion in accordance with each specific object.

1.4. LIST OF ESIA PREPARATION AND IMPLEMENTATION STAKEHOLDERS

The ESIA report of the Project is prepared for the Project Management Unit of Waterways. List of the experts joining in preparation of the report is presented in Table 1.7.

Table 1.7. List of Experts Prepared the ESIA

No.	Full name	Qualifications	Responsible for	Signature
I. Project owner's representative				
1.	Duong Thanh Hung	Master of Inland waterway ports	Taking legal responsibility for all contents of the ESIA	
2.	Tran Quoc Bao	Master of Business Administration	Directing and managing the preparation of EIA reports	
3.	Le Dinh Vu	Bachelor of Hydropower and Irrigation resources	Coordinating and monitoring the implementation plan of the EIA report preparation	
4.	Nguyen Thi Thanh	Master of Environmental Technology	Coordinating different stakeholders in the preparation of ESIA	
5.	Vo Thi Hong Phong	Master of Environmental management	Coordinating and monitoring the implementation plan of the EIA report making	
II. Consultant's members				
6.	Bui Thi Thanh Huyen	Master of Environmental Science	Being representative of CEDA consultant firm.	
7.	Dinh Thi Thuy Hang	Master of Environmental Technology	Team Leader	
8.	Phan Vu Loi		Senior Social Development specialist	
9.	Nguyen Hong Quan		Senior Water resources specialist	
10.	Ngo Xuan Quang		Senior Ecological specialist	
11.	Nguyen Tien Dzung		Senior Resettlement specialist	
12.	Hoang Hoa		Senior Gender and Social Inclusion specialist	
13.	Nguyen Thi Thu		Ethnic Minority issues	

CHAPTER 2. PROJECT DESCRIPTION

2.1. PROJECT'S GENERAL INFORMATION

2.1.1. Project name

Southern Waterways Logistics Corridors Project, for which the abbreviation of "SWLC" or "Project" stands in this report.

2.1.2. Project owner

Line agency: ***Ministry of Transport***

Implementing agency: ***Project Management Unit Waterways (PMUW)***

Director: Mr. Duong Thanh Hung

PMUW's office in Hanoi:

Address: 308 Minh Khai Street, Hai Ba Trung District, Ha Noi

Telephone/Fax:(024) 39747633/ (024) 39747634

Email: pmuwhanoi@gmail.com

PMUW's office in Ho Chi Minh City:

Address: 1041/80 Tran Xuan Soan Street, Tan Hung Ward, District 7, Ho Chi Minh

Telephone/Fax: 02837751012

Email: pmuwhanoi@gmail.com

Project Management Unit Waterways under Ministry of Transports responsible to the Client for technical issues of the Project, including: bid and proposal preparation, tender package evaluation and Environmental and Social Impact Assessment (ESIA) report preparation.

2.2. PROJECT OBJECTIVES AND COMPONENTS

2.2.1. Project objectives

2.2.1.1. General objectives

The overall goal of the project is to improve the inland waterway infrastructure system; reduce waterway traffic congestion and accidents; reduce emissions contributing to environmental protection; reduce the transport distance and logistics costs; promote economic development, especially the Mekong Delta region; and increased connectivity for different types of transport. This goal will be realized by renovating and upgrading two transport corridors logistics transport connecting the Mekong Delta region with Ho Chi Minh City and linking the economic triangle area of Ho Chi Minh City-Dong Nai-Binh Duong with Cai Mep-Thi Vai port area, contributing to hunger eradication, poverty reduction, socio-economic development, ensuring border security in localities in the Southeast and Mekong Delta.

The project will be built on the basis of advanced transport technology to improve the quality of transportation, minimize the environmental impact through efficient energy use and accelerate the development of multilateral transport. Furthermore, to ensure the sustainability of investment, the waterway project will combine (i) development of other transport sectors, rural and urban transport networks in particular and (ii) rural development includes irrigation and flood control to effectively adapt and address the problems of climate change and sea level rise.

2.2.1.2. Specific objectives

The objective for the East - West corridor [from Hau river (Can Tho City)→ Tra On river → Mang Thit river → Co Chien river → Cho Lach canal → Tien river → Ky Hon canal; (through Cho Gao canal); Rach La canal → Vam Co river → Nuoc Man canal → Can Giuoc river → Soai Rap river (HCM City)]: Improvement, upgrading to grade II inland waterways with channel width B = 55m for canal, B = 75m for rivers, operating least available depth H = 3.3 m, minimum bend radius R = 320m for canals and R = 450m for rivers, vertical clearance T=7.5m (7m limit) for self-propelled vessel up to 600DWT and 3-layer container vessel navigating 24/24h. Self-propelled vessel up to 1,500DWT using tides at high water level to navigate.

The objective for the North - South Corridor [crossing Dong Nai river (Dong Nai port) → Nha Be river → Long Tau river → Dong Tranh river → Tac Cua river → Go Gia river → Thi Vai river (Cai Mep Thi Vai Port Area)]: Improvement channel with width B=90m, least available depth H=7.0m, minimum bend radius R=450m, clearance T=9.5m for safe and smooth navigation of self-propelled vessel 5,000 DWT, 4-layer container vessel.

Table 2.1. Length and grade of the channel after improvement and upgrading

No.	Waterway	Length (km)	Grade[7]	Waterway	Length (km)	Grade
	East –West Corridor			**North – South Corridor**		
1	Hau River (Can Tho Port)	17	Special[8]	Dong Nai River (Dong Nai Port)	30	Special
2	Tra On River	8.8	2 [9]	Nha Be River	9.3	Marine
3	Mang Thit River	46.4	2	Long Tau River	9.1	Marine
4	Co Chien River	10.2	Special	Dong Tranh River	15.7	Marine
5	Cho Lach Canal	7.9	2	Tac Cua River	6.0	Marine
6	Tien River	31.1	Special	Go Gia River	8.9	Marine
7	Ky Hon River	6.8	2	Thi Vai River (CM TV port area)	3	Marine
8	Cho Gao Canal (*)	11.6	2			
9	Rach La River	10.2	2			
10	Vam Co River	10	Special			
11	Nuoc Man Canal	2	2			
12	Can Giuoc River	9.6	2			
13	Soai Rap River (HCM City)	25.5	Marine			
	Total	**197**			**82**	

Note: (*) Will be implemented in the Upgrading Cho Gao Canal Project (phase 2), but not categorized as associated facility.

2.2.2. Project components

The SWLC Project consists of three components as follows:

Components A: Upgrading East – West Corridor to meet the standard of grade II for inland

[7] IW grade is classified based on TCVN 5664:2009 - Rules for Technical Classification of Inland Waterways.
[8] IW of special grade is the inland waterway part of the transport route that can be effectively exploited for barges over 4x600 tons and inland waterway vessels with a tonnage of over 1,000 tons.
[9] IW of grade 2 is the inland waterway part of the transport route that can be effectively exploited for barges of 4 x 400 tons and 2 x 600 tons and inland waterway vehicles with a tonnage of up to 600 tons.

waterways.

Component B: Renovating the North-South corridor to meet the standard of navigable channels and inland waterways.

Component C: Consultant service, including technical design and construction supervising.

This ESIA will cover Component A and B, aiming at renovating and upgrading the infrastructure of two Southern inland waterways corridor as below:

- East – West corridor: connecting Mekong delta (Can Tho economic center) with HCMC;
- North – South corridor: connecting Binh Duong – Dong Nai – HCMC with Cai Mep – Thi Vai (CMTV) port complex.

The project has started with budget from the Project Preparation Technical Assistance Fund (PPTAF) since October 2016, and was proposed to be invested in the form of 100% state budget allocation using ODA loans of the World Bank; counterpart capital of the Vietnamese Government.

The first EIA report of the project was approved in Decision No. 1328/QD-BTNMT dated April 26, 2018 of the Minister of Natural Resources and Environment. Until now, the project has been adjusted and required updating EIA and ESIA for new approval by MONRE and WB respectively.

2.3. PROJECT LOCATIONS

The Project area is located in the Southern part of Vietnam, including Ho Chi Minh City (HCMC), Long An, Tien Giang, Dong Nai, Ben Tre and Vinh Long provinces. It is bordered by Tra Vinh, Soc Trang, Can Tho and Hau Giang provinces at the south; Dong Thap, Tay Ninh provinces at the west; Binh Duong, Binh Phuoc provinces at the north and Ba Ria Vung Tau and the East Sea at the east. The total project area is approximately 3,000 square km. The population of the whole all Project-related provinces is made up of about in a 50% of urban and 50% of rural population. However, within the Project affected river/canal network, there are no major cities; it contains mostly and it is primary made up of rural population and peri-urban areas (including 5 townships).

The main transport route in the Project area is river system of Tien River; with the Hau River (Bassac River) connecting to Soai Rap River; Dong Nai River via Cho Gao Canal. The Project area is divided into two distinct geographical settings: the Mekong Delta region (the East – West[10] corridor) and the greater HCMC region (Dong Nai and Ho Chi Minh City in the North – South [11] corridor).

[10] East-West Corridor: waterway connecting Can Tho port to Ho Chi Minh city from: Hau river (Can Tho city) → Tra On river → Mang Thit river → Co Chien river → Cho Lach canal → Tien river → Rach Ky Hon; (via Cho Gao channel); Rach La → Vam Co river → Nuoc Man canal → Can Giuoc river → Soai Rap river (Ho Chi Minh City), the entire length of the East-West corridor is 197 km.

[11] North - South Corridor: waterway connecting Dong Nai port to Cai Mep Thi Vai port cluster from: Dong Nai river (Dong Nai port) → Nha Be river → Long Tau river → Dong Tranh river → Tac Cua river → river Go Gia → Thi Vai river (Cai Mep-Thi Vai port cluster), the entire length of the North - South corridor is 82 km.

Source: Pre-FS, 2021

Figure 2.1. SWLC project locations

The control coordinates of the project according to each canal route are summarized in detail in the following table:

Table 2.2. The control coordinates of the project on each waterway

No	Waterways	Scope	Coordinates	Administrative boundaries
I	**East – West corridor**			
1	Mang Thit river	- Starting point: Tra On town, Tra On district, Vinh Long (near Tra On bridge). - End point: Chanh An commune, Mang Thit district, Vinh Long province and Quoi An commune, Vung Liem district, Vinh Long province.	X (m) 1101933.225 Y(m) 600446.239 X (m) 1123786.232 Y(m) 628049.811	- The length of the canal is 46.4km. - The route passes through administrative areas such as: + Centers of Tra On, Thien My, Nhon Binh and Xuan Hiep, Tra On and Vinh Long districts; + Loan My commune, Tuong Loc, Tam Binh town, Tam Binh district, Vinh Long. + Tan An Luong commune, Vung Liem district, Vinh Long; Tan Long Hoi commune, Mang Thit district, Vinh Long.
2	Cho Lach river	- Starting point: Hoa Nghia commune, Cho Lach district, Ben Tre.	X (m) 1154290.979 Y(m)	- The canal route is 7.9km long. - The route passes through administrative areas such as: Hoa

No	Waterways	Scope	Coordinates	Administrative boundaries
		- End point: Cho Lach town, Cho Lach district, Ben Tre.	591793.259 X (m) 1152506.181 Y(m) 586103.298	Nghia commune, Son Dinh commune, Cho Lach town, Cho Lach district, Ben Tre.
3	Ky Hon canal	- Starting point: Xuan Dong commune, Cho Gao district, Tien Giang - End point: Long Binh Dien commune and Cho Gao town, Cho Gao district, Tien Giang	X (m) 1101933.225 Y(m) 600446.239 X (m) 1123786.232 Y(m) 628049.811	- The canal route is 6.8km long. - The route passes through administrative areas such as: Long Binh Dien commune, Xuan Dong commune and Cho Gao town, Cho Gao district, Tien Giang province.
5	Rach La canal	- Starting point and ending point: Thanh Vinh Dong commune, Chau Thanh district, Long An and Dong Son commune, Go Cong Tay district, Tien Giang	X (m) 1154259.728 Y(m) 673712.363 X (m) 1123786.232 Y(m) 628049.811	- The length of the canal is about 10.2km. - The route passes through administrative areas such as: + Thanh Vinh Dong commune, Chau Thanh district, Long An. + Dong Son commune, Go Cong Tay district, Tien Giang.
6	Nuoc Man canal – Can Giuoc river	- Starting point: Long Huu Tay commune, Can Giuoc district, Long An. - End point: Soai Rap estuary, Can Giuoc district, Long An.	X (m) 1159459.633 Y(m) 681344.843 X (m) 1162433.428 Y(m) 689369.292	- The length of the canal is 11.6km. Only install buoys and navigational signals. - The route crosses the territory of Long Huu Tay commune, Can Giuoc district, Long An province.
II	**North – South corridor**			
7	Tac Cua river	Starting point: Thanh An commune, Can Gio district, HCMC End point: Phuoc An commune, Nhon Trach district, Dong Nai	X (m) 1172475.251 Y(m) 711784.975 X (m) 1170289.633 Y(m) 716608.813	- The length of the river route is about 6.0km. - The route passes through the following administrative areas: + Thanh An commune, Can Gio district, HCMC. + Phuoc An commune, Nhon Trach district, Dong Nai.

The relative positions of waterways on the East-West Corridor and the North-South Corridor are shown in the following figures:

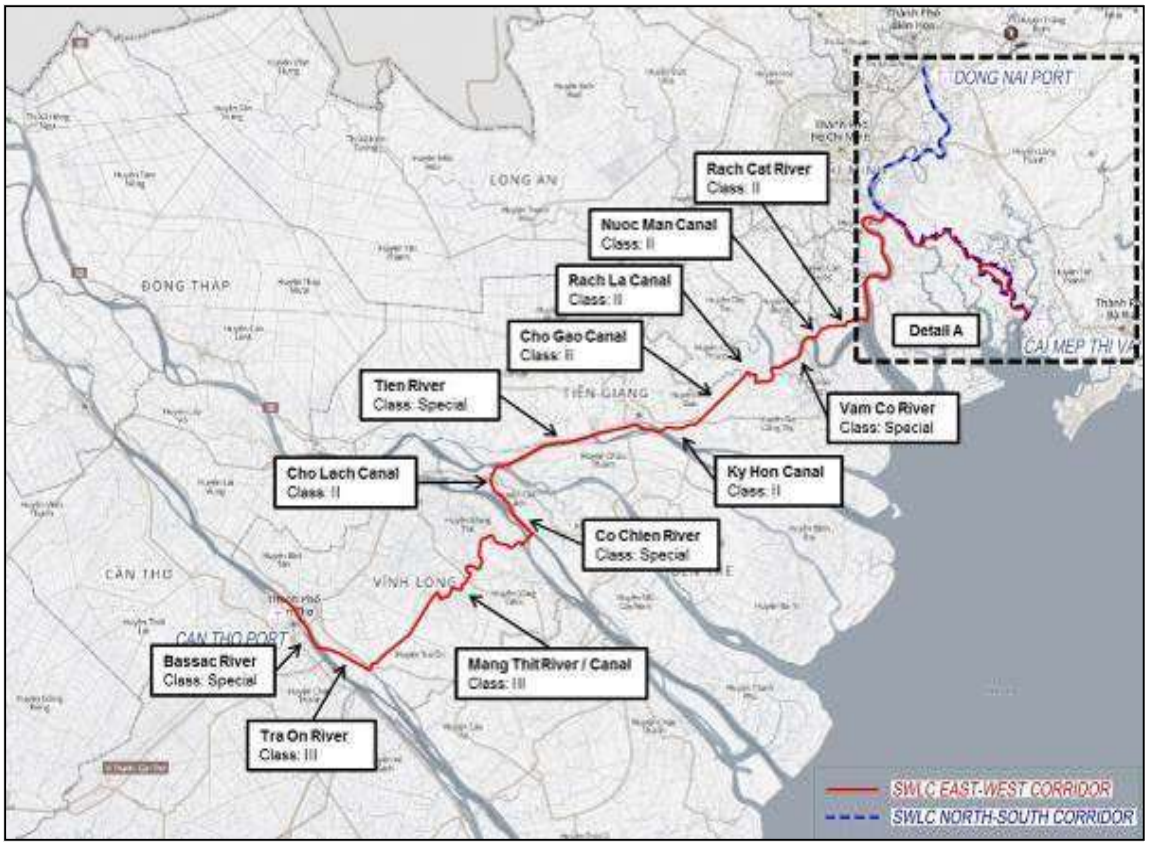


Figure 2.2. Locations of waterways on East - West corridor

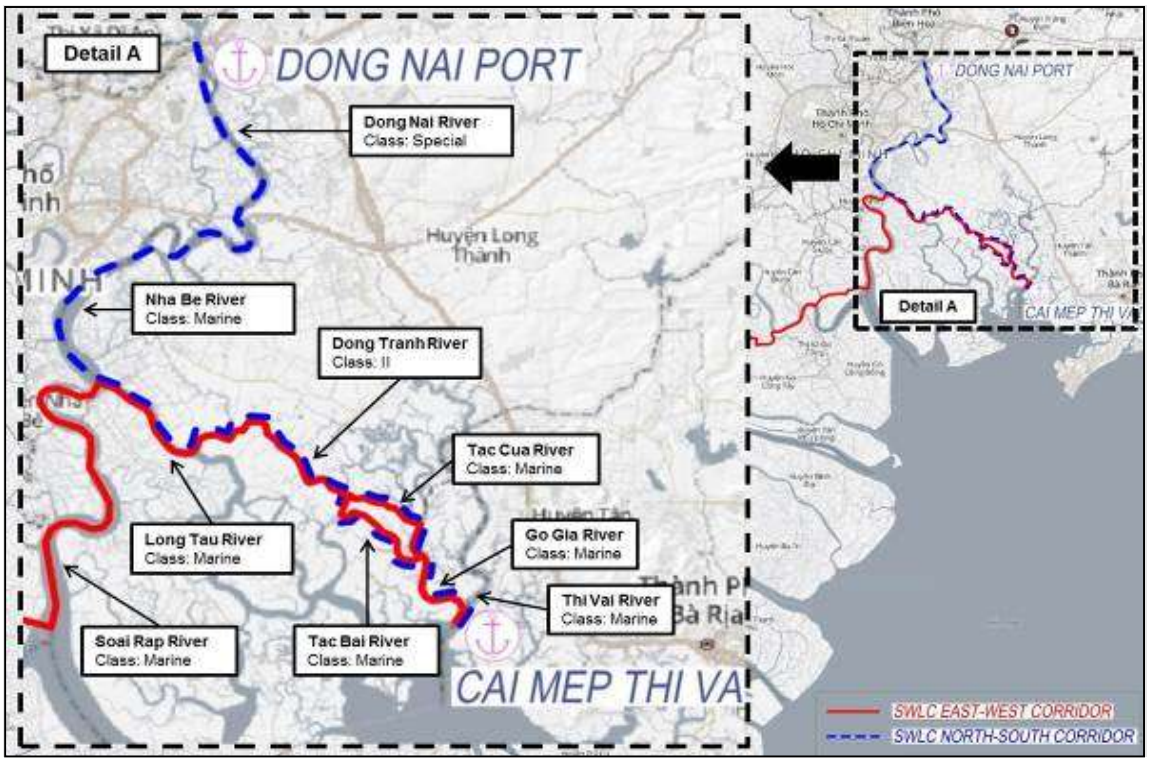


Figure 2.3. Locations of waterways on North - South corridor

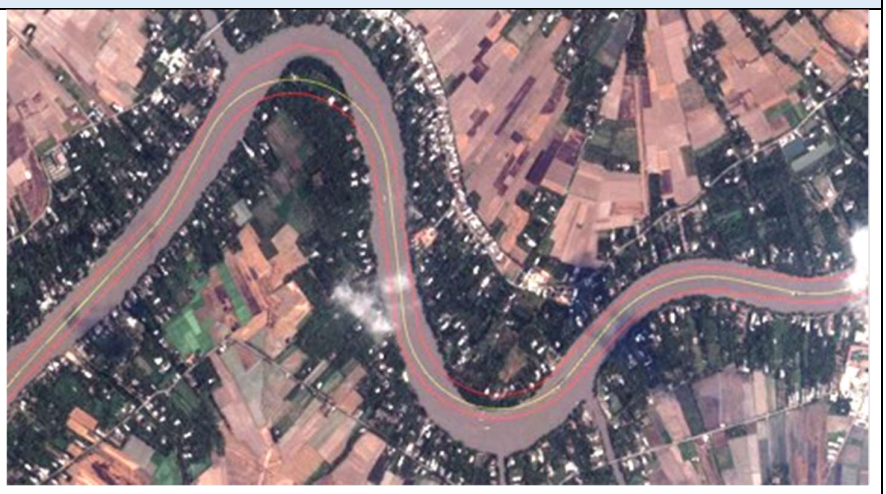
The project does not stretch continuously on the whole waterway corridors, within the scope of

project as well as scope of ESIA report, the correlation with natural, socio-economic objects is carried out for each section of the waterway as summarized in Table 2.3.

Table 2.3. The current status of segments on the corridors under SWLC project

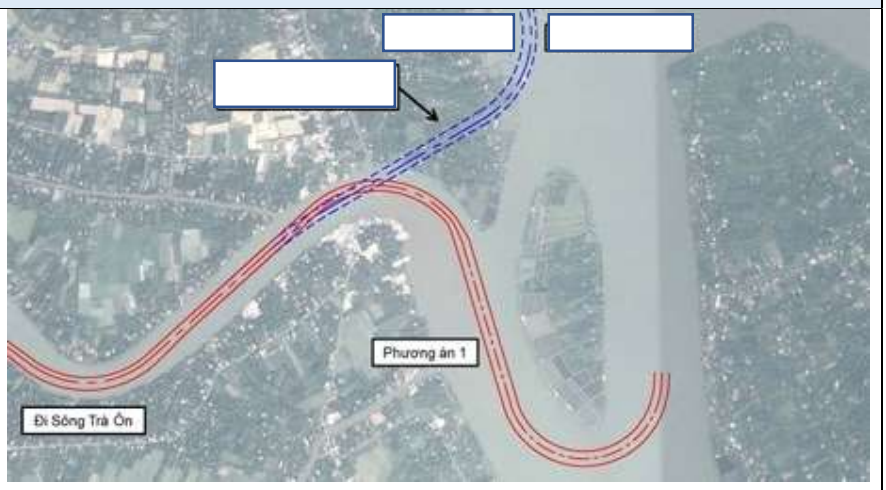
Location	Characteristics of the current status of natural - socio-economic objects in relation to the project
1. Mang Thit River	
Section 01 Km0 - Km2+500 (Mang Thit River)	 **Current Status** - The area is relatively flat, the average width of the river is about 100 m with the width of the channel about 80 m and the water depth ranging from 8 m to 12 m. - The river section passes through Tra On town, the densely populated area is located on the right bank of the river with the town market located on the riverbank. Along both sides of the river, there is a ferry landing stage (at the beginning of the route), a gas station and a building material yard. - National historical site of Phuoc Hau pagoda is located 500 m from the beginning of the Mang Thit river route to the west. + Tra On Protestant Church and Nhi My Pagoda (right photo) are located along the river. **Project activities:** + The bend correction combined with embankment at one (01) position from Km0+900 (blue line with image of projected area - left photo above).

Location	Characteristics of the current status of natural - socio-economic objects in relation to the project
Section 02 Km9+00 - Km17+00 (Mang Thit River)	 **Current Status:** + This section is 8 km long, relatively flat, the average width of the river is about 75 m with the width of the channel about 55 m and the water depth ranging from 3.5 m to 10 m. The shallowest section in Tam Binh town area has an average depth of only 3 - 5 m. + The concentrated residential area of Tam Binh town is mainly located on the left bank of the river, near the middle of zone 03. The river section passing through the town has many houses, offices, and gas stations located on both sides of the river. Tam Binh town market is located right on the riverbank at the intersection with canal 3/2. Along both sides of the river outside the town is an area of orchards, mainly oranges, grapes, and rice fields. Provincial road 904 gradually separates from the river bank on the left and intersects with provincial road 905 at the entry point of Tam Binh town. There are several companies, shipyards, barges, 2 ferry landing stages and 4 river wharfs at this section. + The points to pay attention to marked by the number on the photo are: (1) Tuong Loc commune domestic water supply station; (2) Tam Binh Market is located along the riverside; (3) Protestant Church in Tam Binh town area. **Project activities:** + The project will dredge some sections. + The embankment is expected to follow the light blue line in this section.

Location	Characteristics of the current status of natural - socio-economic objects in relation to the project
Section 03 Km17+00 - Km19+500 (Mang Thit River)	 **- Current Status:** + This section is 2.5 km long, the river meanders with many bends, the average width of the river is about 110 m, the width of the channel is about 80 m and the water depth ranges from 4 m to 7 m. + Along both sides of the river are residential areas of Hoa Hiep commune, Tam Binh district and Xuan Hiep commune, Tra On district. Along the two banks of the river, in addition to the residential areas, there is an area of 3 crops of rice. Provincial road 901 starts running along the banks of Mang Thit river from the end of the section at the center of Xuan Hiep commune. There are several gas stations, 3 wharfs, and ferries on the river at this section. + The points to pay attention are: (1) Hoi Trinh ferry; (2) Communal house at hamlet 10 - Hoa Hiep; (3) Hoa Hiep Commune Water Supply Plant; (4) Ong Muoi gas station; (5) An Lac Pagoda; (6) Ba Dien ferry; (7) Xuan Hiep Commune Water Plant; (8) Xuan Hiep Church; (9) Cao Dai Tien Thien Holy Family; and (10) Thien Buu Tu Pagoda. In which, points (1), (4), (5), (6) and Hoa Hiep kindergarten and primary school which are expected to have to relocate or lose land due to the implementation of the Project, especially score (5) An Lac pagoda currently has more than 1000 Buddhists. **Project activities:** + The project will conduct tracing and straightening at this section (marked in blue) in the territory of Xuan Hiep commune, Tra On district. + Embankment at the bend correction at two (02) positions.

Location	Characteristics of the current status of natural - socio-economic objects in relation to the project
Section 04 Km19+500 to Km24+500 (Mang Thit River)	 **Current Status:** + This section is 5 km long, the river meanders with 2 bends, the average width of the river is about 130 m, the width of the channel is about 100 m and the water depth ranges from 5 m to 12 m. + Along both banks of the river are residential areas of Hoa Hiep and Hoa Thanh communes, Tam Binh district and Xuan Hiep commune, Tra On district. Along the two banks of the river, in addition to the residential areas, there is an area of 3 crops of rice. Provincial road 901 runs along the right bank of the Mang Thit River. There are a number of large business establishments located on both sides of the river in this area. + The points to pay attention to marked by number on the image that are likely to be affected in terms of area during project implementation are: (1) Phuoc An Pagoda; (2) Thien Ngoc Enterprise; (3) Tra On Food Enterprise; (4) The domestic water plant in Hoa Thanh commune. **Project activities:** The project will conduct bend correction at one (01) position and build local roads section by section in the territory of Xuan Hiep and Hoa Hiep communes, Tra On district and Tan An Luong commune, Vung Liem district.

Location	Characteristics of the current status of natural - socio-economic objects in relation to the project
Section 05 Km24+500 to Km31+500 (Mang Thit River)	 **Current Status:** + This section is 7 km long, the river meanders with many bends, the average width of the river is about 150 m, the width of the channel is about 90 m and the water depth ranges from 5 m to 9 m. + Along both sides of the river are residential areas of Tan Long Hoi commune, Mang Thit district and Tan An Luong commune, Vung Liem district. The central residential area of Tan An Luong commune is located on the right bank of the river, along National Highway 53. The Mang Thit bridge crosses the river on the National Highway 52 axis. Along the riverbanks, in addition to the residential areas, is an area of rice cultivation, pig farms and raising catfish Provincial road 901 runs along the right bank of the Mang Thit River. There are a number of gas stations, facilities selling construction materials, agricultural supplies, milling, shipbuilding, coir factories and some schools located on both sides of the river in this section. + The points that may be affected by the implementation of the Project are: (1) Cao Dai Temple of Tan Long Hoi; (2) Phat Quang Pagoda; (3) Tan Long Hoi communal house; (4) Tan Long Hoi Water Plant; (5) Areas frequently subject to major landslides; (6) Chau Van Tiep Communal House; (7) Nguyen clan Chi tomb (since 1926); (8) Cao Dai Temple Thanh Long Palace (9) Temple of God Hoi Long; (10) Cao Dai Holy Family Thuong Linh Dan; (11) Tan An Luong biofuel factory; and (12) The 220kv power transmission line crosses the Mang Thit River. **Project activities:** + Bend correction at one (01) position.

Location	Characteristics of the current status of natural - socio-economic objects in relation to the project
Section 06 Km31+500 to the end of route Km46+486 (Mang Thit river)	 **Current Status:** + The area is relatively flat, the average width of the river is about 160 m with the width of the channel about 10 m and the water depth ranging from 5 m to 12 m. + Cai Nhum town is located on the left bank of the river, near the intersection with Duong Trom river. In addition to the town area, along both sides of the river are rice cultivation areas and fruit trees. Provincial road 901 runs along the right bank of the river to the end of the route. Provincial road 903 runs along the river for a section of Cai Nhum town. There are a number of brick kilns, Tan Quoi hamlet market, Cai Nhum market, gas station, 1 wharf and 2 ferry landing stages in which Mang Thit ferry is a large ferry, located at the end of the river, the section that empties into the Co Chien River. + The points to pay attention to marked by the number on the photo are: (1) Tan An Hoi domestic water plant; (2) Lady Chua Xu Temple; (3) Phan Chanh Hoi Temple and Phuoc Hai Vihara (under construction); (4) Domestic water plant in Cai Nhum town and Cai Nhum market; (5) Ong Bon pagoda; (6) Vinh Lac pagoda; (7) An Phuoc Pagoda; and (8) old Catholic churches. **Project activities:** The project will only install navigation aids at the mouth of the Mang Thit river that flows into the Co Chien river following the selected option in red line.
2. Cho Lach canal	

Location	Characteristics of the current status of natural - socio-economic objects in relation to the project
Section 07 Km0+00 to the end of route Km7+900 (Cho Lach canal)	 **- Current Status:** + Cho Lach canal is narrow with an average width of about 70m and water depth ranging from nearly 4m to 5m. + The middle area of the canal is Cho Lach town with many connecting routes. Currently, there are 2 old and new Cho Lach bridges crossing the canal, in which the old Cho Lach bridge is an iron bridge (not allowing cars and three- and four-wheeled vehicles to cross the bridge) to serve the people of the town. Along the canal there are a number of petrol stations, establishments selling agricultural products and Cho Lach market is located along the river on the right-hand side. The areas along the canals of Son Dinh and Hoa Nghia communes are mainly for planting fruit trees and some catfish farming areas (Hoa Nghia commune). + The points to pay attention to marked by the number on the photo are: (1) New Cho Lach Bridge; (2) Old Cho Lach Bridge (to be replaced); (3) Damaged embankment along Cho Lach canal; (4) Cho Lach Evangelical Church; (5) Cho Lach Cathedral; (6) Holy Cao Dai An Tien. **Project activities:** + Dredging and embanking some sections; + Build a new Cho Lach 2 bridge to replace the current old Cho Lach bridge.
3. Kỳ Hon canal	
Section 08	Ky Hon canal is narrow with an average width of about 70m and water depth

Location	Characteristics of the current status of natural - socio-economic objects in relation to the project
Km20+300 Km26+969	ranging from nearly 4m to 5m. + The location of the bend correction is in Cho Gao district, Tien Giang province. The bend correction section is flat, and mostly is paddy field or land with small bushes or grass. **Project activities:** The project will conduct bend correction at one (01) positions.
4. Rach La canal	
Section 09 **Km5+000 – Km8+600** Rach La canal	 **Current Status:** + Rach La canal is about 10.2km long, connecting Cho Gao canal with Vam Co river. This section of the canal is on average 110 m wide with a channel width of about 60 m. Water depth ranges from nearly 4 m to 5 m. + The location of the bend correction is the boundary between two communes: Thanh Vinh Dong, Chau Thanh district, Long An province and Dong Son commune, Go Cong Tay district, Tien Giang province. Near the beginning of the 1st section of the tarpaulin section is the Thanh Vinh Dong ferry, located on provincial road 827, connecting the center of Thanh Vinh Dong and Dong Son communes. + Currently, the bend correction location is mainly rice and aquaculture land. **Project activities:** The project will conduct bend correction at two (02) positions.
5. Tac Cua river	

Location	Characteristics of the current status of natural - socio-economic objects in relation to the project
Section 10 **Km0+200 – Km4+800** **Tac Cua river**	 **Current Status:** The river in this area is about 220m wide on average with a channel width of about 110m. The water depth ranges from nearly 4 m to more than 10 m. **Project activities:** The project will carry out bend correction at two (02) sections.

2.4. SCOPE OF WORKS

2.4.1. Main items of the project

2.4.1.1. Project's main work items and auxiliary works

The SWLC project is expected to perform the work divided into main work items and auxiliary work items, which are specifically listed as follows:

Main work items

- Dredging and bend correction: reaching grade II inland waterways on routes: Mang Thit, Cho Lach, Ky Hon, Rach La canals in the East-West corridor and Tac Cua river in the North – South corridor.

- Embankment: in some sections on Mang Thit rivers, Cho Lach canal and Rach La canal (on East-West corridor).

- Bridge construction: build one new Cho Lach bridge to replace the old one.

Auxiliary works

- Local roads: Return 7,122 km of local roads at 23 segments in the East-West corridor.

- Irrigation sluices: Return 80 irrigation sluices.

- Navigational aids: Install additional boys and signs to improve traffic safety.

The overall items of the project are summarized in the following table.

Table 2.4. Total civil work packages under SWLC project

Target sections	Volume of dredging *(m^3)*	Length of embankment *(m)*	Number of bridges	Length of local road *(m)*	Number of irrigation and drainage outlets	Installment of navigation aids
Component 1: East-West Corridor						
Tra On	-	-	-	-	-	Yes
Mang Thit	2.355.000	13.154	-	4.566	45	Yes
Cho Lach	1.240.000	8.770	1	1.496	29	Yes
Ky Hon	50.000					
Rach La	614.510	1.060	-	1.060	6	-
Nuoc Man, Can Giuoc	-	-	-	-	-	Yes
Component 2: North-South Corridor						
Tac Cua	256.000	-		-	-	-
Total	**4.515.510**	**22.984**	**1**	**7.122**	**80**	**4 locations**

Source: Pre-FS, 2021

10 ferry landing stages on Mang Thit river will be rebuilt based on private budget of their local owners after receiving compensation and as per their own schedule.

Based on the current constraints for navigation and other activities in the project area, the improvement constructions for SWLC East – West and North – South Corridors have been proposed as follows:

Table 2.5. Improvement constructions for each waterway

No	Waterway	Work items
I	**East – West corridor**	
1	Mang Thit river	**Dredging** - Dredging position: 10 sections with a length of 13.3 Km, specifically: Km0+070 - Km0+300, Km0+700 - Km1+100, Km9+470 - Km17+200, Km19+400 - Km 19+800, Km19+950 - Km 20+400, Km21+660 - Km22+150, Km23+400 - Km24+00, Km24+100 - Km24+550, Km26+700 - Km27+050, Km27+250 - Km28+000. - Curved cutting position: 1 position from Km17+600 - Km18+600 - Total volume: 2,355,000 m^3 **Embankment** - Embankment locations: 17 locations, specifically at km 00+600 - km 01+100, km 09+600 - km 13+200, KM 09+400 - km 09+800, km 13+200 - km 13+400, km 13+200 - km 14+600, km 14+600 - km 15+200, km 14+600 - km 17+000, km 15+200 - km 15+600, km 15+600 - km 17+200, km 17+400 - km 18+800, km 17+400 - km 18+600, km 19+400 - km 19+800, km 20+200 - km 20+400, km 20+600 - km 22+000, km 23+500 - km 24+000, km 24+000 - km 24+600, km 26+400 - km 27+200). - Length of embankment: 13,154 m. In which: Embankment of grade 2A: 600 m long; embankment of grade 2B: 14,338 m long. **Installation of buoys and signs**: additional. **Local Road** - Locations: 13 locations, specifically at MT-a-0+000, Km0+660-Km1+071, Km13+400-Km13+476, Km14+020-Km14+100, Km15+834-Km16+430, Km17+000-Km17+180, Km17+400-Km17+889, Km17+625-Km18+614, Km19+440- Km19+685, Km19+975-Km20+244, Km21+720-Km21+968, Km23+ 525-Km23+826, Km24+120-Km24+466. - Total volume of local roads: 4,566 m on both sides of the river/canal; - All construction grade B2. **Irrigation sluices**: 45 sluices will be returned, in which: 25 round culverts of D60 reinforced concrete and 20 round culverts of D40 reinforced concrete.
2	Cho Lach canal	**Dredging** - Dredging location: Dredging the entire canal route from Km0+00 - Km7+910. - Dredging length: 7,910 m. - Total volume: 1,240,000 m^3 **Embankment** - Embankment locations: 10 locations including: km 0+500 - km 0+700, km 2+300 - km 4+800, km 4+800 - km 6+770, km 6+770 - km 7+800 , km 2+000 - km 3+000, km 3+000 - km 3+400, km 3+400 - km 3+800, km 5+500 - km

No	Waterway	Work items
		5+900, km 5+900 - km 6+770 , km 6+770 - km 7+850 - Length of embankment: 8,770 m. In which, embankment of grade 2: length 3,345 m; embankment of grade 3: 1,045 m long; embankment of grade 4: length 4,380 m **Building a new bridge**: replacing the old Cho Lach bridge (Cho Lach 2 bridge in the area of Cho Lach town and Son Dinh commune, Cho Lach district, Ben Tre) with a cable-stayed suspension bridge with a total length of 372.56 m; bridge width: 6.5 m. The construction site coincides with the old bridge location. **Installation of buoys and signs**: additional. **Returning local roads** - Locations: 6 locations including: Km0+480-Km0+659, Km2+015-Km2+410, Km5+400-Km5+500, Km5+500-Km5+860, Km5+720 - Km6+000, Km6+000-6+200 - Total volume of local roads: 1,496 m; in which type A is 884 m; Type B1 is 551 m. **Return of irrigation culverts**: 29 culverts, of which: 1 reinforced concrete box culvert 2x200x300; 4 round culverts of D100 reinforced concrete; 4 round culverts of reinforced concrete D80; 7 D60 reinforced concrete round culverts and 13 D40 reinforced concrete round culverts.
3.	Ky Hon canal	**Dredging** - Dredging location: 1 position Km20+300 Km26+969. - Dredging length 3.7 Km - Total volume: 50,000 m^3
4.	Rach La canal	**Dredging** - Dredging location: 2 locations (Km5+000 - Km6+200 and Km7+400 Km8+600). - Dredging length:2.4 Km - Bend correction: 2 positions (Km5+200 - Km6+000 and Km7+400 - Km8+400). - Total volume: 614,510 m^3 **Embankment** - Embankment locations: 5 locations including: km 5+200 - km 6+200; km 5+200 - km 6+200; km 6+200 - km 6+600; km 7+600 - km 8+200; km 7+400 - km 8+600 - Length of embankment: 1,060 m. In which: embankment type 2A: 830 m long and embankment type 2B 3043 m long. **Returning local roads:** - Number of locations: 2 locations: km 5+230 – km 5+912, km 7+570 – km 8+421. - Total length of local roads: 1,060 m. All are grade B2. **Irrigation culverts:** 6 culverts will be returned, in which: 1 reinforced concrete box culvert 2x120; 5 round culverts of reinforced concrete D40 **Installation of buoys and signs**: additional.
II	**North – South corridor**	

No	Waterway	Work items
5	Tac Cua river	**Dredging** - Dredging locations: 5 locations (Km0+200 – Km0+600, Km0+900 – Km1+250, Km2+400 – Km2+800, Km2+900-3+300, Km4+400 – Km4+800). - Dredging length: 1.7 Km. - Total volume: 256,000 m^3

2.4.1.2. Scope of investment

- East-West Corridor: To renovate and upgrade to grade II IWT technology for self-propelled ships up to 600T, 3-class container ships usually for convenient and safe circulation; Self-propelled ships up to 1,500T take advantage of high tides to circulate. According to standard 12910:2020 Inland waterway channels - Design requirements and TCVN 5664:2009 - Technical classification of inland waterways, the East - West corridor has the following parameters:

+ Channel width B=55 m for canal, B=75 m for river; running depth H=3.3 m, dredging depth (including backup between 2 maintenance periods) H0=3.77 m.

+ Bend radius: Ensure the minimum radius of curvature is 320 m for canals and minimum 450 m for rivers.

+ Vertical and horizontal clearance: The width of the navigable compartment for the bridge crossing the canal is 50 m and the river crossing is 60 m; bridge headroom 7.5m (7m limit).

- North - South Corridor: To improve the channel for self-propelled ships up to 5,000T and 4-deck container ships for convenient and safe circulation. According to standard 12910:2020 Inland waterway channel - Design requirements and Standard TCVN 5664:2009 - Technical classification of inland waterways, the North - South corridor has the following parameters:

+ Width of stream B=90 m; running depth H=7.0 m, dredging depth (including backup between 2 maintenance periods) H0=7.44 m.

+ Bend radius: Ensure the minimum radius of curvature reaches 450 m.

+ Vertical and horizontal clearance: The width of the navigable space for the bridge crossing the canal is 75 m and the river crossing is 120 m; bridge headroom Htt=9.5 m.

The technical specifications of two corridors are shown in Tbale 2.6.

Table 2.6. Technical specifications of each corridor

Corridor	Width (m)		Navigable depth (m)	Bend radius (m)		Horizontal clearance (m)		Vertical clearance (m)
	Canal	River		Canal	River	Canal	River	
East – West	55	75	H=3,3	320	420	50	60	7
North – South	-	90	H=7,0	-	450	75	120	9,5

2.4.2. Dredging works

Dredging is necessary for the East - West and North - South corridors of the SWLC project to meet the requirements for safe and convenient navigation of ships. The channels need to be widened, deepened and corrected in some positions.

Based on topographic survey results collected from Egis research documents in 2017, the

Consultant calculated the dredging quantity of improved and upgraded river/canal routes. The consultant reviewed the Egis Consultant's 2017 Mathematical Modeling Research Report to evaluate the use of topographic survey results. The research report on mathematical model confirmed that the sedimentation level on the river/canal routes is not significant even after improving and upgrading. The actual observation results in 2020 also show that the degree of canal bank erosion does not alter the quantity calculation results significantly.

Referring to the results of the topographic survey in 2021 for Cho Gao canal route in Upgrading the Cho Gao canal route project (Phase 2), - the canal route with high sedimentation potential due to the water border between the Tien River and the Vam Co River, the sedimentation quantity in 2021 compared with the topographic survey results in 2016 is 23,040m^3/739.909m^3=0.031 (equivalent to an increase of 3.1% < 10% of the calculated back up quantity for this period).

Therefore, at the stage of preparing the technical report, the use of topographic survey data in 2017 to calculate the quantity is acceptable and still within the allowable limit. In addition, the Vietnam Maritime Administration is currently preparing to implement the project of socializing dredging, maintaining and upgrading Dong Tranh river channel with the dredging of the channel for 5000T ships to travel; that is why project SWLC dredging quantity is only calculated for the quantity of bend correction that meets SWLC project standards, but not channel bottom dredging quantity. On the basis of topographic survey parameters, standard dimensions of the design flow, the Consultant has determined the project's centerline and at the same time preliminarily calculated the required dredging quantity in the next figures.

The estimated dredging workload and main components of dredged materials are listed in Table 2.7.

Table 2.7. Estimated dredging workload and components of dredged material

No	Waterway	Quantity [m^3]	Main components of dredged material
East – West Corridor			
1	Mang Thit River	2,355,000	Dark gray clay, from elastic to flowing state
2	Cho Lach Canal	1,240,000	Highly elastic clay, dark gray, blue gray, flowing state
3	Ky Hon Canal	50,000	Clay – mixed clay, brown gray – brown – dark yellow, yellowish gray – gray – blue gray, soft and elastic
4	Rach La Canal	614,510	
North – South Corridor			
5	Tac Cua River	256,000	Highly elastic clay, dark gray, flowing state
Total		**4,515,510**	

Source: Pre-FS, 2021

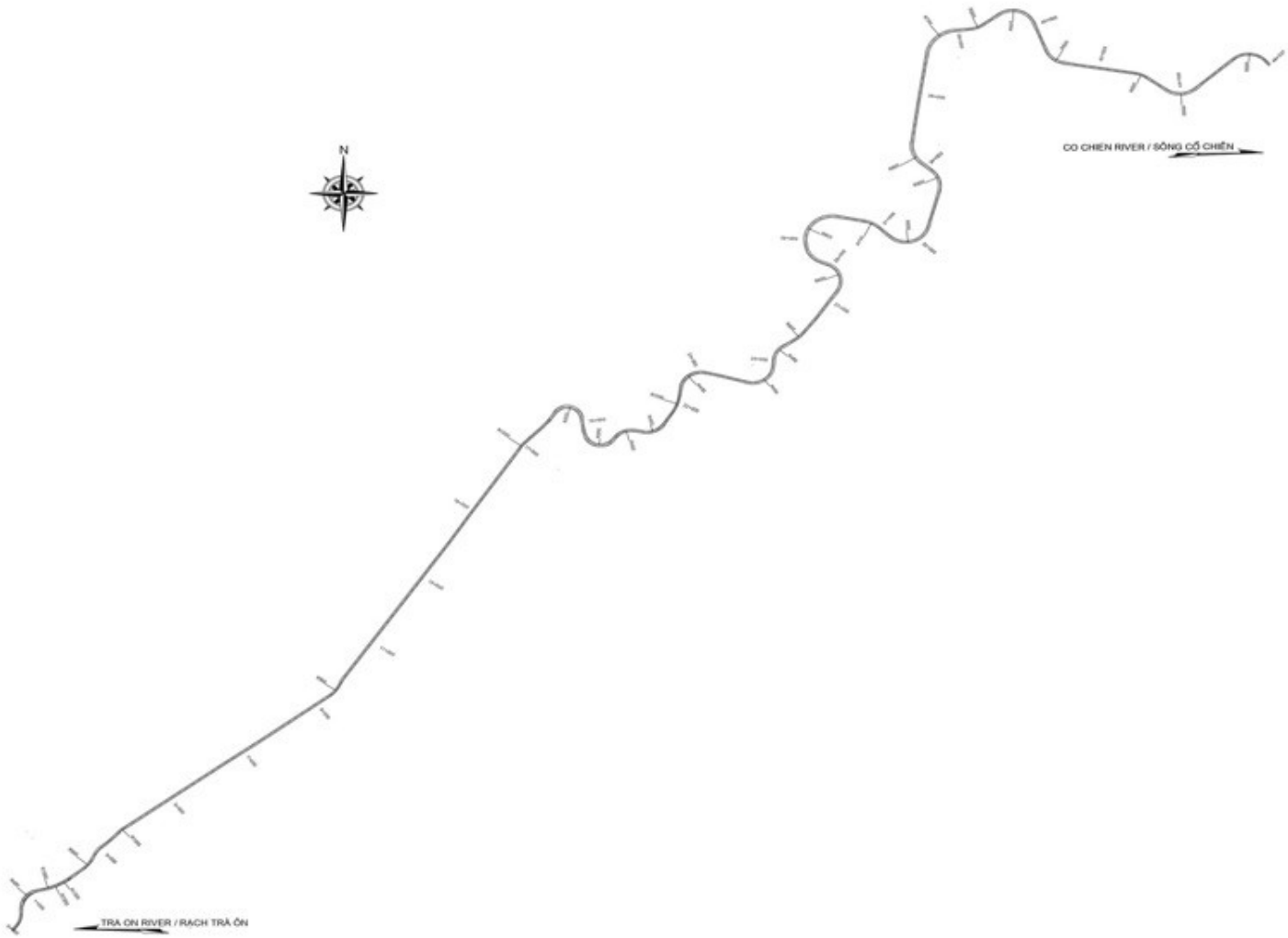


Figure 2.1. The dredged alignment center of Mang Thit river

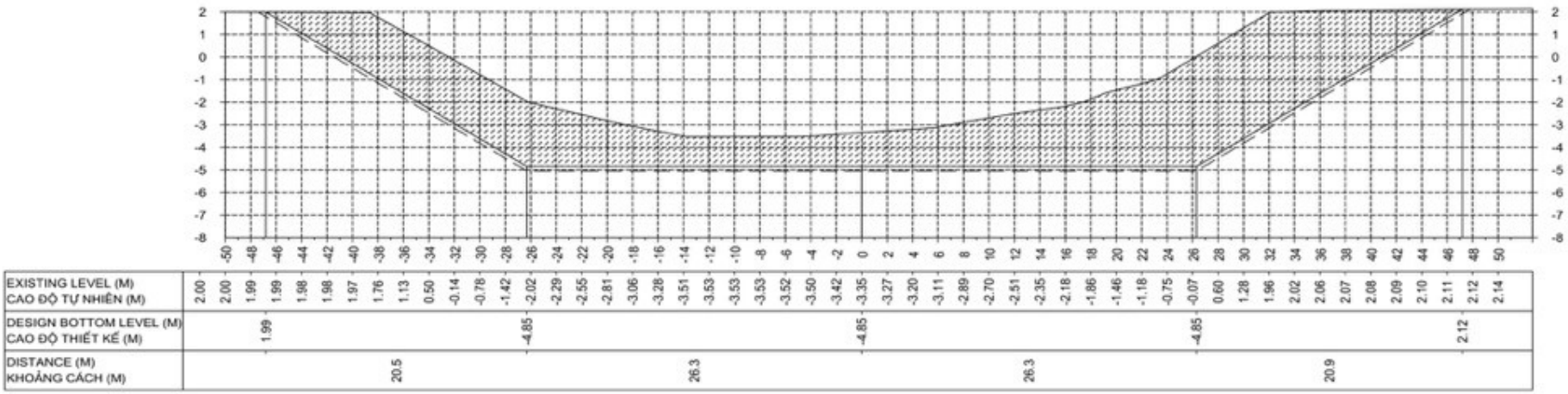


Figure 2.2. Typical dredging cross section of Mang Thit river (straight segment)

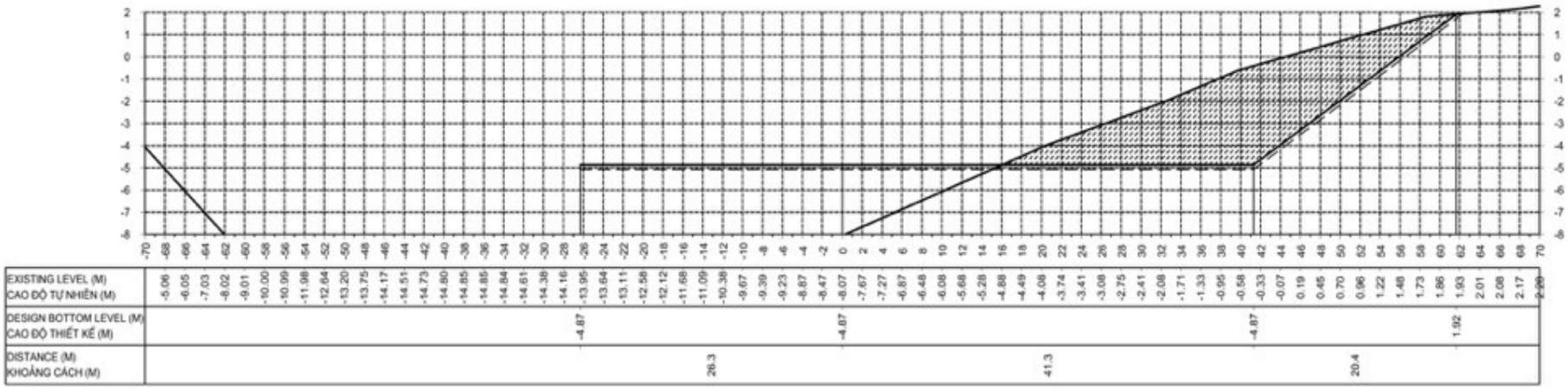


Figure 2.3. Typical dredging cross section of Mang Thit river (curved segment)

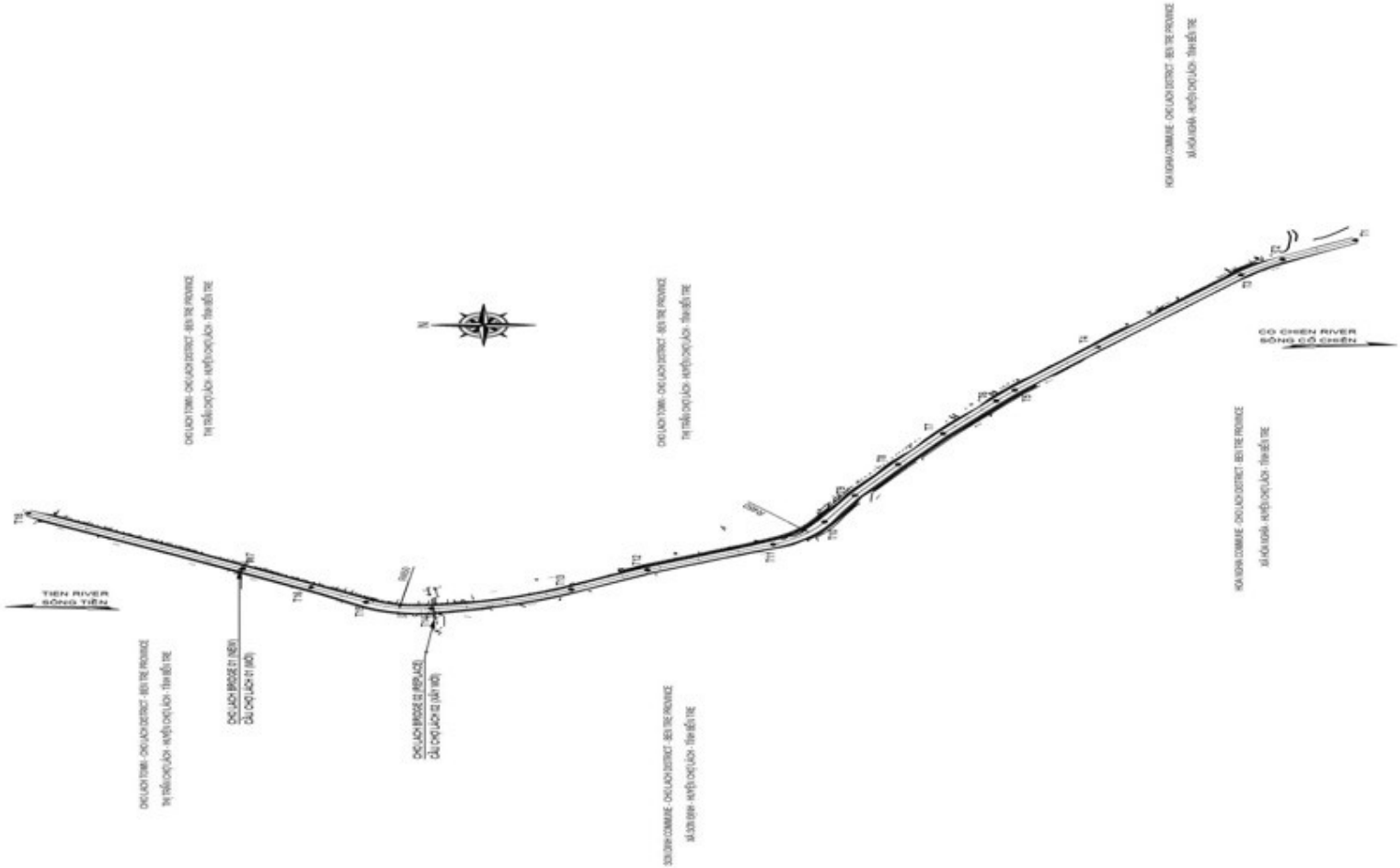


Figure 2.4. The dredged line of Cho Lach canal

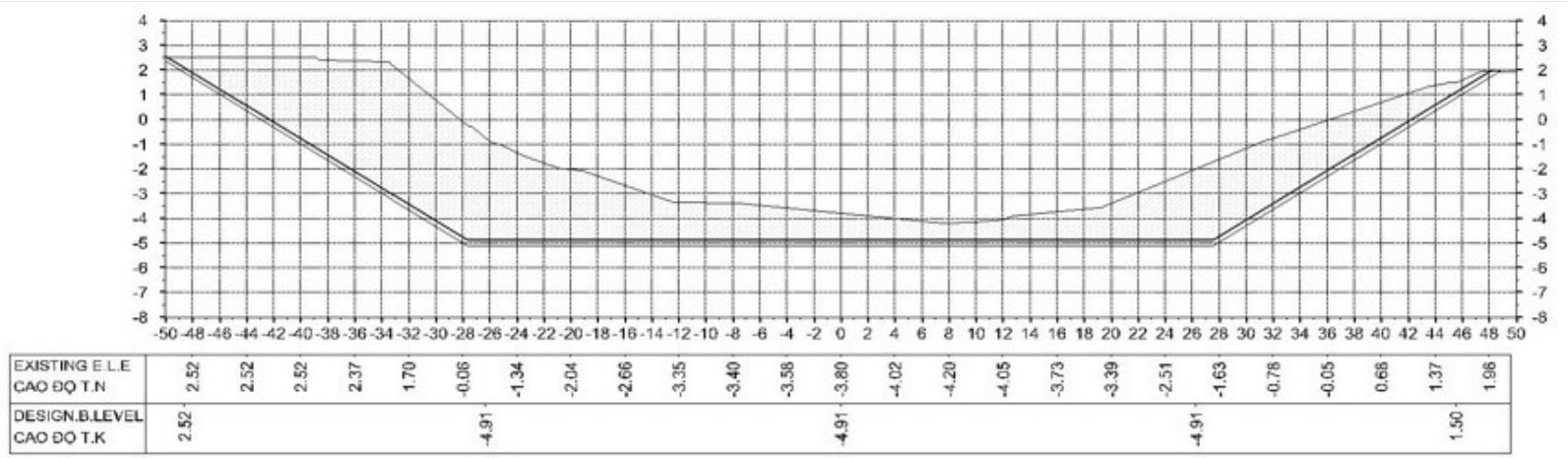


Figure 2.5. Typical dredging cross section of Cho Lach canal (no embankment)

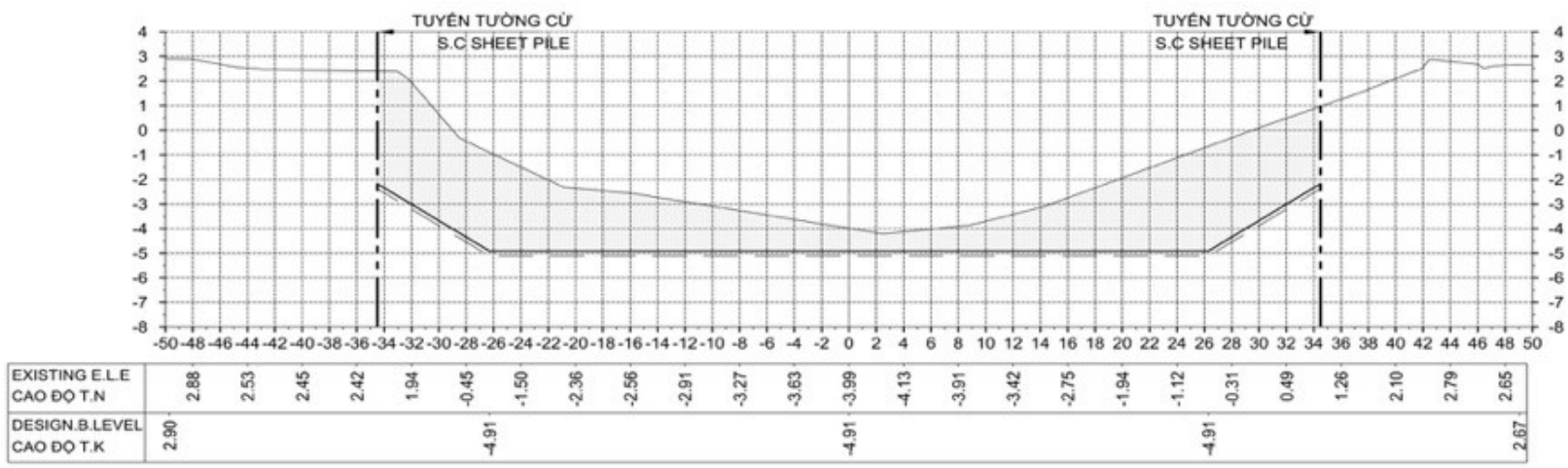


Figure 2.6. Typical dredging cross section of Cho Lach canal (with embankment)

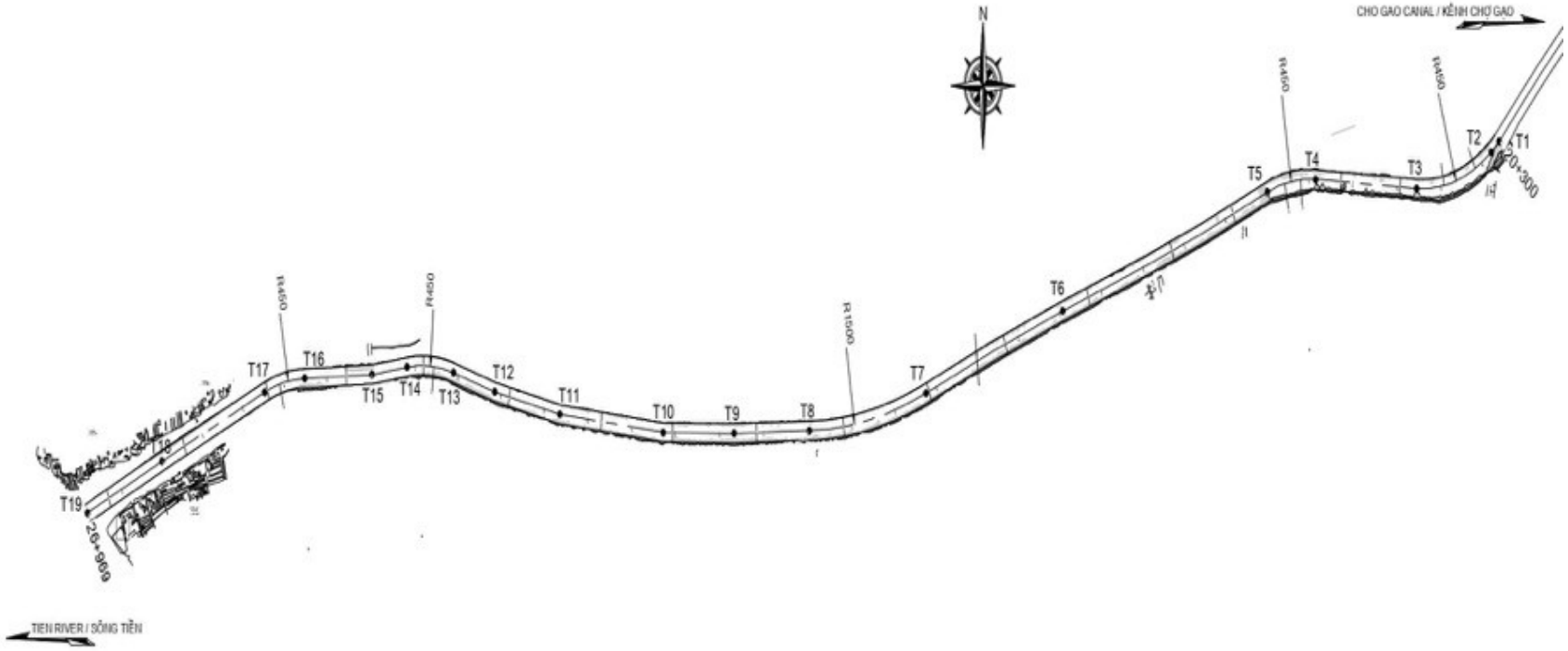


Figure 2.7. The dredged line of Ky Hon canal

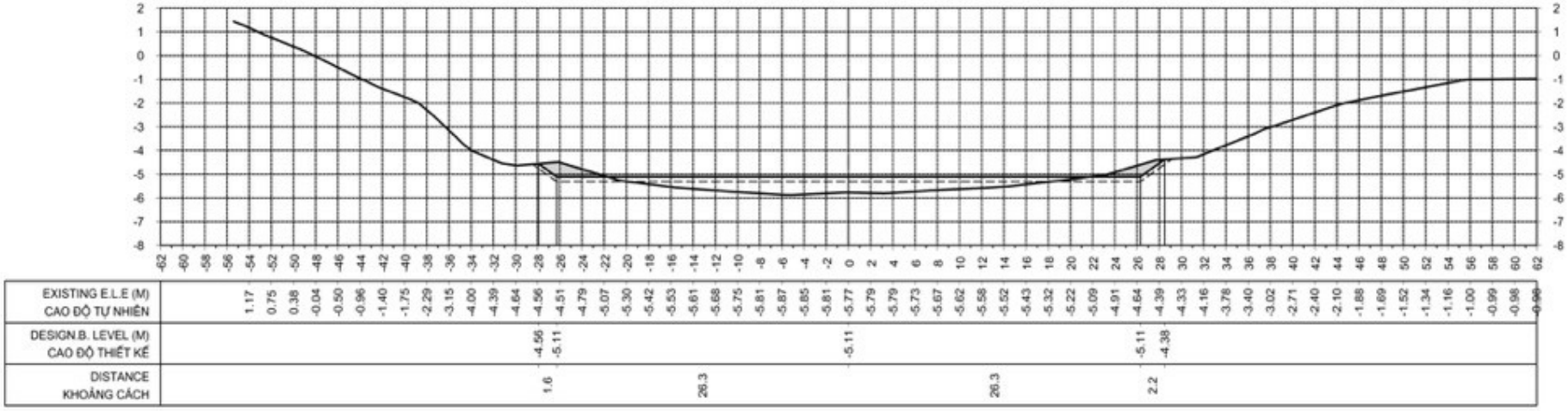


Figure 2.8. Typical dredging cross section of Ky Hon canal (straight segment)

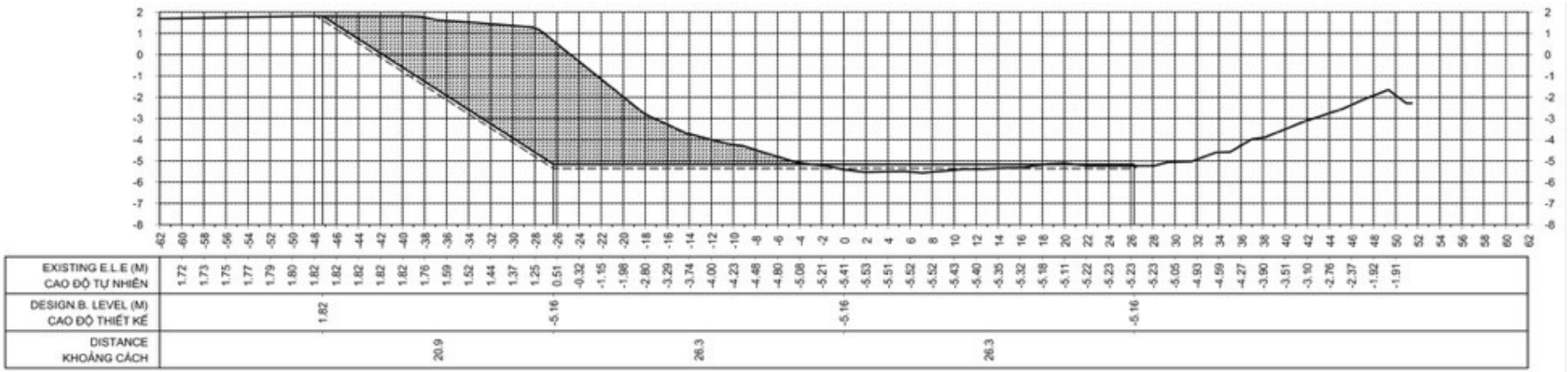


Figure 2.9. Typical dredging cross section of Ky Hon canal (curved segment)

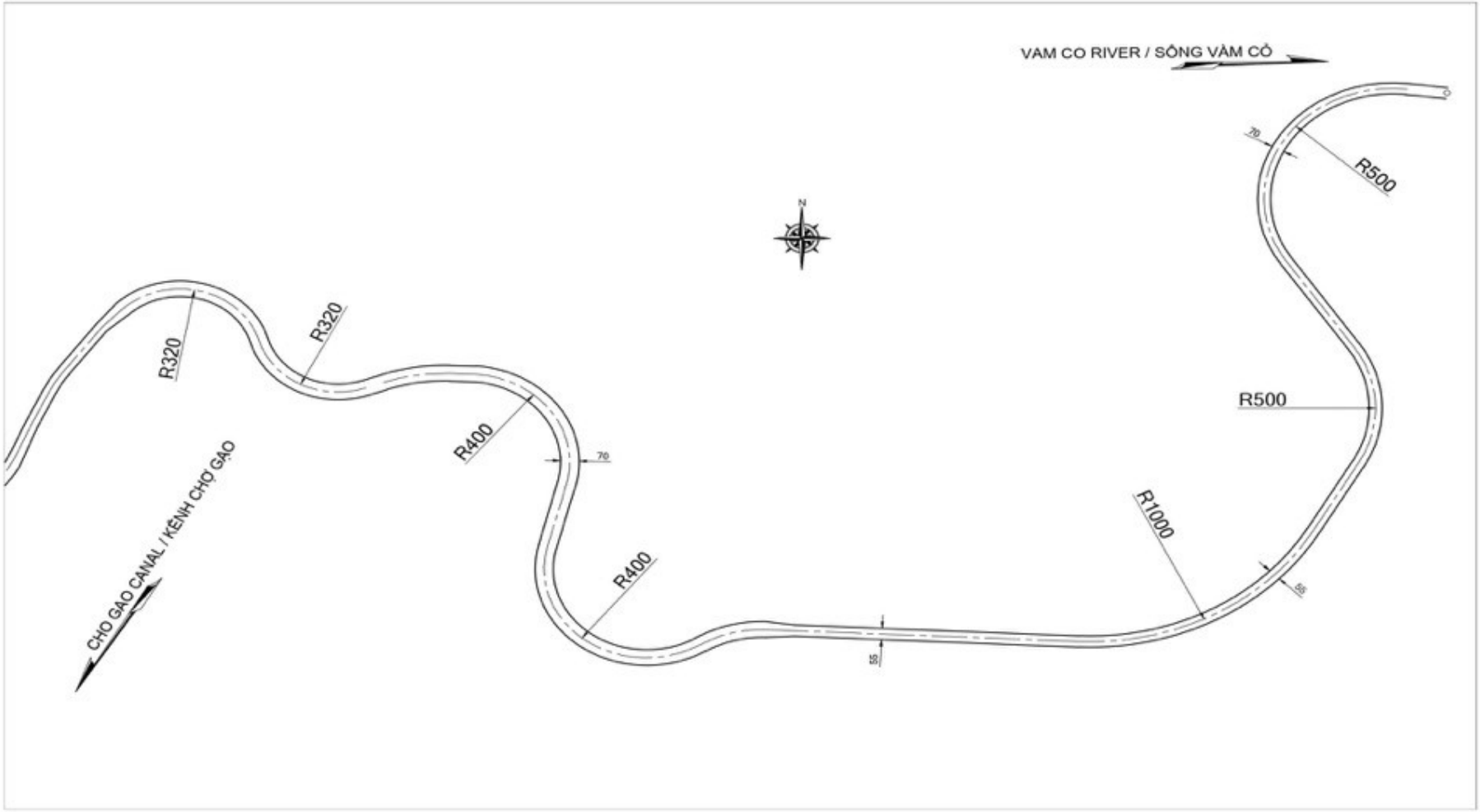


Figure 2.10. The dredged line of Rach La canal

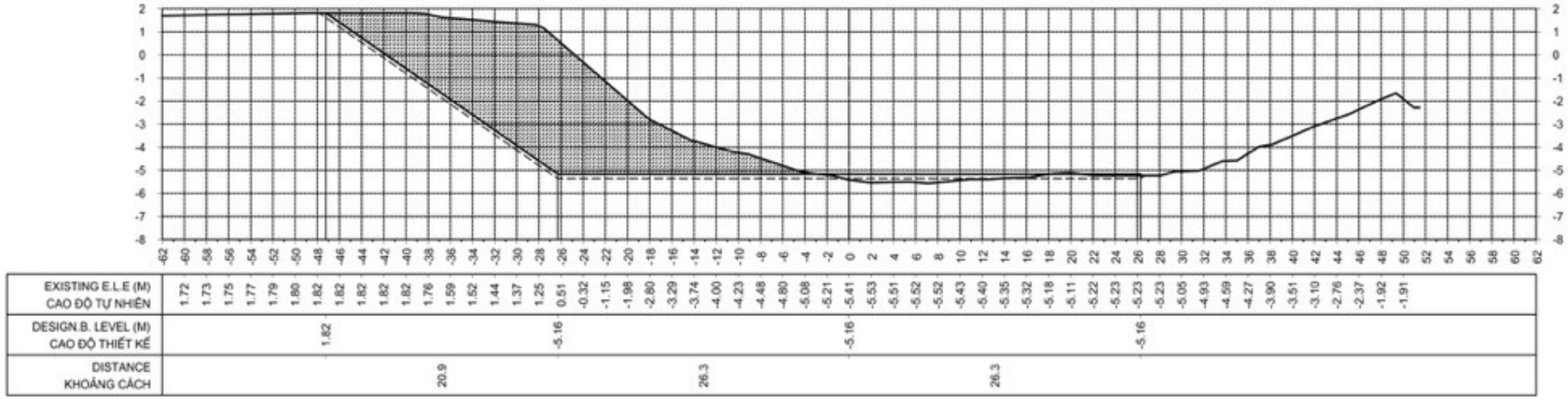


Figure 2.11. Typical dredging cross section of Rach La river (bend correction segment)

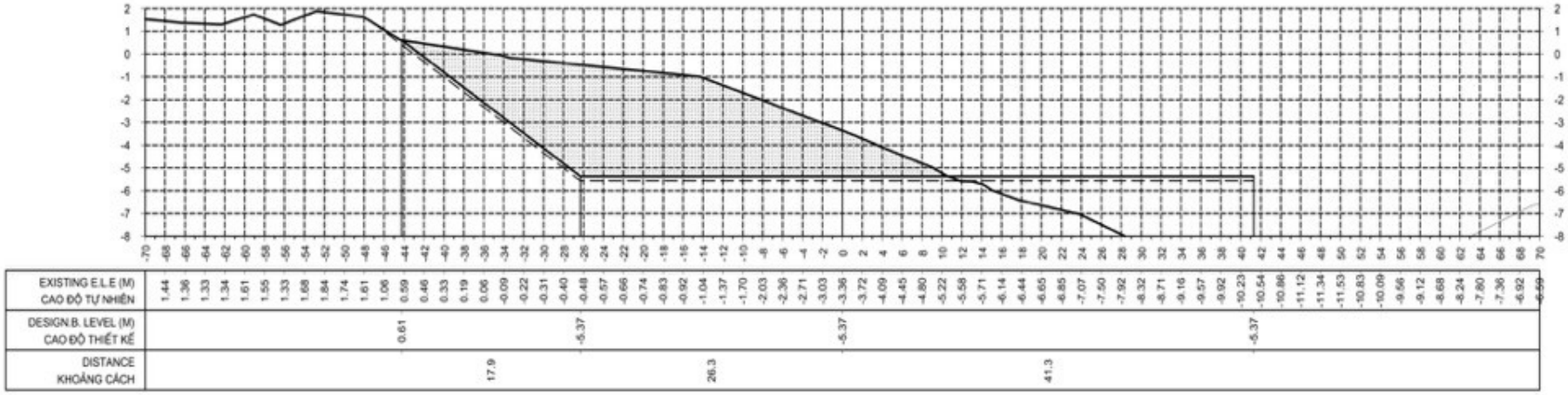


Figure 2.12. Typical dredging cross section of Rach La river (straight segment)

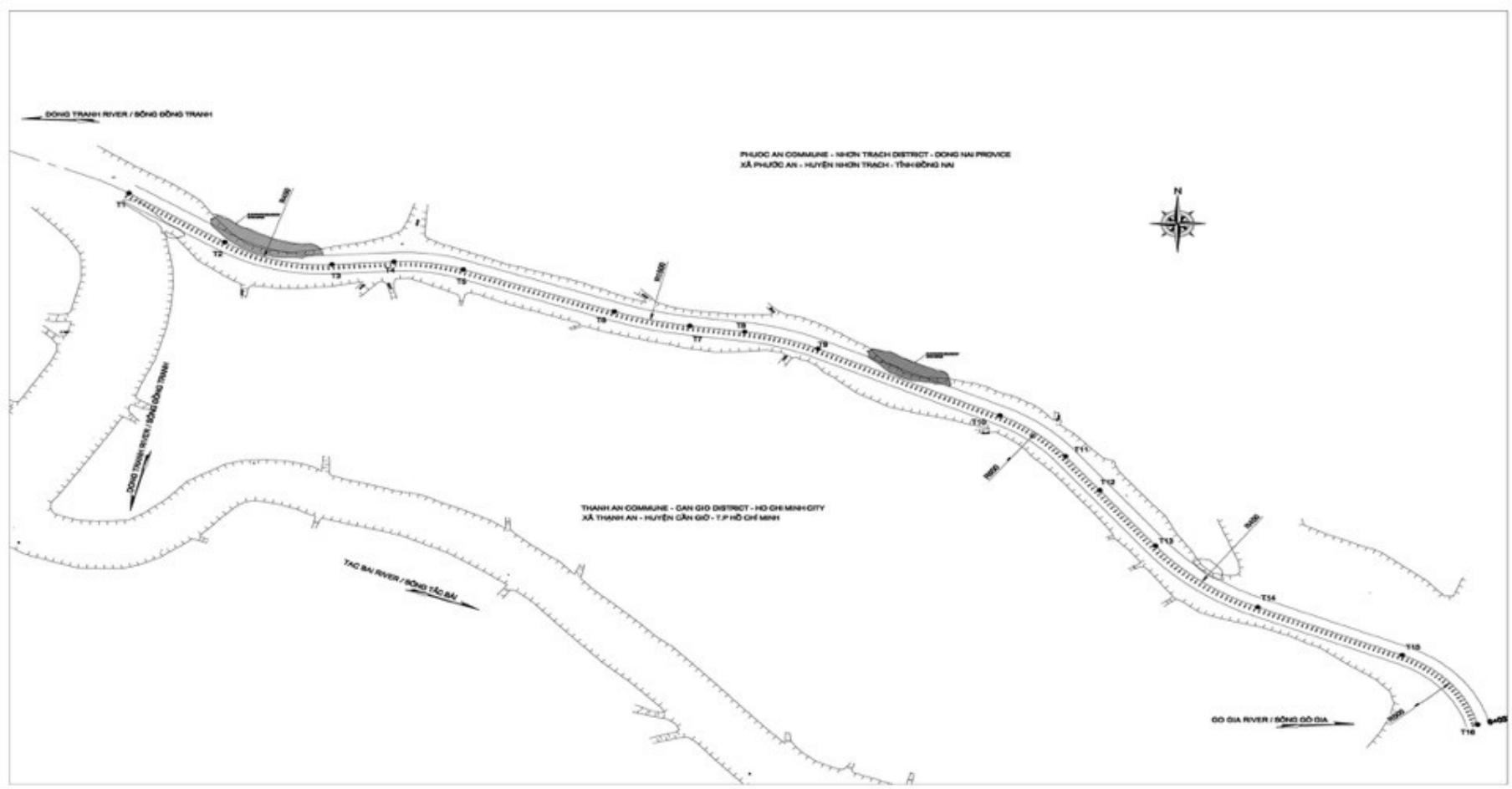


Figure 2.13. The dredged line of Tac Cua river

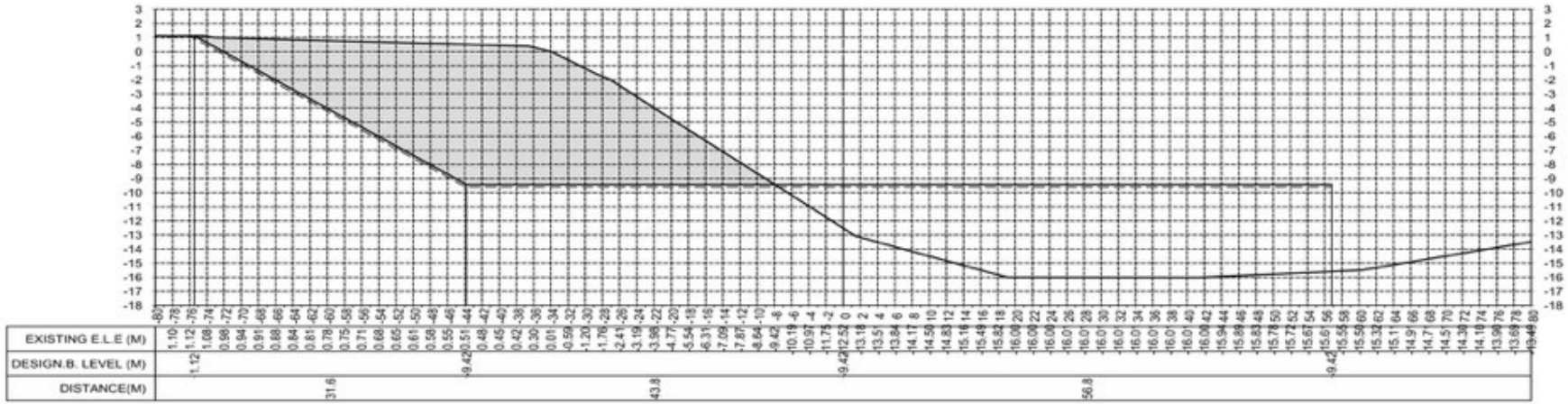


Figure 2.14. Typical dredging cross section of Tac Cua river (curved segment)

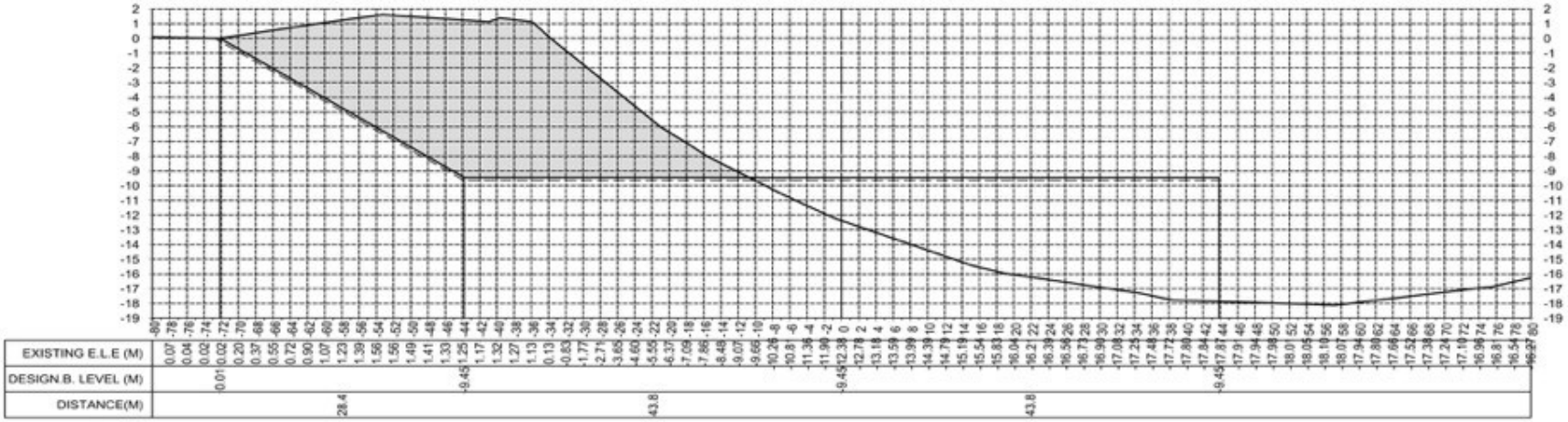


Figure 2.15. Typical dredging cross section of Tac Cua river (straight segment and bend correction)

2.4.3. Embankments

At several locations along the SWLC East – West Corridors, due to envisaged dredging works, embankments need to be performed. The primary objective of the embankments is to protect the slopes from erosion and instability of the dike. Secondary objectives of the embankments could be beautification of the slopes, easy access to the water and landing stages for small vessels.

The embankment works are implemented in areas with high risk of landslides and bend correction locations along the Mang Thit, Cho Lach and Rach La canals.

The major goal of the bank protection system is to protect the slope from eroding and to ensure structure stability. The second goal is to meet aesthetic standards while also making it easier for small vessels to access the channel and ferry boat stages. In this project, the following type of bank protection is considered:

Type A: Inclined-slope bank protection with concrete blocks and reno-mattress (Figure 2.16)

Type B: Vertical-wall bank protection with concrete sheet piles (Figure 2.17).

The total length of embankment work is 22,984 km, divided by each waterway as follows:

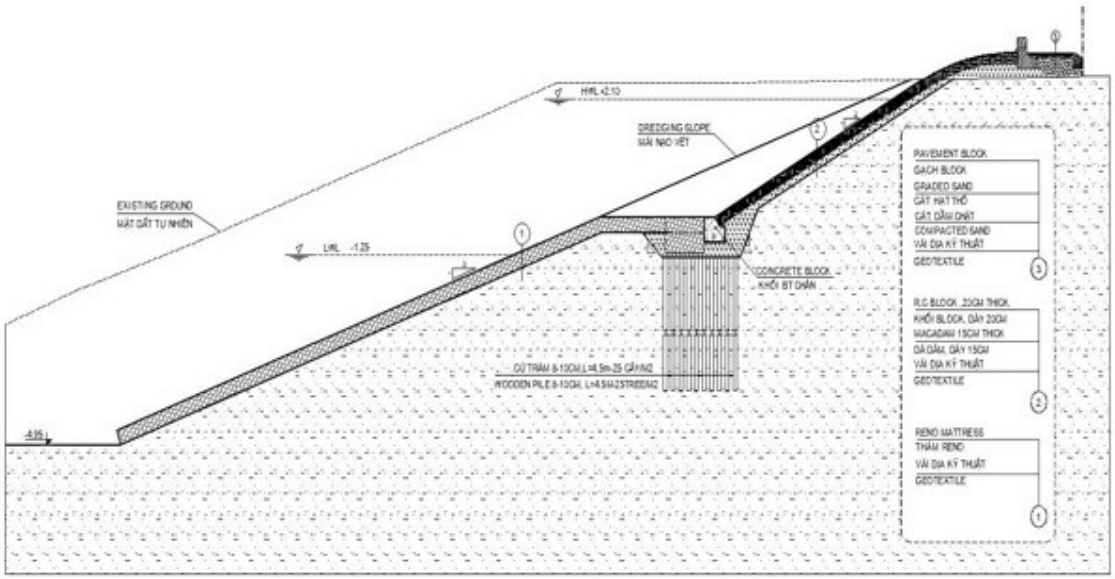


Figure 2.16. Typical cross-section of type A embankment

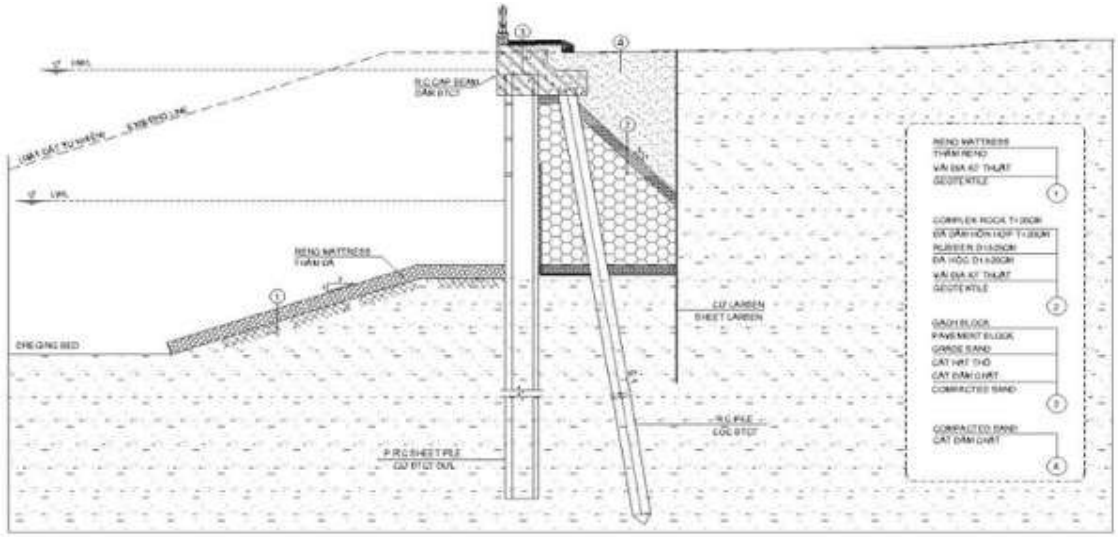


Figure 2.17. Typical cross-section of type B embankment

Based on the advantages and disadvantages and the actual conditions of the waterway, types and length of embankment are proposed as in Table 2.8.

Table 2.8. Proposed embankments work

Segment	Point name	Length of type A [m]	Length of type B [m]
Mang Thit river			
L1	K1 - K2	192	-
L2	K3 - K4	412	-
L3	K5 - K6	234	-
L4	K7 - K8	3.574	-
L5	K9 - K10	172	-
L6	K11 - K12	1.250	-
L7	K13 - K14	594	-
L8	K15 - K16	2.346	-
L9	K17 - K18	252	-
L10	K19 - K20	1.230	-
L11	K21 - K22	525	-
L12	K23 - K24	477	-
L13	K25 - K26	276	-
L14	K27 - K28	286	-
L15	K29 - K30	243	-
L16	K31 - K32	347	-
L17	K33 - K34	424	-
L18	K35 - K36	320	-
Sub-total		**13.154**	-

Segment	Point name	Length of type A [m]	Length of type B [m]
Cho Lach canal			
L1	K1 - K2	168	-
L2	K3 - K4	1.372	-
L3	K5 - K6	-	1.969
L4	K7 - K8	-	1.045
L5	K9 - K10	900	-
L6	K11 - K12	460	-
L7	K13 - K14	445	-
L8	K15 - K16	-	450
L9	K17 - K18	-	868
L10	K19 - K20	-	1.093
Sub-total		**3.345**	**5.425**
Rach La canal			
L1	K1 - K2	440	-
L2	K3 - K4	360	-
L3	K5 - K6	260	-
Sub-total		**1.060**	**-**

Source: FS report, Egis, 2018

Layout of embankment sections of Mang Thit, Cho Lach and Rach La Canals are showed in Figure 2.18; 2.19 and 2.20 below.

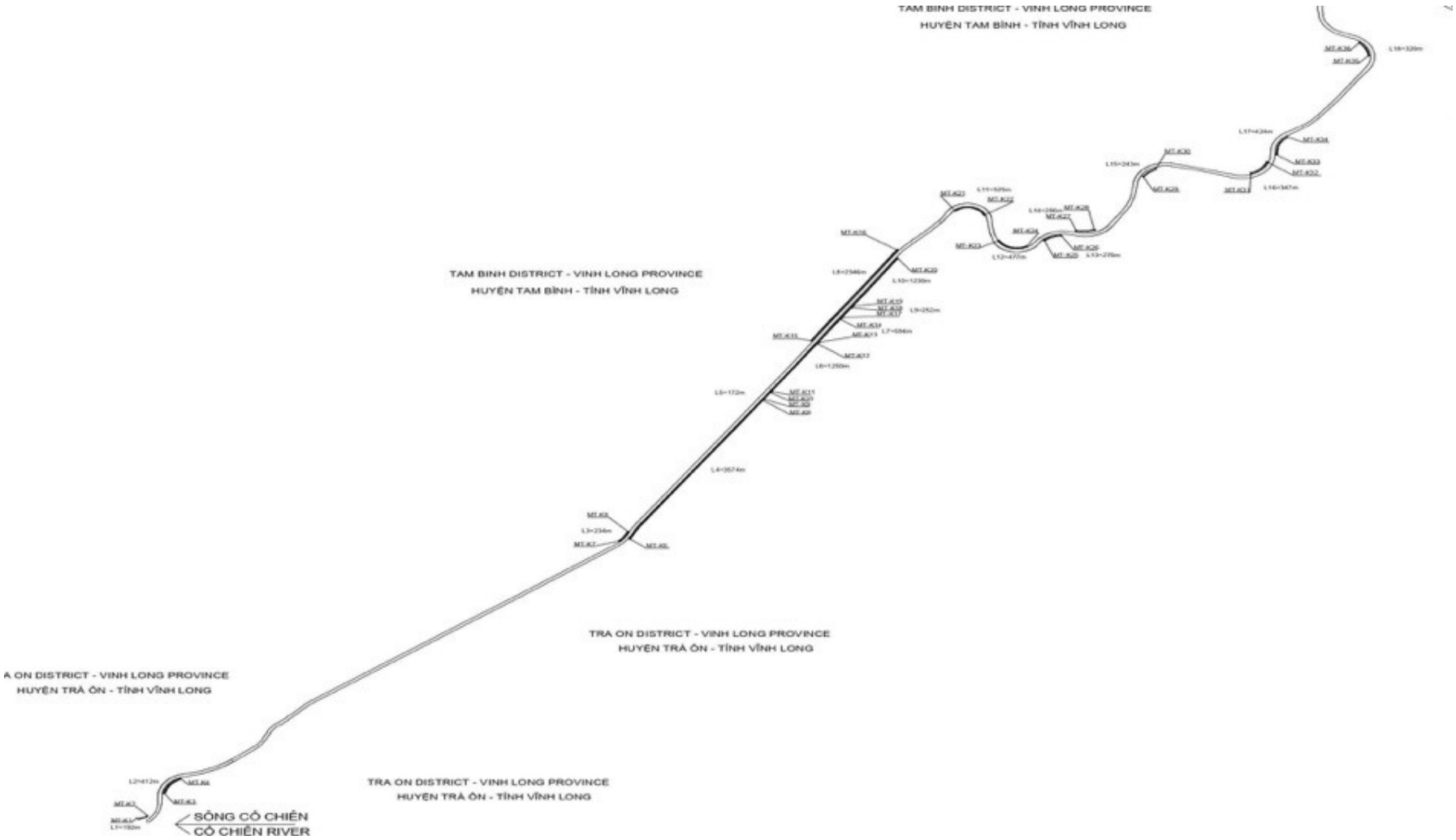


Figure 2.18. Proposed embankments Mang Thit river

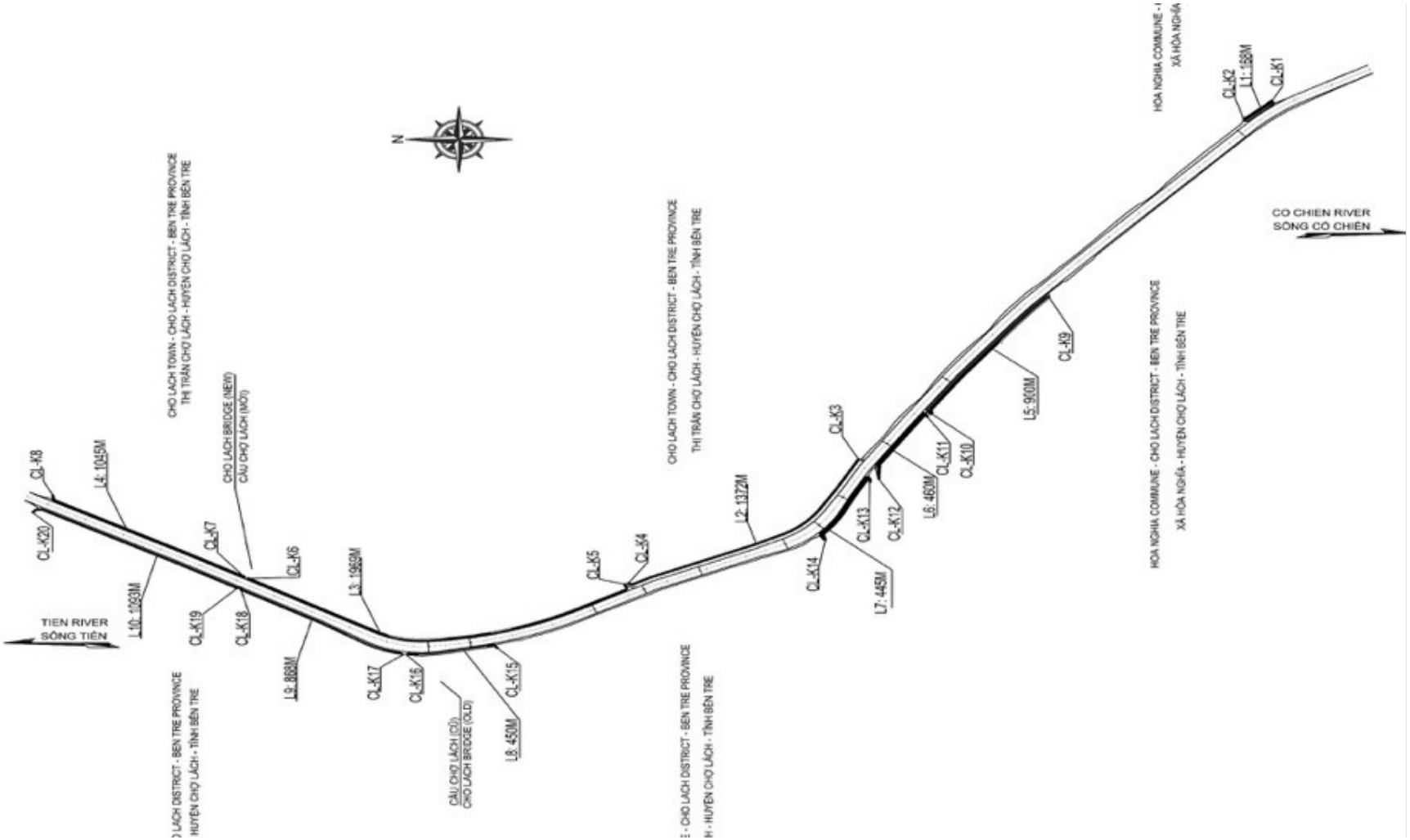


Figure 2.19. Proposed embankment for Cho Lach canal (East-West Corridor)

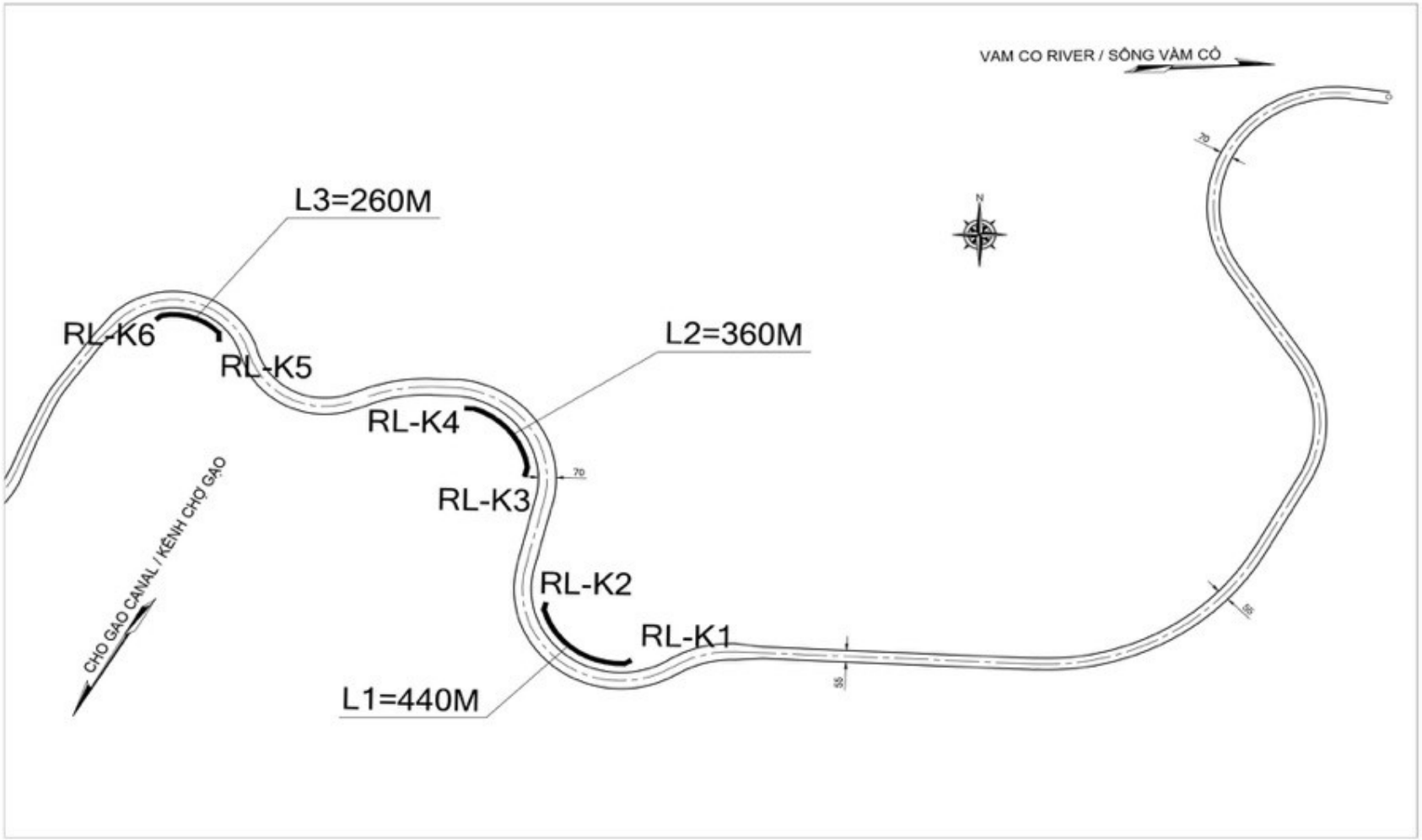


Figure 2.20. Proposed embankment for Rach La canal (East-West Corridor)

2.4.4. Bridge construction

2.4.4.1. Building new Cho Lach 2 Bridge

Based on the 5% anticipated water level in the future, the necessary air clearance and horizontal clearance of existing bridges, there is only Cho Lach 2 bridge on the East-West Corridor of the SWLC project needs to be newly constructed due to limited horizontal clearance. Limiting the width of the navigable compartment (currently only available for grade III canals and has been degraded and damaged). For Tra On bridge completed and put into use in 2010 and new Mang Thit bridge put into use from June 2020, although there is limitation vertical clearance when raising the canal to level II, it can be overcome by navigation aids speed limit warning and can take advantage of lower water level than MNCTK for 3-layer container ships (with 1 high-container layer) passing through the bridge. The North-South corridor of the SWLC project from Dong Nai port to Cai Mep Thi Vai port area currently has no bridges that need to be improved.

Cho Lach bridge (old) (EW-CL-03)	
	Type: Main bridge
	Existing vertical clearance: 7.0 m
	Existing horizontal clearance: 30 m
	Type of superstructure: Steel

Figure 2.21. Old Cho Lach bridge in Cho Lach town

Cho Lach bridge (illustrated in Figure 2.21 above) is located on the old route of QL57, section passing Cho Lach town, this route is a plain grade V road with a roadbed of 6.5m, a road surface of 5.5m, passing through the center of Cho Lach town (now called is Dong Khoi street). According to the decision No. 2654/QD-UBND dated December 26, 2014 of the People's Committee of Ben Tre province on approving the general planning project for construction of Cho Lach town in the period to 2030, the main roads in the town are equivalent level IV plain. The old Cho Lach bridge is a bailey steel bridge, with 5 spans with a span diagram (2x18 + 36 + 2x18 = 108 m), the bridge width is 2.5+2x0.5=3.5 m. This bridge was built in 1985 and renovated in 1993, now due to the serious deterioration of the bridge, it is only for pedestrians, motorbikes and rudimentary vehicles. Large and heavy vehicles use Cho Lach 1 bridge on the QL57 bypass, this bridge does not require renovation. Therefore, Cho Lach 2 bridge is mainly

designed to serve the travel needs of people in the town and neighboring localities.

The vertical and navigational clearance of the proposed Cho Lach bridge 2 are 7.5 m and 50 m respectively as shown in Figure 2.22.

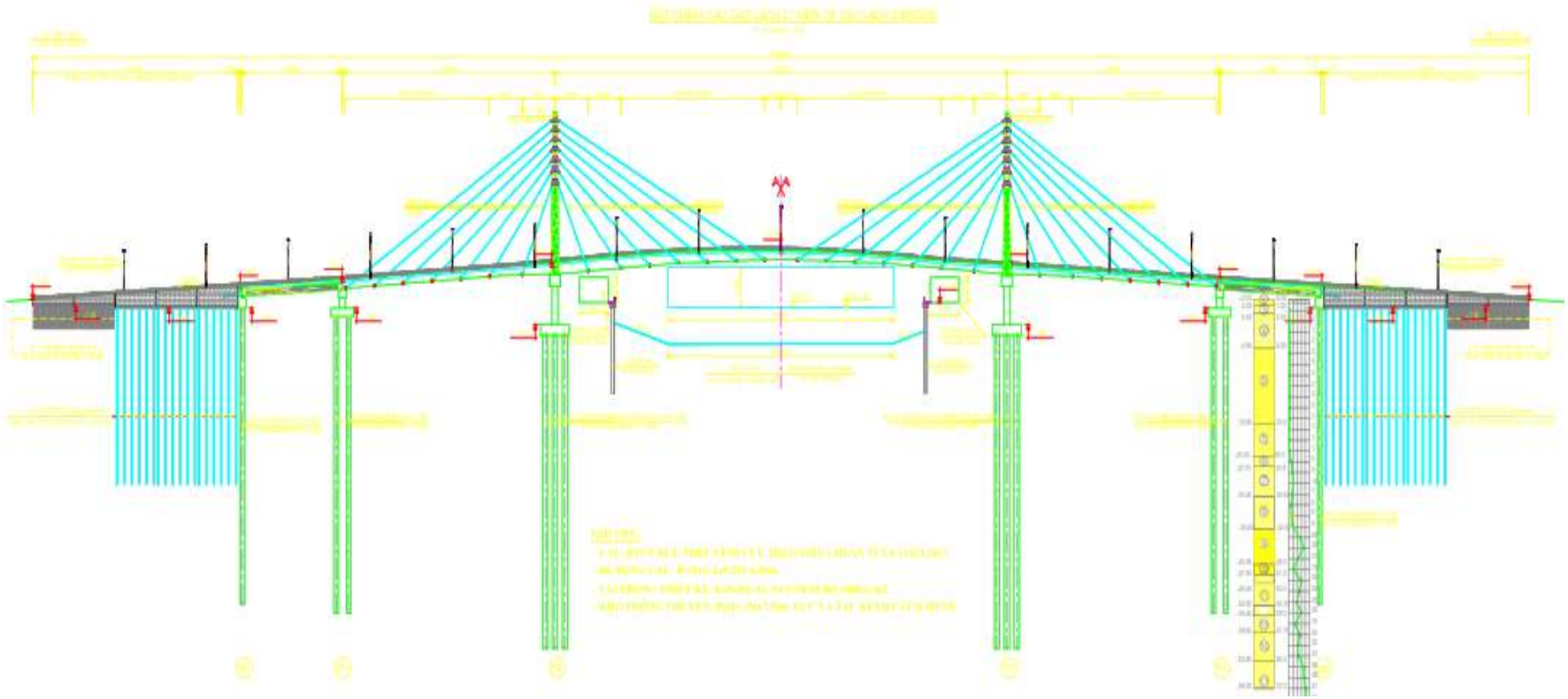


Figure 2.22. Design of new Cho Lach 2 bridge

2.4.4.2. Power lines improvement

Power lines of different voltages cross the SWLC East – West and North – South Corridors. 8 power lines on the SWLC East – West Corridor have insufficient vertical clearance as showed in Table 2.10 below. No power line improvements are required on the SWLC North – South Corridor.

The project will propose the power management agency to increase the clearance height of the power lines to match the necessary standards. The improvement of power lines only require vertical clearance based on existing facilities, therefore not requiring land acquisition. The cost of raising the vertical clearance of the power line will be included in the cost of compensation for site clearance for the local implementation.

Table 2.9. Existing power lines to be improved (SWLC East – West Corridor)

No.	Waterway	Voltage	Quantity	Vertical clearance [m]	
				Estimated	Required
1	Mang Thit river	<22 KV	1	9.5	13.5
2	Mang Thit river	35 KV	1	11.0	13.5
3	Mang Thit river	110 KV	1	12.0	14.0
4	Cho Lach Canal	22 KV	1	12.0	13.5
5	Ky Hon Canal	8.6 KV	1	12.0	13.5
6	Cho Gao Canal	22 KV	1	12.0	13.5
7	Rach La Canal	220 KV	2	12.0	13.5
8	Nuoc Man Canal	110 KV	1	8.0	14.0

Source: Pre-FS, 2021

2.4.5. Irrigation and drainage constructions

With the proposed improvements works, when widening dredging of the waterways, existing outlets for irrigation and drainage might be impacted. Analyzing the SWLC East – West and North – South Corridors, it can be seen that several irrigation and drainage outlets along Mang Thit river, Cho Lach Canal and Rach La Canal are impacted and need to be replaced accordingly.

The number of irrigation and drainage implemented within the scope of this project is initially shown in Table 2.10.

Table 2.10. Number of designed irrigation and drainage sewers

No.	Waterway	Quantity (size in cm)					Total
		2 x 200 x 300	2 x ¬120	¬100	¬80	¬60	
1	Mang Thit River	-	1	-	-	44	45
2	Cho Lach Canal	1	-	4	4	20	29
3	Rach La Canal	-	-	-	-	06	06
	Total	1	1	4	4	70	80

Typical cross-sections drainage outlet is shown in Figure 2.23.

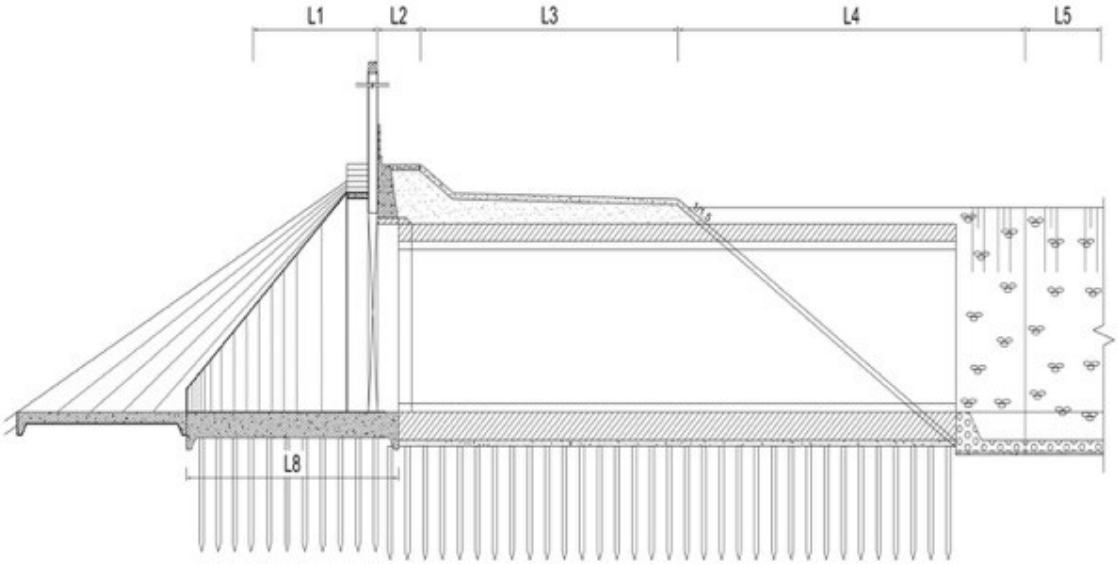


Figure 2.23. Typical cross-sections drainage outlet

2.4.6. Local road

At some locations the local roads along Mang Thit river, Cho Lach Canal and Rach La Canal are impacted and need to be compensated accordingly. At the location bend correction, it is necessary to build new roads combination with embankment protection to avoid erosion. The residential roads that need to be built within the project scope are preliminarily listed in Table 2.11.

Table 2.11. Locations of improved local roads

No	Name	Side	Type	Length [m]
1. Mang Thit river				
1	R1 - R2	L	Type B2	187
2	R3 - R4	R	Type B2	428
3	R5 - R6	R	Type B2	94
4	R5A - R6A	R	Type B2	68
5	R7 - R8	R	Type B2	628
6	R9 - R10	R	Type B2	157
7	R11 - R12	R	Type B2	525
8	R13 - R14	L	Type B2	477
9	R15 - R16	R	Type B2	306
10	R17 - R18	L	Type B2	338
11	R19 - R20	R	Type B2	252
12	R21 - R22	L	Type B2	363
13	R23 - R24	R	Type B2	407
14	R25 - R26	L	Type B2	336
Total				**4,566**
2. Cho Lach canal				
1	R1 – R2	R	Type B1	191
2	R3 – R4	L	Type B1	379
3	R5 – R6	R	Type A	102

No	Name	Side	Type	Length [m]
4	R7 – R8	L	Type A	361
5	R9 – R10	R	Type A	265
6	R11 – R12	L	Type A	198
Length of Type A				**926**
Length of Type B				**570**
Total				**1,496**
3. Rach La canal				
1	R1 - R2	R	Type B2	440
2	R3 - R4	L	Type B2	360
3	R5-R6	L	Type B2	260
Total				**1,060**

The local roads will be improved based on the existing routes to meet the requirements as per described above, therefore will not require land acquisition.

The drawings of local roads under SWLC Project are shown in Figure 2.24 to 2.28.

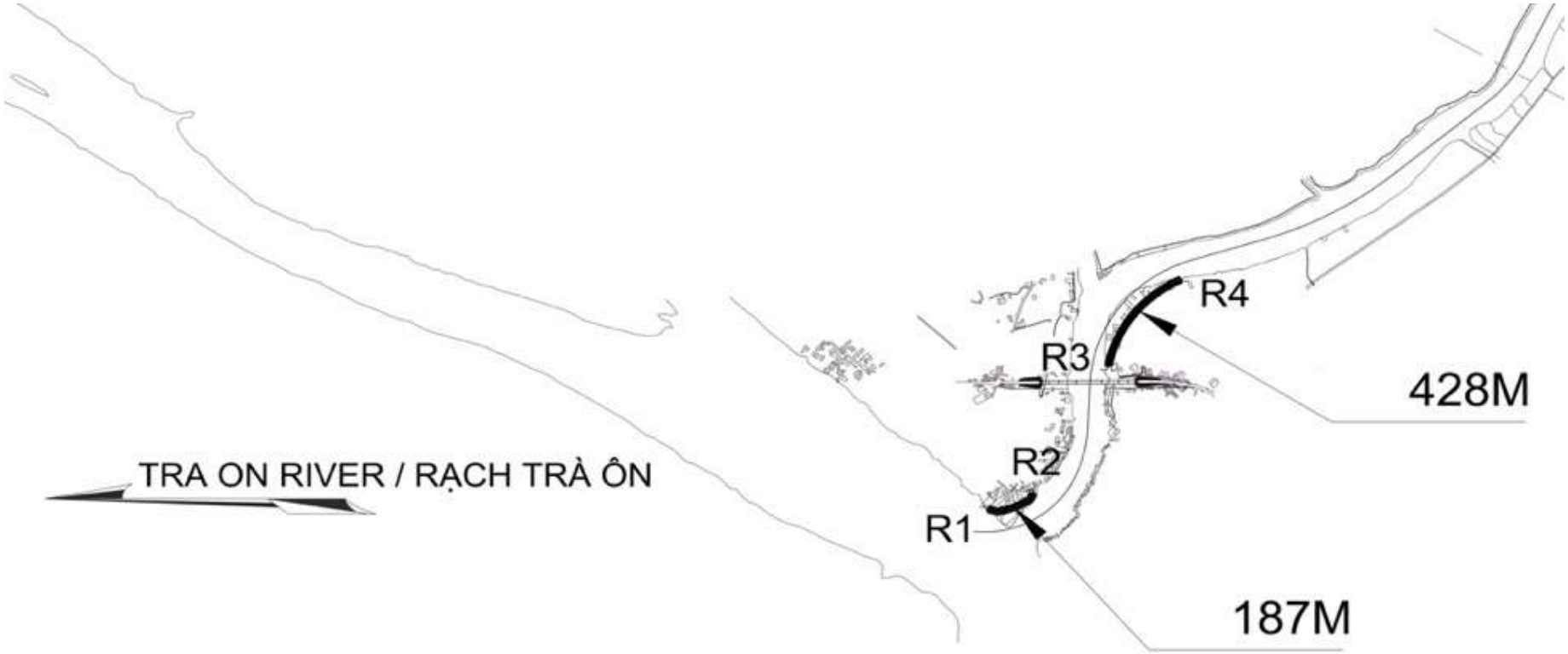


Figure 2.24. Local roads – Mang Thit river (R1 – R4)

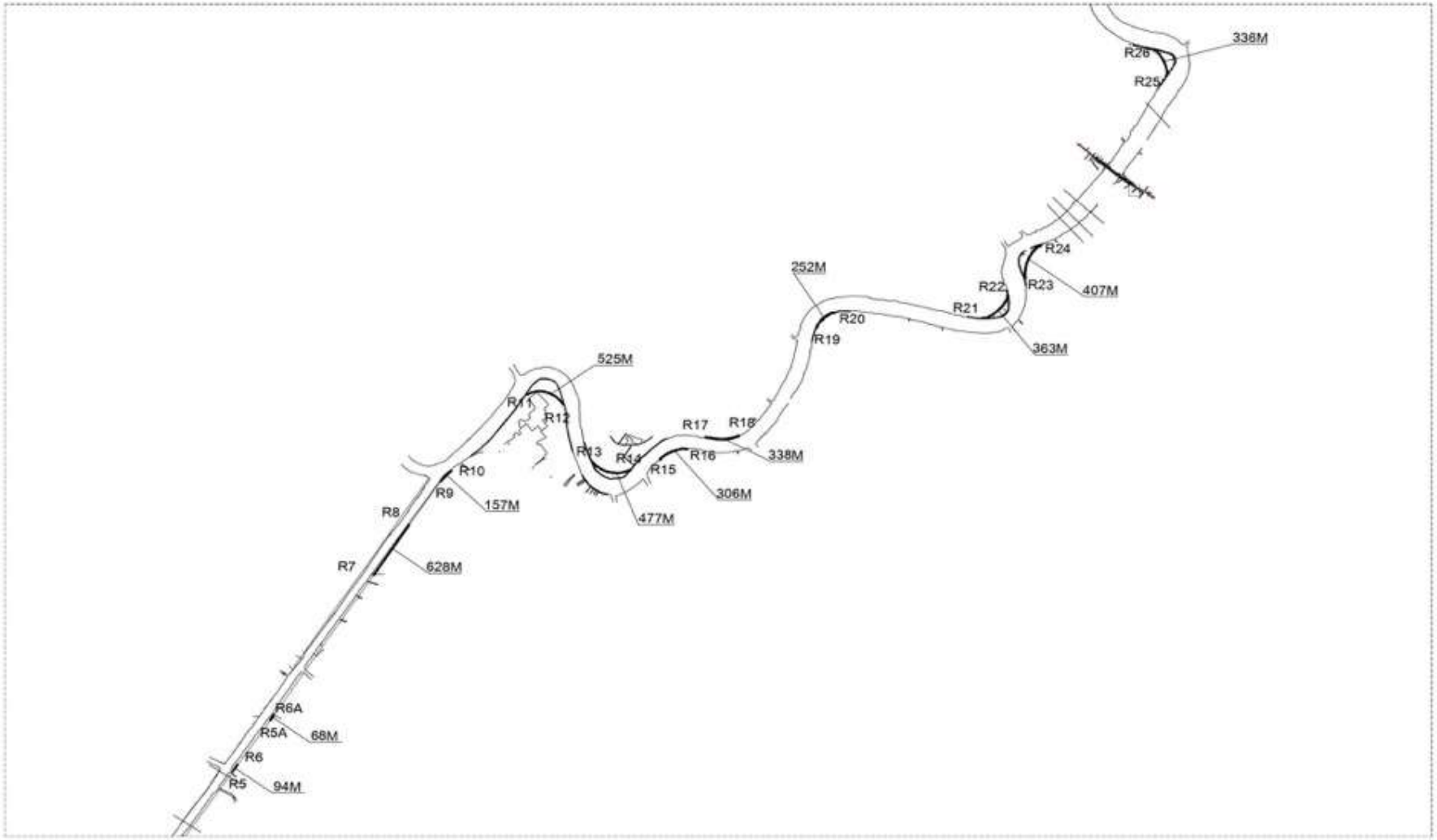


Figure 2.25. Local roads – Mang Thit river (R5 – R26)

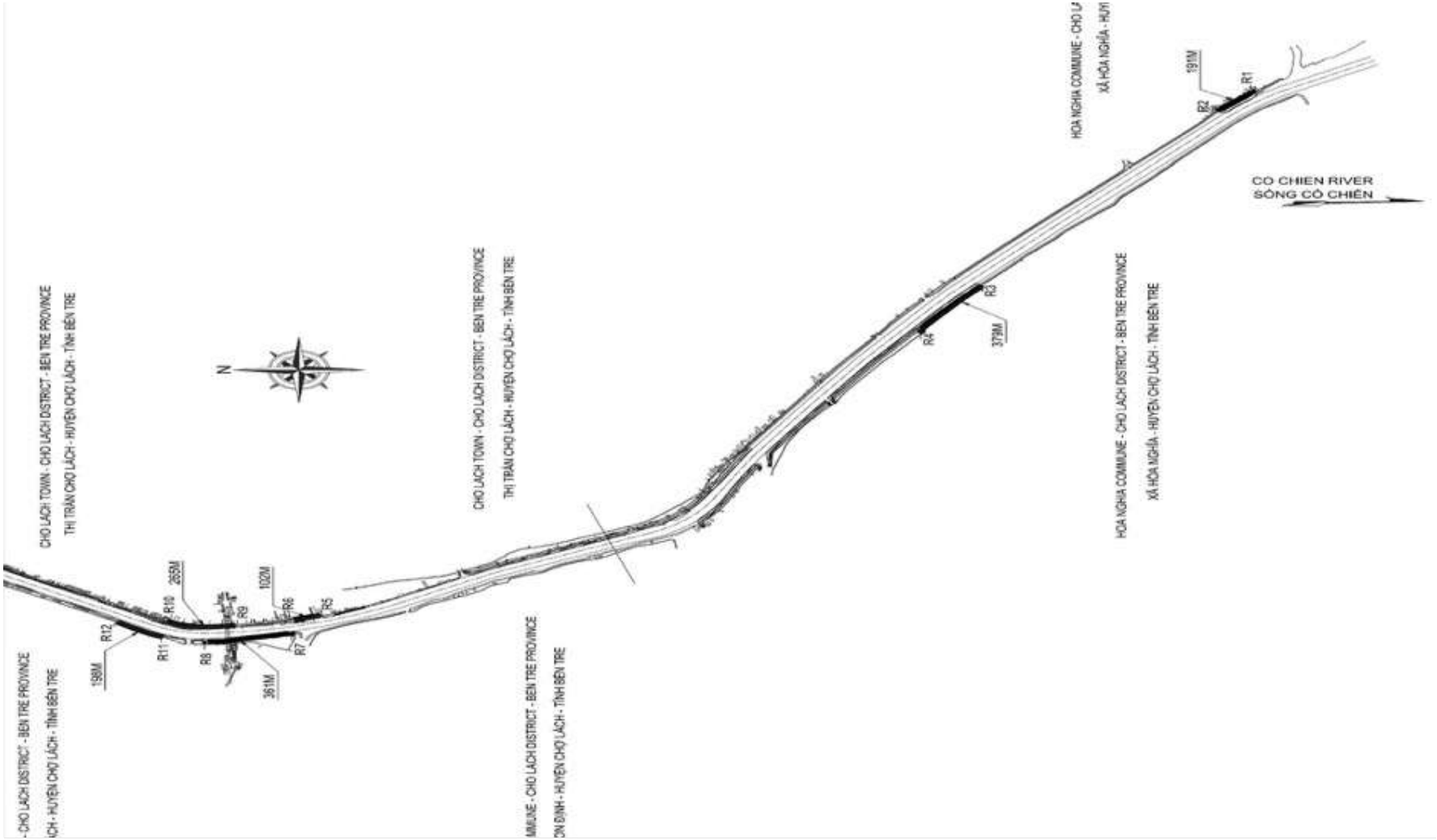


Figure 2.26. Local road – Cho Lach canal

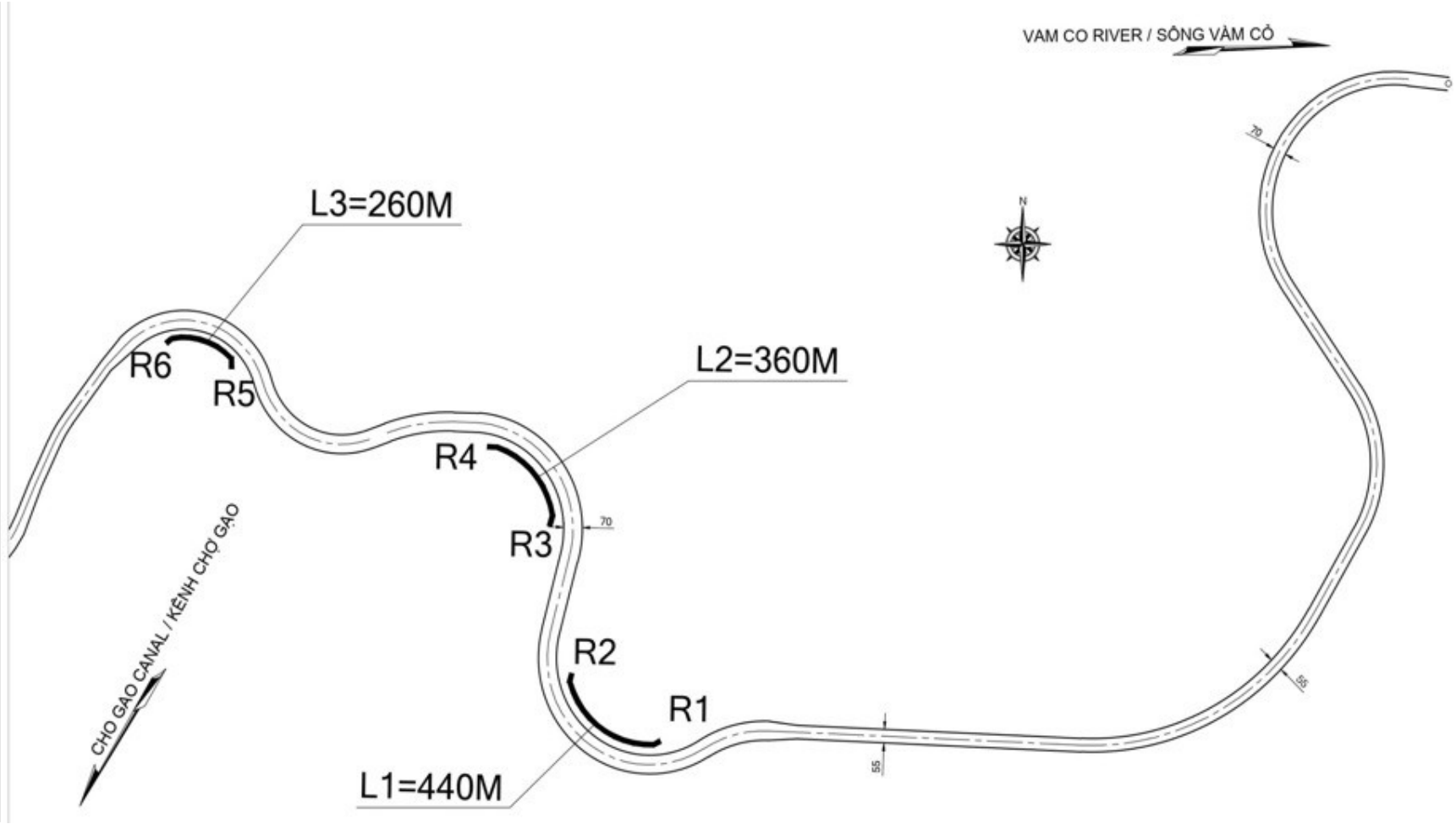


Figure 2.27. Local roads – Rach La canal

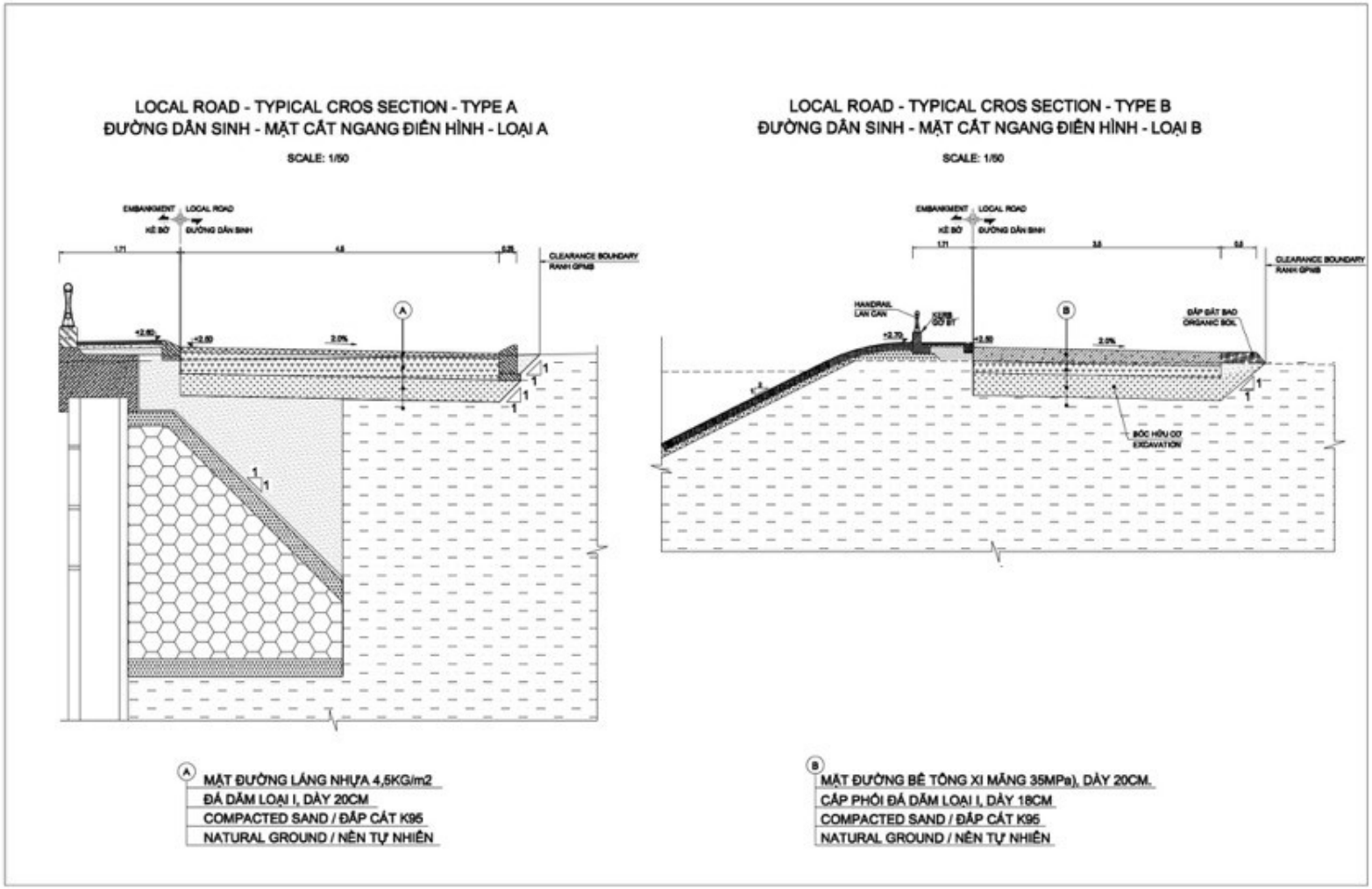


Figure 2.28. Typical cross-sections of local roads

2.4.7. Improving inland shipping safety and navigation aids

One of the SWLC FS project objectives is to increase shipping safety of inland navigation in the MKD and the Southeast.

This is to be realized by providing (i) a shorter route for bigger vessels (navigation class II) between Can Tho port, Dong Nai port and CMTV port complex, and (ii) improve navigation aids.

The shorter route is to be materialized by upgrading the East West Corridor, via Mang Thit river and Cho Lach canal, to navigation class II, thus shortening the navigation distance for class II vessels about 92km compared to the existing route running through Tien river - Vam Nao river - Hau river (equivalent to 10 hours less sailing time).

Navigation aids are required to improve the safety for day and night navigation according to QCVN 39:2020/BGTVT, to determine the types of waterway signals that need to be installed additionally or replaced to ensure navigation safety. Along both the SWLC East – West and North – South Corridors, navigation aids are in place.

For the North-South corridor through Dong Tranh and Tac Cua rivers: it is a common channel with the navigation channel. Vietnam Maritime Administration has issued Decision No. 1026/QD-CHHVN dated October 24, 2014 approving the installation of a navigational signaling system for the channel. Marine signaling system in accordance with the national technical regulations on maritime signaling has now been set up and is being operated and maintained by the Southern Maritime Safety Corporation ensuring that 3,000DWT to 5,000DWT loading vessels are eligible for navigation on the channel. That is why temporarily it is not necessary for the SWLC Project to install additional signals for this channel. In addition, the Upgrading Cho Gao Canal project also plan to install a signaling system along the Rach La - Cho Gao - Ky Hon route. Therefore, SWLC project will not install signals on these river sections to determine and improve the navigational signaling system along the project corridor.

However, it is necessary to organize detailed survey and update the current status of waterway signals in the next steps to determine the implementation of improvement of Aids of navigation along the project corridor according to the following options:

- Remove: refers to existing aids to navigation, which is not necessary anymore and need to be removed;
- Relocate: refers to existing aids to navigation, which will be relocated;
- Newly installed: refers to new aids to navigation to be implemented.

Table 2.12 summarizes preliminary data of signal buoys which need to be handled by routes. The locations of the navigational aids will be specified later.

Table 2.12. Total navigation aids to be removed, relocated and installed by routes

No	Name of river/canal	Remove	Relocate	Newly installed
1	Tra On	-	1	33
2	Mang Thit	30	42	243
3	Cho Lach	10	30	43
4	Nuoc Man- Can Giuoc	-	2	30

2.5. CONSTRUCTION METHODS

2.5.1. Construction methods for dredging

2.5.1.1. Site Preparation

The preparation of construction sites will be carried out in the following orders:

- Positioning and localizing works;
- Preparing construction site and workers' camps and site office;
- Mobilizing machinery and equipment;
- Locate temporary area at site to gather dredging sludge.

2.5.1.2. Dredging procedure

The dredging is carried out based on a successive basis in the following orders:

- Construction of temporary drain system;
- Demarcate construction section on the canal by using wooden piles or sand sacks at the two ends of the demarcated section. On average each section is 50-100 m long;
- Dry off the section by water pump in the pile/sack coffer;
- Use specialized equipment combined with manual labor to dry dredge canal to the designed elevation;
- Sludge is directly pumped to the disposal site (suction dredger) or put in the barge then transport to the disposal site (clamshell dredger).
- Construction of embankment as designed.

The dredging procedures for inland waterways and related environmental issues is described in the Figure 2.29:

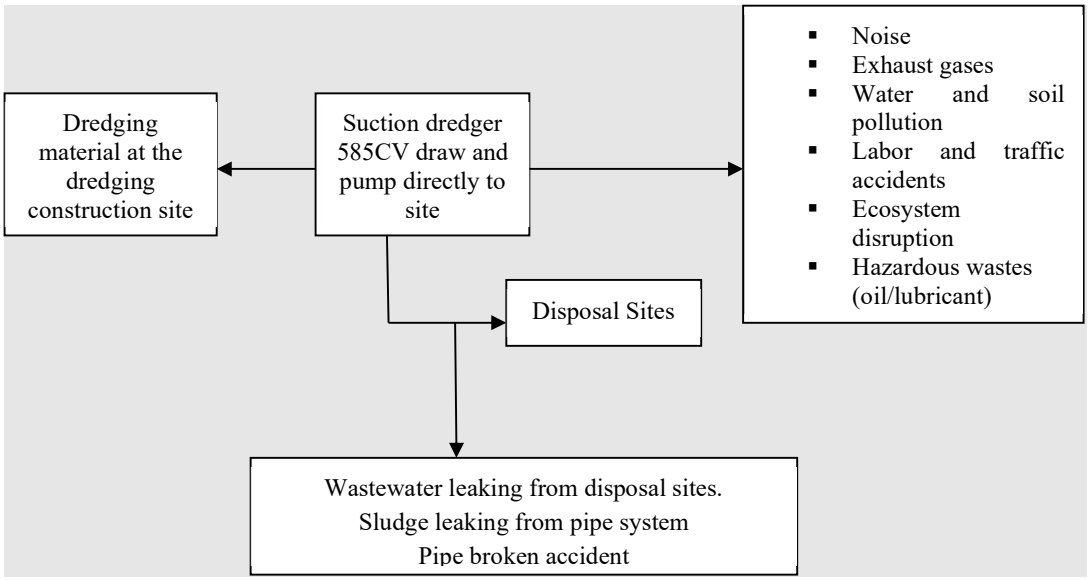


Figure 2.29. Dredging procedures and anticipated environmental issues

2.5.1.3. Main Dredging Methods

Construction methods include the following three main methods:

- Method 1: Draw and pump directly to the disposal sites using suction dredger;

- Method 2: Dredging with clamshell dredger or bucket dredger → transfer by barge to the disposal site.
- Method 3: Dredging with clamshell dredger or bucket dredger → transfer by barge to a transfer stations → draw and pump to the disposal site.

There are various types of dredging equipment available for executing capital dredging works. The following types of dredging equipment are commonly used for capital and/or maintenance dredging such as but not limited to:

- Trailing Suction Hopper dredger;

- Cutter Suction dredger;

- Bucket dredger;

- Backhoe dredger;

The use of grab/clamshell dredgers, backhoe dredgers or bucket dredgers for large scale dredging in the inland waterways is impractical and costly due to their low production rate and the need to double handle the dredged spoil i.e., load into barges and then unload barges and place on the land. Grab / clamshell dredgers can be deployed for certain locations where dredging quantities are low and accessibility for cutter suction dredgers is restricted i.e., close to bridge foundations and existing structures or where houses are encroached along the waterways.

Environmentally, the preferred dredging method is suction dredge / cutter suction dredge. These methods minimize the loss of sediment during the dredging. The dredged material is then conveyed to the disposal sites through pipes.

2.5.1.4. Construction methods of disposal site

To ensure safety in all dredging procedures, the Project owner will prepare the disposal sites (field, garden and residential land) in accordance with current regulations as follows:

Dike:

- Using excavator to build up dike at the site without existing bunds.
- Dike embankment: Using in site filling to embank the dike in a trapezoid shape with the dimension as follows:
- Width of Dike's crest: 0.5 m
- Width of Dike's top surface: 1.5 m
- Water prevention rubber: 0.4 m

Settling cell and confining cell:

- Organize settling basin and drawer suitable with each disposal site.
- Design the settling basin and drawer to minimize the risk of dike rupture.

Drainage system:

- For the installation of sludge pumping pipe from barge to disposal site
- Location of disposal site with crossing transportation road: install iron shelter on both sides of the pipe to ensure traffic safety.
- Location of disposal site without crossing road: install pipe to pump directly to the disposal site.

The disposal site illustrated in Figure 2.30 is designed with the following components:

- Girdle shaped dike: dike structure is filling soil (excavated at site), using excavator combine with drainage construction work. The dike dimension is: dike crest: 1.5 m in

width; dike height: 1.5 m; dike slope 1:1. The internal side will be covered with tarpaulin;

- Overflow gate: embank with filling soil and cover with tarpaulin, the gate base will be consolidated with sand sack to prevent erosion. The gate will be leveled up in accordance with the sludge dumping volume. The gate dimension is 1.5 m crest width; overflow level height of 1 to 1.2 m; the gate width of 3.5 m.
- Drainage system: to drain water from the disposal site to the river. The drainage will be designed in trapezoid shape and the dimension of 1.5 m base width; 1.5 m in height and slope ratio of 1:1.
- The discharge gate will be sheet piled, reinforced with sand sacks and covered with tarpaulin.
- The wastewater quality will be monitored during the construction phase.

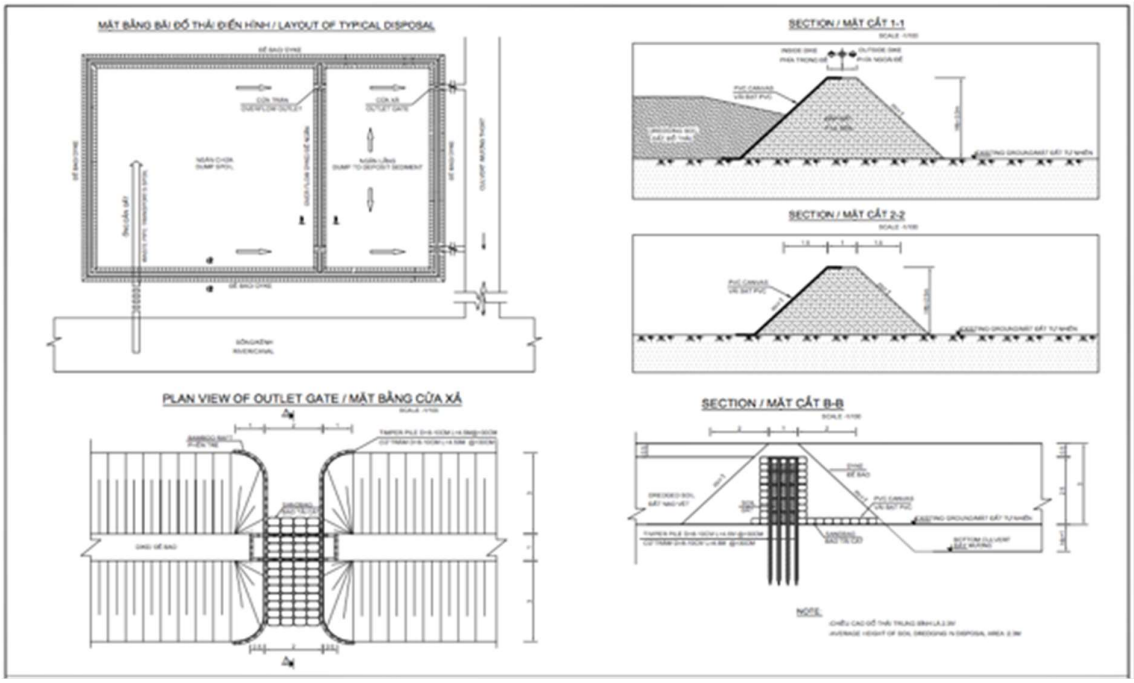


Figure 2.30. Typical Design of Disposal Site of the Project

2.5.2. Construction methods for river embankment

Within this project the following embankments are considered:

- Type A: Sloped embankments with concrete blocks and Reno mattresses

- Type B: Vertical embankments made of concrete sheet piles

The selected type of embankments is based on experience in Vietnam in general and the MKD in particular.

Embankment works will be implemented right after the completion of dredging activities.

2.5.2.1. Construction Method

Construction method with slope embankment (Type A)

- Using excavator and manual work to excavate soil, slope cutting and foot tray digging.
- Geo-textile lay down by barge and combines with diver.
- Install sheet pile for foundation improvement.
- Construct revetment foundation including gabion, blocking compound.

- Construct Reno mattresses under low water designed level by machine and combine with the diver.
- Construct filter layer including geo-textile and macadam course.
- Pave revetment slope by concrete block.
- Construct car barrier.
- Completion and hand over.

Construction method with vertical embankment (Type B)

- Revetment crests route alignment.
- Piling by hammerhead or ship piling.
- Sheet piling by vibrator hammer with water jetting.
- Revetment slope excavation.
- Filter layer construction.
- Construct rock formation inside the revetment.
- Construct Reno mattress to protect slope face.
- Construct head beam.
- Install handrail.
- Completion and hand over.

2.5.2.2. Construction Procedure

The procedure of embankment construction is showed in Figure 2.31.

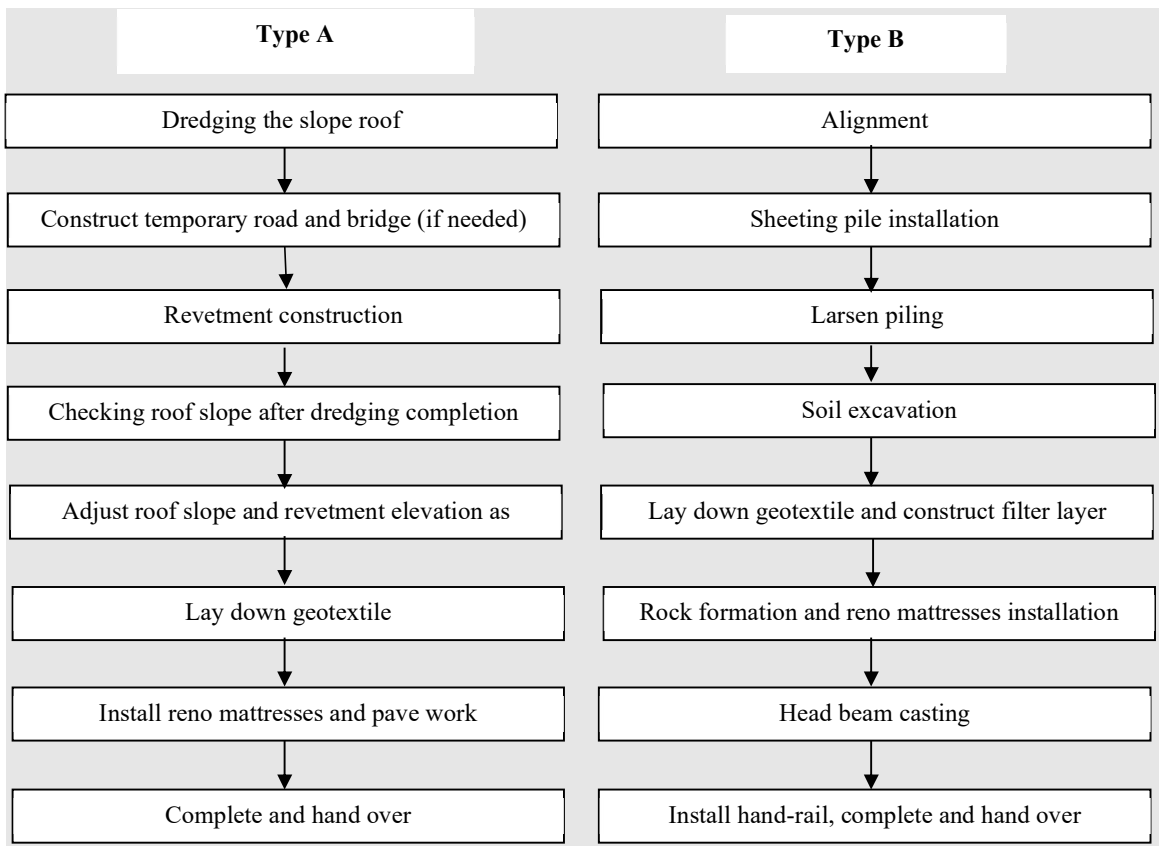


Figure 2.31. Embankment Method and Procedure Diagram

2.5.3. Construction methods for bridges

Regarding the type of bridge structure, different options are analyzed. Using a concrete bridge with a simple span, the maximum span length of 42 m is not enough. It is also possible to use

a balanced cantilever bridge, but this type of structure has a high cost, so it is mainly used when the bridge requires a large span, such as on the Mang Thit river. Cho Lach canal is relatively narrow, so it is not economical to use cantilever bridge

Cho Lach 2 Bridge is designed as a simple cable-stayed bridge similar to a cable-stayed bridge in Cho Gao Town, Cho Gao District, Tien Giang Province with a design load of 0.65HL93 (as proposed by the Department of Transport of Ben Tre Province at Document No. 3674/UBND-KT dated June 30, 2021, pedestrians 300kg/m2, bridge 6.5m wide (2x3+2x0.25) 364m long including 5 spans (25+52+110+52) +25m and two retaining walls at the bridgehead (50x2) m.

The construction of Cho Lach 2 Bridge will be implemented as follows:

Step 1: Construction site preparation

+ Old bridge demolishment: Demolish the old structure of the bridge

+ The bridge construction site in Cho Lach town has a high-density population so the site will be arranged along the route with buffer zone of 3 m from each side of the bridge structure. The mobile construction site will be allocated under the bridge abutment during abutment construction.

Step 2: Abutment construction

+ Waterside abutment and pier construction: Site clearance, piling, foundation pit excavation, construct abutment and pier in accordance with the design, completion.

+ Underwater pier construction: Auger-cast piles construction. Water prevention cofferdam, water pump out, foundation pit excavation, construct pier in accordance with the design, completion.

Step 3: Bridge span construction

+ Construct beams span first and approaches span later.

Step 4: Construction of barrier wall at bridge ends.

Step 5: Construction of bridge surface and frontage road

+ For existing route: rugged existing road surface. Construct bedding layer and new surface in accordance to the design.

+ For new route: filling bed layer and compaction work.

+ Construct pavement layer, consolidate as required.

Step 6: Construct other items

+ Construct drainage system, lightning system and other item in consistent with other construction works of the Project.

+ Implement environmental recovery.

2.5.4. Construction methods for irrigation and drainage outlets

The construction procedure of sluice/outlet is showed in Figure 2.32.

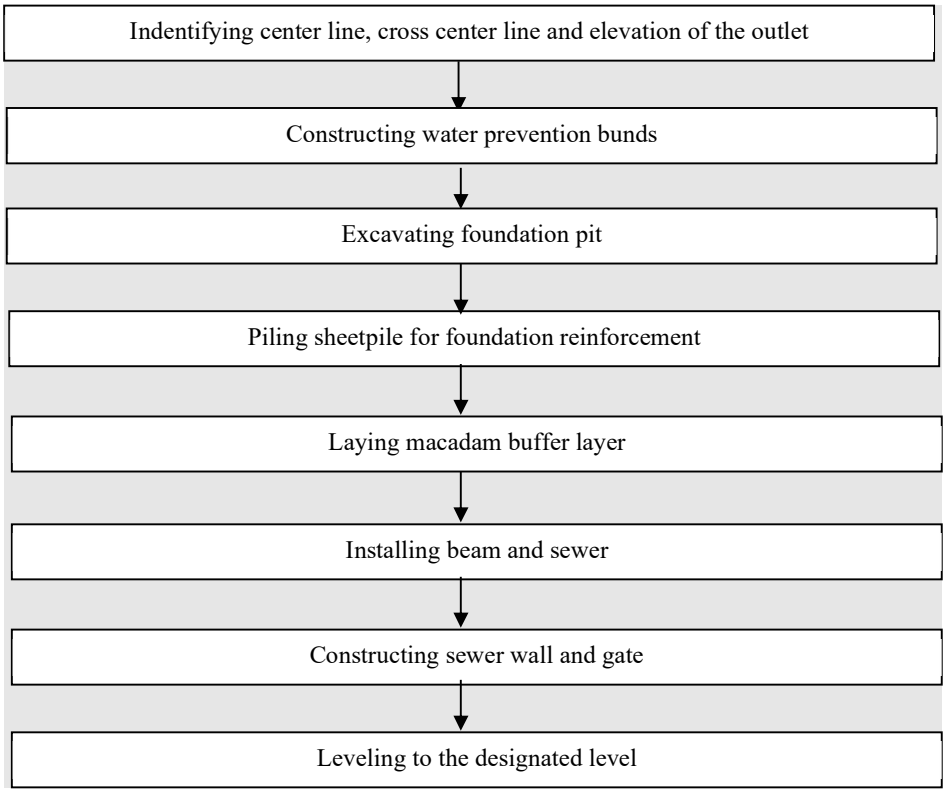


Figure 2.32. Sluice/Outlet Construction Procedure Diagram

2.5.5. Construction methods for local roads

The construction methods of local roads are illustrated in Figure 2.33:

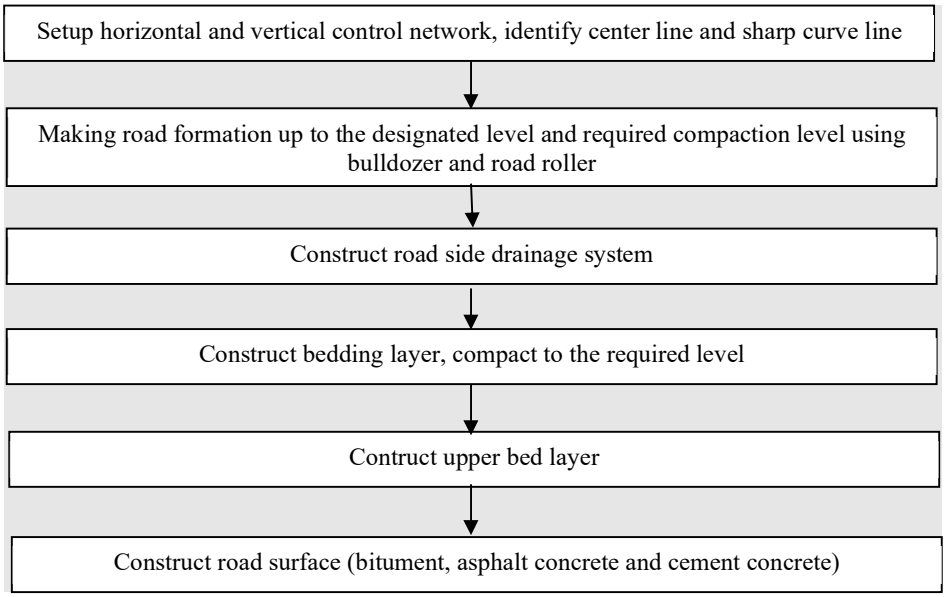


Figure 2.33. Local Road Construction Procedure Diagram

The construction methods of foot bridge connecting with local road are illustrated in Figure 2.34:

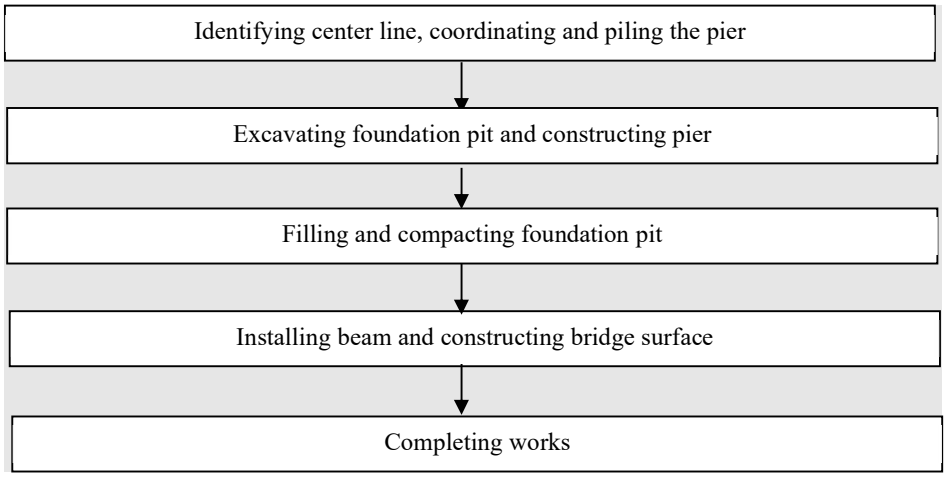


Figure 2.34. Foot Bridge Construction Procedure Diagram

2.5.6. Construction methods for navigational aids

Construction procedure and methodology is listed as follows:

2.5.6.1. Light and signal tower

- Determine position and coordination.
- Foundation pit excavation.
- Sheet pile piling.
- Foundation casting;
- Install tower frame.
- Install navigation aids like signal, light.
- Complete other works: painting, numbering…

2.5.6.2. Buoy installation

Install new buoys and relocate buoys

- Buoy making, pan casting, purchasing navigation aids. Buoy will be made at the mechanical workshop and checking before use.
- Transport buoy sets, chains, and pans to the installation site: Transport buoy set including chains, pans to the quay by truck with crane. The crane will lift the buoy set to the vessel. Vessel leaves the quay and goes to installation site.
- Buoy installation: Install anchor chain to the buoy, put pan in the right position, install navigation aids.

Buoyage:

- Coordinate to buoy location
- Bring buoy and auxiliary items to the assembly point
- Anchoring vessel and launch crane system
- Drop buoy pan
- Drop buoy
- Connect pan and buoy by chain
- Checking the buoy location follow the design.

2.6. LIST OF EQUIPMENT AND MACHINERY

Machinery and equipment used for Project construction are common equipment that have been deployed in similar river and canal dredging projects in Vietnam. Depending on the capacity of contractors for each construction works and sections, construction machinery and equipment

will be mobilized based on actual construction conditions as presented in Table 2.13.

Table 2.13. List of construction equipment and machinery

No	Equipment	Quantity
For dredging works		
1	Suction dredger HA97 4170 CV or equivalent	4
2	Suction dredger 1200 CV or equivalent	4
3	Suction dredger 585 CV or equivalent	4
4	Floating crane 30 tons	4
5	Clamshell dredger TC82 495 CV or equivalent.	4
6	Bucket chain excavator 1.6 m^3	4
7	Excavator 1.25 m^3	2
8	Other construction machines, material transportation machine	1
For bridge construction		
1	Excavator	6
2	Bulldozer	10
3	Dwelling machine	2
4	Roller	4
5	Crane	2
6	Truck	10
7	Hydraulic lifter	20
8	Generator	2
9	Hydraulic jack	20
10	Auger-cast pile machine	2
For embankment construction		
1	Automotive chain wheel diesel hammer	2
2	Vibrator hammer	2
3	Chain wheel crane 20 tons, 50 tons	4
4	Crane 10T	2
5	Truck	4
6	Excavator	4
7	Barge	4
8	Pressure pump	2
9	Piling machine	2
10	Roller	2
11	Concrete mixer 250 and 500 L	2
12	Bulldozer 180 CV	4
13	Trailing vessel 150 CV	4
14	Generator	2
For navigation aids replacement and installation		
1	Excavator	2
2	Barge 200 T	2
3	Trailing vessel 360 CV	1
4	Crane 10 T	2
5	Truck	2
For Local Road Construction		
1	Excavator	4
2	Bulldozer 108 CV	4
3	Macadam laying machine	4

No	Equipment	Quantity
3	Asphalt laying machine	2
4	Roller	2
5	Truck	5
6	Concrete mixer 500 l	2
7	Generator	1
For Irrigation and Drainage Outlets Construction		
1	Excavator	2
2	Concrete mixer	1
3	Truck	2
4	Roller	1
5	Generator	1
For Disposal Site Construction		
1	Excavator	2
2	Truck	2
3	Roller	1
4	Generator	1

2.7. DEMAND FOR CONSTRUCTION MATERIAL AND ENERGY SUPPLY

2.7.1. Demand for Raw Materials

The demands for raw materials providing for construction works of the Project are presented in Table 2.14:

Table 2.14. Type and Quantity of Main Raw Materials

Type	Unit	Quantity
Fined grain asphalt concrete	ton	117,382
Macadam 0,075-50 mm (base course)	m^3	1,445,908
High density steel cable	kg	4,089,708
Ground leveling sand	m^3	1,385,511
Coarse sand	m^3	24,206
Medium grain sand	m^3	50,227
Fine grain sand	m^3	162
Standing pile	pile	64,483
Cement concrete pile 35 x 35 cm	m	354,721
Cement concrete pile 40 x 40 cm	m	36,865
Wooden pile	m	3,913,718
Larsen pile IV	m	4,039
Reinforce concrete pile W740	m	115,266
Rip rap	m^3	141,638
Macadam 1x2	m^3	145,174
Macadam 4x6	m^3	10,493
Cement concrete beam DUL L = 24.54 m	piece	8
Supper T beam, L=38.2 m	piece	3,416
Pulling anchor head	piece	3,678
Nail (several types)	piece	3,844
Terrazzo brick 5 cm thickness	m^2	4,830
Cement brick 5.5 cm thickness	m^2	23,413
Anchoring cable 15.2 mm	piece	7,063

Type	Unit	Quantity
6 m-length centrifugal concrete pipe D1000 mm	m	344,855
Well casing Ø1200, steel 3 cm thickness	m	3,546
Well casing Ø1500, steel 3 cm thickness	m	7,377
Reno mattress (2 x 1 x 0.4) m	Piece	8,283
Reno mattress (2 x 6 x 0.3) m	Piece	19,321
Reno mattress (2 x 6 x 0.3) m	Piece	19,321
Shaped Steel	kg	2,937,420
Shaped Steel (m)	m	349,492
Hanging strap shaped steel	kg	66,764
Casing shaped steel	kg	10,362
Galvanized shaped steel	kg	742,355
Galvanized steel	kg	189,875
Tube galvanized steel	kg	2,900,042
Plate steel	kg	1,922,770
Rounded steel D<=18 mm	kg	23,782,613
Rounded steel D>10 mm	kg	3,906,365
Rounded steel D>10 mm	kg	3,906,365
Geo-textile	m^2	1,286,449
Cement PCB40	kg	47,359,054

2.7.1.1. Material supplying sources

- Cement: using cement from Holcim Factory, Ha Tien, Nghi Son cement or other kinds of equivalent cement meeting the technical requirement of TCVN.
- Steel: purchase from local construction material agent that meet technical requirement of TCVN.

Other materials will be purchased from the following mines:

Quarry

(i) ANTRACO:

- Address: Ro Leng village, Chau Lang commune, Tri Ton district, An Giang province. Managed and explored by: ANTRACO JSC.
- Capacity: 30,000,000 m^3
- Exploitation and expansion capacity: 1,000,000 m^3/year. Expansion capacity: 70 ha
- Transportation distance to Mang Thit River: 85 km through Mac Can Dung canal (or 8000 canal) and Hau River.
- The main rock here is Tuf Andesit and grey white Andesit. The quarry has provided rock for other construction projects in the region like National Road No.1; Can Tho Bridge; Vam Cong Bridge and other civil construction project in Southwestern area of Vietnam.

(ii) Chau Pha quarry (Lot No.0)

- Address: Tan Chau village, Tan Chau commune, Tan Thanh district, Ba Ria Vung Tau
- Owner: Ba Ria Vung Tau Trade and Production JSC.
- Address: 229 Cach Mang Thang 8 road, Ba Ria city, Ba Ria Vung Tau.
- Total area: 44 ha with capacity of 11 million m^3, production based on customer's demand, average annual production of 500,000 – 1,000,000 m^3.
- Distance to the Project site (Dong Tranh River) is about 30 km through Phu My - Toc Tien road and National Road No. 51.

- The rock is grayish blue rhyolite rock extract from Tuf Andesit and grey white Andesit. The quarry has provided rock for other construction projects in the region such as National Road No. 51; Long Thanh - Dau Giay Express way; provincial roads; district road and other civil construction projects in the South of Vietnam.

(iii) Thanh Phu 1 quarry

- Address: Thanh Phu commune, Vinh Cuu district, Dong Nai province.
- Owner: Bien Hoa Building Materials Production and Construction JSC.
- Address: K4/79c Nguyen Tri Phuong, Buu Hoa ward, Bien Hoa city, Dong Nai.
- Capacity: 45,000,000 m^3.
- Annual exploitation capacity: 2,500,000 m^3.
- Transportation distance from the quarry to Dong Tranh River is about 75 km via Dong Nai River.
- The rock is grayish blue rhyolite rock extract from Tuf Andesit and grey white Andesit. The quarry has provided rock for other construction projects in the region such as HCMC East-West Boulevard; Long Thanh - Dau Giay Express way; Thu Thiem Bridge and Sai Gon River tunnel; HCMC - Trung Luong Express way; N2 route; other roads and local civil construction works.

Filling soil mine

(iv) Tam Phuoc borrow sources

- Address: Tam Phuoc commune, Bien Hoa city, Dong Nai.
- Owner: Hoa An JSC, Bien Hoa branch.
- Capacity: 1,000,000 m^3. Provide as customer demands.
- Distance from the mine to National Road No. 51 is 3 km and from Road No. 51 to the nearest construction site in Dong Tranh River is about 35 km.
- Filling soil type is mixed grayish yellow and grayish brown clay. The mine has provided filling soil for other projects such as National Road No. 51; Long Thanh – Dau Giay express way; other roads and civil construction projects in the Southeastern area of Vietnam.

These mines/borrow sources do not only provide construction materials for this Project, but also for other projects of neighboring provinces. They are qualified and have approved license to provide construction material in the Project area. The demands for construction materials of the SWLC Project will not cause any opening of new mines.

The selection of specific contractors based on the specific technical requirements will propose mine of construction materials supply. Bidding and contract documents should ensure the material mines proposed by contractors must meet the technical requirements, certificate of permits of environmental protection and mining licenses.

2.7.1.2. Construction material yards

Construction material yard No.1

- Address: An Hoi 1 village, Tan An Hoi commune, Mang Thit district, Vinh Long.
- Owner: Le Thi Canh, Hoang Nam Private Enterprise.
- Material types:
  - Tan Chau coarse sand, Bien Hoa-Dong Nai coarse sand
  - Construction rock (different types)
  - Civil construction hollow brick

- Cement
- Iron and steel

- Price: market price
- The materials will be supplied on Mang Thit riverbank or transport to site on the demands.
- Construction material has been provided for civil construction works in the region.

Construction material yard No.2

Address: Go An village, Tan An Luong commune, Vung Liem district, Vinh Long

Owner: Phuoc Hung Private enterprise.

Material types:

- Tan Chau coarse sand, Bien Hoa-Dong Nai coarse sand.
- Construction rock (different type)
- Civil construction hollow brick.
- Cement.
- Iron and steel.
- Price: market price.

The material will be supplied on Mang Thit riverbank or transport to site on the demands.

Construction material has been provided for civil construction works, local road and bridge construction in the region.

Construction material yard No.3

Address: Village No.8, Tan An Luong commune, Vung Liem district, Vinh Long province.

Owner: Nguyen Khiem private trade enterprise.

Material types:

- Tan Chau coarse sand, Bien Hoa-Dong Nai coarse sand.
- Construction rock (different type)
- Civil construction hollow brick.
- Cement.
- Iron and steel.

Price: market price.

The materials will be supplied on Mang Thit riverbank or transport to site on the demands.

Construction material has been provided for civil construction works, local road and bridge construction in the province and surrounding area.

Construction material yard No.4

Address: Tan Thieng village, Tan An Hoi commune, Mang Thit district, Vinh Long province.

Owner: Hai Minh Material Construction shop.

Material types:

- Tan Chau coarse sand, Bien Hoa-Dong Nai coarse sand
- Construction rock (different type)
- Civil construction hollow brick
- Cement
- Iron and steel

Price: market price

The materials will be supplied on Mang Thit riverbank or transport to site on the demands.

Construction material has been provided for civil construction works, local road and bridge construction in the province and surrounding area.

Construction material yard No.5

Address: An Hoi 1 village, Tan An Hoi commune, Mang Thit district, Vinh Long.

Owner: Trinh Le Quan One Member Co Ltd.

Material types:

- Tan Chau coarse sand, Bien Hoa-Dong Nai coarse sand
- Construction rock (different type)
- Civil construction hollow brick
- Cement
- Iron and steel

Price: market price.

The materials will be supplied on Mang Thit riverbank or transport to site on the demands.

Construction material has been provided for civil construction works, local road and bridge construction in the province and surrounding area.

Construction material yard No.6

Address: Village No.3, Long An commune, Long Thanh district, Dong Nai.

Material types:

- Coarse sand, extracted from Dong Nai River
- Construction rock (different type)
- Civil construction hollow brick.
- Cement
- Iron and steel

Price: market price.

The materials will be supplied on Dong Nai riverbank or transport to site on the demands.

Construction material has been provided for civil construction works, local road and bridge construction in the province and surrounding area.

Construction material yard No.7

Address: Lang Cat commune, Tan Thanh district, Ba Ria – Vung Tau

Material types:

- Coarse sand, extracted from Dong Nai River
- Construction rock (different type)
- Civil construction hollow brick
- Cement
- Iron and steel

Price: market price.

The materials will be supplied on Thi Vai riverbank or transport to site on the demands.

Construction material has been provided for civil construction works, local road and bridge construction in the province and surrounding area.

2.7.1.3. Other construction material sources

Other material sources like cement, construction brick, and steel will be purchased from above-mentioned construction material yards. These material providers have been verified and licensed for the exploitation and purchase of building materials.

2.7.2. Demand for water supply

The water demand for a person in rural area is 60 liters/ day (TCXD 33-2006) or equivalent with 0.06 m^3 per day.

During the construction phase, the estimated number of workers is 300, and therefore total water demand is 0.06 x 300 = 18 m^3/ day.

Water supply source: The drinking water supply for workers is bottled water, purchased from local shops. River water will be used for washing and cleaning purposes with a simple treatment option of coagulation.

2.7.3. Power and fuel supply

The national electricity grid system already covers the entire provinces and areas where the Project construction works cross over, and therefore, the accessibility of power supply source for construction activities and operation management is quite easy.

In addition, standby generators will be arranged for ensuring smooth construction and operation activities in the case of power failure.

Oil and gas for the operation of construction machineries is provided by local businesses.

2.8. SOLID WASTES AND DISPOSAL SITES

Solid waste generated during construction phase requires disposal includes dredged and excavated materials, biomass for forested/vegetated land removal and topsoil excavated from the construction of the local road, bridges and embankment sections, domestic wastes from workers camps, debris from the demolition of existing structures and bridges, and construction wastes including some hazardous solid waste.

There are many options for disposing of dredged material, such as putting in dead-end canals, ponds, or in low-lying areas. For similar waterway projects in the past, the dredged material area was usually ponding and ditches or low-lying areas with the construction of embankments with storage/ settling compartments and draining water into rivers and canals after sludge deposition. In case of acidic soil, the dike banks should be covered with a PVC film to ensure that water does not penetrate through the dike. It is necessary to apply a lime layer on top of the deposited material.

Safety warning signs should be arranged at the dredging material area to avoid danger to people when the sediment has not yet consolidated. The disposal site should be located near the dredging area to limit the transportation distance as well as the cost of dredging. It is necessary to control the amount of dredged soil and sedimentation/drainage process at the construction sites to avoid overflowing the dyke and affecting the environment.

In project research report of 2017, Egis Consultants also conducted dredged material disposal area survey and collected 28 dredged material disposal areas including: 16 disposal areas along the Mang Thit river; 02 disposal areas in Cho Lach canal; 05 disposal areas in Rach La and 05 disposal areas along Dong Tranh river. The total capacity of the disposal areas is 10.2 million m^3 compared to the project's dredged volume of about 4,5 million m^3.

Disposal sites are proposed in accordance with location of dredging routes (waterways). The locations of disposal sites should be nearby the dredging areas in order to minimize

environmental impacts causing air pollution due to transportation and to reduce construction costs. The location and capacity of proposed disposal sites for the Project in Table 2.15 are initially identified.

Table 2.15. List of proposed disposal sites

No	Code	Location	Chainage	Area [ha]	Capacity [m^3]
Mang Thit river					
1	BD-01	Tra On town, Tra On district, Vinh Long	Km 0+200 - Km 0+600	6.2	142,600
2	BD-02	Tuong Loc commune, Tam Binh district, Vinh Long	Km 10+200 - Km 10+600	4.9	112,700
3	BD-03	Tuong Loc commune, Tam Binh district, Vinh Long	Km 11+400 - Km 11+800	5.7	131,100
4	BD-04	Tuong Loc commune, Tam Binh district, Vinh Long	Km 12+400 - Km 12+800	4	92,000
5	BD-05	Tuong Loc commune, Tam Binh district, Vinh Long	Km 13+500 - Km 14+000	10	230,000
6	BD-06	Tuong Loc commune, Tam Binh district, Vinh Long	Km 14+800 - Km 15+200	8	184,000
7	BD-07	Tuong Loc commune, Tam Binh district, Vinh Long	Km 15+800 - Km 16+200	10	230,000
7	BD-08	Tuong Loc commune, Tam Binh district, Vinh Long	Km 15+800 - Km 16+600	15	345,000
8	BD-09	Tuong Loc commune, Tam Binh district, Vinh Long	Km 17+000 - Km 17+800	10	230,000
9	BD-10	Xuan Hiep commune, Tra On district, Vinh Long	Km 17+900 - Km 18+700	20	460,000
10	BD-11	Xuan Hiep commune, Tra On district, Vinh Long	Km 17+800 - Km 18+200	9.7	223,100
11	BD-12	Xuan Hiep commune, Tra On district, Vinh Long	Km 19+200 - Km 19+800	7.5	172,500
12	BD-13	Xuan Hiep commune, Tra On district, Vinh Long	Km 19+200 - Km 19+801	2	46,000
13	BD-14	Hoa Hiep commune, Tam Binh district, Vinh Long	Km 19+200 - Km 19+802	7	161,000
14	BD-15	Tan An Luong commune, Vung Liem district, Vinh Long	Km 19+200 - Km 19+803	7	161,000
15	BD-16	Hoa Thanh commune, Tam Binh district, Vinh Long	Km 19+200 - Km 19+804	10	230,000
16	BD-17	Tan An Luong commune, Vung Liem district, Vinh Long	Km 19+200 - Km 19+805	2	46,000
Sub-total					**3,197,000**
Rach La canal					
1	BD-01	Binh Phu commune, Go Cong Tay district, Tien Giang	Km 2+200 - Km 3+000	17.6	528,000
2	BD-02	Dong Son commune, Go Cong Tay district, Tien Giang	Km 4+000 - Km 4+800	8.7	261,000
4	BD-03	Thanh Vinh Dong commune, Chau Thanh district, Long An	Km 5+300 - Km 5+800	8.1	186,300
3	BD-04	Thanh Vinh Dong commune, Chau Thanh district, Long An	Km 6+000	18.3	366,000
5	BD-05	Dong Son commune, Go Cong Tay district, Tien Giang	Km 7+700 - Km 8+200	11.7	269,100

No	Code	Location	Chainage	Area [ha]	Capacity [m^3]
Sub-total					**1,341,300**
Cho Lach canal					
1	BD-01	Son Quy commune, Cho Lach district, Ben Tre	Son Quy industrial zone	40	600,000
2	BD-02	An Phuoc commune, Mang Thit district, Vinh Long	An Dinh industrial zone	60	900,000
Sub-total					**1,500,000**

Source: Pre-FS, 2021

2.9. LABOR DEMAND

During the project implementation, during the project implementation, the PMUW will engage various contractors to implement various type of project works, including technical design, construction supervision, civil works construction, etc. The labor requirements for these works depend on the scale of each individual civil works. The timing of labor requirements will fluctuate depending on the construction stages. The different categories of contracted workers are anticipated below.

- **Skilled workers of the contractors/sub-contractors (Construction Company)**: Permanent technical staff of the contractors will be engaged in the project, including project managers, construction engineers, construction foreman, drivers, environmental and social officers, administrative, finance officers, etc. This number is estimated to be about 300 workers in total.
- **Unskilled workers engaged by the contractor/subcontractors**: To reduce a large number of migrant workers to construction sites, the project encourage the contractors and subcontractors to engage local unskilled workers for simple works such as construction of ancillary works, walls, excavation/levelling, loading/unloading materials, supporting for builders, site cleaners, watering construction sites, etc. To ensure equality in employment opportunities, contractors will be required, as part of their contract with PMUW, to coordinate with the PMUW to provide job opportunities to local residents who are poor or affected by the project and need jobs for extra income. Local female workers are encouraged to perform works that are suitable to them as per Labor Code 2019. Where needed, contractor may contact local mass organizations such as Women's Union to seek their support in recruitment of unskilled female workers. For this project, local unskilled workers mobilized for road construction are estimated to be around 90 people in total.

The total number of direct and contracted workers to be mobilized for project implementation is estimated to be around 390 persons. The number of workers by categories are identified in Table 2.16.

Table 2.16. Estimated number of workers engaged in the project

Type of project workers	Characteristics of project workers	Duration of labor mobilization	Estimated number of workers
Skilled workers engaged by the contractors	Mostly national technical permanent staff	Duration of labor mobilization vary, depending on construction stages and	300

Type of project workers	Characteristics of project workers	Duration of labor mobilization	Estimated number of workers
		needs.	
Unskilled workers	local workers	Duration of labor mobilization vary, depending on construction stages and needs	90
Total			**390**

Source: PMUW, 2021

The number of workers for each construction site is 20 – 70 (see Table 2.17). In order to reduce cost, create jobs for local people and limit social-environment impacts due to labor influx, local workers will be prioritized. Worker's camps are likely to be required during the construction and the awarded contractors will be responsible for finding the camp locations and ensuring the proper arrangement and sanitary conditions of the camps. The reality of current projects shows that contractors often rent houses from local people to save on construction costs of camps and sanitation systems. In the opposite case, the construction area of the camp varies from 100-150m2 at the construction site.

Table 2.17. Expected number of workers at the sites

No.	Construction site	Number of workers
Dredging works		
1	Mang Thit river	40
2	Cho Lach canal	30
3	Rach La canal	20
4	Ky Hon canal	20
Embankment works		
1	Mang Thit river	40
2	Cho Lach canal	30
3	Rach La canal	20
	Bridge construction	
2	Cho Lach 2 bridge	70
Local road construction		
1	Mang Thit river	50
2	Cho Lach canal	40
3	Rach La canal	30
Total		**390**

Expectedly, the number of workers will make up about 60%-70% of total labor at each site. No worker under 18 is allowed to work for the project. Their age ranges from 18 to 35; there is a small number of qualified workers or managed (about 5%) at aged 35-50. At each construction site, the percentage of male and female workers is 75% and 25%, respectively.

2.10. PROJECT BUDGET AND IMPLEMENTATION SCHEDULE

The Project cost is estimated at USD242.71 million, of which USD158.69 million is expected to be financed by the World Bank (WB); the USD83.44 million balance will be provided by the Government. In addition, the Government of Australia through the Aus4Transport Program will provide USD 0.58 million equivalent (excluding VAT) to finance the update of the Project feasibility study (FS) and the update of the Project environmental and social assessment instruments (ESAI).

The Project will be implemented from 2022 to 2026. The main milestones of the Project Implementation Plan are as follows:

- The project is intended to start when the Loan Agreement is signed at the middle of 2022 and will be completed in a 4-year period including contract finalization, report completion and a 12 months warranty period. The warranty period will be guaranteed by the contractor;
- For contractor selection for surveying, technical design and bidding documents, it is expected to start in May 2022, contracts to be signed in February 2023 and completed within 10 months;
- It is necessary to define land acquisition and resettlement requirements as early as possible during the detailed design stage. Because these activities take a lot of time and affect the construction progress of works. It is expected that the site clearance will be carried out from October 2023 to July 2024.
- Bidding and selection of construction contractors will be conducted from December 2023 to August 2024. The first construction and installation contracts are expected to be signed at 2nd Quarter 2024 to carry out construction. Construction works are expected to be completed and handed over in February 2026, not including warranty period.

2.11. PROJECT IMPLEMENTATION ARRANGEMENT

2.11.1. Ministry of Transport (MOT)

The Ministry of Transport as the lead agency will have overall responsibility for overseeing the project report implementation with the Government and in response to the World Bank's requirements. The Ministry of Transport will control the progress of the Project Implementation Plan.

MOT will approve bidding documents/requests for proposals, bid/proposal evaluation reports, bidding results and contracts in accordance with the Procurement Law. The Department of Transport Cost and Quality Management will review the above aspects of the Project and advise the MOT leaders for approval.

2.11.2. Project Management Unit – Waterways (PMUW)

PMUW will expectedly be the “implementing agency” for Components A, B include preparing and submitting to MOT, as required for approval, studies, detailed designs, bidding documents and contract documents. Subsequently PMUW will manage all the contracts for works, goods and consultancies for these two components.

PMUW is responsible for overall project management, monitoring implementation progress, and coordinating project activities including:

- Coordination and liaison between the Line Agencies, Project Owners, their Implementing Agencies, and other Ministries;

- Coordinating the implementation of site clearance in localities, reviewing audit reports, financial reports, social and environmental monitoring reports, project investment evaluation and monitoring reports and other studies and reports related to the Project;
- Monitoring the Project's physical and financial progress.

2.11.3. Project Financing Agencies

❖ ***DFAT – Aus4Transport***

The ESIA updates will be financed by the Government of Australia through the Aus4Transport Program. The engagement of the consultants and the financing of the services through the Aus4Transport Program are expected to expedite the recruitment and mobilization of the consultants and subsequently the delivery of the updated ESIA which meet the requirements of ESF.

❖ ***World Bank***

The WB will monitor SWLC Project implementation through the Quarterly Financial Management Reports, and bi-annual supervision reports twice a year by the PMUW.

Periodic Progress Reports will be prepared by all of the Technical Assistance Consultants carrying out their respective assignments. These reports once reviewed and approved by the Client, will then be submitted to the WB.

The WB will conduct Supervision Missions every six months and will conduct a mid-term review after about 24 months of implementation. The WB will work closely with PMUW to review the performance of Technical Consultants. The WB will be represented by a Task Team Leader, who will be responsible for the provision of all official communications between the WB and the SWLC Project's agencies.

CHAPTER 3. NATURAL, ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS OF THE PROJECT AREA

3.1. NATURAL CONDITIONS

3.1.1. Geographical location of the Project

The project area stretches along the rivers/canals of Mekong Delta (MKD) which is formed by the two major branches of the Mekong River – Tien and Hau rivers – and Southeast region (SER). The MKD consists of 13 provinces, including: Long An, Tien Giang, Ben Tre, Vinh Long, Tra Vinh, Can Tho, Soc Trang, Bac Lieu, Ca Mau, Kien Giang, An Giang, Dong Thap and Hau Giang. Geographically, it has a large area of 4,081.6 thousand ha including 2,615.6 thousand ha of agricultural production land, 254 thousand ha of forestry land, 248.2 thousand ha of specially used land and 28.2 thousand ha of homestead land (as of 2018). *(General Statistics Office of Vietnam, 2020)*

The Southeast region has an area of over 23,552.8 km² with the total population of 1,8342.9 thosand persons (as of 2020, *General Statistics Office of Vietnam)*. The Southeast region has one municipality under the command of the central government city directly under the central government, Ho Chi Minh City, and 5 provinces including Ba Ria - Vung Tau province, Binh Duong, Binh Phuoc, Dong Nai and Tay Ninh. The Southeast is the most developed economic region in our country, leading the country in terms of exports and investment.

Given their geographical location, both MKD and SER have a dense network of waterways (rivers, canals) and they play a vital role in the country's economy. SER is the global gateway of Vietnam, contributing up to 38% of the total GDP in 2020[12] while being located at the most downstream portion of the Mekong River Basin. MKD is the country's agricultural hub, contributing to 30% of the total GDP of Vietnam. Accordingly, the delta provides more than 56% of rice production, 60% of fruit production and 83.5% of shrimp and 98% of catfish products[13].

Importantly, SER is located in the Southern Key Economic Zone and MKD is adjacent to this key economic area and has a crucial two-way relationship with the main economic area of the country. Bordering Cambodia and sharing the Mekong River is a favorable condition for business exchanges and cooperation with other countries in the region. Further, the MKD occupies a coastline with more than 600 km in length and many archipelagos such as Tho Chu and Phu Quoc. Therefore, MKD is an essential gateway for international waterways between South and Southeast Asia as well as Australia and other Pacific islands.

The Project area is located in MKD and SER with two main waterways corridors: (i) East - West corridors from Can Tho port to HCMC and Cai Mep Thi Vai port complex (CMTV); and (ii) North - South corridor from Dong Nai port to CMTV.

The Project will be implemented in 29 communes/wards, belonging to 6 Provinces namely Ben Tre, Long An, Tien Giang and Vinh Long in MKD and HCMC, Dong Nai in SER as shown in Table 3.1 and the location of the two corridors is showed in Figure 3.1.

[12]https://congthuong.vn/vung-dong-nam-bo-va-ky-vong-but-pha-152001.html

[13]https://thoibaotaichinhvietnam.vn/nong-nghiep-dong-bang-song-cuu-long-tang-truong-voi-toc-do-cao-94164.html

Table 3.1. Administrative boundaries of the Project

No	Waterway segments	Communes/Wards	District	Province
1.	Mang Thit river, 46.4 km long	Tra On	Tra On	Vinh Long
2.		Thien My		
3.		Nhon Binh		
4.		Xuan Hiep		
5.		Loan My	Tam Binh	
6.		Tuong Loc		
7.		Hoa Hiep		
8.		Hoa Thanh		
9.		Tam Binh town		
10.		Tan An Luong	Vung Liem	
11.		Tan An Hoi	Mang Thit	
12.		Tan Long Hoi		
13.	Cho Lach canal, 7.9km long.	Hoa Nghia	Cho Lach	Ben Tre
14.		Son Dinh		
15.		Cho Lach town		
16.	Ky Hon canal 6.8km long	Long Binh Dien	Cho Gao	Tien Giang
17.		Xuan Dong		
18.		Hoa Dinh		
19.		Song Binh		
20.		Cho Gao town		
21.	Rach La canal 10.2km long	Thanh Vinh Dong	Chau Thanh	Long An
22.		Dong Son	Go Cong Tay	Tien Giang
23.		Binh Phu		
24.	Nuoc Man – Can Giuoc canal, 11.6km long	Phuoc Dong	Can Duoc	Long An
25.		Long Huu Tay		
26.		Long Huu Dong		
27.		Tan Lap	Can Giuoc	
28.	Tac Cua river, 6.0km long	Thanh An	Can Gio	Ho Chi Minh City
29.		Phuoc An	Nhon Trach	Dong Nai

Figure 3.1. The segments of East - West and North - South Corridors under dredging, bend correction, embankments and local roads construction

Note: The red and blue lines are segments of East – West and North – South corridors having construction activities including dredging, bend corrections, embankments and local roads.

The Project intervention areas include the rivers and canals with major civil engineering works of dredging, embankment, constructing bridge, local roads, irrigation and drainage outlets, navigational aids.

3.1.2. Topography

❖ ***HCMC and Dong Nai in SER***

The Southeast has large rivers such as the Dong Nai river system, Saigon River, Nha Be river, Soai Rap river, Thi Vai river, and Cai Mep river. These rivers have quite wide riverbeds and their depths; therefore, this is the place where the main sea ports of the region are located.

The terrestrial topography in this region is generally relatively flat, the riverine soils are of low elevation (average elevation from 0,40m to 1 m for field land), mainly mangrove or bare soil ares scattered along Tac Cua Rivers The topography is divided by small canals. The bottom elevation of these canals is from -0.5 m to -2.0 m below sea level on average.

❖ ***Mekong Delta region***

The topography is relatively flat and slightly low with the altitude reduce gradually toward the rivers and to the sea and generally in Northwest-Southeast direction. The popular altitude of the area is from +0.3 m to +3.0 m above sea level but varies from province to province. Tien Giang has the lowest average altitude with 0.8 – 1.1m above Mean Sea Level (MSL) and the slope

ratio is lower than 1% while Ben Tre has the highest absolute altitude, up to 3.5 m above MSL, especially in Cho Lach town with the absolute altitude up to 5 m above MSL[14]. Most of the Mekong Delta is strongly influenced by tides, floods in the rainy season, and lack of fresh water in the dry season.

3.1.3. Geological condition

3.1.3.1. Mekong Delta region (MKD) – the East - West Corridor

The MKD is formed by the deposition of fine-grained sediments from the Mekong River and the East Sea. The top layer consists of alluvial soil with very soft clay with a variety of thickness on hard clay and/or silt to fine silt.

The Project area contain a series of river/canal networks connecting with or distributing to two main river systems: Tien and Hau River with an area of 1.2 million hectares alluvial soil, accounting for 29.7 % of the region's natural land area and about one-third of the whole country's alluvial soil area. This soil group is a high fertility, and is suitable for rice crops, fruit trees, and short-term industrial trees.

MKD has Kanozoi loose sedimentary soil located on Mezoic bedrock, with considerable thickness, around 800-1,000 m. Sediment types can be classified into the following main layers:

- Holocene layer (QIV): located on surface to depth of about 35-48 m. This is young sediment, including sand and clay. Grain components are from fine to medium.
- Pleistocene layer (QII-III): The depth from 88 to 207 m, containing sand and gravel and clay with marine sediments.
- Pliocene layer (N2): The thickness from 304 to 359 m, containing sandy clay with medium particles.
- Miocene layer (N1): The thickness from 420 to 440 m, containing sandy clay with medium particles.

Irrigation and infrastructure facilities are mainly built on the Holocene layer which has soft sediments. This layer has a high clay content with lots of organic impurities, usually in water-saturated status, so it has poor load-bearing capacity. According to the survey documents for drilling work of My Thuan Bridge construction project in Vinh Long province, this layer has soft soil with poor load-bearing capacity so the foundation treatment is necessary before construction commencement. For canals, their banks contain soils with high content of dust and clay, usually in condition of water saturation. Therefore, during design, construction and operation management, it is necessary to have protection and treatment measures to prevent erosion along canals. Materials used for construction are only river sand and clay, and other materials must be transported from other places, such as Ha Tien or from Southeastern area of Vietnam (See Table 3.2).

Table 3.2. Geological properties of soil in the project area

Layer	Thick (m)	Soil consistency (B)	C (kg/cm^2)	Friction angle	HST (mm/day)
Layer 1	18	0.7 – 1.0	0.075	9 – 13	10
Layer 2	4- 13	1.65	0.03	26	10
Layer 3	3 -7	0.5	0.02	8	10
Layer 4	-	0.7 -1	0.05	29	10

[14] Web portal of Tien Giang, Long An, Ben Tre and Vinh Long PPCs

(Source: EIA - SUUP Vinh Long approved by DONRE, 3/2018)
Note: H.S.T is the permeability coefficient (mm/day.night), C is the cohesion coefficient

3.1.3.2. Southeast region – the North-South Corridor

References have been made to the Rach Dia - Rach Doi Dredging Project that shares the same geological settings of Southeast region with the surveyed depth is more than 30 m. The results are summarized as follows:

- *Layer 1a:* Topsoil layer (D): right on the ground, presents in on land borehole HK1 and HK3 with the thickness varied from 1.4 – 0.9 m. The main components are plastic to stiff clay, sand small gravel, and brownish black in color.
- *Layer 1:* High plasticity clay, (CH), very soft to lose clay: is observed in all boreholes with thickness varied from 9.0 m to 17.5 m. N – SPT value is 0 – 3. The main components are grayish black/ green clay. This is a weak soil layer and should be paid attention during the design and construction works.
- *Layer 2:* High plasticity (CL), soft plasticity: This layer presents in all boreholes. The thickness varied from 3.9 m to 5.1 m. N – Standard penetration test (SPT) value: 6 – 10. The main components are greenish grey soil/ clay mixed with brownish yellow color. The status of the layer is soft plasticity soil.
- *Layer 3:* Clayey sand, silt sand (SC-SM), loose medium dense: this layer presents in all boreholes. Its thickness varied from 9.7 m to 11.4 m. In borehole No. HK2 and HK3, this layer contains some small plastics to stiff clay layer with the thickness of about 1 m. N – SPT value is 10 – 36. The main components are medium to fine sand, mixed with clay, greenish gray with partly light yellow.

3.1.4. Climatic and meteorological conditions

3.1.4.1. Temperature

❖ ***Mekong Delta Region (MKD)***

It belongs to the tropical monsoon region with 2 seasons: rainy season (from May to November) and dry season (from December to April of the following year) with little unusual fluctuations.

Temperature characteristics of the Mekong Delta (MKD) region are summarized as follows:

- Average temperature: 24.9ºC – 25.2ºC.
- Highest temperature: 35.7ºC – 38ºC.
- Lowest temperature: 17ºC – 19ºC.

Due to climate fluctuations, the month with highest and lowest temperature of a year may change. Among monitoring years, 80-90 % has the highest average temperature in April and 10-20 % in May. The lowest average temperatures occur in January accounting for 85% of the time, while December accounts for about 15 % of the time among monitoring years.

The highest daily temperature occurs at 12 pm and the lowest temperatures usually occurs at 3-4 am. The biggest daily amplitude is in the dry season (7-8ºC) and the lowest is in the rainy season (6-7ºC); the absolutely lowest is 16.2ºC for a short time during the day. Average temperatures are above 35ºC and lasts 4-5 days in the dry months. The region has 206 days/year with an average temperature of 26.0ºC to 28.0ºC.

The climate of the MKD, which is almost always hot and often humid, is classified as tropical monsoonal conditions. In the warmest months of March and April, average temperature ranges

from 30ºC to 38ºC. Cooler temperatures prevail from November to February.[15]

The average annual rainfall is about 1400mm - 2000mm, mainly distributed in the rainy season, accounting for 90 to 95% of the annual rainfall.

The main wind directions in the rainy season are from the southwest and the west with the frequency of the month ranging from 40% to 70%, the monthly average speed from 3.9m/s to 4.9m/s; In the dry season is the Northeast and the East, the frequency fluctuates between 30% and 70%, the average speed is 5.9 to 8.9m/s. In December and January, there usually appear short-term, strong winds, sometimes blowing directly ashore, adversely affecting the coastal structures and boat operations in the estuary.

Storms and tropical depressions usually happen from October to December, but storms are also very rare. On average, it takes about 15 years ÷ 20 years for a storm to directly hit the area. The maximum wind intensity in a storm is usually only level 9, level 10.

❖ ***Southeast region***

Wind, storm

The Southeast has two distinct seasons, the rainy season starting from May to October and the dry season from November to April. The basic features of wind direction and speed are as follows:

- From April to November dominated by Westerly and Southwesterly wind.
- From November to March dominated by Easterly wind.

According to wind data at Vung Tau station, the average wind speed was about 3.10 m/s. The maximum wind speed is 26 m/s from the southwest direction and June. The maximum monthly average wind speed is 4,70 m/s in March and the lowest is 2 m/s in October.

Rainy season

In general, the rainy season in the Southeast is from May to October. The months with the lowest average rainfall of the year are from January to March.

Temperature:

- Average temperature : 26ºC.
- Highest temperature : 38ºC (April).
- Lowest temperature : 17ºC (December).
- Temperature amplitude in rainy season reaches 5.5ºC to 8ºC, in dry season reaches 5ºC to 12ºC.

3.1.4.2. Humidity

❖ ***Mekong Delta Region (MKD)***

The humidity pattern in the Mekong Delta is closely related to and influenced by the rainfall pattern. Annual relative average humidity is from 83.1% to 84.7%. September and October have the highest value of average relative humidity, ranging from 88% to 89.4%. January and February have the lowest average relative humidity, ranging from 76% to 81.2%.

❖ ***Southeast region***

The relative humidity is dependent on the heat regime, which is inversely proportional to the

[15] www.mrcmekong.org

heat regime, when the lowest temperature is the highest humidity. The air humidity is lowest at 1 – 2 pm of the day and increases at 7 am in the following day. Yearly, the average monthly humidity in the rainy season is higher than dry season. In accordance with the monitoring data of Southern Region Hydro-meteorological Center, the average monthly humidity in the rainy season is 76.6 %; the different humidity between months in the season is 13% in which September has the highest humidity in the year. The average monthly humidity in the dry season is 70 % to 75 %.

3.1.4.3. Evaporation and Rainfall Regime

❖ ***Mekong Delta Region (MKD)***

Evaporation regime: Annual average evaporation amount (Piche) of MKD is about 100 mm. In the dry season, because of much sunshine and low air humidity, evaporation amount is high. March has the highest evaporation with about 115 mm. In the rainy season, evaporation amount is lower compared to that of the dry season; September and October have the lowest evaporation amount that is 51-53 mm.

Rainfall regime: Mekong Delta has abundant and relatively stable annual rainfall. Spatially, annual rainfall variation is quite clear. The average annual precipitation of 1400-1900 mm is influenced by the monsoon pattern with a significant difference in rainfall between the rainy season and the dry season. The rainy season starts from May to the end of November, coinciding with the period of the southwest monsoon, accounting for 93 – 96 % of annual rainfall. The dry season begins in December and ends in April of the following year, coinciding with the northeast monsoon with a total rainfall making up 14 -17 % of annual rainfall.

The annual average number of rainy days in MKD is relatively high (on average 103-127 days/year). Similar to annual rainfall, the number of rainy days in a year tends to decrease gradually from the southwest side to the northeast side of the region.

During the rainy season, rainfall increases from May (154-216 mm) and reaches the highest level in September - October (215-329 mm), then gradually decrease, with lowest level in November average about 115-154 mm.

Hau River area has high rainfall, where the rainy season starts earlier than Co Chien River (in Can Tho and Dai Ngai). The average rainfall reaches 174 -216 mm in May while in Vinh Long and Tra Vinh, rainfall reaches only 154-173 mm.

During the dry season, except for the first and the last months of the season (December and April), rainfall is around 50 mm with approximately 3-8 rainy days. During the months in the middle dry season, rainfall reaches approximately 10 mm with 1-2 rainy days. February has the lowest rainfall from 2-8 mm.

❖ ***Southeast region***

Similar to humidity, the monthly evaporation value also varies seasonally. The evaporation value decreases from May to November in the rainy season and increases from December to April in the following year

Annual rainfall in HCMC varies between 1,200 and 1,900 mm. However, Tac Cua rivers in Can Gio coastal district have an average annual rainfall is less than 1,200 mm. The dry season starts in December to April in the following year.

The monthly rainfall also varies significantly. In the middle of the rainy season, Cv[16] ratio is about 0.3-0.6, in which August and September are the two months with stable rainfall amount

[16] CV ratio: Display the variation of rainfall in several years.

of the year. There are large variations in the beginning and ending months of the rainy season with Cv ratio reaches 0.5 to 1. In the dry season, due to limitation of the rainfall, rain events with about 100 mm coupled with squalls can make a great variation in the Cv ratio, from 1 Cv to 2 Cv.

3.1.4.4. Sunshine and Wind Regime

❖ ***Mekong Delta Region (MKD)***

Wind regime

Two windy seasons are made of the northeast and the southwest monsoons. The former usually starts from November in the northeast and a little bit later in the southwest, ending in April in the area near to East Sea and a little bit earlier in West Sea. The main component is eastern winds accounting for 50 to 70 % of all occurrences during the month.

The southwest monsoon normally starts from May in West Sea, a little bit later in the East Sea, usually ending in early October in West Sea and a little bit earlier in East Sea. The main component is western winds making up 40 -50 % of all occurrences during the month. The average wind speed is 1.2 to 2.5 m/s, the highest wind speed varies from 20 to 24 m/s.

Sunshine regime

Mekong Delta has a high number of sunshine hours. The average number of sunshine hours per year is from 6.4 to 7.7 hours/day. February, March and April have the highest number of sunshine hours (average 8-10 hours/day). The lowest number of sunshine hours (average 5-6 hours/day) falls in August, September and October. The high number of sunshine hours per day is favorable to plant growth and development, and is a good condition for intensive cultivation of short-day crops.

❖ ***Southeast region***

According to the general trend of the two-monsoon wind directions, every year, these wind directions appear in SER:

- The Northeast wind direction, from November/December - April/May, is the prevailing wind direction of the dry season and brings cold air from the North that is tropicalized to become hot and dry. Dominated by the terrain, the Northeast wind direction could be deviated to form secondary directions such as East, North, and East - Northeast.
- The Southwest wind direction, from May to November, is the prevailing wind direction in the rainy season, blowing from the Bay of Bengal, carrying moisture and is the main cause of rain for the season. The Southwest wind direction could be deviated to West or Southwest when it reaches this area.

3.1.5. Tidal regime

❖ ***Mekong Delta Region (MKD)***

In general, MKD is influenced by an irregular semi-diurnal tidal regime. The difference between the top bottoms of high tides is 2.5 - 3.5 m, and approximately 1.0 m of low tides. According to statistical data at regional hydrological stations, the highest water level in November is > 1.68 m and the lowest in the dry season is < 2 m (in June). The tidal amplitude is quite large (about 3.82 m), riparian zones have the average maximum tidal level is > 1.38 m falling in October - December; the lowest tidal level is < 2.44 m in April – May.

❖ ***Southeast region***

The area has a semi-diurnal tidal regime; most days of the month have 2 times of spring tide and 2 times of neap tide. The largest tidal amplitude of up to 3-4 m is one of the largest tidal amplitudes in Vietnam. The time between two tidal legs and two tidal peaks is usually about 12

hours to 12 hours 30 minutes. In one month, there are two times of high tides and two times of low tides. During the high tides of the year, which usually occurs from September to February of the following year, the low tide peak occurs from May to August. In the East Sea, the average tide water level is about 1.2 to 1.3 m, the peaks can reach 1.5 to 1.6 m and the average tidal water level from -2.6 to -2.8 m, the low tide legs can reach -3.0 m.

3.1.6. Water resources and hydrology

❖ ***Mekong Delta Region (MKD)***

River system

The two largest rivers in MKD are the Tien River and the Hau River. The Mekong separates at Phnom Penh into the main northern branch of the Mekong River – so called the Tien River after entering Vietnam and the southern branch of the Mekong River (Bassac River) that is called the Hau River after entering Vietnam. The network of these two main branches is summarized as follows:

- The Tien River is the main northern branch of the Mekong through Vietnam with the total length of more than 250 km. Its distributaries include (i) the My Tho River – flowing through Ben Tre and Tien Giang provinces with 45.3 km in length; (ii) the Ba Lai River – flows crossing Ben Tre province with 55 km in length; (iii) the Ham Luong River – stretching over Ben Tre province with 70 km in length; and (iv) the Co Chien River - 82 km long crossing through Ben Tre, Tra Vinh and Vinh Long provinces.
- The Hau River is the southern branch of the Mekong River with the total length of more than 200 km. It flows through Chau Doc, Long Xuyen districts (An Giang province); Vinh Long Province; Can Tho city; Chau Thanh district (Hau Giang province), and Soc Trang province before pouring to the East Sea through Dinh An and Tranh De estuaries.
- The Vam Nao River in An Giang province and Mang Thit River in Vinh Long province connect these two rivers. Besides the two major river systems, MKD also has a vast canal network, providing water sources for production, irrigation and domestic activities of the people. These canals also serve as the waterways connecting residential areas for trading purposes of local people.
- The water depth of Tien and Hau Rivers are increasing significantly in the last 10 years17 with 5-7 m increased in the period of 2008 - 2016. The changes of water depth level at some locations are illustrated in Figure 3.1 below.

[17] http://tuoitre.vn/vi-sao-song-tien-song-hau-sau-bat-thuong-1155532.htm

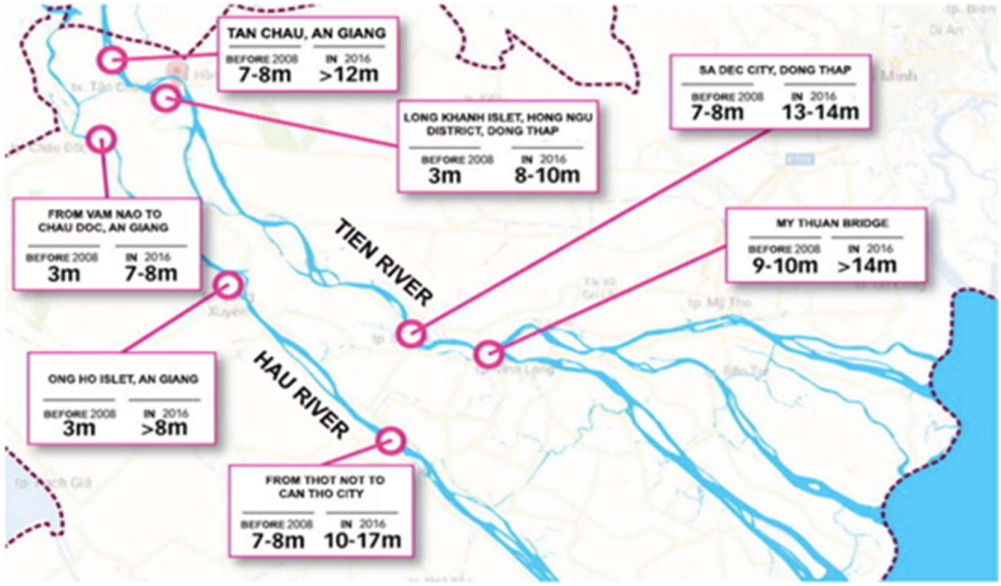


Figure 3.1. Changes in Water Depth at several locations along Tien and Hau Rivers (2008 – 2016)

Wave feature

Wave regime is influenced by northeast and southwest monsoons, and 2 transition months between these two monsoons.

- *Northeast monsoon*: waves are commonly in the North direction; wave altitude is high (approximately from 2 m onwards).
- *Southwest monsoon:* waves are commonly in the West and Southwest directions; wave altitude is lower than the one is the Northeast monsoon.

April and October are typical transition periods between the two monsoons, and therefore, the frequency of waves is fairly distributed all directions.

Surface water resources

The main water source of the MKD is river water of Mekong and rainwater. Both these sources are changing by seasons. The annually flow volume of Mekong River to the MKD is about 410 billion m^3, mainly distributed in 50:50 ratio via Tien River in Tan Chau and Hau River in Chau Doc and Vam Nao.

The surface water quality in the main river of MKD is evaluated in the range of 90-100 in water quality criteria (in accordance with the regulations of Ministry of Environment and Natural Resources (MONRE)) and could be used for domestic water supply.

Water in Mang Thit river serves as the source for two supply water treatment plants as follows:

- Vung Liem water supply station located in Trung Tin Hamlet, Vung Liem town, Vung Liem district, Vinh Long province. This plant has a capacity of 3,000 m^3/day.night with the water sources taken from Mang Thit river, at the segment flowing through Vung Liem town, Vung Liem district.

- Cai Nhum supply water plant, under Mang Thit Water and Environment joint stock company, located at No.143/4, Nguyen Hue street, Cai Nhum commune, Mang Thit district, Vinh Long province. This plant has a capacity of 1,200 m^3/day.night. The water source for this plant is the segment flowing through Cai Nhum commune along Mang Thit river.

Groundwater resources:

According to VNMC, the total groundwater resources of the MKD is 22,513,989 m^3/day with the safety volume for exploitation is 4,502,597 m^3/day. Current exploitation volume of MKD is 1,905,782 m^3/day. The two project provinces of Ben Tre and Vinh Long are the provinces with lowest daily exploitation volume of 213,727 m^3/day and 308,863m^3/day. Groundwater quality in accordance with QCVN 09-MT:2015/BTNMT is quite good and could be used for domestic water supply and irrigation purposes[18].

❖ ***Southeast region***

River system

The two main river systems in the region are Dong Nai River and Thi Vai River:

- Dong Nai River is the longest territory river in Vietnam with the total length of 586 km; covering 5 upstream provinces including: Lam Dong, Dak Nong, Binh Phuoc, Dong Nai, Binh Duong provinces before reaching the East Sea in Can Gio district, HCMC. Dong Nai River has 6 main tributaries comprising Da Dang river, Da Nhim river, Dai Nga river, Be river, La Nga river, and Sai Gon river.
- Thi Vai River is 76 km long, starts in Long Thanh district, Dong Nai province, flows through Dong Nai, Ba Ria Vung Tau and HCMC before discharging to the East Sea in Ganh Rai bay.
- The water catchment of Dong Nai River is about 37,330 km^2 and the density of river network varies from 0.5 to 1 km/km^2. The flow coefficient ratio of Dong Nai River is in medium level (μ=0.5). The downstream section of Dong Nai River is quite large. From Tan Uyen to the sea (about 143 km) the average width ranks from 1 to 4.5 km and the water depth is about 18 m.
- Thi Vai River has an average width of 400 to 650 m and average depth of 22 m; the deepest point is about 60 m. The river basin is the depression area; which creates a large pool of seawater during the high tide period.
- Sai Gon River – the section in HCMC has an average width of 225 - 370 m and average depth of 20 m.

Main ports in the region are concentrated along the Sai Gon River and the Thi Vai River such as Sai Gon port, Cai Mep port and CMTV port complex.

3.1.7. Mineral resources

The mineral resources in the project area by canal/river section are as follow:

- Mang Thit river: Poor mineral resources; River sand is distributed mainly in the rivers of Co Chien, Tien, Pang Tra, Hau with total reserves of 129.8 million m^3. Clay for production of brick, tiles and ceramic products has a reserve of 200 million m^3 of good quality.
- Cho Lach Canal: No kinds of mineral resources, which are economic values and large stocks for exploiting. Only few kinds of common minerals are construction materials with low reserves such as sand, clay, and brick.
- Ky Hon, Rach La Canal: Peat reserves of 5 million m^3 in Cai Lay and Tan Phuoc districts; Clay reserve in Cai Be district; Sand reserves of 93 million m^3 and annual exploitation of 33.5 million m^3 mainly in Tien River.
- Tac Cua River: Stones and paving stones, clay bricks and tiles, quartz sand, building sand, leveling materials.

[18] https://vnmc.gov.vn/luu-vuc-song-cuu-long/

3.1.8. Climate change situation

3.1.8.1. Basin-wide impacts of climate change on ecosystem services in the whole Project area

Water resource availability is recognized as crucial for agriculture, national economies and sustainable development in the Lower Mekong Basin (LMB) in general and in the Project area in particular to secure food productivity and livelihoods for more than 80% of its population (Mekong River Commission, MRC 2011). Further agricultural development is also important to support a rapidly increasing population and to improve human well-being in the region. Demand for agricultural products from the LMB is expected to increase 20–50% in the next 30 years to support world population growth (MRC 2015). Besides the provision of food and water, the LMB has become one of the most active regions for hydropower development. The total installed power capacity of 26 existing medium and large dams on tributaries of the Mekong River is approximately 27,000 MW but could potentially rise to 29,700 MW if all planned dams are completed (MRC 2011).

The overall amount of water is not limited in the LMB, but some areas could be affected by altered rainfall patterns due to climate change, particularly during the dry season from November through May. cultivation. Shrinking rice production in the LMB is a concern because it will affect the food security of an increasing world population and the livelihood of local communities. Furthermore, the water distribution system is limited and varies greatly across the LMB.

The downscaled climate data indicates that annual rainfall in the LMB is expected to increase from 1697 mm at the baseline to 1831 mm in 2030, and to 1968 mm in 2060 under the wetter overall GCM forecast. The maximum increment of 344 mm, or 20% from the baseline, is predicted in Vietnam in 2060. Low emissions (RCP2.6) would also increase temperature about 0.4 °C across the LMB. Rising temperatures (by 1.5 and 3°C) are expected for the medium emissions (RCP4.5) and medium climate sensitivity, and for high emissions (RCP8.5) and high climate sensitivity, respectively.

The estimated amount of annual water runoff in the entire LMB was 635 million m^3 and the average rainfall depth per pixel was 1024 mm, or approximately 59% of total rainfall. Contributions of annual flow from Vietnam was 78.1 million m^3. The highest runoff depth of 1314 mm, 65% of annual precipitation was found in LMB in Vietnam.

Although the growing season varies within the LMB and changes from year to year, the rainy season spans approximately late May to November. The LMB was divided into four classes for transplanting paddy based on mean temperature in growing season, water requirement in growing season, slope, effective root depth, and soil drainage.

The suitability assessment showed that almost 36% of the LMB was classified as highly suitable for rice and 20% was moderately suitable. In addition, 10.4% of the LMB was low or marginally suitable due to severe limitations of slope, water availability and soil texture. Furthermore, 34% of all paddy areas at the baseline was not suitable, meaning less than 20% of average yield productivity would be obtained from the high suitability class (FAO 1976). Under the predicted drier overall climate in combination with medium emissions in 2030, highly suitable areas for rice declines to 33%, and approximately 14% of the existing highly suitable class will be downgraded to moderately suitable, mainly due to a lack of available water in the growing season. Although the total extent of moderately suitable and low or marginally suitable classes now and in the future are similar, the spatial distribution would be significantly altered from class to class and place to place. For instance, approximately 25% of the current moderately suitable class was predicted to become low suitable (S3; 13%) and not suitable for paddy (N; 12%) in 2030 under the drier overall climate combined with medium emissions scenario.

Existing total irrigated area in the LMB is estimated at 4 million ha of which Vietnam accounts

for 56%, Thailand 36%, Cambodia 7% and Lao PDR 2%. Irrigation projects improve paddy from moderately suitable to highly suitable, that is, from 33.29% of total paddy area to 35.49%. However, irrigation only marginally improves low and not suitable classes due to limitations of erosion hazard and soil texture.

3.1.8.2. Sea level rise scenarios for the Mekong Delta region

The sea level rise scenario is built for the Mekong Delta in which Can Tho corresponds to three scenarios A1FI (high scenario), B2 (medium scenario), B1 (low scenario).

Relative sea level rise for the region is constructed according to future global average rise and past rise including observed data from oceanographic station and satellite according to linear equation. The estimates show that the correlation coefficient between global mean sea level rise and past sea level rise analyzed from satellite data and measured actual data is 0.65 and 0.64, respectively.

On that basis, the relative sea level rise scenario for the project area is presented as Table below. In the first 50 years of the century, sea level is predicted to rise at a slower rate than in the next 50 years (only about 20-25 cm/50 years). Under the high scenario, the sea level tends to increase faster than the low and medium scenarios. By mid-21st century, sea level rise is about 22-30 cm. At the end of the century, the highest sea level rise due to climate change for the Mekong Delta is about 79-99 cm for the high scenario and 51-66 cm for the low scenario, the medium scenario has 59-75 cm water level rise as shown in Table 3.3.

Table 3.3. Sea level rise scenarios due to climate change for the project area (cm)

Year	Scenarios		
	High	**Medium**	**High**
2020	8-9	8-9	8-9
2030	13-14	12-14	11-13
2040	19-21	17-20	17-19
2050	***26-30***	23-27	22-26
2060	35-41	30-35	28-34
2070	45-53	37-44	34-42
2080	56-68	44-54	40-50
2090	68-83	51-64	46-59
2100	79-99	59-75	51-66

3.1.8.3. Provincial climate change response action plans

❖ ***Climate change response action plan in Ho Chi Minh City***

The People's Committee of Ho Chi Minh City has just issued an action plan No. 3273/QĐ-UBND dated 08 September 2021, to respond to climate change for the 2021-2030 period, with a vision to 2050.

Accordingly, by 2030 the city strives to reduce emissions by 10% and move towards a low-carbon economy, this figure will increase to 30% if international support is available. In the period of 2021-2025, focus on perfecting mechanisms and policies on responding to climate change; implementing solutions, tasks and priority projects to improve capacity to respond to climate change and reduce damage caused by climate change; increase resilience and improves the adaptive capacity of the community, raise awareness to be ready to adjust to climate change. In the period 2026-2030, with a vision to 2050, the city will strengthen coordination and integration of activities in implementing solutions and tasks, improving the capacity of sectors, fields, economic sectors, and ecosystems to increase resilience to climate change.

Specific objectives in the period 2021-2025, focusing on perfecting mechanisms and policies on responding to climate change; inherit and implement priority solutions, tasks and projects in order to improve capacity to respond to climate change and reduce damage caused by climate change. Improve the effectiveness of climate change adaptation through strengthening state management of climate change, promoting the integration of climate change adaptation into city master plans and plans. Implement activities to reduce greenhouse gas emissions, take advantage of the opportunities of climate change to develop a low-carbon economy.

In the period 2026-2030, with a vision to 2050, continue to strengthen coordination and integration of activities in the implementation of solutions and tasks to improve the capacity of sectors, fields, economic sectors, communities and ecosystems to increase their resilience to climate change and be ready to adjust to climate changes. Improve resilience of infrastructure systems, adaptability of natural ecosystems and biodiversity; strengthen the resilience of natural ecosystems and protect and conserve biodiversity against the impacts of climate change. Promote adaptation actions that have co-benefits in mitigating climate change risks and are economically, socially and environmentally effective. Implement activities to reduce greenhouse gas emissions, take advantage of opportunities of climate change to develop a low-carbon economy.

Ho Chi Minh City focuses on a number of groups of solutions on strengthening institutional capacity, policies, science and technology solutions, mobilizing financial resources, and international cooperation to proactively respond to climate change in the 2021- 2020 period. 2030, vision to 2050 in Ho Chi Minh City.

For Construction and urban planning sector

Key activities of the construction and urban planning sector to combat climate change are as follows:

- Assessing impacts of climate change on new construction planning areas, building models of smart cities to cope with climate change, prevent flooding and upgrade drainage systems:
    - Control subsidence in the HCMC through the management of groundwater extraction, concreting and building permits to avoid exacerbating tidal flooding.
    - Research to take advantage of the natural low position and re-develop urban areas to create opportunities for water storage through construction of rainwater reservoirs, utilization of parks or vacant lots, and use of pavement lining materials. wet.
    - Develop a plan to help people adapt to the flood situation in a certain period of time, especially for areas identified as not yet suitable for protection by structural solutions, develop an appropriate plan respond, mobilize support so that people in the area can better adapt to life, and at the same time build a warning system for people to avoid incidents that cause damage to people and properties.
- Assess the impact of climate change on the supply of clean water and adjust the master plan on water supply taking into account the ability to cope with the impacts of climate change (water shortage, saline intrusion and pollution, etc).
- Ensure water source security, water supply safety (raw water reservoir, relocate raw water extraction point.).
- Reducing emissions of greenhouse gases in the fields of production of building materials, development of appropriate urban and construction works, and urban technical infrastructure.
- Perfecting institutions, mechanisms and policies to support and encourage enterprises producing building materials and construction works to invest in technology improvement, strengthen production management capacity, and build construction industry. program to reduce greenhouse gas emissions.

- Improve management capacity on GHG emission reduction in the management field of the construction industry.

For transportation industry:

- Assess the impact of climate change, develop the transport infrastructure system in the direction of improving resilience to climate change.
- Develop flexible transport infrastructure, adapting to climate change. Upgrading and improving traffic in areas often threatened by flooding and sea level rise.
- Promote the application of environmentally friendly technologies; encourage the use of renewable energy sources, clean energy in transportation.
- Propagate and raise awareness for organizations and individuals about climate change, green growth in transportation.

❖ ***Climate change response action plan in Vinh Long province***

Located in the center of the Mekong Delta,Vinh Long no longer has favorable weather conditions as before, but has become increasingly vulnerable to climate change.

According to Vinh Long's Department of Agriculture and Rural Development, climate change has resulted in more and more extreme types of natural disasters appearing in this locality, typically heavy rain, thunderstorms, and tornadoes, riverbank erosion, saltwater intrusion and storm surge.

Specifically, each year during the period of 2010 - 2020, Vinh Long has hundreds of damaged houses along with many crops and buildings damaged caused by storms and hurricanes. Most recently, in 2020, 332 houses collapsed and their roofs were blown off due to storms and tornadoes. In the first four months of 2021, 33 houses collapsed and their roofs were blown off.

Recently, although the flooding in the Mekong River is not large, in Vinh Long, the high tide has continuously increased, always at a high level. For many years, the tidal peak of the following year is higher than the previous year. The salinity of rivers and canals in the province is higher and penetrates deeper into the mainland than in previous years. Damage caused by natural disasters tends to increase over the years.

The People Committee of Vinh Long issued Decision No. 637/QD-UBND dated 23 March 2021 on the Climate change response action plan for Vinh Long province in the period 2021 – 2023, with a vision to 2050.

❖ ***Climate change response action plan in Dong Nai province***

To mitigate and respond to climate change, the Provincial People's Committee of Dong Nai has issued Decision No. 2728/QD-UBND on the Action Plan to respond to climate change in Dong Nai province for the period of 2021-2030, with a vision to 2050.

The climate assessment report of Dong Nai province issued at the end of July 2021 shows that Dong Nai is less heavily affected by climate change, but under the impact of urbanization, industrialization and population growth, factors such as: temperature, rainfall, drought, salinity intrusion change impacts on socio-economic development of the province.

In terms of temperature, the temperature tends to increase continuously throughout the province, with an average increase of 0.028-0.063^{o}C/year. In which, the southern region includes: Bien Hoa city and most of the districts of Long Thanh and Nhon Trach are areas recorded with high temperature factors. This is also the region with the highest temperature increase in the province. This result reflects the reality of the simultaneous impact of urbanization, increase in concrete surface area and climate change.

The total annual rainfall increases from 1,300-2,000 mm in the 2010-2015 period to 1,700-2,600 mm in the 2016-2020 period. The northern region includes the districts of Tan Phu, Dinh

Quan and Vinh Cuu with high annual rainfall intensity. Meanwhile, the South and Southeast regions such as Cam My and Long Thanh have low total annual rainfall. The increase and decrease in rainfall in these areas has caused phenomena such as landslides, drought, and saltwater intrusion.

❖ ***Climate change response action plan in Ben Tre province***

To mitigate and respond to climate change, the Provincial People's Committee of Ben Tre has just issued Decision No. 1012/QD-UBND dated 07 May 2021 on the Action Plan to respond to climate change in Ben Tre province for the period of 2021-2030, with a vision to 2050.

The action plan to respond to climate change in Ben Tre province in the period of 2021 - 2030 identifies 101 specific tasks, programs, schemes, projects and activities to achieve the nine set goals. Among them, there are a number of typical goals: strengthening resilience and improving adaptive capacity of communities, economic sectors and ecosystems; proactively ready to respond to natural disasters, reduce disaster risks and reduce damage caused by natural disasters and climate change.

Specifically, the province strives that by 2023, the system of irrigation works, freshwater reservoirs to regulate water against saline intrusion in the province will be completed and closed. By 2025, the province will be proactive in supplying enough fresh water for daily life and production in the context of natural disasters, saline intrusion and prolonged drought.

The province also replicates the models of farming and livestock with economic efficiency and climate change adaptation in the 2016-2020 period, in order to enhance the effectiveness of climate change adaptation. On the other hand, the province adjusts the cropping schedule to suit each ecological sub-region and is suitable when the system of irrigation works is completed and closed.

3.2. BASELINE ENVIRONMENTAL QUALITY

The project owner collaborated with the environmental monitoring unit namely the Center for Environmental Technology in Ho Chi Minh City (under the Institute of Environmental Technology – Vietnam Academy of Science and Technology, sub-contracted by ESIA consultant) to carry out baseline environmental analysis of the project area. Three rounds of sampling for environmental analysis were conducted in November 2021 and each round was 1 week ahead. This chapter also refers to some information collected from the ambient environment monitoring conducted in 2017, desk review of secondary data and information where relevant.

The Center for Environmental Technology in Ho Chi Minh City has been granted the Certificate of eligibility for environmental monitoring service activities number VIMCERTS 032 under Decision No. 1041/QD-BTNMT dated 05/05/2020 by the Ministry of Natural Resources and Environment to be an eligible environmental monitoring unit. Sampling locations and detail analysis results are presented in the Annex 2. Analysis results and comments on baseline environmental quality are presented below. The test results of environmental samples are compared with applicable Vietnamese standards, and EHSG standard where applicable.

3.2.1. Baseline monitoring results for ambient air quality

Air quality parameters taken on November 2021 in Mang Thit river, Cho Lach canal, Ky Hon canal, Rach La canal, and Tac Cua river shows that the contents of pollutants such as SO_2, CO, NO_2, and TSP are lower than National Standard on Ambient Air Quality QCVN 05:2013/BTNMT (per hour on average). This result shows that the ambient air quality in those waterways in 3 different rounds is relatively good, with no signs of pollution caused by socio-economic development and people's livelihood activities. The average of 3 rounds of analysis

results are shown in Table 3.4. The detailed monitoring result are shown in Annex 2.

Table 3.4. Baseline monitoring results of ambient air quality

No	Parameter	Unit	Baseline air quality					QCVN 05:2013/ BTNMT
			Mang Thit	Cho Lach	Ky Hon	Rach La	Tac Cua	
1	Temperature	°C	32	31.9	32	31.9	31.8	-
2	Humidity	%RH	62	62.3	61.5	62.4	62	-
3	Wind speed	m/s	1	0.8	1	0.7	0.8	-
4	Wind course	-	285NW	325NW	220SW	70NE	135SE	-
5	SO_2	µg/m^3	21	19.4	23.5	23.2	22.4	350
6	CO	µg/m^3	4008	5228	5	5251	3277	30,000
7	NO_2	µg/m^3	25	36.3	43.3	30.7	51.4	200
8	TSP	µg/m^3	60	58.3	46	35.9	23.3	300

QCVN 05:2013/BTNMT *- National technical regulation on ambient air quality (on average, per hour).*

As can be seen from the monitoring results as well as from the observation at site, there have been no extra projects implemented in the waterways routes of SWLCP since 2017, the ambient air quality in Mang Thit river, Cho Lach canal, Ky Hon canal, Rach La canal and Tac Cua river in three different rounds of environmental monitoring in November 2021 are quite the same. In comparison to the monitoring results conducted in 2017, the ambient air quality has had no significant change.

3.2.2. Baseline monitoring results for Noise

Noise levels measured in Mang Thit river, Cho Lach canal, Ky Hon canal, Rach La canal and Tac Cua river on Novembet 2021 are lower than National Standard on Noise QCVN 26:2010/BTNMT (in normal places, from 6h till 22h). This result shows that the noise level in waterways routes under SWLCP has no signs of pollution caused by socio-economic development and people's livelihood activities. In comparison to monitoring result conducted in 2017, there has been no significant change.

The average measurement results of 3 monitoring rounds are shown in Table 3.5. The detailed monitoring result are shown in Annex 2.

Table 3.5. Baseline noise level

No	Time of measurement *(November 2021)*	Noise level, Leq (dBA)					QCVN 26:2010/ BTNMT
		Mang Thit	Cho Lach	Ky Hon	Rach La	Tac Cua	
1	08h00'-09h00'	66.9	66.8	62.7	62.4	59.5	70
2	09h00'-10h00'	66.3	65.1	62.7	62.9	59.9	70
3	10h00'-11h00'	65.5	66.8	62.8	62.7	59.8	70
4	11h00'-12h00'	65.6	66.3	62.8	62.7	60.2	70
5	12h00'- 13h00'	64.4	65.2	62.6	62.7	59.8	70
6	13h00'-14h00'	66.8	64.5	62.8	62.7	59.5	70
7	14h00'- 15h00'	65.2	64.3	62.7	63.8	59.3	70
8	15h00'-16h00'	67	66.7	62.8	62.1	59.7	70
9	16h00'-17h00'	66.3	65.1	62.6	63.9	60.3	70
10	17h00'-18h00'	65.3	67	62.9	63.5	59.3	70

No	Time of measurement *(November 2021)*	Noise level, Leq (dBA)					QCVN 26:2010/ BTNMT
		Mang Thit	Cho Lach	Ky Hon	Rach La	Tac Cua	
11	18h00'-19h00'	65.4	66.5	62.7	61.9	59.7	70
12	19h00'-20h00'	64.3	65.3	62.6	63.7	59.9	70

QCVN 26:2010/BTNMT: *National technical regulation on noise.*

3.2.3. Baseline monitoring results for Surface water quality

The average test results of two surface water quality samples per each waterway taken in November 2021 (at the starting and end point of Mang Thit river, Cho Lach canal, Ky Hon canal, Rach La canal and Tac Cua river) in 3 different rounds are shown in the following table. Detailed monitoring results in 3 rounds are shown in Table 3.6.

Table 3.6. Baseline monitoring results for Surface water quality

No	Parameters	Unit	Mang Thit		Cho Lach		Ky Hon		Rach La		Tac Cua		QCVN 08-MT: 2015/ BTNMT *(B1 grade)*
			Starting point	End point	Starting point	End point	Starting point	End point	Starting point	End point	Starting point	End point	
1	pH	-	7.3	7.4	7.5	7.5	7.4	7.3	7.3	7.4	7.5	7.5	5.5 to 9
2	BOD_5 (20° C)	mg/L	15	**20**	**21**	**35**	**41**	**33**	**52**	**27**	**58**	**47**	15
3	Temperature	°C	29	29	29	29	29	29	29	29	29	29	-
4	Chemical Oxygen Demand	mg/L	29	**44**	**47**	**68**	**79**	**73**	**103**	**56**	**106**	**56**	30
5	Dissolved Oxygen	mg/L	5	5	5	5	5	5	5	5	5	5	≥ 4
6	Total Suspended Solids	mg/L	**110**	**98**	**89**	**88**	**105**	**120**	**84**	**80**	**338**	**282**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	ND (MDL = 0.02)	ND (MDL = 0.02)	ND (MDL = 0.02)	ND (MDL = 0.02)	ND (MDL = 0.02)	ND (MDL = 0.02)	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	ND (MDL = 0.30)	ND (MDL = 0.30)	ND (MDL = 0.30)	ND (MDL = 0.30)	ND (MDL = 0.30)	ND (MDL = 0.30)	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	ND (MDL = 0.03)	ND (MDL = 0.03)	ND (MDL = 0.03)	ND (MDL = 0.03)	ND (MDL = 0.03)	ND (MDL = 0.03)	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	ND (MDL = 0.001)	ND (MDL = 0.001)	ND (MDL = 0.001)	ND (MDL = 0.001)	ND (MDL = 0.001)	ND (MDL = 0.001)	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	ND (MDL = 0.0002)	ND (MDL = 0.0002)	ND (MDL = 0.0002)	ND (MDL = 0.0002)	ND (MDL = 0.0002)	ND (MDL = 0.0002)	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01

No	Parameters	Unit	Mang Thit		Cho Lach		Ky Hon		Rach La		Tac Cua		QCVN 08-MT: 2015/ BTNMT *(B1 grade)*
			Starting point	**End point**	**Starting point**	**End point**	**Starting point**	**End point**	**Starting point**	**End point**	**Starting point**	**End point**	
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	ND (MDL = 0.0004)	ND (MDL = 0.0004)	ND (MDL = 0.0004)	ND (MDL = 0.0004)	ND (MDL = 0.0004)	ND (MDL = 0.0004)	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	ND (MDL = 0.0003)	ND (MDL = 0.0003)	ND (MDL = 0.0003)	ND (MDL = 0.0003)	ND (MDL = 0.0003)	ND (MDL = 0.0003)	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	0.25	1.46	0.21	0.18	0.46	0.61	0.19	0.76	ND (MDL = 0.05)	ND (MDL = 0.05)	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	ND (MDL = 0.3)	ND (MDL = 0.3)	ND (MDL = 0.3)	ND (MDL = 0.3)	ND (MDL = 0.3)	ND (MDL = 0.3)	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1043	987	1043	987	1310	1043	6733	313	1367	1043	7500

Note: *QCVN 08-MT:2015/BTNMT: National technical regulation on surface water quality. column B1 - surface water for irrigation purposes or other uses with similar water quality requirements or intended use as type B2 (waterway and other uses with low quality requirements).*

The results showed that most of the parameters are within national allowable limits QCVN 08-MT:2015/BTNMT, however, BOD_5, COD and TSS exceeded the permissible standard as follows:

- In Mang Thit river: BOD_5, COD and TSS exceeded the permissible standard from 1.05 to 2 times.
- In Cho Lach canal: BOD_5, COD and TSS exceeded the permissible standard from 1.05 to 1.9 times.
- In Ky Hon canal: BOD_5, COD and TSS exceeded the permissible standard from 2 to 3 times.
- In Rach La canal: BOD5, COD and TSS exceeded the permissible standard from 1.5 to 3.5 times.
- In Tac Cua canal: however, BOD5, COD and TSS exceeded the permissible standard from 1.3 to 7 times.

As can be seen from the previous table, some parameters in the surface water exceeds the allowable limits under the national technical regulations on surface water. The pollutants are related to organic compounds and suspended solids, revealing that the excess of contaminants in surface water is probably caused by the movement of inland waterway vessel together with the domestic activities of local people. Besides, the concentrations of iron varied from the starting point to the end point of the canal, showing that there are several sources of pollution along the canal, contributing to the significant increase in the concentration of iron in water.

3.2.4. Baseline monitoring results for Groundwater quality

According to Article 28 on Monitoring of Water resource under Law of Water resources No. 17/2012/QH13 and Circular 17/2021/TT-BTNMT regulating the monitoring of groundwater exploitation and use, only units who exploit or use water recource have to conduct water quality monitoring. In fact, groundwater will not be exploited or used in the construction/operation phase of SWLC Project. In addition, based on the field work survey results, local people do not use ground water for either drinking/bathing or irrigation/fish farming, they use tap water provided by local supply water treatment plants. Therefore, groundwater was not sampled and analyzed for the baseline survey of SWLC Project.

For reference, the result of groundwater quality at proposed newly replaced Cho Lach bridge in the Project area which is cited from the project ESIA in 2017 is described in Table 3.7. This analysis result indicates that all monitoring parameters meet the national permitted limits of QCVN 09-MT: 2015/BTNMT.

Table 3.7. Groundwater quality near the construction site of Cho Lach bridge taken in 2017

No.	Parameter	Unit	Analysis Result	QCVN 09-MT:2015/BTNMT
1	Temperature	^0C	29.5	-
2	pH	-	6.23	5.5 – 8.5
3	Turbidity	NTU	ND (LOD= 2)	-
4	EC	S/m	0.024	-
5	Hardness	mg $CaCO_3$/L	100	500
6	Mn	mg/L	ND (LOD = 5.10^{-2})	0.5
7	As	mg/L	ND (LOD = 5.10^{-3})	0.05
8	Cd	mg/L	ND (LOD = 2.10^{-3})	0.005
9	Hg	mg/L	ND (LOD = 5.10^{-4})	0.001
10	Coliforms	MPN/100 mL	93	3

Notes:

- Sampling location: in the Cho Lach Canal, near old Cho Lach Bridge and Cho Lach town PC near the bridge construction site of Cho Lach bridge under SWLC Project.
- ND: Not Detected
- LOD: Level of Detection
- QCVN 09-MT:2015/BTNMT: National technical regulation on groundwater quality.

3.2.5. Baseline monitoring results for Sediment quality

The sediment quality in SWLC Project was referred to recent studies of sediment quality in the approved ESIA of typical projects nearby including:

- Project of dredging the Tien river waterway (Cua Dai) from Binh Thang dam to Thua Duc estuary, Binh Dai district, Ben Tre province, baseline monitoring was conducted in June and July 2020, the sampling locations were along the Mekong river

- Investment project of construction and upgrading of Cho Gao canal (phase 2), baseline monitoring was conducted in January 2021, the location of this project is in between Rach La and Cho Lach canal;

- Investment project of construction of Rach Mieu 2 bridge connecting Tien Giang province and Ben Tre province, baseline monitoring was conducted in June 2021. The project is deployed on a total length of about 17.6 km, starting point at Dong Tam intersection (intersection of National Highway 1 with provincial road 870) in Chau Thanh district, Tien Giang province; the end point on Highway 60, the section near Ham Luong Bridge in Ben Tre.

The SWLC Project has similar natural and geological conditions, and also has some intersection points with the projects mentioned above. The monitoring results of sediments in those projects show that all analysed heavy metals meet the permissible standard as in QCVN 43:2017/BTNTM. The detailed monitoring results are showed in Table 40, 41, 42 of Annex 2.

From a scientific perspective, environmental quality objectives for sediments are primarily driven by the aquatic life and ecosystem services associated with a body that are valued either inherently or by society [19]. There has been no big change in the waterways under SWLC Project since 2017 monitoring round, therefore, the sediment quality is likely to remain unchanged. Referring to the monitoring results in 2017, the baseline monitoring results for sediment quality showed that all monitoring parameters meet the allowable level of QCVN 43:2012/BTNMT as presented in Table 3.8.

Table 3.8. Sediment Quality in the Project Area taken in 2017

Parameter	**Analysis Result** *(mg/kg)*						**QCVN 43:2012/ BTNMT** *(mg/kg)*	**QCVN 43:2017/ BTNMT** *(mg/kg)*
	TT1	TT2	TT3	TT4	TT5	TT9		
Cd	ND (LOD = 1.10^{-3})	ND (LOD = 1.10^{-3})	ND (LOD = 1.10^{-3})	ND (LOD = 1.10^{-3})	ND (LOD = 1.10^{-3})	ND (LOD = 1.10^{-3})	**3.5**	**3.5**
Pb	27.9	18.5	12.6	12.2	15.8	19.6	**91.3**	**91.3**
Cu	9.40	20.0	9.50	ND (LOD = 1)	17.7	16.4	**197**	**197**
Hg	ND (LOD =0.01)	ND (LOD =0.01)	ND (LOD =0.01)	ND (LOD =0.01)	ND (LOD =0.01)	ND (LOD =0.001	**0.5**	**0.5**

[19] Kwok, Kevin & Batley, Graeme & Wenning, Richard & Zhu, Lingyan & Vangheluwe, Marnix & Lee, Shirley. (2013). Sediment quality guidelines: Challenges and opportunities for improving sediment management. Environmental science and pollution research international. 21. 10.1007/s11356-013-1778-7.

Parameter	Analysis Result *(mg/kg)*						QCVN 43:2012/ BTNMT *(mg/kg)*	QCVN 43:2017/ BTNMT *(mg/kg)*
	TT1	TT2	TT3	TT4	TT5	TT9		
Zn	85.5	76.9	62.5	18.7	89.3	119	**315**	**315**

Notes:

- Monitoring locations: TT1 – Mang Thit river, near the confluence with Tra On River, Tra On town, Tra On district, Vinh Long province; TT2 – Mang Thit river, near Tam Binh town, Tam Binh district, Vinh Long province; TT3 – Mang Thit river, under Mang Thit Bridge, Tan An Luong commune, Vung Liem district, Vinh Long province; TT4 – Mang Thit river, near the confluence with Co Chien River, Mang Thit ferry, Chanh An commune, Vung Liem; TT5 – Cho Lach Canal, near old Cho Lach Bridge and Cho Lach town PC; TT9 - At Thanh Vinh Dong ferry on Rach La canal, Thanh Vinh Dong commune, Chau Thanh district, Long An.
- ND: Not Detected
- QCVN 43:2011/BTNMT: National Technical Regulation on Sediment Quality.
- QCVN 07:2009/BTNMT: National Technical Regulation on Hazardous Waste Thresholds.
- QCVN 03-MT:2015/BTNMT: National Technical Regulation on the allowable limits of Heavy Metals in the Soils.

Remarks:

The monitoring results of sediment samples are compared with QCVN 43:2012/BTNMT – National technical regulation on sediment quality. The results show that:

- In comparison with QCVN 43:2012/BTNMT for freshwater sediments, all measured values of 10 sediment samples meet the national regulated standards.
- As monitoring sediment and sludge samples meet the requirements of QCVN 03-MT:2015/BTNMT (limits of heavy metals in the soils), these are favorable for the management practices of dredging sludge and sediments. The dredged sediments and sludge can be disposed at landfills for being treated as solid wastes. These dredging materials can be also used for leveling at nearby households or can be used as fertilizer for trees.
- In fact, newly dredged material has a high amount of organic compounds and pathogenic microbial (e.g. *E. Coli*), thus should not be used directly for agricultural purpose. This could rather be drained out and kept at least 03 months enabling to remove the microbial and partial decomposition of organic compounds. The sediments could then be used for perennial crops or planting tree for urban landscape purpose, based on the actual needs of local people. Otherwise, it will be transported and disposed at temporal disposal sites.

Referring to an example of a project implemented in a similar agriculture land area recently funded by the World Bank under Vietnam Scaling up Urban Upgrading Project, Vi Thanh city subproject of Hau Giang province since 2017: The canals to be dredged within the above project area directly receive wastewater from urban areas and intensive rice fields as well as water transportation. In this subproject ESIA, the total hydrocarbons, pesticides with Cl^- and P^- radicals in sediment samples had been analyzed, all samples resulted in non-detection *(please refer detail in the Table 2.11, page 49-50 of Vi Thanh city subproject).* Accordingly, in Vinh City Priority Infrastructure and Urban Resilience Development Project, the field sampling of sediment samples in Vinh river, Hoa Loc and Hoa Thai canals for testing pesticides were conducted by ESIA consultants. Of which, three sediment samples including one sample in Vinh river at 200m downstream of Vinh, Ke Gai and Dao rivers junction point and two samples in Hoa Loc and Hoa Thai canals were taken and analyzed for the concentration of pesticides in dredged materials. The monitoring showed that the level of residual pesticides in dredged materials in those locations were not detected. In the SWLC Project, there is no source of wastewater discharging directly to the waterways, therefore, the possibility of pesticides

appearing in dredged materials is low and it is unnecessary to analyze the concentration of pesticide in dredged materials.

3.3. BIOLOGICAL RESOURCES

From the experience in similar projects, the impact corridor is set at 500m from the banks to the outside, 1km in the upsteam area and 2-5 km in the downstream area from the dredging/embankment locations. The biological resources for MKD and SER will be identified and assessed accordingly.

3.3.1. Wetlands of international importance under Ramsar Convention [20]

Vietnam became a member of the Ramsar Convention in 1989. So far, nine wetlands in the country have been recognised as Ramsar sites – wetlands of international importance. Among the nice Ramsar wetlands, there are five wetlands which are located in the South including:

- Bau Sau Wetlands and Seasonal Floodplains – habitat of Siamese crocodiles (Dong Nai province)
- Tram Chim National Park (Dong Thap province)
- Mui Ca Mau National Park – three sides bordering the sea (Ca Mau province)
- Lang Sen Wetlands Reserve (Long An province)
- U Minh Thuong National Park (Kien Giang province)

3.3.1.1. In the SER region

❖ ***Bau Sau Wetlands and Seasonal Floodplains – habitat of Siamese crocodiles (Dong Nai province)***

In 2005, Bau Sau Wetlands and Seasonal Floodplains, part of Cat Tien National Park in the southern province of Dong Nai, was designated as the 1,499th Ramsar site in the world and the second in Vietnam.

Bau Sau (Crocodile Lake) Wetlands and Seasonal Floodplains. 04/08/05; Dong Nai; 13,759 ha; 11°28'N 107°23'E. Cat Tien National Park. A freshwater complex and transition zone between the Great Annamite ecoregion and lower Mekong Delta with Vietnam's last remaining lowland semi-evergreen forests representative of the Indo-Chinese region. Bau Sau is a key habitat for 50 very rare IUCN red-listed species like Siamese Crocodile, Asian Arowana, Black-shanked Douc, Asian Elephant, Wild Gaur, Yellow-cheeked Crested Gibbon and Smooth-coated Otter, 131 endemic fish and 6 species of turtles, tortoises and terrapins. Several red-listed birds include Pseudibis davisoni, Cairina scutulata, Grus antigone and Leptoptilos javanicus, and plants Dipterocarpus dyeri and Diospyros mun. Despite human activities such as subsistence fishing, hunting and collection of wood products, it is the best-conserved and almost pristine habitat of the national park as a result of enhanced protection by local management. It also serves as a floodwater retention reservoir with significant flow regulation protecting populated downstream localities. An ecological threat arises from invasion of exotic Mimosa pigra and water hyacinth bringing succession from open water to swamp vegetation. Conservation efforts include control of invasive species, crocodile census, waterbird surveys, awareness raising and range patrolling. Other rare animal species here include Asian elephant, sun bear, Asian black bear and tiger. Bau Sau is also home to the Siamese crocodile, which is listed as critically endangered in Vietnam's Red Data Book (2007) and on the International Union for Conservation of Nature (IUCN) Red List (2012).

[20] https://rsis.ramsar.org/

The map of this wetland in shown in Figure 3.2.

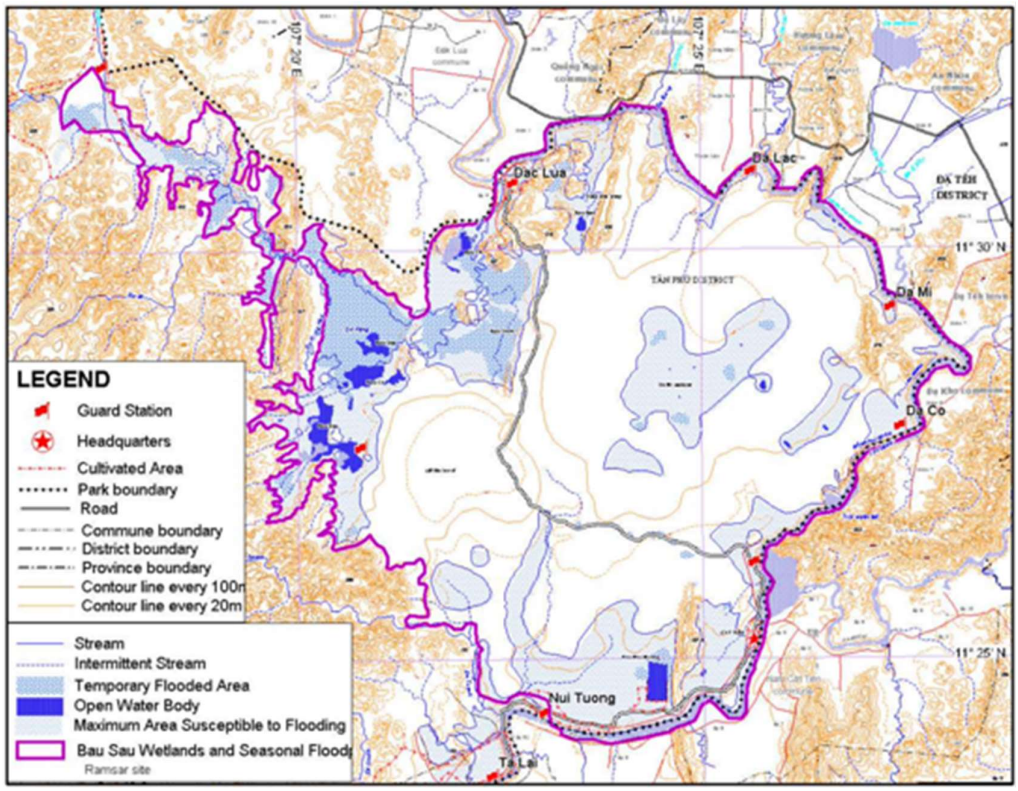


Figure 3.2. Map of Bau Sau wetland

This wetland is located in Cat Tien National park, and as shown in Figure 3.2, this wetland is about 100km from the nearest point in North-South corridor. Therefore, it is not within the impact corridor of the SWLC Project.

3.3.1.2. In the MKD

- ***Tram Chim National Park (Dong Thap province)***

Tram Chim National Park in the southern province of Dong Thap was named the 2,000th Ramsar site in the world and the fourth in Vietnam in 2012.

Tram Chim National Park (7,313 hectares, 10°4249N 105°3012E) is one of the last remnants of the Plain of Reeds wetland ecosystem, which previously covered some 700,000 ha of the Mekong Delta in southwestern Viet Nam. The site is one of the very few places in the region where the Brownbeard Rice (Oryza rufipogon) communities survive. The wetland supports 9 bird and 5 fish species that are globally threatened, including the critically endangered Bengal Florican Houbaropsis bengalensis and the Giant Barb Catlocarpio siamensis. The site regularly supports more than 20,000 waterbirds in the dry season, and more than 1% of the population of 6 waterbird species, especially the Easter Sarus Crane Grus antigone sharpii. The near natural landscape of the park serves to break wave energy during the flood season, helping to protect the houses of about 20,000 people along its eastern and southern dykes, as well as having a significant capacity to mitigate the damage from floods and droughts for the downstream part of the Mekong Delta. The beautiful landscape of the park attracts visitors internationally. The site has historical values as during the American-Vietnam war many battles took place in the plain. The park is a rich source of grass for fodder, trees for fuel and, most importantly, fish, which provide the main source of protein for local people. Tram Chim is one of the demonstration sites of the Mekong River Basin Wetland Biodiversity Conservation and

Sustainable Use Programme, Phase I, implemented by IUCN, the Mekong River Commission (MRC), and UNDP, with funding from UNDP/GEF and SIDA. The goal of the programme is to assist countries in the Lower Mekong subregion to develop new approaches to integrating the protection and sustainable use of wetland biodiversity with economic development, including ecotourism development. Recently, from 2007 to 2011, WWF supported Tram Chim National Park with a series of research and pilot activities to rehabilitate the natural habitats.

The map of this wetland in shown in Figure 3.3.

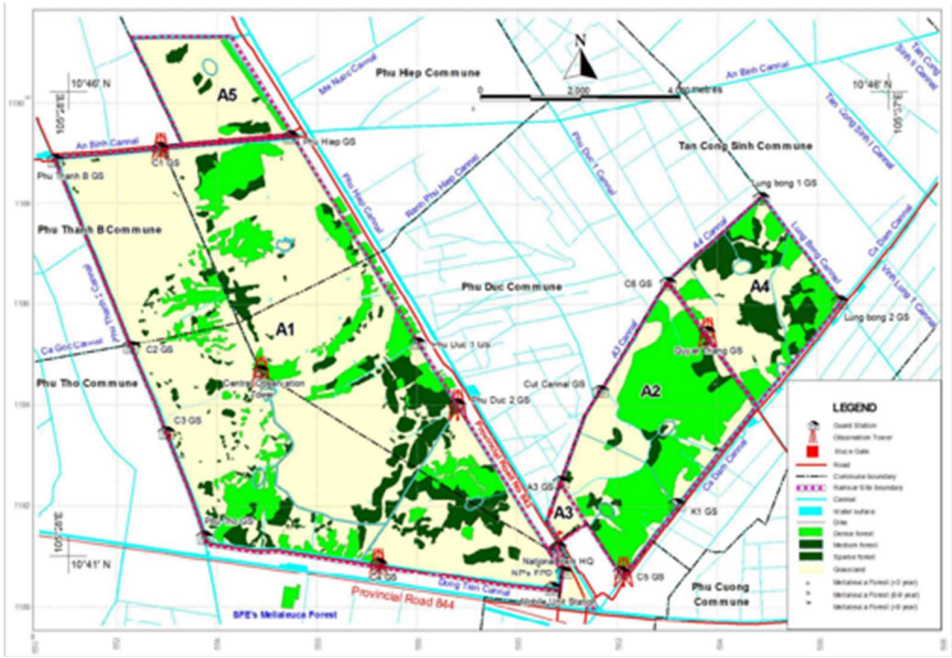


Figure 3.3. Map of Tram Chim National park

This wetland is located in Tam Nong district, Dong Thap province and is about 74km away from the nearest point in East – West corridor. Therefore, this wetlend in not within the impact corridor of the SWLC Project.

- ***Mui Ca Mau National Park – three sides bordering the sea***

Also in 2012, Mui Ca Mau (Ca Mau Cape) National Park, in the southernmost province of Ca Mau, entered the list of wetlands of international importance, becoming the 2,088th of its kind in the world and the fifth in Vietnam. The map of this wetland in shown in Figure 3.4.

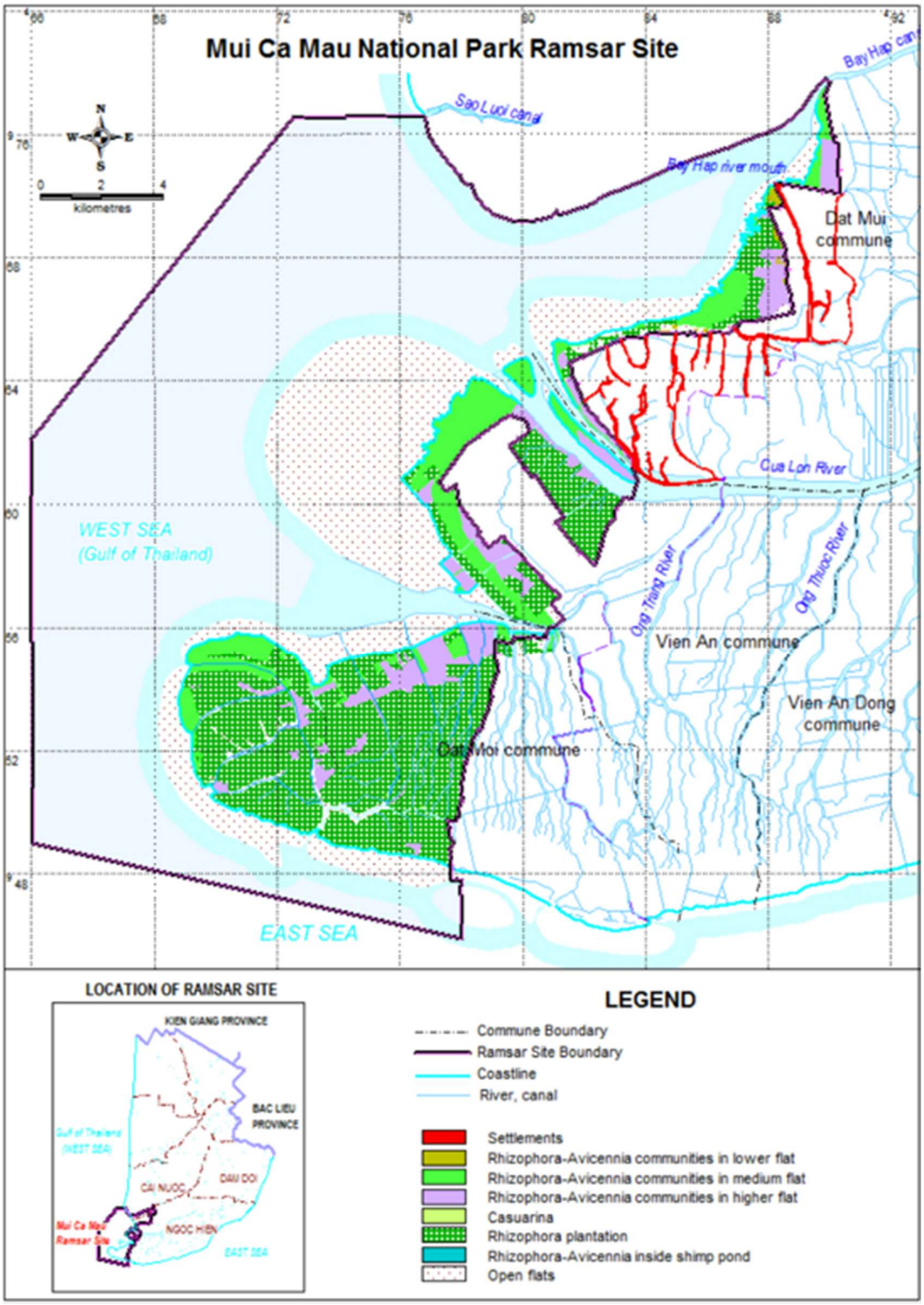


Figure 3.4. Map of Mui Ca Mau National park

Situated at the southernmost tip of Viet Nam, Mui Ca Mau supports the largest remaining area of mangrove forests (13,400 ha) and intertidal mudflats (26,000 ha) in the Ca Mau Peninsula as well as the Indochina Mangroves biogeographic region.

Originally, the site held some 1.6 million hectares of natural wetlands but the vast majority of the mangrove was destroyed during the Vietnam War and, later, by conversion to aquacultural ponds and agricultural land. Rehabilitation efforts began in the late 1990s as a result of the

decline in shrimp production and the later establishment of Mui Ca Mau National Park. Most of the aquacultural ponds inside the park have been abandoned and now support extensive areas of re-colonising mangrove forest. It is the only place in the country where two different tidal regimes interact, which contributes to the aggradation that is building new mud-flats and creating favourable habitats for many species, such as the critically endangered Four-toed Terrapin Batagur baska, the endangered Hairy Nosed Otter Lutra sumatrana and the endangered Black-faced Spoonbill Platalea minor. The site also provides important stopover and wintering habitats for a large number of waterbirds.

It has a large area of intertidal mudflats and submerged forests. This is the only place in Vietnam that has three sides bordering the sea and where two different tidal regimes interact, which contributes to building new mudflats and creating favourable habitats for many species. The site also provides important stopover and wintering habitats for a large number of water birds.

In 2010, the IUCN recorded many globally endangered species here, including primates, birds, otters, reptiles and fishes.

As located in the southernmost of Ca Mau province, this wetland is not within the impact corridor of SWLC Project with the average distance of about 168 km from the end point of East – West corridor.

- ***Lang Sen Wetlands Reserve***

Lang Sen Wetland Reserve, part of Dong Thap Muoi (the Plain of Reeds) in the Mekong Delta, was designated as the seventh Ramsar site in Vietnam in 2015.

Lang Sen Wetland Reserve is a wetland complex in the "Plain of Reeds" of the Mekong Delta, which comprises a mosaic of seasonally flooded grassland, open swamp, and riverine Melaleuca and mixed forests. The Site supports the best sample of natural riverine forests in the Mekong Delta, and provides habitat for a wide diversity of waterbirds and fish species. It regularly supports more than 20,000 waterbird individuals in the dry season, including globally threatened species such as the endangered greater adjutant (Leptoptilos dubius) and the vulnerable sarus crane (Grus antigone). The Site also hosts globally vulnerable reptiles such as the Indochinese spitting cobra (Naja siamensis) and Southeast Asian softshell turtle (Cuora amboinensis). 27 of 87 fish species recorded in Lang Sen live only in the lower Mekong Basin; these include the critically endangered Mekong giant catfish (Pangasianodon gigas) and giant barb (Catlocarpio siamensis). According to a 1969 map, Lang Sen Wetland Reserve then covered around 10,000 hectares. With its current area of 4,802 hectares, the Site is the second largest remaining area of the Plain of Reeds. Local communities have long exploited Lang Sen Wetland Reserve; most of it is divided into small agro-forestry production patches, some managed by local households, and others by state bodies.

The map of this wetland in shown in Figure 3.5.

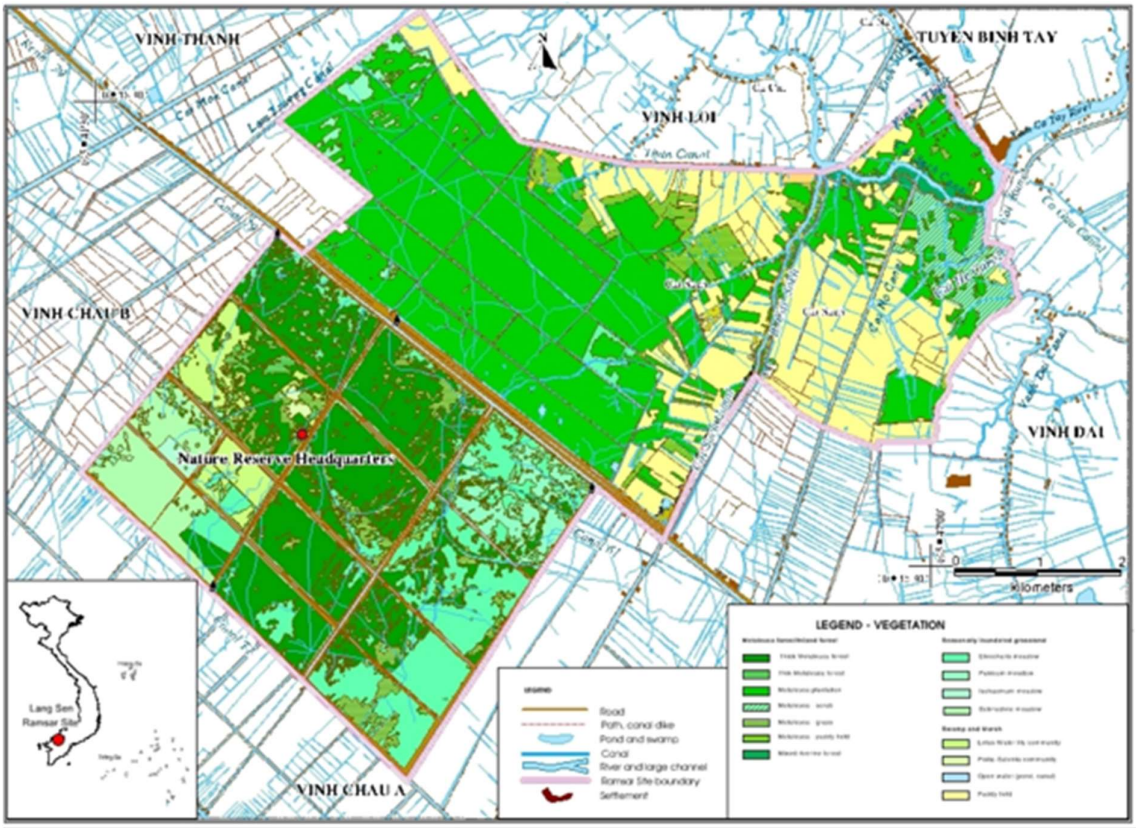


Figure 3.5. Map of Lang Sen wetlands reserve

This wetland is about 68km from the nearest point in the East – West corridor. Therefore, it is not within the impact corridor of the SWLC Project.

❖ ***U Minh Thuong National Park***

The eighth Ramsar site in Vietnam is U Minh Thuong National Park in the Mekong Delta province of Kien Giang, which gained the recognition in 2016.

U Minh Thuong National Park is one of the last remnants of climax peat swamp forest in the biogeographic region, dominated by mixed forests and Melaleuca forests on peat that covers around 3,000 ha (approximately 37%) of the Park. The Site is recognized as one of the three highest priority sites for wetland conservation in the Mekong Delta. It is home to distinctive flora and fauna including 32 mammal species, 187 bird species, 34 reptile and amphibian species, 37 fish species, and 203 insect species. Many of these are globally threatened, including the endangered yellow-breasted bunting (Emberiza aureola), yellow-headed temple turtle (Heosemys annandalii), Sunda pangolin (Manis javanica) and fishing cat (Prionailurus viverrinus). It is also one of the only three sites in the world known to support a population of the endangered hairy-nosed otter (Lutra sumatrana). The Site regularly hosts more than 20,000 waterbirds. Most of the fish species observed are native and the distribution of eight of these is restricted to the lower Mekong Basin.

U Minh Thuong National Park supports large areas of peat layers and a complex system of canals that can store a large volume of water. It functions as a sponge that maintains the groundwater level and releases surface water to the surrounding areas, and supports production and daily activities of the local communities surrounding the Park. In addition, the Site is of significant spiritual, historical, archaeological, educational and scientific value.

The map of this wetland in shown in Figure 3.6.

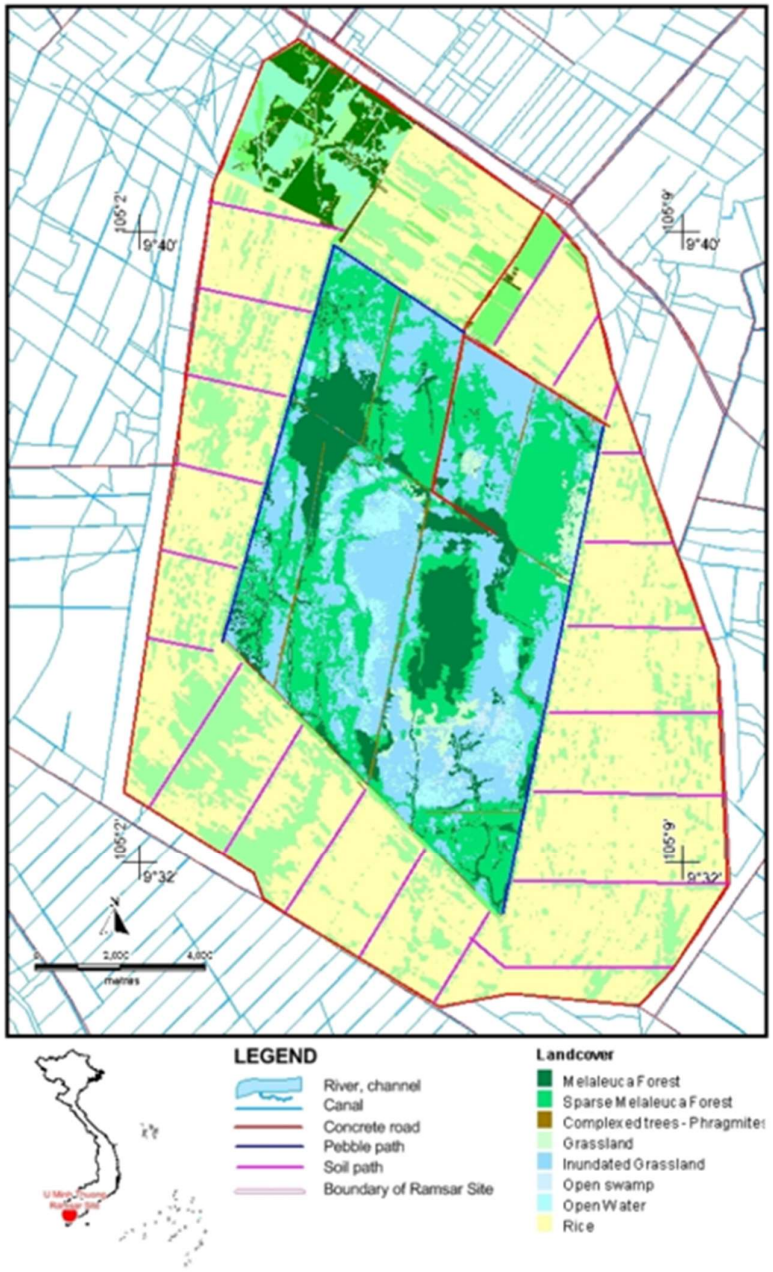


Figure 3.6. Map of U Minh Thuong National park

This wetland is about 93 km from the nearest point in East – West corridor. Therefore, it is not within the impact corridor of the SWLC Project.

The locations of five (05) Ramsar wetlands mentioned above and their distances to the project construction site is illustrated in Figure 3.7.

Figure 3.7. Maps of Ramsar wetlands in MKD and SER in their distances to SWLC Project construction sites

In conclusion, those wetlands are not within the impact's corridor of the SWLC Project.

3.3.2. Forests

3.3.2.1. North - South corridor

This area includes Dong Tranh and Tac Cua River which will pass beside the Can Gio mangrove biosphere reserve. There are not any civil works which impact directly to the Can Gio mangrove biosphere reserve of the Can Gio district of Ho Chi Minh city.

The Can Gio Mangrove Biosphere Reserve is located in the coastal district southeast of Ho Chi Minh City. The reserve provides opportunities to advance environmental protection across a continuum of habitats, ranging from coastal areas to the boundaries of Ho Chi Minh City, the biggest industrial city in Viet Nam. The mangrove forest hosts the highest diversity of mangrove plant species, mangrove-dwelling invertebrates and mangrove-associated fish and shellfish species in the sub-region, and is regarded as the 'green lungs' of the city.

The Can Gio mangrove forest grew out of a comparatively recent brackish swamp with soil foundations created by the Saigon and Dong Nai Rivers. The development of the mangrove forest is dependent on high precipitation and a high density of rivers interweaving the area, which provide a rich and plentiful supply of alluvium in the estuarine regions. The soil formed in Can Gio has been created by a combination of clay alluvial depositions, vitriolic processes and a brackish water table.

Can Gio encompasses diverse habitats including mangroves, wetlands, salt marshes, mud flats and sea grasses. The ecosystem functions as the 'green lungs' of Ho Chi Minh City absorbing carbon dioxide and other polluting agents on a daily basis.

The mangroves contain a high diversity of floral and faunal species. According to the current data published on the Can Gio Mangrove Biosphere Reserve, these include mangrove species such as Rhizophora apiculate, Thespesia populnea and Acanthus ebracteatus. A high number of faunal species appear in the biosphere reserve including king cobra (Ophiophagus Hannah), saltwater crocodile (Crocodilus porosus), spot-billed pelican (Pelecanus philippensis) and fishing cat (Felis viverrina). There are no communities living in the core area and buffer zone with the exception of forest protectors and their households, forestry staff and a few fishermen who operate traditional shrimp-trappers in some canals within the mangrove forest.[21]

Can Gio mangrove forest reserve includes the entire area of Can Gio protection forest, and the remaining administrative area of Can Gio district, divided into 3 regions: [22]

1. The core zone covers an area of 6,134.43 ha, has the function of preserving the mangrove ecosystem of both planted and natural forests; conservation of mangrove landscapes and wildlife habitats, especially waterfowl; conserving water bodies and alluvial flats along river banks and along the coast for natural regeneration of both plants and animals; limited scientific research and ecotourism.

2. The buffer zone covers an area of 29,152.10 ha of forest land and 12,763.56 ha of water surface, with the function of restoring ecosystems based on the dominant communities; core zone protection; creating more space for wild animals beyond the core zone; creating natural landscapes and humanistic culture in service of eco-tourism; create conditions for models of forestry and fishery to combine with the environment.

3. The transition zone covers an area of 13,227.79 ha of forest land and 7,267.47 ha of water surface, including the remaining areas of Can Gio district. The transition zone has the function of encouraging economic development models, cooperating with the participation of managers, economic establishments, mass organizations, religion, culture, society, and other scientists, educational institutions…

❖ ***Biodiversity of Can Gio mangrove biosphere reserve***

Synthesize and update information on biodiversity in Can Gio mangrove forest reserve:

- Flora: there are 318 species of higher plants
  - Major group of mangroves: 37 species
  - Group of trees participating in mangroves: 56 species
  - Group of imported plants: 225 species
- + Fauna:
  - Insects: 89 species
  - Fish: 282 species
  - Amphibians: 36 species
  - Reptiles: 36 species
  - Birds: 164 species
  - Animals: 35 species
- Adventure creatures: 66 species of floating animals, 66 species of floating plants.

❖ ***Conservation areas and rare species***

In Can Gio mangrove forest reserve, there are 3 conservation areas for animals, including:

- Bird Sanctuary (Vam Sat Bird Sanctuary) is the habitat of about 2,000 birds belonging to 33 species, of which 26 species are settled and 07 species are migratory.

[21] https://en.unesco.org/biosphere/aspac/can-gio/
[22] https://rungngapmancangio.org/

- The Bat Sanctuary (Bat Dam) in sub-zone 15a is home to more than 500 individuals, mainly Horse bats (Pteropus lylei);
- Monkey Sanctuary (Monkey Island Area), with a population of Maccaca fascicularis that has grown to over 1,000.

In addition, the mangrove forest reserve is also home to many rare and precious flora and fauna species listed in the Vietnam Red Book. In terms of plants, there are 02 species: Red Toad (Lumnitzera littorea) and Chrysanthemum (Azima sarmentosa); There are 09 animal species including:

- Animals: Common female otters (Lutra lutra), Small-clawed otters (Aonyx cinereus), Catfish (Prionailurus viverrinus), Macaque fascicularis;
- Birds: Gray-footed Pelican (Pelecanus philippensis), Snake-necked Pelican (Anhinga melanogaster), Yellow-billed Pelican (Tringa guttifer),
- Reptiles: King cobra (Ophiophagus hannah),
- Fish: Basket-bearing fish (Toxotes chatareus).

3.3.2.2. East – West corridor

There are no national forests in the area of Mang Thit, Cho Lach, Ky Hon, Rach La canals in those provinces Vinh Long, Ben Tre, Tien Giang and Long An. To the east, there are some conservation areas and protected forests such as Lam Truong protected forest, Thua Duc commune, Binh Dai district; coastal protection forest in Thanh Hai commune, Thanh Phu district; Thanh Phong Wetland Nature Reserve and Vam Ho sanctuary, Tan My Commune, Ba Tri District, Ben Tre province. However, these protection forest locations are 50-100 km far from the east-west corridor area.

3.3.3. Aquatic resources

The fish fauna of the Mekong River is recognized as highly diverse, and ranks closely behind that of the Amazon and Congo rivers. Of the entire river basin, the fish diversity is greatest in the Mekong River Delta. More than 160 species of freshwater fish have been identified in the rivers of the Mekong River Delta or migrating upstream; 89 species of freshwater fish were found in coastal estuaries and 4 species of estuarine fish were found upstream. Nineteen of the fish species recorded in the Vietnamese Mekong Delta (VMD) are on the IUCN Red List and in the Vietnam Red Book (Hilton-Taylor 2000; VRDB 2007; IUCN 2014) and their habitat of those species are the Hau river and the Tien river, far from the waterways of SWLC Project. The biological communities in the VMD, especially the benthic macro invertebrate and littoral macro invertebrate communities had been significantly impacted by human activities.

3.3.3.1. Phytoplankton

There are 53, 61, 67 phytoplankton species belonging to 6 algae groups were observed in Cho Lach canal within the Project area in 3 monitoring rounds respectively. They are Cyanophyta, Chrysophyta, Bacillariophyta, Chlorophyta, Charophyta, Dinophyta, of which Bacillariophyta branch accounting for 67% on average of 3 monitoring rounds is the most common algae and Chrysophyta is the least common when appearing only once in the third monitoring round. The other branches and their species are Cyanophyta (27% on average), Chlorophyta (4%), Dinophyta (2%) and rare appearance of other species (Table 3.10).

In Mang Thit river, the most predominant species is Bacillariophyta with 35%, 63% and 55% on average appearing in 3 monitoring rounds together with other 4 species including Cyanophyta (37% on average), Chlorophyta (11%), Charophyta (less than 1%) and very rare appearance of Dinophyta group in 3 monitoring rounds. Detailed monitoring results in November 2021 is shown in Annex 2.

Cell density of all species appearing in 3 monitoring rounds are summarized in Table 3.9.

Table 3.9. Cell density of Phytoplankton in the Project area

Phytoplankton group	Cell density (cell/liter)					
	Cho Lach canal			Mang Thit river		
	1st round	*2nd round*	*3rd round*	*1st round*	*2nd round*	*3rd round*
Cyanophyta	1 045	240	380	3 305	1 118	1 018
Chrysophyta	25	20	90	158	70	-
Bacillariophyta	-	-	-	-	100	-
Chlorophyta	392	-	-	162	518	700
Charophyta	80	-	-	1 370	-	100
Dinophyta	60	-	-	1 340	80	60
TOTAL	**1885**	**1386**	**4176**	**6264**	**5214**	**2759**

The phytoplankton component structure (%) in Cho Lach canal and Mang Thit river/river are illustrated in Figure 3.8 and 3.9 below:

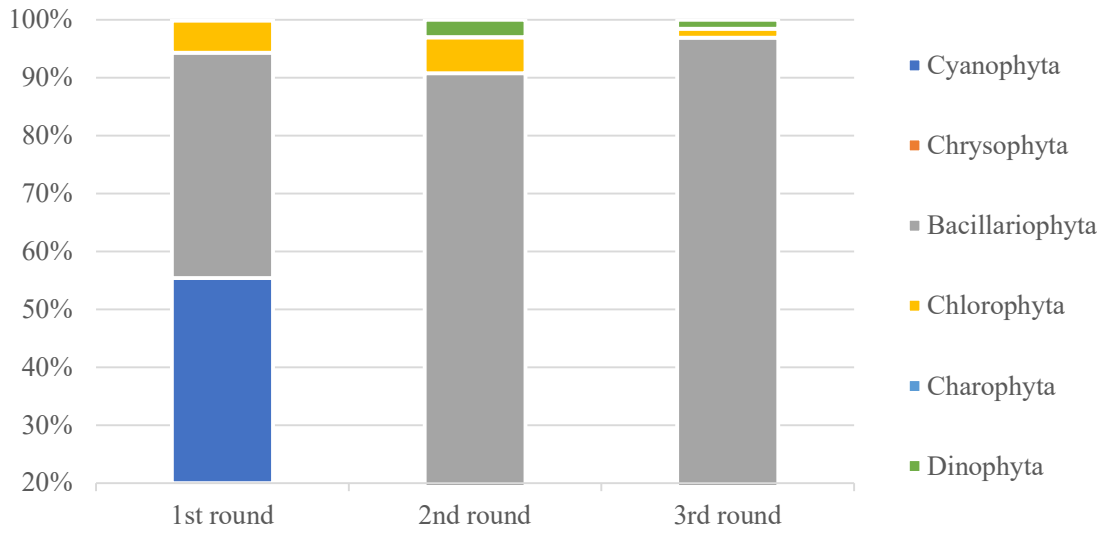


Figure 3.8. Phytoplankton component structure in Cho Lach canal

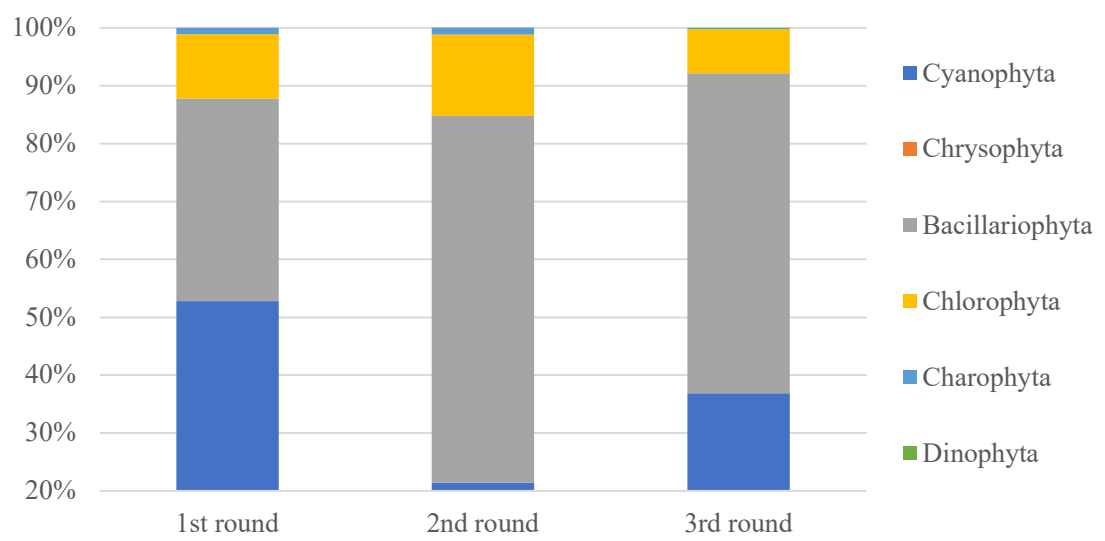


Figure 3.9. Phytoplankton component structure in Mang Thit river

3.3.3.2. Zooplankton

15, 17, 21 zooplankton species appear in Cho Lach canal in three monitoring rounds with the number of individuals per m^3 varying by 20467, 44817, and 66,617 individuals respectively. Similarly, 33, 28, 27 zooplankton species appear in Mang Thit river in three monitoring rounds with the number of individuals per m^3 varying by 18,017; 25,667; 20,200 individuals respectively (see Figure 3.10, 3.11). Detailed monitoring results are shown in Annex 2.

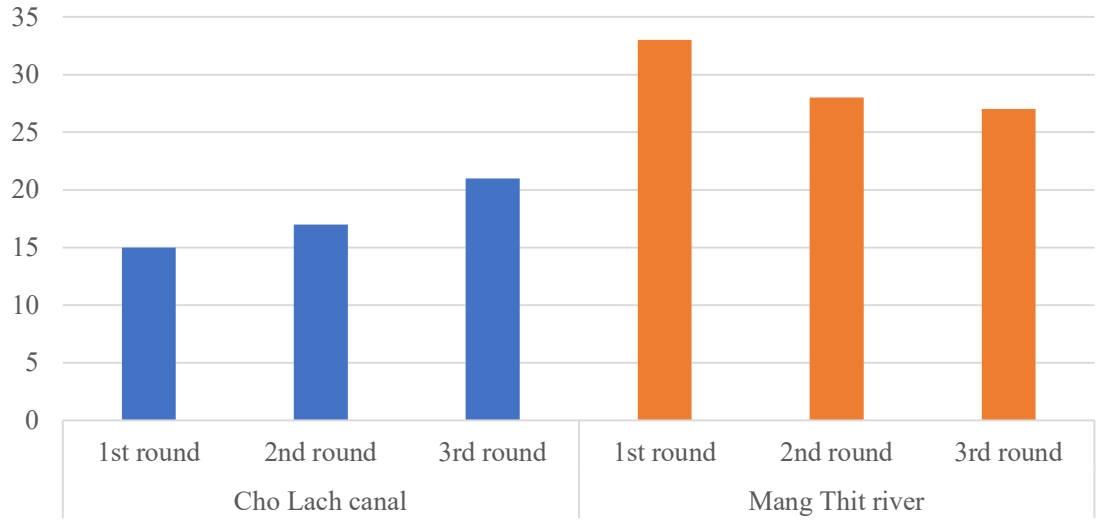


Figure 3.10. Number of Zooplankton species in the Project area

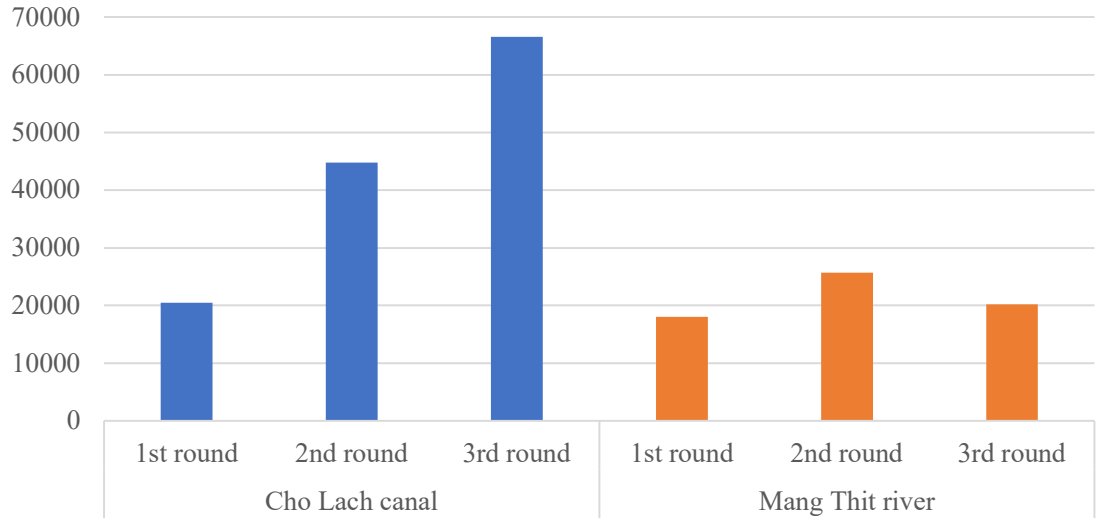


Figure 3.11. Individuals' density of zooplankton in the Project area

3.3.3.3. Benthic macro invertebrates

9-19 species of large invertebrate zoo benthos was found in the Project area in three monitoring rounds. There are 12 species of Mollusca phylum, 1 species of aquatic insect under Diptera order, 4 species of Annelida phylum (2 species of Polychaeta and 2 species of Oligochaeta) and 7 species of Crustacean phylum (under Amphipoda, Mysidacea and Isopoda). Detailed monitoring results are shown in Annex 2.

The distribution of macro benthic interverbrates species and individuals found in the Project

area is illustrated in Figure 3.12 and 3.13.

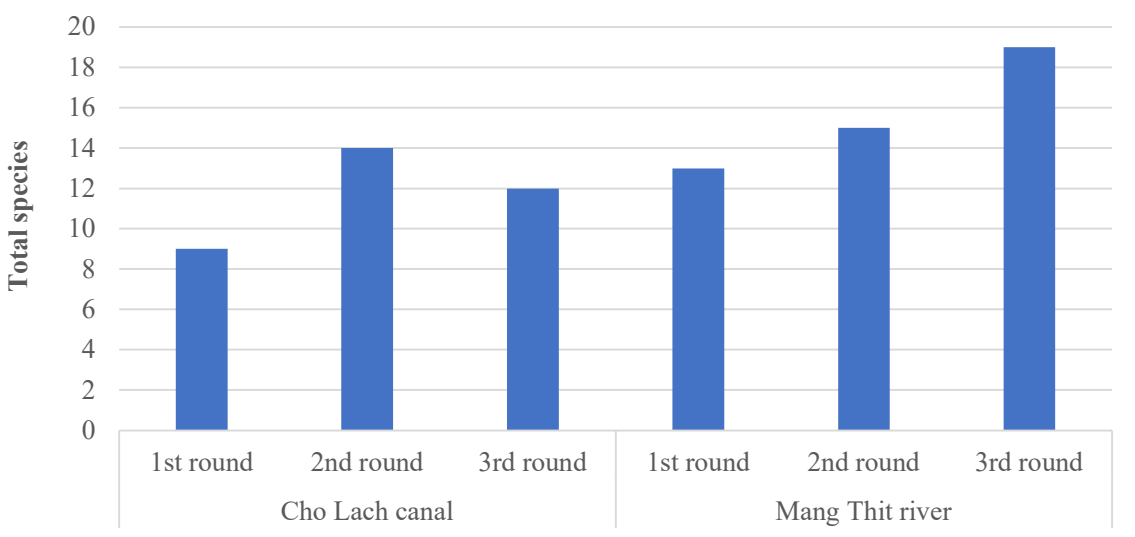


Figure 3.12. Number of macro benthic invertebrate species in the Project Area

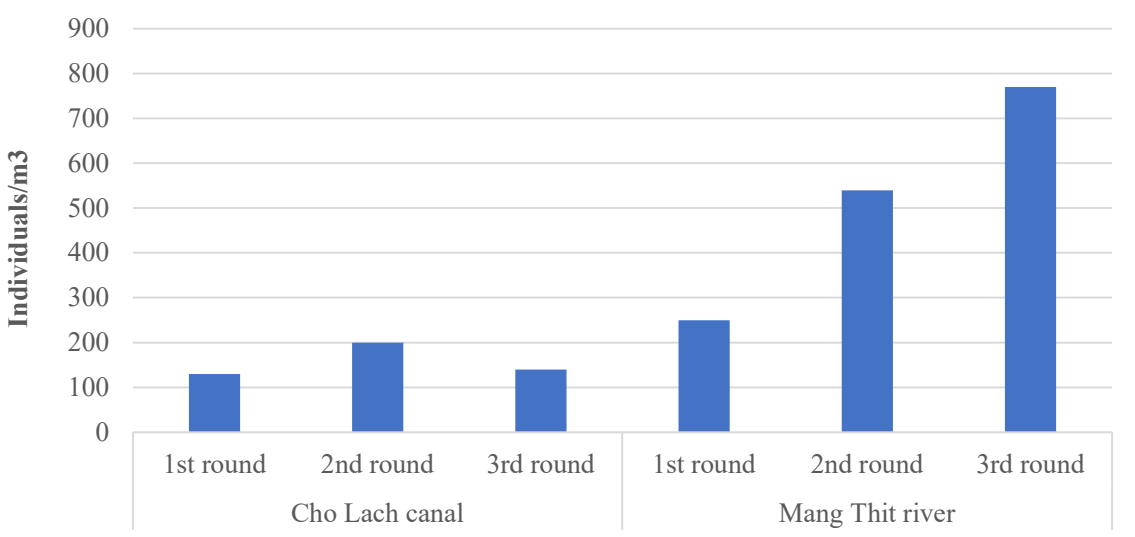


Figure 3.13. Number of macro benthic invertebrates individuals in the Project area

3.3.3.4. Aquatic plants

The Vietnam Mekong Delat (VMD) is dominated by native spike-rush Eleocharis dulcis, which grows in moist habitats. The aquatic species in the VMD vary spatially and are influenced by topography, flooding regime, and soils. Species include *Eleocharis ochrostachys, Panicum repens, Lepironia articulata, Scleria poaeformis, Oryza rufi- pogon,* and *Ischaemum rugosum; Sarcocephalus coad- unata, Elaeocarpus madopetalus, Cassia grandis, Melaleuca leucadendra, and Lagerstroemia speciosa* have been observed on the banks of waterways. Native helophytes (marsh plants), such as *Nelumbium nelumbo* and several species of waterlily (Nymphaea), were abundant along waterways, and were often found growing with the native Hymenachne pseudointerrupta, a palatable grass that is popular among water buffaloes. Mimosa pigra, an invasive pest species found within the Tram Chim National Park, has taken over about 30% of the original area of Eleocharis, a preferred food source for the vulnerable

Sarus Crane. Additionally, species such as the water hyacinth (*Eichhornia crassipes*) have invaded freshwater wetlands, and in particular standing water MWBP and RSCP, across the VMD. Because of land use change and the proliferation of invasive species, the last remaining community of the native sedge Lepironia articulata (Cyperaceae) in the VMD is now restricted to seasonally inundated grassland that covers an area of 2,000 ha in Phu My Village (Kien Giang Province).

In the Cho Lach district, Ben Tre province, flora species only belong to freshwater habitats all year round with woody plants such as Cà na (*Elaeocarpus hygrophilus*), Chiếc (*Barringtonia macrostachya*), Gáo (*Neolamarckia cadamba*), Trâm bầu (*Combretum quadrangulare*), Bằng lăng nước (*Lagerstroenia sp*) mixing with several kinds of grass and bushes such as Sậy (*Phragmites vallatoria*), Chuối nước (*Hanguana malayana*), Nghễ (*Polygonum pulchrum*), Lục bình (*Eichhornia crassipes*), Lúa ma (*Oryza rufipogon*), Môn nước (*Colocasia esculenta*), etc.

According to Vinh Long Department of Natural Resources and Environment (2016), the Tien River, Hau River and Mang Thit river are prioritized for environmental protection and sustainable use. This was reported in the biodiversity conservation planning in Vinh Long province for the period of 2015 - 2020 and orientation to 2030. Especially, the Mang Thit River, Luc Si Thanh and Thanh Binh Isles were planned in the planning biodiversity conservation (Figure 3.14).

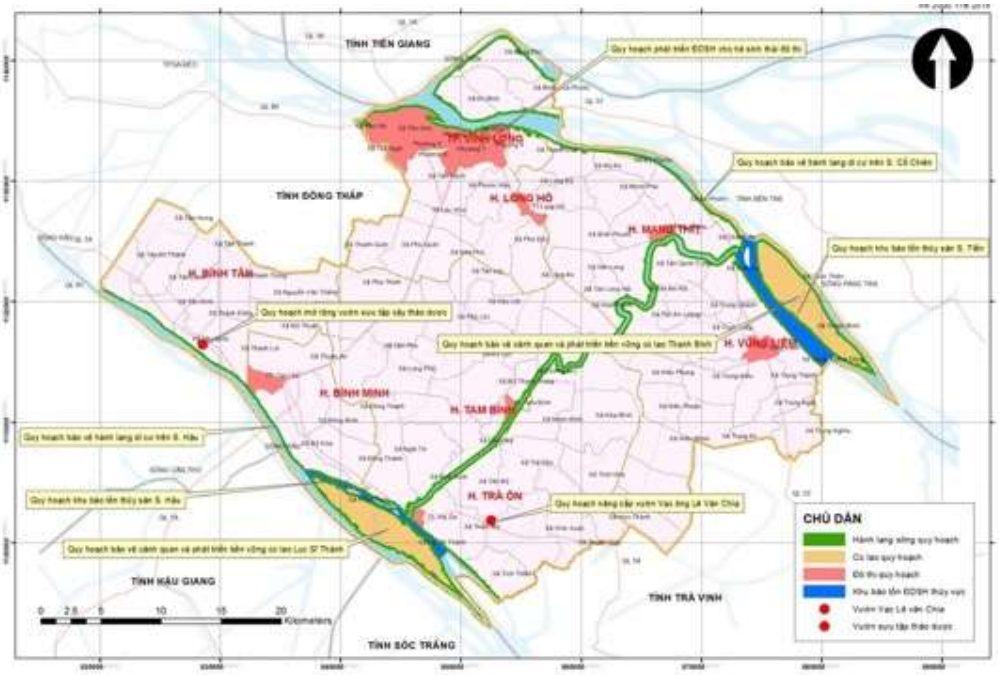


Figure 3.14. Map of biodiversity conservation planning in Vinh Long province for the period 2015 - 2020 and orientation to 2030

3.3.3.5. Aquatic fauna

The fish fauna of the Mekong River is recognized as highly diverse, and ranks closely behind that of the Amazon and Congo rivers. Of the entire river basin, the fish diversity is greatest in the Mekong River Delta. There are at least 1200 species of fish, and possibly as many as 1700, living in the Mekong Basin. High diversity is also exhibited by other aquatic animal and plant groups. It is important to note that "fisheries" in the Mekong are based upon much more than just fish and include the multitude of other animals and plants that are exploited. Possibly as

much as 30 percent of production from the fishery comes from non-fish sources. [23]

In combining literature review (secondary data) and field survey implemented in 2017, there are 155 fish species under 36 families and 11 classes in the Project area, including freshwater and brackish water fish. Of which, common carp species has the largest number with 45 species, making up 29 %, cat-fish and perch classes are found in 38 species, making up 23.9 % and 24.5 %, respectively. Other classes were observed with small number of species, from 1 to 7 species, making up 0.6 % to 4.5 % (See Table 3.10).

Table 3.10. List of Common Fish Species in the Project Area

No.	Species	Number of Species	Percentage (%)
1	Feather back	2	1.3
2	Sardine	2	1.3
3	Common carps	45	29.0
4	Pomfret	1	0.6
5	Basa	37	23.9
6	Menpachi	3	1.9
7	Spotted gar	7	4.5
8	Eel	7	4.5
9	Bass fish	38	24.5
10	Flounder	7	4.5
11	Trout	6	3.9
Total		**155**	**100**

Source: Southern Institute of Ecology, 2012

Some main types of fish observed during site visit (caught by local people) have also showed that they are mainly carps, bass fish and basa.

Most of the fish in the Project area is caught for livestock and poultry breeding practices. Some species could be used for ornamental purposes. Local people are also breeding fish for exporting in which basa (cat-fish) is the mainly cultivated fish in the area of Tan Long Hoi commune, Mang Thit district (Vinh Long province) and Hoa Nghia commune, Cho Lach district (Ben Tre province).

3.3.4. Terrestrial-biological resources

Biodiversity, ecological habitats, and environmental conditions in the VMD have been assessed and surveyed by numerous researchers. Although most national parks and conservation reserves in the VMD are relatively small, they play an important role in maintaining biodiversity and the region is recognized as a global hot spot for species diversity. While more than 21,017 plant, 14,458 animal, and 3,000 aquatic species have been identified in surveys of terrestrial ecosystems in inland wetlands in Vietnam (MONRE 2019), species of animals and plants continue to be discovered. Despite the rich biodiversity, only two mammals of conservation significance remain, namely the hairy nosed otter and the dugong. At least 37 bird species of conservation significance and 470 species of fish, of which 28 are endemic and 4 are only found in the VMD.

There are some available data of floral species from Vinh Long province. According to investigation of the Institute of Tropical Biology (2019), 857 floral species of 136 families belonging to 7 floral phyla were found distribute in the Vinh Long province. These terrestrial plants are typical for Mekong delta province distribute along the project East – West corridor

[23] https://www.mrcmekong.org/assets/Publications/report-management-develop/Mek-Dev-No2-Mek-River-Biodiversityfiisheries-in.pdf

(See Table 3.11).

Table 3.11. Taxon composition of in Vinh Long province

Phylum	Family	Species
Lycopodiophyta	1	1
Polydiophyta	10	16
Cycadophyta	1	2
Pinophyta	3	3
Magnoliopsida	89	464
Liliopsida	32	371
	136	**857**

(Source: Institute of Tropical Biology, 2015)

As case of terrestrial plants, animals in the East – West corridor project area were limited information. Only some available data about mammal and bird fauna. According to the Institute of Tropical Biology (2015), 16 mammal species of 8 families of 5 orders (Table 3.12) and 55 bird species of 22 families in 10 orders (Table 3.13) were recorded in Vinh Long province.

Table 3.12. List of mammal species in Vinh Long province

Order Chiroptera
***Family* Pteropodidae**
Species: *Cynopterus sphinx* (Vahl, 1797)
Species: *Cynopterus brachyotis* (Muler, 1838)
***Family* Vespertilionidae**
Species: *Scotophilus kuhlii* (Leach, 1882)
Order Insectivora
Species: *Suncus murinus* (Linnaeus, 1766)
Order Rodentia
***Family* Sciuridae**
Species: *Tamiops rodolphii* (Milne & Edwards, 1867)
***Family* Muridae**
Species: *Mus musculus* (Linnaeus, 1758)
Species: *Rattus losea* (Swinhoe, 1871)
Species: *Mus caroli* (Bonhote, 1902)
Species: *Rattus norvegicus* (Fischer de Waldheim, 1803)
Species: *Bandicota indica* (Bechstein, 1800)
Species: *Rattus exulans* (Peale, 1848)
***Family* Hisricidae**
Species: *Hystrix brachyura* (Linnaeus, 1758)
Order Carnivora
***Family* Mèo Felidae**
Species: *Felis bengalensis* (Kerr, 1792)

***Family* Viverridae**
Species: *Herpestes javanicus* (Geoffroy, 1818)
Species: *Paradoxurus hermaphroditus* (Pallas, 1777)
Order Primates
***Family* Cercopithecidae**
Species: *Macaca fascicularis* (Rafles, 1821)

Table 3.13. Composition of bird species in Vinh Long province

Orders	Number of families	Number of species
Pelecaniformes	1	3
Coconiiformes	1	5
Caprimulgiformes	1	1
Cuculiformes	1	5
Coraciiformes	2	7
Passeriformes	12	24
Columbiformes	1	5
Gruiformes	1	2
Strigiformes	1	1
Charadriiformes	1	2

Moreover, the private bird sanctuary (existing area 1.8 ha) in Tan My commune, Tra On district which is about 18 km away from Mang Thit river was planned to preserve the landscape and maintain the bird population for biodiversity conservation, environmental education and development (See Table 3.14).

Table 3.14. Conservation bird species in Vinh Long province

Scientific name	VN 2007 red book	IUCN
Anhinga melanogaster	VU	NT
Phalacrocorax carbo	EN	LC

3.4. SOCIAL, ECONOMIC AND CULTURAL CONDITIONS

3.4.1. Population and demographic

In 2020, Viet Nam continued to maintain the replacement level fertility. In addition, the crude death rate and infant mortality rate decreased, the average life expectancy at birth increased due to the success of people's health production and the development in medicine as well as people's living standard improvement.

The national average population was estimated at 97.58 million persons in 2020, an increase of 1,098.7 thousand persons, and equivalent to an increase of 1.14% in comparison with that in 2019. The percentage of the population in the urban areas continuously showed an upward trend, while the population in the rural areas gradually decreased. The population structure by gender remained almost unchanged. Of which, the urban population was 35.93 million persons, accounting for 36.82%; the rural population was 61.65 million persons, making up 63.18%; the

male and female population was 48.59 million persons and 48.99 million persons, respectively with the corresponding shares of 49.80% and 50.20%.

The total fertility rate in 2020 reached 2.12 children per woman, which was lower than the replacement level fertility. The sex ratio at birth was 112.1 male births per 100 female birth; the average of birth rate was 16.3‰; The national average life expectancy at birth in 2020 was 73.7 years, of which the male average life expectancy of male was 71 year and the female was 7 6.4 year.

In MKD and SER, the population as of 2020 is described in Table 3.20:

Table 3.15. Population characteristics in the Project area

No	Province	**Average population** *(thous. persons)*			**Population changes** *(%)*		**Labor force at 15 years of age and above** *(thous. persons)*
		Male population	Female population	Total population	Natural increase rate of population	Population growth rate	
1	Ben Tre	633.1	659.3	1292.4	0.41	0.26	827.1
2	Tien Giang	868.9	903.7	1772.5	0.56	1.35	1112.1
3	Long An	855.5	858.2	1713.7	0.84	1.09	1029.3
4	Vinh Long	503.9	519.0	1023.0	0.46	0.03	603.6
5	Dong Nai	1613.7	1564.3	3177.4	1.27	2.05	1767.6
6	Ho Chi Minh City	4493.8	4733.8	9227.6	1.0	2.09	4769.6
Total		**8968.9**	**9238.3**	**18206.6**	**-**	**-**	**10109.3**

(Source: Statistical Yearbook 2020)

3.4.2. Economic conditions

Agriculture and fisheries still remain the backbone of the economy of the Mekong Delta, the proportion of basic sectors (agriculture/fishery) is higher than that of the Southeast. Agriculture (including forestry and fisheries) has slowed down and maintained a 0.3 percentage point difference over the national rate during 2011-2015 period. Similarly, the industry-construction sector has maintained a higher growth rate than the whole country at approximately 2 percentage points for the 2001-2015 periods. Meanwhile, the Southwest service sector also experienced a higher growth rate, at 1.1-percentage point for the 2011-2015 periods.

The service sector has the high growth. The main service centers are located in Can Tho, Kien Giang and An Giang. However, the industry and construction sector have a low increase in the Mekong River Delta. The low growth rate of the agricultural sector is a challenge to the future development because this sector still plays a very important economic role in the Mekong Delta region.

Tourism in the Mekong Delta is mainly based on the advantages of the provinces in the area, which are rivers/canals, islands and eco-tourism. Tourism products mainly focus on: passenger transport by boat along the waterway network; bringing visitors to garden eco-tourism; performance of traditional Southern folk songs; and study tours to the national parks. Almost of the provinces in the region rely on the available resources for tourism development because of advantageous characteristics, including intertwined river systems, mangrove forests, orchards.

3.4.2.1. Gross Domestic Product

National GDP in 2019 reaches 3.738.546 thousand of billions of dongs (price compared with 2010), growth 7,02% compared with 2018. In which, agriculture, forestry and aquaculture sector increased by 2,01%, accounting for 4,6% general growth; industry and construction sector increased by 8,90%, accounting for 50,4%; service sector increased by 7,3%, accounting

for 45%.

Regarding economic structure in 2019, agriculture, forestry and aquaculture sector accounts for 13,96% GDP; industry and construction sector 34,49%; service sector 41,64%; products taxes less subsidies on production accounts for 9,91% (Structure in 2018 respectively: 14,68%; 34,23%; 41,12%; 9,97%).

The economic growth rate was higher than the population growth, so the GDP per capita at current prices increased from 2,097 USD per person in 2015 to 2,202 USD per person in 2016 (an increase of 105 USD compared to that in the previous year); 2,373 USD per person in 2017 (a rise of 171 USD); 2,570 USD per person in 2018 (an upturn of 197 USD); 2,714 USD per person in 2019 (a spread of 144 USD); estimated figure in 2020 reached 2,779 USD per person, 1.33 times higher than the GDP per capita in 2015. Based on 2017 purchasing power parity, the GDP per capita in 2019 reached 8,041 USD per person, 1.4 times higher than 2015 corresponding figure.

Economic growth gradually shifted to depth, reflecting in the increased contribution of total factor productivity (TFP) to the growth of the economy. In the 2016-2020 period, TFP's contribution to economic growth averaged 45.42%, much higher than the average of 32.84% in the period 2011-2015. Along with that, Incremental Capital - Output Ratio (ICOR) decreased from 6.42 in 2016 to 6.08 in 2019. On average, in the period 2016-2019, the ICOR reached 6.13, lower than the figure of 6.25 in the period 2011-2015. In 2020, due to heavy negative impacts of the Covid-19 pandemic, production and business activities were delayed, construction projects that completed and put into use did not promote their capacity as the economy under the normal conditions as before, the ICOR reached 14.28 and overall for the whole period 2016-2020 reached 7.04.

The economic structure continuously shifted towards reducing the share of agriculture, forestry and fishery sector; increasing the share of industry, construction and service sectors. The share of agriculture, forestry and fishery sector in 2020 GDP preliminarily reached 14.85%, a decrease of 1.47 percentage points compared to 2016; the share of industry and construction sector attained 33.72%, a rise of 1 percentage point; the share of service sector achieved 41.63%, a growth of 0.71 percentage points.

3.4.2.2. Regional GDP

GDP per province gives information about the economic strength of the province. Because the GDP per sector is known, it also gives insight in the sector structure per province. In the commodity forecasts GDP is used for a number of commodities that have shown a growth in the past that is closely correlated with GDP.

❖ ***Southeast Region***

The Southeast region is an important motivational economic area of the country and the "gateway" of Vietnamese economy to the world. The Southeast provinces contribute greatly in total value of industrial production, exports and state budget. Particularly, the region currently contributes 38% GDP of the country, 48% export value, nearly 41% state budget and accounts for about 47% investment projects, more than 43% FDI of the country…In 2020, many Southeast provinces has overcome their difficulties due to the COVID-19 pandemic and achieved recognizable outcome. The GDP of Binh Duong in 2020 has increased by 6,91%, the province attracts FDI of 1,845 billion USD (exceeding 31,8% annual plan). Ho Chi Minh city contributes in export growth with a total value of 44 billion USD. Ba Ria - Vung Tau earns a spotlight in contribution to state budget, with total state budget collection of 100,47% planned value, about 76.400 billion VND.

❖ ***Mekong Delta Region***

Mekong Delta region currently accounts for 20% of the national population, contributing 18% national GDP; this region is severely impacted by climate change. According to Annual economic report of Mekong Delta region in 2020, its economic role is gradually diminishing compared with other regions, its contribution in national GDP for the past three decades has greatly decreased. In 1990, GDP of Ho Chi Minh city took up only 2/3 that of Mekong Delta region, after two decades, GDP of Mekong Delta region only 2/3 that of Ho Chi Minh city and this trend still maintains until now.

Main reasons were given by experts, which is Mekong Delta region is tasked with ensuring food security for the country, the region only focuses on agriculture and rice growing, leading to slow shift to higher productivity sectors. Immigration is another hot topic in Mekong Delta region. The immigration situation from Mekong Delta region to Ho Chi Minh city and Southeast regions recently has become an alarm. Currently, Mekong Delta region has the lowest rate of immigration in the country, which is 4,9% during period 2009-2019, its highest rate recorded is 44,8%, this makes the regional population decrease. Moreover, labor capacity of Mekong Delta region is comparatively low due to lack of FDI investment, with small scale of industrial production activities due to limited infrastructure. Mekong Delta region is also a "bottom land" of the country in terms of urbanization. Rate of urbanization of the region after 10 years only increases slightly from 22,8% to 25,1%, given national rate from 29,6% to 34,4%.

Therefore, Mekong Delta's provinces need more investment in infrastructure, policy of attracting investment, quality well-trained human resources to meet the development demand in the region. These policies need to be open, dynamic to create business environment which facilitate establishment of large corporate with sufficient competitiveness in domestic and foreign markets contributing to development of Mekong Delta region.

3.4.2.3. GDP in the future (from 2020 to 2040)

In a number of publications, the possible development of GDP in Vietnam is discussed. All studies assume a GDP growth of between 4 (low) and 7% (high) per year in the coming 25 years. A common feature is a gradually stabilizing of economic growth.

In the SWLC study, three scenarios for GDP have been developed. A medium scenario, a low and a high scenario. The medium scenario forecasts a GDP growth of 5.5%. A differentiation has been made between rural and urban areas. Urban areas will grow faster than rural areas. So, for urban areas 6% is the medium, for rural areas 5%.

The high and the low GDP scenario are 1.5% higher respectively lower. This gives a range that's fits perfectly in the studies evaluated. The economic growth is expected to decline after 2030. This is mainly due to the aging population and the decreasing population growth.

3.4.3. Aquaculture and Fisheries

The Mekong River has an annual captured fish production of about 2.3 million tones, equivalent to around 11 billion USD. Although the Mekong provides important ecological and socioeconomic benefits to millions of people, it is facing intensive change due to anthropogenic stressors. Among 571 species recorded, 119 were identified as indicator species. Based on the abundance and biomass comparison curves, the fish community was in a healthier condition. The highest species richness and diversity were observed, so these subgroups deserve high management and conservation priority.

3.4.4. Socio-economic and environmental survey on affected households

3.4.4.1. Land use and acquisition

The SWLC Project will require the extension, dredging, and construction of embankment of a number of canal sections. All of the civil works shall cause land acquisition/land use restriction

impacts in five provinces, namely Dong Nai, Long An, Ben Tre, Tien Giang, and Vinh Long.

Based on preliminary design and Inventory of Losses (IOL), the project will affect an estimate total of 1,068 households and 26 organizations/institutions in 05 provinces including Dong Nai, Long An, Ben Tre, Tien Giang, and Vinh Long.

Out of 1,068 affected households of the project: (i) the total number of the households to be relocated is 358; (ii) the PAHs having more than 20% of productive land affected is 201 households and will be considered as severely affected households. All these figures will be updated in site-specific resettlement plans when detailed design is available.

3.4.4.2. Population

The population in Southern Vietnam has increased with almost 10 million people in the last 20 years. An important difference between the Southeast region (including Ho Chi Minh City) and the Mekong River Delta is the growth rate. The Mekong River Delta has been growing less than 1% a year, while the Southeast region showed a growth of 2.8% per year between 1995 and 2015.

Red River region and Southeast region are two most populated areas in the country, respectively 1.060 people/km^2 and 757 people/km^2. During period 2009-2019, Southeast region has the highest ratio of average population growth in the country (2,37%/year), this is a dynamic economic center, attracting a lot people for their likelihood; Mekong Delta region has the lowest ratio of average population growth (0,05%/year).

The ongoing urbanization is one of the main reasons of the difference in population growth. Cities like Ho Chi Minh City attract many people from rural areas.

The total population of districts within the Project area and total people who were surveyed are showed in Table 3.16 and 3.17 accordingly.

Table 3.16. Population characteristics of the Project's district

No.	City/Provinces in the project area	Natural Area (km2)	Population	HHs in district	Affected HHs	Poor HHs (in district)		Near poor HHs (in district)	
						No. of poor HHs	%	No. of near poor HHs	%
I	**HCMC**								
1.1	Can Gio District	704.45	71,256	14,483	-	855	5.90	2,483	17.14
II	**DONG NAI PROVINCE**								
2.1	Nhon Trach District	410.84	260,173	48,359	1	598	1.24	1,024	2.12
III	**LONG AN PPROVINCE**								
3.1	Chau Thanh District	155.24	109,812	20,641	3	306	1.48	571	2.77
3.2	Can Giuoc District	215.10	214,914	41,093	-	563	1.37	1,049	2.55
3.3	Can Duoc District	218.20	187,359	36,240	-	997	2.75	846	2.33
IV	**TIEN GIANG PROVINCE**								
4.1	Go Cong Tay District	184.48	131,252	27,401	4	467	1.70	607	2.22
4.2	Cho Gao district	235.04	186,803	36,485	-	890	2.44	1,261	3.46
V	**BEN TRE PROVINCE**								
5.1	Cho Lach District	168.04	147,289	27,428	464	1,007	3.67	1,163	4.24
VI	**VINH LONG PROVINCE**								
6.1	Tra On District	259.31	134,787	38,844	156	1,864	4.80	1,730	4.45
6.2	Tam Binh District	290.65	153,805	32,312	426	1,097	3.40	1,366	4.23
6.3	Vung Liem District	294.33	159,183	45,162	-	1,391	3.08	2,134	4.73
6.4	Mang Thit District	159.90	99,201	20,581	14	183	0.89	253	1.23
	TOTAL				**1,068**				

(Source: Statistical Yearbook 2020)

Table 3.17. Number of people to be surveyed

No	Province	Total heads being surveyed	People at the working ages (16-60)					People outside the working ages (<16 and >60)				
			Male	Percent age	Female	Percent age	Total	Male	Percent age	Female	Percent age	Total
I	**Ben Tre**	**1 011**	**327**	**50%**	**332**	**50%**	**659**	**167**	**47%**	**185**	**53%**	**352**
II	**Vinh Long**	**1 553**	**517**	**52%**	**472**	**48%**	**989**	**270**	**48%**	**294**	**52%**	**564**
III	**Long An**	16	7	64%	4	36%	11	2	40%	3	60%	5
IV	**Tien Giang**	18	5	50%	5	50%	10	5	63%	3	38%	8
V	**Dong Nai**	0					0					0
Total		**2 598**	**856**	**51%**	**813**	**49%**	**1 669**	**444**	**48%**	**485**	**52%**	**929**

3.4.4.3. Ethnicity

The Kinh people account for the majority in the project area with 97% of the total number of surveyed households. Two other groups are also present, the Hoa and the Khmer. In the project area, 301 households belong to Hoa (Chinese) ethnic group (0.6%), mainly in the province of Vinh Long with 212/301 households. The Khmer people have a long history of collective attachment to the land they occupy (along with a distinct identify, language, and socio-cultural institutions). They represent the second largest population in Vinh Long province, accounting for 2.1% of the province's population, and mainly reside in remote and isolated communities along canals. They are located mainly in Vinh Long province with 1,514 households/1,534 Khmer households present in the project area. In Vinh Long, the Khmer ethnic group is mainly concentrated in Loan My commune and Hoa ethnic groups are concentrated in Tam Binh town and Tra On town.

The household sizes of ethnic minorities also slightly vary, with the average household size of Kinh people being 3.8 persons, Hoa people being 4.2 persons and Khmer household with the average size of 4.5. The ethnicity in the Project area is summarized in Table 3.18. According to recent survey results conducted in December 2021, only one Hoa household in Vinh Long province will be directly affected by land acquisition within the project areas.

Table 3.18. Main Ethnic Groups in the Project Area

No.	Commune	Population		Ethnicity					
				Kinh		Hoa		Khmer	
		HHs	People	HHs	People	HHs	People	HHs	People
1	Ben Tre	9,648	35,048	9,643	35,033	5	15	-	-
2	Tien Giang	4,551	17,422	4,510	17,301	40	120	1	1
3	Long An	1,607	8,542	1,607	8,542	-	-	-	-
4	Vinh Long	33,825	128,958	32,099	121,652	212	854	1,514	6,452
5	Dong Nai	11,339	45,234	11,276	45,006	44	173	19	55
	Total	**60,970**	**235,204**	**59,135**	**227,534**	**301**	**1,162**	**1,534**	**6,508**

3.4.4.4. Education

The education attainment of respondents is not relatively high, and this reflects accurately the general education level of the Southwest region as compared to the whole country.

Of the 1,068 household's heads, 1.49 % of them are illiterate with majority of female, 33.4 % has primary school level and at this level, the number of males is higher than female ones with a figure of 1 %. The household's heads having secondary school level accounted for 33.4 %, in which number of male heads is higher than female ones with a figure of 8 %. There is 25.3 % of household's heads have high school level and at this level the number of male heads is almost double that of female heads. There is only 1.3 % of household's heads have vocational training in the intermediate level. Similarly, the number of male heads is two-fold higher than female heads. The numbers of people have university degree accounts for 5.1 %. At this level, female-headed households make up only 25 % compared to male heads. The below graph (Figure 3.15) shows the educational levels of household's heads by gender.

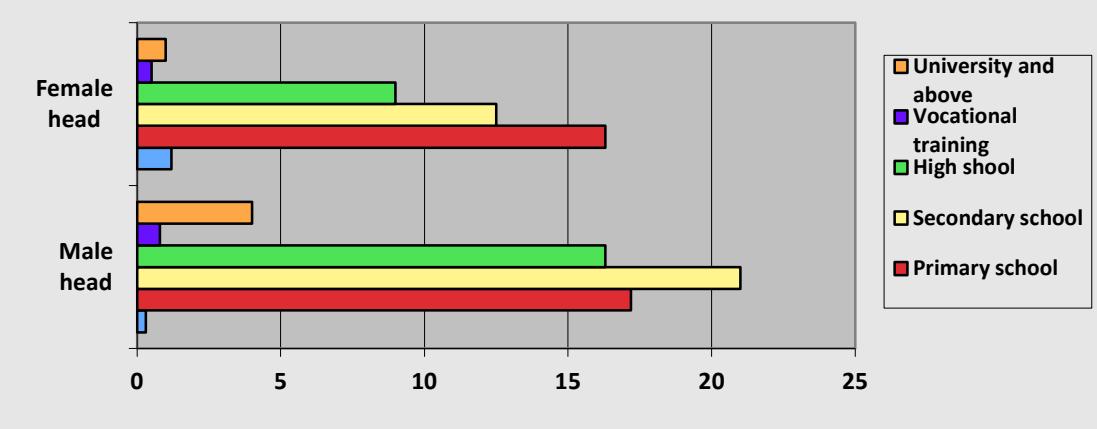


Figure 3.15. Education Attainment of Household's Heads

Low education attainment will be an obstacle for household's heads to be able to absorb quickly and firmly on project policies. It is likely that female heads who are always less educated than male household heads would be a barrier for them to work as temporary worker for the Project. Therefore, document on project information needs to be written in the most intelligible way and must be distributed to households for reference at any time. Moreover, there should be a strategy to attract female household heads to work as temporary worker for the Project.

3.4.4.5. Occupation

The occupation in different sectors are summarized in Figure 3.16.

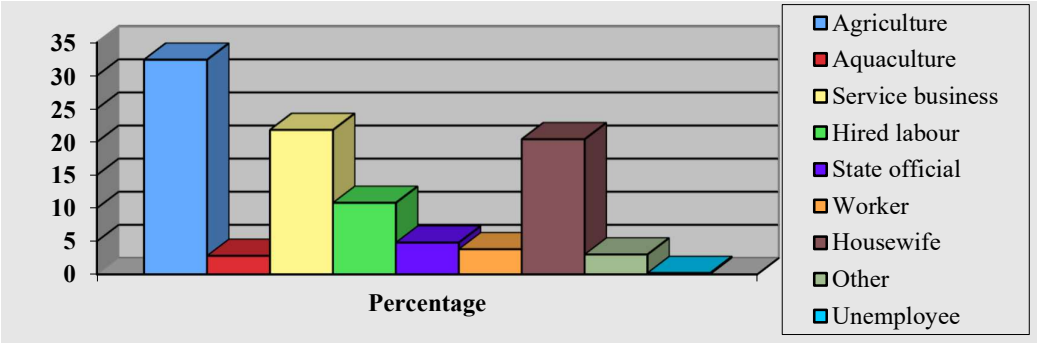


Figure 3.16. Percentage of occupation

According to the survey, farming households take the highest proportion of 32.4 %; followed by aquaculture accounting for 21.8 %. The majority of these household heads live in Tra On town, Tam Binh town of Vinh Long Province and Cho Lach town of Ben Tre Province. Housewives and retired people account for 20.4 %, most of them are female heads which figure is two times higher than male ones. Hired labor accounts for 10.8 %, they often work in commune and town areas, but a small percentage of people also work where hired labor market is in high demand. The proportions of state official and workers in private companies account for 4.8 % and 3.8 % respectively; most of them are young and middle-aged people. People with unstable jobs account for 3 % and only 0.2 % are unemployed.

3.4.4.6. Income

At present, most households in Vietnam have a diversified income source. In determining the living conditions of the households, it appears that in addition to the main source of incomes (the highest and most stable), households have secondary incomes. Sources of secondary income are usually extra work or salaries of household's members.

According to data provided by towns and communes, the average per capita of households in Ben Tre is 36 million VNDs, Tien Giang is 29,500,000 VNDs, and Long An is 28,651,875 VNDs. Vinh Long is 20,123,750 VNDs and Dong Nai has the highest income with 43,000,000 VNDs.

Of the 1,068 households, households with the incomes which is mainly dependent on agricultural activities accounted for 31.9 %, followed by service business with 22.5 %, hired labor accounted for 16.5 %, from the wages of workers was 12.3 %, and salaries from government employees was 6.5 %. Households earning income from aquaculture accounted for 3.5 % and receiving support from relatives and family members who go to work far away was 2.9 %. There are 1.9 % of household heads having pension and 2.1 % of income from other sources such as property leasing or driving, mason, etc.

Total of 602 households have secondary incomes, in which 9.8 % of households with additional income from agriculture, 6.5 % of households with additional income from hired labor, 4.8 % of households with additional support from relatives and family members, 4.7 % from workers' wages and 2.2 % are from civil servants. 4.8 % of households have income from small business; 4.7 % from other sources and 3.3 % from aquaculture. Finally, 1.5 % of households have secondary incomes from pension.

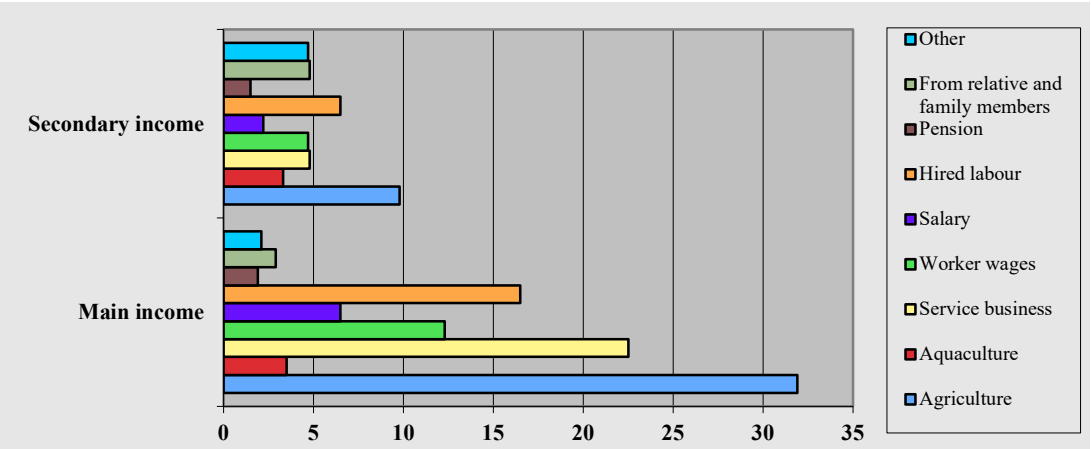


Figure 3.17. Income Sources

The survey results also show that 0.5 % of households have income less than 1 million VND/ month; 13.3 % of households earn from 1 million to 3 million VND/month. This may allow saying that they may be poor and pro-poor households in the area.

The proportion of households having monthly earns from 3 million to 5 million is 42.9 % and households having monthly earns more than 5 million VND is 43.2 % of the total surveyed households.

When comparing household's incomes and expenditures, 29.6 % of households did not balance their incomes and expenditures during the last year, 49 % of households having incomes from other production activities can be met with household's expenditures and 21.4 % of households have a larger income than household's expenditures (See Figure 3.17).

3.4.4.7. Health Care System

There are 28 out of 29 communes and towns in the area have medical stations or centers meeting the standards set by the National Commune Health in the period of 2011-2020 (See Table 3.19). Equipment, medical staffs are invested and planned in terms of both quantity and professional qualifications. Communal health stations are responsible for providing primary health care services for the people. However, the purpose of these visits is for common diseases and

vaccination, periodical examination for children and medical check-up for veterans or people with health insurance. In severely case, people are more likely to go to well-equipment clinics, hospitals or general clinics.

Table 3.19. Communal Health Stations

No	Province	Scale			Staff						
		Solid	Semi-solid	Number of beds	Doctor	Physician	Nurse	Mid-wife	Pharmacist	Nursing	Untrained midwife
1	Tien Giang	x		21	3	11	5	3	4	5	-
2	Ben Tre	x	x	11	2	5	2	3	3	2	-
3	Dong Nai	x		5	1	1	1	1	1	1	1
4	Long An	-	-	114	16	37	17	16	21	17	-
5	Vinh Long	x	-	20	3	5	5	5	3	3	1
Total				**171**	**25**	**59**	**30**	**28**	**32**	**28**	**2**

Faced with the increasing number of COVID-19 infections, many provinces and cities in the Mekong Delta decided to implement a model of isolation and treatment of mild F0 at home. This is a measure to reduce the risk of overcrowding in centralized treatment facilities and create conditions for mild cases of F0 to be cared for by loved ones in a familiar environment, thereby feeling comfortable and recovering quickly.

3.5. TECHNICAL INFRASTRUCTURE IN THE PROJECT AREA

3.5.1. Traffic system

3.5.1.1. Road traffic

The main road infrastructure connecting the largest ports with the hinterland (Figure 3.18) is as follows:

- The CMTV Port area is connected to the national highway QL51. QL51 connects Vung Tau in the south with Dong Nai's capital city Bien Hoa and is the backbone infrastructure to many industrial parks in Dong Nai.
- South of Bien Hoa, the QL51 connects with the national highway QL1A, which is the highway connecting Mekong Delta and HCMC with Central and North Vietnam. In HCMC's urban highway system, the QL1A is the northern and the western tangent and is important artery to the industrial parks in the north of HCMC and Binh Duong. The Dong Nai Bridge is part of QL1A and from there access roads connect to the Binh Duong and Dong Nai container terminals.
- In Long Thanh, southeast of HCMC, the QL51 intersects with the recently opened East-West expressway (CT101). This expressway is open to motorized vehicles only. In HCMC's District 2 (in the East of HCMC), CT101 ends and has links to HCMC's highway ring system. In An Lac (in the West of HCMC) CT101 has its continuation towards the Mekong-Delta up to My Tho, where it connects to QL1A. Between HCMC and My Tho, QL1A is a parallel route to CT101.
- The connecting roads between CT101 in District 2 and An Lac are urban highways that form the southern tangent of HCMC's highway system. Truck traffic either passes through a tunnel under the Saigon River or crosses the Phu My bridge.
- The CT101 and the connecting East-West Highways provide access to HCMC's Cat Lai terminal and VICT. To those terminals, the highways QL52 and QL13 are important connections to the industrial parks in the north of HCMC, near Bien Hoa and in Bien Duong Province. QL52 and QL13 also provide access to the ICDs on the Saigon River.

- In Mekong-Delta, from My Tho, the QL1A is the road connecting with western and northern parts of MKD. The road has bridges over the Tien and Hau River, near Vinh Long and Can Tho. MKD's South-eastern provinces Ben Tre an Tra Vinh regions in MKD are connected by the QL60 with the Rach Mieu bridge Crossing the Tien River.

Figure 3.18. Road traffic network

Apart from the Expressway, all highways pass through semi-urban and urban environments, have level crossings and often have mixed traffic. On main arteries in and around HCMC, roads can be 2x6 lanes wide and on those stretches freight and long-distance traffic are successfully separated from the local (often motorcycle) traffic. On most of the network, average speeds are relatively low and traffic congestion occurs frequently.

Truck traffic is banned during daytime or during peak hours on an important part of the road network of Ho Chi Minh City. Particularly the road traffic approaching Cat Lai terminal and the terminals through inner districts of HCMC are affected. From the West, only the access to Cat Lai over Phu My bridge is open for 24 hours.

The provincial roads and urban roads in the region vary in quality, with some provinces for example having low shares of paved roads. On larger distance from the highly urbanised regions, the network of roads that is suited for heavy vehicles (container trucks) traffic is not well developed.

3.5.1.2. Waterway traffic

The region consisting of the Mekong Delta (MKD) together with the area located North-East of the Mekong Delta (NE-MKD) has a dense network of rivers and canals, and a large number of sea and river ports. According to Circular 46/2016/TT-GBTVT dated 29 December 2016, there are almost 3,000 km of navigable waterways in the MKD. Inland waterway transport is important mode of transport for transporting goods between the MKD and Ho Chi Minh City (HCMC) and Cai Mep – Thi Vai (CMTV) area. Looking at the main cargos for inland waterway transport (construction materials, energy products, rice and fertilizers) and comparing ton-

kilometers, the share of inland waterways is 62% and road transport 38%. Related to the inland waterway transport it is expected that in the future the market share will further grow. An overview of the IWT network is shown in the figure 3.

Southern inland waterway system is concentrated in Mekong Delta region, connecting economic development center Ho Chi Minh city with Southeast large sea ports, including main routes and corridors as follows:

- Route Ho Chi Minh city to Kien Luong through Cho Gao channel with length 313km, which includes a section of about 180 km grade II – inland waterway and a section of about 68 km in Vam Co, Tien river and Hau river special grade.
- Corridor 1: Route Ho Chi Minh city to Ca Mau - Nam Can through Cho Gao channel with length 387km, which includes a section of about 180km grade II – inland waterway and a section of about 51km special grade.
- Corridor 2: Route Ho Chi Minh city to Kien Giang through Thap Muoi channel No. 1 with a section of 278km, grade III – inland waterway and a section of 36km special grade.
- Corridor 3: Coastal route from Ho Chi Minh city to Ca Mau – Nam Can through Tra Vinh - Bac Lieu channel - Ca Mau with length 342km, which include a section of 180km grade II – inland waterway and a section of about 41km special grade. Due to several difficulties, this corridor has not been invested completely.

Moreover, there are other by-pass routes with high demand of transportation: Port route Sai Gon - Hieu Liem (Dong Nai river); port route Sai Gon - Ben Suc (Sai Gon river); route from Ho Chi Minh city to Moc Hoa (Long An) - Dong Thap Muoi through Vam Co Tay river; route Sai Gon - Ben Keo (Tay Ninh); connecting route between Thi Vai - Soai Rap. Regional seaports connect almost all transportation routes, inland waterway ports with large quantity of transported commodities.

Demand for container transportation is increasing, which stimulates transportation demand for inland waterway in. Container transportation is being carried out mainly at Southern inland waterway route, from Cai Mep – Thi Vai port, Ho Chi Minh city to Mekong Delta region through following ports: Sa Dec and Cao Lanh (Dong Thap), My Thoi (An Giang), Cai Cui (Can Tho) and via Cambodia (including both import-export and transshipment from Cambodia).

Cai Mep Port (BR VT)

Cai Cui Port (Can Tho)

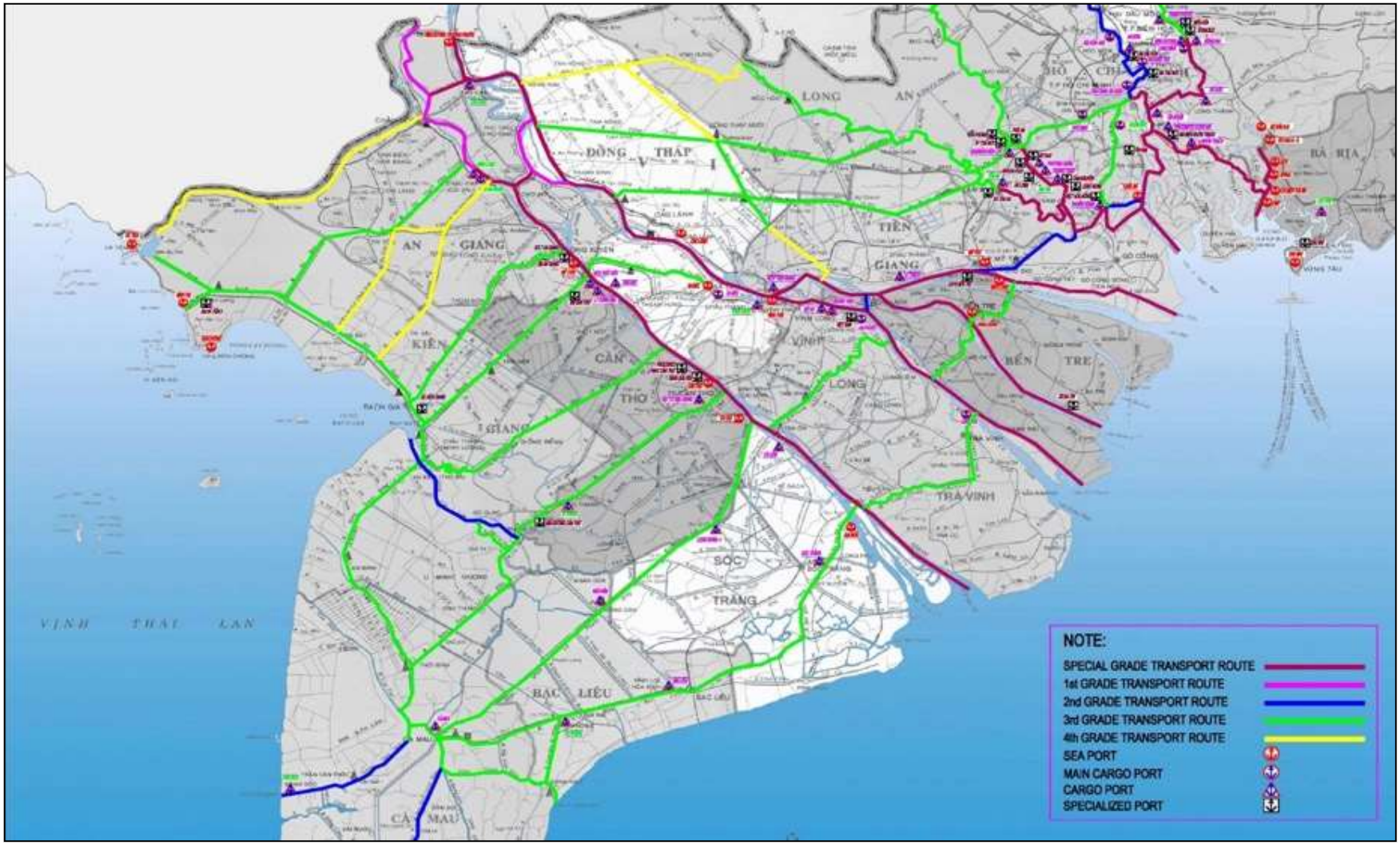


Figure 3.19. Existing inland waterway network

The two main waterways within the MKD are the Tien River and Bassac River. Both rivers run parallel and discharge into the East Sea. Different waterways connect the two main rivers, such as Vam Nao River, Lap Vo – Sa Dec Canal, Doc Phu Hien Canal and Mang Thit River / Canal.

The main connection between the MKD and HCMC is Cho Gao Canal. Cho Gao Canal is one of the busiest canals in Vietnam. In 2013, Ministry of Transport has issued Decision No. 1738/QD-BGTVT dated June 21, 2013 approving adjustment in construction investment of Improvement of Cho Gao channel, which construction was completed for Phase 1 in 2016; Ministry of Transport also issued decision No. 1782/QD-BGTVT dated September 14, 2020 approving Phase 2 investment, which currently the project is being implemented, expected completion in 2023. The objective is to upgrade Cho Gao Canal to meet the standards of a Class II for Inland Waterways.

The waterways in the MKD Inland Waterway Network are divided into different classes. Circular 46/2016/TT-BGTVT dated 29 December 2016 by the Ministry of Transport, provides an overview of each waterway with it class today and envisaged class in the 2030.

Figure 3.13 shows the network of inland waterways used by container barges. The waterway dimensions (water draft, width and bends) and the air clearance of bridges together determine maximum carrying capacities of container barges. These capacities are expressed in TEU.

Currently, there are 56 marine channels of 1.034,90km, including 45 public marine channels invested by the State with length 994,46km and 11 specialized marine channels invested by Corporate with length 40,445km. The commodity and container transportation use the following routes:

- The Dong Nai River between Cat Lai terminal and the Dong Nai Bridge is currently used by river barges of up to 250-TEU-capacity. These barges carry 5-layers of containers, 5 containers wide and 10 TEU in length. More common is the use of 160-TEU (5x5x8) and 96/128-TEU barges (4(or3)x4x8). The waterway dimensions allow for up to 5000 DWT sea vessels and therefore the use of even larger inland waterway barges would be possible. Using such larger barges however would need berths in the terminals along this river (Dong Nai Port and Binh Duong Port) to be adjusted. Navigation further upstream is constrained the Dong Nai Bridge, which is part of the national Highway QL1A. The older part of the bridge (with lanes for eastbound traffic) has 5.5 meters' air clearance, therefore constraining inland navigation to up to 2-layers of containers. The newer part for QL1A's westbound road traffic has air clearance of 7 meters, which is sufficient for barges with 3 layers of containers. Consultation of the road authority learned that works to elevate the bridge are not expected before 2030. About 5 km further upstream from the Dong Nai Bridge is the recently reconstructed Ghenh railway bridge with 6.2-meter air clearance, which is also not sufficient for carriage of 3 layers of containers. This is a disadvantage for container transportation in upstream Dong Nai river.
- Soai Rap channel currently has a standard depth of -9,5m, which is related to the development of port area in Hiep Phuoc, in case of constructing a channel receiving larger sea vessels into Soai Rap ports, together with the development of Hiep Phuoc area, a great quantity of commodities will be attracted into this area, this leads to a reduction in inland commodities to CMTV area because of higher distance between CMTV and Ho Chi Minh city and other Southeast provinces than that from Hiep Phuoc and Cat Lai port area.
- The route between Ho Chi Minh City seaports (Cat Lai Port, Hiep Phuoc, VICT, SPCT) and the CMTV Port area is over special class waterways, navigable by sea vessels of DWT 20,000 or more and therefore there are no constraints to large-scale river barging.
- On the Saigon River, regular container traffic is up to the river based ICDs in the Truong Tho port in Thu Duc District of HCMC. The barges in use have capacities of 96 TEU with 3 layers of containers. The waterway provides similar capacity further upstream, where the

new Phu Long bridge and the new Binh Loi railway bridge have 7m air clearance under the project of improvement, upgrade of Sai Gon river channel section Binh Loi railway bridge to Ben Suc port under BOT method; However, the upstream navigation is yet constrained by the Old Phu Long Bridge, but this bridge is due to be demolished. After that the river will be navigable for the 96 TEU barges up to Ben Suc, about 100 km upstream of Saigon river's mouth. Moreover, the project of improvement, upgrade of Sai Gon river channel section Binh Loi railway bridge to Ben Suc port also upgrades a waterway channel section from Binh Loi bridge to Ben Suc port where vessel 1000 ton can be received, however, due to several difficulties, this item is not being continued now. If this project is completed, it will facilitate navigation of large-capacity vessel in this channel with container transportation being connected through Southeast ports such as Cai Mep - Thi Vai and other ports.

- The maximum allowable barge capacities on transport routes between Mekong-Delta differ between the alternative routes. Container barge traffic now is infrequent and irregular and therefore there is no clear pattern of routes on that trade. The incumbent inland waterway transport operators indicated that they had navigated the route along SWLC-corridor Alt.1 between HCMC and terminals in An Giang and Can Tho on the Bassac River with 128-TEU barges. This 128-TEU capacity in normal conditions is limited to 96-TEU, because of air clearance constraints on the Cho Gao Canal only allowing 3-layers of containers. This Cho Gao Canal is a class-II waterway and is the constraining link on the routes to Mekong Delta. The dimensions of the 96/128-TEU barges are beyond its design parameters, but operators can navigate the stretch within tidal windows. For that they must accept waiting times of up to 6 hours before passage. A meeting revealed that even 160 TEU barges (120-TEU on 3-layers) have navigated the Cho Gao canal in a service between Cambodia and HCMC. With current low traffic volumes in Mekong Delta, the use of smaller barges is more common. Advantage is that these smaller barges can use shorter routes. Barges of 36 TEU capacity (3 layers) typically use SWLC-corridor Alt.3 (Mang Tith River) to/from Can Tho and Hau Giang and the SWLC-corridor Alt.6 (Lap Vo – Sa Dec Canal) to/from An Giang. The dimensions of the SWLC-corridor Alt.3 are sufficient to also accommodate 54-TEU barges.

Figure 3.20. Maximum TEU capacity on the inland waterway network

The carriage of containers in barges is a relatively recent phenomenon in Vietnam. So far, not much attention has been paid to optimizing barge designs to container traffic. These barges are the same as those that are in use for dry bulk cargoes. Because most of container traffic in Vietnam has been on special-class waterways with no physical constraints, the design characteristics of container barges so far have never been challenged. A comparison with barges used in Europe learns that there is much room for improvement to barges that must navigate routes with infrastructure constraints, like in the Mekong-Delta. Draught of European 208-TEU barges are lower than Vietnamese 96 TEU barges.

3.5.1.3. Railway transportation

In the project area, there is only railway line, which is the north–south railway line that connects with Central and North Vietnam. The line starts in Saigon Station (District 3 of HCMC). The railway line is single track and narrow gauge and mainly functions for passenger and parcel traffic, but also handles a small share of general cargo traffic. The line is not connected to ports or to inland terminals and has no facilities dedicated to container transshipment.

3.5.2. Water supply

Most of communes in the Project area have a system of water treatment plants to meet daily domestic demands of local people. Most of water supply plants are located on the banks of Mang Thit and Cho Lach canals, using river water as the water supply source. Therefore, the potential impacts on the quality of surface water during the construction and operation phases should be paid adequate attention.

3.5.3. Electricity and communication

The percentage of people using national power grid within the Project's communes and districts is more than 99% of the total population. In the Project area, households have no mains electricity meters (mostly using electricity from neighboring households).

The communication system has also developed with all project communes have telephone and Internet connections. Mobile phone signal also covers most of the Project areas to ensure the communication demands for people.

3.5.4. Solid waste treatment

Recently, there is no centralized solid waste treatment facility in the Project area, wastes are collected and handled by households through burning or burying practices. The disposal sites are usually only planned for major towns such as Cho Lach town where a disposal site is planned to be located about 450 m far from the East side of Cho Lach canal at Km 6+00 and Tra On town whose disposal site is located two kilometers to the East side at the beginning of the Mang Thit River.

3.5.5. Cultural resources

3.5.5.1. Tangible cultural resources

Along the rivers and canals system, there are many religious objects such as temples, pagodas, churches, shrines, temples, etc. In the Project area, along the Mang Thit and Cho Lach canals, there are two national history monuments, namely (i) Phuoc Hau Pagoda, located along National Highway 54 and near the bank of the Tien River, at the beginning of estuary in Tra Co Town, 600 m northeast away from the Ngai Tu Commune, Tam Binh District, Vinh Long Province and (ii) Ngoc Son Quang religious area is located in Tan An Hoi Commune, Mang Thit District, Vinh Long Province; 600 m far from the west of Mang Thit River at km 34+500.

The details of information on cultural resources are described in Table 3.20.

Table 3.20. Cultural resources in the project area

Name/Picture	Distance to the Project (m)	Description
1. Mang Thit river		
 Phat Tanh pagoda	206	It is on the West of disposal site No.1. Roadside of NR54 It is often crowded on the 1st and the full moon days of the month
 Tra On Protestant Church	170	On the right bank of the canal. 200 believers come and pray weekly. 17 part-time staffs
 Nhi My pagoda	220	On the right bank of the canal. 3,000 Buddhist believers come and pray weekly. It is often crowded on the 1st and the full moon days of the month
 Tuong Loc Church	30	On the left side of the canal 300 believers come and pray weekly. 6 priests
 An Lac pagoda	450 m	On the left bank of the canal. 4,000 Buddhist believers come and pray weekly. It is often crowded on the 1st and the full moon days of the month
	170	On the right side of the canal It is often crowded on the 1st (Soc day) and the full moon (Vong day) days of the month

Name/Picture	Distance to the Project (m)	Description
 Thien Tien Kao Dai church		
 Xuan Hiep church	280	On the right side of the canal 100 believers come and pray every Sunday. 1 priest
 Cau Moi church	80	Near Mang Thit Bridge on left side of the canal 236 believers come and pray every Sunday. 1 priest
 Thuong Linh Dan church	168	On the right side of the canal It is often crowded on the 1st (Soc day) and the full moon (Vong day) days of the month
 Tan Long Hoi church	275	On the left side of the canal It is often crowded on the 1st (Soc day) and the full moon (Vong day) days of the month
2. Cho Lach Canal		
 Cho Lach protestant church	90	On the right side of the canal and located outside of the town center. 300 believers come and pray every week.

Name/Picture	Distance to the Project (m)	Description
 Cho Lach cathedral	40	Near Cho Lach 2 Bridge and on the right side of Cho Lach canal. 468 believers come and pray every Sunday. 1 priest
 An Tiem Kao Dai church	24	On the right side of the canal, closed to Cho Lach 1 Bridge. It is often crowded on the 1st (Soc day) and the full moon (Vong day) days of the month
3. Rach La Canal		
 Linh Chieu pagoda	20	Located on the left side of Rach La Canal, opposite to the second embankment section of Rach La. A small pagoda with no people living. Local people often pray on the 1st and the full moon days of the month. Fisherman usually visit and pray for luck while working on the water

3.5.5.2. Intangible cultural resources

In MKD and also in Southeast region, there are many traditional festivals which are intangible cultural resources of the local people. Below are some typical festivals of the region.

- **Coconut Offering Ceremony (Thac Con Festival) - Spiritual festival of Soc Trang province**

This is a traditional festival of Soc Trang province on the full moon day of February every year. The festival takes place in An Hiep commune, Chau Thanh district. Thac Con festival has the custom of offering cotton vases made of coconut fruit. Because of this unique feature, people call this "coconut offering ceremony". According to the concept of the people here, the water in the pure coconut is a sign of luck and peace. This is a typical cultural festival of the Southwest region.

- **Ok Om Bok Festival - The biggest festival in the West**

Ok Om Bok festival is the most anticipated festival of the year for Khmer people. On the 14th and 15th day of the 10th lunar month every year, the villagers conduct a moon worshiping ceremony right in front of their house, then gather at the temple to do the ceremony together. That's why Ok Om Bok is also known as "moon worshiping ceremony". If in Soc Trang, people go to Nuoc Ngot Lake, and in Tra Vinh, they gather at Ba Om Pond to attend the ceremony.

The most unique and attractive part of the Ok OM Bok festival in the West is the go boat racing. The western boat racing festival uses boats as a popular means of transport in the river areas. The racing boats are somewhat more unique as they are carved in the trunk of the Sao tree, the

outer shape is painted to resemble the snake god Nagar - the mascot of the Khmer people. The nose and rudder are curved and can accommodate about 40 paddlers. The rowers are carefully selected, the strong boys of the region. Ngo boat racing is a traditional ritual of the Mekong Delta region, to send off the water god after the crop is planted to the sea. In addition to racing boats, releasing water lights is also an indispensable activity in Ok Om Bok festival.

- **Bull Racing Festival and Dolta Festival in An Giang Province**

This is also one of the famous festivals of An Giang province, the festival is held every year on the occasion of Dolta New Year. This Tet holiday is held from August 29 to September 1 of the lunar calendar, with the concept of remembering the birth, birth and upbringing of grandparents and remembering the original ancestors.

During these Tet holidays, there is a very attractive bull racing tradition. Usually held alternately at Thamit Pagoda, Ta Miet Pagoda. This is a typical Western cultural festival that attracts tourists. Western bull racing festival has bold folk colors, attractive and vibrant, attracting a large number of people in the region and tourists to attend.

- **Cholchnam Thmay - Traditional New Year's Day of the Western Khmer**

Held annually on the 13th, 14th and 15th of the third lunar month, Cholchnam Thmay is also known as "the ceremony of giving birth". This is the time when the Khmer have finished farming, so they can have fun. This festival custom is similar to the Lunar New Year of the Kinh people. On these days, the Khmer people in the western provinces all pack banh tet, prepare fruits, and incense to worship the Buddha. This is also one of the unique cultural festivals of the West.

- **Cai Rang Floating Market**

Cai Rang Floating Market is a floating market specializing in exchanging, buying and selling agricultural products, fruits, goods, food, eating and drinking on the river and is a unique attraction of Cai Rang district, Can Tho city. The unique and main feature of Cai Rang floating market is that it specializes in trading fruits and specialties of the Mekong Delta. In the past, floating markets were formed because roads and means of road traffic were not developed, while the demand for buying and selling and exchanging goods, people gathered on the river and by means of boats and boats. Today, although the road network has developed widely, floating markets still exist and grow busier and busier.

The festivals mentioned above do not take places on the waterways and auxiliary works under the SWLC Project or in the area of influence of the project.

3.6. SITE-SPECIFIC BASELINE CONDITIONS

3.6.1. Sensitive receptors

The details of information on sensitive receptors are described in Table 3.21.

Table 3.21. Sensitive receptors in the Project Area

Name/Picture	Construction works	Distance to the Project (m)	Description
Mang Thit river			

Name/Picture	Construction works	Distance to the Project (m)	Description
 Phat Tanh pagoda	Disposal site 01	206	It is on the West of disposal site No.1. Roadside of NR54 It is often crowded on the 1st and the full moon days of the month
 Tra On Protestant Church	Dredging, bend correction Km0+700 to Km 1+100	170	On the right bank of the canal. 200 believers come and pray weekly. 17 part-time staffs
 Nhi My pagoda		220	On the right bank of the canal. 3,000 Buddhist believers come and pray weekly. It is often crowded on the 1st and the full moon days of the month
 Tam Binh town	Dredging, embankment Km9+500 to Km 17+200	10	Along the Mang Thit river, mainly on the left bank. Center of Tam Binh district with population of about 6,000 people.
 Huong Duong Kindergarten		250	Serving Tam Binh town children. 100 children
 Tam Binh General Hospital		72	On the left side of the canal General hospital serves Tam Binh district. 130 hospital bed; 11 departments and 3 administrative units
		32	On the left side of the canal Serving Tam Binh town and surrounding communes. Around 600 pupils.

Name/Picture	Construction works	Distance to the Project (m)	Description
 Luu Van Liet primary school			
 Office blocks of Tam Binh		55	On the left side of the canal Administrative area of Tam Binh town.
 Tam Binh market		25	Along the left side of the canal Open daily and serve Tam Binh town and surrounding area.
 Tuong Loc Church		30	On the left side of the canal 300 believers come and pray weekly. 6 priests
 Tuong Loc B primary school		82	On the left side of the canal Serve Tuong Loc 1 and 2 communes, Tam Binh district, Vinh Long. Around 500 pupils
 Nhon Binh B primary school		18	On the right side of the canal Serve Nhon Binh commune, Tra On district, Vinh Long. Around 450 pupils
	Bend correction, dredging Km17+400 to Km 18+800	Riverside of the new cutting section	On the right bank of the canal Serve Xuan Hiep commune, Tra On district, Vinh Long. Around 450 pupils

Name/Picture	Construction works	Distance to the Project (m)	Description
Xuan Hiep A primary school			
 An Lac pagoda		450 m	On the left bank of the canal. 4,000 Buddhist believers come and pray weekly. It is often crowded on the 1st and the full moon days of the month
 Thien Tien Kao Dai church	Dredging Km19+000 to Km20+400	170	On the right side of the canal It is often crowded on the 1st (Soc day) and the full moon (Vong day) days of the month
 Xuan Hiep church		280	On the right side of the canal 100 believers come and pray every Sunday. 1 priest
 Tan An Luong residential area	Mang Thit Bridge Km25+600	15	Along the canal and National Road No. 53 Center of Tan An Luong commune
 Cau Moi church		80	Near Mang Thit Bridge on left side of the canal On the right side of the canal 236 believers come and pray every Sunday. 1 priest
 Thuong Linh Dan church		168	On the right side of the canal It is often crowded on the 1st (Soc day) and the full moon (Vong day) days of the month

Name/Picture	Construction works	Distance to the Project (m)	Description
 Tan Long Hoi church		275	On the left side of the canal It is often crowded on the 1st (Soc day) and the full moon (Vong day) days of the month
Cho Lach Canal			
 Khung Le Kindergarten	Dredging, embankment Km0+000 to Km7+900	20	A branch of Cho Lach town kindergarten with 50 kids. Located on the right side of Cho Lach canal and roadside of provincial road No. 172
 Cho Lach protestant church		90	On the right side of the canal and located outside of the town center. 300 believers come and pray every week.
 Cho Lach town residential area		15	Along both sides of Cho Lach Canal and the Cho Lach 2 Bridge. The population of Cho Lach town is about 12,000 people.
 Cho Lach cathedral		40	Near Cho Lach 2 Bridge and on the right side of Cho Lach canal. 468 believers come and pray every Sunday. 1 priest
 Cho Lach General Hospital		70	On the right side of the canal General hospital serves Cho Lach district

Name/Picture	Construction works	Distance to the Project (m)	Description
 An Tiem Kao Dai church		24	On the right side of the canal, closed to Cho Lach 1 Bridge. It is often crowded on the 1st (Soc day) and the full moon (Vong day) days of the month
Rach La Canal			
 Linh Chieu pagoda	Bend corection (2 segments), dredging, embankment Km5+000 to Km8+800	20	Located on the left side of Rach La Canal, opposite to the second embankment section of Rach La. A small pagoda with no people living. Local people often pray on the 1st and the full moon days of the month. Fisherman usually visit and pray for luck while working on the water

3.6.2. Proposed disposal sites

Disposal sites are proposed nearby the dredging areas in order to minimize environmental impacts causing air pollution due to transportation and to reduce construction costs.

The locations of these disposal sites are preliminary as no discussion took place with land users. During detail design, the locations of these sites will be identified precisely, and consultation will be conducted with the land users in order to reach agreement.

Location and capacity of proposed disposal sites for the Project are listed in Table 3.22:

Table 3.22. List of proposed disposal sites

No	Code	Location	Chainage	Area [ha]	Capacity [m^3]
Mang Thit river					
1	BD-01	Tra On town, Tra On district, Vinh Long	Km 0+200 - Km 0+600	6.2	142,600
2	BD-02	Tuong Loc commune, Tam Binh district, Vinh Long	Km 10+200 - Km 10+600	4.9	112,700
3	BD-03	Tuong Loc commune, Tam Binh district, Vinh Long	Km 11+400 - Km 11+800	5.7	131,100
4	BD-04	Tuong Loc commune, Tam Binh district, Vinh Long	Km 12+400 - Km 12+800	4	92,000
5	BD-05	Tuong Loc commune, Tam Binh district, Vinh Long	Km 13+500 - Km 14+000	10	230,000
6	BD-06	Tuong Loc commune, Tam Binh district, Vinh Long	Km 14+800 - Km 15+200	8	184,000
7	BD-07	Tuong Loc commune, Tam Binh district, Vinh Long	Km 15+800 - Km 16+200	10	230,000
7	BD-08	Tuong Loc commune, Tam Binh district, Vinh Long	Km 15+800 - Km 16+600	15	345,000
8	BD-09	Tuong Loc commune, Tam Binh	Km 17+000 - Km	10	230,000

No	Code	Location	Chainage	Area [ha]	Capacity [m³]
		district, Vinh Long	17+800		
9	BD-10	Xuan Hiep commune, Tra On district, Vinh Long	Km 17+900 - Km 18+700	20	460,000
10	BD-11	Xuan Hiep commune, Tra On district, Vinh Long	Km 17+800 - Km 18+200	9.7	223,100
11	BD-12	Xuan Hiep commune, Tra On district, Vinh Long	Km 19+200 - Km 19+800	7.5	172,500
12	BD-13	Xuan Hiep commune, Tra On district, Vinh Long	Km 19+200 - Km 19+801	2	46,000
13	BD-14	Hoa Hiep commune, Tam Binh district, Vinh Long	Km 19+200 - Km 19+802	7	161,000
14	BD-15	Tan An Luong commune, Vung Liem district, Vinh Long	Km 19+200 - Km 19+803	7	161,000
15	BD-16	Hoa Thanh commune, Tam Binh district, Vinh Long	Km 19+200 - Km 19+804	10	230,000
16	BD-17	Tan An Luong commune, Vung Liem district, Vinh Long	Km 19+200 - Km 19+805	2	46,000
Total					**3,197,000**
Rach La canal					
1	BD-01	Binh Phu commune, Go Cong Tay district, Tien Giang	Km 2+200 - Km 3+000	17.6	528,000
2	BD-02	Dong Son commune, Go Cong Tay district, Tien Giang	Km 4+000 - Km 4+800	8.7	261,000
4	BD-03	Thanh Vinh Dong commune, Chau Thanh district, Long An	Km 5+300 - Km 5+800	8.1	186,300
3	BD-04	Thanh Vinh Dong commune, Chau Thanh district, Long An	Km 6+000	18.3	366,000
5	BD-05	Dong Son commune, Go Cong Tay district, Tien Giang	Km 7+700 - Km 8+200	11.7	269,100
Total					**1,341,300**
Cho Lach canal					
1	BD-01	Son Quy commune, Cho Lach district, Ben Tre	Son Quy industrial zone	40	600,000
2	BD-02	An Phuoc commune, Mang Thit district, Vinh Long	An Dinh industrial zone	60	900,000
Total					**1,500,000**

Source: Feasibility Study, PMUW, 2018

3.7. CAPACITY, EXPERIENCE OF THE IMPLEMENTING AGENCIES AND NEEDS

3.7.1. Experience of provincial authorities

The key functions and experiences of provincial departments and related project implementing agencies are provided in Table 3.23 below.

Table 3.23. Key functions of provincial authorities

Field	Department	Key Functions
Environmental Management	DONRE	Monitor, appraise and recommend for PPC approval.
OHS Management	DOLISA	Labour management, OHS policies
Traffic Management, Fire	Police	Appraise and management of Fire Risks

prevention		
Social Management	Police	Social security management
Cultural Heritage Management	DOCST	Cultural Heritage management
Waterway Management	DOT	Waterway Usage management
Water Resource Management	DONRE	Environmental and Water Resource Management
Fishery Rresource Management	DARD	Fishery resource Management

3.7.2. Experience of PMUW

3.7.2.1. Project Implementation Experience

So far, several inland waterway projects financed by the World Bank, ADB have been implemented in Vietnam. There are also projects have been implemented in the Mekong Delta region such as *the* Vietnam *Inland Waterways and Ports Rehabilitation Project*; *the Mekong Delta Transport Infrastructure Development Project*. The implementation of these past World Bank-financed projects enriches the PMUW (and MoT) with environmental and social management performance.

3.7.2.2. Capability of Staff

An assessment of safeguards implementation capacity of existing PMUW staff indicates that PMUW staffs have limited knowledge on WB safeguard requirements as well as limited knowledge of environment and social issues. Such lack of capacity represents a risk to project implementation of safeguards requirements contained in the ESMP and, as required by the WB policy, is to be addressed through capacity building. Therefore, it is proposed to provide capacity building through technical assistance that will support the PMUW during the implementation of the safeguard requirements. The technical assistance will provide the necessary technical support the PMUW in its works with contractors as well as other entities involved in the implementation of the ESMP.

CHAPTER 4. ALTERNATIVES ANALYSIS

This chapter presents analyses of scenarios for "Without Project" and "With Project" and summarizes the analysis of engineering design alternatives for each component in the case of "with Project". The results of these analyses are shown below.

4.1. "WITH" AND "WITHOUT" THE PROJECT ALTERNATIVES

In the case of not implementing the Project, the existence of constraints for navigation and inland waterways in the two selected East - West and North - South Corridors remains in the Project area, including:

- Various waterway sections that is not consistent between each other. Main rivers sections are categorized as Class I, whereas sections in canals are Class IV or even below the requirement of inland waterways standards;
- Many bridges are not sufficient clearance or span width. This leads to barriers for the transportation of goods and commodities from the Mekong Delta region to Ho Chi Minh City and Northeast region;
- Aids to navigation are not maintained or modernized, as they should be. Nighttime navigation is not easy. Information provided to ships and vessels is very limited.
- In addition, there are also institutional constraints remain:
  - Waterways management is shared between many entities: Vietnam Inland Waterways Administration (VIWA), Inland Waterways Management and Maintenance Companies (WAMICOs), Maritime Administrations, DoT, etc.).
  - Funds made available for waterways maintenance/development are too limited. Waterways management companies cannot levy traffic dues.

The analyses of environmental and social on scenarios "With" and "Without Project" are summarized in Table 4.1 below.

Table 4.1. Analysis of Alternatives "WITH PROJECT" and "WITHOUT PROJECT"

Major E&S Issues	WITHOUT PROJECT	WITH PROJECT
Environmental Issues		
Air Pollution	Inconsistent waterways routes will cause inland traffic congestion, increase in exhaust gases release to the environments.	- Upgrading the regional waterways transportation system will increase efficient connectivity of transport links, which minimizes congestion on the key waterways; - Project's implementation will pose negative impacts on ambient air quality due to construction activities. However, these effects are short term and will cease when the construction phase is completed.
Water Pollution	Surface water is partly polluted by the direct discharge of domestic wastes and effluent from households living along the canals/ rivers.	The implementation of the Project would cause potential risks of water pollution as follows: - The dredging activities will disturb sediments of river/canal bed leading to an increase in suspended solids and turbidity of surface water (river water). This may cause negative effects on intake water supply sources for water treatment plants along Mang Thit river.

Major E&S Issues	WITHOUT PROJECT	WITH PROJECT
		- River/canal water is polluted by the direct discharge of domestic wastes and effluent from construction sites and worker camps. However, these effects are short term, will be minimized by good practices of management and will cease when the construction phase is completed.
Landslide	Landslide risks are increased due to heavy rains, strong tidal surges, and waves from the movement of the vessels. Landslides are occurring, lead to loss of agricultural land along the canals/rivers and affect infrastructure, even killing people by falling into the erosion area.	Landslide risks will be minimized and reduced by new embankments protecting river and canal banks.
Forest, fish and aquatic life	No impacts on forest, fish and aquatic life	- Temporary impacts: Increase water turbidity, reduce photosynthesis capacity of phytoplankton and consequently effect to other species in the food chain; Reduce the capacity of aquaculture and fisheries.
Social Issues		
Land Acquisition and Resettlement	Not affected by land acquisition and resettlement.	- About 1,068 households are estimated to be affected, including 710 households are affected by land acquisition and 358 households must be relocated.
Disturbance of daily community activities	No impacts on the lives and activities of local people living along the Project rivers/ canals.	- Livelihoods and daily activities of local people as well as community's relations will be affected by relocation and construction activities.
Community Safety and Risk	Erosion is a major problem along canals with intense navigation, especially Cho Gao Canal.	- Embankments will be improved, reducing soil erosion and landslides and thus ensure the safety of people and property of the community.
Employment during Construction	None	- Waterways have to be designed and built; result in higher employment in the construction sector. During the construction phase, many local non-skilled workers may be hired and this will create short-term income opportunities for local people.
Supporting Waterways Navigation on the Project Canals/Rivers	None	- The dredging work will dredge the convex part of the rivers/canals, leveling river/canal bottom and stabilize the water flow and support smooth waterway navigation along the Project rivers/canals.
Improving Navigation Safety along the Waterways	None	- Construction works include bend cutting, dredging and navigation aids installing to ensure the standardization of Class II; eliminate the "black spots" of waterways traffic safety on the North - South and East - West corridors.

4.2. ALTERNATIVES CONSIDERED

4.2.1. Route plan according to Egis International research

The objective of Multi Criteria Analysis (MCA) was to identify the preferred SWLC inland waterway alternatives, for both the SWLC East – West and North – South corridors, to be upgraded to navigation class II (being the navigation class of the Cho Gao canal). The identification of the preferred SWLC inland waterway A alternatives for upgrading is based on a multi criteria analysis.

According to Egis' prior research on the project, the following are the ideal criteria for determining the SWLC project's inland waterway option:

- The transport cost benefit per invested USD and annual maintenance costs for the required upgrading;
- The increase of safety of navigation, defined by the relative navigation time and taking into account the total length of the route and traveling time via ship lock;
- The environmental, social and resettlement (ES&R) impact of the required upgrading interventions, and;
- Total investment required for corrective measures to upgrade the channel.

The preferred B, C and D alternatives are determined on the basis of the total length of the routes, the ES&R impact and the required investments for upgrading.

In the financial and economic feasibility analysis, the preferred SWLC alternatives are to be evaluated against the 0-alternative. A1 (existing Tien River - Vam Nao River - Hau River path with no correction) are presently used by navigation class II vessels operated in the Mekong Delta area.

The following figure shows the different alternative for both the East West and North South corridor of SWLC project.

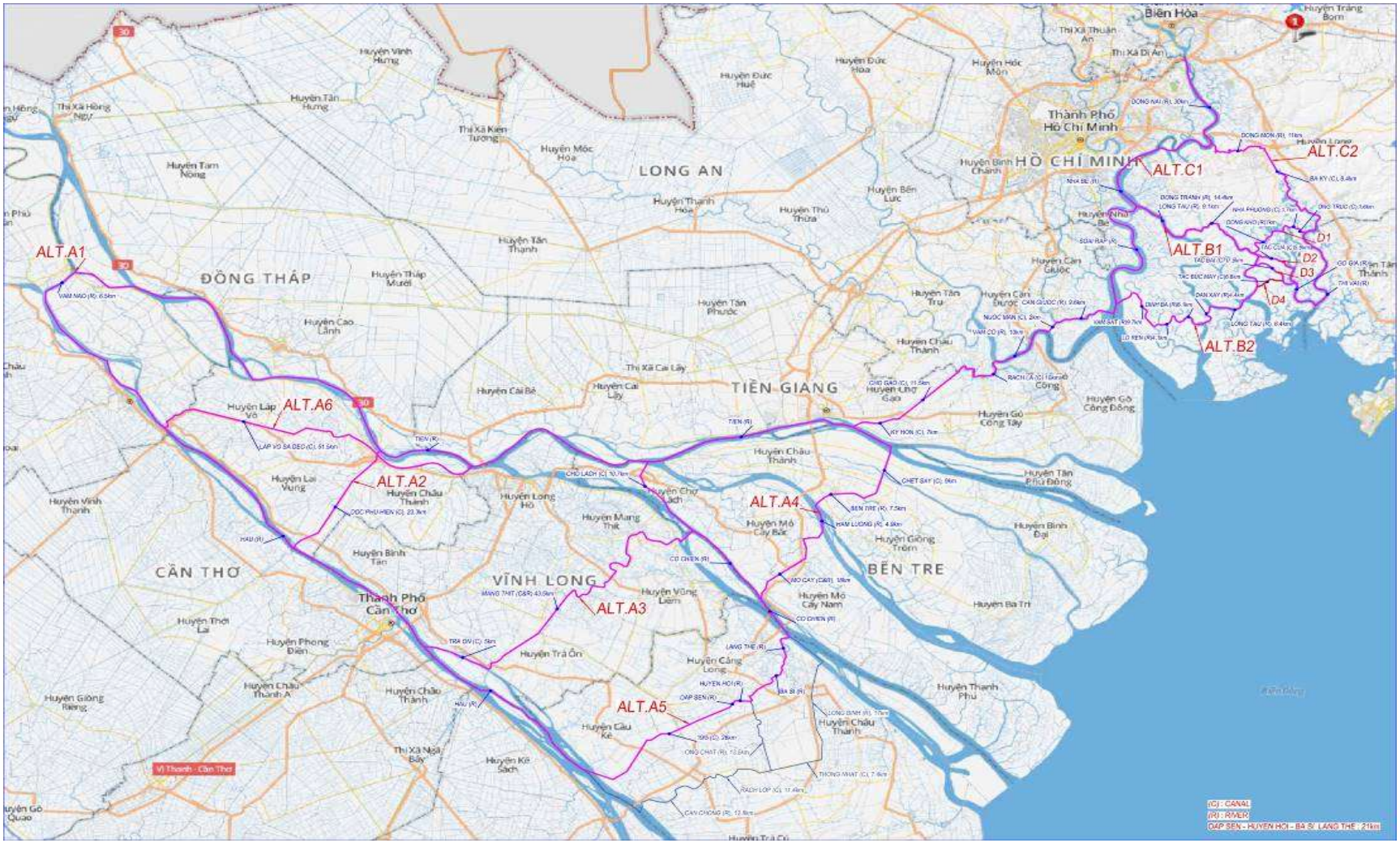


Figure 4.1. Inland Waterway alternatives

4.2.1.1. East – West Corridor

The A alternatives of the SWLC East – West Corridor connect Can Tho port with the Soai Rap River.

It should be noted that the existing Alt.A1 route for container ships and vessels up to 1500T traffic is considered as 0-alternative. No improvements are required up to the Cho Gao channel to adjust Alternative A1 to navigation class II (from Ky Hon canal, via Cho Gao canal and Rach La canal to the Soai Rap river, improvements are required but those are the same for all A alternatives).

Consequently, alternative A1 will not be included in identifying the preferred route for improvement.

Table 4.2. Results of Multi-Criteria Analysis

Altenative	B/C ratio	Safety	ES&R	Investment	Total	Rank
Alt A2	20	10	96	30	156	3
Alt A3	**23**	**11**	**57**	**20**	**110**	**1**
Alt A4	109	12	63	68	250	4
Alt A5	253	17	75	119	465	5
Alt A6	37	13	50	40	140	2

The Multi-Criteria Analysis results show that Alt. A3 is the preferred alternative for upgrading to navigation class II.

Analysis of B and D alternatives

The B and D alternatives of the SWLC's East – West Corridor connect Soai Rap River with the CMTV port area.

It is to be noted that Alt. D1 is not evaluated as, compared to the other D alternatives, the route is considerably longer and requires much more interventions (bend cuttings and dredging) to upgrade to navigation class II.

Table 4.3. Analysis of B and D alternatives

Alternative	Distance (in km)	ES&R impact (score)	Investment (in Mill. USD)
B1-D2	**70,1**	**0**	**0**
B1-D3	70,8	0	0
B2-D4	52,2	227	101,6

The B2-D4 alternative gives only a marginal distance saving (abt. 18 km.) compared to the B1 alternatives but the environmental, social and resettlement impacts to upgrade the B2 alternatives are immense (mainly caused by the fact the B2-D4 route is crossing the core area of the Can Gio Mangrove Biosphere Reserve). Moreover, the required investment of USD 101.6 million USD to upgrade Alternative B2-D4.

From the above it can be concluded that B1-D2 Alternative is the preferred route for connecting to the A alternatives for completing the East – West Corridor from Can Tho port to HCMC.

4.2.1.2. North - South Corridor

The C Alternatives in combination with the D Alternatives form the SWLC North-South Corridor and connect Dong Nai port with CMTV port cluster.

The C1 alternative also includes a D section as to connect to the CMTV port area.

Table 4.4. Analysis of C and D alternatives

Alternative	Distance (km)	Shiplock	ES&R impact (score)	Investment (in million USD)
C1-B1-D2	**82,0**	**0**	**43**	**7,3**
C1-B1-D3	81,8	0	43	9,6
C2	67,2	1	72	254,5

It is to be noted that the upgrading interventions of C1 are based on navigation class I, while the upgrading interventions for C2 are defined by navigation class II, which makes alternative C1 much more attractive as bigger vessels can be used for cargo transportation and thus resulting in a potentially much higher financial and economic feasibility. This is also emphasized by the total required investments of over 250 m. USD for alternative C2 and only 9.6 m. USD for the C1 alternatives.

The C2 alternative gives only a marginal distance saving (abt. 14 km.) compared to the C1 alternatives, but this transportation distance saving is off-set by the time required to pass the lock in alternative C2 (90 minutes on average). Moreover, the environmental, social and resettlement impacts to upgrade the C2 alternative are much higher than for the C1 alternatives.

From the above it can be concluded that the C1-D2 Alternative is the preferred route for the North – South Corridor.

4.2.2. Preferable alternative

Based on the consideration and consideration of Egis research documents on the route options of the project, the consultant proposes the selection of the transport corridor as follows:

Table 4.5. Route and length SWLC's East – West Corridor

Route	Length [km]
Hau River (Can Tho City) – Tra On River – Mang Thit River / Canal – Co Chien River – Cho Lach Canal – Tien River – Ky Hon Canal – Cho Gao Canal – Rach La Canal – Vam Co River – Nuoc Man Canal – Can Giuoc River – Soai Rap River (HCMC)	197

Table 4.6. Route and length SWLC's North – South Corridor

Route	Length [km]
Dong Nai River (Dong Nai Port) – Nha Be River – Long Tau River – Dong Tranh River – Tac Cua River – Go Gia River – Thi Vai River (CMTV Port Area)	82

The selected route for SWLC project is shown in the following map.

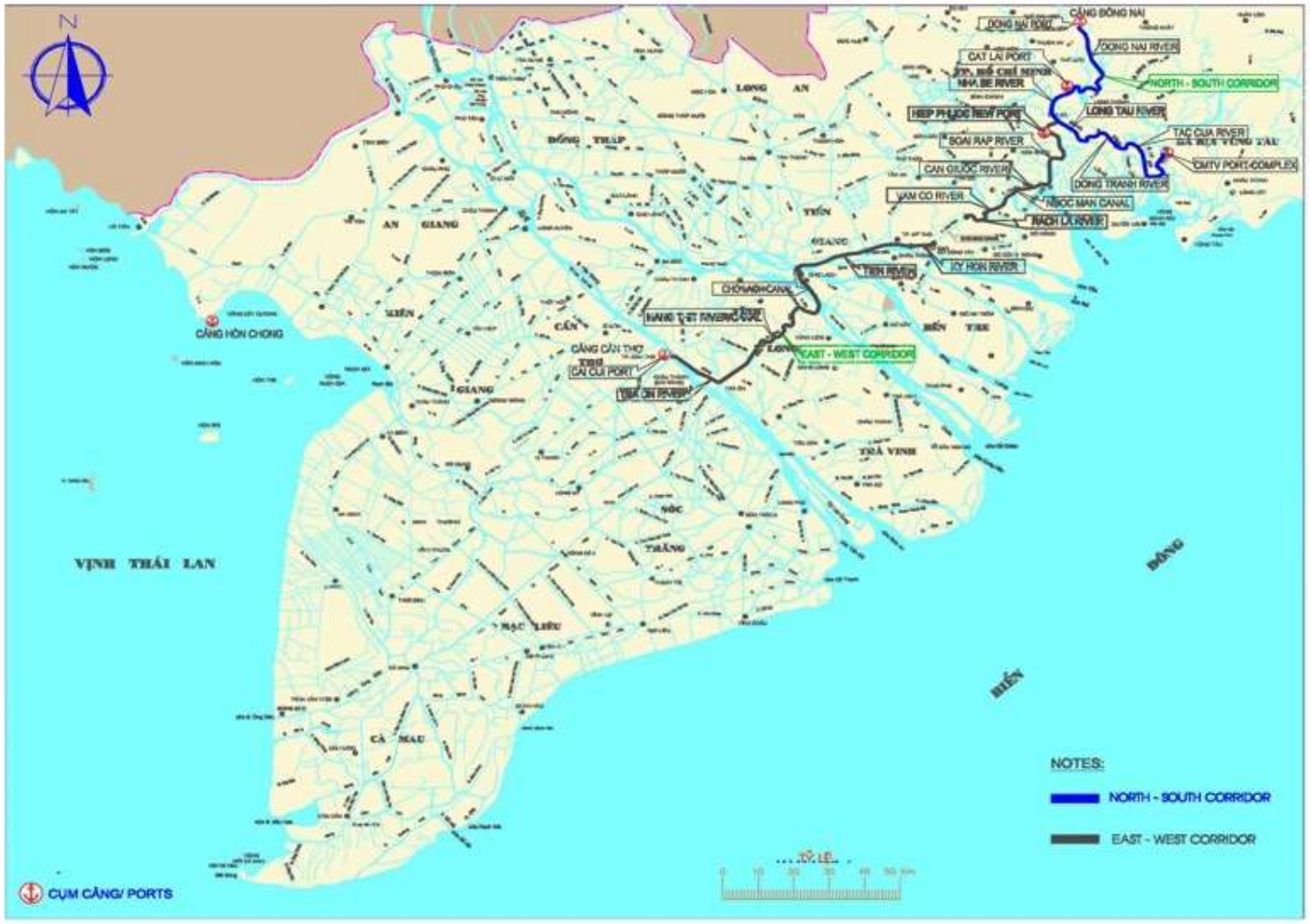


Figure 4.1. Selected route for SWLC's East - West and North – South Corridor

4.2.3. Technology and Design Alternatives

a) Channel Configuration

The 2017 Feasibility Study (FS) included both bend correction and bend cuttings of Dong Tranh and Tac Cua revers, resulting in permanent clearance of of 3.2 ha of buffer zone of Can Gio protection forest and environmental impacts associated with excavation/dredging and disposal of about 8.6 million cubic meters of the excavated/dredged materials. However, to avoid impacts on the protection forest and land acquisition and resettlement of local households, bend cuttings have been removed in the revised design of the channel configuration. No land acquisition of the protection forest is required, and the volume of the dredged/excavated materials is reduced to approx. 4.5 mil cubic meters. The changes from bend cutting to bend correction are illustrated in the pictures below:

CHANNEL CONFIGURATION – MANG THIT SECTION	
	
Basic design 2017 Two options of Bend Cutting Rmin = 500m	Basic design 2021 Bend Correction Rmin = 330m Crossing = 1.5Lt=165m
CHANNEL CONFIGURATION – RACH LA SECTION	
	
Basic design 2017 Two options of Bend Cutting Rmin = 500m	Basic design 2021 Bend Correction Rmin = 330m Crossing = 1.5Lt=165m
CHANNEL CONFIGURATION – DONG TRANH SECTION	
	
Basic design 2017 Bend Cutting Rmin = 700m	Basic design 2021 Bend Correction Rmin = 450m Crossing = 1.5Lt=165m

b) Dredging

Several dredging methods are commonly used depending on the depth of the sediments, and to address site specific environmental concerns. An important environmental impact of dredging can be caused by turbidity plumes generated during dredging. Increased turbidity can impact ecological sensitive areas by reduced light penetration, reduced visibility, clogging and burial. Given the location and nature of the project investment, the following dredging methods have been considered.

Trailing Suction Hopper Dredge is most commonly used for maintenance dredging in coastal areas. They are normal sea going ships with a large hopper and equipped with single or double trailing suction pipes that end in a draghead. When dredging with a trailing suction hopper dredger the main source for a turbidity plume is the overflow. The overflow is a vertical shaft ending at the keel through which excess sea water from the hopper is released. This excess water can contain fine sediment fractions which did not have sufficient time to settle in the hopper. Under the keel of the vessel the turbid water from the overflow will mix with the ambient water flowing past the keel in such manner forming a turbulent plume.

Grab dredge is relatively simple and involve the collection of sediments in a crane-mounted bucket, the jaws of which are opened and closed to trap the sediment. Depending on the type of material to be dredged different grab bucket designs can be employed, such as mud grabs, sand grabs and heavy digging grabs. When dredging with a grab dredger sediment leakage and resuspension are caused by: i) resuspension when the bucket impacts the sediment bed, closes, and is pulled off the bottom; ii) sediment losses as the bucket is pulled through the water column (either raised from the bottom or lowered from the surface); iii) sediment losses when the bucket breaks the water surface; iv) sediment/water spillage or leakage as the bucket is hoisted and swung from the water to the barge. In addition, losses of sediment can occur if the barge is allowed to overflow (to increase the effective load) and it is likely that this practice increases suspended sediment concentrations around the dredging operation.

Backhoe dredge is described above and can be used for both capital and maintenance dredging projects. Backhoe dredge can result in increased sediment suspension during the raising of the bucket. Spillage can occur throughout the complete height of the water column. The bucket leaving a clean surface carries the majority of the loosened soil away, however there is a risk of a spill layer remaining if there is excessive spillage whilst the bucket is lifted and the operator must maintain the optimal horizontal position in order to prevent spillage.

Cutter suction dredge is usually an accurate method of dredging, as it is limited to where the head is deployed. The cutter suction dredge dislodges material with a rotating cutter equipped with cutting teeth. The loosened material is sucked into the suction mouth located in the cutter head by means of centrifugal pump installed on the pontoon or ladder of the dredger. Further transport of the material to the relocation site is achieved by hydraulic transport through a discharge pipeline. Occasionally the material can be pumped into transport barges for further transport. The resuspension caused by the cutter suction dredger can be reduced by the following considerations: i) Cutter speed, swing velocity and suction discharge must be optimised with respect to each other. The continuous improvements in automation, control and the cutter suction head positioning have afforded considerable economic and environmental advantage; ii) A moveable shield around and above a cutter head or suction head reduces the escape of suspended material into the surrounding water column; and iii) Optimisation of the design of the cutter head with respect to the material being dredged to improve the direction of the material toward the suction intake. This method minimizes the loss of sediment during the dredging. Therefore, environmentally, it is the preferred dredging method.

c) Embankment

Embankments are important to maintain the navigation stability. Bank erosion due to navigation

or high flow velocities can create dangerous situations for the residents and infrastructure located along the canal banks. At several locations along the SWLC East – West Corridors, embankments are being proposed for Mang Thit River (13 km, type A), Cho Lach canal (5.4 km, types A and B), and Rach La canal (1.1 km, type A). Two types of embankment are considered; type A for sloped embankments with concrete blocks and Reno mattresses and type B for vertical embankments made of concrete sheet piles. These hard embankments will be used at narrowed riverbed, the channel follows closely to the bank to limit the site clearance. In addition, soft embankment at the channel far from the bank with slope roof of 7m is also considered. Typical cross-section of type A, B, and soft embankments are provided below:

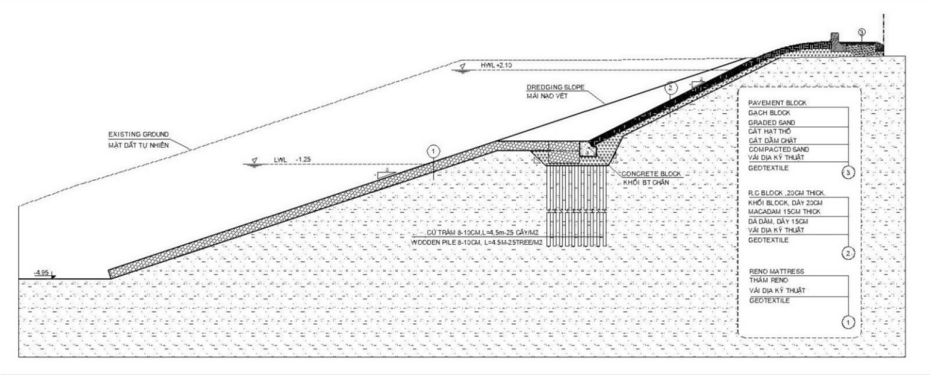


Figure 4.1. Typical cross-section of type A embankment

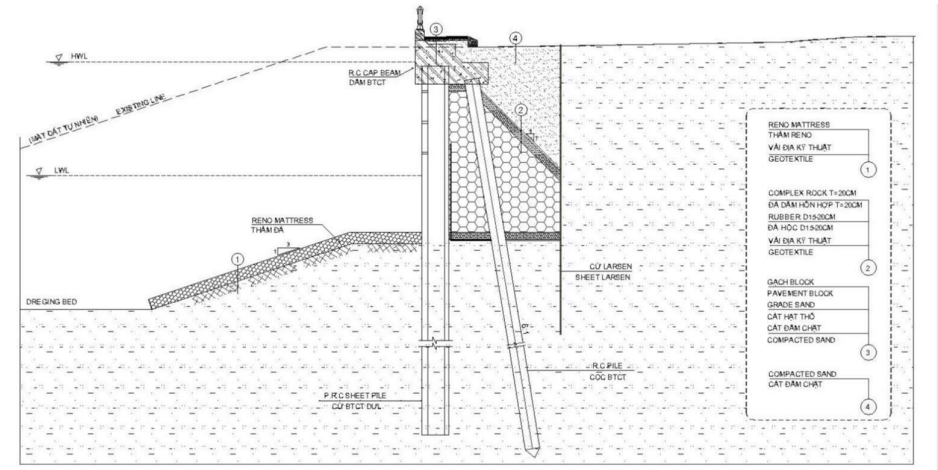


Figure 1.2. Typical cross-section of type B embankment

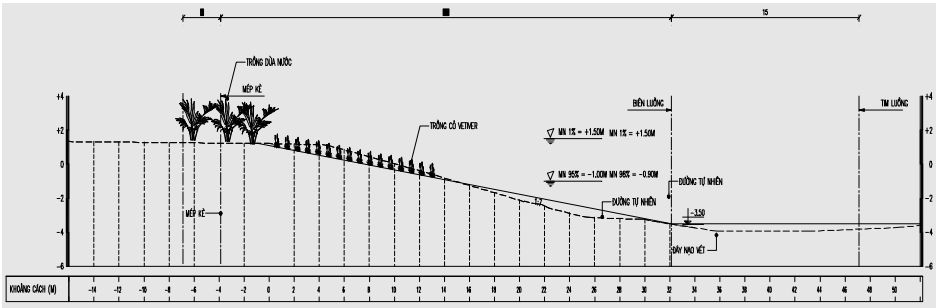


Figure 1.3. Typical soft embankment

Type A and B embankments

These embankment types will better protect the banks from erosion, but less environmental-friendly than the soft embankment. These techniques use stone and cement materials transported from other sources will increase environmental and social impacts and risks at the mines and on the transportation route because of dust, emissions, traffic safety, labor safety. They also obstruct, interrupt the movement between aquatic and terrestrial environments of amphibians and create heat absorption and reflection surfaces increasing local temperature in summer. From the social perspective, the hard embankment will limit site clearance area, suitable to the sections where local households are living. However, they require a higher investment cost.

Soft embankment

Green infrastructure approach will also be used in designing and implementing infrastructure of the river and canal embankments to improve their durability and performance as well as the beauty, amenity, and multiple functions of the areas where they are located. The techniques considered include brush mattress, vegetated gabions, vegetated geotextiles, vegetated revetment, vegetated riprap, vetiver grass. For example, geotextile materials could bring a flexible structural element. For stability and protection against erosion, geocells can be placed on embankment surfaces for further vegetation using regional plants. The covering vegetation also provides valuable aesthetic properties.

The banks that are protected by plants are environmentally friendly due to development of vegetation, native plants as submerged trees, creating habitat for some nearshore creatures such as shrimp, snail, crab and fish, etc. Soft embankment will require larger area of site clearance compared to the hard solution, while incurring a lower investment cost.

By analysis of technical methods, environmental impacts and current status of each sections of the river and canals, both soft and hard embankment options are selected for different sections of the project depending on the geotechnical and natural conditions of the river and canals.

CHAPTER 5. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

The assessment on environmental and social impacts and risks for the Project is carried out in three phases: pre-construction, construction and operation. The assessment results are the basis for making recommendations on mitigation measures and sound management plans for the project. The assessment team made great effort in complying with the requirements of ESS1 and other ESSs applied in the Project, and covering the issues mentioned in EHSG, etc. Of which all direct, indirect, cumulative impacts and risks are taken into consideration.

This chapter will be presented in the following structure as shown in Figure 5.1:

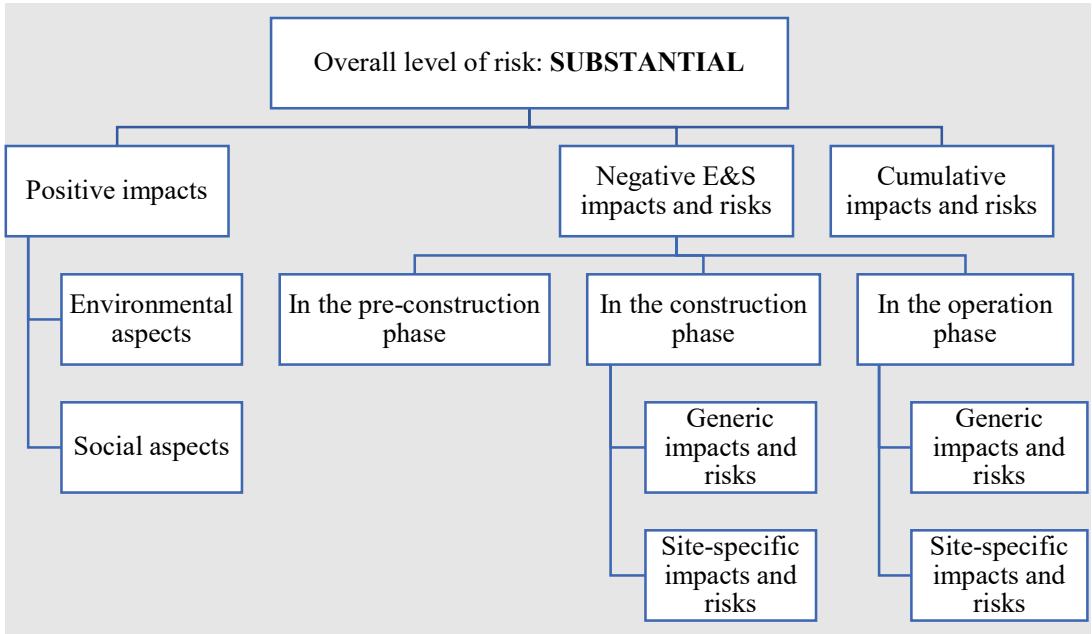


Figure 5.1. Structure of SWLCP's impacts and risks to be assessed

The assessment considers the impacts and risks listed in ESS1 of the WB ESF, including those aspects listed in the EHSG, those related to community health and safety (ESS4), those about climate change as a cross cutting issue across all ESS, economic and social impacts (ESS5 and ESS7). The assessment considered the direct, indirect, and cumulative impacts and risks are required in the ESS1. The impacts and risks related to the workers and their working conditions with several aspects listed in ESS2 were discussed. The aspects mentioned in ESS3 about pollution risks, use of energy have been considered, and forest, aquatic species, fishes and aquaculture and other living natural resources covered under ESS6 have been considered in the ESIA/ESMP. ESS10 has been applied for the public consultation and participation as well as information disclosure. The potential negative environmental impacts and risks are presented below.

5.1. POSITIVE IMPACTS

The Mekong Delta is an important role in Vietnam's national economic development. In order to develop the economy of the Mekong Delta in the future, it is necessary to strengthen the transportation network, connecting the region with domestic and international markets. Since the IWT network is already available, it should be exploited and made full use of its potential. Inland water transport has many advantages over road transport for safety reasons, less emissions, and lower transportation costs.

According to the calculation results of the Consultant in the 2017 FS final report of the SWLC project before separating the two constructions, the project is economically feasible with the economic internal rate of return (EIRR) of the project is 12.5%, Net present value (NPV) is $ 90.1 million.

The SWLC project implementation will improve the transport infrastructure system; reduce congestion on major waterways; reduce time and cost of transporting goods from the producer to the consumer market through upgrading waterways in the region; contribute positively to the goal of poverty reduction, socio-economic development, reduce the accident rate on waterways, and ensure security in the border areas of the province in the Mekong Delta and Southeast region. However, the project will also have adverse impacts related to the need for land acquisition and involuntary resettlement.

5.1.1. Positive environmental impacts

The project area includes the Mekong Delta and the Southeast which are formed by two main river systems, the Dong Nai river system and the Mekong river system. The total length of national IWT routes managed by the central government in the Mekong Delta and the Southeast region is about 3000 km.

The project includes many rivers with a small, folding radius that do not ensure safety for navigation on Mang Thit rivers (8 curved sections), Cho Lach canal (some sections are too narrow and shallow), Cho Lach bridge has short vertical clearance, narrow horizontal clearance, Rach La canal (4 curved sections), and Tac Cua River (5 curved sections). Therefore, it greatly limits the potential for water transportation in the region. With the current status of transport routes not at the same level, there are still some dry and narrow sections with folding radius mentioned above, which greatly affects the shipping business.

The expected positive impacts of the SWLC Project's implementation are:

- **Reduce the need for construction material for road transport:** Total transport in 2015 was 418.12 million ton, divided in 62% inland waterway transport and 38% road transport. In the transport forecasts 2030 and 2040, total transport is expected to keep growing up to 861.82 million ton and 1,365.26 million ton in 2030 and 2040 respectively. This will reduce the already high pressure for building materials, steel and energy because these commodities are needed in fast growing economies for building houses, infrastructure and to meet the growing demand for energy. An effective inland waterway transportation will increase the percentage of inland waterway transport, reduce the demand for road infrastructure construction and reduce the demand on natural resources for construction materials like sand, soil, stone, etc.
- **Reduce the cost of cargo transportation:** The project will invest in upgrading routes on the East-West Corridor to level II to ensure safe circulation of 3-class container ships, self-propelled vessel up to 1500T, gradually increasing the proportion of freight transport by container, reduce shipping cost. The project also connects port clusters in major economic centers, dry ports (ICD) to transport import and export goods. The project also promotes the potential and advantages of the Cai Mep-Thi Vai port cluster in the logistics chain in the South, contributing to promoting economic development in the region in particular and the country in general.
- **Reduce logistic cost:** Diversifying modes of transport, especially developing IWT in the South will contribute to reducing logistics costs, increasing competitiveness for goods, promoting regional economic development through improving hub connectivity between Can Tho city as economic center and Southeast economic center such as Ho Chi Minh city and Cai Mep-Thi Vai port group (Ba Ria Vung Tau), gradual implementing Decision No. 355/QD-TTg dated February 25, 2013 by Prime Minister regarding approval of strategy

adjustment of Viet Nam transportation development up to 2020, vision up to 2030; No. 1071/QD-BGTVT dated April 24, 2013 and No. 4360/QD-BGTVT dated December 12, 2015 by Ministry of Transport regarding approval of adjustment in master plan of Viet Nam inland waterway transportation development up to 2020 and vision up to 2030; Decision No. 68/QD-TTg dated January 15, 2018 regarding approval of Master plan adjustment of Mekong Delta region up to 2030 and vision up to 2050 by Prime Minister and Resolution No. 59-NQ/TW dated August 05, 2020 by Ministry of Politics regarding construction and development of Can Tho city up to 2030, vision up to 2045 which states clearly "implementing development projects for waterway corridors and logistics in Southern area".

- **Shortening the navigation distance for class II vessels:** The shorter route is to be materialized by upgrading the East West Corridor, via Mang Thit river and Cho Lach canal, to navigation class II, thus shortening the navigation distance for class II vessels about 92 km compared to the existing route running through Tien river - Vam Nao river - Hau river (equivalent to 10 hours less sailing time). For the current North-South corridor, self-propelled vessels up to 5,000 DWT have to wait for tide in order to navigate, some sections do not ensure the width and curvature radius, so the traffic is inconvenient and unsafe. If invested and improved, SPV 5,000 DWT and 4-layer container ships can circulate safely and smoothly 24/24 hours on the North-South corridor.

Thus, it can be seen that the transport benefits are mainly due to the shorter distance traveled from the Mekong Delta to HCM City and major ports in the region (and vice versa). Shorter distances mean lower transportation costs while lower emissions and improved navigation safety is expected due to shorter travel distances. The improved connectivity could lead to a mode shift in the future and enhance the competitive position of manufactured and processed goods along this new link, significantly contributing to poverty reduction, sustainable socio-economic development and reduction of environmental pollution, strengthening the connection of IWT and maritime transport, between the Mekong Delta and the Southeast to the Cai Mep - Thi Vai ports.

5.1.2. Positive social impacts

Positive economic impacts of the project will be more at the regional level (reducing the transportation time and cost to the consumer market in connection to the increased and better traffic, improving the waterway transport infrastructure system, reducing congestion and traffic accidents). As the waterways already exist and are quite intensively used by boats, impacts on communities along the SWLC corridors may be limited. However, the proposed Project's components will have positive impacts on the socioeconomic development of the project area. Short-term positive impacts on employment are also anticipated.

- **Positive impacts on the socioeconomic development of the project area**

The agricultural economy of the Mekong Delta is not sufficient to support the goal of raising the standard of living for the millions of relatively poor people, especially in view of the volatile world market prices for rice. The policy of the Government and Provincial People's Committees are therefore trying to diversify the economy, encourage increased industrialization and attract foreign investment. An efficient primary infrastructure network, including inland waterways, is essential to support this goal. Moreover, the transportation of goods by inland waterways was increasing substantially over the years. The improved connection can in future also lead to modal shift and improve the competitive position of production and processing along the new connection.

The indirect structural effects consist of the impact of the investment on the economics of the project area. New infrastructure can be an incentive for new production locations. These effects

mainly manifest themselves with the investment of new highways, which offer opportunities for direct access to faster transport. Investments in waterways can offer the opportunity for water-bound activities. An example could be rice-processing plants at the upgraded Mang Thit River. The improvement of the waterways is a necessity, but not a sufficient condition for such investments. That is the reason why it is very hard to quantify these structural indirect effects. In countries with a highly developed infrastructure the indirect effects tend to be small, but for countries like Vietnam, they could be larger.

For the improvement of irrigation and drainage outlets, local people can benefit from the better irrigation system in the area, which supports them from having enough freshwater for irrigation especially in dry season, and also for the drainage system of the area.

- **Community safety and risk**

Landslides on most sections of the Project's waterways due to changes in water flow and the impacts of waves caused by waterways transportation. At several locations along the SWLC East West and North South Corridors, due to envisaged dredging works, embankments need to be improved. A total of 23 km of new embankment will be built. The primary objective of the embankments is to protect the slopes from erosion and instability of the existing structures. Landslides also cause loss of agricultural land along the canals/rivers and affect infrastructures. The Project's interventions will have a positive impact on preventing the soil erosion, landslides at the locations where were not embanked before and thus protect local people from losing their homes as well as production land.

Secondary objectives of the embankments could be the improved landscape of the slopes, easy access to the water and landing stages for small vessels. This will contribute to enhance the quality of life of the residents along the upgraded canals especially in suburban areas.

- **Impacts on employment during construction**

The Project implementation will result in higher employment in the construction sector. The indirect effects consist of the supply to the construction sector (building materials for bridge, embankment and local roads works). During the construction process, many local non-skilled workers may be hired and this will create short-term income opportunities for local people.

- **Supporting waterways navigation on the project canal/river**

The dredging works will dredge the convex part of the rivers/canals, leveling river/canal bottom and stabilize the water flow and support smooth waterway navigation along the Project rivers/canals. A better waterways navigation will also support the tourism activities on the waterways along the Mekong River system and contribute to the economic development of the Project area.

- **Promoting aquaculture and fisheries in the operation phase**

The dredging works followed by embankment construction will support bank stabilization of rivers/canals in the operational phase of the SWLC Project and reduce the suspended sediment content in the water. Embankment works will reduce landslide and bank erosion and also support the reduction of mud content in the water. In turn, this will create positive impact for increase of phytoplankton communities in the water bodies and support the development of fish. Fisheries along the river bank will also gain benefit from the improvement of the waterways as the Project will ultimately reduce the traffic density along the river banks through the decrease in the risk of incidents and accidents between the fishing facilities and the passing vessels.

- **Improving navigation safety along the waterways of the Project canal/river**

Construction works include bend cutting, dredging, navigation aids installing to ensure the

standardization of Class II will improve the transport capacity of the rivers and canals, eliminating the "black spots" of waterways traffic safety on the North - South and East - West corridors which are the busiest waterways in Vietnam. Improving navigation safety will also decrease the risk of accident and related incidents such as oil and/or chemical spill.

5.2. CLASSIFICATION OF NEGATIVE IMPACTS AND RISKS

There will be some potential negative environmental and social impacts and risks during the pre-construction, construction and operation of the facilities under the SWLC Project. These potential negative impacts and risks are classified based on criteria as below:

❖ ***Substantial Impacts (S)***

- Impacts on large land area, important areas, or changes in environmental conditions in a period of more than two years;
- Impacts exceeding permitted standards and regulations. Long-term and large-scale impacts;
- Changes in ecological systems, impacts on ecological systems of large areas, or medium impacts (lasting for more than two years) yet required recovery period of the affected ecological systems is ten years;
- Impacts on health and safety of people;
- Economic losses and damages to the sub-project nearby people and communities;
- Potential significant social and environmental impacts which can only be controlled and mitigated if proper mitigation measures are implemented.

❖ ***Moderate Impacts (M)***

- Impacts on large areas for a period from six months to two years;
- Changes in ecological systems or ecological functions at the localities in a short time and recovery capacity is good. The impact levels are similar to current changes yet such impacts can have a cumulative effect;
- Impacts might (or might not) affect people's health, causing impacts on persons in the surrounding areas;
- Impacts are medium, localized and temporary and mitigation measures should be carried out.

❖ ***Low Impacts (L)***

- Social and environmental impacts that cause significant changes in less than six months or medium changes for a period of less than two years;
- Impacts are within permitted standards and regulations, causing minor changes at present. Impacts are fully controlled;
- Impacts that might affect daily activities yet not cause any obstruction to communities;
- Insignificant impacts on health and living standards of people;
- Impacts are minor, localized, and can be neglected.

❖ ***No Impacts (N)***

Based on the analysis of baseline data, field survey and discussions with officials and stakeholders, the project's potential negative impacts on the physical, biological and economic environments have been identified and assessed. Level of potential negative environmental impacts and risks are classified as substantial and specified in Table 5.1.

Table 5.1. Potential ES negative impacts of the Project

Description	Physical			Biological		Social				Others	
	Air, noise, vibration	***Soil, water***	***Solid waste, dredged materials***	***Terrestrial biological resource***	***Aquatic biological resource***	***Land acquisition, resettlement***	***Labor influx, community disturbance***	***Physical cultural resources***	***Livelihood***	***Local flooding, traffic, safety***	***Impact outside the project area***
Dredging works East – West Corridor: Mang Thit river (2,355,000 m^3), Cho Lach Canal (1,240,000 m^3), Ky Hon Canal (50,000m^3), Rach La Canal (614,510 m^3). North – South Corridor: Tac Cua river (256,000 m^3).											
Pre construction	N	L	N	L	L	M	N	N	L	N	N
Construction	L	M	S	L	L	N	L	L	M	L	L
Operation	L	L	L	N	N	N	N	N	N	L	L
Embankment works The total length of embankment work is 22,984 km, implementing on Mang Thit river, Cho Lach canal, Rach La canal.											
Pre construction	N	N	N	N	N	N	N	N	L	N	N
Construction	L	L	L	L	M	L	L	N	S	M	M
Operation	L	N	L	N	N	N	N	N	L	L	L
Bridges construction Construction of 1 new bridge named Cho Lach 2. The vertical and navigational clearance of the proposed Cho Lach bridge 2 are 7.5 m and 50 m respectively.											
Pre construction	M	N	L	L	L	S	L	N	M	L	L
Construction	M	L	L	L	L	N	M	L	M	L	L
Operation	L	N	N	N	N	N	N	L	L	L	L
Local road At the location bend correction, build new roads combination with embankment protection to avoid erosion with total length of 4,566m.											
Preconstruction	L	N	N	M	N	M	L	N	L	L	L

Description	Physical			Biological		Social				Others	
	Air, noise, vibration	***Soil, water***	***Solid waste, dredged materials***	***Terrestrial biological resource***	***Aquatic biological resource***	***Land acquisition, resettlement***	***Labor influx, community disturbance***	***Physical cultural resources***	***Livelihood***	***Local flooding, traffic, safety***	***Impact outside the project area***
Construction	M	M	L	M	L	N	L	N	L	L	L
Operation	L	N	N	L	N	L	L	N	L	N	N
Irrigation and drainage outlets construction Replace several irrigation and drainage outlets along Mang Thit river (45), Cho Lach Canal (29) and Rach La Canal (6).											
Pre construction	N	N	N	N	N	N	N	N	N	N	N
Construction	L	N	L	L	N	N	L	N	L	L	L
Operation	N	N	N	N	N	N	N	N	N	N	N
Navigational aids installment To improve navigation aids, navigational aids will be replaced, reallocated or newly installed on Tra On canal, Mang Thit river, Cho Lach canal, Nuoc Man – Can Giuoc canal.											
Pre construction	N	N	N	N	N	N	N	N	N	N	N
Construction	N	N	L	N	N	N	N	N	L	N	N
Operation	N	N	N	N	N	N	N	N	N	N	N

Note: N: No impact; L: Low impact; M: Moderate impact; S: Substantial impact.

The structured assessment presented below will be proportionate to the level of potential impacts and risks during Pre-Construction, Construction and Operation phases. Where there are similar types of impacts and risks between types of works, more thorough assessment and analysis would be carried out for the items that the potential impacts and risks are more likely and significant and a brief discussion on the same topic will be provided for other work items.

5.3. NEGATIVE IMPACTS AND RISKS IN THE PRE-CONSTRUCTION PHASE

The potential environmental and social impacts and risks at the preparation phase to be considered include: (i) land acquisition; (ii) Safety risks related to the unexploded ordnances (UXO) left from the war ended in 1975. These impacts and risks are summarized below.

5.3.1. Land Acquisition

Land acquisition in the pre-construction phase is the preparation for construction sites of the dredging works, bridge construction, embankments, and other auxiliary works of the Project. Dismantling and relocation of the existing construction works of the affected households are expected to last for 2-3 months / section. Site clearance and resettlement, however, often have a relatively long-lasting impact on the lives of affected people, starting from the project preparation stage to the completion of the project.

The SWLC Project will require the extension, dredging, and construction of embankment of a number of canal sections. All of the civil works shall cause land acquisition/land use restriction impacts in five provinces, namely Dong Nai, Long An, Ben Tre, Tien Giang, and Vinh Long. Based on preliminary design and Inventory of Losses (IOL), the project will affect a total of 1,068 households and 26 organizations/institutions in 05 provinces including Dong Nai, Long An, Ben Tre, Tien Giang, and Vinh Long. Out of 1,068 affected households of the project: (i) the total number of the relocated households is 358; (ii) the PAHs having more than 20% of productive land affected is 201 households, and will be considered as severely affected households.

The potential impacts on land acquisition are described in Table 5.2.

Table 5.2. Scope of affected households and land acquisition under SWLCP

No.	Provinces	Affected Households			Affected Persons	Severely AHs	Affected EM HHs	Affected Organizations	Scope of land acquisition (m^2)				
		Partially	Relocated	Total					Residential Land	Productive Land	Public Land	Other Land	Total
1	Dong Nai	1	0	1	3	0	0	1	0	0	54,816.7	0	54,816.7
2	Long An	3	0	3	14	1	0	0	0	3,890.9	0	0	3,890.9
3	Ben Tre	278	186	464	2,336	58	0	13	34,063.8	62,936.6	11,868.0	420.0	97,420.4
4	Tien Giang	4	0	4	19	0	0	0	0	3,856.7	0	0	3,856.7
5	Vinh Long	424	172	596	2,793	142	1	12	47,714.2	202,944.9	5,194.8	108.6	250,767.7
	Total	**710**	**358**	**1,068**	**5,165**	**201**	**1**	**26**	**81,778.0**	**273,629.1**	**71,879.5**	**528.6**	**410,752.4**

Source: Results of IOL and socio-economic surveys, Dec. 2021

Note:

- The method to determine the scope of land acquisition is overlapping maps between the cadastral maps and land acquisition boundaries (ROW).
- Number of affected households is determined based on the cadastral maps provided by the local authority.

In addition, it is anticipated that about 250 ha of ponds/ditches and low-lying land arranged and approved by the People's Committees of the provinces in accordance with the local land using needs for dredging area from the project. About 50ha of land will be temporarily affected during construction period; these impacts include temporary use of land for material gathering, workers' camps, and construction sites. More details about land acquisition are provided in the Resettlement Plan (RP) of the Project. All resettlement and livelihood restoration will be done in accordance with ESS5

5.3.2. Safety risk related to unexploded ordnances

The Project construction sites have been much affected by human activities including extensive development, and therefore, UXOs have already been cleared. However, there can be remaining UXOs from the wartime, which can be encountered during excavation works.

If the unexploded ordnances (UXO) are not cleared, this can be a risk in construction phase which can directly affect workers, local people and surrounding infrastructure. The project area has been highly developed by human activities, and thus there is not high probability that UXO will be encountered. The consequence of UXO would have a long-term impact on the psychology, health, property and lives of workers and people in the vicinity of the incident. At the same time, these impacts can affect a wide range, affecting the air, causing deterioration of soil quality. However, these impacts can be mitigated through clearance of bombs, mines, and unexploded ordnances by functional units.

Project's work items that need clearance of UXO include: (i) local roads which will be build/renovated along the waterways; (ii) embankment works and (iii) bridge construction site. During the construction, the risk of explosion may directly affect those who directly involved in the clearance work because of the potential of the war's left-over unexploded ordnances. The clearance process may detonate mines and unexploded ordnance due to improper clearance techniques, posing a danger to the clearance workers' lives. This impact is considered Substantial, but can be mitigated because the clearing unit is a military unit, with full functionality, technical equipment, qualifications and experience.

5.4. NEGATIVE IMPACTS AND RISKS IN THE CONSTRUCTION PHASE

5.4.1. Generic impacts and risks

5.4.1.1. Impacts on air quality

a. Dust and air pollutants

❖ ***Dust from dredging works***

The dredging is conducted on the water surface, thus dust, exhaust gases such as CO, SO_2, NO_2 generated from construction machinery will not have any significant impact because the emissions are at low level, intermittent and construction on water which is mostly far from residential areas. Therefore, impacts of dust and exhaust gases generated from dredging machinery are negligible.

❖ ***Dust from material transportation in the embankment construction site***

The operation of construction vehicles using diesel will release exhaust gases containing gaseous pollutants into the environment such as: dust, CO, SO_2, NO_x, VOC, etc. Dust and exhaust gases generated by the transportation of materials from the embankments of river sections.

The construction materials include rock, geotextile and soil and the excavated and backfilled materials. The transportation plan for embankment material for each waterway is shown in Table 5.3.

Table 5.3. Volume of embankment material and transportation

Waterway routes	Embankment length (m)	Total volume of material (tons)	Average distance from material supplier (km)	Construction duration (day)	Capacity of transportation vehicles (tons)	Number of turns a day (back and forth)
Transporting material by waterway						
Mang Thit river	13 154	200 000	14	180	200	8
Cho Lach canal	8 770	120 000	8	150	200	6
Rach La canal	1 060	18 000	10	30	200	4
Transporting material by road						
Mang Thit river	13 154	70 000	15	180	16	50
Cho Lach canal	8 770	55 000	15	150	16	46
Rach La canal	1 060	4 000	10	30	16	18

The level of emission of pollutants depends on many factors such as air temperature, vehicle speed, travel distance, fuel type, pollution control measures. Transportation means used for the embankment both in waterway and road, include boats, barges 200T, diesel trucks with a tonnage of 16 tons. The air pollution coefficient of the material transportation means is presented in Table 5.4:

Table 5.4. Air Pollution Coefficient related to means of transport

No.	**Transportation vehicles**	**Pollutants (kg/1000km)**			
		TSP	SO_2	NO_x	CO
1	Boat, barge	0.68	13.6 S [24]	9.07	0.0036
2	Truck 3.5 – 16 tons	1.35	4.15 S	14.4	2.9

Based on rapid identification of waste sources from vehicles according to air pollution coefficients, pollutant load generated from transportation vehicles is calculated according to the circulation coefficient in 1h, the emission coefficient of transportation vehicles and length of transportation. Details about dust (TSP) and exhaust gases generated from material transportation process are shown in Table 5.5:

Table 5.5. Added pollutants during transportation of embankment material

No.	**Waterway routes**	**Added concentration of pollutants** *(ug/m³)*			
		TSP	**SO_2**	**NO_x**	**CO**
1	Mang Thit river	49	21	528	97
2	Cho Lach canal	44	18	478	89
3	Rach La canal	18	9	197	35

The added concentration of gaseous pollutants combined with baseline pollutants in the area which are measured in three monitoring rounds (on the average, from Chapter 3) are shown in Table 5.6.

[24] S is the percentage of Sulfur in fuel

Table 5.6. Total concentration of pollutants in the dredging areas during transportation of embankment material

No.	Waterway routes	Total concentration of pollutants *(ug/m³)*			
		TSP	SO_2	NO_x	CO
1	Mang Thit river	109	42	553	4 074
2	Cho Lach canal	102	38	514	5 317
3	Rach La canal	54	32	228	4 785
QCVN 05-MT:2013/BTNMT (1h)		300	350	200	30 000

According to the calculation of air pollutants from the transportation of embankment materials above, the overall concentration of TSP, SO_2, CO satisfy the permissible concentration as regulated in QCVN 05-MT:2013/BTNMT – National Regulation on Ambient air quality (on the average of 1 hour). The NO_2 load in Mang Thit river is 2.8 times over the limit, 2.6 times in Cho Lach canal and 1.1 times in Rach La canal. However, the contaminants mentioned above will impact directly on workers working in the construction sites, this impact is short-term and intermittent, and the movement of wind will help to disperse and dilute this contaminant once discharged into the environment. Therefore, the impacts from road and waterway transportation during embankment construction are assessed at low level and can be mitigated by appropriate measures.

❖ ***Dust and exhaust gases from the operation of construction equipment for embankment works***

For calculating the emission volume (CO, NO_2, SO_2) generated from the operation of machines, equipment during construction process such as earthwork, ground leveling, etc. (using one ton of oil for internal combustion engines), this ESIA report is based on Natz Transport, Shun Dar Lin, 2005. Emission factors are presented in Table 5.7.

Table 5.7. Emission factors of exhaust gases from construction equipment

Coefficient of oil used *(kg/ton of material)*	Emission factors (kg/ton of oil)		
	SO_2	NO_x	CO
0.1	2.8	12.3	0.05

Source: Natz Transport and Shun Dar Lin 2005

Therefore, the volume of exhaust gases during the operation of construction equipment in embankment and bridge construction activities are estimated in Table 5.8:

Table 5.8. Added pollutants from the operation of construction equipment in embankment construction site

Waterways	Embankment length (m)	Total volume of material (ton)	Construction duration (day)	Added concentration *(ug/m³)*		
				SO_2	NO_x	CO
Mang Thit river	13 154	190 000	180	15	66	0.1
Cho Lach canal	8 770	128 000	150	18	80	0.1
Rach La canal	1 060	14 000	30	82	361	0.5

The added concentration of gaseous pollutants combined with baseline pollutants in the area which are measured in 3 monitoring rounds (on the average, from Chapter 3) are shown in Table 5.9.

Table 5.9. Total concentration of pollutants during embankment construction along the embankment routes

No.	Waterway routes	Total concentration of pollutants *(ug/m³)*		
		SO_2	NO_x	CO
1	Mang Thit river	36	91	3 977
2	Cho Lach canal	38	116	5 228
3	Rach La canal	105	392	4 751
QCVN 05-MT:2013/BTNMT (1h)		350	200	30 000

According to the calculation of added concentration of air pollutants from embankment equipment, most of pollutants (combined with baseline level) are within the permissible limits regulated in QCVN 05-MT:2013/BTNMT – National Regulation on Ambient air quality. Only NO_2 emission load is 2 times higher than the standard. With the wind and other meteorological conditions, those contaminants will be dispersed and diluted along the river/canal banks. Therefore, the emission of exhaust gases when operating construction machinery and equipment is considered to be low level, localized in the area of each embankment section. These pollutants can cause respiratory and eye diseases. These pollutants will affect directly officers, workers and local people living along the embankment sections. There are no sensitive receptors in or near the construction areas. The impact period is short during the operation of construction machinery and equipment at each embankment section, but these impacts can be minimized by taking appropriate mitigation measures. So, this impact is assessed to be low.

❖ ***Exhausted gases from the operation of construction equipment and machinery at the bridge construction site***

Apply the same calculation methods as of above section to calculate the total concentration of dust and exhaust gases from construction equipment. The results of exhausted gases from the operation of construction equipment and machinery at the bridge construction site are shown in Table 5.10.

Table 5.10. Total concentration of pollutants from construction equipment in the bridge construction site

Concentration	Exhausted gases		
	SO_2	NO_x	CO
Total concentration of pollutants *(ug/m³)*	529	2 276	5 237
QCVN 05-MT:2013/BTNMT (1h)	350	200	30 000

According to the calculation of added concentration of air pollutants from bridge construction equipment, CO concentration is within the permissible limits regulated in QCVN 05-MT:2013/BTNMT – National Regulation on Ambient air quality. The concentration of SO_2 and NO_2 emission load are 1.5 and 11.4 times higher than the standard. With the wind and other meteorological conditions, those contaminants will be dispersed and diluted along the river/canal banks. Therefore, the emission of exhaust gases when operating construction machinery and equipment is considered to be Low level, localized in the area of each embankment section. These pollutants will directly affect officers, workers and local people living around the construction site. The impact period is short during the operation of construction machinery and equipment at each embankment section, but these impacts can be minimized by taking appropriate mitigation measures. Since, this impact is assessed to be low.

❖ ***Dust from the demolition of the existing bridge***

The existing Cho Lach old bridge will still be in use during the construction of the new bridge. These will be demolished once the new bridge is completed.

Dust is mainly generated from the demolition of the reinforced concrete abutments and piers, which is carried out on a large scale and transported on-site by the local collection unit, so the impact level of dust emissions is considered to be low. Dust would mainly affect the construction workers who area presence at the site during demolition. The impact is short-term and can be minimized by applying appropriate mitigation measures.

- ***Dust from earthwork, ground leveling in bridge construction site***

Dust generated during the construction of bridge are from excavated soil, backfill soil, and leveling the ground. The volume of excavation is approximately 185,000 m^3, filling 200,000 m^3, making up a total of 385,000 m^3, which is equivalent to about 558,250 tons.

The volume of earthworks is calculated for each bridge construction site, with a total volume of earthworks of 558,250 tons. According to the WHO rapid assessment document – 2003, the emission factor of dust during leveling with soil material is 1 – 10g dust/m^3. The amount of dust generated during the excavation, backfilling, and leveling of the construction site is estimated to be 1,925 kg within 18 months, equivalent to 3.56kg/day. The added concentration of dust caused by this activity is accounted for 4,185 (ug/m^3), combined with baseline level at 58 (ug/m^3), making up a total of 4,244 (ug/m^3), far higher than the permissible limit of TSP in ambient air according to QCVN 05:2013/QCVN at 300 (ug/m^3).

According to the calculation results of dust load generated by excavation, backfilling, leveling, and comparison to the national technical regulation QCVN 05:2013/BTNMT, the average dust concentration during leveling of Cho Lach bridge is higher than the standard of 14 times. The dust will primarily affect 100 construction workers; residential areas adjacent to the Project at Cho Lach town. Furthermore, most of the dust is precipitable dust which can easily and quickly deposit onto the ground within 5 minutes. In addition, part of dredged materials could be reused for backfilling works along the site, so the total actual excavated volume will be lower than that calculated, the emitted dust volume is also smaller than forecasted in the most adverse scenario mentioned above.

The impact is concentrated in the bridge construction area, specifically at the nearest residential areas from the construction area. The effect of dust from excavation and leveling activities is considered as short-term within 18 non-consecutive months. Actually, the earthworks only take place in the first 3 to 8 months since commencing the bridge construction and in the last month when the site is reinstated. The months in the middle period mainly cover the construction of foundation, piers, abutment and other structures on the surface. As a result, the level of impact is assessed as Moderate. Mitigation measures in place will minimize these impacts.

- ***Dust fromtransportation of materials and wastes in the bridge construction site***

The operation of diesel vehicles carrying materials and waste will release dust and exhaust gases such as CO, NO_2, SO_2 into the surrounding environment. Based on the volume of bridge construction listed in Chapter 2, the volume to be transported for Cho Lach bridge by road is estimated to be 300,000 equivalent tons. With the average distance from material supplier to the site at about 14 km, 180 days, the number of trips (back and forth) per day is calculated to be about 70.

The same calculation method was applied for the added concentration of dust exhaust gases generated from the transportation of materials. The baseline monitoring results of air quality in Cho Lach canal is taken from Chapter 3 to calculate the total concentration of dust and exhaust gases. The added concentration of gaseous pollutants combined with baseline pollutants in the area which are measured in 3 monitoring rounds (on the average) are shown in Table 5.11.

Table 5.11. Concentration of dust during transportation of construction material for Cho Lach bridge

Item	TSP	SO_2	NO_x	CO
Added concentration of pollutants *(ug/m³)*	63	19	667	134
Baseline concentration of pollutants *(ug/m³)*	58	20	36	5,229
Total concentration of pollutants *(ug/m³)*	121	39	703	5,363
QCVN 05-MT:2013/BTNMT (1h)	300	350	200	30,000

The calculation results indicate that dust (TSP), SO_2, CO concentrations at the bridge construction site satisfy the permissible limits of QCVN 05-MT:2013/BTNMT but the concentration of NO_2 exceeds 3.5 times in comparison to the standard. However, the NO_2 once discharged into the atmosphere will be dispersed and diluted by the wind and other meteorological conditions.

❖ ***Dust and gas emission from excavation and backfilling in the local road construction site***

Excavation, ground leveling is considered to be the most significant source of dust during the construction phase for all works. The volume of earthworks is shown in Table 5.12:

Table 5.12. Volume of earthworks in local roads construction

No.	Local road	Total length *(m)*	Number of segments	Excavation *(m³)*	Backfilling *(m³)*	Total *(m³)*	Tons equivalent
1	Mang Thit river	4,566	13	185,000	200,000	385,000	558,250
2	Cho Lach canal	1,496	6	60,613	65,528	126,141	182,905
3	Rach La canal	1,060	2	42,948	46,430	89,378	129,598

The level of dust dispersion during ground leveling process depends on various factors such as position of the project site, excavated and backfilled volume, volume of materials gathered at the site, wind speed and direction, the exposure of materials with the air space. The amount of diffused dust is calculated on the basis of pollution coefficient and the earthwork volume. According to the World Health Organization guidelines, the pollution coefficient E is calculated using the following formula:

(CT1)

Of which, CT1 includes: E - pollution coefficient (kg/ton); k - Particle structure, with mean value of 0.2; $\bar{u}$ - Average wind speed in the project area (1.8 m/s); M - Average humidity of the materials (20%).

With the conditions of mean particle structure, average wind speed, humidity of earthwork materials, etc. the pollution coefficient E is determined to be = 0.0143 (kg/ton).

It is assumed that the construction period of the coastal road lasts about 24 months. The average concentration of suspended dust within 1h and 24h at the construction site and surrounding areas are calculated as shown in Table 5.13:

Table 5.13. Concentration of generated dust due to earthwork for the local road

Positions	Volume (ton)	Dust load (kg)	Surface area (m^2)	Load (kg/day)	Average concentration (1h) (mg/m^3)	Average concentration (24h) (mg/m^3)
Mang Thit area	87,873	1,300	150,000	3,611	0.751	0.501
20 m from the site					0.642	0.423
50 m from the site					0.364	0.280
100 m from the site					0.274	0.153
300 m from the site					0.147	0.146
Cho Lach area	87,873	1,300	150,000	3,611	0.751	0.501
20 m from the site					0.642	0.423
50 m from the site					0.364	0.280
100 m from the site					0.274	0.153
300 m from the site					0.147	0.146
Rach La area	87,873	1,300	150,000	3,611	0.751	0.501
20 m from the site					0.642	0.423
50 m from the site					0.364	0.280
100 m from the site					0.274	0.153
300 m from the site					0.147	0.146
QCVN 05:2013/BTNMT					0.3	0.2

The results of dust concentration calculation show that total dust concentration within 1 hour in construction area on average exceeds the permissible standards of QCVN 05:2013/BTNMT (limitation 0.3 mg/m^3) at highest level is 2.5 times and meets the standard at a distance of 100m. High content of dust at the site will cause the most impact on workers. When a person breathes in, large particles are stopped in the nose until they are removed mechanically by blowing the nose or sneezing. Some of the smaller particles may reach the windpipe and the dividing air tubes that lead to the lungs. The way the respiratory system responds to inhaled particles depends on where the particle settles. Common effects of dust including itchy or burning eyes, throat and skin irritation, coughing or sneezing and/or respiratory or breathing difficulties, including asthma attacks. Larger particles such as sand may become trapped in the nose and throat but can be expelled by coughing or sneezing but very small, fine particles (particulates) may cause more serious health problems because they can be inhaled deep into the lungs and airways.

Dust from earthwork, ground leveling will directly affect health of local people or nearby business households, disturbing or posing difficulties for their daily life due to dust cover on their things. Dust mainly affects local households who live along the road. The calculation results in above table should that the receptors affected with dust due to earthwork in the construction phase of coastal road are located within the radius of 50-100m and listed in the above table. This impact is assessed to be Moderate and can be mitigated through Environmental and Social Codes of Practice (ESCOPs) presented in the ESMP, Chapter 6.

❖ ***Dust and gas emission from transportation of materials and wastes***

Applying the same calculation methods to calculate the load of dust from transportation of materials and wastes. The estimated results are shown in Table 5.14.

Table 5.14. Total concentration of pollutants in the local road

No.	Waterway areas	Total concentration of pollutants *(ug/m³)*			
		TSP	SO_2	NO_x	CO
1	Mang Thit river	131	50	664	4,889
2	Cho Lach canal	123	45	617	6,381
3	Rach La canal	65	38	273	5,742
QCVN 05-MT:2013/BTNMT (1h)		300	350	200	30,000

Impacts happen during the construction of works, gradually reduce until the works are put into operation. Impacts occur mainly 8-10 hours/day. For the local road, with large volume of materials that need transporting, the traffic volume is >122 trips/day (during 24 months of construction), average transportation distance of 50km. Dust and emissions directly affect households living near the construction site, district road and inter-communal roads, however, the residential density is not dense but localized in villages along the route. In addition, emission level and emitted gases depend on various factors such as characteristics and status of transportation vehicles and fuel used (these factors affect the emission level), current status of transportation routes (affect the traffic circulation speed), and characteristics of transported materials (disassembled or bonded, whether it is loose or not). The impact level is assessed to be moderate and can be mitigable by ESCOP, which is applicable to all construction common impacts and risks.

❖ ***Dust and emissions from operation of construction equipment***

For calculating the emission (CO, NO_2, SO_2) from the operation of machines, equipment during construction process such as earthwork, ground leveling, etc. (using one ton of oil for internal combustion engines), this ESIA report is based on Natz Transport, Shun Dar Lin, 2005. Applying the same calculation method gives the estimated results as in Table 5.15:

Table 5.15. Total concentration of pollutants from operation of construction equipment

No.	Waterway area	Total concentration of pollutants *(ug/m³)*		
		SO_2	NO_x	CO
1	Mang Thit river	45	103	4,021
2	Cho Lach canal	39	134	4,312
3	Rach La canal	58	176	3,099
QCVN 05-MT:2013/BTNMT (1h)		350	200	30,000

According to the calculation of total concentration of air pollutants from road construction equipment, all of pollutants are within the permissible limits regulated in QCVN 05-MT:2013/BTNMT – National Regulation on Ambient air quality. With the wind and other meteorological conditions, those contaminants will be dispersed quickly and cause no harms to the surrounding areas. Therefore, the emission of exhaust gases when operating construction machinery and equipment is considered to be low and can be mitigated.

❖ ***Dust and gas emission from the replacement of irrigation and drainage outlets***

The replacement of irrigation and drainage outlets will take place at 45 positions on Mang Thit waterway, 29 positions on Cho Lach waterway and 6 positions on Rach La waterway, therefore, the dust and gas emission from such activities will impact directly on local people and their travelling in short term. However, this impact is occurring within several days of replacement and only around the replacement positions, most of dust is precipitable within a few minutes, therefore, this impact is considered low and can be mitigated.

❖ ***Dust and gas emission from the replacement and installation of navigation aids***

The replacement and installation of navigation aids will take place on Tra On canal, Mang Thit river, Cho Lach canal, Nuoc Man – Can Giuoc canal, which is likely to generate no dust and gas emission into the ambient air. The transportation of navigation aids from supplier to the site is about one trip per several days. Therefore, it can be considered as no impact from this activity in terms of dust and gas emission generation.

b. Noise

All the construction activities will occur during day-time. Therefore, the level of noise generated in the construction phase will be compared with permissible standard for working time (from 6h to 21h) according to the National regulation of noise QCVN 26:2010/BTNMT.

❖ ***Noise from dredging works***

Noise levels from dredging equipment at the measurement distance r_1 = 1.5m are shown in Table 5.16.

Table 5.16. Noise level at Source - from dredging equipment

No.	Machines/capacity	Number of equipment	Source noise (dBA)		
			$L_{A, eq}$ (Low)	$L_{A, eq}$ (High)	$L_{A, eq}$ (Medium)
1	Suction dredger HA97 4170 CV or equivalent	4	74	88	81
2	Suction dredger 1200 CV or equivalent	4	71	73	72
3	Suction dredger 585 CV or equivalent	4	71	79	75
4	Floating crane 30 tons	4	75	88	81.5
5	Clamshell dredger TC82 495 CV or equivalent	4	69	83	76
6	Bucket chain excavator 1.6 m^3	4	70	82	76
7	Excavator 1.25 m^3	4	72	85	78.5
8	Backup generator (30 to 50kW)	1	77	89	83

To predict the overall noise level in the most extreme condition when all the machinery mentioned above are operating simultaneously, the resonant noise can be calculated as follows:

$$L_{\Sigma} = 10 \times \lg \sum_{i=1}^{n} 10^{0,1 \times L_i}$$

In which: L_{Σ} is the total noise level; L_i is the source noise of level i; n: total noise sources.

Results of estimated resonant noise level in the dredging area are shown in Table 5.17:

Table 5.17. Calculated resonant noise level in the dredging area

No.	Machines/capacity	Number of equipment	Noise level (dBA)		
			$L_{A, eq}$ (Low)	$L_{A, eq}$ (High)	$L_{A, eq}$ (Medium)
1	Suction dredger HA97 4170 CV or equivalent	4	74	88	81
2	Suction dredger 1200 CV or equivalent	4	71	73	72
3	Suction dredger 585 CV or equivalent	4	71	79	75
4	Floating crane 30 tons	4	75	88	81.5
5	Clamshell dredger TC82 495 CV or equivalent	4	69	83	76
6	Bucket chain excavator 1.6 m^3	4	70	82	76
7	Excavator 1.25 m^3	4	72	85	78.5
8	Backup generator (30 to 50kW)	1	77	89	83
Resonant noise level (L_{Σ})			**87.1**	**99.5**	**93.1**
Permissible standards			**70dBA (6h-21h); 55dBA**		

No.	Machines/capacity	Number of equipment	Noise level (dBA)		
			$L_{A, eq}$ (Low)	$L_{A, eq}$ (High)	$L_{A, eq}$ (Medium)
			(21h-6h)		
Notes: Permissible standards according to QCVN 26:2010/BTNMT – National technical regulation on noise - 1h on average					

However, the noise level will decrease by distance and is determined by the formula:

$$\Delta L_d = 20.\lg [(r_2/r_1)]^{(1+a)} \text{ (dBA)}$$

In which: a: factor taking into account the noise absorption effect of ground terrain (within the construction site, there is no significant obstacles preventing the propagation of noise, then a = 0); r_1 is the measurement distance of a given typical noise level (m); r_2 is the distance from the noise source to the calculated position (m).

The calculated resonant noise level reduced by distance from source is shown in Table 5.18:

Table 5.18. Noise level at a specific distance from the dredging area

Noise level	Measurement distance	Source noise (dBA)		
		$L_{\sum}$ (Low)	$L_{\sum}$ (High)	$L_{\sum}$ (Medium)
Resonant noise level in the dredging area	1.5 m	87.1	99.5	93.1
Reduced noise level at a distance away from dredging area	10 m	70.6	83.0	76.7
	20 m	64.6	77.0	70.6
	50 m	56.6	69.1	62.7
	100 m	50.6	63.0	56.7
	150 m	47.1	59.5	53.1
	200 m	44.6	57.0	50.6
	500 m	36.6	49.1	42.7
Permissible standards		**70dBA (6h-21h); 55dBA (21h-6h)**		
Notes: Permissible standards according to QCVN 26:2010/BTNMT – National technical regulation on noise - 1h on average				

The results of reduced noise level at a distance away from dredging area in the table above show that noise level within 20m away from the dredging area from 6:00 to 21:00 will potentially exceed the permissible standard regulated in QCVN 26:2010/BTNMT - National technical regulation on noise. However, within such distance, there is now civil activities of local people. The noise level at the distance above 50m from the dredging area satisfied the permissible standard of noise level (below 70dBA). In addition, the noise generation is intermittent. Therefore, the noise level from the dredging area will not have negative impacts on local people in the area. The noise will directly impact on the construction workers who are directly looking at the site. In general, the significance of impacts from noise and vibration is rated at low and can be mitigated by appropriate measures.

❖ ***Noise from bridge construction***

Almost all machines cause noise during operation. In the case, all machines operate at the same time, the resonant noise will increase the noise level. Compared with the previous method of driving piles, the noise and vibration are lower, which can be considered as a bored pile drilling method that causes less noise and vibration. The noise is generated from (i) the machinery engines causing noise in the front door of the working platform and the rear radiator, (ii) operating the machines such as start the engine to connect the drill rod/ lift the drill rod out, turn off the engine during the drilling process; And the pouring of excess mud from drilling piles on the gathering site/barge that needs to be considered at the height of soil release (iii) choosing a machine with an electrification method such as converting dynamic machine into

electric motors to reduce noise level.

Applying same calculation method for noise from bridge construction equipment and machinery as described in Chapter 2, the resonant noise in bridge construction area is shown in Table 5.19.

Table 5.19. Noise level at a specific distance from the bridge construction site

Noise level	Measurement distance	Source noise (dBA)		
		$L_{\sum (Low)}$	$L_{\sum (High)}$	$L_{\sum (Medium)}$
Resonant noise level in the bridge construction site	1.5 m	88.3	101.9	95.0
Reduced noise level at a distance away from the bridge construction site	10 m	71.8	85.4	78.5
	20 m	65.8	79.4	72.5
	50 m	57.8	71.4	64.5
	100 m	51.8	65.4	58.5
	150 m	48.3	61.9	55.0
	200 m	45.8	59.4	52.5
	500 m	37.8	51.4	44.5
Permissible standard		**70dBA (6h-21h); 55dBA (21h-6h)**		
Notes: Permissible standards according to QCVN 26:2010/BTNMT – National technical regulation on noise - 1h on average				

The results of reduced noise level at a distance away from bridge construction site in the table above show that maximum noise level within 50m away from the bridge construction site from 6:00 to 21:00 will potentially exceed the permissible standard regulated in QCVN 26:2010/BTNMT - National technical regulation on noise. However, the noise generation is intermittent. Therefore, the noise level from the bridge construction site will not have significant impacts on local people in the area. The noise will directly impact on the construction workers who are directly looking at the site. In general, the significance of impacts from noise is rated at low.

❖ ***Noise from local road construction***

In the construction phase, noise is generated mainly from transportation vehicles for earthwork, ground leveling, stone payment and machines operating at the site. The operation of transportation vehicles and construction equipment such as bulldozers, compactors, commercial asphalt trucks, excavators, trucks etc., also cause significant noise and vibration pollution. Applying the same calculation methods for noise from local road construction equipment and machinery as described in Chapter 2, the resonant noise level caused by road construction activities are listed in Table 5.20, 5.21 and 5.22.

Table 5.20. Noise level at a specific distance from the road construction site in Mang Thit river area

Noise level	Measurement distance	Source noise (dBA)		
		$L_{\sum (Low)}$	$L_{\sum (High)}$	$L_{\sum (Medium)}$
Resonant noise level in the road construction site	1.5 m	**93.7**	**102.9**	**98.1**
Reduced noise level at a distance away from the bridge construction site	10 m	77.3	86.4	81.7
	20 m	71.2	80.4	75.6
	50 m	63.3	72.4	67.7
	100 m	57.3	66.4	61.7
	150 m	53.7	62.9	58.1
	200 m	51.2	60.4	55.6
	500 m	43.3	52.4	47.7

Noise level	Measurement distance	Source noise (dBA)		
		$L_{\sum (Low)}$	$L_{\sum (High)}$	$L_{\sum (Medium)}$
Permissible standard		**70dBA (6h-21h); 55dBA (21h-6h)**		
Notes: Permissible standards according to QCVN 26:2010/BTNMT – National technical regulation on noise - 1h on average				

Table 5.21. Noise level at a specific distance from the road construction site in Cho Lach canal area

Noise level	Measurement distance	Source noise (dBA)		
		$L_{\sum (Low)}$	$L_{\sum (High)}$	$L_{\sum (Medium)}$
Resonant noise level in the road construction site	1.5 m	**92.4**	**102.2**	**97.1**
Reduced noise level at a distance away from the bridge construction site	10 m	76.0	85.8	80.6
	20 m	69.9	79.7	74.6
	50 m	62.0	71.8	66.6
	100 m	56.0	65.8	60.6
	150 m	52.4	62.2	57.1
	200 m	49.9	59.7	54.6
	500 m	42.0	51.8	46.6
Permissible standard		**70dBA (6h-21h); 55dBA (21h-6h)**		
Notes: Permissible standards according to QCVN 26:2010/BTNMT – National technical regulation on noise - 1h on average				

Table 5.22. Noise level at a specific distance from the road construction site in Rach La canal area

Noise level	Measurement distance	Source noise (dBA)		
		$L_{\sum (Low)}$	$L_{\sum (High)}$	$L_{\sum (Medium)}$
Resonant noise level in the road construction site	1.5 m	**95.6**	**104.1**	**99.7**
Reduced noise level at a distance away from the bridge construction site	10 m	79.1	87.6	83.2
	20 m	73.1	81.6	77.2
	50 m	65.1	73.7	69.2
	100 m	59.1	67.6	63.2
	150 m	55.6	64.1	59.7
	200 m	53.1	61.6	57.2
	500 m	45.1	53.7	49.2
Permissible standard		**70dBA (6h-21h); 55dBA (21h-6h)**		
Notes: Permissible standards according to QCVN 26:2010/BTNMT – National technical regulation on noise - 1h on average				

According to the calculation results in Table 5.20, 5.21 and 5.22, the noise level is only significant at a distance of 1.5m from the source, at a distance above 50m, the construction vehicles and equipment is within the permissible limits (<70dB). The noise is decreased by distances from the construction site. Among the above noise sources, the most noticeable is the noise from trucks transporting construction materials through residential areas. Therefore, noise mainly direct affects construction workers and people living near construction site. According to the calculation results, noise level at the construction sites is Low, and in a short time. Moreover, as equipment doesn't operate at the same time but in each phase/shift or upon schedule, construction volume, each type of equipment to be used, impact from resonant operating machines equipment at one site is very low. Noise will stop when the construction is finished. Therefore, this impact is assessed to be low.

❖ ***Noise from replacement of irrigation and drainage outlets and replacement/ installation of navigation aids***

The replacement of irrigation and drainage outlets as well as replacement/installation of navigation aids won't use heavy equipment and machinery which can possibly cause significant noise. In addition, the scope of construction is limited around the outlets to be replaced and the duration of work is short-term, therefore likely causing no impacts on local people's life, it only impact directly on workers working at the site. Noise level from this activity is rated at low and can be avoided.

c. Vibration

Vibration can be generated mainly from equipment operating with large capacity and often on sites such as bulldozers, excavators, air compressors, etc. from activities of leveling, pile driving during construction of bridge abutment and embankment. Vibration can directly affect the workers involved in operating the machines, the people living nearby and the infrastructure around the construction site. Vibration will affect people's daily life, business activities and other structures and even cause the cracks or collapses of houses. When the intensity is small and the impact is short, this vibration has a good effect like increasing muscle strength, reducing fatigue. When the intensity is high and the effect is long, it can cause discomfort to the body. Vibration combined with noise makes the hearing organ too tired, affecting human health. Excessive vibration can also damage structures. When significant vibrations affect a building, structural damage such as cracking of foundation walls or cracking in masonry elements, as well as excessive sloping of floors, can be observed. This damage appears similarly with other structural issues which may affect a building. Typical vibration levels of some construction equipment are shown in Table 5.23.

Table 5.23. Vibration of some typical construction machinery and equipment

No	Type of construction machinery and equipment	Reference vibration (by vertical direction, dB)
1	Excavator	80
2	Bulldozer	79
3	Heavy transport vehicle	74
4	Roller	82
5	Air compressor	81

Source: U.S. Environmental Protection Committee Vibration from construction equipment and construction machinery, NJID, 300.1, 31 – 12 – 197

To forecast the amount of vibration decreasing by distance, following formula is used:

$$L = L_o - 10\lg (r/r_o) - 8.7a (r - r_o) \ (dB)$$

Where:

- L is vibration in dB at a distance "r" meters away from the source;
- L_o is vibration in dB measured at a distance "r_o" meters from the source. Vibration at a distance of r_o = 10 m is generally acknowledged as source vibration.
- a is the intrinsic vibration reduction coefficient on clay ground of about 0.5.

Forecasting results are presented in Table 5.24.

Table 5.24. Vibration decreases by distance

No	Equipment	Source vibration (r_0=10m)		Vibration at distance							
				r=12m		r=14m		r=16m		r=18m	
		L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)
1	Excavator	80	1.72	70.5	0.58	61.1	0.20	51.9	0.07	42.6	0.02
2	Bulldozer	79	1.53	69.5	0.51	60.1	0.17	50.9	0.06	41.6	0.02
3	Heavy transport vehicle	74	0.86	64.5	0.29	55.1	0.10	45.9	0.03	36.6	0.01
4	Roller	82	2.17	72.5	0.73	63.1	0.25	53.9	0.08	44.6	0.03
5	Air compressor	81	1.93	71.5	0.65	62.1	0.22	52.9	0.08	43.6	0.03
QCVN27:2010/BTNMT, permissible limit 75dB from 6 ÷ 21h and baseline level from 21h÷6h.											
DIN 4150, 1970 (German), 2mm/s: No impact; 5mm/s: flaking; 10mm/s: potential impact on structural bearing component; 20 ÷ 40mm/s: affecting structural bearing component;											

According to the calculation results in **Error! Reference source not found.**, the vibration caused by construction machinery and equipment at a distance of 12m is within the permissible limits of QCVN 27: 2010/BTNMT (<75dB) and will decrease by distance from the source. This vibration impact will mainly affect construction workers at the site. However, vibration impact should be considered in construction sites near the residential area, but at a low level:

- The intersection of traffic routes with canals.
- Residential area near Cho Lach bridge.

The direct impact due to vibration is assessed to be Low because the equipment will only operate intermittenly and the impact only happen at the construction site where workers can work if shifts and can be protected by labor protective equipment. Vibration impact can be minimized through the application of appropriate construction methods and construction plans.

5.4.1.2. Impacts on water quality

a. Domestic wastewater generated from workers' camp and daily activities

Each construction site will gather their own workers for construction work. The number of workers will concentrate mostly in the first phase of the project and will decrease as the work progresses. According to Vietnam construction standards - TCXDVN 33-2006, the standard norm of supply water per person per day is 45 liters/person/day. It is estimated that the whole volume of potable water will be wastewater after use. Therefore, the total volume of domestic wastewater can be calculated based on the number of workers at sites multiplying by the standard norm of supply water. Based on the number of workers at each construction sites, the total daily wastewater will vary as in Table 5.25:

Table 5.25. Estimated volume of domestic wastewater at the construction sites

No.	Construction site	Number of workers	Volume of domestic wastewater per day *(m^3/day)*
Dredging works			
1	Mang Thit river	40	1.8

No.	Construction site	Number of workers	Volume of domestic wastewater per day *(m^3/day)*
2	Cho Lach canal	30	1.35
3	Rach La canal	20	0.9
4	Ky Hon canal	20	0.9
Embankment works			
1	Mang Thit river	40	1.8
2	Cho Lach canal	30	1.35
3	Rach La canal	20	0.9
Bridge construction			
2	Cho Lach 2 bridge	70	3.15
Local road construction			
1	Mang Thit river	50	2.25
2	Cho Lach canal	40	1.8
3	Rach La canal	30	1.35
Total		**390**	**17.55**

Domestic wastewater from construction workers is the main cause affecting the water quality in the surrounding area. Domestic wastewater contains many residues, easily degradable organic matter, nutrients and pathogenic bacteria, which can pollute surface and ground water sources if there is not prompt treatment. At the same time, if domestic wastewater is not collected, there is a potential risk of epidemics (gastrointestinal, respiratory, skin diseases) affecting workers and nearby people.

Based on the amount of pollutants presented in the Report on the current status of urban wastewater - Institute of Environmental Science and Technology - Hanoi University of Science and Technology in 2006, the amount of pollutants daily discharged by each person into the environment is given in Table 5.26:

Table 5.26. Volume of pollutants generated by each person per day

No	Pollutants	Volume (g/person/day)
1	BOD_5	45 - 54
2	Total suspended solids	70 - 145
3	Oil, grease	10 - 30
4	NO_3^- (by N)	6 - 12
5	PO_4^{3-} (by P)	0,8 - 4,0
6	Coliform	10^6- 10^9 MPN/100ml

Source: Report on the current status of urban wastewater - Institute of Environmental Science and Technology - HUT, 2006

Concentration of pollutants in untreated domestic wastewater is calculated by following formula:

$$M = \frac{m}{V} \qquad \text{(CT3)}$$

Where:

- M: Concentration of calculated pollutant
- m: Pollutant load (kg/day).
- V: Total generated wastewater (m^3/day)

Calculation results are presented in Table 5.27.

Table 5.27. Concentration of pollutants in untreated domestic wastewater

No	Pollutant	Concentration of pollutants in untreated domestic wastewater (mg/L)	QCVN 14:2008/BTNMT (column B)
1	BOD_5	582	50
2	TSS	1265	100
3	Oil, grease	235	20
4	NO_3^- (by N)	106	50
5	PO_4^{3-} (by P)	28	10
6	Coliform	$100x10^6$ - $60x10^9$ MPN/100mL	5000 MPN/100mL

The calculation results in the above table show that, concentrations of pollutants in the untreated domestic wastewater are much higher than permissible limits in the QCVN 14:2008/BTNMT (column B). Wastewater of this type usually contains total suspended solids (TSS), organic substances (BOD_5, COD), nitrogen and phosphorus-containing substances as well as microorganisms that need to be controlled and treated before being discharged. This is a significant source of pollution which without proper treatment can directly affect the living environment of workers and people around the project area, causing epidemics and directly affecting the groundwater and surface water. Surface water areas prone to this risk are: Mang Thit river, Cho Lach canal, Rach La canal and Ky Hon canal.

However, the direct impact due to domestic wastewater is considered to be Low and mitigable because: (i) the volume of domestic wastewater generated at each camp is not large, and the Contractor also employs local labor or rent houses so the amount of wastewater generated is lower than the calculation; (ii) the impact is localized, only in each worker camp area; (iii) The amount of wastewater is generated intermittently during the day; (iv) Construction period is short (15-24 months depending on construction items); (v) Domestic wastewater will be collected through existing system of the area or via collecting system of Contractor in their worker camps, then connecting to the drainage pipeline system of local areas, not discharged directly to the waterways.

b. Surface Runoff

Rainwater can be considered as natural source of pollution and is considered to be clean water if it is not in contact with polluted sources such as: polluted wastewater, gas, soil/mud, etc. The main sensitive receptors of this impact are the water bodies in catchment areas of the rainwater runoffs from the construction site. Pollutants in the rainwater runoff during the construction phase are mainly soil, rock, oil, grease and domestic waste that are swept away by rainwater and become a source of pollution to the surface water, soil and groundwater.

In the dredging site, although dredging vehicles occupy a relatively small surface area, rainwater runoff on the surface can sweep away grease and oil that adhere to the surface or leak around containers, causing water pollution and negative effects to aquatic system of targeted waterways.

According to the WHO's research, the concentration of pollutants in normal rainwater runoff is about 0.5 - 1.5 mg N/l; 0.004 -0.03 mg P/l; 10 - 20 mg COD/l and 10 - 20 mg TSS/l. The receiving sources of rainwater runoff are Mang Thit river, Cho Lach canal, Rach La canal, Ky Hon canal and other canals. In the embankment, bridge construction and local roads construction along the waterways, rainwater runoff from the construction site can sweep away loose materials and soil, minerals on the surface, leaking grease... increasing the content of suspended solids, substances, organic matter, increasing turbidity, oil and grease in water, adversely affecting aquatic ecosystems of water sources. Without drains, rainwater runoff can

affect construction items such as damaging or destroying works in progress, etc. This impact is mainly on rainy season from September to December. However, this direct impact is assessed to be low because:

- The construction site is regularly cleaned by the workers, thus limiting material and loose soil and stones being swept away by rainwater runoff.
- At each construction site, there is a rainwater drainage system.
- Construction activities take place near the waterways as natural receptors.

The impacts due to rainwater runoff can be minimized by appropriate technical and managerial measures, and no indirect adverse impact is anticipated.

c. Construction Wastewater

❖ ***From embankment works***

Construction wastewater for each embankment section of the Project may be generated from the following sources: The process of dredging the embankment roof, washing construction machinery and vehicles; repairing and maintaining of machinery and equipment. However, wastewater is considered not to be generated from above processes, because:

Embankment roof dredging process by excavators with long booms standing on the bank or barges that do not use water, it is considered that no wastewater is generated in this stage. The materials used are stones which are clean materials, which do not need pre-washing before use, so no wastewater is generated in this stage.

The process of machinery, equipment maintenance serving for the Project construction activities are implemented in garages near the Project area, so there is no wastewater from such repair and maintenance process.

Washing dumping trucks which transport materials will not be implemented in the Project's embankment area so there is no wastewater during the construction phase of each embankment section. The maintenance and repair of construction machinery and equipment at garages will be combined with the cleaning of construction equipment in accordance with regulations. Therefore, there is no impacts expected from construction wastewater.

❖ ***From bridge construction***

The construction of abutments and piers using bored pile drilling technology may impact surface water quality in some parts of Cho Lach canal. Some wastewater and sediment may enter water sources. Additionally, wastewater from concrete batching plants, beam casting yards, and washing of construction tools, machinery, and other equipment may also run in the canal and affect its surface water quality. Turbidity increases due to the cohesive clay content of bentonite, impacting both the quality of surface water and the life of aquatic species near bridge construction sites. Surface water flows may be affected at bridge construction sites and access roads.

The impact is considered to be negligible due to the rapid deposition of the clay structures on the river bottom. The surface water quality of Cho Lach canal and its ecosystem are directly affected. The impact is short and localized during the drilling of bored piles, washing machines and equipment. This negative effect can be mitigated by the use of appropriate mitigation measures.

Bentonite solution is used for drilling during bridge construction. It's difficult to manage viscous liquid sludge because it takes on the form of storage space. It may accumulate at the construction site, impede worker and machine. As bentonite mud can spill on the ground, it may cause the roads be muddy, clogs traffic, and creates unsafe conditions. It does obstruct and

directly affect workers during the construction of bored piles for bridges.

Unlike other wastes, it is harder to control bentonite wasted sludge because it has viscous property and easily to be shaped in the special forms/containers; This waste would prevent the working efficiency of workers and machinery, unless being promptly transported to out of the construction site. The sludge even cause harm to machinery and quality of the constructed bridge. Once being overflown on the ground, it could make the roads muddy, obstruct traffic and cause unsanitary. Also, the spill of fuel can result in the appearance of hydrocarbons in this type of wastewater. The impact would be rated moderate and can be minimized by taking appropriate mitigation measures.

- ***Concrete batch plants***

In the course of construction, construction wastewater is mainly generated from the concrete curing process, road washing, washing construction equipment, tools, vehicles, etc. According to experience learned from works with similar scale and characteristics, volume of construction wastewater generated is about 1 - 3 m^3/day upon each construction phase. Despite small volume, construction wastewater usually contains high content of pH (usually pH>12), oil and total suspended solid. If this construction wastewater is not treated, it will cause sedimentation and oil spreading, affecting the receiving water bodies and related creatures. Impacts of construction wastewater is considered to be Low and controllable.

Chromium (Cr^{6+}) in concrete wastewater occurs in very low concentration because Chromium is used as an additive, accounting for a very small percentage of the finished cement product. Chromium is also a factor that causes a cement allergy in people with atopy, due to frequent exposure to cement and as well as its effects on living organisms. Due to the small expected volumes of wastewater per site and mostly using commercial concrete from locally available batching plants, the actual construction time is short. So, this impact is expected to be low and can be minimized.

5.4.1.3. Solid waste generation

a. Domestic waste

Solid wastes are generated from daily activities of construction workers in the camps. The main components of domestic solid waste include decomposable organic substances and persistent inorganic substances such as nylon bags, bottles, old personal items. The average amount of domestic solid waste is about 0.3 - 0.5 kg/person/day (Vietnam National Environment Report 2011 - Solid waste). With the total number of 390 workers/construction site, the amount of domestic solid waste is shown in Table 5.28.

Table 5.28. Domestic wastes from the construction site

No.	Construction site	Number of workers	Domestic solid waste *(kg/day)*	Construction duration *(month)*	Total domestic solid waste *(ton)*
Dredging works					
1	Mang Thit river	40	12 – 20	18	6.48 – 10.8
2	Cho Lach canal	30	9 – 15	12	3.24 – 5.4
3	Rach La canal	20	6 – 10	12	2.16 – 3.6
4	Ky Hon canal	20	6 – 10	9	1.62 – 2.7
Embankment works					
1	Mang Thit river	40	12 – 20	6	2.16 – 3.6
2	Cho Lach canal	30	9 – 15	4	1.08 – 1.8

No.	Construction site	Number of workers	Domestic solid waste *(kg/day)*	Construction duration *(month)*	Total domestic solid waste *(ton)*
3	Rach La canal	20	6 – 10	4	0.72 – 1.2
Bridge construction					
2	Cho Lach 2 bridge	70	21 – 35	18	11.34 – 18.9
Local road construction					
1	Mang Thit river	50	15 – 25	15	6.75 – 11.25
2	Cho Lach canal	40	12 – 20	12	4.32 – 7.2
3	Rach La canal	30	9 – 15	12	3.24 – 5.4
Total		**390**	**117 – 195**		**43.11 – 71.85**

From the above table, the total amount of domestic solid waste of the project is on average 117 – 195 kg/day, with a construction period ranging from 4 to 18 months, the total amount of domestic solid waste is from 43.11 to 81.85 tons. If domestic solid waste is not collected and disposed appropriately,

- It can obstruct the flow during the construction, facilitating flood and congestion (at the construction location of new Cho Lach bridge and other canals).
- It can obstruct traffic when transporting construction materials to the construction site and construction activities of workers (focusing mainly at the construction sites of the local roads in Mang Thit, Cho Lach, Rach La canals and embankments area, and Cho Lach bridge).
- Domestic solid waste containing organic ingredients, containing pathogens, so if there is no proper plan for collection, transportation and treatment, it can create great risks to the water and air environment and can directly affect the health of people and construction workers.

The amount of domestic waste generated during the construction phase, unless being collected and treated according to regulations, will be thrown into the construction area and surrounding area, causing environmental pollution, affecting the aesthetics of the area. By the time, the accumulated wastes will form spontaneous waste dumping sites in the residential areas surrounding the Project area. In addition, wastes dumped indiscriminately on the construction area can be swept away by rain into receptors once it rains, polluting the existing river water, directly affecting the aquatic ecosystem. This is the source of environmental pollution due to bad smell from wastes, leachate which attracts vector-borne disease organisms such as flies, mosquitoes, mice, pathogenic microorganisms, contaminating soil and water, etc. Environmental pollution due to domestic wastes will directly affect workers' health, damage the beautiful landscape and affect environmental sanitation conditions of surrounding community.

However, the direct impact of domestic waste is considered as "low" and can be mitigated through ESCOPs because: (i) The amount of waste generated on each site is low and is collected daily by workers; (ii) the impact is localized at construction sites; (iii) the contractor will employ local labor to limit the amount of domestic waste generated; (iv) worker camps will be located far away from residential areas.

b. Construction waste

Solid waste can be generated during construction from: earthwork, leveling; dredging sludge; transportation of excess raw materials and solid waste; construction activities; maintenance of construction vehicles, equipment. Solid wastes include: excavated and spilled soil, rock and sand. In addition, there can be iron debris and steel scrap; cement bags; wood debris, broken

bricks.

- From embankment works: The volume of wastes generated from the vegetation grubbing and clearance of existing structure is significant. However, among the wastes, (1) timber, fruit trees could be used for firewood, (2) branches, leaves of trees, plants would be used as organic fertilizers, (3) wasted soil, stone, concrete from demolition of houses, structures, fences, yard would be used for embanking local households' yards;
- From bridge construction: Construction solid waste are mainly sourced from failed or broken materials used during processing such as mixed macadam and concrete;
- From local road and irrigation and drainage outlets construction: Solid wastes can be generated during construction of coastal road from: Grubbing/demolition for site clearance, road bed leveling, transportation of materials and excessive solid wastes, construction, maintenance of equipment, construction means, etc. Solid wastes generated consist of: (i) stone, soil, sand excavated and backfilled and dropped; (ii) Debris: Including scrap iron; all kinds of cement bags; wood chips, broken bricks and so on and grubbed plant biomass.

Using the norms issued by the Ministry of Construction *(Document No. 1784/BXD-VP dated August 16, 2007 andOfficial Letter 1776/BXD-VP dated August 16, 2007 by MOC)*, solid waste generated during construction is estimated to be 0.5-1 percent of the total volume of materials, the maximum volume of construction solid waste generated during construction phase is estimated as in Table 5.29:

Table 5.29. Volume of solid waste generated from construction phase

No	Work item	Volume *(ton)*		
		Volume of material	Low loss level (0.5%)	High loss level (1%)
Embankment site				
1	Mang Thit river	190,000	950	1,900
2	Cho Lach canal	128,000	640	1,280
3	Rach La canal	14,000	70	140
Bridge construction				
1	Cho Lach 2 bridge	300,000	1,500	3,000
Local road construction				
1	Mang Thit river	558,250	2,791	5,583
2	Cho Lach canal	182,905	915	1,829
3	Rach La canal	129,598	648	1,296
Irrigation and drainage outlets				
1	Mang Thit river	450	2.25	4.5
2	Cho Lach canal	290	1.45	2.9
3	Rach La canal	60	0.3	0.6

However, these wastes, if not well controlled, can hinder construction work and increase the amount of dust in and around the construction site area, affecting workers and nearby people. Residential areas prone at this risk are: residential area at Cho Lach town, Mang Thit, Cho Lach, Rach La canal embankment areas, local roads and irrigation/drainage outlets along those canals.

In addition, after the construction process, some types of solid waste such as rubble, scrap steel, cement bags, etc. can also be generated. However, this is reusable solid waste and can be salvaged for reuse or sold to units in need so there is low risk of discharging these types of solid wastes into the environment.

This direct impact is assessed at a low because: (i) The volume of waste generated is not large

and only at the construction site; (ii) Construction waste can be segregated and recycled directly at site for clearance and/or as fuel for cooking in the worker capms; (iii) Construction period is short; (iv) solid waste will be collected and transported daily to local disposal sites twice in a week. At the same time, this impact can be mitigated through the measures set out in ESCOPs.

c. Hazardous waste

❖ ***From embankment works***

During construction of the Project works in each embankment location**,** hazardous waste will be generated mainly from the process of repairing machinery with minor errors such as replacing damaged batteries, fluorescent bulbs, oil-soaked rags and disposed machine oil at the construction site. Major maintenance and repairs will take place at specialized garages.

According to experience learned from similar Projects, hazardous waste volume from the construction is not much**,** estimated at about 1-2% of total solid waste, equivalent to 0.5 – 1 kg/day at Mang Thit area, 0.35-0.7 kg/day at Cho Lach area, and 0.15-0.3 kg/day at Rach La area during embankment. Unless being properly managed, the hazardous wastes will cause negative impacts on soil, water and air quality; lubrication oil and grease in containing tanks could be penetrated into the ground, leading to soil contamination. The wastes must be collected, stored, and prevented from contaminating construction sites that can affect water, soil and air quality in project areas as well as surrounding areas. The impact is considered to be Low as the hazardous waste generated at the site would be contained in specialized tanks, contracted with functional units for collection, transportation and treatment in accordance with regulations.

❖ ***From bridge construction***

During construction of bridge works, an amount of hazardous waste will be generated mainly from the process of repairing machinery with minor errors in construction sites such as replacing damaged batteries, fluorescent bulbs, oil-soaked rags and disposed machine oil. Major maintenance and repairs will take place at specialized garages.

Hazardous wastes from bridge construction are not in great amount, but they must be collected, stored, and prevented from spilling onto construction sites, affecting water, soil and air environment in project areas as well as surrounding areas. Hazardous waste may impact on:

Air environment due to dispersion of oil smell and solvent vapor, polluting the air environment and directly deteriorate health of the workers and local people around construction areas.

Water environment: Uncollected wastes will be washed away with stormwater runoff and pollute surface water of Cho Lach canal at bridge construction sites, then spread to surrounding river areas and directly affect their aquatic ecosystem: increased oil and grease content in the water, reduced oxygen exchange and respiratory capacity of aquatic organisms and reduced plankton's photosynthesis. According to assessments in chapter 3 on the current status of biological resources, ecology of Cho Lach canal at construction section is quite simple without rare species that need protection or warning. Therefore, impact is assessed as low.

❖ ***Hazardous wastes from local road construction***

Hazardous waste generated during construction are mainly plastic containers/cans that contain engine oil, oil, gasoline, used fluorescent bulbs, dirty grease from transportation vehicles, etc. Hazardous wastes generated during construction include fluorescent lamps, waste oil, and oily rags. Wasted oil volume makes up 2% total solid waste volume, equivalent to 2kg/day. Although the volume generated is not large, unless being properly managed, these hazardous wastes will have negative impacts on the soil, water, and air quality; Oil and grease can penetrate and contaminate soil and water. Impact level is assessed to be low and manageable

by engaging a licensed service provider.

5.4.1.4. Impacts and risks on physical cultural resources (PCRs)

There is no national and international intangible cultural heritage within the area of influence of the project. As surveyed in Chapter 2, no recognized national and international PCRs are close to the project areas. In view of that, the construction activities of the project do not have any direct impacts on the PCRs in the Project area. However, the construction activities will partially affect the operation of some cultural resources (refer to Table 3.58 for the details of cultural resources adjacent to project construction sites). The impacts include inconvenience in accessibility, dust, noise, exhaust gases and other sanitary and safety conditions, which may cause discomfort for people who come to visit the sites. The detailed impact assessments on the cultural resources are presented in the impacts on sensitive receptors section.

The dredging works, construction of embankments, local roads, bridge, drainage outlets, and navigational aids require excavation of soil, therefore, during construction phases of the works, chance finds can be encountered. However, the possibility of chance finds is LOW because most of the works are carried out on the existing base or on agricultural land. Nevertheless, a chance finds procedure is included in the ESCOPs to address the chance finds.

5.4.1.5. Impacts and ricks on biological resources

Site clearance, dredging activities and construction are likely to create adverse impacts on both local terrestrial and aquatic ecosystems. The assessment in term of impact on the local ecological environment are presented as follows:

a. Impacts and Risks on Aquatic Species

As described in Chapter 3, aquatic species found in the project area include phytoplankton, zooplankton, zoobenthos macro benthic invertebrates and fish. In addition, there are also farmed fish species in aquaculture cages. Depending on the biological behavior, each aquatic plant and animal species dominates a certain water layer. The construction of embankments is not continuous and will be constructed in segments. Aquatic creatures can move to another place if their habitat is disturbed by construction activities. Therefore, the impact on aquatic organisms is assessed to be moderate and short-term in the construction phase, localized in each section in each time of construction. The dredging activities are the key factor that disturbs the water column and affects aquatic flora and fauna in different ways.

❖ ***Impacts on Phytoplankton***

Increase turbidity and suspended solids in the water caused by dredging would obstruct sunlight from penetrating deep in water, limiting photosynthesis capacity of floating plants thus constraining their growth, limiting productivity of primary nutrient producers in the aquatic ecosystem. Some of the phytoplankton are carried away out of water along with the dredged material or damaged by the dredging equipment. After dredging is completed, the remaining phytoplankton continue to growth, spread thus the ecosystem can be recovered relative quickly. On the other hand, as the sediments usually resettle about 15 minutes after dredging stops and the areas to be affected by dredging is within the diameter of 500 m meters, the impact on phytoplankton is temporary; and with limited space. Photosynthetic and respiratory capacity of many species in this rich ecosystem can be restored when pollutant concentrations decrease.

❖ ***Impacts on Zooplankton and benthic invertebrates***

Some benthic invertebrates will be removed together with their habitat by dredging. The others would die when their habitat is damaged by dredging. This impact is not avoidable, happen mainly to the bottom layer, within the dredging corridor and recoverable naturally after about

one year (Prussian et al 1999)[25].

Potential impacts on the Fish and Shrimps in the River. Increase water turbidity and suspended solids may obstruct their respirations CH_4 and H_2S released from bottom mud when being disturbed may cling to their gills, hindering their respiratory process. However, fish and shrimps tend to be able to react immediately as soon as their habitat is disturbed, swim away right when the dredging is started. Therefore, the potential impacts of dredging on the fish would be small. However, if oil and grease is spilled into water during construction, that could be a source of acute toxic to aquatic species and deposits in foods of aquatic species, from low-level flora (algae, phytoplankton) to high level aquatic fauna (fish, etc.).

In general, the impacts on aquatic species are assessed at moderate because (i) the impact occur within a short time, (ii) there are not endangered aquatic species in the waterways under SWLC Project; (iii) aquatic species can travel to a habitat nearby for reproductivity and/or feeding themselves and turn back to their original habitats after the completion of construction works.

b. Impacts on terrestrial biological resources

These impacts are mostly to occur during the site clearance before starting construction when existing trees and vegetation covers within the boundary of construction sites are required to be removed serving embankments and bridge construction works. The existing vegetation cover which are mostly paddy fields and vacant lands thrived with grasses and bushes needs to be removed. However, through site visits, the site clearance will certainly cut down some trees wildly planted along the riverbanks such as bamboo, muntingia calabura, chinaberry, eucalyptus, banyan, banana, guava… the plant biodiversity in both agricultural and urban areas affected by the project is low mostly the said common trees, grasses and bushes.

Beside impacts on terrestrial flora, the removal of tree and vegetation associated with construction activities such as excavation, operation of construction vehicle and equipment also certainly affect the local terrestrial fauna within the project area such as loss of habitat and feeding areas. The local terrestrial fauna and domestic animals affected by the implementation of the project includes mammals (mice, cow...), reptiles (snake, lizard…), birds (sparrow, stork) found in the areas for agricultural activities or livestock (pig, chicken, duck...) and pets (dog, cat) found in the residential areas.

Along the banks of Mang Thit, Cho Lach and Rach La canal, there is no special plants or animals of high value. Embankment construction will require clearance some areas according to real condition at site which can potentially impact on some species' habitat. When grubbing the vegetation in a position, the species living in that location will move to a nearby green area. Thus, the vegetation grubbing will not pose significant impact on living activities exiting species.

The project's terrestrial areas are all altered and changed seriously by human activities for long time. The field survey shows that these areas are the urban land mainly including residential areas, traffic roads and rural area consisting of agricultural cultivation and residential areas. The corresponding terrestrial ecosystems are created by local people including trees and livestock, the fauna is also relatively poor, mainly including cattle and poultry raised by households in their gardens such as chickens, ducks, pigs, cows, etc.

At this stage of the engineering study, it is identified that bend corrections will be made along the following rivers and canals: i) 10 locations along Mang Thit River with a total of 5,359m; ii) 2 locations with a total of 928m along Cho Lach canal; iii) 2 locations of with a total of 10,046m along Rach La

[25] U.S Environmental Protection Agency (USEPA)'s monitoring of recovery of dredging in a river in Alaska showed that substantial recovery of the diversity of macro-invertebrate occurred after one year.

canal; and iv) 2 locations of total of 1,233m along Tac Cua River. The bend corrections would range from 200m to 900m and would not result in blocking or separating the original river and canal course at each section. This activity will result in permanent changes in some of the environmental characteristics in the corridor of impact. The environment at the bend corrections is mainly rice paddy and/or land with low valued vegetation including small bushes and grass which are widespread and abundant. These species are of "least concern" according to the description of the conservation scale by IUCN. Therefore, the adverse impact on the biological resources is not expected to be significant, and appropriated mitigation measures will be included in the dredge management plan and ESMP.

According to the field survey, there is not any endangered species or species needing to be protected within the project's area. For those reasons above, the impact level on terrestrial ecological environment is low.

Also, at this stage no significant biological resources which deem to be vulnerable, critical, or endangered located within the immediate area of influence are along the corridor of impact in the project area. Any additional identified significant biological resources will be assessed and updated in the final ESIA

5.4.1.6. Interruption of traffic activities and public facilities

a. Road traffic

Road traffic is mostly impacted by the construction of new bridge in Cho Lach town. For the bridge construction item, affected subjects are people in residential areas and other roads routes in Cho Lach town. These impacts and risks are caused by as increased density of vehicles on the road and residential areas, increasing the frequency and heavy-loaded vehicles, as well as the risks of traffic collisions and conflicts during construction due to heavy vehicles gathering at rush hours such as heavy and bulky material trucks, etc. In addition, the risks of traffic safety on new bridge which are parallel to and near the old one should be paid attention, including people are unfocused in the course of transport as they busy observing the construction site, drops of materials from high elevation, broken bulky equipment, etc. Impacts are assessed to be moderate and can be mitigated by appropriate measures presented in Chapter 6.

b. Waterway traffic

Different types of dredging equipment will be used for dredging. Oil and water supply vessels, etc. may also be presence at the dredging area at some stage. Due to dredging activities, the navigation of ships and boats will be restricted in about 12 months of implementation. The passage would be narrowed down when dredging vehicles occupy water surface, increased traffic density would pose accident risk between dredging vehicles, fuel supply boats and local people's fishing boats.

Waterway traffic safety risks would mainly be at the two ends of targeted waterways where the density of existing waterway traffic is quite high while water surfaces at some locations are being occupied by local activities.

Mooring of the barges on water surface and transportation of dredging materials along the waterway would disturb local waterway traffic, increase the risk of coalitions between local waterway traffics and dredging machineries particularly at nighttime. Dredging would limit the accessibility of local boats to riverside for mooring purpose.

The impact on water way is assessed to be Low and localized because the implementation will take place on one side of the waterway, the other side should still be adequate for local boats to travel. In addition, the dredging equipment usually stands at one location a few hours at each time. On the other hand, dredging may also affect accessibility of local boats at narrow river sections. There are some small boats of local people travelling or parking along the riverside. When dredging takes place, these boats can travel to a place nearby to moor instead.

After the completion of dredging is the commencement of embankment. The waterway traffic may be affected within 18 months during embankment construction. Transportation and unloading of materials and equipment to the construction sites by water way may pose risks to other waterway traffic means due to increased density of traffic with barges, and machinery as well as workers at the site. However, the impact level is assessed to be Low because the construction is carried out discontinuously along the channel and local traffic density is not crowded.

c. Disruption to existing public facilities and related services

construction may require relocation of such facilities, or construction plants may unintentionally cause damages to them during construction. Power cut off may happen for relocation. These disturb living activities of local people in the area such as: (i) Water pipes of households who are using the river water would be removed for embankment and bridge construction. Similarly, drainage pipes from riverside houses would also be displaced. The construction of embankment will interrupt the water taking or discharging. (ii) Local people can no longer go down the water surface area and mooring area during embankment construction; (iii) boats cannot be parked where they used to but have to move to another place during construction phase; (iv) the tap water pipeline could be slightly deviated from its original position due to the process of moving heavy construction equipment. Accordingly, pollutants would enter into the pipelines at distorted joints, and water in the pipes would be contaminated. In the worst case, water supply would be disrupted if the pipeline is broken or damaged, leading to considerable inconvenience for local people, especially on dry days. These problems will disturb daily activities of local people. The impacts and risks are assessed low as the construction period of each section is short, the pipes can be re-arranged and the number of boats mooring near houses is not dense. This risk is avoidable through appropriate mitigation measures to be developed and controlled by the Contractor.

5.4.1.7. Aesthetic changes in the landscape

The rehabilitation/construction activities would require demolition and excavation on existing works base including old bridge, paths along the embankment routes, existing waterways to be renovated, existing irrigation and drainage outlets to be replaced as well as malfunctioning navigation aids in the construction sites. The implementation of project items will definitely result in demolished houses, bridge, excavated areas, construction sites, stockpiles of construction wastes and material, of which, the effects on the surrounding landscape will be at moderate as it can pose restrictions for the travel, vision and urban beauty, however, this impact is temporary during the construction and can be mitigated through general and practical measures already applied in many projects in Vietnam.

5.4.1.8. Impacts and risks on social aspects, women and children

a. Impacts related to labor influx

Social impacts are mainly generated from the labor influx for construction activities. The construction activities of the SWLCP takes place along Mang Thit, Cho Lach, Rach La, Ky Hon canal, Tac Cua river and each water ways will be splitted into individual segments following detailed design of the project. There are about 20-50 workers at each project site. This impact affects people around the project area and local infrastructure. Social impacts include but not limited to:

i. Conflicts between construction workers and local communities due to differences in habits, customs, culture, lifestyle, employment and income. This impact is likely to be higher in densely populated construction areas such as construction of new bridge at Cho Lach town, dredging and embankment works on Mang Thit river, Cho Lach canal, Rach La canal, Tac Cua river.

ii. Conflicts between local residents and the Contractors when wastes, emissions generated from construction activities such as dust, solid wastes, hazardous wastes, wasted rock and soil from the construction of drainage and wastewater collection system of each work in densely urban population areas with busy trading activities especially at Cho Lach bridge. Conflicts stemming from adverse impacts on crops, rice and vegetables, or erosion and landslides that bury trees along the waterways. Wastewater from worker camps might discharging directly into the waterways under renovation may also lead to conflicts with the local community.

iii. Labor influx can cause social disorders and pose social problems such as gambling, drug, prostitution. Additionally, uncollected and untreated wastewater, which cause adverse impacts such as bad smell, loss of beautiful land scape and poor health of local people, from worker camps can bring workers into conflict with local people. Labor influx could also increase the risk of Gender Based Violence (GBV) and sexual exploitation and abuse (SEA).

However, the social impact is direct and assessed to be low because: (i) the workers are scattered in different segments with a number of 20-50 per each location and the impacts are localized within the construction areas; (ii) Local labor will be prioritized to be mobilized for construction activities; (iii) At the same time, measures to control the age of hired workers must be taken to prevent child labor; (iv) The impacts are mainly occurred in the stages of construction phase and within a short period.

b. Impacts due to improper access

Building new bridge and local roads along the waterway as well as embankment will require a part of existing roads as construction sites. These construction sites are in front of existing residential areas and they need to be fenced around for safety reason. This safety fencing system will cause difficulties on access, even block the accesses to local properties and houses at some small roads. The impacts will be stopped after the completion of these works and that the construction of the works is strongly supported by local people. The impact is considered to be Low and mitigated through transport management methods in the course of construction because: (i) successive construction method is applied, the interruption is localized; (ii) the impacts occur in short period.

c. Disruption of business activities along local streets

The new bridge at Cho Lach is located on existing urban areas where business activities are taken place along the roadsides. These includes small business shops of domestic necessities and foods such as biscuit, candy, fruits, vegetables and coffee shops, etc. The construction activities will cause impacts on these business shops due to increased levels of dust, noise, and block access roads. Incomes of these shops may be reduced or lost if the entrance is blocked or too dusty. Generally, it will be difficult for the affected businesses to attract the customer when construction takes place in front of their shops. Therefore, this impact level is assessed as Moderate and could be mitigated via good construction and management practices. The income losing can be mitigated not only by cash compensation but also livelihood and business restoration programs that are proposed in the project Resettlement Plan.

d. Impacts on Aquaculture

Currently, there are 100 households living on aquaculture (shrimp, crabs and fish). There are also some households living on bottom-harvesting (đăng đáy) which can potentially prevent ships and boats from moving safely on the inland waterways.

The implementation of the Project would affect the aquacultural production on the river/canal. The level of impacts depends on the distance from the aquaculture ponds to the dredging areas.

Those located outside the dredging corridor but within 500 m from the edge of dredging corridor and taking river water to the pond directly (within sedimentation pond) would be mostly affected. Species in the cages could die or have reproductivity reduced as this area suffers the increased turbidity the most. This impact is assessed to be moderate due to increase of turbidity during dredging time which is estimated to be between 25 to 30 days per each river/canal. The potential impacts of dredging on aquaculture can be mitigated through proper dredging practice and construction schedules that take into account the feedback from consultations with the affected households. In the case the aquacultural activities have to be suspended, affected households will receive livelihood support in accordance with RP. For the aquacultural ponds that are located further than 500 m from dredging corridor, the impacts would be expected to be marginal. The exact numbers of households in each type of aquaculture or fishing be determined in the construction phase.

e. Impacts on Fishing Activities

The impact on fishing activities in the project area mostly comes from dredging and embankment works.

Embankment strengthening is carried out with a total length of 13,154m in Mang Thit river, 8,770m in Cho Lach canal, and 1,060m in Rach La canal and is discontinuous, mainly in in areas with clayey soil. Most of the embankment sections are located near the existing residential areas, there is almost no fishing activities next to riverbank, so the level of impact from embankment is assessed as Low.

For dredging activities, there are about 50 households engaging in fish catching on the waterways. They use different means for the fishing (nets, traps, etc.) and catch fish from 15-21 days per month on average. The main fishing season lasts from March to October annually which is mostly in dry season thus and overlaps with dredging period. Dredging work would affect fishmen in different ways at different levels.

For those who do fishing with fixed tools within dredging areas/transport corridor, they will not be allowed to continue their fishing activities in the location during construction and operation phases. They will have to relocate permanently during the dredging. These households should be supported by livelihood restoration programs the project under the RP.

For those who do fishing on fixed tools outside the dredging corridor, the impacts on them would be partial, short term and temporary. Water quality reduction may cause decreases in fish productivity in the river, catching yield may be affected. Catching by fishing tools placed at a fixed location could be reduced when the fish swim away due to disturbance to water column, increased turbidity and TSS. The impact would be at low to moderate level because on average, it takes only one day to complete dredging of about 16-20 m river section (by each of the 5-6 teams carrying out dredging at different sections at the same time) during which about 500m of river section would be affected with reduced water quality. That means for each fixed fishing location, water quality would be affected intermittently by dredging from 25-30 days. This impact is mitigable by the measures presented in the ESMP in Chapter 6.

For those who do fishing with mobile tools such as boats with toads and nets, the potential impacts on their catching yield would be marginal as they can move to other river section not affected by dredging to do fishing. Brackish and saltwater fish is abundant in this section thus fishing should always be possible there. Catching would not be affected, the fishmen would be mainly affected by increased waterway traffic safety risks. The mooring and operation of dredging machinery will occupy the water surface and disturb waterway traffics; While travelling or fishing, fishmen's boats may collide with these construction machineries, thus accidents may happen. The risk is assessed to be moderate because the water surface to be occupied by dredgers is only localized and limited in each period of time; furthermore, dredging

corridor only occupy parts of the river width.

f. Use of child labor and forced labor

To reduce construction costs, child labors can be used for some jobs that do not require qualifications (according to Vietnam's regulations, child is under 15 years old). Due to limited knowledge, children can suffer from labor abuse that affects their psychology, health and ability to learn. However, the impact is assessed to be low as: (i) The experience with the Bank-financed and state budget projects show no cases of child labor or forced labor; (ii) According to the socio-economic survey results, no case of child labor or forced labor use was recorded; (iii) The Contractor need to commit for not hiring child labor for the project-related jobs; (iv) The project Owner will coordinate with local authorities and related units to strictly control the Contractor's labor use; (v) Commitment not to use child labor is one of the required conditions in the bidding documents.

g. Labor disputes and hard-working conditions

The Project's workforce will include direct workers (directly employed by PMUW), contracted workers (recruited by third parties such as contractors or as consultants), and primary supply workers. The project is not likely to engage community workers, as civil works will be the responsibility of contractors.

- ***Direct workers***

The Project direct workers are workers directly employed by the PMUW. The PMUW is responsible for the management and supervision of overall implementation of the Project, including construction work by the contractors. The PMUW will require support from the consultants in specific technical areas (i.e., in project management and coordination, financial management, procurement, construction, environmental/social safeguards, monitoring and evaluation, among others).

- ***Contracted workers***

The PMUW will engage around 8 contractors, which may mobilize subcontractor, for carrying out the implementation of the different works in North – South and East – West corridors and supervision contractors and independent monitoring consultant.

- ***Primary supplier workers***

The construction work under the Project will require primary supplies essential for the functions of the priority infrastructure, such as construction materials including aggregates, bitumen and precast concrete interlocking blocks. Where the contractor will source such materials directly from primary suppliers on an ongoing basis, the workers engaged by such primary suppliers are deemed "primary supply workers", as defined in ESS2. The number and type of primary suppliers will be determined at project implementation stage. The timing of labor use of primary supply workers will cover the construction stage of the project (see Chapter 1 for more details on primary supply workers).

- ***Community workers***

The project will not have community workers as defined under ESS2. The community members to be engaged by the contractors will be categorized and managed as "contracted workers".

- ***Other stakeholders working in connection with the project***

Stakeholders working in connection with the Project other than the above project workers will include the Government civil servants. Some city and provincial government civil servants will be working in connection the Project, which will include DOC, DARD, DONRE, DPI. They will remain subject to the terms and conditions of their existing public sector employment,

which are governed by the Vietnam Labor Code, the Law on Public Employees, and the Law on Civil Servants. There will be no legal transfer of their employment or engagement to the project. The Constitution and the Labor Code prohibit child labor and forced labor. The government civil servants involved in the Project are not expected to be exposed to OHS risks under the project as they will not engage in project-related civil works.

- ***Total number of workers***

The total number of workers is estimated at 390 who will work directly at the construction sites.

The impact level of above risks is assessed to be low because: (i) the impacts are localized within the construction site and scattered in the local areas; (ii) short construction period per each segment; (iii) workers are provided with protective equipment, reasonable construction time; (iv) mitigation measures for these risks have been provided in the ESCOPs in ESIA and workers will be trained on labor safety, traffic safety, sanitation before starting any civil works.

h. Gender based violence (GBV)

The concentration of 20-50 workers at each construction site with about 80% men and 20% women may cause social disturbance, affecting women directly work on the construction site or those living surrounding the project area and their families in the course of construction. For the previous similar works, unmarried women may be disadvantaged in getting married or they may become single mom. Meanwhile, married women can be affected with the happiness of their families. In addition, they may be infectious to communicable diseases, social diseases such as HIV/AIDS, syphilis, etc. (that may affect the next generation). This impact only takes place during construction of works items. However, the impacts on women are assessed as low because: (i) According to the socio-economic survey results, no negative impacts related to women were recorded. At the construction sites: (ii) The number of women workers is not large as local workers are prioritized by the Contractor; (iii) Information about social diseases and prevention methods will be provided to workers through training programs and information disclosure; (iv) Regulations, penalties for the violated workers at the site must be developed; (v) The contractor must be closely work with local authorities to manage the number of workers at the construction site; (vi) The application of worker code of conduct in the construction site will be applied and strict controlled by the Contractor as well as CSC to prevent GBV and SEA.

5.4.1.9. Occupational Health and Safety

The following are the occupational health and safety (OHS) risks that are predicted and assessed in the dredging areas.

With regards to working conditions, workers OHS issues can be from falling into water or even drown when working on water surface/ river due to sickness or loss of balance. In addition, they may also be in contact with materials containing hazardous such as oil, etc. If in direct contact, the short-term health effects could be irritation to the skins or respiratory system while some substances may penetrate through skin and go into body system. Accumulation of workplace hazardous could lead to more long-term health isues.

Other OHS issues related to working conditions would be not enough lighting or inappropriate protection when working in specific conditions or locations.

Working with construction electrical or diesel tools and equipment (e.g., barges, sand pumps), the workers are also exposed to electrical shocks or burning. Extreme weather conditions are also contributors to OHS risks and issues. Strong wind and very heavy rains during storms in coastal areas may make the incomplete/temporarily build works and even construction plants become unstable, even displacement of some construction tools, equipment, materials left in open air leading to accidents to people nearby including the worker. Working for hours in very hot days also may cause exhaustion or even faint to the workers.

For the workers of the dredging as well as other work items, inadequate living conditions in workers' accommodation also led to health and safety issues. Illness related to water-borne diseases may be caused by not having enough clean water for use, lack of access to adequate sanitation facility, poor hygiene conditions at and around the camps. Living at construction sites, being away from home for long durations, if the workers do not follow a healthy living styles but involving in fighting, drinking or prostitutions, they may also be affected with long term health impacts from these activities.

With regards to workers' behaviors, safety risks may come from the worker's awareness and attitude towards the use of Personal Protective Equipment (PPEs) and personal behaviors at construction sites. About PPEs, usually the workers of larger and more experienced contractors are usually well-trained on EHS and provided with adequate PPEs thus they usually follow stricter safety rules at construction sites. However, the workers of smaller/local contractors on use of PPEs (e.g., used as life jackets on rivers) at construction sites to be dependent on the level of enforcement. Examples of worker's careless behaviors that may lead to accidents or even hazard at construction areas including smoking near flammable materials such as oil tanks, careless handling of electrical wires, unauthorized operation of construction plants.

With regards to working conditions, workers OHS issues can be from exposure to pollutants. While the Project would not generate toxic substances, the main pollutants that the workers may be exposed to the most is dust at construction sites, especially during extensive excavation in dry season. In additions, they may also be in contact with materials containing hazardous substances such as oil, solvents, paints, concrete etc. If in direct contact, the short-term health effects could be irritation to the skins or respiratory system while some substances may penetrate through skin and go into body system. Accumulation of hazardous substance through works life would lead to more long-term health serious health impacts thus should be avoided.

Some workers may have to work high above the water – on top of poles or at/under water. The others may have to use electrical/diesel tools for works such as welding. If they are not adequately trained or safe access and PPE is not provided, accidents may happen to the workers causing long-term serious health impacts or even fatalities.

Other OHS issues related to working conditions in road construction would be not enough lighting or inadequate protection when working in specific conditions or locations. Working at night without adequate lighting could be the cause of an accident for the workers if the pipelines are installed at nighttime. Working with construction electrical or diesel tools and equipment (e.g. welding machine), the workers are also exposed to electrical shocks or burning.

Extreme weather conditions can also cause OHS risks and problems. Strong winds and heavy rain during the storm in coastal areas can cause uncompleted/ temporary construction works, over-altitude work, underwater construction, construction with bulky components, even shifting some tools, equipment, construction materials left outdoors leading to accidents for people, including workers. Working hours on very hot days, high outdoor temperatures can also cause exhaustion or even fainting for workers.

For workers building bridges and local roads, inadequate living conditions in workers' accommodations also lead to health and safety issues. Water-related diseases due to insufficient clean water for use, lack of access to adequate sanitation facilities, poor sanitation conditions in and around the camps.

With regards to workers' behaviors, safety risks may come from the worker's awareness and attitude toward the use of Personal Protective Equipment (PPEs) and personal behaviors at construction sites. About PPEs, usually the workers of larger and more experienced contractors are usually well-trained on EHS and provided with adequate PPEs thus they usually follow stricter safety rules at construction sites. However, the workers of smaller/local contractors on

the use of PPEs at construction sites tends to be dependent on the level of enforcement. Examples of worker's careless behaviors that may lead to accidents or even hazard at construction areas including smoking near flammable materials such as oil tanks, careless handling of electrical wires, unauthorized operation of construction plants, careless treatment of wires, unauthorized operation of construction plants, carelessness when working at high altitudes, construction of bridges in the middle of the river, construction of bored piles, assembly of bulky components.

In general, risks related to occupational accidents at the site are low and mitigable by suitable solutions such as (i) trainings on labor safety before and during the construction process; (ii) providing adequate PPE for workers, meeting ESS2 requirements; (iii) applying worker code of conduct; and (iv) conducting worker orientation and education before starting their works at the construction sites.

5.4.1.10. Community Health and Safety Risks -

- ***Dredging works***

The dredging works will impede the navigation, increase the risk of traffic accidents and injury to local fishermen.

For dredging means: dredging machinery and equipment occupy part of the water surface area, obstructing waterway traffic, leading to boat crashes. This incident can occur at any time during the construction process, damaging not only properties but may also lead to losses of human lives

Waterway transport accidents may occur due to overloading of boats and barges, leading to shipwreck and oil spill; The risks of waterway traffic accidents would be higher when boats or barges encounter waves, storms and floods or collide with other boats on rivers. Overloaded vehicles or failure to comply with regulations, damaged signing lights would create danger, traffic safety risk and potentially accidents, wound or even fatal for traffic participants.

The dredging in Mang Thit, Cho Lach, Rach La, Ky Hon canal is carried out under successive method, and at the same time, the area at both ends of the river route is wide (despite high density of boats), the middle-river area is narrowed down and there is no navigation activity. Therefore, the risk of traffic disturbance and waterway traffic accident is low, if occurring, it is only localized and can be mitigated.

Activities from worker camps will generate wastewater, domestic wastes, this may lead to environmental pollution, affecting public health. These issues may also lead to conflict between workers and local community.

Concentration of workers can cause social disorders and pose social problems such as gambling, drug, prostitution. Besides, workers living in camps located in or near residential areas, which can cause conflicts with local people because of uncollected and untreated wastewater and wastes, causing adverse impacts on local communities such as odors, landscape visual and health impacts, etc. The labor influx may increase the risks of Gender based Violence and sexual exploitation and abuse (SEA).

However, the impacts on community health and safety are assessed to be low because (i) construction period for each section is not too long (about 6 months); (ii) Project Owner/ Contractors prioritize to hire local labor; (iii) workers are trained on labor safety and environmental sanitation before starting construction; (iv) the consistent application of worker code of conduct in the construction sites; and (v) the site worker camps is located far away from the local communities.

❖ ***Embankment, bridge and local roads construction***

The traffic disturbances and higher risks to traffic safety also contribute to risks to community safety and social disturbances. In addition, potential risks in bridge construction areas such as bridge abutments, piers and access roads on both sides may affect the daily lives and health of people around the project area or traffic participants. Safety risks for the community at the bridge construction site include:

- Material drops from the height when boats or people pass through the area under the bridge construction site;
- Accidents take place during operation of construction machinery, excavation and embankment or when local people access the site;
- Roads become muddy due to construction activities, posing the risk of traffic accidents for heavy trucks carrying bulky components, concrete mixers when travelling on the roads access to the site;
- Risks of traffic accidents and falling down the river in the course of demolishing existing bridge;
- Traffic safety risks on existing bridge during construction of a new bridge at Cho Lach that are parallel to and near the old ones: residents are distracted while travelling as they focus on the construction activities, material drops from the construction site, or broken bulky construction equipment;
- Exposure to dust, exhausted gases, noise, vibration, wastes, etc. from construction activities: Roadside households would be disturbed by dusts, noise, vibration temporary reduced accessibility to their houses which are located along the road. These impacts may make the affected families change/modify their routine activities as studying (of children), cooking, eating and resting, entertainment.

The risks on residential areas and nearby residential communities are assessed as moderate, and only in certain periods of the construction phase and minimizable by taking construction appropriate measures and plans.

5.4.1.11. Risk from COVID-19 pandemic

The project will be implemented under the continued COVID-19 pandemic, high risks of COVID-19 infection among workers andcommunities who may come from other regions/cities/provinces or countries and local community.

Delivering civil works projects requires the assembly of a workforce, together with suppliers and supporting functions and services, and may lead to congregations of a large number of people. The project may have a workforce from international, national, regional, and/or local labor markets and require workers to live in site accommodation, lodge within communities close to work sites, and/or return to their homes after works. There may be the regular coming and going of support services, such as catering, cleaning services, equipment, material and supply deliveries, and the interaction with specialist sub-contractors bought in to deliver elements of the works.

The potential for the spread of coronavirus infection by projects is high. In addition, projects may experience large numbers of the workforce becoming ill and will need to consider how they will receive treatment, and whether this will impact on local healthcare services, particularly when projects are in remote places where local healthcare facilities could be easily overwhelmed. The presence of international workers, especially if they come from countries with high infection rates, may also cause social tension between the foreign workers and local populations.

The risk level of COVID-19 pandemic in the project areas is moderate because (i) the outbreak

of COVID-19 in the country is under control, (ii) all citizens are aware of the consequences of COVID-19 as well as the importance of 5K methods issued by Ministry of Public Health to prevent the infection of disease; (iii) strict compliance with the government regulation in coronavirus prevention and control must be followed by the PMUW and contractor.

5.4.1.12. Risks and incidents during construction phase

❖ ***Fire and explosion incidents***

Fire and explosion incidents may pose the risk of fire or explosion. This kind of risk can stem from the following causes:

- Fire and explosion can occur when transporting, storing, handling or filling fuel (gasoline, oil, etc.) or due to the unsafety of the fuel supply system, power supply to machines and equipment;
- Sources of fire: cigarette butts, the collisions leading toelectric sparks which contact stored fuels, especially flammable fuels such as gasoline, oil, etc.;
- Short circuit, lightning: Power transmission lines may be damaged at the joints or cover due to long-term use, causing circuit breakage or electrical overload that may result in heat generating, causing fire;
- Fire and explosion due to improper storage of raw materials, fuel that fail to ensure fire safety;
- Fire and explosion due to the operation of construction equipment using diesel oil. The main reason is due to failure to comply with the requirements on fire fighting and protection, throwing cigarette butts into flammable materials, electric shock, ignition in the heating process, etc.

In general, the fire and explosion are likely to happen every time and everywhere in the course of project implementation. Once happening, these incidents will cause impacts on people and properties and serious impacts on environment, specifically: (i) Fire and explosion will affect workers' health, even threaten people' life, leading to other consequences to the victim's family; (ii) Damage assets, technical infrastructure and disrupt the construction process, accompanying typical impacts on the environment and workers at the construction site; (iii) C-Fire and protection will lead to the disperse of pollutants, threatening the natural environment in a wide scope. Of which, the associated impacts of fire will generate a series of the combustion products such as CO, CO_2, NO_x, etc., causing serious impacts on air quality in a wider scope.

This type of risk is assessed to be Moderate and can be avoided by appropriate mitigation measures as described in ESCOPs to be presented in Chapter 6.

❖ ***Fuel and Oil Spills***

Hydrocarbon spillage may take place during dredging, mainly from the transportation, storage offuel for the operation of equipment, machines and vehicles in construction activities, especially marine construction means as barge, canoes, Grab Dredgers, etc. Oil spills could occur due to ships/boats collision, oil-based incidents or the subjective awareness of workers at the site in the course of transportation, oil feeding for equipment, machines or improper management of wasted oil and other oily solid wastes. For the construction phase, the oil leakage and spill will cause serious impacts on water quality and local ecosystem in the project area.

If an incident occurs, its impact is significant, causing water degradation, affecting the self-cleaning ability of water; affecting habitats of aquatic plants and animals; affecting aquaculture activities; causing economic impact and environmental degradation. The impact is long-lasting and the environmental resilience compared to the status quo is low. However, the possibility of this type of incident is low and such incident is mitigable via appropriate measures, especially

via the readiness of contingency plan for this type of risk. Therefore, the level of risk for this risk is assessed to be low.

- ***Localized flooding***

Risks of localized flooding and inundation due to heavy rains, demolition volume of old works, new construction volume, and the construction progress may affect local people in the surrounding area and employees at construction sites, especially when construction items are planned in the rainy and stormy season from May to November every year. Causes of localized flooding: (i) the embankment along access roads, new bridge construction, local road along the waterways could block the existing drainage route. Rainwater flows from the bridge to both slope sides and the bridge feet; (ii) when the volume of drilled sludge or solution is excessive during the construction process; (iii) the river flow is narrowed to serve the construction of bridge abutment. However, this risk potential can occur in rainy season or high tide condition, therefore, its level is assessed to be Low and minimizable through construction plans and appropriate mitigation measures.

- ***Landslide and subsidence***

There are risks of soil subsidence and landslide at bridge abutments, piers, along access roads, local road and embankment works during construction. Soil subsidence and landslide during the construction may impair properties of contractor and local people. More seriously, it also causes safety risks to the workers and local residents. The risks are Low because (i) access roads of bridge are consistent with the transport system, existing roads, and compliance with the planning. (ii) the embankment and local road sections are carried out on the base of current routes; (iii) the ground where the bridge, local roads and embankment sit isn't soft. These impacts can be controlled and minimized by complying with strict construction Environmental and Social Codes of practices (ESCOPs), which will be covered in the next section of this report. When constructing bored pile, either in land or underwater, there is also risks that borehole wall collapse due to warping and deformation of the wall pipe, etc. However, this is a technical issue which can be avoidable by relevant construction methods to be applied by the Contractor.

5.4.2. Site-specific impacts

5.4.2.1. Impacts of excavated and dredged materials

a. Volumes and quality of dredging materials generated

The estimated total volume of materials dredged and excavated from 2 corridors is 4,515,510 m^3, including 2,355,000m^3 from Mang Thit river, 1,240,000 m^3 from Cho Lach canal, 614,510 m^3 from Rach La canal, 50,000 m^3 from Ky Hon canal, and 256,000 m^3 from Tac Cua river. The dredged materials would comprise of mud, dust soil and low-plastic organic soil with grayish-black color and seashell.

The relatively large volume of excavated materials and soil will require land areas for storage or disposal. As studied in 2017, the content of heavy metals including Cu, Pb, Cd, Zn, Hg in the sediments in the dredging areas were lower than allowable limits in QCVN 43:2011/BTNMT - National Technical Regulation on Sediment Quality and QCVN 07:2009/BTNMT - National Technical Regulation on Hazardous Waste Thresholds.

Suitable land areas would need to be defined for the storage and disposal of the materials with volume and quantity discussed above. As the barges would be used to store and transport the dredged materials to the disposal sites, there will be some related impacts and risks on waterway transport and these are discussed in a separate subsection. The potential socio-environmental impacts and risks at the disposal site areas are discussed below.

b. Impacts and Risks at Disposal Sites

In general, around 4.5 million cubic meters of dredged materials requires a considerable land area for storage and disposal. The Project has identified disposal sites for the storage and disposal of such materials as mentioned in Chapter 3. At any single disposal site, there will be the following main potential socio-environmental impacts and risks:

- ***Leakage wastewater generation and impacts***

After being pumped from the barges to a disposal site, the wet dredged materials will settle down gradually and water will be drained from the material. Leakage water will flow out of the dump following gravity. Experience from other dredging projects[26] shows that the ratio of sandy mud - water in the dredged material is 8:2, which means water make up 20% total dredged volume. This proves that the leachate volume is quite large. If not controlled properly, leakage water may cause localized flooding at the surroundings of the disposal sites. This leakage water may contain relative high turbidity (fine materials from dredged materials), causing sedimentation in the drains and receiving water bodies.

- ***Overflow/spreading of dredged materials to the surroundings***

Each disposal site would have specific design height of the dump and containment area. When the disposal materials are dumped at the edge or top of the dump, material may overflow to outside the boundary of the disposal site. On the other hand, the slopes formed at the dump site may be collapse under the load, materials would then fall outside the designated areas, covering vegetation cover or fill up the existing infrastructures or even accidents for human beings.

- ***Safety risks to local communities***

As the barges would be parked at some distance from the final disposal sites, pipelines would be installed for leading the materials to the disposal sites. The pipelines themself and the wet materials when flowing out of the pipes would pose safety risks to local communities, such as people hitting the pipes for some reasons or failures of pipes leading to accidents to the people being presence nearby. After being disposed of, it would take sometimes for the materials/ground at the final disposal site to become stable after most of the moisture/water is drained from the dredged materials. If somebody walks into the unstable disposal areas, there is a risk of drowning.

- ***Water runoff from the sedimentation pond in the disposal site***

At the disposal sites, there will be sedimentation pond, also called sediment traps, formed by excavation and/or an embankment to intercept and retain sediment-laden runoff from a the newly dredged materials for a sufficient period of time to allow the majority of sediment to settle out prior to being released from the site. They may be constructed to handle mass grading runoff from the newly dredged materials as well as rainwater runoff from the disposal sites. Proper use of these structures can greatly reduce sediment transport off-site; if properly designed, installed, and maintained, sediment removal efficiency of 80 percent or greater can be achieved, depending on soil particle size. Sediment traps are often temporary and usually decommissioned after the disturbed area is stabilized.

In general, the above risks are at assessed at low and can be mitigated by the mitigation measures presented in Chapter 6 and DEMP in Annex 1.

5.4.2.2. Water Quality Reduction

Dredging activities would potentially cause significant adverse impacts on water quality.

[26] The Port 7&8 constructions investment project under the Container Long Son Port, Nghi Son town, Thanh Hoa province

Surface water quality would be reduced due to increased suspended solids (TSS) resulting in increased turbidity when the water column is disturbed by dredging, oil and grease may also be increased if there are leakages from the barges and dredging equipment.

a. Turbidity and Total Suspended Solids (TSS)

Dredging would result in increased water turbidity due to the disturbance and dispersion processes of fine and suspended substances from the mud and sediment into river water. The causes of turbidity increase by dredging are:

- Part of dredged materials may drop out of the bucket and spread in water while the bucket is moving from the river bottom to the water surface;
- Bottom mud is disturbed, diffused and scattered from the river bed into the water;
- Turbid leakage water from dredged materials in the gathering areas may return to waterways.

❖ ***Materials Dropping and Spreading***

In the SWLC Project, the Cutter suction dredge is the preferred option for dredging. According to the river/sea Dredging Assessment Manual[27], when using the dredger, bucket, scraper or barge to dredge 1m^3 of materials, 0.3 - 0.4 kg of sediments may be dropped out. With an average of 4.5 million m^3 of dredged materials, it is estimated that about 1,354 – 1,806 tons of material will fall back into the river. These materials will be spreading along the dredged areas, causing increases in water turbidity before they resettle at the bottom of the river.

❖ ***Materials Diffusion and Scattering***

The extent to which the disturbed mud from the bottom layer may diffuse and scatter (thus affecting turbidity) mainly depends on the geological structure of the riverbed and dredging methods. Water would be less turbid when dredging sand layer than the sand mud layer; Using buckets would cause higher turbidity than suction boat.

The composition of dredged materials is mainly muddy sediment in the form of flowing clay which can quickly scatter in the water once dropped, resulting in the increase of turbidity of water.

As cutter suction dredger will be used for dredging activities, the increase of suspended concentrations around cutterhead dredges is restricted to the immediate vicinity of the cutter, where concentrations may be as high as 10 gr/L within 3 m of the cutter; near-bottom levels of 100 to 200 mg/L may be found within a few hundred meters of the cutter. [28]

Dredging activities will disturb sediments associating the reduction of transparency and the increment of turbidity water, such impacts will bring about an overall impairment of the function of the ecosystem in the river. In addition, the drainage or spillage of pollutants from dredging machinery such as oil, petroleum, chemicals and wastewater may incur adverse impacts on aquatic flora and fauna. In most cases, sediment re-suspension is only likely to present a potential problem if sediment is moved out of the immediate dredging location by tidal processes. The water of the river and all canals is only used for irrigation so the sedimentation in water is not a significant issue, however, in case of dredging in Mang Thit river, Cho Lach canal, Rach La canal, Ky Hon canal, there might pose a risk of polluting the water quality of such waterways due to the dispersion of sediments from the dredging. To assess the impact of dredging to the water quality, the distance of dredging material spreading due to dredging activities is estimated as follows:

[27] Ministry of Transport, Japan in 1982
[28] L.C. van Rijn , Turbidity due to dredging and dumping of sediments, 2019

The average water flow of Mekong river is from maximum 12 m^3/s to minimum 2 m^3/s during dry season (Jan to Sep), there is little likelihood that re-suspended sediment will be transported to the wider environment. In general, the effects of suspended sediments and turbidity are generally short term (<1 week after activity) and near field (<100 m from activity place) according to (Bray, Bates & Land 1997)[29]. In deed, the highest velocity of water flow measured by Pre-FS consultant during dry season is 0.48 m/s, according to (Barnard, 1978)[30] the mean particle settling velocity can be approximated using Figure 5.2.

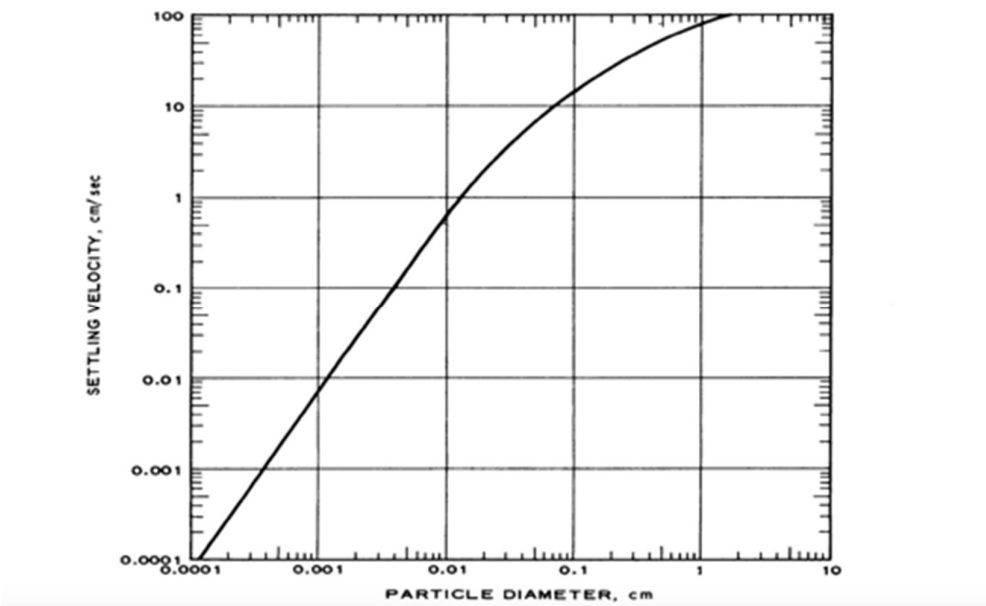


Figure 5.2. Settling velocity versus mean particle diameter

As forecasted in the preliminary draft FS report, the particle size of dredging material in Mang Thit, Cho Lach, Rach La, Ky Hon river/canal is 0.1 mm on average. The settling velocity of particle is estimated as 20 cm/sec. With the depth of dredging at -2.5 m, the suspended particle will be settled in 125 sec. Accordingly, the horizontal spread of the dredging material will reach to 60 m downstream, under the condition of the water flow velocity of 0.48 m/s corresponding to the maximum flow of 12 m^3/s. Therefore, the impact of dredged materials will be estimated to be within 60 downstream.

Turbidity levels around dredging operations can be reduced when necessary, but not without appreciable cost, by improving existing cutterhead dredging equipment techniques (large sets and very thick cuts should be avoided), using watertight buckets and eliminating hopper dredge overflow, or using a submerged overflow system. The dispersion of near-surface turbidity can be controlled, to a certain extent, by placing a silt curtain downstream or around certain types of dredging/disposal operations. Under quiescent current conditions (<0.1 m/s) turbidity levels in the water column outside the curtain may be reduced by as much as 80 to 90 percent. Silt curtains cannot be used in conditions with currents larger than 0.5 m/s. In muddy conditions, the overflow can reach values up to 30% of the total volume of sediment pumped into the hopper and may cause significant environmental problems. This impact is assessed to be moderate and will be managed by appropriate measures.

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[29] Dredging: a Handbook for Engineers, R. N. Bray, A. D. Bates, J. M. Land 1997

[30] Prediction and control of dredged material dispersion around dredging and open-water pipeline disposal operations, Barnard, William D. 1978

b. Dissolved Oxygen (DO)

DO in water may be reduced as the consequence of increased turbidity. As mentioned above, photosynthesis of phytoplankton and algae would be reduced in the dearth of oxygen. Meanwhile, as respiratory systems of aquatic organisms keep working and consuming oxygen, the dissolved oxygen in water would be reduced. Since the farthest distance that dredging can affect turbidity and TSS is about 500 - 600m from dredging location, the risk on DO reduction is short term, temporary and very low. Thus, the impact on DO is assessed at moderate due to (i) the short time of dredging activities at each dredging location and (ii) there is not endandered aquatic species or with high values in the dredged waterways.

c. Oil and Grease

Certain amount of fuel and oils would be stored on the barge or other dredging materials and plants. Some oil and greases may also be leaked on the surface of the barge during operation. Rainwater may wash such leakage oil and grease down into the river/canals, affecting the river water quality. However, this risk is considered to be low and manageable because fuel is usually stored in closed containers and the volume of fuel stored on the barges is usually limited. The concentrations of heavy metals in sediment are low, within allowable limits, so there should not be an issue in liberation of heavy metals to the water column during sediment removal.

Despite localized risks, river water quality greatly links with the health of aquatic species and aquatic ecosystems. For all the above reasons, the impacts on water quality is assessed to be Moderate and can be mitigated through relevant construction methods and workplan of the contractors.

d. Impacts on domestic water supply activities

As a source for supply water treatment plants for local people along Mang Thit river at segment flowing through Vinh Long province, water quality reduction can pose negative impacts on the quality of input for two supply water treatment plants as described in section 3.1.6. However, the locations of these two plants are far away from the construction and dredging sites in Mang Thit river. Specifically, (i) Vung Liem water supply station in Vung Liem town, Vung Liem district is 15km away from the construction and dredging sites in Mang Thit river and (ii) Cai Nhum supply water plant in Cai Nhum commune, Mang Thit district 7.5 km from the construction and dredging sites in Mang Thit river. Additionally, scattering model of sediment as mentioned in item (a) showed that maximum concentrations of suspended solids which are scattered from dredging will decrease rapidly to background values within 60 m to the downstream of dredging locations. Therefore, there is no impacts on these two supply water plants.

5.4.2.3. Risk and incident from dredged materials

About 4.5 million cubic meters of dredged materials will be generated. As the contents of heavy metals in the sediment are within QCVN 43:2017/BTNMT – National Technical Regulation on Sediment Quality, the materials can be stored for beneficial use. Land areas will be needed for the storage of these materials.

There will be impacts and risks associated with dredging, transportation, handling and disposal of material storages in the dredging process:

(i) Spill and Erosion risks. When the dump is significantly higher than the surrounding ground, dredged material may spill downslope into the surrounding areas, filling up vacant or production land, cover vegetation or infrastructure, affecting people's livelihood and agricultural production activities; Barren soils exposed to air and wind may also lead to increases in erosion potentials.

(ii) Localized flooding risks. Materials disposed of at the disposal site may interrupt existing drainage pattern. Rainwater will overflow on top of the materials then run downslope to the surroundings and may cause localized flooding. On the other hand, after the wet material is pumped into the disposal site, leakage water will be drained out. It may contain high turbidity thus it would cause water quality reduction of the receiving water bodies, affecting the growth of aquatic species;

(iii) Depending on the height of the dump, the disposal sites may block the views or access of nearby houses and structures.

The potential risk mentioned above is assessed to be moderate because (i) the total volume of dredged materials are collected from many segments on different waterways including Mang Thit, Cho Lach, Rach La, Ky Hon, Tac Cua river/canal and will be transported immediately to the disposal site, therefore the volume of dredged material at each location is not large; (ii) the components of dredged materials are not hazardous; and (iii) a stand-alone DEMP will be developed and controlled by the contractor for all the dredging works. The impacts can be mitigated by relevant construction methods and management plan of the contractors.

5.4.3. Impacts on Sensitive Receptors

The construction of the project's works may impact on some sensitive receptors located along Project's canal/river and near the construction areas, including the inconvenience of local people's travel by both waterway and road; Emissions and dust can become a nuisance for local people and cultural activities; Risks of traffic safety and accidents related to works. The survey results show that the project's construction activities can affect some sensitive receptors along the canal/river due to transportation of construction material and waste disposal. The impact level is assessed to be Low, temporary and mitigable. Receptors within the radius of 200 - 500 m around the project area are described as follows:

Table 5.30. Impacts on sensitive structures

Sensitive receptors	Descriptions	Impacts
Mang Thit river		
 Phat Tanh pagoda	- Located near the proposed disposal site No.1. - Worship and ceremonies mostly take place on the first day or full moon day	- Dust and emissions - Noise and odor - Obstruct people's approach to the pagoda on both road and waterway. - Risk of community conflict
 Tra On Protestant Church	- Located on the right bank, at the dredging and bend correction section Km0+700 to Km 1+100 - Worship and ceremonies mostly take place on Sunday.	- Dust and emissions - Noise and vibration - Risk of community conflict
	- Located on the right bank, at the dredging and bend correction section Km0+700 to Km 1+100. - Worship and ceremonies	- Dust and emissions - Noise and vibration - Obstruct people's approach to the pagoda on both road and waterway.

Sensitive receptors	Descriptions	Impacts
Nhi My pagoda	mostly take place on the first day or full moon day.	- Risk of community conflict
 Huong Duong Kindergarten	- Located on the left bank, at the dredging and embankment section from Km9+500 to Km 17+200. - Total area of about 400m^2 with 100 children, serving Tam Binh town	- Dust and emissions - Noise and vibration - Community conflict - Impact on extracurricular activities
 Tam Binh General Hospital	- Located on the left bank, at the dredging and embankment section from Km9+500 to Km 17+200. - Total area of about 3,000 m^2 with 130 hospital bed; 11 departments and 3 administrative units.	- Dust and emissions - Noise and vibration - Community conflict
 Luu Van Liet primary school	- Located on the left bank, at the dredging and embankment section from Km9+500 to Km 17+200. - Total area of about 4,800 m^2 with about 600 students.	- Dust and emissions - Noise and vibration - Solid waste - Traffic jams, traffic accidents - Impede the access of parents and school staff - Community conflict - Impact on extracurricular activities
 Tam Binh market	- Located on the left bank, at the dredging and embankment section from Km9+500 to Km 17+200. The market has an area of 1,500m^2, with about 30 business households Trading time is from 6h to 18h daily.	- Dust and emissions - Noise and vibration - Solid waste - Traffic jams, traffic accidents - Obstruct the access and trading activities of local people to Tam Binh market - Community conflict - Impacts on trading and goods exchange of local people
 Tuong Loc Church	- Located on the left bank, at the dredging and embankment section from Km9+500 to Km 17+200 - Total area of about 500m^2 - Worship and ceremonies mostly take place on Sunday.	- Dust and emissions - Noise and vibration - Risk of community conflict

Sensitive receptors	Descriptions	Impacts
 Tuong Loc B primary school	- Located on the left bank, at the dredging and embankment section from Km9+500 to Km 17+200 - Total area of about 600 m^2 with about 500 students.	- Dust and emissions - Noise and vibration - Solid waste - Impact on extracurricular activities
 Nhon Binh B primary school	- Located on the right bank, at the dredging and embankment section from Km9+500 to Km 17+200 - Total area of about 700 m^2 with about 450 students.	- Dust and emissions - Noise and vibration - Solid waste - Community conflict - Impact on extracurricular activities
 Xuan Hiep A primary school	- Located on the right bank, at the bend correction and dredging section from Km17+400 to Km 18+800. - Total area of about 400 m^2 with about 450 students.	- Dust and emissions - Noise and vibration - Impact on extracurricular activities
 An Lac pagoda	- Located on the left bank, at the bend correction and dredging section from Km17+400 to Km 18+800. - Total area of 7,000m2 with 4,000 Buddhist believers come and pray weekly. - Worship and ceremonies mostly take place on the first day or full moon day.	- Dust and emissions - Noise and vibration - Obstruct people's approach to the pagoda by waterway. - Risk of community conflict
Cho Lach Canal		
 Khung Le Kindergarten	- Located on the right bank, at the dredging and embankment section from Km0+000 to Km7+900. - 80m^2 with 50 kids. - Temporary closed due to COVID-19 disease.	- Dust and emissions - Noise and vibration - Community conflict - Impact on extracurricular activities
 Cho Lach protestant	- Located on the right bank, at the dredging and embankment section from Km0+000 to Km7+900. - Total area of about 1,500m^2 - Worship and ceremonies	- Dust and emissions - Noise and vibration - Risk of community conflict

Sensitive receptors	Descriptions	Impacts
church	mostly take place on Sunday.	
 Cho Lach cathedral	- Located on the right bank, at the dredging and embankment section from Km0+000 to Km7+900. - Total area of about 3,000m^2 - 468 believers come and pray every Sunday.	- Dust and emissions - Noise and vibration - Risk of community conflict
 Cho Lach General Hospital	- Located on the right bank, at the dredging and embankment section from Km0+000 to Km7+900. - Total area of about 10,000 m^2	- Dust and emissions - Noise and vibration - Community conflict
 An Tiem Kao Dai church	- Located on the right bank, at the dredging and embankment section from Km0+000 to Km7+900. Total area of 2,000m^2	- Dust and emissions - Noise and vibration - Risk of community conflict
Rach La Canal		
 Linh Chieu pagoda	- Located on the left bank, opposite with the second embankment section of Rach La from Km5+000 to Km8+800. - Total area of about 100m^2.	- Dust and emissions - Noise and vibration - Obstruct people's approach to the pagoda by waterway. - Risk of community conflict

5.5. IMPACTS AND RISKS IN THE OPERATION PHASE

5.5.1. Generic impacts

5.5.1.1. Dust and exhausted gases

When the new bridge Cho Lach 2 and local roads along Mang Thit river, Cho Lach canal and Rach La canal are put into use, the traffic flow rate will sharply increase. Thus, dust and gas emissions from the traffics on roads will affect the ambient air in the residential areas surrounding the project site. The impact is long term and will last throughout the operation phase of the new bridge and local roads, however, it is assed to be moderate because (i) the air quality in the area is quite good and has no sign of pollution (as shown in Chapter 3); (ii) tree lines along the road and large green zones planted in the project will help reduce the air pollution; (iii) people's awareness on limiting use of fossil fuels (petrol, oil, etc.) is raising, biogasoline (E5) and electric bikes are used more popular recently; (iv) the roads will be cleaned periodically by a professional and experienced unit under the management of the Provinces; (v) traffic and warning signs are established suitably for characteristics of each area.

5.5.1.2. Noise and Vibration

The sources of the noise from new bridge and local roads generated mainly from the transport means will affect the households living sparsely along the routes. The process of transportation will certainly generate noise on the roads affecting the living environment of surrounding residential areas. The noise levels of vehicles on the newly constructed roads affecting the surrounding environment at distances of 10 – 100 m are shown in the table below:

Table 5.31. Noise level of motor vehicles

No.	Vehicle types	Noise (dBA)	The noise level from the source (dBA)			
			10m	20m	50m	100m
1	Car	77	60.5	54.5	46.5	40.5
2	Minibus	84	67.5	61.5	53.5	47.5
3	4-stroke motorcycles	70	53.5	47.5	39.5	33.5
4	2-stroke motorcycles	73	56.5	50.5	42.5	36.5
QCVN 26:2010/BTNMT (in the period from 6 am-9 pm)		70 dBA				

The calculation results show that at the position 20m or more from the point source, the noise level is within the allowed limits of QCVN 26:2010/BTNMT (in the period from 6 am-9 pm). Exposure to prolonged or excessive noise has been shown to cause a range of health problems ranging from stress, poor concentration, productivity losses in the workplace, and communication difficulties and fatigue from lack of sleep, to more serious issues such as cardiovascular disease, cognitive impairment, tinnitus and hearing loss. However, the level of noise posed by the operation of the SWLC Project alone are within the permissible standard and occur mostly during day-time. Therefore, the impact of noise on the surrounding residents is assessed to be low.

5.5.1.3. Risks and incidents in the operation phase

a. Road safety and traffic accidents

Road safety is the main impacts in the course of local roads and new bridge Cho Lach 2. The roads with better surface will increase the speed of traffic vehicles. Excess and inappropriate speed are responsible for a high proportion of the mortality and morbidity that result from road crashes. It can be noted that the impact will be mitigated through raising people's awareness of regulations and practices on road use as well as monitoring and restriction of speed and behaviors of drivers. Therefore, the level of risk for road safety is assessed to be low.

b. Erosion and subsidence

During operation, there may be incidents: (i) erosion of embanked banks, cracks of Mang Thit river, Cho Lach canal, Rach La canal, Ky Hon canal; erosion in the abutments of the bridge Cho Lach 2; (iii) erosion and subsidence of the local roads along the waterways as well as embankment areas. These incidents will damage the embankment, bridge, road, infrastructure, cause death and affect assets of surrounding people, tourist and traffic participants. The risks are generated from (i) natural disaster, flooding and long-lasting heavy rain; (ii) construction activities that fail to meeting requirements on quality, technical and materials; (iii) overloaded transportation trucks on roads, bridges, embankments; (iv) irregular operation and maintenance. The risk is assessed low because the detail design will take consideration into the aspect to prevent threats to local community in the operation phase.

c. Natural hazards

There is growing concern about lifeline of the project components during operation (e.g., river embankment, public spaces and transportation systems) and their vulnerability to damage and disruption during major disasters, such as earthquakes and storms. However, the damage by natural hazards during operation is much lower than the ones to the works under construction because, the structures of the works have already secured. Similar to explanations for the risks of natural hazards during construction, but the damage intensity is far less, the risks of natural hazards during operation is assessed as low. Additionally, the risks of natural hazards could be controlled and prevented through design solution implemented during the detailed design of the project.

d. Risk of falling into rivers, canal and drowning

The risk can be posed when going up or down the road below the embankment or at the drainage culvert along the embankment, and travelling through new Cho Lach bridge. Then vehicles can be dropped into Mang Thit, Cho Lach, Rach La, Ky Hon, Tac Cua river/canal. Although in some sections, power coating steel handrail is installed with a height of 80-90cm. However, children and the elderly are in danger of falling into and drowning in rivers, canals due to slippery. This affects health or even causes life of traffic participants. Therefore, specific technical methods should be studied and added in the following stage and public consultation should be held. Thus, the design must take consideration into the aspect to prevent threats to local community in the operation phase, leading to the Low level of risk.

e. Waterway accident due to ship/boat collision

Accidents due to collision of ships transporting materials may occur in the following cases:

- Fog, unfavorable weather, thunderstorms, and storms;
- Vehicles traveling on waterways are not fully equipped with safety equipment and tools;
- The means of boats and ships travelling on the waterway do not comply with the regulations on waterway traffic safety;
- Inexperienced drivers.

It is extremely important for cargo ships to comply with safety regulations, requiring full equipment of warning, information and signal systems and strict compliance with regulations on inland waterway safety. Drivers must have the necessary qualifications and practicing certificates.

If risks or incidents occur, the impact is assessed to be significant due to:

- Impacts on the water environment in the canals in the project area, affecting the ecosystem due to the risk of the oil spill from vehicles.
- Causing economic damage to vehicle owners.
- Affecting the life and health of crew members.

However, the level of risk is assessed to be low because (i) there are new and additional signal buoys and navigational aids to be installed/replaced in the project area, giving more warning for the navigation of ships/boats along the river/canals; (ii) the provincial waterway police department implement their periodical check and observations to ensure the safety on the whole routes in the Project areas.

5.5.2. Site-specific impacts

5.5.2.1. Land use change around new bridge and along local roads

With a new wider and higher bridge as well as local roads along the waterways, the land use may change. Buildings and houses will be built replacing the existing rice fields, more people

including people from other regions will come to settle there. This impact has two sides, positively increasing the land value, promoting the development of local services and trading but negatively losing (i) the income of farmers who now are mostly elderly and women, the people will find more difficult to find a new job in urban areas; (ii) the rural tranquil landscape replaced by an urban dynamic landscape with noise, light and traffic vehicles and social evils such as gamble, stealing may arise. The adverse impacts are assessed as low and has been addressed through not only cast compensation but also income restoration programs presented in the RP.

5.5.2.2. Risk of river embankment collapse

The risk of collapse to the newly embankment along Mang Thit river, Cho Lach canal, Rach La canal work can happen although its occurrence is very low due to (i) extreme weather events that cause heavy rain, flooding and strong water current; (ii) induce impact from future construction work in the area (iii) waterway accidents among others. The collapse of embankment if occurred can cause severe loss of properties and life of local people and damage to the soil structure. Preventive measures should be put in place through the design, construction as well as operation phase.

5.5.2.3. Impacts on local forest

The new bridge, local roads as well as embankment system will help to develop the transportation network in the area, creating favorable condition for civil travel of local people. On the contrary, these works also create the possibility of easier entrance into the forest nearby, resulting in indirect impacts on the biodiversity in such forest. This impact is assessed to be low because (i) the nearest forest in at least 16-km away from the project sites, (ii) each forest has its own forestry protection department, (iii) local authorities with their provincial regulations and plan will help to protect and develop the existing forests.

5.6. CUMULATIVE IMPACTS

This section discusses the cumulative impacts of the project. In this regard, the cumulative impact is the incremental impact of the project when added to impacts from other relevant past, present and reasonably foreseeable developments as well as unplanned but predictable activities enabled by the project that may occur later or at a different location. This assessment focuses on the effects of concurrent construction and operation of the project with other spatially and temporally proximate projects to ensure that the cumulative impacts are identified and evaluated in the project area.

The discussion of impact severity and likelihood of occurrence need not be as detailed as for effects attributable to the project alone. The analysis of cumulative effects in this ESIA focuses on the effects of concurrent construction and operation of the proposed project with other spatially and temporally proximate projects as described below. As such, this cumulative analysis relies on a list of related projects that have the potential to contribute to cumulative impacts in the project area.

In this ESIA, it is considered whether the project construction and operation may contribute to cumulative impacts on the Valued Environmental and Social Components (VECs) on which other existing or future developments within or nearby the project area may also have detrimental effects.

The SWLCP includes the following works: (i) Dredging and bend correction; (ii) Embankment; (iii) Bridge construction; (iv) Local road construction; (v) Irrigation and drainage outlets replacement and installation; (vi) Navigational aids replacement and installation. Based on the detailed analysis and assessment of impacts and risks posed by the projects in the previous sections, the significance of most impacts from these works are assessed to be of Low level and

can be mitigated by relevant mitigation measures. Therefore, the cumulative impacts will be accounted for the dredging works on Mang Thit river, Cho Lach canal and Ky Hon canal.

CIA carried out for this project follows the steps as shown in Figure 5.2:

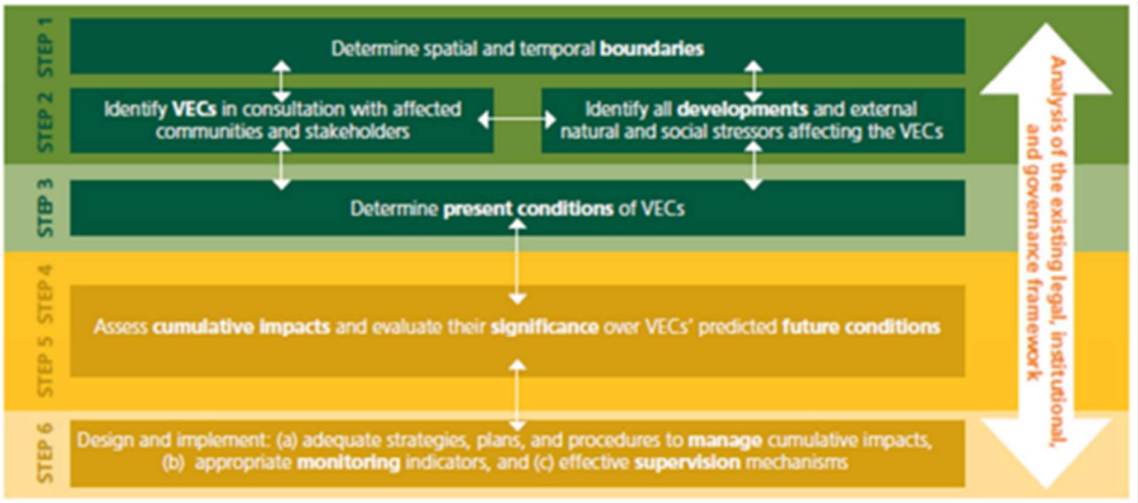

Figure 5.3. Cumulative impacts assessment procedure

5.6.1. Determination of spatial and temporal boundaries

5.6.1.1. Spatial boundary

The study areas of this CIA covers:

- Mang Thit river spreading through 12 communes/wards in Vinh Long province, including Tra On town, Thien My, Nhon Binh, Xuan Hiep (Tra On district), Loan My, Tuong Loc, Hoa Hiep, Hoa Thanh, Tam Binh town (Tam Binh district), Tan An Luong (Vung Liem district), Tan An Hoi, Tan Long Hoi (Mang Thit district).
- Cho Lach canal spreading through 3 communes/wards in Ben Tre province, including Hoa Nghia, Son Dinh, Cho Lach town (Cho Lach district).
- Ky Hon canal spreading through 5 communes/wards in Tien Giang province, including Long Binh Dien, Xuan Dong, Hoa Dinh, Song Binh, Cho Gao town (Cho Gao district).

5.6.1.2. Temporal boundary

The pre-construction of the Project is not accounted for in CIA discussion as no residual effects are expected. Therefore, the temporal boundaries set for this CIA include:

- Construction phase – approximately 26 months, starting in 2024 and progressing toward February 2026.
- Operation phase, starting from March 2026.

5.6.2. Identification of Valued Ecosystem Components (VECs), projects and natural stressors affecting VECs

As mentioned before, the CIA focuses on the dredging activities which potentially causes low to moderate impacts on environmental and social aspects and poses impacts that can potentially cumulate with impacts from other projects, plans, programs in the area. The VECs are determined accordingly, which are located within dredging sites.

5.6.2.1. Identification of VECs

A scoping has been conducted to identify the VECs for which cumulative impacts will be assessed and managed based on review of the recently completed and ongoing investments in

the project area to identify possible linkages and potential cumulative impacts of existing and planned projects. A list of potential VECs have been consulted with the affected communities and the local authorities. The final VECs and their rationales are described below:

- During construction phase: (i) waterway traffic safety: Given the crowded traffic on Mang Thit, Cho Lach and Ky Hon canal, together with local livelihood taking places on the waterway routes, the dredging works with additional equipment and machinery could pose higher risks of waterway traffic accidents and livelihood alteration of some local people living on the waterways; (ii) Water quality in Mang Thit river, Cho Lach river/canal and Ky Hon canal: In general, dredging will directly impacts on the quality of water, clearly shown in turbidity and total suspended solids parameters, resulting in the alteration of habitats of aquatic species in the area. These are the issues of concern by the local communities.
- During operation phase: (i) Water quality of Mang Thit river, Cho Lach canal and Ky Hon canal; and (ii) waterway traffic safety through Cho Lach 2 bridge.

5.6.2.2. Projects affecting VECs

Referring to table 1.3 for related projects in the area, all completed projects shall not be considered for CIA because most their major impacts originated from the construction activities, and there would be more positive impacts in operation phase other than in construction phase. Among the provincial plans, projects and development activities to be implemented in the study areas, projects which potentially contribute to the cumulative impacts in the area are described below:

❖ ***Upgrading Cho Gao Canal Project - Phase 2***

Cho Gao canal is the common name of a waterway with a length of about 28.6 km, passing through the territory of 2 districts of Cho Gao and Go Cong Tay in Tien Giang province and part of Long An province. Cho Gao canal is divided into 3 sections: Rach La canal of about 10.2 km long, Cho Gao segment of about 11.6 km long and Ky Hon canal of about 6.8 km long.

In 2013, the Ministry of Transport approved the investment project upgrading Cho Gao canal with a total length of 27.2 km, from Rach Tram to the Tien River confluence with standard grade II inland waterways. Phase 1 of the project was implemented in 2013 till 2016 with a total cost of 2,263 billion VND. Phase 1 of the project has dredged 17.2 km of the waterway to meet the grade II of inland waterways technical standard.

In 2020, phase 2 of this project was approved by Ministry of Transport under decision No. 1782/QD-BGTVT dated September 14, 2020 for further investment of Upgrading Cho Gao Canal project and this project is now being implemented for Cho Gao segment. This project includes dredging and widening of Cho Gao channel with total length of 9,85 km to reach a width of B=55m, navigational depth 3,1m. This project also includes construction of 9,85 km bank protection, two bridges Binh Phan and Quon Long and local road type B along the channel, auxiliary works. After completion expected in 2023, the channel segment will reach grade II width inland waterway through the entire channel and erosion at Southern bank shall be completely resolved. A segment of Cho Gao canal under severe erosion is shown in Figure 5.3.

This project bases on the same route of Cho Gao waterway together with Rach La and Ky Hon canal of SWLCP, but is conducted independently from the budget and plan by Ministry of Transport, therefore, it is not associated facilities. In addition, the phase 2 of this project for Cho Gao segment is estimated to end in 2023, before the construction phase of SWLCP, so it is a past project of SWLC Project.

Figure 5.4. A part of Cho Gao segment under severe erosion

❖ ***The socializing project of dredging, maintaining and upgrading Dong Tranh waterways and Tat Ong Cu – Tat Bai, Tat Cua to Go Gia river***

There are two river sections coinciding with SWLCP, namely Dong Tranh river and Tac Cua river. Vietnam Maritime Administration has issued decision No. 1026/QD-CHHVN dated October 24, 2014 regarding approval of Economic – Technical report on socialization of dredging and maintenance with following construction and investment scope:

- Dredging and embankment for 15.3km of Dong Tranh river and 6.4km of Tac Cua river. Total dredging volume was estimated to be 1,397,052 m^3.
- Navigation aids system: 26 signal buoy sets with diameter Ø=2m.

Figure 5.5. Dredging on Dong Tranh river in 2016

The Contractor for this project was Hai Hung Thinh Company. The project was implemented in early 2016 with thecompleted workload of 404.413 m^3 dredging, then suspended from December 2016 until now. Currently, Ministry of Transport and Vietnam Maritime Administration are preparing for further implementation of this project, starting from selecting competent contractor and issuing relevant clauses to avoid extra dredging resulting in bank erosion on both sides of the river. However, the contractor and also workplan for this project has not been selected/decided and there is no official information for the estimated continuance time of the project. Therefore, it is not accounted for CIA.

5.6.2.3. Natural Stressors affecting VECs

For dredging activities, heavy rain and high tides are identified as natural stressors affecting the identified VECs.

Heavy rain usually happens from September to January of the following year. Heavy rains may lead to increased traffic safety risks on the waterways due to reduced visions, blowing of big size objects from the land to the waterways, etc.

On the other hand, abnormal heavy rains and extreme weather as consequence of climate change may lead to increase erosion risk in some segment without embankment, adding turbidity to the water thus negatively affecting natural aquatic lives and aquaculture in the river. Respiratory capacity of some individuals may be impaired by the increased water turbidity from surface runoff. Aquatic lives in the Mang Thit, Cho Lach and Ky Hon canals would be affected the most by the natural stressors in the project area.

5.6.3. Determination of present conditions of VECs

Waterways traffic safety risks

The increased traffic density and the composition of the traffic fleet are considered as supplements for assessment of waterways traffic safety risks.

The region consisting of the Mekong Delta (MKD) together with the area located North-East of the Mekong Delta (NE-MKD) has a dense network of rivers and canals, and a large number of sea and river ports. The main connection between the MKD and HCMC is Cho Gao Canal. Cho Gao Canal, of which Ky Hon canal is one segment. The maximum allowable barge capacities on transport routes between Mekong-Delta and Ho Chi Minh city differ between the alternative routes. Container barge traffic now is infrequent and irregular and therefore there is no clear pattern of routes on that trade. Cho Gao Canal of class-II waterway is the constraining link on the routes to Mekong Delta. With current low traffic volumes in Mekong Delta, the use of smaller barges is more common. In addition, aquaculture of local people often causes restriction and sometimes incidents for the navigation of barges and other fleets on the waterways, especially with bottom-harvesting (đăng đáy).

Water quality

According to the monitoring results of surface water in the SWCL waterways, the surface water in Mang Thit, Cho Lach, Ky Hon river/canal is facing the pollution of organic compounds based on the concentration of COD, BOD and TSS in the tested samples that exceeded permissible standards regulated in QCVN 08-MT:2015/BTNMT (type B1). From site survey and consultation with local people, it is noted that the aquatic species in Mang Thit, Cho Lach and Ky Hon canal are not endangered species or having any special value. However, local people are using waterways for aquaculture and fisheries. Depending on the biological behavior, each aquatic plant and animal species dominates certain water layer. No species of flora and fauna in the study area listed as rare or vulnerable in Vietnam Red Book. There are some common fish and prawn such as tilapia, snakehead, catfish, anabas, shrimps, etc. The popular species on the routes are water hyacinth and similar fish species in the project area in addition to phytoplankton, crab, snail and eel species. Currently aquaculture on the on Mang Thit river is quite dense. Some households have been doing fish catching on the river to get supplement nutrients or incomes for their families.

5.6.4. Assessment of cumulative impacts and evaluation of their significance

5.6.4.1. Cumulative impacts in the construction phase

- ***Water traffic safety risks***

Currently, waterway traffic safety risks on the existing waterways in the project area mostly come from the navigation of barges and other fleet conflicting with aquaculture and fisheries happening at the same time on the routes. The extra dredging equipment and machinery on the routes at the same time will cause more restrictions to the daily activities of local people as well as safety of ships/boats. If the barges, ships, boats navigate in the same day with construction equipment, combined with the local aquaculture, traffic density would increase considerably in some sections in the project areas. Increased waterway traffic density would also lead to increases in traffic safety risks. Increased traffic density, dropping of dredging materials along the routes, awareness and health conditions of drivers would be the contributing factors to the cumulated traffic safety risks.

Waterway accidents may result in oil and chemical spill in the watershed, leading to the scope of impacts to increase significantly due to the quick dispersion of oil on the surface of water. Oil spills coat everything they touch and become unwelcome but long-term parts of every ecosystem they enter. If the oil washes into some wetlands, fibrous plants and grasses absorb oil, which can damage plants and make the area unsuitable habitat for aquatic species. When oil eventually stops floating on the water's surface and begins to sink into the riverbed, it can have similar damaging effects on fragile underwater ecosystems, killing or contaminating fish and smaller organisms that are essential links in the food chain. Even small amounts of hazardous substances released into waters can cause significant environmental damage with

far-reaching effects. These risks can be aggravated by increased frequency and intensity of extreme weather events like heavy rain or inundation. These accidents place significant pressure on emergency response services, governments, businesses, industry and communities. In addition, waterway accidents can result in injuries and even fatalities for human. Both crew working on board the ships and local people involved can suffer from the loss of possession, health and even their lives. The increased density of navigation caused by the transportation of dredging materials on the waterway to the dumping sites can be a factor to the level of traffic safety risk when at the same time, there can be more traffic passing through Cho Gao canal after improvement (in the middle of Cho Lach and Ky Hon segments). This cumulative effect is assessed to be moderate and can be avoided by relevant mitigation measures.

❖ ***Water quality***

During construction phase, water quality in the Mang Thit, Cho Lach and Ky Hon canals would mostly be affected by dredging activities as mentioned in previous sections. Besides, the denser traffic through Cho Gao canal after the completion of Phase 2 of Cho Gao dredging project can result in more pollutants discharging into the canal from people living/travelling/doing business on the whole waterways. There can be more organic compounds discharged into the water, leading to more serious water pollution in the area. As a consequence, the aquatic species in those waterways will be directly impacted due to the reduction of water quality as follows:

- The growth and productivity of *Phytoplankton as* the primary nutrient producers in the aquatic ecosystem would be constrained when water turbidity increased by dredging. This potential impact is localized within 500 m from dredging areas, temporary and reversible as turbidity would be resumed after 15 minutes since dredging is halted.
- *Zooplankton.* Some benthic some would die or be removed when their habitat is disturbed by dredging. This impact is not avoidable, happen mainly to the bottom layer, within the dredging corridor and recoverable naturally after about one year.
- Increase water turbidity and suspended solids may obstruct their respirations *Fish and Shrimps in the River.* CH_4 and H_2S[31] released from bottom mud when being disturbed may cling to their gills, hindering their respiratory process. However, fish and shrimps tend to be able to react and swim away from the disturbed areas. Therefore, the potential impacts of dredging on the fish would be low. However, if oil and grease is spilled into water during construction, that could be a source of acute toxic to aquatic species and deposit in foods of aquatic species, from low-level flora (algae, phytoplankton) to high level aquatic fauna (fish, etc.).
- Other existing aquaculture ponds located in the dredging areas would be mostly affected. Species in the cages could die or have reproductivity reduced as this area suffers the increased turbidity the most. However, this risk is assessed to be moderate as the impacts of dredging on each aquaculture pond is estimated to be between 25 to 30 days of construction per segment. Although water quality would be resumed after 15 minutes since dredging is halted, the operations of some aquaculture ponds may have to stop in one season or so.

In addition, water quality in the river would be further decreased with additional loads of TSS from the rainwater runoff in rainy season. However, pollutants in rainwater runoff can easily deposits and familiar to the local environment, therefore, the contribution of rainwater runoff can be minor.

In general, the cumulative effects on water quality would be not avoidable. However, the impact during construction phase is mostly limited within 500 m from the dredging corridor while

[31] According to secondary studies, the major gases are CH_4, and H_2S

surface runoff from construction sites may enter the river from other locations. The river is not a critical habitat, being modified substantially due to human activities especially with intense aquaculture. Too high turbidity of river water or oil spill incidents (e.g. when accidents happen on waterway during construction of the bridges) may lead to significant economic loss of the aquaculture farming households. As the result, the income of the affected households would be reduced, their livelihood may become unstable at some stage. Therefore, this cumulative effect is assessed to be substantial, but can be mitigated by appropriate measures.

5.6.4.2. Cumulative impacts during operation phase

- ***Waterway traffic safety risks***

During the operation phase, when dredging completed and the waterways are put into use, it will lead to easier and faster navigation of ships, boast, barges, etc. In addition, bigger fleet will be allowed to navigate on the upgraded waterway. With explanations similar to construction phase, traffic safety risk is an important issue to be considered and can cumulate with the denser traffic through Cho Gao canal, resulting in more accidents and incidents, potentially leading to loss of possession, injuries and fatalities. Therefore, this cumulative impact can be assessed to be substantial and can be avoided by suitable measures.

- ***Water quality***

From similar project, it is estimated that with the impacts of dredging, it would take 18 months to two years for the riverbed sediment be recovered. Meanwhile, dredging would not cause biodiversity reduction of aquatic species in the watershed. Improvements of water quality in the middle section of the river during operation phase would support the existence and growth of freshwater aquatic species in the river. Aquatic lives may be affected if river water quality is decreased due to leakage of oil and wastes from the ships and boats travelling along the river during operation phase, especially when there are more traffic through the Cho Gao canal, contributing to the overall traffic though Cho Lach and Ky Hon canals. Surface runoff at some sections would ultimately enter Mang Thit, Cho Lach and Ky Hon canals, contributing to the concentration of pollutants in the water. On the other hand, the rehabilitation of Mang Thit, Cho Lach, Ky Hon canal under SWLCP is expected to help improve river water quality in the dry season, providing a better living environment for aquatic species. Therefore, the cumulative impact on river water quality and aquatic species is regarded as “low” and mitigable.

5.6.5. Management and monitoring of cumulative impacts

5.6.5.1. Management and monitoring waterway traffic safety risks

In general, mitigation measures for the management of waterway traffic safety risks are mentioned in previous sections. Also, the design of each waterways already included the replacement and installation of navigation aids such as traffic lights and signs where needed for minimizing traffic safety risks during operation phase. During construction phase, traffic flow could be controlled and coordinated by traffic diversion where possible. Awareness raising, cares for the drivers to avoid being over tired or sleepiness to minimize materials dropping would also help to minimize traffic safety risks along transportation route during construction phase.

Currently traffic safety monitoring and management system has already been put in place. The force of Waterways Police under Traffic Police Department of Ministry of Police will be responsible for the assurance and management of safe navigation of vessels on the waterways. At the same time, when the new waterway is handed over, the provincial authorities would coordinate on waterway management including traffic control and safety monitoring.

5.6.5.2. Management and monitoring aquatic species

- ***In the Construction phase***

The dredging works should clearly describe the requirements on water quality management, minimizing the release of pollutants into the water. The dredging management plan to be carried out by contractors under the supervision of PMUW already proposed measures such as covering materials in order to avoid being washed away into the river, isolate oils and hazardous substances in closed containers. All construction sites should be required to strictly control surface runoff, minimizing earthworks in the rainy season and ensuring that sedimentation is trapped before the surface flow entering Mang Thit, Cho Lach and Ky Hon canals. Local authorities should enhance compliance monitoring.

- ***In the Operation phase***

The potential impacts on the turbidity of the Mang Thit, Cho Lach and Ky Hon canals is low as the river banks are partly embanked. It it is recommended that the provincial authorities should control the management of environmental issues posed by any future projects along the waterways. In addition, the province should also prepare and implement fishery and water resources management plan towards ensuring sustainability of these resources.

Currently, water quality monitoring at in Mang Thit, Cho Lach and Ky Hon canals is polluted by organic compounds and suspended solids as described in Chapter 3. The periodical environmental monitoring schedule conducted by DONREs can be used as reference for water pollution control, protecting the aquatic lives in the river/canals. It is recommended that monitoring of aquatic species be carried out as part of the annual schedule for environmental monitoring program of provincial DONREs.

5.7. CLIMATE CHANGE ISSUES

Climate Change Mitigation and Adaptation Co-benefits

The project is expected to generate high climate change mitigation co-benefits. Inland waterways transport (IWT) is a low-carbon transport mode compared to road and railways. It consumes only 17 percent of road's and 50 percent of rail's energy consumption (ton-km).[32] It also produces up to one-sixth of the carbon dioxide emissions of trucking. In Vietnam, road transport contributes to about 80 percent of the transport sector's GHG emissions. Further mainstreaming IWT in Vietnam's transport mix is vital for decarbonizing Vietnam's transport sector and achieving its envisioned low-carbon transition to a green economy.

The project will contribute to Vietnam's planned transition to a green economy and lead to significant GHG emission savings. The project will lead to a net GHG emission reduction of 4.3 million tCO_2e compared to the baseline emissions (without project).[33] After upgrading the river sections, the East–West Corridor will reduce travel distance by about 92 km than the existing alternative route. With higher navigation classes, the upgraded East–West Corridor will be able to accommodate vessels five times larger which would allow for more mass consolidation of cargo, requiring less vessels for the same amount of cargo and increasing energy efficiency. Furthermore, container vessels of about 128–200 Twenty-Foot Equivalent Unit (TEU) could navigate, which is equivalent to about 128–200 trucks per vessel. The North–South Corridor will allow container freight transport demand to move from the currently

[32] European Parliament. 2015.

[33] This is estimated in line with the economic analysis of shorter and more efficient routes, over the infrastructure's standard economic lifetime. Mitigation effects are larger if the scenarios of further modal shift from road as well as unimproved waterways losing competitiveness are considered, as cargo shifts back to trucking which emits up to six times more emissions.

overloaded and congested National Highway number 51, the main route connecting the HCMC and the Cai Mep – Thi Vai (CMTV) ports, as well as from the congested roads connecting the HCMC port from the Mekong Delta. Businesses sometimes must reserve 1.5 times more transit time than usual to ensure on-time delivery by roads, which further increases emissions.[34]

Key Climatic Assessment

With tropical monsoonal conditions, the climate of the MKD is mostly hot and humid. In the warmest months of March and April, average temperatures range from 30ºC to 38ºC. Cooler temperatures prevail from November to February, ranging from 17ºC to 27ºC. The MKD has abundant annual rainfall. The average annual precipitation of 1,400–1,900 mm is influenced by the monsoon patterns, resulting in distinct rainy and dry seasons. The rainy season starts from May to the end of November, coinciding with the period of the southwest monsoon, accounting for 93–96 percent of the annual rainfall. The dry season begins in December and ends in April of the following year, coinciding with the northeast monsoon with a rainfall making up 14–17 percent of the annual rainfall.

Climate Change Vulnerability and Adaptation

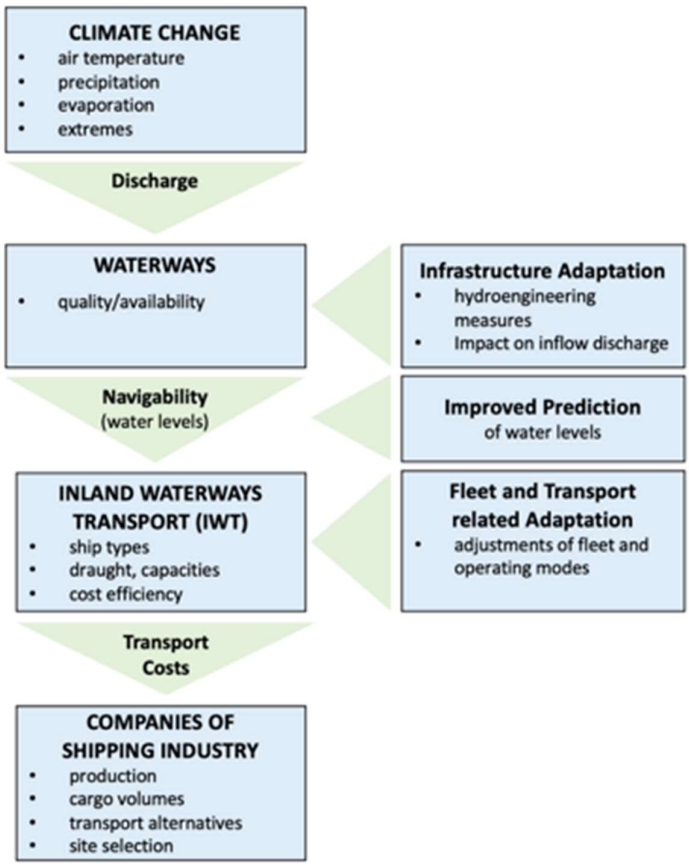

Figure 5.6. Impact Chain from Climate Change to IWT

Climate change has significant impacts on IWT. Figure 5.5 shows an impact chain from climate change to IWT.[35] Climate change-induced variations in temperature, evaporation, and

[34] MOT. 2021.

[35] Hendrickx, C., and T. Breemersch. 2012. "The Effect of Climate Change on Inland Waterway Transport." *Procedia - Social and Behavioral Sciences* 48: 1837–1847.

precipitation levels (volume and distribution) affect water levels in inland waterways and thereby the navigability for IWT. Furthermore, climate change induces extreme precipitation, riverine flooding, and flash flooding. According to the World Bank's Climate Change Knowledge Portal, Vietnam has extremely high exposure to flooding, ranking as the most vulnerable country globally along with Bangladesh. Floods and storms are the top two most damaging hazards in Vietnam historically (Figure 5.6), and this is expected to exacerbate due to climate change.

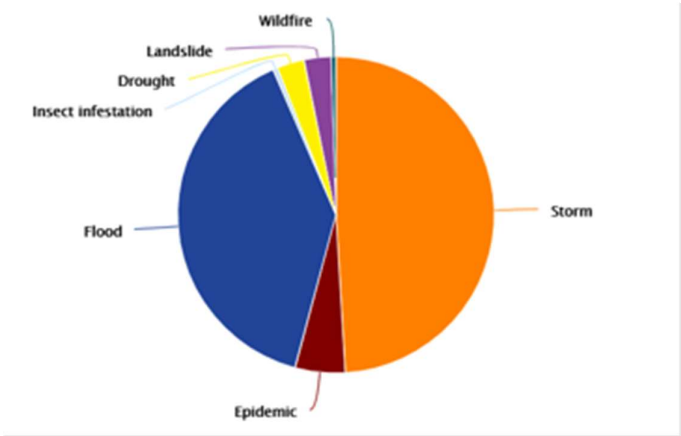

Figure 5.7. Average Annual Natural Hazard Occurrence in Vietnam for 1900–2018

Source: Climate Change Knowledge Portal, World Bank (2021).

5. The increased flooding results in higher risks for riverbank erosion thereby undermining the structural stability of IWT channel infrastructure. During floods, the huge amount of water flows with higher velocity tears away the top layers of soil at riverbanks. The occurrence of erosion and landslide events along the river/canal network of the MKD has been occurring at an increasing trend. A summary of erosion and landslides in the MKD is presented in Table 5.32.[36]

Table 5.32. The Potential Erosions and Landslides in the MKD

No.	River	Length of Riverbanks (L) (m)	Number of Positions of Strong Soil Erosion and Landslide	Length of Soil Erosion and Landslides (Ls) (m)	Percent of Ls/L (%)
1	Tien	618,600	27	87,900	14.21
2	Co Chien	277,400	6	16,300	5.88
3	Ham Luong	151,800	3	7,300	4.81
4	My Tho	80,600	2	3,000	3.72
5	Hau	595,800	23	48,320	8.11
6	Vam Nao	12,460	2	5,700	45.75
7	Mang Thit	89,860	4	2,600	2.89
8	Ca Mau-Bac Lieu	130,400	3	410	0.31
9	Ganh Hao	68,800	1	970	1.41
10	Bay Hap	98,000	3	2,570	2.62
11	Cua Lon	65,000	3	2,190	3.37

[36] World Bank. 2007. *Environment Impact Assessment for Waterway Network Improvement Projects*. World Bank, Washington, DC.

No.	River	Length of Riverbanks (L) (m)	Number of Positions of Strong Soil Erosion and Landslide	Length of Soil Erosion and Landslides (Ls) (m)	Percent of Ls/L (%)
12	Ong Doc	78,000	2	6,000	7.69
13	Dam Doi	18,000	1	1,200	6.67
14	Cai Nai	24,000	1	1,000	4.17
	Total	**2,308,720**	**81**	**185,460**	**8.03**

Figure 5.8. Reno Mattress along the River Bank in Vietnam

Source: Port & Waterway Engineering Consultant Joint Stock Company (2021)

Figure 5.9. Reno Mattress along the River in Vietnam

Source: Port & Waterway Engineering Consultant Joint Stock Company (2021)

To adapt to these climate change-induced risks, the full project design aims to apply resilient engineering measures to enhance the resilience of the infrastructure. The project will result in deeper and wider channels, which would allow for navigation in the dry season. Further, the design has added 30 cm considering sea level rise (high scenario), when determining waterway dimensions, embankment crests, access roads, drainage outlets, and vertical clearances of the bridge and power lines. The procurement of navigation aids and materials used, will also consider exposure to changing climate patterns. Embankments under the project will prevent riverbank erosion. Furthermore, the project will use a climate-resilient/friendly reno mattress and concrete block combination as the embankment structure in most river sections. This technology allows plants to grow on the surface of the reno mattresses (Figure 5.7 and 5.8) and thereby increases the soil stability at riverbanks against erosion. Embankments along the project rivers will apply this technology wherever technically feasible, of which the reno mattress and concrete block combination accounts for about 80 percent. In other words, 80 percent of the new embankment length will have enhanced resilience to climate change-induced erosion risks.

CHAPTER 6. EVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Based on the negative impacts and risks discussed in Chapter 5, this Chapter presents the Environmental and Social Management Plan (ESMP) for the SWLCP. This ESMP covers:

(1) Summary of Potential Impacts and Risks

(2) Mitigation measures proposed for Feasibility Study (FS) and Detail Design (DD), pre-construction, construction and operation phases along with implementation responsibilities for each investment item;

(3) Compliance monitoring and environmental quality monitoring program;

(4) Environmental and Social compliance framework;

(5) Capacity building and training programs;

(6) Cost estimates; and

(7) Grievance Redress Mechanism (GRM)

(8) Subplans including the Labour Management Procedures (LMP), Stakeholder Engagement Plan (SEP), and Dredging and Excavation Management Plan (DEMP) (in the annexes).

After contract signing, the contractor will be required to prepare and submit a contractor's site-specific Environmental and Social Management Plan (CESMP) for each contract package and submit to the CSC and PMUW for review and clearance, as well as submission review by the Bank for alignment with ESF requirements.

In addition, the Resettlement Policy Framework (RPF) and site-specific RP (Resettlement Plan) are also closely related to this ESMP andcross-referenced in the ESIA/ESMP.

6.1. SUMMARY OF KEY POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS AND RISKS

Key potential environmental and social impacts and risks are summarized inTable 6.1.

Table 6.1. Summary of negative impacts and risks

Phase	Impacts and risks	
Pre-Construction	Land acquisition, resettlement and impacts on livelihood; Safety risks related to Unexploded ordinances	
Construction	*Generic impacts and risks (all investment items)*	*Specific impacts and risks*
	Dust, noise, gas emission and vibration; Generation of wastewater; Generation of domestic and construction wastes Disturbance to roadway/waterway traffic and accessibility, and increased traffic safety; Reduced landscape values; Sedimentation and localized Flooding risks; Soil subsidence risks; Damages to existing infrastructure and/or	* Dredging: • Water quality reduction; • Biological impacts and risks; • Disturbance to fishery, aquaculture and otheruse activities; • Increased Waterway traffic safety risks; • Impacts and risks during transportation and disposal of dredged materials

Phase	Impacts and risks	
	disruption of related services; Community and Occupational Health and Safety Risks; Hazard Risks; Social impacts and risks: social disturbance, Gender-based violence risks, sexual exploitation and abuse risk, wastes and internal issues among workers living in the construction camp.	* Embankment strengthening: • Disruption of access to water
		* Bridges: • Site-specific impacts and risks • Increased localized river bank erosion risks
		* Road: • Site specific Impacts and risks; • Forest/Vegetation Clearance, increased forest fire risks
		* Irrigation and drainage outlets: • Site specific impacts and risks; • Temporary inundation.
		* Navigation aid • Site specific impacts and risks.
Operation	* Local road and new bridge: - Increased dust, noise, vibration and emission - Increased traffic safety risks, accessibility - Localized flooding risks - Landscape	
	* Waterways on 2 Corridor: - Increased river bank erosion risks - Changes in water quality and related biological impacts - Increased waterway traffic and safety risks	
	Cumulative impacts and risks Climate Change Issues	

6.2. MITIGATION MEASURES

The mitigation measures proposed below have taken account of the requirements set out in the Environmental and Social Standards relevant to the Project, including ESS1, 2, 3, 4, 5, 6, 8 and 10 with the aims of minimizing emissions and pollution, efficient use of excavated and dredging materials for beneficial purposes, ensure sound working environmental and health protection for the workers, minimizing community health and safety risks, support to those affected by livelihood, compensation for costal forest loss, establishing and maintaining communication channels with project stake holders.

6.2.1. Mitigation measures proposed for FS and detailed design

6.2.1.1. Dredging

- Conduct public consultations on the locations and peak times that dredging should be minimized or avoided;
- Design the waterway warning signs to ensure waterway safety in the operation phase.
- Develop dredging specifications with the requirements to minimize impacts on aquaculture, fishing and other water use activities on the river.

6.2.1.2. Embankments

- Design the steps with handrails along the embankment to maintain safe access to water for local communities;
- Use soft embankment where technically feasible with native plants are prioritized.
- Design wastewater collection and drains serving the households affected with drainage pipelines
- Design measures for slope protection by hard engineering structures, bioengineering measures or combined measures as appropriate.

6.2.1.3. Bridge

- Siting the bridge and access road alignment to minimize acquisition of residential land;
- Identify the scope of land acquisition area taking into account consideration the safety of households located along the approach roads of the bridge during construction and operation phases.
- Design measures for slope protection by hard engineering structures, bioengineering measures or combined measures as appropriate.
- Design safe intersections of access roads with existing roads to avoid traffic conflicts during operation phase. In addition, the project shall ensure the design of the railing system on the bridge, the lighting system and the signboards to warn about the bridge/allowable load to ensure traffic safety when the project is completed.

6.2.1.4. Local Roads

- Siting road alignment to avoid environmental or social sensitive features such as populated residential areas, existing forests and beaches. Alternative analysis discussed in detail such considerations during the siting of the coastal roads and bridges;
- Landscaping along the footpath with a row of trees, native plants should be prioritized.;
- Design a drainage system along and crossing the road to prevent flooding risks at roadside areas. Conduct consultation with local communities on the size and locations of culverts to ensure that the location and design of pipes/culverts are appropriate.
- Design smooth connections/adjoining access with other roads or roadside facilities;
- Design traffic control measures at the T-junctions and intersections;
- Design energy-saving lighting system with good architectural design of the poles to provide additional values for ensuring the urban landscape.
- Design roads with universal access, ensure safe and convenience access for the disadvantaged people including wheelchairs, edged and blind peoples with walking sticks.

6.2.1.5. Irrigation and drainage outlets

- Develop workplan to restrict the interruption of local people from using irrigation and drainage outlets.
- Contingency plan for temporary inundation caused by removing old drainage outlets.

6.2.1.6. Navigational aids

- Assign enough lighting system when installing navigational aids at night to prevent ships/boats collision.
- Select appropriate locations for navigational aids to ensure safe trips on the waterways, including removal at 40 locations, displacement at 75 locations and installation at 349 locations.

6.2.2. Measures applied at Pre-Construction

6.2.2.1. Mitigation measures for land acquisition

Negative impacts due to land acquisition for the project are foreseeable. In order to diminish the land acquisition impacts, the proponent and consultant will consider the existing State/Government regulations on compensation, relocation, and land acquisition in the early stage of the detailed technical design.

During detailed design, the location of disposal sites will be reassessed in order to reduce land acquisition.

During detailed design, PMUW will study carefully the scale and scope of the implementation of the Project's civil construction works to minimize land acquisition impacts. At the same time, the PMUW will closely coordinate with the local authorities the Land Fund Development Center (LFDC) of each province to carry out dissemination activities so that the local communities understand the roles and significance of the Project for which thus cooperate and supervise the contractors' performance during the implementation of the Project's civil construction works.

The following procedures will be complied:

- The LFDC will inform the affected people within the time frame the reason for land acquisition, the overall schemes for compensation, ground clearance and resettlement. After the decision on land recovery and schemes for compensations, ground clearance and resettlement will be consulted to reach agreement and approved by the PPC and made public, the landholder and/or landowner must abide by the decision on land recovery or acquisitions.
- The AHs will be compensated or relocated that will improve their livelihoods/living standards or at least the same with the previous conditions.
- PMUW will co-ordinate with LFDC of concerned areas to set up schemes for compensation and resettlement, which will be implemented before the commencement of the Project.

It is estimated that the Project will affects 410,752.4 m^2 with total 1,068 AHs in 5 provinces, including 81,778 m^2 of residential land; 273,629 m^2 of agricultural land. The largest number of affected households are Ky Hon - Cho Gao – Rach La Canal section (397 households) and Mang Thit river (398 households) and also there are households in Ky Hon - Cho Gao – Rach La Canal section and Mang Thit river must be relocated for the Project implementation.

The estimated cost for the Resettlement Action Plan (RAP) of the Project is approximately 1,686,454,400,632 VND (equivalent to 74,097,294 USD as the exchange rate of 22,760 VND = 1 USD).

The estimated cost for land clearance and resettlement is calculated based on provisions set by People Committees of Vinh Long, Ben Tre, Tien Giang, Long An and Dong Nai provinces and the policies determined by the World Bank. The Detailed mitigation measures for land acquisition are provided in the separated RP for each province.

6.2.2.2. Mitigation of UXO Risks

PMUW will sign a contract with the military civil engineering agency or Provincial Military Base for UXO detection and clearance at the construction sites. UXO clearance will be executed right after the completion of site compensation and before the implementation of demolition and ground leveling. No construction activity will be allowed until the UXO clearance is completed.

6.2.3. Mitigation measures proposed for construction phase

The mitigation measures proposed for Construction phase cover the Worker's Codes of Conduct, COVID-19 Preparedness Plan, Labour Management Procedures, Environmental Codes of Practices, and the Specific Mitigation Measures, and the subplans (in the annex). Relevant elements will be incorporated into the Terms of References for Consulting Service and/or civil work construction contracts as instructed below. In addition, the PMUW and CSC will be responsible for coordinating the works between the contractors who implement diffent civil work contracts at the same time, sharing construction sites and access, etc. would be cooperated to each other to ensure that the works are implemented in coordinated ways, the potential ESHS impacts and risks are minimized or under control.

The Workers' Codes of Conduct, LMP and COVID-19 Preparedness Plan will be applied to the entire project thus will be incorporated into relevant sections of any consulting or construction bidding or contractual documents

6.2.3.1. Worker's code of conduct

The Code of Conduct shall address, but not limited to, the following measures:

- All of the workforce shall abide by the laws and regulations of the Socialist Republic of Vietnam;
- Illegal substances, weapons and firearms shall be prohibited;
- Pornographic material and gambling shall be prohibited;
- Fighting (physical or verbal) shall be prohibited;
- Creating nuisances and disturbances in or near communities shall be prohibited;
- Disrespecting local customs and traditions shall be prohibited;
- Smoking shall only be allowed in designated areas;
- Maintenance of appropriate standards of dress and personal hygiene;
- Maintenance of appropriate standards hygiene in their accommodation quarters;
- Residing camp workforce visiting the local communities shall behave in a manner consistent with the Code of Conduct; and
- Failure to comply with the Code of Conduct, or the rules, regulations, and procedures implemented at the construction camp will result in disciplinary actions.

Prohibitions. The following activities are prohibited on or near the project site:

- Cutting of trees for any reason outside the approved construction area;
- Hunting, fishing, wildlife capture, or plant collection;
- Buying of wild animals for food;
- Use of unapproved toxic materials, including lead-based paints, asbestos, etc.;
- Disturbance to anything with architectural or historical value;
- Building of fires;
- Use of firearms (except authorized security guards);
- Use of alcohol by workers during working hours;
- Gambling should be strictly forbidden.
- Washing cars or machinery in streams or creeks;
- Doing maintenance (change of oils and filters) of cars and equipment outside authorized areas:
- Disposing trash in unauthorized places;

- Driving in an unsafe manner in local roads;
- Having caged wild animals (especially birds) in camps;
- Working without safety equipment (including boots and helmets);
- Creating nuisances and disturbances in or near communities;
- The use of rivers and streams for washing clothes;
- Indiscriminate disposal of rubbish or construction wastes or rubble;
- Littering the site;
- Spillage of potential pollutants, such as petroleum products;
- Collection of firewood;
- Poaching of any description;
- Explosive and chemical fishing;
- Latrine outside the designated facilities; and
- Burning of wastes and/or cleared vegetation.

Security. Some security measures shall be put into place to ensure the safe and secure running of the camp and its residents. Some of these security measures include:

- The list of workers must be registered to local authorities in accordance with existing Vietnamese regulations
- Children under 18 years of age will not be hired under the Project according to ESS2 requirements.
- Adequate, day-time night-time lighting shall be provided;
- Control of camp access. Access to the camp shall be limited to the residing workforce, construction camp employees, and those visiting personnel on business purposes;
- Prior approval from the construction camp manager for visitor's access to the construction camp;
- A perimeter security fence at least 2m in height constructed from appropriate materials;
- Provision and installation in all buildings of firefighting equipment and portable fires extinguishers.

Any construction worker, office staff, Contractor's employees or any other person related to the project found violating theses prohibitions will be subject to disciplinary actions that can range from a simple reprimand to termination of his/her employment depending on the seriousness of the violation.

6.2.3.2. Labour Management Procedures

A Labor Management Procedure (LMP) was developed as a stand-alone document for addressing the impacts on and of labor and working conditions of the project. The LMP identifies the main labor requirements and risks associated with the project and help the PMU and Contractor to determine the resources necessary to address project labor issues. The LMP will enable different project-related parties, for example, staff of the project management unit, contractors and sub-contractors and project workers, to have a clear understanding of what is required on a specific labor issue. The LMP is a living document, which is initiated early in project preparation, and is reviewed and updated throughout development and implementation of the project. The LMP has 12 chapters. Chapter 1 served as Introduction. An overview of labor use in the project is presented in Chapter 2. Key potential labor risks are listed in Chapter 3. Legislative Framework governing labor employment in Vietnam 2 is discussed in Chapters 4 and 5. Implementation Arrangements, Age Requirement, Policies and Procedures and Timing of labor requirements follows in the subsequent chapters. Grievance Redressal Mechanism and

Contractor Management are presented in the last two chapters 10 and 11 respectively, while Chapter 12 relates to primary supply workers.

6.2.3.3. COVID-19 Preparedness Plan

The Implementing Agencies (IA) and contractors should refer to guidance issued by relevant authorities, both national and international (e.g. WHO), which is regularly updated (WHO advice for the public, including on social distancing, respiratory hygiene, self-quarantine, and seeking medical advice, can be consulted on this WHO website: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-forpublic).and following the 5K instruction by Ministry of Health for prevention of COVID, that is: facemask-disinfection-distance-no gathering – health declaration). To minimize the impacts of the COVID-19 pandemic, the following measures and procedures are proposed:

Staffing

- The PMUW and CSC each will assign the Environmental Officer (EO) to conduct regular monitoring and enforce the Contractors on the implementation of the precautionary and prevention measures in relation to COVID-19 at the project construction sites and camps;
- Each Contractor assign one staff to be in charge on COVID-19 prevention and related actions at the construction sites and camps.

Rules to Follow

To provide training for all employees and workers to take standard precautions. Follow the 5K instruction of the Ministry of Health, meaning " Face mask – Disinfection – Distance – No gathering – Health declaration" with the following main contents:

- Face mask: to wear cloth masks regularly in public places, places where people gather; Wear medical masks at medical facilities and quarantine areas.
- Disinfection: to wash hands often with soap or hand sanitizer. To disinfect the surfaces or items which are frequently touched (doorknobs, phones, tablets, desks, chairs, etc.). Keep the house clean, wash and keep the house well ventilated.
- Distance: to keep your distance when in contact with others.
- No gathering: not to gather in crowds.
- Health declaration: to make medical declaration on PC COVID developed by Ministry of Police; to install the BlueZone application at https://www.bluezone.gov.vn to be warned about the risk of COVID-19 infection.

Workplace and Staff Management

Office, Site Offices, Camp, Accommodations

- Provide disinfection hand-washing liquid and request all staff and visitors to wash hands when coming into the office.
- Practice the 5K rules declared by the Ministry of Health Wear Masks, Disinfection, Maintain Distances, no gathering and implement Health Declaration.
- Place posters and notices at the office with regards to wearing masks and hand disinfection
- Establish and maintain log books for staff and visitors
- The Contractors shall provide adequate face masks and hand disinfectants for all staff including technical staff and the workers to use;
- Training on EHS include COVID-19 preventions, in addition to awareness about STDs

Staff Management

- When social distancing is applied, the PMUW allocate staff to work from home using information technology. Only limited number of staff will be allowed to come to the office.
- Stay at home and isolate with others if do not feel well.
- Remember COVID-19 hotlines
- Regularly clean up the surfaces and door handles.
- Wear masks at the construction sites, maintain the 2m distance.
- Obtaining full information about employees and workers and promptly and strictly implementing measures to prevent and control the COVID-19 epidemic under the motto "4 on-site" i.e., on-site guidance, on-site mobilization, on-site handling and on-site logistics;
- Having a plan to ensure adequate area for all employees, workers of subcontractors and suppliers to accommodate and work on the site; preparing medical forces, isolation rooms and implement medical control measures to prevent and control the COVID-19 epidemic, ensure an effective response to all possible situations, minimize the possibility of infection in the construction site
- No gathering of more than the number of workers/people declared by authorities in working spaces such as meeting rooms, working platforms, elevators and other confined spaces at the construction site;
- Organizing to measure body temperature for people going in and out of the construction; measuring workers' temperature at the beginning and end of each shift; In case the body temperature is 37.5°C or higher, the person must be put in temporary quarantine and the case must be immediately reported to the local health authorities.
- Organizing the screening of laborers coming from epidemic zones inside and outside the country to notify local administrations to have proper quarantine arrangements.

Responses in Specific Circumstances

***Scenario 1:** Detected someone belonging to high-risk groups due to being in contact with commers from infected countries or regions. Implement the followings:

- Inform local health authorities
- Follow the instructions and requests of local health authorities including isolations;
- Inform the CSC and PMU by email or telephones. Contact in-person to PMU/CSC staff is forbidden.
- Request all other staff working at the project construction site/offices where covil-19 positive case (F0) is recorded not to leave the project areas while waiting for instruction of local health authorities.
- Trace-tracking those who have been in contact with F0

***Scenario 2:** There is a suspected COVID-positive case. Implement the followings:

- Strictly follows the instructions of health authorities
- Transfer the documents and materials related to the case for the health authorities, including health declaration document, family contacts, medical history and other relevant materials
- Isolate at home, carry out self-monitoring and inform the medical staff about the health of related project staff who are not subjected to compulsory centralized isolation.
- Establish communication channel with health authority about the status of the patient or suspected to be positive so as supports can be provided in timely manner

- Halt all activities at the work place/construction sites where a positive case has been detected during isolation period. For the works that cannot be halted, allocate alternative staff to carry out the works.
- Regularly report to the CSC and PMU on the situation

*** Scenario 3:** When "negative" in confirmed by health authority to the case of suspected "positive" case or patient recovered after treatment. Implement the followings:

- Isolate at home, carry out self-monitoring and inform the medical staff about the health of related project staff who are not subjected to compulsory centralized isolation.
- Maintain communication with health authority about the status of the related individuals so as supports can be provided in timely manner
- Mass clean up the workplace and accommodation areas where the suspected cases have been too after the health authority have disinfected the areas or lifted the isolations

6.2.3.4. Environmental and Social Codes of Practices (ESCOP)

The ESCOP will be applied to all civil works packages thus will be incorporated into relevant section of the construction bidding and contractual documents. Note that in addition to ESCOP, the Construction Bidding documents of each specific bid package will also incorporate relevant specific mitigation measures and subplans relevant to the natural and locations of the civil works covered under that Package.

Table 6.2 lists the mitigation measures, under the form of Environmental and Social Codes of Practices (ESCOP), to address the common negative construction impacts list below:

i. Management of dust, air quality and exhaust emission;
ii. Management of noise and vibration;
iii. Wastewater management;
iv. Solid waste management;
v. Hazardous waste management;
vi. Water quality management;
vii. Biodiversity management;
viii. Management of sedimentation, erosion, flooding, subsidence risks;
ix. Management and control of traffic safety risks;
x. Management of impacts on existing infrastructure and services;
xi. Management of social impacts and risks;
xii. Chance finds procedures;
xiii. Management of community health and safety;
xiv. Management of workers' health and safety.

These ESCOPs are the overall regulations and practices on the specific issues. Based on this, the Contractor will develop and overall Contractor Environmental and Social Management Plan (CESMP) for each construction site area, submit to PMUW and CSC for review and approval before commencement of construction.

Table 6.2. Environmental and Social Codes of Practices (ESCOPs)

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
1. Management of dust and exhaust emissions	• The Contractor is responsible for compliance with relevant Vietnamese legislation with respect to ambient air quality. • The Contractor shall ensure that the generation of dust is minimized and is not perceived as a nuisance by local residents and shall implement a dust control plan to maintain a safe working environment and minimize disturbances for surrounding residential areas/dwellings. • The Contractor shall implement dust suppression measures (e.g. use water spraying vehicles to water roads, covering of material stockpiles, etc.) as required. • Material loads shall be suitably covered and secured during transportation to prevent the scattering of soil, sand, materials, or dust. • Exposed soil and material stockpiles shall be protected against wind erosion and the location of stockpiles shall take into consideration the prevailing wind directions and locations of sensitive receptors. • Dust masks should be used where dust levels are excessive. • All vehicles must comply with Vietnamese regulations controlling allowable emission limits of exhaust gases. • Vehicles in Vietnam must undergo a regular emissions check and get certified named: "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT; • There should strictly be no burning of solid wastes or construction materials (e.g., wood, rubber, oil-based rag, emptied cement bags, paper, plastic, bitumen, etc.) on site.;	• TCVN 6438-2005: Road vehicles. Maximum permitted emission limits of exhaust gas. • QCVN 05: 2013/MONRE: National technical regulation on ambient air quality. • WB's EHS standard	• Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
2. Management of noise and vibration	- The contractor is responsible for compliance with the relevant Vietnamese legislation with respect to noise and vibration. - All vehicles must have appropriate "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT to avoid exceeding noise emission from poorly maintained machines. - Measures to reduce noise to acceptable levels should be implemented, including: + Selecting equipment with lower sound power levels + Installing suitable mufflers on engine exhausts and compressor components + Installing acoustic enclosures for equipment casing radiating noise + Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier + Barriers should be located as close to the source or to the receptor location to be effective + Installing vibration isolation for mechanical equipment + Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas + Re-locating noise sources to less sensitive areas to take advantage of distance and shielding + Siting permanent facilities away from community areas if possible + Taking advantage of the natural topography as a noise buffer during facility design + Reducing project traffic routing through community areas wherever possible • Developing a mechanism to record and respond to complaints	• Decree No. 08/2022/ND-CP guiding the implementation of Environmental Protection Law. • QCVN 26:2010/ BTNMT: National technical regulation on noise • QCVN 27:2010/ BTNMT: National technical regulation on vibration; • WB's EHS standard	• Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
3. Wastewater management	• The Contractor must be responsible for compliance with the relevant Vietnamese regulations on wastewater discharges into surroundings and ensure that wastewater will not be discharged directly to waterways. • The contractors will use clean water efficiently, minimizing the volumes of wastewater generated • Mobile or constructed toilets must be provided on site for construction workers following WB standards for worker accomodation including facilities for women. • Consider hiring local workers to reduce wastewater generation on site. • Provide septic tanks for collecting and treating wastewater from toilets. • Wastewater from kitchens, showers, sinks and toilets shall be discharged into a local sewerage system. • Wastewater from washing vehicles and construction equipment shall be collected into a settling hole before discharged into local drainage system. • At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed of or effectively cleaned by pumping the waste with a vacuum truck.	• QCVN 14:2008/ BTNMT: National technical regulation on domestic wastewater; • QCVN 40:2011/ BTNMT: National technical regulation on industrial wastewater; • WB's EHS standard	• Contractor	• PMUW, CSC, IESMC
4. Solid waste management	• The contractor will make beneficial usage of excavated materials for back-filling or tree planting where possible; • Before construction, a solid waste control procedure (reuse part of the excavated soil to back-filling as if, storage, provision of bins, site clean-up schedule, bin clean-out schedule, etc.) must be prepared by Contractors. and it must be carefully followed during construction activities. Waste segregation procedures should be put in place with the aim of recyling as much waste as possible, especially for construction solid wastes. • Before construction, all necessary waste disposal permits or licenses must be obtained. • Measures shall be taken to reduce the potential for litter and negligent behavior with regard to the disposal of all refuse. At all places of work, the Contractor shall provide litter bins, containers and refuse collection facilities.	• Decree No. 08/2022/ND-CP guiding the implementation of Environmental Protection Law. • WB's EHS standard	• Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• Solid waste may be temporarily stored on site in a designated area approved by the Construction Supervision Consultant and relevant local authorities prior to collection and disposal through a licensed waste collector, for example, URENCO. • Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. • No burning, on-site burying or dumping of solid waste shall occur. • Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc. shall be collected and separated on-site from other waste sources for reuse, for use as fill, or for sale. • If not removed off site, solid waste or construction debris shall be disposed of only at sites identified and approved by the Construction Supervision Consultant and included in the solid waste plan. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas, such as in areas of natural habitat or in watercourses.			
5. Hazardous waste management	• Fuels and chemicals must be safely stored in areas with impermeable ground with roofs and surrounding banks, equipped with safety warning signs located at least 20 m from the camps and downwind of prevailing winds and at minimum setback from watercourses 25 to 30 m. • Collect, store, and transported for treatment all hazardous wastes (road asphalt, waste oil and grease, organic solvents, chemicals, oil paints, etc.) in accordance with Circular No. 36/2015/TT-BTNMT on management of hazardous waste • Collect and temporarily store used oil and grease separately in specialized containers and place in safe and fire-free areas with impermeable floors and roofs, at a safe distance from fire sources following relevant regulations. Sign contracts with for oil and grease to be delivered to suppliers/ manufacturers • Do not use unapproved toxic materials, including paint containing lead, asbestos, etc.	• Decree No. 08/2022/ND-CP guiding the implementation of Environmental Protection Law. • WB's EHS standard	• Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• The removal of asbestos-containing materials or other toxic substances shall be performed and disposed of by specially trained and certified workers. • Used oil and grease shall be removed from site and sold to an approved used oil recycling company. • Do not perform any maintenance (change of oil and filter) of cars and equipment outside the designated area. • Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery shall be collected in holding tanks and removed from site by an approved specialized oil recycling company for disposal. • Used oil or oil-contaminated materials that could potentially contain PCBs shall be securely stored to avoid any leakage or affecting workers. • Unused or rejected tar or bituminous products shall be returned to the supplier's production plant. • Relevant agencies shall be promptly informed of any accidental spill or incident • Store chemicals appropriately and with appropriate labelling • Appropriate communication and training programs should be put in place to prepare workers to recognize and respond to workplace chemical hazards • Report all incidences of oil spills immediately and prevent any risks of oil spills • Prepare and initiate a remedial action following any spill or incident. In this case, the contractor shall provide a report explaining the reasons for the spill or incident, remedial action taken, consequences/damage from the spill, and proposed corrective actions. • In the event that accidental leakage or spillage of diesel/chemicals/chemical wastes takes place, the following response procedures shall be followed immediately by the Contractor(s): → *The person who has identified the leakage/spillage shall immediately check if anyone is injured and shall then inform the Contractor(s), Supervision Engineer and PMUW;*			

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• The Contractor(s) shall ensure any injured persons are treated and assess what has spilled/ leaked; • Should the accidents/incidents generate serious environmental pollution (e.g., spillage /leakage of toxic or chemicals, large scale spillage / leakage, or spillage /leakage into the nearby water bodies, the Contractor shall immediately inform PMUW; • In such cases, the Contractor(s) shall take immediate action to stop the spillage /leakage and divert the spilled /leaked liquid to nearby non-sensitive areas; • The Contractor(s) shall arrange maintenance staff with appropriate protective clothing to clean up the chemicals/chemical waste. This may be achieved through soaking with sawdust (if the quantity of spillage/leakage is small), or sand bags (if the quantity is large); and/or using a shovel to remove the topsoil (if the spillage/leakage occurs on bare ground); and • Depending on the nature and extent of the chemical spill, evacuation of the activity site may be necessary; • Spilled chemicals must not be flushed to local surface drainage systems. Instead, sawdust or sandbags used for clean-up and removed contaminated soil shall be disposed of by following the procedures for chemical waste handling and disposal already described; • The Contractor(s) shall prepare a report on the incident detailing the accident, clean up actions taken, any pollution problems and suggested measures to prevent similar accidents from happening again in future. The incident report shall then be submitted to the Supervision Engineer and PMUW for review and keep in the records. The incident report shall also be submitted to DONRE, if required			
6. Water quality management	• The Contractors are responsible for controlling surface water quality when discharging it out of construction sites, in accordance with QCVN 08-MT: 2015/BTNMT and QCVN 14:2008/BTNMT; • Store used and unused oil and petrol on impermeable surface covered with a roof, with warning (flammable and danger) signs, and contained within	• Decree No. 08/2022/ND-CP guiding the implementation of	• Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	surrounding fences for easy control and collection in case of leakage. Locate oil and petrol storage areas at least 25m from any ponds, lakes, rivers, and streams. Restrict accessibility to these temporary storages to only authorized persons; • Perform concrete mixing on impermeable ground only, at least 20 m far from any water sources. Collect wastes and wastewater containing cement at sedimentation traps and drainage ditches regularly to limit number of solids entering receptors; • Maintain vehicles and replace oil at designated workshops only. Do not perform these activities at sites; • Collect and keep used/waste oil and materials polluted with oil/chemicals in containers, store in safe places (on impermeable grounds, roofed, fenced and with warning signs) for regular collection by licensed dealers; • Carry out concrete mixing on impermeable grounds only. Collect wastes and wastewater containing cement at the sedimentation traps and drainage ditches regularly to limit number of solids entering receptors; • Provide sedimentation pits and ditches at all construction sites; • Provide appropriate toilets for the workers as per WB accommodation guidelines; • Avoid carrying out excavation and backfilling in rainy weather; • Collect and transport materials and wastes generated during excavation and backfilling materials to designated sites for reuse or final disposal as soon as possible; • Maintain vehicles and equipment, including oil replacement or lubrication, at designated areas only. Ensure that no chemicals, petrol, oil, or grease are leaked into the soil, drains or water sources. Use trays to hold rags and materials used in maintenance. Collect and dispose wastes in accordance with effective hazardous waste management requirements.	Environmental Protection Law. • QCVN 08-MT:2015/ BTNMT – National Technical Regulation on surface water quality; • QCVN 14:2008/ BTNMT: National technical regulation on domestic wastewater; • WB's EHS standard		
7. Biodiversity management	• Avoid disturbances and damage to the existing vegetation and green trees. • Do not store materials and wastes at places having vegetation cover. Store them on barren land instead;	• Law on environmental	• Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• If trees can be replanted somewhere, move them instead of cutting the trees down; • If any invasive species are found during construction phase, transport to another place and burn them before disposed of to prevent them from regrowing at disposal site; • Chemicals/herbicides must not be used to clear vegetation; all vegetation removal should be done manually (is this correct?) • Minimize the areas disturbed, especially in locations having trees or vegetation; Determine areas to be undisturbed for protection during construction. • Do not remove or damage the vegetation without direct instructions. • Do not cut trees outside the approved construction area for any reason • Do not buy any wildlife for food; • No birds and animals should be collected nor kept in cages in camps • No collection of firewood. • Do not burn litter that damages vegetation. • Do not gather materials and wastes at places covered with vegetation or with green trees, but on vacant land instead. • Trees cannot be cut down unless explicitly authorized in the vegetation clearing plan. • When needed, temporary protective fencing will be erected to efficiently protect the preserved trees before commencement of any works within the site. • The Contractor shall ensure that no hunting, trapping, shooting, poisoning of wildlife takes place. • If invasive plants are found during site-clearance, the plants are not to be transported out of the construction site but burned safely on-site.	protection No. 72/ 2020/QH14. • Decree No. 08/2022/ND-CP guiding the implementation of Environmental Protection Law. • ESS6		
8. Management of sedimentation,	**Management of Flooding Risks** • Periodically and thoroughly remove soils, stones and wastes from drainage sewers and ditches inside and around the construction site.	• Law on environmental	Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
erosion, flooding, subsidence risks	• Neatly gather materials and wastes so as to limit them being swept away by stormwater. • Carry out ground levelling and rolling after discarding materials at disposal sites. • Install supports to protect the walls where excavation is deeper than 2 m. • Check the existing drains within and surrounding the construction sites, improve before levelling to ensure rainwater can be drained properly; • Load construction material and wastes at least 10 m from any existing drainage ditches or water sources to minimize materials from entering the channels which may lead to sedimentation and blockage; • Clean up the existing drains regularly.	protection No. 72/ 2020/QH14 • QCVN 08-MT: 2015/BTNMT – National technical regulation on surface water quality • QCVN 18:2021/BXD – National technical regulation on safety in construction • WB EHS Standard		
9. Management and control of traffic safety risks	• Install and maintain sign boards, fences, signal lights to direct traffic to ensure traffic safety. Ensure adequate lighting at night time; • Only use vehicles with valid registration. Trucks must be covered to prevent materials from dropping along the routes to cause dusts and accidents; Arrange and provide separate passageway with safe and easy access for pedestrian and for people with disability and mobility issues especially the areas in proximity of schools, including easy wheel chair access and hand rail. Make staff available any time for helping people with disability if needed. • Set up traffic and maintain instruction signs and warnings to secure safety for people and means of transport during construction. • Put speed limit signs at a distance of 200 m from the construction site. • Carefully cover materials on trucks. Do not load to a height of 10cm higher than the truck body so as not to spill out and scatter materials onto roads, giving rise to dust and endangering road users. Collect spilt soils and materials at the construction site each day to avoid slippery incidents for vehicles. • Do not park vehicles in the roads longer than necessary. Do not allow construction vehicles and materials to encroach upon the pavements.	• Law No. 23/2004/QH11 law of inland waterway traffic • Law No. 48/2014/QH13 Amending and supplementing some articles of the law of inland waterway traffic • Law on road transport No. 23/2008/QH12; • Law on construction No. 50/2014/QH13; • Law No. 38/2009/QH12 dated 19/6/2009 amending and supplementing	Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• Install night lighting of all construction sites. • Significant increases in number of vehicle trips must be covered in a construction plan previously approved. Routing, especially of heavy vehicles, needs to take into account sensitive sites such as schools, and markets. • Installation of lighting at night must be done, if necessary, to ensure safe traffic diversion. • Avoid material transportation for construction during rush hours.	some articles of the Law relating to capital construction investment • QCVN 18:2021/BXD – National technical regulation on safety in construction • ESS4		
10. Management of impacts on existing infrastructure and services	• Provide information to affected households on working schedules as well as planned disruptions (at least 5 days in advance). • The Contractor must only use vehicles of sizes and loads within permissible limits for the roads along such vehicles' route. • During the construction under power lines, deploy qualified staff to observe and give instructions to the drivers of cranes and excavators so as to avoid causing damages to power lines, telecommunications lines, etc. • Stop construction when existing works are damaged. Identify causes of related incidents and work out solutions. In case the damages are due to the Contractors' actions, the Contractors have to repair, recover, and compensate for all damages at their own expenses. The results of handling such damages must be approved by the Supervisor Engineer. • Reinstall the road surface and sidewalks at construction sites after the construction of sewer lines has been completed. • The contractor should ensure alternative water supply to affected residents in the event of disruptions lasting more than one day. • Any damages to existing cable utility systems shall be reported to the authorities and repaired as soon as possible.	• Decree 144/2021/ND-CP provisions on penalties for administrative violations in the field of security, order and social safety; prevention of social evils; fire protection and prevention; survey, search; prevention of family violence.	Contractor	• PMUW, CSC, IESMC
11. Management of social impacts and risks	• Conduct temporary residence for workers with local authorities;	• Decree 144/2021/ND-CP provisions on penalties for administrative	Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• Inform the community of construction schedule 02 weeks in advance. In case of water and power outage for construction, affected will be notified 05 days in advance by the PMUW. • Limit construction activities at night. If construction at night is unavoidable or interruption to service supply (water and power cut-off), the community must be informed at least 05 days in advance and the information will be repeated 1 day. • Place planks or other means crossing open pipe trenches in oder to provide safe temporary access for local communities. • Hire local labors to implement simple jobs. Provide training on environmental, safety and health for the workers before assigning jobs. • Prepare and distribute Codes of Conducts and request workers to comply by signing the code of conduct between Contractors and workers. <u>Gender equality requirements:</u> • Jobs of workers will be based on the gender equality and will have no discrimination for any gender-related employment, recruitment, conditions for recruitment (including jobs, salary and benefits), termination and access to training courses. • In order to address the risk of excluding vulnerable groups (such as women and people with disabilities) from employment opportunities, the Contractors are required to recruit such groups as part of unskilled employees. • Contractors will be required to comply with the National Law on gender equality in the workplace, which includes adequate and appropriate maternity and nursing leave; and restrooms and toilets must be separate from men and women. • Contractors will also be requested to address potential sexual exploitation or harassment issues in recruiting or keeping skilled or unskilled female workers for supporting the project. <u>Requirements applicable to the main supplier's workforce:</u> • Give priority to recruiting local labor. • Ensuring the workforce is contracted under the current regulations.	violations in the field of security, order and social safety; prevention of social evils; fire protection and prevention; survey, search; prevention of family violence; • Decree 130/2021/ND-CP provisions on sanctioning administrative violations in the field of social assistance, protection and support for children • ESS2 and ESS4		

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• Training and raising the awareness of the local people in traffic to limit risks and accidents. • No child or forced labor will be used for the Project.			
12. Chance Finds Procedures	If artefacts or remains are exposed during excavation or construction, the Contractor shall: • Stop the construction activities in the area of the chance find; • Delineate the discovered site or area; • Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities or the provincial Department of Culture, Sport and Tourism takes over; • Notify the Construction Supervision Consultant who in turn will notify responsible local or national authorities in charge of the Cultural Property of Viet Nam (within 24 hours or less); • Relevant local or national authorities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values; • Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage; • If the cultural sites and/or relics are of high value and site preservation is recommended by the professionals and required by the cultural relics' authority, the Project's Owner will need to make necessary design changes to accommodate the request and preserve the site; • Decisions concerning the management of the finding shall be communicated in writing by relevant authorities;	• Law on Cultural Heritage No. 28/2001/QH10. • Law on Cultural Heritage Amending and Supplementing No. 32/2009/QH12. • Decree No. 98/2010/ND-CP for supplementary and reformation • ESS8	Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• Construction works could resume only after permission is granted from the responsible local authorities concerning safeguard of the heritage.			
13. Management of community health and safety	• The Contractor will have to conform to regulations in QCVN 18:2021/BXD by the Ministry of Construction on safety in construction. • The Contractor will have to public the construction schedule for local residents. • The Project owner and contractor are to cooperate closely with the local government in performing effective community sanitation in case of epidemic symptoms breaking out in the area. • The Project owner and contractor are to cooperate with local authorities in preventing conflicts between workers and local communities; with the local health agency in developing and implementing plans for control of diseases among workers. • Fence off excavation pits and open channels with luminous cordon and warning signs. Provide sufficient lighting when carry out construction at night. No public access to any construction site. • Limit the speed of transport means to 20km/h within 200m from the construction site so as to minimize dust and noise. • Keep noise-generating machines and vehicles at such suitable distances that noise transmitted to residential areas will not be higher than 70dBA. • Use static compacting when the road base is constructed near areas with many households and weak temporary works to restrict vibration.	• QCVN 18:2021/BXD – National technical regulation on safety in construction • Decree 06/2021/ND-CP guidelines on quality management, constructionand maintenance of construction works • Circular No. 10/2021/TT-BXD dated August 25, 2021 on providing Guidance on implementation of several articles and measures for implementation of the Decree No. 06/2021/ND-CP and the Decree No. 44/2016/ND-CP. • Circular 121/2021/TT-BQP on technical process of investigation, survey, and explosion classification • ESS4	Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
14. Management of worker's health safety	• Provide training in EHS to workers for raising their awareness of infectious diseases especially HIV/AIDS within 2 weeks prior to the commencement of packages for construction items lasting at least 6 months. • Provide first-aid kit at site office and camps. • Provide workers with PPE such as masks, gloves, helmets, shoes/boots, goggles, safety belt, etc. and enforce wearing during working especially working at heights and in dangerous areas. • Limit or avoid working in extreme weather conditions, e.g., too hot, heavy rain, strong wind, and dense fog. • PPE should be assigned according to degree of occupational risk: Provide proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. In noisy locations, hearing protection should be used. Harnessess should be used when working at height. Masks must be wearing everytime. • Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hot work on tanks or vessels that have contained flammable materials. • Safely install power lines at offices and in construction sites and do not lay connectors on the ground or water surface. Electric wires must be with plugs. Place outdoor electric panels in protection cabinets. Ensure proper warning signage on all electrical facilities • Provide sufficient lighting when carrying out construction activities at night.	• QCVN 18:2021/BXD – National technical regulation on safety in construction • Decree 06/2021/ND-CP guidelines on quality management, constructionand maintenance of construction works • Circular No. 10/2021/TT-BXD dated August 25, 2021 on providing Guidance on implementation of several articles and measures for implementation of the Decree No. 06/2021/ND-CP and the Decree No. 44/2016/ND-CP. • Circular 121/2021/TT-BQP on technical process of investigation, survey, and explosion classificationESS2	Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• Locate noise-generating sources and concrete mixing plants far enough from and downwind of residential areas and camps. • Store fuels and chemicals in areas with impermeable ground, roofs, surrounding banks, and warning signs at least 20 m far from and downwind of residential areas and the camps. • Provide training in fire-fighting to workers and fire-extinguishers for the camps. • Prepare an emergency plan for chemical/fuel spill incident risk before construction begins. • Provide the camps with sufficient supplies of clean water, power, and sanitary facilities. There must be at least one toilet compartment for every 25 workers, with separate toilets for males and females. Workers' beds must be provided with mosquito nets so as to prevent dengue fever. Temporary tents will be unacceptable. • Clean camps, kitchens, baths, and toilets and sanitize regularly, and keep good sanitation. Provide dustbins and collect wastes daily from the camps. Clear drainage ditches around the camps periodically. • Stop all construction activities during rains and storms, or upon accidents or serious incidents. • Contractor to ensure compliance with the requirements and procedures of the project Labor Management Procedure (LMP). • Implement the COVID-19 Preparedness Plan.			
15. Communication to local community	• Maintain open communications with the local government and concerned communities; the contractor shall coordinate with local authorities (leaders of local wards or communes, leader of villages) for agreed schedules of construction activities at areas nearby sensitive places or at sensitive times (e.g., religious festival days). • Copies in Vietnamese of this ESCOP and of other relevant environmental safeguard documents shall be made available to local communities and to workers at the site.	• Decree 144/2021/ND-CP provisions on penalties for administrative violations in the field of security, order and social safety; prevention of social evils; fire protection	Contractor	• PMUW, CSC, IESMC

Issues	Mitigation measures	Vietnamese regulation	Responsibility	Supervised by
	• Provide a community relations contact from whom interested parties can receive information on site activities, Project status and Project implementation results. • Monitor community concerns and information requirements. • Respond to telephone inquiries and written correspondence in a timely and accurate manner. • Inform local residents about construction schedules, interruption of services, traffic detour routes, and demolition, as appropriate. • Limit construction activities at night. When necessary, ensure that night work is carefully scheduled and the community is properly informed so they can take necessary measures. • At least five days in advance of any service interruption (including water, electricity, telephone, bus routes) the community must be advised through postings at the Project site, at bus stops, and in affected homes/businesses. • Provide technical documents and drawings to local authority and community, especially a sketch of the construction area and the ESMP of the construction site. • Notification boards shall be erected at all construction sites providing information about the Project, as well as contact information about the site managers, so that any affected people can have the channel to voice their concerns and suggestions	and prevention; survey, search; prevention of family violence; • ESS10.		

6.2.3.5. Dredging and excavation management

At FS and detail design stage, the Dredging and Excavation Management Plan (DEMP) attached in Appendix 1 will be updated for incorporation into the Bidding document.

After contract signing, the Contractor must prepare a Contractor's DEMP based on the project DEMP and submit to the Construction Supervision Consultant and Project Owner for review and approval before construction commencement.

6.2.3.6. Specific mitigation measures for bridge and local road construction

- The bridge works shall be scheduled to avoid the high river flow season;
- Descriptions on measures for spill prevention, and sedimentation control, surface water flow diversion, reinstatement, etc.
- Local authority and community shall be informed about the construction works the existing bridge with at least two weeks' notice.
- Equip all workers with life jackets, safety belts, ear plugs and other required PPE when building bridge over a river or streamline.
- Ensure adequate lighting at night time.
- Life vests and protective equipment are provided to the workers and enforce the use when working in or above water surface, especially during construction of bridge abutments (2-3m high above the water surface);
- For bridge construction, the waste shall be controlled strictly to restrict discharge or dumping of any wastewater, slurry, waste, fuels and waste oil into the water. All these materials must be collected and disposed of on land at the banks. The slurry and sediment shall also pump to the banks for disposal and shall not be allowed to discharge to the rivers directly;
- After bridge construction, the works area shall be reinstated.
- Concrete mixing directly on the ground shall not be allowed and shall take place on impermeable surfaces;
- All runoff from batching areas shall be strictly controlled, and cement-contaminated water shall be collected, stored and disposed of at an approved site and regulated in the CESMP;
- Unused cement bags shall be stored out of the rain where runoff won't affect it; Used (empty) cement bags shall be collected and stored in weatherproof containers to prevent windblown cement dust and water contamination and then reused for other purposes or sold to waste collector for recycling;
- All excess concrete shall be removed from site on completion of concrete works and disposed of. Washing of the excess into the ground is not allowed. All excess aggregate shall also be removed or resued for back-filling.
- In the course of bore pile driving, the use of bentonite must be conducted inside a cofferdam made of earth or steel to prevent any spillage from overflowing into the environment and all the mixture of soil and bentonite and bentonite spilled over must be collected and the following forms of processing any spillage are recommended:
    - Construction of bridge pier (abutments) on land: spillage of mixture of soil and bentonite although liquefied and bentonite will be primarily handled: Waste solution of bentonite will be collected into a collector drain, sump or cistern to avoid direct discharge within the construction site, then it will be deposited, preliminary dried and transported for disposal at a designated location either for recycling or recovering the bentonite;
    - Construction of piers adjacent to the flow: soil mixed with bentonite, even liquefied, and spilled bentonite will be either moved to storage yards on the shore or placed in containers for depositing or drying and then transported to indicate waste dumps for recycling and recovering the bentonite.

- For any in water construction for bridges, there shall be strict waste control plan to restrict discharge or dumping of any directly discharge of wastewater, slurry, waste, fuels and waste oil into the water. All these materials must be collected and disposed at the banks. The slurry and sediment shall also pump to the banks for disposal and shall not be allowed to discharge to the rivers directly;
- Reinstatement of watercourse crossings shall be carried out, including generic methods for all watercourse crossings and site-specific methods statements for significant or sensitive watercourse crossings;
- After bridge construction, the works area, stream diversion, settlement pond areas and temporary bypasses shall be reinstated to the satisfaction of the ECO and SES.

❖ **Earthworks, Cuts and Fill Slopes Management**

Earthworks, cuts and fill slopes shall be carefully managed to minimize negative impacts on the environment

- All earthworks shall be properly controlled, especially during the rainy season.
- The Contractor shall maintain stable cut and fill slopes at all times and cause the least possible disturbance to areas outside the prescribed limits of the works.
- The Contractor shall complete cut and fill operations to final cross-sections at any one location as soon as possible and preferably in one continuous operation to avoid partially completed earthworks, especially during the rainy season.
- In order to protect any cut or fill slopes from erosion, in accordance with the drawings, cut off drains and toe-drains shall be provided at the top and bottom of slopes and be planted with grass or other plant cover. Cut off drains should be provided above high cuts to minimize water runoff and slope erosion.
- The Contractor shall use the excavated material from for filling unless the CSC consider the material unsuitable for filling;
- Any excavated cut or unsuitable material shall be disposed of in designated disposal areas as agreed to by the CSC;

❖ **Concrete Mixing Stations**

- Construction sites, including concrete mixing stations and asphalt stations will minimize the land occupation by setting them at the interchange areas where relatively large areas of land will be needed eventually.
- Concrete mixing must be done on impermeable ground, waste and waste water containing cement must be collected through drains with slurry sump on-site before being discharged into the receiving source.

  The concrete mixing station must be at least 200 meters away from residential houses or other sensitive buildings such as Buddhist pagodas, churches, temples, school gates, medical facilities and public agencies.

❖ **Rainwater runoff in drilling**

While drilling, all runoff should be directed away from any open excavation. If it rains, rainwater runoff flowing into the bridge foundation can be prevented by the following measures:

- Heavy rain comes during excavation: Use plates for covering the excavated hole so that the rainwater flowing into the hole is at minimum. At the same time, pump the volume of rainwater in the hole to avoid subsidence of the excavated hole's wall, wetting the ground that makes it difficult for soil excavation and transportation.
- Groundwater volume generated at the project area is quite large. The contractor shall use pump to remove the water out of the foundation to sediment tank/pond then be

collected and discharged into regulated site.

❖ **Dismantling of the existing bridge**

- Inform local authorities and people of the dismantling and demolition schedule at least one month before demolition.
- Install and maintain warning signs about bridge demolition on both roadway and waterway.
- Install and maintain solid fences, block access at the two ends of the bridges at least one week before mobilization of machines and construction plants for demolition. Arrange staff to guard the construction site 24 hours a day. Ensure adequate lighting at night.
- Install traffic diversion signs 600m backward away from the bridge before being blocked for demolition and re-construction.
- Start dismantling of the existing bridges only after the new ones are open, access is smooth.
- Installing 2.5m high iron sheets to barrier two approaches to the bridge which are near the residential area to ensure safety for local people during demolition work. The dismantled materials will be reused or sold to authorized company.

❖ ***Spoil Disposal Sites***

If the Contractor proposes any new sites as disposal sites during the construction phase, they have to be approved by PMUW and relevant local authorities. The contractor should ensure that these sites (a) are not located within designated forest or cultivated areas, or any other properties; (b) do not impact natural drainage courses; and (c) where they can cause future slides, (d) do not impact endangered/rare flora. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas. The final use of the disposal site shall be approved by the local government. Besides the requirements for the location of spoil disposal sites, the following actions shall be put into place:

- Land owners shall be compensated if farmland is occupied for disposal sites;
- Before the commencement of the disposal operation, 30 cm of natural soil from the surface shall be first removed and stored at the site. This material will be reserved and used at the end of the disposal operation as cover material for the rehabilitation of the disposal site.
- If the disposal site would be located near a river or water course, a retaining wall and/or interception ditch or settling ponds shall be built prior to the initiation of the construction activities. The surface runoff shall be retained and settled first before allowed discharge into the receiving water;
- To ensure the stability of the spoil disposal site, the mortar rubble masonry pavement and grouted rubble toe protection shall be adopted to prevent erosion and maintain stability.
- A drainage ditch shall be built around the disposal site to control surface runoff;
- The construction of disposal sites and transportation of spoils at night is strictly prohibited near residential areas. The sites shall be watered for dust suppression during their operation;
- Disposal sites close to patches of agricultural land will be limited in size to avoid damages to crops.

6.2.3.7. Site-specific mitigation measures for sensitive receptors

The common impacts of the construction activities on the sensitive receptors and on the people working/using the services of these sensitive receptors are dust and emissions, noise, vibration and impact on extracurricular activities. To minimize these impacts, the contractor should apply

the following measures during the construction phase:

- Try to schedule construction activity avoid the working hours of the sensitive receptors, avoid Soc and Vong day when construct near the pagoda and Sunday when construct near the church.
- Do not load and unload materials and waste within 20m from the sensitive receptors.
- Signs and officials must be arranged to direct the traffic flow on waterway
- Enforce compliance to the workers of conduct particularly with regards to language and behaviors when present in the area near the temple, pagoda, church…

The site-specific mitigation measures for Sensitive receptors are presented in Table 6.3 below:

Table 6.3. Specific mitigation measures for impacts on sensitive receptors

Sensitive receptors	Impacts and Risks	Specific mitigation measures	Responsibility	Supervision
Mang Thit river				
Phat Tanh pagoda 	- Dust and emissions - Noise and odor - Obstruct people's approach to the pagoda on both road and waterway. - Risk of community conflict	- Do not load materials and waste within 20 m from the pagoda - Water the construction areas located within 100m from the temple in hot, dry day - Minimize the volume of materials and wastes temporarily loaded in the area and minimize the activities that generate noise in the 1st and 15th of lunar month - Enforce compliance to the workers of conduct particularly with regards to language and behaviors when present in the area near the pagoda	Contractors	PMUW, CSC, IESMC
Tra On Protestant Church 	- Dust and emissions - Noise and vibration - Risk of community conflict	- Minimize the volume of materials and wastes temporarily loaded in the area and minimize the activities that generate noise on Sunday morning and ceremonies/ events. - Enforce compliance to the workers of conduct particularly with regards to language and behaviors when present in the area near the church	Contractors	PMUW, CSC, IESMC
Nhi My pagoda 	- Dust and emissions - Noise and vibration - Obstruct people's approach to the pagoda on both road and waterway. - Risk of community conflict	- Water the construction areas located within 100 m from the pagoda in hot, dry day - Minimize the volume of materials and wastes temporarily loaded in the area and minimize the activities that generate noise in the 1st and 15th of Lunar month - Enforce compliance to the	Contractors	PMUW, CSC, IESMC

Sensitive receptors	Impacts and Risks	Specific mitigation measures	Responsibility	Supervision
		workers of conduct particularly with regards to language and behaviors when present in the area near the pagoda		
Huong Duong Kindergarten 	- Dust and emissions - Noise and vibration - Community conflict - Impact on extracurricular activities	- Try to schedule construction activity before or after class hours to avoid noise, vibration, and children distraction - Place warning and speed limit signs and reflective fences along the canal at the kindergarten section. - Water the construction areas located within 100 m from the residential area at least triple times in a hot, dry day.	Contractors	PMUW, CSC, IESMC
Tam Binh Hospital 	- Dust and emissions - Noise and vibration - Community conflict	- Try to schedule construction activity avoid the rest hours (11h30-13h; 17h30-7h00 of the next day) to avoid noise, vibration, odor and affect the patient. - Place warning and speed limit signs and reflective fences along the canal at the hospital section. - Water the construction areas located within 100 m from the residential area at least triple times in a hot, dry day.	Contractors	PMUW, CSC, IESMC
Luu Van Liet primary school 	- Dust and emissions - Noise and vibration - Solid waste - Traffic jams, traffic accidents - Impede the access of parents and school staff - Community conflict - Impact on extracurricular activities	- Try to schedule construction activity before or after class hours to avoid noise, vibration, and school children distraction - Arrange staff to direct traffic on this section on peak hours during peak construction period (7h-7h30; 11h-11h30; 13h-13h30; 16h30 - 17h30) - Place warning and speed limit signs and reflective fences along the canal at the school section. - Water the construction areas located within 100 m from the residential area at least triple times in a hot, dry day.	Contractors	PMUW, CSC, IESMC
Tam Binh market	- Dust and emissions - Noise and vibration - Solid waste - Traffic jams, traffic	- Try to schedule construction activity avoid the market hours - Place warning and speed limit signs along the canal at the market	Contractors	PMUW, CSC, IESMC

Sensitive receptors	Impacts and Risks	Specific mitigation measures	Responsibility	Supervision
	accidents - Obstruct the access and trading activities of local people to Tam Binh market - Community conflict - Impacts on trading and goods exchange of local people	section. - Limit pressing horn for vessel when transporting in the canal at the market section - Closely work with local community to ensure the best solution to issues and complaints related to the construction activities - For waterway, signs and officials must be arranged to direct the traffic flow - Conduct successive construction to minimize the business activities in the market - Boats suitable with the area must be arranged so that the loading and unloading activities are facilitated - Compensation for business households if the Project's activities cause interruption to their business in the long run. - Use of temporary market area (if required) to remain the trading activities of local people.		
Tuong Loc Church 	- Dust and emissions - Noise and vibration - Risk of community conflict	- Minimize the volume of materials and wastes temporarily loaded in the area and minimize the activities that generate noise on Sunday morning and ceremonies/ events. - Enforce compliance to the workers of conduct particularly with regards to language and behaviors when present in the area near the church	Contractors	PMUW, CSC, IESMC
Tuong Loc B primary school 	- Dust and emissions - Noise and vibration - Solid waste - Impact on extracurricular activities	- Try to schedule construction activity before or after class hours to avoid noise, vibration, and school children distraction - Arrange staff to direct traffic on this section on peak hours during peak construction period (7h-7h30; 11h-11h30; 13h-13h30; 16h30 - 17h30) - Place warning and speed limit signs and reflective fences along	Contractors	PMUW, CSC, IESMC

Sensitive receptors	Impacts and Risks	Specific mitigation measures	Responsibility	Supervision
		the canal at the school section. - Water the construction areas located within 100 m from the residential area at least triple times in a hot, dry day.		
Nhon Binh B primary school 	- Dust and emissions - Noise and vibration - Solid waste - Impact on extracurricular activities	- Try to schedule construction activity before or after class hours to avoid noise, vibration, and school children distraction - Arrange staff to direct traffic on this section on peak hours during peak construction period (7h-7h30; 11h-11h30; 13h-13h30; 16h30 - 17h30) - Place warning and speed limit signs and reflective fences along the canal at the school section. - Water the construction areas located within 100 m from the residential area at least triple times in a hot, dry day.	Contractors	PMUW, CSC, IESMC
Xuan Hiep A primary school 	- Dust and emissions - Noise and vibration - Impact on extracurricular activities	- Try to schedule construction activity before or after class hours to avoid noise, vibration, and school children distraction - Place warning and speed limit signs and reflective fences along the canal at the school section. - Water the construction areas located within 100 m from the residential area at least triple times in a hot, dry day.	Contractors	PMUW, CSC, IESMC
An Lac pagoda 	- Dust and emissions - Noise and vibration - Obstruct people's approach to the pagoda by waterway. - - Risk of community conflict	- Water the construction areas located within 100m from the temple in hot, dry day - Minimize the activities that generate noise in the 1st and 15th of lunar month - Enforce compliance to the workers of conduct particularly with regards to language and behaviors when present in the area near the pagoda - For waterway, signs and officials must be arranged to direct the traffic flow	Contractors	PMUW, CSC, IESMC
Cho Lach Canal				

Sensitive receptors	Impacts and Risks	Specific mitigation measures	Responsibility	Supervision
Khung Le Kindergarten 	- Dust and emissions - Noise and vibration - Community conflict - Impact on extracurricular activities	- Try to schedule construction activity before or after class hours to avoid noise, vibration, and children distraction - Place warning and speed limit signs and reflective fences along the canal at the kindergarten section. - Water the construction areas located within 100 m from the residential area at least triple times in a hot, dry day.	Contractors	PMUW, CSC, IESMC
Cho Lach Protestant Church 	- Dust and emissions - Noise and vibration - Risk of community conflict	- Minimize the volume of materials and wastes temporarily loaded in the area and minimize the activities that generate noise on Sunday morning and ceremonies/ events. - Enforce compliance to the workers of conduct particularly with regards to language and behaviors when present in the area near the church	Contractors	PMUW, CSC, IESMC
Cho Lach Cathedral 	- Dust and emissions - Noise and vibration - Risk of community conflict	- Minimize the volume of materials and wastes temporarily loaded in the area and minimize the activities that generate noise on Sunday morning and ceremonies/ events. - Enforce compliance to the workers of conduct particularly with regards to language and behaviors when present in the area near the cathedral	Contractors	PMUW, CSC, IESMC
Cho Lach general hospital 	- Dust and emissions - Noise and vibration - Community conflict	- Try to schedule construction activity avoid the rest hours (11h30-13h; 17h30-7h00 of the next day) to avoid noise, vibration, odor and affect the patient. - Place warning and speed limit signs and reflective fences along the canal at the hospital section. - Water the construction areas located within 100 m from the residential area at least triple times in a hot, dry day.	Contractors	PMUW, CSC, IESMC
An Tiem Kao Dai Church	- Dust and emissions - Noise and vibration	- Minimize the volume of materials and wastes temporarily loaded in the area and minimize	Contractors	PMUW, CSC, IESMC

Sensitive receptors	Impacts and Risks	Specific mitigation measures	Responsibility	Supervision
	- Risk of community conflict	the activities that generate noise on Sunday morning and ceremonies/ events. - Enforce compliance to the workers of conduct particularly with regards to language and behaviors when present in the area near the church		
Rach La Canal				
Linh Chieu Pagoda 	- Dust and emissions - Noise and vibration - Obstruct people's approach to the pagoda by waterway. - - Risk of community conflict	- Do not load materials and waste within 20 m from the pagoda - Water the construction areas located within 100 m from the pagoda in hot, dry day - Enforce compliance to the workers of conduct particularly with regards to language and behaviors when present in the area near the pagoda	Contractors	PMUW, CSC, IESMC

6.2.4. Mitigation measures in the operation phase

As mentioned in Chapter 5, potential impacts that can happen in operation phase were considered in the project preparation phase. Therefore, the Proposal covers measures coping with potential impacts and risks during operation phases, along with environmental-friendly solutions and green coverage opportunity. Costs related to mitigation measures were included in the project's cost estimates. Meanwhile, some mitigation measures will be specified in detail design drawing and shopdrawing.

6.2.4.1. Mitigation measures of generic impacts

Mitigation measures for generic impacts are shown in Table 6.4.

Table 6.4. Mitigation measures of generic impacts in operation phase

Generic impacts	Mitigation measures	Implementation	Supervision
Dust and emission Roads, bridges, local roads, improvement of drainage canals	- Regularly clean sand and soil on roads, bridges to reduce dust generation; - Spraying water, washing roads at least once a day in the dry season to minimize dust swept from the surface of bridges/roads; - Transportation vehicles must be covered to avoid material dropping on roads; - Vehicles must be registered to meet the requirements issued by the State; - Plant and maintain trees on both road sides to prevent dust from spreading into people's houses along the roads	- Operation management unit - Local government	- Operation management unit - Local government

Generic impacts	Mitigation measures	Implementation	Supervision
Noise from vehicles The local roads on Mang Thit, Cho Lach, Rach La canal	- Training and raising the awareness of traffic participants. - To arrange suitable speed limit signs in the residential areas. - To arrange signs to prohibit honking when passing through sensitive areas. - Plant and maintain trees on both road sides to prevent noise from spreading into people's houses along the roads	- Operation management unit - Local government	- Operation management unit - Local government
Change in ecological land scape and land use purpose	- Improving people knowledge on socio-economic development opportunity. - Coordinate with local authorities in management, migration and use of land on both sides of the roads and ditches. - Consult and raise awareness of people living near the Project area about the sense of keeping environmental sanitation, ecological landscapes and protection of works.	- Operation management unit - Local government	- Operation management unit - Local government
Risks and incidents in operation phase	***Road safety during operation of road and embankment*** - Improving knowledge of local people on road use regulations and practices via environmental communication on social media. - Monitoring and enforcement of driver speed and behavior. - When traffic volume is high, generation of dust, exhausted gases, noise, and vibration could be an additional issue but this could be mitigated through watering. ***Risks of falling from height (into rivers, streams and drowning*** - Design and erect fences or barrier gate at the up and down steps to the walking paths under the embankment, - Build handrail for bridge - Plug warning signs and install lighting system in the positions. - Place warning signs at high-rise areas and bridges - Educate local communities about this risk in the first operational phase for local people accustomed to this situation. - Taking first aids for persons who get accidents and transporting them to the nearest hospitals and health service units. ***Risks of landslide and subsidence*** - Regularly check locations at risks of landslide, subsidence (bridge abutments, embankments, positions with soft and unstable soil ground).	-	-

Generic impacts	Mitigation measures	Implementation	Supervision
	- Allocate funds for maintenance, carry out periodical maintenance. - Raise awareness of road users not allowed to carrying overload as stipulated. - Check the works before, during and after the rainy/storm season to take appropriate corrective measures. - Coordinate with authorities and people in protection of right of way.		

6.2.4.2. Mitigation of impacts in operation phase of local road and bridge

Mitigation measures for impacts in operation phase of local road and bridge are shown in Table 6.5.

Table 6.5. Mitigation measures of impacts in operation phase of local road and bridge

Impacts, risks	Mitigation measures	Implemented by	Monitored by
Risks of flooding after completion of new roads	- Provide additional drainage culverts across the road with dimension appropriate to the rain intensity and flow rate in the project area, if necessary. - Consult with local authorities and people in the areas which are susceptible to flooding to timely add drainage culverts. - Release the flow at the areas susceptible to flooding before, during and after rainy/stormy season. - Frequently remain the work, bridge and drainage ditches along the road.	- Operation and management unit	- Operation and management unit - Functional agencies
Traffic safety during the operation of local road and Cho Lach bridge	- Raise people's awareness of regulations and practices on road use; - Monitor and follow the driving speeding and behavior; - When the traffic density is high, emitted dusts, exhaust gases, noise and vibration can be problems, but the impacts can be mitigated through provincial long-term plans.	- Operation and management unit	- Operation and management unit - Functional agencies

6.2.4.3. Mitigation of impacts in operation phase of renovated waterways

Mitigation measures for impacts in operation phase of renovated waterways are shown in Table 6.6.

Table 6.6. Mitigation of impacts in operation phase of renovated waterways

Site specific impacts	Mitigation measures	Implemented by	Monitored by
1. Change the flowing, drainage regime	- The Project Owner work with local authorities and people to frequently check the status of the work to promptly detect the risks of erosion due	- Operation and management	- Operation and management

Site specific impacts	Mitigation measures	Implemented by	Monitored by
	to the flow. - Periodically maintain, arrange suitable budget to implement the maintenance operation of waterways.	unit - Local authorities	unit - Functional agencies
2. Impacts on aquatic ecosystem and sources of fishery products	- Communicate, raise local people's awareness of environmental protection, especially water quality. - Collect bags, excess foods in the course of production, do not indiscriminately littering to surrounding areas or river/canals. - Communicate, raise people's awareness of maintenance of traffic vehicles (boats) to limit the oil leakage into river/canals. - Domestic wastewater of local people whould be collected to area drainage system, to avoid flowing to surrounding channels. - Recommend funding plan to the management unit to study the aquatic resources in river/canals to re-assess the fluctuation (if any) about the species and their distribution; complete the database on the aquatic resources in the area; - Comply with the aquatic development plan and sustainably manage the aquatic resources in Mang Thit, Cho Lach, Rach La, Ky Hon, Tac Cua routes.	- Operation and management unit - Local authorities	- Operation and management unit - Functional agencies
3. Impact on waterway traffics	- Communicate, raise people's awareness of agricultural product transportation: Strictly comply with traffic safety, do not carry over-load as prescribed, etc. - Equip appropriate waterway traffic signs in areas with high traffic density. - Communicate, raise people's awareness of maintenance of waterway vehicles.	- Operation and management unit - Local authorities	- Operation and management unit - Functional agencies
4. Risks of falling into the river and drowning	- Design and build handrail or prevention items, especially at steps of the path below the embankment. - Build bridge handrail - Erect warning signs and install lighting system in different positions. - Place warning signs in high-elevation positions and bridge - Communicate the risks in the initial operation phase for local people to acknowledge and get along well with this situation. - Provide first aid for victims and transfer them to the nearest hospital or medical service units.	- Operation and management unit - Local authorities	- Operation and management unit - Functional agencies

6.2.5. Measures to address Climate change issues

Guidelines on the process of integrating climate change issues in to road project design and implementation have been developed as part of the "Guidelines on Improvement and

Rehabilitation of Local Roads". The document was developed as a technical assistance provided under the World Bank-financed Local Road Assets Management Program (LRAMP). That Guidelines have been officially adopted by the Directorate Road of Vietnam (DRVN) thus should be applied during SWLCP implementation. Below are some key contents of the Guidelines,

The Guidelines are applicable to roads, bridges, tunnels and bypasses. Climate aspects covered under that guidelines include sea level rise, storms and tropical cyclones, changes of rainfall in relations to flooding risks, landslides, increased ambient air temperature, weather extreme events and earth quakes. Socio-economic and domestic background are taken into account in the process. The examples of climate change impacts on the proposed road project are:

- Reduce the level of road safety and connectivity due to prolonged land slides and flooding;
- Connectivity between the project areas with the others is disrupted due to severe damages of the roads
- The road is not sustainable and require high costs for upgrading or repair, i.e. drainage system is degraded and become in effective after increased rainfalls in peak days.
- Increase repair and maintenance costs due to land slides

According to the Guidelines, the vulnerability of local communities to climate change may be caused by the followings, taking into account the probability of occurrence:

- Increased flooding in the area due to reduced permeable surface areas
- Increased accessibility to ecologically sensitive sites that leads to environmental degradation and threats to the buffer zones that provide flood or drought mitigation functions
- Degradation of drinking water supply sources and the environment, the ecosystems associated with increased population along the alignment of the proposed road.
- Microclimate alterations.

For setting adaptation targets, the following aspects could be considered:

- Temperature variations: the increases of ambient air temperature in the hot season and reduce in the cold season, or maximum temperature, or the numbers of very hot durations may affect the construction schedule, reduce the durability and life expectancy of road and bridge structures (distortions caused by expansions of materials/connections under the heat);
- Changes in rainfall (increase in rainy season) leads to increased flow rate intensity that could result in more prolonged and deeper inundation, delays in construction progress, increased erosion and landslide risks. The consequences would be threats to the stability of the road base, road infrastructure and traffic disruptions;
- Increased intensity and frequency of weather extreme events including floods would affect drainage system, damage the roads and bridges, disrupt traffic;
- Sea level rise may increase flooding and inundation risks in riverside areas, reduce drainage capacity and increase salinity intrusion. These affect the road structures, corrode steel structures and the steels in reinforced concrete structure. As the result, roads would be degraded or damaged sooner
- Faster and stronger currents may affect the abutments and piles of the bridges, increase erosion risks of riverside roads;

The Guidelines proposed three types of solutions for climate change adaptation, including (i): Technical (select design standards to be applied, design of road base structure and road surface, material standards and specifications, design of dimensions and cross section, drainage and protective structures; (ii) Non-technical solutions: prepare and implement plans for maintenance and early warning, natural hazard and emergency preparedness, carry out adjustments of road alignment, masterplan or land use plan, environmental management; and (iii) non-intervention solutions: to be applied when the impacts of climate change is beyond project and the nature of the changes is not clear, or the costs overweigh adaptation benefits.

The guidelines considered consultation and awareness raising as an important step in the process. The final step is the preparation of implementation schedule and institutional arranges.

The key steps of the process for incorporation of the Climate Change issues into project design and implementation are presented in the diagram below, detail explanations are provided in Section 4 of the Guidelines document.

6.3. ENVIRONMENTAL AND SOCIAL COMMITMENT PLAN

The project owner has developed and will implement an Environmental and Social Commitment Plan (ESCP), which will set out measures and actions required for the project to achieve compliance with the ESSs over a specified timeframe. The ESCP has been agreed with the Bank and will form part of the legal agreement. The ESCP has been disclosed locally at the project sites and at the WB external website.

The ESCP takes into account the findings of the Environmental and Social Impact Assessment (ESIA), the Bank's environmental and social due diligence, and the results of engagement with stakeholders. It is an accurate summary of the material measures and actions required to avoid, minimize, reduce or otherwise mitigate the potential environmental and social risks and impacts of the project. The ESCP also sets out a process that allows for adaptive management of proposed project changes or unforeseen circumstances.

The project owner will implement diligently the measures and actions identified in the ESCP in accordance with the timeframes specified, and will review the status of implementation of the ESCP as part of its monitoring and reporting.

The project owner will notify the Bank promptly of any proposed changes to the scope, design, implementation or operation of the project that are likely to cause an adverse change in the environmental or social risks or impacts of the project. The project owner will carry out, as appropriate, additional assessment and stakeholder engagement in accordance with the ESSs, and propose changes, for approval by the Bank, to the ESCP and relevant management tools, as appropriate, in accordance with the findings of such assessments and consultation. The updated ESCP will be disclosed.

The project owner will monitor the environmental and social performance of the project in accordance with the legal agreement (including the ESCP). The extent and mode of monitoring will be agreed upon with the Bank, and will be proportionate to the nature of the project, the project's environmental and social risks and impacts, and compliance requirements. The project owner will ensure that adequate institutional arrangements, systems, resources and personnel are in place to carry out monitoring. Where appropriate and as set out in the ESCP, the project owner will engage stakeholders and third parties, such as independent experts, local communities or NGOs, to complement or verify its own monitoring activities. Where other agencies or third parties are responsible for managing specific risks and impacts and implementing mitigation measures, the project owner will collaborate with such agencies and third parties to establish and monitor such mitigation measures.

6.4. ROLES AND RESPONSIBILITITES FOR ESMP IMPLEMENTATION

6.4.1. Institutional Arrangements

The tables and figures below summarize the roles and responsibilities of the key stakeholders and their relationships during the implementation of the environmental and social management plan.

- Contractors will be responsible for implementing mitigation measures. These measures will be included in bidding documents and their costs are included in construction bid packages;
- CSC will be responsible for monitoring the day-to-day implementation of mitigation measures. Related costs are included in the CSC's service contract;
- IESMC will be responsible for overall environmental monitoring which includes support to the PMUW in implementing environmental and social supervision and monitoring, and responsible for reporting on the implementation through monitoring reports.

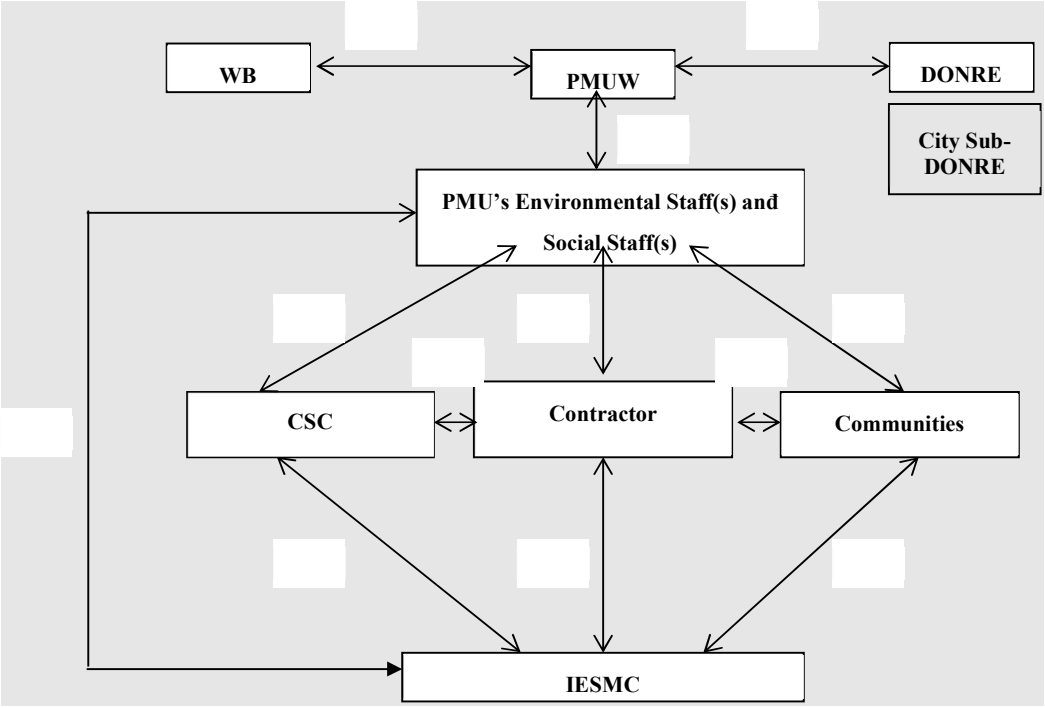

Figure 6.1. Organization diagram for ESMP Implementation

6.4.2. Roles and responsibilities

Specific responsibility of stakeholders is shown in Table below.

Table 6.7. Annotation on Roles and Responsibilities

Stakeholder	Responsibilities
PPC	Overall responsible for environmental safeguard compliance of the Project
PMUW	Be responsible for monitoring the overall Project implementation, including environmental and social compliance. PMUW will be responsible for ESMP implementation and environmental and social performance of the Project during the construction and operational phases:

Stakeholder	Responsibilities
	(i) closely coordinate with local authorities in the participation of the community during Project implementation; (ii) Ensure that the detailed design include all environment mitigation measures proposed in the ESMP; (iii) monitor and supervise to ensure adequate contents of ESMP are incorporated into bidding and contractual documents; (iv) ensure that an environmental management system is set up and functions properly; (v) Report on ESMP implementation to DONRE and the WB. (vi) Implement diligently the measures and actions identified in the ESCP in accordance with the timeframes specified, and will review the status of implementation of the ESCP as part of its monitoring and reporting.
PMUW Environmental and Social Staff(s) (ES)	Be responsible for monitoring the implementation of the Project ESMP. Specifically, ES will be responsible for: (i) Monitor the incorporation of ESMP into the detailed technical designs and civil works bidding and contractual documents; (ii) Monitor the incorporation of ESMP and monitoring and supervision into the TORs, bidding and contractual documents for the Construction Supervision Consultant (CSC) and other safeguard consultant (IESMC); (iii) provide inputs to the consultant selection process; (iv) review reports submitted by the CSC and safeguard consultants; (v) conducting supervision and monitoring and recommending corrective action. The EO and SO will be supported by the IESMC in this regard. (vi) Carry out the field visits to certify compliance or recommend corrective/improvement actions (vii) propose solutions to handle social and resettlement issues of the Project; and (viii) prepare environmental and social performance section on the progress and review reports to be submitted to the DONRE and the World Bank.
Contractors	- Assign Environmental, Social Health and Safety (EHS) staff to monitor contractor's compliance to ESIA/ESMP. - Prepare Contractor ESMP (CESMP) for each construction site area, submit to PMUW and CSC for review and approval before commencement of construction. - Obtain all permissions for construction (traffic control and diversion, excavation, labor safety, etc. before civil works) following current regulations. - Implement the mitigation measures specified in the ESMP, CESMP, bidding documents, RP, SEP, EM plan, etc. - Actively communicate with local residents and authorities and take actions to address their ESHS concerns during construction. - Ensure that all staff and workers understand the procedure and their tasks in the environmental management program. - Carry out the field visits to certify compliance or recommend corrective/improvement actions - Report to the PMUW and CSC on any difficulties and their solutions. - Report to PMUW and CSC if environmental accidents occur and coordinate with agencies and keys stakeholders to resolve these issues.

Stakeholder	Responsibilities
	- Assign a Safety, Social and Environmental Officer (SEO) - Assign a focal point for grievances
Construction Supervision Consultant (CSC)	- Assign qualified Environmental and Social Staff(s) to supervise the implementation of ESMP and ensure compliance - The CSC will assign a social staff to oversee and coordinate social/resettlement aspects of the Project; - Be responsible for routine environmental and social supervision and reporting during construction phase. - Assist the PMUW in reporting and maintaining close coordination with the local community. - Arrange, implement training on HIV/AIDs awareness raising for all workers, CSC team and PMUW staff. The cost for this training included in the consulting service contract. - Carry out the field visits to certify compliance or recommend corrective/improvement actions - Carry out the periodical environmental quality monitoring during construction period and first-year-operation, prepare periodical environmental monitoring and supervision reports for submission to Vietnamese authorities.
Independent Environmental and Social Monitoring Consultants (IESMC)	- Provide support to PMUW to establish and operate an environmental management system, coordinate with the CSC team to provide trainings to the Contractors on project environmental management requirements - Provide training, implement capacity building activities for relevant agencies during Project implementation, carry out random field visits to certify compliance or recommend corrective/improvement actions. - Prepare monitoring reports after each visit.
Local Community	- Participate in volunteer community environmental and social monitoring.
Provincial DONRE	Monitoring compliance with the Government environmental requirements.
District Natural Resources and Environment Division	- Monitor and inspect environmental safety assurance activities in the project area - Check and handle violations. - Guide ward/communal staff in charge of environmental management in the locality. - Periodically report to the Department of Natural Resources and Environment on arising environmental issues. Coordinate with stakeholders, participate in research and inspection, and resolve arising environmental incidents.
Environmental Police Division	- Coordinate with relevant departments and agencies to monitor, control and resolve violations to the Environment Law. Handle serious violations, investigate responsibilities of related parties as well as take part in solving serious environmental incidents.
Public Utility Companies (electricity, water supply, drainage, telecommunications, etc.)	- Coordinate with the PMUW and the Contractor to carry out relocation of underground works and set up temporary connections at proposed crossings to ensure the continuous provision of basic services for people's lives. Take part in dealing with related incidents (fire and explosion of electric cables, breaks of telecommunication cables, water pipe cracks, etc.

6.5. ENVIRONMENTAL AND SOCIAL COMPLIANCE FRAMEWORK

6.5.1. Environmental duties of the PMUW/Detail design consultants

In the process of preparing TOR for consulting services and construction bidding documents, PMUW will work closely with consultants to ensure: i) contract packaging and cost estimations includes ESMP implementation, including the services of independent safeguard monitoring, environmental sampling/monitoring and compliance supervision, reporting etc.; ii) ESCOPs and relevant common as well as site-specific mitigation measures are incorporated into the bidding documents; iii) environmental supervision and training are included in the scope of works assigned to the construction supervision consultant.

At feasibility study/detail engineering design stage, the PMUW shall work closely with the feasibility study consultants and detail design engineers to ensure that the greening/landscaping, environmentally friendly solutions and relevant mitigation measures proposed in the ESIA/ESMP are considered and incorporated into the engineering design as appropriate.

During construction phase, the PMUW shall work closely with the supervision consultant to monitor the compliance of contractors and report to relevant authorities. PMUW will also direct the supervision consultant and contractors on the actions to be undertaken in case when issues are arisen, incidents or accidents etc. The PMU is also responsible for ensuring effective implementation of the LMP during construction.

The PMUW will assign at least one staff with suitable qualifications to be Environmental Officer (EO) and one staff with suitable qualification to be Social Officer (SO) throughout project implementation.

- The EO will oversee environmental issues and monitor safeguard compliance of the Project. The EO will be supported by the Independent Environmental Monitoring Consultant, the Environmental Officers of the construction supervision team as well as the contractors.
- The SO will oversee and coordinate social/resettlement aspects of the Project. The SO will be supported by the Independent Resettlement Monitoring Consultant, the social staffs of the construction supervision team/contractors.

6.5.2. Environmental and Social Duties of the Contractor

The contractor firstly shall adhere to minimize the impact that may result from project construction activities and secondly, apply the mitigation measures under the ESMP to prevent harm and nuisances on local communities and environment caused by the impacts in construction and operation phases.

Remedial actions that cannot be effectively carried out during construction should be implemented upon completion of the works (and before issuance of the Works Acceptance Certificates).

The Contractors' duties include but not limit to:

- Comply with relevant legislative requirements governing the environment, public health and safety;
- Ensure satisfactory implementation of the project LMP;
- Work within the scope of contractual requirements and other tender conditions;
- Organize representatives of the construction team to participate in the joint site inspections undertaken by the Environmental Supervisors (ES) of the CSC;
- Carry out any corrective actions instructed by the Environmental Officer (EO) Social Officer (SO) of the PMUW and the ES;
- In case of non-compliances/ discrepancies, carry out investigation and submit proposals on

mitigation measures, and implement remedial measures to reduce environmental/social impacts;

- Stop construction activities, which generate adverse impacts, upon receiving instructions from the EO and the ES. Propose and implement corrective actions and carry out alternative construction methods, if required, to minimize the environmental impacts; Non-compliance by the Contractor will be cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of the EO and the ES.
- In case the contractor proposes to use source of raw materials that have not been covered in Project ESIA, the contractor will report to the CSCs and PMUW and coordinate with them in carrying out due–diligence environmental review of these materials sources to assess their compliance to national environmental requirements. Only complied sources can be used under this project.
- The contractor shall be responsible for implementation of corrective measures at his costs. The contractor shall also be responsible for paying the costs of damages caused by non-compliance to ESMO and/or applicable environmental regulations.

6.5.3. Contractor's Environmental and Social Management Plan (CESMP)

After contract signing, the contractor will be required to prepare and submit a contractor's site-specific Environmental and Social Management Plan (CESMP) for each contract package and submit to the CSC and PMUW for review and clearance, as well as submission review by the Bank for alignment with ESF requirements.

The objective of the Contractor Environmental and Social Management Plan (CESMP) is to provide information for environmental and social management during the proposed works/activities on site of SWLCP. This is to ensure that the Contractor (and any subcontractors) have minimal impact on the environment. The CESMP will detail how the contractor will mitigate construction impacts and documents the contractor's response to inspecting, monitoring, verifying, internal auditing and correcting or improving environmental and social performance. The CESMP must be site-specific and should include details of control measures that will be implemented on site to minimize any potential environmental impacts from the proposed works/activities. If the proposed works/activities contained within the CESMP are altered during the Contract, the CESMP will be required to be modified by the Contractor to reflect these changes or modifications. The contents of the CESMP should include the following:

(i) A statement of policy, providing a definition of the Contractor's environmental policy and an indication of commitment to the execution of its Site Environmental Management Plan.

(ii) A brief document description; Date of issue; Revision status; Distribution list; and preparation personnel details and signoff.

(iii) Applicable laws and regulations associated with the requirements in the Project ESMP. Identification of the contractor licenses, permits and approval associated with the CESMP.

(v) Details on how the environmental and social impacts identified in the Project ESIA will be managed on site, including: 1) the site-specific measures to mitigate impacts during construction; 2) ESCOPs; 3) the Contractor ESMP to be developed after the contractor is selected and before construction starts; and 4) the Contractor's Dredging and Excavation Management Plan is required to develop.

(vii) Detailed environmental and social training that all site contractor personnel (including subcontractors) are required to undertake. As a minimum all contractor personnel working at the Project sites must: i) be familiar and understand the CESMP for the works; ii) be aware of their environmental responsibilities and legal obligations on site; and iii) undertake health and safety and emergency response training.

(viii) Specific capabilities, support mechanisms and resources necessary to satisfactorily implement the CESMP. Detailed environmental and social responsibilities of all contractor personnel including subcontractors working on site with appropriate knowledge, skills and training for specific tasks shall be identified.

(ix) The contractor shall be responsible for preparing monthly environmental reports, as a section within the Progress report required in the bidding document, including accident and incident reporting if any, for submitting to the Project owner. The contents of these reports may include following details:

- Implementation of the Contractor's CESMP complying with the agreed program;
- Any difficulties encountered in the implementation of the CESMP and recommendations for remedying them for the future;
- The number and type of non-compliances and proposed corrective actions;
- Reports from the Subcontractors involved in the implementation of the CESMP, including minutes of meetings and discussions held by the Contractor;
- Minutes of meeting from discussions held with the Project owner regarding implementation of the CESMP.
- Implementation of the Worker Code of Conduct and Occupational Health and Safety Management Plan including Community Safety.

6.5.4. Contractor's Safety, Social and Environmental Officer (SSEO)

The contractor shall be required to appoint competent staff(s)as the Contractor's on-site safety, social and environment officer (SSEO). The SSEO must be appropriately trained in environmental management and must possess the skills necessary to transfer environmental management knowledge to all personnel involved in the contract. The SSEO will be responsible for monitoring the contractor's compliance with the ESMP requirements and the environmental specifications. The duties of the SSEO shall include but not be limited to the following:

- Carry out environmental site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to pollution control and adequacy of environmental mitigation measures implemented;
- Monitor compliance with environmental protection measures, pollution prevention and control measures and contractual requirements;
- Monitor the implementation of environmental mitigation measures;
- Prepare audit reports for the site environmental conditions;
- Investigate complaints and recommend any required corrective measures;
- Advise the contractor on environment improvement, awareness and proactive pollution prevention measures;
- Recommend suitable mitigation measures to the contractor in the case of non-compliance. Carry out additional monitoring of noncompliance instructed by the ES of PMUW and CSC
- Inform the contractor and ES (of PMUW and CSC) of environmental issues, submit contractor's ESMP Implementation Plan to the ES of PMUW and CSC, and relevant authorities, if required;
- Keep detailed records of all site activities that may relate to the environment.
- Employ or appoint qualified staff to undertake necessary actions and measures to ensure labor related issues, such as occupational safety and health expert (s) to manage OHS issues.
- Prepare a labor management procedure (Contractor's LMP) and an C-ESMP (Contractor's

ESMP) including OHS regulations)[37] which will apply to their contracted workers who work on the projects.

- Submit Contractors' LMP and C-ESMP to PMUW/CSC for review and approval prior to commencing staff mobilization to the project site for the awarded assignments.
- Supervise subcontractors' construction works, including their implementation of the Contractor's LMP and C-ESMP.
- Maintain recruitment and employment records for contracted workers (including subcontractors), including documentation that verify minimum labor age as set forth in this LMP.
- Provide regular training to contracted workers on issues, but not limited to, such as occupational safety and health, and other social risks such as GBV, SEA/SH, code of conduct to maintain good relationship with local community, etc.
- Require primary supplier to identify and address risks of child labor, forced labor, GBV, SEA/SH, and occupational safety and health for primary supply workers.
- Develop and implement the grievance mechanism based on the GRM set forth in this LMP for contracted workers, including ensuring that grievances received from contracted workers are resolved promptly, and reporting the status of grievances and resolutions to the CSC and PMUW. This grievance mechanism will be part of the Contractor's LMP.
- Ensure that all contractor and subcontractor workers understand and sign the Code of Conduct prior to the commencement of works,
- Implement all necessary measures to address the risks of sexual exploitation and abuse (SEA)/sexual harassment (SH) as specified in the contractor's LMP/C-ESMP and ensure full implementation of these measures.
- Report timely to PMUW any accidence happened in their construction work place and on the performance of labor and occupational safety and health.
- Develop plans and take actions for prevention and mitigation of COVID-19 outbreaks.

❖ ***Incident reporting***

The contractors are required to inform the Construction Supervisors and the Employer any incidents listed below within agreed timeframe:

- Any violations to national laws, regulations or international agreements.
- Any serious accidents or fatalities.
- Significant impacts that cause losses to personal property such as traffic accidents, damages to local houses/roads and other incidents.
- Serious surface/ground water pollution.
- Failures of embankments at disposal sites that cause serious pollutions to the surroundings
- Bush fire related to worker's behaviors/labor influx
- Any claims related to sexual harassment, child abuse or any other incidents related to children.
- Receive a complaint about pollution or damages.

[37] The Contractor's LMP and the Contractor's ESMP may be prepared as separate documents or integrated into a single document.

6.5.5. Independent Environmental and Social Monitoring Consultant (IESMC)

An IESMC shall be contracted PMUW to provide some environmental safeguard training for PMUW staff and carry out environmental auditing. The IESMC shall carry out the monitoring, including:

- Provide support to PMUW to establish and operate an environmental management system, coordinate with the CSC team to provide trainings to the Contractors on project environmental management requirements
- Provide training, implement capacity building activities for relevant agencies during Project implementation, carry out random field visits to certify compliance or recommend corrective/improvement actions
- Provide training for PMUW and the CSC, and the representatives of the Contractors on socio-environmental, health and safety issues related to construction;
- Evaluate environmental quality at the areas affected by the construction activities (including site observations, reviewing environmental quality data provided by the CSC, review of other available documents, and supplement sampling if necessary);
- Review contractor's environmental compliance including the implementation of mitigation measures and documentation;
- Review PMUW and CSC compliance to ESMP.
- The IESMC will also provide technical advice and assistance to the PMUW and the EO and SO in environmental and social matters.

6.5.6. Environmental Supervision during Construction (CSC)

During construction phase, a qualified CSC reporting to the PMUW shall carry out the environmental and social supervision. The CSC will assign environmental and social staff(s), will be responsible for inspecting, and supervising all construction activities to ensure that mitigation measures adopted in the ESMP are properly implemented, and that the negative environmental and social impacts of the Project are minimized. The CSC shall engage sufficient number of Environmental Supervision Engineers with adequate knowledge on environmental protection and construction project management to perform the required duties and to supervise the Contractor's performance. Specifically, ES of CSC will:

- Review and assess on behalf of the PMUW whether the construction design meets the requirements of the mitigation and management measures of the ESMP,
- Review and clear contractor's C-ESMP;
- Coordinate with PMUW Environmental Officer (EO) in reviewing environmental compliance at newly proposed borrow pits and quarries and advise PMUW on whether these are eligible for use by the Project;
- Verify and confirm with PMUW environmental and social supervision procedures; parameters, monitoring locations, equipment and results;
- Supervise contractor's implementation of its CESMP including their performance, experience and handling of site environmental issues, and provide corrective instructions;
- Arrange, implement training on HIV/AIDs awareness raising for all workers, CSC team and PMUW staffs;
- Arrange, implement training on COVID-19 awareness raising for all workers, CSC team and PMUW staffs;
- Implement the environmental quality sampling and prepare periodical environmental monitoring reports, including reports on ESMP implementation status to the PMUW

and prepare environmental supervision statement during the construction phase; and

- Review payment requests related to environmental mitigation costs if applicable.

6.5.7. Compliance with legal and contractual requirements

The constructions activities shall comply not only with general contractual condition on environmental protection and pollution control requirements in the bidding document, the Project's ESCP, ESIA/ESMP, and the C-ESMP, but also with environmental protection and pollution control laws of the Socialist Republic of Viet Nam and ESF requirements.

All the works method statements submitted by the Contractor to the CSC and PMUW for approval to see whether sufficient environmental and social protection and pollution control measures have been included.

The CSC and PMUW shall also review the progress and program of the works to check that relevant environmental laws have not been violated, and that any potential for violating the laws can be prevented.

The Contractor shall copy relevant documents to the SEO and the ES of CSC and PMUW. The document shall at least include the updated work progress report, the updated work measure, and the application letters for different license/permits under the environmental protection laws, and all the valid license/permit. The SEO and the ES shall also have access, upon request, to the Site Log-Book.

After reviewing the documents, the SEO or the ES shall advise the PMUW and the contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the SEO or the ES concludes that the status on license/permit application and any environmental protection and pollution control preparation works may not comply with the work measure or may result in potential violation of environmental protection and pollution control requirements, they shall advise the Contractor and the PMUW accordingly.

6.5.8. Penalty System

The bidding documents would require the Contractor to arrange for Environmental, Social, Health and Safety (ESHS) Performance Security at the amount of 1 to 3% of the contract value. In case that serious non-compliance, environmental pollution or social issues are detected and the contractor do not correct them within an allowed timeframe, the budget from ESHS Performance Security will be used to pay for a third party mobilized by the PMUW to address these issues.

On the other hand, if non-compliance with the Contractor's ESMP and environmental regulations are discovered by CSC/ES/IESMC/PMUW during the site supervision, up to 2% values of interim monthly payment of the contractor will be held back. The Contractor will be given a grace period (determined by CSC/PMUW) to repair the violation. If the Contractor satisfactorily performs the repairs within the grace period (confirmed by CSC/PMUW), no penalty is incurred and the upholding money will be paid to the Contractor. However, if the Contractor fails to successfully make the necessary repairs within the grace period, the Contractor will pay the cost for a third party to repair the damages (deduction from their payment).

In case of IESMC/CSC/PMUW not detecting non-compliances with environmental regulations of the contractor, they will be responsibility payment to repair the violation.

Based on this Environmental and Social Compliance Framework including the penalty system the CSC will develop a detailed penalty system for environmental and social non-compliance and submit it to the PMUW for approval to put into implementation.

6.5.9. Reporting Arrangements

The Project Management Unit of Waterways (PMUW) is responsible for conducting internal monitoring of the implementation of the RP. In addition, the PMUW will hire an external monitoring agency (EMA) to undertake independent monitoring of the process of RP implementation and to assess living standard of the affected people during and after the completion of the resettlement.

Both internal and external (independent) monitoring will regularly (on a monthly basis for internal and biannual basic for independent monitoring). An end-of-project evaluation on the implementation of resettlement is required and report will be prepared to confirm whether the objectives of ESS5 were achieved.

ESMP monitoring and reporting requirements are summarized in table below.

Table 6.8. Regular Reporting Requirements

No.	Report Prepared by	Submitted to	Frequency of Reporting
1	Contractor to the Employer	PMUW	Once before construction commences and monthly thereafter
2	Construction Supervision consultant (CSC)	PMUW	Weekly and monthly
4	Community	PMUW	After each periodical monitoring
5	IESMC	PMUW	Every three-month
6	PMUW	DONRE	Every six-month
7	PMUW	WB	Every six-month

6.6. ENVIRONMENTAL AND SOCIAL MONITORING PROGRAM

The environmental monitoring and supervision for construction phase for the entire project is presented in the below table. Sampling locations are described in the Annex 5 and the number of samples are made in accordance with progress of each work. The environmental management and monitoring will be carried out by the PMUW as the Project Owner.

Table 6.9. The environmental monitoring and supervision for construction phase

Monitored items	Construction phase
I. Loal road	
Monitoring of air quality, noise, vibration	
1. Monitoring parameters	TSP, CO, NO_2, SO_2, Noise (L_{eq}), vibration (with description of micro climatic conditions during environmental monitoring)
2. Monitoring frequency	Measurements taken **every three-months**, the first monitoring at each work item will be within one month since construction commencement and will continue through the construction period of each local road.
3. Applied Regulation	QCVN 05:2013/BTNMT, QCVN 06:2009/BTNMT; QCVN 26:2010/BTNMT; QCVN 27:2010/BTNMT
4. Monitoring positions	5 samples, of which: + 02 samples at the construction areas of the local road on Mang Thit river, closest to residential area. + 01 sample at the construction area of the local road on Cho Lach canal, closest to residential area. + 01 sample at the construction area of the local road on Rach La canal, closest to residential area.

II. Dredging works	
Surface Water Quality Monitoring on Mang Thit, Cho Lach, Rach La, Ky Hon, Tac Cua canal/river	
1. Monitoring parameters	pH, DO, turbidity, COD, BOD_5, TSS, $N\text{-}NH_4^+$, $N\text{-}NO_3^-$, $P\text{-}PO_4^3$, oil & grease, Coliform
2. Monitoring frequency	Measurements taken **every three-months**, start as early as possible after contract signing and continue through the dredging duration in each waterway. Besides, pH and turbidity should be done daily by the contractor when dredging is taking place by using portable equipment: Measure 01 sample from 25 to 50m from the dredging site and 01 sample from about 500m downstream from the dredging site (in the direction of the main stream)
3. Applied Regulation	QCVN 08-MT:2015/BTNMT
4. Monitoring Locations	10 samples, of which: + 01 sample around the dredging location and 01 sample at 300m from dredging location to the downstream of Mang Thit river. + 01 sample around the dredging location and 01 sample at 300m from dredging location to the downstream of Cho Lach canal. + 01 sample around the dredging location and 01 sample at 300m from dredging location to the downstream of Rach La canal. + 01 sample around the dredging location and 01 sample at 300m from dredging location to the downstream of Ky Hon canal. + 01 sample around the dredging location and 01 sample at 300m from dredging location to the downstream of Tac Cua river
Sediments on waterways	
1. Monitoring parameters	As, Hg, Cd, Pb
2. Monitoring frequency	Measurements taken **every three-months**, start as early as possible after contract signing and continue through the dredging duration in each waterway.
3. Applied Regulation	QCVN 43:2017/BTNMT
4. Monitoring Locations	05 samples at 05 dredging sites (01 sample from the dredged/excavated material at each construction site).
Fish and aquatic life	- Mobilizing one fisheries and aquaculture monitoring expert (can be the expert in the independent environmental and social monitoring expert team). Every quarter, this expert will collect/consolidate data from the community monitoring group (as presented below); and will annually conduct basic survey on the quantity and yield of fishes in the project area. Scope of survey will be determined during the preparation of the detail design, then specified in the TORs for IESMC. - Mobilizing the community's involvement in monitoring: In each commune project, two to three people will be mobilized to participate in monitoring, of which one person is a staff in charge of aquaculture/fishing activities in the commune and one or two people are members from regular fishing households on Mang Thit, Cho Lach, Rach La, Ky Hon, Tac Cua river/canal. These people will record species and catches on the river every week or every month depending on the fishing season and will provide information to the fisheries monitoring expert mentioned below. - Report shall be formulated once a year in the dry season: before, during and after construction (before the project is completed).
Leakage wastewater from the disposal sites	

1.Monitoring parameters	pH, TSS, As, Hg, Cd, Pb
2. Monitoring frequency	Measurements taken **every three-months**, start as early as possible after contract signing and continue through the dredging duration in each waterway.
3. Applied Regulation	- QCVN 40:2011/BTNMT
4. Monitoring Locations	- The locations will be updated in the Basic Design phase as per actual condition of disposal sites. - Generally, 01 sample for each disposal site at the discharge point of the leakage wastewater from the disposal sites
III. Construction of embankments	
Monitoring of air quality, noise, vibration	
1. Monitoring parameters	TSP, CO, NO_2, SO_2, Noise (L_{eq}), vibration
2. Monitoring frequency	Measurements taken **every three-months**, start as early as possible after contract signing and continue through the embankment construction period in each waterway.
3. Applied Regulation	QCVN 05:2013/BTNMT, QCVN 06:2009/BTNMT; QCVN 26:2010/BTNMT; QCVN 27:2010/BTNMT
4. Monitoring Locations	6 samples at embankment locations in Mang Thit, Cho Lach, Rach La river/canal, closest to the current residential area, 2 sample at the starting point and middle point of each site.
IV. Construction of bridge	
Monitoring of air quality, noise, vibration	
1. Monitoring parameters	TSP, CO, NO_2, SO_2, Noise (L_{eq}), vibration
2. Monitoring frequency	Measurements taken **every three-months**, the first monitoring at each work item will be within one month since construction commencement and will continue through the construction period of bridge.
3. Applied Regulation	QCVN 05:2013/BTNMT, QCVN 06:2009/BTNMT; QCVN 26:2010/BTNMT; QCVN 27:2010/BTNMT
4. Monitoring Locations	02 samples in the construction site (01 sample in the middle of the construction site and 01 sample nearest the resident area)
Surface Water Quality Monitoring	
1. Monitoring parameters	pH, DO, COD, BOD_5, TSS, $N\text{-}NH_4^+$, $N\text{-}NO_3^-$, $P\text{-}PO_4^3$, oil & grease, Coliform, Fe
2. Monitoring frequency	Measurements taken **every three-months**, start as early as possible after contract signing and continue during the entire construction phase of Cho Lach bridge.
3. Applied Regulation	QCVN 08-MT:2015/BTNMT
4. Monitoring Locations	02 samples: 01 under the bridge construction site and 01 sample at 300m from the construction site to the downstream.

6.7. SAFEGUARD CAPACITY BUILDING PROGRAM

PMUW's E&S staff has already had much experience with the E&S requirements of the World Bank with theold OP. However, this project is the first case that apply the new ESF. PMUW's E&S capacity assessment conducted during project preparation revealed the need for further capacity building in specific ESSs during project implementation. Such gaps will be addressed through capacity building program as part of the ESMP.

The Table below proposed a training program on E&S. Detail training programs will be developed and implemented by IESMC team in coordination with the CSC Environmental and

Social Officer.

- *Trainee groups:* the PMUW staff, the ESO department staff, the field engineers (FE), construction supervision consultants (CSC), the contractors, representatives of relevant stakeholders and local communities in the project area. The contractors take the responsibility for training workers and drivers.
- *Training Schedule:* Training will be given at least one month before performing the first construction contract. Subsequent training sessions can be modified to suit the construction schedule for project components.
- *Frequency of training:* The basic training programs given in the table below will be provided every 6 months annually, and the contents will be updated and tailored to items to be implemented. Training programs for PMUW staff are expected to continue in the first years of the Project. Three-day training for CSC and contractors is also planned to take place twice a year for at least 2 years.

Table 6.10. Advanced environmental and social training program

I. Subjects	**PROJECT MANAGEMENT UNIT WATERWAYS**
Training course	Environmental/social monitoring and reporting
Participants	Staff in charge of environmental and social issues; environmental managers
Training frequency	Within one month since IESMC is mobilized
Duration	One day
Content	Project-related general environmental/social management including the request from World Bank (ESF), Department of Natural Resources and Environment, in collaboration with competent authorities and concerned stakeholders; Environmental monitoring for the Project includes: Requirements of environmental/social monitoring; Monitoring and implementation of mitigation measures; Guiding and monitoring contractors, CSC and community representatives in the implementation of environmental monitoring; Forms used in environmental monitoring processes; Reaction and risk control; Guiding and monitoring contractors, CSC on management of grievances Manner of receiving and submit forms; Other issues to be determined.
Responsibility	With the help of the Technical Assistance Team, the Independent Environmental and Social Monitoring Consultant (IESMC) and PMUW implement safety policies.
II. Subjects	**CSC, CONTRACTORS, REPRESENTATIVES OF LOCAL AUTHORITIES (WARDS/COMMUNES), COMMUNITIES**
Training course	Implementation of mitigation measures
Participants	CSC; construction engineers, site construction field manager. Staff in charge of environment and social issues, the contractor; representatives of local authorities; representatives of urban groups (i.e., street vendors)
Training frequency	Shortly after awarding contracts to the contractors with updates on demand
Duration	Two-day training for CSC and contractors, and one-day training for others
Content	Overview of the overall environmental/social monitoring; Requirements of environmental/social monitoring; The roles and responsibility of the contractors and CSC;

	The content and method of environmental monitoring; Reaction and risk control; Introducing monitoring forms and instructing on filling out forms and reporting incidents; Information on the Grievance Redress Mechanism. Other issues to be determined Preparing and submitting reports
Responsibility	With the help of technical assistance teams, PMUW, the independent environmental and social monitoring consultant (IESMC) implement safety policies.
III. Subjects	**COMMUNITIES/ WORKERS**
Training course	Safety and environmental sanitation; social issues
Participants	Representatives of workers (team leaders) working directly for the project components
Training frequency	As appropriate
Duration	One day of presentation and one day of on-site presentation
Content	Brief presentation on safety issues and overview on the environment; Key issues requiring the attention of the community and construction workers to mitigating safety risks (land roads, waterways, equipment, machinery, etc.) as well as reducing pollution (dust, exhaust gases, oil spills, waste management, etc.); Management of safety and environmental sanitation on site and at workers' camps; Mitigation measures applied on site and camps; Safety measures for electricity, mechanical engineering, transportation, air pollution; Methods of dealing with emergency situations; The rights and responsibilities of environmental monitoring Environmental monitoring, environmental monitoring form Measures to mitigate the social impact and monitoring implementation Other issues to be determined
Responsibility	Contractors, PMUW with the assistance of IESMC

6.8. ESTIMATED COSTS FOR ESMP IMPLEMENTATION

6.8.1. Estimated Costs for Environmental and Social Monitoring Program

According to the unit price of environmental monitoring in the locality, the estimated cost for environmental quality monitoring of the project is stated in the table below:

Table 6.11. Estimated cost for environmental monitoring and analysis

(Exchange rate: 1 USD = 22,690 VND)

No.	Contents	Unit	Sampling rounds	Samples per round	Price	Total	
					VND	VND	USD
1	**Coastal road**						
a	Air quality, noise, vibration	sample	4	5	3,500,000	70,000,000	3,086
2	**Dredging and excavation**						
a	Surface water	sample	4	10	2,000,000	80,000,000	3,526
b	Sediments	sample	4	5	1,500,000	30,000,000	1,323

c	Fish and aquatic life	times	3	1	100,000,000	300,000,000	13,222
d	Wastewater from the disposal sites	sample	4	10	2,000,000	80,000,000	3,526
3	**Embankments**					-	-
a	Air quality, noise, vibration	sample	4	6	3,500,000	84,000,000	3,703
4	**Bridge**					-	-
b	Air quality, noise, vibration	sample	6	2	3,500,000	42,000,000	1,852
d	Surface water	sample	6	2	2,000,000	24,000,000	1,058
4	*Preparing report (4 years)*	*Report*	**16**	**1**	20,000,000	320,000,000	14,104
Total						**1,030,000,000**	**45,400**

6.8.2. Estimated cost for IESMC

According to the Project implementation schedule (from 2024 to 2026) and periodic IESMC mobilization requirements. It is estimated cost for IESMC that is presented in the table below:

Table 6.12. Estimated Costs of IESMC

(Exchange rate: 1 USD = 22,690 VND)

No	Content	Unit	Amount	Unit price (VND)	Sub-total (VND)	Sub-total (USD)
1	Experts 'salary	person-month	36	30,000,000	1,080,000,000	47,599
2	Accommodation	person-day	180	600,000	108,000,000	4,760
3	Travel expenses	Trip/ person	100	5,000,000	500,000,000	22,037
4	Office and communication	month	36	3,000,000	108,000,000	4,760
	Total				**1,796,000,000**	79,154

6.8.3. Estimated Costs for Training Program

According to the Project implementation schedule (from 2024 to 2026) and periodic IESMC and CSC mobilization requirements as well as expected number of bidding packages. It is estimated cost for training program on environmental/social monitoring management capacity that is presented in the table below.

Table 6.13. Estimated costs for training and capacity building

(Exchange rate: 1 USD = 22,690 VND)

Training content	Trainee	Unit	Quantity	Price	Total	
				VND	*VND*	*USD*
A. Capacity building programs on safeguard policies (trained by IESMC)						
I. Environmental monitoring and reporting						
PMUW	Staff in charge of environmental issues; environmental managers	course	4	10,000,000	40,000,000	1,763
II. Implementation of mitigation measures						
Total work items	CSC, Construction engineers, site manager	course	12	10,000,000	120,000,000	5,289

	(2 courses/1 package x 6 packages)					
III. Safety and environmental sanitation						
Total work items	Representatives of workers (2 courses/1 package x 6 packages)	course	12	5,000,000	60,000,000	2,645
				Sub-total (A)	**220,000,000**	**9,697**
B. HIV/Aids, COVID-19 and GBV training (done by CSC)						
Total work items	Workers, CSC team and PMUW staff (2 courses/1 package x 6 packages)	course	12	20,000,000	240,000,000	10,578
				Sub-total (B)	**240,000,000**	**10,578**
				Total: (A)+(B)	**460,000,000**	**20,275**

6.8.4. Total estimated costs for ESMP implementation

The following table provides a cost estimate for the implementation of environmental management plan (ESMP). The cost of ESMP[38] implementation will include (i) the costs of implementing mitigation measures by the contractor, (ii) expenses supervised by CSC, (iii) cost of the independent environmental monitoring consultant (IESMC), (iv) the costs of environmental quality monitoring, (v) the cost of safety management for the PMUW, including both technical assistance in implementing safety policies and training programs. The costs of implementing mitigation measures during construction will be a part of the value of construction contracts, while the costs for a site-specific environmental monitoring plan (SEMP) by the construction supervision consultant (CSC) will be provided in construction supervision contracts. The costs of the PMUW operations relating to ESMP are allocated from the project management budget of the PMUW, including safety training programs, and basic allowances to participants in the monitoring programs. After the project has been completed, the costs of environmental monitoring of constructed works will be taken from the operation and maintenance budget of the city.

It should be noted that the involvement of the community in the process of ESMP implementation is completely voluntary participation for the benefit of own community and households. The following Table below provides the estimated costs for environmental quality monitoring and IESMC (in accordance with national practices) for reference purposes. However, final costs will be updated in the detailed design phase.

Table 6.14. Estimated Costs of ESMP Implementation

Content	**Items of the project**	
	VND	USD
(a) Mitigation during construction	As a part of the contract	
(b) Monitoring safeguard compliance during construction	As a part of the cost for Construction Supervision Consulting (CSC)	
(c) Running cost of PMUW social and environmental units	As part of the costs for the PMUW	
(d) Environmental quality monitoring (done by CSC)	**1,030,000,000**	**45,400**

[38] Excluding costs for RP implementation and independent monitoring the performance of RP/EMP

Content	Items of the project	
	VND	USD
(e) Independent environmental monitoring consulting (IESMC)	1,796,000,000	79,154
(f) Safeguard Capacity building programs (done by IESMC)	220,000,000	9,697
(g) HIV /Aids, COVID-19 and GBV Training (done by CSC)	240,000,000	10,578

Note: The costs for independent monitoring agency for resettlement and social issues will be covered under the Resettlement Plans to be prepared

6.8.5. Grievance Redress Mechanism (GRM)

GRM is established in two levels including the Bank-wide grievance mechanism and the Project level.

The World Bank's Grievance Redress Mechanism: Communities and individuals who believe that they are adversely affected by a WB-financed project may submit complaints to the available project-level grievance redress mechanism or the WB's Grievance Redress Service (GRS). The GRS will ensure that complaints received are promptly reviewed to address project-related concerns. The affected communities and individuals of the project may submit their complaints to the WB's independent Inspection Panel that will determine whether harms occurred, or can occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the WB's attention, and the Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit www.worldbank.org/grs. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

The GRM at Project level is presented below.

6.8.5.1. Purpose of the Project GRM

The project has designed a set of Grievance Redress Mechanisms (GRM)which complainants can easily use to lodge a grievance/ concern. The GRMs guide complainants through steps on how a complaint could be filed, including channels through which a complaint can be submitted, time-limit for each step, acknowledgement of receipt of complaint, notification of resolution decision, etc.). During the grievance resolution process, dialogues will be hold between GRM personnel in charge and the aggrieved person, where possible, to offer opportunity for both sides to understand the issue, clarify and solve the grievance in a manner that is amicable and efficient. The project also has an appeal option that complainant can resort to, particularly when they are not satisfied with the complaint resolution results, or they did not hear back from the grievant resolving unit within the specified timeframes.

6.8.5.2. Description of the Project GRMs

The project GRMs are developed on the basis of current relevant laws and regulations of Viet Nam which hold agencies in charge of complaint resolution accountable to the complaint resolution process. All grievances will be registered, processed, and followed up. Grievance resolution results will be documented by agencies receiving and resolving the complaints. PMUW will also maintain a record of all project related grievances. A GRM focal will be appointed within PMUW to assist PMUW in following up the resolution process of all project related grievance, and to receive and transfer complaints in agency in charge of compliant resolution. Under this project, collective grievances are also accepted. A collective complaint

can be lodged through the group's representative. For EM peoples, informal grievance mechanism currently adopted by EM people are accepted to ensure the GRM that the EM prefers is culturally appropriate to them.

To ensure vulnerable group can easily access and use the project's GRM, project GRMs will disclosed and clarified to them during consultation meetings during project preparation and project implementation. These GRMs are also posted at the dedicated website of PMUW, and websites of provincial DOTs, and posted at billboards of Peoples Committee at all project communes. During consultation sessions, project leaflet that contains also project GRMs will be delivered to all affected people who attend the consultation sessions. Contact details, including name of PMUW GRM focal points, telephone, email, are available on PMUW webpage, and in leaflet in case complaints want to call to seek further guidance on how to use project's GRM.

The guiding principles for GRM are as follows:

- Based on the guidance of the above legal documents, the following guiding principles are used to ensure the requirements of the national laws and those of the World Bank regarding GRM design are harmonized:
    - **Project's GRM will be disclosed in public domains** (e.g. websites of PMUW, provincial DOT, notice board at commune People's Committee…).
    - **Complaint can be lodged in written or verbal[39], and through multiple channels**, including direct submission (handing), postal mail, email, and telephone to commune PC and/or PMUW.
    - **Complainant can appoint his/her representative**. In case they cannot directly file a complaint, complainant can ask their family member, or someone they trust to transcribe their complaint, and act as their representative to lodge the complaint.
    - **Anonymous complaints are accepted through all project channels dedicated to receiving grievances**. Complaints that are anonymous will be registered and processed if sufficient information are provided to allow further investigation.
    - **Complaint will be registered in logbook** by parties receiving the complaints and will be monitored by the party in charge of complaint resolution. A grievance database will be established and maintained by PMUW and managed by PMUW's GRM focal point).
    - **Complainant will be acknowledged in writing**. For all levels (commune, district and province), the person/agency in charge of resolving the complaint will notify complainants in writing and initiate the complaint resolution process within 10 days from receipt of the complaint.
    - **Timeframe for grievance resolution is specified for each step**, including period of prescription. All grievances will be acknowledged within 10 working days and solved within (i) 30 working days of receiving the grievance for the first level (maximum 45 working days for complicated case or remote area); (ii) 45 working days of receiving the grievance for the second and third levels (maximum 60

[39] If verbal complaint is made at one-stop shop of Peoples Committee at commune, district, or provincial levels, the competent person who receive the complainant at the one-stop shop will guide the complainant to fill in complaint form. If complainant does not know how to write, the person receiving the complainant will help the complainant write down his/her complaints and asked the complainant for their signature or fingerprint to the form completed (Article 8, Law on Complaints 2011).

working days for complicated case or remote area).

- **A grievance resolution decision will be issued** in writing and sent to the complainant, and the relevant parties within 3 and 7 working days following the date of issuing decisions for the first and second levels, respectively. Decision of the court is final decision that both defendant and complainant have to execute.
- **Complainants bear no costs associated with the entire complaint resolution process**. Costs related to grievances arising as a result of project impact will be borne by the project.
- **Public disclosure of complaint resolution decisions will be made**. Information that identifies complainants will be removed for privacy reason.

- Based on the above principles, three GRMs have been designed for project use, including GRM for complaints related to (1) land acquisition, (2) labor management, and (3) gender-based violence (SEA and SH). Details of these procedures are provided in respective documents: Resettlement Plan and Labor Management Procedures. Please see RP and LMP for details. A summary of the three GRM procedures are provided below.

❖ ***For land acquisition and physical resettlement issues***

- Complaint concerning land acquisition, physical resettlement, and relevant issues are expected to be lodged through commune Peoples' Committees. Submission of complaints can be done using emails, postal, hand delivery, or verbally through direct meeting or telephone. Within 10 days from the date of receiving the complaint, the person in charge of complaint resolution shall accept the complaint and notify the complainant in writing. Time limit for complaint resolution – from the date of acceptance, is 30 days for first-time complaint, and 45 days for second time and third-time complaint. The statute of limitation (for initiating a lawsuit) is 30 days from the date the time-limit for complaint resolution expires, and from the date the complainant receives the complaint resolution decision. In remote area where travel is difficult, statute of limitation can be extended but not exceed 45 days. Complainant can also initiate a lawsuit at any stage of the grievance resolution process if they disagree with the complaint resolution decision, or if the case are not resolved following the expiry of the time-limit for complaint resolution (see Resettlement Plans for details) [the link of PMUW's website will be inserted here].
- Complaints can also be submitted to PMUW – in writing or verbally, through PMUW dedicated channels. Complaints filed through PMUW will be registered in PMUW GRM logbook and will be transferred to parties directly responsible for resolving the grievances – as per law.

❖ ***For labor and working conditions***

- Complaints related to employment opportunities, wages, payment, working conditions, health, safety, administrative acts and decisions, discipline decisions, etc. are handled through different procedures as regulated by the law. The GRM for project workers provides steps that direct and contracted workers can follow to file a complaint related to labor and working conditions. Project workers can submit their complaint in writing, or face-to-face verbally – except for complaint against discipline decision which must be submitted to their employer/contractor who are responsible for solving first-time complaint. Complainant can also lodge a grievance through PMUW using email, post, or telephone using PMUW dedicated channels for GRM. Complainant can bring their case to the court of law at any stage during the complaint resolution process (See Labor Management Procedures for details). [the link of PMUW's website will be inserted here].

❖ ***For SEA and SH***

- For emergency, domestic violence incidences can be reported to nearest police stations, or to commune People's Committee or the village head. These units are legally responsible to taking action to address the incidence, including provision of immediate help and support to the GBV survivors. In addition, these formal channels, domestic violence incidences can be reported through informal channels, such as GBV community-based groups that are established with the support of provincial Women's Union to provide assistance to GBV victims.
- When non-emergency cases, GBV grievance can be submitted verbally or in writing through commune Peoples' Committees. Complaints can also be sent through PMUW by telephone, letter, or email. GBV complaints are redressed in accordance with the Vietnam's Law on Complaint 2011. The time limit for complaint resolution – from the date of acceptance, is 30 days for first-time complaint, and 45 days for second time and third-time complaint. Complainant may bring the case to the court if the case is not resolved following the expiry of the time-limit for complaint resolution. If complaint disagrees with the complaint resolution decision/result, they can initiate a lawsuit to court of law within 30 days from the date of issuance of the complaint resolution decision. In remote area where travel is difficult, statute of limitation can be extended but shall not exceed 45 days. Complainant can initiate a lawsuit at any stage of the grievance resolution process (See Labor Management Procedures for details).

6.8.5.3. Responsibilities of PMUW

- PMUW will work closely with PC at all levels to actively monitor and assist the resolution of any grievance received from complainants. PMU will appoint two staff members to serve as GRM focal point and GRM operator for GBV issues. The GRM focal point will maintain a logbook that record all grievances received, including information related to the nature of the grievances, dates of receipt, names, contact details of the aggrieved affected persons, actions that have been taken, and status of grievance resolution.
- Names and contact details of GRM Focal Points and GRM operator for GBV issues will be included in project GRMs, and will be disseminated through project' information booklet, PMUW website, and posted at public billboard at People's Committees of all project communes. All complaints and grievances will be documented carefully and fully and will be resolved in a timely and transparent manner. A summary of grievance resolution results will be made public through PMUW's quarterly internal monitoring report and semi-annual independent monitoring report of independent monitoring consultant. All costs associated with the grievances of the complainant will be borne by the project.

CHAPTER 7. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

7.1. SUMMARY OF PUBLIC CONSULTATION PROCESS

The World Bank's policy on Environmental and Social Standards No.1 (ESS1); Environmental and Social Standards No.5 (ESS5) and Environmental and Social Standards No.10 (ESS10) require consultation and notification to affected people and local authority on social and environmental issues during project preparation.

The WB's Environmental and Social Standard 5 (ESS5) and the Environmental and Social Standard 10 (ESS10) requires the consultation, notice to affected people and local authorities of socio-environmental issues in the course of project preparation. Also, public consultation for ESIA report must also comply with the requirements of Decree 18/2015/ND-CP dated February 14, 2015, Decree No. 40/2019/ND-CP dated May 13, 2019 and Circular 25/2019/TT-BTNMT dated December 31, 2019 of Ministry of Natural Resources and Environment for environmental impact assessment and environmental protection plan.

The public consultation must be implemented with the purpose: (i) share information about items and expected activities of the project to local community and related parties; and (ii) collect comments and concerns about site-specific characteristics and environmentally sensitive issues in the project area (including 6 districts/cities, equivalent to 29 communes) from local authorities and community. On this basis, the community's concerns and solutions may be proposed in the Environmental and Social Impact Assessment

Consultation with ward/communal PCs A consultation with ward/communal PCs was implemented from November 2021 to December 2021, including the following contents:

- Overall introduction of the project, investment items of the project, identification of residential quarters/groups in the project area.
- Introduction to the basic requirements of the World Bank's ESF.
- Current status of environmental hygiene of works in wards and outstanding issues.
- Potential environmental and social impacts and risks of the project on local communities
- Solutions proposed by the community to limit environmental impacts and issues in the course of project implementation.
- Comments for the construction of the works.

Participants in community consultation meetings include:

- Representative of PMUW;
- Representative of Safeguard policy consultants
- Representative of communal PC;
- Representative of local departments, agencies
- Head/deputy head of village
- Representatives of AHs (affected households of land acquisition/resettlement and fisher people/shimp farmers and affected households of environmental impacts and risks)

7.2. RESULTS OF PUBLIC CONSULTATION

The first round of public consultation was conducted in December 2021 – January 2022 after the restart of the SWLC Project.

The public consultation was carried out in 29 communes/wards by direct interview with affected households in the project areas on the following contents:

- Introduce an overview of the project, identify the area/residential group in the project area.

- Introduce the World Bank's safeguard policies on environment and resettlement.
- Current status of environmental sanitation in the wards and outstanding issues.
- Solutions from the community to mitigate the environmental impacts and associations in the process of project implementation.
- Comments on the construction of works.

The summarizy of interviewees in the project areas is presented in the Table 7.1.

Table 7.1. Summary of interviewees in the project areas

No	Location of waterways	Scope of land acquisition and site clearance (individual/ households)		Number of affected households (Ahs)	Number of AHs joining consultation	Reallocated households	Em household (if any)	Community meeting		In-depth interview	Group discussion	
		Yes	No					Number	Participant		Number	Participant
A	Tac Cua route											
I	HO CHI MINH CITY											
1.1	Can Gio district											
	Thanh An commune		*X*									
II	DONG NAI			1	-	-	-	-	-	-	-	-
2.1	Nhon Trach district			1	-	-	-	-	-	-	-	-
	Phuoc An commune	*X*		1	-	-	-	-	-	-	-	-
B	Nuoc Man – Can Giuoc route (about 11.6 km long, with installation and replacement of navigation aids only)											
I	LONG AN											
1.1	Can Giuoc district											
	Tan Lap commune		*X*									
1.2	Can Duoc district											
	Phuoc Dong Commune		*X*									
	Long Huu Tay Commune		*X*									
	Long Huu Dong Commune		*X*									
C	Rach La route (about 10.2 km long)											
I	LONG AN			3	3	-	-	-	-	-	-	-
1.1	Chau Thanh District			3	3	-	-	-	-	-	-	-
	Thanh Vinh Dong Commune	*X*		*3*	*3*							
II	TIEN GIANG			4	4	-	-	-	-	-	-	-
2.1	Go Cong Tay District			4	4	-	-	-	-	-	-	-
	Dong Son Commune	*X*		4	4	-	-	-	-	-	-	-

No	Location of waterways	Scope of land acquisition and site clearance (individual/ households)		Number of affected households (Ahs)	Number of AHs joining consultation	Reallocated households	Em household (if any)	Community meeting		In-depth interview	Group discussion	
		Yes	No					Number	Participant		Number	Participant
	Binh Phu Commune		*X*									
D	Ky Hon route (about 6.8 km long)											
I	TIEN GIANG											
1.1	Cho Gao district											
	Long Binh Dien Commune		*X*									
	Xuan Dong Commune		*X*									
	Hoa Dinh Commune		*X*									
	Song Binh Commune		*X*									
	Cho Gao town		*X*									
E	Cho Lach route (about 7.9 km long)											
I	BEN TRE			**464**	**252**	**186**	**-**	**1**	**15**	**1**	**1**	**5**
1.1	Cho Lach district			**464**	**252**	**186**	**-**	**1**	**15**	**1**	**1**	**5**
	Hoa Nghia Commune	*X*		*78*	*62*	*17*	*-*	*1*	*15*	*1*	*1*	*5*
	Son Dinh Commune	*X*		*171*	*64*	*52*						
	Cho Lach town	*X*		*215*	*126*	*117*						
F	Mang Thit route (about 46.4 km long)											
I	VINH LONG			596	399	172	1	-	-	-	-	-
1.1	Tra On district			156	100	21	1	-	-	-	-	-
	Tra On town	*X*		*10*	*5*	*3*						
	Thien My Commune	*X*		*4*	*3*	*1*	*1*					
	Nhon Binh Commune	*X*		*50*	*39*	*9*						
	Xuan Hiep Commune	*X*		*92*	*53*	*8*						
1.2	Tam Binh District			426	288	144	-	-	-	-	-	-
	Loan My Commune	*X*		*29*	*20*	*12*						

No	Location of waterways	Scope of land acquisition and site clearance (individual/ households)		Number of affected households (Ahs)	Number of AHs joining consultation	Reallocated households	Em household (if any)	Community meeting		In-depth interview	Group discussion	
		Yes	No					Number	Participant		Number	Participant
	Tuong Loc Commune	*X*		*362*	*238*	*123*						
	Hoa Hiep Commune	*X*		*21*	*20*	*6*						
	Hoa Thanh Commune	*X*		*14*	*10*	*3*						
	TT. Tam Binh		*X*									
1.3	Vung Liem District											
	Tan An Luong Commune		*X*									
1.4	Mang Thit district			14	11	7	-	-	-	-	-	-
	Tan An Hoi Commune	*X*		*2*	*1*	-						
	Tan Long Hoi Commune	*X*		*12*	*10*	*7*						
	TOTAL			1068	658	358	1	1	15	1	1	5

The concerns and comments of the consulted people for the project are summarized as in Table 7.2.

Table 7.2. Summary of discussion results and PMUW's feedback

No.	Results of discussion	Project Owner's feedback
1	The concentration of workers in the area poses a risk of social impacts such as gambling, prostitution, drug addiction, theft, fraud, traffic, etc., which can disturb the lives of local households.	The contractor will give priority to recruiting local workers for simple jobs. This will be specified in the bidding documents. The supervision mechanism is strict and there will be supervision from PMU; construction supervision and independent supervision. There is also the supervision of other competent authorities.
2	Engagement of gathered experts, manpower and construction workers will lead to cultural conflicts and relationship conflicts with the host community. Information propagation for raising people's awareness will be required.	The contractor will give priority to recruiting local workers for simple jobs. This will be specified in the bidding documents.
3	The construction of bridges and roads and dredging of river will cause great impacts on employment and income of households, especially vulnerable households including the poor, the elderly, single female-headed household with children independent.	The project will strictly follow the mitigation measures mentioned above to minmize the impact on people's life and health under the supervision of independent supervisors, PMU and the Donor.
4	The component of river dredging and bridge construction will affect the traffic connection of the people on both sides, etc., so the project is proposing to have a plan to build temporary roads/bridges.	The project will strictly follow the mitigation measures mentioned above to minmize the impact on people's life and health under the supervision of independent supervisors, PMU and the Donor.
5	During the construction of project activities, especially river dredging work item, etc., the movement of ferries and barges for transporting machinery and raw materials on river/canals can cause ship collisions and possible risk of oil spill which can cause negatively impact on the ecosystem and the habitat of animals and plants, etc. The project will be required to pay attention and have	The contractor will implement preventive and mitigation measures corresponding to each construction method. The contractor shall be under the supervision of the PMU, Construction Supervisor and independent supervisor during the construction process.

	timely mitigation measures.	
6	Construction of roads and bridges may cause disturbance to daily life, business activities of households, administrative agencies, tourism activities and cultural festivals, etc.;	The contractor will implement preventive and mitigation measures corresponding to each construction activity
7	The concentration of labor at the construction sites can cause social disorder, increase in social diseases and generation of domestic waste.	The contractor will give priority to recruiting local workers for simple jobs. This will be specified in the bidding documents. During the project implementation, the contractor will be under the supervision of the PMU, construction supervisor and independent supervisor, and other relevant functional agencies
8	Community cohesion, village relationships, customs and habits will be affected, etc., (especially severely affected households who are relocated or resettled).	The contractor will give priority to recruiting local workers for simple jobs. This will be specified in the bidding documents. During the project implementation, the contractor will be under the supervision of the PMU, construction supervisor and independent supervisor, and other relevant functional agencies
10	There will be potential environmental incidents during the construction phase in the fuel depots and possible risks of fire and explosion due to leakage, electrical shock, causing unsafety.	The contractor will implement preventive and mitigation measures corresponding to each construction activity During the project implementation, the contractor will be under the supervision of the PMU, construction supervisor and independent supervisor, and other relevant functional agencies

7.3. RESULTS OF CONSULTATIONS WITH AUTHORITIES IN CHARGE

PMUW has sent official letter No. 646/DT-KTTD dated 01 December 2021 to 29 communes/wards to inform them about the SWLC Project and asking for their official comments on the Premilinary ESIA of the SWLC Project. Due to the restrictions caused by COVID-19 pandemic, most of communes/wards to be consulted were closed for warrantine or isolation during December 2021 and January 2022. The PPC will back to work and give their comments via letters which will be updated in the ESIA.

The public consultation and information dissemination is expected to continue in February 2022 given that the situation of COVID-19 will be better and travel restrictions will be removed by then.

It is noted that during the implementation of SWLCP, IESMC will continue to conduct public consultation about the environmental and social impacts and risks at the construction sites, in order to ensure the full compliance of Contractors and Project Owner with proposed ESMP.

7.4. INFORMATION DISCLOSURE

The first draft ESIA, SEP, LMP, and ESCP in Vietnamese were disclosed locally at the communes within the project area, at 29 Communes/Wards on December 2021 and January 2022 for public consultation. Based on the contents of ESIA, local people can get information of the Project and contribute their opinions/comments on environmental issues. The final draft ESIA, and final draft, SEP, LMP, and ESCP in English will disclose at the WB external website on January, 2022 for public consultation. The final ESIA both in the local language and English will be disclosed locally at the project sites and at the WB external website.

ANNEX

ANNEX 1 – DREDGING AND EXCAVATION MANAGEMENT PLAN

1. Location and volume of dredging and excavation

- The total volume of dredged and excavated materials is about 4,515,510 m^3
- Location of dredging and bend correction in the following table:

Table 1: Location of dredging and excavation

No	Segment	Administrative location	Length (m)	Volume (m^3)
1	**Mang Thit river**		**11,750**	**2,355,000**
-	Km0+070 - Km0+300	Tra On town, Tra On district, Vinh Long	230	31,668
-	Km0+700 - Km1+100	Thien My commune, Tra On district	400	104,442
-	Km9+470 - Km17+200	Loan My Commune, Tuong Loc Commune, Tam Binh Town, Tam Binh, Vinh Long; Nhon Binh commune, Xuan Hiep commune, Tra On district, Vinh Long	7,730	1,163,025
-	Km19+400 - Km 19+800	Xuan Hiep Commune, Tra On	400	18,898
-	Km19+950 - Km 20+400	Xuan Hiep Commune, Tra On	450	32,357
-	Km21+660 - Km22+150	Xuan Hiep Commune, Tra On	490	379
-	Km23+400 - Km24+00	Xuan Hiep Commune, Tra On	600	140,952
-	Km24+100 - Km24+550	Tan An Luong Commune, Vung Liem District, Vinh Long	350	159,868
-	Km26+700 - Km27+050	Tan Long Hoi Commune, Mang Thit District, Vinh Long	350	83,020
-	Km27+250 - Km28+000	Tan An Luong Commune, Vung Liem, Vinh Long	750	48,900
2	**Cho Lach**		**7,910**	**1,240,000**
-	Km0+00 - Km7+910	Hoa Nghia Commune, Son Dinh, Cho Lach Town, Cho Lach district	7,910	1,240,000
3	**Ky Hon canal**		**6,669**	**50,000**
	Km20+300 - Km26+969	Cho Gao District, Tien Giang	6,669	50,000
4	**Rach La canal**		**2,400**	**614,510**
-	Km5+000 - Km6+200	Thanh Vinh Dong commune, Chau Thanh district, Long An province	1,200	
-	Km7+400 - Km8+600	Dong Son commune, Go Cong district, Tien Giang province	1,200	
5	**Tac Cua river**		**1,850**	**256,000**
-	Km0+200 – Km0+600	Phuoc Khanh Commune, Nhon Trach, Dong Nai	400	
-	Km0+900 – Km1+250	Phuoc Khanh Commune, Nhon Trach, Dong Nai	350	
-	Km2+400 – Km2+800	An Phuoc Commune, Nhon Trach, Dong Nai	400	
-	Km2+900-3+300	An Phuoc Commune, Nhon Trach, Dong Nai	400	

No	Segment	Administrative location	Length (m)	Volume (m^3)
-	Km4+400 – Km4+800	An Phuoc Commune, Nhon Trach, Dong Nai	400	

2. Final Disposal Site

The expected disposal sites for dredged and excavated materials are listed below:

Table 2: Location of disposal sites

No	Code	Location	Chainage	Area [ha]	Capacity [m^3]
Mang Thit river					
1	BD-01	Tra On town, Tra On district, Vinh Long	Km 0+200 - Km 0+600	6.2	142,600
2	BD-02	Tuong Loc commune, Tam Binh district, Vinh Long	Km 10+200 - Km 10+600	4.9	112,700
3	BD-03	Tuong Loc commune, Tam Binh district, Vinh Long	Km 11+400 - Km 11+800	5.7	131,100
4	BD-04	Tuong Loc commune, Tam Binh district, Vinh Long	Km 12+400 - Km 12+800	4	92,000
5	BD-05	Tuong Loc commune, Tam Binh district, Vinh Long	Km 13+500 - Km 14+000	10	230,000
6	BD-06	Tuong Loc commune, Tam Binh district, Vinh Long	Km 14+800 - Km 15+200	8	184,000
7	BD-07	Tuong Loc commune, Tam Binh district, Vinh Long	Km 15+800 - Km 16+200	10	230,000
7	BD-08	Tuong Loc commune, Tam Binh district, Vinh Long	Km 15+800 - Km 16+600	15	345,000
8	BD-09	Tuong Loc commune, Tam Binh district, Vinh Long	Km 17+000 - Km 17+800	10	230,000
9	BD-10	Xuan Hiep commune, Tra On district, Vinh Long	Km 17+900 - Km 18+700	20	460,000
10	BD-11	Xuan Hiep commune, Tra On district, Vinh Long	Km 17+800 - Km 18+200	9.7	223,100
11	BD-12	Xuan Hiep commune, Tra On district, Vinh Long	Km 19+200 - Km 19+800	7.5	172,500
12	BD-13	Xuan Hiep commune, Tra On district, Vinh Long	Km 19+200 - Km 19+801	2	46,000
13	BD-14	Hoa Hiep commune, Tam Binh district, Vinh Long	Km 19+200 - Km 19+802	7	161,000
14	BD-15	Tan An Luong commune, Vung Liem district, Vinh Long	Km 19+200 - Km 19+803	7	161,000
15	BD-16	Hoa Thanh commune, Tam Binh district, Vinh Long	Km 19+200 - Km 19+804	10	230,000
16	BD-17	Tan An Luong commune, Vung Liem district, Vinh Long	Km 19+200 - Km 19+805	2	46,000
Sub-total					**3,197,000**
Rach La canal					
1	BD-01	Binh Phu commune, Go Cong Tay district, Tien Giang	Km 2+200 - Km 3+000	17.6	528,000
2	BD-02	Dong Son commune, Go Cong Tay district, Tien Giang	Km 4+000 - Km 4+800	8.7	261,000
4	BD-03	Thanh Vinh Dong commune,	Km 5+300 - Km	8.1	186,300

No	Code	Location	Chainage	Area [ha]	Capacity [m^3]
		Chau Thanh district, Long An	5+800		
3	BD-04	Thanh Vinh Dong commune, Chau Thanh district, Long An	Km 6+000	18.3	366,000
5	BD-05	Dong Son commune, Go Cong Tay district, Tien Giang	Km 7+700 - Km 8+200	11.7	269,100
Sub-total					**1,341,300**
Cho Lach canal					
1	BD-01	Son Quy commune, Cho Lach district, Ben Tre	Son Quy industrial zone	40	600,000
2	BD-02	An Phuoc commune, Mang Thit district, Vinh Long	An Dinh industrial zone	60	900,000
Sub-total					**1,500,000**

Although a separate management plan is prepared for the excavated materials of the entire project, disposals of the excavated materials will also follow the above principles. During construction phase additional tests for deeper layer will also be carried out by the contractors.

3. Contractor's Dredging Management Plan

The Contractor is required to prepare a Contractor's Dredging and Excavation Management Plan (CDEMP) and submit to the Construction Supervision Consultant and Project Owner for review and approval before construction commencement. The CDEMP will include, but not limited to the followings:

- The Scope of Works in the Contract package, construction method and schedule.
- Volume and quality of water quality and sediment quality in the dredging area covered by the contract.
- Water users that may be affected by the dredging and embankment lining.
- Materials uploading and transportation method: indicate proposed route of the transport from the dredged site to the disposal area, time of operation, type of vehicles/trucks and proposed measures to reduce the leakage of the dredged materials from the transport trucks,
- Schedule to inform the nearby communities about the project, disclosure of name and contact number for possible complaints.
- Potential social and environmental impacts, including the site-specific impacts and risks.
- Mitigation measures to address the potential impacts and risks. The mitigation measures should be proposed based on ESIA/ESCOP, ESMP, SEMP, the potential impacts and mitigation measures presented in Section 4 and 5 of this Plan and the following requirements:
    - Environmental Quality Monitoring plan carried out by the contractor (following the proposed monitoring program in ESIA at least).
    - For soil and sediment: The number of samples taken will follow the following guidelines

Table 3: The number of Sediment samples

Volume of dredged (m3)	No of Sediment Samples
Up to 25,000	3
25,000 to 100,000	4-6

100,000 to 500,000	6-10
500,000 to 2,000,000	10-20
For each 1,000,000 above 2,000,000	Additional 10

  - At least one water, soil and sediment sample must be taken for each contract package

- Consultation with affected community about the draft CDEMP
- Excavated soil are separated from dredged materials from source. Excavated soils will be reused on-site and off-site as much as possible and transported to the nearest disposal site appraised under ESIA, or identified and approved during detail engineering design or construction phase;
- The mitigation measures are adequate to address the potential social and environmental impacts associated with various steps and activities, areas of influence and receptors of dredging, temporary storage, transportation and final disposal of the dredged materials.
- Field survey are carried out by the Contractor during the preparation of the CDMP in order to identify if there are additional sensitive receptors not identified previously under Vinh Long UDCR project and proposed additional site-specific mitigation measures accordingly.
- Contractor's environmental monitoring plan are included
- Commitments to carry out corrective actions when excessive pollution is determined, or when there are complaints about environmental pollution, social impacts from any stake holders

4. Potential impacts and mitigation measures for dredging and excavation works

Table 4: Impacts and relevant mitigation measures for dredging and excavation works

Impacts and Description	Mitigation Measures
AT DREDGING and TEMPORARY LOADING AREAS	
Odor and air pollution, nuisance Decomposition of organic matters under anaerobic conditions generates strong odor-generated gases such as SO_2, H_2S, VOC etc. When the muds are disturbed and excavated, these gases are released much faster into the air. Exposure to odor pollution affects the health of workers, local residents and cause public nuisance	- Inform the community at least one week before dredging is started - Minimize the duration of temporary loading of dredged materials on-site - temporary loading materials must be transported to the disposal site within 48 hours - Load the materials on-site tidily - Do not load the materials temporarily outside the construction corridor determined for each canal section - Avoid loading the sludge in populated residential areas or near public buildings such as kindergarten. Load the sludge as far from the houses and buildings as far as possible - Cover the temporary sludge loads when loading near sensitive receptors or longer than 48 hours unavoidable
Dust and nuisance Temporary loading of sludge at the construction site cause nuisance to the public	- Avoid temporary loading of dredged materials on-site - Dredged materials must be transported to the final disposal sites earliest possible and no later than 48

Impacts and Description	Mitigation Measures
Dry and wet mud may be dropped along the dredging area and on transportation route causing nuisance to the public and traffic safety risks	hours from dredging. - Use truck with water-tight tank to transport wet/damp dredged materials; - All trucks must be covered tightly before leaving construction site to minimize dust and mud dispersion along the road
Traffic Disturbance The placement and operation of dredging equipment and construction plants on the ground, temporary loading of the dredged materials may obstruct or disturb traffic and cause safety risks for the people travelling on the canal-side road, particularly on canal-crossing bridges which are usually very narrow	- Arrange worker to observe and direct excavator driver when traffic is busy
Social Disturbance Concentration of workers and equipment, construction plants, temporary loading of materials and wastes, traffic disturbance, dusts and odor pollution etc. will disturb daily activities and the lives of local residents Conflicts may also be arisen if workers, waste, materials, equipment etc. are present outside the construction corridor	- Inform the community at least one week before construction is started - Monitor to ensure that physical disturbances are within the construction corridors only - Contractor recruit local labors for simple works, brief them about project environmental and safety requirements before started working - Contractor register the list of workers who come from other localities to the commune at the construction site - Led the water leaked from wet/damp dredged materials going back to the river, not to affect garden or agricultural land - Keep the areas to be disturb minimal - Enforce workers to comply with codes of conducts
Landslide and soil subsiding risks at dredging area Relative deep excavation or cut and fills on the embankments that create slopes may lead to landslide and soil subsiding at the slops or excavated areas, particularly in rainy weather Deep excavation also causes risks to the existing buildings nearby, particularly the weak structures or located too close to the deep excavation area.	- During field survey for the preparation of CDEMP, the contractor in coordination with the Environmental Officer of PMU and the Environmental Consultant of the CES identify weak structures that may be at risk and determine appropriate mitigation measures accordingly - Consider and select appropriate dredging method that allow minimizing soil subsiding risks, for example carry out stepped excavation, stabilize slops in parallel to dredging - Apply protective measures such as sheet piles at risky locations
Water Quality Degradation Turbidity in water will be increased when the mud is disturbed; Water leaked from dredged material and surface runoff through disturbed ground also contains high solid contents. Muddy water entering irrigation	- Build coffer dams surrounding the dredging area and pump the water out before starting dredging - If dredging is carried out directly onto the water, dredge at intervals to allow suspended materials to resettle before continuing. Observe water color at 20 m upstream and stop dredging when water color

Impacts and Description	Mitigation Measures
ditch will cause sedimentation. Aquatic lives in the canal would also be affected by turbid water.	there started to change
Increased Safety risk for the Public	- Place stable barriers along the construction corridor boundary to separate the site with nearby structures - Place warning signs and reflective barriers along the construction area, at dangerous locations and within sensitive receptors - Ensure adequate lighting at
Health and Safety risk to the workers The health of workers may be affected due to exposure to odor and other contaminants from sludge Risk of being drown	- Within two weeks before dredging is started, the contractor will coordinate with local authority to identify good swimmers or those who can dive in the locality, and hire at least one of them at each canal construction site deeper than 3 m and there are workers working on or near water surface. - Provide and enforce the workers to use masks. If and when working in the water, protective cloths, rubber boots, gloves and hats must be wearing.
Others	- Other relevant measures specified in ESCOP or proposed by the contractors as necessary
MATERIAL LOADING AND TRANSPORTATION	
Dust and nuisance, traffic safety risks Dust or wet materials may be dropped along the transportation route	- Use water-tight tank trucks for transporting wet/dam materials - Cover the materials tightly before leaving the construction site - Do no overload material on the trucks
AT FINAL DISPOSAL SITE	
Landslide and soil subsiding risks at final Disposal site Landslide and subsiding risk may happen on slopes created at the final disposal site of dredged materials if the slopes created are too high, steep or unstable	- Level the materials after being disposed off - Slopes of the dumps will not be steeper than 45° - Build/create the walls to protect slopes - Create and maintain drainage at the foot of each dump higher than 2 m
Soil and Water Quality Pollution The disposal of salty soil would not affect the existing soil quality No risks of subsidence and landslide for residential areas around this area No impacts on river water quality.	- Apply measures that ensure rainwater onto the materials is not mix with the surface runoff from the surrounding to overflow uncontrolled at the site; rainwater will be infiltrated onto the ground on-site. This can be done by the following mitigation measures: - Build drainage ditches surrounding the designated disposal area - Use impermeable materials to cover the walls surrounding the materials to isolate it with the surrounding - Other measures proposed by the contractors to

Impacts and Description	Mitigation Measures
	meet pollution control targets

ANNEX 2 – BASELINE ENVIRONMENTAL MONITORING RESULTS

1. Baseline environmental monitoring program

The project owner collaborated with the environmental monitoring unit namely the Center for Environmental Technology in Ho Chi Minh City (under the Institute of Environmental Technology – Vietnam Academy of Science and Technology, sub-contracted by ESIA consultant) to carry out baseline environmental analysis of the project area. Three rounds of sampling for environmental analysis were conducted in November 2021 and each round was 1 week ahead.

The Center for Environmental Technology in Ho Chi Minh City has been granted the Certificate of eligibility for environmental monitoring service activities number VIMCERTS 032 under Decision No. 1041/QD-BTNMT dated 05/05/2020 by the Ministry of Natural Resources and Environment to be an eligible environmental monitoring unit.

The monitoring program was developed as in the following table:

Table 1. Baseline environmental monitoring program

No.	Sampling locations	Coordinates	Date of sampling		
			1st round	2nd round	3rd round
Ambient air quality					
1	Along Mang Thit waterway route	X: 617959.1 Y: 1117429.2	01/11/2021	08/11/2021	15/11/2021
2	Along Cho Lach waterway route	X: 622335.4 Y: 1134545.0	01/11/2021	08/11/2021	16/11/2021
3	Along Ky Hon waterway route	X: 654241.5 Y: 1143119.6	03/11/2021	10/11/2021	17/11/2021
4	Along Rach La waterway route	X: 673268.0 Y: 1154285.2	02/11/2021	09/11/2021	16/11/2021
5	Along Tac Cua waterway route	X: 716509.2 Y: 1170866.4	01/11/2021	08/11/2021	15/11/2021
Surface water quality					
1	Starting point of Mang Thit river	X: 628049.8 Y: 1123786.2	01/11/2021	08/11/2021	15/11/2021
2	End point of Mang Thit river	X: 600446.2 Y: 1101933.2	01/11/2021	08/11/2021	15/11/2021
3	Starting point of Cho Lach canal	X: 591793.3 Y: 1154290.9	01/11/2021	08/11/2021	16/11/2021
4	End point of Cho Lach canal	X: 586103.3 Y: 1152506.2	01/11/2021	08/11/2021	16/11/2021
5	Starting point of Ky Hon canal	X: 600446.2 Y: 1101933.2	03/11/2021	10/11/2021	17/11/2021
6	End point of Ky Hon canal	X: 628049.8 Y: 1123786.2	03/11/2021	10/11/2021	17/11/2021
7	Starting point of Rach La canal	X: 673712.4 Y: 1154259.7	02/11/2021	09/11/2021	16/11/2021
8	End point of Rach La canal	X: 628049.8 Y: 1123786.2	02/11/2021	09/11/2021	16/11/2021
9	Starting point of Tac Cua river	X: 711784.9 Y: 1172475.3	01/11/2021	08/11/2021	15/11/2021
10	End point of Tac Cua river	X: 716608.8 Y: 1170289.6	01/11/2021	08/11/2021	15/11/2021
Biological condition					

No.	Sampling locations	Coordinates	Date of sampling		
			1st round	2nd round	3rd round
1	Starting point of Mang Thit river	X: 628049.8 Y: 1123786.2	01/11/2021	08/11/2021	15/11/2021
2	Starting point of Tac Cua river	X: 711784.9 Y: 1172475.3	01/11/2021	08/11/2021	15/11/2021

2. Baseline environmental monitoring results

The monitoring results are compared with the following standards:

- QCVN 05:2013/BTNMT - National technical regulation on ambient air quality (on average, per hour).
- QCVN 26:2010/BTNMT - National technical regulation on noise.
- QCVN 08-MT:2015/BTNMT - National technical regulation on surface water quality. column B1 - surface water for irrigation purposes or other uses with similar water quality requirements or intended use as type B2 (waterway and other uses with low quality requirements).

2.1. Baseline environmental monitoring results in Mang Thit river

The results of baseline environmental monitoring are shown in the tables below:

Table 3. Ambient air quality in Mang Thit river (1st round)

No	Parameter	Unit	Result (01/11/2021)						QCVN 05:2013/ BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	ºC	31	31.9	32.8	32.5	31.5	30.1	-
2	Humidity	%RH	68.5	63.4	60.7	60.1	60.1	61.8	-
3	Wind speed	m/s	0.5	1.5	0.9	1	0.7	0.6	-
4	Wind course	-	285NW	285NW	285NW	285NW	285NW	285NW	-
5	SO_2	µg/m^3	18	18	19	20	23	20	350
6	CO	µg/m^3	3220	3440	3710	4350	4800	4920	30,000
7	NO_2	µg/m^3	12	15	19	22	23	25	200
8	TSP	µg/m^3	62.1	58.7	79.4	49.6	62.8	54.5	300

Table 4. Ambient air quality in Mang Thit river (2nd round)

No	Parameter	Unit	Result (08/11/2021)						QCVN 05:2013 /BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	ºC	31.5	31.7	33.4	32.1	31.6	29.9	-
2	Humidity	%RH	68.5	62.8	60.8	60.5	60.7	62	-
3	Wind speed	m/s	0.8	1.1	0.5	1	1.1	1.1	-
4	Wind course	-	285NW	285NW	285NW	285NW	285NW	285NW	-
5	SO_2	µg/m^3	24	20	21	20	21	19	350
6	CO	µg/m^3	3520	3630	3740	ND	3260	3610	30,000
7	NO_2	µg/m^3	72	26	26	28	28	29	200
8	TSP	µg/m^3	65	52.3	79.2	50.4	55.5	51.2	300

Table 5. Ambient air quality in Mang Thit river (3rd round)

No	Parameter	Unit	Result (15/11/2021)						QCVN 05:2013 /BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	ºC	31.6	32	32.8	32.5	31.7	29.9	-
2	Humidity	%RH	67.7	62.7	60	59.7	60.3	61.7	-
3	Wind speed	m/s	0.6	1	0.8	1.2	1	1.3	-
4	Wind course	-	285NW	285NW	285NW	285NW	285NW	285NW	-
5	SO_2	µg/m^3	21	24	22	21	21	21	350
6	CO	µg/m^3	4770	5110	4900	4290	3760	3560	30,000
7	NO_2	µg/m^3	19	20	20	20	21	22	200
8	TSP	µg/m^3	67.5	54.4	77.9	47.6	65	50.3	300

Table 6. Baseline noise level in Mang Thit segment

No	Time of measurement	Noise level, Leq (dBA)		
		1st round (1/11/2021)	2nd round (8/11/2021)	3rd round (15/11/2021)
1	08h00'-09h00'	66.8	67.1	66.9
2	09h00'-10h00'	66.4	66.2	66.2
3	10h00'-11h00'	65.3	65.4	65.7
4	11h00'-12h00'	65.7	65.8	65.3
5	12h00'- 13h00'	64.7	64.1	64.3
6	13h00'-14h00'	66.7	66.7	67
7	14h00'- 15h00'	65.2	65.2	65.1
8	15h00'-16h00'	66.9	66.9	67.1
9	16h00'-17h00'	66.1	66.5	66.2
10	17h00'-18h00'	65.4	65.3	65.1
11	18h00'-19h00'	65.4	65.5	65.3
12	19h00'-20h00'	64.2	64.3	64.3
QCVN 26:2010/BTNMT (Normal places)		70	70	70

Table 7. Surface water quality in Mang Thit river (1st round)

No	Parameters	Unit	Result (1/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.71	7.66	5.5 to 9
2	BOD_5 (20º C)	mg/L	**16**	**21**	15
3	Temperature	ºC	29.2	29.2	-
4	Chemical Oxygen Demand	mg/L	**32**	**47**	30
5	Dissolved Oxygen	mg/L	5.32	5.11	≥ 4
6	Total Suspended Solids	mg/L	**108**	**100**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3

No	Parameters	Unit	Result (1/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	0.28	1.14	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1.1×10^3	1.1×10^3	7,500

Table 8. Surface water quality in Mang Thit river (2nd round)

No	Parameters	Unit	Result (8/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.08	7.52	5.5 to 9
2	BOD_5 (20° C)	mg/L	**16**	**20**	15
3	Temperature	°C	29.1	29.2	-
4	Chemical Oxygen Demand	mg/L	**31**	**45**	30
5	Dissolved Oxygen	mg/L	5.61	5.64	≥ 4
6	Total Suspended Solids	mg/L	**112**	**106**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	<0.15 (LOQ=0.15)	1.41	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	9.3×10^2	9.3×10^2	7,500

Table 9. Surface water quality in Mang Thit river (3rd round)

No	Parameters	Unit	Result (15/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.07	7.16	5.5 to 9
2	BOD_5 (20°C)	mg/L	13	**18**	15
3	Temperature	°C	29.1	29.1	-
4	Chemical Oxygen Demand	mg/L	25	**39**	30
5	Dissolved Oxygen	mg/L	5.18	5.31	≥ 4
6	Total Suspended Solids	mg/L	**110**	**89**	50

No	Parameters	Unit	Result (15/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	0.21	**1.83**	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1.1×10^3	9.3×10^2	7,500

2.2. Baseline environmental monitoring results in Cho Lach canal

The results of baseline environmental monitoring are shown in the tables below:

Table 10. Ambient air quality in Cho Lach canal (1st round)

No	Parameter	Unit	Result (02/11/2021)						QCVN 05:2013/ BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	°C	31.1	32.1	33.1	32.2	32.1	30.4	-
2	Humidity	%RH	68.5	63	60.6	60	60.5	61.7	-
3	Wind speed	m/s	1	0.8	0.5	0.6	0.8	1	-
4	Wind course	-	325NW	325NW	325NW	325NW	325NW	325NW	-
5	SO_2	µg/m³	22	20	19	19	20	20	350
6	CO	µg/m³	6 030	6 160	6 200	5 890	6 090	6 080	30,000
7	NO_2	µg/m³	30	37	36	36	38	38	200
8	TSP	µg/m³	61	51.1	69.6	53.3	57.5	51	300

Table 11. Ambient air quality in Cho Lach canal (2nd round)

No	Parameter	Unit	Result (09/11/2021)						QCVN 05:2013 /BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	°C	31.2	32.1	33.5	32.9	31.9	30.4	-
2	Humidity	%RH	68.2	62.9	60	60.5	60.2	61.7	-
3	Wind speed	m/s	0.9	0.7	0.7	0.9	0.8	1.1	-
4	Wind course	-	325NW	325NW	325NW	325NW	325NW	325NW	-
5	SO_2	µg/m³	21	21	19	19	19	18	350
6	CO	µg/m³	4 160	4 020	3 320	3 710	4 320	4 470	30,000
7	NO_2	µg/m³	39	45	49	56	56	59	200
8	TSP	µg/m³	62.9	52.1	72.5	49.7	63.9	57.8	300

Table 12. Ambient air quality in Cho Lach canal (3rd round)

No	Parameter	Unit	Result (16/11/2021)						QCVN 05:2013 /BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	°C	31.7	32.4	32.9	32.8	31.5	29.9	-
2	Humidity	%RH	67.8	63.3	60.4	60.1	60.5	61.9	-
3	Wind speed	m/s	0.6	0.6	1	1.2	0.9	0.9	-
4	Wind course	-	325NW	325NW	325NW	325NW	325NW	325NW	-
5	SO_2	µg/m^3	20	18	19	18	19	18	350
6	CO	µg/m^3	4 600	5 290	5 670	6 080	6 510	5 510	30,000
7	NO_2	µg/m^3	22	21	22	23	23	23	200
8	TSP	µg/m^3	60.1	51.3	69	48.3	61.3	57.5	300

Table 13. Baseline noise level in Cho Lach canal

No	Time of measurement	Noise level, Leq (dBA)		
		1st round (02/11/2021)	2nd round (09/11/2021)	3rd round (16/11/2021)
1	08h00'-09h00'	66.9	67	66.6
2	09h00'-10h00'	65.1	65.3	65
3	10h00'-11h00'	66.8	66.7	66.9
4	11h00'-12h00'	66.2	66.5	66.3
5	12h00'- 13h00'	65	65.4	65.1
6	13h00'-14h00'	65.1	63.1	65.4
7	14h00'- 15h00'	64.4	64.2	64.3
8	15h00'-16h00'	66.7	66.6	66.7
9	16h00'-17h00'	65.2	64.9	65.1
10	17h00'-18h00'	67	66.9	67
11	18h00'-19h00'	66.3	66.7	66.5
12	19h00'-20h00'	65.1	65.4	65.4
QCVN 26:2010/BTNMT (Normal places)		70	70	70

Table 14. Surface water quality in Cho Lach canal (1st round)

No	Parameters	Unit	Result (02/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.52	7.63	5.5 to 9
2	BOD_5 (20° C)	mg/L	**23**	**37**	15
3	Temperature	°C	29.1	29.2	-
4	Chemical Oxygen Demand	mg/L	**50**	**72**	30
5	Dissolved Oxygen	mg/L	5.51	5.22	≥ 4
6	Total Suspended Solids	mg/L	**89**	**95**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3

No	Parameters	Unit	Result (02/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	0.27	0.17	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	9.3×10^2	9.3×10^2	7,500

Table 15. Surface water quality in Cho Lach canal (2nd round)

No	Parameters	Unit	Result (09/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.48	7.71	5.5 to 9
2	BOD_5 (20° C)	mg/L	**22**	**35**	15
3	Temperature	°C	29.1	29.1	-
4	Chemical Oxygen Demand	mg/L	**48**	**68**	30
5	Dissolved Oxygen	mg/L	5.44	5.51	≥ 4
6	Total Suspended Solids	mg/L	**94**	**79**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	ND (MDL = 0.05)	0.17	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1.1×10^3	9.3×10^2	7,500

Table 16. Surface water quality in Cho Lach canal (3rd round)

No	Parameters	Unit	Result (16/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.36	7.28	5.5 to 9
2	BOD_5 (20°C)	mg/L	**19**	**33**	15
3	Temperature	°C	29.2	29.1	-
4	Chemical Oxygen Demand	mg/L	**42**	**63**	30
5	Dissolved Oxygen	mg/L	5.09	5.61	≥ 4
6	Total Suspended Solids	mg/L	**85**	**90**	50

No	Parameters	Unit	Result (16/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	0.15	0.21	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1.1×10^3	1.1×10^3	7,500

2.3. Baseline environmental monitoring results in Ky Hon canal

The results of baseline environmental monitoring are shown in the tables below:

Table 17. Ambient air quality in Ky Hon canal (1st round)

No	Parameter	Unit	Result (03/11/2021)						QCVN 05:2013/ BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	ºC	31.2	32	33.2	32.4	31.5	30.1	-
2	Humidity	%RH	68.4	63.6	60.8	60.2	60.6	62.1	-
3	Wind speed	m/s	0.8	1	0.4	0.5	0.7	0.8	-
4	Wind course	-	220SW	220SW	220SW	220SW	220SW	220SW	-
5	SO_2	µg/m^3	22	22	23	26	27	27	350
6	CO	µg/m^3	4.340	4.620	4.600	5.050	4.990	5.220	30,000
7	NO_2	µg/m^3	38	41	52	50	53	54	200
8	TSP	µg/m^3	35,2	31,3	42,1	35,3	31,3	36,9	300

Table 18. Ambient air quality in Ky Hon canal (2nd round)

No	Parameter	Unit	Result (10/11/2021)						QCVN 05:2013 /BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	ºC	31.5	32.4	32.6	32.3	32.0	29.8	-
2	Humidity	%RH	67.8	62.6	60.9	59.7	60.3	61.9	-
3	Wind speed	m/s	0.8	0.8	0.5	1.2	0.9	1.2	-
4	Wind course	-	220SW	220SW	220SW	220SW	220SW	220SW	-
5	SO_2	µg/m^3	26	28	29	31	25	24	350
6	CO	µg/m^3	ND (MDL = 3,000)	3,920	4,200	4,610	4,670	4,590	30,000
7	NO_2	µg/m^3	44	48	57	62	55	56	200
8	TSP	µg/m^3	35,9	38,9	46	35,9	32,7	31,1	300

Table 19. Ambient air quality in Ky Hon canal (3rd round)

No	Parameter	Unit	Result (17/11/2021)						QCVN 05:2013 /BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	°C	31,1	32,1	33,6	32,5	31,6	29,7	-
2	Humidity	%RH	68,2	63	60,4	59,8	60	62,1	-
3	Wind speed	m/s	0,9	1,4	1,2	1	0,7	1,3	-
4	Wind course	-	220SW	220SW	220SW	220SW	220SW	220SW	-
5	SO_2	µg/m^3	18	19	18	19	19	20	350
6	CO	µg/m^3	4.220	4.840	4.950	5.150	4.880	5.040	30,000
7	NO_2	µg/m^3	26	28	29	29	29	28	200
8	TSP	µg/m^3	39,5	38,9	45,9	38,4	32,8	36,4	300

Table 20. Baseline noise level in Ky Hon canal

No	Time of measurement	Noise level, Leq (dBA)		
		1st round (03/11/2021)	2nd round (10/11/2021)	3rd round (17/11/2021)
1	08h00'-09h00'	62.7	62.7	62.8
2	09h00'-10h00'	62.6	62.8	62.7
3	10h00'-11h00'	62.7	63	62.7
4	11h00'-12h00'	62.8	62.9	62.7
5	12h00'- 13h00'	62.7	62.4	62.7
6	13h00'-14h00'	63.1	62.5	62.7
7	14h00'- 15h00'	63.1	62.4	62.6
8	15h00'-16h00'	62.6	63.1	62.8
9	16h00'-17h00'	62.8	62.7	62.4
10	17h00'-18h00'	62.7	63.1	62.9
11	18h00'-19h00'	62.8	62.8	62.4
12	19h00'-20h00'	62.3	62.9	62.6
QCVN 26:2010/BTNMT (Normal places)		70	70	70

Table 21. Surface water quality in Ky Hon canal (1st round)

No	Parameters	Unit	Result (03/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.68	7.12	5.5 to 9
2	BOD_5 (20° C)	mg/L	**43**	**35**	15
3	Temperature	°C	29.3	29.1	-
4	Chemical Oxygen Demand	mg/L	**84**	**78**	30
5	Dissolved Oxygen	mg/L	5.16	5.19	≥ 4
6	Total Suspended Solids	mg/L	**102**	**112**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05

No	Parameters	Unit	Result (03/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	0.46	0.83	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	9.3×10^2	9.3×10^2	7500

Table 22. Surface water quality in Ky Hon canal (2nd round)

No	Parameters	Unit	Result (10/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.36	7.33	5.5 to 9
2	BOD_5 (20° C)	mg/L	**41**	**33**	15
3	Temperature	°C	29.2	29.1	-
4	Chemical Oxygen Demand	mg/L	**80**	**74**	30
5	Dissolved Oxygen	mg/L	5.33	5.08	≥ 4
6	Total Suspended Solids	mg/L	**107**	**128**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	0.46	0.83	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1.5×10^3	1.1×10^3	7500

Table 23. Surface water quality in Ky Hon canal (3rd round)

No	Parameters	Unit	Result (17/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.21	7.32	5.5 to 9
2	BOD_5 (20°C)	mg/L	**38**	**31**	15
3	Temperature	°C	29.2	29.1	-
4	Chemical Oxygen Demand	mg/L	**74**	**68**	30
5	Dissolved Oxygen	mg/L	5.33	5.41	≥ 4
6	Total Suspended Solids	mg/L	**106**	**120**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9

No	Parameters	Unit	Result (17/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	0.45	0.17	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1.5×10^3	1.1×10^3	7,500

2.4. Baseline environmental monitoring results in Rach La canal

The results of baseline environmental monitoring are shown in the tables below:

Table 24. Ambient air quality in Rach La canal (1st round)

No	Parameter	Unit	Result (02/11/2021)						QCVN 05:2013/ BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	ºC	31.1	31.7	33.1	32.5	31.4	30.7	-
2	Humidity	%RH	68.6	63.5	60.8	60.5	60.7	62.3	-
3	Wind speed	m/s	0.8	0.8	0.5	1.1	0.4	0.7	-
4	Wind course	-	70NE	70NE	70NE	70NE	70NE	70NE	-
5	SO_2	µg/m^3	26	26	27	27	27	17	350
6	CO	µg/m^3	ND (MDL = 3000)	3 200	ND (MDL = 3000)	ND (MDL = 3000)	3 440	ND (MDL = 3000)	30,000
7	NO_2	µg/m^3	16	18	18	22	31	26	200
8	TSP	µg/m^3	36.9	39.1	42.1	39.5	35.7	30	300

Table 25. Ambient air quality in Rach La canal (2nd round)

No	Parameter	Unit	Result (09/11/2021)						QCVN 05:2013 /BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	ºC	31.6	32	33.4	32.9	31.5	30.2	-
2	Humidity	%RH	68.2	62.8	60.7	60	60.3	61.6	-
3	Wind speed	m/s	1.1	0.8	0.6	0.6	0.7	1	-
4	Wind course	-	70NE	70NE	70NE	70NE	70NE	70NE	-
5	SO_2	µg/m^3	13	13	14	16	16	17	350
6	CO	µg/m^3	5,840	6,390	5,310	5,230	4,630	4,580	30,000
7	NO_2	µg/m^3	38	40	42	43	44	45	200
8	TSP	µg/m^3	35.7	31	43.1	36.3	37.1	25.4	300

Table 26. Ambient air quality in Rach La canal (3rd round)

No	Parameter	Unit	Result (16/11/2021)						QCVN 05:2013 /BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	°C	31.4	32.4	33	32.7	32.1	30	-
2	Humidity	%RH	68.1	63.1	60.6	60.1	60.2	61.9	-
3	Wind speed	m/s	< 0.4	0.5	0.5	0.6	0.8	0.5	-
4	Wind course	-	70NE	70NE	70NE	70NE	70NE	70NE	-
5	SO_2	µg/m^3	32	30	28	29	30	29	350
6	CO	µg/m^3	6 220	5 160	6 450	5 650	5 630	5 780	30,000
7	NO_2	µg/m^3	28	28	28	28	29	29	200
8	TSP	µg/m^3	42.8	32	41.5	35.3	34.5	28.7	300

Table 27. Baseline noise level in Rach La canal

No	Time of measurement	Noise level, Leq (dBA)		
		1st round (02/11/2021)	2nd round (09/11/2021)	3rd round (16/11/2021)
1	08h00'-09h00'	62.5	62.4	62.4
2	09h00'-10h00'	62.9	62.9	62.8
3	10h00'-11h00'	63	62.5	62.7
4	11h00'-12h00'	62.5	62.8	62.7
5	12h00'- 13h00'	62.6	62.9	62.6
6	13h00'-14h00'	62.4	62.9	62.7
7	14h00'- 15h00'	63.9	63.7	63.9
8	15h00'-16h00'	62	62	62.2
9	16h00'-17h00'	64.2	63.8	63.8
10	17h00'-18h00'	63.9	62.9	63.7
11	18h00'-19h00'	61.8	61.8	62.1
12	19h00'-20h00'	63.6	64	63.6
QCVN 26:2010/BTNMT (Normal places)		70	70	70

Table 28. Surface water quality in Rach La canal (1st round)

No	Parameters	Unit	Result (02/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.45	7.31	5.5 to 9
2	BOD_5 (20° C)	mg/L	**54**	**29**	15
3	Temperature	°C	29.2	29.2	-
4	Chemical Oxygen Demand	mg/L	**108**	**59**	30
5	Dissolved Oxygen	mg/L	5.33	5.42	≥ 4
6	Total Suspended Solids	mg/L	**89**	**77**	50
7	Ammonia (as of N)	mg/L	0.27	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3

No	Parameters	Unit	Result (02/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	<0.15 (LOQ=0.15)	0.86	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	**1.1×10^4**	2.4×10^2	7,500

Table 29. Surface water quality in Rach La canal (2nd round)

No	Parameters	Unit	Result (09/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.25	7.49	5.5 to 9
2	BOD_5 (20° C)	mg/L	**52**	**28**	15
3	Temperature	°C	29.1	29.2	-
4	Chemical Oxygen Demand	mg/L	**103**	**57**	30
5	Dissolved Oxygen	mg/L	5.19	5.38	≥ 4
6	Total Suspended Solids	mg/L	**78**	**85**	50
7	Ammonia (as of N)	mg/L	0.26	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	<0.15 (LOQ=0.15)	0.86	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	4.6×10^3	2.4×10^2	7,500

Table 30. Surface water quality in Rach La canal (3rd round)

No	Parameters	Unit	Result (16/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.19	7.28	5.5 to 9
2	BOD_5 (20°C)	mg/L	**49**	**25**	15
3	Temperature	°C	29.2	29.1	-
4	Chemical Oxygen Demand	mg/L	**97**	**51**	30
5	Dissolved Oxygen	mg/L	5.52	5.06	≥ 4
6	Total Suspended Solids	mg/L	**86**	**79**	50

No	Parameters	Unit	Result (16/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	0.19	0.57	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	4.6×10^3	4.6×10^2	7500

2.5. Baseline environmental monitoring results in Tac Cua river

The results of baseline environmental monitoring are shown in the tables below:

Table 31. Ambient air quality in Tac Cua canal (1st round)

No	Parameter	Unit	Result (01/11/2021)						QCVN 05:2013/ BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	°C	31.6	32.1	32.6	32.6	31.8	29.8	-
2	Humidity	%RH	68.2	63	60.4	60.1	60.7	62.3	-
3	Wind speed	m/s	0.7	1	0.8	0.7	0.7	1	-
4	Wind course	-	135SE	135SE	135SE	135SE	135SE	135SE	-
5	SO_2	µg/m³	26	26	27	28	27	29	350
6	CO	µg/m³	3.720	3.880	3.860	3.900	4.220	3.610	30,000
7	NO_2	µg/m³	85	91	81	85	85	81	200
8	TSP	µg/m³	21	20.9	22.4	21.9	20.7	20	300

Table 32. Ambient air quality in Tac Cua canal (2nd round)

No	Parameter	Unit	Result (08/11/2021)						QCVN 05:2013/ BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	°C	31	32.1	33.1	32.1	32.1	30.1	-
2	Humidity	%RH	63.8	63.3	61	60	60.6	61.9	-
3	Wind speed	m/s	0.4	0.9	0.5	0.8	1.3	0.7	-
4	Wind course	-	135SE	135SE	135SE	135SE	135SE	135SE	-
5	SO_2	µg/m³	17	22	23	23	24	24	350
6	CO	µg/m³	4,330	4,280	4,450	4,310	4,310	4,390	30,000
7	NO_2	µg/m³	32	35	37	38	40	40	200
8	TSP	µg/m³	20.7	29.2	27.2	26.4	23	25.5	300

Table 33. Ambient air quality in Tac Cua canal (3rd round)

No	Parameter	Unit	Result (15/11/2021)						QCVN 05:2013/ BTNMT
			08h00	10h00	12h00	14h00	16h00	18h00	
1	Temperature	°C	31.8	32	32.9	32.3	31.6	30.1	-
2	Humidity	%RH	63.8	62.8	60.7	60.5	60.4	62.3	-
3	Wind speed	m/s	0.6	0.9	1.1	0.7	0.7	0.6	-
4	Wind course	-	135SE	135SE	135SE	135SE	135SE	135SE	-
5	SO_2	µg/m^3	17	17	17	18	19	19	350
6	CO	µg/m^3	5,320	5,340	5,490	5,340	5,690	5,710	30,000
7	NO_2	µg/m^3	32	32	33	33	33	33	200
8	TSP	µg/m^3	22.2	21.5	26.1	21.6	25.1	24.5	300

Table 34. Baseline noise level in Tac Cua canal

No	Time of measurement	Noise level, Leq (dBA)		
		1st round (01/11/2021)	2nd round (08/11/2021)	3rd round (15/11/2021)
1	08h00'-09h00'	59.5	59.6	59.5
2	09h00'-10h00'	59.9	59.8	60.1
3	10h00'-11h00'	59.9	59.7	59.8
4	11h00'-12h00'	60.3	59.9	60.3
5	12h00'- 13h00'	60.3	59.6	59.6
6	13h00'-14h00'	59.3	59.8	59.5
7	14h00'- 15h00'	59.1	59.3	59.4
8	15h00'-16h00'	59.6	59.4	60.1
9	16h00'-17h00'	60.2	60.4	60.3
10	17h00'-18h00'	59.5	59.4	59.1
11	18h00'-19h00'	59.5	59.6	60.1
12	19h00'-20h00'	59.8	60	59.8
QCVN 26:2010/BTNMT *(Normal places)*		70	70	70

Table 35. Surface water quality in Tac Cua canal (1st round)

No	Parameters	Unit	Result (01/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.39	7.56	5.5 to 9
2	BOD_5 (20° C)	mg/L	**61**	**72**	15
3	Temperature	°C	29.1	29.1	-
4	Chemical Oxygen Demand	mg/L	**111**	**38**	30
5	Dissolved Oxygen	mg/L	5.25	5.36	≥ 4
6	Total Suspended Solids	mg/L	**345**	**288**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01

No	Parameters	Unit	Result (01/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	ND (MDL = 0.05)	ND (MDL = 0.05)	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1.5×10^3	1.1×10^3	7500

Table 36. Surface water quality in Tac Cua canal (2nd round)

No	Parameters	Unit	Result (08/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.39	7.42	5.5 to 9
2	BOD_5 (20° C)	mg/L	**58**	**36**	15
3	Temperature	°C	29.1	29.1	-
4	Chemical Oxygen Demand	mg/L	**106**	**68**	30
5	Dissolved Oxygen	mg/L	5.58	5.69	≥ 4
6	Total Suspended Solids	mg/L	**332**	**256**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	ND (MDL = 0.05)	ND (MDL = 0.05)	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1.1×10^3	9.3×10^2	7500

Table 37. Surface water quality in Tac Cua canal (3rd round)

No	Parameters	Unit	Result (15/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
1	pH	-	7.57	7.66	5.5 to 9
2	BOD_5 (20°C)	mg/L	**55**	**33**	15
3	Temperature	°C	29.2	29.2	-
4	Chemical Oxygen Demand	mg/L	**100**	**63**	30
5	Dissolved Oxygen	mg/L	5.31	5.38	≥ 4
6	Total Suspended Solids	mg/L	**337**	**301**	50
7	Ammonia (as of N)	mg/L	ND (MDL = 0.02)	ND (MDL = 0.02)	0.9
8	Nitrate (as of N)	mg/L	ND (MDL = 0.30)	ND (MDL = 0.30)	10

No	Parameters	Unit	Result (15/11/2021)		QCVN 08-MT:2015/ BTNMT *(B1 grade)*
			Starting point of waterway segment	End point of waterway segment	
9	Phosphate (as of P)	mg/L	ND (MDL = 0.03)	ND (MDL = 0.03)	0.3
10	Arsenic (As)	mg/L	ND (MDL = 0.001)	ND (MDL = 0.001)	0.05
11	Cadmium (Cd)	mg/L	ND (MDL = 0.0002)	ND (MDL = 0.0002)	0.01
12	Lead (Pb)	mg/L	ND (MDL = 0.0004)	ND (MDL = 0.0004)	0.05
13	Mercury (Hg)	mg/L	ND (MDL = 0.0003)	ND (MDL = 0.0003)	0.001
14	Iron (Fe)	mg/L	ND (MDL = 0.05)	ND (MDL = 0.05)	1.5
15	Oil and grease	mg/L	ND (MDL = 0.3)	ND (MDL = 0.3)	1
16	Coliform	MPN/ 100mL	1.5×10^3	1.1×10^3	7500

2.6. Phytoplankton in the project area

Table 38. Phytoplankton in the Project Area

No.	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
	CYANOPHYTA						
1	*Anabaena* sp.	25	20	90	158	70	
2	*Aphanocapsa* sp.					100	
3	*Lyngbya circumcreta* G.S.West, 1907	392			162	518	700
4	*Microcystis aeruginosa* (Kützing) Kützing, 1846	80	*	*	1370	*	100
5	*Microcystis wesenbergii* (Komárek) Komárek ex Komárek, 2006	60			1340	80	60
6	*Oscillatoria princeps* Vaucher ex Gomont, 1892	180	70	170			
7	*Oscillatoria* sp.	50	150	120	150	60	
8	*Phormidium mucicola* Nauman & Huber-Pestalozzi, 1929	258			125	290	158
9	*Planktothrix* sp.	*					
10	*Trichodesmium erythraeum* Ehrenberg ex Gomont, 1892					*	
	CHRYSOPHYTA						
11	*Dictyocha fibula* Ehrenberg, 1839			3			
	BACILLARIOPHYTA						
12	*Amphiprora alata* (Ehrenberg) Kützing, 1844		2	1			
13	*Amphora laevis* Gregory, 1857			2			
14	*Asterionella japonica* Cleve, 1882	16	72	280			15
15	*Bacteriastrum varians* Lauder, 1864			7			
16	*Bellerochea horologicalis* Stosch, 1977			8			
17	*Biddulphia mobiliensis* (J.W.Bailey) Grunow, 1882	1	9	35		*	*
18	*Biddulphia regia* (Schultze) Ostenfeld, 1908		6				
19	*Biddulphia reticulum* (Ehrenberg) Boyer, 1900		2	2			
20	*Biddulphia sinensis* Greville, 1866		1	3			*

No.	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
21	*Chaetoceros abnormis* A.I.Proshkina-Lavrenko	5	3	2			
22	*Chaetoceros affinis* Lauder, 1864		4	16			
23	*Chaetoceros curvisetus* Cleve, 1889	7	72	40			
24	*Chaetoceros diversus* Cleve, 1873		8	84			4
25	*Chaetoceros lorenzianus* Grunow, 1863						4
26	*Chaetoceros pelagicus* Cleve, 1873	4	6	9			
27	*Chaetoceros peruvianus* Brightwell, 1856			3			
28	*Chaetoceros subtilis* Cleve, 1896		6				
29	*Climacodium biconcavum* Cleve, 1897	*	4	4			4
30	*Climacosphenia moniligera* Ehrenberg, 1843			4			
31	*Corethron hystrix* Hensen, 1887		1	1			
32	*Coscinodiscus bipartitus* Rattray, 1890	*	2	18			*
33	*Coscinodiscus jonesianus* (Greville) Ostenfeld, 1915	1	4	6		*	1
34	*Coscinodiscus marginatus* Ehrenberg, 1843			1			
35	*Coscinodiscus radiatus* Ehrenberg, 1841	3	19	228	2	2	9
36	*Coscinodiscus* sp.	1	10	49			
37	*Coscinodiscus thorii* Pavillard, 1925	*	15	24			1
38	*Cyclotella comta* (Ehrenberg) Kützing, 1849	2	7	175	*	5	2
39	*Cyclotella meneghiniana* Kützing, 1844	1	10			2	
40	*Ditylum sol* (A.Schmidt) Cleve, 1900	7	36	168			7
41	*Eucampia cornuta* (Cleve) Grunow, 1883		6				
42	*Guinardia flaccida* (Castracane) H.Peragallo, 1892	4	4	47	*	2	6
43	*Gyrosigma attenuatum* (Kützing) Rabenhorst, 1853		*	10			
44	*Gyrosigma sinense* (Ehrenberg) Desikachary, 1988			*		1	
45	*Hemiaulus membranaceus* Cleve, 1873	4		6			
46	*Hemiaulus sinensis* Greville, 1865	2	14	24			7
47	*Lauderia borealis* Gran, 1900		9	21			
48	*Lithodesmium variabile* H.Tanako, 1979		*	4			
49	*Melosira granulata* (Ehrenberg) Ralfs, 1861	613		18	2184	3276	1404
50	*Navicula membranacea* Cleve, 1897			2		*	
51	*Nitzschia closterium* (Ehrenberg) W.Smith, 1853	1	4				
52	*Nitzschia longissima* (Brébisson) Ralfs, 1861		2	4		1	1

No.	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
53	*Nitzschia lorenziana* Grunow, 1880		2	5		*	*
54	*Nitzschia paradoxa* (J.F.Gmelin) Grunow, 1880	34		*			
55	*Paralia sulcata* (Ehrenberg) Cleve, 1873			4			
56	*Planktoniella sol* (G.C.Wallich) Schütt, 1892		5	12			
57	*Pleurosigma angulatum* (J.T.Quekett) W.Smith, 1852		5	1			
58	*Pleurosigma elongatum* W.Smith, 1852	*	18	32			3
59	*Rhizosolenia alata* Brightwell, 1858	*	5	8		*	
60	*Rhizosolenia bergonii* H.Peragallo, 1892		3	2			
61	*Rhizosolenia calcar-avis* Schultze, 1858		1			*	2
62	*Rhizosolenia crassispina* J.L.B.Schröder, 1906	7	23	54			15
63	*Rhizosolenia imbricata* Brightwell, 1858	4	4	35		*	5
64	*Rhizosolenia setigera* Brightwell, 1858	3	18	45		1	3
65	*Rhizosolenia stolterfothii* H.Peragallo, 1888	3	5	54			7
66	*Skeletonema costatum* (Greville) Cleve, 1873	*	154	152			13
67	*Streptotheca thamesis* Shrubsole, 1891		2	1			
68	*Surirella robusta* Ehrenberg, 1841			1	*	*	*
69	*Surirella spiralis* Kützing, 1844			9			
70	*Synedra acus* Kützing, 1844	3			4	5	4
71	*Synedra ulna* (Nitzsch) Ehrenberg, 1832	3				7	1
72	*Thalassionema nitzschioides* (Grunow) Mereschkowsky, 1902	4	435	1944	4	2	6
	CHLOROPHYTA						
73	*Actinastrum hantzschii* Lagerheim, 1882				24		
74	*Ankistrodesmus falcatus* (Corda) Ralfs, 1848				1		
75	*Ankistrodesmus gracilis* (Reinsch) Korshikov, 1953					*	
76	*Coelastrum microporum* Naegeli, 1849	*				16	*
77	*Crucigenia fenestrata* (Schmidle) Schmidle, 1900				48		
78	*Dictyosphaerium pulchellum* H.C.Wood, 1873				32		24
79	*Eudorina elegans* Ehrenberg, 1832	40			112	206	20
80	*Franceia tenuispina* Korshikov, 1953	1				*	
81	*Micractinium pusillum* Fresenius, 1858				*		

No.	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
82	*Oocystis borgei* J.W.Snow, 1903				6	4	
83	*Pandorina morum* (O.F.Müller) Bory, 1824	*			104	16	
84	*Pediastrum duplex* Meyen, 1829	32	74	16	256	336	128
85	*Pediastrum simplex* Meyen, 1829	*		48	64		32
86	*Pediastrum tetras* (Ehrenberg) Ralfs, 1845				*	20	
87	*Scenedesmus acuminatus* (Largerheim) Chodat, 1902	8			8	8	
88	*Scenedesmus bernardii* G.M.Smith, 1916		8		16		
89	*Scenedesmus quadricauda* (Turpin) Brébisson, 1835	8	4		4	8	4
90	*Sphaerocystis schroeteri* Chodat, 1897	16			20	116	
91	*Tetraëdron incus* (Teiling) G.M.Smith, 1926				2		
92	*Tetraëdron regulare* Kützing, 1845	*			*	1	1
	CHAROPHYTA						
93	*Closterium ehrenbergii* Meneghini ex Ralfs, 1848	*	1		*	*	
94	*Closterium gracile* Brébisson ex Ralfs, 1848					1	*
95	*Closterium nematodes* Joshua, 1886					1	
96	*Desmidium baileyi* (Ralfs) Nordstedt, 1880	*			52	50	
97	*Euastrum sinuosum* Kützing, 1849				*	*	
98	*Staurastrum gracile* Ralfs ex Ralfs, 1848	*			3	4	1
99	*Staurastrum megacanthum* P.Lundell, 1871				*	*	
100	*Staurastrum ophiura* P.Lundell, 1871				2	*	
101	*Staurastrum smithii* Prescott, 1967	1			7	3	1
102	*Staurastrum zonatum* Børgesen, 1890				3	1	
	DINOPHYTA						
103	*Ceratium furca* (Ehrenberg) Claparède & Lachmann, 1859	1	15	43			5
104	*Ceratium fusus* (Ehrenberg) Dujardin, 1841		*	4			
105	*Ceratium hirundinella* (O.F.Müller) Dujardin, 1841		*	*	1	1	
106	*Dinophysis caudata* Saville-Kent, 1881		6	6	*		1
107	*Gonyaulax polygramma* Stein, 1883			*			
108	*Protoperidinium conicum* (Gran) Balech, 1974		1				
109	*Protoperidinium divergens* (Ehrenberg) Balech, 1974		1				
110	*Protoperidinium excentricum* (Paulsen) Balech, 1974		1				
111	*Protoperidinium pellucidum* Bergh, 1881		10	6			

No.	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
112	*Protoperidinium subinerme* (Paulsen) A.R.Loeblich III, 1969		7	1			
113	*Pyrophacus steinii* (Schiller) Wall & Dale, 1971			4			
	Total spieces	**53**	**61**	**67**	**40**	**50**	**44**
	Cell density/liter	**1885**	**1386**	**4176**	**6264**	**5214**	**2759**

2.7. Zooplankton in the project area

Table 38. Zooplankton in the Project area

No.	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
	Kingdom PROTOZOA						
	Phylum CILIOPHORA						
	Class SPIROTRICHEA						
	Order Tintinnida						
	Family Codonelidae						
1	*Tintinnopsis mortenseni* Schmidt	83	333	417	200		333
	Family Codonellopsidae						
2	*Codonellopsis aspera* Kofoid & Campbell		33	417			
	Kingdom ANIMALIA						
	Phylum ROTIFERA						
	Class EUROTATORIA						
	Subclass MONGONONTA						
	Order Flosculariaceae						
	Family Filiniidae						
3	*Filinia camasecla* Myers				*	333	800
4	*Filinia longiseta* Ehrenberg						200
5	*Filinia opoliensis* (Zacharias)				*	667	400
6	*Filinia terminalis* Plate					333	
	Family Hexathridae						
7	*Hexathra mira* (Hudson)				333	*	*
	Order Ploima						
	Family Brachionidae						
8	*Brachionus angularis* Gosse				600	333	*
9	*Brachionus calyciflorus amphicerus* (Ehrenberg)				*	83	
10	*Brachionus calyciflorus calyciflorus* Pallas				200		
11	*Brachionus caudatus* (Apstein)				*	167	

No.	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
12	*Brachionus plicatilis* Müller						
13	*Brachionus urceolaris* Muller				*	*	
14	*Keratella cochlearis* Gosse				200	*	
15	*Keratella lenzi* (Hauer)				200	667	
16	*Keratella tropica* (Apstein)				200	333	
17	*Plationus patulus* (O.F. Müller)				*	83	
	Family Epiphanidae						
18	*Epiphanes macroura* (Barrois & Daday)					333	
	Family Lecanidae						
19	*Lecane curvicornis* (Murray)				*		
20	*Lecane papuana* (Murray)				*		333
	Family Synchaetidae						
21	*Polyarthra vulgaris* Carlin				600	1000	
	Phylum ARTHROPODA						
	Class BRANCHIOPODA						
	Order Cladocera						
	Family Bosminidae						
22	*Bosminopsis deitersi* Richard				*	*	333
23	*Bosmina longirostris* (O.F. Müller)	400		17	200	667	*
	Family Moinidae						
24	*Ilyocryptus spinifer* Herrick				200	*	*
25	*Moina macrocopa* (Straus)				200	1000	333
	Family Sididae						
26	*Diaphanosoma sarsi* Richar				*	250	*
	Class HEXANAUPLIA						
	Subclass COPEPODA						
	Order Calanoida						
	Family Paracalanidae						
27	*Acrocalanus indicus* Tanaka			67			
28	*Paracalanus crassirostris* Dahl	*	1667	13750			
29	*Paracalanus parvus* (Claus)	200	*	83			
	Family Pseudocalanidae						
30	*Clausocalanus arcuicornis* (Dana)	200		33			
	Family Pontellidae						
31	*Labidocera* sp.	600	*				
	Family Centropagidae	50					
32	*Centropages furcatus* (Dana)	*	50	*			

No.	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
	Family Diaptomidae						
33	*Heliodiaptomus falxus* Shen & Tai				200	*	50
34	*Neodiaptomus botulifer* Kiefer				*	*	83
	Family Pseudodiaptomidae						
35	*Pseudodiaptomus* sp.		333	833	*	83	83
36	*Schmackeria dubia* (Kiefer)			*			
37	*Schmackeria speciosa* Dang			33			
	Family Acartidae						
38	*Acartia spinicauda* Giesbrecht		*				
39	*Acartia tsuensis* Ito		233	5000	200		*
40	*Acartiella sinensis* Shen & Lee			*			
	Order Cyclopoida						
	Family Corycaeidae						
41	*Corycaeus* sp.		*	33			
	Family Cyclopidae						
42	*Hemicyclops japonicus* Itoh & Nishida	*	333				
43	*Microcyclops varicans* Sars	5400		33	5000	4667	1000
44	*Mesocyclops leuckarti* (Claus)				200	*	*
45	*Tropocyclops prasinus* (Fisher)	133			200	333	83
	Family Oithonidae						
46	*Oithona nana* Giesbrecht		1000	10000			*
47	*Oithona similis* Claus		*				*
48	*Oithona simplex* Farran			417			
	Order Harpacticoida						
	Family Tachidiidae						
49	*Euterpina acutifrons* (Dana)			417			
	Class OSTRACODA						
	Order Podocopida						
	Family Cyprididae						
50	*Hemicypris anomala* Klie	*	*	33	*	*	83
	LARVA						
51	Copepoda nauplius	12200	40333	35000	6800	10000	15667
52	Bivalvia larva	1200			1667	4333	333
53	Decapoda		*	33			*
54	Gastropoda	*			417		*
55	Polychaeta larva		500		200		83

2.8. Benthic macro invertebrates

Table 39. Species Component of Zoo Benthos and Invertebrates

Stt	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
	Phylum MOLLUSCA						
	Class Gastropoda						
	Family Nassariidae						
1	*Nassarius stolatus* (Gmelin, 1791)				10		
	Class Bivalvia						
	Family Pholadidae						
2	*Pholas* sp.				50		
	Family Tellinidae						
3	*Tellina* sp.						30
	Phylum ANNELIDA						
	Class Polychaeta						
	Family Amphinomidae						
4	*Chloeia violacea* Horst, 1910		10			10	20
	Family Capitellidae						
5	*Dasybranchus caducus* (Grube, 1846)		10				
6	*Heteromastus similis* Southern, 1921					10	20
7	*Notomastus aberans* Day, 1957			10			
8	*Notomastus* sp.				10		
9	*Parheteromastus tenuis* Monro, 1937		10	20			
	Family Cirratulidae						
10	*Chaetozone flagellifera* Gallardo, 1968				10		10
11	*Caulleriella glabra* Gallardo, 1968		10				
	Family Lumbrineridae						
12	*Lumbriconereis heteropoda* Marenzeller, 1879	20	10	10	10		
13	*Lumbrineris* sp.	20	10	10			
	Family Magelonidae						
14	*Magelona* sp.	10	10	10		20	10
	Family Nephtyidae						
15	*Nephtys oligobranchia* Southern, 1921	20	20	10	70		10
	Family Nereididae						
16	*Dendronereis arborifera* Peters, 1854						10
	Family Onuphidae						
17	*Diopatra variabilis*Southern,	10	20	10			

Stt	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
	1921						
	Family Orbiniidae						
18	*Scoloplos* sp.	10	20	10		50	60
	Family Pilargidae						
19	*Loandalia indica* Thomas, 1963					30	30
20	*Sigambra hanaokai* (Kitamori, 1960)				10		
	Family Sabellidae						
21	*Potamilla* sp.					110	100
	Family Scalibregmatidae						
22	*Scalibregma inflatum* Rathke, 1843				10		
	Family Spionidae						
23	*Laonice cirrata* (M. Sars, 1851)						30
24	*Prionospio* sp.					10	10
25	*Scolelepis (Scolelepis) squamata* (O.F. Muller, 1806)					10	10
	Family Sternaspidae						
26	*Sternaspis scutata* (Ranzani, 1817)	20	20	10		160	10
	Family Trichobranchidae						
27	*Terebellides stroemii* Sars, 1835		10			30	270
	Phylum ARTHROPODA						
	Class Crustacea						
	Order Decapoda						
	Family Pasiphaeidae						
28	*Parapasiphae* sp.		10			10	
	Family Porcellanidae						
29	*Raphidopus ciliatus* Stimpson, 1858				10		
	Family Sergestidae						
30	*Acetes* sp.				10		
	Family Xenophthalmidae						
31	*Xenophthalmus pinnotheroides* White, 1846			10		30	10
32	*Decapoda larva*						10
	Order Amphipoda						
	Family Ampeliscidae						
33	*Ampelisca bocki* Dahl, 1944	10	30	20			
	Family Aoridae						
34	*Grandidierella* sp.				30	40	80
	Family Corophiidae						
35	*Corophium* sp.					10	40

Stt	Scientific name	Cho Lach canal			Mang Thit river		
		1st round	2nd round	3rd round	1st round	2nd round	3rd round
	Order Isopoda						
36	*Isopoda larva*				10		
	Order Stomatopoda						
	Family Squillidae						
37	*Rissoides desmaresti* (Risso, 1816)					10	
	Phylum ECHINODERMATA						
	Class Ophiuroidea						
	Family Amphiuridae						
38	*Amphioplus* sp.	10		10	10		
Total species		**9**	**14**	**12**	**13**	**15**	**19**
Individuals/m^3		**130**	**200**	**140**	**250**	**540**	**770**

2.9. Sediment quality in simillar/nearby projects

There are three projects sharing the similar conditions and locations with SWLC Project namely:

- Project of dredging the Tien river waterway (Cua Dai) from Binh Thang dam to Thua Duc estuary, Binh Dai district, Ben Tre province, herebelow referred to Project 01.

- Investment project of construction and upgrading of Cho Gao canal (phase 2) , herebelow referred to Project 02.

- Investment project of construction of Rach Mieu 2 bridge connecting Tien Giang province and Ben Tre province, herebelow referred to Project 03.

The results of sediment quality analysis are shown in the tables below:

Table 40. Sediment quality analysis of Project 01

No	Parameter	Unit	Results						QCVN 43:2017/ BTNMT *(brackish water sediment)*
			TT1	TT2	TT3	TT4	TT5	TT6	
1	pH	-	7.65	7.83	7.22	6.75	6.53	7.04	-
2	As	mg/kg	5.19	4.76	4.38	3.94	4.11	4.42	**41.6**
3	Ba	mg/kg	3.81	2.43	2.19	2.25	1.76	2.36	-
4	Cd	mg/kg	0.72	0.57	0.42	0.61	0.35	0.81	**4.2**
5	Pb	mg/kg	28.3	32.4	25.1	30.7	28.3	35.7	**112**
6	Co	mg/kg	0.26	0.51	0.42	0.68	0.34	0.92	-
7	Cu	mg/kg	23.1	21.9	10.6	17.2	15.7	22.4	**108**
8	Zn	mg/kg	70.4	95.8	56.3	65.9	71.5	89.6	**271**
9	Ni	mg/kg	11.8	16.4	8.54	10.1	14.6	17.3	-
10	Se	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	-
11	Hg	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	**0.7**
12	Cr	mg/kg	33.7	37.2	28.5	35.3	31.1	36.1	**160**
13	Total cyanide	mg/kg	1.62	2.48	1.23	1.82	2.07	2.56	-
14	Va	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	-
15	Ta	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	-
16	Be	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	-
17	Sb	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	-

No	Parameter	Unit	Results						QCVN 43:2017/ BTNMT *(brackish water sediment)*
			TT1	TT2	TT3	TT4	TT5	TT6	
18	Mo	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	-
19	Floride	mg/kg	1.67	1.25	1.38	1.14	1.73	2.49	-
20	Oil and grease	mg/kg	35.1	26.1	17.6	22.9	20.5	28.7	-
21	Pesticides	µg/kg	2.84	2.36	1.62	1.72	2.61	3.12	-
22	Total organic compopunds	mg/kg	4.38	3.15	5.83	3.21	6.47	8.65	**100**

Note:

- TT01: LK5
- TT02: LK63
- TT03: LK103
- TT04: LK17
- TT05: LK45
- TT06: LK86

Table 41. Sediment quality analysis of Project 02

No	Parameter	Unit	Results		QCVN43:2017/ BTNMT *(fresh water sediment)*
			TT1	TT2	
I	**Round 1: 11 Jan 2021**				
-	As	mg/kg	ND (MDL = 0.1)	ND (MDL = 0.1)	**17**
-	Pb	mg/kg	11.3	14.3	**91.3**
-	Hg	mg/kg	ND (MDL = 0.01)	ND (MDL = 0.01)	**0.5**
-	$Cr^{(b)}$	mg/kg	22.8	22.1	**90**
-	Oil and grease	mg/kg	ND (MDL = 1)	ND (MDL = 1)	-
-	Cu	mg/kg	14.9	9.7	**197**
-	CN^-	ppm	ND (MDL = 0.18)	ND (MDL = 0.18)	-
-	Chloride based Pesticide	µg/kg	ND (MDL = 5)	ND (MDL = 5)	-
-	Phosphorus based Pesticide	µg/kg	ND (MDL = 5)	ND (MDL = 5)	-
II	**Round 2: 18 Jan 2021**				
-	As	mg/kg	ND (MDL = 0.1)	ND (MDL = 0.1)	**17**
-	Pb	mg/kg	37.4	29.6	**91.3**
-	Hg	mg/kg	ND (MDL = 0.01)	ND (MDL = 0.01)	**0.5**
-	$Cr^{(b)}$	mg/kg	13.6	12.2	**90**
-	Oil and grease	mg/kg	ND (MDL = 1)	ND (MDL = 1)	-
-	Cu	mg/kg	22.8	25.9	**197**
-	CN^-	ppm	ND (MDL = 0.18)	ND (MDL = 0.18)	-
-	Chloride based Pesticide	µg/kg	ND (MDL = 5)	ND (MDL = 5)	-
-	Phosphorus based Pesticide	µg/kg	ND (MDL = 5)	ND (MDL = 5)	-
III	**Round 3: 25 Jan 2021**				
-	As	mg/kg	ND (MDL = 0.1)	ND (MDL = 0.1)	**17**
-	Pb	mg/kg	16.2	18.1	**91.3**
-	Hg	mg/kg	ND (MDL = 0.01)	ND (MDL = 0.01)	**0.5**
-	$Cr^{(b)}$	mg/kg	22.7	24.5	**90**
-	Oil and grease	mg/kg	ND (MDL = 1)	ND (MDL = 1)	-

No	Parameter	Unit	Results		QCVN43:2017/ BTNMT *(fresh water sediment)*
			TT1	TT2	
-	Cu	mg/kg	24.4	22.3	**197**
-	CN^-	ppm	ND (MDL = 0.18)	ND (MDL = 0.18)	-
-	Chloride based Pesticide	µg/kg	ND (MDL = 5)	ND (MDL = 5)	-
-	Phosphorus based Pesticide	µg/kg	ND (MDL = 5)	ND (MDL = 5)	-

Note:

- TT01: The intersection of Rach La with Vam Co River
- TT02: Cho Gao Bridge

Table 42. Sediment quality analysis of Project 03

Code of sample	As	Cd	Pb	Zn	Cu
	mg/kg	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*
I	**Round 1: 31 May 2021**				
TT01	ND	ND	29.4	82.6	37.7
TT02	ND	ND	27.5	57	42.4
TT03	ND	ND	23.8	87.7	39.7
TT04	ND	ND	26.6	96.9	42.1
II	**Round 2: 5 June 2021**				
TT01	ND	ND	31.3	86.8	32.8
TT02	ND	ND	28.5	48.8	36.5
TT03	ND	ND	28.6	90.7	43.1
TT04	ND	ND	19.1	86.1	41.9
III	**Round 3: 12 June 2021**				
TT01	ND	ND	27.4	70.3	32.5
TT02	ND	ND	21.5	43.7	31.9
TT03	ND	ND	25.1	83.7	38
TT04	ND	ND	17.4	76.7	39
QCVN 43:2017/BTNMT *(fresh water sediment)*	**17**	**3.5**	**91.3**	**315**	**197**

Note:

- TT01: Rach Mieu 2 Bridge (Tien Giang Province)
- TT02: Bridge over My Tho River - Rach Mieu Bridge 1 (Tien Giang & Ben Tre Provinces)
- TT03: Ba Lai Bridge 2, Tam Phuoc Commune, Chau Thanh District (Ben Tre Province)
- TT04: Song Ma Bridge, UD173 Tam Phuoc Commune, Chau Thanh District (Ben Tre Province)

ANNEX 3 – IMAGES OF PUBLIC CONSULTATION

The public consultation conducted from December 2021 to January 2022 were captured as in the following images.






































A6


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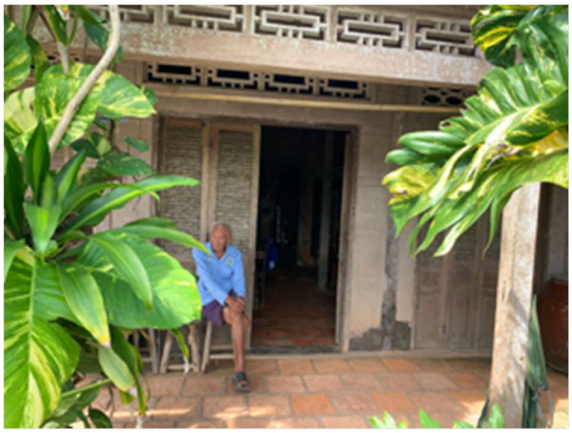













































TRẠM CẢNH SÁT ĐƯỜNG THỦY
PHƯỚC ĐÔNG


BẢNG THỰC HIỆN
CÁCH LY PHÒNG, CHỐNG
DỊCH COVID-19