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THE SOCIALIST REPUBLIC OF VIET NAM

**THE DETAILED DESIGN STUDY
ON
HO CHI MINH CITY
WATER ENVIRONMENT IMPROVEMENT PROJECT
IN
THE SOCIALIST REPUBLIC OF VIET NAM**

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ABBREVIATIONS

1. ORGANIZATIONS

ADB	Asian Development Bank
CDM	Camp Dresser & MaKee International Inc.
CEC	City Environment Company
CITENCO	Ho Chi Minh City Environmental Company
DARD	Department of Agriculture and Rural Development
DFP	Department of Finance-Pricing
DHI	Danish Hydraulics Institute
DOF	Department of Finance
DOSTE	Department of Science, Technology, and Environment
DPI	Department of Planning and Investment
DTPW	Department of Transport and Public Works
ENCO	Environmental Committee (renamed recently to the Environmental Management Section)
GOJ	Government of Japan
GOV	Government of Viet Nam
HCMC	Ho Chi Minh City
IDA	International Development Association
JICA	Japan International Cooperation Agency
JBIC	Japan Bank for International Cooperation (previous name: Overseas Economic Cooperation Fund: OECF)
MARD	Ministry of Agriculture and Rural Development
MOC	Ministry of Construction
MOF	Ministry of Finance
MOSTE	Ministry of Science, Technology, and Environment
MPI	Ministry of Planning and Investment
OECF	Overseas Economic Cooperation Fund (renamed to Japan Bank for International Cooperation: JBIC)
OWM	Office of Waterway Management
PC	People's Committee
PCHCMC	People's Committee of Ho Chi Minh City
PMU	Project Management Unit
SDC	Sewerage and Drainage Company
SOE	State Owned Enterprise
UDC	Urban Drainage Company
UPI	Urban Planning Institute
URENCO	Urban Environment Company
USAID	United State International Assistance Department
WB	World Bank
WSC	Water Supply Company

2. TERMINOLOGY

ATP	Affordability to Pay	BOD	Biochemical Oxygen Demand
B/C	Benefit by Cost Ratio	cm	Centimeter
CIF	Cost, Insurance and Freight	COD	Chemical Oxygen Demand
DHWL	Design High Water Level	DLWL	Design Low Water Level
DO	Dissolved Oxygen	FC	Foreign Currency
EIRR	Economic Internal Rate of Return	FOB	Free on Board
FIRR	Financial Internal Rate of Return	GIS	Geographic Information System
GRDP	Gross Regional Domestic Products	GDP	Gross Domestic Products
ha	Hectare	HH/HHs	Household or Households
IDF	Intensity-Duration-Frequency	kg	Kilogram
km	Kilometer	km ²	Square kilometer
kw	Kilowatt	l	Litter
m	Meter	m/s	Meter per second
m ²	Square meter	m ³	Cubic meter
m ³ /s	Cubic meter per second	mg	Milligram
mg/l	Milligram per liter	mm	Millimeter
LC	Local Currency	NLTN	Nhieu Loc Thi Nghe
NPV	Net Present Value	OM or O/M	Operation and Maintenance
s	Second	SCF	Standard Conversion Factor
SE	South East	SS	Suspended Solid
SAPROF	Special Assistance for Project Formation		
THBNDT	Tau Hu Ben Nghe Doi Te	THLG	Tan Hoa Lo Gom
TLBC	Thanh Long Binh chang	TQC	Total Quality Control
US\$	United States Dollar	VND	Vietnamese Dong
WTP	Willingness to Pay	%	Percent

Chapter 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

Ho Chi Minh City (hereinafter referred to as “HCMC”) is the largest city in Viet Nam as well as the socio-economic, technological and international trading center of the southern region of the country. HCMC has been rapidly urbanized and expanded without a sufficient development of city infrastructure, especially urban drainage and sewerage systems due to the current remarkable economic development and population increase of the city (about 4.4 million people in 1996, population has increased two (2) times in 20 years). Accordingly, HCMC has suffered economic and social damages caused by floods due to its geographic features with low ground elevation, the hydrological conditions with high precipitation and tidal effect of the Saigon River, and insufficient drainage system constructed in the city since the French colonial period. Some areas have been affected frequently by serious inundation and require the implementation of the urgent measures to improve the current flood situation. HCMC also faces serious water pollution problems of the canals and rivers in the urbanized area, which are deteriorating sanitary and health conditions in the living environment, because domestic and industrial wastewater are directly discharged into the canals and rivers without any treatment. In addition, the solid waste dumping by the legal and illegal houses on and along the canals worsen the water quality, smell and landscape of the canals. These houses and the accumulated sludge and deposit on the canal bed obstruct smooth waterway transportation.

To cope with these situations, the Government of the Socialist Republic of Viet Nam (hereinafter referred to as “GOVN”) requested the Government of Japan (hereinafter referred to as “GOJ”) to implement a Japan’s technical cooperation program. Thus, the Japan International Cooperation Agency (hereinafter referred to as “JICA”), the official agency responsible for the implementation of the program conducted the Study on Urban Drainage and Sewerage System for Ho Chi Minh City in the Socialist Republic of Vietnam between July 1998 and January 2000. In Phase I of eight (8) months, Master Plan of Urban Drainage and Sewerage System for the Study Area of about 650 km², which is projected future urbanized area of HCMC in 2020, was formulated and Tau Hu-Ben Nghe, Doi-Te Basin (hereinafter referred to as “THBNDT Basin”) located in the central part of HCMC was selected and identified as the highest priority area. In Phase II from April 1999 to January 2000, Feasibility Study on Urban Drainage and Sewerage System targeting year of 2010 for the highest priority area of THBNDT Basin was carried out. Then, Water Environmental Improvement Project consisting of (i) Tau Hu-Ben Nghe canal improvement, (ii) pump drainage improvement for three (3) low-lying areas, (iii) existing combined sewer improvement, (iv) construction of interceptor and conveyance sewers, (v) construction of sewage intermediate pumping station and (vi) wastewater treatment plant was recommended to be implemented in two (2) phases.

In parallel with the F/S Study, GOVN requested GOJ in October 1999 to conduct the Detailed Design Study on Ho Chi Minh City Water Environmental Improvement Project in the Socialist Republic of Viet Nam (hereinafter referred to as “the Study” and “the Project”) in accordance with the relevant laws and regulations in force in Japan. GOJ sent the appraisal mission for the Project from the Japan Bank for International Cooperation (hereinafter referred to as “JBIC”) to Viet Nam in November 1999, and also the JICA mission headed by Mr. Takanori Jibiki to discuss the Scope of Work (S/W) of the Study in January 2000. S/W and Minutes of Meeting (M/M) were agreed upon between the People’s Committee of Ho Chi Minh City (hereinafter referred to as “PCHCM”) and JICA on 10 January 2000. GOJ decided to implement the detailed design of the Study and JICA dispatched the study team in April 2000. Both governments agreed that the Study should be under the agreement between GOV and JBIC.

The Detailed Design Study was divided into two (2) stages; (1) Definitive Plan Stage and (2) Detailed Design Stage. Definitive Plan covers the entire priority area selected by the F/S with the target year 2010. Definitive plan consists of (i) Review F/S and (ii) Basic Design. Detailed Design covers the Phase I project with the target year 2005.

1.2 Objectives of the Study

The objectives of the Study are;

- (1) to conduct a definitive plan study, which includes review of the JICA F/S, and confirmation of the optimum plan of drainage and sewerage development project for THBNDT Basin;
- (2) to prepare a detailed design, a cost estimate, a construction plan, and operation and maintenance program and draft tender documents of the Project; and
- (3) to pursue technology transfer to the counterpart personnel of GOV in the course of the Study.

1.3 Organization of the Study

The Study is conducting by the Study Team organized by JICA. The Team is composed of the following twenty-four (24) members:

Members of the Team

Assignment Name

- | | | |
|---|---|-----------------------|
| 1. Team Leader | : | Mr. Kondo Masami |
| 2. Deputy Team Leader/Drainage Engineer | : | Mr. Tokumasu Toshiaki |
| 3. Deputy Team Leader/Sewerage Engineer | : | Mr. Kikuta Hiroshi |

4. Wastewater Treatment Engineer	:	Mr. Takano Hisao
5. Hydrology / Hydraulic Engineer	:	Mr. Hassan M.M.Sabbir
6. Landscape Architect	:	Mr. Tanaka Hiroshi
7. Water Quality Expert	:	Mr. Kawachi Masahiro
8. Sewer Line Engineer (1)	:	Mr. Katsuki Takaaki
9. Sewer Line Engineer (2)	:	Mr. Miura Seizo
10. Civil Engineer (1)	:	Mr. Kimura Toru
11. Civil Engineer (2)	:	Mr. Sato Nobuyuki
12. Mechanical Engineer (Treatment Plant)	:	Mr. Kawazu Shinya
13. Mechanical Engineer (Pumping Station)	:	Mr. Sugiura Kenichiro
14. Electrical Engineer	:	Mr. Kawashima Hideomi
15. Shield Tunnel Engineer	:	Mr. Nakamatsu Udai
16. Cost Estimator	:	Mr. Ikeda Minoru
17. Geodetic Engineer	:	Mr. Ikeda Masayuki
18. Soil Mechanical Engineer	:	Mr. Numata Makoto
19. Soil Foundation Engineer	:	Mr. Nakazawa Akira
20. Economic and Financial Expert	:	Mr. Okano Hiroshi
21. Environmental Expert	:	Mr. Ikeda Kazuhiko
22. Institutional Expert	:	Mr. Koda Shigeyoshi
23. Document Specialist	:	Mr. G.J Douglas
24. Coordinator	:	Ms. Ochiai Chiho

The PCHCMC, the executing agency for the Study organized the Project Management Unit (hereinafter referred to as “the PMU”), which shall act as the technical and implementing counterpart for the Team. The PMU will be organized with the following members

Members of the Project Management Unit

<u>Name</u>	<u>Position</u>
Mr. Tran Minh Dung	Director
Ms. Le Thi Anh Hong	Standing Deputy Director
Mr. Do Viet Dung	Deputy Director
Ms. Duong Ngoc Hong	Expert
Mr. Chau Minh Nhan	Expert
Ms. Nguyen Thu Phuong	Expert
Ms. Vo Thi Ngoc Hue	Expert
Ms. Troung Thi Kim Khanh	Expert
Mr. Pham Van Phuoc	Expert
Mr. Nguyen Van Toan	Expert
Mr. Nguyen Son Nghia	Expert
Ms. Tran Pham Thi Phuong Thao	Chief Accountant

The PCHCMC established a Steering Committee to coordinate with other ministries and authorities concerned as well as to avoid any works duplicated. Vice Chairman of PCHCMC is the Chairman of the Steering Committee. This Committee also steers the East-West Highway Construction Project. The Steering Committee is organized with the following members.

Members of the Steering Committee

<u>Name</u>	<u>Position</u>
Mr. Vu Hung Viet	Chairman (Vice Chairman of PCHCMC)
Mr. Vo Dung	Standing Vice Chairman (Director, Dep. Communication and Public Works)
Mr. Nguyen Minh Dung	Vice Chairman (Director, Dep. Land and Housing)
Members of S/C are representatives of following offices.	
Ministry of Science, Technology and Environment	
Ministry of Construction	
Ministry of Communication and Public Works	
Ministry of Planning and Investment	
Mr. Nguyen Van Hiep	Vice Bureau of PCHCMC
Mr. Tran The Ngoc	Deputy Director, Dep. Land and Housing
Mr. Nguyen Le Dung	Chairman, Steering Committee of Urban Waterbody Program
Mr. Tran Minh Dung	Deputy Director, Dep. Communication and Public Works
Mr. An Dung	Deputy Chief, Chief Architect Office PCHCMC
Mr. Huyuh Kim Phat	Deputy Director, Dep. Planning and Investment
Mr. Lam Trieu	Deputy Director, Dep. Pricing and Finance
Mr. Tran Phuong Tue	Dep. Science, Technology and Environment
Mr. Tran Chi Dung	Deputy Director, Urban Planning Institute
Representatives of PC Districts of 1,2,4,5,6,7,8 and Binh Chanh	

Chapter 2

STUDY AREA

CHAPTER 2 STUDY AREA

2.1 Land Use

The Study Area for the Definitive Plan, which is shown in Fig. 2.1 covers the central part of Ho Chi Ninh City with an area of 3,065.4 ha, defined as THBNDT sewerage development zone, and the isolated areas of Thanh Da of 15.4 ha, Ben Me Coc (1) of 70.9 ha and Ben Me Coc (2) of 46.0 ha for pump drainage improvement areas. An area of 45 ha for wastewater treatment plant site in Binh Hung, Binh Chanh District is also included in the Study Area.

The Study Area of 3,065.4 ha for sewerage development is estimated based on the administrative boundary. Hence, this 3,065.4 ha includes areas of parks, palace, waterways and open space of 273.4 ha, which are not expected to discharge wastewater. Following open spaces and waterways are excluded from the sewerage development area; (1) Zoo of 20.6 ha and Thong Nhat Place of 12.6 ha from District 1, (2) Tao Dan Park of 19.7 ha from District 3, (3) Phu Tho Stadium of 32.3 ha from District 11 and (4) waterways of Saigon River of 59.5 ha, Tau Hu – Ben Nghe canal of 46.5 ha, Doi – Te canal of 66.8 ha and other rivers and canals of 15.4 ha. Subsequently, THBNDT sewerage development area becomes to be 2,791.6 ha covering the following nine (9) districts entirely or partially.

District	Sewerage Service Area (ha)
1	512.1
3	51.8
4	354.1
5	417.1
6	157.0
8	744.2
10	288.9
11	148.8
Tan Binh	117.6
Total	2,791.6

Whole sewerage development area is fully urbanized as residential, commercial and institutional areas except the south of district 8. Ben Me Coc (1) and (2) areas for pump drainage improvement are not urbanized yet.

Existing land use conditions of respective districts in sewerage development area are summarized in Table 2.1 and Fig. 2.2.

Residential area of 2,029.8 ha occupies about 73% of the total sewerage development area. Public land use consisting of commercial area, office area and educational area of 390.5 ha is about 14% of the sewerage development area. Industrial and warehouse areas are mainly located along the canals in Districts 1, 4, 5 and 8 from their convenience of transportation.

There are two major commercial/service centers in the sewerage development area; District 1 and the area between District 5 and 6. Ben Nghe ward in District 1 facing the Saigon River is the largest commercial, tourist and civic center of HCMC. Binh Tay market area in China Town in District 6 is another commercial center. These areas are not specified as the commercial center only but also occupied by residential area.

Future land use plan in the year 2020 prepared by UPI is shown in Table 2.2 and Fig. 2.3.

About 160 ha of the existing residential area in district 1 will be transferred to institutional and commercial area and the area for institutional and commercial use in district 1 occupies about 68% of the sewerage development area in District 1.

Existing industrial area of 72 ha and agricultural area of about 146 ha in District 8 will be transferred to the residential area.

2.2 Population

The existing population of the Study Area is about 1.5 million. Based on the government policy to decrease population in the inner city area of Ho Chi Minh City (HCMC), the future population in the Study Area will be reduced to be about 1.4 million in the year 2020. Based on the future population projected by Urban Planning Institute of HCMC (UPI), future population distribution of the respective districts in the Study Area are estimated and shown in the following table.

Area	Existing (1997)	Future (2010)	(2020)
THBNDT Sewerage Development Zone	1,468,703	1,421,778	1,390,282
District 1	(209,866)	(203,200)	(198,349)
District 3	(53,254)	(51,353)	(49,937)
District 4	(220,651)	(214,305)	(209,998)
District 5	(251,386)	(232,956)	(220,000)
District 6	(100,629)	(99,093)	(98,046)
District 8	(288,293)	(275,824)	(269,650)
District 10	(185,196)	(184,419)	(183,822)
District 11	(101,056)	(100,336)	(98,681)
District Tan Binh	(58,372)	(60,292)	(61,799)
Thanh Da Pump Drainage Area0	5,506	6,069	6,502
Ben Me Coc (1) Pump Drainage Area	13,850	11,149	9,071
Ben me Coc (2) Pump Drainage Area	8,986	7,233	5,885
Total	1,497,045	1,446,219	1,411,740

2.3 Present Situation of Inundation and Water Environment

2.3.1 Inundation Condition

Many flood s are occurred in rainy season from June to November and in high tide season from September to January. The floods are classified broadly into three (3) types from their origin as follows;

- External Flood: Flooding in the lowland area caused by high water level of surrounding river and canal
- Internal Flood: Regional Inundation in the relatively highland area caused by heavy rain and insufficient capacity of drainage facilities
- Mixed Flood: Flooding caused by both reasons mentioned above

Some places in the central highland city area are usually flooded due to insufficient drainage capacity of the existing sewers. Average inundation depth and duration are

surveyed at about 25 to 44 cm and 2.5 to 13.3 hours. Construction of additional sewer lines is expected.

On the other hand, Thanh Da, Ben Me Coc (1) and (2) areas has been flooded seriously about 10 times a year by tidal effect of Saigon River and Tau Hu & Doi canals during the high tide season. Average inundation depth and duration are surveyed at about 30 to 40 cm and 2.5 to 5.4 hours. Introduction of pump drainage improvement by polder system is expected.

Existing inundation condition in each district is shown in the table below. The inundation area in this table covers not only inside of the Project area but also outside of it.

District	Inundation Area (ha)		Frequent Inundation		Heaviest Inundation	
	Built-up	Agricultural	Depth	Duration	Depth	Duration
	Land	Land	(cm)	(hour)	(cm)	(hour)
1	34.3	0	28	2.2	42	4.2
3	65.5	0	27	3.4	47	5.0
4	30.1	0	20	1.0	47	24.0
5	147.3	0	22	1.1	40	20.0
6	348.5	0	25	10.9	65	12.6
8	203.8	514.3	31	3.1	44	4.9
10	63.3	0	30	2.8	69	3.8
11	100.5	0	31	2.5	78	8.8
Tan Binh	35.0	0	29	6.3	30	6.8
Binh Thanh	30.0	0	25	2.8	35	4.5

Flood damages consisting of direct and indirect damages are estimated to be 106.7 billion VND per year in 2000 and 186.3 billion VND per year in 2020.

2.3.2 Water Environmental Condition

Based on the water quality survey conducted by JICA in the master plan stage and the field observation in this definitive plan stage, the existing river and canal water quality conditions in the Study Area illustrated in Fig. 2.4 and summarized as follow.

- Tau Hu – Ben Nghe canal is polluted by the domestic, commercial and industrial wastewater discharged from the Study Area and Tam Hoa – Lo Gom basin. BOD level in Tau Hu – Ben Nghe canal ranges from 50 to 250 mg/l
- There is no significant difference in water quality of Tah Hu – Ben Nghe canal between rainy and dry season.

- A portion of Ben Nghe and Te canals near by Saigon River, water quality is mitigated by introduction of Saigon River water in high tide.
- Water quality of Doi – Te canal is less polluted comparing with that of Tau Hu – Ben Nghe canal. The drainage capacity of Doi – Te canal of about 130 m³/sec. is much larger than that of Tau Hu – Ben Nghe canal of about 20 m³/sec. This large water flow contributes to mitigate the pollution by dilution, conveying and aeration of polluted water.
- While, wastewater discharged to Tau Hu – Ben Nghe canal just remains in the canal and aggravates the water environment of the canal.
- Water quality of western part of Tau Hu canal from the junction of Tan Hoa – Lo Gom canal is not deteriorated so much.
- Water quality of Ong Lon and Cay Kho canals is also deteriorated by discharged wastewater to Tau Hu – Ben Nghe, Doi – Te canals especially in low tide

2.4 Relevant On-going Projects

There are several relevant on-going projects in HCMC, (i) HCMC Environment Sanitation Project loaned by World Bank, (ii) Sanitation and Urban Upgrading Project for Tan Hoa - Lo Gom supported by Belgium Government, (iii) HCMC Environmental Improvement Project loaned by Asian Development Bank and (iv) Dredge and Rehabilitation Project on Ben Nghe - Tau Hu - Lo Gom for Navigation by local fund. The details of each project are summarized as following.

2.4.1 HCMC Environment Sanitation Project

This project covers Nhieu Loc - Thi Nghe (NLTN) basin located nearby the THBNDT basin. This NLTN basin was selected by the Master Plan for the Urban Drainage and Sewerage Development conducted by JICA in 1999 as the second priority area for drainage and sewerage development following THBNDT basin. NLTN basin is 33 km² and has the existing population of about 1.2 million. NLTN canal is the main drain and collector for sewage and storm water into which some 280 km of existing combined sewer discharge. The hydraulic capacity of the canal has decreased over the years by the accumulation of sewage sludge and sediment. The canal water emanating the offensive odor with BOD of ranging between 150-200 mg/l and fecal coliforms of around 800,000/100 ml is as same as the raw sewage quality. The existing combined sewers have

also insufficient capacity to discharge the runoff from the new development that has occurred over the past two decades. In addition, many existing combined sewers constructed in French colony were collapsed and caused the regional inundation.

To deal with these problems, the World Bank made a loan to implement HCMC Environmental Improvement Project, which consists of Wastewater and Drainage components with a total project cost of about 200 million USD.

Proposed systems of both wastewater and drainage components are mentioned below;

Wastewater Sector:

Wastewater collected by the existing combined sewers is diverted at 56 combined storm overflow chambers into proposed interceptor sewer. This interceptor sewer with a diameter of 3 m and 8.4 km long is proposed along NLTN canal constructed by pipe-jacking method. The interceptor discharges wastewater by gravity into a proposed deep wastewater pumping station equipped mechanical screens to remove solids and 12 large submersible pumps with a total capacity of 67,000 m³/hr. Wastewater is discharged to Saigon River after the preliminary treatment by screening.

At the first stage of development, wastewater is discharged to Saigon River without adequate treatment and expected to be diluted by river water. While in the future stage, this wastewater pumping station will be converted to the intermediate wastewater pumping station to convey wastewater to the proposed treatment plant located in District 2.

Drainage Sector:

Drainage component consists (i) replacement and extension of existing combined sewers of about 72 km with a pipe diameter of ranging from 600 mm to 1,800 mm and box culverts of ranging 1,200 mm to 4,000 mm wide, (ii) dredging NLTN canal of about 18 km long with a dredging volume of about 1,100,000 m³, (iii) field investigation of existing secondary combined sewer of about 54 km and rehabilitation of up to 30 km and (iv) construction of tertiary sewers of 270 km long with a diameter less than 400 mm.

The construction will be scheduled to commence at the middle of year 2001 and to complete at the middle of year 2007. The location of the project is shown in Fig. 2.5.

2.4.2 Sanitation and Urban Upgrading Project for Tan Hoa - Lo Gom

Tan Hoa - Lo Gom (THLG) basin of about 2,498 ha is located in the west of THBNDT basin with an existing population of 703,400. THLG basin covers parts of District 6, 8, 11, Tan Binh and Binh Chanh.

The objectives of the project are sanitation improvement and urban upgrading by applying community participation.

In line with the objectives of the project, following eight (8) pilot projects (five (5) projects in District 6 and three (3) projects in Binh Chanh District) were proposed and studied.

District 6:

- Construction of intermediate garbage collection station with a capacity of 60 ton/day
- Construction of one side embankment THLG canal at Ong Buong and road along THLG canal between Cho Lon bridge and Phu Dinh Coal enterprise
- Develop the resettlement site for 250 houses with infrastructure
- Construction of economic activity area consisting of market and production workshop for small business
- Improvement and upgrading slum area of 0.89 ha

Binh Chanh District:

- Construction of wastewater treatment plant by aerated lagoon with a capacity of wastewater from 120,000 to 200,000 people
- Formulation of resettlement area for 100 to 150 houses
- Construction of small market

Among eight (8) pilot projects, only No. 5 pilot project was completed. Remaining seven (7) projects will be completed by the end of 2004 with the supplementary support of Belgium government.

For THLG basin, feasibility study for urban upgrading and sanitation improvement will be conducted till 2003.

The location of this project is shown in Fig. 2.5.

2.4.3 HCMC Environmental Improvement Project

This project financed by ADB, consists of four (4) components; (i) Cleaner production, (ii) Improvement of existing drainage system in Hang Bang basin, (iii) Solid waste collection and transportation, and (iv) Solid waste treatment by landfill.

The feasibility study for above four (4) components was conducted and approved by PCHCMC and central government in 2001.

One component of improvement of existing drainage system in Hang Bang basin (Hang Bang project) is related to our project. Hang Bang project covers the area of 3.8 km², which consists a part of Districts 5, 6 and 11.

The project proposed to enlarge the discharge capacity by installation one additional outlet and replacement of 5 existing outlets to Tau Hu canal. The detailed is explained in Chapter 2 in Vol. II. The location of Hang Bang Project is shown in Fig. 2.5.

2.4.4 Related On-going Projects for THBN Canal Improvement

Following three (3) on-going projects are related to THBN canal improvement project:

- Dredging and Rehabilitation Project on Ben Nghe-Tau Hu-Lo Gom for Navigation
- Rehabilitation pf Ben Chuong Duong-Ben Ham Tu-Tran Van Kieu Road
- East-West Highway Construction Project

Refer to the details of these three (3) projects explained in Section 3.2 in this Volume.

The location of the relevant projects is shown in Fig. 2.5.

Table 2.1 Existing Land Use Condition of Respective District in Sewerage Development Area

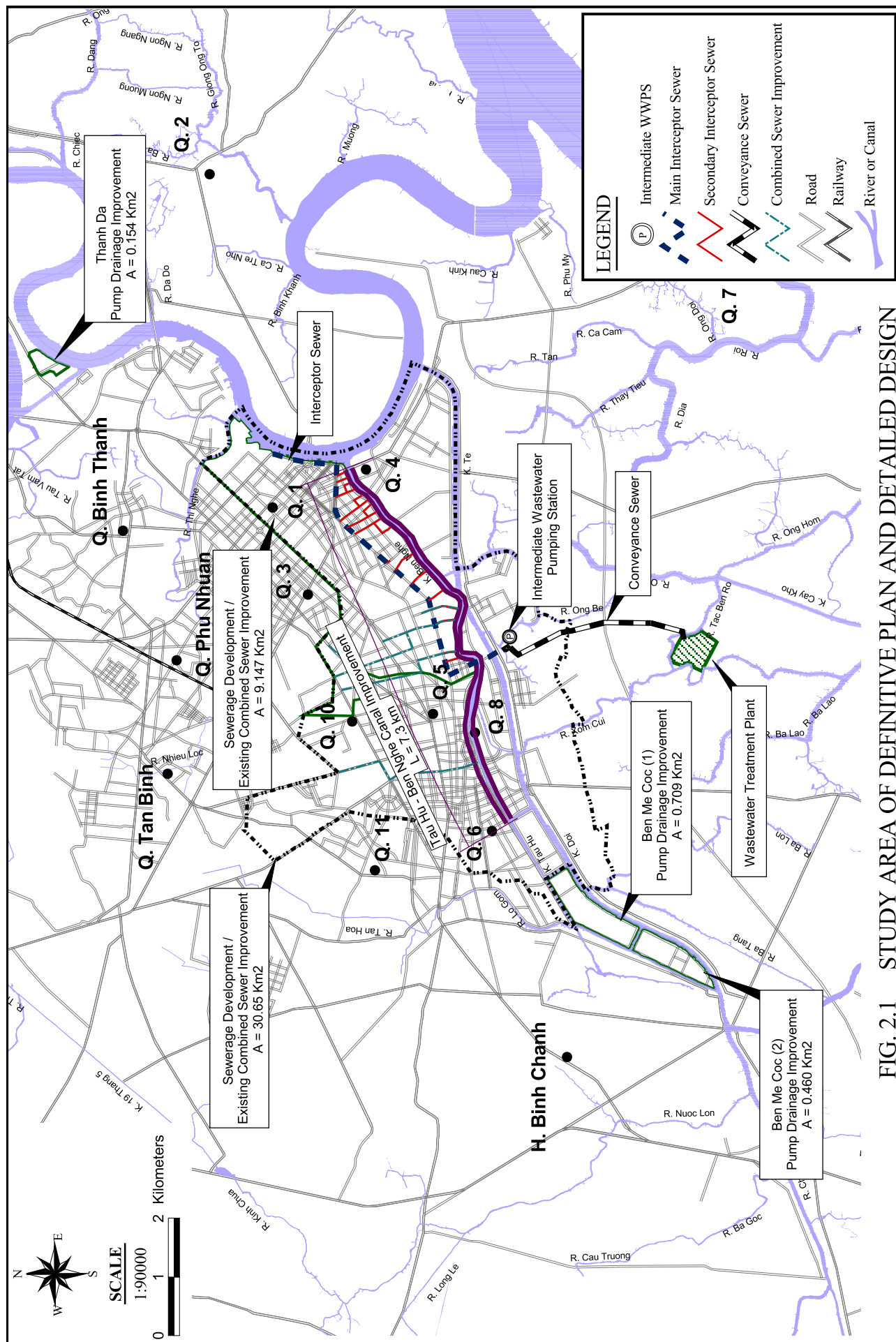
District	Sewerage Covered Area (ha)	Residential Area (ha)	Industrial and Warehouse Area (ha)	Commercial Area (ha)	Office Area (ha)	Educational Area (ha)	Other Area (ha)	Public Land Use Area (ha)	Public Land Use Ratio in Sewerage Area
1	512.1	304.9	27.1	83.6	91.5	5.0	0.0	180.1	35%
3	51.8	34.8	0.3	5.7	4.8	2.0	4.2	12.5	24%
4	354.1	291.3	47.8	1.6	8.7	4.7	0.0	15.0	4%
5	417.1	297.2	11.6	50.9	30.4	27	0.0	108.3	26%
6	157	91.9	41.6	9.4	4.9	9.2	0.0	23.5	15%
8	744.1	498.7	72.2	3.9	12.4	10.6	146.3	27.0	4%
10	288.9	267.6	2.4	1.2	9.4	8.3	0.0	18.9	7%
11	148.8	133.0	12.8	1.3	1.1	0.7	0.0	3.0	2%
Tan Binh	117.7	110.4	5.2	0.4	0.8	0.8	0.0	2.1	2%
Total	2,791.6	2,029.8	220.9	158.0	164.1	68.3	150.4	390.5	14%

Note: Public land use area means land use for commercial, office and educational use
Public land use ratio means public land use area / sewerage covered area

Table 2.2 Future Land Use Condition (2020) of Respective District in Sewerage Development Area

District	Sewerage Covered Area (ha)	Residential Area (ha)	Industrial and Warehouse Area (ha)	Institutional Area (ha)	Additional Green Space (ha)
1	512.1	141.3	0.0	346.1	24.7
3	51.8	51.8	0.0	0.0	0.0
4	354.1	330.6	31.7	11.7	11.8
5	417.1	286.9	0.0	130.2	0
6	157	108.1	0.0	48.9	0
8	744.1	733.7	0.0	0.0	10.4
10	288.9	255.3	0.0	31.1	2.5
11	148.8	140.3	0.0	0.0	8.5
Tan Binh	117.7	114.7	0.0	0.0	3.0
Total	2,791.6	2,162.7	31.7	568.0	60.9

Note: Figures are measured based on the future land use map prepared by UPI.



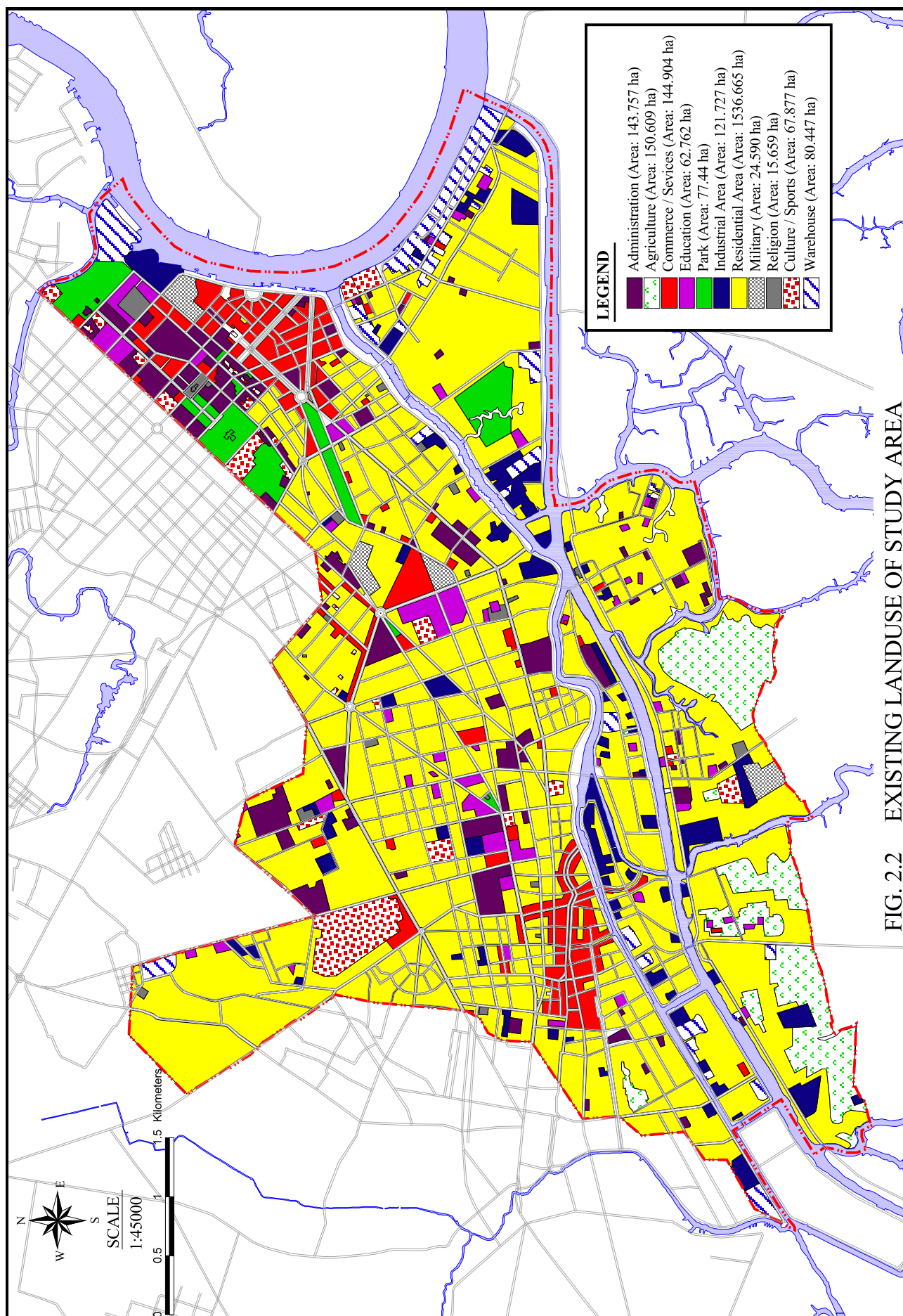


FIG. 2.2 EXISTING LANDUSE OF STUDY AREA

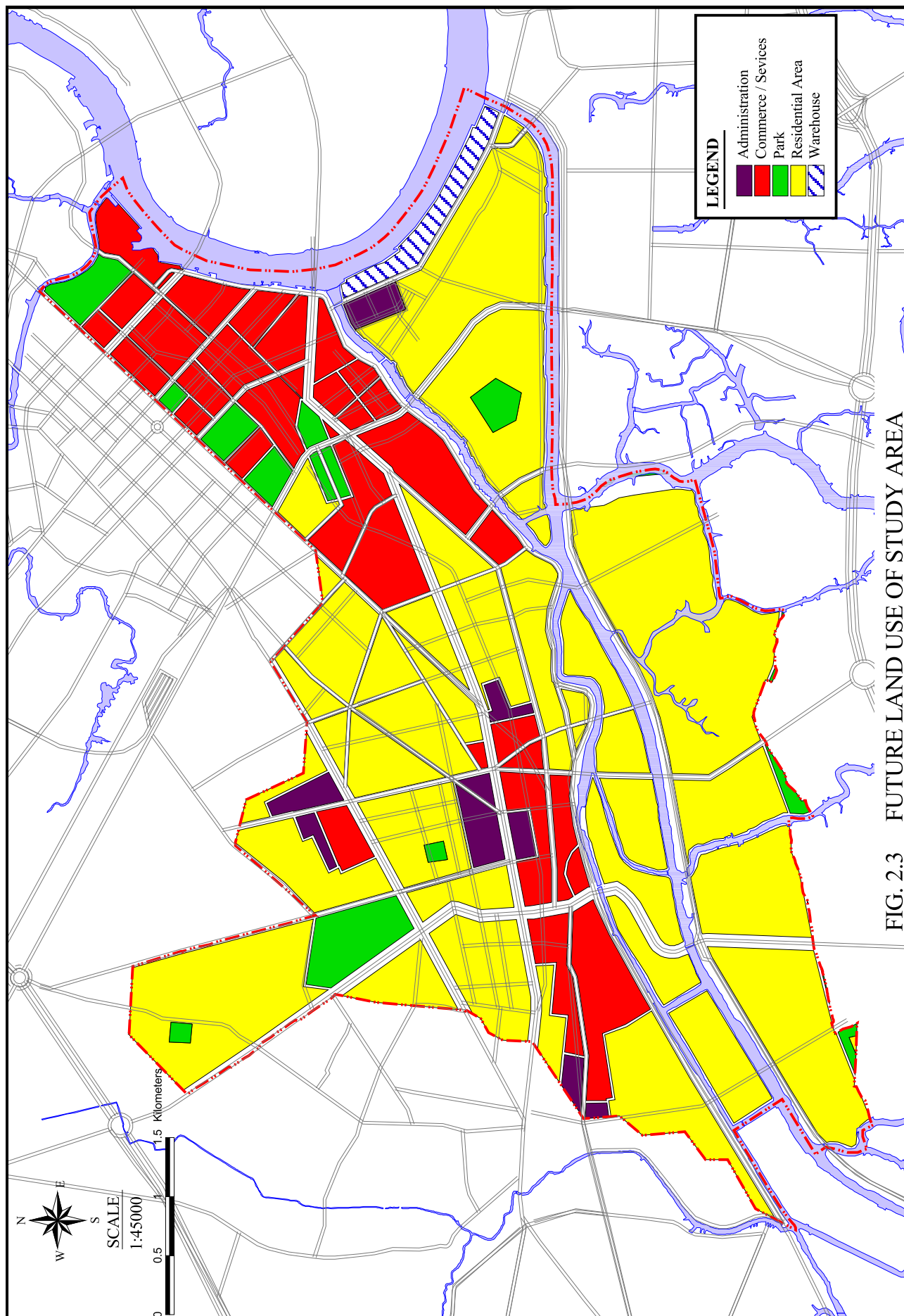
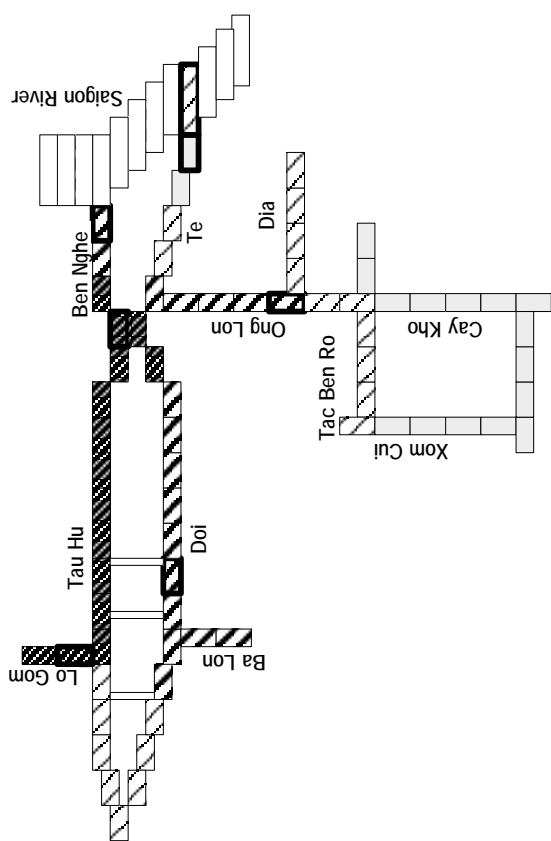
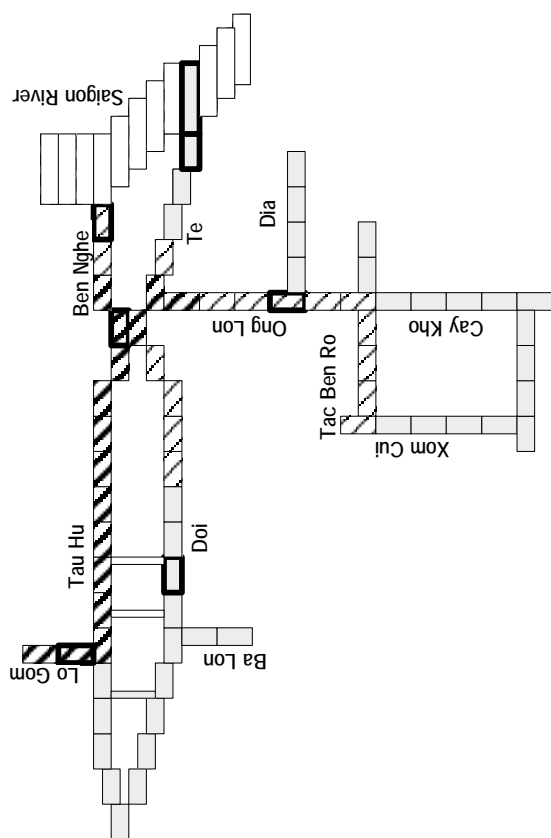


FIG. 2.3 FUTURE LAND USE OF STUDY AREA

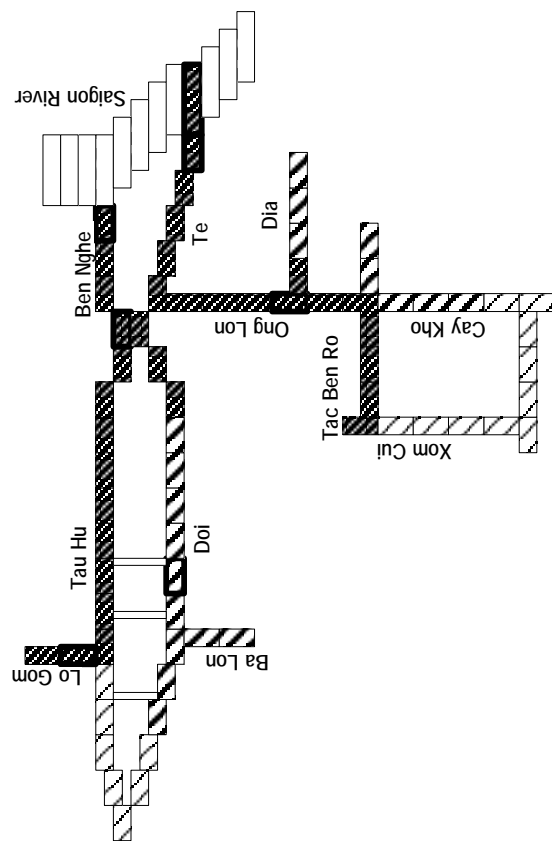
Rainy Season (High-tide)



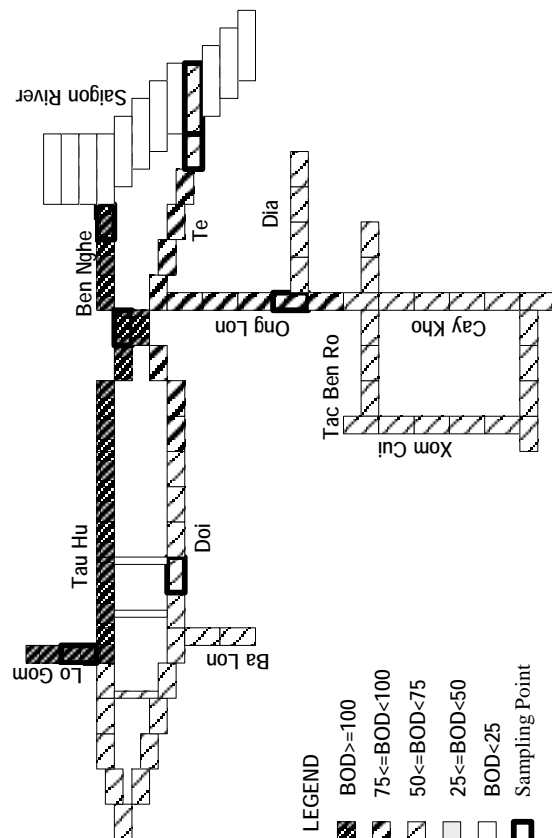
Early Dry Season (High-tide)



Rainy Season (Low-tide)



Early Dry Season (Low-tide)



LEGEND

- BOD ≥ 100
- 75 ≤ BOD < 100
- 50 ≤ BOD < 75
- 25 ≤ BOD < 50
- BOD < 25
- Sampling Point

FIG. 2.4 DISTRIBUTION OF WATER QUALITY IN RIVER/CANAL (1998)

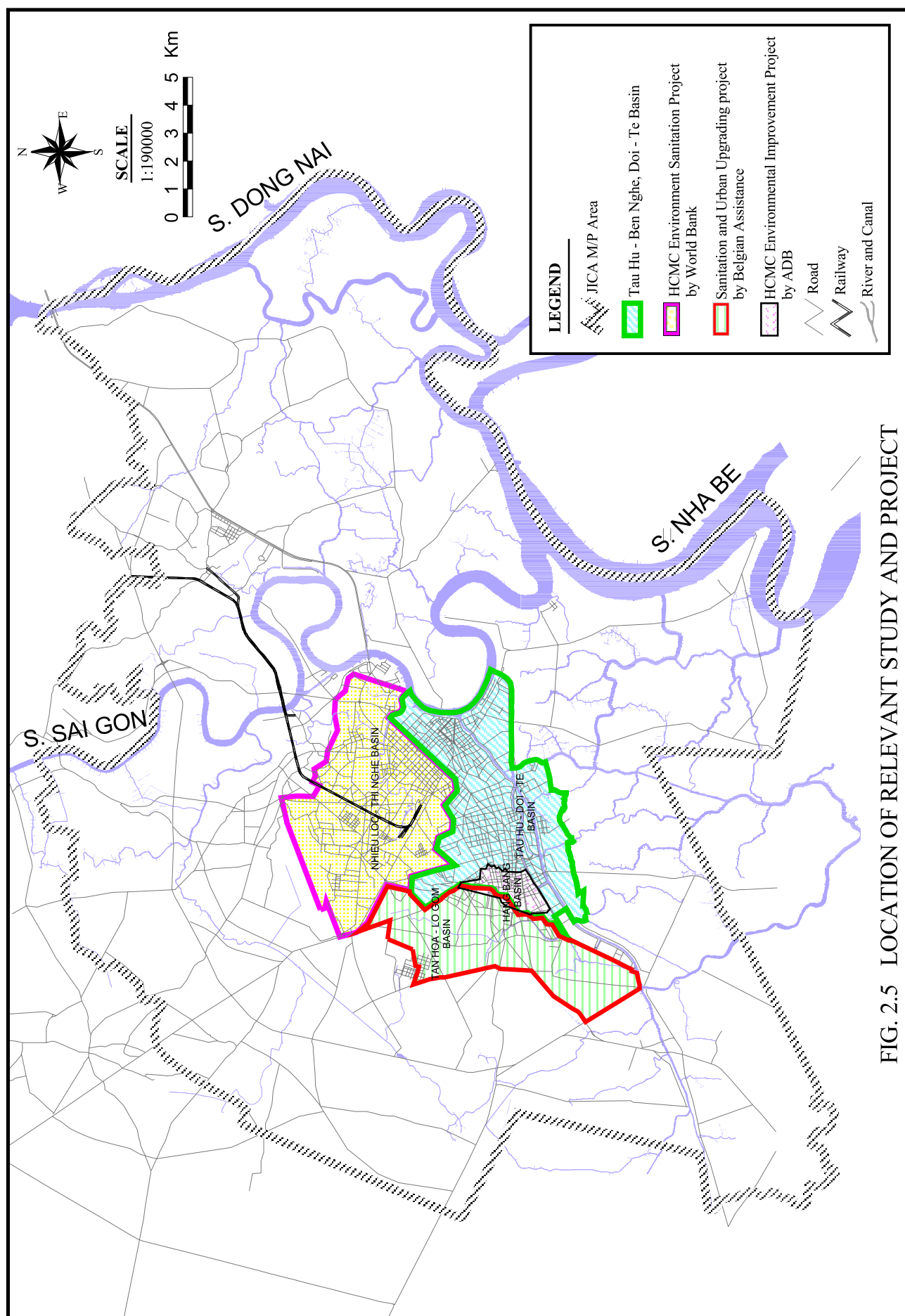


FIG. 2.5 LOCATION OF RELEVANT STUDY AND PROJECT