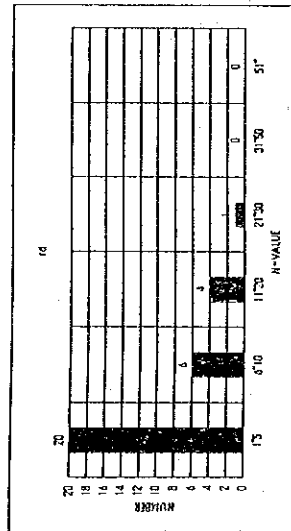


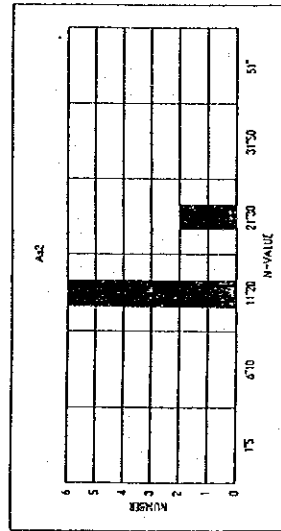
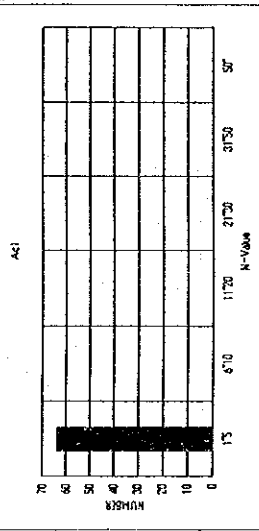
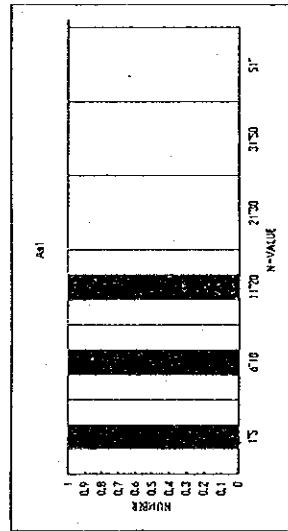
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FIG. II.5.1
 LOCATION MAP OF MACHINE BORING ALONG
 WEST FLOODWAY/GARANG RIVER

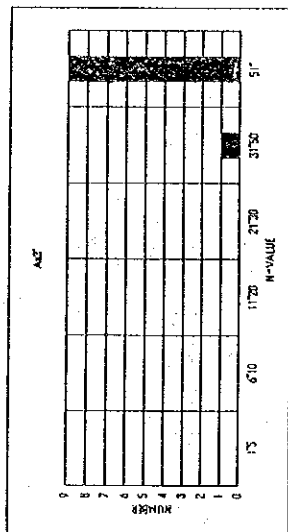
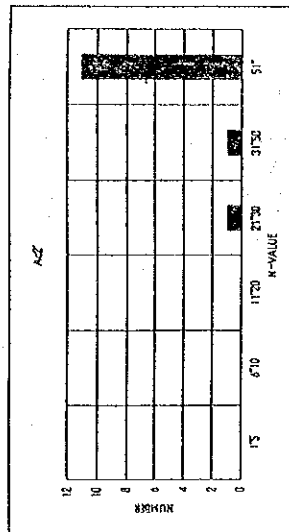
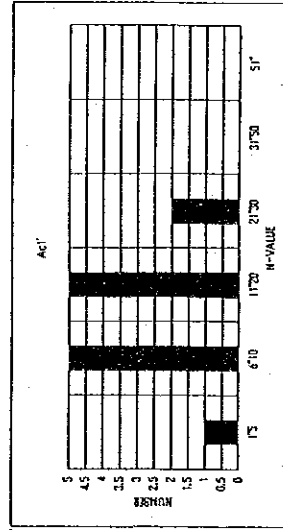
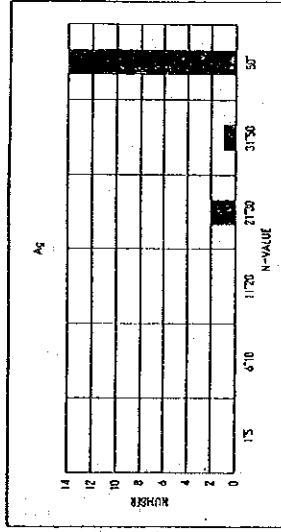
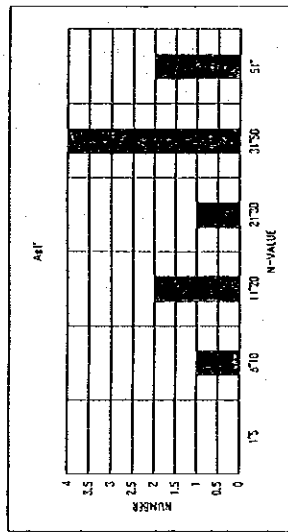
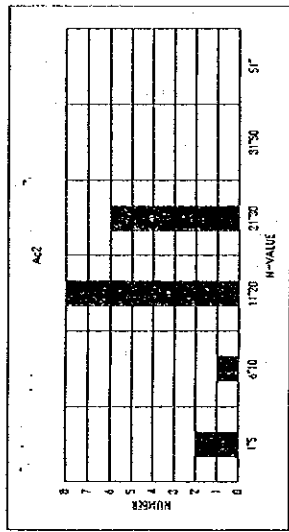
RIVER DEPOSIT



SHALLOW MARINE DEPOSIT



FLUVIAL DEPOSIT



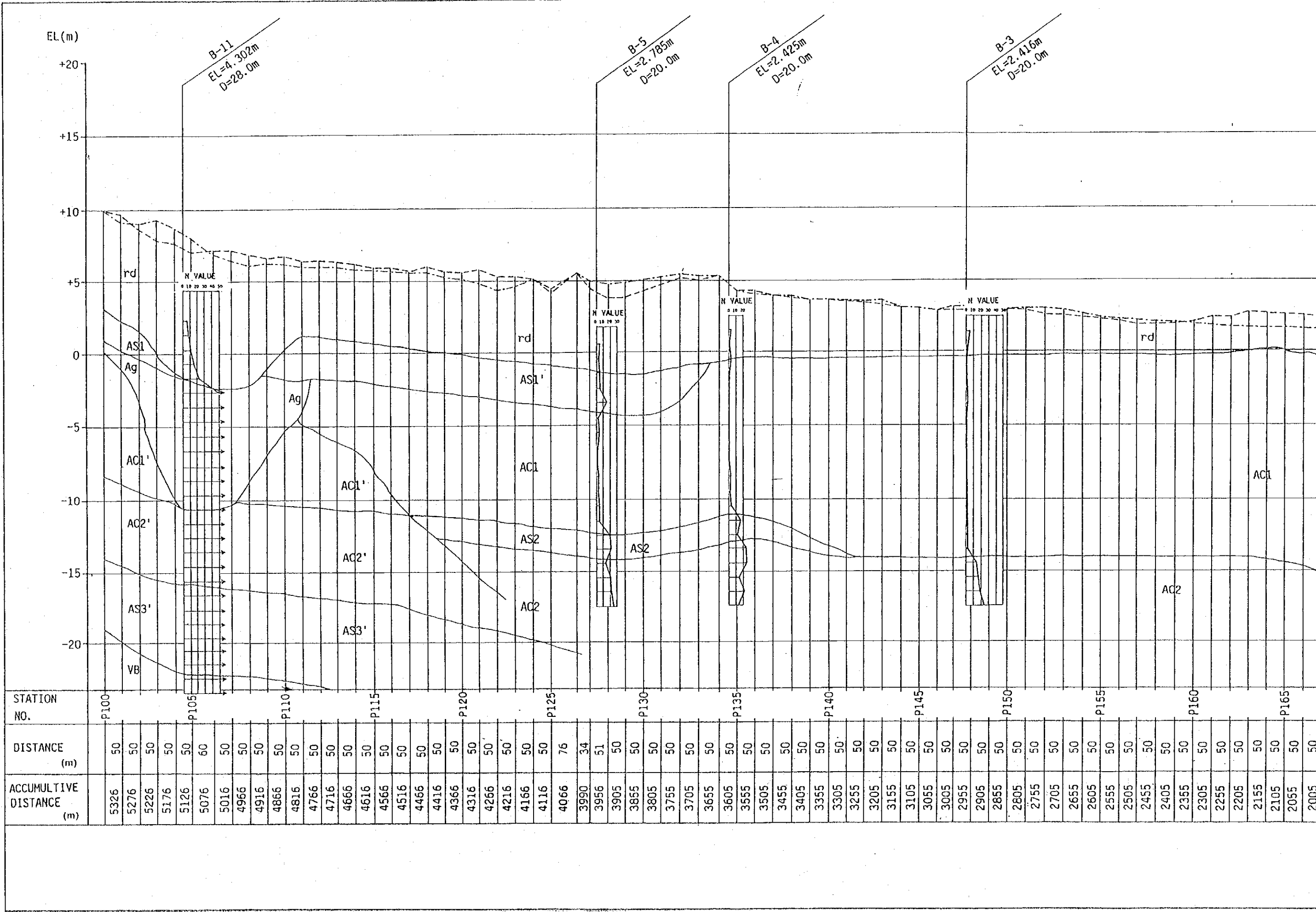
N-VALUE OF EACH SOIL

SOIL LAYER	NUMBER	AVERAGE	MINIMUM	MAXIMUM
RIVER DEPOSIT	31	4.9	1	24
SHALLOW MARINE DEPOSITS				
UPPER SAND LAYER (A41)	3	8	4	15
UPPER CLAY LAYER (A4)	64	1.5	1	4
LOWER SAND LAYER (A42)	8	15.9	12	21
LOWER CLAY LAYER (A43)	17	16.2	1	25
ELUVIAL DEPOSITS				
UPPER SAND LAYER (A31)	10	30	7	>50
GRAVEL LAYER (A4)	17	>46.4	22	>50
UPPER CLAY LAYER (A4)	13	13.5	5	27
LOWER CLAY LAYER (A42)	13	>47.8	28	>50
BASAL SAND LAYER (A3)	10	>48.1	31	>50
BASEMENT ROCK	10	>50	>50	>50
TOTAL	196			

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Fig II.5.2

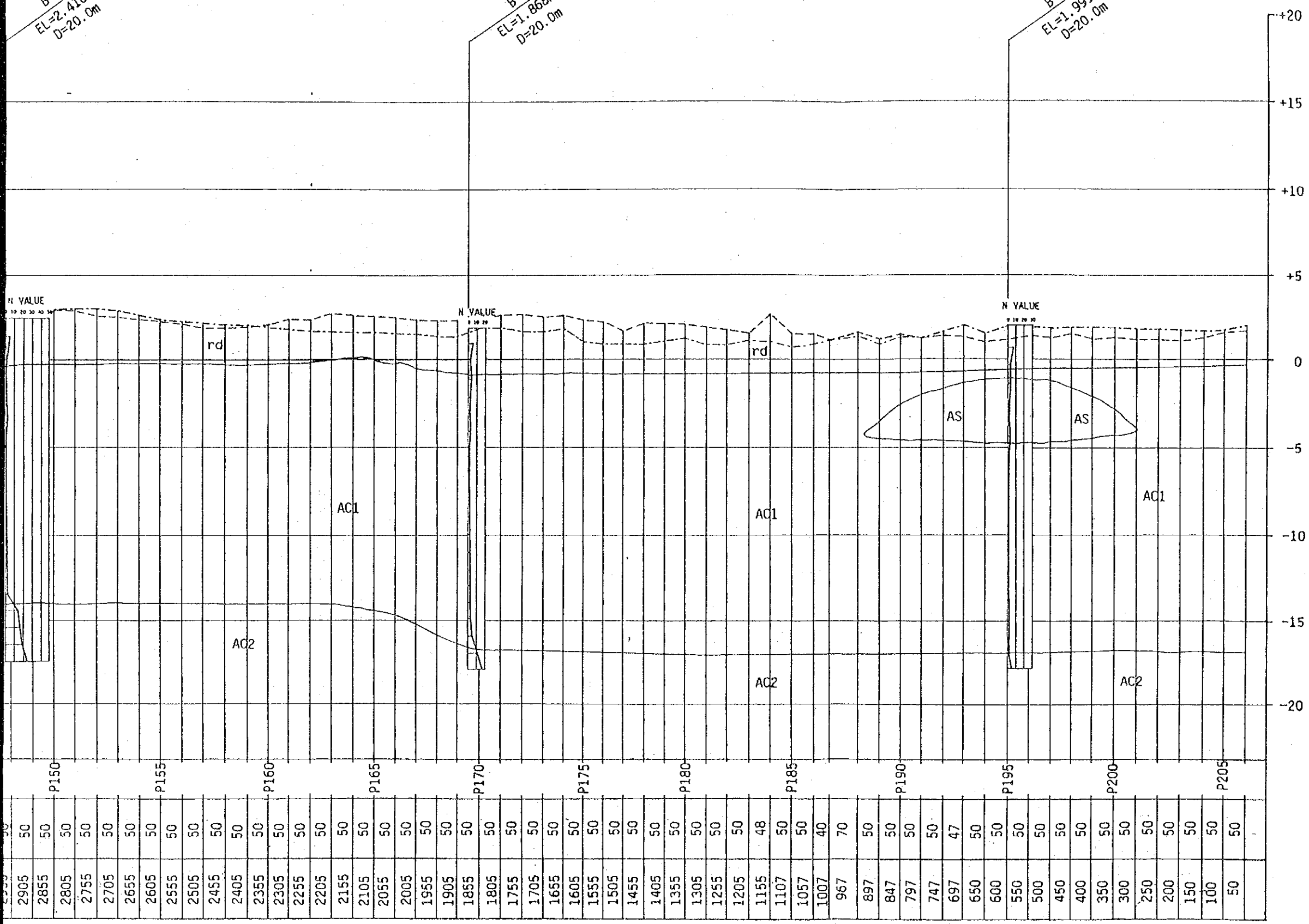
HISTOGRAM OF N-VALUE



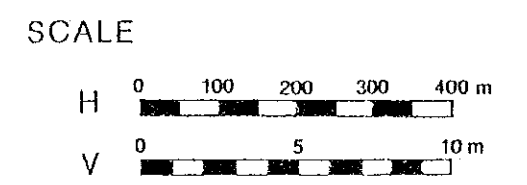
B-3
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D=20.0m

B-2
EL=1.868m
D=20.0m

B-1
EL=1.999m
D=20.0m

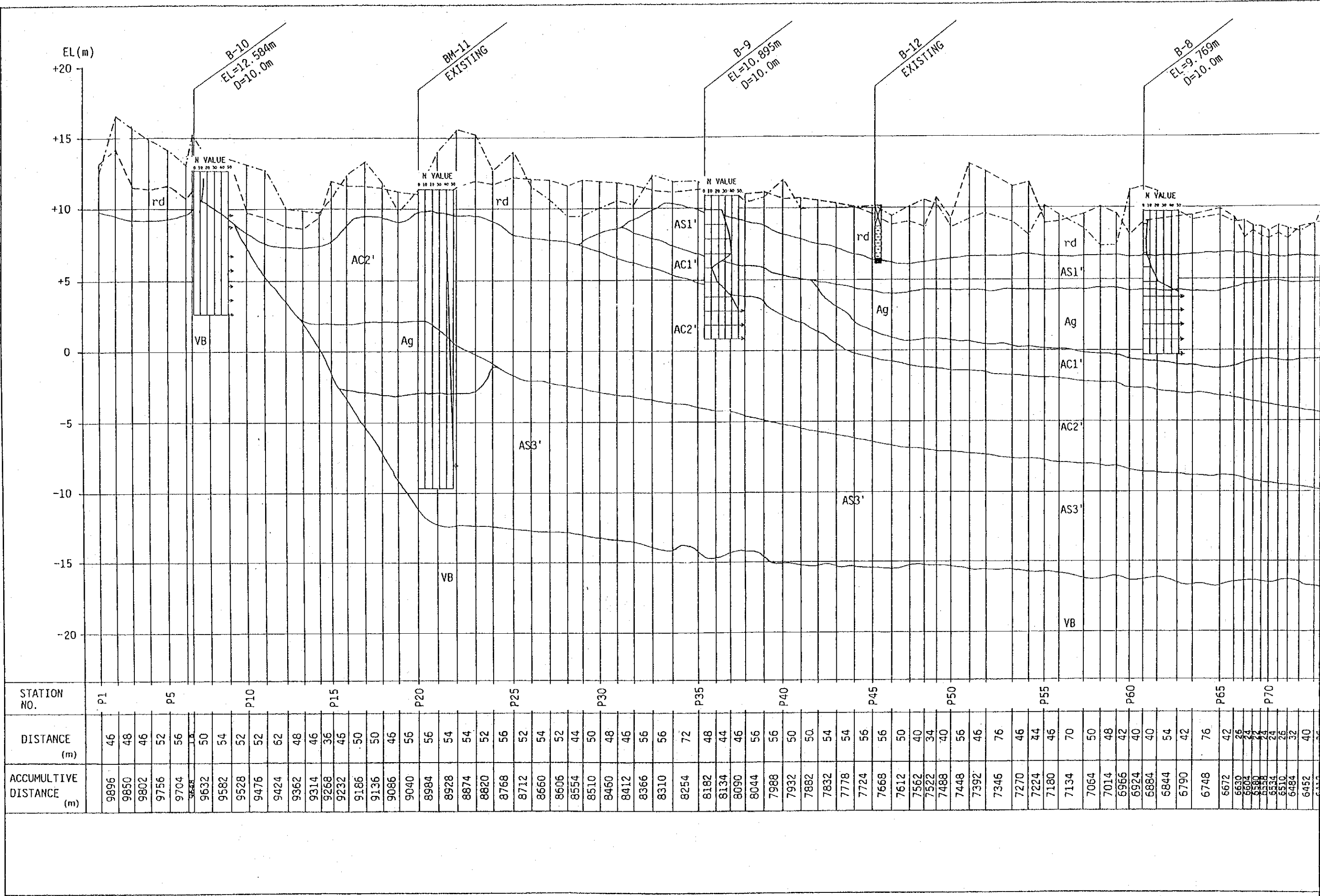


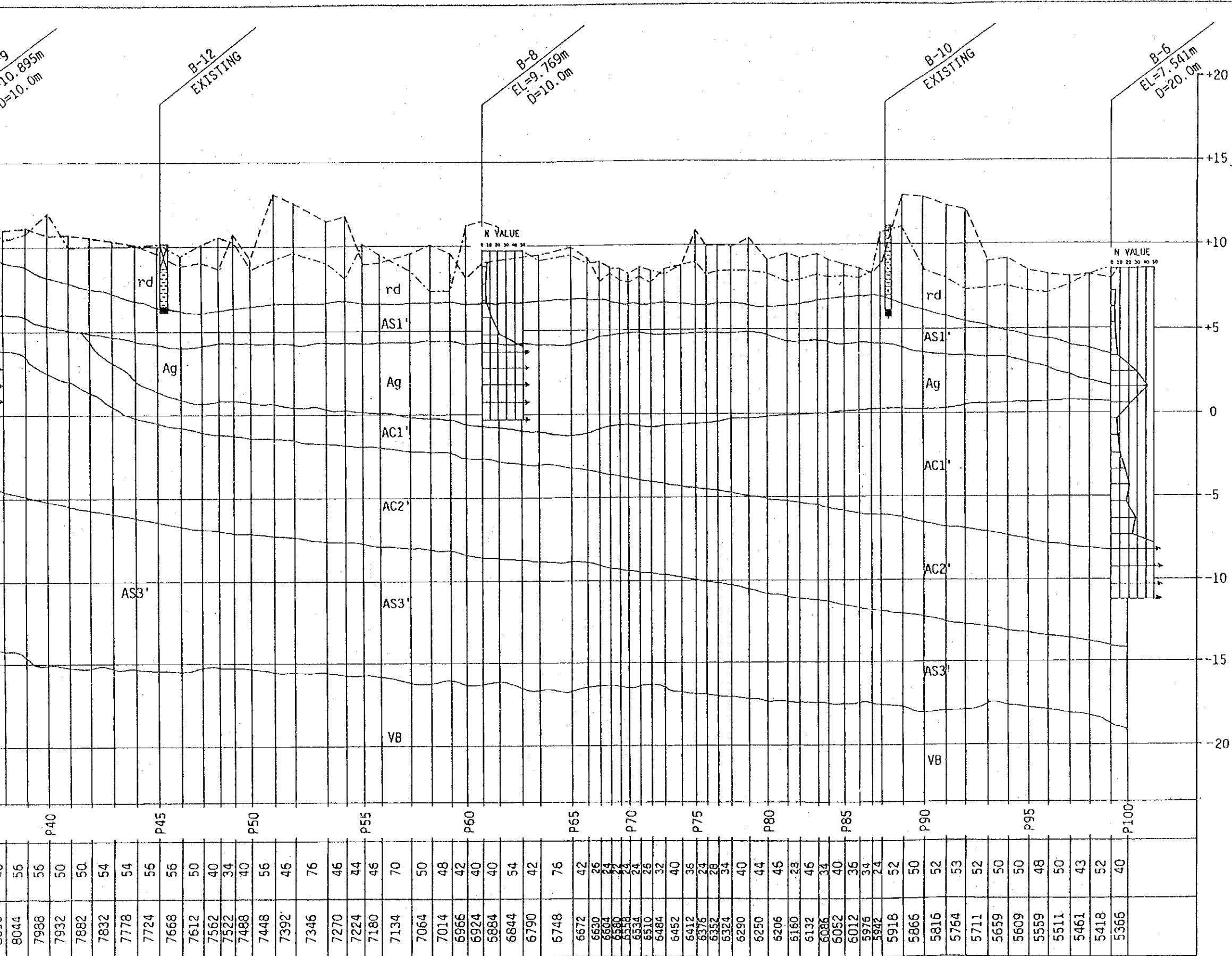
Symbol	Description	N-Value (Average)	Thickness (m)
rd	River bed deposit, consists of clay, silt and gravel with roots of plant.	1 - 15 (3.8)	1 - 8 (locally 10m)
As1	Sand, silty - clayey sand with organic materials (coarse, shell), colored gray to dark gray.	1 - 15 (8.8)	2 - 3
As1'	Sand and silty sand interbedded with gravel, colored gray, dark gray to brownish gray.	7 - 50+ (30.8)	1 - 4
Ag	Sand and gravel to boulder that is very hard, grain size > 5.0mm - above	23 - 50+ (48.8)	1 - 2
Ac1	Clay and silt intercalated fine sand, contains organic materials (shell), colored dark gray.	1 - 4 (1.5)	0 - 15
Ac1'	Mainly consists of silt, locally clay with sand and gravel, colored dark gray.	5 - 27 (13.8)	2 - 3
Ac2	Sand interbedded with clay, silt and gravel, colored gray to dark gray.	12 - 21 (15.8)	2 - 3
Ac2	Clay and silt intercalated with sand and gravel, colored dark gray.	1 - 25 (18.2)	5+
Ac2'	Silt with gravel and sand, well-compacted, colored dark gray to brownish dark gray.	28 - 50+ (47.8)	3 - 10
Ac2''	Sand with gravel, well-compacted, colored dark gray to brownish gray.	31 - 50+ (48.1)	3 - 10
	Fluvial Deposits	-	-
	Shallow Marine Deposits	-	-
Qty	Base rock (Ocean formation) Tuffaceous sandstone, conglomerate, volcanic breccia	30+	7+



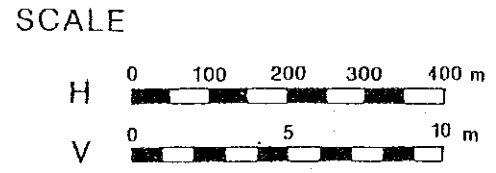
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Fig. II. 5. 3 (1/2) SUBSOIL PROFILE OF
 WEST FLOODWAY/GARANG RIVER





Symbol	Description	N-value (Average)	Thickness (m)
rd	River bed deposit, consists of clay, silt and gravel with roots of plants.	1 - 15 (13.4)	1 - 1 locally 10m
As1	Sand, silty - clayey sand with organic materials (coral, shell), colored gray to dark gray.	4 - 15 (8.0)	2 - 3
As1'	Sand and silty sand interbedded with gravel, colored gray, dark gray to brownish gray.	7 - 50 (30.4)	3 - 4
Ag	Sand and gravel to boulder that is very hard, grain size $0.25 - 60\text{mm}$	11 - 30 (40.8)	1 - 3
Ac1	Clay and silt intercalated fine sand, contain organic materials (shell), colored dark gray.	1 - 1 (1.5)	8 - 10
Ac1'	Mainly consists of silt, locally clay with sand and gravel, colored dark gray.	5 - 27 (13.4)	2 - 3
As2	Sand interbedded with clay, silt and gravel, colored gray to dark gray.	11 - 11 (11.1)	2 - 3
Ac2	Clay and silt intercalated with sand and gravel, colored dark gray.	1 - 25 (10.1)	5+
Ac2'	Silt with gravel and sand, well-compacted, colored dark gray to brownish dark gray.	28 - 50 (47.0)	1 - 10
As3'	Sand with gravel, well-compacted, colored dark gray to brownish gray.	31 - 50 (40.1)	3 - 10
	Fluvial Deposits	-	-
	Shallow Marine Deposits	-	-
P1g	Base rock (Dumai Formation) Tuffaceous sandstone, conglomerate, volcanic breccia	50+	7+



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Fig. 1.5.3 (2/2) SUBSOIL PROFILE OF
 WEST FLOODWAY/GARANG RIVER

III SOCIOECONOMY AND LAND USE

III SOCIOECONOMY AND LAND USE

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CHAPTER 1 POPULATION

A population census was conducted in 1961, 1971, 1980 and 1990. According to the 1990 census, the population of Indonesia and Central Jawa Province were 179,322,000 and 28,522,000, respectively, and from 1980 to 1990, the average annual growth rates were 1.97% and 1.17% (refer to Tables III.1.1 to III.1.3).

The study area include the nine kecamatans of Semarang City (Kotamadya), the six kecamatans in Kabupaten Kendal and the two kecamatans in Kabupaten Semarang. The population of the study area was 1,724,000 in 1990. The breakdown and population density by kecamatan are given in Table III.1.4.

The study area and Semarang City have the area of 1,042 km² and 374 km², and population density in 1990 were 1,654 persons/km² and 3,348 persons/km², respectively. The number and size of households in the study area in 1990 are shown in Table III.1.5.

The population of Central Jawa Province during the period from 1980 to 1990 is shown in Table III.1.3. The average annual population growth rate in the period is estimated to be 1.17%. The future population in the study area by the year 2015 has been projected for only the purpose of formulation of the Master Plan based on the above figure and the results are given in Table III.1.6.

CHAPTER 2 DEVELOPMENT POLICY

2.1 National Development Policy

National development plans have been formulated in the Fifth Five-Year Development Plan (Repelita V) to promote sustainable socioeconomic growth in Indonesia. The basic concepts for the growth are given as follows.

- (1) To uplift the living standard of the people; and
- (2) To establish a strong foundation for the next development stage.

In conformity with the above basic concepts, the Repelita V puts emphasis on economic development. The economic development aims to achieve a well-balanced economic structure focusing on the agricultural sector with the consolidation of food self-sufficiency and promotion of product diversity, and on the industrial sector with the promotion of export-oriented industries. Repelita V also aims to provide adequate employment opportunities for the rapidly growing labour force which is expected to expand with 11.9 million new job hunters in the next five years. To this end, environmental aspects are to be taken into consideration in planning the development scheme so as to maintain the balance between ecology and development.

2.2 Regional Development Policy

Policies on regional development are to be established to realize the basic concepts and objectives of the national development policy. In Repelita V, development of rural areas and small

cities were given priority to achieve a well-balanced development between urban areas and big cities.

2.3 Sectoral Development Policy

Development policies in major sectors are described below.

(1) Agriculture

The agricultural sector covers food crop agriculture, fishery, cattle breeding, plantation and forestry. Development of this sector aims at the improvement of the quality and quantity of production, the development of an integrated farm operation to sustain food self-sufficiency, the fulfillment of nutrition requirements and the increase of commodity production for export and domestic use.

(2) Industry

The development of the industrial sector aims at a balanced structure between the industrial and agricultural sectors, diversification of commodities and improvement of the quality of commodities, especially those for export.

(3) Mining

The development of the mining sector is focused on research, exploration and exploitation of new mineral resources and increase of production by appropriate investment and application of new technology.

(4) Energy

The development of the energy sector aims at diversification of energy sources putting emphasis on

development of electric power generation, transmission and distribution to promote development in such other sectors as industrial, tourism, business and so on.

(5) Environment

Environmental management and conservation plans are to be part of all development programs to attain a well-balanced development involving all sectors. Environmental studies are required to confirm the fulfillment of this requirement.

CHAPTER 3 ECONOMIC STRUCTURE

3.1 National Economic Structure

(1) Economic Growth

The Gross Domestic Product (GDP) in Indonesia for the period 1985-1990 had grown from Rp. 94,720 billion to Rp. 197,721 billion with the average annual growth rate of 15.9%. Among the sectors, the manufacturing/industry sector was dominant with the average annual growth rate of 24.5% in the same period (refer to Table III.3.1).

In Repelita V (fiscal years 1988 - 1993), the target of the average economic growth rate was set at 5.0% per annum with the sectoral growth rate given as follows.

<u>Sector</u>	<u>Average Annual Growth Rate</u>
Agriculture	3.6%
Mining	0.4%
Manufacturing/Industry	8.5%
Construction	6.0%
Trade	6.0%
Transportation/Communications	6.4%
Other Sectors	6.1%

(2) Government Budget

Budgetary expenditures of the central government amounted to Rp. 46,654 billion in fiscal year 1990/91, consisting of Rp. 29,998 billion for the service sector and Rp. 16,656 billion for the development sector. As shown in Table III.3.2,

budgetary expenditures indicated a high average annual growth rate of about 20% for the service sector, while there was little growth of 9% for the development sector during the period 1985/86 to 1990/91.

(3) External Trade

In 1980, exports in Indonesia amounted to US\$23,950 million against the imports of US\$10,834 million, i.e., the balance of trade indicated an export surplus of US\$13,116 million which was the most favorable balance in the past. After that year the amount of exports, on the decrease due to international recession in the oil market, fell to US\$14,805 million in 1986, although the trade balance still maintained the export surplus amounting to US\$4,087 million. However, the external trade of Indonesia, indicating an upward trend after 1986, amounted to the exports of US\$29,620 million and the imports of US\$25,906 million in 1991, i.e., an export surplus of US\$3,714 million. On the other hand, the external trade balance which excluded petroleum and gas from the exports and imports was in an unfavorable situation every year during the period from 1980 to 1991 (refer to Table III.3.3).

3.2 Regional Economic Structure

(1) Economic Growth

The Gross Regional Domestic Product (GRDP) in Central Jawa Province for the period 1985 - 1989 had grown from Rp. 10,124 billion to Rp. 18,782 billion at the current market price with the average growth rate of 16.7% per annum (refer to Table III.3.4). However, GRDP per capita in the same period showed Rp. 376,615

in 1985 and Rp. 668,030 in 1989 with average growth rate of 15.4% per annum.

In Repelita V, the economic growth in Central Jawa Province is anticipated at 6.0% per annum and the target sectoral growth rates are as follows.

<u>Sector</u>	<u>Average Annual Growth Rate</u>
Agriculture	5.0%
Industry	12.0%
Trade	3.1%
Transportation	5.5%
Others	6.2%

(2) Constitution of Gross Regional Domestic Product

By sector, Gross Regional Domestic Product is given annually as follows. The details are shown in Table III.3.4.

<u>Sector</u>	Share (%)				
	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Agriculture	30.0	31.0	29.9	32.7	32.0
Industry	20.9	20.8	22.9	22.4	23.8
Trade	18.6	18.5	18.7	17.7	18.3
Others	30.5	29.7	28.4	27.2	25.9
Total	100.0	100.0	100.0	100.0	100.0

(3) Sectoral Economy

Agriculture

Major food crops produced in Central Jawa Province are shown in Table III.3.5. In 1990, 8,096,000 tons of paddy were harvested at the yield rate of 5.23 t/ha.

As shown in the table, the amount of production and yield rate of all major food crops except peanut are increasing in the recent five years. The average growth rate of paddy production shows 3.6% per annum which exceeds the average growth rate of population of 1.17% in Central Jawa Province.

Mining

The mining sector consists of three groups, Group A, Group B and Group C. Groups A and B include most of the strategic items and are handled mostly by the government. The products in groups A and B consist of oil and gas, tin, coal, bauxite, nickel, gold, manganese, iron ore, silver and others, which are not produced so much in Central Jawa Province.

The major mining sector items in Central Jawa Province are in Group C which include sand, gravel, marble, bentonite, limestone, calcite, dolomite, andesite, clay, feldspar, gypsum and others. However, production amounts are not available.

Industry

In Central Jawa Province, food and beverage processing is dominant in terms of gross output at Rp. 3,625 billion, followed by the textile industry with Rp. 1,629 billion in 1989 (refer to Table III.3.6).

(4) Budget of Regional Government

Budgetary expenditures of the Central Jawa Provincial Government amounted to Rp. 516,281 million in fiscal year 1990/91 at an average annual growth rate of about 10% during the period 1982/83 to 1990/91. This

expenditure is composed of Rp. 491,614 million (95%) for services and Rp. 84,239 million (5%) for development. Both indicated the average growth rates of 9.3% and 10.3% per annum, respectively, during the said period.

CHAPTER 4 GOVERNMENT ORGANIZATION

4.1 Central Government

Based upon the 1945 Constitution, Indonesia established a Republic headed by a President who is elected by the People Deliberative Assembly as the highest state institution. The organization of the central government is shown in Fig. III.4.1.

The Ministry of Public Works in the central government was set up under Presidential Decree No. 44/1974. The organizational structure was later modified by Presidential Decree No. 15/1984. The Decree of the Minister No. 211/1984 covers the basic tasks and functions of the Ministry as a governmental organization to undertake development projects. (refer to Fig. III.4.2)

River improvement programs are handled by the Sub-Directorate of Rivers, Directorate General of Water Resources Development (DGWRD). The Directorate of Rivers is directly concerned in river development and its specific tasks are technical planning and design, implementation, and operation and maintenance. It also carries out feasibility studies on river works, especially flood control. (refer to Figs. III.4.3 and III.4.4)

Urban drainage and municipal water supply programs are managed by the Directorate General of CIPTA KARYA (Housing, Building and Urban Development). The Directorate of Environmental Sanitation is the agency concerned in the planning, design, implementation, operation and maintenance of urban drainage. Municipal water supply is handled directly by PDAM (Water Supply

Public Corporation) under the supervision of the Directorate of Clean Water. (Refer to Fig. III.4.5)

4.2 Local Government

There are 27 provinces in Indonesia headed by governors who are appointed by and responsible to the President of the Republic. The relationship of the provincial and other local governments are shown in Fig. III.4.1, and the organization of the local government is shown in Fig. III.4.6.

Public works directly concerning each province are undertaken by the provincial public works office (DINAS PU). Development programs for water resources and river basins in Central Java Province are managed by the Provincial Public Works Office for Water Resources (DINAS PU Pengairan), and its organization is shown in Fig. III.4.7.

CHAPTER 5 LAND USE

5.1 Present Land Use in Central Jawa Province

Central Jawa Province which has 32,548 km² is divided into 10,010 km² (31%) of wet land and 22,538 km² (69%) of dry land. Irrigated farmland occupies about 70% of the wet land and the utilization of dry land is given as follows.

<u>Utilization</u>	<u>Area (km²)</u>	<u>Ratio in Dry Land (%)</u>
House Compound	5,667	25.0
Cleared Land	7,740	34.3
Meadow	84	0.4
Fishpond	294	1.3
Water Pond	34	0.2
Fallow Pond	40	0.2
Wooded Land	488	2.2
Government Forest	5,839	25.9
Estate	828	3.7
Others	1,524	6.8
Total	22,538	100.0

Change in land use can be seen at wet lands and farmlands with the tendency of gradual decrease, and at house compound and estate with the tendency of gradual increase in the past decade. Such changes will accelerate in the next decade due to the governmental policy of industrialization.

5.2 Present Land Use in the Study Area

The study area consists of the entire Semarang City and parts of Kabupaten Kendal and Kabupaten Semarang.

Semarang City occupies almost 36% of the study area and about 40% of Semarang City is occupied by house compounds which include residential and commercial areas and 12% by paddy fields and reservoirs called wet land.

The study area includes six of the 15 kecamatans of Kabupaten Kendal. These six kecamatans occupy around 45% of the study area and house compound occupy only 12% of the area of the six kecamatans. However, the paddy fields and reservoir areas, cleared land which is farm land, and government forest each occupy 21% to 24% of the wet land.

The study area includes two of the 14 kecamatans of Kabupaten Semarang. These two kecamatans occupy about 19% of the study area and wet land, government forest and cleared land respectively occupy 24%, 22% and 21% of the area of the two kecamatans. House compound and plantation estate each occupy 15%.

The present land use in the study area is presented in Table III.5.1.

5.3 Future Land Use in Semarang City

The present and authorized future land use of Semarang City (for the year 2000 are as presented in Repelita V, 1989-1993) are shown in Figs. III.5.1 and III.5.2. Based on the present and future land use in 2000, the future land use plan for the year 2015 was projected in this study for the purpose of formulating only the master plan.

The present and future land use in 2000 are classified into 13 categories; however, these are herein summarized into four categories for the sake of simple

projection of land use in 2015. The categorization is given as follows.

Category of Land Use Plan in 2015	Category of Present Land Use and Land Use Plan in 2000	Area (ha)	Ratio (%)
Business Area	Trade	288	0.77
	Office	123	0.33
Residential Area	Housing	16,284	43.58
Industrial Area	Industry	1,356	3.63
	Bus & Truck Terminal	146	0.39
	Railway Station	146	0.39
	Airport	232	0.62
	Harbour & Warehouse	395	1.06
Green Zone & Others	Recreation & Sports Area	460	1.23
	Cultural Facilities	19	0.05
	Educational Facilities	1,065	2.85
	Health Facilities	105	0.28
	Greenbelt and Road	16,747	44.82
Total		37,366	100.00

The Directorate of City and Regional Planning, Directorate General of Human Settlement, Ministry of Public Works had projected the trend of each category of land use in its report "Review on Big Cities or Metropolitan Cities Spatial Planning, July 1990," as summarized below. Based on the Future Land Use Plan in the year 2000 and this trend, the Future Land Use Plan in the year 2015 is projected as shown in Fig. III.5.3.

Business Area	+0.60%/year
Residential Area	+0.70%/year
Industrial Area	+0.75%/year
Green Zone & Others	-0.74%/year

TABLES

Table III. 1. 1 POPULATION OF INDONESIA (1990)

Province	Population		
	Male	Female	Total
1 D. Istimewa Aceh	1,717,032	1,698,843	3,415,875
2 North Sumatera	5,122,921	5,133,106	10,256,027
3 West Sumatera	1,957,681	2,041,439	3,999,120
4 Riau	1,698,099	1,608,116	3,306,215
5 Jambi	1,029,664	986,495	2,016,159
6 South Sumatera	3,170,975	3,105,972	6,276,947
7 Bengkulu	605,768	573,354	1,179,122
8 Lampung	3,083,539	2,922,340	6,005,879
9 DKI Jakarta	4,173,199	4,080,836	8,254,035
10 West Jawa	17,736,290	17,644,863	35,381,153
11 Central Jawa	14,078,299	14,443,393	28,521,692
12 D. Istimewa Yogyakarta	1,432,279	1,480,775	2,913,054
13 East Jawa	15,920,832	16,582,983	32,503,815
14 Bali	1,385,293	1,392,518	2,777,811
15 West Nusa Tenggara	1,646,320	1,723,329	3,369,649
16 East Nusa Tenggara	1,620,824	1,647,820	3,268,644
17 East Timor	386,939	360,811	747,750
18 West Kalimantan	1,650,889	1,588,346	3,239,235
19 Central Kalimantan	720,775	675,559	1,396,334
20 South Kalimantan	1,296,608	1,300,964	2,597,572
21 East Kalimantan	987,328	889,335	1,876,663
22 North Sulawesi	1,256,454	1,222,339	2,478,793
23 Central Sulawesi	877,033	834,294	1,711,327
24 South Sulawesi	3,410,863	3,570,783	6,981,646
25 South East Sulawesi	673,862	675,757	1,349,619
26 Maluku	946,069	910,006	1,856,075
27 Irian Jaya	862,400	779,030	1,641,430
Total	89,448,235	89,873,406	179,321,641

Note : Including Homeless and Island Tribes Which 127,418 People in Total
Source : Statistical Year Book of Indonesia 1991
Central Bureau of Statistics, Jakarta, January 1991.

Table III. 1. 2 POPULATION OF CENTRAL JAWA PROVINCE (1990)

Level II Regional Administration	Population		
	Male	Female	Total
1 Kab. Cilacap	745,177	742,131	1,487,308
2 Kab. Banyumas	671,834	676,991	1,348,825
3 Kab. Purbalingga	363,227	369,051	732,278
4 Kab. Banjarnegara	385,701	386,073	771,774
5 Kab. Kebumen	556,085	564,897	1,120,982
6 Kab. Purworejo	346,137	354,651	700,788
7 Kab. Wonosobo	334,364	331,187	665,551
8 Kab. Magelang	504,350	511,522	1,015,872
9 Kab. Boyolali	412,985	431,209	844,194
10 Kab. Klaten	527,093	559,042	1,086,135
11 Kab. Sukoharjo	332,105	340,726	672,831
12 Kab. Wonogiri	472,514	486,378	958,892
13 Kab. Karanganyar	343,860	354,088	697,948
14 Kab. Sragen	405,829	419,688	825,517
15 Kab. Grobogan	566,920	581,410	1,148,330
16 Kab. Blora	379,863	387,429	767,292
17 Kab. Rembang	255,504	258,176	513,680
18 Kab. Pati	519,776	544,339	1,064,115
19 Kab. Kudus	307,775	323,547	631,322
20 Kab. Jepara	409,714	417,943	827,657
21 Kab. Demak	407,556	415,270	822,826
22 Kab. Semarang	385,771	400,039	785,810
23 Kab. Temanggung	307,325	309,433	616,758
24 Kab. Kendal	396,823	402,294	799,117
25 Kab. Batang	292,139	299,508	591,647
26 Kab. Pekalongan	345,267	354,543	699,810
27 Kab. Pematang	546,532	567,696	1,114,228
28 Kab. Tegal	611,152	628,199	1,239,351
29 Kab. Brebes	750,135	771,700	1,521,835
30 Kod. Magelang	59,854	63,359	123,213
31 Kod. Surakarta	242,257	261,919	504,176
32 Kod. Salatiga	47,552	50,520	98,072
33 Kod. Semarang	612,811	638,160	1,250,971
34 Kod. Pekalongan	119,219	123,655	242,874
35 Kod. Tegal	113,093	116,620	229,713
Total	14,078,299	14,443,393	28,521,692

Note : Including Sailors, Homeless and Inland Tribes

Source : 1990 Central Jawa Population Census

Central Jawa Statistics Office, February 1991

Table III. 1. 3 POPULATION GROWTH OF CENTRAL JAWA PROVINCE

Year	Population	Growth Rate (%)
1980	25,391,969	
1981	25,755,502	1.43
1982	26,048,075	1.14
1983	26,315,992	1.03
1984	26,620,930	1.16
1985	27,272,534	2.45
1986	27,360,665	0.32
1987	27,591,886	0.85
1988	27,839,931	0.90
1989	28,154,522	1.13
1990	28,521,692	1.30

Annual Average Population
Growth in Central Jawa Province: 1.17

Source : Central Jawa Statistics Office, 1991

Table III. 1. 4 POPULATION IN THE STUDY AREA (1990)

Kecamatan	Village/ Kelurahan	Area (km ²)	Total Population	Population Density (person/km ²)
I Semarang City (Kodya.)				
1	Central Semarang	16	58,727	21,049
2	North Semarang	16	159,638	13,381
3	East Semarang	20	221,724	7,672
4	South Semarang	35	227,743	3,614
5	West Semarang	36	268,960	8,601
6	Genuk	16	160,362	2,657
7	Gunung Pati	15	46,362	901
8	Mijen	13	40,324	598
9	Tugu	10	65,390	1,158
	Other *	-	1,741	
	Subtotal	177	1,250,971	3,348
II Kabupaten Kendal				
10	Brangsong	12	38,092	1,103
11	Kaliwungu	15	83,736	777
12	Singorojo	14	42,181	339
13	Boja	18	51,329	801
14	Limbangan	16	26,182	365
15	Pegandon	24	61,577	933
	Subtotal	99	303,097	647
III Kabupaten Semarang				
16	Ungaran	22	94,079	1,272
17	Klepu	21	75,423	600
	Subtotal	43	169,502	849
Grand Total				
		319	1,041.87	1,723,570
				1,654

Sources : - Kodya Semarang in Figure 1990
 - Kabupaten Kendal & Kabupaten Semarang in Figure 1990
 - Central Jawa Population : Complete result of 1990 Census,
 Central Jawa Statistics Office, February 1991.

Note : *Including sailors and homeless

Table III. 1. 5 NUMBER OF HOUSEHOLD IN THE STUDY AREA (1990)

Location	Area (km ²)	Population	Population Density (persons/km ²)	Number of Household	Household Size (persons/hh)
Semarang City	373.66	1,250,971	3,348	268,797	4.7
Kab. Kendal	468.59	303,097	647	69,338	4.4
Kab. Semarang	199.62	169,502	849	34,771	4.9
Study Area	1,041.87	1,723,570	1,654	372,906	4.6

Source : - Central Jawa in Figures 1991
 - Kodya Semarang in Figures 1990
 - Kabupaten Kendal in Figures 1990
 - Kabupaten Semarang in Figures 1990
 - 1990 Population Cencus by Central Jawa Statistics Office,
 February 1991

Table III. 1. 6 POPULATION PROJECTION IN THE STUDY AREA (1990-2015)

Kecamatan	1990	1995	2000	2005	2010	2015
I Semarang City						
1 Central Semarang	58,727	62,243	65,971	69,922	74,109	78,547
2 North Semarang	159,638	169,198	179,330	190,069	201,452	213,516
3 East Semarang	221,724	235,002	249,075	263,991	279,800	296,556
4 South Semarang	227,743	241,381	255,836	271,157	287,396	304,606
5 West Semarang	268,960	285,067	302,138	320,231	339,408	359,734
6 Genuk	160,362	169,965	180,143	190,932	202,365	214,484
7 Gunung Pati	46,362	49,138	52,081	55,200	58,506	62,009
8 Mijen	40,324	42,738	45,298	48,011	50,886	53,933
9 Tugu	65,390	69,305	73,456	77,855	82,518	87,459
Other	1,741	1,845	1,956	2,073	2,197	2,329
Subtotal	1,250,971	1,325,882	1,405,284	1,489,441	1,578,637	1,673,173
II Kabupaten Kendal						
10 Brangsong	38,092	40,373	42,791	45,353	48,069	50,948
11 Kaliwungu	83,736	88,751	94,065	99,698	105,669	111,997
12 Singorojo	42,181	44,707	47,384	50,222	53,229	56,417
13 Boja	51,329	54,403	57,661	61,114	64,774	68,653
14 Limbangan	26,182	27,750	29,412	31,173	33,040	35,018
15 Pegandon	61,577	65,265	69,173	73,315	77,705	82,359
Subtotal	303,097	321,249	340,486	360,875	382,486	405,392
III Kabupaten Semarang						
16 Ungaran	94,079	99,713	118,410	112,013	118,721	125,831
17 Klepu	75,423	79,940	84,727	89,801	95,178	100,878
Subtotal	169,502	179,653	203,137	201,814	213,899	226,709
Grand Total	1,723,570	1,826,784	1,948,907	2,052,130	2,175,022	2,305,274

Table III. 3. 1 GROSS DOMESTIC PRODUCT (GDP) OF INDONESIA AT CURRENT MARKET PRICES BY INDUSTRIAL ORIGIN

(Unit : Rp. Billion)

Industry	Year						Average Annual Growth Rate (%) (1985-1990)
	1985	1986	1987	1988	1989	1990	
1. Agriculture, Forestry & Fishery	22,413.2 (23.7)	24,750.5 (24.1)	29,116.0 (23.3)	34,277.9 (24.1)	39,547.0 (23.6)	43,062.1 (21.8)	14.0
2. Mining & Quarrying	15,403.6 (16.3)	11,502.8 (11.2)	17,266.8 (13.8)	17,161.8 (12.1)	22,140.4 (13.2)	28,748.2 (14.5)	13.3
3. Manufacturing Industries	12,903.8 (13.6)	17,184.7 (16.8)	21,150.4 (16.9)	26,252.4 (18.5)	30,573.3 (18.3)	38,601.5 (19.5)	24.5
4. Electricity, Gas & Water Supply	781.3 (0.8)	647.1 (0.6)	746.9 (0.6)	869.0 (0.6)	1,008.3 (0.6)	1,258.1 (0.6)	10.0
5. Construction	5,301.8 (5.6)	5,313.8 (5.2)	6,087.4 (4.9)	7,169.2 (5.0)	8,884.2 (5.3)	10,827.8 (5.5)	15.4
6. Trade, Hotel & Restaurant	14,697.5 (15.5)	17,083.4 (16.7)	21,048.3 (16.9)	24,379.2 (17.2)	28,330.4 (16.9)	32,153.7 (16.3)	16.9
7. Transportation & Communication	6,050.5 (6.4)	6,406.9 (6.2)	7,442.6 (6.0)	8,139.6 (5.7)	9,305.5 (5.6)	11,040.9 (5.6)	12.8
8. Banking & Other Financial Intermediaries	2,802.4 (3.0)	4,058.8 (4.0)	4,795.1 (3.8)	5,322.4 (3.7)	6,550.8 (3.9)	7,902.3 (4.0)	23.0
9. Ownership of Dwelling	2,443.0 (2.6)	2,976.0 (2.9)	3,349.1 (2.7)	3,736.0 (2.6)	4,151.1 (2.5)	4,890.8 (2.5)	14.9
10. Public Administration & Defence	7,925.1 (8.4)	8,307.3 (8.1)	8,911.8 (7.1)	9,446.2 (6.6)	11,174.2 (6.7)	12,801.4 (6.5)	10.1
11. Service	3,998.6 (4.2)	4,314.6 (4.2)	4,902.5 (3.9)	5,351.1 (3.8)	5,829.5 (3.5)	6,434.1 (3.3)	10.0
G D P	94,720.8 (100.0)	102,545.9 (100.0)	124,816.9 (100.0)	142,104.8 (100.0)	167,494.7 (100.0)	197,720.9 (100.0)	15.9

Sources : Statistical Year Book of Indonesia, 1991, Biro Pusat Statistik

Note : Figures in Parenthesis Indicate Distribution in Percent

Table III. 3. 2 BUDGET OF CENTRAL GOVERNMENT OF INDONESIA

(Unit : Rp. Billion)

Fiscal Year	Receipt			Expenditure		
	Routine	Development	Total	Routine	Development	Total
1895/86	19,252	3,572	22,824	11,951	10,873	22,824
1986/87	16,141	5,752	21,893	13,559	8,332	21,891
1987/88	20,803	6,158	26,961	17,482	9,477	26,959
1988/89	23,004	9,991	32,995	20,739	12,251	32,990
1989/90	28,740	9,429	38,169	24,331	13,834	38,165
1990/91	39,546	9,905	49,451	29,998	16,656	46,654
Average Annual Growth Rate (%)	15.5	22.6	16.7	20.2	8.9	15.4

Sources : Statistical Year Book of Indonesia, 1991, Biro Pusat Statistik

Table III. 3. 3 TREND OF EXTERNAL TRADE OF INDONESIA (1980-1991)

(Unit : Million US\$)

Year	Including Petroleum and Gas			Excluding Petroleum and Gas		
	Export (1)	Import (2)	Balance (3)-(1)-(2)	Export (4)	Import (5)	Balance (6)-(4)-(5)
1980	23,950.4	10,834.4	13,116.0	6,168.8	9,085.9	(2,917.1)
1981	25,164.5	13,272.1	11,892.4	4,501.3	11,550.4	(7,049.1)
1982	22,328.3	16,858.9	5,469.4	3,929.2	13,314.1	(9,384.9)
1983	21,145.9	16,351.8	4,794.1	5,005.3	12,207.0	(7,201.7)
1984	21,887.8	13,882.1	8,005.7	5,869.7	11,185.3	(5,315.6)
1985	18,586.7	10,259.1	8,327.6	5,868.8	8,987.5	(3,118.7)
1986	14,805.0	10,718.4	4,086.6	6,528.4	9,632.0	(3,103.6)
1987	17,135.6	12,370.3	4,765.3	8,579.5	11,302.3	(2,722.8)
1988	19,218.5	13,248.5	5,970.0	11,536.9	12,339.4	(802.5)
1989	22,158.9	16,359.6	5,799.3	13,480.1	15,164.4	(1,684.3)
1990	25,675.3	21,837.1	3,838.2	14,604.2	19,916.6	(5,312.4)
1991	29,620.3	25,906.4	3,713.9	18,190.2	24,066.2	(5,876.0)

Source : Statistical Year Book of Indonesia, 1991, Biro Pusat Statistik

Note : Figures in parenthesis indicate negative

Table III. 3. 4 GROSS REGIONAL DOMESTIC PRODUCT OF CENTRAL JAWA PROVINCE
AT CURRENT MARKET PRICES

(unit: Rp. Billion)

Industrial Sector	1985	1986	1987	1988	1989	Annual Growth Rate (%)
1. Agriculture	3,034.1 (30.0)	3,560.4 (31.0)	4,064.8 (29.9)	5,370.2 (32.7)	6,015.5 (32.0)	18.7
2. Mining & Quarring	50.4 (0.5)	57.2 (0.5)	68.5 (0.5)	84.0 (0.5)	99.2 (0.5)	18.4
3. Manufacturing Industries	2,118.5 (20.9)	2,391.5 (20.8)	3,117.8 (22.9)	3,681.5 (22.4)	4,464.6 (23.8)	20.5
4. Electricity, Gas & Water Supply	65.0 (0.6)	83.6 (0.7)	98.5 (0.7)	101.1 (0.6)	133.1 (0.7)	19.6
5. Construction	517.7 (5.1)	543.0 (4.7)	588.6 (4.3)	774.0 (4.7)	750.5 (4.0)	9.7
6. Wholesail & Retail Trade	1,881.7 (18.6)	2,127.6 (18.5)	2,544.9 (18.7)	2,910.2 (17.7)	3,436.2 (18.3)	16.2
7. Transport & Communication	391.5 (3.9)	442.2 (3.8)	498.6 (3.7)	592.4 (3.6)	693.2 (3.7)	15.4
8. Banking & Other Financial Intermediary	151.4 (1.5)	179.4 (1.6)	228.1 (1.7)	293.2 (1.8)	367.8 (2.0)	24.8
9. Ownership of Dwelling	346.5 (3.4)	365.6 (3.2)	392.9 (2.9)	423.4 (2.6)	471.0 (2.5)	8.0
10. Public Administration	1,269.3 (12.5)	1,421.2 (12.4)	1,617.4 (11.9)	1,782.6 (10.9)	1,918.8 (10.2)	10.9
11. Service	298.1 (2.9)	325.7 (2.8)	373.7 (2.7)	410.2 (2.5)	432.4 (2.3)	9.7
Gross Regional Domestic Product (GRDP)	10,124.2 (100.0)	11,497.4 (100.0)	13,593.8 (100.0)	16,422.8 (100.0)	18,782.3 (100.0)	16.7

Sources : Central Jawa in Figures 1991

Table III. 3. 5 PRODUCTION OF MAJOR FOOD CROPS IN CENTRAL JAWA PROVINCE

CROPS	1986	1987	1988	1989	1990	Average Growth Rate (%)
1. Paddy						
Harvested Area(1,000ha)	1,506.8	1,460.2	1,473.5	1,556.6	1,548.8	-
Production(1,000 t)	7,025.8	7,113.0	7,206.6	7,818.7	8,096.2	3.6
Yield Rate(t/ha)	4.66	4.87	4.89	5.02	5.23	-
2. Wet Land Paddy						
Harvested Area(1,000ha)	1,441.6	1,402.6	1,407.6	1,494.2	1,484.0	-
Production(1,000 t)	6,882.3	6,967.3	7,048.0	7,662.4	7,912.8	3.5
Yield Rate(t/ha)	4.77	4.97	5.01	5.13	5.33	-
3. Dry land Paddy						
Harvested Area(1,000ha)	65.2	57.6	65.9	62.4	64.8	-
Production(1,000 t)	143.5	145.7	158.6	156.3	183.4	6.3
Yield Rate(t/ha)	2.20	2.53	2.41	2.50	2.83	-
4. Corn						
Harvested Area(1,000ha)	632.4	433.4	743.7	541.2	655.6	-
Production(1,000 t)	1,383.6	1,139.9	1,619.6	1,256.6	1,814.3	7.0
Yield Rate(t/ha)	2.19	2.63	2.18	2.32	2.77	-
5. Cassava						
Harvested Area(1,000ha)	256.2	268.1	278.2	278.5	280.7	-
Production(1,000 t)	2,998.2	3,826.3	3,489.8	3,530.2	4,270.1	9.2
Yield Rate(t/ha)	11.70	14.27	12.54	12.68	15.21	-
6. Sweet Potato						
Harvested Area(1,000ha)	24.1	22.6	26.1	23.0	23.9	-
Production(1,000 t)	230.9	224.6	252.3	252.8	270.0	4.0
Yield Rate(t/ha)	9.58	9.94	9.67	10.99	11.30	-
7. Peanuts						
Harvested Area(1,000ha)	120.5	101.5	114.6	120.7	130.1	-
Production(1,000 t)	130.4	110.8	114.5	124.3	135.1	0.9
Yield Rate(t/ha)	1.08	1.09	1.00	1.03	1.04	-
8. Soybeans						
Harvested Area(1,000ha)	169.0	126.8	150.2	166.0	197.8	-
Production(1,000 t)	179.1	138.2	165.9	199.5	257.7	9.5
Yield Rate(t/ha)	1.06	1.09	1.10	1.20	1.30	-

Sources : Central Jawa in Figures 1991

Table III. 3. 6 GROSS OUTPUT, INPUT AND VALUE ADDED BY INDUSTRIES IN CENTRAL JAWA PROVINCE(1989)

(Unit : Rp. Million)

Industry	Gross Output	Input	Value Added at Market Price	Indirect Taxes	Value Added at Factor Cost
Food, Beverage and Tobacco	3,625,304	2,284,839	1,340,464	802,782	537,681
Textile, Clothing and Leather	1,628,775	1,133,183	495,592	15,143	480,448
Wood, Wood Products incl. Furniture	400,476	244,956	155,520	3,343	152,176
Paper and Paper Product, Printing and Publishing	111,469	84,255	27,214	5,698	21,515
Chemicals, Petroleum, Coal, Rubber and Plastics	394,070	254,971	139,098	8,386	130,711
Non Metallic Minerals Except Petroleum and Coal	117,902	60,598	57,304	6,145	51,158
Basic Metal	46,323	23,206	23,117	264	22,853
Fabricated Metal Product, Machinery and Equipment	291,080	187,844	103,235	6,637	96,597
Other Manufacturing Industry	21,118	13,975	7,142	357	6,785
Total	6,636,517	4,287,827	2,348,686	848,755	1,499,924

Source: Central Java in Figures 1991
Central Java Statistic Office

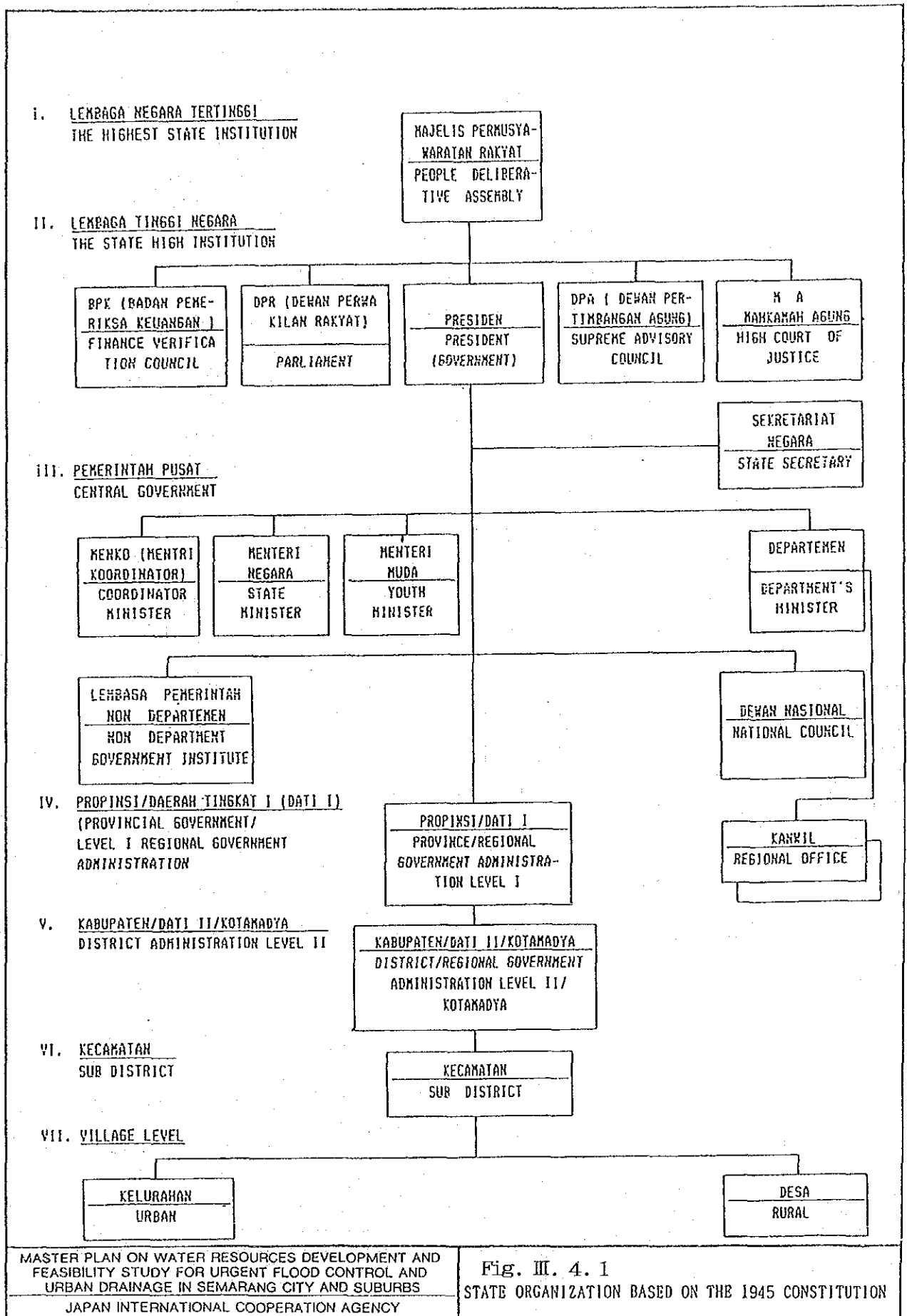
Table III. 5. 1 PRESENT LAND USE IN STUDY AREA

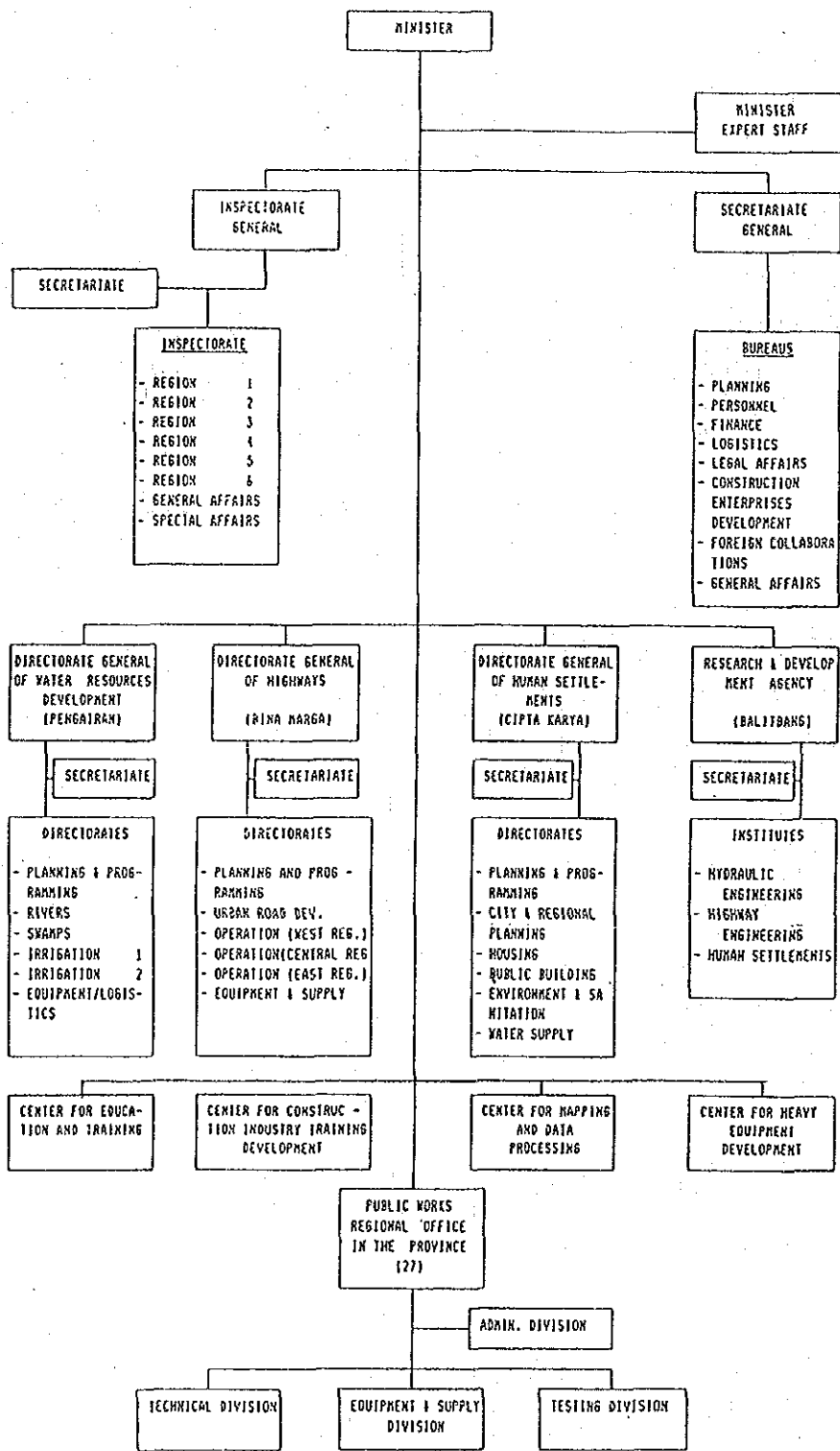
(Unit : km²)

No.	Kecamatan	Wet Land					Dry land							Grand Total		
		Irrigated Area	Others	Total	House Compound	Cleared Land	Headows	Fish Pond	Fallow Land	Hooded Land	Gov. Forest	Estate	Others		Total	
I. SEMARANG CITY																
1.	Central Semarang	-	-	-	2.71	-	-	-	-	-	-	-	-	0.08	2.79	2.79
2.	North Semarang	-	-	-	9.72	0.02	-	-	-	-	-	-	-	-	11.93	11.93
3.	East Semarang	0.16	0.07	0.23	22.30	2.68	-	0.50	-	-	-	-	-	3.19	28.67	28.90
4.	South Semarang	0.74	6.32	7.06	26.36	23.65	0.26	0.36	0.27	-	-	-	-	5.05	55.96	63.02
5.	West Semarang	0.42	0.43	0.85	19.21	2.15	-	-	-	-	-	-	-	7.66	30.42	31.27
6.	Gemuk	-	2.31	2.31	48.65	2.62	-	-	-	-	-	-	-	2.41	58.04	60.35
7.	Gunung Pati	10.16	5.93	16.09	9.70	22.37	0.99	-	-	-	-	0.57	1.74	35.37	51.46	51.46
8.	Mijen	2.47	8.65	11.12	7.21	27.23	-	-	0.25	10.06	9.46	2.13	56.34	67.46	67.46	
9.	Tugu	6.76	2.39	9.15	5.52	15.08	-	0.16	0.55	6.44	0.22	4.40	47.33	56.48	56.48	
	Sub Total	20.71	26.10	46.81	151.38	95.80	1.25	20.75	1.02	16.50	10.25	28.83	326.85	373.66	373.66	
II. KABUPATEN KENDAL																
10.	Brangsong	15.16	0.06	15.22	4.79	6.08	-	1.89	-	1.64	-	4.91	19.31	34.53	34.53	
11.	Kaliwungu	18.97	1.08	20.05	9.46	17.26	0.09	12.67	-	35.86	-	12.31	87.65	107.70	107.70	
12.	Singorojo	0.91	9.22	10.13	14.26	38.43	-	-	-	27.50	20.92	13.31	114.42	124.55	124.55	
13.	Boja	2.64	19.36	22.00	15.21	20.01	0.34	0.01	-	3.69	1.02	1.82	42.10	64.10	64.10	
14.	Limbangan	-	11.81	11.81	5.51	24.35	0.14	-	-	16.54	11.41	1.95	59.90	71.71	71.71	
15.	Pegandon	17.39	3.72	21.11	8.96	4.97	-	-	-	21.23	-	9.73	44.89	56.00	56.00	
	Sub Total	55.07	45.25	100.32	58.19	111.10	0.57	14.57	0.00	106.46	33.35	44.03	368.27	468.59	468.59	
III. KABUPATEN SEMARANG																
16.	Ungaran	13.34	6.87	20.21	17.58	20.26	-	0.01	-	5.39	6.87	3.52	53.73	73.94	73.94	
17.	Klepu	19.57	7.76	27.33	13.13	21.81	-	-	-	39.12	22.23	2.06	98.35	125.68	125.68	
	Sub Total	32.91	14.63	47.54	30.71	42.07	0.00	0.01	0.00	44.51	29.10	5.68	152.08	199.62	199.62	
	Grand Total	108.69	85.98	194.67	240.28	248.97	1.82	35.33	1.02	167.47	72.70	78.54	847.20	1,041.87	1,041.87	

Source: Kodya Semarang in Figures 1990
Kabupaten Kendal in Figures 1990
Kabupaten Semarang in Figures 1990

FIGURES

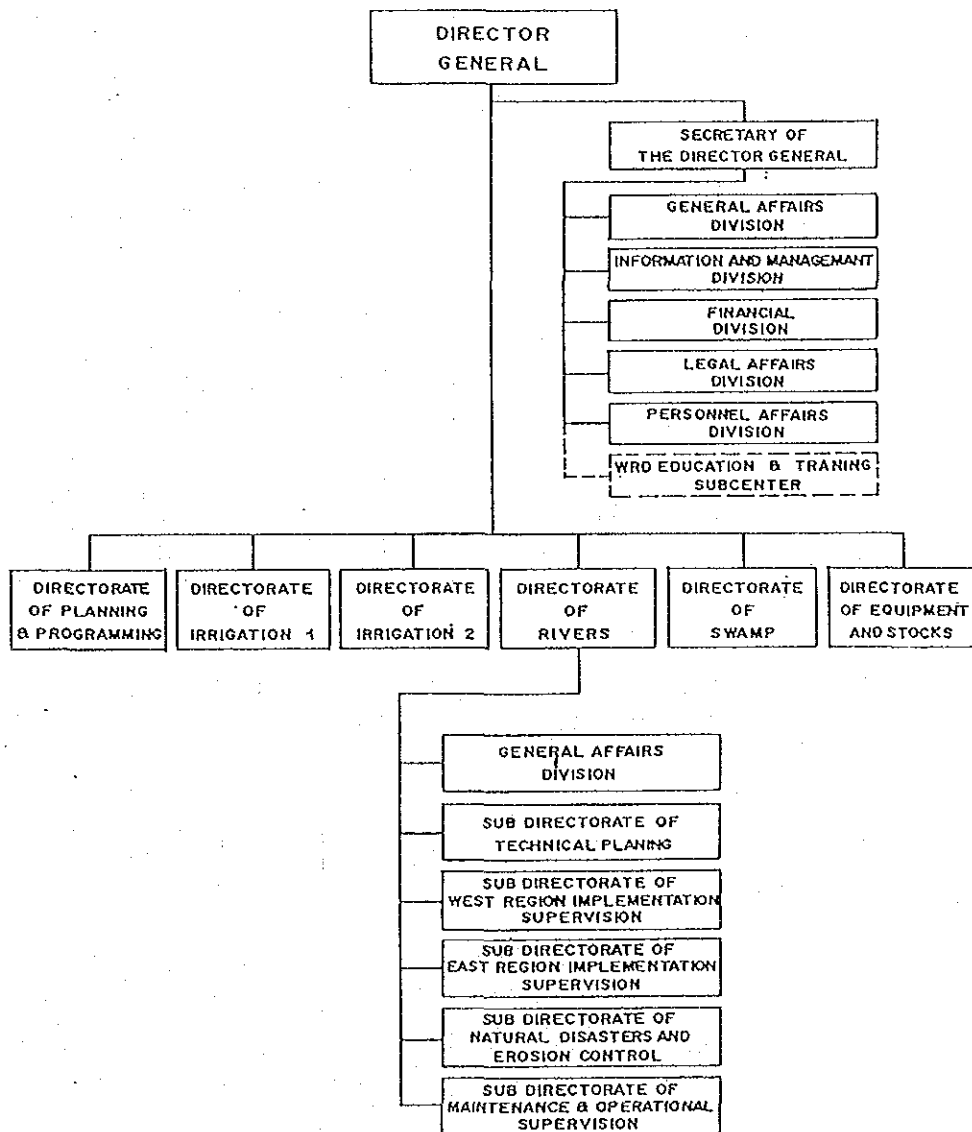




Source: Decree of the Minister of Public Works No 211/KPTS/1981
(Organization Structure and Work Systems of MPW)

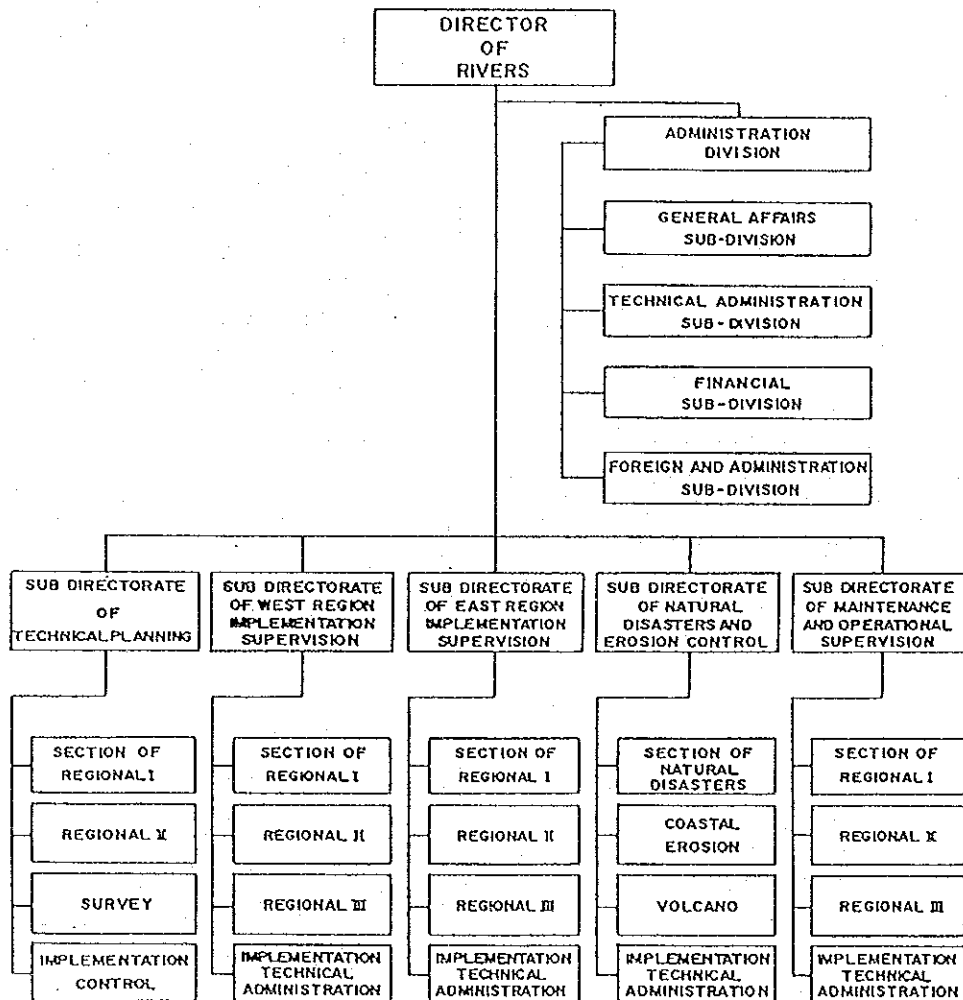
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Fig. III. 4. 2
ORGANIZATION CHART OF THE MINISTRY OF PUBLIC WORKS



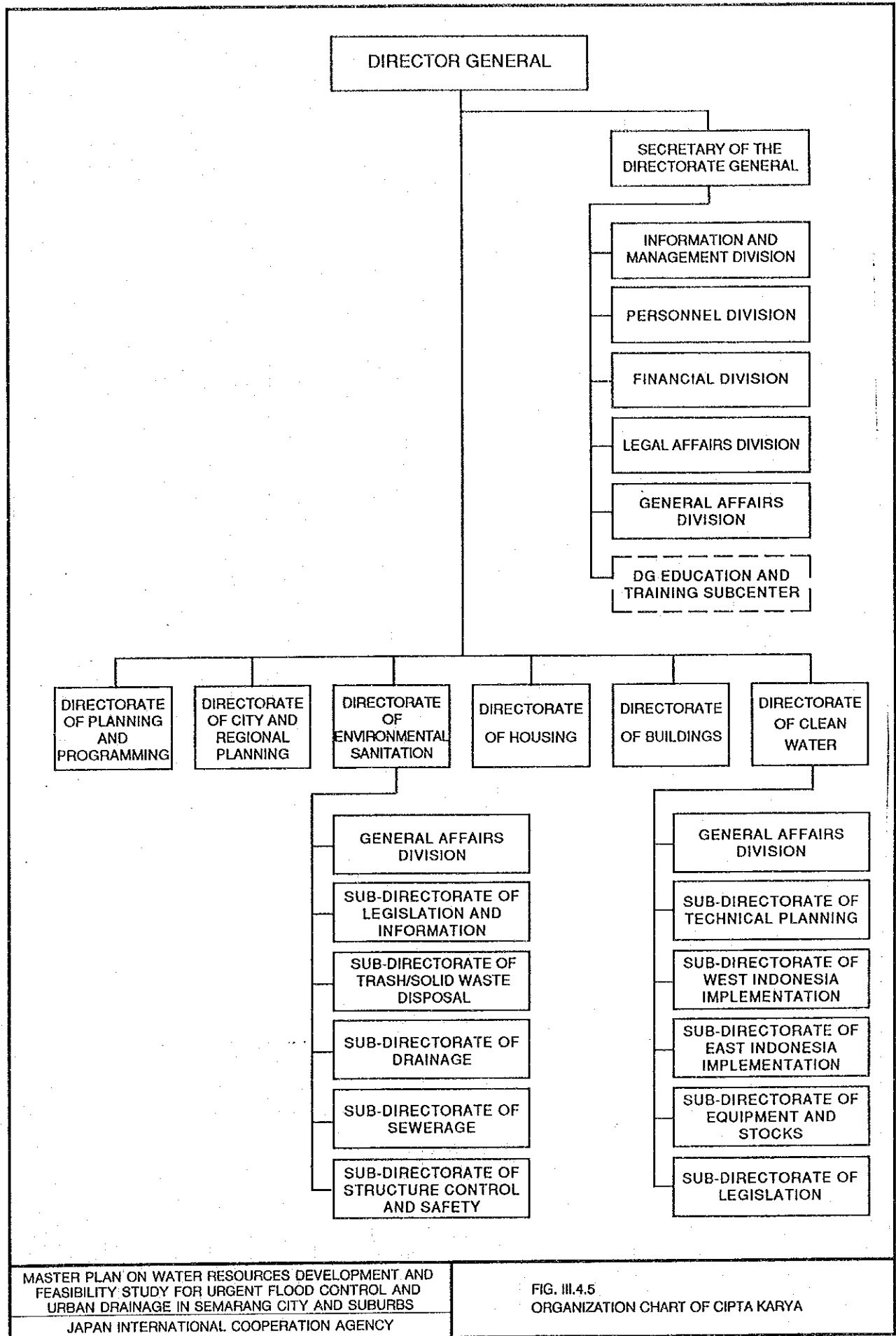
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Fig. III. 4. 3
 ORGANIZATION CHART OF DIRECTORATE GENERAL OF
 WATER RESOURCES DEVELOPMENT



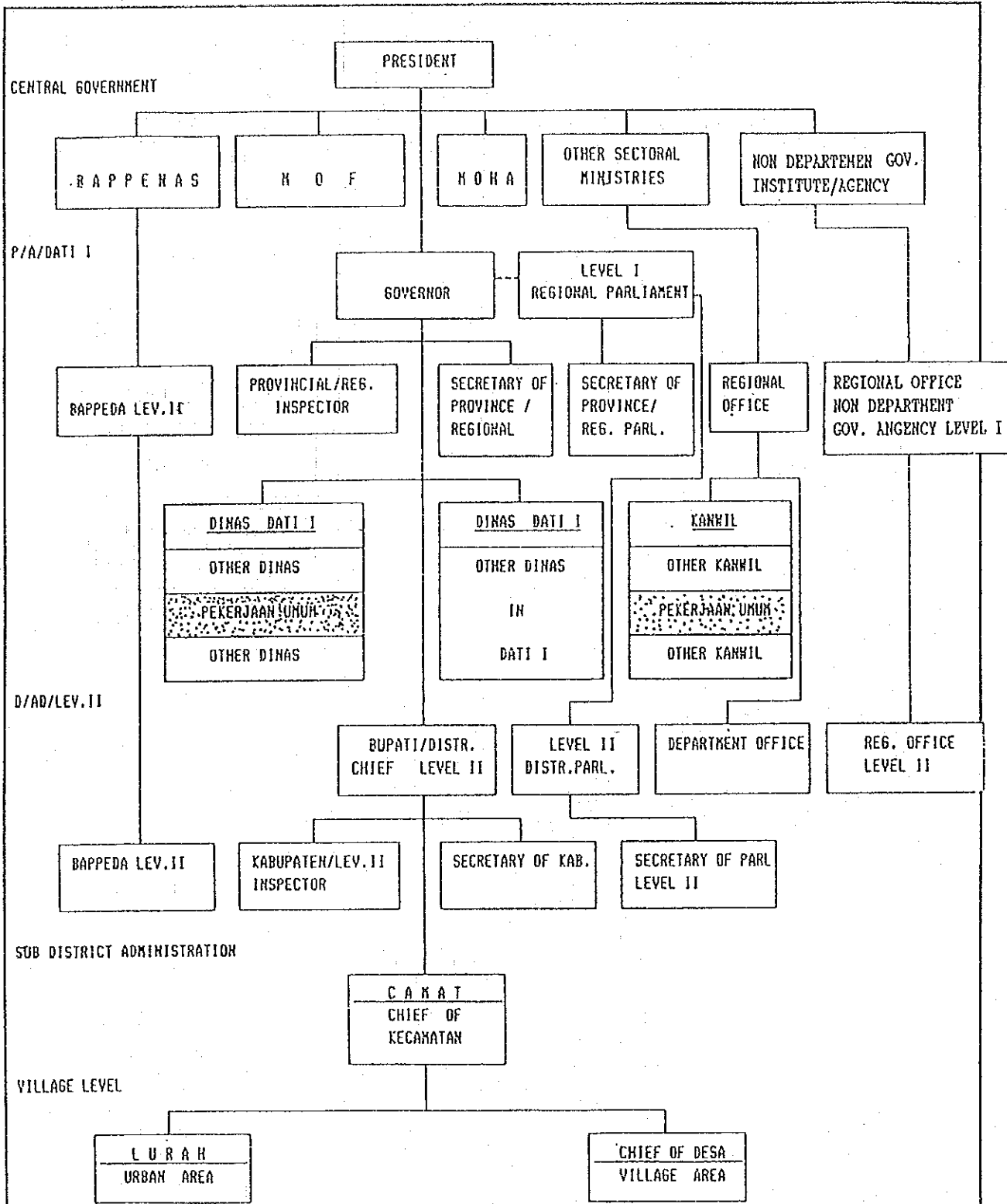
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Fig. III. 4. 4
 ORGANIZATION CHART OF DIRECTORATE OF RIVERS



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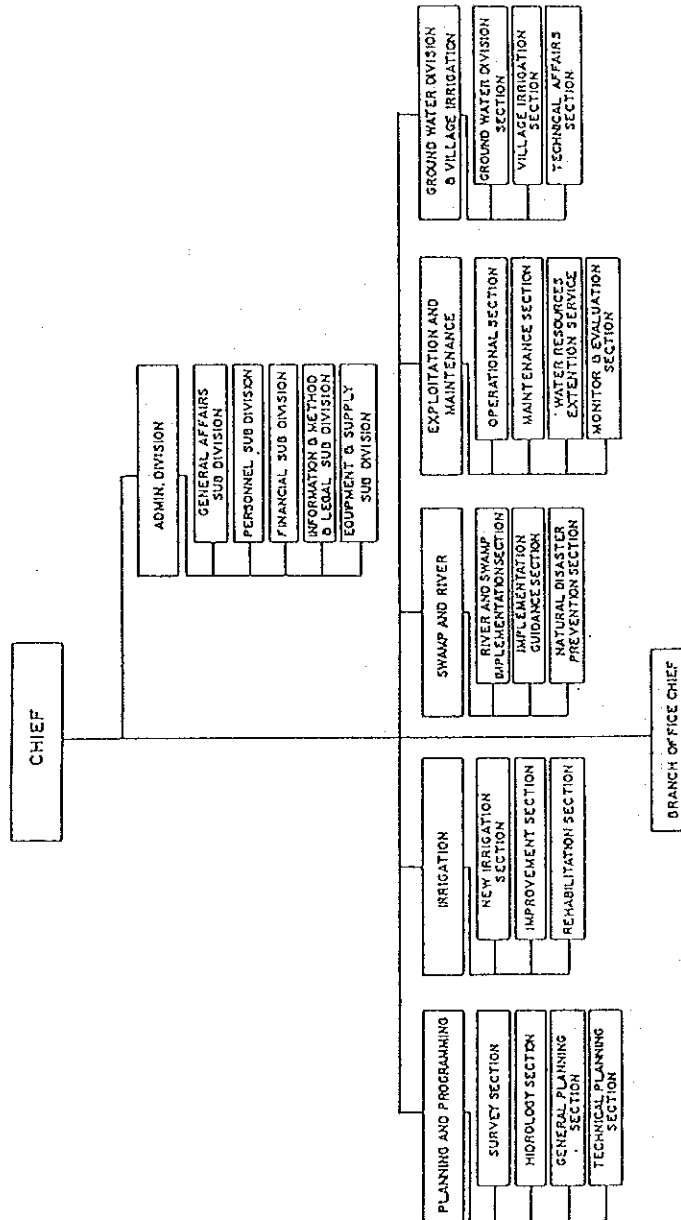
FIG. III.4.5
 ORGANIZATION CHART OF CIPTA KARYA



Note - BAPPENAS : National Development Planning Board
 - BAPPEDA : Regional Development Planning Board
 - H O F : Ministry Of Finance
 - H O H A : Ministry Of Home Affair
 - D A T I : Level I Regional Administration

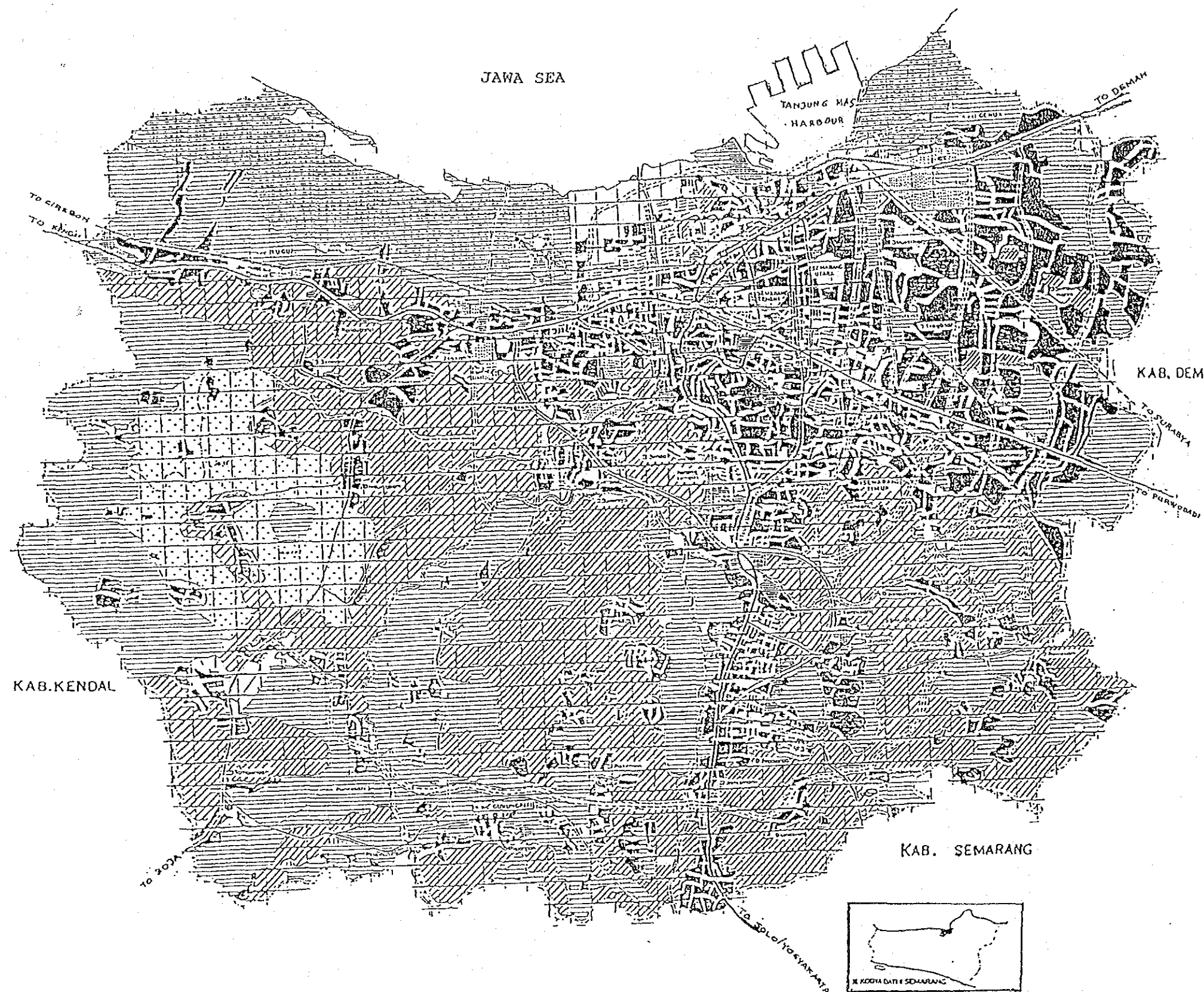
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FIG. III.4.6 ORGANIZATION CHART OF LOCAL GOVERNMENT


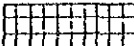
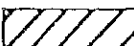
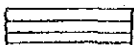
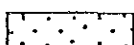
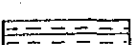
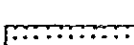
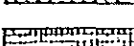
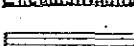
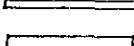
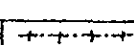
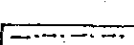

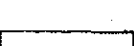

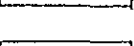
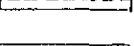


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FIG. III.4.7
ORGANIZATION CHART OF PROVINCIAL PUBLIC
WORKS OFFICE FOR WATER RESOURCES



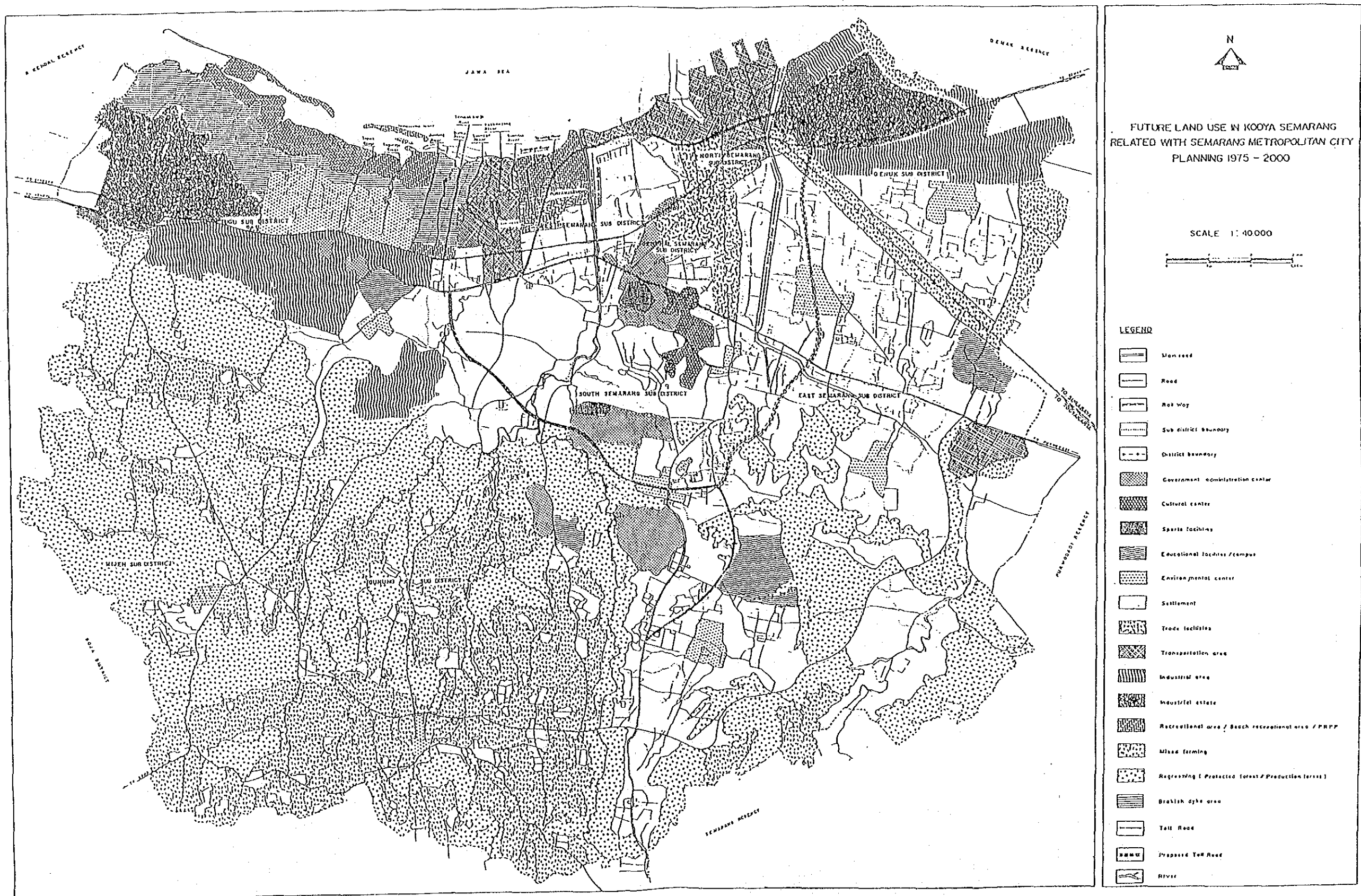
LEGEND

-  Settlement
-  Rice field
-  Cleared Land
-  Garden
-  Estate/Plantation
-  Brakish Dyke
-  Industry/Factory
-  Land for Services
-  Land for Employment
-  Allocated Land
-  Kotamadya boundary
-  Kecamatan boundary
-  River
-  Road
-  Tollroad
-  Proposed Tollroad
-  Railway



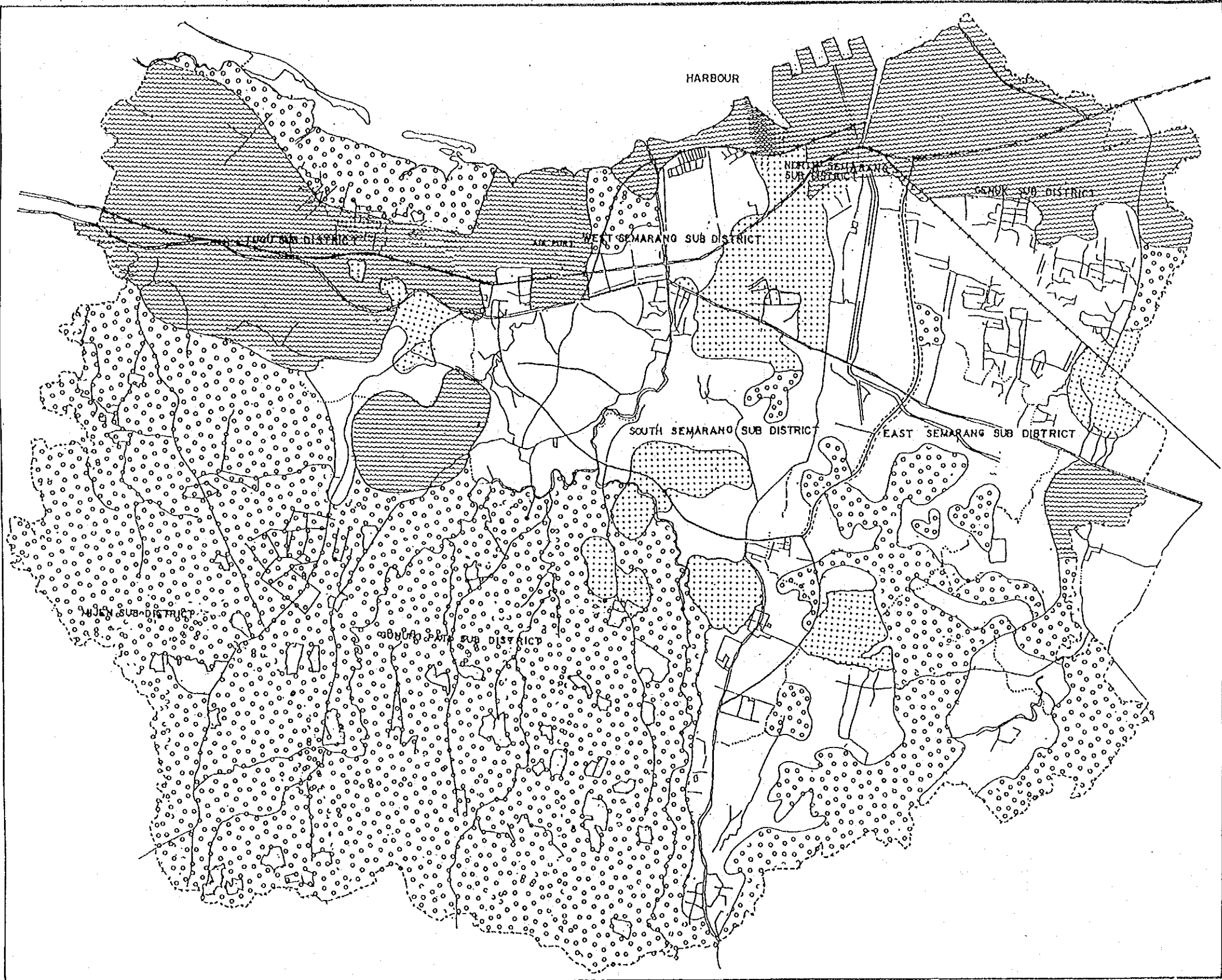
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Fig. III.5.1
 Present Land Use in Semarang City



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Fig. III.5.2
Future Land Use Plan in Semarang
City for the Year 2000



LEGEND

- BUSINESS AREA
- RESIDENTIAL AREA
- INDUSTRIAL AREA
- GREENZONE & OTHERS
- MAIN ROAD
- ROAD
- RAIL WAY
- SUB DISTRICT BOUNDARY
- DISTRICT BOUNDARY
- TOLL ROAD
- PROPOSED TOLL ROAD
- RIVER

Resource :
 Review on Spatial Planning of Metropolitan city, 1990 Directorate of City & Regional Planning, DG of Human Settlement, Min. of Public Work.

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Fig. III.5.3
 Future Land Use Plan in Semarang City for the Year 2015

IV ENVIRONMENTAL ANALYSIS

IV ENVIRONMENTAL ANALYSIS

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CHAPTER 1 PRESENT ENVIRONMENTAL CONDITION OF THE STUDY AREA

1.1 The Study Area

Geography

The study area is within the watershed boundaries of Blorong River, Bringin River, West Floodway/Garang River, East Floodway and Babon River, covering about 1,000 km² which include the whole of Semarang City and parts of two regencies (kabupaten), Kab. Kendal and Kab. Semarang, which lie adjacent to Semarang City.

Topography and Geology

The study area is located on a flat plain in the north and on a hilly land in the south. It can be classified into the following areas by topographic conditions:

(1) Low Flat Area

This is the coastal area in the north which has a generally sloping gradient of between 0 to 3% with elevation of 0.75 to 3.5 m above mean sea level. This area is formed by alluvial sediments consisting of gravel, sand, clay and silt.

(2) Hilly to Moderately Undulating Area

This area is located between the low flat area in the north and the mountainous area in the south on elevation 3.5 to 50 m and with the slope gradient of 3 to 15%. This area is

formed by sedimentary and volcanic rocks as the base rock.

(3) Hilly Area with Heavy Undulation

In the southern part of the study area is a hilly area on elevation of more than 50 m above mean sea level. This area is formed by sedimentary or volcanic rock.

Climate

Semarang has the tropical type of climate. Generally, the climate of Semarang can be divided into two seasons; namely, the dry season from May to October and the rainy season from November to April. The heavy rainfall period is normally in December and January.

The southeast trade winds carry dry air between May and October. From November to April, the northwest monsoon gives rise to the heavy rains during the rainy season.

Climatic data between 1980 and 1989 at the airport (Weather Station: A. Yani No. 41a) are shown in Fig. IV.1.1. The annual mean temperature is about 27°C. The highest monthly mean temperature is 35°C in October, and the lowest temperature is 21°C in August. The mean annual rainfall from 1980 to 1989 is 2,460 mm. The maximum mean monthly rainfall is approximately 500 mm in January, and the minimum rainfall is 60 mm in August.

Ground Water

The ground water is one of the sources of potable water for Semarang City. The groundwater in the study area can be divided into two types as follows:

(1) Unconfined Ground Water

The ground water table is influenced by the season, and water quality depends on the environmental conditions. Unconfined ground water is not so clean and the taste is rather salty at places close to the beach. Most of the residents in the downtown area of Semarang use ground water from wells with depths of 3 to 8 m, because of the limited water provided by PDAM. Residents of upland areas can use the water from wells of 20 to 40 m deep during the rainy season, and the quality of water in this area is better than the downtown area.

(2) Confined Ground Water

The confined ground water is used as water source of PDAM. The water volume is quite constant and the quality is appropriate as drinking water. In the downtown of Semarang, the aquifer is formed out of the alluvial and sediment deposits of Garang River. The depth of the aquifer is around 50 to 90 m with the deepest zone at the northeast and the shallow aquifer is located at Garang River.

Biota

In the study area, lowland forests and the original coastal vegetation are already lost. However, the area has a potential diversity of flora and fauna

such as productive animals used for doing work, fishes, and wild animals. A variety of plants such as forest plants, wild plants, agricultural crops, and food crops densely exist.

Population

According to the population census in 1990, the total amount of population of Indonesia was about 180 million and annual population growth was 1.97% during the period 1980-1990.

The population of Central Jawa accounts for 16% of the total population of Indonesia, or about 28.5 million. The population of Central Jawa had the annual average population growth rate of 1.17% during the period 1980-1990. The population density in Semarang City was 3,348 persons/km² in 1990.

The population of Indonesia and Central Jawa are as follows:

	<u>Indonesia</u>	<u>Central Jawa</u>
1985	164,629,618	27,272,534
1990	179,321,641	28,521,692

1.2 The Study Area for Each Sub-Project

Environmental conditions of objective study areas for the plans of flood control, water resources development and urban drainage are described below.

1.2.1 Study Area of Flood Control Plan

Blorong River

(1) Geography

Blorong River is located in the western part of the study area, and it flows for about 60 km from Mt. Ungaran to the river mouth. Blorong River has a catchment area of 157 km². Glaggah River is the major tributary of Blorong River lying in the eastern area of the river basin and meeting the main stream upstream of the existing irrigation intake structure of Pengilon Weir.

(2) Land Use

The mouth of Blorong River is tidal flat used for net fishing. The inland area is used as fishponds.

Paddy field spread widely at the upstream of fishponds up to Blorong Bridge (Jl. Raya Kendal to Kaliwungu), and this section also is used for fishing.

From Blorong Bridge to Railway Bridge, the river is narrow and flows in forest and cultivated areas. There are some communities in several places and residents use the river water for bathing and washing clothes.

Upstream of Railway Bridge, paddy fields spread widely, and there are cultivated areas for cassava, tobacco and so on.

(3) Water Quality

Diponegoro University surveyed water quality at 5 points along Blorong River in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

According to the survey, concentration of DO ranges from 6 to 11 ppm and BOD ranges from 4 to 8 ppm excluding the Blorong Bridge (Jl. Raya Kendal - Kaliwungu) point. Some sampling points like Blorong Bridge show a higher concentration of BOD at 24.4 ppm. Water quality of both the upstream and downstream of Blorong River is the same, and is better than the other objective rivers.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants).

There are at least 17 species in the first group, with rice, banana and cassava as the dominant species. Generally, mango, pineapple and lamtora are found.

In the second group, found are jati (teak), kirinyu, opo-opo kebo, rumput ilalang, rumput teki and sentyosema.

Fauna

Based on the field observation and the information from local people, there are at least 20 species of birds, 4 species of mammals, and some kinds of reptiles and insects. The most common birds are Emprit, Derkuku, Kutilang (thrush), Penthet, Prenjak and Trocokan. Other species are scarce, and these are Bubut, Cipo and Kaapasan. The common mammal is rat. The common reptiles are lizard and snake. The insects are the grasshopper, the dragonfly, the kepik, the bumblebee, the butterfly, bees and ants.

(5) Aquatic Biota

Diponegoro University surveyed six points for benthos. The survey shows that kinds of species and number are relatively varied; around 0 to 6 kinds with 0 to 901 individuals/m². The most common is *Brotia spadicea*. From the viewpoint of benthos, river water is polluted.

Bringin River

(1) Geography

Bringin River flows from the south to the north, 15.5 km long with a catchment area of 32.1 km². From the viewpoint of topography, the river basin is divided into three, the upper, the middle and the lower reaches as follows:

- (a) The upper reaches is a hilly area with a very steep gradient of less than 1/100, taking about 55% of the entire river basin.
- (b) The middle reaches is agricultural land with a steep gradient of 1/100 to 1/750, taking about 40% of the entire river basin.
- (c) The lower reaches is an urbanized area which is being developed along the national road, taking the remaining 5% of the river basin.

(2) Land Use

There are wide paddy fields from the river mouth to Kendal-Semarang Bridge of the national road. Upstream of Kendal-Semarang Bridge are forests, cultivated areas and residential areas along the river.

(3) Water Quality

Diponegoro University surveyed water quality at 2 points downstream of Bringin Bridge (Semarang-Jakarta Highway) along Bringin River in May 1993. Results of the water quality survey and the sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

Values of DO, BOD, phosphate, nitrogen and others stay the same at any sampling station downstream of Bringin Bridge (DO: 7 ppm; BOD: about 2 ppm; total phosphate: 5 ppm; total nitrogen: 9 ppm).

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants). There are at least 10 species of the first group, and 24 species of the second group.

Banana, randu and bamboo are the dominant species of the first group.

Waru, Kirinyu, Rpt panikum, Jawer kotok and Ilalang are the dominant species of the second group.

Fauna

There are at least 14 species and some birds are for conservation such as Belibis, Blekok and Tengkek.

The mammal found there is the rat, and the reptiles include lizard. The insects found there are almost the same as those found in Blorong River.

(5) Aquatic Biota

Diponegoro University surveyed two points for benthos. The survey shows that kinds of species and number are relatively few, around 2 to 4 kinds with 450 to 3,090 individuals/m². The most common is Tubitex and Chironomus. From the viewpoint of benthos, river water is polluted.

Silandak River

(1) Geography

Silandak River which has 8.5 km² of catchment area and 11 km of river stretch flows from Mt. Pancang-pancing toward the Ahmad Yani Airport. Before reaching the airport, the river separates into the following two, the floodway and the diversion channel.

The floodway, 2.9 km long, flows along the west side of the airport into Jawa Sea. The diversion channel with a catchment area of 2 km² flows at the east side of the airport toward Jawa Sea.

(2) Land Use

Fishponds spread in the river mouth area, and there are also drainage networks in the area. There are paddy fields in the west side of the Ahmad Yani Airport. Residential area is located around the Silandak Bridge of the national road.

Upstream of the Silandak Bridge, Silandak River flows through areas planted with banana and coconut palm, cultivated areas and residential areas.

(3) Water Quality

Diponegoro University surveyed water quality at 3 points along Silandak Floodway and Siangker River in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

Downstream of Silandak Bridge, water of the Diversion Channel is polluted with higher concentrations of BOD, phosphate and nitrogen than the Floodway, but with lower concentration of DO. It can be said that the water of the Diversion Channel is more polluted by organic matters than the Floodway.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants). There are at least 5 species of the first group, and 25 species of the second group.

Banana is a dominant species of the first group. The most common plants of the second group are Rumput Beta, Sentrsema, Rumput grinting and ilalang.

Fauna

There are at least 15 species of birds. Some birds are for conservation, such as Belibis, Blekok, Tengkek. Mammals include the rat, and reptiles include the lizard. The insects found there are same as those found in other places.

(5) Aquatic Biota

Diponegoro University surveyed three points along the river for benthos. The survey results show that kinds of species and number

are relatively high, around 1 to 3 kinds with 2,595 to 38,250 individuals/m². The most common is Chironomus. From the viewpoint of benthos, the water is highly polluted.

West Floodway/Garang River

(1) Geography

Garang River which has 204 km² of catchment area and 32 km of river stretch, flows from Mt. Ungaran to the north. Garang River connects with two major tributaries, Kreo River and Kripik River. Simongan Weir is on the downstream of the confluence with Garang River and Kreo River. Garang River connects with West Floodway (the name downstream of Simongan Weir). The stretch of Garang River from the confluence with Kreo River to the river mouth of West Floodway is 9.6 km long. Kreo River and Kripik River have catchment areas of 70 km² and 34 km², respectively. Simongan Weir is about 5.3 km upstream of the river mouth.

(2) Land Use

Recreation facilities such as harbour and swimming pool are located in the left side of the river mouth. From the river mouth to the railway bridge, there is a residential area along the river sides, and there are some cultivated areas inside the channel. Stands for canoe race are located on the left bank. Density of housing on the right side is higher than the other side.

From the railway bridge to Simongan Weir, there are residential areas on both sides, and

residents can enjoy volleyball, soccer and other activities on the left side of the high water channel in the dry season. The right side is used as residential area, workshop and market.

Upstream of Simongan Weir, small communities are located on the riverside, and there are some factories. Residents use the river for washing clothes, bathing and playing with water. The riverbed is excavated by hand for sand and gravel collection. From the river mouth to the Toll Road Bridge, there are lots of ferries for crossing the channel.

(3) Water Quality

Diponegoro University surveyed water quality at 9 points along Garang River, Kreo River, Kripik River and West Floodway in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

One sampling point has higher concentrations of organic matter than the other points. This sampling point is located between the confluence with Kreo and Kripik. This point has the concentration of 45.4 ppm of COD (other stations: 3 to 8 ppm), 10.16 ppm of PO₄-P (other points: 2 to 4 ppm), 11.21 ppm of total-phosphate (others points: 2 to 9 ppm), and 0.62 ppm of NO₃-N (other points: 0.03 to 0.09 ppm). The higher concentration at this sampling point may be attributed to pollution by human activities.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants). There are at least 25 species of the first group, and 58 species of the second group.

Banana, Nanga and Bamboo are dominant species in the first group.

The most common plants of the second group are Kirinyu, Sikejut, Glagah, Kangkungan, Pulutan, Rumput ilalang.

Fauna

There are at least 10 species of birds. Some birds belong to unique species such as the Burung Blekok and the Heron. There are more than three mammals; unique animals are Luwak and Marten (night food animal), and the others are lizards and insects.

(5) Aquatic Biota

Diponegoro University surveyed the study area for aquatic flora and fauna, and 10 points for benthos in June, 1992.

In the upstream of the river, some fresh water fishes are found in a small amount such as Mujair (telapia), Tawes (carp), Lele (walking catfish) and Gabus (snake head fish). In the downstream of the river, under the influence of

seawater intrusion, some brackish water fishes such as Belanak (flathead mullet), Petek (soapy fish), Keting (macrones fish), Kiper (catfish), Kerapu (groper fish) and some shrimps are found.

In the upstream of Simongan Weir, benthos is relatively few, around 3 to 5 kinds with concentration of 51 individuals/m². In the downstream of the weir, the concentration is 105 - 1,170 individuals/m².

East Floodway

(1) Geography

East Floodway has the catchment area of 29.7 km² and 12 km of river stretch. Upstream, the river flows through the hilly and mountainous area southeast of Semarang City. The catchment area of East Floodway consists of the following three watersheds:

Candi River Basin	5.8 km ²
Bajok River Basin	6.8 km ²
Kedunurundu River Basin	17.1 km ²

In 1920, a flood diversion channel of about 1.7 km in length was constructed to divert flood run-off discharge of less than 200 m³/s flowing from the upper reaches of Babon River into East Floodway.

(2) Land Use

In the river mouth area, there are fishponds and small mangrove forests along the river and coastal line. Paddy fields spread widely

between the Semarang-Surabaya Highway Bridge and the Semarang-Purwodadi Bridge, and there are some communities in several places on the right side. On the left side are residential areas and small workshops.

From Semarang-Parwodadi Bridge to Gayon Sari Bridge is residential area. Riversides of this area and Bajok River, one of the tributaries of the East Floodway, are used for illegal dumping sites of garbage. Garbage is scattered on the river banks and the riverbed. River water is polluted by leachate generated from garbage.

(3) Water Quality

Diponegoro University surveyed water quality at 5 points along East Floodway in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

Upstream of Semarang-Parwodadi Bridge, the river banks of East Floodway and its tributaries are used for dumping of solid waste, as mentioned above. Leachate generated from solid waste includes high concentration of organic matters. Upstream of the place where solid waste is scattered, concentrations of organic matters are not so high, for example, BOD is 1.4 ppm and COD is 23.1 ppm at Tegal Kengkung Bridge. However, the downstream of the dumping site and tributaries used as dumping sites show that the quality of river water is worse (DO: 0 ppm, BOD: 153 ppm, COD: 253 ppm). Methane gas is generated from the riverbed, and river water has a black color.

This condition of water quality exists down to the river mouth.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants). There are at least 12 species of the first group, and 29 species of the second group.

Banana and Lantorogung are the most common species in the first group.

The dominant species of the second group are Glagah, Kiringyu and Opo-opo kebo. Other common and dominant species are Kangkungan, Pulutan, Ilalang, Sentrosema and Sikejut.

Fauna

There are at least 15 species of birds. Some birds are for conservation, such as Tengkek. Most birds are Derkuku, Emprit, Peking and Penthet. Rat is found as the mammal, while the reptiles are lizard and snake.

(5) Aquatic Biota

Diponegoro University surveyed five points for benthos. The survey results show that kinds of species and number are around 1 to 3 kinds with 0 to 21,375 individuals/m². From the viewpoint of benthos, river water is polluted.

Babon River

(1) Geography

Babon River with a catchment area of 77 km² and river length of 30 km is located in the eastern part of the study area, and it flows from Mt. Ungaran northward to Jawa Sea. A major river control structure called Pucang Gading Weir is located at about 13 km upstream of the river mouth. Pucang Gading Weir functions as intake facility for irrigation and flood control facility.

(2) Land Use

Paddy fields spread along the river sides from the river mouth to Babon Bridge (Semarang-Surabaya Highway), and there are some factories in several places along the river.

Upstream of Babon Bridge, there are cultivated areas for rice, banana, cassava and others. There are some communities in several places along the river. This section is used by residents for washing clothes and bathing.

(3) Water Quality

Diponegoro University surveyed water quality at 5 points along East Floodway in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

There are some factories around Babon River (Semarang-Surabaya Highway). Downstream of this bridge, river water is polluted by

effluent from factories. Quality of river water, which contains almost 0 ppm of DO, 66 ppm of BOD and 250 ppm of COD, is worse. Concentration of DO (7 to 10 ppm), BOD (about 5 ppm) and COD (20 to 40 ppm) is the same at all sampling points upstream of this bridge.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants). There are at least 20 species of the first group, and 45 species of the second group.

Banana, Cassava, Peanut and Sengon are the dominant species in the first group. Other common species are Coconut, Lamtoro and Lamtorogung.

Kangkungan, Glagah, Ilalang and Sentrosma are the dominant species in the second group.

Fauna

There are at least 16 species of birds. Some birds are for conservation, such as Tengkek. Most birds are Derkuku, Emprit, Peking and Penthet. The mammals found there are at least 4 species and rat is the most common. The reptiles and insects are almost the same as those found in other places.

(5) Aquatic Biota

Diponegoro University surveyed four points for benthos. The survey results show that kinds of species and number are around 3 to 6 kinds with 204 to 2,142 individuals/m². The most common are Chironomus and standard. From the viewpoint of benthos, river water is highly polluted.

1.2.2 Study Area of Urban Drainage Plan

This study area covers commercial, industrial, housing and cultivated areas at present. Cultivated and open space areas, however, may change as commercial, industrial or housing area in the future. Drainage channels are used for not only drainage of stormwater but also for household wastewater containing night soil, and as dumping site for garbage. Therefore, water quality is not good, and piles of garbage accumulate on channel beds.

The urban drainage area in Semarang City can be divided into three: Eastern Semarang Area, Central Semarang Area and Western Semarang Area. Conditions of each area are described as follows:

Eastern Semarang Area

(1) Geography

Eastern Semarang Area of 47.8 km² is bounded on the west and south by East Floodway, on the east by Babon River, and on the north by the coastline of Jawa Sea. The area is mainly divided into two drainage zones, Siringin River and Tenggang River, with river basins of 14.1 km² and 28.7 km², respectively. The

remaining area includes the Babon river basin of 5 km².

(2) Land Use

East Semarang Area is located east of East Floodway. In the north of Semarang-Surabaya national road, fishponds spread. Some large scale factories are distributed along the national road. There are residential areas south of this national road, and there are commercial areas along this national road and other main roads such as Majapahit Road.

(3) Water Quality

Diponegoro University surveyed water quality at 3 stations in Eastern Semarang Area in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.2 and Fig. IV.1.4.

Downstream of Semarang-Surabaya national road on Tenggang River, concentration of BOD (57.4 ppm), COD (113 ppm) and PO₄-P (9.11 ppm) are higher than other sampling points (upstream of Tenggang River: 10 ppm of BOD, 20 ppm of COD, 3.04 ppm of PO₄-P; Siringin River: 11 ppm of BOD, 30 ppm of COD, 2.45 ppm of PO₄-P).

(4) Terrestrial Biota

Flora

The terrestrial vegetation in Siringin River, Tenggang River and its tributaries can be grouped into (a) economic and agricultural plants, and (b) forest and other plants. There

are at least 10 species of the first group, and 24 species of the second group.

Banana, Jambu air, and Mango are the dominant and most common plants of the first group.

The dominant species of the second group are Angsana, Waru, Kirinyu and Sentracema.

Fauna

There are at least 11 kinds of birds. One of them is a protected bird, Tengkek. The mammals, reptiles and insects, in general, are almost the same as those found in other places.

(5) Aquatic Biota

In this drainage area that covers Siringin River, Tenggang River and its tributaries, found are 2 to 5 kinds of benthos with 0 to 7,035 individuals/m². The dominant species is Chironomus thummi. Benthos found inhabit the highly polluted area.

Central Semarang Area

(1) Geography

Central Semarang Area of 27.2 km² for urban drainage system is located in the central area of Semarang City between East Floodway and West Floodway. The area is mainly divided into three drainage areas as below, and the remaining area of about 8.9 km² consists of several small independent drainage areas.

Semarang River Basin : 11.2 km² (including
Asin River Basin:
4.3 km²)

Banger River Basin : 6.5 km²

Bulu River Basin : 0.6 km²

(2) Land Use

There are industrial, commercial and residential areas in Central Semarang Area. Population density is higher than other areas. Land use of a part of Central Semarang Area is shown in Fig. IV.1.3.

(3) Water Quality

Diponegoro University surveyed water quality at 7 points in Central Semarang Area in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.2 and Fig. IV.1.4.

Water quality of this area is more polluted than the other two urban drainage areas, Eastern Semarang and Western Semarang. Concentration of DO is almost 0 ppm so that the river water is under anaerobic condition. Water quality of Central Semarang excluding the upstream of Semarang River is more than 10 ppm of BOD, more than 60 ppm of COD, and almost 0 ppm of DO. It seems reasonable to suppose that Central Semarang Area is polluted by domestic waste.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants, and (b) forest and other plants. There are about 5 species of the first group, and at least 12 species of the second group.

Banana and Mango are the dominant and most common species of the first group.

Angsana, Jaranan and Lamtorogung are the dominant plants of the second group.

Fauna

At least 9 kinds of birds are found in this area. The mammals are usually cultivated species. The reptiles found include lizard and snake. The Insects are butterfly, ants, bees, dragonfly, grasshopper and others.

(5) Aquatic Biota

In the drainage area that include Banger River and Bulu River are found 0 to 2 kinds of benthos with 0 to 45 individuals/m². The dominant specie is Chironomus thummi. Benthos found inhabit the highly polluted area.

Western Semarang Area

(1) Geography

Western Semarang Area is bounded on the east by West Floodway, on the west by Siangker River,

and on the north by the coastline of Jawa Sea. In the north of the area is wet land, and is planted with mangrove. The area covers a newly developed area and the Ahmad Yani Airport. This area is 12.4 km². The area is divided into three drainage zones, Karangayu-Ronggolawe river basin, Tawan river basin and Silandak river basin as below, and the rest of the area of 5.1 km² includes Ahmad Yani Airport and fishponds:

Karangayu-Ronggolawe River Basin:	4.5 km ²
Tawan River Basin	: 1.4 km ²
Silandak Drainage Basin	: 1.4 km ²

(2) Land Use

The northern part of this area is developing as residential and industrial areas. South of the railway are residential and commercial areas, and the commercial area is located especially along Siliwangi Street.

(3) Water Quality

Diponegoro University surveyed water quality in Western Semarang Area in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.2 and Fig. IV.1.4.

There are two sampling points for water quality at Karangyu River. From the concentration of DO, this river is under the anaerobic condition. Concentration of BOD at the upstream point (49 ppm) is higher than the downstream (2 ppm).

(4) Terrestrial Biota

Flora

The terrestrial flora in this area is relatively small, about 23 species. The most common plants are Angsana and Asam kranji. The dominant species, particularly near the PRPP (Greater Market for Promotion and Development), are Glagah, Ilalang, Rumput merah and Wam.

Fauna

There are at least 14 kinds of terrestrial fauna. Some birds are for conservation, such as Tengkek, Jantingan. Rat and lizard are the most common fauna.

(5) Aquatic Biota

In this drainage area that covers Ronggolawe River are 14 to 19 kinds of benthos with 360 to 2,800 individuals/m². The dominant species are Diatoma. From the viewpoint of benthos, river water is lower polluted.

1.2.3 Study Area of Water Resources Development Plan

Kedung Suren Dam

(1) Geography

The proposed Kedung Suren Dam is located on Blorong River downstream of the confluence with Glagah River.

Morphologically, this area form a small hilly area. The river stretch is relatively straight

and V-shaped with a slope of about 30 degrees. The river has no high water channel, and its flow is strong. The Blorong River is categorized as young stage.

(2) Land Use

This area is hilly, and is surrounded by teak forest. This teak forest belongs to the government and is managed by the Forest Department.

Upstream of the proposed dam axis is a village named Kedung Suren Sirowo which has about 75 families. Approach road for dam site from the east passes through Kedung Suren Mijil and Darupono village.

(3) Water Quality

Diponegoro University surveyed water quality around the proposed dam site in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

The water quality at the proposed dam site is the same at any point downstream and upstream. Water samplings at the proposed dam site show 9.1 ppm of DO and 3.6 ppm of BOD. Compared with other proposed dams, water quality at Kedung Suren dam site is better.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants). There are at least 7 species of the first group, and 33 species of the second group.

Bamboo and Lamtoro are the dominant species in the first group.

The most common plants of the second group are Awar-awar, Glagah, Jambu air hutan, Jati, Katu, Kirinyu, Marygold, Opo-opo, Pulutan, Rembeta, Sidaguri, and Tembelekan.

Fauna

Conditions of terrestrial fauna in the proposed dam site are the same as those mentioned in Subsection 1.2.1, Study Area of Flood Control Plan.

(5) Aquatic Biota

Conditions of aquatic biota in the proposed dam site are the same as those mentioned in Subsection 1.2.1, Study Area of Flood Control Plan.

Mundingan Dam

(1) Geography

The proposed Mundingan Dam on Kreo River is located upstream of the proposed Jatibarang Dam. In the upstream of this proposed site, Kreo River branches into Paramasan River and Kran River.

Morphologically, the proposed dam site is located downstream of the confluence where the river stretch is relatively straight and forms a narrow-steep valley. The slope gradient is about 45 degrees. The valley is V-shaped, so there is no high water channel. River flow is relatively rapid. Morphologic conditions in the confluence point is different with the proposed dam site. In this location, the river morphology is categorized as mature stage.

(2) Land Use

In upstream of this proposed dam site, paddy fields spread widely, and chili plantations are located along the Paramasan River. The riverbed in this area is excavated by hand for sand and gravel mining.

In this proposed dam site is a village named Kedung Mengangan. This village has about 400 households, and another village, Trawas, is near the proposed site.

(3) Water Quality

Diponegoro University surveyed water quality around the proposed dam site in May 1993.

Results of the water quality survey and sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

The water quality of Paramasan River, Kran River and Kreo River is the same. The water quality at sampling points shows more than 8 ppm of DO and about 3 ppm of BOD.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants). There are at least 8 species of the first group, and 18 species of the second group.

Padi sawah is the dominant species in the first group.

The most common plants of the second group are Glagah, Kremah, Rumput teki, Semanggi, Sikejut, and Tapak liman.

Fauna

Conditions of terrestrial fauna in the proposed dam site are the same as those mentioned in Subsection 1.2.1, Study Area of Flood Control Plan.

(5) Aquatic Biota

Conditions of aquatic biota in the proposed dam site are the same as those mentioned in

Subsection 1.2.1, Study Area of Flood Control Plan.

Jatibarang Dam

(1) Geography

The proposed Jatibarang Dam is located on Kreo River downstream of the Kreo Cave. The river in this site is relatively straight. Its river bank, 150 m in height, is narrow and very steep with slope gradient of 70° to 80°, and the river valley is V-shaped. River flow velocity is quite high. The river morphology is categorized as young stage.

In the downstream of the dam axis, the river is wide and its valley is U-shaped. The river morphology is mature stage.

(2) Land Use

Paddy fields spread upstream of the proposed site, and cassava and banana are planted in several places. The riverbed is used for sand and gravel mining. Land use around Jatibarang dam site is shown in Fig. IV.1.5.

The proposed dam site area covers the Goa Kreo Park that is managed by the Tourism Agency, Semarang City. This park has functions as city forest. The Goa Kreo Park was established in 1985. Many people come and enjoy this park. Location and number of visitors of recreational area and facilities in Semarang City, and number of visitors in Goa Kreo Park are shown in Fig. IV.1.6 and Tables IV.1.3 and IV.1.4.

This area is very famous for habitation of many wild monkeys and Goa Kreo (Kreo Cave) Park. "Goa Kreo" is Indonesian term for Kreo Cave. Goa Kreo is a very important site for Semarang people. According to the Tourism Agency, Sunan Kalijogo, one of the nine Moslem Saints, had visited this cave when he was islamizing people of this area.

(3) Water Quality

Diponegoro University surveyed water quality around the proposed dam site in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

Water quality of Jatibarang dam site shows 8 ppm of DO and 3.8 ppm of BOD. Water quality is the same as the river water quality of Mundingan dam site.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants). There are at least 10 species of the first group, and 25 species of the second group.

Bamboo, Jambu Biji, Keluwih, Lamtoro, and Nangka are the dominant species in the first group.

The most common plants of the second group are Kemuning, Kirinyu, Preh, Pulutan, Rotan, and Rumput jarum.

Fauna

Conditions of terrestrial fauna in the proposed dam site are the same as those mentioned in Subsection 1.2.1, Study Area of Flood Control Plan.

(5) Aquatic Biota

Conditions of aquatic biota in the proposed dam site are the same as those mentioned in Subsection 1.2.1, Study Area of Flood Control Plan.

Babon Dam

(1) Geography

The proposed Babon Dam is located on Penggarong River, Desa Kebontaman, Rowosari Village, Sub-district of South Semarang, downstream of the confluence between Pengkol and Penggarong River.

Penggarong River flows from southwest to northeast. The river originates from the north side of Mt. Ungaran. The proposed dam site is located in a hilly area. However, the valley is 1,300 m in width, and river sides are deposited with soil. The river flow frequently moves around the high water channel (shifting). The valley is U-shaped and river flow is slow. The river in this section is in mature stage.

River deposition consists of sand, gravel and pebble.

(2) Land Use

Cultivated land for rice and banana exists on both river sides. Forest and grassy land are distributed on the slopes of the valley. Ramasari Village is on the right side of the river, and a new estate exists on the top of the hill on the left side downstream of proposed dam site.

(3) Water Quality

Diponegoro University surveyed water quality around the proposed dam site in May 1993. Results of the water quality survey and sampling points are shown in Table IV.1.1 and Fig. IV.1.2.

Water quality at the proposed Babon dam site shows 9.2 ppm of DO and 4.8 ppm of BOD, which are the same as the Pucang Guding Weir site downstream.

(4) Terrestrial Biota

Flora

The terrestrial flora in this area can be grouped into (a) economic and agricultural plants (cultivated plants), and (b) forest and other plants (natural plants). There are at least 9 species of the first group, and 36 species of the second group.

Bamboo is the dominant species in the first group.

The most common plants of the second group are Glagah, Kangkungan and Rumput ilalang.

Fauna

Conditions of terrestrial fauna in the proposed dam site are the same as those mentioned in Subsection 1.2.1, Study Area of Flood Control Plan.

(5) Aquatic Biota

Conditions of aquatic biota in the proposed dam site are the same as those mentioned in Subsection 1.2.1, Study Area of Flood Control Plan.

CHAPTER 2 ENVIRONMENTAL IMPACT STUDY IN INDONESIA

2.1 System of Indonesian Environmental Impact Assessment

The Indonesian Government has established an Environmental Impact Assessment System. In 1982, the principles of Environmental Management, which is prescribed in Act No. 4, Basic Provisions for the Management of the Living Environment, was established.

Then, Environmental Impact Assessment prescribed in the regulation of "The Analysis of Environmental Impact" No. 29, 1986, was established. In this regulation, the following activities and projects require Environmental Impact Assessment:

- (1) Change in land structure and landscape;
- (2) Exploitation of renewable and non-renewable resources;
- (3) Processes and activities which can potentially create depletion, degradation, and deterioration of natural resources;
- (4) Processes and activities which may affect the social and cultural environment;
- (5) Processes and activities which can interfere with the protection of natural resources or the conservation of natural heritage;
- (6) The introduction of plants, animals, and micro-organisms;

- (7) The production and use of biotic and non-biotic materials; and
- (8) The application of technology that is predicted to have great potential to affect the environment.

The important impacts of activities and projects on living environment are determined in this regulation as follows:

- (1) The number of people affected by the project;
- (2) The size of the impact area;
- (3) The duration of the impact;
- (4) The intensity of the impact;
- (5) The number of components affected by the project;
- (6) The cumulative effects of the impacts; and
- (7) The reversibility or irreversibility of the impact.

The proponent must prepare some necessary documents such as PIL, KA-ANDAL, ANDAL, PEL, KA-SEL, SEL, RKL and RPL. These documents are submitted to AMDAL Commission which is in charge of environmental impact assessment. The above abbreviated words mean as follows:

PIL Preliminary Environmental Information Report

KA-ANDAL Terms of Reference of ANDAL

ANDAL	Environmental Impact Analysis
PEL	Preliminary Environmental Evaluation Report
KA-SEL	Terms of Reference of SEL
SEL	Environmental Evaluation Study
RKL	Environmental Management Plan
RPL	Environmental Monitoring Plan

2.2 Documents of Environmental Impact Assessment

According to Indonesian regulation of "The Analysis of Environmental Impact" No. 29, 1986, PIL and ANDAL are defined as follows:

PIL is a brief assessment of the proposed activity, its environmental setting, the possible environmental impacts due to such activities and a plan of action to manage these environmental impacts.

ANDAL is a detailed and in-depth study of the significant impacts of a proposed activity.

Contents of environmental documents are prescribed by the Decree of the Minister of Population and Environment, "Guideline for the Analysis of Environmental Impact of Proposed Projects" No. KEP 50, 1987." In general, these documents consist of following items:

PIL

- I Identity of the Proponent
- II Brief Description of the Proposed Development Activity
- III Short Description of the Feature of the Environment
- IV Environmental Impact Evaluation and Its Handling
- V Bibliography
- VI Biographical Data of the PIL Author

AMDAL

- I Introduction
- II Planned Activity
- III Description of the Existing Environment
- IV Determination of Significant Impact
- V Evaluation of Significant Impact
- VI Bibliography
- VII Appendices

2.3 AMDAL Study Required for the Project

According to the Decree by the Minister of Public Works No. 531, 1989, AMDAL Study has a screening

stage. Basically, new projects are divided into four types of requirement as follows (refer to Fig. IV.2.1):

- (1) The project requires PIL first. If ANDAL is required after finishing the PIL study, ANDAL study is carried out after preparing KA-ANDAL.
- (2) The project requires only PIL study.
- (3) The project requires KA-ANDAL and ANDAL study.
- (4) The project does not need environmental study.

Generally, master plan study requires PIL, and feasibility study requires ANDAL. In case of a project, therefore, sub-projects with master plan study excluding feasibility studied sub-projects should carry out PIL. Sub-projects with feasibility study need ANDAL study. Project components and required environmental impact study levels are shown in Table IV.2.1.

CHAPTER 3 PRELIMINARY ENVIRONMENTAL IMPACT STUDY (PIL) FOR MASTER PLAN

The PIL study for the Master Plan has been entrusted to the Diponegoro University in Semarang City under the supervision of the JICA Study Team, and the PIL report has been approved by the Central AMDAL Commission. In accordance with the regulations of the Indonesian government, both positive and negative impacts supposed to be brought about by construction implementation shall be taken up in the PIL study.

3.1 Targets of the PIL Study

According to the Indonesian regulations on environmental impact assessment, the master plan study needs PIL study. However, since the ANDAL study for the priority projects selected for the Feasibility Study from the Master Plan was made as described in CHAPTER 4, the PIL study for the priority projects was not conducted in accordance with the government regulations.

The Master Plan covers the Flood Control Plan, the Water Resources Development Plan and the Urban Drainage Plan, and each plan has the following project components:

Flood Control Plan

- River improvement
- Dam construction

Urban Drainage Plan

- Improvement of urban drainage system

Water Resources Development Plan

- Dam construction
- Construction of interbasin transfer facilities

The projects for the Master Plan are summarized by type of structure as below:

- River improvement
- Dam construction
- Construction of interbasin transfer facilities
- Improvement of urban drainage system

The PIL study has been conducted for the above four components, as mentioned below.

(1) River Improvement

The ANDAL study for West Floodway/Garang River, the priority project selected for the Flood Control Plan, is done in CHAPTER 4. Therefore, it is excluded from the PIL study.

The sub-projects of river improvement for the Flood Control Plan cover the following five (5) rivers/channels:

- (a) Blorong River
- (b) Bringin River
- (c) Silandak River
- (d) East Floodway
- (e) Babon River

(2) Dam Construction

The ANDAL study for Jatibarang Dam, the priority project selected for both the Flood Control Plan and Water Resources Development

plans is done in CHAPTER 4. Therefore, it is also excluded from the PIL study.

The following three (3) dams are proposed for water resources development:

- (a) Kedung Suren Dam on Blorong River, for flood control and water resources development;
- (b) Mundingan Dam on Kreo River, for water resources development; and
- (c) Babon Dam on Babon River, for water resources development.

(3) Construction of Interbasin Transfer Facilities

Interbasin transfer facilities are to convey surplus water from Blorong River to Mundingan Dam Reservoir for purposes of water resources development.

(4) Improvement of Urban Drainage System

From the viewpoint of urban drainage system, Semarang City is divided into three areas: Eastern, Central and Western Semarang. Since the ANDAL for Semarang River, Baru River, and Asin River in Central Semarang Area which were selected as priority projects is done in CHAPTER 4, they were excluded from the PIL study.

In the each area, the following rivers are included in the PIL study:

Eastern Semarang Area

- Siringin River
- Tenggang River

Central Semarang Area

- Banger River
- Bulu River

Western Semarang

- Ronggolawe River
- Karangayu River
- Tawang River
- Silandak Channel

3.2 Project Activities

The outline of project activities is given below.

River Improvement

The project activities of river improvement are as follows:

- (1) Blorong River (total length: 6,500 m)
 - Construction of earth dike : Length: 6,500 m
 - Excavation : Volume: 169,000 m³
 - Reconstruction of road bridge : 1 bridge
- (2) Bringin River (total length: 5,040 m)
 - Construction of earth dike : Length: 4,500 m
 - Excavation : Volume: 191,900 m³

- Reconstruction of road bridge : 3 bridges
 - Reconstruction of railway bridge : 1 bridge
- (3) Silandak River (total length: 5,300 m)
- Construction of earth dike : Length: 2,920 m
 - Excavation : Volume: 243,900 m³
 - Reconstruction of road bridge : 2 bridges
 - Reconstruction of railway bridge : 1 bridge
- (4) East Floodway (total length: 12,000 m)
- Construction of earth dike : Length: 5,000 m
 - Excavation : Volume: 1,045,500 m³
 - Reconstruction of railway bridge : 1 bridge
- (5) Babon River (total length: 17,400 m)
- Construction of earth dike : Length: 3,640 m
 - Construction of foreland channel : Length: 4,000 m
 - Excavation : Volume: 1,130,900 m³
 - Reconstruction of road bridge : 9 bridges
 - Reconstruction of railway bridge : 1 bridge

Dam Construction

Technical data on the three (3) dams proposed for PIL study are shown in Table IV.3.1. The major project activities of dam construction are as follows:

- Construction of temporary facilities, namely batching plant, crushing plant, contractor's camp, etc.
- Diversion works
- Temporary cofferdam
- Excavation
- Concrete placing or rock embankment
- Demobilization or demolition of temporary facilities

Construction of Interbasin Transfer

Project activities for the construction of interbasin transfer are as follows:

- Construction of an intake weir on Blorong River
- Construction of a tunnel from Blorong River to Mundingan Dam Reservoir (2.0 m in width, 2.0 in height, 1,600 m in length; gradient is 1/1,000)

Improvement of Urban Drainage System

Project activities for the improvement of urban drainage system are as follows:

(1) Eastern Semarang Area

Siringin River (total length: 9,220 m)

- Construction of earth dike : Length: 6,120 m
- Construction of retaining wall : Length: 3,100 m
- Dredging : Volume: 465,000 m³
- Channel width expansion : Length: 9,220 m

Tenggang River (total length: 13,700 m)

- Construction of earth dike : Length: 4,350 m
- Construction of retaining wall : Length: 9,350 m
- Dredging : Volume: 452,000 m³
- Channel width expansion : Length: 13,700 m
- Construction of new diversion channel ; Length: 2,250 m

(2) Central Semarang Area

Banqer River (total length: 6,680 m)

- Construction of earth dike : Length: 2,090 m
- Reinforcement of existing retaining wall : Length: 1,130 m
- Construction of retaining wall : Length: 3,460 m
- Dredging : Volume: 344,000 m³
- Channel width expansion : Length: 6,680 m

Bulu River (total length: 1,750 m)

- Construction of retaining wall : Length: 1,750 m
- Dredging : Volume: 31,000 m³
- Channel width expansion : Length: 1,750 m

(3) Western Semarang Area

Ronggolawe River (total length: 3,250 m)

- Reinforcement of existing retaining wall : Length: 1,000 m
- Construction of retaining wall : Length: 2,250 m
- Dredging : Volume: 86,000 m³

- Channel width expansion : Length: 3,250 m

Karangayu River (total length: 2,680 m)

- Reinforcement of existing retaining wall : Length: 1,580 m
- Construction of retaining wall : Length: 1,100 m
- Dredging : Volume: 35,000 m³
- Channel width expansion : Length: 2,680 m

Tawang River (total length: 1,200 m)

- Reinforcement of existing retaining wall : Length: 1,200 m
- Dredging : Volume: 35,000 m³

Silandak Channel (total length: 850 m)

- Construction of retaining wall : Length: 850 m
- Dredging : Volume: 24,000 m³
- Channel width expansion : Length: 850 m

3.3 Identification of Environmental Impact

The project activities involved in the Master Plan have both positive and negative environmental impacts.

The project impact flow that cover the possible positive and negative impacts on the environment in the pre-construction phase, construction phase, and after construction phase are shown in Fig. IV.3.1.

The environmental impact evaluation was conducted by a qualitative comparison of the environmental components between with- and without-project.

Predicted important and large scale impacts obtained by the PIL study are as follows.

3.3.1 Pre-Construction Phase

The project component in the pre-construction phase is the land acquisition for the project area.

(1) Impacts Common to all Projects

Positive Impact

Positive environmental impact is not found in the pre-construction phase.

Negative Impact

Land acquisition for the project sites will cause a significant negative impact. Activities of land acquisition which consists of inventory of ownership, determination of compensation price and its payment must be conducted after having a coordination meeting with related institutions and residents.

Land acquisition causes resettlement, since a number of people must be relocated. The implementing agency should make every effort for the successful execution of the resettlement program.

(2) River Improvement

Negative Impact

Area of land acquisition and number of house evacuation for the proposed river improvement are as follows:

River	Land Acquisition (ha)	House Evacuation (number)
Blorong River	0	0
Bringin River	42.30	73
Silandak River	9.80	0
East Floodway	1.14	4
Babon River	66.00	289
Total	119.24	366

(3) Dam Construction

Negative Impact

Area of land acquisition and number of house evacuation for proposed dam sites are as follows:

Dam	Land Acquisition (ha)	House Evacuation (number)
Kedung Suren Dam	1,160	1,470
Mundingan Dam	315	470
Babon Dam	485	1,330
Total	1,960	3,270

Land acquisition for the construction of dams will cause negative impact, particularly, Kedung Suren Dam which needs as large as about 1,200 ha of land acquisition. The required land for acquisition covers forests in the proposed Kedung Suren and Babon reservoirs which are managed by the Forest Department, and village land also is required in three dams.

(4) Construction of Interbasin Transfer Facilities

Negative Impact

The intake weir is located downstream of the confluence of Blorong River and Tambangan River. There will not be a large area for land acquisition, because tunnel is adopted in the master plan study. Therefore, impact by land acquisition for the construction of interbasin transfer facilities is not expected.

(5) Improvement of Urban Drainage System

Negative Impact

Areas of land acquisition and number of house evacuation for proposed channels are as follows:

Channel	Land Acquisition (ha)	House Evacuation (number)
Siringin River	26.82	81
Tenggang River	18.90	158
Tenggang Floodway	16.43	0
Banger River	7.75	239
Bulu River	2.02	90
Ronggolawe River	2.87	100
Karangayu River	1.54	69
Tawang River	0	0
Silandak Channel	1.47	20
Total	77.80	757

Land acquisition for the project sites causes significant negative impact on proposed areas.

3.3.2 Construction Phase

Project components in the construction phase are as follows:

- Employment of laborers
- Mobilization of laborers
- Mobilization of construction materials
- Mobilization and operation of heavy equipment
- Land clearing
- Construction of temporary facilities or structures
- Road relocation
- Construction of diversion for dams
- Construction of dam and appurtenant structures
- Construction of tunnel type conveyance for interbasin transfer and appurtenant structures
- Construction of drainage facilities
- River dredging, excavation and widening
- Construction and improvement of dike
- Reconstruction of road and railway bridges
- Demobilization of heavy equipment
- Demobilization and demolition of temporary facilities or structures
- Demobilization of laborers

(1) Impacts Common to all Projects

Positive Impact

Implementation of any project will bring positive impacts such as increment of employment opportunity, increase of economic

activities around the construction sites and so on.

Negative Impact

The mobilization of construction materials and operation of heavy equipment will generate air pollutants such as CO, NO₂, and dust. It is expected that the above activities will cause air pollution and noise. Increase of traffic volume by the construction vehicles may cause public road damage and traffic disturbance.

(2) River Improvement

Negative Impact

Dredging work will cause river water turbidity that will bring adverse influence to aquatic biota, particularly, benthos at the downstream of the site. However, the area and duration is limited.

Furthermore, dredging work will bring about disposable materials. Therefore, spoil bank with enough capacity has to be prepared nearby the site.

Compaction equipment for embankment works will cause vibration at the site, and during the reconstruction of bridges road traffic will be disturbed by detours.

(3) Dam Construction

Negative Impact

The impact on terrestrial biological communities is expected to disappear due to cut-and-fill work and erosion by land clearing work.

Riverbed conditions will not be changed so much by the excavation because construction sites are protected by cofferdams. Therefore, aquatic biota particularly benthos at the downstream will not be affected.

(4) Construction of Interbasin Transfer Facilities

Negative Impact

Water conveyance tunnel is employed for the interbasin transfer. Major impacts by the structure are the excavated materials from the tunnel and the decline of groundwater during the construction works. The groundwater will recover after completion since the tunnel is lined with concrete.

(5) Improvement of Urban Drainage System

Negative Impact

Improvement of urban drainage system in the construction phase includes:

- Mobilization of construction materials and laborers
- Mobilization and operation of heavy equipment
- Construction of temporary facilities and structures

- Demolition of existing structures
- Construction of structures
- Demobilization of heavy equipment and laborers
- Demobilization and demolition of temporary facilities and structures

The above activities use heavy equipment and it is possible that construction activities will increase air pollution, noise level, vibration level and traffic jam. Since the construction sites are situated in densely populated areas, such impacts mentioned above will give adverse influence to residents nearby the sites.

During construction period of the urban drainage system, the construction of structures and operation of heavy equipment will occupy space around project sites. Consequently, construction activities will obstruct road transportation. Furthermore, traffic volume will increase because of conveyance of construction materials.

3.3.3 Post Construction Phase

Project components in the post construction phase are as follows:

- Reservoir impounding
- Reservoir operation
- Watershed management
- Operation and maintenance of flood control facilities
- Utilization of excavated material for land reclamation

(1) River improvement

Positive Impact

After completion of river improvement works, river water will flow smoothly during the rainy season and floodwaters can be controlled. In the dry season, river maintenance flow is assured and, consequently, the condition of river is improved. Infrastructures, life and property could be protected from floods. Furthermore, epidemics will remarkably decrease.

Negative Impact

In rivers whose river improvement are made by excavation of the existing high water channel, open space for residents will be inevitably reduced. Since the design riverbed follows the existing one, the condition of tidal water intrusion to rivers will not change so much.

(2) Dam Construction

Positive Impact

Dam construction will bring about effective flood control, public water supply, electric power generation and assurance of river maintenance flow. These effects will enhance people's life standard very much.

Negative Impact

After impounding water in the reservoir, impact on terrestrial biota is expected to disappear in reservoir areas.