JAPAN INTERNATIONAL COOPERATION AGENCY

DIRECTORATE GENERAL OF HUMAN SETTLEMENTS
MINISTRY OF PUBLIC WORKS
REPUBLIC OF INDONESIA

THE IDENTIFIED DESIGN
FOR
URBAN DRAINAGE PROJECT
IN
THE CITY OF JAKARTA

FINAL REPORT

VOLUME II

SUPPORTING REPORT

ANNEX-IV

No.10 Environmental Impact Assessment
No.11 Social Impact Management Plan

DECEMBER 1991

NIPPON KOEI CO., LTD.
TOKYO, JAPAN

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DIRECTORATE GENERAL OF HUMAN SETTLEMENTS
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The cost estimate is based on the price level of June 1997 and the monthly mean exchange rates in June 1997. The monthly mean exchange rates in June 1997 are:

US$ 1.00 = ¥ 115.00 = Rp. 2,350

ABBREVIATIONS

(1) Local Terms

BAKOSURTANAL	Badan Koordinasi Survei dan Penetaan Nasional	:National Mapping Agencies
BAPPENAS	Badan Perencanaan Pembangunan National	:National Planning and Development Board
BPS	Biro Pusat Statistic	:Central Bureau of Statistics
BINA MARGA		:Directorate General of Road Development
CIPTA KARYA		:Directorate General of Human Settlements
DGWRD		:Directorate General of Water Resources Development
DINAS TATA KOTA		:Department of City Planning, DKI Jakarta
DKI Jakarta	Daerah Khusus Ibukota Jakarta	:Special Region of Capital City Jakarta
DPMA	Direktorat Penyelidikan Masalah Air	:Directorate of Hydraulic Engineering
DPU	Departmen Pekerjaan Umum	:Ministry of Public Works
DPU DKI Jakarta	Dinas Pekerjaan Umum DKI Jakarta	:Department of Public Works, DKI Jakarta
DPUP	Dinas Pekerjaan Umum Propinsi	:Provincial Department Office of Public Works
JABOTABEK		:Jakarta-Bogor-Tangerang-Bekasi
JASA MARGA		:Indonesia Highway Corporation
Kabupaten		:Regency
Kecamatan		:Sub-district
Kelurahan		:District
Kotamadya		:Municipal City
PELITA	Pembangunan Lima Tahun	:Five-Year Development
PERUM PERUMNAS		:National Urban Development Corporation

PMG	Pusat Meteorogi dan Geofisika	:Meteorological and Geophysical Center
P.P.	Priok Pile	
P.T.	Perusahaan Terbatas	: Private Estate Enterprise (Company Ltd.)
PWSCC	Proyek Pengembangan Wilayah Sungai Ciliwung-Cisadene	: Ciliwung-Cisadane River Basin Development Project Office
RKL		:Environmental Management Program
RPL		:Environmental Monitoring Program
REPELITA	Rencana Pembangunan Lima Tahun	:Five-Year Development Plan
TTG.	Tanda Tinggi Geodesi	

(2)International or Foreign Organization

GOI	:Government of the Republic of Indonesia
GOJ	:Government of Japan
IBRD	:International Bank for Reconstruction and Development
JICA	:Japan International Cooperation Agency
OECF	:Overseas Economic Cooperation Fund

(3) Foreign Terms

EIRR	:Economic Internal Rate of Return
FIRR	:Financial Internal Rate of Return
GDP	:Gross Domestic Product
GNP	:Gross National Product
GRP	:Gross Regional Product
PMF	:Probable Maximum Flood
NPV	:Net Present Value
O&M	:Operation and Maintenance
IEI	:Initial Environmental Evaluation
B/Q	:Bill of Quantities
TOR	:Terms of Reference

B/C	:Box Culvert
CAD	:Computer-aided Design
EIA	:Environmental Impact Assessment
ICB	:International Competitive Bidding
LCB	:Local Competitive Bidding
JIS	:Japan Industrial Standards
ASTM	:American Society for Testing and Materials

(4) Numerical Units

Length

mm	millimeter
cm	centimeter
m	meter
km	kilometer

Area

mm^2	square millimeter
cm^2	square centimeter
m^2	square meter
km^2	square kilometer
ha	hectare

Volume

cm^3	cubic meter
m^3	cubic meter
Ltr	liter

Weight

gr	gram
kg	kilogram
ton	metric ton

Time

sec	second
min	minute
hr	hour
yr	year

Others

%	percent
℃	degree centigrade
10^3	thousand
10^6	million
10^5	billion

Money

Exchange Rate

Rp.	Indonesian Rupiah	Official rate as of June, 1997
¥	Japanese yen	US$ 1= Rp 2,350 = ¥ 115
US$	US dollar	

No. 10

Environmental Impact Assessment

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1 INTRODUCTION

1.1 Background of the Project

Jakarta, the capital of Republic of Indonesia, is undergoing through the process of rapid urbanization in recent years, resulting in an intense population growth that its population reached 4.6 million in 1975. In 1990 it had reached 8,259,600 million then to 9,341,400 at the end of 1996. This rapid growth is caused by many factors, such as the lack of thriving economy in the rural areas, high demand on urban labor and subsequent rapid urbanization and the development of urban infrastructures. Among others, the development of urban infrastructures such as the housing areas and the drainage system, including water supply system are not catching up the growth of population. Thus there are still seen in some locations that the local population is severely affected by flooding during the rainy seasons.

It has been estimated that the population of Jakarta in 2010 will reach 12.8 million. The Government of Indonesia has been making progress to overcome various problems unique to urban setting including the flooding problem in Jakarta and many projects have been accomplished to date. One of them was to prepare the Master Plan of Drainage and Flood Control for Jakarta in 1972. However, because of the rapid population growth and intensive urban development in Jakarta, the Master Plan needed to be revised thereafter. In response to this, Japan International Cooperation Agency (JICA) conducted the study on Urban Drainage and Wastewater Disposal of the City of Jakarta (hereinafter referred to as the "JICA Study") that was completed in 1991. As a consequence, as shown in the Fig 4, Cengkareng west area and Meruya Utara area (both of them hereinafter referred to as the "Project Area") has been selected as the area urgently required to conduct rehabilitation of urban drainage system due to the following reasons:

- The extent and the frequency of the flood damages are greater than the other areas in Jakarta
- The drainage requirement to meet future urban development is acutely necessary than the other areas in Jakarta
- The rate of progress of the urban development in the project area is rapid than the other areas in Jakarta
- The project area is already with very high population density; and
- The income level of residents in the project area is relatively low.

There are 12 habitual inundation areas within the project area as is shown in Fig1 in Cengkareng west area and in Meruya Utara area. They are counted for 273.4 ha, while total potential inundation area is 474.3 ha. Depth of habitual inundation area within the project area is estimated to be 20 to 50 cm and the duration of inundation is from 1 day to 7 days. For the potential inundation area, depth goes up to 30 - 60 cm and duration is from 1 day to 10 days.

In order to provide drainage system, various drainage channels within the project area have been suggested as shown in Fig 3. These drainage channels are compared to those of existing shown in Fig 2. The project area covers 4,700 ha including residential, commercial and industrial areas which will increase from 2,350 ha in 1990 to 3,525 ha in 2005. Population in the project area was 263,000 in 1988 and is expected to reach 456,000 in 2010, given the average annual growth rate of 2.53% per year.

As the implementation of drainage development project in the project area takes place, it may cause the impact to the environment. In accordance with the Government Regulation of the Republic of Indonesia No.51, Year 1993, Environmental impact analysis should be prepared for the project .

Based on the Decree of The Minister of State for the Environment of the Republic of Indonesia No. Kep. 11/MENLH/3/1994 regarding the "Types of Business or Activity which shall be completed with the Environmental Impact Assessment (AMDAL= Analisis Mengenai Dampak Lingkungan)", the design of urban drainage development in Cengkareng west area is subject to environmental impact analysis.

1.2 Basic Laws and Regulations

Laws and Regulations related to the study on Environmental Impact Assessment for the project are as follows:

(1) Government Act of the Republic of Indonesia No5 of the Year 1974 on the Regional Development Principles (Undang-Undang No.5 tahun 1974 mengenai Ketentuan-Ketentuan Pokok Pembangunan Daerah);

(2) Government Act of the Republic of Indonesia No 11 of the Year 1974 on the Public Water Supply/Irrigation Water (Undang-Undang No. 11 tahun 1974 mengenai Pemasokan Air Bersih/Air Irigasi);

(3) Government Act of the Republic of Indonesia No 4 of the Year 1982 on the Principles of the Management of Living Environment (Undang-Undang Lingkungan Hidup No. 4 tahun 1982 tentang Ketentuan-Ketentuan Pokok Pengelolaan Lingkungan Hidup);

(4) Government Act of the Republic of Indonesia No 22 of the Year 1982 on the Principles of Water Management (Undang-Undang No. 22 tahun1982 Mengenai Ketentuan-Ketentuan Pokok Pengelolaan Air);

(5) Government Act of the Republic of Indonesia No 5 of the Year 1990 on the Principles of the Conservation of Ecosystem and Natural Resources (Undang-Undang No. 5 tahun 1990 mengenai Ketentuan-Ketentuan Pokok dari Konversi Sumberdaya Alam Hayati dan Ekosistemnya);

(6) Government Act of the Republic of Indonesia No 24 of the Year 1992 on the Principles of the Management of Spatial Use (Undang-Undang No. 24 tahun 1992 mengenai Ketentuan-ketentuan Pokok Penetaan Ruang);

(7) Government Regulation No. 20 of the Year 1990 on the Control of Water Pollution (Peraturan Pemerintah No. 20 tahun 1990 tentang Pengendalian Pencemaran Air);

(8) Decree of the President of the Republic of Indonesia No.77 of the Year 1994 on the Environmental Impact Management Agency (Keputusan Presiden Republik Indonesis No. 77 tahun 1994 tentang Badan Pengendalian Dampak Lingkungan/BAPEDAL);

(9) Government Regulation No. 32 of the Year 1990 on the Management of Protected Area (Pereaturan Pemerintah No. 32 tahun 1990 tentang Pengelolaan Kawasan Lindung);

(10) Government Regulation No. 35 of the Year 1991 on the River Act (Peraturan Pemerintah No. 35 tentang Sungai);

(11) Government Regulation No. 44 of the Year 1993 on the Position, Basic Tasks, Function, Organizational Structure and Administration of Minister of State (Peraturan Pemerintah No. 44 tahun 1993 tentang Kedudukan, Tugas Pokok, Fungsi, Susunan Organisasi dan Tata Kerja Menteri Negara);

(12) Government Regulation No. 51 of the Year 1993 on Environmental Impact Assessment (Peraturan Pemerintah No. 51 tahun 1993 tentang Analisis Mengenai Dampak Lingkungan/AMDAL);

(13) Decree of the President of Indonesia No. 55 of the Year 1993 on the Land Established for the Development of Public Interest (Keputusan Presiden Republik Indonesia No. 55 tahun 1993 mengenai Tanah yang Ditetapkan untuk Pembangunan Kepentingan Umum);

(14) Decree of the Ministry of State for the Living Environment No. KEP-11/MENKLH/ 3/1994 on the Types of Business or Activities Required to Prepare an Environmental Impact Assessment (Keputusan Mentri Negara Lingkungan Hidup No. KEP-11/ MENKLH/3/1994 tentang Jenis Usaha atau Kegiatan Yang Wajib Dilengkapi dengan Analisis Mengenai Dampak Lingkungan/AMDAL);

(15) Decree of the Minister of State for the Living Environment No. KEP-12/MENKLH/ 3/1994 on the General Guidelines for Environmental Management Procedures and Environmental Monitoring Procedures (Keputusan Mentri Negara Lingkungan Hidup No. KEP-12/MENKLH/3/1994 tentang Pedoman Umum Upaya-Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan);

(16) Decree of the Minister of State for the Living Environment No. KEP-13/MENKLH/ 3/1994 on Guidelines for Membership and Working Procedures for EIA/AMDAL Commissions (Keputusan Mentri Negara Lingkungan Hidup No. KEP-13/MENKLH/ 3/1994 tentang Pedoman Susunan Petunjuk Keanggotaan dan Tata Kerja untuk Komisi AMDAL);

(17) Decree of the Minister of State for the Living Environment No. KEP-14/MENKLH/ 3/1994 on the General Guidelines for the Preparation of an Environmental Impact Assessment (Keputusan Mentri Negara Lingkungan Hidup No. KEP-14/MENKLH/ 3/1994 tentang Pedoman Umum Penyususnan Analisis Dampak Lingkungan);

(18) Decree of the Minister of State for the Living Environmental No. KEP-15/MENKLH/ 3/1994 on Establishment of an Environmental Impact Assessment Commission for Integrated Activities (Keputusan Mentri Negara Lingkungan Hidup No. KEP-15/ MENKLH/3/1994 tentang Pembentukan Komisis Analisis Mengenai Dampak Lingkungan Terpadu);

(19) Decree of the Minister of State for the Living Environmental No. KEP_056 of the Year 1994 on the Guidelines for the Determination of Significant Impacts (Keputusan Mentri Negara Lingkungan Hidup No. KEP-056 tahun 1994 tentang Pedoman Mengenai Ukuran Penting);

(20) Regulation of the Minister of Public Works No. 46/PRT/1990 on the Technical Guidance on Environmental Impact Assessment for Public Works (Peraturan Mentri Pekerjaan Umum No. 46/PRT/1990 tentang Pedoman Teknis AMDAL Proyek-Proyek Bidang Pekerjaan Umum);

(21) Decree of the Minister of Public Works No. 506/KPTS/1990 on the Guidance of the Method of Determination which Perfects and Completes in EIA for Public Works Study (Keputusan Mentri Pekerjaan Umum No. 506/KPTS/1990 tentang Petunjuk dari Metode Penentuan Menyempurnakan dan Melengkapi Analisis Mengenai Dampak Lingkungan "AMDAL" untuk Proyek Bidang Pekerjaan Umum);

(22) Decree of Minister of Public Works No. 779/KPTS/1990 on the Technical Guidance of Environmental Impact Assessment for Public Works Study Concerning the Use of Surface Water (Keputusan Mentri Pekerjaan Umum No. 779/KPTS/1990 tentang Petunjuk Teknis Analisis Mengenai Dampak Lingkungan untuk Bidang Pekerjaan Umum mengenai Penggunaan Air Permukaan);

(23) Regulation of Minister of Public Works No. 63/PRT/1993 on the Boundary of River Limit, Benefit Area of River and the Authorized Area of River (Peratutan Mentri Pekerjaan Umum No. 63/PRT/1993 tentang Batas Sungai, Daerah Manfaat Sungai, dan Daerah Kekuasaan Sungai);

(24) Other Regulations of National, Regional, and Local Level relevant to EIA (Peraturan Tingkat Nasional, Tingkat Propinsi dan Tingkat Kabupaten/Walikota mengenai AMDAL).

1.3 Purpose of the Use and the Objectives of Environmental Impact Assessment (EIA)

1.3.1 Use of EIA

The use of EIA is to assess present environmental profile of the project area and analyze impacts to the environment induced by the construction works of the project whose purpose is to protect local residents and their economic activities of Cengkareng west area and Meruya Utara area from the damages caused by flood events.

1.3.2 Objectives of EIA study

The objectives of EIA Study are as follows:

- To control habitual floods;
- To minimize damages caused by habitual floods;
- To minimize public health hazard induced by flood water;
- To minimize the direct damages to the public transportation system and indirect damages associated with it causing severe disruption to the general economic activities of the City of Jakarta; and
- To make best possible use of the area in relation to urban development upon completion of the project ; and
- To make best possible use of the project facilities for the subsequent urban development works.

1.4 Scope of EIA Study

1.4.1 Boundaries of project area

(1) Administrative boundaries

The administrative boundaries of EIA Study are determined by the administrative areas potentially affected by the project components. In this respect, the project area is within the administrative boundaries of DKI Jakarta.

(2) Boundaries of ecological area

Ecological boundaries of the area subject to EIA Study are defined generally as the area of ecological continuity. However, the ecological continuity of the project area has been lost to the extensive urban development of the project area and a few patches of agro-ecological areas. Thus the project area should be considered as an integrated sub-ecological area of which urban and agro-ecological areas are created within the ecological entity in the limited area within the western part of Java Island.

Since the project area includes the mouth of the Tanjungan and Kamal drainage channels, the area within Jakarta Bay should also be set out as a part of ecological area. Depending on the engineering requirement and the future reclamation plan intended to conduct in the coastal area of North Jakarta (Jakarta Utara), a radius of 1,500 m from the mouth of these drainage channels should be set out as part of ecological boundary subject to EIA Study within the framework of the study.

(3) Project boundaries

Boundaries of the project area that consists of the sites of project activities are essentially the catchment area of the drainage basins. In relation to the administrative boundaries, and ecological boundaries, the project boundaries are described as follows:

- The boundary between DKI Jakarta and Tangerang to the west,
- Mookervart canal to the south,
- Cengkareng floodway to the east,
- Java Sea to the north, and
- Maruya Utara area to the south of Main Project area, which is a separate area within the framework of the project .

(4) Technical boundaries

Technical boundaries of the project area are determined according to the factors affecting the performance of EIA Study such as the available amount of budget, length of study period and the availability and the capacity of qualified study team members as well as the degree of difficulty of the accessibility to the project area. These factors that restrict the best possible performance of EIA should be considered in relation to the above three categories of boundary.

As a result, the project area is a relatively small portion of very high population density urban area within DKI Jakarta. The area encompassed by the ecological boundaries of the project area is identical to the administrative boundaries of the project area and the area is accessible by all means. It is therefore essential to determine that the ecological boundaries on land areas and those extended to the Jakarta Bay from the mouth of the drainage channels should be determined as the technical boundaries subject to study for EIA Study as shown in Fig 4.

1.4.2 Main issues of the project area

(1) Inundation areas

a. There are 12 habitual inundation areas within the project area and they are counted for 273.40 ha, while potential inundation area is 474.3 ha. Depth of habitual inundation area in the project area was estimated to be 20 to 50 cm and the duration is from 1 day to 7 days. For the potential inundation area, depth goes up to 30 - 60 cm and duration is from 1 day to 10 days.

b. Total flood damages made in 1988 was estimated at Rp.1,262 million. It is expected to increase to Rp.7,085 million in 2010 if no drainage system was developed in the project area. Direct damages to the private property are accounted for approximately 80 % of the total flood damages.

(2) Expected environmental impact

a. Social impact in relation to the land acquisition and subsequent relocation of a large number of local residents with land certificate for the construction works of the drainage channels is very significant and the most severe among others.

b. Social impact on dust and noise emanated from the construction works should hamper the daily life of general public during the construction period.

c. Social impact on the removal of squatters, depending on the way and the area(s) they are relocated to, is very significant.

d. Involuntary changes of occupation of the local residents within the project area upon relocation should occur as they resettle in the areas away from their present residential areas.
e. Limited area of mangrove growth is replaced by the drainage channels at the mouth of the Kamal and Tanjungan drainage channels.
f. Limited area of river morphology and subsequent natural drainage is changed as a result of the construction works of the project .
g. Limited changes on land use of the project area should take place upon completion of the project .

1.4.3 Project activities affecting environmental components

The project activities affecting the environmental components are subdivided into four stages of pre-construction, construction preparation, construction implementation and post-construction period.

(1) Pre-construction period
a. Topographical survey and soil investigation works.
b. Design of the project components including the alignment and the dimension of channels.
c. Land acquisition and compensation.
d. Relocation of the population.

(2) Construction preparation period
a. Mobilization of construction equipment.
b. Construction of storage areas for construction materials.
c. Construction of access road.
d. Mobilization of manpower.
e. Preparation of supporting facilities for the construction works.
f. Land clearing and demolition of existing buildings.

(3) Construction implementation period
a. Excavation works of the rivers and drainage channels.
b. Construction works of dikes and its associated structures.
c. Construction and reconstruction of bridges.
d. Diversion of the existing road for construction of bridges or culverts.

(4) Post-construction period

a. Draining flood water and sewage.
b. Operation and maintenance of structures and facilities.
c. Making use of inspection road.
d. Monitoring of living conditions of the local residents within the project area including water quality, dust and noise, etc.

1.4.4 Environmental components affected by the project

(1) Physico-chemical environment

(a) Climate

Following components of the climate in the project area are subject to investigation:

- Mean temperatures (maximum, minimum, and average per month)
- Relative humidity (maximum, minimum, and average per month)
- Rainfall (maximum, minimum, and average per month), and
- Wind conditions (directions and velocity that prevail)

(b) Air quality and noise

(i) Air quality

Investigation should be conducted on the present conditions of air quality based on the data obtained during the period of EIA Study by comparing the data with the air quality standard being adapted by DKI Jakarta or the Central Government of Indonesia, whichever is strict. The data also should be used for comparison with the data that would be obtained during the construction period and analysis should be made if there is any effect on the general public.

(ii) Noise

Investigation should be conducted on the present conditions of noise based on the data obtained during the period of EIA Study and comparison should be made for the data with the standard being adapted by DKI Jakarta or the Central Government of Indonesia, whichever is strict. The data also should be used for comparison with the data that would be obtained during the construction period and analysis should be made if there is any effect on the general public. Audiometers that give values in decibels should be used for obtaining data.

(c) Hydrology

Examination should be conducted on the flow characteristics of the rivers and any other permanent water bodies in the project area including quantity, quality, physical characteristics of the rivers, present use of water, and effect of tide water intrusion.

Investigation on the water quality should be conducted to analyze physical, chemical and micro-biological characteristics, including temperatures, sedimentation, suspended solid, DO, BOD, COD, and other parameters related to the public use of the river and coastal water within the project area.

(d) Physiography

Investigation on geography, morphology, geology, topography, and characteristics and types of soil in the project area should be conducted including map study, in relation to land use patterns associated with soil distribution for characterization of the existing physiographic environment.

Investigation on the designated spoil bank(s) for disposal of excavated materials should also be conducted. Evaluation should be made for possible changes on the topography, soil components and the patterns of land use in the spoil bank area and its effect will be analyzed.

(2) Biological environment

(a) Flora

Inventory survey should be made for protected, endangered or threatened plant species identified within the project area, various vegetation communities found in the project area both in the natural environment, the environment developed by the composition and structures of human activities including agro-ecological areas. Source of food supply and habitat for wildlife, especially those for water fowls on the coastal areas as well as those in the wet land areas within the project area should be identified.

(b) Fauna

Inventory survey should be made for the estimated range, migration patterns, and population and density of wildlife, especially those of migrating birds, which are considered important because of their economic, ecological and aesthetic values, or the value for tourism including the study if there are protected insects and their habitat.

(c) Important ecological area and conservation area

There is an area of 15.4 ha reserved for Muara Angke Natural Reserve at the estuary of Angke river, 3 km east of the project area. Investigation should be made if the area is affected during the construction period and upon completion of the project .

There is an area of 12.7 ha reserved for Angke - Kapuk Protection Forest in the area and the Tanjungan drainage channel is constructed in this place where the mangrove plantation area is located. Investigation should be made to clarify environmental impacts induced by the project .

(d) Aquatic biota

Inventory survey should be made for aquatic life of economic and/or scientific values in the areas around the estuary of Tanjungan and Kamal drainage channels as well as in the coastal area between Kamal drainage channel and Angke river and in fish catch in the fishing area within the technical boundaries and evaluation should be made if they are affected by the project .

(3) Socio-economic environment

(a) Demographic characteristic

Number of population and its density, age distribution, occupation, social aspect of the population such as the level of education, and the characteristic of urbanization in the project area should be examined as it will have to reflect the way when the drainage system is developed. Interview should be made for local residents subject to formal resettlement scheme and their population characteristics should be presented in order to aid the decision making for preparation of resettlement area.

(b) Public health

General conditions of the present sanitary development in the project area including existing public health facilities and the top 10 diseases prevailing in the project area should be identified, especially water borne diseases. Potential sanitary development, or existing plan, within the project area upon completion of the study should be evaluated.

(c) Economic activities

Examination should be made for types of occupation, income level, major products, level of technology the population has attained, land tenure system, and other characteristics relevant to the economic activities such as a flow of materials and commercial goods for manufacturing for commercial activities and for daily necessities of the residents living within the project area.

Investigation should be made for fish catch of the fishermen living in the area along Kamal drainage channel, their fishing ground, and those engaged in aquaculture or any occupations related to the use of water or salt water within the coastal area and other environmental resources in the north of the project area.

(d) Land use patterns

General patterns of land use should be examined in relation to the economic activities of the project area. Investigation should be made for also zoning system of DKI Jakarta. Its land use policy within the project area upon completion of the study is as follows:

- Investigate regional development planning, spatial use planning, land use planning, and other natural resource or land use plans within the project area.
- Evaluate environmental components in terms of comparative cost-benefit analysis i.e. with and without the study.

(e) Cultural and religious activities

Examination should be made for components of the local traditional customs and religion or any other cultural area associated with the local traditions as follows :

- Cemetery or any areas of social, cultural and religious values;
- Events with which a group of people or communities interact with land area(s);
- Facilities important to the local life style in terms of archaeology, aesthetic, tourism and recreation for the local, national and international level.

(f) Resettlement of the local residents with land certificate

Survey should be made for perspectives of the local residents on resettlement, their desirable relocation areas and the method of resettlement based on the data obtained during the interview with the local residents subject to relocation including definition of basic policy for resettlement of the local residents whether it is made in monetary compensation or the land-to-land exchange. Investigation should be made for the existing legal frameworks that define the policy including identification of the organization, institution or agency responsible for the entire resettlement operation.

Total number of families legally possessing, leasing or renting properties within the project area should be identified and that they are entitled to compensation for resettlement within the framework of the project .

(g) Relocation of squatters

Investigation should be made for possibilities on the policy and method of relocation of the squatters based on the data obtained during the interview survey including identification of responsible government organization, institute or agency for relocation of the squatters. Estimation of the total cost of relocation should be made based on the policy and method of relocation determined within the framework of EIA Study.

(h) Infrastructure and public facilities in the resettlement area

Examination should be made for general condition on the development of public utilities such as electricity, telephone, road, railway, supply of clean water and etc.

1.5 Identification of the Initiator of the Project and the Consultant for EIA Study

1.5.1 Identification of the initiator of EIA study

Authorizer : Project Manager of Urban Drainage Jakarta
Address : Proyek Drainase Perkotaan Jakarta
Dinas Pekerjaan Umum, DKI Jakarta
Jalan Taman Jatibaru No.1
Jakarta Pusat Tel. (021) 385-4229

1.5.2 Identification of the consultant of EIA study

Authorizer : Ir. Moeljadi Sasrasoebrata
Address : PT AMYTHAS Expert & Associates
Jalan Kemang Raya No. 17 A
Jakarta Selatan
Tel. (021) 719-4704

The composition of consultant for EIA Study on the Detailed Design For Urban Drainage Project in the City of Jakarta is as follows:

No.	Field of Study		Expertise
1	Team Leader	:	Ir. Sabarman Ranudiwiryo Msi
2	Sociologist/Socio-economist	:	Drs. Slamet Prayitno
3	Public Health Specialist	:	Drs. Mosmodiono Msi

4	Hydrologist	:	Ir. Puntarawan, Ces
5	Biologist	:	Drs. NA. Syakrie
6	Resettlement Expert	:	Ir. Malonda C Panjaitan
7	Environmentalist	:	Ir. Ratnaniengsih

2 METHODOLOGY OF EIA

2.1. Approach of EIA Study

The approach used in executing the EIA Study is as follows:

- To make use of the overall information of the plan of project activity
- To collect information on the existing environment
- To analyze the environment affected by the project activity; and
- To consult valid regulations related to protection of the natural and socio-economical environment.

The data from the survey in the field as primary data, and the secondary data are used to identify and analyze impacts induced by the project activities. Thereby main issues will be highlighted. These result will then be classified to estimate their extent, intensity, duration, the level of significance based on conventional method of classification. Further, based on these classified impacts, holistic evaluation of the project activity as a whole is made. Thus the result of the evaluation will be made use of as the basis of determination for the alternatives of project activity, and environmental management plan.

2.2 Method of Data Collection

2.2.1 Primary data collection

Primary data collection is a method to obtain data directly from the field by the EIA Study team through the observation, field survey and measurement including interview survey for those subject to relocation using questionnaire specifically developed for the project. Primary data collection should cover:

(1) Physico-chemical environment

Field observation for physiographical feature is conducted. For air quality, noise and water quality, electro-mechanical devices will be used to sample and/or measure their level of quality at selected sampling locations within the project area.

(2) Biological environment

General transaction covering whole of the project area for fauna and flora including aquatic life will be conducted. If necessary, sampling of plant and fish species is conducted. Plankton and benthos are investigated at the same place as sampling for water quality is conducted.

(3) Socio-economic environment

As per attached, questionnaire for interview survey on the households subject to relocation and the squatters will be conducted for obtaining primary data. General field observation will be conducted in order to obtain primary data on land use, aesthetic value of the project area, and the area(s) of scientific, religious and cultural values.

2.2.2 Secondary data collection

Any sources of available secondary data on physico-chemical, biological and socio-economic environment should be collected from the reports on the project of similar nature or those of conducted or being conducted in and around the project area as well as from the published documents and books including topographical maps and land use maps as well as the aerial photographs.

2.3 Method of Data Analysis

2.3.1 Physico-chemical environment

(1) Climate

The climate data collected from Cengkareng Observation Station of the Department of Meteorology and Geophysics should cover rainfall, temperature, humidity, direction and velocity of wind.

(2) Topography

Terrain in the project area is so flat that the measurement of slope gradient will not be conducted. Present water pass and available 1:5,000 topographic map will be the major source of information for the analysis of topography of the project area.

(3) Geology

Collection of primary data on geological investigation conducted separately by the engineering section of the study team should cover most of the geological information. Field observation would also conducted to help analyze the data.

(4) Hydrology

The analysis and data processing of hydrology should cover the average and maximum discharge of the drainage channels in the project area. Measuring of the area of cross section and average velocity of the drainage channels will be conducted. Formula used to count the discharge of the water in the river is as follows:

$$Q = F \times V$$

where :

Q = Discharge of river in m^3/sec (calculated)

V = Average velocity of river in m/sec (measured)

F = Area of average cross section of river in m^2 (measured)

while:

$$F = B \times h$$

where:

F = Area of average cross section of river in m^2 (measured)

B = Average width of water surface in linear meter (measured)

h = Average depth of water in the river in linear meter (measured)

(5) Air quality and noise level

(a) Air quality

Sampling locations identified for air quality is shown in Fig 6. Parameters to be monitored are as follows:

- Total Suspended Solid Particles (TSSP, $\mu g/m^3$)
- Nitrogen Dioxides (No_x, $\mu g/m^3$)
- Carbon Monoxide (CO, ppm)
- Hydrocarbons (HC, ppm)
- Sulfur Oxides (So_x, $\mu g/m^3$)
- Lead (Pb, $\mu g/m^3 \mu g/m^3$)

Based on the obtained data, each value is compared to the standard of air quality being adapted in DKI Jakarta.

(b) Noise level

Measuring noise level in decibels (dB) at the selected locations as shown in Fig 6 is conducted. Obtained data is used as reference data during the construction period as noises is generated from each construction machinery. Thus comparison and analysis of the results could be conducted. The result is also compared with the standardized maximum values of the noise being adopted by DKI Jakarta.

(6) Water quality

Sampling locations for water quality is shown in Fig 6. Parameters to be measured are as follows:

- Total Suspended Solids (TSS)
- Dissolved Oxygen (DO)
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- pH (pH)
- Other chemical parameters as per the Standard of Water Quality being adapted to use in DKI Jakarta.

Based on the obtained data, each value is compared to the standard of water quality being adapted by DKI Jakarta.

2.3.2 Biological environment

(1) Flora

Where necessary, sampling of flora will be conducted. As stated before, environmental conditions of the project area is highly urbanized and the natural environment has been replaced by patches of agro-ecological areas. Thus extent of field observation would be limited to urban and agro-ecology in most area within the project area. However, there are some mangrove forest on the coastal area of the project area. Obtained data are evaluated based on the value index system.

(2) Fauna

Limited to field observation and interview survey as well as the analysis on the secondary data showing the species prevailing in the project area. Evaluation is conducted based on the "present" and "not present" value system.

(3) Important ecological area and conservation area

Limited to secondary data analysis is conducted to Muara Angke Nature Reserve which is outside of the project area.

Limited to secondary data analysis will be conducted to the area of the "Protected Forest of Angke - Kapuk" for mangrove protection area around the mouth of Tanjungan drainage channel. However, field observation will be conducted to ascertain secondary data on the protection area.

(4) Aquatic biota

Fish species are analyzed based on the existing secondary data. Sampling will be conducted as water quality sampling is conducted for plankton and benthos that are analyzed based on the value of individual numbers contained per unit volume of water.

2.3.3 Socio-economic environment

(1) Demographic characteristics

Based on the existing census data, general characteristics of the existing population in the project area will be analyzed.

(2) Public health

Based on the existing published data, general characteristics of the public health conditions within the project area will be analyzed.

(3) Economic activities

General economic activities are observed on site and the result will be analyzed in relation to the existing secondary data.

(4) Land use patterns

Existing land use map will be used as the basis of land use analysis.

(5) Scientific, cultural and religious areas

Existing secondary data, interview survey and field observation would be integrated for the analysis of scientifically culturally and religiously important areas.

(6) Resettlement of local residents with land certificate

Based on the interview survey using questionnaire as per attached, tabulation of the result of interview survey will be conducted to produce basis of the analysis of general characteristics of the local residents subject to relocation.

(7) Relocation of squatters

Based on the interview survey using questionnaire conducted at the same time for the interview survey of the local residents with land certificate, tabulation of the result will be conducted to produce the basis of analysis of general characteristics of the squatters subject to relocation.

(8) Infrastructure and public facilities for the resettlement areas

Based on the existing secondary data, including government regulations, necessary infrastructure and public facilities for the resettlement areas will be analyzed.

2.4 Method of Identification of the Impact

Based on the identified project activities and the present environmental conditions, interaction matrix method is used to identify the impacts.

2.5 Method of Prediction of the Significant Impact

Identified changes of environmental quality in relation to the implementation of the project activities would be analyzed for prediction of significant impact. Where the extent of the changes of environmental quality require follow-up mitigation measures, environmental management plan is formulated.

Extent of impacts will be identified by comparing the actual environmental quality with the projected quality of finished drainage development activity. Various approaches dealt with in order to analyze the extent of impact as follows:

- Conventional method;
- Mathematical model;
- Non-conventional method;
- Analogy; and
- Judgment by experienced experts

Determination of significant impact predicted to occur with the project activities within the project area will be conducted by using the BAPEDAL guidance of significant impact prediction, Ministerial Decree of the Environment and Population, No. 49/MENKLH/6/1987.

2.6 Method of Evaluation of the Impact

Evaluation of environmental impact is a holistic system of analysis for the environmental components predicted to be affected by the project activities. In relation to the Ministerial Decree of the Environment and Population, No. 49/MENKLH/ 6/1987, it depicts as follows:

- Number of people affected;
- Extent of affected area;
- Duration of the impact;
- Intensity of the impact;
- Number of other environments components affected;
- Cumulative nature of impact; and
- Reversibility or irreversibility of the impact.

Evaluation of the environmental impact is to determine overall quality of the environmental components that are significantly affected by the project activities.

2.7 Method of Formulation of the Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL)

In order to minimize significant impacts predicted to take place as a result of the implementation of the project, the following approaches are employed to formulate Environmental Management Plan and Environmental Monitoring Plan.

- Technical approach
- Social- economical approach, and
- Institutional approach.

It is obvious that relocation of the local residents with land certificate and the squatters is the major part of environmental management plan and it is separately dealt with as "Social Impact Management Plan".

2.7.1 Environmental management plan (RKL)

Based on the identified impacts and the result of their evaluation derived from the EIA Study, Environmental Management Plan is formulated where necessary. The following is the items of description that form Environmental Management Plan:

- Type of important impact;
- Source of important impact;
- Level of impact;
- Objective of environmental management;
- Effects of environmental management;
- Location, method and period of conducting environment management measures; and
- Institution of environmental management consisting of executioner, supervisor, and receiver of the environmental management report.

2.7.2 Method of formulating environmental monitoring plan (RPL)

Based on the identified impacts and the result of their evaluation derived from the EIA Study, Environmental Monitoring Plan is formulated where necessary so as to provide information for the follow-up actions, or the information necessary for the Environmental Management Plan. Environmental Monitoring Plan is also necessary to conduct if the known present knowledge do not suffice to conduct Environmental Management Plan. Following is the items of description that form Environmental Monitoring Plan:

- Type of important impact;
- Source of important impact;
- Reasons and the parameter of environment necessary to monitor;
- Objective of environmental monitoring;
- Method and procedure of environmental monitoring;
- Location, duration and frequency of environment monitoring; and
- Institution conducting environmental monitoring consisting of executioner, supervisor, and receiver of environmental monitoring report.

3 COMPONENTS OF PROJECT ACTIVITY

3.1 Background of the Project

There have been a lot of efforts made by the Government of Indonesia in order to overcome the flood events in DKI Jakarta. One of their efforts was to prepare the Master Plan of the Drainage and Flood Control for Jakarta in 1972. Because of ever growing population and the rapid urban development in Jakarta, the Master Plan of the Drainage and Flood Control for Jakarta in 1972 needed to be revised and the Directorate General of Human Settlements of the Department of Public Works made a request to the Government of Japan for the up-dated detailed study. In response to this, Japan International Cooperation Agency (JICA) conducted the Study that was completed in 1991. As a consequence, from this revision of the Master Plan, Cengkareng west area and Meruya Utara area has been selected as the area urgently required to conduct urban drainage system due to the following reasons:

- The extent and the frequency of the flood damages are greater than the other areas;
- The drainage requirement to meet future land development is necessary than the other areas;
- The progress rate of urban development is rapid than the other areas;
- The area is already with very high population density; and
- The income level of residents in the project area is relatively low.

There are 12 habitual inundation areas within the project area as shown in Fig 1 and they are counted for 273.40 ha, while potential inundation area is 474.3 ha. Depth of habitual inundation area in the project area is estimated to be 20 to 50 cm and the duration is from 1 day to 7 days. For the potential inundation area, depth goes up to 30 - 60 cm and duration is from 1 day to 10 days. To alleviate the flood events, therefore, a series of drainage channel construction works have been suggested as shown in Fig 3.

3.2 Use and Objectives of the Project

3.2.1 Use of the project

The use of Project is to alleviate flood events by constructing adequate urban drainage system which may protect the Cengkareng west area and Maruya Ilir area from the damages caused by flooding. Thereby disruption on the economic activities of the general

public is refrained from occurring and the standard of living in the project area is maintained moderate, and the damages to the properties of the local residents by flooding is abstained.

3.2.2 Objectives of the project

The objectives of project are as follows :

- To control habitual floods
- To minimize damages caused by habitual floods
- To minimize public health hazard induced by flood water
- To minimize the direct damages to the public transportation system and the indirect damages associated with it causing severe disruption to the general economic activities of the City of Jakarta, and
- To make best possible use of the project area in relation to urban development scheme upon completion of the project, and
- To make best possible use of the project as drainage channel construction works for the subsequent urban development works.

3.3 Schedule of the Implementation of the Project

3.3.1 Schedule of activity

The schedule of activity for each project component is as follows :

- Detailed design of this project will be finished in October 1998;
- Agreement of financing from the donor is started in the beginning of December 1997. Process of completing the agreement takes up to the beginning of December 1998;
- Land acquisition and resettlement procedure should start in the middle of, or at the end of 1998;
- Tender procedure takes place from the middle of 1998 to the middle of 2000.
- Construction works of drainage channels including the construction of access road, inspection road, foot and vehicular bridges, and other necessary structures will start in the middle of 2000;
- Completion of the project is expected in the middle of December 2003.

3.3.2 Outline of drainage development works

(1) Construction area and excavation works

(a) Kamal drainage channel:

(i) Kamal drainage channel (main);

Volume of soil excavation	:	222,000 m^3
Required land area for drainage channel	:	1,411,738 m^2
Land area of building facilities	:	944,472 m^2
Area of existing facilities	:	370,303 m^2

(ii) Kamal drainage channel (branch);

Volume of soil excavation	:	45,000 m^3
Required land area for drainage channel	:	89,054 m^2
Land area of building facilities	:	57,956 m^2
Area of existing facilities	:	25,083 m^2

(b) Tanjungan drainage channel:

Volume of soil excavation	:	51,000 m^3
Required land area for drainage channel	:	439,380 m^2
Land area of building facilities	:	391,282 m^2
Area of existing facilities	:	11,230 m^2

(c) Saluran Cengkareng drainage channel:

Volume of soil excavation	:	83,000 m^3
Required land area for drainage channel	:	431,581 m^2
Land area of building facilities	:	228,877 m^2
Area of existing facilities	:	32,760 m^2

(d) Gede/Bor drainage channel:

Volume of soil excavation	:	29,000 m^3
Required land area for drainage channel	:	231,581 m^2
Land area of building facilities	:	78,877 m^2
Area of existing facilities	:	32,760 m^2

(e) Maruya Ilir Area and its surroundings:

Volume of soil excavation	:	83,000 m^3
Required land area for drainage channel	:	34,530 m^2
Land area of building facilities	:	34,530 m^2
Area of existing facilities	:	68 m^2

(2) List of project components

(a) Improvement of existing drainage system of 13.08 km consisting of:

- Kamal drainage channel : 4.45 km
- Tanjungan drainage channel : 0.90 km
- Saluran Cengkareng drainage channel : 4.23 km
- Meruya Area : 1.20 km
- Gede/Bor drainage channel : 2.30 km

(b) Construction of new drainage system of 6.28 km consisting of:

- Kamal drainage channel : 2.77 km
- Tanjungan drainage channel : 1.64 km
- PIK Junction drainage channel : 0.77 km
- Meruya Area : 1.10 km

(c) Concrete ditch and culvert in Meruya area of 2.8 km.

(d) Revetment of 13.52 km consisting of :

- Kamal drainage channel : 6.68 km
- Tanjungan drainage channel : 0.35 km
- Saluran Cengkareng drainage channel : 4.19 km
- Gede/Bor drainage channel : 2.30 km

(e) Improvement of existing bridges consisting of:

(a) Vehicular Bridge

- Kamal drainage channel : 13 Bridges
- Saluran Cengkareng drainage channel : 12 Bridges

(ii) Foot bridge

- Kamal drainage channel : 16 Bridges

(f) Construction of new bridges consisting of :

- Kamal drainage channel : 14 Bridges
- Tanjungan drainage channel : 13 Bridges
- PIK Junction drainage channel : 1 Bridge

(g) Intersection with motor way consisting of:

- Kamal drainage channel : 1 section
- Tanjungan drainage channel : 1 section
- PIK Junction drainage channel : 1 section

(h) Improvement of 1 sluice gate at the exit of Saluran Cengkareng drainage channel

(i) Acquisition of land of 37.9 ha consisting of:
- Kamal drainage channel : 20.8 ha
- Tanjungan drainage channel : 9.4 ha
- Saluran Cengkareng drainage channel : 5.6 ha
- PIK Junction drainage channel : 0 ha
- Gede/Bor drainage channel : 0.6 ha
- Meruya drainage channel : 0.5 ha

(j) Resettlement of residents with land status
- Kamal drainage channel : 155 families
- Tanjungan drainage channel : 41 families
- Saluran Cengkareng drainage channel : 1 families
- PIK Junction drainage channel : 0 families
- Gede/Bor drainage channel : 0 families
- Meruya drainage channel : 4 families

(k) Resettlement of squatters along:
- Kamal drainage channel : 967 families
- Tanjungan drainage channel : 10 families
- PIK Junction drainage channel : 0 families
- Saluran Cengkareng drainage channel : 351 families
- Gede/Bor drainage channel : 115 families
- Meruya drainage channel : 4 families

(l) Relocation of factories, school, mosques and others along:
- Kamal drainage channel : 39 places
- Tanjungan drainage channel : 3 places
- PIK Junction drainage channel : 0 places
- Saluran Cengkareng drainage channel : 7 places
- Gede/Bor drainage channel : 13 places
- Meruya drainage channel : 0 places

(3) Schedule of implementation

Implementation of drainage construction works is divided into four stages as follows:

(a) Pre-construction period;

This period of activities will mainly induce psychological unrest among the general public living along the drainage channels as:

- Survey for determination of channel alignment is conducted
- Area of land acquisition is surveyed, and
- The resettlement is arranged.

(b) Construction preparation period;

This period of activities will affect most of the living conditions on site as the following works are conducted:

- Mobilization of materials and construction equipment is conducted
- Mobilization of manpower is conducted
- Construction and operation of construction workers' camp and storage areas conducted
- Operation of borrow area is established

(c) Construction implementation period;

This period of activities will affect most of the local living conditions as well as the traffic within the project area as the following works are conducted:

- Excavation and dredging works as well as hauling of excavated materials conducted
- Construction of dike and other structural works area conducted
- Construction of bridges and improvement of vehicular bridges and foot bridges are conducted
- Construction of sluice gate and revetment is conducted.

(d) Post-construction period;

In this period, the operation and maintenance work may affect local environment such as:

- Operation and maintenance of structures; and
- Making use of inspection road for public use.

4 ENVIRONMENTAL PROFILE OF THE STUDY AREA

4.1. Physico-chemical Environment

4.1.1 Climate, air quality and noise level

(1) Rainfall

As shown in Table 1, monthly rainfall data collection started from 1986 up to 1995 have been obtained from Cengkareng Weather Observation Station. There have been maximum rainfall of 2,171 mm and minimum rainfall of 1,069 mm during the past ten years.

(2) Temperature, humidity, direction and velocity of wind

As shown in Tables 2 to 5, the climatic patterns of the project area is classified as tropical climate with average maximum temperature of 35.2 ^{0}C and average minimum temperature of 17.4 ^{0}C from the Year 1986 to the Year 1995. The average minimum and maximum humidity from the Year 1986 to the Year 1995 are between 75 % and 96 %. The average minimum and maximum velocity of wind are recorded as 18 knot and 52 knot from the Year 1986 to the Year1995. Prevailing wind direction is NW to NWN.

(3) Air quality

Present air quality in the study area have been investigated and the result is shown in Table 8. In some places, level of dust contained in the air is very high. Level of lead (Pb) at all locations of measurement was relatively high.

(4) Noise

Present noise level in the study area is shown in Table 9. Except in Meruya Utara area, level of noise measured in Cengkareng Barat areas is relatively high.

4.1.2 Physiography

The topographical conditions of the study area is generally flat and the slope is between 0^0 and 8^0. The project area is a part in the swamp area located on the coast of Java Sea to the north. The area is often flooded during the rainy season, especially on the low land areas. The lithology of the study area consists of weathered volcanic rock, shale, clay and sand loose.

Topography of the project area is the elevation of approximately 2 - 8 m from the sea level with flat relief which consist of the remnant of coastal alluvial basin. The difference in elevation is than 8 m. This condition causes the area to be influenced by tidal water throughout the year.

4.1.3 Hydrology

In the observation of hydrological conditions, generally flat topography causes stagnant water from the beginning to the mouth of drainage channels. Foot and vehicular bridges with their clearance to the water surface generally very small and that they cause further stagnation of water. As a result, transportation of suspended solid and other material in and out of the study area does not take place. Thus water quality in the drainage channels is generally very low. Table 6 shows water quality of various sampling locations within the study area. The result is compared to Table 7 Standard of River Water Quality in DKI Jakarta and Fig 8 shows water sampling locations.

4.2 Biological Environment

4.2.1 Biological conditions of the waters in the project area

At is generally known that addition of chemicals, domestic waste water, industrial discharge/urban waste and other pollutants to the river will affect water organism's life. Thus biological aspect together with the chemical and physical aspects of the water in the river will illustrate the conditions of the water quality.

Each kind of water organism has a different ability to adapt to the condition of water. Very high degree of pollution in the water should cause the death or diminish of the population growth of one or many types of organisms. On the other hand, polluted water will encourage growth of other kinds of organism. Organism which can withstand and grow in certain degree of pollution is called "indicator organism" or "biological indicator"

Polluted water contains normally limited species of biological organism with each organism's population very large. Based on this, "index diversity" of organism in the water is to illustrate the changes of community structure and the pollution rate of water.

4.2.2 Plankton and benthos

(1) Kamal drainage channel

The Kamal drainage channel, including main stream and its branch, is a drainage for Tegal Alur in Jakarta Barat and Kamal Muara in Jakarta Utara. These drainage channels go through densely populated areas mixed, with some industry in the midstream and a dense settlement, ponds, and the fishing village of the downstream areas.

Based on the field survey, a list of water organisms is shown in Tables 10 and 11 for Sampling Locations. Sampling Location ST-G is located in the upstream of the Kamal drainage channel, Sampling Location ST-H is located in the midstream of the Kamal drainage channel and Sampling Location ST-I is in the downstream near the estuary. Sampling Location ST-G which receives waste from the dense settlement areas shows a Shannon-Wiener diversity index (H') for plankton 0.95 and its saprophytic index -1.4; in the middle part of the river at the Sampling Location ST-H shows a diversity index (H') of 0.98 and X = -100, while downstream H' = 0.87 and X = -1.75 based on Persoone and De Pauf Classification. It belongs to α - mesosaprophytic classification, which means that it is moderately to heavily polluted.

The plankton type which is encountered with high abundance individuals from upstream to downstream is *Oscillatoria sp.* and *Nitzschia sp.* for phytoplankton type. For zooplankton, *Arcella sp.* and *Difflugia sp.* are found while for benthos type, *Tubifex sp.* and the *Sphidonosis sp.* are frequently found.

(2) Saluran Cengkareng drainage channel

Sampling at two locations in this drainage channel have been taken; Sampling Location ST-F in the upstream and Sampling Location ST-E in the downstream area. The area the drainage channel goes through is heavily congested settlement area including some open areas. From the midstream to the estuary of the drainage channel to Cengkareng floodway is dominated by dense settlements.

The uniformity of organism types in the Saluran Cengkareng Drainage Channel is low with the Shannon-Wiener index value (H') of 0.84 in the upstream area and 0.57 in the downstream area. The saprophytic index is -1.00 in the upstream area and -1.4 in the downstream area. It belongs to α - mesosaprophytic which means that the water quality is moderately to heavily polluted.

The phytoplankton type which is high abundance individual value in this area is the *Oscillatoria sp., Euglena sp., and Nitschia sp.*, while zooplankton type with high abundance

individual value is *Arcella sp.* and *the Nauplius*. Benthos type of *tubifex sp.* and *Ophidonaris sp.* are found in the drainage channel.

(3) Mookervaat canal

Mookervaat canal is located alongside Daan Mogot Road with its riverbank dominated by industry and settlements. A portion of the water of Mookervaat canal is flowing into Cengkareng floodway. Survey on plankton and benthos in Moookervaart River was done at Sampling Location ST-A in the upstream and Sampling Location ST-B in the downstream areas. Phytoplankton frequently found here are *Melosira sp.* and *Oscillatoria sp.* For zooplankton with high abundance individual value is *Undella sp.* and *Vorticella sp.*, while benthos is not found in both sampling locations. Non-existence of benthos is due to excavations of the river bottom which is still underway in that area. Analysis indicates that plankton in Mookervaat canal belongs to α - mesosaprophytic with diversity index value H' of 0.93 in the upstream area and 1.64 in the downstream area, while saprophytic index value is -0.50 in the upstream and 0.56 in the downstream area.

(4) Cengkareng floodway

The Cengkareng floodway is the main drainage channel which receives water from a number of secondary drainage channels in West Jakarta. Cengkareng floodway in the study area starts from Daan Mogot Road up to its estuary in Kapuk on the coastal area of Jakarta Utara. Observations of water organisms in Cengkareng floodway was conducted at the three Sampling Locations of Sampling Location ST-C at the Upper Cengkareng floodway, Sampling Location ST-D at Kapuk Bridge and Sampling Location ST-L at the intersection of the toll road to the airport. The number of species of phytoplankton found in the Cengkareng floodway varies between 12 and 19 and zooplankton 7 to 13 types with the Shannon diversity index varying between 1.54 up to 2.00 and the saprophytic index -0.54 up to -0.88. Type of phytoplankton with highest individual abundance value is *Oscillatoria sp.* and *Melosira sp.* in all Sampling Locations, while zooplankton of Arcella sp. has been the highest individual abundance value.

4.2.3 Nekton

Nekton means various kind of fish and prawns living in the same places, in the temporary places or are living around in some places close to each other.

In the study area, especially in the fresh water marshland, many labyrinth type of fishes can be found. They live there temporarily, like *Ophiocephalus Striatus* (gabus), *Clarias batrachus* (lele), *Oreochromis mossambicus* (mujair), and *Trichogaster pectoralis* (sepat). While in the brackish water marshland near the coast, *Mugil cephalus* (belanak), *Oreochromis mossambicus* (mujair), *Oreochromis niloticus* (nila) and *Chanos chanos* (bandeng) are found. In the drainage channels, ikan sapu-sapu are found. In coastal areas many *Anadara sp.* (kerang darah) and *Perna Viridis* (Kerang hijau) are found, which are cultivated by most fish farmers in that area.

4.2.4 Water plants

Water plants often found within the study area are *Eichornia crassipes* (eceng gondok). Many of them are found in Kamal drainage channel, Tunjungan Drainage Channel and Cengkareng floodway. Other types of waterplant found are *Ipomoea aquatica* (kangkung), *Ipomoea percaprae* (kangkungan) and *Limnocharis flava* (genjer).

In the Cengkareng floodway, Eichornia Crassipes can be seen along the riverbanks and in the middle of the river especially underneath the bridge where the water is stagnant. Together with it, Ipomoea aquatica forms floating islands in the middle of river. If the water flow is fast these islands will be driven to the sea eventually.

In the Kamal drainage channel, Eichornia crassipes are found alongside the river banks and at junctions and estuaries where the water flow is relatively slow or where the river is shallow. These plants are also found plenty in a large body of water like marshland in the upstream area of the main stream of the Kamal drainage channel.

4.2.5 Flora and fauna on land

(1) Flora

(a) Kamal drainage channel

The observation results in the area along the Kamal drainage channel is that the vegetation type consists of 30 different species such as *Pterocarpus indicus* (pohon angsana) as the most dominant type. It has the importance value index of 28.23, followed by *Dalbergia lactifolia* (sonokeling) with importance value index of 14.00 and *Cocos nucifera* (kelapa) with importance value index of 13.91.

(b) Saluran Cengkareng drainage channel

In the Saluran Cengkareng drainage channel area, there are 33 different species of plant with the most dominant type of Cocos nucifera (kelapa). Its importance value index is 37.08 followed by *Melia azedarach* (mindi) with importance value of 24.93 and the ambon tree with importance value of 11.66

(c) Tunjungan drainage channel

The vegetation composition in the Tunjungan drainage channel area consists of 13 types, mainly *Musa paradisiaca* (pisang) with importance value of 43.76. Others are *Cocos nucifera* (kelapa), and *Pterocarpus indicus* (angsana) whose importance value is 15.25 each and *Arecha sp* (palem) with importance value of 15,25.

(d) PIK Junction drainage channel

In the area along the PIK Junction drainage channel near outer ring road, the most dominant species of plant is *Switzenia microphyla* (mahoni) with importance value of 36.91, followed by *Pterocarpus indicus* (angsana) with importance value of 25.65 and *Melia azedarach* (mindi) with importance value of 20.35.

(e) Meruya utara area

In the Meruya Utara Area, the most dominant species of plant is *Switzenia microphyla* (mahoni) with importance value of 31.91, followed by *Pterocarpus indicus* (angsana) with importance value of 23.65 and *Melia azedarach* (mindi) with importance value of 16.75.

(f) Mangrove forest

The mangrove forest is still left in a limited number of patches on the coastal area in the north of the study area. It stretches alongside the coast from the area near the mouth of the Tunjungan drainage channel to the mouth of Cengkareng floodway. In the area near the mouth of Cengkareng floodway, width of the mangrove forest is 50 -100 m and approximately 800 m long. In the area near Tanjungan drainage channel, small patches of approximately 50 m by 100 m each are left over.

Species forming the mangrove forest in this area consist of *Rhizopora sp.* (bakau) with importance value of 18.78, *Bruguiera sp* (bakau) with importance value of 18.78 and *Avicenis sp.* (api-api) with importance value of 128.98.

Including the mangrove forest, there are wide area of mangrove plantation area in and around the Tanjungan drainage channel. The area has been designated as "Protection Forest" under the administration of the Department of Forest, DKI Jakarta.

(2) Fauna

Species of fauna found during the survey in the study area is shown in Table 14. The study area consists mainly of human settlements, industrial and commercial establishments as well as a few patches of agricultural land, and only a small part is an open area for natural habitat such as in Pantai Kapuk in the form of mangrove forest whose area is around 9 ha.

Species of fauna found in the study area therefore consists generally of domestic animals like chicken, ducks, goats, buffaloes, and pet animals. Other fauna found in the study area are *Rattus sp.* (tikus), *Mabouya multifaciata* (kadal) and *Varamus salvator* (biawak) found on the river banks.

The species found on the coastal areas are mainly birds, especially *Amas gibberifrons* (belibis) which are normally found in small groups. Other types on the coast are *Egretta sp.* (bangau) and *Larus sp.* (burung camar).

4.3 Socio-economic Environment

4.3.1 Administrative area

The project area is located in the northwest corner of DKI Jakarta which covers four Kecamatans and nine Kelurahans as shown in the Table 15.a. The area of kelurahans that cover the project area is 52.33 km^2 and it is 7.9 % of the area of DKI Jakarta of 661.26 km^2

4.3.2 General population characteristics of the study area

The project area is one of the fastest growing region in DKI Jakarta. This growing trend is caused partly by the outer-ring road and the toll road to Sockarno Hatta International airport in the north of the project area and the other toll road to Tangerang to the south of the project area. These road system serve as major means of transportation of goods and services.

There are also two major local roads linking DKI Jakarta and Tangerang to the west. Because of these road networks, there are many large scale housing development works being undertaken within the project area.

As shown in Table 15 a., population in the project area in 1994 was 261,894. This is 3.5 % of the population in DKI Jakarta of 7,515,392. The average population increase in the project area from 1990 to 1994 is 4.03%. This is compared to the rate of population increase in the 1980s of 3.89 %. Among others, Pegadungan shows the largest population increase of 10.57 %. Overall population density of the project area is 5,806 persons/km^2 and this is compared with the population density in DKI Jakarta of 10,192 persons/km^2.

Age distribution is relatively young and approximately half of the population is the major work force is indicated in the Table 15.b. However, their level of income as shown in Table 15.d., is relatively low as more than half of the population earn less than Rp.400,000 a month.

4.3.3 Occupation

Population concentrating in the project area is generally considered as inexpensive source of labor in DKI Jakarta. They are employed in various sectors. As is shown in Table 15.c, the largest employer is industry which employ 41 % of the local population in the project area. Commercial sector employs 2 % only. There are a large percentage of people engaging trading, usually local grocery shops that is counted for 13.7 % followed by the government employees of 10.1 %. There are a lot of peddlers and transportation with motorcycle. These are classified in the others. Recent trend of economic activities within the project area is the decline of agricultural activities as rapid urbanization is overtaking it.

On the other hand, the population living along the Kamal drainage channel within Jakarta Utara, to the north of toll road, are heavily dependent on the Jakarta bay fisheries, extracting a variety of mollusks and small fish, equipment and facilities such as fishing boats which they bring in and out through the river are essential to their economy.

4.3.4 Land use

(1) Present land use

As shown in Fig 9 a., present land use within the project area based on the administrative area is summarized as follows:

Category of land use	Area (m^2)	Percentage
Residential Area	24,439,000	46.7
Swamp/Fishponds	8,036,000	15.3

Industrial/Commercial	9,719,000	18.6
Agricultural Area	6,279,000	12.0
Road, Drainage and Others	3,857,000	7.4
Total	52,330,000	100.0

* Note: The above land use area within the project area that are directly and indirectly affected by the project is wider than the catchment area of 37.98 km^2.

Most of the open spaces within the project area are in possession of the private developers for housing and commercial development. Agricultural area is concentrated in Kecamatan Penjaringan while industrial/commercial area is concentrated in Kecamatan Kamal along the road linking Tangerang and DKI Jakarta.

(2) Future land use

As shown in Fig 9 b., future land use by the year 2005 within the project area is summarized as follows:

Land Use	Area (m^2)	Percentage
Residential Area	30,718,000	58.7
Swamp/Fishponds	2,459,000	4.7
Industrial/Commercial	11,146,000	21.3
Agricultural Area	3,035,000	5.8
Road, Drainage and Others	4,972,000	9.5
Total	52,330,000	100.0

Drastic reduction of open space while increase of residential area is obvious. However, the above figure does not include the area planned by PANTURA for reclamation of the north coast area. It does not also reflect the coastal area of revitalization planned by PANTURA as definite plan is yet to be determined.

4.3.5 Infrastructure

Because of rapid urbanization taking place within the project area, level of the development of infrastructure within the project area is relatively high. Piped water supply by PAM is available however only in the newly developed areas. For a majority of the households within the project area, the main source of water for domestic use is from well, either pumped by machine or by hand, and the main source of drinking water is distributed

through large tanks installed on the corners of streets within the project area installed by PAM.

Water from the shallow well sank within the project area contains salt to some extent and generally considered as not suitable for human use. However, the local residents make use of it as it does not cost compared to the water distributed by PAM. Electricity has been made available to all households within the project area. However, there is a statistics of approximately 6 % of the local households still use oil lamp. Gas is used for cooking purpose in most households within the project area. Depending on the mode of cooking, cost of operation, and for other reasons, kerosene stoves are also popular means for cooking among the households within the project area.

4.3.6 Population directly affected by the project activities

The separate volume of the "Social Impact Management Program" describes the details of population directly and indirectly affected by the implementation of the project .

4.3.7 Public health

(1) Water-born diseases

Main diseases reported as affecting the inhabitants of the project area are :Diarrhea, Cholera, Dysentery, Typhoid, Paratyphoid, Tape Worms, Nematode Worms, Mycosis, Gastro-enteritis, Tuberculosis, D.H.F, Diphtheria, Hepatitis A and Hepatitis B.

BAPEDAL has established a direct relationship between the rate of hospital admissions for diarrhea with fecal Coliform based on the four year of river sampling data. It is important to note that diarrhea is found to be the cause of 8% mortality across Indonesia and 5.4% of mortality on Java Island.

Waterborne diseases have their origin in disease vectors living in water puddles (Cholera), inadequate use of water for food preparation, and in the area adjacent to solid waste disposal.

(2) Air-born diseases

Epidemiological studies in the US show a significant correlation between concentrations of total suspended solids (TSP) in the air and several respiratory illness. Estimates of about 1,500 deaths per year in Jakarta attributable to the excess level of air pollution that has been reported in Jakarta.

The airborne lead pollution originated from the exhaust of motor vehicles results in high blood level in large sectors of the population as breathing air contaminated with lead. Taking contaminated food and water also responsible.

Health effects induced by excessive concentrations of lead in the air of Jakarta include significant number of cases related to hypertension and coronary heart disease. Among the slum dwellers of Jakarta, such as the majority of the population living within the study area, the blood level is relatively high, being these levels virtually twice of those found in the rural population.

(3) Solid waste disposal

It is estimated that as much as 30% of the solid waste generated in Jakarta reaches the rivers and canals. Unsafe solid waste disposal has the following major environmental impacts:

- Pollution of groundwater and surface water;
- Blockage of drainage causing flooding;
- Proliferation of pests and other vectors of diseases;
- Air pollution caused by garbage burning and gaseous contamination;
- Health effects caused by any of the above impacts;
- Negative impacts on land values; and
- Toxic waste hazard to children playing outdoors in or near the solid waste disposal area.

All of the above conditions are applicable to the study area.

4.3.8 Scientific, cultural and religious areas and the aesthetic value of the study area

There is no specific cultural or religious activities nor the areas identified as important for the local population for their aesthetic value system as well as for that of national and international or from the view points of science such as archaeology and anthropology within the project area.

5 IDENTIFICATION AND PREDICTION OF IMPACT

5.1 Identified Environmental Impact

5.1.1 Pre-construction period

(1) Field investigation

As shown in Fig 11, pre-construction p eriod of the project activities gathering information on the engineering design and environmental impact assessment should lead to social unrest to some extent. Members of the community within the project area start wondering to think if they would be badly affected and that they would lose their properties and houses. This is an impact not very significant but the feeling of suspicion lingers until actual impacts start causing direct impact to them.

(2) Land acquisition

Land acquisition is the activity causing the largest impact to the general public among other activities as shown in the Fig 11. It involves major reorganisation of individual families who are directly affected by the project . With the land acquisition, individual family will have to change various parts of their family life ranging from the working arrangement, employment, or even occupation to their children's educational facilities, general social facilities, conditions on the public health, and other social unrest. This is the most direct and significant impact among others.

(3) Resettlement arrangement for t he residents with land status

Impacts on resettlement arrangement and its relationships are shown in Fig 11. Within the frame work of the project , a number of low cost apartment blocks will be constructed in order to house local residents subject to relocation. Some local residents will move to the area they selected for their own purposes and preferences. Upon resettlement of them, arrangement to cope with the new living environment would be the last stage of the social impact directly caused to the local residents subject to resettlement.

On the other hand, those residents originally living in or around the resettlement areas would begin receiving social impact. They would have to cope with the increase of population, reorganisation of public facilities and use of them, and other factors affected by the resettlement arrangement. Thus the impact upon commencement of the resettlement arrangement is considered relatively significant to them.

(4) Resettlement arrangement to the local residents without land status

Present laws and regulations in DKI Jakarta does not provide provisions for the local residents subject to relocation without land status to assure the relocation areas are provided for them. They are originally illegal residents living on the riverside areas but recognised by the local government office of Rukun Warga or Rukun Tattanga. In some cases, Kelurahan office recognise that they have paid to acquire their living space, usually built on the riverside area that belongs to the central or local government. It is termed as "Statement of Recognition of Payment" and it usually states that a party has paid certain amount of money to the other in order to acquire a living space built on the address given on the statement. Thereby no third party can claim for a living space and urge for evacuation. If it occurred, the third party usually sneak to live in the living space without a cost. This is the arrangement developed during the past decades that it was intending to reduce the dispute over living space. As a result, they receive quasi-formal resident status and receive address for mail services, telephone and electricity.

Relocation of these local residents usually does not involve full payment of compensation. As a result, therefore, they move out to other areas where they can acquire a living space, usually on the riverside area and repeat the same procedure. It is therefore other riverside areas already congested would have to take local residents moving from the area affected by the project. Thus, upon evacuation of the local residents with resident status from the present location to other areas will cause further impact, in many cases, to other riverside areas where the areas are already congested with the similar nature of local residents. Their opinion on the relocation is very well reflected in the opinion survey is shown in Table 16. It is obvious that they demand the area where they can re-establish by themselves and it is not always the riverside areas they like to select.

(5) Opinion on resettlement of the local residents living in and around the resettlement areas

As shown in Table 16, the result of socio-economic survey on the opinion of the local residents living in and around the resettlement areas expressed their concern over the resettlement arrangement as follows:

- New-comers should be those with permanent jobs so as to compete no part of the business in the resettlement areas;
- New comers should maintain their new houses tidy and clean and in good order; and
- New comers should introduce themselves to the incumbent residents and intermix harmoniously over time.

5.1.2 Construction preparation period

(1) Mobilisation of construction equipment and workforce

Fig 12 shows the impacts and their relationships during the construction preparation period. Mobilisation of construction equipment and workforce to the project area is a formal declaration of the arrangement of project activities. Itself does not cause any actual significant impact since they move into the area already acquired for the construction works. However, depending on the arrangement of demolishing buildings in the acquired land area would cause dust, noise and danger to the general public to some extent.

In the case of preparing dike construction works in the downstream area of the Tanjungan drainage channel, fish ponds adjacent to the construction area or its preparation area is open to the public. Thus the general public visiting the area for fishing as well as those owning the fishing ponds should be forced to stay alert. This will last for as long as the construction works are conducted in the area.

It is during this stage that the public transportation is forced to rearrange its services as detours on the portions of the road within the project area will have to be made. The public transportation and private vehicles would therefore be able to continue its services during the construction period. The users of the public transportation, however, should suffer by the rearrangement of the transportation as traffic congestion and slowing down of the travelling time to their working places should occur during the period of construction works.

(2) Construction of access road

When the excavation and filling for access road for the Tanjungan drainage channel is conducted, mangrove plantation area in the area between Jakarta Bay and Jl.Tol Prof.Sediyatmo will be damaged. The area is designated as mangrove growth area. Thus, damages made by the construction work for the access road will last for as long as the period of construction works conducted in the area. Upon completion of the project, plantation area is reinstated with the selected species of mangrove.

5.1.3 Construction implementation period

(1) Excavation works

As shown in Fig 13, the excavation works of the river bottom will produce silty sludge materials and it usually emanate odor not acceptable to the general public. Dropped silt

would dry to cause dust problem too. Transportation of the material to the spoil bank may cause adjacent road to become untidy and emanating odor depending on the way the silty material is transported. Water quality in the drainage channels will be changed especially its turbidity. In the case of the Tanjungan drainage channel, it may cause impact to the fish ponds in the adjacent area.

(2) Construction works of structures

Major construction works for the project includes revetment, parapet wall, dike, foot and vehicular bridge, inspection road, culvert and sluice gate. All of these works are conducted in the congested residential areas except for a few places like downstream areas near the mouth of Kamal and Tanjungan drainage channels. Noise, dust and disruption to the traffic would be the major impacts during the construction period. During this period, the general public within the project area and those travelling through the project area would also be affected as the traffic is disrupted. As shown in Table 17, subsequent impacts are the most significant among others.

Construction works for dike in the downstream area of the Tanjungan drainage channel would be conducted in the fish pond. Depending on the arrangement to prevent construction materials forming the dike from entering into the fish ponds, significant impact should occur or even further claim of compensation for the fish pond may be raised as construction works are conducted without care.

During the rainy season, flood events should take place as before. However, since construction works are undertaken on site, general public should feel that the flood is caused by the construction works. Thus, depending on the work arrangement, negative feeling among local residents should grow to some extent. Such quasi-negative impact will also be a part of the impact during the construction period.

(3) Reconstruction works of bridges

Existing bridges are subject to reconstruction as the width of the drainage channels are widened. Depending on the availability of detour route and the area of construction for temporary bridge, bridges subject to reconstruction could cause very severe traffic congestion. Those on Jl.Kamal Muara would probably be the most delicate reconstruction works since working areas for temporary diversion of the traffic is limited. Relationships of the impacts on the relocation of bridges are shown in Fig 13.

5.1.4 Post construction period

(1) Use of inspection road

Fig 14 shows the relationships of the environmental impacts during the post construction period. Upon completion of the construction works, the general public usually make use of the crest of dike as public road or foot path. It will provide opportunities to short cut to the destinations of the general public. It will provide safety of traffic to some extent as the traffic is light and heavy vehicles will not make use of the area. On the other hand, disfiguring of the dike should occur and it will cause changes in the originally intended design capacity of the dike to some extent. In general, positive impact to the public would be greater than the negative impact.

(2) Environmental monitoring works

Upon completion of the resettlement arrangement, monitoring work for the social impact which might occur in the resettlement area should be commenced. This is the monitoring works to ensure that the resettlement areas are arranged to the contentment of the local residents moved into the area. Thereby, positive feeling on the resettlement is enhanced as well as the items of work necessary to improve will be revealed to further satisfaction of the local residents.

(3) Operation and maintenance of the project

Upon completion of the construction works, structures are put into operation and maintenance. Drainage channels and other structures are to function for their own purposes. Thereby negative impacts lingering within the project area should promptly disappear. Upon advent of rainy season, the effect of the improved drainage channels should demonstrate its result. Thereby the then negative feelings among the local residents within the project area should quickly recede i.e. positive impact should emerge within the project area.

6 EVALUATION OF ENVIRONMENTAL IMPACTS

6.1 Regulations Concerning Evaluation of the Environmental Impacts

Regulations concerning the evaluation of environmental impacts are as follows:

(1) Decree of the head of environmental impact management agency

Decree of the Head of Environmental Impact Management Agency No. KPTS 056/1994 Concerning the Guidelines of the Significance of Impacts determines:

- Number of people affected;
- The extent of the impacts;
- Duration of the impacts;
- Intensity of the impacts;
- Number of other environmental components affected;
- Cumulative nature of the impacts; and
- Reversibility or reversibility of the impacts;

(2) Decree of the ministry of public works

Ministry of Public Works Decree No. 184/KPTS/1991 concerning Technical Guidelines of Environmental Impacts Assessment for Public Works Project specifically states that:

"Urban drainage project induces some potential negative impacts according to the stages of the project as follows:

- Impacts during the pre-construction stage;
- Impacts during the construction stage;
- Impacts during the post-construction stage.

6.2 Major Impacts During the Pre-construction Period

6.2.1 Relocation operation and land acquisition

Relationships of the environmental impact during the pre-construction period is shown in Fig 11. Drainage channels within the framework of the project are sub-divided into three different stages of construction works. Thus, depending on the arrangement of the

sequence of construction works, the local residents in different areas receive impacts caused by the project at different times over time. Those of living along the Kamal drainage channel (main) and the local residents living adjacent to the drainage area will receive massive impact as relocation operation takes place during the period of land acquisition followed by massive excavation works.

The Kamal drainage channel (branch) and the Saluran Cengkareng drainage channel are relatively large drainage channels that require large scale operations including a large number of households subject to relocation. It is therefore the local residents living along these drainage channels will receive relatively significant impact as they relocate. In places, there are no relocation operation is necessary but the construction works for relatively wide drainage channel are conducted.

Construction of the Tanjungan drainage channel is relatively large operation in the area from midstream to the mouth of the drainage channel. In its upstream area, factory warehouses and 22 households are subject to relocation. Thus the operation induces relatively small impacts.

Gede/Bor Drainage Channel is a medium scale operation comparing to the other drainage construction works such as the PIK Junction drainage channel and Meruya Ilir drainage channel which are very small scale construction works. With Gede/Bor drainage channel construction works, 30 households would be subject to relocation while PIK Junction drainage channel does not involve any households for relocation. In Meruya Ilir area, 7 households would have to be relocated Thus very small impacts are induced by the construction works of these drainage channel construction works.

Regardless of the scale of operation, effort to minimise the impacts and to avoid misunderstanding among those concerned with the project and the areas affected by the project is conducted through dissemination of information to the related local government offices on the project activity. The project manager in-charge of the resettlement program plays an important role for the extensive dissemination of information on the project as the community leaders and the local residents living within or near the drainage channel will demand punctual service on relocation operation.

6.2.2 Resettlement areas

Resettlement areas prepared to receive the residents moving from the project area would become congested as resettlement operation progresses. Incumbent residents will have to prepare to go along with the new comers.

On the other hand, resettling residents will face to reorganisation of job opportunity. Method of commuting to the working place or to schools, use of social facility and infrastructure new to the resettling residents, public health conditions and other minor matters on the general daily life would also have to reorganise to some extent.

These rearrangement with the resettling residents would be the major social impacts associated with resettlement operation of the project. These impacts are the largest impacts comparing to other impacts induced by the project and it will last for a few years before all the major and minor impacts associated with the relocation operation disappear.

6.3 Major Impacts During Construction Preparation Period

6.3.1 Mobilisation of manpower

Relationships of the environmental impact during the construction preparation period is shown in Fig 12. Mobilisation of manpower required for the project would mean work opportunities are available for the local residents who are at the moment without permanent job. Thus income of the local residents is generated to some extent. On the other hand, as workforce is mobilised from other areas, establishing workers' camp within the project area will induce some social unrest among the local residents. This will depend on the way the workers camp areas are established. In many cases, as workers' camp areas are established, local food vendors will thrive during the construction period.

Among the reasonably foreseeable obvious impacts, water supply, which is already short within the project area, or not efficiently supplied as no piped water supply system is yet to be developed. At present, however, water is being transported in plastic cans and distributed by manual labour within the project area. This would become one of the major issues of the project area as the construction works demand large quantity of water during the construction period. Thus, there is a high potential of the shortage of water as large amount of water would be used for the construction works unless separate water source is provided exclusively to the construction areas. The present labour for water distribution is reduced during the construction period as higher payment of the construction works may absorb more labour to the construction works.

6.3.2 Mobilisation of construction equipment and materials

Mobilisation of heavy equipment and materials would cause impacts to the general public as well as to the public transportation and air pollution within the project area. To minimise the impact, the first step is to confirm with the local government for the programme of mobilisation for construction equipment and materials. Information concerning diversion of the traffic and the schedule of diversion, means to co-ordination with the existing traffic conditions are all important to minimise the impact.

6.3.3 Construction of access road

Land clearing and subsequent access road construction works would emanate noise and dust which would directly affect those living adjacent to the construction areas. Depending on the alignment of access road, temporary land acquisition for a limited period of which construction works are conducted would become necessary. To minimise the impact, the first step is to confirm with the local government and neighbourhood associations about the programme of land clearing, which in many cases local government offices are requested for witness. Information concerning the transportation of demolished materials and its schedule should be co-ordinated with the local government office and neighbourhood associations.

6.4 Major Impacts During Construction Implementation Period

6.4.1 Excavation works

Relationships of the environmental impact during construction period is shown in Fig 13. Excavation of the river bottom will emanate odour and sludge possibly oozing out to the adjacent residential areas if care was not taken during the excavation operation. It will also give impacts to water quality as turbidity of the water in the drainage channel is increased. On the other hand, the present sludge material lying at the bottom of each drainage channel within the project area are cleaned up during the construction implementation period. Thus, upon completion of the construction works, unpleasant environment of the drainage channel with sludge will disappear until such time that the drainage channels are filled up with sludge over time.

To minimise the impact, the first step is to confirm the local government office about the programme of transportation for excavated materials and disseminate the information among the local residents through the local neighbourhood associations.

6.4.2 Transportation of excavated materials

Transportation of excavated materials to designated spoil banks would cause the road soiled with spills to some extent. This will cause minor impacts to the traffic to some extent. On the other hand, the excavated materials disposed in the public dump would provide soil material to cover existing solid waste. If the designated spoil bank was sand pit near the river bank or coastal area, it will level the existing land surface. Either the spoil bank was a public dump or a sand pit, it will enhance to grow vegetation to some extent as well as to cover up strong odour of the area.

6.4.3 Construction works of Structures

Dikes, parapet walls, and sluice gates are the major structures necessary to construct within the framework of the project . Dike construction works would involve importation of earth material, filling and compaction. Parapet wall and sluice gate construction works would involve excavation, foundation works, and concrete placing including steel material assembling works. These works require wide working area and the access road to it. Nature of the works for dikes and parapet walls require very narrow and elongated working areas. These works would therefore cause a lot of noise, dust and vibration emanated to the adjacent areas as construction works are conducted with heavy construction equipment mobilised to the site.

Construction area for the dikes and parapet walls adjacent to the public road would require traffic diversion. It would require proper arrangement of diversion, road sign for detouring, and a few attendants. Dissemination of information on the rearrangement of traffic is also necessary in order to avoid confusion among the local residents. Thus, to minimise the impact, the first step is to confirm with the local government for the program of mobilisation for construction equipment and materials. Information concerning rearrangement of traffic and schedule of arrangement, means to co-ordination with the existing traffic conditions are all important to minimise the impact.

6.4.4 Reconstruction of bridges

There are total number of 76 pedestrian and vehicular bridges necessary to reconstruct within the framework of the project. When a bridge is demolished during the excavation works, for instance, it is not reconstructed for several months until dike or parapet walls are constructed before the bridge is reconstructed. Thus, as the bridge is demolished, traffic has to be diverted. It would require sometimes very long distance to travel to the other side of the road. Heavy traffic jam should occur if the bridge was on the major road.

In order to mitigate social unrest among the general public using bridges within the project area, dissemination of information is essential. To minimise the impact, the first step is to confirm with the local government for the programme of mobilisation for construction equipment and materials. Information concerning the diversion of traffic and the schedule of diversion, means to co-ordination with the existing traffic conditions are all important to minimise the impact. Department of Traffic, DKI Jakarta and the Traffic Police would cooperate with the contractor.

6.5 Major Impacts During Post-construction Period

6.5.1 Use of inspection road as public road

Relationships of the environmental impact in the post-construction period is shown in Fig 14. Use of inspection road built on the dikes as public road would provide conveniences to the local residents hitherto afflicted of the lack of wider road for transportation of goods i.e. positive impact is induced by the project . On the other hand, there is a possibility that the dikes are endangered as they might face destruction and sliding as used by the general public over time. Thus maintenance works would become an important factor to minimise negative impact on the dike and its use.

6.5.2 Operation and maintenance of the project facilities

Any flood events during the rainy season in the future are potentially alleviated with the project facilities. Water pollution and solid waste finding its way into the drainage channels would have to be orderly drained as the drainage channels and their associated facilities are properly operated and maintained during the post-construction period. It is considered as positive impact for the general public within the project area. The result of the environmental impact evaluation is shown in Table 17.

6.5.3 Positive changes of coastal ecosystem

Upon completion of the Kamal and Tanjungan drainage channels, relatively clean fresh water from the drainage channels mixes with salt water. This provides aquatic habitats with a lower average salinity than the waters of open ocean. Thus, estuaries of these drainage channels would provide more plant biomass per square meter than other areas within the project area after the completion of the construction works. Depending on the way the drainage channels are maintained, this condition of the enhancement plant ecology will be maintained for a while until such time that the drainage channels filled up with sludge and polluted water overflow to the estuary over time.

7 SUGGESTED RESETTLEMENT AREAS FOR THE SQUATTERS

7.1 Historical Development of Squatters

As described in the Section 5, historical development of the local residents living on the riverside areas are complex. There are a number of reasons but not limited to as follows:

- Because of the difficulties to maintain decent standard of life in the rural areas of Indonesia, peasant families begin moving into urban areas where job opportunities are much better then in the rural areas;
- Traditional peasant family lives on the river bank for easy fetching of water and disposal of sewage in the agricultural areas. Thus they select riverside area when they move in to the project area;
- When a living space is available at a low cost on the riverside area, peasant family tends to accept the offer as it is a way to avoid dispute over a patch of living space;
- Local residents are aware of the condition of living in the riverside area that they have to move out when the government demands. However, it never happened to them for a long period of time;
- It is always easy and cheap to move out to other riverside areas if they have to. Living space in the riverside areas are always available and inexpensive;
- Living in the riverside area is not a crime. Thus they will not be arrested for a jail sentence.
- Commercial and industrial sectors in DKI Jakarta have grown by taking advantage of the situation as cheep labor is always available from the squatters;

Urban planning scheme of DKI Jakarta can not ignore the issue of squatters ever increasingly causing problems on the urban environment while the economy in DKI Jakarta is taking advantage of inexpensive labor market. The issue on the ever increasing squatters in DKI Jakarta would probably be solved if historical development of the squatters, sources of the cause of in-flow of rural population, capacity of absorbing in-flow of the squatters in relation to the national economy. It would probably one of the most important issues for DKI Jakarta during the next decade. The issue of squatters from the spatial planning and urban development point of views would not solve entirely. However, the following sections contain some suggestions in relation to resettlement of the squatters related to the project .

7.2 Demand on Land Certificate

Table 16 shows a set of questions and the result surveyed during the field survey in December 1996. The question is a set of "Social Facilities", "Infrastructure", and "Non-physical Development" and a combination of them that the squatters think they need to have when they move to other locations.

The squatters living on the riverside areas pronounced their concern over the living conditions as the top priority. For the question on the "Non-physical Development" of the resettlement areas, for instance, the squatters demands job opportunity and granting of land certificate. For the question of a combination of "Non-physical Development" with "Social Facilities" and "Infrastructure", the local residents showed their concern over job opportunity and granting land certificate. To them infrastructure and social facilities are secondary to the needs of job opportunity and granting land certificate.

Approximately three quarters of the local residents are actually concerned with the job opportunity and the land certificate when they move out to other areas. It is therefore their aspiration that they are interested in obtaining land certificate and enter into the formal economic force as well as to become recognized member of the urban society within DKI Jakarta.

7.3 Recommended Resettlement Arrangement for Squatters

Detailed resettlement arrangement for the squatters has been described in the Social Impact Management Plan annexed to this EIA report. The plan is in its infant stage at this point of its development. There should be a lot of room for further development based on the discussions made by the experts of different expertise on this issue. To brief, however, the essence of the plan within the framework of the project is as follows:

- The squatters, whether they have received resident status or not, will be given an option to rent bare land prepared by the government within the project area;
- Renting fee of bare land is established according to the cost of development;
- Rent is paid by the squatters to the government over 10 year period, or any fixed period of time as determined by the government;
- Land certificate to each renter is provided;
- At the end of the fixed period of time, renting areas are sold to private developer for commercial purposes;

- Renters are requested to relocate at the end of the fixed renting period;
- Compensation for relocation is paid by the government to the renters;
- During the renting period, government can launch social development plan as considered necessary.

The above arrangement has been suggested to be conducted within the framework of the project. Thus, bare land created by the government as resettlement area exclusively for the squatters would be formally surveyed and registered with the Regional Office of Land Administration as government land. This is a similar arrangement and procedure made to the land acquired from the local residents for drainage channel areas. Thereby the created bare land as renting area for the squatters become a part of government possession and that the renters are formally recognized as legitimate residents within the government owned land as they pay the rent. What is important with this arrangement is that, upon agreement, they are formally granted legitimate land certificate as a result of resettlement arrangement. With this arrangement, they will become formal taxpayer and recognized member of the local community.

As the squatters are allocated to live in a unit of bare land with minimum rent, they can move their building materials for reconstruction of their living or commercial spaces. As is explained in the Social Impact Management Plan, they are allowed to pay minimum rent for the land over 10 year period or any fixed period of time. Upon accumulation of the 10 year period of rent, the government should be ready to sell the land to private developer. Alternatively, the government could launch low cost apartment complex construction plan in the rented area.

With a formal land use plan of the rented land, squatters are asked to relocate with full compensation for the area they have rented for. With the amount of compensation the squatters could afford to move out to a unit of low-cost apartment.

7.4 Advantage and Disadvantage of Creating Renting Areas for Squatters

7.4.1 Advantages

There are a number of advantages creating renting areas for the squatters as follows:

- The issue lingered on the administration of DKI Jakarta is legitimately solved;
- Land areas hitherto having no specific purpose of use could be effectively developed

and made use of by the government as renting areas for the squatters;

- Land areas not actively developed by private developers, such as marsh land or the area prone to flooding, can be put into the use of further development upon release of the renting areas;
- Business on real estate may be enhanced to some extent;
- Cost implications of the renting area do not cause any budget deficiency within the budget of DKI Jakarta on the condition that the renting areas are sold to the private developers without exceptions, or the area is made used of for low cost apartment complex construction works;
- Illegality of the squatters is eliminated at the end of the renting period i.e. issue of squatters seen in every riverside area in DKI Jakarta could essentially be solved while the squatters could achieve their aspiration to become legitimate member of the society;
- Water quality of the river and solid waste in and around the rivers in DKI Jakarta should be greatly up-graded upon achievement of the squatter resettlement plan;
- Government assistance to the squatters on this program itself could be considered as extra goodwill of the administration;

7.4.2 Disadvantages

With the creation of renting area for the squatters, the following disadvantages, but not limited to, are foreseen:

- Not many land areas are available for renting to the squatters unless filling operation is conducted to marsh land or low lying areas prone to flooding i.e. commercially viable areas can not be made use of the purpose of resettling the squatters;
- Creating renting areas for the squatters may not be positively accepted by the local residents;
- Commercial development in the renting area is held up for a fixed period;
- Commercial value of the renting area may be lost after the fixed period of time;
- Tight government budget may not allow to conduct similar plan associated with other economic development projects taking place within DKI Jakarta as initial cost for filling or similar operation is necessary;
- Resettlement plan for the squatters may encourage rural families to flow into DKI Jakarta for obtaining legitimate land certificate i.e. unless in-flow of the rural population becoming illegal residents in DKI Jakarta are checked, vicious circle on the issue of squatter is repeated for the years to come.

7.5 Recommendations to Laws and Regulations

7.5.1 Creation of renting areas for squatters

A decree dealing with the creation of renting areas to settle down those living on the riverside areas within DKI Jakarta at present will have to be enacted. It is necessary as the Social Impact Management Plan suggested to conduct within the framework of the project includes resettlement of the squatters, whether they have obtained resident status or without it. The decree should declare the following:

- Creation of the resettlement areas for the squatters should be made possible in order to give right of way of the project improving drainage channels within the boundaries of DKI Jakarta. It is necessary for the Urban Drainage Project of the City of Jakarta that takes place in Jakarta Barat and Jakarta Utara so as to avoid the squatters moving into other drainage channel area and claim for the second, or even third compensation money.
- Those living in the riverside areas of the drainage channels subject to rehabilitation under are subject to resettlement to the designated areas created by DKI Jakarta.
- Resettlement areas designated for resettlement of the squatters are created by DKI Jakarta in the "designated locations" and the "address".
- Designated resettlement areas shall be purchased by DKI Jakarta. Where necessary, the area is filled or excavated and make good to resettle designated number of families relocated from the riverside areas of the drainage channels subject to rehabilitation under "The Detailed Design for Urban Drainage Project in the City of Jakarta".
- Rent of the designated resettlement areas per unit of land shall be determined by the factors of prevailing land price, initial input of cost of preparation, expected sum accumulated with the collector over a fixed period of time as well as the price at the designated time of disposal.
- Resettling squatters are subject to sign contract prepared by DKI Jakarta for rent.
- Eligibility of the renter shall be the squatters relocated from the riverside areas of the drainage channels subject to relocation under "The Detailed Design for Urban Drainage Project in the City of Jakarta".
- Eligible renter shall be entitled to receive no compensation. However, DKI Jakarta shall assist to move their building materials and movable possessions to the designated resettlement areas.
- No squatters so desire to move to the areas other than the designated areas prepared by DKI Jakarta shall not be entitled to claim any compensation of whatsoever.

- Designated resettlement areas shall be disposed at the end of the fixed period for rent. The area shall be made use of for commercial development if disposed to private developer. The area shall be, alternatively, disposed to other purposes such as the area for low cost housing development, public parks, cemetery, or any other public purposes.
- Resettled squatters shall be subject to relocation upon request made by DKI Jakarta at the end of the fixed period of time.
- Upon request made by DKI Jakarta for relocation from the designated rented areas, the renter shall be entitled to claim for compensation at the rate of state land whose rate of which is prevailing at the time of relocation.

The same arrangement should be initiated with other project related to rehabilitation of the existing drainage channels within DKI Jakarta. Alternatively, in order to maintain riverside areas free from the squatters, independent project dealing with the squatters could be conducted elsewhere in DKI Jakarta. Any further elaboration on the topic is outside of the scope of works of the project .

7.5.2 Controlling inflow of the squatters

Decrees and associated mechanism to control in-flow of the squatters to DKI Jakarta may have to be elaborated. The decree should depict a mechanism associated with it such as more tight patrolling system to the riverside areas, preventive measures to create settlement areas in the riverside area, etc. At present, newly created canals are fenced to dissuade the squatters to break in. Creating more job opportunities within the rural economy could be considered as one of the mechanism to prevent the squatters to flow in to DKI Jakarta.

Direct measures that the project should conduct in relation to prevent the squatters from living in the riverside area are to fence up the riverside area upon completion of the project .