PERUSAHAAN UMUM LISTRIK NEGARA
AGENCY OF THE MINISTRY OF MINES AND ENERGY
GOVERNMENT OF THE REPUBLIC OF INDONESIA

KOTAPANJANG HYDROELECTRIC POWER PROJECT

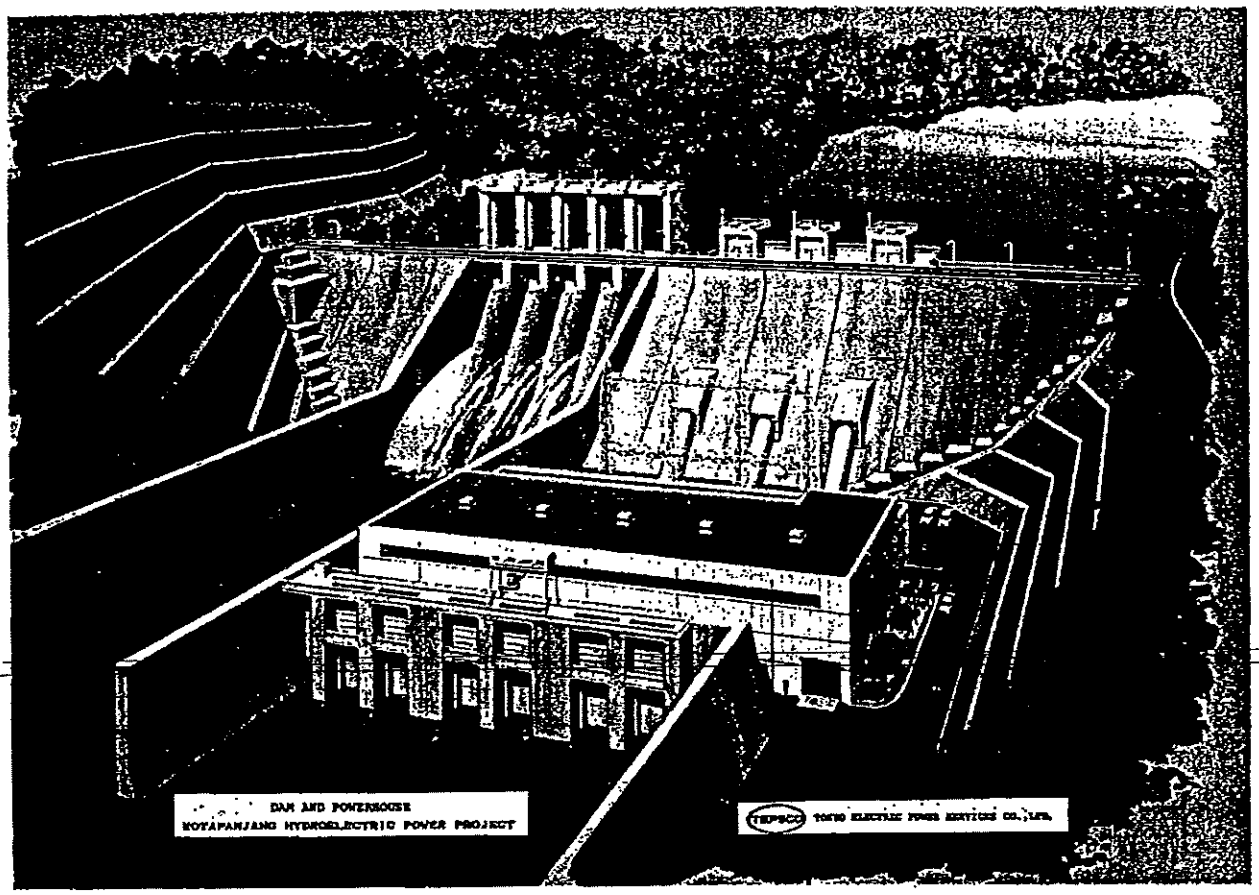
DETAILED DESIGN REPORT

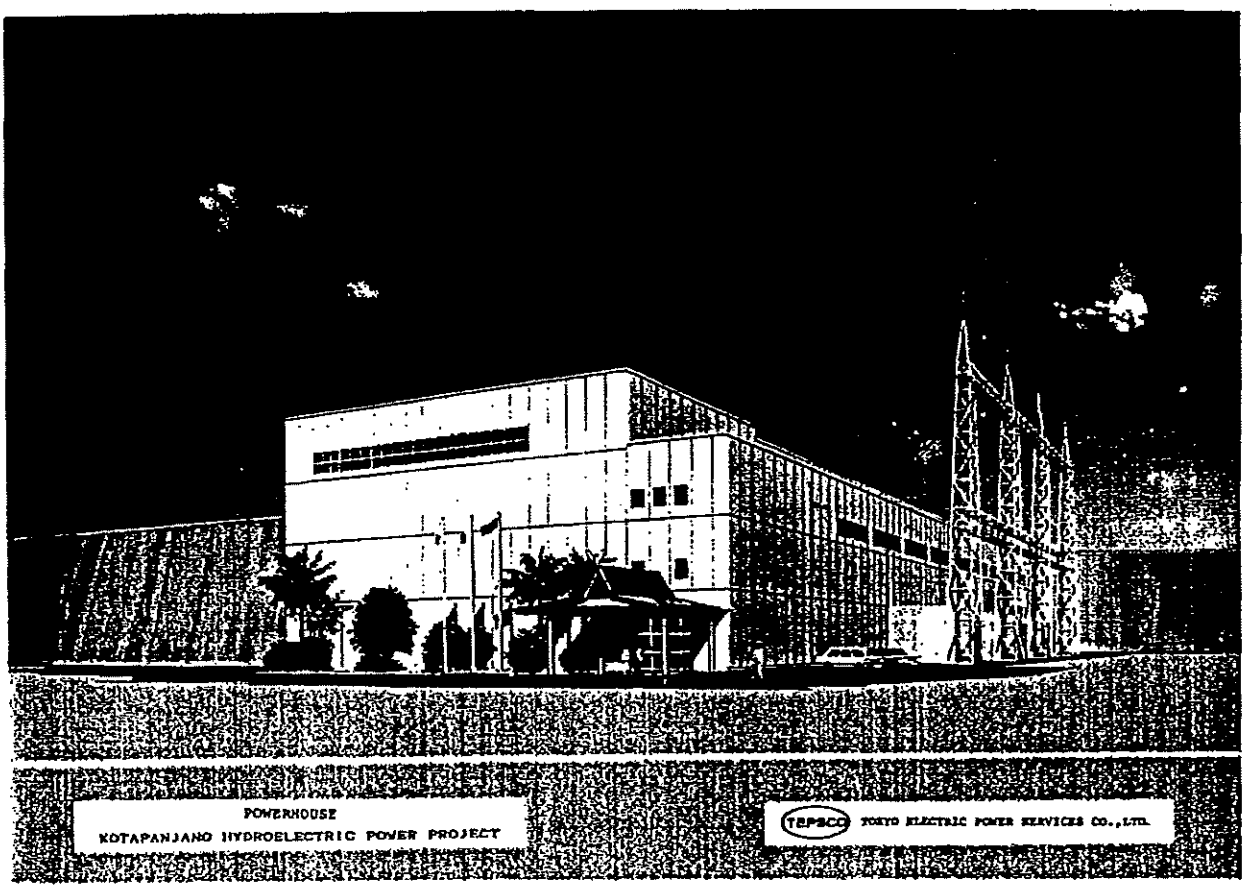
VOLUME I

GENERAL

AUGUST 1988

TOKYO ELECTRIC POWER SERVICES CO., LTD.
IN ASSOCIATION WITH
P.T. YODYA KARYA

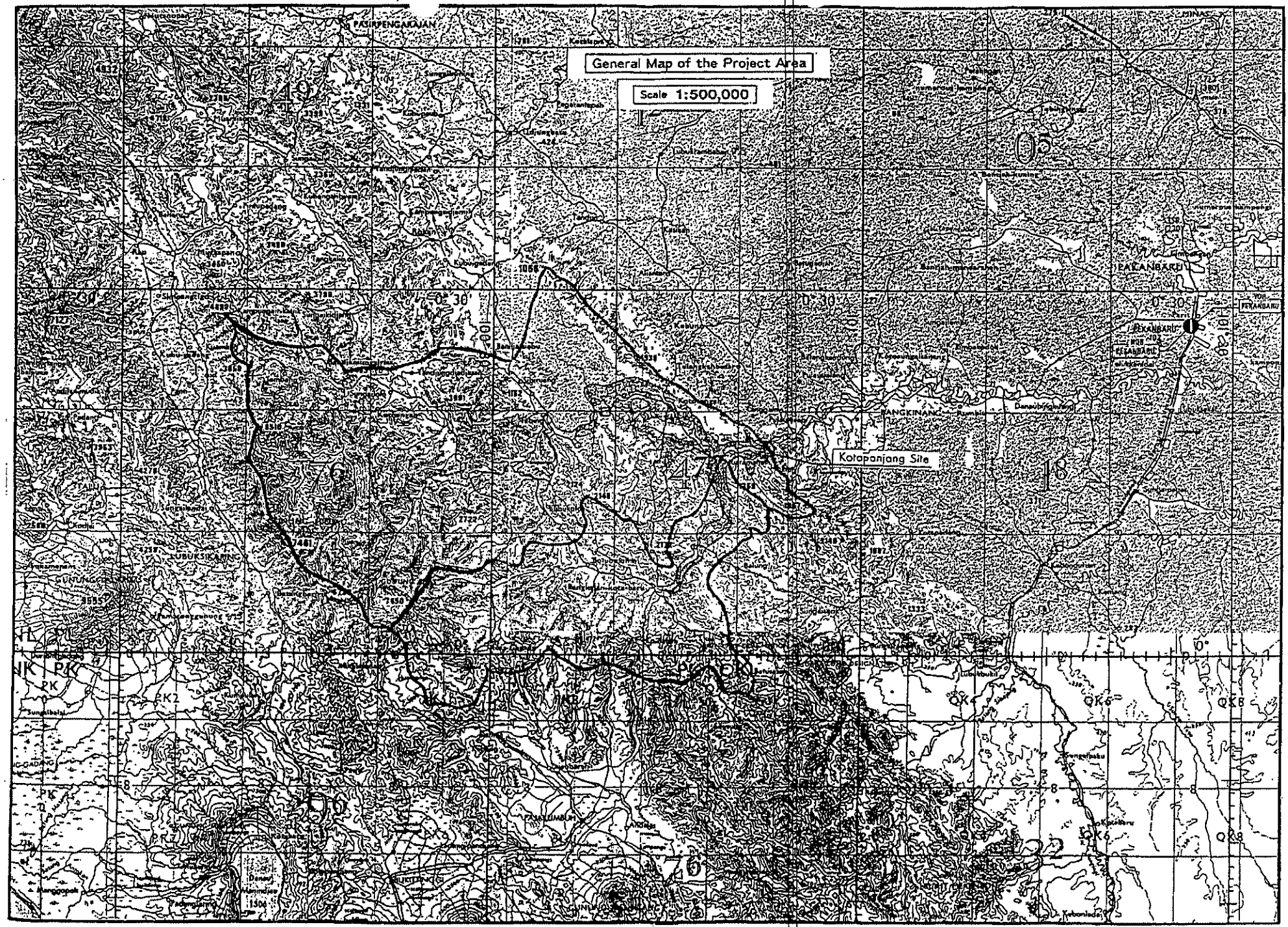

DAM AND POWERHOUSE
KOTAPANJANG HYDROELECTRIC POWER PROJECT
TEPSCO TOKYO ELECTRIC POWER SERVICES CO.,LTD.


POWERHOUSE
KOTAPANJANG HYDROELECTRIC POWER PROJECT
TEPSCO TOKYO ELECTRIC POWER SERVICES CO.,LTD.

DETAILED DESIGN REPORT (KOTAPANJANG H.E.P.P.)

GENERAL CONTENTS OF REPORT

VOLUME		
Vol. 1	GENERAL	
Vol. 2	CIVIL WORKS - PART 1	Dam
Vol. 3	CIVIL WORKS - PART 2	Powerhouse and River Diversion
Vol. 4	CIVIL WORKS - PART 3	Transmission Tower Foundation, Substation and Switchyard foundation
Vol. 5	Appendix 1 to Vol.2,3,& 4	Drawings (Civil Works)
Vol. 6	Appendix 2 to Vol.2 & 3	Hydrology
Vol. 7	Appendix 3 to Vol.1,2,3&4	Geology -Part 1
Vol. 8	Appendix 3 to Vol.1,2,3&4	Geology -Part 2 (Drawings)
Vol. 9	Appendix 3 to Vol.1,2,3&4	Geology -Part 3 (Suplement Data)
Vol. 10	Appendix 4 to Vol.2 & 3	Aggeregate and concrete Test
Vol. 11	Appendix 5 to Vol.2 & 3	Hydraulics Model Test-Part 1 Spillway Structure
Vol. 12	Appendix 5 to Vol.2 & 3	Hydraulics Model Test-Part 2 Intake Structure
Vol. 13	METAL WORKS	
Vol. 14	Appendix 1 to Vol.13	Drawings (Metal Works)
Vol. 15	Generating Equipment and Transmission Line Materials	
Vol. 16	Appendix 1 to Vol. 15	150 KV Transmission Line (Design)
Vol. 17	Appendix 2 to Vol. 15	Route Survey Result
Vol. 18	Appendix 3 to Vol. 15	Calculation Steel Tower Strength
Vol. 19	ARCHITECTURAL WORKS	
Vol. 20	Appendix 1 to Vol.19	Drawings (Architectural Works)
Vol. 21	RELOCATION ROAD - PART 1	National Road
Vol. 22	RELOCATION ROAD - PART 2	Provincial Road
Vol. 23	Appendix 1 to Vol.21&22	Drawings - Part 1 National Road
Vol. 24	Appendix 2 to Vol.21&22	Drawings - Part 2 Provincial Road
Vol. 25	BRIDGE	
Vol. 26	Appendix 1 to Vol.25	Drawings (Bridge)
Vol. 27	PREPARATORY WORKS	
Vol. 28	Appendix 1 to Vol 27	Drawings (Preparatory Works)
Vol. 29	CONSTRUCTION PLANNING AND PROGRAM	
Vol. 30	CONSTRUCTION COST ESTIMATE	
VOL. 31	Appendix 1 to Vol. 30	Economic and Financial Analysis
Vol. 32	Environmental Management Plan (RKL)	
Vol. 33	Environmental Monitoring Plan (RPL)	


General Map of the Project Area
Scale 1:500,000
Kotapanjang Site
PASIRPENGARAIAN
PEKANBARU
RANGKINANG
SUBUKSIKAMBING

Volume 1 General

C O N T E N T S

Chapter 1 Introduction

1 Introduction

1.1 Authorization

The detailed design report of the Project was prepared for PLN in accordance with the Article 6.3 (a) of the Agreement No. PJ.007/PST/1987 dated January 15, 1987 regarding Specifications, Designs and Reports for the Kotapanjang Hydroelectric Power Project.

This detailed design will form the fundamental data to work out the Tender Documents for the procurement and construction of the Project.

1.2 Composition of the Report

After submission of the Basic Design Report in January 1988, a few modifications of the construction planning and program as well as a series of structural and other studies on the project components were added to the contents of the Basic Design Report.

This report consists of a total 33 volumes as listed below, which includes 18 appendices containing the supporting data.

Volume 1	General	
Volume 2	Civil Works - Part 1	Dam and Diversion Tunnel Structures
Volume 3	Civil Works - Part 2	Powerhouse, Tailrace Structures and Others
Volume 4	Civil Works - Part 3	Transmission Tower Foundation Substation and Switchyard Foundation
Volume 5	Appendix 1 to Vol.2,3 & 4	Drawings (Civil Work)
Volume 6	Appendix 2 to Vol.2,3 & 4	Hydrology
Volume 7	Appendix 3 to Vol.2,3 & 4	Geology - Part 1
Volume 8	Appendix 3 to Vol.2,3 & 4	Geology - Part 2
Volume 9	Appendix 3 to Vol.2,3 & 4	Geology - Part 3
Volume 10	Appendix 4 to Vol.2 & 3	Aggregate and Concrete Test
Volume 11	Appendix 5 to Vol.2 & 3	Hydraulic Model Test

		- Part 1 Spillway Structures
Volume 12	Appendix 5 to Vol.2 & 3	Hydraulic Model Test - Part 2 Intake Structure
Volume 13	Metal Works	
Volume 14	Appendix 1 to Vol.13	Drawings (Metal Works)
Volume 15	Electrical Works	Generating Equipment and Transmission Line Materials
Volume 16	Appendix 1 to Vol.15	Transmission Line Design
Volume 17	Appendix 2 to Vol.15	Route Survey Result
Volume 18	Appendix 3 to Vol.15	Calculation Steel Tower Strength
Volume 19	Architectural Works	
Volume 20	appendix 1 to Vol.19	Drawings (Architectural Works)
Volume 21	Relocation Road Part 1	National Road
Volume 22	Relocation Road Part 2	Provincial Road
Volume 23	Appendix 1 to Vol.21 & 22	Drawings - Part 1 National Road
Volume 24	Appendix 2 to Vol.21 & 22	Drawings - Part 2 Provincial Road
Volume 25	Bridge	
Volume 26	Appendix 1 to Vol.25	Drawings (Bridge)
Volume 27	Preparatory Works	
Volume 28	Appendix 1 to Vol.27	Drawings (Rreparatory Works)
Volume 29	Construction Planning and Program	
Volume 30	Construction Cost Estimate	
Volume 31	Appendix 1 to Vol.30	Economic Analysis
Volume 32	Environmental Managing Plan (RKL)	
Volume 33	Environmental Monitoring Plan (RPL)	

Chapter 2 Outline of the Project

2 Outline of the Project

2.1 Specification of Kotapanjang Hydroelectric Power Project and Relating facilities

The Detail Design was made to finalize the fundamental framework of the Project as well as its component structures have been established.

The main features of the Project are as follows:

1) Capacity of the Power Plant

Maximum Output : 114,000 kW
(38,000 x 3 Units)

[redacted]

Annual Average Generated Energy : 542 x 10^6 kWH

2) Reservoir

Reservoir Capacity : 1,545 x 10^6 m^3

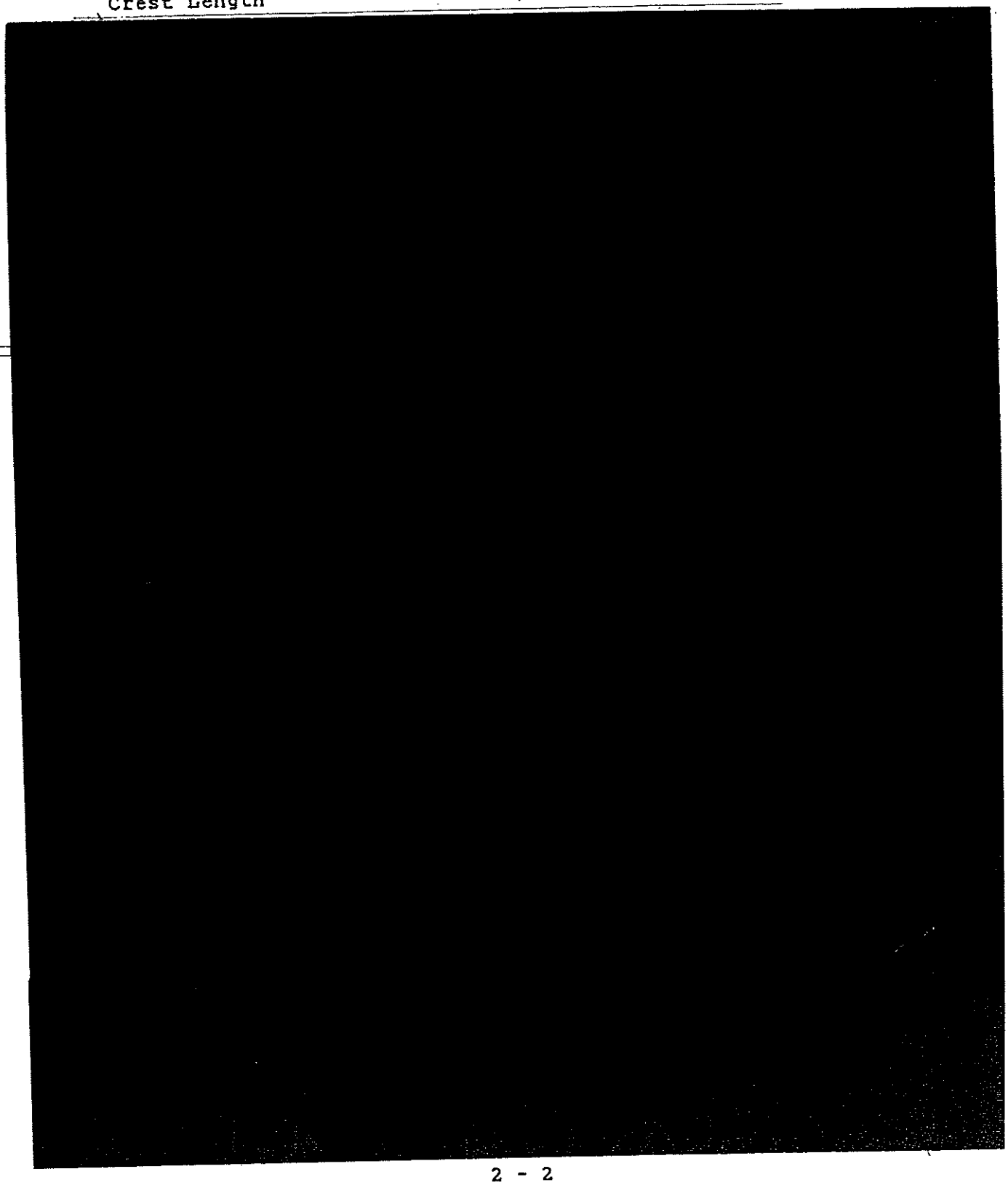
[redacted]

Surface Area : 124 km^2

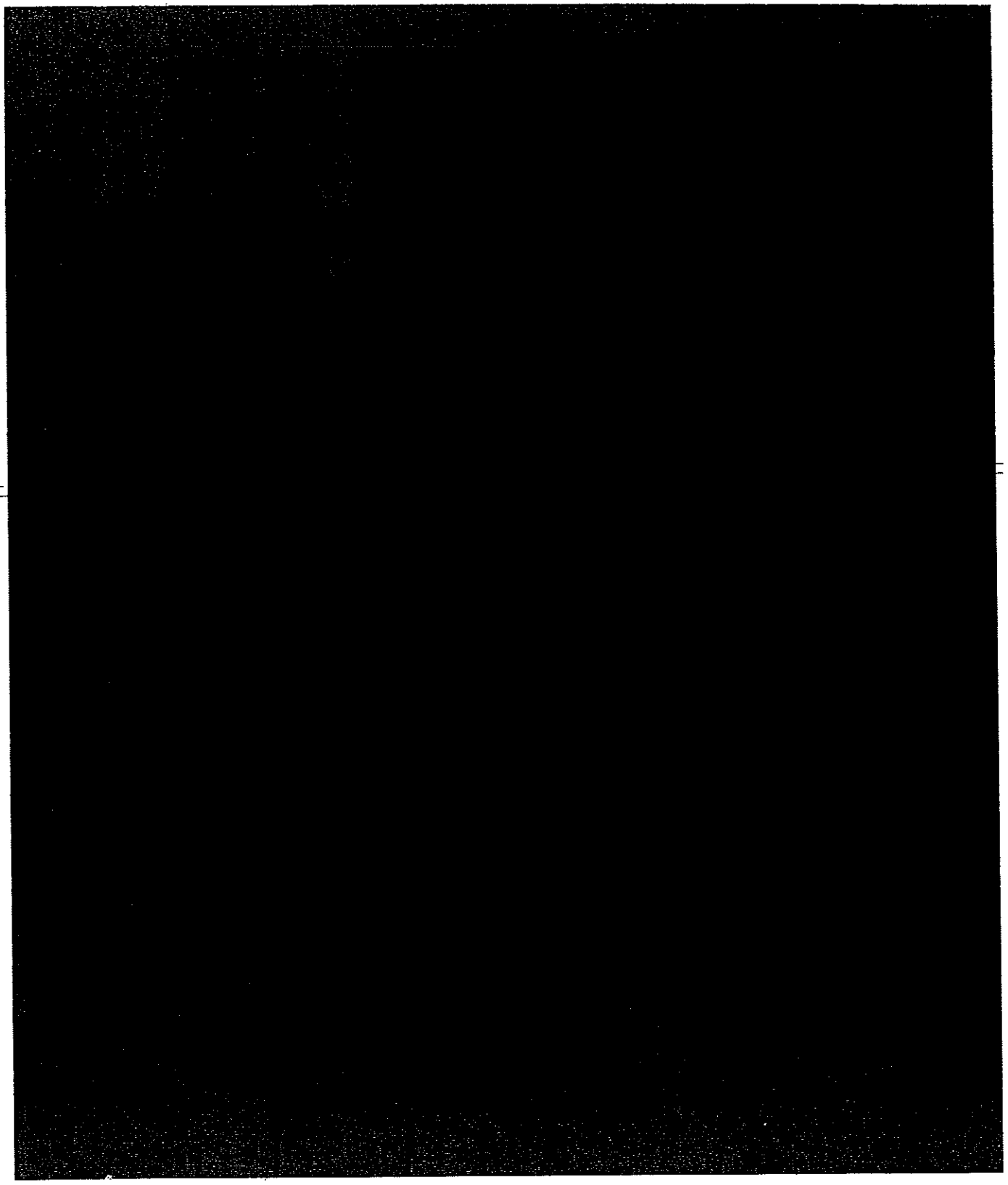
[redacted]

3) Dam

Height	: 58.0 m
Crest Length	: 257.5 m



2.2 Implementation of the Project



[redacted]

2.3 construction Schedule

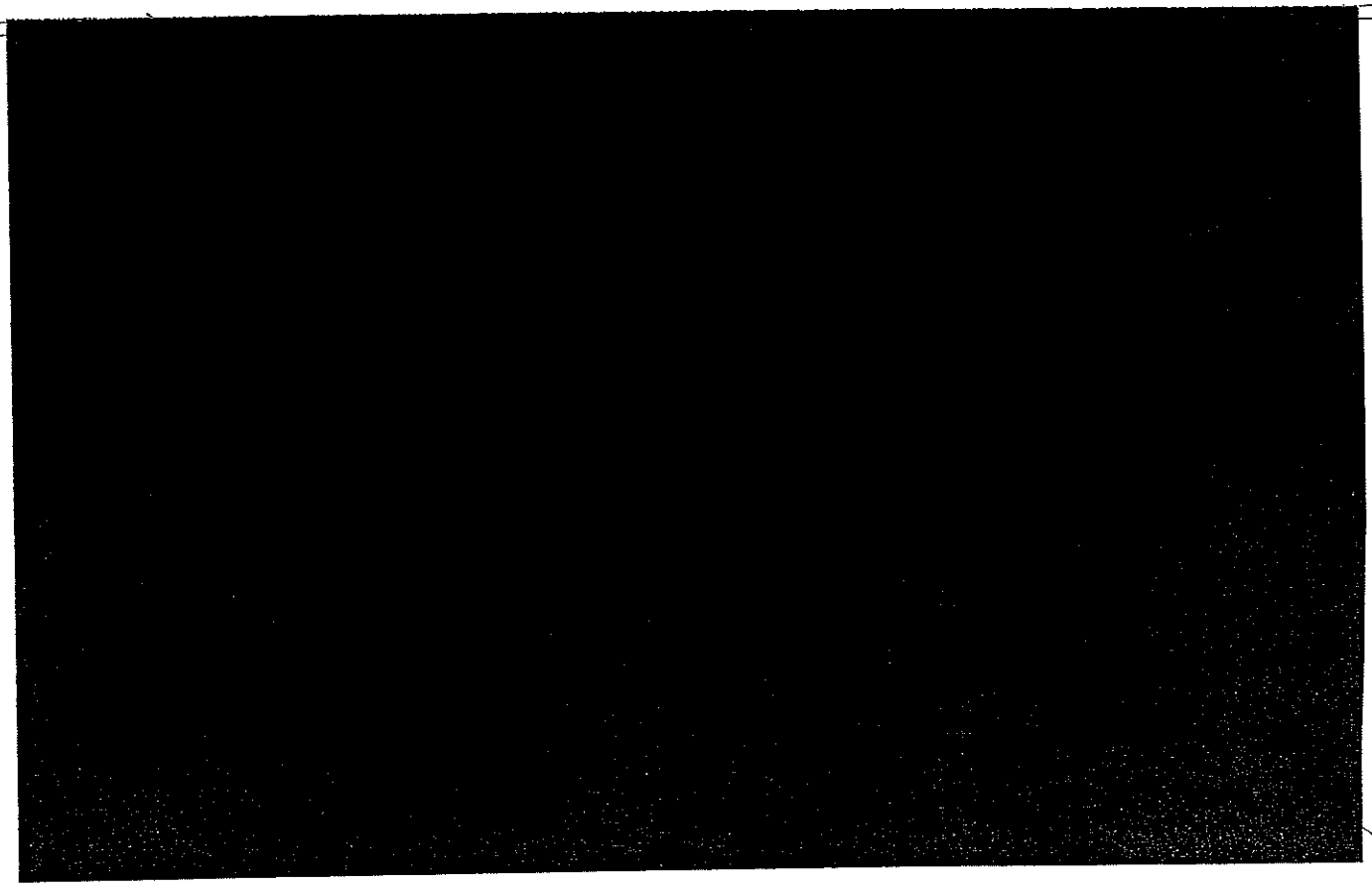
[redacted]

Chapter 3 Technical Feasibility

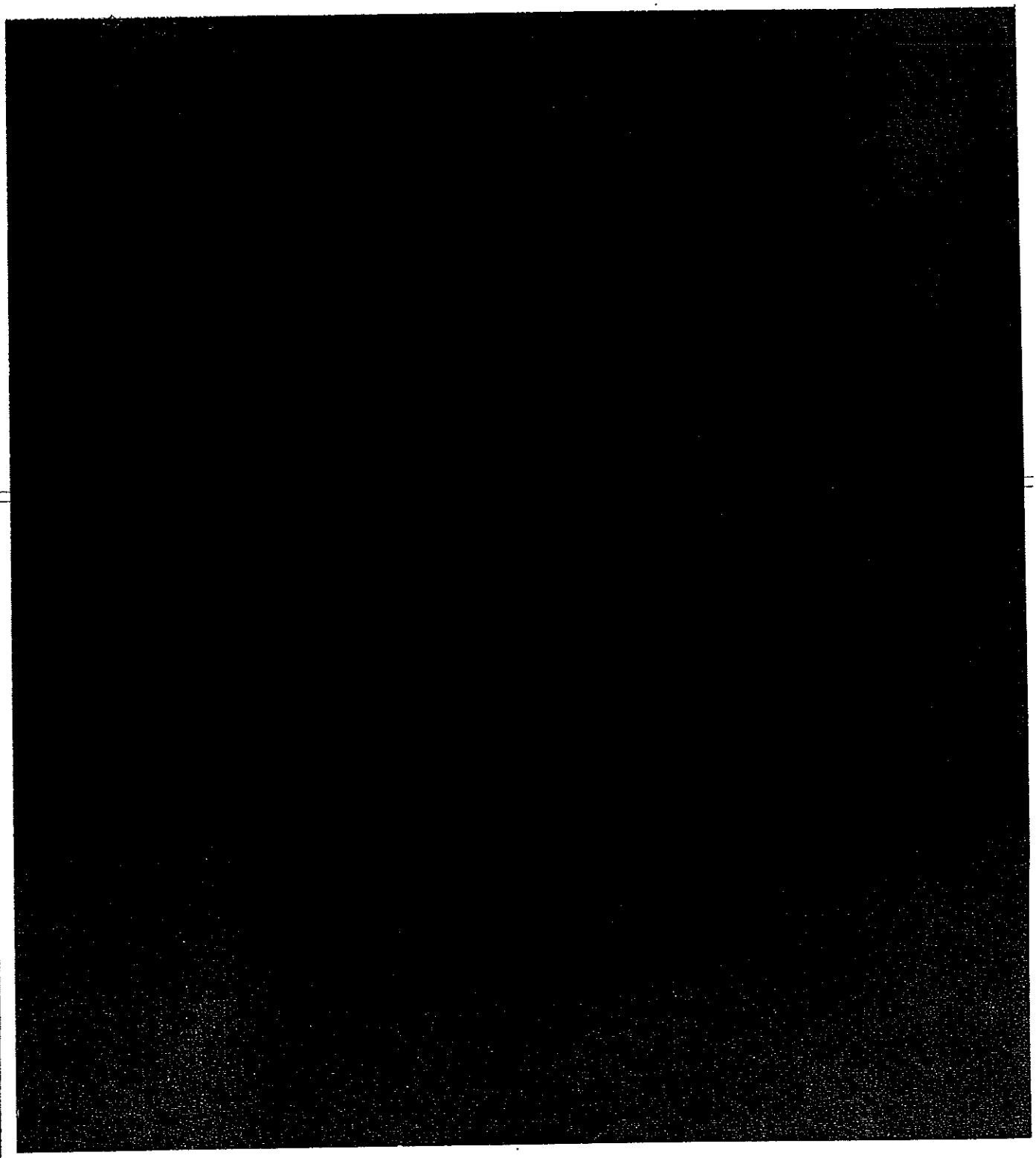
3 Technical Feasibility

3.1 Natural Surroundings

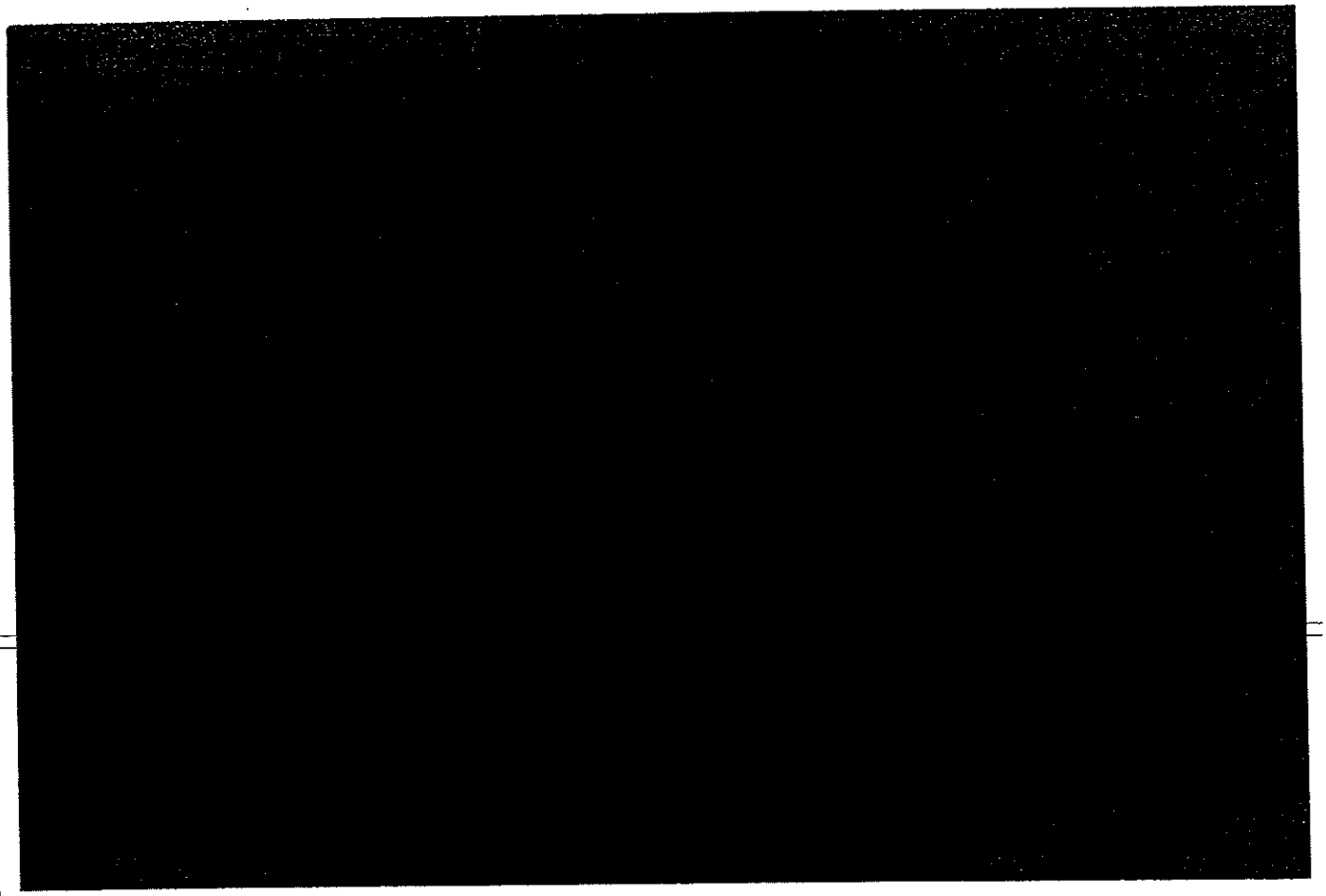
3.1.1 Hydrology



3.1.2 Geology



3.1.3 Sedimentation



3.1.4 Seismology

3.1.5 Aggregates and Cement

1) Aggregate for Concrete

Total concrete volume of main component structures of the Project amounts to approximately 452 thousand cubic meters, of which

Dam Main	286 x $10^3 m^3$
Intake and Stilling basin	44 x $10^3 m^3$
Diversion works (Open, Tunnel, Coffers)	61 x $10^3 m^3$
Penstock route, Powerhouse, and Tailrace	61 x $10^3 m^3$
T o t a l	452 x $10^3 m^3$

The total amount of aggregate to be used is approximately 574 x $10^3 m^3$.

Concrete mix design studies have been made using the aggregates from the deposit in Kuok and Pulau Gadang Gravel Pits. The study indicates coarse aggregate from the Gravel Pits is good quality and reasonably well graded, whereas the sand need to be re-graded in order to satisfy the particle distribution adopted in typical design of mass concrete.

- Kuok Gravel Pit (Refer to Fig. 9)

Kuok Gravel Pit is located about 8 km downstream of the dam site. According to the field investigation carried out so far, the total deposit in the Kuok Gravel Pit is vast (approximately 1,900 x $10^3 m^3$ in the reserve volume) and sufficient for the supply of necessary concrete volume of the Project.

The deposit distributes in an area of approximately 350,000 m^2 with 5 to 6 m thickness. The deposit is overlain by silty layer of 1.5 to 2.0 m depth, which needs to be removed before the extraction of the aggregates.

It should be noted, that the sand and gravel layer is deposited almost below the ground water table, which changes in close connection with the nearby river water level. This necessitates deliberate extraction plan for assuring construction safety.

- Pulau Gadang Gravel Pit (Refer to Fig. 10)

There is also a natural deposit of sand and gravels in the river course of the Kampar Kanan River.

Pulau Gadang Gravel Pit is located at 3 km upstream of the dam site. The river deposit distributes in 1 to 5 m thickness along the river banks, and overlain by silty layer. The probable reserve of the deposit is rather limited (approximately 190 x $10^3 m^3$), but abundant in coarse aggregate of about 80 mm size suitable for the concrete aggregate of the main dam body.
The deposit area is sometimes inundated during flood, which needs careful arrangement for construction schedule to ayoid any detrimental flood inundation of the Gravel Pit.

It should be mentioned that a solid granite rock suitable quality for the coarse aggregate of the mass concrete is available at the Quarry Site located at Muara Mahat, some 8 km upstream of the dam. During the Basic Design stage maximum aggregate size of 150 mm was proposed for the mass concrete, ant it was planned that the crushed granite rock to make up deficiencies in the natural materials in excess of 80 mm size.

After detailed investigations, it was concluded that the maximum size of coarse aggregate to be reduced to 80 mm, based on the thermal analyses of the heat hydration properties of the concrete mix as well as cost comparison analyses. Primary conclusions supporting the change in the mix design are given below.

- Use of maximum 80 mm size aggregate presents no special problems to be considered in the curing of the mass concrete, if the concrete placing was performed below 27°C in the mix temperature. This is accomplished by shifting the placing work in the nighttime and with a minimum precooling of the aggregates.

- The cost in the additional volume for the coarse aggregates from the Gravel Pits plus increase in the cement quantity and other associated works is estimated to be considerably smaller than that required for using the crushed granite from the Quarry Site.

2) Cement

From the view-points of economic and domestic products promotion, the use of local cement should be encouraged. Padang Cement, produced in P.T. SEMEN PADANG, Padang, will be used for the Kotapanjang Project.

Moderate heat Portland cement (Type II) is used in mass concrete to minimize the heat of hydration, and ordinary Portland cement (Type I) is for other parts of structural concrete.
Both Type I and Type II cement produced by P.T. SEMEN PADANG have been tested and proved to be sufficient quality for making concrete.

The total amount of cement to be used in the main component structures of the Project is approximately 100 thousand tons. The production capacity at the cement factory is adequate for the supply of necessary cement volume of the Project, which amounts to a maximum daily consumption of about 240 tons of type II cement during a peak stage in the dam concreting works.

Trial mixes were made in the laboratories with these cement and aggregates proposed for the construction. The mix shall contains a chemical admixture to lower water cement ratio.
According to the result of laboratory test, the concrete given by the specified mix has the sufficient quality for the dam construction.

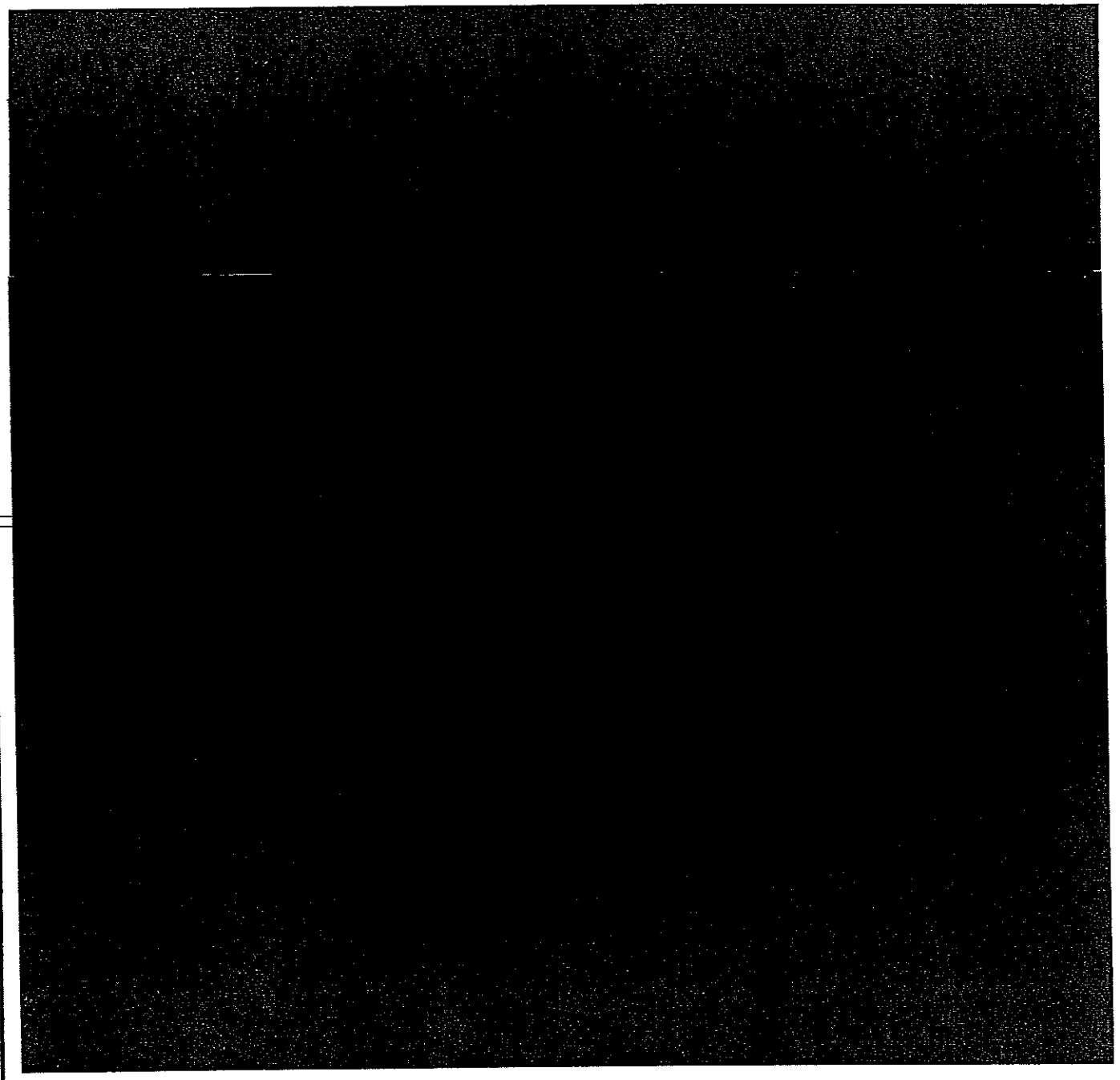
3.2 Detailed Design of the Project

[redacted]

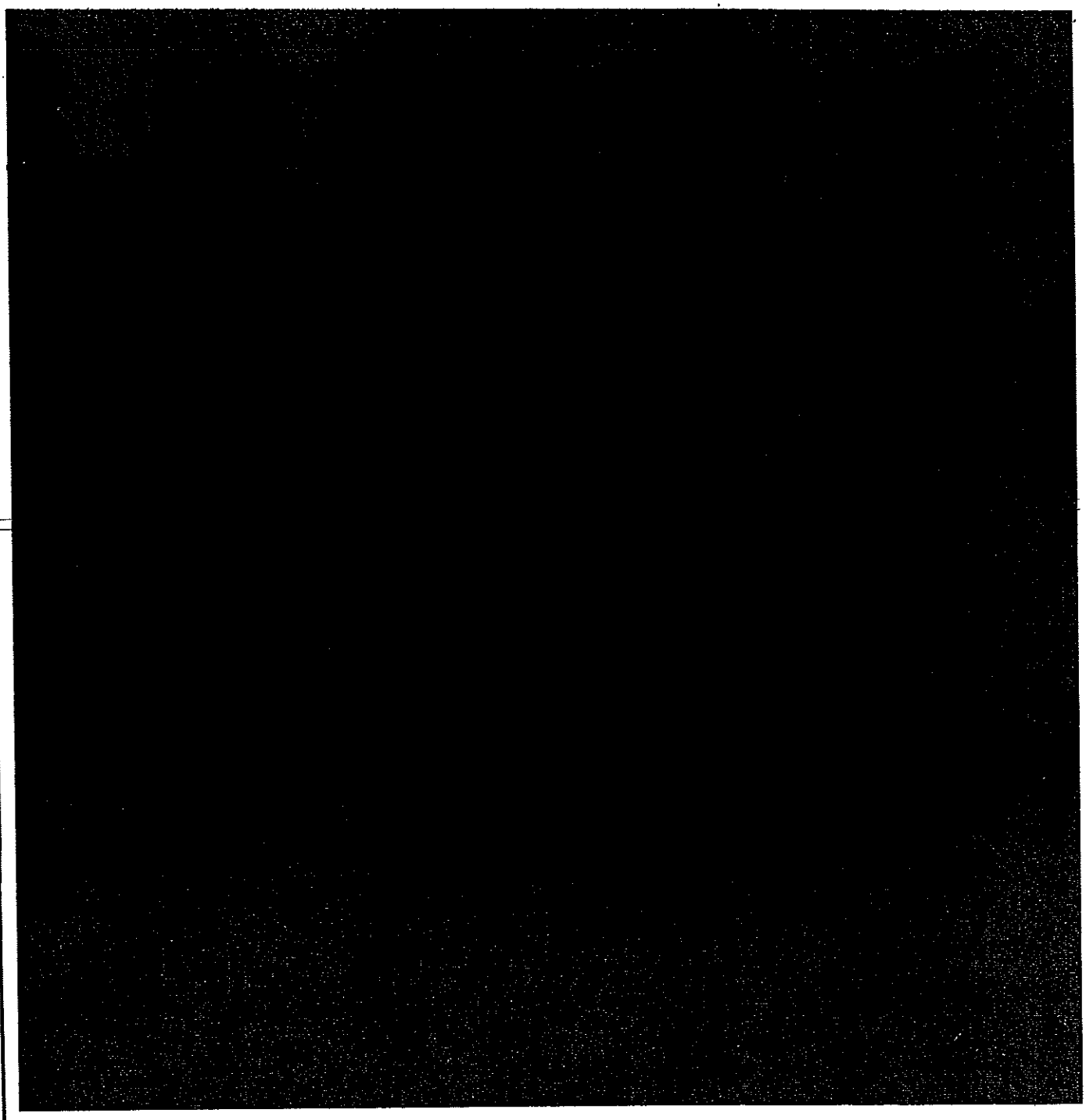
3.2.1 Civil Works

[redacted]

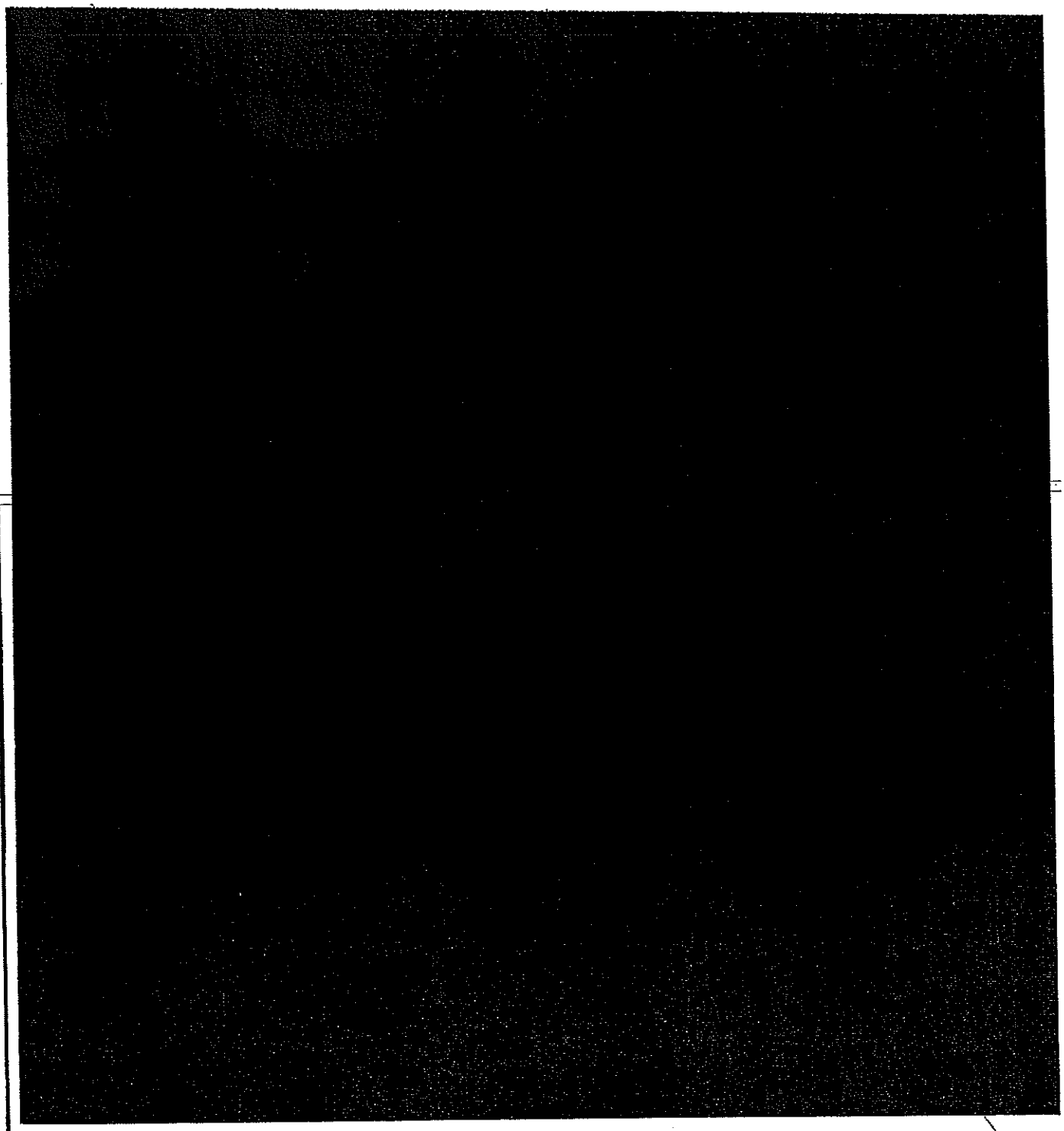
3.2.2 Electro-Mechanical Works



3.2.3 Preparatory Works



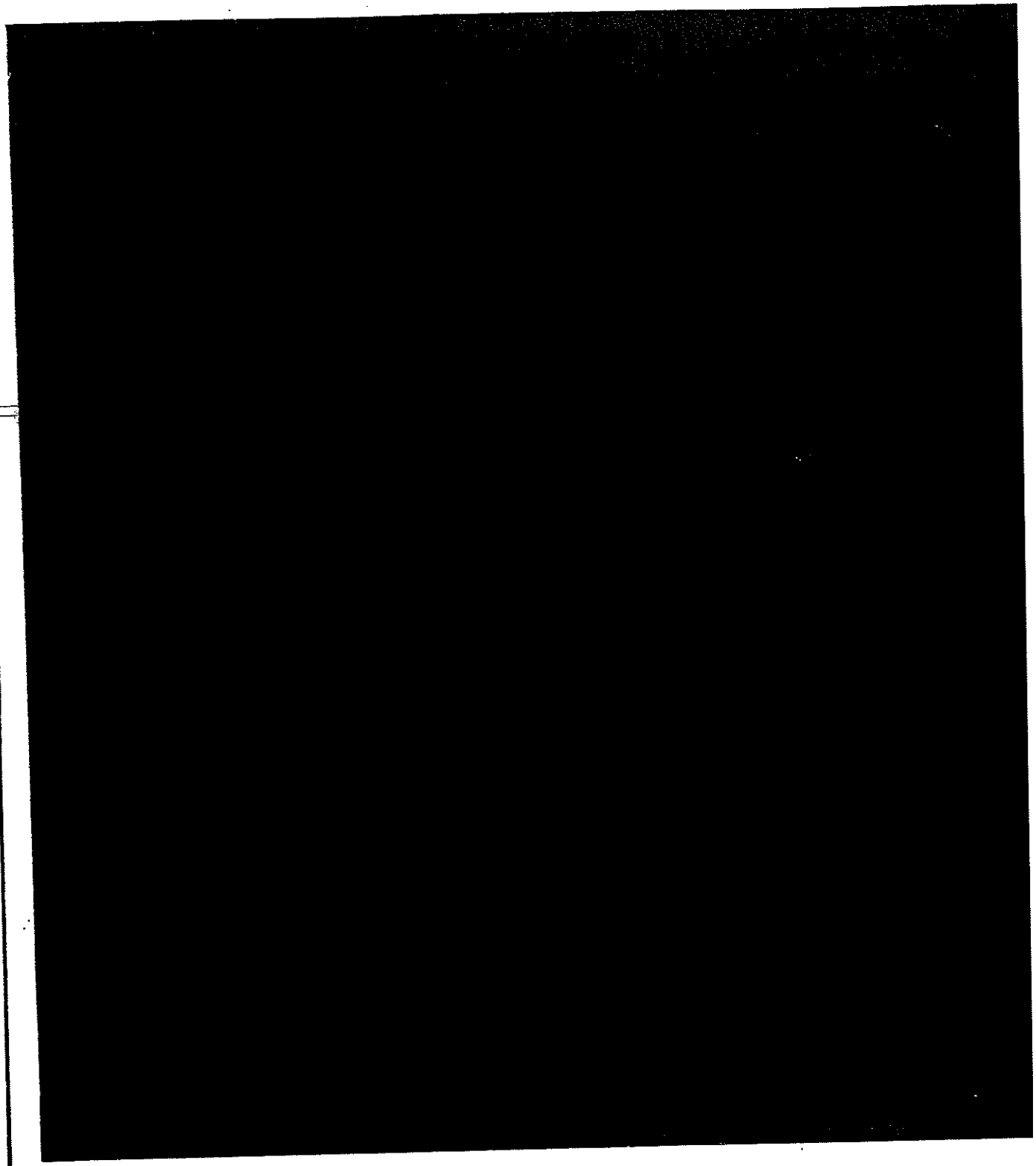
3.2.4 Environmental Works (Refer to Fig.18)



Chapter 4 Economic and Financial Feasibility

4 Economic and Financial Feasibility

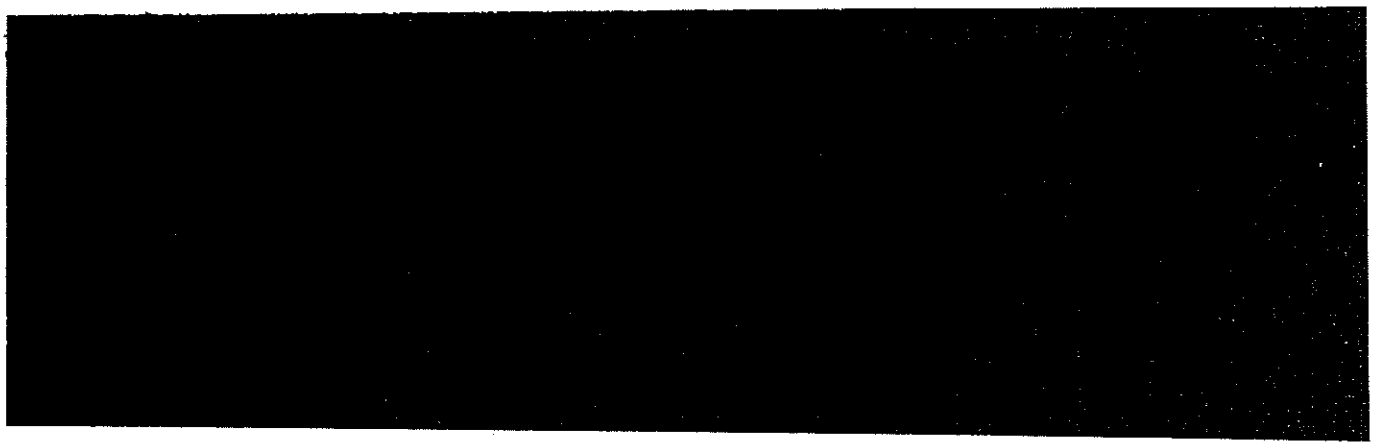
4.1 Summary of Economic and Financial Analysis

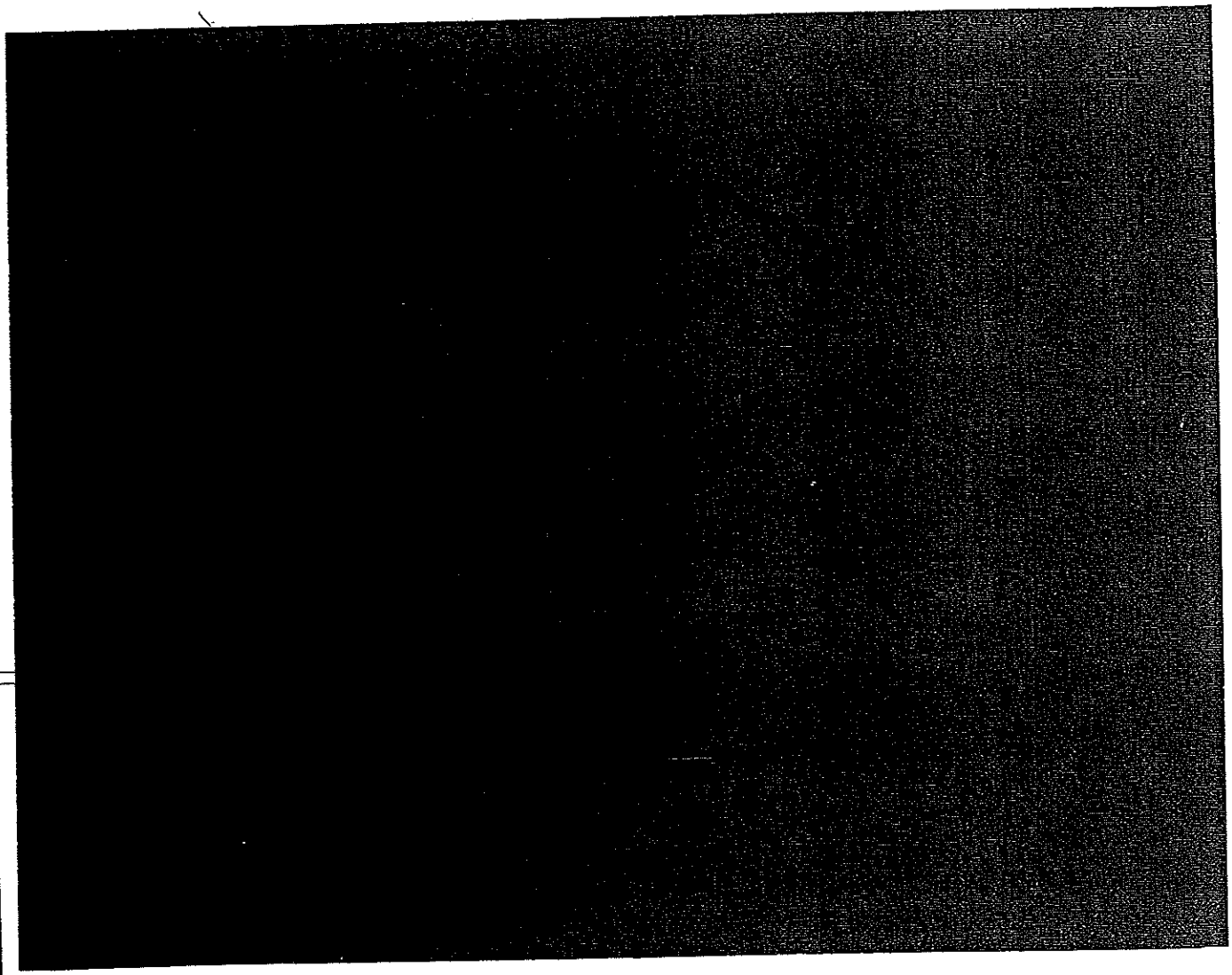


4.2 Economic Analysis

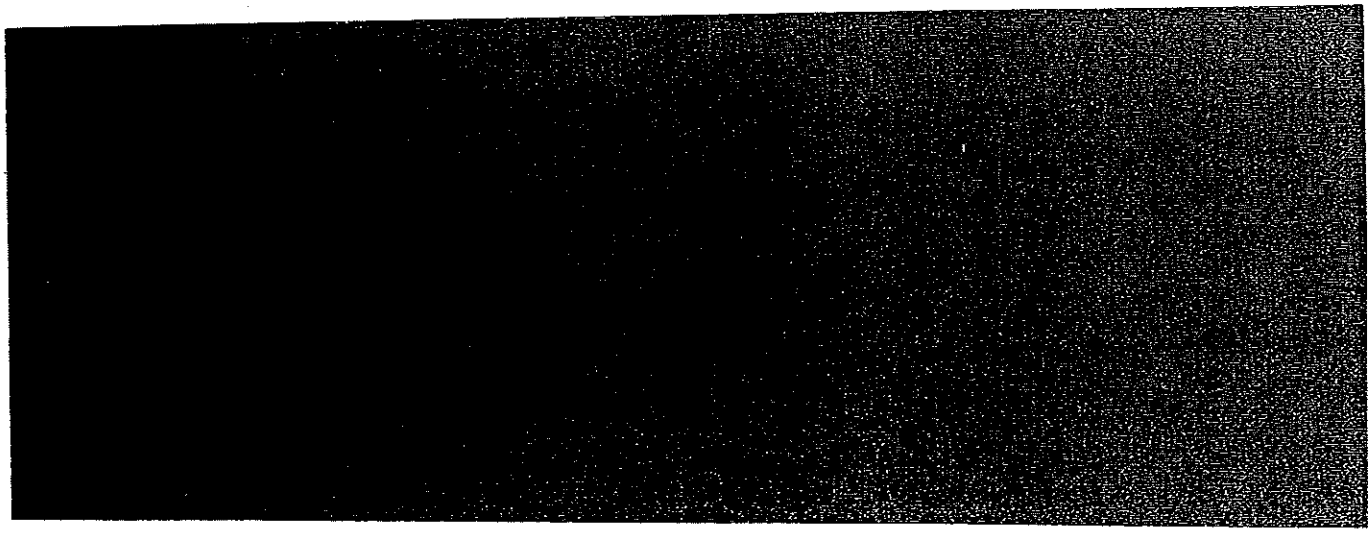
4.2.1 Economic Analysis Method Adopted

4.2.2 Basic Assumption



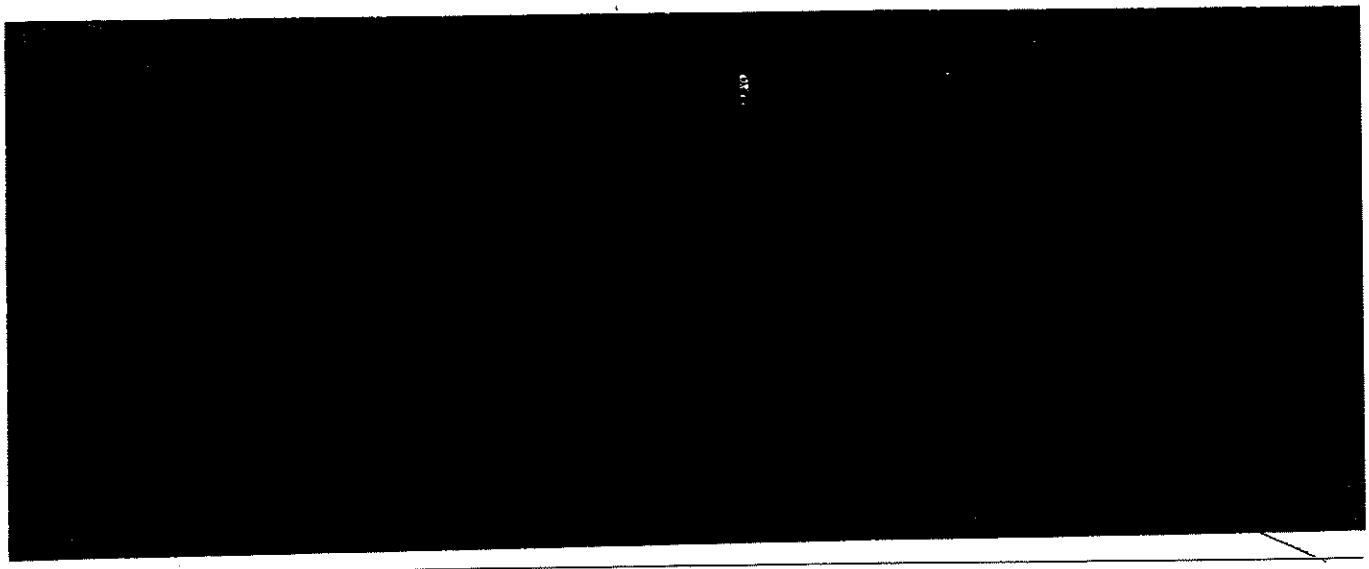


4.2.3 Summary of Calculation Result

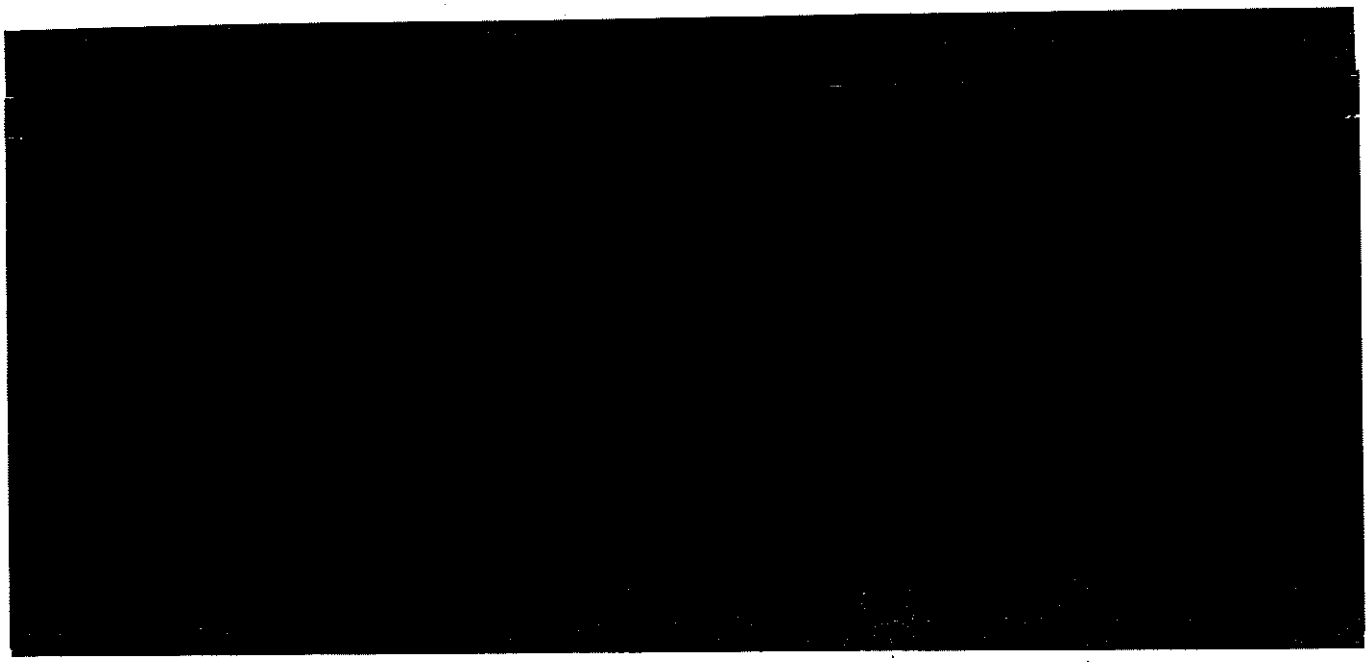


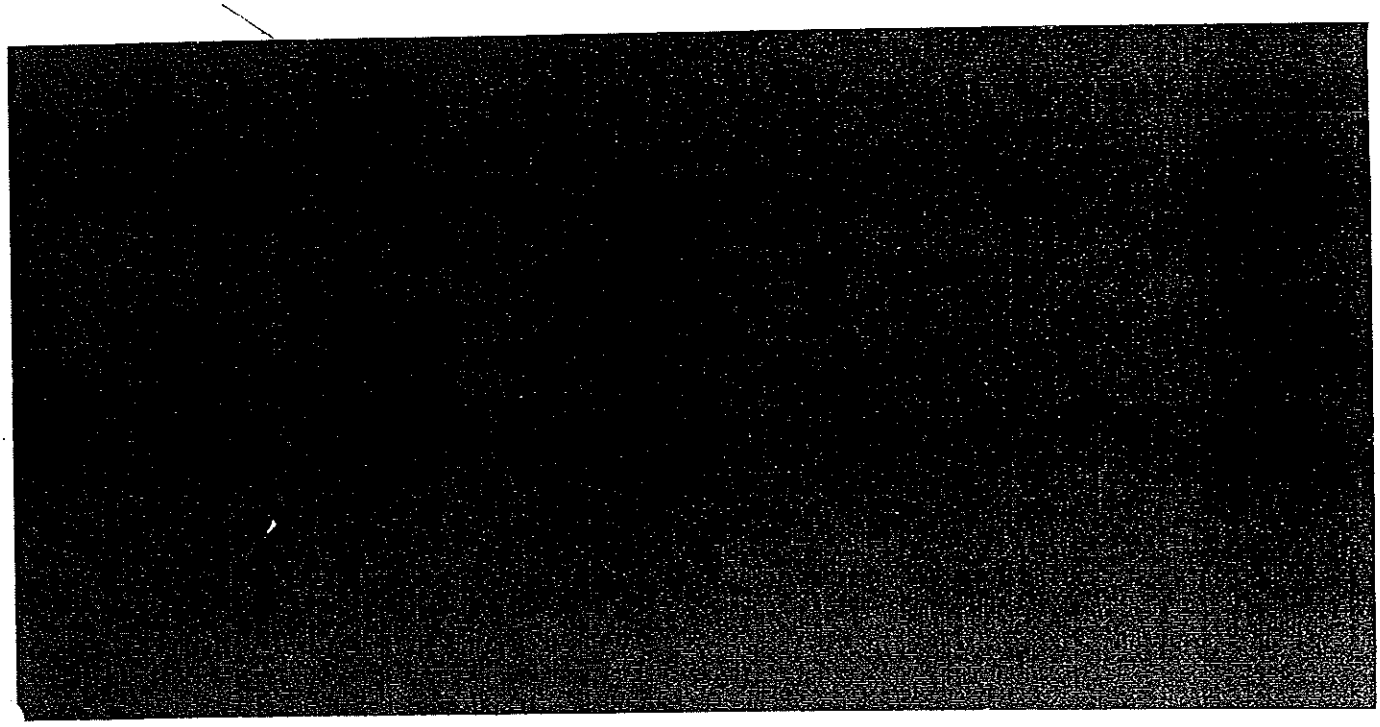
4.3 Financial Analysis

4.3.1 Financial Analysis Method Adopted

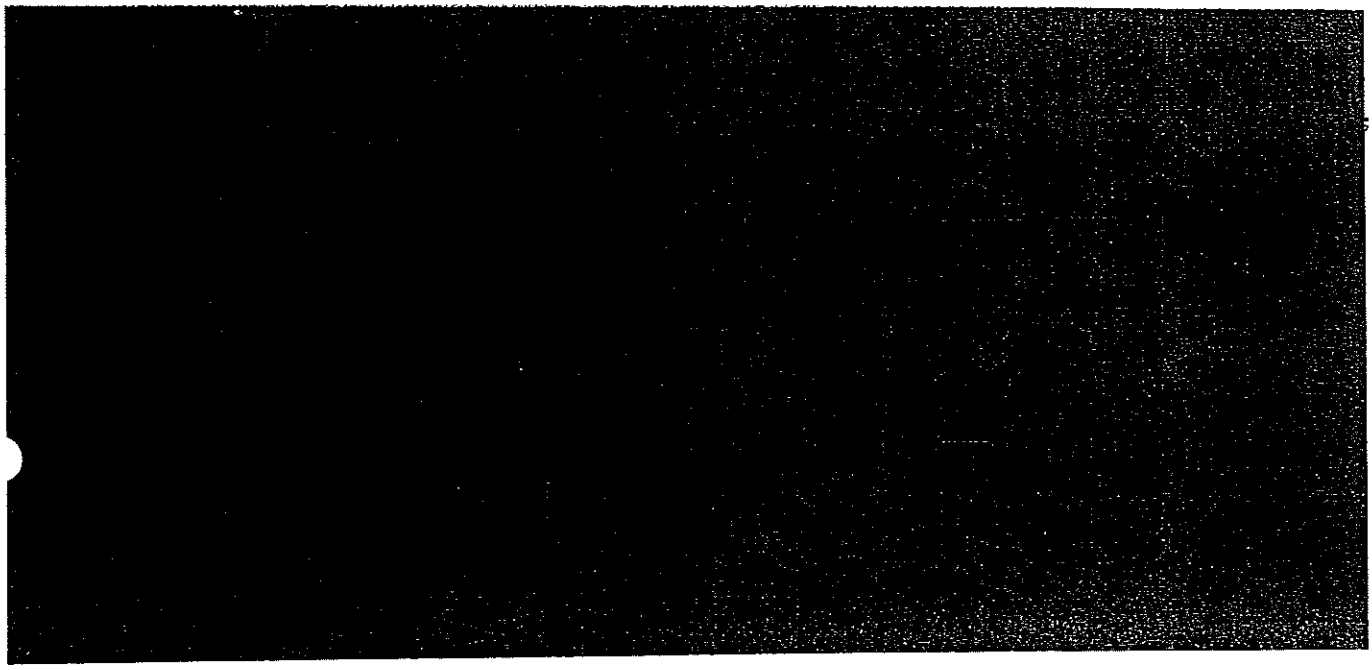


4.3.2 Basic Assumption





4.3.3 Summary of Calculation Result



Chapter 5 Implementation Program

5 Implementation Program

5.1 Introduction

5.1.1 Background of the Project

To cope with the urgent necessity of developing electric power resources in the island of Sumatra, the Government of the Republic of Indonesia requested the Government of Japan to make a pre-feasibility study of the hydroelectric power projects in island of Sumatra. The study, carried out in 1980 by The Tokyo Electric Power Services Co., Ltd., Tokyo, Japan (hereinafter referred to as TEPSCO), clarified the possible power potentials existing in the reaches of the Kampar River in Riau Province, especially the Kotapanjang Project.

The Government of Japan accepted a further request from the Government of the Republic of Indonesia for the feasibility study of the Kotapanjang Hydroelectric Power Development Project on the Kampar river system, and entrusted the Japan International Cooperation Agency, Tokyo, Japan, (hereinafter referred to as JICA) to execute the above feasibility study. The JICA organized a survey team composed of engineers and experts of TEPSCO, and dispatched the survey team to Indonesia from January 1982. The work was co-ordinated by Perusahaan Umum Listrik Negara (Agency of Ministry of Mines and Energy of the Republic of Indonesia, hereinafter referred to as PLN), with considerable assistance provided from the National Planning and Development Board (BAPPEDA), the Central Bureau of Statistics, the Department of Public Works (DPUP), as well as officials of the Riau Province. The feasibility study report, submitted in March 1984, assessed the feasibility of the said project with an output of 111 MW.

PLN has carried out since then a series of the detailed field survey and project study in collaboration with TEPSCO, and the following reports have been prepared to date:

Inception Report, April 1987
Basic Design Report, January 1988
Detailed Design Report, July 1988

In the Detail Design Report, the power plant of 114 MW capacity with 542 GWh generated energy of the Project has been finalized.

The location of the Project site is identified in Exhibits 4.

The energy to be produced by the Kotapanjang power station shall be supplied to the Central Sumatra Power System.

5.1.2 Necessity of the Project

1) National policy toward power development

Indonesia's National Development based on systematic planning has been proceeding in stages, and now the Government of Indonesia has launched its fifth five-year development plan from April 1988 to March 1993.

The Government's policy launched as first priority is "equally distributed development in the entire region". "Equally distributed" means that development project or facilities should be carried out equally in the whole regions.

Indonesia's energy policy is called "General Policy for energy". It includes oil conservation and energy diversification by utilizing natural gas and coal, developing hydropower and geothermic power, and also utilizing waste product of forest industries. Nuclear energy will also be utilized if necessary.

The utilization of hydropower is still very low, a big amount of its resources is still left undeveloped.

The concept of the integrated hydropower development in province of Riau is one of the special efforts in order to be able to maintain equally distributed development in the entire regions of Indonesia.

The Kampar River, the largest rivers in Sumatra Island, has two large tributaries, flows down on the eastern part of the catchment area of 21,530 km^2.

The Kampar Kanan is the northernmost tributary of the Kampar river system. The characteristics of the Kampar river basin are summarized as follows:

- The river has a large catchment area.
- The river gradient is gentle in the reservoir area, and a large pocket is located upstream of the dam site.
- The river assumes a valley form for a distance of 1 km around the area of dam site.

These facts prove that the Kampar Kanan River is ideal with abundant discharge and possessing large capacity reservoir area by constructing medium high dam, both of which are indispensable for hydroelectric power development at low power cost.

PLN intends to extent the existing installed capacity in Central Sumatra. To meet the immediate required power demand, PLN installs gas turbine power plants and diesel power plants. To meet the power demand in the former half of 1990's, PLN has planned to develop the Ombilin Coal-fired power plant (50 MW x 2 units) and the Kotapanjang Hydroelectric power plant to meet further power demand forecast after 1995 of approximately 100 MW. Concurrently, PLN is promoting the expansion of the 150 KV transmission line to interconnect the power systems of West Sumatra and Riau.

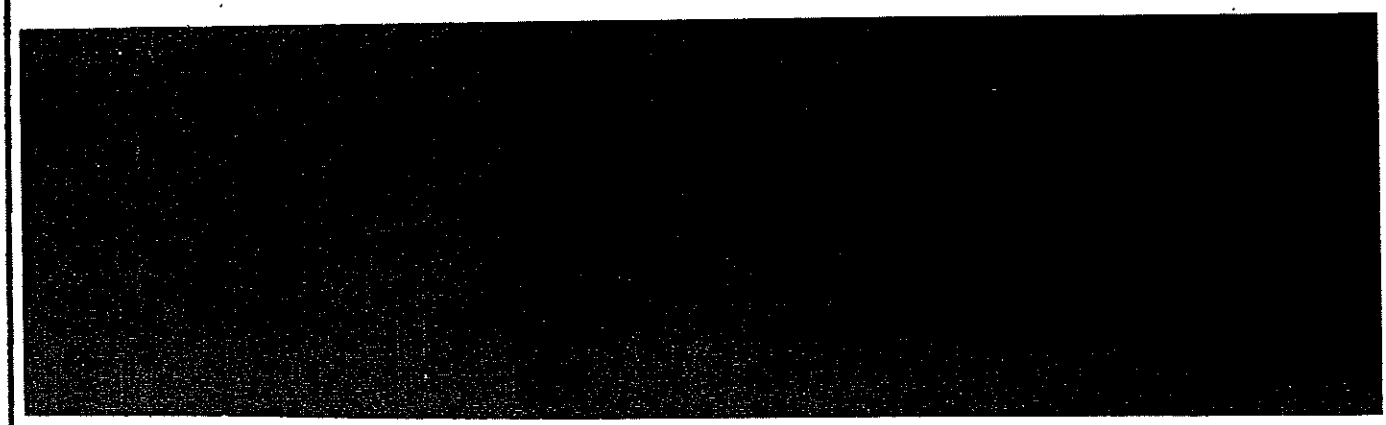
5.2 Implementation of Project

5.2.1 Scope of the Project

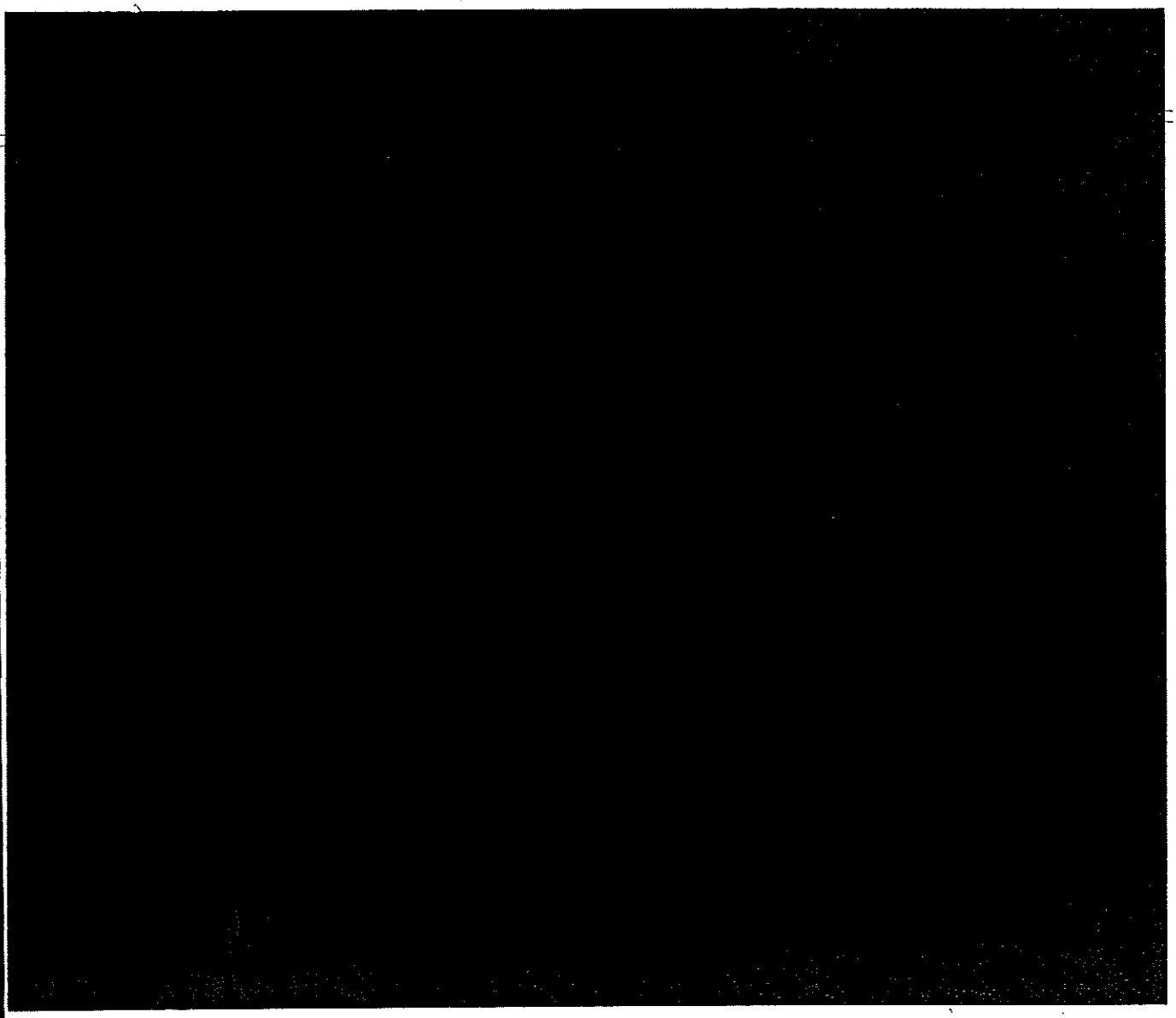
[redacted]

5.2.2 Finance of the Project

[redacted]



5.2.3 Contract Program



List of Exhibits

List of Figures

List of Figures (Cont'd)

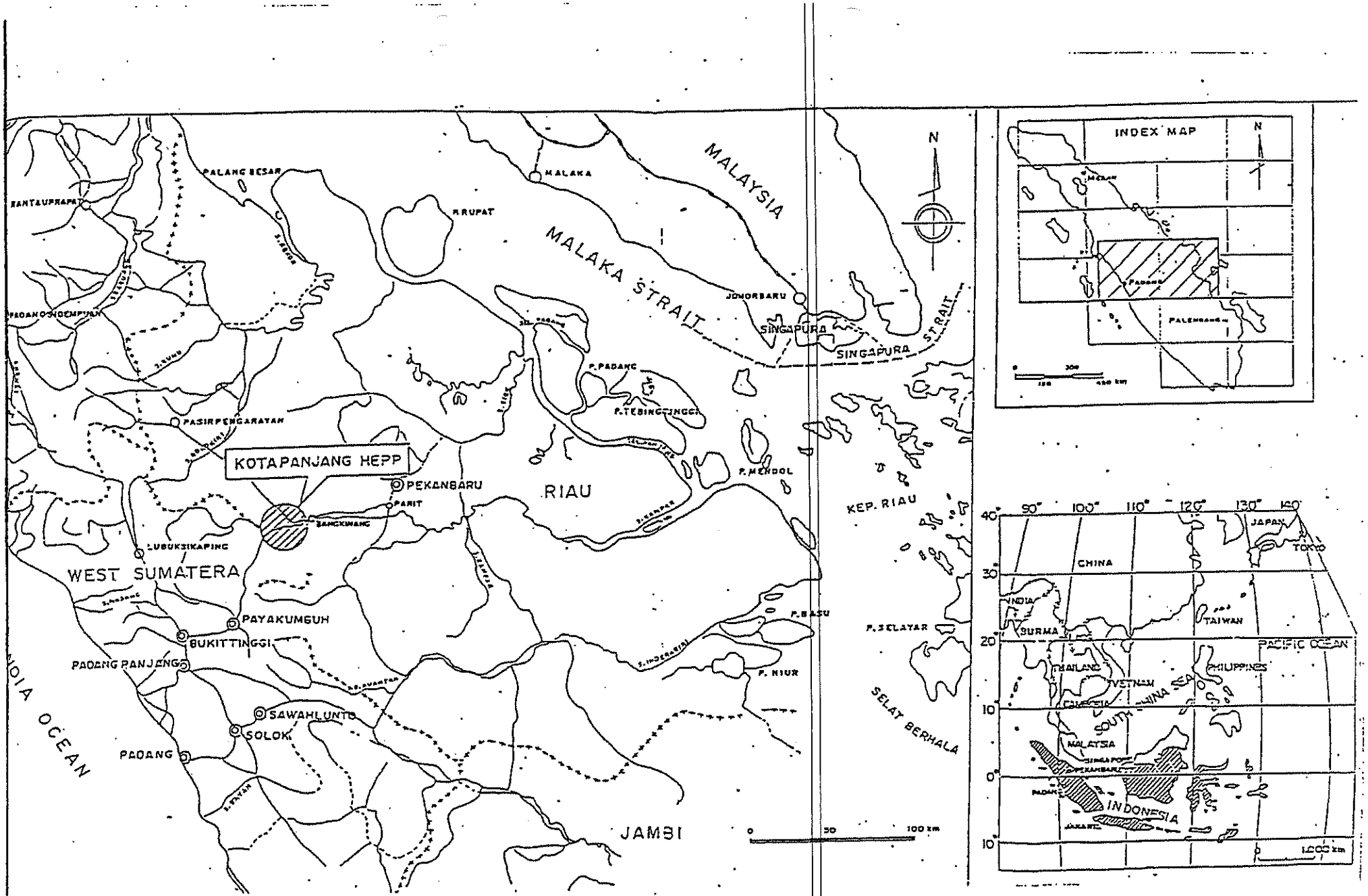


Exhibit 4. Location of Project Site

Power source	Installed capacity (MW)
WEST SUMATRA	
HYDRO	78.5
GAS TURBINE	42.7
DIESEL	38.8
Sub-Total	160.0
RIAU	
DIESEL	31.5
Total	191.5

Exhibit 5. Present Power Sources

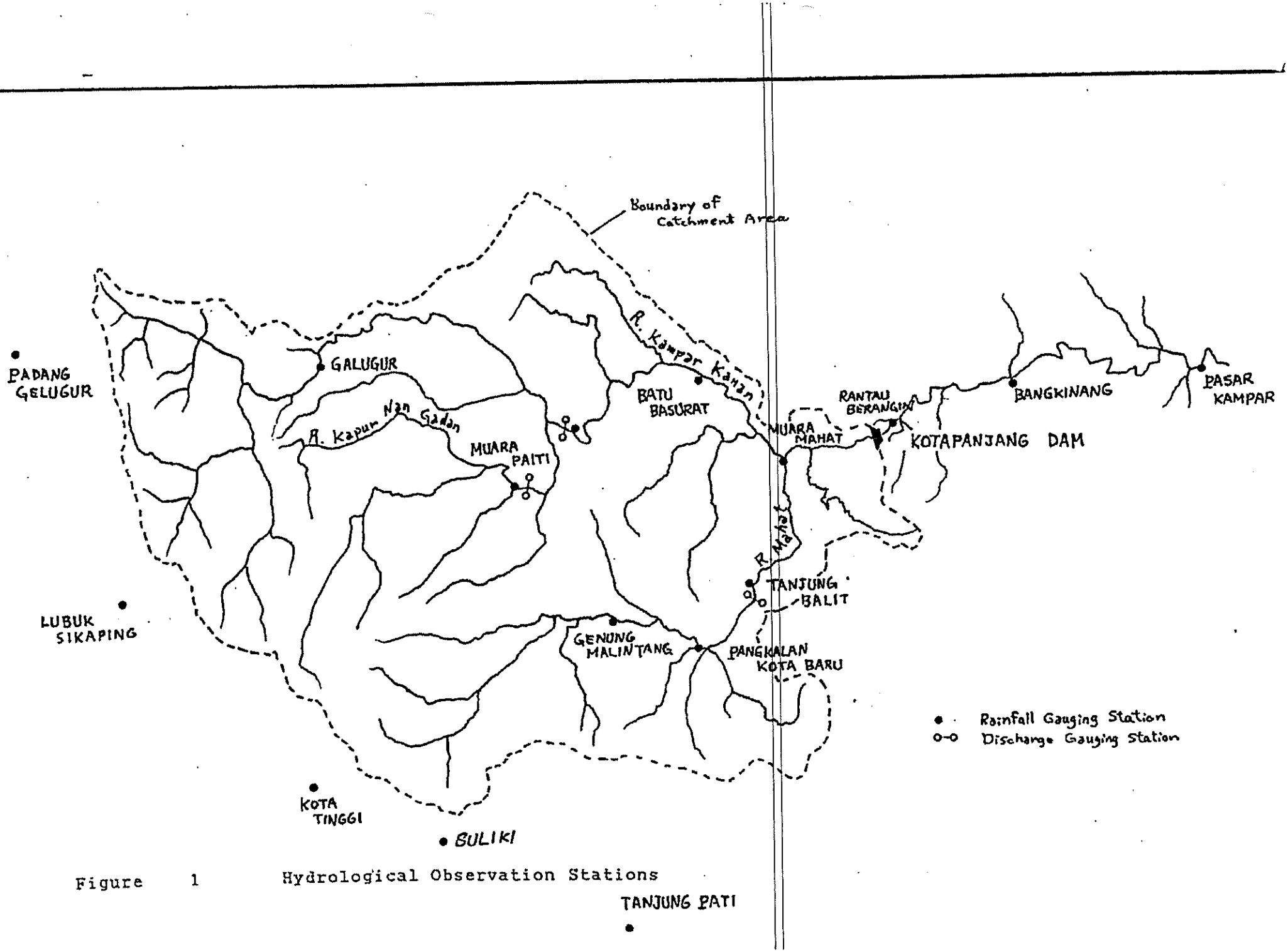


Figure 1 Hydrological Observation Stations

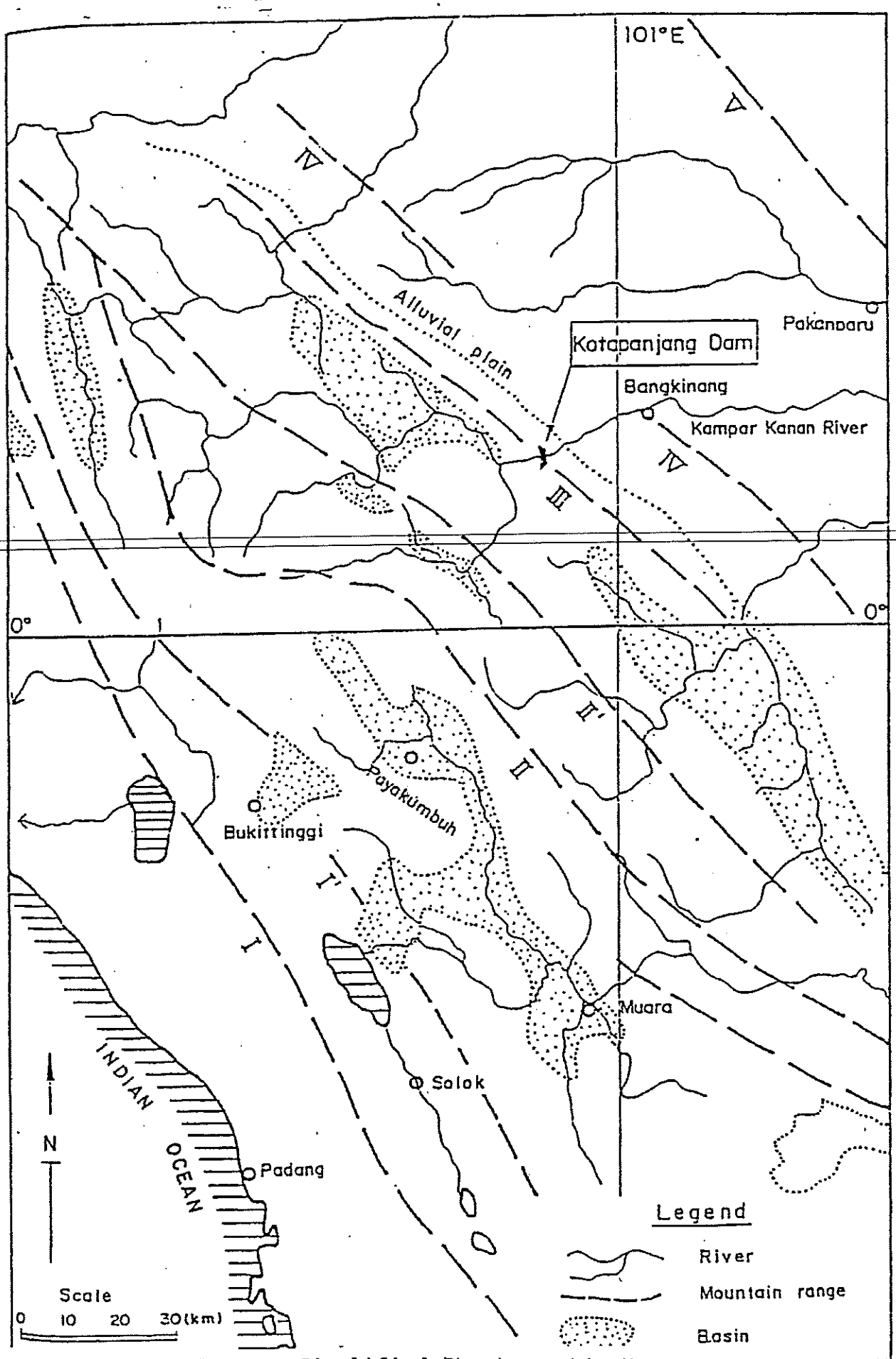


Figure 3 Simplified Physiographic Map

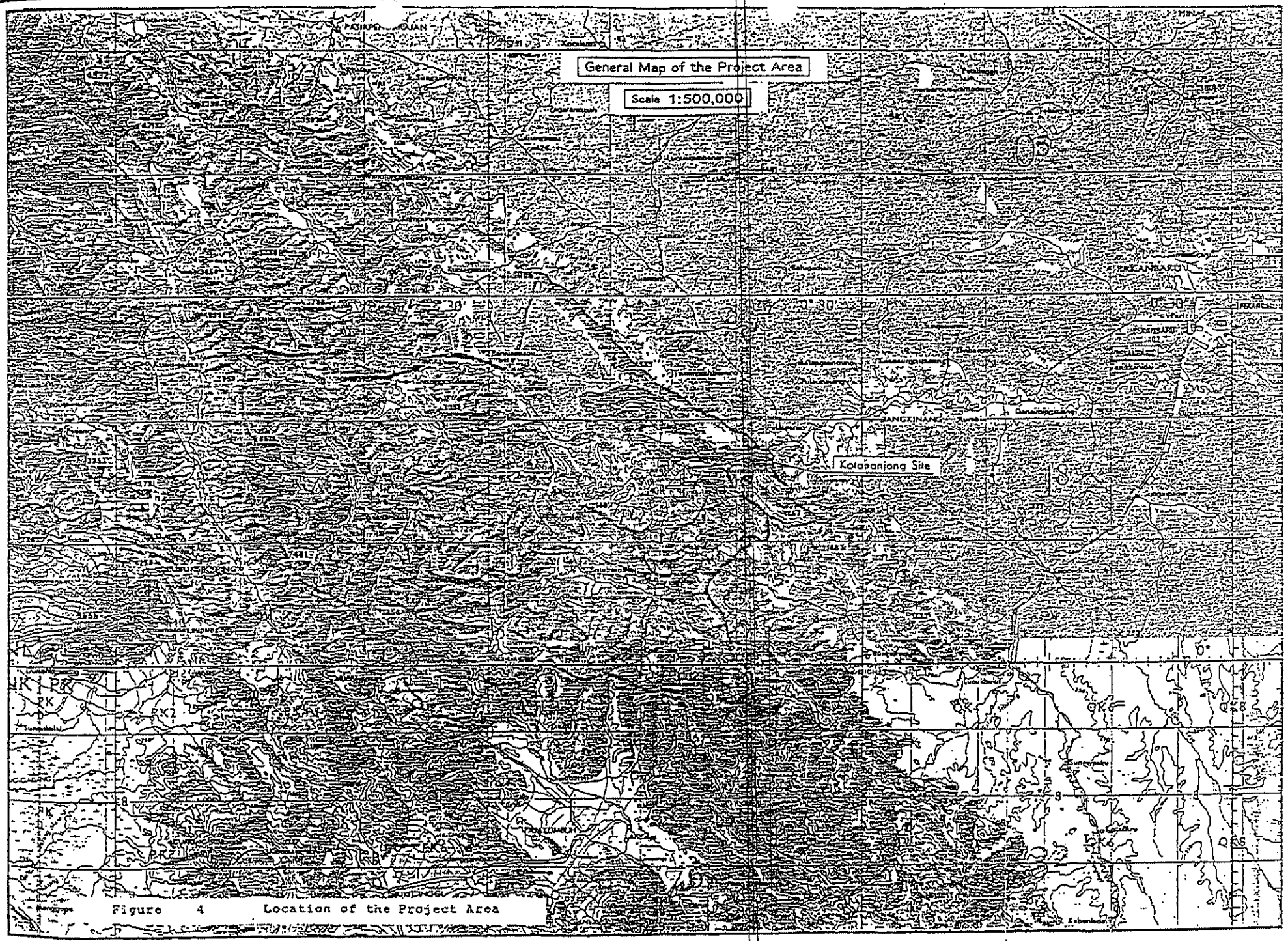


Figure 4 Location of the Project Area

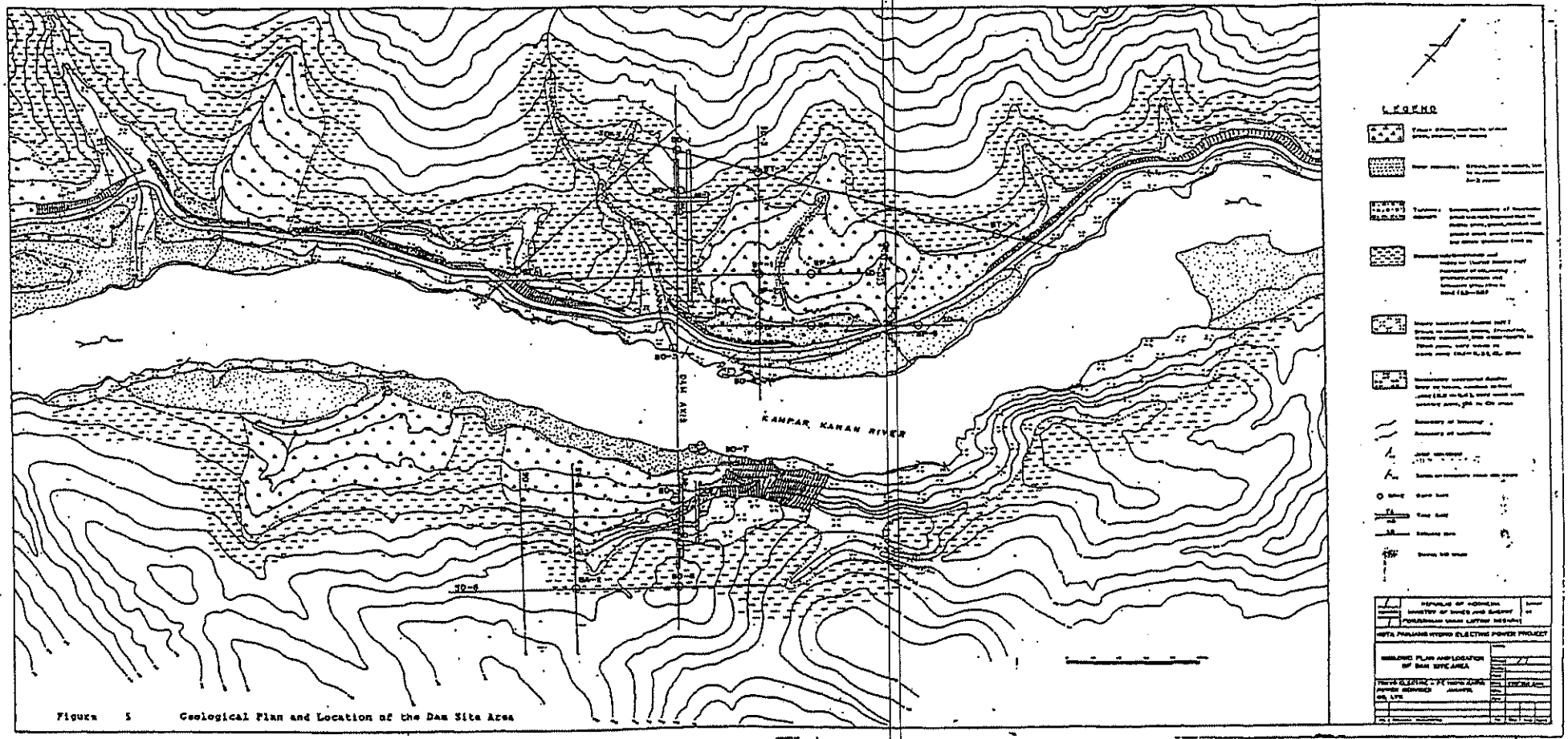


Figure 5 Geological Plan and Location of the Dam Site Area

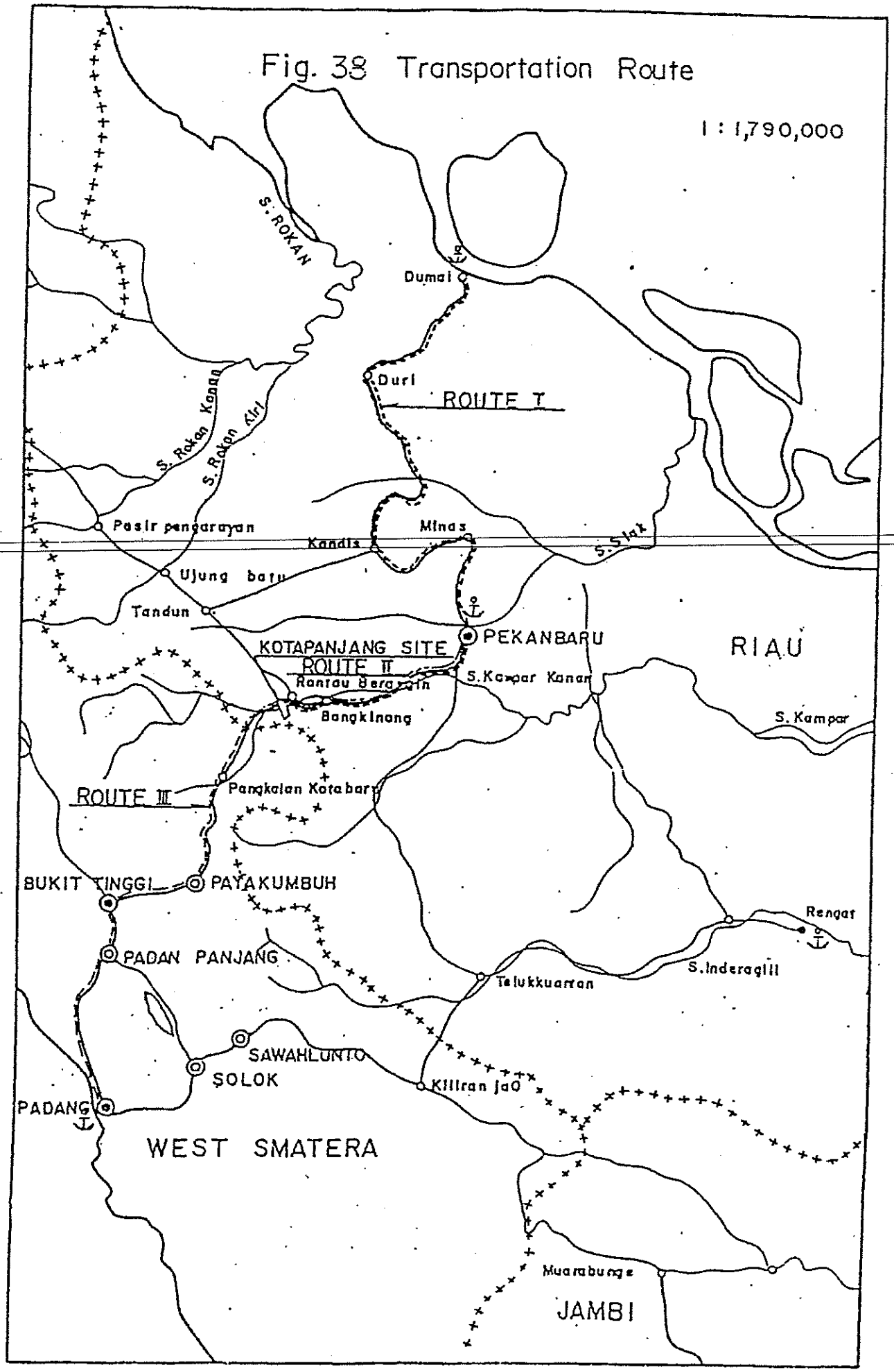


Figure 17 Transportation Route

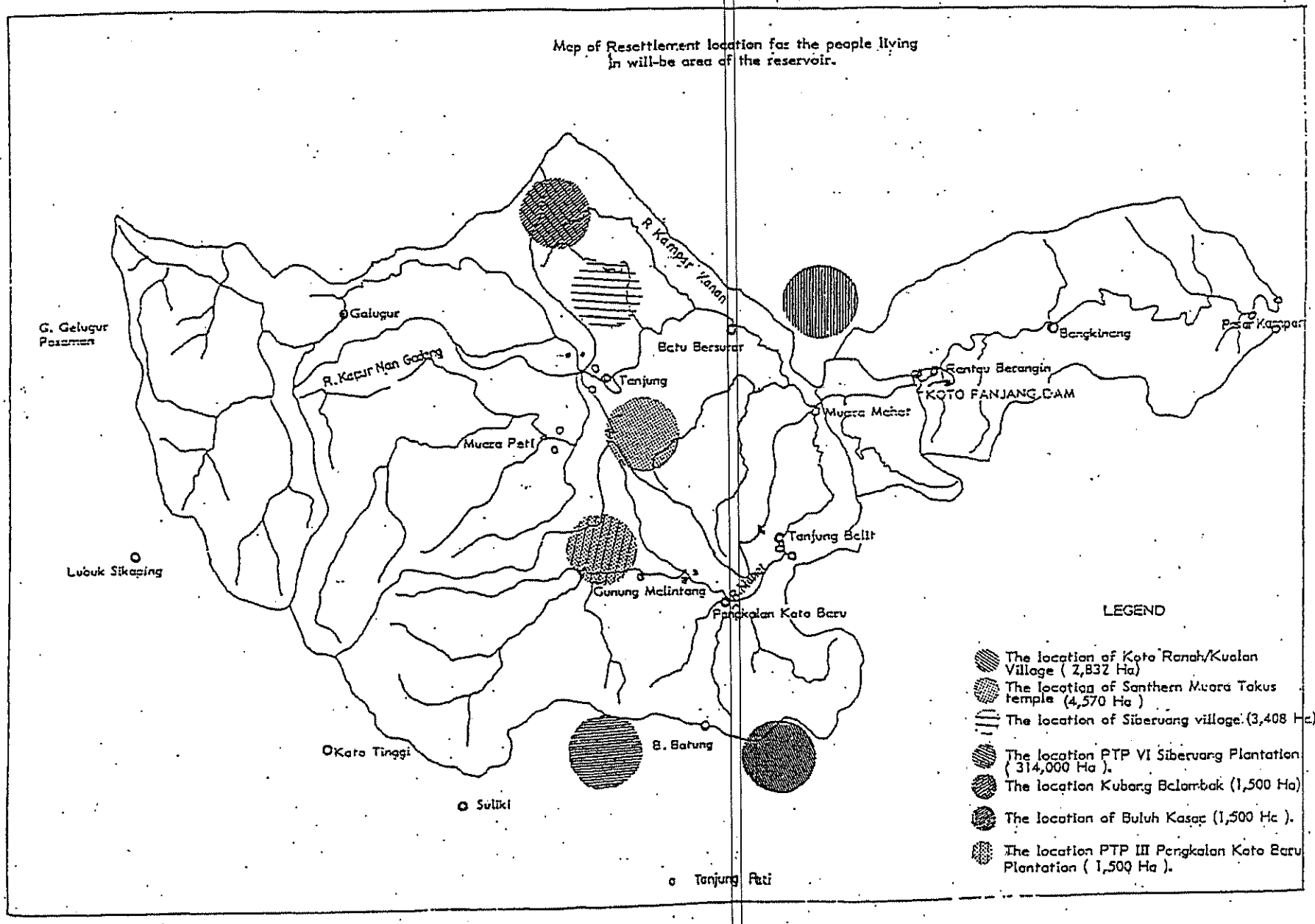


Figure 18 Map of Resettlement Location

PERUSAHAAN UMUM LISTRIK NEGARA
AGENCY OF THE MINISTRY OF MINES AND ENERGY
GOVERNMENT OF THE REPUBLIC OF INDONESIA

KOTAPANJANG HYDROELECTRIC POWER PROJECT

DETAILED DESIGN REPORT

VOLUME 31

APPENDIX 1 TO VOL. 30

ECONOMIC AND FINANCIAL ANALYSIS

AUGUST 1988

TOKYO ELECTRIC POWER SERVICES CO., LTD.
IN ASSOCIATION WITH
P.T. YODYA KARYA

DETAILED DESIGN REPORT (KOTAPANJANG H.E.P.P.)

GENERAL CONTENTS OF REPORT

VOLUME		
Vol. 1	GENERAL	
Vol. 2	CIVIL WORKS - PART 1	Dam
Vol. 3	CIVIL WORKS - PART 2	Powerhouse and River Diversion
Vol. 4	CIVIL WORKS - PART 3	Transmission Tower Foundation, Substation and Switchyard foundation
Vol. 5	Appendix 1 to Vol.2,3,& 4	Drawings (Civil Works)
Vol. 6	Appendix 2 to Vol.2 & 3	Hydrology
Vol. 7	Appendix 3 to Vol.1,2,3&4	Geology -Part 1
Vol. 8	Appendix 3 to Vol.1,2,3&4	Geology -Part 2 (Drawings)
Vol. 9	Appendix 3 to Vol.1,2,3&4	Geology -Part 3 (Suplement Data)
Vol. 10	Appendix 4 to Vol.2 & 3	Aggeregate and concrete Test
Vol. 11	Appendix 5 to Vol.2 & 3	Hydraulics Model Test-Part 1 Spillway Structure
Vol. 12	Appendix 5 to Vol.2 & 3	Hydraulics Model Test-Part 2 Intake Structure
Vol. 13	METAL WORKS	
Vol. 14	Appendix 1 to Vol.13	Drawings (Metal Works)
Vol. 15	Generating Equipment and Transmission Line Materials	
Vol. 16	Appendix 1 to Vol. 15	150 KV Transmission Line (Design)
Vol. 17	Appendix 2 to Vol. 15	Route Survey Result
Vol. 18	Appendix 3 to Vol. 15	Calculation Steel Tower Strength
Vol. 19	ARCHITECTURAL WORKS	
Vol. 20	Appendix 1 to Vol.19	Drawings (Architectural Works)
Vol. 21	RELOCATION ROAD - PART 1	National Road
Vol. 22	RELOCATION ROAD - PART 2	Provincial Road
Vol. 23	Appendix 1 to Vol.21&22	Drawings - Part 1 National Road
Vol. 24	Appendix 2 to Vol.21&22	Drawings - Part 2 Provincial Road
Vol. 25	BRIDGE	
Vol. 26	Appendix 1 to Vol.25	Drawings (Bridge)
Vol. 27	PREPARATORY WORKS	
Vol. 28	Appendix 1 to Vol 27	Drawings (Preparatory Works)
Vol. 29	CONSTRUCTION PLANNING AND PROGRAM	
Vol. 30	CONSTRUCTION COST ESTIMATE	
VOL. 31	Appendix 1 to Vol. 30	Economic and Financial Analysis
Vol. 32	Environmental Management Plan (RKL)	
Vol. 33	Environmental Monitoring Plan (RPL)	

Volume 31

Appendix 1 to Vol.30

ECONOMIC AND FINANCIAL ANALYSIS

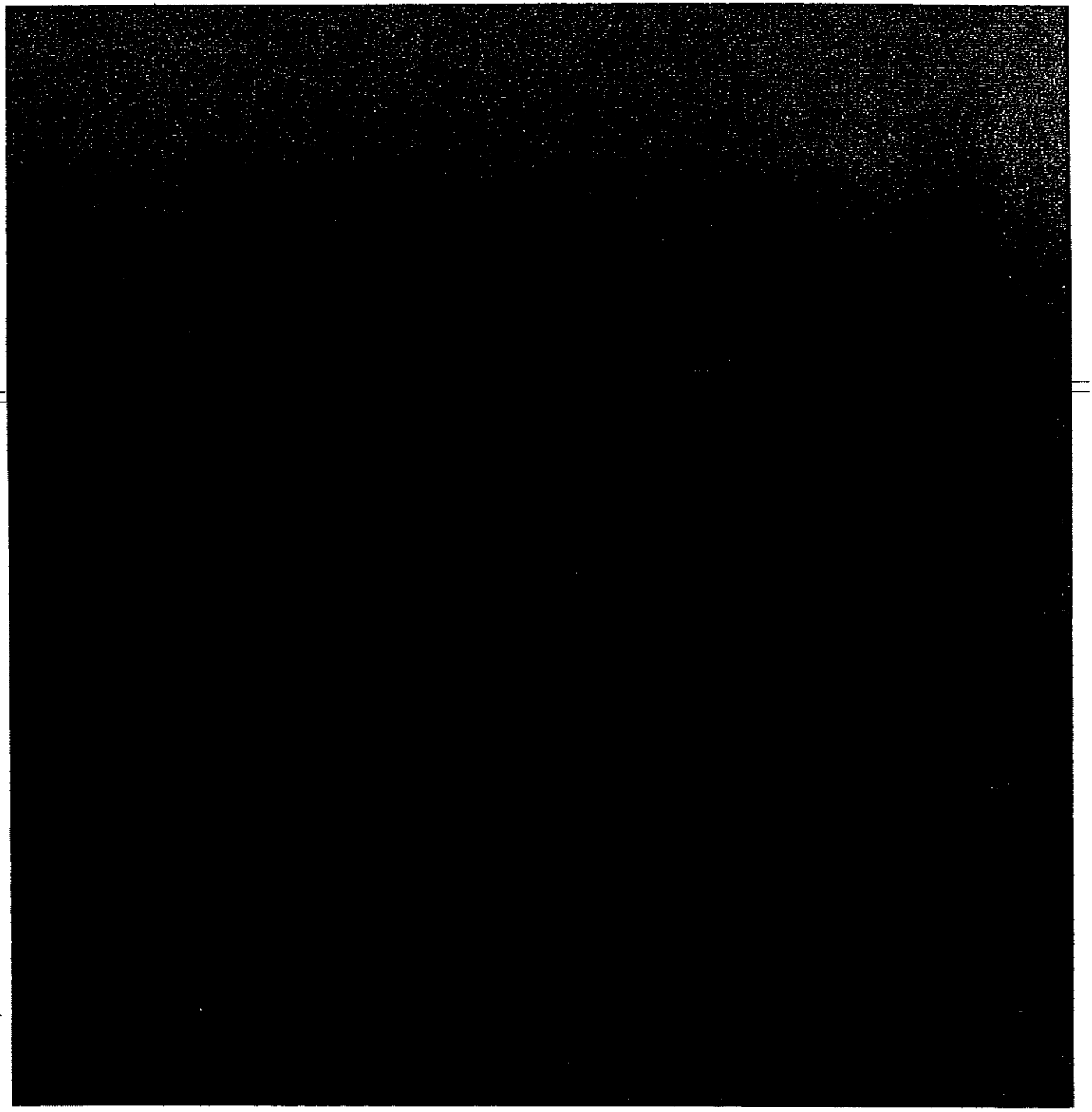
APPENDIX

List of Table

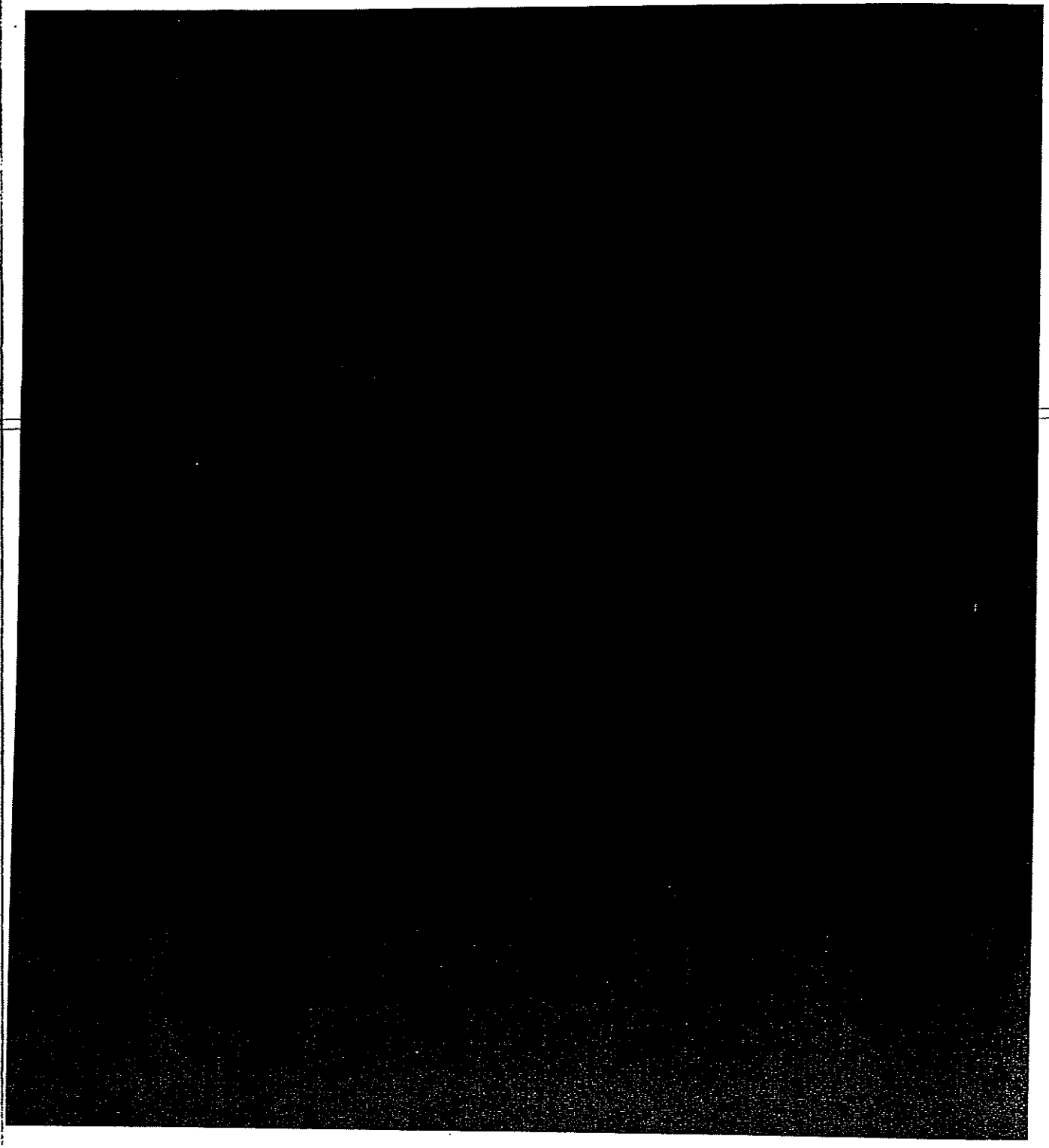
List of Figure

1. SUMMARY AND CONCLUSION

1.1 Economic Analysis

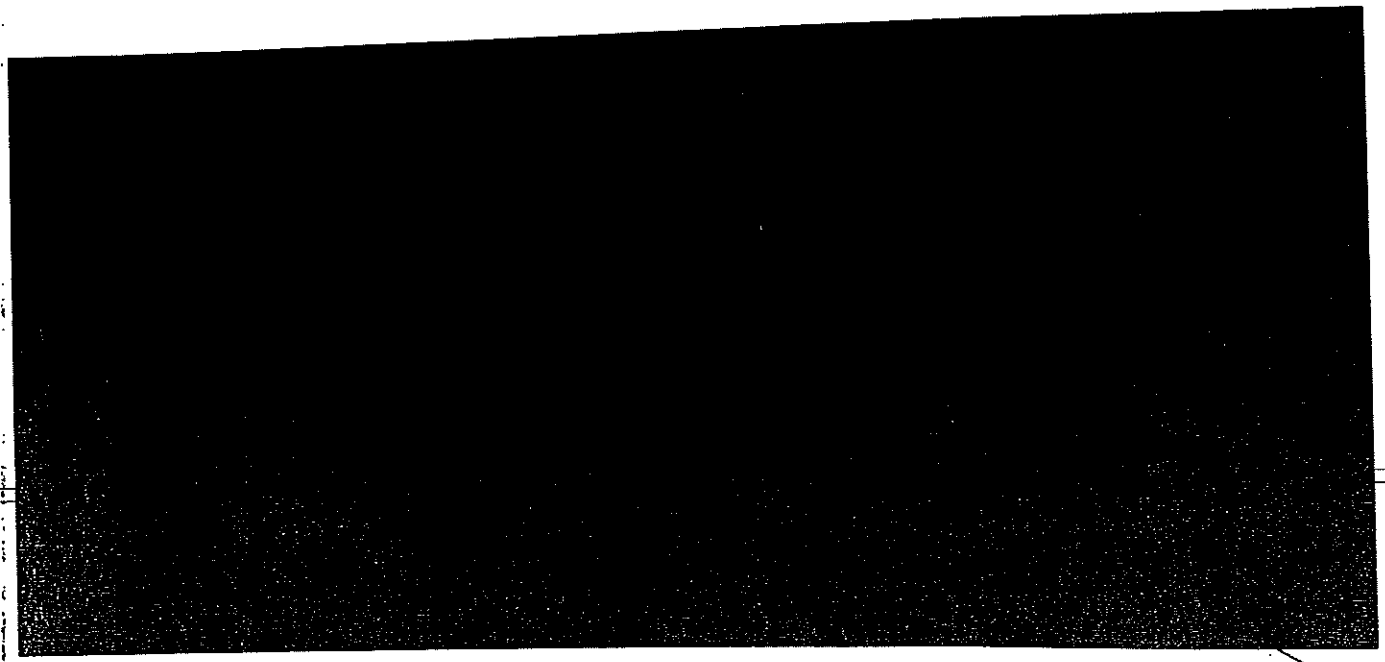


1.2 Financial Analysis



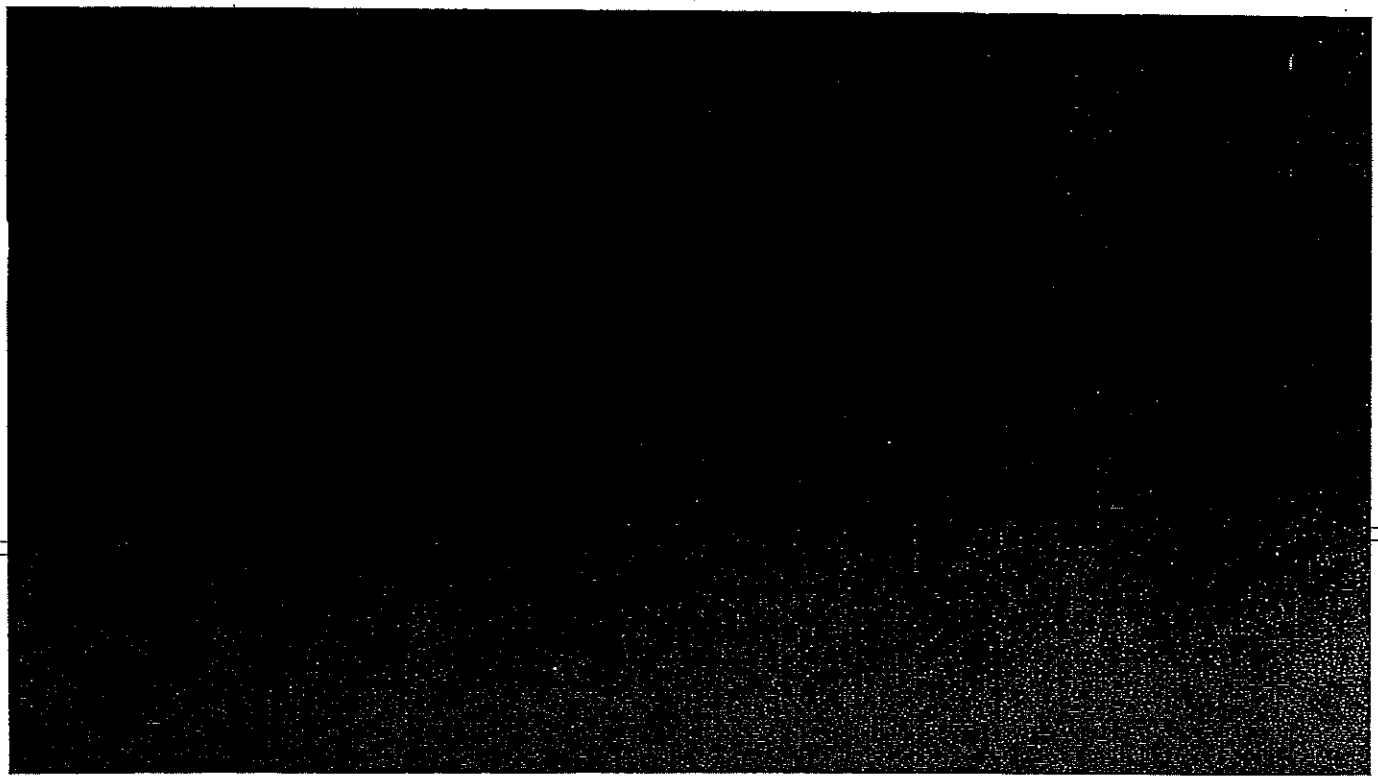
1.3 Other Aspects of Economic Analysis

1.3.1 Population in Reservoir Area



1.3.2 Economic Impact to Riau Province

1.4 Analysis by Willingness to Pay Method



2. BACKGROUND

2.1 Background of the Project

The province of Riau is located in the central region of Sumatra. Riau's annual output of oil of approximately 150 million barrels is almost one half of the total production of the country. This makes Riau the largest oil-producing province in Indonesia. The province has a extensive land area of 94,562 square kilometres in which four major rivers, including the Kampar River, are found. Despite abundant resources, the economy of Riau is still relatively under-developed compared with other provinces.

The Government of Indonesia, however, is implementating the Fourth Five Year Plan (1984/85 to 1988/89, REPELITA IV) in which it aims to improve the general standard of living and to ensure balanced regional development. Once REPELITE IV projects are instituted it can be expected that regional development in Riau, including the improvement of social infrastructure, the development of industries and transmigration programs, will accelerate rapidly.

On the other hand, power facilities of the Public Power Utility (Perusahaan Umum Listrik Negara, or PLN) in the Province of Riau had an installed capacity of only 31.5 MW as of 1986. The power distribution network is also inadequate, with the region having an electrification rate of only 10.2%. The present demand for power is mainly in and around urban areas, with the power being totally supplied by means of independent diesel engine generators.

The demand for power placed on PLN in Riau in recent years has shown high growth rates of 17.0% over the eleven-year period from 1975 to 1985, except for Kepulauan Riau, and the

annual growth of electric power demand is forecast to be 17% from 1981 to 1991, and 19% from 1991 to 2000.

In order to meet this increasing power demand, PLN has considered utilization of the abundant water resources in the Province, and is actively engaged in the promotion of water resources power project developments and the establishment of main transmission network systems. The development of these water resources will undoubtedly contribute greatly to the national economy by helping to conserve Indonesia's petroleum reserves. This hydroelectric power project is part of this development and it will contribute to lower oil consumption on the domestic market, thereby making the oil available for export.

Against this background, it was proposed that the Kotapanjang Hydroelectric Power Project, in the middle reaches of the Kampar Kanan River, be implemented. This will be the first hydroelectric power project in Riau Province.

2.2 Importance and Necessity of Project Construction

- Promotion of Development

The rapid growth of the Indonesian economy is largerly owed to its income from oil exports. From 1977 to 1986, income from oil averaged about 58% of the total export income. At the same time, the contribution of oil production to the annual national revenue from 1981/82 to 1986/87 averaged 55.1%. It is thus clear that oil production is vital to Indonesia's economic growth and development.

Of the total production of oil in Indonesia, the amount produced in Riau Province was 49% in 1980, 49% in 1981, 44% in 1982, and 51% in 1983. This is about 48% per annum on average. On the other hand, the economy of Riau Province remains comparatively more depressed than that in other provinces, owing to a shortfall in public investments. Therefore, the implementation of the Project by the Indonesian Government would elevate Riau to a level economically comparable with other provinces. Also, the promotion of development in Riau Province conforms to the basic policy of the Indonesian Government, which aims at the adjustment of income differences among provinces, and fair distribution of the benefits of development.

- Non oil Policy

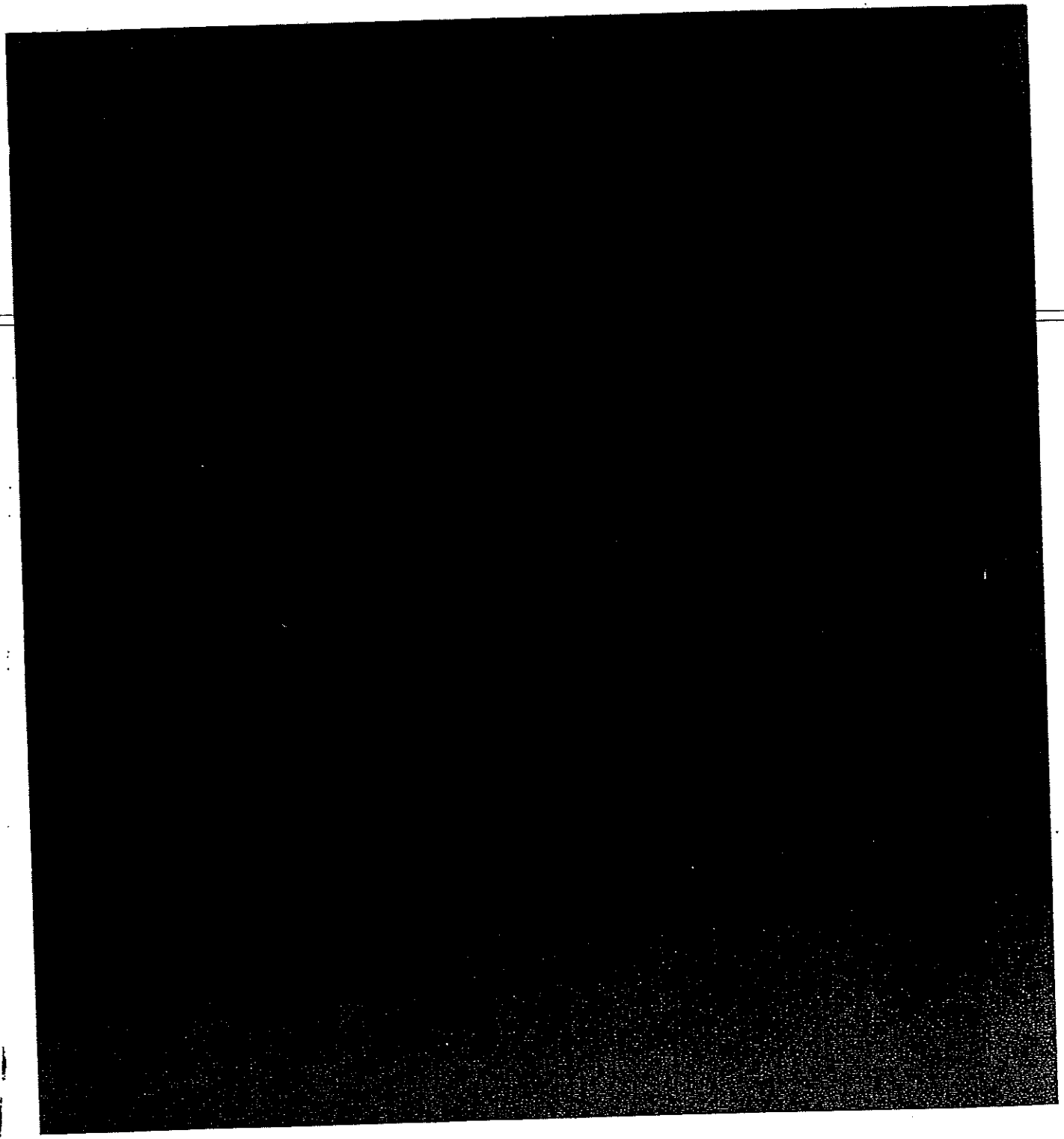
The Government's "non-oil policy" aims at developing oil-substituting energy sources and preserving domestic oil reserves. Under this policy, the Government can set aside more oil for export, thereby strengthening the national economy through foreign currency acquisition. The Kotapanjang Hydroelectric Power Project, together with other developments, will play an important role in achieving this. They will symbolically exemplify the "non-oil policy" by promoting oil conservation through the development of hydroelectric and coal-fired generation facilities, and also set an example for other oil-producing provinces.

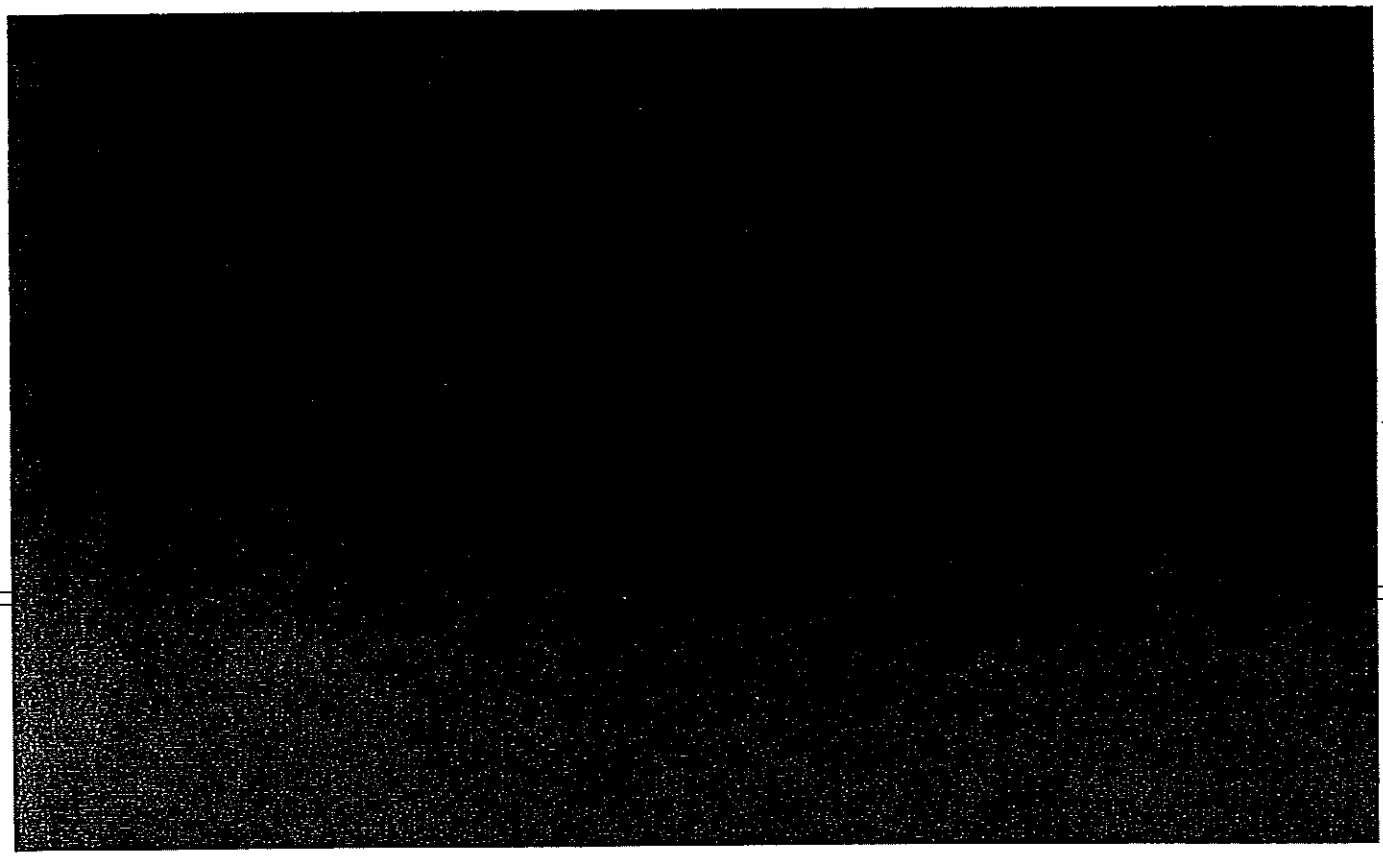
- The Importance of Location

From a geographical point of view, the location of the proposed project site is important in terms of oil economy, trans-policy administration between Sumatra and Java Islands, international industries, international transportation through the Malacca straits and proximity to Singapore, etc.

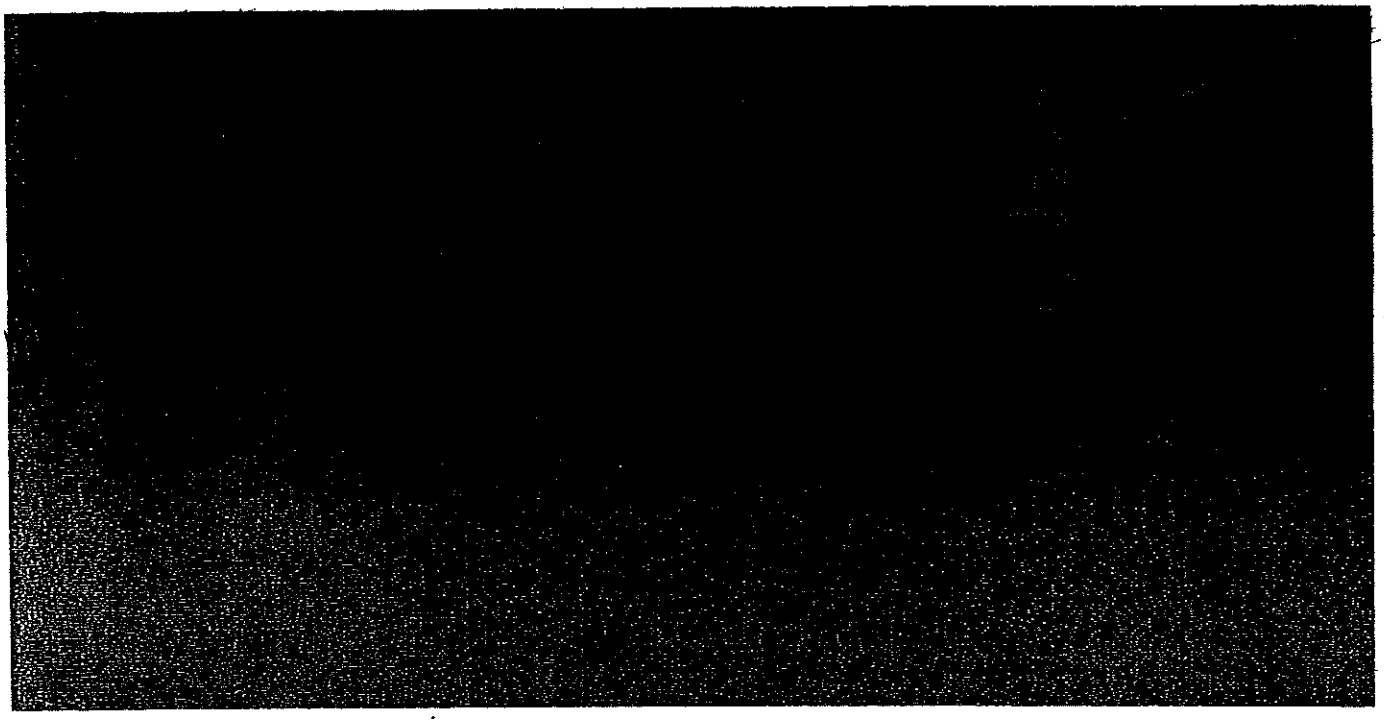
3. DEMAND AND SUPPLY OF ELECTRIC POWER

3.1 Electric Power Condition

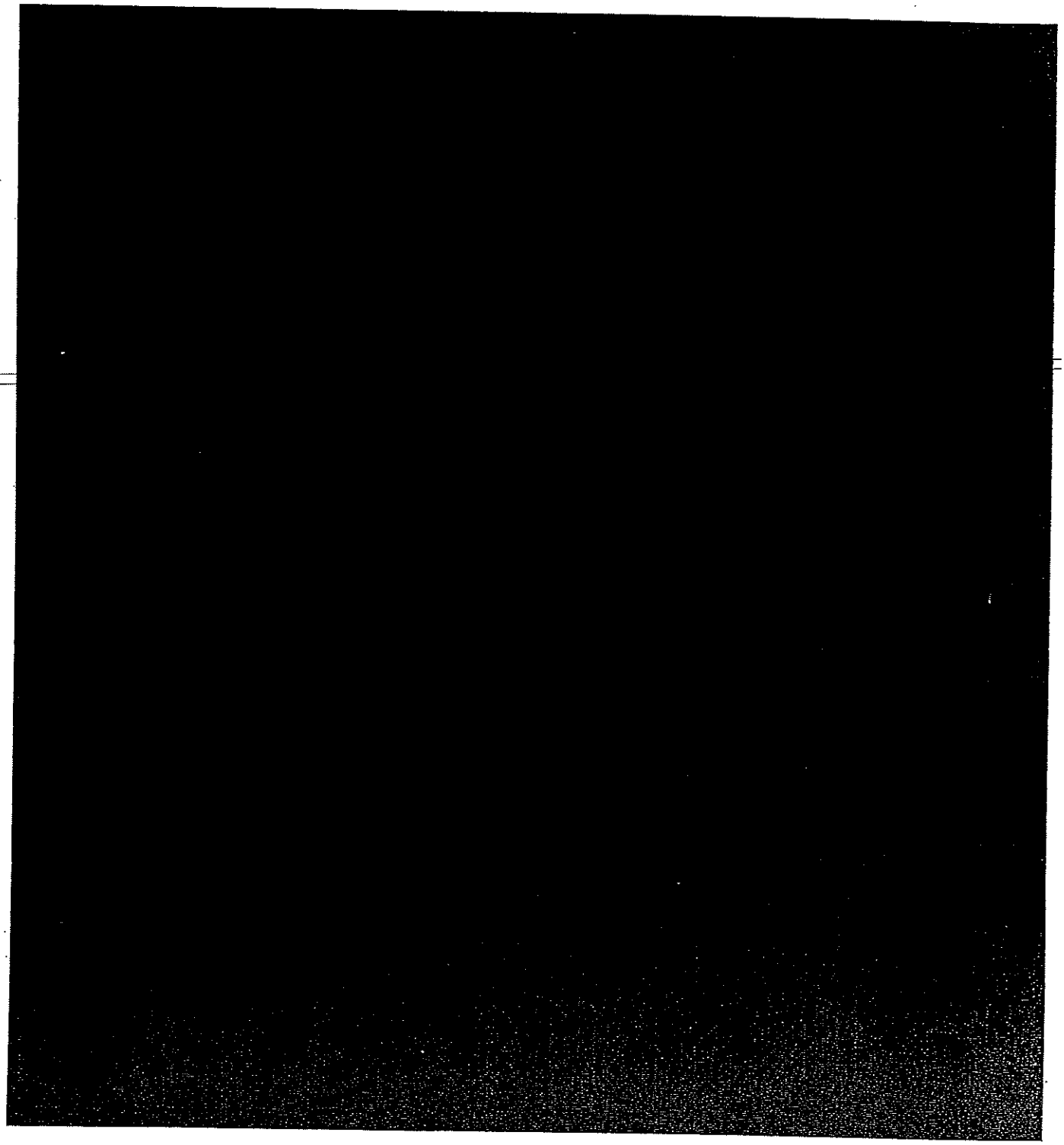




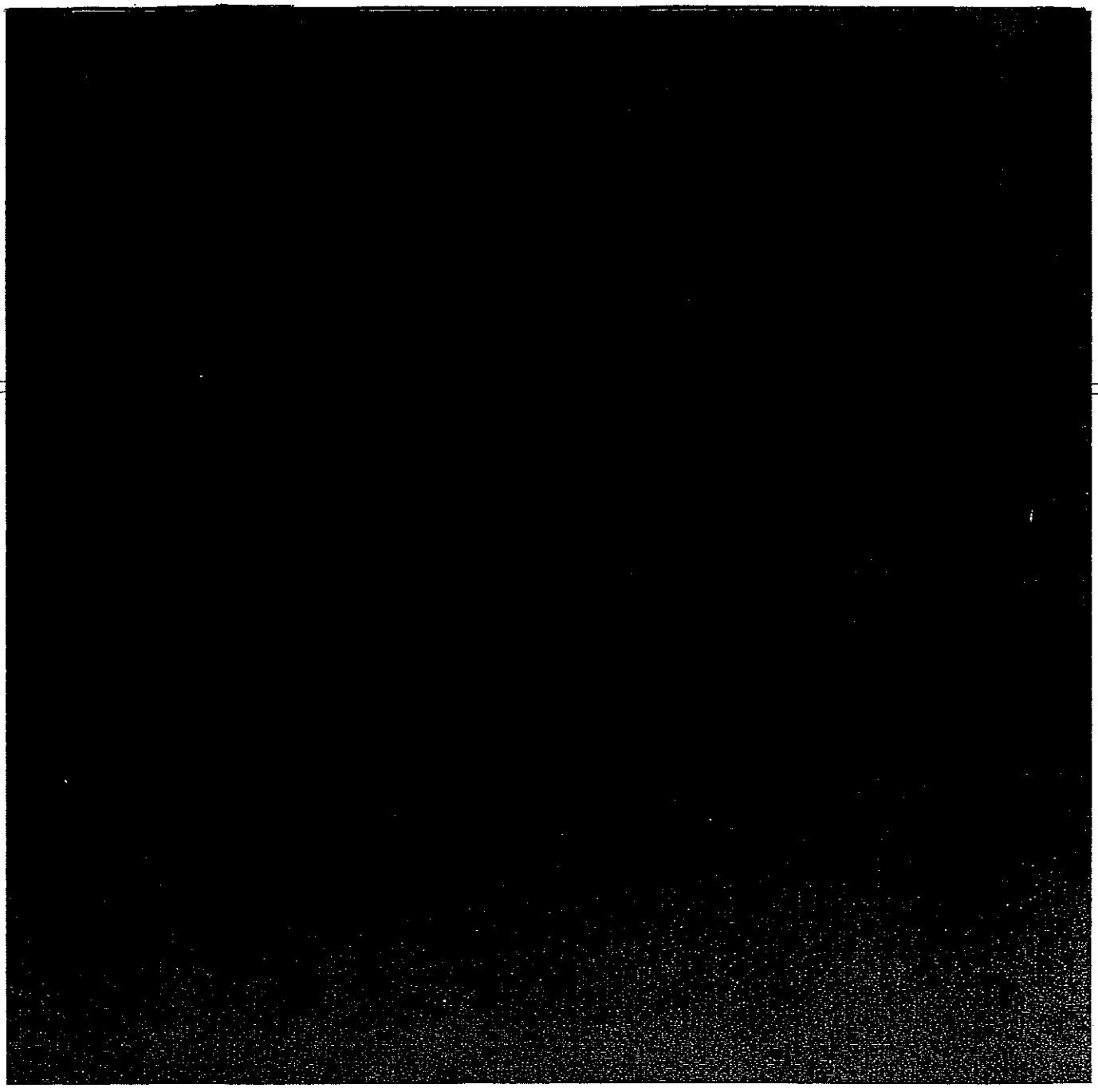
3.2 Power Demand Forecast



3.3 Power Facility Extension Plan



4. POWER GENERATION PLAN



5. PRINCIPAL DIMENSIONS OF KOTAPANJANG PROJECT

Capacity of the Power Plant

Maximum Output : 114,000 KW (38,000 x 3 Units)

Annual Generated Energy : 542 x 10^6 kWh

Reservoir

Reservoir Capacity : 1,545 million m3

Surface Area : 124 Km2

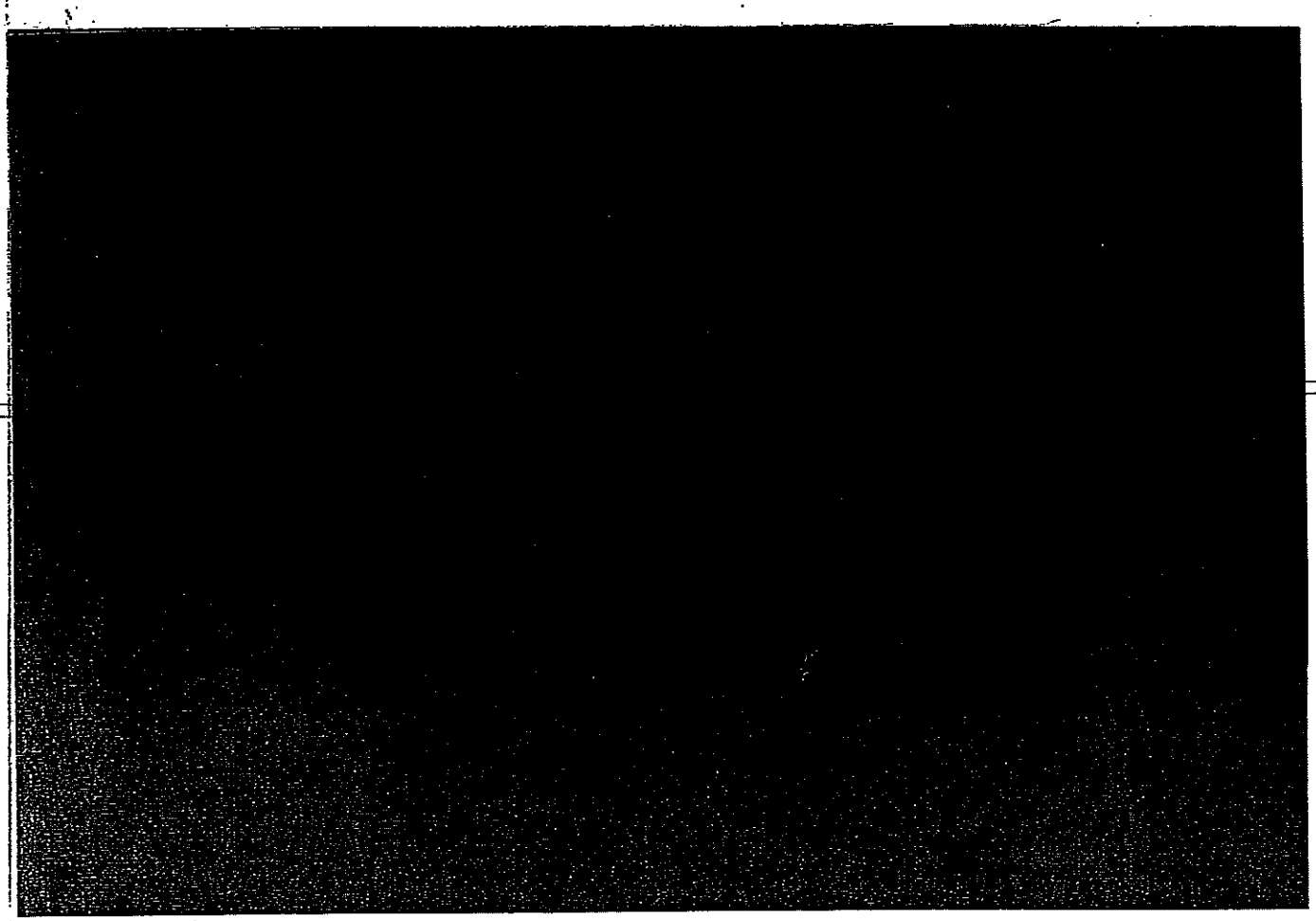
Dam

Height : 58.0 m

Crest length : 257.5 m

6. CONSTRUCTION PLANNING AND IMPLEMENTATION SCHEDULE

6.1 General



6.2 Contract Packing

[redacted]

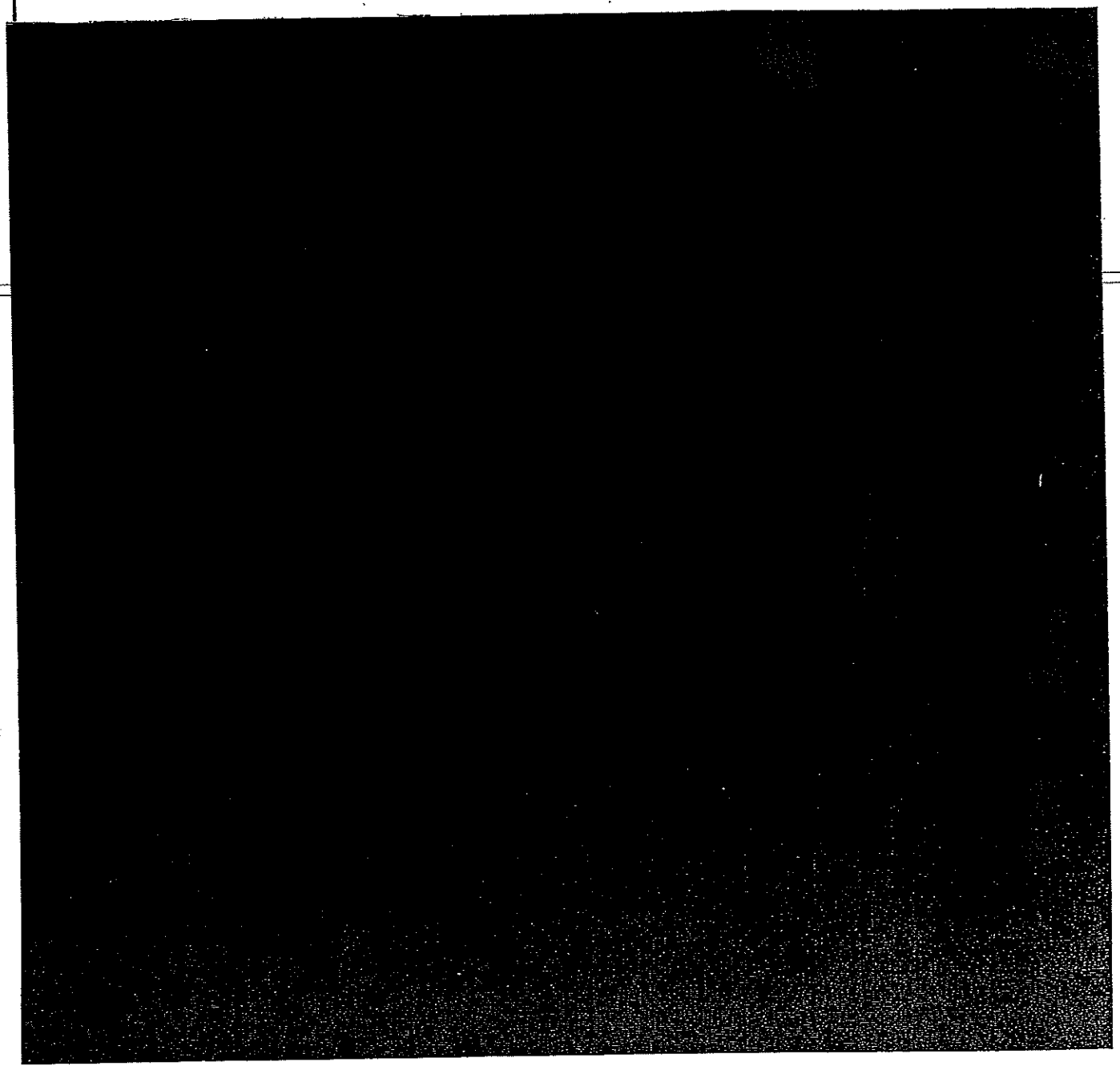
6.3 Construction Time Schedule

[redacted]

6.4 Construction Cost Estimate and Disbursement Schedule

7. ECONOMIC ANALYSIS

7.1 Methodology



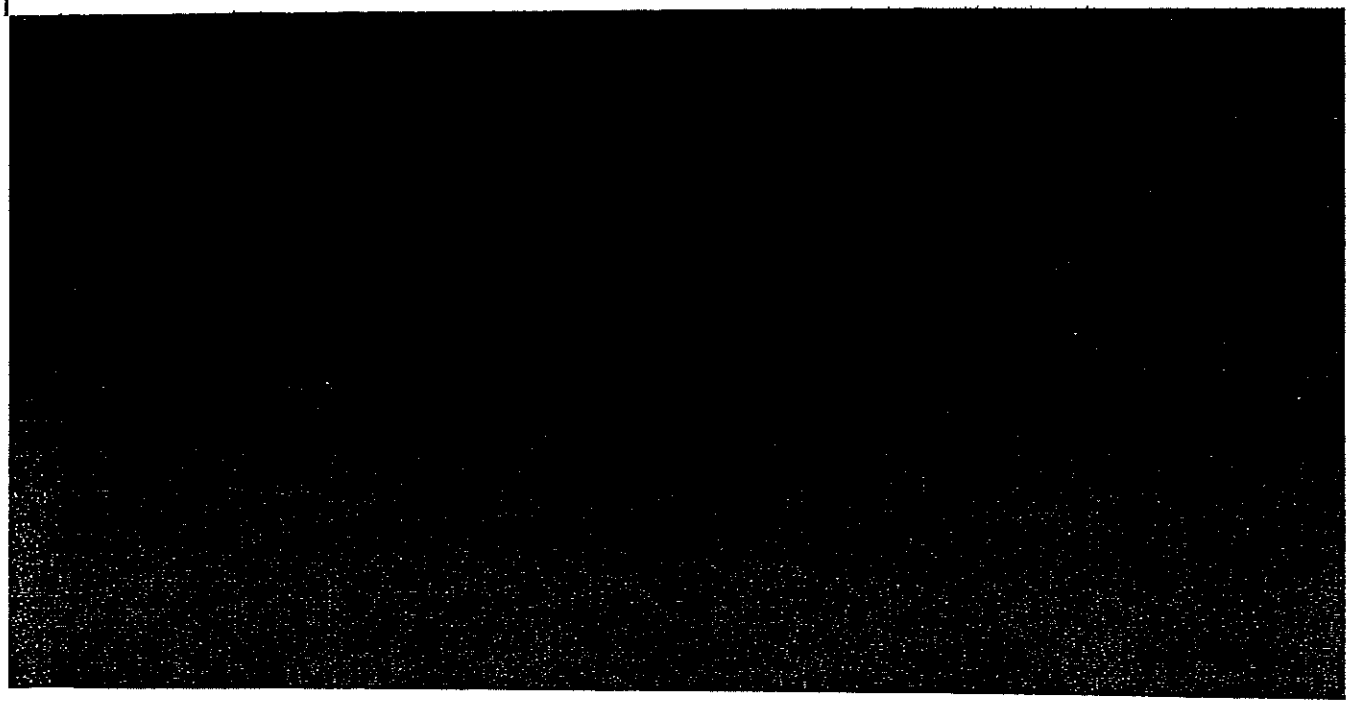
[redacted]

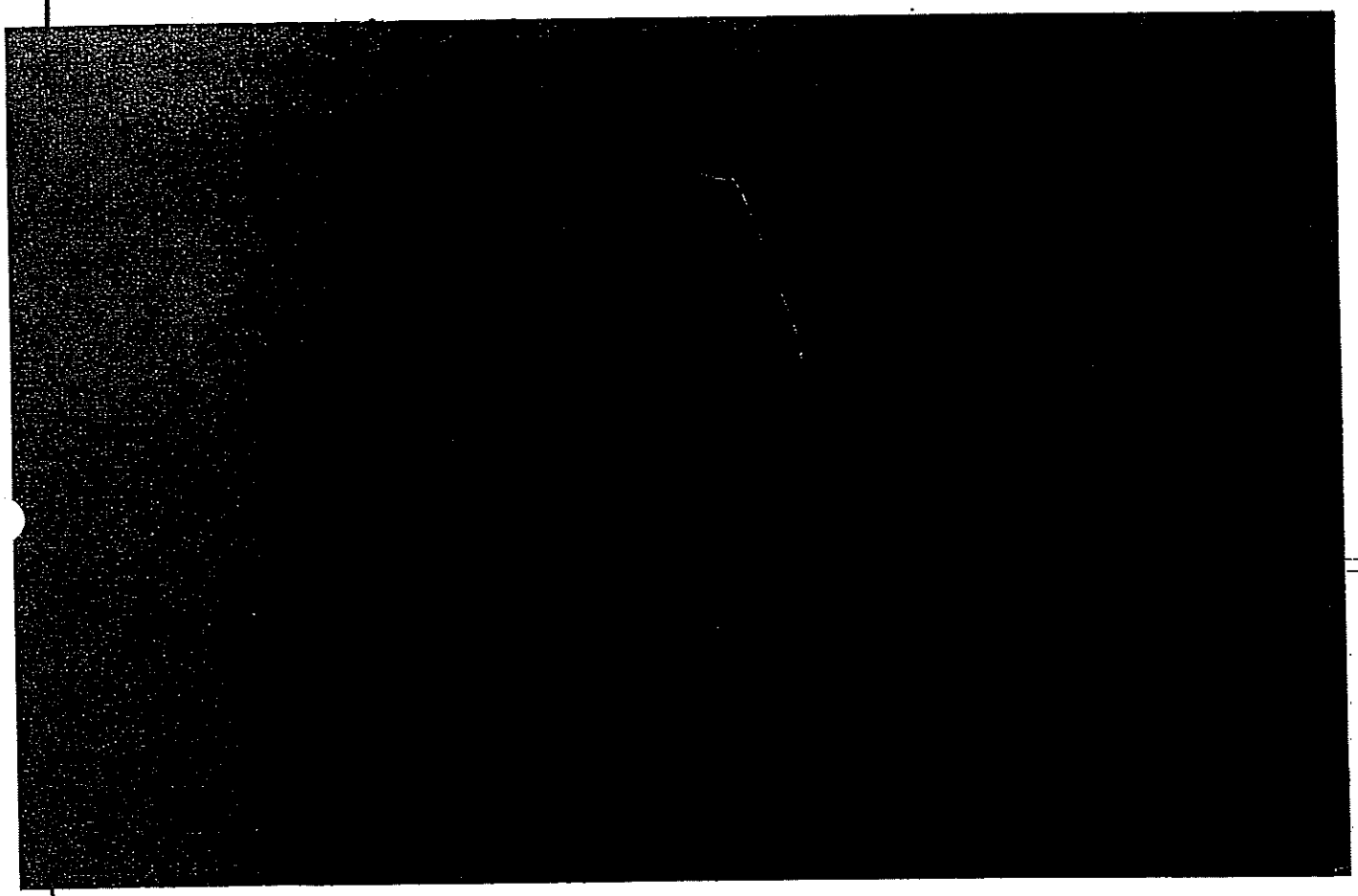
7.2 Project Benefit

7.2.1 Identification of Project Benefit

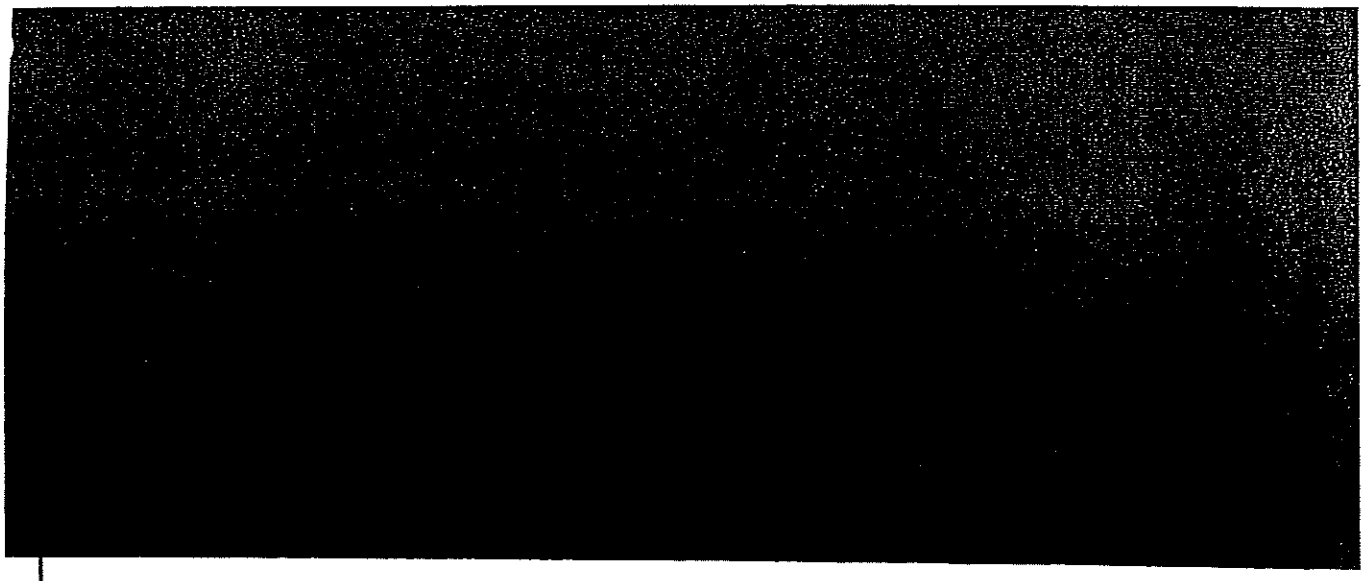
[redacted]

7.2.2 Alternative Thermal Power Plant



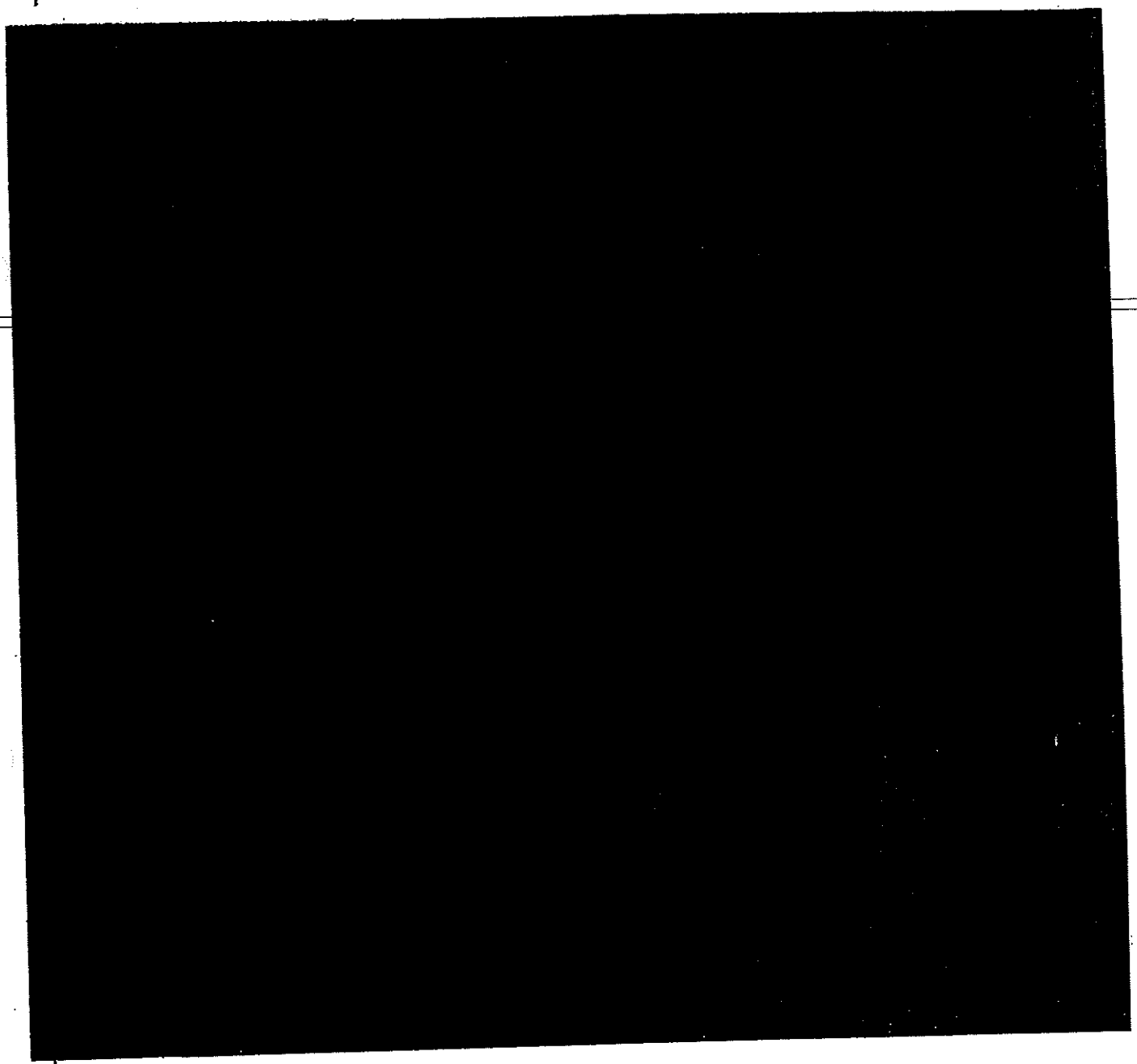


7.2.3 Economic Benefit of Kotapanjang Project

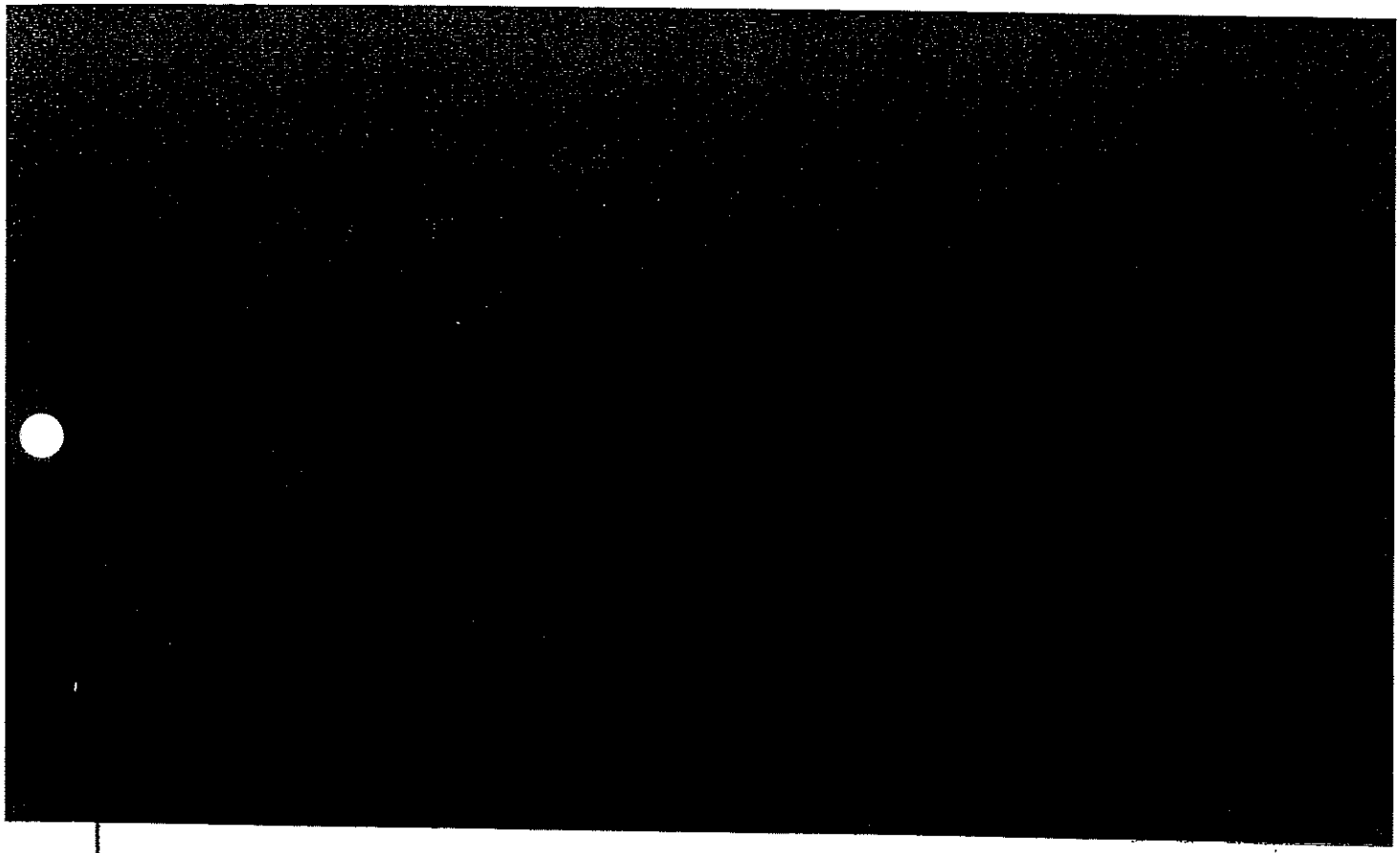


7.3 Project Cost

7.3.1 Economic Cost of Construction Cost



7.3.2 Transmission Line Construction Cost



7.3.3 Economic Construction Cost Disbursement Schedule

[redacted]

7.3.4 Operation and Maintenance Costs and Re-investment Cost

[redacted]

7.3.5 Salvage Value

[redacted]

7.4 Economic Internal Rate of Return

[redacted]

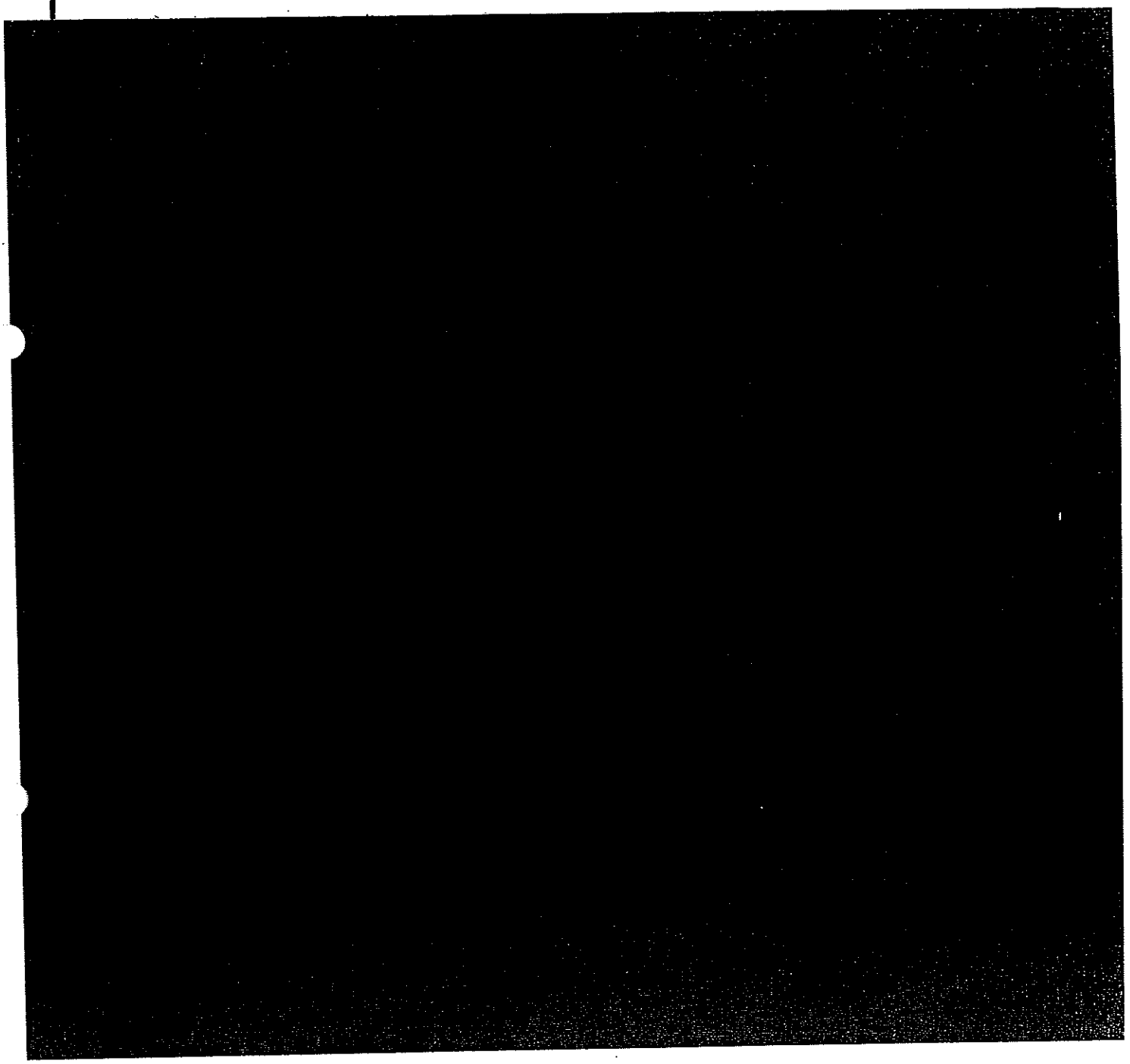
7.5 Sensitivity Analysis

[redacted]

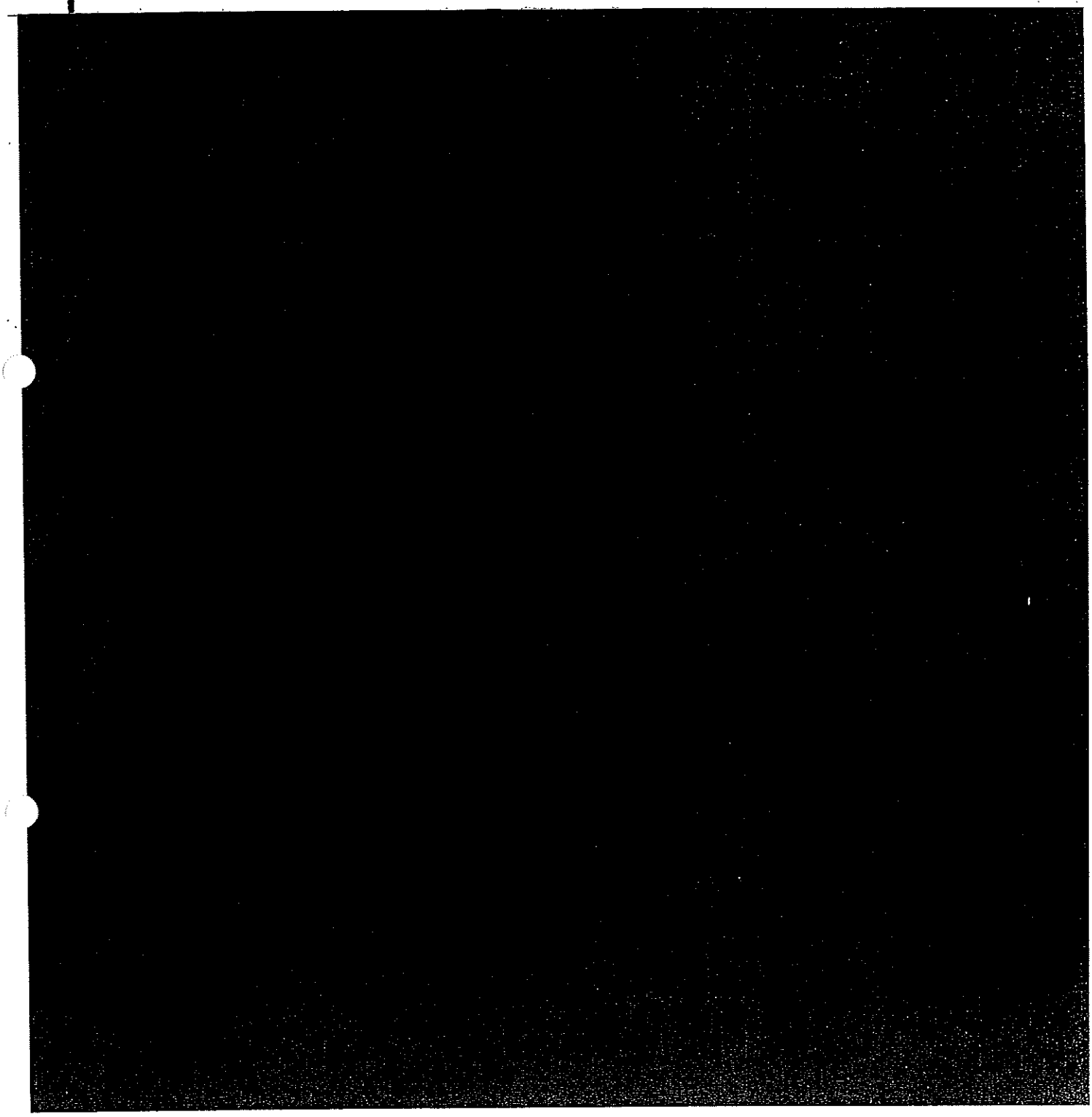
7.5.1 Sensitivity on Construction Cost of the Kotapanjang Project

[redacted]

7.5.2 Sensitivity on Coal Price

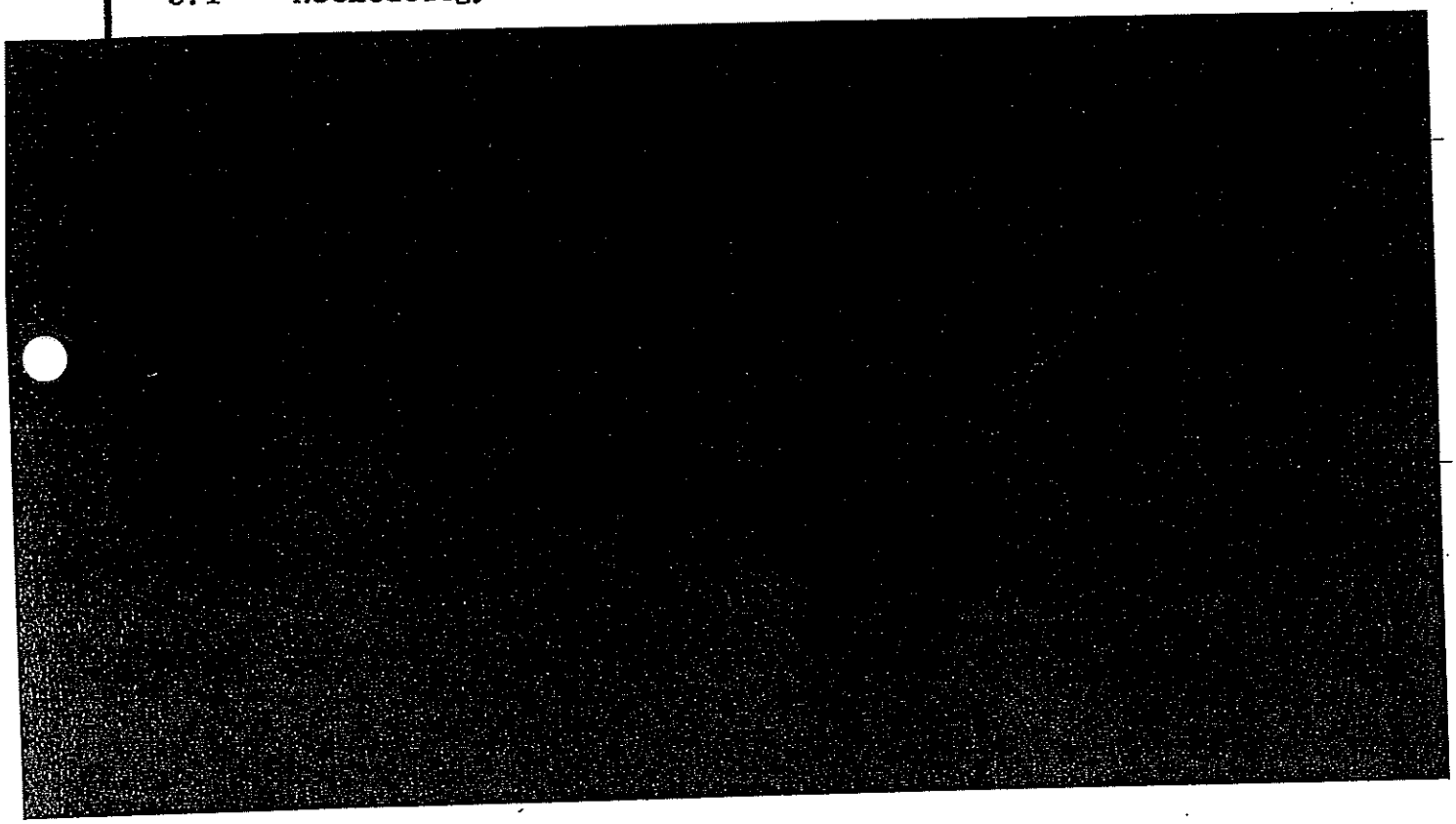


7.5.3. Sensitivity on Construction Cost of Alternative Thermal Power Plant



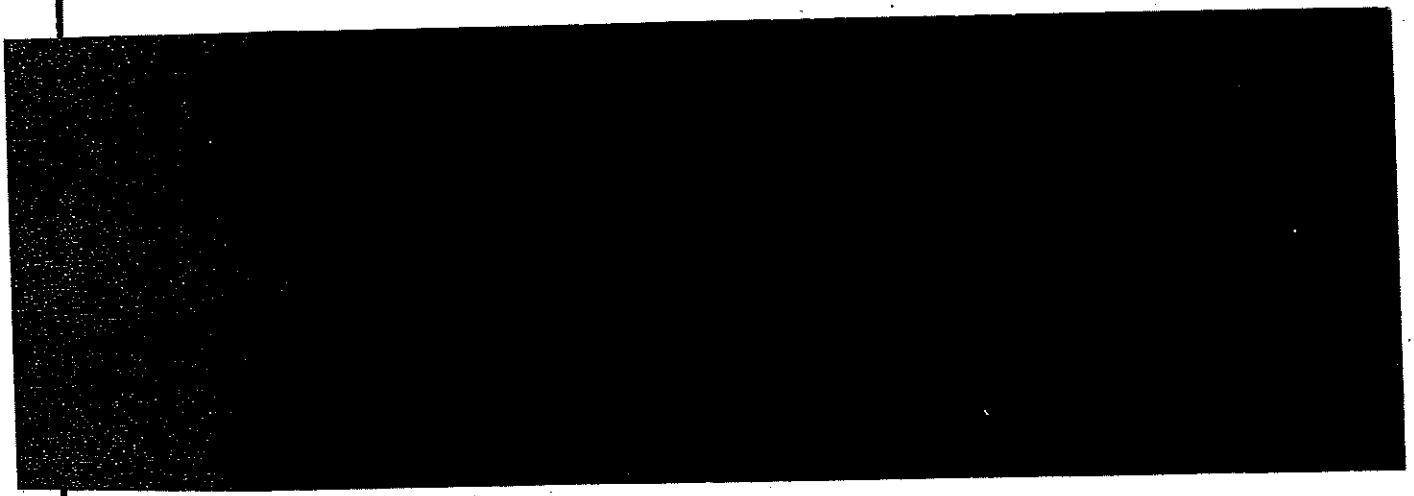
8. FINANCIAL ANALYSIS

8.1 Methodology



8.2 Financial Cost of The Project

8.2.1 Construction Cost



8.2.2 Operation and Maintenance Cost

[redacted]

8.3 Project Benefit

8.3.1 Electricity Sales Rate

[redacted]

[redacted]

8.3.2 Salable Energy

[redacted]

8.3.3 Financial Benefit

[redacted]

8.4 Financial Internal Rate of Return

8.5 Sensitivity Analysis

[redacted]

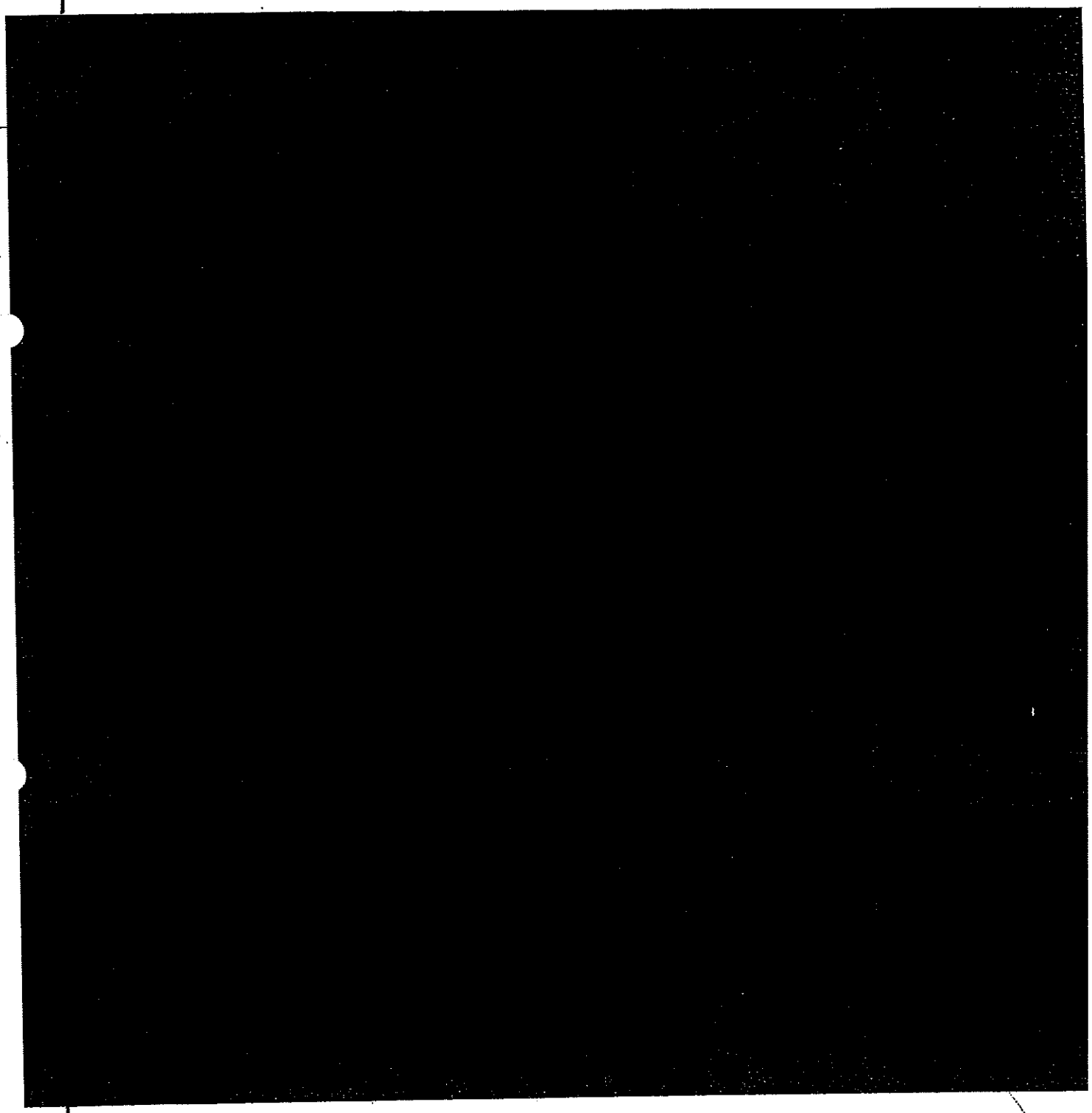
8.5.1 Cases of Sales Price Increase

[redacted]

8.5.2 Result of Sensitivity Analysis

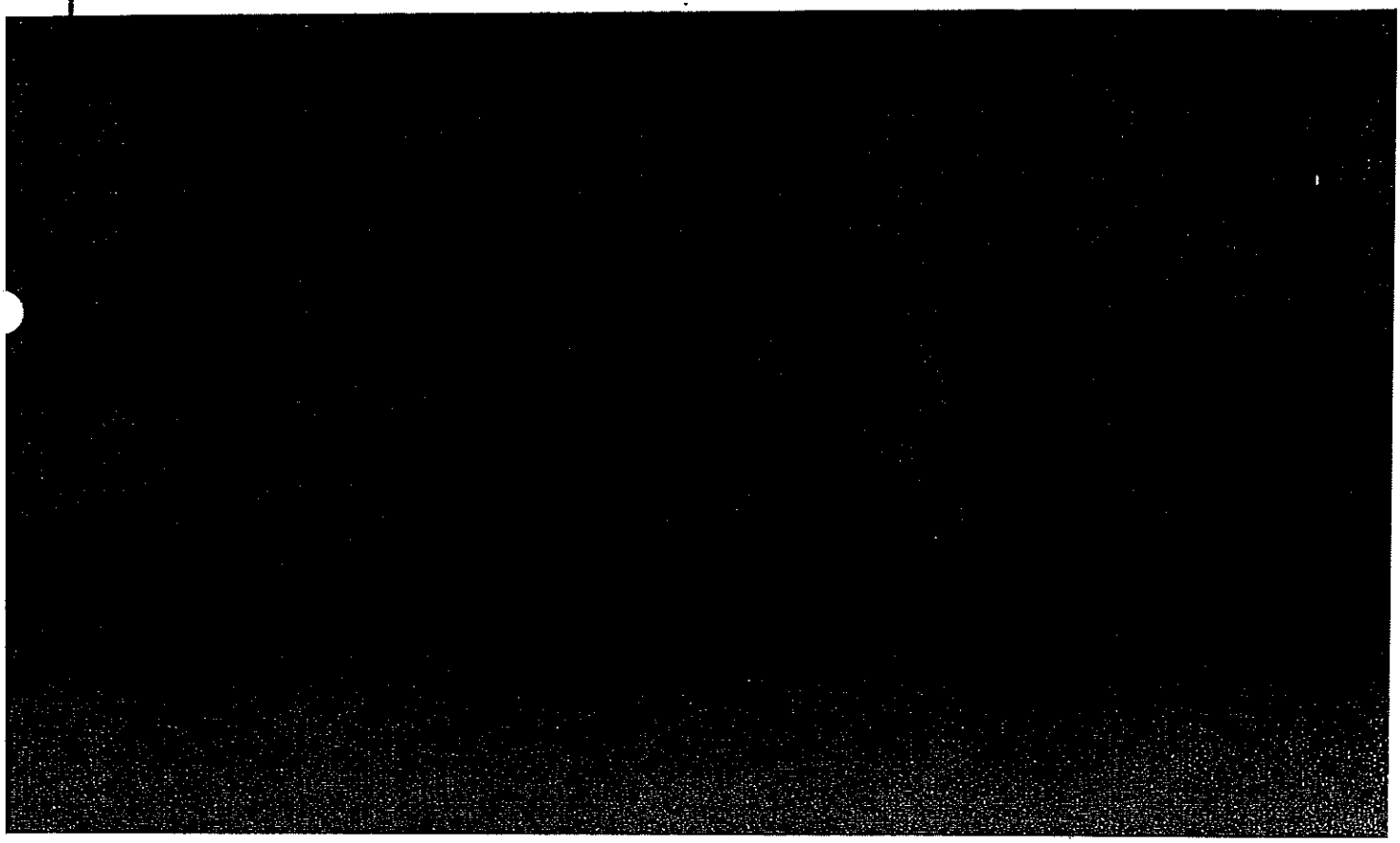
[redacted]

9. OTHER FACTORS AFFECTING THE PROJECT



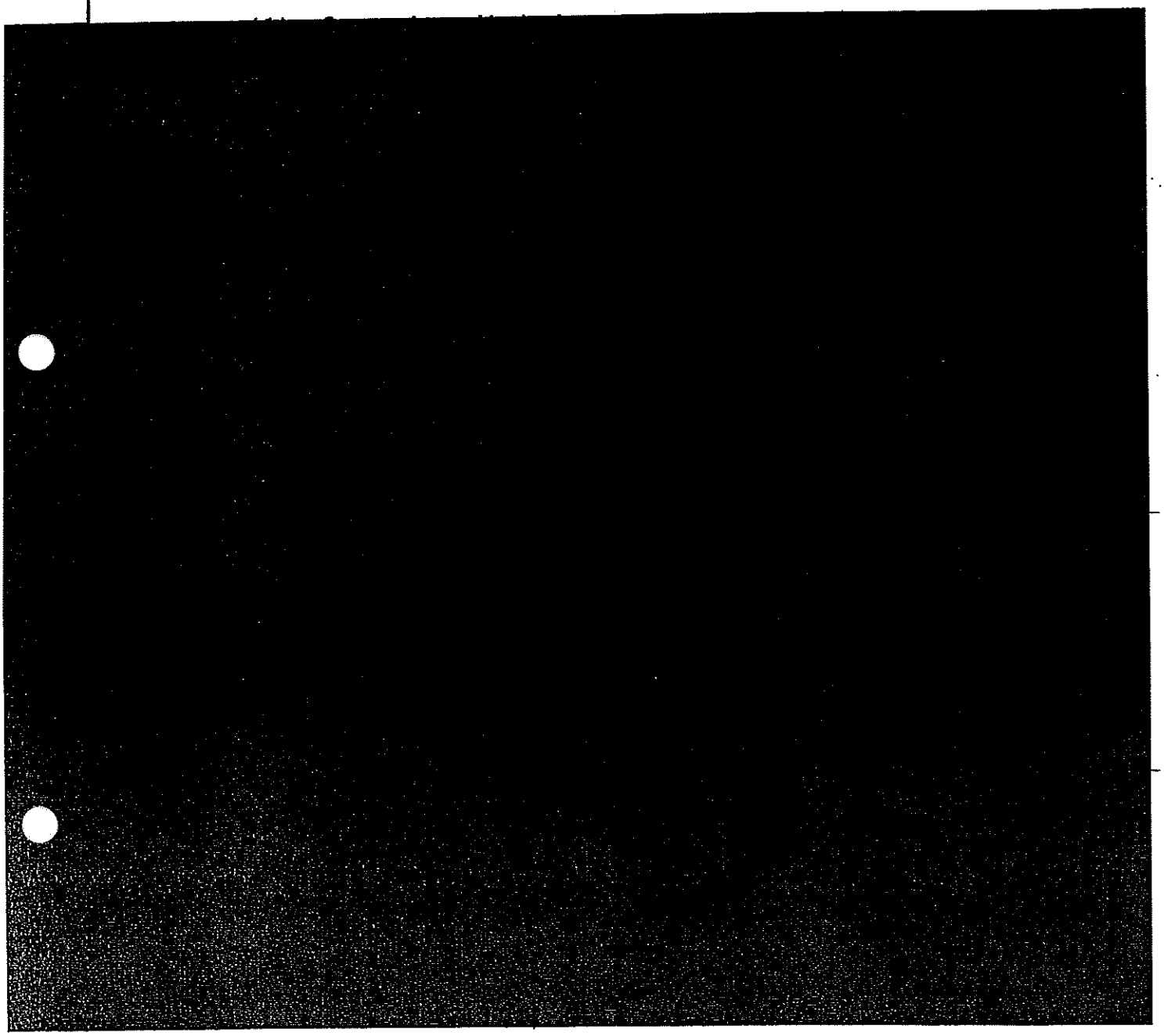
APPENDIX

I. General

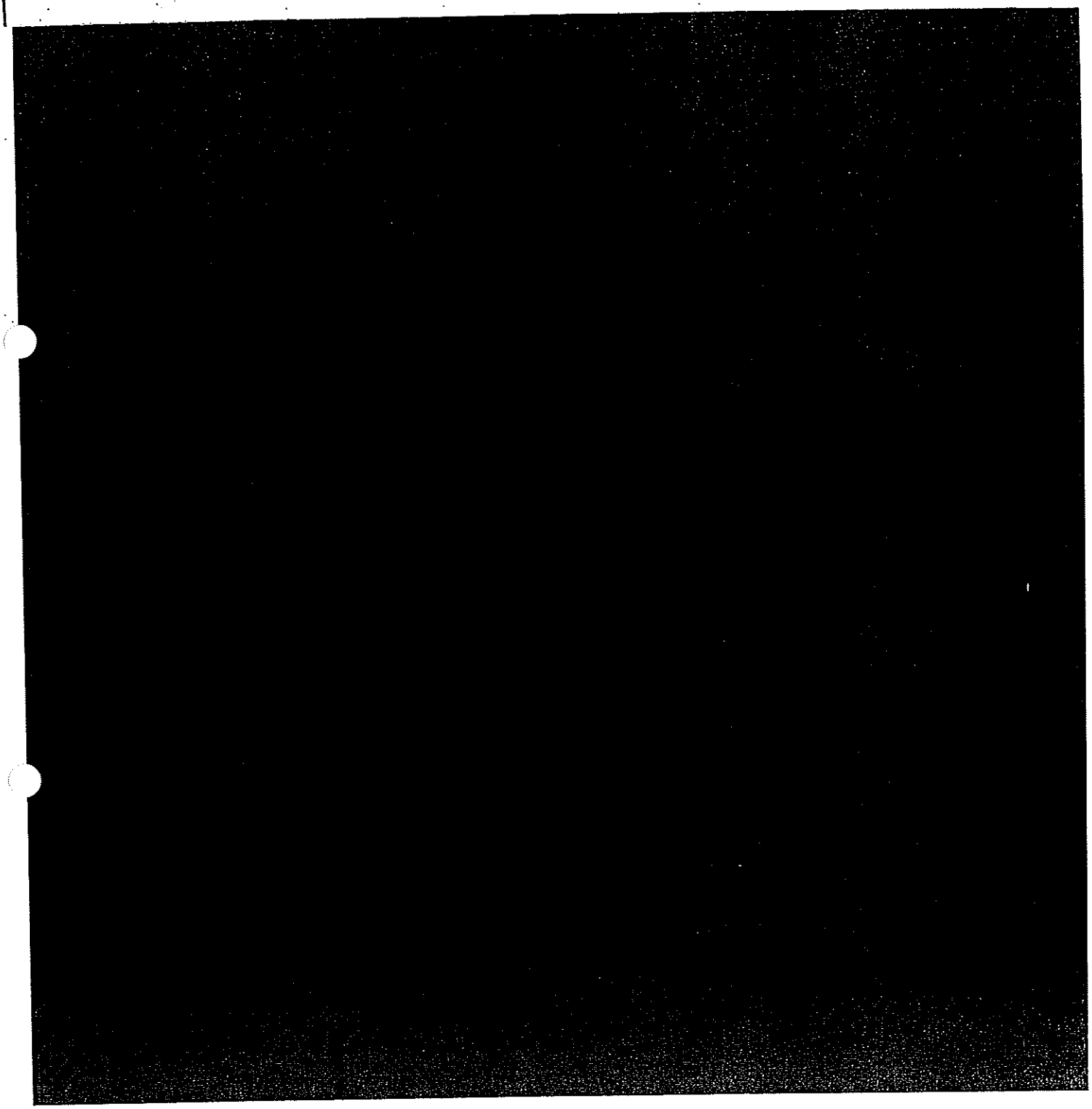


II. Summary of Results

III. Comparative Study of System Cost



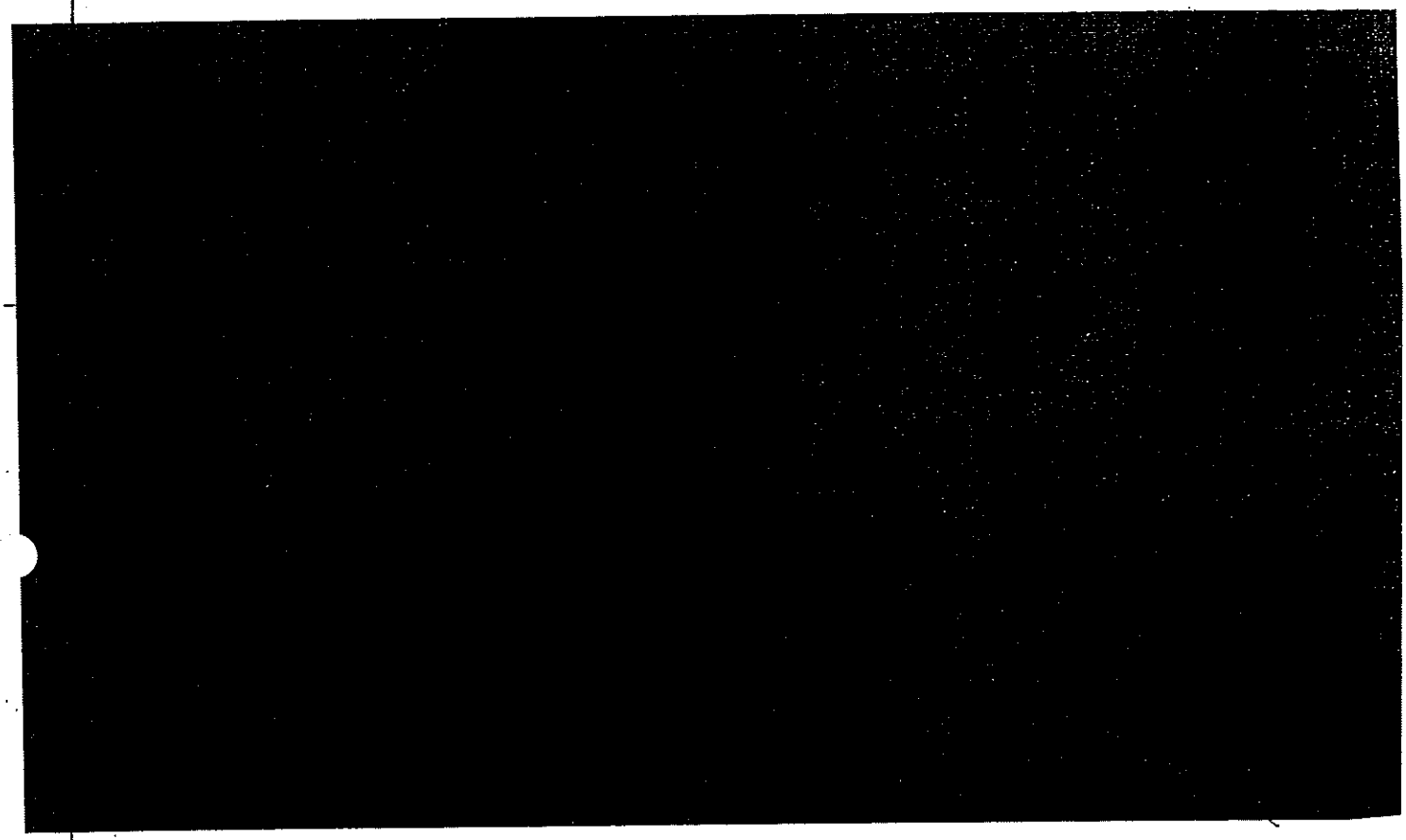
IV. Economic Internal Rate of Return



[redacted]

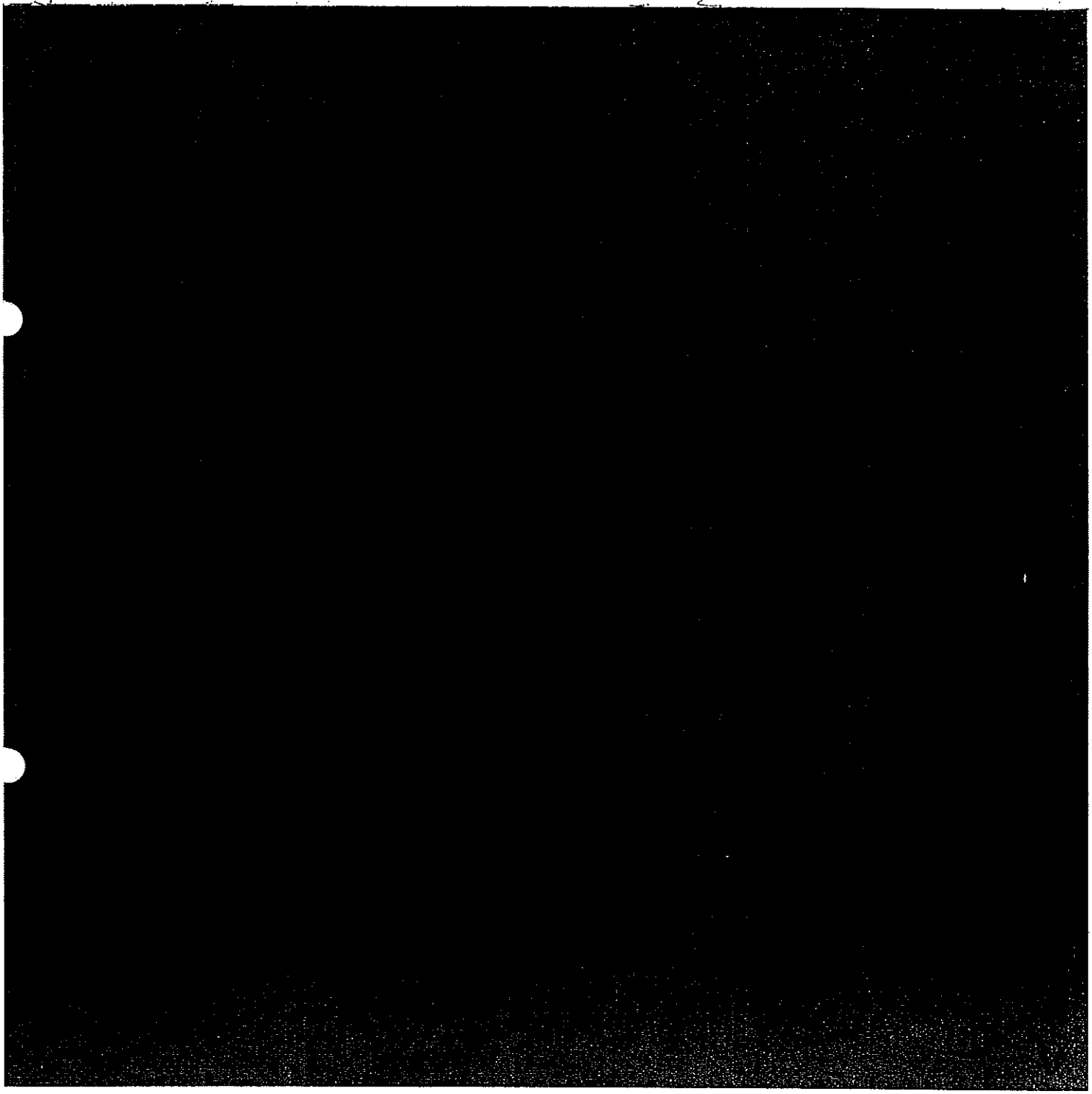
V. Financial Internal Rate of Return

[redacted]



VI. Kilowatt-Hour Generation Cost of Kotapanjang Project

VII. Conclusion



PERUSAHAAN UMUM LISTRIK NEGARA
AGENCY OF THE MINISTRY OF MINES AND ENERGY
GOVERNMENT OF THE REPUBLIC OF INDONESIA

KOTAPANJANG HYDROELECTRIC POWER PROJECT

DETAILED DESIGN REPORT

VOLUME 32

ENVIRONMENTAL MANAGEMENT PLAN (RKL)

AUGUST 1988

TOKYO ELECTRIC POWER SERVICES CO., LTD.
IN ASSOCIATION WITH
P.T. YODYA KARYA

PERFACE

The Koto Panjang Hydroelectric Power Plant project in the Regency of Kampar, Riau Province, is one of the projects that utilize water resource for generating electric power. This project will be useful to improve the national welfare, especially to satisfy the need for the electric energy that keeps increasing.

Beside the expexted benefit of the project, the activities of the devlopment of the project will bring with them various kinds of environmental risks.

According to the Act of the Republic of Indonesia no.4/1982, the Government Regulation no.29/1986, and the Ministerial Regulation issued in June 1987 by the Ministery of Mines and Energy, an Environment Management Plan (RKL) and an Environment Monitoring Plan (RPL) should be provided for every project.

The study of RKL and RPL for the Koto Panjang HPP carried out by the Riau University is based on an agreement between the Tokyo Electric Power Services Co., Ltd. (TEPSCO) and the Riau University (UNRI), the document of which was signed by the two parties in November 19, 1987.

The study is aimed at specifying measures to avoid or to minimize the negative impacts and to maximize or to maintain the positive impacts due to the construction of the Koto Panjang HPP project. In addition, the study will also examine and determine relevance agencies responsible to undertake the environment management and monitoring, and to determine the amount and the source of cost needed for that purpose.

The report of this study is in three separate reports, that is the Revision of Amdal Data of Koto Panjang HPP, RKL report and the RPL report.

Since the scope of this study is quite broad, the team of the study has been assisted by various agencies and individuals, especially in collecting field survey data. Hereby we would like to express our appreciation and thank to the followings:

1. [redacted]
2.
3.
4.
5.
6.
7.
8. The other agencies and individuals.

We also would like to express our sincere gratitude to TEPSCO who has entrusted UNRI to carry out this study.

Our deep thanks are also conveyed to the Rector of UNRI for his continueous guidance and support, without which the completion of this study is impossible.

Pekanbaru, July 1988

The team of study for Environment Management Plan and Environment Monitoring Plan for the Koto Panjang Hydroelectric Power Project

[redacted]

NIP. 130 252 929

STUDY TEAM

A. Liable Officer	[redacted], Riau University
B. Data Source	[redacted] Regional Development Planning Board of Riau Province [redacted] Electric Network Project Diesel-Electric Power Project of Riau
C. Research Team	
1. Chairman	[redacted] (Statistician and holder of Type-B diploma in Impact Analysis
2. Secretary	[redacted], B.Sc., MLS (Physicist, Library and Information Scientist)
3. Technical Coordinator	[redacted] (Ecologist and Environmentalist)
4. Sub Coordiator	[redacted], MS (Biologist)
	[redacted], MS (Agriculture economist)
	[redacted]MS. (Historian)
5. Members	[redacted],MSc (Aqua-Culturologi)
	[redacted],MSc (Fish-Culturologist)
	[redacted], SU (Chemist)
	[redacted] (Chemist)
	[redacted] (Geologist and Regional Planner)

[redacted]
(Soil Scientist)
[redacted], MSc
(Agronomist and Regional Planner)
[redacted]
(Educationist)
[redacted]
(Mathematisian)
[redacted]
(Historian)
[redacted], BA
(Historian and Archeologist)

TABLE OF CONTENTS

CHAPTER ONE
I N T R O D U C T I O N

A. Background

This report has been prepared to be submitted to PLN as a part of Design Report, and also prepared to comply with new government regulation.

According to the Act of the Republic of Indonesia no.4 of 1982 concerning Basic Provisions for Management of the Living Environment and Government Regulation No. 29 of 1986, the Report of Environmental Impact Assessment (hereinafter as "the Report") has been prepared by the ANDALAS University in 1984.

Further the Guidelines have been implemented by the Ministery of Mines and Energy in June 1987 pertaining to the procedures and practical execution of Regulation no. 29 and the Environmental Management Plan (RKL) and the Environmental Monitoring Plan (RPL) have to be submitted to the Commission and its infrastructure, Technical Committee of both Central and Local.

The additional studies for preparing these two reports (RKL & RPL) have been undertaken by the Riau University (UNRI) including the works to update and renew the data enumerated in the ANDAL Report. The method of the updating of the data are shown in the appendix one.These two reports have been completed in the end of March 1988.

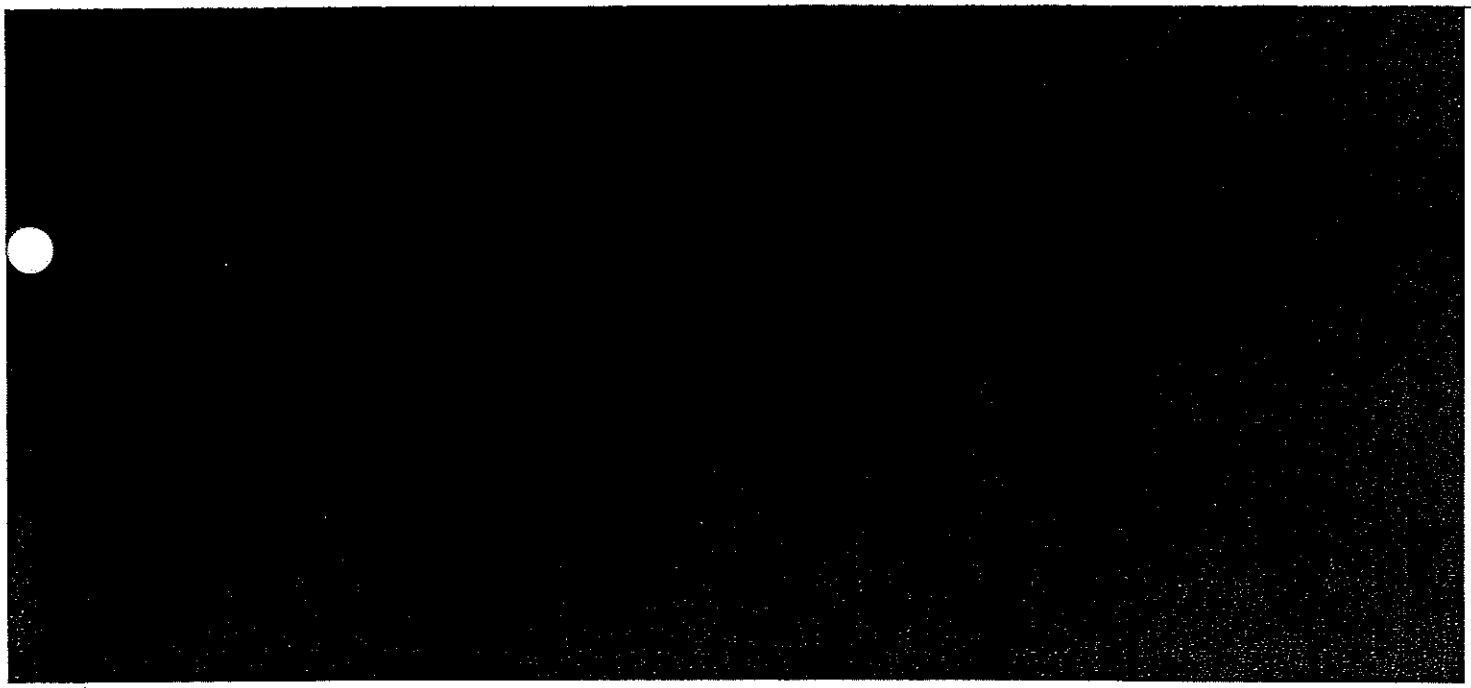
The construction of Koto Panjnag Hydroelectric Power Plant in the district of Kampar, Riau Province, is the realization of the project stated in the National Development Plan.

Although any development effort should be directed to the betterment of national welfare, it often happens that development activities bring with them various environmental risks in addition to the benefits desired.

In order to protect the environment and the people living around the project area from any harmful environmental impacts, measures should be taken to manage and monitor the environmental conditions. Due to the construction works of the project, the changes in the environment will occur not only in bio-geophysic terms but also in terms of socio-economy as well as socio-culture. The possible environmental impacts, positive or negative, have been studied.

B.Objectives and Uses of RKL and RPL

1. Objectives



[redacted]

2. Uses

[redacted]

C'. Approaches For RKL

1. Technical Approach

[redacted]

2.Economic Approach

[redacted]

3. Institutional Approach

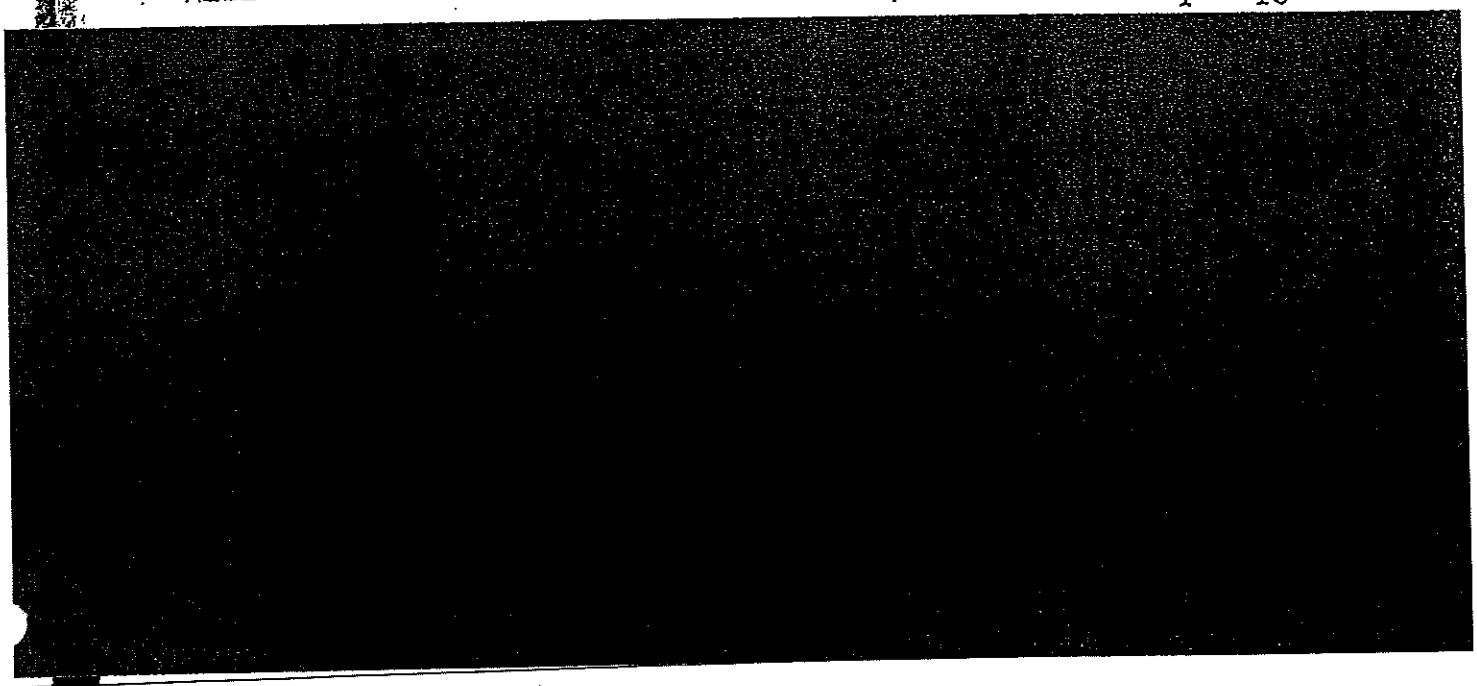
[redacted]

D. Scope of the Study.

[redacted]

1. Reservoir area

[redacted]



2. Down-stream and Watershed.

CHAPTER TWO

SUMMARY OF THE ENVIRONMENTAL IMPACT ANLYSIS (ANDAL) STUDY OF THE KOTO PANJANG HYDROELECTRIC POWER PLANT PROJECT

A. General Description of the Project.

[redacted]

B. Potential Environmental Impacts that Need to be Managed.

[redacted]

1. Preliminary Stage

[redacted]

2. Construction Stage

[redacted]

[redacted]

3. Operation stage

[redacted]

CHAPTER THREE
ENVIRONMENT MANAGEMENT PLAN (RKL)
FOR THE KOTO PANJANG HPP PROJECT

A.Preliminary Stage

1. Bio-geophysic Component.

[redacted]

2. Socio-economic and socio-cultural component.

[redacted]

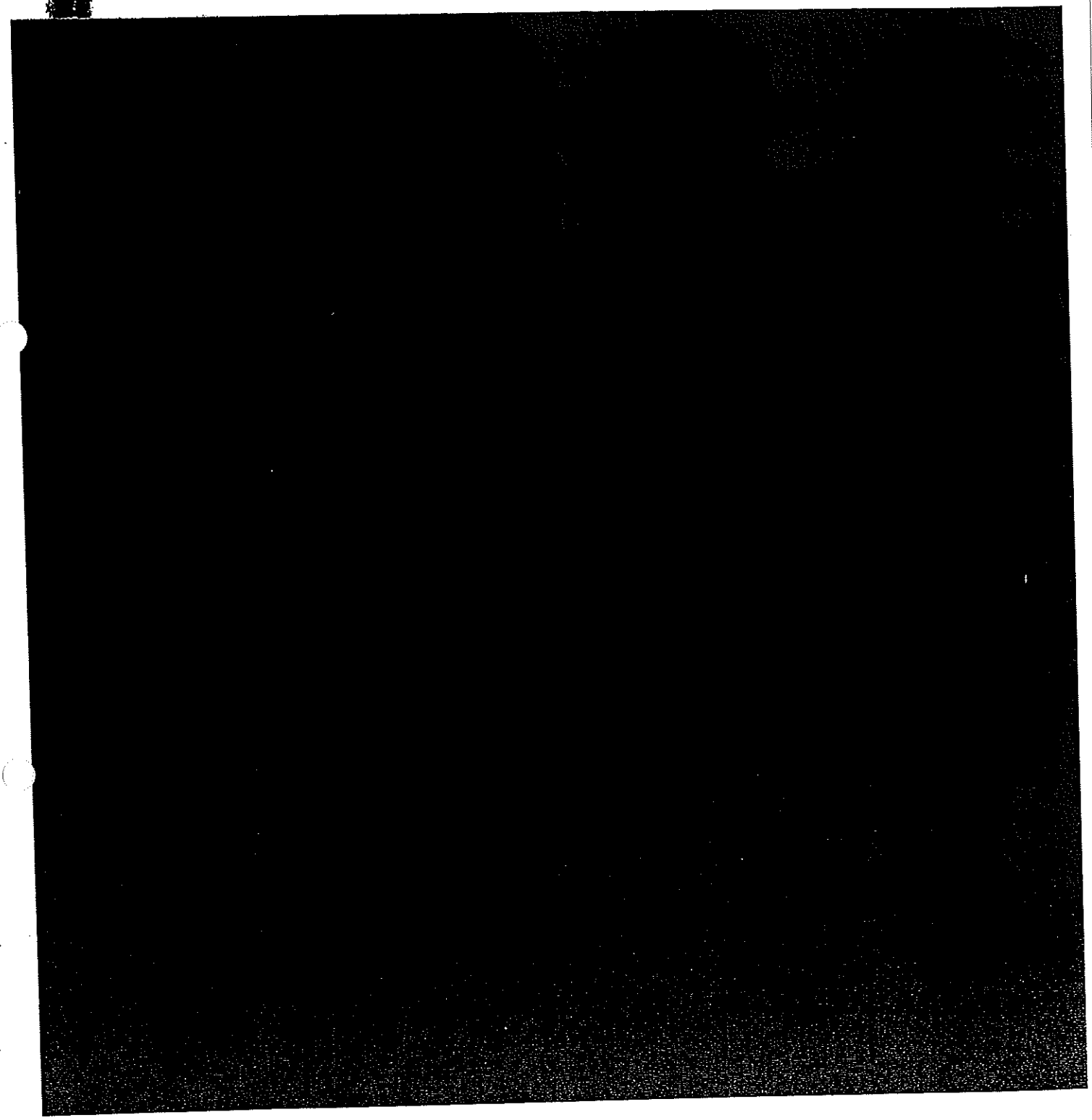
[redacted]

B. Construction Stage

1. Bio-geophysic Component

[redacted]

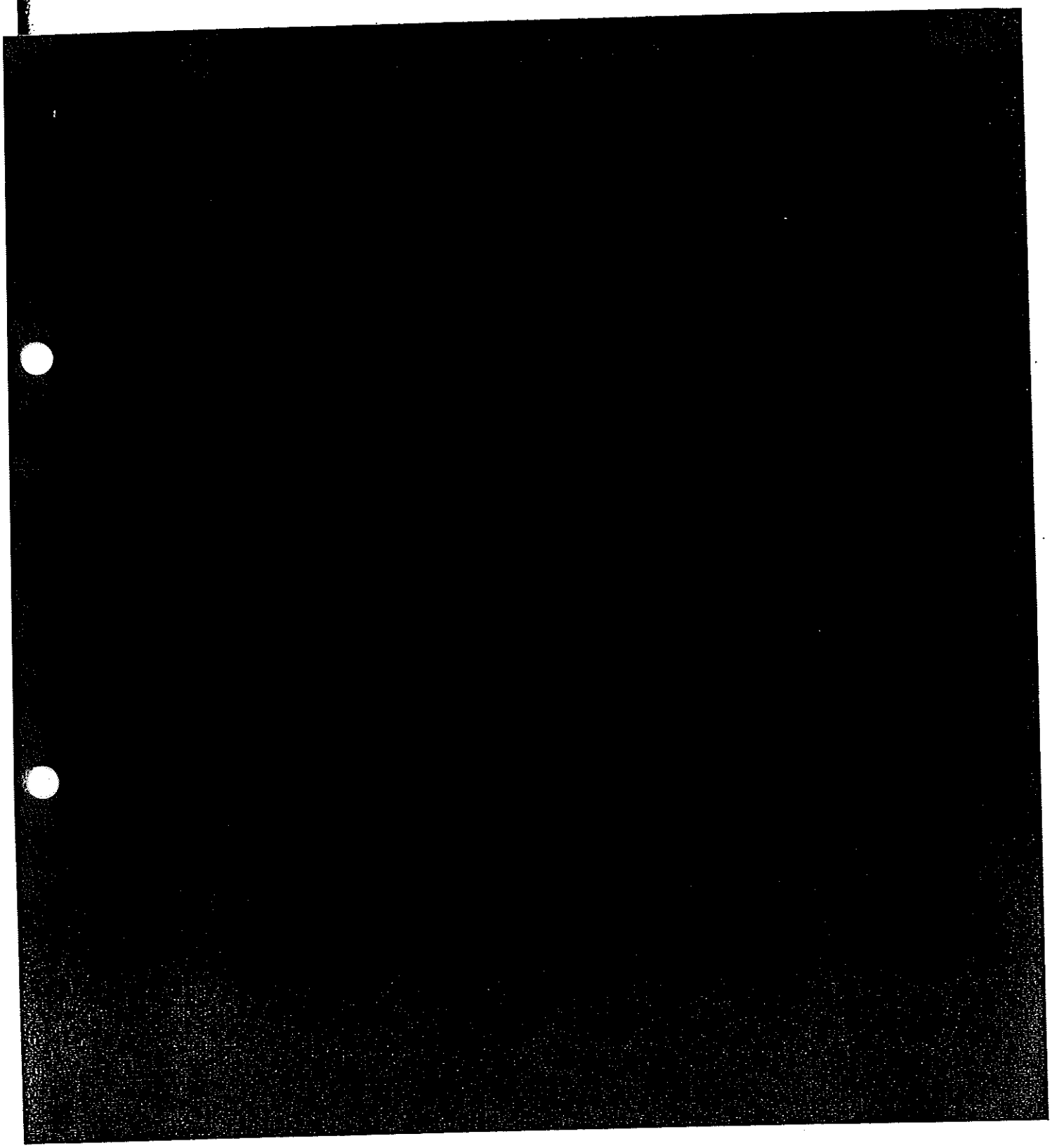
2. Socio-economic and Socio-cultural Component

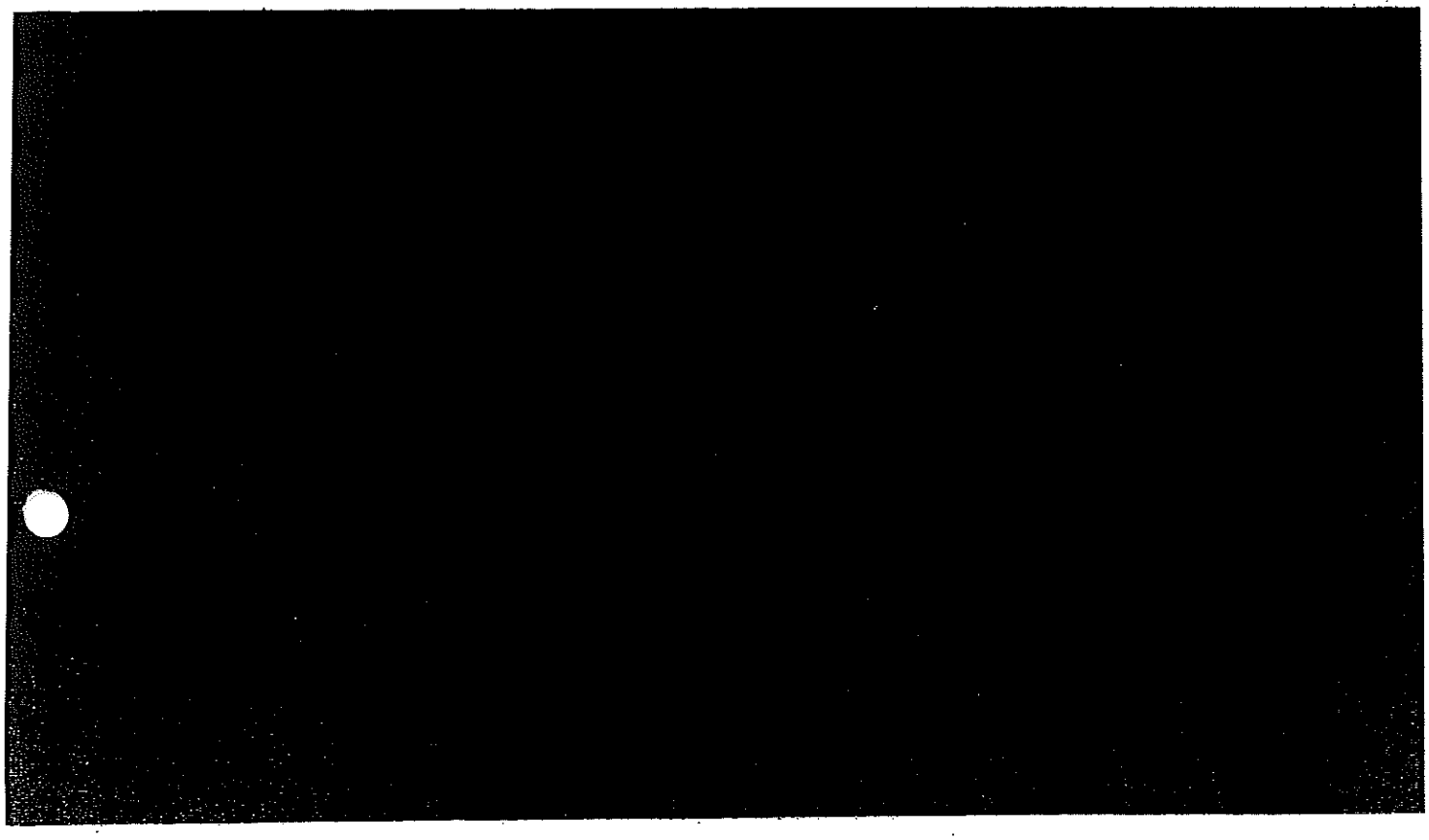


C. OPERATION STAGE.

1. Bio-Geophysic Component.

2. Socio-economic and Socio-Cultural Component .





D. Matrix of Environment Management Plan.

E. Procedure, Related government institutions deadling with compensation and resettlement can be seen in the Appendix (Pictures 1 to 10).

PERUSAHAAN UMUM LISTRIK NEGARA
AGENCY OF THE MINISTRY OF MINES AND ENERGY
GOVERNMENT OF THE REPUBLIC OF INDONESIA

KOTAPANJANG HYDROELECTRIC POWER PROJECT

DETAILED DESIGN REPORT

VOLUME 33

ENVIRONMENTAL MONITORING PLAN (RPL)

AUGUST 1988

TOKYO ELECTRIC POWER SERVICES CO., LTD.
IN ASSOCIATION WITH
P.T. YODYA KARYA

PERFACE

The Koto Panjang Hydroelectric Power Plant project in the Regency of Kampar, Riau Province, is one of the projects that utilize water resource for generating electric power. This project will be useful to improve the national welfare, especially to satisfy the need for the electric energy that keeps increasing.

Beside the expected benefit of the project, the activities of the development of the project will bring with them various kinds of environmental risks.

According to the Act of the Republic of Indonesia no.4/1982, the Government Regulation no.29/1984, and the Ministerial Regulation issued in June 1987 by the Ministery of Hines and Energy, an Environment Management Plan (RKL) and an Environment Monitoring Plan (RPL) should be provided for every project.

The study of RKL and Rpl for the Koto Panjang HPP carried out by the Riau University is based on an agreement between the Tokyo Electric Power Services Co., Ltd. (TEPSCO) and the Riau University (UNRI), the document of which was signed by the two parties in November 19, 1987.

The study is aimed at specifying measures to avoid or to minimize the negative impacts and to maximize or to maintain the positive impacts due to the construction of the Koto Panjang HPP project. In addition, the study will also examine and determine relevance agencies responsible to undertake the environment management and monitoring, and to determine the amount and the source of cost needed for that purpose.

The report of this study is in three separate reports, that is the Revision of Amdal Data of Koto Panjang HPP, RKL report and the RPL report.

Since the scope of this study is quite broad, the team of the study has been assisted by various agencies and individuals, especially in collecting field survey data. Hereby we would like to express our appreciation and thanks to the followings:

1. [redacted]
2.
3.
4.
5.
6.
7.
8. The other agencies and individuals.

We also would like to express our sincere gratitude to TEPSCO who has entrusted UNRI to carry out this study..

Our deep thanks are also conveyed to the Rector of UNRI for his continueous guidance and support, without which the completion of this study is impossible.

Pekanbaru, July 1988

The team of study for Environment Management Plan and Environment Monitoring Plan for the Koto Panjang Hydroelectric Power Plant

[redacted]

NIP. 130 252 929

STUDY TEAM

A. Liable Officer
[redacted], Riau University

B. Data Source
[redacted]
Regional Development Planning Board of Riau Province
[redacted], BE
Electric Network Project Diesel-Electric Power Project of Riau

C. Research Team

1. ~~Chairman~~ [redacted]
(Statistician and holder of Type-B diploma in Impact Analysis

2. Secretary [redacted], B.Sc., MLS
(Physicist, Library and Information Scientist)

3. Technical Coordinator [redacted]
(Ecologist and Environmentalist)

4. Sub Coordiator [redacted], MS
[redacted], MS
(Agriculture economist)
[redacted] MS.
(Historian)

5. Members [redacted], MSc
(Aqua-Culturologi)
[redacted], MSc
(Fish-Culturologist)
[redacted], SU
(Chemist)
[redacted]
(Chemist)
[redacted]
(Geologist and Regional Planner)

RESEARCH CENTER OF RIAU UNIVERSITY

[redacted]
(Soil Scientist)
[redacted], MSc
(Agronomist and Regional Planner)
[redacted]
(Educationist)
[redacted]
(Mathematisian)
[redacted]
(Historian)
[redacted], BA
(Historian and Archeologist)

TABLE OF CONTENTS

CHAPTER ONE

I N T R O D U C T I O N

A. Background

[redacted]

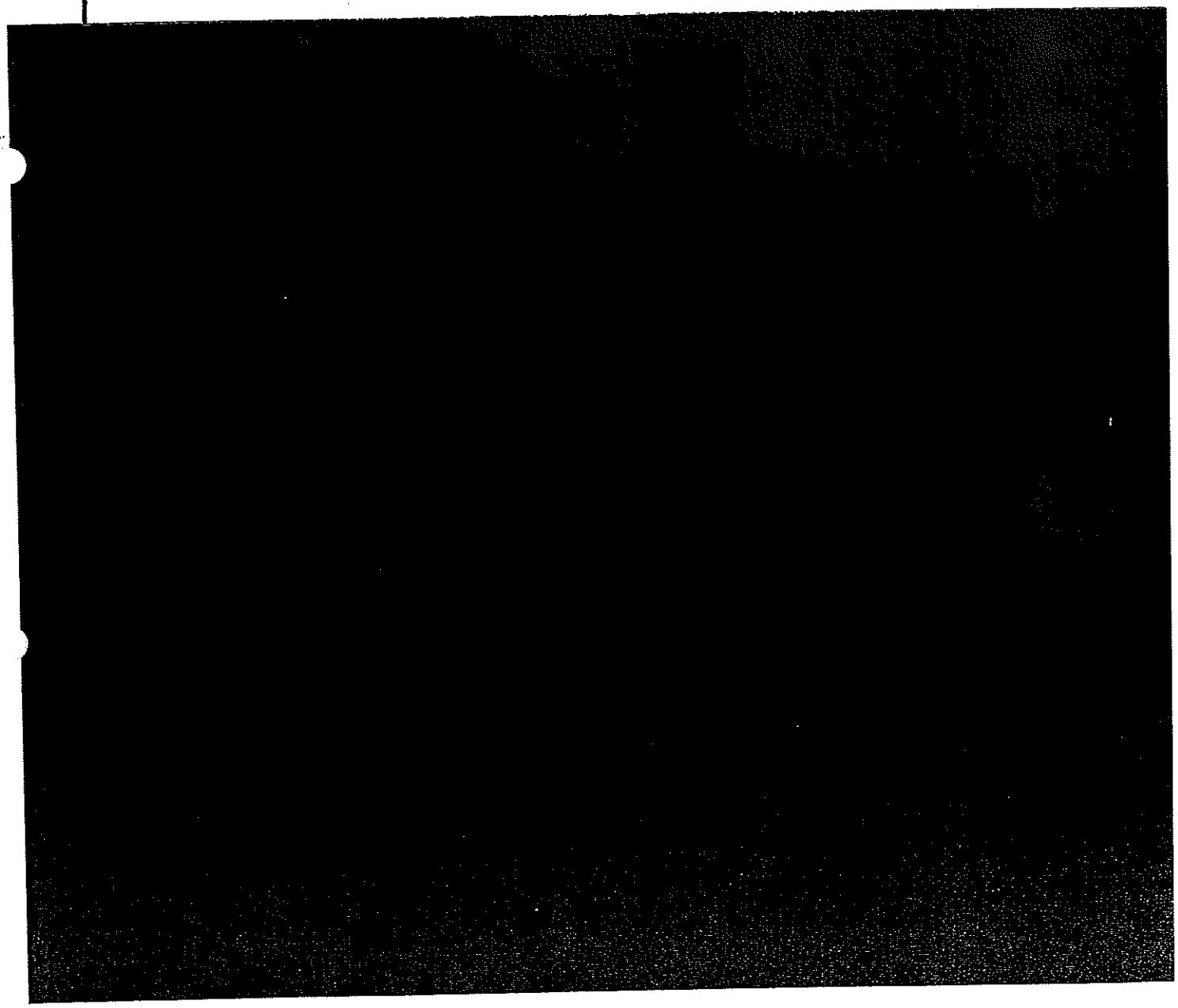
[redacted]

B. Objectives and Uses of RPL

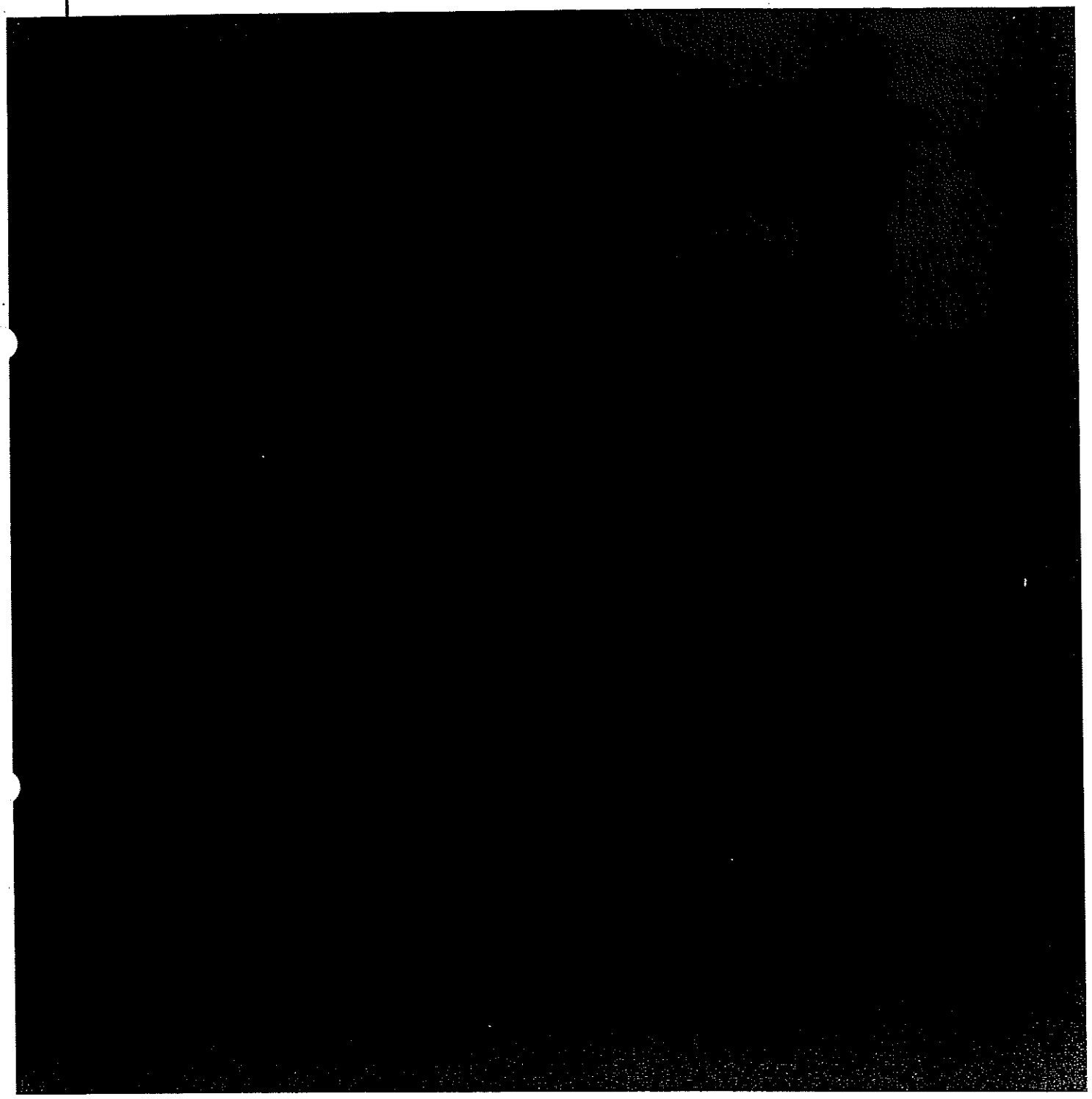
1. Objectives

[redacted]

2. Uses



C. Environmental Monitoring Approach System



CHAPTER TWO
ENVIRONMENT MONITORING PLAN
OF THE KOTO PANJANG HYDROELECTRIC POWER PLANT PROJECT

A. Preliminary Stage

[redacted]

1. Social Tension.

[redacted]

2. Cultivated land speculation.

[redacted]

B. Construction Stage

[redacted]

1. Job Opportunity.

[redacted]

[redacted]

2. Social Jealousy.

[redacted]

3. The damage of road.

[redacted]

4. People Safety from Wild and Poisonous Animals.

[redacted]

5. The People Safety from the Danger of Drowning.

[redacted]

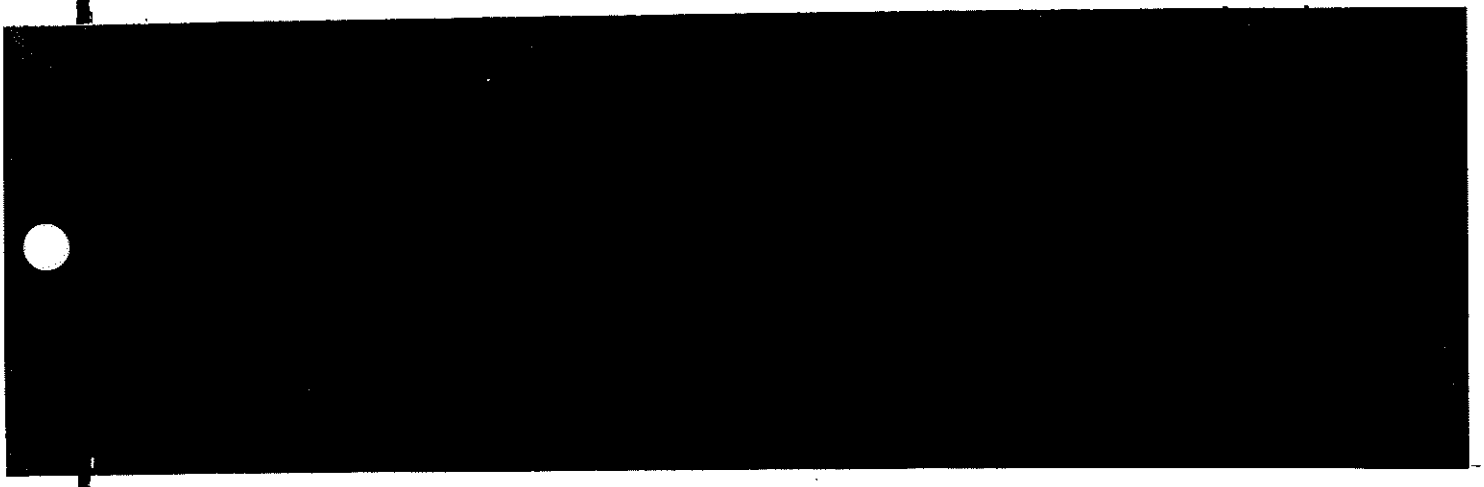
6.The Damage of Forest.

[redacted]

C. Operation Stage

1. Conservation of Muara Takus Temple.

2. Unemployment.

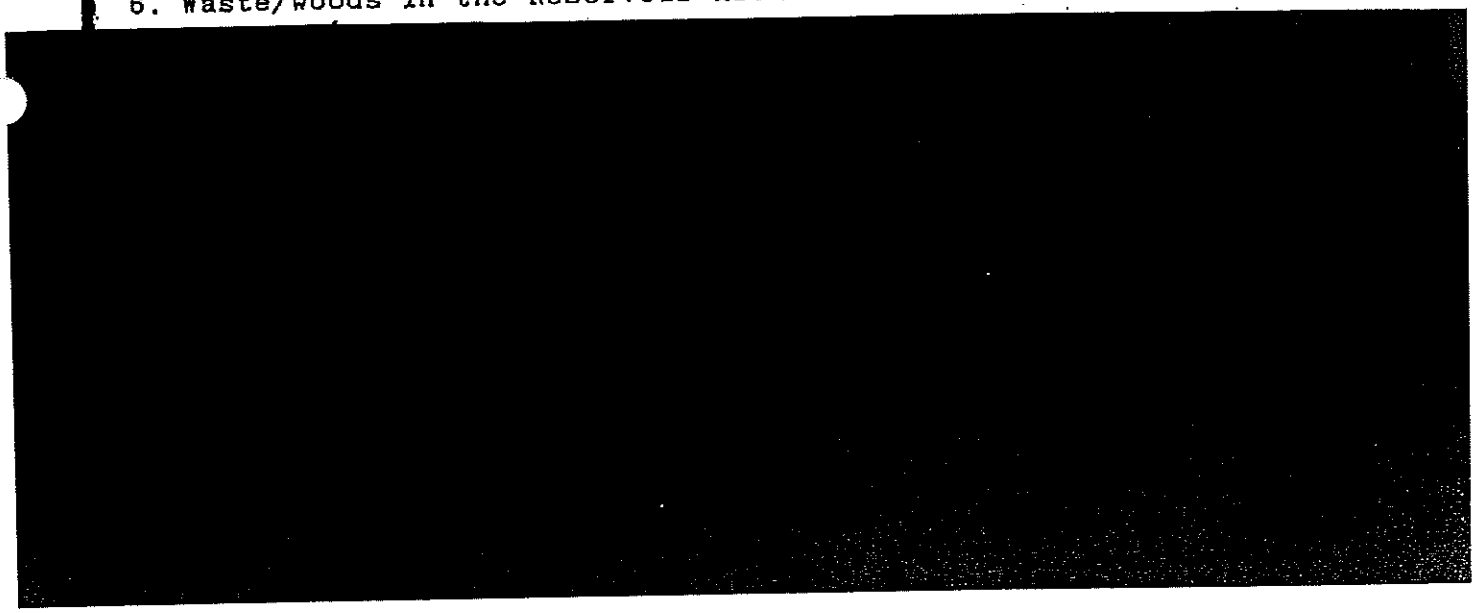


3. Vectorial Organism.

4. Water quality .

5. The Sedimentation and Erosion monitoring

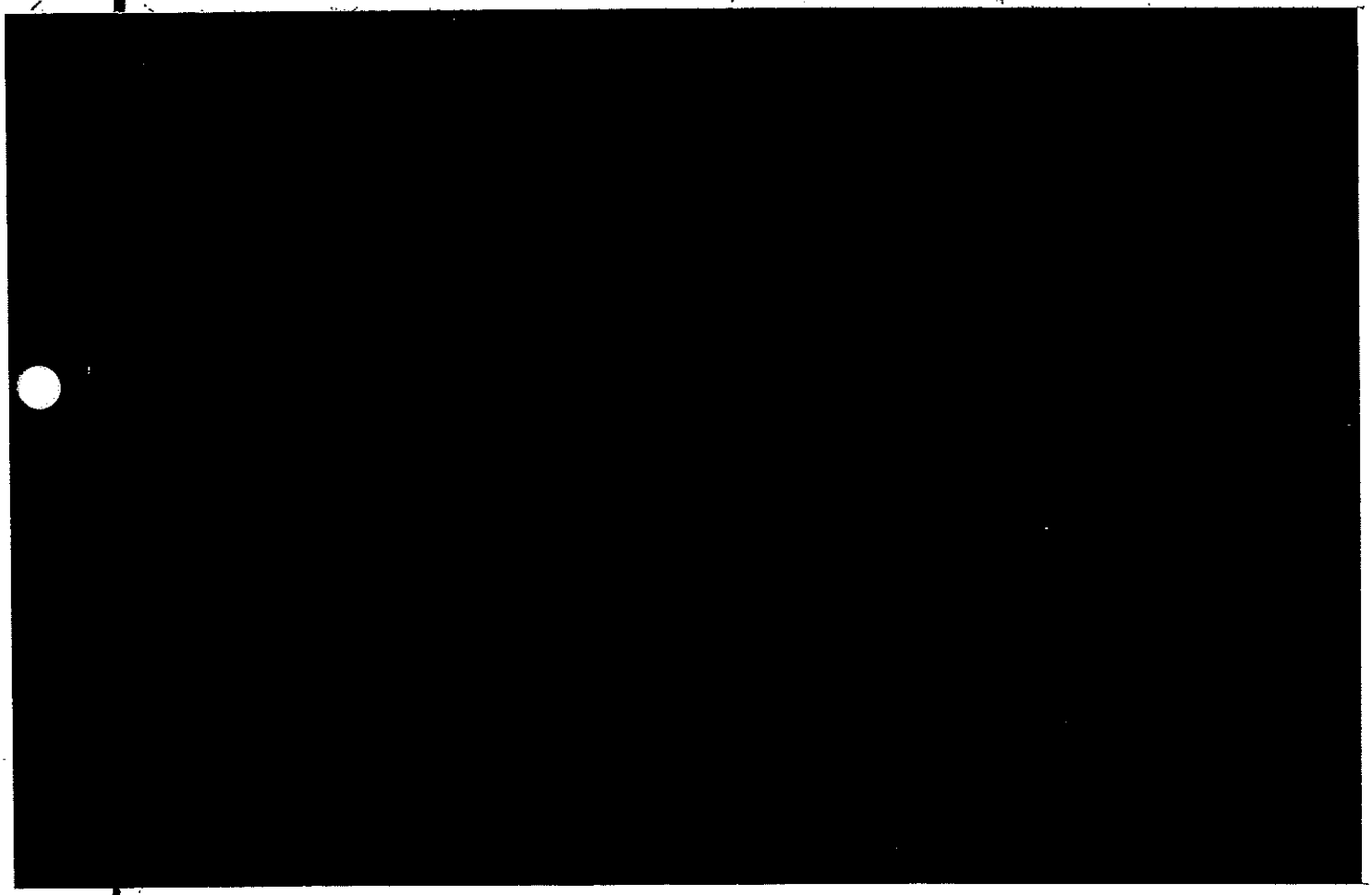
6. Waste/woods in the Reservoir Area



7. Water sponger plant (gulma air)

8. Monitoring of Ecological Changes

9.Monitoring of Socio-economic and Socio-cultural changes.



D. Matrix of Environment Monitoring Plan.

PERUSAHAAN UMUM LISTRIK NEGARA
AGENCY OF THE MINISTRY OF MINES AND ENERGY
GOVERNMENT OF THE REPUBLIC OF INDONESIA

KOTAPANJANG HYDROELECTRIC POWER PROJECT

DETAILED DESIGN REPORT

APPENDIX TO VOL. 32 and 33

THE REVISION OF ANDAL STUDY DATA OF

THE KOTAPANJANG H.P.P.

AUGUST 1988

TOKYO ELECTRIC POWER SERVICES CO., LTD.
IN ASSOCIATION WITH
P.T. YODYA KARYA

PERFACE

The Koto Panjang Hydroelectric Power Plant project in the Regency of Kampar, Riau Province, is one of the projects that utilize water resource for generating electric power. This project will be useful to improve the national welfare, especially to satisfy the need for the electric energy that keeps increasing.

Beside the expexted benefit of the project, the activities of the devlopment of the project will bring with them various kinds of environmental risks.

According to the Act of the Republic of Indonesia no.4/1982, the Government Regulation no.29/1986, and the Ministerial Regulation issued in June 1987 by the Ministery of Mines and Energy, an Environment Management Plan (RKL) and an Environment Monitoring Plan (RPL) should be provided for every project.

The study of RKL and RPL for the Koto Panjang HPP carried out by the Riau University is based on an agreement between the Tokyo Electric Power Services Co., Ltd. (TEPSCO) and the Riau University (UNRI), the document of which was signed by the two parties in November 19, 1987.

The study is aimed at specifying measures to avoid or to minimize the negative impacts and to maximize or to maintain the positive impacts due to the construction of the Koto Panjang HPP project. In addition, the study will also examine and determine relevance agencies responsible to undertake the environment management and monitoring, and to determine the amount and the source of cost needed for that purpose.

The report of this study is in three separate reports, that is the Revision of Amdal Data of Koto Panjang HPP, RKL report and the RPL report.

Since the scope of this study is quite broad, the team of the study has been assisted by various agencies and individuals, especially in collecting field survey data. Hereby we would like to express our appreciation and thank to the followings:

1. [redacted]
2.
3.
4.
5.
6.
7.
8. The other agencies and individuals.

We also would like to express our sincere gratitude to TEPSCO who has entrusted UNRI to carry out this study.

Our deep thanks are also conveyed to the Rector of UNRI for his continueous guidance and support, without which the completion of this study is impossible.

Pekanbaru, July 1988

The team of study for Environment Management Plan and Environment Monitoring Plan for the Koto Panjang Hydroelectric Power Project

[redacted]

NIP. 130 252 929

RESEARCH CENTER OF RIAU UNIVERSITY

STUDY TEAM

A. Liable Officer	[redacted], Riau University
B. Data Source	[redacted] Regional Development Planning Board of Riau Province [redacted], BE Electric Network Project Diesel-Electric Power Project of Riau
C. Research Team	
1. Chairman	[redacted] (Statistician and holder of Type-B diploma in Impact Analysis
2. Secretary	[redacted], B.Sc., MLS (Physicist, Library and Information Scientist)
3. Technical Coordinator	[redacted] (Ecologist and Environmentalist)
4. Sub Coordiator	[redacted], MS (Biologist) [redacted]., MS (Agriculture economist)
	[redacted] MS. (Historian)
5. Members	[redacted],MSc (Aqua-Culturologi) [redacted],MSc (Fish-Culturologist) [redacted], SU (Chemist) [redacted] (Chemist) [redacted] (Geologist and Regional Planner)

RESEARCH CENTER OF RIAU UNIVERSITY

[redacted]
(Soil Scientist)
[redacted], MSc
(Agronomist and Regional Planner)
[redacted]
(Educationist)
[redacted]
(Mathematisian)
[redacted]
(Historian)
[redacted], BA
(Historian and Archeologist)

LIST OF CONTENTS

APPENDIXES

CHARTS:

TABLES:

[redacted]

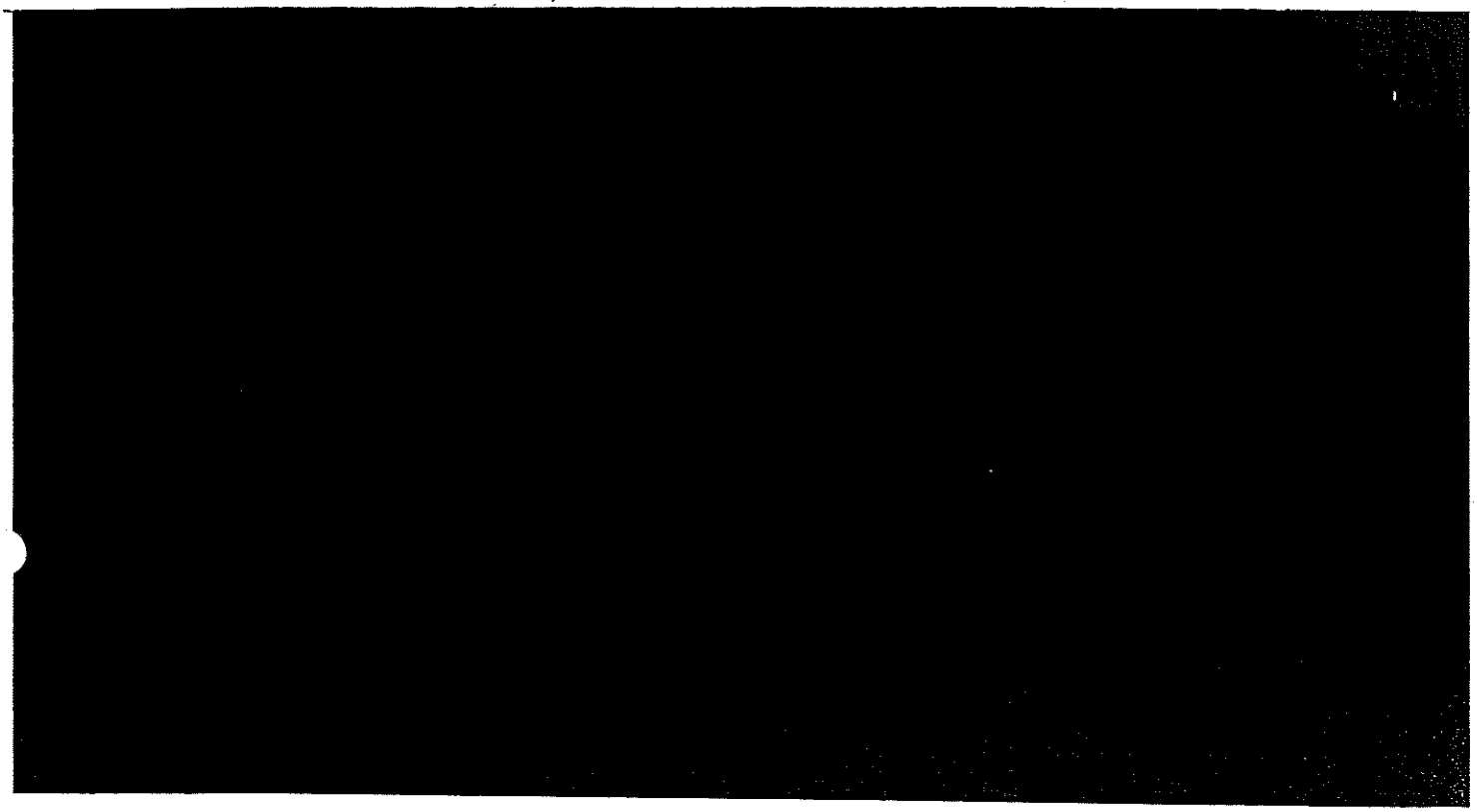
A. Study Method

[redacted]

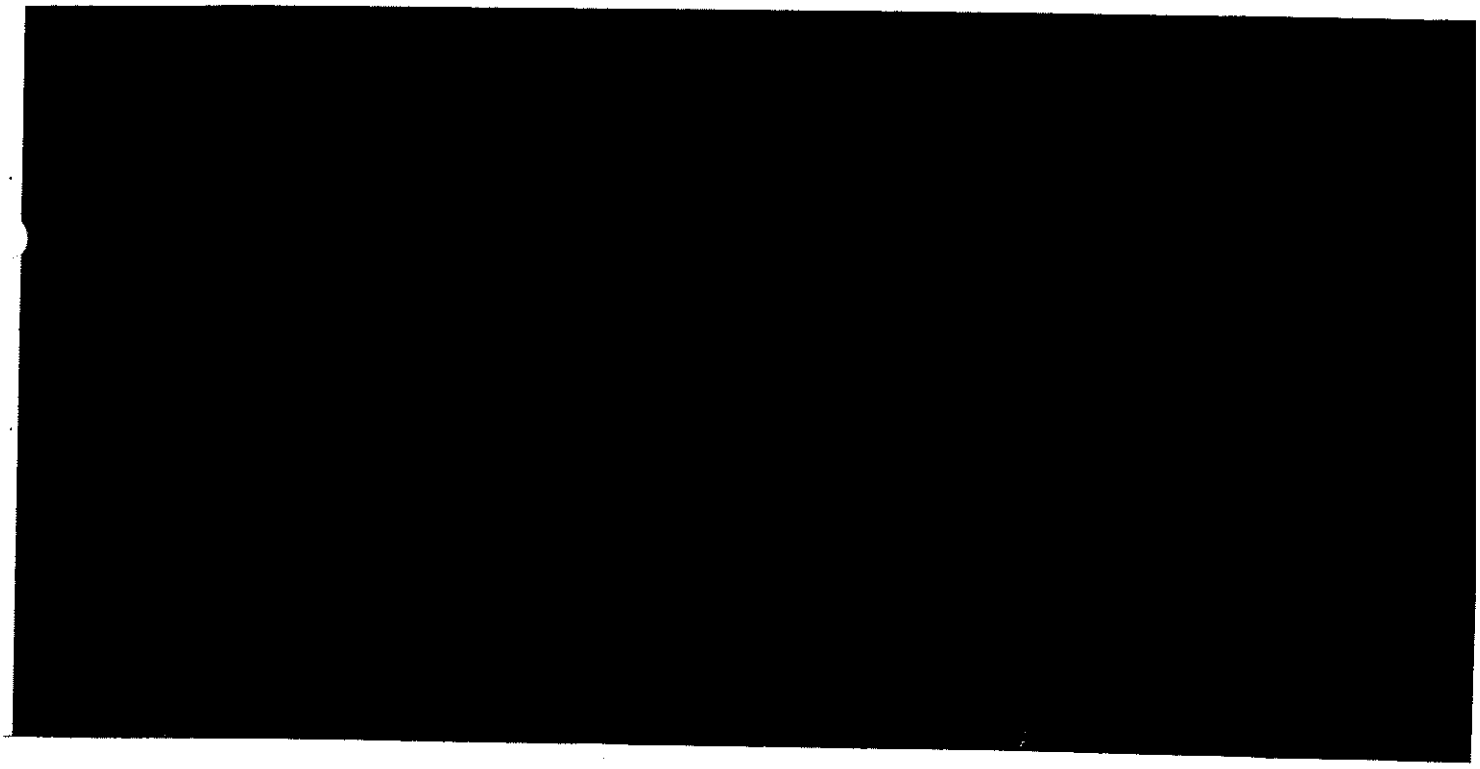
1. The Method of Bio-geophysical Data Collection

a. Water organism

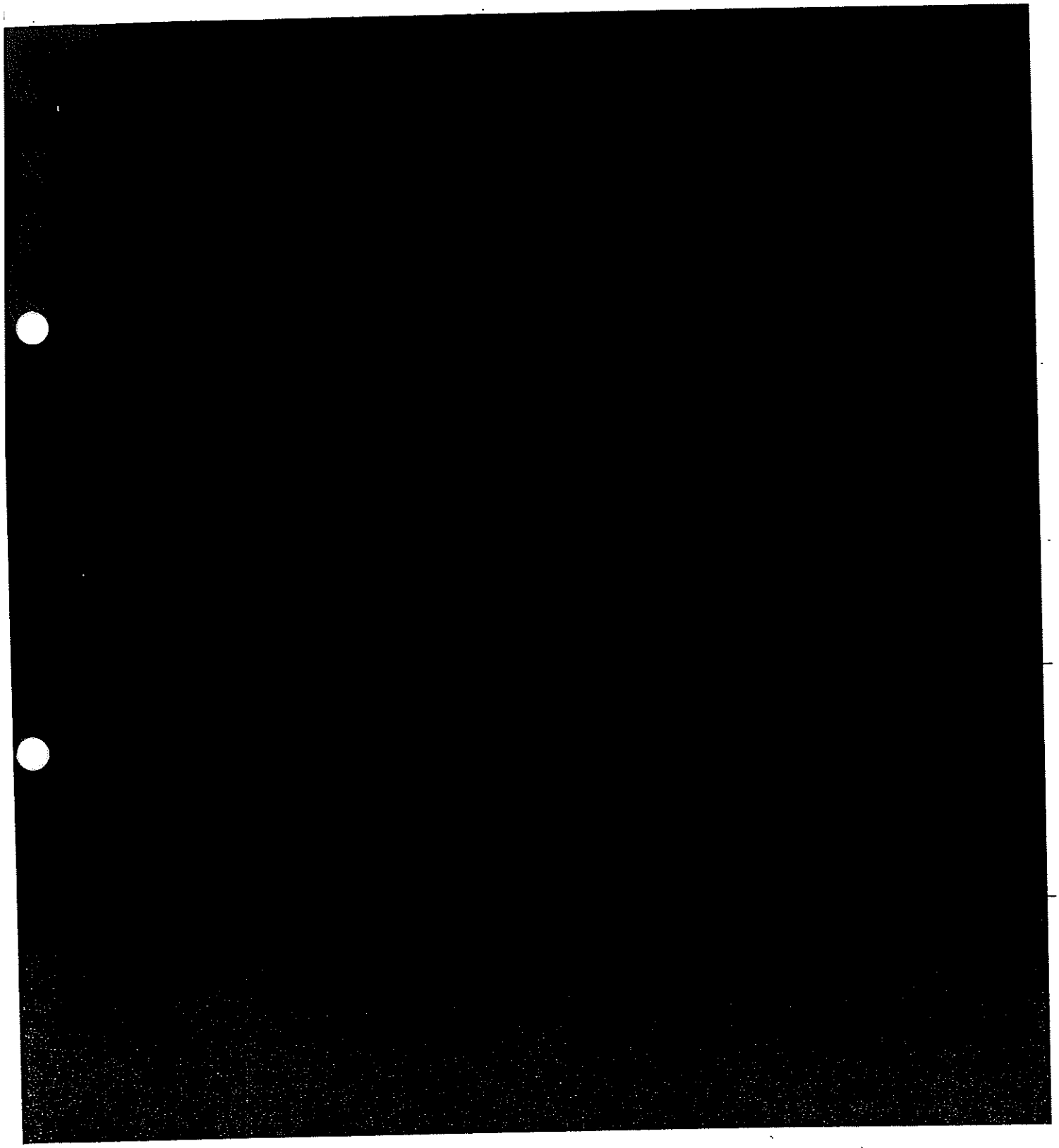
[redacted]



b. Vegetation



2. Method of Socio-economic Data Collection and Analysis



3. Method of Collection and Analysis of the Socio-cultural Data

[redacted]

a. Method of Data Collection

[redacted]

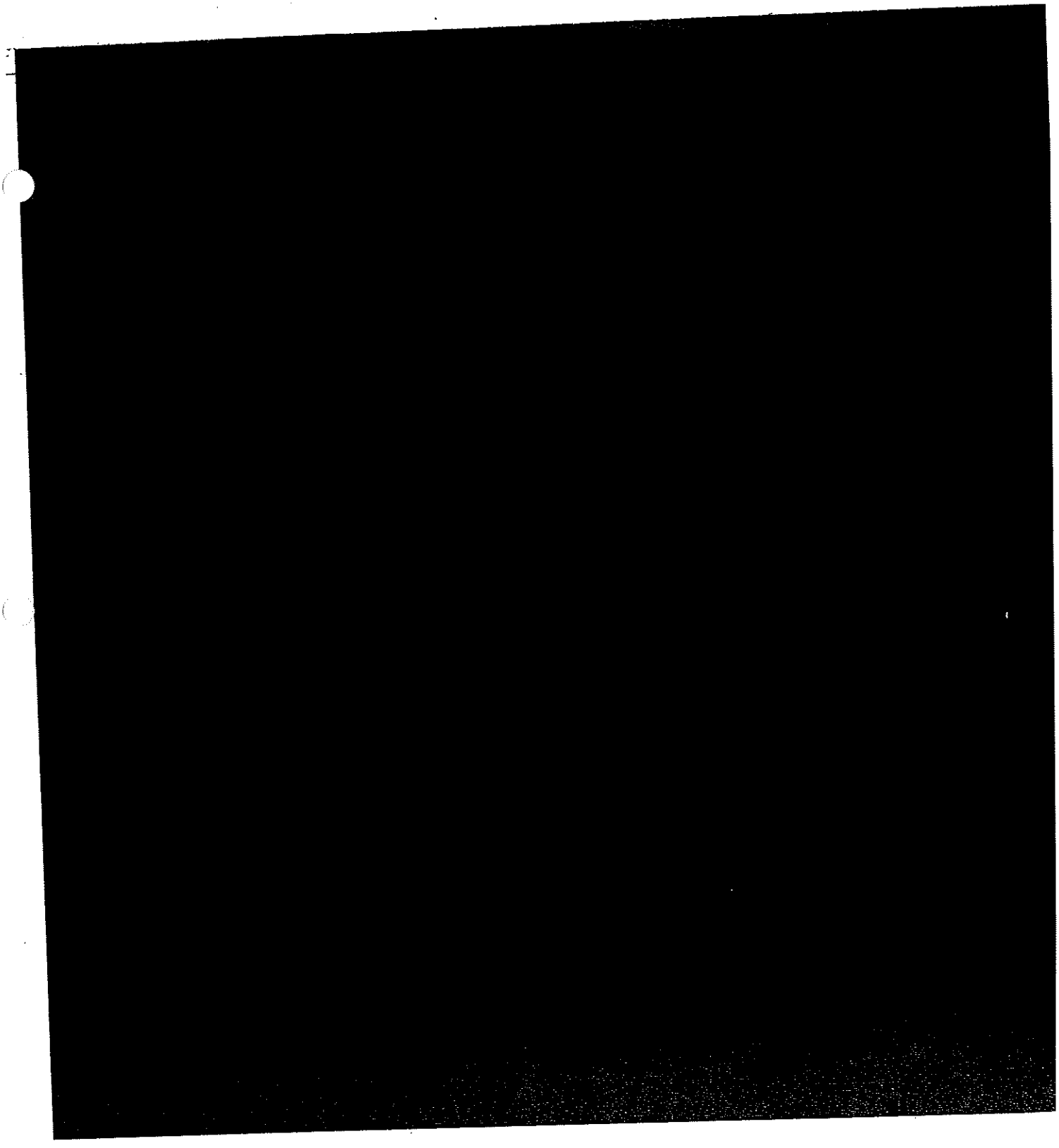
b. Research Locations

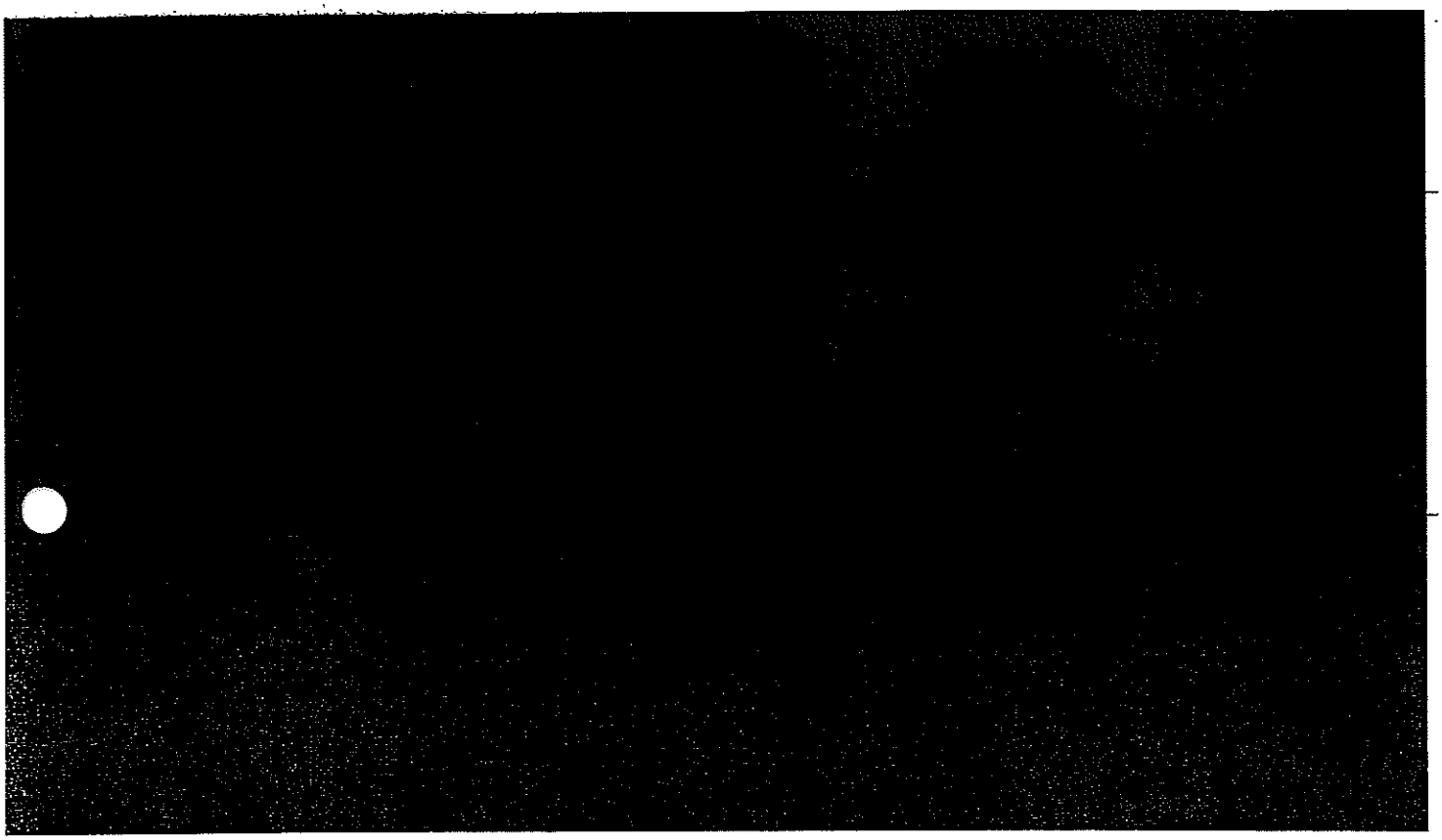
[redacted]

B. Environment Condition Based on the Data Revision

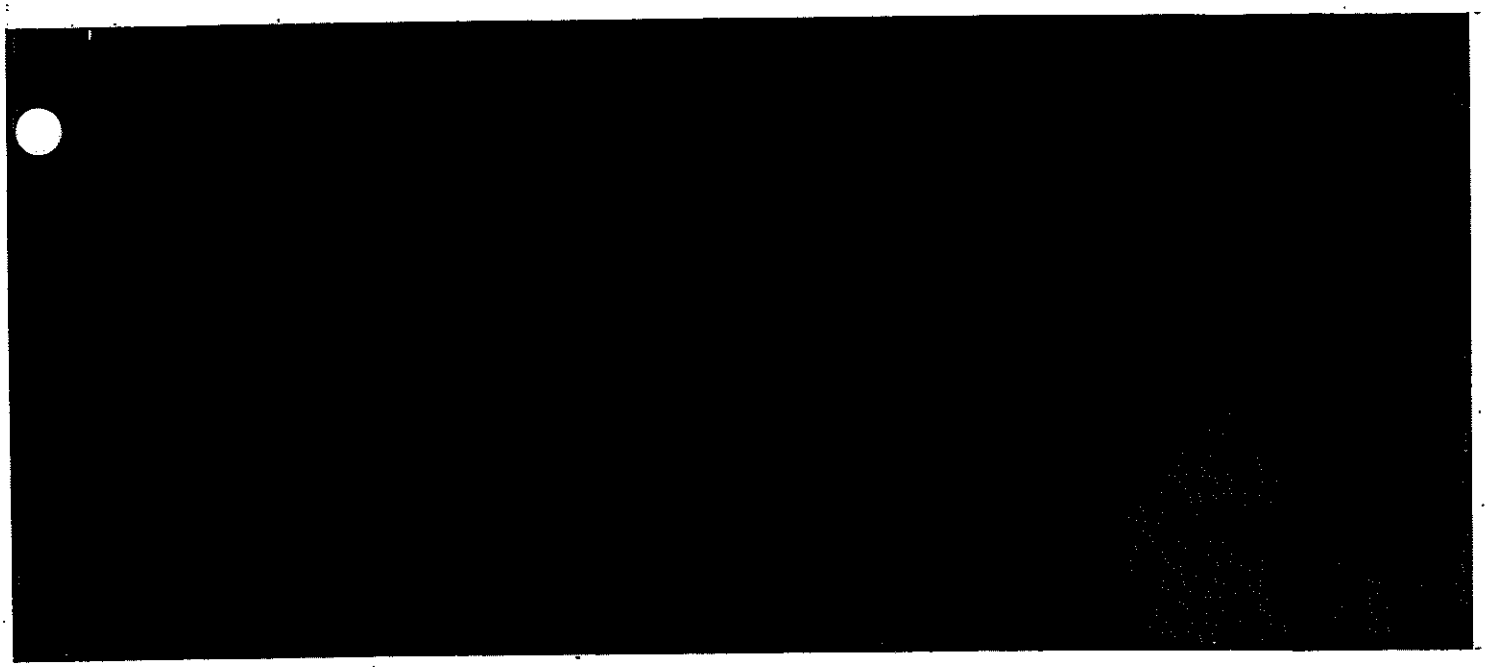
1. Bio-geophysical Component.

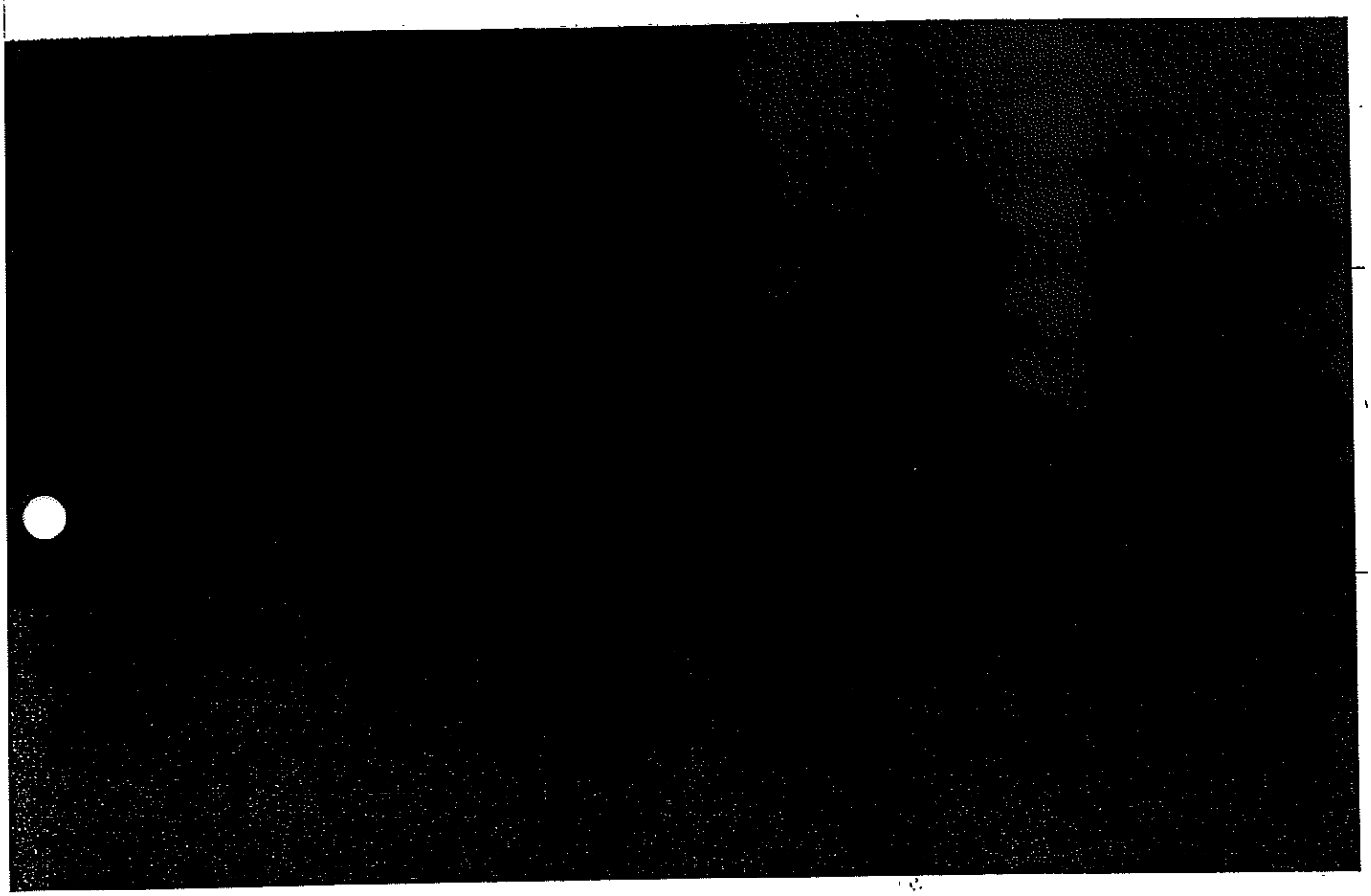
a. Sedimentation around the Bridge of Pangkalan Koto Baru



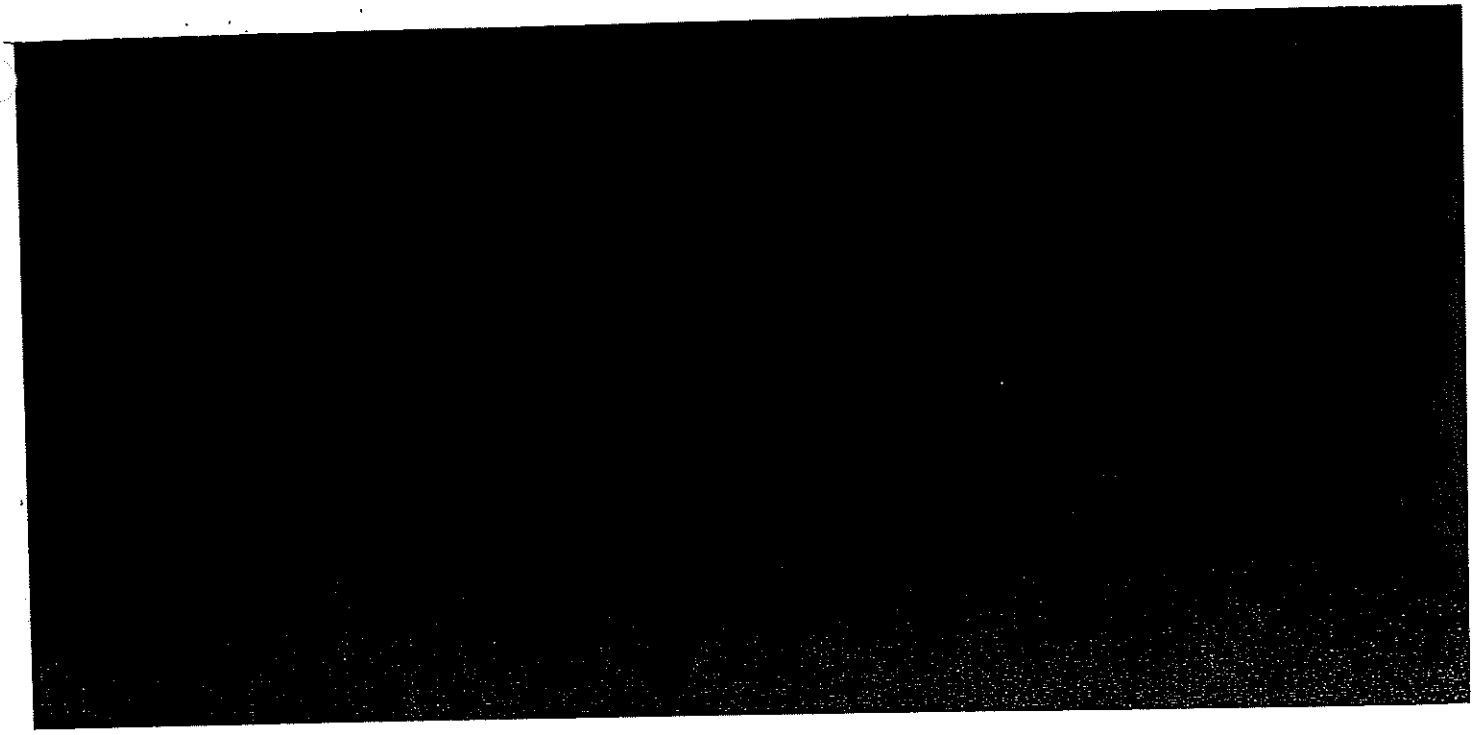


b. Water System Around the Bridge of Pangkalan Koto Baru





c. Water System Around the Dam

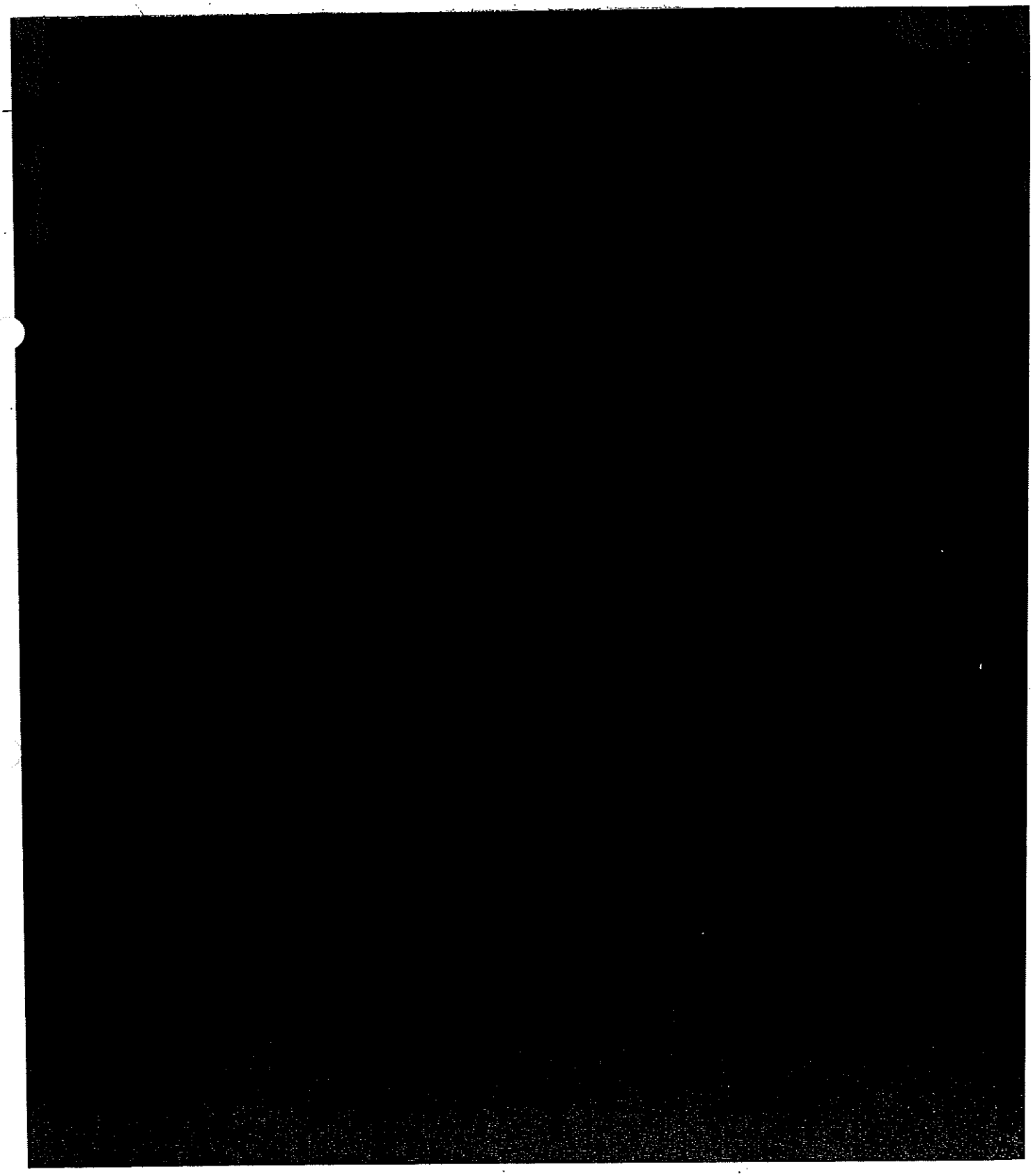


[redacted]

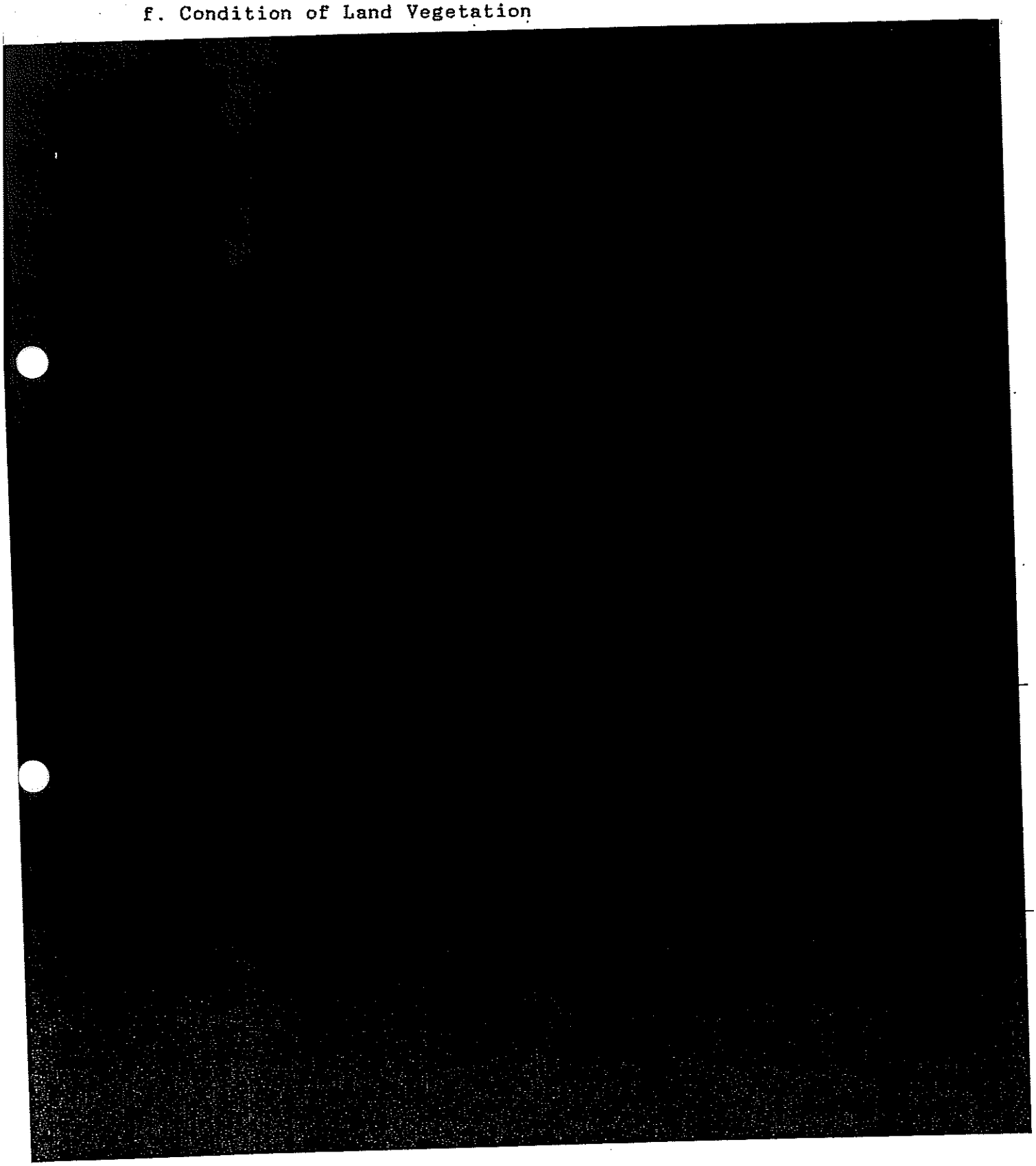
d. The Supporting Ability of the Soil in the Reservoir Area

[redacted]

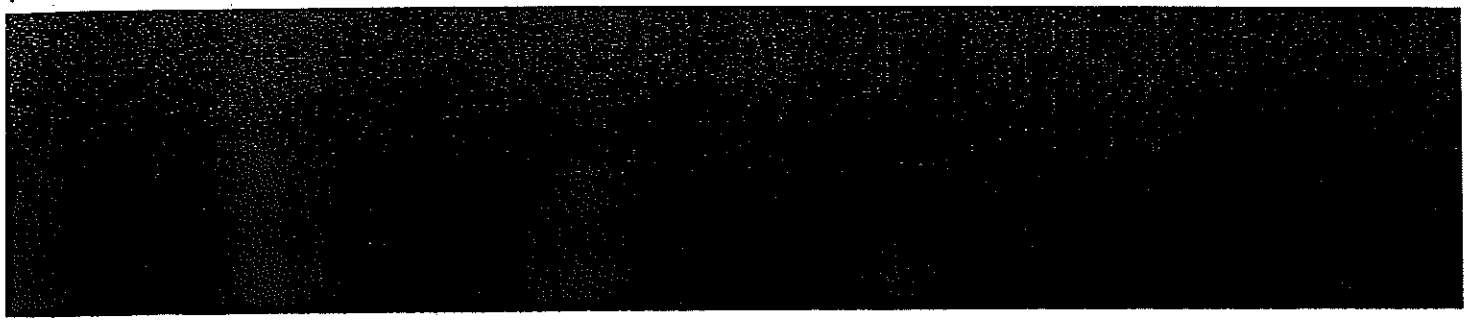
e. Water Organism Condition.



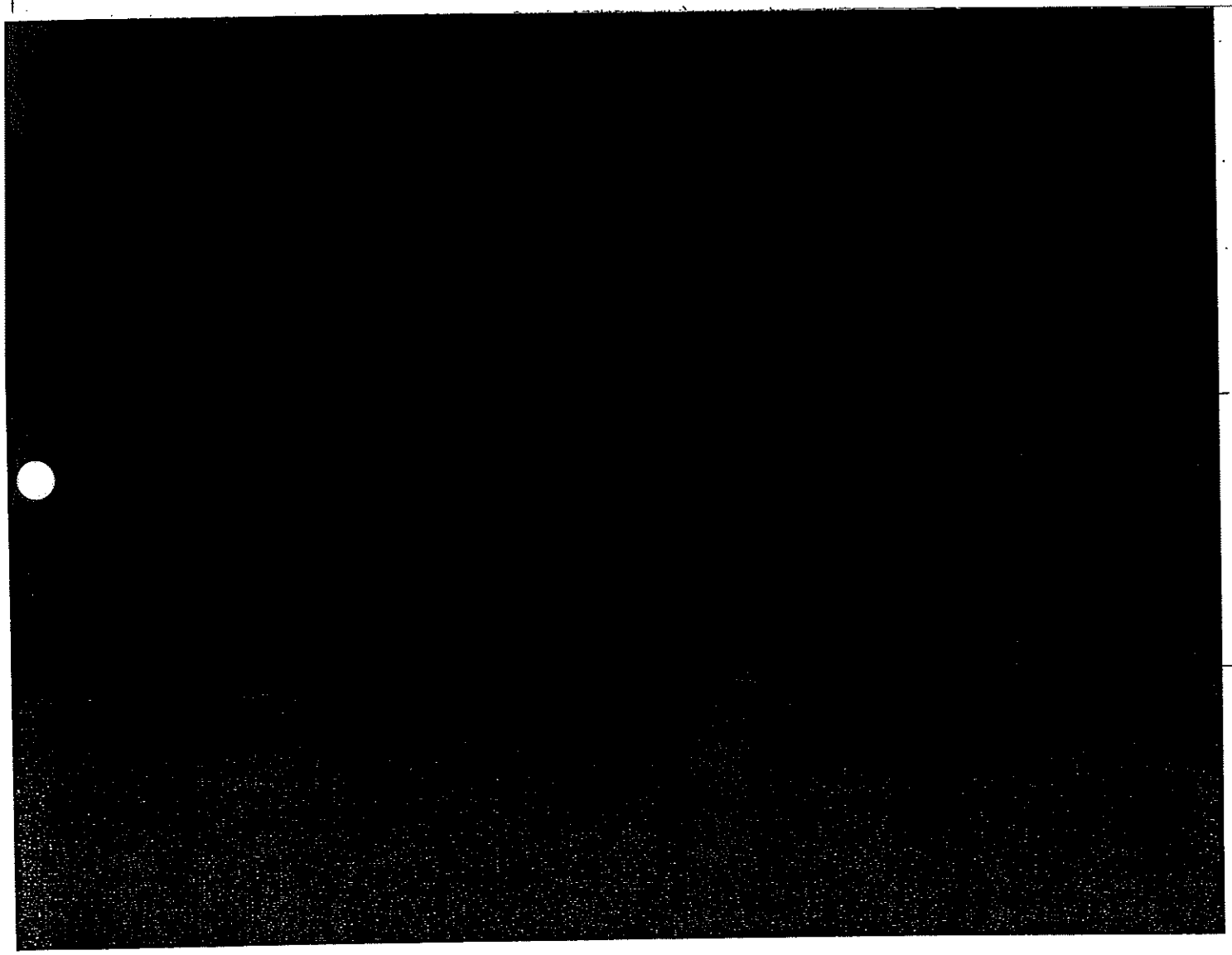
f. Condition of Land Vegetation

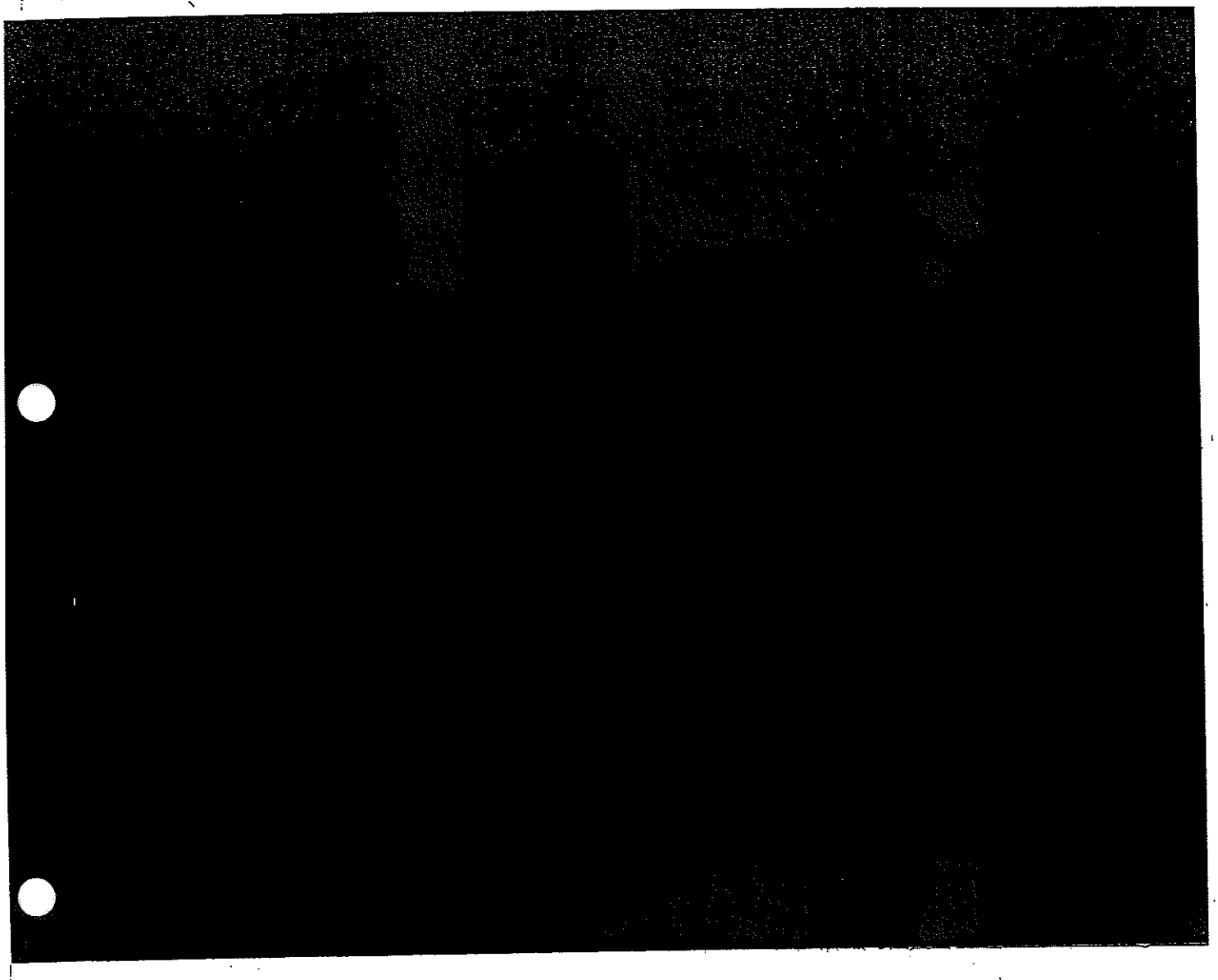


2.Socio-economic and Socio-cultural Components.

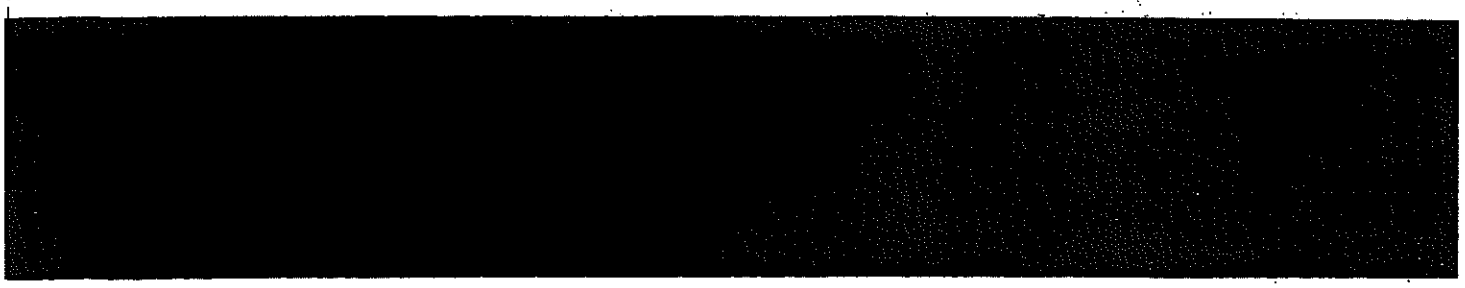


a.Social Component within the Reservoir Area.





b. Socio-Cultural Component of the Environment



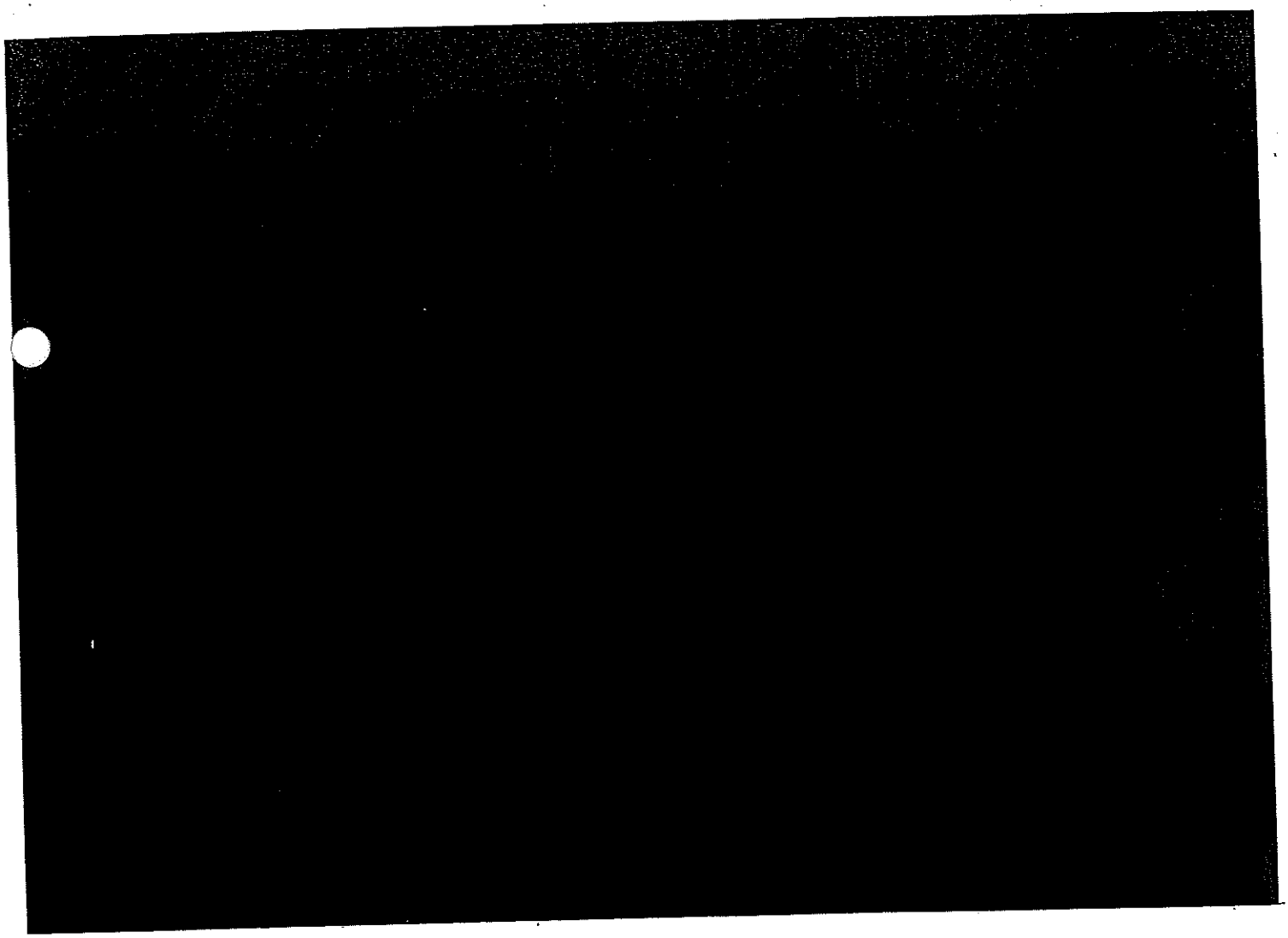
[redacted]

C. Method of Environment Impact Analysis

[redacted]

1. Identification of Impact

2. Prediction of Impact



[redacted]

3. Impact Evaluation

[redacted]

D. Result of the Environment Impact Analysis of Koto Panjang HPP

[redacted]

[redacted]

1. The impact in the term of economic value

[redacted]

[redacted]

2. Impact in the term of the people health

[redacted]

[redacted]

3. Environmental Changes that can not be Evaluated

[redacted]

4. The less important impact of the Koto Panjang HPP

[redacted]

RESEARCH CENTER OF RIAU UNIVERSITY

Map of Resettlement location of Koto Panjang HPP.

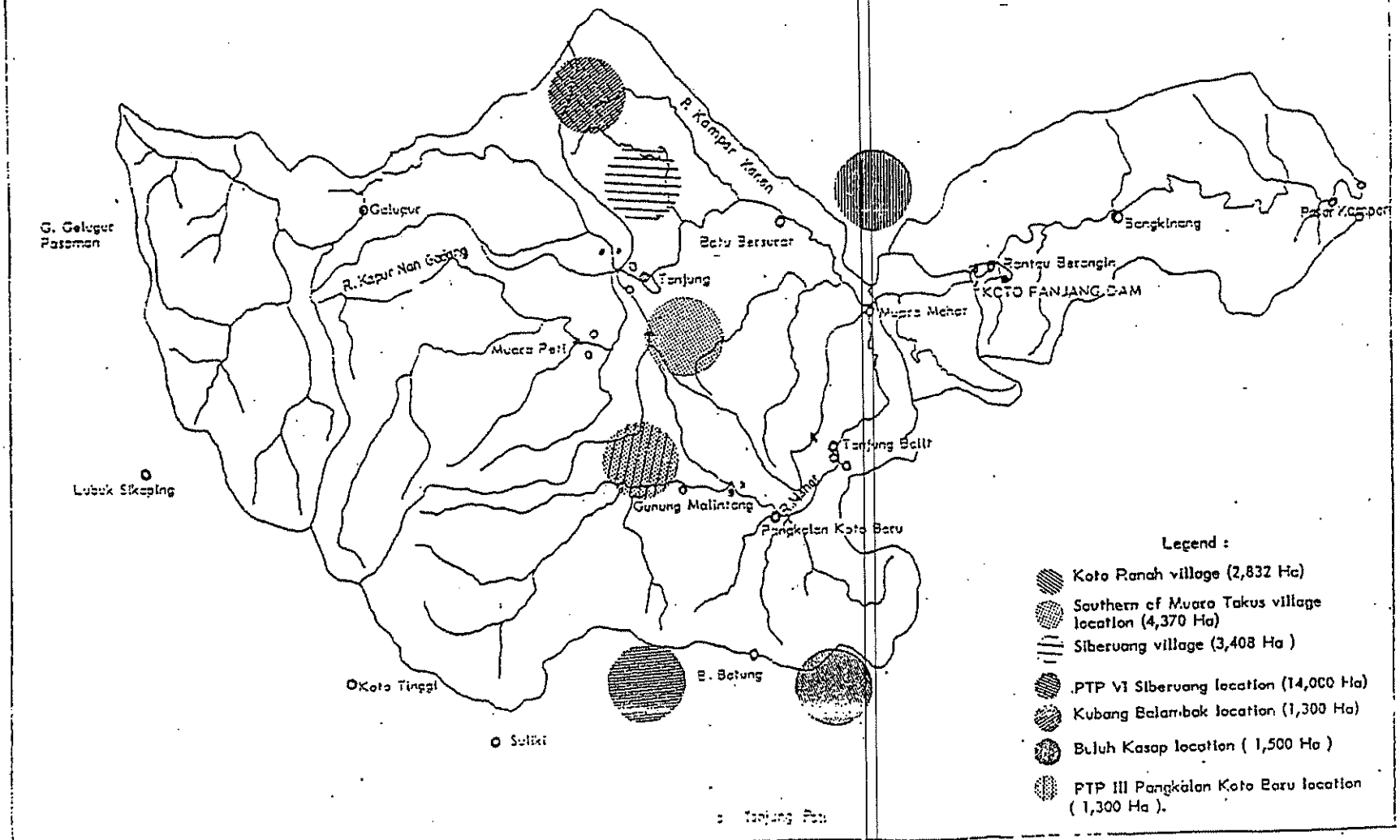


Chart RD - 9

Table. RD-7. WATER QUALITY CRITERIA
GROUP A : DRINKING WATER THAT CAN BE USED DIRECTLY WITHOUT PROCESSING.

Parameter	Unit	Maximum Sugested	Allowable Maximum	Note
(1)	(2)	(3)	(4)	(5)
PHYSIC				
Temperature	o C	Normal water temperature	Normal water temperature	
Colour	Unit PtCo	5	50	
Odor	-	Odorless	Odorless	
Taste	-	Tasteless	Tasteless	
Turbidity	mg/l SiO 2	5	25	
Resolved residu	mg/l	500	1500	
K I M I A				
pH	mg/l	6,5 - 8,5	6,5 - 8,5	range
Calcium (Ca)	mg/l	75	200	
Magnesium (Mg)	mg/l	30	150	
Hardness				
Barium (Ba)	mg/l	0	0,05	
Iron (Fe)	mg/l	0,1	1	
Mangaan (Mn)	mg/l	0,05	0,50	
Copper (Cu)	mg/l	0	1	
Zink (Zn)	mg/l	1	15	
Hexavalence Chrome (Cr)	mg/l	0	0,05	
Cadmium (Cd)	mg/l	0	0,01	
Total Mercury (Hg)	mg/l	0,005	0,001	
Lead (Pb)	mg/l	0,05	0,1	
Arsene (As)	mg/l	0	0,05	
Selenium (Se)	mg/l	0	0,01	
Cianide (CN)	mg/l	0	0,05	
Sulfide (S)	mg/l	0	0	
Flouride (F)	mg/l	-	1,5	Minimum 0,5
Clouride (Cl)	mg/l	200	600	
Sulphate (SO_4)	mg/l	200	400	
Ammonia (NH_3)	mg/l	0	0	
Nitrate (NO_3)	mg/l	20	44	
Nitrite (NO_2)	mg/l	0	0	
Permangganate Value	mg/l $KMnO_4$	0	10	

RESEARCH CENTER OF RIAU UNIVERSITY

(1)	(2)	(3)	(4)	(5)
Active Blue Compound				
Metilen	mg/l	0	0,50	
Phenol	mg/l	0,001	0,002	
Oil & Fat	mg/l	0	0	
Chloroform Carbon Extract	mg/l	0,04	0,50	
PCB	mg/l	0	0	
BACTERIOLOGY				
Coliform group	MPN/100 ml	0	0	
Parasitic Germs		0	0	
Pathogenic Germs		0	0	
RADIOACTIVITY				
Total B. Aktivities	pC/l	-	100	
Strotium - 90	pC/l	-	2	
Radium - 220	pC/l	-	1	
INSECTISIDE	mg/l	0	0	

RESEARCH CENTER OF RIAU UNIVERSITY

WATER QUALITY CRITERIA

GRUP B : STANDARD WATER WHICH IS GOOD FOR DRINGKING AND HOUSEHOLDS USAGE, AND OTHER PURPOSE, BUT NOT SUITABLE FOR GROUP A.

Parameter	Unit	Maximum Sugested	Allowable Maximum	Note
(1)	(2)	(3)	(4)	(5)
FISIKA				
Temperatur	°C	Normal Water Temperature	Normal Water Temperature	
Resolved Residue	mg/l	500	1500	
KIMIA				
pH	mg/l	5 - 9	5 - 9	
Barium (Ba)	mg/l	0	1	
Total Iron (Fe)	mg/l	0,1	1	
Total Mangaan (Mn)	mg/l	0	0,5	
Copper (Cu)	mg/l	0	1	
Zink (Zn)	mg/l	1	15	
Hexavalence Chrome (Cr)	mg/l	0	0,5	
Cadmium (Cd)	mg/l	0,0005	0,01	
Total Mercury (Hg)	mg/l	0,05	0,001	
Lead (Pb)	mg/l	0	0,1	
Arsen (As)	mg/l	0	0,05	
Selenium (Se)	mg/l	0	0,01	
Sianide (CN)	mg/l	0	0,05	
Sulphide (S)	mg/l	0	0	
Flouride (F)	mg/l	-	1,5	Minimum 0,5
Chloride (Cl)	mg/l	200	600	
Sulphate (SO_4)	mg/l	200	400	
Ammonia ($N-NH_3$)	mg/l	0,01	0,5	
Nitrate (NO_3)	mg/l	20	44	
Nitrite (NO_2)	mg/l	0	0	
Dissolved Oxygen (DO)	mg/l	6	0	Surface water DO = 6, soil water not required
Biological Oxygen Demand (BOD)	mg/l	-	6	
Chemical Oxygen Demand (COD)	mg/l	-	10	
Active Blue Compound metilen	mg/l	0	0,5	

RESEARCH CENTER OF RIAU UNIVERSITY

(1)	(2)	(3)	(4)	(5)
Phenol	mg/l	0,001	0,002	
Oil & Fat	mg/l	0	0	
Chloroform Carbon Extract	mg/l	0,04	0,5	
PCB	mg/l	0	0	
BAKTERIOLOGI				
Colliform group	MPN/100 ml	-	10000	
Feces Coliform	MPN/100 ml	-	2000	
RADIOACTIVITY				
Total B. Activities	pCi/l	-	100	
Srontium - 90	pCi/l	-	2	
Radium - 220	pCi/l	-	1	
INSECTISIDE				to be proposed
	mg/l			
	mg/l			
	mg/l			
	mg/l			
	mg/l			

RESEARCH CENTER OF RIAU UNIVERSITY

WATER QUALITY CRITERIAKRITERIA KUALITA AIR
GROUP C : WATER GOOD FOR FISHING AND
ANIMAL HUSBANDRY AND CAN BE USED FOR
OTHER PURPOSES, BUT NOT SUITABLE
FOR A AND B USAGES

Parameter	Unit	Maximum	Note
(1)	(2)	(3)	(4)
FISIKA			
Temperatur	°C	Normal Water Temperature ± 4 °C	
Resolved Residue	mg/l		
KIMIA			
pH	mg/l	6 - 9	
Copper (Cu)	mg/l	0,02	
Zink (Zn)	mg/l	0,02	
Hexavalence Chrome (Cr)	mg/l	0,05	
Cadmium (Cd)	mg/l	0,01	
Total Mercury (Hg)	mg/l	0,002	
Lead (Pb)	mg/l	0,03	
Arsen (As)	mg/l	1	
Selenium (Se)	mg/l	0,05	
Sianide (CN)	mg/l	0,02	
Sulphide (S)	mg/l	0,002	
Flouride (F)	mg/l	1,5	
Free Ammonia (NH_3)	mg/l	0,02	
Nitrite (NO_2)	mg/l	0,2	
Free Chllorine (Cl_2)	mg/l	0,003	
Dissolved Oxigen (DO)	mg/l	3	Maximum: 8 hours per 24 hours
Active Blue Compound			
Metilen	mg/l	0,2	
Phenol	mg/l	0,001	
Oil & Fat	mg/l	1	
RADIOACTIVITY			
Total b. Activities	pCi/l	1000 *)	*)Activity without Sr - 90, Ra - 226
Srontium - 90	pCi/l	10	
Radium - 226	pCi/l	3	
INSECTISIDE	mg/l	-	to be proposed

WATER QUALITY CRITERIA
GROUP D : WATER GOOD FOR FARMING AND
CAN BE USED FOR INDUSTRIES, HYDROELECTRIC POWER,
WATER TRAFFIC AND OTHER PURPOSES,
BUT NOT SUITABLE FOR A, B, AND C USAGES

Parameter	Unit	Maximum	Note
(1)	(2)	(3)	(4)
FISIKA			
Temperatur	0 C	Normal Water Temperature	Recording to local condition
Resolved Residue	mg/l	1000-2000	1000 sensitive plant 2000 for rather
K I M I A			
pH	mg/l	6 - 8	
Mangaan (Mn)	mg/l	2	
Copper (Cu)	mg/l	0,2	
Zink (Zn)	mg/l	5	
Hexavalence Chrome (Cr)	mg/l	5	
Cadmium (Cd)	mg/l	0,01	
Total Mercury (Hg)	mg/l	0,005	
Lead (Pb)	mg/l	5	
Arsen (As)	mg/l	1	
Selenium (Se)	mg/l	0,05	
Nickel (Ni)	mg/l	0,5	
Cobalt (Co)	mg/l	0,2	
Boron (B)		1	
% Na (% Alkali Salt)		60	
Sosium Absorptin Ratio (SAR)		10 - 18	
RADIOACTIVITY			
Total B. Activities	pCi/l	1000 *)	*) Activity without Sr - 90, Ra - 226
Srontium - 90	pCi/l	10	
Radium - 226	pCi/l	3	
			Note : In the area where the people used to eat fresh vegetables it is warnet to wash the vegetables first

RESEARCH CENTER OF RIAU UNIVERSITY

WATER QUALITY CRITERIA
GROUP E : WATER NOT SUITABLE FOR
GROUP A, B, C, AND D USAGES

Parameter	Unit	Maximum	Note
(1)	(2)	(3)	(4)
FISIKA			
Temperatur	°C	Normal water temperature ± 5 °C	
Resolved Residue	mg/l	5000	
KIMIA			
pH	mg/l	6 - 9	
Iron (Fe)	mg/l	10	
Copper (Cu)	mg/l	5	
Zink (Zn)	mg/l	10	
Hexavalence Chrome (Cr)	mg/l	5	
Cadmium (Cd)	mg/l	0,1	
Total Mercury (Hg)	mg/l	0,005	
Lead (Pb)	mg/l	5	
Arsen (As)	mg/l	1	
Sianide (CN)	mg/l	1	
Sulphide (S)	mg/l	1	
Flouride (F)	mg/l	2	
Free Chlorine (Cl_2)	mg/l	0,5	
Free Ammonia (NH_3)	mg/l	2	
Nitrite (NO_2)	mg/l	1	
Dissolved Oxigen (DO)	mg/l	2	Maxieum 8 hours per 24 hours
Biological Oxygen Demand (BOD)	mg/l	30	
Chemical Oxygen Demand (COD)	mg/l	50	
			*) Activity without Sr - 90 Ra - 226
			to be proposed

Table RD – 24 Sub - Districts By Cultivated Land

SUB - DISTRICT	Extent (Sq Km)	Cultivated Land (Ha)	Not Cultivated Land (Ha)
1	(2)	(3)	(4)
1. Rangkinang	547,39	33618	21121
2. K a m p a r	1003,53	100353	-
3. Siak Hulu	4150,87	214466,72	200620,28
4. Langgam	3069,17	11679,8	2952337,2
5. Pangkalan Kuras	1724,75	71797	100678
6. B u n u t	3486,21	49805	298816
7. Kuala Kampar	3707,77	221774	149003
T O T A L	17689,69	703493,52	1065475,48

Table RD – 25 Sub - Districts by Extent, Village and Population

SUB - DISTRICT	Extent (Sq Km)	Villages	Population
(1)	(2)	(3)	(4)
1. Bangkinang	547,39	14	49148
2. K a m p a r	1003,53	27	79887
3. Siak Hulu	4150,87	25	86778
4. Langgam	3069,17	10	9170
5. Pangkalan Kuras	1724,75	17	10956
6. B u n u t	3486,21	19	12320
7. Kuala Kampar	3707,77	14	29029
T O T A L	17689,69	126	277288

Table RD - 27 Cultivated Land by Utilization

SUB - DISTRICT	Cultivated Land By Utilization			
	Rice Field	Garden Lot	F a r m	Shepherding Fields
1	(2)	(3)	(4)	(5)
1. Bangkinang	1657	3596	5303,5	-
2. K a m p a r	14577	8097,30	30850,81	453,18
3. Siak Hulu	1493,11	19101,66	43454,84	281,82
4. Langgam	8	671	2468	-
5. Pangkalan Kuras	30	432	2893	-
6. B u n u t	125	2737	5335	10
7. Kuala Kampar	5440	23238	29151	1682
T O T A L	233440,11	57872,96	119456,96	2427

Continued

Table RD – 27 Cultivated land by Utilization

SUB - DISTRICT	Cultivated Land By Utization			
	Ponds/Swamps	Plantation	Others	Total
1	(6)	(7)	(8)	(9)
1. Bangkinang	722,5	12015	10324	33618
2. Kampar	42,79	4026,88	42305,04	100353
3. Siak Hulu	165779,73	33152,73	100402,88	214466,72
4. Langgam	2	2649	5881,8	11679,8
5. Pangkalan Kuras	8764	1470	58208	71797
6. Bunut	3447,7	6141	32009	49805
7. Kuala Kampar	54171	38673	69379	221774
TOTAL	83729,72	98127,61	318509,97	703493,52

Table RD – 28 Rice Fields by Harvest frequency

SUB - DISTRICT	Rice Field (Ha)		
	Harvested twice/year	Harvested once/year	T o t a l
1	(2)	(3)	(4)
1. Bangkinang	864	793	1657
2. K a m p a r	12106	2471	14577
3. Siak Hulu	1493,11	-	1493,11
4. Langgam	8	-	8
5. Pangkalan Kuras	30	-	30
6. B u n u t	125	-	125
7. Kuala Kampar	300	5150	5450
T O T A L	14926,11	8414	14926,11

Table RD – 29 Households and Population Growth

SUB – DISTRICTS	Households		Population		Average Growth (%)
	1980	1987	1980	1987	
1	2	3	4	5	6
1. Bangkinang	7919	9166	42460	49148	2,11
2. K a m p a r	12616	14480	69600	79887	1,99
3. Siak Hulu	13357	17112	67735	86778	3,60
4. L a n g g a m	1615	2017	7344	9170	3,22
5. Pangkalan Kuras	2323	2591	9823	10956	1,57
6. B u n u t	2319	2717	10515	12320	2,29
7. Kuala Kampar	5196	6064	24874	29029	2,23
T O T A L	45345	232351	23231	277288	2,56

Table RD - 30 Households By Main Occupation

SUB - DISTRICT	Main Occupation				
	Agriculture	Mining	Industry	Construction	
1	(2)	(3)	(4)	(5)	
1. Bangkinang	3588	310	305	234	
2. Kampar	9384	565	216	514	
3. Siak Hulu	9073	876	506	511	
4. Langgam	1577	-	8	34	
5. Pangkalan Kuras	2338	39	-	9	
6. Bunut	2417	-	-	-	
7. Kuala Kampar	3912	-	355	137	
TOTAL	32289	1790	1390	1439	

Continued

Table RD - 30 Households by Main Occupation

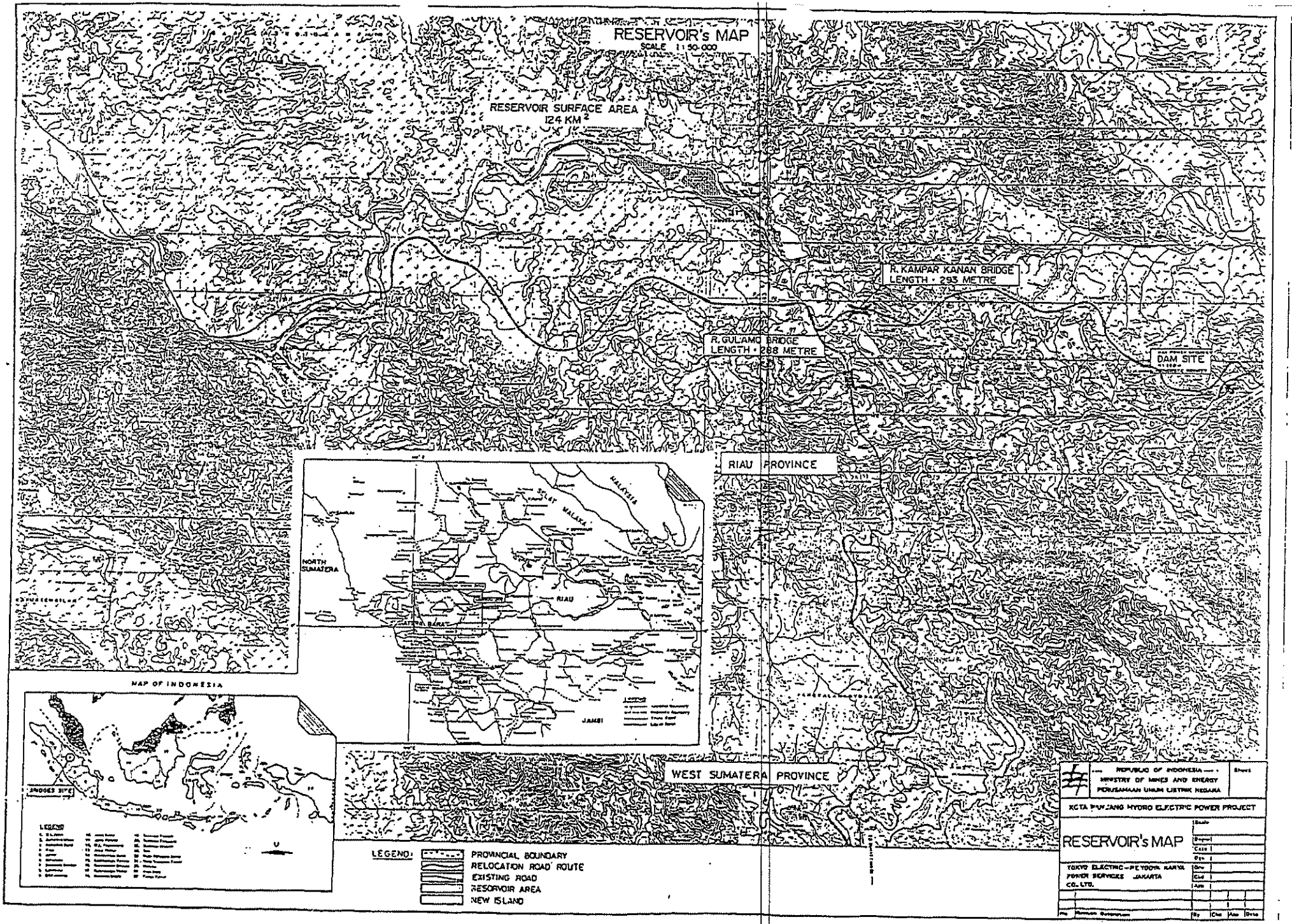
SUB - DISTRICTS	Main Occupation				
	Trading	Transportation	Service	Other	T o t a l
1	2	3	4	5	6
1. Bangkinang	871	205	609	3044	9166
2. K a m p a r	1243	497	1776	285	14480
3. Siak Hulu	1603	358	3314	871	17112
4. L a n g g a m	130	20	17	231	2017
5. Pangkalan Kuras	74	5	126	-	2591
6. B u n u t	60	4	80	156	2717
7. Kuala Kampar	364	126	184	986	6064
T O T A L	4345	1215	6106	5573	54147

Table RD - 31 Number Of Villages By Transportation Facilities

SUB - DISTRICT	Number of Villages by Transportation Facilities			
	Water Trans	Land Trans	Water & Land	T o t a l
1	(2)	(3)	(4)	(5)
1. Bangkinang	-	12	2	14
2. K a m p a r	-	26	1	27
3. Siak Hulu	-	22	3	25
4. Langgam	-	5	5	10
5. Pangkalan Kuras	1	16	-	17
6. B u n u t	6	13	-	19
7. Kuala Kampar	9	5	-	14
T O T A L	16	99	11	126

Table RD - 32 Type Of Transportation

SUB - DISTRICTS	Type Of Transpoon					
	Cart	Canoes	Motor Boat	Vessels	Motor Cycles	Motor Vehicles
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Bangkinang	49	350	7	-	44	140
2. Kampar	-	9	33	-	-	251
3. Siak Hulu	20	726	180	2	2533	344
4. Langgam	11	-	5	24	3	11
5. Pangkalan Kuras	-	196	22	1	44	12
6. Bunut	10	441	5	109	30	2
7. Kuala Kampar	-	414	92	188	142	9
TOTAL	90	2136	344	324	2796	769


RESERVOIR's MAP
SCALE 1:50,000
RESERVOIR SURFACE AREA
124 KM²
R. KAMPAR KANAN BRIDGE
LENGTH : 293 METRE
R. GULAMO BRIDGE
LENGTH : 288 METRE
DAM SITE
RIAU PROVINCE
WEST SUMATERA PROVINCE
NORTH SUMATERA
SELAT MALAKA
MALAYSIA
RIAU
JAMBI
MAP OF INDONESIA
JAKARTA
LEGEND:
PROVINCIAL BOUNDARY
RELOCATION ROAD ROUTE
EXISTING ROAD
RESERVOIR AREA
NEW ISLAND
REPUBLIC OF INDONESIA
MINISTRY OF MINES AND ENERGY
PERUSAHAAN UMUM LISTRIK NEGARA
KOTA PANJANG HYDRO ELECTRIC POWER PROJECT
RESERVOIR's MAP
TOKYO ELECTRIC-PETTOGA KARYA
POWER SERVICES JAKARTA
CO., LTD.