JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

INSTITUTO COSTARRICENSE DE ELECTRICIDAD (ICE)

THE FEASIBILITY STUDY
ON
LOS LLANOS HYDROELECTRIC POWER
DEVELOPMENT PROJECT
IN
THE REPUBLIC OF COSTA RICA

FINAL REPORT

ELECTRIC POWER DEVELOPMENT CO., LTD.

TOKYO, JAPAN

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

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FINAL REPORT

MARCH 1996

ELECTRIC POWER DEVELOPMENT CO., LTD.
KOKUSAI KOGYO CO., LTD.
TOKYO, JAPAN

P R E F A C E

In response to a request from the Government of the Republic of Costa Rica, the Government of Japan decided to conduct the Feasibility Study on Los Llanos Hydroelectric Power Development Project in the Republic of Costa Rica and entrusted the study to Japan International Cooperation Agency (JICA).

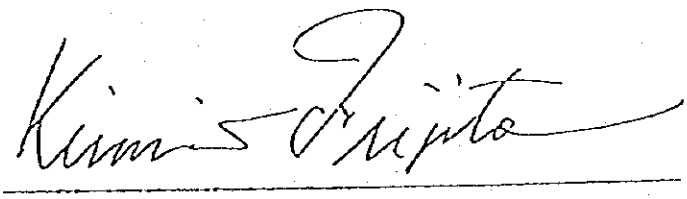
JICA sent a study team led by Mr. Yasumasa EBI of Electric Power Development Co., Ltd. (EPDC) and organized by EPDC and Kokusai Kogyo Co., Ltd., to the Republic of Costa Rica seven times from August 1994 to February 1996.

The team held discussions with the officials concerned of the Government of the Republic of Costa Rica and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

I hope this report will contribute to the promotion of the plan and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Costa Rica for their close Cooperation throughout the Study.

March 1996



Kimio FUJITA
President
Japan International Cooperation Agency

March 1996

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Fujita,

Letter of Transmittal

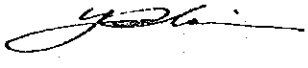
We are pleased to submit to you the feasibility report on the Los Llanos Hydroelectric Power Development Project in the Republic of Costa Rica. This report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the formulation of the above mentioned project. Also included are comments made by Instituto Costarricense de Electricidad of the Republic of Costa Rica during technical discussion on the draft final report which were held in San José.

This report presents a run-of-river type hydroelectric power scheme including related transmission line. After completion of the project, the plant can be effectively used to supply ample and stable domestic energy, in order to cope with increasing peak power demand which is estimated to reach 1550MW in 2004.

In view of the importance of power development and of the need for socio-economic development of the Republic of Costa Rica, we recommend that the Costa Rican Government implement this Project as a top priority.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of International Trade and Industry. We also wish to express our deep gratitude to Instituto Costarricense de Electricidad and other authorities concerned of the Government of Costa Rica for the close cooperation and assistance extended to us during our investigation and study.

Very truly yours,



Yasumasa Ebi
Team Leader
Los Llanos Hydroelectric Power Development Project

Los Lagos Project

March 1996

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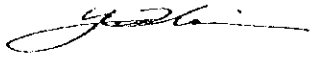
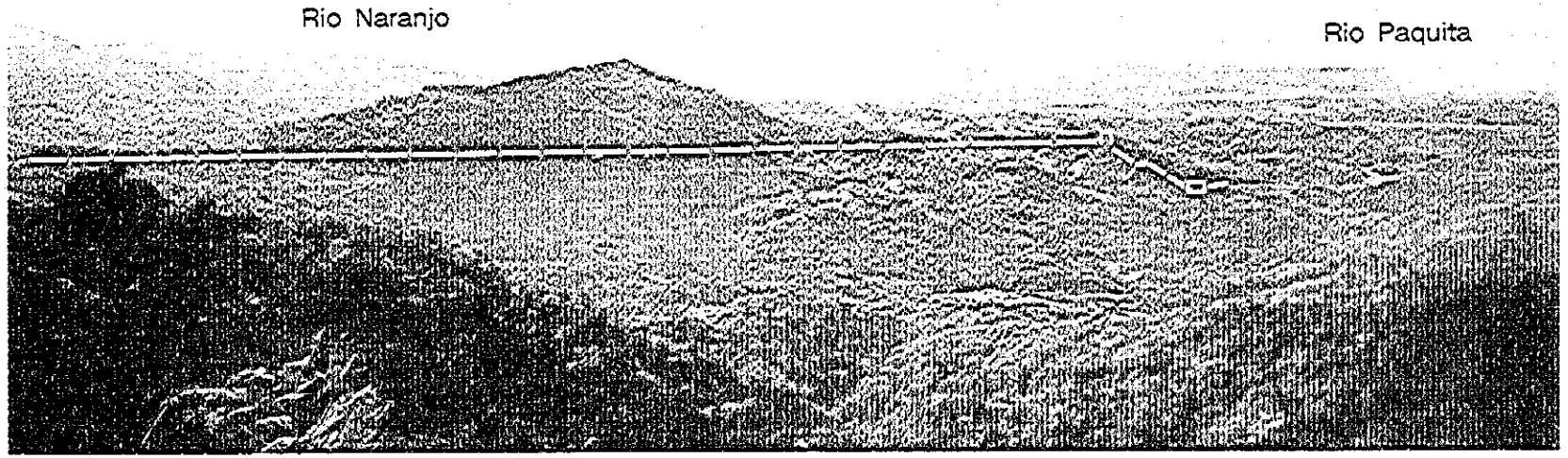
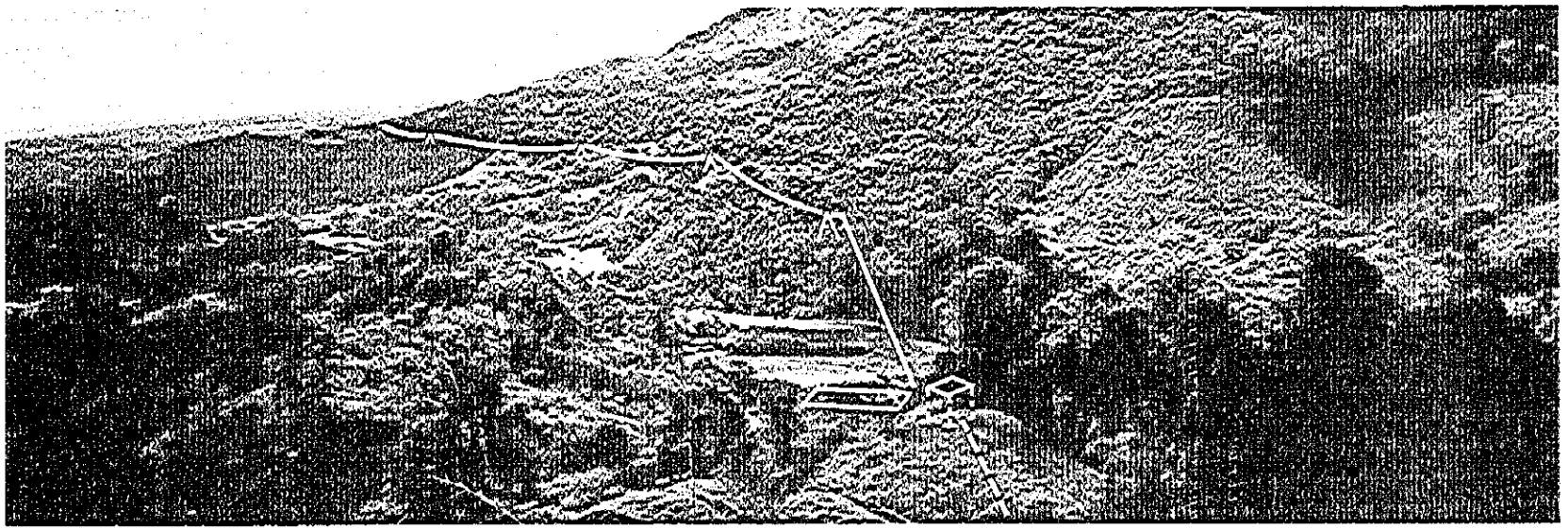


Yasumasa Ebi
Team Leader
Los Llanos Hydroelectric Power Development Project

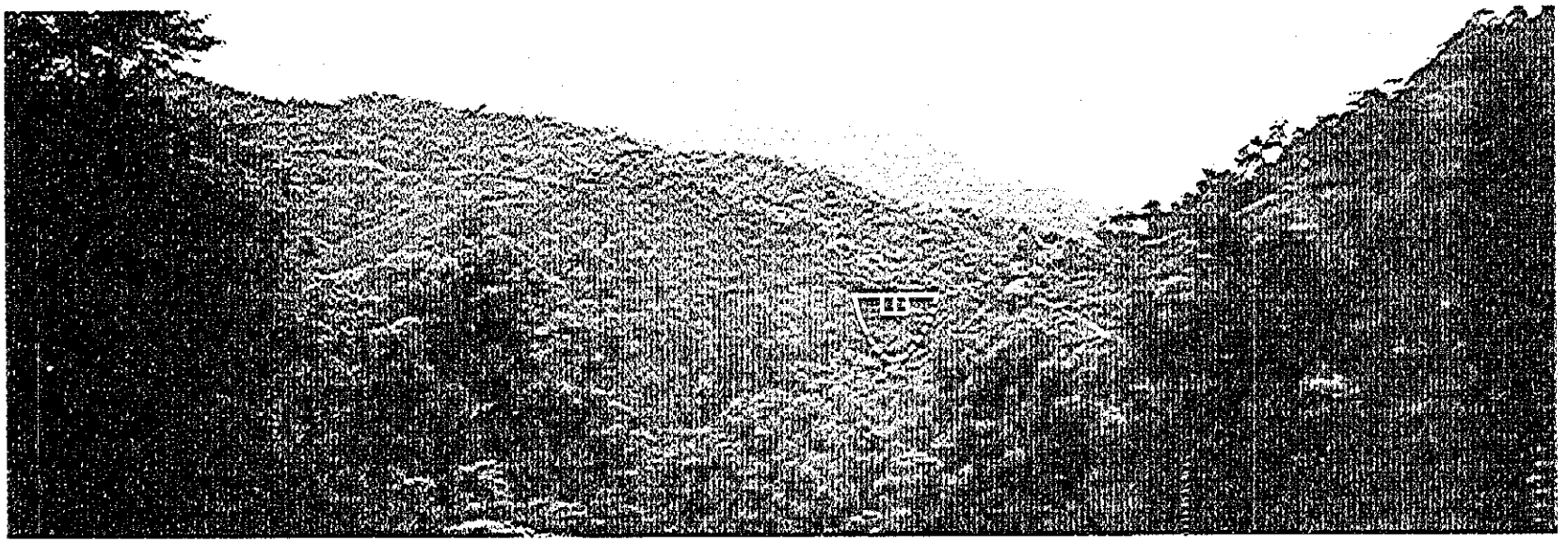
Project



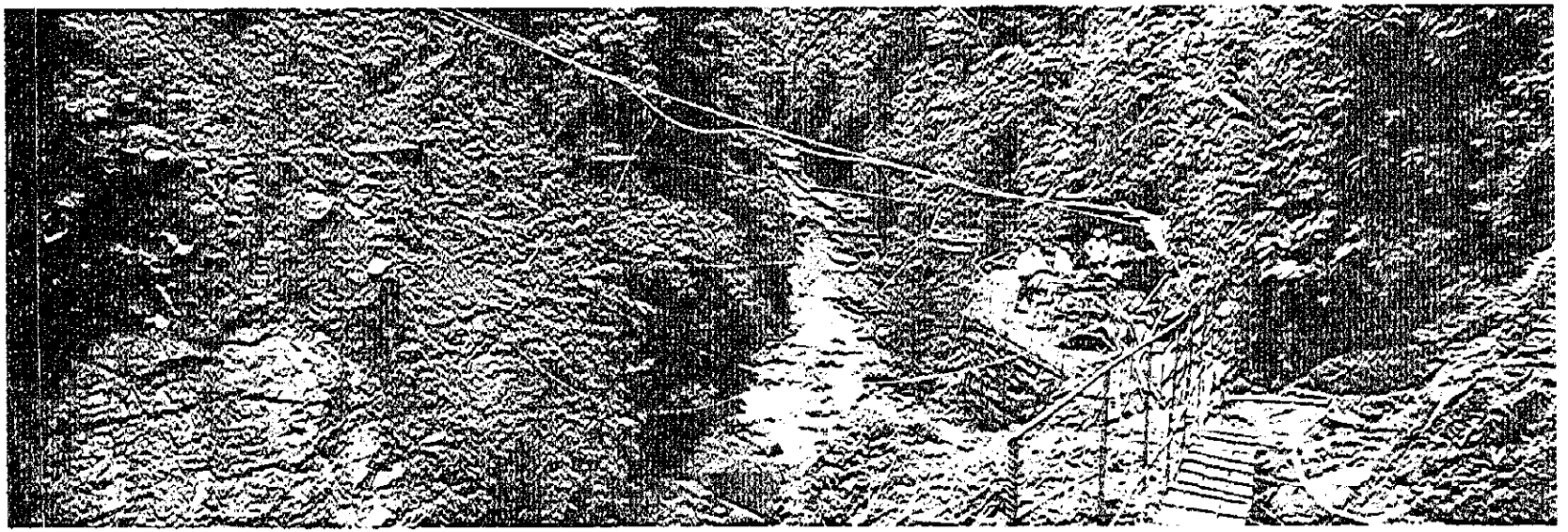
Power Tunnel Route View from the upper-reach of Paquita river



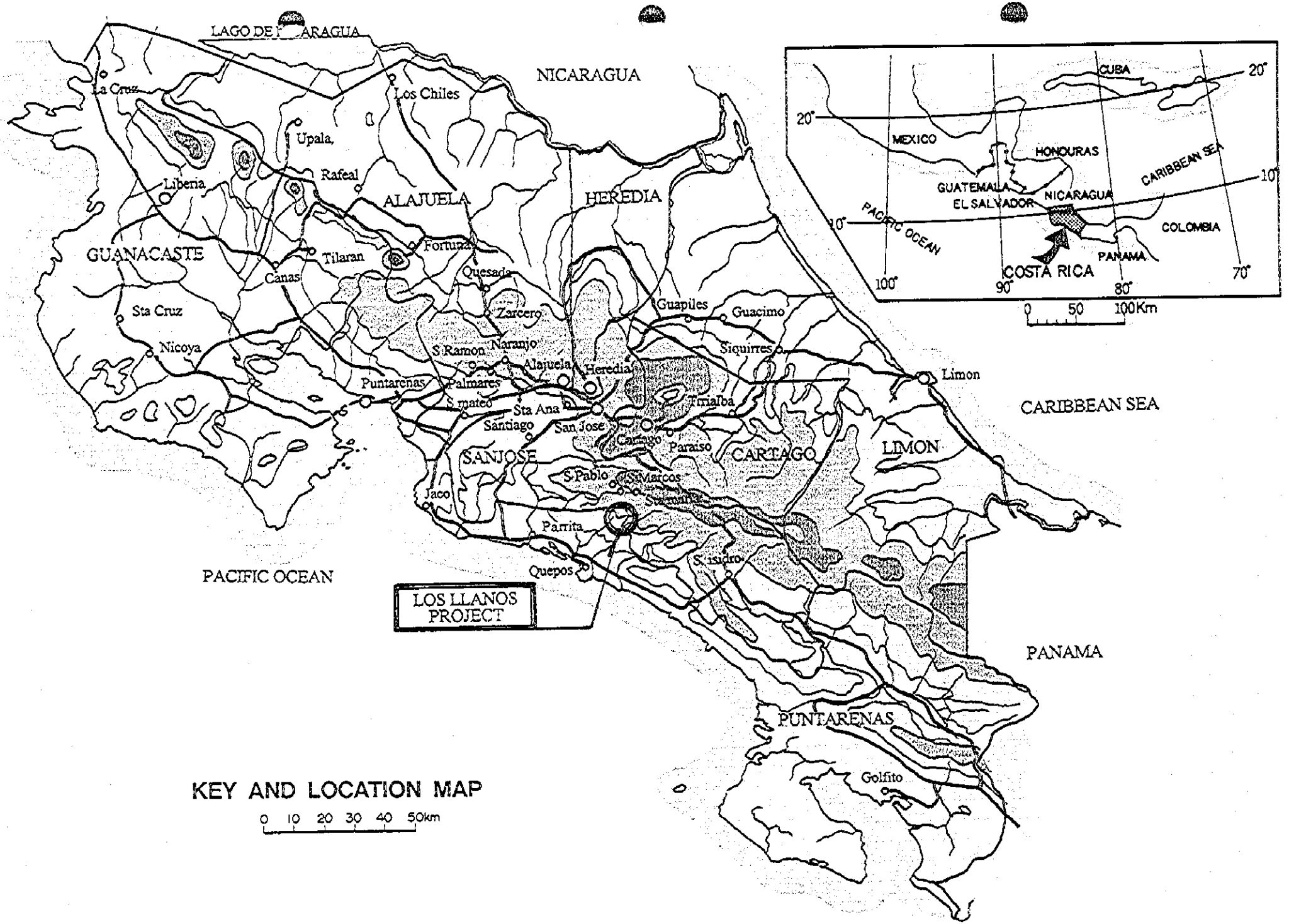
Los Llanos Powerhouse Site View from the peak of San Isidro mountain



Los Llanos Dam Site View from the upstream left bank



Los Llanos Dam Axis Adit No.1 at the right bank of EL. 445.22


LAGO DE NICARAGUA
NICARAGUA
La Cruz
Los Chiles
Upala
Rafeal
Liberia
ALAJUELA
HEREDIA
GUANACASTE
Tilaran
Fortuna
Canas
Quesada
Sta Cruz
Zarcero
Guapiles
Guacimo
Nicoya
S.Ramon
Naranjo
Siquirres
Alajuela
Heredia
Limon
Puntarenas
Palmares
S.mateo
Sta Ana
Trialba
CARIBBEAN SEA
Santiago
San Jose
Cartago
Paraiso
SANJOSE
CARTAGO
LIMON
S.Pablo
S.Marcos
Jaco
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PACIFIC OCEAN
LOS LLANOS PROJECT
PANAMA
PUNTARENAS
Golfito
KEY AND LOCATION MAP
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CUBA
20°
MEXICO
HONDURAS
CARIBBEAN SEA
10°
GUATEMALA
EL SALVADOR
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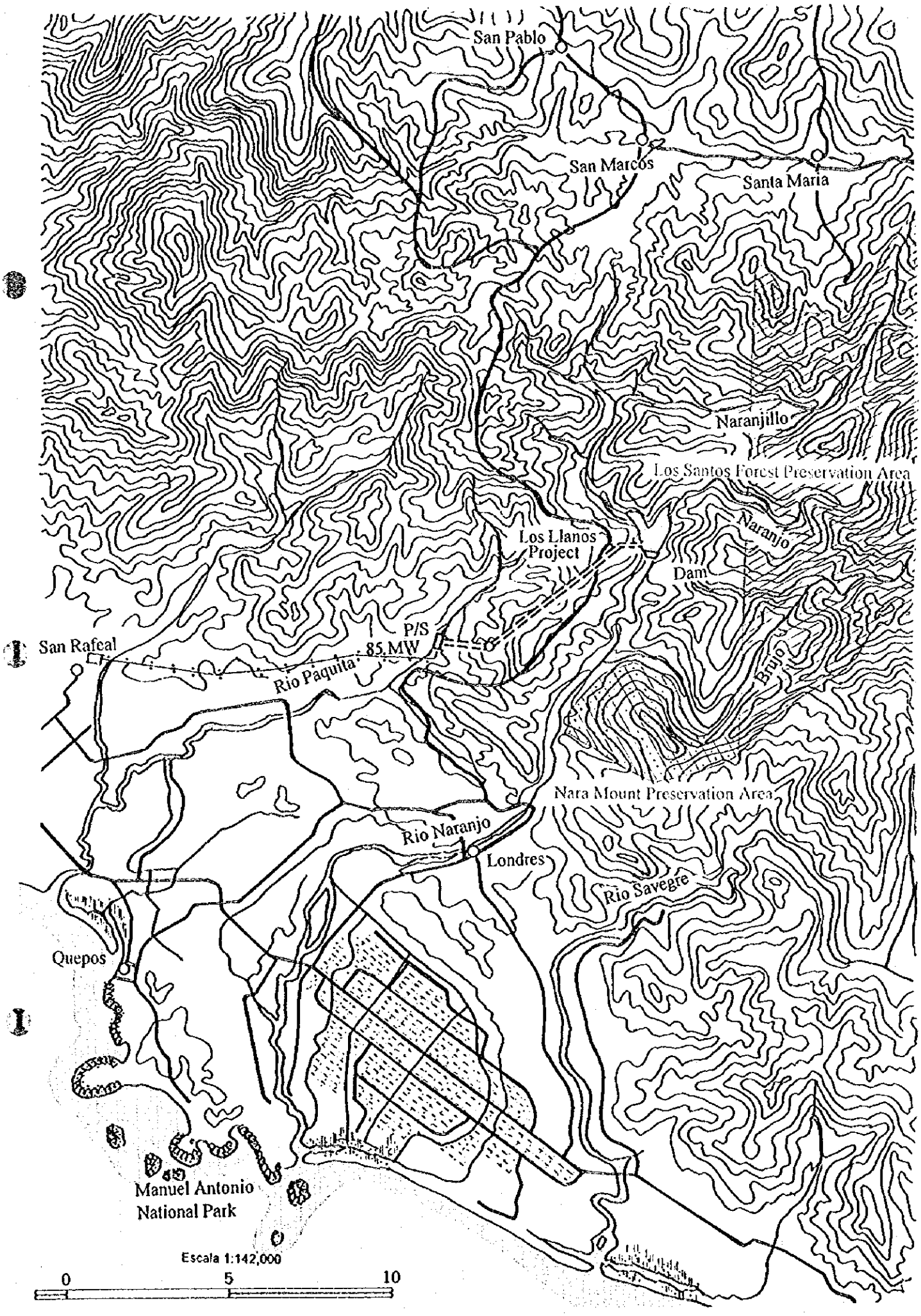
San Pablo
San Marcos
Santa Maria
Naranjillo
Los Santos Forest Preservation Area
Naranjo
Los Llanos
Project
Dam
P/S
85 MW
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Rio Paquita
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Nara Mount Preservation Area
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Manuel Antonio
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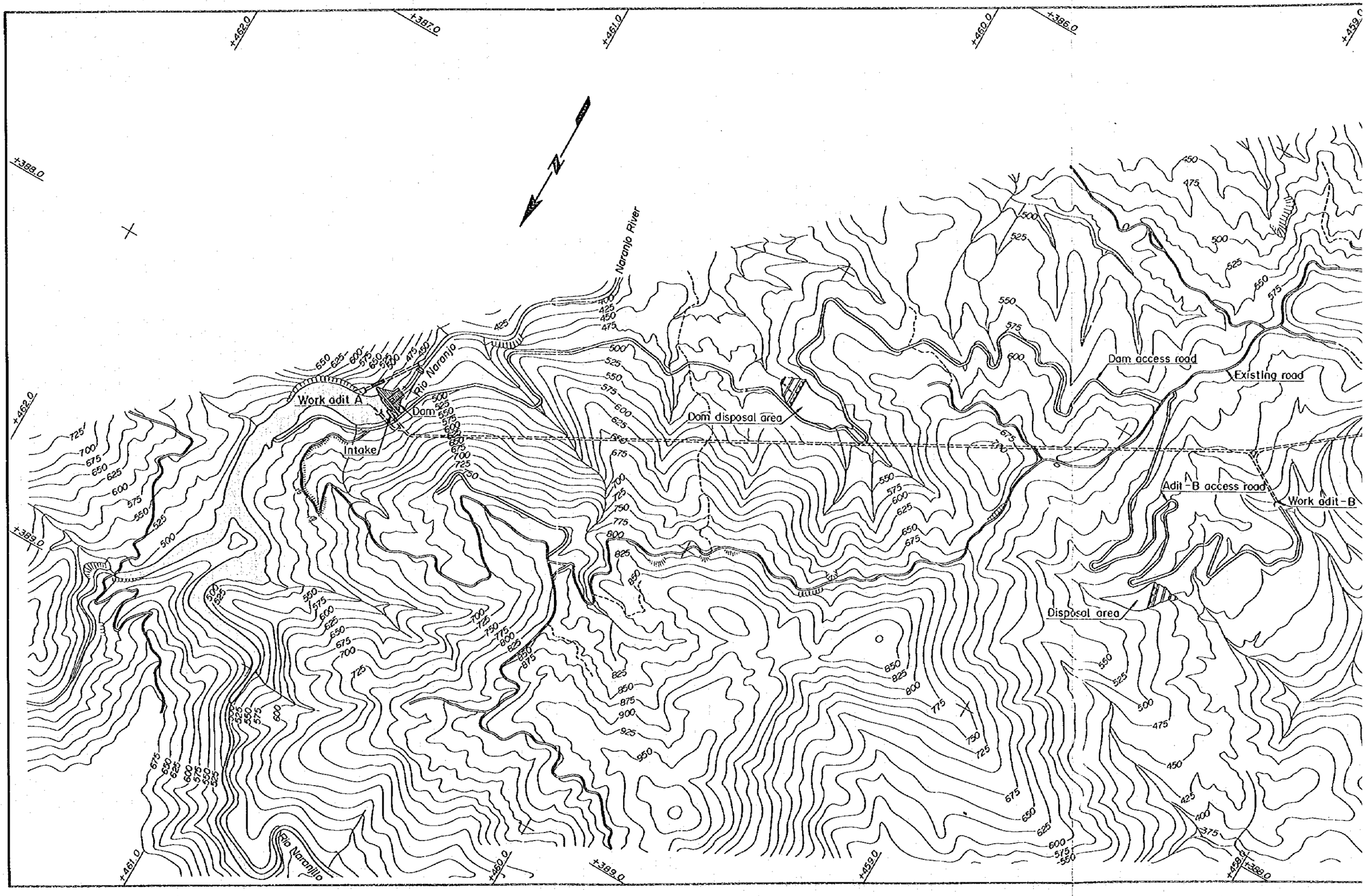
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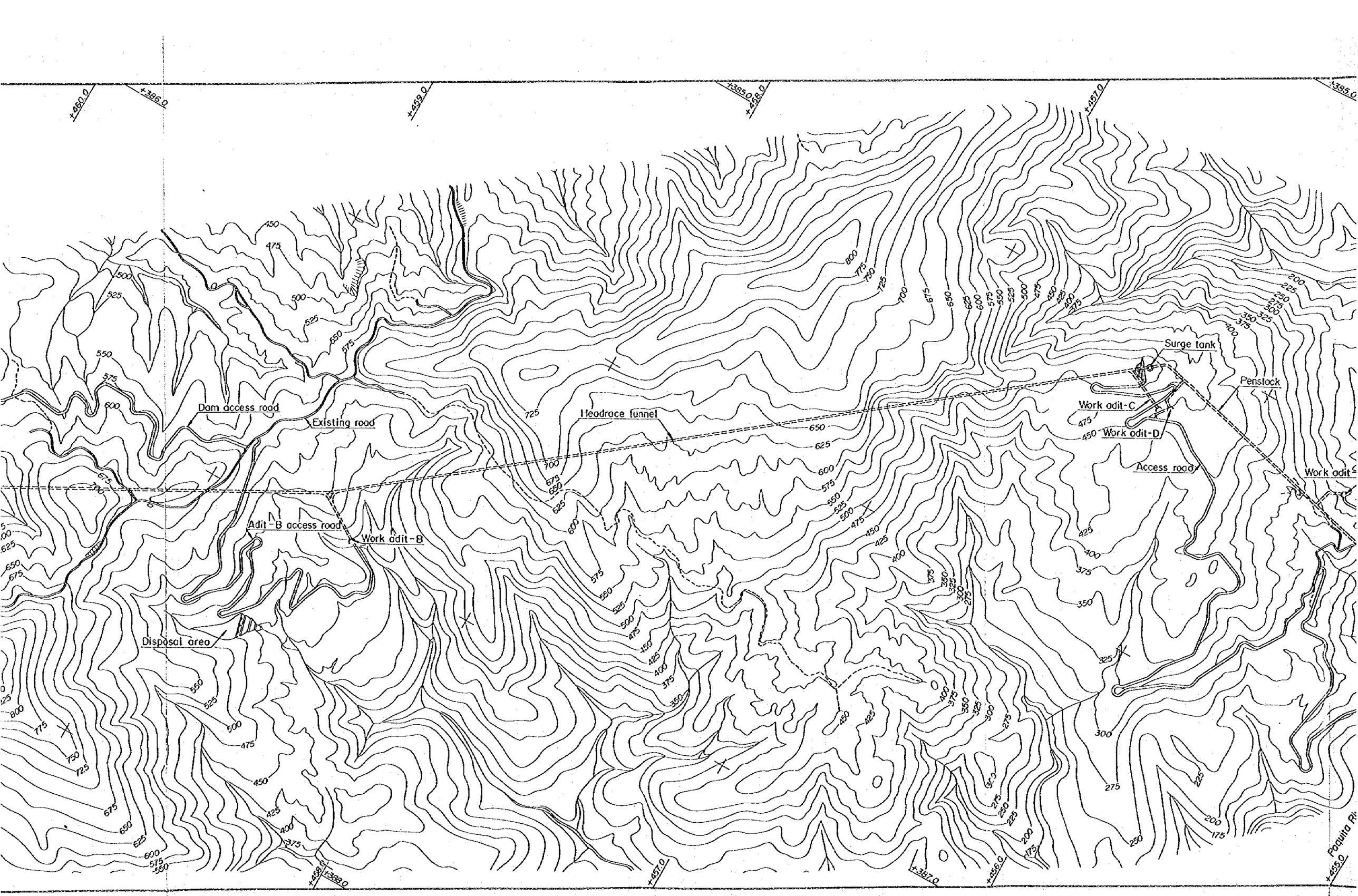
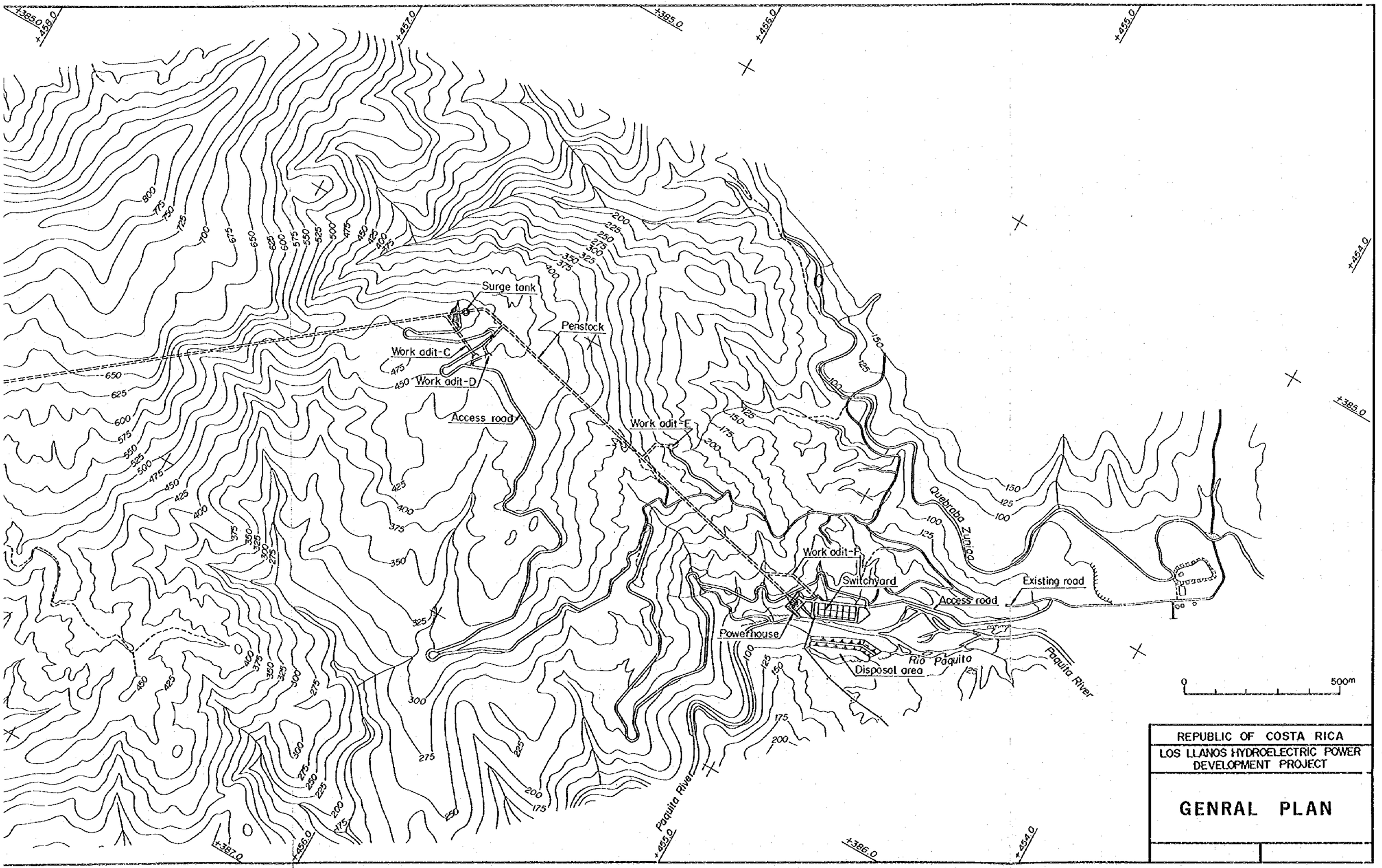
N
Naranjo River
Río Naranjo
Work adit A
Dam
Intake
Río Naranjillo
Dam disposal area
Dam access road
Existing road
Adit-B access road
Work adit-B
Disposal area


Dam access road
Existing road
Headrace funnel
Surge tank
Penstock
Work adit-C
Work adit-D
Access road
Work adit
Adit-B access road
Work adit-B
Disposal area


Surge tonk
Penstock
Work adit-C
Work adit-D
Access road
Work adit-E
Work adit-F
Switchyard
Powerhouse
Access road
Existing road
Disposal area
Río Paquita
Paquita River
Paquita River
Quebraba Zuniga
0
500m
REPUBLIC OF COSTA RICA
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT
GENRAL PLAN

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CHAPTER 3 GENERAL DESCRIPTION OF THE PROJECT AREA

CHAPTER 4 PRESENT STATE OF ELECTRIC POWER INDUSTRY

CHAPTER 5 DEMAND FORECAST AND POWER SUPPLY PLAN

CHAPTER 6 METEOROLOGY AND HYDROLOGY

CHAPTER 13 ENVIRONMENT

UNITS AND ABBREVIATIONS

1. Domestic Organizations of Costa Rica

MIDEPLAN	Ministerio de Economía y Planificación
MIRENEN	Ministerio de Recursos Naturales y Energía
ICE	Instituto Costarricense de Electricidad
CNFL	Compañía Nacional de Fuerza y Luz, S.A.
COOPEALFARO	Cooperativa de Electrificación Rural de Alfaro Ruiz
COOPELESCA	Cooperativa de Electrificación Rural de San Carlos
COOPEGUANACASTE	Cooperativa de Electrificación Rural de Guanacaste
COOPESANTOS	Cooperativa de Electrificación Rural de los Santos
ESPH	Empresa de Servicios Públicos de Heredia
JASEC	Junta Administrativa del Servicio Eléctrico de Cartago
CCT	Centro Científico Tropical
FUNDEVI	Fundación de la Universidad de Costa Rica para la Investigación
ICT	Instituto Costarricense de Turismo

2. International/Foreign Organizations

JICA	Japan International Coperation Agency
EPDC	Electric Power Development Co., Ltd. (Japan)
IEC	International Electrotechnical Commission
LGL	Le Groupe LGL (Canada)
ODA	Overseas Development Administration (UK)
OECD	Organization for Economic Cooperation and Development
SIEPAC	Sistema de Interconexión Eléctrica Países América Central
USAID	United States Agency for International Development (USA)

3. Technical Terms

ACSR	Alumnum conductor steel reinforced
CA	Catchment area
EL	Elevation (m) above sea level
HWL	High water level
LWL	Low water level
PMF	Probable maximum flood
PMP	Probable maximum precipitation

4. Economic Terms

B/C	Benefit - Cost ratio
B-C	Net present value
EIRR	Economic internal rate of return
F/C	Foreign currency
FIRR	Financial internal rate of return
GDP	Gross domestic product
GNP	Gross national product
IDC	Interest during construction
L/C	Local currency

5. Other Terms

D/D	Detailed design
EIA	Environmental Impact Assessment
F/S	Feasibility study
IEE	Initial Environmental Evaluation
LOGOS	Logiciel du Gestion Optimal du System Electrique
O&M	Operation and Maintenance
P.H.	Proyecto Hidroeléctrico (=Hydroelectric Project)
PIB	Producto Interno Bruto (=GDP)
PS	Power station
S.E.	Subestación (=Substation)
SEN	Sistema Eléctrico Nacional (=National Electrticity System)

6. Measurement

Length	
mm	Millimeter
cm	Centimeter
m	Meter
km	Kilometer
Area	
m^2	Square meter
ha	Hectar
km^2	Square kilometer
Volume	
l, lt, L	Liter
kl	Kiloliter
m^3	Cubic meter
m^3/s	Cubic meter per second
Weight	
g	Gram
kg	Kilogram
t, ton	Metric ton
TEP	Petroleum equivalent ton
Time	
ms	Mili second
s, sec	Second
min	Minute
h, hr	Hour
d	Day
M	Month
yr	Year

Electrical Measures

V	Volt
kV	Kilovolt
A	Ampere
Hz	Hertz (cycle)
W	Watt
kW	Kilowatt (10^3 W)
MW	Megawatt (10^6 W)
GW	Gigawatt (10^9 W)
kWh	Kilowatt hour
MWh	Megawatt hour
GWh	Gigawatt hour
kVA	Kilovolt ampere
MVA	Megavolt ampere
MCM	Milcircular mils

Others

BOD	Biochemical oxigen demand
dB	Decibel
hPa	Hecto Pascal
kcal	Kilo Calorie
kg f/cm^2	Kilogram force per square centimeter
rpm	Round per minute
%	Percent
Lu	Lugeon
°C	Degrees Centigrade

7. Currencies

US$ or $	US dollar
¢	US cent
¢, C	Costa Rican Colon

Summary

Summary

SUMMARY

This is a report on the results of the feasibility study conducted for the Los Llanos Hydroelectric Power Plant Project in the Republic of Costa Rica from 1994 to 1996 by Japan International Cooperation Agency (JICA), as technical assistance by the Japanese government. This report will be submitted to the government of Costa Rica and Instituto Costarricense de Electricidad (ICE) by JICA through the Ministry of Foreign Affairs of Japan. The feasibility study results are summarized as follows.

(1) The Project Characteristics

Los Llanos Hydroelectric Power Development Project consists of a power generation plan to construct a run-of-river type power plant using the head between the dam constructed at a point in the mid-stream part of the Naranjo River, with a 144 km^2 catchment area that can be regulated to meet the peak power demand, and diverted water using a 5.5 km waterway to the Paquita River, and a power transmission plan to transmit the power from the plant to a substation of the 500 kV Central America interconnecting transmission line.

This is a pluvial region with clearly distinguished wet and dry seasons providing an average annual rainfall of 5,500 mm. The total catchment area of the Naranjo River is 332 km^2. Its principle tributaries are the Naranjillo River in the upper streams and the Brujo River in the lower streams. Its average annual runoff is estimated to be about 35m^3/s - 40m/s. The project site is the confluence with the Naranjillo River and the average annual runoff is 15m^3/s. The guaranteed discharge (95%) is calculated to be 3.91m^3/s.

For the main stream, there are the Los Reyes, the Milagro, the Nara and the Los Llanos main stream development projects. Of these projects, this Los Llanos project is considered to present the highest generation efficiency. It is, therefore, the most promising hydro-electric power development project at the national master plan stage.

Coffee growers live upstream from the project site and live stock farmers live in the hills downstream. There are, however, no residents in the expected submergence area near the project site. There are also no roads or public buildings for which compensation would be required in the area. African palm is grown in the brackish-water area in the inner area and at the mouth of the river which also has mangrove groves. The river water is used

(max. 1.8m^3/s) to cultivate this palm during the dry season, and these are the only water rights existing for the Naranjo River.

The project is thought to help and not damage the growth of the mangroves. As for the palm, there will be several days in a year when the current water intake cannot be secured, thereby causing production decrease. This will be subject to compensation.

Power demand in the Republic of Costa Rica has increased rapidly in recent years. In 1993 it increased by 7.4%. However, Costa Rica does not produce fossil fuel which is economical and thus mainly relies on hydro-power generation. Considering these conditions and the physical aspects of the development project, the commissioning of this project is expected to be in about 2005.

However, when the power demand projection is considered, it is seen that 2005 is not early enough. It is, therefore, desirable that the Los Llanos Hydro-electric Power Plant be commissioned as soon as possible.

(2) Climate and Hydrology

Runoff gauging stations and meteorological stations are located in the basin and in the area surrounding this project. The Londres runoff gauging station is the oldest of these and is reliable. The correlation between the observed values at the Londres runoff gauging station and the daily discharge observation at the dam site is very high. Therefore, the calculation is based on a 23-year discharge at Londres. Regarding the flood volume, the PMP (probable maximum precipitation) was derived from the meteorological value, and from the rainfall intensity and time distribution maximum flood was calculated by discharge calculation. The PMF (probable maximum flood) at the dam site was 1,590 m^3/s.

Sediment flowing down the river is divided into suspended load and bed load, and is correlated to the river discharge. Although the supplement rate differs depending on the reservoir capacity, the projected sedimentation load was calculated for 50 years and the dam's estimated sedimentation face height was set at 497 m.

(3) Geology, Material and Earthquake

The bed rock which represents the geology of this area is sedimentary rock from between the Mesozoic era Jurassic period to the Tertiary Eocene epoch, and hardened sediment of

the Quaternary age end which partly covers it. For the dam, the foundation is sufficiently solid and hard conglomerate is distributed. The power plant site is on the left bank of the Paquita River, located near the border of conglomerate distributed in the waterway route and the lower marl.

Regarding the concrete aggregate, there is sufficient riverbed sand gravel near the power plant. However, crushed stone derived from raw ore sandstone from upstream, is planned to be used at the dam site. The epicenters of the earthquakes which occurred from 1990 to 1994 within a 1,000 km diameter of the project site are concentrated along the Pacific Ocean coast. The results of statistical probabilistic analysis of these earthquake data and the existing earthquake data were fully studied and the design lateral seismic factor of the project site was set at 0.15.

(4) Power/Energy Demand and Supply

In 1993, the per capita energy demand in Costa Rica Was 1,370 kWh, similar to other developing countries. In the developing countries, a macro method using the correlation with the economic growth to formulate the demand projection is applied in many cases. Being very close, there is almost no difference between this value and the growth rate projected by ICE. Therefore, the demand and supply balance plan produced by ICE was employed.

In Costa Rica, power is provided mostly by hydro with thermal supplementation. Therefore, power supply depends on the river flow and changes in that flow serve to greatly affect the system. Therefore, when studying the balance, considering the firm output of hydro, the daily load factor was 66%.

When this project is commissioned in 2005, it is expected that it will contribute greatly to Costa Rica's power demand and supply and to the overall economic development of the area.

(5) Transmission Plan

Costa Rica's power transmission system is constructed of 230kV and 138kV transmission lines. In about 2000 - 2003, a 500kV Central American interconnecting transmission line (SIEPAC) is planned to be materialized and commissioned. In the neighboring Pirris Hydroelectric Power Project also, the voltage will be decreased to 230kV from the 500kV substation (San Rafael) of SIEPAC and interconnected to San Jose, the capital.

Considering transmission energy, including those of future projects, and lowering its effect on the interconnecting line at outages, this project will be connected at San Rafael Substation by one 230 kV circuit. The transmission route is about 22 km long and is economical, running from the power plant, crossing the Paquita River, running through the mountains at the right bank to the foot of the mountain to reach the plains to the San Rafael Substation.

(6) Environment and Compensation

Environmental impact must be considered, based on the laws of the country. Costa Rica, however, has no guidelines at this time.

In this study, the initial environmental examination (IEE) was conducted following JICA guidelines, which is based on the environmental consideration method for development study/plan establishing in international organizations such as the World Bank and United Nations Environmental Plan, and bilateral assistance organizations.
In this study, environmental impact assessment (EIA) was conducted on environmental items which were judged to be more necessary.

In the entire Brujo River area, which is a tributary in the northeast part of Naranjo River basin and not directly involved in this project, is a forest conservation area. Besides that, however, there are no conservation areas. Coffee is grown and stock farms are run in the hills in the upper reaches and the mid-stream area involved in this development project. None, however, will be affected by the project such as being submerged and are not directly connected with the main stream of the river.

At the river mouth, a part of the right bank is designated as the Manual Antonio National Park and a resort area along the coastline including the Quepos Reef is located next to the park. An alluvial fan is formed on the left bank from the lower reaches to the river mouth, and palms are grown here. At the outside, a sandbar is formed on the shoreline and mangroves lie in the brackish-water in-between.

(7) Optimum Development Project Outline

The outline of the Los Llanos hydro-electric power development project is as follows. The installed capacity is 85 MW. The annual guaranteed energy of this hydro-electric power plant is calculated to be 107 GWh. When compared with a diesel thermal power plant, this equals 22,800 tons/oil consumption.

(8) Construction Process and Cost

The construction period for this project is expected to be 4 years considering the weather, topography, construction scale, construction material, structure location and preparation works. Considering the supply and demand balance, it is necessary to prepare for the construction following the rough schedule below if the project is to be commissioned in 2005.

Duration		Item
Apr. 1996 - Sep. 1997		Further Investigation Works
Jun. 1996 - Dec. 1997		Request of ICE to MIDEPLAN
Sep. 1996 - Aug. 1998	(2.0 years)	Detailed Design
Jun. 1998 - Dec. 1999	(1.5 years)	Finance Formalities
Jan. 2000 - Dec. 2000	(1.0 year)	Approval of Congress
Mar. 2001 - Dec. 2001	(0.8 year)	Bidding of Contract
Jan. 2001 - Dec. 2004	(4.0 years)	Construction

The construction cost for this project is calculated on the assumption that the design, construction, materials and products of currently expected technical standards will be applied. The geological conditions and topographical characteristics and construction scale were also considered in the calculation.

The construction cost of this project was calculated in both domestic and foreign currencies. Access roads, camping facilities, environmental protection measures, power transmission line, switchyard, engineering fees, management cost and interest during the construction period are included. It does not, however, include inflation costs. This calculation was made in January, 1995. (Exchange rate: US$1 = 168 Colones).
The construction cost is US$151,763 and the power generation end construction cost is US$0.04/kWh.

(9) Economic and Financial Evaluation

In making the economic evaluation, the alternative facility approach method was used to estimate and assess the economic cost for the project and the alternative thermal power plant. The flow chart for the benefits and cost based on the economic cost of the project is shown in Table 14-4. Economic internal rate of return (EIRR), net present value (B-C), and benefit and cost ratio (B/C) are as follows.

Economic internal rate of return (EIRR)	:	20.2%
Net present value (B-C)	:	US$42,389,000
Benefit/cost ratio (B/C)	:	1.43

It is deemed that regarding the economic viability of this project, the construction and operation of this project is far more economical than constructing an alternative thermal power plant which would offer an equivalent service. This superiority will be maintained until the social discount rate which reflects the opportunity cost of capital reaches 20.2%. In financial evaluation, the financial internal rate of return was calculated as 12.4%. It can be concluded that this is a financially sound power generation project, even at the current electricity rate.

This evaluation is subject to condition that Pirris Hydropower Project will have been completed before commissioning of Los Llanos Project.

Los Llanos Hydroelectric Power Project

Item	Unit	Contents
River		Naranjo River
Catchment Area	km^2	143.7
Annual Inflow	10^6m^3	471.8
Design Flood	m^3/s	1,600
Project Feature		Run-of-River Type
Maximum Discharge	m^3/s	27
Maximum Effective Head	m	359.4
Installed Capacity	MW	85
Reservoir		Daily Regulation (5 hours)
High Water Level	m	477.4
Low Water Level	m	470.0
Effective Storage Capacity	10^3m^3	653
Surface Area	10^3m^2	100
Dam		Concrete Gravity
Height x Crest Length	m x m	62.4 x 114
Dam Volume	10^3m	89,200
Headrace		
Inner Diameter x Length	m x m	3.1 x 5,540
Surge Tank		
Inner Diameter x Height	m x m	8.0 x 57.3
Penstock		
Inner Diameter x Length	m x m	3.10 ~ 2.02 x 1,540 x 1 line 1.25 x 26 x 2 lines
Powerhouse		Steel Reinforced Concrete, Open type
Width x Length	m x m	19 x 37
Turbine (Vertical Shaft Francis)	MW x Units	43.7 x 2
Generator (3-phase AC)	MVA x Units	50.0 x 2
Switchyard	kV	230
Width x Length	m x m	40.0 x 120
2 Circuit Line	kV	230
Power Generation		
Annual Total Energy	GWh	389
Firm Energy	GWh	107

Conclusion and Recommendation

Conclusion and Recommendation

CONCLUSION AND RECOMMENDATION

Los Llanos Hydroelectric Power Project is located at the mid-stream part of the Naranjo River which flows into the Pacific Ocean, 50 km south of San Jose in the Republic of Costa Rica. The study team conducted a feasibility study on the power generation and the related transmission line projects. Through these studies, it is concluded that this project is technically, economically and environmentally feasible. The content of this conclusion follows.

CONCLUSION

(1) As of January, 1995, the total generating capacity of electric facilities in the Republic of Costa Rica was 1,098 MW, of which 83% is by hydro. On the other hand, of the hydropower potential which can be economically developed, only 8% has been developed. The project aims to effectively utilize hydro-power resources, an important energy resource, within Costa Rica and supply ample and stable electric power.

(2) Costa Rica's power demand has increased steadily each year. It is projected that the annual growth rate from 1995 to 2005 will be 7.6%. The peak demand in 2004 is projected to be 1550 MW, and new facilities for more than 400 MW will be required.

(3) Considering the power demand projection, detailed design, time required for funding and the construction period, it was determined that this project should be commissioned into the nationwide electric power system in 2005.

(4) The Naranjo River development plan suggested in the master plan was restudied, and the appropriate layout considering development time, development scale, discharge and gross head was selected. The geological and topographical conditions and conditions based on environmental impact assessment were compared and studied, and the most economically viable development plan was selected.

(5) The construction cost was estimated on the assumption that design, construction, materials and products will be of the technical standards as of January, 1995. The topographical and area conditions of the project site and construction scale were considered in the work cost, and import duties and interest during construction were included. The construction cost including domestic and foreign currencies is US$152 million.

(6) The economic viability of this project is deemed superior to alternative thermal power facilities. The construction cost per kWh is US$0.04 and is an economical energy source

compared to other countries. The cost and income of this project was estimated and the economic internal rate of return discounted to the present value became 20.2%, showing that it is a feasible project considering the national economy, subject to condition that Pirris Hydropower Project will have been completed before commissioning of Los Llanos Project.

(7) A concrete gravity-type dam will be employed considering the topography, geology, construction cost and operational ease. The most appropriate and economical ground-type power plant will be used considering the topographical and geological conditions. Functionally and economically superior Francis turbines which provide excellent efficiency and maximum energy generation will be used. There are no problems likely to hinder the construction of this project and the project is technically feasible.

(8) There are no residents within the planned reservoir area. There are no roads or public buildings for which compensation would be required. However, palm is grown in an area where the water flow will be reduced. The only irrigation facility on the Naranjo River exists at that location. The maximum irrigation water volume is $1.8m^3/s$ and river water is used for cultivation. Production will be decreased and appropriate compensation is added to the construction cost.

(9) Environmental aspect to be noted within the project area is that mangroves are cultivated in the brackish-water at the mouth of the river. The mangrove growth and the sandbar growth along the shoreline is deeply related and the plan must not shut out suspended sand during the flood period. As this project's dam only regulates and does not store (hold sand), it will not decline the sandbar at the river mouth. An appropriate amount of environmental measures cost is added to the construction cost.

(10) It was assessed that this project will provide only minimal affect on the surrounding natural and social environment, and will contribute greatly to the stable supply of electricity and to the development of the society in the area.

RECOMMENDATIONS

Los Llanos Hydroelectric Power Development Project is technically, economically and environmentally feasible. The Project is justified to be commissioned in 2005 according to the Power Development Plan of Costa Rica, therefore, it is recommended that the project be implemented.

It is necessary to implement the following matters in order to realize the Project.

(1) To make preparations required for construction such as detailed design and composition of bid documents.

(2) The additional investigations mentioned in Chapter 15 "Further Investigations" should be carried out, to be reflected in the detailed design.

(3) For the commissioning of the Project in the year 2005, it is necessary to arrange for construction funds; to invite tenders and select the contractor at the beginning of 2000 and to start the main work during the dry season. Main schedule until commissioning and required time is shown below:

Required period			Item
Sep/1996	- Aug/1998	(2.0 years)	Detailed design
Jun/1998	- Dec/1999	(1.5 years)	Finance formalities
Jan/2000	- Dec/2000	(1.0 year)	Approval of Congress
Mar/2001	- Dec/2001	(0.8 year)	Bidding of Contract
Jan/2001	- Dec/2004	(4.0 years)	Construction

(4) Relocation of roads to be affected by implementation of the Project, compensation for land, houses, etc. to be affected must be done for the smooth implementation of the Project. It is also necessary to continue the study and monitoring of expected environmentally affected items.