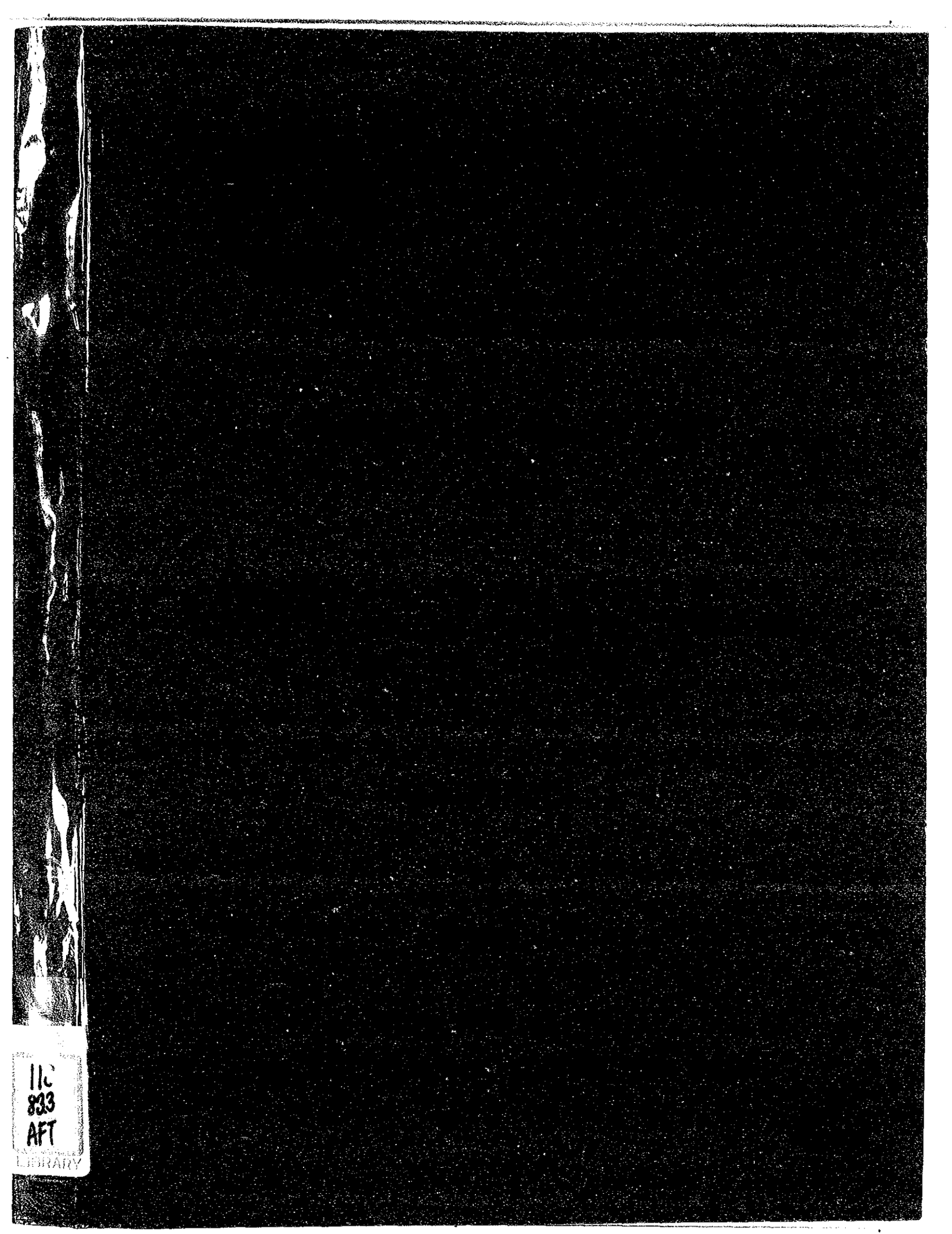


REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

MASTER PLAN STUDY

ON

IMPROVEMENT OF COMMUNAL IRRIGATION SYSTEMS THROUGH PHYSICAL AND INSTITUTIONAL DEVELOPMENT AND RURAL DEVELOPMENT IN SOUTHERN TARLAC PROVINCE

APPENDIX I

OCTOBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

APPENDIX- I (Supporting Data for Master Plan)

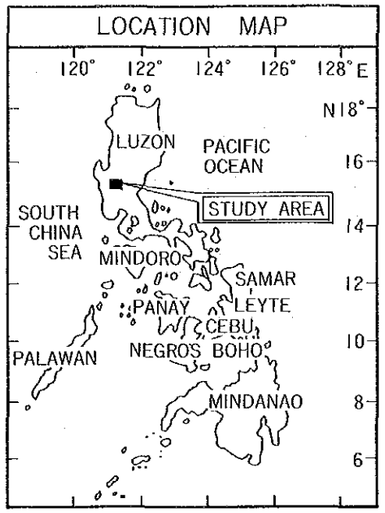
GENERAL MAP

IMPROVEMENT OF COMMUNAL IRRIGATION SYSTEMS
THROUGH PHYSICAL AND INSTITUTIONAL DEVELOPMENT AND
RURAL DEVELOPMENT IN SOUTHERN TARLAC PROVINCE

COMMUNAL IRRIGATION SYSTEMS UNDER THE PROJECT

Name of CIS	Area(Ha)	Name of CIS	Area(Ha)	Name of CIS	Area(Ha)
1. Bamban	1,051	8. Marila	100	15. Magao	620
2. San Pedro	120	9. San Martin	280	16. Tinang	850
3. Malonzo	240	10. Baluto	740	17. Sto Rosario	200
4. Bangcu	700	11. Lilibangan	240	18. Sta Monica	740
5. Susuba Cutcut	40	12. San Bartolome	375	19. Calcluan	80
6. Telebance	389	13. San Isidro	635		
7. Sta Rita	135	14. Lucong	2,250	Total Area	9,785

LOCATION MAP



LEGEND :

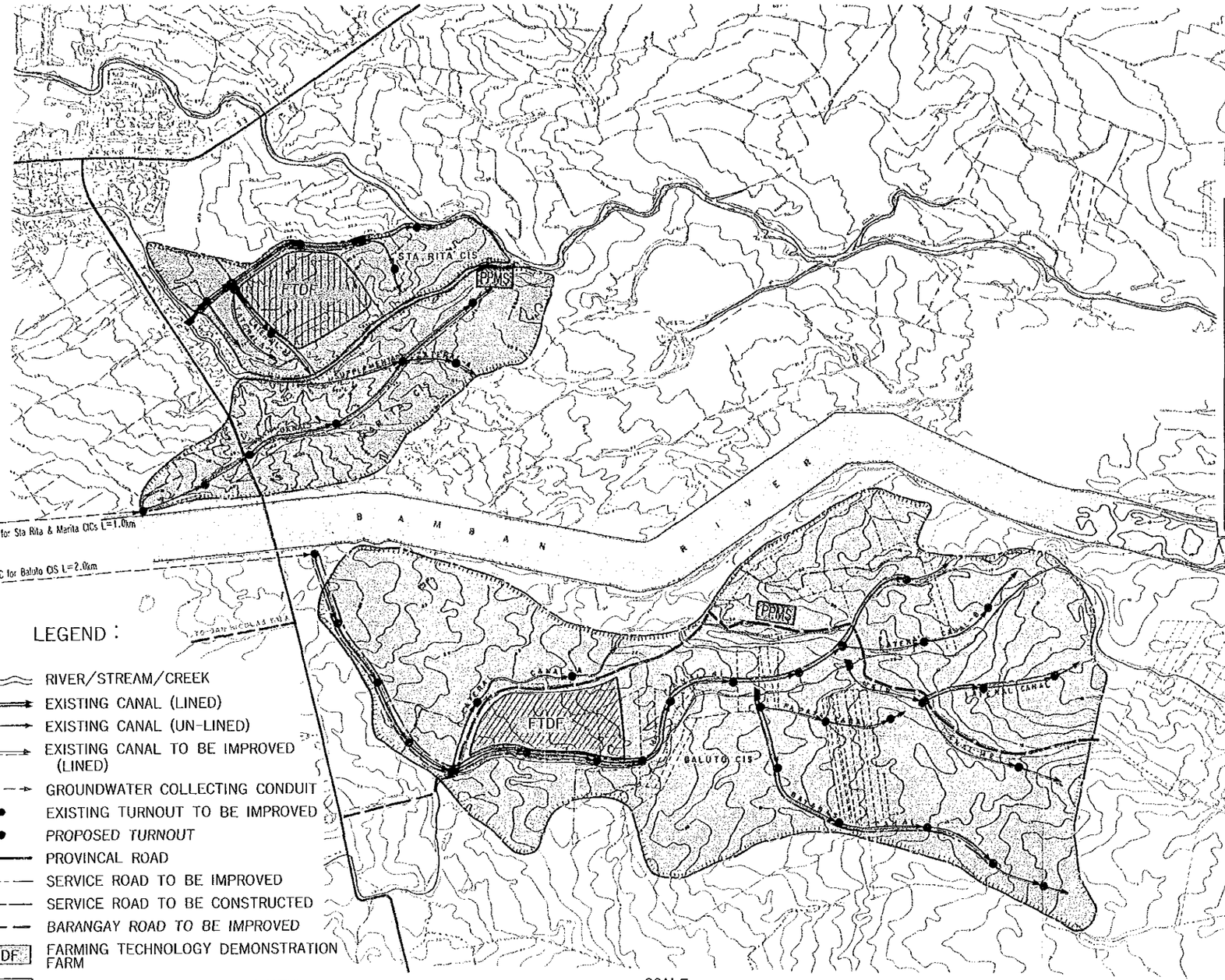
- NATIONAL OR PROVINCIAL ROAD
- BOUNDARY OF CIS
- BOUNDARY OF NIS
- BARANGAY ROAD
- RIVER OR CREEK
- EXISTING. DIVERSION DAM
- BRUSH OR DIVERSION DAM TO BE IMPROVED
- EXISTING CANAL
- CANAL TO BE IMPROVED OR CONSTRUCTED
- PROPOSED GROUNDWATER COLLECTING CONDUIT
- PROPOSED LINK CANAL OF B.B.M.P
- SEED MULTIPLICATION STATION (SMS)

MAJOR DEVELOPMENT COMPONENTS

Development Components	Unit	Total	Phase-I (Pilot)	Phase-II
1) Agricultural Infrastructure Development				
a) Irrigation Facilities Development				
Canals	Km	37	1	36
Canal Structures	Unit	95	44	251
Service Road	Km	73	10	63
Intake Facilities	Unit	7	1	6
b) Diversion Dams Improvement				2
Replacement by Rubber Dams	Unit	4	2	2
Rehabilitation	Unit	6	–	6
c) Groundwater Collecting Conduit	Unit	4	2	2
b) Shallow Wells	Unit	271	12	259
e) Drainage Development	Km	4	–	4
2) Farm Road Development				
Barangay Road	Km	53	8	45
Farm-to-market Road	Km	58	1	57
3) Agricultural Development				
Farming Technology Demonstration Farm	Farm	11	2	9
Seed Multiplication Station	Sta.	1	1	–
Pilot Primary Marketing Station	Sta.	2	2	–
Primary Marketing Station	Sta.	3	–	3
Post-harvest Technology Demonstration Farm	Farm	5	2	3
Duck Raising	Pla.	5	–	5
Fishery Pond	*Pla.*	5	–	5
4) Institutional Development				
Support Assistance for Strengthening IAs		L.S.	L.S.	L.S.
Support Assistance MFIA		L.S.	L.S.	L.S.
Support Assistance for Strengthening FIAs		L.S.	–	L.S.
Support Assistance for Strengthening CIAs		L.S.	–	L.S.
Support Assistance for Stregthening ASS		L.S.	–	L.S.
Support Assistance for Seminar & Training		L.S.	L.S.	L.S.

LAYOUT

PILOT COMMUNAL IRRIGATION SYSTEMS DEVELOPMENT
(Pilot CISD)



COMPONENTS OF PILOT CISD

COMPONENTS	QUANTITY
1) Agricultural Infrastructure Development	
a) Canal Rehabilitation	
Canal Rehabilitation	3,400 m
Turnout	38 units
Service Road (Main & Lateral Canals)	6,690 m
b) Intake Facility Rehabilitation	1 unit
c) Diversion Dam Rehabilitation (Tinang & Lucong CISs)	2 units
d) Groundwater Collecting Conduit (GCC)	
GCC (Sta Rita & Marita CISs)	1.0 km
GCC (Baluto CIS)	2.0 km
e) Shallow Wells Development (Equipment & Wells)	12 wells
2) Farm Road Development	
a) Barangay Road	8,200 m
b) Farm-to-market Road	500 m
3) Agricultural Development	
a) Farming Technology Demonstration Farm (FTDF)	2 farms
b) Seed Multiplication Station (SMS)	1 station
c) Pilot Primary Marketing Station (PPMS)	2 stations
d) Post-harvest Technology Demonstration Farm (PTDF)	2 farms
4) Institutional Development	
a) Support Assistance for Strengthening of IAs	L.S.
b) Support Assistance for MFIA	L.S.
c) Assistance for Seminor and Training	L.S.

LIST OF CISs IN PILOT CISD

NAME OF CIS	POTENTIAL AREA
Sta Rita CIS	135 Ha.
Marita CIS	100
Baluto CIS	740
TOTAL	975

APPENDIX A General

A.1 Implementing Arrangement (I/A) for the Master Plan Study

A.2 List of Personnel Contacted by the Study Team

A.3 List of Japanese Government Officials Participated with the Master Plan Study

A.4 Member List of the Study Team

A.1 Implementing Arrangement (I/A) for The Master Plan Study

IMPLEMENTING ARRANGEMENT ON THE TECHNICAL COOPERATION

BETWEEN

JAPAN INTERNATIONAL COOPERATION AGENCY

AND

NATIONAL IRRIGATION ADMINISTRATION

FOR

MASTER PLAN STUDY

ON

IMPROVEMENT COMMUNAL IRRIGATION SYSTEMS

THROUGH PHYSICAL AND INSTITUTIONAL DEVELOPMENT

AND RURAL DEVELOPMENT

IN SOUTHERN TARLAC PROVINCE

IN

THE REPUBLIC OF THE PHILIPPINES

AGREED BETWEEN

JAPAN INTERNATIONAL COOPERATION AGENCY

AND

NATIONAL IRRIGATION ADMINISTRATION

MR. KATSUHIRO KAKIUCHI
Team Leader of
Preliminary Survey Team,
Japan International
Cooperation Agency

ATTY. FEDERICO N. ALDAY, JR.
Administrator
National Irrigation
Administration

February 21, 1989

Manila, Philippines

I. INTRODUCTION

In response to the request of the Government of the Republic of the Philippines (hereinafter referred to as "GOP"), the Government of Japan hereinafter referred to as "GOJ") has decided to conduct the Master Plan Study on Improvement of Communal Irrigation Systems through Physical and Institutional Development and Rural Development in Southern Tarlac Province in the Republic of the Philippines (hereinafter referred to as "the Study"), and exchanged the Note Verbales with GOP concerning the implementation of the Study.

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of GOJ will undertake the Study, in accordance with the relevant laws and regulations in force in Japan.

On the part of GOP, National Irrigation Administration (hereinafter referred to as "NIA"), shall act as a counterpart agency to the Japanese study team and also as a coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study .

The present document constitutes the implementing arrangement between JICA and NIA under the above mentioned Notes Verbales exchanged between two governments.

II. OBJECTIVES OF THE STUDY

The objective of the Study is to formulate a master plan for improvement of communal irrigation systems through physical and institutional development and rural development in Southern Tarlac Province.

III. STUDY AREA

The study area covers about 40,000 hectares in Southern Tarlac Province.

IV. SCOPE OF THE STUDY

The Study will consists of two Phases.

I. Phase I

(1). Collection, review and analysis of relevant data, information and field survey on the followings.

1) Natural Conditions

a) Topography

b) Meteorology and Hydrology

c) Geology and Hydrogeology

d) Soil

2) Social Conditions

a) Population

b) Social organization

c) Regional and national development programmes

d) Economy

3) Agriculture

a) Land use

b) Farming

c) Land ownership

d) Farmers organizations, especially irrigator's associations

e) Farm household economy

f) Marketing

g) Processing of agricultural products

4) Agricultural Infrastructure

a) Irrigation and drainage systems

b) Agricultural road

5) Social rural infrastructure

(2) Identification and evaluation of the development potentials and constraints based on the results of the above survey.

(3) Selection of the priority project(s) area

II. Phase II

(1). Supplementary data collection and field survey

(2) Formulation of the master plan which will consist of the following.

1) Improvement and Development plan of irrigation and drainage systems

2) Improvement and Development plan of agricultural facilities.

3) Improvement plan of social rural infrastructure

4) Improvement plan of farmers organization, especially irrigator's associations, and agricultural supporting system

5) Project implementation plan

a) Identification of the priority project(s)

b) Schedule of Project implementation

c). Organization for Project implementation

d) Project operation and management

6) Project evaluation

(3) Execution of pre-feasibility study on the priority project(s)

V. REPORTS

JICA shall prepare and submit the following reports in English to GOP.

1. Inception Report

Thirty (30) copies at the commencement of the Phase I study.

2. Progress Report (I)

Thirty (30) copies at the end of the field study of the Phase I study.

3. Interim Report

Thirty (30) copies at the commencement of the Phase II study.

4. Progress Report (II)

Thirty (30) copies at the end of the field study of the Phase II study.

5. Draft Final Report

Thirty (30) copies at the end of Phase II study.

GOP shall provide JICA with its comments on the draft final report within one (1) month after the receipt of it.

6. Final Report

Fifty (50) copies within two(2)months after the receipt of the comments of GOP on the Draft Final Report.

VI. STUDY SCHEDULE

The tentative work schedule is shown in the Appendix.

VII. UNDERTAKING OF GOP

In accordance with the Notes Verbales exchanged between GOJ and GOP, GOP shall accord privileges, immunities and other benefits to the Japanese study team and, through the authorities concerned, take necessary measures to facilitate smooth conduct of the Study.

1. GOP shall be responsible for dealing with claims which may be brought by third parties against the members of the Japanese study team and shall hold them harmless in respect of claims or liabilities arising in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims or liabilities arise from gross negligence on willful misconduct of the above-mentioned members.
2. NIA shall, at its own expense, provide the Japanese study team with the following, if necessary, in cooperation with other agencies concerned:
   (1) Available data and information related to the Study,
   (2) Counterpart personnel,
   (3) Suitable office space with necessary equipment both in Metro Manila and in the project site,
   (4) Credentials or identification cards to the members of the Japanese study team.
3. NIA shall make necessary arrangements with other governmental and non-governmental organizations concerned for the following:
   (1) to secure the safety of the Japanese study team
   (2) to permit the members of the Japanese study team to enter, leave and sojourn in the Philippines for the duration of their assignment therein: and exempt them from alien registration requirements and consular fees;
   (3) to exempt the members of the Japanese study team from taxes, duties, fees and other charges on equipment, machinery and other materials

brought into the Philippines for the conduct of the Study:

(4) to exempt the members of the Japanese study team from income tax and charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Japanese study team for their services in connection with the implementation of the Study;

(5) to provide necessary facilities to the Japanese study team for remittance as well as utilization of the funds introduced into the Philippines from Japan in connection with the implementation of the Study:

(6) to secure permission for entry into private properties or restricted areas for the conduct of the Study;

(7) to secure permission to take all data and documents (including photographs) related to the Study out of the Philippines to Japan by the study team;

(8) to provide medical services as needed and its expenses will be chargeable against the members of the Japanese study team.

VII. UNDERTAKING OF GOJ

In accordance with the Notes Verbales exchanged between GOJ and GOP, through JICA, shall take the following measures for the implementation of the Study:

1. to dispatch, at its own expense, study team to the Philippines;
2. to pursue technology transfer to the Philippine counterpart;
3. to provide necessary equipment for the implementation of the Study, which will remain the property of JICA unless otherwise agreed.

IX. CONSULTATION

JICA and NIA shall consult with each other in respect of any matter that may arise from or in connection with the Study.

APPENDIX

Tentative Schedule

Item \ Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PHASE I Field Work															
PHASE I Home Work															
PHASE II Field Work															
PHASE II Home Work															
Reports	△ IC/R			△ P/R(I)		△ IT/R		△ P/R(II)				△ DF/R			△ F/R

IC/R : Inception Report
IT/R : Interim Report
F/R : Final Report
P/R : Progress Report
DF/R : Draft Final Report

A.2 LIST OF OFFICIAL CONTACTED DURING THE FIELD SURVEY

NIA (National Irrigation Administration)

MR.JOSE B. DEL ROSARIO,JR, Administrator
MR.DOMINGO T. BAUTISTA, Deputy Administrator
MR.WILFREDO S. TIANGCO, Asst.Admr.for Project Development & Implementation
DR.JOSE A.GALVEZ, Asst.Admr. for Systems Operation and Equipment Management
MR.MAXIMINO A.ECLIPSE, Asst.Admr.for Administrative Services
MR.ISIDRO R.DIGAL, Manager, Project Development Dept.
MR.JOSE A.CEDENO,Manager,Communal Irrigation Development Project
MR.ROGELIO F.GUSILATAR, Asst.Project Manager,CIDP
MR.EDILBERTO B.PAYAWAL, Manager,System Management Division
MR.ARTHUR V.LAZARO, OIC,Institutional Development Department
MR.D.MACATUMBAS,Division Manager, Institutional Dev't Div.
MR.ARTEMIO L.BALIAO,Farmers'Assistance Superviser,IDD
MR.RODOLFO D.GALES, Principal Engr. DSD
MR.ALEX CRUZ, Head, Cost Estimate, DSD
MR.EPIFANIO C. GACUSAN, Div. Chief, Land Resources Use and Economics, PDD
MR.ROMEO F. POTENCIANO, Div.Chief, Water Resources Utilization Div. PDD
MR.ABELARDO Y.ARMENTIA, Div.Chief, Feasibility Study & Environme Div. PDD
MR.R.P.DELA ROSA, Division Manager,PDD
MR.ROLANDO MALOLES, Head,Groundwater Section,PDD
MR.MILO LANDICHO, Head, Hydrology Section,PDD
MR.P.SUPNET, Principal Geologist,PDD
MR.CANDIDO L.RAQUEPO, Economist,PDD
MR.ALFREDO FORMARAN, Irrigation Engr. PDD
MR.FILOMENO P.VENTURA, Hydrologist,PDD
MR.WILSON LAYAOEN, Geologist, PDD
MR.HERMINIGILDO S. TABARES, Soil Scientist,PDD
MR.GUILLERMO DE GUZMAN, Agronomist,PDD
MR.EDILBERTO B.PUNZAL,Div.Chief,Planning Formulation Div.PDD
MS.VILMA M. BAYANGOS, Engr. PDD
MA.EDEN SELVA,Sociologist, PDD
MA.ERMESITA C.FLESTADO, Farmer's Organization,PDD

Region III Irrigation Office

MR.TIBURCIO C.LAYUG, OIC, Regional Irrigation Engr.
MR.LEONARDO S.GONZALES, Irrigation Superintendent,AMRIS

TARLAC PIO (Tarlac Provincial Irrigation Office)

MR.MARCELINO P.MANALO, Provincial Irrigation Engineer
MR.BENJAMIN Z.PASION, Sr. Engineer
MR.ALBERTO C.COTACO,Construction Engineer
MR.ALFREDO T.AGUILAR, Irrigation Technician
MR.ADRIANO P.BUSOG, ICO Chief,

BBMP (Balog Balog Multipurpose Project)

MR.HONORIO M.ENCARNACION, Project Manager
MR.RUBEN S.ATIENZA, Asst. Project Manager
MR.MANADO SOLITO, Chief, Field Engineering Section, Division II
MR.ERIA SANCHAGO, Division Manager II
MR.VICENTE R.VICMUDO
MR.ABERARDO T.AROMIN, Geologist
MR.JUN LACUESTA

NEDA Region III in San Fernando, Pampanga

MR.NESTOR MIJANES, Acting Regional Director
MR.ALEX RAMON Q. CABANILLA, Asst.Regional Director
MA.RUTH D.RUIZ, Chief, Social Service Division
MR.NELSON G. GENITO, Supervising Eco.Div.Specialist OIC,Economic Division
MR.EDGARDO D. SULIT, Chief, Infrastructure Division
MR.JOSE S. SUNGA, OIC, Operation Division

DBM (Department of Budget and Management)
MR.GUILLERMO N. CARAGUE, Secretary

DA (Department of Agriculture) in Tarlac Province

MS.LUCRECIA G.ILAGA, PAO (Provincial Agricultural Officer)
MR.ROMEO Y.VERON, Chief, Planning Unit of PAO
MR.DANTE S.PABLACIO, Concepcion Municapal Agricultural Officer
MR.ALEJANDRO P.JUAN,Acting Bamban Municipal Agricultural Officer

DAR (Department of Agrarian Reform) in Tarlac Province

MR.BENNY R.CUENCO, Provincial Agrarian Reform Officer
MR.ALFREDO D.REYES,Municipa; Agrarian Reform Officer,Capas
MR.CRISTOBAL S.SAMIDO,Municipal Agrarian Officer, Bamban

BS (Bureau of Soils)

MR.ALEX MICOSA, Chief, Soil Survey Division, BS, Manila
DR.ROGER N.CONCEPCION, Soil Survey & Agricultural Land Resources Use and Planning Specialist, Agricultural Land Management Evaluation Division

NSO (National Statistics Office)

MR.ALFREDO D.BATOY, Chief, Tarlac Branch

UPLB (University of the Philippines at Los Banos)

DR.EMERICO R.MENDOZA, Professor, AED

IRRI (International Rice Research Institute)

MR.SALAZAR, Agricultural Engineering Department

PHILRICE (PhilippineRice Research Institute)

MR.FEUMARI M.TORSIZO, Supv.Sci. Research Specialist,RED (Rice Engineering Division), Marigaya, Munos
MS.LEONIDES S.HALOS, Sr.Sci. Research Specialist, RED, Marigaya

NAPHIRE (National Postharvest Institution for Research and Extension)

MR.ROSENDO S.RAPUSAS, Chief, Post Harvest Systems Analysis & Development Division, Marigaya

NFA (National Food Authority)

MR.EDUARDO L.GALANG, Regional Director,Region III Office, Cabanatuan, Nueva Ecija
MR.REYMONDO F.CONCEPCION, Regional Engineer, Region III Office
MR.DARIO L.GARCIA, Provincial Manager, Provincial Office, Aguso
MR.ANTONIO A.PUNO, Plant Engineer, Provincial Officer
MR.JOSE P.PAGUC, Manager,Concepcion GID Warehouse

SDA (Sacobia Development Authority)

MR.SIGFREDO R.BAUTISTA,Program Coordinator
MR.FRANCO N.MIGUEL, Head,Monitoring and Information Division

Quedan Guarantee Fund Board

MR.GALO B.GARCHITORENA, Executive Director,Head Office,Manila
MR.BENIGNO D.SANTOS, Manager,Aguso Grains Center, Tarlac,Tarlac
MR.SOLITO A.SALAZAR, Operation Officer, Aguso Grains Center
MS.DOLORES M.MANZANO, Operation Officer, Aguso Grains Center

Tarlac Provincial Government Office

MR.MARIANO UN.OCAMPO III, Governor
MR.EDGARDO C.MENDOZA, Sr.Executive Assistant, Office of Governor
MR.ANTONIO C.ANTONIO, Executive Assistant, Office of Governor

Municipal Office of Conception

MR.DANILO D.DAVID, Municipal Mayor
MR.ALFREDO P.AVENA, Minicipal Vice Mayor
MS.ELIZABETH C.BUCU, Municipal Planning and Development Coordinator

Municipal Office of Capas

DR.HERMES E.FRIOS, Municipal Mayor

Municipal Office of Bamban

MR.LEONARDO E.SORIANO, Municipal Mayor
MR.JULY A.VITUG, Municipal Planning & Development Coordinator

LWUA (Local Water Utilities Administration)

MR.HERBERT J.JEAN JAQUET, Manager, Public Affair Department

DPWH (Department Of Public Works and Highway)

Project Management Office (PMO)

MR.RENCRY PADERNAL,Project Manager IV
MR.DANNY CASTILLON,

Office of District Engineer

MR.GOLOFREDO C.CORITATIVO, District Engineer
MR.BENJAMIN C.LOPES, Supervising Civil Engineer, Construction Section
MR.ARMANDO G.PAMORAG, Rural Water Supply Section
MR.MILAROS D.BURGOS, Supervising Civil Engineer Planning and Design Section

RWDC (Rural Water Development Corporation)

MR.LUIS CERRAFON,Manager,Operation Div.
MR.JOSE RONCESVALLES

TARLAC PROVINCIAL HOSPITAL

DR.ANTONIO S. LOPES, General Manager
DR.MANNUEL L. YAMBAO, Chief of Hospital

DECS (DEPARTMENT OF EDUCATION, CULTURE AND SPORTS)

DR.EMILIDRO F. TACAGARAN, Assistant Superintendent

DTI (Department of Trade and Industries)

MS.THELMA R.FERRER, Provincial Chief

LAND TRANSPORTATION OFFICE

MR.LUCIANO L.MANILLO, Chief Officer

OFFICE OF TELECOMMUNICATION

MR.EDGARDO A. NATIVIDAD, Acting Chief Operator

PROVINCIAL POST OFFICE

MR.FELIPE B. TIGLA, Postmaster

PLDT (Philippine Long Distance Telephone)

MR.WILLIAM ABEDES, Chief Officer

TARELCO II

MR.VIRGILIO H.VELADE, General Manager

COUNTERPART PERSONNEL OF THE FOLLOWING EXTERTISES:

Chief of Counterpart Personnel Group --	MR. EPIFANIO C. GACUSAN
Irrigation and Drainage ----------	MR. ALFREDO FORMARAN
Meteorology and Hydrology ----------	MR. FILOMENO P. VENTURA
Canal and Structual Design ----------	MISS VILMA M. BAYANGOS
Geology and Hydrogeology ----------	MR. WILSON LAYAOEN
Soil and Land Use ----------	MR. HERMINIGILDO S.TABARES
Agronomy ----------	MR. GUILLERMO DE GUZMAN
Post-Harvest and Marketing ----------	MR. GUILLERMO DE GUZMAN
Rural Infrastructure ----------	MR. ALBERTO C. COTACO
Cost Estimate ----------	MR. ALBERTO C. COTACO MISS VILMA M.BAYANGOS
Rural Sociology ----------	MA. EDEN SELVA
Farmer's Organization ----------	MA. ERMESITA C. FLESTADO
Agro-Economy ----------	MR. CANDIDO L. RAQUEPO
Project Evaluation ----------	MR. CANDIDO L. RAQUEPO

A.3 List of Japanese Government Officials Participated with the Master Plan Study

Japan International Cooperation Agency (JICA)
Agricultural, Forestry and Fisheries Planning and Survey Department

Mr. Suguru NAGAI, Director
Mr. Katsuhiko KAMEDA, Head, Technical Affairs Div.
Mr. Mitsuhiko OHTA, Deputy Head, Technical Affairs Div.
Mr. Yuji OKAZAKI, Deputy Head, Technical Affairs Div.
Mr. Yoshiaki NISHIKAWA

JICA Manila Office

Mr. Moriya MIYAMOTO, Resident Representative
Mr. Katsuhiko OSHIMA, Deputy Resident Representative
Mr. Noriaki NIWA, Asst. Resident Representative
Mr. Katsuhiko OZAWA, Asst. Resident Representative

Ministry of Foreign Affairs

Mr. Kazuhiko TODA

Embassy of Japan in the Philippines

Mr. Naoki HAYASHIDA, First Secretary

Ministry of Agriculture, Forestry and Fisheries

Mr. Kunihiro DOI
Mr. Shinji KAWABE

JICA Expert detailed in NIA

Mr. Sumio OISHI
Mr. Yukinori OUCHI

Advisory Committee for the Master Plan Study

Mr. Kazuyoshi FURUKAWA, Leader
Mr. Masaru SASAKI, Irrigation and Drainage
Mr. Kuraji KATOH, Agriculture

A.4 Member List of the Study Team

Work Period :

The First Field Survey : August 8 - November 2, 1989

The Second Field Survey : January 11 - March 16, 1990

Team Members :

Mr. Yoshio ARAI,	Leader
Mr. Fumihiko KOMADA,	Irrigation and Drainage Engineer cum Asst. Leader / Group Leader
Mr. Jiro YABE,	Meteorology and Hydrology Expert
Mr. Eiji GOTO,	Rural Development Expert / Cost Engineer
Mr. Shigemi KIMURA,	Geology and Hydrogeology Expert
Mr. Masashi TAKANO,	Agro-Economist cum Group Leader
Mr. Kunihiko OHNO,	Soil and Land Use Expert
Mr. Katsuhiko NAGATA,	Agronomist
Mr. Sakae TAMURA,	Post-Harvest and Marketing Expert
Mr. Kenichiro KONDO,	Project Economist

APPENDIX B Socio-Economy

B. 1 National Economy

B. 2 Regional Economy

B. 3 Development Component

Appendix B.1 National Economy

Table B.1.1

GROSS NATIONAL PRODUCT, 1976–1986
(At Constant 1972 Prices)

Year	GNP (Million P)	Growth Rate (Percent)	Per Capita GNP (Pesos)	Growth Rate (Percent)
1976	73336	7.40	1690	4.58
1977	77983	6.34	1749	3.49
1978	82478	5.76	1801	2.97
1979	88158	6.89	1874	4.05
1980	92531	4.96	1915	2.19
1981	95722	3.45	1932	(0.89)
1982	97539	1.90	1921	(0.57)
1983	98766	1.26	1890	(1.61)
1984	91644	(7.07)	1718	(9.10)
1985	87766	(4.23)	1605	(6.58)
1986	89094	1.51	1591	(0.87)

( ) negative value

Source of data: NEDA, National Accounts Staff

Table B.1.2

SUMMARY OF GROSS NATIONAL PRODUCT, 1976-1986
(At Constant 1972 Price)

Year	GNP Growth Rate (%)
1960 - 1970	5.2
1970 - 1980	6.4
1980 - 1983	2.1
1983 - 1984	-7.1
1984 - 1985	-4.2
1985 - 1986	1.5

Table B.1.3

DISTRIBUTION OF EMPLOYMENT BY TYPE OF INDUSTRY, 1976–1986
(In Percent)

	1976	1977	1978	1980	1981	1982	1983	1984	1985	1986
Total Employment	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture, fishery and forestry	53.8	52.1	52.2	51.4	51.2	51.3	51.4	49.6	48.9	50.0
Mining and quarrying	0.6	0.3	0.4	0.6	0.5	0.4	0.5	0.7	0.6	0.7
Manufacturing	11.2	10.6	10.8	11.0	10.4	10.0	9.8	9.8	9.7	9.2
Electricity, gas and water	0.4	0.3	0.3	0.4	0.4	0.3	0.4	0.4	0.4	0.3
Construction	3.0	3.4	3.2	3.6	3.4	3.5	3.6	3.9	3.5	3.1
Wholesale and retail	9.8	9.4	10.1	10.1	11.2	11.0	11.4	12.4	13.2	13.7
Transportation, storage and communication	4.2	4.8	4.3	4.4	4.2	4.4	4.3	4.4	4.7	4.1
Financing, insurance, real estate and business services	16.7	2.4	2.2	2.0	1.8	2.2	1.8	1.9	1.7	1.9
Community, social and personal services		16.0	16.3	16.4	16.9	16.8	16.6	16.6	17.2	17.1
Activities not adequately defined	0.3	0.7	0.2	-	-	-	-	-	-	-

Note: Data were based on the third quarter survey of the LFS, using past quarter as reference period.

- negligible

Source of basic data: NCSO, Integrated Survey of Households

Table 1.1.4

POPULATION BY REGION, 1975 AND 1980–1986
(In Thousands)

Region	1975	1980	1981	1982	1983	1984	1985	1986
Philippines	42071	48098	49536	50782	52055	53351	54668	56004
National Capital Region	4970	5925	6155	6345	6540	6739	6942	7147
Region I Ilocos Region	3269	3540	3611	3682	3754	3827	3902	3979
II Cagayan Valley	1933	2215	2282	2340	2398	2459	2521	2584
III Central Luzon	4210	4802	4946	5069	5195	5322	5458	5590
IV Southern Tagalog	5214	6118	6333	6516	6703	6894	7089	7287
V Bicol Region	3194	3476	3572	3657	3744	3832	3921	4012
VI Western Visayas	4146	4525	4645	4755	4866	4978	5092	5207
VII Central Visayas	3387	3787	3876	3951	4031	4112	4195	4278
VIII Eastern Visayas	2600	2799	2856	2909	2963	3017	3073	3129
IX Western Mindanao	2048	2528	2608	2670	2734	2798	2863	2928
X Northern Mindanao	2314	2758	2851	2930	3011	3094	3178	3264
XI Southern Mindanao	2714	3346	3458	3551	3644	3739	3836	3934
XII Central Mindanao	2070	2270	2339	2402	2466	2531	2598	2665

Note: Figures are as of July 1, unless otherwise stated.

Source: NCSO, Census of Population and Housing and Population Studies Division

Table B.1.5

AVERAGE ANNUAL POPULATION GROWTH RATES BY REGION, 1975 AND 1980-1986
(In Percent)

Region	1975-1980	1981	1982	1983	1984	1985	1986
Philippines	2.71	2.52	2.52	2.51	2.49	2.47	2.44
National Capital Region	3.58	3.10	3.08	3.07	3.05	3.05	2.95
Region I Ilocos Region	1.61	1.95	1.95	1.96	1.96	1.95	1.97
II Cagayan Valley	2.76	2.49	2.51	2.52	2.52	2.51	2.50
III Central Luzon	2.67	2.49	2.49	2.49	2.48	2.51	2.42
IV Southern Tagalog	3.25	2.90	2.89	2.87	2.85	2.82	2.79
V Bicol Region	1.71	2.38	2.38	2.36	2.35	2.33	2.32
VI Western Visayas	1.76	2.37	2.36	2.33	2.31	2.28	2.26
VII Central Visayas	2.26	2.02	2.03	2.02	2.01	2.00	1.98
VIII Eastern Visayas	1.48	1.85	1.85	1.84	1.83	1.82	1.82
IX Western Mindanao	4.30	2.41	2.39	2.37	2.34	2.32	2.27
X Northern Mindanao	3.57	2.82	2.79	2.77	2.74	2.71	2.71
XI Southern Mindanao	4.28	2.69	2.67	2.64	2.61	2.58	2.55
XII Central Mindanao	1.86	2.70	2.68	2.66	2.64	2.61	2.58

Note: Growth rate for 1975-1980 was based on census results for 1975 and 1980 while those for 1981-1986 were based on the revised population projections for the Philippines (Series 2: Moderate Fertility and Mortality Decline).

Source of data: NCSO, Population Studies Division.

Table B.1.6

EMPLOYMENT RATE BY REGION, 1976-1978 and 1980-1986
(In Percent)

Region	1976	1977	1978	1980	1981	1982	1983	1984	1985	1986
Philippines	93.6	95.5	92.9	91.8	91.2	90.6	92.1	89.4	88.9	88.9
National Capital Region	-	-	-	86.4	83.8	81.3	84.7	78.1	73.9	71.4
Region I Ilocos Region	-	-	-	94.0	94.2	93.8	92.8	91.0	90.3	90.6
II Cagayan Valley	-	-	-	93.9	92.7	94.4	95.0	92.0	93.4	93.9
III Central Luzon	-	-	-	88.5	87.5	86.2	86.4	86.8	88.1	88.8
IV Southern Tagalog	-	-	-	91.4	91.6	90.7	91.9	88.7	87.6	89.8
V Bicol Region	-	-	-	93.8	93.8	93.8	95.3	92.1	93.5	92.5
VI Western Visayas	-	-	-	92.4	91.6	90.4	93.6	89.6	90.8	89.2
VII Central Visayas	-	-	-	92.5	93.0	92.9	95.0	94.9	93.0	94.2
VIII Eastern Visayas	-	-	-	93.6	92.8	94.4	95.3	90.3	91.9	94.4
IX Western Mindanao	-	-	-	92.4	92.5	92.2	92.4	95.7	92.7	93.3
X Northern Mindanao	-	-	-	92.0	92.0	92.3	92.6	91.2	91.3	90.9
XI Southern Mindanao	-	-	-	94.3	93.0	93.2	94.1	90.7	92.6	90.2
XII Central Mindanao	-	-	-	96.3	94.9	94.7	96.5	95.5	94.6	94.9

Note: Data were based on the October round of the ISH, using past week as reference period.

Source of data: NCSO, Integrated Survey of Households

Table B.1.7

UNDEREMPLOYMENT RATE BY REGION, 1980-1986
(In Percent)

Region	1980	1981	1982	1983	1984	1985	1986
Philippines	34.5	36.3	34.2	35.9	35.7	33.7	36.0
National Capital Region	11.3	21.7	12.3	10.5	16.2	16.2	14.3
Region I Ilocos Region	36.1	34.6	34.2	40.7	35.6	32.0	35.2
II Cagayan Valley	33.0	35.5	34.3	37.3	26.3	28.6	34.9
III Central Luzon	27.1	19.7	25.1	27.1	24.8	24.2	26.5
IV Southern Tagalog	35.5	37.3	36.7	37.3	35.9	31.1	34.8
V Bicol Region	45.3	46.0	44.8	45.3	48.3	48.8	46.4
VI Western Visayas	34.7	36.3	38.3	42.0	39.5	38.2	42.2
VII Central Visayas	41.8	41.1	38.9	36.8	39.8	38.4	38.0
VIII Eastern Visayas	47.1	43.4	48.4	44.6	47.0	45.1	46.3
IX Western Mindanao	27.8	35.9	22.3	30.9	31.7	29.1	29.5
X Northern Mindanao	39.9	42.3	35.3	43.0	36.0	40.0	41.9
XI Southern Mindanao	38.6	42.5	39.1	35.3	39.9	32.4	41.1
XII Central Mindanao	49.5	51.4	47.2	51.5	47.5	47.5	51.9

Notes: 1. Underemployment rate is the ratio, in percent, of the number of employed persons working less than 40 hours a week over the total employed.
2. Data were based on the October round of the ISH, using past week as reference period.

Source of basic data: NCSO, Integrated Survey of Households

Table B.1.8

GROSS REGIONAL DOMESTIC PRODUCT (GRDP), 1985-1986
(In Million Pesos at Constant 1972 Prices)

Region	1985	Percent to Total	1986	Percent to Total	Growth Rate (%)
Philippines	89803	100.0	90770	100.0	1.08
National Capital Region	26618	29.6	26631	29.4	0.05
Region I Ilocos Region	3746	4.2	3809	4.2	1.68
II Cagayan Valley	2375	2.6	2273	2.5	(4.29)
III Central Luzon	7533	8.4	7598	8.4	0.86
IV Southern Tagalog	12289	13.7	12652	14.0	2.95
V Bicol Region	3459	3.9	3397	3.7	(1.79)
VI Western Visayas	6981	7.8	7024	7.7	(0.62)
VII Central Visayas	6280	7.0	6386	7.0	1.69
VIII Eastern Visayas	2419	2.7	2416	2.7	(0.12)
IX Western Visayas	3341	3.7	3381	3.7	1.20
X Northern Mindanao	4898	5.4	4824	5.3	(1.51)
XI Southern Mindanao	6159	6.9	6439	7.1	4.55
XII Central Mindanao	3705	4.1	3940	4.3	6.34

Source of basic data: NEDA, National Accounts Staff

Table B.1.10
DISTRIBUTION OF GROSS DOMESTIC PRODUCT
BY SECTOR

Year	Primary Industry (%)	Secondary Industry (%)	Tertiary Industry (%)
1970	31.5	25.0	43.6
1975	26.8	34.1	39.1
1980	25.6	36.2	38.2
1985	28.8	31.9	39.3
1986	26.8	28.4	35.7

Source of data: NEDA, 1985 Economic and Social Indicators

Table B.1.9

POVERTY THRESHOLD BY REGION AND URBAN-RURAL
1985 and 1986

Region	TOTAL			URBAN			RURAL		
	Poverty Threshold (Pesos)		Growth Rate (%)	Poverty Threshold (Pesos)		Growth Rate (%)	Poverty Threshold (Pesos)		Growth Rate (%)
	1985	1986		1985	1986		1985	1986	
Philippines	2382	2372	(0.4)	3021	3071	1.7	2066	2001	(3.1)
National Capital Region	3282	3450	5.1	3282	3450	5.1	-	-	-
Areas Outside NCR	2285	2244	(1.8)	2912	2904	(0.3)	2066	2001	(3.2)
Region I Ilocos Region	2374	2350	(1.0)	3093	3089	(0.1)	2139	2090	(2.3)
II Cagayan Valley	2194	2214	0.9	2897	3035	4.8	2092	2085	(0.3)
III Central Luzon	2550	2491	(2.3)	3153	3055	(3.1)	2102	2053	(2.4)
IV Southern Luzon	2471	2482	0.4	3048	3101	1.7	2174	2141	(1.5)
V Bicol Region	2148	2050	(4.6)	2625	2690	2.5	2047	1901	(7.1)
VI Western Visayas	2449	2383	(2.7)	3069	3025	(1.4)	2249	2165	(3.7)
VII Central Visayas	1982	1957	(1.3)	2426	2419	(0.3)	1819	1774	(2.4)
VIII Eastern Visayas	2016	1982	(1.7)	2733	2707	(1.0)	1822	1785	(2.1)
IX Western Mindanao	2118	1988	(6.1)	2650	2593	(2.1)	2025	1875	(7.4)
X Northern Mindanao	2262	2232	(1.3)	2952	2970	0.6	2022	1958	(3.2)
XI Southern Mindanao	2388	2350	(1.6)	2998	2972	(0.9)	2079	1998	(3.9)
XII Central Mindanao	2233	2208	(1.1)	2624	2572	(2.0)	2161	2142	(0.9)

Notes: 1. The total poverty threshold is the monthly income required to satisfy 100 percent of nutritional requirements and other needs of a family of six.
2. The total poverty threshold in 1986 was updated based on the current prices of the goods and services.

Source of data: Interagency Working Group on Poverty Determination (NEDA, NCSO and FNRI)

Appendix B.2 Regional Economy

Table B.2.1

AREA OF FARMS BY LAND USE, BY REGION AND BY PROVINCE
1980

Region/ Province	Total Farm Area (Ha.)	Arable Land (Ha.)	Land Under Permanent Crops (Ha.)	Land Under Permanent Meadows and Pas-tures (Ha.)	All other Lands (Ha.)
Philippines	9,034,354.01	4,487,678.82	3,313,053.96	610,124.18	623,476.35
Metropolitan Manila Area (National Capital Region)	71,186.94	38,463.51	21,186.65	6,539.09	4,997.69
Region 1	373,601.66	286,776.88	13,616.82	38,110.04	35,097.92
Abra	24,044.64	16,240.62	1,322.97	2,999.55	3,481.50
Benguet	42,634.39	25,566.14	1,594.57	7,901.18	7,572.50
Ilocos Norte	40,482.26	32,696.06	578.68	3,573.12	3,634.40
Ilocos Sur	43,419.97	33,873.91	791.02	4,515.12	4,239.92
La Union	41,086.73	28,320.63	2,675.20	6,874.02	3,216.88
Mt. Province	19,228.34	8,789.33	1,284.61	5,056.77	4,097.63
Pangasinan	162,705.33	141,290.19	5,369.77	7,190.28	8,855.09
Region 2	568,345.64	409,834.02	34,729.37	67,898.66	55,883.59
Batanes	4,543.80	1,741.76	162.87	2,189.35	449.82
Cagayan	147,524.57	119,720.67	6,411.44	8,114.23	13,278.23
Ifugao	33,497.77	13,730.41	2,404.52	11,807.77	5,555.07
Isabela	222,344.24	184,088.78	7,104.80	15,793.00	15,357.66
Kalinga-Apayao	78,612.71	35,207.52	11,584.89	15,639.39	16,180.91
Nueva Vizcaya	56,787.35	34,802.28	5,196.30	13,310.72	3,478.05
Quirino	25,035.20	20,542.60	1,864.55	1,044.20	1,583.85
Region 3	468,552.70	418,568.52	20,350.24	20,017.64	9,616.30
Bataan	20,697.84	12,787.19	5,812.85	1,581.20	516.60
Bulacan	66,692.30	59,258.82	2,890.59	3,315.97	1,226.92
Nueva Ecija	183,733.49	173,331.21	1,776.67	7,392.14	1,233.47
Pampanga	71,738.16	69,512.23	1,796.06	273.65	156.22
Tarlac	97,107.59	83,175.83	5,360.93	3,872.67	4,698.16
Zambales	28,583.32	20,503.24	2,713.14	3,582.01	1,784.93
Region 4	1,126,140.53	363,347.00	578,901.62	76,209.80	107,661.42
Batangas	127,284.14	45,884.13	72,826.36	4,208.61	4,365.04
Cavite	47,842.52	21,272.24	25,555.51	56.25	958.52
Laguna	67,350.06	25,341.34	39,712.23	1,098.84	1,197.65
Marinduque	33,797.53	7,728.57	21,860.29	2,468.46	1,740.21
Occidental Mindoro	93,959.99	48,812.87	6,004.27	32,604.27	6,537.88
Oriental Mindoro	128,464.28	57,773.46	60,738.40	8,002.22	1,950.20
Palawan	203,376.44	60,445.61	61,241.30	11,017.60	70,671.93
Quezon	320,012.29	61,324.09	232,599.19	10,120.17	15,948.85
Rizal	27,958.43	14,176.06	10,499.19	1,377.61	1,905.57
Romblon	48,510.26	7,637.13	35,761.69	2,896.98	2,214.46
Aurora	27,584.59	12,951.50	12,103.19	2,358.79	171.11
Region 5	945,534.19	282,983.19	542,112.09	75,721.13	44,717.78
Albay	145,099.01	46,712.95	89,865.67	2,975.52	5,544.87
Camarines Norte	106,468.74	14,556.47	84,200.68	2,982.10	4,729.49
Camarines Sur	260,889.62	100,387.37	140,533.34	14,761.01	5,207.90
Catanduanes	40,580.68	12,441.44	23,256.37	3,134.94	1,747.93
Masbate	259,200.97	84,974.32	101,555.54	49,298.83	23,372.28
Sorsogon	133,295.17	23,910.64	102,700.49	2,568.73	4,115.31
Region 6	745,856.90	513,388.70	130,347.72	49,203.29	52,917.19
Aklan	44,496.95	20,250.42	22,089.54	1,457.20	699.79
Antique	68,094.49	41,242.81	12,873.30	10,053.00	3,925.38
Capiz	86,885.17	55,171.93	18,090.00	8,025.45	5,597.79
Iloilo	246,238.14	175,610.18	36,094.80	18,748.16	15,785.00
Negros Occidental	300,142.15	221,113.36	41,200.08	10,919.48	26,909.23

Table B.2.1 (continued)

AREA OF FARMS BY LAND USE, BY REGION AND BY PROVINCE
1980 (continued)

Region/ Province	Total Farm Area (Ha.)	Arable Land (Ha.)	Land Under Permanent Crops (Ha.)	Land Under Permanent Meadows and Pastures (Ha.)	All other Lands (Ha.)
Region 7	529,711.54	296,825.60	159,559.61	31,229.09	42,097.24
Bohol	138,331.74	75,486.39	54,009.85	5,238.30	3,597.20
Cebu	163,328.21	94,147.38	55,930.12	5,936.44	7,314.27
Negros Oriental	220,484.17	122,911.88	48,396.45	19,857.01	29,318.83
Siquijor	7,567.42	4,279.95	1,223.19	197.34	1,866.94
Region 8	645,711.14	202,076.46	387,531.09	18,250.33	37,853.26
Eastern Samar	78,351.87	18,193.50	49,500.86	1,813.54	8,843.97
Leyte	274,034.73	110,928.89	139,780.58	9,877.08	13,448.18
Northern Samar	129,228.97	26,422.93	94,870.84	2,394.69	5,540.51
Samar (Western Samar)	99,645.42	35,846.61	51,785.49	2,173.68	9,839.64
Southern Leyte	64,450.15	10,684.53	51,593.32	1,991.34	180.96
Region 9	769,827.16	297,904.60	367,218.49	49,803.87	54,900.20
Basilan	66,299.20	4,657.15	55,694.95	3,482.35	2,464.75
Tawi-Tawi	38,548.65	7,536.26	22,675.10	2,117.45	6,219.84
Zamboanga del Norte	225,871.70	90,952.00	86,951.49	12,962.64	35,005.57
Zamboanga del Sur	340,270.54	183,303.06	126,312.10	21,723.90	8,931.48
Sulu	98,837.07	11,456.13	75,584.85	9,517.53	2,278.56
Region 10	892,326.83	422,369.52	328,590.47	64,132.04	77,234.80
Agusan del Norte	87,137.99	32,549.24	45,314.74	4,520.37	4,753.64
Agusan del Sur	126,135.45	72,169.08	16,951.62	932.70	36,082.05
Bukidnon	331,257.56	217,374.45	52,157.30	44,828.66	16,897.15
Camaguin	10,650.90	2,148.23	7,962.51	56.53	483.63
Misamis Occidental	86,239.36	17,075.52	61,043.97	3,487.46	4,632.41
Misamis Oriental	156,502.00	52,859.61	83,946.38	8,487.39	11,208.62
Surigao del Norte	94,403.57	28,193.39	61,213.95	1,818.93	3,177.30
Region 11	1,086,214.03	440,414.53	528,357.64	63,497.73	53,944.12
Davao del Norte	262,857.67	115,591.15	118,259.68	9,507.77	19,499.06
Davao Oriental	155,448.01	28,089.71	109,955.90	13,520.27	3,882.13
Davao del Sur	287,589.57	88,728.63	166,681.87	14,111.34	18,067.73
South Cotabato	248,761.01	162,886.34	60,005.73	22,330.25	3,538.69
Surigao del Sur	131,557.77	45,118.70	73,454.46	4,028.10	8,956.51
Region 12	811,344.75	514,726.29	200,552.15	49,511.47	46,554.84
Lanao del Norte	138,493.21	59,519.68	62,750.88	7,421.69	8,800.96
Lanao del Sur	145,914.88	91,295.81	37,152.77	4,396.11	13,070.19
Maguindanao	167,578.73	116,671.75	32,388.90	5,142.42	13,375.66
North Cotabato	244,293.58	164,691.48	50,744.90	19,416.72	9,440.48
Sultan Kudarat	115,064.35	82,547.57	17,514.70	13,134.53	1,867.55

Source: National Census and Statistics Office, 1980 Census of Agriculture.

Table 8.2.2 Existing National Irrigation System/Project in Region III

Name of System/Project	Province	Service Area (Ha)
Upper Pampanga River Integrated Irrigation System (UPRIIS)	Nueva Ecija	101,517
Angat-Magat River Irrigation System (AMRIS)	Bulacan	31,485
Tarlac-San Miguel-O'Donnell River Irrigation System (TASMORIS)	Tarlac	17,075
Camiling Riverv Irrigation System	Tarlac	8,100
Porac-Gumain River Irrigation System	Pampanga	4,405
Colo-Caulaman River Irrigation System	Pampanga	1,036
Nayom River Irrigation System	Zambales	1,148
Bucao River Irrigation System	Zambales	1,230
Sto Tomas River Irrigation System	Zambales	3,877
Total of 9 Systems		169,873
Balog Balog Multi-Purpose Project (BBMP)	Tarlac	39,150
Bayto River Irrigation Project	Zambales	1,600
Bagsit River Irrigation Project	Zambales	2,080
Total of 3 Projects		42,830

Source: NIA Region III Office

Table 8.2.3 Existing Communal Irrigation System/Project in Region III in 1980

Province	Communal Irrigation System Number	Communal Irrigation System Service Area	Communal Irrigation Project Number	Communal Irrigation Project Service Area
Bataan	74	6,329 Ha	4	1,393
Bulacan	34	3,740	13	1,084
Nueva Ecija	45	19,185	14	5,325
Pampanga	104	10,661	11	8,400
Tarlac	52	16,632	9	3,069
Zambales	75	8,774	23	6,057
Total of Region	384	65,321	74	25,328
Philippines	5,741	534,271	2,278	364,545

Source: NIA ,PDD Provincial Profile

Table 8.2.4 Existing Communal Irrigation System/Project by Service Area in Region III in 1980

Province	Total	Number of System: Below 50 Ha	51 - 100	101 - 200	201 - 500	501 - 1,000	Over 1,000Ha
Bataan	74	40	16	12	5	1	-
Bulacan	34	15	9	7	1	2	-
Nueva Ecija	45	3	8	7	14	10	3
Pampanga	104	16	15	38	33	2	-
Tarlac	52	4	8	15	18	5	2
Zambales	75	32	22	10	9	1	1
Total	384	110	78	89	80	21	6

Source: NIA, PDD Provincial Profile

Appendix B.3 Development Component

Table B-3-1 Project Component by Scheme

Development Component	Unit	Scheme-I	Scheme-II
1. Agricultural Infrastructure Development			
1) Canal Rehabilitation	Km	32.5	32.5
2) Intake Facility Rehabilitation	Unit	14	4
3) Diversion Dam Rehabilitation	Unit	12	12
4) Groundwater Collecting Conduit	Km	5	5
5) Unified Diversion Dam	Unit	-	1
6) Drainage	Km	4	4
7) Shallow Wells	Unit	271	271
2. Farm Road Development			
1) Barangay Road	Km	52.9	52.9
2) Farm-to-market Road	Km	57.9	57.9
3. Agricultural Development			
1) FTDFP	Lot	11	11
2) SMS	Lot	1	1
3) PPMS	Lot	5	5
4) PTDFP	Lot	5	5
5) Duck Raising	Lot	5	5
6) Fishery pond	Lot	5	5
4. Institutional Development			
1) Support Assistance for Strengthening IAs		LS	LS
2) Following Assistance for MFIA		LS	LS
3) Support Assistance for Strengthening FIAs		LS	LS
4) Support Assistance for Strengthening CFAs		LS	LS
5) Support Assistance for Strengthening ASS		LS	LS
6) Assistance for Seminar and Training Program		LS	LS

Table B-3-2 Project Cost by Scheme

Unit: 1,000 Pesos

Development Component	Scheme-I	Scheme-II
1. Agricultural Infrastructure Development	307,779	428,006
1) Canal Rehabilitation	119,247	119,247
2) Intake Facility Rehabilitation	13,881	2,152
3) Diversion Dam Rehabilitation	15,379	15,379
4) Groundwater Collecting Conduit	143,506	143,506
5) Unified Diversion Dam	-	131,956
6) Drainage	8,180	8,180
7) Shallow Wells	7,586	7,586
2. Farm Road Development	118,769	118,769
1) Barangay Road	94,366	94,366
2) Farm-to-market Road	24,403	24,403
3. Agricultural Development	96,100	96,100
1) FTDFP	1,400	1,400
2) SMS	2,200	2,200
3) PPMS	89,000	89,000
4) PTDFP	750	750
5) Duck Raising	2,350	2,350
6) Fishery Pond	400	400
4. Institutional Development	13,394	13,394
1) Support Assistance for Strengthening IAs	4,303	4,303
2) Following Assistance MFIA	3,882	3,882
3) Support Assistance for Strengthening FIAs	298	298
4) Support Assistance for Strengthening CFAs	298	298
5) Support Assistance for Strengthening ASS	2,636	2,636
6) Assistance for Seminar and Training Program	1,977	1,977
5. Total of 1 to 4	536,042	656,269
6. Administration & Engineering	107,209	131,254
7. Physical Contingency	96,488	118,128
Grand Total	739,739	905,651

APPENDIX C Meteorology and Hydrology

C. 1 Climate

C. 2 Rivers and Streams

C. 3 Water Resources

C. 4 Installation of Water Level Gauge Seation

C.1 Climate

There are four climate and rainfall stations located inside or near the project area (refer to Figure C-1-1). Collected meteorological data from these stations are shown as Table C-1-1.

C.1.1 General Condition

The climate of the Study area falls under the First Type of the Coronas' classification system (refer to Figure C-1-2). This type is characterized by two clearly distinct seasons, dry from November to April, wet from May to October.

C.1.2 Meteorological Conditions

The isohyetal map of annual rainfall in Tarlac presented with 2,000mm (refer to Figure C-1-3).

Annual rainfall at four rainfall stations (Cabanatuan,Hacienda Luisita,Clark Air Base,O'donnell RIS) are as follows (refer to Figure C-1-4,Table C-1-2,3,4,5):

Station	Annual Rainfall	Duration
Cabanatuan	1883mm	1949-1984 (36 Years)
Hacienda Luisita	1878mm	1968-1988 (21 Years)
Clark Air Base	1926mm	1946-1988 (42 Years)
O'Donnell RIS	1964mm	1948-1967 (19 Years)

Other climatic conditions are summarized as Table C-1-6.

C.2 Rivers and Streams

There are three stream gauging stations near the Study area. And collected records are shown as Figure C-2-1.

C.2.1 River Basins

River basins that cover the Study area are as follows:

- Bamban river 298 sq.km
  - Bamban river 263 sq.km
  - Balen creek 35 sq.km
- Lucong river 225 sq.km
- Tinang river 104 sq.km

C.2.2 Parua River Flow Analysis

The discharge records within Study Area are available at Parua(Bamban) River(148.0sq.km). However, according to these records, there are some problems as follows:

- The discharge records tend to increase year by year.
- Runoff percentage is very high.
- Influences of human works are found in the discharge pattern.

Therefore the discharge of Parua river should be estimated.

In this study, Tank Model Method has been adopted. The basic concept of the Tank Model Method is that the runoff and percolation from outlets of the tank shall be expressed in an exponential function (refer to Figure C-2-2).

- Several tanks with outlets on their side and bottom are arranged in series. And rainfall would pour into the first tank, and evapotranspiration would be deducted from the first tank and second tank.

- Some water in each tank would be discharged out from the side outlet of the tank, and the other would be transferred to the next tank through the bottom outlet(percolation outlet). In this way, the total amount of water to be discharged out from the side outlets would be estimated as the runoff from a basin area.

- When the rainfall of X mm pours into the first tank, the water depth would be X mm per unit area in that tank. When the stored water is X, the amount of a x X would be discharged as runoff and b x X as percolation per unit hour; in other words, (a+b)X is discharged and the remainder in the tank is {1-(a+b)}X.

- Consequently, the rate of remaining water is equivalent to {1-(a+b)}, and the ratio of runoff and percolation is b. By this model, the runoff would be expressed in the exponential function with the rate of {1-(a+B)}.

In order to determine each coefficient of the tank model, the rainfall records of O'donnell should be used. Because the rainfall records of Hacienda Luisita are available from 1968. After many times' trial-and-error, the decided configuration of the tank model is shown as Figure C-2-3.

Discharge of Parua was calculated by using this method and rainfall records of Hacienda Luisita for 21 years from 1968 to 1988(refer to Table C-2-11,12).

C.2.3 Runoff by River basin

The Study area is divided into two basin considering runoff form. One is the runoff of mountain and other is the runoff of flat ground.

Bamban river basin consists of mountain basin mostly. However, Lucong river basin is made of mountain and flat ground basin. Further Balen Creek basin , Tinang River basin and California River basin consist of the flat ground basin.

The runoff in Lucong river's mountain basin is estimated at about 70% of Bamban river's specific discharge by judging from observed discharge.

The discharge in the flat ground basin should be estimated on the basis of certain assumed conditions and discharge measurement. In this Study, the Tank Model method has been adopted to estimate the runoff discharge in the flat ground basins.

The form of the tank model is shown as Figure C-2-5.
By using this model, runoff discharge was represented from 1968 to 1988. Judging from these calculated discharge, the annual mean runoff depth in the flat ground basin is estimated at 2.1 mm/day.

C.3 Water Resources

C.3.1 Hydrological Probability and Design Year

The probability analysis on rainfall and discharge had been made by applying rainfall data available at Hacienda Luisita and calculated discharge at Parua for the period of 21 years.

For this analysis, Iwai's equation was adopted. This equation was treated as hydrological data by logarithmic normal distribution as follows:

$$\log (x + b) = \log (Xo + b) \frac{1}{a} \xi$$

where,

Xo; median of data

$$b = \frac{1}{m} \sum_{i=1}^{m} bs \qquad bs = \frac{X_e X_e - X^2 g}{2Xg - (Xe - Xs)}$$

m; integer close to $\frac{1}{n}$ n; number of data

$$\frac{1}{a} = \frac{\sqrt{2n}}{2 - 1} Sx \qquad Sx = \text{standard deviation}$$

ξ ; probability variation transformed into logarithm

The results of these analyses are as follows:

probability	1/2	1/5	1/10
Annual rainfall	1806.3	1485.3	1348.9
Annual drought days	295.6	305.3	310.5
Consecutive drought days	75.9	95.9	107.6
Annual discharge(cum/s/year)	1119.2	888.3	808.2
Drought discharge(cum/s)	1.2	0.8	0.6

Under considering these results, design year for water utilization scheme has been determined.

Design year ; Drought year, 1982
Equivalent to probability (w) = 1/5
Medium year ; 1971, (w) = 1/2
Wet year ; 1972, (w) = 1/1
Abnormal drought year ; 1983

C.3.2 Water Resources

Water balance study on the Study area should be computed to analyze the conditions of water resources utilization in 1982(design year).

Basic formula that stands for water balance in the area is as follows:

$$Fout = Fin + R + Rf - Wr$$

where Fout : outflow from area
Fin : inflow into area
R : precipitation
Rf : return flow from neighboring area
Wr : water requirement

This computation was executed by ten days

1) Condition of water balance study

a) Rainfall

The rainfall at Hacienda Luisita should be adopted as the representative rainfall in the Study Area. And effective rainfall was computed by daily.

b) Discharge at intake of each CIS

Discharge at the intake of each CIS should be estimated as

the total amount of discharge from mountain basin and flat ground basin.

c) Crop water requirement

Refer to Irrigation plan

d) Return flow

Return flow is defined as following formula.

$$Rf = Rfr \times (Wr - Et - Dp)$$

where Rf : return flow
Rfr : return flow rate
Wr : water requirement
Et : evapo-trnspiration
Dp : deep percolation

Return flow rate were estimated based on discharge measurement at the intake of each CIS (refer to Figure C-3-1).

2) Water Resources

Water balance study were examined on present condition and proposed one in 1982. And the study on proposed condition was performed under considering available discharge from Ground-water collecting conduit. Through this study, the available water resources of each river basin are estimated as following:

- Bamban river	(wet season)	62,766,000 cum
	(dry season)	39,265,000 cum
- Lucong river	(wet season)	139,208,000 cum
	(dry season)	37,095,000 cum
- Balen creek	(wet season)	16,058,000 cum
	(dry season)	1,628,000 cum
- Tinang river	(wet season)	31,663,000 cum
	(dry season)	3,211,000 cum

C.3.3 Water utilization scheme

The result of water balance study on each CIS were shown as Table C-3-2,3 and Figure C-3-2.

C.4 Installation of Water Level Gauge Station

C.4.1 Water Level Gauge Station

In order to understand the discharge conditions of Parua(Bamban) River and Cut-Cut(Lucong) River, 2 water level gauges were installed. In installing those instrument, suitable sites should be found under considering following condition:

- Being able to observe discharge through out the year.
- The point where gut is stable.
- Being easy of access to the sites for observing point.
- Being not immersed in flood.
- Being not disturbed by water intake.

1) Parua(Bamban) River

On the lower reaches from MacArthur High-Way of Bamban River, there are so many intakes. And it is difficult of access to the site. Therefore, the site should be selected within a limit from the confluence of Bamban River and Marimla River to the intake of Bamban CIS. After field reconnaissance, water level gauge should be installed on the left bank at 100m downstream from the confluence of those two rivers.

2)Cut-Cut (Lucong) River

There is fixed weir at Conception in Lucong River. On the lower reaches from this fixed weir, it is no use to observe discharge because of influence by water intake. And on the reaches from Highway bridge to fixed weir, it is difficult of access to the site. Furthermore, on this reaches, flow is disturbed by human works. Therefore water level gauge should be on the right bank near Highway bridge.

C.4.2 Rating Curve

The rating curves of 2 water level gauge stations were made by the results of analyzing observed discharges. In this study, least square method was adopted as analyzing method.

The rating curves(regression curves) at both site, Bamban site and Cut-Cut site, are as follows :

- Bamban site

Regression Curve	$y=20.175012(x+0.4)^{3.026387}$
Correl Coefficient	0.966

- Cut-Cut site

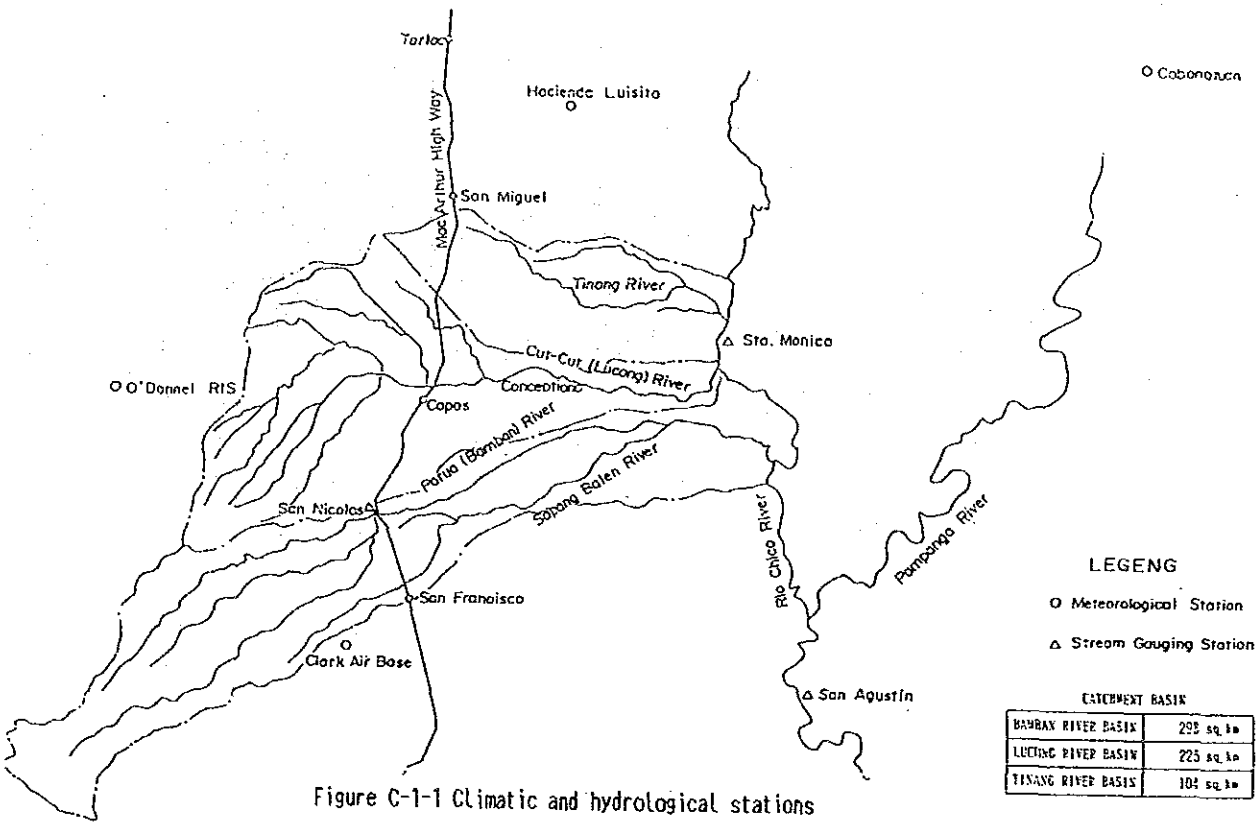


Figure C-1-1 Climatic and hydrological stations

Table C-1-1 Historic meteorological and streamflow records

	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
Daily Rainfall																																											
Hacienda Luisita																																											
Clark Air Base																																											
O Donnel RIS																																											
Cabanatuan																																											
Temperature																																											
Hacienda Luisita																																											
Clark Air Base																																											
Cabanatuan																																											
Relative Humidity																																											
Hacienda Luisita																																											
Clark Air Base																																											
Cabanatuan																																											
Wind Speed																																											
Hacienda Luisita																																											
Clark Air Base																																											
Cabanatuan																																											
Sunshine How																																											
Hacienda Luisita																																											
Evaporation																																											
Hacienda Luisita																																											
Daily Discharge																																											
Parua ,River																																											
Rio Chico River																																											
Pampanga River																																											

Monthly

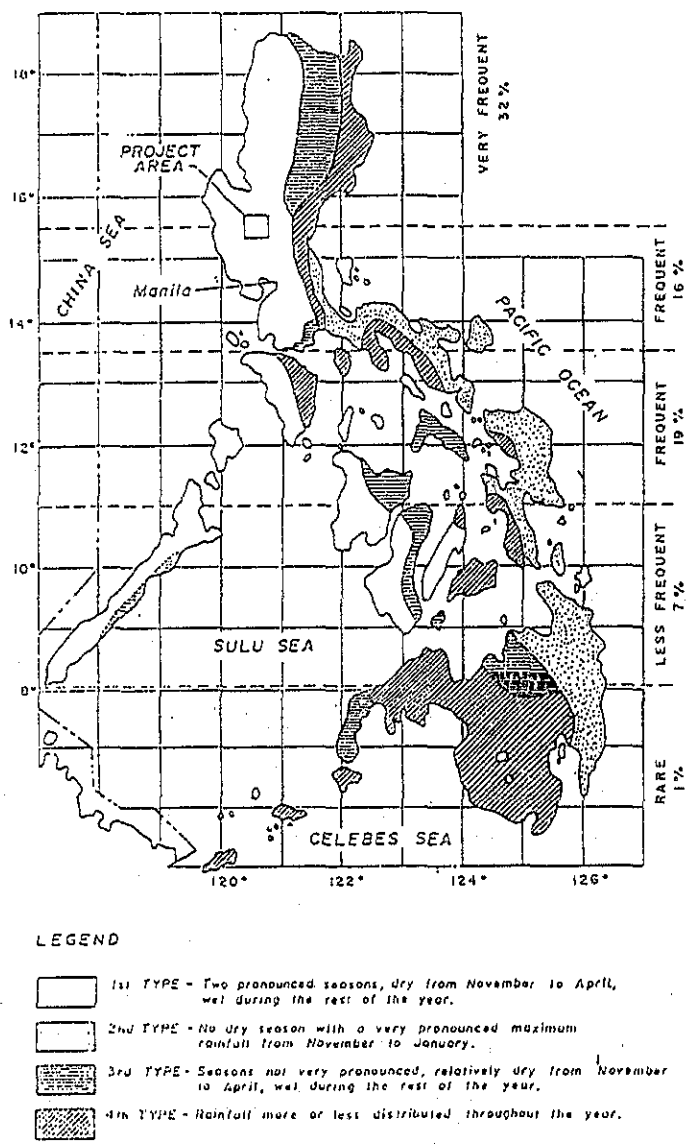


Figure C-1-2 Climate map of The Philippines

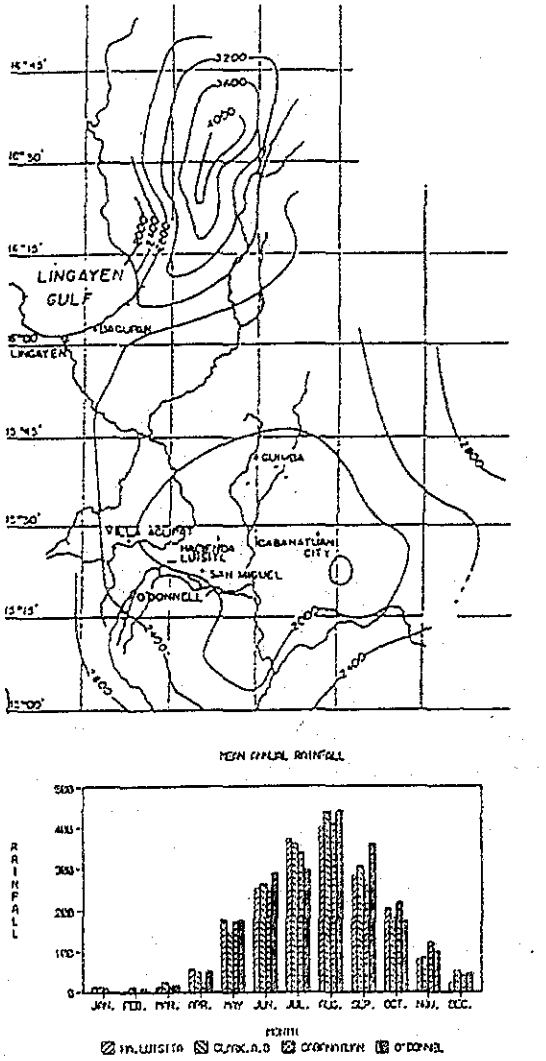
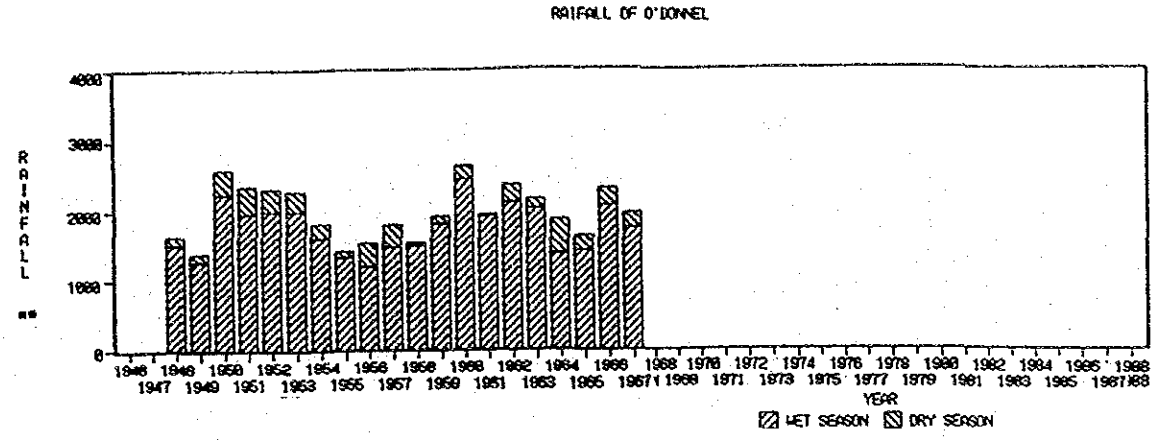
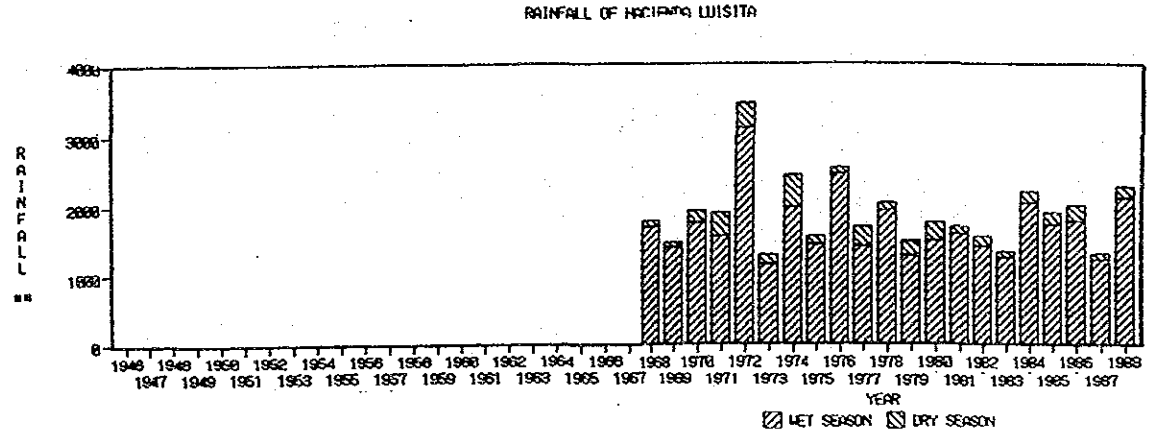
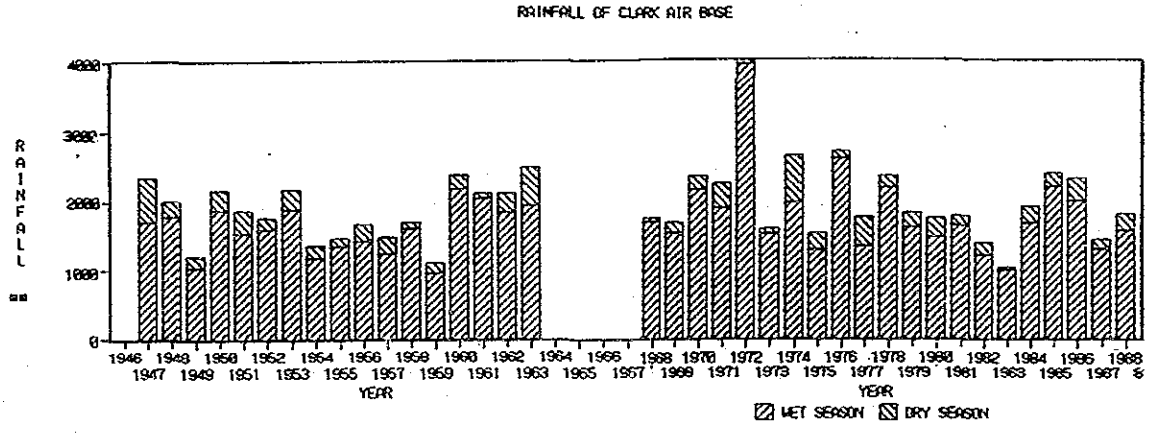


Figure C-1-3 Isohyetal map







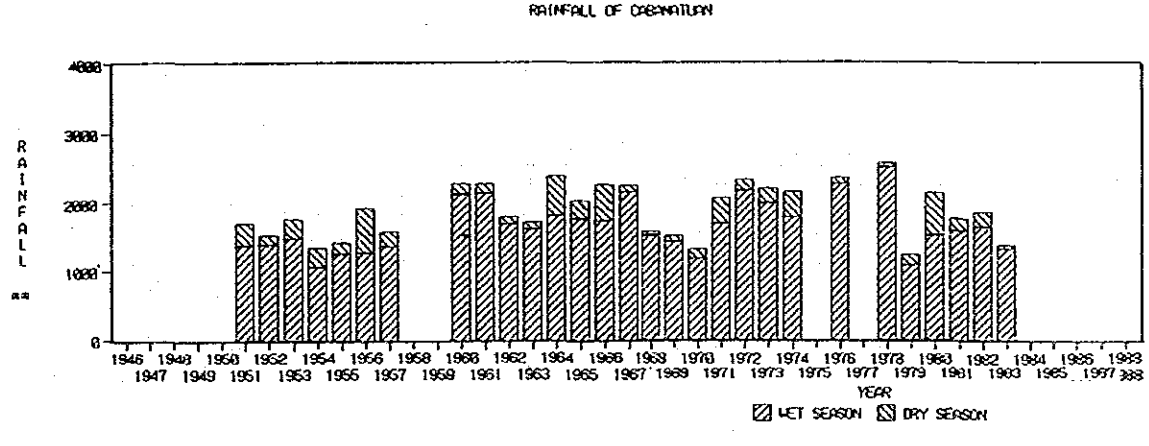


Figure C-1-4 Annual rainfall records at each station

Table C-1-2 Annual rainfall records of O'Donnell(1948-1967)

Unit:mm

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET SEASON	DRY SEASON	TOTAL
1948	8.8	0.0	0.0	0.0	0.0	0.0	0.0	772.6	568.5	172.5	52.3	86.7	1580.6	139.8	1345.5
1949	0.0	0.0	0.6	0.0	0.0	88.3	412.1	288.8	316.7	168.8	61.5	58.5	1278.7	120.8	1190.7
1950	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1951	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1952	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1953	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1954	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1955	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1956	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1957	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1958	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1959	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1960	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1961	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1962	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1963	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1964	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1965	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1966	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1967	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AVE.	2.1	19.8	15.9	62.1	178.8	287.5	285.7	443.2	359.3	172.8	101.3	49.1	1736.5	227.6	1984.2

Table C-1-3 Annual rainfall records of Hacienda Luisita(1968-1988)

Unit:mm

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET SEASON	DRY SEASON	TOTAL
1968	12.7	1.5	9.9	38.7	243.1	224.3	249.7	642.8	283.2	45.2	32.5	0.0	1690.3	87.4	1775.6
1969	0.0	0.0	8.5	2.3	214.4	188.1	321.6	385.0	250.9	108.9	51.3	19.8	1350.9	72.9	1484.8
1970	6.1	0.0	5.8	185.7	65.5	318.5	217.9	582.7	481.8	154.9	37.8	29.0	1712.4	184.4	1928.8
1971	2.3	8.3	10.6	28.2	255.5	267.2	241.5	88.1	365.5	335.9	100.1	106.4	1552.8	336.8	1889.7
1972	21.1	0.3	47.2	229.1	182.2	288.9	1589.8	723.4	321.3	15.7	44.7	18.3	2102.5	350.7	2453.2
1973	8.8	1.8	1.8	58.8	128.8	131.1	142.7	268.8	81.3	308.0	85.1	1.0	1143.7	148.6	1292.3
1974	18.4	7.1	3.8	196.3	87.0	294.4	276.1	716.3	258.8	323.1	198.4	46.7	1956.5	462.8	2419.2
1975	21.8	1.3	11.7	11.4	242.8	186.2	219.2	258.8	268.8	254.2	18.7	71.6	1411.4	128.5	1539.9
1976	22.8	8.7	1.8	55.4	184.8	728.1	148.8	274.8	482.7	13.2	1.3	4.3	2432.8	94.5	2526.5
1977	23.4	8.8	15.8	8.8	143.8	214.8	418.1	288.8	328.2	2.8	248.3	8.3	1397.7	278.7	1676.4
1978	2.8	1.8	8.8	28.8	121.2	174.2	385.1	617.2	314.2	388.8	31.5	48.6	1912.8	97.7	2010.5
1979	14.8	8.3	8.8	84.7	158.8	181.3	268.8	487.7	234.7	38.9	77.5	27.4	1373.4	213.9	1587.3
1980	8.8	8.8	18.8	2.3	132.3	25.9	444.8	258.2	428.8	178.8	238.8	13.2	1480.8	271.3	1751.3
1981	1.5	8.8	15.5	1.3	138.8	378.8	488.4	348.1	188.1	136.1	62.5	17.3	1515.5	98.1	1613.5
1982	8.8	8.8	82.7	48.5	58.8	224.8	413.2	244.8	368.5	87.8	36.6	4.6	1405.3	153.4	1558.7
1983	54.8	1.8	4.8	88.4	78.2	242.8	8.8	432.3	137.7	248.7	24.1	8.8	1238.1	89.3	1327.4
1984	20.5	2.8	35.1	85.8	258.8	345.4	238.5	584.2	244.6	433.6	5.6	8.2	2224.1	187.4	2191.5
1985	8.8	3.6	4.3	86.3	71.1	825.8	244.1	388.8	275.3	186.8	48.5	21.1	1712.1	174.8	1886.1
1986	22.1	25.8	27.7	2.8	136.4	288.7	488.3	368.6	388.7	253.5	135.6	25.4	1748.8	238.8	1988.8
1987	6.6	8.8	8.8	25.1	46.5	223.8	185.4	417.1	228.8	186.4	38.5	25.4	1288.8	55.8	1343.7
1988	8.4	11.3	8.8	53.6	248.2	185.3	148.5	283.8	188.3	483.2	82.4	8.8	2182.4	172.7	2275.1
AVE.	12.5	3.5	13.7	55.8	180.1	252.5	371.2	488.8	283.8	202.6	78.8	22.5	1691.8	187.1	1878.8

Table C-1-4 Annual rainfall records of Clark Air Base(1946-1988)

Unit:mm

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET SEASON	DRY SEASON	TOTAL
1946	9.2	4.8	1.8	5.1	6.7	339.5	223.8	287.8	338.1	184.5	-	5.9	1352.9	25.8	1377.8
1947	8.8	8.8	182.4	93.3	178.8	141.1	251.5	543.8	341.1	248.5	225.3	147.1	1784.2	648.1	2352.3
1948	12.2	13.8	8.8	88.8	115.8	88.1	512.4	636.9	374.6	142.8	27.4	78.8	1771.8	231.3	2003.1
1949	8.8	24.6	8.8	8.8	84.8	298.3	147.8	251.8	116.6	182.9	63.1	96.4	1829.2	184.1	1213.3
1950	9.9	5.3	57.2	46.8	98.6	184.8	397.4	541.8	316.2	339.5	43.7	131.9	1856.4	294.8	2150.4
1951	12.5	1.8	8.8	29.3	297.8	243.5	115.4	875.8	142.8	88.5	153.6	134.8	1548.2	331.6	1871.8
1952	1.7	8.4	14.2	44.4	176.2	228.8	136.8	524.8	348.1	178.1	2.8	88.5	1584.8	182.1	1756.1
1953	1.8	17.8	15.2	26.4	123.7	319.6	368.9	688.5	215.8	188.8	138.8	142.1	1876.4	295.1	2171.5
1954	8.8	21.6	25.8	5.4	78.2	91.8	178.3	438.1	278.3	111.8	131.8	6.1	1178.4	188.1	1359.5
1955	45.2	8.8	8.8	11.5	61.8	178.3	481.2	219.2	291.4	188.7	58.8	3.6	1335.8	117.2	1453.8
1956	7.7	78.4	8.8	38.1	178.8	68.8	281.8	342.5	488.1	158.8	84.3	38.5	1413.8	253.8	1666.8
1957	46.3	38.7	55.7	75.8	61.7	188.7	328.6	395.8	153.8	118.4	24.5	7.5	1246.3	248.5	1486.8
1958	18.8	21.6	26.8	19.3	24.2	344.8	418.6	278.1	454.1	184.4	8.5	3.5	1613.3	93.8	1787.1
1959	23.2	3.8	34.3	2.5	78.8	71.2	92.8	441.5	223.8	58.8	88.8	1.7	858.2	145.3	1183.5
1960	4.8	38.2	3.8	148.3	187.8	378.3	174.3	1888.3	295.8	188.4	11.2	1.3	2165.1	188.5	2384.6
1961	8.3	3.4	38.8	8.5	173.4	872.7	428.4	352.7	242.5	178.8	26.5	8.3	2038.5	67.8	2186.4
1962	72.8	5.3	15.4	88.5	63.1	185.5	821.7	335.8	618.8	38.2	85.8	8.8	1834.3	278.1	2112.4
1963	1.3	1.8	43.2	45.7	128.8	568.2	485.2	287.4	511.8	38.6	3.4	451.5	1948.1	548.1	2486.2
1964	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1965	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1967	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1968	11.5	8.8	8.8	27.3	151.2	92.6	348.3	788.8	243.6	58.1	24.3	8.8	1888.8	63.1	1743.8
1969	8.5	5.8	3.4	64.5	219.2	167.5	382.3	371.8	237.8	138.1	55.8	31.5	1517.7	161.5	1678.2
1970	8.8	8.8	5.8	66.6	88.1	338.8	372.1	388.8	852.6	285.1	84.1	38.4	2137.4	282.8	2348.3
1971	14.8	3.2	24.8	14.2	275.8	378.2	331.2	121.6	388.2	488.1	288.4	87.4	1895.2	348.8	2245.8
1972	33.6	8.4	63.7	54.4	188.1	328.4	2278.2	873.3	255.3	17.3	18.8	28.8	3938.8	284.8	4141.2
1973	2.3	1.1	3.8	5.3	84.6	188.8	311.8	344.1	175.2	428.2	75.5	7.8	1588.7	95.8	1682.5
1974	4.3	32.5	18.8	194.3	188.7	484.5	228.1	758.3	144.7	327.1	368.8	75.8	1985.4	683.7	2649.1
1975	34.4	8.4	5.1	33.5	144.3	152.5	183.7	458.8	183.4	283.8	48.7	188.2	1284.8	229.3	1514.2
1976	16.8	6.1	44.4	15.8	825.2	655.3	274.1	318.8	488.6	44.7	2.8	16.8	2684.8	88.6	2784.5
1977	7.1	8.8	3.8	57.7	188.5	138.8	358.6	318.5	382.2	18.3	362.2	8.8	1333.4	421.8	1765.2
1978	8.8	8.9	18.4	22.8	151.6	143.5	258.1	754.1	384.2	473.4	31.8	88.8	2175.8	171.2	2347.1
1979	2.5	8.3	8.8	22.6	284.2	88.8	248.4	732.8	274.1	58.7	148.3	29.2	1812.1	288.8	1813.8
1988	23.6	8.8	188.7	4.3	131.3	83.8	538.8	256.3	288.4	185.2	115.1	24.4	1484.5	277.1	1761.6
1981	1.8	8.3	8.8	36.1	141.8	481.3	338.3	272.8	288.5	183.5	58.8	41.4	1835.7	138.4	1774.1
1982	8.8	42.7	28.8	44.2	124.5	88.3	454.1	315.2	174.8	48.8	41.1	22.1	1288.8	188.1	1388.1
1983	22.1	1.8	8.5	3.6	48.5	38.5	342.1	348.2	134.4	83.5	13.8	8.8	883.1	48.8	1834.8
1984	1.5	8.5	188.7	128.4	148.6	338.3	277.8	425.7	151.4	231.6	13.5	8.5	1873.3	246.1	1919.4
1985	8.8	4.1	4.2	145.3	187.4	818.1	224.8	381.7	278.1	232.1	48.8	8.8	2188.2	288.5	2388.8
1986	21.3	23.8	1.8	8.4	155.8	228.2	457.4	451.8	438.5	278.1	215.1	46.5	1883.8	318.8	2311.8
1987	8.5	8.5	8.8	32.8	83.5	284.8	221.8	328.8	387.1	88.3	65.3	41.1	1385.8	148.2	1448.8
1988	12.7	81.8	2.3	78.5	188.2	288.5	282.1	148.8	188.7	448.2	82.8	1.5	1568.1	248.8	1885.8
AVE.	12.2	12.7	24.8	47.3	147.8	282.5	358.2	448.8	383.8	181.2	84.8	51.4	1688.2	238.8	1928.8

Table C-1-5 Annual rainfall records of Cabanatuan(1949-1988)

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET SEASON	DRY SEASON	TOTAL
1949	-	-	11.9	0.0	189.4	188.7	488.2	245.1	251.0	-	-	-	-	-	-
1950	1.5	0.0	77.1	92.9	-	124.8	417.9	203.9	439.5	329.6	-	119.4	-	-	-
1951	1.0	0.0	0.5	14.5	193.0	224.3	278.5	448.3	188.3	45.5	214.2	88.6	1375.9	319.6	1695.5
1952	3.1	3.5	11.5	11.0	221.1	255.7	142.6	248.0	388.2	-	42.5	65.9	1387.4	138.4	1525.8
1953	1.0	1.0	27.4	25.4	255.7	188.0	215.1	485.7	213.9	128.1	149.8	71.7	1477.9	278.3	1756.2
1954	1.5	17.0	5.3	88.4	39.7	94.1	225.9	289.3	262.0	152.3	162.1	9.3	1089.3	275.6	1328.9
1955	22.2	0.0	0.0	16.5	79.0	138.9	218.5	417.7	278.6	134.1	95.6	30.7	1259.0	165.9	1424.9
1956	5.1	0.0	2.5	281.4	66.3	84.2	162.3	355.7	585.0	113.8	289.7	90.0	1267.3	648.7	1916.0
1957	23.2	1.0	7.3	13.7	88.6	333.7	271.8	365.1	217.8	82.3	178.2	0.0	1359.3	221.4	1580.7
1958	0.0	10.0	0.0	0.0	55.6	319.2	288.9	264.2	368.9	-	-	-	-	-	-
1959	-	-	32.8	0.0	42.1	94.6	179.0	558.0	214.7	-	138.7	6.9	-	-	-
1960	2.6	49.5	18.2	55.6	169.5	245.0	231.7	622.7	452.7	482.4	39.9	3.3	2115.0	161.1	2276.1
1961	0.0	1.3	56.0	2.0	150.9	599.0	468.0	492.3	287.5	158.5	82.4	1.0	2126.1	142.7	2268.8
1962	4.6	0.0	2.8	37.2	133.2	388.4	468.4	288.0	453.8	35.6	57.6	0.3	1679.4	102.5	1781.9
1963	0.0	27.4	1.3	0.0	145.0	522.3	217.3	389.3	328.3	11.4	14.8	63.1	1605.6	186.1	1711.7
1964	9.3	1.4	69.8	7.2	124.2	488.0	223.7	432.5	288.8	338.0	287.5	197.1	1799.0	572.9	2372.1
1965	0.0	0.0	0.0	135.8	182.9	364.4	888.1	282.9	244.9	128.4	118.1	19.4	1752.8	271.7	2024.7
1966	1.0	0.0	7.0	24.4	566.0	118.1	223.5	492.0	226.8	114.1	445.2	54.8	1729.3	533.9	2263.2
1967	2.0	0.0	0.0	14.1	282.3	384.8	282.1	488.2	629.7	255.8	86.7	0.0	2133.9	104.2	2238.1
1968	5.0	0.0	0.6	22.1	144.1	88.4	242.0	567.8	338.5	125.2	51.3	0.0	1597.2	79.2	1585.4
1969	6.5	0.0	0.0	0.0	87.2	283.0	369.7	242.4	314.8	128.2	57.5	13.0	1416.3	83.8	1500.1
1970	1.5	1.3	4.0	13.7	18.6	234.6	169.0	361.9	179.3	222.6	76.5	34.5	1184.0	132.4	1316.4
1971	1.3	2.3	11.5	0.0	279.7	237.2	354.5	213.0	239.4	360.1	161.9	188.7	1682.9	354.5	2048.4
1972	67.2	0.0	31.5	12.9	198.2	144.4	1004.7	434.0	385.4	17.5	38.7	18.4	2157.1	168.8	2325.9
1973	5.6	3.3	0.3	1.9	126.4	249.5	248.3	818.3	146.9	681.3	191.9	9.0	1980.7	212.0	2192.7
1974	0.0	0.0	1.0	73.2	14.5	323.6	250.3	629.3	144.6	399.0	226.6	72.3	1769.1	373.1	2142.2
1975	16.1	0.3	16.0	7.7	121.4	-	285.9	253.6	256.7	255.5	35.0	139.4	-	-	-
1976	2.4	0.0	11.2	0.0	931.1	469.6	141.9	338.6	350.3	28.5	32.6	44.8	2259.0	91.8	2350.8
1977	6.4	0.0	0.0	0.0	189.6	178.7	389.0	367.3	285.9	-	198.9	-	-	-	-
1978	0.0	5.4	0.0	0.5	99.7	291.2	433.4	606.9	563.8	513.5	34.9	16.2	2497.5	57.8	2555.3
1979	0.6	1.1	0.0	0.0	194.4	134.2	224.8	382.4	148.9	87.4	127.8	12.5	1884.1	180.1	1244.2
1980	1.2	0.6	114.7	0.0	218.2	178.2	388.1	182.1	412.7	125.2	478.2	27.4	1498.5	622.1	2120.6
1981	0.0	0.0	0.0	42.7	123.6	511.5	383.7	312.4	282.2	127.4	136.7	1.3	1588.8	148.7	1761.5
1982	0.0	1.6	12.6	44.1	36.0	172.6	634.5	467.3	279.1	51.3	78.3	69.9	1641.6	206.5	1848.1
1983	1.8	0.0	1.0	2.5	67.5	147.1	152.7	427.3	328.2	189.3	52.3	0.0	1312.1	57.4	1369.5
1984	45.2	0.0	29.0	128.7	281.9	378.0	187.9	672.2	119.3	275.1	-	0.0	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVE.	10.0	0.9	14.3	21.6	173.0	258.9	337.6	418.9	278.9	219.2	123.1	40.3	1683.7	199.2	1883.2

Table C-1-6 Summary of climatic conditions

CLIMATIC ELEMENT	Duration	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
MEAN TEMPERATURE (C)														
1. Cabanatuan City	(1949-88)	25.3	26.4	27.4	29.2	29.5	28.5	28.0	27.4	27.7	27.7	27.0	26.3	27.6
2. San miguel,Tarlac	(1968-85)	25.1	25.6	26.9	28.5	28.9	28.2	27.5	27.2	27.5	27.1	26.6	25.7	27.1
3. Angeles (Clark)	(1945-83)	25.6	26.1	27.2	28.9	27.8	27.2	26.7	27.2	27.2	26.7	26.1	27.2	27.2
MEAN MAXIMUM TEMPERATURE (C)														
1. San Miguel,Tarlac	(1962-85)	31.5	32.4	34.1	35.4	35.1	33.5	32.5	31.4	32.4	32.4	32.3	31.5	32.9
2. Angeles (Clark)	(1945-83)	29.5	31.1	32.2	33.8	33.3	31.7	30.6	30.8	30.6	30.6	30.0	29.5	31.1
MEAN MINIMUM TEMPERATURE (C)														
1. SAN Miguel,Tarlac	(1958-85)	18.8	19.8	19.8	21.9	22.9	23.0	22.8	22.8	22.3	21.8	20.7	19.8	21.3
2. Angeles (Clark)	(1945-83)	21.1	21.1	22.2	23.0	24.4	23.9	23.3	23.3	23.3	23.3	22.8	21.7	22.8
MEAN RELATIVE HUMIDITY (%)														
1. Cabanatuan City	(1949-88)	74.2	68.6	65.4	64.0	71.4	80.2	83.3	86.3	84.5	84.5	78.4	74.9	76.3
2. San Miguel,Tarlac	(1968-85)	78.9	75.2	76.8	71.8	73.2	79.2	88.2	90.5	86.7	83.8	80.6	78.5	80.6
3. Angeles (Clark)	(1945-83)	74.8	73.0	70.8	70.8	75.0	78.8	82.0	85.8	81.8	77.8	75.0	75.8	76.8
MEAN WIND SPEED (km./hr.)														
1. Cabanatuan City	(1962-88)	6.9	7.6	6.5	5.4	5.8	4.3	5.0	4.5	4.2	4.6	6.7	7.7	5.7
2. San Miguel, Tarlac	(1974-85)	9.3	9.1	8.7	8.2	7.6	7.6	4.6	6.5	6.1	7.8	9.5	11.1	8.1
3. Angeles (Clark)	(1945-83)	8.3	9.3	9.3	7.4	7.4	7.4	7.4	7.4	5.6	7.4	9.3	9.3	7.4
MEAN SUNSHINE HOUR (hrs./da)														
1. San Miguel,Tarlac	(1968-85)	7.1	8.5	7.9	9.3	8.2	5.8	5.5	4.3	4.8	6.8	6.8	6.9	6.8
MEAN EVAPORATION (mm./mo.)														
1. San Miguel,Tarlac	(1968-85)	144.8	181.2	289.4	211.4	188.1	181.2	186.2	182.9	132.6	118.8	127.3	135.5	1730.8

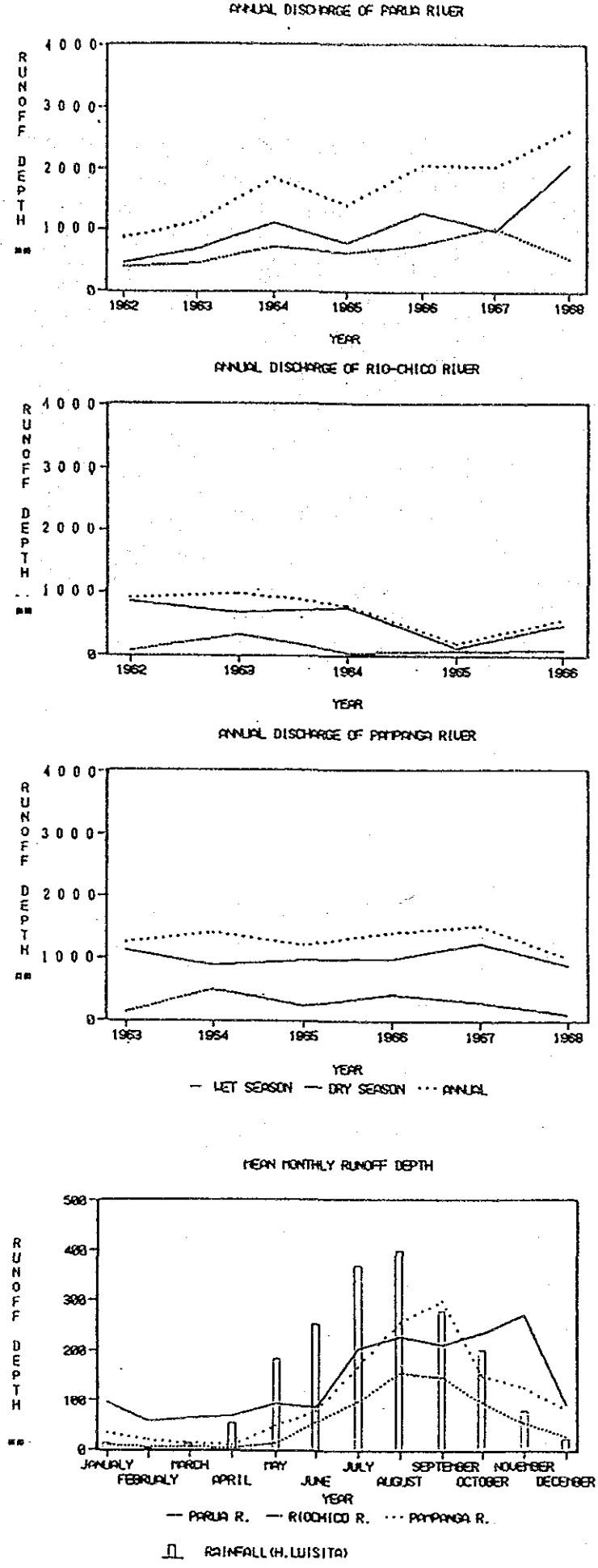


Figure C-2-1 Annual discharge records at each stream gauging station

Table C-2-1 Mean monthly discharge records of Parua river(1962-1968)

AREA:14850.KMS UNIT:CUM/S

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	AVR(WET)	AVR(DRY)	ANNUAL
1962	1.911	1.740	1.992	2.950	2.021	1.749	5.451	3.549	9.147	4.753	9.979	4.781	4.273	3.692	3.665
1963	3.338	2.811	1.701	1.736	2.131	7.144	5.302	5.840	7.484	8.834	10.648	5.124	6.159	4.291	5.178
1964	4.991	3.065	2.921	2.801	2.121	5.248	2.789	10.469	11.830	27.477	21.710	5.846	10.226	6.021	9.321
1965	15.131	8.876	2.681	5.900	10.458	7.128	5.413	5.288	8.519	7.853	1.803	1.767	7.326	5.843	6.585
1966	2.111	2.491	3.380	2.515	8.433	2.320	8.095	18.479	21.700	12.747	23.712	4.502	11.979	7.272	9.625
1967	5.284	4.154	4.459	4.471	4.520	9.222	4.004	5.939	6.450	22.374	22.775	7.387	9.845	9.752	9.490
1968	4.315	3.231	7.347	8.560	4.005	3.759	42.491	35.005	29.727	7.842	4.104	5.292	19.005	5.140	12.117
AVE.	5.226	3.441	3.814	3.951	5.107	4.704	11.169	12.364	12.838	12.407	15.526	4.989	9.731	6.184	7.918

Table C-2-2 Monthly discharge records of Parua river(1962-1968)

AREA:14850.KMS UNIT:CUM/S

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET TOTAL	DRY TOTAL	ANNUAL
1962	50.230	40.030	50.460	95.510	62.450	52.400	168.890	110.820	244.490	147.340	262.100	140.292	785.850	669.650	1455.500
1963	102.600	76.070	52.740	52.600	66.050	214.320	164.350	210.820	230.640	273.840	318.880	158.920	1169.140	769.910	1939.050
1964	130.320	87.150	90.550	87.030	97.070	157.470	117.760	320.740	330.910	851.400	651.543	194.320	1885.759	1239.910	3125.668
1965	480.850	192.340	111.100	177.010	324.150	213.780	147.810	147.839	255.550	213.830	54.085	54.785	1346.850	1058.550	2405.502
1966	65.450	67.220	105.160	75.440	267.020	49.410	216.060	603.840	650.810	385.140	801.360	139.580	2284.410	1214.150	3518.230
1967	163.090	118.310	130.240	134.120	140.110	106.460	275.400	184.110	183.490	692.580	703.250	220.339	1673.350	1764.190	3437.452
1968	133.780	92.420	227.740	190.000	140.070	112.790	1316.920	1180.250	422.100	210.330	123.120	141.040	3525.350	938.900	4461.250
AVE.	162.818	97.224	112.824	115.510	159.069	143.049	346.869	368.844	331.151	389.814	465.173	154.826	1798.479	1106.596	2905.231

Table C-2-3 Monthly runoff depth of Parua river(1962-1968)

AREA:14850.KMS UNIT:mm

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET TOTAL	DRY TOTAL	ANNUAL
1962	26.570	20.665	24.256	49.910	30.574	30.025	98.048	64.220	142.077	86.015	157.886	86.517	450.760	390.931	849.497
1963	60.422	43.025	30.709	28.754	30.660	125.117	95.045	128.308	134.644	159.875	185.643	92.775	692.525	444.207	1128.732
1964	81.333	50.077	52.002	50.007	56.600	91.920	60.740	182.081	183.180	497.247	380.359	107.093	1100.870	723.920	1424.710
1965	273.424	112.402	64.050	103.316	188.234	124.001	87.085	87.599	149.180	127.023	31.574	31.971	786.328	617.964	1404.202
1966	38.209	39.242	61.350	44.052	156.232	40.037	126.509	352.512	380.037	230.440	502.440	81.473	1286.760	767.179	2053.888
1967	95.024	67.000	80.702	78.297	81.784	100.040	160.774	107.400	112.055	404.001	574.003	133.325	976.975	1029.953	2490.728
1968	78.087	54.032	122.002	114.400	86.966	65.030	760.797	645.011	282.172	127.450	71.875	25.764	2050.042	549.115	2496.152
AVE.	84.102	56.764	65.300	67.430	92.290	82.910	202.490	227.001	218.036	232.485	271.814	89.910	1050.816	646.017	1698.029

Table C-2-4 Flow regime of Parua river(1962-1968)

AREA:14850.KMS UNIT:CUM/S

YEAR	WET SEASON				DRY SEASON				ANNUAL							
	QMAX	QMEAN	QMIN	TOTAL	QMAX	QMEAN	QMIN	TOTAL	QMAX	Q95	Q185	Q275	Q355	QMIN	QMEAN	TOTAL
1962	63.850	4.271	1.470	785.850	12.080	3.700	1.400	669.650	69.856	4.480	2.350	1.850	1.530	1.470	3.940	1455.500
1963	70.200	6.354	1.770	1169.140	18.500	4.204	1.510	769.910	70.200	8.120	3.520	2.270	1.630	1.510	5.286	1939.050
1964	53.450	10.249	2.030	1885.750	31.080	6.813	2.070	1239.910	63.450	9.080	3.490	3.010	2.000	2.870	8.540	3125.660
1965	25.250	7.320	1.710	1346.950	17.400	5.040	1.500	1058.550	25.250	9.000	4.480	2.460	1.835	5.590	1.504	2405.500
1966	70.650	11.970	1.650	2284.840	146.100	7.260	1.090	1314.150	146.100	11.100	3.520	2.270	1.830	1.650	9.832	3518.230
1967	68.450	9.094	1.710	1673.350	122.850	9.740	2.030	1764.190	122.850	8.140	4.400	4.160	1.530	1.710	3.410	3437.450
1968	146.100	19.160	1.090	3525.350	11.100	5.150	2.000	938.900	146.100	11.100	5.640	4.160	3.033	1.490	12.197	4464.250
AVE.	71.621	9.775	1.878	1798.439	51.393	6.104	2.167	1106.596	92.971	8.289	3.970	2.941	2.034	2.527	7.224	2905.231

NOTE: QMAX : MAXIMUM DISCHARGE
Q95 : 95DAY WATER DISCHARGE
Q185 : ORDINARY WATER DISCHARGE
Q275 : LOW WATER DISCHARGE
Q355 : DROUGHTY DISCHARGE
QMIN : MINIMUM DISCHARGE
QMEAN : MEAN DISCHARGE

Table C-2-5 Mean monthly discharge records of Rio-Chico river(1962-1968)

AREA:2890SQ.KMS UNIT:CUM/S

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	AVR(WET)	AVR(DRY)	ANNUAL
1962	-	-	-	-	-	-	83.840	149.590	157.590	69.880	20.790	7.740	-	-	-
1963	7.140	8.080	2.730	2.280	2.690	130.110	158.080	157.680	173.870	47.830	11.960	23.690	84.289	12.915	60.498
1964	19.990	16.020	11.020	0.030	0.020	24.640	66.110	162.880	101.400	150.520	117.530	82.820	66.578	59.090	64.082
1965	12.790	5.840	3.110	1.120	4.590	72.210	169.450	118.280	130.410	93.440	11.750	1.800	74.069	8.045	52.060
1966	1.640	1.690	6.280	7.230	35.630	6.380	9.040	2.980	20.690	4.410	30.740	12.450	11.531	11.600	11.557
1967	0.004	0.080	0.080	0.000	0.010	25.650	30.970	133.530	116.840	72.480	60.180	2.200	48.414	17.596	38.141
1968	2.430	0.170	-	0.050	3.860	0.380	17.730	122.670	-	-	-	-	-	-	-
AVE.	7.332	5.418	4.024	2.772	9.493	44.565	76.321	121.877	117.970	72.047	43.485	21.782	56.976	21.851	45.267

Table C-2-6 Monthly discharge records of Rio-Chico river(1962-1968)

AREA:2890SQ.KMS UNIT:CUM/S

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET TOTAL	DRY TOTAL	TOTAL
1962	-	-	-	-	-	-	2574.100	4637.200	4726.040	2141.360	622.420	239.940	-	-	-
1963	221.280	248.720	84.580	65.080	83.400	3003.420	4090.100	4000.160	5192.240	1402.760	350.920	734.280	20599.600	1713.640	22161.720
1964	619.840	464.880	341.490	181.900	304.460	745.180	2049.300	5049.300	3041.960	4660.190	3525.000	2567.590	16379.930	7780.390	23556.940
1965	396.400	163.680	96.380	33.520	139.560	2160.260	5253.320	3667.010	3912.270	2000.520	352.570	55.800	19104.840	1898.270	19133.210
1966	50.800	44.880	194.280	217.000	1101.330	191.450	29.020	89.760	856.300	136.750	922.200	385.850	2017.500	1814.650	4221.150
1967	0.120	0.000	0.000	0.000	0.560	766.510	1209.850	4139.350	3505.700	2244.250	2045.500	60.350	11063.940	2113.970	13977.910
1968	75.450	4.800	0.000	1.500	110.800	249.100	549.620	3082.650	-	-	-	-	-	-	-
AVE.	227.315	154.433	119.437	83.163	291.522	1336.887	2365.953	3753.369	3539.118	2281.385	1304.560	675.288	13984.782	2880.224	16610.186

Table C-2-7 Monthly runoff depth of Rio-Chico river(1962-1968)

AREA:2890SQ.KMS UNIT:mm

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET TOTAL	DRY TOTAL	TOTAL
1962	-	-	-	-	-	-	106.410	191.704	195.332	88.623	25.731	9.919	-	-	-
1963	9.148	10.202	3.496	2.727	3.440	161.360	202.400	202.875	214.646	61.207	14.830	30.352	851.540	78.841	922.382
1964	25.624	19.218	14.117	7.482	12.580	30.886	84.721	208.749	126.754	192.899	145.750	106.143	677.104	318.332	995.436
1965	16.387	6.763	3.984	1.386	5.760	89.553	217.171	161.593	161.732	119.741	14.576	2.307	759.929	45.402	796.331
1966	2.100	1.852	8.020	0.971	45.529	7.914	1.200	3.710	35.469	5.853	30.123	15.951	116.475	76.025	191.500
1967	0.005	0.000	0.000	0.000	0.024	31.807	49.940	171.120	144.904	82.777	84.660	2.826	490.452	87.391	577.843
1968	3.119	0.198	0.000	0.062	4.952	10.200	22.721	157.200	-	-	-	-	-	-	-
AVE.	9.397	6.394	4.937	3.438	12.051	55.271	97.000	155.163	148.300	93.402	53.838	27.916	577.388	119.398	696.698

Table C-2-8 Mean monthly discharge records of Pampanga river(1963-1968)

AREA:5487.50 KM$ UNIT:CUM/S

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	AVR(WET)	AVR(DRY)	ANNUAL
1963	50.940	56.960	29.590	29.630	17.000	387.280	819.990	687.920	911.990	185.210	54.710	102.920	344.926	51.975	251.779
1964	56.550	45.590	24.750	22.250	33.380	89.895	291.420	695.480	461.870	588.650	812.340	470.940	272.208	208.587	281.915
1965	132.480	84.580	39.310	27.330	98.370	199.290	915.230	416.570	552.890	294.830	223.610	86.820	298.991	98.922	242.635
1966	58.050	43.940	24.410	11.140	553.870	252.190	275.130	443.590	750.690	188.180	589.350	371.410	303.128	164.367	283.306
1967	138.520	55.190	28.110	17.880	13.660	228.930	279.770	978.190	887.920	589.460	427.590	62.860	377.893	121.895	388.719
1968	42.940	29.830	35.080	32.170	37.990	57.380	162.610	599.160	888.890	388.180	45.030	97.830	278.183	44.958	282.413
AVE.	79.362	51.998	31.828	21.787	118.882	195.131	487.393	621.885	745.523	359.658	312.385	197.733	312.325	115.849	261.841

Table C-2-9 Monthly discharge records of Pampanga river(1963-1968)

AREA:5487.50 KM$ UNIT:CUM/S

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET TOTAL	DRY TOTAL	TOTAL
1963	1579.300	1569.880	900.290	619.880	529.580	11816.880	19219.980	18845.480	27409.580	5741.480	1641.480	3126.380	84266.980	9422.880	92183.780
1964	1753.880	1325.980	1977.380	667.490	1034.280	2889.280	9834.180	21278.580	13858.980	18848.380	18482.380	14847.180	86957.380	18878.180	103282.480
1965	4106.980	2368.380	1218.880	818.880	1228.680	5949.680	25272.280	12913.880	16618.480	9139.780	6711.380	2666.650	73150.880	17894.850	89006.150
1966	1576.250	1205.280	756.880	334.180	17356.880	7563.150	8529.180	13751.580	22529.750	2351.250	15283.680	11513.780	74162.450	18586.450	103658.280
1967	4232.280	1545.250	871.380	512.580	424.180	6948.850	8672.880	30323.880	26637.980	18273.450	12822.850	1924.550	82583.980	21913.650	113113.750
1968	1324.150	778.150	1109.750	805.180	1177.880	1718.880	5047.880	18542.880	27286.850	12279.080	1351.850	2698.850	68047.480	9238.250	74282.880
AVE.	2428.380	1465.283	906.875	652.883	3622.789	5853.983	12629.193	19276.880	22374.587	11130.850	9355.917	6129.392	76527.942	21019.558	95987.833

Table C-2-10 Monthly runoff depth of Pampanga river(1963-1968)

AREA:5487.50 KM$ UNIT:mm

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	WET TOTAL	DRY TOTAL	TOTAL
1963	21.935	20.988	11.893	8.244	7.852	146.722	255.989	251.881	385.966	76.469	21.862	41.039	1122.346	125.491	1247.837
1964	23.348	17.648	14.349	8.869	13.774	26.768	128.325	283.497	184.547	239.745	245.873	197.748	991.797	587.054	1388.859
1965	54.788	31.543	16.234	10.919	16.257	79.228	338.599	171.988	221.313	121.731	89.427	35.517	974.291	238.341	1212.621
1966	28.994	16.852	10.077	4.459	231.164	100.733	113.598	183.155	299.953	44.635	232.456	153.358	987.766	407.379	1395.145
1967	56.369	20.581	11.695	6.828	5.649	91.475	115.513	403.881	354.789	243.382	170.853	25.633	1233.128	291.867	1524.987
1968	17.690	10.364	14.781	12.954	15.687	22.894	67.221	246.973	362.367	163.543	17.995	35.935	906.328	109.618	1015.938
AVE.	32.356	19.515	13.141	8.697	48.264	77.969	168.207	256.736	298.989	148.251	121.611	81.637	1019.271	279.958	1299.230

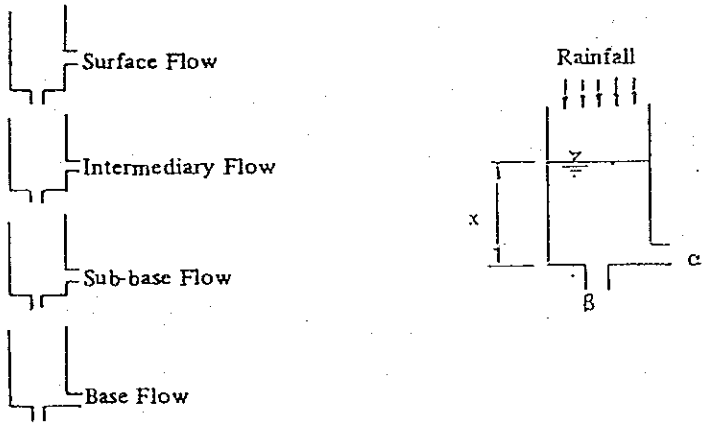
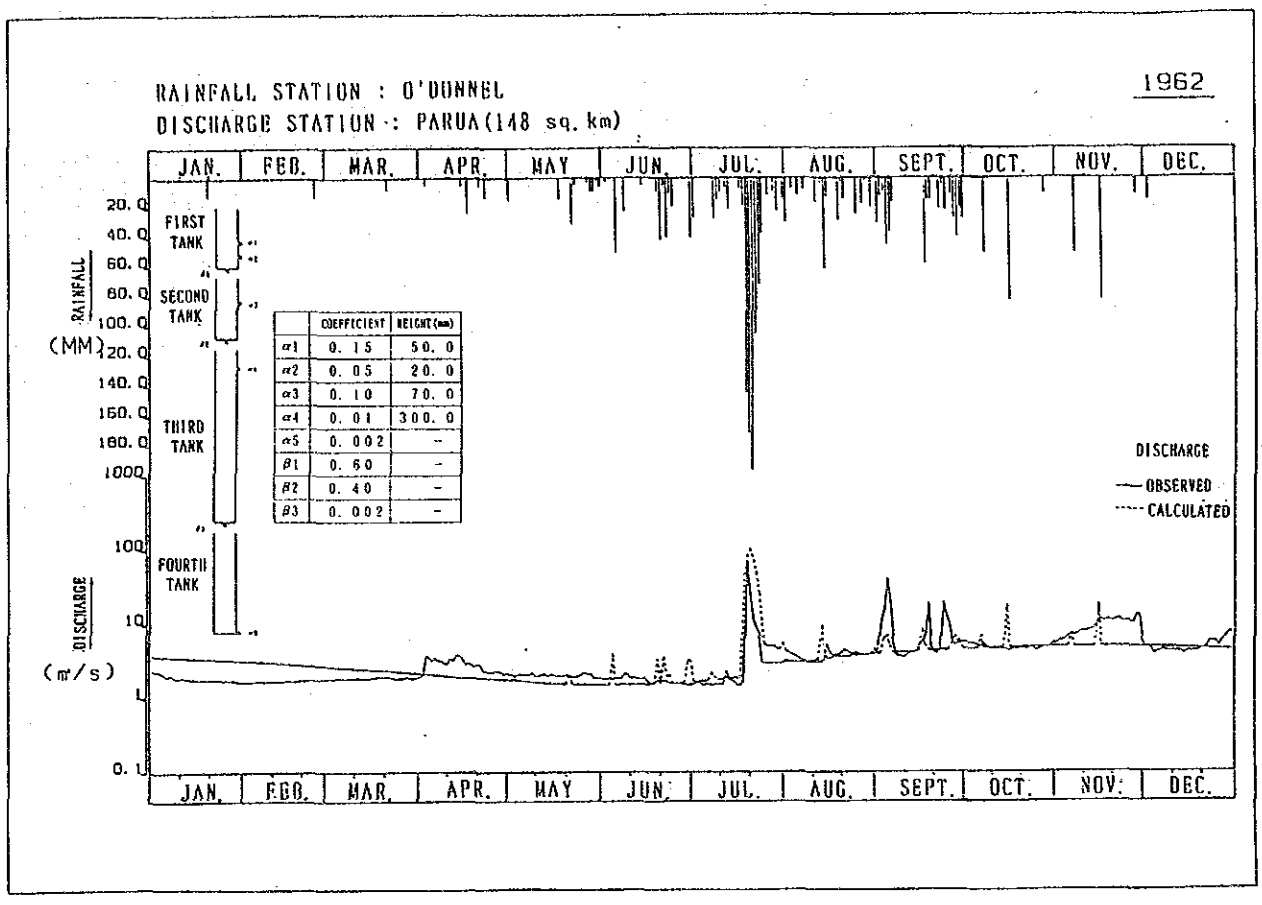


Figure C-2-2 Concept of the Tank Model Method



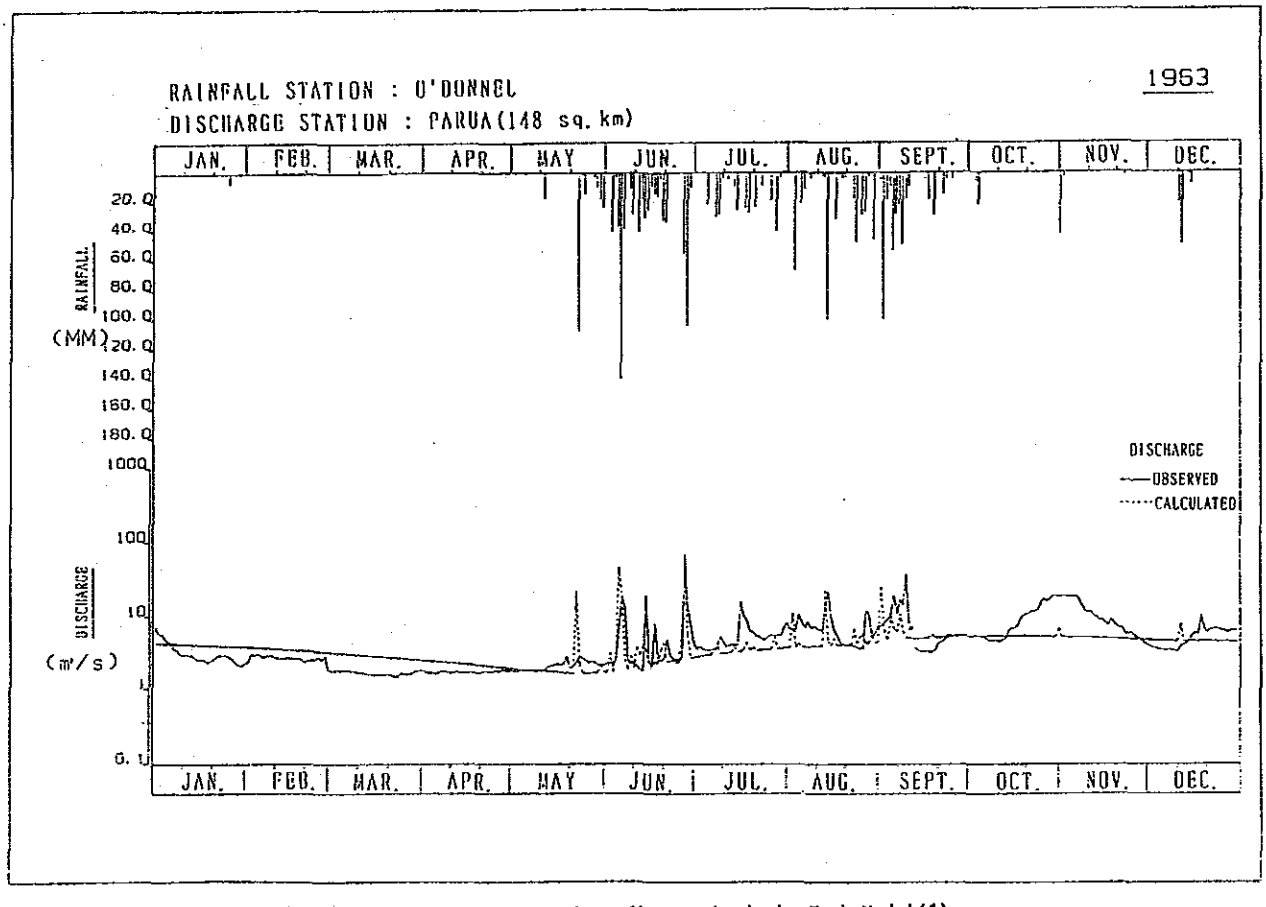
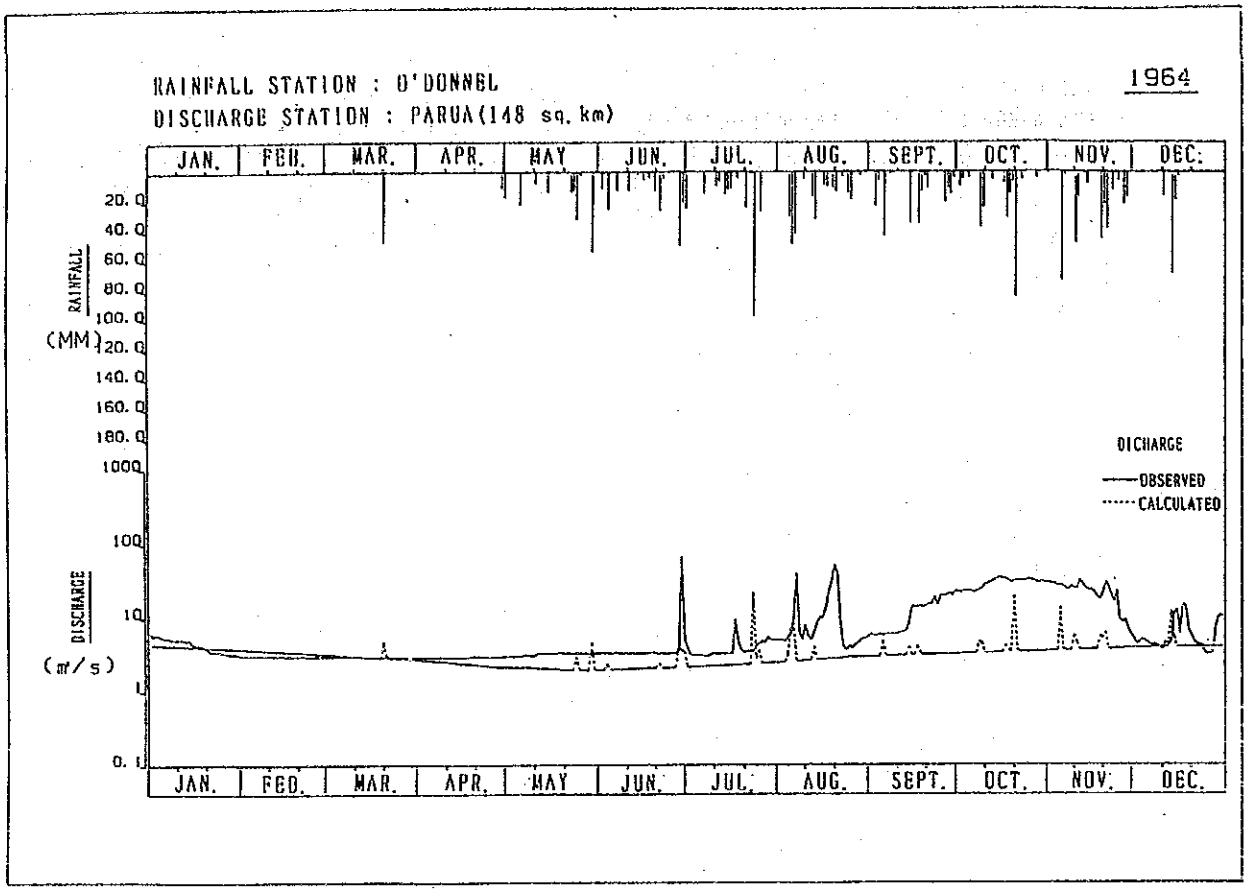


Figure C-2-3 Results of Parua river flow analysis by Tank Model(1)



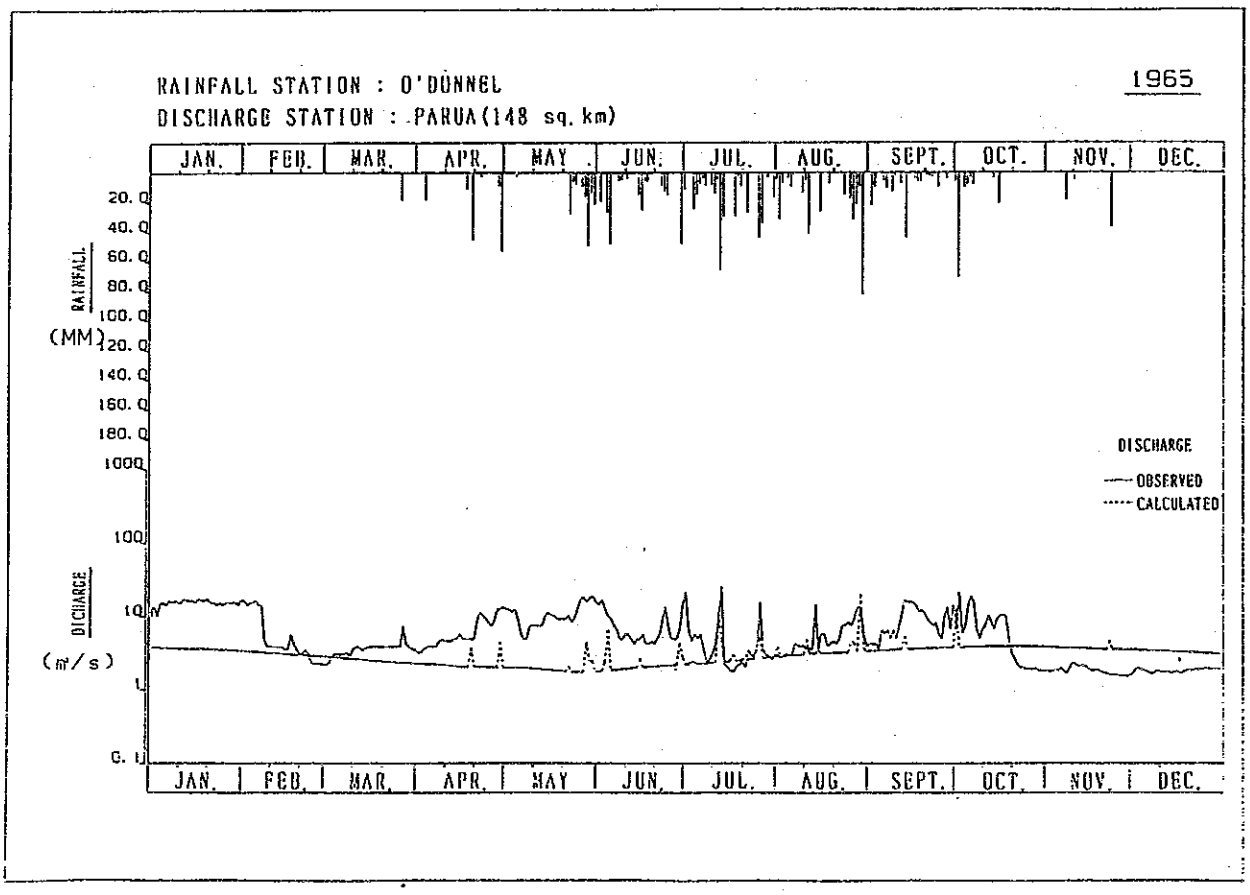
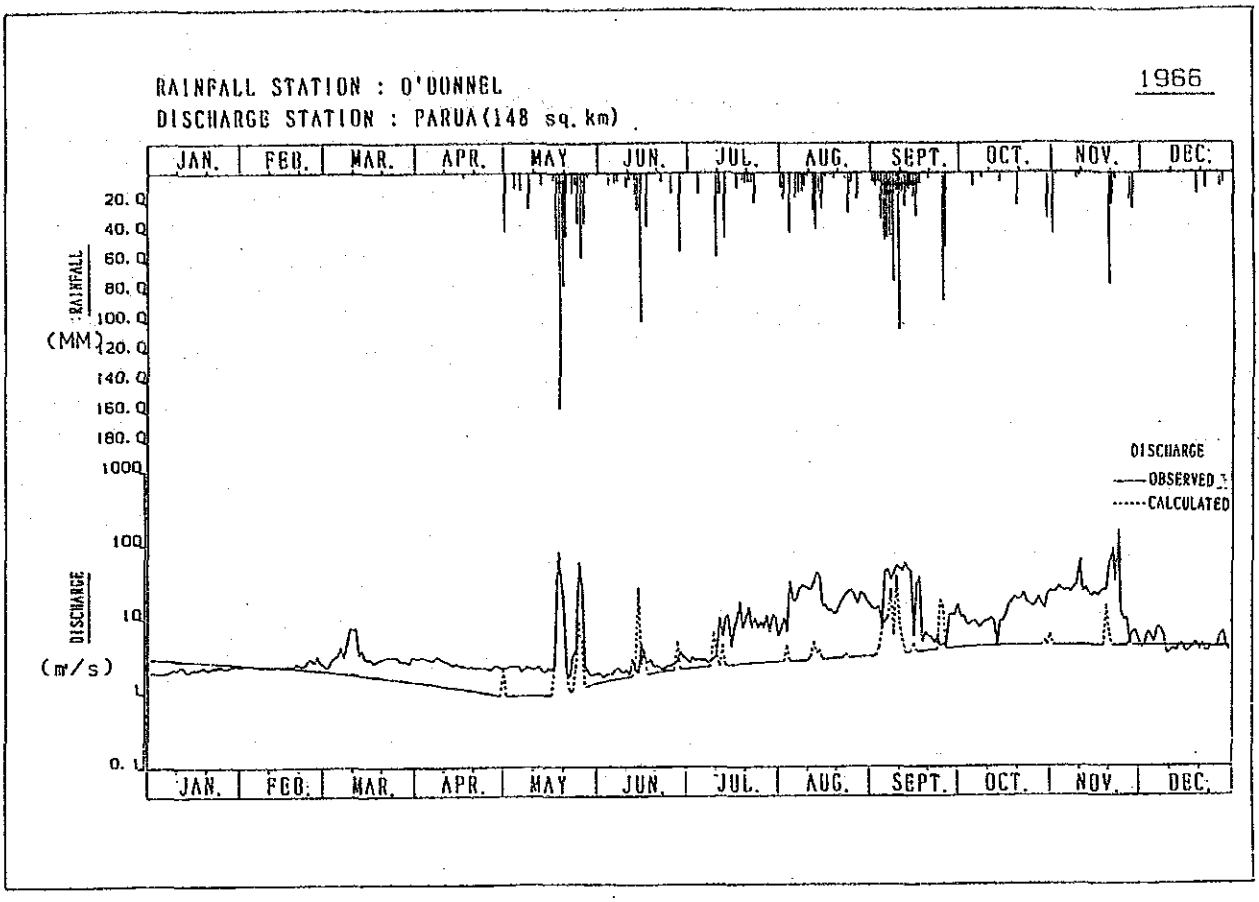


Figure C-2-3 Results of Parua river flow analysis by Tank Model(2)



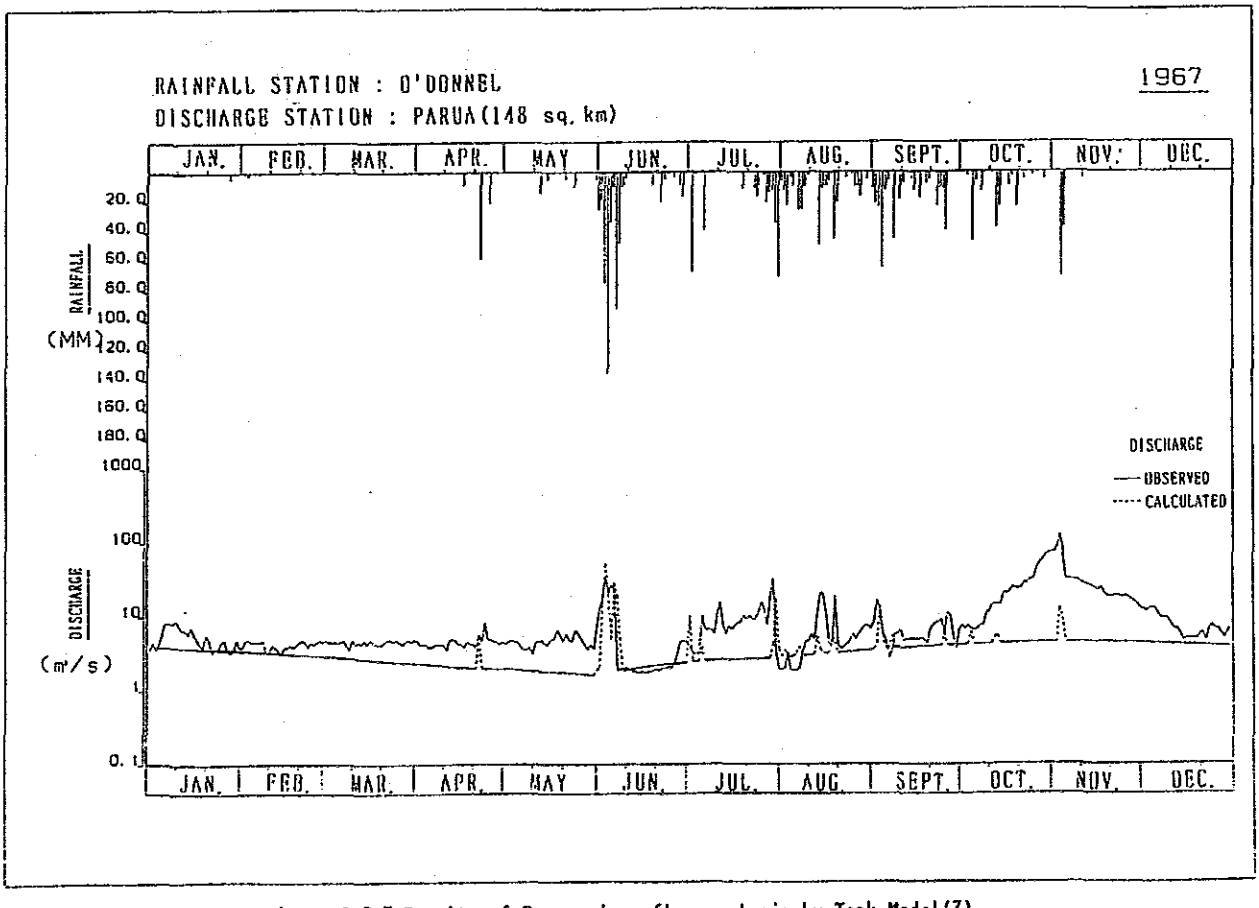


Figure C-2-3 Results of Parua river flow analysis by Tank Model(3)

Table C-2-11 Mean monthly calculated discharge of Parua river(1968-1988)

(Unit : cum/s)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1968	3.502	3.001	2.447	1.880	1.887	2.616	2.416	7.879	4.594	4.193	4.024	3.564	3.506
1969	3.058	2.557	2.015	1.455	1.371	1.301	2.062	3.160	2.861	3.282	3.056	2.769	2.414
1970	2.330	1.875	1.375	0.976	0.758	1.599	1.881	4.722	5.926	3.851	3.776	3.425	2.711
1971	2.959	2.469	1.943	1.434	1.376	2.111	2.059	2.387	3.146	4.482	3.669	3.725	2.649
1972	3.392	2.939	2.406	2.842	2.156	2.745	24.679	16.521	8.126	7.781	7.435	6.728	7.358
1973	6.039	5.369	4.666	3.972	3.762	3.546	3.452	3.665	3.607	7.070	4.133	3.758	4.419
1974	3.249	2.770	2.236	1.999	1.764	2.488	3.412	11.045	4.543	5.235	5.268	4.978	4.099
1975	4.541	4.001	3.385	2.787	2.810	2.580	3.142	3.256	3.746	4.613	3.910	3.601	3.530
1976	3.281	2.781	2.237	1.874	11.189	9.807	4.950	5.616	6.028	5.650	5.311	4.727	5.296
1977	4.205	3.648	3.076	2.456	2.028	2.143	3.649	3.762	4.100	4.100	6.617	3.821	3.632
1978	3.321	2.810	2.257	1.695	1.354	1.441	2.146	5.380	3.763	5.705	4.655	4.383	3.250
1979	3.908	3.395	2.805	2.405	2.105	2.095	2.305	6.583	3.984	3.617	3.389	3.025	3.304
1980	2.597	2.113	1.597	1.094	1.317	0.639	2.753	2.089	3.239	3.172	5.529	3.319	2.455
1981	2.850	2.361	1.852	1.319	1.079	1.657	2.850	3.235	3.617	3.620	3.533	3.168	2.598
1982	2.723	2.241	1.908	1.409	1.073	1.409	2.926	2.484	3.823	3.234	3.180	2.773	2.433
1983	2.503	2.007	1.514	0.991	0.720	0.634	1.086	3.427	1.921	2.676	2.328	1.981	1.818
1984	1.637	1.227	0.815	0.444	0.772	1.345	1.852	3.482	3.442	5.894	3.998	3.777	2.398
1985	3.254	2.750	2.202	1.744	1.461	7.364	3.148	3.643	4.150	5.228	4.010	3.670	3.550
1986	3.169	2.778	2.260	1.744	1.465	1.732	5.178	3.532	4.704	4.956	4.426	4.070	3.341
1987	3.594	3.064	2.492	1.936	1.472	1.645	1.703	5.265	3.049	3.134	2.877	2.521	2.730
1988	2.138	1.713	1.239	0.848	0.896	1.085	8.545	3.228	3.360	6.454	4.274	4.124	3.175
Mean	3.250	2.756	2.225	1.776	2.039	2.475	4.104	5.102	4.082	4.664	4.257	3.710	3.365

Table C-2-12 Calculated flow regime of Parua river(1968-1988)

CA=148.0sq·km UNIT:cum/s

Year	MAX-Q	95DAYQ	185DAYQ	275DAYQ	355DAYQ	MIN-Q	MEANQ	TOTALQ
1968	75.860	3.741	3.001	2.130	1.626	1.619	3.506	1283.024
1969	18.456	2.911	2.437	1.405	1.159	1.133	2.414	880.999
1970	60.231	3.426	1.981	1.194	0.725	0.672	2.711	989.404
1971	24.860	3.202	2.432	1.728	1.249	1.226	2.649	966.795
1972	82.154	7.673	3.593	2.417	1.996	1.930	7.358	2693.205
1973	74.623	4.487	3.798	3.563	3.378	3.369	4.419	1612.883
1974	117.927	4.513	2.989	2.099	1.666	1.628	4.099	1495.971
1975	26.043	3.883	3.478	2.691	2.317	2.249	3.530	1288.509
1976	76.743	5.239	4.215	2.547	1.463	1.448	5.296	1938.388
1977	63.160	3.955	3.499	2.506	1.922	1.884	3.632	1325.525
1978	34.821	4.201	2.818	1.722	1.175	1.130	3.250	1186.170
1979	66.464	3.502	3.059	2.183	1.995	1.985	3.304	1206.060
1980	55.314	2.888	1.912	1.001	0.590	0.541	2.455	898.535
1981	12.747	3.371	2.643	1.644	0.889	0.863	2.598	948.192
1982	22.393	2.895	2.309	1.489	0.913	0.905	2.433	888.125
1983	25.904	2.179	1.780	0.820	0.556	0.547	1.818	663.577
1984	34.768	3.520	1.636	0.794	0.368	0.346	2.398	877.491
1985	88.427	3.809	3.039	2.055	1.267	1.249	3.550	1295.765
1986	41.335	3.938	2.818	1.877	1.353	1.351	3.341	1219.509
1987	87.126	2.970	2.501	1.765	1.296	1.268	2.730	996.629
1988	150.559	3.509	2.125	1.186	0.624	0.571	3.175	1161.973
Mean	59.044	3.801	2.765	1.848	1.358	1.329	3.365	1229.359 (71mm)
Specific Discharge	39.895	2.568	1.868	1.249	0.918	0.898	2.274	830.555

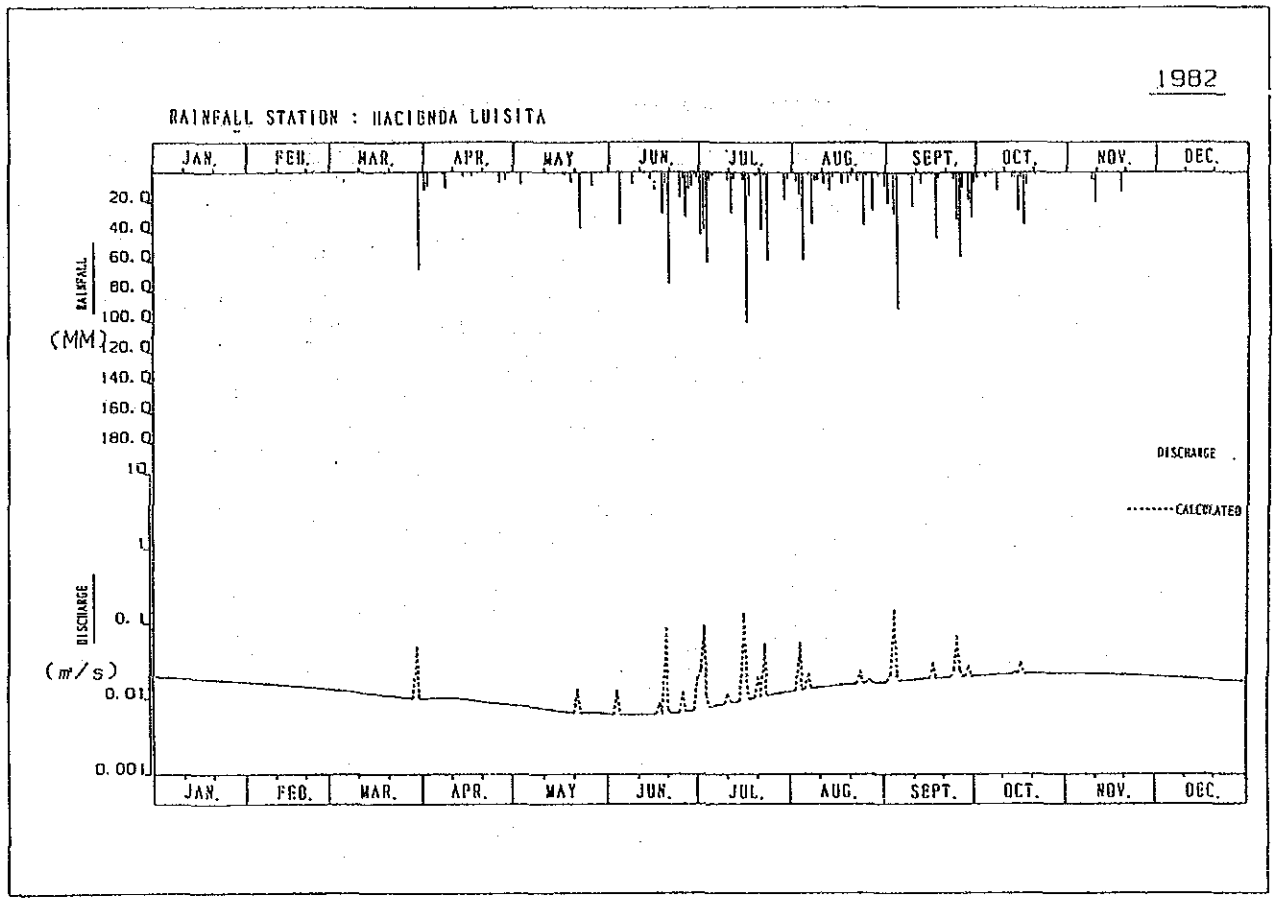


Figure C-2-4 Discharge from the mountain basin

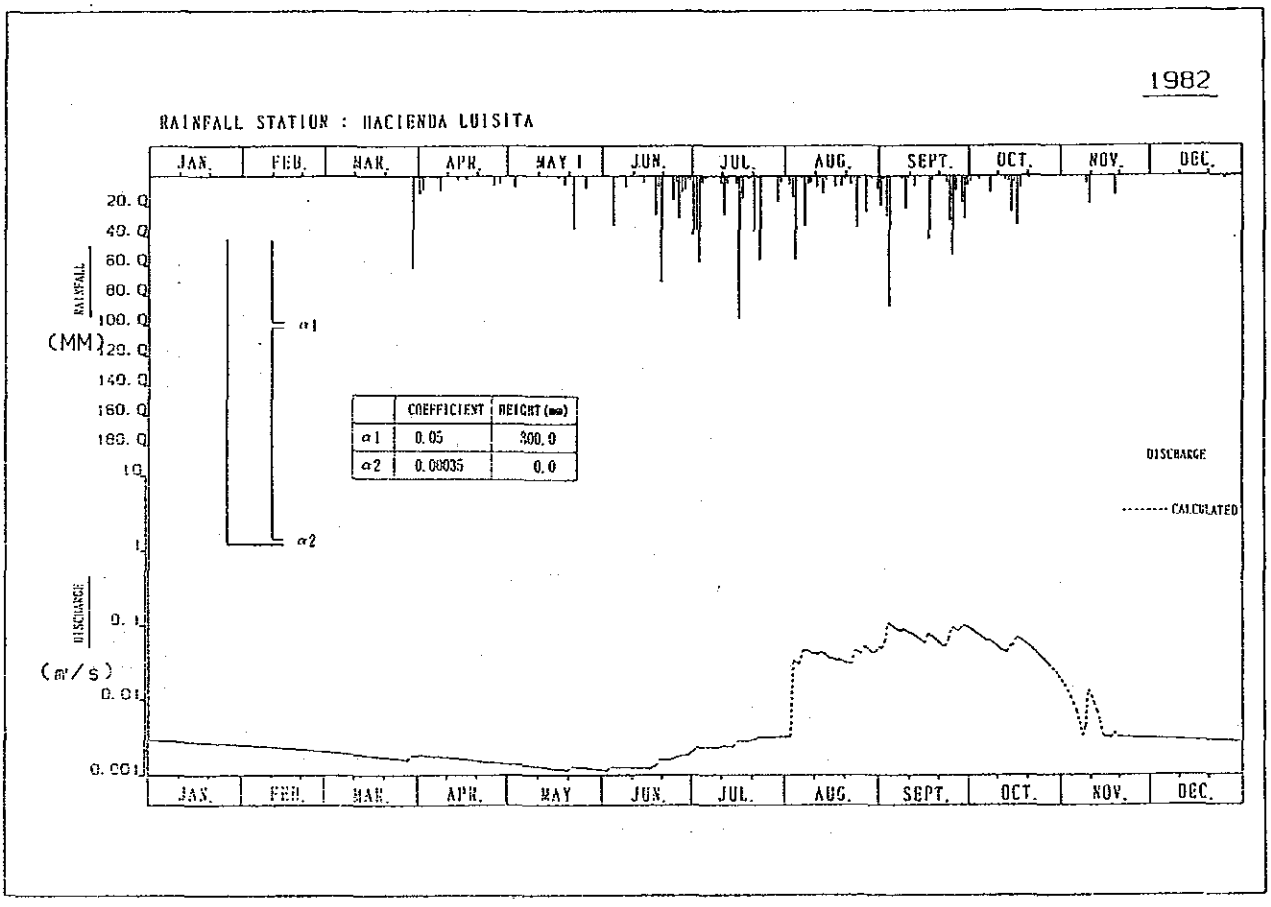


Figure C-2-5 Discharge from the flat ground basin

Table C-3-1 Probability analysis of hydrological data

YEAR	Meteorology						Discharge of Parua			
	Annual Rainfall		Annual Draught Days		Consecutive Draught Days		Annual Discharge		Draughty Discharge	
	Amonnt	Probability	Days	Probability	Days	Probability	Amonnt (cum/s/year)	Probability	Amonnt (cum/s/year)	Probability
1968	1776	2.1	88	1.1	299	2.6	1283	1.5	1.626	1.4
1969	1465	5.5	128	30.8	305	4.8	881	5.3	1.159	2.2
1970	1927	1.7	92	4.1	300	2.9	989	3.0	0.725	5.8
1971	1890	1.7	70	1.6	279	1.1	967	3.3	1.249	1.9
1972	3863	1.0	49	1.1	282	1.1	2693	1.0	1.996	1.2
1973	1292	14.5	100	6.3	305	4.8	1613	1.2	3.378	1.0
1978	2419	1.1	79	2.3	281	1.1	1496	1.3	1.666	1.4
1975	1580	4.0	58	1.2	298	2.4	1289	1.5	2.317	1.1
1976	2527	1.1	92	4.1	301	3.1	1938	1.1	1.463	1.6
1977	1676	2.7	72	1.8	301	3.1	1326	1.4	1.922	1.2
1978	2010	1.5	109	10.9	283	1.1	1186	1.8	1.175	2.1
1979	1487	5.0	76	2.0	308	7.1	1206	1.7	1.995	1.2
1980	1751	2.2	82	2.8	307	6.2	899	4.7	0.590	10.2
1981	1674	2.7	78	1.9	290	1.4	948	3.5	0.889	3.6
1982	1559	3.8	88	3.3	303	3.9	888	5.0	0.913	3.4
1983	1327	11.8	69	1.6	312	12.6	664	239.1	0.556	12.1
1984	2192	1.3	61	1.3	277	1.0	878	5.4	0.368	86.3
1985	1886	1.8	91	3.9	291	1.5	1296	1.5	1.267	1.9
1986	1999	1.5	86	1.1	285	1.2	1220	1.7	1.353	1.7
1987	1304	13.4	106	9.0	313	18.8	997	2.9	1.296	1.8
1988	2275	1.2	88	1.1	292	1.6	1162	1.8	0.624	8.7

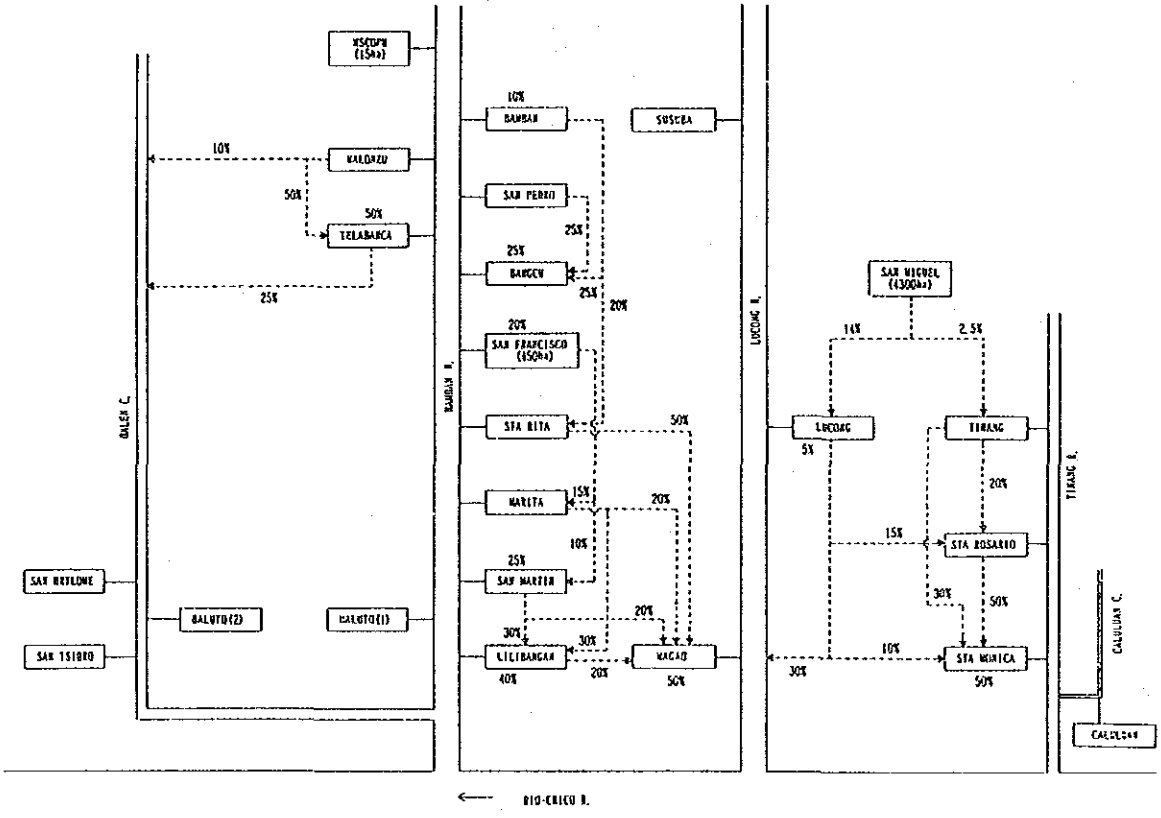


Figure C-3-1 Return flow rate

Table C-3-2 Water balance study on present conditions

(M³/m³)

NAME OF CIS	WET SEASON					DRY SEASON				
	AVAILABLE WATER	RETURN FLOW	IRRIGATION WATER			AVAILABLE WATER	RETURN FLOW	IRRIGATION WATER		
			GRAVITY	S. PUMP	CONDUIT			GRAVITY	S. PUMP	CONDUIT
BAMBAN R.										
BAMBAN	39585.6	2.1	77.5	-	-	36914.3	360.2	7867.6	-	-
SAN PEDRO	39508.1	-	17.9	-	-	29046.3	-	1856.2	-	-
MALONZO	42665.3	-	29.4	-	-	27512.3	-	3664.8	-	-
BANGCU	43996.7	11.4	63.4	-	-	23985.8	1949.2	5783.6	-	-
TELABANCA	43933.6	10.7	43.7	-	-	18201.7	2035.1	3500.0	94.9	-
STA RITA	43826.1	4.2	13.0	-	-	11100.4	720.2	85.0	122.9	-
MARITA	43813.1	2.7	12.3	-	-	11015.4	456.6	18.2	0.4	-
SAN MARTIN	43800.8	4.2	31.7	-	-	11008.6	353.3	53.2	57.3	-
BALETO(1)	43769.1	-	13.2	-	-	10955.2	-	-	-	-
LILIBANGAN	62399.7	7.8	28.1	-	-	12845.9	359.8	1018.6	13.5	-
LUCONG R.										
SUSUBA	2993.9	-	6.0	-	-	303.8	-	123.9	-	-
LUCONG	44030.6	27.8	271.3	-	-	22940.5	4478.8	14000.2	80.6	-
MAGAO	92183.4	35.9	34.1	-	-	13851.0	4007.7	3124.0	106.4	-
BALEN C.										
SAN BRTLOME	15241.7	4.3	35.6	12.4	-	1545.5	776.6	950.0	129.4	-
BALUTO(2)	16022.6	-	1.9	41.9	-	678.7	-	-	-	-
SAN ISIDRO	16020.7	-	-	67.3	-	678.7	-	-	-	-
TINANG R.										
TINANG	13154.9	4.3	30.7	2.4	-	1334.0	727.6	780.8	38.2	-
STA ROSARIO	29001.1	13.9	8.5	-	-	2163.2	1347.7	949.1	23.0	-
STA MONICA	30806.8	19.8	25.1	-	-	1397.9	2022.3	248.0	49.6	-
CALULUAN	816.5	-	1.9	10.1	-	83.0	-	-	-	-

Table C-3-3 Water balance Study on proposed conditions

(M³/m³)

NAME OF CIS	WET SEASON					DRY SEASON				
	AVAILABLE WATER	RETURN FLOW	IRRIGATION WATER			AVAILABLE WATER	RETURN FLOW	IRRIGATION WATER		
			GRAVITY	S. PUMP	CONDUIT			GRAVITY	S. PUMP	CONDUIT
BAMBAN R.										
BAMBAN	39575.3	5.6	621.8	-	-	36924.0	355.0	7524.7	-	-
SAN PEDRO	38953.5	-	100.3	-	-	29399.5	-	1777.5	-	-
MALONZO	42028.4	-	200.5	-	-	27944.1	-	3555.0	-	-
BANGCU	43188.7	29.5	555.3	-	-	24527.4	1923.2	5482.6	-	-
TELABANCA	42633.5	23.6	301.4	-	-	19044.6	2016.5	3374.9	-	-
STA RITA	41962.9	11.3	-	-	101.4	12413.8	710.4	-	-	1289.2
MARITA	41962.9	5.1	-	-	78.5	12413.8	450.5	-	-	1030.5
SAN MARTIN	41962.9	8.6	-	-	225.3	12413.8	701.3	-	-	2353.6
BALETO(1)	41962.9		-	-	142.1	12413.8	-	-	-	2518.0
LILIBANGAN	60153.2	15.3	-	-	135.8	14258.5	1322.0	-	-	2256.3
LUCONG R.										
SUSUBA	2993.9	-	14.6	18.9	-	303.8	-	118.5	-	-
LUCONG	44030.6	52.7	1513.2	100.0	-	22940.5	4420.2	13350.1	3.8	-
MAGAO	90936.4	77.0	146.9	159.7	-	14500.9	5191.5	1339.6	-	-
BALEN C.										
SAN BRTLOME	15241.7	9.1	74.8	229.4	-	1545.5	767.8	879.0	130.7	-
BALUTO(2)	15983.3	-	6.6	135.5	334.2	749.7	-	224.9	2293.0	5924.5
SAN ISIDRO	15976.8	-	2.1	373.9	-	524.6	-	-	-	-
TINANG R.										
TINANG	13154.9	8.1	64.3	136.6	-	1334.0	717.8	734.2	29.2	-
STA ROSARIO	28967.5	26.3	60.7	80.1	-	2210.0	1335.5	372.6	13.6	-
STA MONICA	30721.1	39.4	26.5	184.8	-	1521.2	2003.0	135.4	63.6	-
CALULUAN	816.5	-	4.3	62.6	-	83.0	-	-	-	-

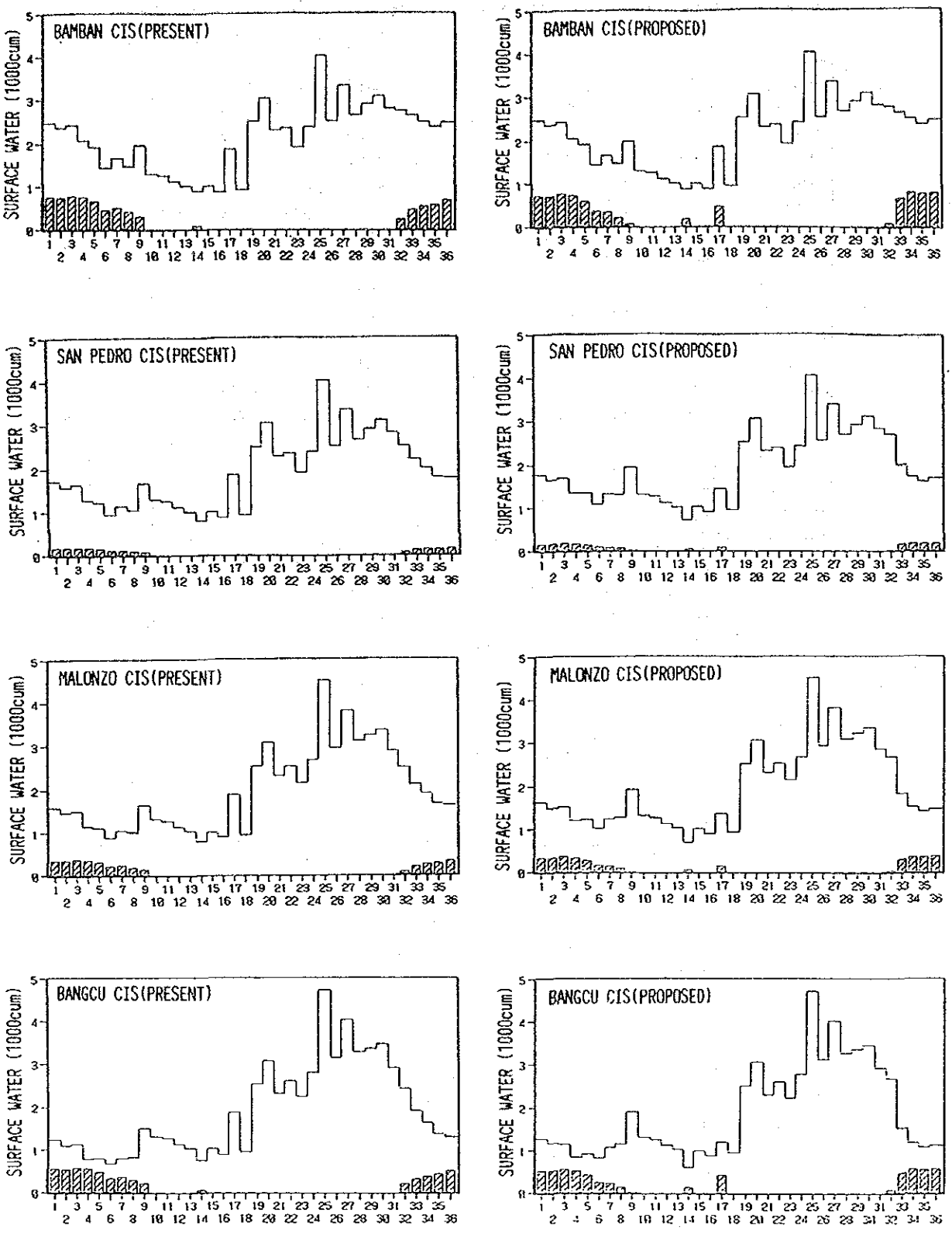


Figure C-3-2 Water balance study on each CIS(1)

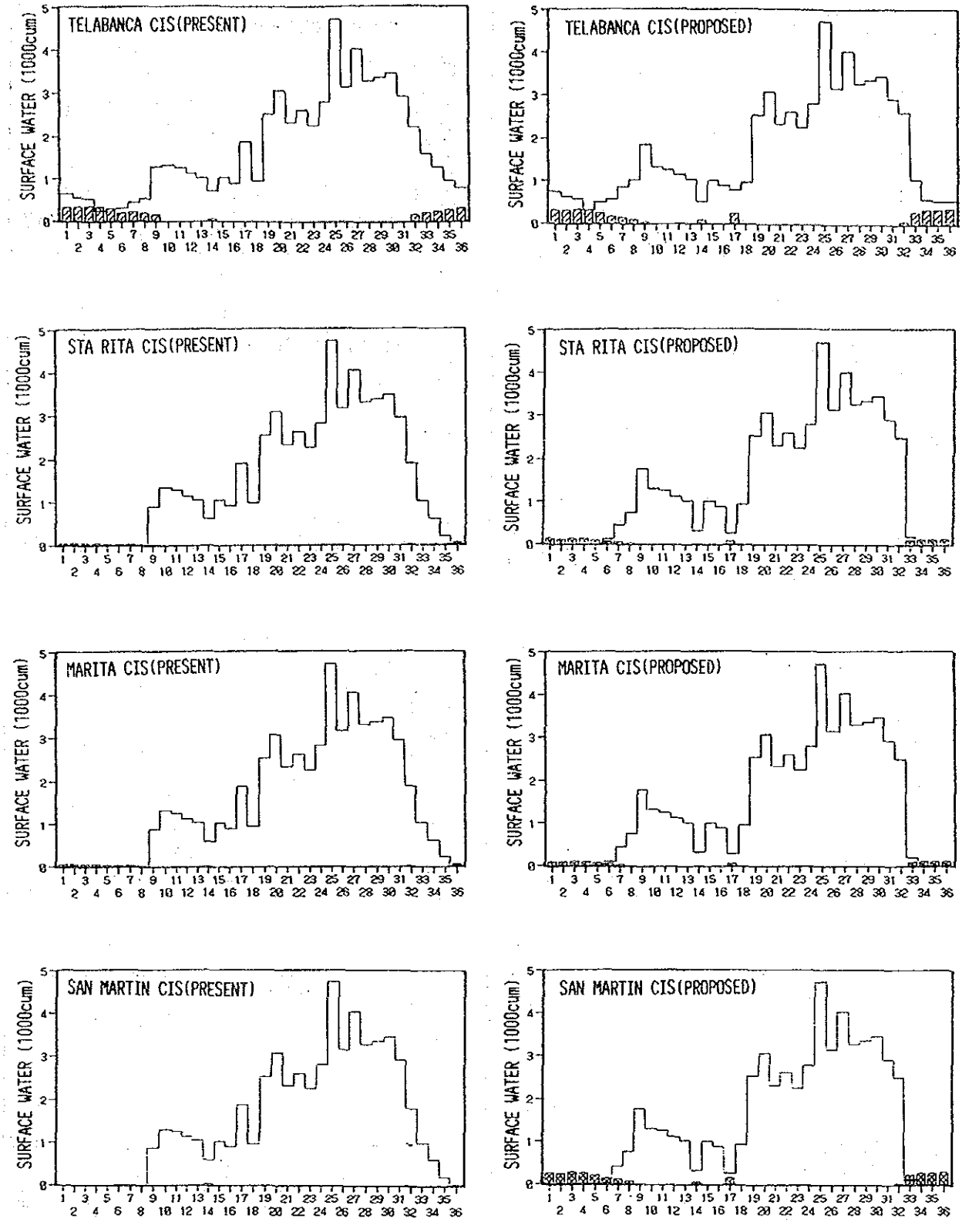


Figure C-3-2 Water balance study on each CIS(2)

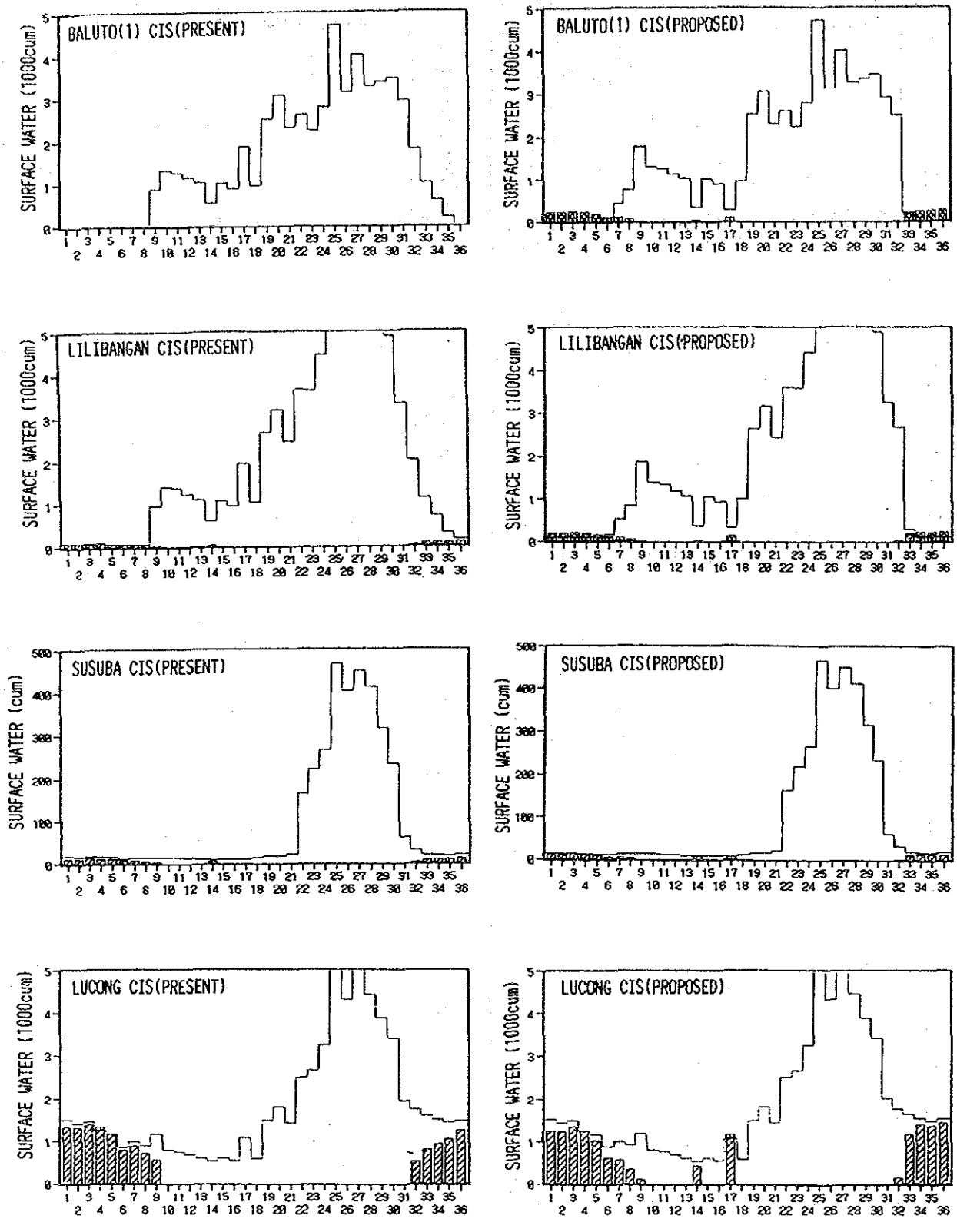


Figure C-3-2 Water balance study on each CIS(3)

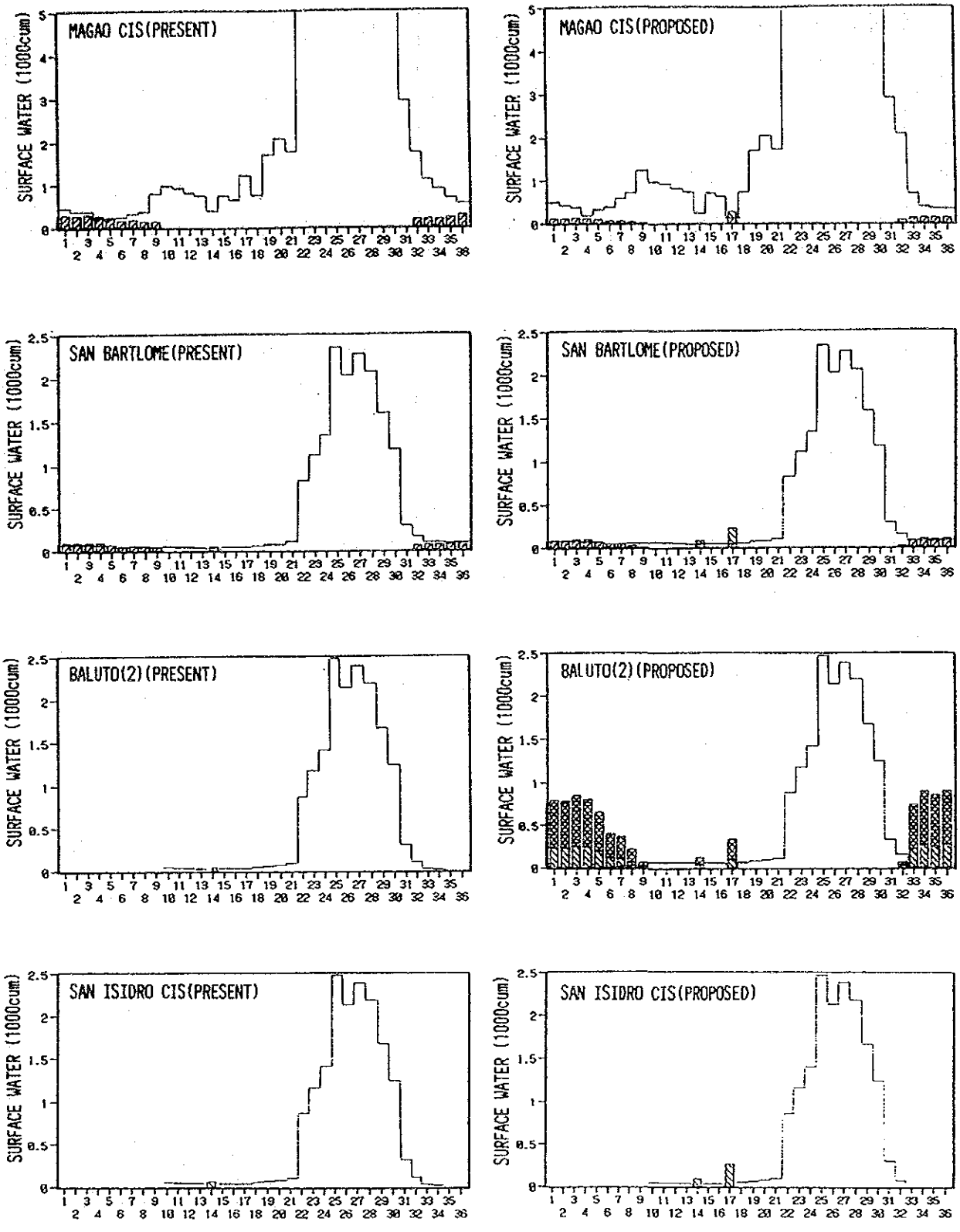


Figure C-3-2 Water balance study on each CIS(4)

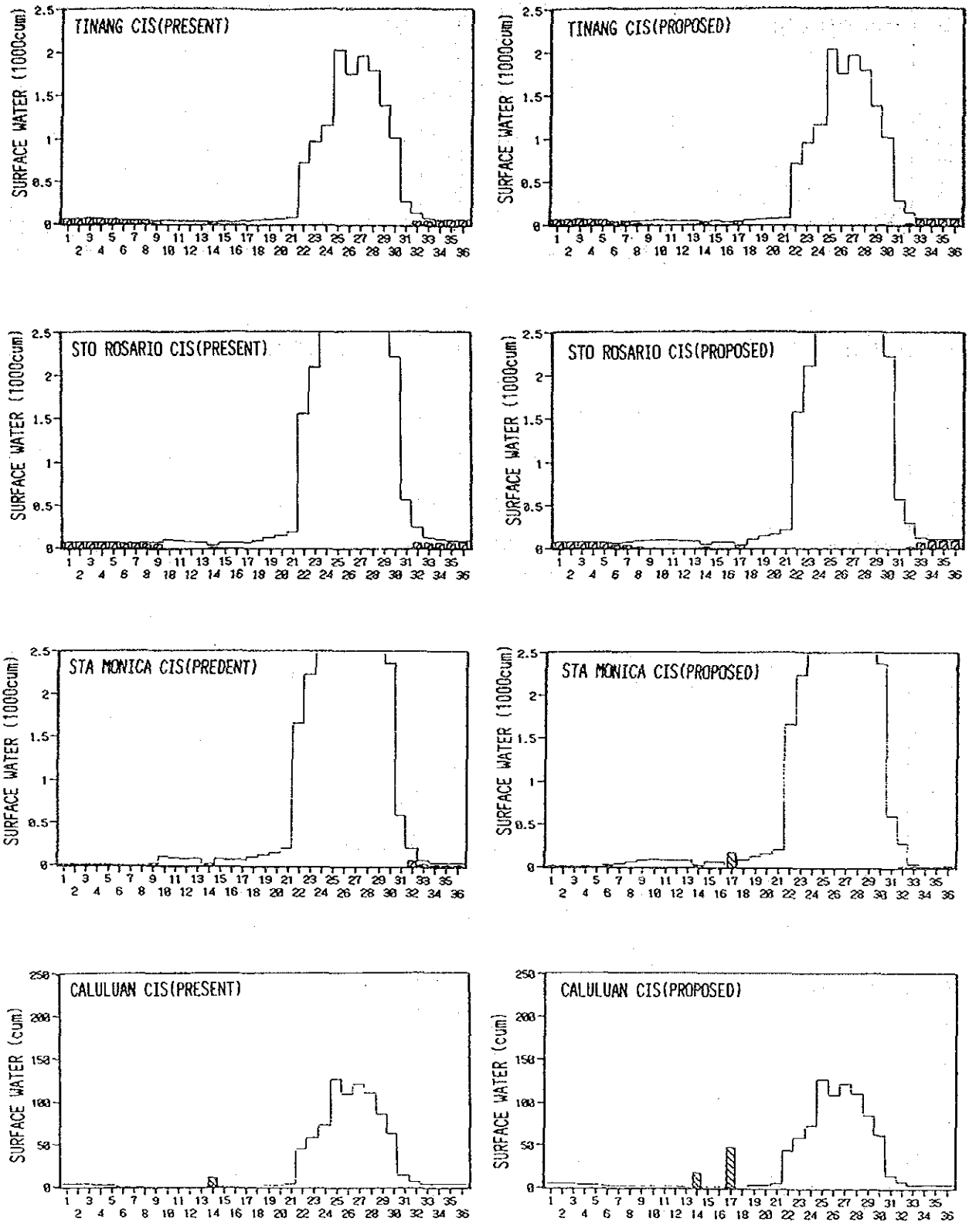


Figure C-3-2 Water balance study on each CIS(5)

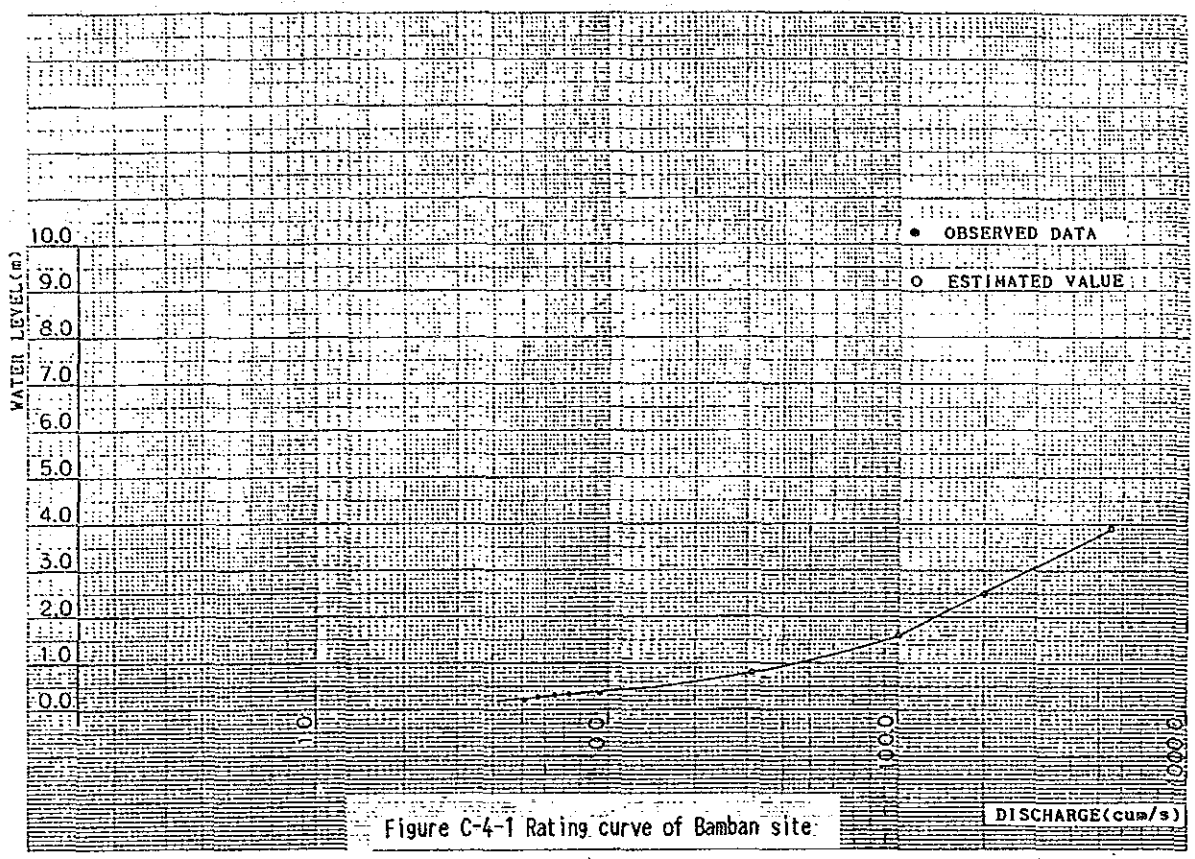


Figure C-4-1 Rating curve of Bamban site

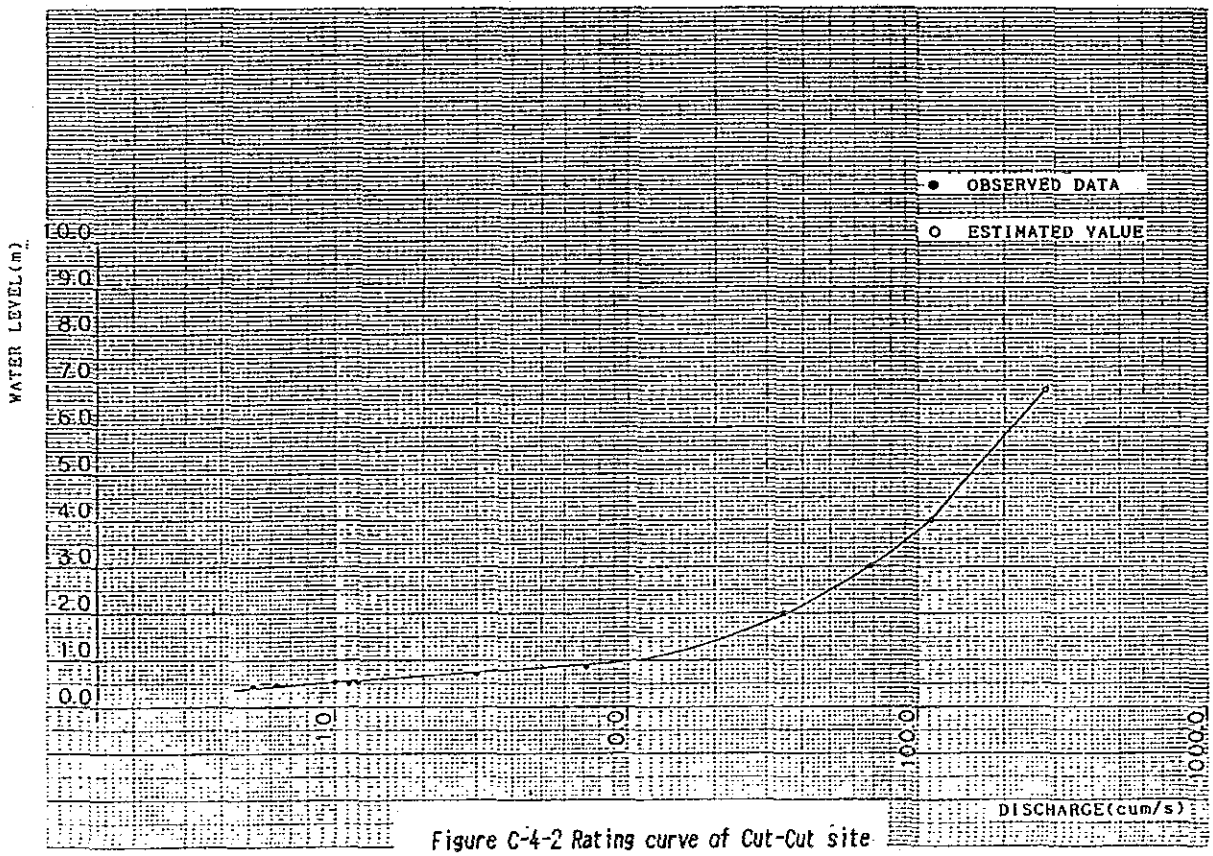


Figure C-4-2 Rating curve of Cut-Cut site

APPENDIX D Geology and Hydrogeology

Table D-1 Stratigraphy

Age	Rock Type	Lithological Description
Late Pleistocene to Recent	Alluvium Alluvial fan and Terrace deposits	Heterogeneous mixture of fine and coarse sediments. Sand and silt with slight amount of gravel to boulder fragments. Thickness attains 60 meters.
Pliocene to Quaternary	Bamban Formation	Angular to subrounded clastics ranging from large boulder to poorly sorted coarse sand. Tuffaceous cementation. The beds dips up to eight to ten degrees.
Upper Miocene to Pliocene	Tarlac Formation	Poorly indurated sandstone, siltstone, claystone, and conglomerate with occasional tuff.
Middle to Upper Miocene	Malinta Formation	Medium indurated and compacted sandstone, siltstone with sandy shale and conglomerate. About 1,375 meters thick.
Lower to Middle Miocene	Morioes Formation	Highly indurated yellowish-brown sandstone, sandy shale, conglomeraters. About 1,500 meters thick.
Pliocene to Quaternary	Volcanics	Small plugs consisting of Basalt and Andesite intruding the Moriones Formation.
Pre-Jurassic	Basement Complex	Basic coarse-grained rocks and volcanic rocks, including Andesites, Diorites, and Gabbros, fine Basalts and Obsidians.

Table D-2 Quality of Water

No.	Location	EC (s/cm)	PH	Temperature (℃)	Discharge (m^3/s)	Remarks
RF 1	Bamban river (1)	210	7.2	34.5	8.70	Bamban Bridge
RF 2	- do - (2)	220	7.1	32.0	5.03	Sand quarry
RF 3	- do - (3)	240	7.3	35.0	3.92	Bangcu
RF 4	- do - (4)	220	6.7	32.5	3.78	Magalang Bridge
RF 5	- do - (5)	165	7.5	33.5	4.93	Intake No.2
RF 6	- do - (6)	245	6.8	37.0	4.05	Lilibangan
RF 7	Magao river	310	6.5	35.0	1.85	
RF 8	Caluluan river	290	7.0	31.0	0.20	
RF 9	Santa Rosa	200	5.5	28.0	0.16	
RF10	Tinang	220	6.2	30.5	1.30	
RF11	San Juan Camino	200	6.8	31.0	0.18	
RF12	San Jose	280	6.8	32.5	1.13	
RF13	Sapang Balem river	180	6.5	32.0	0.36	
RF14	Cut-cut river	230	6.4	29.5	2.47	
RF15	San Francisco	360	6.4	31.0	0.11	
RF16	San Roque	275	6.2	31.5	0.14	
RF17	Cut-cut river	195	6.4	31.3	4.19	Bridge
RF18	Chico river	290	7.4	33.0	1.96	
SS 1	San Martin spring	175	6.7	30.5	0.08	Near Intake 2
SW 1	Bamban SW	245	6.3	29.0		
SW 2	Lilibangan SW	450	6.1	29.0		Sulphuric smell
SW 3	Tinang SW	820	6.4	29.0		
SW 4	Culatingan SW	500	7.0	29.0		Near Chico river
DW 1	Magao DW	125	6.5	29.0		Artesian
DW 2	Sta.Rosario DW	560	7.2	28.5		
DW 3	Matalusad DW	640	7.8	30.0		Artesian, Sulphuric

Note: RF : River SW : Shallow well
SS : Spring / Seepage DW : Deep well

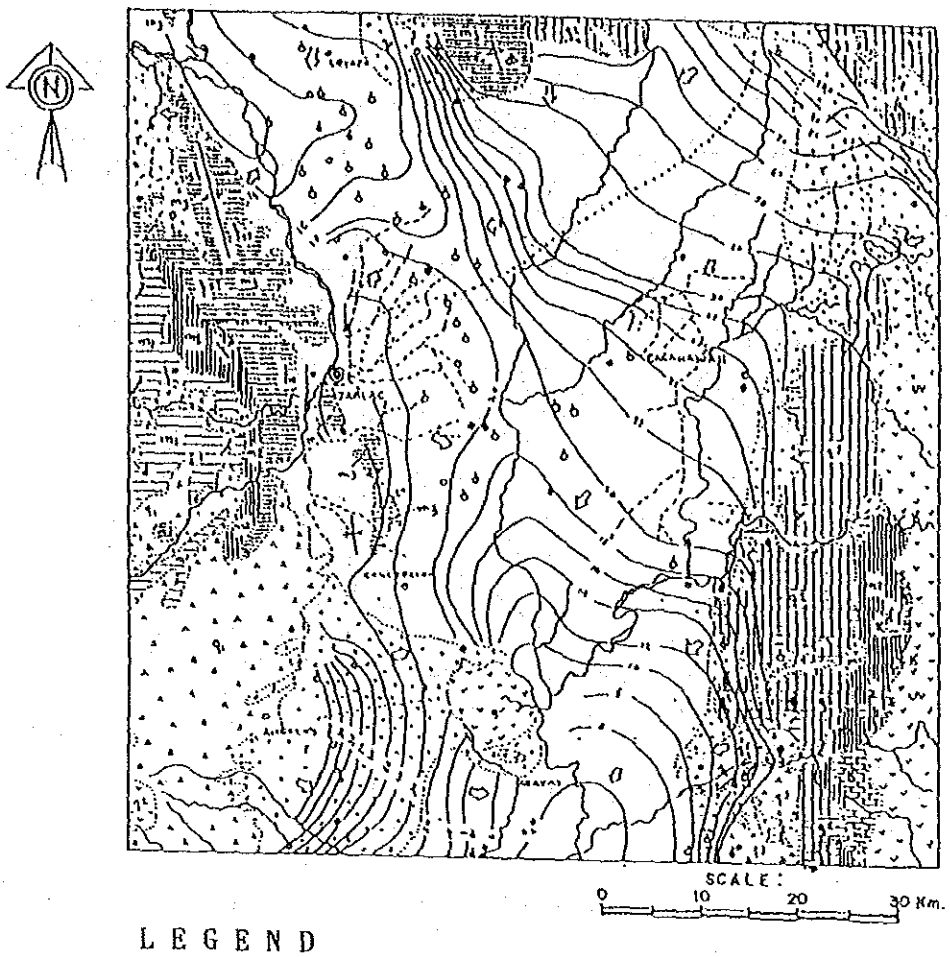
Table D-3 Inventory of Shallow Wells In the CISs

Name of CIS	Location of well	Depth of well (m)	Diameter of well (m)	Static Water Level(m)
1. Bamban	San Rafael,Bamban	18.29	0.114	5.49
	Banaba,Bamban	45.73	0.10	6.10
	Anupul,Bamban	37.80	0.114	7.60
	Dela Cruz,Bamban	25.30	0.10	5.49
	La Paz,Bamban	7.012	0.10	4.57
	Culubase,Bamban	16.0	0.10	4.51
	Pacalcal,Bamban	12.2	0.114	5.49
	Dela Cruz,Bamban	—	0.10	4.57
	Anupul,Bamban	26.52	—	5.49
	Banaba,Bamban	—	0.10	7.5
	Pacalcal,Bamban	—	0.10	6.10
	La Paz,Bamban	55.8	0.10	4.47
	Anupul,Bamban	7.012	0.114	7.5
	San Rafael,Bamban	18.29	0.114	5.47
	Anupul,Bamban	22.30	0.114	4.57
2. San Pedro	—	—	—	—
3. Malonzo	Malonzo,Bamban	19.2	0.10	4.57
4. Bangcu	—	—	—	—
5. Susuba/Cut cut	—	—	—	—
6. Telabanca	Telabanca,Concepcion	30.49	0.114	3.66
7. Sta.Rita	Sta.Rita,Concepcion	23.2	0.10	3.66
	Sta.Rita,Concepcion	24.02	0.10	3.66
8. Marita	—	—	—	—
9. San Martin	San Martin,Concepcion	16.77	0.114	3.66
10. Baluto	San Antonio,Concepcion	16.16	0.10	3.05
	Baluto,Concepcion	51.32	0.114	4.57
	Baluto,Concepcion	36.36	0.125	4.57
11. Lilibangan	—	—	—	—
12. San Bartolome	San Bartolome,Concepcion	28.90	0.114	4.57
13. San Igidro	San Igidro,Concepcion	35.0	0.114	3.66
14. Lucong	Sta.Cruz,Concepcion	—	0.10	3.05
	Corazon de Jesus,Concepcion	13.3	0.10	4.57
	Malupa,Concepcion	18.3	0.10	4.57
	Culatingan,Concepcion	18.2	0.10	4.57
	Talleunduc Sar Miguel, Concepcion	21.9	0.10	4.57
	Sta.Cruz,Concepcion	24.7	0.10	4.57
	Cafe,Concepcion	16.16	0.10	4.57
	Sta.Cruz,Concepcion	2.74	0.125	4.3
	Culatingan,Concepcion	30.47	0.127	4.3
	Concepcion,Energerey	36.57	0.1143	3.04
	San Jose,Concepcion	30.47	0.127	4.3
	Bang cal,Concepcion	25.90	0.127	3.6
	Malupa,Concepcion	24.38	0.127	3.25
	Pitabunan,Concepcion	21.33	0.127	3.66
	Taliaunduc,Concepcion	30.47	0.127	4.57
	Sta.Cruz,Concepcion	30.47	0.127	4.26
	Culatingan,Concepcion	30.47	0.127	3.65
	Taliaunduc,Concepcion	30.47	0.127	4.26
	Pitabunan,Concepcion	21.33	0.127	4.57
	Malupa,Concepcion	18.28	0.127	4.57
	San jose,Concepcion	24.38	0.127	4.26
	Sta.Cruz,Concepcion	33.52	0.1016	7.01
15. Magao	Magao,Concepcion	28.34	0.1000	4.27
16. Tinang	Murcia,Concepcion	—	0.150	4.57
	Parang,Concepcion	15.54	1.100	3.66
	Sta.Rosa,Concepcion	30.47	0.127	4.87
	San Agurtin,Concepcion	33.52	0.127	4.26
	Murcia,Concepcion	—	—	—
17. Sta.Rosario	Sta.Rosario,Concepcion	23.3	0.100	4.57
	Sta.Rosario,Concepcion	30.47	0.127	4.30
	Sta.Rosario,Concepcion	30.47	0.127	4.87
	Parulong,Concepcion	36.57	0.1016	5.48
18. Sta.Monica	Sta.Monica,Concepcion	35.67	0.100	4.57
	Sta.Monica,Concepcion	26.70	0.100	4.57
19. Caluluan	Caluluan,Concepcion	18.47	0.100	3.66
	Caluluan,Concepcion	30.47	0.127	3.90
	Caluluan,Concepcion	30.47	0.127	4.87

Table D-4

Seasonal Variation of Groundwater Level (Shallow Wells , 1976)

WELL No.	G.W.LEVEL(m) a.m.s.l.		DRAW DOWN
	APRIL	SEPTEMBER	(m)
C-01	50.57	51.89	1.32
NJ-3	15.88	18.46	2.58
NJ-16a	20.34	22.18	1.84
P-5	38.83	39.90	1.07
T-10a	20.35	28.71	0.36
T-11	38.50	39.39	0.89
V-03	20.47	20.67	0.20
17992	74.53	--	--
18051	60.55	64.58	2.03
18259	1.48	3.71	2.43
18366	50.81	52.57	1.76
18367	49.49	52.57	3.08
18397	11.59	13.43	1.84
19317	80.50	--	--
39623	8.66	9.85	1.19
42603	90.38	--	--
50509	13.13	13.99	0.86
50536	22.55	24.36	1.81
53634	14.42	16.24	1.82
53668	60.96	61.86	0.90
58724	45.34	48.11	2.77
6973	--	49.74	--
8369	--	43.45	--
17392	--	11.30	--
17982	--	76.70	--
19318	--	96.91	--



LEGEND

A. EXTENSIVE AND RICH AQUIFER
(FREQUENTLY HIGH PERMEABILITY)
ALLUVIAL DEPOSITS ; MOSTLY SAND, GRAVEL AND SILT

B. LOCAL OR DISCONNECTED AQUIFER
(VARIABLE PERMEABILITY)
ALLUVIAL DEPOSITS ; MOSTLY SAND, SILT AND CLAY
AGGLOMERATE SANDY TUFF AND CINDER BEDS
CONGLOMERATES AND SANDSTONE
TAFFACEOUS CLASTIC ROCKS

C. FISSURED ROCKS
(FREQUENTLY HIGH PERMEABILITY)
LIMESTONE

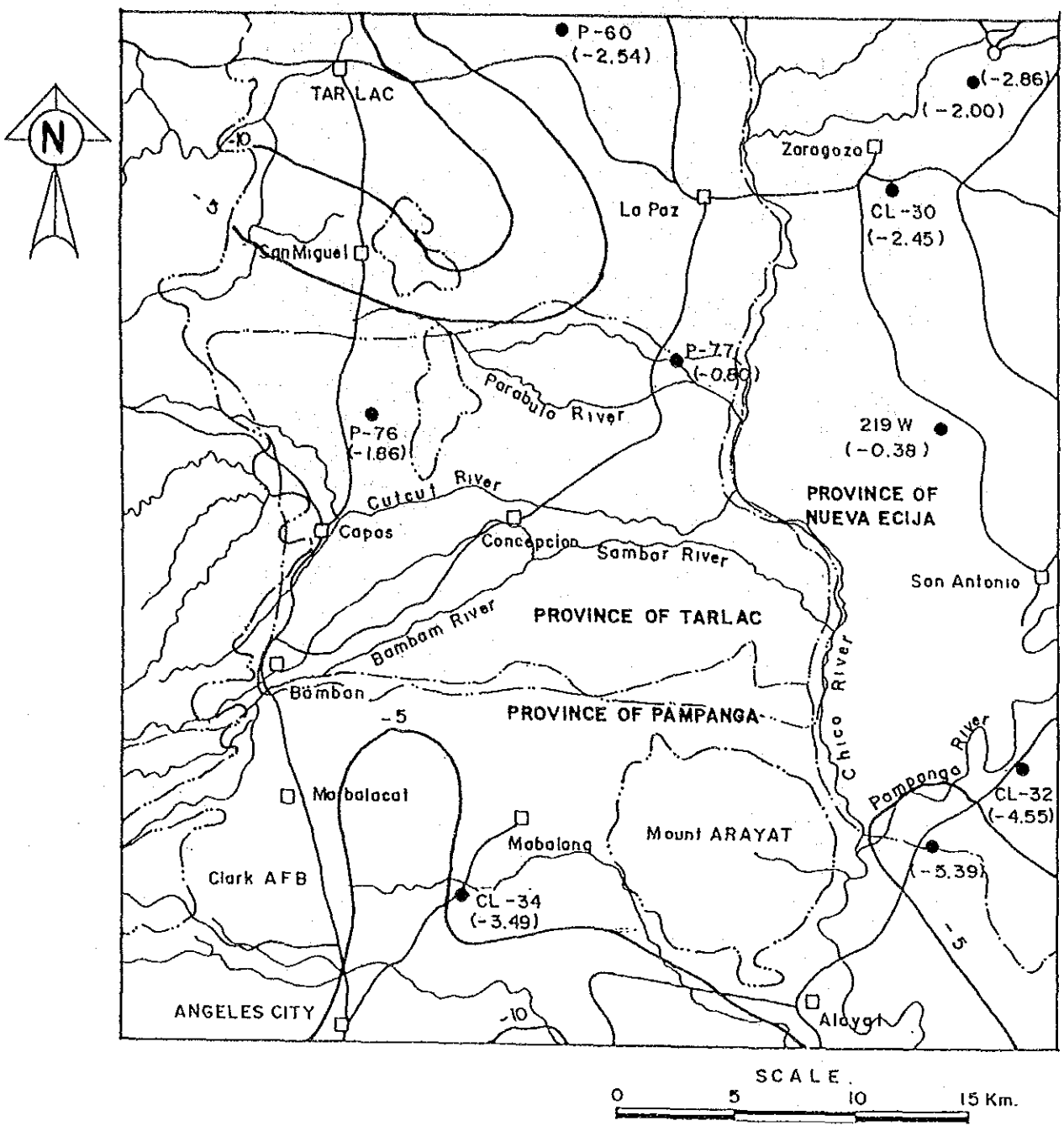
PIEZOMETRIC CONTOUR OF GROUNDWATER LEVEL (IN METERS ABOVE M.S.L.)
DIRECTION OF GROUNDWATER FLOW
SPRING DISCHARGE OF 10-100 L/S
B O R E H O L E
ARTESIAN WELL
THERMAL SPRING 37 °C
10 DIP AND STRIKE OF BEDS

D. REGIONS WITHOUT OR ONLY VER
LOCAL GROUND WATER
(LOW TO VERY LOW PERMEABI
PYROCLASTIC ROCKS
SAND STONE, CONGLOMERATE AND PYROCLASTIC ROCKS
SHALE, SANDSTONE AND CO
LOMERATE

E. REGIONS WITHOUT GROUNDWATE
EVEN AT GREAT DEPTH
(LOW TO VERY LOW PERMEABI
VOLCANIC ROCKS
QUATZ DIORATE AND DIORI
(STOCKS AND DIKES)
UNDIFFERENTIATED VOLCAN ROCKS
(DIABASE DIKE COMPLEX)
D A M
IRRIGATION CANAL
GEOLOGICAL BOUNDARY
F A U L T
A N T I C L I N E
S Y N C L I N E

HYDROGEOLOGIC MAP
CENTRAL LUZON, PHILIPPINES
(BUREAU OF MINES) ...PLATE 1-1

Figure D-1 Hydrogeological Map



LEGEND

- ● LOCATION OF WELLS
- BOUNDARY OF PROVINCE
- BOUNDARY OF ALLUVIUM
- R O A D
- (-275) DEPTH TO POTENTIOMETRIC BELOW GROUND LEVEL (IN METERS)
- -5 DEPTH TO POTENTIOMETRIC BELOW GROUND LEVEL (IN METERS)

Figure D-2 Depth to Potentiometric Surface in April (Shallow Wells)

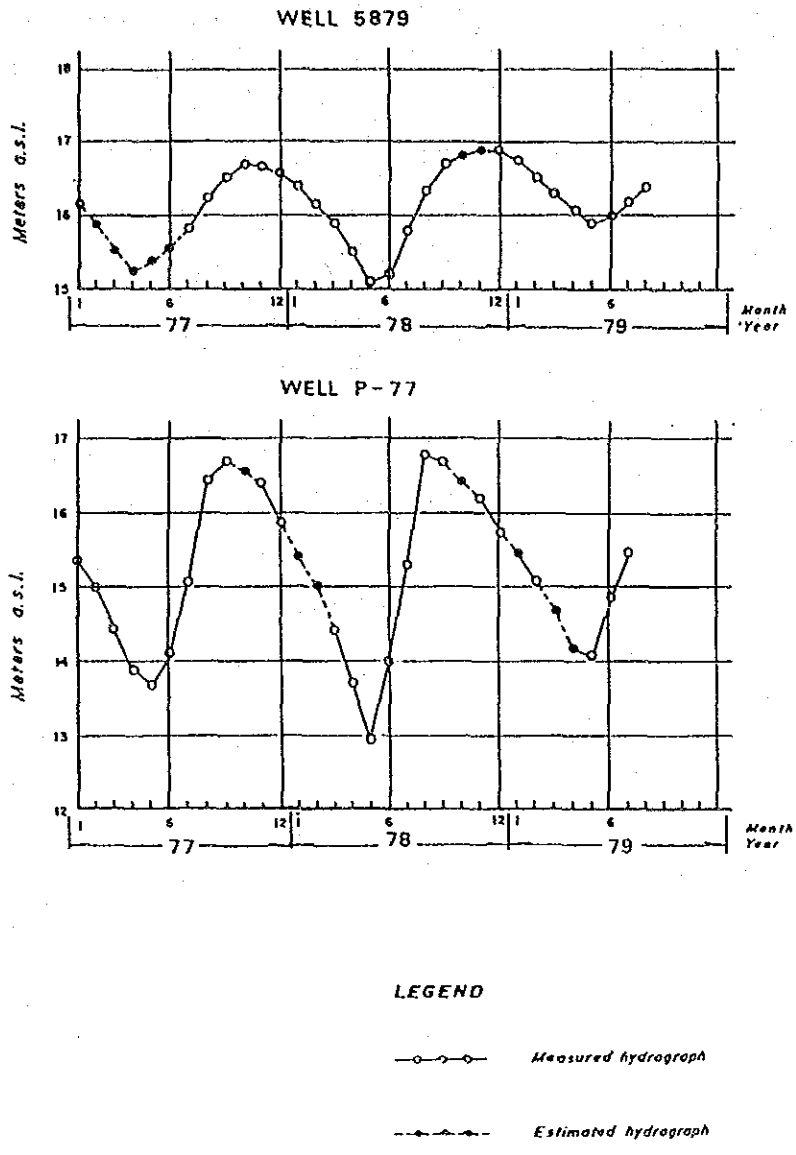
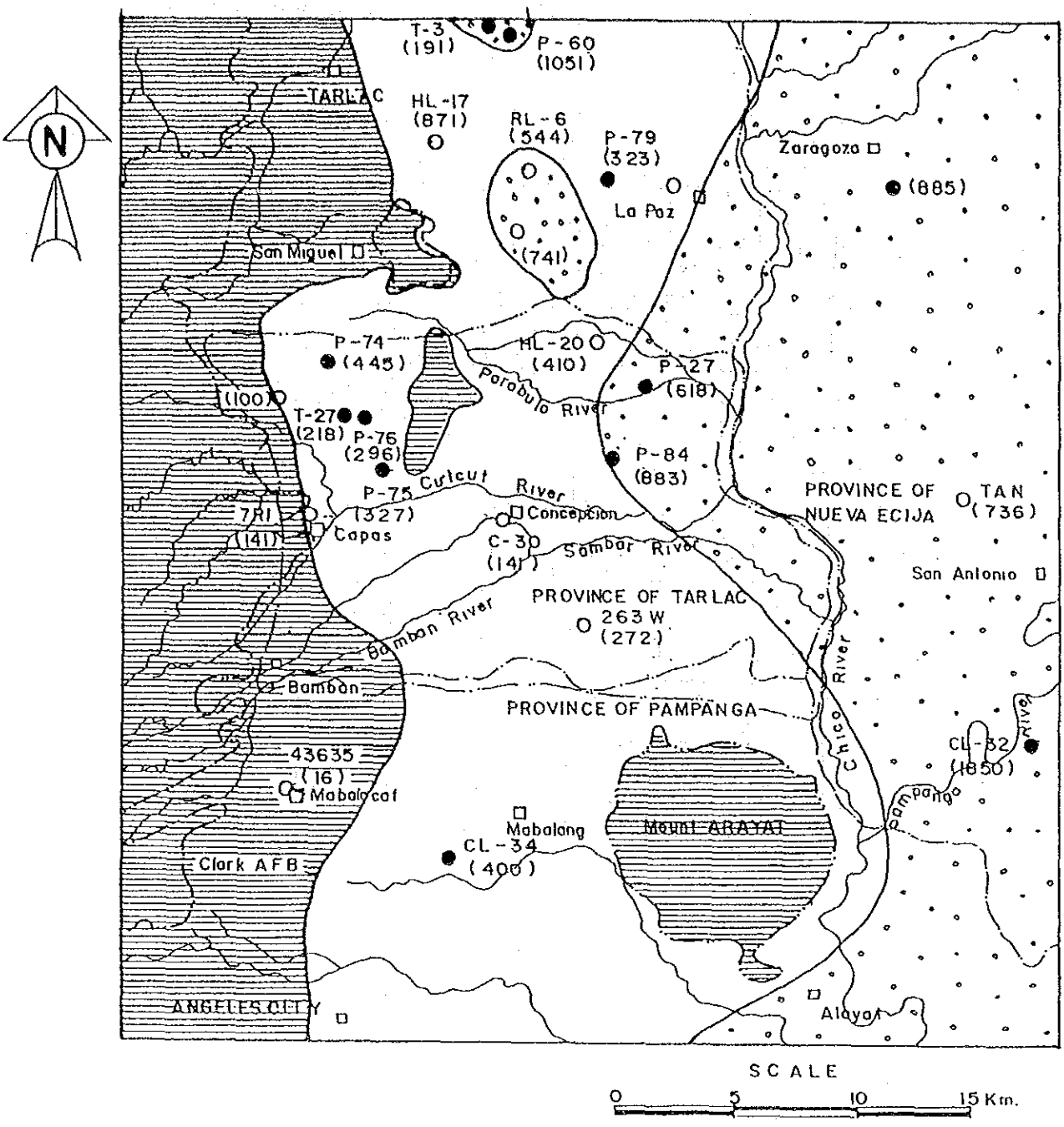


Figure D-3 Hydrograph in the Reference Wells



LEGEND

501 – 1000 M^2 / DAY

101 – 500 M^2 / DAY

LESS THAN 100 M^2 / DAY

CL-12 NIA DRILLED WELLS

(2500) TRANSMISSIVITY IN M^2 / DAY

218W OTHER WELLS

BOUNDARY OF ALLUVIUM

Figure D-4 Regional Variation in Transmissivity

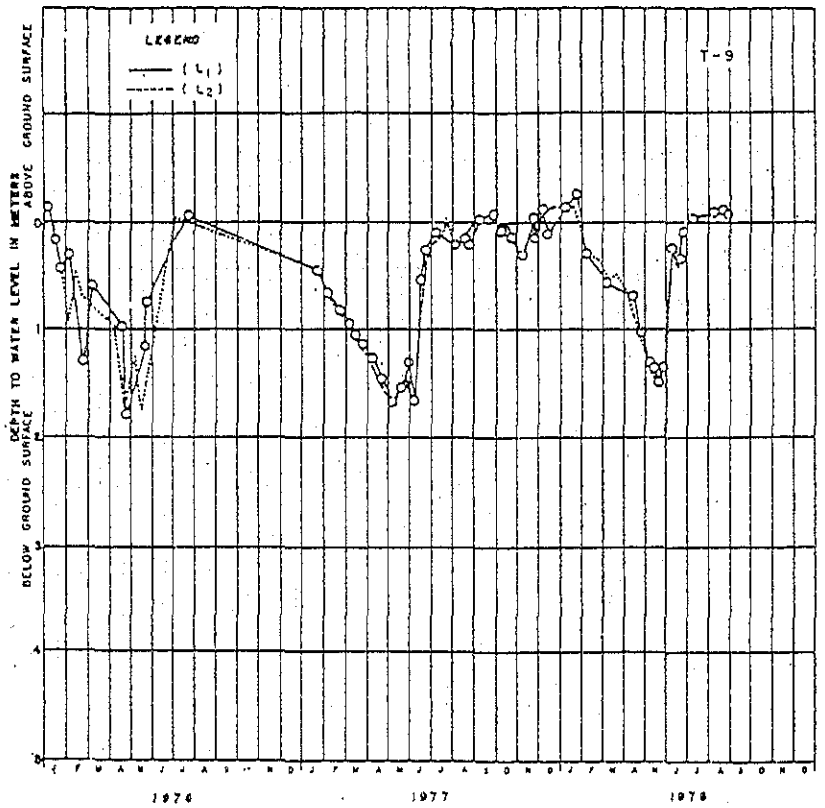


Figure D-5 Hydrograph on Observation Well T-9

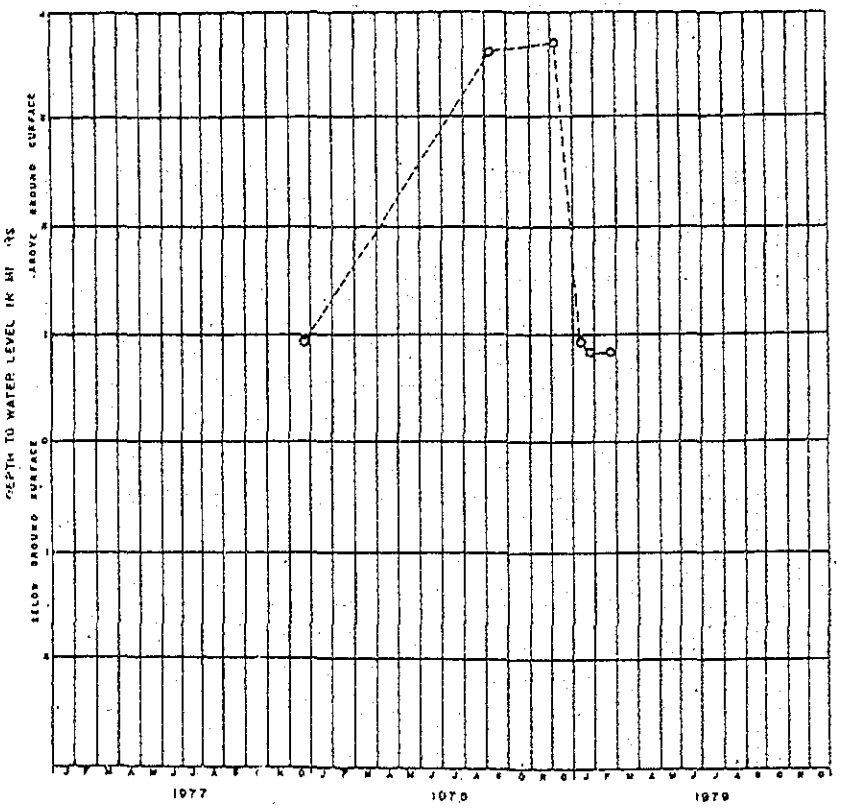


Figure D-6 Hydrograph on Well P-39

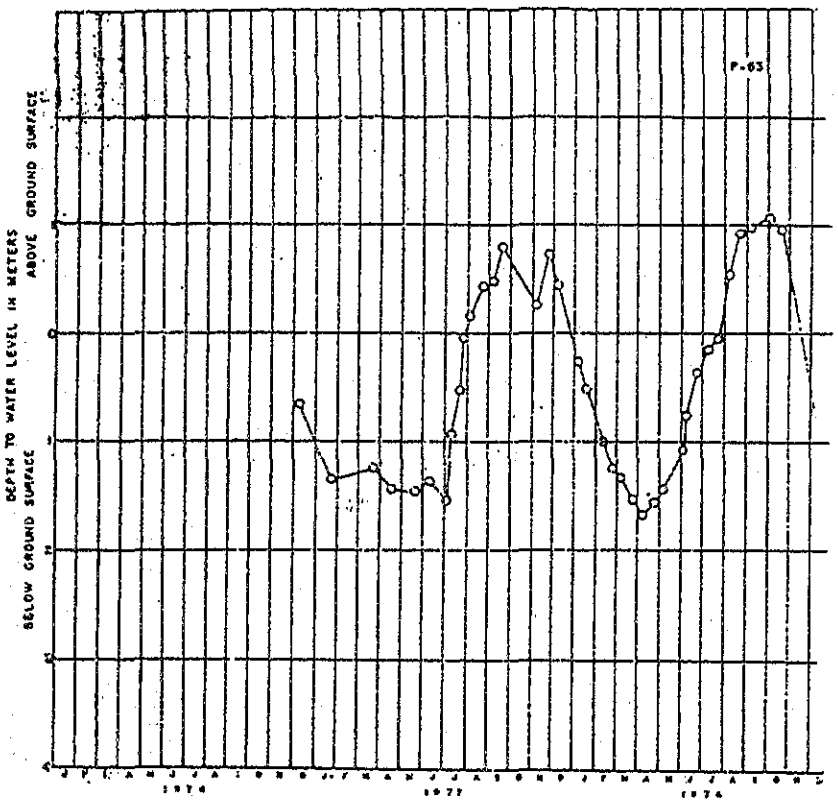


Figure D-7 Hydrograph on Well P-63

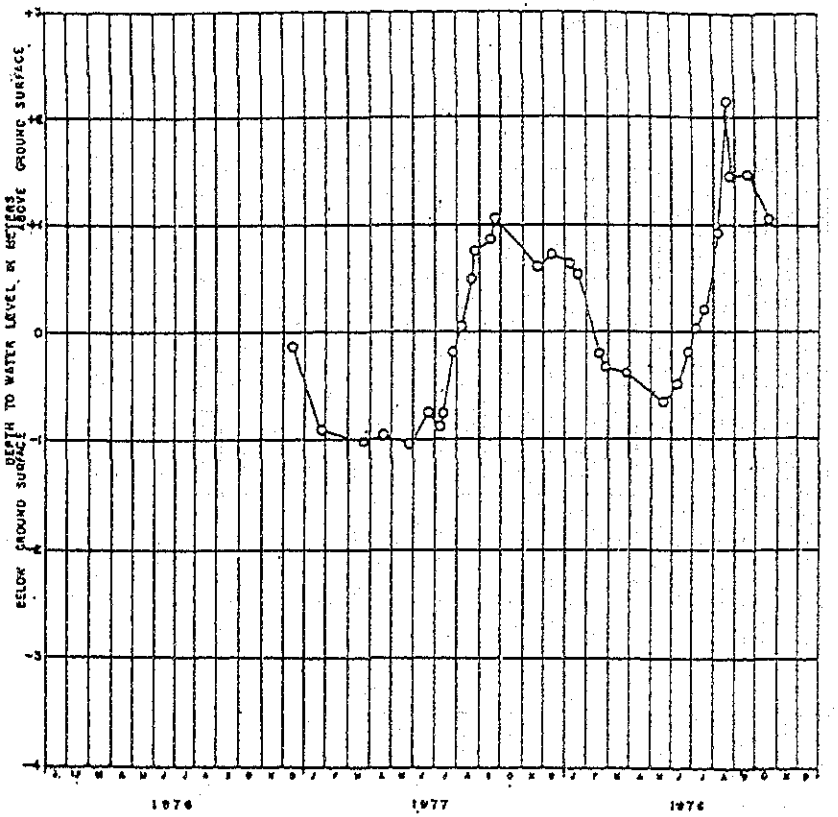


Figure D-8 Hydrograph on Well P-78

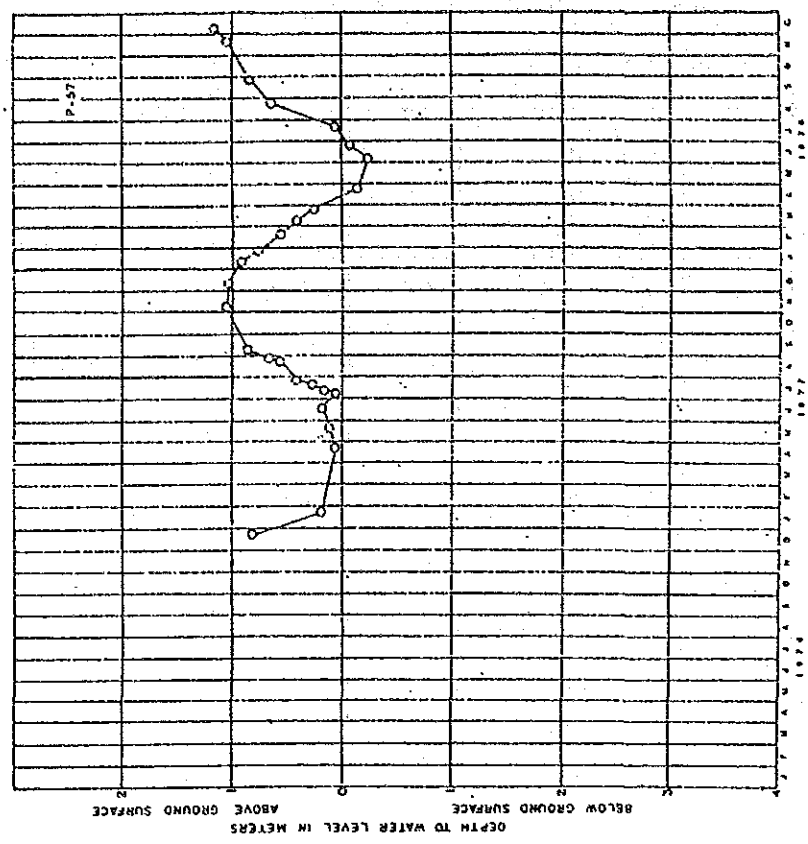


Figure D-10 Hydrograph on Well P-57

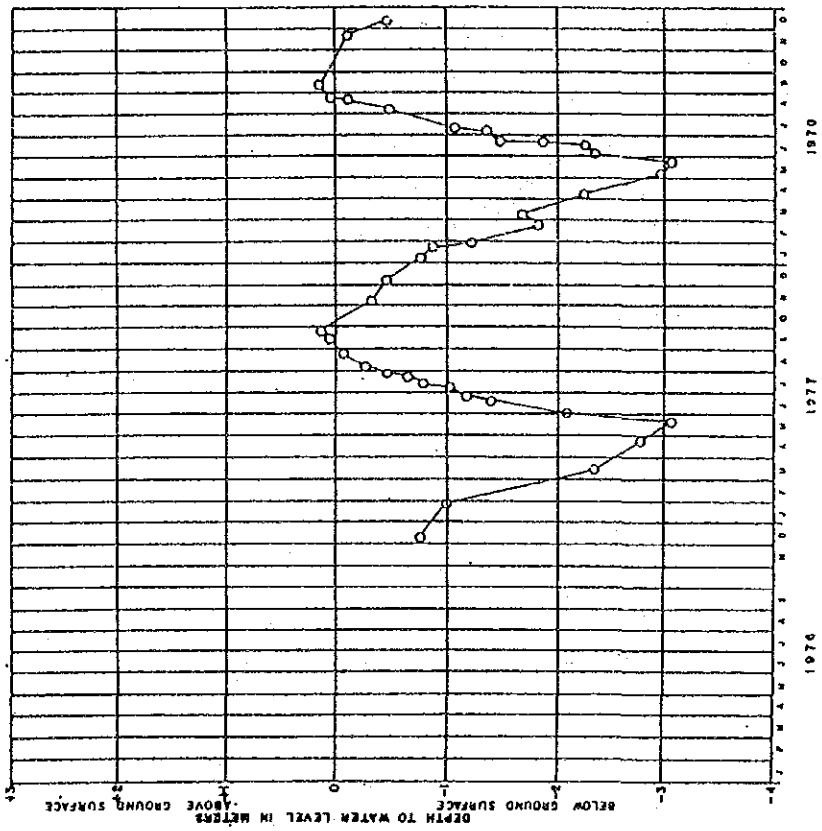
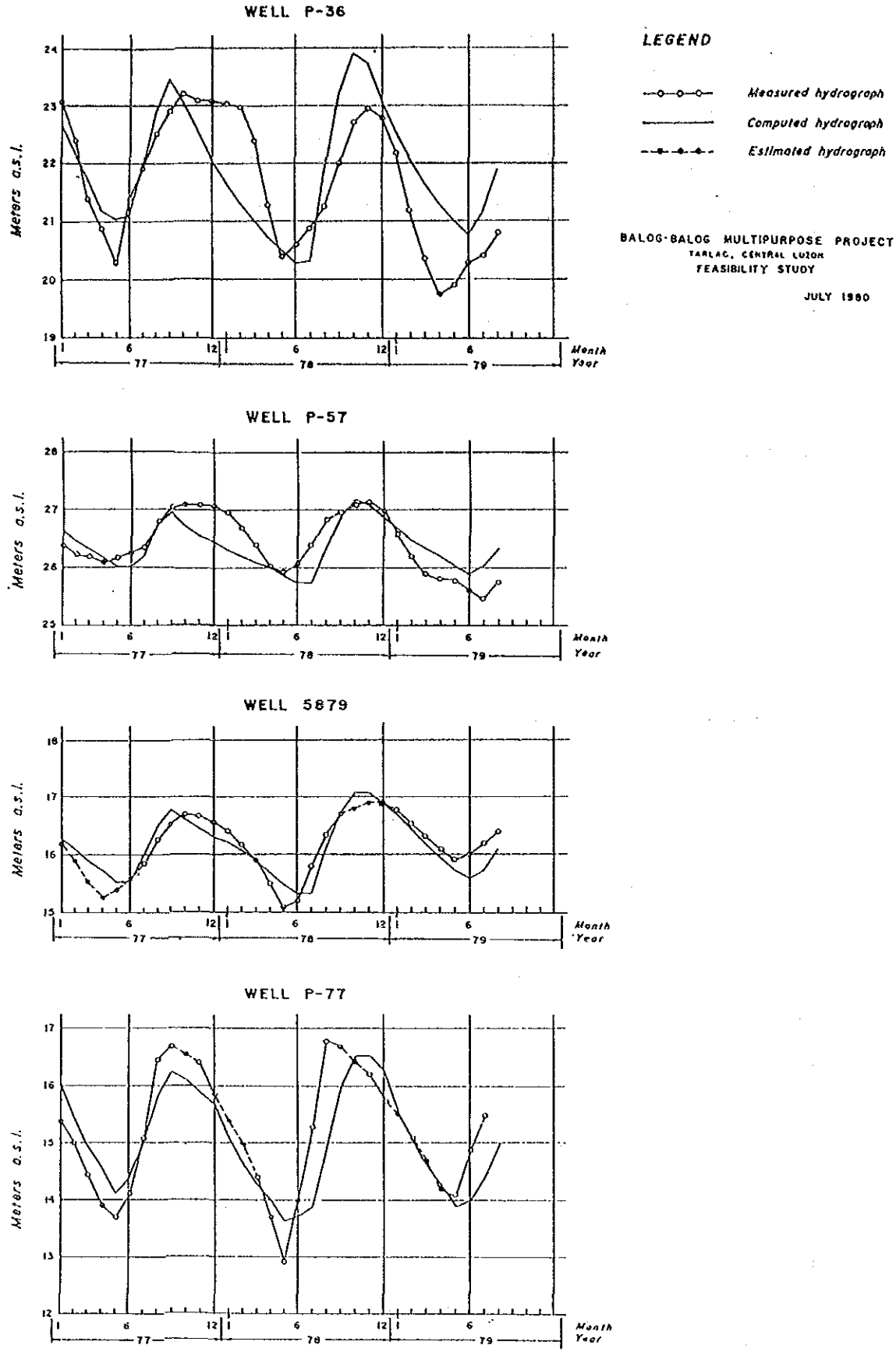


Figure D-9 Hydrograph on Well P-79

Figure D-11
Hydrograph in Some of the Reference Wells



APPENDIX E Soils and Land Use

E.1 Soil Profile In The Study Area

E.2 Existing Soil Profile Data In The Study Area

E.3 Stick Boring Data In The Study Area

E.1 Soil Profile in The Study Area

Test Pit No. A-1

Location : North of Ligaya,BAMBAN CIS,Bamban,Tarlac.
Landform : Alluvial Plain
Relief : Almost Level to Flat
Landuse : Sugarcane
Elevation : 12m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Good
Erosion : No Apparent Erosion
Soil Parent Material : Alluvial Deposits
Soil Series : Luisita Sandy Loam

Profile Description :
(Depth)
0- 30cm : Friable Granular Dark Brown SandyLoam, Moderately Soft, Very Faint Mottled.

- 70 : Single Grain Gray Sand, Moderately Soft.

-100 : Gray Coarce Sand incruding 1-2%rounded small pebbles.

Test Pit No. A-2

Location : North of Bangcu,BANGCU CIS,Bamban,Tarlac.
Landform : Alluvial Plain
Relief : Almost Level to Flat
Landuse : Paddy Rice
Elevation : 14m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Fair
Erosion : No Apparent Erosion
Soil Parent Material : Alluvial Deposits
Soil Series : Cabatican Silt Loam

Profile Description :
(Depth)
0- 20cm : Friable Granular Gray Sandy Loam with Brown Mottles, Moderately Soft,

- 40 : Blocky Gray SandyLoam with a lot of Brown Mottles Moderately Soft,

-100 : Weak Blocky Gray Silt Loam to Silty ClayLoam with Yelloish Brown Mottles,Moderately Hard to Moderate ly Soft.1

Test Pit No. A-3

Location : East of SanPedro,SANPEDRO CIS,Bamban,Tarlac.
Landform : Alluvial Plain
Relief : Almost Level to Flat
Landuse : Paddy rice
Elevation : 17m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Fair
Erosion : No Apparent Erosion
Soil Parent Material : Alluvial Deposits
Soil Series : Baran Silt Loam

Profile Description :
(Depth)
0- 15cm : Granular Brownish Gray Silt Loam with Yellowish Brown Mottles, Soft,

- 30 : Angular Blocky Olive Black Sandy Loam, Moderately Hard,

-100 : Single Grain Gray Loamy Sand to Coarce Sand with Brown Mottles incruding 5-10%rounded small pebbles

Test Pit No. A-4

Location : East of SantaRita,SANTARITA CIS,Concepcion, Tarlac.
Landform : Alluvial Plain
Relief : Almost Level to Flat
Landuse : Paddy Rice
Elevation : 8m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Fair
Erosion : No Apparent Erosion
Soil Parent Material : Alluvial Deposits
Soil Series : Baran Silt Loam

Profile Description :
(Depth)
0- 15cm : Friable Granular Dark Brown Silt Loam with Olive Brown Mottles, Soft,

- 40 : Nutty Brownish Black Silty Clay Loam with a lot of Dark Brown Mottles, Moderately Hard.

- 75 : Gray Silty Clay Loam with Yellowish Brown Mottles Moderately Soft to Moderately Hard

76- : Gray Sandy Clay Loam,

Test Pit No. A-5

Location : East of Lilibangan,LILIBANGAN CIS,Concepcion,Tarlac
Landform : Alluvial Plain
Relief : Almost Level to Flat
Landuse : Paddy Rice
Elevation : 5m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Good
Erosion : No Apparent Erosion
Soil Parent Material : Alluvial Deposits
Soil Series : Pawin Sandy Loam

Profile Description :
(Depth)
0- 15cm : Friable Nutty Gray Fine Sandy Loam, Soft.

- 30 : Subangular Gray Loosy Sand with Faint Olive Mottles,Hard.

- 36 : Gray Sand

- 47 : Subangular to Nutty Gray Fine Sandy Loam with Brown Mottles,Moderately Soft.

48- : Gray Loamy Sand to Sand

Test Pit No. A-6

Location : South of SantaRosa,LUCONG CIS,Concepcion,Tarlac,
Landform : Alluvial Plain
Relief : Almost Level to Flat
Landuse : Paddy Rice
Elevation : 6m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Fair
Erosion : No Apparent Erosion
Soil Parent Material : Alluvial Deposits
Soil Series : Zaragoza Clay Loam

Profile Description :
(Depth)
0- 17cm : Sharp Angular Blocky Gray Silty Clay Loam, Modera tely Soft, very Faint Brown Mottled,

- 48 : Weak Nutty or Angular Gray Silty Clay Loam with very Faint Brown Mottles, Moderately Soft to Moderately Hard.

-100 : Gray Silty Clay Loam to Silty Clay,very weak Nutty Structure, very Faint Olive Mottled.

Test Pit No. A-7

Location : West of Culatigan,LUCONG CIS,Concepcion,Tarlac,
Landform : Alluvial Plain
Relief : Almost Level to Flat
Landuse : Paddy Rice
Elevation : 5m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Fair
Erosion : No Apparent Erosion
Soil Parent Material : Alluvial Deposits
Soil Series : Zaragoza Clay Loam

Profile Description :
(Depth)
0- 15cm : Angular Blocky Dark Brown Fine Sandy Loam with Brown Mottles, Moderately Soft,

- 50 : Angular Yellowish Gray Fine Sandy Clay Loam with Brown Mottles, Moderately Hard,

- 70 : Weak Blocky Gray Fine Sandy Loam with very Faint Yellowish Brown Mottles, Moderately Soft to Modera tely Hard,

-100 : Weak Blocky Gray Silty Clay Loam with Yellowish Brown Mottles, Moderately Soft,

E.2 Existing Soil Profile Data in The Study Area

Master Pit No. B-1

Location : Bo.Estrada, Capas, Tarlac,
Landform : Alluvial Terrace
Relief : Nearly Level
Landuse : Paddy Rice
Elevation : 16m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Good
Erosion : No Apparent Erosion
Soil Parent Material : Alluvial Deposits
Soil Series : San Manuel

Profile Description :
(Depth)
0- 21cm.: Light gray fine sandy loam, very weak fine sub-angular blocky,diffuse wavy boundary.

- 33 : Dark gray fine sandy loam, many dark yellowish brown mottles, very weak fine subangular blocky, gradual wavy boundary.

- 58 : Dark gray sandy clay, moderate firm subangular blocky,discontinuous pores,diffuse smooth boundary

- 86 : Gray sandy clay, few fine faint brownish yellow mottles, medium subangular blocky,random tubular pores, diffuse smooth boundary.

130 : Gray sandy clay loam, moderately weak subangular blocky,presence of random tubular pores.

Master Pit No. B-2

Location : Bo.San Bartolome, Concepcion, Tarlac,
Landform : Old Alluvial Plain
Relief : Almost Flat
Landuse : Paddy Rice
Elevation : 14m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Moderately Good
Erosion : Not Noticeable
Soil Parent Material : Old Alluvial Deposits
Soil Series : Lapaz

Profile Description :
(Depth)
0- 12cm.: Very pale brown fine sandy loam, single grain to weak granular, no mottle, smooth clear boundary.

- 31 : Very pale brown sandy loam, firm granular, few fine to coarse tubular pores, smooth abrupt boundary.

- 67 : Very pale brown fine sandy loam, firm granular, few fine distinct dark yellowish brown mottles,few fine tubular pores, wavy abrupt boundary..

-160 : Dark yellowish brown fine sand, single grain structure.

Master Pit No. B-3

Location : Bo.San Nicolas Balas, Concepcion, Tarlac,
Landform : Alluvial Plain
Relief : Nearly Level
Landuse : Paddy rice
Elevation : 55m
Slope : 1%
Surface Drainage : Good
Internal Drainage : Good
Erosion : No Apparent Erosion
Soil Parent Material : Old Alluvial Deposits
Soil Series : Cabetican

Profile Description :
(Depth)
0- 10cm.: Brown fine sandy loam, fine granular structure, few fine faint brownish yellow mottles, clear smooth boundary.

- 50 : Grayish brown fine sandy loam,weak grunular, comcom fine faint yellowish brown mottles, clear wavy boundary.

- 85 : Dark gray clay loam, fine granular structure, no mottles, clear smooth boundary.

-105 : Gray coarse sand, single grain structure.

Master Pit No. B-4

Location : Balitucan, Concepcion, Tarlac,
Landform : Old Alluvial Plain
Relief : Almost Flat
Landuse : Mongo
Elevation :
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Moderately Good
Erosion : Not Noticeable
Soil Parent Material : Old Alluvial Deposits
Soil Series : Banga

Profile Description :
(Depth)
0- 18cm.: Very pale brown loamy fine sand, single grain to weak granular structure,no mottle, smooth boundary

- 60 : White fine sand, common coarse to fine distinct dark yellowish brown mottles, single grain structure, smooth abrupt boundary.

-122 : Light gray fine sand, few fine distinct dark yellowish brown mottles, single grain structure, smooth abrupt boundary.

-180 : Very pale brown fine sand, single grain,no mottle

Master Pit No. B-5

Location : Bo.Tinang, Concepcion,Tarlac,
Landform : Alluvial Terrace
Relief : Slightly Undulating to Gently Sloping
Landuse : Paddy Rice
Elevation : 10m
Slope : 0-1%
Surface Drainage : Fair
Internal Drainage : Fair
Erosion :
Soil Parent Material : Alluvial Deposits
Soil Series : Zaragoza

Profile Description :
(Depth)
0- 12cm.: Gray sandy clay loam, moderately weak medium subangular blocky, common medium distinct brownish yellow mottles, gradual smooth boundary.

- 72 : Dark gray to brown sandy clay loam, moderately weak medium subangular blocky structure, many coarse prominent dark yellowish brown mottles, common coarse black concretion,common oblique tubular pores, diffuse smooth boundary.

- 90 : Light brownish gray coarse sandy clay loam with gravel,weak medium angular blocky structure,medium distinct dark yellowish brown mottles,random interstitial pores,few coarse black concretion.

-120 : Brown loamy coarse sand with gravel, common fine distinct dark yellowish brown mottles.

-150 : White coarse sand with gravel.

Master Pit No. B-6

Location : Bo. Parang, Concepcion, Tarlac
Landform : Residual Terrace
Relief : Slightly Undulating
Landuse : Sugarcane
Elevation : 9m
Slope : 0-2%
Surface Drainage : Good
Internal Drainage : Fair
Erosion :
Soil Parent Material : Residual Deposits
Soil Series : Tarlac

Profile Description :
(Depth)
0- 13cm.: Brown fine sandy loam, moderately weak medium angular blocky structure, smooth abrupt boundary.

- 40 : Dark grayish brown fine sandy loam, weak medium subangular blocky structure, few fine faint dark yellowish brown mottles,gradual wavy boundary.

- 56 : Grayish brown sandy clay loam, very weak medium subangular blocky structure, common random interstitial pores, gradual smooth boundary.

-117 : Dark gray sandy clay loam,moderately to very weak subangular blocky structure, common random interstitial pores, common medium distinct to coarse prominent very dark brown and dark yellowish brown mottles.

Master Pit No. B-7

Location : Ligaya,Concepcion, Tarlac,
Landform : Alluvial Terrace
Relief : Very Slightly Sloping to Nearly Level
Landuse : Paddy Rice
Elevation :
Slope : 0.6-1%
Surface Drainage : Good
Internal Drainage : Good
Erosion : Not Noticeable
Soil Parent Material : Old Alluvial Deposits
Soil Series : Luisita

Profile Description :
(Depth)
0- 13cm.: Grayish brown loamy fine sand, structurelrss, clear smooth boundary.

- 36 : Grayish brown loamy fine sand, common fine distinct dark yellowish brown mottles, very weak fine granular structure, abrupt wavy boundary.

- 92 : Gray sand, single grain structureless, presence of very few gravels, clear smooth boundary.

-120 : Light gray sand, with thin stratified layer of silt, structureless, clear smooth boundary.

Master Pit No. B-8

Location : Sitio Nangca Santiago, Concepcion, Tarlac.
Landform : Alluvial Plain
Relief : Almost Level to Flat
Landuse : Paddy Rice
Elevation :
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Moderately Good
Erosion : Not Apparent Erosion
Soil Parent Material : Alluvial Deposits
Soil Series : San Manuel

Profile Description :
(Depth)
0- 11cm.: Light gray loam, moderately weak granular, few fine faint light yellowish brown mottlings, abrupt smooth boundary.

- 32 : Grayish brown sandy clay loam, moderately strong subangular blocky structure,few faint light yellowish brown brown mottlings, few medium soft black concretion,clear smooth boundary.

- 50 : Dark grayish brown sandy loam,few fine faint dark yellowish brown mottlings,presence of very few highly weathered sandstones, moderately strong sub angular blocky , many tubular contenuous pores, clear smooth boundary.

-132 : Light grayish brown to light gray loamy fine sand to fine sand, presence of moderately and highly weathered sandstones, very weak to single grain structure, presence of Fe stains.

Master Pit No. B-9

Location : Bo.Sto.Domingo Capas, Tarlac,
Landform : Residual Terrace
Relief : Slightly Sloping and Gently Undulating
Landuse : Paddy rice
Elevation : 14m
Slope : 0-1%
Surface Drainage : Good
Internal Drainage : Good
Erosion :
Soil Parent Material : Residual Deposits
Soil Series : Tarlac

Profile Description :
(Depth)
0- 13cm.: Gray fine sandy loam, weak fine subangular blocky structure,many common dark yellowish brown mottles diffuse smooth boundary.

- 43 : Dark grayish brown sandy clay loam, moderately weak medium subangular blocky, common random interstitial pores, diffuse wavy boundary.

- 67 : Grayish brown sandy clay loam, moderately medium subangular blocky, random interstitial pores, graduary wavy boundary.

- 90 : Grayish brown coarse sandy clay loam, subangular blocky,common medium distinct dark yellowish brown mottles,interstitial pores,diffuse broken boundary

-110 : Light brownish gray sandy clay loam, moderately weak fine angular blocky, few fine faint yellow mottles.

E.3 Stick Boring Data in The Study Area

Table E-3-1 Stick Boring Data (1)

C. I. S.	BANBAN				SAN PEDRO	MALONZO		BANGCU
No.	1	2	3	4	1	1	2	1
0cm	LS-S	FSL	SiCL	SCL	SCL	SiCL	FSL	SCL
	15cm	15cm		10cm	15cm	20cm	20cm	20cm
20	35cm	SiCL	20cm	SL	SL	FSL	SL-LS	
40		40cm	SiCL	40cm	25cm			SCL
	S			FSL	SL-LS	50cm	50cm	
60		SL-S					SiL	60cm
			65cm	75cm	70cm		-SiCL	
80			〃			LS-CoS	75cm	SL-LS
			FSL	FLS			CoS-S	
100			-FLS					
water table	>-100 cm	±0cm	±0cm	±0cm	±0cm	+3cm	±0cm	+5cm
Site	North of Ligaya	North east of Pacalcal	East of Pacalcal	North of Calubasa	East of San Pedro	South of Ligaya	North of Bangcu	Northwest of SanFrancisco

+~m : mottling

Table E-3-2 Stick Boring Data (2)

C. I. S.	BANGCU		SUSUBA	TELEBANCA			SANTA RITA	MARITA
No.	2	3	1	1	2	3	1	1
0cm	SL	SL-SCL	C	FSL	FSL	SL	FSL	SL
	15cm			20cm	20cm	20cm	15cm	15cm
20	LS-S	20cm	35cm	〃		LS-S	SiL	
40	40cm	CL		L-CL				LS
	S	60cm	P. M.	60cm	LS-S	50cm	50cm	50
60		SCL				CoS	SiCL	
80				SCL		80cm		LS-S
		85cm			85cm		90cm	
100		SL			SiCL		SiCL	
water	±0cm	>-100 cm	±0cm	+10cm	-50cm	±0cm	>-100 cm	±0cm
Site	North of Bangcu	North of SanFrancisco	South of Susuba	West of SanNicolas	North of Telebanca	South of Banaba	East of Santa Rita	North east of San Martin

Table E-3-3 Stick Boring Data (3)

C. I. S.	SAN MARTIN		BALUTO		MAGAO		SAN BARTOLOME	
No.	1	2	1	2	1	2	1	2
0cm	LS	SL	FSL	SiCL	LS	SL	FSCL	SCL
20	25cm	20cm SL-LS	15cm SL	30cm CoLS	25cm LS	15cm LS-S	20cm FSL-LS	20cm FSL
40		50cm		50cm		50cm	50cm	50
60	S	SL-LS		FSL	60cm		CoLS-S	LS-S
80			70cm	70cm	FSL -FS			
100			LS	SCL	90cm			
water table	+0cm	+0cm	±0cm	+3cm	+5cm	+0cm	±0cm	±0cm
Site	East of San Martin	South east of the Area	South east of Baluto	South of Baluto	South of Magao	East of Magao	South of SanBar tolome	East of SanBar tolome

Table E-3-4 Stick Boring Data (4)

C. I. S.	SAN ISIDRO		LUCONG					
No.	1	2	1	2	3	4	5	6
0cm	LS	LS 15cm	SL 10cm	SCL	SiCL	FSCL 15cm	FSL	SL 15cm
20	25cm	FSL	LS 25cm	20cm LS	20cm FSCL	FSCL	20cm	LS-S
40	S	45cm	SL 40cm	35cm			FSCL	
60	70cm	FSL	LS 65cm	LS-S	65cm	75cm		70cm
80	CoS		FSL 90cm		SCL	SiCL	80cm FSCL	SiL 80cm
100								SiCL
water table	>-100 cm	>-100 cm	-90cm	-20cm	-70cm	-80cm	-70cm	>-100 cm
Site	East of San Isidro	West of Sanisi dro	East of San Cristo	North east of San Cristo	South of Santa Rosa	West of Culati gan	West of Cafe	South of Santa Maria

Table E-3-5 Stick Boring Data (5)

C. I. S.	LUCONG	LILIBANGAN		TINANG	STO. ROSARIO	SANTA MONICA		CALULUAN
No.	7	1	2	1	1	1	2	1
0cm	SCL 15cm	SL 10cm	FSL	FSL	SiCL	SiCL	SiL -SiCL	FSL
20	FSCL	LS	20cm FLS	30cm	20cm	20cm SiCL	20cm SiCL	20cm FSL
40	50cm	40cm	30cm		SiC	40cm	-SiC	40cm
60	LS	LS	SiL -SiCL	SCL	75cm	SiCL -C	55cm SiC-C	FSCL 65cm
80	80cm SiCL					85cm C		SiCL
100			95cm					
water table	>-100 cm	>-100 cm	>-100 cm	±0cm	±0cm	±0cm	±0cm	+2cm
Site	East of Talimu ndoc	West of Liliba ngan	East of Liliba ngan	South of Tinang	North of Magunt ing	North of Santa Monica	East of Santa Monica	North of Caluluan