

Table 9.5 ANNUAL DISBURSEMENT SCHEDULE FOR THE ALTERNATIVE DEVELOPMENT PROJECT

	1992/93		1993/94		1994/95	
	F/C (US\$ 1,000)	Total (Rp. mil.)	F/C (US\$ 1,000)	Total (Rp. mil.)	F/C (US\$ 1,000)	Total (Rp. mil.)
1 Detailed Design	224	614	224	614		
2 Land Acquisition	0	950		950		
3 Construction Works						
1) Direct Cost	2,671	7,816	668	1,954	2,003	5,862
2) Value Added Tax	307	899	77	225	230	674
Sub-total	2,978	8,715	745	2,179	2,234	6,536
4 Contingencies						
1) Physical Contingency	401	1,172	100	293	301	879
2) Price Contingency	178	1,566	25	243	153	1,323
Sub-total	579	2,738	126	536	453	2,202
5 Procurement of O&M Equipment	604	28	14	573	14	573
6 Engineering Services	267	782	67	196	200	587
7 Administration Cost	80	234	20	59	60	176
8 Training Program	0	107	0	27	0	80
<b>TOTAL</b>	<b>4,732</b>	<b>14,168</b>	<b>224</b>	<b>1,564</b>	<b>2,961</b>	<b>10,153</b>

Remark Price escalation rate : F/C = 3%/year L/C = 8%/year

Table 9.6 FINANCIAL CASH FLOW STATEMENT OF THE ALTERNATIVE DEVELOPMENT PROJECT

(Unit : Rp. Million)

Year	Year in Order	Project Cost		O & M Cost		Cash Outflow		Cash Inflow		Foreign Loan	Government Budget	Government Subsidy	Water Charge	Total Inflow(B)	Balance (B)-(A)	Accumulated Loan
		Cost	Cost	Cost	Cost	Loan Interest	Loan Repayment	Total Outflow(A)	Total Inflow(B)							
1992	1	1,028	0	0	0	0	21	1,049	21	820	208	0	0	1,049	0	820
1993	2	5,000	0	0	0	0	121	5,121	121	4,000	1,000	0	0	5,121	0	4,820
1994	3	15,000	0	0	0	0	421	15,421	421	12,000	3,000	0	0	15,421	0	16,820
1995	4	0	40	0	0	0	461	461	461	0	0	0	0	461	0	16,820
1996	5	0	48	0	0	0	469	469	469	0	0	0	0	469	0	16,820
1997	6	0	122	0	0	0	421	543	543	0	0	0	0	543	0	16,820
1998	7	0	210	0	0	0	421	631	631	0	0	0	0	631	0	16,820
1999	8	0	210	0	0	0	421	631	631	0	0	0	0	631	0	16,820
2000	9	0	210	0	0	0	421	631	631	0	0	0	0	631	0	16,820
2001	10	0	210	0	0	0	421	631	631	0	0	0	0	631	0	16,820
2002	11	0	210	0	0	0	399	841	841	0	0	0	0	841	0	15,979
2003	12	0	210	0	0	0	378	1,429	1,429	0	0	0	0	1,429	0	15,138
2004	13	0	210	0	0	0	357	1,408	1,408	0	0	0	0	1,408	0	14,297
2005	14	0	210	0	0	0	336	1,387	1,387	0	0	0	0	1,387	0	13,456
2006	15	0	210	0	0	0	315	1,366	1,366	0	0	0	0	1,366	0	12,615
2007	16	0	210	0	0	0	294	1,345	1,345	0	0	0	0	1,345	0	11,774
2008	17	0	210	0	0	0	273	1,324	1,324	0	0	0	0	1,324	0	10,933
2009	18	0	210	0	0	0	252	1,303	1,303	0	0	0	0	1,303	0	10,092
2010	19	0	210	0	0	0	231	1,282	1,282	0	0	0	0	1,282	0	9,251
2011	20	0	210	0	0	0	210	1,261	1,261	0	0	0	0	1,261	0	8,410
2012	21	0	210	0	0	0	189	1,240	1,240	0	0	0	0	1,240	0	7,569
2013	22	0	210	0	0	0	168	1,219	1,219	0	0	0	0	1,219	0	6,728
2014	23	0	210	0	0	40	147	1,238	1,238	0	0	0	0	1,238	0	5,887
2015	24	0	210	0	0	253	126	1,430	1,430	0	0	0	0	1,430	0	5,046
2016	25	0	210	0	0	213	105	1,369	1,369	0	0	0	0	1,369	0	4,205
2017	26	0	210	0	0	0	84	1,135	1,135	0	0	0	0	1,135	0	3,364
2018	27	0	210	0	0	0	63	1,114	1,114	0	0	0	0	1,114	0	2,523
2019	28	0	210	0	0	0	42	1,093	1,093	0	0	0	0	1,093	0	1,682
2020	29	0	210	0	0	0	21	1,072	1,072	0	0	0	0	1,072	0	841
2021	30	0	210	0	0	0	0	1,051	1,051	0	0	0	0	1,051	0	0
Total		21,028	24,790	2,007	7,500	16,820	72,145	72,145	51,117	16,820	4,208	0	0	72,145	0	0

Remarks: Foreign Loan: Annual interest of 2.5% for repayment period of 30 years including 10-year grace period.

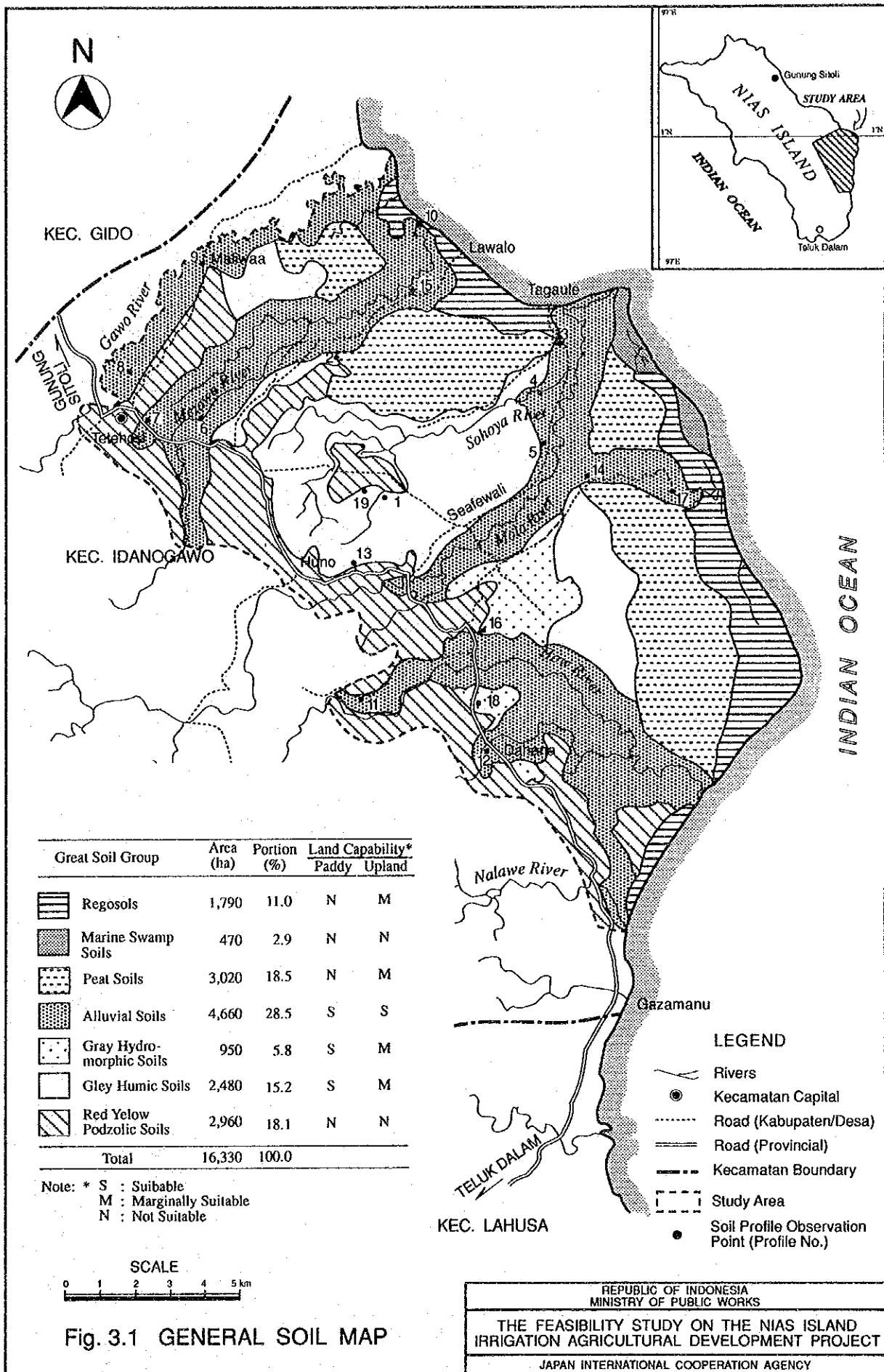


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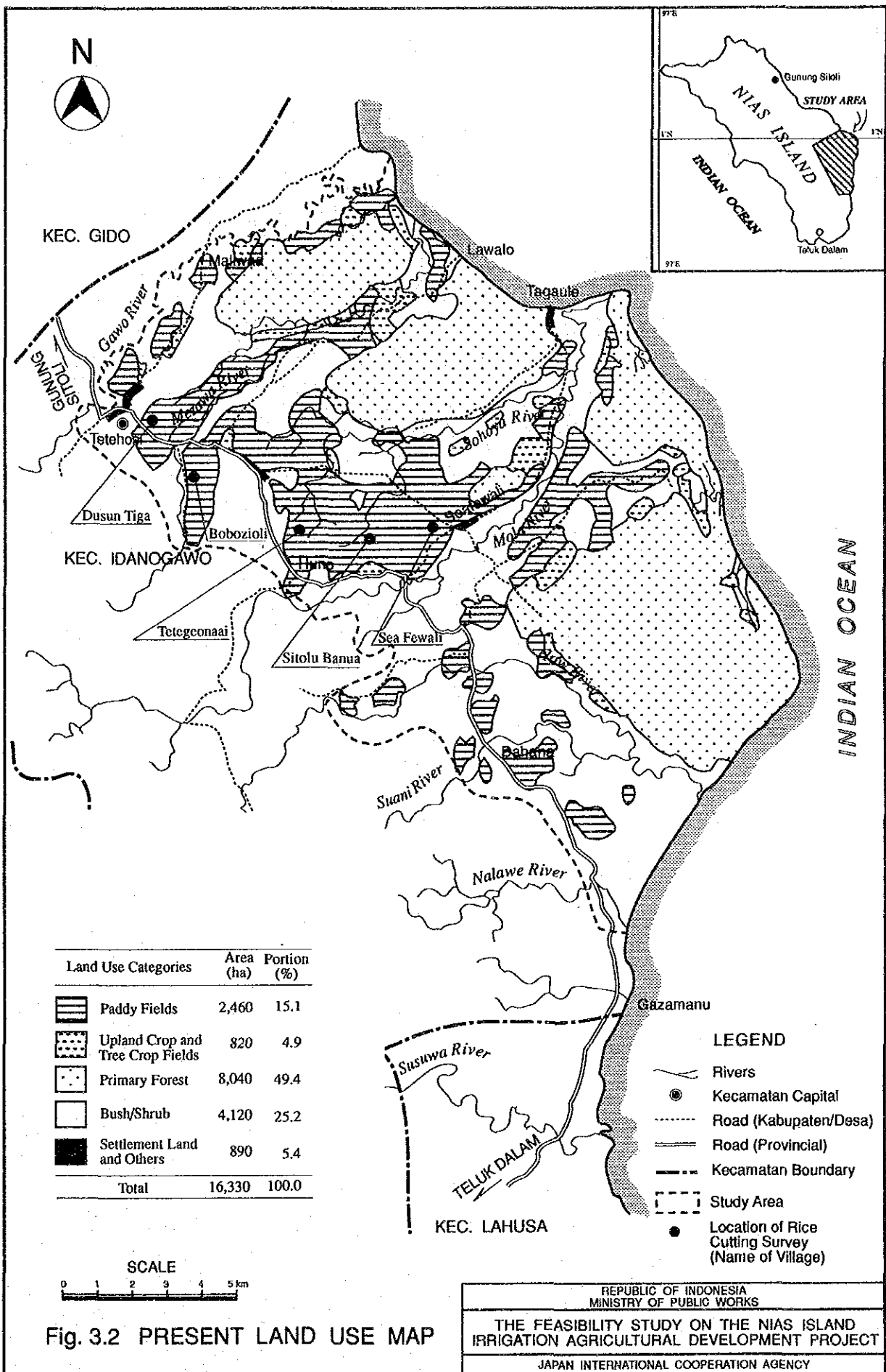
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## ***FIGURES***



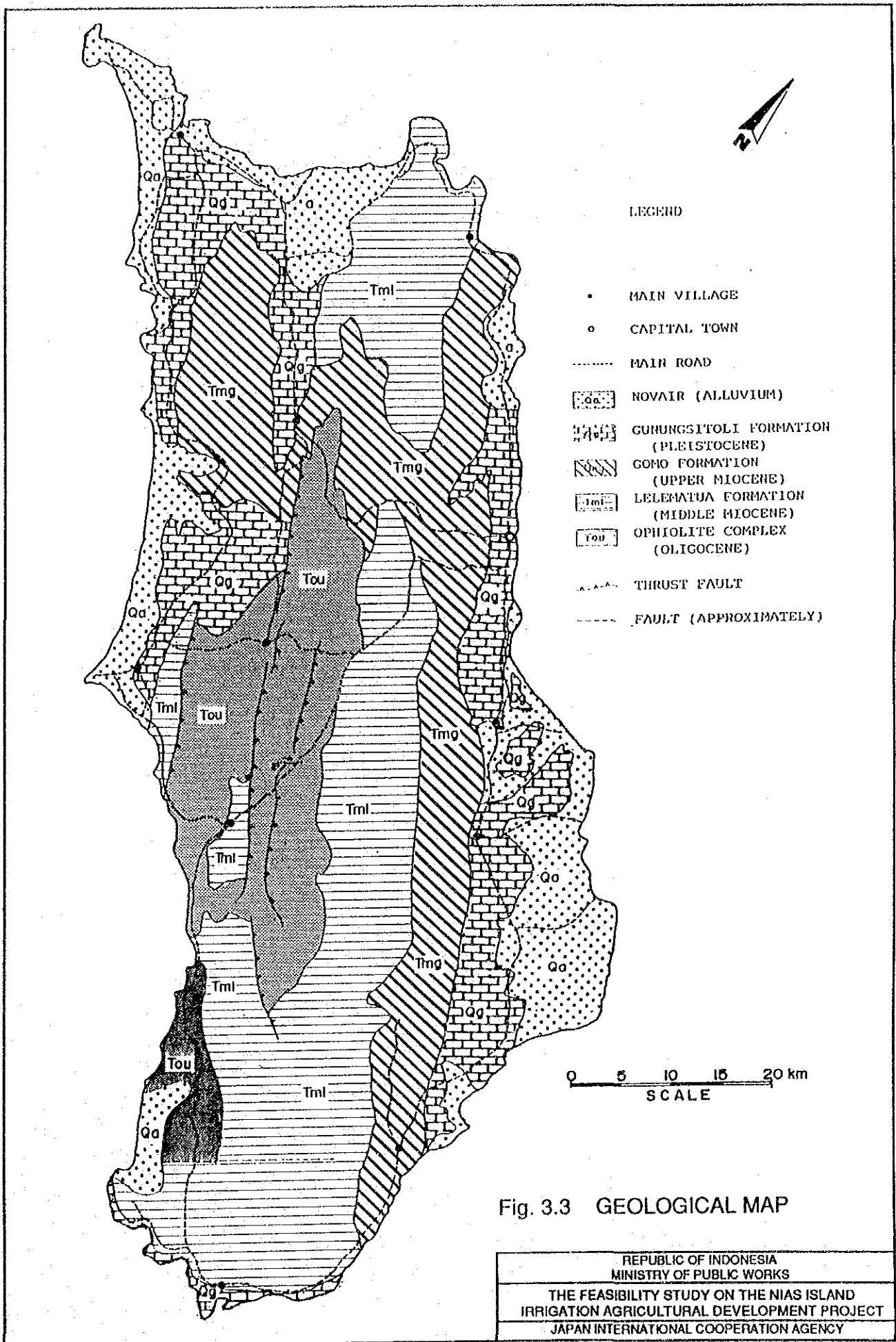




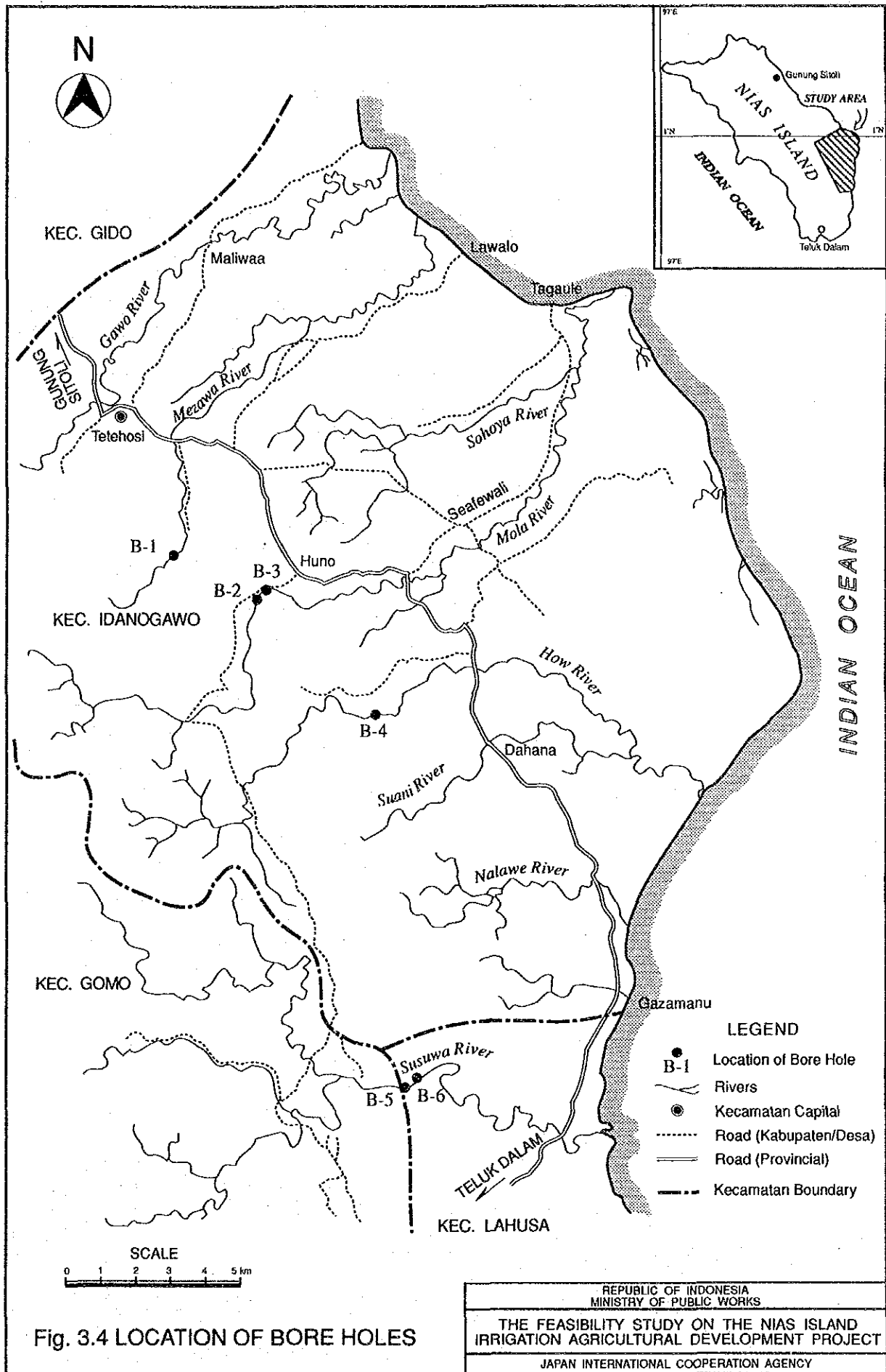














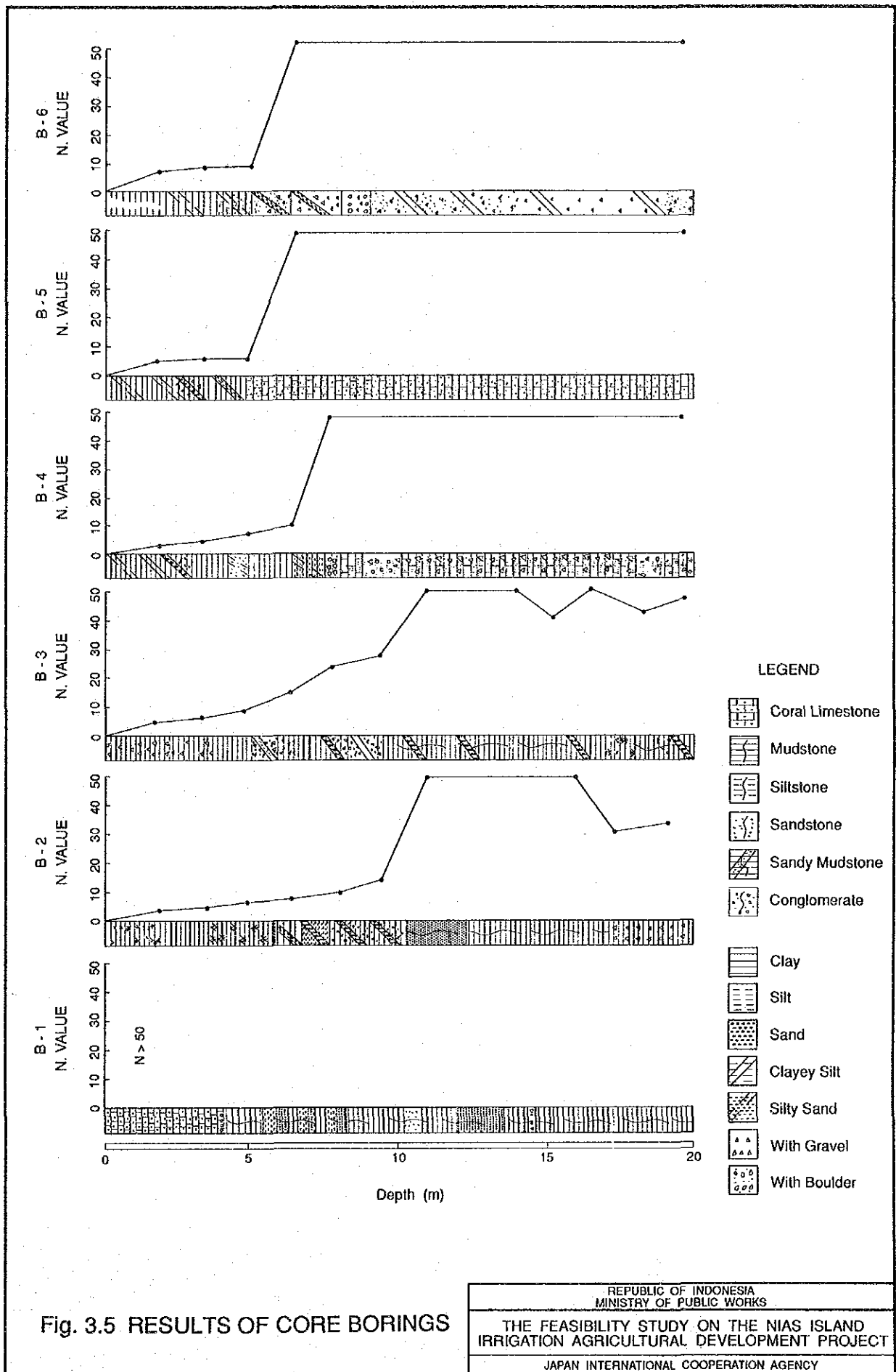


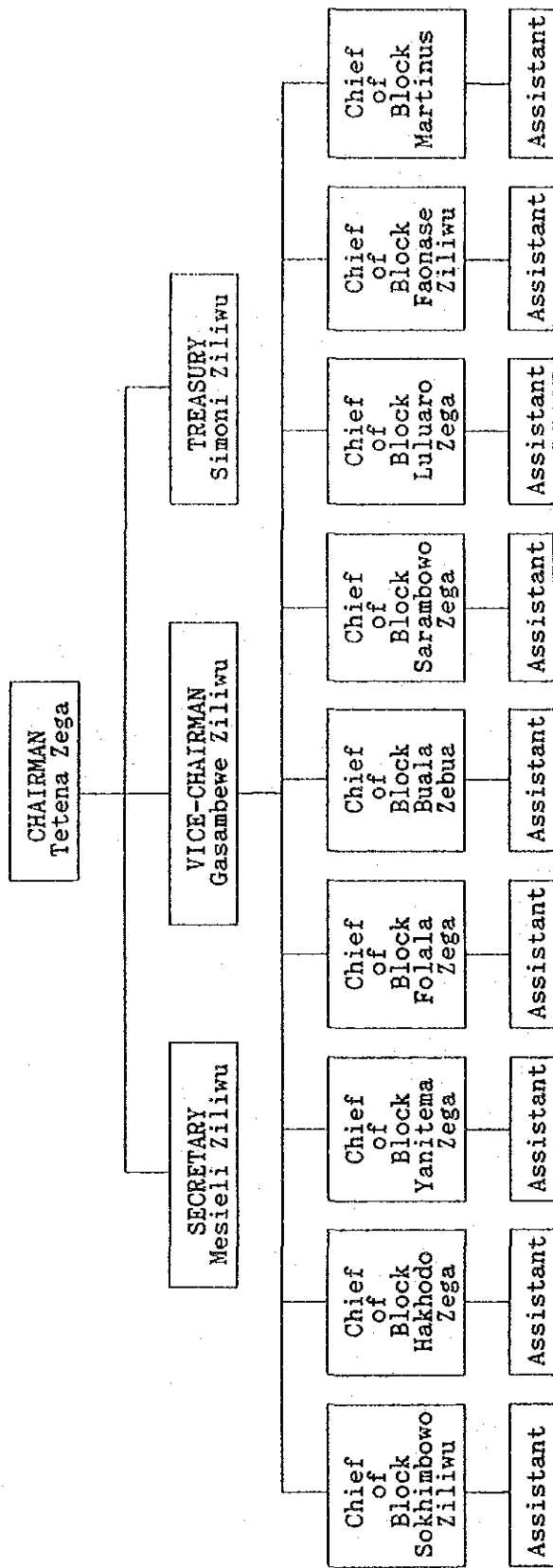
Fig. 3.5 RESULTS OF CORE BORINGS

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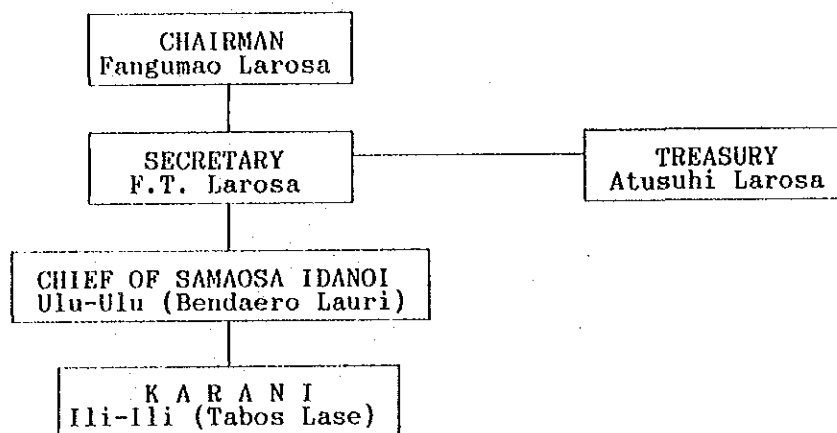
Source : P3A Afia

Fig. 3.6 ORGANIZATION OF P3A (AFIA)

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 THE FEASIBILITY STUDY ON THE NIAS ISLAND  
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Source : P3A Madawa

Fig. 3.7 ORGANIZATION OF P3A  
(BAWEDESOLO)

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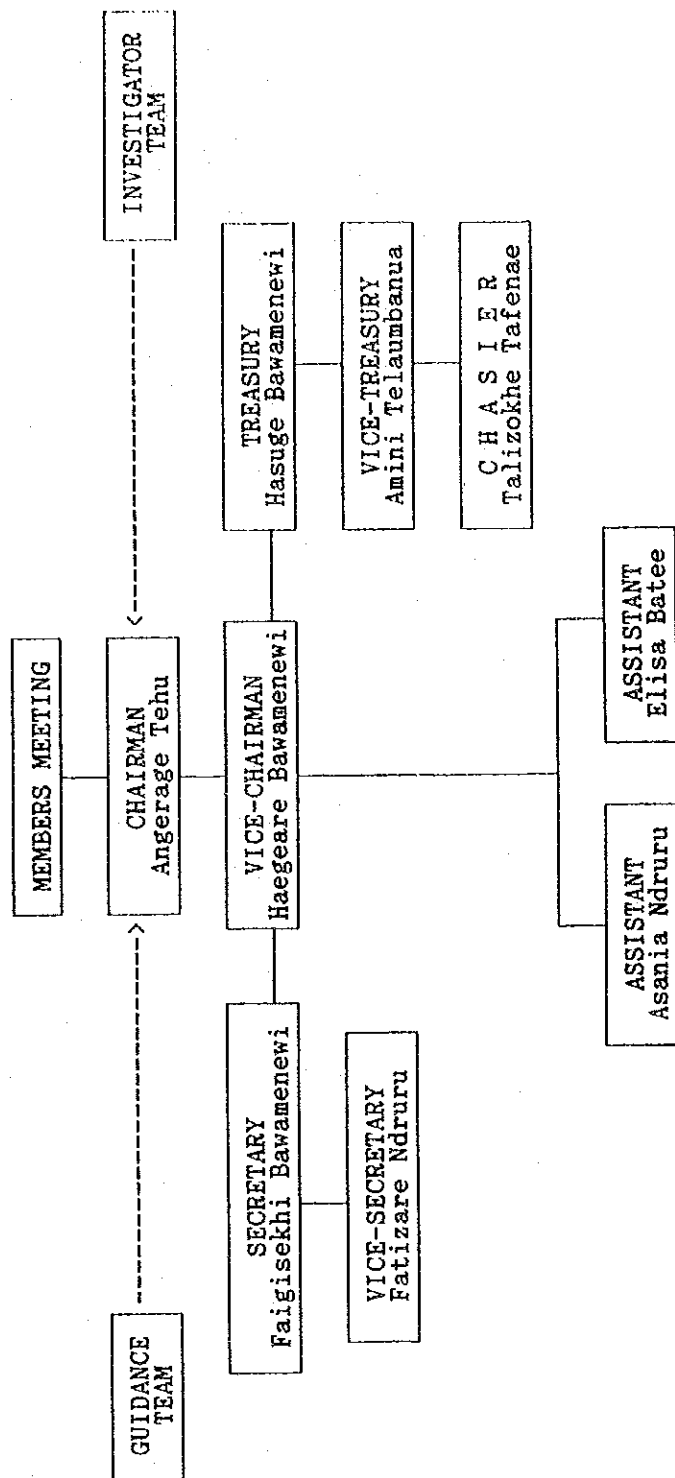


Fig. 3.8 ORGANIZATION CHART OF KUD  
TOLONG MENOLONG

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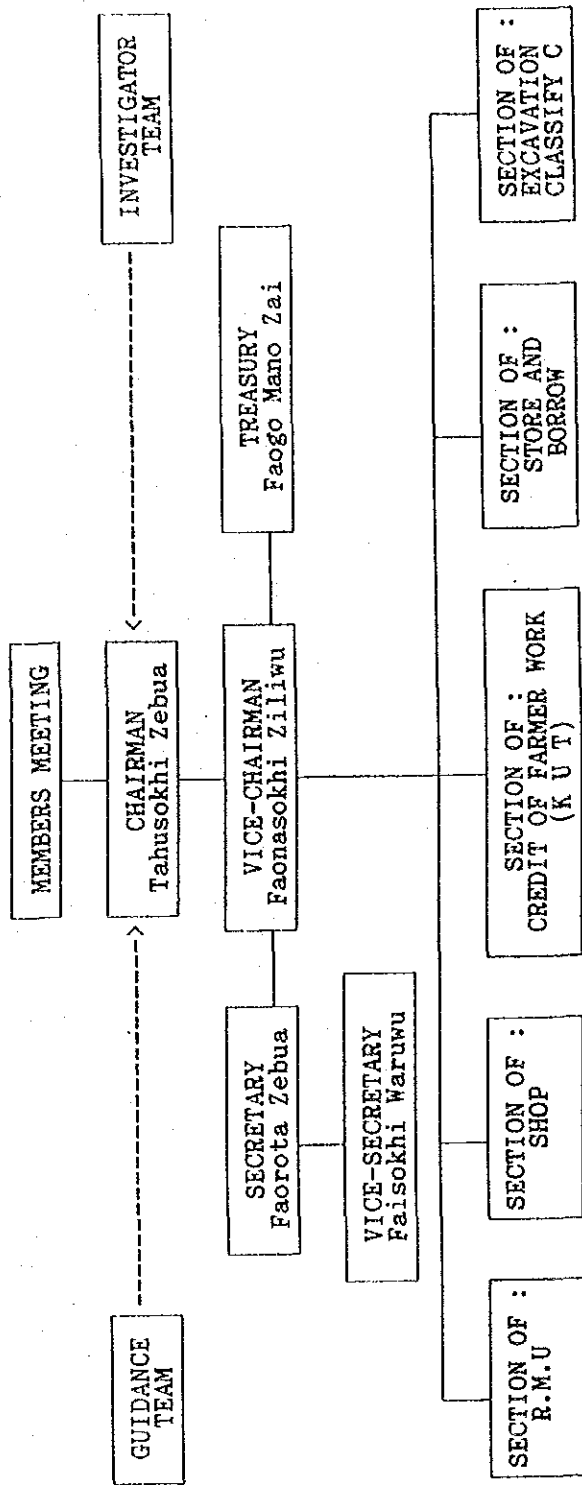


Fig. 3.9 ORGANIZATION CHART OF KUD MASA KARYA

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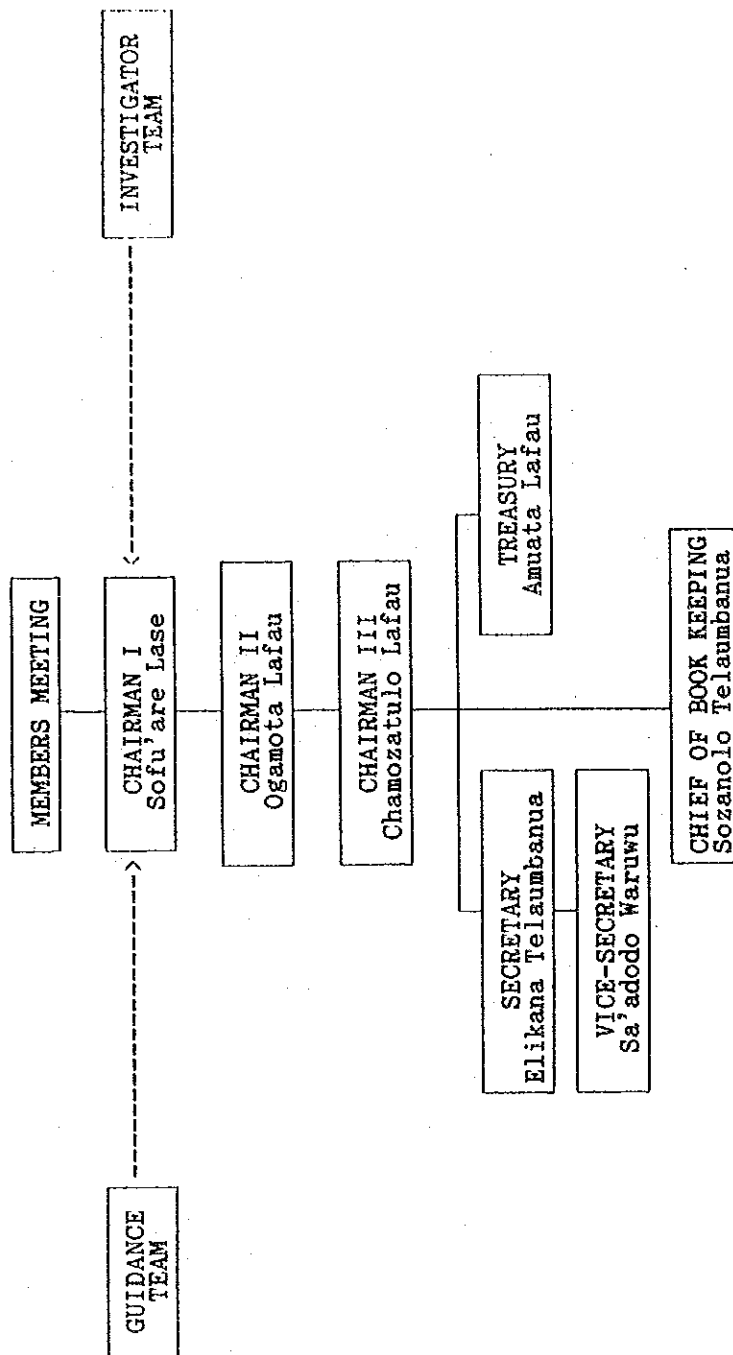


Fig. 3.10 ORGANIZATION CHART OF KUD SEHATI MAJU

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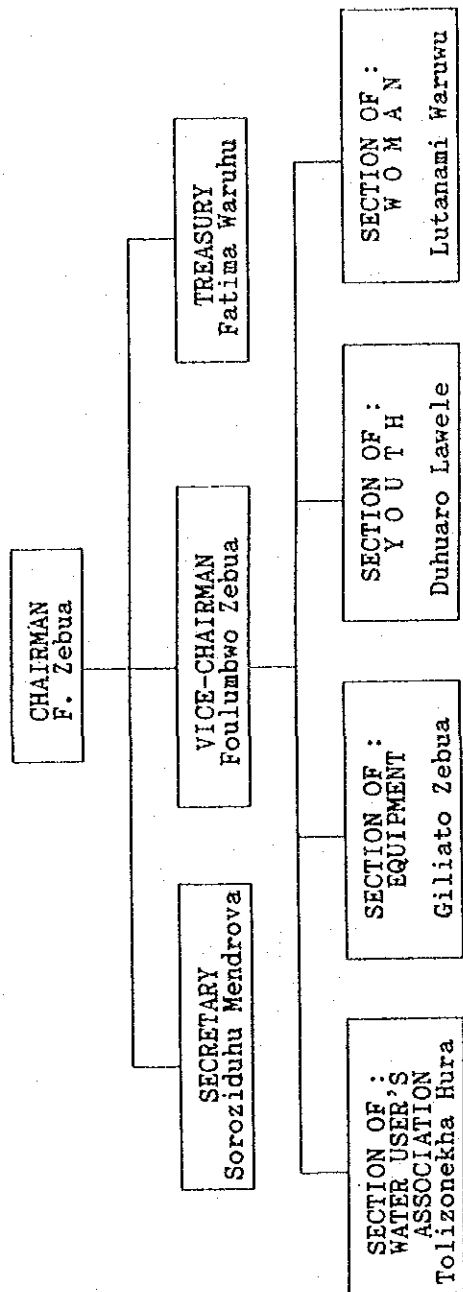


Fig. 3.11 ORGANIZATION CHART OF FARMER'S GROUP (TALABU)

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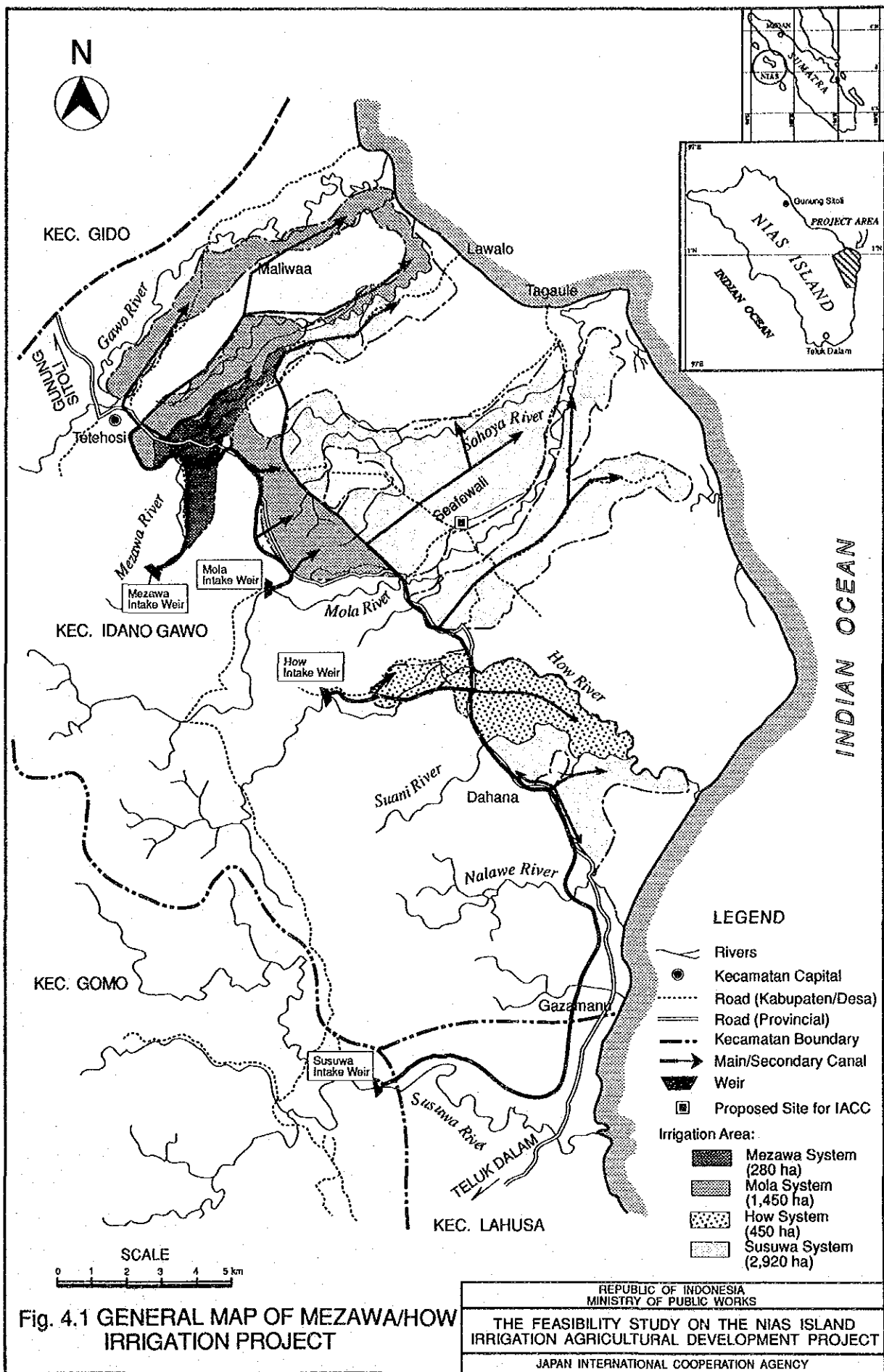
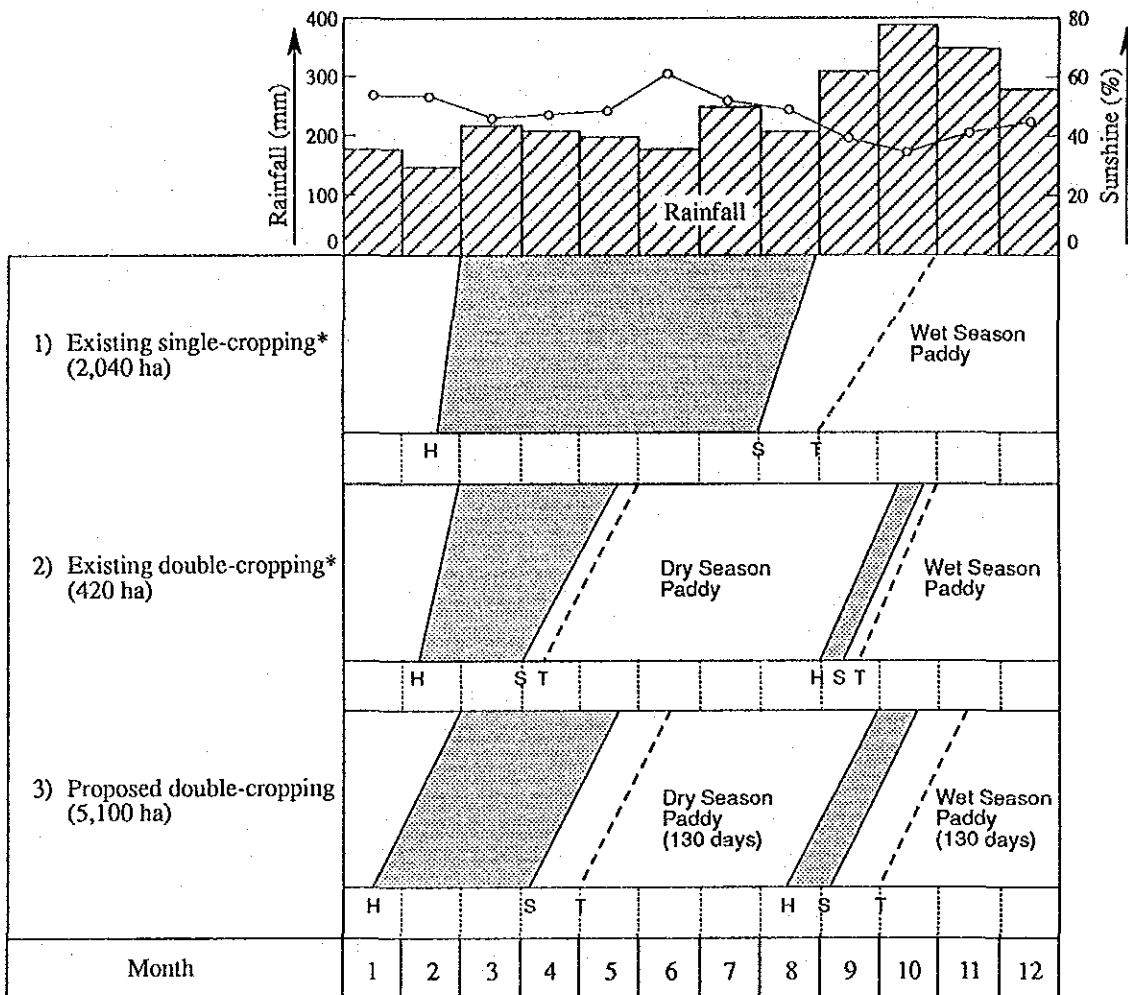


Fig. 4.1 GENERAL MAP OF MEZAWA/HOW IRRIGATION PROJECT





LEGEND	
	Rainfall
	Fallow period
S	Sowing
T	Transplanting
H	Harvesting

Remarks  
 1. Sunshine hours are daily total from 8 A.M. to 4 P.M.  
 2. Rainfall data at Sitoli Mountain Station is used.  
 (average of 85 years)  
 \* Data Source : Crop cutting survey

Fig. 4.2 EXISTING AND PROPOSED CROPPING PATTERN IN MEZAWA/HOW PROJECT AREA



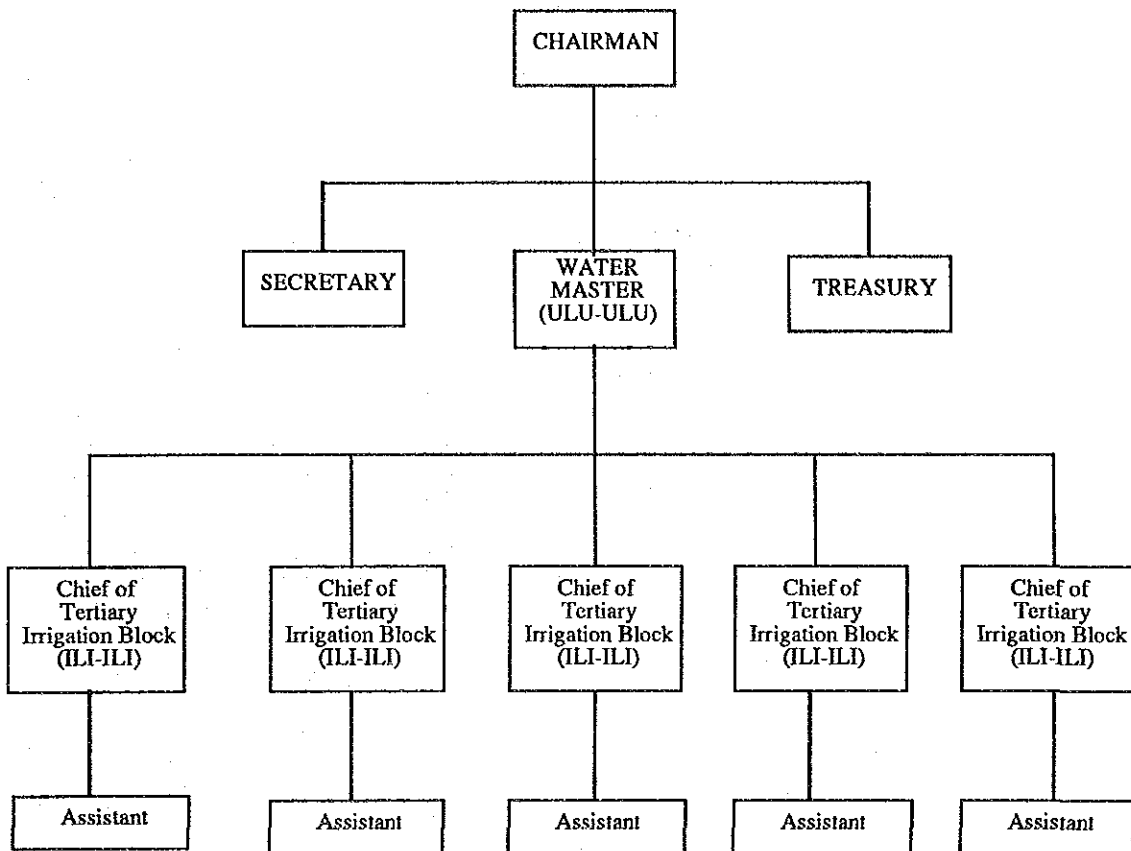


Fig. 4.3 PROPOSED ORGANIZATION OF THE P3As

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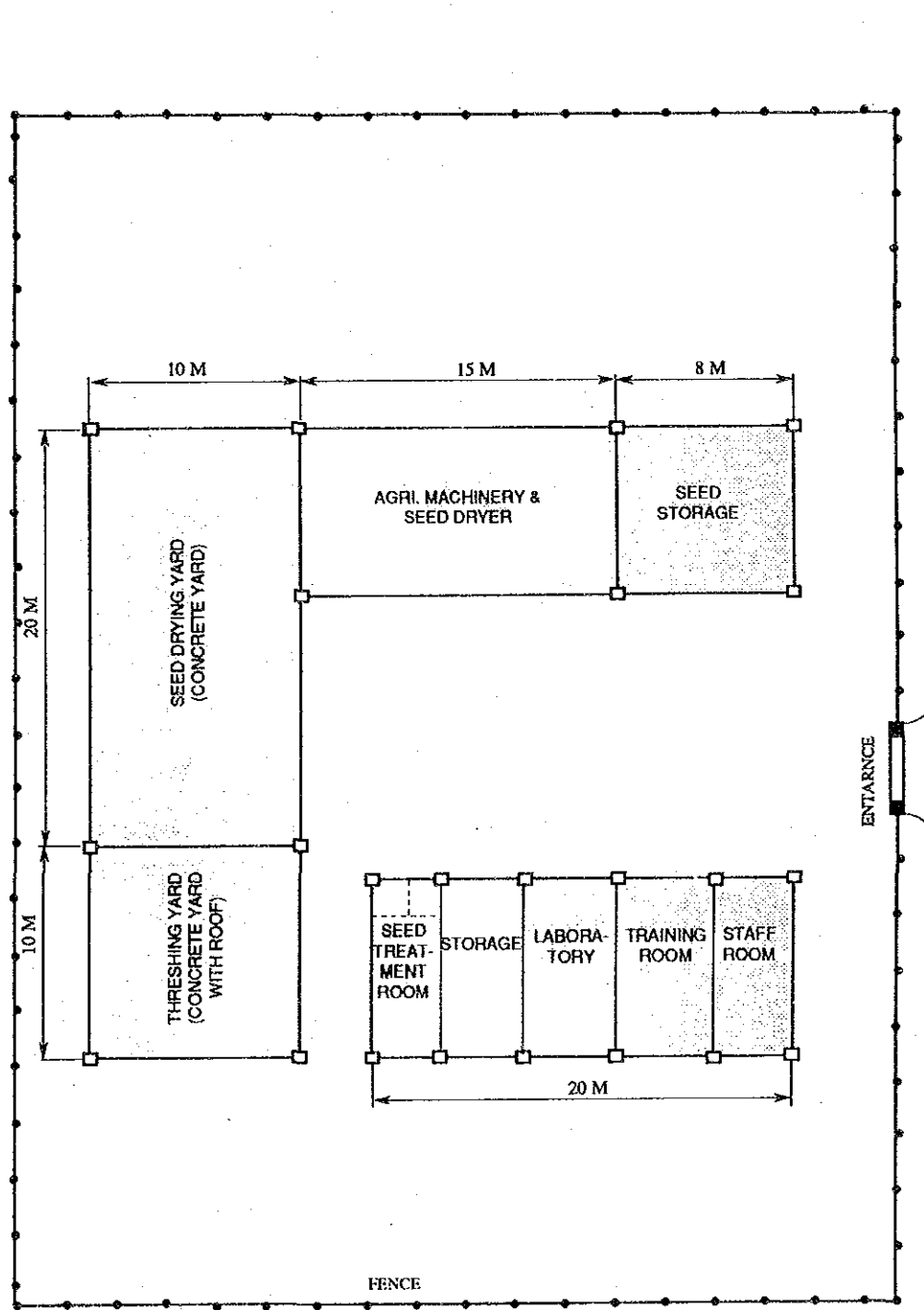
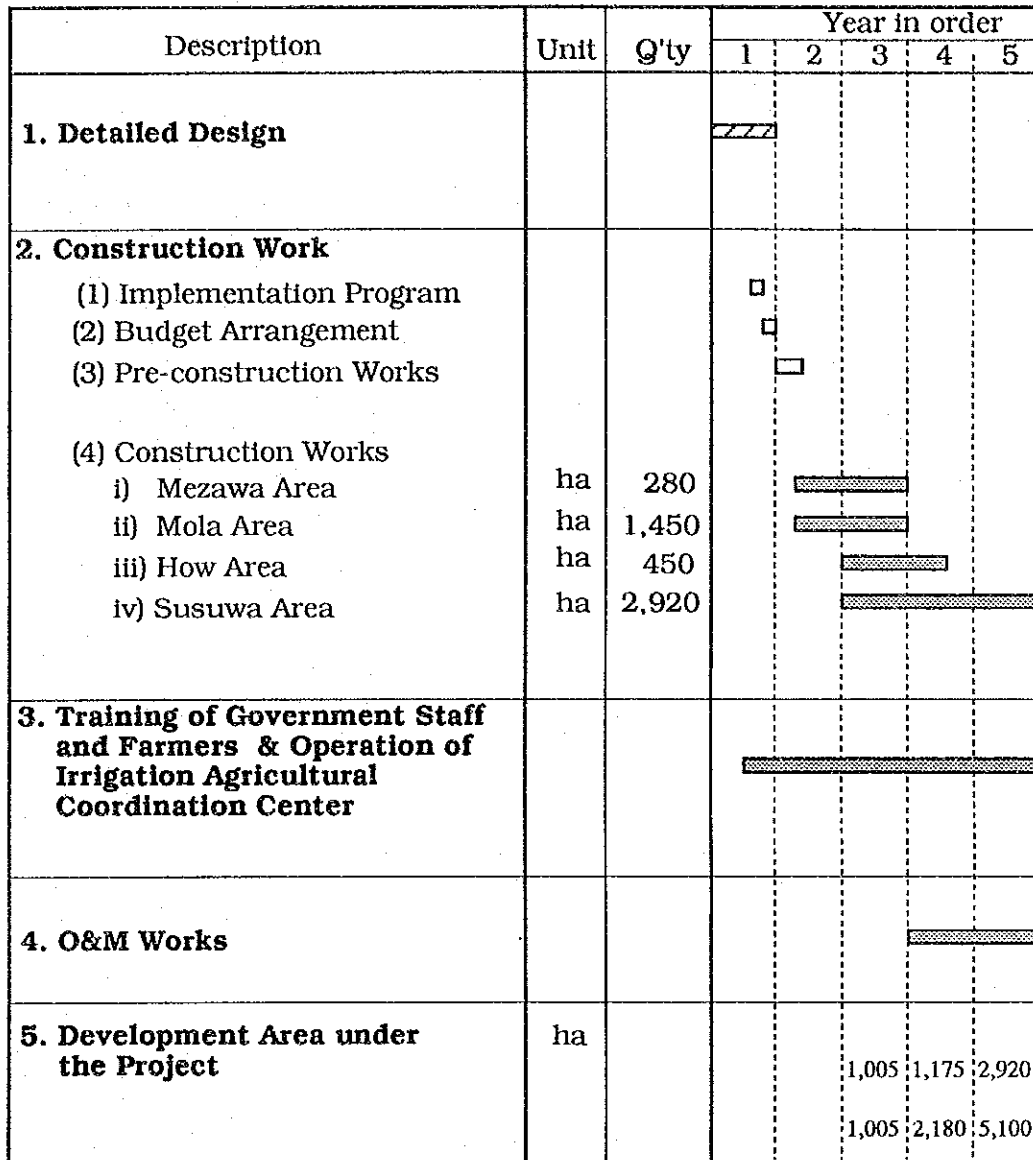


Fig. 4.4 GENERAL LAYOUT OF IACC

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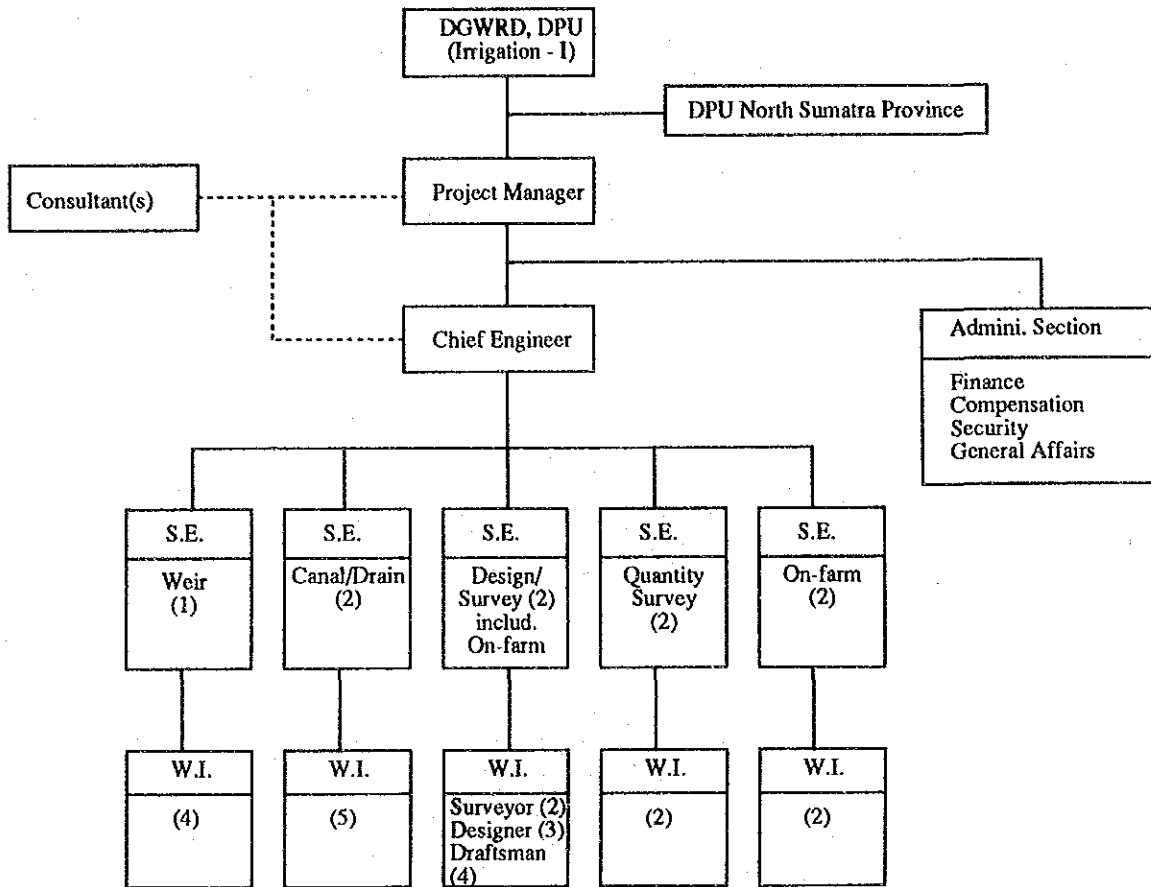
NOTE

- ▨ Detailed Design
- Pre-construction Works
- ▨ Project Works

Fig. 6.1 IMPLEMENTATION TIME SCHEDULE

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Remarks

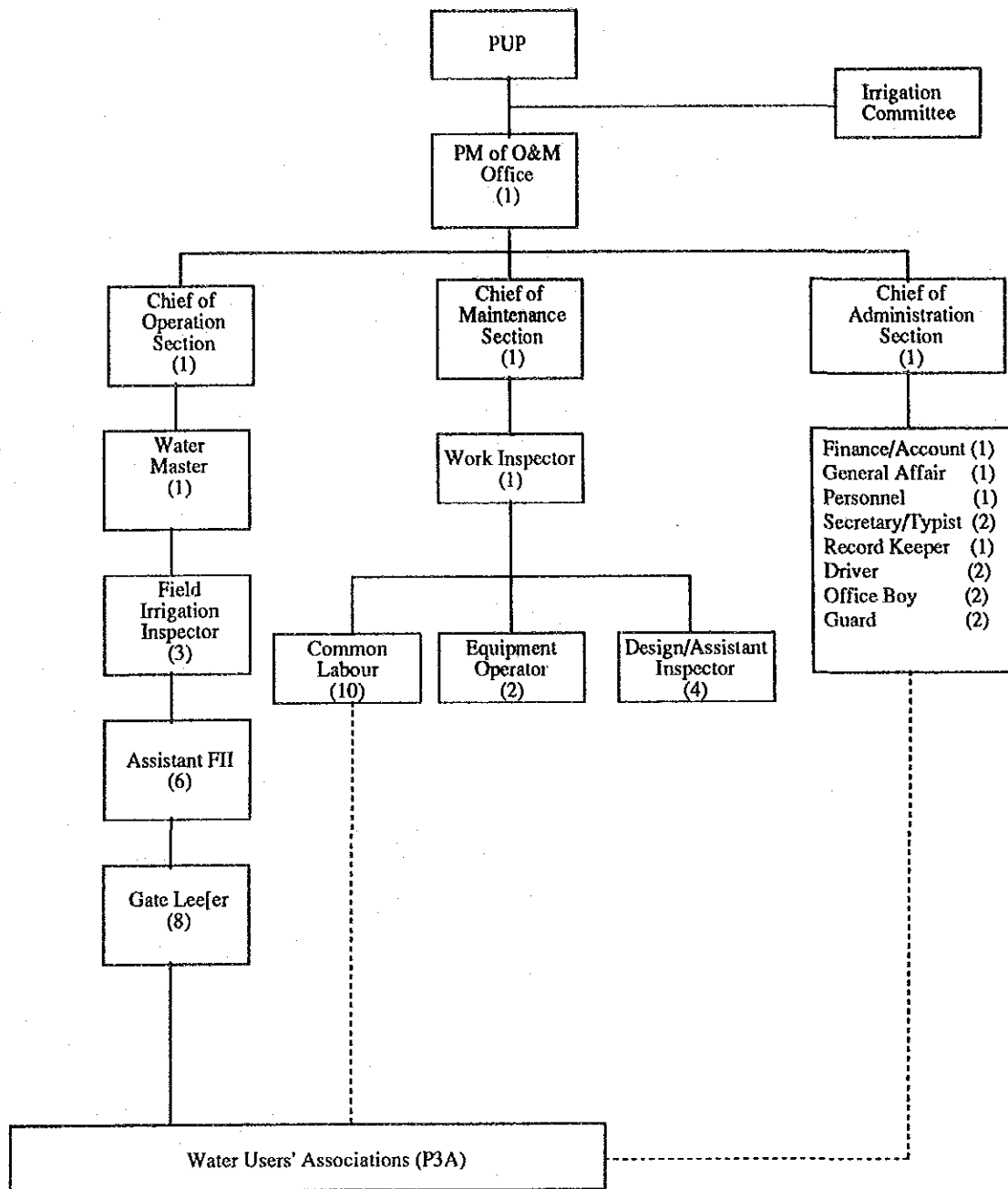
S.E. : Site Engineer

W.I. : Work Inspector

Fig. 6.2 PROPOSED ORGANIZATION OF PROJECT OFFICE

REPUBLIC OF INDONESIA MINISTRY OF PUBLIC WORKS
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PUP : DPU, North Sumatra Province  
 PM : Project Manager of the Office  
 FII : Field Irrigation Inspector  
 \* : Repair and periodical maintenance  
 of O&M equipment will be subject to  
 local workshop in Gunung Sitoli

Fig. 6.3 PROPOSED ORGANIZATION OF O&M OFFICE

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 IRRIGATION AGRICULTURAL DEVELOPMENT PROJECT  
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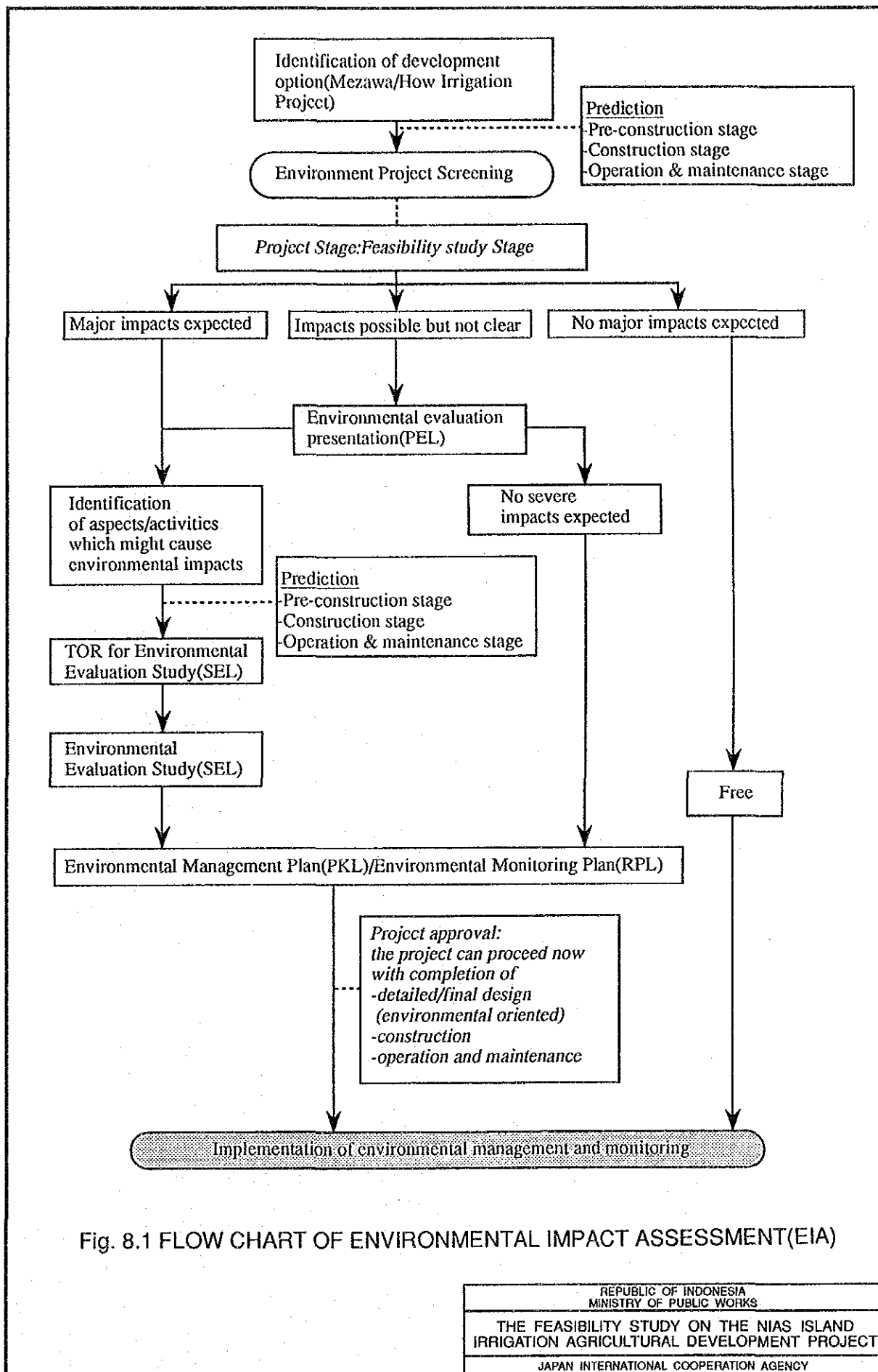
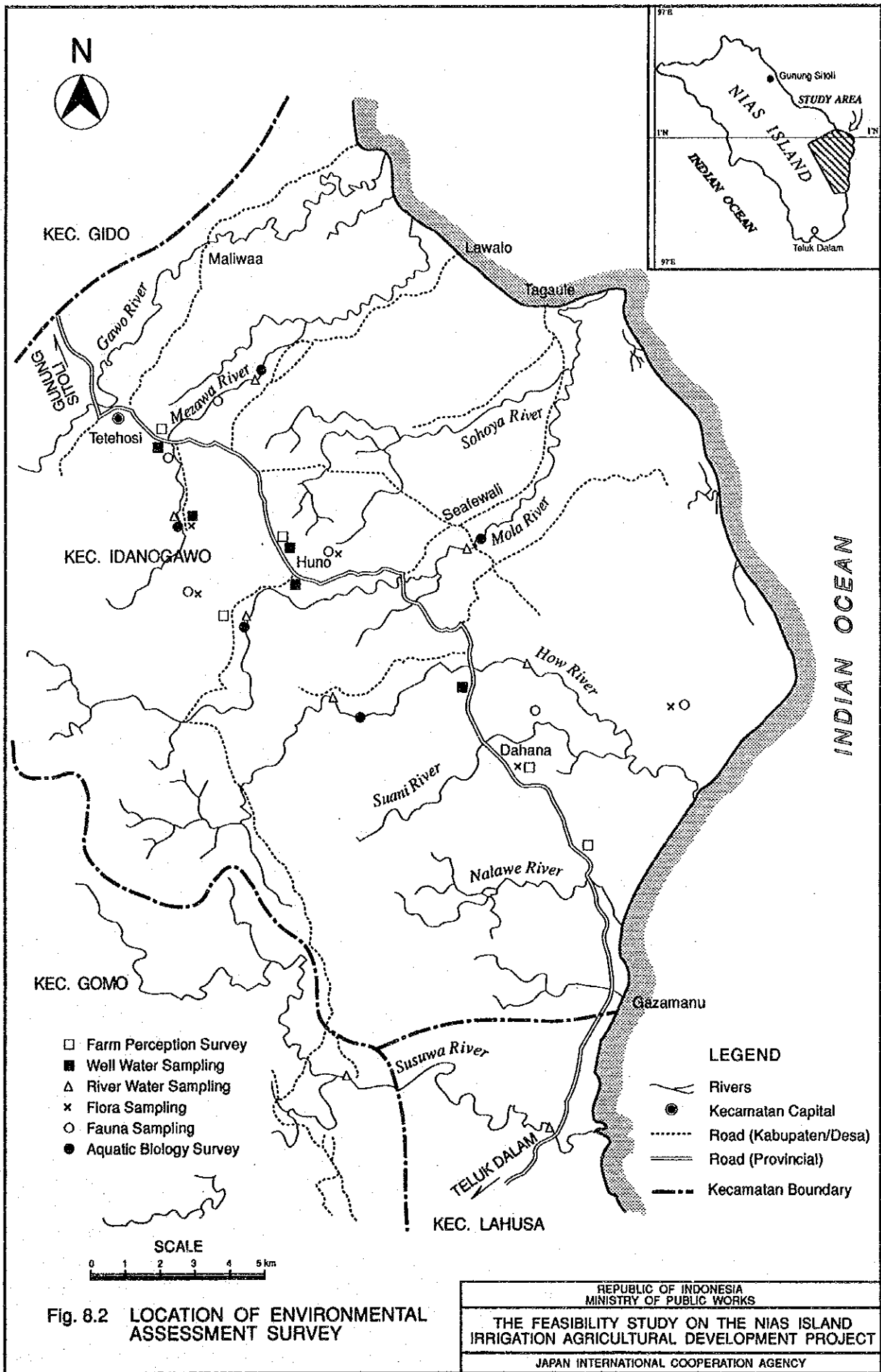
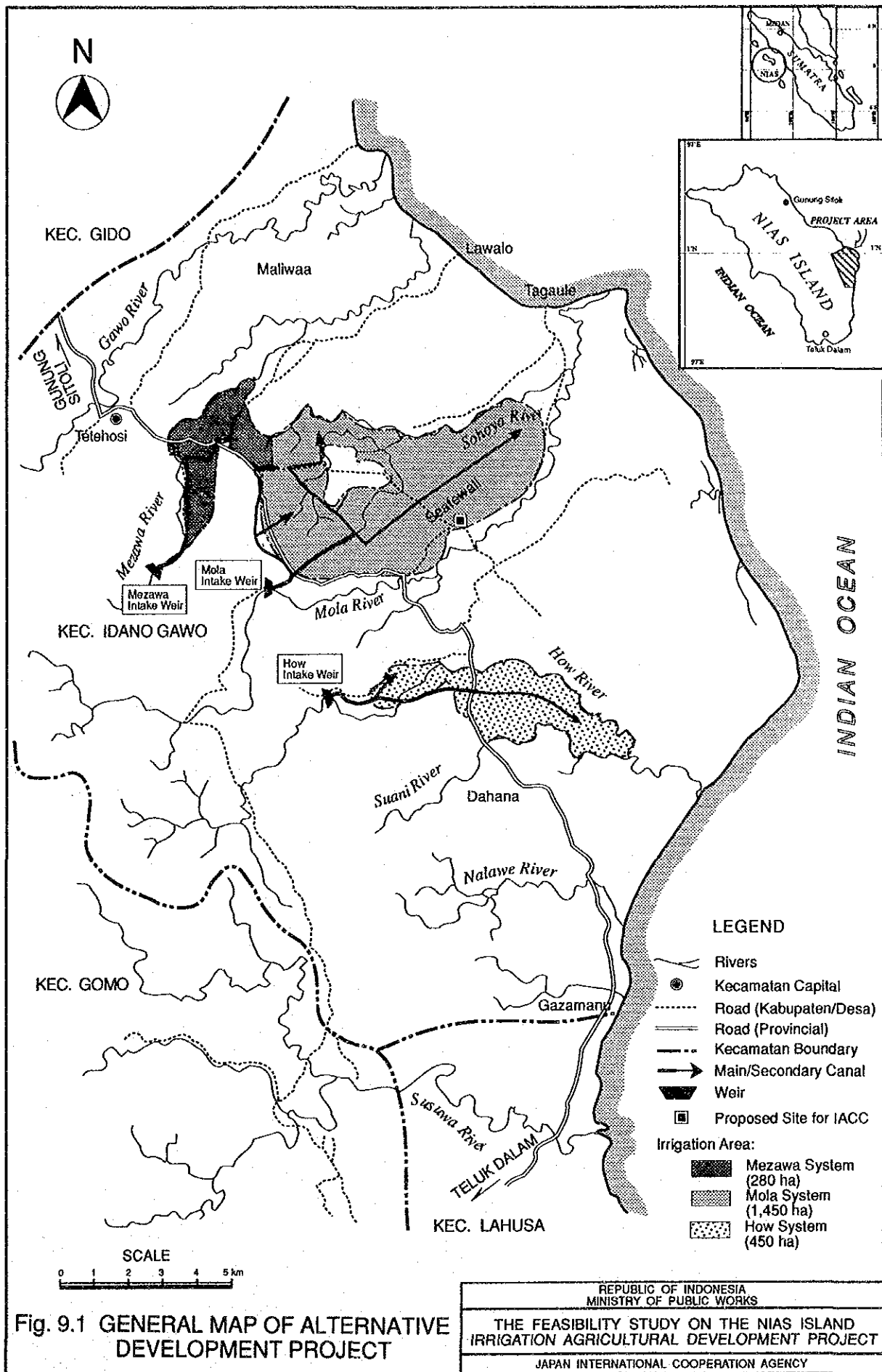


Fig. 8.1 FLOW CHART OF ENVIRONMENTAL IMPACT ASSESSMENT(EIA)











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## ***Appendix A***

### ***Soils***





Appendix A  
SOILS

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Table A-1 RESULTS OF SOIL ANALYSIS (1/2)

Pit No./Layer	P.S. Distribution(%)				Specific Gravity	pH (H <sub>2</sub> O)	pH (KCl)	pH (D)	EC (umhos)	Av. P (ppm)	Av. K (ppm)	T-C (%)	T-N (%)	C/N Ratio	SO <sub>4</sub> (ppm)	Cl (ppm)	
	Sand	Silt	Clay	Texture													
No.1	0-3 cm	10	35	55	Clay	0.55	3.7	3.0	0.7	225	20	56	26.79	1.36	19.7	42	70
Peat	3-17 cm	12	8	80	Clay	0.52	3.8	3.1	0.7	150	5	21	26.00	1.20	22.2	57	106
Soil/	17-35 cm	8	52	40	SiC	0.32	3.8	3.1	0.7	100	35	33	40.05	1.41	28.4	12	14
Gley	>35 cm	6	51	43	SiC	0.33	4.2	3.3	0.9	75	19	17	41.48	1.53	27.1	11	10
Humic																	
No.2	0-14 cm	20	28	52	Clay	0.75	4.7	3.7	1.0	60	10	42	7.10	0.31	22.9	39	46
Peat	14-25 cm	16	35	49	SiC	0.49	4.3	3.4	0.9	145	20	11	16.00	0.82	19.5	33	38
Soil	25-200 cm	78	11	11	SiC	0.50	3.9	3.3	0.6	1,100	9	26	28.89	0.84	34.4	535	39
No.3	0-8 cm	16	54	30	SiCL	0.62	5.6	4.9	0.7	270	74	265	15.17	0.67	22.6	80	121
Alluvi-	8-15 cm	16	48	36	SiCL	0.73	6.0	5.4	0.6	235	27	40	8.78	0.44	20.0	144	174
al Soil	15-31 cm	16	37	47	Clay	0.77	6.6	5.8	0.8	65	4	10	4.09	0.16	25.6	11	21
	31-64 cm	17	25	58	Clay	0.85	6.8	6.0	0.8	60	5	15	3.47	0.13	26.7	13	16
No.4	0-21 cm	20	23	57	Clay	0.73	5.9	5.2	0.7	135	19	83	4.71	0.34	13.9	9	9
Alluvi-	21-70 cm	16	28	56	Clay	0.76	6.3	5.2	1.1	70	13	73	3.25	0.17	19.1	6	4
al Soil	70-100 cm	52	9	40	SC	0.99	6.4	5.3	1.1	25	8	25	2.47	0.05	49.4	4	4
	>100 cm	52	7	41	SC	0.96	6.4	5.3	1.1	25	8	30	2.45	0.04	61.3	4	4
No.8	0-14 cm	22	29	49	Clay	0.72	6.0	5.2	0.8	115	7	57	6.93	0.35	19.8	14	13
Alluvi-	14-34 cm	16	36	48	Clay	0.77	6.4	5.2	1.2	65	6	41	4.79	0.16	29.9	4	5
al Soil	34-53 cm	41	32	28	CL	0.82	7.4	6.5	0.9	135	5	41	3.76	0.09	41.8	4	4
	53-85 cm	54	25	21	SCL	0.82	8.0	7.0	1.0	110	4	36	2.09	0.06	34.8	4	6
No.15	0-12 cm	74	19	7	SL	0.89	5.5	4.3	1.2	50	11	30	3.89	0.16	24.3	26	23
Alluvi-	12-30 cm	77	10	13	SL	0.94	5.2	4.1	1.1	25	2	10	2.58	0.08	32.3	15	14
al Soil	30-45 cm	73	4	23	SCL	0.98	5.2	4.1	1.1	25	2	10	2.61	0.07	37.3	7	6
	45-80 cm	69	41	26	SCL	1.01	5.2	4.1	1.1	20	2	10	2.19	0.04	54.8	3	6
No.18	0-15 cm	13	15	72	Clay	0.77	6.0	5.1	0.9	550	72	217	26.94	1.62	16.6	30	49
Gray	15-70 cm	13	7	80	Clay	0.91	6.0	5.4	0.6	35	7	30	2.60	0.09	28.9	7	6
Hydro.	70-100 cm	10	11	79	Clay	0.96	6.5	5.4	1.1	25	7	30	1.87	0.06	31.2	13	7
No.19	0-12 cm	24	10	66	Clay	0.62	4.5	3.6	0.9	2	24	41	31.10	0.46	67.6	546	349
Gley	12-37 cm	18	22	60	Clay	0.72	5.0	3.9	1.1	90	4	31	13.70	0.11	124.5	27	59
Humic	37-53 cm	25	33	42	Clay	0.76	5.2	4.1	1.1	40	5	41	8.89	0.09	98.8	27	30
Soil	53-70 cm	20	37	43	Clay	0.77	5.4	4.3	1.1	25	10	51	3.12	0.07	44.6	18	17

Table A-1 RESULTS OF SOIL ANALYSIS (2/2)

Pit No./Layer	CEC (meq/100g)	EX-K (meq/100g)	EX-Ca (meq/100g)	EX-Mg (meq/100g)	EX-Na (meq/100g)	B.S. (%)	ESP (%)	EPP (%)	AI (meq/100g)	H (meq/100g)	AI-H (%)	CEC (%)
No.1	0-3 cm	71.39	0.58	8.57	1.52	0.43	16	0.6	0.8	7.00	4.95	51.8
Peat	3-17 cm	66.20	0.27	7.71	0.73	0.35	14	0.5	0.4	5.92	3.61	51.3
Soil/	17-35 cm	68.53	0.19	5.95	0.46	0.46	10	0.4	0.3	0.84	0.67	18.0
Gley Humic	>35 cm	67.65	0.18	5.70	0.47	0.47	10	0.5	0.3	0.62	0.23	11.2
No.2	0-14 cm	35.13	0.30	10.23	2.78	0.30	39	0.9	0.9	6.01	5.27	45.3
Peat	14-25 cm	64.29	0.03	10.50	2.00	0.41	20	0.6	0.0	2.63	1.66	24.9
Soil	25-200 cm	51.91	0.13	8.04	1.26	0.30	19	0.6	0.3	0.72	0.63	12.2
No.3	0-8 cm	35.40	0.80	19.60	2.47	0.51	66	1.4	2.3	0.03	0.00	0.1
Alluvi-	8-15 cm	30.72	0.18	19.77	0.63	0.29	68	0.9	0.6	0.02	0.00	0.1
al Soil	15-31 cm	19.78	0.08	12.63	0.36	0.30	68	0.5	0.4	0.02	0.00	0.1
	31-64 cm	15.95	0.10	10.74	0.61	0.20	73	1.3	0.6	0.02	0.00	0.2
No.4	0-21 cm	38.93	0.76	26.10	5.32	0.30	83	0.8	2.0	0.02	0.00	0.1
Alluvi-	21-70 cm	33.94	0.48	24.80	4.28	0.20	88	0.6	1.4	0.03	0.00	0.1
al Soil	70-100 cm	9.73	0.13	6.63	0.96	0.20	81	2.1	1.3	0.03	0.00	0.4
	>100 cm	7.18	0.10	5.05	0.76	0.16	85	2.2	1.4	0.02	0.00	0.3
No.8	0-14 cm	34.18	0.37	25.86	2.59	0.25	85	0.7	1.1	0.06	0.00	0.2
Alluvi-	14-34 cm	29.29	0.19	23.78	1.90	0.16	89	0.5	0.6	0.03	0.00	0.1
al Soil	34-53 cm	23.53	0.17	18.29	2.31	0.34	91	1.4	0.7	0.03	0.00	0.1
	53-85 cm	16.39	0.09	13.91	0.27	0.11	88	0.7	0.5	0.03	0.00	0.2
No.15	0-12 cm	11.34	0.18	2.34	0.86	0.20	32	1.8	1.6	1.78	1.42	47.2
Alluvi-	12-30 cm	7.21	0.08	0.85	0.30	0.11	19	1.5	1.1	0.23	0.00	14.6
al Soil	30-45 cm	6.36	0.10	0.57	0.12	0.11	14	1.7	1.6	4.34	3.42	89.6
	45-80 cm	5.25	0.06	1.36	0.23	0.07	33	1.3	1.1	2.15	1.21	66.1
No.18	0-15 cm	61.47	1.05	36.68	1.74	1.13	66	1.8	1.7	0.05	0.00	0.1
Gray	15-70 cm	14.62	0.21	10.86	1.13	0.02	85	1.4	1.4	0.02	0.00	0.2
Hydro.	70-100 cm	13.26	0.18	10.32	1.30	0.05	89	0.4	1.4	0.02	0.00	0.2
No.19	0-12 cm	28.23	0.24	2.49	0.65	0.20	13	0.7	0.9	5.78	4.54	74.2
Gley	12-37 cm	24.16	0.24	10.13	1.17	0.20	49	0.8	1.0	5.94	3.72	45.1
Humic	37-53 cm	14.88	0.40	8.42	2.02	0.20	74	1.3	2.7	5.12	2.92	42.1
Soil	53-70 cm	11.22	0.34	7.21	1.79	0.32	86	2.9	3.0	4.02	2.28	39.5

Table A-2 SOIL PROFILE DESCRIPTION (1/19)

Profile No.	:	1
Classification		
a. PPT/SRI	:	Organosol Hemik
b. FAO/UNESCO	:	Histosol
c. USDA	:	Tropohemists
Physiography	:	Physiography
Topography	:	Flat (2%)
Parent Material	:	Organic materials
Drainage	:	Drainage
Present Land Use	:	Bush
Location	:	Bawaudao
Ground Water Level	:	85 cm

Horison/ Layer	Depth (cm)	Description
H 1	0 - 3	Brownish black (10 YR 2/3); clay loam; weak fine granular structure; friable (moist); clear waved boundary.
H 2	3 - 17	Dark brown (10 YR 3/3); loam; weak fine granular structure; friable (moist); clear waved boundary.
H 3	17 - 35	Dark brown (7.5 YR 3/4); organic matter hemists; clear waved boundary.
H 4	> 35	Brown (7.5 YR 4/4); organic matter hemists.

Table A-2 SOIL PROFILE DESCRIPTION (2/19)

Profile No. : 2  
 Classification  
 a. PPT/SRI : Organosol Hemik  
 b. FAO/UNESCO : Histosol  
 c. USDA : Tropohemist, Tropofibrist  
 Physiography : Convex slope  
 Topography : Flat (2%)  
 Parent Material : Organic materials  
 Drainage : Poor  
 Present Land Use : Grass, bush  
 Location : Hilianaa  
 Ground Water Level : 65 cm

Horison/ Layer	Depth (cm)	Description
H 1	0 - 14	Mottled bright yellowish brown (10 YR 6/8) and yellowish gray (2.5 Y 6/1); clay; massive; very friable; non sticky (wet); smooth boundary.
H 2	14 - 25	Grayish brown (5 YR 4/2); clay loam; massive; slightly sticky; clear smooth boundary.
H 3	25 - 200	Brownish black (5 YR 2/2); fibrist material; non sticky.

Table A-2 SOIL PROFILE DESCRIPTION (3/19)

Profile No.	:	3
Classification		
a. PPT/SRI	:	Alluvial
b. FAO/UNESCO	:	Fluvisol
c. USDA	:	Fluvaquent
Physiography	:	Flooded plain
Topography	:	Flat (2%)
Parent Material	:	Alluvial materials
Drainage	:	Poor
Present Land Use	:	Bush
Location	:	Onolimbo
Ground Water Level	:	64 cm

Horison/ Layer	Depth (cm)	Description
A 1	0 - 8	Brownish black (7.5 YR 2/2); loam; weak, fine granular structure; friable (moist); abrupt wavy boundary.
AC 1	8 - 15	Dark brown (7.5 YR 3/3); clay loam; weak fine granular structure; slightly sticky (moist); clear wavy boundary.
AC 2	15 - 31	Mottled brown (10 YR 4/4); clay loam; massive; slightly sticky; clear wavy boundary.
AC 3	31 - 64	Mottled grayish yellow brown (10 YR 5/2); clay; massive; smooth boundary.



Table A-2 SOIL PROFILE DESCRIPTION (4/19)

Profile No. : 4  
 Classification  
 a. PPT/SRI : Alluvial  
 b. FAO/UNESCO : Fluvisol  
 c. USDA : Fluvaquent  
 Physiography : Flooded plain  
 Topography : Flat (2%)  
 Parent Material : Alluvial materials  
 Drainage : Imperfect  
 Present Land Use : Bush  
 Location : Sohoya  
 Ground Water Level : 20 cm

Horison/ Layer	Depth (cm)	Description
A 1	0 - 21	Dull brown (7.5 YR 5/3); clay; weak fine angular blocky structure; sticky (wet); waved boundary.
AC 1	21 - 70	Mottled bright brown (7.5 YR 5/6), and brownish gray (7.5 YR 6/1); clay; massive; sticky; clear waved boundary.
AC 2	70 - 100	Brownish gray (5 YR 6/1); clay loam; massive; sticky; diffuse smooth boundary.
AC 3	+100	Grayish brown (5 YR 4/2); sandy loam; massive; sticky.

Table A-2 SOIL PROFILE DESCRIPTION (5/19)

Profile No.	:	5
Classification		
a. PPT/SRI	:	Alluvial
b. FAO/UNESCO	:	Fluvisol
c. USDA	:	Fluvaquent
Physiography	:	Flooded plain
Topography	:	Flat (2%)
Parent Material	:	Alluvial materials
Drainage	:	Imperfect
Present Land Use	:	Upland
Location	:	Humene
Ground Water Level	:	60 cm

Horison/ Layer	Depth (cm)	Description
Ap	0 - 10	Dark reddish brown (5 YR 3/2); clay loam; weak fine granular structure; friable (moist); waved boundary.
A 1	10 - 20	Dull reddish brown (7.5 YR 4/4); clay loam; weak fine angular blocky structure; sticky (wet); waved boundary.
AC 1	20 - 40	Mottled orange (7.5 YR 7/8) and brownish (7.5 YR 6/1); clay loam; massive; sticky (wet); waved boundary.
AC 2	40 - 60	Mottled orange (7.5 YR 7/8) and light brownish gray (7.5 YR 7/1); clay; massive; sticky (wet).

Table A-2 SOIL PROFILE DESCRIPTION (6/19)

Profile No. : 6  
 Classification  
 a. PPT/SRI : Alluvial  
 b. FAO/UNESCO : Fluvisol  
 c. USDA : Fluvaquent  
 Physiography : Flood plain  
 Topography : Flat (3%)  
 Parent Material : Alluvium  
 Drainage : Poor (4)  
 Present Land Use : Coconut, bush  
 Location : Loloanaa  
 Ground Water Level : 75 cm

Horison/ Layer	Depth (cm)	Description
H 1	0 - 14	Brown (7.5 YR 4/3), clay loam; weak fine granular structure; friable (moist), slightly sticky (wet); clear waved boundary.
A 1	14 - 36	Mottled dull brown (7.5 YR 5/4); clay loam; massive; slightly sticky (wet); clear waved boundary.
AC 1	36 - 59	Mottled orange (7.5 YR 6/8) and brownish gray (7.5 YR 6/1); sandy loam; massive; slightly sticky (wet); diffuse waved boundary.
AC 2	59 - 80	Mottled orange (7.5 YR 6/8) and gray (10 Y 5/1); clay loam; massive; sticky (wet).

Table A-2 SOIL PROFILE DESCRIPTION (7/19)

Profile No. : 7  
 Classification  
 a. PPT/SRI : Alluvial Hemik  
 b. FAO/UNESCO : Fluvisol  
 c. USDA : Fluvaquent  
 Physiography : Flood plain  
 Topography : Flat (3%)  
 Parent Material : Alluvium  
 Drainage : Poor (4)  
 Present Land Use : Grass, coconut, bush  
 Location : Tetehosi/Loloanaa  
 Ground Water Level : 60 cm

Horison/ Layer	Depth (cm)	Description
H 1	0 - 8	Dark reddish brown (5 YR 3/3); clay loam; fine granular structure; slightly sticky (wet); medium roots; clear waved boundary.
A 1	8 - 32	Mottled yellow orange (7.5 YR 7/8); clay loam; massive; sticky (wet); diffuse waved boundary.
AC	32 - 60	Olive gray (5 G Y); clay; massive; sticky (wet); gley 40 cm.

Table A-2 SOIL PROFILE DESCRIPTION (8/19)

Profile No. : 8  
 Classification  
 a. PPT/SRI : Alluvial  
 b. FAO/UNESCO : Fluvisol  
 c. USDA : Fluvaquent  
 Physiography : Flood plain  
 Topography : Flat (2%)  
 Parent Material : Alluvium  
 Drainage : Imperfect (3)  
 Present Land Use : Upland, grass  
 Location : Bobozaali  
 Ground Water Level : 100 cm

Horison/ Layer	Depth (cm)	Description
Ap	0 - 14	Dull brown (7.5 YR 5/4); clay loam; fine granular structure; very friable (moist); medium roots; clear waved boundary.
AC 1	14 - 34	Mottled brown (7.5 YR 4/4); clay loam; massive; slightly sticky (wet); medium roots; clear waved boundary.
AC 2	34 - 53	Mottled grayish brown (7.5 YR 6/2); loam; massive; slightly sticky; clear waved boundary.
AC 3	53 - 85	Mottled dark grayish (2.5 Y 5/2); loam; massive; slightly sticky.

Table A-2 SOIL PROFILE DESCRIPTION (9/19)

Profile No.	:	9
Classification		
a. PPT/SRI	:	Alluvial
b. FAO/UNESCO	:	Fluvisol
c. USDA	:	Fluvaquent
Physiography	:	Flood plain
Topography	:	Flat (3%)
Parent Material	:	Alluvium
Drainage	:	Moderately well drained (2)
Present Land Use	:	Paddy
Location	:	Maliawe
Ground Water Level	:	60 cm

Horison/ Layer	Depth (cm)	Description
Ap	0 - 19	Mottled bright brown (7.5 YR 5/8) and brownish black (7.5 YR 2/2); clay loam; massive; friable (moist); much fine roots; abrupt waved boundary.
A 1	19 - 29	Mottled brownish black (7.5 YR 3/2); clay loam; massive; slightly sticky (wet); gradual waved boundary.
B1ir	29 - 43	Mottled yellowish gray (2.5 Y 5/1); clay loam; massive; slightly sticky (wet); clear waved boundary.
B2ir	43 - 60	Mottled light gray (2.5 Y 7/1); clay; massive; sticky (wet).

Table A-2 SOIL PROFILE DESCRIPTION (10/19)

Profile No. : 10  
 Classification  
 a. PPT/SRI : Alluvial  
 b. FAO/UNESCO : Fluvisol  
 c. USDA : Fluvaquent  
 Physiography : Levee marine  
 Topography : Flat (2%)  
 Parent Material : Alluvial materials  
 Drainage : Poor (4)  
 Present Land Use : Bush  
 Location : Lowalo  
 Ground Water Level : 30 cm

Horison/ Layer	Depth (cm)	Description
A 1	0 - 7	Yellowish gray (2.5 Y 5/3); clay loam; massive; sticky; much fine roots; clear waved boundary.
A 12	7 - 25	Mottled bright brown (7.5 YR 5/8) and gray (5 Y 5/1); light clay; massive; sticky; much fine roots; clear waved boundary.
B 1	25 - 60	Gray (5 Y 5/1); light clay; massive; sticky; few coarse roots and upper much fine roots; diffuse waved boudary.
AC	60 - 100	Olive gray (2.5 G Y 5/1); clay loam; massive.

Table A-2 SOIL PROFILE DESCRIPTION (11/19)

Profile No. : 11  
 Classification  
     a. PPT/SRI : Alluvial  
     b. FAO/UNESCO : Fluvisol  
     c. USDA : Fluvaquent  
 Physiography : Flood plain  
 Topography : Flat (3%)  
 Parent Material : Colluvial  
 Drainage : Poor (4)  
 Present Land Use : Upland  
 Location : Hillilawa  
 Ground Water Level : 40 cm

Horison/ Layer	Depth (cm)	Description
Ap	0 - 6	Brownish black (7.5 YR 3/2); clay loam; weak medium granular structure; friable (moist); few fine roots; clear waved boundary.
AC 1	6 - 25	Dull yellowish orange (10 YR 4/3); clay loam; massive; slightly sticky (wet); few fine roots; gradual waved boundary.
AC 2	25 - 75	Dull yellowish orange (10 YR 5/4); sandy clay loam; massive; slightly sticky (wet); gradual waved boundary.
AC 3	75 - 100	Dull yellowish orange (10 YR 5/4); sandy clay loam; massive; slightly sticky (wet).



Table A-2 SOIL PROFILE DESCRIPTION (12/19)

Profile No. : 12  
 Classification :  
 a. PPT/SRI : Alluvial  
 b. FAO/UNESCO : Fluvisol  
 c. USDA : Fluvaquent  
 Physiography : Flood plain  
 Topography : Flat (2%)  
 Parent Material : Alluvium  
 Drainage : Poor (4)  
 Present Land Use : Paddy  
 Location : Dahana  
 Ground Water Level : 58 cm

Horison/ Layer	Depth (cm)	Description
Ap	0 - 4	Dark brown (7.5 YR 3/3); clay; massive; sticky (wet); fine medium roots; clear waved boundary.
B1ir	4- 38	Mottled olive gray (7.5 Y 6/3) and brownish gray (10 YR 6/1); clay; massive; sticky (wet); fine few roots; diffuse waved boundary.
B2ir	38 - 60	Mottled olive gray (7.5 Y 6/3) and yellowish gray (2.5 Y 5/1); light clay; massive; stikcy (wet); diffuse waved boundary.
AC	60 - 100	Yellowish gray (2.5 Y 5/1); light clay; massive; sticky (wet).

Table A-2 SOIL PROFILE DESCRIPTION (13/19)

Profile No.	:	13
Classification		
a. PPT/SRI	:	Alluvial
b. FAO/UNESCO	:	Fluvisol
c. USDA	:	Fluvaquent
Physiography	:	Flood plain
Topography	:	Flat (2%)
Parent Material	:	Alluvium
Drainage	:	Poor (4)
Present Land Use	:	Bush
Location	:	Telubanua
Ground Water Level	:	32 cm

Horison/ Layer	Depth (cm)	Description
A 1	0 - 9	Brownish black (10 YR 3/2) clay loam; fine weak granular structure; friable (moist); fine medium roots; clear waved boundary.
B1ir	9 - 75	Mottled yellow orange (10 YR 7/8) and yellowish gray (2.5 Y 6/1); clay massive; sticky (wet); fine medium roots; gradual waved boundary.
AC	75 - 100	Gray (5 Y 6/1); clay; massive; sticky (wet).

Table A-2 SOIL PROFILE DESCRIPTION (14/19)

Profile No.	:	14
Classification		
a. PPT/SRI	:	Alluvial
b. FAO/UNESCO	:	Fluvisol
c. USDA	:	Fluvaquent
Physiography	:	Flood
Topography	:	Flat (3%)
Parent Material	:	Alluvium
Drainage	:	Imperfect (3)
Present Land Use	:	Bush
Location	:	Sema
Ground Water Level	:	42 cm

Horison/ Layer	Depth (cm)	Description
A 1	0 - 15	Dark brown (7.5 YR 3/4); clay loam; weak fine granular structure; friable (moist); must fine roots; clear waved boundary.
B1ir	15 - 42	Mottled bright brown (7.5 YR 5/8) and yellowish gray (2.5 Y 5/1); clay; massive; sticky (wet); few coarse roots; diffuse waved boundary.
AC	42 - 100	Gray (5 Y 6/1); clay; massive; sticky (wet).

Table A-2 SOIL PROFILE DESCRIPTION (15/19)

Profile No.	:	15
Classification		
a. PPT/SRI	:	Alluvial
b. FAO/UNESCO	:	Fluvisol
c. USDA	:	Fluvaquent
Physiography	:	Flood plain
Topography	:	Flat (3%)
Parent Material	:	Alluvium
Drainage	:	Imperfect (3)
Present Land Use	:	Bush
Location	:	Lowalo
Ground Water Level	:	65 cm

Horison/ Layer	Depth (cm)	Description
H	0 - 12	Very dark brown (7.5 YR 2/3); clay loam; weak medium granular structure, friable (moist), slightly sticky (wet); much roots; abrupt wavy boundary.
A1ir	12 - 30	Mottled reddish brown (5 YR 4/8) and brownish gray (7.5 YR 5/1); sandy loam; angular blocky structure; friable (moist); much fine roots; gradual wavy boundary.
B1ir	30 - 45	Mottled reddish brown (5 YR 4/8) and grayish brown (10 YR 6/2); sandy loam; massive; very friable (moist); diffuse wavy boundary.
B2ir	45 - 80	Mottled reddish brown (5 YR 4/8) and grayish brown (2.5 Y 6/2); sand; massive; slightly sticky; diffuse wavy boundary.
C 1	80 - 95	Gray (7.5 Y 6/1); sand; massive; sticky (wet); clear wavy boundary.
C 2	95	Gray (5 Y 4/1); organic materials are dominantly fibric.

Table A-2 SOIL PROFILE DESCRIPTION (16/19)

Profile No.	:	16
Classification		
a. PPT/SRI	:	Gray Hyrdomorphic
b. FAO/UNESCO	:	Gleysol
c. USDA	:	Tropaquept
Physiography	:	Convex slope
Topography	:	Flat (2%)
Parent Material	:	Organic materials
Drainage	:	Poor (4)
Present Land Use	:	Bush
Location	:	Dahana
Ground Water Level	:	49 cm

Horison/ Layer	Depth (cm)	Description
A 1	0 - 6	Brownish gray (7.5 YR 3/2); clay loam; weak medium granular structure; friable (moist); fine medium roots; clear waved boundary.
B1ir	6 - 12	Mottled black (7.5 YR 2/1) and bright yellowish brown (10 YR 6/8); clay loam; massive; sticky (wet); fine medium (roots); gradual waved boundary.
B2ir	12 - 68	Mottled black (7.5 YR 2/1) and yellowish gray (2.5 Y 6/1); clay loam; massive; stikcy (wet); gradual waved boundary.
BC	68 - 100	Gray (7.5 GY 5/1); sandy clay loam; massive.

Table A-2 SOIL PROFILE DESCRIPTION (17/19)

Profile No. : 17  
 Classification  
     a. PPT/SRI : Alluvial Hemik  
     b. FAO/UNESCO : Fluvisol  
     c. USDA : Fluvaquent  
 Physiography : Convex slope  
 Topography : Flat (2%)  
 Parent Material : Alluvium  
 Drainage : Poor (4)  
 Present Land Use : Bush  
 Location : Siema  
 Ground Water Level : 35 cm

Horison/ Layer	Depth (cm)	Description
A 1	0 - 15	Brownish gray (7.5 YR 4/1); organic materials; massive; slightly sticky (wet); much fine roots; gradual waved boundary.
B1ir	15 - 70	Mottled orange (7.5 YR 6/8) and light gray (2.5 Y 7/1); clay loam; massive; slightly sticky; diffuse waved boundary upper much fine roots.
C	70 - 100	Gray (5 Y 5/1); sandy loam; massive; slightly sticky (wet).

Table A-2 SOIL PROFILE DESCRIPTION (18/19)

Profile No.	:	18
Classification		
a. PPT/SRI	:	Gray Hydromorphic
b. FAO/UNESCO	:	Gleysol
c. USDA	:	Trophaquept
Physiography	:	Convex slope
Topography	:	Flat (2%)
Parent Material	:	Organic
Drainage	:	Poor (4)
Present Land Use	:	Bush
Location	:	Sisarahili
Ground Water Level	:	52 cm

Horison/ Layer	Depth (cm)	Description
A 1	0 - 14	Mottled orange (5 YR 6/8) and brownish black (5 YR 3/1); clay loam; weak fine granular structure; friable (moist); fine medium roots; clear waved boundary.
B1ir	14 - 40	Mottled yellowish gray (2.5 Y 5/1) and bright yellowish brown (10 YR 6/8); fine clay; massive; sticky (wet); fine medium roots; gradual waved boundary.
BC	40 - 130	Gray (5 Y 6/1); fine clay; massive; sticky (wet).

Table A-2 SOIL PROFILE DESCRIPTION (19/19)

Profile No.	:	19
Classification		
a. PPT/SRI	:	Humic gley
b. FAO/UNESCO	:	Gleysol
c. USDA	:	Tropaquept
Physiography	:	Foot hill
Topography	:	Flat (2%)
Parent Material	:	Colluvial
Drainage	:	Imperfect (3)
Present Land Use	:	Bush
Location	:	Modali
Ground Water Level	:	57 cm

Horison/ Layer	Depth (cm)	Description
A 11	0 - 12	Brownish (7.5 YR 3/2); clay loam; weak moderate angular blocky structure; sticky (wet); clear waved boundary.
A 12	12 - 37	Mottled bright brown (7.5 YR 5/8) and light brownish (7.5 YR 7/2); clay; weak moderate angular blocky structure; sticky (wet); clear waved boundary.
B1ir	37 - 53	Mottled bright brown (10 YR 5/8) and light brownish (7.5 YR 7/2); clay; massive; sticky (wet); gradual waved boundary.
B2ir	53	Mottled brownish gray (10 YR 6/1) and gray (7.5 Y 5/1); clay; massive; sticky (wet).

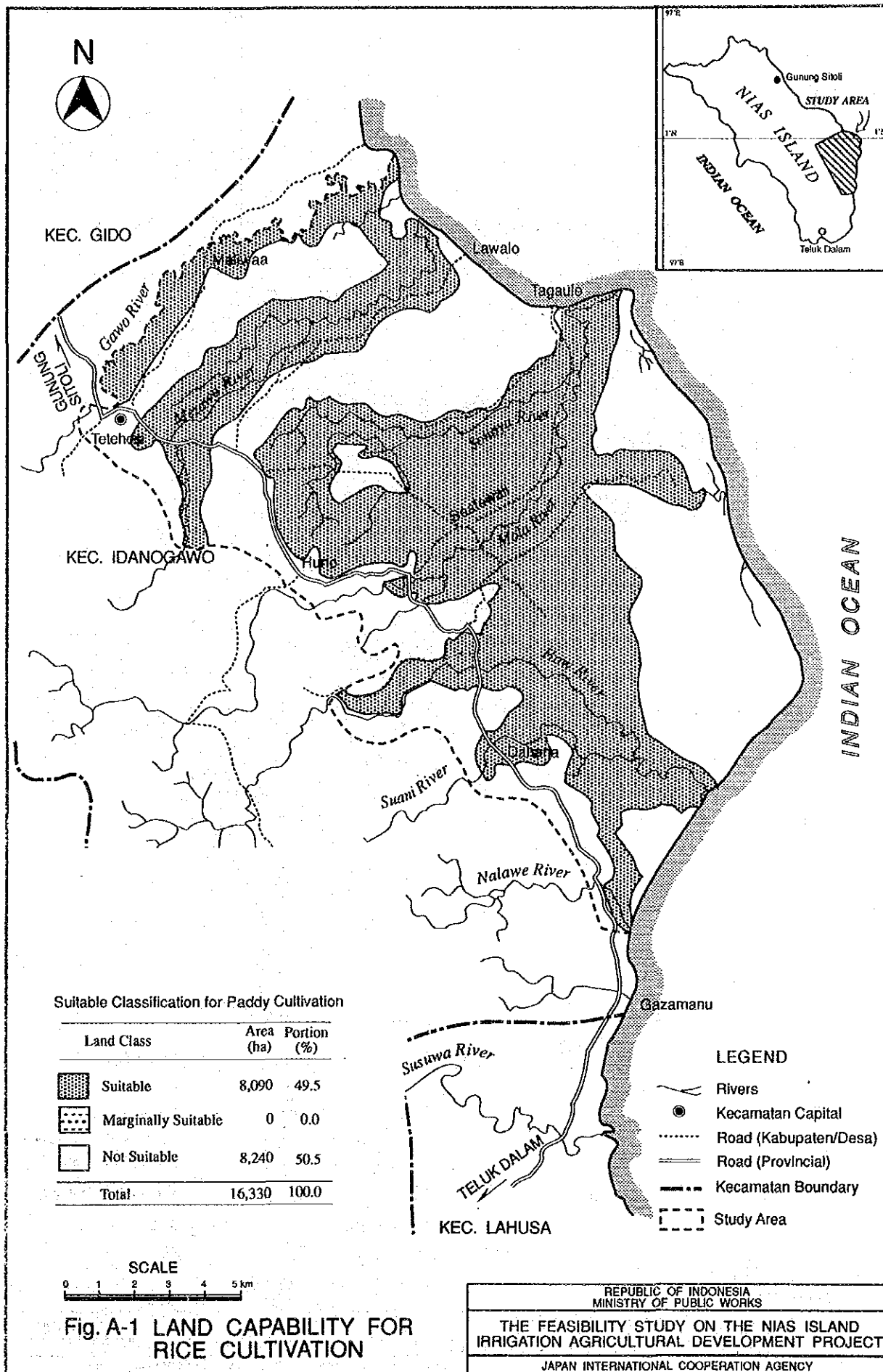


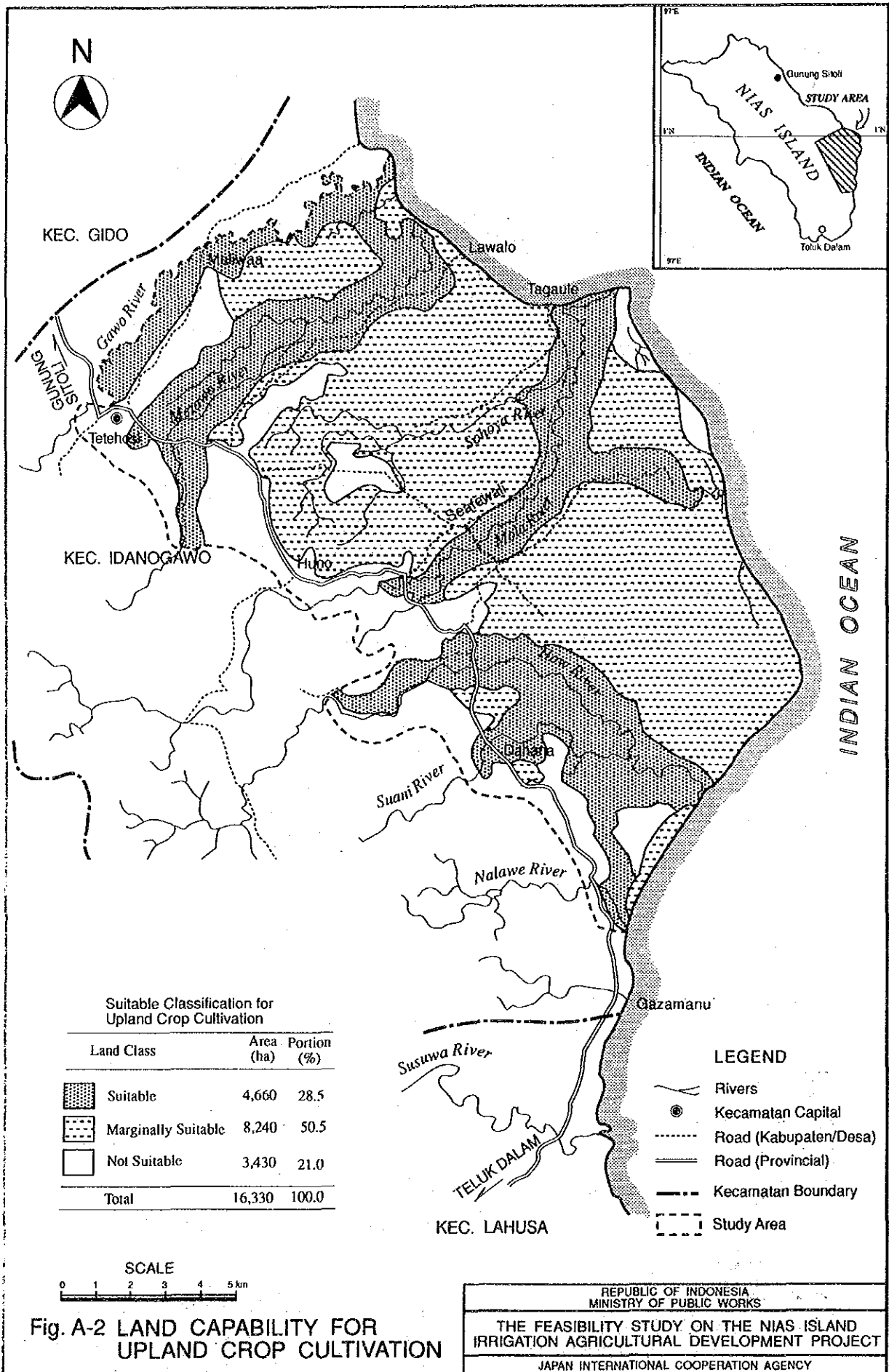
Table A-3 CRITERIA FOR LAND CAPABILITY

Criteria	Land Suitability		
	Rice Farming	Upland crop Farming	Tree crop Farming
<b>1. Slope (%)</b>			
< 3	S	S	S
3 - 24	M	S	S
25 - 40	N	N	S
> 40	N	N	N
<b>2. Effective Soil Depth (cm)</b>			
> 90	S	S	S
60 - 90	S	S	S
30 - 60	M	S	S
< 30	N	M	N
<b>3. Drainage Condition</b>			
Well	N	S	S
Moderate	S	S	S
Poor	S	N	M
<b>4. Soil Texture</b>			
Fine	S	S	S
Medium	S	S	S
Coarse	N	M	S
<b>5. Soil Reaction (pH (H<sub>2</sub>O))</b>			
pH > 7.5	N	N	N
pH 6.6 - 7.5	M	S	S
pH 5.6 - 6.5	S	S	S
pH 4.6 - 5.5	S	S	S
pH 3.6 - 4.5	M	N	N
pH < 3.5	N	N	N
<b>6. Groundwater Quality</b>			
Fresh	S	S	S
Brackish/Sulphurous	N	N	S
Saline (tidal)	N	N	N

Note : S = Suitable  
M = Marginally Suitable  
N = Not Suitable

Source: Modified DGFC, DA and USU Standard.





The Feasibility Study on  
The Nias Island Irrigation Agricultural Development Project

Vol. III  
**FEASIBILITY STUDY FOR THE MEZAWA/HOW  
IRRIGATION DEVELOPMENT PROJECT**

# **Appendix B**

## **Climate and Hydrology**



Appendix B  
CLIMATE AND HYDROLOGY

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Table B-1 SUMMARY OF METEOROLOGICAL STATIONS

No	Station	Latitude (N)	Longitude (E)	Altitude (M)	Starting Year	Jurisdiction
92	Teluk Dalam	0°34'	97°49'	3	1954 -1964	Departemen Perhubungan
92C	Tetehosi	1°10'	97°37'	50	1954 -1964	
93	G.Sitoli	1°13'30"	97°38'30"	6	1951	
94C	Mandrehe			100	1954 -1957	
9	Lolofitu	0°58'21"	97°45'12"	250	1983	Departemen Pekerjaan Umum
11	Tefao	1°23'17"	97°16'43"	20	1984	
12	Lolowau	0°54'02"	97°34'58"	300	1984	
28	Awa'ai	1°23'30"	97°29'17"	6	1984	
29	Tetehosi	0°51'20"	97°49'13"	20	1984	

Source : Badan Meteorologi Dan Geofisika, Departemen Perhubungan,  
Badan Penelitian and Departemen Pekerjaan Umum



Table B-2 AVAILABLE METEOROLOGICAL DATA

No	Station	Period of Collected Data				
		Rainfall	Temperature	Humidity	Wind Velocity	Sunshine
92	Teluk	1954-1961	D.N.	D.N.	D.N.	D.N.
	Dalam	1964	D.N.	D.N.	D.N.	D.N.
92C	Tetehosi	1954	D.N.	D.N.	D.N.	D.N.
		1956-1964	D.N.	D.N.	D.N.	D.N.
93	G.Sitoli	1980-1989	1980-1989	1980-1989	1980-1989	1980-1989
94C	Mandrehe	1954-1955	D.N.	D.N.	D.N.	D.N.
		1957	D.N.	D.N.	D.N.	D.N.
9	Lolofitu	1983	1983-1985	1983-1984	1983-1986	1983-1987
		1986-1990	D.N.	D.N.	D.N.	D.N.
11	Tefao	1985	D.N.	1984-1985	1984-1985	1984-1985
12	Lolowau	1985	1985-1987	1984-1987	1984-1987	1984-1987
		1988-1989	D.N.	D.N.	D.N.	D.N.
28	Awa'ai	1985	N.O.	N.O.	N.O.	N.O.
		1988-1990	N.O.	N.O.	N.O.	N.O.
29	Tetehosi	1985-1990	N.O.	N.O.	N.O.	N.O.

Note: D.N. : Data not collected.  
N.O. : Non-observation.

Table B-3 SUMMARY OF CLIMATIC CONDITION

Station	Annual Rainfall (mm)	Temperature (°C)	Humidity (%)	Sunshine (%)	Wind Velocity (m/s)
Teluk Dalam	2,854	-	-	-	-
Tetehosi	1,727	-	-	-	-
G.Sitoli	2,941	25.6	89	49	2.97
Mandrehe	2,836	-	-	-	-
Lolofitu	3,487	26.4	(97)	35	0.40
Tefao	*	*	(95)	43	0.23
Lolowau	*	27.2	88	39	0.43
Awa'ai	2,247	-	-	-	-
Tetehosi	3,151	-	-	-	-

Note: 1) ( ); data is only a year  
 2) Mark(\*); the lack of data

Table B-4 MONTHLY RAINFALL AT G. SITOLI STATION

(Unit: mm/month)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1951	-	224	291	216	351	99	316	43	145	222	355	234	-
1952	504	255	81	359	136	204	310	263	369	428	251	202	3,362
1953	240	83	238	162	125	278	193	200	241	288	552	322	2,922
1954	243	158	307	316	224	379	259	97	36	222	339	229	2,809
1955	272	123	94	136	138	132	101	107	135	248	555	142	2,183
1956	169	124	216	129	111	126	137	194	208	447	682	209	2,752
1957	119	76	264	200	242	128	418	456	407	351	429	680	3,770
1958	100	100	245	186	352	114	43	281	155	463	360	192	2,591
1959	147	175	367	220	239	168	302	348	252	619	232	486	3,555
1960	296	159	143	202	156	194	266	300	316	300	463	146	2,941
1961	173	370	326	273	229	224	71	188	172	142	183	358	2,709
1962	84	100	317	184	175	167	-	284	251	623	233	170	-
1963	50	160	66	80	165	45	219	235	225	329	153	448	2,175
1964	165	166	195	130	119	302	296	130	757	661	283	168	3,372
1965	19	80	217	209	152	262	129	135	436	237	240	211	2,327
1970	155	114	170	422	205	309	405	122	415	698	190	254	3,459
1971	171	161	175	91	285	48	155	113	232	454	331	515	2,731
1972	57	61	194	406	81	176	406	142	780	246	410	179	3,138
1973	158	273	197	312	205	219	233	207	191	420	398	351	3,164
1974	70	210	154	156	-	-	-	-	298	347	336	239	-
1975	366	239	74	225	90	91	284	287	323	245	199	261	2,684
1976	101	167	165	195	162	113	-	155	225	441	-	-	-
1977	196	175	23	220	127	145	187	193	348	490	343	148	2,595
1978	77	104	181	93	299	213	469	221	314	344	302	220	2,837
1979	146	100	115	389	169	245	365	219	319	448	471	233	3,219
1980	104	159	203	206	241	190	242	123	249	470	334	447	2,968
1981	57	188	163	294	399	214	179	120	340	325	209	211	2,699
1982	113	135	357	268	244	247	185	202	172	379	257	363	2,922
1983	158	94	264	135	217	86	214	202	319	483	276	268	2,716
1984	286	206	195	189	184	230	374	280	431	306	315	298	3,294
1985	174	114	322	152	229	125	310	195	250	280	401	297	2,849
1986	397	71	371	111	186	183	224	187	218	332	293	271	2,844
1987	177	74	288	179	161	221	237	329	383	307	471	289	3,116
1988	202	202	381	191	184	177	159	283	487	265	610	236	3,377
1989	416	126	221	311	227	137	156	286	295	392	294	224	3,085
1990	284	245	259	145	95	184	290	284	240	-	-	-	-
AVE.	184	155	218	214	197	182	246	212	304	379	346	279	2,941
AVE.*	186	156	220	216	199	184	249	214	306	382	349	282	2,941
(%)	6.3	5.3	7.5	7.3	6.8	6.2	8.5	7.3	10.4	13.0	11.9	9.6	100

Source: Badan Meteorologi Dan Geofisika, Departemen Perhubungan

Note: \*: Corrected average

Table B-5 (1/3) THE METEOROLOGICAL DATA AT G. SITOLI STATION

## (1) TEMPERATURE

## a) AVERAGE

Year	(Unit: °C)												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1980	25.8	25.9	25.8	26.4	26.0	25.9	25.4	25.4	25.4	25.3	25.4	24.8	25.6
1981	25.0	25.6	26.6	25.8	26.1	25.7	25.0	25.3	25.0	25.0	25.2	25.7	25.5
1982	25.4	25.3	25.1	26.0	26.2	25.7	25.1	25.2	25.1	25.3	25.7	26.2	25.5
1983	26.5	26.9	26.8	27.0	26.3	26.2	25.6	25.7	25.4	25.4	25.1	25.3	26.0
1984	25.2	25.5	25.6	25.6	26.0	25.5	24.9	24.8	24.7	25.1	25.4	24.9	25.3
1985	25.7	25.9	25.8	25.9	25.7	25.3	24.4	25.1	25.0	25.2	24.9	25.3	25.4
1986	25.6	25.9	25.8	25.6	25.9	25.8	25.3	25.1	25.0	24.9	24.7	26.2	25.5
1987	26.0	26.0	26.4	26.3	26.1	26.3	25.5	25.9	25.7	25.9	25.4	25.9	26.0
1988	26.2	26.0	26.4	26.5	26.2	25.7	25.7	25.3	25.4	24.9	25.0	24.8	25.7
1989	26.1	25.4	25.3	25.2	25.0	25.5	25.0	24.8	25.2	25.0	25.5	26.0	25.3
<b>AVE.</b>	<b>25.8</b>	<b>25.8</b>	<b>26.0</b>	<b>26.0</b>	<b>26.0</b>	<b>25.8</b>	<b>25.2</b>	<b>25.3</b>	<b>25.2</b>	<b>25.2</b>	<b>25.2</b>	<b>25.5</b>	<b>25.6</b>

## b) MAXIMUM

Year	(Unit: °C)												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1980	30.8	30.9	30.6	30.8	30.8	30.5	30.0	29.9	29.7	29.4	29.4	28.9	30.1
1981	30.3	30.3	31.6	30.1	30.4	30.7	29.8	30.8	29.6	28.9	29.4	30.2	30.2
1982	30.5	30.2	30.0	30.5	30.7	30.6	30.0	30.1	30.0	29.9	30.0	30.6	30.3
1983	31.0	31.6	31.4	31.7	30.5	31.3	30.9	31.0	29.9	29.9	29.8	29.8	30.7
1984	30.0	30.6	30.3	30.0	30.7	30.4	29.6	29.3	29.3	29.5	29.6	29.8	29.9
1985	30.8	31.0	30.6	30.5	30.3	30.7	29.7	30.3	29.6	29.9	29.6	29.9	30.2
1986	30.3	31.2	30.3	30.4	30.8	30.7	30.0	30.4	29.8	29.4	29.5	30.8	30.3
1987	30.5	31.3	31.2	31.2	31.0	31.4	31.0	30.9	30.2	30.1	29.5	30.5	30.7
1988	30.8	30.8	31.2	31.3	30.9	30.9	30.8	30.1	29.9	29.2	29.1	29.7	30.4
1989	30.6	30.2	30.1	30.1	30.9	30.5	29.7	29.7	29.6	29.0	29.0	30.1	30.0
<b>AVE.</b>	<b>30.6</b>	<b>30.8</b>	<b>30.7</b>	<b>30.7</b>	<b>30.7</b>	<b>30.8</b>	<b>30.1</b>	<b>30.3</b>	<b>29.8</b>	<b>29.5</b>	<b>29.5</b>	<b>30.0</b>	<b>30.3</b>

## c) MINIMUM

Year	(Unit: °C)												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1980	22.4	22.3	22.7	23.4	22.8	22.4	22.1	22.3	22.5	22.5	22.8	22.4	22.6
1981	21.4	22.3	23.1	23.0	23.3	22.2	21.8	21.0	22.3	22.2	22.1	22.6	22.3
1982	21.6	22.2	22.1	22.8	23.1	22.2	21.4	21.9	21.7	22.5	22.8	22.9	22.3
1983	22.9	23.4	23.7	23.8	23.3	22.6	22.3	22.4	22.4	22.4	21.7	22.2	22.8
1984	22.1	22.2	22.4	22.5	22.6	22.2	21.5	21.6	21.3	21.8	22.4	21.6	22.0
1985	21.6	21.8	22.2	22.2	22.1	20.6	20.3	21.2	21.1	21.7	21.4	21.5	21.5
1986	21.4	20.9	21.8	21.4	21.2	20.8	20.4	20.0	20.5	20.9	20.1	21.7	20.9
1987	21.4	21.1	21.2	21.7	21.7	21.4	21.0	21.3	21.5	21.9	21.5	21.4	21.4
1988	21.7	21.1	21.9	21.8	21.4	20.6	20.5	20.8	21.1	20.3	20.3	19.9	21.0
1989	20.9	20.3	20.0	20.5	20.9	19.5	19.5	19.8	20.4	20.3	20.6	20.8	20.3
<b>AVE.</b>	<b>21.7</b>	<b>21.8</b>	<b>22.1</b>	<b>22.3</b>	<b>22.2</b>	<b>21.5</b>	<b>21.1</b>	<b>21.2</b>	<b>21.5</b>	<b>21.7</b>	<b>21.6</b>	<b>21.7</b>	<b>21.7</b>

Table B-5 (2/3) THE METEOROLOGICAL DATA AT G. SITOLI STATION

## (2) HUMIDITY

Year	(Unit: %)												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1980	85	85	87	88	88	86	86	85	87	88	88	90	87
1981	85	86	84	89	87	86	87	84	87	89	89	88	87
1982	87	87	90	89	89	88	88	89	89	90	89	88	89
1983	86	86	88	88	89	87	89	88	89	90	88	89	88
1984	88	86	88	89	88	89	89	89	89	89	89	89	89
1985	85	86	88	90	91	86	89	88	89	89	91	90	89
1986	89	85	88	92	90	87	85	89	91	92	91	88	89
1987	89	88	88	90	90	90	90	90	90	91	92	90	90
1988	88	89	89	89	89	91	88	90	90	92	92	90	90
1989	90	89	89	91	90	88	90	91	91	92	92	88	90
AVE.	87	87	88	90	89	88	88	88	89	90	90	89	89

## (3) RAINY DAYS

Year	(Unit: days)												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1980	21	12	20	23	20	14	20	18	18	20	26	25	20
1981	10	16	16	25	21	15	19	11	26	23	18	17	18
1982	13	16	21	21	20	16	18	19	17	25	27	25	20
1983	18	15	22	21	24	15	20	19	25	24	22	24	21
1984	22	20	27	23	24	21	27	27	20	24	26	23	24
1985	20	14	21	20	19	13	23	20	23	26	28	27	21
1986	22	13	28	18	18	18	19	17	24	23	22	19	20
1987	20	18	23	28	26	23	21	26	25	28	29	24	24
1988	25	22	31	27	15	17	17	23	-	24	-	17	-
1989	-	-	21	25	-	12	-	-	24	26	26	21	-
AVE.	19	16	23	23	21	16	20	20	22	24	25	22	21

## (4) SUNSHINE

Year	(Unit: %)												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1980	50	65	47	49	55	63	55	51	34	42	41	32	49
1981	61	54	65	47	50	64	45	70	37	31	49	54	52
1982	65	53	36	55	51	67	58	45	45	41	48	60	52
1983	65	54	53	53	49	58	55	59	48	43	47	50	53
1984	54	48	44	50	55	55	48	41	48	41	54	49	49
1985	71	65	50	54	53	74	56	54	44	50	42	47	55
1986	49	72	48	46	57	68	56	47	33	39	40	55	51
1987	37	52	45	42	45	48	48	44	36	39	31	42	42
1988	46	50	42	-	49	53	65	40	31	20	20	40	-
1989	56	40	42	37	46	57	38	34	35	30	40	42	41
AVE.	55	55	47	48	51	61	52	49	39	38	41	47	49

Table B-5 (3/3) THE METEOROLOGICAL DATA AT G. SITOLI STATION

(5) WIND SPEED

Year	(Unit: m/s)												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1980	2.64	2.65	2.52	2.30	2.61	2.92	3.24	3.07	2.93	3.19	3.21	2.94	2.85
1981	2.77	3.03	2.74	2.69	3.10	2.98	3.19	2.97	3.14	2.79	3.05	2.79	2.94
1982	2.61	3.09	3.02	3.12	2.79	4.51	3.04	3.19	2.97	2.95	2.83	2.84	3.08
1983	2.99	3.23	3.00	3.00	3.12	2.85	3.30	3.24	3.07	2.80	3.34	2.77	3.06
1984	3.00	2.98	2.89	3.00	2.54	2.86	2.80	2.80	3.38	3.12	3.04	2.87	2.94
1985	2.92	3.09	2.80	2.61	2.22	2.85	2.61	3.02	3.02	3.04	2.81	2.84	2.82
1986	2.84	2.87	3.30	2.54	2.61	2.83	3.04	3.20	3.31	2.52	3.28	2.74	2.92
1987	3.09	3.14	3.22	2.88	2.67	3.10	3.14	2.95	2.66	3.00	2.81	3.24	2.99
1988	2.64	2.91	3.17	2.80	3.32	3.05	3.24	2.84	3.19	2.94	3.46	2.85	3.03
1989	3.22	2.98	3.12	3.12	2.99	3.65	2.87	2.99	2.88	3.25	2.86	2.84	3.06
AVE.	2.87	3.00	2.98	2.81	2.80	3.16	3.05	3.03	3.05	2.96	3.07	2.87	2.97

Source: Badan Meteorologi and Geofisika, Departemen Perhubungan

Table B-6 MONTHLY RAINFALL AT TETEHOSSI

(Unit: mm/month)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1954	-	50	125	388	265	209	240	161	344	236	314	231	-
1955	-	-	-	-	-	-	-	-	-	-	-	-	-
1956	91	75	102	74	86	137	121	171	129	396	*	223	-
1957	20	67	167	164	97	97	229	164	214	200	193	111	1,723
1958	12	24	80	98	156	145	8	153	207	251	364	137	1,635
1959	60	28	229	222	88	112	127	142	158	397	239	162	1,964
1960	160	85	140	160	97	24	311	207	363	253	392	30	2,222
1961	64	93	82	129	244	118	127	89	145	173	222	243	1,729
1962	81	35	86	126	130	104	138	154	226	267	116	122	1,585
1963	125	12	75	47	94	55	93	42	128	214	245	100	1,230
1964	22	134	-	-	-	65	130	51	101	211	-	-	-
AVE.	71	60	121	156	140	107	152	133	202	260	261	151	1,727
(%)	3.9	3.3	6.7	8.6	7.7	5.9	8.4	7.4	11.1	14.3	14.4	8.3	100.0

Source: Departemen Perhubungan, Badan Meteorologi  
Dan Geofisika

Note : Mark (-) ; Data is not available  
Mark (\*) ; Data is not complete

Table B-7 CONSECUTIVE DROUGHT DAY G, SITOLI STATION

(Unit: days)

Year	Ranking									
	No.1		No.2		No.3		No.4		No.5	
	Date	Days	Date	Days	Date	Days	Date	Days	Date	Days
1980	FEB. 5 - 21	17	JAN.23 -FEB.3	12	JAN.11 - 21	11	OCT.16 - 26	11	JUNE.14 - 22	9
1981	JULY.31 -AUG.18	19	JAN.20 -FEB.1	13	SEPT.30 -OCT.12	13	DEC.17 - 29	13	JAN7-16 MAR1-10	10
1982	JAN.20 - 31	12	AUG.22 - 31	10	FEB.10 - 18	9	JAN.12 - 18	7	NOV.17 - 23	7
1983	JUNE.21 -JULY.5	15	MAR.30 -APR.8	10	FEB. 7 - 15	9	MAY.27 -JUNE.4	9	AUG.21- SEP.29-	9
1984	FEB. 7 - 16	10	AUG.31 -SEPT.7	8	NOV.14 - 21	8	MAY.10 - 16	7	AUG.11- DEC.8-	7
1985	JUNE.22 -JULY.4	13	JAN.20 - 30	11	AUG. 4 - 14	11	FEB.21 -MAR.1	9	OCT.8- DEC.19	9
1986	MAY.10 - 24	15	AUG. 6 - 20	15	FEB.17 - 27	11	FEB. 4 - 12	9	MAY.26- JUNE13-	8
1987	FEB.19 -MAR.3	13	MAY. 6 - 17	12	JAN.21 - 30	10	APR.14 - 23	10	JUNE.5 - 13	9
1988	MAY.18 - 31	14	JAN. 7 - 18	12	APR.14 - 25	12	JULY.15 - 23	9	FEB. 8 - 15	8
1989	FEB. 1 - 17	17	JUNE.4 - 18	15	MAR. 7 - 19	13	JULY.19 - 31	13	DEC.10 - 19	10

Source: Badan Meteorologi Dan Geofisika, Departemen Perhubungan



Table B-8 MAXIMUM DAILY RAINFALL

(Unit: mm/day)

Year	Ranking									
	No.1		No.2		No.3		No.4		No.5	
	Date	(mm)	Date	(mm)	Date	(mm)	Date	(mm)	Date	(mm)
1980	OCT.29	73.1	FEB.26	71.5	OCT. 9	64.9	DEC.21	64.3	OCT.14	61.8
1981	MAY. 3	105.3	JUNE.9	85.0	MAR.11	61.7	OCT.29	59.9	DEC. 1	53.7
1982	OCT.15	101.5	AUG.20	73.7	MAR. 5	72.2	JUNE.29	70.0	MAR.22	68.2
1983	OCT.18	79.8	OCT. 8	76.3	OCT.27	70.3	MAY.15	61.8	MAR. 7	61.7
1984	NOV. 1	77.9	JUNE.24	71.5	SEPT.20	68.3	SEPT.23	67.6	SEPT.27	61.7
1985	AUG.15	84.0	SEPT.17	65.9	DEC.15	65.5	MAR.15	64.8	JUNE.17	64.5
1986	JAN.7	133.4	NOV.29	90.2	DEC. 3	68.9	SEPT.7	60.0	JAN.31	52.4
1987	SEPT.21	111.3	JUNE.30	101.6	OCT.21	86.1	AUG. 4	84.6	MAY.29	70.0
1988	SEPT. 5	77.2	NOV.22	75.0	NOV.19	62.7	DEC.22	63.8	DEC.14	63.6
1989	JAN. 1	84.3	JAN.21	74.0	MAY.11	66.5	NOV. 4	66.5	DEC. 1	53.8

Source: Badan Penelitian and Pengembangan Pekerjaan Umum, Departemen Pekerjaan Umum

Table B-9. MAXIMUM RAINFALL

(Unit: mm/hour)

Year	Ranking									
	No. 1		No. 2		No. 3		No. 4		No. 5	
	Date Hour	Rain (mm)	Date Hour	Rain (mm)	Date Hour	Rain (mm)	Date Hour	Rain (mm)	Date Hour	Rain (mm)
1984	01.NOV		20SEPT		17.APR		22.DEC		24.AUG	
	02-03	46.3	11-12	45.3	15-16	34.0	12-13	32.8	12-13	32.2
1985	03.NOV		15.DEC		17SEPT		17JULY		30.OCT	
	03-04	49.6	14-15	45.7	14-15	45.5	15-16	40.4	17-18	32.9
1986	07.JAN		29.NOV		26.AUG		12.OCT		25.MAY	
	00-01	70.3	13-14	57.8	15-16	33.2	14-15	30.5	13-14	30.2
1987	30JUNE		04.AUG		29.MAY		21.OCT		04.DEC	
	13-14	85.0	01-02	78.9	16-17	58.4	23-24	41.6	15-16	41.3
1988	05SEPT		22.DEC		10.MAY		08.OCT		01MARC	
	14-15	61.7	08-09	54.8	06-07	49.5	14-15	39.3	00-01	39.3
1989	01.JAN		01.DEC		01JUNE		05.AUG		28MARC	
	22-23	60.4	05-06	46.5	14-15	36.8	15-16	34.8	00-01	32.2

Source: Badan Penelitian and Pengembangan Pekerjaan Umum, Departemen Pekerjaan Umum

Table B-10 PROBABILITY OF ANNUAL RAINFALL  
(G.Sitoli Station)

Return Period	Value (mm/year)
1/100	2,144
1/ 50	2,223
1/ 30	2,289
1/ 20	2,346
1/ 10	2,462
1/ 5	2,609
1/ 3	2,755
1/ 2	2,916

Period: 31 years (From 1952 to 1989)

PROBABILITY ANALYSIS OF  
CONSECUTIVE DROUGHT DAY

Return Period	Value (Days)
1/2	14
1/5	17
1/10	18
1/30	20
1/50	20

Table B-11 THE OBSERVATION OF RIVER DISCHARGE

Date	Name of River	Mezawa	Gawo	Gido	Mola	Muzoi
	Catchment area (Km <sup>2</sup> )	22.0	76.0	68.0	73.0	344.0
21 Aug., 1990						
Discharge	Q(m <sup>3</sup> /s)	0.26	1.73	0.92	-	-
Specific run-off	q	1.182	2.276	1.353	-	-
22 Aug., 1990						
Discharge	Q(m <sup>3</sup> /s)	-	-	-	1.48	-
Specific run-off	q	-	-	-	2.027	-
25 Aug., 1990						
Discharge	Q(m <sup>3</sup> /s)	0.26	0.85	0.79	-	-
Specific run-off	q	1.182	1.118	1.162	-	-
30 Aug., 1990						
Discharge	Q(m <sup>3</sup> /s)	-	-	-	1.59	-
Specific run-off	q	-	-	-	2.178	-
31 Aug., 1990						
Discharge	Q(m <sup>3</sup> /s)	-	-	-	-	9.56
Specific run-off	q	-	-	-	-	2.779
1 Sept., 1990						
Discharge	Q(m <sup>3</sup> /s)	0.60	2.42	-	-	-
Specific run-off	q	2.727	3.184	-	-	-
6 Sept., 1990						
Discharge	Q(m <sup>3</sup> /s)	1.36	6.84	-	-	-
Specific run-off	q	6.182	9.000	-	-	-
11 Sept., 1990						
Discharge	Q(m <sup>3</sup> /s)	-	-	-	7.21	-
Specific run-off	q	-	-	-	9.877	-
13 Sept., 1990						
Discharge	Q(m <sup>3</sup> /s)	0.60	3.62	-	-	-
Specific run-off	q	2.727	4.763	-	-	-
27 Sept., 1990						
Discharge	Q(m <sup>3</sup> /s)	-	-	-	-	22.98
Specific run-off	q	-	-	-	-	6.680

Note: Q(m<sup>3</sup>/s) is a discharge converted by current meter  
Specific run-off ; q (m<sup>3</sup>/s/100 Km<sup>2</sup>)  
Catchment area ; the point of discharge's observation

Source: JICA Study Team, 1990

Table B-12 CALCULATION OF EVAPOTRANSPIRATION

Month	ETpen (mm)	ET (mm/month)	ETpt (mm/day)	2 x ETpt	ETa (mm/day)	ETa (mm/month)
Jan.	5.62	174	4.79	9.58	5.62	123
Feb.	5.82	163	4.91	9.82	5.82	112
Mar.	5.95	184	4.79	9.58	5.95	113
Apr.	5.80	174	4.41	8.82	5.80	91
May	5.38	167	4.41	8.82	5.38	107
Jun.	4.95	149	4.66	9.32	4.95	131
Jul.	5.07	157	4.16	8.32	5.07	101
Aug.	5.39	167	4.41	8.82	5.39	106
Sep.	5.83	175	4.16	8.32	5.83	67
Oct.	5.97	185	4.03	8.06	5.97	65
Nov.	5.83	175	4.16	8.32	5.83	75
Dec.	5.65	175	4.41	8.82	5.65	98
Total		2,045				1,189

STATION : GUNUNG SITOLI  
RETURN PERIOD 1/5 : (1952 ~ 1989)

mm/MONTH

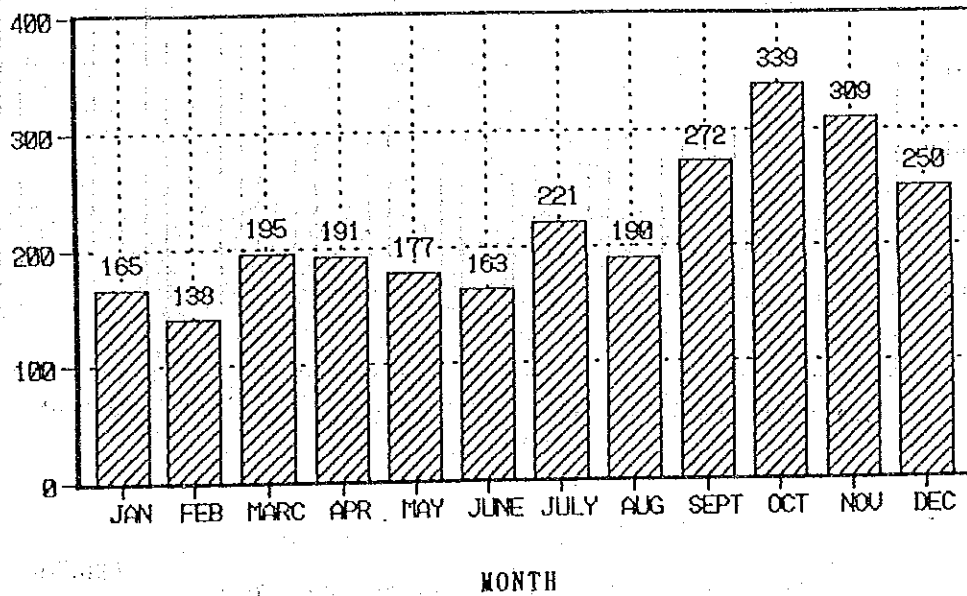
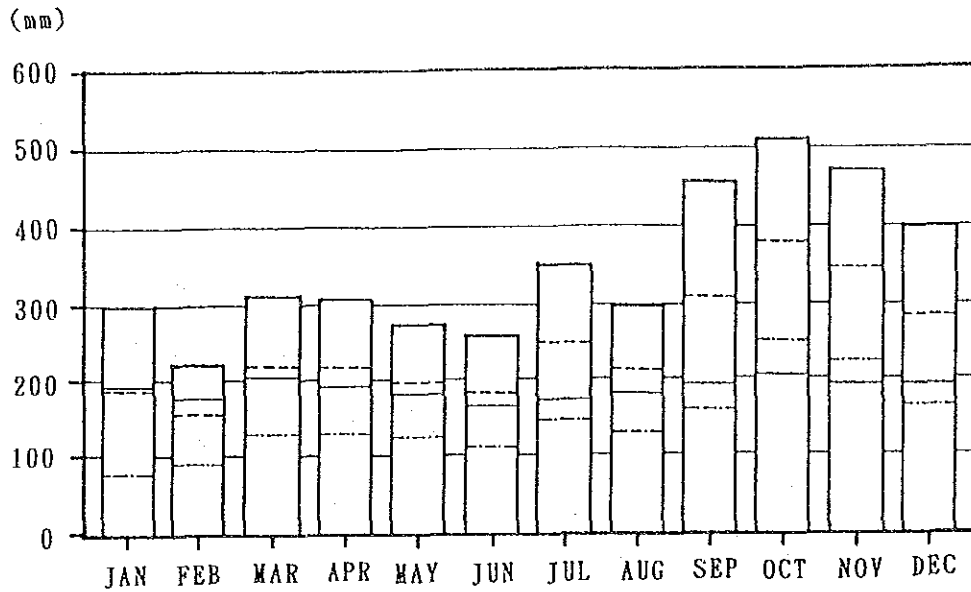


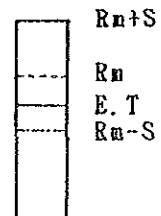
Fig. B-1 HYETOGRAPH AT G. SITOLI STATION

REPUBLIC OF INDONESIA  
MINISTRY OF PUBLIC WORKS  
THE FEASIBILITY STUDY ON THE NIAS ISLAND  
IRRIGATION AGRICULTURAL DEVELOPMENT PROJECT  
JAPAN INTERNATIONAL COOPERATION AGENCY



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Year
E.T.	192	179	205	192	183	165	174	183	192	205	192	192	
R <sub>m</sub>	186	156	220	216	199	184	249	214	306	382	349	282	2941
STD	111	67	91	88	74	73	102	84	148	131	125	118	375
R <sub>m</sub> +S	297	223	311	304	273	257	351	298	454	513	474	400	3316
R <sub>m</sub> -S	75	89	129	128	125	110	147	129	159	251	224	164	2566
S/R <sub>m</sub>	0.60	0.43	0.41	0.41	0.37	0.40	0.41	0.39	0.48	0.34	0.36	0.42	0.13

LEGEND



Note E.T. :Monthly Evapotranspiration (=ET<sub>0</sub>×1.1)  
 R<sub>m</sub> :Mean monthly rainfall (mm)  
 S : Standard deviation  
 V : Coefficient of variation

Fig. B-2 RELATION BETWEEN MEAN MONTHLY EVAPOTRANSPIRATION AND RAINFALL

REPUBLIC OF INDONESIA  
 MINISTRY OF PUBLIC WORKS  
 THE FEASIBILITY STUDY ON THE NIAS ISLAND  
 IRRIGATION AGRICULTURAL DEVELOPMENT PROJECT  
 JAPAN INTERNATIONAL COOPERATION AGENCY

The Feasibility Study on  
The Nias Island Irrigation Agricultural Development Project

Vol. III  
**FEASIBILITY STUDY FOR THE MEZAWA/HOW  
IRRIGATION DEVELOPMENT PROJECT**

## ***Appendix C***

### ***Irrigation and Drainage***





## Appendix C IRRIGATION AND DRAINAGE

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Table C-1 EXISTING ROAD NETWORK

No.	Road Section		Length (km)	Total Width (m)	Pavement Condition (km)			Status (km)	
	From	To			Asphalt	Stone	Earth	Normal	Damaged
<b>Provincial Road</b>									
P1	Ie. Gawo	Mezawa	2.5	3	1.5	1		2.5	
P2	Mezawa	Sitolu Banua	8.5	3			8.5		8.5
P3	Sitolu Banua	Ie. Susuwa	12	3			11.5		11.5
	Sub Total		23		1.5	1	20	2.5	20
<b>Kabupaten Road</b>									
K1	Tetehosi	Maliwa'a	5.9	3	3	2.9		3	2.9
K2	Hilina'a Tafuo	Seafewali	6.2	3			6.2		6.2
K3	Seafewali	Tagaule	6.9	1-3			6.9		6.9
	Sub Total		19		3	2.9	13.1	3	16
<b>Desa Road</b>									
D1	Hilina'a Tafuo	Lawalo	8.5	1-3			8.5		8.5
D2	Botohanega	Woli	5.5	1.5			5.5		5.5
D3	Sohoya	Hao	2	1.5			2		2
D4	Hiliholu	Soma	8	1			8		8
D5	Hilihoru	Hilifaosi	5	3			5	0.5	4.5
D6	Mezawa	Hilibaruze	3	2		3			3
	Sub Total		32		0	3	29	0.5	31.5
Total			74		4.5	6.9	62.1	6	67.5

Table C-2 EXISTING ROAD CROSSING STRUCTURES

No.	Road Section		Nos. of Structures			Status	
	From	To	Bridge	Culvert	Total	Normal	To be repaired
Provincial Road							
P1	Ie. Gawo	Mezawa	2		2		2
P2	Mezawa	Sitolu Banua	19		19		19
P3	Sitolu Banua	Ie. Susuwa	25	1	26	2	24
	Sub Total		46	1	47	2	45
Kabupaten Road							
K1	Tetehosi	Maliwa'a	3	3	6	6	
K2	Hilina'a Tafuo	Siofewali	14	11	25	13	12
K3	Seafewali	Tagaule	28	3	31	6	25
	Sub Total		45	17	62	25	37
Desa Road							
D1	Hilina'a Tafuo	Lawalo	22		22	1	21
D2	Botohanega	Woli			0		
D3	Sohoya	Hao			0		
D4	Hilihoru	Soma	3		3		3
D5	Hilihoru	Hilifaosi	2		2		2
D6	Mezawa	Hilibaruze	3		3	1	2
	Sub Total		30	0	30	2	28
Total			121	18	139	29	110

Table C-3 ESTIMATE OF IRRIGATION WATER REQUIREMENT

Basic Meteorological Data

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Air Temperature (Centigrade in degree)												
Mean	25.8	25.8	26	26	26	25.8	25.2	25.3	25.2	25.2	25.2	25.5
Relative Humidity (%)												
Mean	87	87	88	90	89	88	88	88	89	90	90	89
Wind Velocity (m/s)												
Average	0.4	0.5	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.3	0.4	0.4
Sunshine (%)												
Average	55	55	47	48	51	61	52	49	39	38	41	47

Unit Diversion Water Requirement (l/sec/ha)

Period (day)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1 - 15	0.00	0.00	0.00	1.47	1.22	1.12	0.64	0.00	1.19	0.95	0.83	0.66
16 - End	0.00	0.00	0.91	1.10	1.19	1.12	0.17	0.43	0.83	0.90	0.83	0.31

Calculation Conditions :

- 1 All procedures follow DGWRD Irrigation Design Standard
- 2 Crop water requirement is based on FAO reference evapotranspiration
- 3 Percolation loss is estimated to be 1 mm
- 4 Water layer replacement requirement of 50 mm is introduced
- 5 Overall irrigation efficiency is estimated to be 60 %
- 6 Cropping area factor follows the proposed cropping pattern

Table C-4 RESULTS OF WATER BALANCE STUDY

Period	Unit Diversion Requirement (l/s/ha)	Mezawa River System			Mola River System			How River System			Susuwu River System			
		Design Discharge (m3/s)	Available Discharge (m3/s)	Balance (m3/s)	Design Discharge (m3/s)	Available Discharge (m3/s)	Balance (m3/s)	Design Discharge (m3/s)	Available Discharge (m3/s)	Balance (m3/s)	Design Discharge (m3/s)	Available Discharge (m3/s)	Balance (m3/s)	
Jan.	1 - 15	0.00	0.00	0.36	0.36	0.00	1.86	1.86	0.00	0.59	0.59	0.00	4.46	4.46
	16 - 31	0.00	0.00	0.36	0.36	0.00	1.86	1.86	0.00	0.59	0.59	0.00	4.46	4.46
Feb.	1 - 15	0.00	0.00	0.32	0.32	0.00	1.66	1.66	0.00	0.52	0.52	0.00	3.97	3.97
	16 - 28	0.00	0.00	0.32	0.32	0.00	1.66	1.66	0.00	0.52	0.52	0.00	3.97	3.97
Mar.	1 - 15	0.00	0.00	0.41	0.41	0.00	2.13	2.13	0.00	0.67	0.67	0.00	5.10	5.10
	16 - 31	0.91	0.25	0.41	0.15	1.32	2.13	0.81	0.41	0.67	0.26	2.66	5.10	2.45
Apr.	1 - 15	1.47	0.41	0.41	0.00	2.13	2.16	0.03	0.66	0.68	0.02	4.29	5.19	0.89
	16 - 30	1.10	0.31	0.41	0.11	1.60	2.16	0.57	0.50	0.68	0.19	3.21	5.19	1.97
May	1 - 15	1.22	0.34	0.37	0.03	1.77	1.93	0.16	0.55	0.61	0.06	3.56	4.62	1.06
	16 - 31	1.19	0.33	0.37	0.04	1.73	1.93	0.20	0.54	0.61	0.07	3.47	4.62	1.14
June	1 - 15	1.12	0.31	0.35	0.04	1.62	1.82	0.20	0.50	0.57	0.07	3.27	4.37	1.10
	16 - 30	1.12	0.31	0.35	0.04	1.62	1.82	0.20	0.50	0.57	0.07	3.27	4.37	1.10
July	1 - 15	0.64	0.18	0.46	0.28	0.93	2.40	1.47	0.29	0.76	0.47	1.87	5.75	3.88
	16 - 31	0.17	0.05	0.46	0.41	0.25	2.40	2.15	0.08	0.76	0.68	0.50	5.75	5.26
Aug.	1 - 15	0.00	0.00	0.40	0.40	0.00	2.06	2.06	0.00	0.65	0.65	0.00	4.94	4.94
	16 - 31	0.43	0.12	0.40	0.27	0.62	2.06	1.44	0.19	0.65	0.46	1.26	4.94	3.69
Sep.	1 - 15	1.19	0.33	0.59	0.26	1.73	3.08	1.35	0.54	0.97	0.43	3.47	7.37	3.90
	16 - 30	0.81	0.23	0.59	0.36	1.17	3.08	1.90	0.36	0.97	0.60	2.37	7.37	5.01
Oct.	1 - 15	0.95	0.27	0.71	0.44	1.38	3.68	2.31	0.43	1.16	0.73	2.77	8.83	6.06
	16 - 31	0.90	0.25	0.71	0.45	1.31	3.68	2.38	0.41	1.16	0.76	2.63	8.83	6.20
Nov.	1 - 15	0.83	0.23	0.67	0.44	1.20	3.48	2.28	0.37	1.10	0.72	2.42	8.34	5.92
	16 - 30	0.83	0.23	0.67	0.44	1.20	3.48	2.28	0.37	1.10	0.72	2.42	8.34	5.92
Dec.	1 - 15	0.66	0.18	0.52	0.34	0.96	2.74	1.78	0.30	0.86	0.57	1.93	6.56	4.64
	16 - 31	0.31	0.09	0.52	0.44	0.45	2.74	2.29	0.14	0.86	0.72	0.91	6.56	5.66

Irrigation Area : Mezawa River System 280 ha  
Mola River System 1,450 ha  
How River System 450 ha  
Susuwu River System 2,920 ha  
Total 5,100 ha

Table C-5 PROPOSED IRRIGATION SYSTEM

Source of Water	Name of System	Intake Facility	Commanding Area		Peak Diversion Discharge (m <sup>3</sup> /sec)
			Location	Net Area (ha)	
1 Mezawa River	Mezawa System	Mezawa Intake Weir	(1) Right bank of Mezawa R. (2) Left bank of Mezawa R.	280	0.41
2 Mola River	Mola System	Mola Intake Weir	(1) Left bank of Mola R. (2) Left bank of Mezawa R. (3) Right bank of Gawo R.	1,450	2.13
3 How River	How System	How Intake Weir	(1) Left bank of How R. (2) Right bank of How R.	450	0.66
4 Susuwa River	Susuwa System	Susuwa Intake Weir	(1) Right bank of Suani R. (2) Right bank of Mola R. (3) Left bank of Mola R.	2,920	4.29
Total				5,100	7.50



Table C-6 PROPOSED DRAINAGE SYSTEM

No.	Name of Drainage System	Outlet River/ Canal	Project Area		External Area		Total Drainage		
			Area (ha)	Discharge (cu.m/s)	Area (ha)	Discharge (cu.m/s)	Area (ha)	Discharge (cu.m/s)	
1.	Gawo System	Gawo R.	636	2.31	288	1.57	3.88		
2.	Mezawa System	Penakawa R.	510	1.87	409	2.27	4.14		
		Mezawa R.	908	3.56	430	2.47	6.03		
3.	Mola System	Woli R.	643	2.29	543	2.97	5.26		
		Doripe R.	307	1.32	126	0.74	2.06		
		Vanea R.	349	1.27	71	0.43	1.70		
		Sohaya R.	643	2.38	0	0.00	2.38		
4.	Mola2 System	Mola R.	1,435	5.04	9	0.06	5.10		
		-	418	1.60	0	0.00	1.60		
5.	How System	How R.	528	2.06	0	0.00	2.06		
		Suani R.	559	2.11	0	0.00	2.11		
6.	Nalawe System	Nalawe R.	327	1.20	0	0.00	1.20		
Total								37.52	

Table C-7 ESTIMATE OF DRAINAGE WATER REQUIREMENT

Case	Land Use	Rainfall Data	Design Rainfall (mm/day)	Water Balance (mm/day)	Storage Depth (mm)	Runoff Coefficient	Drainage Depth (mm)	Drainage Modulus (l/s/ha)
a.	Paddy field	3-day consecutive rain	150	-6	50	-	82	3.17
b.	Non-paddy field	1-day consecutive rain	105	0	0	0.65	-	

Equations for Drainage Requirement

a. for Paddy Field

$$\text{Drainage Requirement} = 1.62 * \text{Drainage Modulus} * \text{Area}(A)^{0.92} = 5.14A^{0.92}$$

b. for Non-paddy Field

$$\text{Drainage Requirement} = 0.116 * \text{Design Rainfall} * \text{Runoff Coefficient} * \text{Area}(A)^{0.92} = 7.95A^{0.92}$$

Calculation Conditions

- a. Design rainfall is with 20% probability of exceedence.
- b. All calculation procedures follow DGWRD Irrigation Design Standards.
- c. Water balance is sum of irrigation, evapotranspiration and percoration.
- d. Average storage depth is estimated based on field investigation.
- e. Drainage depth is calculated by the following equation.

$$\text{Drainage Depth} = \text{Design Rainfall} + \text{Number of consecutive days} * \text{Water Balance} - \text{Average Storage Depth}$$

- f. Drainage modulus is an unit conversed from Drainage Depth
- g. Runoff Coefficient is selected supposing that non-paddy area is covered by light forest.

Table C-8 LIST OF PROPOSED O&M EQUIPMENT

Item	Specification	Required Nos.
<b>I. Operation Equipment</b>		
(1) Jeep type car	4,000 cc, 4 x 4	2
(2) Station wagon	1,500 cc, 4 x 4	1
(3) Motor cycle	125 cc	10
(4) Wireless radio	50 km	4
(5) Personnal computer	32 bit w/printer	2
<b>II. Maintenance Equipment</b>		
(1) Backhoe	0.4 m3	2
(2) Bulldozer	13 ton	2
(3) Wheel loader	1 m3	1
(4) Motor grader	9 ton	1
(5) Slope compactor	3 ps	4
(6) Concrete mixer	0.12 m3	2
(7) Submergible pump	50 mm dia.	2
(8) Portable generator	3 kVA	2
(9) Dump truck	6 ton	2

Table C-9 MAIN FEATURES OF THE DIVERSION WEIR

Item	Mezawa Weir	Mola Weir	How Weir	Susuwa Weir
1 Location	Mezawa river	Mola river	How river	Susuwa river
2 Intake discharge (m <sup>3</sup> /s)	0.41	2.13	0.66	4.29
3 Design flood discharge (m <sup>3</sup> /s)	139	346	184	533
4 River bed slope	1/50	1/400	1/300	1/250
5 Dimensions				
1) Weir body				
Type	Fixed weir (Concrete)	Fixed weir (Masonry)	Fixed weir (Masonry)	Fixed weir (Masonry)
Height of fixed weir	3.5 m	3.0 m	2.5 m	3.0 m
Length of fixed weir	12 m	40 m	28 m	60 m
2) Scouring gate				
Width	—	2.5 m (2 spans)	2.5 m	2.5 m (2 spans)
3) Crest elevation	46 m	35 m	32.5 m	28 m
4) Intake facility	Trash rack	Sluice gate	Sluice gate	Sluice gate
Width	2 m	1.8 m x 2 sets	1.8 m	2.5 m x 2 sets
5) Sand settling basin				
Type	Concrete flume of rectangular section	Masonry flume of rectangular section	Trapezoidal canal with masonry lining	Trapezoidal canal with masonry lining
Length	30 m	70 m	30 m	70 m
Width	2 m	5 m	5 m (bottom width)	10 m (bottom width)

Table C-10 LENGTH OF MAIN AND SECONDARY IRRIGATION CANALS

Name of Irrigation System	Nos of Canals	Length (m)	Type of Canal
<b>1 Mezawa System</b>			
- Main canal	1	1,000	Masonry lining
- Secondary canal	1	3,450	Masonry lining
<b>Total</b>	<b>2</b>	<b>4,450</b>	
<b>2 Mola System</b>			
- Main canal	1	9,150	Masonry lining
- Secondary canal	7	23,000	Masonry lining
<b>Total</b>	<b>8</b>	<b>32,150</b>	
<b>3 How System</b>			
- Main canal	1	4,400	Masonry lining
- Secondary canal	2	4,050	Masonry lining
<b>Total</b>	<b>3</b>	<b>8,450</b>	
<b>4 Susuwa System</b>			
- Main canal	1	25,300	Masonry lining
- Secondary canal	10	30,590	Masonry lining
<b>Total</b>	<b>11</b>	<b>55,890</b>	
<b>GRAND TOTAL</b>	<b>24</b>	<b>100,940</b>	

Table C-11 RELATED STRUCTURES ON IRRIGATION CANALS

		Nos of Structures		
		Main Canal (nos)	Secondary Canal (nos)	Total (nos)
I	Mezawa System			
	Turnout / Division		6	6
	Spillway		1	1
	Drop	1	6	7
	Total	1	13	14
II	Mola System			
	Turnout / Division	10	33	43
	Culvert	2	2	4
	Syphon	1		1
	Spillway	1	4	5
	Drop	1	19	20
	Check	3	1	4
	Aqueduct		3	3
Total	18	62	80	
III	How System			
	Turnout / Division	3	19	22
	Culvert	1		1
	Syphon	1		1
	Spillway	1	1	2
	Drop	2	7	9
	Check	1	1	2
Total	9	28	37	
IV	Susuwa System			
	Turnout / Division	3	67	70
	Culvert	2	4	6
	Syphon	5		5
	Spillway	5	5	10
	Drop		26	26
	Check	2	3	5
	Aqueduct		1	1
Total	17	106	123	
<b>GRAND TOTAL</b>		<b>45</b>	<b>209</b>	<b>254</b>

Table C-12 LENGTH OF DRAINAGE CANALS

Name of Irrigation System		Nos of Canals	Length (m)
I	Mezawa System		
	1 Ie. Naai	1	4,000
	Total	1	4,000
II	Mola System		
	1 Ie. Saeto	1	1,600
	2 Ie. Nadu	1	700
	3 Ie. Penokawa	1	5,500
	4 Ie. Woli	2	5,100
	5 Ie. Dolipe	1	2,000
	6 Ie. Vanea	1	1,300
	Total	7	16,200
III	How System		
	1 Ie. Suani	1	5,000
	Total	1	5,000
IV	Susuwa System		
	1 Ie. Mezawa	7	5,100
	2 Ie. Woli	2	4,300
	3 Ie. Doripe	4	9,000
	4 Ie. Lagasimahe	2	4,000
	5 Ie. Mola	2	3,200
	6 Toma	2	9,500
	7 Ie. Malawo	1	2,000
	Total	20	37,100
GRAND TOTAL		29	62,300

Table C-13 RELATED STRUCTURES ON DRAINAGE CANALS

Name of Irrigation System	Nos of Structures		
	New	Repaired	Total
<b>I Mezawa System</b>			
Cross Drain	3	0	3
Drain Culvert	1	0	1
Bridge	0	1	1
<b>Total</b>	<b>4</b>	<b>1</b>	<b>5</b>
<b>II Mola System</b>			
Cross Drain	6	0	6
Drain Culvert	0	0	0
Bridge	0	0	0
<b>Total</b>	<b>6</b>	<b>0</b>	<b>6</b>
<b>III Susuwa System</b>			
Cross Drain	11	0	11
Drain Culvert	2	0	2
Bridge	0	2	2
<b>Total</b>	<b>13</b>	<b>2</b>	<b>15</b>
<b>GRAND TOTAL</b>	<b>23</b>	<b>3</b>	<b>26</b>



Table C-14 LIST OF WAGE AND MATERIALS

Description	Unit	Price (Rp.)
<b>I WAGE</b>		
1 Common labour	day	4,000
2 Semi skilled labour	day	4,350
3 Skilled labour	day	4,500
4 Head of skilled labour	day	4,500
5 Supervisor of labour	day	4,500
6 Assistant	day	4,000
7 Steel worker	day	5,000
<b>II FUEL, LUBRICANT &amp; ELECTRICITY</b>		
1 Gasoline	lit	385
2 Diesel oil	lit	250
3 Gear oil	lit	5,000
4 Grease	kg	3,500
<b>III MATERIALS</b>		
1 Fine sand	cu.m	8,000
2 Coarse sand	cu.m	9,200
3 Stone	cu.m	9,000
4 Gravel	cu.m	12,000
5 Artificial brick	pcs	85
6 Wood of dia. 12-15cm (4.5m)	cu.m	175,000
7 Portland cement, 40 kg	zac	7,500
8 Reinforcement bar, deformed	kg	1,500
9 Nail 2 - 4"	kg	1,600
10 Multiplex wood, 4 mm x 1.2m x 2.4	sheet	9,100
11 Multiplex wood, 6 mm	sheet	14,300
12 Multiplex wood, 9 mm	sheet	21,500
13 Multiplex wood, 12 mm	sheet	27,000
14 Concrete pipe, dia. 0.2m	m	4,500
15 Concrete pipe, dia. 0.6m	m	38,500
16 Concrete pipe, dia. 0.8m	m	44,000
17 Concrete pipe, dia. 1.0m	m	64,000
18 Gabion	cu.m	1,920

Table C-15 UNIT CONSTRUCTION COST FOR MAJOR WORKS

	Description	Unit	L.C. (Rp.)	F.C. (US\$)	Total Unit Cost (Rp.)
I	Compensation				
1	Land Aquisition				
	Commercial area	sq.m	1,000	0.00	1,000
	Resident	sq.m	500	0.00	500
2	House Compensation				
	Permanent	sq.m	200,000	0.00	200,000
	Semi permanent	sq.m	150,000	0.00	150,000
	Simple	sq.m	125,000	0.00	125,000
3	Tree Compensation	nos	250,000	0.00	250,000
II	Earth Works				
1	Clearing and grubbing	sq.m	274	0.16	570
2	Stripping	cu.m	1,750	1.72	4,932
3	Excavation				
	Excavation, Rock	cu.m	3,217	3.42	9,544
	Excavation by Bulldozer	cu.m	1,864	1.72	5,046
	Excavation for structure	cu.m	1,143	1.15	3,271
	Excavation by manpower	cu.m	2,583	0.00	2,583
4	Embankment				
	Embankment w/excavated material	cu.m	721	0.67	1,961
	Embankment by manpower	cu.m	1,869	0.57	2,924
	Embankment w/borrowed material	cu.m	1,876	1.69	5,003
5	Backfill for structure	cu.m	861	0.56	1,897
6	Road metalling w/gravel	cu.m	6,603	6.18	18,036
7	Sod facing	sq.m	1,276	0.00	1,276
III	Concrete Works				
1	Concrete				
	Concrete, Type A w/ Scaffolding	cu.m	154,634	37.92	224,786
	Concrete, Type A w/o Scaffolding	cu.m	139,106	2.46	143,657
	Concrete, Type D w/ Scaffolding	cu.m	107,573	13.10	131,808
	Concrete, Type D w/o Scaffolding	cu.m	102,914	2.46	107,465
2	Form for Concrete	sq.m	24,158	0.00	24,158
3	Reinforcement bar	ton	1,835,649	8.22	1,850,856
IV	Other Civil Works				
1	Concrete Pipe				
	Concrete pipe, D=1000 mm	m	78,669	0.07	78,799
	Concrete pipe, D=800 mm	m	54,168	0.05	54,261
	Concrete pipe, D=600 mm	m	47,168	0.04	47,242
	Concrete pipe, D=200 mm	m	5,639	0.01	5,658
2	Stone Masonry				
	Stone masonry, canal lining	cu.m	63,349	17.16	95,095
	Stone masonry, structure	cu.m	59,299	17.16	91,045
3	Gabion mattres	cu.m	8,100	0.00	8,100
4	Riprap protection	cu.m	33,421	17.08	65,019

Table C-16 PROCUREMENT COST O&amp;M EQUIPMENT

Item	Specification	Required Nos	Unit Price		Amount		Total (1,000 Rp.)
			F.C. (US\$)	L.C. (1,000 Rp.)	F.C. (US\$)	L.C. (1,000 Rp.)	
<b>I. Operation Equipment</b>							
(1) Jeep type car	4,000 cc, 4 x 4	2	17,596	814	35,192	1,628	66,733
(2) Station wagon	1,500 cc, 4 x 4	1	7,705	356	7,705	356	14,611
(3) Motor cycle	125 cc	10	1,585	73	15,850	733	30,056
(4) Wireless radio	50 km	4	3,716	172	14,864	687	28,186
(5) Personal computer	32 bit w/printer	2	8,470	392	16,940	783	32,122
<b>II. Maintenance Equipment</b>							
(1) Backhoe	0,4 m3	2	72,000	3,330	144,000	6,660	273,060
(2) Bulldozer	13 ton	2	97,300	4,500	194,600	9,000	369,010
(3) Wheel loader	1 m3	1	81,500	3,769	81,500	3,769	154,544
(4) Motor grader	3.7 m	1	120,000	5,550	120,000	5,550	227,550
(5) Tamper	80 kg	4	2,100	97	8,400	389	15,929
(6) Concrete mixer	0.3 m3	2	3,200	148	6,400	296	12,136
(7) Submergible pump	65 mm dia.	2	1,300	60	2,600	120	4,930
(8) Portable generator	3 kVA	2	3,224	149	6,448	298	12,227
(9) Dump truck	6 ton	2	43,000	1,989	86,000	3,978	163,078
<b>III. Agricultural Machinery</b>							
(1) Tractor	40 Hp	1	28,750	1,330	28,750	1,330	54,517
(2) Tractor	7.5 Hp	1	4,107	190	4,107	190	7,788
(3) Hurrow		1	3,861	179	3,861	179	7,321
(4) Traler	2.3 ton	1	4,518	209	4,518	209	8,567
(5) Combine harvestor		1	98,571	4,559	98,571	4,559	186,915
(6) Fan		2	2,218	103	4,436	205	8,412
(7) Measuring instrument 3 kg		1	4,518	209	4,518	209	8,567
(8) Copy machine		1	4,107	190	4,107	190	7,788
(9) Type writer		1	1,396	65	1,396	65	2,647
(10) Video camera		1	2,054	95	2,054	95	3,895
					896,817	41,478	1,700,589

Table C-17 ANNUAL DISBURSEMENT SCHEDULE OF THE MEZAWA/HOW PROJECT

	1992/93			1993/94			1994/95			1995/96			1996/97		
	F/C (US\$ 1,000)	L/C (Rp. mil.)	Total (Rp. mil.)	F/C (US\$ 1,000)	L/C (Rp. mil.)	Total (Rp. mil.)	F/C (US\$ 1,000)	L/C (Rp. mil.)	Total (Rp. mil.)	F/C (US\$ 1,000)	L/C (Rp. mil.)	Total (Rp. mil.)	F/C (US\$ 1,000)	L/C (Rp. mil.)	Total (Rp. mil.)
1 Detailed Design	946	2,217	3,967	946	2,217	3,967									
2 Land Acquisition	0	2,670	2,670		2,670	2,670									
3 Construction Works															
1) Direct Cost	9,380	24,253	41,606	2,345	6,063	10,402	2,345	6,063	10,402	2,814	7,276	12,482	1,876	4,851	8,371
2) Value Added Tax	1,079	2,789	4,785	270	697	1,196	270	697	1,196	324	837	1,436	216	558	957
Sub-total	10,459	27,042	46,391	2,615	6,761	11,598	2,615	6,761	11,598	3,138	8,113	13,917	2,092	5,408	9,278
4 Contingencies															
1) Physical Contingency	1,407	3,638	6,241	352	910	1,560	352	910	1,560	422	1,091	1,872	281	728	1,248
2) Price Contingency	925	6,626	8,334	88	677	840	178	1,267	1,595	364	2,487	3,161	293	2,195	2,737
Sub-total	2,330	10,264	14,575	440	1,586	2,400	530	2,176	3,156	786	3,579	5,034	575	2,923	3,986
5 Procurement of O&M Equipment	897	41	1,700	21	850	888				425	444	1,231			
6 Engineering Services	938	2,425	4,160	235	606	1,040	235	606	1,040	281	728	1,248	188	485	832
7 Administration Cost	281	728	1,248	70	182	312	70	182	312	84	218	374	56	146	250
8 Training Program	0	250	250	0	63	63	0	63	63	0	75	75	0	50	50
<b>TOTAL</b>	<b>15,851</b>	<b>45,637</b>	<b>74,962</b>	<b>946</b>	<b>4,887</b>	<b>6,637</b>	<b>3,380</b>	<b>10,048</b>	<b>16,301</b>	<b>3,449</b>	<b>9,787</b>	<b>16,168</b>	<b>4,715</b>	<b>13,156</b>	<b>21,879</b>

Price escalation rate : F/C = 3%/year L/C = 8%/year

Remark

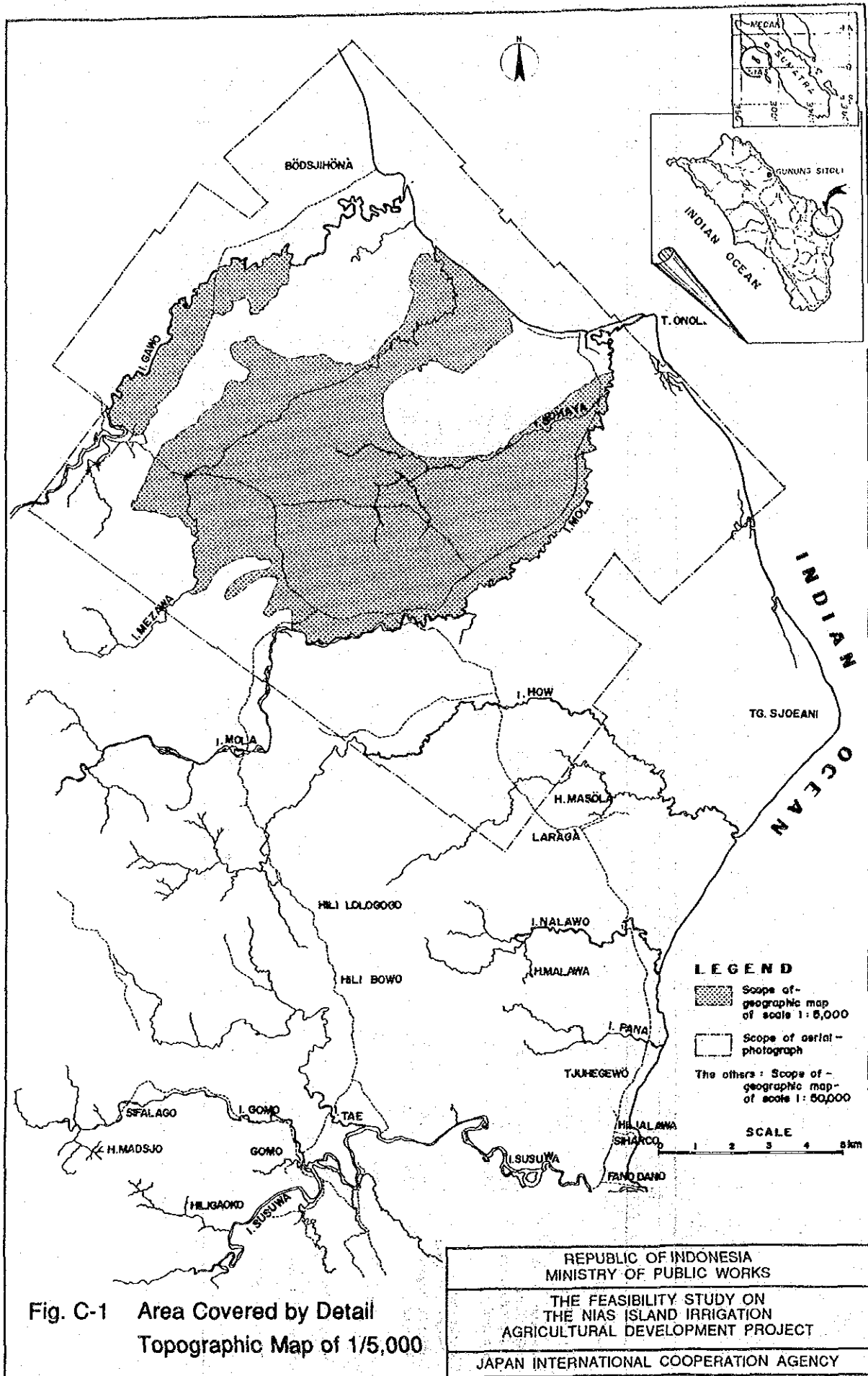
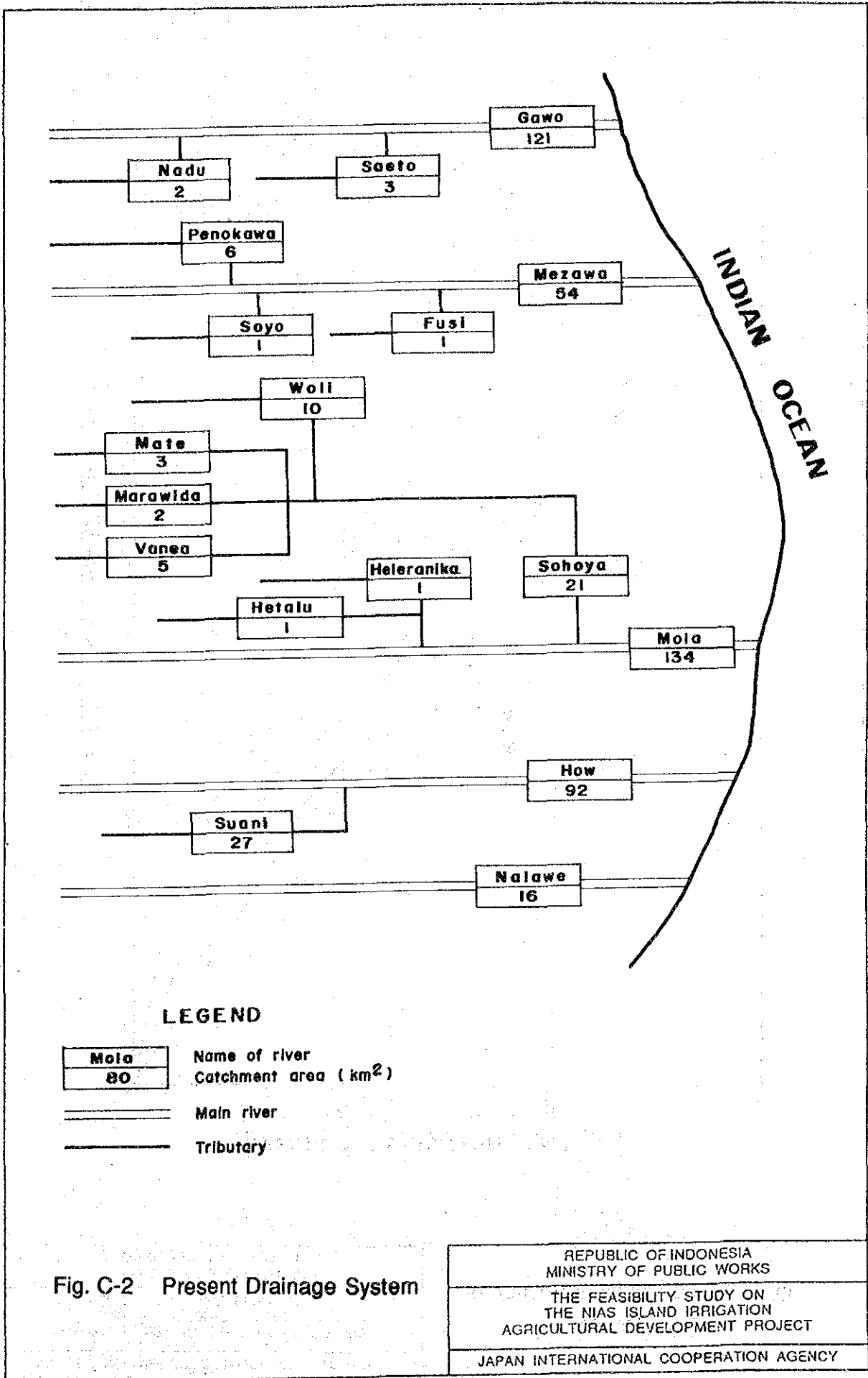


Fig. C-1 Area Covered by Detail  
Topographic Map of 1/5,000



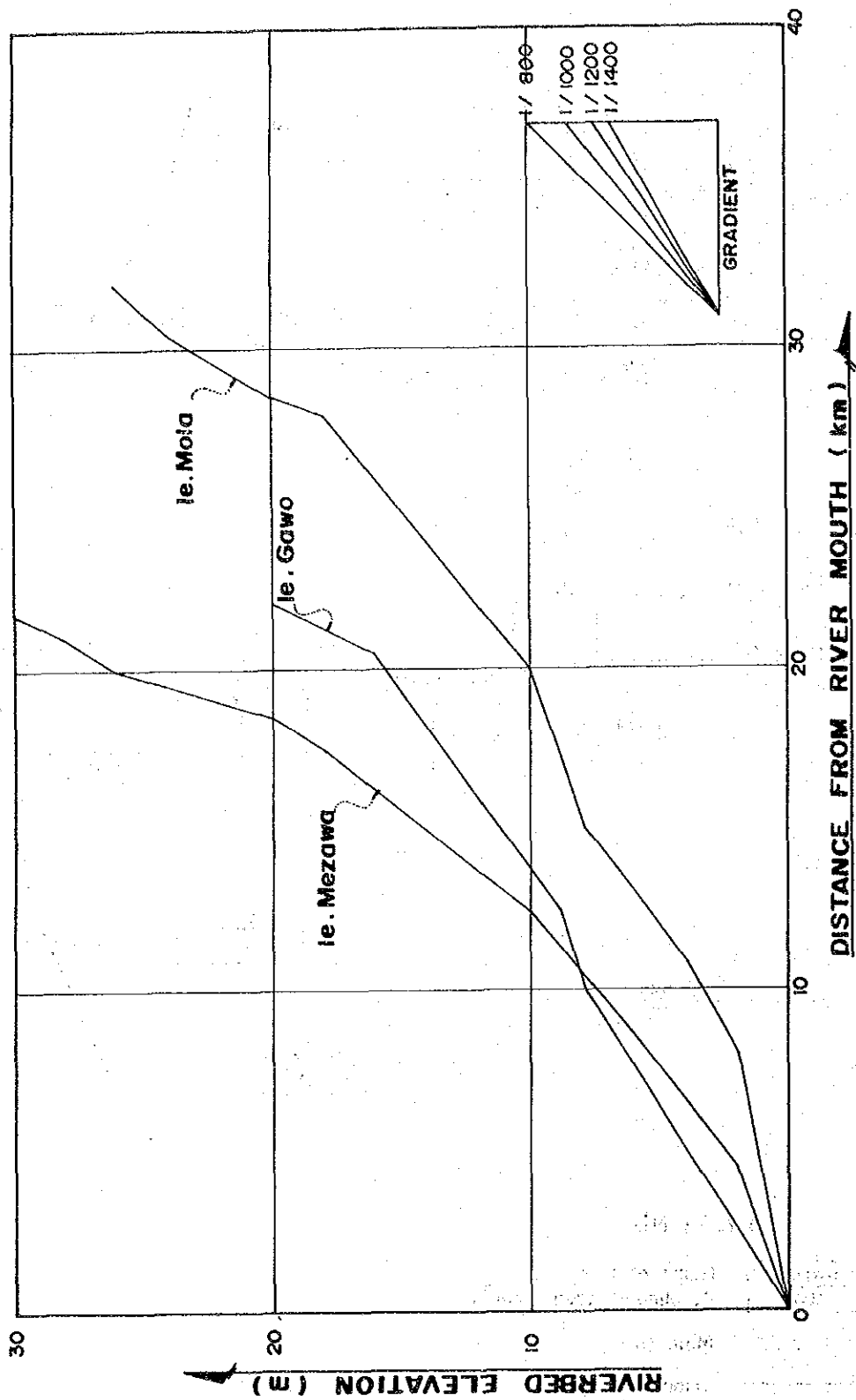


Fig. C-3 Longitudinal Section of Main Rivers

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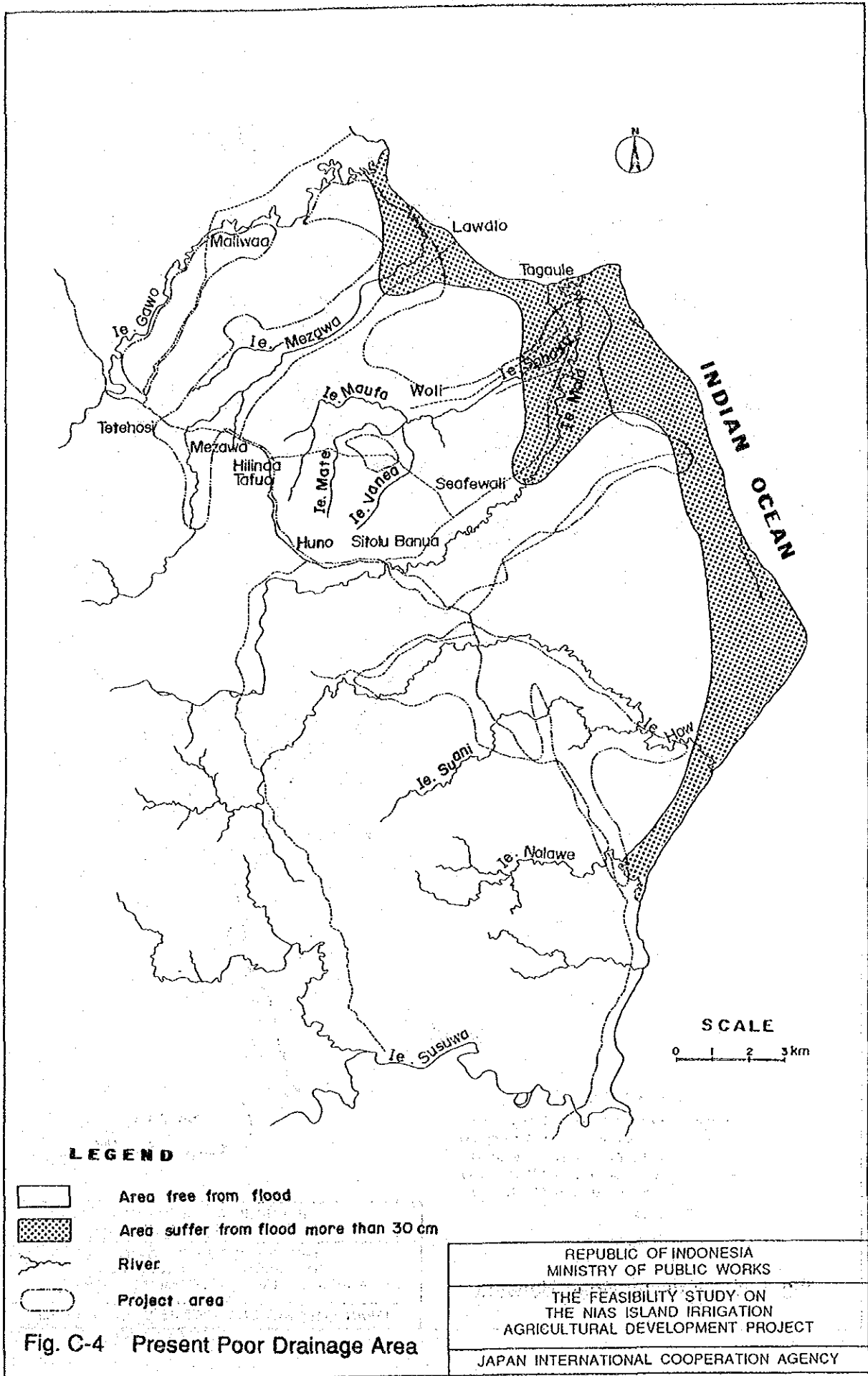


Fig. C-4 Present Poor Drainage Area



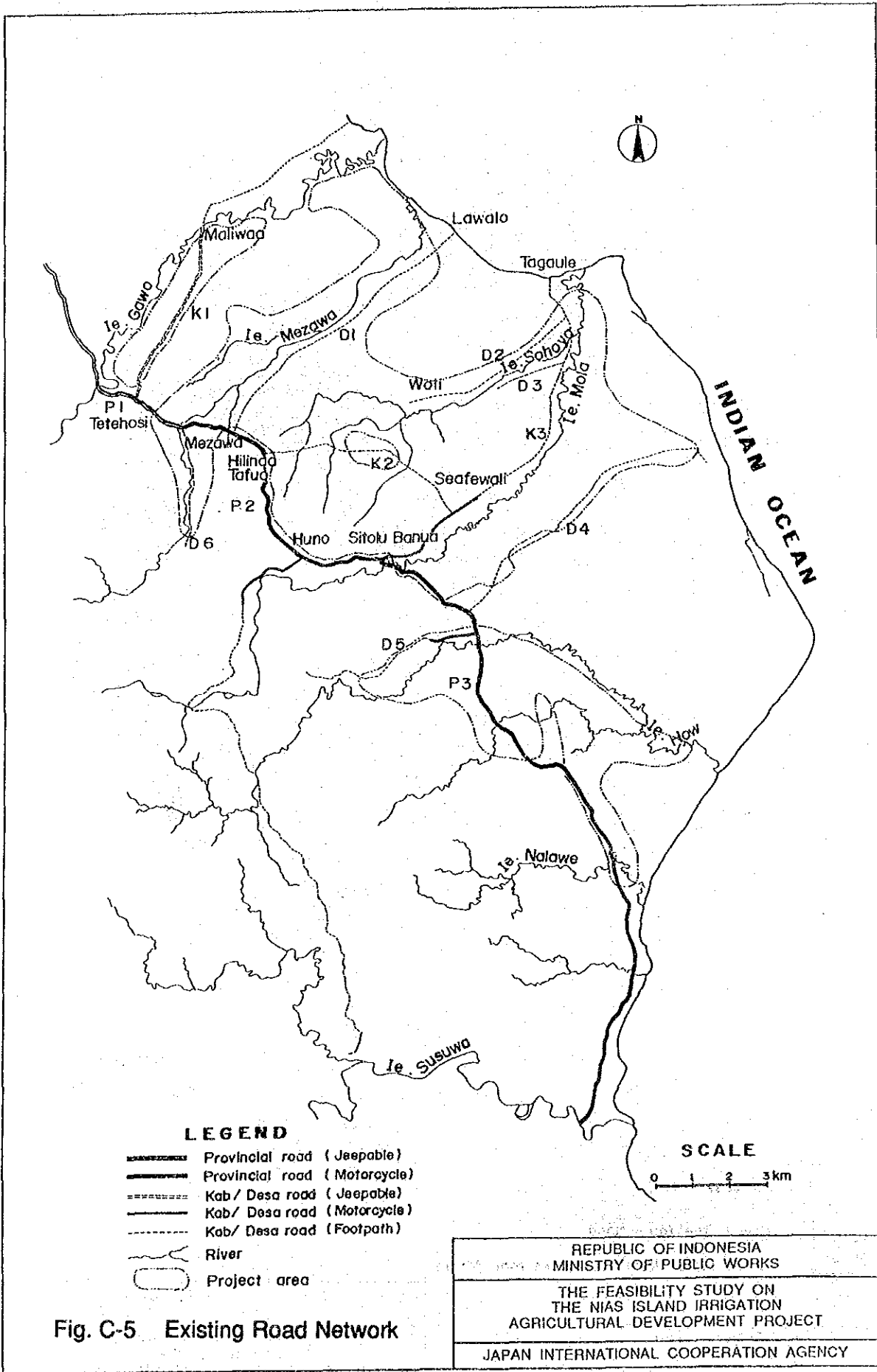
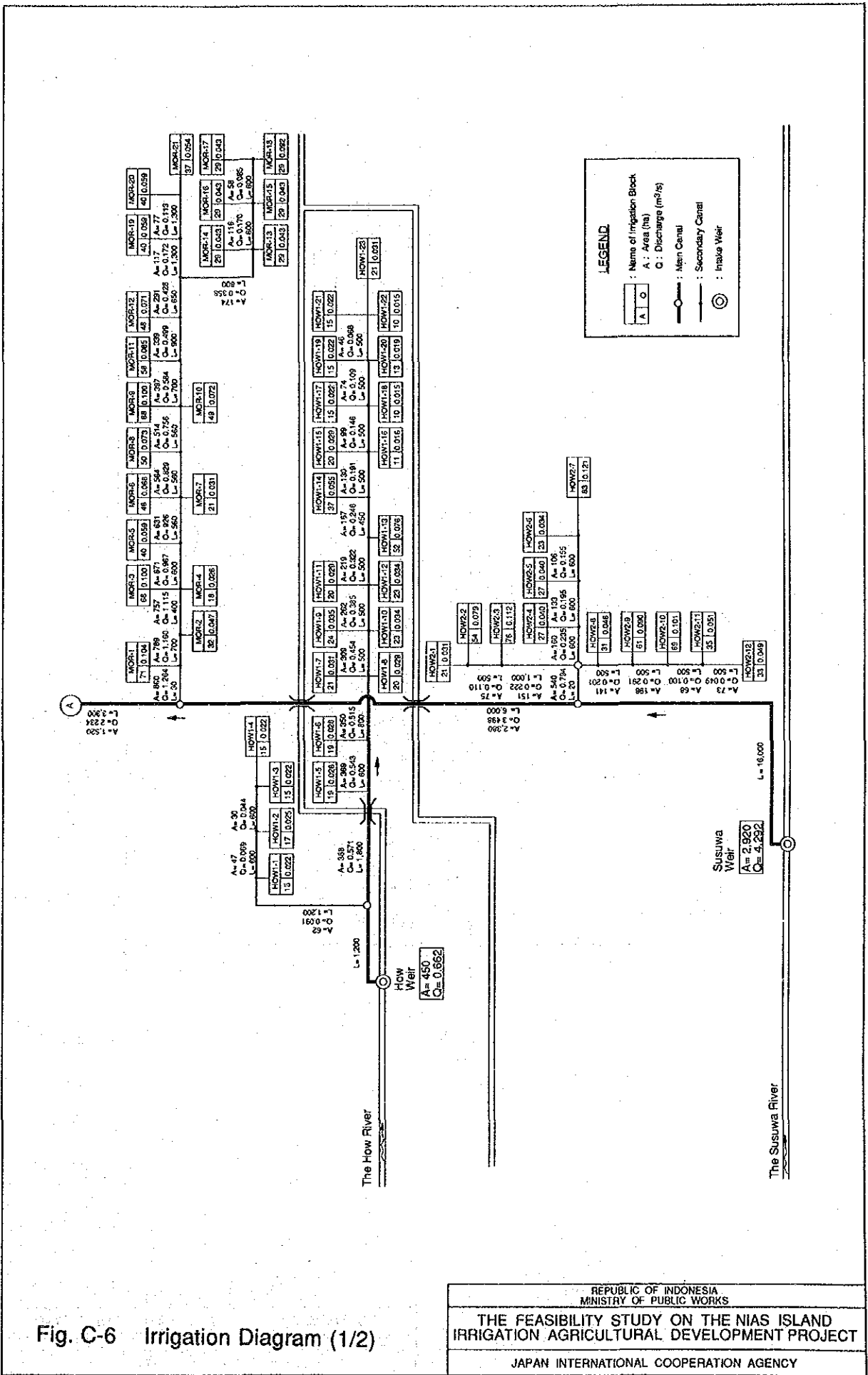
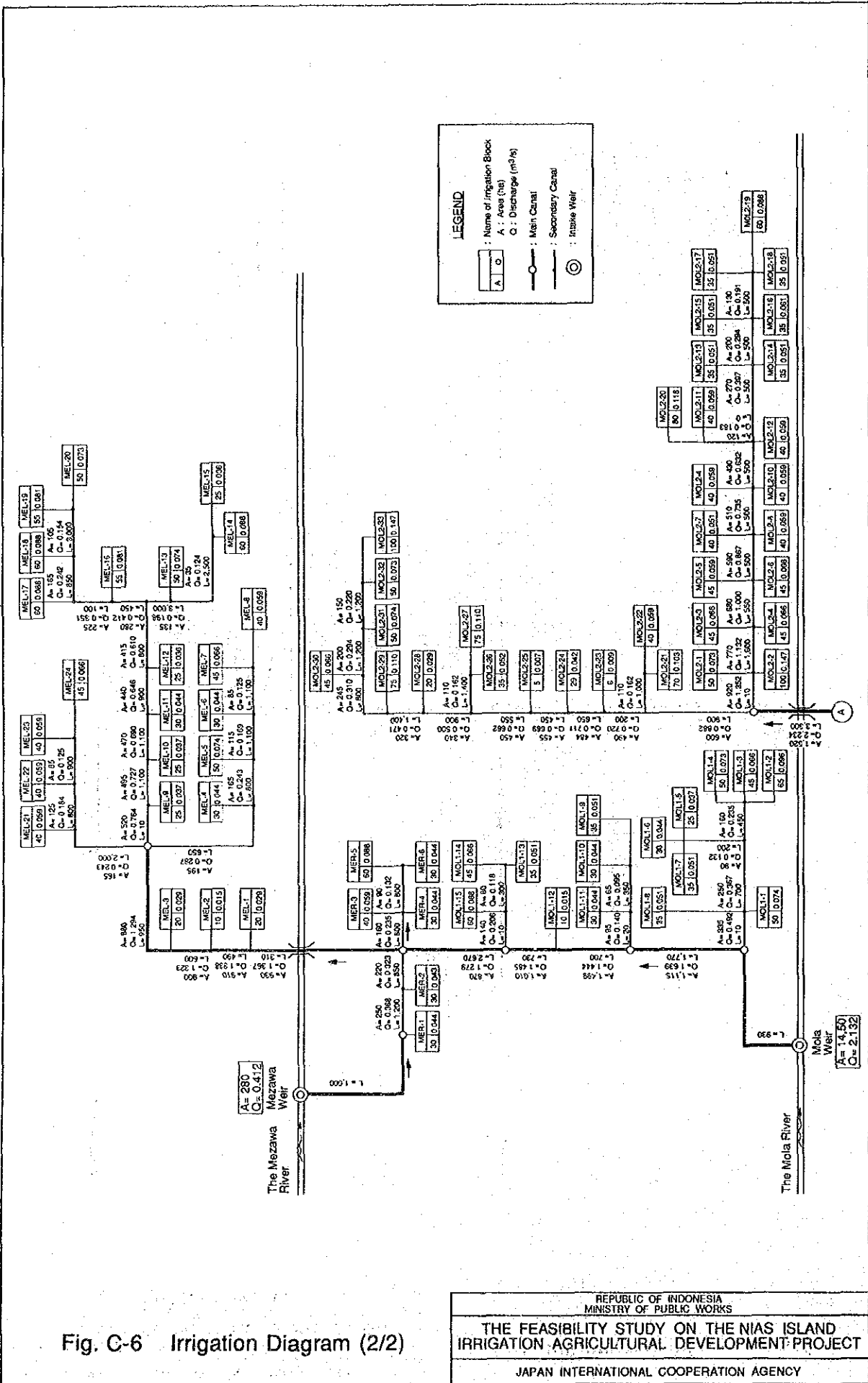
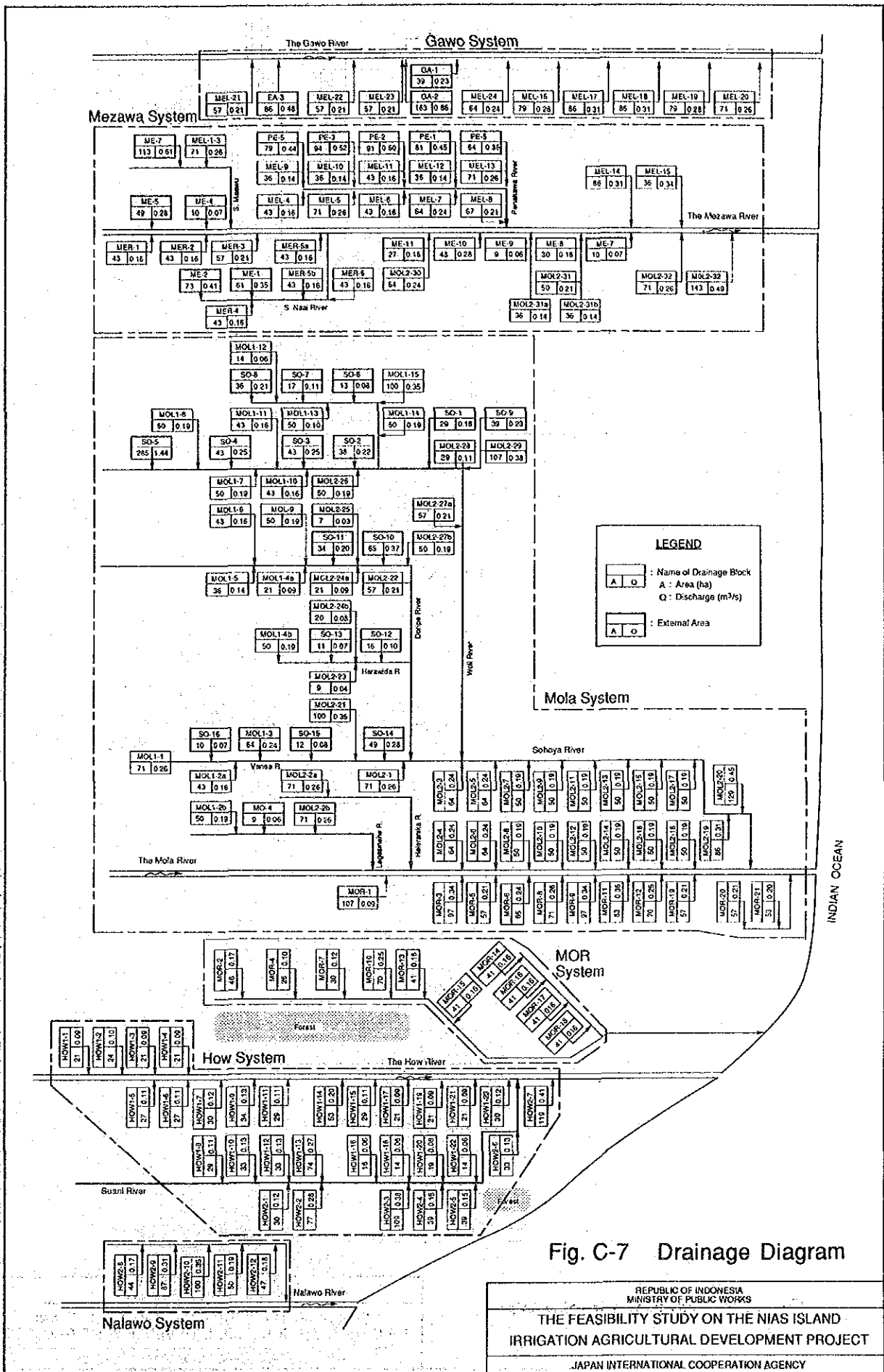


Fig. C-5 Existing Road Network



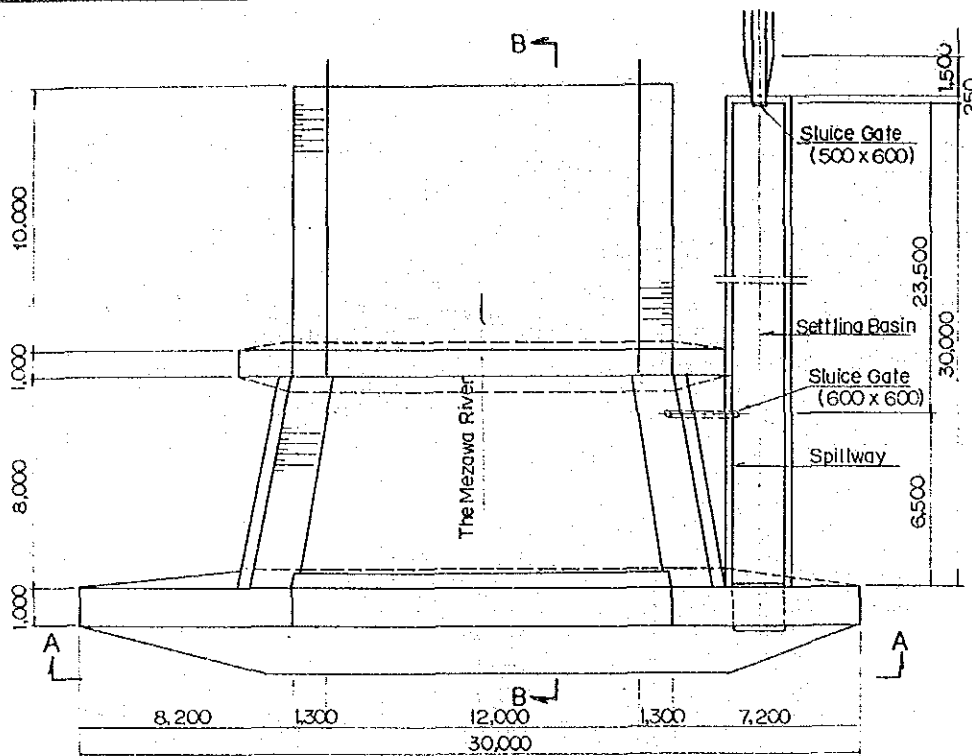




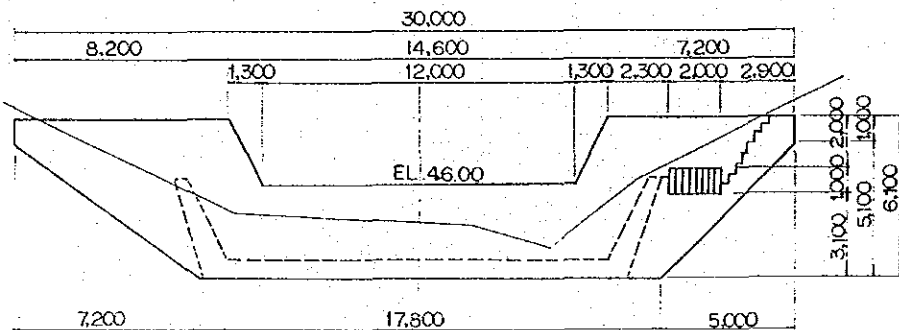
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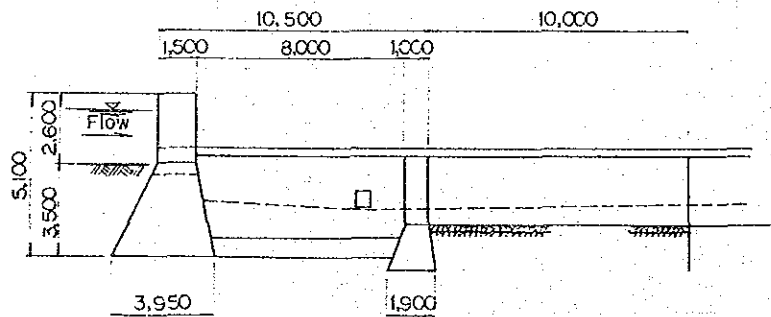
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PLAN



SECTION A-A



SECTION B-B

Fig. C-8 Mezawa Intake Weir

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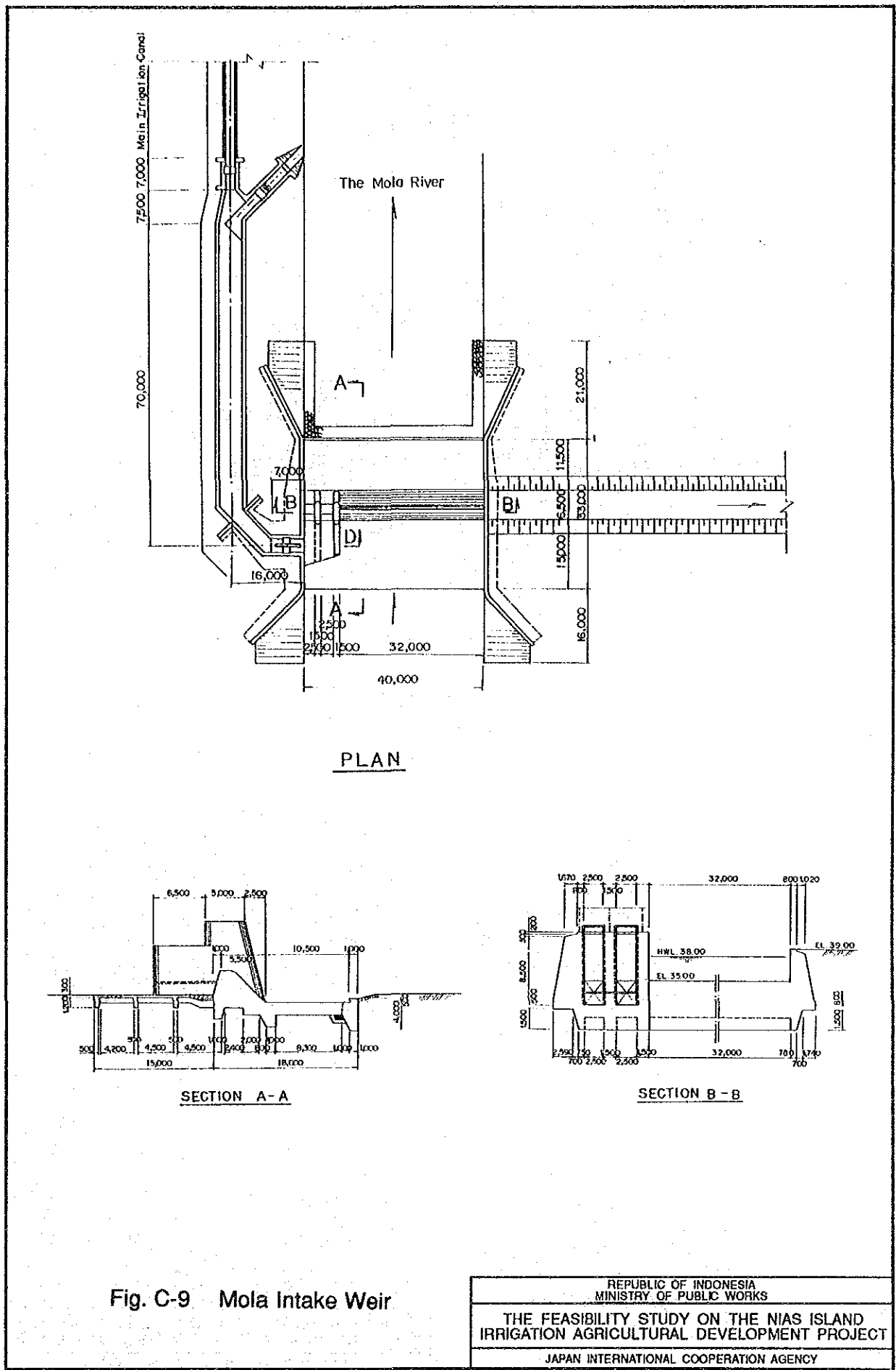


Fig. C-9 Mola Intake Weir

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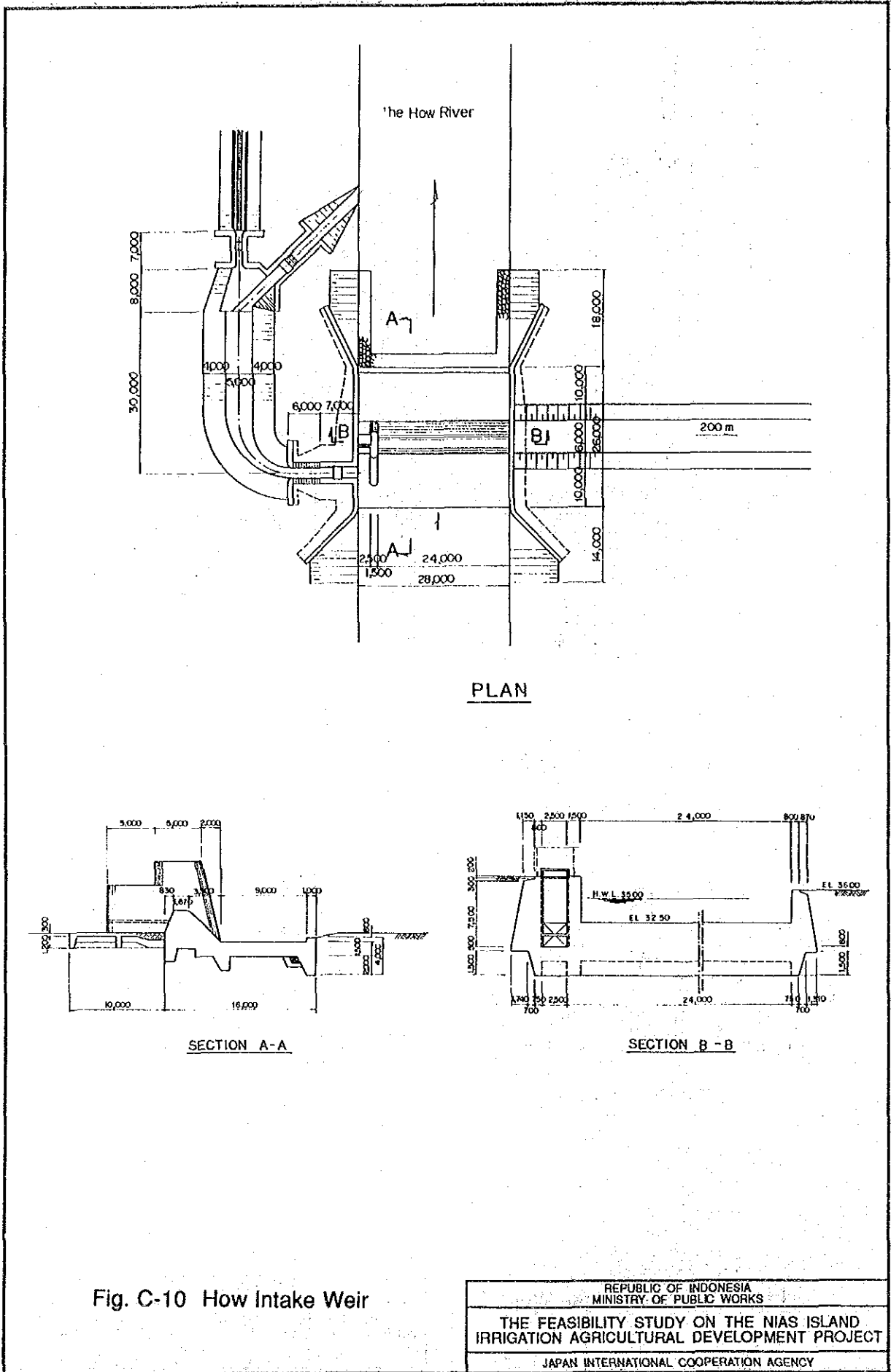
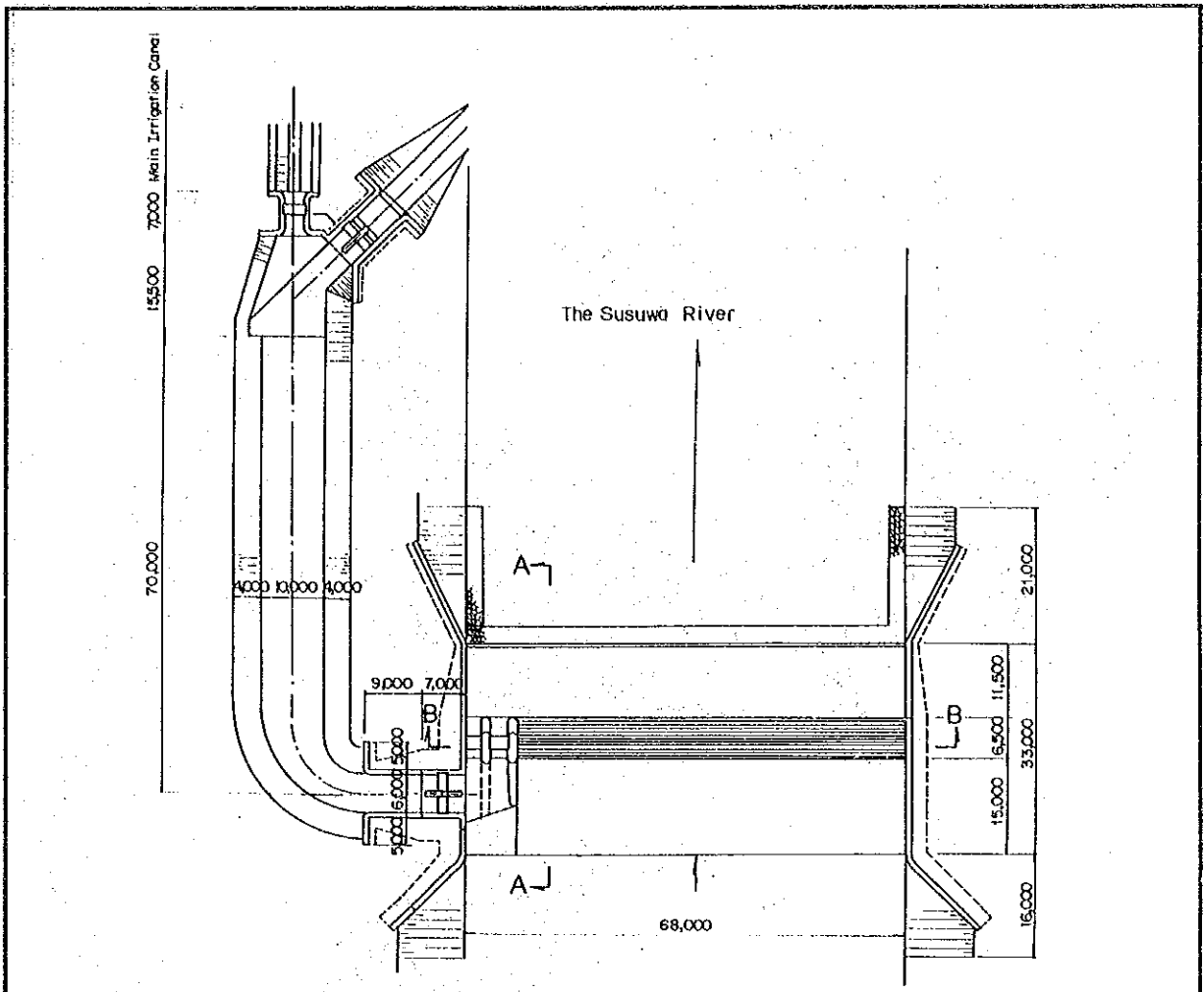


Fig. C-10 How Intake Weir

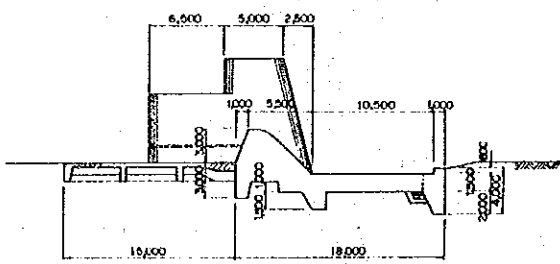
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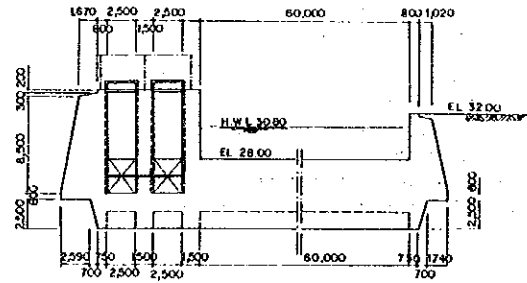
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PLAN



SECTION A-A



SECTION B-B

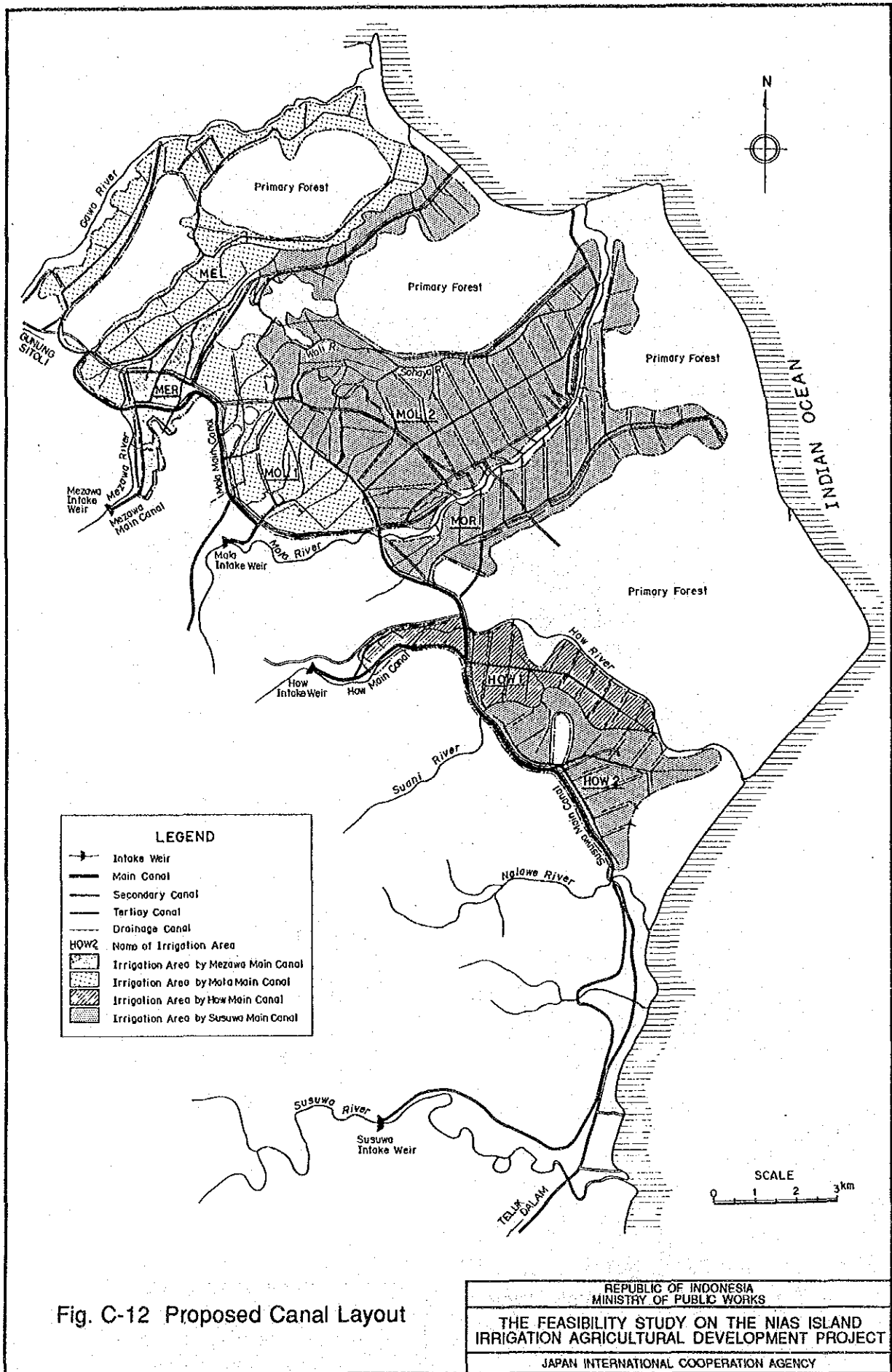
Fig. C-11 Susuwa Intake Weir

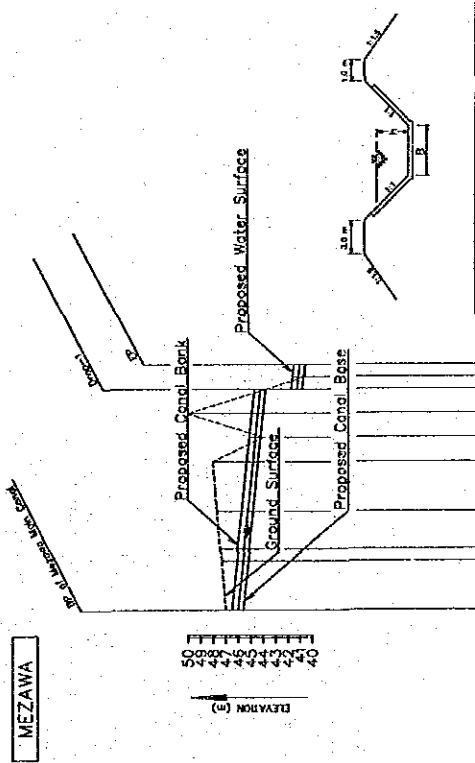
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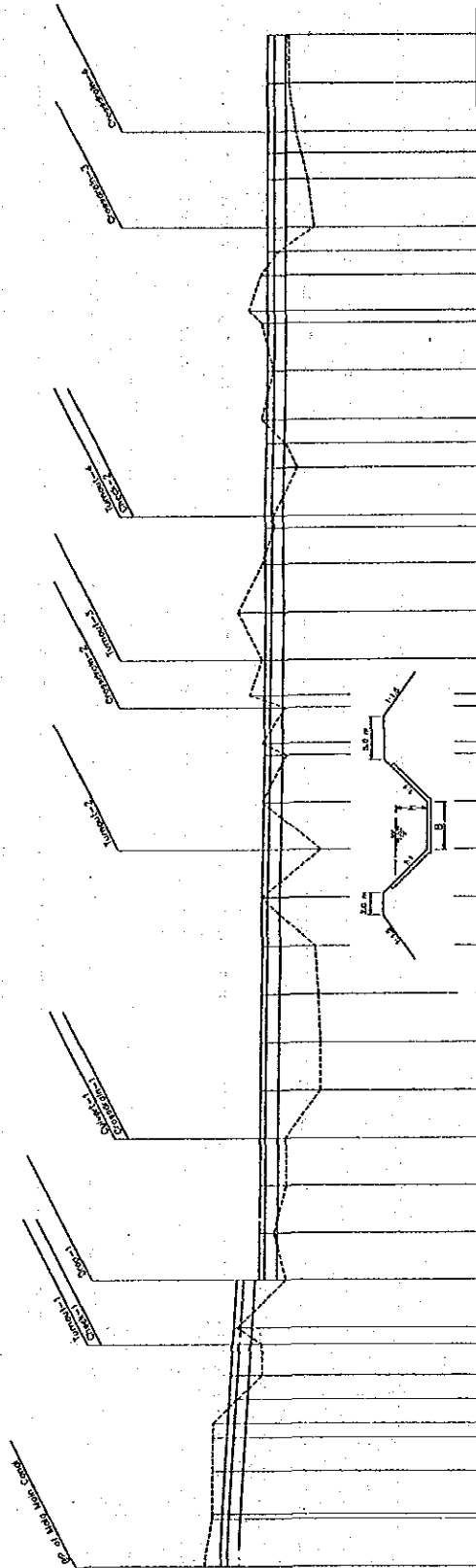
CANAL TYPE	0	100	200	300	400	500	600	700	800	900	1000
CANAL BANK ELEVATION	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
WATER SURFACE ELEVATION	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
CANAL BASE ELEVATION	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
GROUND SURFACE ELEVATION	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
REDUCED DISTANCE	0.00	100.00	200.00	300.00	400.00	500.00	600.00	700.00	800.00	900.00	1000.00
DISTANCE	0.00	100.00	200.00	300.00	400.00	500.00	600.00	700.00	800.00	900.00	1000.00
STATION NO.	0+00	0+100	0+200	0+300	0+400	0+500	0+600	0+700	0+800	0+900	0+1000
CURVE											

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 TITLE  
 PROFILE OF MEZAWA MAIN CANAL  
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Fig. C-13 Profile of Mezawa Main Canal

HORIZONTAL SCALE (m)  
 0 200 400 600 800 1000

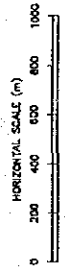
PLATE NO.



CANAL TYPE	STATION	REDUCED DISTANCE	DISTANCE	STATION NO.	CURVE
CANAL BANK ELEVATION	31.20	0.00	0.00	1+000	
WATER SURFACE ELEVATION	31.20	0.00	0.00	1+000	
CANAL BASE ELEVATION	31.20	0.00	0.00	1+000	
GROUND SURFACE ELEVATION	31.20	0.00	0.00	1+000	
REDUCED DISTANCE	31.20	0.00	0.00	1+000	
DISTANCE	31.20	0.00	0.00	1+000	
STATION NO.	31.20	0.00	0.00	1+000	
CURVE	31.20	0.00	0.00	1+000	

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 TITLE  
 PROFILE OF MOLA MAIN CANAL  
 (1/2)  
 JAPAN INTERNATIONAL COOPERATION AGENCY

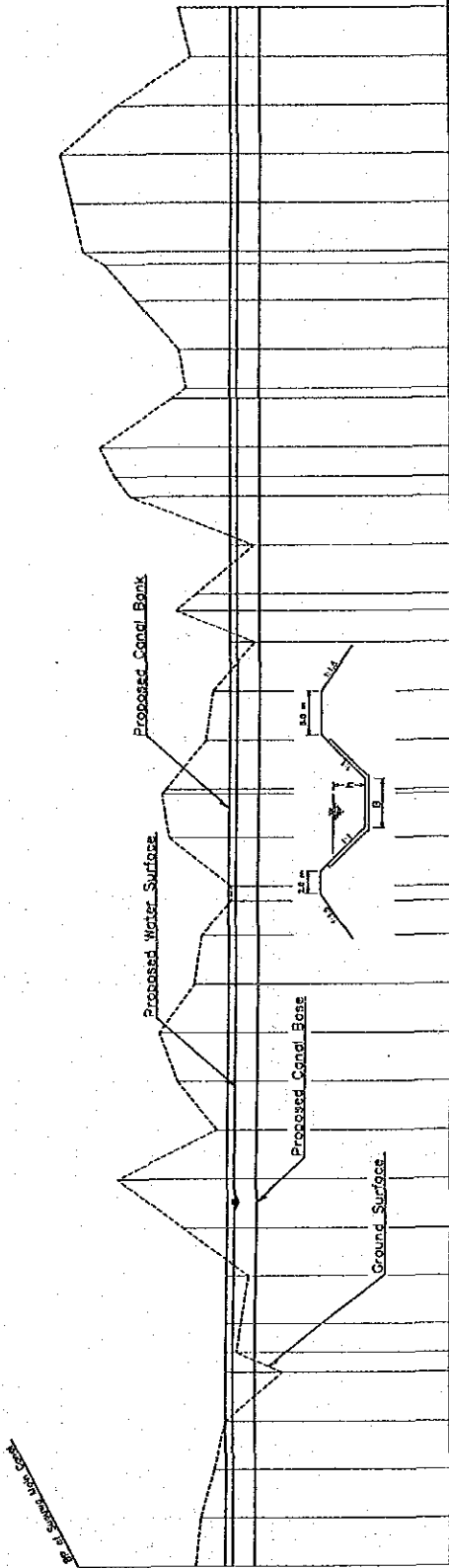
Fig. C-14 Profile of Mola Main Canal (1/2)







SUSUWA



CANAL TYPE	CANAL BANK ELEVATION	WATER SURFACE ELEVATION	CANAL BASE ELEVATION	GROUND SURFACE ELEVATION	REDUCED DISTANCE	DISTANCE	STATION NO.	CURVE
	27.80	27.70	27.80	27.80	0.00	0.00	0+00	S
	28.37	28.27	28.37	28.37	200.00	200.00	0+20	S
	28.37	28.27	28.37	28.37	400.00	400.00	0+40	S
	28.34	28.24	28.34	28.34	600.00	600.00	0+60	S
	28.32	28.22	28.32	28.32	800.00	800.00	0+80	S
	28.32	28.22	28.32	28.32	1000.00	1000.00	0+100	S
	28.25	28.15	28.25	28.25	1200.00	1200.00	0+120	S
	28.25	28.15	28.25	28.25	1400.00	1400.00	0+140	S
	28.19	28.09	28.19	28.19	1600.00	1600.00	0+160	S
	28.17	28.07	28.17	28.17	1800.00	1800.00	0+180	S
	28.18	28.08	28.18	28.18	2000.00	2000.00	0+200	S
	28.18	28.08	28.18	28.18	2200.00	2200.00	0+220	S
	28.18	28.08	28.18	28.18	2400.00	2400.00	0+240	S
	28.18	28.08	28.18	28.18	2600.00	2600.00	0+260	S
	28.18	28.08	28.18	28.18	2800.00	2800.00	0+280	S
	28.05	27.95	28.05	28.05	3000.00	3000.00	0+300	S
	28.05	27.95	28.05	28.05	3200.00	3200.00	0+320	S
	28.05	27.95	28.05	28.05	3400.00	3400.00	0+340	S
	28.05	27.95	28.05	28.05	3600.00	3600.00	0+360	S
	28.05	27.95	28.05	28.05	3800.00	3800.00	0+380	S
	28.07	27.97	28.07	28.07	4000.00	4000.00	0+400	S
	28.07	27.97	28.07	28.07	4200.00	4200.00	0+420	S
	28.04	27.94	28.04	28.04	4400.00	4400.00	0+440	S
	28.02	27.92	28.02	28.02	4600.00	4600.00	0+460	S
	28.02	27.92	28.02	28.02	4800.00	4800.00	0+480	S
	28.01	27.91	28.01	28.01	5000.00	5000.00	0+500	S
	27.99	27.89	27.99	27.99	5200.00	5200.00	0+520	S
	27.99	27.89	27.99	27.99	5400.00	5400.00	0+540	S
	27.99	27.89	27.99	27.99	5600.00	5600.00	0+560	S
	27.99	27.89	27.99	27.99	5800.00	5800.00	0+580	S
	27.99	27.89	27.99	27.99	6000.00	6000.00	0+600	S
	27.99	27.89	27.99	27.99	6200.00	6200.00	0+620	S
	27.99	27.89	27.99	27.99	6400.00	6400.00	0+640	S
	27.99	27.89	27.99	27.99	6600.00	6600.00	0+660	S
	27.99	27.89	27.99	27.99	6800.00	6800.00	0+680	S
	27.99	27.89	27.99	27.99	7000.00	7000.00	0+700	S
	27.99	27.89	27.99	27.99	7200.00	7200.00	0+720	S
	27.99	27.89	27.99	27.99	7400.00	7400.00	0+740	S
	27.99	27.89	27.99	27.99	7600.00	7600.00	0+760	S
	27.99	27.89	27.99	27.99	7800.00	7800.00	0+780	S
	27.99	27.89	27.99	27.99	8000.00	8000.00	0+800	S
	27.99	27.89	27.99	27.99	8200.00	8200.00	0+820	S
	27.99	27.89	27.99	27.99	8400.00	8400.00	0+840	S
	27.99	27.89	27.99	27.99	8600.00	8600.00	0+860	S
	27.99	27.89	27.99	27.99	8800.00	8800.00	0+880	S
	27.99	27.89	27.99	27.99	9000.00	9000.00	0+900	S
	27.99	27.89	27.99	27.99	9200.00	9200.00	0+920	S
	27.99	27.89	27.99	27.99	9400.00	9400.00	0+940	S
	27.99	27.89	27.99	27.99	9600.00	9600.00	0+960	S
	27.99	27.89	27.99	27.99	9800.00	9800.00	0+980	S
	27.99	27.89	27.99	27.99	10000.00	10000.00	0+1000	S

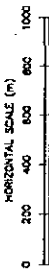
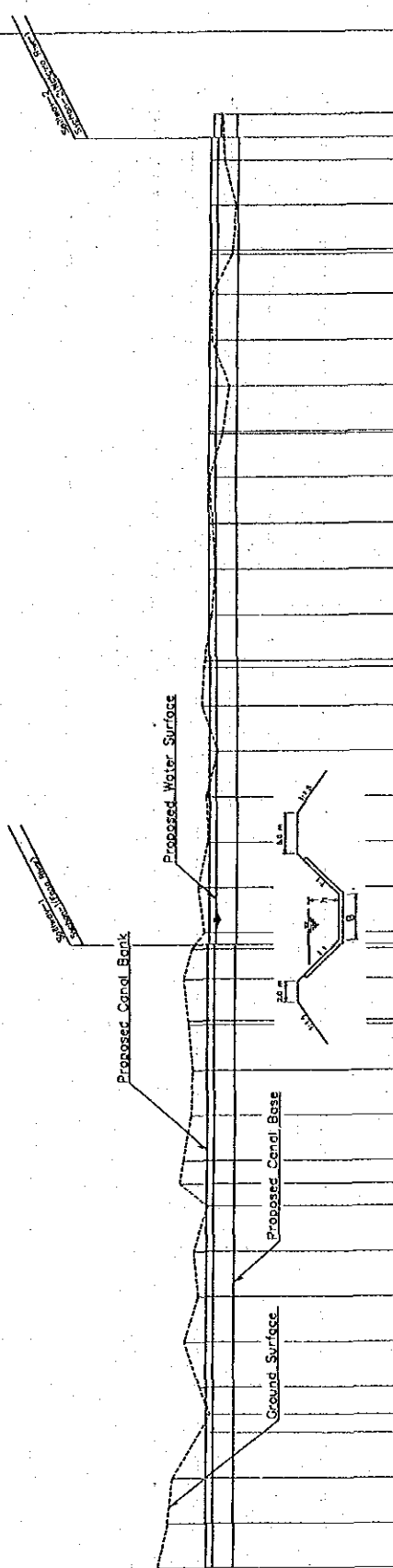


Fig. C-16 Profile of Susuwa Main Canal (1/4)

REPUBLIC OF INDONESIA  
 MINISTRY OF PUBLIC WORKS  
 THE FEASIBILITY STUDY ON THE HAS ISLAND  
 IRRIGATION AGRICULTURAL DEVELOPMENT PROJECT  
 TITLE  
 PROFILE OF SUSUWA MAIN CANAL  
 (1/4)  
 JAPAN INTERNATIONAL COOPERATION AGENCY

PLATE NO.

SUSUWA



CANAL TYPE	CANAL BANK ELEVATION	WATER SURFACE ELEVATION	CANAL BASE ELEVATION	GROUND SURFACE ELEVATION	REDUCED DISTANCE	DISTANCE	STATION NO.	CURVE
	28.60	28.60	28.60	28.60	0.00	0.00	0+00	
	28.70	28.70	28.70	28.70	10.00	10.00	0+10	
	28.80	28.80	28.80	28.80	20.00	20.00	0+20	
	28.90	28.90	28.90	28.90	30.00	30.00	0+30	
	29.00	29.00	29.00	29.00	40.00	40.00	0+40	
	29.10	29.10	29.10	29.10	50.00	50.00	0+50	
	29.20	29.20	29.20	29.20	60.00	60.00	0+60	
	29.30	29.30	29.30	29.30	70.00	70.00	0+70	
	29.40	29.40	29.40	29.40	80.00	80.00	0+80	
	29.50	29.50	29.50	29.50	90.00	90.00	0+90	
	29.60	29.60	29.60	29.60	100.00	100.00	0+100	
	29.70	29.70	29.70	29.70	110.00	110.00	0+110	
	29.80	29.80	29.80	29.80	120.00	120.00	0+120	
	29.90	29.90	29.90	29.90	130.00	130.00	0+130	
	30.00	30.00	30.00	30.00	140.00	140.00	0+140	
	30.10	30.10	30.10	30.10	150.00	150.00	0+150	
	30.20	30.20	30.20	30.20	160.00	160.00	0+160	
	30.30	30.30	30.30	30.30	170.00	170.00	0+170	
	30.40	30.40	30.40	30.40	180.00	180.00	0+180	
	30.50	30.50	30.50	30.50	190.00	190.00	0+190	
	30.60	30.60	30.60	30.60	200.00	200.00	0+200	
	30.70	30.70	30.70	30.70	210.00	210.00	0+210	
	30.80	30.80	30.80	30.80	220.00	220.00	0+220	
	30.90	30.90	30.90	30.90	230.00	230.00	0+230	
	31.00	31.00	31.00	31.00	240.00	240.00	0+240	
	31.10	31.10	31.10	31.10	250.00	250.00	0+250	
	31.20	31.20	31.20	31.20	260.00	260.00	0+260	
	31.30	31.30	31.30	31.30	270.00	270.00	0+270	
	31.40	31.40	31.40	31.40	280.00	280.00	0+280	
	31.50	31.50	31.50	31.50	290.00	290.00	0+290	
	31.60	31.60	31.60	31.60	300.00	300.00	0+300	
	31.70	31.70	31.70	31.70	310.00	310.00	0+310	
	31.80	31.80	31.80	31.80	320.00	320.00	0+320	
	31.90	31.90	31.90	31.90	330.00	330.00	0+330	
	32.00	32.00	32.00	32.00	340.00	340.00	0+340	
	32.10	32.10	32.10	32.10	350.00	350.00	0+350	
	32.20	32.20	32.20	32.20	360.00	360.00	0+360	
	32.30	32.30	32.30	32.30	370.00	370.00	0+370	
	32.40	32.40	32.40	32.40	380.00	380.00	0+380	
	32.50	32.50	32.50	32.50	390.00	390.00	0+390	
	32.60	32.60	32.60	32.60	400.00	400.00	0+400	
	32.70	32.70	32.70	32.70	410.00	410.00	0+410	
	32.80	32.80	32.80	32.80	420.00	420.00	0+420	
	32.90	32.90	32.90	32.90	430.00	430.00	0+430	
	33.00	33.00	33.00	33.00	440.00	440.00	0+440	
	33.10	33.10	33.10	33.10	450.00	450.00	0+450	
	33.20	33.20	33.20	33.20	460.00	460.00	0+460	
	33.30	33.30	33.30	33.30	470.00	470.00	0+470	
	33.40	33.40	33.40	33.40	480.00	480.00	0+480	
	33.50	33.50	33.50	33.50	490.00	490.00	0+490	
	33.60	33.60	33.60	33.60	500.00	500.00	0+500	
	33.70	33.70	33.70	33.70	510.00	510.00	0+510	
	33.80	33.80	33.80	33.80	520.00	520.00	0+520	
	33.90	33.90	33.90	33.90	530.00	530.00	0+530	
	34.00	34.00	34.00	34.00	540.00	540.00	0+540	
	34.10	34.10	34.10	34.10	550.00	550.00	0+550	
	34.20	34.20	34.20	34.20	560.00	560.00	0+560	
	34.30	34.30	34.30	34.30	570.00	570.00	0+570	
	34.40	34.40	34.40	34.40	580.00	580.00	0+580	
	34.50	34.50	34.50	34.50	590.00	590.00	0+590	
	34.60	34.60	34.60	34.60	600.00	600.00	0+600	
	34.70	34.70	34.70	34.70	610.00	610.00	0+610	
	34.80	34.80	34.80	34.80	620.00	620.00	0+620	
	34.90	34.90	34.90	34.90	630.00	630.00	0+630	
	35.00	35.00	35.00	35.00	640.00	640.00	0+640	
	35.10	35.10	35.10	35.10	650.00	650.00	0+650	
	35.20	35.20	35.20	35.20	660.00	660.00	0+660	
	35.30	35.30	35.30	35.30	670.00	670.00	0+670	
	35.40	35.40	35.40	35.40	680.00	680.00	0+680	
	35.50	35.50	35.50	35.50	690.00	690.00	0+690	
	35.60	35.60	35.60	35.60	700.00	700.00	0+700	
	35.70	35.70	35.70	35.70	710.00	710.00	0+710	
	35.80	35.80	35.80	35.80	720.00	720.00	0+720	
	35.90	35.90	35.90	35.90	730.00	730.00	0+730	
	36.00	36.00	36.00	36.00	740.00	740.00	0+740	
	36.10	36.10	36.10	36.10	750.00	750.00	0+750	
	36.20	36.20	36.20	36.20	760.00	760.00	0+760	
	36.30	36.30	36.30	36.30	770.00	770.00	0+770	
	36.40	36.40	36.40	36.40	780.00	780.00	0+780	
	36.50	36.50	36.50	36.50	790.00	790.00	0+790	
	36.60	36.60	36.60	36.60	800.00	800.00	0+800	
	36.70	36.70	36.70	36.70	810.00	810.00	0+810	
	36.80	36.80	36.80	36.80	820.00	820.00	0+820	
	36.90	36.90	36.90	36.90	830.00	830.00	0+830	
	37.00	37.00	37.00	37.00	840.00	840.00	0+840	
	37.10	37.10	37.10	37.10	850.00	850.00	0+850	
	37.20	37.20	37.20	37.20	860.00	860.00	0+860	
	37.30	37.30	37.30	37.30	870.00	870.00	0+870	
	37.40	37.40	37.40	37.40	880.00	880.00	0+880	
	37.50	37.50	37.50	37.50	890.00	890.00	0+890	
	37.60	37.60	37.60	37.60	900.00	900.00	0+900	
	37.70	37.70	37.70	37.70	910.00	910.00	0+910	
	37.80	37.80	37.80	37.80	920.00	920.00	0+920	
	37.90	37.90	37.90	37.90	930.00	930.00	0+930	
	38.00	38.00	38.00	38.00	940.00	940.00	0+940	
	38.10	38.10	38.10	38.10	950.00	950.00	0+950	
	38.20	38.20	38.20	38.20	960.00	960.00	0+960	
	38.30	38.30	38.30	38.30	970.00	970.00	0+970	
	38.40	38.40	38.40	38.40	980.00	980.00	0+980	
	38.50	38.50	38.50	38.50	990.00	990.00	0+990	
	38.60	38.60	38.60	38.60	1000.00	1000.00	0+1000	

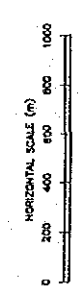
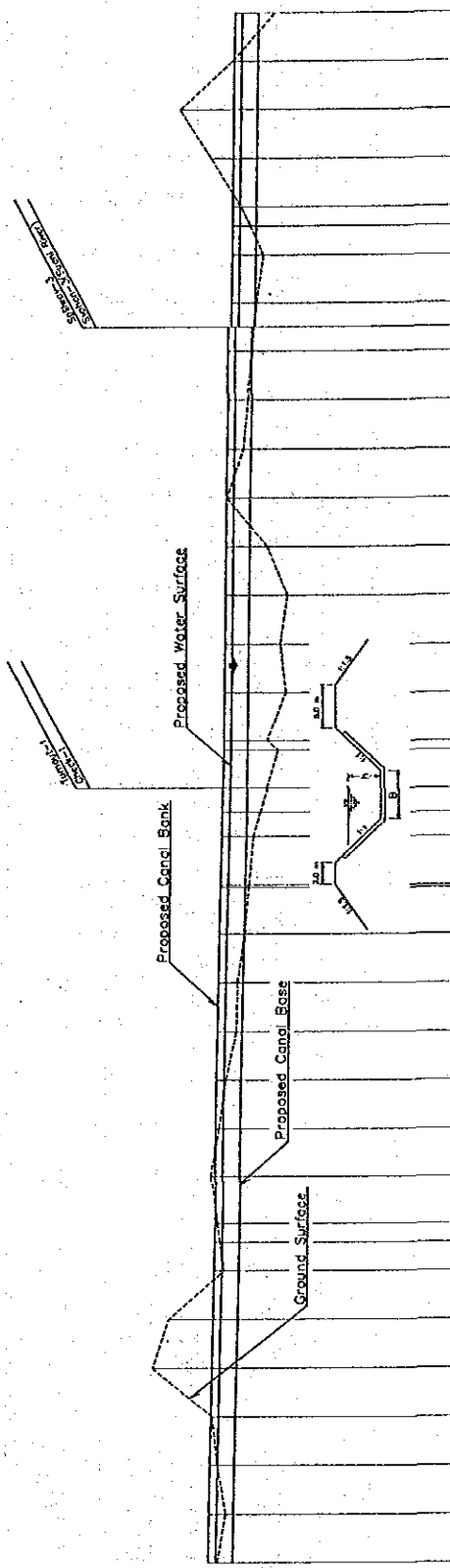
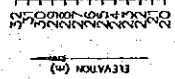


Fig. C-16 Profile of Susuwa Main Canal (2/4)

REPUBLIC OF INDONESIA  
 MINISTRY OF PUBLIC WORKS  
 THE FEASIBILITY STUDY ON THE MAS ISLAND  
 IRRIGATION AGRICULTURAL DEVELOPMENT PROJECT  
 TITLE  
 PROFILE OF SUSUWA MAIN CANAL  
 (2/4)  
 JAPAN INTERNATIONAL COOPERATION AGENCY

PLATE NO. ...

SUSUWA

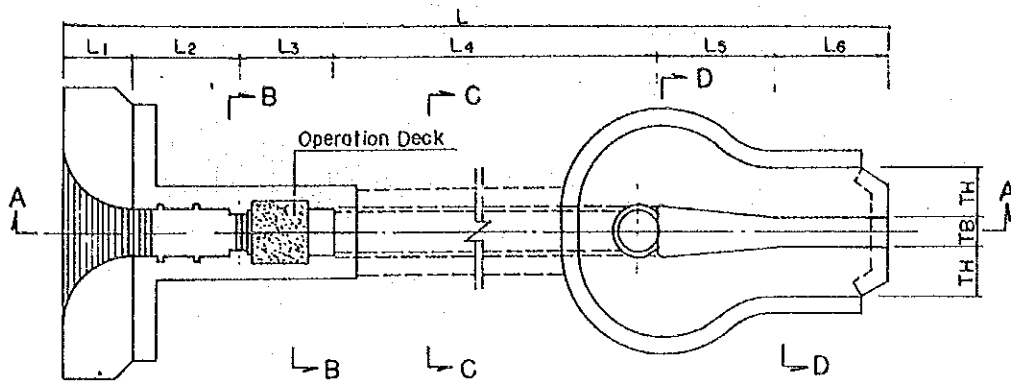


CANAL TYPE	CANAL BANK ELEVATION	WATER SURFACE ELEVATION	CANAL BASE ELEVATION	GROUND SURFACE ELEVATION	REDUCED DISTANCE	DISTANCE	STATION NO.	CURVE
	28.13	28.13	28.13	28.13	0.00	0.00	13 + 00	
	28.63	28.63	28.63	28.63	0.00	0.00	13 + 50	
	29.13	29.13	29.13	29.13	0.00	0.00	14 + 00	
	29.63	29.63	29.63	29.63	0.00	0.00	14 + 50	
	30.13	30.13	30.13	30.13	0.00	0.00	15 + 00	
	30.63	30.63	30.63	30.63	0.00	0.00	15 + 50	
	31.13	31.13	31.13	31.13	0.00	0.00	16 + 00	
	31.63	31.63	31.63	31.63	0.00	0.00	16 + 50	
	32.13	32.13	32.13	32.13	0.00	0.00	17 + 00	
	32.63	32.63	32.63	32.63	0.00	0.00	17 + 50	
	33.13	33.13	33.13	33.13	0.00	0.00	18 + 00	
	33.63	33.63	33.63	33.63	0.00	0.00	18 + 50	
	34.13	34.13	34.13	34.13	0.00	0.00	19 + 00	
	34.63	34.63	34.63	34.63	0.00	0.00	19 + 50	
	35.13	35.13	35.13	35.13	0.00	0.00	20 + 00	
	35.63	35.63	35.63	35.63	0.00	0.00	20 + 50	
	36.13	36.13	36.13	36.13	0.00	0.00	21 + 00	
	36.63	36.63	36.63	36.63	0.00	0.00	21 + 50	
	37.13	37.13	37.13	37.13	0.00	0.00	22 + 00	
	37.63	37.63	37.63	37.63	0.00	0.00	22 + 50	
	38.13	38.13	38.13	38.13	0.00	0.00	23 + 00	
	38.63	38.63	38.63	38.63	0.00	0.00	23 + 50	
	39.13	39.13	39.13	39.13	0.00	0.00	24 + 00	
	39.63	39.63	39.63	39.63	0.00	0.00	24 + 50	
	40.13	40.13	40.13	40.13	0.00	0.00	25 + 00	
	40.63	40.63	40.63	40.63	0.00	0.00	25 + 50	
	41.13	41.13	41.13	41.13	0.00	0.00	26 + 00	
	41.63	41.63	41.63	41.63	0.00	0.00	26 + 50	
	42.13	42.13	42.13	42.13	0.00	0.00	27 + 00	
	42.63	42.63	42.63	42.63	0.00	0.00	27 + 50	
	43.13	43.13	43.13	43.13	0.00	0.00	28 + 00	
	43.63	43.63	43.63	43.63	0.00	0.00	28 + 50	
	44.13	44.13	44.13	44.13	0.00	0.00	29 + 00	
	44.63	44.63	44.63	44.63	0.00	0.00	29 + 50	
	45.13	45.13	45.13	45.13	0.00	0.00	30 + 00	
	45.63	45.63	45.63	45.63	0.00	0.00	30 + 50	
	46.13	46.13	46.13	46.13	0.00	0.00	31 + 00	
	46.63	46.63	46.63	46.63	0.00	0.00	31 + 50	
	47.13	47.13	47.13	47.13	0.00	0.00	32 + 00	
	47.63	47.63	47.63	47.63	0.00	0.00	32 + 50	
	48.13	48.13	48.13	48.13	0.00	0.00	33 + 00	
	48.63	48.63	48.63	48.63	0.00	0.00	33 + 50	
	49.13	49.13	49.13	49.13	0.00	0.00	34 + 00	
	49.63	49.63	49.63	49.63	0.00	0.00	34 + 50	
	50.13	50.13	50.13	50.13	0.00	0.00	35 + 00	
	50.63	50.63	50.63	50.63	0.00	0.00	35 + 50	
	51.13	51.13	51.13	51.13	0.00	0.00	36 + 00	
	51.63	51.63	51.63	51.63	0.00	0.00	36 + 50	
	52.13	52.13	52.13	52.13	0.00	0.00	37 + 00	
	52.63	52.63	52.63	52.63	0.00	0.00	37 + 50	
	53.13	53.13	53.13	53.13	0.00	0.00	38 + 00	
	53.63	53.63	53.63	53.63	0.00	0.00	38 + 50	
	54.13	54.13	54.13	54.13	0.00	0.00	39 + 00	
	54.63	54.63	54.63	54.63	0.00	0.00	39 + 50	
	55.13	55.13	55.13	55.13	0.00	0.00	40 + 00	
	55.63	55.63	55.63	55.63	0.00	0.00	40 + 50	
	56.13	56.13	56.13	56.13	0.00	0.00	41 + 00	
	56.63	56.63	56.63	56.63	0.00	0.00	41 + 50	
	57.13	57.13	57.13	57.13	0.00	0.00	42 + 00	
	57.63	57.63	57.63	57.63	0.00	0.00	42 + 50	
	58.13	58.13	58.13	58.13	0.00	0.00	43 + 00	
	58.63	58.63	58.63	58.63	0.00	0.00	43 + 50	
	59.13	59.13	59.13	59.13	0.00	0.00	44 + 00	
	59.63	59.63	59.63	59.63	0.00	0.00	44 + 50	
	60.13	60.13	60.13	60.13	0.00	0.00	45 + 00	
	60.63	60.63	60.63	60.63	0.00	0.00	45 + 50	
	61.13	61.13	61.13	61.13	0.00	0.00	46 + 00	
	61.63	61.63	61.63	61.63	0.00	0.00	46 + 50	
	62.13	62.13	62.13	62.13	0.00	0.00	47 + 00	
	62.63	62.63	62.63	62.63	0.00	0.00	47 + 50	
	63.13	63.13	63.13	63.13	0.00	0.00	48 + 00	
	63.63	63.63	63.63	63.63	0.00	0.00	48 + 50	
	64.13	64.13	64.13	64.13	0.00	0.00	49 + 00	
	64.63	64.63	64.63	64.63	0.00	0.00	49 + 50	
	65.13	65.13	65.13	65.13	0.00	0.00	50 + 00	
	65.63	65.63	65.63	65.63	0.00	0.00	50 + 50	
	66.13	66.13	66.13	66.13	0.00	0.00	51 + 00	
	66.63	66.63	66.63	66.63	0.00	0.00	51 + 50	
	67.13	67.13	67.13	67.13	0.00	0.00	52 + 00	
	67.63	67.63	67.63	67.63	0.00	0.00	52 + 50	
	68.13	68.13	68.13	68.13	0.00	0.00	53 + 00	
	68.63	68.63	68.63	68.63	0.00	0.00	53 + 50	
	69.13	69.13	69.13	69.13	0.00	0.00	54 + 00	
	69.63	69.63	69.63	69.63	0.00	0.00	54 + 50	
	70.13	70.13	70.13	70.13	0.00	0.00	55 + 00	
	70.63	70.63	70.63	70.63	0.00	0.00	55 + 50	
	71.13	71.13	71.13	71.13	0.00	0.00	56 + 00	
	71.63	71.63	71.63	71.63	0.00	0.00	56 + 50	
	72.13	72.13	72.13	72.13	0.00	0.00	57 + 00	
	72.63	72.63	72.63	72.63	0.00	0.00	57 + 50	
	73.13	73.13	73.13	73.13	0.00	0.00	58 + 00	
	73.63	73.63	73.63	73.63	0.00	0.00	58 + 50	
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	74.63	74.63	74.63	74.63	0.00	0.00	59 + 50	
	75.13	75.13	75.13	75.13	0.00	0.00	60 + 00	
	75.63	75.63	75.63	75.63	0.00	0.00	60 + 50	
	76.13	76.13	76.13	76.13	0.00	0.00	61 + 00	
	76.63	76.63	76.63	76.63	0.00	0.00	61 + 50	
	77.13	77.13	77.13	77.13	0.00	0.00	62 + 00	
	77.63	77.63	77.63	77.63	0.00	0.00	62 + 50	
	78.13	78.13	78.13	78.13	0.00	0.00	63 + 00	
	78.63	78.63	78.63	78.63	0.00	0.00	63 + 50	
	79.13	79.13	79.13	79.13	0.00	0.00	64 + 00	
	79.63	79.63	79.63	79.63	0.00	0.00	64 + 50	
	80.13	80.13	80.13	80.13	0.00	0.00	65 + 00	
	80.63	80.63	80.63	80.63	0.00	0.00	65 + 50	
	81.13	81.13	81.13	81.13	0.00	0.00	66 + 00	
	81.63	81.63	81.63	81.63	0.00	0.00	66 + 50	
	82.13	82.13	82.13	82.13	0.00	0.00	67 + 00	
	82.63	82.63	82.63	82.63	0.00	0.00	67 + 50	
	83.13	83.13	83.13	83.13	0.00	0.00	68 + 00	
	83.63	83.63	83.63	83.63	0.00	0.00	68 + 50	
	84.13	84.13	84.13	84.13	0.00	0.00	69 + 00	
	84.63	84.63	84.63	84.63	0.00	0.00	69 + 50	
	85.13	85.13	85.13	85.13	0.00	0.00	70 + 00	
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	86.63	86.63	86.63	86.63	0.00	0.00	71 + 50	
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	88.63	88.63	88.63	88.63	0.00	0.00	73 + 50	
	89.13	89.13	89.13	89.13	0.00	0.00	74 + 00	
	89.63	89.63	89.63	89.63	0.00	0.00	74 + 50	
	90.13	90.13	90.13	90.13	0.00	0.00	75 + 00	
	90.63	90.63	90.63	90.63	0.00	0.00	75 + 50	
	91.13	91.13	91.13	91.13	0.00	0.00	76 + 00	
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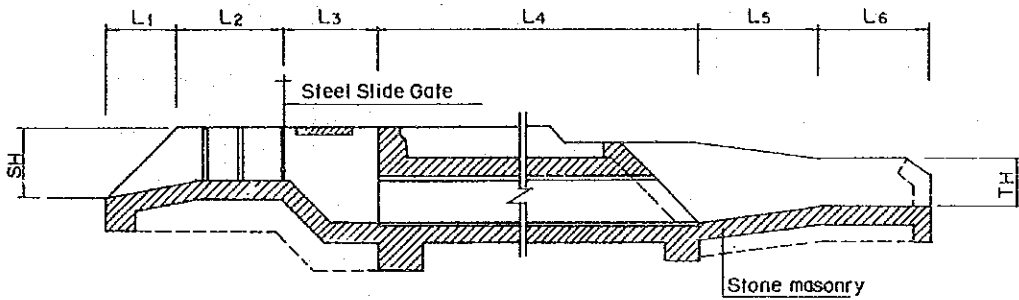




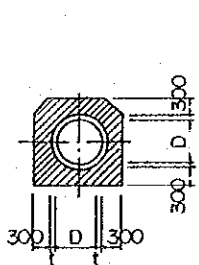
# TURNOUT



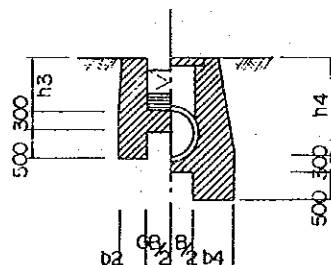
## PLAN



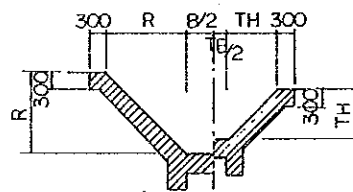
## SECTION A-A



## SECTION C-C



## SECTION B-B



## SECTION D-D

Fig. C-17 Canal Structures, Turnout

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# DIVISION STRUCTURE

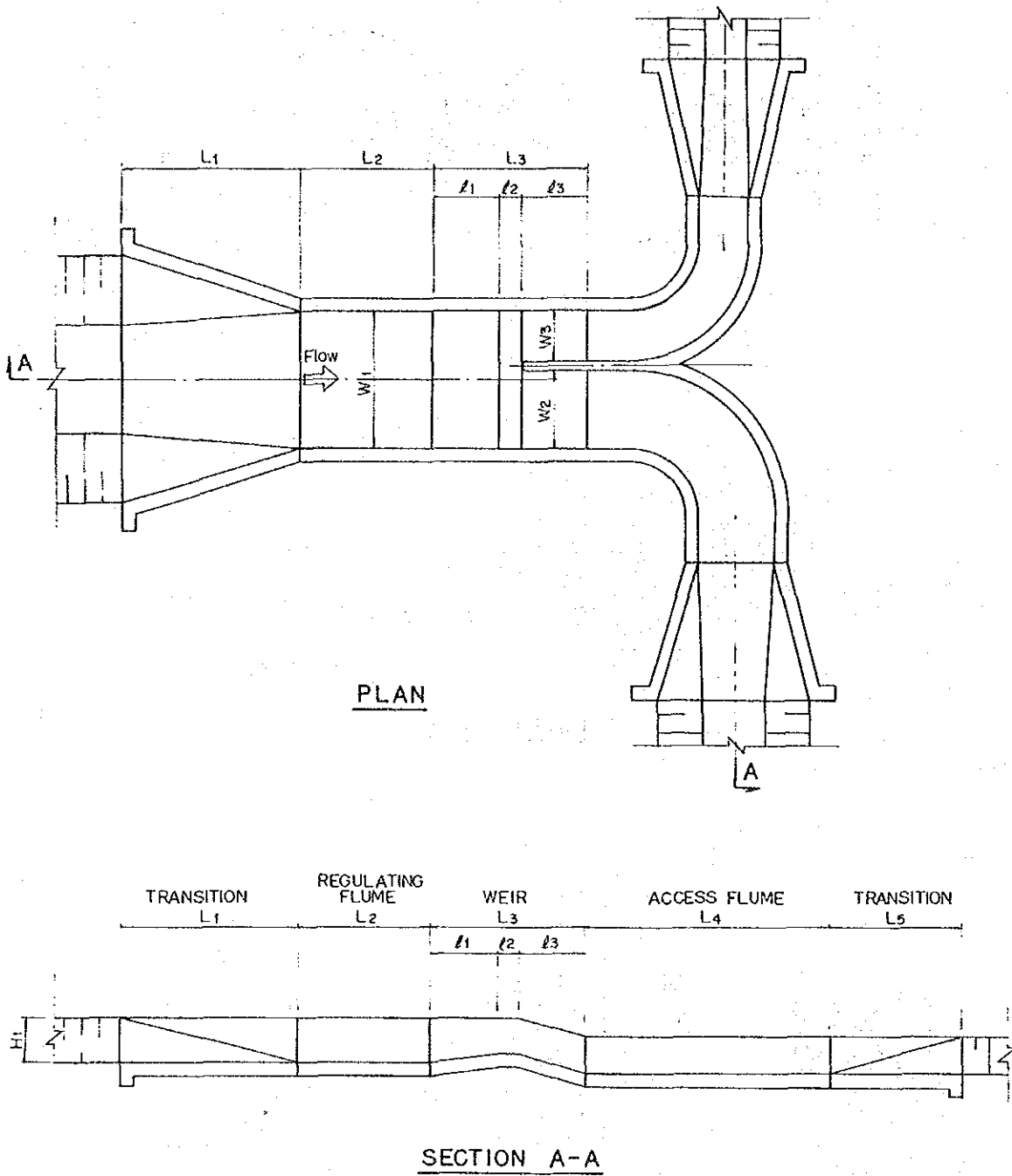
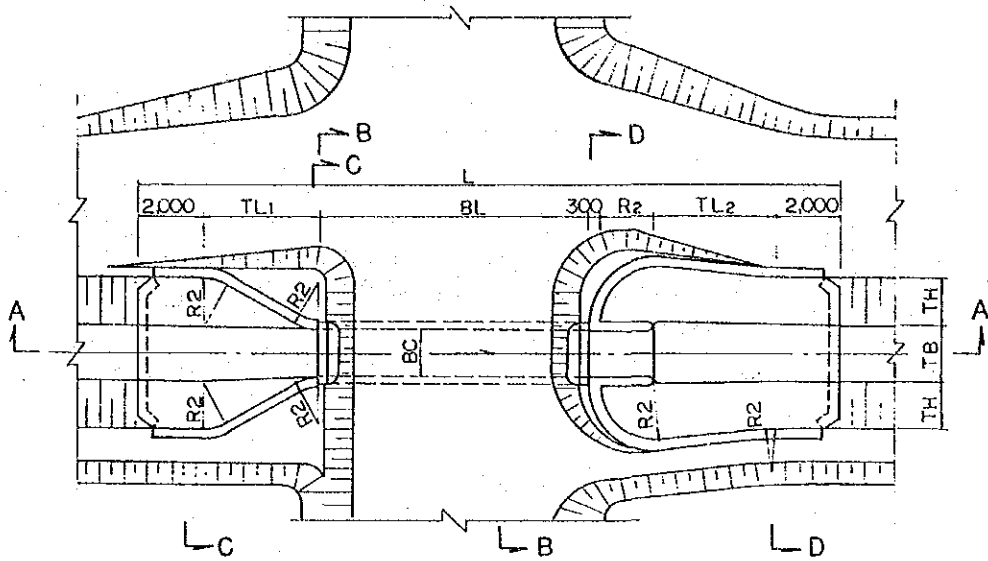
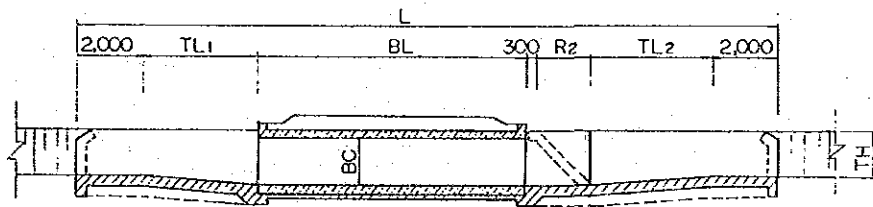


Fig. C-18 Canal Structures, Division Structure

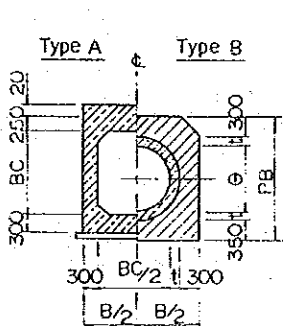
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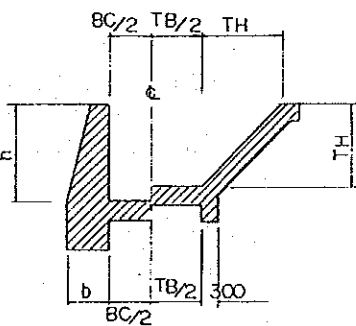
PLAN



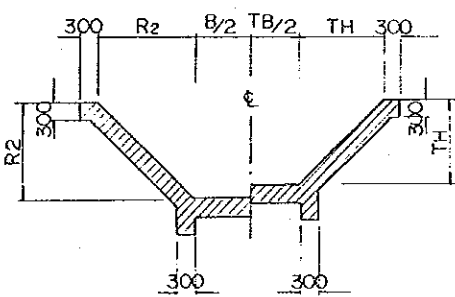
SECTION A-A



SECTION B-B



SECTION C-C



SECTION D-D

Fig. C-19 Canal Structures, Culvert

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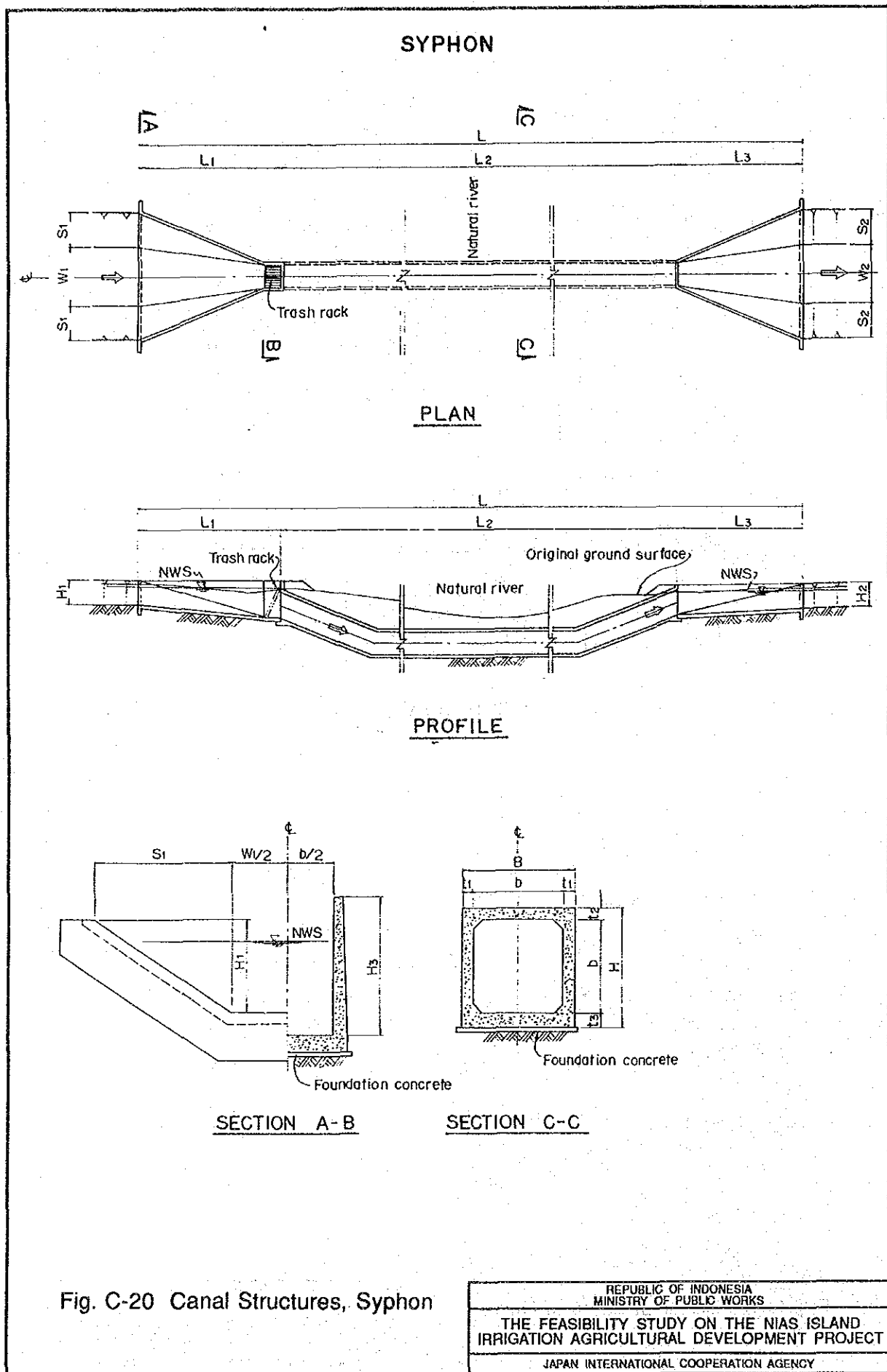


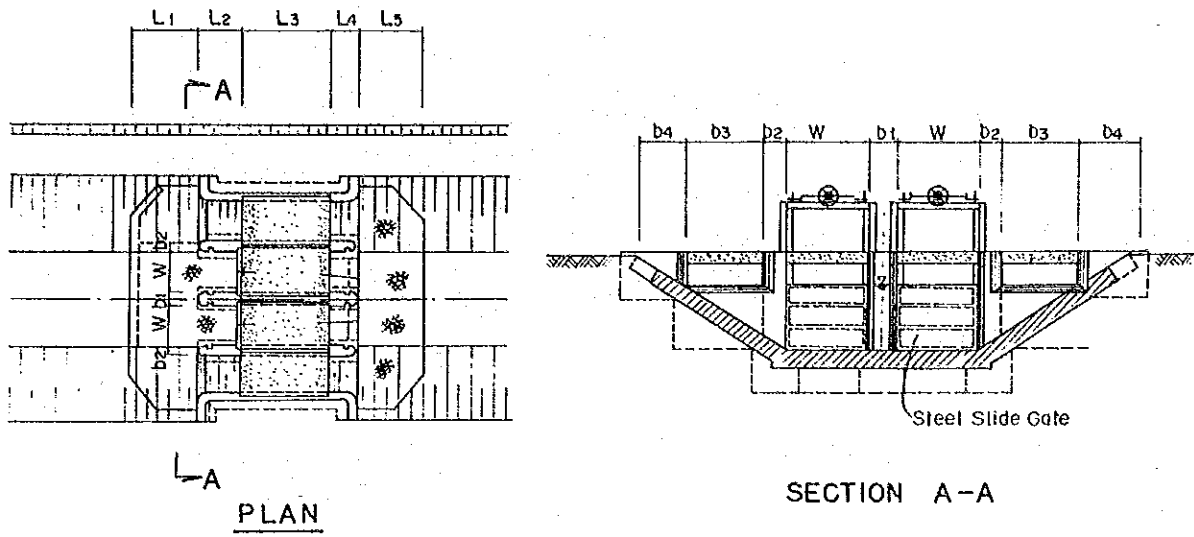
Fig. C-20 Canal Structures, Siphon

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CHECK (Type A)



CHECK (Type B)

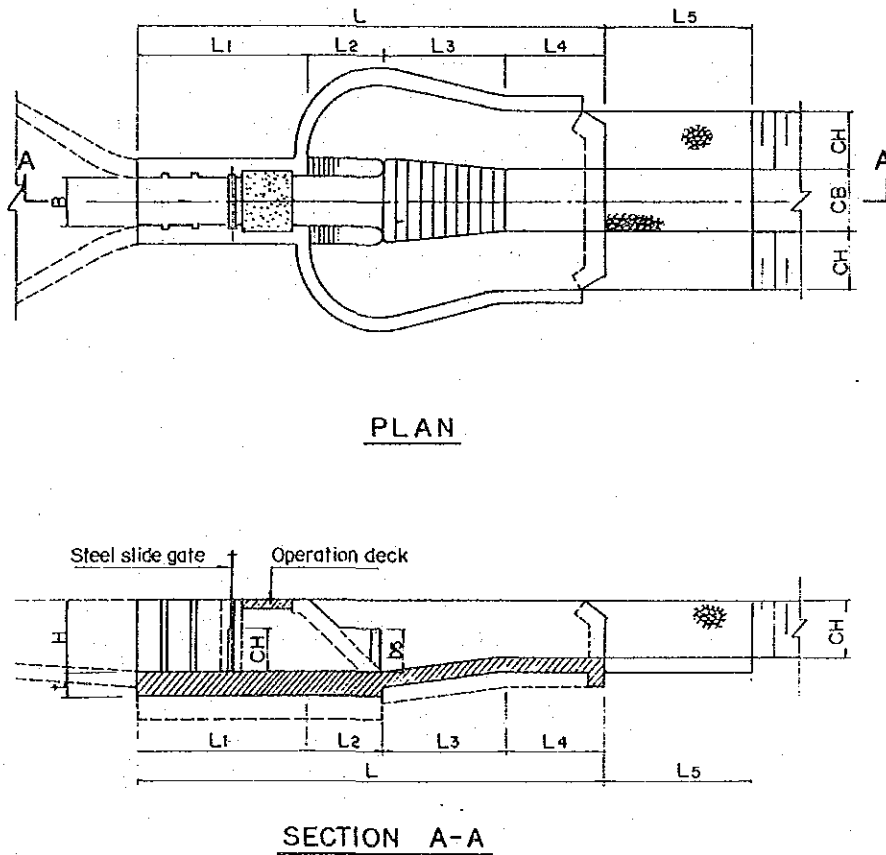
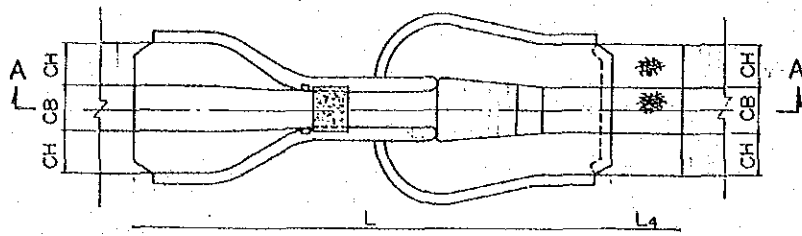


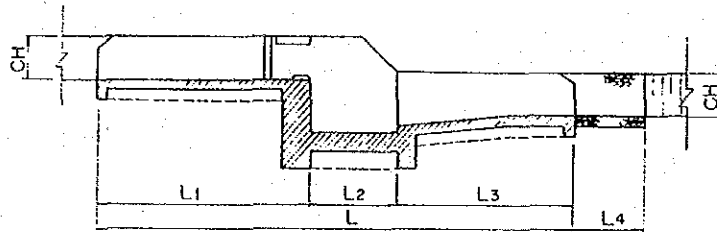
Fig. C-21 Canal Structures, Check

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DROP

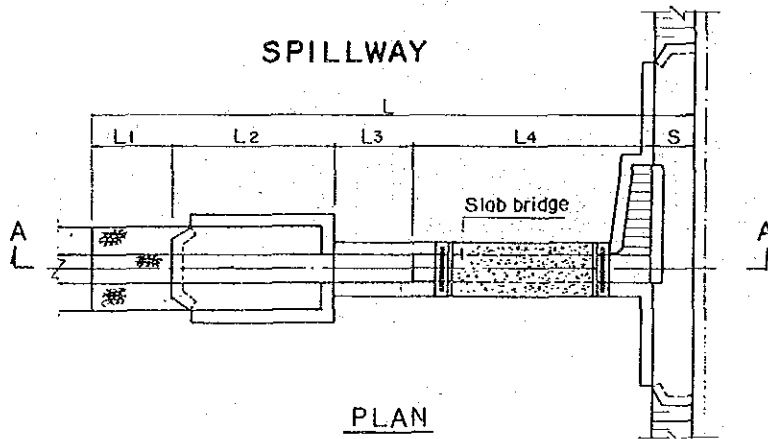


PLAN

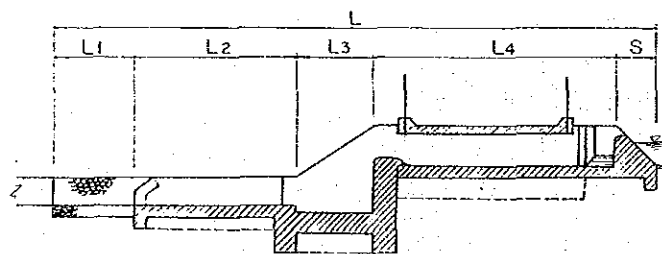


SECTION A-A

SPILLWAY



PLAN

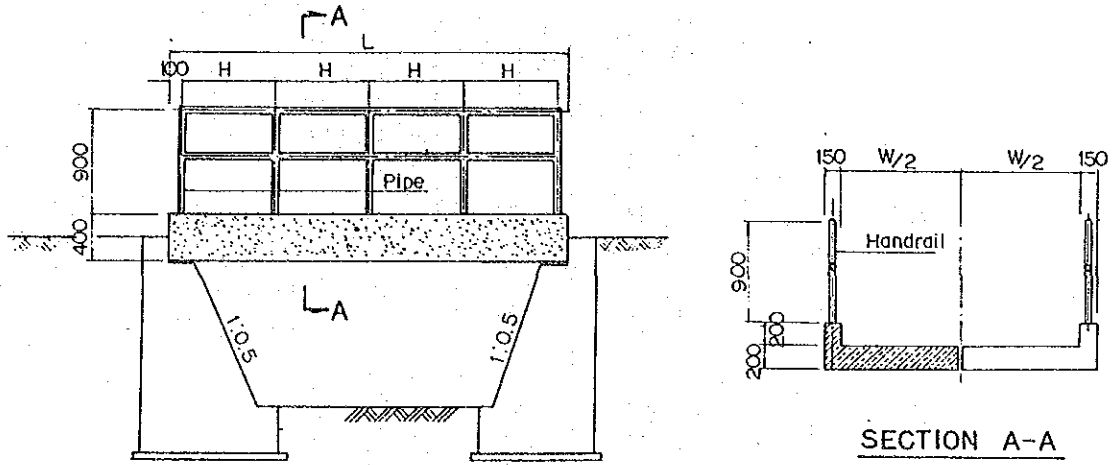


SECTION A-A

Fig. C-22 Canal Structures  
Drop & Spillway

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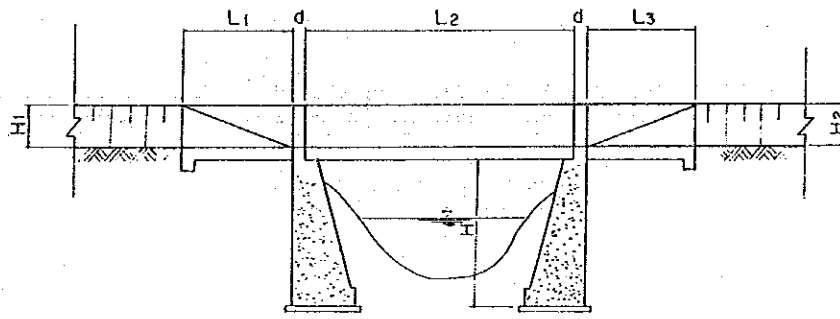
# BRIDGE



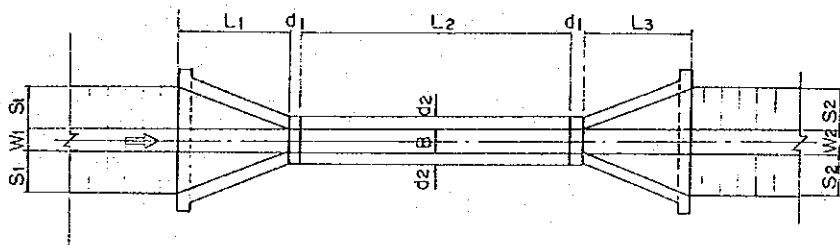
PLAN

SECTION A-A

# AQUEDUCT



PROFILE



PLAN

Fig. C-23 Canal Structures  
Bridge & Aqueduct

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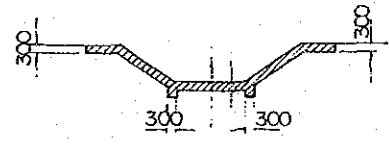
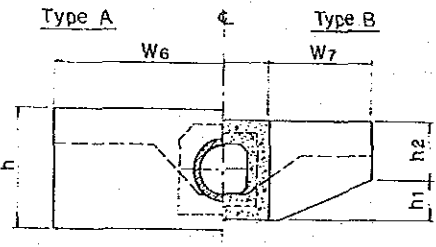
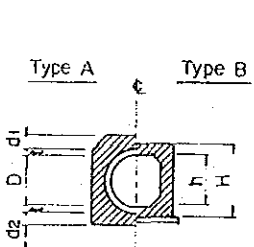
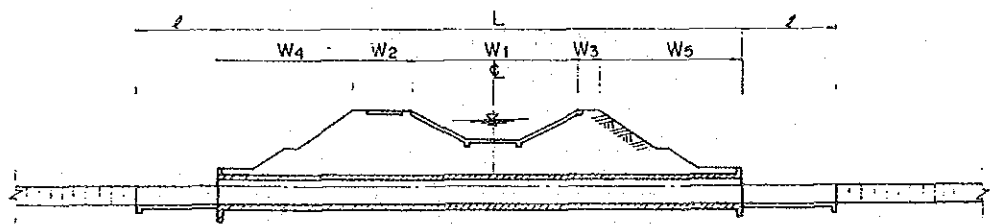
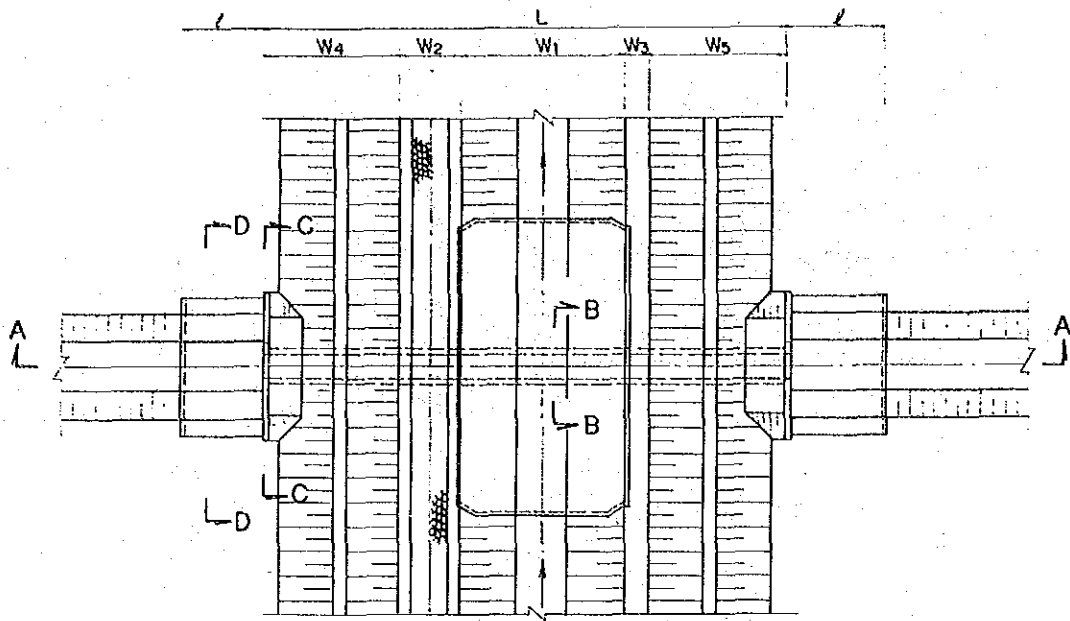


Fig. C-24 Canal Structures, Cross Drain

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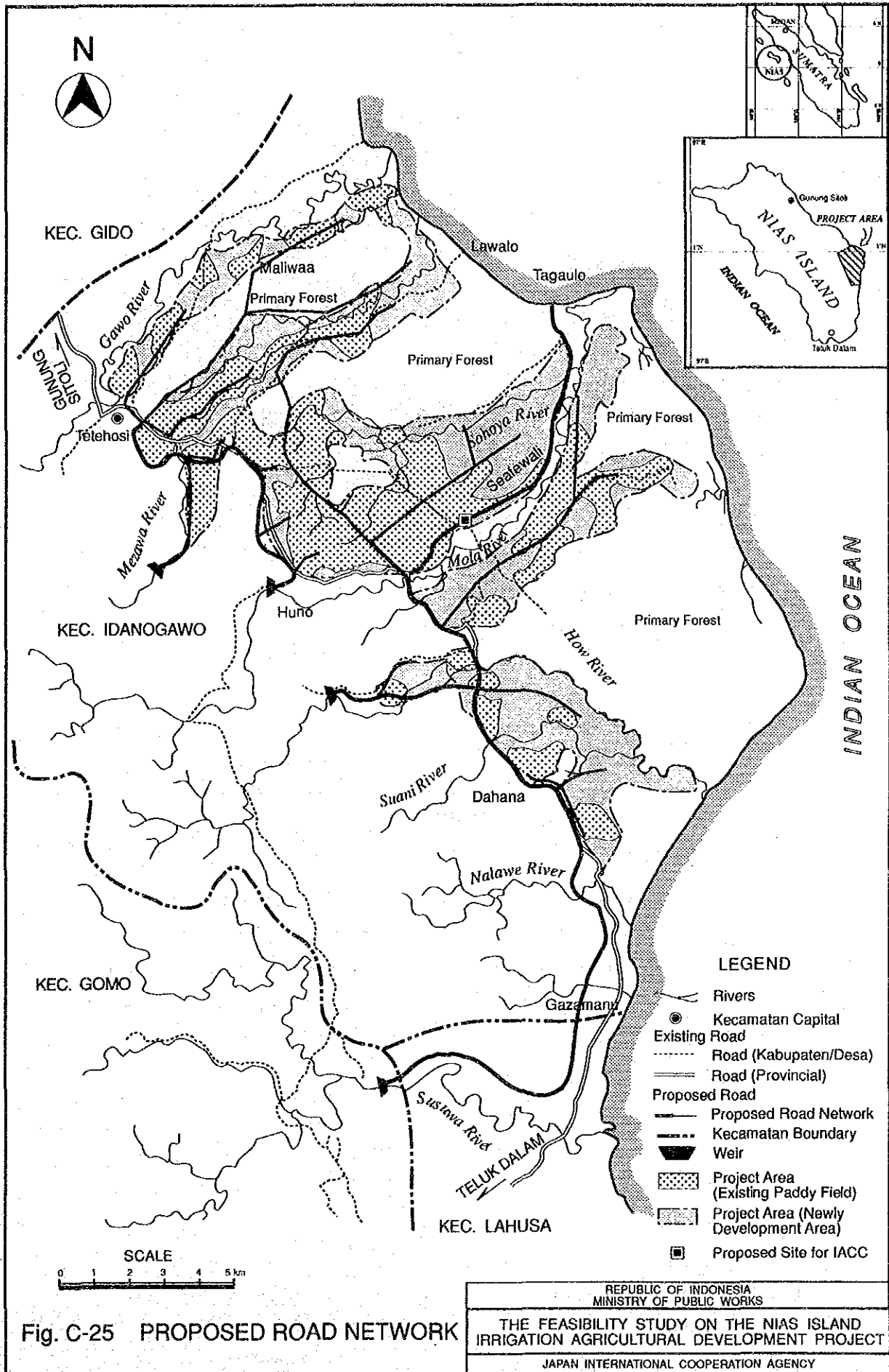


Fig. C-25 PROPOSED ROAD NETWORK

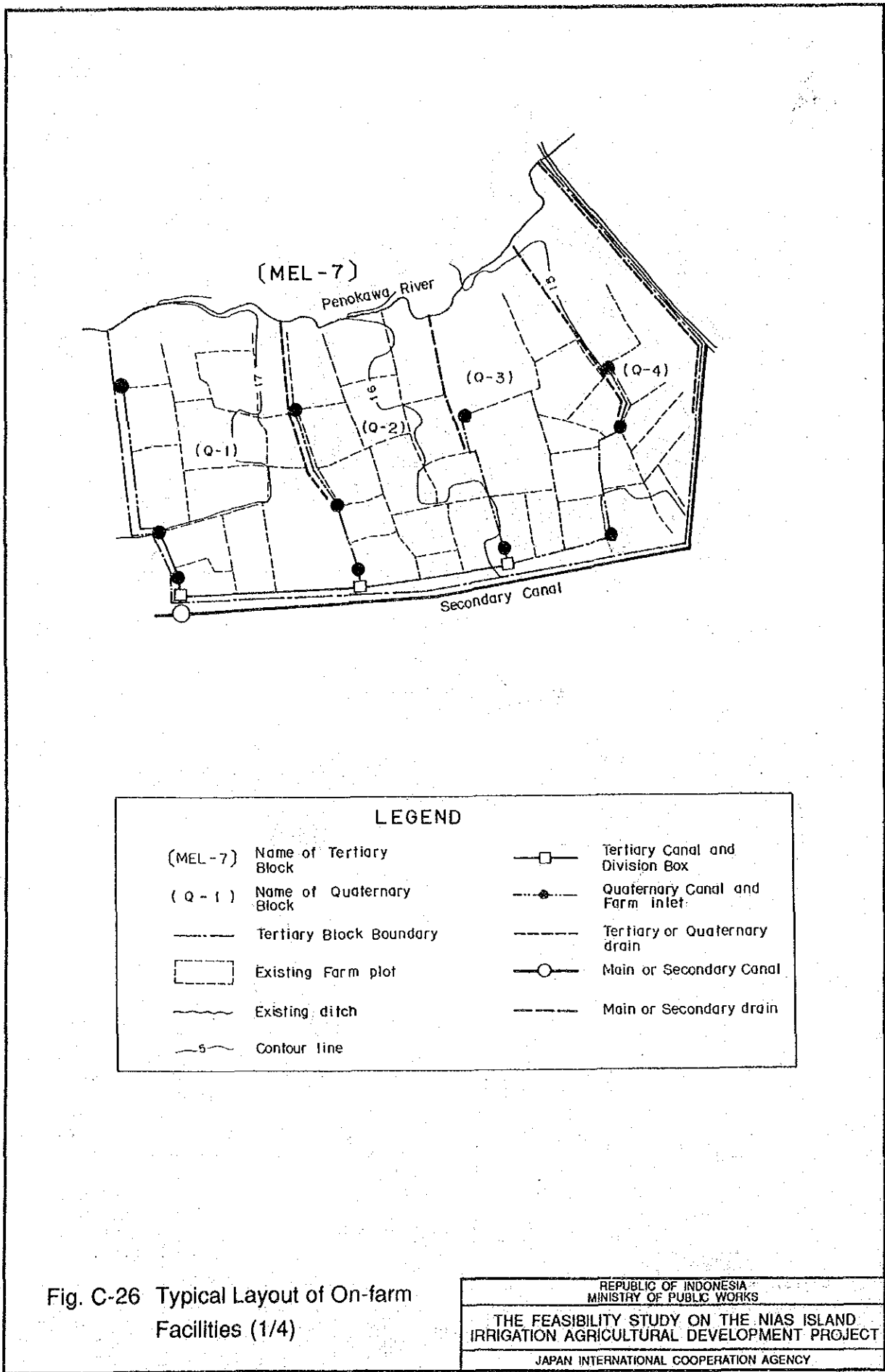
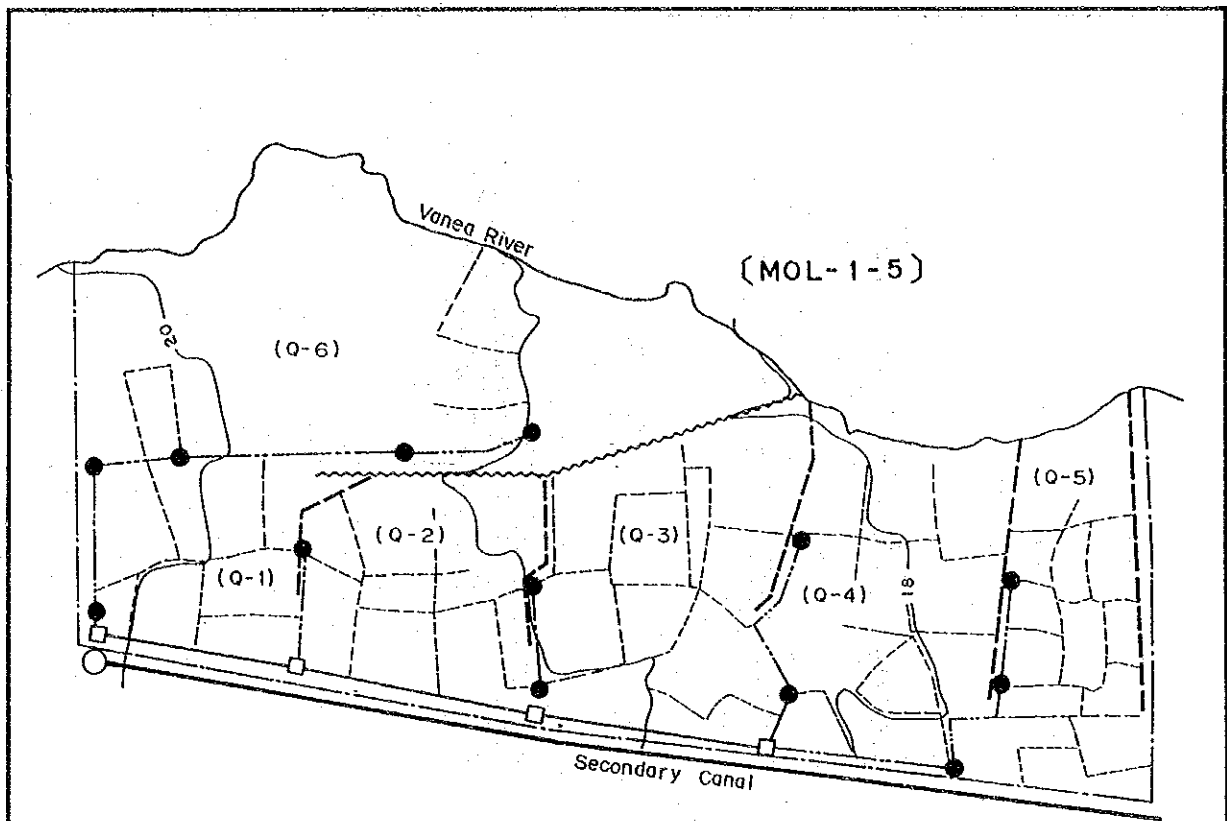


Fig. C-26 Typical Layout of On-farm Facilities (1/4)

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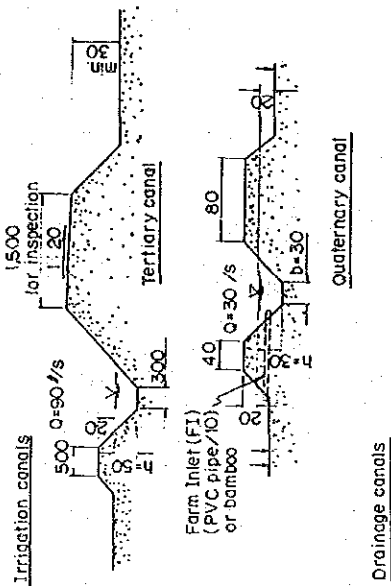


LEGEND	
(MOL-1-5) Name of Tertiary Block	—□— Tertiary Canal and Division Box
(Q-1) Name of Quaternary Block	—●— Quaternary Canal and Farm inlet
———— Tertiary Block Boundary	----- Tertiary or Quaternary drain
▭ Existing Farm plot	—○— Main or Secondary Canal
~~~~~ Existing ditch	----- Main or Secondary drain
—5— Contour line	

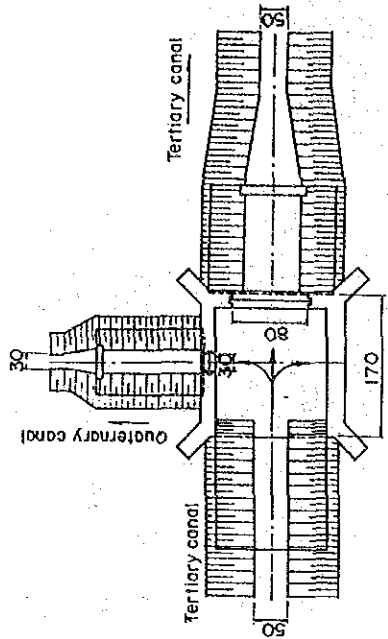
Fig. C-26 Typical Layout of On-farm Facilities (2/4)

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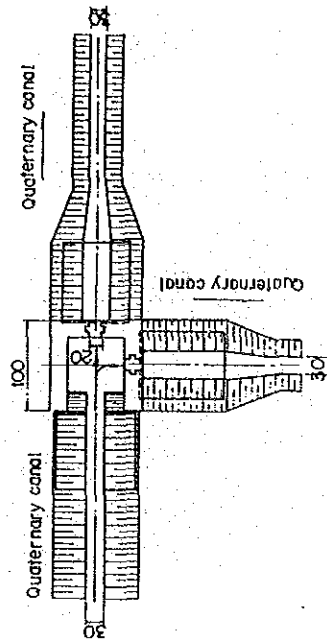
CANAL SECTION (cm)



DIVISION BOX (DB)



QUATERNARY DIVISION BOX (Q-DB)



RELATED STRUCTURE (cm)

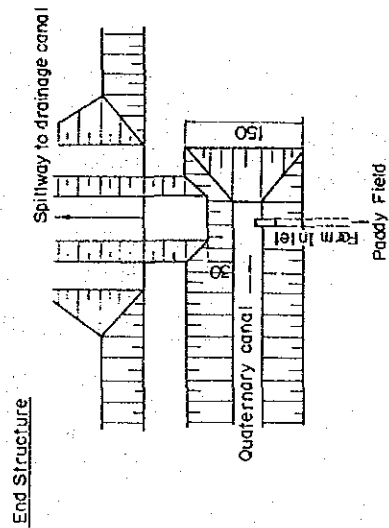


Fig. C-26 Typical Layout of On-farm Facilities (3/4)

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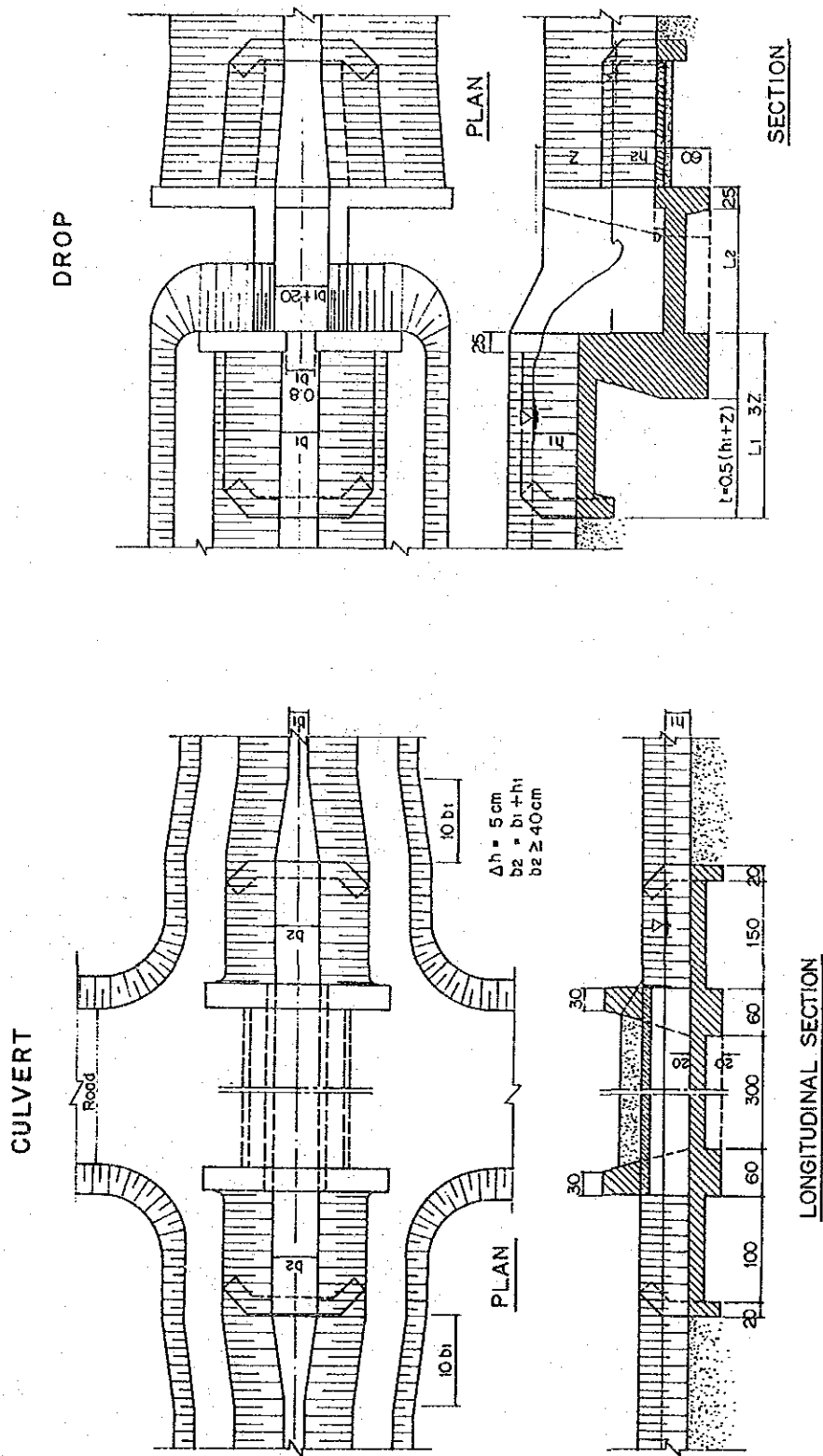


Fig. C-26 Typical Layout of On-farm Facilities (4/4)

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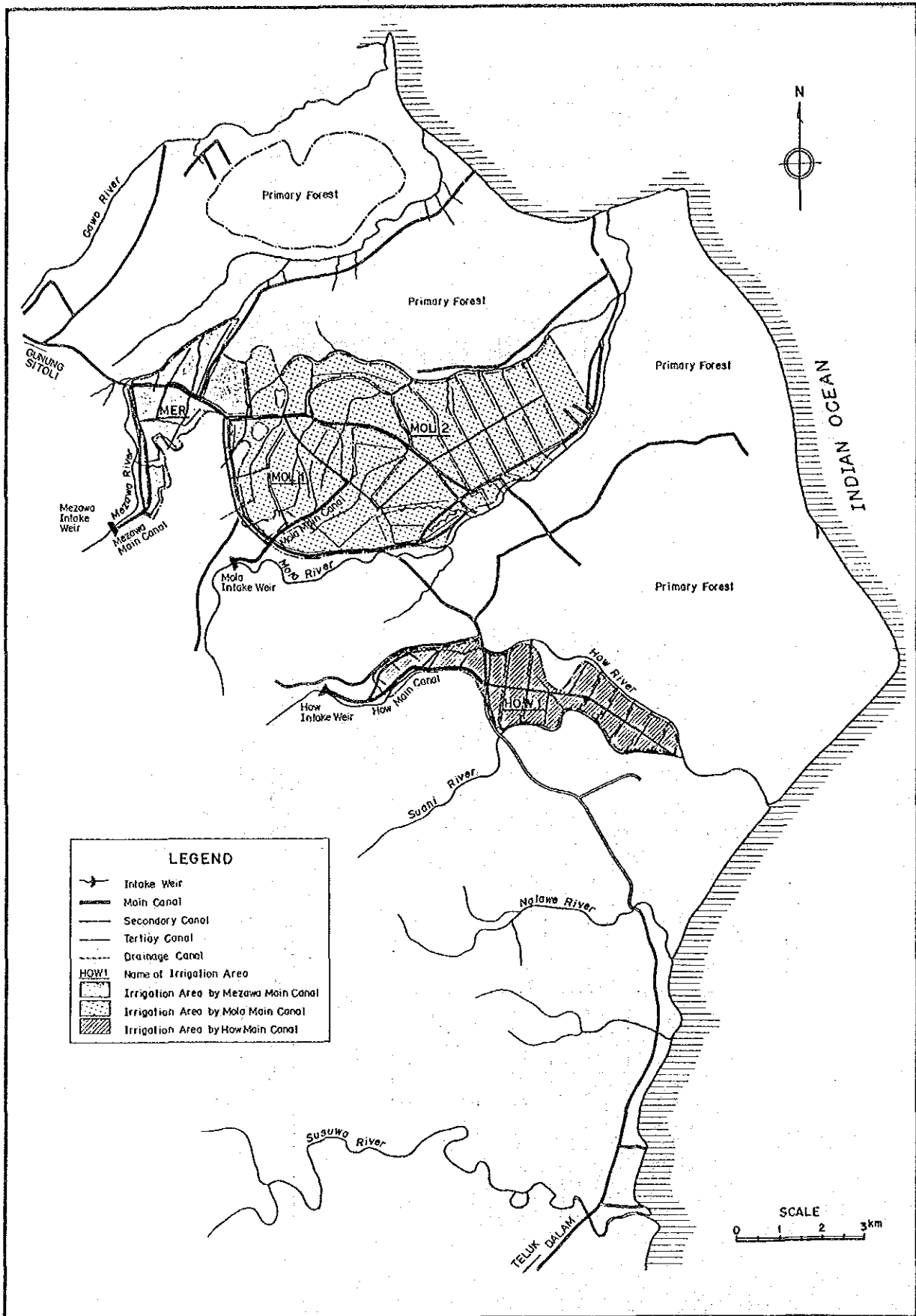


Fig. C-27 Proposed Canal Layout of the Alternative Development Project

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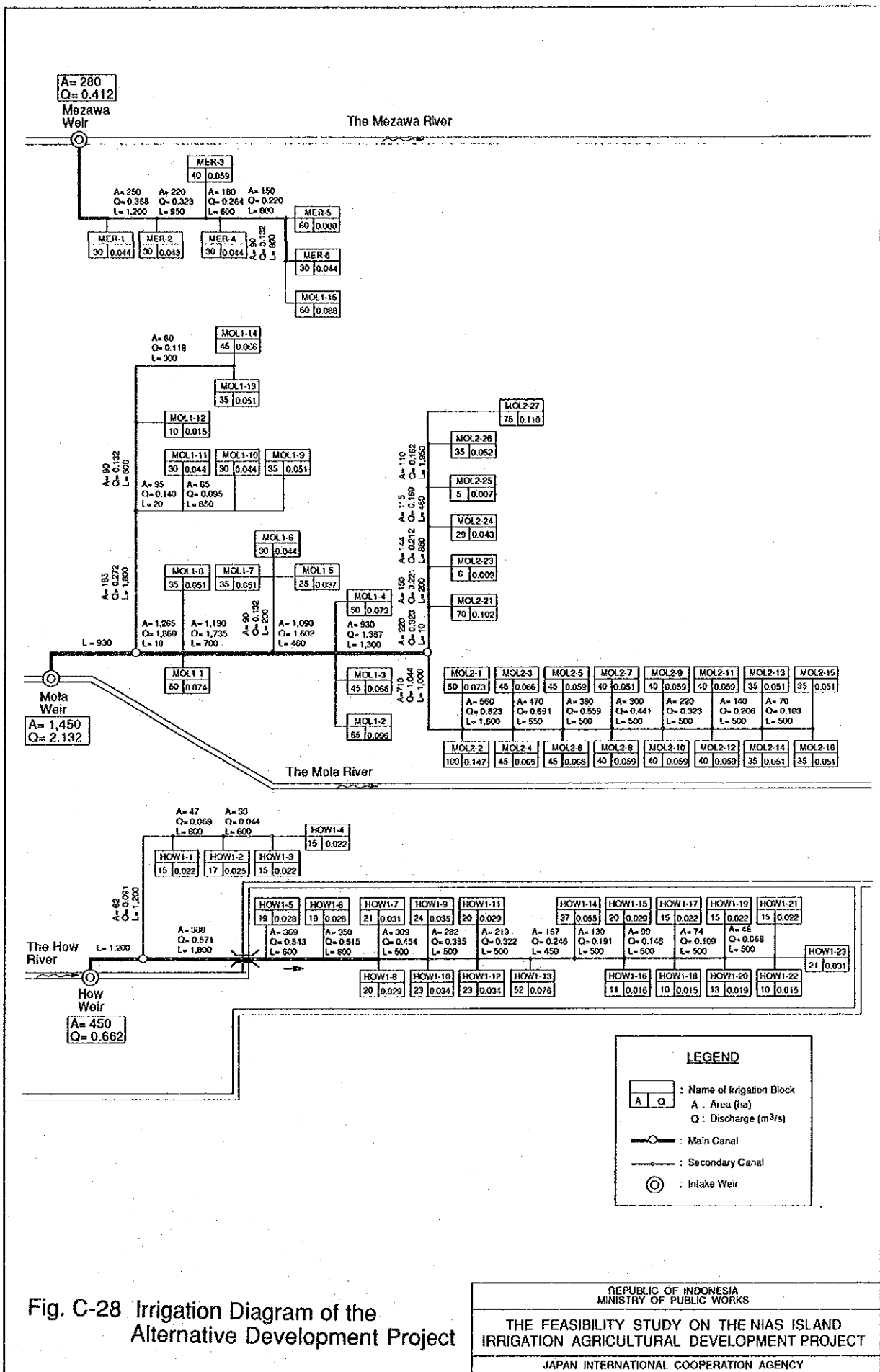


Fig. C-28 Irrigation Diagram of the Alternative Development Project



JICA