(Unit: US$/m)

Name of Material	DIP	Steel Pipe	GFRP
Material Cost	310	270	300
Installation Cost	30	160	60
Total	340	430	360

Notes: These prices do not include the costs of earth works, pipe bends, thrust block and valve works.
A pipe diameter of 700 mm was used for cost estimate.
DIP; ductile iron pipe
GFRP; glass fibre reinforced pipe

Ductile iron pipe is therefore proposed as the pipe material resulting the economic comparison above.

3.3 Free Town Pumping Station

There are two sets of pump equipment at Free Town pumping station. Recorded discharge by these two pumps were 0.305 m^3/sec. In order to maximize the use of water from the Free Town Wells, i.e. 0.55 m^3/sec, new pump sets are required.

The optimum type and number of pumps were examined from economic and technical view points. As a result, five sets of submersible pumps are proposed including construction of three additional wells.

Basic features of pumps proposed are as follows:

Pump type	:	submersible pump
Pump capacity	:	6.36 m^3/min., 75 kw
Total head	:	45 m
Required power	:	75 kw
No.	:	5

3.4 Open Canals and Related Structures

3.4.1 Open canals

The existing open canal system is provided to deliver pumped water from Free Town, Marine Terminal, and Bodles pumping stations to farming land. The main canal commences at the outlet point of the Free Town pipeline and several distributory canals branch off from the main canal. Both main and distributory canals would be lined with concrete.

The total lengths of the main and distributory canals are computed to be 7.9 km and 10.3 km respectively.

3.4.2 Canal related structures

Similar structures will be required for this canal system as discussed in the previous sub-section 2.2.5.

4. DRAINAGE FACILITIES

4.1 Function and Requirement

The drainage canal system will consist of the following canals based on function:

(1) Field ditch

Field ditches are provided to drain excessive water and to control the sub-surface water level at each farm plot.

(2) Collector drain

Collector drains convey excessive water and subsurface water collected by the field ditches to secondary or main drains.

(3) Main and Secondary drains

Main and Secondary drains transport water from collection drain to natural gullies or rivers.

Of the above items (1) and (2) are categorized as on-farm level development. Item (3) is, therefore, dealt with in this section.

4.2 Drainage Canal

4.2.1 Design conditions

(1) Design discharge

Design discharge for secondary and main drainage canals are determined by applying the equation below:

$$Q = A.Rn.\ C.10{,}000/3{,}600.T$$

where, Q = design drainage discharge (lit/sec)
A = drainage area (ha)
Rn = max. rainfall in n hours, R24 = 142 mm
C = runoff percentage
T = drainage time (hr)

Using the equation above, unit design discharge under various field conditions was computed and is summarized in the table below:

Land Use	Condition of Ground Surface	Drainage Area	Drainage Time	Run Off Percentage	Unit Design Discharge
		(ha)	(hr)	(%)	(lit/sec/ha)
Rice field	Flat	100	24	65	10.7
Upland crop	Flat	100	48	50	4.1
Upland crop (high percolation)	Flat	1,000	72	50	2.7
Upland crop (high percolation)	Flat	500	60	50	3.3

(2) Canal section

The drainage canal section was planned as follows:

- Type : Trapezoidal earth canal
- Permissive maximum velocity : 0.7 m/sec
- Minimum free board : 0.3 m
- Inside slope : 1:1.0

4.2.2 Layout planning of drainage canal

The layout of the drainage canals was planned on the topographic map at a scale of 1/12,500. The total length of secondary drainage canals will be 21.4 km. The drainage canal system in the project area is shown in Fig. I-4 of Annex-I.

4.3 Related Structures

A drainage culvert is proposed at places where drainage canals pass under the roads.

5. ROADS

5.1 Function and Requirement

Two types of road are planned in the project area in accordance with their functions. Operation and maintenance roads (O&M road) which will be constructed along the main, branch and minor branch canals (in case of the St. Dorothy Scheme, roads are already provided along the main and distributory canals) for canal operation and maintenance purposes. The other category is for roads which are utilized for regional traffic including transportation of agricultural input and output and classified as main and farm roads. Farm roads being categorized as on-farm level development, are not included in this section.

5.2 Main Road

Main roads have been planned after taking into consideration existing and planned road networks. The width of main roads would be 8.0 m (6.5 m effective width) taking expected traffic density into consideration. These roads would be paved with compacted marl. The total length of main road required is 75.0 km.

5.3 Operation and Maintenance Road (O&M road)

Operation and maintenance roads (O&M road) would be provided alongside all canals which are rehabilitated and/or newly constructed in the project.

O&M roads along the main, and branch canals will need sufficient width to accommodate heavy construction equipment doing canal maintenance and repair works. Therefore, the width of these roads are would be designed as 5.0 m (4.0 m effective width). O&M roads along minor branch canals, however, would be 4.0 m wide (3.0 m effective width). All these roads would be paved with compacted marl 10 cm thick.

6. PRINCIPAL FEATURES OF THE PROJECT

A. Rio Cobre Irrigation Area

1. Source of Irrigation : Rio Cobre and Groundwater

2. Irrigation Area : 13,130 ha (32,500 acres) Gross

3. Irrigation Facility

3.1 Headworks (Rehabilitation)

1) Raising of weir	:	0.6 m x 90 m
2) Replacement of intake gate	:	8 Nos.
3) River revetment	:	Additional apron length of 80 m
4) Grouting work	:	Chemical grout

3.2 Main Canal (Rehabilitation)

1) Canal type	:	Trapezoidal concrete lined and rectangle reinforced concrete lined canal
2) Design discharge	:	9.63 m^3/sec
3) Canal length	:	4.7 km (2.9 miles)
4) Related structures		
- Bifurcation	:	1 No.
- Aqueduct	:	1 No.
- Bridge	:	8 Nos.
- Spill Way	:	1 No.

3.3 East Main Canal (Rehabilitation)

1) Canal type	:	Trapezoidal concrete lined canal
2) Design discharge	:	4.10 m^3/sec
3) Canal length	:	4.7 km (2.9 miles)
4) Related structures		
- Bifurcation	:	1 No.
- Turnouts	:	13 Nos.
- Checks	:	7 Nos.
- Drops	:	8 Nos.
- Bridges	:	8 Nos.

3.4 West Main Canal (Rehabilitation)

1) Canal type	:	Trapezoidal concrete lined canal
2) Design discharge	:	6.35 m^3/sec
3) Canal length	:	2.8 km (1.8 miles)

4) Related structures

- Bifurcation	:	1 No.
- Turnout	:	1 No.
- Check	:	1 No.
- Drops	:	4 Nos.
- Bridges	:	3 Nos.

3.5 Hartland Branch Canal (Rehabilitation)

1) Canal type	:	Trapezoidal concrete lined canal
2) Design discharge	:	2.77 m^3/sec
3) Canal length	:	7.1 km
4) Related structures		
- Turnouts	:	9 Nos.
- Checks	:	6 Nos.
- Drops	:	9 Nos.
- Culverts	:	12 Nos.

3.6 Old Harbour Branch Canal (Rehabilitation)

1) Canal type	:	Trapezoidal concrete lined canal
2) Design discharge	:	3.54 m^3/sec
3) Canal length	:	10.6 km
4) Related structures		
- Turnout	:	10 Nos.
- Checks	:	6 Nos.
- Drops	:	9 Nos.
- Culverts	:	13 Nos.

3.7 Old Harbour Extension Canal (New construction)

1) Canal type	:	Trapezoidal concrete lined canal
2) Design discharge	:	0.58 m^3/sec
3) Canal length	:	5.1 km
4) Related structures		
- Syphons	:	3 Nos.
- Turnouts	:	6 Nos.
- Checks	:	6 Nos.
- Aquaducts	:	1 No.
- Culverts	:	5 Nos.

3.8 Minor Branch Canal(Rehabilitation)

1) Canal type	:	Trapezoidal concrete lined canal
2) Total canal length	:	53.0 km

2) Occupied area : 200 ha
3) Type of dike : homogeneous earth filling
4) Height of dike : 4.2 m to 10.0 m

3.10 Black River Reservoir (New Construction)

1) Storage capacity : 3.8 million m^3 (Gross)
2) Occupied area : 80 ha
3) Type of dike : homogeneous earth filling
4) Height of dike : 4.8 m to 8.8 m

3.11 Amity Hall Reservoirs (Existing)

1) Storage capacity : 1.2 million m^3

3.12 Mendes Pen Reservoirs (Rehabilitation)

1) Storage capacity : 0.4 million m^3

3.13 Nightingale Pumping Station (New Construction)

1) Design discharge : 150 lit/sec
2) Pump capacity : 4.5 m^3/min x 2 Nos.
3) Pipeline : Ductile iron pipe
D = 400 mm, L = 1.5 km
4) Farm pond : 50 m x 50 m x 2 m

3.14 No. 1 Amity Hall Pumping Station (New Construction)

1) Design discharge : 150 lit/sec
2) Pump capacity : 4.5 m^3/min x 2 Nos.
3) Pipeline : Ductile iron pipe
D = 400 mm, L = 0.1 km

3.15 No. 2 Amity Hall Pumping Station (New Construction)

1) Design discharge : 150 lit/sec
2) Pump capacity : 4.5 m^3/min x 2 Nos.
3) Pipeline : Ductile iron pipe
D = 400 mm, L = 0.1 km

3.16 March Pen Pumping Station

1) Design discharge : 142 lit/sec
2) Pump capacity : 4.5 m^3/min x 2 Nos.
3) Pipeline : Ductile iron pipe
D = 400 mm, L = 1.0 km

2) Pump capacity : 4.5 m^3/min x 2 Nos.
3) Pipeline : Ductile iron pipe
D = 400 mm, L = 1.0 km
4) Farm pond : 50 m x 50 m x 2 m

3.17 Syphon at Rio Cobre

1) Design discharge : 574 lit/sec
2) Material of pipe : Ductile iron pipe
3) Diameter : D = 900 mm
4) Length : L = 134 m

B. St. Dorothy Irrigation Area

1. Source of Irrigation Area : Groundwater

2. Irrigation Area : 1,490 ha (3,680 acres) Gross

3. Irrigation Facilities

3.1 Free Town Pumping Station (Renewal)

1) Design discharge : 0.55 m^3/sec
2) Type of pump : Submersible pump
3) Pump capacity : 6.6 m^3/min
4) Number of pump sets : 5 Nos.

3.2 Free Town Additional Wells (New Construction)

1) Size of well : D = 400 mm
2) Number : 3 Nos.

3.3 Free Town Pipeline (Renewal)

1) Design discharge : 0.55 m^3/sec
2) Material of pipe : Ductile iron pipe
3) Diameter : 700 mm
4) Length : 2.8 km

3.4 Free Town Canal (Rehabilitation)

1) Canal type : Trapezoidal concrete lined canal
2) Design discharge : 0.55 m^3/sec
3) Canal length : 7.9 km

4) Canal related structures

- Syphons	:	10 Nos.
- Turnouts	:	11 Nos.
- Checks	:	8 Nos.
- Drops	:	4 Nos.
- Culverts	:	19 Nos.
5) Distributory canal	:	10.3 km

C. Drainage Facility

1. Secondary Drainage Canal

1) Canal type	:	Trapezoidal earth canal
2) Total length	:	21.4 km

D. Road

1. Main Road

1) Width	:	8.0 m (6.5 m effective)
2) Pavement	:	Marl (t = 100 mm)
3) Total length	:	75.0 km

2. Main O&M Road

1) Width	:	5.0 m (4.0 m effective)
2) Pavement	:	Marl pavement (L = 100 mm)
3) Total length	:	42.9 km

3. Branch O&M Road

1) Width	:	4.0 m (3.0 m effective)
2) Pavement	:	Marl pavement (L = 100 mm)
3) Total length	:	64.8 km

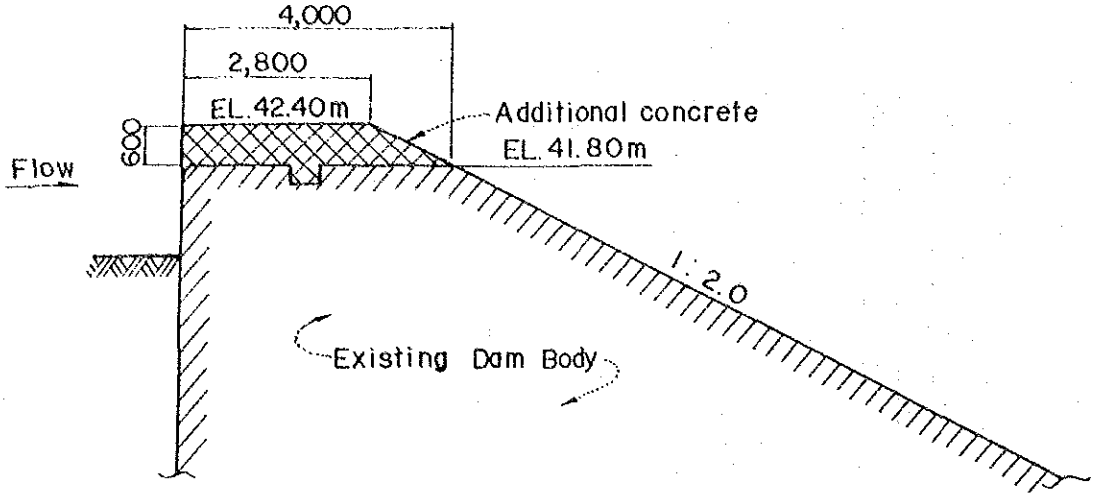
E. On-Farm Development (Net Area)

1. Flood Irrigation Area	:	2,800 ha (6,900 acres)
2. Furrow Irrigation Area	:	2,250 ha (5,560 acres)
3. Sprinkler Irrigation Area	:	1,830 ha (4,520 acres)
4. Drip Irrigation Area	:	200 ha (490 acres)

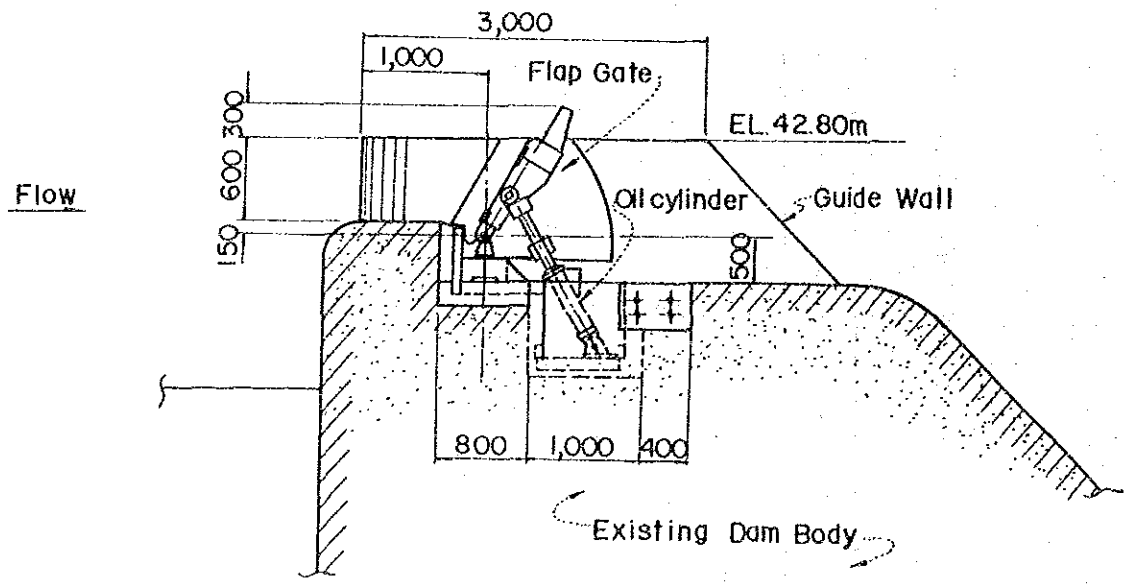
Table K-1 LIST OF CANAL RELATED STRUCTURES

Name of Structure	Name of Canal							
	Main	East	West	Hartland	Old Harbour	Extension	Free Town	Total
Bifurcation	1	1	1	0	0	0	0	3
Syphon	0	1	0	0	0	3	10	14
Turnout	0	13	1	9	10	6	11	50
Check	0	7	1	6	6	6	8	34
Drop	0	8	4	9	9	0	4	34
Aqueduct	1	0	0	0	0	1	0	2
Bridge	8	8	3	0	0	0	0	19
Culvert	0	0	0	12	13	5	19	49
Spillway	1	0	0	0	0	0	0	1

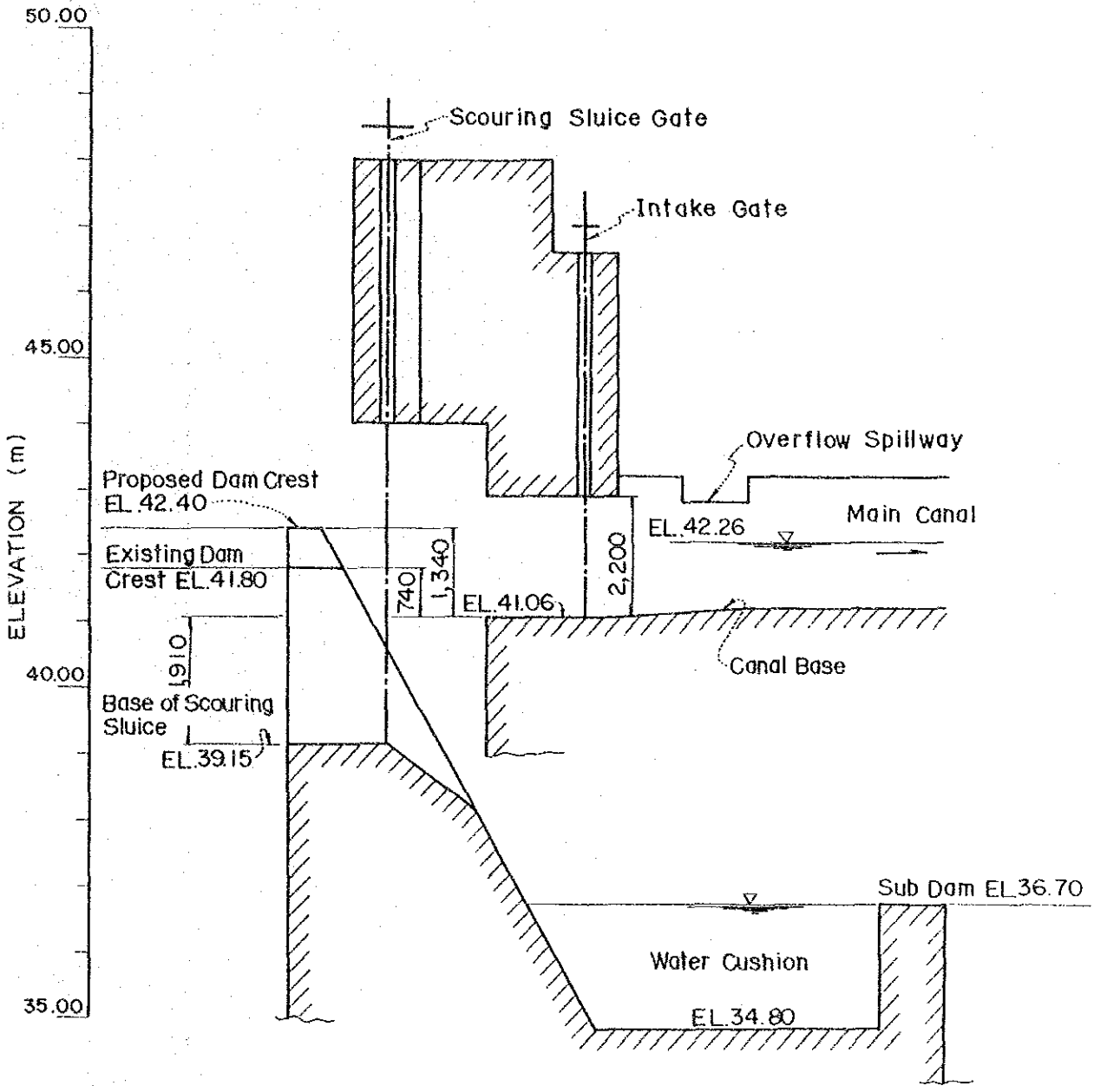
ALTERNATIVE 1 (Fixed Weir)



ALTERNATIVE 2 (Movable Weir)



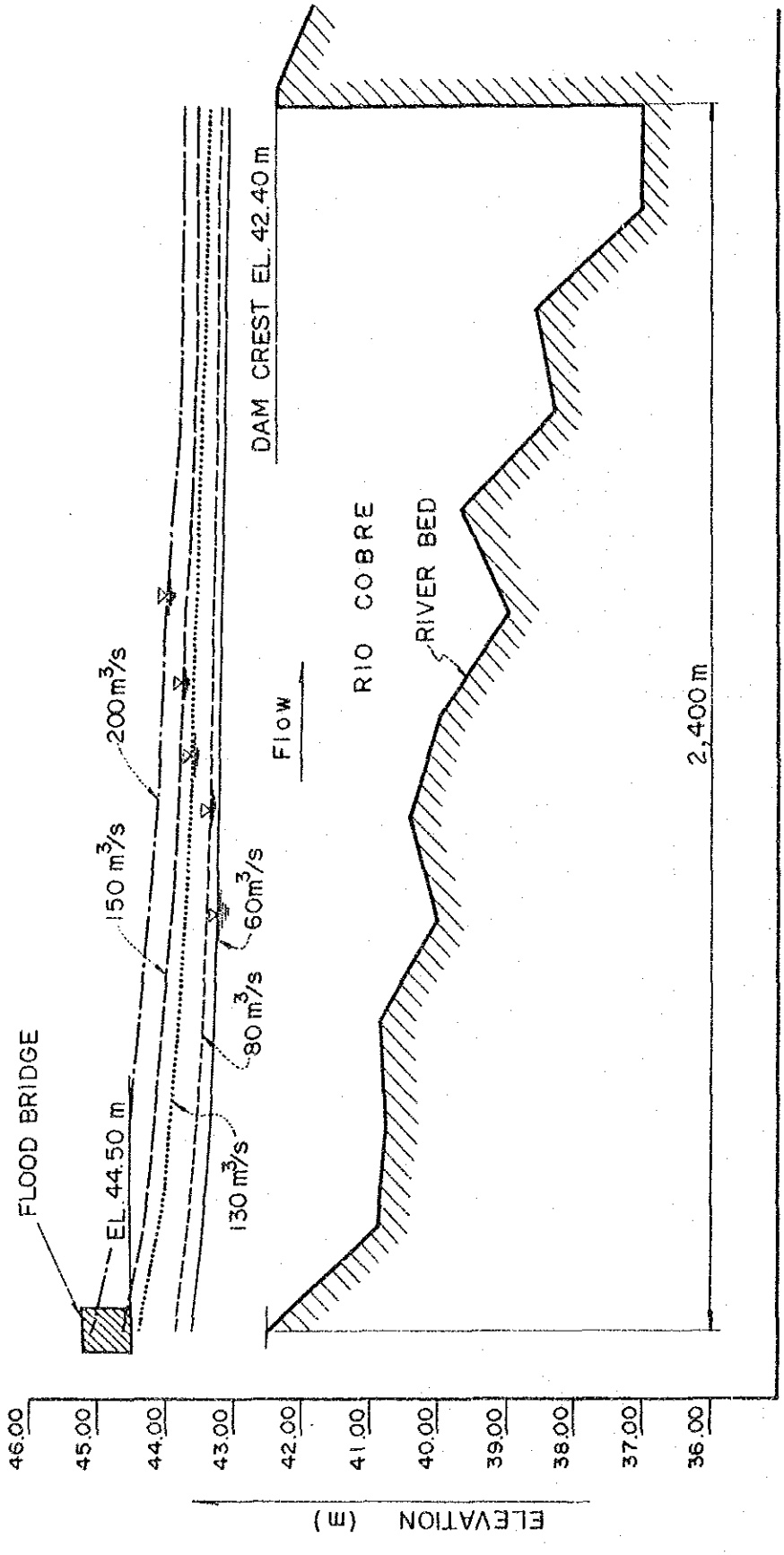
THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME
Fig. K-1 ALTERNATIVE PLANS OF DAM HEIGHTENING
JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. K-2
SCHEMATIC VIEW OF DAM INTAKE

JAPAN INTERNATIONAL COOPERATION AGENCY

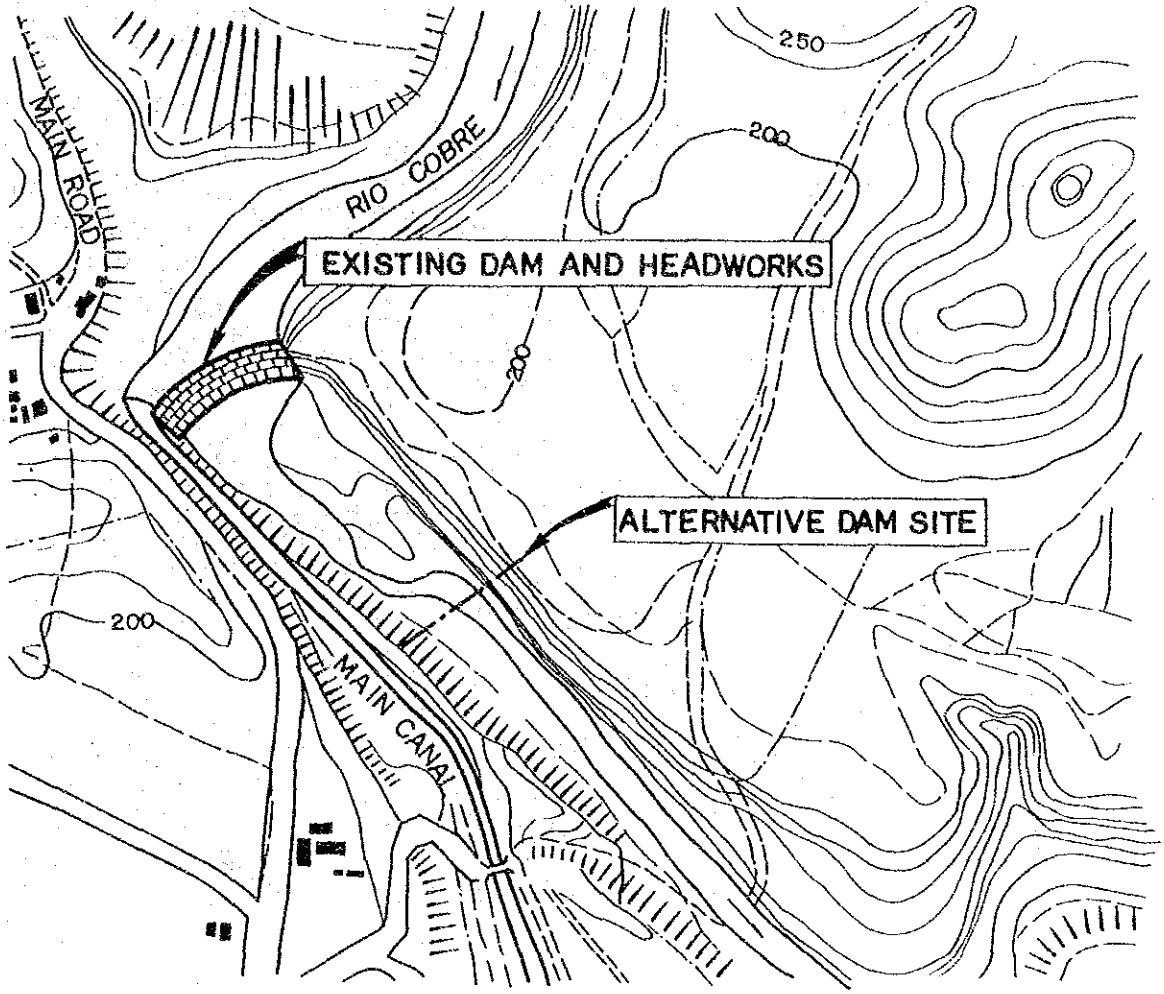


THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

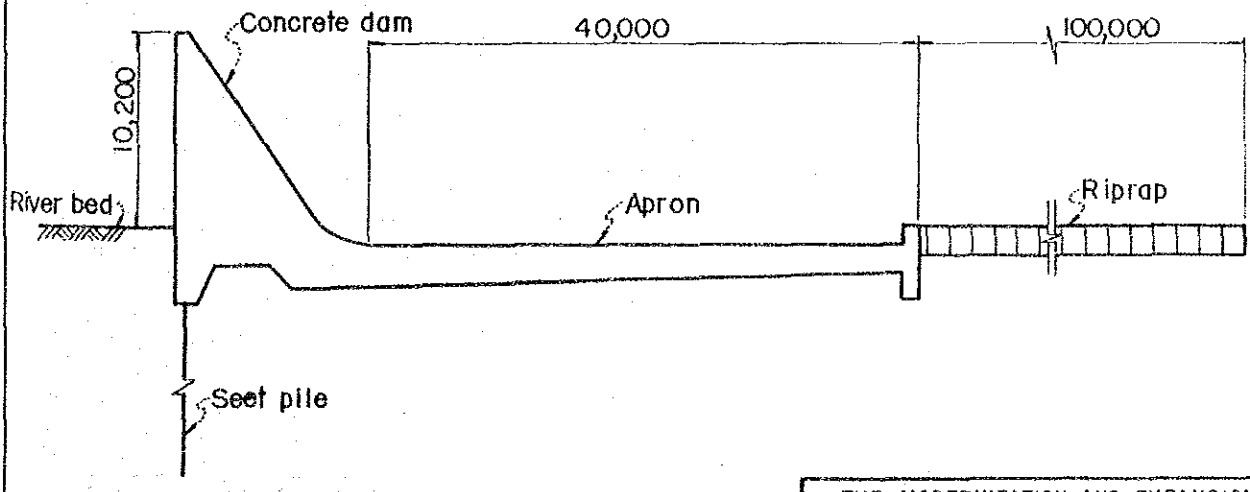
Fig. K-3
BACK WATER UNDER VARIOUS FLOOD DISCHARGE

JAPAN INTERNATIONAL COOPERATION AGENCY

LOCATION MAP OF ALTERNATIVE DAM SITE

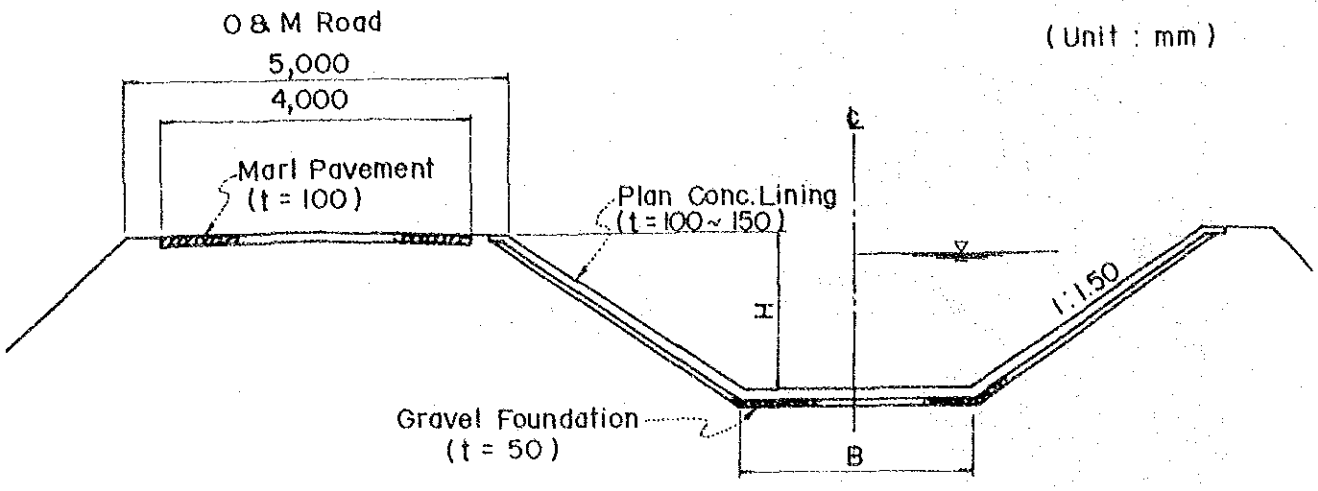


TYPICAL CROSS SECTION OF ALTERNATIVE DAM



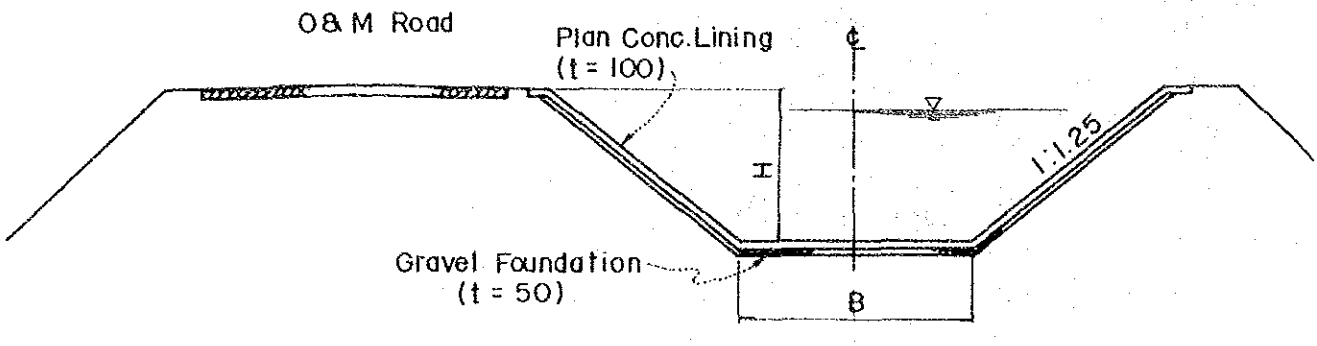
THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME
Fig. K-4 ALTERNATIVE DAM PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

MAIN AND BRANCH CANAL



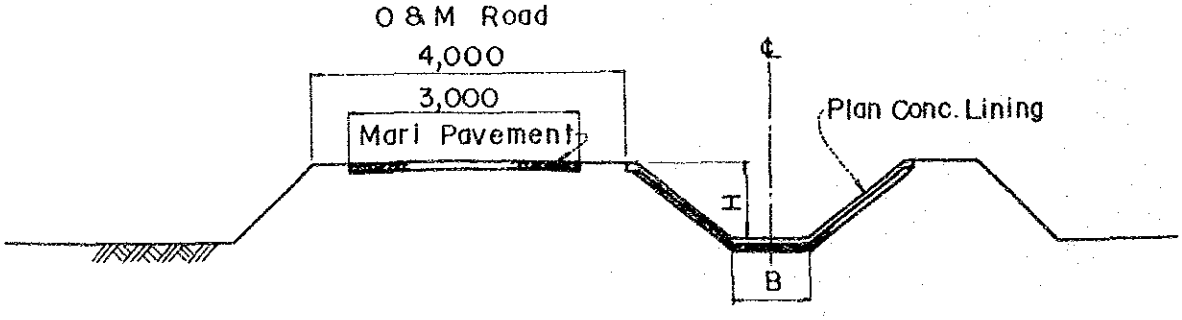
(Unit : mm)

TYPE A

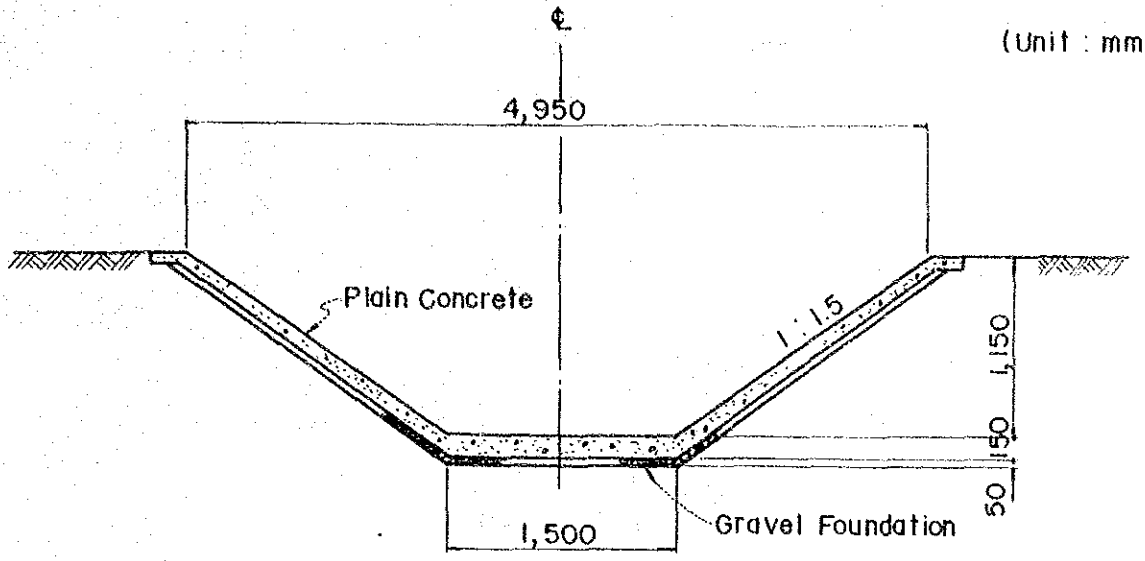


TYPE B

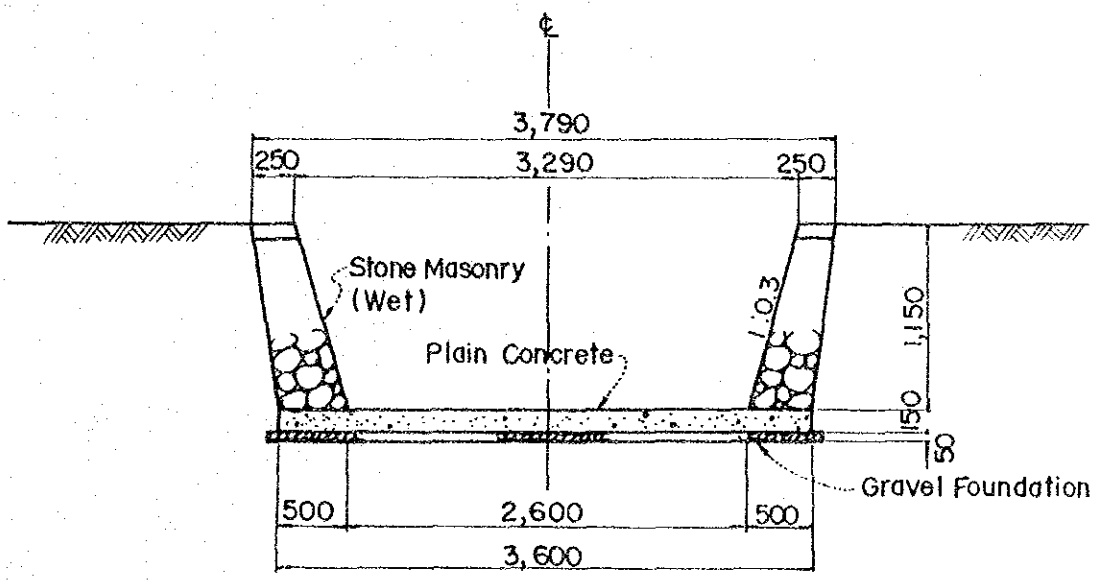
MINOR BRANCH CANAL



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME
Fig. K-5 TYPICAL CROSS SECTION OF CANALS
JAPAN INTERNATIONAL COOPERATION AGENCY

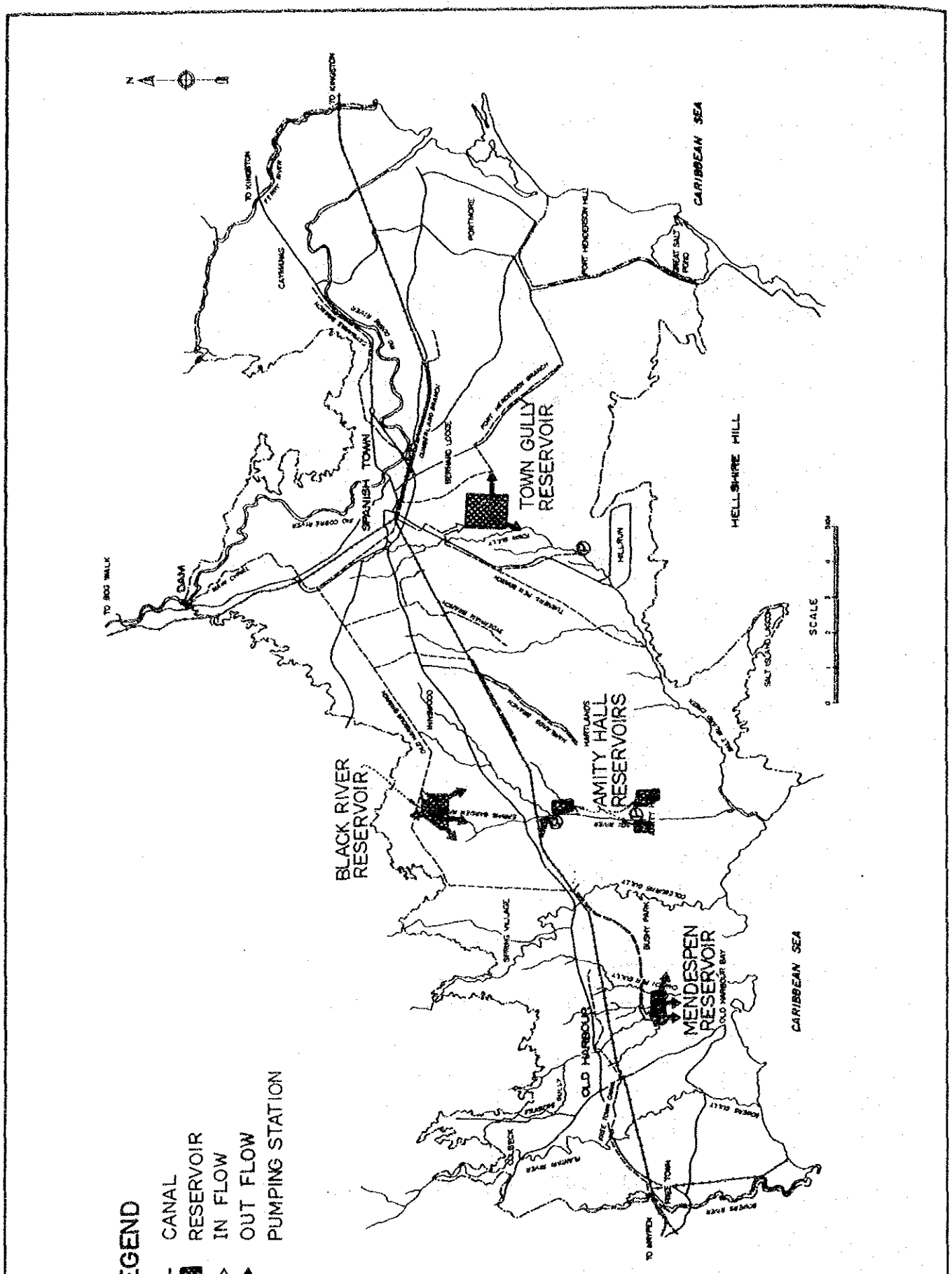


PLAIN CONCRETE LINING CANAL



STONE MASONRY LINING CANAL

THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME
Fig. K-6 ALTERNATIVE PLANS OF CANAL LINING
JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. K-7
LOCATION MAP OF RESERVOIRS

JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX - L

PROJECT ORGANIZATION

ANNEX-L

PROJECT ORGANIZATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. PRESENT ORGANIZATION

1.1 General

There are two (2) irrigation schemes in operation in the study area at present: the Rio Cobre irrigation scheme and the St. Dorothy irrigation scheme. The former is currently managed, operated and maintained by the Rio Cobre Irrigation Works (RCIW) a division of Ministry of Agriculture (MOA), while the latter functions under the St. Dorothy Plain Irrigation Authority (SDPIA) which is run by an irrigation board.

1.2 Rio Cobre Irrigation Works (RCIW)

The Rio Cobre irrigation scheme, started in 1870, was the first major endeavour by the Government to develop irrigated agriculture. Construction of a diversion dam across the Rio Cobre river about 8 km (5 miles) north of Spanish Town was completed in 1876. It is a gravity flow system deriving the bulk of its water from the Rio Cobre dam. The system irrigates about 9,500 ha (28,800 acres) of land in the St. Catherine plains through about 54 km (34 miles) of main and branch canals.

At present approximately 107 million m^3 of water is available and sold annually to some 250 customers. Water is supplied on a continuous flow contract basis. Each contract is for the supply of the specified number of cubic yards per hour on the understanding that this flow will be available at a constant rate throughout the year. About 3 million m^3 of water are sold on this basis to the National Water Commission (NWC) for Spanish Town domestic water supply. The last adjustment of the contract rate was in 1983 when it was increased from J$ 3.60, which had been in force for the last 30 years, to J$ 12.00 per cubic yard per hour per year. The billings and income of RCIW for the last three (3) years are given in the table below:

(Unit: J$)

Item	1982/83	1983/84	1984/85
Billings	103,221	195,880	342,903
Income	46,447	72,495	91,313

This shown that RCIW' performance in collecting revenue is very poor.

The irrigation system is operated directly by the Government through MOA and not by an irrigation authority as is the case with other irrigation systems in the island. The work involved in the operation and maintenance of the system is carried out by 44 staff headed by a works manager.

The management structure of RCIW is shown on Fig. L-1 and the number of staff in the various categories is listed in Table L-1. In addition to the permanent staff, there are normally some 15 labourers employed on a casual basis, when budget allocations permit, for canal maintenance, weed cleaning, etc.

The works manager is assisted by some eight (8) persons on the administration side, and is responsible for billing for water supplied. The works overseers are responsible under the works manager for the field works. A measurement section, under a gauge inspector, looks after the weirs, notches and flumes used to control and measure the flow to individual contract holders. A dam sluice attendant is responsible for the intake works at the headworks dam and is also responsible for 18 canal attendants and their support staff. Two (2) district constables are responsible for security and the enforcement of the canal regulations.

RCIW has its office and works yard in Spanish Town. Accommodation is provided at the headworks dam for the dam sluice attendant, and other accommodation close to main control areas is provided for canal attendants.

Estimates of RCIW expenditure details for 1983/84 and 1984/85 are set out in Table L-2. The expenditure of RCIW was estimated at J$ 1.2 million in 1983/84 and J$ 1.3 million in 1984/85 respectively. However, budgets from the Government and revenue from water supplied were unsufficient to meet the estimates of RCIW expenditure which covered only expenditure of personnel emoluments.

1.3 St. Dorothy Plain Irrigation Authority (SDPIA)

The total area under cultivation is approximately 1,870 ha (4,620 acres). It is served by about 16 km (10 miles) of pipelines and 28 km (17 miles) of canals. The system consists of seven (7) deep wells of which four (4) wells are using for flood irrigation and three (3) are for sprinkler irrigation, supplying approximately 29 million m^3 of water to some 210 farmers annually. The water is sold to the farmers on a contract basis, as by RCIW, at J$ 30.00 per cubic yard per hour per year for sprinkler irrigation. The total revenue for water in 1985/86 was estimated at J$ 102,640 or 73% of total billings. This is very high when compared with RCIW's performance of 27%. However, this collection of revenue includes billings of previous years. Consequently, the real revenue of SDPIA in 1985/86 is still quite low.

SDPIA was established by the St. Dorothy Plain Irrigation Establishment Order, 1961. SDPIA is run by an irrigation board, which is appointed by the Minister of Agriculture. The day to day workings of SDPIA are handled by a staff of 18 persons headed by a works overseer. The number of staff in the various categories, and the management structure of SDPIA are given in Table L-3 and Fig. L-2. The main functions of SDPIA are:

- to manage, control and operate, subject to any directions given by the Minister, the irrigation system in the relevant irrigation area,
- to manage and control the distribution of water from the system, and
- to formulate and implement programme for development of the irrigation scheme.

NWC and Underground Water Authority (UWA) provide any necessary technical advice and assistance to SDPIA in carrying out their duties. Jamaica Soya Products, dairy and cattle-rearing enterprises are also supported by this irrigation system.

The itemized expenditure of SDPIA in 1985/86 and 1986/87 is given in Table L-4. The total expenditure of SDPIA in 1985/86 was estimated at about J$ 2.2 million. Most of this expenditure was on electric charges for operation of pumps which makes up three quarters of total expenditure. The revenue from the water supplied, covered only 6% of the electric charges. SDPIA depends upon a subsidy from the Government for great part of their expenditures.

SDPIA is faced with many problems:

- shortage of water due to saline intrusion and drought,
- large amounts owing to Jamaica Public Service Company for electric power supplied which results in the frequent disconnection of pumps,
- low revenue because of low irrigation dues,
- leaking woodstave pipeline,
- shortage of vehicles,
- lack of relevant training for the staff,
- illegal blocking and water extraction from the canal at nights and weekends,
- shortage of staff,
- water dues outstanding from consumers, and
- absence of recording devices for pumps.

2. CROP DIVERSIFICATION PROJECT

The Crop Diversification Project financed by United States Agency for International Development (USAID) consists of the following four (4) elements:

(1) Strengthening Agro 21,
(2) Small Infrastructure Rehabilitation,
(3) Operation and Maintenance (O&M), and
(4) Small Scale Farmer Linkage

Of the above elements, O&M are as essential as rebuilding the irrigation works. While RCIW, now under MOA, has this responsibility, it has neither the funds nor the authority to adequately accomplish these tasks. Financing provided under this elements will be channelled to Agro 21, RCIW, and UWA in order to upgrade overall Government capability to properly operate, maintain, and monitor the rehabilitated irrigation system.

Total USAID funds budgeted for the project elements, including inflation, are approximately US$ 43 million. Details of the project elements are outlined in the following sections.

2.1 Agro 21

Agro 21 aims to assist RCIW to enhance its expertise in interfacing with water users and in properly managing the multiplicity of water problems. The crop Diversification Project will finance:

(1) Long term technical assistance (US$ 120,000)

A consultant will provide inter agency coordination with respect to this project area's O&M needs to help to ensure that RCIW and MOA maintain sufficient people on site and proper timing of activities.

This individual will also participate in negotiations with RCIW, MOA and the Ministry of Finance for revenue generation to provide the maintenance and security services needed. Water user fees at a reasonable level, will be collected and turned over to RCIW, to support O&M for the system.

(2) Interim measures (US$ 100,000)

This project will provide funding to enable Agro 21 to contract with RCIW to provide maintenance and security for the system on an interim basis as it is rehabilitated pending establishment of a satisfactory revenue generating procedure. This will include strengthening RCIW by the addition of staff specifically for the rehabilitation work.

2.2 Rio Cobre Irrigation Works (RCIW)

At present UWA, a statutory body, is responsible for monitoring water use, water levels and water quality for an Assessment Study of both the Rio Cobre and St. Dorothy irrigation systems administered by RCIW and SDPIA respectively. The study funded by this project will:

(a) assess current institutional arrangements for the management O&M of these irrigation systems. Included within this assessment will be a survey of water users to determine the level of water availability, water costs and on-farm water management practices for current cropping patterns.

(b) provide recommendations for an acceptable reorganization of these irrigation systems, that will provide for accountability of management performance and sustainability of the systems based on equitable user fees. The recommendations will include:

- a plan and schedule for organizing water user associations for these irrigation systems. This plan will provide for the direct participation of representatives of water users in the management of the systems, and to the extent possible, for the participation of water users in carrying out improvements to and maintenance of the systems
- a training plan for the water users in on-farm water management techniques.

This project will finance implementation of the recommendations put forth by the assessment study following acceptance by the relevant Jamaican entities.

(1) Long-term technical assistance (US$ 760,000)

As consultant will work as a counterpart to the current works manager of RCIW. This individual would also provide the expertise necessary to upgrade the general technical competency of RCIW. The consultant would also be responsible for identifying needs for additional short-term technical assistance in specialty areas.

This project will finance the temporary addition to RCIW staff of local on-farm water management specialists. These individuals would work with the farmers to build up confidence in the system. They would provide technical advice on the amount of water required, given a farmer's soil, crop combination and acreage.

(2) Short term technical assistance (US$ 160,000)

It is anticipated that the following categories of specialists will be needed to provide the necessary short term technical assistance:

- irrigation engineer
- on-farm water management specialist

- economist/sociologist
- management/organizational specialist
- financial/institutional development specialist

(3) Operations support (US$ 175,000)

This project will provide supplemental operations support to RCIW pending institution of a satisfactorily self-sufficient revenue generating arrangement for the irrigation system's O&M. This will include funding for necessary additional personnel, supplies, and vehicles' fuel and maintenance.

(4) Training (US$ 90,000)

This project will also finance training of RCIW staff to upgrade their capabilities to adequately monitor and coordinate the use of the water in the system. The instruction will be provided in part by short-term specialists and in part by knowledgeable individuals currently in the Government or in the Jamaican private sector. Training will also be provided for water users via workshops in order to upgrade on-farm water management techniques.

(5) Commodities (US$ 188,000)

In line with the recommendations developed as part of the assessment, this project will finance the commodities and equipment necessary to upgrade the capabilities of RCIW to a level of efficient operation of the systems. It is expected that these will include vehicles, tools, survey equipment, water measurement devices, communications equipment, and office equipment.

It will also include funds to set up a revolving loan fund within RCIW to allow canal attendants to finance their own work-related transportation (a motorcycle).

(6) Small infrastructure (US$ 856,000)

Funds will be provided to assist RCIW in carrying out the rehabilitation of small infrastructure works outside the initial investor-oriented rehabilitation already identified by Agro 21. These would focus on, but not be limited to, rehabilitation activities which would improve the operation of the system as a whole and directly benefit the farmers currently in the area. Prior to initiation of these works, short-term technical assistance would draw up facilitate economic feasibility and engineering plans to facilitate implementation by RCIW.

2.3 Underground Water Authority (UWA)

(1) Commodities (US$ 90,000)

Environmental monitoring of project activities will be the responsibility of UWA. This will include monitoring of (a) water quality with respect to both salinity and contamination by pesticides and other pollutants, (b) groundwater extraction, and (c) soil

salinity. However, UWA currently does not have the vehicles, instruments and spare parts necessary to allow it to take on this additional task. This project will provide funding to finance two (2) small 4WD vehicles, lab fees, spare parts for the drilling equipments, instruments and other equipment necessary to carrying out the monitoring activities.

3. THE NATIONAL IRRIGATION COMMISSION LIMITED

The Government of Jamaica is contemplating the establishment 'the National Irrigation Commission Limited' (NIC) a body to be entitled. The objects for which NIC is to be established are:

(1) to manage, operate, maintain and expand such existing and future irrigation schemes and systems as may now or from now on be established by the Government or by any department or agency and in particular the Rio Cobre Irrigation system which is currently managed, operated and maintained by RCIW a division of MOA.

(2) to identify and designate the persons or other legal entities who or which shall be entitled to use the water generated or provided by such irrigation schemes or systems and to fix and collect the rates or charges to be paid by such persons or other legal entities for the use of such water.

(3) to expend the fees collected from the users of such water pursuant to its obligations hereunder and in compliance with these objects but otherwise in the unfettered discretion of NIC.

(4) to appoint such managers consultants and executive officers as NIC shall from time to time in its unfettered discretion deem requisite for the effectual implementation of these objects.

(5) to ensure that such water is utilized only for the irrigation of crops and for such other purposes as NIC may from time to time decide.

(6) to compile and distribute to the authorised users of such water such rules as from time to time may be deemed necessary by NIC to ensure that such water is not a subject of waste and is used economically as well as such other rules as may from time to time be considered by NIC expedient.

(7) to provide for the said irrigation system such security whether in the form of guards or artificial devices or both as NIC shall consider requisite to prevent or reduce the incidences of the taking of water by unauthorised persons and damage to canals, wells and other property used in connection with the said irrigation system as well as pollution of the water.

(8) to acquire whether by legislation of the Government or otherwise such rights and easements as are requisite for the proper and effectual management, operation and maintenance of the said irrigation system.

4. PROPOSED ORGANIZATION

4.1 General

Management aspects are of fundamental importance to the success of the development plan. The true measure of success of an irrigation project is not the completion of the construction aspects but the way in which the water and land resources are subsequently used for the benefit of the locality. It is the duty of management to ensure the optimum use of these resources.

The St. Dorothy irrigation scheme is relatively small and its expansion is limited through lack of good quality water within its boundaries. Since the eastern boundary of the St. Dorothy irrigation scheme and the western one of the Rio Cobre irrigation scheme are contiguous, these two (2) schemes could easily be combined to form one (1) organization for administrative purposes. An amalgamation of these two (2) schemes would result in additional acreage being brought into production, particularly in the Bushy Park area, where at present the lands irrigated by the St. Dorothy irrigation scheme suffer severe water shortages.

Therefore it is proposed that the present RCIW and SDPIA should be reorganized and combined into a single organization to fulfill the functions of an irrigation scheme for the whole of the coastal plains. This proposed organization, St. Catherine Irrigation System (SCIS), would function as a branch office of NIC mentioned in Chapter 3 for the efficient management of the water passing through the systems. The task of SCIS would be to supply timely water for agriculture and in the quantity and quality necessary to meet irrigation requirements. The objectives of SCIS would be:

(1) to develop an adequate supply,
(2) to deliver the water as economically as possible,
(3) to maximize benefits from the project,
(4) to minimize losses through the system,
(5) to provide all possible help to the user in the most efficient use of water and
(6) to be accountable to NIC for the efficient management of the water passing through the system.

4.2 Management Functions

The following functions should be undertaken by SCIS:

(1) Preparation of a water delivery schedule

(a) Schedules should be developed for the delivery of sufficient irrigation water to users as required to meet crop requirements.

(b) Adequate turnouts and measuring devices must be installed at farm inlets to ensure equitable distribution to each user.

(c) The water measuring system should be reorganized by setting up reliable measuring weirs or flumes at selected locations.

(d) Canal seepage losses should be determined by the inflow-outflow method or by field permeability tests.

(e) Schedules should be printed and made available to the users for their information. This should be revised as necessary to show differences in demand.

(f) The present wasteful continuous flow methods should be abandoned and the demand system, involving the delivery of water to the farm at times and in quantities requested by the water users, should be introduced wherever possible.

(g) For administrative convenience, SCIS might introduce a rotational system of water delivery.

(2) Operation and maintenance

(a) It is essential that constant supervision and surveillance of the distribution system including pumps, conveyance channels, control structures, turnout gates, etc. are carried out by SCIS to minimize water losses.

(b) Adequate maintenance of above elements is essential to its development.

(c) Funds and facilities must be readily available to carry out necessary repairs.

(d) SCIS must maintain permanent maintenance crews whose duties would include, among other items, regular removal of aquatic growth and ditch bank weeds.

(e) Operation and maintenance records should be kept on all pumps and motors.

(f) SCIS should maintain quality control of all repair work, replacement of structures of all kinds, head-gates and measuring devices. The latter should be calibrated periodically to ensure correct readings.

(g) It is proposed that the operation and maintenance of the irrigation system be monitored by the field personnel and the office in Spanish Town through the telecommunication network as shown on Fig. L-4.

(h) A Citizen Band radio system would be introduced to provide a telecommunications network to cover the whole irrigation area in view of the low density of the present telephone network.

(3) Responsibility for water user rights

(a) It would be the responsibility of SCIS to ensure, through the appropriate legal bodies, the rights to use water in the project area.

(b) These rights should be maintained and safe-guarded from encroachment by other uses, and from water quality deterioration.

(c) Vigilance must be maintained to prevent dumping of industrial wastes, sewage and other such pollutants into any of the conveyance systems.

(d) Careful monitoring must be maintained where dangers of increasing salinity exist beyond acceptable standards of crop tolerance. Wherever mixing of waters is done, quality control must be exercised by SCIS to prevent excessive salt build-up in the soils.

(e) Re-use of waste waters and mixing with good quality waters must be carefully controlled.

(f) Provision must be made for the disposal of usable waste water by efficient drainage.

(g) Of utmost importance is the need to avoid competition for the water resources; such competition is developing rapidly as additional water is derived from the Rio Cobre Basin.

(4) Water delivery records

(a) SCIS should maintain adequate records to substantiate the delivery of water to users; such records will form the basis for water charges.

(b) SCIS should also serve as a check on the adequacy of operation and the accountability of the available water supply.

(5) Water costs

(a) Appropriate water rate to the users should be established by SCIS in accordance with accepted procedures.

(b) Each user would be allotted water on the basis of land area and cropping patterns in accordance with consumptive use criteria.

(c) If more water is requested than needed to satisfy farm irrigation requirements, a fee considerably higher than the standard should be charged. Such a policy would tend to discourage unnecessary water application and encourage more efficient use.

(6) Land formation

(a) SCIS must engage in a programme to encourage and promote land levelling. Where possible, an incentive programme should be adopted to assist the farmer with the costs of land levelling.

(b) SCIS should establish the standards and procedures to be followed, and make the necessary information available to the farmer. Where sprinkler systems are used, there would be no need to level land; high efficiencies can be obtained when systems are properly designed and operated.

(c) Incentive payments may also be considered instead of land levelling to encourage more efficient use of water.

(d) SCIS should be in a position to advise users on the various alternatives open to them. This may be done in cooperation with the Production and Extension Division of MOA.

(7) Education programmes

(a) It would be the responsibility of SCIS to promote and sponsor educational programmes and short courses to develop better understanding of good irrigation practice and system operation.

(b) SCIS should undertake a training programme to upgrade the quality of the irrigators and enhance their knowledge of irrigation practice, and especially of:

- consumptive use requirement of crops,
- relationship between soil, water, fertilizer and crops,
- stream measurement,
- problems resulting from excessive water application such as water logging, leaching of plant nutrients, salinity build-up and runoff problems,
- problems of under-irrigation and reduction of yields due to excessive plant stress,
- water saving through controlled plant stress,
- operation of the delivery system and the necessity to report wastes and system defects, and
- the level of instruction must, of course, be oriented to the capability of the irrigators and the information material prepared accordingly.

(8) Professional staff training

(a) SCIS should institute long and short range staff training programmes.

(b) These programmes must cover all phases of operation and maintenance and should be tied to a system of career advancement with professional examinations.

(c) The training programmes should cover the following subjects:

- operation and maintenance of pumps,
- conveyance system design and maintenance,
- conveyance losses,
- aquatic and ditch-bank weed control,
- maintenance of control structures and their operation,
- water measurement,
- irrigation water requirements,
- methods of water application and distribution
- irrigation efficiencies, and
- plant-water-soil-fertilizer relationship to crop production.

(9) Coordination and cooperation

(a) SCIS should be able to provide all information required by the farmers concerning crop production and marketing.

(b) To achieve this, SCIS must maintain liaison with the Marketing and Credit Division of MOA, Agro 21, the Agricultural Development Corporation, the Jamaica Development Bank, and other various research organizations.

(10) Accountability to NIC

SCIS should be responsible to a system manager appointed by NIC. An annual accounting procedure should be adopted, with regular monthly meetings held between the system manager and system staff. A form of reporting and periodical reports should be set up to provide information on the following areas for the system manager's review:

(a) water supply problems, quantity and quality,
(b) water delivery,
(c) system maintenance - replacements and repair problems,
(d) cost of operations for water delivery,
(e) assessments to farmers and payments for water,
(f) progress report on system improvement, user and professional staff training and improvement,
(g) review of water rights and control of water quality and pollution,
(h) research programmes to develop data and information for improvement of water use and crop yields,
(i) communication programmes between users and SCIS staff for discussion of problems on irrigation distribution arisen, and
(j) reporting to NIC.

4.3 Managing Organization

4.3.1 Organization and duties

Capital expenditure on irrigation development should be financed by the Government, either from its own resources or through a financing institution, and it will be necessary for the Government to retain control of the management of SCIS through NIC. NIC would appoint a system manager and the professional and administrative staff to form a permanent organization, which would act as an arm of NIC to transact and carry out all business associated with the irrigation operation.

Government control would be exercised through the system manager appointed by NIC. The term of office should be limited, and should be phased so that when one appointee is to be released, the incoming one would be appointed to overlap for a time and thus provide continuity. Appointments should be made from those with a knowledge of irrigated agriculture, and should not be salaried. The spectrum of representation should be broad, and should include an adequate representation of farmers, both large and small landholders. SCIS should be assured of NIC financing to carry out its functions. Money received by SCIS in payment for services and sale of water should, in turn be accounted for and fed back into the system in accordance with NIC decisions.

The proposed organizational structure of SCIS is illustrated on Fig. L-2.

4.3.2 Responsibility of staff

In order to accommodate the duties as well as to provide for greater operational efficiency and improved maintenance, the staff would be required as set out Table L-3. The duties to be performed by the staff of SCIS would include:

(1) operation of sluices at the diversion dam,

(2) operating, starting and stopping of pumps,

(3) maintenance and repairs of pumps,

(4) maintenance and repairs to canals, pipelines and drains,

(5) measurement of water flow and the operation of gates in channels and valves in pipelines for the control of water deliveries to the farms,

(6) scheduling of irrigation,

(7) water contracts, consumers' accounts and statements, etc.,

(8) reports on water use and distribution, cost of irrigation water, methods of improving distribution, cooperative irrigation of small lots, etc.,

(9) maintaining a record of farm layouts, irrigable acreage, soil depths, frequency of irrigation and sprinkler irrigation if used, and in the latter case a record of layout of laterals, etc.,

(10) advice to farmers on operating sprinkler systems,

  (a) checking farmers' sprinkler systems for efficiency operation and necessary replacements.

  (b) sprinkler delivery tests on typical sprinkler layouts and analysis of data to determine irrigation efficiency.

(11) checking delivery tests on typical sprinkler layouts and analysis of data to determine irrigation efficiency,

(12) collection of data on hours of pump operation, water consumed per farm, etc., and

(13) liaison with the Agricultural Research Station on irrigation schedules, soil testing and sampling.

One of the first duties of the system manager as the officer responsible for the efficient operation of the project area will be to define the duties of his subordinate staff, including the preparation of plans showing specific areas commanded by each overseer and canal attendant.

Other functions will be the systematic collection and recording of data on water use, river diversion and sluice operation, pumping hours, pump discharge, pressures and drawdown and in the case of sprinkler systems, pipeline losses, number of irrigations, efficiency of water distribution including tests to determine uniformity of sprinkler delivery, and demonstrating to farmers the method of setting up and scheduling irrigation.

An assistant manager and a works manager will assist a system manager with all important functions in the operations of the scheme and in the collection of field and climatic data which will eventually serve to improve the efficiency of the entire scheme.

Each works overseer will be responsible for coordinating the activities of the operational and maintenance personnel working in his section, implementing irrigation schedules, collecting data and reporting to the system manager on operational procedure, defects in the system and climatic conditions.

The canal attendants, acting under the instructions of the works overseers, will record the hours of pumping and drawdown, operate valves and gates, measure canal flows, inform the farmers of the hours of irrigation and maintain a record of the water consumed by each farmer. Additionally he should advise farmers with sprinkler systems on their layout and make notes of defects in the equipment, wastage of water and pressure variations in the pipelines. He will be issued with a detailed plan showing the precise area under his command, the distribution and acreage of the lots and names of owners, the layout of the canals and pipelines with the position and capacity of outlets, the water allocation of each farmer and other items of interest. A copy of this plan and operating instructions should be posted on the wall of the pump house. This officer, who will form an important link between the farmer and a system manager, should be trained to take soil samples for moisture determinations and to collect data on field conditions. He should also be able to start and stop pumps whenever the pump operators are not available.

Pump operators should be assigned so that each will be responsible for the operation and maintenance of a specified number of pumps located within each section. They should be capable of carrying out minor repairs and replacement of parts if necessary, but major repairs or overhauls should be executed by a reliable electrical firm on contract.

REFERENCES

(1) Development and Management of Water Resources, Jamaica, Rio Cobre Basin Annex I to V, 1974, UNDP/FAO

(2) Draft Water Resources Development Master Plan Jamaica, Report 2: Water Demand Inventory, 1985, UNDP/Underground Water Authority, Ministry of Agriculture

(3) Sugar Industry Studies, Irrigation Phase 2 Review, Volume I, Ministry of Agriculture

(4) Memorandum and Articles of Association of 'National Irrigation Commission Limited', Ministry of Agriculture

Table L-1 LIST OF RCIW STAFF

Staff	Number
Works Manager	1
Works Overseers	4
Accountant	1
Clerical Officers	3
Stenographer	1
Gauge Inspector	1
Dam Sluice Attendant	1
Driver	1
Mechanical Operator	1
Artisan	1
Gangers	2
Canal Attendants	18
Sidemen	1
Station Attendant	1
Watchmen	4
District Constables	2
Total	44

Remarks: In addition to the above staff, 15 labourers are employed

Table L-2 ESTIMATES OF RCIW EXPENDITURE IN 1983/84, 1984/85 AND 1985/86

Item	1983/84	1984/85	1985/86
1. Personnel Emoluments	772,000	860,000	775,000
2. Travelling	22,000	31,000	43,000
3. Supplies and Materials	180,000	133,000	233,000
4. Rental of Buildings	1,000	1,000	1,000
5. Hire of Construction Equipment	4,000	4,000	-
6. Utilities	74,000	75,000	75,000
7. Hire of Office Equipment	33,000	45,000	45,000
8. Awards	2,000	3,000	5,000
9. Office Equipment	76,000	165,000	7,000
Total	1,160,000	1,313,000	1,184,000

Table L-3 LIST OF SDPIA STAFF

Staff	Number
Works Overseers	2
Accountant	1
Clerical Officer	1
Typist	1
Pump Attendants	2
Field Assistant	1
Mechnical Opeator	1
Canal Attendants	6
District Constable	1
Watchman	1
Office Attendant	1
Total	18

Remarks: In addition to the above staff, 5 weekly paid labourers,1 daily paid labourer, 4 temporary watchmen, 6 task workers, 1 part-time office cleaner and 2 temporary pump attendants are employed.

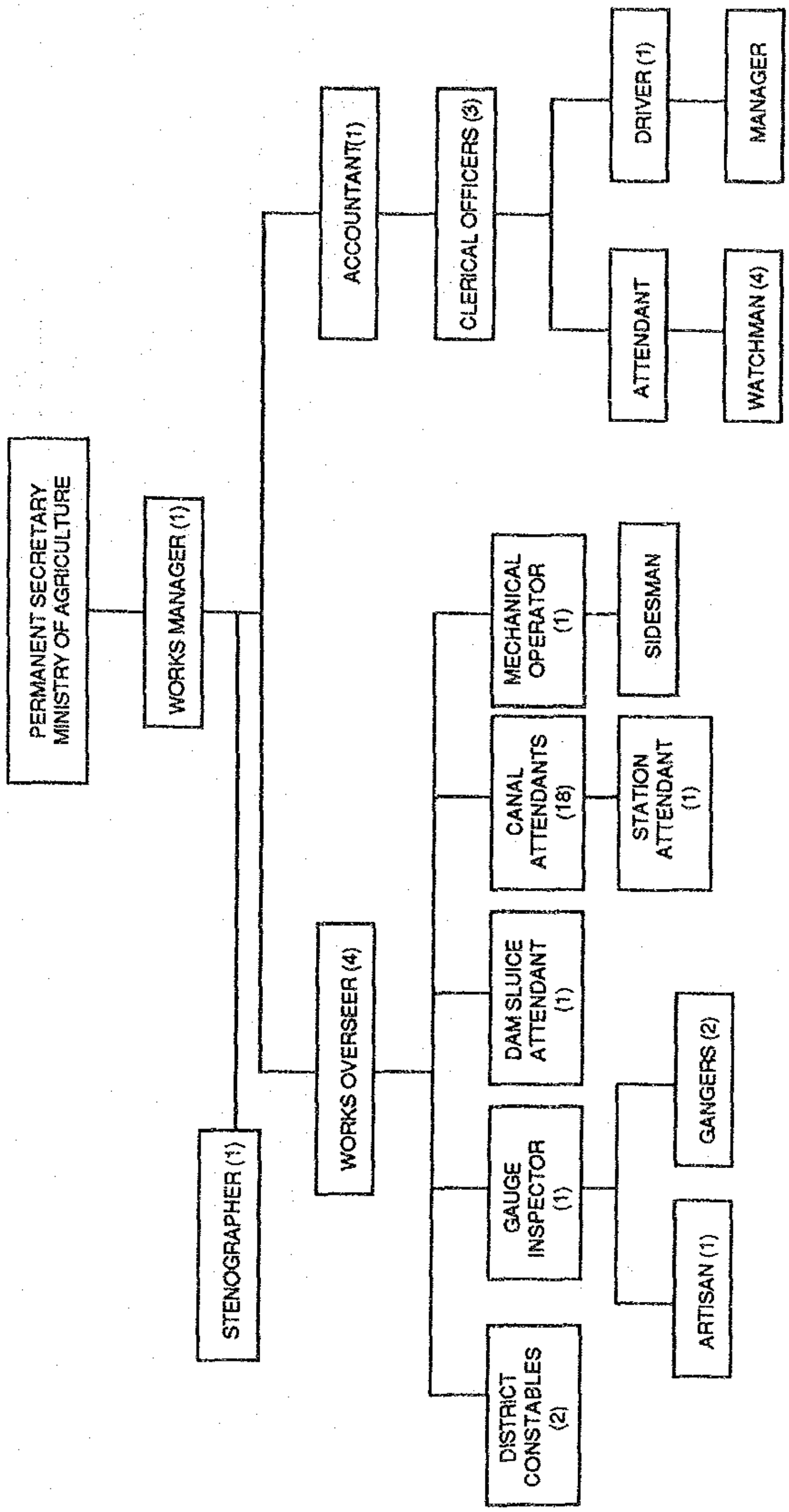
Table L-4 ESTIMATES OF SDPIA EXPENDITURE IN 1985/86 AND 1986/87

Item	1985/86	1986/87*
1. Personnel Emoluments	270,944	298,114
2. Travelling	26,751	26,264
3. Supplies and Materials	67,480	79,100
4. Utilities	1,600,600	1,800,600
5. Maintenance	196,324	206,508
Total	2,162,099	2,410,586

Remark : * Preliminary estimation

Table L-5 LIST OF PROPOSED ORGANIZATION STAFF

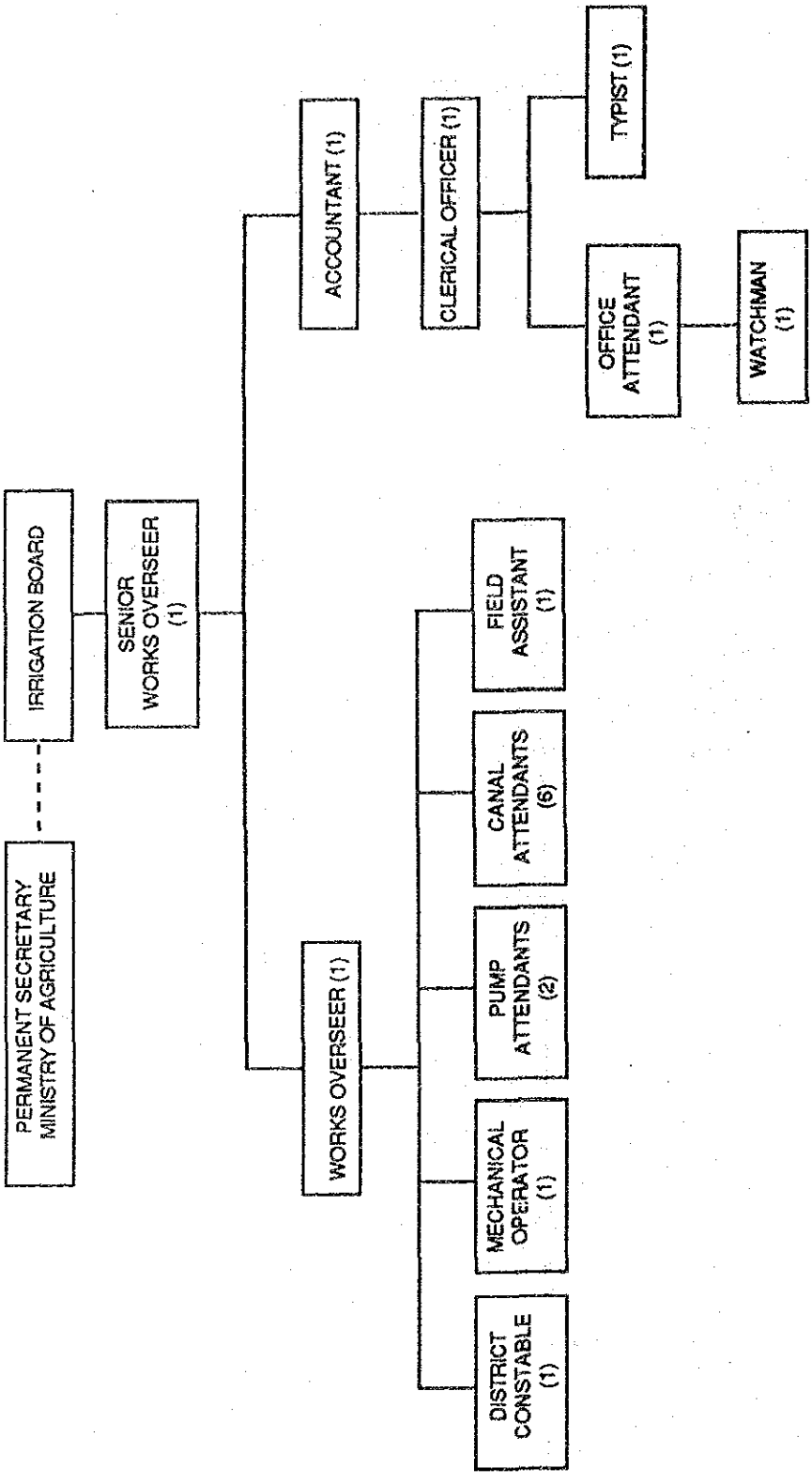
Staff	Number
Manager	1
Assistant Manager	1
Senior Works Overseas	1
Dam Overseers	1
Works Overseers	3
Pump Operators	4
Canal Attendants	26
Mechanic	1
Drivers	3
Office Manager	1
Clerks	2
Typists	2
Draughtsman	1
Storekeeper	1
Watchmen	2
Labourer (canal clearing gang)	12
Total	62



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. L-1
MANAGEMENT STRUCTURE OF RCIW

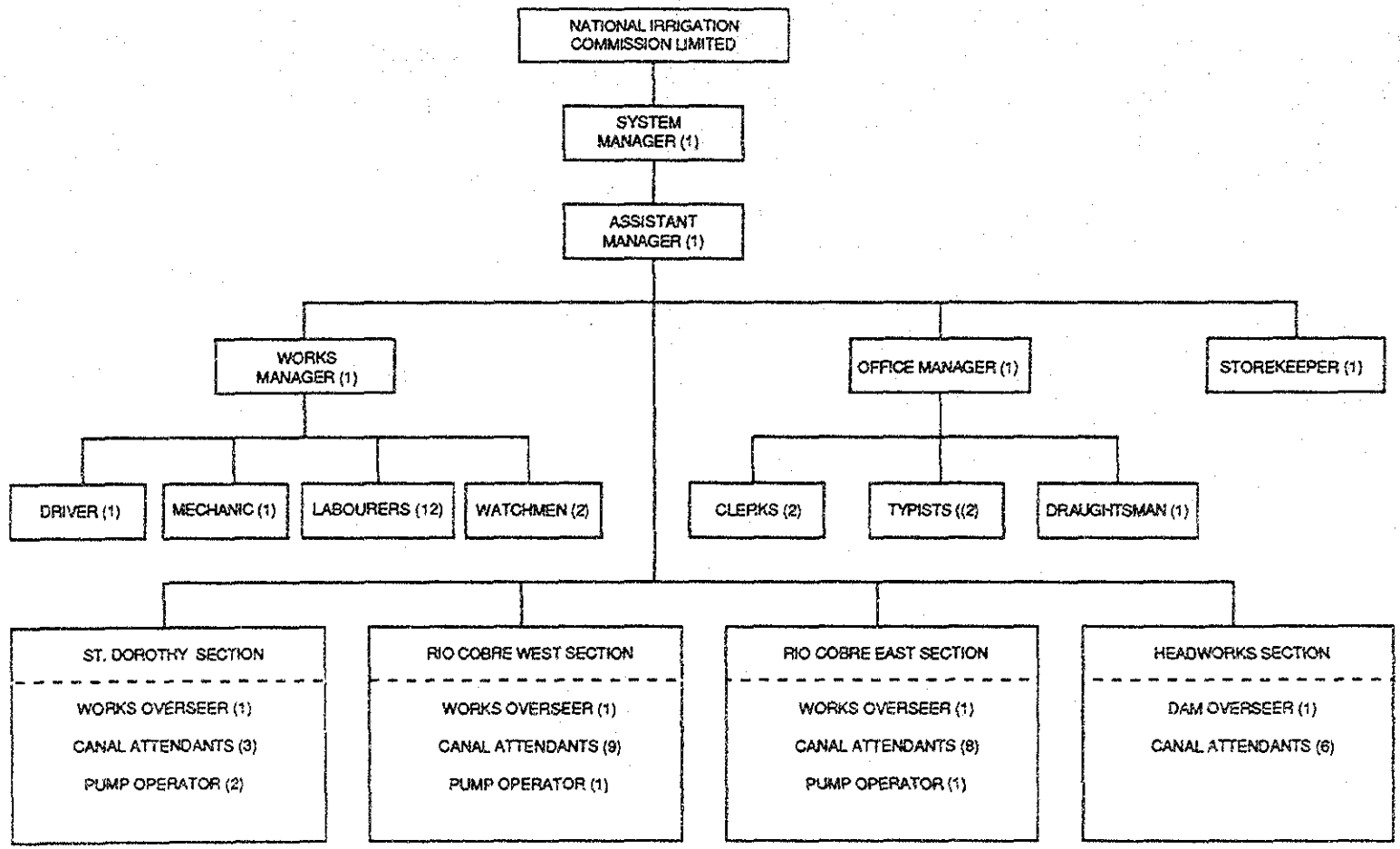
JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. L-2
MANAGEMENT STRUCTURE OF SDPIA

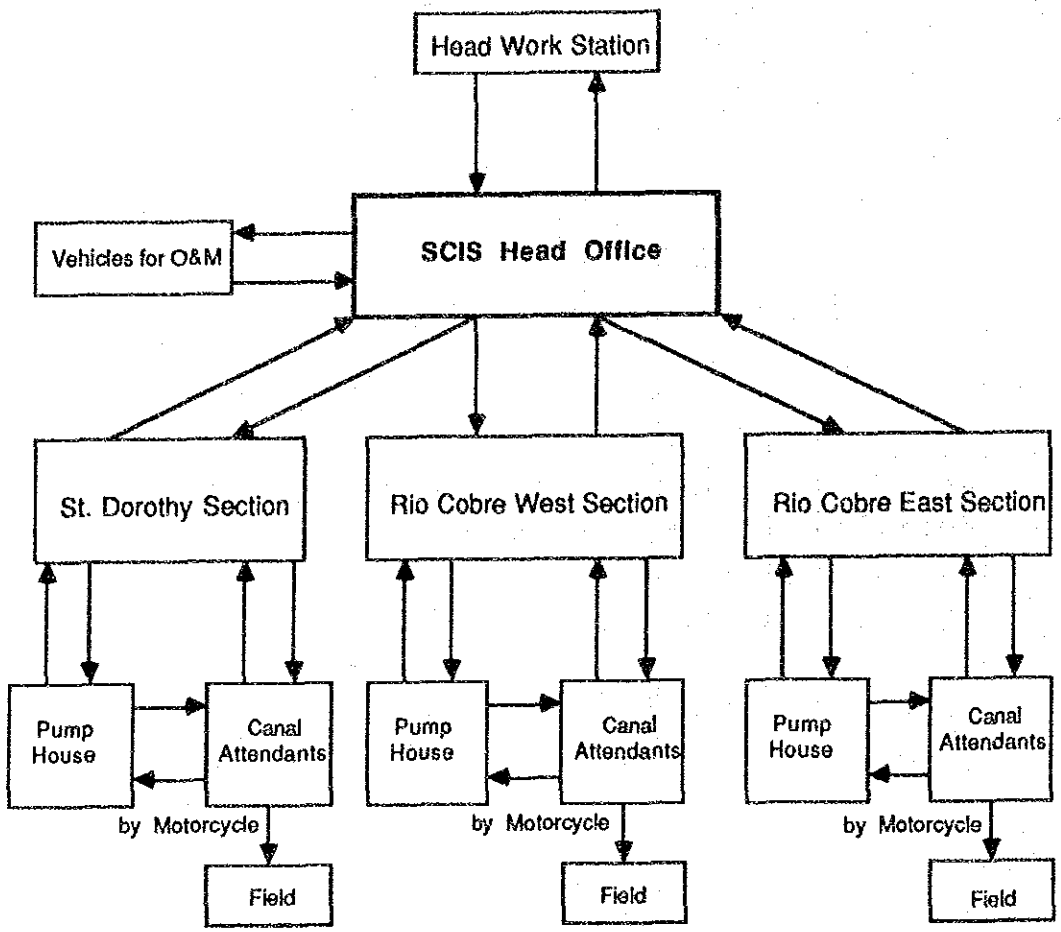
JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. L-3
MANAGEMENT STRUCTURE OF PROPOSED ORGANIZATION

JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. L-4
TELECOMMUNICATION NETWORK SYSTEM

JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX - M

IMPLEMENTATION PROGRAMME AND PROJECT COST

ANNEX-M

IMPLEMENTATION PROGRAMME AND PROJECT COST

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. IMPLEMENTATION SCHEDULE

1.1 Basic Considerations of Project Implementation

The implementation schedule for the project was worked out on the basis of the following basic considerations:

(1) The project consist of three areas:

- Rio Cobre East	7,100 ha
- Rio Cobre West	6,030 ha
- St. Dorothy Area	1,490 ha
Total Project Area	14,620 ha

(2) The construction schedule is drawn up in such a way as to make capital investment productive as soon as possible.

(3) The major civil works and on-farm development works are rationally integrated in due consideration of the agricultural development programme particularly paddy land development.

(4) Rehabilitation and improvement works for the Head Works and Main Canal will be carried out without stopping the existing water supply to the downstream irrigated area and municipal water supply to Spanish Town.

(5) Before commencement of the actual construction works, about 12 months of detailed design, preparation of tender documents, tender calling and tender award are needed. A consultant will be engaged by the Project Office to prepare the detailed design, tender documents supervision of construction works, assistance and guidance in operation and maintenance of the project facilities.

1.2 Implementation Programme

The time required for construction of the Project would be about 4 years including detailed design and contract award. A tentative implementation schedule is shown in Fig. M-1.

Immediately after the mobilization of the works made by the Contractor, the rehabilitation and improvement of the headworks and head reach down to bifurcation will be carried out without interrupting the present water flow to the downstream requirement.

Since Agro 21 development plan is under implementation in the eastern half of the project area, both East and West Main Canals will be constructed almost in parallel so as to get irrigation benefit as early as possible. In veiw or rather long time required for reservoir dike construction, construction of Town Gully Reservoir will be carried out in parallel with main canal construction so that the eastern half of the project area would benefit partly by the middle of third year and remainder by the end of third year.

As soon as ductile iron pipe for Free Town pipeline is delivered, the construction of St. Dorothy Irrigation Scheme will be commenced, probably beginning in the second year of construction. The improvement works for the Old Harbour Branch Canals will commence at the beginning of third year, and be followed by the construction of minor branch canals. The on-farm works in the Rio Cobre West area will be started in the middle of second year and be completed by the end of fourth year. Irrigation benefits from the project in both Rio Cobre West and St. Dorothy areas would be realised partly from the end of third year and fully by the end of fourth year. The construction of drainage system and road network will be commenced in the middle of second year and be completed by the end of fourth year. These works will be carried out taking into account the progress of on-farm development as well as the construction of the minor branch canals.

1.3 Construction Plan

1.3.1 Work quantities and construction materials

The quantities of works and main construction materials needed for each areas are shown below:

(1) Work quantities

Item	Unit	Main Structure	Rio Cobre East	Rio Cobre West	St. Dorothy Area	Total
(a) Civil works						
Excavation	10^3 m^3	170	60	262	53	545
Embankment and backfill	10^3 m^3	27	64	310	44	445
Concrete for canal	10^3 m^3	14	10	31	3	58
Reinforced iron bar	ton	274	94	130	46	544
Gravel foundation	10^3 m^3	2	3	14	3	22
Marl pavement	10^3 m^3	2	11	55	16	84
(b) Reservoir works						
Excavation	10^3 m^3	-	181	141	-	322
Embankment (Randam zone)	10^3 m^3	-	828	609	-	1,437
Rip-rap	10^3 m^3	-	41	28	-	69
Gravel and marl	10^3 m^3	-	26	25	-	51
Sand filter and foundation	10^3 m^3	-	42	27	-	69

(2) Construction Materials

Item	Unit	Main Structure	Rio Cobre East	Rio Cobre West	St. Dorothy Area	Total
Cement	10^3 m^3	5	3	9	1	18
Gravel for concrete	10^3 m^3	11	7	35	3	56
Sand for concrete	10^3 m^3	8	6	18	2	34
Fuel	k lit	230	1,070	1,130	60	2,490

Remark: Main structures are dam, main canal and bifurcation.

(3) On-farm Development

Item	(Net) Unit	Rio Cobre East	Rio Cobre West	St. Dorothy Area	Total
Furrow	ha	-	1,610	640	2,250
Rice field	ha	-	2,800	-	2,800
Sprinkler	ha	-	1,220	610	1,830
Drip	ha	-	-	200	200
Road	km	-	350	100	450
Drainage	km	-	450	130	580

1.3.2 Workable days

The annual workable days for the construction works are planned to be 250 days (21 per month) with due consideration to the climatic conditions and social practices.

1.4 Construction Machinery

The construction equipment needed for project implementation was estimated from the work quantities, constructime time schedule, construction method and site specific conditions as shown below:

Construction Equipment	Number of Specifications	Equipment
Bulldozer	11 ton	12
Bulldozer	21 ton	8
Backhoe	0.6 m^3	13
Bulldozer (with Ripper)	21 ton	3
Clamshell	0.8 m^3	2
Carry-all scraper	21 ton	6
Tractor shovell	2.2 m^3	4
Tractor shovell	1.0 m^3	4
Vibration roller	11-12 ton	3
Vibration roller	2.5-2.8 ton	8
Vibration roller	0.5-0.6 ton	8
Tyre roller	11-12 ton	4
Slope compactor	3 PS	8
Vibration compactor	50-60 kg	8
Rammer	60-100 kg	8
Dump truck	11 ton	20
Truck	8 ton	7
Water tanker	6 m^3	4
Fuel tanker	6 k lit	4
Concrete mixer	0.2 m^3 7 HP	15
Vibro hummer	40 HP	1
Truck crane	25 ton	1
Truck crane	4.8-4.9 ton	4
Agitator truck	1.5 m^3	7
Motor garder	2.5 m	5
Butcher plant	20 m^3/hr	1
Generator	125 kvA	2
Welded machine	300 A	2
Drainage pump	8 HP	5

1.5 Construction Plan

Since the existing irrigation system of both the Rio Cobre Irrigation Works and St. Dorothy Irrigation Works is presently operated throughout the year without interrupting any water supply for both agriculture and municipal purposes, the construction plan is made taking fully the above specific conditions into account. The Headreach in the Rio Cobre Irrigation Scheme will be therefore rehabilitated in such a way that the deep cutting portion with about 800 m long be constructed in situ drying up the site by sheet pile during its construction time and the remaining portion of 3.5 km be constructed after diverting irrigation water through temporary canal to be constructed along the side of headreach. The East Main Canal and the upper reach of the West Main Canal are also planned to be constructed diverting irrigation water through temporary construction along

the side of canal. About 7 km long of Old Harbour Branch will be dismantled and then utilized for inspection road after implementation of new canal.

The earth works and large concrete works are mainly carried out by machinery, while concrete structure works, masonry work and canal lining for minor branch canals will be carried out by manpower.

2. PROJECT COST

2.1 Basic Conditions

The costs for implementation of the project were estimated on the basis of preliminary design of the project facilities, and on the following basis:

(1) The exchange rate used in the estimated is; US$ 1.00 = J$ 5.50 = J¥ 160

(2) The main construction works will be carried out by contractors selected through international competitive bidding. The construction machineries and equipments would be provided by the contractors themselves. Therefore, depreciation cost of machineries and equipments is considered in the estimate of the construction cost.

(3) Taxes on the constriction materials, machinery and equipment to be imported from abroad, if needed, would be exempt from estimation in the construction cost.

(4) The construction costs are divided into foreign and local currency portions. Local currency portion is estimated based on the current prices of the materials in Kingston in 1986 and foreign currency portion is estimated based on the CIF prices at Kingston, making reference to FOB prices of materials and equipment in Japan in 1986. The classification of local and foreign currency portions is defined as follows:

(a) The local currency portion would cover:

- labour force,
- cement, gravel, sand, stone and wooden materials
- RC pipe
- Gate less than 2.0 m x 2.0 m
- Fuel and lubricants
- Inland transportation costs
- General expenses provided by the Government

(b) The foreign currency portion would cover:

- Depreciation cost of construction machinery and equipment
- Plants to be installed for the project such as pumps, motors, etc.
- Reinforcing bars
- Gate more than 2.0 m x 2.0 m
- Contrator's general expenses and profits for foreign contractors
- Expenses and fees of engineering services by foreign consultants
- Procurement cost of O&M equipment of the facilities

(5) Physical contingencies related to the constriction quantities is set at about 10% of the direct cost.

(6) Price contingencies; 5% per annum for the foreign currency portion and 10% per annum for the local currency portion, are also included.

2.2 Cost Estimate

The project cost comprises the direct construction cost, procurement cost of O&M equipment, engineering services and administration costs and physical contingency. The project cost is estimated based on the detail unit cost analysis and quantity calculation for the project works.

Total project cost is estimated to be US$ 64.3 million consisting of US$ 34.1 million foreign currency equivalent and US$ 30.2 million of local currency portion as shown in Table M-1. The direct construction costs as summarized as shown in Table M-3.

The annual fund requirement for the project execution is worked out based on the implementation schedule as shown on Fig. M-1. The annual disbursement schedule by each project cost is presented in Table M-2. The summary of direct construction cost is shown in Table M-3, and their breakdown is shown in Table from M-4 to M-8.

The procurement cost of major operation and maintenance equipment is estimated as shown in Table M-9. The general expenses for the administration of construction work is estimated and shown in Table M-10 and M-11, respectively.

The cost for the engineering service made by foreign consultants in tentatively estimated. Engineering service includes preparation of detailed design, tender documents, tender evaluation and construction supervision.

The prices of basic materials and labour wages used in the estimate and the unit cost for the major work items are shown in Table M-12 and M-13, respectively.

Breakdown of construction cost is calculated using detailed unit costs. Each unit cost is composed of the basic unit cost and working rate of labour and/or construction machinery.

2.3 Annual Operation and Maintenance Costs

The annual operation and maintenance costs include the salaries of the project administrative and water control staff, the materials and labour costs for maintenance of project facilities, the costs for operation and maintenance of O&M equipment, and the running costs of project facilities.

The annual operation and maintenance costs at the full development stage of the project is estimated at US$ 1.75 million. The summary of these costs are shown in Tables M-14 and M-15.

2.4 Replacement Cost

Some of the facilities, especially mechanical and electrical facilities have a shorter useful life than civil works and have to be periodically replaced. The replacement costs and useful lives of these facilities are shown in Table M-16.

3. ORGANIZATION FOR THE PROJECT EXECUTION

Ministry of Agriculture (MOA) is given responsibilities for planning, developing and implementing all national irrigation systems in the island. MOA will be the executing body for implementation of the project.

Technical Service division of MOA will directly be responsible for design and supervision of construction of the project in association with Engineering Services division under Technical Service division. Director of Technical Service division will be responsible for overall execution of the project, and will coordinate activities of all relevant governmental agencies in connection with implementation of the project. The management structure of the organization for project execution illustrated on Fig. M-2.

For execution of the project, the special project unit will be established under Technical Services division during the construction period. This unit will be phased out after completion of the project construction. The project unit consists of all the necessary staff including foreign consultants, local consultants and other administrative staff who will be employed during the construction period to ensure the smooth and efficient execution of the project.

The number of staff required was estimated paying due attention to work quantities, implementation schedule and characteristics of the project as follows:

(Unit: man-month)

Item	Detailed Design	Construction Supervision	Total
Foreign consultants	100	170	270
Local consultants	90	190	280
Administration staff	50	450	500

Detailed design works will be carried out by MOA engineering staff with assistance of the consultants, in principal. The period of 12 months is required for the detailed design works including review of the feasibility study, additional surveys and investigations, and preparation of the detailed design and tender documents.

All construction works would be executed by full contract basis. MOA staff will supervise all construction works during the period of 36 months. The engineering assistant services by the consultants will be carried out during the period of major construction works.

Table M-1 SUMMARY OF INITIAL INVESTMENT COST

(Unit: 1,000 US$)

Item	Foreign Currency	Local Currency	Total
1. Direct Construction Cost			
1.1 Main Structure	3,620	2,480	6,100
1.2 Rio Cobre East Area	4,100	2,830	6,930
1.3 Rio Cobre West Area	4,550	4,690	9,240
1.4 St. Dorothy Area	1,830	870	2,700
1.5 Main Road and Secondary Drainage Canal	500	270	770
Sub-total	14,600	11,140	25,740
1.6 On Farm Development	8,160	7,910	16,070
1.7 Total	22,760	19,050	41,810
2. O&M Equipment	800	0	800
3. General Expense	0	350	350
4. Engineering Service	3,300	1,300	4,600
5. Sub-total (1+2+3+4)	26,860	20,700	47,560
6. Physical Contingency (10%)	2,690	2,070	4,760
7. Sub-total (1+2+3+4+6)	29,550	22,770	52,320
8. Price Contingency	4,550	7,420	11,970
9. Grand Total (1+2+3+4+6+8)	34,100	30,190	64,290

Table M-2 ANNUAL OF DISBURSEMENT SCHEDULE

(Unit: 1,000 US$)

Item	1st Year		2nd Year		3rd Year		4th Year		Total		
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	Total
1. Direct Construction Cost									0	0	0
1.1 Main Structure	0	0	3,190	2,020	430	460	0	0	3,620	2,480	6,100
1.2 Rio Cobre East Area	0	0	1,850	1,250	2,250	1,590	0	0	4,100	2,840	6,940
1.3 Rio Cobre West Area	0	0	370	720	1,550	2,100	2,630	1,860	4,550	4,680	9,230
1.4 St. Dorothy Area	0	0	60	140	1,720	620	50	110	1,830	870	2,700
1.5 Main Road and Secondary Drainage Canal	0	0	130	70	250	130	120	70	500	270	770
1.6 Sub-total	0	0	5,600	4,200	6,200	4,900	2,800	2,040	14,600	11,140	25,740
1.7 On Farm Development	0	0	1,600	1,600	3,200	3,100	3,360	3,210	8,160	7,910	16,070
1.8 Total	0	0	7,200	5,800	9,400	8,000	6,160	5,250	22,760	19,050	41,810
2. O&M Equipment	0	0	0	0	0	0	800	0	800	0	800
3. General Expense	0	40	0	110	0	100	0	110	0	360	360
4. Engineering Service	950	400	850	350	800	300	700	250	3,300	1,300	4,600
5. Sub-total (1+2+3+4)	950	440	8,050	6,260	10,200	8,400	7,660	5,610	26,860	20,710	47,570
6. Physical Contingency (10%)	95	44	805	626	1,020	840	766	561	2,686	2,071	4,757
7. Sub-total (1+2+3+4+6)	1,045	484	8,855	6,886	11,220	9,240	8,426	6,171	29,546	22,781	52,327
8. Price Contingency	52	48	908	1,446	1,769	3,058	1,816	2,864	4,545	7,416	11,961
9. Grand Total (1+2+3+4+6+8)	1,097	532	9,763	8,332	12,989	12,298	10,242	9,035	34,091	30,197	64,288

Remarks; FC=Foreign Corrency
LC= Local Currency

Table M-3 SUMMARY OF DIRECT CONSTRUCTION COST

(Unit: 1,000 US$)

Item	Quantity	Currency		
		Foreign	Local	Total
1. Main Structure				
1.1 Rio Cobre Dam	L.S	2,340	1,100	3,440
1.2 Main Canal	4.70 km	1,280	1,380	2,660
1.3 Sub-total		3,620	2,480	6,100
2. Rio Cobre East Area				
2.1 East Main Canal	4.75 km	350	670	1,020
2.2 Minor Branch Canal	6.64 km	70	130	200
2.3 Town Gully Reservoir	9.6 mil. m3	3,180	1,530	4,710
2.4 Connection Canal of Reservoir	2.45 km	140	430	570
2.5 March Pen Pump Station	L.s	360	70	430
2.6 Sub-total		4,100	2,830	6,930
3. Rio Cobre West Area				
3.1 West Main Canal	2.82 km	180	370	550
3.2 Old Harbour Branch Canal	10.60 km	560	1,050	1,610
3.3 Extension Branch Canal	5.10 km	250	450	700
3.4 Hartland Branch Canal	7.10 km	250	620	870
3.5 Minor Branch Canal	46.39 km	510	1,030	1,540
3.6 Brack River Reservoir	3.8 mil. m3	2,050	1,020	3,070
3.7 Nightingale Pump Station	L.s	500	100	600
3.8 Amity Hall Pump Station	L.s	250	50	300
3.9 Sub-total		4,550	4,690	9,240
4. St. Dorothy Area				
4.1 Free Town Pipeline and Pump	2.81 km	1,540	240	1,780
4.2 Free Town Open Canal	7.85 km	180	410	590
4.3 Free Town Distributory Canal	10.27 km	110	220	330
4.4 Sub-total		1,830	870	2,700
5. Main Road and Secondary Drainage Canal				
5.1 Main Road	75.0 km	470	225	695
5.2 Secondary Drainage Canal	21.4 km	30	45	75
5.3 Sub-total		500	270	770
6. Total(1+2+3+4+5)		14,600	11,140	25,740
7. On Farm Development				
7.1 Furrow	2250 ha	1,260	1,670	2,930
7.2 Rice Field	2800 ha	2,660	3,780	6,440
7.3 Sprinkler	1830 ha	3,700	2,160	5,860
7.4 Drip	200 ha	540	300	840
7.5 Sub-total	7080 ha	8,160	7,910	16,070
8. Ground Total(6+7)		22,760	19,050	41,810

Table M-4(1/3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR THE MAIN STRUCTURE

(Unit: US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
1. Preparatory Works	L.s	1	169,000	119,000
2. Rio Cobre Dam				
2.1 Dam			21,500	39,000
- Reinforced Concrete	m3	280	6,000	23,000
- Reinforced Iron Bar	ton	2	9,000	1,000
- Plywood Form	m2	180	0	3,000
- Miscellaneous Works	L.s	1	1,500	3,000
- Temporary Works	L.s	1	5,000	9,000
2.2 Apron			55,000	117,500
- Temporary Works	L.s	1	5,000	11,000
- Excavation	m3	1,200	3,000	1,000
- Reinforced Concrete	m3	1,200	25,000	99,000
- Reinforced Iron Bar	ton	35	22,000	3,000
- Plywood form	m2	200	0	3,500
2.3 Rip-rap			108,000	345,000
- Temporary Works	L.s	1	5,000	16,500
- Excavation	m3	8,500	22,000	4,500
- Concret Block	m2	4,100	81,000	324,000
2.4 Left Bank Wall			15,000	27,500
- Temporary Works	L.s	1	1,000	1,000
- Excavation	m3	200	500	500
- Reinforced Concrete	m3	200	4,500	17,000
- Reinforced Iron Bar	ton	14	9,000	1,000
- Plywood Form	m2	400	0	6,000
- Wooden Scaffolding	m2	180	0	2,000
2.5 Left Bank Revetment			13,500	46,000
- Temporary Works	L.s	1	500	2,000
- Excavation	m3	100	500	500
- Reinforced Concrete	m3	80	2,000	7,000
- Reinforced Iron Bar	ton	4	2,500	500
- Plywood Form	m2	240	0	4,000
- Wooden Scaffolding	m2	120	0	500
- Wet Stone Masonry	m2	630	8,000	31,500
2.6 Right Bank Revetment			31,500	114,000
- Temporary Works	L.s	1	1,500	5,500
- Excavation	m3	300	1,000	2,000
- Reinforced Concrete	m3	130	3,000	11,000
- Reinforced Iron Bar	ton	7	4,000	500
- Plywood Form	m2	400	0	7,000
- Wooden Scaffolding	m2	200	0	1,000
- Wet Stone Masonry	m2	1,800	22,000	87,000
2.7 Intake Gate	nos	8	57,000	6,000
2.8 Clift Protection Fence			7,500	15,000
- Temporary Warks	L.s	1	500	500
- Reinforced Concrete	m3	60	1,000	5,000
- Reinforced Iron Bar	ton	3	2,000	500
- Plywood Form	m2	400	0	7,000
- H-steel		11	4,000	2,000

Table M-4(2/3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR THE MAIN STRUCTURE

(Unit: US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
2.9 Guide Wall			15,500	6,500
- Temporary Works	L.s	1	1,500	500
- Reinforced Concrete	m3	20	500	2,000
- Reinforced Iron Bar	ton	2	500	500
- Plywood Form	m2	100	0	2,000
- Wooden Scaffolding	m2	100	0	1,000
- Sheet Pile	ton	15	13,000	500
2.10 River Base Block			16,500	48,500
- Temporary Works	L.s	1	1,500	4,500
- Excavation	m3	1,700	4,000	1,000
- Concret Block	m2	540	11,000	43,000
2.11 River Revetment(Upstream)			166,000	43,000
- Temporary Works	L.s	1	118,000	2,000
- Excavation	m3	500	500	500
- Reinforced Concrete	m3	240	5,000	20,000
- Reinforced Iron Bar	ton	12	7,500	1,000
- Plywood Form	m2	500	0	9,000
- Wooden Scaffolding	m2	250	0	1,000
- Wet Stone Masonry	m2	180	2,000	9,000
- Sheet Pile	ton	36	33,000	500
2.12 Sub-total(1 to 11)			507,000	808,000
2.13 Miscellaneous Works	L.s	1	40,000	80,000
2.14 Sub-total(12+13)			547,000	888,000
2.15 Grouting	L.s		1,686,000	164,000
2.16 Total(14+15)			2,233,000	1,052,000
3. Main Canal L=4.70km				
3.1 Earth Works			146,500	145,500
- Land Clearing (Mixed Tree and Grass)	ha	1.8	500	1,000
- Land Clearing(Grass)	ha	7.2	0	2,500
- Excavation	m3	102,000	80,500	28,500
- Backfilling	m3	3,800	10,000	3,500
- Residual Earth Works	m3	109,200	55,500	23,000
- Slope Tamping	m2	84,300	0	12,500
- Sodding	m2	39,400	0	74,500
3.2 Concrete Works			258,500	772,500
- Lining Concrete	m3	4,700	116,500	397,500
- Reinforced Concrete	m3	1,600	34,000	134,500
- Leveling Concrete	m3	200	4,500	13,000
- Plywood Form	m2	7,700	0	133,000
- Reinforced Iron Bar	ton	94	60,000	8,000
- Gravel Foundation	m3	2,200	20,000	13,000
- Wooden Scaffolding	m2	800	0	3,500
- Miscellaneous Works	L.s	1	23,500	70,000

Table M-4(3/3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR THE MAIN STRUCTURE

(Unit: US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
3.3 Temporary Works			550,000	108,000
- Excavation	m3	39,400	32,000	13,500
- Embankment	m3	3,700	7,000	3,000
- Backfilling	m3	18,000	34,000	10,000
- Residual Earth Work	m3	11,100	14,000	6,000
- Slope Tamping	m2	44,000	0	6,500
- Steel Sheet Pile Works	m	800	463,000	69,000
3.4 Related Structure			50,500	154,000
- Bridge	nos	8	43,000	146,000
- Aquaduct	nos	1	6,500	6,000
- Spill Way	nos	1	1,000	2,000
3.5 O & M Road			23,500	14,000
- Excavation	m3	11,000	7,000	3,500
- Marl Pavement	m3	1,800	16,500	10,500
3.6 Sub-total			1,029,000	1,194,000
4. Bifurcation				
4.1 Earth Works			5,000	6,000
- Excavation	m3	3,100	2,000	1,000
- Backfilling	m3	1,100	1,000	500
- Residual Earth Works	m3	2,100	1,000	500
- Slope Tamping	m2	1,000	0	500
- Sodding	m2	400	0	500
- Existing Concrete Breaking Work	m3	200	1,000	3,000
4.2 Concrete Works			83,000	87,000
- Reinforced Concrete	m3	520	11,500	44,500
- Leveling Concrete	m3	50	1,000	3,000
- Plywood Form	m2	1,500	0	26,000
- Reinforced Iron Bar	ton	42	27,000	3,500
- Gravel Foundation	m2	170	1,500	1,000
- Wooden Scaffolding	m2	270	0	1,000
- Miscellaneous Works	L.s	1	2,000	4,000
- Sluice Gate	nos	2	40,000	4,000
4.3 Pump Station			101,000	22,000
- Pump Q=6.3 m3/min ø200 x ø150 x 15 kw	nos	2	84,000	4,000
- Pump House	m2	25	0	16,000
- Steel Pipe ø450	m	30	8,000	1,000
- Net Fence	m	300	9,000	1,000
4.4 Sub-total			189,000	115,000
5. Total(1 to 4)			3,620,000	2,480,000

Table M-5(1/3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR THE RIO COBRE EAST AREA

(Unit: US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
1. Preparatory Works	L.s	1	185,000	123,000
2. East Main Canal L=4.70 km				
2.1 Earth Works			61,500	29,500
- Excavation	m3	27,200	22,000	7,500
- Embankment	m3	16,100	29,000	10,500
- Backfilling	m3	23,300	10,500	4,500
- Slope tamping	m2	40,000	0	6,000
- Sodding	m2	400	0	1,000
2.2 Concrete Works			107,000	336,000
- Lining concrete	m3	3,600	89,000	305,000
- Plywood form	m2	400	0	7,000
- Gravel foundation	m3	1,400	13,000	8,000
- Miscellaneous works	L.s	1	5,000	16,000
2.3 Related Structure			59,000	191,000
- Turnout	nos	13	6,000	37,000
- Drop	nos	8	18,000	36,000
- Check gate	nos	7	6,000	32,000
- Bridge	nos	8	21,000	74,000
- No. 2 Bifurcation	nos	1	8,000	12,000
2.4 O&M Road			23,500	14,500
- Excavation	m3	1,000	500	500
- Embankment	m3	4,000	6,000	3,000
- Sodding	m2	1,500	0	3,000
- Marl pavement	m3	1,900	17,000	8,000
2.5Sub-total			251,000	571,000
3. Rio Cobre Syphon Works L=0.18 km				
3.1 Earth Works			2,000	1,000
- Excavation	m3	1,200	1,000	500
- Backfilling	m3	1,000	1,000	500
3.2 Concrete Works			69,000	45,000
- Reinforced concrete	m3	240	5,000	20,000
- Leveling concrete	m3	20	500	1,000
- Plywood form	m2	700	0	12,000
- Reinforced iron bar	ton	14	9,000	1,000
- Gravel and sand foundation	m3	70	500	500
- Miscellaneous works	L.s	1	1,000	1,500
- Ductile iron works ø900	m	130	53,000	9,000
3.3 River Revetment Works			6,000	16,000
- Excavation and embankment	m3	1,100	1,000	500
- Slope tamping and sodding	m2	400	0	500
- Plain concrete	m3	200	4,000	14,500
- Gravel foundation	m3	100	1,000	500
3.4 Temporary Works	L.s	1	8,000	6,000
3.5 Sub-total			85,000	68,000
4. Minor branch canal L=6.64 km				
4.1 Terners pen	m	6,640	43,000	115,000
4.2 O&M Road	m	6,640	24,000	11,000
4.3 Sub-total			67,000	126,000

Table M-5(2/3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR THE RIO COBRE EAST AREA

(Unit: US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
5. Town Gully Reservoir A=200ha V=9,600 mil m3				
5.1 Earth Works			2,982,000	1,410,000
- Land stripping	m3	137,000	60,000	21,000
- Excavation(Drain canal)	m3	44,000	19,000	7,000
- Embankment(Random zone)	m3	828,000	2,170,000	695,000
- Rip-rap t=0.30m	m3	41,000	331,000	219,000
- Sand filter and foundation	m3	42,000	225,000	165,000
- Gravel(Toe drain)	m3	21,000	132,000	95,000
- Marl pavement	m3	5,000	45,000	22,000
- sodding	m2	98,000	0	186,000
5.2 Related Structure	L.s	1	50,000	50,000
5.3 Sub Total			3,032,000	1,460,000
6. Connection Canal L=0.50km (Canal for inlet) ø1000				
6.1 Earth Works			18,000	7,500
- Excavation	m3	8,000	6,000	2,000
- Backfilling	m3	6,300	11,000	4,000
- Slope tamping	m3	5,400	0	1,000
- Residual earth works	m3	1,800	1,000	500
6.2 Concrete works			27,000	169,500
- Plain concrete	m3	1,100	24,500	81,500
- Plywood form	m2	2,000	0	34,500
- Gravel foundation	m3	150	1,500	1,000
- Miscellaneous works	L.s	1	1,000	6,000
- RC pipe ø1000	m	500	0	46,500
6.3 Related structure			7,000	8,000
- inlet works	L.s	1	1,000	2,000
- Miscellaneous works	L.s	1	6,000	6,000
6.4 Sub-total			52,000	185,000
7. Connection canal L=0.38km (Canal for outlet) ø800				
7.1 Earth works			21,000	9,000
- Excavation	m3	9,000	7,000	2,500
- Backfilling	m3	7,200	13,000	5,000
- Slope tamping	m2	6,500	0	1,000
- Residual earth works	m3	1,900	1,000	500
7.2 Concrete works			31,000	168,000
- Plain concrete	m3	1,300	28,000	91,000
- Plywood form	m2	2,300	0	39,000
- Gravel foundation	m3	200	1,500	1,000
- Miscellaneous work	L.s	1	1,500	6,000
- RC pipe ø800	m	380	0	31,000
7.3 Sub-total			52,000	177,000

Table M-5(3/3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR THE RIO COBRE EAST AREA

(Unit: US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
8. Connection canal L=1.50km				
(Canal for outlet)				
8.1 Earth works			10,000	5,000
- Excavation	m3	3,800	3,000	1,000
- Slope tamping	m2	4,500	0	1,000
- Residual earth works	m3	3,800	2,000	1,000
- Marl pavement(O&M Road)	m3	520	5,000	2,000
8.2 Concrete works			15,000	46,000
- Lining concrete	m3	500	10,500	36,000
- Plywood form	m2	50	0	1,000
- Gravel foundation	m3	300	2,000	1,000
- Miscellaneous works	L.s	1	500	2,000
- Related stracture	L.s	1	2,000	6,000
8.3 Sub-total			25,000	51,000
9.March pen pump station				
(Town Gully)				
9.1 Pump Q=4.5m3/min	nos	2	90,000	10,000
9.2 Pipeline(ductile ø400)	m	1,000	250,000	50,000
9.3 Farm poud 50m x 50m x 2m	L.s	1	6,000	4,000
9.4 Other works	L.s	1	5,000	5,000
9.5 Sub-total			351,000	69,000
10. Total(1 to 9)			4,100,000	2,830,000

Table M-6(1/3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR THE RIO COBRE WEST AREA

(Unit; US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
1. Preparatory Works	L.s	1	209,000	237,000
2. West Main canal L=2.8 km				
2.1 Earth Works			52,000	39,500
- Land stripping	m3	6,200	4,000	1,500
- Excavation	m3	28,000	22,000	8,000
- Embankment	m3	6,600	12,000	4,000
- Backfilling	m3	17,200	8,000	3,000
- Residual earth works	m3	12,400	6,000	2,500
- Slope tamping	m2	45,000	0	6,500
- Sodding	m2	7,400	0	14,000
2.2 Concrete works			75,000	233,500
- Lining concrete	m3	2,500	62,000	211,500
- Plywood form	m2	300	0	5,000
- Gravel foundation	m3	1,000	9,000	6,000
- Miscellaneous works	L.s	1	4,000	11,000
2.3 Related structure			28,000	70,500
- Turnout	nos	1	1,500	6,000
- Bridge	nos	3	8,000	28,000
- Drop	nos	4	9,500	19,500
- Check gate	nos	1	1,000	5,000
- No.3 Bifurcation	nos	1	8,000	12,000
2.4 O&M Road			19,000	11,500
- Excavation	m3	3,200	2,000	1,000
- Embankment	m3	4,500	6,000	2,000
- Sodding	m2	1,900	0	3,500
- Marl pavement	m3	1,200	11,000	5,000
2.5 Sub-total			174,000	355,000
3. Old harbour branch canal L=10.6km				
3.1 Earth works			211,000	141,000
- Land stripping	m3	22,600	13,000	5,500
- Excavation	m3	53,200	42,000	15,000
- Embankment	m3	72,800	130,000	48,000
- Backfilling	m3	34,200	15,500	6,500
- Residual earth works	m3	20,700	10,500	4,000
- Slope tamping	m2	83,000	0	12,500
- Sodding	m3	26,000	0	49,500
3.2 Concrete works			223,000	700,000
- Living concrete	m3	7,500	186,000	634,500
- Plywood form	m2	900	0	15,500
- Gravel foundation	m3	2,900	26,500	17,000
- Miscellaneous works	L.s	1	10,500	33,000
3.3 Related structure			27,000	103,000
- Turnout	nos	10	2,500	22,500
- Drop	nos	9	19,500	40,500
- Check gate	nos	6	2,000	17,000
- Culvert	nos	13	3,000	23,000
3.4 O&M Road			74,000	53,000
- Excavation	m3	5,900	4,000	1,500
- Embankment	m3	31,100	50,000	21,000
- Sodding	m2	10,900	0	21,000
- Marl pavement	m3	2,200	20,000	9,500
3.5 Sub-total			535,000	997,000

Table M-6(2/3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR THE RIO COBRE WEST AREA

(Unit: US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
4. Old harbour extention branch canal L=5.1km				
4.1 Earth works			76,000	47,000
- Land clearing	ha	5.2	0	2,000
- Excavation	m3	20,900	16,500	6,000
- Embankment	m3	17,800	32,000	12,000
- Backfilling	m3	15,400	27,500	10,000
- Slope tamping	m2	39,800	0	6,000
- Sodding	m2	6,000	0	11,000
4.2 Concrete works			109,000	307,000
- Lining concrete	m3	1,100	27,000	93,000
- Reinforced concrete	m3	940	20,500	81,000
- Leveling concrete	m3	50	1,000	3,500
- Plywood form	m2	2,100	0	36,500
- Reinfotced iron bar	ton	47	30,000	4,000
- Gravel foundation	m3	800	7,000	5,000
- R.C Pipe ø800	m	600	0	38,000
- River reretment works	L.s	1	8,500	26,000
- Miscellaneous works	L.s	1	5,000	14,000
- Temporary works	L.s	1	10,000	6,000
4.3 Related structure			5,000	41,000
- Turnout	nos	6	1,500	13,500
- Check gate	nos	6	2,000	17,000
- Culvert	nos	5	1,500	10,500
4.4 O&M Road			47,000	32,000
- Excavation	m3	4,000	2,000	1,000
- Embankment	m3	17,800	29,000	12,000
- Sodding	m2	6,000	0	11,000
- Marl pavement	m3	1,800	16,000	8,000
4.5 Sub-total			237,000	427,000
5. Hartland branch canal L=7.1km				
5.1 Earth works			44,000	45,000
- Excavation	m3	27,900	19,000	7,000
- Embankment	m3	7,100	11,000	4,000
- Backfilling	m3	17,400	8,000	3,000
- Residual earth work	m3	12,600	6,000	2,500
- Slope tamping	m2	56,000	0	8,500
- Sodding	m3	10,700	0	20,000
5.2 Concrete works			137,000	429,000
- Lining concrete	m3	4,600	114,000	389,000
- Plywood form	m2	500	0	9,000
- Gravel foundation	m3	1,800	16,500	10,500
- Miscellaneous works	L.s	1	6,500	20,500
5.3 Related structure			27,000	99,000
- Turnout	nos	9	2,000	20,000
- Drop	nos	9	19,500	40,500
- Check gate	nos	6	2,500	17,500
- Culvert	nos	12	3,000	21,000
5.4 O&M Road			29,000	14,000
- Excavation	m3	3,100	2,000	500
- Embankment	m3	800	1,000	500
- Marl pavement	m3	2,900	26,000	13,000
5.5 Sub-total			237,000	587,000

Table M-6(3/3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR THE RIO COBRE WEST AREA

(Unit; US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
6. Minor branch canal L=46.39km				
6.1 Old harbour branch	m	25,090	179,000	491,000
6.2 Hartland branch	m	14,280	102,000	288,000
6.3 Sydemham branch	m	7,020	46,000	126,000
6.4 O&M Road	L.s	1	163,000	76,000
6.5 Sub-total			490,000	981,000
7. Black river reservior V=3.8mill m3,A=80ha				
7.1 Earth works			1,920,000	901,000
- Land stripping	m3	97,000	49,000	17,000
- Excavation(Drain canal)	m3	30,000	16,000	5,000
- Embankment(Random zone)	m3	609,000	1,330,000	431,000
- Rip-rap t=0.30m	m3	28,000	221,000	146,000
- Sound filter and foundation	m3	27,000	140,000	103,000
- Gravel(Toe drain)	m3	21,000	129,000	93,000
- Marl pavement	m3	4,000	35,000	17,000
- Sodding	m2	47,000	0	89,000
7.2 Diversion river works			7,000	21,000
- Excavation	m3	14,000	7,000	2,000
- Slope tamping	m2	5,000	0	2,000
- Sodding	m2	9,000	0	17,000
7.3 Related structure	L.s	1	25,000	50,000
7.4 Sub-total			1,952,000	972,000
8. Nightingale pump station				
8.1 Pump Q=4.5m3/min	nos	2	90,000	10,000
8.2 Pipeline(ductile ø400)	m	1,500	375,000	75,000
8.3 Farm poud 50m x 50m x 2m	L.s	1	6,000	4,000
8.4 Other works	L.s	1	5,000	5,000
8.5 Sub-total			476,000	94,000
9. Amity hall pump station(Black river)				
9.1 Up-stream			120,000	20,000
- Pump Q=4.5m3/min	nos	2	90,000	10,000
- Pipeline(ductile ø400)	m	100	25,000	5,000
- Other works	L.s	1	5,000	5,000
9.2 Down-stream			120,000	20,000
- Pump Q=4.5m3/min	nos	2	90,000	10,000
- Pipeline(ductile ø400)	m	100	25,000	5,000
- Other works	L.s	1	5,000	5,000
9.3 Sub-total			240,000	40,000
10.Total(1 to 9)			4,550,000	4,690,000

Table M-7 BREAKDOWN OF DIRECT CONSTRUCTION COST FOR ST. DOROTHY AREA

(Unit; US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
1. Preparatory Works	L.s	1	90,000	37,000
2. Free town pipeline and Pump L=2.8 km				
2.1 Earth Works			45,000	23,000
- Excavation	m3	15,500	12,000	4,500
- Sand bed	m3	2,000	10,500	8,000
- Backfilling	m3	12,300	22,000	8,000
- Residual earth works	m3	1,200	500	500
- Slope tamping	m2	13,500	0	2,000
2.2 Pipeline works			949,000	129,000
- Ductile irom pipe ø700	m	2,808	825,000	112,000
- Miscellaneous works	L.s	1	124,000	17,000
2.3 Related Structure			44,000	18,000
- Air value works	nos	4	4,000	4,000
- Sluice value works	nos	2	25,000	3,000
- Drain value works(Brow-off)	nos	3	4,000	4,000
- Turnout ø450	nos	1	5,000	1,000
- Reilway crossing works	nos	1	6,000	6,000
2.4 (Pump station works			425,000	61,000
- Submersible moter pump and well (P=6.6m3/min x ø250 x 75kw x 380v)	nos	5	393,500	17,500
- Additional well(ø400)	nos	3	30,000	30,000
- Pump house works	m2	20	0	13,000
- Net-fence works	m	50	1,500	500
2.5 Sub-total			1,463,000	231,000
3. Free town open canal L=7.9km				
3.1 Earth Works			39,000	34,000
- Excavation	m3	16,300	13,000	4,500
- Embankment	m3	10,400	19,000	7,000
- Backfilling	m3	3,800	7,000	2,500
- Sodding	m2	10,600	0	20,000
3.2 Concrete Works			80,000	255,000
- Lining concrete	m3	1,300	30,500	105,000
- Reinforced concrete	m3	800	17,000	66,000
- Leveling concrete	m3	100	2,000	6,000
- Reinforced iron bar	ton	31	20,000	2,500
- Plywood form	m2	2,200	0	36,500
- Gravel foundation	m3	800	6,500	4,000
- R.C pipe ø600	m	40	0	2,000
- R.C pipe ø500	m	600	0	21,000
- Miscellaneous works	L.s	1	4,000	12,000
3.3 Related structure			14,000	85,000
- Turnout	nos	11	2,500	22,500
- Drop	nos	4	4,000	8,000
- Culvert	nos	17	4,500	31,500
- Check gate	nos	8	3,000	23,000
3.4 O&M Road			37,000	17,000
- Excavation	m3	5,900	3,500	1,500
- Embankment	m3	7,900	12,500	5,500
- Marl pavement	m3	2,300	21,000	10,000
3.5 Sub-total			170,000	391,000
4. Free town distributory canal L=10.3km				
4.1 Distributory canal	m	10,270	71,000	194,000
4.2 O&M Road	m	10,270	36,000	17,000
4.3 Sub-total			107,000	211,000
5. Total(1 to 4)			1,830,000	870,000

Table M-8 BREAKDOWN OF DIRECT CONSTRUCTION COST FOR MAIN ROAD AND SECONDARY DRAINAGE CANAL

(Unit; US$)

Item	Unit	Q'ty	Foreign Currency	Local Currency
1. Preparatory works	L.s		28,000	14,000
2. Main road	km	75.0	445,000	214,000
3. Secondary drainage canal	km	21.4	27,000	42,000
4. Total			500,000	270,000

Table M-9 PROCUREMENT COST OF MAJOR OPERATION AND MAINTENANCE EQUIPMENT

(Unit;US$)

Equipement	Quantity	Unit Price	Total
1. Bulldozer 11ton	2	95,000	190,000
2. Backhoe 0.6m3	1	125,000	125,000
3. Tractor Shovel 1.0m3	1	54,000	54,000
4. Dump Truck 8ton	1	41,000	41,000
5. Truck 4ton	2	16,000	32,000
6. Light Truck 4 Wheel Drive 2ton	2	12,000	24,000
7. Passenger Car 4Wheel Drive 2ton	6	12,000	72,000
8. Tire Roller 8-20ton	1	57,000	57,000
9. Vibration Roller 2.5-2.8ton	1	20,000	20,000
10. Vibration Roller 0.5ton	2	6,500	13,000
11. Slope Compactrer	2	7,000	14,000
12. Concrete Mixer 0.2m3,7PS	2	3,500	7,000
13. Pump with Engine 7PS	2	2,000	4,000
14. Sub-total			653,000
15. Workshop Equipment	L.s	1	16,000
16. Spare Parts(20%)	L.s	1	131,000
17. Total			800,000

Table M-10 GENERAL EXPENSES
(Construction Stage)

(Unit; US$)

Year	Staff* Salary	Labour Wage	Office Expenses	Fuel Cost for Passenger Car	Other Related Cost	Total
1	36,000		1,500	1,500	2,000	41,000
2	90,000	7,000	4,000	3,000	6,000	110,000
3	75,600	7,000	8,000	4,500	6,900	102,000
4	75,600	7,000	8,000	4,500	6,900	102,000
Total	277,200	21,000	21,500	13,500	21,800	355,000

Remarks; * =Refer to Table M-11

Table M-11 STAFF SALARY FOR PROJECT OFFICE

(Unit; US$)

	Director		Engineer		Assistant Engineer		Administrator		Equipment Procurement Office		Clarical Staff		Total	
Year	No.	Salary	No.	Salary	No.	Salary	No.	Salary	No.	Salary	No.	Salary	No.	Salary
1	1	14,400	2	16,800	1	4,800	-	-	-	-	-	-	4	36,000
2	1	14,400	3	25,200	4	19,200	1	8,400	1	8,400	3	14,400	13	90,000
3	-	-	3	25,200	4	19,200	1	8,400	1	8,400	3	14,400	12	75,600
4	-	-	3	25,200	4	19,200	1	8,400	1	8,400	3	14,400	12	75,600
Total		28,800		92,400		62,400		25,200		25,200		43,200	41	277,200

Table M-12 PRICE LIST OF BASIC MATERIALS AND LABOUR WAGES

Item	Unit	Unit Price (J$)	Remarks
A. LABOUR FORCE			
1. Heavy Equipment Operator			
(a) Crane	man-day	58.77	
(b) Back Hoe	man-day	58.77	
(c) Bulldozer	man-day	48.26	
(d) Front End Loader	man-day	48.26	
2. Dump Car Driver		35.27	
3. Skilled worker			
(a) Mason	man-day	39.57	
(b) Carpenter	man-day	43.31	
(c) Bar Bender	man-day	38.36	
4. Common Labour	man-day	26.37	
B. MATERIALS			
1. Portland Cement	ton	638.60	J$22.27/94bound
2. Gravel(Washing)	m3	44.50	J$34.0/c.y.
3. Sand(Washing)	m3	39.30	J$30.0/c.y.
4. Re-bar	ton	2,600.00	
5. Timber for Form	m2	68.80	2"x4"x14'
6. Plywood	m2	55.80	4'x8'x0.48"
7. Light Oil	lit	2.90	J$11.00/gal
8. Disel Oil	lit	2.08	J$7.90/gal
9. Engine Oil	lit	10.03	J$38.00/gal
10. Limestone	m3	39.30	J$30.0/c.y.
11. R.C Pipe			
300(12")	m	67.50	J$81.0 per 4ft.length
450(18")	m	102.30	J$131.0 per 4ft.3"length
600(24")	m	133.60	J$171.0 per 4ft.3"length
800(30")	m	204.70	J$262.0 per 4ft.3"length
900(36")	m	341.20	J$377.0 per 4ft.length
1,200(48")	m	467.50	J$561.0 per 4ft.length
1,500(60")	m	662.50	J$795.0 per 4ft.length

Table M-13(1/3) LIST OF UNIT COST FOR MAJOR WORK ITEMS

(Unit; US$)

Item		Unit	Foreign Currency	Local Currency	Total
1. Excavation by man-power(Clay)		m3	-	5.40	5.40
2. Excavation and Pulling(Clay soil)					
Bulldozer 11t	L=10m	m3	0.38	0.16	0.54
Bulldozer 11t	L=20m	m3	0.59	0.25	0.84
Bulldozer 11t	L=30m	m3	0.81	0.34	1.15
3. Excavation and Pulling(Sandy Soil)					
Bulldozer 11t	L=10m	m3	0.32	0.14	0.46
Bulldozer 11t	L=20m	m3	0.51	0.21	0.72
Bulldozer 11t	L=30m	m3	0.70	0.29	0.99
4. Excavation and Puling(Sand)					
Bulldozer 11t	L=10m	m3	0.28	0.12	0.40
Bulldozer 11t	L=20m	m3	0.45	0.19	0.64
Bulldozer 11t	L=30m	m3	0.61	0.25	0.86
5. Excavatoion and Pulling(Clay Soil)					
Bulldozer 21t	L=10m	m3	0.32	0.11	0.43
Bulldozer 21t	L=20m	m3	0.51	0.17	0.68
Bulldozer 21t	L=30m	m3	0.69	0.24	0.93
6. Excavation and Pulling(Sandy soil)					
Bulldozer 21t	L=10m	m3	0.28	0.10	0.38
Bulldozer 21t	L=20m	m3	0.44	0.15	0.59
Bulldozer 21t	L=30m	m3	0.60	0.21	0.81
7. Excavation and Pulling(Sand)					
Bulldozer 21t	L=10m	m3	0.25	0.08	0.33
Bulldozer 21t	L=20m	m3	0.39	0.13	0.52
Bulldozer 21t	L=30m	m3	0.53	0.18	0.71
8. Excavation by Backhoe 0.6m3					
(Clay soil)		m3	0.79	0.28	1.07
(Sandy soil)		m3	0.69	0.24	0.93
9. Excavation by Clamshell 0.8m3					
(Clay soil)		m3	2.57	0.54	3.11
(Sandy soil)		m3	1.83	0.38	2.21
10. Excavation and Loading by Tractor Shovell 1.0 m3					
(Clay and Sand)		m3	0.80	0.21	1.01
(Gravel)		m3	1.00	0.27	1.27
11. Excavation and Loading by Tractor Shovell 2.2 m3					
(Clay and Sand)		m3	0.59	0.14	0.73
(Gravel)		m3	0.74	0.18	0.92
12. Hauling by Dump-truck 10-11t (Clay and Sand)					
	L=0.2km	m3	0.59	0.29	0.88
	L=0.5km	m3	0.66	0.32	0.98
	L=1.0km	m3	0.79	0.39	1.18
	L=2.0km	m3	1.05	0.51	1.56
	L=3.0km	m3	1.31	0.64	1.95
	L=4.0km	m3	1.56	0.77	2.33
	L=5.0km	m3	1.81	0.89	2.70
	L=6.0km	m3	2.07	1.02	3.09
	L=10.0km	m3	3.10	1.52	4.62
	L=20.0km	m3	5.65	2.78	8.43
	L=30.0km	m3	8.07	3.96	12.03

Table M-13(2/3) LIST OF UNIT COST FOR MAJOR WORK ITEMS

(Unit; US$)

Item		Unit	Foreign Currency	Local Currency	Total
13. Hauling by Dump-truck 10-11t (Gravel)					
	L=0.2km	m3	0.68	0.33	1.01
	L=0.5km	m3	0.77	0.38	1.15
	L=1.0km	m3	0.91	0.45	1.36
	L=2.0km	m3	1.21	0.59	1.80
	L=3.0km	m3	1.50	0.74	2.24
	L=4.0km	m3	1.79	0.88	2.67
	L=5.0km	m3	2.09	1.03	3.12
	L=6.0km	m3	2.38	1.17	3.55
	L=10.0km	m3	3.59	1.76	5.35
	L=20.0km	m3	6.46	3.17	9.63
	L=30.0km	m3	9.42	4.63	14.05
14. Hauling by Dump-truck 10-11t (Rock)					
	L=0.2km	m3	0.86	0.42	1.28
	L=0.5km	m3	0.97	0.47	1.44
	L=1.0km	m3	1.15	0.57	1.72
	L=2.0km	m3	1.53	0.75	2.28
	L=3.0km	m3	1.90	0.93	2.83
	L=4.0km	m3	2.26	1.11	3.37
	L=5.0km	m3	2.63	1.29	3.92
	L=6.0km	m3	3.01	1.48	4.49
	L=10.0km	m3	4.52	2.22	6.74
	L=20.0km	m3	8.37	4.11	12.48
	L=30.0km	m3	11.89	5.84	17.73
15. Compaction by Bulldozer	11t	m3	0.30	0.13	0.43
	21t	m3	0.40	0.16	0.56
16. Spreading by Bulldozer	11t	m3	0.34	0.14	0.48
	21t	m3	0.43	0.15	0.58
17. Spreading and Compaction by Bulldozer					
	11t	m3	0.64	0.27	0.91
	21t	m3	0.90	0.31	1.21
18. Compaction					
by Vibration-roller 2.5-2.8t		m3	0.41	0.13	0.54
by Tire-roller 8.0-20.0t		m3	0.16	0.06	0.22
19. Excavation and Spreading					
by Carry-all Scraper 21t (Clay soil)					
	L=50m	m3	0.77	0.23	1.00
	L=100m	m3	1.05	0.32	1.37
	L=150m	m3	1.32	0.40	1.72
	L=200m	m3	1.60	0.48	2.08
	L=250m	m3	1.88	0.57	2.45
	l=300m	m3	2.16	0.65	2.81
	L=350m	m3	2.43	0.74	3.17
	L=400m	m3	2.71	0.82	3.53

Table M-13(3/3) LIST OF UNIT COST FOR MAJOR WORK ITEMS

(Unit; US$)

Item		Unit	Foreign Currency	Local Currency	Total
20. Excavation and Spreading					
by Carry-all Scraper 21t (Sandy soil)					
	L=50m	m3	0.59	0.18	0.77
	L=100m	m3	0.81	0.24	1.05
	L=150m	m3	1.02	0.31	1.33
	L=200m	m3	1.24	0.37	1.61
	L=250m	m3	1.45	0.44	1.89
	l=300m	m3	1.66	0.50	2.16
	L=350m	m3	1.88	0.57	2.45
	L=400m	m3	2.09	0.63	2.72
21. Excavation by Ripperdozer 21t					
(Soft Rock)	L=30m	m3	0.31	0.10	0.41
22. Pulling by Bulldozer 11t					
(Soft Rock)	L=30m	m3	0.75	0.32	1.07
Pulling by Bulldozer 21t					
(Soft Rock)	L=30m	m3	0.69	0.24	0.93
23. Excavation by Rockdrill 20kg					
(Rock)		m3	5.2	13.9	19.1
(Soft Rock)		m3	3.9	7.6	11.5
24. Slope Tamping by man-power					
(Rough)		m2	-	0.15	0.15
(Complete)		m2	-	0.30	0.30
25. Gravel Foundation		m3	9.13	5.92	15.05
26. Sand Foundation		m3	5.35	3.93	9.28
27. Marl Pavement		m3	9.13	4.38	13.51
28. Land Clearing(Grass)		ha	-	348.0	348.0
29. Land Clearing(Mixed Tree and Grass)		ha	394.7	500.1	894.8
30. Grading and Levelling by Bulldozer		100m2	3.6	1.3	4.9
31. Sodding		m2	-	1.9	1.9
32. Plain Concrete(1:3:6)					
∂28=180kg/cm2=2600PSI		m3	22.6	74.7	97.3
33. Lining Concrete(1:3:6)					
∂28=180kg/cm2=2600PSI		m3	24.8	84.6	109.4
34 Reinforced Concrete(1:2:4)					
∂28=240kg/cm2=3500PSI		m3	22.0	86.2	108.2
35. Leveling Concrete(1:4:8)					
28=140kg/cm2=2000PSI		m3	23.4	69.7	93.1
36. Reinforced Iron Bar by man-power		ton	639.5	85.0	724.5
37. Plywood Form(Small Structure)		m2	-	17.4	17.4
38. Wooden Form(Big Structure)		m2	-	31.6	31.6
39. Net Fencing of Steel		m	28.8	2.6	31.4

Table M-14 ANNUAL OPERATION AND MAINTENANCE COST

(Unit; x10^3 US$)

Item	Unit	Amount
1. Salary and wages		310
1) Staff salalies(see Table M-15)		180
2) Labour wages		130
2. Office expenses		60
3. O&M for pump stations		830
1) Pump		520
2) Pump for on Farm		310
4. Repair and maintenance cost		390
1) Repair of Main Structure and Reservior		50
2) Cutting grass		80
3) Repair of lining concrete		90
4) Repair of road pavement		60
5) Repair of on farm facility		80
6) Other		30
5. Miscellaneous		160
6. Total		1750

Table M-15 ANNUAL STAFF SALARY AT O&M STAGE

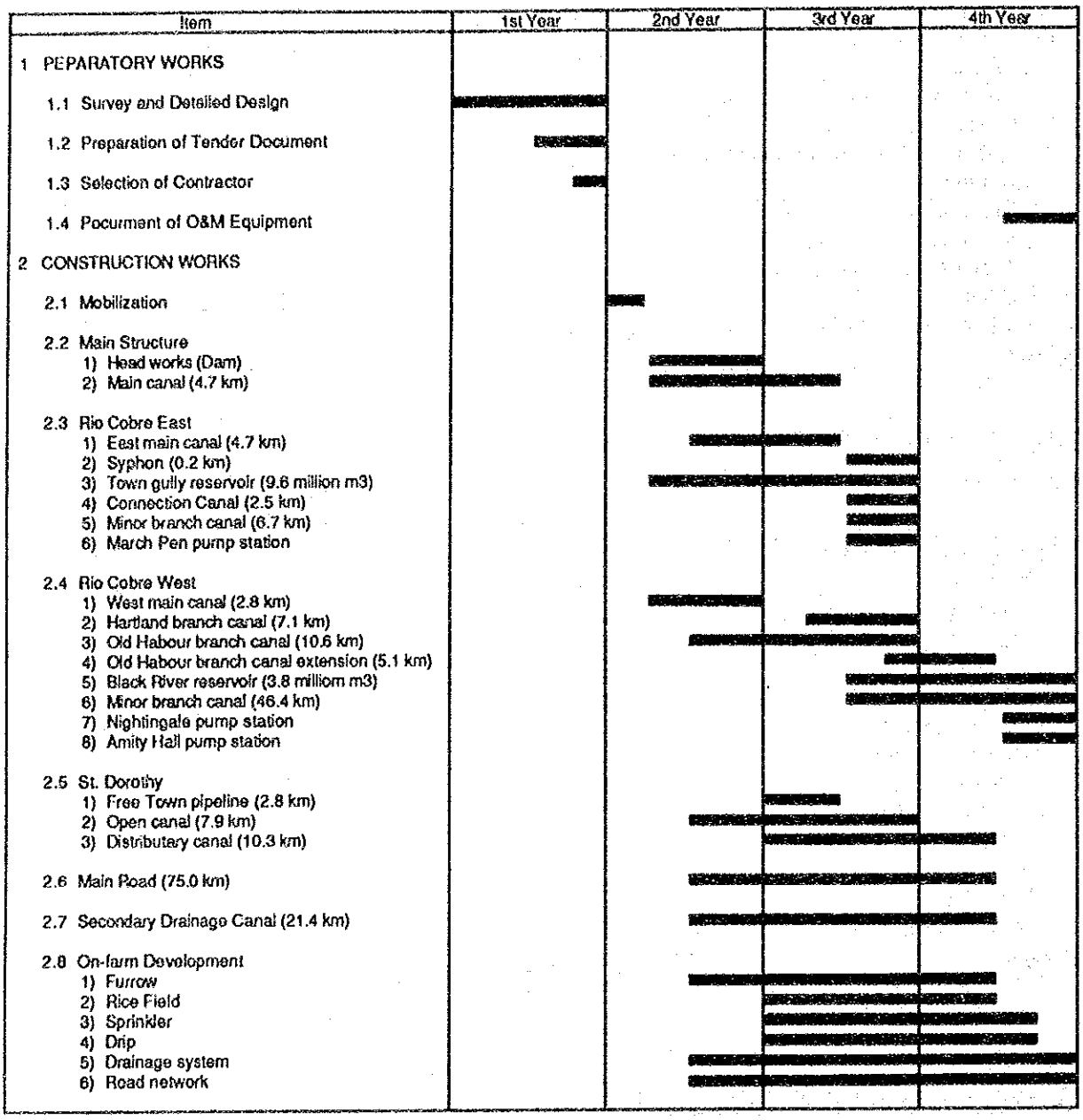
(Unit; US$)

Item	Required Number	Monthly Rate	Annual Amount
1. Management Department			
1) Director	1	1,200	14,400
2) Secretary	2	400	9,600
2. Technical Department			
1) Manager	1	1000	12,000
2) Irrigation engineer	2	700	16,800
3) Civil engineer	2	700	16,800
4) Mechanical engineer	2	700	16,800
5) Assistant engineer	6	400	28,800
6) Clerical staff	3	400	14,400
3. Admistration Department			
1) Finance office	2	700	16,800
2) Personnel	3	700	25,200
3) Land management	1	700	8,400
4. Total			180,000

Remarks: The salary of drivers and operators is included in the labour wages in Table M-14

Table M-16 REPLACEMENT COST AND USEFUL LIFE

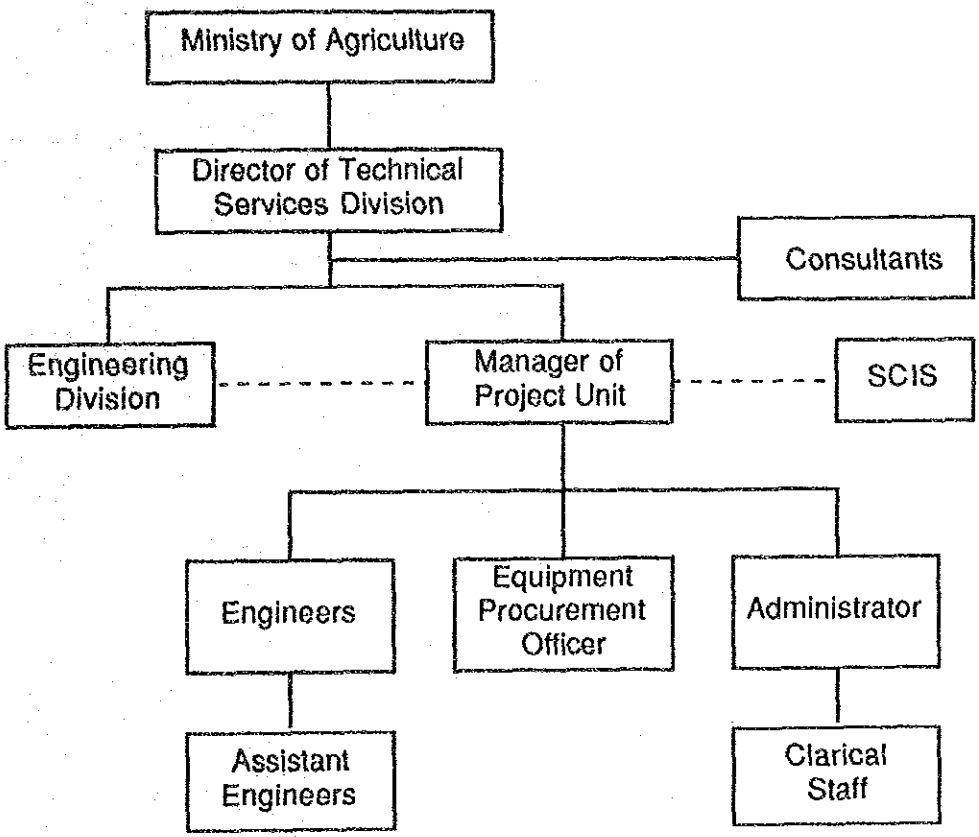
Item	Useful Life (year)	Replacement Cost (US$)	
1. O&M Equipment (see Table M-9)			
1) Heavy equipment	10	499,000	
2) Vehicles and small equipment	5	301,000	
2. Project Facilities			
1) Irrigation pump	20	2,560,000	-5,800,000
2) Gate for irrigation facilities	20	350,000	



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. M-1
PROJECT IMPLEMENTATION SCHEDULE

JAPAN INTERNATIONAL COOPERATION AGENCY



THE MODERNIZATION AND EXPANSION OF THE RIO COBRE IRRIGATION SCHEME

Fig. M-2
ORGANIZATION STRUCTURE FOR PROJECT EXECUTION

JAPAN INTERNATIONAL COOPERATION AGENCY