From the poor maintenance of the Mahiyangana - Badula road, rehabilitation of the main roads connecting Geselpota with the American Road will help the farmers transporting to the markets of Mahiyangana and of Giradrukotte, centre town of the Mahaweli System C.

There is no bridge crossing the Diyabana Oya running between the main canal and the branch canal, the submerged bridge has been broken by the flood in 1983/1984 Maha and not rehabilitated. New bridge is proposed at the same point to get back transport from Senehigama to Geselpota.

4.5.2 Rehabilitation of Roads

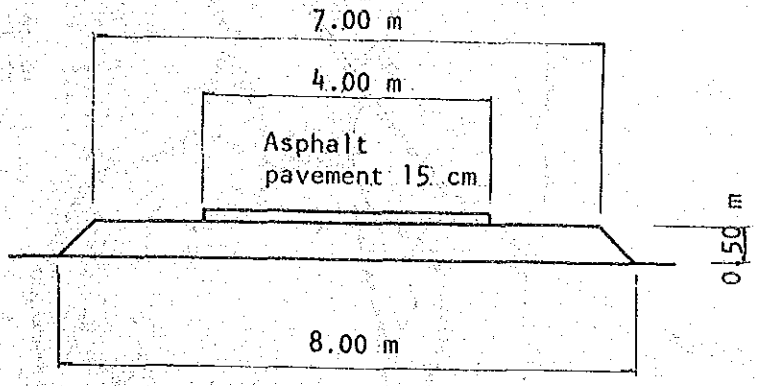
Roads are proposed to be rehabilitated as three grades, Road I, Road II and Road III considering their importance utilization. Typical cross sections of these Roads are shown in Fig. 4.5.1.

Operation and maintenance roads were broken in some parts by the trench excavation by the farmers so as to get irrigation water at their convenience under condition. These operation and maintenance roads for the irrigation system are planned to be rehabilitated as Road II or III at the time of canal rehabilitation works.

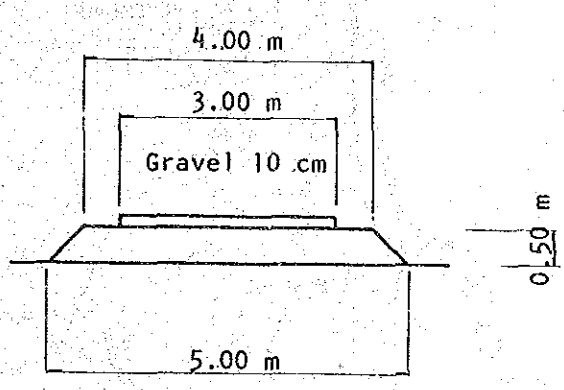
The existing unpaved main roads are proposed to be rehabilitated as Road II in the following sections:

Geselpota - American Road 5,500 m

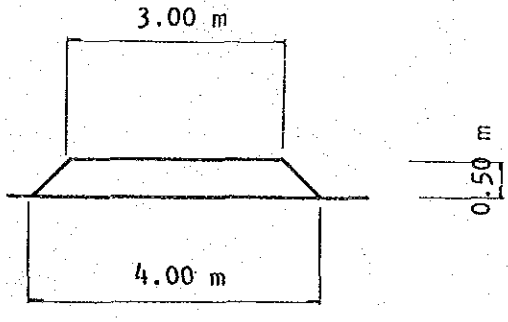
New bridge of prestressed concrete, 4 m in width and 50 m in length, is planned to build over the Diyabana Oya at the same point of the broken submerged bridge. Operation and maintenance road of D-1 canal of Tract II connecting to the proposed PC bridge is planned to be rehabilitated at the time of improvement work of the irrigation system. The section of proposed roads rehabilitation are shown in Fig. 4.5.2.



(a) Road I



(b) Road II



(c) Road III

Fig.4.5.1 TYPICAL CROSS SECTION OF ROAD

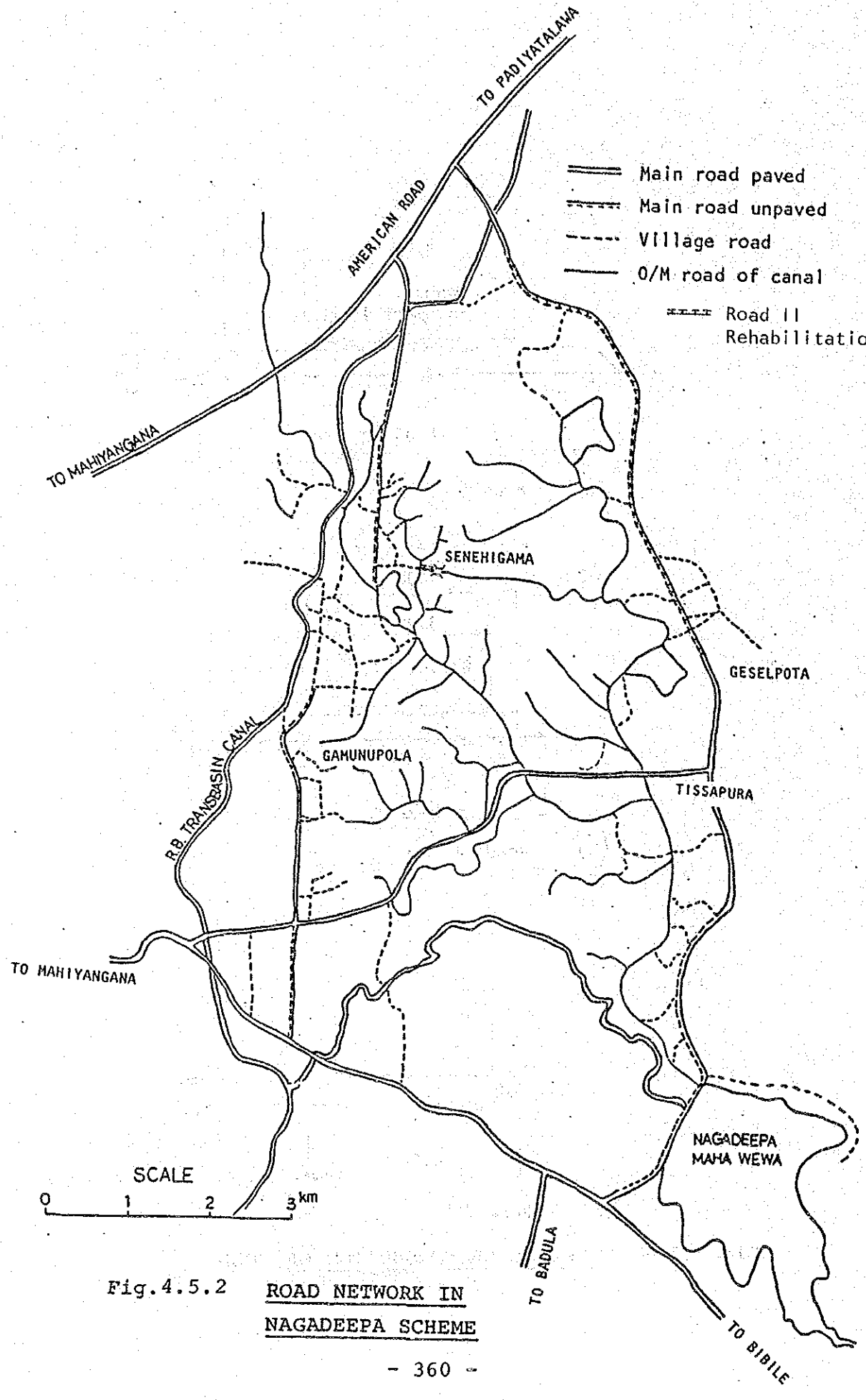


Fig.4.5.2 ROAD NETWORK IN NAGADEEPA SCHEME

As Work II project, the existing unpaved main roads are proposed to be paved as Road I in the following sections:

Geselpota	- American Road	5,500 m
Gamunupola	- American Road	5,400 m
Senehigama	- American Road	1,400 m

4.6 RURAL WATER SUPPLY PLAN

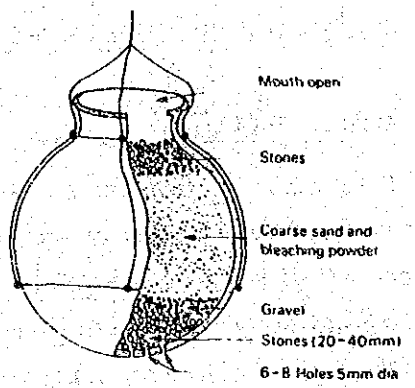
4.6.1 Basic Policy

Sources of domestic water depend mainly on wells in this area of which many wells come to be dried up in case of closure of the main canal. Almost all wells cannot satisfy the microbiological standards of the World Health Organization (WHO). Existing pit wells should be improved to stop entering and seepage of polluted surface water and be dug more deeply in order to keep ground water even in dry season. Disinfection should be carried out for all wells to secure the villagers to a extent of the microbiological standards of WHO.

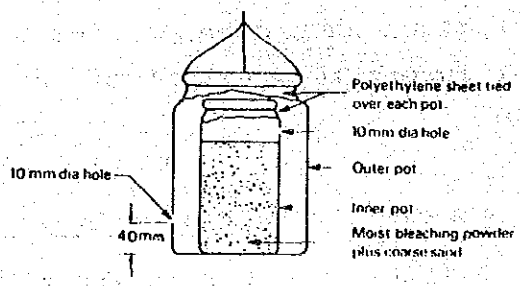
4.6.2 Improvement of Water Quality

Quality of water in the main canal is polluted in proportion to flow down and usually is not used as drinking water. Water quality of all wells as sources of domestic water is under the WHO's maximum permissible level for chemical and physical characteristics and does not pass the microbiological standards of the WHO. For all wells disinfection should be executed because of difficulty in preventing completely intermix of coliform organisms. Disinfection method has to be simple enough for farmers to control by themselves. Adding chlorine to water by use of tablets of calcium hypochlorite is convenient and easy to operate but tablets are more costly than hypochlorite powder and sometimes it will be difficult to get the tablets.

Pot chlorinator method by use of powder will be suitable for this area; two types of pot chlorinator are shown in Fig. 4.6.1. The single pot can cover to sixty people and the double pot is suitable for serving up to twenty people. In the light of average families for a well in the area, the simple pot is proposed under a obligation to replenish containing materials of sand and bleach at same quantity.



(a) Single Pot System



(b) Double Pot System

Fig.4.6.1
POT CHLORINTORS FOR DISINFECTING WELLS

4.6.3 Rehabilitation of Wells

Existing wells in the area can be classified into three types, pit well of 69%, concrete lining of 25% and brick made well of 6%. Existing pit wells should be dug deeply to catch groundwater lowering in level during dry season and after closure the sluice of the main canal. Hume pipes are inserted to protect erosion inside of well and backfill is made of gravel in space between hume pipes and wall. Upper portion is backfilled by clayey soil to stop seepage from the

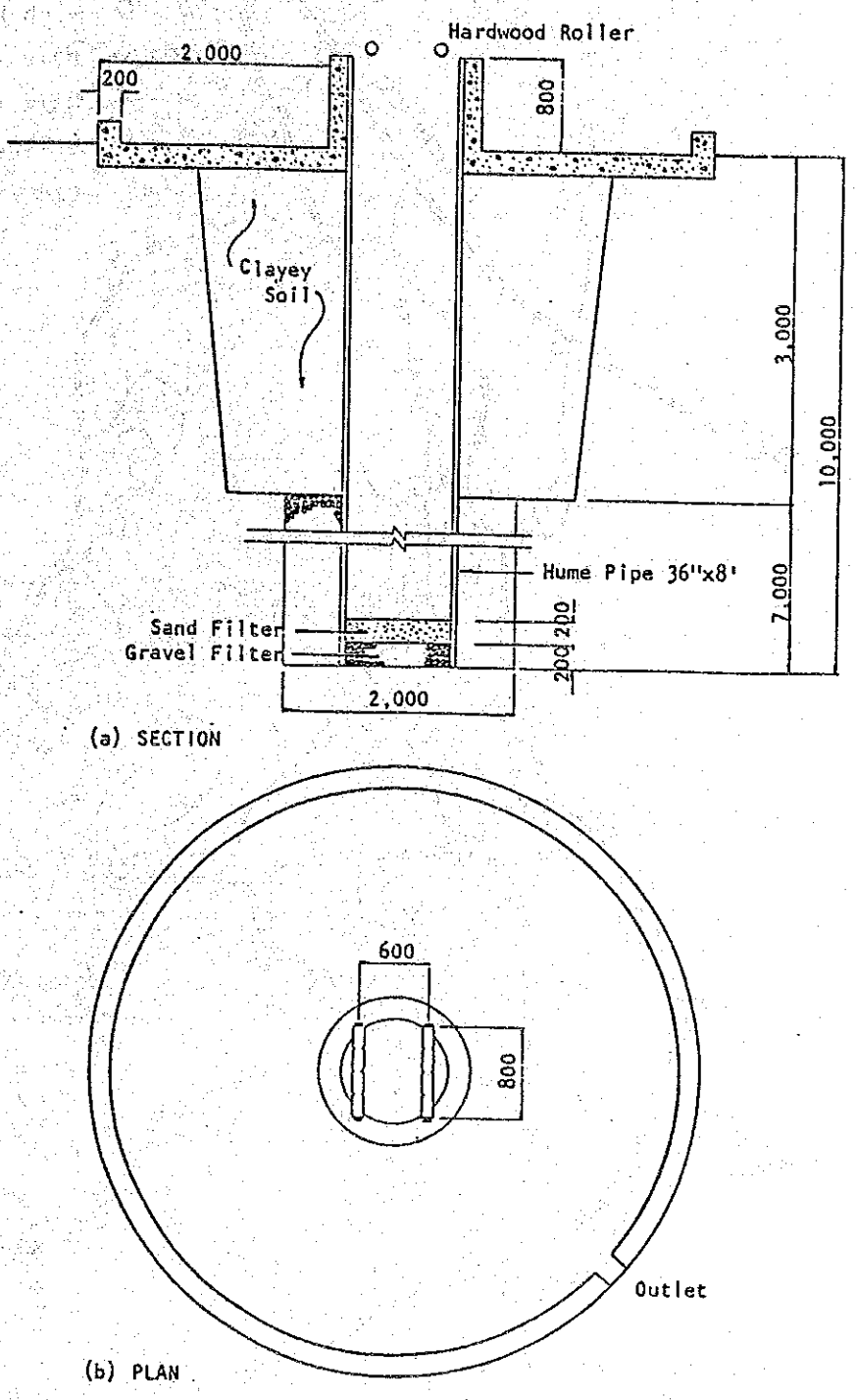


Fig. 4.6.2 PROTOTYPE WELL

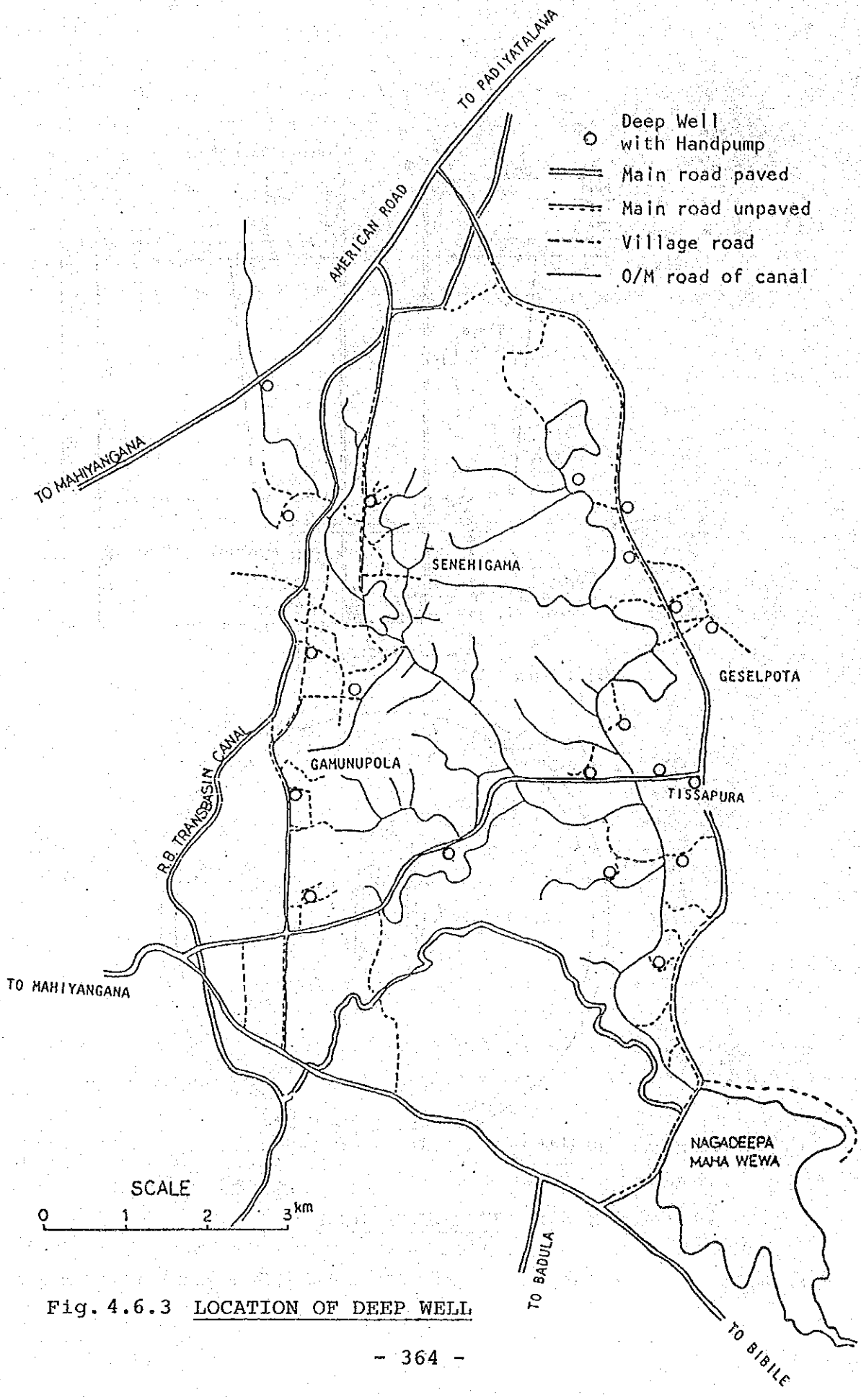


Fig. 4.6.3 LOCATION OF DEEP WELL

surface. Wall and concrete slob is made at the outside portion of well and its prototype is shown in Fig. 4.6.2.

Planning the rehabilitation to install wells such as one well per fifty villagers, total 375 wells is necessary in this Scheme and new 85 wells shall be dug as the difference between the above number and existing number 290. Rehabilitation is made for existing 200 pit wells.

4.6.4 Tube Wells

20 new deep wells are proposed, which are approximately 15 m in depth with attached handpumps. Prototype well without handpump is shown in Fig. 4.6.2. Deep wells with handpumps are planned to set in the dense populated areas where big drawdown of groundwater level is predicted. The location is shown in Fig. 4.6.3, and its design is the same as those in Minipe scheme.

4.7 OPERATION AND MAINTENANCE

4.7.1 Basic Policy

Operation and maintenance of facilities in the Nagadeepa Scheme can be divided broadly into two categories, i.e. water management facilities and road facilities. The government agencies related the INMAS Programme are required to be functional and to maintain the reservoir, the main canal, the branch canal and D-canals forming part of the System. Field canals are to be maintained by the farmers under the supervision of the related agencies.

The Highway Department is required to maintain the main roads and paved portion of the O & M road of the canal system. Up to now, these roads are being maintained by the Highway Department.

The land Commissioner has been expected to maintain village roads except O & M roads of canals up to the present. But the maintenance of village roads has been abandoned due to the lack of budgetary provision. Therefore, the village roads would have to be maintained by the line agencies under the INMAS Programme.

4.7.2 Agencies and Organisation

Operation and maintenance of the irrigation systems would continue to be responsibility of the Irrigation Department under the overall coordinated programme by the Irrigation Management Division.

The ID staffs such as technical assistants, work supervisors and water distributors being engaged in O & M would continue working for the system.

The farmers in the Scheme are expected to have within their competence to participate gradually and necessarily in the organisation under the coordinated control of the agencies. They would be imposed upon O & M for field canals regarding the following aspects:

(a) Maintaining and cleaning.
(b) Water distribution and control.

4.7.3 Operation and Maintenance Cost

O & M expenditures under the existing limited budgetary appropriation are about Rs 300 per ha including farmers labour contributions to cleaning field canals and ID costs as shown in Table 3.8.2.

Accoridng to the "Typical O & M Cost per ac per annum for gravity irrigation works (1982 prices)" which was analysed on performance in 16 selected schemes by the Irrigation Department.

The O & M cost for gravity irrigation works in 1982 was justified to be Rs 200 per ac. (Rs 500 per ha).

In consideration of price escalation, these expenditures have to be raised to Rs 600 per ha for proper O & M.

5. IMPLEMENTATION PLAN

5.1 BASIC POLICY

By taking into consideration of the present cropping in the Scheme Area, the project implementation has to be planned on the following assumptions:

(1) It would takes five years for the civil works and another three years for implementation of the programmes.

(2) The construction programme would be so worked out as in principle to concentrate the construction works in the Yala season and to bring the project area under full cultivation during the rainy (Maha) season.

(3) The required labour force for the construction works would be obtainable primarily from the project area and the settlers would be able to share the benefit of the project in the form of labour wages earned from the inception of project implement of during the periods when cultivation cannot be undertaken.

(4) Because construction is to be concentrated in the Yala season and it would be necessary to handle a considerable volume of construction works in a short period, machinery would be utilized to a large extent.

(5) As for the machinery and materials necessary for the construction works, those which are available in Sri Lanka would be mainly used.

(6) The major works would be executed by a general contractor but the minor works could be done by force account in case of need.

5.2 PROEJCT EXECUTING AGENCY

The Irrigation Management Division of the Ministry of Lands and Land Development, which acts as the executing agency for the "Programme for Integrated Management of Major Irrigation Schemes" starting from 1985 in Sri Lanka and the Irrigation Department organised under the same Ministry would be jointly responsible for the implementation of this project.

5.3 REHABILITATION WORK PLAN

5.3.1 Construction Method

(1) Canal

Rehabilitation works on canals will start after harvest of the Maha under dry condition by stopping flows in the canals. It is necessary to do the works efficiently during the Yala season since water would be made available in the canal during the Maha season. Accordingly, almost of all the construction materials would be procured during Maha season and stored in designated places with the required storage capacity in order to commence the canal works as soon as water flow through the canal system ceases.

For the provision of rubble packing for bank protection, the rubble would be laid on a crushed stone foundation made above an impervious layer to minimize seepage loss from the embankment body.

The portions where the existing canal bottom level is higher than the design level would be stripped while lower-level protions would be left as they are.

(2) Road

The Yala season would be best suited mainly for the construction of a road network used for D/M road of

the distributary canals as well as of rural roads, because it would be difficult to carry out the construction works in Maha in view of the requirement that the Project Area should be under cultivation during that season.

5.3.2 Construction Materials and Machinery

Most of the construction materials required for this project are available in Sri Lanka. Since there is some difficulty in procuring explosives, which would be used for production of embankment-protection stones, utmost care would have to be exercised in its procurement and storage.

Aggregates used for concrete work and stones for embankmant protection purpose could be procured within the Project Area.

Major construction machinery required for rehabilitation works are grouped into each unit by works (shown in Table 5.3.1).

Each work would require the following number of machinery unit to meet construction schedule.

Work	Unit
Main & Branch Canal	1
D & F Canal	2
Road System	1

5.3.3 Surveys and Detailed Design

Prior to the commencement of the construction works for this project, the following works should be done.

(1) Topographical Survey

- Topographical survey on canals and roads, based on the preliminary design work done in this Study.

Table 5.3.1 LIST OF MACHINERY : NAGADEEPA SCHEME

Machinery for One Unit

Main Canal & Branch Canal		D- and F-Canal		Road System	
Dozer, Crawler 100 HP		Dozer, Crawler 100 HP		Dozer, Crawler 100 HP	
Loader, Crawler 1.4 cu.m		Backhoe, Crawler 0.8 cu.m		Motor Grader	
Backhoe, Crawler 0.8 cu.m		Dump Truck 11 ton	2 Nos.	Dump Truck 11 ton	2 Nos.
Dump Truck 11 ton	3 Nos.	Concrete Mixer		Roller, Vibratory	
Concrete Mixer		Water Pump 2"		Water Bowser	
Water Pump 2"		Air Compressor		Farm Tractor 45 HP & 2.8 cu.m Trailor	2 Nos.
Air Compressor		Roller, Vibratory			
Pneumatic Drill		Farm Tractor 45 HP & 2.8 cyd Trailor	5 Nos.		
Roller, Vibratory					
Farm Tractor 45 HP & 2.8 cyd Trailor	5 Nos.				

- Topographical survey on the sites for construction of project offices and INMAS stations.

(2) Detailed Design and Preparation of Tender Documents

- Detailed designs, preparation of bills of quantities and estimation of construction costs.

- Preparation of tender documents including the design drawing required for bidding.

5.4 WORK SCHEDULE

Based on the basic policies adopted for the implementation of this project, the work schedule has been prepared on the following basis:

(1) Construction Period

Construction takes five years, following the detailed design work which would be completed within one year.

(2) Canal Works and Water Issue

The construction of canals would be concentrated in the dry season but some work could possibly be continued even when the irrigation water is being issued for the Maha cultivation during the rainy season.

(3) The INMAS stations are proposed to build at the first year for using as field offices.

The work schedule is given in Fig. 5.4.1.

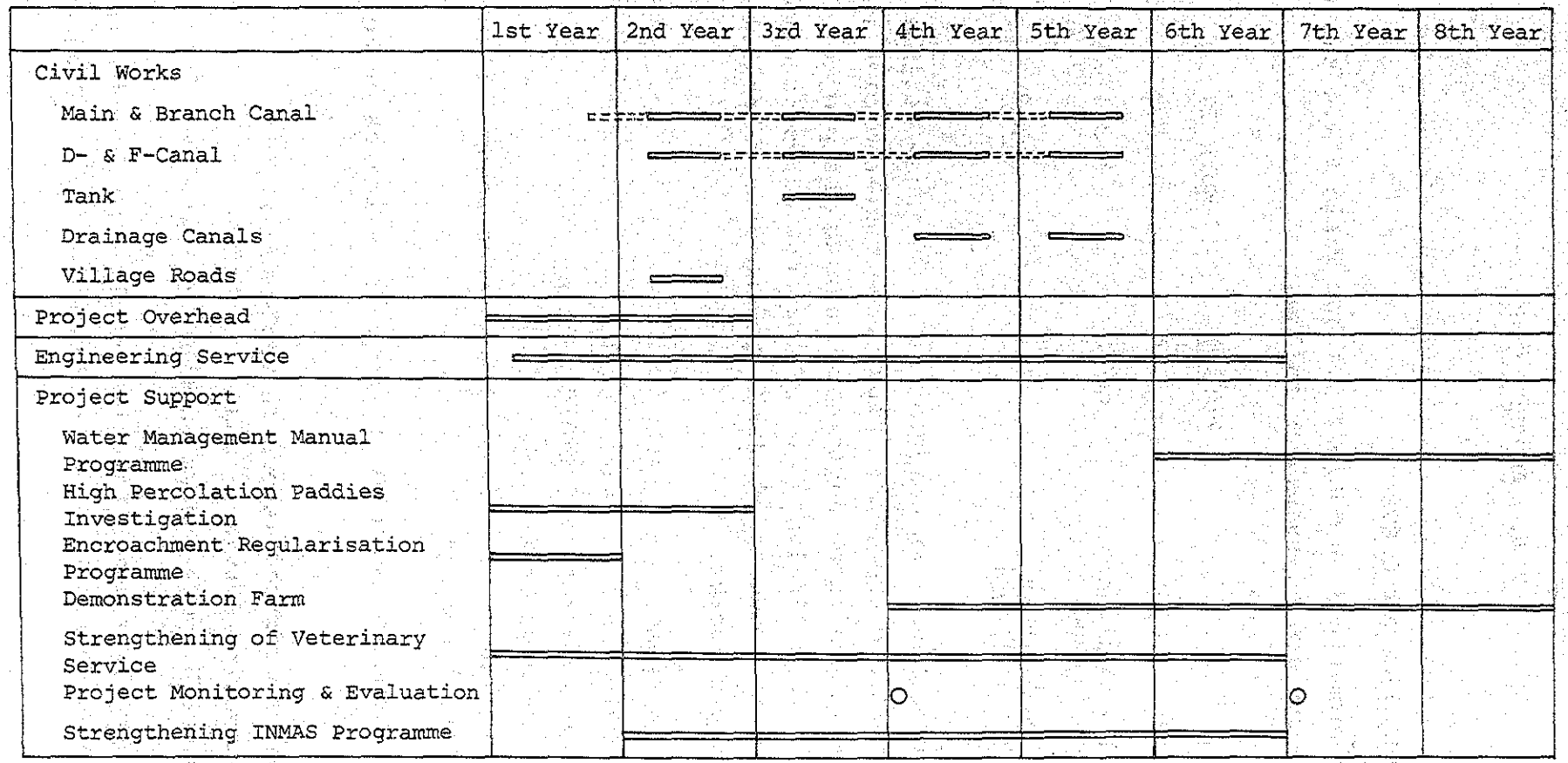


Fig. 5.4.1 WORK SCHEDULE OF NAGADEEPA SCHEME

6. PROJECT COST

6.1 WHOLE PROJECT COSTS

As summarized in Table 6.1.1 and Table 6.1.4 the total project costs are estimated as follows:

	Work I	Work II
(Rs. 1,000)	102,560	37,670
Dollar Equivalent (US$1,000)	3,730	1,371
Yen Equivalent (¥1,000,000)	783	288

These figures have been computed based on those estimated as of the end of December, 1985 plus price contingencies reflecting the inflation rates anticipated during the project duration. The major element included in the cost estimates is civil works which are made up of the following five rehabilitations and improvement works:

1) Reservoir,
2) Main canal & Branch canal,
3) Distributary and field canals,
4) Drainage canals and
5) Village roads (canal maintenance roads are included in 2) and 3)).

The other elements included in the cost estimates on Work (I) are:

Project overhead (shown in Table 6.1.2),
Engineering Services, and
Project Support (shown in Table 6.1.3).

Project Support as administration overhead will cover various programmes and strengthening line agencies in the Project.

Physical contingencies rated at 10% and price contingencies set at an annual rate of 5% for the foreign exchange component and at an annual rate of 15% for the local currency portion are also added to calculate the total project costs.

6.2 BREAKDOWN OF PROJECT COSTS

(1) Unit Cost

The unit cost used for estimating the construction costs as of the end of December 1985 has been taken from the "Data for Costing, January, 1980" published by the Government of Sri Lanka (Irrigation Department of the Ministry of Lands and Land Development) and also based on revised unit costs of January 1985 issued by the same department. Recourse has also been taken to the "Revised Rates for Civil Engineering Works, 1984" issued by the Mahaweli Engineering Construction Agency.

(2) Foreign Exchange and Local Currency Components

The construction costs divided into the two components of foreign exchange and local currency have been estimated in terms of the unit costs taken from the above cited "Data for Costing (1980)".

(3) Price Contingencies

Based on the "International Financial Statistics, November 1985" issued by IMF, price contingencies reflecting the inflation rates have been tentatively fixed at an annual rate of 5% for the foreign exchange component and at an annual rate of 15% for the local currency component (based on the average inflation rates from 1980 through 1984 in Sri Lanka). The undermentioned table incorporates the future inflation rates from 1986 through 1994 estimated by using the above inflation rates. Construction costs, which are those estimated at the beginning of the corresponding year,

have been computed in each fiscal year by a multiplication of the inflation rate over the previous year.

6.3 INVESTIMENT SCHEDULE

The project costs by year are estimated from the first year as commencement of works through the 8th year as per the implementation schedule. (shown in Tables 6.3.1 - 6.3.3)

Table 6.1.1 NAGADEEPA SCHEME PROJECT COST - WORK (I) -

Unit: Rs. '000

	Total Cost	F.C.	L.C.
1. Civil Works			
1) Main & Branch Canals	24,100	11,800	12,300
2) D- & F-Canals	15,300	7,800	7,500
3) Tank	1,900	1,000	900
4) Drainage Canals	4,700	2,500	2,200
5) Roads	2,700	1,300	1,400
Sub-total	48,700	24,400	24,300
2. Project Overhead	7,300	6,100	1,200
3. Engineering Services	5,000	3,500	1,500
4. Base Cost (1 + 2 + 3)	61,000	34,000	27,000
5. Project Support (Administration)	7,000	2,400	4,600
6. Physical Contingency (10 % of Base Cost)	6,000	3,600	2,400
7. Sub-total (4 + 5 + 6)	74,000	40,000	34,000
8. Price Contingency	28,560	6,460	22,100
Total Project Cost	102,560	46,460	56,100
(Dollar Equivalent to US$1,000)	3,730	1,690	2,040
J.Yen 1,000,000	783	355	428

* Currency Equivalents:

1 US$ = 27.5 Rs = 210 Yen

1 Rs. = 0.0364 US$ = 7.64 Yen

Table 6.1.2

NAGADEEPA SCHEME PROJECT OVERHEAD DETAILED COST

- WORK (I) - IRRIGATION DEPT. PROCUREMENT

Unit : Rs '000

	Unit Cost	Quantity	Toatl Cost	F.C.	L.C.
A. Office & Quaters					
Grade III	200	1	200	60	140
Grade III Repair	6	5	30	10	20
Grade II	150	2	300	90	210
INMAS Stations (Field Office)	500	2	1,000	300	700
Miscelloneous			70	40	30
S ub-total			1,600	500	1,100
B. Vehicle					
Jeeps	380	4	1,520	1,520	0
Staff Car	300	1	300	300	0
Spare Parts & Tools			180	180	0
Sub-total			2,000	2,000	0
C. Construction, O & M Machinery					
Pickup Trucks 1.5 tOn	440	2	880	880	0
Farm Tractors & Trailors	300	5	1,500	1,500	0
Lorries 5 ton	450	2	900	900	0
Sub-total			3,600	3,600	0
D. Office Equipment & Miscellaneous			100	0	100
TOTAL			7,300	6,100	1,200

Table 6.1.3 NAGADEEPA SCHEME - WORK (I) - PROJECT SUPPORT DETAILED COST

(unit : Rs '000)

	Quantity	Unit Cost	Total Cost	F.C.	L.C.
A. Irrigation Department					
Water Management Mannual Programme			500	200	300
High Percolation Paddies Investigation			300	180	120
Others			200	120	80
Sub-total			1,000	500	500
B. Land Commissioner's Dept.					
Buildings:					
Quarters Repair	10	50	500	150	350
Encroachment Regularisation Programme			130	30	100
Others			70	20	50
Sub-total			700	200	500
C. Dept. of Agriculture					
Buildings:					
Quarters Grade III	1	200	200	60	140
Grade II	1	150	150	50	100
Demonstration Farm			250	70	180
Literature & Extension Materials			150	50	100
Farmer Training, Field days			150	50	100
Banana, Sugar Cane Pilot Project			250	50	200
Others			150	70	80
Sub-total			1,300	400	900
D. Dept. of Agrarian Services					
Buildings:					
Fertilizer Store 80 Mt	1	170	170	50	120
" 20 Mt	2	80	160	50	110
Vehicles:					
Motorcycle	1	30	30		30
Bicycles	3	2	6	6	
Lorry 3 t	1	250	250	250	
Others			84	44	40
Sub-total			700	400	300

	Quantity	Unit Cost	Total Cost	F.C.	L.C.
E. Dept. of Animal Production & Health					
Buildings:					
Quarter Grade III	1	200	200	60	140
Grade II	1	150	150	50	100
Construction of Wind Mills			100	50	50
Cattle and Buffaloes Upgrading Programme			100	50	50
Strengthening of Veterinary Services			400	120	280
Curd Project			40		40
Others			110	70	40
Sub-total			1,100	400	700
F. Irrigation Management Div.					
Office Building	1	500	500	200	300
Quarters Grade III	1	200	200	60	140
Grade II	1	150	150	50	100
Salaries & Other Payment for I.O.'s (5 years)			400		400
Project Monitoring and Evaluation			300	50	250
Strengthening INMAS Programme (5 years)			500	100	400
Others			150	40	110
Sub-total			2,200	500	1,700
Total :			7,000	2,400	4,600

Table 6.1.4 NAGADEEPA SCHEME PROJECT COST - WORK (II) -

Unit: Rs. '000

		Total Cost	F.C.	L.C.
1.	Civil Works			
	1) Rural Water Supply	12,300	6,770	5,530
	2) Road	7,660	4,240	3,420
	Sub-total	19,960	11,010	8,950
2.	Project Overhead	2,000	1,600	400
3.	Engineering Services	2,000	1,400	600
4.	Base Cost (1 + 2 + 3)	23,960	14,010	9,950
5.	Project Support (Administration)	1,600	960	640
6.	Physical Contingency (10% of Base Cost)	2,440	1,430	1,010
7.	Sub-total (4 + 5 + 6)	28,000	16,400	11,600
8.	Price Contingency	9,670	2,190	7,480
	Total Project Cost	37,670	18,590	19,080
	(Dollar Equivalent to US$1,000)	1,371	677	694
	J. Yen 1,000,000)	288	142	146

* Currency Equivalents:

1 US$ = 27.5 Rs = 210 Yen

1 Rs. = 0.0364 US$ = 7.64 Yen

Table 6.3.1 IMPLEMENTATION SCHEDULE NAGADEEPA SCHEME : WORK (I)

DETAILED COSTS BY YEAR

Unit : Rs. '000

Item	Cost	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
1. Civil Work									
a) Main Canal & Branch Canal	24,100		4,100	5,000	7,800	7,200			
b) D- & F-Canal	15,300		5,000	5,600	3,100	1,600			
c) Tank	1,900			1,900					
d) Drainage Canals	4,700				2,700	2,000			
e) Roads	2,700		2,700						
Sub-toatl	48,700		11,800	12,500	13,600	10,800			
2. Project Overhead	7,300	6,200	1,100						
3. Engineering Service	5,000	1,600	1,000	700	700	700	300		
4. Base Cost (1+2+3)	61,000	7,800	13,900	13,200	14,300	11,500	300		
5. Project Support (Administration)	7,000	1,020	770	2,220	610	410	760	770	440
6. Physical Contingency (10 % of Base Cost)	6,000	770	1,350	1,300	1,400	1,150	30		
Sub-total	74,000	9,590	16,020	16,720	16,310	13,060	1,090	770	440
7. Price Contingency	28,560	640	3,430	5,660	7,750	8,270	1,060	1,020	730
Total Project Cost	102,560	10,230	19,450	22,380	24,060	21,330	2,150	1,790	1,170

Table 6.3.2 NAGADEEPA SCHEME IMPLEMENTATION SCHEDULE OF PROJECT SUPPORT : WORK (I)

DETAILED COSTS BY YEAR

Unit : Rs. '000

	Cost	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
Irrigation Department									
Water Management Manual Programme	600						200	200	200
High Percolation Paddies Investigation	400	200	200						
Land Commissioner's Department									
Quarters	550	250	300						
Encroachment Regularisation Programme	150	150							
Department of Agriculture									
Quarters	400			400					
Demonstration Farm	300				60	60	60	60	60
Literature & Extension Materials	150				40	40	40	30	
Farm Training, Field Days	150						50	100	
Banana, Sugar Cane Pilot Project	300						100	100	100
Department of Agrarian Service									
Fertilizer Store	350			250	100				
Vehicles	350	350							
Dept. of Animal Production & Health									
Quarters	400			400					
Construction of Wind Mills	100		50	50					
Cattle & Baffaloes Upgrading Programme	100		50	50					
Strengthening of Veterinary Service	450	70	70	70	80	80	80		
Curd Project	50					50			
Irrigation Management Division									
Office & Quarter	900			900					
Salaries & Other Payment for I.O.'s (5 years)	400				80	80	80	80	80
Project Monitoring & Evaluation	350				150			200	
Strengthening INMAS Programme	550		100	100	100	100	150		
TOTAL	7,000	1,020	770	2,220	610	410	760	770	440

Table 6.3.3 IMPLEMENTATION SCHEDULE NAGADEEPA SCHEME : WORK (II)

DETAILED COSTS BY YEAR

Unit : Rs. '000

	Cost	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year
1. Civil Work									
a) Rural Water Supply	12,300		3,300	3,000	3,000	3,000			
b) Road	7,660		3,660	4,000					
Sub-total	19,960		6,960	7,000	3,000	3,000			
2. Project Overhead	2,000	1,600	400						
3. Engineering Service	2,000	600	500	500	200	200			
4. Base Cost (1+2+3)	23,960	2,200	7,860	7,500	3,200	3,200			
5. Project Support (Administration)	1,600	250	250	250	300	250	300		
6. Physical Contingency (10 % of Base Cost)	2,440	220	800	760	330	330			
Sub-total	28,000	2,670	8,910	8,510	3,830	3,780	300		
7. Price Contingency	9,670	180	1,910	2,880	1,810	2,390	500		
Total Project Cost	37,670	2,850	10,820	11,390	5,640	6,170	800		

7. ECONOMIC EVALUATION

7.1 SCOPE AND APPROACH

7.1.1 Objective and Criteria

The main objective of the economic evaluation is to provide the standard for judging the economic feasibility of this Project from the national economic point of view.

During the procedure of the evaluation, the prices of goods and materials should be expressed not in financial prices but in economic prices (details will be mentioned in section 7.2.1). The main attention will be put on the comparison between "With Case" and "Without Case" in all components. The basic principle is to reckon the difference between the two as the cost and the benefit of this Project.

7.1.2 Scope of Construction Costs

This Project comprises many aspects such as rehabilitation of the irrigation and road system, rural water supply, rural industry development and improvement of transportation. As stated in para 4.1, the project components are divided into two categories;

(i) Work (I) - Works for rehabilitation and improvement of irrigation, drainage and road systems.

(ii) Work (II) - Works under the Community Development Programme.

The object for project evaluation is to be limited in the components of Work (I) which affect directly project benefits.

7.2 METHODOLOGY OF EVALUATION

7.2.1 Assumptions for Analysis

For the economic evaluation of the project the methodology adopted is the economic analysis which is the comparison of the tangible cost and benefit in present value derived from this project.

Countable (tangible) economic benefits and costs have been calculated using the following methodology and procedure.

(1) Clarification of the amount and the timing of the generation of the actual cost and benefit in market price.

evaluation period - 30 years
1st year - year when the detail design for construction starts

(2) Conversion of the financial prices into economic price for re-examined economic cost and benefit.

(3) Calculation of the economic internal rate of return based upon the net present values of the cost and benefit.

(4) Judgement by sensitivity tests on the possible risky cases which may affect the feasibility of this project.

Benefit and cost items are listed below. These benefits and costs are calculated for 30 years (project life).

Benefit	Cost
Paddy Production Increase (With-Without)	Construction Cost (As it is spent)
Chillie "	Production Cost Increase (With-Without)
Cowpea "	
Greengram "	Operation and Maintenance
Soyabean "	Cost Increase (With-Without)

Details will be mentioned in following sections.

Economic evaluation was carried out under the following assumptions.

(1) Construction requires 5 years of time. During the construction work the agricultural activities cannot be undertaken in Yala season (2 seasons for Minipe I, II, 4 seasons for Minipe III, IV and Nagadeepa. In Maha season normal agricultural activities can be carried out.

(2) The expenditure for construction cost will be spent for five years after the start of the work of the detail design for construction.

(3) The price is expressed in latest (1985 end) price. Price escalation is not considered.

(4) Calculation of the production increase is based on unmilled rice prices. The economic price is based upon the international price estimated by World Bank.*

(5) For the field crop prices, the financial prices are used for economic prices.

(6) Conversion factor is adopted as the World Bank report applies to Sri Lanka such as

0.85 for Standard Conversion Factor,
0.6 for Shadow Wage Rate. (0.85 for skilled labor)

(7) Tax interest, depreciation and subsidy as far as they are known should be subtracted for the conversion of the prices into economic price.

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* World Bank document of Mahaweli Ganga Development Project IV May, 1984

(8) In case items can not be valued at economic prices, financial prices are used for; e.g. power and domestic water charges, etc.

7.2.2 Economic Cost

- Construction Cost

Economic Costs are limited in the construction costs for the rehabilitation of the irrigation and road facilities which bring directly about the increase of the production of the several agricultural products in the benefitted area. (Table 7.2.1)

- Production Cost Increase

Production Cost of the several agricultural products will also increase. The difference expressed in economic price between "With Case" and "Without Case" will be listed as the economic cost.

- Operation and Maintenance Cost Increase

Operation and Maintenance Cost will also increase by aiming at appropriate level. The difference between "With Case" and "Without Case" expressed in economic prices will be listed as the economic costs. (details shown in Annex 14)

7.2.3 Economic Benefits

- Production Increase

Production increases are expected in paddy, chillie, cowpea, greengram, soyabean as already shown in para 4.3.3. The production difference between "With Case" and "Without Case" multiplied by the each economic price can be reckoned as part of the component of the economic benefits.

7.2.4 Economic Feasibility

The economic internal rate of return is calculated by converting the cost and benefit into the present value as follows:

Economic Internal Rate of Return (%)

Area	IRR
Minipe	16.9
Nagadeepa	17.7
Incorporation	17.1

These rates are over the 9% which is prevalent as the interest rate of the Bank of Ceylon and People's Bank. These rates are a little over 13% which is the opportunity cost applied by World Bank and other international banking facilities for Sri Lanka. The economic internal rate of this project shows that the economic feasibility of the project is not too low from the national economic point of view. Table 7.2.2 summarizes the economic cash flow of the base case of Minipe and Nagadeepa rehabilitation projects.

7.2.5 Project Risks and Sensitivity Tests

The project's economic viability was tested for its sensitivity with several assumptions of the risk occurrences.

- Prolongation of the construction work of rehabilitation

It is often observed that construction work cannot be executed as planned. The test was done in case the work was completed 3 years after the scheduled construction.

- 10% decrease of Paddy Yields

This is one of the key issues. Estimation of the yield of the paddy in base case is 5.0 ton/ha (Maha), 4.5 ton/ha (Yala). Risk was tested when they are 4.5 ton/ha (Maha), 4.0 ton/ha respectively.

- 10% decrease of upland crop prices

The price of highland crop are apt to fluctuate. The sensitivity analysis was executed in case the prices decreased 10% for entire project life.

Next table shows the results of the sensitivity tests.

Minipe Scheme

Possible Risky Case	Economic Internal Rate of Return (%)
Prolongation of the construction work	14.9
10% decrease of Paddy Yields	12.7
10% decrease of upland crop prices	16.2

Nagadeepa Scheme

Possible Risky Case	Economic Internal Rate of Return (%)
Prolongation of the construction work	17.5
10% decrease of Paddy Yields	14.3
10% decrease of upland crop prices	17.1

Case of Incorporation

Possible Risky Case	Economic Internal Rate of Return (%)
Prolongation of the construction work	15.1
10% decrease of Paddy Yields	13.0
10% decrease of upland crop prices	16.3

Table 7.2.1 PROJECT COST - WORK (I) -

Unit : Rs '000

	Total	Minipe	Nagadeepa
1. Civil Works			
Total Cost	231,700	183,000	48,700
Foreign	115,200	90,800	24,400
Local	116,500	92,200	24,300
2. Project Overhead			
Total Cost	21,900	14,600	7,300
Foreign	17,800	11,700	6,100
Local	4,100	2,900	1,200
3. Engineering Services			
Total Cost	25,400	20,400	5,000
Foreign	17,800	14,300	3,500
Local	7,600	6,100	1,500
4. Base Cost (1+2+3)			
Total Cost	279,000	218,000	61,000
Foreign	150,800	116,800	34,000
Local	128,200	101,200	27,000
5. Project Support (Administration)			
Toatl Cost	19,800	12,800	7,000
Foreign	6,700	4,300	2,400
Local	13,100	8,500	4,600
6. Physical Contingency			
Total Cost	27,200	21,200	6,000
Foreign	16,400	12,800	3,600
Local	10,800	8,400	2,400
7. Sub-toatl (4+5+6)			
Total Cost	326,000	252,000	74,000
Foreign	173,900	133,900	40,000
Local	152,100	118,100	34,000
8. Price Contingency			
Total Cost	136,460	107,900	28,560
Foreign	31,170	24,710	6,460
Local	105,290	83,190	22,100
Total Project Cost			
Total Cost	462,460	359,900	102,560
Foreign	205,070	158,610	46,460
Local	257,390	201,290	56,100
Dollar Equivalent to US$1,000			
Total Cost	16,830	13,100	3,730
Foreign	7,460	5,770	1,690
Local	9,370	7,330	2,040
J. Yen 1,000,000			
Total Cost	3,533	2,750	783
Foreign	1,567	1,212	355
Local	1,966	1,538	428

* Currency Equivalents: 1 US$ = 27.5 Rs = 210 Yen

Table 7.2.2 ECONOMIC CASH FLOW (BASE CASE - MINIPE & NAGADEEPA)

Unit : Million Rs

Year	1	2	3	4	5	6	7	8	9	10	11	12-30
Economic Benefit												
Net Economic Benefit from												
Paddy	-	-40.31	-40.31	-40.31	-40.31	26.43	58.96	73.23	83.12	91.81	100.04	105.57
Chillies	-	-2.44	-2.44	-2.44	-2.44	6.84	14.72	22.94	31.67	42.7	50.18	50.18
Cowpea	-	-0.56	-0.56	-0.56	-0.56	0.37	1.85	3.25	4.7	6.44	7.32	7.32
Greengram	-	-0.57	-0.57	-0.57	-0.57	1.7	2.73	3.78	4.9	6.39	7.32	7.32
Soya bean	-	-0.14	-0.14	-0.14	-0.14	2.37	3.47	4.7	6.11	7.7	8.9	8.9
Total Economic Benefits	-	-44.02	-44.02	-44.02	-44.02	37.71	81.73	107.9	130.5	155.04	173.76	179.29
Economic Cost												
Construction Cost	29.27	54.0	54.0	80.5	72.65	3.25	2.01	1.13				
Net Increase of Protection Cost	-	-28.0	-28.0	-28.0	-28.0	19.56	38.82	44.52	47.39	51.33	53.44	53.44
Net Increase of Operation and Maintenance Cost	-	-	-	-	-	4.56	4.56	4.56	4.56	4.56	4.56	4.56
Total Economic Cost	29.27	26.0	26.0	52.5	44.65	27.37	45.39	50.21	51.95	55.89	58.0	58.0
Net Economic Benefit	-29.27	-70.02	-70.02	-96.52	-89.3	10.34	36.34	57.69	78.55	99.15	115.76	121.29

8. RECOMMENDATION AND OUTSTANDING ISSUES

PROMOTION OF INMAS AND PROJECT SUPPORT PROGRAMMES

The Minipe and Nagadeepa Rehabilitation Projects have been proved to be technically feasible and economically sound and to meet the project targets, namely, good water management, appropriate supply of agricultural inputs, application of modern agricultural techniques, strengthening farmer supporting services and motivating farmers towards self-help.

The programme for Integrated Management of Major Irrigation Schemes (INMAS) seek to attain an overall objectives covering all the aspects mentioned above. Therefore it would be no exaggeration to say that this Project attributes its success to the effective implementation of the INMAS Programme and various supporting programmes under close cooperation of the line agencies.

In implementations of these programmes, farmer participation in the Project activities would definitely constitute an essential part of it by providing a forum for dialogue and inter-action both among farmers and between farmers and officers working in the Project Area.

There are many officers working in the Project Area with their normal duties being assinged by their respective agencies. In addition of farmer support, strengthening the line agencies such as construction of offices, quarters and provision of vehicles would also be indispensable. Thus, the related agencies are expected to execute mainly the following programmes in the middle and/or after rehabilitation works:

Irrigation Department

- Water Management Manual Programme
- High Percolation Paddies Investigation

Land Commissioner's Department

- Enchroachment Regularisation Programme

Department of Agriculture

- Demonstration Farm
- Farmer Training and Provision of Literature & Extension Materials
- Banana, Sugar Cane Pilot Project

Department of Animal Production & Health

- Cattle and Buffaloes Upgrading Programme
- Strengthening of Veterinary Services
- Curd Project

Department of Agrarian Services

- Provision of Fertilizer Store

Irrigation Management Division

- Project Monitoring and Evaluation Programme
- Strengthening INMAS Programme

These expenditures are estimated in Project Support costs (as stated in the previous chapter).

In order to provide for better co-ordinations and effectiveness, INMAS Stations are proposed for both Schemes; four Stations in the Minipe and two Stations in the Nagadeepa Scheme. (estimated in Project Overhead)

It is expected that discussions will be held between the line agencies regarding the staffing of such stations.

JOB OPPORTUNITIES FOR SECOND AND THIRD GENERATION

Rural Industry (Livestock)

There are no developed rural industries of any significance in either Scheme.

But, there already exists considerable potential for the development of livestock keeping as a rural industry both in Minipe and in Nagadeepa since around 90% of the farmers use either cattle and/or buffaloes for land preparation, and large numbers of both these species are to be found in each of these two schemes.

Livestock development might be promising of the prospective future demand and marketing in the large economic sphere is realized.

The basic policy is to emphasise removal of the present contraints. (para 4.4.12)

In addition of various proposed programmes, it is proposed to reclaim the uncultivated high land along the Mahaweli River for use as pasture land which could lay the foundation for future livestock development in Minipe.

The pasture land is scheduled to be developed at the same time as the rehabilitation works on the irrigation system. (proposed as Work II)

After reclamation, a basic policy on utilization of the pasture land covering the Nagadeepa Scheme as well should be made after discussions between the Ministry of Rural Industries Development and the Ministry of Lands and Land Development.

Livestock development is recommended for step by step implementation according to the regional programmes and the economic development so as to prepare job opportunities for the second and third generation settlers in the Project Areas.

Bridge across the Mahaweli River (Minipe)

Under the Mahaweli Development Programme System C starting from 1980, construction of towns and infrastructures are in progress at the opposite bank side of the Minipe Scheme. For economic development in the Minipe area, especially Stage III and IV, it would be essential to collaborate with System C area which is within the same economic sphere.

Stage III and IV of the Minipe Scheme, which are at present connected to the neighbouring areas only through Hettipola, tend to be isolated and cut-off from the main-stream of economic activity. It is very necessary therefore that these two Stages should be linked to future centres of economic development. Such a link would serve as a stimulus to economic growth in the Scheme Area (para 4.5.4).

In view of this necessity, a bridge crossing the Mahaweli River at Hembarawa is recommended for construction in order to link these two stages with the larger economic sphere.

Follow-up studies regarding the future trend of demands and marketing of agricultural and dairy products, animal power and labour requirement as well should be undertaken in association with related agencies prior to implementation of the Bridge Project: (Economic evaluation shown in Annex 14)

HIGH PERCOLATION PADDY LANDS

High and medium percolation paddy lands have been identified in the Minipe Area (para 3.4.6). Follow-up study for both the Schemes would be undertaken to evolve a plan for sub soil layer improvement and soil dressing measures and identifying their location more clearly.

REGULARISATION OF ENCROACHMENTS

Encroachment is a problem for water management both in Minipe and in Nagadeepa. The encroachers in the Minipe Scheme are generally sons of the settlers themselves and consequently there is a great deal of social cohesion between the settlers and the encroachers. In Nagadeepa, however, our field investigations revealed that the encroachers are predominantly outsiders who have come to work as casual labourers in the Scheme. Consequently there is few social cohesion between the encroachers and the settlers themselves.

Through regularisation of encroachement, encroachers' participation to the farmers' organisations would be secured prior to the rehabilitation works especially in the Nagadeepa Area.

The Register Programme should be executed prior to the rehabilitation works by identifying D & F canal covering areas and specification and encroachment areas in separate sections for the whole project areas. Land Register would be indispensable not only to regularisation but to drawing up water management plan. This Programme is estimated in Project Support costs.

HEEN GANGA GAUGING STATION

Discharge of the Heen Ganga as an important additional water source was surveyed by the Team during the field study period of June and July, 1985. However any other discharge records have not been available.

A gauging station near the proposed diversion weir site should be built and commence recording daily discharge as soon as possible.

* * * * * * *

DRAWINGS

(MINIPE SCHEME)

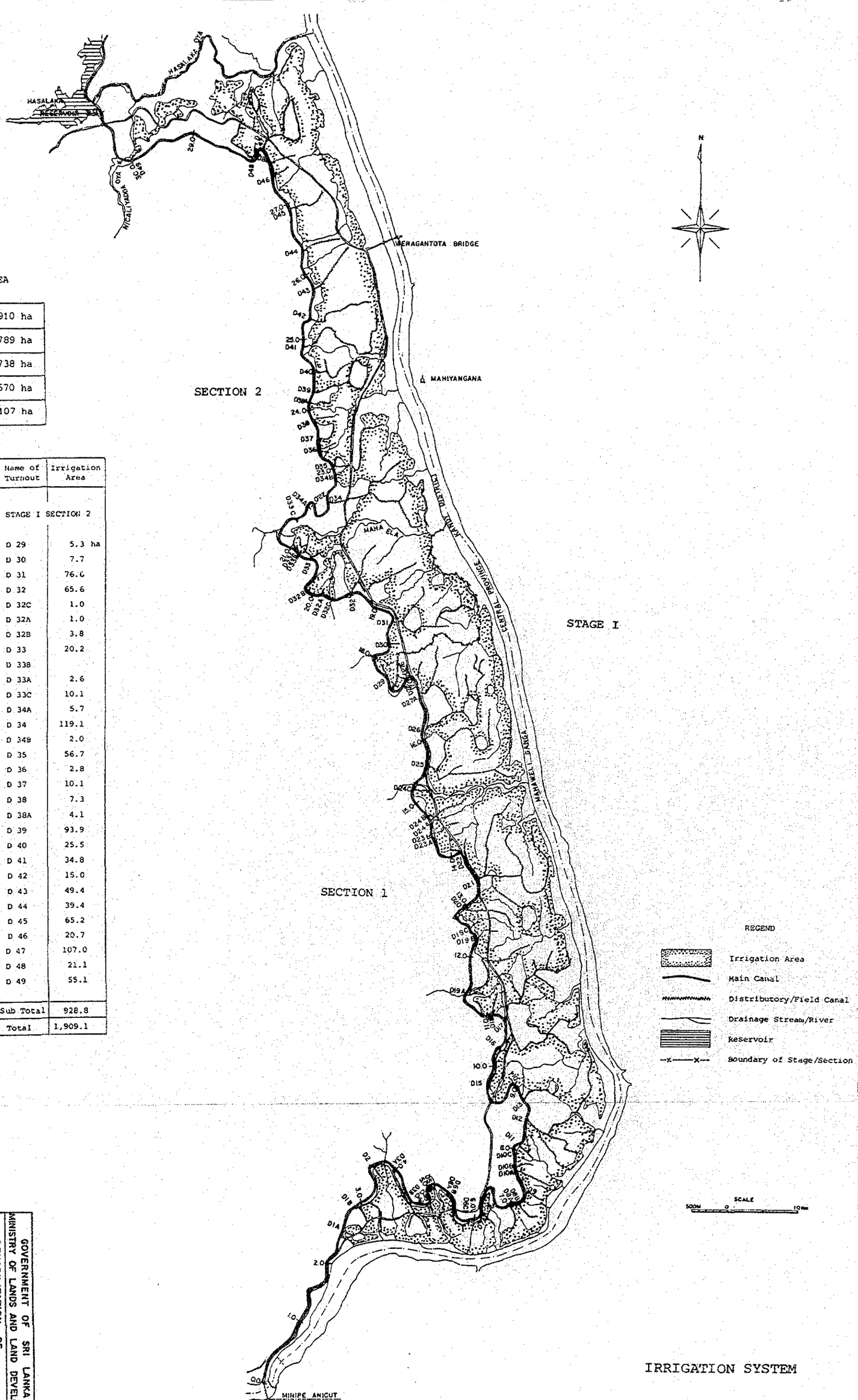
LIST OF DRAWINGS

D.W.G. No.	Title
01 - 1/3	Existing Irrigation System - Stage I -
01 - 2/3	Existing Irrigation System - Stage II -
01 - 3/3	Existing Irrigation System - Stage III & IV -
02 - 1/8 ↓ 02 - 8/8	Longitudial Section of Main Canal
03	Flow Measuring Device
04	Gated Regulator
05	Turnout
06	Spill cum Causeway with Wasteway
07	Drainage Undercrossing
08	Foot Bridge
09	Bathing & Washing Place
10	Heen Ganga Intake Facilities

IRRIGATION AREA

STAGE I	1,910 ha
STAGE II	1,789 ha
STAGE III	1,738 ha
STAGE IV	670 ha
TOTAL	6,107 ha

Name of Turnout	Irrigation Area	Name of Turnout	Irrigation Area
STAGE I SECTION 1		STAGE I SECTION 2	
D 1A	10.9 ha		
D 1B	37.6	D 29	5.3 ha
D 2	2.8	D 30	7.7
D 3A	8.9	D 31	76.6
D 3	32.8	D 32	65.6
D 4A	1.4	D 32C	1.0
D 4B	3.6	D 32A	1.0
D 5	2.0	D 32B	3.8
D 6A	2.0	D 33	20.2
D 6B	15.0	D 33B	
D 6C	4.0	D 33A	2.6
D 7A	8.9	D 33C	10.1
D 7B	9.8	D 34A	5.7
D 8A	9.7	D 34	119.1
D 8B	16.7	D 34B	2.0
D 9	9.8	D 35	56.7
D 10A	12.1	D 36	2.8
D 10B	3.6	D 37	10.1
D 10C		D 38	7.3
D 11	6.5	D 38A	4.1
D 12	85.0	D 39	93.9
D 13	37.3	D 40	25.5
D 14	14.6	D 41	34.8
D 15	6.5	D 42	15.0
D 16	74.1	D 43	49.4
D 17	69.7	D 44	39.4
D 18	14.2	D 45	65.2
D 19A	30.4	D 46	20.7
D 19B	16.2	D 47	107.0
D 19C	4.9	D 48	21.1
D 20	19.8	D 49	55.1
D 21	149.8		
D 22	2.0	Sub Total	928.8
D 23A	15.4	Total	1,909.1
D 23B	9.5		
D 24A	15.4		
D 24B	2.4		
D 24C	2.4		
D 25	103.7		
D 26	66.8		
D 27A	31.2		
D 27B	6.5		
D 28	4.4		
Sub Total	980.3		



STAGE I

IRRIGATION SYSTEM

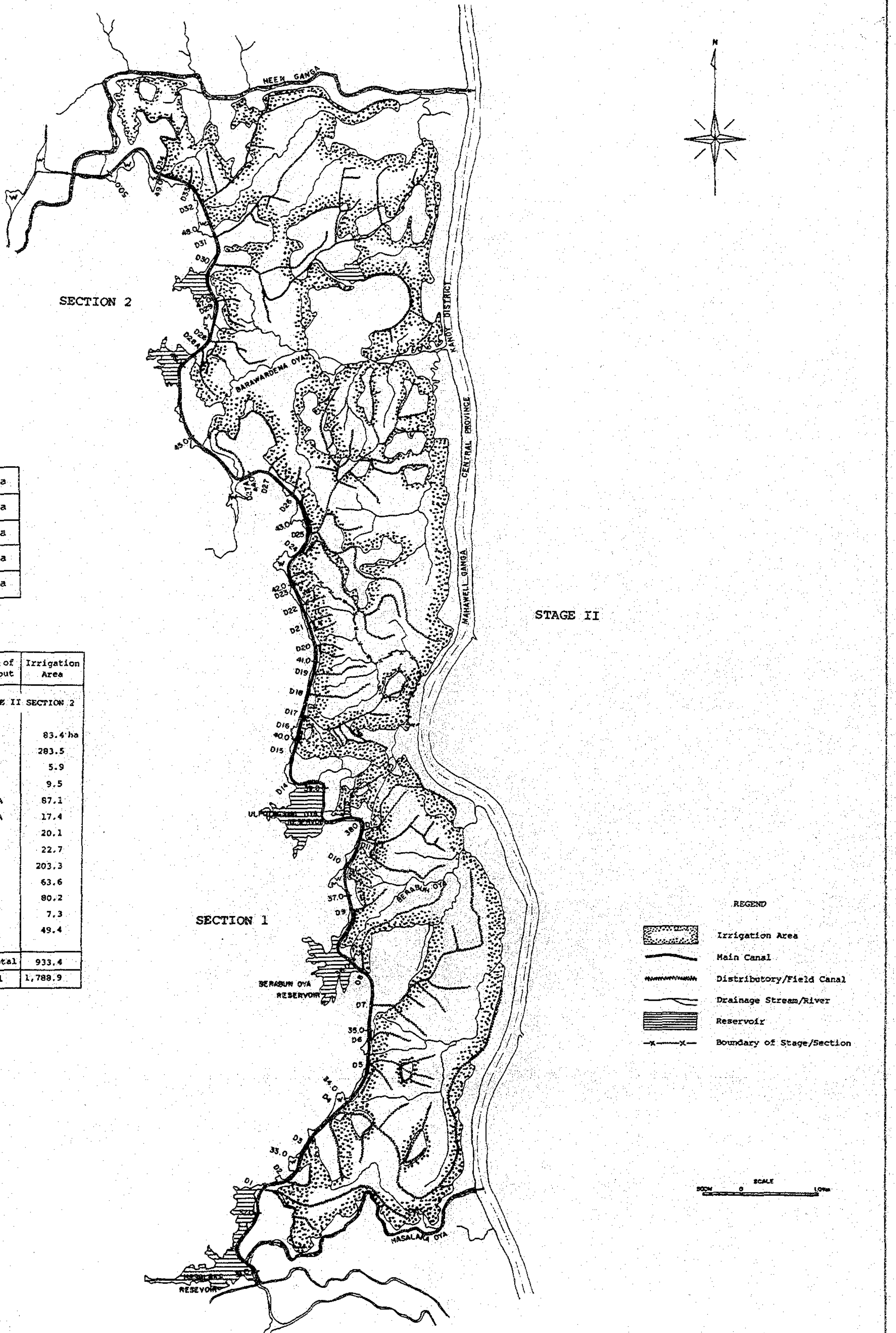
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT
REHABILITATION OF
MINIPE IRRIGATION SCHEME

EXISTING IRRIGATION SYSTEM
- STAGE I -

DATE: MARCH 18, 1986 | D.W.G. No.: 01-1/3

JAPAN INTERNATIONAL COOPERATION AGENCY

IRRIGATION SYSTEM



IRRIGATION AREA

STAGE I	1,910 ha
STAGE II	1,789 ha
STAGE III	1,738 ha
STAGE IV	670 ha
TOTAL	6,107 ha

Name of Turnout	Irrigation Area
STAGE II SECTION 1	
D 1	71.1 ha
D 2	5.5
D 3	9.7
D 4	163.6
D 5	43.7
D 6	17.8
D 7	129.6
D 8	42.2
D 9	19.9
D 10	8.7
D 11	80.6
D 12	54.5
D 13	21.7
D 14	11.7
D 15	6.5
D 16	12.1
D 17	80.0
D 18	25.1
D 19	15.0
D 20	13.8
D 21	8.1
D 22	7.7
D 23	6.9
Sub Total	855.5

Name of Turnout	Irrigation Area
STAGE II SECTION 2	
D 24	83.4 ha
D 25	283.5
D 26	5.9
D 27	9.5
D 27A	87.1
D 28A	17.4
D 28	20.1
D 29	22.7
D 30	203.3
D 31	63.6
D 32	80.2
D 33	7.3
D 34	49.4
Sub Total	933.4
Total	1,788.9

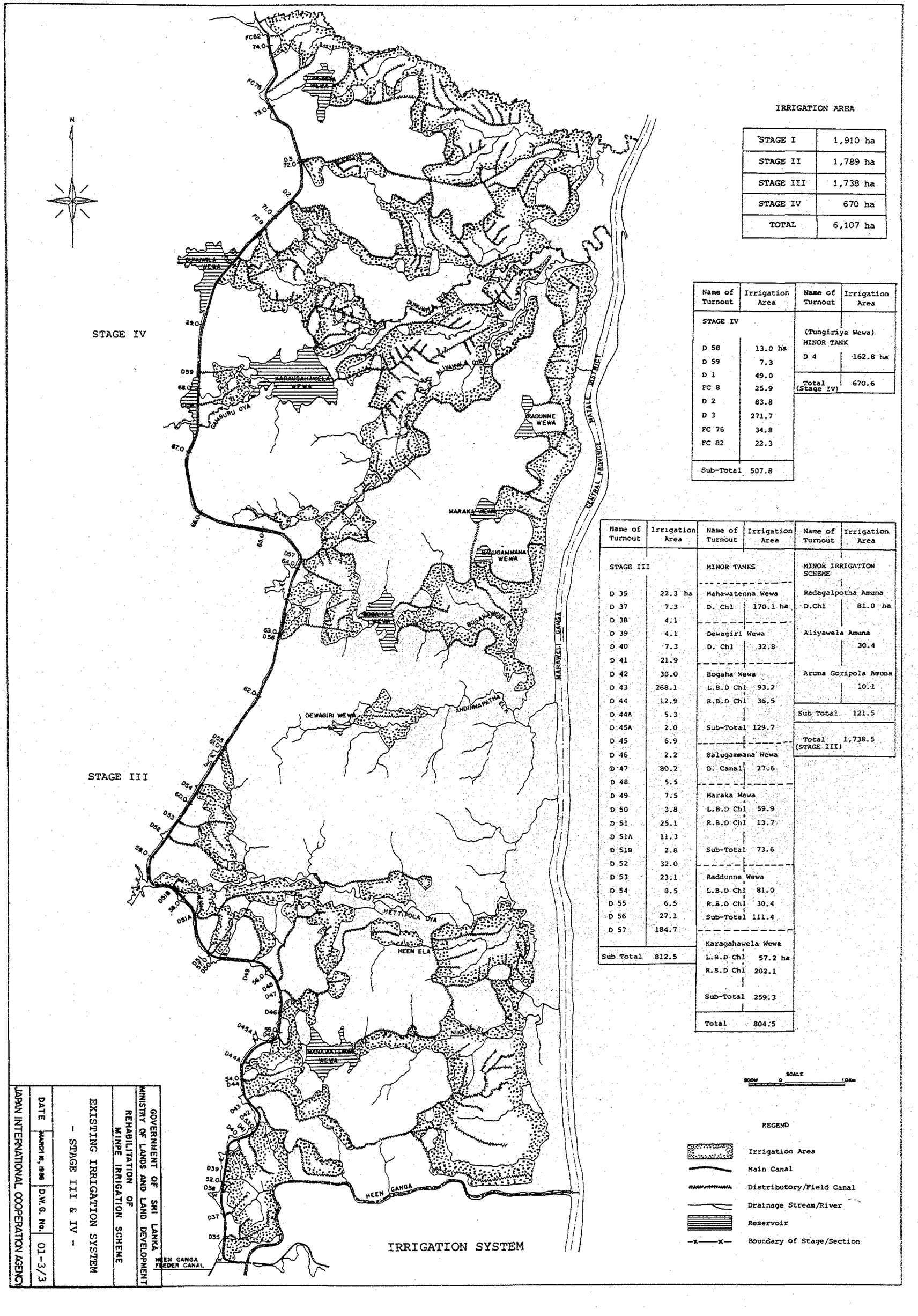
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF MINPE IRRIGATION SCHEME

EXISTING IRRIGATION SYSTEM
- STAGE II -

DATE	MARCH 18, 1986	D.W.G. No.	01-2/3

JAPAN INTERNATIONAL COOPERATION AGENCY



IRRIGATION AREA

STAGE I	1,910 ha
STAGE II	1,789 ha
STAGE III	1,738 ha
STAGE IV	670 ha
TOTAL	6,107 ha

Name of Turnout	Irrigation Area	Name of Turnout	Irrigation Area
STAGE IV		(Tungiriya Wewa) MINOR TANK	
D 58	13.0 ha	D 4	162.8 ha
D 59	7.3		
D 1	49.0	Total (Stage IV)	670.6
FC 8	25.9		
D 2	83.8		
D 3	271.7		
FC 76	34.8		
FC 82	22.3		
Sub-Total	507.8		

Name of Turnout	Irrigation Area	Name of Turnout	Irrigation Area	Name of Turnout	Irrigation Area
STAGE III		MINOR TANKS		MINOR IRRIGATION SCHEME	
D 35	22.3 ha	Mahawatenna Wewa		Radagalpotha Amuna	
D 37	7.3	D. Chl	170.1 ha	D.Chl	81.0 ha
D 38	4.1				
D 39	4.1	Dewagiri Wewa		Aliyawela Amuna	
D 40	7.3	D. Chl	32.8		30.4
D 41	21.9				
D 42	30.0	Bogaha Wewa		Aruna Goripola Amuna	
D 43	268.1	L.B.D Chl	93.2		10.1
D 44	12.9	R.B.D Chl	36.5		
D 44A	5.3			Sub Total	121.5
D 45A	2.0	Sub-Total	129.7		
D 45	6.9			Total (STAGE III)	1,738.5
D 46	2.2	Balugammana Wewa			
D 47	30.2	D. Canal	27.6		
D 48	5.5				
D 49	7.5	Maraka Wewa			
D 50	3.8	L.B.D Chl	59.9		
D 51	25.1	R.B.D Chl	13.7		
D 51A	11.3				
D 51B	2.8	Sub-Total	73.6		
D 52	32.0				
D 53	23.1	Raddunne Wewa			
D 54	8.5	L.B.D Chl	81.0		
D 55	6.5	R.B.D Chl	30.4		
D 56	27.1	Sub-Total	111.4		
D 57	184.7				
		Karagahawela Wewa			
Sub Total	812.5	L.B.D Chl	57.2 ha		
		R.B.D Chl	202.1		
		Sub-Total	259.3		
		Total	804.5		

REGEND

- Irrigation Area
- Main Canal
- Distributory/Field Canal
- Drainage Stream/River
- Reservoir
- Boundary of Stage/Section

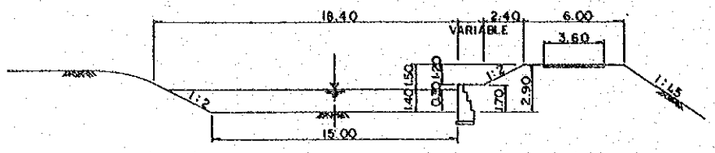
EXISTING IRRIGATION SYSTEM
- STAGE III & IV -

MINPE IRRIGATION SCHEME
REHABILITATION OF

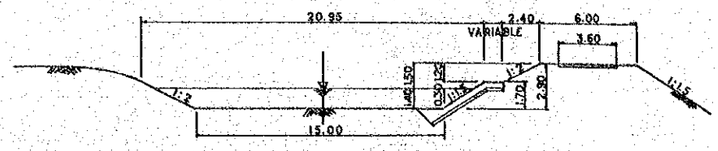
MINISTRY OF LANDS AND LAND DEVELOPMENT
GOVERNMENT OF SRI LANKA

DATE	MARCH 18, 1996
D.W.G. No.	01-3/3

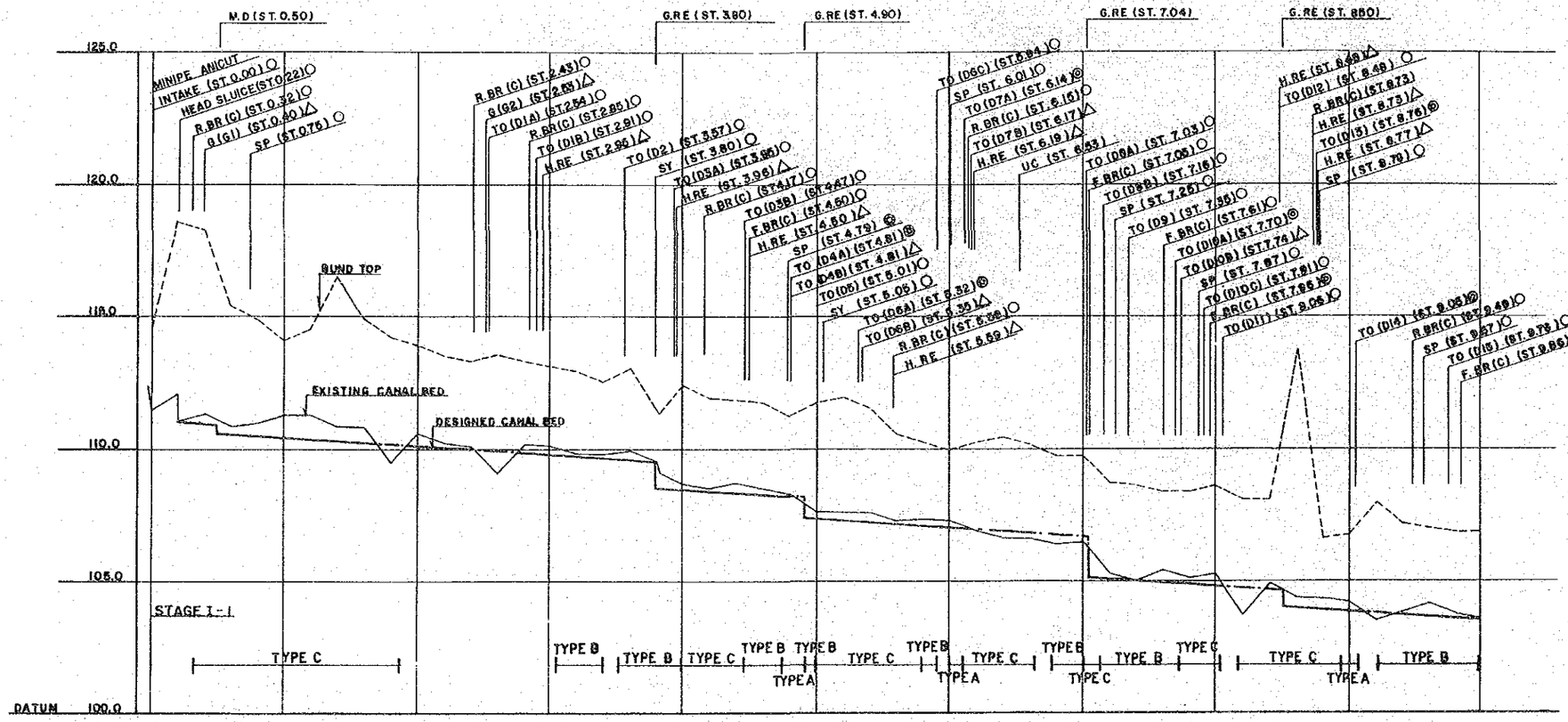
JAPAN INTERNATIONAL COOPERATION AGENCY



TYPICAL SECTION (STAGE I-I, TYPE A)



TYPICAL SECTION (STAGE I-I, TYPE B)



Note: Proposed Bathing & Washing Place and Access Slope for Buffalos are Not Given

LEGEND

———	to be Newly Constructed
○	to be Repaired
⊗	to be Reconstructed
△	to be Removed
M.D	Measuring Device
TO	Turnout in Main Canal
G. RE	Gate Regulator
H. RE	H-beam Regulator
G. SP	Gated Spillway
SP	Spillway
SY	Syphon
OC	Over Crossing
R. BR (c)	Bridge (Road / concrete)
R. BR (w)	Bridge (Road / wood)
F. BR (c)	Bridge (Foot / concrete)
F. BR (w)	Bridge (Foot / wood)
UC	Drainage Under Crossing
CL	Drain Culvert
G	Gauging staff

VERTICAL SCALE
0 5M

HORIZONTAL SCALE
0 500 1000M

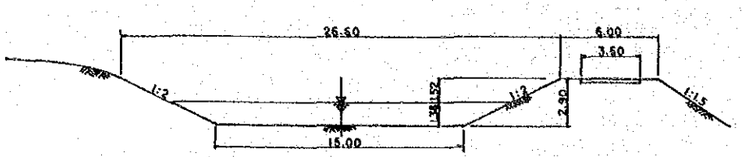
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF
MINPE IRRIGATION SCHEME

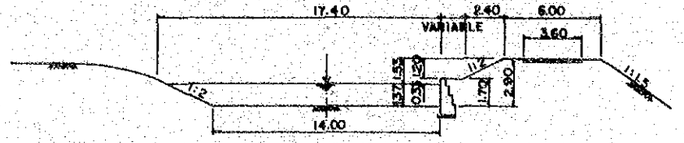
LONGITUDINAL SECTION
OF
MAIN CANAL (1)

DATE	MARCH 18, 1986	D.W.G. No.	02-1/8

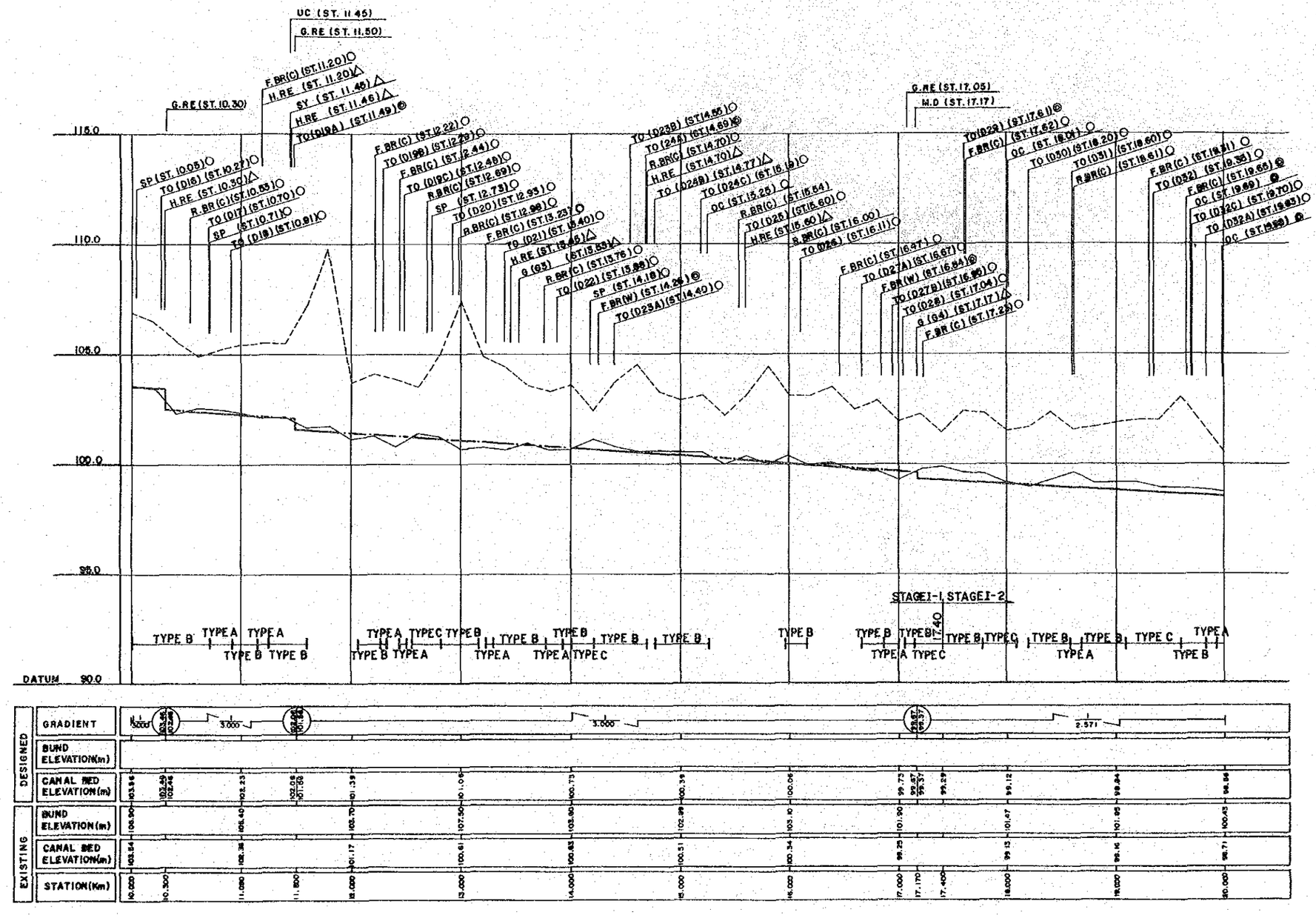
JAPAN INTERNATIONAL COOPERATION AGENCY



TYPICAL SECTION (STAGE I-1, TYPE C)



TYPICAL SECTION (STAGE I-2, TYPE A)



DESIGNED	GRADIENT	1/3000, 1/3000, 1/3000, 1/2571
	BUND ELEVATION(m)	
	CANAL BED ELEVATION(m)	103.96, 102.49, 102.48, 102.23, 102.08, 101.98, 101.39, 101.06, 100.73, 100.39, 100.06, 99.73, 99.67, 99.57, 99.39, 99.12, 98.84, 98.56
EXISTING	BUND ELEVATION(m)	106.50, 106.40, 105.70, 107.50, 103.80, 102.99, 103.10, 101.90, 101.67, 101.95, 100.43
	CANAL BED ELEVATION(m)	103.84, 102.36, 101.17, 100.61, 100.83, 100.51, 100.34, 99.23, 99.13, 98.16, 98.71
	STATION(Km)	10.020, 10.300, 11.080, 11.800, 12.000, 14.000, 15.000, 16.020, 17.000, 17.170, 17.400, 18.000, 19.000, 20.000

LEGEND

⌐¬	to be Newly Constructed
○	to be Repaired
◉	to be Reconstructed
△	to be Removed
M.D	Measuring Device
TO	Turnout in Main Canal
G.RE	Gate Regulator
H.RE	H-beam Regulator
G.SP	Gated Spillway
SP	Spillway
SY	Syphon
OC	Over Crossing
R.BR (c)	Bridge (Road / concrete)
R.BR (w)	Bridge (Road / wood)
F.BR (c)	Bridge (Foot / concrete)
F.BR (w)	Bridge (Foot / wood)
UC	Drainage Under Crossing
CL	Drain Culvert
G	Gauging staff

VERTICAL SCALE 0 5M

HORIZONTAL SCALE 0 500 1000M

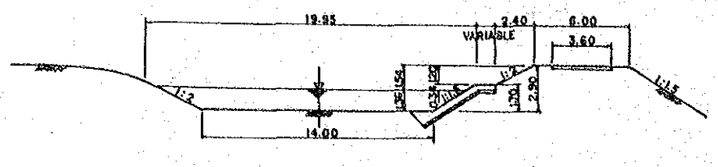
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF
MINPE IRRIGATION SCHEME

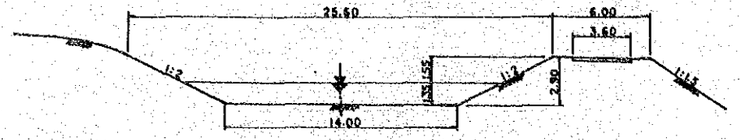
LONGITUDINAL SECTION OF MAIN CANAL (2)

DATE	MARCH 18, 1986	D.W.G. No.	02-2/8

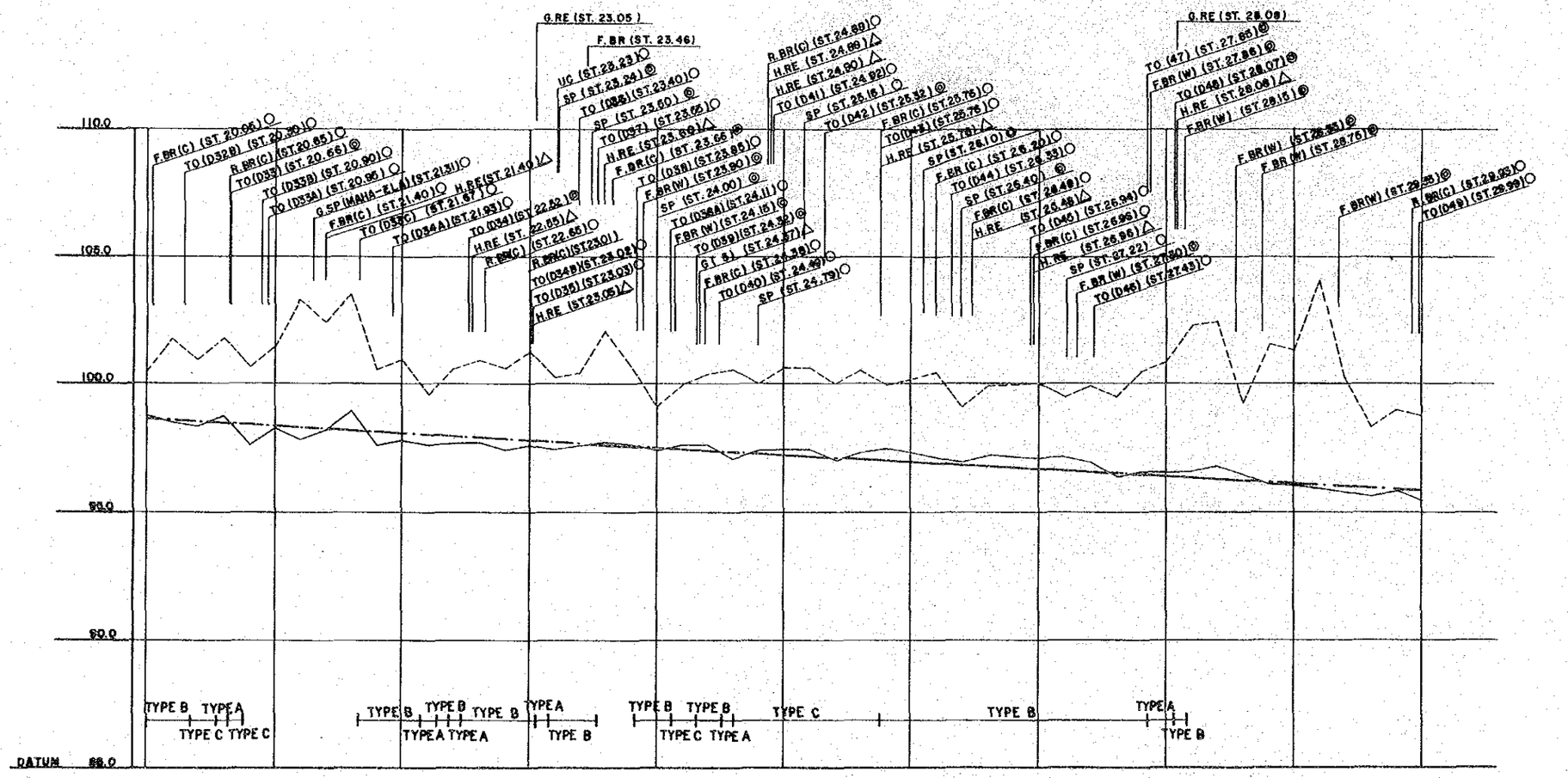
JAPAN INTERNATIONAL COOPERATION AGENCY



TYPICAL SECTION (STAGE I-2, TYPE B)



TYPICAL SECTION (STAGE I-2, TYPE C)



LEGEND

———	to be Newly Constructed
O	to be Repaired
◎	to be Reconstructed
△	to be Removed
M.D	Measuring Device
TO	Turnout in Main Canal
G. RE	Gate Regulator
H. RE	H-beam Regulator
G. SP	Gated Spillway
SP	Spillway
SY	Syphon
OC	Over Crossing
R.BR (c)	Bridge (Road / concrete)
R. BR (w)	Bridge (Road / wood)
F. BR (c)	Bridge (Foot / concrete)
F. BR (w)	Bridge (Foot / wood)
UC	Drainage Under Crossing
CL	Drain Culvert
G	Gauging staff

VERTICAL SCALE
0 5M
HORIZONTAL SCALE
0 500 1000M

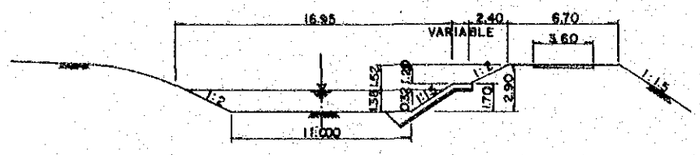
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF
MINPE IRRIGATION SCHEME

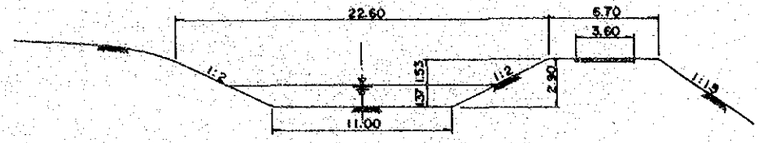
LONGITUDINAL SECTION OF MAIN CANAL (3)

DATE	MARCH 18, 1986	D.W.G. No.	02-3/8

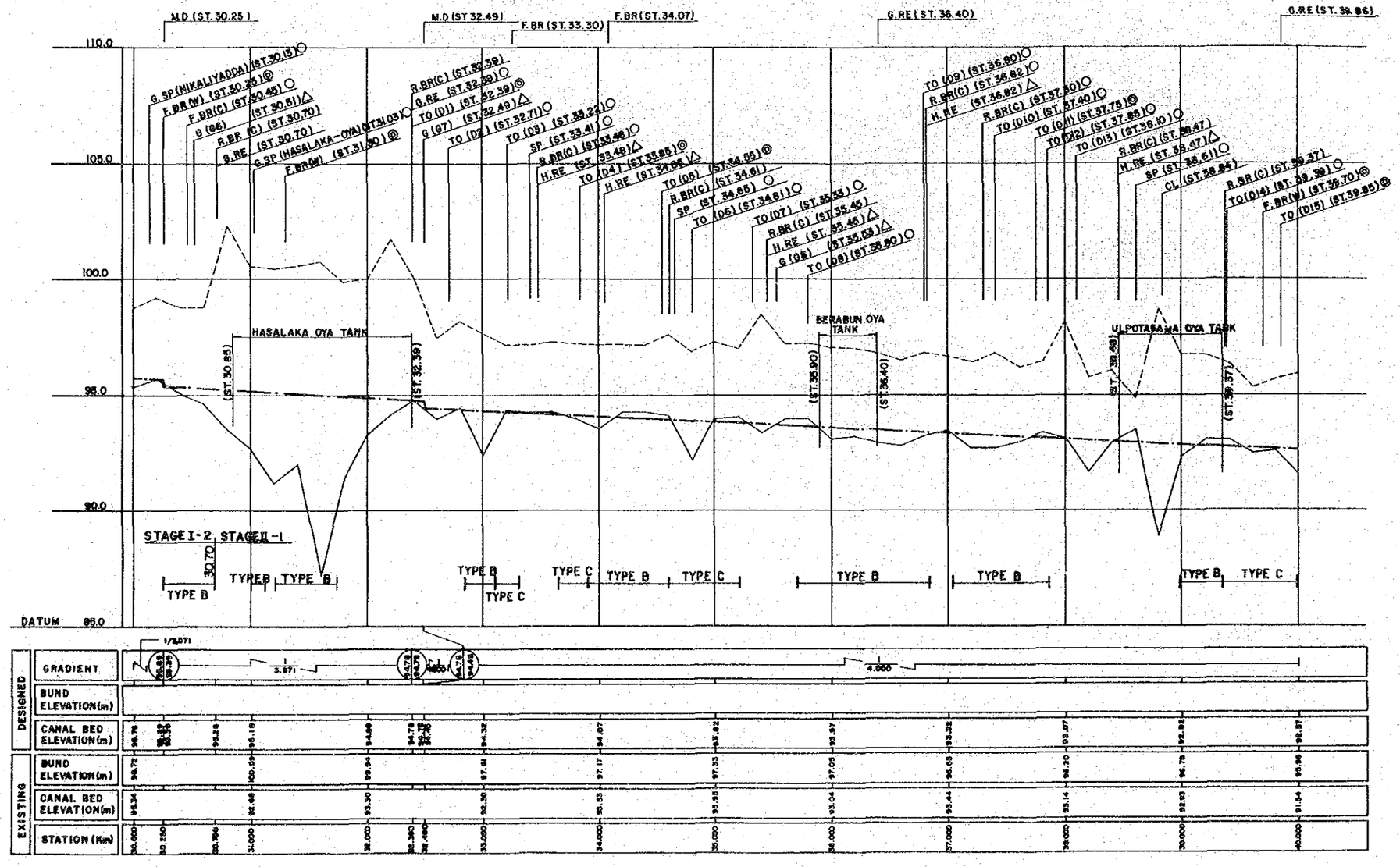
JAPAN INTERNATIONAL COOPERATION AGENCY



TYPICAL SECTION (STAGE II-1, TYPE B)



TYPICAL SECTION (STAGE II-1, TYPE C)



LEGEND

⌐¬	to be Newly Constructed
O	to be Repaired
Ⓡ	to be Reconstructed
△	to be Removed
M.D	Measuring Device
TO	Turnout in Main Canal
G.RE	Gate Regulator
H.RE	H-beam Regulator
G.SP	Gated Spillway
SP	Spillway
SY	Syphon
OC	Over Crossing
R.BR (c)	Bridge (Road / concrete)
R.BR (w)	Bridge (Road / wood)
F.BR (c)	Bridge (Foot / concrete)
F.BR (w)	Bridge (Foot / wood)
UC	Drainage Under Crossing
CL	Drain Culvert
G	Gauging staff

VERTICAL SCALE
0 5M

HORIZONTAL SCALE
0 500 1000M

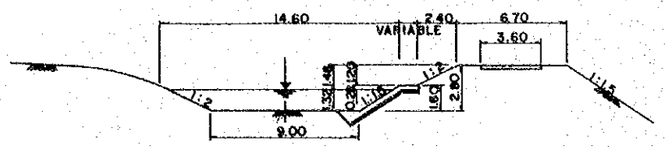
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF
MINIPE IRRIGATION SCHEME

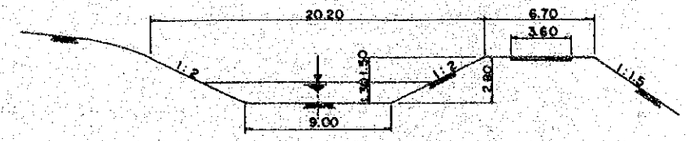
LONGITUDINAL SECTION OF MAIN CANAL (4)

DATE	MARCH 19, 1986	D.W.G. No.	02-4/8

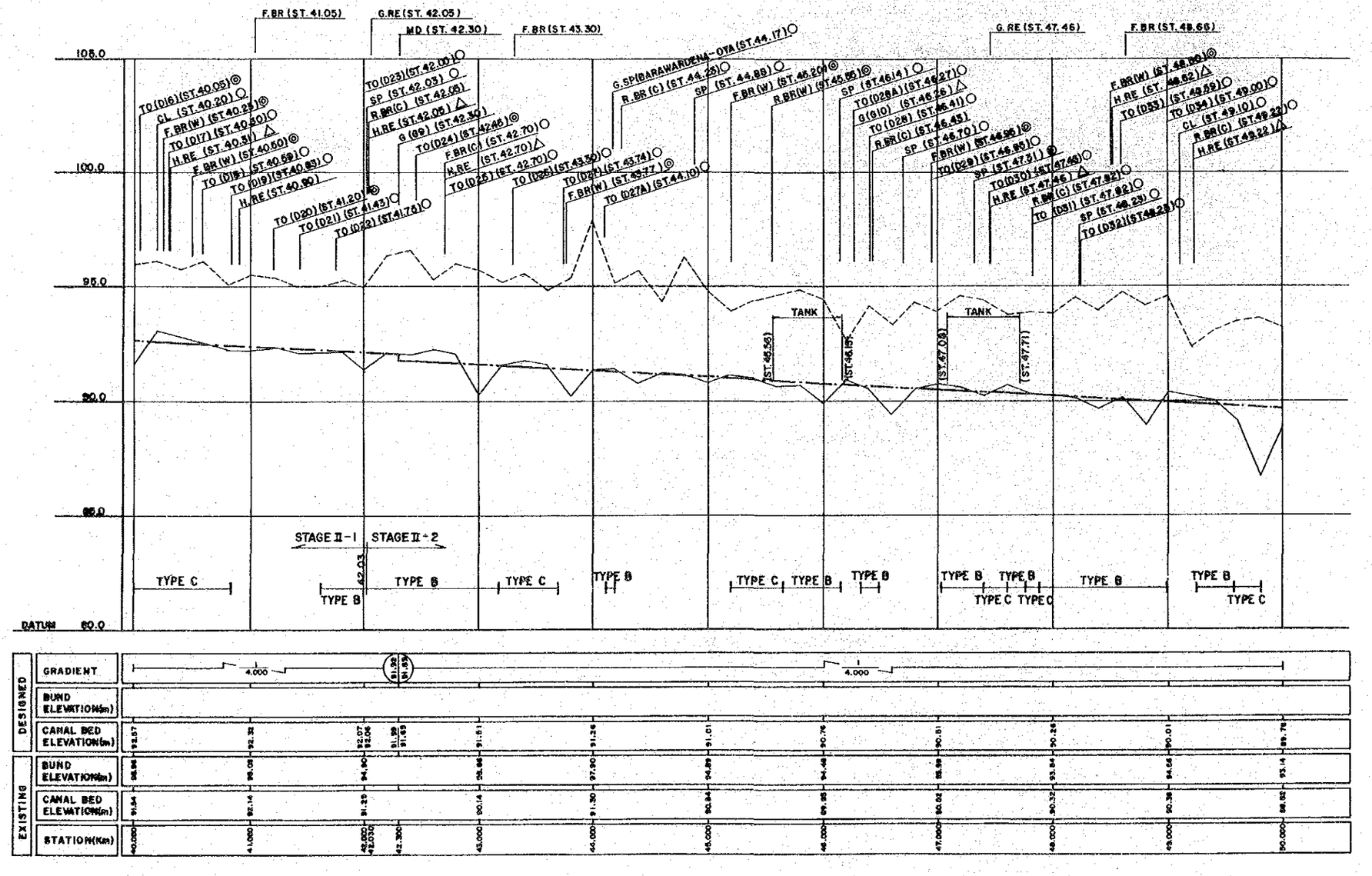
JAPAN INTERNATIONAL COOPERATION AGENCY



TYPICAL SECTION (STAGE II-2, TYPE B)



TYPICAL SECTION (STAGE II-2, TYPE C)



LEGEND

⌐¬	to be Newly Constructed
○	to be Repaired
⊗	to be Reconstructed
△	to be Removed
M.D	Measuring Device
TO	Turnout in Main Canal
G. RE	Gate Regulator
H. RE	H-beam Regulator
G. SP	Gated Spillway
SP	Spillway
SY	Syphon
OC	Over Crossing
R. BR (c)	Bridge (Road/concrete)
R. BR (w)	Bridge (Road/wood)
F. BR (c)	Bridge (Foot/concrete)
F. BR (w)	Bridge (Foot/wood)
UC	Drainage Under Crossing
CL	Drain Culvert
G	Gauging staff

VERTICAL SCALE
0 5M
HORIZONTAL SCALE
0 500 1000M

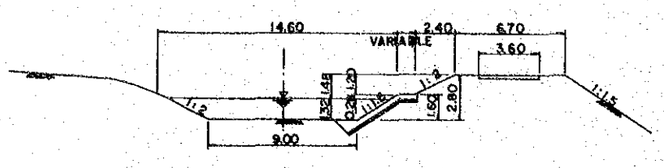
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF
MINIPE IRRIGATION SCHEME

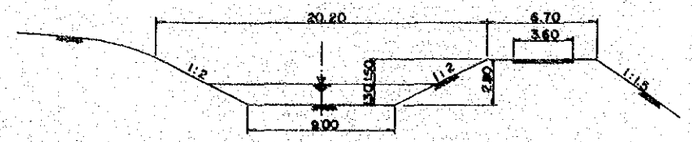
LONGITUDINAL SECTION OF MAIN CANAL (5)

DATE	MARCH 18, 1986	D.W.G. No.	02-5/8

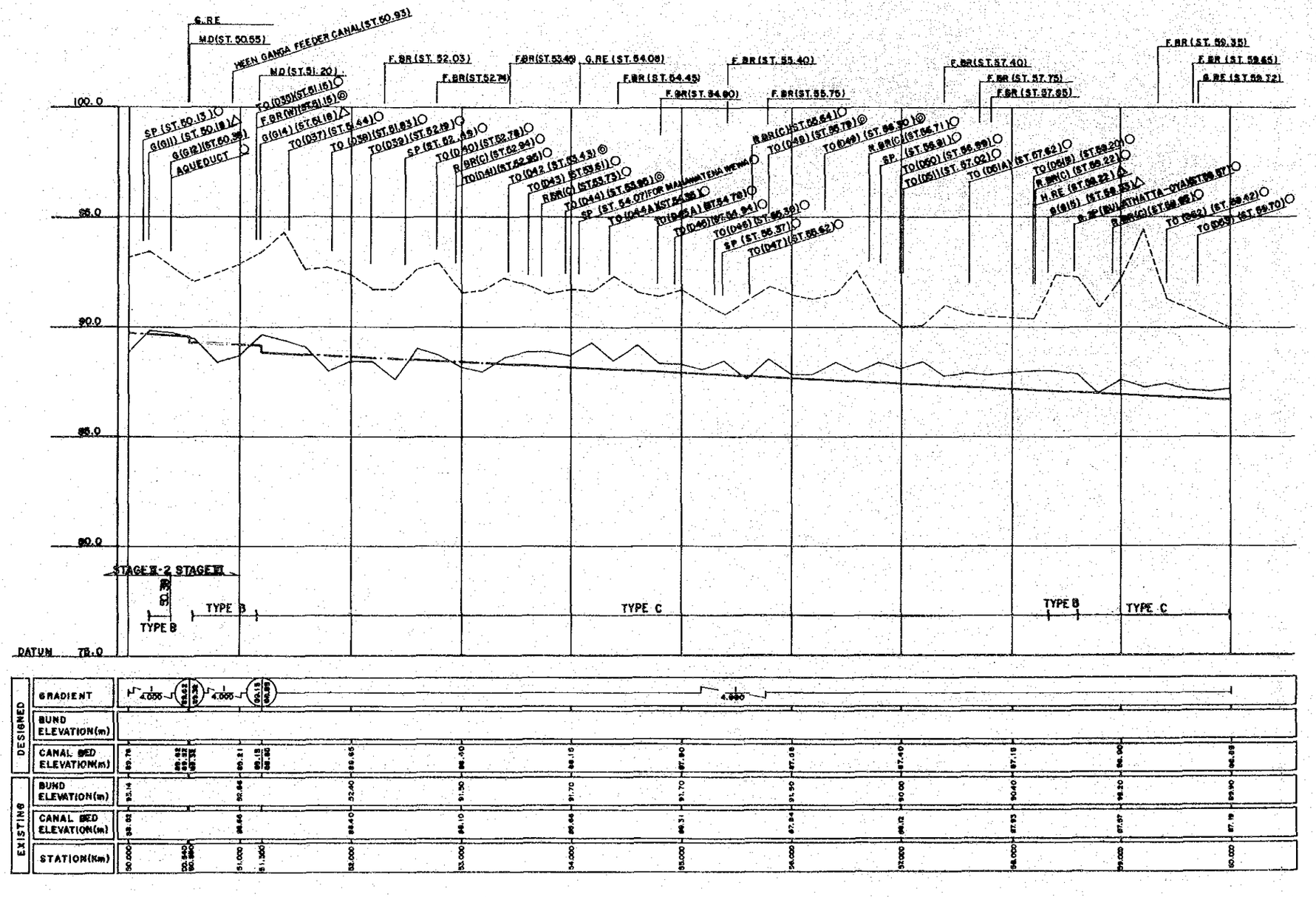
JAPAN INTERNATIONAL COOPERATION AGENCY



TYPICAL SECTION (STAGE III, TYPE B)



TYPICAL SECTION (STAGE III, TYPE C)



LEGEND

———	to be Newly Constructed
O	to be Repaired
◎	to be Reconstructed
△	to be Removed
M.D	Measuring Device
TO	Turnout in Main Canal
G.RE	Gate Regulator
H.RE	H-beam Regulator
G.SP	Gated Spillway
SP	Spillway
SY	Syphon
OC	Over Crossing
R.BR (c)	Bridge (Road/concrete)
R.BR (w)	Bridge (Road/wood)
F.BR (c)	Bridge (Foot/concrete)
F.BR (w)	Bridge (Foot/wood)
UC	Drainage Under Crossing
CL	Drain Culvert
G	Gauging staff

VERTICAL SCALE 0 5M

HORIZONTAL SCALE 0 500 1000M

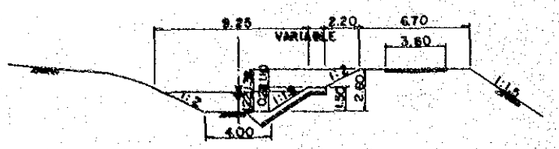
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF
MINPE IRRIGATION SCHEME

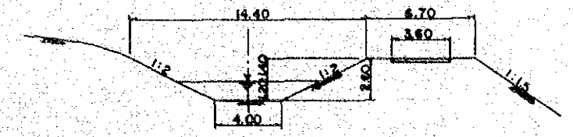
LONGITUDINAL SECTION OF MAIN CANAL (6)

DATE	MARCH 18, 1986	D.W.G. No.	02-6/8

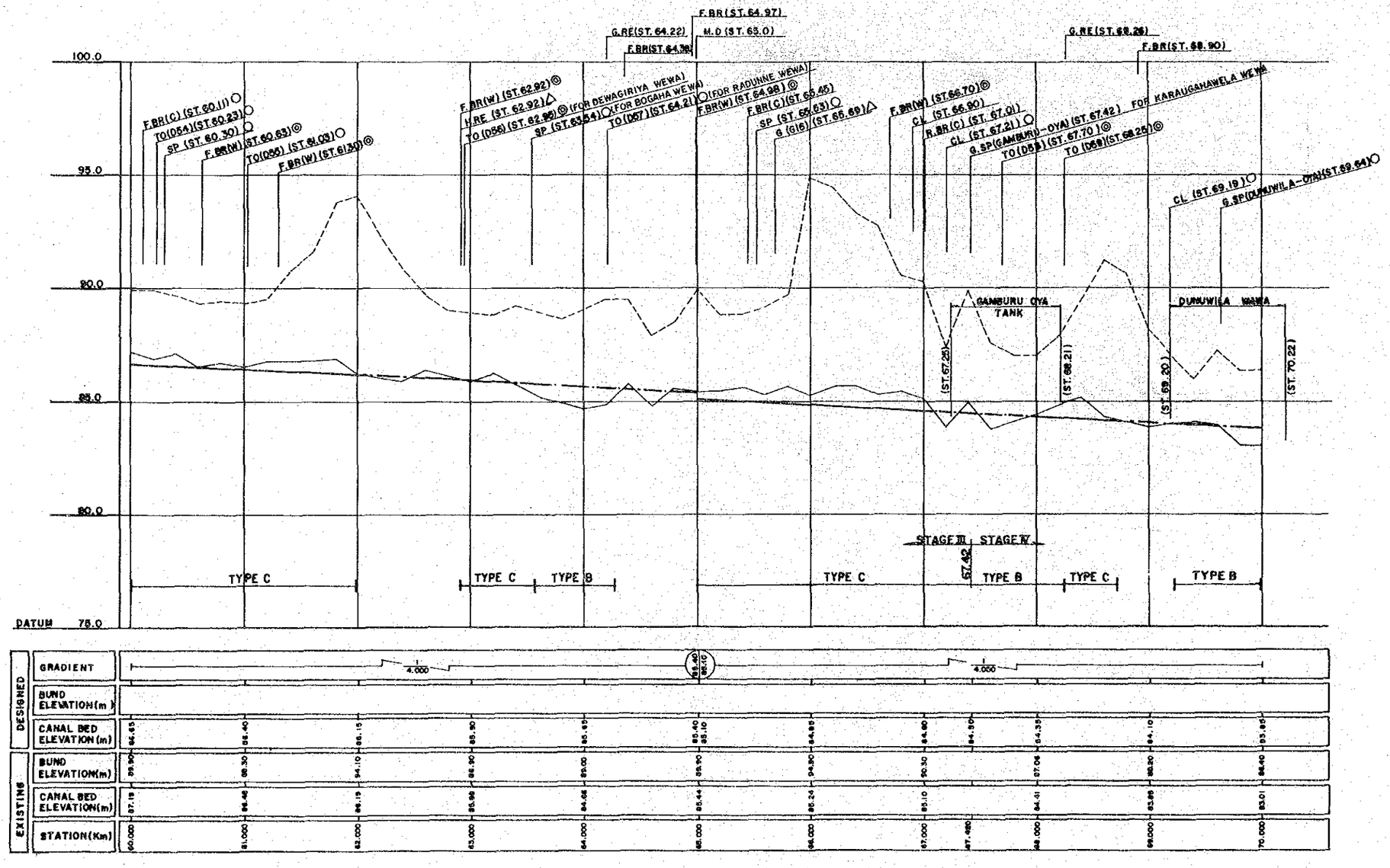
JAPAN INTERNATIONAL COOPERATION AGENCY



TYPICAL SECTION (STAGE Ⅳ, TYPE B)



TYPICAL SECTION (STAGE Ⅳ, TYPE C)



LEGEND

⌐¬	to be Newly Constructed
○	to be Repaired
⊕	to be Reconstructed
△	to be Removed
M.D	Measuring Device
TO	Turnout in Main Canal
G.RE	Gate Regulator
H.RE	H-beam Regulator
G.SP	Gated Spillway
SP	Spillway
SY	Syphon
OC	Over Crossing
R.BR(c)	Bridge (Road/concrete)
R.BR(w)	Bridge (Road/wood)
F.BR(c)	Bridge (Foot/concrete)
F.BR(w)	Bridge (Foot/wood)
UC	Drainage Under Crossing
CL	Drain Culvert
G	Gauging staff

VERTICAL SCALE
0 5M

HORIZONTAL SCALE
0 500 1000M

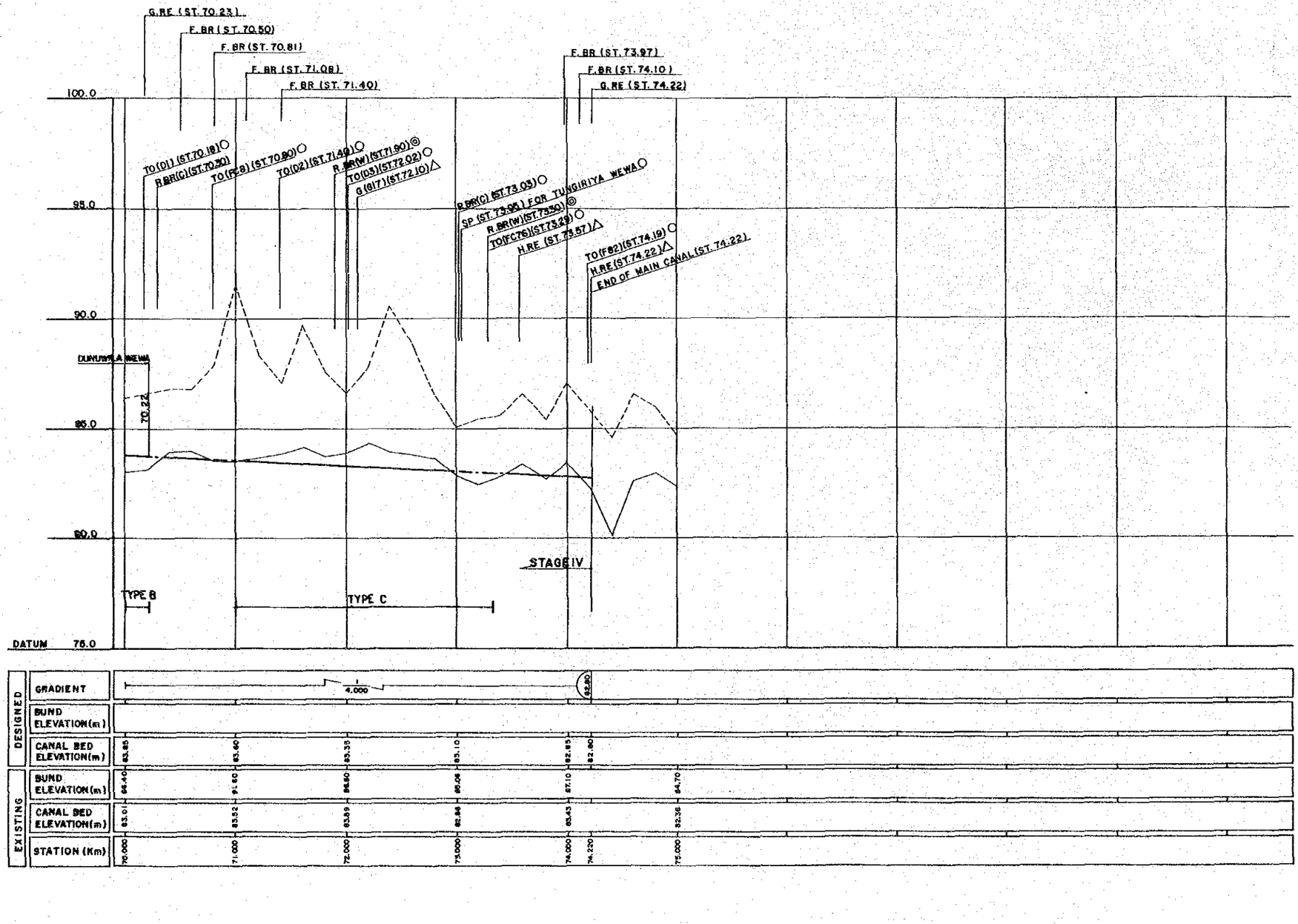
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF
MINPE IRRIGATION SCHEME

LONGITUDINAL SECTION OF MAIN CANAL (7)

DATE	MARCH 18, 1986	D.W.G. No.	02-7/8

JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

⌐¬	to be Newly Constructed
○	to be Repaired
⊗	to be Reconstructed
△	to be Removed
M.D	Measuring Device
TO	Turnout in Main Canal
G.RE	Gate Regulator
H.RE	H-beam Regulator
G.SP	Gated Spillway
SP	Spillway
SY	Syphon
OC	Over Crossing
R.BR (c)	Bridge (Road / concrete)
R.BR (w)	Bridge (Road / wood)
F.BR (c)	Bridge (Foot / concrete)
F.BR (w)	Bridge (Foot / wood)
UC	Drainage Under Crossing
CL	Drain Culvert
G	Gauging staff

VERTICAL SCALE
0 5M

HORIZONTAL SCALE
0 500 1000M

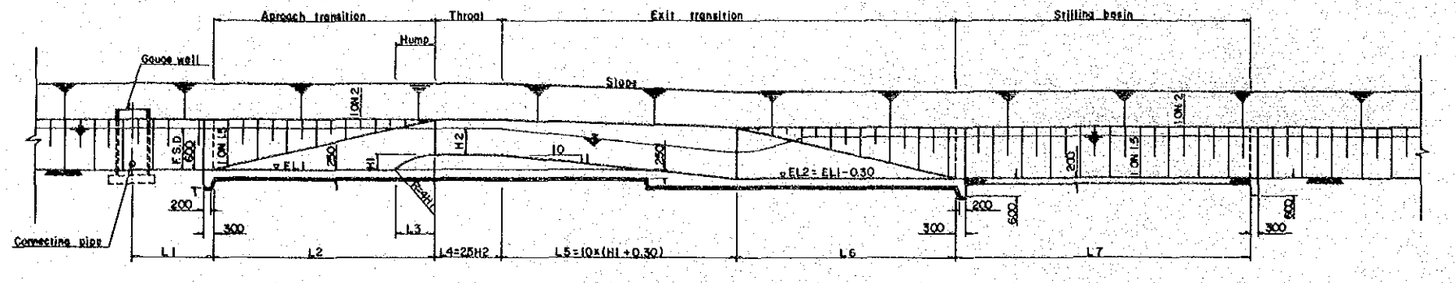
GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF
MINPE IRRIGATION SCHEME

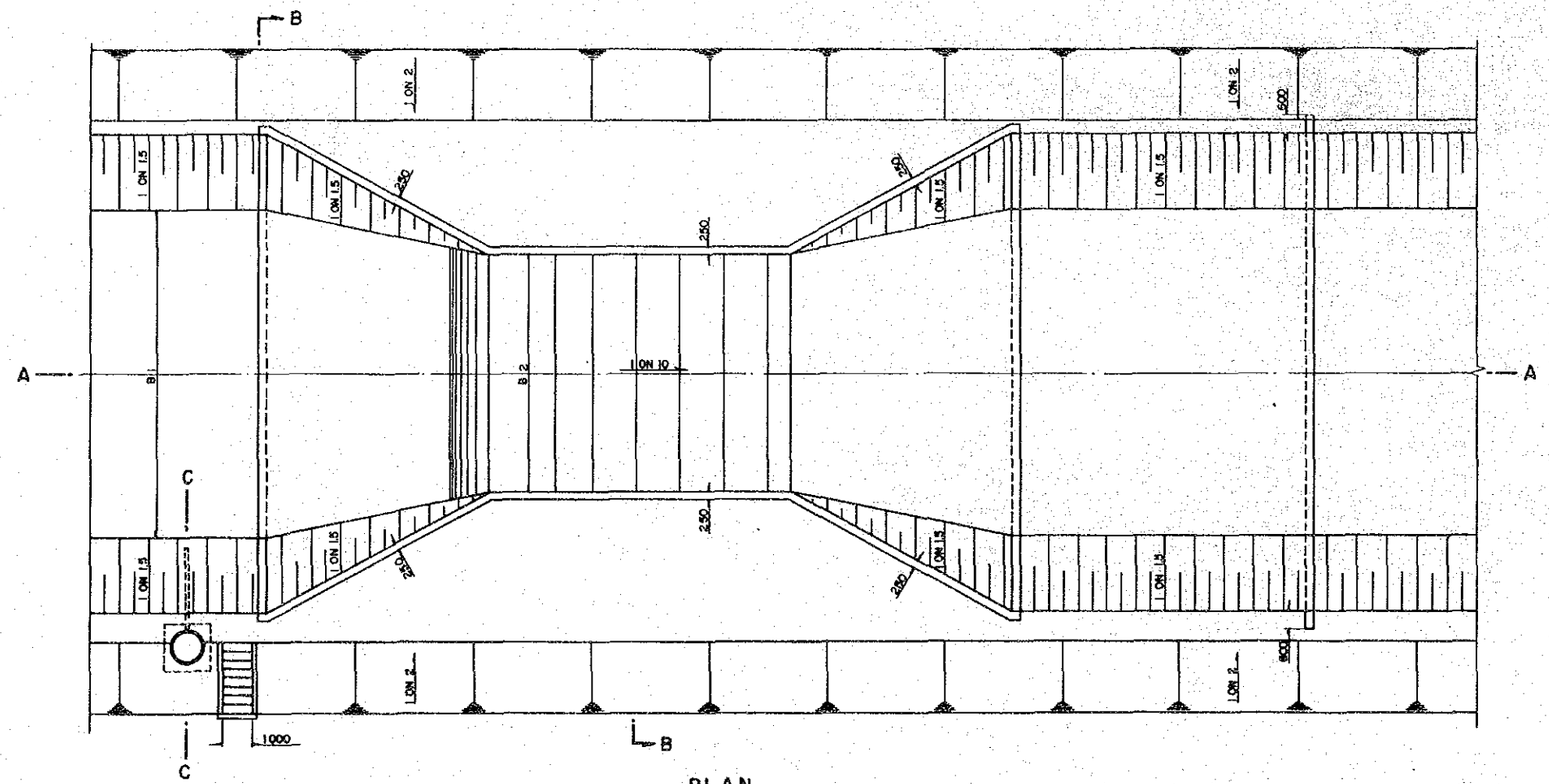
LONGITUDINAL SECTION OF MAIN CANAL (8)

DATE	MARCH 18, 1986	D.W.G. No.	02-8/8

JAPAN INTERNATIONAL COOPERATION AGENCY



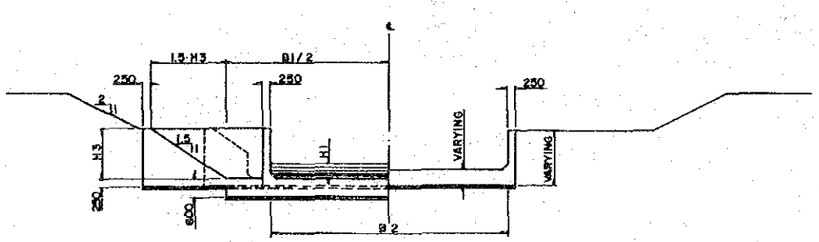
SECTIONAL ELEVATION A-A
SCALE 1:200



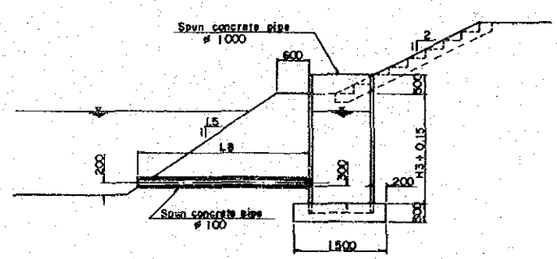
PLAN
SCALE 1:200

DIMENSIONS

STAGE	I -1	I - 2	II - 1	II - 2	III
F.S.D	1.40	1.37	1.38	1.32	1.32
Q(m3/s)	19.70	16.20	12.60	9.60	9.60
B1	15.00	14.00	11.00	9.00	9.00
B2	14.00	11.50	9.00	7.00	7.00
H1	0.52	0.49	0.50	0.45	0.45
H2	0.88	0.88	0.88	0.87	0.87
H3	1.70	1.70	1.70	1.60	1.60
L1	2.50	2.50	2.50	2.50	2.50
L2	5.00	6.50	7.50	5.00	5.00
L3	1.38	1.30	1.32	1.19	1.19
L4	2.20	2.20	2.20	2.20	2.20
L5	8.20	7.90	8.00	7.50	7.50
L6	5.00	6.50	7.50	5.00	5.00
L7	12.00	11.00	9.00	7.00	7.00
L8	2.90	2.90	2.90	2.70	2.70



SECTIONAL ELEVATION B-B
SCALE 1:200



DETAIL OF GAUGE WELL C-C
SCALE 1:100

GOVERNMENT OF SRI LANKA
MINISTRY OF LANDS AND LAND DEVELOPMENT

REHABILITATION OF
MINPE IRRIGATION SCHEME

FLOW MEASURING DEVICE

DATE	MARCH 18, 1986	D.W.G. No.	03

JAPAN INTERNATIONAL COOPERATION AGENCY