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FEASIBILITY REPORT
ON
THE INGINIMITIYA RESERVOIR PROJECT

VOLUME II: MAIN REPORT

OCTOBER [illegible]

[illegible]

REPUBLIC OF SRI LANKA

FEASIBILITY REPORT
ON
THE INGINIMITIYA RESERVOIR PROJECT

VOLUME I : MAIN REPORT

OCTOBER 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

P R E F A C E

Sri Lanka's national economy has been basically maintained by the pattern of trade in which tea, rubber and cononuts are exported to pay the import bills on foodstuff, operation and maintenance resources and developmental requirements. Annual import of about 40% of its food grain requirements, however, is becoming increasingly difficult due to worsening position of its foreign exchange earnings which have been traditionally raised mainly by exporting the said three agricultural commodities. Hence the Government of Sri Lanka has been trying to encourage nontraditional exports while launching a nationwide campaign in achieving increased food self-sufficiency.

It was in full sympathy with the Food Production Increase Drive in Sri Lanka that the Government of Japan committed a financial assistance for implementation of the Inginimitiya Reservoir Project in the Japan-Sri Lanka Joint Communique which was announced on the occasion of the official visit to Japan of Madame Sirimavo R. D. Bandaranaike, the ex-Prime Minister of the Republic of Sri Lanka in November 1976. The Government of Japan thereby undertook to conduct a preliminary survey on the Inginimitiya Reservoir Project by a 6-member team dispatched by the Japan International Co-operation Agency for 15 days from December 12, 1976; the team was headed by Mr. Isamu Sakane, Senior Civil Engineer of Construction Department, Ministry of Agriculture and Forestry.

Sequent on the findings and observations of the preliminary survey team, the Japan International Cooperation Agency dispatched in April 1977 a Feasibility Study Team on the same project comprising of 6 experts headed by Mr. Minoru Imai of the Japan Engineering Consultants Co., Ltd. This Feasibility Study Team enjoyed all-out cooperation and assistance from the officials concerned of the Government of Sri Lanka and prepared, in the concluding stage of its 40-days long survey, an Interim Report which contained all the techno-economic parameters mutually agreed upon in the course of the joint-study.

Draft Feasibility Report on the project was presented to the Sri Lanka Government in August 1977 and a minute covering its comments on the draft was signed between the Sri Lanka Government officials and the JICA's Draft Report Mission in Colombo in the same month. The comments given therein have been duly incorporated in this Final Report which is submitted in two volumes.

I firmly believe that this report is a valuable contribution to the social and economic development in Sri Lanka as well as promotion of friendship between the Republic of Sri Lanka and Japan.

Finally, I take this opportunity to express my heartfelt gratitude to the officials of the authorities concerned of the Republic of Sri Lanka for their kind cooperation and assistance extended to the team, without which the survey work could not have been completed so successfully.

October, 1977

Shinsaku HOGEN
President
JAPAN INTERNATIONAL COOPERATION AGENCY

LETTER OF TRANSMITTAL

Mr. Shinsaku HOGEN,
President,
Japan International Cooperation Agency,
Tokyo, Japan

October, 1977

Feasibility Report on the Inginimitiya Reservoir Project, Sri Lanka.

Dear Sir;

We have the honour to submit herewith the Feasibility Report on the captioned project in two volumes which have been completed by the survey team headed by the undersigned.

It has been our great pleasure to attend at this work for upgrading the content of the feasibility report, which had been worked out by the Government of Sri Lanka in August 1976 and presented to the Government of Japan on the occasion of the official visit to Japan of Madame Sirimavo R. D. Bandaranaike, the ex-Prime Minister of the Republic of Sri Lanka in November 1976, to the level qualifiable for appraisal by the overseas financial institution of the Government of Japan.

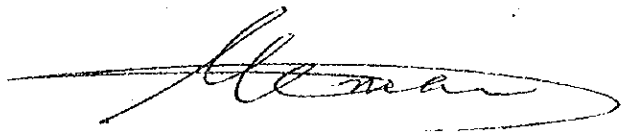
This report is the final product of a series of work undertaken by our team, under the general supervision of the Advisory Group which was organized by you for this specific purpose. It started in terms of techno-economic surveys which were conducted jointly with the officials concerned of Sri Lankan Government for 40 days since April 2, 1977 with the results having been summarized in the Interim Report dated May 9, 1977; the ensuing home work which was commenced immediately upon our return produced the Final Draft Report which was presented to and commented upon by the both Governments in August 1977; these comments have been duly incorporated into the present report.

Upon completion of our assignment, we are very happy to say that the project is technically sound and economically viable. It is our sincere hope that it should proceed to the next stage of the detailed designing along the recommendations presented in this report so that it would be im-

plemented at the earliest possible point of time.

In conclusion, we wish to express our sincere-most appreciation and gratitude to the personnel of your Agency, the Japanese Embassy in Sri Lanka, and the officials of the authorities concerned of the Government of Sri Lanka for the courtesies and cooperation liberally afforded us during our field survey and home office work.

Very truly yours,



Minoru IMAI
Leader

Inginimitiya Reservoir Project
Feasibility Study Team

(Advisor to the Japan Engineering
Consultants Co., Ltd.)

SUMMARY AND CONCLUSIONS

i. Accounting for about one-third of the GNP, more than one-half of all employment, about four-fifths of export earnings and much of the Government revenue, agriculture constitutes a dominant sector of Sri Lanka national economy. Yet, Sri Lanka has been annually importing about 40% of its food grain requirements which is becoming increasingly difficult due to worsening position of its foreign exchange earnings which have been traditionally raised mainly by exporting tea, rubber and coconuts. The Government has been trying to encourage non-traditional exports while launching a nation-wide campaign in achieving increased food self-sufficiency.

ii. The potential for increased food self-sufficiency is greater in the dry zone as agricultural use of the land has almost reached a saturation point in the wet zone. This is the reason why the Government is currently undertaking an ambitious irrigation project of Mahaweli Ganga Diversion towards the dry and intermediate zones where nearly 200 major tank irrigation schemes are already existing, serving a total cultivated area of about 400,000 acres, or under construction planning to irrigate thousands of additional land. Experiences with the existing irrigation schemes in the dry zone, however, show that poor maintenance of irrigation systems, careless water management and inadequate agricultural supporting services are the prime constraints limiting agricultural production in the schemes. The proposed project would be a prototype for ameliorating most of these limiting factors from the construction stage through development period and to demonstrate how to bring these and many other newly coming irrigation schemes in the dry zone to their full potential.

iii. The project would include: (a) construction of a 2 miles 5,000 feet-long earth dam across the Mi-Oya at the present Inginimitiya Tank site, with all the necessary facilities for irrigation/drainage and farm road network, to provide year-round irrigation benefits to 6,300 acres of the project area for production of paddy and other subsidiary food crops by both the domiciled farmers and newly settling families; (b) establishment of the well equipped project headquarters to train the farmers, who will organize themselves into the Agricultural Productivity Committee (APC), the Cultivation Committees (CCs) and the agricultural cooperatives, in such as water

management; improved farming techniques; agricultural production planning; credit, input supply and marketing, etc., so that the full development of the project area in the future would become self-propelling within reasonable number of years; (c) construction of machinery centres, offices and store-rooms of the farmers' organizations and provision of farm equipment for land preparation and plant protection to enable the farmers to obtain farm production above a certain constant level by adhering to highly intensive cropping calendar; and (d) technical assistance to the project farmers through the project headquarters in their attaining, and if possible surpassing, the development targets under the project.

iv. Total project costs are estimated at Rs 167.7 million (US$23.0 million), comprising of Rs 72.5 million (US$10.0million) in foreign exchange component and Rs 95.2 million (US$13.0 million) in local currency. The major elements in the cost estimates are: civil works (Rs 59.3 M or US$8.1 M), construction machinery (Rs 35.6 M or US$4.9 M), agricultural equipment and vehicles (Rs 5.2 M or US$0.7 M), technical assistance (Rs 16.3 M or US$2.2 M), and engineering and administration (Rs 10.0 M or US$1.4 M) -- making the base project cost Rs 132.7 million (US$18.2 million). Physical contingencies (Rs 5.9 million or US$0.8 million) and price contingencies (Rs 29.0 million or US$4.0 million) would bring the total project cost to Rs 167.7 million (US$23.0 million).

v. Farm equipment for land preparation and plant protection and the vehicles required for the project headquarters will be provided under bona-fide external assistance scheme or schemes, and the technical assistance for agricultural development (and project evaluation) will also be offered in the similar manner.

vi. Project implementation would take five years. The civil works would be carried out on force account by the Irrigation Department (ID), under the Ministry of Irrigation, Power and Highways (MIPH), which would also be responsible for operation and maintenance of the civil works after their completion. Among the civil works proposed under the project are some simple, labour-intensive and individually smaller works, particularly land development, irrigation/drainage channel and farm road networks, which would be carried out through small unit cost contracts with the groups of

the settlers, under the supervision of ID.

vii. The Department of Agriculture (DA) in the Ministry of Agriculture and Lands (MAL) would be responsible for the extension services and the Rural Institutions & Productivity Laws Division of the same Ministry, for credit supply through the Bank of Ceylon and input distribution; the Paddy Marketing Board would be responsible for marketing of agricultural products, and the Department of Co-operative Development, for credit through the People's Bank and distribution of rations and consumer goods through the local multi-purpose co-operative societies (MPCSs). To facilitate inter-agency co-ordination, Project Steering Committee will be constituted at the centre by the Irrigation Department, the Department of Agriculture and the Land Commissioner's Office, and under the aegis of this Steering Committee the project headquarters which include representatives from the concerned agencies would be responsible for day-to-day development activities in the project area.

viii. At full development by the 11th of the project year, annual paddy production in the area as a result of the project is expected to reach 15,200 tons compared to the current 2,200 tons. The production of the subsidiary crops like soya beans, pulses and chillies would also be considerable. The project-related increase of agricultural products would represent an annual foreign exchange savings of about US$2.8 million.

ix. Apart from various socio-economic benefits the project would bring forward by its implementation and through ensuing agricultural development, the project's economic rate of reutrn, which has been computed primarily based on the projected 1985 world market prices, would be 18%. Sensitivity tests under a variety of adverse assumptions result at different rates but they are invariably above 10% thus indicating that the project remains economically viable.

July 1977.

Statistical data for Inginimitiya Reservoir Scheme

Reservoir

Drainage area - total	215 sq. miles
- between Inginimitiya & Abakolawewa	150 "
Maximum annual yield (for 150 sq. miles)	336,906 Acre-ft
Maximum monthly yield (-do-)	157,391 "
Minimum annual yield (-do-)	10,869 "
Minimum monthly yield (-do-)	0
Maximum water surface elevation	206.0 ft. MSL
Normal maximum operating pool WSEL	202.0 "
Minimum water surface EL	181.0 "
Capacity at EL 206.0 MSL	72,000 Acre-ft
Capacity at EL 202.0 MSL	53,000 "
Capacity at EL 181.0 MSL	4,200 "
Effective storage capacity EL 202 -EL 181	48,800 "
Area at EL 206.0 MSL	5,030 Acres
Area at El 202.0 MSL	4,100 "
Area at El 181.0 MSL	850 "

Dam

Type - Homogeneous Type	
Length	2 Miles (4,690 ft
Top width	20 ft
Crest level	212 ft. MSL
Maximum height	60 ft
River bed level	153 ft. MSL
Side slopes /on 2.5 U/S & /on 2.0 D/S	
Approximate number of cubes	393,000 Cubes

Spillway

Design flood discharge	50,000 Cusec
Return peried of MFD	200 Year
Type All Radial Gate (20ft x 20ft)	
Number of Gate	6 Nos

Width of Spillway		135 ft.
Length of tail channel (to Mi Oya)		6,460 ft
Slope of tail channel		1/1000
Width of tail channel		300 ft
Width of emorgency spillway		800 ft

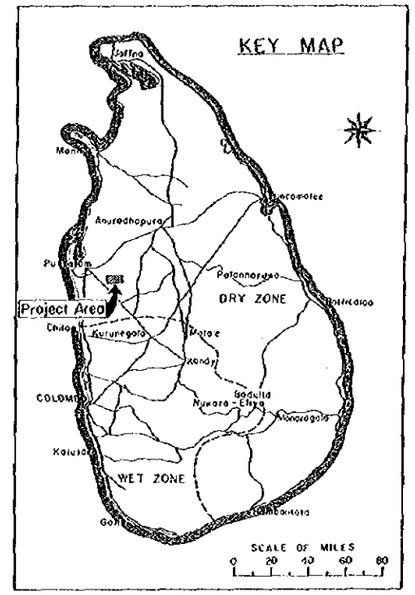
Sluice

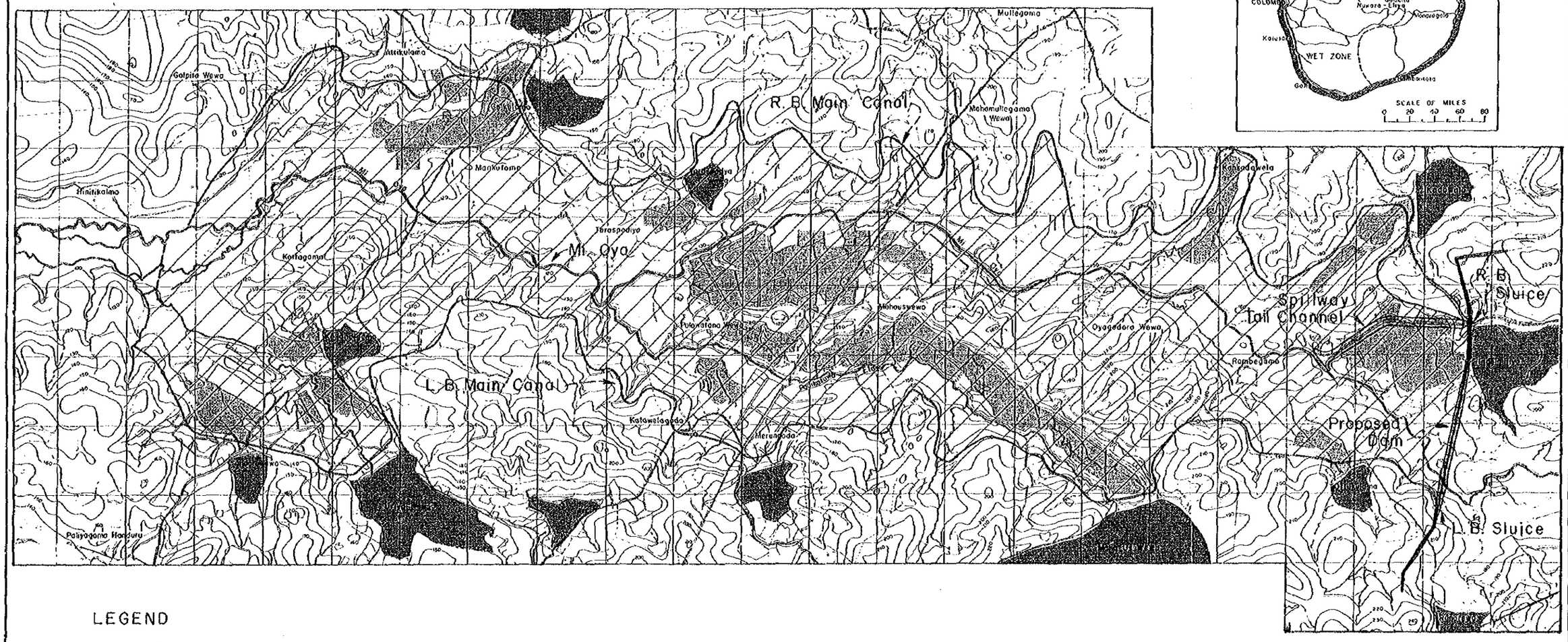
Type RC tower type		
Discharge	LB	105 Cusec
	FB	61 "
Irrigation Area	LB	4,000 Acres
	FB	2,300 "
Sill level		181 ft. MSL
Maximum head of water		21 ft

Main Canal

Type Earth Channel		
Length of canal	LB	13.3 Miles
	RB	16.2 "
Capacity in Cuses	LB	105 Cusec
	RB	61 "
Irrigation area	LB	4,000 Acres
	RB	2,300 "
Gradient		1/3,500 ∿ 1/3,000
Side slopes		1:1.5
Bed width at start	LB	11' - 4"
	RB	8' - 3"
Full supply depth	LB	3' - 6"
	RB	3' - 0

GENERAL PLAN OF THE INGINIMITIYA RESERVOIR PROJECT





LEGEND

- ; Main Canal
- ; Existing Paddy Field
- ; Existing Tank
- ; Road
- ; Project Area

SCALE OF MILES
0 5 10 15 20

INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

GENERAL PLAN

Date: Jun. 1977 | D.W.G. No. 1

FREQUENTLY USED ABBREVIATIONS FOR OFFICERS

ADAEO	-	Assistant District Agricultural Extension Officer
AI	-	Agricultural Instructor
AO	-	Agricultural Officer
DAEO	-	District Agricultural Extension Officer
DDA	-	Deputy Director of Agriculture
GA	-	Government Agent
KVS	-	Village Level Government Extension Worker (Krushikarma Viyaptha Sevaka)
PAEO	-	Project Agricultural Extension Officer
SAI	-	Senior Agricultural Instructor
SMS	-	Subject Matter Specialist

GLOSSARY

chena	-	slash and burn or "shifting" agriculture
District	-	The principal administrative sub-division There are 22 Districts in Sri Lanka.
maha	-	northeast monsoon season (September/October to February/March)
paddy	-	the unhusked rice-grain, usually measured in bushels
rice	-	the husked rice, ready for cooking (also referred to as "milled rice")
purana villages	-	villages which were existing for more than 50 years
rotational irrigation	-	intermittent irrigation
yala	-	southwest monsoon season (April to August)

FISCAL YEAR

January 1 - December 31

CURRENCY EQUIVALENTS

The Sri Lanka Rupee which was officially linked, on May 24, 1976, to a basket of currencies with the initial parity rate based on the prevailing Rupee/Pound rate equated to about US$1.00 = Rs 8.66 or Rs 8.70 if rounded. The official rate was recently fixed at US$1.00 = Rs 7.28 and this rate, which is in effect during the preparation of the report, has been used throughout the report, except where stated to the contrary.[1/]

US$1	=	Rs 7.28
Re 1	=	US$0.137
Rs 1 Million	=	US$137,363

WEIGHTS AND MEASURES

1 acre (ac.)	=	0.405 hectares (ha.)
1 mile (mi.)	=	1.609 kilometers (km.)
1 square mile (sq.mi.)	=	2.589 square kilometers (km^2)
1 foot (ft.)	=	0.3048 meter (m.)
1 acre foot (ac.ft.)	=	1233.5 cubic meters (m^3)
1 inch (in.)	=	25.4 millimeters (mm.)
1 cubic foot per second (cusec) or (c.f.s.)	=	0.0283 meters' per second
1 cube	=	100 cubic foot = 2.832 m^3
1 pound (lb.)	=	0.4536 kilograms (kg.)
1 long ton = 2,240 lb.	=	1.016 metric tons
1 hundred weight (cwt.) = 50.8 kg.	=	112 lb.
1 bushel (bu.) of paddy	=	45 lb.
1 pint	=	0.57 liters (l.)

1/ Through the sale and purchase of Foreign Exchange Entitlement Certificates (FEECs), Sri Lanka effectively practices a dual exchange rate. Most non-foodgrain imports have to pay a surcharge of 65% through the purchase of FEECs. Most non-traditional exports receive a 65% premium over the official rate through the sale of FEECs.

PLANS

1	inch	= 4	chains	corresponds to	1:3168
1	"	= 8	"	"	1:6336
1	"	= 12	"	"	1:9504
1	"	= 1	mile	"	1:63360
1	"	= 4	miles	"	1:253,440
1	"	= 8	"	"	1:506,808
1	"	= 24	"	"	1:1,520,640

PRINCIPAL ABBREVIATIONS AND ACRONYMS USED

APC	-	Agricultural Productivity Committee
BG	-	Batalagoda (a new improved HYV)
CC	-	Cultivation Committee
CFC	-	Ceylon Fertilizer Corporation
DA	-	Department of Agriculture
DME	-	Department of Machinery and Equipment
FAO	-	Food and Agriculture Organization
FEEC	-	Foreign Exchange Entitlement Certificate
GDP	-	Gross Domestic Product
GNP	-	Gross National Product
GOSL	-	Government of Sri Lanka
ID	-	Irrigation Department
KVS	-	Village Level Government Extension Worker (Krushikarma Viyaptha Sevaka)
LHG	-	Low Humic Gley Soils
M	-	Million
MAL	-	Ministry of Agriculture and Lands
MDB	-	Mahaweli Development Board
MIPH	-	Ministry of Irrigation, Power and Highways
MPCS	-	Multi-Purpose Cooperative Societies
O & M	-	Operation and Maintenance
PMB	-	Paddy Marketing Board
RBE	-	Reddish Brown Earth

SRI LANKA

FEASIBILITY STUDY OF THE INGINIMITIYA RESERVOIR PROJECT

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I INTRODUCTION

1.01 Madame Sirimavo R. D. Bandaranaike, the ex-Prime Minister of the Republic of Sri Lanka paid an official visit to Japan on November 12, 1976. She stayed in Japan with her group till November 18, 1976 and on the day before her departure, the Japan - Sri Lanka Joint Communique was announced which contains a reference to the host country's preparedness to offer a financial assistance for implementation of some of Sri Lanka's development projects including the Inginimitiya Reservoir Project, the Outside Colombo Area Telecommunication Project, and the Fishing Gear Factory Project. In materializing the spirit expressed in the aforementioned Joint Communique, the Government of Japan undertook to conduct a preliminary survey of the Inginimitiya Reservoir Project, by a 6-member team dispatched by the Japan International Cooperation Agency, for 15 days from December 12, 1976. The Team was headed by Mr. Isamu Sakane, Senior Civil Engineer of Construction Department, Ministry of Agriculture and Forestry.

1.02 The preliminary survey team reported back to the Japan International Cooperation Agency and the Government of Japan its observation of the Inginimitiya Project that it is technically feasible and it would bring a significant benefit for agricultural development, particularly in the Dry Zone, of Sri Lanka, and urged to send a Feasibility Study Team to help upgrading the contents of the Feasibility Report which had been prepared by the Government of Sri Lanka to the level qualifiable for appraisal by the overseas financial institution of the Government of Japan.

1.03 Since its arrival in Sri Lanka on April 2, 1977, the Feasibility Study Team conducted a joint-study with the officials of the Government of Sri Lanka, especially those of the Irrigation Department, Ministry of Irrigation, Power & Highways who have been concerned with the Inginimitiya Project. The alterations of the original designs and norms contained in the Report which had been prepared by the Irrigation Department having been made on the part of its authors since the visit of the JICA Preliminary Survey Team at the end of 1967, this Feasibility Study Team offered several suggestions and advices upon their improvements side by side with not a few observations on some of the basic concepts which have important bearings on

the philosophy and strategy of the entire project.

1.04 The Team's contributions in such a joint work were warmly appreciated and promptly incorporated into the final decisions on the part of the Irrigation Department and it was agreed upon in the later stage of the survey that the opinions mutually arrived at with each and every problematic point encountered in the course of their joint study should be committed in the Interim Report, which the Team submitted to the Government of Sri Lanka on May 9, 1977, shortly before its departure from the island.

1.05 This Feasibility Study Report contains the results of the Team's joint study with the officials of Sri Lanka on the Inginimitiya Reservoir Project and of the home work ensuing its return to Japan on and along the basic agreements included in the said Interim Report.

1.06 This Report has been presented in two volumes -- the Main Report (Volume I), containing the principal facts, conclusions and recommendations, and the Notes (Volume II), containing all the background engineering and other information upon which the formulation and evaluation of the project has been based.

II BACKGROUND

2.01 The Republic of Sri Lanka is a tropical island in the Indian Ocean and it has a total land area of 16.2 million acres (about 25,300 square miles), about 5 million acres are used for agriculture, 9.3 million acres are under forest, and the remaining 1.9 million acres consist of water bodies, urban areas and others. About half of the forest land is believed to be potentially suitable for agricultural development. 80% of the total estimated population of about 13.5 million is rural.

2.02 Sri Lanka can be divided into two distinct zones on the basis of precipitation: the wet zone (average annual rainfall over 75 inches), situated in the southwest quadrant and covering about 30% of the land area, and the dry zone (average annual rainfall 35 to 75 inches) covering the remainder of the island. The wet zone has been almost fully developed under the main export crops, tea, rubber and coconut, plus rice and it supports more than three-quarters of the total population and accounts for about 70% of the cultivated land. In the dry zone, on the other hand, large extents of land are still available, but a systematic supply of irrigation water is essential for its agricultural development.

The Economy

2.03 Since 1970, the national income growth has averaged 2.5% a year, only slightly higher than the population growth rate, and her per capita income has been pegged to a low level of about US$150 (US$145 in 1975). Though modest is her economy, the acuteness of the need to solve unemployment problem now constitutes a major socio-economic and political issue. The social welfare and equitable income distribution policies which have been emphasized by the past governments did bring about a rather well-developed system of health care and other public services and a high literacy rate, on its positive side. Unfortunately, however, these developments have not been accompanied by a satisfactory growth in output, mainly because of inadequate investment in productive sectors, thus failing to meet the increasing demand of the people for the amenities of life and offering little chance of employment particularly for the educated youth.

A large part of the labour force, perhaps about one quarter, is unemployed or underemployed, and all the indications seem to betray any substantial improvement in this matter for some years in the past. In addition to the open unemployment and underemployment which is evident in the towns, there is a wide-spread seasonal unemployment in the rural areas.

2.04 In its foreign exchange position, Sri Lanka has been severely affected by a rapid deterioration in its terms of trade particularly during the last few years: while prices of its major imports, foodgrains, fertilizers and petroleum products have shot up, price increases for its main export items: tea, coconut and rubber have been relatively moderate. The resulting severe foreign exchange gap made it extremely difficult to effect an adequate replacement and modernization of much of the capital stock of the economy which is obsolete and over-used, to say least of any new development of significant scale. Despite very tight budgetary resources available to the Government, it is now determined to devote whatever resources it can raise by the measures including economization of its current expenditure, towards production-oriented investments, particularly those for increasing food production. The Government seems to be least prejudicial against bona-fide external assistance in this respect.

The Agricultural Sector

2.05 Agriculture constitutes a dominant sector of Sri Lanka's economy by contributing about one-third of the gross national product (GNP), more than one-half of all employment, over four-fifths of export earnings and much of the Government revenues. This naturally gives it a pivotal role in influencing the economic activity and the course of development in the country. Climatically speaking, the island is suitable for year-round crop production of a wide range of both the tree crops and the field crops. The variations in precipitation and elevation make it possible to grow tea, rubber and coconuts in the former category of the crops, and in the latter, paddy, manioc, chillies, maize, pulses, potatoes and millets. Roughly half of the total cultivated area of 5.0 million acres is devoted for the tree crops made up of the three major traditional export items, and the other half for the field crops. Paddy claims the lionhead share of the cultivated area (1.3 million acres) whose cropping intensity ranges from about 185% in

the wet zone to about 110% in the dry zone, the average for the whole country being 150%.

2.06 In the decade ending in 1973 (which is accepted as the last "normal year" whose agricultural outputs are statistically indentifiable), food-grain production increased by about 36% (3.1% annually), while the tree crop sector output increased by 10% only. Although paddy production in the country reached 77 million bushels in 1970, it was mainly due to the favourable weather conditions as will be known from the fact that both the Maha and Yala crops harvested in 1975 were much below normal, that is, about 55 million bushels or around two-thirds of the 1970 production because it was another bad year following a severe drought year of 1974. Even before the arrival of a series of drought years, the combined output increase in the agricultural sector as a whole recorded a figure of 25% of an annual rate of 2.3% only.

2.07 The Government is not at all ignorant of the factors responsible for such a slow growth of agricultural production. Improvements are being undertaken to make good the sluggish performance of the tree crop sector which has largely been a result of inadequate investment due to poor financial returns and an uncertain investment climate. In the field crop sector, the Government started paying increasing concerns on such as poor water management, lack of adequate farm power for timely tillage, inadequate attention to extension, marketing and credit facilities and the system of control and subsidies which works to reduce incentives to the farmers.

2.08 The counter-measures which the Government has been intensifying to overcome the difficulties being faced in the field crop production sector are: increases in guaranteed support prices and elimination of compulsory paddy procurement to provide production incentives; reduction in free and subsidized rations; import restriction on subsidiary food crops such as chillies, onions, potatoes and pulses to promote domestic production; establishment of Agricultural Productivity Committees (APCs) as so many local bodies for planned farming to improve the supply of farm inputs and supporting services, and strengthening of the related farmer organizations. An increased emphasis on efficient water utilization and management is one of the most important aspects in this connection.

Dry Zone Agriculture

2.09 The major constraint for agricultural development in the dry zone is water. Due to the climatic reasons, the set patterns of annual precipitation, in particular, make agriculture in the dry zone entirely dependent upon irrigation during the Yala season and, because of erratic monsoons, supplementary irrigation is necessary even during the Maha season. This was the case thousands of years ago when an extensive network of irrigation tanks (reservoirs) was developed in the northern part of the country since about 600 B.C. Many of them came to be reconditioned and incorporated into new irrigation systems over the last century so much so almost 1 million acres are now coming to be irrigated in the dry zone. Efforts beyond reconditioning of the ancient tank networks took shape in the implementation of such multi-purpose water development projects as Gal Oya and Uda Walawe, and the Government is currently undertaking an ambitious irrigation project of Mahaweli Ganga Project which would make an addition of some 600,000 acres to the existing irrigable acreage in the dry and intermediate zones of Sri Lanka.

2.10 However, a spacial expansion of the irrigable area alone would not solve the question unless it is accompanied by a vertial intensification of farming by use of the increased supply of irrigation water. Sri Lanka farmers are following the traditional methods of irrigation for thier cultivation of paddy; they let water run continuously all through its growing period and the wastage of an enormous amount of water beyond meeting the consumptive use requirements of the crop has been justified in the name of weed control. Again, paddy is normally sown, as often witnessed in the tank schemes, only after the tanks are deemed to be sufficiently full to assure an adequate water supply to mature a Maha crop. If the tanks do not fill until late in the monsoon, sowing is correspondingly delayed, and "bethma" farming is ultimately decided upon on the areas restricted to the availability of the tank water. Thus, much of the monsoon rain is not utilized for crop production. Better utilization of "effective rainfall" which should be made feasible by proper operation and management of the irrigation systems and improved methods of irrigation would result at a substantial increase of the irrigated area with the existing water supply.

Inginimitiya Reservoir Project

2.11 The Mi-Oya Basin in which the proposed project is located is the second driest region in the country only next to Hambantota, and the Members of the State Assembly representing the area have constantly voiced the request of the villagers for an assured supply of water for their paddy fields. As the soils in the project area are also fertile, the project was included in 1951 in the priority lists of the District Agricultural Committee of the region. This let to a reconnaissance report which recommended a two mile long earth dam at Inginimitiya. Since then, several dam sites were investigated and the present site was chosen as the most suitable. The Survey Department carried out a large programme of Engineering Surveys of the development area. Drilling and soil investigations commenced in 1965. The investigations are almost complete and specification designs for the project which were prepared by the Irrigation Department have been finalized except a few which need additional studies at the detail design stage. Financial provision has also been made in the Government Budget for 1977.

III THE PROJECT AREA

Location

3.01 The Project area is located in Kirimetiyawa Puttuwa and Karambe Puttuwa, Puttalam District in the North Western Province of Sri Lanka and it covers a gross area of 9,200 acres (3,723 ha) of which 6,300 acres (2,550 ha) is to be brought under year-round irrigation (net area). It is bordered by the right bank main canal in the north; the left bank main canal in the south; the proposed dam in the east, and the tapering point of the right bank main canal and some brooklets in the west. The Mi-Oya is running down from the west to the east almost at the centre of the project area; the total length of this belt-shaped area is 9 1/2 miles (15.2 km) and its width averages about 2 1/2 miles (4.0 km).

3.02 Except the existing agricultural lands and hamlets scattering around them, the project area is generally covered by jungles of medium-density; the existing agricultural lands coming under the project area jointly occupy about one-quarter of the entire development area. The proposed dam is located at the site where the existing Inginimitiya Tank lies - about 14 miles away from Galgamuwa - but its scale is much bigger, three-times longer in dam length for instance, than that of the existing Inginimitiya Tank.

Topography and Land-Use

3.03 The project area, being embraced within the two main canals running on both banks of the Mi-Oya, spreads along the east-west direction, mildly descending in its altitude from 180 feet (55 m) at the eastern-most part to 100 feet (30 m) at the western end. The area totalling 9,200 acres is gently sloping down from both main canals towards the Mi-Oya; the net irrigable area consists of 1,640 acres of the existing agricultural lands, plus 4,660 acres which are now generally covered by jungles, sporadically thrushed and burnt for "chena" cultivation during the Maha seasons.

Climate

Temperatures

3.04 The climate in the project area is tropical with nearly constant temperatures (mean monthly temperatures ranging from 78°F to 84°F, annual average being 81°F) making it suitable for year round cropping, if not handicapped by large variations in rainfall. Mean monthly temperatures at Puttalam are as follows:

Table 3-1 Mean Monthly Temperatures at Puttalam

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
°F	77.8	79.8	81.3	82.7	83.4	82.7	82.0	82.1	82.2	80.9	79.4	78.0	81.0
°C	25.4	26.3	27.3	28.2	28.6	28.2	27.8	27.8	27.9	27.2	26.3	25.6	27.2

Rainfall

3.05 Although the mean annual rainfall is about 54 inches, about 75 ~ 90% of that occurs during Maha and immediate post-Maha (50 ~ 60% during October and December and 25 ~ 30% in April and May) and the rest during June to September (Yala season). The rainfall pattern is highly erratic; the onset of the northeastern monsoon may vary more than a month and the amount of rainfall also varies considerably, from year to year. The gap between the maximum (87 inches = 2,210 mm) and the minimum (29 inches = 740 mm) annual rainfalls is as big as 58 inches (630 mm) during the last 20 years, whose average reads 54 inches (1,370 mm).

The monthly rainfalls recorded at the observatory at Mahauswewa which is located almost at the centre of the project area read as follows:

Table 3-2 Monthly Rainfall at Mahauswewa

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Inches	2.23	1.76	3.40	8.67	4.69	1.62	1.53	1.21	2.18	10.00	10.05	7.01	54.35
mm.	57	45	86	220	119	41	39	31	55	254	255	178	1,380

Evaporation

3.06 A table showing mean monthly evaporation at Tabbowa not far away from the project area is given below:

Table 3-3 Mean Monthly Evaporation at Tabbowa

Pan Evaporation (in inches)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
4.37	4.64	5.95	5.54	5.70	6.02	6.04	6.88	6.46	5.30	4.00	4.09	64.99

Surface Evaporation (in inches)

3.50	3.71	4.76	4.43	4.56	4.82	4.83	5.50	5.17	4.24	3.20	3.27	51.99

(Surface evaporation corresponds to 80% of pan evaporation.)

Relative Humidity

3.07 Mean relative humidity varies from 64% to 74% at Puttalam, and from 61% to 78% at Maha Illuppallama, during the last 20 years, as follows:

Table 3-4 Mean Monthly Relative Humidity at Puttalam and Maha-Illuppallama

At Puttalam (in %)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
69	65	64	69	72	71	71	70	70	72	74	74	70

At Maha-Illuppallama (in %)

72	66	61	67	70	67	64	63	62	70	77	78	68

Relative humidity ranges within 10% over a year, but its fluctuation between day time (average 70%) and night time (at time as much as 90%) is considerable.

Wind

3.08 Winds blow on the wings of monsoons: from northeastern direction during the Maha season (October to March, the strongest in January) and from southwestern direction during the Yala season (April to September, the strongest in June). Wind velocity as measured at Puttalam and Maha-Illuppallama is given in the mean monthly milage as follows. Considering their location, the one on the sea-shore and the other in the interior, that at Inginimitiya is supposed to lie somewhere inbetween the two.

Table 3-5 Mean Monthly Wind Velocity at Puttalam and Maha-Illuppallama

(in miles/day)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
At Puttalam	147	145	133	123	214	276	259	262	251	171	124	140	187
At Maha-Illuppallama	104	103	90	81	166	237	235	233	224	127	82	95	148

Geology

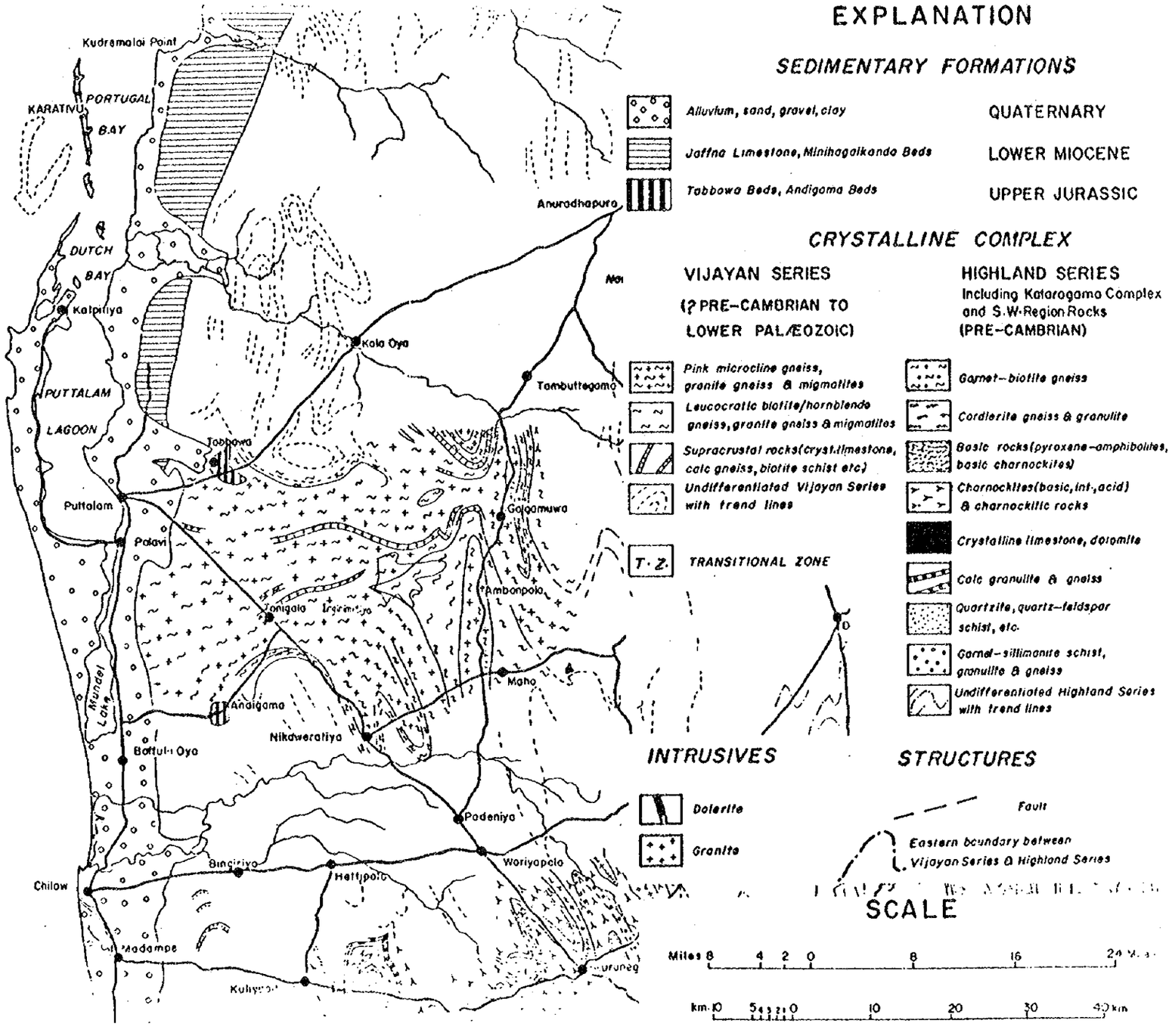
3.09 The project area stands on the pink microcline gneiss and granite gneiss which are covered by reddish brown soils. There are found a considerable quantity of gravels in the alluvial layer on the flood plain. The Geological Map of the project area is shown in Fig. 3-1. On the right bank flank of the existing Inginimitiya dam axis a prominent outcrop of pink granite is available but the sound rock is believed to exist not deeper than 20 feet from the ground surface. The results of the core drilling tests along the proposed dam axis are given in Fig. 3-2. The obtained boring cores are mostly less than 4 inches in length. Mayilewa is the most suitable quarry site for riprap materials and Tonigala granite provides very good aggregates for concrete works.

3.10 The results of the laboratorial and insitu tests with the embankment materials previously undertaken by the Government are shown in Table 3-6, and Fig. 3-3 shows the location where the samples were collected.

Three test pits have been dug to confirm availability of the construction materials and the borrow areas have been identified as shown in Fig. 3-3. Embankment materials are available to a depth of 10 feet; the weathered rock is also useful as such materials though no test has been made. The sands for Toe drain are obtainable from the Mi-Oya river bed, and the gravel materials underneath riprap can be collected at the alluvial gravel layer upstream of the borrow area No. 1.

Fig. 3 - 1

GEOLOGICAL MAP



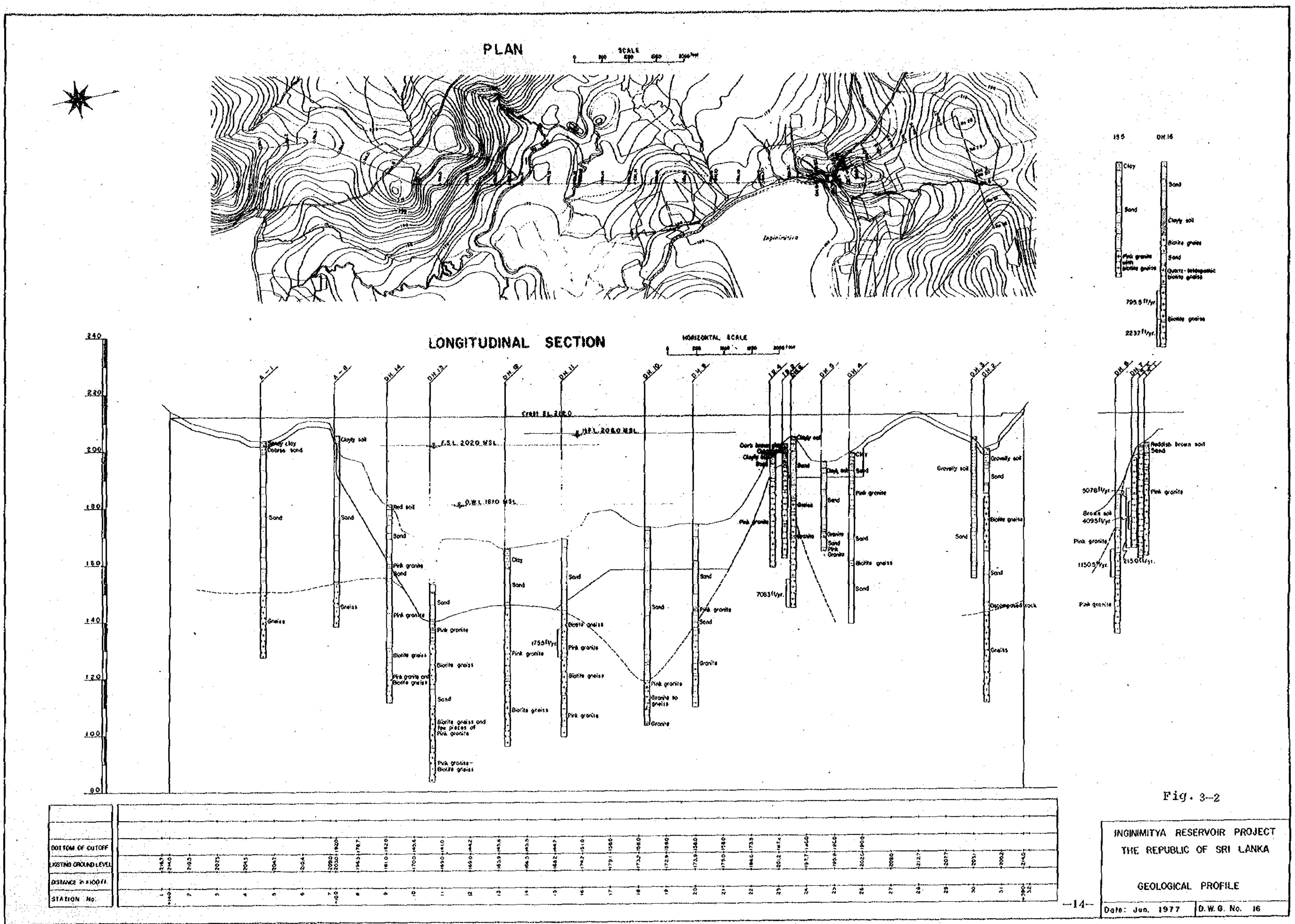

PLAN
SCALE
LONGITUDINAL SECTION
HORIZONTAL SCALE
Crest EL 2120
HFL 2080 MSL
F.S.L. 2020 MSL
D.W.L. 1810 MSL
BOTTOM OF CUTOFF
EXISTING GROUND LEVEL
DISTANCE in x100 ft.
STATION No.
INGINIMITYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA
GEOLOGICAL PROFILE
Date: Jun. 1977
D.W.G. No. 16

Fig. 3-2

Fig3-3 PROPOSED DAM AXIS AND BORROW AREA

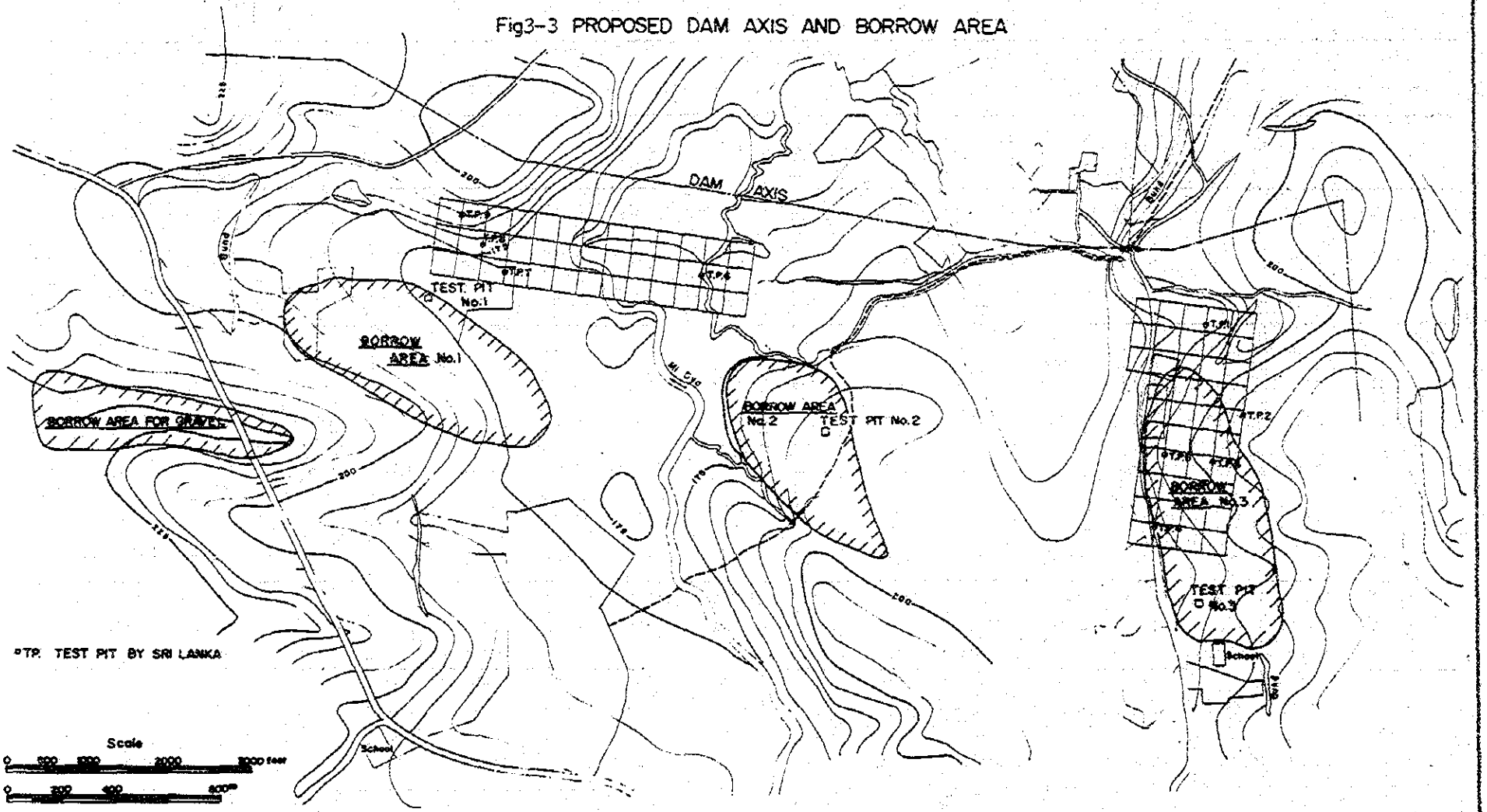


Table 3-6 Summary of Laboratory Tests and Insitu Tests

	Sample No.	IM.3	IM.5	IM.6	IM.7	IM.9	IM.10	IM.13	IM.14	IM.15	IM.16	IM.17	IM.18	IM.19	IM.20
	Pit No.	2	3	3	4	5	5	7	7	8	8	9	9	10	10
	Depth in Feet below G.L.	3"-3'	4"-2'	2'-6'	3"-3'	4"-2'6"	2'6"-6'	3"-2'6"	2'6"-6'	3"-2'6"	2'6"-6'	3"-3'	3'-6'	3"-2'6"	2'6"-6'
	Classification	SC	CL	GC	GC	CL	SC	SC	SC	SC	GC	SM	GC	SC	GC
ATTERBERG LIMITS	Liquid Limit	37.0	43.4	54.10	43.0	43.00	51.30	26.70	48.30	40.40	53.30	60.70	41.80	35.70	47.40
	Plastic Limit	20.3	19.89	23.25	18.45	18.60	21.12	13.11	19.10	18.61	23.68	34.30	17.90	17.65	21.98
	Plasticity Ind.	16.7	23.51	30.85	24.55	24.40	30.18	13.59	29.20	21.79	29.62	26.40	23.90	18.05	25.42
GRAIN SIZE ANALYSIS	Clay <0.002mm %	8.1	20.3	16.6	8.2	7.1	16.0	16.0	15.6	10.7	14.3	18.3	7.1	9.6	14.3
	Silt 0.002-0.006mm %	6.6	5.9	7.4	4.8	2.5	4.0	1.0	3.2	5.6	3.0	2.2	2.3	5.0	2.7
	Sand 0.006-2.0mm %	77.0	72.8	68.1	40.6	44.5	74.1	82.2	68.7	77.7	69.0	74.3	44.6	82.4	75.2
	Gravel >2.0mm %	8.3	1.0	7.9	46.4	46.0	5.9	0.8	12.5	6.0	13.7	5.2	46.0	3.0	7.8
	Pass 200 Mesh %	43.5	54.9	47.2	33.8	51.1	47.0	44.0	39.7	46.0	41.9	48.5	22.7	41.6	38.0
	Uniformity Coefficient Cu	80			904					74			288	97	
COMPACTION & PENETRATION	Optimum Moist. Content %	13.9	17.2	12.7	12.0	15.4	14.4	12.8	13.7	15.3	13.8	19.7	12.6	13.2	14.0
	Maximum Dry Density LBS/CUFT	114.1	107.8	117.9	119.7	111.7	112.3	115.6	114.9	110.4	113.5	101.7	115.6	114.7	111.6
	Penetration Resist. LBS/SQFT	750	375	700	550	725	600	525	450	460	450	600	500	575	660
TRIAXIAL COMPRESS	Cohesion LBS/SQFT	11.3					8.1					11.3	6.1		
	Angle of Internal friction	17°50'					20°30'					22°00'	26°35'		
PER-COLATION	Percolation Rate FT/YR.	0.0112	0.0075	1.20	0.008	0.041	0.032	0.0114	0.0056	0.0018	0.0113	0.203	0.012	0.0079	0.0027
	Consolidation %	9.15	6.12	8.70	5.23	6.20	6.00	6.78	7.32	6.22	6.57	5.92	5.3	6.22	7.68
INSITU TEST	Moisture Content %					7.8					8.4	6.3			
	Bulk Density LBS/CUFT.			{TP.1 DEPTH 4'0" - 6'9"}		124.5			{TP.2 DEPTH 4'0" - 6'9"}		122.2	135.0			
	Percolation Rate FT/YR.					313.6					31.0				

Soils and Land Classification

3.11 Soil surveys of the development area, both highland and lowland coming under the project, were obtained from soil surveys carried out at reconnaissance level by the Land Use Division of the Irrigation Department under the National Soil Survey Programme and from aerial photo interpretation. Such soil survey data and a soil map prepared thereupon were made available to the Feasibility Study Team for its own exploratory survey; they have been found mostly correct and reliable as a whole. The soil map prepared by the Land Use Division of ID is given in Fig. 3-4 which shows the distribution of the main soil groups that were identified and mapped. Out of the seven soil groups found in the project area, the important agriculturally suitable soils are:

Reddish Brown Earths: These soils are coloured reddish brown and are of moderate depth. The texture of the surface is sandy loam to sandy clay loam. Soil pH is slightly acid to neutral and there is no accumulation of harmful salts in the profile. The chemical fertility of the soil is quite good, but nitrogen and phosphorus will have to be supplied regularly. The soils are well drained. Reddish brown earths are most suitable for high value crops such as cotton, soya beans and pulses during drier season and paddy with supplementary irrigation during the wet season. These soils have a farily high water duty for paddy and require irrigation every 5th or 6th day in dry weather.

Low Humic Gley Soils: These soils are moderately deep soils with periodically high groundwater levels and are usually found in the lower topographical areas. The texture is variable from sandy loam to sandy clay loam. The soils are imperfect to poorly drained. The soil pH is neutral to weakly alkaline and occasional concentrations of salts are found in the lower depths of the soil profile. The chemical fertility of the soil is quite good except for nitrogen and phosphorus which will have to be supplied regularly. These soils are best suited for paddy cultivation under irrgation during both Maha and Yala seasons. Adequate drainage is essential.

Alluvial Soils of Variable Drainage and Texture: These soils occur in the flood plains of rivers and streams, as alluvial deposits.

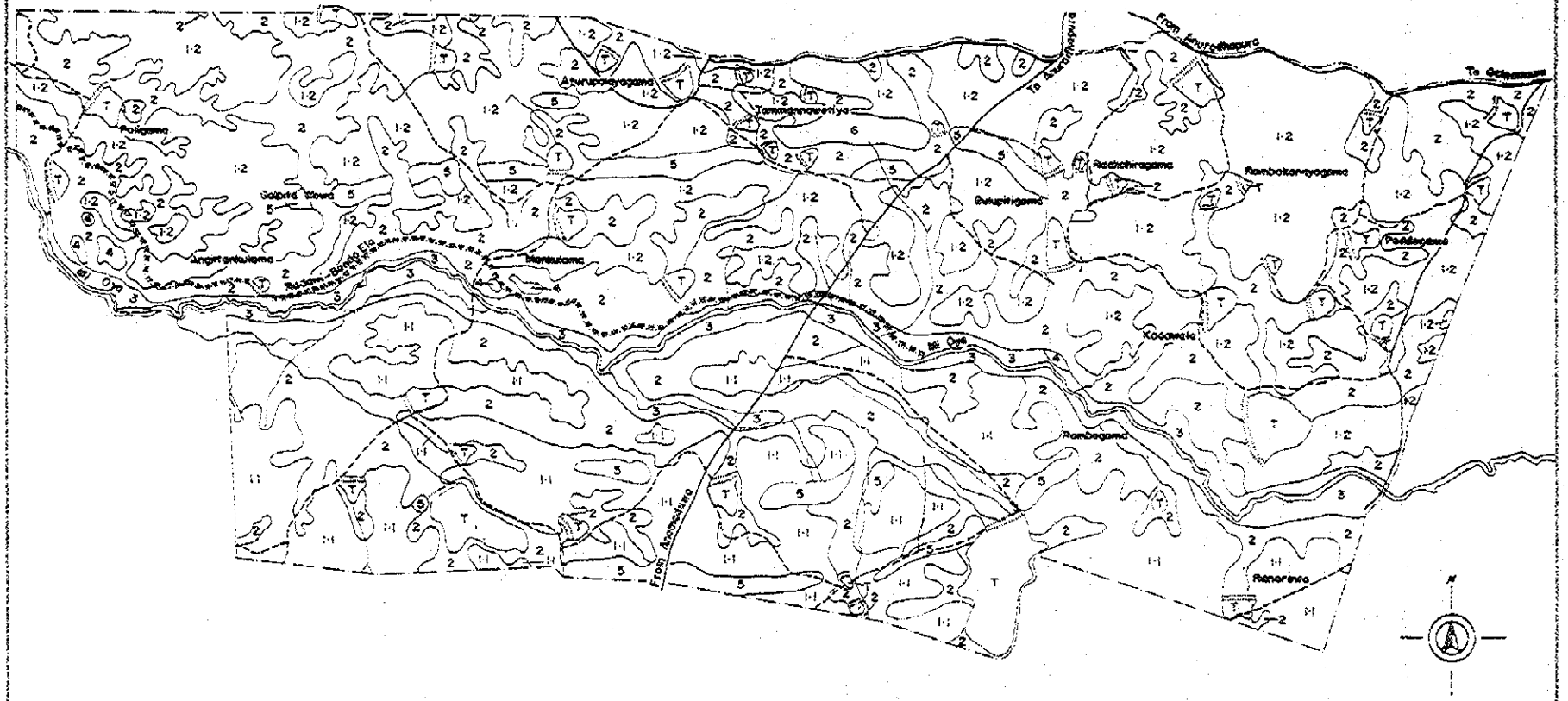
They are deep to very deep, brown to yellowish brown and greyish brown soils having variable textures. Most of these soils are imperfectly to poorly drained soils having loamy to clayey textures. The soil pH is neutral, well suited for irrigated rice cultivation.

Suspected Saline and/or Alkaline Soils: These are low humic gley soils, alluvial soils or solonety soils having harmful concentrations of soluble salts (salinity) or a high percentage of sodium in the exchange complex (alkalinity). They can be utilized for paddy cultivation after approximate reclamation measures are taken. These measures are flushing and draining for saline soils and addition of chemical amendments (like gypsum) followed by draining for alkali soils. The occurrence of these soils is so limited, however, that they present only a localized probelm to be tackled at the farm level.

3.12 The relevant findings by the Team and the relationship between the soils and irrigation practices are dealt upon to a certain extent in Volume II, under III: Soils and Land Classification.

Fig. 3-4 **SOIL MAP OF INGINIMITIYA RESERVOIR PROJECT**

(Based On Aerial Photo Interpretation & National Soil Survey Data)



Hydrology

3.13 Under the project, the Mi-Oya is going to be harnessed into a principal source of irrigation water towards the development area of 6,300 acres by closing it with a dam at Inginimitiya; Mahauswewa Tank, the biggest reservoir among the existing tanks in the area will be utilized as a supplementary source of irrigation water.

Mi-Oya originates in the 1,000 feet-high Dambulla hills in the Pallokollo Forest reserve and runs westward for about 86 miles before flowing into Puttalam Lagoon. The slope of the river flow inside the project area is about 1/1,000. Mi-Oya has a drainage area of about 215 sq.miles (556.8 km^2) in the neighbourhood of Mahauswewa but, due to the diversion at Abakolawewa to the extent of 65 sq.miles, the effective drainage area is limited to 150 sq.miles (388.5 km^2).

The yield of the Mi-Oya has been measured for over 30 years in the past at Mahauswewa. However, it is risky to use the mean figures either on monthly or annual basis for planning purposes since the rainfall pattern is highly erratic in the dry zone as is shown in the following Table which is based on the rainfall records obtained at Mahauswewa during the past 20 years:

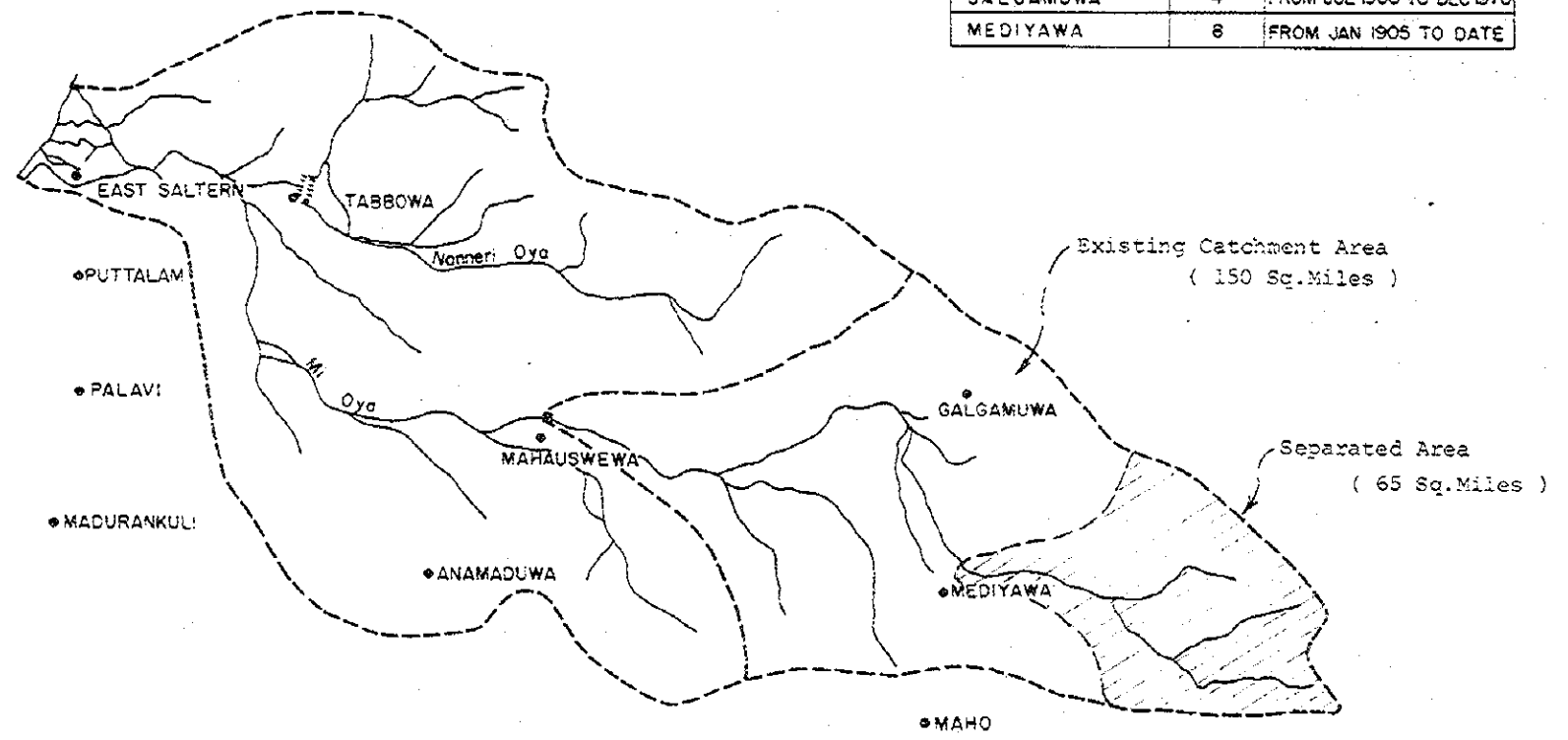
Table 3-7 Mi-Oya's Discharges at Mahauswewa for the last 20 years

Item	Annual Discharge
Maximum Rainfall Year (1957/58)	336,906 ac.ft.
Minimum Rainfall Year (1974/75)	10,869 "
20 Years' Average (simple)	94,515 "
25% Frequency	99,541 "
50% "	73,819 "
75% "	49,676 "

Fig. 3-5

MI OYA BASIN

RAINFALL STATION	WEIGHT	PERIOD OF RECORDS
MAHAUSWEWA	2	FROM JAN 1892 TO DATE
GALGAMUWA	4	FROM JUL 1908 TO DEC 1970
MEDIYAWA	8	FROM JAN 1905 TO DATE



Present Land Use and Production Patterns

3.14 The entire area coming under the project covers 9,200 acres of which 6,300 acres would be made irrigable all through the year. As about 1,640 acres are currently used as paddyfield, 4,660 acres jungle-covered land would be newly developed under the project. Since stable agricultural production takes place in the Dry Zone only through tank irrigation, supplementarily during Maha season but exclusively during Yala season, the extent of irrigability is synonymous with the entirety of land which can be productively used for cultivation of paddy which is the staple food of the people. The existing agricultural land, therefore, has its own sources of irrigation which, in our case, are Mahauswewa Tank and several other smaller village tanks. In the command area of Mahauswewa Tank which is the biggest and the most dependable in the region, the irrigable area has been limited to about 80% during Maha season and to about 40% during Yala season, for the last 15 years or so; apart from paddy cultivation, cultivation of some subsidiary food crops like cow peas, green gram, and the like is nevertheless possible and is actually tried out in the gardens and upland fields during Maha season. The pattern of irrigability and correspondingly the pattern of cropping in the command area of Mahauswewa Tank is supposed to be duplicated, though in much less favourable ratios, in the rest of the existing agricultural land.

Socio-Economic Issues

3.15 The present land-use and production patterns in the existing agricultural land have not yet been studied in necessary details (some hearing from the farmers who happened to be living in the neighbourhood of the soil sampling spots are tabulated in the Study Report). It could, however, be said that by and large the farming is of subsistent level even within the existing agricultural land, to say nothing of the agricultural productivity in the area which would be newly developed which is almost negligible except some chena cultivation during Maha season.

IV THE PROJECT

GENERAL

4.01 The project would include: (a) construction of a 2 miles 5,000 feet-long earth dam across the Mi-Oya at the present Inginimitiya Tank site, with all the necessary facilities for irrigation/drainage and farm road network, to provide year-round irrigation benefits to 6,300 acres of the project area for production of paddy and other subsidiary food crops by both the domiciled farmers and newly settling families; (b) establishment of the well-equipped project headquarters to train the farmers, who will be organized into APC, CCs and agricultural cooperatives, in such as water management; improved farming techniques; agricultural production planning; credit, input supply and marketing, etc., so that the full development of the project area in the future would become self-propelling within reasonable number of years; (c) construction of machinery centres, office and store-rooms of the farmer organizations, and provision of farm equipment for land preparation and plant protection to enable the farmers to obtain farm production above a certain constant level by adhering to highly intensive cropping calendar; and (d) technical assistance to the project farmers through the project headquarters in their attaining,and if possible surpassing, the development targets under the project.

AGRICULTURAL DEVELOPMENT

4.02 Type of Farming and Broad Patterns of Production: It is intended under the project to clear, develop and consolidate some 4,660 acres of land which has not been systematically used for agricultural purposes and divide it into the small market-oriented family farm of 2.5 acres each. The existing agricultural land which spreads over some 1,640 acres will also be consolidated, but no radical changes to its land distribution and tenure is anticipated. The development of both the existing and newly developed farms requires that the scientific agricultural techniques including the use of proper amounts of fertilizers, other agro-chemicals and the farm machinery be extended among the farmers side by side with organization and management of the appropriate farmers' institutions for water management, procurement

of credits and facilitating for supply of agricultural input materials and marketing of the produce.

Land Use and Cropping Patterns

4.03 The broad patterns of land-use and agricultural production would be governed by topographic and soil conditions in the project area: lowland (5,200 acres) which is comprised of 1,640 acres of the existing agricultural land and 3,560 acres of the newly developed land covers 83% of the entire irrigable area under the project and is meant for paddy production during both Maha and Yala seasons while, in agreement with land classification patterns, artificially and naturally well-drained highland (1,100 acres) will be used for cultivation of paddy during Maha season and of subsidiary food crops such as soya beans and pulses and cash crop like dried chillies during Yala season. Cropping patterns on the low and highlands are shown in Fig. 4-1.

Future Project Output and Development Schedule

4.04 Project implementation would be phased over 5 years and the full project benefits would be achieved 5 years after project implementation in the newly developed land. In the meanwhile, with special attention given to water management, extension work and credit/input supply guidance, it is expected that the average yields of the crops will steadily increase from the moderate level to much higher and constant level as the farmers would be equipped with suitable agricultural machinery and obtain proper experience in managing their own farms and institutions. The output expected per acre in the newly developed land in the 6th and the 11th year will be as follows:

	Paddy	Soya Bean	Pulses	Chillies (dry)
6th year	45 bushels	6 cwt.	5 cwt.	7 cwt.
11th year	80 "	12 "	10 "	15 "

4.05 The estimated agricultural inputs and outputs in the newly developed land under the project are given in Table 4-1.

4.06 The yield-increase would start in the existing agricultural land from the 5th year when the headwork including main canals should be ready for operation. Due to the experiences in corp cultivation and water control previously accumulated among the farmers, plus intensive water management and extention services as well as institutional training under the project, the average yields of the proposed crops which are expected in the newly developed land only in the 11th year are supposed to be obtained in the 7th year in the command area of Mahauswewa Tank, and in the 8th year in the rest of the existing agricultural land. The agricultural inputs and outputs estimated in the existing agricultural land during the construction period and under the project are given in Tables 4-2 and 4-3, respectively.

Fig. 4-1 Proposed Cropping Pattern

▨ : Land Preparation.

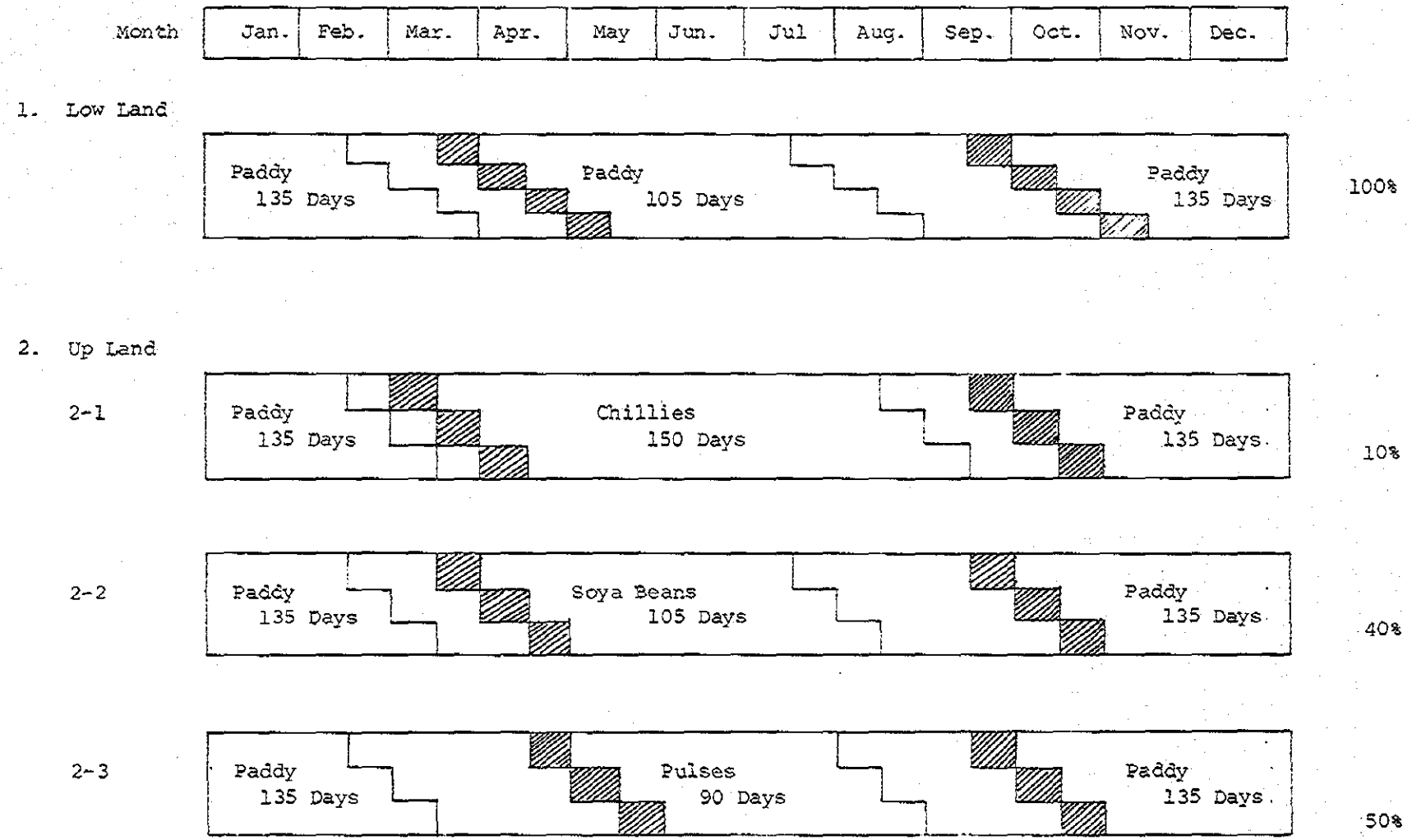


Table 4-1 Agricultural Production in The Newly Developed Area under The Project (Financial)

		Type of Land	Low Land			High Land				
		Size	3,560 acres			1,100 acres				
		Irrigability	85% during Maha & 80% during Yala			85% during Maha & 80% during Yala				
		Cropping Pattern	Paddy (during Maha)	Paddy (during Yala)	Total	Paddy (during Maha)	Upland Crops (during Yala) Soya Beans	Pulses	Chillies	Total
		Area under Crops	3,026Ac.	2,848Ac.	5,874Ac.	935Ac.	352Ac. (40%)	440Ac. (50%)	88Ac. (10%)	880Ac. (100%)
6th Year	Production	Yield per Acre	45bu	45bu		45bu	6cwt	5cwt	7cwt	
		Production (Rs1,000)	136.2	128.2	264.4	42	2,112	2,200	616	
		Unit Price (Rs)	33	33		33	84	128	1,000	
		G.P.V. (Rs1,000)	4,494.5	4,230.6	8,725.1	1,386	177.4	281.6	616	2,461
	Cost	Cost per Acre (Rs)	579	579		579	410	390	1,289	
		Total Cost (Rs1,000)	1,752	1,649	3,401	541.4	144.3	171.6	113.4	970.4
		N.P.V. (Rs1,000)	2,743	2,582	5,325	844.6	33.1	110	502.6	1,490.3
7th Year	Production	Yield per Acre	52bu	52bu		52bu	7.2cwt	6cwt	8.6cwt	
		Production (Rs1,000)	157.4	148.1	305.5	48.6	2,534	2,640	757	
		Unit Price (Rs)	33	33		33	84	128	1,000	
		G.P.V. (Rs1,000)	5,194.2	4,887.3	10,081.5	1,603.8	212.9	337.9	857	2,911.6
	Cost	Cost per Acre (Rs)	650	650		650	483	460	1,428	
		Total Cost (Rs1,000)	1,966.9	1,851.2	3,818.1	607.8	170	202.4	125.7	1,105.9
		N.P.V. (Rs1,000)	3,227.3	3,036.1	6,263.4	996	42.9	135.5	631.3	1,805.7
8th Year	Production	Yield per Acre	59bu	59bu		59bu	8.4cwt	7cwt	10.2cwt	
		Production (Rs1,000)	178.5	168	346.5	55.2	2,957	3,080	897.6	
		Unit Price (Rs)	33	33		33	84	128	1,000	
		G.P.V. (Rs1,000)	5,890.5	5,544	11,434.5	1,821.6	248.4	394.2	897.6	3,361.8
	Cost	Cost per Acre (Rs)	746	746		746	535	530	11,583	
		Total Cost (Rs1,000)	2,257.4	2,124.6	4,382	697.5	188.3	233.2	139.3	1,258.3
		N.P.V. (Rs1,000)	3,633.1	3,419.4	7,052.5	1,124.1	60.1	161.0	758.3	2,103.5
9th Year	Production	Yield per Acre	66bu	66bu		66bu	9.6cwt	8cwt	11.8cwt	
		Production (Rs1,000)	199.7	188	387.7	61.7	3,379	3,520	1,038.4	
		Unit Price (Rs)	33	33		33	84	124	1,000	
		G.P.V. (Rs1,000)	6,590.1	6,204	12,794.1	2,036.1	283.9	436.5	1,038.4	3,794.9
	Cost	Cost per Acre (Rs)	906	906		906	631	634	1,839	
		Total Cost (Rs1,000)	2,741.6	2,580.3	5,321.9	847.1	222.1	279.0	161.8	1,510.0
		N.P.V. (Rs1,000)	3,848.5	3,623.7	7,472.2	1,189	61.8	157.5	876.6	2,284.9
10th Year	Production	Yield per Acre	73bu	73bu		73bu	10.8cwt	9cwt	13.4cwt	
		Production (Rs1,000)	220.9	207.9	428.8	68.3	3,802	3,960	1,179.2	
		Unit Price (Rs)	33	33		33	84	128	1,000	
		G.P.V. (Rs1,000)	7,289.7	6,860.7	14,150.4	2,253.9	319.3	506.9	1,179.2	4,259.3
	Cost	Cost per Acre (Rs)	1,043	1,043		1,043	705	701	2,116	
		Total Cost (Rs1,000)	3,156.1	2,970.5	6,126.6	975.2	248.2	308.4	186.2	1,718.0
		N.P.V. (Rs1,000)	4,133.6	3,890.2	8,023.8	1,276.7	71.1	198.5	993	2,541.3
11th Year	Production	Yield per Acre	80bu	80bu		80bu	12cwt	10cwt	15cwt	
		Production (Rs1,000)	242.1	227.8	469.9	74.8	4,424	4,400	1,320	
		Unit Price (Rs)	33	33		33	84	128	1,000	
		G.P.V. (Rs1,000)	7,989.3	7,517.4	15,506.7	2,468.4	354.8	563.2	1,320	4,706.4
	Cost	Cost per Acre (Rs)	1,185	1,185		1,185	780	770	2,190	
		Total Cost (Rs1,000)	3,585.8	3,374.9	6,960.7	1,108	274.6	338.8	210.3	1,931.7
		N.P.V. (Rs1,000)	4,403.5	4,142.5	8,546	1,360.4	80.2	226.4	1,109.7	2,774.7

Table 4-2 Paddy Production in The Existing Agricultural Lands during The Construction Period (in Financial Prices)

		Command Area of Mahauswewa Tank		The Rest of The Existing Agricultural Land	
Total Area		850 acres		790 acres	
Irrigability		80% during Maha Season	40% during Yala Season	80% during Maha Season	40% during Yala Season
Area under Paddy		680 acres	340 acres	632 acres	316 acres
Production	Yield per Acre	59 bushels	59 bushels	52 bushels	52 bushels
	Total Production	40,120 bl.	20,060 bl.	32,864 bl.	16,432 bl.
	Unit Price	Rs33	Rs33	Rs33	Rs33
	G.P.V. (Rs1,000)	Rs1,324	Rs662	Rs1,085	Rs542
Cost	Seed & Chemicals	Rs256	"	Rs206	"
	Farm Machinery/Labour	Rs400	"	Rs360	"
	Miscellaneous	Rs90	"	Rs84	"
	Cost per Acre	Rs746	Rs746	Rs650	Rs650
	Total Cost (Rs1,000)	Rs507	Rs254	Rs411	Rs205
N.P.V. (Rs1,000)		Rs817	Rs408	Rs674	Rs337

Table 4-3 Paddy Production in The Existing Agricultural Lands under The Project (in Financial Prices)

Diviison of Area		Command Area of Mahauswewa Tank						The Rest of The Existing Agricultural Lands							
Total Area		850 acres						790 acres							
Irrigability		85% during Maha			80% during Yala			85% during Maha Seaosn				80% during Yala Season			
Area under Paddy		723 acres			680 acres			672 acres				632 acres			
Project Year		5th Yr.	6th Yr.	7th Yr.	5th Yr.	6th Yr.	7th Yr.	5th Yr.	6th Yr.	7th Yr.	8th Yr.	5th Yr.	6th Yr.	7th Yr.	8th Yr.
Production	Yield per Acre (bu)	66	73	80	66	73	80	59	66	73	80	59	66	73	80
	Total Production (bu)	47,718	52.779	57.840	44,880	49,640	54,400	39,648	44,352	49,056	53,760	37,288	41,712	46,136	50,560
	Unit Price (Rs)	Rs33/bushel			Rs33/bushel			Rs33/bushel				Rs33/bushel			
	G.P.V. (Rs1,000)	1,575	1,742	1.909	1,481	1,638	1,795	1,308	1,464	1,619	1,774	1,230	1,377	1,523	1,669
Cost	Seeds/Chemicals (Rs)	346	436	530	346	436	530	256	346	436	530	256	346	436	530
	Farm Machinery/Labour	440	480	520	440	480	520	400	440	480	520	400	440	480	520
	Miscellaneous	120	127	135	120	127	135	90	120	127	135	90	120	127	135
	Cost per Acre (Rs)	906	1,043	1,185	906	1,043	1,185	746	906	1,043	1,185	746	906	1,043	1,185
	Total Cost (Rs1,000)	655	754	857	616	709	806	501	609	701	796	472	573	659	749
N.P.V. (Rs1,000)		920	988	1,052	865	929	989	807	855	918	978	758	804	864	920

WATER USE

Source of Water

4.07 The Yield of the Mi-Oya: The Mi-Oya is the principal source of water for irrigating the development area. The design drainage area of the Mi-Oya is limited to 150 sq.miles due to 65 sq.miles diversion at Abakola-wewa. The river's yield which has been measured since 1946 to date at Mahauswewa corresponds to that from 150 sq.miles. The monthly yeild for the last 20 years is given in Table 4-4.

4.08 Existing Tanks: There are several small-medium sized tanks (reservoirs) in the project area and it is due to such tanks that 1,640 acres existing paddyfields have been maintained irrespective of crop success percentages which has been highly erratic either in Maha or Yala because of the fundamental limitations inherent to the existing tanks. Therefore, all of them have been ignored except Mahauswewa Tank which will be utilized as a supplementary source of irrigation water for agricultural development in the project area.

Table 4-5 Area of the Existing Paddyfields in the Project Area

Name of Tanks	Area (in acres)
Right Bank	
Inginimitiya Tank	200
Kadawela Tank	45
Kankadawela Tank	30
Galkulama Tank and others	200
Sub-total	475
Left Bank	
Mahauswewa Tank	850
Ottukulama Tank	25
Uriyawewa Tank	290
Sub-total	1,165
Grand Total	1,640

Table 4-4 Mean Monthly Yield Figures for Maha Uswewa

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Total
1955/56	26,453	27,846	43,537	9,225	1,368	16,478	455	222	367	369	369	178	126,867
1956/57	20	5,641	6,617	366	141	145	11,375	860	2,891	190	61	41	28,348
1957/58	6,461	59,382	157,391	24,459	6,991	16,111	52,464	6,659	1,210	1,394	1,681	2,703	336,906
1958/59	2,597	2,620	6,327	1,443	267	712	Nil	4,978	1,661	640	346	250	21,941
1959/60	10,694	19,030	20,263	5,742	3,045	1,473	3,230	2,334	988	5,928	927	165	73,819
1960/61	473	30,183	8,973	6,785	3,287	1,857	632	695	719	1,141	576	303	55,624
1961/62	2,475	20,721	13,884	6,770	3,463	2,905	2,457	7,660	2,010	738	3,310	1,055	67,498
1962/63	88,666	20,582	12,211	88,518	10,817	5,350	4,162	3,926	2,043	1,485	812	550	239,122
1963/64	2,647	52,912	62,382	15,430	5,934	5,696	1,772	1,388	1,141	990	1,055	822	152,169
1964/65	832	13,316	6,278	2,348	1,836	859	9,389	21,069	2,560	719	4,439	784	64,449
1965/66	8,332	13,446	47,762	4,503	4,330	1,598	13,127	3,012	1,893	505	333	700	99,541
1966/67	9,680	39,953	15,721	7,801	4,499	2,366	4,025	1,572	709	416	297	1,210	88,249
1967/68	17,091	9,882	40,049	6,585	2,624	10,274	5,619	2,101	1,076	1,307	459	259	97,326
1968/69	1,610	30,500	18,982	5,532	3,000	2,166	2,230	1,206	422	87	392	154	66,281
1969/70	9,356	8,902	12,662	15,254	7,968	3,632	18,275	10,740	2,604	881	1,030	1,148	92,452
1970/71	4,085	7,510	6,665	4,570	2,776	2,875	5,657	5,471	1,562	826	982	560	43,539
1971/72	5,683	12,058	31,011	2,582	2,101	944	3,491	28,122	2,241	1,800	752	1,241	92,025
1972/73	12,999	40,851	12,805	2,728	1,847	2,160	7,486	1,005	792	396	293	198	83,560
1973/74	2,447	3,528	12,591	4,714	772	2,132	18,869	1,552	1,653	1,146	226	46	49,676
1974/75	Nil	172	212	44	3,400	190	1,420	2,435	196	2,800	Nil	Nil	10,869
Mean	10,635	20,952	26,811	10,770	3,523	3,996	8,307	5,350	1,437	1,190	918	618	94,513

Project Hydrology

4.09 Rainfall: Rainfall records, some of them for the past half a century since 1925, are available at 3 rainfall stations: the one in the project area at Mahauswewa and the other two in the Mi-Oya's basin at Gamgamuwa and Mediyama. The data obtained at Mahauswewa rainfall station have been used for analytical purposes of the irrigation plan, as it is situated almost at the centre of the project area.

As has been emphasized elsewhere in this Report, it is risky to use the mean rainfall figures for calculation of the irrigation requirements and water balance. The rainfalls of different probabilities as have been computed from Mahauswewa data read as follows:

Table 4-6 Probable Rainfalls at Mahauswewa

Probability	Annual Rainfall (in)
1/50	90.13
1/20	80.05
1/10	72.26
1/5	64.15
1/2	51.89

The corresponding maximum daily rainfalls and continuous drought days are given in Tables 4-7 and 4-8, respectively:

Table 4-7 Probable Maximum Daily Rainfalls at Mahauswewa

Probability	Maximum Daily Rainfall (in)
1/50	8.31
1/20	7.12
1/10	6.20
1/5	5.24
1/2	3.80

Table 4-8 Probable Continuous Drought Days at Mahauswewa

Probability	Continuous Drought Days
1/50	160
1/20	136
1/10	117
1/5	97
1/2	68

4.10 Flood Discharge: Peak flood discharges have been computed from the hourly rainfall records which have been kept at Puttalam and Maha-Illuppallama. The weighted ratios as computed by use of Thiessen Polygon method are 0.92 at Maha-Illuppallama and 0.08 at Puttalam. The records of a significant flood which occured in October 1967 have been used for hydrographing in obtaining the peak discharges in different probabilities in the project area, with the following results:

1/100 years probability : 60,100 cusecs
1/200 " " : 65,600 "
1/1,000 " " : 78,600 "

The proposed spillway has been designed on the 1/200 year probability as is usual in Sri Lanka.

Irrigation Efficiency

4.11 Effective Rainfall: In computing the monthly effective rainfall, the same standards as have been adopted in Sri Lanka for many irrigation schemes including Mahaweli project have been used:

(a) Lowland Paddy

ER = (R - 1) x 0.67 (inches)

ER $\geq$ 9" ER = 9"

R $\leq$ 1" ER = 0

(b) Upland Crops

ER = (R - 0.25) x 0.67 (inches)

ER $\geq$ 3" ER = 3"

R $\leq$ 0.25" ER = 0

Note: ER : Monthly Effective Rainfall
R : Monthly Rainfall

4.12 Water Requirements for Land Preparation: 7" per crop of paddy on the lowland, and 1.5" per crop on the highland including that of upland rice, in accordance with the similar cases in other irrigation projects in the country.

4.13 Percolation and Dyke Leakage Losses: These losses in the lowland paddyfield vary according to the soil conditions. In the light of the soil textures (low humic gley soils and alluvial soils of variable drainage and texture) available in the lowland of the project area, these losses are estimated at 6 inches per month.

4.14 Irrigation Efficiency: 50% irrigation efficiency is applied to the upland crops including upland rice.

4.15 Conveyance Losses: Conveyance and diversion losses are combinedly estimated at 30% of the irrigation requirement.

Gross Water Requirements

Gross water requirements are expressed in terms of:

(1) Crop Water Requirement = Evapo-transpiration + [Percolation or Irrigation Loss (Field)];

(2) Irrigation Requirement = Crop Water Requirement + Farm Waste - Effective Rainfall;

(3) Diversion Requirement = Irrigation Requirement + Conveyance and Diversion Losses.

Crop water consumption requirement (evapo-transpiration) is calculated by the following formula:

ET (Crop) = ETo x Crop Factor

where: ET (Crop) : Evapo-transpiration
ETo : Reference evapo-transpiration (not adjusted)

ETo values can be obtained by the modified Penman Method which was developed by FAO; the monthly ETo which were used for Mahaweli Scheme have been adopted, as follows:

Table 4-9 Monthly ETo

Month:	1	2	3	4	5	6	7	8	9	10	11	12
ETo:	4.7	5.0	6.2	5.9	6.4	6.9	7.5	7.6	7.5	6.2	4.3	4.5

4.16 Assuming that the cropping patterns shown in Fig. 4-1 will be introduced on the entire net irrigation area, with the standardized crop factors effective in Sri Lanka, crop water requirement, irrigation requirement and diversion requirement will be as computed in Tables 4-10 and 4-11. Effective rainfall has not been taken into account in their calculations.

Water Balance

4.17 The water balance of the proposed reservoir computed on the basis of the water requirements as specified under the preceding paragraph, the

effective rainfall and the Mi-Oya's yield, is shown in Fig. 4-2. Success percentage of crop cultivation in the net irrigable area of 6,300 acres will be:

Maha season :	85%
Yala season :	80%

Table 4-10 Calculation Sheet for Total Water Requirement (Monthly)

1. Lowland

Month	ETo	I.R. (in)	Total Irrigation Water Requirement		Total Diversion Water Requirement	
			(Ac.ft.)	(ft^3/Sec)	(Ac.ft.)	(ft^3/Sec)
Jan.	4.7	11.5	4,983	83.7	6,478	108.8
Feb.	5.0	10.0	4,333	72.8	5,633	94.6
Mar.	6.2	6.2	2,687	45.2	3,493	58.8
Apr.	5.9	8.1	3,510	59.0	4,563	76.7
May	6.4	13.1	5,677	95.4	7,380	124.0
Jun.	6.9	14.0	6,067	102.0	7,887	132.6
Jul.	7.5	12.4	5,373	90.3	6,985	117.4
Aug.	7.6	5.0	2,167	36.4	2,817	47.3
Sep.	7.5	1.8	780	13.1	1,014	17.0
Oct.	6.2	8.1	3,510	59.0	4,563	76.7
Nov.	4.3	11.0	4,767	80.1	6,197	104.1
Dec.	4.5	11.1	4,810	80.8	6,253	105.0
Total	72.7	112.3	48,664		63,263	

2. Upland

Month	ETo	I.R. (in)	Total Irrigation Water Requirement		Total Diversion Water Requirement	
			(Ac.ft.)	(ft^3/Sec)	(Ac.ft.)	(ft^3/Sec)
Jan.	4.7	9.8	898	15.1	1,167	19.6
Feb.	5.0	8.1	743	12.5	966	16.3
Mar.	6.2	2.3	211	3.5	274	4.6
Apr.	5.9	3.1	284	4.8	369	6.2
May	6.4	8.1	743	12.5	966	16.3
Jun.	6.9	12.5	1,146	19.3	1,490	25.1
Jul.	7.5	12.8	1,173	19.7	1,525	25.6
Aug.	7.6	4.6	422	7.1	549	9.2
Sep.	7.5	0.7	64	1.1	83	1.4
Oct.	6.2	6.6	605	10.2	787	13.3
Nov.	4.3	8.2	752	12.6	978	16.4
Dec.	4.5	9.2	843	14.2	1,096	18.5
Total	72.7	85.9	7,884		10,250	

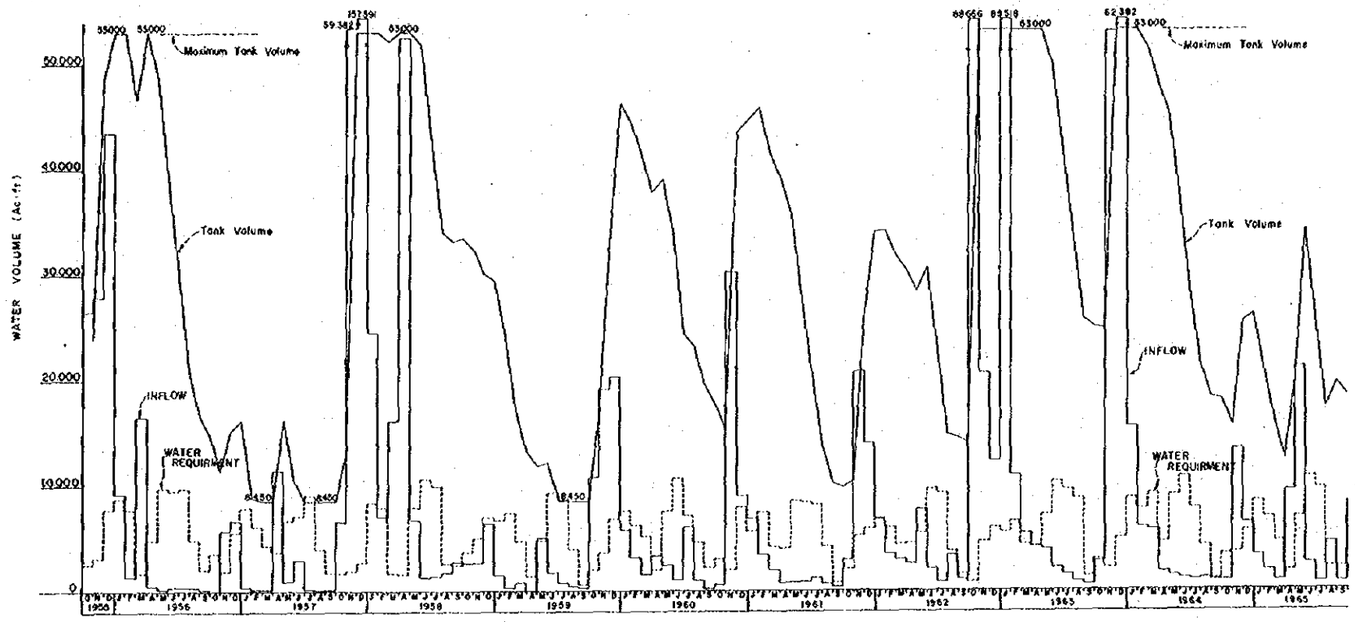
3. Total

Month	Lowland		Upland		Total	
	D.W.R. (Ac.ft.)	D.W.R. (ft^3/Sec)	D.W.R. (Ac.ft.)	D.W.R. (ft^3/Sec)	D.W.R. (Ac.ft.)	D.W.R. (ft^3/Sec)
Jan.	6,478	108.8	1,167	19.6	7,645	128.4
Feb.	5,633	94.6	966	16.3	6,599	110.9
Mar.	3,493	58.8	274	4.6	3,767	63.4
Apr.	4,563	76.7	369	6.2	4,932	82.9
May	7,380	124.0	966	16.3	8,346	140.3
Jun.	7,887	132.6	1,490	25.1	9,377	157.7
Jul.	6,985	117.4	1,525	25.6	8,510	143.0
Aug.	2,817	47.3	549	9.2	3,366	56.5
Sep.	1,014	17.0	83	1.4	1,097	18.4
Oct.	4,563	76.7	787	13.3	5,350	90.0
Nov.	6,197	104.1	978	16.4	7,175	120.5
Dec.	6,253	105.0	1,096	18.5	7,349	123.5
Total	63,263		10,250		73,513	

Note: The above Tables do not include the effective rainfalls; Those including the effective rainfalls are given in Tables 5-8 through 5-17 in Volume II: Notes.

Table 4-11 Calculation Sheet for Total Water Requirement

Month		Lowland (5,200 Ac)				Upland (1,100 Ac)					Total	
		I.R. (in)	Irrigation Water Requirement		Diversion Water Requirement		I.R. (in)	Irrigation Water Requirement		Diversion Water Requirement		Diversion Water Requirement	
			ft³/sec	Ac.ft	ft³/sec	Ac.ft		ft³/sec	Ac.ft	ft³/sec	Ac.ft	Ac.ft	ft³/sec
J	1	1.92	83.9	832	109.1	1,082	1.62	15.0	149	19.5	194	1,276	128.6
	2	1.92	83.9	832	109.1	1,082	1.62	15.0	149	19.5	194	1,276	128.6
	3	1.93	84.3	836	109.6	1,087	1.64	15.1	150	19.6	195	1,282	129.2
	4	1.93	84.3	836	109.6	1,087	1.64	15.1	150	19.6	195	1,282	129.2
	5	1.93	84.3	836	109.6	1,087	1.64	15.1	150	19.6	195	1,282	129.2
	6	1.88	82.2	815	106.9	1,060	1.56	15.2	151	19.8	196	1,256	126.7
F	1	1.94	84.8	841	110.2	1,093	1.68	15.5	154	20.2	200	1,293	130.4
	2	1.94	84.8	841	110.2	1,093	1.68	15.5	154	20.2	200	1,293	130.4
	3	1.88	82.2	815	106.9	1,060	1.58	14.6	145	19.0	189	1,249	125.9
	4	1.44	62.9	624	81.8	811	1.08	10.0	99	13.0	129	940	94.8
	5	1.44	62.9	624	81.8	811	1.08	10.0	99	13.0	129	940	94.8
	6	1.38	60.3	598	78.4	777	1.00	9.3	92	12.1	120	897	90.5
M	1	1.05	45.9	455	59.7	592	0.64	5.9	59	7.7	77	669	67.4
	2	1.05	45.9	455	59.7	592	0.64	5.9	59	7.7	77	669	67.4
	3	0.97	42.3	420	55.0	546	0.64	5.9	59	7.7	77	623	62.7
	4	1.07	46.8	464	60.8	603	0.13	1.2	12	1.6	16	619	62.4
	5	1.07	46.8	464	60.8	603	0.13	1.2	12	1.6	16	619	62.4
	6	1.07	46.8	464	60.8	603	0.13	1.2	12	1.6	16	619	62.4
A	1	1.08	47.2	468	61.4	608	0.34	3.1	31	4.0	40	648	65.4
	2	1.08	47.2	468	61.4	608	0.34	3.1	31	4.0	40	648	65.4
	3	1.08	47.2	468	61.4	608	0.35	3.2	32	4.2	42	650	65.6
	4	1.57	68.6	680	89.2	884	0.69	6.4	63	8.3	82	966	97.5
	5	1.61	70.4	698	91.5	907	0.69	6.4	63	8.3	82	989	99.8
	6	1.61	70.4	698	91.5	907	0.70	6.5	64	8.5	83	990	100.0
M	1	2.17	94.8	940	123.2	1,222	1.11	10.3	102	13.4	133	1,355	136.6
	2	2.21	96.6	958	125.6	1,245	1.17	10.8	107	14.0	139	1,384	139.6
	3	2.21	96.6	958	125.6	1,245	1.19	11.0	109	14.3	142	1,387	139.9
	4	2.15	94.0	932	122.2	1,212	1.52	14.0	139	18.2	181	1,393	140.4
	5	2.20	96.1	953	124.9	1,239	1.59	14.0	139	18.2	181	1,420	143.1
	6	2.20	96.1	953	124.9	1,239	1.59	14.0	139	18.2	181	1,420	143.1
J	1	2.30	100.5	997	130.7	1,296	1.93	17.8	177	23.1	230	1,526	153.8
	2	2.35	102.6	1,018	133.4	1,323	2.01	18.6	184	24.2	239	1,562	157.6
	3	2.35	102.6	1,018	133.4	1,323	2.01	18.6	184	24.2	239	1,562	157.6
	4	2.35	102.6	1,018	133.4	1,323	2.21	20.5	203	26.7	264	1,587	160.1
	5	2.37	103.6	1,027	134.7	1,335	2.21	20.5	203	26.7	264	1,599	161.4
	6	2.28	99.6	988	129.5	1,284	2.11	19.5	193	25.4	251	1,535	154.9
J	1	2.39	104.5	1,036	135.9	1,347	2.41	22.3	221	29.0	287	1,634	164.9
	2	2.41	105.3	1,044	136.8	1,357	2.41	22.3	221	29.0	287	1,644	165.8
	3	2.31	100.9	1,001	131.2	1,301	2.32	21.5	213	28.0	277	1,578	159.2
	4	1.79	78.2	776	106.7	1,009	1.93	17.8	177	23.1	230	1,239	129.8
	5	1.79	78.2	776	101.7	1,009	1.92	17.7	176	23.0	229	1,238	124.7
	6	1.69	73.8	732	95.9	952	1.82	16.8	167	21.8	217	1,169	117.7
A	1	1.17	51.1	507	66.4	659	1.15	10.6	105	13.8	137	796	80.2
	2	1.17	51.1	507	66.4	659	1.14	10.6	105	13.8	137	796	80.2
	3	1.07	46.8	464	60.8	603	1.14	10.6	105	13.8	137	740	74.6
	4	0.54	23.6	234	30.7	304	0.37	3.4	34	4.4	44	348	35.1
	5	0.54	23.6	234	30.7	304	0.36	3.3	33	4.3	43	347	35.0
	6	0.54	23.6	234	30.7	304	0.36	3.3	33	4.3	43	347	35.0
S	1	-	-	-	-	-	0.08	0.7	7	0.9	9	9	0.9
	2	-	-	-	-	-	0.08	0.7	7	0.9	9	9	0.9
	3	-	-	-	-	-	0.08	0.7	7	0.9	9	9	0.9
	4	0.58	25.3	251	32.9	326	0.17	1.6	16	2.1	21	347	35.0
	5	0.58	25.3	251	32.9	326	0.17	1.6	16	2.1	21	347	35.0
	6	0.58	25.3	251	32.9	326	0.17	1.6	16	2.1	21	347	35.0
O	1	1.09	47.6	472	61.9	614	0.79	7.3	72	9.5	94	708	71.4
	2	1.09	47.6	472	61.9	614	0.79	7.3	72	9.5	94	708	71.4
	3	1.09	47.6	472	61.9	614	0.79	7.3	72	9.5	94	708	71.4
	4	1.59	69.5	689	90.4	896	1.41	13.0	129	16.9	168	1,064	107.3
	5	1.59	69.5	689	90.4	896	1.41	13.0	129	16.9	168	1,064	107.3
	6	1.59	69.5	689	90.4	896	1.41	13.0	129	16.9	168	1,064	107.3
N	1	1.89	82.6	819	107.4	1,065	1.34	12.4	123	16.1	160	1,225	123.5
	2	1.89	82.6	819	107.4	1,065	1.34	12.4	123	16.1	160	1,225	123.5
	3	1.89	82.6	819	107.4	1,065	1.34	12.4	123	16.1	160	1,225	123.5
	4	1.77	77.3	767	100.5	997	1.38	12.8	127	16.6	165	1,162	117.1
	5	1.77	77.3	767	100.5	997	1.38	12.8	127	16.6	165	1,162	117.1
	6	1.77	77.3	767	100.5	997	1.38	12.8	127	16.6	165	1,162	117.1
D	1	1.83	80.0	793	104.0	1,031	1.50	13.9	138	18.1	179	1,210	122.1
	2	1.83	80.0	793	104.0	1,031	1.50	13.9	138	18.1	179	1,210	122.1
	3	1.85	80.9	802	105.2	1,043	1.52	14.0	139	18.2	181	1,224	123.4
	4	1.87	81.7	810	106.2	1,053	1.52	14.0	139	18.2	181	1,234	124.4
	5	1.87	81.7	810	106.2	1,053	1.52	14.0	139	18.2	181	1,234	124.4
	6	1.88	82.2	815	106.9	1,060	1.54	14.2	141	18.5	183	1,243	125.4
Total		112.28	4,906.1	48,654	6,383.6	63,250	85.83	792.6	7,864	1,030.8	10,231	73,481	7,414.4



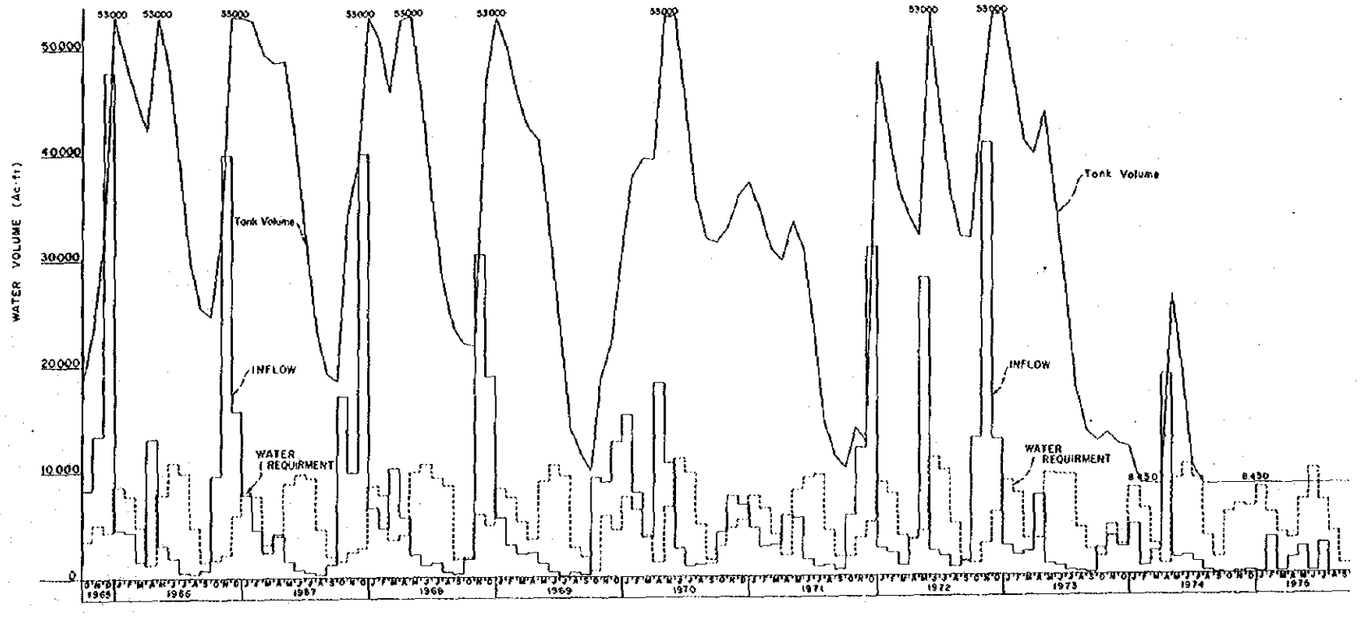


Fig. 4 - 2

WATER BALANCE STUDY
FOR
INGINIMITIYA RESERVOIR PROJECT

Irrigation System

4.18 Irrigation system proposed under the project envisages construction of a reservoir with an effective storage capacity of 48,800 ac.ft. at the site of the existing Inginimitiya Tank; this would be made a principal source of water to irrigate 6,300 ac. in the project area. The reservoir would be equipped with each one tower-type sluice on both banks to intake the maximum discharges of 61 ft^3/sec and 105 ft^3/sec which are required for optimal irrigation of 2,300 ac. on the right bank and 4,000 ac. on the left bank, respectively. The cross sections of the main canals running down on the both banks are so designed as to flow down the abovementioned maximum discharges in the upper sections but gradually become smaller to suit the diminishing flows in the lower sections: 3 types of canal are designed for the right bank main canal and 4 types for the left bank main canal. The intake weirs which will be built along the main canals divert specific amounts of irrigation water into the secondary channels through the controllable gates; tertiary channels would bring the irrigation water to each liyadda. The total irrigable area of 6,300 ac. includes 1,640 ac. of the existing agricultural land and 4,660 ac. of newly developed land.

Rural Development Mechanism

4.19 Preparatory Works: Agricultural development under the project would enter into full operation since the 6th of project year. However, preparatory works such as establishment of the Project Steering Committee at the centre prior to project implementation and of the Project Headquarters since the 3rd project year are essential; the former to settle broad policy matters in materializing the recommendations and specifications contained in this report and the detail design (technical) report which will follow, and the latter to attend at settlement and re-settlement of the newly recruited farmers from outside the project area and of the villagers who have been domiciled for generations in the reservoir bed area and neighbourhood of the proposed dam-axis so that the farmers brought into the project area in groups would be assured with the minimum necessary living conditions and employment opportunities either through small unit cost contracts in the

project construction works or by temporary Maha cultivations on the newly reclaimed land.

Project Development Works

4.20 (a) Farmer Organizations & Their Functions: The project area farmers both those domiciled in the existing agricultural land and those to be settled and re-settled will organize, with the Government sanction and encouragements, one Agricultural Productivity Committee (APC) catering for the entire project area, and each one Cultivation Committee (CC) and agricultural co-operative in 4 sub-areas into which the whole development area would be divided.

4.21 (b) Project Coordination with the Farmer Organizations: APC will be officed adjacent to the Project Headquarters, and each one of the 4 sub-areas will have, at the most strategical point, one office which will be used jointly by the sub-areal CC and agricultural co-op which will be provided with one store-room or godown for keeping adequate amounts of agricultural input materials ready for timely supply within the sub-area. The project will build at the same place each one Farm Machinery Centre which is equipped with repair and maintenance facilities for the agricultural machinery and equipment allocated for efficient joint-use among the sub-areal farmers, under the supervision and guidance of the Project Headquarters. In other words, the project area farmers would come under One Agricultural Productivity Committee (APC) and they would be organized into 4 Cultivation Committees (CCs) and 4 agricultural co-ops. For their proper functioning, APC should have its office adjacent to the Project HQ building and 4 offices and godowns (to be commonly used by CCs and co-ops) and 4 Farm Machinery Centres.

4.22 (c) Responsibilities and Function of the Project Headquarters: The Water Management Unit which is manned with the officers opted from ID would look after the O & M of irrigation facilities down to the distributory channels and concurrently train the Cultivation Committees on O & M of the irrigation facilities and water control below the secondary channels. The Agricultural Production Unit which is manned with the officers provided by AD would manage 4 Machinery Centres while training the APC in agricultural

planning and each individual farmer in the scientific farming techniques. The Credit, Marketing & Community Development Unit which is staffed with the officers deputed from the Rural Institutions & Productivity Laws Division, the Paddy Marketing Board, and the Department of Co-operative Development will carter for the project area farmers through proper supervision and guidance of their organizations, agricultural co-op. in particular, in such as credit, input supply and marketing, not in spoon-feeding manner but by teaching and training them into strong and efficient working bodies capable to undertake all such agricultural supporting activities within reasonable number of years. Colonization Officer will be held responsible for the farmers' general welfare in cooperation with this Unit.

4.23 (d) Farmers' Own Initiatives & Actions for Agricultural Development: Through such intensive training and education during the first 6 years of the project agricultural development, it is expected that the Project Headquarters would gradually hand over its function to the farmers' organizations since the 12th year so that it could entirely withdraw from day-to-day control and supervision over the farmers after the 15th year, except the Water Management Unit which would follow to be held responsible for O & M of the irrigation/drainage facilities the distributory channels upward.

PROPOSED IRRIGATION WORKS

Dam

4.24 (a) Dam-Axis: Several dam sites were investigated and the present one was ultimately chosen as the most suitable dam-site by the Irrigation Department from such considerations as of geology, storage capacity, and the availability of foundation rock at the location of spillway. After field exploratory surveys, the Feasibility Study Team endorsed the ID's decision.

4.25 (b) Reservoir Scale and Dam Type: Water balance computation between the water requirements for irrigating 6,300 ac. and the storage capacities of the reservoir has resulted at identification of the Full Water Level at 202 M.S.L. The maximum and the effective storage capacities

corresponding to FWL at 202 MSL have been estimated at 53,000 ac.ft. and 48,800 ac.ft., respectively (see H-Q curves shown in Fig. 4-3). The total length of the dam will be 2 miles 4,690 feet. In view of the availability of homogenous and suitable embankment materials in the vicinity of the dam-site, the type of this earth dam has been decided to be "homogenous" type which is justifiable from both the technical as well as the economic considerations.

4.26 (c) Embankment Design: The width of dam-crest has been determined at 20 feet for vehicular traffic on it after completion. The slopes of the dam were originally proposed to be 1 on 3 on the upstream and 1 on 2.5 on the downstream but, upon design parameter as shown in Table 4-12 and stability analysis with computer as given in Table 4-13, it has been decided to adopt 1:2.5 on the upstream and 1:2.0 on the downstream. Protection of the upstream slope against washing-out by the waves will be effected by riprap which is to be provided inbetween 6 feet below the dead water level and 5 feet above the F.W.L. Downstream slope will be protected by turfing.

Utmost care is required in designing and constructing downstream drains as they are pivotal for the stability of homogeneous earth dam; toe drain and horizontal drain are proposed on the downstream slope. As a rule, cutoff trench should be dug deep down to the foundation rock, but in our foundation treatment, excavation to the depth of one-third the dam height would do where the foundation rock exists deeper and/or at the abutments. Proposed dam section is shown in Fig. 4-4.

Table 4-12 Design Parameter

		Embankment	Sand Blanket & Toe Drain	Foundation
Wet Density	lb/ft^3	133	119	-
	t/m^3	2.131	1.906	-
Saturated Density	lb/ft^3	135.7	-	132
	t/m^3	2.173	-	2.115
Cohesion	lb/ft^3	1,150	0	1,035
	t/m^3	5.615	0	5.054
Angle of Internal Friction	DEG	23°30'	30°00'	21°09'
	RAD	0.4105	0.523599	0.36928

Table 4-13 Slope Stability Analysis

Case \ Safety Factor	Sri Lanka Proposals		Revised Proposals		Tolerable
	Upstream	Downstream	Upstream	Downstream	Safety Factor
Fill completed condition	1.89	1.77	1.83	1.62	1.5
Full storage time	2.19	1.93	1.91	1.78	1.3 - 1.5
Rapid drawdown time	2.05	-	1.86	-	1.2

4.27 (d) Spillway Designing: The site for spillway has been finalized on the right bank of the dam where foundation rock is outcropped. This decision was made on the ground of engineering, structural and operational advantages. For selecting the most appropriate type, comparative studies have been made among various type as follows:

(i) uncontrolled overflow weir type;
(ii) uncontrolled - side channel type;
(iii) controlled - all gate system;
(iv) controlled and uncontrolled - a combined type.

Speaking from the principles, the uncontrolled type would be more suitable and yet it has been rejected due to the following reasons:

(i) spillway crest is to be longer (2,000 feet);

(ii) foundation rock is not running evenly; assuming a mountain like shape, it is tapering down at both ends;

(iii) connection with tail channel requires a large-scale work;

(iv) either a bridge over the spillway or a round-about road leading from the tail channel is required for control, and

(v) construction cost and the required facilities become very large due to the above reasons.

An alternative idea of combining a solid weir type with gates has also been dropped from the undermentioned reasons:

(i) discharge flow over the radial gate is to be avoided as a rule;

(ii) the longer is the crest line, the deeper becomes the foundation rock;

(iii) with the width of gate being fixed at 20', the length of the solid weir part will be, if the number of gates should be diminished by one, as follows:

Size of Radial Gate	Nos.	Weir Length
w 20 feet x h 20 ft.	6	280 feet
w 20 feet x h 15 ft.	9	196 feet

thus, the weir length become very long;

(i) related structures, the tail channel and control bridge in particular, will become large-scaled, if the combined system be adopted;

(ii) the combined system requires more construction cost.

On the other hand, a fully controlled type would make obligatory the special attention and care against untimely failure of its operation.

Although the all gate system has eventually been adopted, it should be emphasized that further data, particularly geological data to determine the stability of the spillway, are badly wanted, and final decision is to be made in the final design stage.

Design flood discharge has been identified, through hydrological analysis discussed under Hydrology, at 1/200 years probability with the peak discharge of 65,600 ft^3/sec. Inflow-outflow computations have been made by means of hydrographing to obtain the maximum outflow discharge over the spillway. Two alternative outflow discharges have been obtained, the one over 6 gate-spillway, each gate 20' x 20', and the other, over 9 gate-spillway, each gate 20' x 15':

Alternative 1: (20' x 20') 6 gates: Max. Q = 50,000 ft^3/sec

" 2: (20' x 15') 9 " : Max. Q = 52,000 ft^3/sec

Eventually, Alternative 2 has been adopted and the type of gate has been decided as the Radial gate which is extensively used in Sri Lanka, because it can be locally manufactured. Two out of six radial gates will be adjustable to avoid vibration which occurs when the gate remains half opened. Water Stage and Storage Capacity of Reservoir according to this plan is shown Fig. 4-5.

To warrant the safety of the dam, an emergency spillway will be provided on the right bank for the distance of about 800 feet.

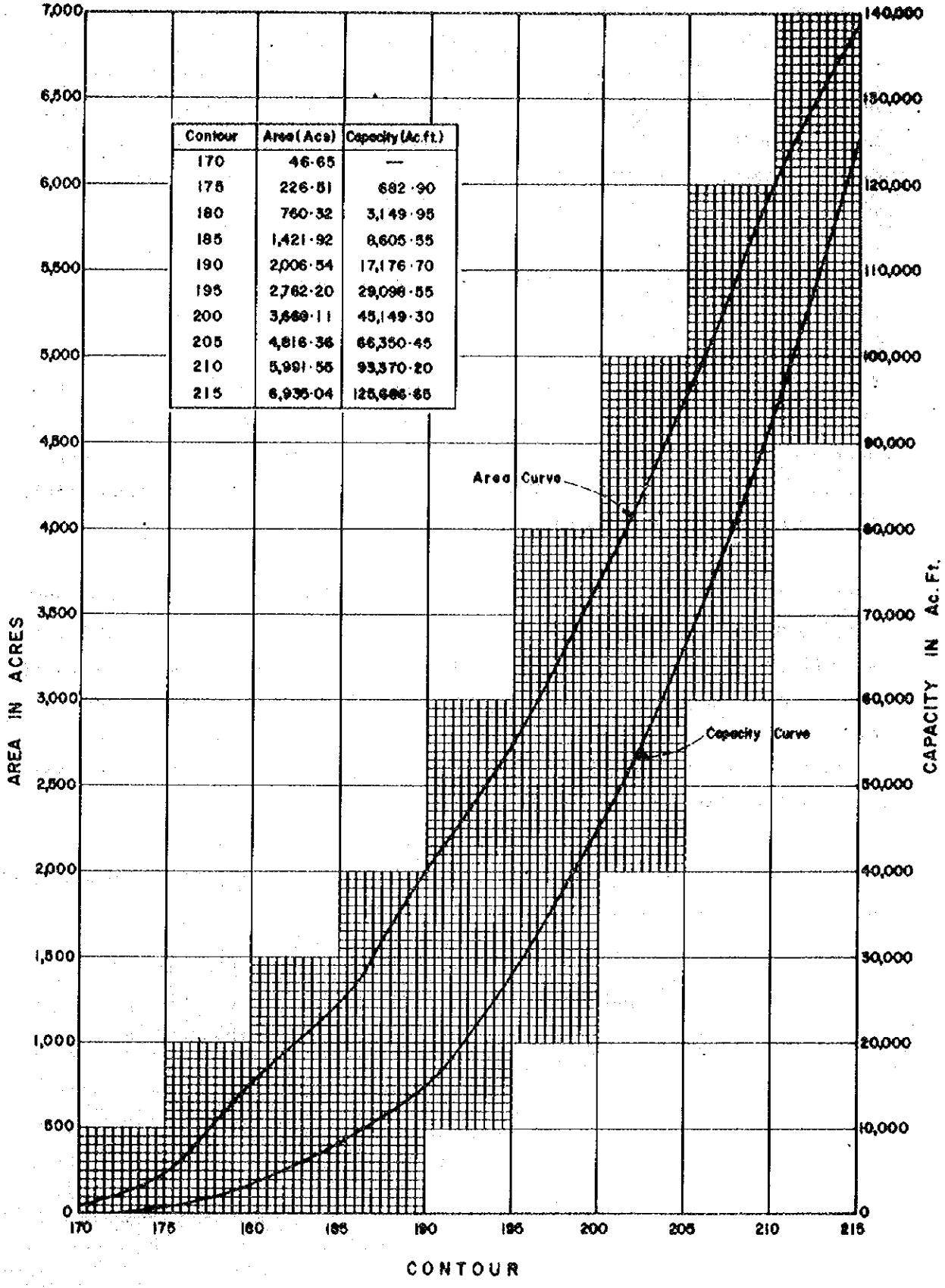
4.28 (e) Coffer Dam: Coffer dam will be built on the upstream of the embankment and its capacity would be enough to hold the maximum gross discharge occurable during three months of July to September judging from the last 20 years' records. Crest height is fixed at 184 MSL; the crest width, 10 feet; and the upstream/downstream slope, 1:2.5.

4.29 (f) Tail Channel: Its cross-section has been decided to allow flowing down of the design flood discharge of 50,000 ft^3/sec; calculations with the possible back water of the Mi-Oya give assurance that the spillway would suffer no influence at all from the back water. Two water channels have been provided; the low-water channel will have the cross-section similar to that of the Mi-Oya. Tail channel section is shown in Fig. 4-6. Its total design length is 6,460 feet.

4.30 (g) Intake Facilities: Tower-type sluice will be provide on both banks; their intake capacities are as follows:

	Irrigable Area	Discharge
Right Bank Sluice	2,300 ac.	61 ft^3/sec.
Left " "	4,000 ac.	105 ft^3/sec.

Fig 4-3 AREA CAPACITY CURVE



Contour	Area (Acs)	Capacity (Ac.ft.)
170	46·65	—
175	226·81	682·90
180	760·32	3,149·95
185	1,421·92	8,605·55
190	2,006·54	17,176·70
195	2,762·20	29,098·55
200	3,669·11	45,149·30
205	4,816·36	66,350·45
210	5,991·55	93,370·20
215	6,935·04	125,686·65

Fig. 4-4 PROPOSED DAM SECTION

SCALE : 40 FEET TO AN INCH

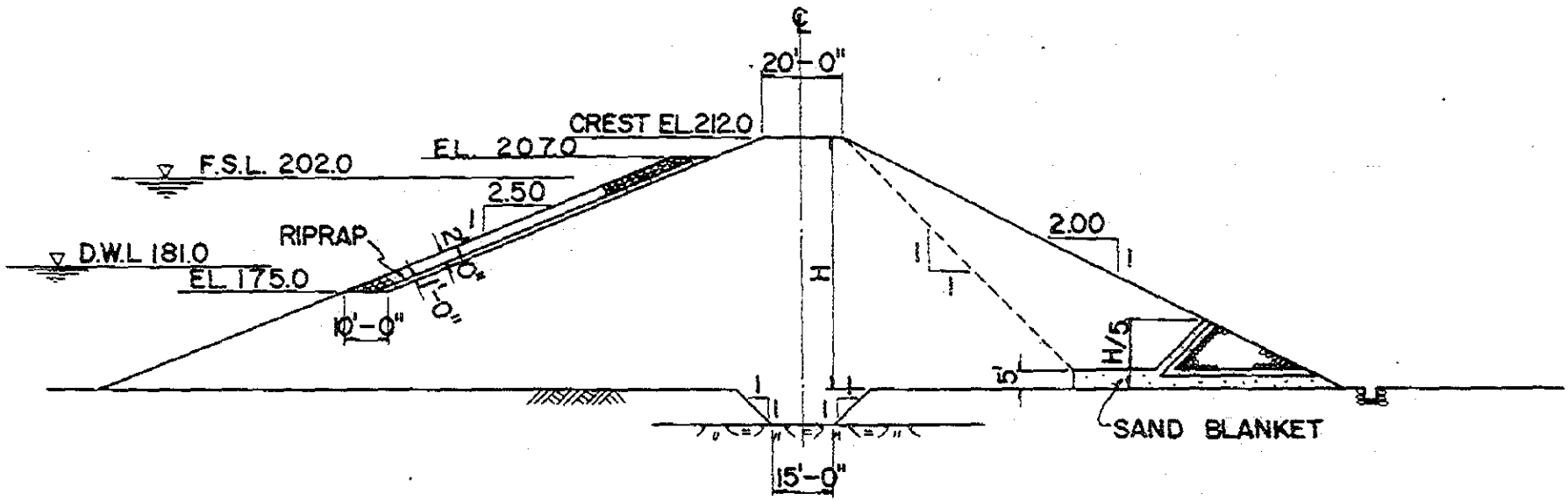


Fig. 4-5 WATER STAGE AND STORAGE CAPACITY OF RESERVOIR

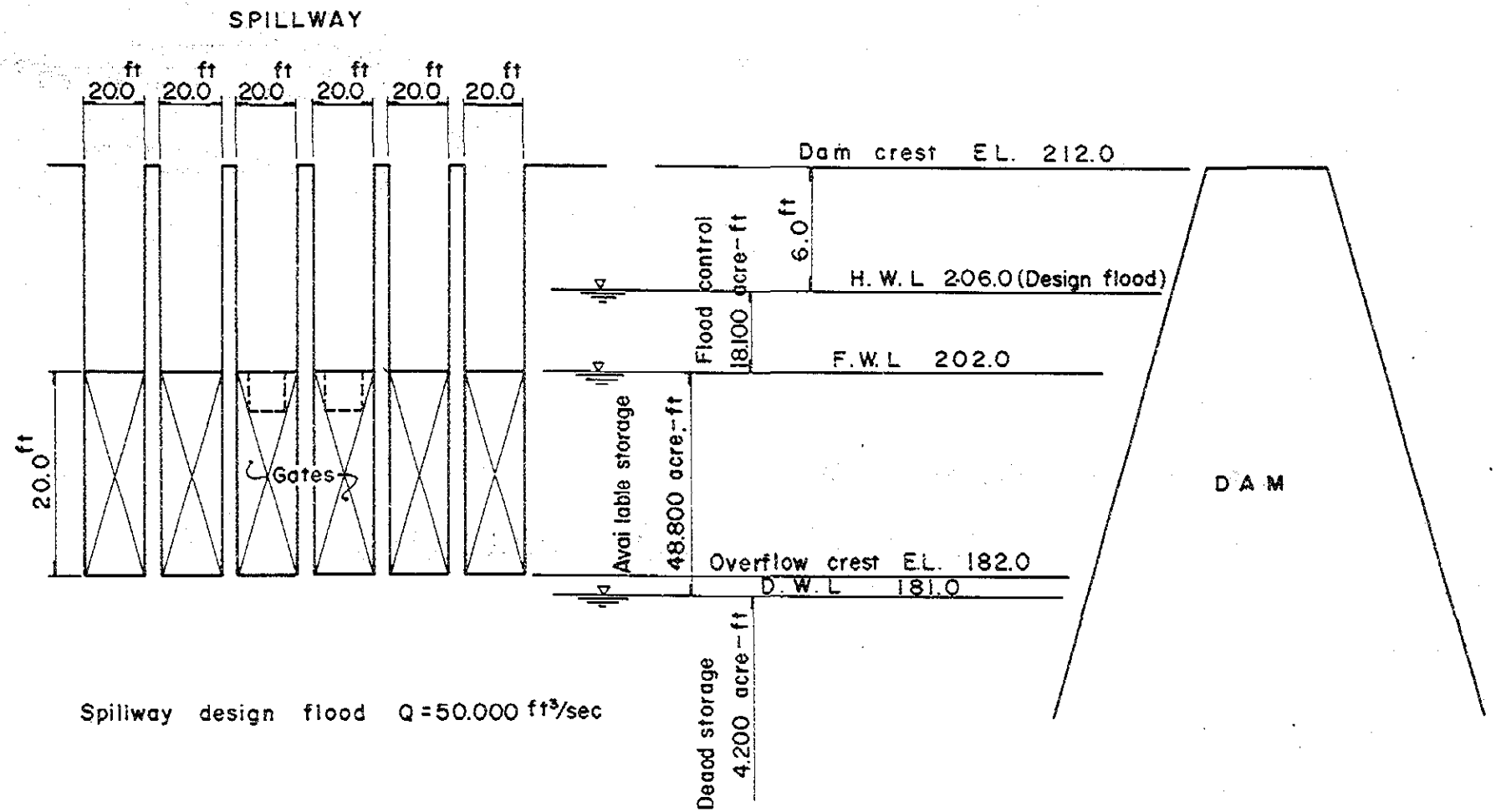
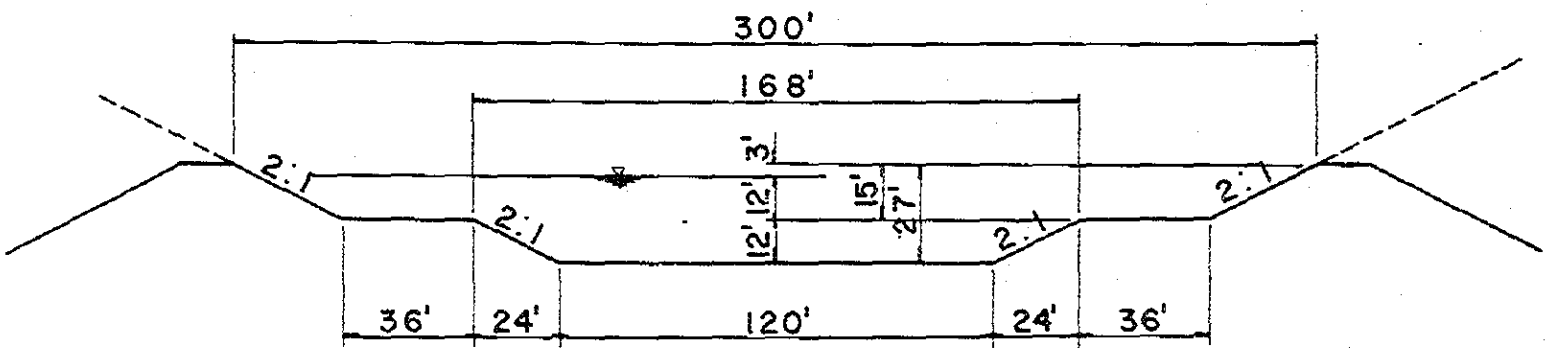


Fig. 4 - 6 Spillway Tail Channel Section



IRRIGATION FACILITIES

4.31 For each of the banks (2,300 ac. on the right bank and 4,000 ac. on the left bank), a set of the main canal, the related structures, the lateral channels and the farm facilities (farm ditches, farm drainages, farm roads, etc.) are planned.

4.32 (a) Main Canal: Starting from the right and left sluices, the main canals have been drawn on the 4-chain and 8-chain topographical maps; they have to be re-confirmed through additional surveys in the detail design stage. They are designed as open earth canals with an inside slope of 1:1 1/2. Their banks will be utilized for O & M purposes. Canal networks are shown in Fig. 4-7, and their cross sectional calculations are given in Table 4-14. Particulars of the main canals are summarized as follows:

Canal	Type	Discharge ($ft^3/sec.$)	Length (mile)
L.B. Canal	1	105.0	3.0
	2	79.0	4.0
	3	45.1	3.0
	4	14.6	3.3
Total:			13.3
B.B. Canal	1	61.0	7.0
	2	38.2	6.0
	3	14.3	3.2
Total:			16.2

4.33 (b) Related Structures: Crossings (aqueducts, culverts, bridges, etc.) over the streams, drainage channels, and roads are planned. Among the crossings, aqueducts will be preferred to siphons as far as possible. Water management facilities such as turn-outs, check-gates and water management facilities are all designed and planned for.

Fig 4-7

Canal Network and Discharge Assignment

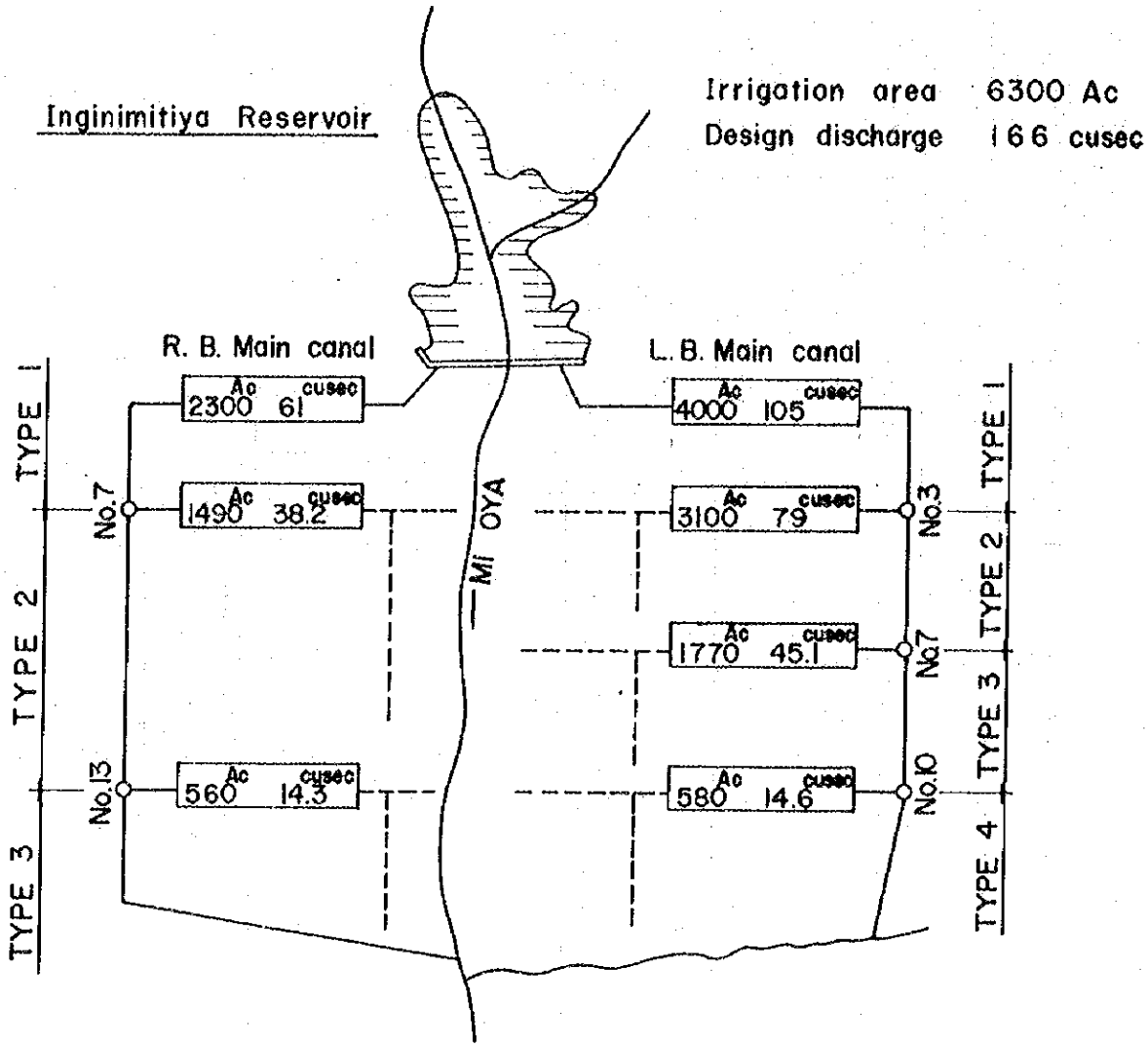
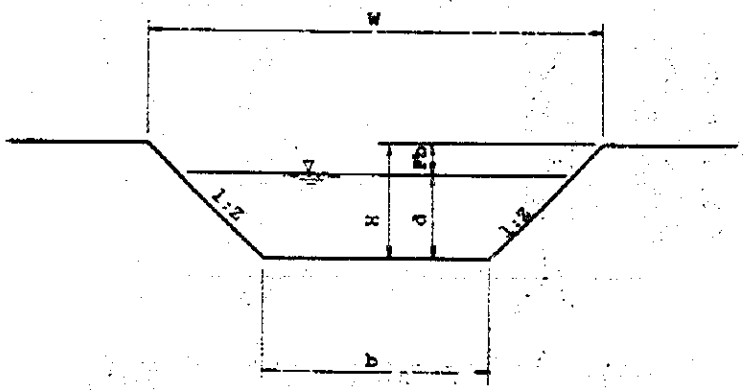


Table 4-14 Hydroulic Calculation of Standard Cross Section for Main Canal

	Type	1 Qd cuft/s	2 I	3 n	4 $\frac{1}{n}\sqrt{I}$	5 b	6 z	7 d	8 b/d	9 A ft²	10 p ft	11 R(=A/P) ft	12 R^2/3	13 V ft/s	14 cuft/s Qc(=A.V)	15 H	16 W	17 Fb	18 *L
Left Bank Main Canal	1	105.0	1/3500	0.0168	1.0061	11'-4"	1.5	3'-6"	3.2	58.041	23.952	2.423	1.804	1.815	105.4	5'-5"	27'-7"	1'-11"	3.0
	2	79.0	"	"	"	9'-6"	"	3'-3"	2.9	46.719	21.218	2.202	1.692	1.703	79.6	5'-1"	24'-9"	1'-10"	4.0
	3	45.1	"	"	"	6'-11"	"	2'-9"	2.5	30.366	16.832	1.804	1.482	1.491	45.3	4'-5"	20'-2"	1'-8"	3.0
	4	14.6	1/3000	"	1.0868	3'-1"	"	2'-0"	1.5	12.166	10.294	1.182	1.118	1.215	14.8	3'-6"	13'-7"	1'-6"	3.3
Right Bank Main Canal	1	61.0	1/3500	"	1.0061	8'-3"	"	3'-0"	2.8	38.250	19.067	2.006	1.591	1.600	61.2	4'-9"	22'-6"	1'-9"	7.0
	2	38.2	"	"	"	6'-0"	"	2'-8"	2.3	26.667	15.615	1.708	1.429	1.437	38.3	4'-4"	19'-0"	1'-8"	6.0
	3	14.3	1/3000	"	1.0868	3'-0"	"	2'-0"	1.5	12.000	10.211	1.175	1.114	1.210	14.5	3'-6"	13'-6"	1'-6"	3.2

* L; Length of Main Canal (Miles)



LAND CONSOLIDATION

4.34 Except the existing paddyfields and the hamlets scattering around them, the project development area is generally covered by jungles of medium-density which would not cause special difficulties in their clearing. The area for land consolidation can be divided into (a) mild slope (s = 1/50), and (b) flat openings (s = 1/300 - 1/500) spreading on both banks of the Mi-Oya. 1,640 ac. of the existing paddyfield is included in the flat openings.

The standard size for each liyadde will be 1/4 acre, if topography permits. However, field sizes may be varied in order to achieve efficient use of farm machinery and good water management. The farmland allocated to each family will be 2 1/2 acres, measuring 310 feet by 70 feet. Temporary ridge on ridges may be built within a block to make water management easier or to suit particular crops to be grown.

Irrigation and drainage laterals are provided independently per family farm. Farm roads lead from the settlers' villages to their farms, running along the irrigation channels to make water management easier.

Land levelling of the paddyfield will be maintained within ±2 inches, and the gradient of the field surface will be either horizontal or a little inclined toward drainage lateral.

CONSTRUCTION PROGRAMME

Overall Plan

4.35 Project implementation has been planned on the following assumptions:

(i) Working Days -- 280 working days a year is a feasible proposition judging from the daily rainfall data in the past; the work will be done on two shifts in a day;

(ii) Construction Period -- construction will take full five years, following the detail design work and specifications which would be completed within 8 months.

As is shown on the Construction Schedule (Fig. 4-8), detail design/specifications and land acquisition will be two important jobs to be completed in the 1st year; access and road diviations, construction of buildings, jungle clearing and stripping on the dam site, and excavation for spillway would be done in the 2nd year; in the 3rd year dam embankment work, spillway construction, outlet works and irrigation distributory work would continue side by side with land development and settlement; dam body, spillway, outlet works would be completed and Maha rains could be stored in the reservoir in the 4th year; 5th year would see the irrigation distributory system completed and land development and settlement being continued on; 6th year is the year of full completion of the construction work. Details of the construction methods are given in Volume II: Notes.

Construction Machinery

4.36 Construction machinery generally fall in the same categories as proposed by ID except a minor alteration in their size and number. Net working hour has been assumed to be 80% 8 hours a day. The number of the required machinery has been calculated from the sets of machinery combined for execution of each item of the construction work, and the machinery will shift from one item of the construction work to another according to the Schedule. The machinery deployment programme has been worked out from the viewpoint of full and continuous use of the given number with no surplus

machinery on waiting list; the number and specifications of the construction machinery required are stipulated in Table 4-15; extra number of the machinery which will be called for specific duty or duties and replacement of those expiring their workable life are also specified.

Fig. 4-8 Proposed Construction Schedule

Work	Item	Unit	Quantity	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Designs & Specifications		Item	1						
Procurement of Machinery		Item	1						
Acquisition Access & Road Deviations		Item	1						
Dam Body	Jungle Clearing	Acres	196						
	Stripping	Cubes	103,800						
	Excavation	Cubes	49,100						
	Embankment	Cubes	249,300						
	Riprap	Cubes	20,700						
Spillway & Tail Channel	Excavation	Cubes	244,100						
	Rock Excavation	Cubes	25,800						
	Concrete	Cubes	2,500						
	Radial Gate	sq.ft	2,400						
Outlet Works	L.B. Sluices Concrete Works	Cubes	120						
	R.B. Sluices Concrete Works	Cubes	80						
Irrigation Distributory System	L.B. Main Canal Jungle Clearing	Acres	91						
	L.B. Main Canal Earth Works	Cubes	33,000						
	R.B. Main Canal Jungle Clearing	Acres	105						
	R.B. Main Canal Earth Works	Cubes	36,800						
	Distributory & Field Channel	Acres	6,300						
Land Development	Jungle Clearing	Acres	4,660						
	Land Leveling	"	6,300						
	Ripping & Cross Ripping	"	6,300						
Land Settlement	Settlement of Colonists	Acres	6,300						
Land Acquistion		Item	1						

Table 4-15 Machinery Programme

Equipment & Machinery	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	Notes
Cl.1 Tractor (21^{t}, $180 \sim 200^{p.s.}$)	0	4	(5)	5	0	0	
Dozer ($4,265^{B} \times 1,013^{H}$ mm)	0	4	(5)	5	0	0	Cl.1 Tractor
Cl.2 Tractor (15^{t}, $130^{p.s.}$)	0	3	(4)	4	0	0	
Dozer (3,825 x 923 mm)	0	(1)	1	1	0	0	Cl.2 Tractor
Cl. S Tractor (32^{t}, $300^{p.s.}$)	0	(4)	4	4	4	1	
Dozer (4,065 x 1,360 mm)	0	2	3	(4)	4	1	Cl.S Tractor
Rooter (N=3)	0	2	3	(4)	4	1	"
Scraper (12 m^3)	0	(2)	2	1	0	0	"
Moter Scraper (11 m^3)	0	2	(6)	6	0	0	
Sheep foot roller ($2.9 \sim 5.6^{t}$)	0	2	(3)	3	0	0	Cl.2 Tractor
Moter grader (B=2.2m, 53Hp)	0	2	(3)	3	0	0	
Excavator ($1.2m^3$, $145^{p.s.}$)	0	0	(1)	1	0	0	
Lorry Tipper (4^{t}, $100^{p.s.}$)	0	6	(7)	2	0	0	
Compresser	0	3	(4)	2	0	0	
Jack Hammer	0	6	(8)	4	0	0	
Shovel Loader ($1.2m^3$, $70^{p.s.}$)	0	1	(2)	2	0	0	
Euclid Rear Damp (15^{t}, $210^{p.s.}$)	0	(8)	8	8	0	0	
Crusher ($50 \sim 90$t/hr, $75^{p.s.}$)	0	(1)	1	1	0	0	
Pump	0	0	(4)	4	4	0	
Water Bowser	0	2	(3)	3	0	0	
Fuel Bowser	0	(2)	2	2	2	1	
Jeep	0	(4)	4	4	4	4	
Concrete Mixer ($0.3m^3$, $5.5^{p.s.}$)	0	0	(2)	2	0	0	
Farm Tractor (5^{t})	0	0	0	(3)	3	3	
Disk harrow (24" x 20)	0	0	0	(3)	3	3	offset type

( ) Max Nos

COST ESTIMATES

4.37 Total Project Costs: The total project costs are estimated at Rs 167.7 million (US$23.0 million), comprising of Rs 72.5 million (US$10.0 million) or about 43% of the total, in the foreign exchange component and Rs 95.2 million (US$13.0 million) in the local currency. Estimates are based on preliminary design, with unit prices at May 1977 levels. The major elements included in the cost estimates are: civil works (Rs 59.3 M or US$8.1 M), construction machinery (Rs 35.6 M or US$4.9 M), agricultural equipment and vehicles (Rs 5.2 M or US$0.7 M), technical assistance (Rs 16.3 M or US$2.2 M), and engineering and administration (Rs 10.0 M or US$1.4 M), totaling to a basic project cost of Rs 132.7 M or US$18.2 M. Physical contingencies of Rs 5.9 M or US$0.8 M (10% of the civil works costs) and price contingencies of Rs 29.0 M or US$4.0 M (25% of the basic costs minus land acquisition and settlement costs, plus physical contingencies) bring total project cost including land acquisition and settlement costs to Rs 167.7 M or US$23.0 M. Estimated project costs are summarized in Table 4-16.

4.38 Construction Cost (Civil Works Cost): Construction cost is made up of the foreign exchange component and the local currency portion. The foreign exchange components required for the project construction consist of such items as are shown in Table 4-17. In computing the project construction cost, the costs for fuels and cement out of the "indirect" foreign exchange components (item 02 and a part of item 03 in Table 4-17) have been accounted for the local currency portion. Other "indirect" foreign exchange components such as spillway gates, etc. (item 08) and steel (a part of item 03), however, remain in the foreign exchange portion. Thus the items included in the foreign exchange components of the construction cost are those given in Table 4-18. Accordingly, the construction cost out of the total project costs is estimated at Rs 145.0 million (US$19.9 million) which would be comprised of Rs 46.8 million (US$6.4 million) in the foreign exchange and Rs 98.1 million (US$13.5 million) in the local currency. They are summarized in Table 4-19.

Unit Construction Cost: Unit construction cost has been computed from the "Evaluation of Unit Prices and Rate Analysis" adopted by the Irrigation Department. As the unit prices given in this document include the depreciations and spare parts as well as repair costs of the construction machinery and vehicles, these have been isolated and accounted for separately.

As for the unit costs not available therein, the relevant lists and tables have been used for computation.

Construction Machinery Cost: The necessary kinds and number of construction machinery have been identified from the Construction Schedule; they have been allocated to each item of the construction work so that it would be deployed continuously all through the construction period. Construction machinery cost has been computed by the formula:

$$\text{Procurement Price} \times \frac{\text{Used time}}{\text{Life time}} = \text{Machinery Cost}$$

Machinery price is quoted in cif. Colombo, plus 8% handling charges from Colombo to the project site. Sri Lanka standards have been applied for estimation of the spare parts and their inspection fee (procurement price + handling charges x 25%). Repair and maintenance costs of the construction machinery are estimated as per the local standard (procurement price + handling charges x 25%) and the general charges have been added at the rate of 8% of the machinery cost. The details of the construction machinery cost are given in Table 4-20.

Contingencies: 10% physical contingencies of the civil works costs and price contingencies reflecting the inflation rates for the investment costs minus land acquisition and settlement costs, plus physical contingencies have been added. The above quoted "Evaluation of Unit Prices and Rate Analysis" specifies the average inflation rate from 1969 to 1973 as 6.7%. Price contingencies have been computed assuming the following compounded inflation rates:

Year	:	1978	1979	1980	1981	1982	1983
Rate of Inflation (%)	:	6.7	13.8	21.4	29.5	38.2	47.4

4.39 Comparison to the Original Cost Estimates by ID: The construction cost estimated in ID's original F/S report (August 1976) was Rs 80 million; this estimate was tentatively amended to Rs 96.2 million after the joint-study between the ID and the JICA Feasibility Study Team, in May 1977; as a result of the home work by the F/S Team, it has now been revised to Rs 145 million. In the last estimate, the land acquisition cost, construction machinery cost, machinery repair and maintenance costs, and physical/

price contingencies have been either isolated and accounted for separately or newly added up to the former cost estimates. The details of the construction cost estimate comparison are as follows:

		Cost Estimates (Rs '000)		
		Original (Aug.1976)	Jt.Study (May 1977)	JICA F/S (June 1977)
01.	Land, right of way	1,000	1,000	1,000
02.	Access & Road deviation	1,500	1,500	500
03.	Dam	20,349	24,200	9,000
04.	Spillway & Tail channel	7,800	10,000	12,000
05.	Outlet works	1,250	1,000	900
06.	Irrigation facilities	16,450	24,570	20,600
07.	Land development	13,500	12,000	7,000
08.	Land settlement	6,300	5,229	5,300
09.	Construction machinery	-	-	35,600
10.	Machinery repair/maintenance	-	-	9,300
11.	General charges	11,851	16,691	10,000
12.	Physical contingencies			5,930
13.	Price contingencies	-	-	27,822
	Total	80,000	96,190	144,952

4.40 Annual Disbursement of Construction Cost: The annual disbursement of the construction cost according to the Construction Schedule is given in Table 4-21.

4.41 Alternative Construction Cost Estimates: JICA's F/S Team computed the project construction cost broadly in two ways: the one by handling all the construction items which Sri Lanka cannot do without foreign exchange as "foreign exchange components", the other by allocating the "indirect" foreign exchange components to the local currency portion. In the latter, there have been prepared three alternative estimates: A where fuel cost have been allocated to the local currency (but some foreign exchange requirement for Land Settlement inclusive), B where fuel, cement, steel, spillway gates and land settlement requirements having been allocated to the local currency, and C where fuel and cement costs have been allocated to the local currency (ignoring any possible foreign exchange requirements for Land Settlement).

Eventually, the last alternative (C) has been presented in this Report.

Construction cost estimate allocating all the construction itmes for which foreign exchange is required and the alternative cost estimates (A) and (B) are presented under X: Construction Cost in Volume II: Notes.

4.42 Construction Costs of the Facilities for Agricultural Development and O & M: Construction costs of the project headquarters office, machinery centres, offices and store-rooms of the farmers' organizations and other facilities for agricultural development and O & M have been allocated under Engineering, Administration and Overhead Charges.

Table 4-16 Total Project Costs

Item	Local	Foreign	Total /a	Dollar Equivalent ($ Thousand) /a	% of Total
	....(Rs Thousand)....				
I. Land Acquisition	1,000	-	1,000	137.4	0.6
II. Civil Works					
Access & Road Deviation	500	-	500		
Dam Structure	8,331	669	9,000		
Spillway & Tail Channel	9,766	2,234	12,000		
Outlet Works	795	105	900		
Irrigation Facilities	19,141	1,459	20,600		
Land Development	6,457	543	7,000		
Repair & Maintenance of Machinery	9,300	-	9,300		
Sub-total	54,290	5,010	59,300	8,145.6	35.4
III. Construction Machinery	2,100	33,500	35,600	4,890.1	21.2
IV. Land Settlement	5,300	-	5,300	728.0	3.2
V. Farm Equipment and Supplies for Agricultural Development					
Farm Equipment	303	3,782	4,085		
Vehicles & Supplies for Development	85	1,064	1,149		
Sub-total	388	4,846	5,234	719.0	3.1
VI. Technical Assistance /b	500	15,800	16,300	2,239.0	9.7
VII. Engineering & Administration	8,500	1,500	10,000	1,373.6	6.0
Basic Project Cost	72,078	60,656	132,734	18,232.7	79.2
VIII. Physical Contingencies 10% of II)	5,429	501	5,930	814.6	3.5
Sub-total	77,507	61,157	138,664	19,047.3	82.7
IX. Price Contingencies 25% of II+III+V+VII+VIII)	17,677	11,339	29,016	3,985.7	17.3
Total Project Cost	95,184	72,496	167,680	23,033.0	100.0

/a Figures may not agree exactly due to rounding.
/b Includes Rs 0.2 M for the project evaluation.

Table 4-17 Foreign Exchange Component of the Construction Cost

Item	Contents	Value		Direct or Indirect
		Rs Million	US$'000	
01. Construction Machinery	Important machinery: 79 Nos.			
	Spare parts: 19 kinds	26.400	3,626	Direct
02. Fuels	Diosoline: 3.33M gal. @ Rs 3/=	9.990		
	Lubricant: 81,000 gal.@ Rs10/=	0.810		
		10.800	1,484	Indirect
03. Foreign Component of Cement and Steel	Cement: 21,000 cubes x 13 sacks x Rs 10/=	2.730		
	Steel: allow sum Rs 1,400/ ton	0.870		
		3.600	495	Indirect
04. Spares for Machinery and Equipment		7.100	975	Direct
05. Tools, Accessories and Surveying Instruments		1.000	137	Direct
06. Blasting Material		0.990	136	Direct
07. Generators, Electric Fittings and others		0.600	83	Direct
08. Spillway Gates, etc.		1.550	213	Indirect
09. Other materials		0.85	117	Indirect
10. Engineering Services		1.500	206	Direct
11. Contingencies		12.429	1,707	
Total		66.819	9,179	

Table 4-18 Direct Foreign Exchange Component of the Construction Cost

	Item	Contents		Value	
				Rs Million	US$'000
01.	Construction Machinery	Important Machinery: 79 Nos.			
		Spare parts: 19 kinds		26.400	3,626
02.	Fuels			0	0
03.	Foreign Component of Cement and Steel	Cement	0		
		Steel	0.870	0.870	120
04.	Spares for Machinery and Equipment			7.100	975
05.	Tools, Accessories and Surveying Instruments			1.000	137
06.	Blasting Material			0.990	136
07.	Generators, Electric Fittings and others			0.600	83
08.	Spillway Gates, etc.			1.550	213
09.	Engineering Services			1.500	206
10.	Contingencies			6.804	935
	Total			46.814	6.431

Table 4-19 Construction Cost Estimate

(Fuel & cement costs being allocated to Local currency portion)

(unit: '000Rs.)

	Item	Total	Foreign	Local
I.	Civil works	59,300	5,010	54,290
	Access & road deviation	500	-	500
	Dam structure	9,000	669	8,331
	Spillway & Tail channel	12,000	2,234	9,766
	Outlet works	900	105	795
	Irrigation facilities	20,600	1,459	19,141
	Land development	7,000	543	6,457
	Repairs & maintenance of machinery	9,300	-	9,300
II.	Construction Machinery	35,600	33,500	2,100
III.	Land Acquisition	1,000	-	1,000
IV.	Land Settlement 1/	5,300	-	5,300
	Sub-Total (I ∿ IV)	101,200	38,510	62,690
V.	Engineering, Administration & Overhead charges	10,000	1,500	8,500
VI.	Physical Contingencies (I) x 10%	5,930	501	5,429
	Sub-Total (I ∿ VI)	117,130	40,511	76,619
VII.	Price Contingencies (I+II+V+VI) x 25%	27,822	6,303	21,519
	Total	144,952	46,814	98,138

1/ Foreign exchange requirement presupposed for Land Settlement has now been ignored;

2/ Figures may not agree exactly due to rounding.

Table 4-20 Depreciation Cost of Equipment and Machinery

(Unit US$)

Equipment & Machinery	Size & Capacity	Unit	Quantity (1)	Total Price: Unit price (2)	Total Price: Amount (3)=(1)x(2)	Total Life Time (4)	Used time: Time (5)	Used time: % (6)=(5)/(4)	Depreciation cost (7)=(3)x(6)
(1) C.I.F. Price									
Tractor (cℓ =1)	21t 180 200P.S		5	76,300	381,500	50,000	41,168	82.3	313,974
Dozer	4,265B x 1,013H		5	5,700	28,500	"	"	"	23,455
Tractor (cℓ =2)	15t 130P.S		4	61,100	244,400	40,000	18,199	45.5	111,202
Dozer	3,825B x 923H		1	3,900	3,900	10,000	3,057	30.6	1,193
Sheep foot Roller	2.9∿5.6t		3	10,000	30,000	30,000	15,042	50.1	15,030
Tractor (cℓ =3)	32t 300P.S		4	139,000	556,000	40,000	38,466	96.2	534,872
Dozer	4,065B x 1,360H		4	10,000	40,000	40,000	31,838	79.6	31,840
Rooter	N=3		4	11,000	44,000	"	"	"	35,024
Scraper	12m3		2	37,400	74,800	20,000	6,628	33.1	24,758
Moter Scraper	11m3		6	182,000	1,092,000	60,000	38,402	64.0	698,880
Moter grader	2.2B 65P.S		3	25,300	75,900	30,000	9,501	31.7	24,060
Excavator	0.6m3 100P.S		1	63,000	63,000	10,000	1,705	17.1	10,773
Lorry Tipper	4t 100P.S		7	15,400	107,800	70,000	12,238	17.5	18,865
Compressaer	10.5m2/m 105P.S		4	13,800	55,200	(12,000x4) 48,000	13,962	29.1	16,063
Jack Hammer	3.4m2/m		8	800	6,400	(5,000x8) 40,000	27,924	69.8	4,467
Shovel Loader	1.2m3 70P.S		2	25,100	50,200	20,000	6,719	33.6	16,867
Enchid Rear Damp	15t 210P.S		8	66,400	531,200	80,000	35,745	44.7	237,446
Crusher	50∿90t/h		1	32,000	32,000	10,000	2,440	24.4	7,808
Pump	150mm		4	1,800	7,200	(5,000x4) 20,000	6,000	30.0	2,160
Water Bowser	6,000ℓ		3	17,500	52,500	30,000	9,501	31.7	16,642
Fuel Bowser	"		2	17,500	35,000	20,000	10,000	50.0	17,500
Jeep			4	6,800	27,200	40,000	40,000	100.0	27,200
Concrete Mixer	0.28∿0.4m3		2	7,600	15,200	20,000	6,000	30.0	4,560
Farm Tractor	5t 50P.S		3	22,000	66,000	30,000	7,721	77.2	50,952
Disk harrow	24" x 20nos		3	3,000	9,000	30,000	7,721	77.2	6,948
Sub Total					3,628,900				2,252,539(62%)
					≒26,418,392Rs ≒26,400,000				≒16,398,483Rs ≒16,400,000
(2) Local Handling (Total price) x 8%					2,100,000Rs				2,100,000Rs
Total					28,500,000Rs				18,500,000Rs

* US$1.00 = Rs7.28

Table 4-21 Annual Disbursement of Construction Cost

Unit: Rs 1,000

Works	Total	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
I. Civil Works	59,300	-	2,010	14,000	18,170	15,050	10,070
(Foreign Currency	(5,010	-	(110	(2,340	(1,210	(840	(510
(Local Currency	54,290	-	1,900	11,660	16,960	14,210	9,560
II. Construction Machinery	35,600	-	35,600	-	-	-	-
(Foreign Currency	(33,500	-	(33,500	-	-	-	-
(Local Currency	2,100	-	2,100	-	-	-	-
III. Land Acquisition	1,000	1,000	-	-	-	-	-
(Foreign Currency	(-	-	-	-	-	-	-
(Local Currency	1,000	(1,000	-	-	-	-	-
IV. Land Settlement	5,300	-	-	1,760	1,780	1,760	-
(Foreign Currency	(-	-	-	-	-	-	-
(Local Currency	5,300	-	-	(1,760	(1,780	(1,760	-
V. Engineering, Administration & Overhead Charge	10,000	5,000	1,000	1,000	1,000	1,000	1,000
(Foreign Currency	(1,500	(1,500	-	-	-	-	-
(Local Currency	8,500	3,500	(1,000	(1,000	(1,000	(1,000	(1,000
VI. Physical Contingency	5,930	-	201	1,400	1,817	1,505	1,007
(Foreign Currency	(501	(-	(11	(234	(121	(84	(51
(Local Currency	5,429	-	190	1,166	1,696	1,421	956
Sub-total (I + II + V + IV)	110,830	5,000	38,811	16,400	20,987	17,555	12,077
(Foreign Currency	(40,511	(1,500	(33,621	(2,574	(1,331	(924	(561
(Local Currency	70,319	3,500	5,190	13,826	19,656	16,631	11,516
VII. Prices Contingency	27,822	335	5,356	3,510	6,191	6,706	5,724
(Foreign Currency	(6,303	(101	(4,640	(550	(393	(353	(266
(Local Currency	21,519	234	716	2,960	5,798	6,353	5,458
Total	144,952	6,335	44,167	21,670	28,958	26,021	17,801
(Foreign Currency	(46,814	(1,601	(38,261	(3,124	(1,724	(1,277	(827
(Local Currency	98,138	4,734	5,906	18,546	27,234	24,744	16,974

V ORGANIZATION AND MANAGEMENT

PROJECT IMPLEMENTATION

5.01 Civil Works: The ID would be responsible for implementation of the civil works proposed under the project. It would prepare final plans and specifications and procure the necessary construction machinery and materials with the technical advices and suggestions offered by a qualified expatriate engineering consultant. The supervision of the construction work would be done by ID. Among the civil works envisaged under the project are some simple, labour-intensive and individually small works, particularly for land development, irrigation/drainage channel and farm road networks, which would be carried out through small unit cost contracts with the groups of the settlers, under the supervision of the ID.

5.02 Settlement: The project implementation and development of the project area involves the problem of settlement and re-settlement of two groups of farmers: the one consisting of the farmers newly recruited from outside the project area and the other, of the villagers who have been domiciled for generations in the reservoir bed area and at the proposed dam axis. When alloting lands under the project, it would be necessary to give the latter farmers preference over the former. The total estimated number of families to be settled/re-settled would be 1,864 (4,660 ac. of newly developed area ÷ 2.5 ac = 1,864 families).

The selection of allottees shall be on the basis that is being presently adopted under Mahaweli Scheme.

PROJECT COORDINATION

5.03 It has already been stated that the project's success depends on coordination and cooperation among different agencies of the Government as well as on friendly joint-action between the project authorities and the farmers' own organization. Inter-departmental Project Steering Committee and joint-family system of all the concerned agencies united in the Project Headquarters are hoped to function smoothly. The relationships between the

Project Headquarters and the project area farmers would roughly be as follows.

AGRICULTURAL EXTENSION & SUPPORTING SERVICES

5.04 The Project Headquarters would deal with the area farmers through institutional method; the farmers' organizations such as the Agricultural Productivity Committee (APC), Cultivation Committees(CCs), and the agricultural co-operatives as well as the local Multi-Purpose Cooperative Societies (MPCSs) would function, individually and as a whole, as flexible pipe or pipes connecting the Project Headquarters with the area farmers. The general atmosphere in which the joint-work would take place should be most cordial and reciprocal; otherwise, it would be very difficult to bring about the expected agricultural development to say least of transfering the development responsibilities to the farmers' own organizations within reasonable number of years (education and training would last for 12 years starting from the 3rd year through the 14th year). The organization chart of the Project Headquarters is shown in Fig. 5-1; a list of vehicular equipment of the same, in Table 5-1, and its unit-wise operational costs are estimated in Tables 5-2 to 5-4. The estimated cost of the vehicular equipment of the Project Headquarters would be Rs 1.0 million - cif. Colombo - and the estimated total cost for O & M, extension services and education/training in supporting services would amount to Rs 1.0 million/year during the 6th and the 14th year.

AGRICULTURAL EQUIPMENT

5.05 Agricultural machinery and equipment required to help the project area farmers adhering to highly intensive cropping calendar proposed under the project and raising the yeilds of the crops of the expected levels are listed in Table 5-5, and their costs which would amount to Rs 3.8 million or US$0.5 miliion cif. Colombo are accounted for in the total project cost.

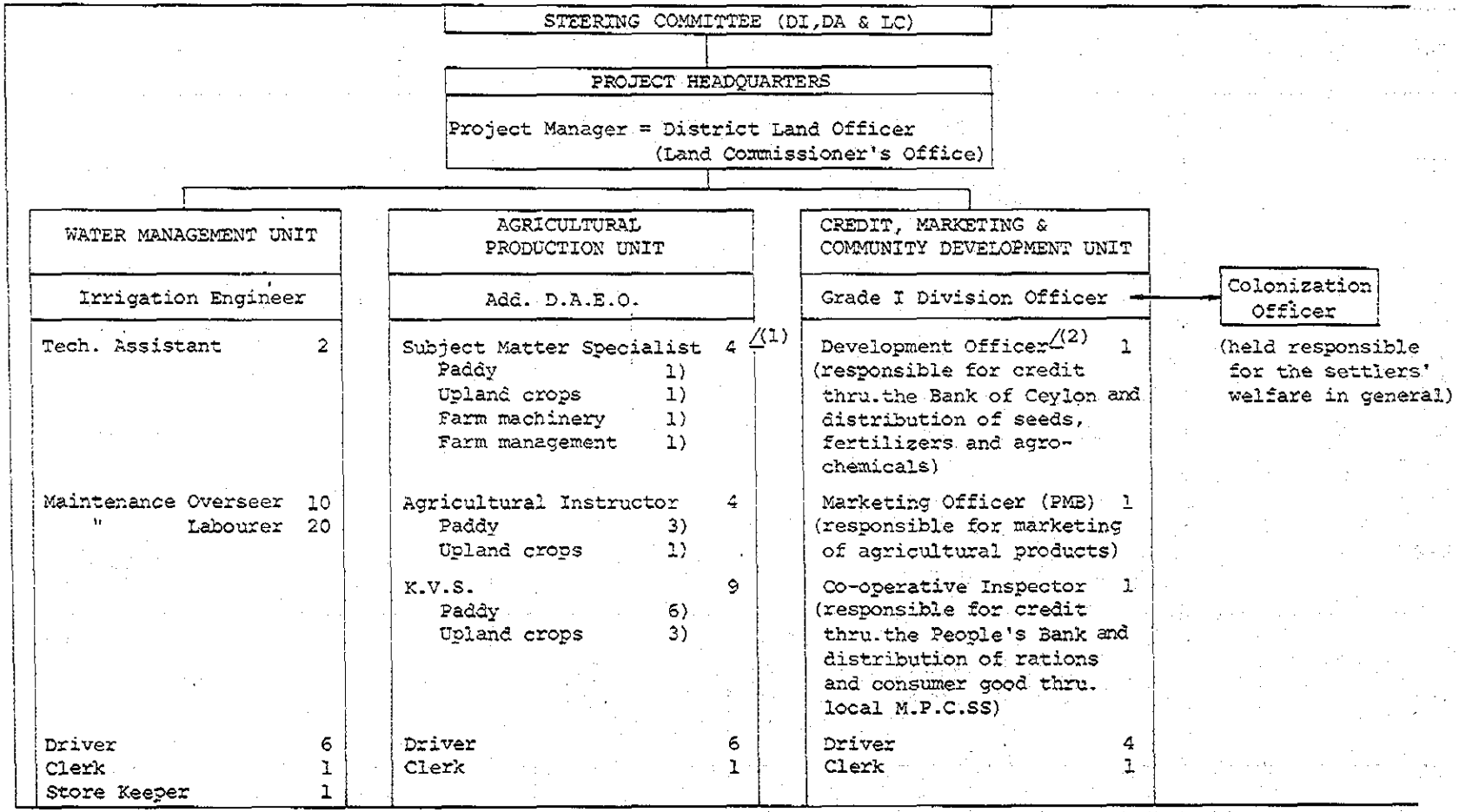
TECHNICAL ASSISTANCE

5.06 In bringing up the project area farmers into due heirs of agricultural development responsibilities, it would be quite desirable to obtain

technical assistance by a group of expatriate but sympathetic experts who can approach the problems of extension of modern production techniques including mechanized farming, farmers' organizations and rural welfare in a coordinated manner. Technical assistance in water management will be limited for upland crop irrigation. A group of 6 such experts with good qualifications would be welcome in attaining the development objectives of the project for the period of 6 years starting from the 5th year.

5.07 Although this project is not necessarily very big in size, it is expected to be undertaken as a kind of prototype project which would be exemplary in both engineering and agricultural development aspects for the rest of the tank irrigation schemes in the dry zone. Heavy emphasis, therefore, would have to be placed on an depth evaluation of the project impact. The Government is requested to retain the services of an appropriate research institution for this purpose; detailed proposals for evaluation might be obtained from some of the national, expatriate or combined teams before entering into full agreement. Rs 0.2 million is allocated for the purpose under the heading of Technical Assistance.

Fig. 5-1 Organization Chart of the Project Headquarters



(*) All the Staff shall be residing in the Project Site.

(1) They are stationed at Puttalam, but visit the Project 2 days every week or as often as required.

(2) Development Officer deputed from the Rural Institutions & Productivity Laws Div., M/A & L.

Table 5-1 Equipment Requirements of the Project Headquarters

	Jeep	5-ton Truck	Agricultural Tractor w/2 ton Trailer	Motor Cycle	Bicycle	Mini Bus	Spare Parts
Project Manager	1						25%
Water Management Unit	1		5	2	32		25%
Agricultural Production Unit	2	1	2	4	10	2	25%
Credit & Marketing Unit	1	1	2	3	1		25%
Total	5	2	9	9	43	2	25%

Table 5-2 Operation Cost

WATER MANAGEMENT

(O & M of Irrigation Facilities)

Staff Requirement for 6,300 Ac. Project Area

Staff Position	No.	Salary/Yr.(Rs.)	Total Cost (Rs.)
Engineer	1	12,000	12,000
Technical Assistant	2	6,000	12,000
Store-keeper	1	4,000	4,000
Clerk	1	4,000	4,000
		(General Service)	32,000
Maintenance Overseer	10	4,000	40,000
" Labourer	20	3,000	60,000
Driver	6	4,800	28,800
			128,800
	Leave & Travel 20%		26,000
		(Project Cost)	154,800

Equipment Requirements for 6,300 Ac. Project Area

Item	No.	Hr./Year	Cost/Hr. (Rs.)	Total Annual Operation Cost(Rs.)
5-ton Truck	1	800	40	32,000
Agricultural Tractor	5	800	35	140,000
4-wheel Drive - Field Car	1	1,500	25	37,500
Motor Cycle	2	1,500	6	18,000
Bicycle	32	1,500	-	-
	Total Annual Operation Cost			227,500
	Contingencies 10%			22,750
				250,250
	Grand Total			405,050
			Say	405,000

Table 5-3 Operation Cost

AGRICULTURAL DEVELOPMENT

(Extension Service)

Staff Requirement for 6,300 Ac. Project Area

Staff Position	No.	Salary/Year(Rs.)	Total Cost (Rs.)
Additional DAEO	1		13,000
Subject Matter Specialist	4		
Paddy (1)			
Upland crops (1)		(Attached to Puttalam Kachcheri)	
Farm machinery (1)			
Farm management (1)			
Agricultural Instructor	4		41,000
Paddy (3)			
Upland crops (1)			
Clerk	1		4,000
		(General Service)	58,000
K.V.S.	9	5,000	45,000
Paddy (6)			
Upland crops (3)			
Driver	6	4,800	28,800
			73,800
	Leave & Travel 20%		14,760
		(Project Cost)	88,560

Equipment Requirements for 6,300 Ac. Project Area

Item	No.	Hr./Year	Cost/Hr. (Rs.)	Total Annual Operation Cost(Rs.)
5-ton Truck	1	800	40	32,000
4-wheel Drive Field Car	2	1,500	25	75,000
Motor Cycle	4	1,500	6	36,000
Bicycle	10	1,500	-	-
Mini-Bus	2	1,500	18	27,000
Agricultural Tractor	2	800	35	56,000
	Total Annual Operation Cost			226,000
	Contingencies 10%			22,600
				248,600
	Grand Total			337,160
			Say	338,000

Table 5-4 Operation Cost

CREDIT, INPUT SUPPLY, MARKETING & COMMUNITY DEVELOPMENT

Staff Requirement for 6,300 Ac. Project Area

Staff Position	No.	Salary/Year (Rs.)	Total Cost (Rs.)
Grade I Division Officer	1		
Development Officer	1		50,000
Marketing Officer	1		
Co-op. Inspector	1		
Clerk	1	4,000	4,000
		(General Service)	54,000
Driver	4	4,800	19,200
	Leave & Travel 20%		3,840
		(Project Cost)	23,040

Equipment Requirements for 6,300 Ac. Project Area

Item	No.	Hr./Year	Cost/Hr. (Rs.)	Total Annual Operation Cost(Rs.)
5-ton Truck	1	800	40	32,000
Agricultural Tractor	2	800	35	56,000
4-wheel Drive Field Car	1	1,500	25	37,500
Motor Cycle	3	1,500	6	27,000
Bicycle	1	1,500	-	-
	Total Annual Operation Cost			152,500
	Contingencies 10%			15,250
				167,750
	Grand Total			190,790
			Say	191,000

Table 5-5 Farm Equipment List (for 6,300 Ac. Project Area)

	Item	Quantity	Estimated Unit Cost (cif Colombo) (US $1,000)	Total Cost
A.	4-wheel tractor[1/]	20	7.0	140
	Tyre Tiller	20	1.0	20
	Heavy Duty Cultivator	20	0.9	18
	Disc Plough	5	1.2	6
	Offset Disc Harrow	5	1.6	8
	2 Ton Trailor	20	0.9	18
	Spare Parts (25%)[2/]		LS	53
				263
B.	2-wheel Tractor[3/]	50	3.0	150
	Spare Parts (25%)		LS	38
				188
C.	Equipment for Repair and maintenance facilities		LS	50
D.	Sprayers			
	Knapsack Power (duster/mister)	25	0.3	7.5
	Knapsack Hand	50	0.1	5
	Duster Hand	20	0.1	2
	Spare Parts (25%)		LS	4
				18.5
	Grand Total			519.5 (Say 520)

1/ Including Rotavator, Plough, Puddling Wheels, Level Board, etc.
2/ Particularly Rotavator Blader, Tyres & Tubes, Engine Parts like piston rings, injectors, etc.
3/ Including Rotavator, Leveller, Puddling Wheels, Ploughs, Spring Blader, 1.5 ton Treilor, etc.

A. To be put in custody, operation and maintenance of the Project HQ(i/c Agric. Prod. Unit);
B. To be put in custody, operation and maintenance of the Project HQ (i/c Agric. Prod. Unit) for 2 years after completion of the Project, then sold to the Farmers' Co-op. and operated by those who will have obtained enough training and experience in driving & repair/maintenance;
C. To be allocated among 4 Farm Machinery Centers which are under the control of the Project HQ (i/c Agric. Prod. Unit);
D. Same as above, but after the settlers will have good knowledge in their use sold to the Farmers'Co-op. for joint use or directly to the settlers particularly those who are engaged in upland crop cultivation.

VI AGRICULTURAL PRODUCTION AND FARM INCOME

6.01 Agricultural Production Increases: Year-round supply of irrigation water and strengthened extension and supporting service would lead to fairly intensive cultivation and to considerably high crop yields. Although paddy would remain to be the dominant crop, there would be a significant diversification into crops such as soya beans, pulses and chillies. Little increases in cropping intensity and yields are considered likely under the "without" project situation in the existing agricultural land. However, the headworks including main canals would be ready for operation in the fifth year of construction according to the Construction Schedule. Therefore, the benefits from the existing lands of 1,640 acres would accrue to the project from the fifth year onwards. The estimated present production levels in the existing agricultural lands and their projected production levels are given in Tables 4-2 and 4-3. The projected production levels in the newly developed area since year 6 to year 11 and the expected productions in the entire project area are given in both financial values and economic values in Tables 11-4 and 11-5 in Volume II: Notes.

6.02 Farm Requisites: Agricultural input requirements have been estimated roughly along the recommendations given by DA (Table 6-1) which would be given in monetary terms as follows:

		Paddy	Soya Beans	Pulses	Chillies
		....(Production Cost/ac. in Rs)....			
Seeds & Chemicals	1/	530	220	170	1,150
Farm machinery and Hired labour	2/	520	480	520	1,080
Miscellaneous	3/	135	80	80	160
		1,185	780	770	2,390

1/ Chemicals include fertilizers, pesticides and weedicides;

2/ Cost of combined use of 2-wheeler and 4-wheeler; as for hired labour, see Agricultural Labour below;

3/ Include interests on crop loans, Land Betterment charges and crop insurance premium.

6.03 Expected Tempo of Input Increases: At the start of the agricultural development, it would be hazardous to invite inexperienced farmers to use high amounts of inputs which would result in heavy loss if crops were to fail. Thus, in the newly developed area, it is expected that only 20 per cent of the recommended applications of fertilizers and agro-chemicals will be used in the first year; their dozage may increase as farmers would get experience and learn their value.

Expected Tempo of Input Increases

Project Year :	6th	7th	8th	9th	10th	11th
Percentage :	20	30	40	60	80	100

6.04 Farm Labour: Based on an equivalent of 2.0 full time adult workers per household (5.5 persons) working an average of 250 days per year, the requirement of hired labour per acre during the "peak months" would be:

40 days for paddy cultivation during Maha & Yala each;
60 days for subsidiary food crops during Yala season;
90 ~ 120 days for chillies cultivation during Yala season.

The labour wage is estimated at Rs 8/day.

6.05 Farm Products Prices: The farm-gate prices of the agricultural products are assumed as follows:

Item	Price
Paddy	Rs 33/bushel
Soya Beans	Rs 84/cwt.
Pulses	Rs 128/cwt.
Chillies (dry)	Rs 1,000/cwt.

6.06 Farm Incomes: The representative farm families in the lowland and highland, each alloted with 2.5 acres of land would enjoy at full development the net production value of Rs 6,000 ~ 6,300 per year.

Table 6-1 Details of Input Requirements at Full Development (per Ac.)

	Paddy (130 days) Lowland	Paddy (100 days) Lowland	Chillies	Soya Bean	Pulses
Seeds	2 bushels	2 bushels	1 lb.	0.35 cwt.(60 lbs.) Inoculated with Nitrogen Culture	0.1 cwt
Fertilizers	Urea 1.6 cwt.N Superphosphate 0.8 cwt.P_2O_5 Potash 1.2 cwt.K_2O	1.2 cwt.N 0.8 cwt.P_2O_5 1.2 cwt.K_2O	Ammon. 1.0 cwt.N -Sulph. 0.8 cwt.P_2O_5 0.6 cwt.K_2O	Ammon. 1.0 cwt.N -Sulph. 1.0 cwt.P_2O_5 0.5 cwt.K_2O	Ammon. 0.2 cwt.N -Sulph. 0.5 cwt.P_2O_5 0.5 cwt.K_2O
Pesticides	Gamma BHC 6% 100 lbs Sumithion 50% 60 fl.OZ.	70 lbs. 30 fl.OZ	Sumithion 50% 180 OZS Thicvit 270 OZS Manazate D 80% 20 OZS	Malathion 50% 60 OZS	Malathion 50% 60 OZS Ceresan Wet SD 1 kg
Weedicides	3.4 DPA 3.5 Pints MCPA 40% 1.5 Pints Dalapon 80% 1 lb.	3.5 Pints 1.5 Pints 1 Pints	Lasso 40% 10 Pints	Linuron 50% 1.5 lbs.	-

(Mahaweli Development Project)

VII BENEFITS AND JUSTIFICATION

7.01 Nearly 200 major tank irrigation schemes are already existing, serving a total cultivated area of about 40,000 acres, or under construction planning to irrigate thousands of additional land. Experiences with the existing irrigation schemes in the dry zone, however, show that poor maintenance of irrigation systems, careless water management and inadequate agricultural extension and supporting services are the prime constraints limiting agricultural production in the schemes. The proposed project would be a prototype for ameliorating most of these limiting factors from the construction stage through development period and to demonstrate how to bring these and many other newly coming irrigation schemes in the dry zone to their full potential. Successful implementation of this project, therefore, would open the way for quantitative as well as qualitative improvements of the tank irrigation schemes which could contribute enormously in achieving increased food self-sufficiency in Sri Lanka.

7.02 On a more direct level, the project-related increase of agricultural production in the project area would reach 13,000 tons in paddy alone, in Year 11. This would represent an annual gross foreign exchange savings of about US$3 million; allowing for the added imports of fuel, fertilizers, agro-chemicals and farm equipment this would represent annual net foreign exchange savings of not less than US$1.5 million.

7.03 Apart from various socio-economic benefits the project would bring forward by its implementation and through ensuing agricultural development, only the project-related increase in crop production is assumed to be the project benefit. Based on the following assumptions, the project's economic rate of return is estimated at about 18%:

(a) a five year project implementation and a 50 year project life;

(b) full agricultural development five years after project completion;

(c) projected 1985 world market prices in terms of 1976 dollars for agricultural inputs and outputs;

(d) allowance for the shortage of foreign exchange by using a shadow rate of US$1.00 = Rs 12.00, and

(e) all farm labour valued at about 33% of the average market wage rate of Rs 8 per man-day and construction labour at the market wage.

IRRs calculated in both financial values and economic values are given in Tables 11-6 and 11-7 in Volume II: Notes.

7.04 Further sensitivity tests indicate that the project remains variable under a variety of adverse assumptions about costs and benefits. Results from some of the important tests are given below:

	Alternative	Rate of Return
(a)	Basic case	18%
(b)	A decrease of 10% in net benefit	15%
(c)	An increase of 10% in project investment costs	17%
(d)	A two year delay in realizing the full project benefits	16%
(e)	Combination of (b) and (c)	14%
(f)	Combination of (c) and (d)	15%
(f)	Combination of (b), (c) and (d)	12%

VIII RECOMMENDATIONS AND OUTSTANDING ISSUES

General

8.01 Project Steering Committee

Project Steering Committee would be constituted by the Irrigation Department, the Department of Agriculture, and the Land Commissioner's Office, as soon as the project's foreign exchange portion should be approved and the local currency portion endorsed by the Government budget. The Committee which is meant for decision-making on the policy matters concerning, and inter-agency coordination for, project implementation and agricultural development under the project would function well if a broad division of work should be made that ID would concern mainly with the construction aspect, the DA with the agricultural development, and the LC with the selection and settlement of the project area farmers. The Committee would be chaired by the Director of Irrigation.

Project Implementation

8.02 Further studies, tests and surveys as mentioned below are required by the time of detail designing:

(1) Hydrlogy: Flood discharge of the Mi-Oya -- computation of the discharge capacity.

(2) Boring and Soil Tests:

(i) Additional boring at the following points are required for detail designing:

- Sites for structures (aqueducts, culverts, bridges, siphons, etc.) (as many as required) across the Main Canals: for confirmation of soil conditions

(ii) Soil Tests

- Soil tests (permeability, compaction, etc.) at the points where trench core may fail to reach the foundation rock are

necessary to check the safety of the dam-body against leakage and sinking.

(3) Surveys

(i) Profile levelling and cross levelling surveys at the Dam-axis, borrow areas, new access road, spillway tail channel and Main canals;

(ii) Plain surveys (s 1/300) as well as profile levelling surveys at spillway, outlets and at the sites for the Main canal crossing structures.

(4) Design: Two alternative radial gate systems (I) and (II) are proposed: (I) w 20' x h 20' 6 Nos. and (II) w 20' x h 15' 9 Nos. According to the data available up to date the alternative (I) is preferrable from cost and structual viewpoints, while the alternative (II) is more advantageous from hydraulic (dam stability) viewpoint. However, before deciding on which gate system is to be adopted, it would be necessary to study, from the data which would be made available from additional studies, whether the gate should be combined with weir or not. As radial gate can not be kept half open, adjustable gate (flapped gate) has been adopted; in view of the complexity which flapped gate involves in its operation and manufacture, however, roller type gate (w 13' x h 12' 3 Nos.) corresponding to 1 radial gate discharge has also been studied. Final decision on this question in the detail designing stage depends on the results of additional boring tests.

8.03 Engineering Services: Engineering services accounted for in the foreign exchange component of the construction cost cover the following:

Consulting services including advices in detail designing and specification of the construction machinery, etc., and checking of the works undertaken by the local engineers. Such services would include: (a) additional surveys and studies; (b) confirmation of the design standards; (c) engineering advices and suggestions in designing of the dam, spillway, outlets, tail channel, roads, etc., (d) engineering advices and suggestions in designing of the main canals, aqueducts, culverts, bridges,

turn-outs, check-gates, etc., (e) cost calculations and specification of construction machinery, its kinds and number, etc., and (f) expert advices on agricultural development aspects of the project. Such consulting services will be provided both on the field as well as in Japan.

A. Field Services:

1. One irrigation engineer and one construction engineer will associate themselves with the local engineers for about 6 months in the first stage of the detail design work;

2. A team of experts of the undermentioned formation will visit Sri Lanka both in the initial stage of detail design work and at the time of its completion, each time for about one month, for pertinent advices as well as checking-ups:

Formation of the Experts' Team

Field of Expertise	Number of Expert	Period of Assignment (manmonth)		Total Number of Manmonths
		At Initial Stage of D.D.	After Completion of D.D.	
1. Leader (irrigation/ drainage engineer)	1	1	1	2
2. Geologist	1	1	-	1
3. Cost planner/ Mechanical engineer	1	1	1	2
4. Agricultural economist	1	1	1	2
5. Hydrologist	1	1	-	1
6. Agronomist	1	1	-	1
	6	6	3	9

B. Home Work:

Liaison, negotiations and maintenance of constant contact with the Overseas Economic Cooperation Fund and other relevant Ministries of the Government of Japan; supporting services to the outgoing experts and preparation of necessary reports and documents. Eight (8) staffs will be working 0.5 manmonth each. Total manmonths: 4.

Cost Calculation:

1. Remuneration

Field Services	6 M/M	@ 8,000$/M =	48,000$
	15 "	@ 7,000$/M =	105,000$
Home Work	4 "	@ 5,500$/M =	22,000$
	Sub-total:		175,000$

2. Out-of-Pocket Expenses

a. International Travels		
	11 x 1,300$	14,300$
b. Excess Baggage & Mobilization Cost		16,700$
	Sub-total:	31,000$
	Total:	206,000$
		(≒ 1,500,000 Rs.)

Agricultural Development

8.04 Project Headquarters: Project Headquarters would start functioning in the Year 3 with the staff formation 1/4 of the full development level (Year 6 through Year 14); its main job during the year would be a smooth settlement and re-settlement of the farmers into the project area and assurance of their livelihood (gainful employment through small unit cost contracts of the construction work and temporary farming). It would be strengthened to 1/2 of the full development level in the Year 4; its main work would be finalization and establishment of the Model Farm, identification of the APC office site, demarcation of 4 sub-areas and selection of the building-sites for the Farm Machinery Centres, offices and store-rooms of

CCs and agricultural co-ops., and preparation for organizing MPCSs for the domiciled farmers and the settled/re-settled farmers. The Project Headquarters would be strengthened to 3/4 of the full development level in the Year 5; project headquarter building and the Farm Machinery Centres would be completed within this year side by side with construction of APC office, CC-Agric. co-ops. offices and store-rooms. Organization of APC, CCs and agricultural co-ops. would be completed, together with that of MPCSs for the domiciled and settled/re-settled farmers. Extension work and institutional training should be started in the existing agricultural land as the headworks including main canals would be ready for operation in the 5th year.

8.05 Settlement: The farmers living for generations in the reservoir bed area and at the proposed dam-axis would be given appropriate compensations and afforded priority over the newly recruited farmers in settlement. Both new settlers and the resettled farmers would be assured with good assistance in occupying their allotments in the project area and offered with minimum necessary habitation and living circumstances including provision of schools, medical facilities and postal/tele-communication services. The farmers settling and re-settling in the project area should make a pledge to the Government not to engage in "chena" cultivation as it jeopardizes timely adherence to highly intensive cropping calendar based on year-round irrigation. 88 families of them who have good experiences in farming practices, enough family labour and comparatively better education will be selected for allocation into the Model Farm.

8.06 Farmers' Organizations: It is most undesirable that the farmers domiciled in the existing agricultural lands and the farmers re-settling from the reservoir bed area and the proposed dam-axis and from outside the project area should be organized separately into APC, CCs, agricultural co-ops., and MPCSs. Therefore, it is proposed to put the entire project area under one independent APC, and each one CC and agricultural co-op. for each one of 4 sub-areas. MPCSs should be organized or re-organized in the new settlers' villages and in the existing villages. In this case, agricultural co-ops. and MPCSs may be better made one organization which maintains agricultural production section in each of 4 sub-areas and necessary number of consumer service depots in the settlers' villages.

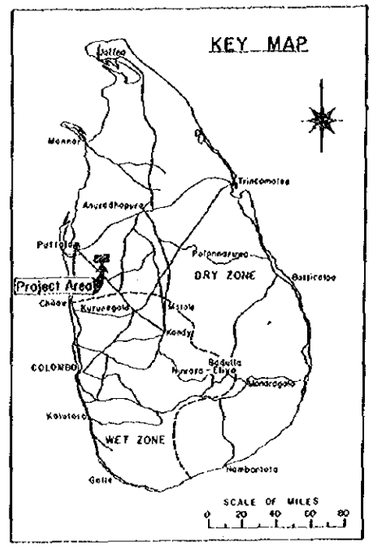
8.07 Technical Assistance and Project Evaluation: A group of 6 expatriate experts would enter the project area in the Year 5 to acclimatize themselves for full operation since the Year 6. They would assist the project area farmers, through the poject headquarters and the farmers' organizations, to attain the yield targets proposed under the project before the Year 10 when they are supposed to leave the project. Project evaluation would start in completing the socio-economic bench-mark survey in the entirety of the project area prior to the project implementation; project evaluation would be carefully made on two aspects of the project: the one is on the engineering aspect and the other, on agricultural development aspect. On the former aspect, it would be necessary to evaluate the performance of the construction work by checking if the final plans, designs and specifications could have been materialized within predecided costs and schedules; if the designed capacities and efficiencies could have been attained. On the latter aspect, evaluation would be made with: (i) economicality of agricultural inputs/outputs - particularly with upland crops; (ii) link-up among credit, input supply and marketing; (iii) extension of scientific farming techniques including farm mechanization; (iv) project headquarters' performance; and (v) efficiency of the farmers' organizations.

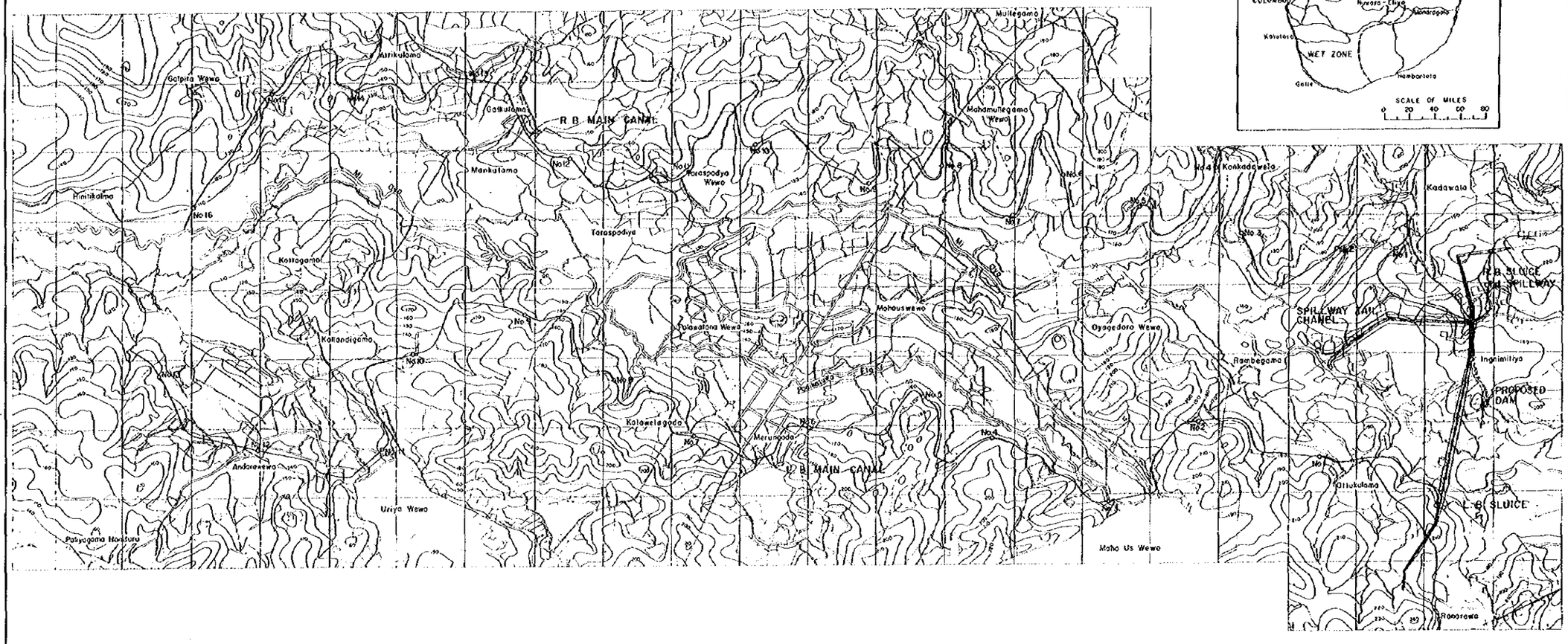
8.09 Farm Equipment and Vehicular Equipment: A part of the farm equipment would be provided since the Year 5 primarily for the use in the Model Farm and more than half of the farm equipment would be brought into the project area in Year 6 and the remainder in the Year 7. Construction and manning of the Farm Machinery Centres should proceed according to the above schedule of farm equipment introduction into the project area. Vehicular equipment for the project headquarters would be provided since the Year 3: 1/3 during Year 3; 1/3 during Year 4, and 1/3 during Year 5.

8.10 Prohibition of "chena" Cultivation: The farmers allocated their lands within the project area should be prohibited to engage in "chena" cultivation as it jeopardizes proper adherence to highly intensive cropping calendar based on year-round irrigation. In the case of the tank irrigation scheme of this scale, it would be difficult to avoid squatting-down of under-employed farmers outside the immediate confines of the project area; they would provide source of temporary labour during the peak seasons inside the project area. For the maintenance of their livelihood and specifically

for this purpose alone, they might be allowed to engage in "chena" cultivation which is prohibited to the farmers inside the project area.

GENERAL PLAN OF THE INGINIMITIYA RESERVOIR PROJECT





SCALE OF MILES
0 05 10 15 20

INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

GENERAL PLAN

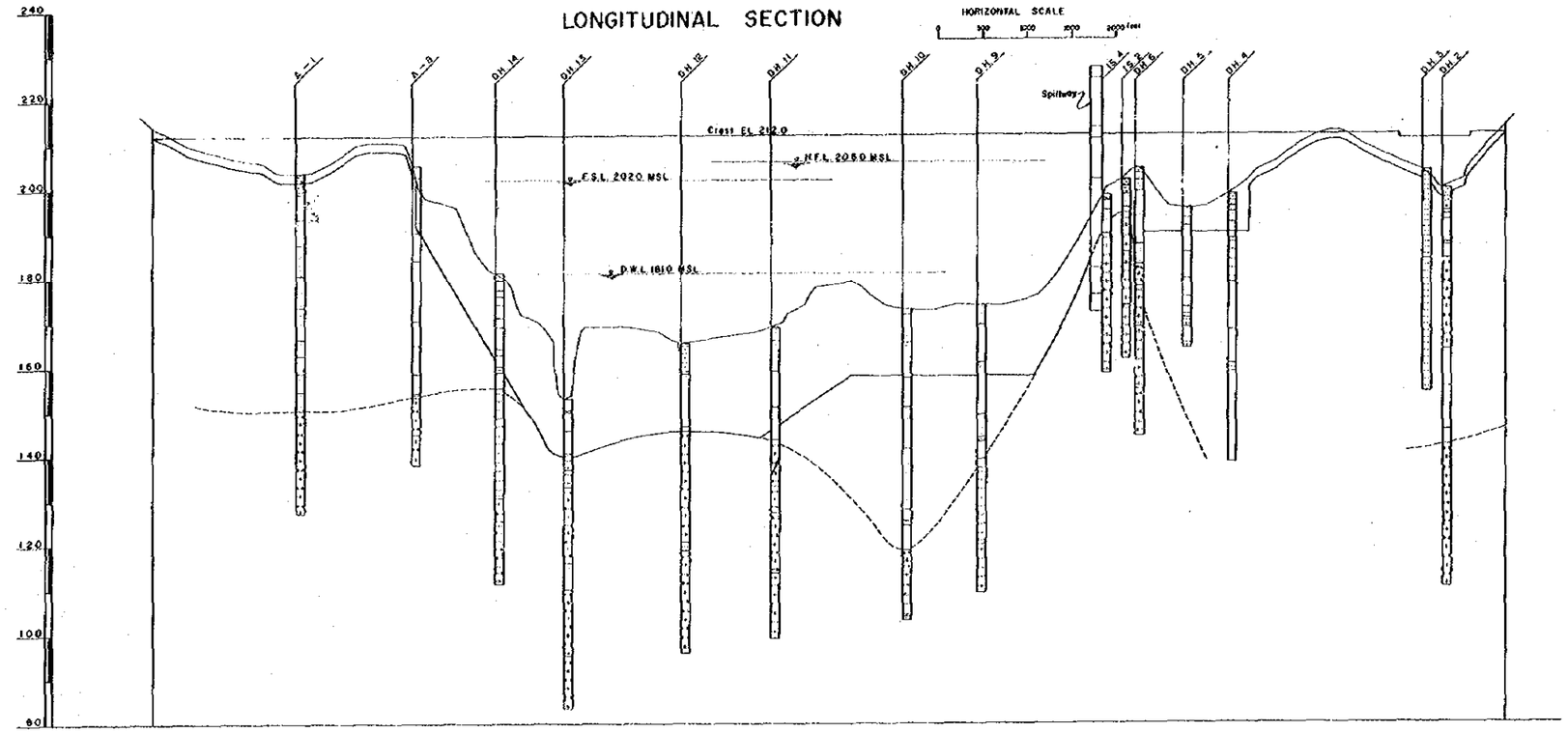
Date: Jun. 1977 | D.W.G. No. 1

PLAN

SCALE 500 1000 2000 3000 feet

LONGITUDINAL SECTION

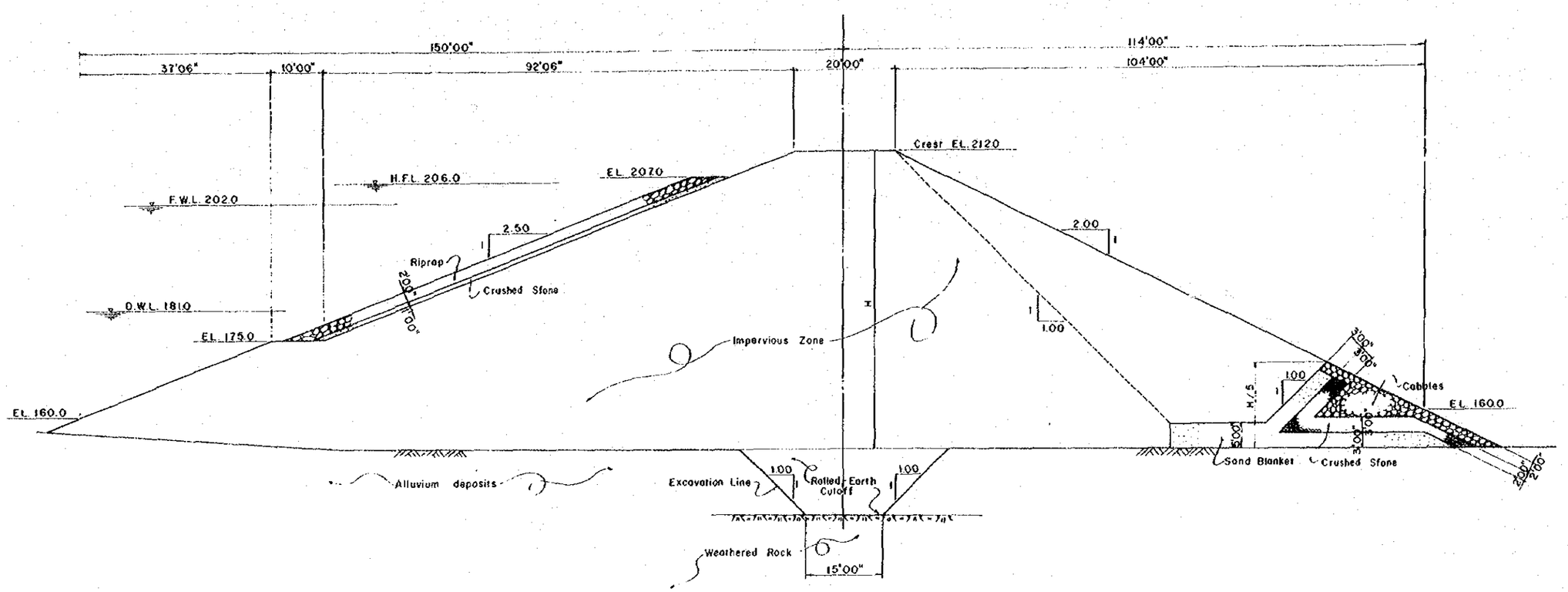
HORIZONTAL SCALE 500 1000 2000 3000 feet



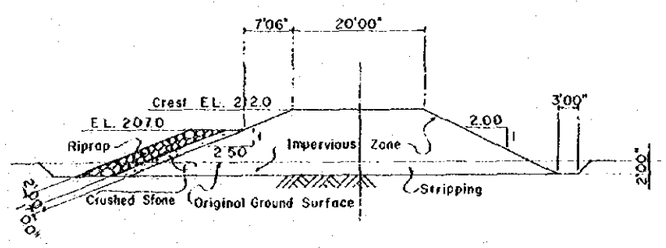
INGINIMITYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA
DAM
PLAN & LONGITUDINAL SECTION

Date: Jun. 1977 | D.W.G. No. 2

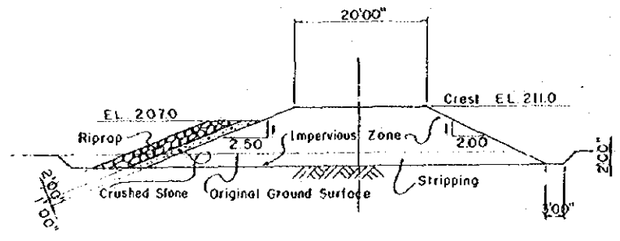
TYPICAL DAM SECTION



DAM SECTION AT ABUTMENT HIGHER THAN 202 MSL



SECTION OF EMERGENCY SPILLWAY



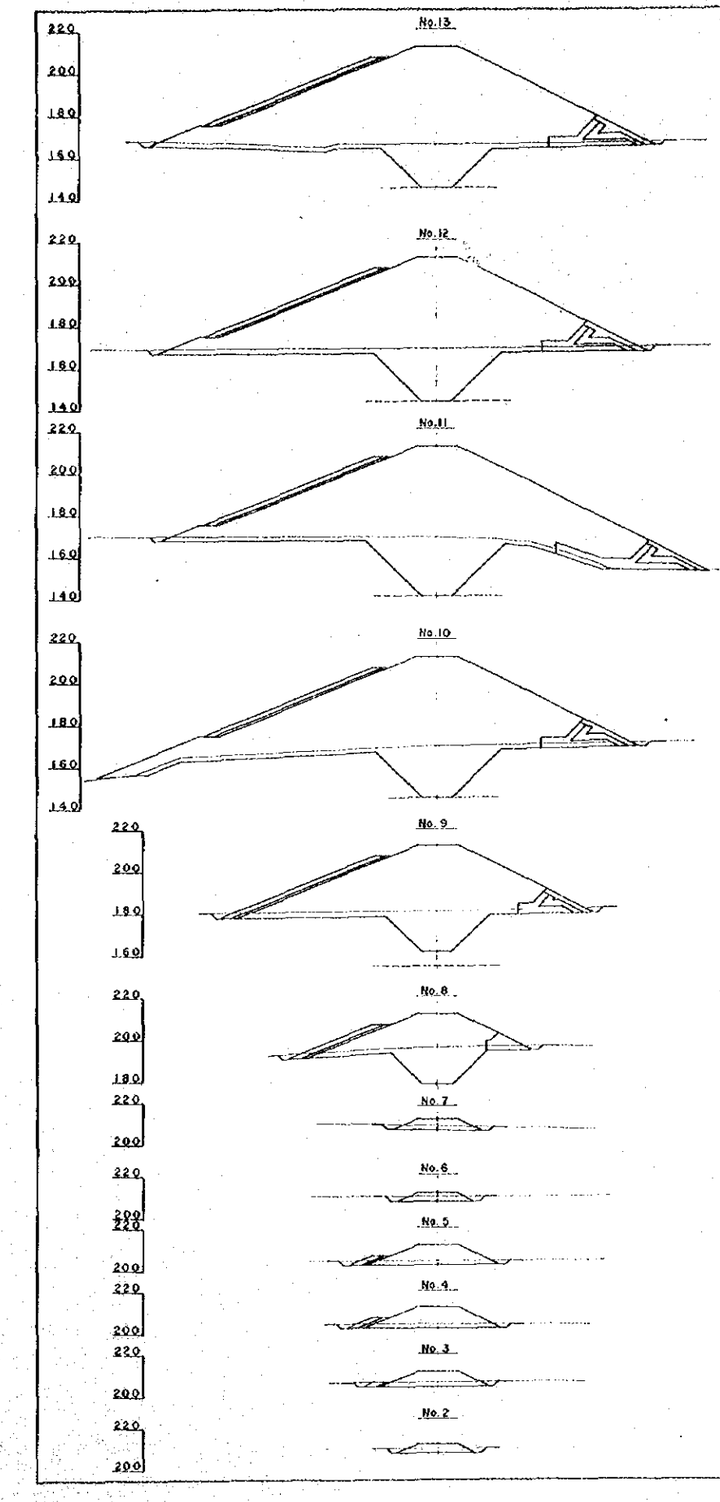
Scale

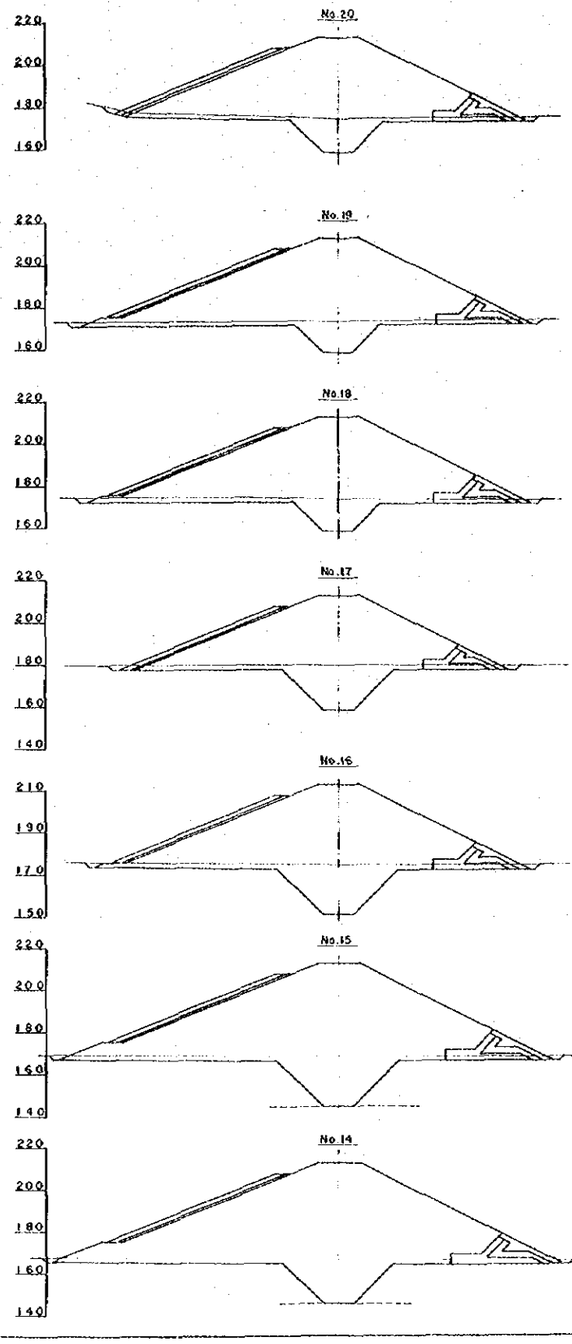
0 10 20 40 60 80 feet

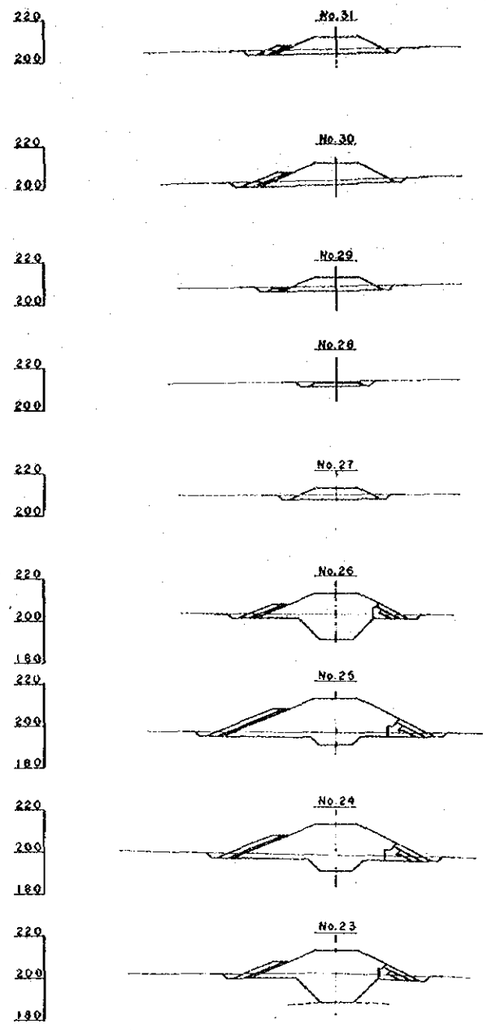
INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

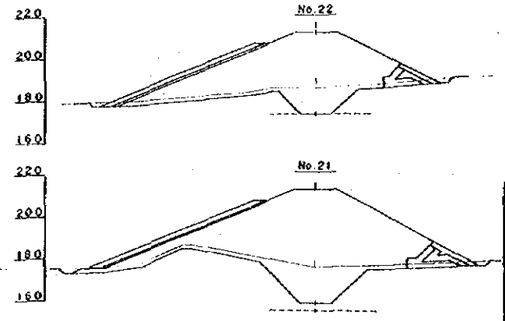
DAM
TYPICAL CROSS SECTION

Date: Jun. 1977 | D.W.G No. 3





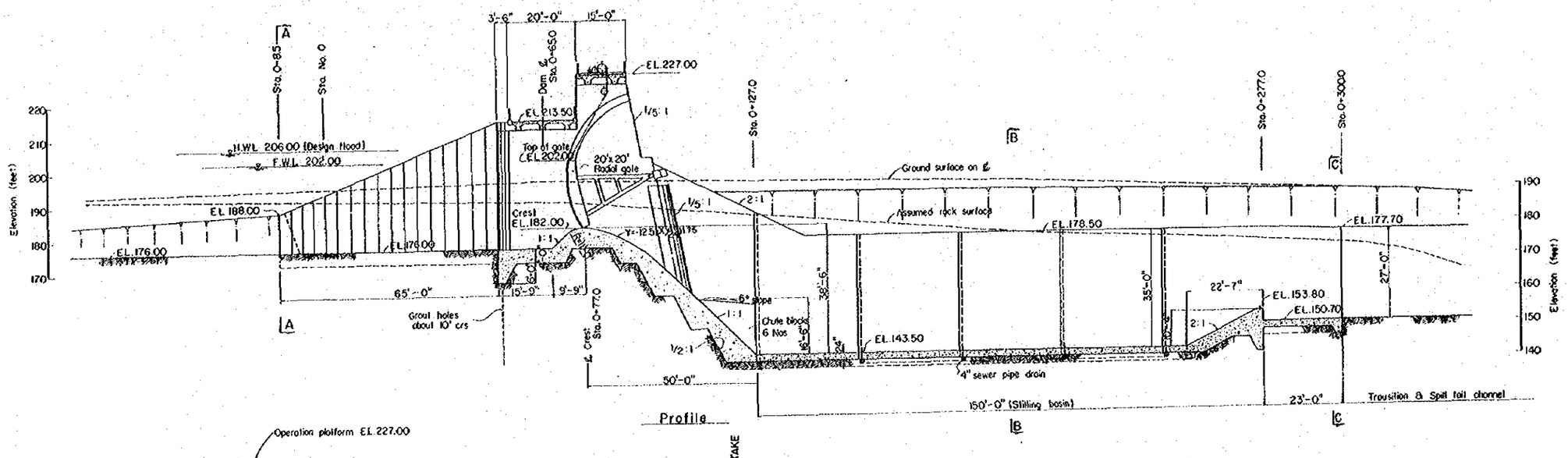




INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

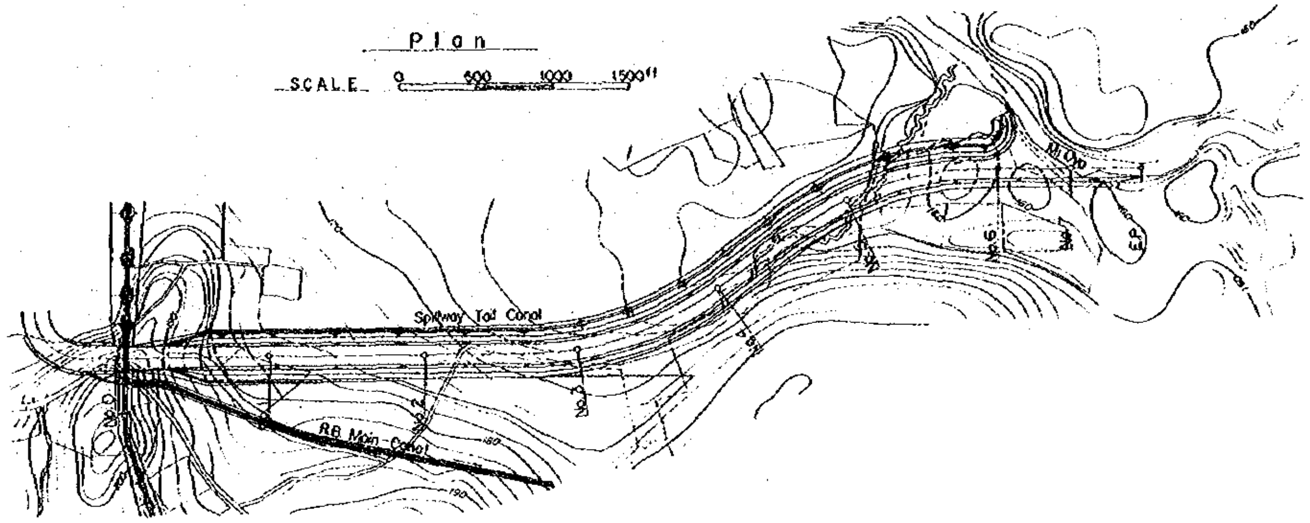
DAM SECTIONS

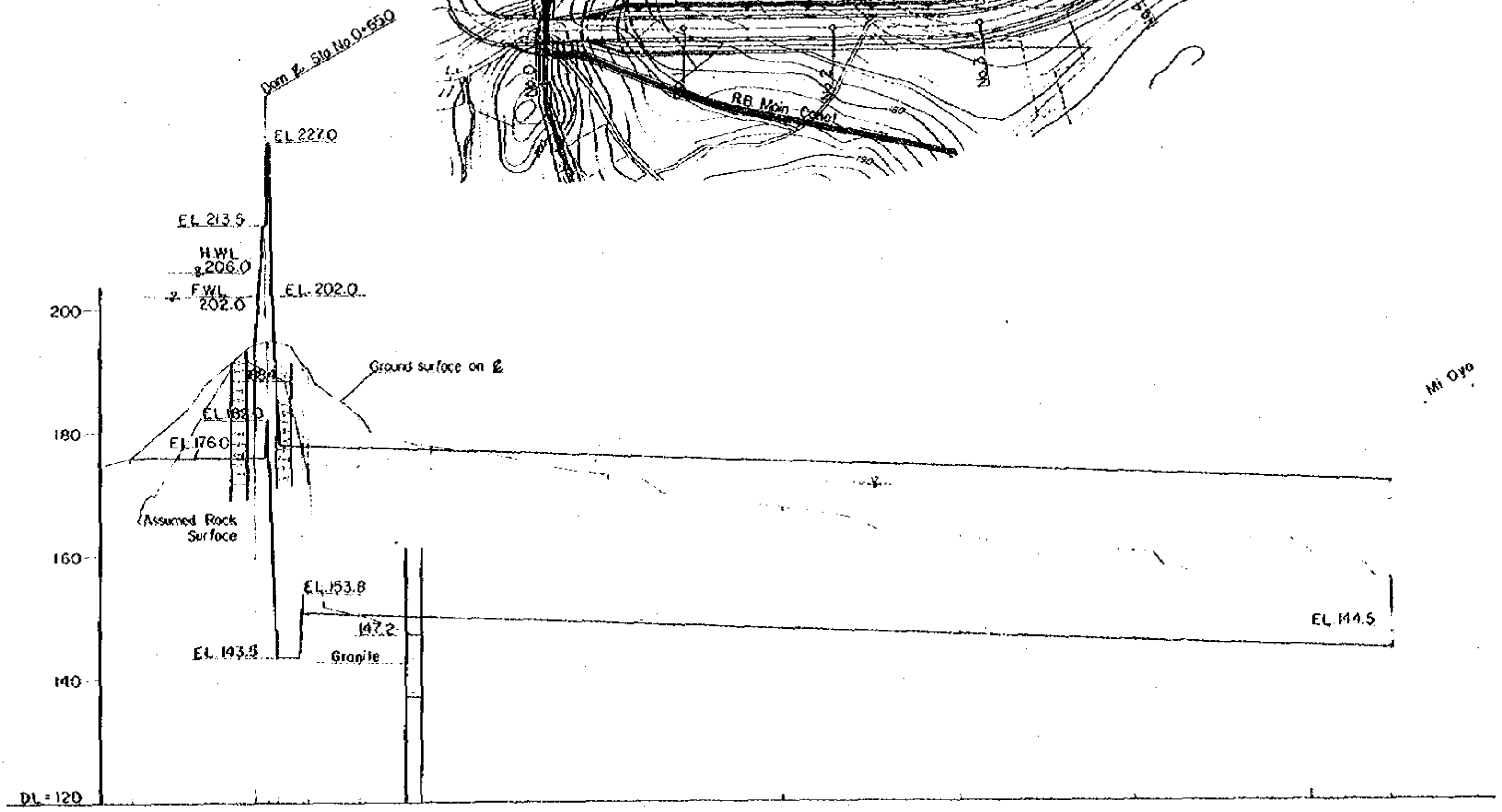
Date: Jun. 1977 | D.W.G. No. 4


A
Sta. 0-8.5
Sta. No. 0
3'-6"
20'-0"
15'-0"
Dam @ Sta. 0-65.0
EL. 227.00
EL. 213.50
1/5:1
H.W.L. 206.00 (Design flood)
F.W.L. 202.00
Top of gate EL. 202.00
20'x20' Radial gate
Sta. 0+127.0
B
Sta. 0+277.0
Sta. 0+300.0
C
Ground surface on ℄
Assumed rock surface
EL. 188.00
EL. 176.00
Crest EL. 182.00
2:1
1:1
EL. 178.50
EL. 177.70
Elevation (feet)
220
210
200
190
180
170
190
180
170
160
150
140
65'-0"
15'-9"
9'-9"
Grout holes about 10' c/s
Crest Sta. 0-77.0
6" slope
Chute blocks 6 Nos
EL. 143.50
1/2:1
50'-0"
4" sewer pipe drain
38'-6"
35'-0"
22'-7"
EL. 153.80
EL. 150.70
27'-0"
150'-0" (Stilling basin)
23'-0"
Trousition & Spill tail channel
Profile
Operation platform EL. 227.00
Dam crest EL. 212.00
EL. 213.50
EL. 211.00
Top of gate EL. 202.00
6-20'x20' Radial gates
Crest EL. 182.00
EL. 188.00
Ground surface
Assumed rock surface
135'-0"
EL. 176.00
EL. 166.00
175'-0"
35'-0"
Grout holes 40' deep about 10' c/s
Section A-A
R.B INTAKE
R.B Main Canal
Ground surface
1½:1
1:1
18"
EL. 177.70
Assumed rock surface
1/4:1
EL. 159.50
EL. 150.70
24"
27'-0"
Compacted backfill
Anchor bars
14'-0"
Section C-C
Ground surface
184.75
EL. 180.00
EL. 178.50
135'-0"
Compacted backfill
35'-0"
EL. 143.50
4'-0"
Anchor bars
4" Sewer pipe drain
Stilling Basin Cross Section (B-B)
Reservoir elevation - feet
207
206
205
204
203
202
34 36 38 40 42 44 46 48 50 52 54
Discharge - Thousand sec-feet
Spillway Discharge Curve
10 0 10 20 30
Scale of feet
GENERAL PLAN
INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA
SPILLWAY
PROFILE & SECTIONS
Date: Jun. 1977
DWG No. 5

Plan

SCALE 0 500 1000 1500ft

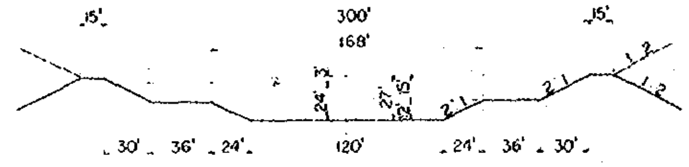




Grade							1/1000								
Depth of Exca						39.8	32.4	27.8	24.0	19.5	15.5	14.3	15.0	11.5	
Hight of Emban.															
Top Bank		193.0				177.7	177.4	177.0	176.0	175.0	174.0	173.0	172.0	171.5	
Water Surf.						174.7	174.4	174.0	173.0	172.0	171.0	170.0	169.0	168.5	
Bottom of Canal	176.0	176.0	182.0	[illegible]	[illegible]	150.7	150.4	150.0	149.0	148.0	147.0	146.0	145.0	144.5	
Ground Elev.	176.0	194.3				190.5	192.8	177.8	173.0	167.5	162.5	160.3	160.0	156.0	143.9
Accum Dist	700.0	0	77.0	127.0	277.0	300.0	600.0	1000.0	2000.0	3000.0	4000.0	5000.0	6000.0	6460.0	6940.0
Dist	700.0	0	77.0	50.0	150.0	23.0	300.0	400.0	1000.0	1000.0	1000.0	1000.0	1000.0	460.0	480.0
Station No.	-700	No.0	+77	+127	+277	+300	+600	No.1	No.2	No.3	No.4	No.5	No.6	+460	E.P.

Spillway Tail Channel Section

SCALE 0 50 100ft



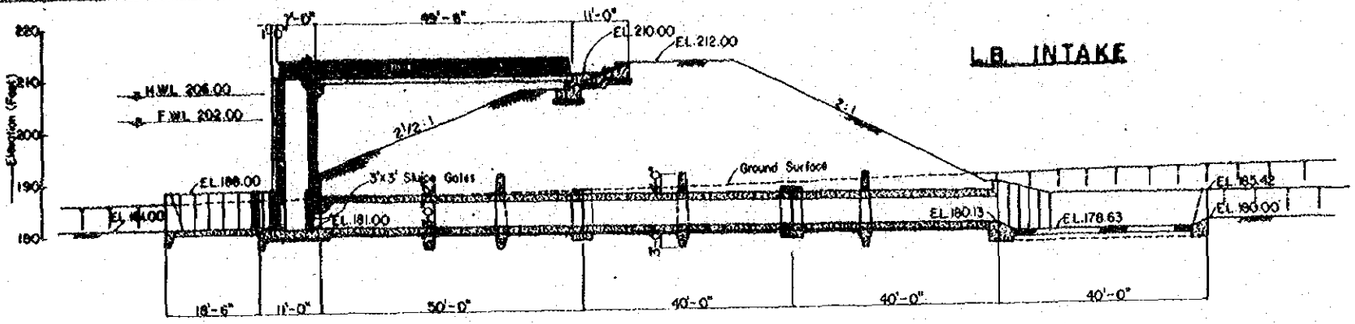
Profile SCALE

Vertical 0 10 20 30 40ft

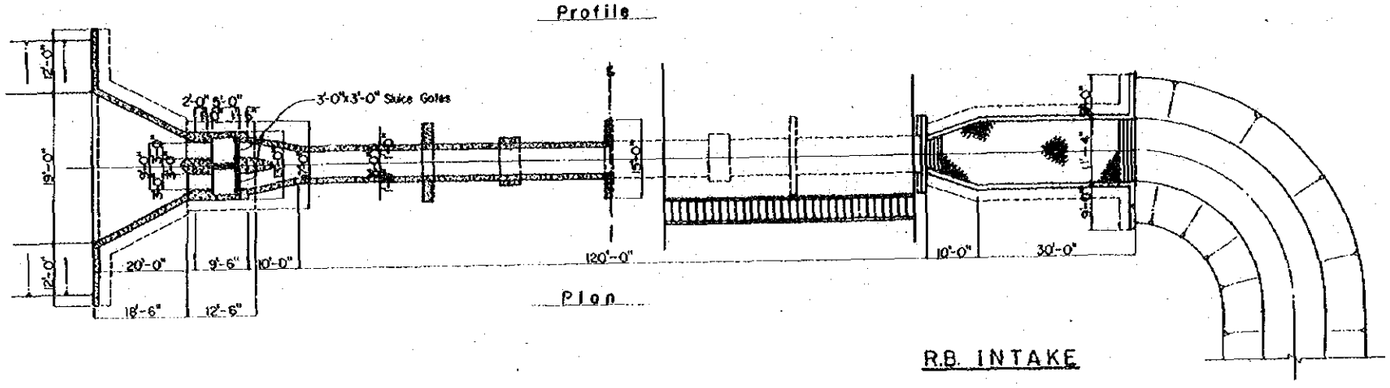
Horizontal 0 500 1000 1500 2000ft

INGINIMITIYA RESERVOIR PROJECT THE REPUBLIC OF SRI LANKA	
SPILL WAY TAIL CHANNEL PROFILE & SECTIONS	
Date: Jun. 1977	DWG No. 6

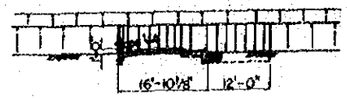
L.B. INTAKE



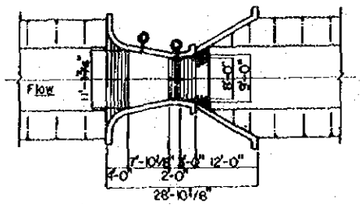
Profile

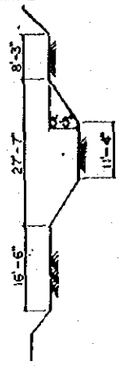


Plan

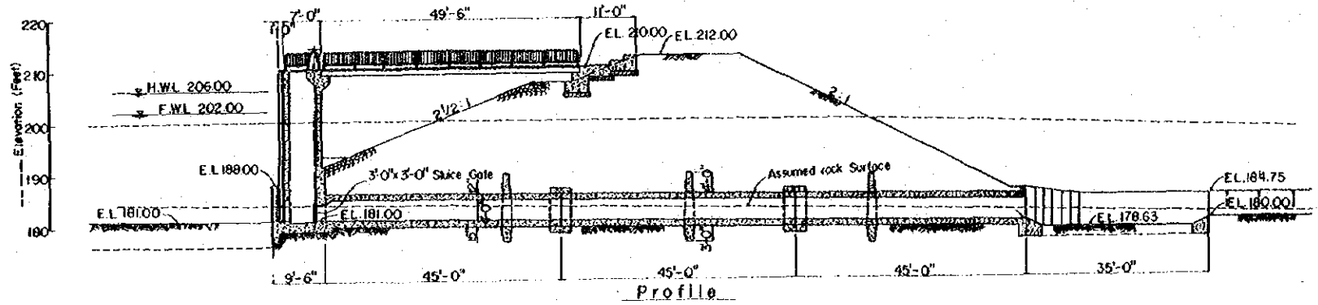


Parshall Measuring Flume (Throat Width-8' In)

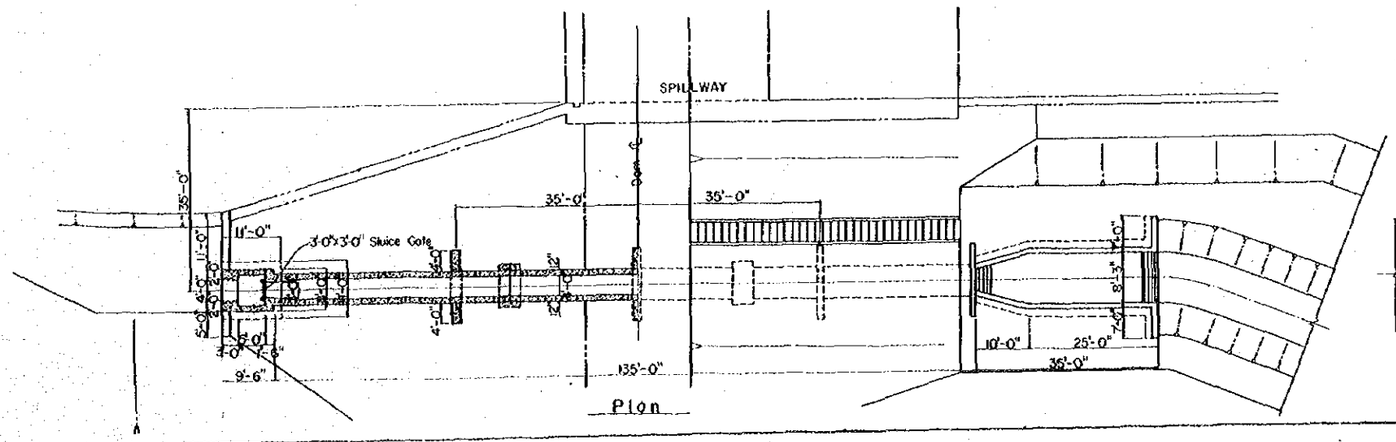




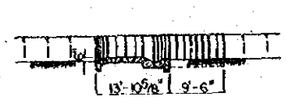
R.B. INTAKE

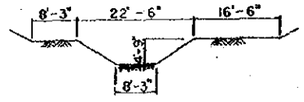


Profile

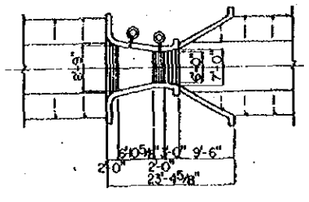


Plan





Parshall Measuring Flume (Throat Width 6' In)



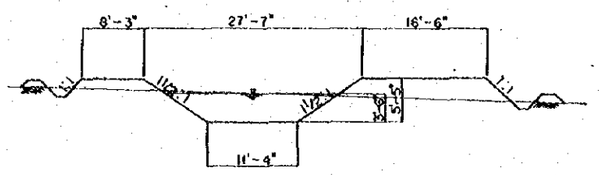
Scale of Feet

INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

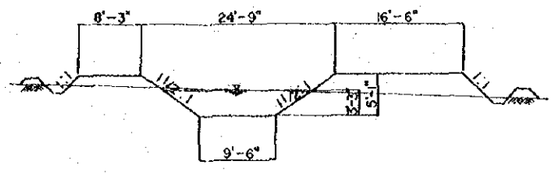
INTAKE WORKS
PROFILE & SECTIONS

Date: Jun 1977 | D.WG No. 7

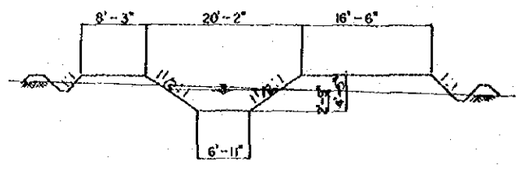
Type-1 SCALE : A

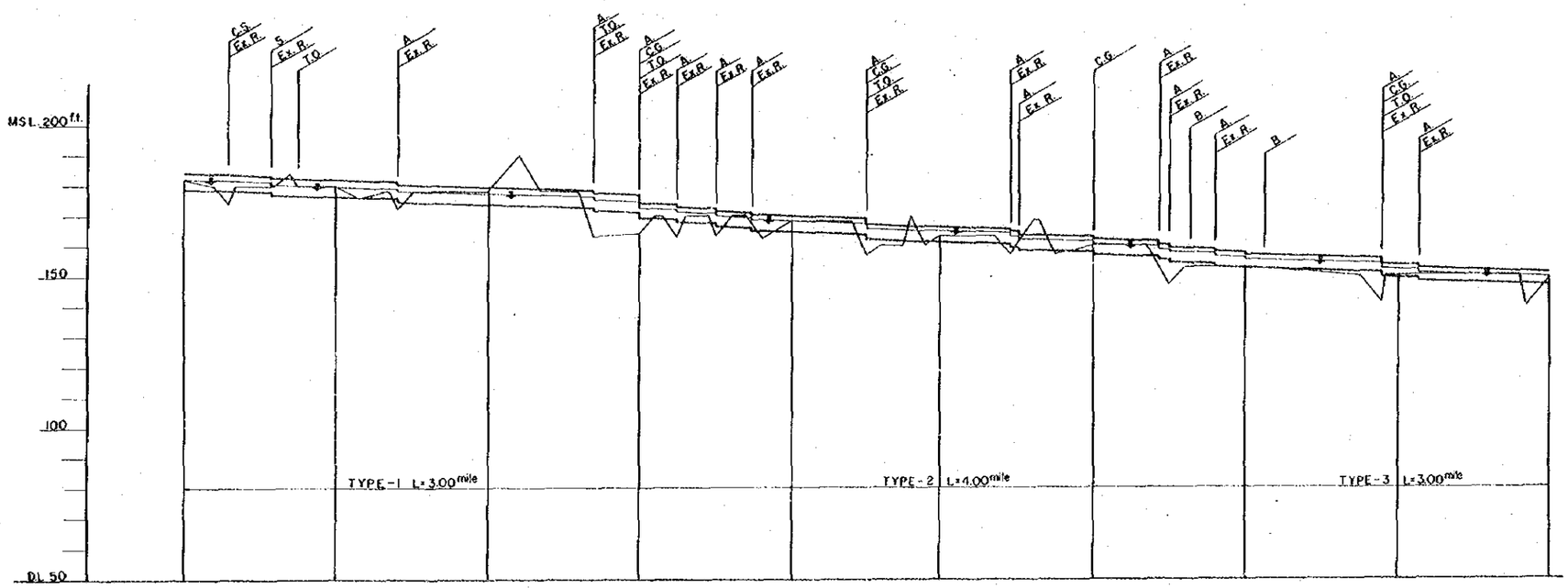


Type-2 SCALE : A



Type-3 SCALE : A





Grade		1/3500			1/3500			1/3500	
Depth of Exca.	3.0	3.5	4.0	7.5 5.5	3.0	1.5	2.1 3.1	0.6	1.1	2.6
Hight of Embon.										
Top Bank	+84.4	+81.9	+79.4	176.9 174.6	+70.1	+66.6	163.0 162.0	157.5 156.8	+53.3	+50.8
Water Surf.	+82.5	+80.0	+77.5	175.0 172.8	+68.3	+64.8	161.2 160.2	155.7 155.2	+51.7	+49.2
Bottom of Canal	+79.0	+76.5	+74.0	171.5 169.5	+65.0	+61.5	157.9 156.9	152.4	+48.9	+46.4
Ground Elev.	+82.0	+80.0	+78.0	+64.0	+68.0	+63.0	+60.0	+53.0	+50.0	+49.0	+46.0
Accum Dist	0	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
Dist		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Station No.	No. 0	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9

Legend

- A — Aqueduct
- S. — Siphon
- C.G. — Check Gate
- T.O. — Turn Out
- D.S. — Drop Structure
- C.S. — Cross Siphon
- B — Bridge
- Ex. R. — Existing River

SCALE

Horizontal 0 0.5 1.0 mile

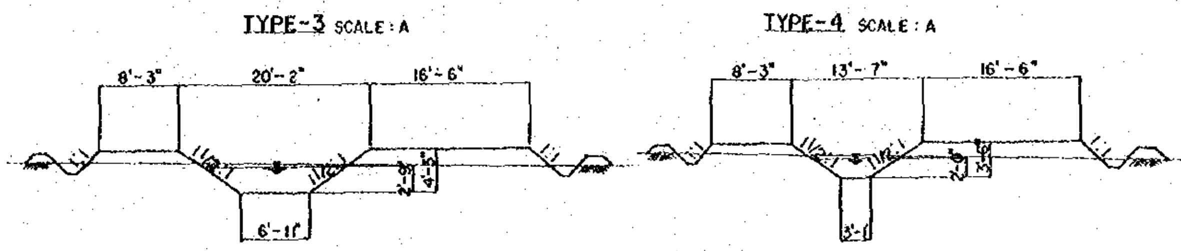
Vertical 0 10 20 30 40 50 ft

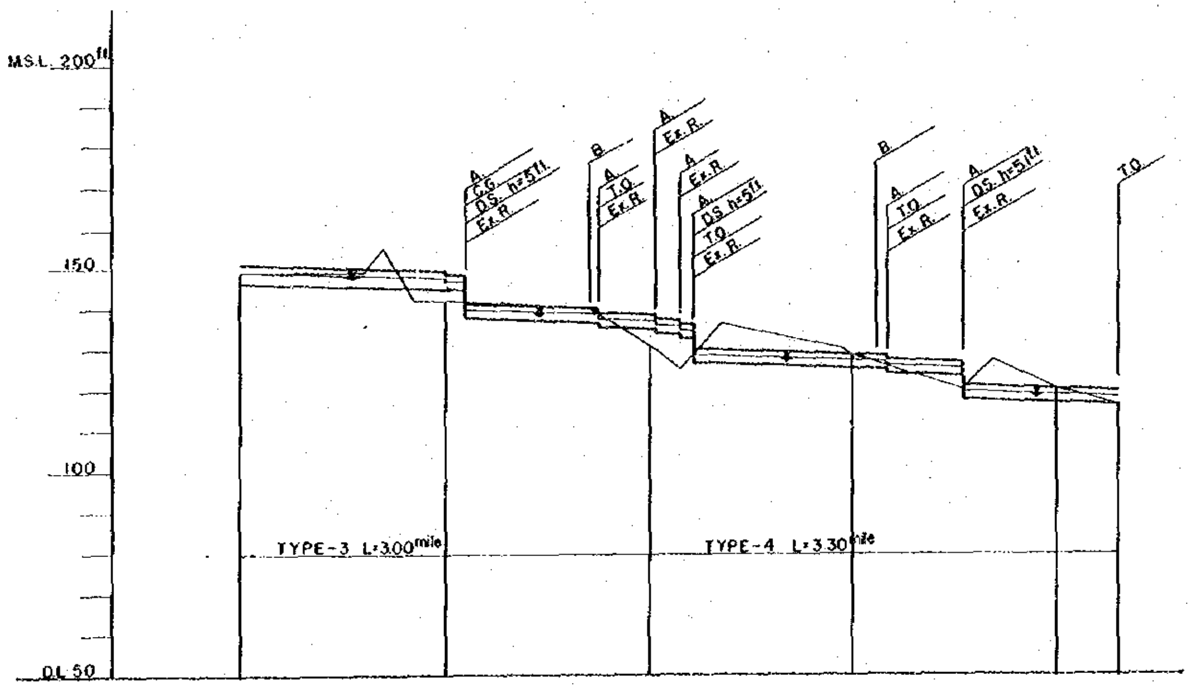
A 0 5 10 ft.

INGINIMTIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

L.B. MAIN CANAL (1)
PROFILE & SECTIONS

Date : Jun. 1977 | DWG No. 8



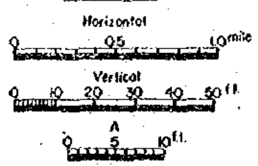


Grade	1/3500		1/3000			
Depth of Exco.	2.6			2.6	3.5	0
Hight of Embon.		2.9	4.1			
Top Bank	150.8	149.3 / 148.4	138.6	128.9	120.0	119.5
Water Surf.	149.2	147.7 / 146.9	137.1	127.4	118.5	118.0
Bottom of Canal	146.4	144.9	135.1	125.4	116.5	116.0
Ground Elev.	149.0	142.0	131.0	128.0	120.0	116.0
Accum Dist.	9.00	10.00	11.00	12.00	13.00	13.30
Dist	1.00	1.00	1.00	1.00	1.00	0.30
Station No.	No.9	No.10	No.11	No.12	No.13	+030

Legend

- A. Aqueduct
- S. Siphon
- C.G. Check Gate
- T.O. Turn Out
- D.S. Drop Structure
- C.S. Cross Siphon
- B. Bridge
- Ex.R. Existing River

SCALE



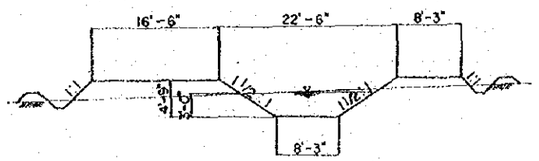
INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

L.B. MAIN CANAL (2)

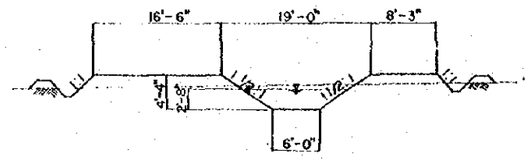
PROFILE & SECTIONS

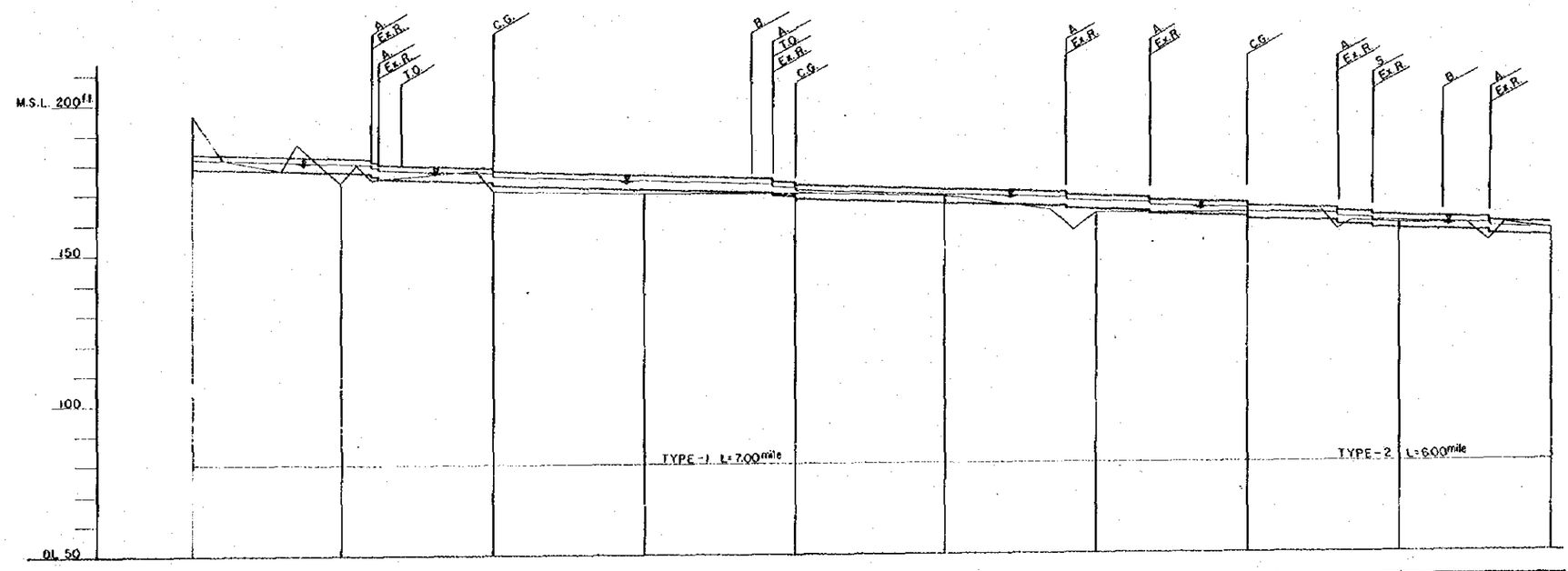
Date: Jun. 1977	DWG No. 9

TYPE-1 SCALE : A



TYPE-2 SCALE : A





Grade		1/3500						1/3500		
Depth of Exca.	18.0				1.0	2.5		1.6 2.6	2.1	2.6
Hight of Embon.		3.5	3.0 2.0	1.5			0.9			
Top Bank	183.8	182.3	178.8 177.8	176.3	173.8 172.8	171.3	168.7	166.2 164.7	161.2	158.7
Water Surf.	182.0	180.5	177.0 176.0	174.5	172.0 171.0	169.5	166.9	164.4 163.1	159.6	157.1
Bottom of Canal	179.0	177.5	174.0 173.0	171.5	169.0 168.0	166.5	163.9	161.4 160.4	156.9	154.4
Ground Elev.	197.0	174.0	171.0	170.0	170.0	169.0	163.0	163.0	159.0	157.0
Accum Dist.	0	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
Dist	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Station No.	No.0	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9

Legend

- A — Aqueduct
- S — Siphon
- C.G. — Check Gate
- T.O — Turn Out
- D.S — Drop Structure
- C.S — Cross Siphon
- B — Bridge
- Ex.R. — Existing River

SCALE

Horizontal 0 0.5 1.0mile

Vertical 0 10 20 30 40 50ft.

A 0 5 10ft.

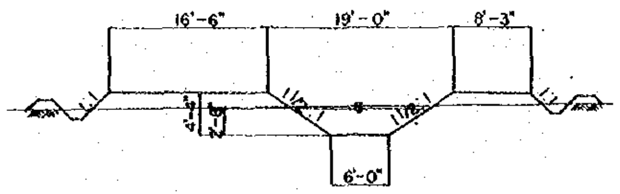
INGINIMTIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

R.B. MAIN CANAL (1)

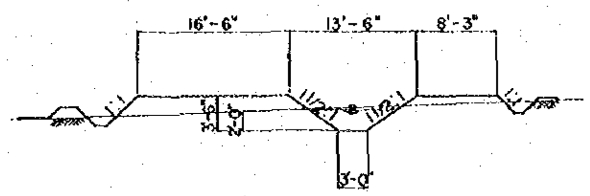
PROFILE & SECTIONS

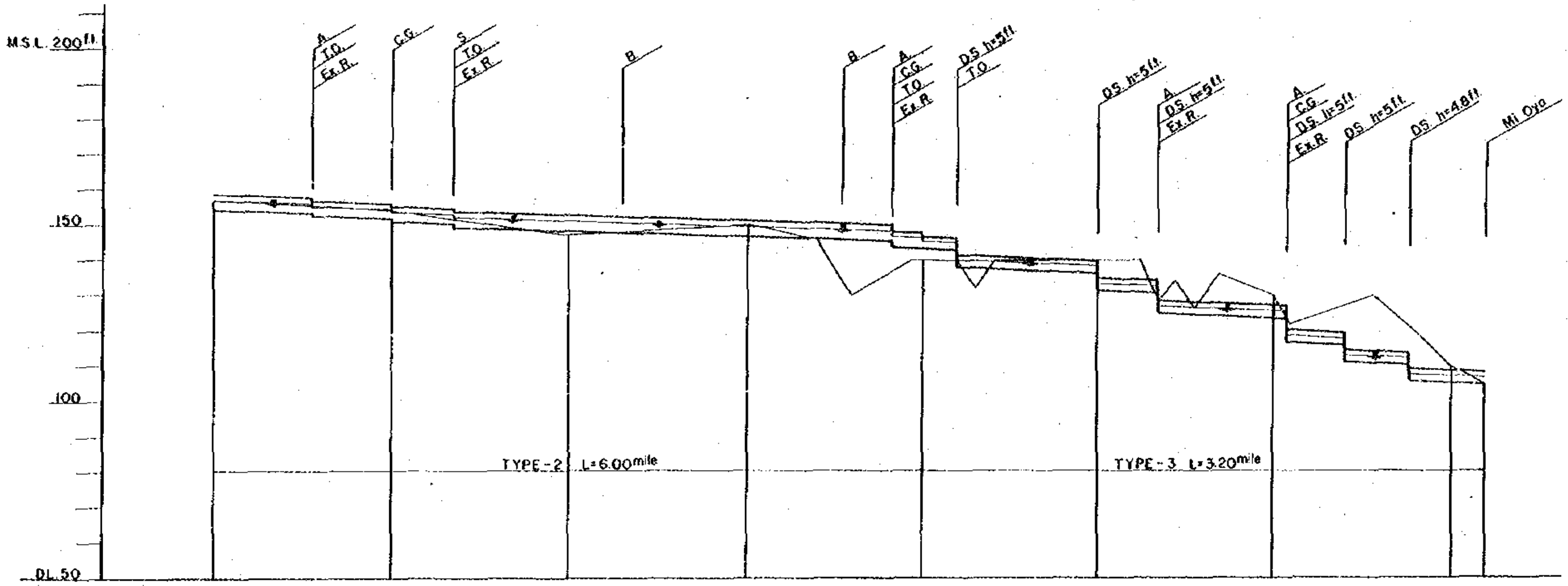
Date: Jun. 1977 | DWG No. 10

TYPE-2 SCALE : A



TYPE-3 SCALE : A



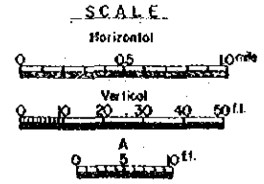


Station No.	No. 9	No.10	No.11	No.12	No.13	No.14	No.15	No.16	020
Grade	1/3500					1/3000			
Depth of Exca.	2.6	2.1 / 2.3		3.1		3.4 / 8.4	6.1	4.7	0
Hight of Embon.			1.4		3.4				
Top Bank	158.7	156.2 / 155.2	152.7	151.2	147.7 / 146.9	140.1 / 135.1	127.4	108.8	108.5
Water Surf.	157.1	154.6 / 153.6	151.1	149.5	146.1 / 145.4	138.6 / 133.6	125.9	107.3	107.0
Bottom of Canal	154.4	151.9 / 150.9	148.4	146.9	143.4	136.6 / 131.6	123.9	105.3	105.0
Ground Elev.	157.0	154.0	147.0	150.0	140.0	140.0	130.0	110.0	105.0
Accum. Dist.	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	16.20
Dist.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.20

Legend

- A — Aqueduct
- S. — Siphon
- C.G. — Check Gate
- T.O. — Turn Out
- D.S. — Drop Structure
- C.S. — Cross Siphon
- B. — Bridge
- Ex.R — Existing River

SCALE

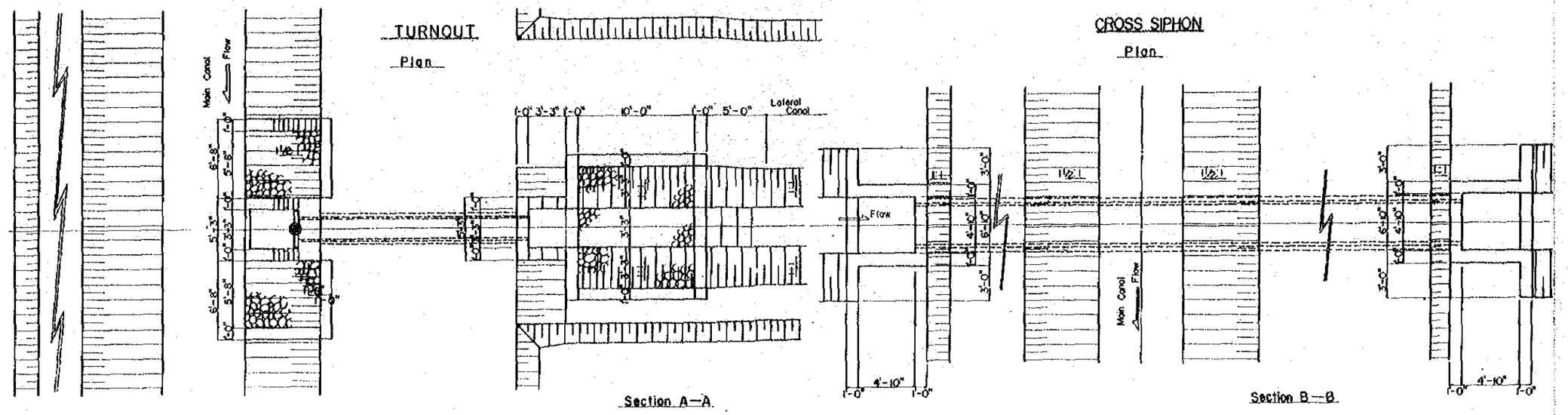


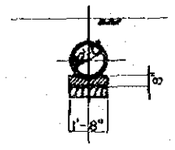
INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

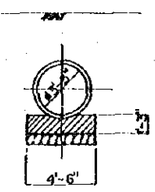
R.B. MAIN CANAL (2)

PROFILE & SECTIONS

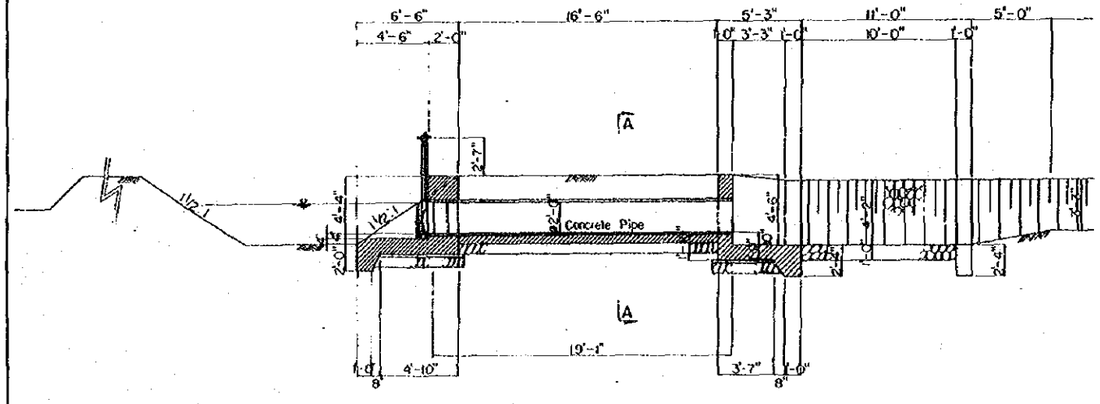
Date: Jun. 1977 | DWG No. 11



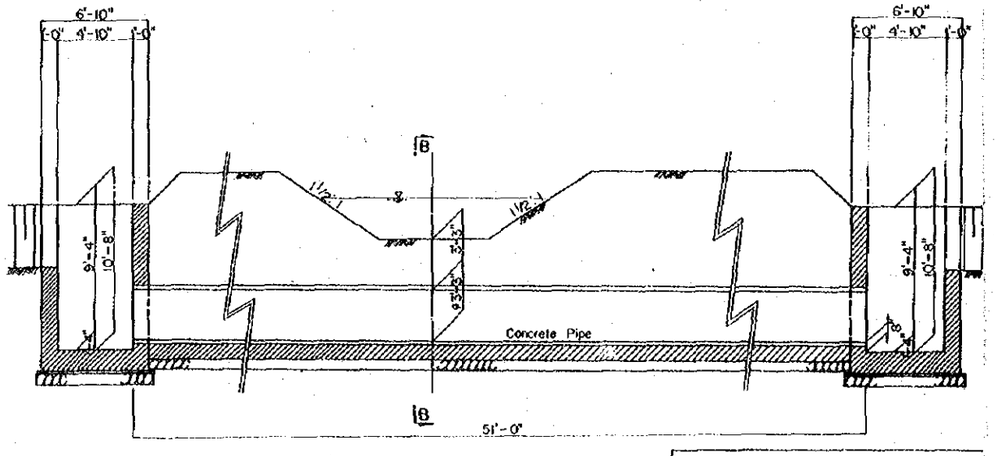




Profile



Profile



SCALE

0 5 10 15 20 ft.

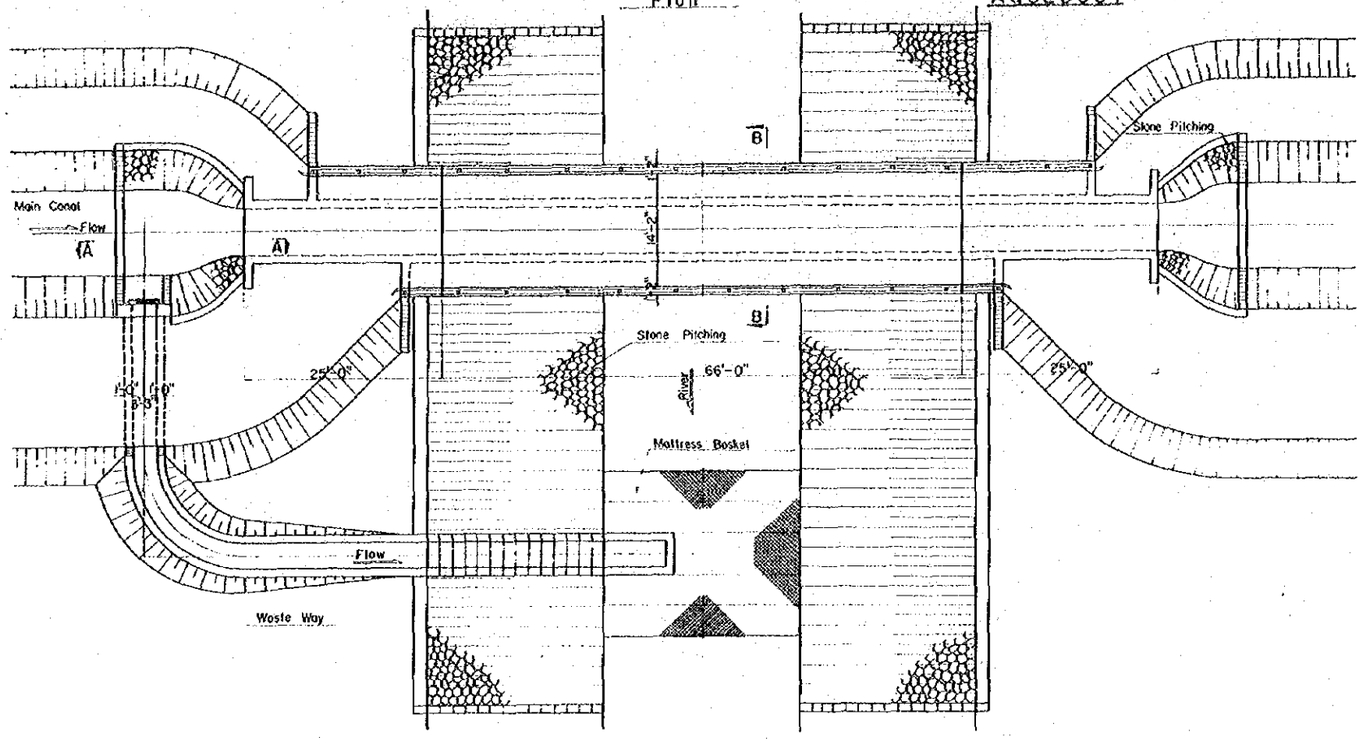
INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

TURNOUT & CROSS SIPHON
PROFILE & SECTIONS

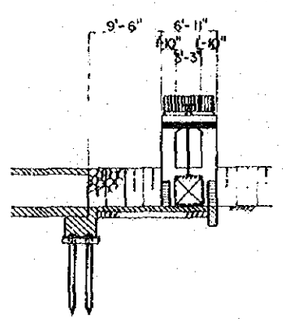
Date : Jun 1977 | DWG No. 12

AQUEDUCT

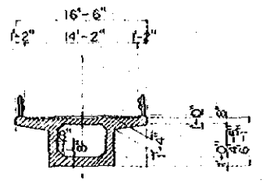
Plan



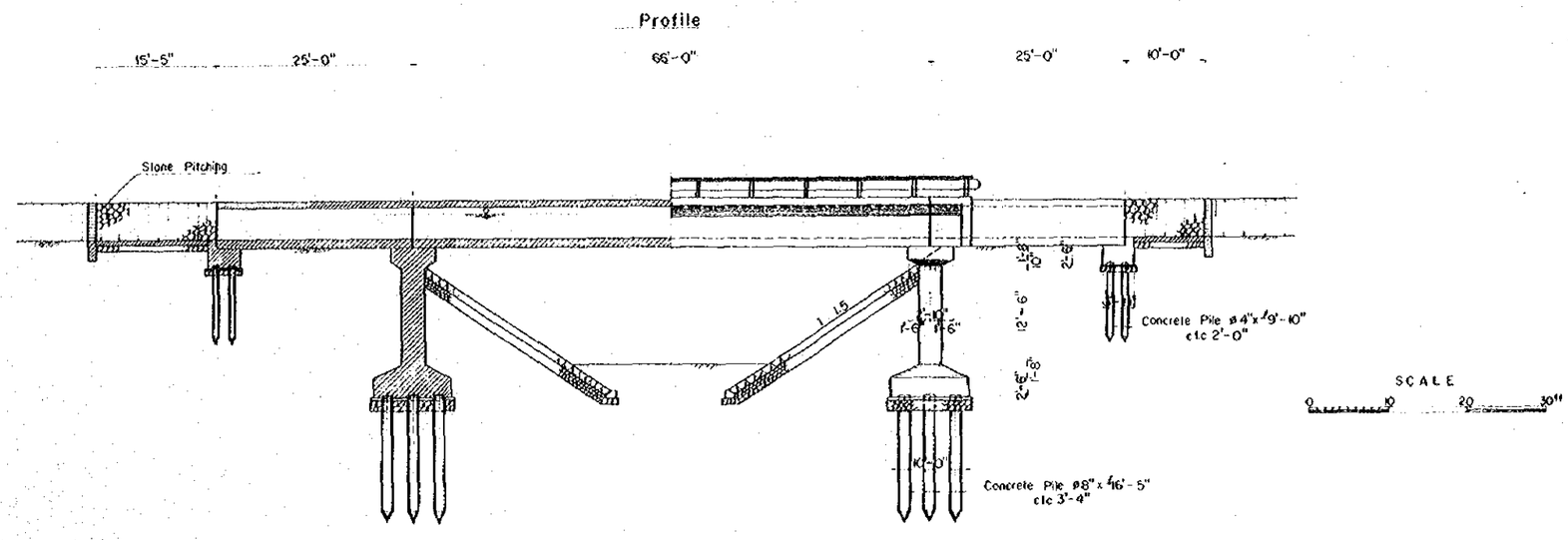
Section A—A



Section B—B



Profile



SCALE 0 10 20 30ft

INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

AQUEDUCT

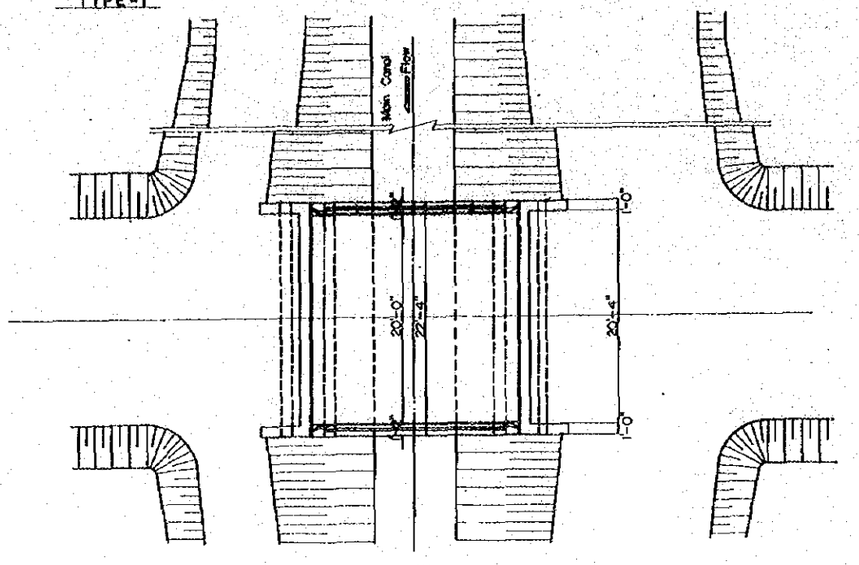
PROFILE & SECTIONS

Date Jun 1977 | DWG No 13

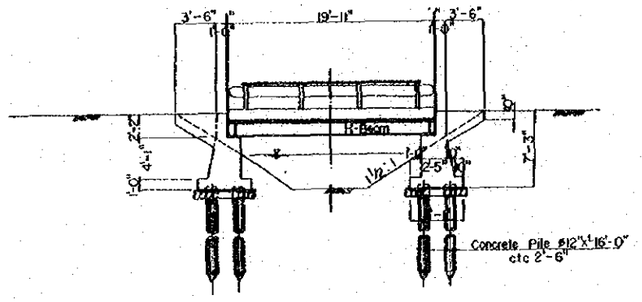
BRIDGE

TYPE - 1

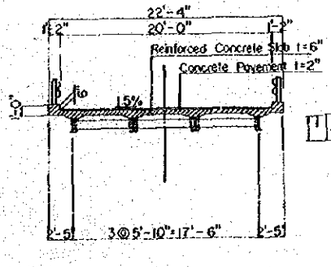
Plan



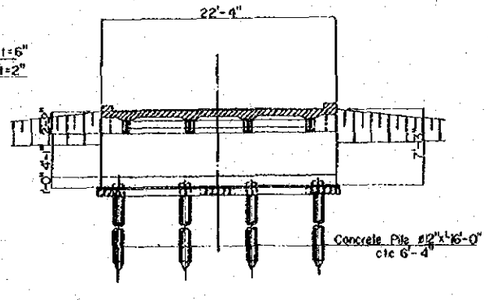
Profile



Cross Section

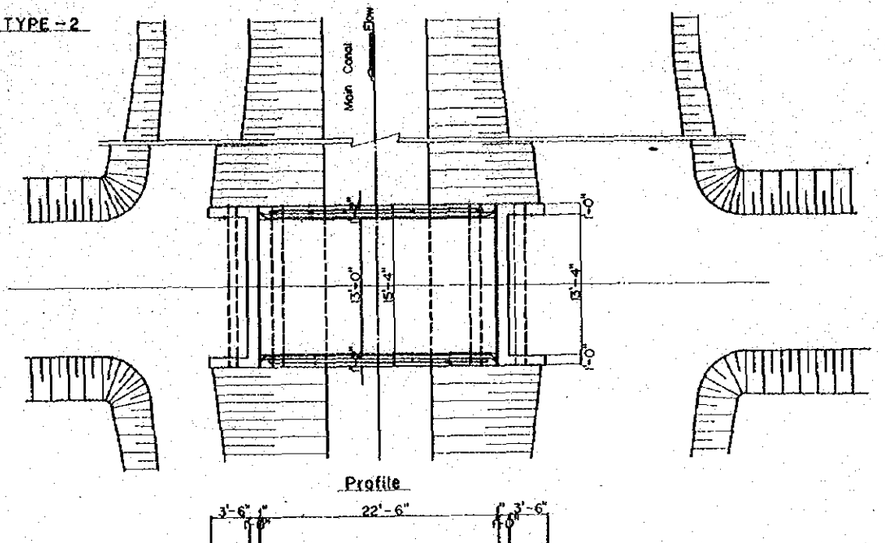


Abutment

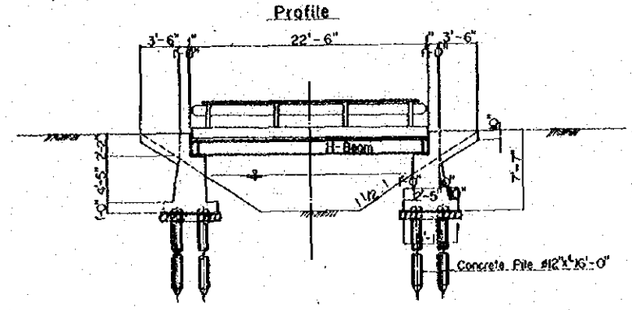


TYPE - 2

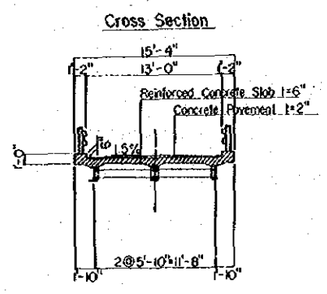
Plan



Profile



Cross Section



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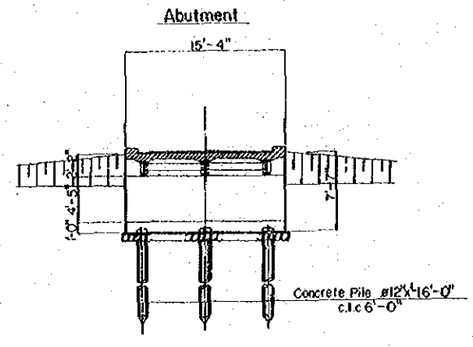
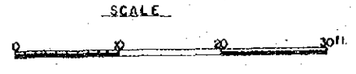


SCALE



INGINIMITIYA RESERVOIR PROJECT
THE REPUBLIC OF SRI LANKA

BRIDGE (TYPE 1, 2)
PROFILE & SECTIONS

Date: Jun. 1977 | DWG No. 14