

CO-OPERATIVE REPUBLIC OF GUYANA

**REPORT FOR THE YEARS  
1975 & 1976**

By

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**HYDROPOWER DIVISION  
MINISTRY OF ENERGY AND NATURAL RESOURCES  
GEORGETOWN**

**SEPTEMBER, 1977**

A C K N O W L E D G E M E N T

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HYDROPOWER DIVISION, MINISTRY OF ENERGY & NATURAL RESOURCES

E. L. Lee  
Chief Hydropower Engineer (ag)

1.0 Introduction

The volume of work under the supervision of the Hydropower Division was steadily increasing from the formation of the Division in 1972 to 1974. But, after the end of 1974 the volume of work under the control of the Division decreased steadily mainly because of the fact that the Upper Mazaruni Project was put under the supervision of the Upper Mazaruni Development Authority in 1975 and because all of the Hydropower Engineers were seconded to work for the Upper Mazaruni Development Authority in 1976.

The Upper Mazaruni Project is the largest and most important hydro-electric scheme in Guyana, hence priority was given to this project.

2.0 Projects

- I) Closure of Tumatumari Dam (1975).
- II) Consolidation of Tumatumari Dam 1976
- III) Upper Mazaruni Project - Geophysical investigations of the Kurupung Hydropower plant area and the Sand Landing Dam Site. (early 1975).
- IV) The Essequibo Deep Harbour Survey (administered by Chief Hydropower Engineer, Ramsahoye up to July 1975)
- V) The U.N./Guyana Hydropower Inventory Study. (1975)
- VI) The Topographical Surveys of the Chi Chi Diversion Scheme. (1976).

2.1 Closure of Tumatumari Dam

The closure of the Tumatumari Dam was successfully completed by means of wooden cribs filled with rocks on 25th April, 1975. This closure of the dam was due to a large measure to the efforts of Clerk of Works, Clifford Brotherson who was loaned to the Hydropower Division by the Hydraulics Division.

As originally planned the work was done by the Guyana Defence Force under the supervision of the Hydropower Division.

Firstly a trestle was constructed to carry the rail car from the quarry area to the gap. The rail car was hauled by means of a winch. Rocks were blasted from the islands downstream of the dam. Large rocks of about 1 cu. yd. were dumped in the gaps during the low flow period to form a rock mattress on which the wooden cribs made from round wood obtained from the forest nearby were constructed.

The cribs were then filled with boulders of random size ( $\frac{1}{2}$  cu.ft. - 2 cu.ft) by means of the rail car.

#### Consolidation of the Tumatumari Dam

During the 1974 May - June wet period the trestle bridge was washed away and work on consolidating the gaps stopped.

The trestle bridge was reconstructed in September, 1975 but consolidation of the back slope of the dam in the gaps was greatly retarded because of the removal of the compressor hoses in October 1975 by the Guyana Defence Force to the Upper Mazaruni Road Project causing a stoppage of blasting and stockpiling of boulders at Tumatumari.

The progress of the works was also hampered by the transfer of the trailer which was used to haul lumber from the forest to the river to the Upper Mazaruni Road Project.

When the Guyana Defence Force was asked to take part in the construction of the Upper Mazaruni Road Project the Tumatumari Project suffered because not only tools and equipment were removed from Tumatumari to the Upper Mazaruni Road Project but also the key men (carpenter foreman, welder, blaster) who obviously preferred to work on the Road Project because of the incentive offered i.e. the Upper Mazaruni Road Project allowance.

Cde C. Brotherson became so frustrated over the slow progress of work because of the removal of tools, equipment and key men that he returned back to the Hydraulics Division at the end of January, 1976.

The high water during December 1975 again washed away the trestle bridge and the bridge over the tailrace.

Early in 1976 because of the high water in the Potaro River the trestle bridge could not be built and work was therefore concentrated on stockpiling of lumber and the building of a bridge over the tailrace. Blasting for boulders were also held up because the compressor hoses were not returned until the latter half of April, 1976.

Low water in the Potaro permitted work in reconstruction of the 12' wide trestle bridge on 19th September, 1976, 251 feet to the major gap was completed by mid October and by mid December when the project was closed for the holidays 900 tons of boulders were dumped to replace those washed away in the major gap.

#### Supervision

After Cde. C. Brotherson left the Tumatumari Project at the end of January, 1976, no person represented the Hydropower Division on site until 26th October, 1976 when Cde. G. Narain, technician arrived at Tumatumari. The Construction Foreman, Cde. D. Lashley arrived on site on 12th November, 1976.

Construction Cost      See Figures 2.1.1 and 2.1.2

Expenditures were as follows:

1972	\$77,061	
1973	70,000	
1974	58,583	
1975	58,892	
1976	30,000	
	<u>\$295,236</u>	Say \$295,000

To this cost must be added labour supplied by the army. This hidden cost is estimated to be \$295,000 to the end of 1976 making a total cost of G \$590,000. In 1959 Sir William Halerow and Partners Consulting Engineers of London had estimated £65,000 for closing the gaps with boulders. Adding 15% inflation from 1959 - 1976 we arrive at a cost of \$845,000 G which is greater than the estimated cost of \$650,000 if the project is completed in 1977.

General Remarks

According to the Guyana Electricity Corporation report, Supply of Electricity to Konawaruk and Mahdia dated 30th September, 1976, the projected loads for the Tumatumari-Konawaruk-Mahdia triangle are as follows:

Tumatumari	200 KW
Konawaruk	750 KW
Mahdia	<u>200 KW</u>
Total anticipated load	<u>1150 KW</u>

The rated capacity of the Tumatumari Hydro Station is 1500 KW and the estimated output is 1300 KW which can be used to supply the triangle Guyana Electricity Corporation recommended there the diesel station at Tumatumari should be renovated to use as standby power when one of the turbines is taken out for repairs or servicing.

Guyana Electricity Corporation has estimated the cost of maintaining the 3 diesel sets each of 250 KW to be \$130,000/year for a period of 17% of a year i.e. for about nine weeks. Thus if one diesel plant of 250 KW was used to supply Tumatumari with power it would cost about \$255,000/year to maintain. This is far more than the annual expenditure on construction. After the consolidation of the gap it is recommended that \$40,000 per year be set aside for maintaining the dam with labour supplied from the National Service because the concrete structures are at the end of their economic life 20 years and are cracking up especially the grouted concrete spillweir.

Large floods will also move some of the boulders which will have to be replaced during the dry periods.

The Chief Hydropower Engineer has repeatedly pointed out that equipment in the form of a mobile crane and front end loader for lifting large boulders are urgently needed during the low flow periods to push the progress of work. (See report to Permanent Secretary, Ministry of Energy & Natural Resources dated 26th April, 1976). To date, no such equipment were used on the project. It was also pointed out that blasting should also be carried out continually to build up a stockpile of boulders for use during the dry weather.

Priority should be given to this project during the dry period to consolidate the portions of the dam constructed over the gap with 1 cu.yd. boulders with a slope of 1.7 because if it is left as it now exists it will certainly fail.

#### UPPER MAZARUNI PROJECT

#### 2.3 Geophysical Survey of the tunnel line and power house area by Energoprojekt.

A team of Energoprojekt geophysical engineers consisting of

Jovan Prvulovic  
 Nilorad Todorovic  
 Vladimir Justinic  
 Jovan Cicmil

along with Senior Surveyor J. O. Yhap and Surveyor Maraj left for Kurupung during the latter part of October, 1975 to do the geophysical field work on the tailrace tunnel line, and Sand Landing Dam areas.

The head of the team Jovan Prvulovic returned to Belgrade in early December 1974 because of illness. He was replaced by Nikola Grujic in late January, 1975.

Field work was called off in mid December 1974 for the Christmas holidays and restarted in late January, 1975.

The field work was completed in early March 1975 and the Energoprojekt engineers left for Belgrade in the latter part of March 1975.

Progress on the field work was retarded mainly due to the fact that there was no field engineer available to assign to the site because Mr. H. Rahim, Specialist Engineer resigned in October 1974 and to Guyana Airways Corporation aircraft limitations at Kurupung where only small aircrafts of the twin otter type can land.

Details of the Geophysical Investigations can be found in the Energoprojekt Report on geophysical investigations carried out in the areas of Kurupung Hydropower plant and Sand Landing Dam which was completed in July, 1975.



With the submission of the geophysical report by Energoprojekt work on the Upper Mazaruni Project supervised by Hydropower Division was concluded and the Upper Mazaruni Development Authority took over supervision of the project with the new consultants Sweco.

COST OF GEOPHYSICAL REPORT

The Energoprojekt consultants of Belgrade, Yugoslavia were paid \$58,144 U.S. for their report on Geophysical Investigations of the Upper Mazaruni Project in the Hydropower Plant and Sand Landing Dam area. The local cost of geophysical surveys was \$319 thousand dollars G making a total of \$450 thousand dollars G. (\$1 U.S. = \$2.26 G).

COST OF INVESTIGATIONAL WORK ON THE UPPER  
MAZARUNI PROJECT WHICH WAS SUPERVISED  
BY HYDROPOWER DIVISION See Fig. 2.3.1

The cost of works were as follows:

	<u>Foreign Consultants</u> <u>Energoprojekt</u> Th. \$ U.S.	<u>Local Cost</u> Th. \$ G.
1972	Free	259.1
1973	56.5	544.8
1974	44.5	439.3
1975	207.6	319.0
	<u>\$308.6</u>	\$1,562.2
Rate of exchange \$1 U.S. = \$2.26		
	\$308.6 U.S.	697.4
Sum total expenditure		<u>\$2,259.6</u>

### The Essequibo Deep Harbour Survey

The objective of the Essequibo Deep Harbour Survey was to gather preliminary data of:-

- a. Windepeed and Direction
- b. Current readings
- c. Borehole logging in bedrock
- d. Seismic sub-bottom profiling
- e. Side scan sonar survey
- f. Bathymetric survey
- g. Water quality and suspended sediment profiling
- h. Bottom sediment sampling

In a prefeasibility study on the problems involved in developing and maintaining a deep water terminal within the extent of the survey area i.e. from Swart Hoek Pointe to the 50 foot (15 metre) contour across the Continental Shelf as shown on figure 2.4.1.

The American Consultants E. G. & G. International Inc. (Messrs. Edgerton, Germeshausen and Grier were the founders of this Company) were chosen by the United States Agency for International Development after the Guyana selection committee consisting of Messrs. Phillip Allison, Technical Specialist, Lawrence Charles, Chief Hydraulics Officer and Edwin Lee, Chief Hydronpower Engineer (ag) had recommended them from a field of four other consulting companies viz:

- I. Decca Survey (Latin America) Inc.
- II. Republic Engineering Consultants  
Ocean Science and Engineering Inc.  
Parsons Brinckerhoff Quade and Douglas Inc.
- III. Stanley Consultants Inc.
- IV. Tetra Technical Inc.

The consultants started the work in July, 1974 and completed their work in June, 1976. The final report which is available from the Chief Surveyor (Ministry of Works) was issued in 3 volumes in August, 1976.

The Chief Hydronpower Engineer, Mr. S.I. Ramsahoye administered this project on behalf of the Government of Guyana until his resignation at the end of July, 1975 when Mr. Paul Kranenburg (Chief Surveyor, Ministry of Works) succeeded him.

The E. G. & G. project manager was Mr. Rollin E. Phipps (Senior Geologist). Field operations and equipment operation, maintenance and repair were performed by Guyanese technical trainees under the direction of E. G. & G. technical advisers so that Guyanese personnel can continue the data collection after the consultants left the country.

Cost of Study      See Fig. 2.1.2.

The approximate cost of the study borne by U.S.A.I.D. loan agreement No. 504-L-009 is about \$890,000 U.S. and the local cost from Government of Guyana funds is estimated as \$600,000 G. up to the end of 1976.

### General Remarks

Continuation of data collection has been recommended by the consultants and Government should provide funds to continue this data collection so that a proper feasibility study could be carried out in the near future otherwise we may find that we have to go through another process of data collection before a proper feasibility study could be undertaken.

#### 2.5 The UN/Guyana Hydropower Inventory Study 1975

The UN/Guyana Hydropower Inventory Study which was started in July 1974 was completed in draft form in December 1975. The final report was completed in April 1975 by the Consultants Montreal Engineering Limited of Canada.

The scope of the study was as follows:

- 1) To provide an electric power market survey and forecast to the year 1995.
- 2) To provide a physical inventory of all hydro sites with a capacity of at least 20 MW at 30% annual capacity factor (6 average MW of energy).
- 3) To provide an inventory showing economic priority for development for all sites of more than 50 MW at 30% annual capacity factor (15 average MW of energy), that can provide power at a lower cost than that from new thermal plants.
- 4) To obtain additional field information and prepare more accurate cost estimates for about ten "most promising" sites from the inventory described in (3) above.
- 5) To carry out pre-feasibility studies for three sites, one to meet each of the following possible initial loads as established by the electric power market forecast:
  - (i) the basic load, i.e. normal domestic, commercial and small industrial loads;
  - (ii) basic load plus the load requirement of a 60,000 ton per year aluminum smelter.

## 5) Cont'd

- (iii) basic load plus the load requirement of a 200,000 ton per year aluminum smelter.

And, in addition, to re-estimate the cost of the Upper Mazaruni Diversion Scheme as reported on by the Yugoslav engineering and consulting company Energoprojekt, on the same basis as the three pre-feasibility studies.

- 6) To assist the Government in extending its hydrological network to improve streamflow data for those sites that are identified as most promising for future development of water resources.
- 7) To conduct a programme of training of national technical staff through the provision of a limited number of fellowships in the fields of hydrology and engineering economics, as well as in-service training of personnel in the professional and sub-professional categories.

The Chief Hydropower Engineer, Mr. S.I. Rameehoye administered the project on behalf of the government until his resignation at the end of July 1975 when Mr. E.L. Lee succeeded him. Supervision of the Bank was provided initially by Mr. H. Wieseaman and later by Mr. R.A. Moacota.

The Project Director was Mr. Murdo Murchison of Montreal Engineering Company Limited, the consultants carrying out the study. The U.N.D.P. representative in Georgetown was initially Mr. T. Niwa, then Mr. D.A. Simon and then Mr. J. Schutzenberger.

The organisation chart is as shown in Figure No.

The Managing Engineer was Mr. K.G. Brittain of Montreal Engineering and the Co-project Manager was Mr. E.L. Lee of the Hydropower Division.

The project was hampered by shortages of engineers and experienced technicians and draughtsmen. Most of the technicians and draughtsmen had to be trained in hydropower work which they were doing for the first time.

Cost of Study see Fig. 2.5.1.

The cost of the study was borne jointly by the United Nations Development Programme grant and by funds supplied by the Guyana Government.

The cost borne by the Guyana Government for labour, camping equipment (supervision not included) subsistence, ration allowance, fuel, aircraft transportation.

	Th. \$G.
1974	169.1
1975	647.4
Local Cost Total	816.5

borne by Guyana Government.

A breakdown of the cost borne by U.N.D.P. grant was as indicated hereunder:

	Canadian \$
Services in Guyana attach No. 1	435,749
Canada No. 2	111,106
International travel " No. 3	43,220
Other reimbursable costs attach No. 4	187,747
Total	\$777,822

(\$2.26 G = \$1 Can. ) or \$175,787 G

Local Cost borne by U.N.D.P. see attach. No. 5 = \$129,070 G

	Th. \$ G.
Total Cost borne by Guyana Government	816.5
" U.N.D.P.	1887.0
Sum total cost	2703.5

REPUBLIC OF GUYANA  
HYDROELECTRIC POWER STUDY  
ESTIMATED FOREIGN CURRENCY EXPENDITURES

Attachment No. 1.

Services in Guyana  
(In Canadian Dollars)

<u>Name</u>	<u>Position</u>	<u>Agreed Fixed</u> <u>Rate/Month</u>	<u>Estimate of</u> <u>July 31, 1975</u>		<u>Estimate of</u> <u>October 21, 1975</u>		<u>Increase</u>	<u>Decrease</u>
			<u>Man-Months</u>	<u>Cost</u>	<u>Man-Months</u>	<u>Cost</u>		
M. Murchison	Study Director	6975	1.8	12,555	2.3	16,043	3,488	
K.G. Brittain	Managing Engineer	6170	14.6	89,977	15.6	96,252	6,275	
J.R. Breckon	Chief Design Engineer	5715	12.6	72,242	13.0	74,295	2,053	
P.D. Plunkett	Chief Field Engineer	5705	13.8	78,727	13.9	79,300	573	
I. Blown/Mylrae/ Rollins	Chief Geologist	4555	9.7	44,023	9.7	44,023		
F. Meth/R. Stewart	Ecologist	3930	0.8	3,275	0.8	3,275		
J. Badzioch	Transmission System Engineer	5795	0.4	2,125	0.4	2,125		
S.F. Jenkinson	Market Analyst	4090	1.3	5,180	1.3	5,180		
R.K. Bucklend	Economic Analyst	4525	0.5	2,418	0.5	2,418		
J.A. Randle	Senior Hydrologist	6460	1.0	6,675	0.9	6,008		667
W. Stichling	Sedimentologist	5000	0.7	3,333	0.7	3,333		
E.P. Collier	Hydrometrist	5000	0.5	2,166	0.5	2,166		
R.A. Shery	Layout Design Engin.	4545	1.5	6,817	1.8	8,180	1,363	
C. Szoo	Layout and Cost Design Engineer	4905	1.5	7,357	0.8	3,924		3,433
Sr. Consultants	Specialists	5950	1.0	5,950	1.0	5,950		
I. Bachtik	Field Engineer	3464	6.9	23,909	6.9	23,909		
L.E. Rydell/ S.E. Sporseen	Sr. Design Engineer	6260	6.0	37,560	9.0	55,340	17,780	
L. Simpson	Sr. Draftswoman	2685			1.5	4,028	4,028	
	<b>TOTAL</b>		<b>74.6</b>	<b>404,289</b>	<b>80.6</b>	<b>435,749</b>	<b>35,560</b>	<b>4,100</b>
						<b>404,289</b>	<b>4,100</b>	
						<b>31,460</b>	<b>31,460</b>	

REPUBLIC OF GUYANA  
HYDROELECTRIC POWER SURVEY  
ESTIMATED FOREIGN CURRENCY EXPENDITURES

Attachment No. 2

Services in Canada  
(In Canadian Dollars)

Name	Position	Agreed Fixed Hourly Rate	Estimate of May 1975		October 21, 1975		Increase	Decrease
			Manhours	Cost	Manhours	Cost		
M. Murchison	Study Director	39.35	499	19,632	648	25,499	5,867	
K.G. Brittain	Managing Engineer	34.80	415	14,440	600	20,880	6,440	
S.F. Jenkinson	Market Analyst	23.10	356	8,220	423	9,771	1,551	
R.K. Buckland	Economic Analyst	25.55	224	5,720	224	5,720		
J.A. Randle	Senior Hydrologist	36.45	233	8,485	233	8,485		
W. Stichling	Sedimentologist	33.35	30	1,000	30	1,000		
E.P. Collier	Hydrometrist	33.35	45	1,500	45	1,500		
L.J. Bakar	Layout Design Engineer	25.65	45	1,155				1,155
C. Szoo	Layout & Cost Design Eng.	27.70	175	4,850	175	4,850		
D. Murray	Hydraulics Design Eng.	18.30	180	3,300				3,300
Sr. Consultants	Specialists	33.65	289	9,715	344	11,576	1,861	
S. Detre	Thermal Power Engineer	30.50	52	1,585	13	397		1,188
A.R. Tunnoch	Purchasing Agent	15.10	103	1,561	117	1,767	206	
R.K. Stewart	Ecologist	22.10	150	3,320	150	3,320		
J. Badzioch	Transmission	33.50	66	2,223	139	4,657	2,434	
A.W. Hannah	Transmission	37.15	20	740				740
J. Rollins	Geologist	25.70	40	1,030	93	2,390	1,360	
R. Shery	Layout Design Engineer	25.65			33	846	246	
G. Roman-Court	Sr. Cost Engineer	27.60			105	2,898	2,898	
	Sr. Draftsmen	16.00			150	2,400	2,400	
	Typists	9.00			350	3,150	3,150	
			2,922	88,476	3,372	111,106	29,013	6,383
						88,476	6,383	
						22,630	22,630	



REPUBLIC OF GUYANA  
HYDROELECTRIC POWER SURVEY

Attachment No. 3

International Travel  
(In Canadian Dollars)

	Estimate of	
	<u>May 1975</u>	<u>21 October, 1975</u>
<b>A. <u>Round trip economy class air fares</u></b>		
i) Montreal-Georgetown	20 x 500 = 10,000	23-1/2 x 600 = 14,100
ii) Montreal-Washington	4 x 125 = 500	2 x 150 = 300
iii) Vancouver-Georgetown	8-1/2 x 700 = 5,950	10-1/2 x 700 = 7,350
iv) Vancouver-Montreal-Georgetown	1 x 850 = 850	1 x 850 = 850
v) Ottawa-Georgetown	1 x 700 = 700	2 x 700 = 1,400
	Sub-total	<u>          </u>
	\$18,000	\$24,000
<b>B. <u>Subsistence</u></b>		
i) Washington	10 x 50 = 500	4 x 75 = 300
ii) Montreal	5 x 45 = 225	7 x 60 = 420
	Sub-total	<u>          </u>
	\$ 725	\$ 720
<b>C. <u>Excess baggage to Georgetown and return</u></b>		
25kg/Adult	30-1/2 x 25 x \$2,803 x 2 = 4,275	20 x 25 x \$5 x 2 = 5,000
	Sub-total	<u>          </u>
	\$4,275	\$5,000
<b>D. <u>Household effect shipment</u></b>		
i) 50 kg air freight/adult	3,200	2,200
ii) 1,000 kg sea freight/family	11,300	11,300
	Sub-total	<u>          </u>
	\$14,500	\$13,500
	TOTAL	<u>          </u>
	\$37,500	\$43,220

REPUBLIC OF GUYANA

HYDROELECTRIC POWER STUDY  
ESTIMATED FOREIGN CURRENCY EXPENDITURE

Attachment No. 4

Other Reimbursable Costs

(In Canadian Dollars)

	<u>Estimate of May 1975</u>		<u>Estimate of October 21, 1975</u>	
<b>A. <u>Equipment</u></b>				
i) Hydrometric Stations	11,500		11,505	
ii) Sediment Sampling	4,500		4,052	
iii) Class B. Meteorological Stations	7,400		7,289	
iv) Recording Rain Gauges				
v) Drilling Rig	25,000		15,132	
vi) Resistivity	4,822		1,200	
vii) Seismic			3,665	
viii) Vehicles	18,222	71,444	19,404 <sup>(1)</sup>	62,247 <sup>(1)</sup>
<b>B. <u>Mapping</u></b>				
i) Additional 1: 50,000	2,000			
ii) Pre-feasibility - 3 sites	4,400		6,300	
iii) Datum establishment	2,000		2,500	
iv) Mapping most promising sites	10,000		11,600	
v) 25' contour location	4,200		--	
vi) River profiling	15,000		13,400	
vii) Photo purchase		39,600	2,200	36,000
<b>C. <u>Aircraft</u></b>				
i) Helicopter	2,000			
ii) Fixed Wing (Excludes Counterpart Contribution US \$21,000)	104,000	104,000	71,000	71,000
<b>D. <u>Miscellaneous</u></b>				
i) Telephone, telex, cable	3,000		3,000	
ii) Printing	7,000		12,000	
iii) Supplies & Equipment	3,500	13,500	3,500	18,500
<b>TOTAL</b>		<b>228,544</b>		<b>187,747</b>

(1) Assumes tax rebate of Can \$2,256 will be made by Government.

REPUBLIC OF GUYANA  
HYDROELECTRIC POWER STUDY  
ESTIMATED LOCAL CURRENCY EXPENDITURES  
(In Guyanese Dollars)

Attachment No. 5

		Estimate of	
		<u>May 1975</u>	<u>21 October, 1975</u>
A.	<u>Subsistence allowances for staff in Guyana</u>		
	i) During first 60 days of assignment 660 days at Guy \$55.00 per day	36,300	
	During first 60 days of assignment 726 days at Guy \$55.00 per day		39,930
	ii) During balance of stay 1,419 days at Guy \$45.00 per day	63,855	
	During balance of stay 1,692 days at Guy. \$45.00 per day	100,155	116,070
B.	<u>Telephone, telex, cables, etc.</u>	5,000	3,000
C.	<u>Printing</u>	7,000	10,000
	TOTAL	Guy \$112,155	Guy \$129,070

Total of 2,418 man-days equivalent to 80.6 man-months.

GENERAL REMARKS

The Hydropower Inventory Study of Guyana has enabled us to evaluate the best hydropower sites for a particular load demand of 6 MW or greater.

The Amaila Project in the Potaro valley was found to be the most economical hydropower site for the basic load. Kaiteur was found to be the best site for the basic load plus 60,000 TPY smelter plus kilns.

The Upper Mazaruni Project (1st stage) was found to be the best for the basic load plus the 200,000 TPY smelter plus kilns.

The total hydropower capacity of Guyana based on 60% annual capacity and a 3 year hydrological cycle is as shown:

River Basin or Region	Sites 6 av MW or greater regardless of cost	Site 15 av MW greater at costs less than US\$ 1500/kw
N. W. Coastal	11	
Cuyuni	726	671
Mazaruni	3762	3641
Potaro	1128	1106
N.E. Coastal	35	0
New River	298	178
Essequibo	1636	1610
TOTAL	7596	7206
Say	7600	7200

Progress in the field during the early stage of this study was hampered by the consultants' lack of experience of local conditions in organising field trips especially where Government regulations had to be followed causing delays, and lack of aircraft support by Guyana Airways Corporation. This problem was solved to some extent by long term planning of field trips. Fieldwork was also hampered in mid 1975 by a migration of field workers to the Upper Mazaruni Road Project where they were paid an allowance. This problem was solved by paying the Un/Guyana Hydropower Inventory workers the same allowance offered by the Road Project.

Progress on office work in the early part of the study was not only hampered by shortage of Guyanese engineers, lack of experience of the local technicians and draughtsmen but also to the fact that the consultants attempted to evaluate the Guyana Inventory cost indices in applying some out of date and non relevant costing procedures used on the Inventory Study of Brazil. The costing procedures were revised in the early part of 1975.

Despite delays the study was completed in a reasonable period in Guyana. Fieldwork was only two months late whereas office work was about 2½ months late.

#### Topographical Surveys of the Chi Chi Diversion Scheme (1976)

The aim of the surveys was to bring the Chi Chi Hydropower diversion scheme up to a pre-feasibility level, by doing traverse with levels from the dam site along the Orokang valley to the intake of the proposed tunnel. Then from the intake along the proposed tunnel line to the power house and thence to the outlet of the tailrace and also running levels along 3 saddles of the reservoir rim.

It was also planned to do geological investigations and drilling on

- (i) dam axis
- (ii) intake of power tunnel
- (iii) power house
- (iv) tailrace tunnel

However, early in the year the allocation was cut by half from \$400,000 to \$200,000 thus ruling out geological investigations and drillings.

The object of the surveys was to provide more up to date information concerning the reservoir capacity of the Chi Chi reservoir which will be required for regulation studies of the Upper Mazeruni Project if the dam is to be kept as low as possible and to compare Chi Chi Diversion Scheme with Keieteur Hydroelectric Scheme.

The surveys which were being carried out by the survey Division of the Ministry of Works and Housing were not completed because of lack of funds. All survey works were stopped at the end of September 1976. Only about 40% of the planned works were completed along the Orokang valley.

The main difficulties experienced were:-

1. Lack of air support
11. The inclement weather during the first half of the year.
111. Many survey crew members left the survey party because of dissatisfaction over non payment of U.M.R.P. allowance. In fact they were working under more severe conditions then workers on the Upper Mazaruni Project where helicopters were available.

The surveys were done by one surveyor A.N. Fagu and a technician M. Cadogan. They were supervised by the Senior Surveyor Latchman Singh. Survey reports and plans are available from the Survey Division.

#### Finances

Only about 50% of the survey works were completed at a cost of \$162,9 th \$G. The remaining topographical works will coat about \$150,000 to complete.

#### General Remarks

The topographical surveys so far completed has verified that there is a good hydroelectric diversion scheme at Chi Chi but further topographical geological end drilling works has to be completed before we can determine the feasibility of this site in comparison with Kaieteur

ORGANISATIONAL CHARTS AT THE 31ST DECEMBER, 1975  
AND 31ST DECEMBER, 1976

3.1 Staff

Organisational Charts are es shown in Fig. 3.1.1 and 3.1.2 for the years 1975 and 1976 respectively.

3.2 Vacancies at 1st January, 1975

- 1 Hydrologist
- 1 Engineer Power Economist
- 1 Specialist Engineer - Mechanical/Electrical
- 1 Specialist Engineer - Designs
- 1 Specialist Engineer - Construction
- 1 Assistant Engineer - Geologist
- 1 Senior Engineer - Mechanical
- 1 Senior Engineer - Electrical
- 2 Senior Engineers - Dams
- 2 Senior Engineers - Structures
- 1 Senior Engineer - Hydraulics
- 2 Grade 1 Techniciens
- 1 Senior Technician
- 1 Mechanical Engineer
- 1 Chief Draughtsman
- 5 Civil Engineers
- 1 Grade 1 - Clerk
- 1 Ledger - Clerk
- 1 Records Clerk
- 2 Senior Assistant Draughtsmen

3.2 Vacancies at 1st January, 1976

- 1 Chief Hydropower Engineer
- 1 Specialist Engineer, Hydrologist
- 1 Specialist Engineer Power Economist
- 1 Specialist Engineer Geology
- 1 Specialist Engineer Civil
- 1 Specialist Engineer Mechanical/Electrical
- 1 Senior Mechanical Engineer
- 1 Senior Electrical Engineer
- 5 Senior Engineer Civil
- 1 Mechanical Engineer

3.2 Vacancies at 1st January, 1976 (Cont'd)

1 Electrical Engineer  
 5 Engineers Civil  
 1 Chief Draughtsman  
 2 Senior Assistant Draughtsmen  
 1 Assistant Draughtsman  
 2 Senior Technicians 11  
 2 Technicians 1  
 1 Senior Clerk  
 1 Confidential Secretary  
 1 Accounts Clerk 1  
 1 Typist/Clerk 11 (Records)  
 1 Driver Mechanic 111

3.3 Vacancies filled during 1975

1 Trainee Draughtsman with effect from 25.4.75  
 1 Technician with effect from 26.4.75

3.3 Vacancies filled during 1976

1 Specialist Engineer Civil with effect from 1.8.76  
 1 Specialist Engineer Mechanical/Electrical with effect from 1.9.76  
 1 Senior Clerk with effect from 5.1.76  
 1 Accounts Clerk 1 with effect from 17.8.76  
 2 Senior Technicians with effect from 7.6.76.

3.4 Resignations during 1975

Harry Seepeul - Technician with effect from 31.12.75  
 R. Maraj - Trainee Draughtsman with effect from 31.8.75  
 M. Asgardeen - Electrical Engineer with effect from 26.11.75  
 S.I. Ramsahoye- Chief Hydropower Engineer with effect from 25.7.75

3.4 Resignations during 1976

Dowlet Persaud - Accounts Clerk 11 with effect from 25.4.76  
 Joycelyn Williams- Stenographer 11 with effect from 1.6.76  
 Gowkarran- Labourer 11 with effect from 22.5.76  
 Jagdeo - Apprentice Draughtsman with effect from 31.7.76  
 Abdul Hamid - Asst. Draughtsman with effect from 20.8.76  
 Glen Forde- Vehicle Driver with effect from 4.10.76  
 David Mungra- Draughtsman with effect from 11.11.76  
 Aubrey Persaud- Trainee Draughtsman with effect from 12.11.76  
 Cedric Seeram - Vehicle Driver with effect from 1.12.76



3.4 Resignations during 1976 (Cont'd)

M. Ali - Trainee Draughtsmen with effect from 31.7.76  
Ernest Quallis - Office Manager with effect from 1.2.76.

3.5 Transfers during 1975

Mrs. Pat Whitney - UN/Guyane Hydropower Inventory, Office Manager.  
Mrs. Ramdass - Senior Clerk (ag)  
J. Vandeyar - Secretary with effect from 1.6.75

3.5 Transfers during 1976

Eunice Gherow - Confidential Secretary (ag) with effect from 2.2.76  
Hilton Wilson - Accounts Clerk 11 with effect from 14.1.76  
Desmond Assing - Technician with effect from 20.5.76  
T. Denny - Confidential Secretary with effect from 2.8.76

3.6 Long Leave taken during 1975

Mrs. Pat Whitney - Office Manager

3.6 Long Leave taken during 1976

Edwin L. Lee - Deputy Chief Hydropower Engineer 92 days vacation with effect from 3.8.76  
David Mungra - Draughtsman, 101 days vacation with effect from 3.8.76  
T. Denny (f.e.) - Confidential Secretary, 94 days vacation with effect from 29.4.76.  
Angela Fraser - Accounts Clerk 11- Maternity 11.10.76-31.12.76  
H. Doss - Senior Technician 82½ days vacation with effect from 15.9.76.

3.7 Acting Appointments 1975

E.L. Lee - Deputy Hydropower Engineer acting Chief Hydropower Engineer with effect from 26th July, 1975.

3.7 Acting Appointments 1976

M. Veacock - Assistant Chief Hydropower Engineer acting as Chief Hydropower Engineer vice E.L. Lee on vacation leave with effect from 2.8.76.

### 3.8 General Remarks

Besides doing the duties of the Chief Hydropower Engineer, Cde. E. Lee after consultation with the Technical Specialist was asked to take over the post of Co-project Manager from Cde. J. Holder from 6th November 1975 to represent the Upper Mazaruni Development Authority on Technical aspects of the Upper Mazaruni Project e.g. reviewing and vetting the Report on the Feasibility Study of the Upper Mazaruni Project done by the Swedish consultants Sweco.

Cde. M. Veacock, Assistant Chief Hydropower Engineer was also asked to take up the position of Chief Field Engineer and Cde. R. Tung as Site Engineer with Upper Mazaruni Development Authority. In fact, all the engineers of the Hydropower Division were working for Upper Mazaruni Development Authority for the greater part of 1976.

Cde. M. Veacock, succeeded E. Lee on 3rd August, 1976 when the latter went on his long vacation leave.

#### 4.1 Mechanical Section

The following vehicles were attached to the Division in 1975.

Austin Pick-up GAA 1001

Land Rover PAA 2346 assigned to G.D.F. for Tumatumari Project

Land Rover PAA 3326

Land Rover PAA 3934

Land Rover PAA 5511 returned to U.N.D.P. after the completion of the UN/Guyana Hydropower Inventory Study in December 1975.

Ford Truck GAA 5489 returned to U.N.D.P. after completion of the UN/Guyana Hydropower Inventory Study in December, 1975.

#### 4.1 Mechanical Section

The following vehicles were attached to the Division in 1976.

Austin Pick-up GAA 1001 - over hauled

Land Rover PAA 2346 - Damaged Lay up at G.D.F., Timehri

Land Rover PAA 3326 - Serviceable

Land Rover PAA 3934 - Serviceable

Land Rover PAA 5664 - Serviceable

5 Ton Austin Truck GAA 3937 - under extensive repairs at G.D.F., Tumetumeri.

#### 4.2 General Remarks

The Chief Hydropower Engineer had recommended the purchase of a 4 wheel drive Bedford Truck for use in the interior in the 1976 estimates but permission to purchase the truck was not granted.

Most of the vehicles now working in the Hydropower Division are near the end of their economic life of 5 years and it is recommended that at least one new 4 wheel drive Land Rover should be bought for use on the interior roads where reliable vehicles are needed. A 4-wheel drive Bedford truck is also required to run in the interior to supply hydropower expeditions.

From June-November, 1976 Land Rover FAA 3934 with driver Mangal worked with U.M.D.A. in the interior doing the transmission line survey of the Upper Mazaruni Project. U.M.D.A. provided funds to repair this Land Rover in December 1976, but it was too late to use these funds to do the repairs.

#### 5.1 Stores

In 1975 the Hydropower Division loaned to Upper Mazaruni Development Authority equipment such as tarpaulins, outboard motors, Honda generators to the value of about \$15,000 on the condition that they will be returned in good working order. To date they have not been returned as yet. The estimated value of the stores in 1975 was \$65,000 and in 1976 it was \$75,000.

The staff comprised of a Storekeeper 11, a Stores Clerk 1, a Stores Attendant, a Stores Porter and a Stores Labourer 11.

6.0 Current Expenditure except personnel emoluments and telephones incurred by the Hydropower Division for the years 1975 and 1976 are as indicated below:-

<u>Head and Sub Head of Charge</u>	<u>Allocation Th. \$G</u>	<u>Total Expenditure and Liabilities</u>
30-2 Transport and Travelling	27.1	8.6
30-3 Miscellaneous	1.0	1.0
30-4 Telegrams	0.3	0.1
30-6 Library and Publications	0.5	
30-7 Uniforms	0.2	0.1
30-9 Maintenance of Land and Water Transport	7.0	4.5
30-10 Drawing Instruments Materials & Equipment	4.0	3.9
30-32 Maintenance of Tiboku Base Camp	4.5	1.1
Total	44.6	19.3

<u>Head and Sub Head of Charge</u>	<u>Allocation Th. \$G</u>	<u>Total expenditures and Liabilities Th. \$G</u>
31-2 Transport and Travelling	10.0	3.0
31-3 Miscellaneous	5.0	5.0
31-4 Telegrams	0.2	
31-6 Library and Publications	0.5	0.1
31-7 Uniforms	0.3	0.2
31-9 Maintenance and operation and Land and water transport	17.0	15.8
31-10 Drawing instruments, materials and equipment	4.0	4.0
32 Maintenance of Tiboku	4.5	4.0
34 Maintenance of Guages	28.5	17.5
35 Expenses of Trainees	4.6	0.9
Total	74.6	50.5

7.0 Total Expenditure on Capital Works See Figs 7.1.1 end 7.1.2

The total expenditure on capital works during 1975 for the Upper Mazaruni Project, UN/Guyana Hydropower Inventory Study and Tumatumari Project was G\$1.495 million and 1976 total capital expenditure for Hydropower Surveys-Chi Chi Diversion Scheme and Tumatumari Project was G\$163 thousand.

8.0 Reports

Nineteen reports as listed hereunder were printed by the Hydropower Division in 1975.

Progress Report No. 6 - Essequibo River Project

- E.G. & G.

- 6th January, 1975

Reference to Guyana - UNDP - Hydroelectric Power Survey  
Report on Guyana Hydrometeorological Networks & Data  
Collection

- Montreal Engineering Company Limited

- January, 1975

Guyana Hydroelectric Power Survey Second Quarterly Report

Montreal Engineering Company Limited

- January, 1975

Progress Report No. 7 - Essequibo River Project

E. G. & G.

6th February, 1975

Interim Report on the Preliminary Results of the Hydropower  
Site Inventory -

- Montreal Engineering Company Limited

- February, 1975

Progress Report No. 8 - Essequibo River Project

- E. G. & G.

- 10th March, 1975

Preliminary Report on the Geophysical Investigations of  
Head Race and Tail Race Tunnel Routes end at Sand Landing  
Dam Site

- N. Grujic

- March, 1975

8.0 Reports (Cont'd)

Progress Report on Essequibo Harbour Studies, April 1975

- E. G. & G. International

- 10th May, 1975

Data Report on Essequibo River Project - Volume 1 - Section  
1 & 2; Volume 2 - Sections 3 & 4

Progress Report No. 11 on Essequibo River Project

- E. G. & G. International

- 10th June, 1975

Power Survey - Evaluation of Sedimentation in Selected  
Rivers in Guyana

- Montreal Engineering Company Limited

Guyana Hydropower Survey Appendix 13 - Access Road Costs

- June 1975

Progress Report No. 12 on Essequibo River Project

- E. G. & G. International

- 10th July, 1975

Progress Report No. 13 on Essequibo River Project

- E. G. & G. International

- 11th August, 1975

Progress Report No. 14 on Essequibo River Project

- E. G. & G. International

- 9th September, 1975

Progress Report No. 15 on Essequibo River Project

- E. G. & G. International

- 10th October, 1975

Progress Report No. 16 on Essequibo River Project

- E. G. & G. International

- November, 1975

Progress Report No. 17 on Essequibo River Project

- E. G. & G. International

- 9th December, 1975

E. G. & G. Progress Report No. 9

- E. G. & G. International.

9.0 Community Projects

The Hydropower Division put up a model of the Chidego Reservoir of the Upper Mazaruni Hydroelectric Project in the February, 1975 Guyana Association of Professional Engineers Exhibition at Sophia. The model was given a honorary mention.

10.0 Conclusion

All the Engineers at the Hydropower Division worked for the Upper Mazaruni Development Authority during the greater part of 1976 along with the Sweco Consultants.

# EXPENDITURE FOR CLOSING OF TUMATUMARI DAM — 1975.

EXPENDITURE — DOLLARS x 1000 (G.)

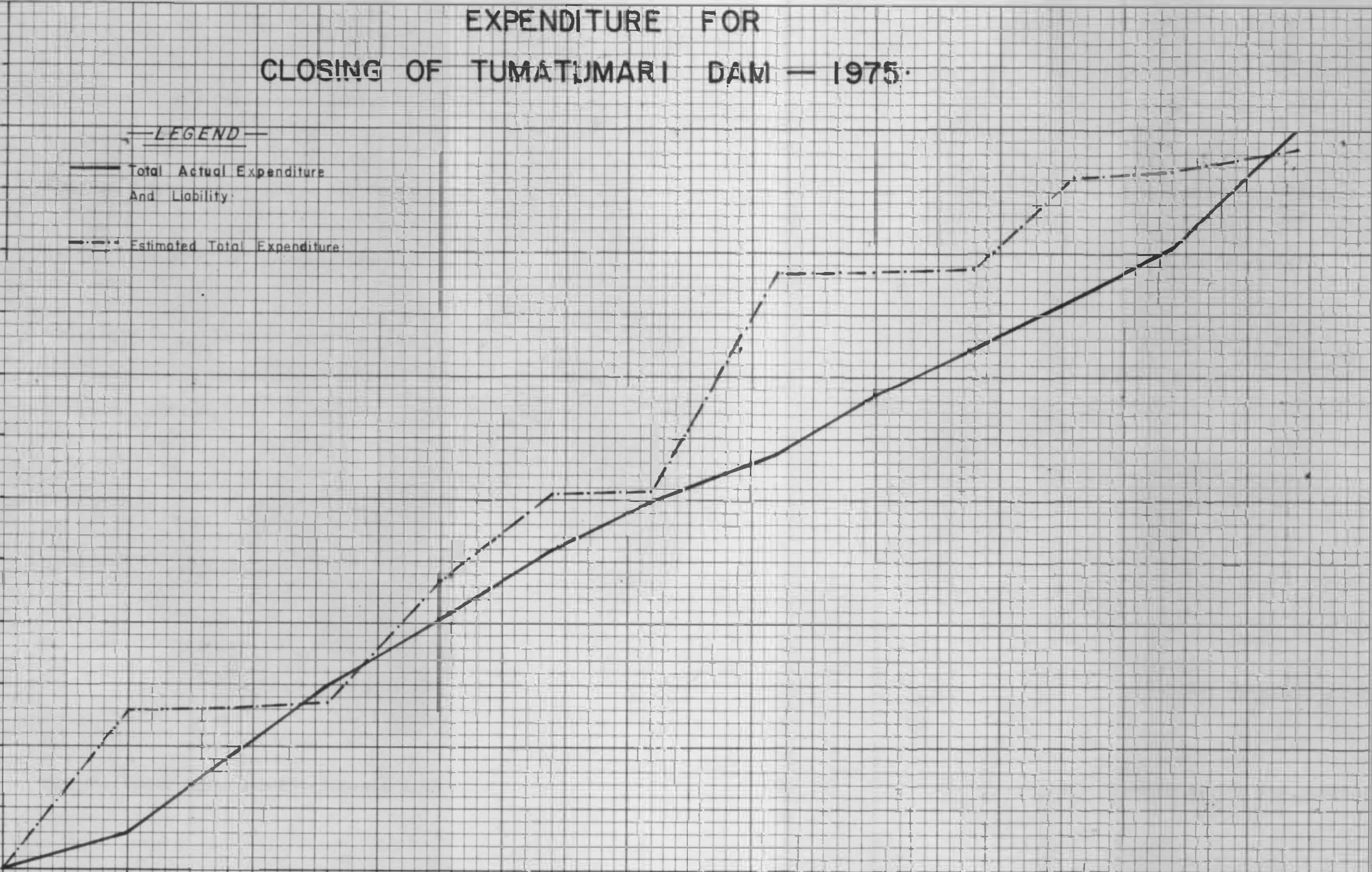
65  
60  
55  
50  
45  
40  
35  
30  
25  
20  
15  
10  
5  
0

— LEGEND —

— Total Actual Expenditure  
And Liability.

- - - - - Estimated Total Expenditure

Month	JANUARY					FEBRUARY					MARCH					APRIL					MAY					JUNE					JULY					AUGUST					SEPTEMBER					OCTOBER					NOVEMBER					DECEMBER				
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52								





# EXPENDITURE FOR TUMATUMARI PROJECT YEAR - 1976

**—LEGEND—**  
 ——— Total Actual Expenditure  
 And Liability  
 - - - - Total Estimated Expenditure

EXPENDITURE — DOLLARS x 1,000 (G)

Month	JANUARY				FEBRUARY				MARCH				APRIL				MAY				JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER							
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52

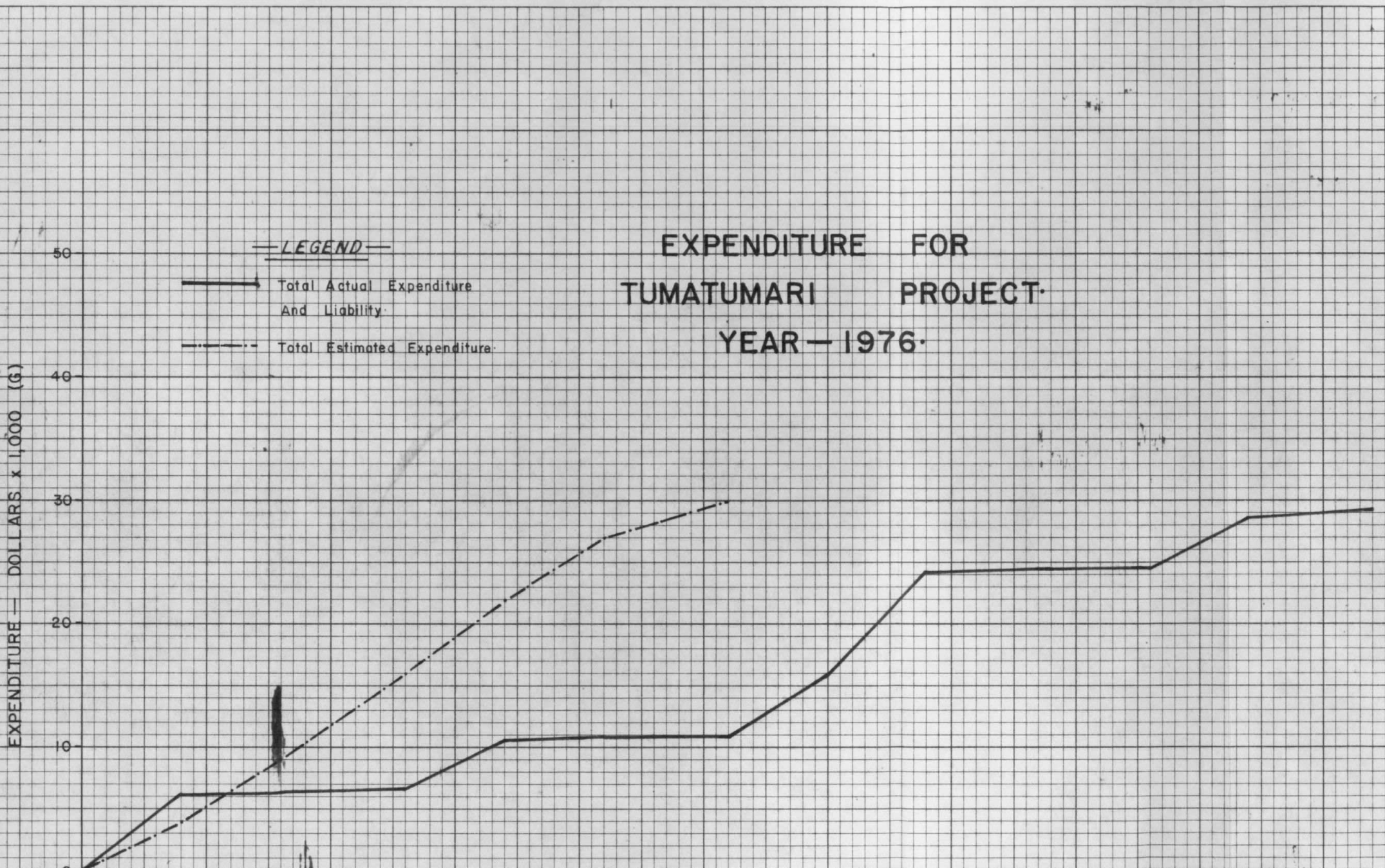
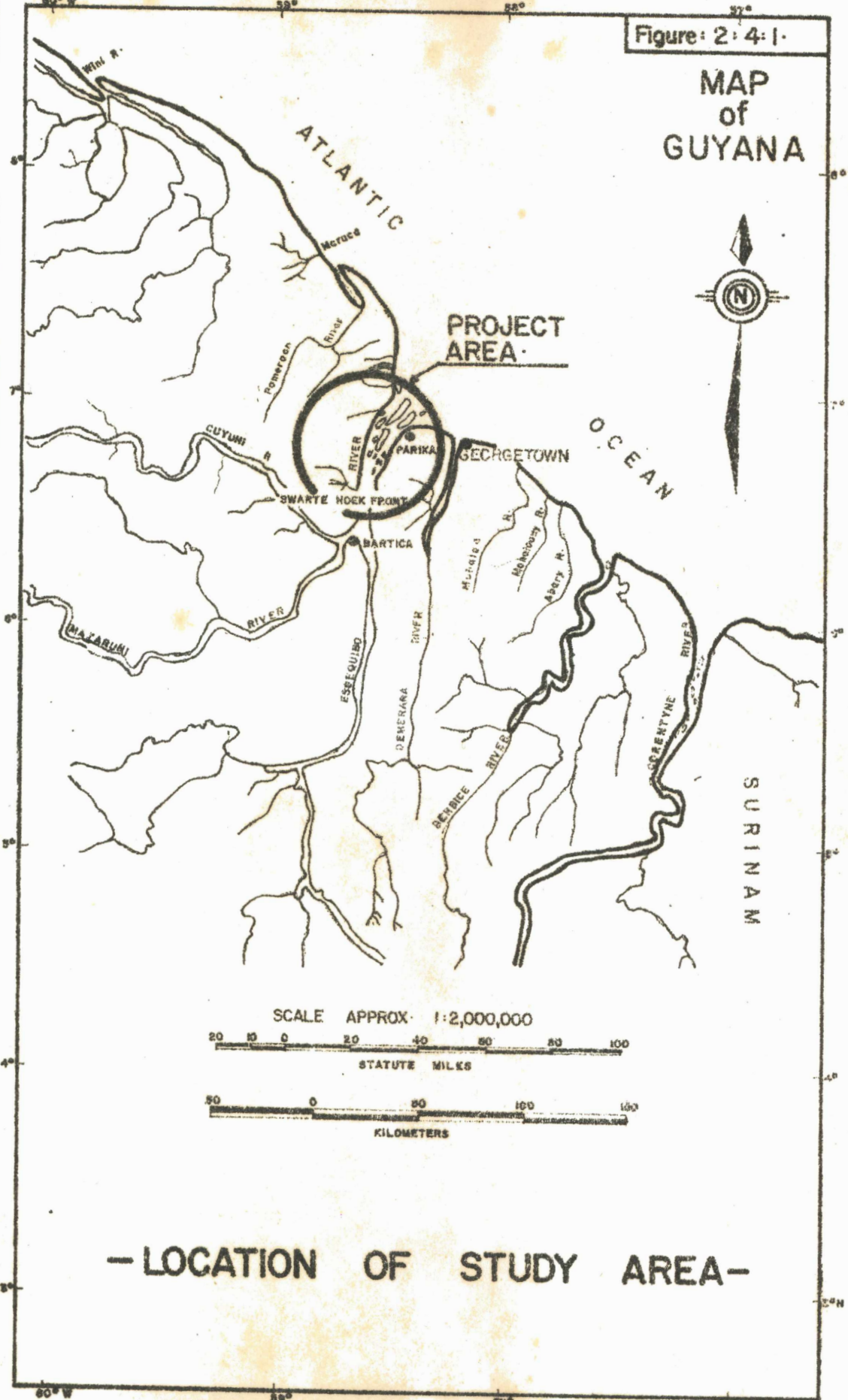


Figure: 2:4:1

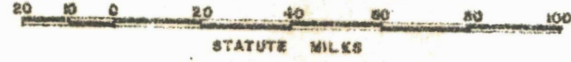
# MAP of GUYANA



**PROJECT AREA**



SCALE APPROX. 1:2,000,000



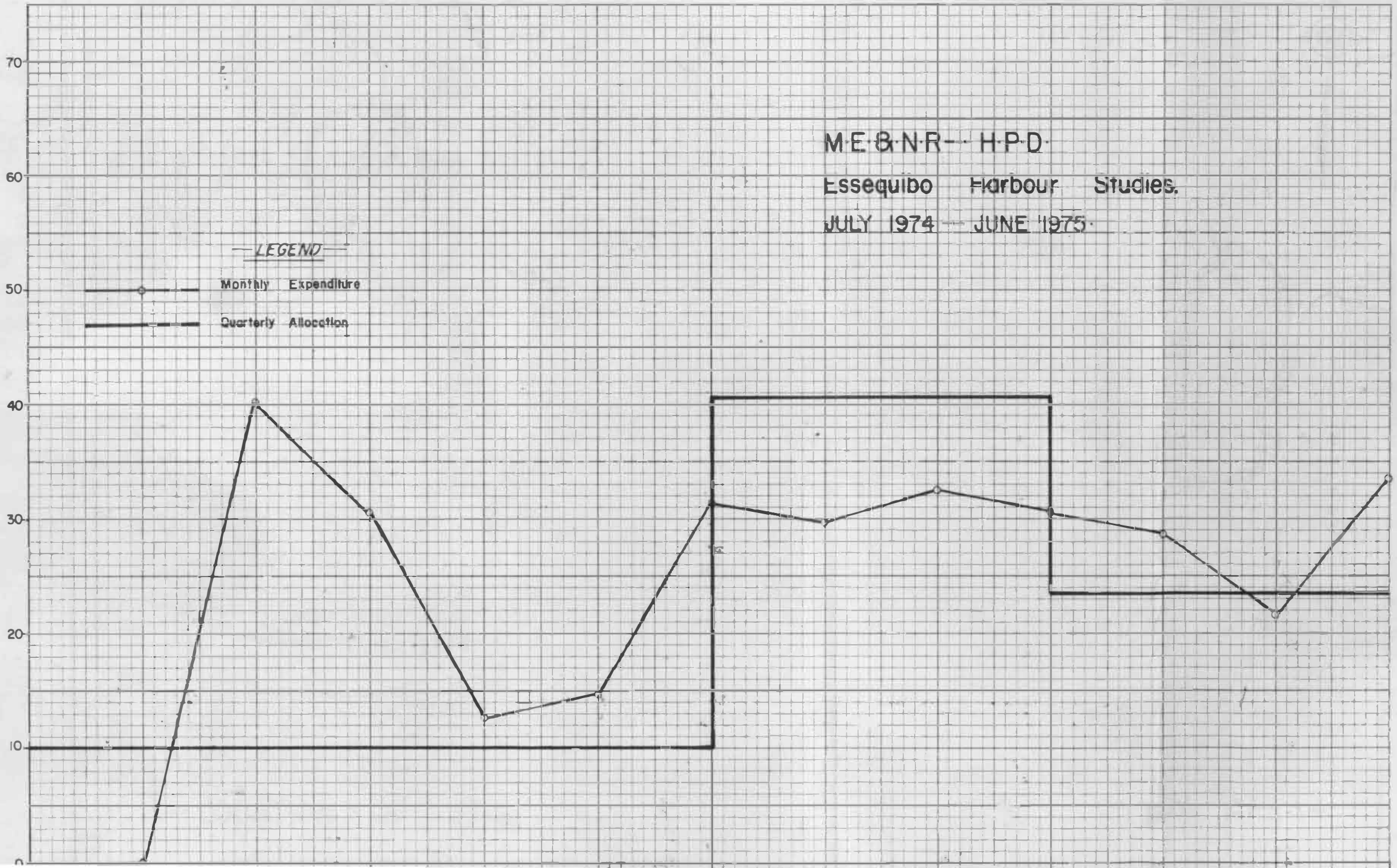
**- LOCATION OF STUDY AREA -**



M.E.B.N.R. - H.P.D.  
Essequibo Harbour Studies,  
JULY 1974 - JUNE 1975.

EXPENDITURE IN DOLLARS — (10<sup>3</sup>)(G)

LEGEND  
Monthly Expenditure  
Quarterly Allocation



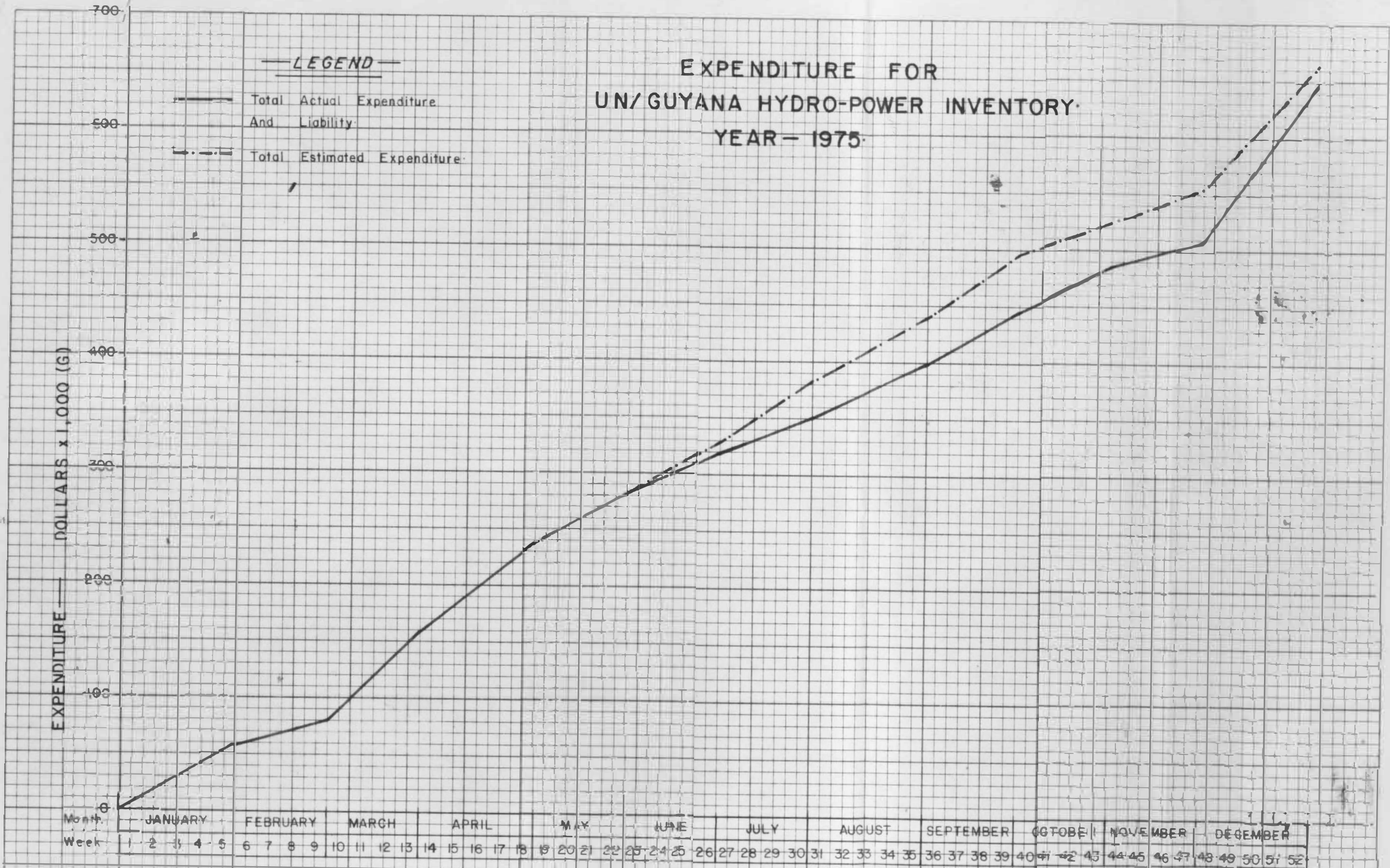
# EXPENDITURE FOR UN/GUYANA HYDRO-POWER INVENTORY YEAR - 1975

LEGEND

- Total Actual Expenditure And Liability
- · - · - Total Estimated Expenditure

EXPENDITURE — DOLLARS x 1,000 (G)

Month	JANUARY					FEBRUARY					MARCH					APRIL					MAY					JUNE					JULY					AUGUST					SEPTEMBER					OCTOBER					NOVEMBER					DECEMBER				
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52								





(CHI-CHI DIVERSION SCHEME)

HYDRO-POWER SURVEYS  
YEAR - 1976.

EXPENDITURE — DOLLARS x 1,000 (G)

— LEGEND —  
 — Total Actual Expenditure  
 - - - Revised Estimated Expenditure

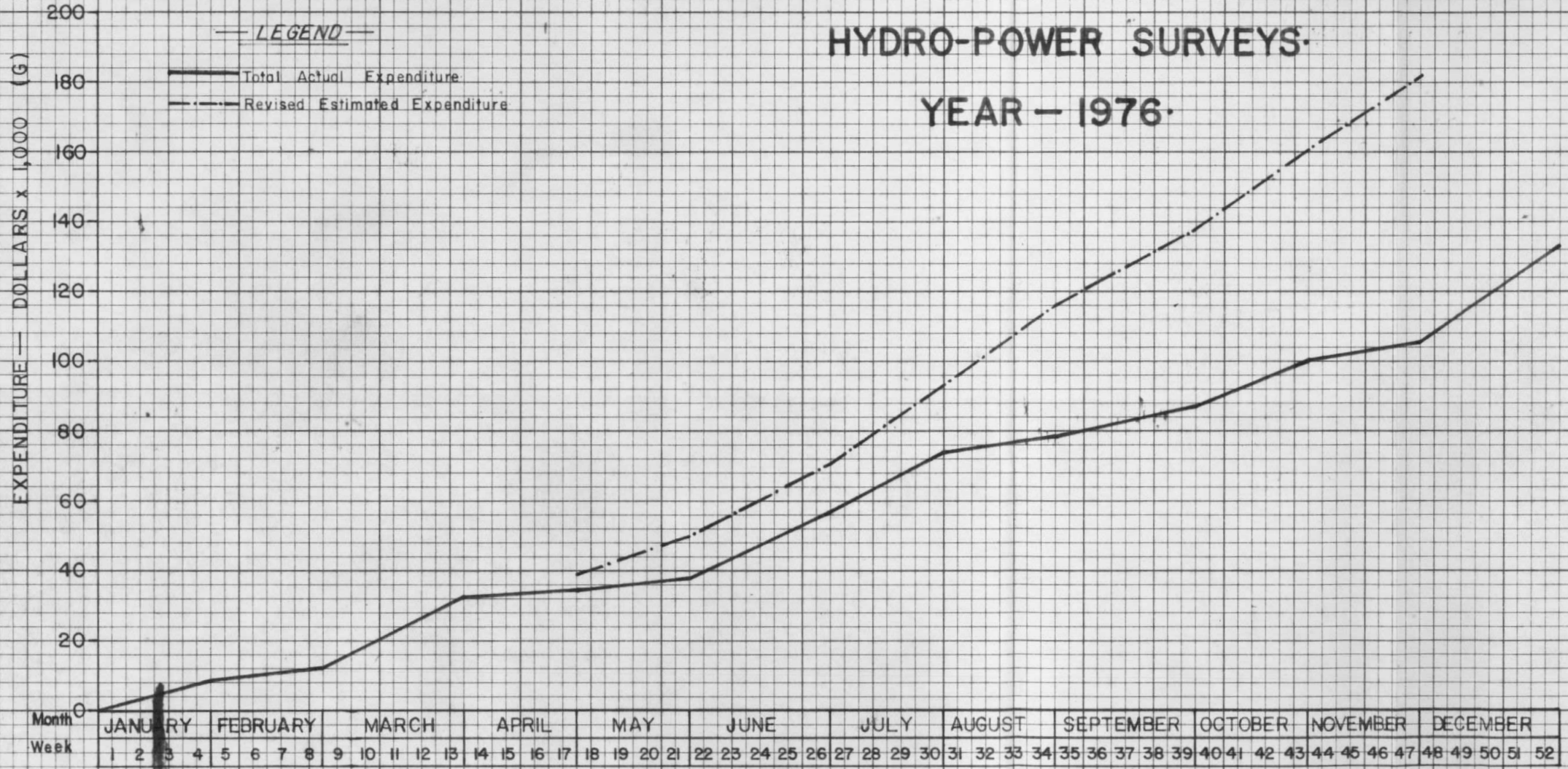
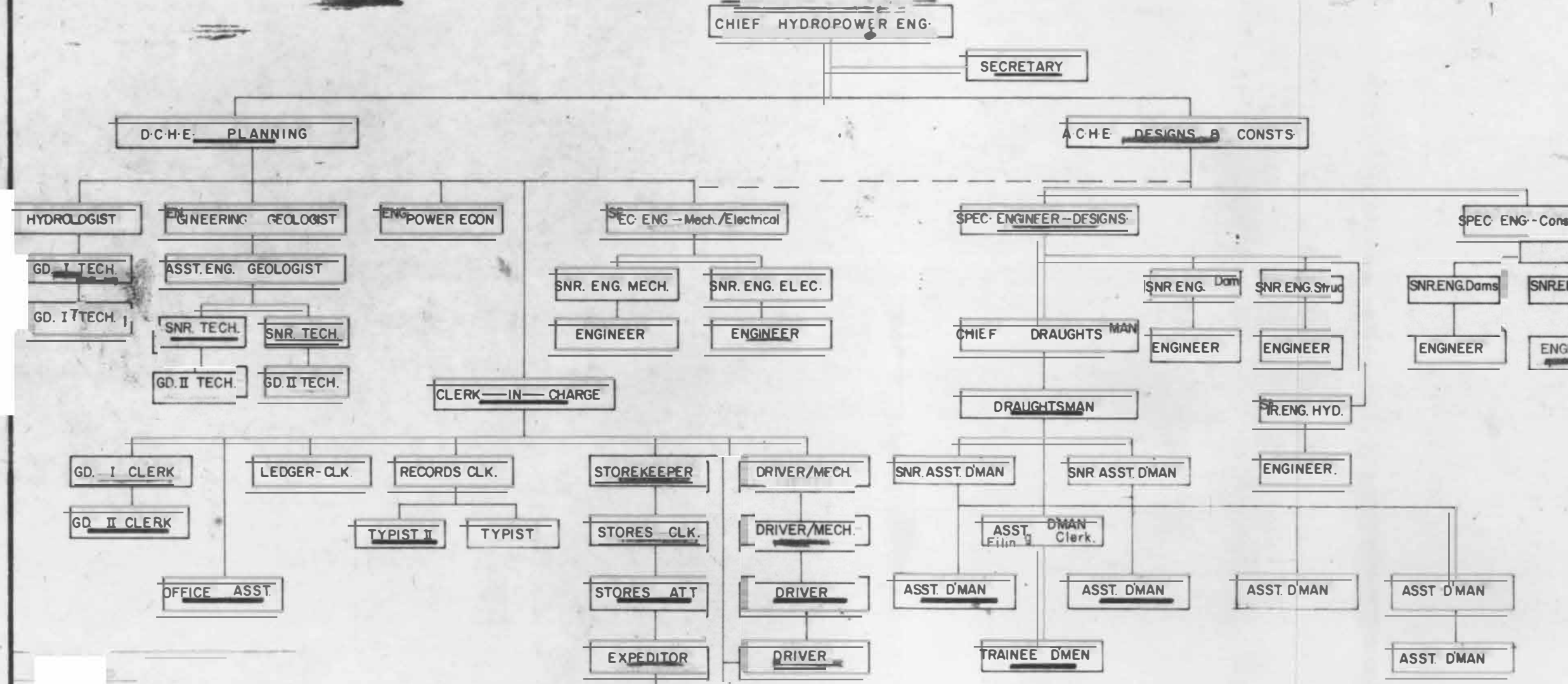


FIG. 2:6:1.

1975

1975

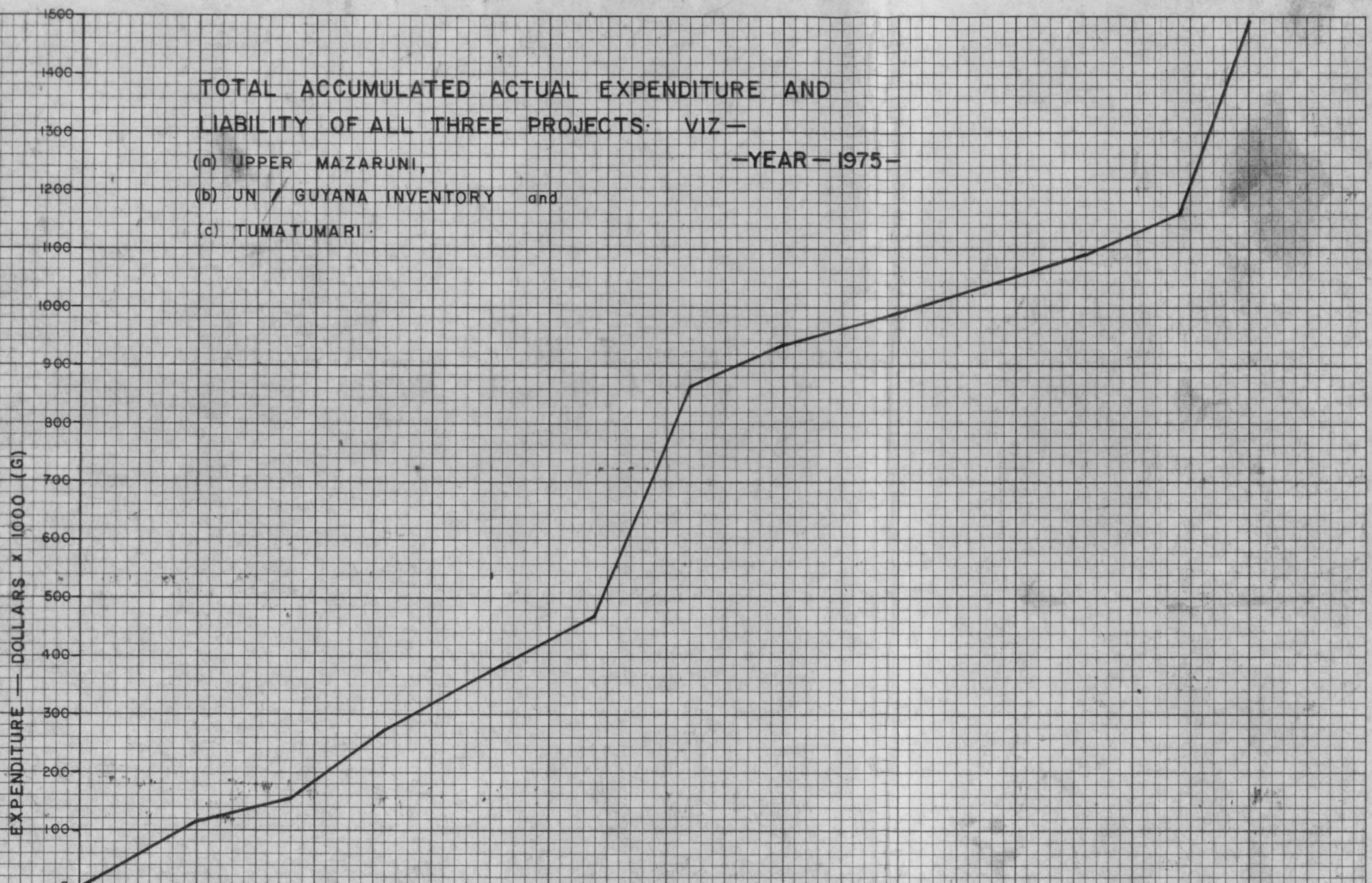
**●●-ORGANISATIONAL CHART-●●**  
**MINISTRY OF ENERGY AND NATURAL RESOURCES**  
**●●HYDROPOWER DIVISION●●**  
**YEAR 1975**







TOTAL ACCUMULATED ACTUAL EXPENDITURE AND  
 LIABILITY OF ALL THREE PROJECTS: VIZ—  
 (a) UPPER MAZARUNI, —YEAR—1975—  
 (b) UN / GUYANA INVENTORY and  
 (c) TUMATUMARI.



Month	JANUARY	FEBRUAR	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Week	1 2 3 4 5	6 7 8 9	10 11 12 13	14 15 16 17 18	19 20 21 22 23	24 25 26 27 28	29 30 31	32 33 34 35	36 37 38 39 40	41 42 43 44 45	46 47 48 49 50	51 52