

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

No. 17

MUNICIPAL WATER SUPPLY PUBLIC CORPORATION(EMPAGUA)  
THE REPUBLIC OF GUATEMALA

THE STUDY  
ON  
THE IMPROVEMENT  
OF  
WASTEWATER MANAGEMENT  
IN  
THE GUATEMALA METROPOLITAN AREA

FINAL REPORT  
VOLUME IV  
SUPPORTING REPORT(II)

AUGUST 1996

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## ABBREVIATIONS

### ABBREVIATIONS OF ORGANIZATION / SIGLAS DE ORGANIZACION

AID	=	Agency for International Development Agencia Internacional para el desarrollo
ANAM	=	National Association of Municipalities Asociacion Nacional de Municipalidades
BANVI	=	National Housing Bank Banco Nacional de Vivienda
BANGUAT	=	Central Bank of Guatemala Banco de Guatemala
BCIE	=	Central American Economic Integration Bank Banco Centroamericano de Integracion Economica
CIDA	=	Canadian International Development Agency Agencia Canadiense de Desarrollo Internacional
CACIF	=	Coordinator Committee of Agricultural, Industrial and Financial Associations Comite Coordinador de Asociaciones Agricolas, Industriales y Financieras
CAPRE	=	Regional Coordinating Committee of Drinking Water and Sanitation of Central America, Panama and Dominican Republic Comite Coordinador Regional de Instituciones de Agua Potable y Saneamiento de Centroamerica, Panama y Republica Dominicana
CIEN	=	National Economic Research Center Centro de Investigaciones Economicas Nacionales
CNPE	=	National Council of Economic Planning Consejo Nacional de Planificacion Economica
CONAMA	=	National Environmental Commission Comision Nacional del Medio Ambiente
CONAP	=	National Council of Protected Area Consejo Nacional de Areas Protegidas
COPECAS	=	Permanent Committee of Coordination of Water and Sanitation Comite Permanente de Coordinacion de Agua y Saneamiento
EDOM	=	Study of Metropolitan Orderliness Estudio de Ordenamiento Metropolitana
DGSS	=	General Bureau of Health Services Direccion General de Servicios de Salud
DST	=	Environmental Sanitation Department Division de Saneamiento del Medio
EMPAGUA	=	Guatemala Municipal Water Supply Corporation Empresa Municipal de Agua de la Ciudad de Guatemala
ERIS	=	Regional School of Sanitary Engineering Escuela Regional de Ingenieria Sanitaria
FAO	=	Food and Agricultural Organization Organizacion de Comidas y Agricultura
GOG	=	Government of Guatemala Gobierno de Guatemala
GOJ	=	Government of Japan Gobierno de Japon
GTZ	=	German Cooperation Agency Sociedad Alemana de Cooperacion
IBRD	=	See "WB" Vease "WB"
IDA	=	International Development Association Asociacion Internacional de Desarrollo
IDB	=	Inter-American Development Bank Banco Interamericano de Desarrollo
IGM	=	Military Geographic Institute Instituto Geografico Militar

IGSS	=	Guatemalan Institute of Social Security Instituto Guatemala de Seguridad Social
INAFOR	=	National Institute of Forestation Instituto Nacional de Forestacion
INDE	=	National Institute of Electrification Instituto Nacional de Electrificacion
INE	=	National Institute of Statistics Instituto Nacional de Estadistica
INFOM	=	National Institute of Municipal Development Instituto Nacional de Fomento Municipal
INSIVUMEH	=	National Institute of Seismology, Vulcanology, Meteorology and Hydrology Instituto Nacional de Sismologia, Vulcanologia, Meteorologia e Hidrologia
INTECAP	=	Technical Institute of Training and Productivity Instituto Tecnico de Capacitacion y Productividad
JICA	=	Japan International Cooperation Agency Agencia de Cooperacion Internacional del Japon
MCTyOP	=	Ministry of Communications, Transportation and Public Works Ministerio de Comunicacion, Transportacion y Obras Publicas
MINFIN	=	Ministry of Public Finance Ministerio de Finanzas Publicas
MSPyAS	=	Ministry of Public Health and Social Assistance Ministerio de Salud Publica y Asistencia Social
MUNI	=	Municipality of Guatemala Municipalidad de Guatemala
OECE	=	Overseas Economic Cooperation Fund of Japan Fondo Japonese de Cooperacion Economica Ultramar
PAHO	=	Panamerican Health Organization Organizacion Panamericana de Salud
PLAMABAG	=	Guatemala City Water Supply Master Plan Plan Maestro de Abastecimiento de Agua a la Ciudad de Guatemala
SEGEPLAN	=	General Secretariat of Economic Planning Secretaria General de Planificacion Economica
SRH	=	Secretariat of Hydraulic Resources Secretaria de Recursos Hidraulicos
UEA	=	Emergency Water Unit Unidad de Emergencia de Agua
UENIA	=	Study Unit of New Water Introduction Unidad de Estudios de Nuevas Introducciones de Agua
UN	=	United Nations Organicacion de Naciones Unidas
UNDP	=	United Nations Development Program Programa de Naciones Unidas para el Desarrollo
UNEHIVAGUA	=	Executant Unit of Hydrological Study of Guatemalan Valley Unidad Ejecutora del Estudio Hidrologico del Valle de Guatemala
UNEPAR	=	Executant Unit of Rural Aqueduct Program Unidad Ejecutora del Programa de Acueductos Rurales
UNESCO	=	United Nations Educational Scientific and Cultural Organization Organizacion Educacional, Cientifica y Cultural de Naciones Unidas
UNICEF	=	United Nations International Children's Emergency Fund Fondo de Naciones Unidas para la Infancia
USAC	=	University of San Carlos of Guatemala Universidad San Carlos de Guatemala
USAID	=	United States Agency for International Development Agencia Internacional de Desarrollo de Estados Unidos
WB	=	World Bank Banco Mundial
WHO	=	World Health Organization Organizacion Mundial de Salud

## ABBREVIATIONS OF TERMS USED IN THIS REPORT

B/C	-	Benefit Cost Ratio
BOD	-	Biochemical Oxygen Demand
CCTV	-	Closed Circuit Television
COD	-	Chemical Oxygen Demand
DSR	-	Debt Service Ratio
EIA	-	Environmental Impact Assessment
EIRR	-	Economic Internal Rate of Return
FIRR	-	Financial Internal Rate of Return
GDP	-	Gross Domestic Product
GDE	-	Gross Domestic Expenditure
GFCF	-	Gross Fixed Capital Formation
HWL	-	High Water Level
IC	-	Intermediate Clarifier
IEE	-	Initial Environmental Examination
NPV	-	Net Present Value
O/M	-	Operation and Management
PDWF	-	Peak Dry Weather Flow
PST	-	Primary Sedimentation Tank
RCP	-	Reinforced Concrete Pipe
SCF	-	Standard Conversion Factor
SDB	-	Sludge Drying Bed
SDT	-	Sludge Digester Tank
SGC	-	Screen •Grit Chamber
TF	-	Trickling Filter
TOR	-	Terms of Reference
VA	-	Value Added
VAT	-	Value Added Tax
WWTP	-	Wastewater Treatment Plant

## ABBREVIATIONS OF MEASURES

1	Length		
	mm	=	millimeter
	cm	=	centimeter
	m	=	meter
	km	=	kilometer
	"	=	inch
2	Area		
	m <sup>2</sup> , sq.m	=	square meter
	ha	=	hectare
	km <sup>2</sup> , sq.km	=	square kilometer
3	Volume		
	cc	=	cubic centimeter
	lit, l,L	=	liter
	lcd	=	liter per capita per day
	m <sup>3</sup> , cu.m	=	cubic meter
	Gal, Gallon (US)	=	3.785 liter
4	Weight		
	mg	=	milligram
	g	=	gram
	kg	=	kilogram
	t	=	ton
5	Time		
	s, sec	=	second
	mim	=	minute
	h, hr	=	hour
	d	=	day
	yr	=	year
6	Money		
	Q	=	Quetzales (unit of Guatemalan currency)
	US\$, \$	=	US Dollar
	¥	=	Japanese Yen
7	Electric Measures		
	A	=	ampere
	V	=	volt
	kV	=	kilovolt
	kW	=	kilowatt

kWh	=	kilowatt hour
kVA	=	kilovolt ampere
Hz	=	hertz

8 Other Measures

mS	=	milli Siemens
$\mu$ mho	=	micromho = conductivity
ppb	=	parts per billion
ppm	=	parts per million
MPN	=	most probable number
‰	=	per thousand
%	=	percent
PS	=	0.736 kW
°	=	degree
'	=	minute
"	=	second
°C	=	degree centigrade

9 Derived Measures Based on the Same Symbols

cm/sec	=	centimeter per second
m/s, m/sec	=	meter per second
cm <sup>3</sup> /min	=	cubic centimeter per minute
m <sup>3</sup> /sec, cu.m/sec	=	cubic meter per second
m <sup>3</sup> /s, cu.m/s	=	cubic meter per second
m <sup>3</sup> /min, cu.m/min	=	cubic meter per minute
m <sup>3</sup> /h, cu.m/h	=	cubic meter per hour
m <sup>3</sup> /day, cu.m/day	=	cubic meter per day
m <sup>3</sup> /d, cu.m/d	=	cubic meter per day
lpcd	=	liter per capita per day
m <sup>3</sup> /m <sup>2</sup> /day	=	cubic meter per square meter per day
m <sup>3</sup> /sec/km <sup>2</sup>	=	specific discharge
kg/day	=	pollutant load
ton/m <sup>2</sup>	=	ton per square meter
kg/day/km <sup>2</sup>	=	unit areal pollutant load
kg/(ha•mm)	=	areal pollutant load per unit rainfall
mg/kg	=	milligram per kilogram
mS/cm	=	milli Siemens per centimeter
mg/L	=	milligram per litre
g/cm <sup>3</sup>	=	gram per cubic centimeter
GPM	=	Gallon per minute

## EXCHANGE RATES USED IN THIS STUDY

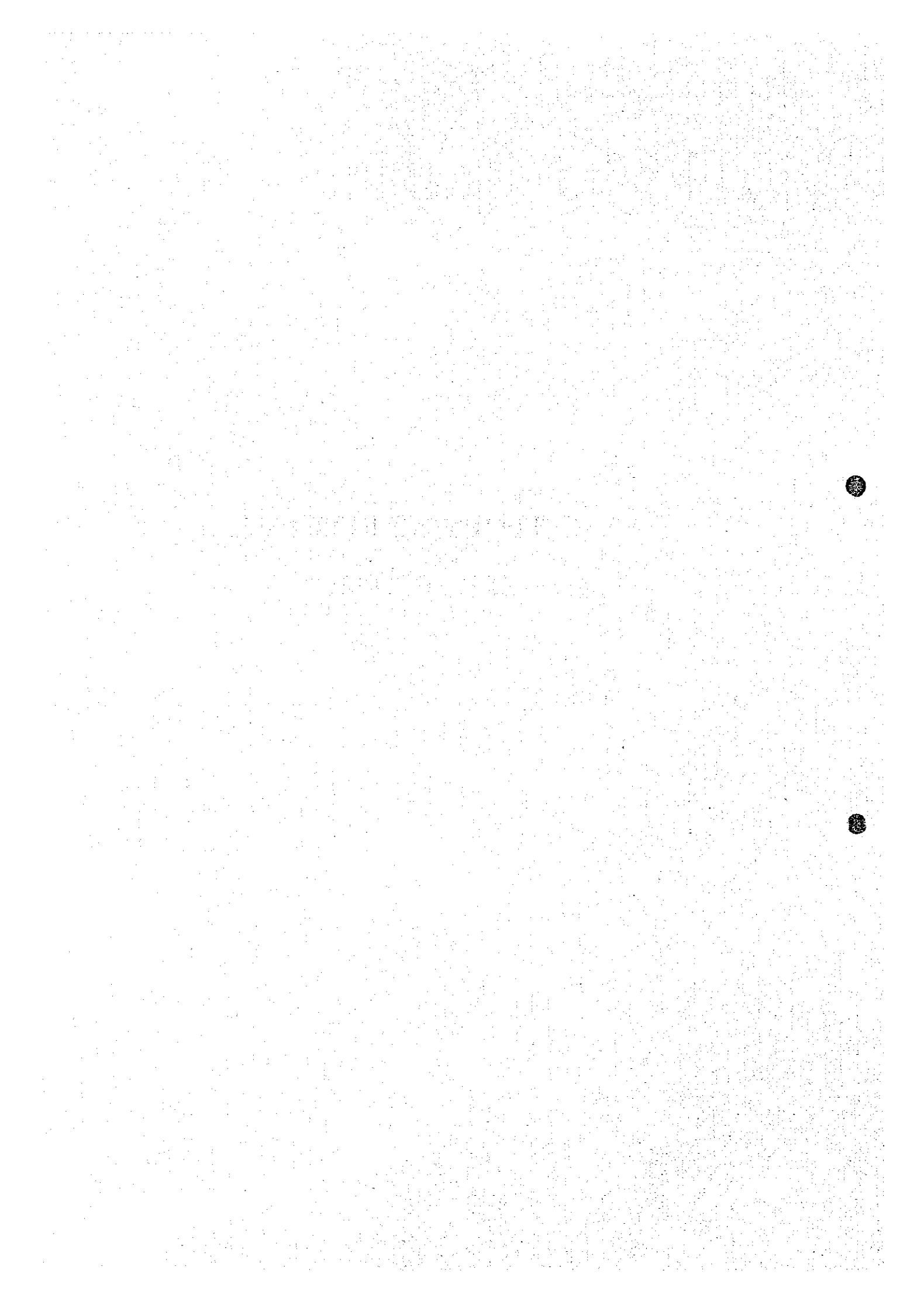
1. Selection of Priority Regions (Master Plan)

1 US\$ = Q 5.71 = Yen 100.75 (average of May '95~April '94)

2. First Stage Project

1 US\$ = Q 5.88 = Yen 99.12 (average of July '95~December '94)

**SUPPORTING REPORT L**  
**SEWER DESIGN**





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SEWER DESIGN  
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## L SEWER DESIGN

### L1 INTRODUCTION

As described in Chapter 9 of Main Report, Volume II, it is proposed that Main Collector Sewer be constructed in six of the eight Regions. This supporting report contains preliminary design calculations and drawings for the main collector sewers in six Regions. It is to be noted that for Central Region and South 3 Region, the design is based on the results of topographical surveys and thus corresponds to those lengths reported in Table 12-10 and Table 12-11, Chapter 12, Main Report, Volume II.

Summary of unit design flow rates, size, and length of collector sewers is shown in Table L-1.

Tables L-2 to L-7 show the design calculations of main collector sewers for each Region. Longitudinal section of collector sewer for each Region and their layout are shown in Fig. L-1 to L-63.

**Table L-1 Size and Length of Collectors for Wastewater Treatment Districts**

Sewer Size (mm)	Length of Main Collector (m)					
	Central *0.000684 (combined) **0.000848	North 1 **0.000759	South 1 **0.000727	South 2 **0.000445	South 3 **0.000523	East 1 **0.000497
200	-	-	-	-	1,350	-
250	-	560	1,770	6,900	-	2,430
300	-	1,060	6,780	5,060	6,230	1,540
350	-	-	2,400	6,750	7,250	4,450
400	-	1,050	-	1,050	4,450	-
450	-	260	6,060	1,670	-	1,560
500	-	4,030	1,400	4,540	1,410	1,400
600	-	2,190	-	-	1,530	1,440
700	-	930	-	-	2,850	-
800	-	1,970	-	-	-	-
1,200	-	-	-	-	1,150	-
1,500	-	11,890	9,350	13,870	10,250	18,850
3,000	11,040	-	-	-	-	-
Total	11,040	23,940	27,760	39,840	36,470	31,670

Note : \* Unit Design Flow Rate (m<sup>3</sup>/s/ha) : combined system

\*\* Unit Design Flow Rate (m<sup>3</sup>/s/ha) : separate system

For shaded regions, namely Central and South Regions, design is based on the results of topographic surveys, and thus correspond to the preliminary design for Feasibility Study.

Source : Study Team

## L2 TYPICAL DESIGN CALCULATION

Typical design calculation for Las vacas Main collector is described below. Central Region consists of combined sewer district (5,945 ha, sewered area 85%) and separate sewer distinct (515 ha, sewered area 0%). Combined sewer distinct is drained by two main collectors, namely Gran Colector de Oriente ( $\phi 2250$ ) and Gran Colector de Poniente ( $\phi 2000$ ). Both of these main collectors join to Gran Colector North which discharges to left bank of Las Vacas River near downstream of Belice Bridge (refer Fig. L-1).

Las Vacas Main Collector is designed to convey the wastewater to the Central WWTP site in Chinautla. Design conditions for the collector are as follows :

### a) Design Flowrate

Design flowrate for the Las Vacas Main Collector is the sum of i) 3 x Hourly maximum flowrate from combined - sewer district and ii) hourly maximum flowrate from separate - sewer area.

$$\begin{aligned} \text{i) Flowrate from combined - sewer area} &= 3 \times \text{Sum of The Design Dry Weather} \\ &\quad \text{Flowrate through Gran Colector de} \\ &\quad \text{Oriente and Gran Colector de Poniente.} \\ &= 3 \times [ 1.906 \text{ m}^3/\text{s} + 2.160 \text{ m}^3/\text{s} ] \\ &= 3 \times 4.066 \text{ m}^3/\text{s} = 12.198 \text{ m}^3/\text{s} \end{aligned}$$

$$\text{ii) Flowrate from separate - sewer area} = 0.437 \text{ m}^3/\text{s}$$

$$\begin{aligned} \therefore \text{Design flowrate for Las Vacas Main Collector} \\ &= 12.198 + 0.437 \\ &= 12.635 \text{ m}^3/\text{s} \end{aligned}$$

### b) Diameter Required and Slope

Diameter and slope are selected such that the pipe capacity is above the design flowrate and flow velocity is in the range of 1.0 to 1.8 m/s.

$$\begin{aligned} \text{Required diameter} &= 3,000 \text{ mm} \\ \text{Slope} &= 1 \text{ m/km (i.e. per thousand)} \\ \text{Flow Velocity} &= 2.0 \text{ m/s} \\ \text{Pipe capacity} &= 14.194 \text{ m}^3/\text{s} \end{aligned}$$

**c) Check for Velocity in the Beginning of Operation (minimum flow)**

Check for velocity will be made for the flowrates in 1995, i.e. 0.863 m<sup>3</sup>/s (estimated flow based on upstream and downstream flow measurements near outfall, Table 4-3, Main Report, Volume II), assuming that this flowrate remains at the commencement of Las Vacas Main Collector.

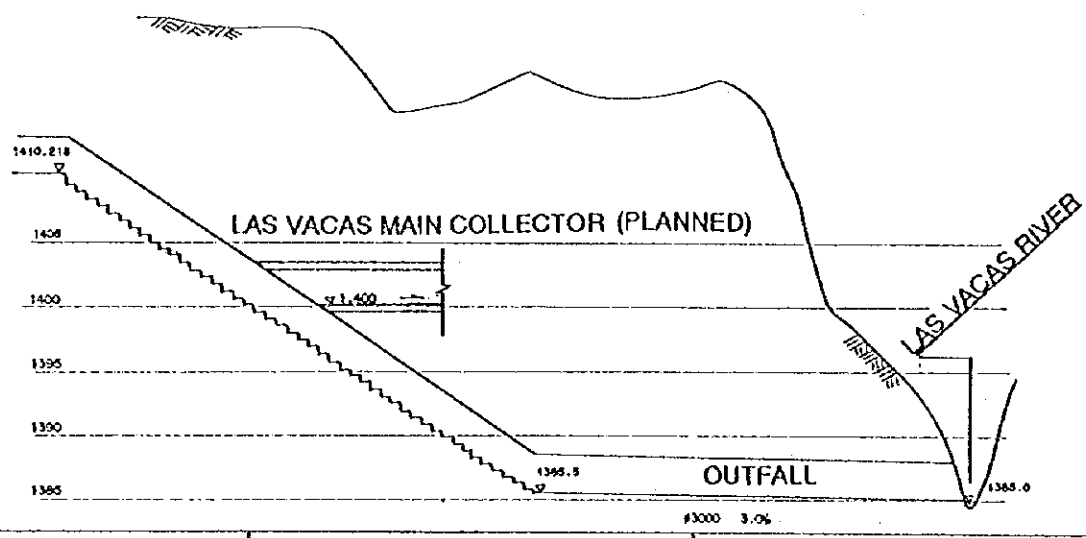
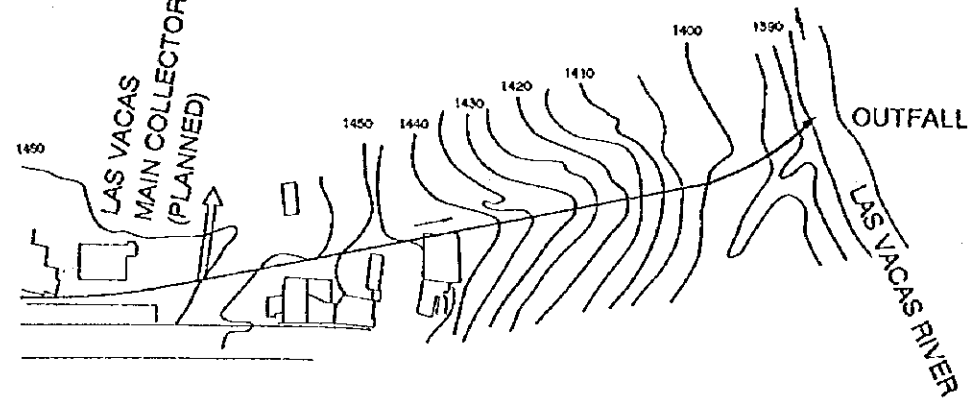
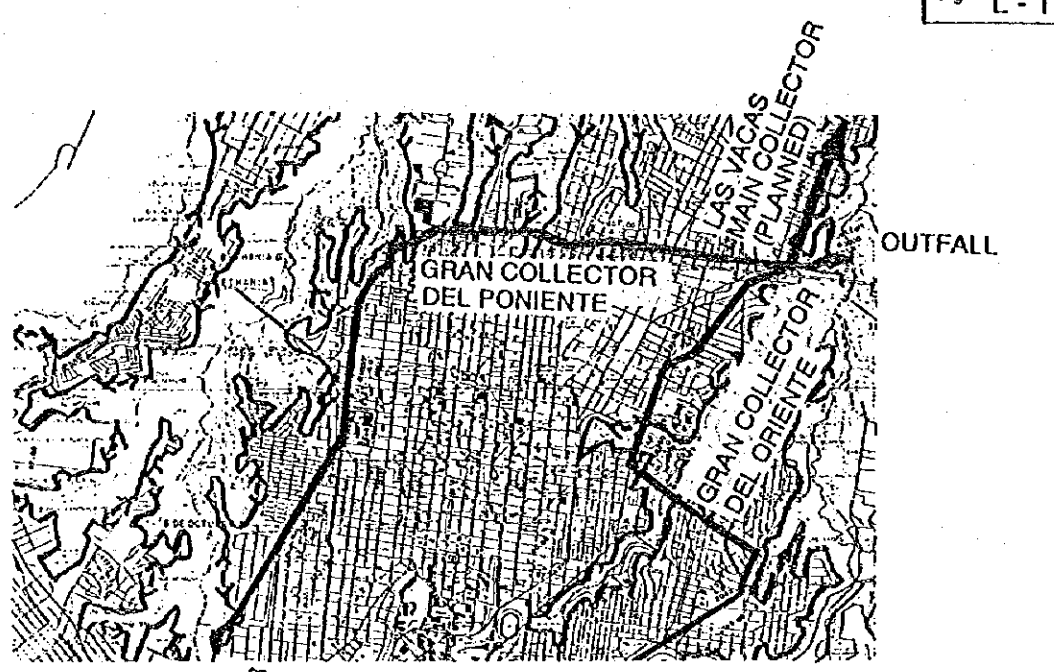
$$\frac{q}{Q_{Full}} = \frac{0.863}{14.194} = 0.061$$

$$\frac{v}{V_{max}} = 0.554$$

$$v = 2.01 \times 0.554 = 1.11 \text{ m/s}$$

Velocity is within 1.0 - 1.8 m/s and therefore selected diameter and slope are suitable.

Fig. L-1



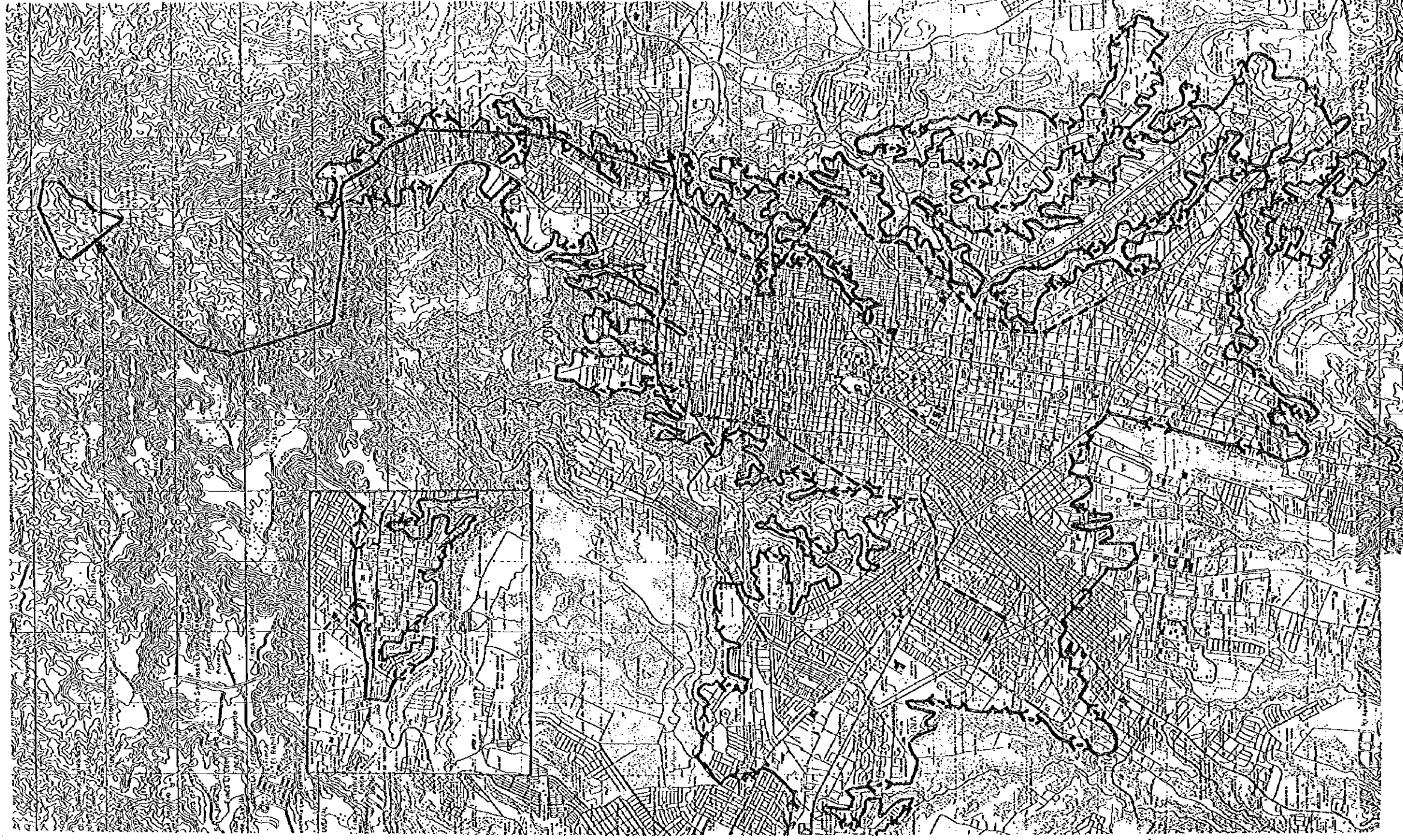
<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LAS VACAS MAIN COLLECTOR NEAR BELICE BRIDGE OUTFALL</p>
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**DESIGN OF MAIN COLLECTORS  
FOR  
CENTRAL REGION**







TITLE  
 LAYOUT OF MAIN COLLECTOR  
 FOR CENTRAL WASTEWATER  
 TREATMENT DISTRICT

THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

THE REPUBLIC OF GUATEMALA  
 GUATEMALA MUNICIPAL WATER  
 SUPPLY PUBLIC CORPORATION  
 (EMPAGUA)



Table L - 2 Computation Form for Main Collector Design, Central Region (1/4)

Central Region										Unit Design Flow Rate (m <sup>3</sup> /s/ha) : 0.000684 (Combined District) / 0.000848 (Separate District)											
Sewer Line No.	Wastewater Treatment District										Design Sewer										Remarks
	Combined District					Separate District					Total Design Flow	Design Flow Rate	Diam	Slope	Velocity	Capacity	Length	Invert Elevation	Ground Surface Elevation	Earth Cover	
	Incrmnt	Cs	Total	Flow	ha	Incrmnt	Cs	Total	Flow	ha											
1	97.00	0.066									97.00	0.066									
2	70.00	0.114								167.00	0.114										
3	68.00	0.161								235.00	0.161										
4	183.00	0.236								418.00	0.236										
5	148.00	0.337								566.00	0.337										
6	184.00	0.112								154.00	0.112										
7	298.00	0.254								372.00	0.254										
8	242.00	0.503								1131.00	0.503										
9	131.00	0.090								131.00	0.090										
10	87.00	0.149								218.00	0.149										
11	144.00	0.099								144.00	0.099										
12	66.00	0.293								678.00	0.293										
13	142.00	1.198								1751.00	1.198										
14	5.00	0.003								5.00	0.003										
15	99.00	0.071								104.00	0.071										
16	198.00	1.404								2053.00	1.404										

Table L - 3 Computation Form for Main Collector Design, Central Region (2/4)

Central Region										Unit Design Flow Rate (m <sup>3</sup> /s/ha) : 0.000684 (Combined District) / 0.000848 (Separate District)									
Sewer Line No.	Wastewater Treatment District					Design Sewer					Remarks								
	Combined District		Separate District			Total Design Flow	Diam	Slope	Velocity	Capacity		Length	Invert Elevation	Ground Surface Elevation	Barth Cover				
	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha											m <sup>3</sup> /s	mm	%	m/s
ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s				
17	130.00	0.093				130.00	0.093				0.093								
18	110.00	0.164				240.00	0.164				0.164								
19	8.00	1.574				250.00	1.574				1.574								
20	723.00	1.726				2524.00	1.726				1.726								
21	83.00	1.783				2607.00	1.783				1.783								
22	174.00	1.992				2781.00	1.992				1.992								
23	132.00	1.992				2913.00	1.992				1.992								
24	151.00	2.095				3064.00	2.095				2.095								
25	94.00	2.160				3158.00	2.160				2.160								
26	172.00	0.113				172.00	0.113				0.113								
27	200.00	0.254				372.00	0.254				0.254								
28	98.00	0.067				98.00	0.067				0.067								
29	100.00	0.068				100.00	0.068				0.068								
30	98.00	0.202				296.00	0.202				0.202								
31	182.00	0.328				480.00	0.328				0.328								
32	708.00	0.725				1060.00	0.725				0.725								

Table L - 4 Computation Form for Main Collector Design, Central Region (3/4)

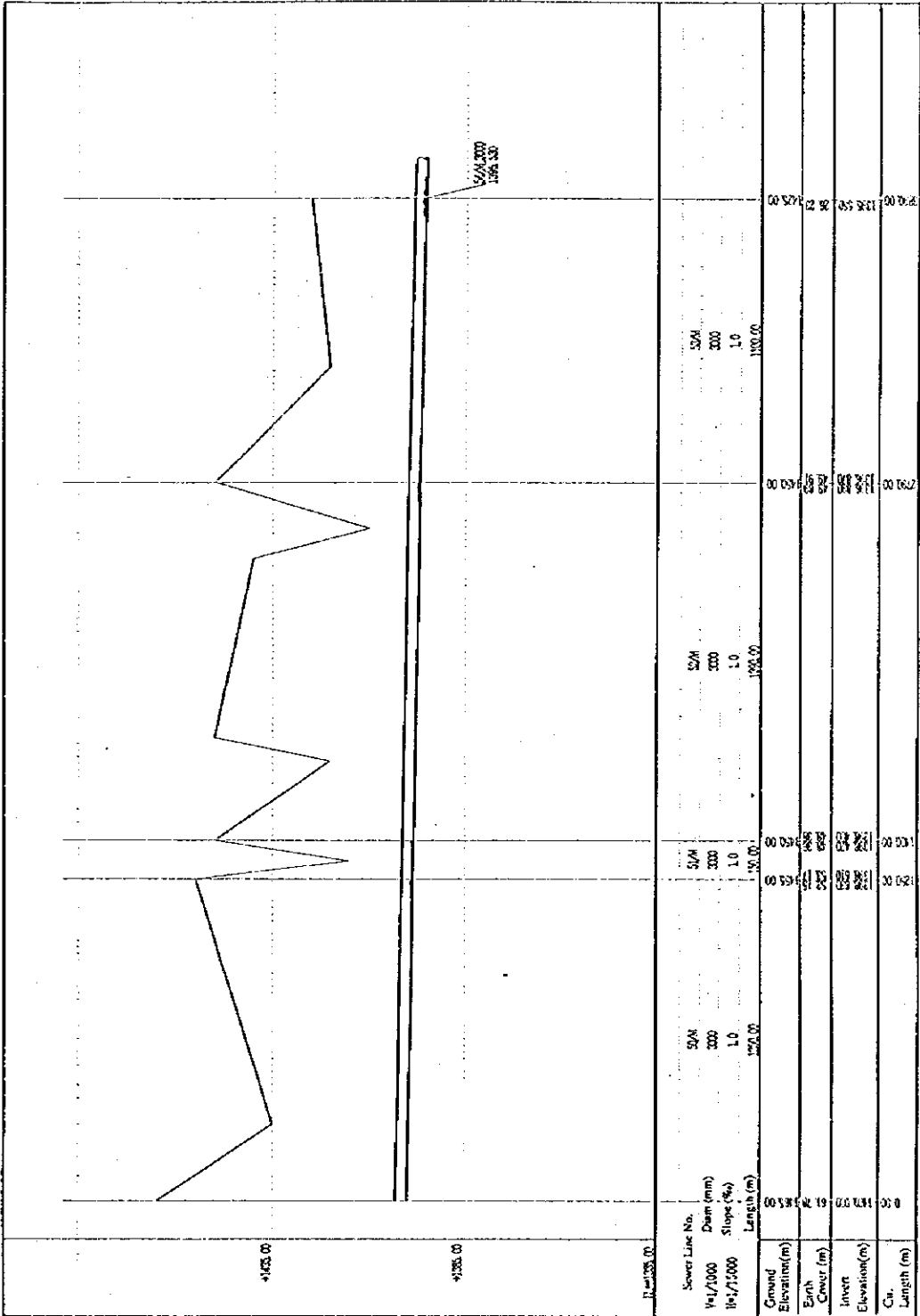
Central Region		Unit Design Flow Rate (m³/s/ha) : 0.000684 (Combined District) / 0.000848 (Separate District)										Remarks					
Sewer Line No.	To Sewer No.	Wastewater Treatment District					Design Sewer					Emb. Cover (m)					
		Combined District		Separate District		Total Area (ha)	Design Flow Rate (m³/s)	Total Design Flow (m³/s)	Diam (mm)	Slope (%)	Velocity (m/s)		Capacity (m³/s)	Length (m)	Invert Elevation (m)	Ground Surface Elevation (m)	
		Invert	Co. Tied	Flow	ha												Invert
32		189.00	1749.00	0.854			1249.00	0.854		0.854							
34		124.00		0.065			124.00	0.065		0.065							
35		107.00	231.00	0.138			231.00	0.138		0.138							
36		115.00	346.00	0.237			346.00	0.237		0.237							
37		68.00	414.00	0.283			414.00	0.283		0.283							
38		73.00		0.090			73.00	0.090		0.090							
39		106.00	179.00	0.172			179.00	0.172		0.172							
40		84.00	263.00	0.180			263.00	0.180		0.180							
41		0.00	263.00	0.180			263.00	0.180		0.180							
42		52.00	375.00	0.272			375.00	0.272		0.272							
43		0.00	739.00	0.303			739.00	0.303		0.303							
44		129.00	2171.00	1.489			2171.00	1.489		1.489							
45		59.00	3736.00	1.579			3736.00	1.579		1.579							
46		191.00		0.131			191.00	0.131		0.131							
47		190.00	371.00	0.254			371.00	0.254		0.254							
48		65.00	2572.00	1.873			2572.00	1.873		1.873							
49		115.00	3387.00	1.906			3387.00	1.906		1.906							



Table L - 5 Computation Form for Main Collector Design, Central Region (4/4)

Central Region															
Unit Design Flow Rate (m³/s/ha) : 0.000684 (Combined District) / 0.000848 (Separate District)															
Sewer Line No.	To Sewer No.	Wastewater Treatment District						Design Sewer						Remarks	
		Combined District			Separate District			Diarm	Slope	Velocity	Capacity	Length	Invert Elevation		Ground Surface Elevation
Increment	Cs	Total	Flow	Increment	Cs	Total	Flow							mm	
ha	m³/s	ha	m³/s	ha	m³/s	ha	m³/s	ha	m³/s	m³/s	m³/s	m³/s	m³/s	m³/s	
S0		0.00	5945.00	4.066			5945.00	4.066						1455.00	
S1		0.00	5945.00	4.066	39.00	0.033	5984.00	4.099	8.132	12.231	14.194	1250.00	1465.00	1465.00	61.75
S2		0.00	5945.00	4.066	0.00	0.033	5924.00	4.099	8.132	12.221	14.194	1250.00	1455.00	1455.00	53.17
S3		0.00	5945.00	4.066	289.00	0.261	6233.00	4.328	8.132	12.460	14.194	1250.00	1450.00	1450.00	48.38
S4		0.00	5945.00	4.066	115.00	0.359	6060.00	4.425	8.132	12.557	14.194	1100.00	1475.00	1475.00	49.91
S5-1		0.00	5945.00	4.066	92.00	0.437	6037.00	4.503	8.132	12.635	14.194	1260.00	1475.00	1475.00	26.25
S5-2		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	1650.00	1390.00	1390.00	1.50
S6-1		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1275.00	1275.00	1.52
S6-2		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1275.00	1275.00	-3.23
S6-3		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1275.00	1275.00	-3.21
S6-4		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1275.00	1275.00	-3.19
S7-1		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	270.00	1225.00	1225.00	-3.17
S7-2		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1225.00	1225.00	-2.12
S7-3		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1225.00	1225.00	-2.10
S8-1		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	530.00	1225.00	1225.00	-2.06
S8-2		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1225.00	1225.00	3.50
S8-3		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1225.00	1225.00	3.52
S8-4		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1225.00	1225.00	3.54
S9-1		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	670.00	1225.00	1225.00	3.56
S9-2		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1225.00	1225.00	15.38
S9-3		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1225.00	1225.00	15.41
S9-4		0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	20.00	1225.00	1225.00	15.43
S10	To The Wastewater Treatment Plant	0.00	5945.00	4.066	0.00	0.437	6037.00	4.503	8.132	12.635	14.194	910.00	1225.00	1225.00	15.45
															1.50

Fig. L - 3

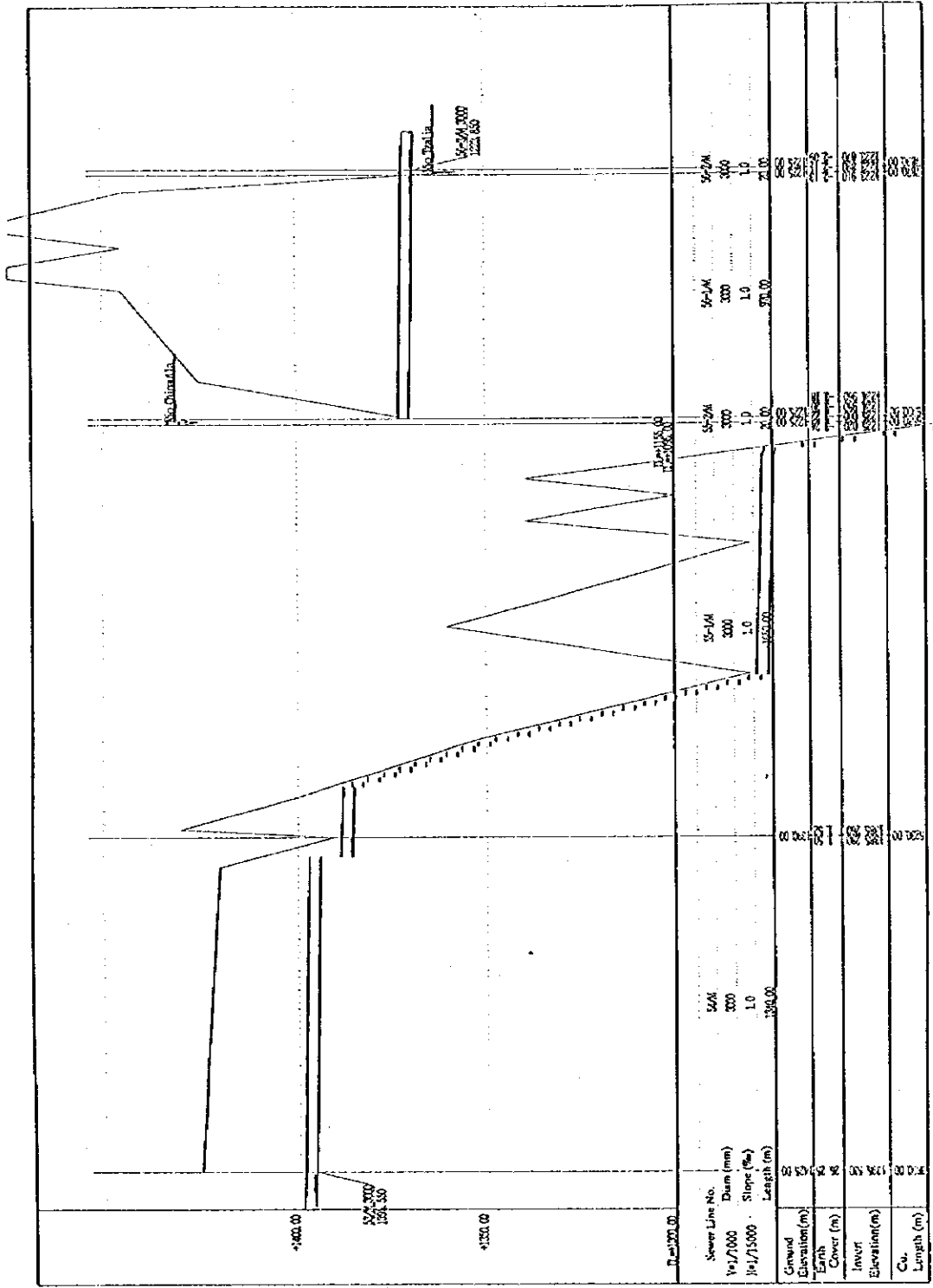


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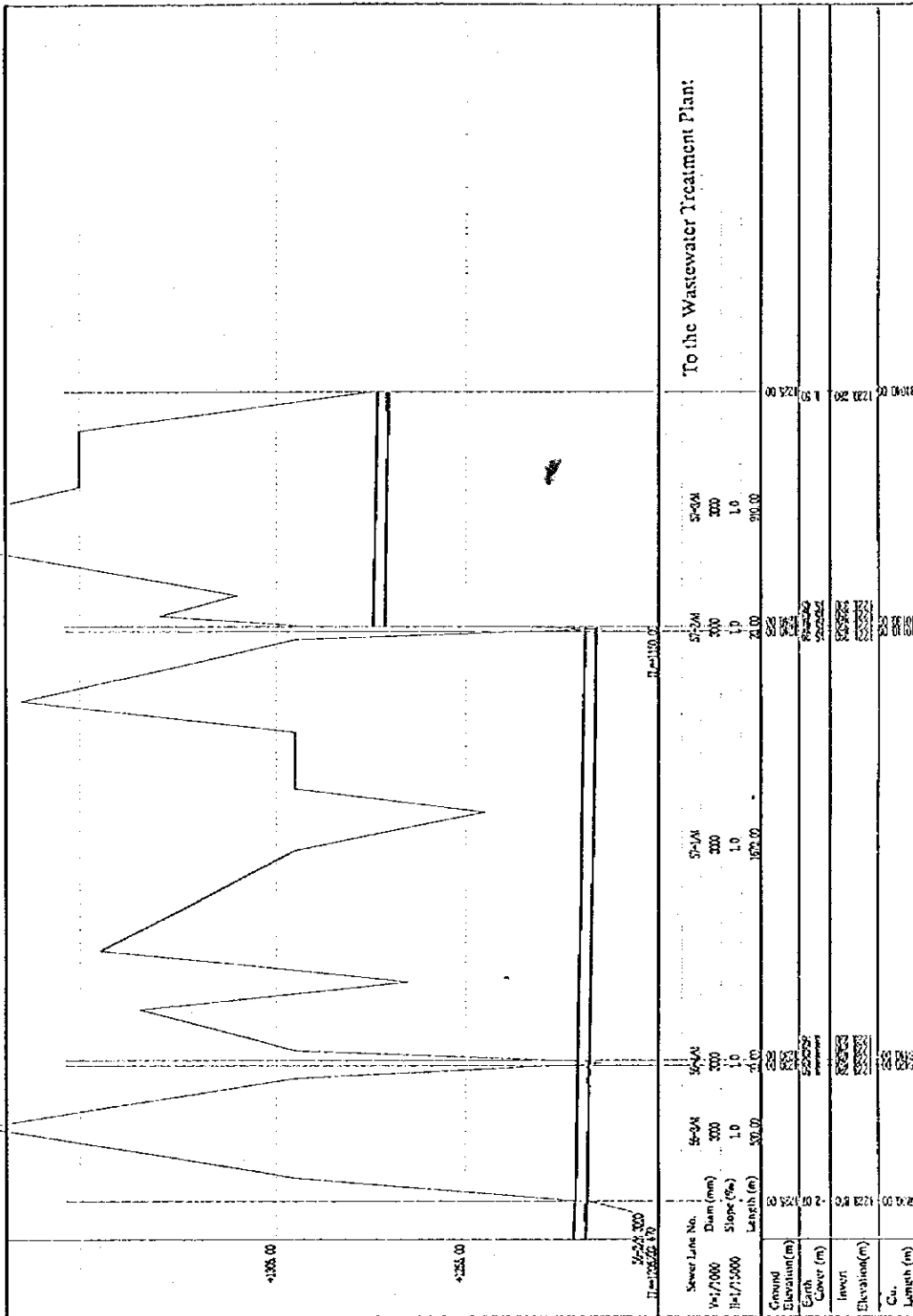
THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR CENTRAL REGION (1/3)

Fig. L - 4



THE REPUBLIC OF GUATEMALA GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)	THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA	TITLE LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR CENTRAL REGION (2/3)
	JAPAN INTERNATIONAL COOPERATION AGENCY	



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 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR CENTRAL REGION (3/3)



**DESIGN OF MAIN COLLECTORS  
FOR  
NORTH 1 REGION**





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(EMPAGUA)

THE STUDY ON  
THE IMPROVEMENT OF WASTEWATER  
MANAGEMENT IN THE GUATEMALA  
METROPOLITAN AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
LAYOUT OF MAIN COLLECTOR  
FOR NORTH 1 WASTEWATER  
TREATMENT DISTRICT



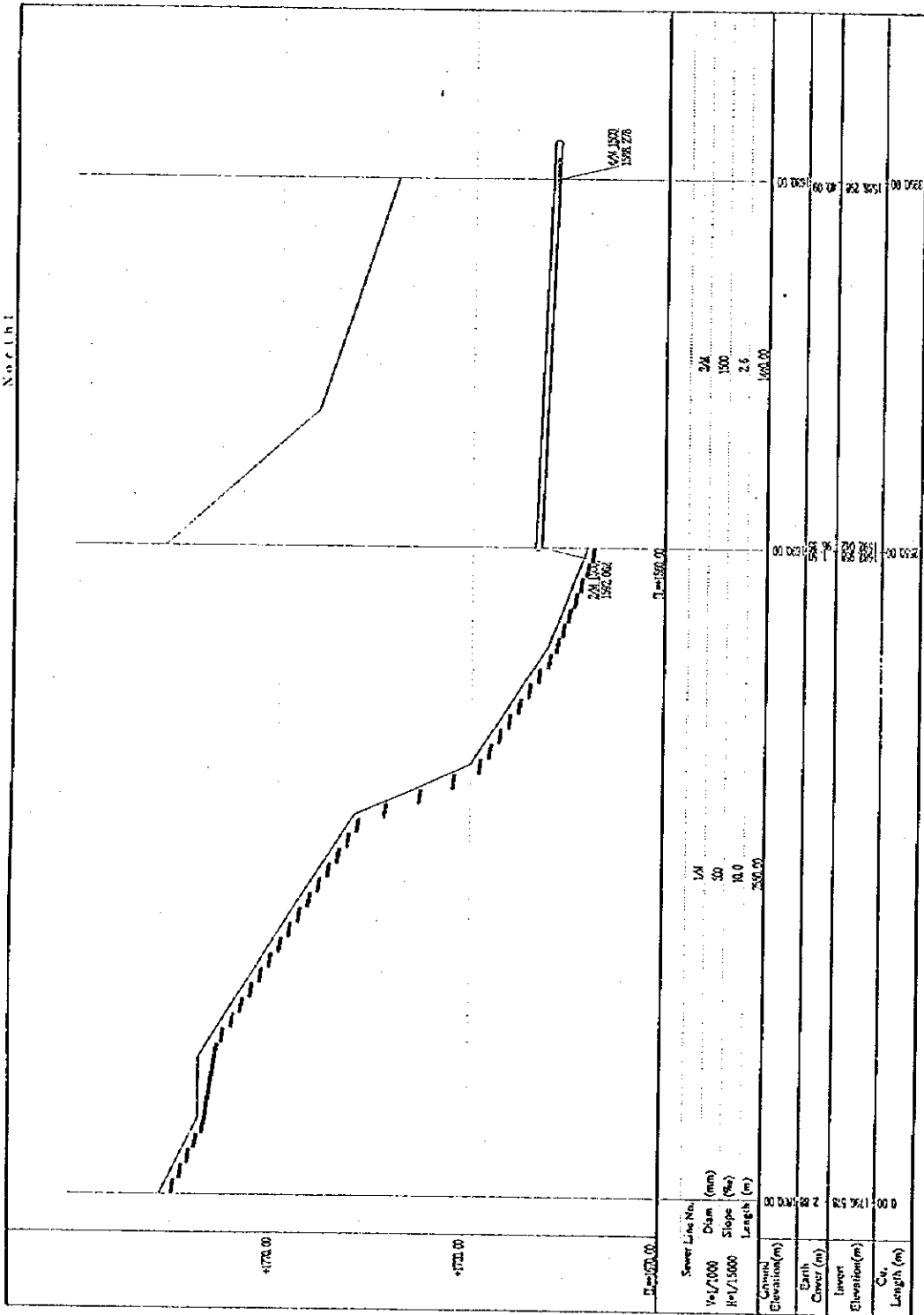
Table L - 63 Computation Form for Main Collector Design, North 1 Region (1/2)

North 1 Region																
Unit Design Flow Rate(m <sup>3</sup> /s/ha) : 0.000759																
Sewer Line No.	Wastewater Treatment District					Design Flow Rate	Total Design Flow	Diam	Design Sewer			Ground Surface Elevation	Earth Cover	Remarks		
	In the District	Increment	Ca. Total	Flow	Increment				Ca. Total	Flow	Slope				Velocity	Capacity
ha	ha	ha	m <sup>3</sup> /s	ha	ha	ha	m <sup>3</sup> /s	mm	%	m/s	m <sup>3</sup> /s	m	m	m		
1	234.00	0.178	0.178	234.00	0.178	0.178	0.178	500	10.0	1.92	0.378	2550.00	1687.958	1690.00	1.50	
2	154.00	0.117	0.117	154.00	0.117	0.117	0.117	1500	2.5	2.04	3.504	790.00	1592.062	1690.00	96.93	
3	58.00	0.444	0.327	464.00	0.327	0.327	0.327	1500	2.5	2.04	3.504	1440.00	1592.062	1690.00	96.25	
4	23.00	467.00	0.354	467.00	0.354	0.354	0.354	1500	2.5	2.04	3.504	700.00	1588.278	1690.00	40.11	
5	185.00	0.140	0.140	185.00	0.140	0.140	0.140	450	10.0	1.79	0.285	260.00	1778.012	1780.00	1.50	
6	27.00	212.00	0.161	212.00	0.161	0.161	0.161	500	10.0	1.92	0.378	1480.00	1687.958	1690.00	1.50	
7	185.00	397.00	0.301	397.00	0.301	0.301	0.301	700	7.0	2.01	0.775	950.00	1657.742	1660.00	3.44	
8	275.00	672.00	0.510	672.00	0.510	0.510	0.510	800	6.0	2.04	1.024	1470.00	1617.624	1620.00	2.42	
9	108.00	1247.00	0.946	1247.00	0.946	0.946	0.946	1500	2.5	2.04	3.504	1820.00	1591.706	1590.00	6.89	
10	64.00	0.049	0.049	64.00	0.049	0.049	0.049	1500	2.5	2.04	3.504	1250.00	1578.628	1610.00	34.75	
11	65.00	0.049	0.049	65.00	0.049	0.049	0.049	300	12.0	1.50	0.105	1060.00	1608.170	1610.00	1.50	
12	111.00	240.00	0.182	240.00	0.182	0.182	0.182	1500	2.5	2.04	3.504	1340.00	1552.400	1600.00	45.99	
13	72.00	0.055	0.055	72.00	0.055	0.055	0.055	1500	2.5	2.04	3.504	2090.00	1551.454	1600.00	46.93	
14	133.00	745.00	0.338	745.00	0.338	0.338	0.338	1500	2.6	2.04	3.504	1150.00	1548.244	1590.00	39.94	
15	2.00	1694.00	1.286	1694.00	1.286	1.286	1.286	1500	2.6	2.04	3.504	210.00	1547.878	1590.00	20.51	

Table L-7: Computation Form for Main Collector Design, North 1 Region (2/2)

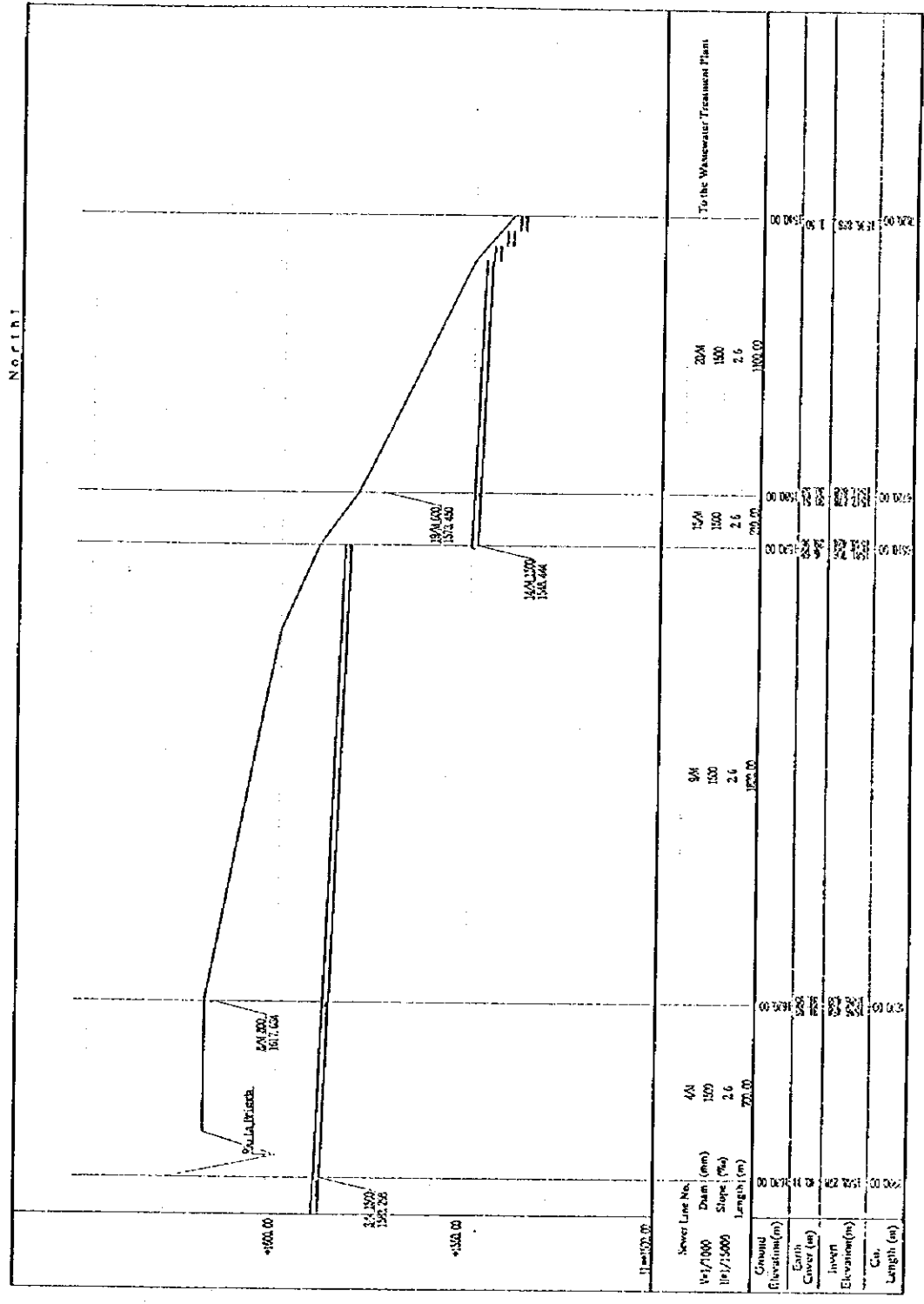
North 1 Region		Unit Design Flow Rate(m <sup>3</sup> /s/ha) : 0.000759																		
Sewer Line No.	To Sewer No.	Wastewater Treatment District						Design Sewer				Remarks								
		In the District	Increment (Ca. Total)	Flow	Increment (Ca. Total)	Flow	Total Area	Diam	Slope	Velocity	Capacity		Length	Invert Elevation	Ground Surface Elevation	Earth Cover				
ha	ha	m <sup>3</sup> /s	ha	ha	m <sup>3</sup> /s	ha	ha	m <sup>3</sup> /s	m/s	m/s	m/s	m	m	m	m					
16		34.00	0.026				34.00	0.026		0.026		0.250	20.0	1.71	0.084	560.00	1647.502	1650.00	2.22	1.50
17		100.00	0.102				134.00	0.102		0.102		0.400	12.0	1.82	0.228	1050.00	1628.065	1630.00	1.50	4.35
18		154.00	0.219				288.00	0.219		0.219		0.600	8.0	1.94	0.549	660.00	1615.005	1620.00	4.35	1.50
19		73.00	0.274				361.00	0.274		0.274		0.600	8.0	1.94	0.549	530.00	1577.830	1580.00	1.52	5.90
20		135.00	1.662				2190.00	1.662		1.662		0.1500	2.6	2.04	3.604	1100.00	1547.838	1580.00	30.33	1.50
		To the Wastewater Treatment Plant																		

Fig. L-7



THE REPUBLIC OF GUATEMALA GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)	THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA	TITLE LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR NORTH 1 REGION (1/8)
	JAPAN INTERNATIONAL COOPERATION AGENCY	

Fig. L - 8

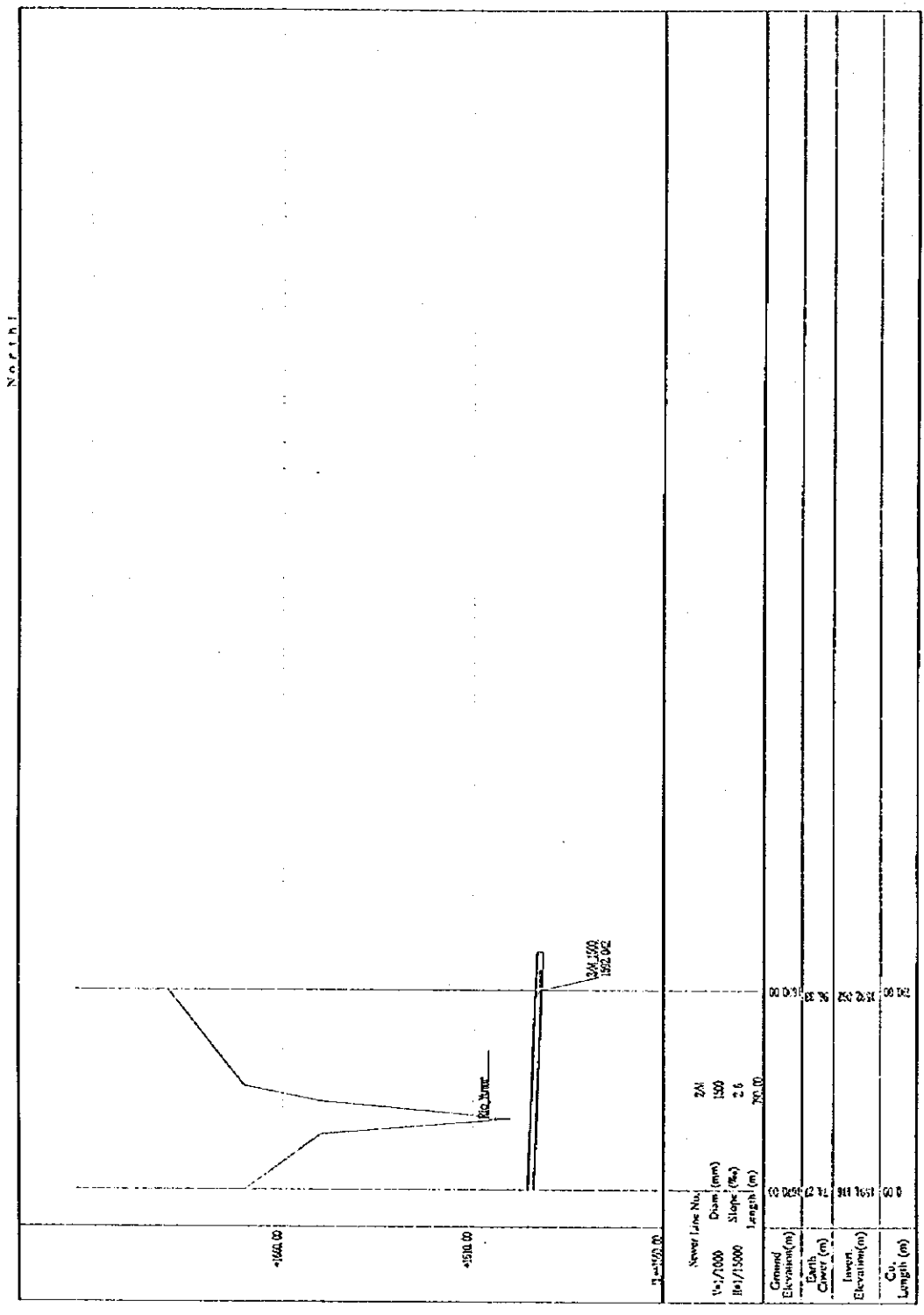


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TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR NORTH 1 REGION (2/8)

Fig. L - 9

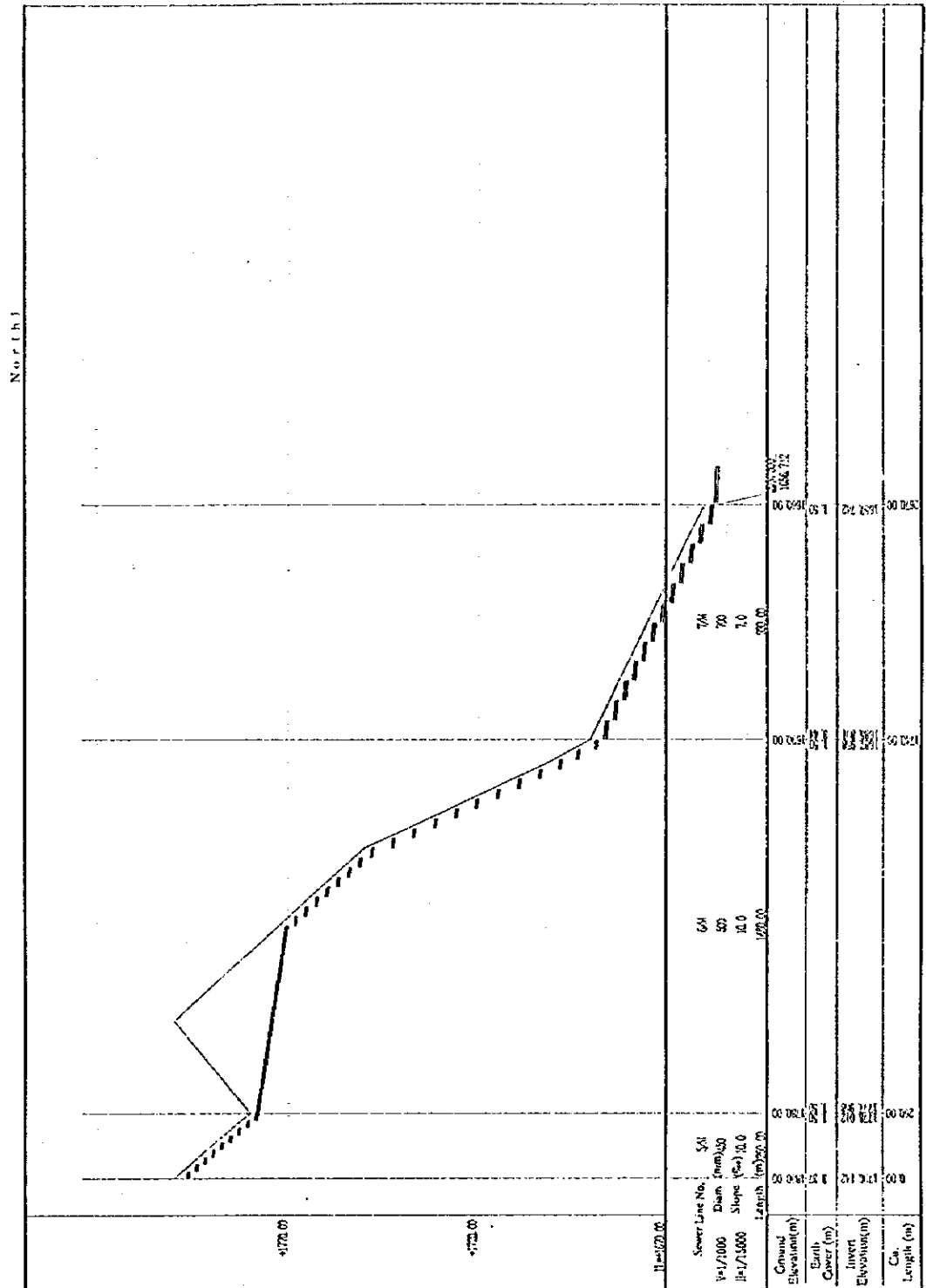


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TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR NORTH 1 REGION (3/8)

Fig. L - 10

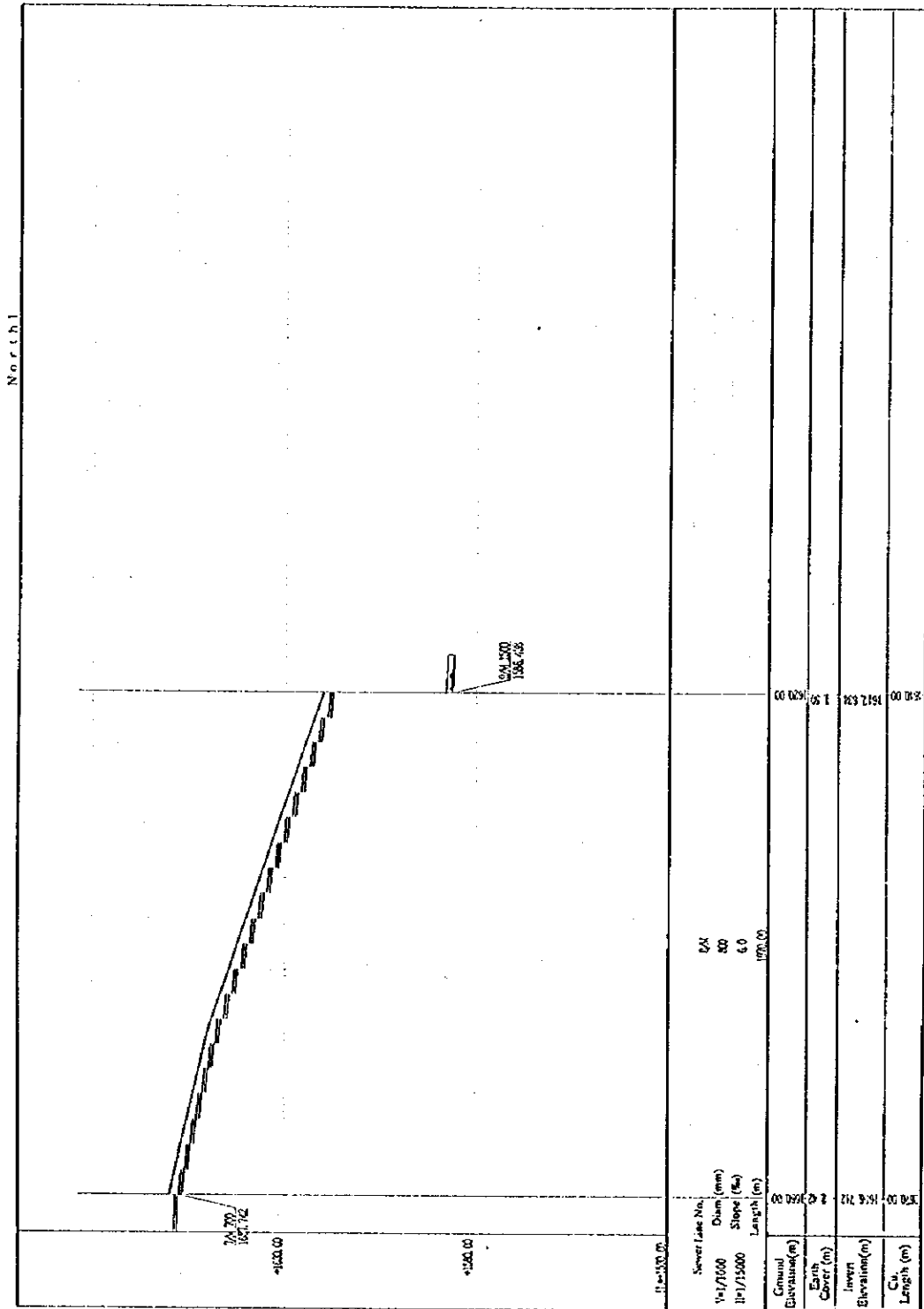


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TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR NORTH 1 REGION (4/8)

Fig. L-11

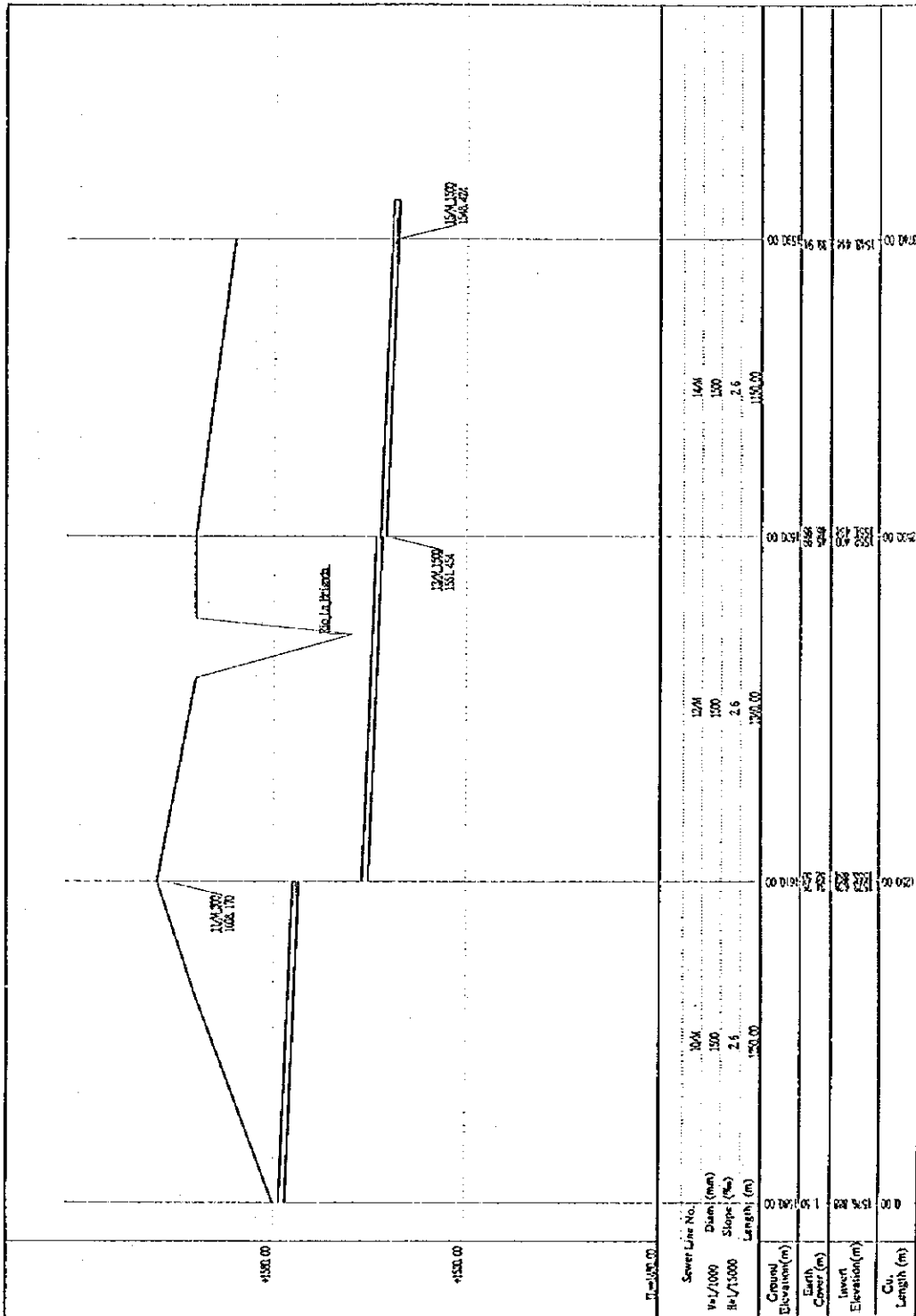


Ground Elevation (m)	Invert Elevation (m)	Length (m)
1500.00	1512.52	100.00

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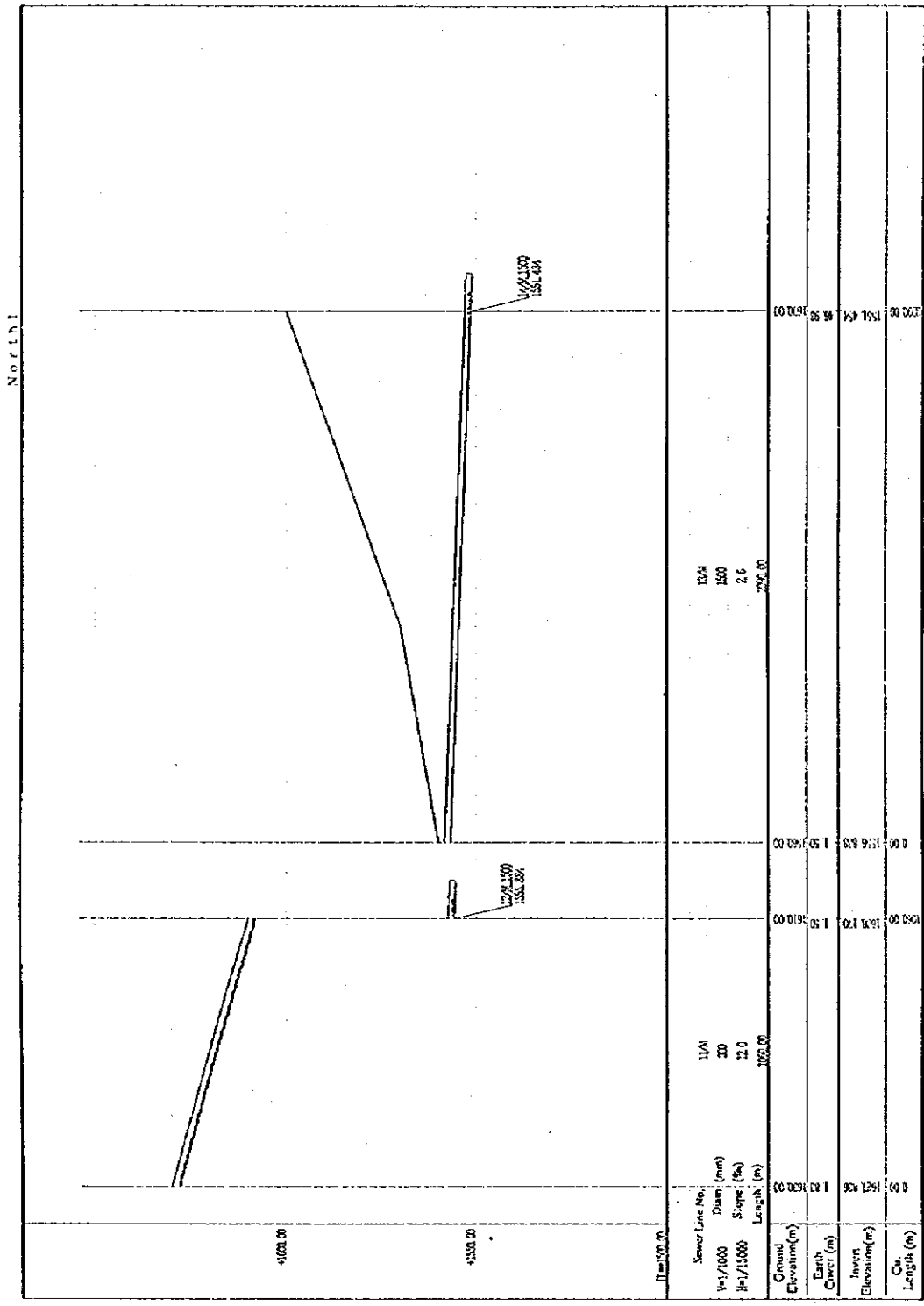
TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR NORTH 1 REGION (5/8)



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	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	

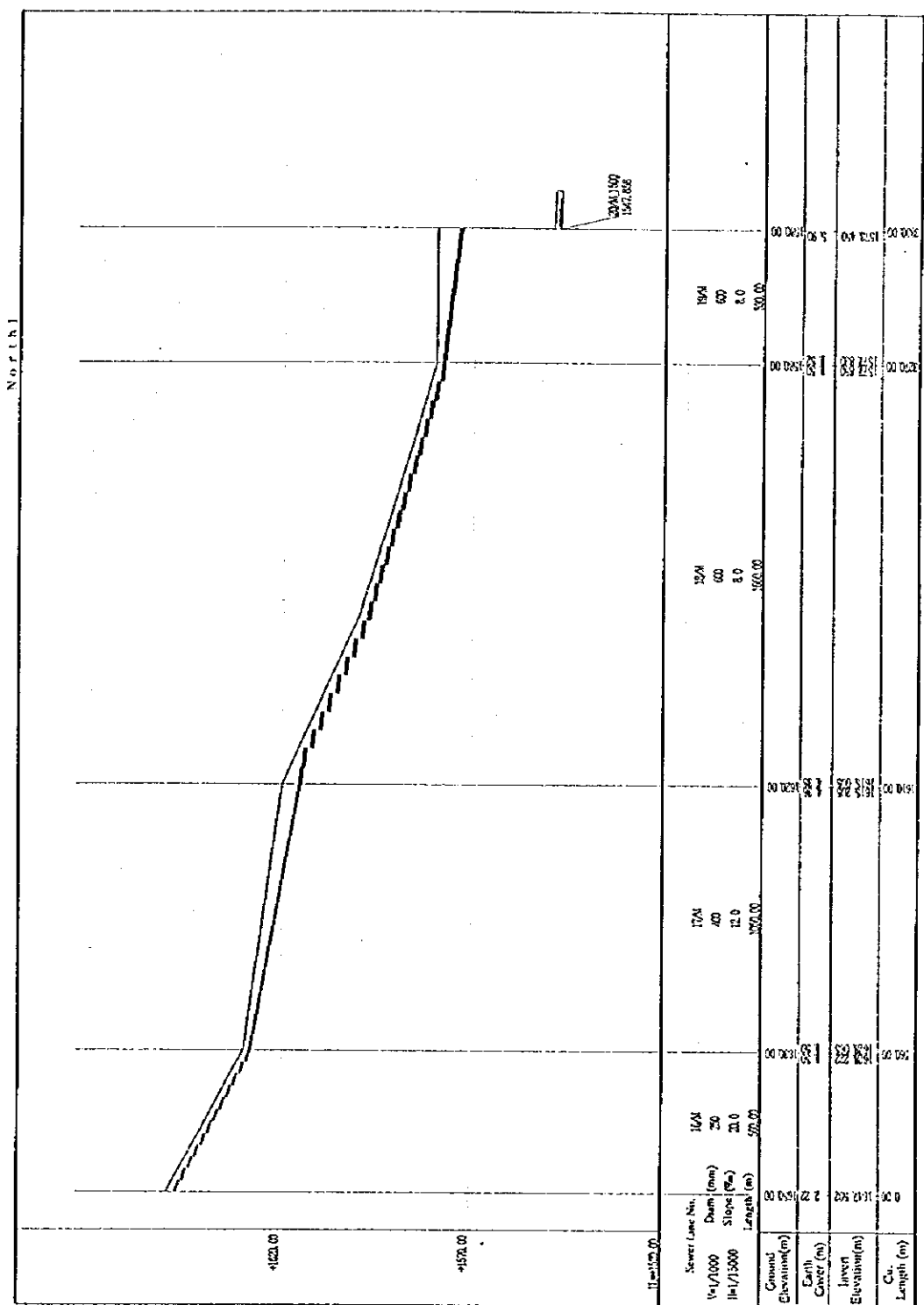


Fig. L - 13



<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR NORTH 1 REGION (7/8)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	

Fig. L - 14



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 (EMPAGUA)

THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR NORTH 1 REGION (8/8)



**DESIGN OF MAIN COLLECTORS  
FOR  
SOUTH 1 REGION**





THE REPUBLIC OF GUATEMALA  
GUATEMALA MUNICIPAL WATER  
SUPPLY PUBLIC CORPORATION  
(EMPAGUA)

THE STUDY ON  
THE IMPROVEMENT OF WASTEWATER  
MANAGEMENT IN THE GUATEMALA  
METROPOLITAN AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE

LAYOUT OF MAIN COLLECTOR  
FOR SOUTH 1 WASTEWATER  
TREATMENT DISTRICT

Table L-8 - Computation, Form for Main Collector Design, South A Region (1/2)

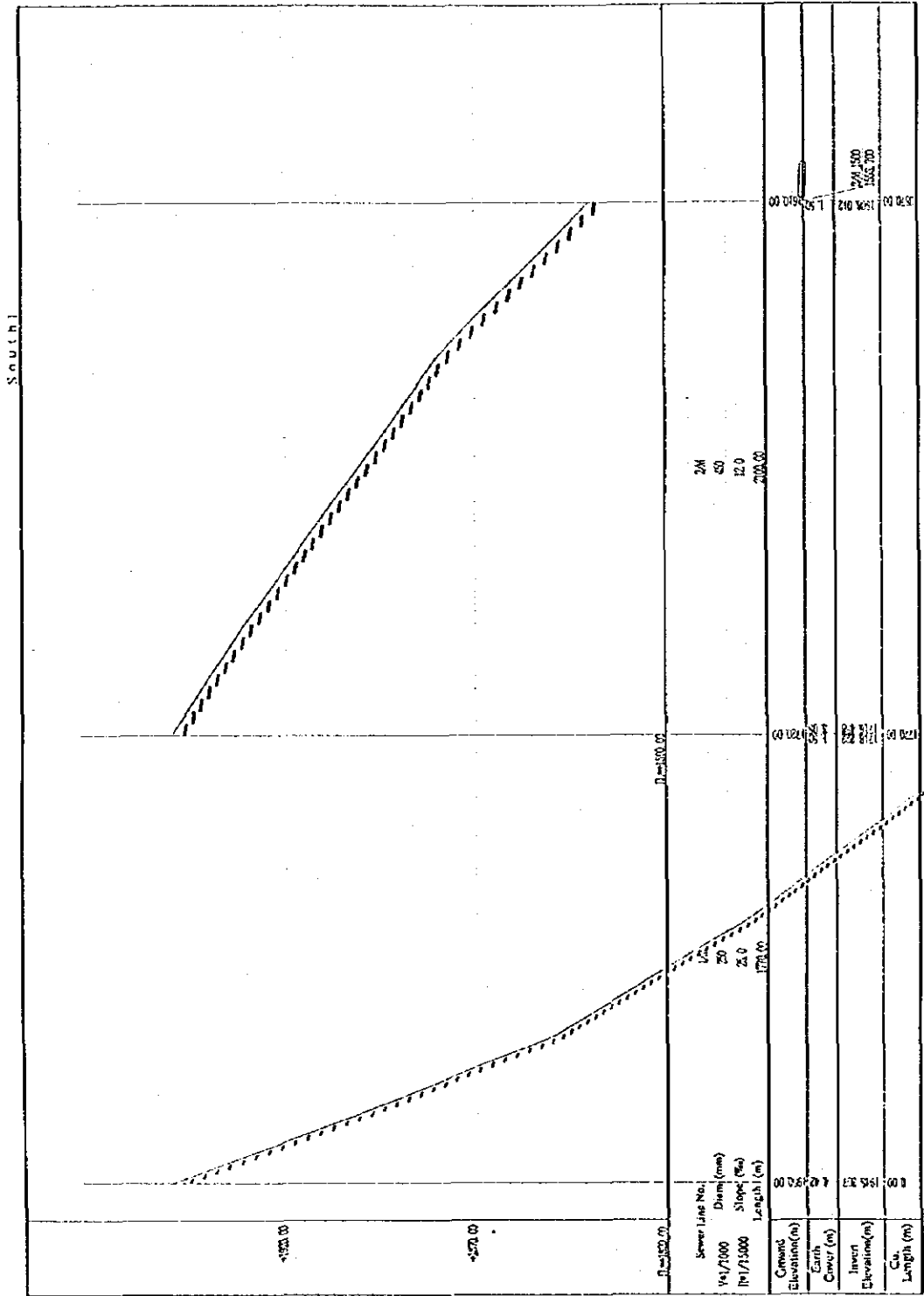
Sewer Line No.		Unit Design Flow Rate (m <sup>3</sup> /s/ha) : 0.000727										Design Sewer					Remarks	
		Wastewater Treatment District					Total Area	Design Flow Rate	Total Design Flow	Diam	Slope	Velocity	Capacity	Length	Invert Elevation	Ground Surface Elevation		Earth Cover
		In the District	Increment	Flow	Increment	Flow												
1	61.00	0.044				61.00	0.044	0.044	250	25.0	1.97	0.094	1770.00	1738.222	1720.00	1.50	4.42	
2	148.00	0.152				209.00	0.152	0.152	450	12.0	1.95	0.312	2030.00	1608.012	1610.00	1.50	3.05	
3	0.00	0.152				209.00	0.152	0.152	1500	2.6	2.04	3.604	830.00	1551.442	1610.00	56.95		
4	85.00	0.052				85.00	0.052	0.052	300	20.0	1.93	0.137	2240.00	1728.170	1720.00	1.50		
5	114.00	0.145				199.00	0.145	0.145	450	12.0	1.95	0.312	2150.00	1508.012	1610.00	1.50	4.97	
6	0.00	0.297				408.00	0.297	0.297	1500	2.6	2.04	3.604	1120.00	1500.526	1580.00	77.76		
7	110.00	0.377				518.00	0.377	0.377	1500	2.5	2.04	3.604	450.00	1499.256	1560.00	59.13		
8	74.00	0.054				74.00	0.054	0.054	300	20.0	1.93	0.137	1050.00	1658.190	1660.00	1.50		
9	108.00	0.132				182.00	0.132	0.132	450	12.0	1.95	0.312	750.00	1559.012	1560.00	1.50	3.40	
10	89.00	0.574				789.00	0.574	0.574	1500	2.6	2.04	3.604	1500.00	1466.888	1470.00	1.50	59.15	
11	75.00	0.055				75.00	0.055	0.055	300	16.0	1.73	0.122	1040.00	1578.170	1580.00	1.50		
12	52.00	0.092				127.00	0.092	0.092	350	16.0	1.92	0.185	1040.00	1548.118	1550.00	1.50	2.45	
13	94.00	0.161				221.00	0.161	0.161	500	10.0	1.92	0.378	1400.00	1497.980	1500.00	1.50	3.28	
14	0.00	0.161				221.00	0.161	0.161	1500	2.6	2.04	3.604	820.00	1401.592	1500.00	96.80		
15	81.00	0.059				81.00	0.059	0.059	300	16.0	1.73	0.122	1120.00	1538.490	1550.00	11.18		
16	119.00	0.145				200.00	0.145	0.145	450	12.0	1.95	0.312	1060.00	1495.172	1500.00	4.34		

Table L-9 - Computation Form for Main Collector Design, South 1 Region (2/2)

South 1 Region																
Sewer Line No.	Wastewater Treatment District							Design Sewer								
	In the District		Incremental		Total		Total Design Flow	Diam	Slope	Velocity	Capacity	Length	Invert Elevation	Ground Surface Elevation	Earth Cover	Remarks
	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s										
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1500	2.6	2.04	3.604	620.00	1401.972	1500.00	96.82	
18	0.00	0.880	0.00	0.880	0.00	1210.00	0.880	1500	2.6	2.04	3.604	1010.00	1399.677	1470.00	68.71	
19	82.00	0.060	0.00	0.060	0.00	82.00	0.060	300	16.0	1.73	0.122	310.00	1399.657	1470.00	68.75	
20	65.00	0.093	0.00	0.093	0.00	128.00	0.093	1500	2.5	2.04	3.604	1020.00	1396.913	1460.00	61.48	
21	162.00	0.211	0.00	0.211	0.00	290.00	0.211	1500	2.6	2.04	3.604	710.00	1460.172	1510.00	48.22	
22	27.00	1.110	0.00	1.110	0.00	1527.00	1.110	1500	2.5	2.04	3.604	970.00	1455.888	1460.00	1.50	
To the Wastewater Treatment Plant																
23	78.00	0.057	0.00	0.057	0.00	78.00	0.057	300	16.0	1.73	0.122	1020.00	1396.892	1460.00	61.50	
24	35.00	0.082	0.00	0.082	0.00	113.00	0.082	350	16.0	1.92	0.185	1360.00	1393.813	1400.00	4.58	
To the Wastewater Treatment Plant																

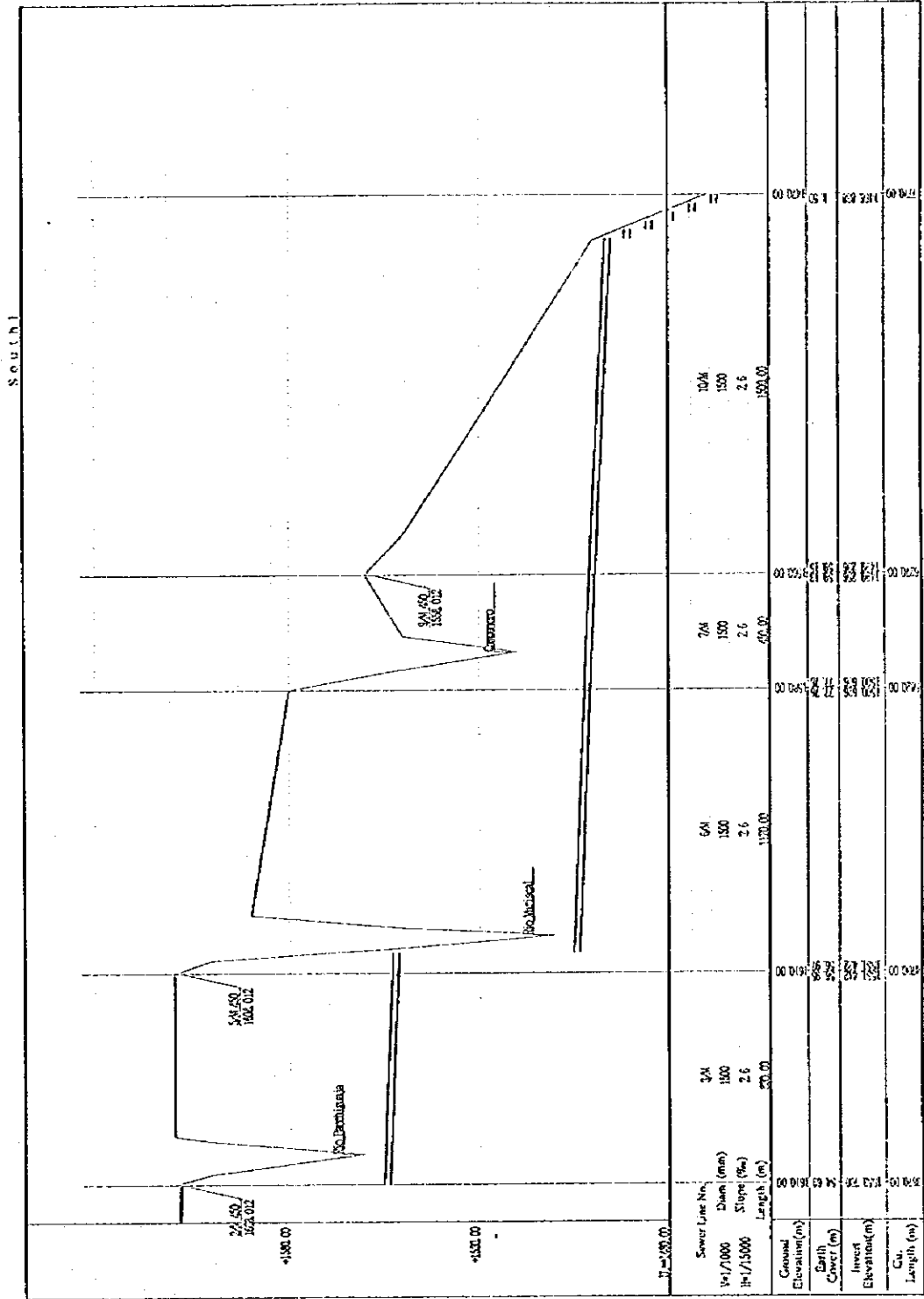


Fig. L - 16



<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 1 REGION (1/9)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	

Fig. L-17

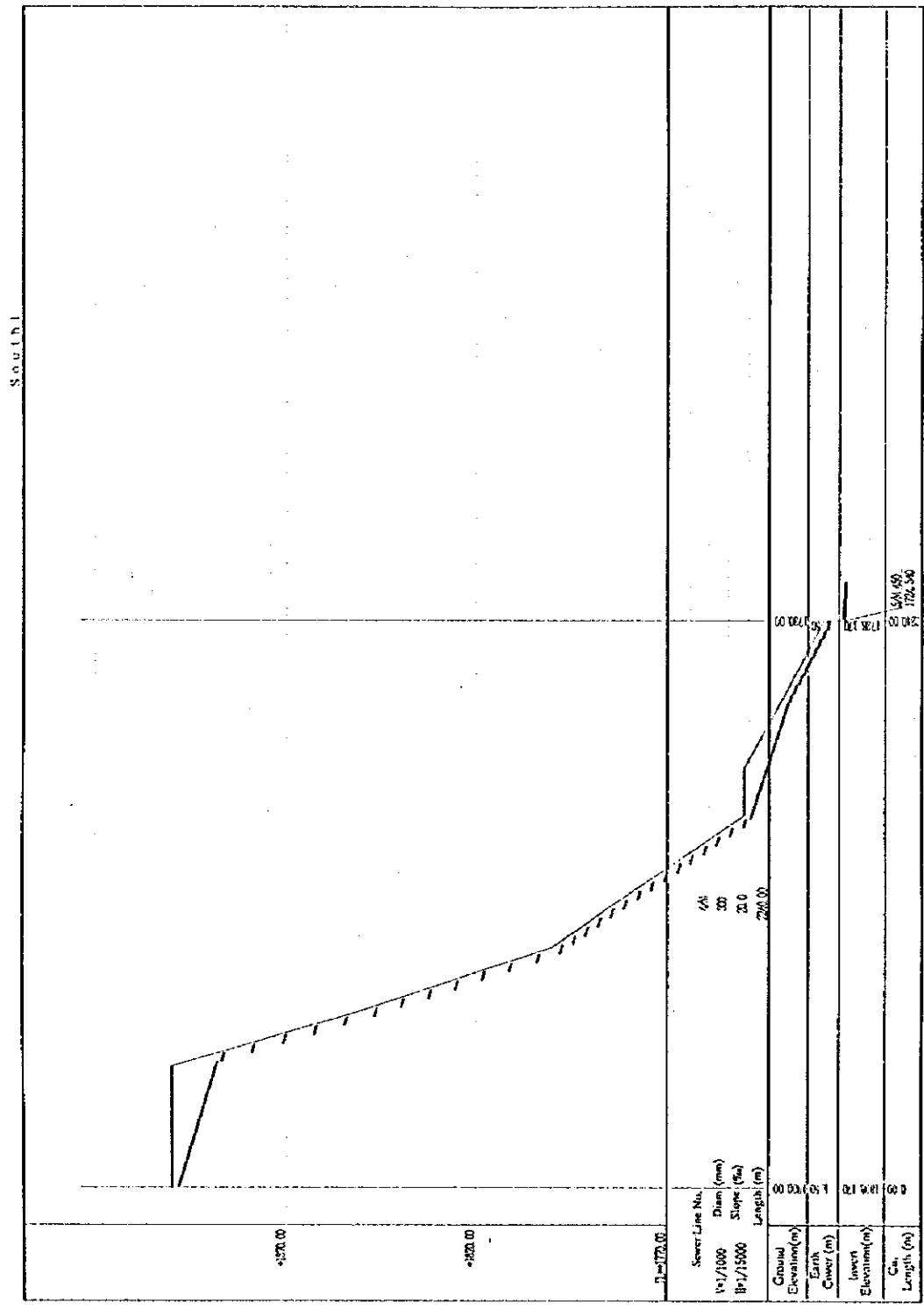


THE REPUBLIC OF GUATEMALA  
 GUATEMALA MUNICIPAL WATER  
 SUPPLY PUBLIC CORPORATION  
 (EMPAGUA)

THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 1 REGION (2/9)

Fig L - 18

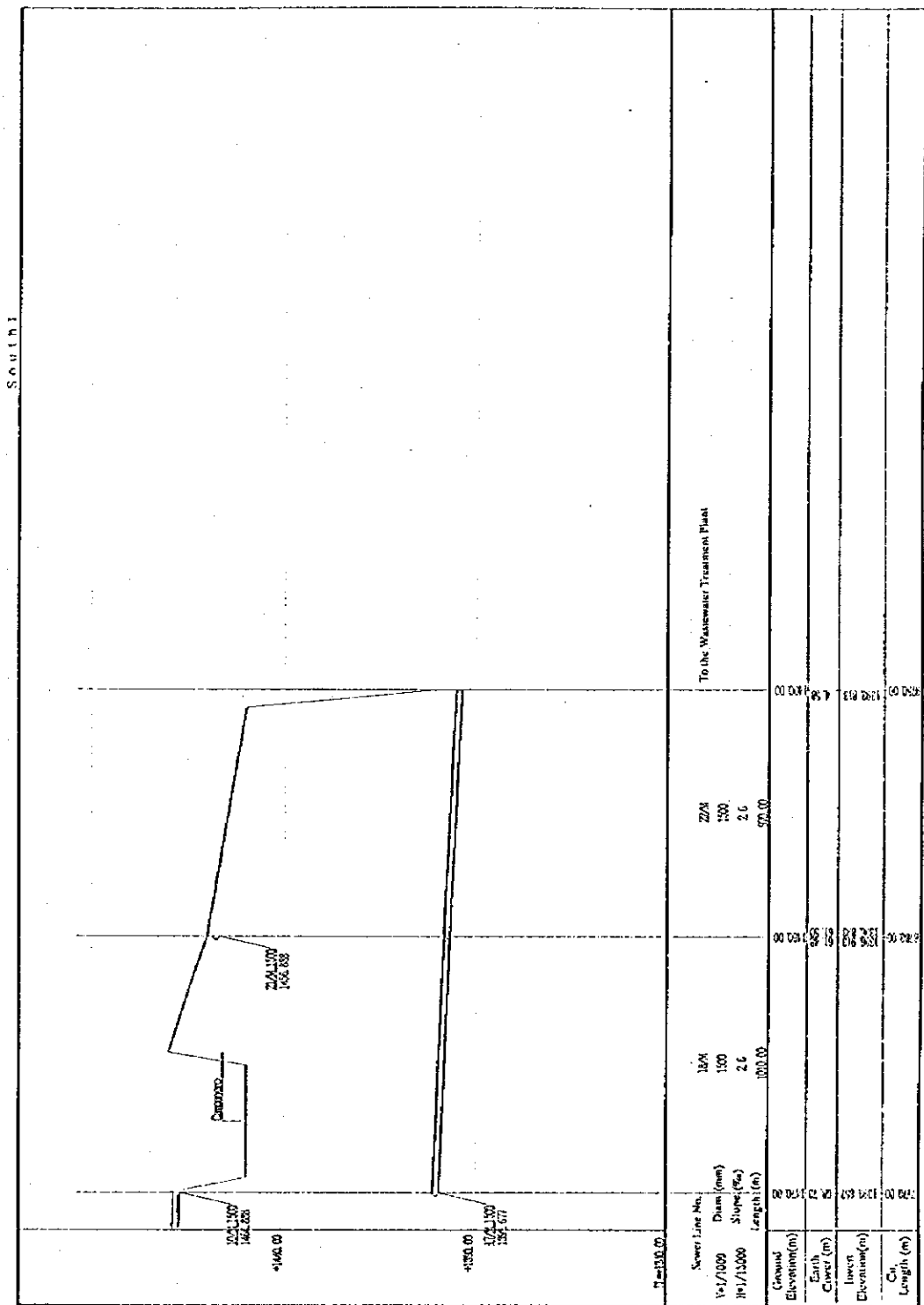


THE REPUBLIC OF GUATEMALA  
 GUATEMALA MUNICIPAL WATER  
 SUPPLY PUBLIC CORPORATION  
 (EMPAGUA)

THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 1 REGION (3/9)

Fig. L - 19

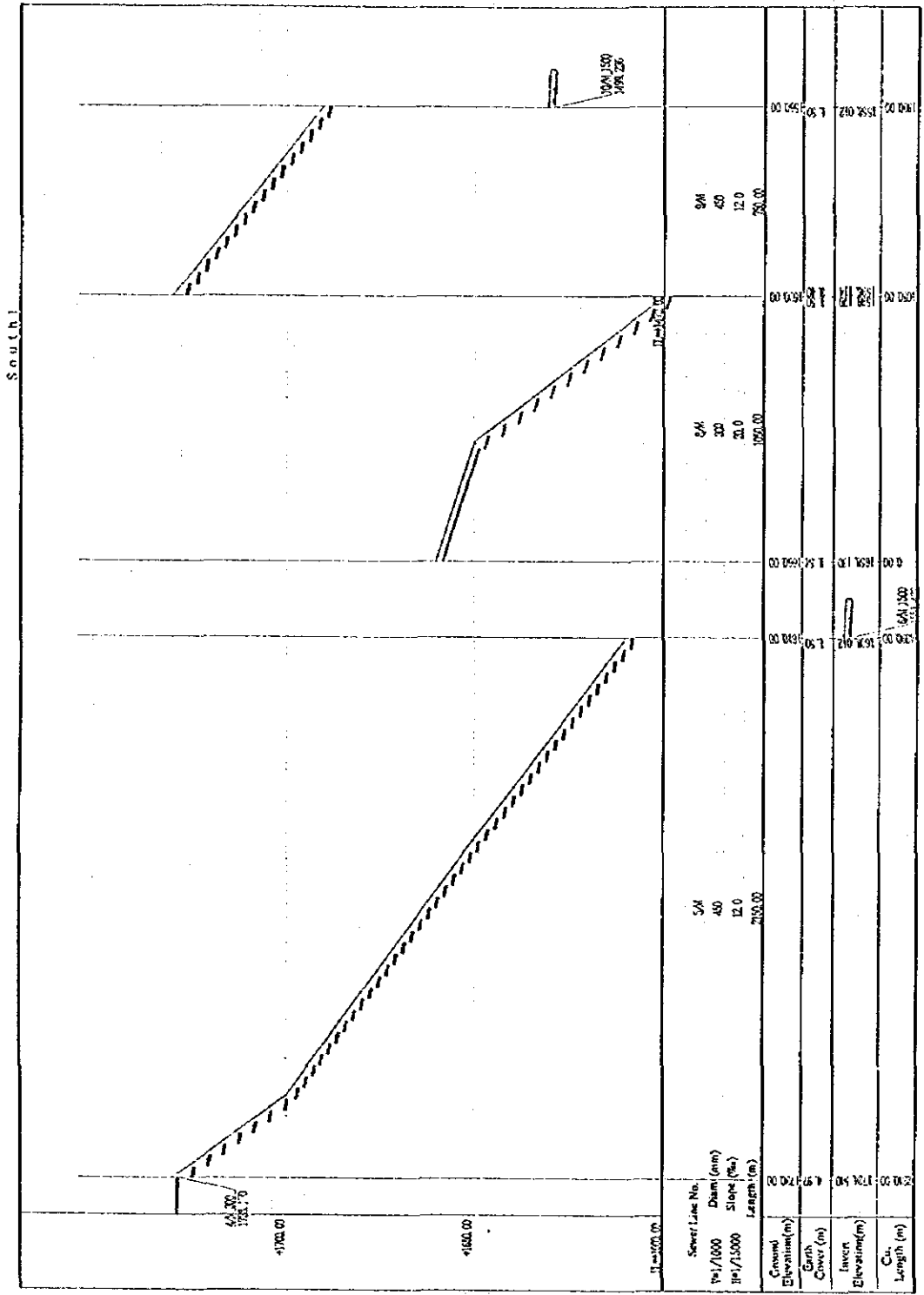


THE REPUBLIC OF GUATEMALA  
 GUATEMALA MUNICIPAL WATER  
 SUPPLY PUBLIC CORPORATION  
 (EMPAGUA)

THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 1 REGION (4/9)

Fig. L - 20

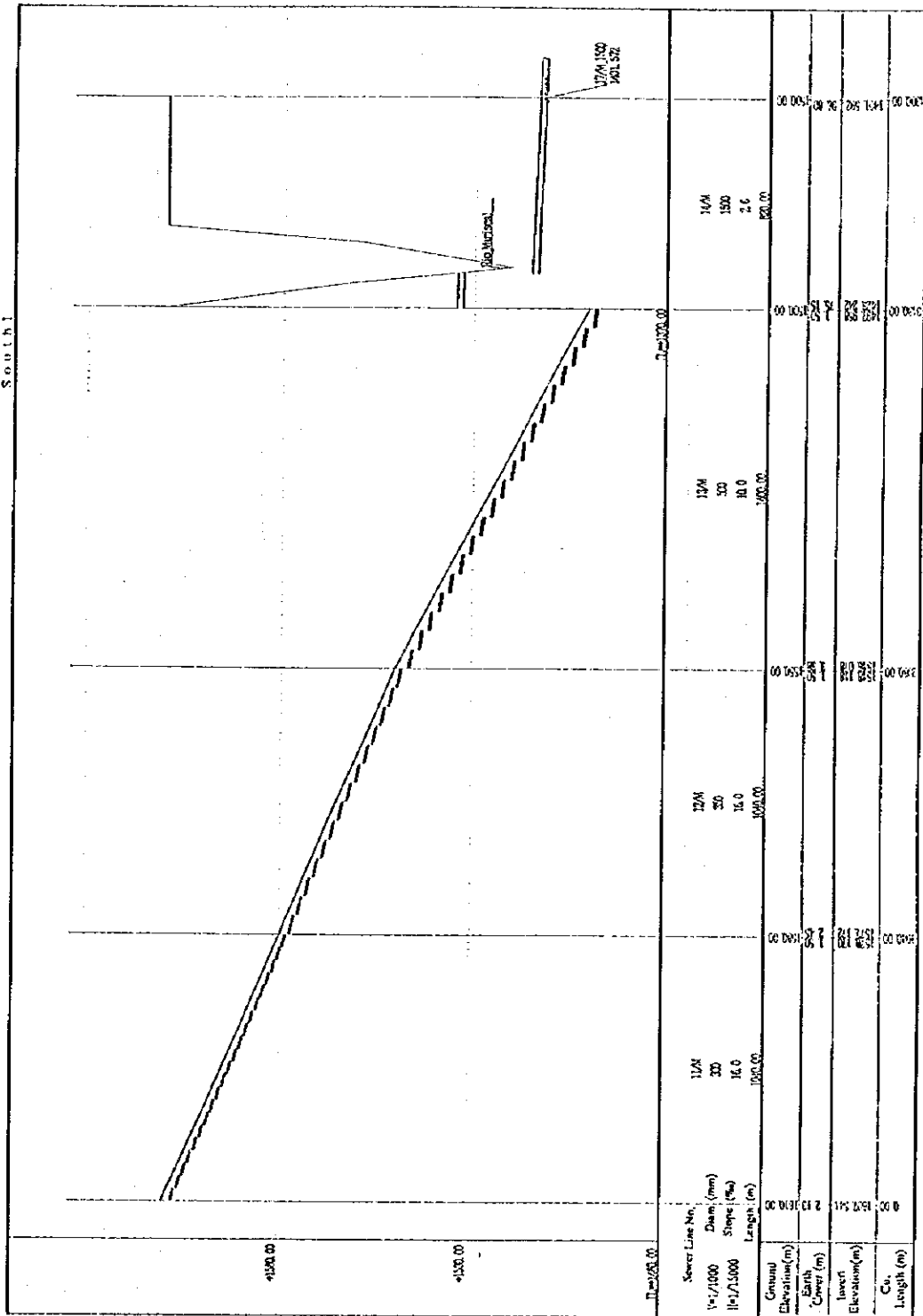


THE REPUBLIC OF GUATEMALA  
 GUATEMALA MUNICIPAL WATER  
 SUPPLY PUBLIC CORPORATION  
 (EMPAGUA)

THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

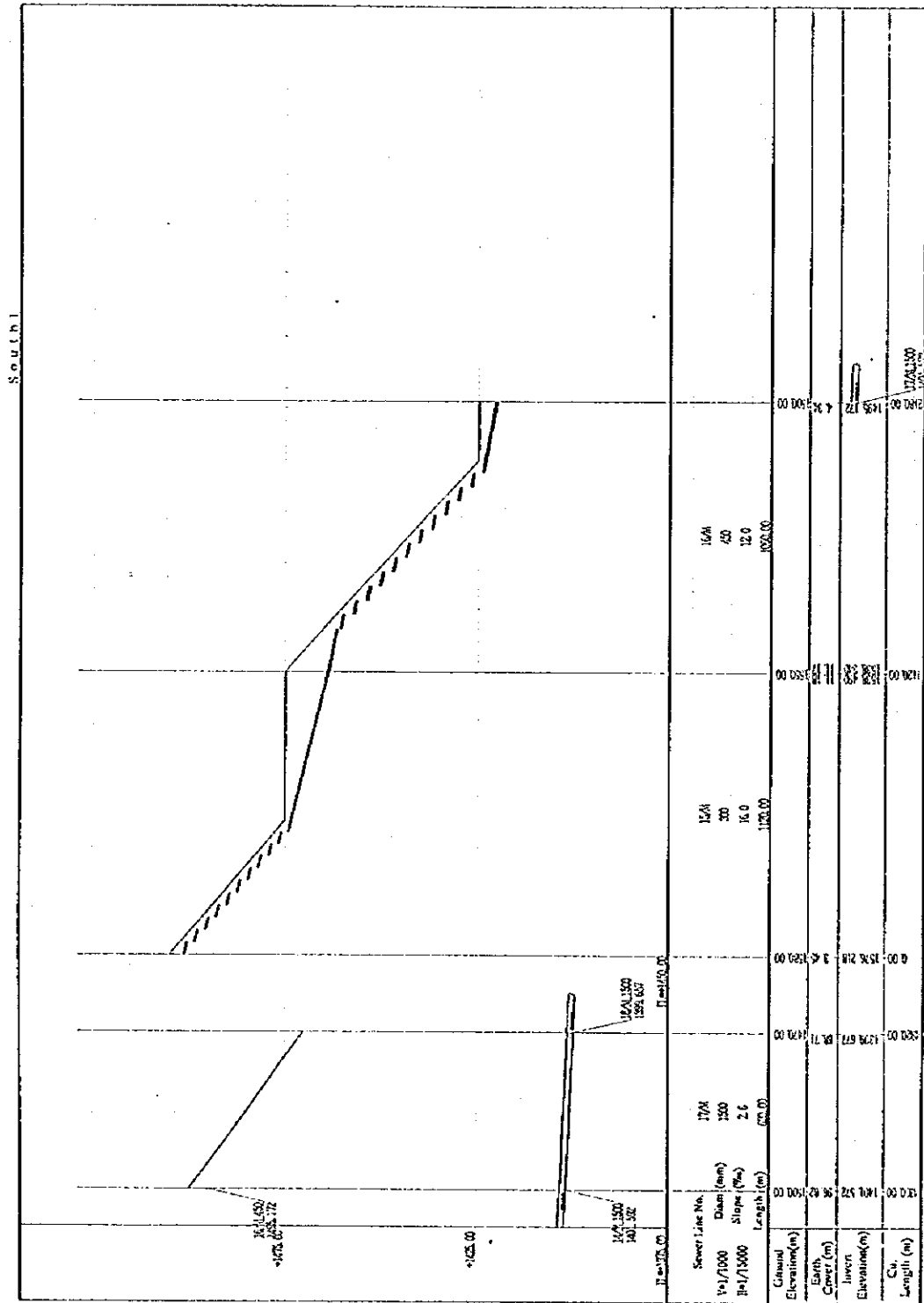
TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 1 REGION (5/9)

Fig. L - 21



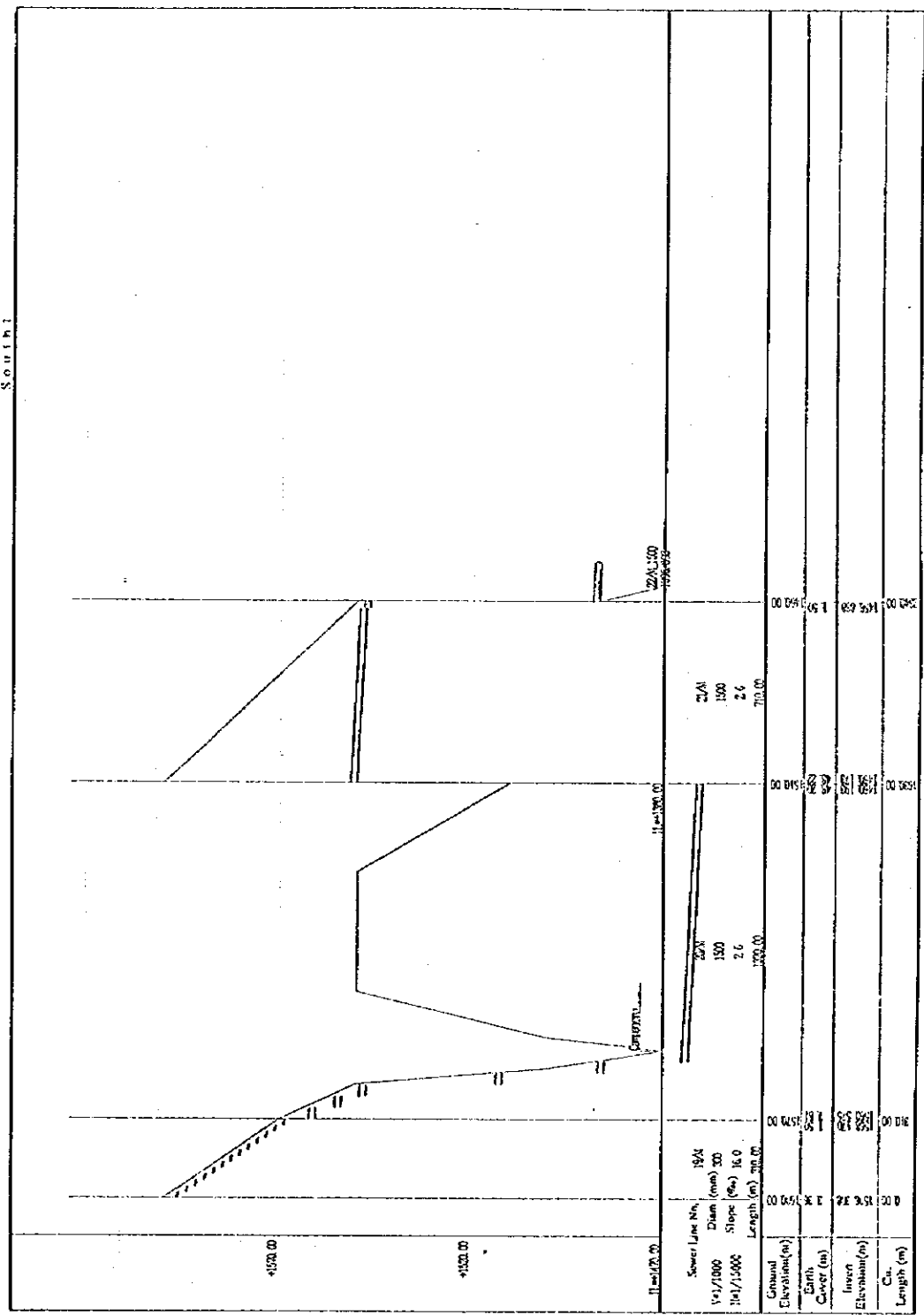
<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 1 REGION (6/9)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	

Fig. L - 22



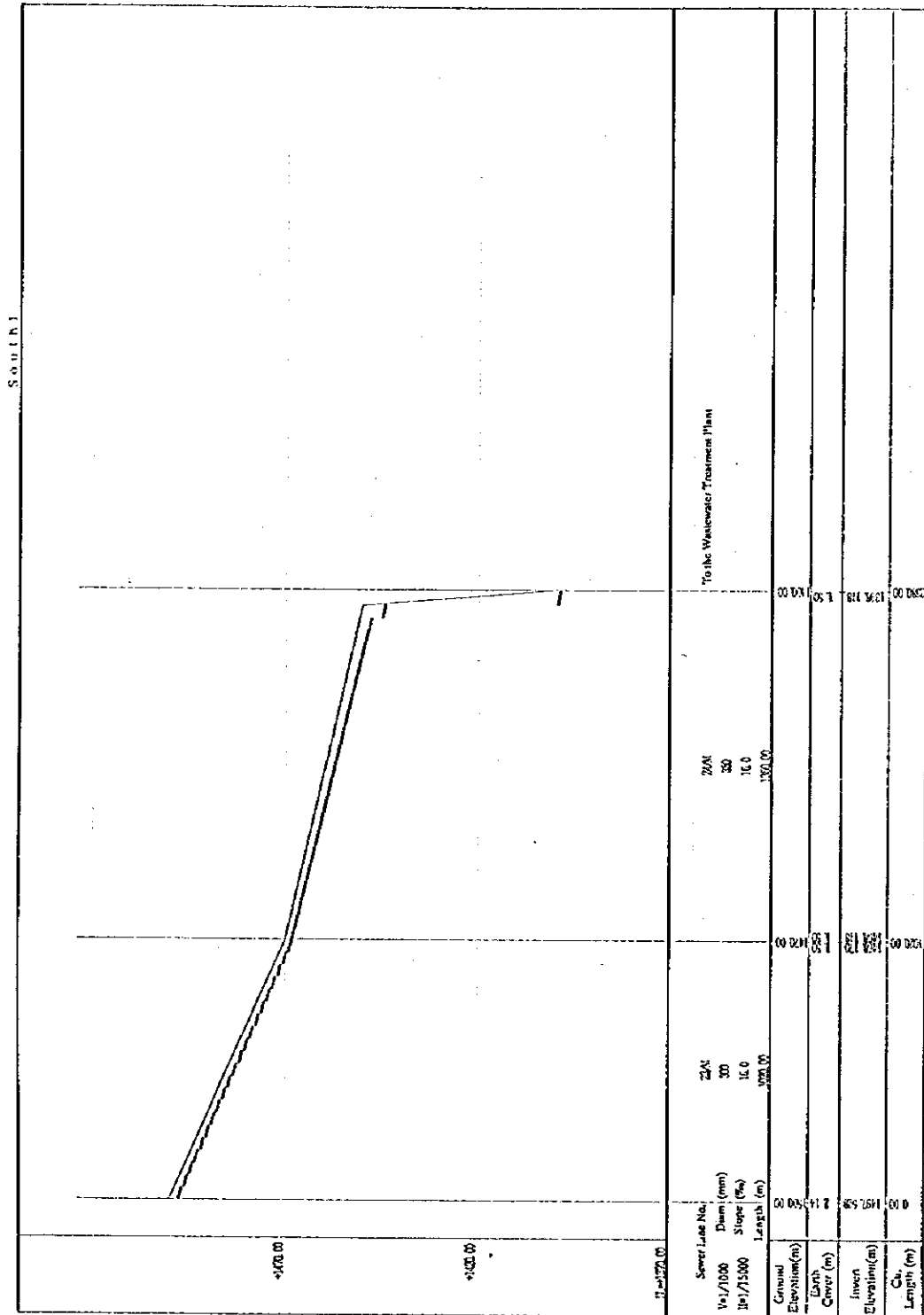
<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 1 REGION (7/9)</p>
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Fig. L - 23



<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 1 REGION (8/9)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	

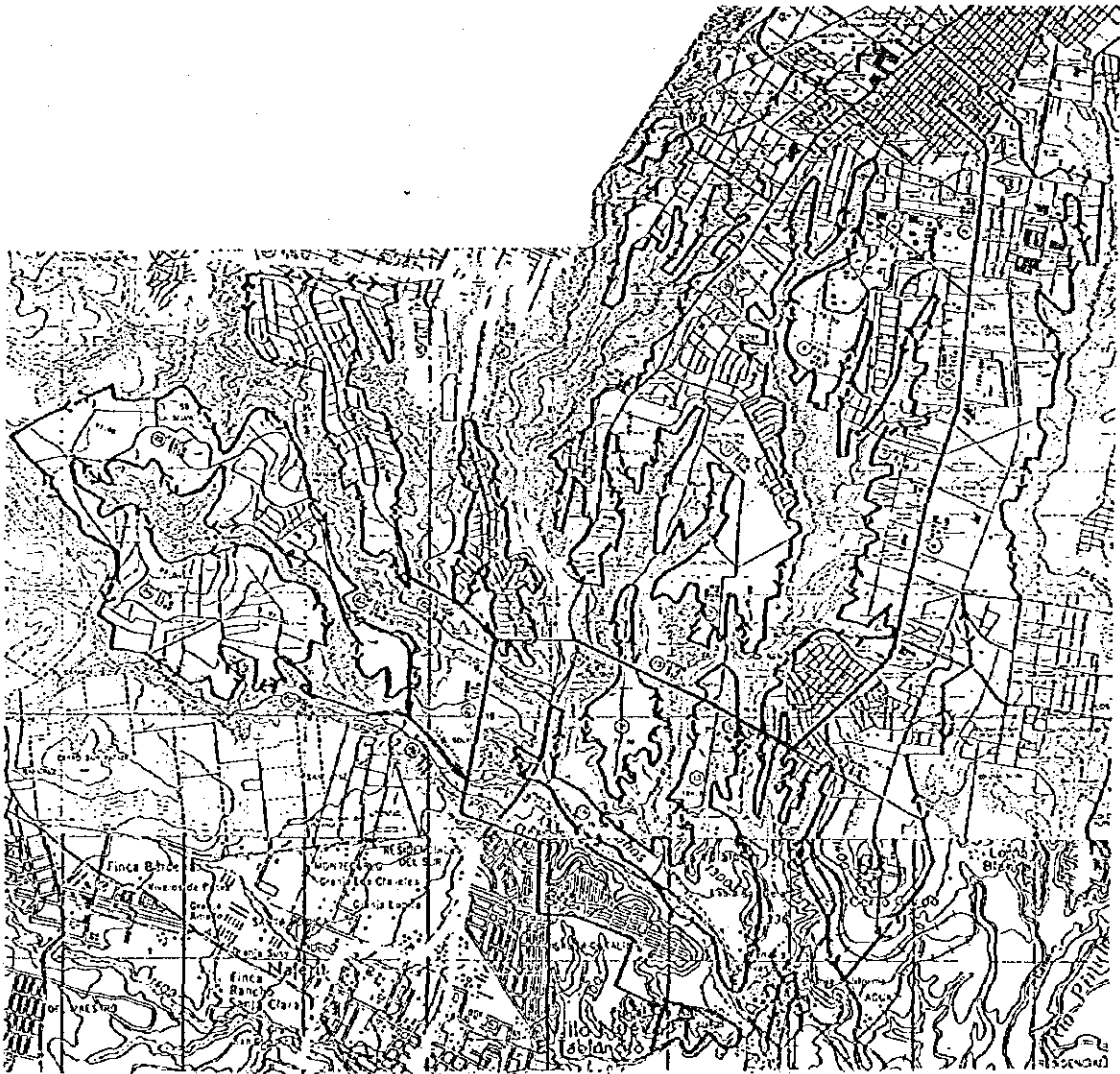




THE REPUBLIC OF GUATEMALA GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)	THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA	TITLE LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 1 REGION (9/9)
	JAPAN INTERNATIONAL COOPERATION AGENCY	

**DESIGN OF MAIN COLLECTORS  
FOR  
SOUTH 2 REGION**





<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LAYOUT OF MAIN COLLECTOR FOR SOUTH 2 WASTEWATER TREATMENT DISTRICT</p>
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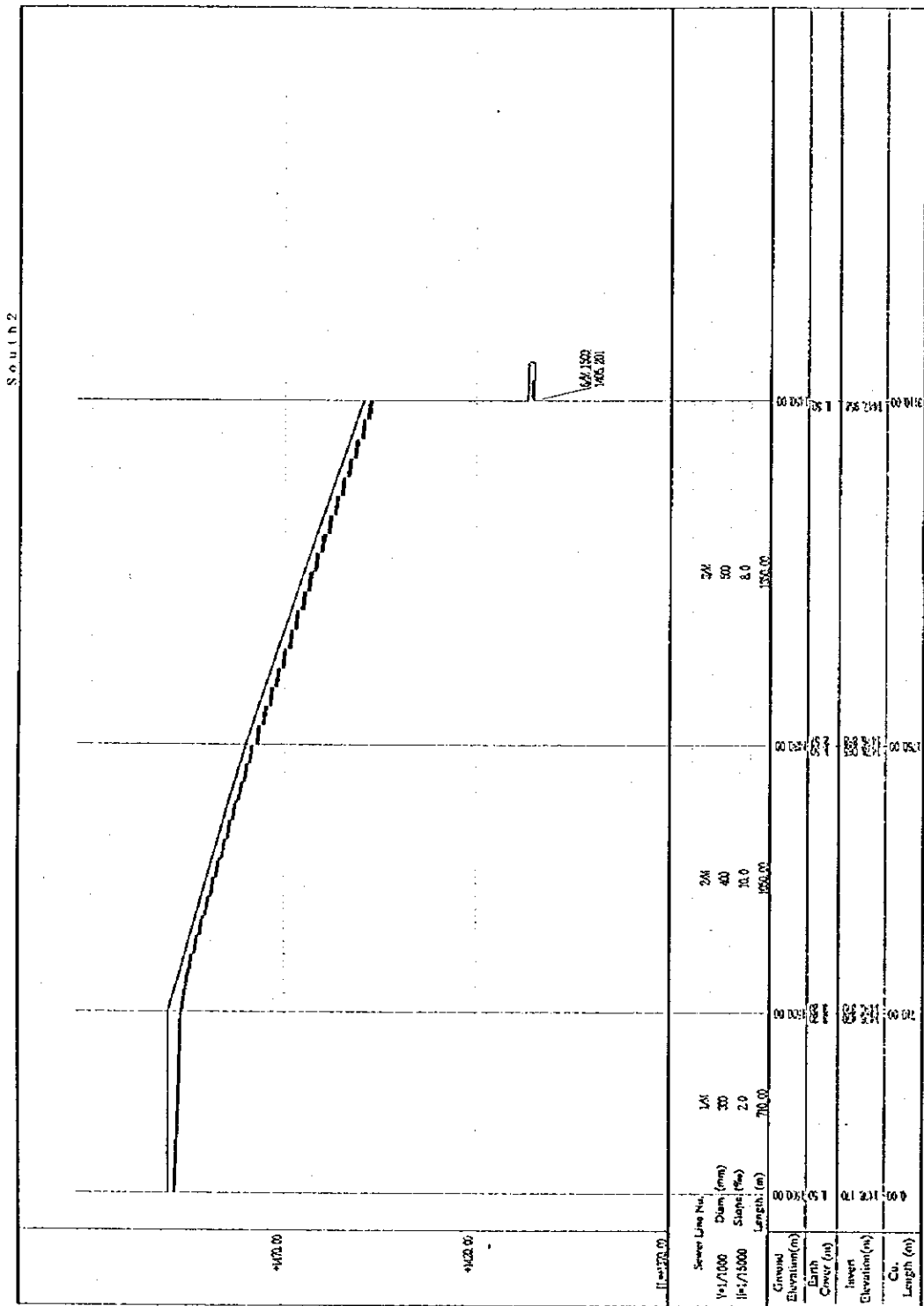
Table L-10 Computation Form for Main Collector Design, South 2 Region (1/2)

Sewer Line No.		Unit Design Flow Rate (m <sup>3</sup> /s/ha) : 0.000445											Design Sewer				Remarks							
		Wastewater Treatment District						Design Sewer																
		In the District						Total Area	Design Flow Rate	Total Design Flow	Diam	Slope							Velocity	Capacity	Length	Invert Elevation	Ground Surface Elevation	Earth Cover
		ha	ha	ha	ha	ha	ha																	
1	45.00	0.020					45.00	0.020	0.020	0.020	300	2.0	0.61	0.043	710.00	1498.170	1500.00	1.50						
2	159.00	0.095					214.00	0.095	0.095	0.095	400	10.0	1.65	0.208	1050.00	1496.370	1500.00	3.20						
3	129.00	0.153					343.00	0.153	0.153	0.153	500	8.0	1.72	0.333	1350.00	1476.888	1480.00	2.57						
6																								
4	49.00	0.022					49.00	0.022	0.022	0.022	250	10.0	1.21	0.059	990.00	1462.182	1470.00	1.54						
5	70.00	0.053					119.00	0.053	0.053	0.053	150	2.6	2.04	3.504	1260.00	1427.044	1460.00	31.34						
6	173.00	0.233					655.00	0.233	0.233	0.233	150	2.6	2.04	3.504	1500.00	1405.201	1450.00	43.19						
7	144.00	0.247					779.00	0.247	0.247	0.247	150	2.6	2.04	3.504	1260.00	1401.023	1420.00	17.37						
10																								
8	99.00	0.044					99.00	0.044	0.044	0.044	150	2.6	2.04	3.504	1100.00	1356.888	1360.00	1.50						
9	41.00	0.052					140.00	0.052	0.052	0.052	150	2.5	2.04	3.504	810.00	1353.888	1420.00	64.50						
10	0.00	0.409					919.00	0.409	0.409	0.409	150	2.6	2.04	3.504	740.00	1327.142	1390.00	41.24						
13																								
11	101.00	0.045					101.00	0.045	0.045	0.045	250	25.0	1.92	0.094	1460.00	1448.102	1450.00	1.62						
12	49.00	0.057					150.00	0.057	0.057	0.057	300	20.0	1.93	0.137	1260.00	1408.222	1410.00	1.50						
13	124.00	0.531					1193.00	0.531	0.531	0.531	150	2.5	2.04	3.504	890.00	1312.547	1380.00	65.84						
14	78.00	0.566					1271.00	0.566	0.566	0.566	150	2.6	2.04	3.504	465.00	1310.289	1390.00	78.10						
18																								
15	135.00	0.060					135.00	0.060	0.060	0.060	350	9.0	1.44	0.158	2040.00	1478.118	1480.00	1.50						
16	132.00	0.119					267.00	0.119	0.119	0.119	450	9.0	1.70	0.270	1670.00	1477.370	1480.00	2.14						

Table L-1.1: Computation Form for Main Collector Design, South 2 Region (2/2)

South 2 Region		Unit Design Flow Rate (m <sup>3</sup> /s/ha) : 0.000445														
Sewer Line No.	To Sewer No.	Wastewater Treatment District						Design Sewer						Remarks		
		In the District		Flow Increment		Total Area	Design Flow Rate	Total Design Flow	Diam	Slope	Velocity Capacity	Length	Invert Elevation		Ground Surface Elevation	Earth Surface Cover
		ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s											
17		179.00	0.396	0.176		396.00	0.176	0.176	300	9.0	1.82	0.358	2470.00	1446.782	1450.00	2.88
18		0.00	1667.00	0.742		1667.00	0.742	0.742	1500	2.6	2.04	3.604	650.00	1291.930	1390.00	96.46
19		132.00	0.059			132.00	0.059	0.059	300	20.0	1.98	0.137	3090.00	1429.170	1440.00	1.50
20		0.00	132.00	0.059		132.00	0.059	0.059	1500	2.6	2.04	3.604	860.00	1315.165	1390.00	73.22
21		51.00	1860.00	0.828		1860.00	0.828	0.828	1500	2.6	2.04	3.604	1170.00	1288.108	1310.00	20.28
22		97.00	0.043			97.00	0.043	0.043	250	25.0	1.92	0.094	2130.00	1496.222	1500.00	1.50
23		83.00	180.00	0.080		180.00	0.080	0.080	350	16.0	1.92	0.185	2640.00	1314.618	1320.00	5.00
24		93.00	0.041			93.00	0.041	0.041	250	25.0	1.92	0.094	2560.00	1438.222	1440.00	1.50
25		87.00	180.00	0.080		180.00	0.080	0.080	350	16.0	1.92	0.185	2070.00	1318.118	1320.00	1.50
26		0.00	350.00	0.160		350.00	0.160	0.160	500	10.0	1.92	0.378	720.00	1397.088	1310.00	4.99
27		0.00	2220.00	0.988		2220.00	0.988	0.988	1500	2.6	2.04	3.604	3050.00	1279.215	1320.00	39.17
		To the Wastewater Treatment Plant														

Fig L - 26



THE REPUBLIC OF GUATEMALA

GUATEMALA MUNICIPAL WATER  
SUPPLY PUBLIC CORPORATION  
(EMPAGUA)

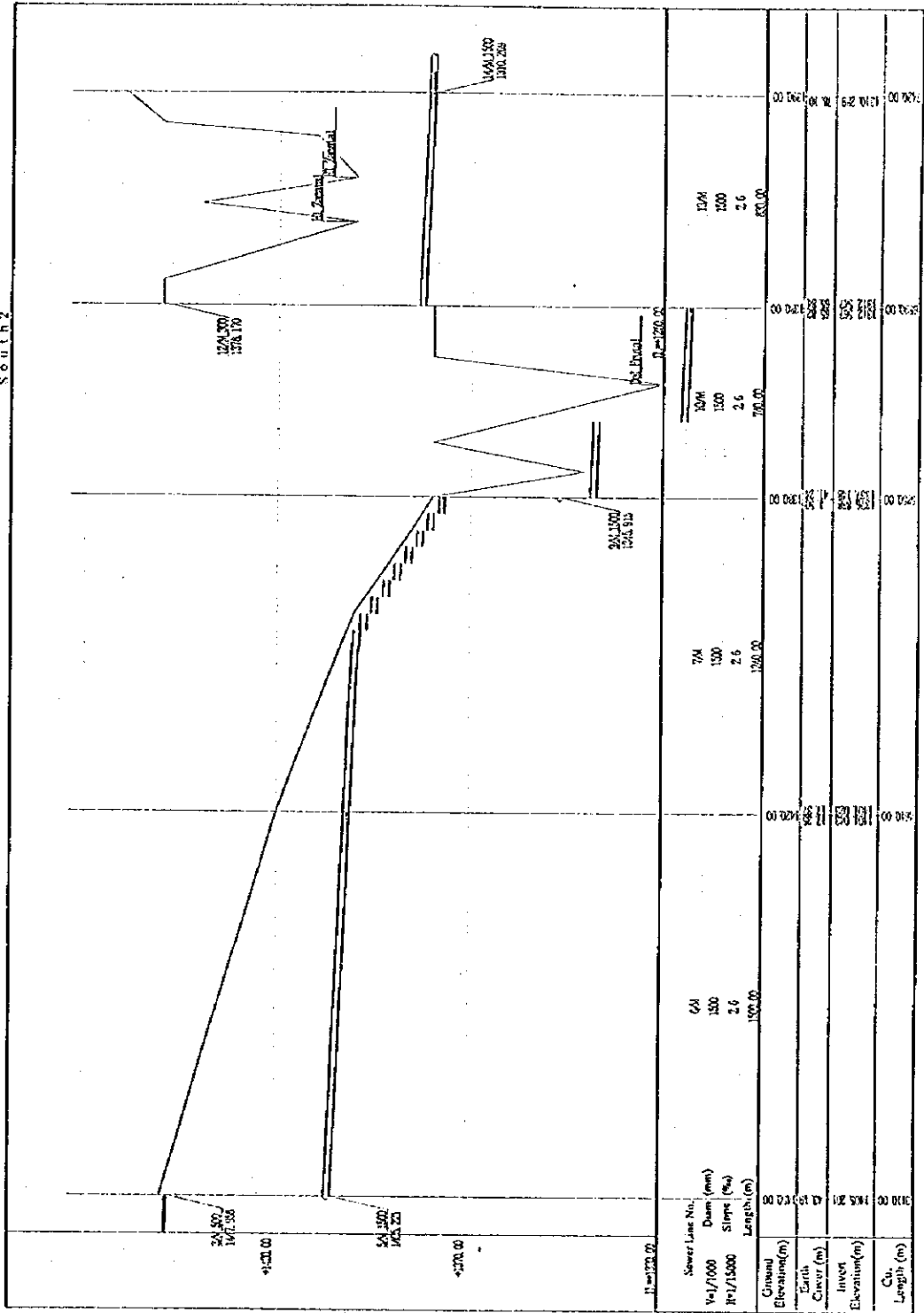
THE STUDY ON  
THE IMPROVEMENT OF WASTEWATER  
MANAGEMENT IN THE GUATEMALA  
METROPOLITAN AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE

LONGITUDINAL SECTION OF  
MAIN COLLECTOR SEWER  
FOR SOUTH 2 REGION (1/14)

Fig. L - 27

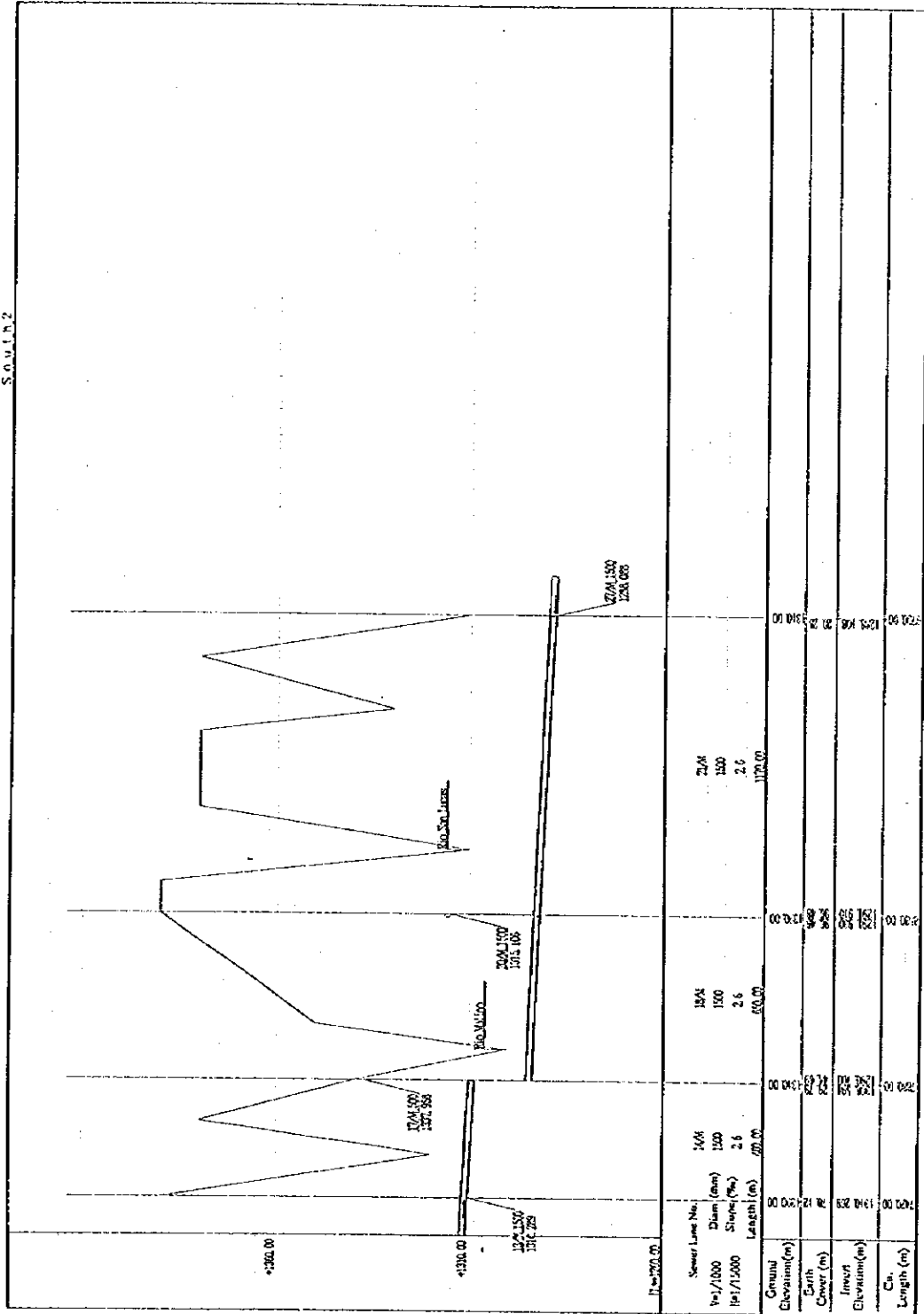


<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 2 REGION (2/14)</p>
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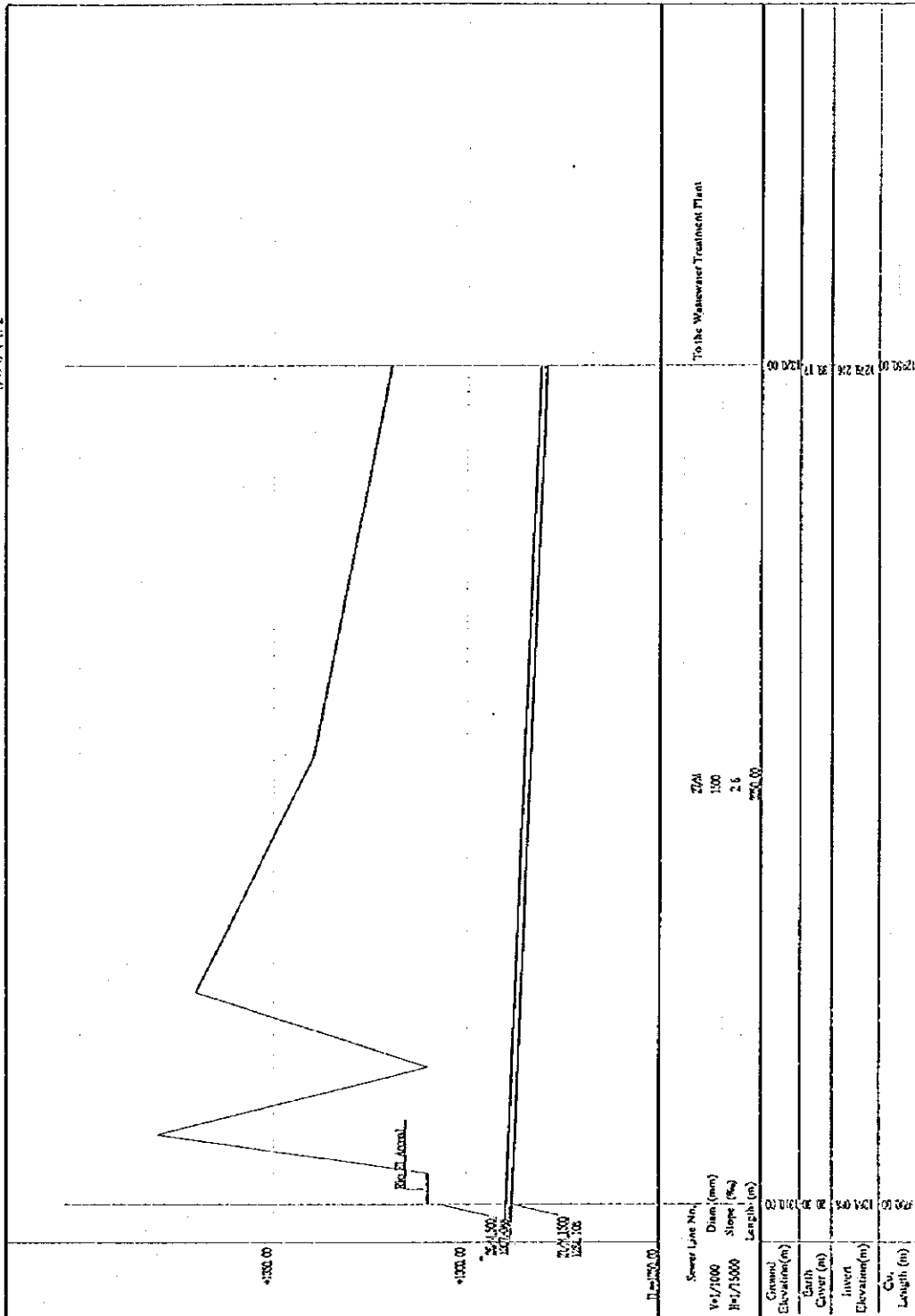
Fig. L - 28

S.O.V.L.B.2



THE REPUBLIC OF GUATEMALA  GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)	THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA	TITLE  LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 2 REGION (3/14)
	JAPAN INTERNATIONAL COOPERATION AGENCY	

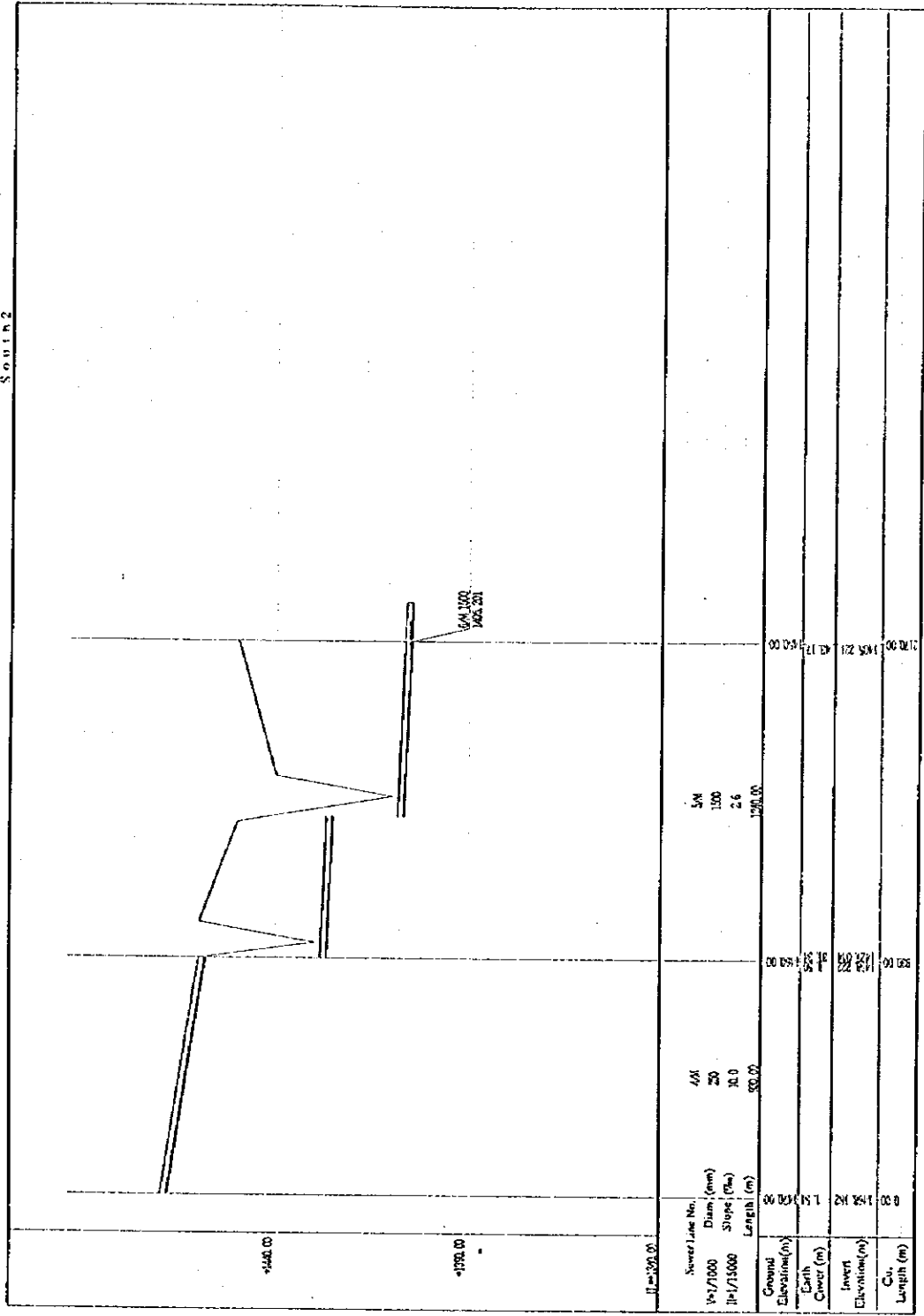
South 2



<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 2 REGION (4/14)</p>
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Fig. L - 30

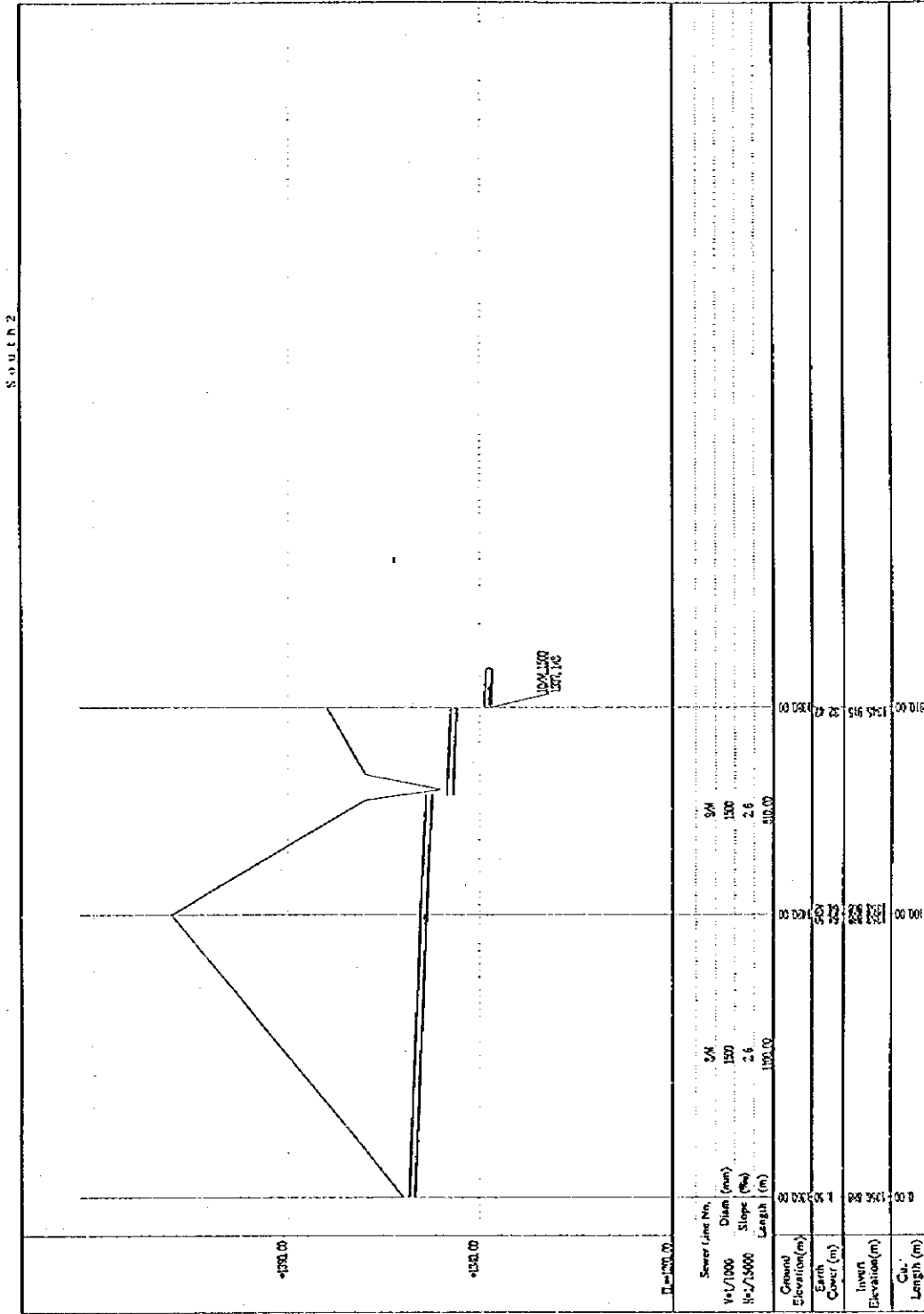
South 2



THE REPUBLIC OF GUATEMALA  
 GUATEMALA MUNICIPAL WATER  
 SUPPLY PUBLIC CORPORATION  
 (EMPAGUA)

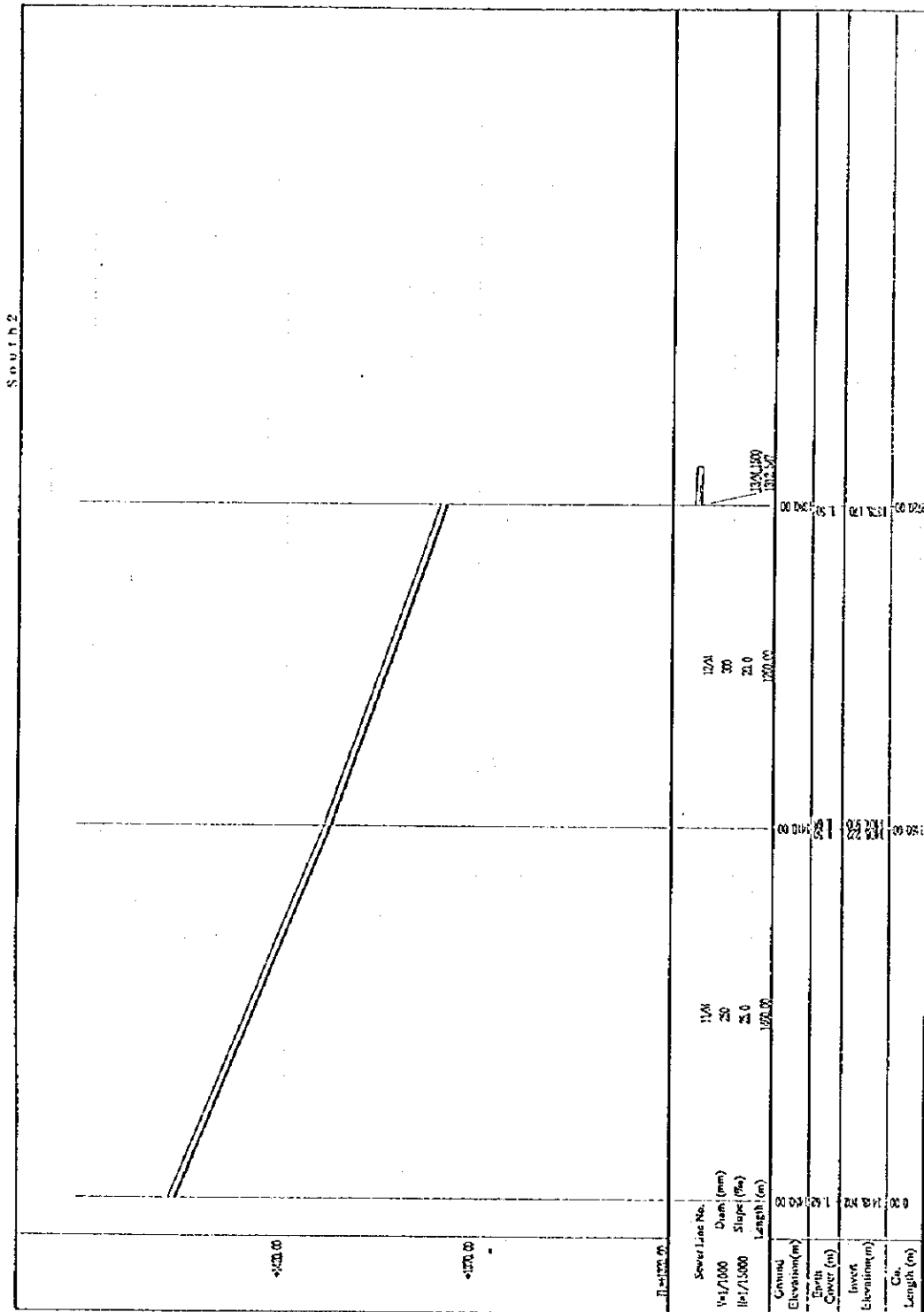
THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 2 REGION (5/14)

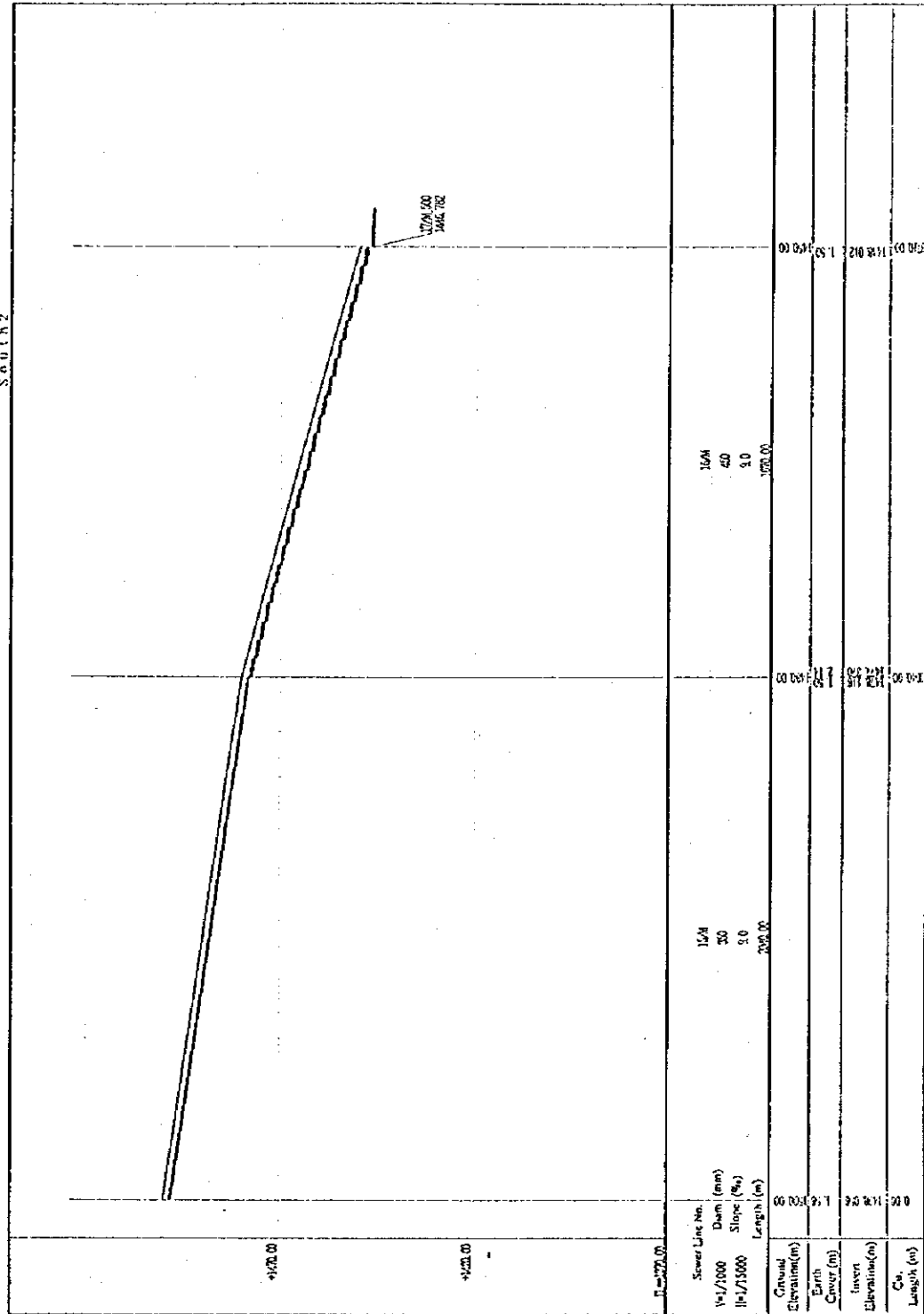


<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 2 REGION (6/14)</p>
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Fig. L - 32



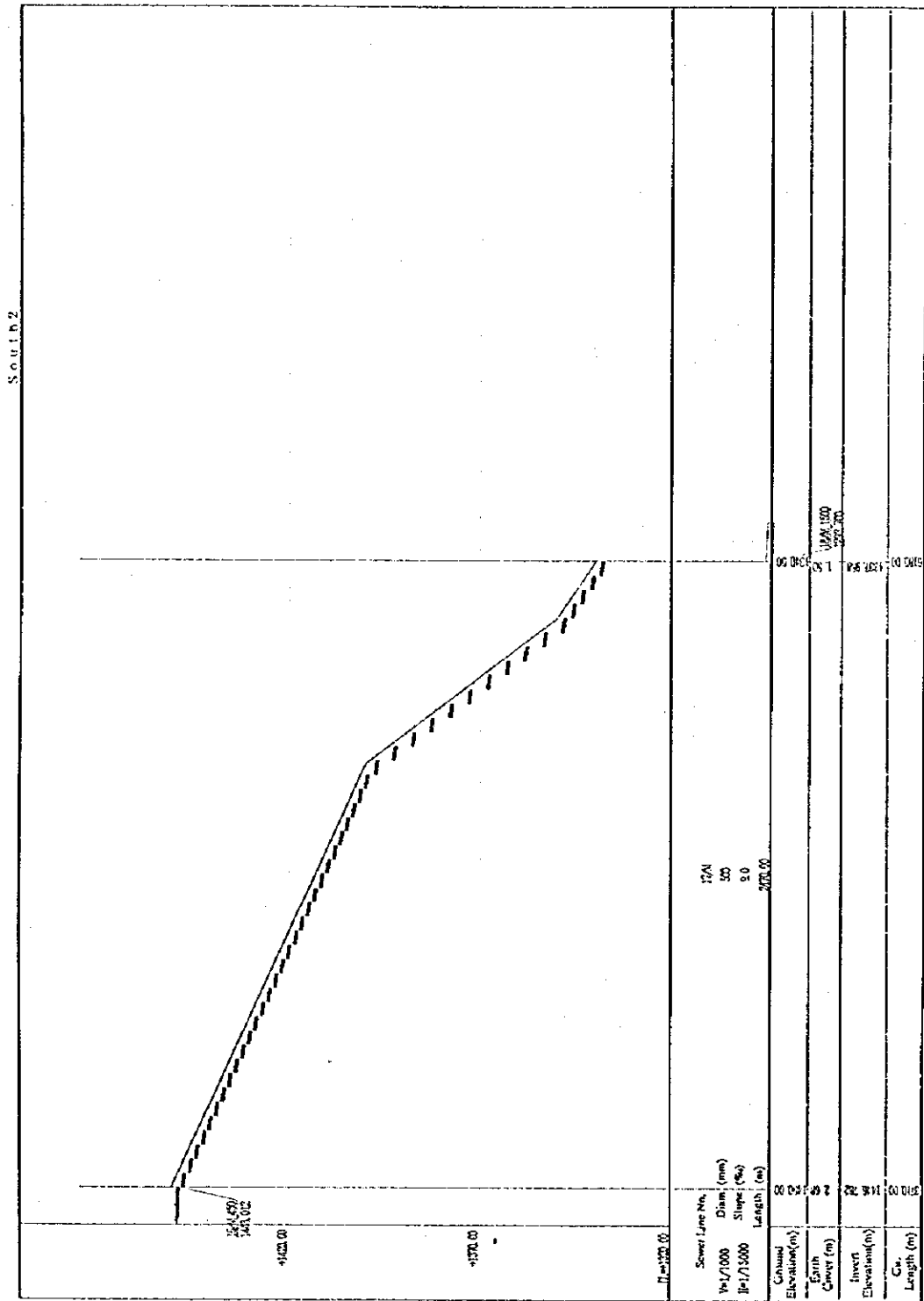
<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 2 REGION (7/14)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	



Station	0+00.00	0+200.00	0+400.00	0+600.00	0+800.00	0+1000.00
Ground Elevation (m)	1204.00	1204.00	1204.00	1204.00	1204.00	1204.00
Earth Cover (m)	0.00	0.00	0.00	0.00	0.00	0.00
Invert Elevation (m)	1204.00	1204.00	1204.00	1204.00	1204.00	1204.00
Ce. Length (m)	0.00	0.00	0.00	0.00	0.00	0.00

<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 2 REGION (8/14)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	

Fig. L - 34



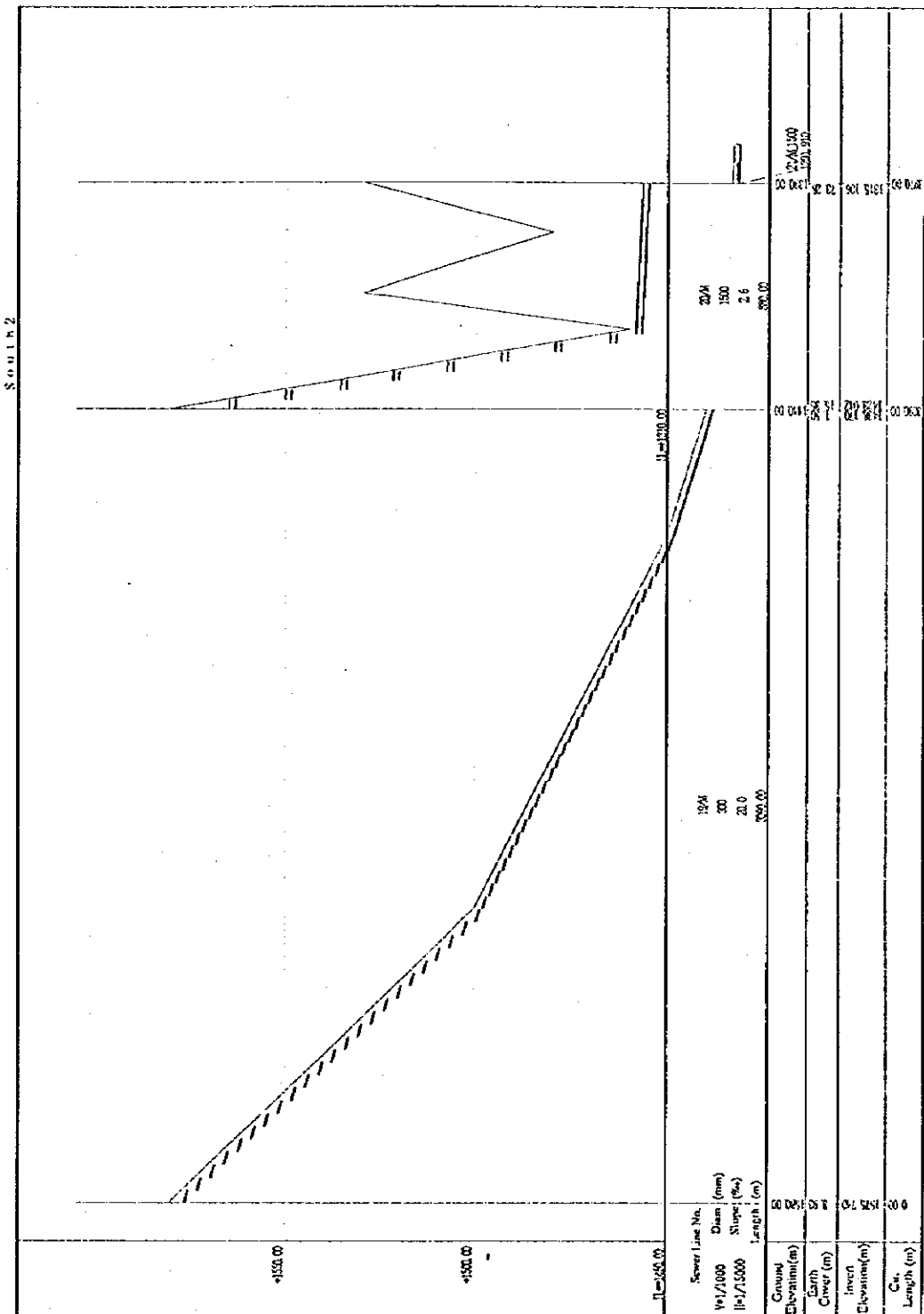
THE REPUBLIC OF GUATEMALA  
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 (EMPAGUA)

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 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 2 REGION (9/14)

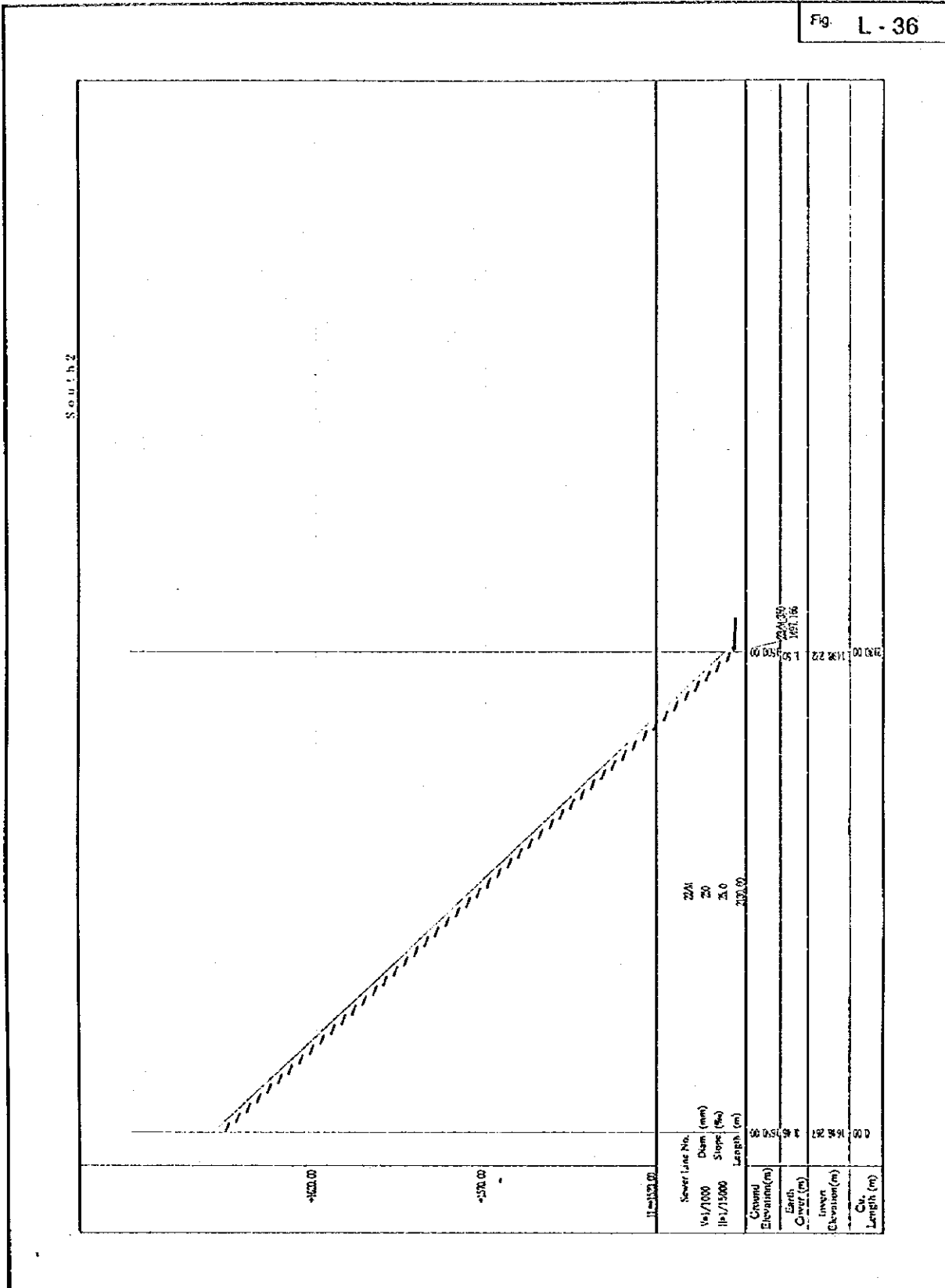
Fig. L - 35



<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 2 REGION (10/14)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	



Fig. L - 36

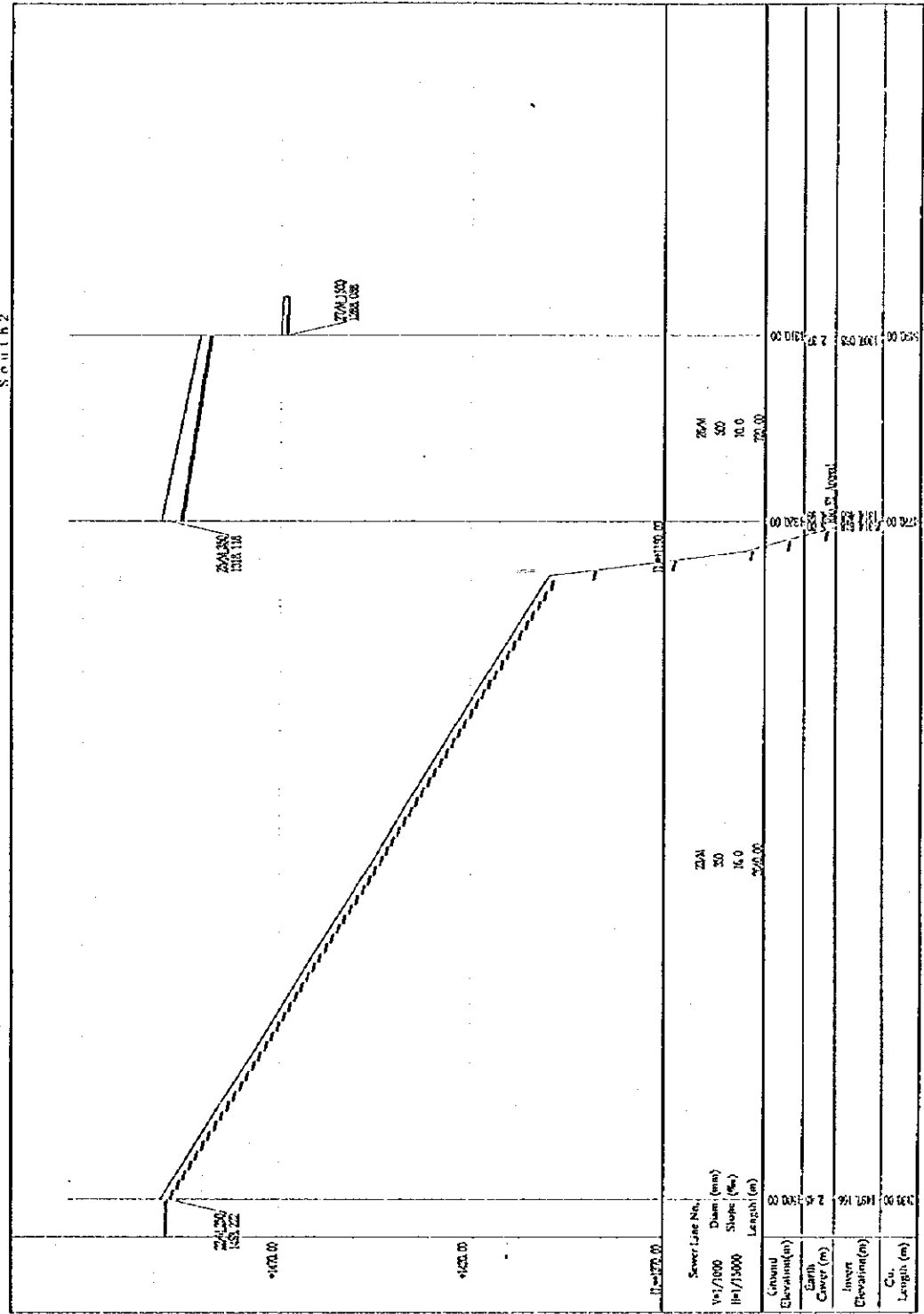


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 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
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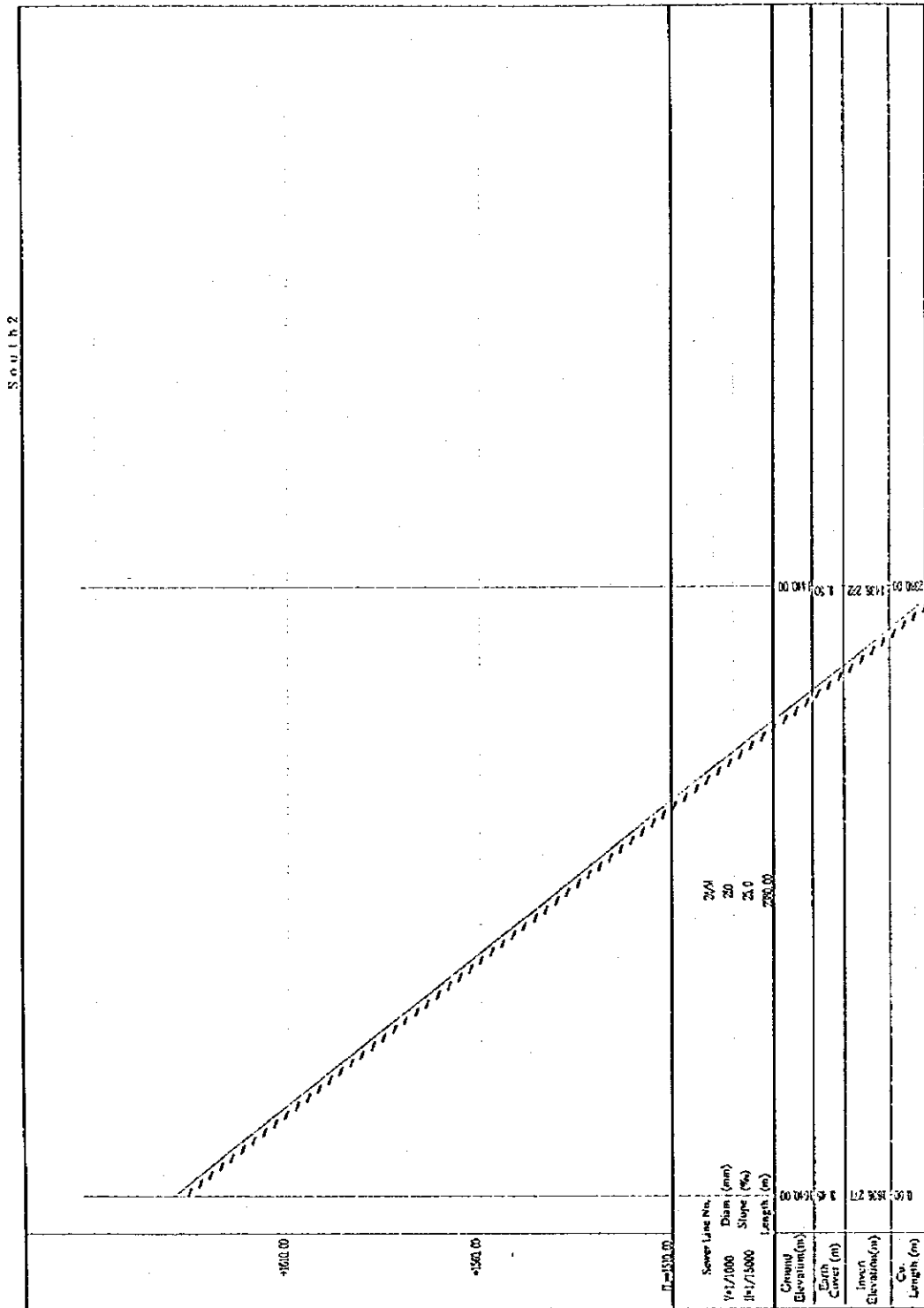
TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 2 REGION (11/14)

Fig. L - 37



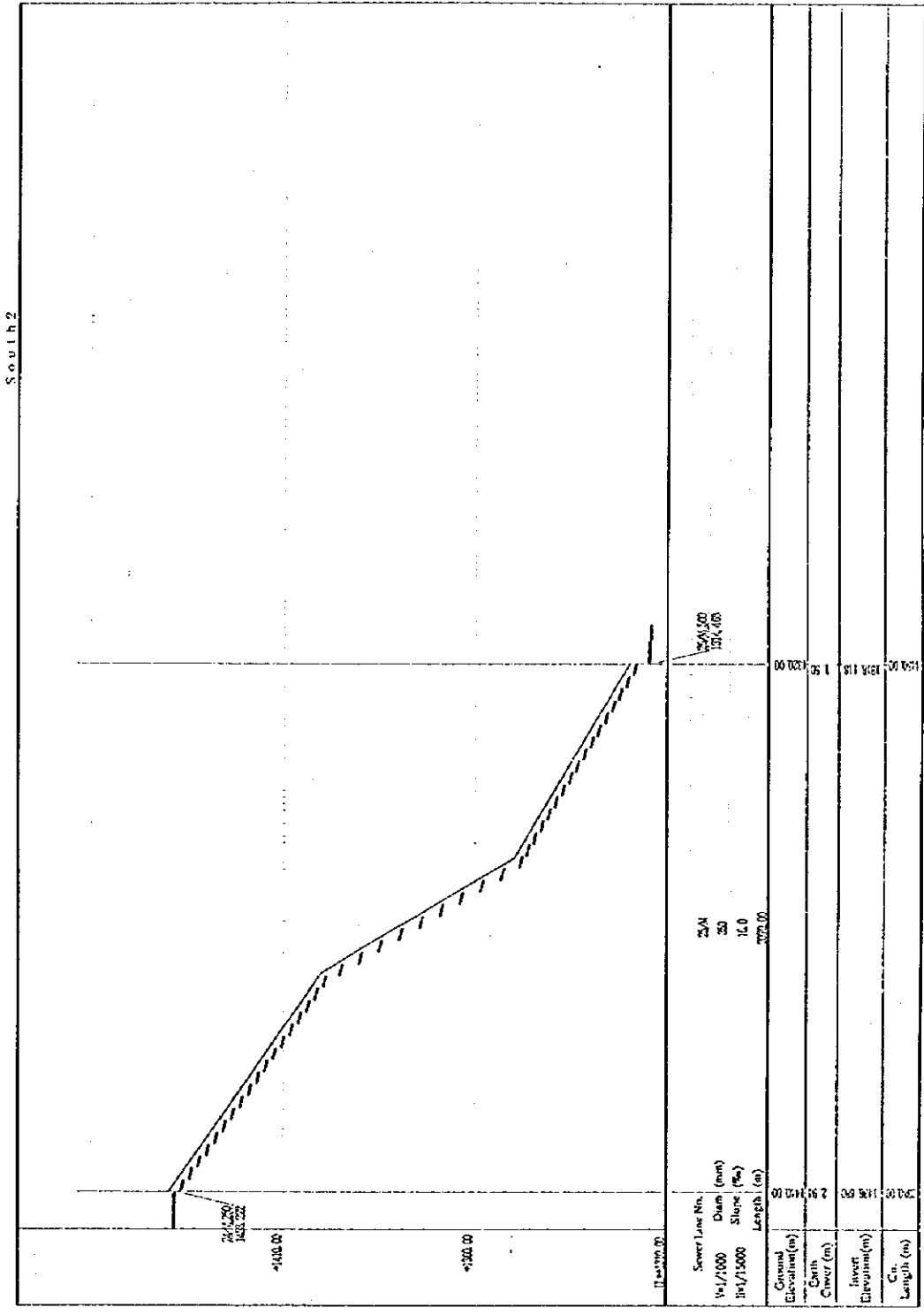
<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 2 REGION (12/14)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	

Fig. L - 38



THE REPUBLIC OF GUATEMALA GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)	THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA	TITLE LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 2 REGION (13/14)
	JAPAN INTERNATIONAL COOPERATION AGENCY	

Fig. L - 39



THE REPUBLIC OF GUATEMALA  
 GUATEMALA MUNICIPAL WATER  
 SUPPLY PUBLIC CORPORATION  
 (EMPAGUA)

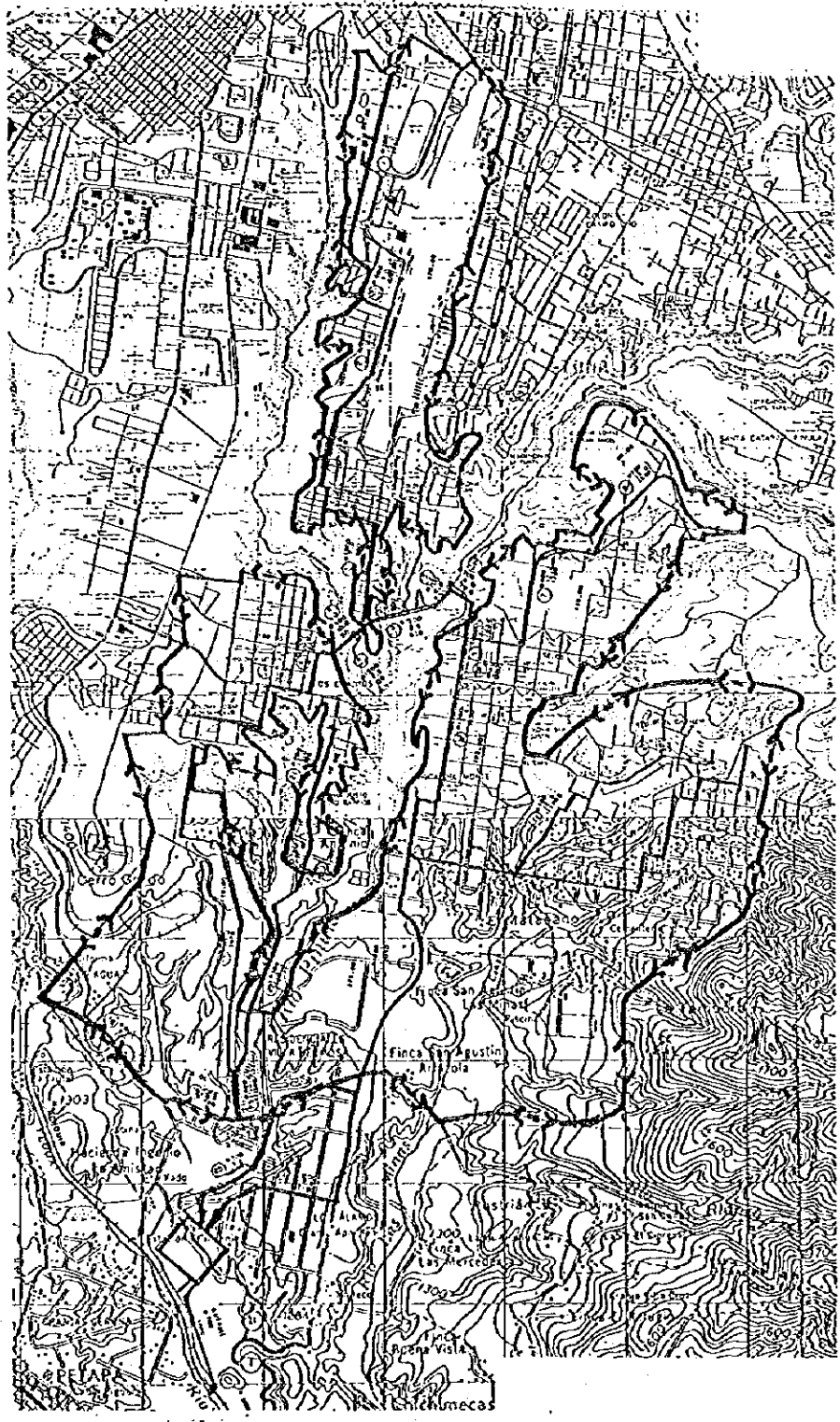
THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 2 REGION (14/14)



**DESIGN OF MAIN COLLECTORS  
FOR  
SOUTH 3 REGION**





<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LAYOUT OF MAIN COLLECTOR FOR SOUTH 3 WASTEWATER TREATMENT DISTRICT</p>
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Table L - 12 Computation Form for Sewer Design, South 3 Region (1/3)

Sewer Line No.		South 3 Region										Unit Design Flow Rate (m <sup>3</sup> /ha) : 0.000522 (In the District) / 0.000522 (Airport)										Design Sewer				Remarks	
		Wastewater Treatment District					Airport					Total Design Flow	Design Flow Rate	Diam.	Slope	Velocity	Gravity Length	Invert Elevation	Ground Surface Elevation	Earth Cover							
		In the District		Airport		Total Area	Flow	Flow	Flow	Flow	Flow										Flow						
		ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s																						
1		95.00	0.050					95.00	0.050		0.050	0.050	0.300	15.0	1.63	0.118	1700.00	1478.170	1460.00	1.908,055	1510.00	1.62					
2-1		60.00	0.081	170.00	0.170	0.089		325.00	0.170		0.170	0.170	0.500	9.0	1.82	0.358	200.00	1457.958	1460.00	1477.043	1460.00	2.42					
2-2		0.00	0.00	0.00	0.00	0.00		325.00	0.170		0.170	0.170	0.1500	2.6	2.04	3.604	1460.00	1452.858	1460.00	1456.888	1460.00	1.50					
3-1		0.00	0.00	0.00	0.00	0.00		325.00	0.170		0.170	0.170	0.1500	2.6	2.04	3.604	280.00	1446.838	1450.00	1452.918	1460.00	25.57					
3-2		113.00	0.140	0.00	0.00	0.089		438.00	0.229		0.229	0.229	0.600	7.0	1.82	0.514	610.00	1387.850	1400.00	1446.228	1450.00	3.12					
3-3		0.00	0.00	0.00	0.00	0.089		438.00	0.229		0.229	0.229	0.1500	2.6	2.04	3.604	650.00	1384.910	1400.00	1396.888	1400.00	1.50					
3-4		0.00	0.00	0.00	0.00	0.089		438.00	0.229		0.229	0.229	0.600	7.0	1.82	0.514	440.00	1387.850	1360.00	1384.890	1400.00	4.46					
4-1		180.00	0.094					180.00	0.094		0.094	0.094	0.400	10.0	1.66	0.208	1510.00	1360.865	1370.00	1436.195	1420.00	3.27					
4-2		0.00	0.00	0.00	0.00	0.089		180.00	0.094		0.094	0.094	0.1500	10.0	4.00	7.069	760.00	1336.828	1340.00	1389.765	1370.00	8.62					
4-3		0.00	0.00	0.00	0.00	0.089		180.00	0.094		0.094	0.094	0.400	10.0	1.66	0.208	50.00	1302.928	1310.00	1360.725	1340.00	18.34					
4-4		0.00	0.00	0.00	0.00	0.089		180.00	0.094		0.094	0.094	0.1500	2.6	2.04	3.604	130.00	1301.490	1360.00	1301.828	1310.00	6.56					
5-1		0.00	0.00	0.00	0.00	0.089		618.00	0.323		0.323	0.323	0.1500	2.6	2.04	3.604	690.00	1289.240	1300.00	1301.470	1360.00	56.92					
5-2		0.00	0.00	0.00	0.00	0.089		618.00	0.323		0.323	0.323	0.700	6.0	1.86	0.717	200.00	1288.000	1300.00	1289.220	1300.00	0.02					
5-3		0.00	0.00	0.00	0.00	0.089		618.00	0.323		0.323	0.323	0.700	6.0	1.86	0.717	70.00	1287.500	1300.00	1288.000	1300.00	1.24					
5-4		0.00	0.00	0.00	0.00	0.089		618.00	0.323		0.323	0.323	0.1500	2.6	2.04	3.604	760.00	1284.704	1300.00	1286.780	1300.00	1.61					
6		86.00	0.045					86.00	0.045		0.045	0.045	0.300	15.0	1.63	0.118	1690.00	1448.170	1450.00	1587.085	1440.00	2.64					
7		119.00	0.107					205.00	0.107		0.107	0.107	0.400	12.0	1.82	0.228	1320.00	1378.065	1380.00	1446.139	1450.00	3.43					
8		62.00	0.139					267.00	0.139		0.139	0.139	0.500	9.0	1.82	0.359	810.00	1387.938	1390.00	1376.902	1390.00	2.56					

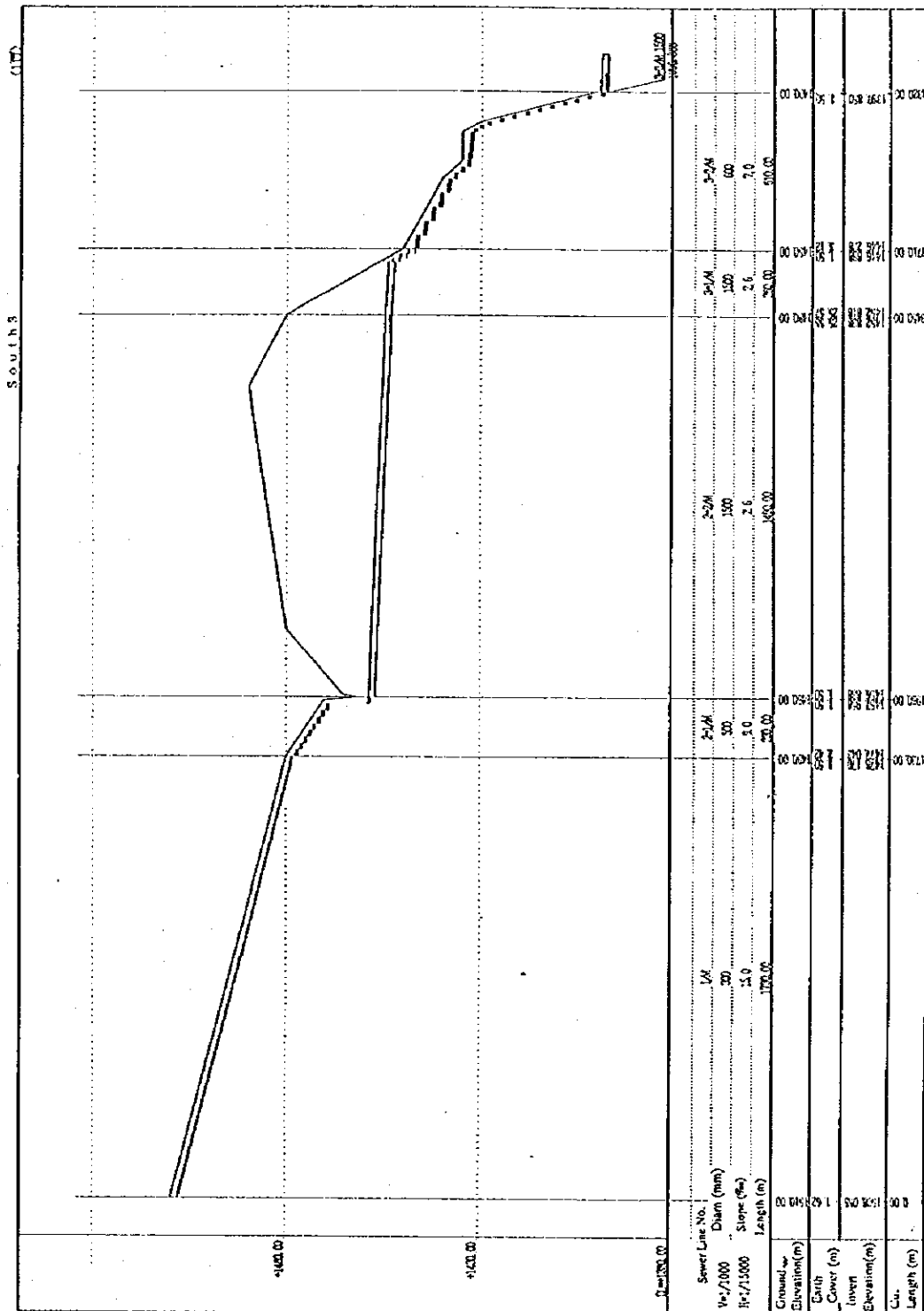
Table L-13 Computation Form for Sewer Design, South 3 Region (2/3)

South 3 Region		Unit Design Flow Rate(m <sup>3</sup> /s/ha) : 0.000522 (In the District) / 0.000522 (Airport)															
Sewer Line No.	To Sewer No.	Wastewater Treatment District					Design Sewer					Remarks					
		In the District		Airport		Total Area	Design Flow Rate	Total Design Flow	Diam	Slope	Velocity		Capacity	Length	Invert Elevation	Ground Surface Elevation	Earth Cover
		ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s												
9		723.00	0.437	0.00	170.00	0.089	1008.00	0.525	0.1500	2.5	2.04	3.504	1500.00	1290.102	1300.00	60.70	
10		110.00	0.057				110.00	0.057	0.300	15.0	1.68	0.118	1000.00	1378.170	1390.00	1.50	
11		97.00	0.108				207.00	0.108	0.400	12.0	1.82	0.228	1150.00	1376.565	1300.00	5.00	
12		138.00	0.072				138.00	0.072	0.350	12.0	1.66	0.160	2610.00	1348.118	1350.00	1.50	
13		288.00	0.150				288.00	0.150	0.500	3.0	1.82	0.353	370.00	1287.958	1200.00	3.40	
14		497.00	0.259				497.00	0.259	0.1500	2.6	2.04	3.604	220.00	1292.647	1320.00	25.54	
15		554.00	0.289				554.00	0.289	0.1500	2.6	2.04	3.604	660.00	1291.032	1320.00	25.56	
16		373.00	0.195	0.921	0.00	170.00	0.089	1.010	0.1500	2.6	2.04	3.604	2010.00	1284.572	1300.00	13.82	
17-1		0.00	0.00	0.921	0.00	170.00	0.089	1.010	0.1500	2.6	2.04	3.604	1050.00	1281.656	1292.00	9.33	
17-2		0.00	0.00	0.921	0.00	170.00	0.089	1.010	0.1200	2.0	1.54	1.744	1150.00	1262.935	1265.70	1.50	
To the Wastewater Treatment Plant																	
18		78.00	0.041				78.00	0.041	0.350	5.0	1.07	0.103	1570.00	1258.118	1250.00	1.50	
19		128.00	0.108				205.00	0.108	0.600	3.0	1.19	0.335	480.00	1256.290	1260.00	3.05	
20		119.00	0.052				119.00	0.052	0.350	10.0	1.52	0.146	3070.00	1278.118	1290.00	1.50	
21		40.00	0.021				40.00	0.021	0.200	17.0	1.36	0.043	1350.00	1298.273	1300.00	1.50	
22		51.00	0.027				51.00	0.027	0.300	10.0	1.37	0.092	1770.00	1278.170	1280.00	1.50	

Table L - 14 Computation Form for Sewer Design, South 3 Region (3/3)

South 3 Region		Unit Design Flow Rate(m <sup>3</sup> /s/ha) : 0.000522 (In the District) / 0.000522 (Airport)																		
Sewer Line No.	In Sewer No.	Wastewater Treatment District						Design Sewer									Remarks			
		In the District			Airport			Total Area	Total Design Flow	Design Flow Rate	Diam	Slope	Velocity	Capacity	Length	Invert Elevation		Ground Surface Elevation	Earth Cover	
ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	mm	%	m/s	m <sup>3</sup> /s	m	m	m	m	
23		12.00	0.065					182.00	0.095			ø 400	3.0	1.56	0.208	380.00	1276.275	1280.00	3.23	
24		0.00	0.203					388.00	0.203			ø 700	3.0	1.32	0.507	280.00	1258.065	1260.00	1.50	
25		37.00	0.222					475.00	0.222			ø 700	3.0	1.32	0.507	1280.00	1252.227	1260.00	7.02	
		To the Wastewater Treatment Plant																		
26		0.00	1.143	0.00	0.089			2360.00	1.232			ø 700	3.0	1.32	0.507	1000.00				
		Total																		

Fig L - 41

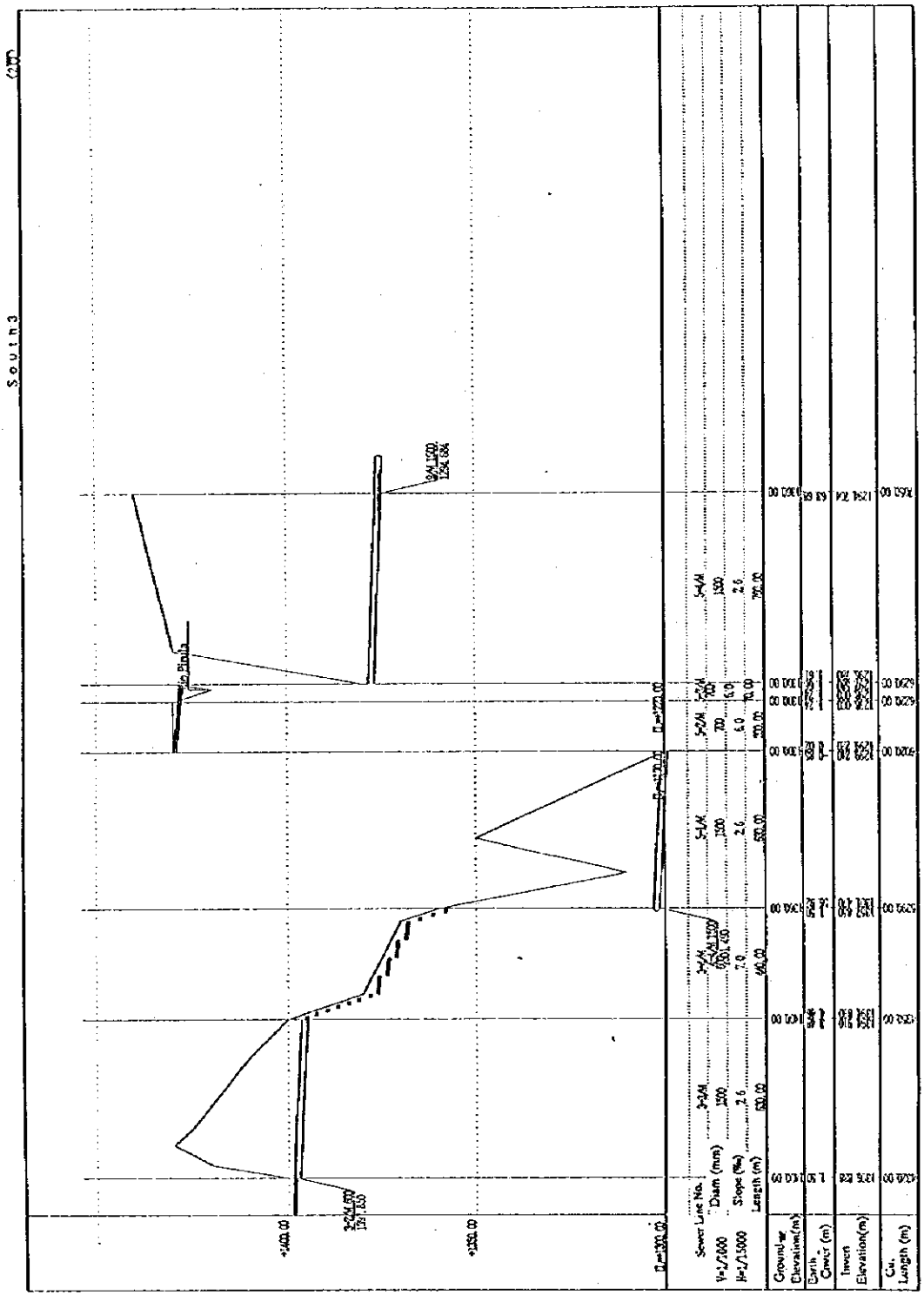


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 SUPPLY PUBLIC CORPORATION  
 (EMPAGUA)

THE STUDY ON  
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 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 3 REGION (1/11)

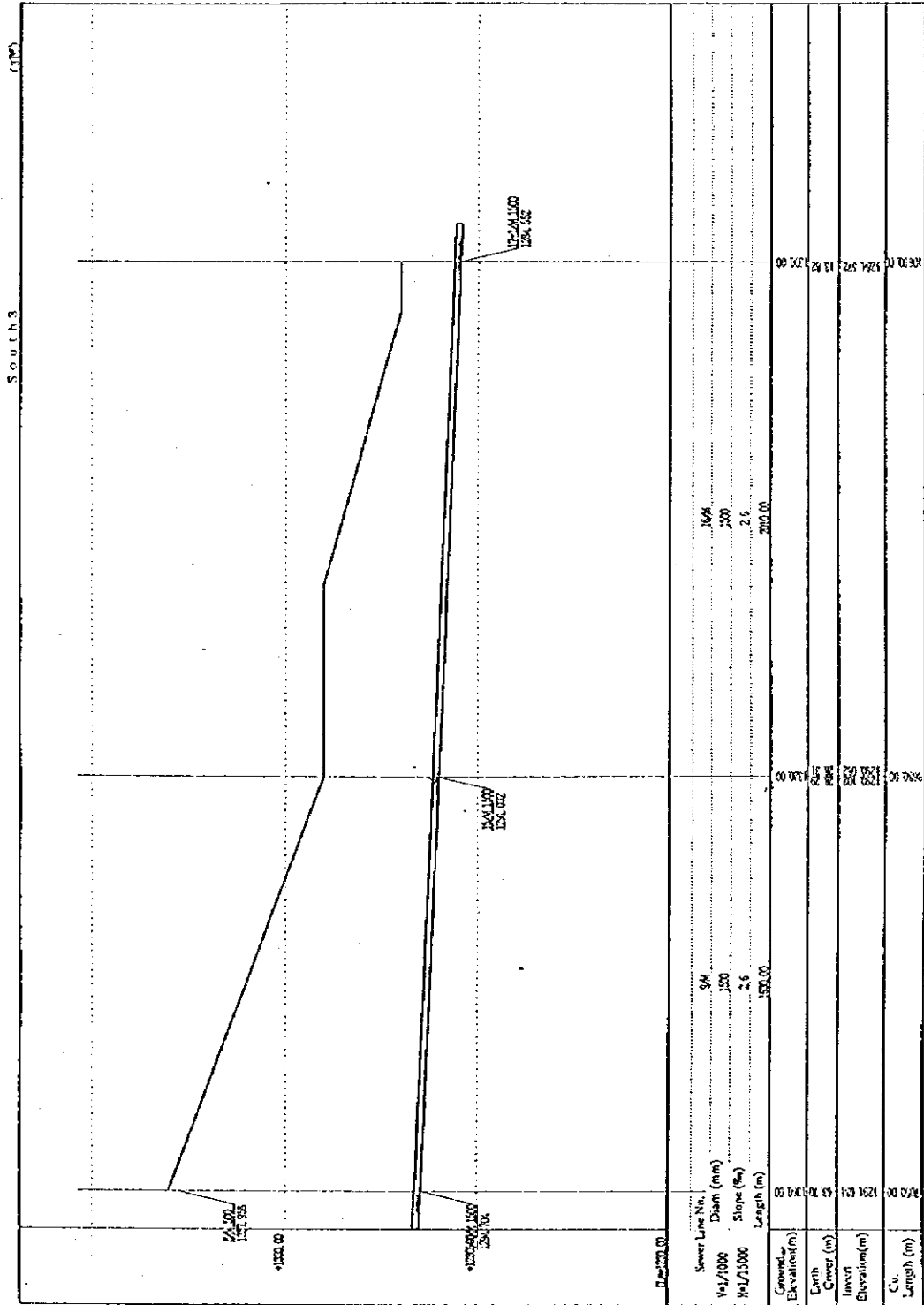
Fig. L - 42



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 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 3 REGION (2/11)



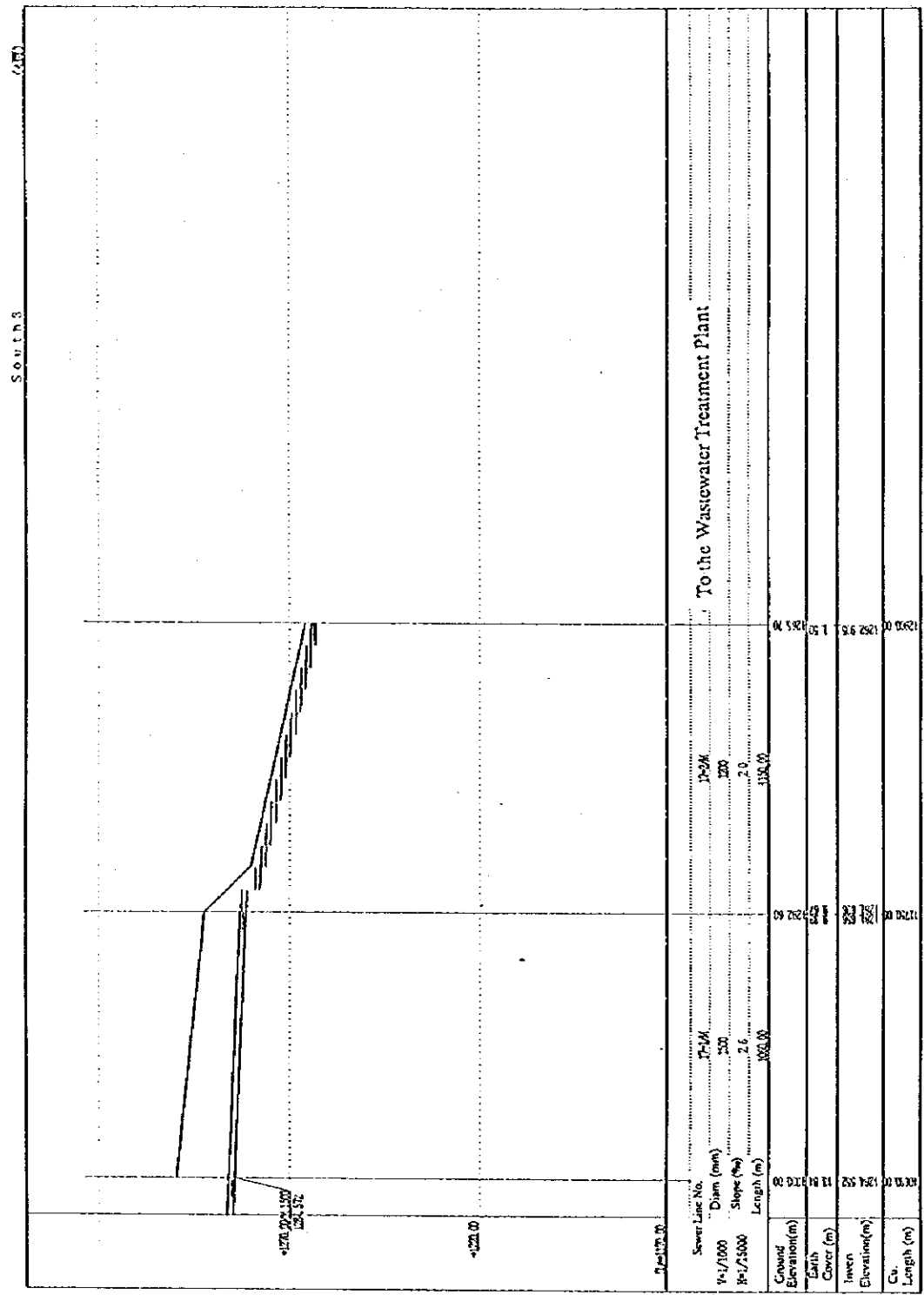
Sewer Line No.	3/1
Diam. (mm)	1500
Slope (%)	2.6
Length (m)	350.00
Ground Elevation (m)	1120.00
Earth Cover (m)	0.00
Invert Elevation (m)	1125.00
Cu. Length (m)	0.00

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 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 3 REGION (3/11)

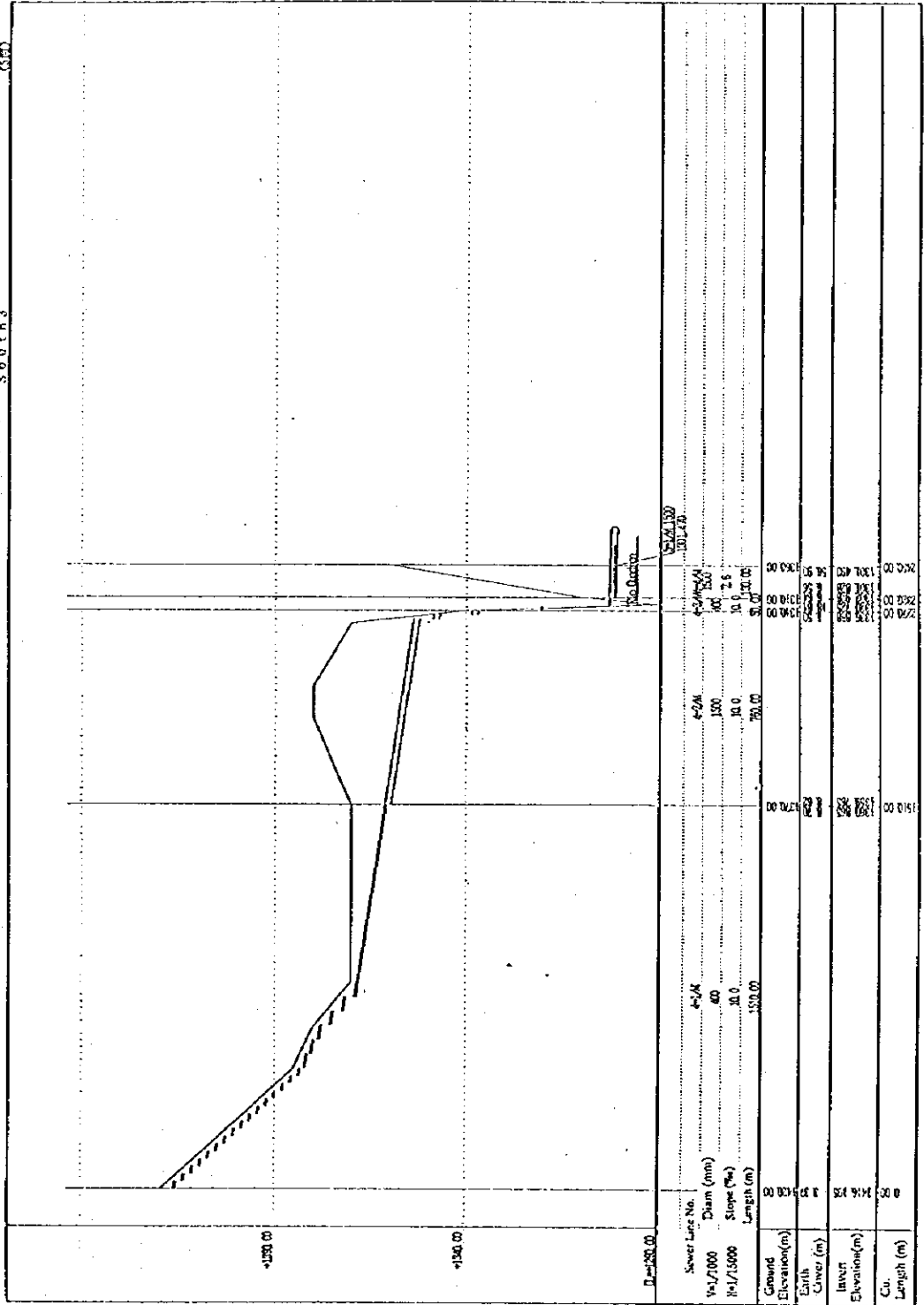
Fig. L - 44



THE REPUBLIC OF GUATEMALA  
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THE STUDY ON  
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 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

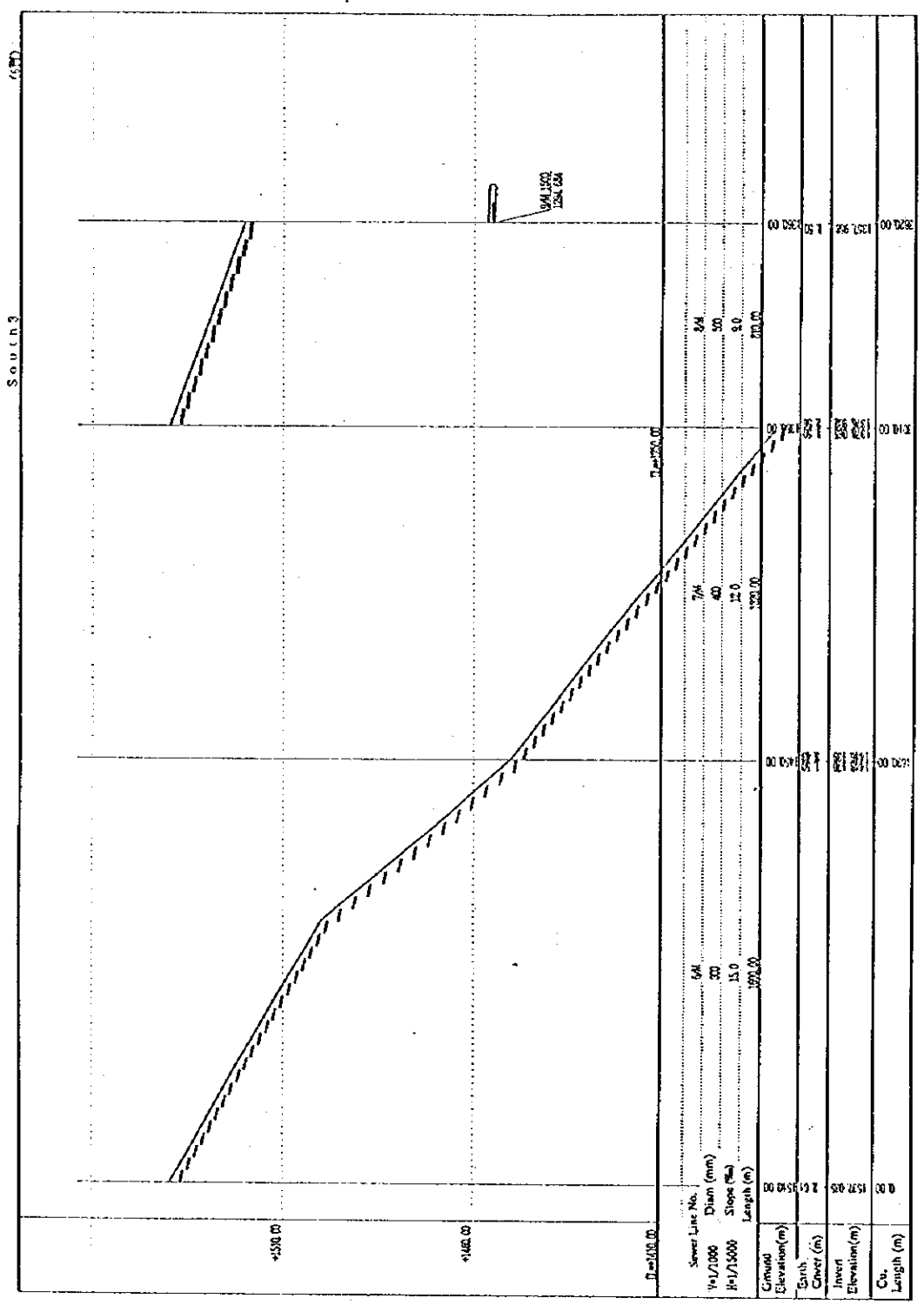
TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 3 REGION (4/11)



<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 3 REGION (5/11)</p>
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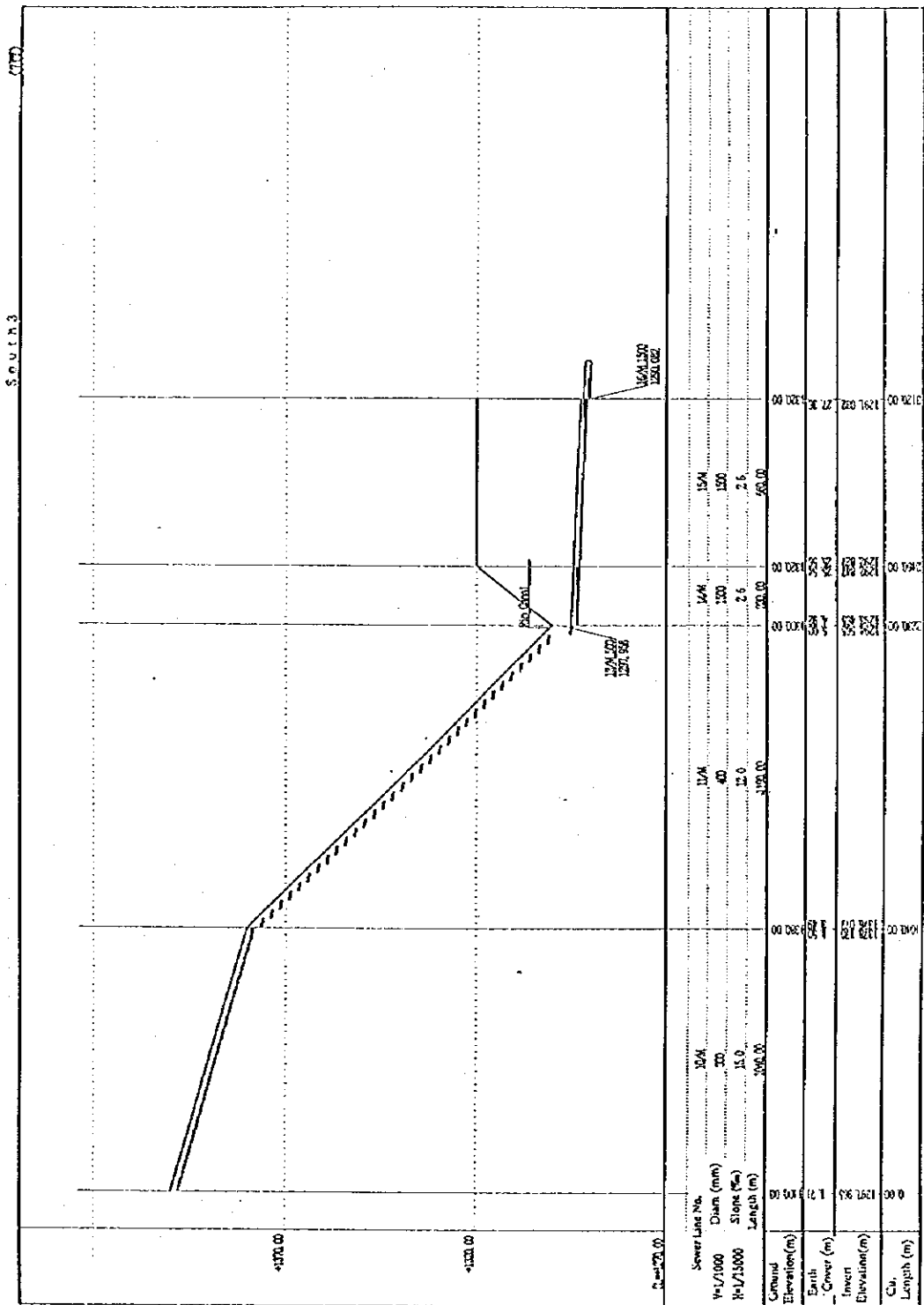


Fig. L - 46



<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 3 REGION (6/11)</p>
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Fig. L - 47

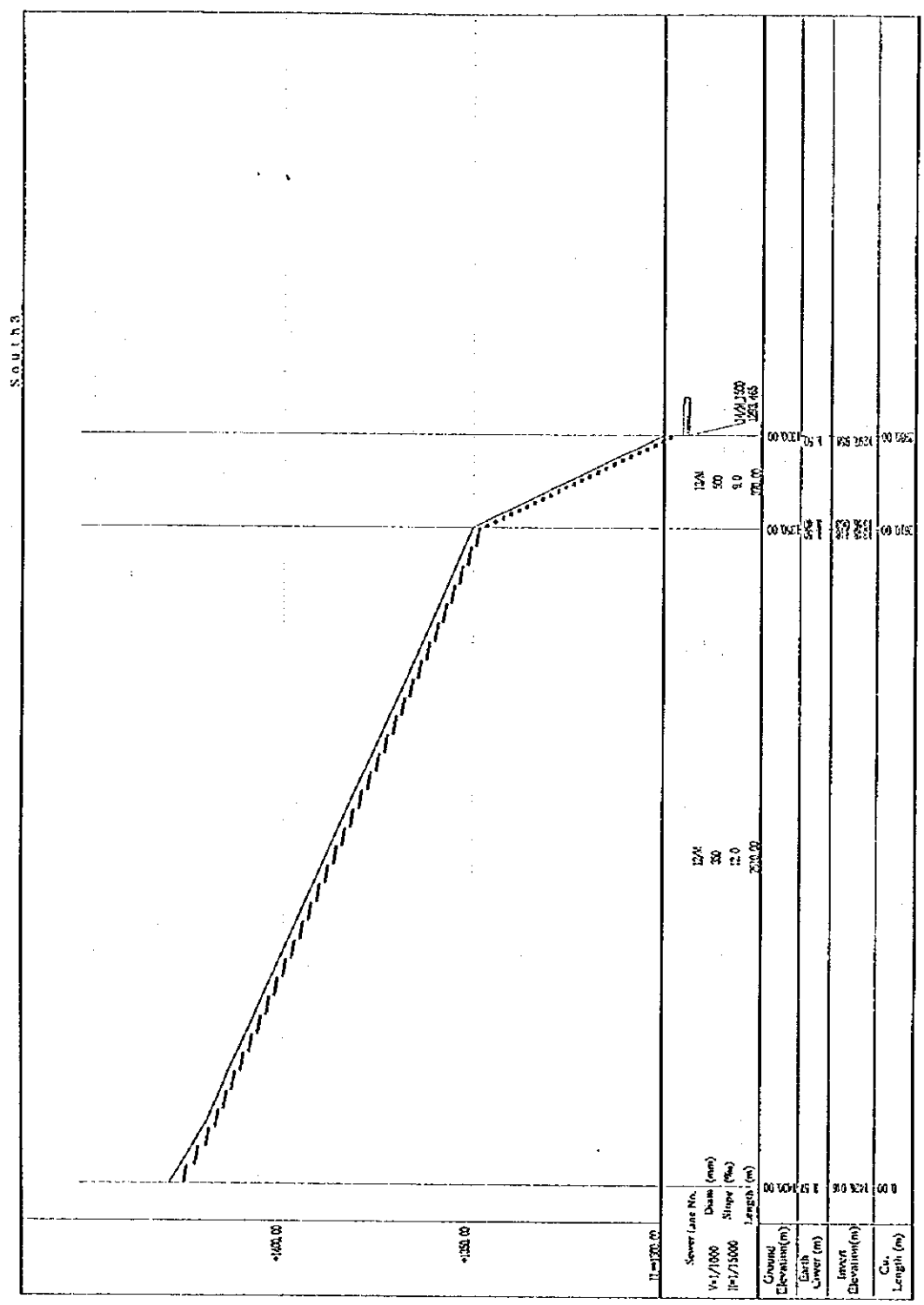


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 (EMPAGUA)

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 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 3 REGION (7/11)

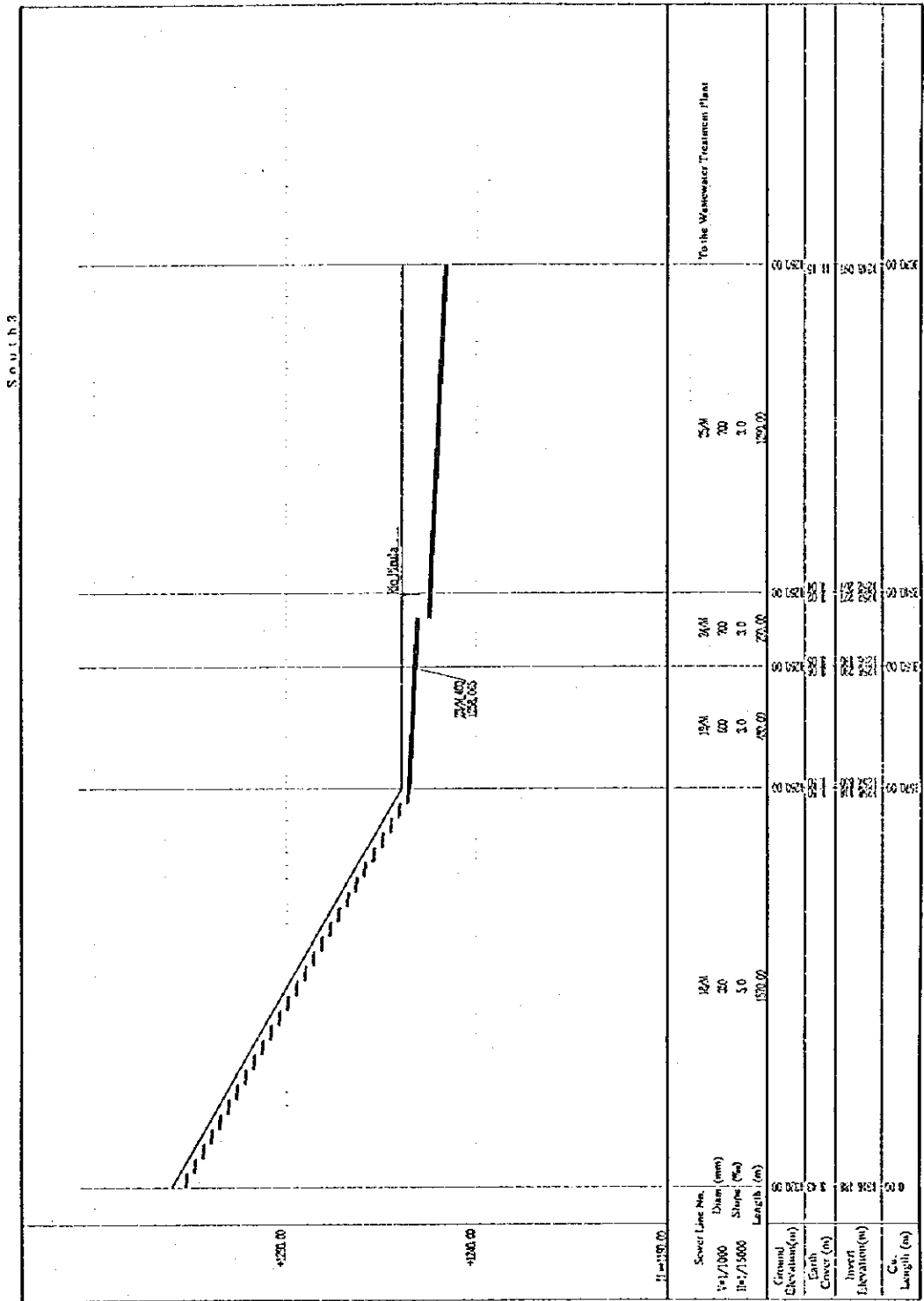
Fig. L-48



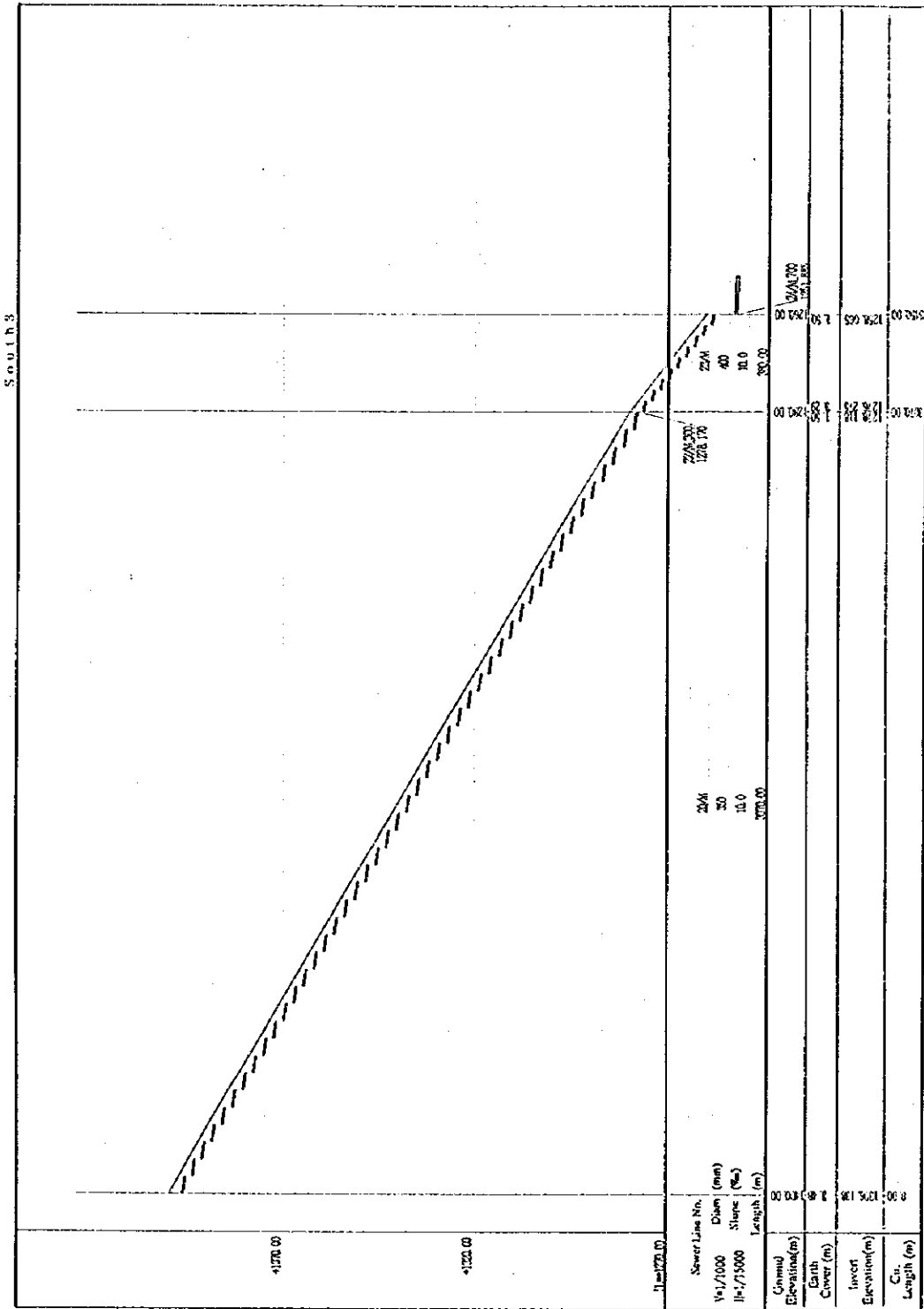
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TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 3 REGION (8/11)



THE REPUBLIC OF GUATEMALA  GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)	THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA	TITLE  LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 3 REGION (9/11)
	JAPAN INTERNATIONAL COOPERATION AGENCY	

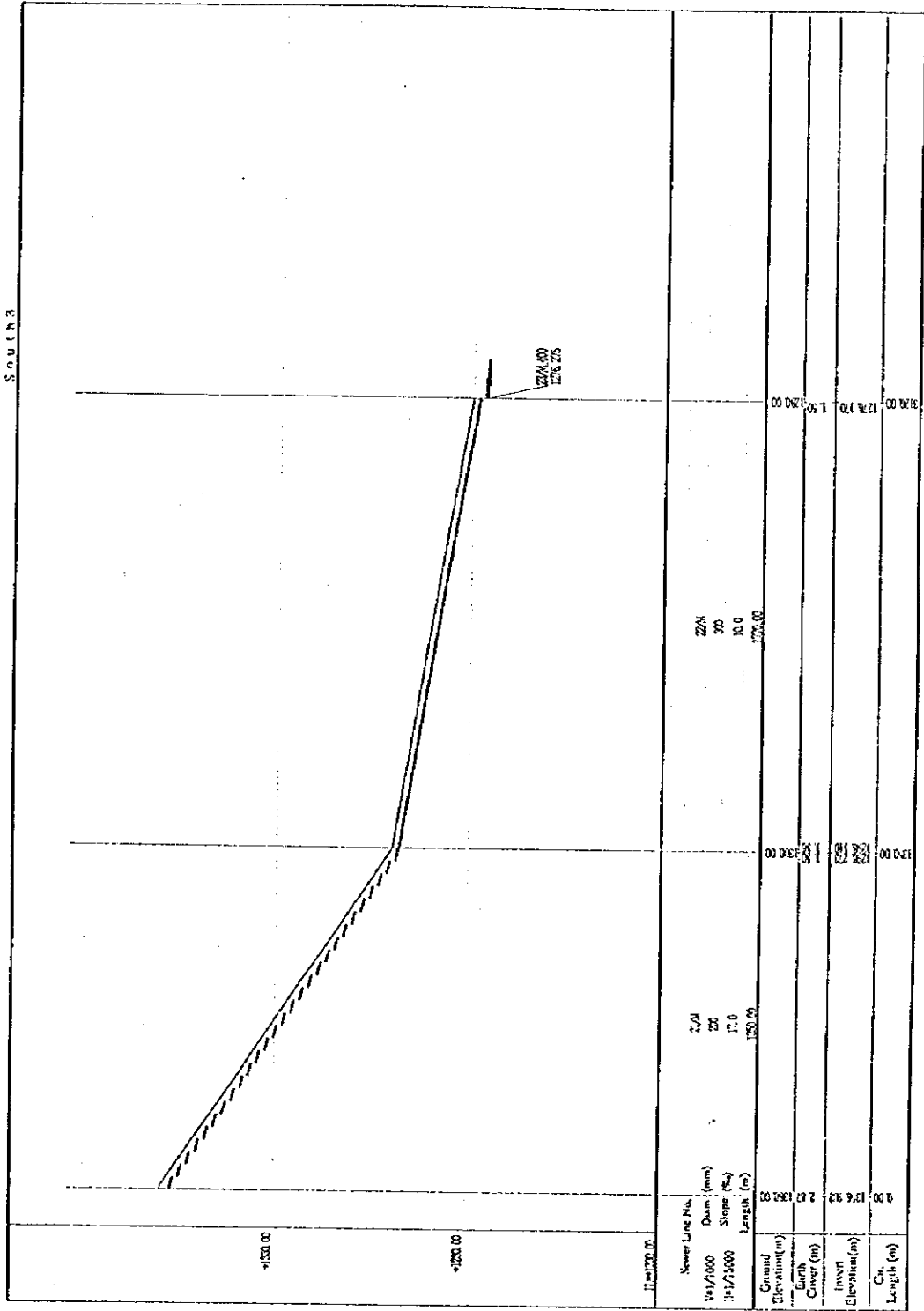


THE REPUBLIC OF GUATEMALA  
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 (EMPAGUA)

THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR SOUTH 3 REGION (10/11)

Fig. L - 51



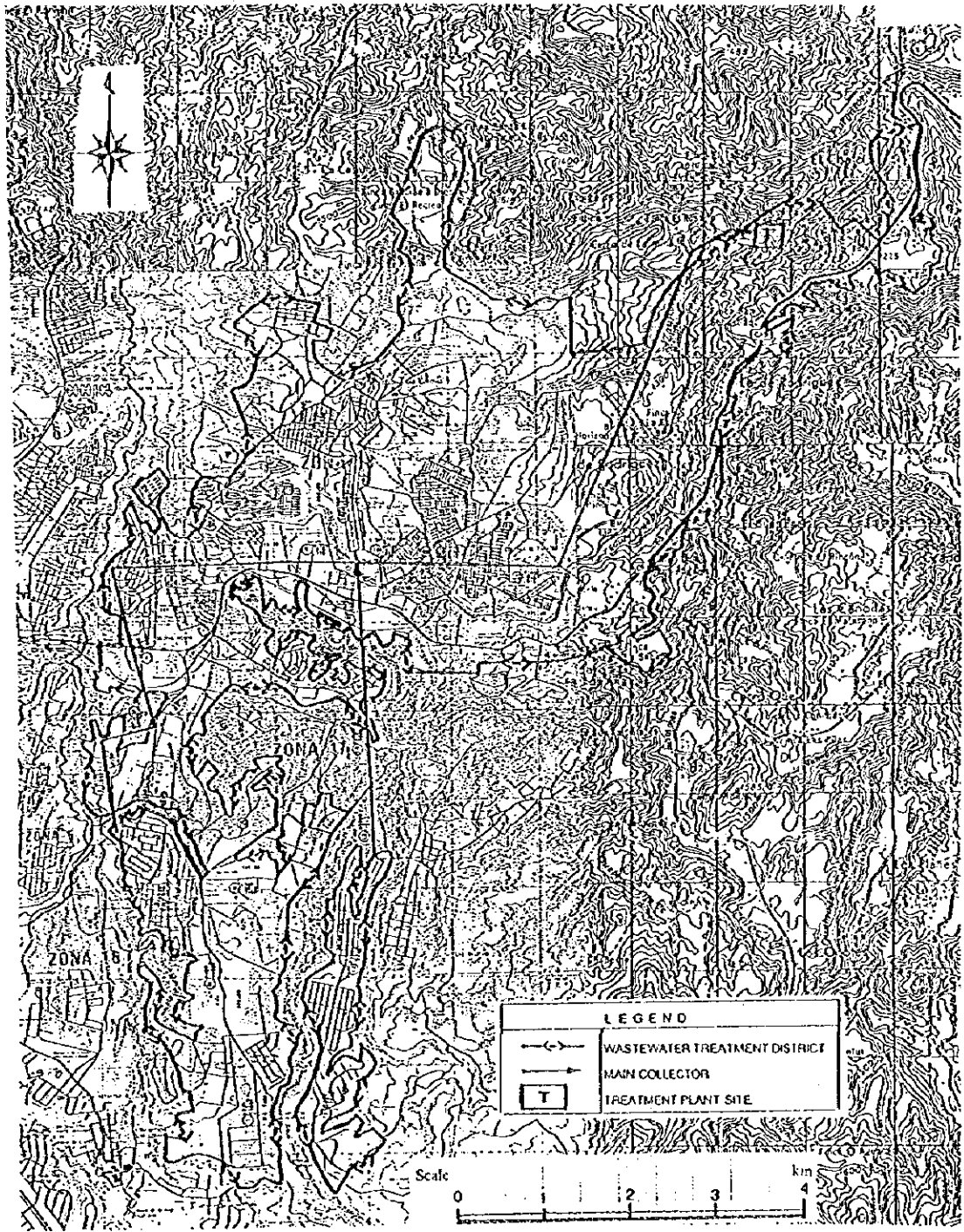
<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR SOUTH 3 REGION (11/11)</p>
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**DESIGN OF MAIN COLLECTORS  
FOR  
EAST 1 REGION**







THE REPUBLIC OF GUATEMALA  
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THE STUDY ON  
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MANAGEMENT IN THE GUATEMALA  
METROPOLITAN AREA  
JAPAN INTERNATIONAL COOPERATION AGENCY

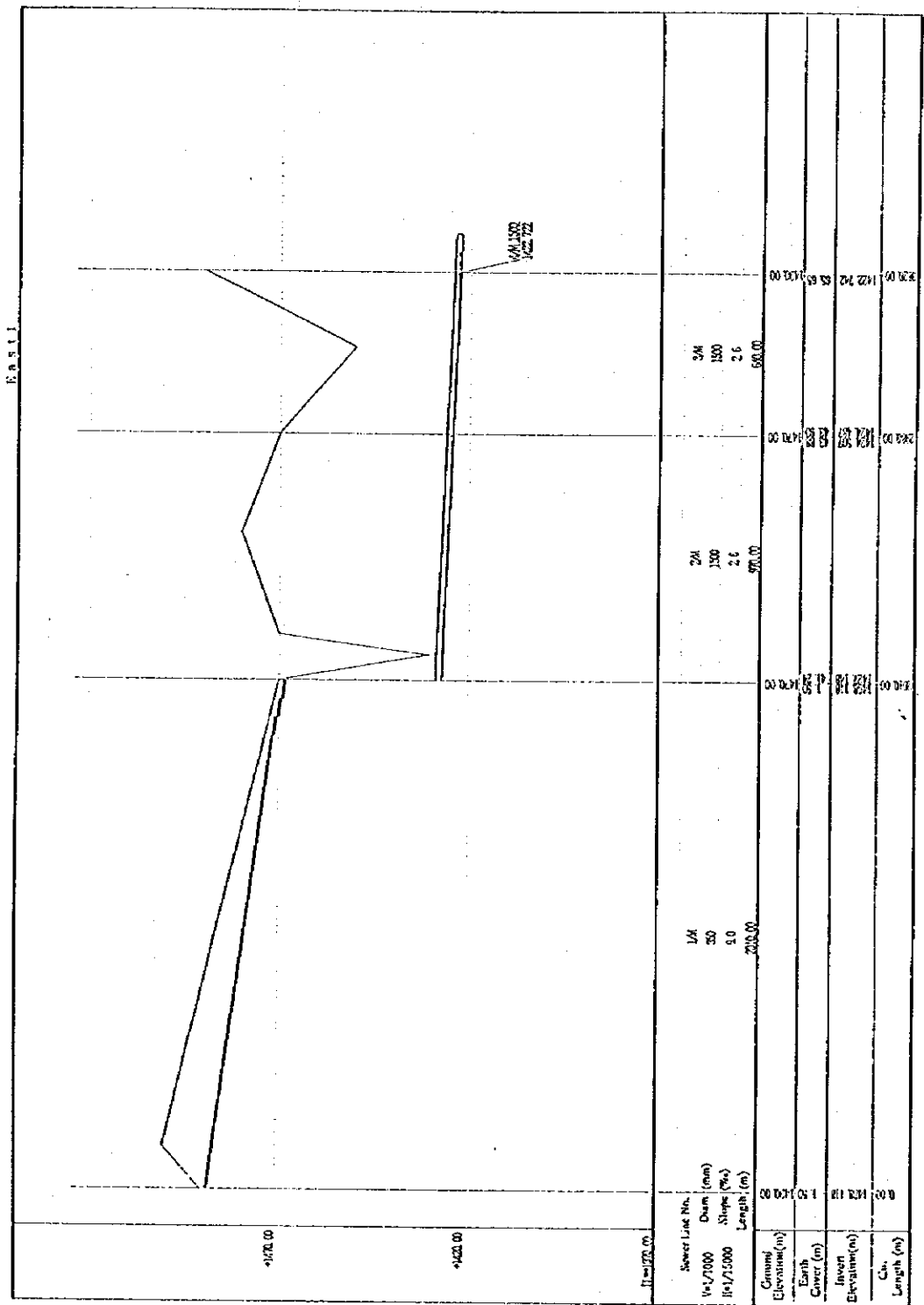
TITLE  
LAYOUT OF MAIN COLLECTOR  
FOR EAST 1 WASTEWATER  
TREATMENT DISTRICT

Table L-15 Computation Form for Main Collector Design, East 1 Region (1/2)

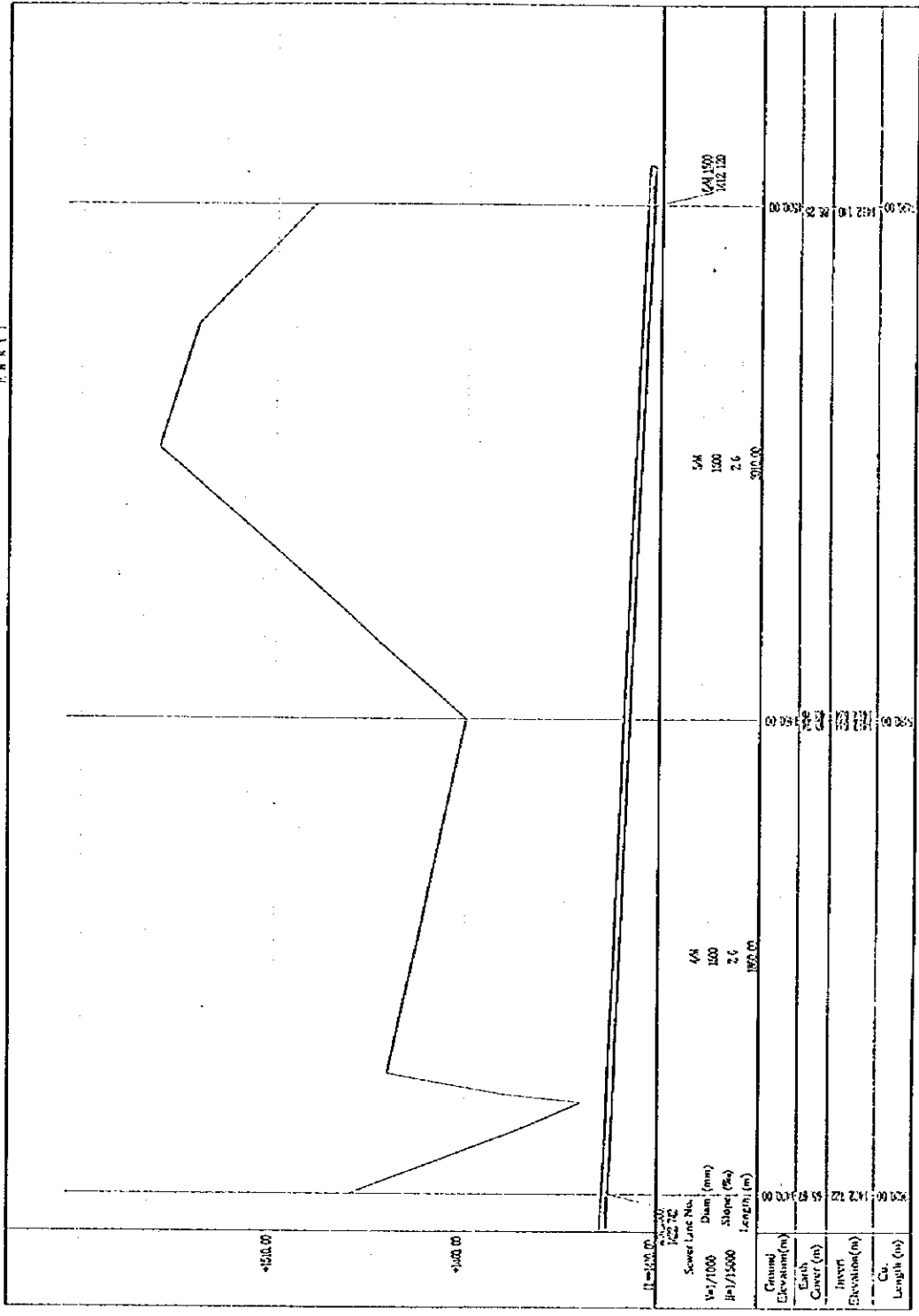
East 1 Region																			
Unit Design Flow Rate(m <sup>3</sup> /s/ha) : 0.000497																			
Sewer Line No.	To Sewer No.	Wastewater Treatment District					Design Sewer					Remarks							
		In the District		District			Total Design Flow	Diam	Slope	Velocity	Capacity		Length	Invert Elevation	Ground Surface Elevation	Earth Cover			
		Increment	Flow	Increment	Flow	Increment											Total Flow		
ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	ha	m <sup>3</sup> /s	m	m	m					
1		130.00	0.065					130.00	0.065		0.065	350	9.0	0.138	2010.00	1498.118	1490.00	1.90	
2		37.00	0.019					167.00	0.083		0.083	1500	2.6	3.604	970.00	1427.148	1470.00	41.24	
3		0.00	0.003					167.00	0.083		0.083	1500	2.6	3.604	540.00	1424.427	1470.00	43.90	
4		300.00	0.133					267.00	0.133		0.133	1500	2.6	3.604	1422.722	1422.742	1490.00	55.55	
5		228.00	0.215					495.00	0.245		0.245	1500	2.6	3.604	1417.644	1460.00	40.74		
6		385.00	0.338					680.00	0.338		0.338	1500	2.6	3.604	1412.120	1500.00	86.27		
7		100.00	0.050					100.00	0.050		0.050	300	15.0	0.118	1540.00	1578.170	1580.00	1.90	
8		172.00	0.135					272.00	0.135		0.135	450	10.0	1.79	0.285	1560.00	1568.012	1550.00	1.90
9		105.00	0.187					377.00	0.187		0.187	500	10.0	1.92	0.378	1400.00	1517.958	1520.00	1.90
10		100.00	0.237					477.00	0.237		0.237	600	8.0	1.94	0.549	1400.00	1497.850	1500.00	1.90
11		75.00	0.037					75.00	0.037		0.037	250	20.0	1.71	0.084	1580.00	1578.222	1580.00	1.90
12		99.00	0.085					174.00	0.085		0.085	350	15.0	1.86	0.179	2440.00	1498.118	1500.00	1.90
13		0.00	0.006					174.00	0.086		0.086	1500	2.6	3.604	810.00	1466.559	1500.00	31.83	
14		0.00	0.324					651.00	0.324		0.324	1500	2.6	3.604	1200.00	1402.802	1500.00	95.59	
15		118.00	0.382					769.00	0.382		0.382	1500	2.6	3.604	1391.214	1391.214	1480.00	97.17	
16		30.00	0.015					30.00	0.015		0.015	250	4.0	0.77	0.038	850.00	1504.592	1510.00	5.22
17		165.00	0.097					195.00	0.097		0.097	1500	2.6	3.604	1150.00	1496.063	1500.00	42.37	

Table D1a: 16 Computation Form for Main Collector Design, East 1 Region (2/2)

East 1 Region													Unit Design Flow Rate (m³/s/ha) : 0.000497												
Sewer Line No.	To Sewer No.	Wastewater Treatment District						Total Area ha	Design Flow Rate m³/s	Total Design Flow m³/s	Diam mm	Design Sewer					Remarks								
		In the District	Increment	Cs	Total	Flow	Increment					Cs	Total	Flow	Slope	Velocity		Capacity	Length	Invert Elevation	Ground Surface Elevation	Earth Cover			
ha	ha	m³/s	ha	ha	ha	ha	ha	m³/s	m³/s	mm	%	m/s	m³/s	m	m	m	m								
18		202.00	597.00	0.197			397.00	0.197	0.197	1500	2.6	2.04	3.604	1230.00	1496.049	1540.00	42.34								
19		0.00	1846.00	0.917			1846.00	0.917	0.917	1500	2.5	2.04	3.604	730.00	1371.656	1480.00	100.73								
20		72.00	1918.00	0.953			1918.00	0.953	0.953	1500	2.6	2.04	3.604	300.00	1374.656	1480.00	103.53								
21		201.00	2119.00	1.053			2119.00	1.053	1.053	1500	2.5	2.04	3.604	510.00	1373.431	1470.00	94.96								
22		150.00	2269.00	1.128			2269.00	1.128	1.128	1500	2.6	2.04	3.604	810.00	1370.851	1420.00	47.54								
23		172.00	2441.00	1.213			2441.00	1.213	1.213	1500	2.6	2.04	3.604	1880.00	1376.988	1340.00	1.50								
24		333.00	2779.00	1.381			2779.00	1.381	1.381	1500	2.5	2.04	3.604	1980.00	1333.694	1340.00	4.69								
25		926.00	3705.00	1.841			3705.00	1.841	1.841	1500	2.5	2.04	3.604	700.00	1206.568	1220.00	21.82								
		To the Wastewater Treatment Plant																							



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 (EMPAGUA)

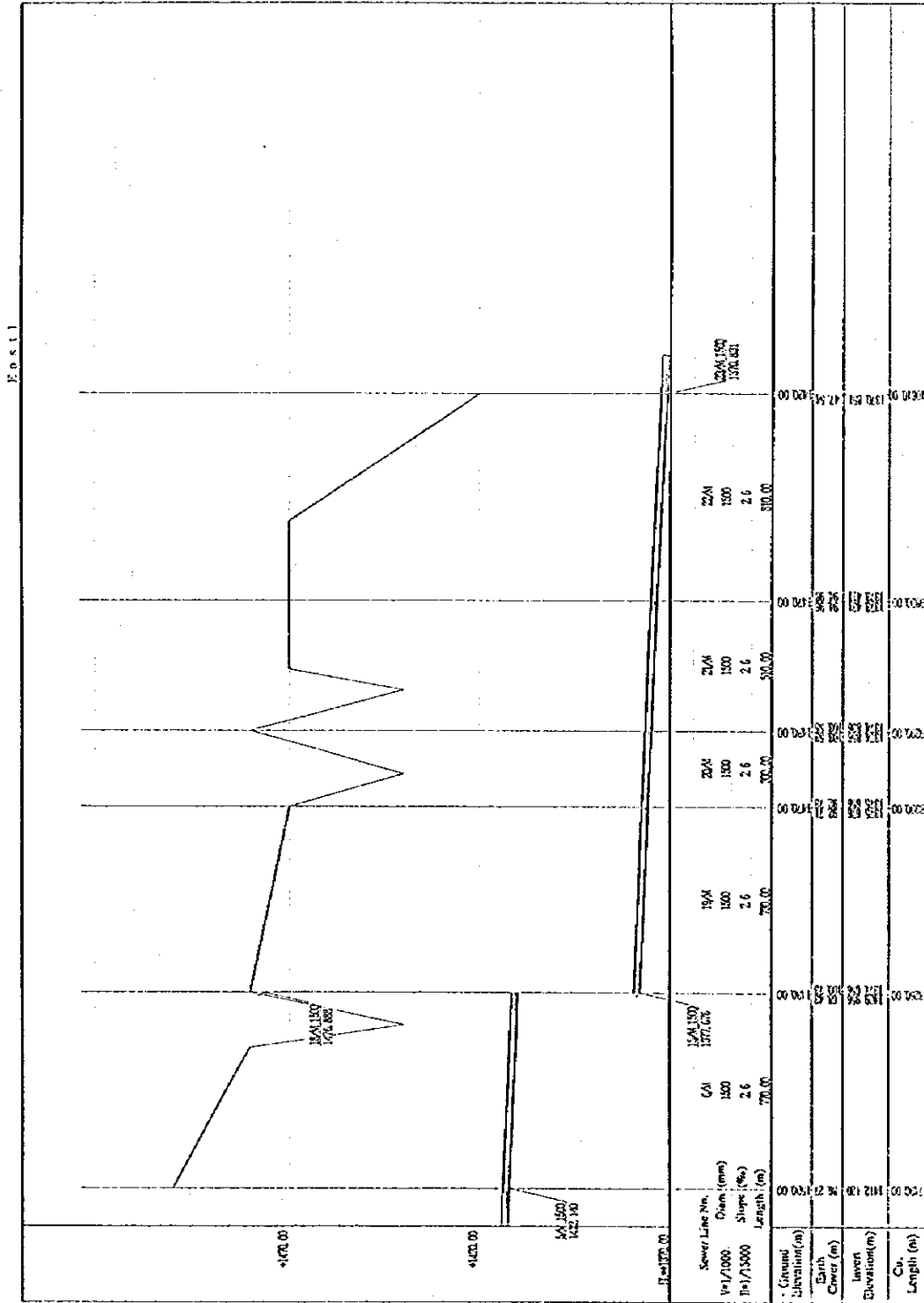
THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE

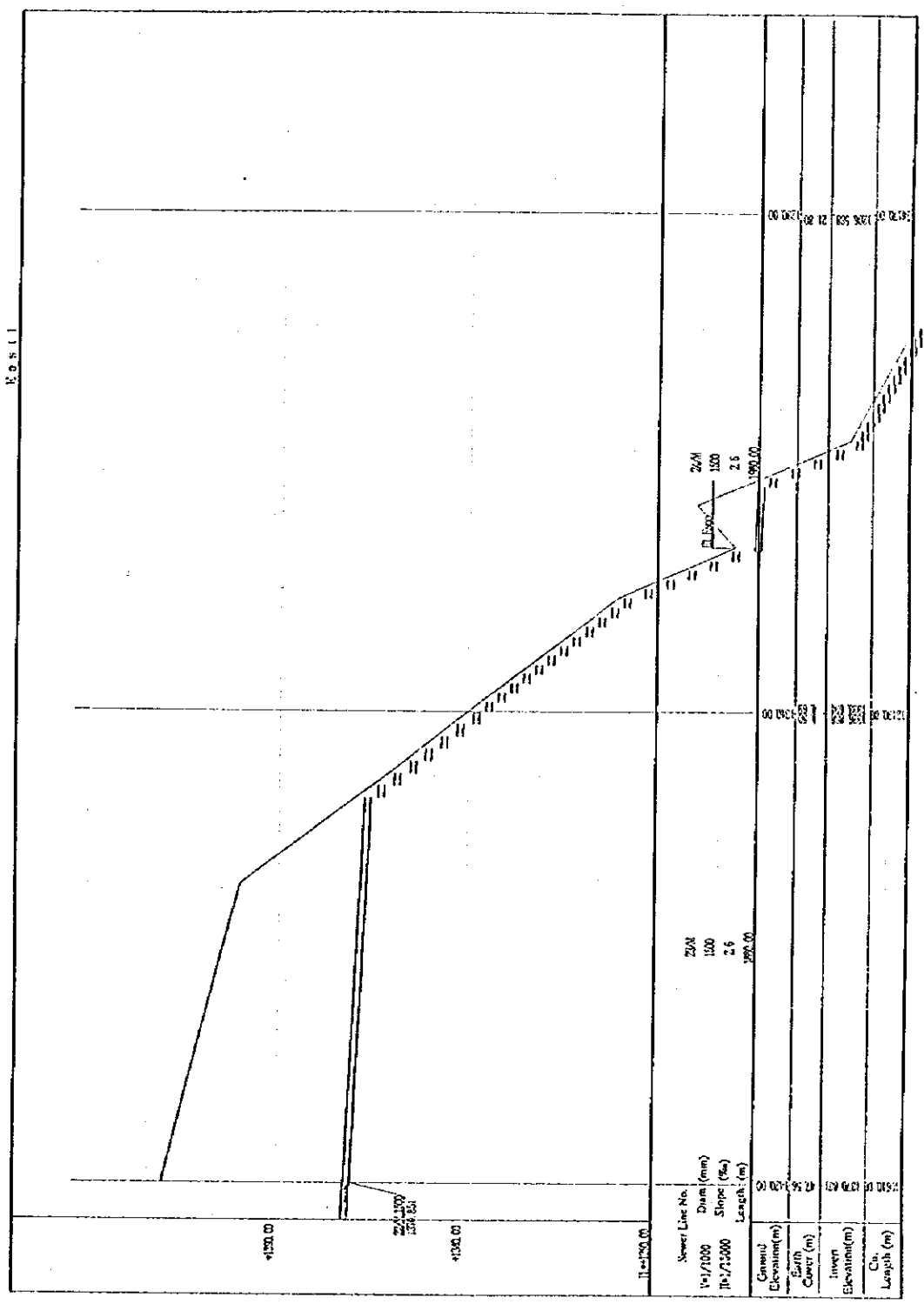
LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR EAST 1 REGION (2/10)

Fig. L - 55



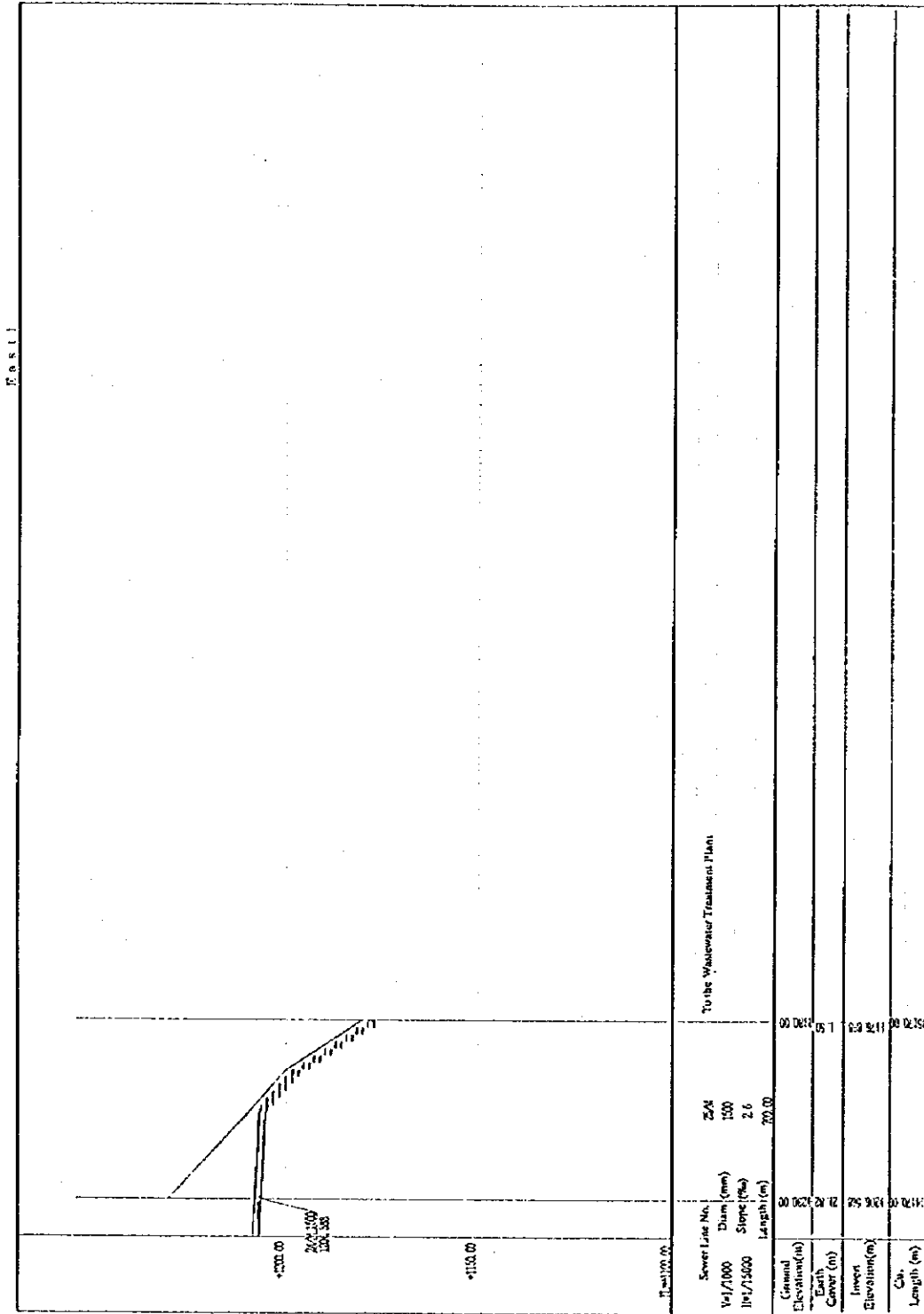
THE REPUBLIC OF GUATEMALA  GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)	THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA	TITLE  LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR EAST 1 REGION (3/10)
	JAPAN INTERNATIONAL COOPERATION AGENCY	

Fig. L - 56



<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR EAST 1 REGION (4/10)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	



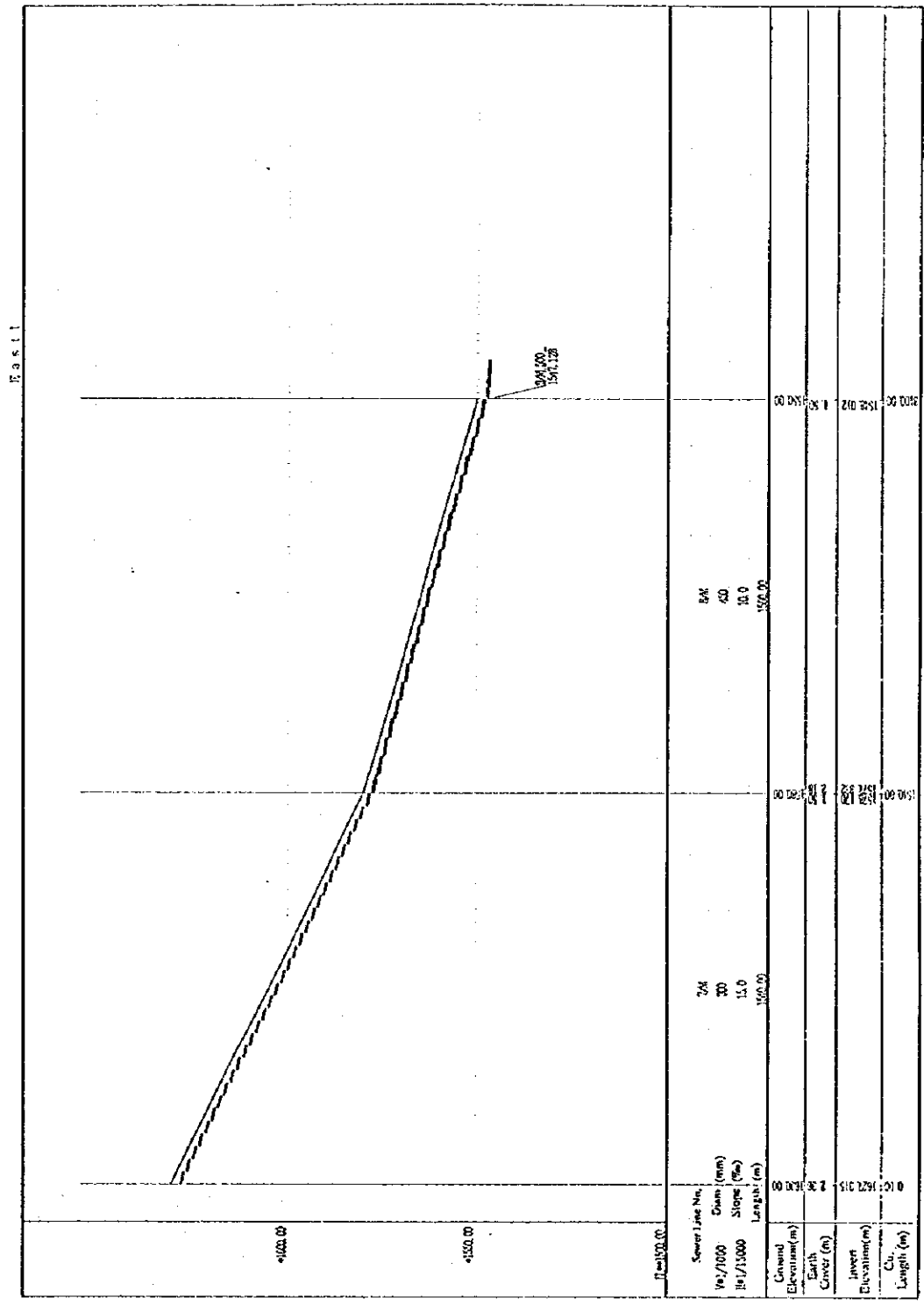


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 SUPPLY PUBLIC CORPORATION  
 (EMPAGUA)

THE STUDY ON  
 THE IMPROVEMENT OF WASTEWATER  
 MANAGEMENT IN THE GUATEMALA  
 METROPOLITAN AREA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE  
 LONGITUDINAL SECTION OF  
 MAIN COLLECTOR SEWER  
 FOR EAST 1 REGION (5/10)

Fig. L - 58



<p>THE REPUBLIC OF GUATEMALA</p> <p>GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)</p>	<p>THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA</p>	<p>TITLE</p> <p>LONGITUDINAL SECTION OF MAIN COLLECTOR SEWER FOR EAST 1 REGION (6/10)</p>
	<p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	