

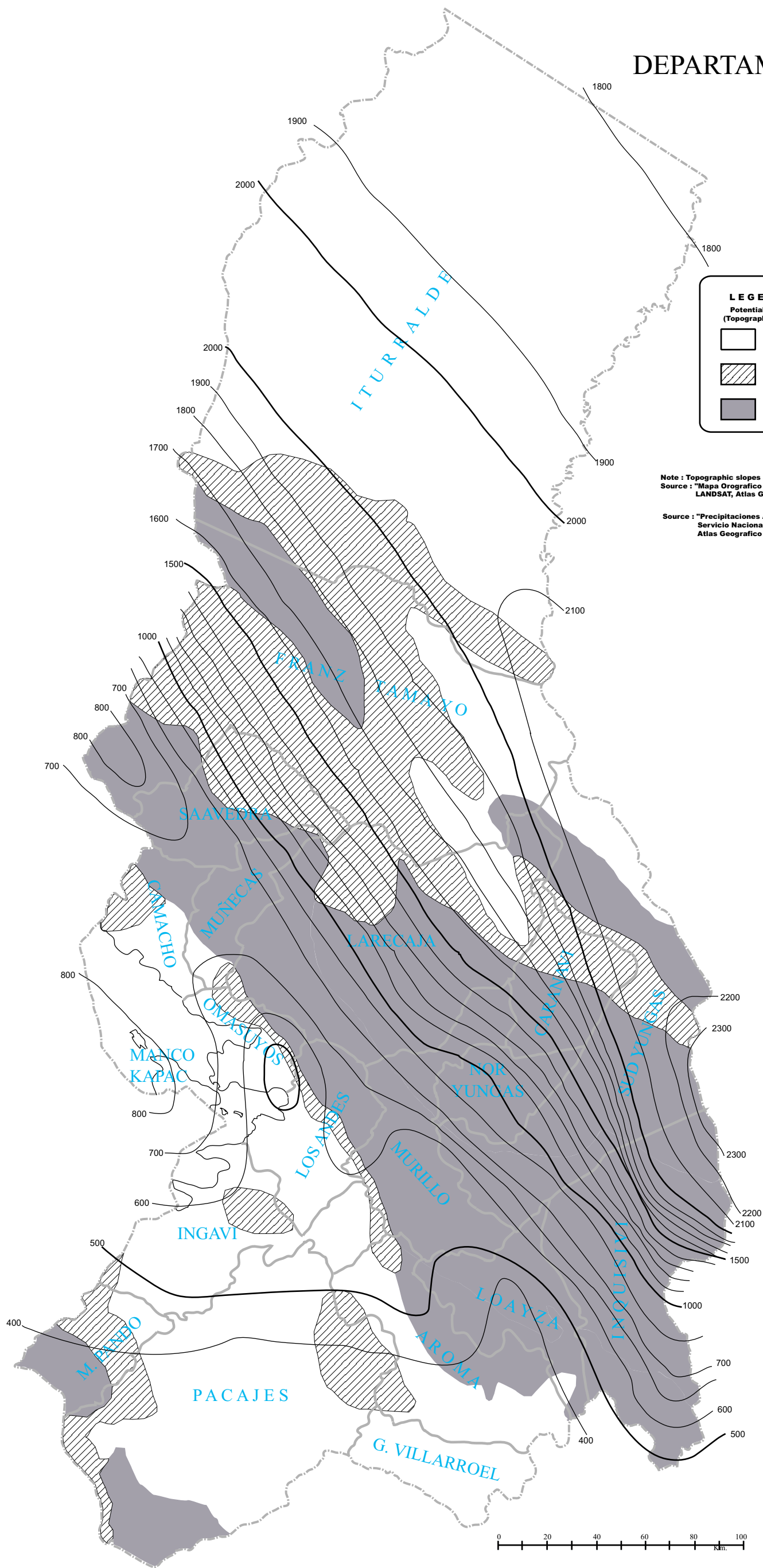
DEPARTAMENTO DE LA PAZ



LEGEND
Potential Head (Topographic Slope)

- Low (Flat area)
- Moderate (Mountain area)
- Steep (Mountain area)

Note : Topographic slopes are decided based on the LANDSAT image.
 Source : "Mapa Orografico de Bolivia", Mapa Base, Con Mosaico de Imagenes LANDSAT, Atlas Geografico de la Republica Bolivia, I.G.M.
 Source : "Precipitaciones Anuales Periodo 1961 - 1990", Servicio Nacional de Meteorologia e Hidrologia, Atlas Geografico de la Republica Bolivia, I.G.M.

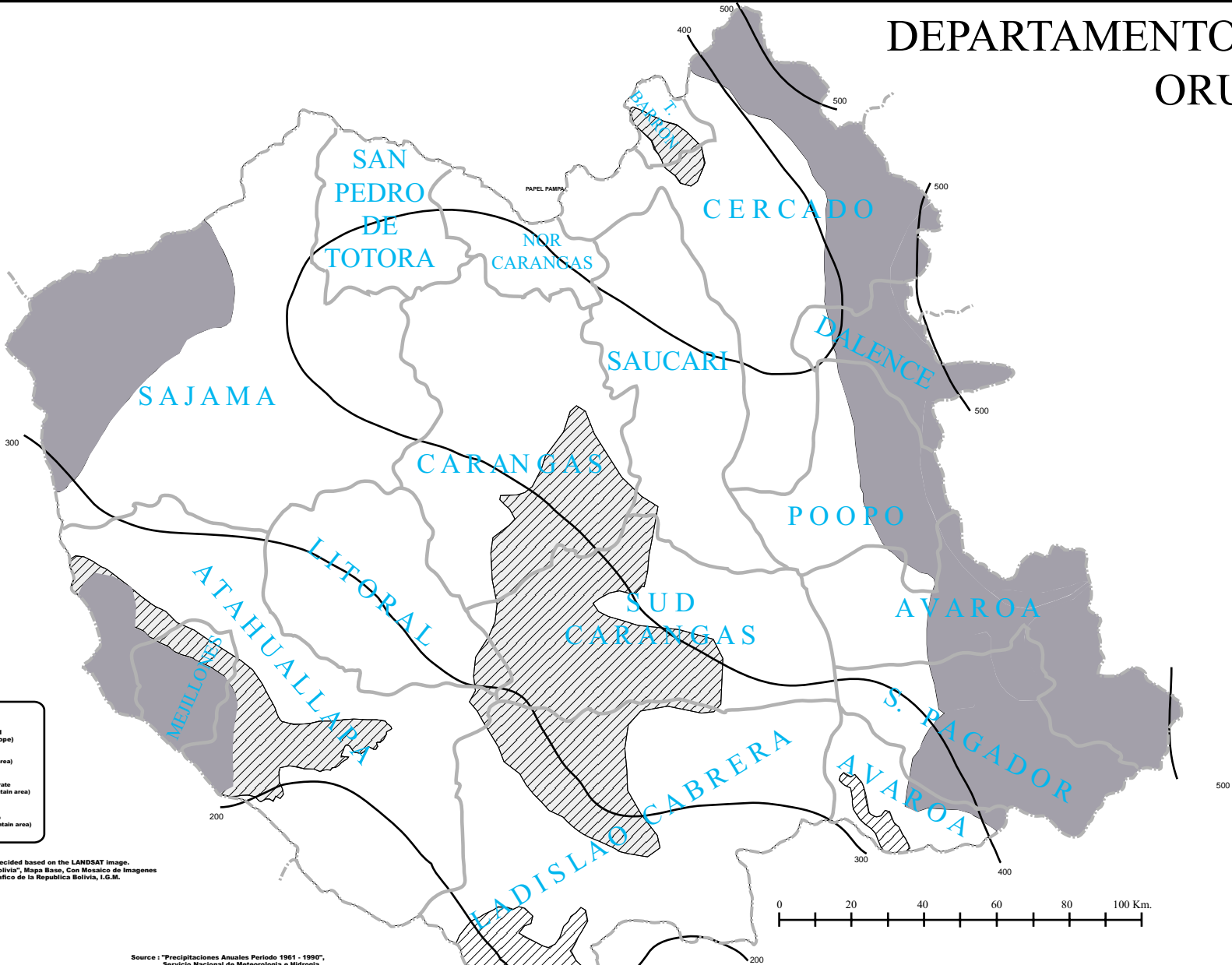


THE STUDY ON RURAL ELECTRIFICATION
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 IN THE REPUBLIC OF BOLIVIA
 JAPAN INTERNATIONAL COOPERATION AGENCY

図 4.1

平均年間降水量の等雨量線図と
 ポテンシャル差図 (ラパス県)

DEPARTAMENTO DE ORURO



LEGEND
 Potential Head
 (Topographic Slope)

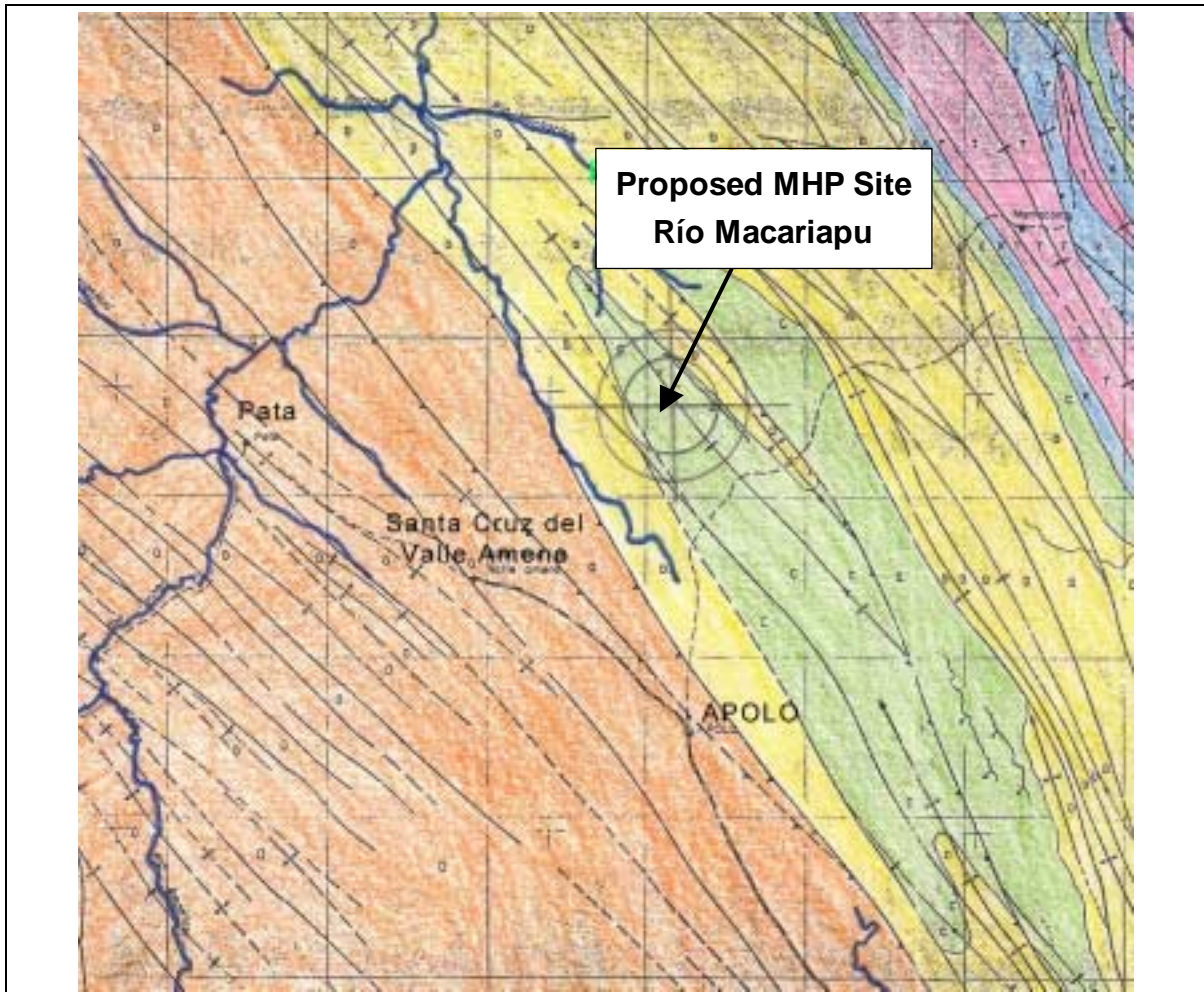
- Low
(Flat area)
- Moderate
(Mountain area)
- Steep
(Mountain area)

Note : Topographic slopes are decided based on the LANDSAT image.
 Source : "Mapa Orografico de Bolivia", Mapa Base, Con Mosaico de Imagenes
 LANDSAT, Atlas Geografico de la Republica Bolivia, I.G.M.

Source : "Precipitaciones Anuales Periodo 1961 - 1990",
 Servicio Nacional de Meteorologia e Hidrologia,
 Atlas Geografico de la Republica Bolivia, I.G.M.

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図 4.2
 平均年間降水量の等雨量線図とポテンシャル落差図
 (オルロ県)



Source: Centro de Investigacion y Aplicacion de Sensores Remitos Ciaser - Geobol", Estudio Integrado de Los Recursos Naturales del Departamento de La Paz, Geologia, Interpretado y Compilado por: Ing. Raul Ballon Ayllon, Apolo, (1985)

LEGEND

- C** **Carboniferous [Carbonifero]** (3.5 ~ 2.7 hundreds million years ago)
 - a) Gritty, limelight with thin diamictitas intercalations. (Altiplano and Oriental Mountain range)
[Areniscas, limolitas con delgadas intercalaciones de diamictitas. (Altiplano y Cordillera Oriental)]
 - b) Diamictitas, limelight, gritty, gritty conglome resides and diamictitas with intercalations of gritty and conglomerates in the superior part. (Subandino North)
[Diamictitas, limolitas, areniscas, areniscas conglome rdicas y diamictitas con intercalaciones de areniscas y conglomerados en la parte superior. (Subandino Norte)]
- D** **Devonian [Devonico]** (4.0 ~ 3.5 hundreds million years ago)
Shale, gritty and limelight [Lutitas, areniscas y lmolts]
- O** **Ordovician [Ordovico]** (4.9 ~ 4.3 hundreds million years ago)
Shale, gritty and limelight [Lutitas, areniscas y lmolts]

图 5.1 アポロ周辺地質図

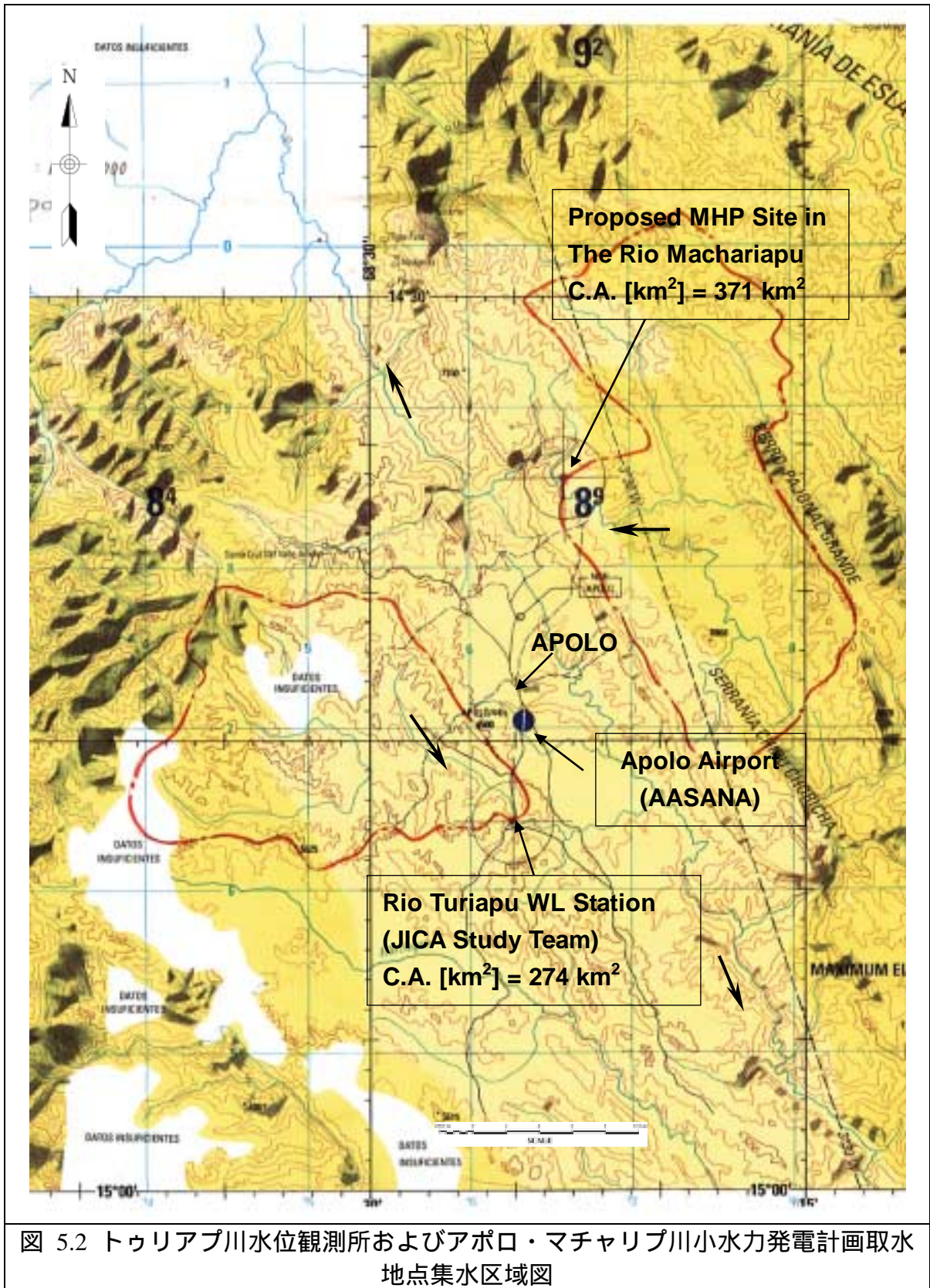


図 5.2 トウリアプ川水位観測所およびアポロ・マチャリプ川小水力発電計画取水地点集水区域図

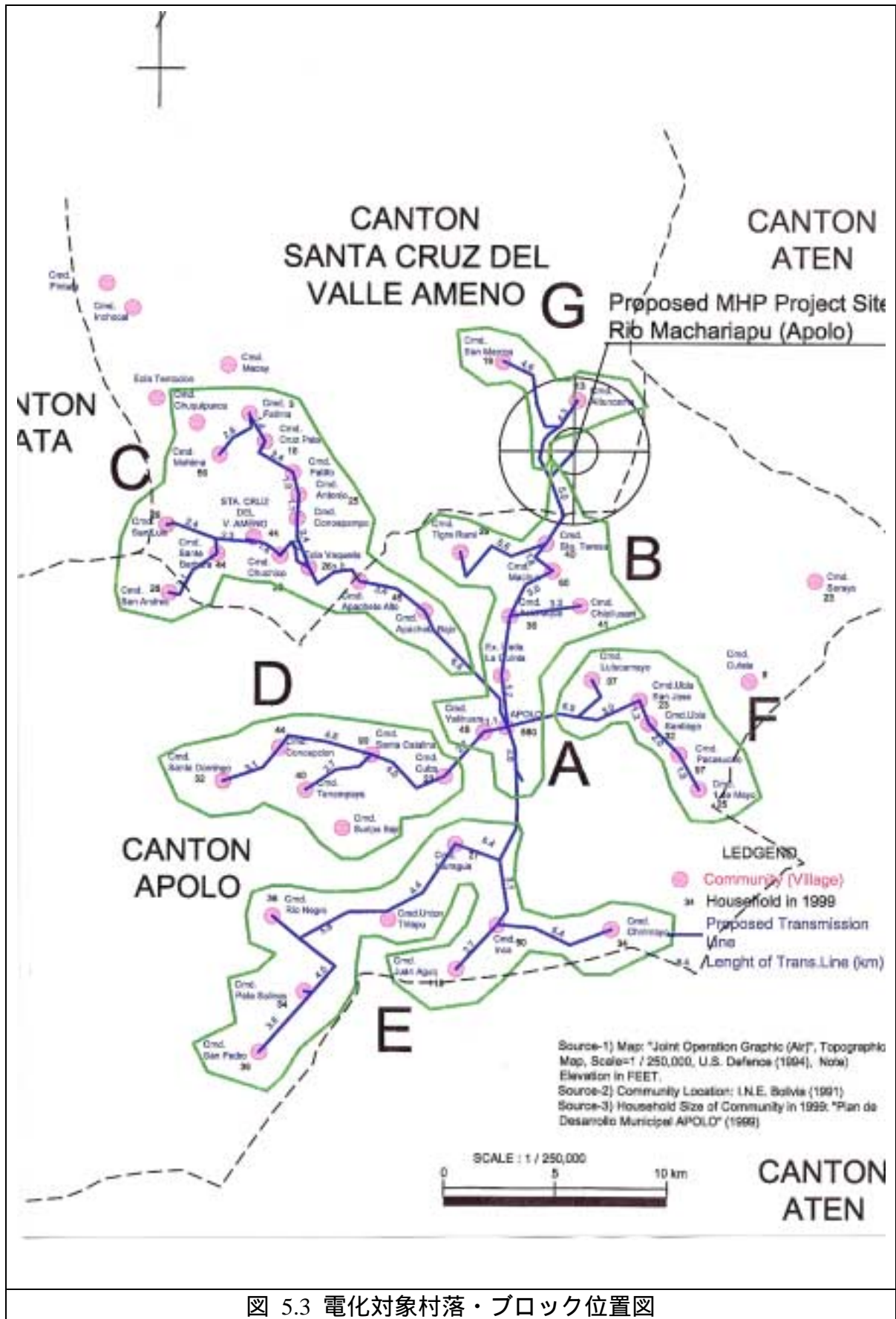


図 5.3 電化対象村落・ブロック位置図

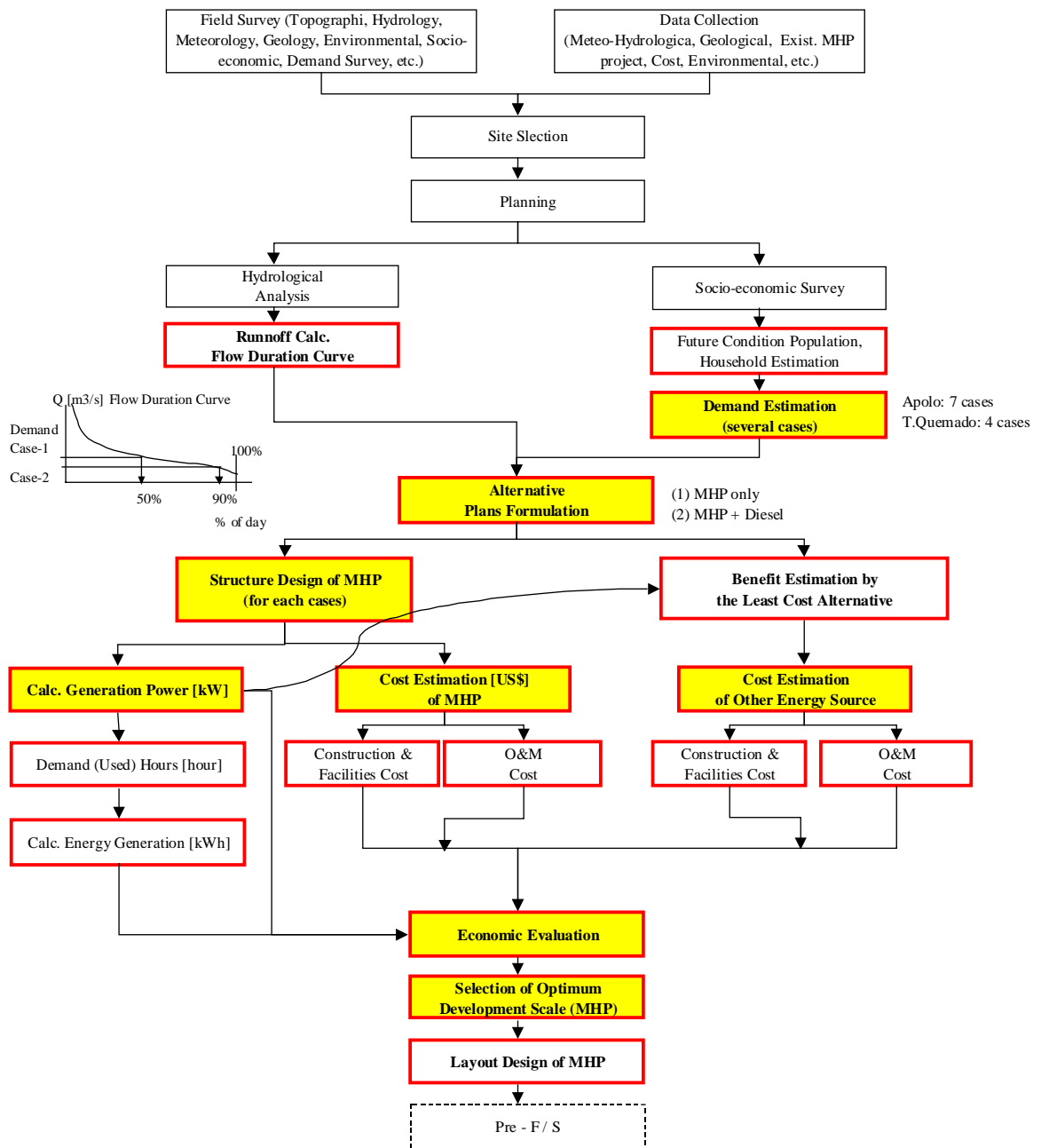
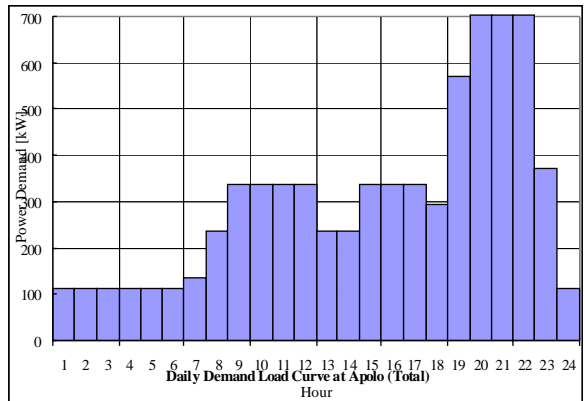
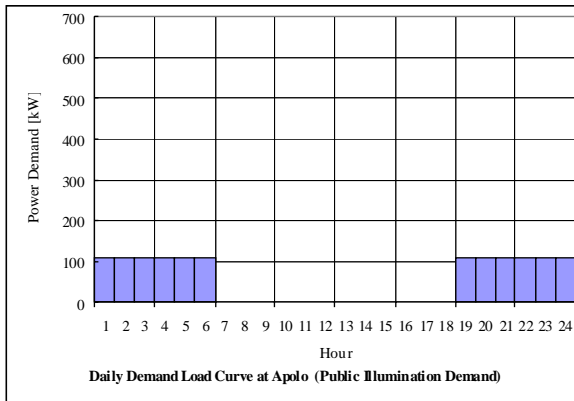
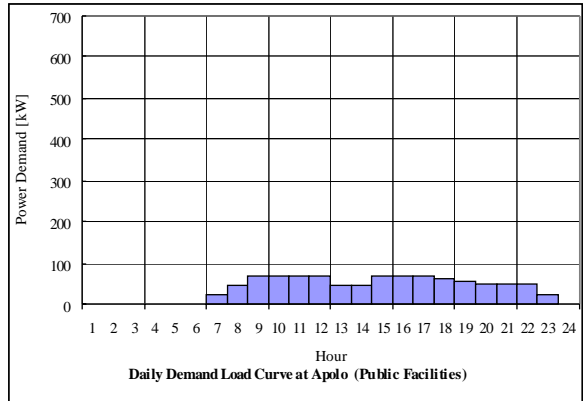
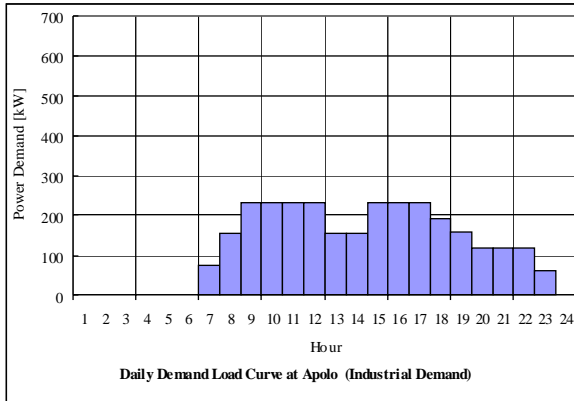
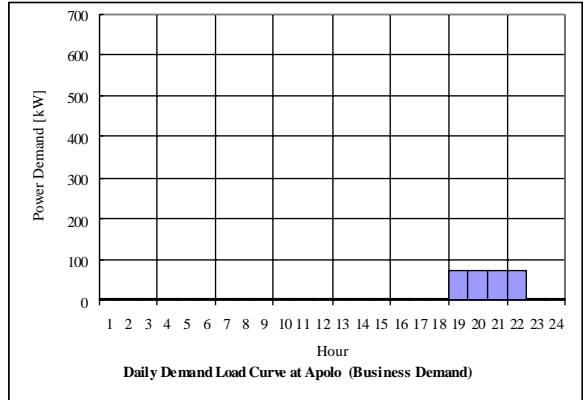
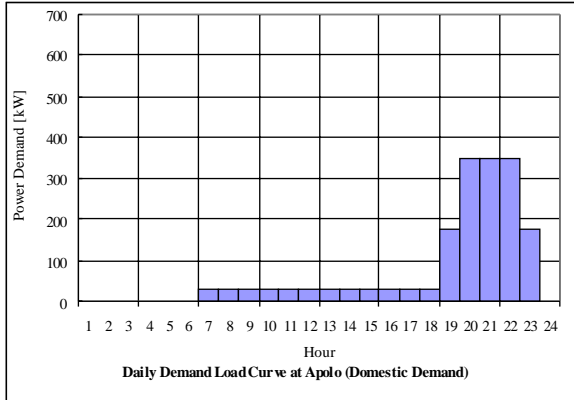


図 5.4 小水力発電計画における最適規模検討フロー

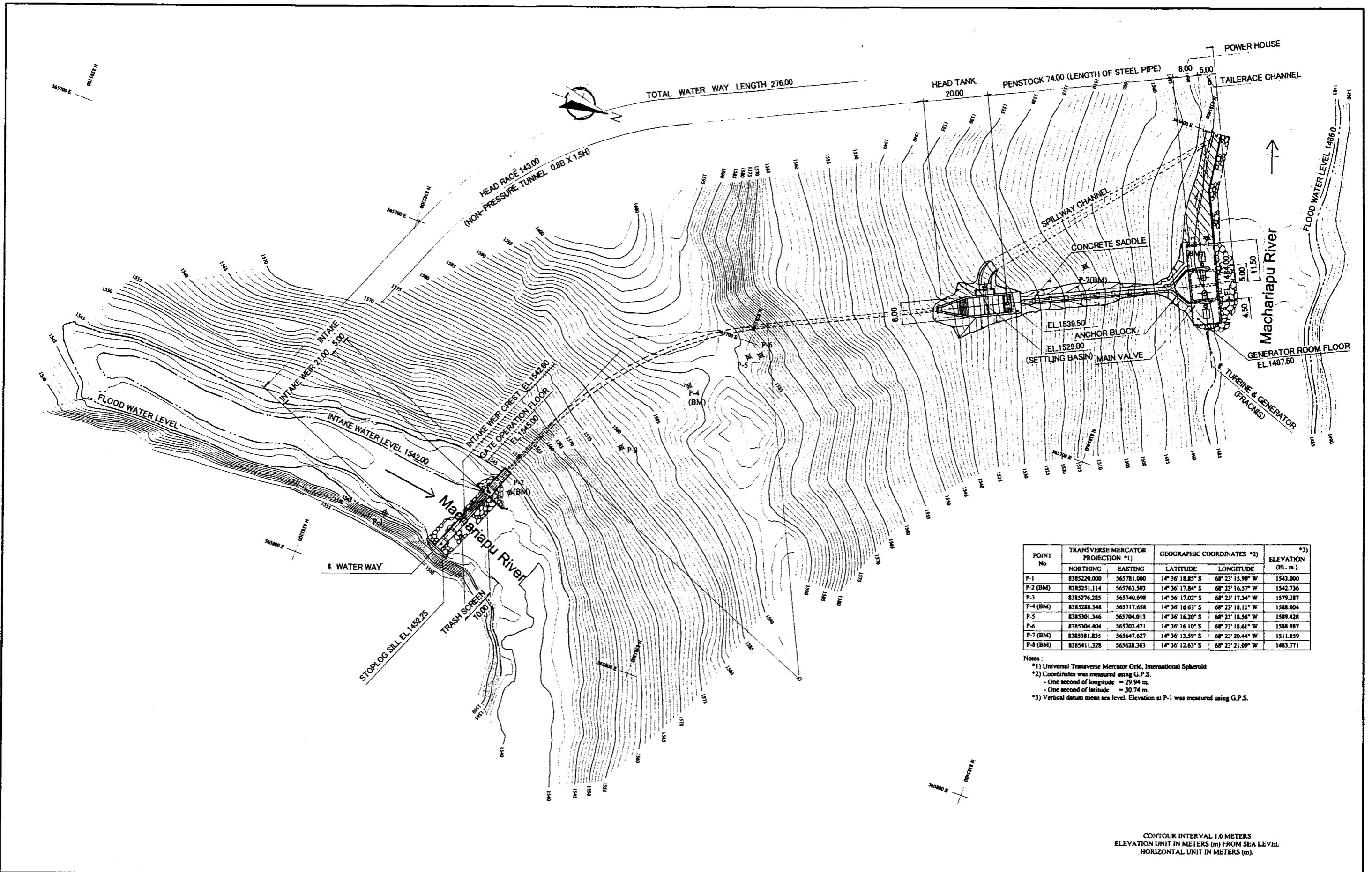
Estimated Demand for Apolo MHP (2005)
[Case-7, Peak=700kW]

	Midnight						Day time												Evening				Midnight		Daily Total Energy Demand (kWh/D)	Monthly Total Energy Demand (kWh/M)	Annual Total Energy Demand (kWh/Y)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00			
1) Domestic	0	0	0	0	0	0	30	30	30	30	30	30	30	30	30	30	30	30	175	350	350	350	175	0	1,760	52,800	642,400
2) Business	3	3	3	3	3	3	7	7	7	7	7	7	7	7	7	7	7	73	73	73	73	3	3	400	12,000	146,000	
3) Industry	0	0	0	0	0	0	77	153	230	230	230	230	153	153	230	230	230	193	157	120	120	120	60	0	2,917	87,500	1,064,583
4) Public (Public Facilities)	110	110	110	110	110	110	23	47	70	70	70	70	47	47	70	70	70	63	167	160	160	160	135	110	2,268	68,050	827,942
(Public Illumination)	0	0	0	0	0	0	23	47	70	70	70	70	47	47	70	70	70	63	57	50	50	50	25	0	948	28,450	346,142
	110	110	110	110	110	110	0	0	0	0	0	0	0	0	0	0	0	0	110	110	110	110	110	110	1,320	39,600	481,800
Total	113	113	113	113	113	113	137	237	337	337	337	337	237	237	337	337	337	294	571	703	703	703	373	113	7,345	220,350	2,680,925



(Case-7, Peak Demand = 700kW)

図 5.5 推定日負荷曲線 (アポロ小水力発電計画)



POINT No	TRANSVERSE MERCATOR PROJECTION *1)		GEOGRAPHIC COORDINATES *2)		ELEVATION (EL. m.) *3)
	NORTHING	EASTING	LATITUDE	LONGITUDE	
P-1	8385220.000	565781.000	14° 36' 18.85" S	68° 23' 15.99" W	1543.000
P-2 (BM)	8385251.114	565763.503	14° 36' 17.84" S	68° 23' 16.57" W	1542.736
P-3	8385276.285	565740.698	14° 36' 17.02" S	68° 23' 17.34" W	1579.287
P-4 (BM)	8385288.348	565717.658	14° 36' 16.63" S	68° 23' 18.11" W	1588.604
P-5	8385301.346	565704.013	14° 36' 16.20" S	68° 23' 18.56" W	1589.428
P-6	8385304.404	565702.471	14° 36' 16.10" S	68° 23' 18.61" W	1588.987
P-7 (BM)	8385381.835	565647.627	14° 36' 13.59" S	68° 23' 20.44" W	1511.859
P-8 (BM)	8385411.328	565628.363	14° 36' 12.63" S	68° 23' 21.09" W	1483.771

Notes:
 *1) Universal Transverse Mercator Grid, International Spheroid
 *2) Coordinates was measured using G.P.S.
 - One second of longitude = 29.94 m.
 - One second of latitude = 30.74 m.
 *3) Vertical datum mean sea level. Elevation at P-1 was measured using G.P.S.

CONTOUR INTERVAL 1.0 METERS
 ELEVATION UNIT IN METERS (m) FROM SEA LEVEL
 HORIZONTAL UNIT IN METERS (m).

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LOCATION : APOLO / FRANZ TAMAYO PROVINCE LA PAZ DEPARTMENT MACHARIAPU RIVER

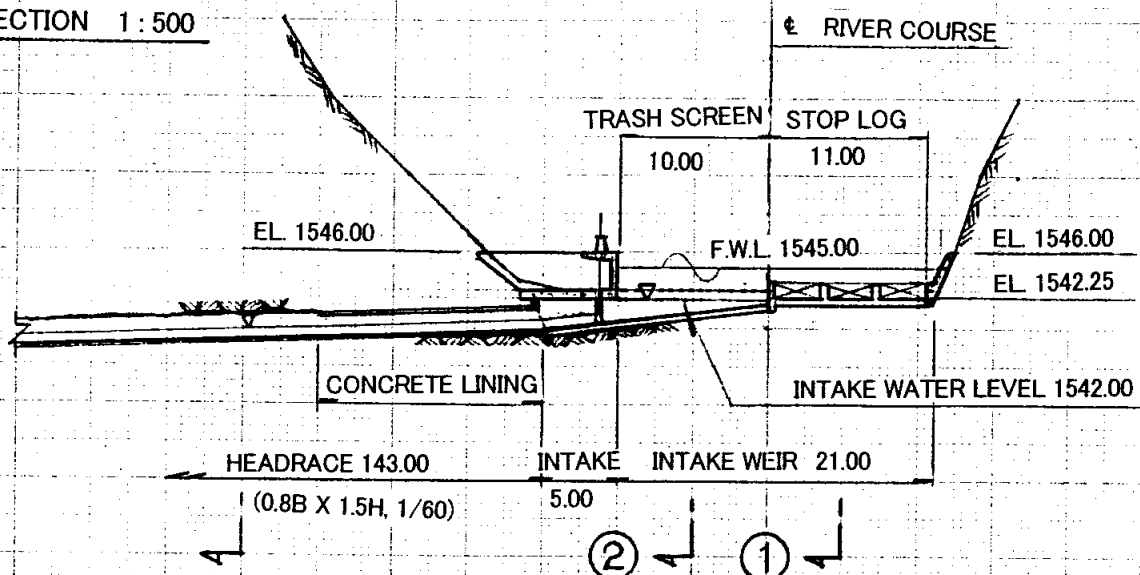
図 5.6 アポロ小水力発電所計画施設配置図 (1/3) (Rio Machariapu)

SCALE : 1:1000

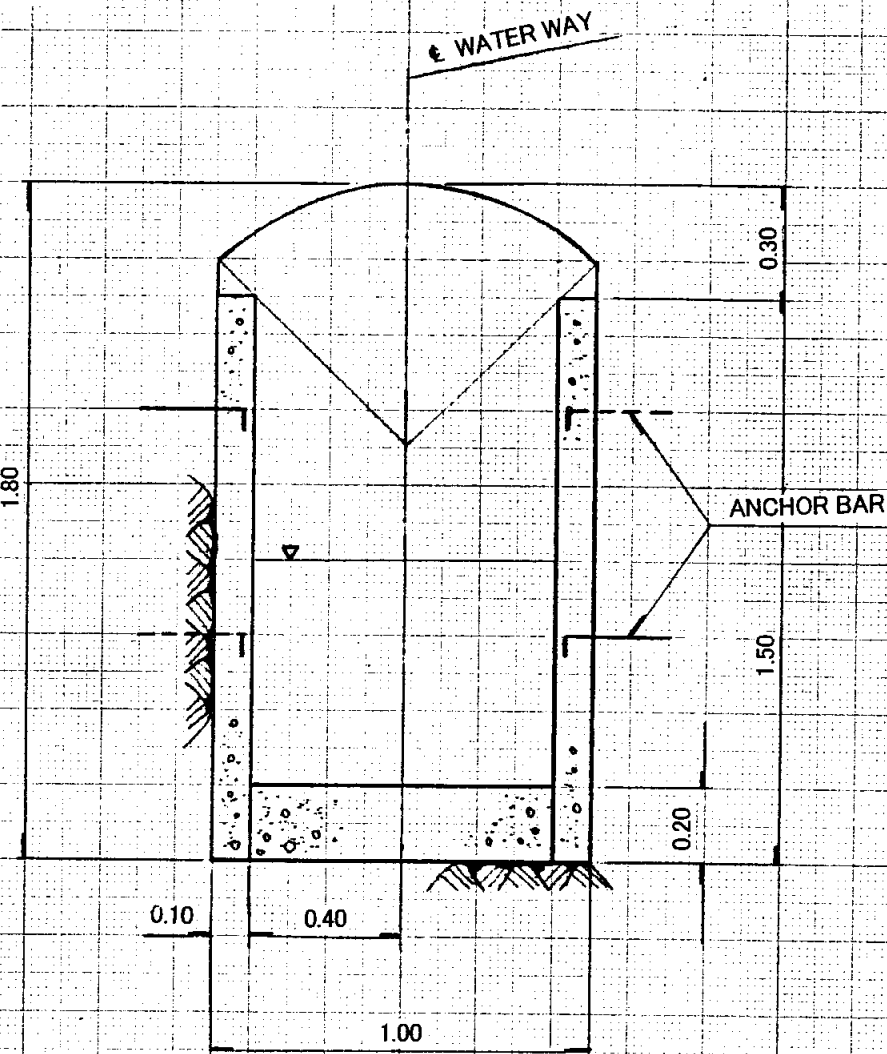
DATE : JULY - 2001

SHEET : 1 / 1

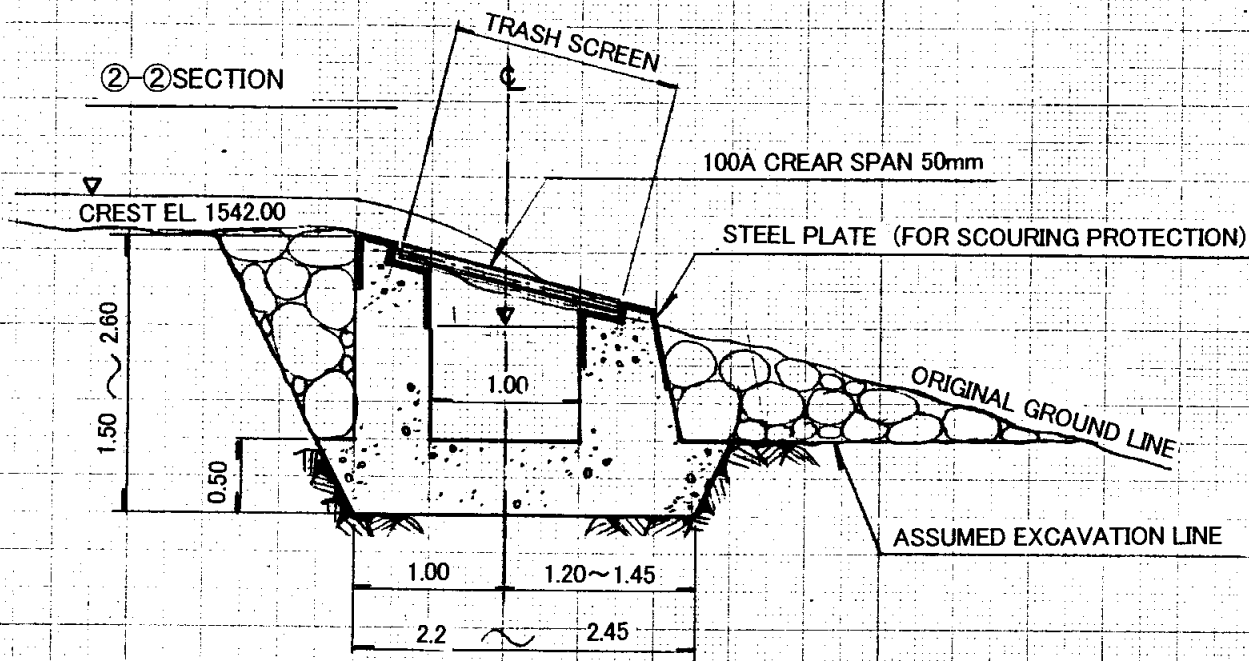
INTAKE LONGITUDINAL SECTION 1 : 500



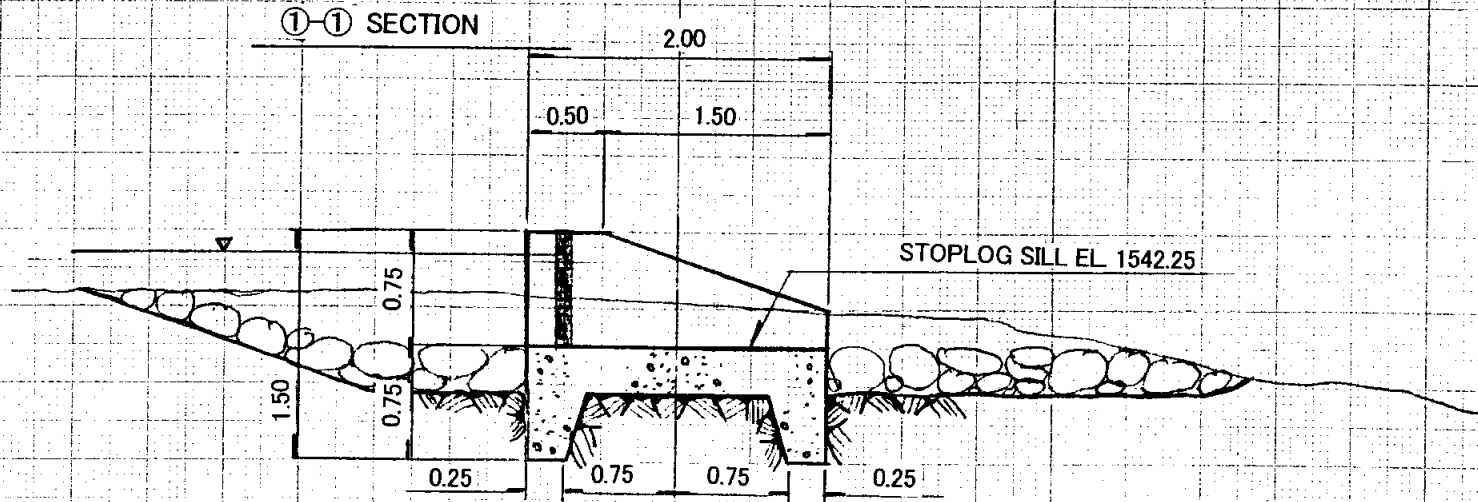
HEADRACE TYPICAL CROSS SECTION 1 : 20



②-② SECTION



①-① SECTION



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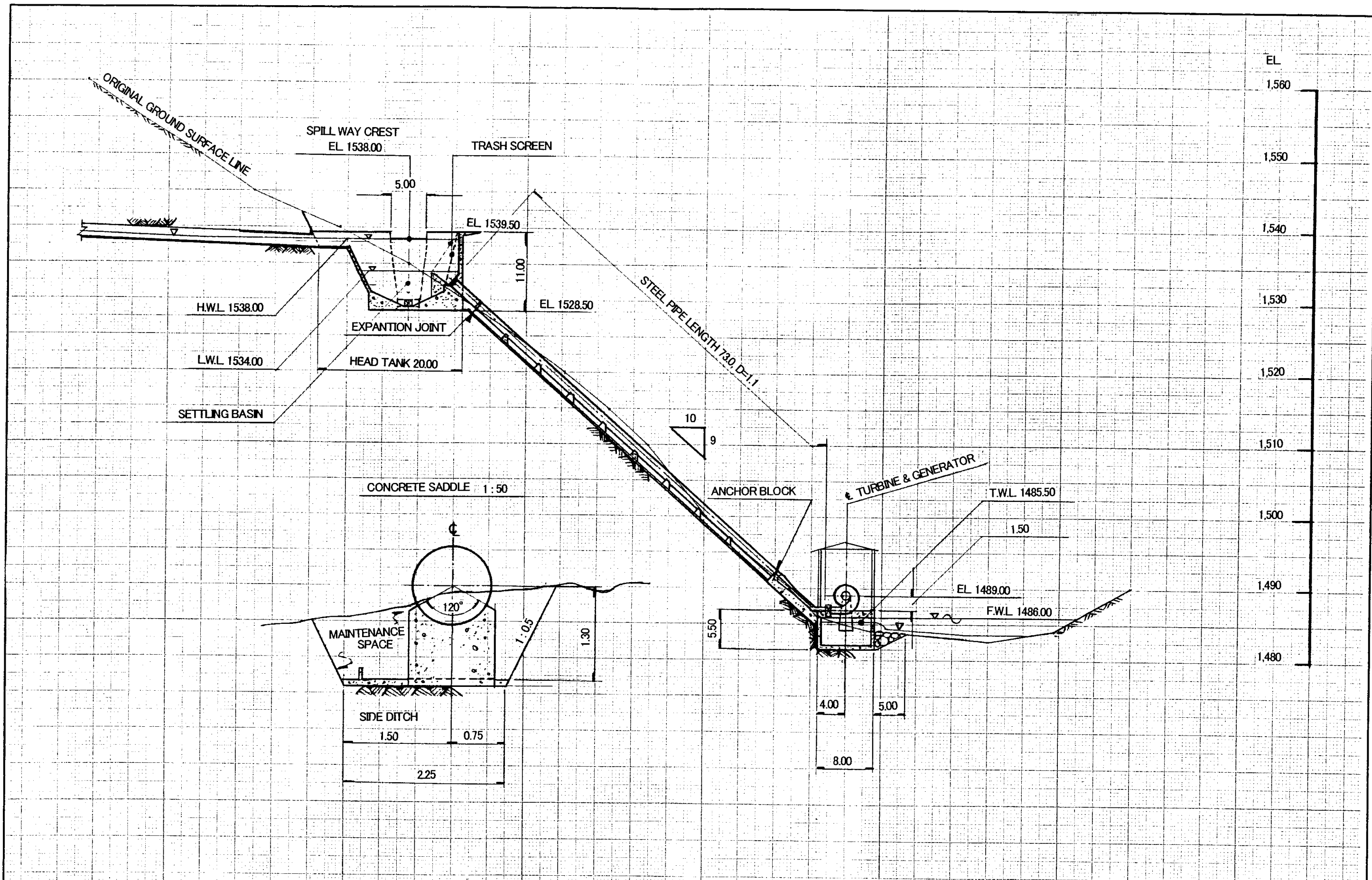
LOCATION :
 APOLO / FRANZ TAMAYO PROVINCE
 LA PAZ DEPARTAMENT
 MACHARIAPU RIVER

図 5.6
 アポロ小水力発電所計画施設配置図
 (2/3)(Rio Machariapu)

SCALE :
 Intake 1 : 500
 Headrace 1 : 20

DATE :
 JULY - 2001

SHEET :
 1 / 1



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 BY RENEWABLE ENERGY
 IN THE REPUBLIC OF BOLIVIA

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

LOCATION :
 APOLO / FRANZ TAMAYO PROVINCE
 LA PAZ DEPARTAMENT
 MACHARIAPU RIVER

図 5.6
 アポロ小水力発電所計画施設配置図
 (3/3)(Rio Machariapu)

SCALE :
 1 : 500

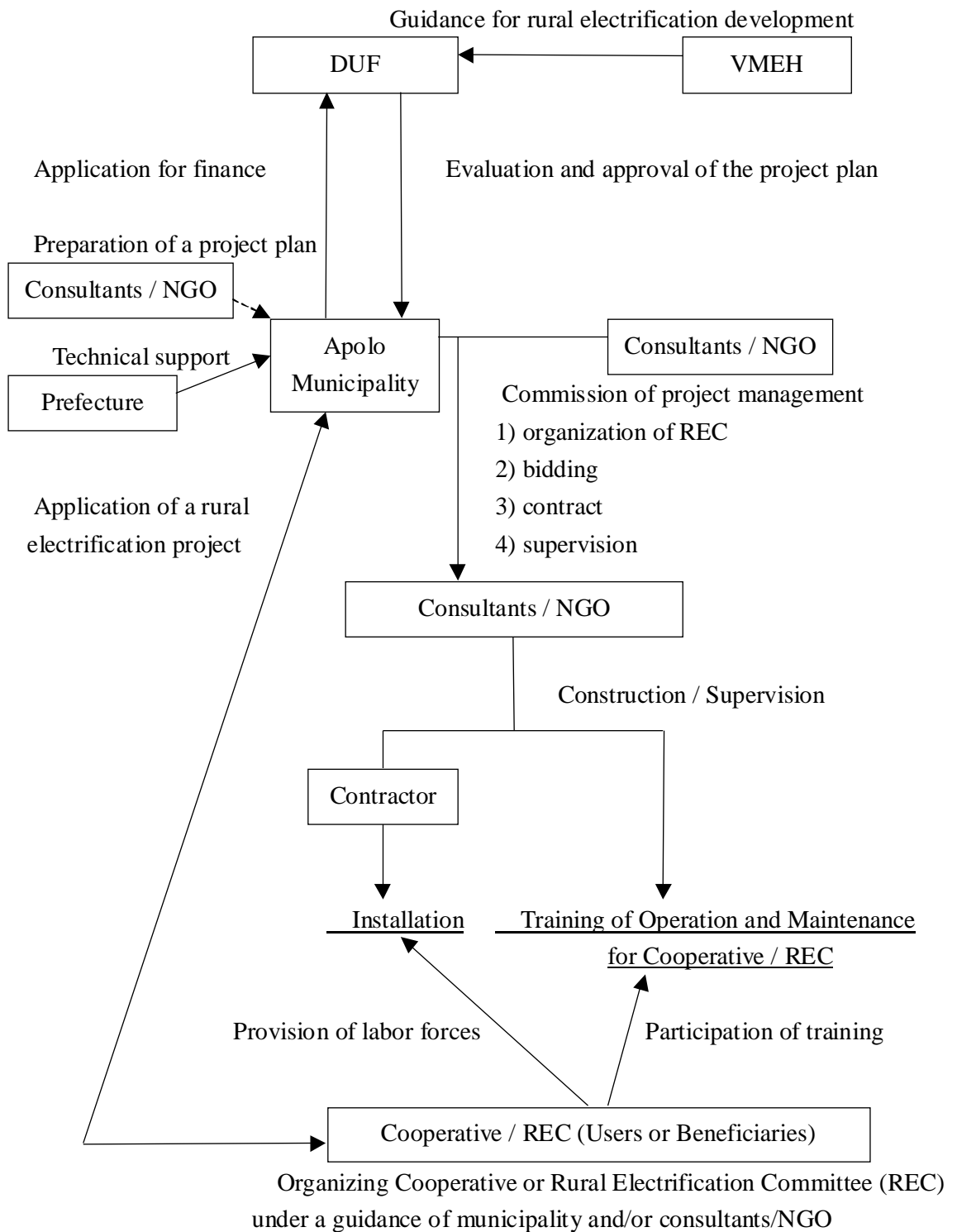
DATE :
 JULY - 2001

SHEET :
 1 / 1

図 5.6
アポロ小水力発電所計画施設配置図
(1/3) (Río Machariapu)

図 5.6
アポロ小水力発電所計画施設配置図
(2/3)(Río Machariapu)

図 5.6
アポロ小水力発電所計画施設配置図
(3/3)(Río Machariapu)



Source: JICA Study Team

図 5.8 アポロ小水力発電計画プロジェクト実施組織（案）