abnormal structure such as faults and sheared zones shall be performed.

13.1 Field Analyses

In the field, approximate analyses shall be made in succession from prospecting lines on which measurements have been completed, and the results shall be reported to the Engineer.

13.2 Precise Analyses

In performing analyses on measurement results, the most appropriate calculation method shall be used in accordance with the purpose, method, and condition of the travel-time curve. Other date (investigation results, existing geological data, etc.) shall be referred to in performing analyses, and they shall be reflected in the results of analysis as much as possible.

Table II.2.1 Work Quantity

Line No.	Length (m)	Remarks
S-1	250	
S-2	250	
S-3	200	
S-4	400	
S-5	200	
S-6	200	
TOTAL	1500	

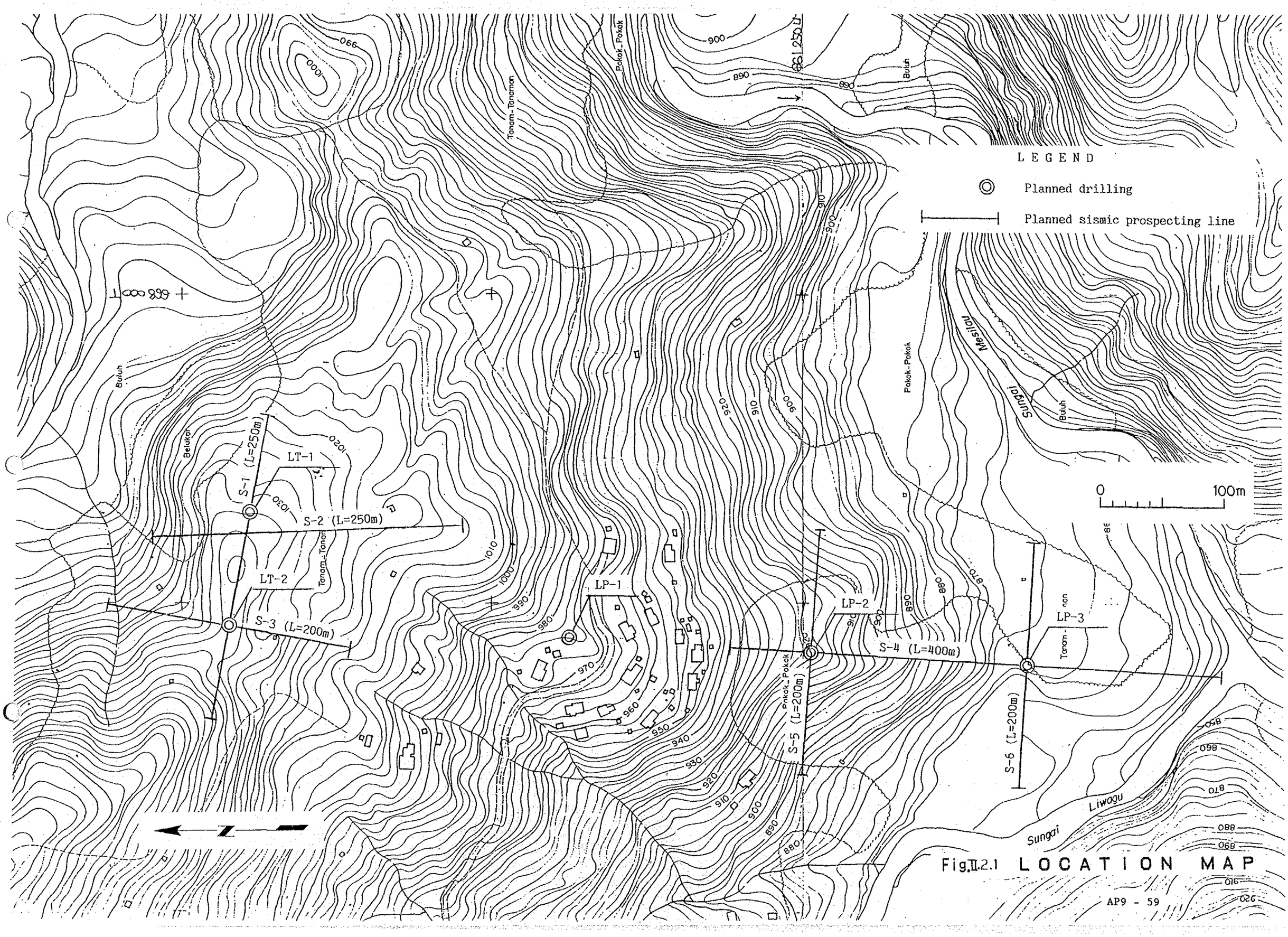


Fig.II.2.1 LOCATION MAP

II.3 GEOLOGIC MAPPING

1. General

The Specification shall be applicable to the Geological Mapping to be performed in order to obtain data necessary for the preliminary design of the Feasibility Study of the Small Scale Hydroelectric Power Development Project at Upper Liwagu River Basin in Sabah, Malaysia.

2. Objective

Objective of engineering geologic mapping of the project site and its surroundings is to clarify as follows:

(1) Distribution and feature of surface deposits and bedrocks
(2) Distribution and feature of faults and sheared zones
(3) Hydrogeologic condition of the site

3. Scope of Work

The specification describes the following works for the Geological Reconnaissance.

(1) Literature investigation
(2) Interpretation of aerial photograph
(3) Drawing of rout map and geologic map
(4) Reporting

4. Preparation of Geologic Mapping

4.1 Literature Investigation

(1) Collection and review of the existing data for topography and geology of the project area

(2) Interpretation of Topographical Map

The topography shows various landforms reflecting the difference of geological condition (e.g. hardness of the ground, the crustal movement). Topographical maps shall be interpreted in terms of talus, fan, terrace, karstic landforms, faults, landslide etc.

4.2 Interpretation of Aerial Photograph

The feature of an aerial photograph is that the shape of the land is exaggerated by stereoscopic view, and particular color tones and intensities can be emphasized. Consequently, it is easier to judge the topography by the aerial photograph than by topographical maps or observations on site.

The identification factors based on features of topography and combinations with color tones shall be as follows:

- drainage patterns (particularly their type and density)
- erosional features
- distribution of surface deposits (talus, terrace etc.) and outcrops
- color tones of surface deposits and outcrops
- vegetative cover
- lineament (straight stream courses, straight alignement of saddle etc.)
- tectonic landform (offset valleys, fault scraps, fault saddles etc.)
- gross geological structures (distribution of strata, direction of bedding, structural landform (homoclinal ridge, anticlinal valley) etc.)
- fault and joint systems
- distribution and form of landslide
- karst landform

These data shall be recorded on the drawings. These interpretation results shall be summarized on 1/50,000-scale and 1/5,000-scale maps.

5. Geologic Mapping

5.1 Topographic Map used for Geologic Mapping

Topographic map at the scale of 1/5,000 (for whole project area) and 1/500 (for the area near the structures) shall be used for geologic mapping.

5.2 Route Map

The important data observed in the field shall be described in route map.

These data must be organized to show the significant engineering geological features of the site. Important items for observations in geologic mapping may be listed as follows:

(1) Topographic feature

- enclosed depression, col, cliff, alluvial plain, alluvial fan, terrace, form of landslide, landform of fault etc.

(2) Property of surface deposits (talus deposit, gravel, residual soil etc.)

- locality of distribution
- origin (weathering of bedrock, terrace, aeolian, landslide etc.)
- areal extent, continuity
- constituent material, particle size distribution
- homogeneity, bedding
- weathering, moisture content, compactness
- relation between surface deposit and bedrock

(3) Property of bedrock

- locality of outcrop
- kindness of rock (constituent material, particle size, fossils etc.)
- bedding (dip and strike, thickness of bed, feature of bedding plane)
- unconformity (shape and condition of surface)
- vein and intrusive rock (dip and strike, thickness, name of rock or mineral, hardness, parting, opening, corrosion)
- weathering (Table II.3.1), alteration
- hardness (Table II.3.1)
- property of crack spacing (Table II.3.1), orientation filling material (type, thickness), parting, opening, leaching

(4) Geological structure

1) Joint, fault, shear zone

- locality
- dip and strike
- continuity
- spacing
- filling material or fault breccia/gouge (type, thickness, compactness)
- parting, opening (leaching)
- roughness of joint/fault plane (slickenside, striation)
- displacement (relation of joint-fault set)
- conjugate joint/fault

2) Fold

- locality
- direction of axis and axial surface
- type (shear fold, slump fold etc.)

(5) Surface water and ground water (stream, creek, pond, spring)

- Locality of distribution
- Flow, temperature, water chemistry

(6) Vegetation (type, age, artificial/natural)

(7) Artificial Structures

5.3 Photos, Sketches and Samples

Important facts shall be recorded by photos, sketches and samples, its localities shall be recorded in rout map.

5.4 Geologic Mapping

Based on literature investigation, interpretation of aerial photograph and geologic reconnaissance, the following geologic maps shall be drawn in accordance with the form shown in appendix. The geological mapping shall be covered as shown in Fig. II.3.1.

- geologic plan of project area
- geologic profile of penstock, powerhouse and tailrace
- geologic sections of intake dam sites

6. Report

The report shall contain the information mentioned in chap. 4 and 5 and the following annexes.

(1) Drawings showing the results of interpretation of aerial photograph
(2) Rout map (1/5,000 and 1/500)
(3) Geologic maps (1/5,000 and 1/500)
(4) Photos and sketches
(5) Samples

Table II.3.1(a) Rock Classification for Adit and Outcrop

Weathering		Hardness		Crack Spacing	
1	Very fresh. No weathering of mineral component.	A	Very hard. Broken into Knifeedged pieces by strong hammer blow.	I	Over 100 cm
2	Fresh. Some minerals are weathered slightly. Usually no brown crack.	B	Hard. Broken into pieces by strong hammer blow.	II	40 - 100 cm
3	Fairly fresh. Some minerals are weathered. Cracks are stained and with weathered material.	C	Brittle. Broken into pieces by medium hammer blow.	III	20 - 40 cm
4	Weathered. Fresh portions still remain partially.	D	Very brittle. Easy broken into pieces by medium hammer blow.	IV	5 - 20 cm
5	Strongly weathered. Most minerals are weathered and altered to second minerals.	E	Soft. Able to dig with hammer.	V	Under 5 cm

Table II.3.1(b) Rock Classification for Drilled Core

Weathering		Hardness		Crack Spacing	
1	Very fresh. No weathering of mineral component.	1	Very hard. Broken into Knifeedged pieces by strong hammer blow.	1	Over 30 cm
2	Fresh. Some minerals are weathered slightly. Usually no brown crack.	2	Hard. Broken into pieces by strong hammer blow.	2	10 - 30 cm
3	Fairly fresh. Some minerals are weathered. Cracks are stained and with weathered material.	3	Brittle. Broken into pieces by medium hammer blow.	3	3 - 10 cm
4	Weathered. Fresh portions still remain partially.	4	Very brittle. Easy broken into pieces by medium hammer blow.	4	1 - 3 cm
5	Strongly weathered. Most are weathered and altered to second minerals.	5	Soft. Able to dig with hammer.	5	Under 1 cm

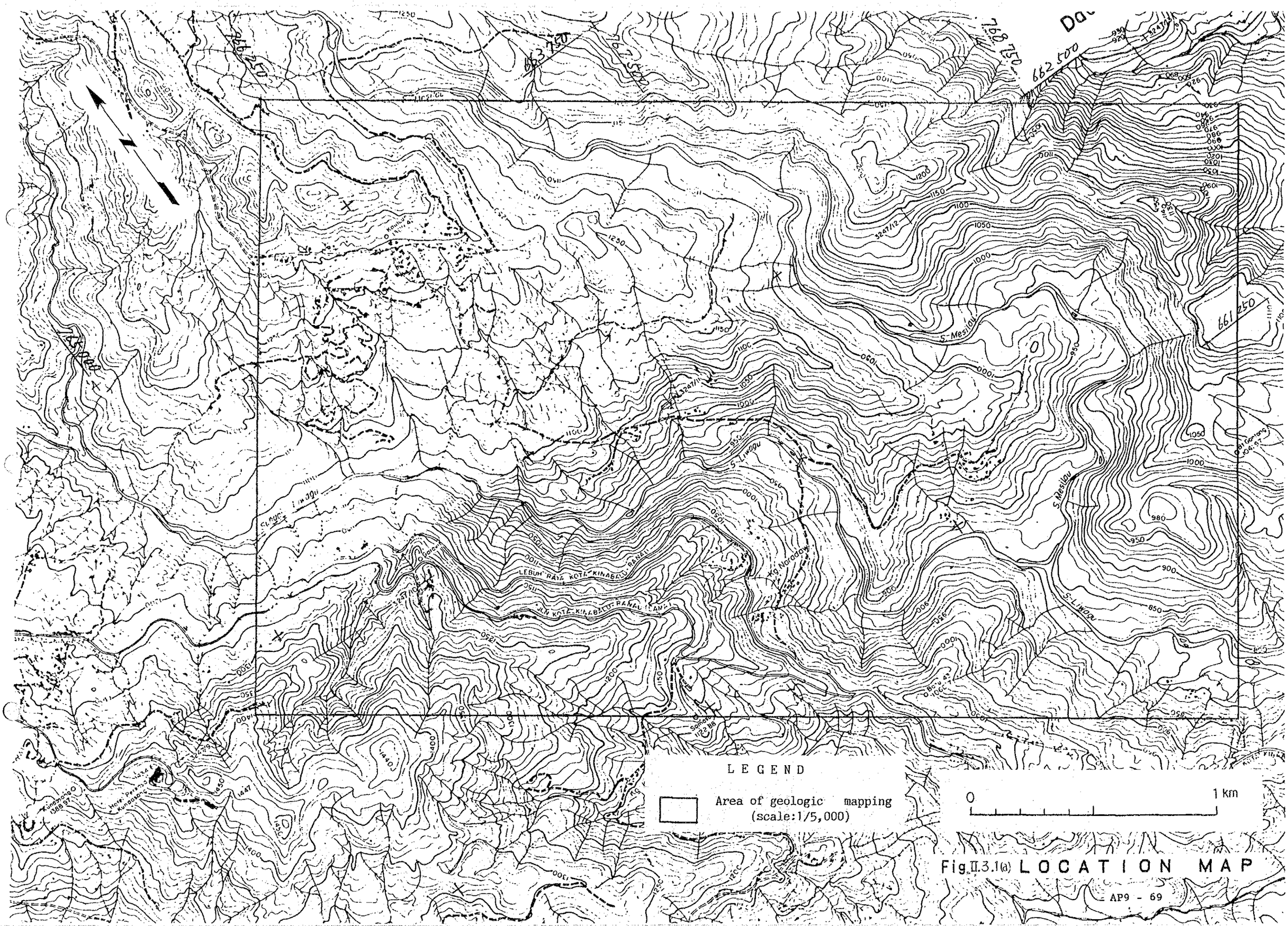


Fig.II.3.1(a) LOCATION MAP

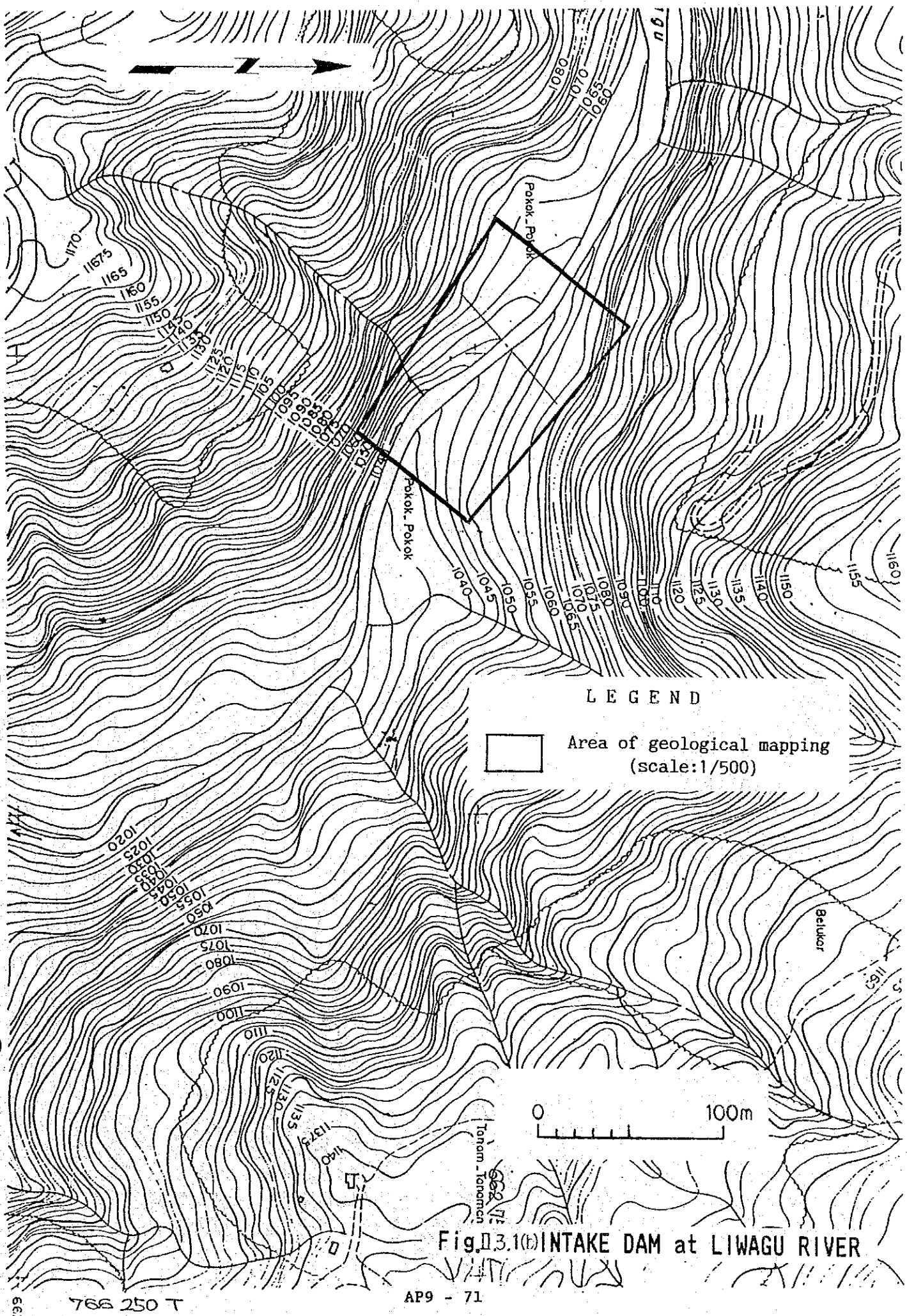


Fig. 3.1(b) INTAKE DAM at LIWAGU RIVER

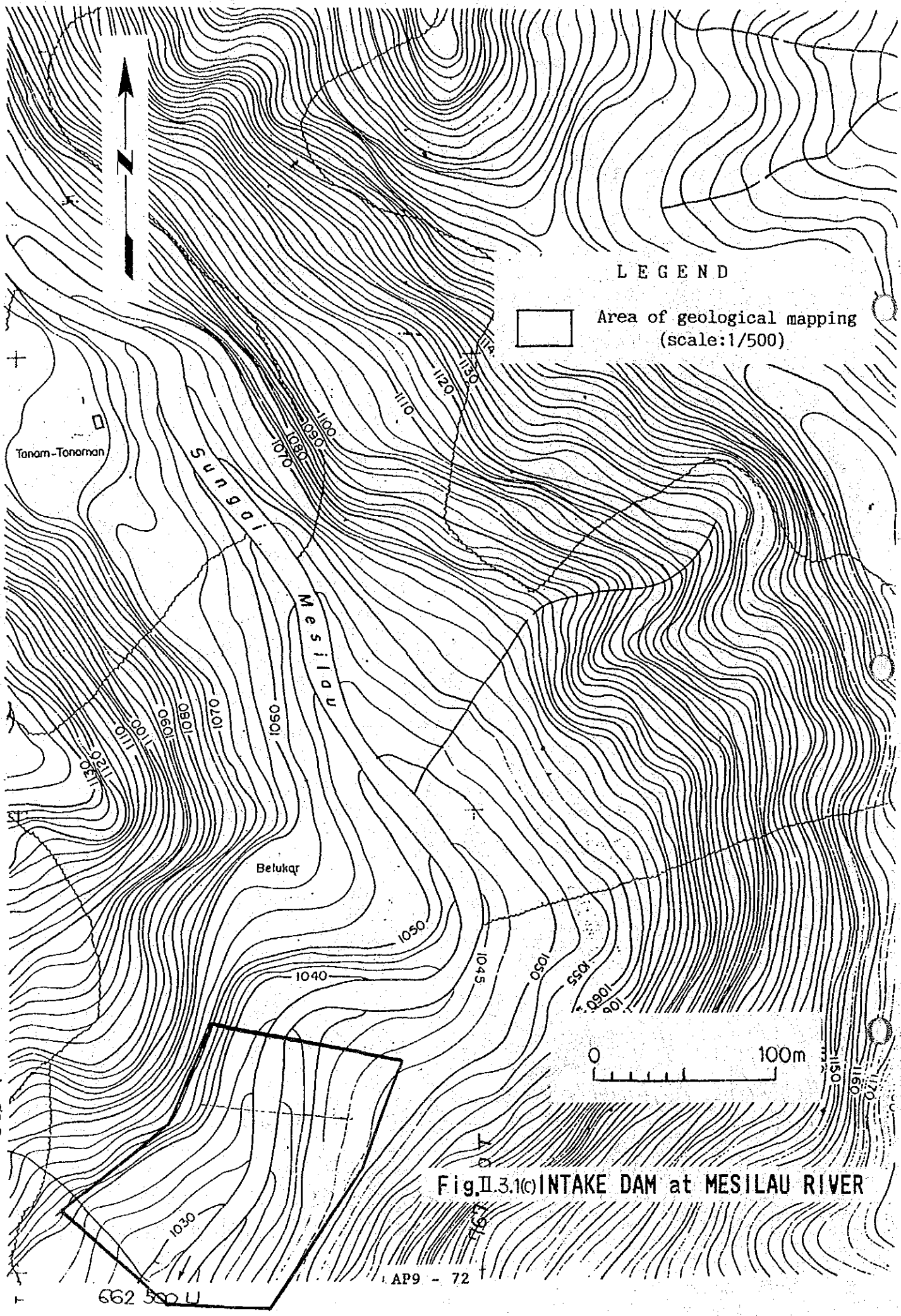


Fig.II.3.1(c) INTAKE DAM at MESILAU RIVER

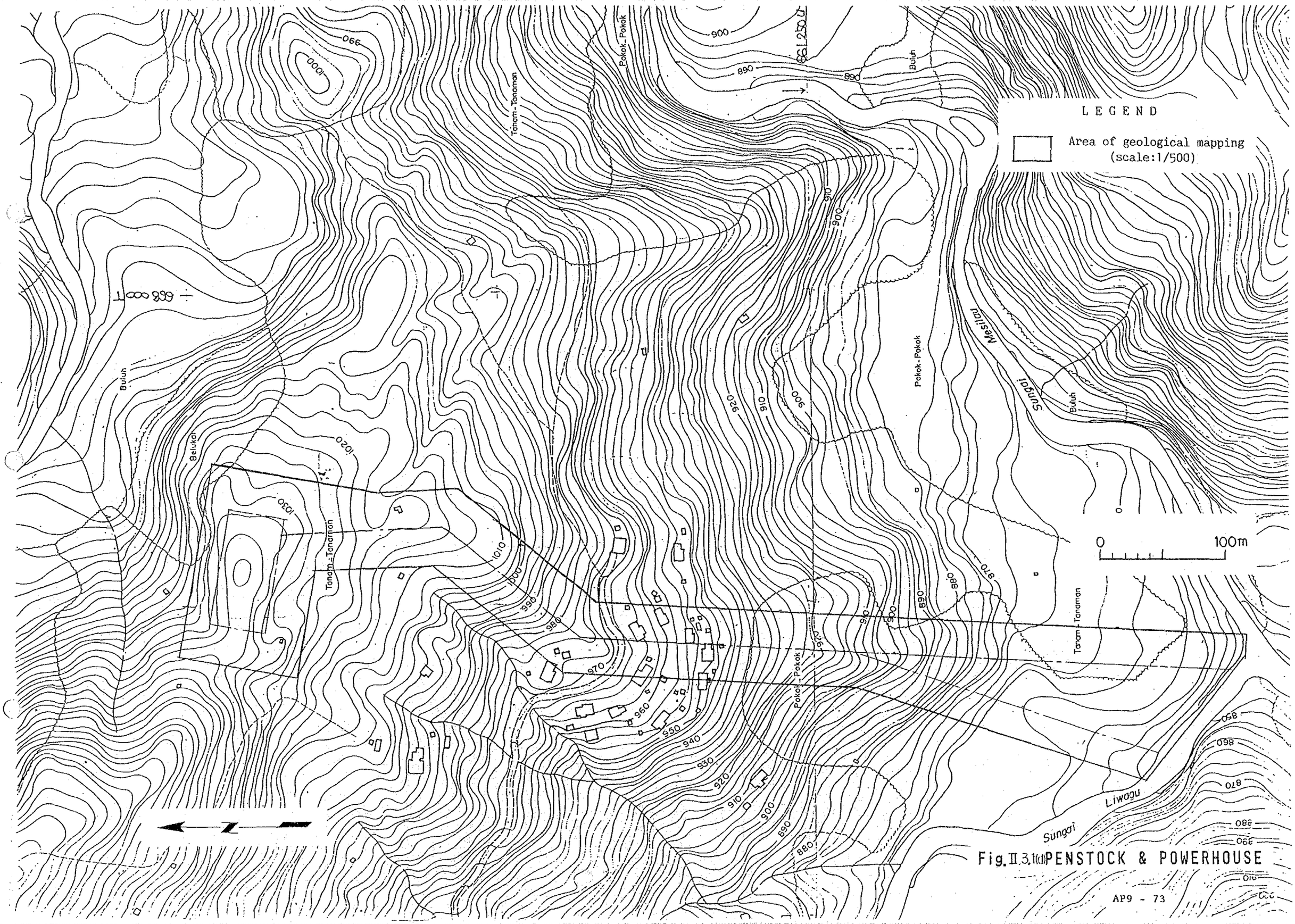


Fig. II.3.10 PENSTOCK & POWERHOUSE

III. HYDROLOGICAL SURVEY

1. General

The Specification shall be applicable to the Hydrological Survey to be performed in order to obtain data necessary for the preliminary design of the Feasibility Study of the Small Scale Hydroelectric Power Development Project at Upper Liwagu River Basin in Sabah, Malaysia.

2. Scope of Work

The work items are as follows;

2.1 Establishment of Stream Gauging Station

2.2 Stream Discharge Measurement

2.3 Preparation of Rating Curve

2.4 Suspended Sediment Measurement

3. Location of Stream Gauging Station

Location of the stream gauging station is shown in Fig. III.1.

4. Work Period

The hydrological survey work shall be completed by the end of October, 1992. The interim data results shall be, however, submitted on the mid-January of 1992.

5. Technical Specifications

All measurement shall be expressed in the metric system and the language shall be English.

5.1 Establishment of Stream Gauging Station

5.1.1 Staff Gauge

Two (2) staff gauges shall be installed in accordance with the procedure of "Standard Stick Gauge for River Station" of DID.

For high flow level	one (1) set
For low flow level	one (1) set

5.1.2 Cross-sectional Surveying

The cross-sectional surveying of the river shall be carried out at stream gauging station. After the flood, the surveying shall be re-executed at same location.

5.2 River Discharge Measurement

The river discharge shall be measured by water level and/or current meter in accordance with "River Discharge Measurement by Current Meter" of DID.

5.3 Preparation of Rating Curve

The rating curve shall be prepared by using water level and discharge data in accordance with the procedure of "Stage Discharge Curves" of DID.

5.4 Suspended Sediment Measurement

The suspended sediment shall be measured in accordance with the procedure of "The Determination of Suspended Sediment Discharge" of DID.

6. Frequency of Measurement

6.1 Water Level

The frequency of water level measurement shall be twice a day.

6.2 Velocity

The frequency of velocity measurement shall be twice a week.

6.3 Suspended Sediment

The frequency of suspended sediment measurement shall be twice a week.

7. Items not Specified in this Specifications

The items not specified in this Specifications shall be instructed by the Engineer as a variation order.

8. Final Products to be Delivered

(1) One (1) set of lateral profile of river at stream gauging station
(2) One (1) set of records of water level and current meter
(3) One (1) set of result of daily discharge
(4) One (1) set of rating curve
(5) One (1) set of records of suspended sediment

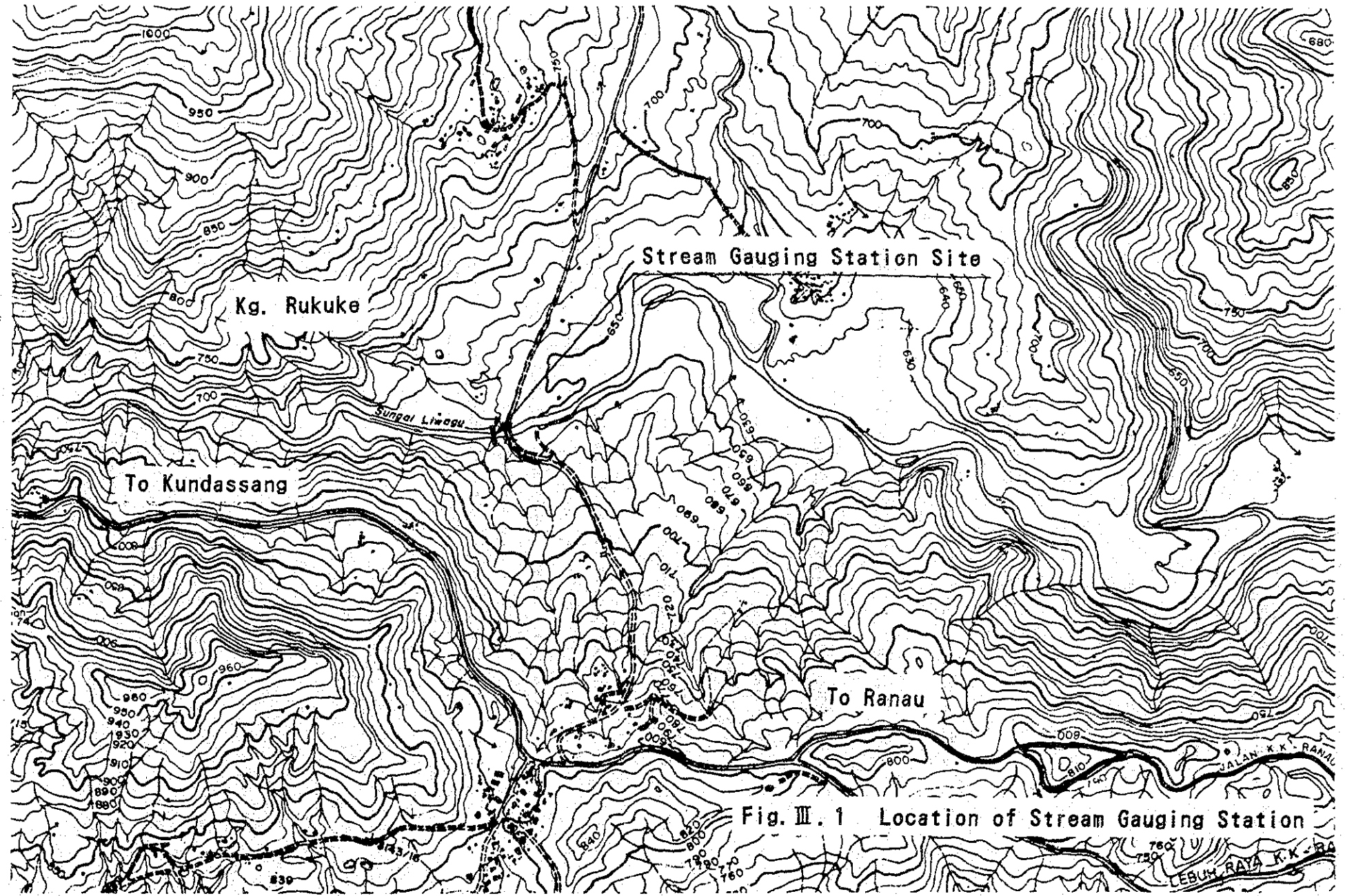


Fig. Ⅲ. 1 Location of Stream Gauging Station

IV. ENVIRONMENTAL IMPACT ASSESSMENT

1. General

The Specification shall be applicable to the Environmental Impact Assessment to be performed in order to obtain data necessary for the preliminary design of the Feasibility Study of the Small Scale Hydroelectric Power Development Project at Upper Liwagu River Basin in Sabah, Malaysia.

2. Scope of Work

Following environmental components shall be surveyed through literatures and, if necessary, through field investigations to provide a general idea on the environment of the project area and impact(s) of the project on the local environment.

If it is obvious that the project has no impact on particular environmental component, it shall be stated as so under that item. If the project has possible impact(s) on the environment, the extent and nature of the impact(s) shall be explained and the mitigation measure(s) to be incorporated into the project shall be described under each item.

If the environmental component(s) have possible impact(s) on the project, they shall be also stated, together with the measure(s) to avoid or reduce these impact(s) if they are negative one(s).

If there are laws and regulations relevant to the project or project area, such as water quality standards, regulations on land use, animals and plants protected by laws, etc., it shall be stated under each item that the present project complies with these legal requirements, with or without mitigation measure(s).

Special attentions shall be paid to the fact that the project could have different impact(s) on the environment during the construction period. Transmission lines also could have impact(s) on the local environment.

3. Environmental Components to be Surveyed

3.1 Geographical Characteristics

Geographical explanations of the project area shall be provided.

3.2 Geological Conditions

Geological characteristics of the project area shall be described together with the comments on their slope stability. Summary of geologic mapping in II.3 can be used as geological conditions in this chapter.

3.3 Soil Conditions

Soil profiles, soil compositions, and subsidence and compaction of the project area shall be provided.

3.4 Seismicity

Previous records of the earthquake in the project area shall be provided. If there is a noticeable possibility of future earthquake, its possible impact(s) on the project shall be explained.

3.5 Land Use

Land uses of the project area shall be described, and, if there are regulations on the land use in the project area (such as national parks, reservations, forest reserves, etc.), their relevance to the project shall be explained. If relevant, ownership of the land in the project area and its relation to the implementation of the project shall be included in the description.

3.6 Surface Water

Present flow regimes of the rivers in the project area shall be described, together with the expected changes of their regimes during

and after the construction period. Data on the present quality of the river water shall be provided, and the impact(s) of the project on the river water quality shall be explained. Special attentions shall be paid to the impact(s) of the waste water discharges into the river(s) during the construction period.

If there are regulations relevant to the water in the project area such an water quality standards, effluent standards, etc., they shall be included, and mitigation measure(s), if they are required for the compliance with these regulations, shall be described.

If the river water is used for industry, fishery, agriculture (irrigation) or domestic water supply, the impact(s) of the project on the water use shall be explained. If relevant, water right of the project area and its relation to the implementation of the project shall be included in the description.

3.7 Atmosphere

If there are regulations relevant to the project area such as air quality standards, emission standards, etc., they shall be provided, and it shall be stated that the present project does not have an impact on the ambient air by nature.

3.8 Noise and Vibration

Expected noise and vibration levels during and after the construction period shall be described, and mitigation measure(s) shall be explained if they are required to comply with the regulations on noises and vibrations.

3.9 Fauna and Flora

Present fauna and flora in the present area shall be described, including aquatic fauna and flora. Vegetations of the project area shall be explained. Special attentions shall be paid to those protected by laws and regulations, and endangered species. Names of

these legally protected organisms shall be provided, and their presence and absence in the project area shall be described.

Presence and absence of fish which migrate through the river in the project area also require special attentions, and, if relevant, the impact(s) of the project on their migration shall be explained together with the measures to secure their migration.

3.10 Local Communities

Social conditions of the local communities in the project area shall be described. Administrative divisions, populations, numbers of households, local industry, agriculture, fishery, forestry, commerce and public facilities (schools, hospitals, etc.), and shall be described, and the impact(s) of the project on the local communities shall be explained.

3.11 Climate

Climate of the project area shall be briefly described.

3.12 Historic and Religious Places or Structures

Historic and religious places or structures, and cultural assets in the project area shall be briefly described, and the impact(s) of the project on them shall be explained.

3.13 Landscape

Photographs showing the landscapes of the project area shall be provided, and the impact(s) of the project on the landscapes shall be explained.

3.14 Compensation

Costs of compensation for the trees and land (ex. crop field) and for the families or households to be affected by the project including the

transmission lines, access roads, etc. shall be estimated. Special attentions shall be paid to the relocation of the houses. Basis of these estimations shall be also provided.

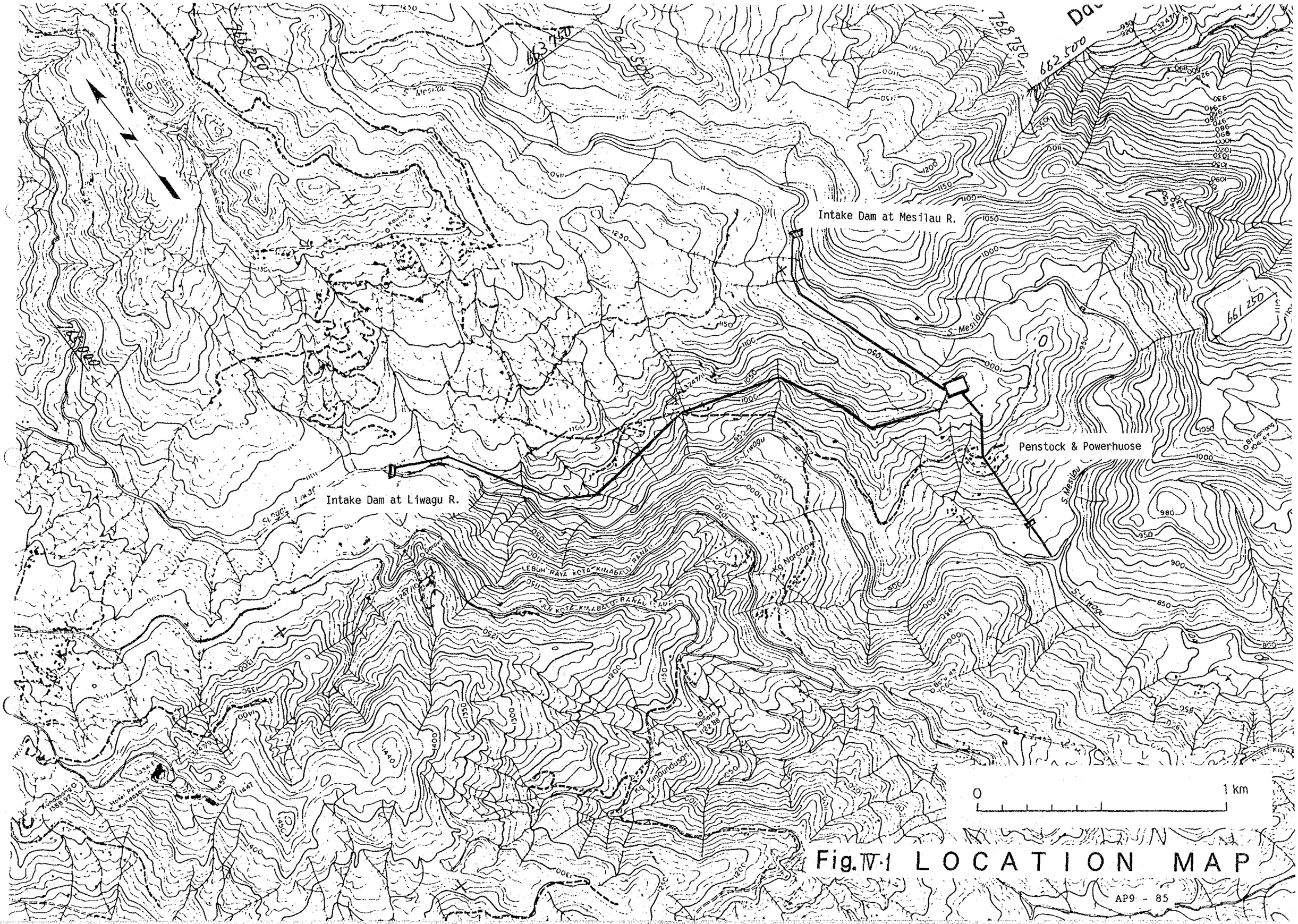


Fig. IV-1 LOCATION MAP

Appendix of Geologic Mapping

The Rule for Geologic Drawing

The Rule for Geologic Drawing

1. General Rule

The matters not prescribed in this detailed rule shall be handled in accordance with the practice as may be used for preparation of the drawing at Geological Survey of Japan.

2. Scope of application

This detailed rule shall apply to all of the drawing concerning geologic mapping.

3. Letters and numerals

Letters and numerals shall be of perpendicular style.

4. Dimensional unit

The dimension shall normally be expressed in meter unit and shall be indicated to the second figure below a decimal point. However, such effective figures below zero may be changeable if and when necessary.

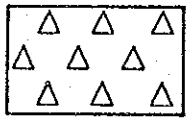
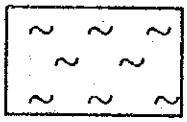
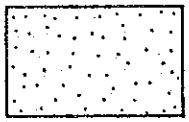
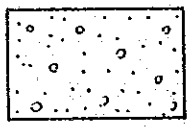
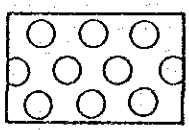
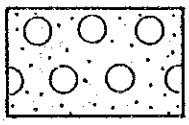
However, width of fault zone or other weak lines and thickness of stratum shall normally be indicated in centi-meter unit, if they have to be indicated clearly. In such case, numerals shall be indicated together with centi-meter unit.

5. Geologic denotation

(1) Symbolic marks for rock (including soil) shall be denoted as specified in Table 1 to Table 4.

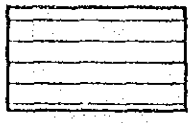
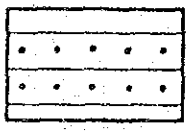
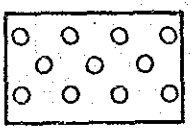
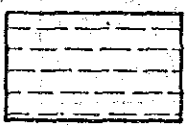
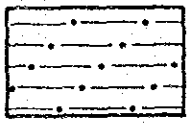
(a) Top soil and sedimentary stratum, etc.

Table 1

Name	Symbolic letter	Symbolic mark	Remark
Top soil & talus	De, Ta		
Clay	Cl		
Sand	S		
Gravel	Gl		
Terrace deposits	Te		Regular circle in regular arrangement
	(Te)		Point or other matrix may be used, if necessary (for example, coexistence with conglomerate).

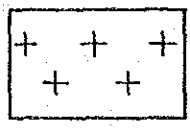
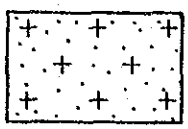
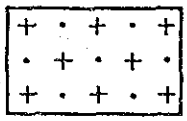
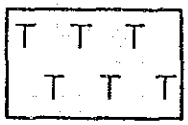
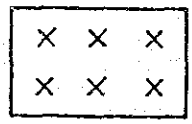
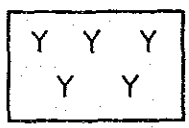
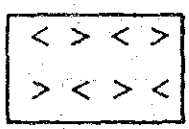
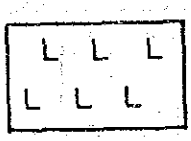
(b) Sedimentary rock

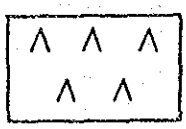
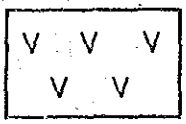
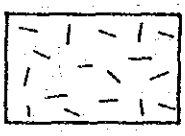
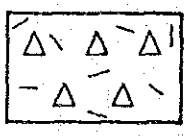
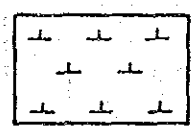
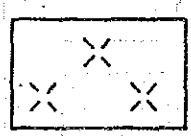
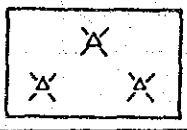
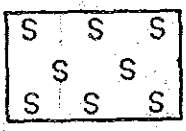
Table 2

Name	Symbolic letter	Symbolic mark	Remark
Sandstone	Ss		'Point' shall be indicated larger than 'that' for sand, with regular space.
Shale Clay-slate stone Marlstone	Sh Sl Ms		Full lines of equal thickness shall be paralled at equal space.
Sandstone/ Clay-slate stone	Ss/Sl		Alternate structure shall be represented by ' / ' mark between symbolic letters.
Conglomerate	Cgl		'Circle' shall be indicated smaller than 'that' for terrace deposits, and shall be of regular circular shape, spaced regularly.
Limestone	Ls		
Quartzite	Ch Qtz		'Broken lines' are used instead of 'full lines' as used for 'shale'.
Sandy shale Sandy clay slate	Sdy Sh Sdy Sl		

(c) Igneous rock

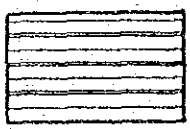
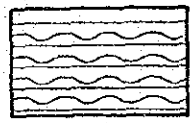
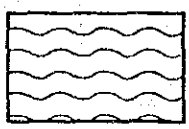
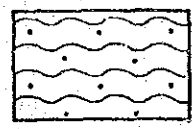
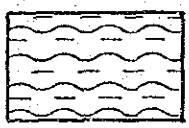
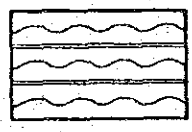
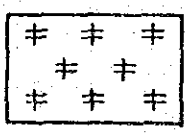
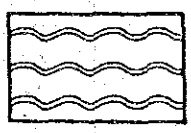
Table 3

Name	Symbolic letter	Symbolic mark	Remark
Granite	Gr		
Weathered-granite	Dg		
Granite-porphyry	Gp		
Quartz-porphyry	Qp		
Diorite	Di		
Gabbro	Ga		
Porphyrite	Pt		Unit symbol [< >] Regular formation of equal space
Rhyolite Quartz trachyte	Ry		

Name	Symbolic letter	Symbolic mark	Remark
Andesite	An		
Dacite	Da		
Basalt	Ba		
Volcanic ash	As		
Agglomerate	Ag		
Diabase	Db		
Schalstein	Sch		
Tuff	Tf		Unit symbol mark ⌈⌋
Tuff-breccia	Tb		
Serpentinite	Sp		

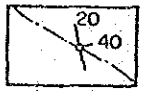
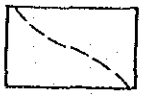
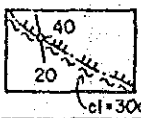
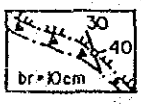
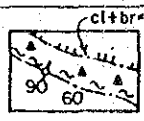
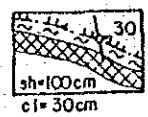
(d) Metamorphic rock

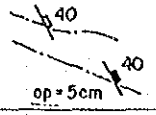
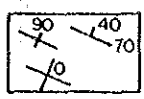
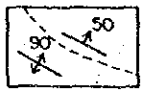
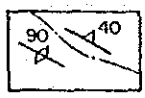
Table 4

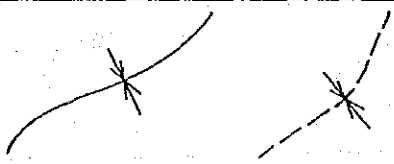
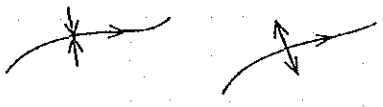
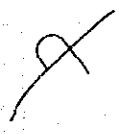
Name	Symbolic letter	Symbolic mark	Remark
Hornfels	Hr		
Black schist	Bsch		
Green schist Chlorite schist	Gsch Csch		
Sandstone schist	Ssch		
Quartz schist	Qsch		
Sericite schist	Sesch		
Gneis	Gn		
Phyrite	Phy		

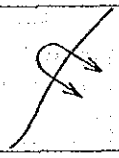
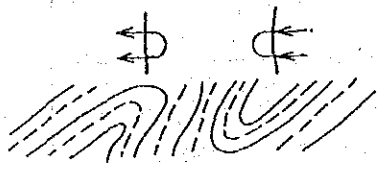
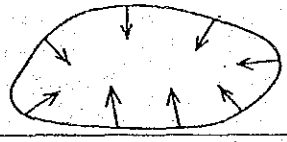
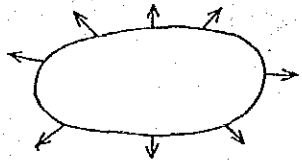
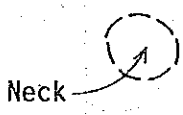
(2) Symbolic marks for geological structure

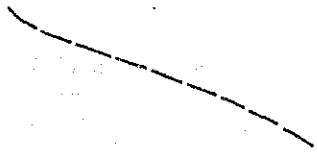
Table 5

Name	Symbol	Remark
Geological boundary	 (dotted line with the space of 2 mm)	° No clear distinction shall be needed particularly between 'Confirmed' and 'Estimated'. Mark ' ? ' may be used as ---?--- for 'estimated', if so required.
Weak line in general and strike & dip		° Weak line shall indicate fault, fracture zone and clay seam joint.
Estimated weak line in general	 (dashed line)	° Mark ' ? ' may be used if and when necessary as is the case of geological boundary.
Fault (contain clay) cl: thickness of clay in cm		° Fault zone shall be identified by adding shag mark to the mark ° Shags shall be put on the sloped side. ° When fault contains clay, it shall be marked with and ° and when fault contains breccia, it shall be marked with ° Width shall be indicated by two parallel line . ° Fracture zone shall be identified by hatching. Hatching mark may also be usable for loose rock, many cracks, weathered area and secondarily fragiled portion of rock. When same marks will be used together with shear zone, they shall be identified distinctly by different space of hatch lines with some explanatory note in the legend. Hatching mark shall not be used for indication of loose gravel stratum, talus and volcanic ash, etc. ° Width of clay or breccia shall be indicated in cm and marked with cm after numerals indicating width
Fault (contain clay)		
Fault (contain breccia)		
Fault (Vertical) (contain clay & breccia)		
Shear zone		

Name	Symbol	Remark
Crack Open crack		◦ Width of open crack shall be indicated as op=5cm, for example.
Strike & dip of bed or schistosity		◦ Strike and dip of various geologic plane shall normally be expressed by numerals without the mark of degree. Numerals of strike may be omissible, unless otherwise especially required.
Strike & dip of igneous contact and uncomformity contact		
Strike & dip of joint (➤ for open joint)		

Name	Symbol	Remark
Axis of syncline		'Broken line' : Estimated
Axis of anticline		'Broken line' : Estimated
Plunging of synclinal & anticlinal axis		
Concealed axis of fold & Axis of anticline		'Dotted line'
Strike and dip of overturned bed		

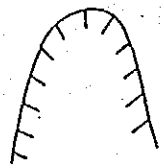
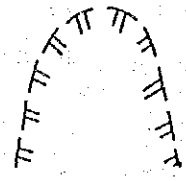
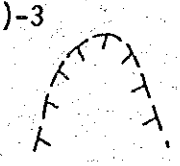
Name	Symbol	Remark
Axis of overturned anticline		
Axis of overturned syncline		
Basin structure		
Dome structure		
Caldera		Same as symbol for weak line.
Estimated caldera		'Broken line'
Assumed or concealed Volcanic neck		Outcrop of volcanic neck shall be indicated in geological boundary.
Fumarole		
Hot spring		
Mineral spring		
Spring (non-hot spring)		Spring water amount shall normally be indicated in the unit of liter per minute.

Name	Symbol	Remark
Drip water		
(Dripping section)		When it is necessary to indicate scope of drip water in tunnel or adit.
Assumed sound rock surface		Thick 'broken line' shall be used to distinguish from estimated weak line.

(3) Symbols indicating landslide or collapse

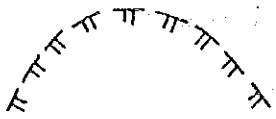
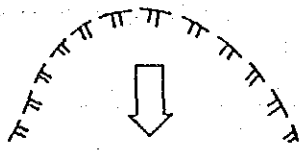
(a) Collapsed and landsliding ground

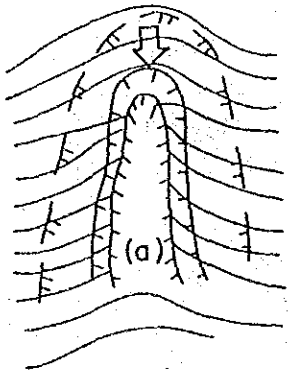
Table 6

Name	Symbol	Remark
Area of collapse Area of landslide	(a)-1 	Same as indicated on topographic map to identify landslide. The area of existing collapse or landslide shall be indicated on topographic map.
Area of probable collapse Area of probable landslide	(a)-2 	The area of probable collapse or landslide shall be indicated on topographic map in addition to (a)-1 above.
Area of old landslide	(a)-3 	The area of old landslide shall be indicated on topographic map.

(b) Dangerousness of collapse and landslide

Table 7

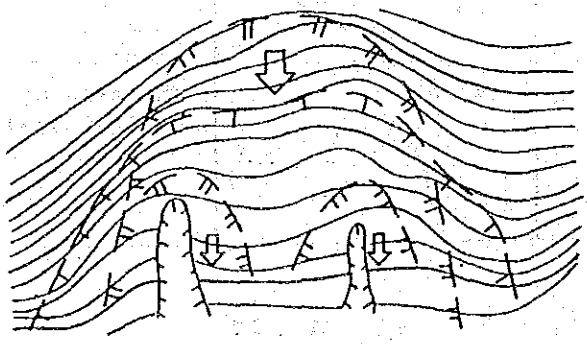
Symbol	Remark
(I) 	The symbolic mark shall be used to indicate the area where there is a great possiblity of causing collapse or landslide, or even where there is no particular need of indicating such dangerousness.
(II) 	The mark shall be given to the dangerous area where potentiality for collapse or landslide seems to be in progress or where there seem to be signs of crack and others suspicious of landslide.



(Example)

(a) Symbolic mark

Symbolic mark showing landslide on topographic drawing



6. Indication of exploratory work (1) - Drilling and excavating

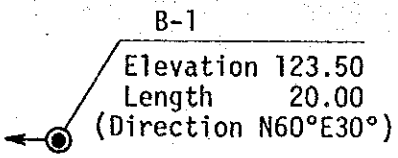
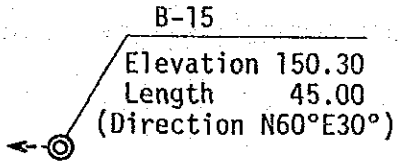
When elevation, length and direction will be duplicated on plan, section and log drawings, they may be omissible on the plan and section drawings. In case where they may be duplicated on both plan and section drawings, they may be omissible on the plan drawing.

(1) Boring

The symbolic letter representing boring shall be indicated as 'B'.

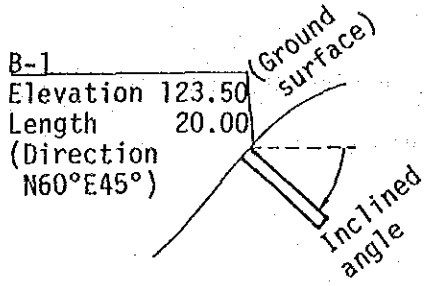
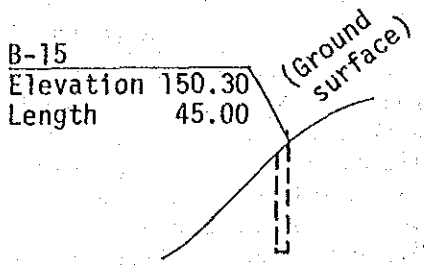
(a) Symbolic marks on plan drawing

Table 8

Name	Symbols	Remarks
Completed boring		Inclined boring shall be identified with arrow mark directed to the direction. Length of that arrow mark shall be indicated by plan projection of boring. Direction and inclined angle of boring shall be indicated below the indicated length.
Planned boring		Inclined boring shall be arrow-marked with dotted line directed to that direction. Length of arrow mark shall be same as provided in 'Completed boring'.

(b) Section drawing symbol

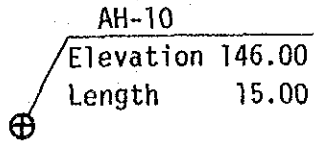
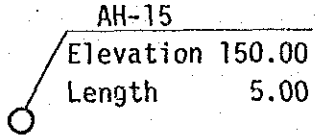
Table 9

Name	Symbol	Remarks
Completed boring		Boring shall be indicated with 'full line'. In case of inclined boring, the projected position shall be indicated on the section line to indicate the inclined direction. (Example) N60°E30°S
Planned boring		Planned boring shall be indicated by use of 'broken line'. Projection of the inclined boring shall be same as provided in 'Completed boring'.

(2) Auger Boring

The symbolic letter representing auger boring shall be indicated as 'AH'.

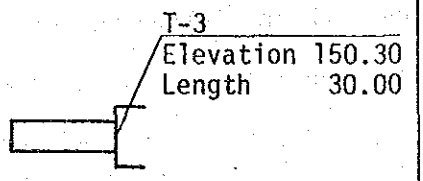
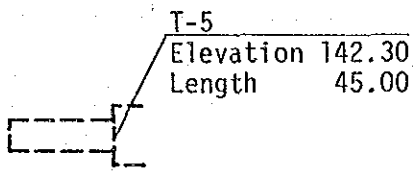
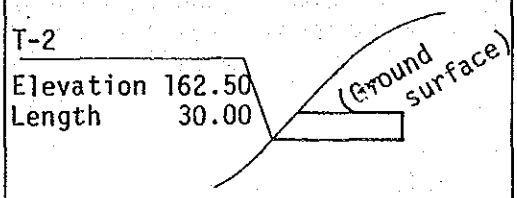
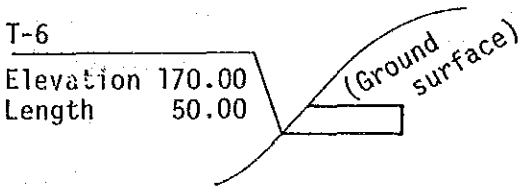
Table 10

	Completed	Planned
Plan symbol		
Section symbol	Same as 'boring'	Same as 'boring'

(3) Adit

The symbolic letter representing the adit shall be indicated as 'T'.

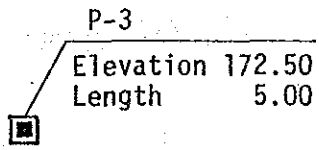
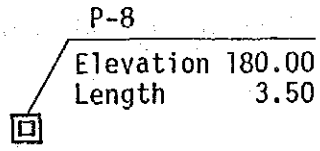
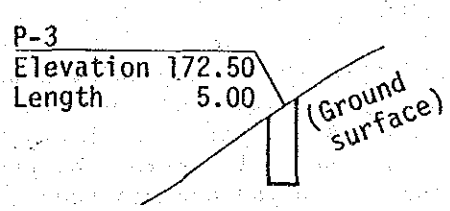
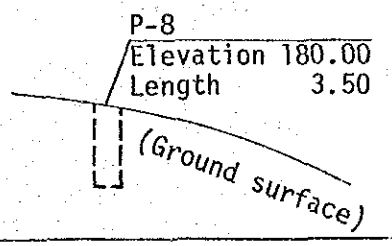
Table 11

	Completed	Planned
Plan symbol		
Section symbol		

(4) Pit

The symbolic letter representing the pit shall be indicated as 'P'.

Table 12

	Completed	Planned
Plan symbol		
Section symbol		

(5) Trench and bench-cut

The symbolic letters representing the trench and bench-cut shall be indicated as 'TC' and 'BC'. The symbol marks shall be same as provided by the 'Excavation Line' of the 'Rule for Civil Engineering Drawing'.

Notes: Projection on the section drawing:

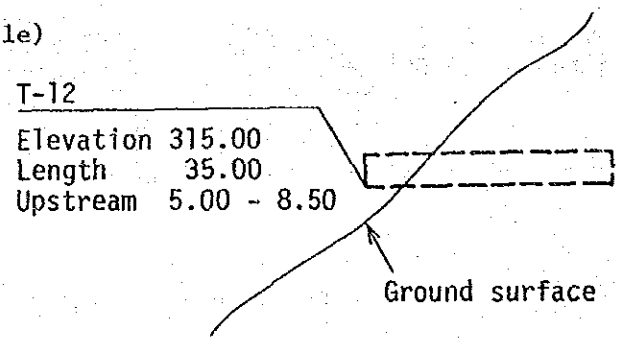
When boring holes or adits not locating on the section line will have to be projected on the section drawing, they shall be indicated in accordance with the following rules:

(a) The projected range shall be within 10 meters.

(b) Projection shall be indicated by use of the broken line. (See the example)

(c) The distance between the section line and the projected area shall be clearly indicated. (See the example)

(Example)



(6) The symbolic marks of the bearing test (jack test) shall be indicated as ⊕ for vertical position, ⊖ for horizontal position and ⊘ for inclined position.

7. Indication of exploratory work (2) - Geophysical prospecting

(1) Seismic prospecting

(a) The sumbolic letter representintg the seismic prospecting shall be indicated as 'S' jand the velocity unit of seismic wave shall be indicated as 'km per second'.

(b) The plan drawing shall normally include prospecting line, length of prospecting, detecting point (location of seismometer), blasting point and prospecting result, etc., which may, however, be limited only to the minimum required items. The prospecting result' referred to above shall mean (a) assumed bedrock surface and (2) velocity distribution of seismic wave. Each of them shall be marked in the following Table.

Table 13

		Planned	Completed	Remarks
Detecting point	Plan	s-2	s-3	° Normally, the section drawing shall not include any planned detecting point but shall include, if necessary, same symbolic mark as used for 'Completed'.
	Section		s-3, s-2, Ground surface	
Detecting point & Prospecting length	Plan	(With detecting point) s-1 s-2 s-3 Prospecting line A (L=2,500)	(With detecting point) s-1 s-2 s-3 Prospecting line A (L=2,500)	° Length of prospecting line shall be indicated, if necessary, in unit of meter, but the indicated numerals shall not be accompanied by 'meter'.
		(Without detecting point) Prospecting line A (L=2,500)	(Without detecting point) Prospecting line A (L=2,500)	° Length of prospecting line shall be expressed in parenthesized figures. The same for 'Completed' shall be marked as (L=).
				° Name of prospecting line shall normally be expressed in alphabetical capital letters.
	Section		(With detecting point) s-1, s-2, s-3, Ground surface Prospecting line A (L=2,500) (Without detecting point) Ground surface Prospecting line A (L=2,500)	° The blasting point shall be expressed by symbolic letters 'Exp' and marked as 'X'.

(c) Indication of prospecting result

a) Assumed bedrock surface:

The symbol mark shall be same as assumed foundation rock line (as prescribed in the foregoing 5. (2).) However, this result shall be distinguished from the others by marking its symbolic letter 'S', when indicated in the general geological drawing or with other investigation results.

b) Velocity distirbution of seismic wave:

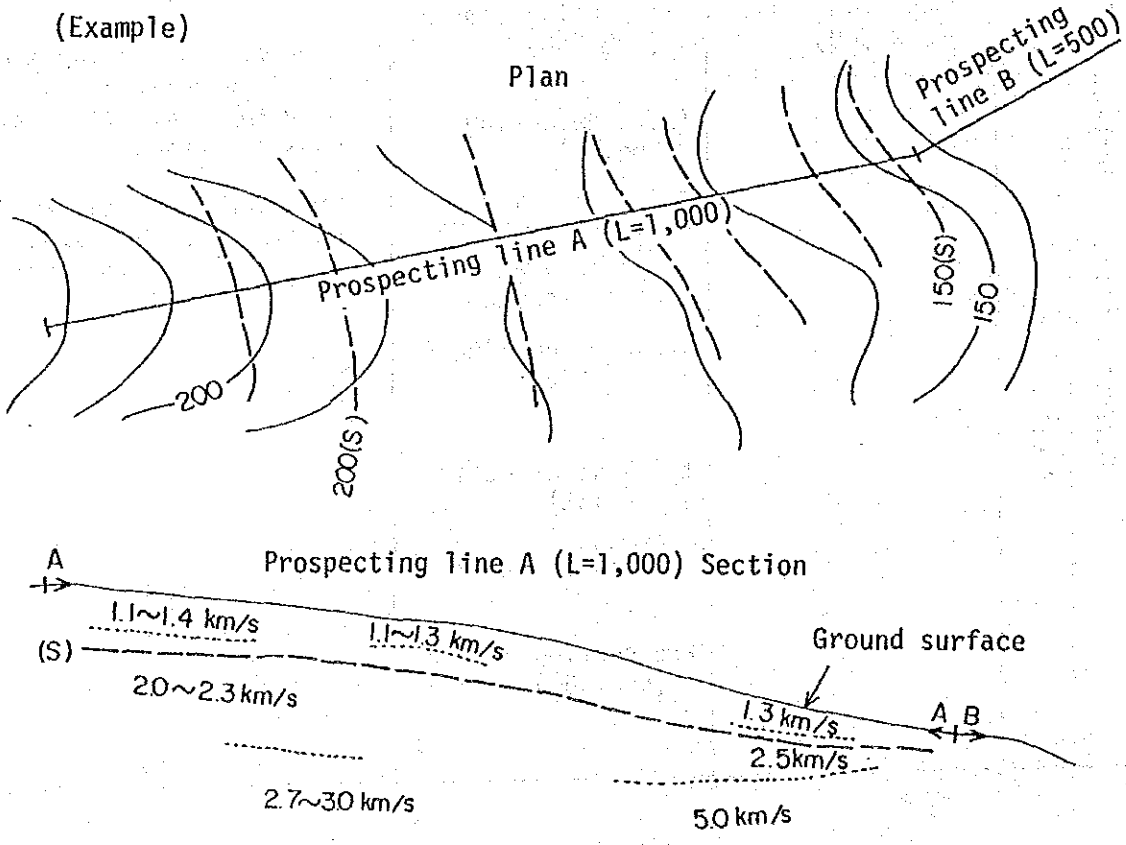
Velocity boundary and velocity contour line of seismic wave shall be indicated with 'very small dotted line' and the value of velocity shall be, in any case, expressed by km/s unit.

Same as is the case of the foregoing a), it shall be marked with its symbolic letter 'S' if and when necessary.

c) Others

Geological structure as introduced by the result of prospecting shall be marked with the symbolic letter 'S' as previously prescribed, if and when necessary.

(Example)



(2) Electrical resistivity prospecting

(a) The symbolic initial representing electrical resistivity prospecting shall be indicated as 'E' and the apparent resistivity of the earth shall be expressed in unit of 'Ω-m'.

(b) The drawing of resistivity prospecting shall normally include prospecting line, prospecting length, measuring center (center jof electrodes) and result of prospecting, which may, however, be limited only to the minimum required items as the case may demand.

The result of prospecting shall principally be composed of a distribution map of the apparent resistivity. Each symbolic mark for prospecting line, prospecting length and measuring center respectively shall be same as the provision set forth in the foregoing item (1) covering seismic prospecting except that the measuring point shall be marked as 'E'.

(c) Indication of prospecting result

The result of prospecting shall be indicated in accordance with the foregoing item (i)-(c), except that the apparent resistivity value shall be expressed as Ω-m' and the sumbolic letter for electrical prospecting shall be marked as 'E'.

(3) Other geophysical prospecting

(a) The symbolic initials representing magnetic prospecting, gravity prospecting and radio-activity prospecting shall be expressed as 'M', 'G' and 'R' respectively.

(b) No special provisions shall be made for symbolic marks representing those prospecting activities mentioned in the above item (a). If the case may demand, such symbolic marks shall be indicated in accordance with the provisions prescribed in the foreoging items (1) and (2).

8. Legend

Legend shall normally be indicated in each drawing.

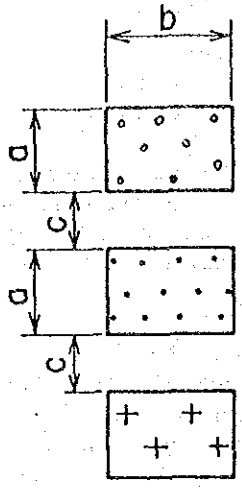
(1) Position for legend

Position for indication of the legend shall normally be provided above the title column of drawing, except the case where the drawing may have very little space for such indication.

(2) Frame size of legend

The ratio of height (a) and width of the legend frame shall normally be 2 to 3. Although no special provision may be made for the size, it may be advisable to follow the example as exemplified in the 'Original drawing standard code A-1'.

(Example)



A-1 A-3

a = 12mm 6

b = 18mm 9

c = 8mm 4

〈 Original drawing standard code A-1 〉

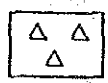
a : b = 2 : 3

(3) Sequential order for entry legent

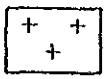
The order for entry into the legend shall start with over-burden, followed by rock, tectomic, geological investigation, and, explanatory note for symbolic marks and remarks, starting from top to bottom and from left to right.

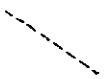
(Example)

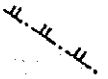
Legend


Top soil and talus


Sandstone


Granite


Geological boundary

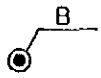

Fault


Fragile zone


Assumed sound rock surface

Strike & dip of strata

Strike and dip of fault



Boring

9. Boring log

The log showing boring result on the geological section shall be indicated at a reduced scale of 1/200 in accordance with the following items:

(1) Depth of the boring shall normally be indicated spacing at 5 m.

(2) Elevation and depth shall be indicated regarding top of hole, rock surface, and hole bottom.

(3) The percentage of core recovery shall be indicated for the section of rock drilling.

(4) Geological legend of the log shall be same as prescribed in the foregoing item 5. covering 'geological indication'.

(5) Any explanation indicating geological condition shall be marked on the right side of the log.

LEMBAGA LETRIK SABAH
WISMA LLS
JALAN TUNKU ABDUL RAHMAN
88673 KOTA KINABALU

TEL: 088-211699
TLX: TENAGA MA 80217
TELEFAX: 088-223320

OUR REF LLS/HYD/170/J1/86 DATE : November 20, 1991

ATTENTION Mr.Tokuji Tezuka - Team Leader

COMPANY EPDC., JAPAN

FROM Hydro Civil Department, SEB, Kota Kinabalu

NO. OF PAGE (S) TWO

Dear Sir,

RE : SMALL SCALE HYDROELECTRIC POWER DEVELOPMENT PROJECT AT UPPER LIWAGU RIVER BASIN, RANAU, SABAH
- FIELD SURVEY WORKS

Reference is made to the Geological Investigation for the above project, which we have tendered out recently.

Upon closing of the tender, the tender price amongst 3 tenderer ranged between $226,160.00 and $230,109.00 which is 2.6 times higher than JICA estimate.

In this connection, we would like to inform you that SEB budget for the whole works including Geological,Topography, EIA and hydrological Investigation is only $250,000.00. Total tendered price (lowest) amount to $446,793.44. As such there is a short fall of $196,793.44. In view of the above, we would like to propose the following:

(i) For Geological Investigation, the Seismic Survey shall be excluded from the contract. We believe that, since this project is still on preliminary stage, Seismic survey is not necessary.

(ii) Topographical Survey will go ahead as per Specification. (For your information the lowest tender is 143% higher than JICA estimate).

(iii) EIA survey tendered price from Universiti Kebangsaan Malaysia is $78,572.44 which is 104% higher than JICA estimate. Presently we are renegotiating to reduce the scope of work according to JICA specification

(iv) Hydrological Survey work, we feel this Survey is not required. We can make use of the existing informations from DID as official source of data.

We hope you would give us your comment to the above as soon as possible.

Your kind attention to the above is most appreciated.

Yours faithfully,

(AMAT AJI)
For GENERAL MANAGER

NA/BM/mt

Cc FSW

TOTAL P.02

TO : Mr.Amat Aji, chief Engineer, SEB

FROM: Mr.Tezuka, Team Leader of JICA

DATE: November 27, 1991

SUBJECT: Field Investigations

Regarding the field invesigations proposed by your fax dated on November 20,1991, the followings are our comments.

1. Geological Investigation

Seismic survey has been proposed by JICA Team based on the Scope of Works. Generally,seismic survey at the penstock line including headpond area are required for Feasibility Study Stage to obtain geological information together with drilling work. Drilling data show only infomation of the points and seismic survey data show information of lines. Relation of the both data will make more high quality geological infomation on the preliminaly design of the related structures.

In the tender price of the field investigation works of the project , we can't understand why the tenderer proposed so high price, since our cost estimation were applied the unit prices based on SEB's information. Mr.Hatano would like to check the breakdown of the tenderer's documents.

JICA is expecting an additional budget if possible, but worry about the delay of the time extension for it.

It is possibility that the seismic survey can be cancelled in the Feasibility Sudy Stage provided that we recommend in the Final Report as the further work at the Detail Design Stage.

2. Hydrological Survey

Hydrological survey proposed by JICA Team are also based on the Scope of Works. Generally, hydrological data such as design discharge are analized using current data of near the project site to confirm the relation of the existing data.

Ten years discharge data from 1970-1979 had been measured at Bedukan gauging station. The data will be used in Feasibility Study of the project. More higher accuracy of the hydrological data will be obtained by the installation of permanent new gauging station. The data will be used in Detail Design Stage.

JICA Team consider that the additional data obtained at the new gauging station are not critical problem in Feasibility Study Stage since the measuring period is very short. But the data will be usefull in Detail Design Stage if new gauging station is installed.

Best regards,

T.Tezuka

Appendix 10 FURTHER INVESTIGATION

Appendix 10

FURTHER INVESTIGATION PLAN

CONTENTS

Appendix 10 FURTHER INVESTIGATION PLAN

1. Topographic Survey

River cross section survey

Liwagu intake dam site	:	Scale 1/200
Mesilau intake dam site	:	Scale 1/200

Topographic survey

Access road to powerhouse	:	Scale 1/500
		L = 1,560 m
		W = 50 m
		A = 0.075 km^2
Liwagu pipeline and access road	:	Scale 1/500
		L = 2,200 m
		W = 50 m
		A = 0.110 km^2
Mesilau pipeline and access road	:	Scale 1/500
		L = 1,000 m
		W = 50 m
		A = 0.050 km^2

2. Seismic Prospecting Survey

Along penstock route

Total length of survey line	:	L = 1,000 m

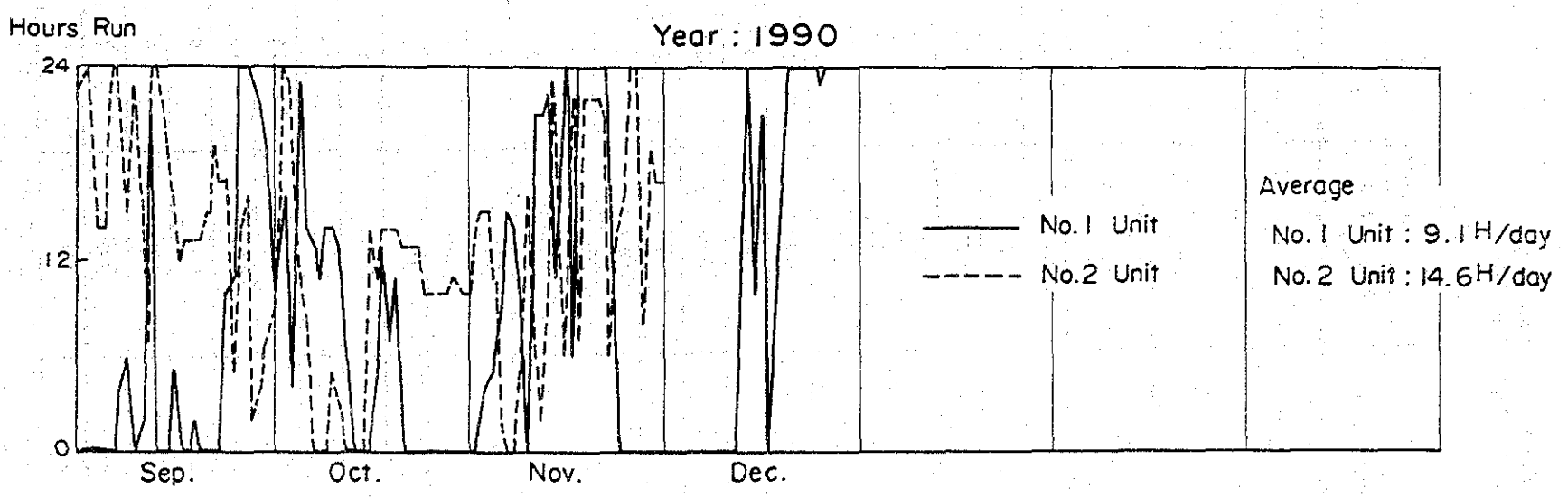
Appendix 11 OPERATION DATA OF CARABAU HYDROELECTRIC POWER STATION

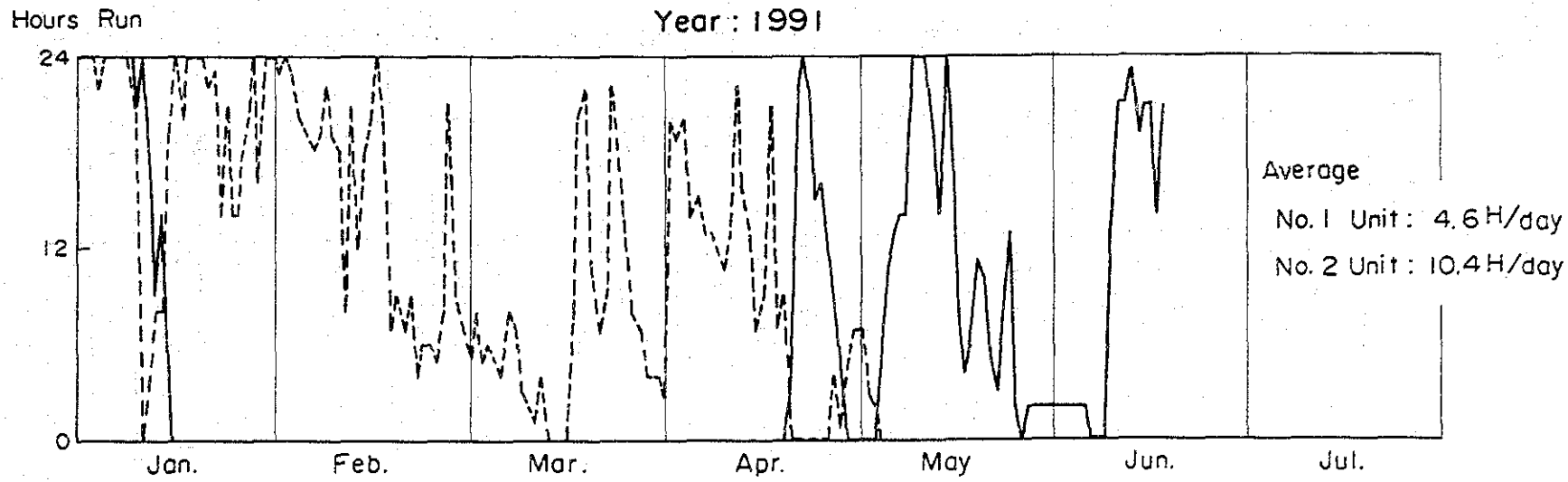
Appendix 11

OPERATION DATA OF CARABAU HYDROELECTRIC POWER STATION

CONTENTS

Monthly Operation Data of Carabau Hydro P.S





Carabau Hydro Power Station Monthly Operation Data - for September 1991

Turbine No. 1			Turbine No. 2	
Date	Peak Load kW	Hours Run	Peak Load kW	Hours Run
1/9/91	0	0	680	23
2/9/91	0	0	700	24
3/9/91	0	0	690	14
4/9/91	0	0	730	14
5/9/91	0	0	740	21
6/9/91	0	0	780	24
7/9/91	420	4	370	24
8/9/91	620	6	800	15
9/9/91	0	0	800	23
10/9/91	530	2	760	16
11/9/91	700	21	400	7
12/9/91	350	7	680	24
13/9/91	0	0	800	24
14/9/91	0	0	780	20
15/9/91	420	5	360	16
16/9/91	0	0	640	12
17/9/91	480	2	400	13
18/9/91	0	0	500	13
19/9/91	0	0	480	11
20/9/91	0	0	640	15
21/9/91	0	0	760	19
22/9/91	0	0	730	17
23/9/91	0	0	640	17
24/9/91	770	10	560	5
25/9/91	460	11	560	14
26/9/91	620	24	390	16
27/9/91	380	24	600	2
28/9/91	500	22	390	4
29/9/91	700	19	300	7
30/9/91	800	10	760	9

Carabau Hydro Power Station Monthly Operation Data - for October 1991

Turbine No. 1			Turbine No. 2	
Date	Peak Load kW	Hours Run	Peak Load kW	Hours Run
1/10/91	480	14	580	16
2/10/91	590	16	580	24
3/10/91	630	4	490	23
4/10/91	650	23	400	14
5/10/91	540	14	480	8
6/10/91	760	13	0	0
7/10/91	680	11	0	0
8/10/91	720	14	0	0
9/10/91	630	14	400	5
10/10/91	460	13	580	3
11/10/91	750	7	765	5
12/10/91	540	3	475	14
13/10/91	0	0	730	14
14/10/91	0	0	760	8
15/10/91	0	0	770	14
16/10/91	660	5	580	10
17/10/91	750	13	0	0
18/10/91	740	7	0	0
19/10/91	680	11	0	0
20/10/91	0	0	780	14
21/10/91	0	0	670	11
22/10/91	0	0	780	14
23/10/91	0	0	730	14
24/10/91	0	0	680	14
25/10/91	0	0	700	13
26/10/91	0	0	650	13
27/10/91	0	0	570	13
28/10/91	0	0	640	10
29/10/91	0	0	620	11
30/10/91	0	0	620	10
31/10/91	0	0	680	10

Carabau Hydro Power Station Monthly Operation Data - for November 1991

Turbine No. 1			Turbine No. 2	
Date	Peak Load kW	Hours Run	Peak Load kW	Hours Run
1/11/91	0	0	780	14
2/11/91	290	1	480	15
3/11/91	380	4	530	15
4/11/91	470	5	580	11
5/11/91	670	9	480	2
6/11/91	640	15	0	0
7/11/91	660	14	0	0
8/11/91	680	8	540	5
9/11/91	0	0	580	16
10/11/91	540	21	480	8
11/11/91	500	21	600	2
12/11/91	500	22	630	8
13/11/91	340	11	470	23
14/11/91	670	16	700	11
15/11/91	440	24	600	6
16/11/91	560	6	480	22
17/11/91	600	24	500	7
18/11/91	610	24	480	23
19/11/91	560	24	545	24
20/11/91	575	24	540	24
21/11/91	560	24	540	21
22/11/91	540	24	535	21
23/11/91	680	9	830	14
24/11/91	0	0	580	16
25/11/91	0	0	820	24
26/11/91	0	0	810	24
27/11/91	700	1	720	8
28/11/91	0	0	860	19
29/11/91	0	0	780	17
30/11/91	0	0	770	17

Carabau Hydro Power Station Monthly Operation Data - for December 1991

Turbine No. 1			Turbine No. 2	
Date	Peak Load kW	Hours Run	Peak Load kW	Hours Run
1/12/91	0	0	850	19
2/12/91	0	0	810	24
3/12/91	0	0	830	18
4/12/91	0	0	900	22
5/12/91	0	0	620	5
6/12/91	0	0	810	24
7/12/91	0	0	850	24
8/12/91	0	0	800	19
9/12/91	0	0	780	19
10/12/91	0	0	730	21
11/12/91	0	0	770	5
12/12/91	540	11	525	24
13/12/91	440	24	700	19
14/12/91	660	10	580	24
15/12/91	840	21	0	0
16/12/91	0	0	780	7
17/12/91	690	10	860	16
18/12/91	480	19	700	16
19/12/91	700	24	400	24
20/12/91	580	24	440	24
21/12/91	600	24	520	24
22/12/91	590	24	480	24
23/12/91	340	23	470	12
24/12/91	630	24	460	16
25/12/91	600	24	440	24
26/12/91	700	24	380	24
27/12/91	700	24	420	22
28/12/91	560	24	360	23
29/12/91	616	24	600	24
30/12/91	640	24	535	24
31/12/91	610	24	545	24

Carabau Hydro Power Station Monthly Operation Data - for January 1992

	Turbine No. 1		Turbine No. 2	
Date	Peak Load (kW)	Hours Run	Peak Load (kW)	Hours Run
1/1/1992	490	24	645	24
2/1/1992	510	24	615	24
3/1/1992	500	24	620	24
4/1/1992	690	24	660	22
5/1/1992	520	24	560	24
6/1/1992	640	24	420	24
7/1/1992	760	24	580	24
8/1/1992	550	24	580	24
9/1/1992	690	21	790	20
10/1/1992	760	24	-	-
11/1/1992	730	17	660	5
12/1/1992	800	9	510	8
13/1/1992	760	14	680	8
14/1/1992	-	-	780	19
15/1/1992	-	-	805	24
16/1/1992	-	-	800	20
17/1/1992	-	-	800	24
18/1/1992	-	-	860	24
19/1/1992	-	-	760	24
20/1/1992	-	-	800	22
21/1/1992	-	-	860	23
22/1/1992	-	-	740	14
22/1/1992	-	-	820	21
23/1/1992	-	-	740	14
24/1/1992	-	-	820	21
25/1/1992	-	-	640	17
26/1/1992	-	-	700	20
27/1/1992	-	-	740	24
28/1/1992	-	-	790	16
29/1/1992	-	-	780	17
30/1/1992	-	-	680	24
31/1/1992	-	-	670	23

Carabau Hydro Power Station Monthly Operation Data - for February 1992

	Turbine No. 1		Turbine No. 2	
Date	Peak Load (kW)	Hours Run	Peak Load (kW)	Hours Run
1/2/1992			640	23
2/2/1992			800	24
3/2/1992			680	23
4/2/1992			640	20
5/2/1992			720	19
6/2/1992			840	18
7/2/1992			685	19
8/2/1992			680	22
9/2/1992			600	17
10/2/1992			560	16
11/2/1992			600	8
12/2/1992			520	21
13/2/1992			580	12
14/2/1992			430	18
15/2/1992			460	20
16/2/1992			800	24
17/2/1992			840	20
18/2/1992			500	7
19/2/1992			480	9
20/2/1992			500	7
21/2/1992			340	9
22/2/1992			310	4
22/2/1992			310	4
23/2/1992			400	6
24/2/1992			600	6
25/2/1992			350	5
26/2/1992			360	8
27/2/1992			500	21
28/2/1992			490	9
29/2/1992			380	6

Carabau Hydro Power Station Monthly Operation Data - for March 1992

	Turbine No. 1		Turbine No. 2	
Date	Peak Load (kW)	Hours Run	Peak Load (kW)	Hours Run
1/3/1992			500	8
2/3/1992			440	5
3/3/1992			400	6
4/3/1992			380	5
5/3/1992			360	4
6/3/1992			400	8
7/3/1992			380	7
8/3/1992			340	3
9/3/1992			100	2
10/3/1992			110	1
11/3/1992			320	4
12/3/1992			-	-
13/3/1992			-	-
14/3/1992			-	-
15/3/1992			-	-
16/3/1992			320	8
17/3/1992			540	20
18/3/1992			800	22
19/3/1992	-	-	400	11
20/3/1992	-	-	400	7
21/3/1992	-	-	660	19
22/3/1992	-	-	540	22
22/3/1992	-	-	400	18
23/3/1992	-	-	380	14
24/3/1992	-	-	320	8
25/3/1992	-	-	260	7
26/3/1992	-	-	420	7
27/3/1992	-	-	420	6
28/3/1992	-	-	420	7
29/3/1992	-	-	210	4
30/3/1992	-	-	240	4
31/3/1992	-	-	250	4

Carabau Hydro Power Station Monthly Operation Data - for April 1992

	Turbine No. 1		Turbine No. 2	
Date	Peak Load (kW)	Hours Run	Peak Load (kW)	Hours Run
1/4/1992			710	20
2/4/1992			620	19
3/4/1992			660	20
4/4/1992			440	14
5/4/1992			220	15
6/4/1992			240	13
7/4/1992			220	13
8/4/1992			210	12
9/4/1992			300	11
10/4/1992			420	13
11/4/1992			680	22
12/4/1992			640	16
13/4/1992			520	11
14/4/1992			430	7
15/4/1992			530	9
16/4/1992			480	21
17/4/1992			430	7
18/4/1992	430	3	440	9
19/4/1992	550	22		
20/4/1992	580	24		
21/4/1992	420	22		
22/4/1992	430	15		
23/4/1992	380	16		
24/4/1992	300	11		
25/4/1992	410	7		
26/4/1992	140	4	200	4
27/4/1992			140	1
28/4/1992			210	5
29/4/1992			240	7
30/4/1992			250	7

Carabau Hydro Power Station Monthly Operation Data - for May 1992

	Turbine No. 1		Turbine No. 2	
Date	Peak Load (kW)	Hours Run	Peak Load (kW)	Hours Run
1/5/1992	240	3		
2/5/1992	250	2		
3/5/1992	320	6		
4/5/1992	620	11		
5/5/1992	1,000	13		
6/5/1992	770	14		
7/5/1992	710	24		
8/5/1992	860	24		
9/5/1992	800	24		
10/5/1992	720	24		
11/5/1992	680	19		
12/5/1992	590	15		
13/5/1992	450	24		
14/5/1992	600	16		
15/5/1992	420	9		
16/5/1992	400	4		
17/5/1992	700	6		
18/5/1992	730	11		
19/5/1992	760	10		
20/5/1992	520	5		
21/5/1992	350	3		
22/5/1992	560	9		
23/5/1992	610	13		
24/5/1992	240	2		
25/5/1992	240	1		
26/5/1992	380	2		
27/5/1992	160	1		
28/5/1992	240	1		
29/5/1992	230	1		
30/5/1992	150	2		
31/5/1992	120	2		

Carabau Hydro Power Station Monthly Operation Data - for June 1992

	Turbine No. 1		Turbine No. 2	
Date	Peak Load (kW)	Hours Run	Peak Load (kW)	Hours Run
1/6/1992	160	2		
2/6/1992	520	5		
3/6/1992	160	2		
4/6/1992	260	3		
5/6/1992	280	2		
6/6/1992	200	1		
7/6/1992	380	1		
8/6/1992	270	1		
9/6/1992	600	13		
10/6/1992	660	21		
11/6/1992	760	21		
12/6/1992	870	23		
13/6/1992	840	19		
14/6/1992	660 640	21 21		
15/6/1992	570	21		
16/6/1992	660	14		
17/6/1992	700	2		
18/6/1992				
19/6/1992				
20/6/1992				
21/6/1992				
22/6/1992				
23/6/1992				
24/6/1992				
25/6/1992				
26/6/1992				
27/6/1992				
28/6/1992				
29/6/1992				
30/6/1992				
31/6/1992				

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