

A-6 Seismic Profile done by ICE

Fig.A-6-1 Seismic Profile Damsite PS-1

Fig.A-6-2 Seismic Profile Damsite PS-2

Fig.A-6-3 Seismic Profile Damsite PS-3

Fig.A-6-4 Seismic Profile Damsite PS-4

Fig.A-6-5 Seismic Profile Damsite PS-5

Fig.A-6-6 Seismic Profile Damsite PS-6

Fig.A-6-7 Seismic Profile Damsite PS-7

Fig.A-6-8 Seismic Profile Damsite PS-8

Fig.A-6-9 Seismic Profile with resistivity Waterway Alignment
Route 2500-3400

Fig.A-6-10 Seismic Profile with resistivity Waterway Alignment
Route 0-400

Fig.A-6-11 Seismic Profile with resistivity Penstock Route No.1

Fig.A-6-12 Seismic Profile with resistivity Penstock Route No.2

Fig.A-6-13 Seismic Profile Power Station Site PC-1

Fig.A-6-14 Seismic Profile Power Station Site PC-3

Fig.A-6-15 Seismic Profile Power Station Site PC-4

Fig.A-6-16 Seismic Profile Power Station Site PC-5

Fig.A-6-17 Seismic Profile Power Station Site PC-6

A-6 Seismic Profile done by ICE

Fig.A-6-1 Seismic Profile Damsite PS-1

Fig.A-6-2 Seismic Profile Damsite PS-2

Fig.A-6-3 Seismic Profile Damsite PS-3

Fig.A-6-4 Seismic Profile Damsite PS-4

Fig.A-6-5 Seismic Profile Damsite PS-5

Fig.A-6-6 Seismic Profile Damsite PS-6

Fig.A-6-7 Seismic Profile Damsite PS-7

Fig.A-6-8 Seismic Profile Damsite PS-8

Fig.A-6-9 Seismic Profile with resistivity Waterway Alignment
Route 2500-3400

Fig.A-6-10 Seismic Profile with resistivity Waterway Alignment
Route 0-400

Fig.A-6-11 Seismic Profile with resistivity Penstock Route No.1

Fig.A-6-12 Seismic Profile with resistivity Penstock Route No.2

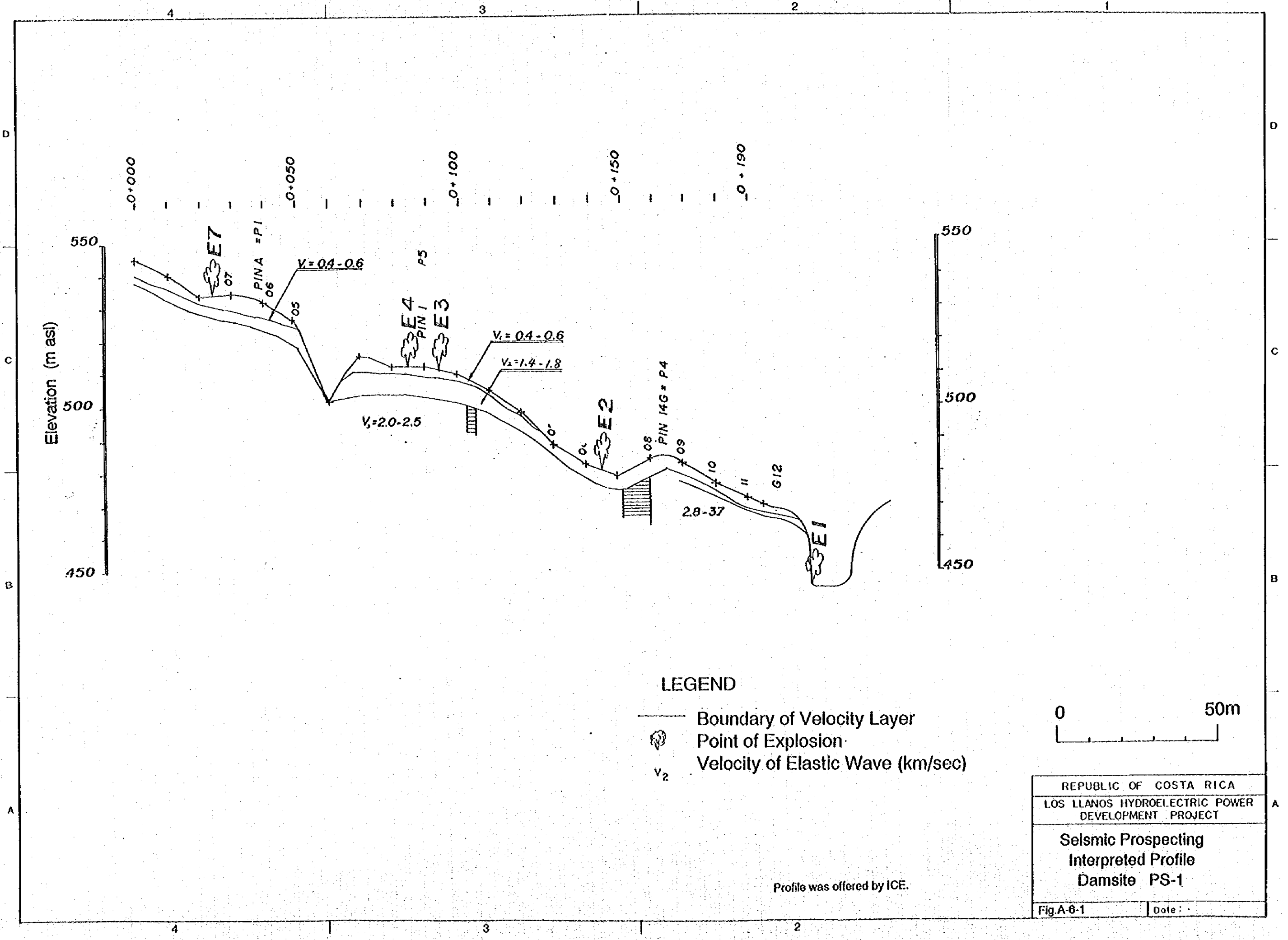
Fig.A-6-13 Seismic Profile Power Station Site PC-1

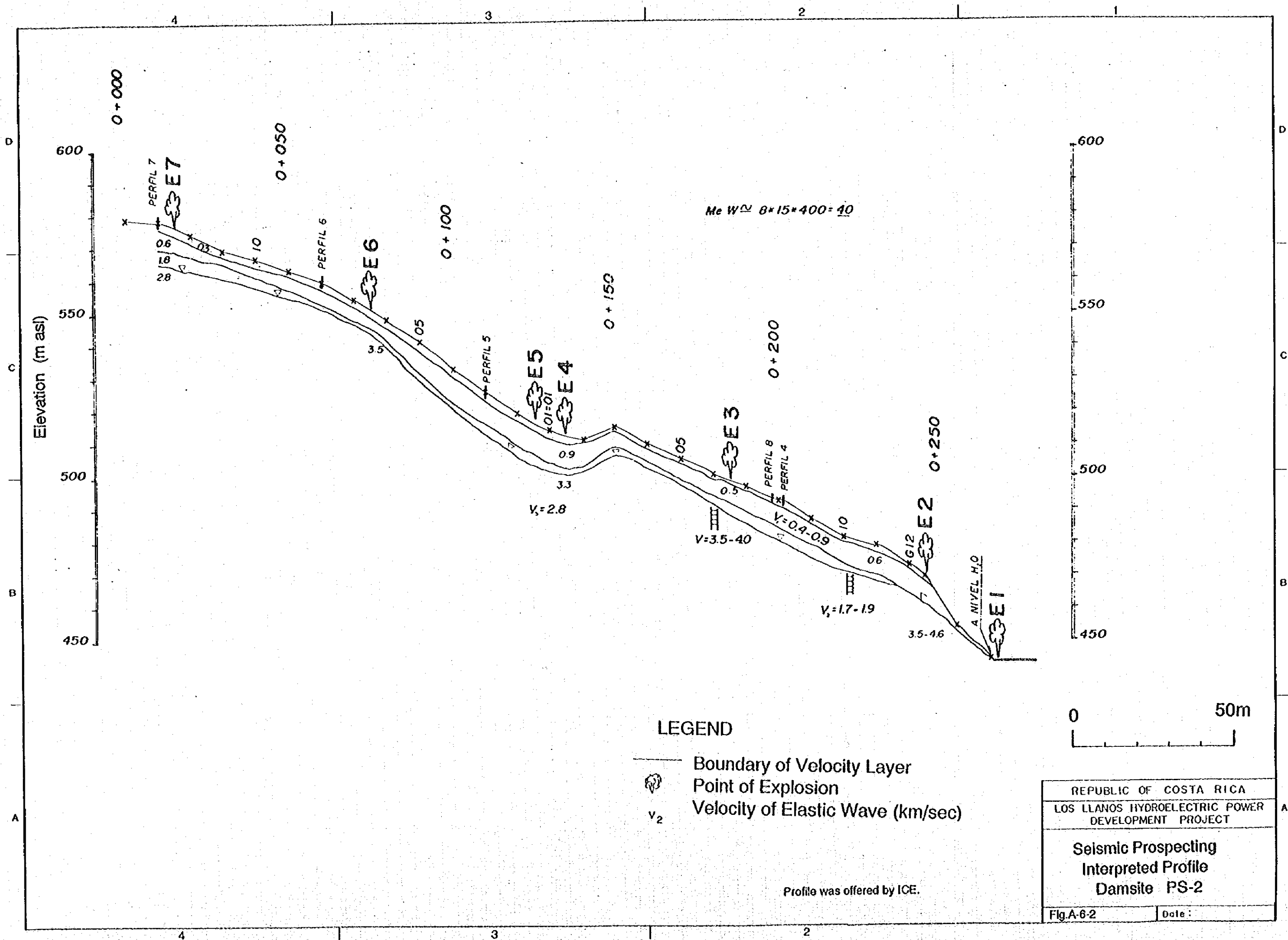
Fig.A-6-14 Seismic Profile Power Station Site PC-3

Fig.A-6-15 Seismic Profile Power Station Site PC-4

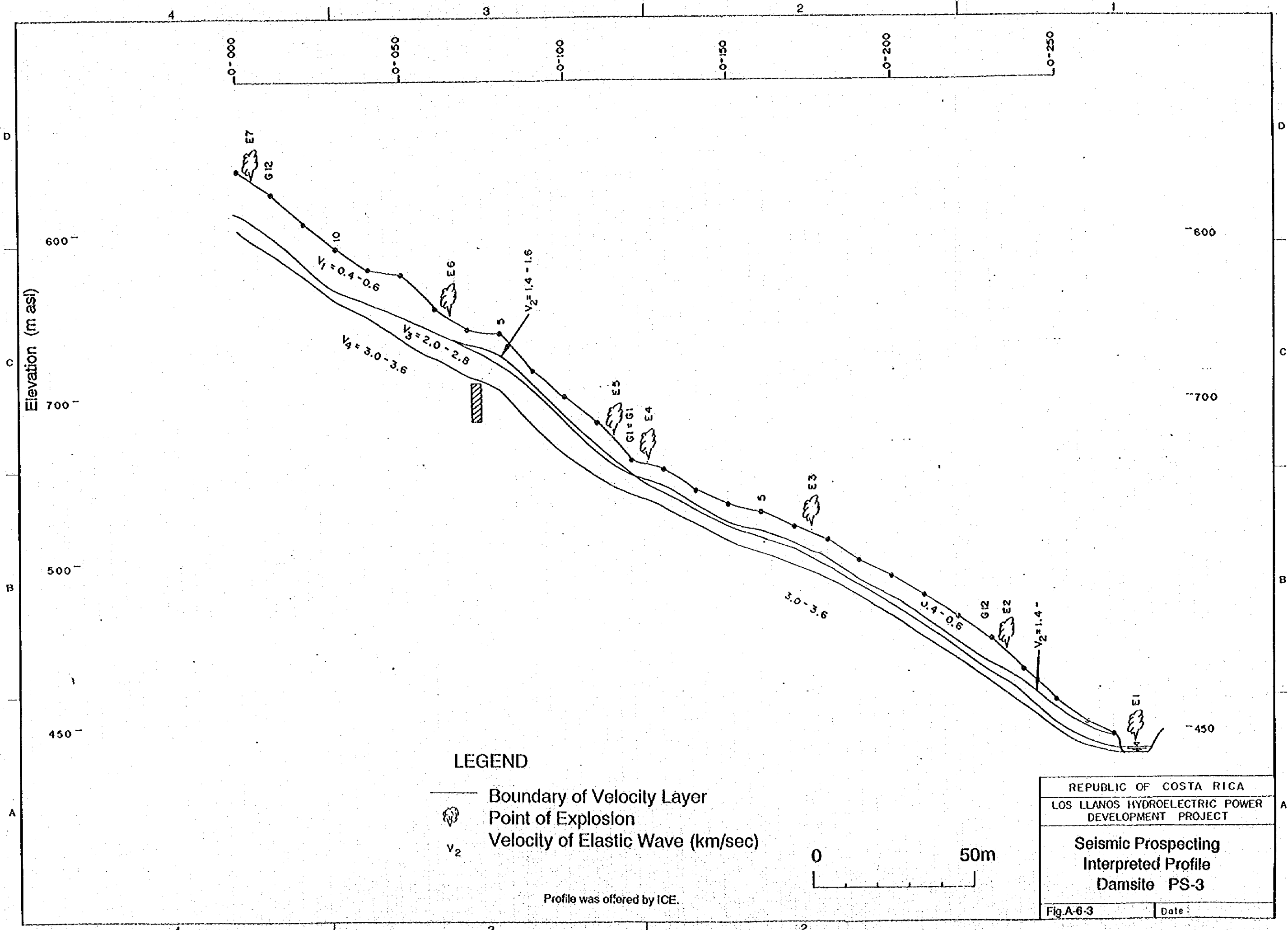
Fig.A-6-16 Seismic Profile Power Station Site PC-5

Fig.A-6-17 Seismic Profile Power Station Site PC-6

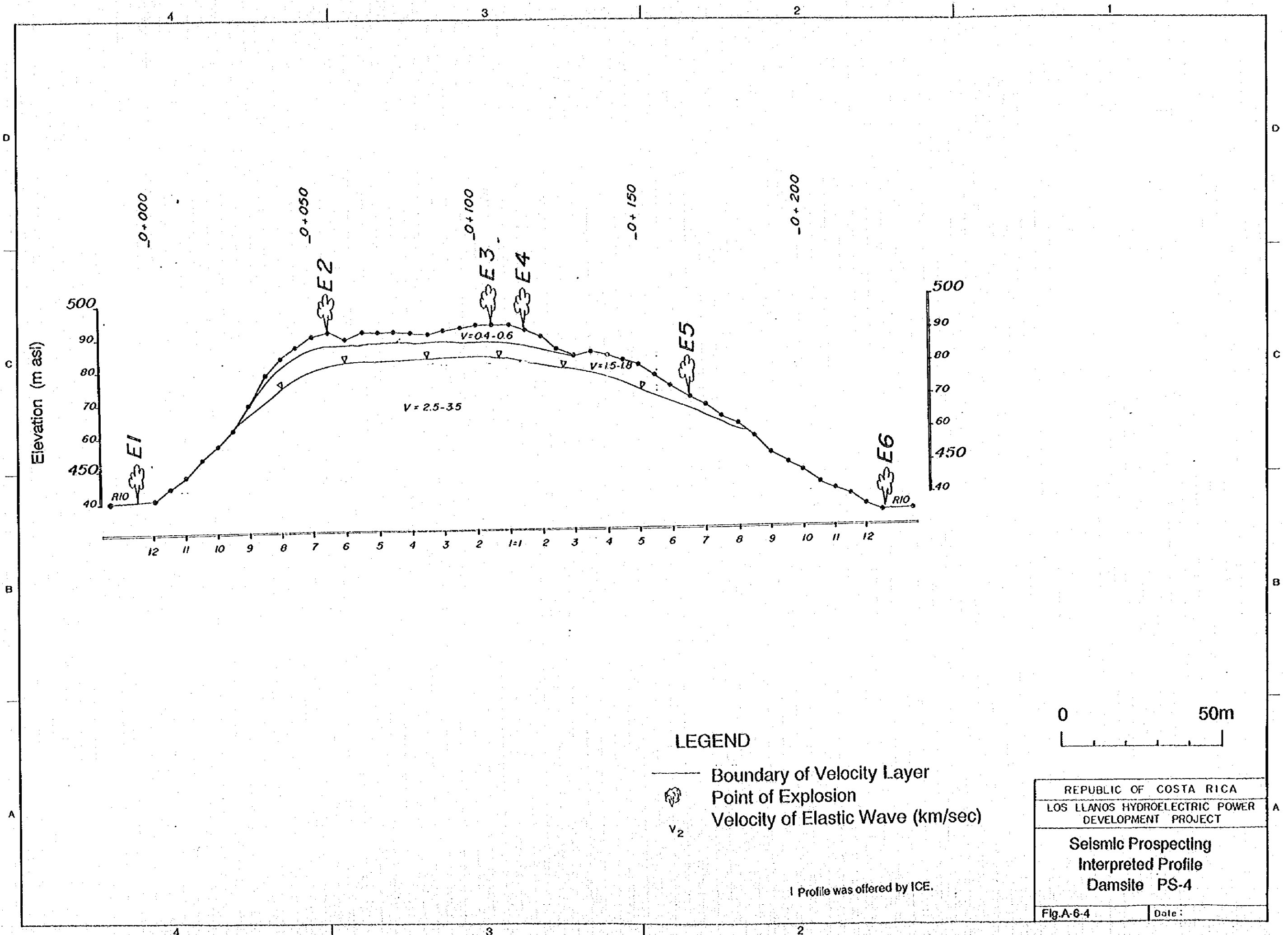


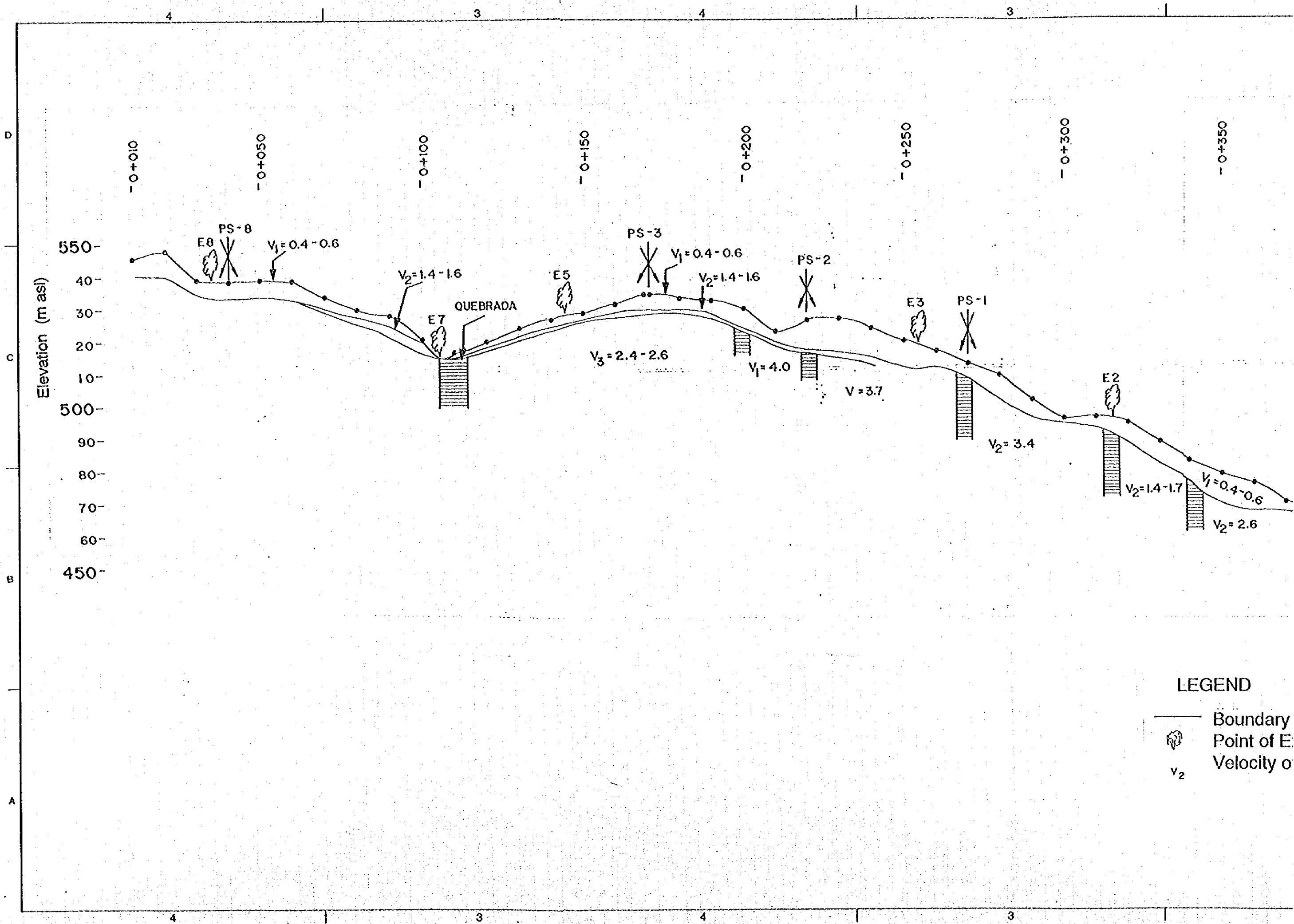


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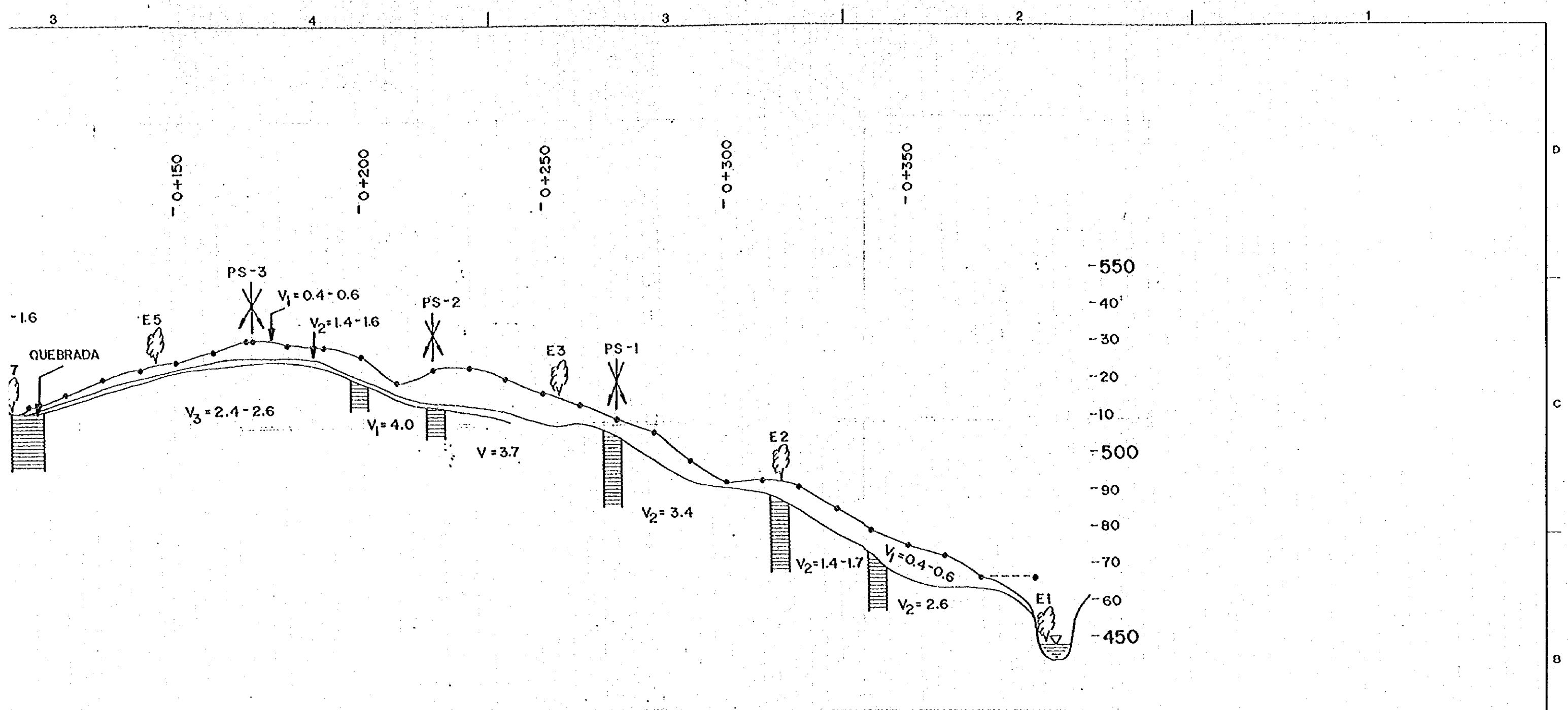
2-7



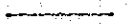



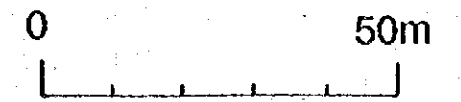
LEGEND

- Boundary
- 🌳 Point of E
- v_2 Velocity of



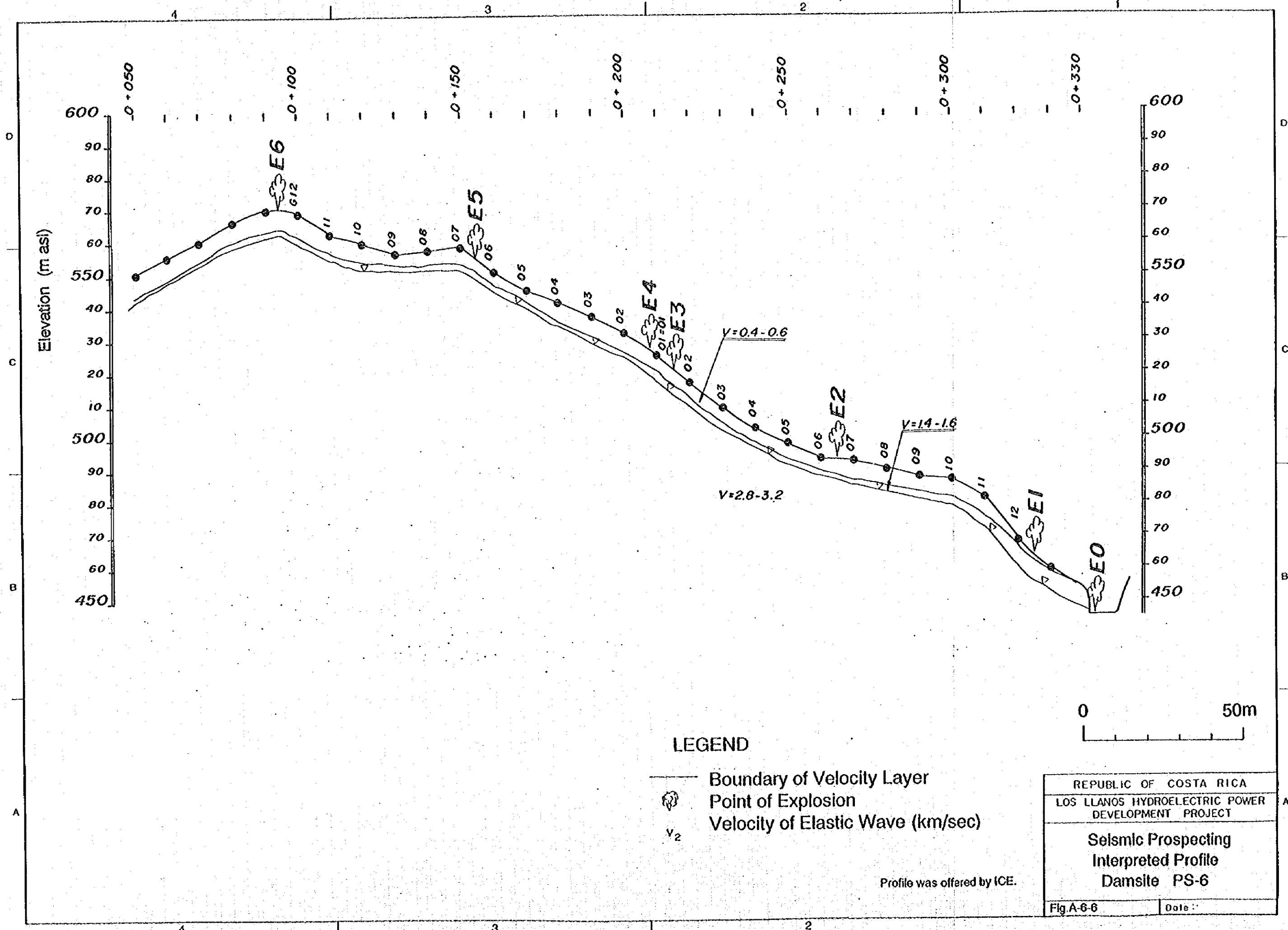
LEGEND

-  Boundary of Velocity Layer
-  Point of Explosion
- V_2 Velocity of Elastic Wave (km/sec)



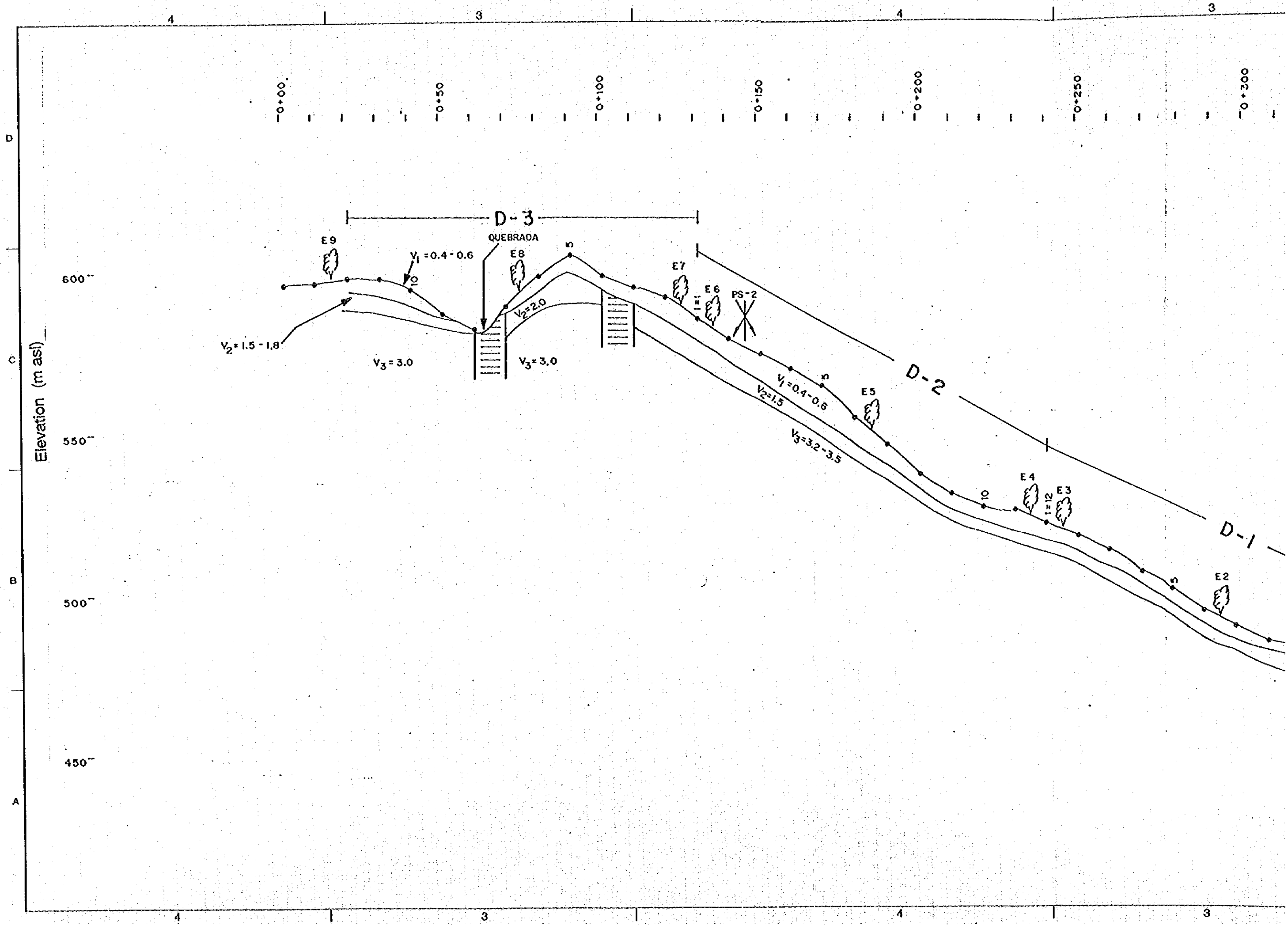
REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Seismic Prospecting Interpreted Profile Damsite PS-5	
Fig.A-6-5	Date:

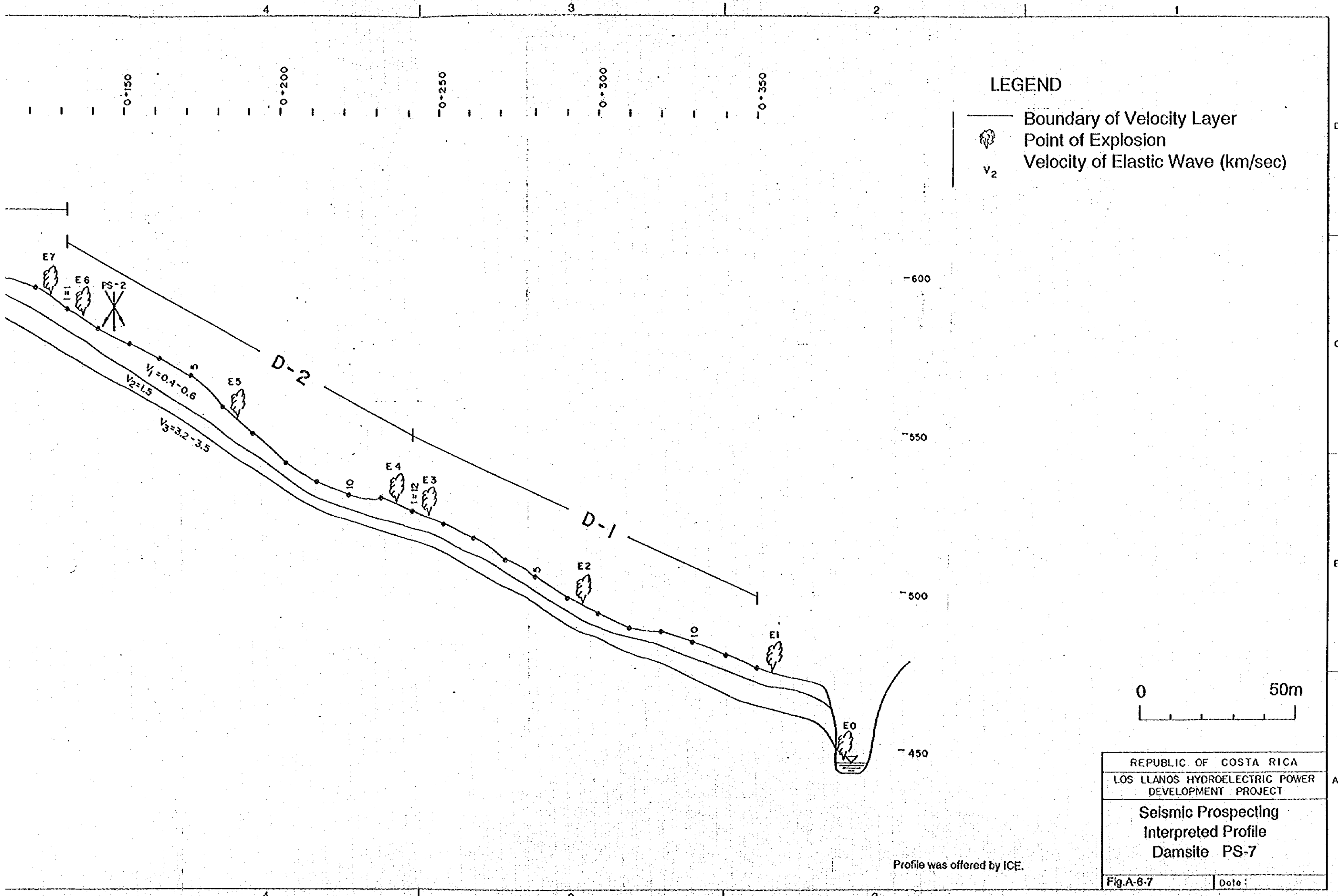
Profile was offered by ICE.



9-9

L-9





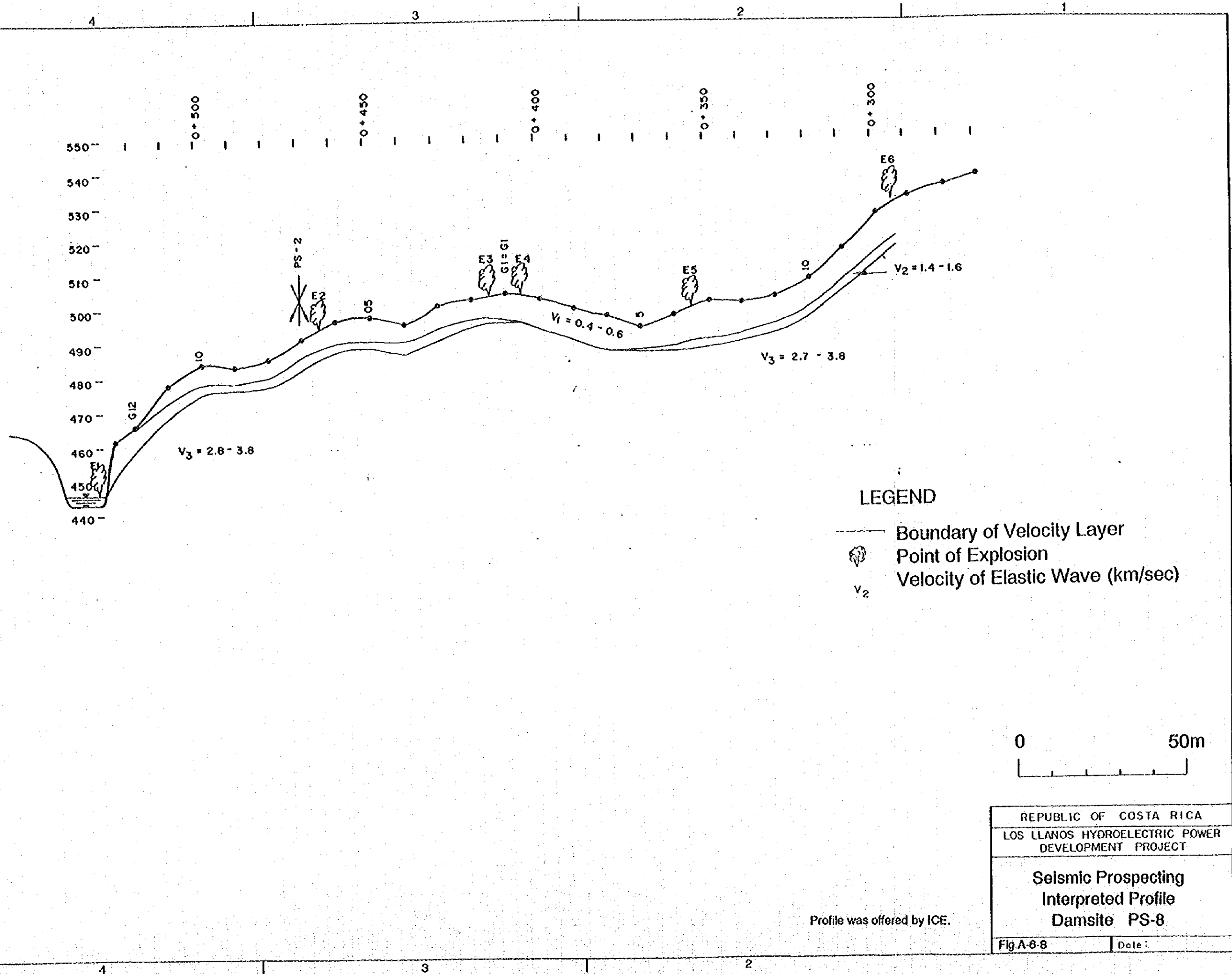
LEGEND

- Boundary of Velocity Layer
- 🌳 Point of Explosion
- v_2 Velocity of Elastic Wave (km/sec)

REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Seismic Prospecting Interpreted Profile Damsite PS-7	
Fig.A-6-7	Date:

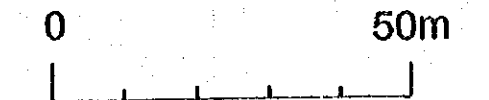
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Elevation (m asl)



LEGEND

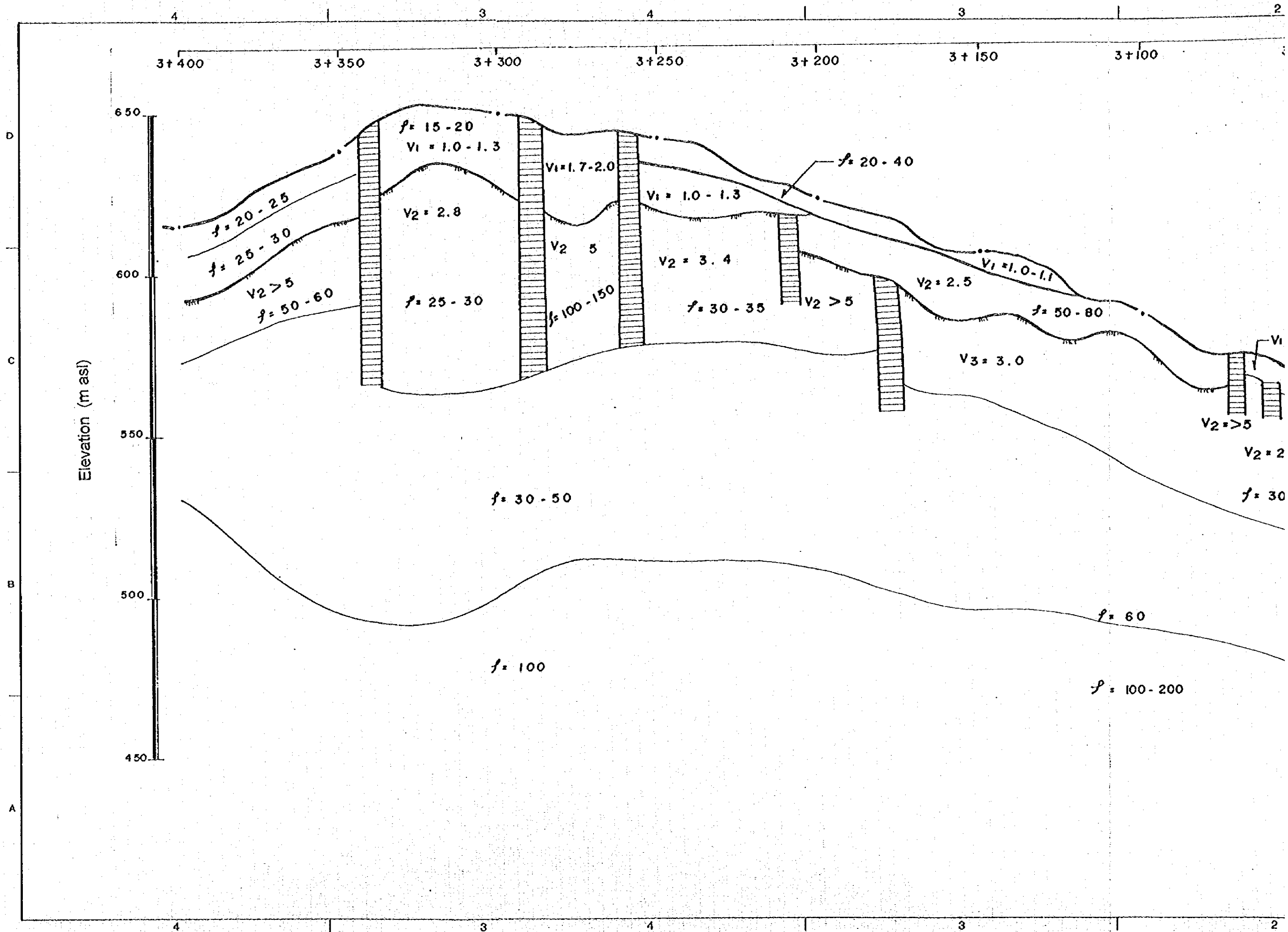
- Boundary of Velocity Layer
- ☁ Point of Explosion
- v_2 Velocity of Elastic Wave (km/sec)

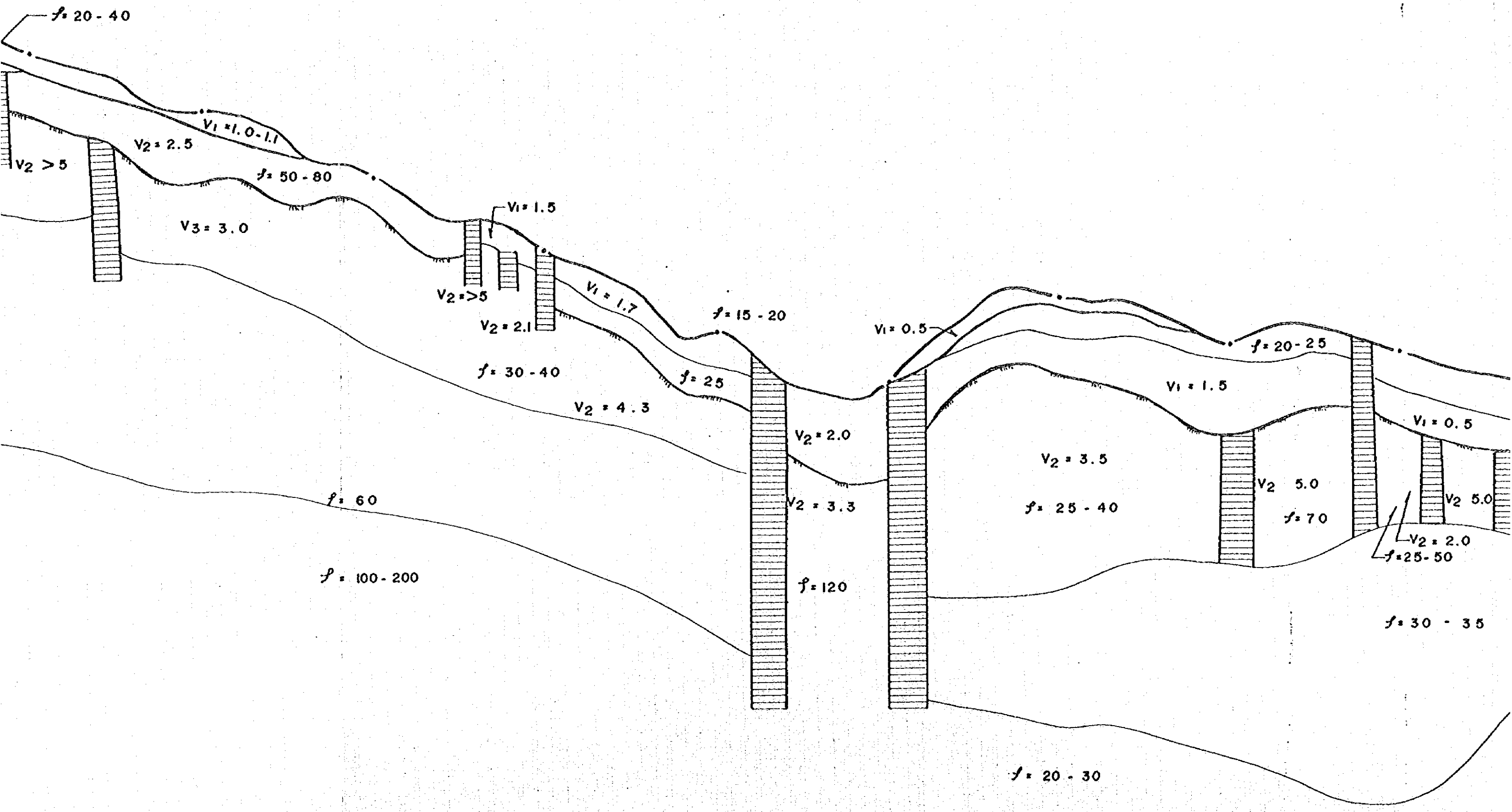
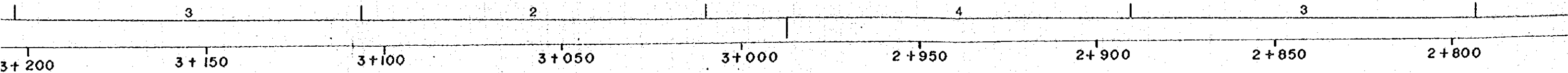


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LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Seismic Prospecting Interpreted Profile Damsite PS-8	
Fig.A-6-8	Date:

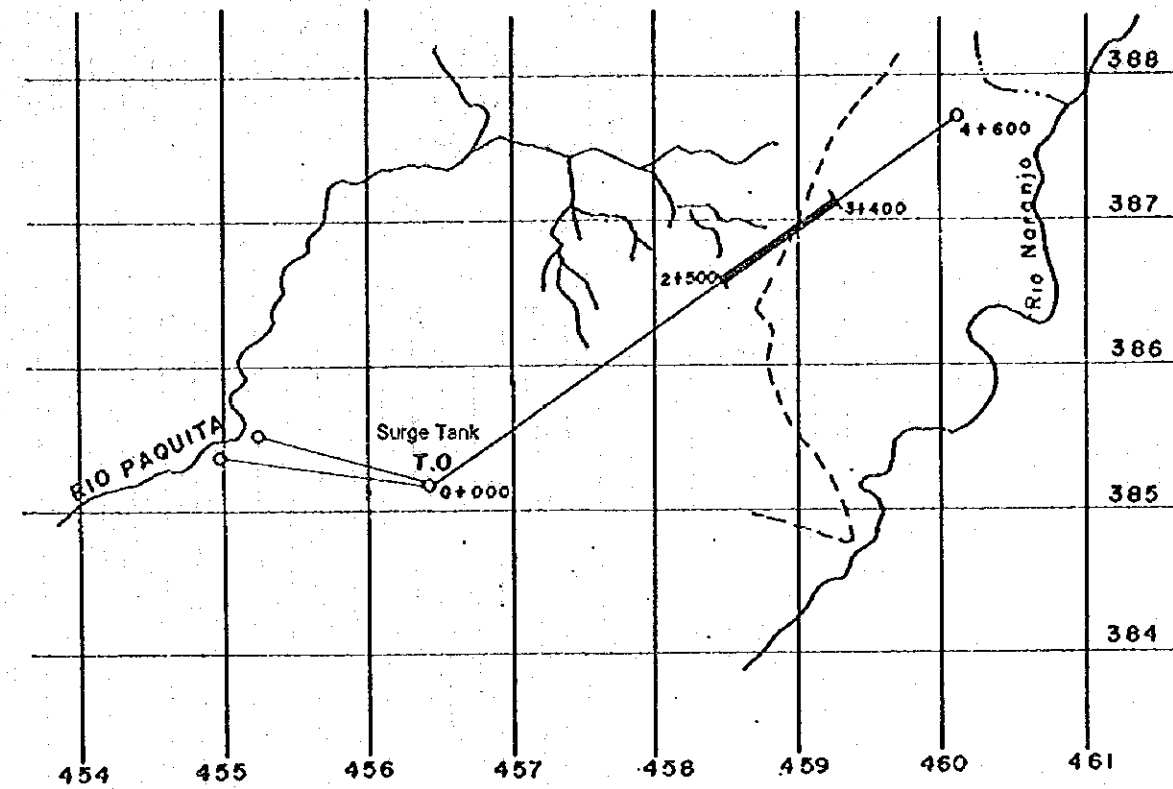
Profile was offered by ICE.

6-9

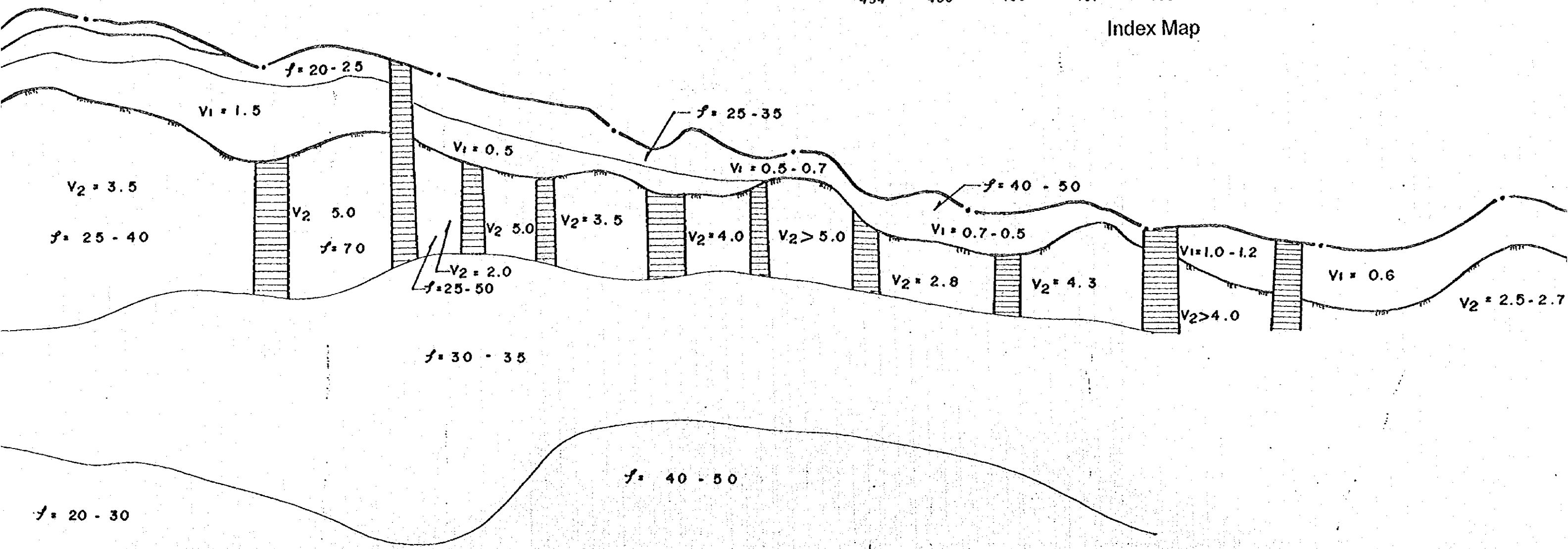




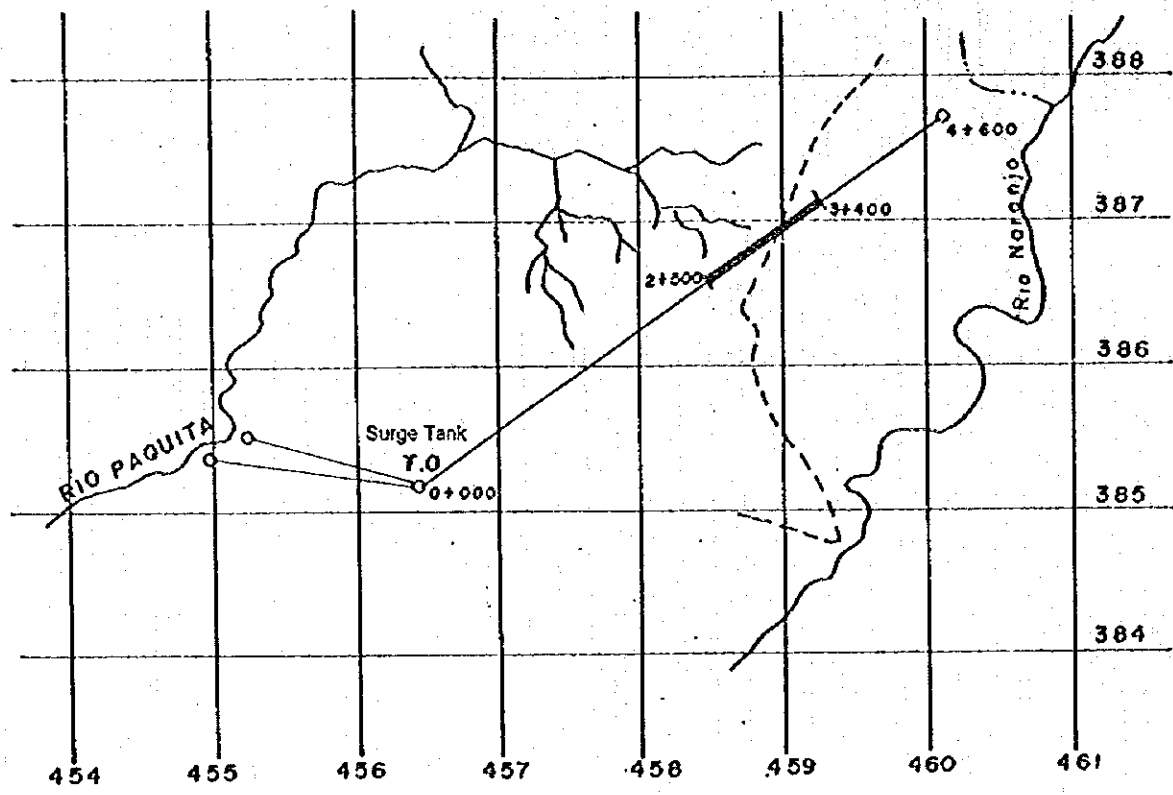
3 2 4 3
 2+900 2+850 2+800 2+750 2+700 2+650 2+600 2+550 2+500



Index Map

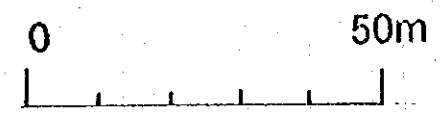
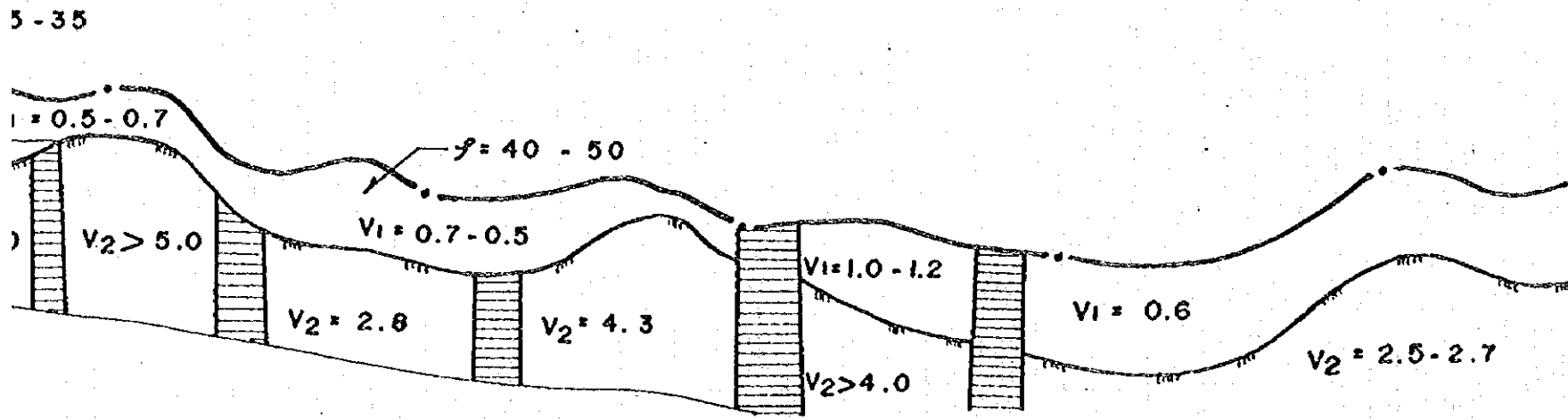


2+700 2+650 2+600 2+550 2+500



Index Map

- LEGEND**
- Geophysical Anomaly
 - Topographic Surface
 - Boundary of Resistivity Layer
 - $v_2 = 2.8$ Velocity of Elastic Wave (km/sec)
 - $f = 25-30$ Resistivity (ohm-m)
 - Boundary of Velocity Layer

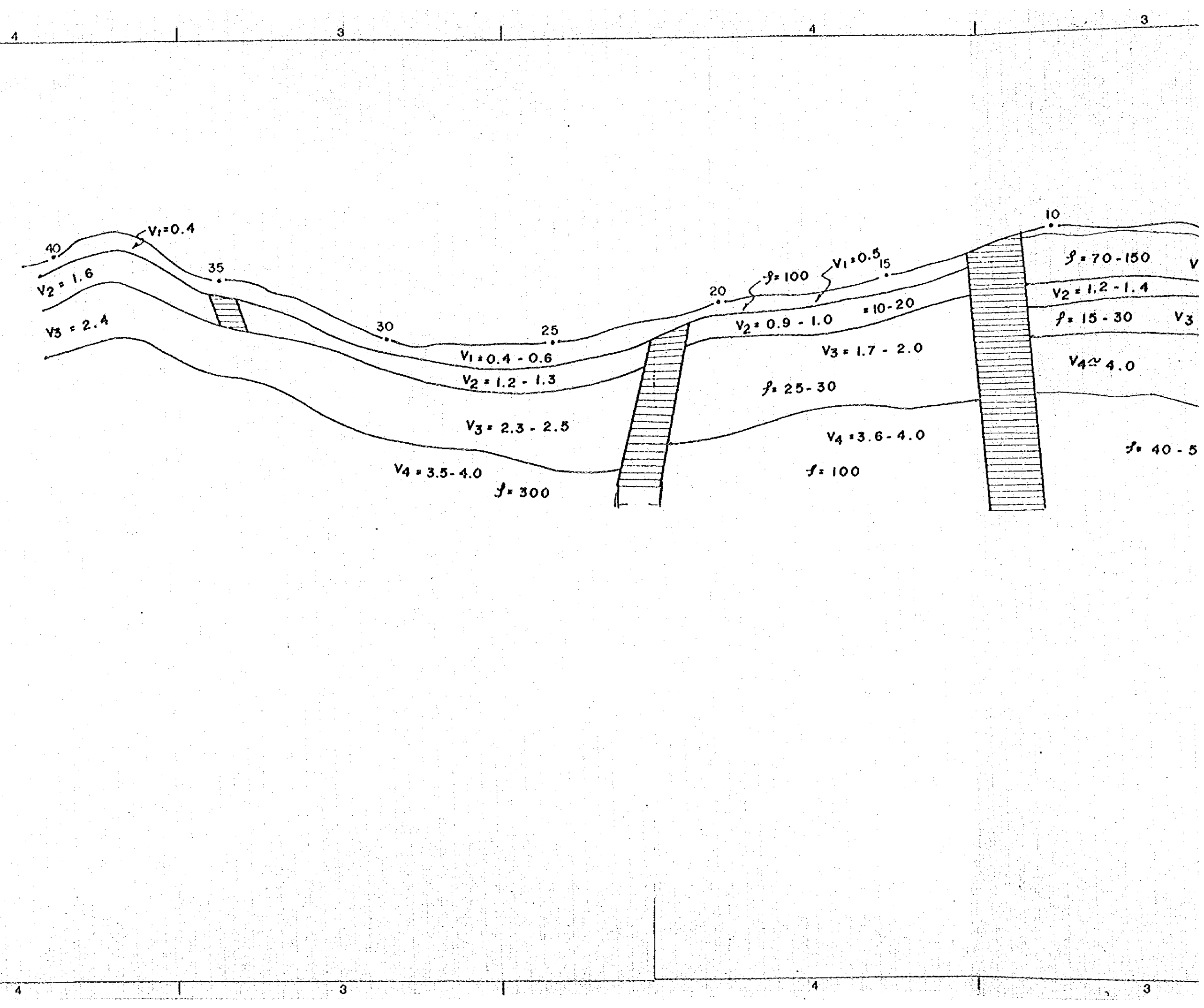
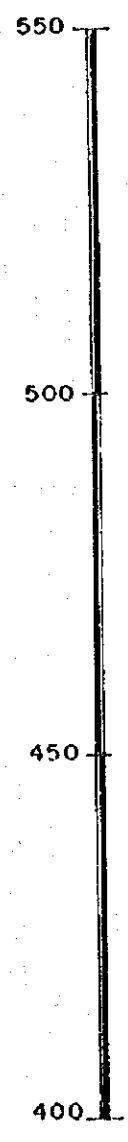


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LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Seismic Prospecting	
Interpreted Profile with Resistivity	
Waterway Alignment Route	
2500-3400	
Fig.A-6-9	Date:

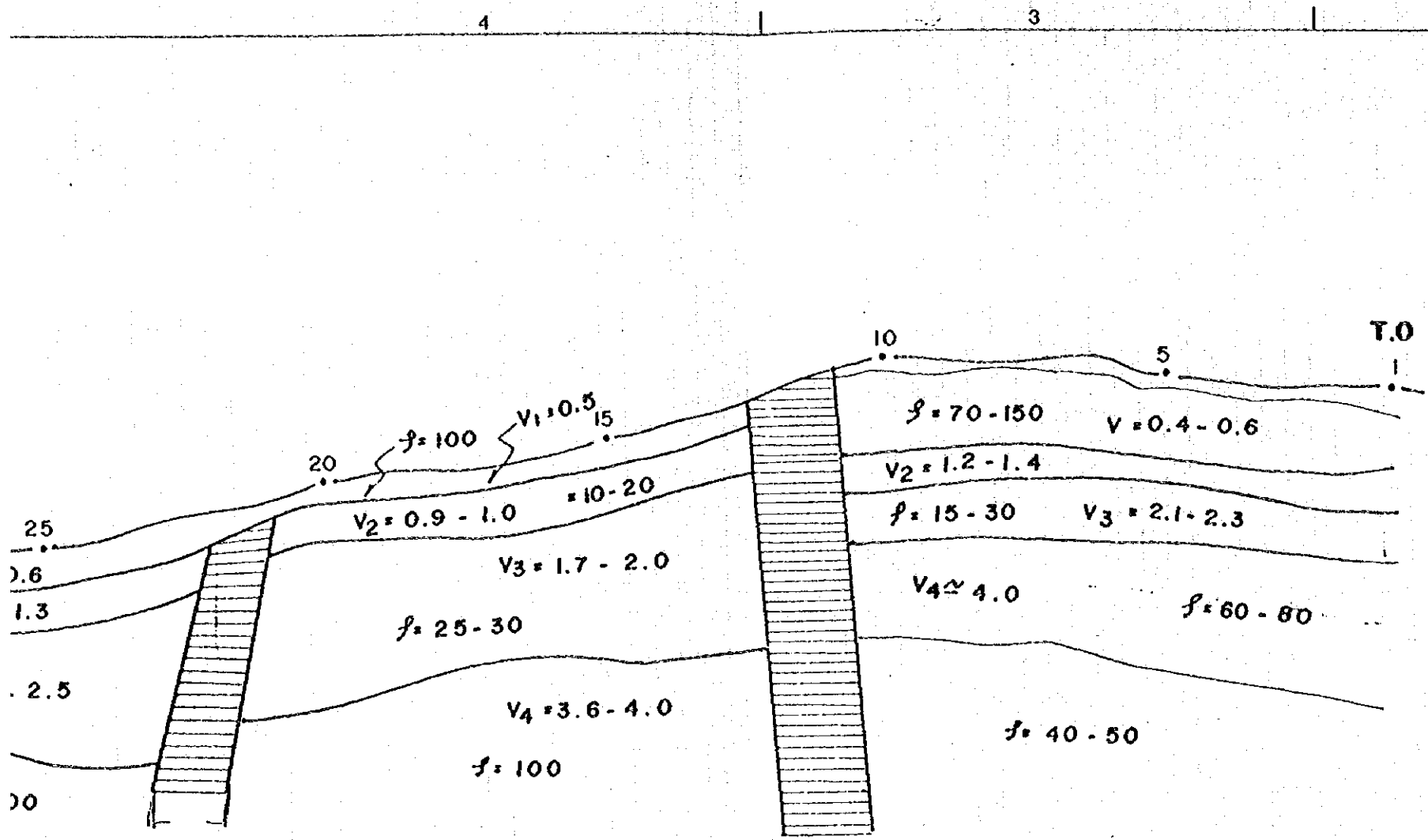
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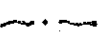

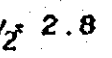
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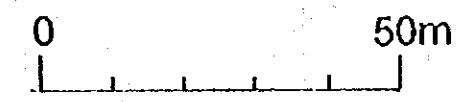
Elevation (m asl)



01-9

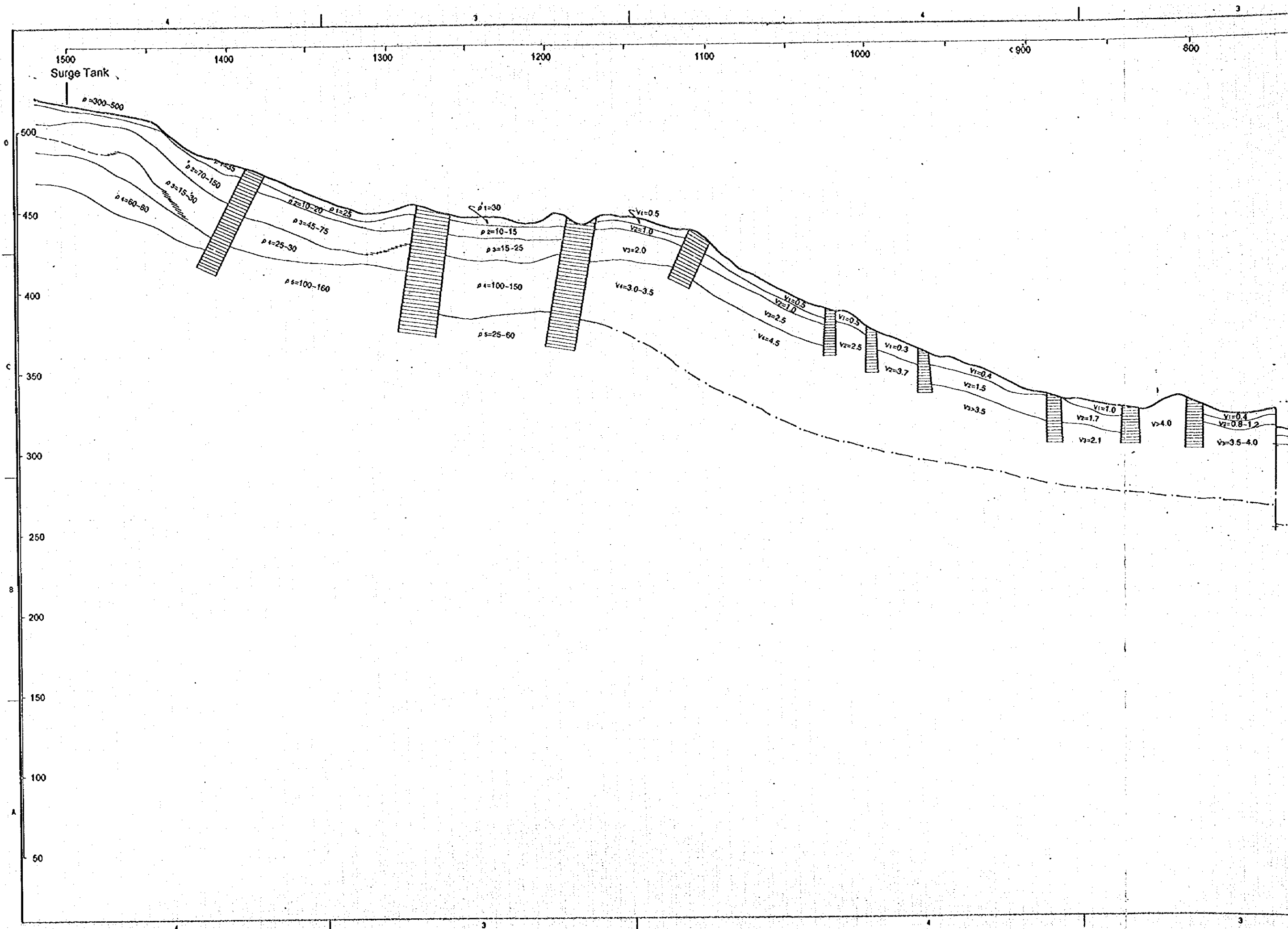


- LEGEND**
-  Geophysical Anomaly
 -  Topographic Surface
 -  Boundary of Resistivity Layer
 -  Boundary of Velocity Layer
 - $V_2 = 2.8$ Velocity of Elastic Wave (km/sec)
 - $f = 25 - 30$ Resistivity (ohm-m)

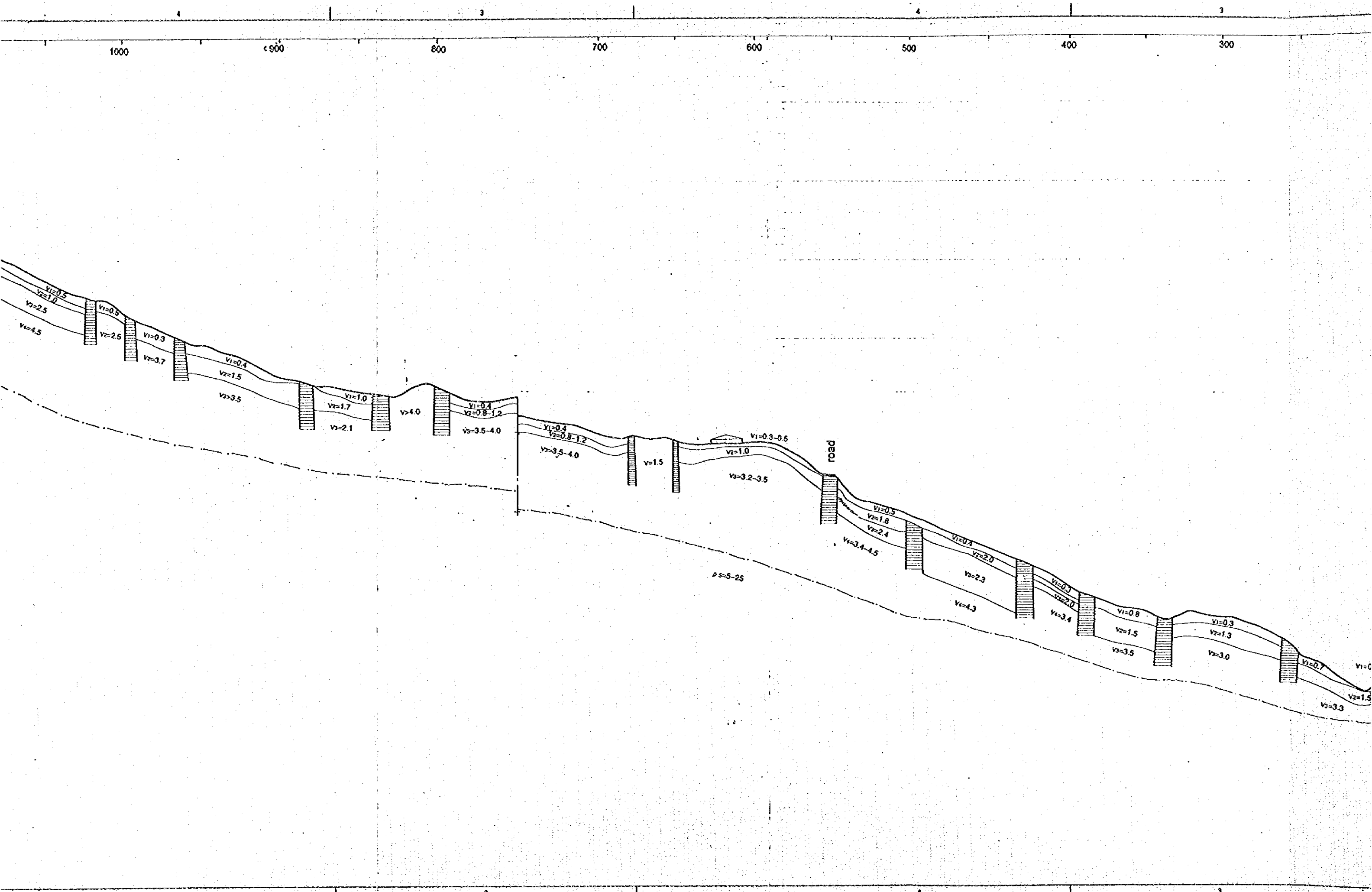


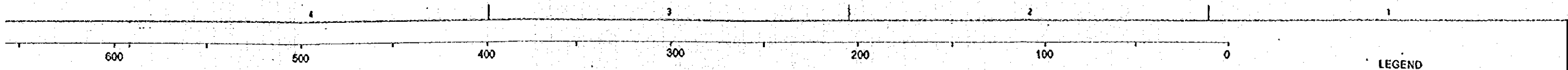
Profile was offered by ICE.

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LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Seismic Prospecting	
Interpreted Profile with Resistivity	
Waterway Alignment Route	
0-400	
Fig.A-6-10	Date:

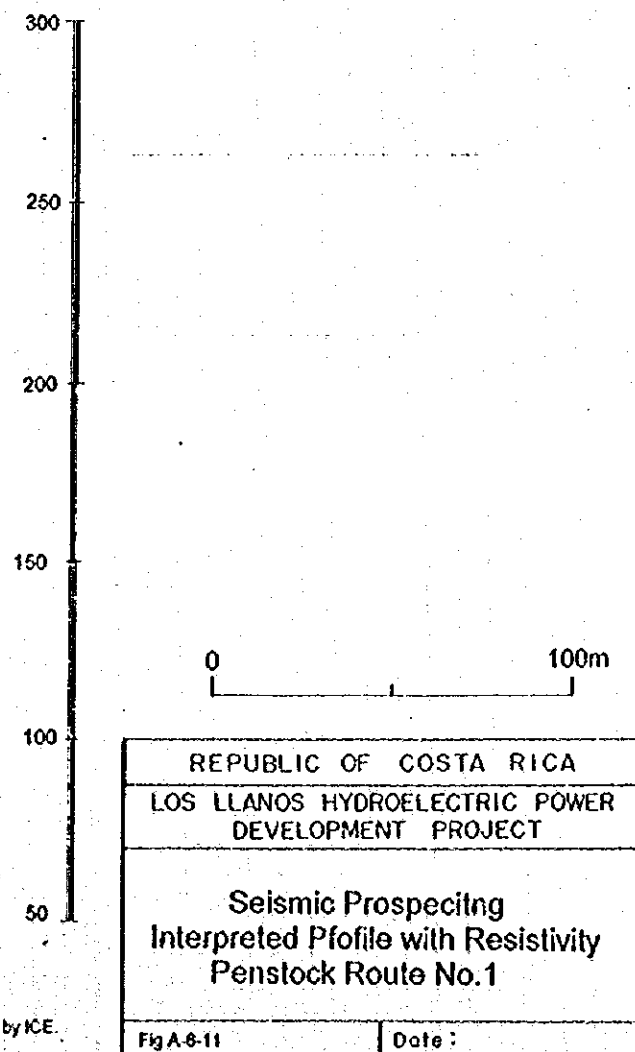
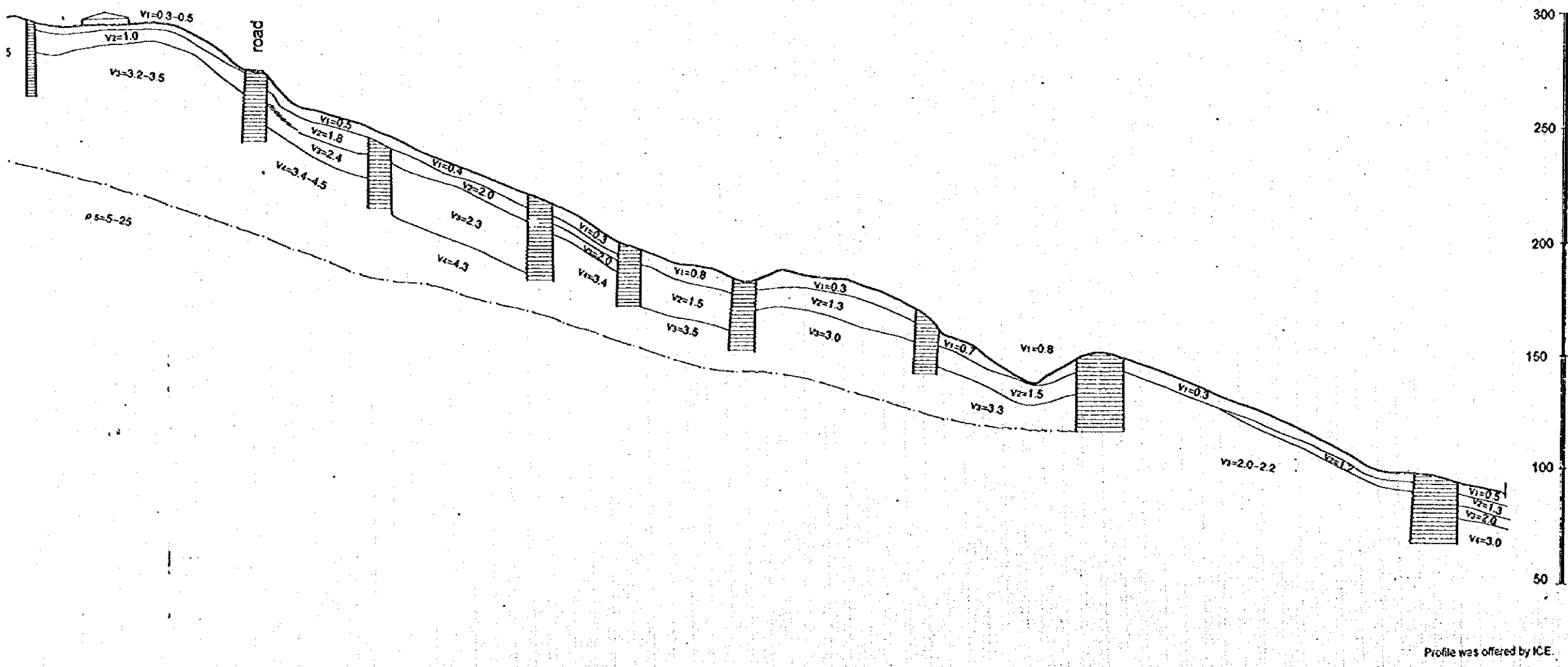
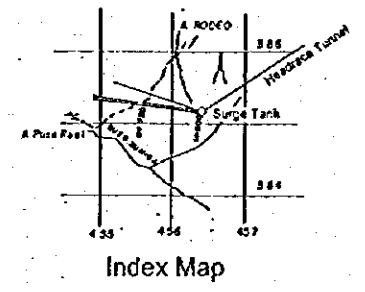


11-7

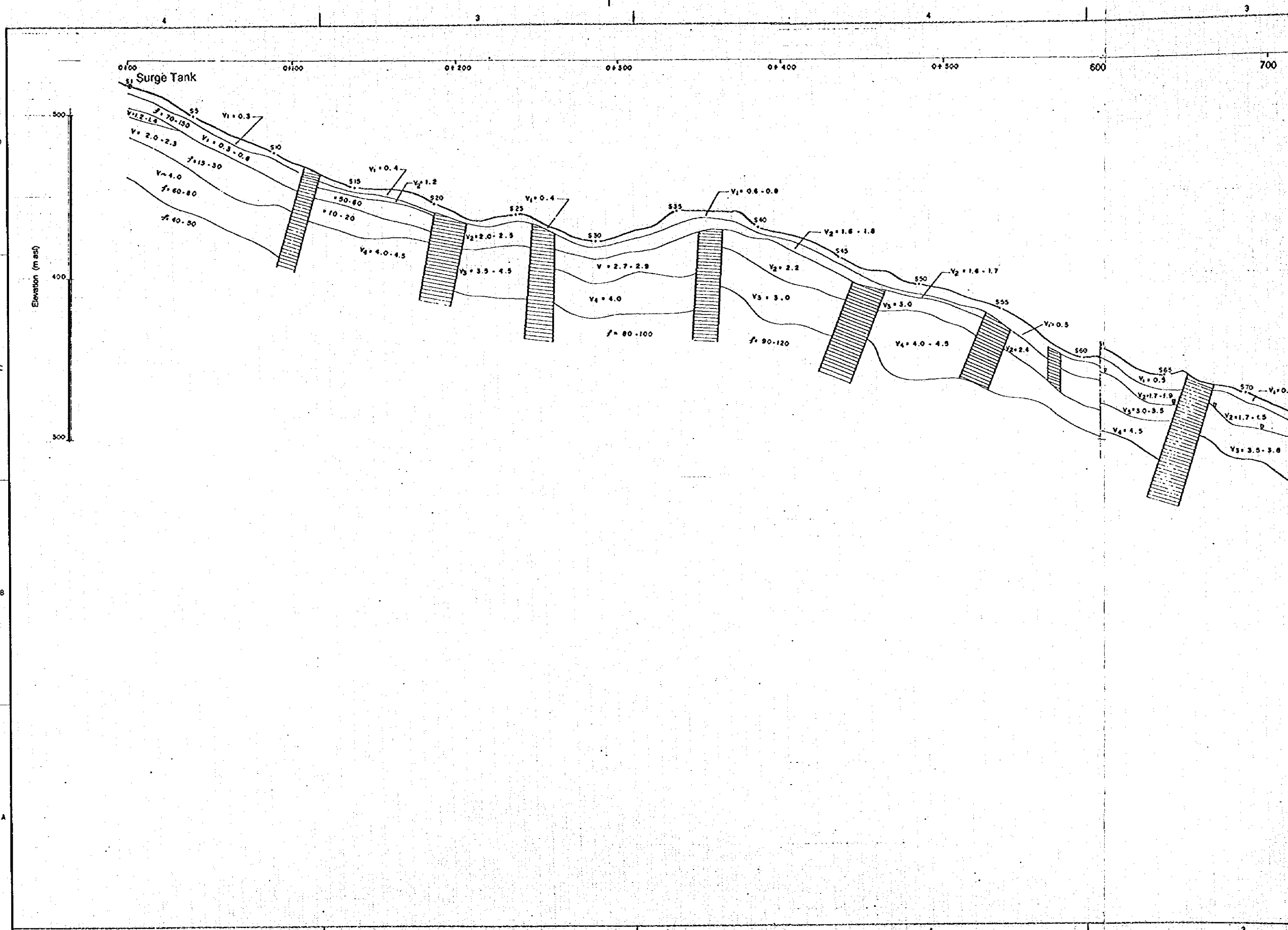


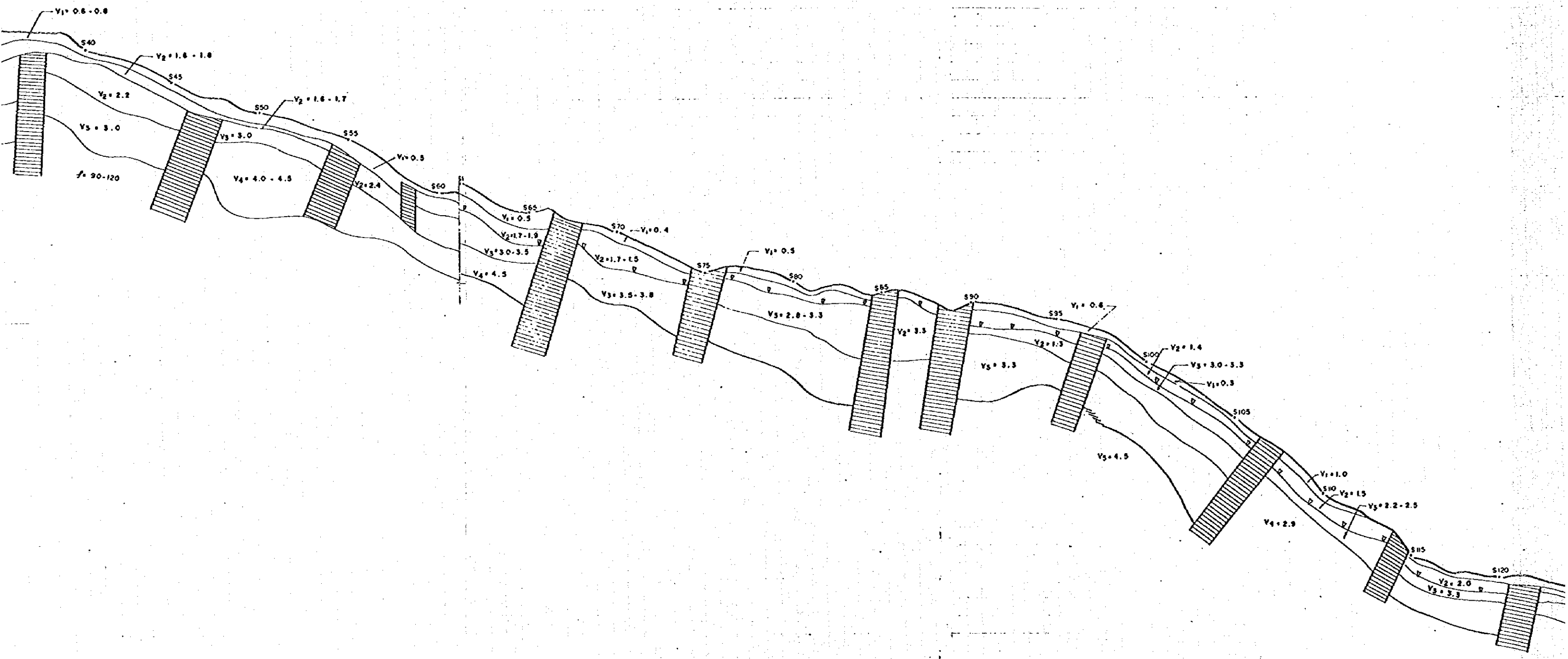
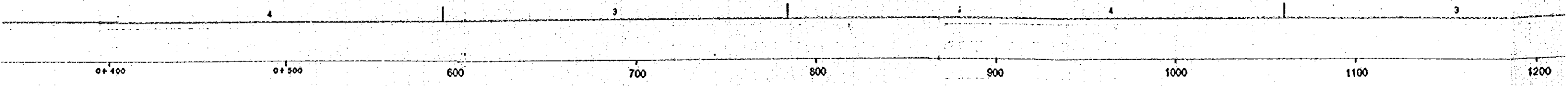


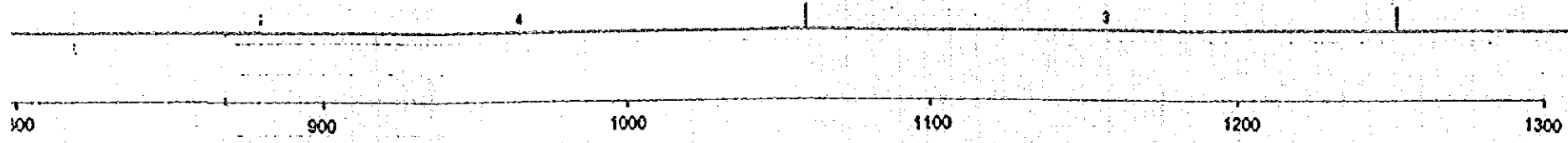
- LEGEND**
- Topographic Surface
 - Boundary of Velocity Layer
 - Boundary of Resistivity Layer
 - v_1, v_2, v_3 Velocity of Elastic Wave (km/sec)
 - Geophysical Anomaly
 - $\rho = 1-25$ Resistivity (ohm-m)



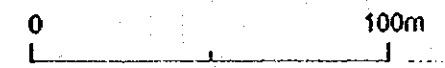
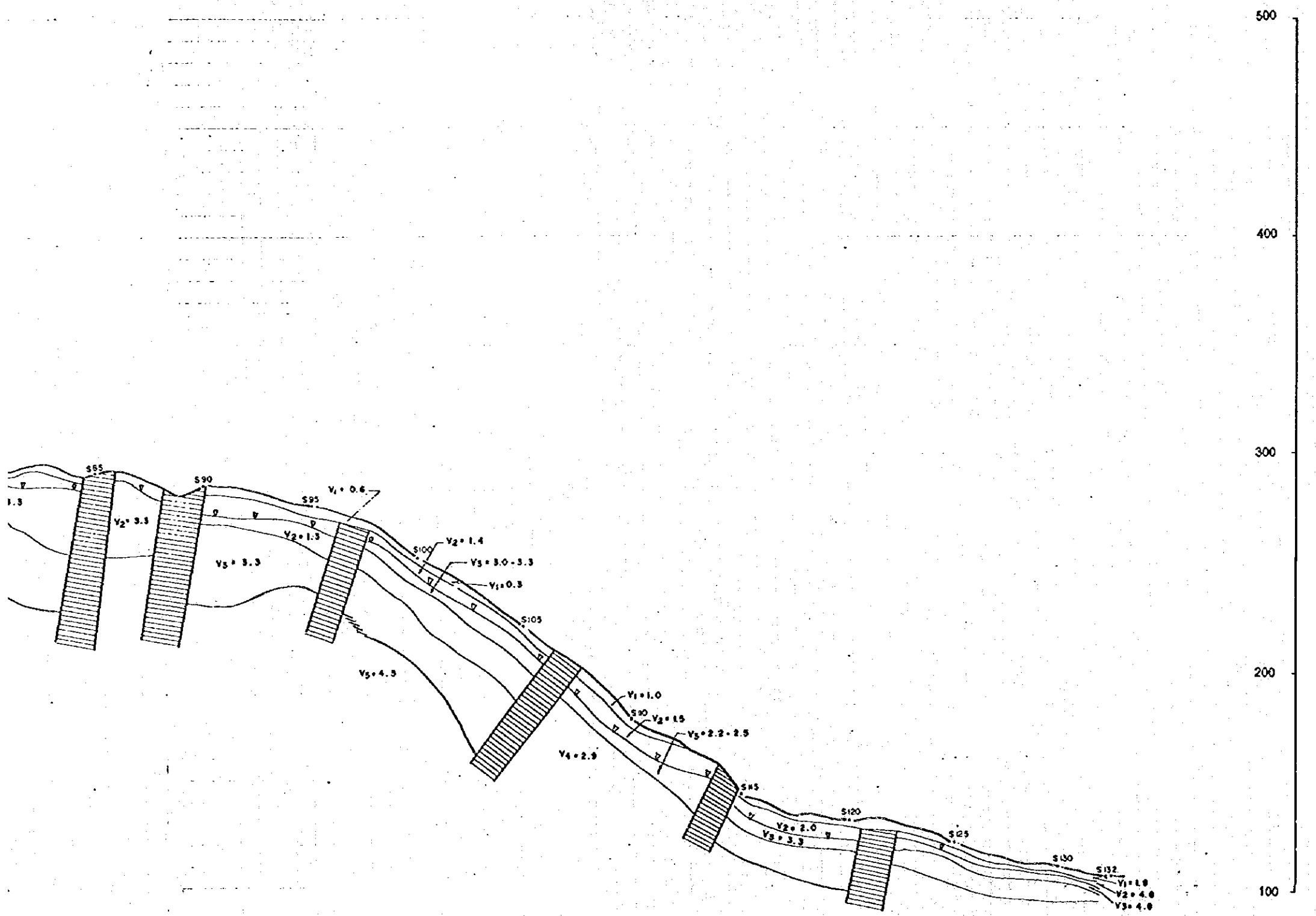
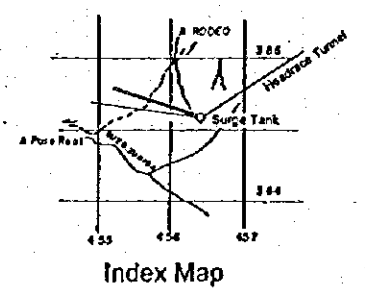
REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Seismic Prospecting Interpreted Profile with Resistivity Penstock Route No. 1	
Fig A-8-11	Date :





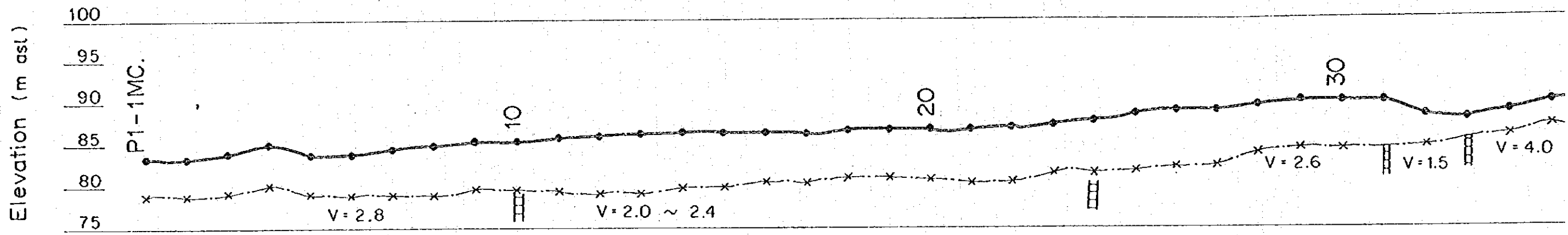


- LEGEND**
- Topographic Surface
 - Boundary of Velocity Layer
 - Boundary of Resistivity Layer
 - v_1, v_2, v_3 Velocity of Elastic Wave (km/sec)
 - Geophysical Anomaly
 - f_1, f_2, f_3 Resistivity (ohm-m)






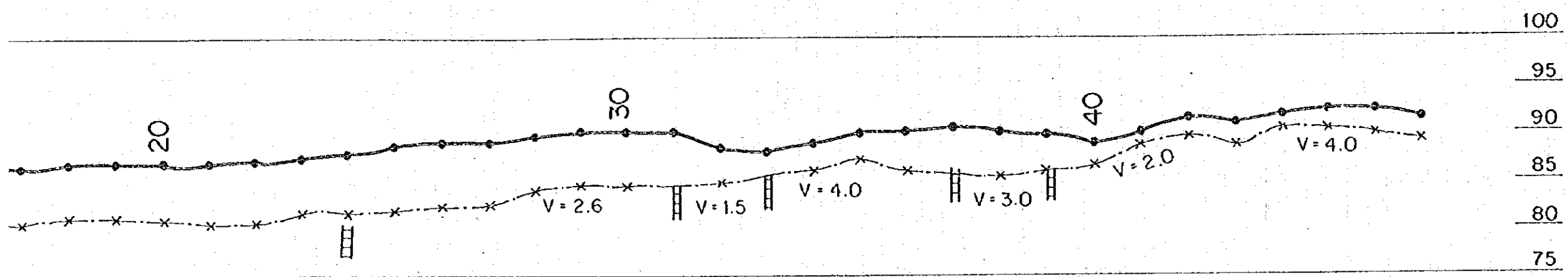
REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Seismic Prospecting Interpreted Profile with Resistivity Penstock Route No.2	
Fig A-6-12	Date :

Profile was offered by ICE.



LEGEND




-  Topographic Surface
-  Boundary of Velocity Layer
-  Velocity Anomaly
- V= Velocity of Elastic Wave (km/sec)

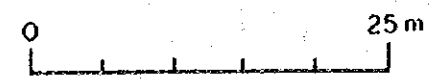
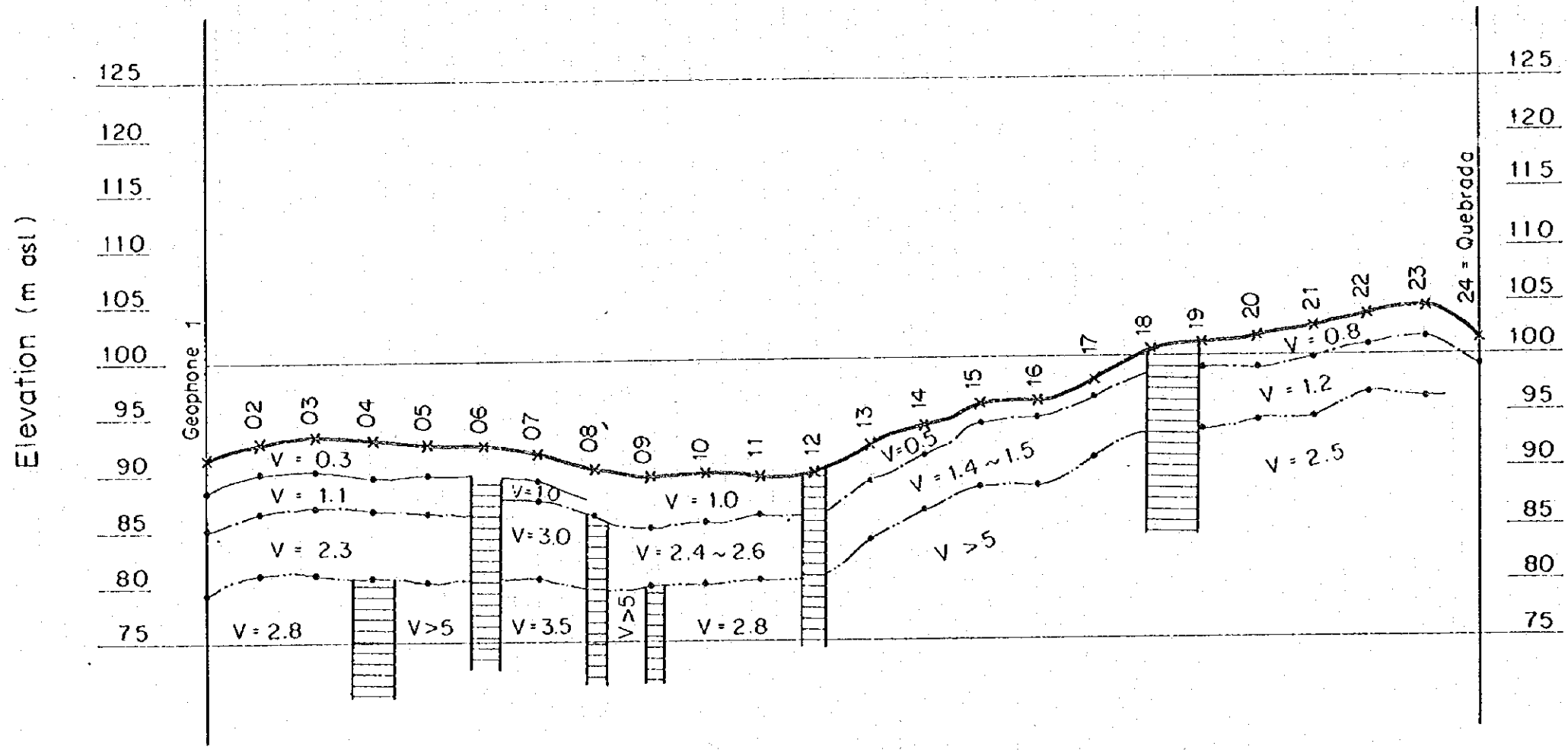


REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROSPECTING INTERPRETED PROFILE POWER STATION SITE PC-1	
Fig. A-6-13	Date:

Profile was offered by ICE.

LEGEND

-  Topographic Surface
-  Boundary of Velocity Layer
-  Velocity Anomaly
- V = Velocity of Elastic Wave (km/sec)



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 LOS LLANOS HYDROELECTRIC POWER
 DEVELOPMENT PROJECT

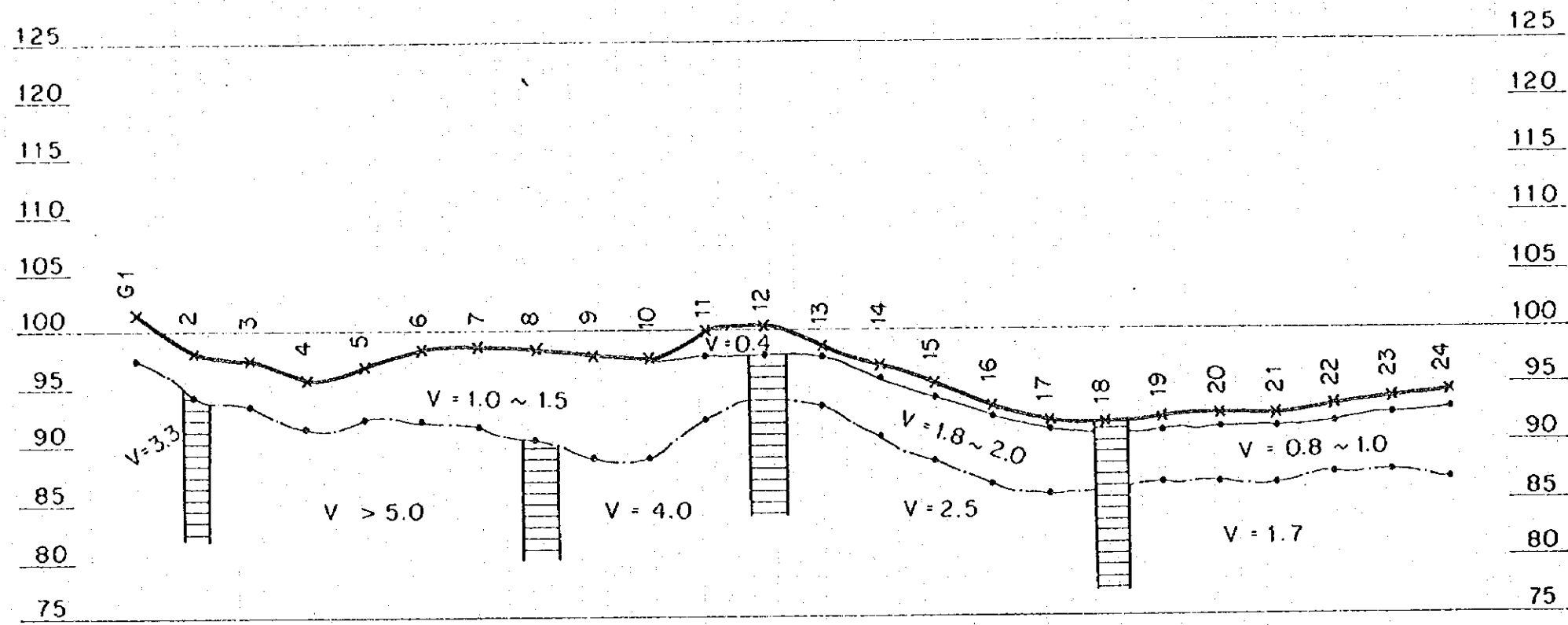
SEISMIC PROSPECTING
 INTERPRETED PROFILE
 POWER STATION SITE PC-3

Fig. A-6-14 Date:

Profile was offered by ICE.

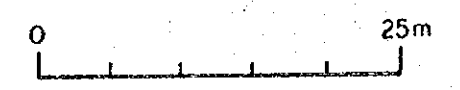
7-1-7

Elevation (m asl)



LEGEND




- Topographic Surface
- Boundary of Velocity Layer
- Velocity Anomaly
- V = Velocity of Elastic Wave (km/sec)

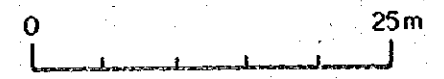
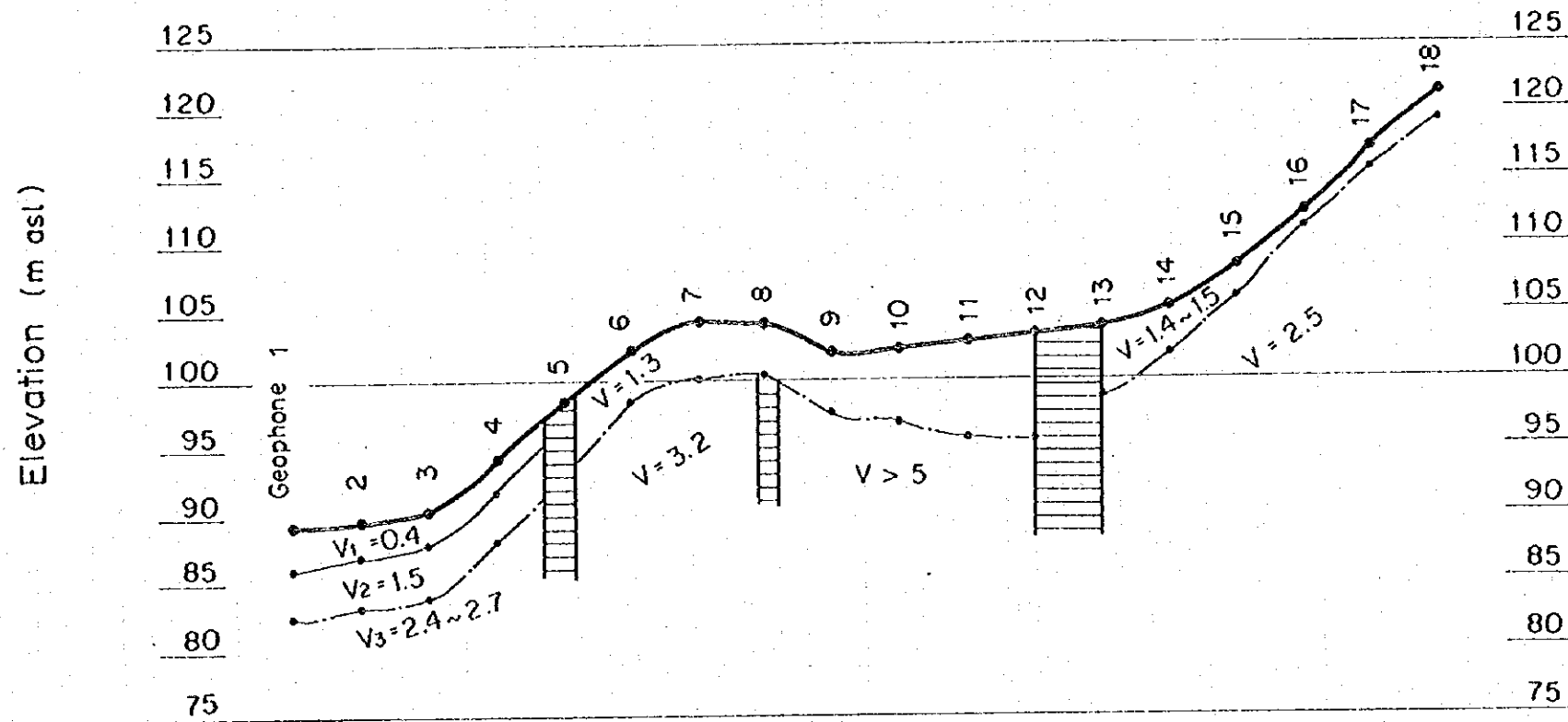


REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROSPECTING INTERPRETED PROFILE	
POWER STATION SITE PC-4	
Fig. A-6-15	Date:

Profile was offered by ICE.

LEGEND

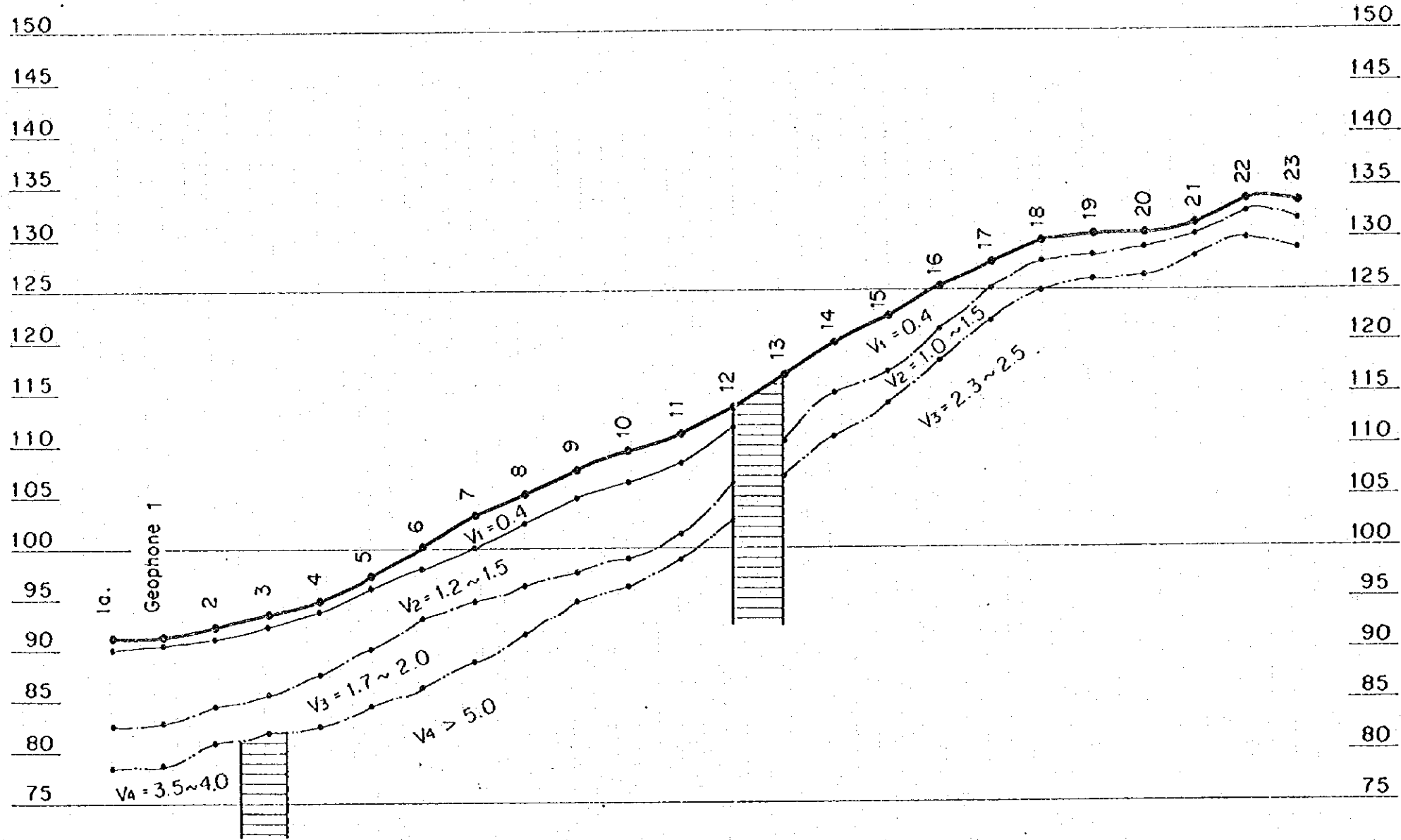
-  Topographic Surface
-  Boundary of Velocity Layer
-  Velocity Anomaly
- V= Velocity of Elastic Wave (km/sec)



REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROSPECTING INTERPRETED PROFILE	
POWER STATION SITE PC-5	
Fig. A-6-16	Date:

Profile was offered by ICE.

Elevation (m asl)



LEGEND

- Topographic Surface
- Boundary of Velocity Layer
- Velocity Anomaly
- $V =$ Velocity of Elastic Wave (km/sec)

REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
SEISMIC PROSPECTING INTERPRETED PROFILE POWER STATION SITE PC-6	
Fig. A-6-17	Date:

Profile was offered by ICE.

F-61-9

A-7 Seismic Profile of Reanalysis

Fig.A-7-1 Interpreted Pprofile PS-3 and Waterway 0-400

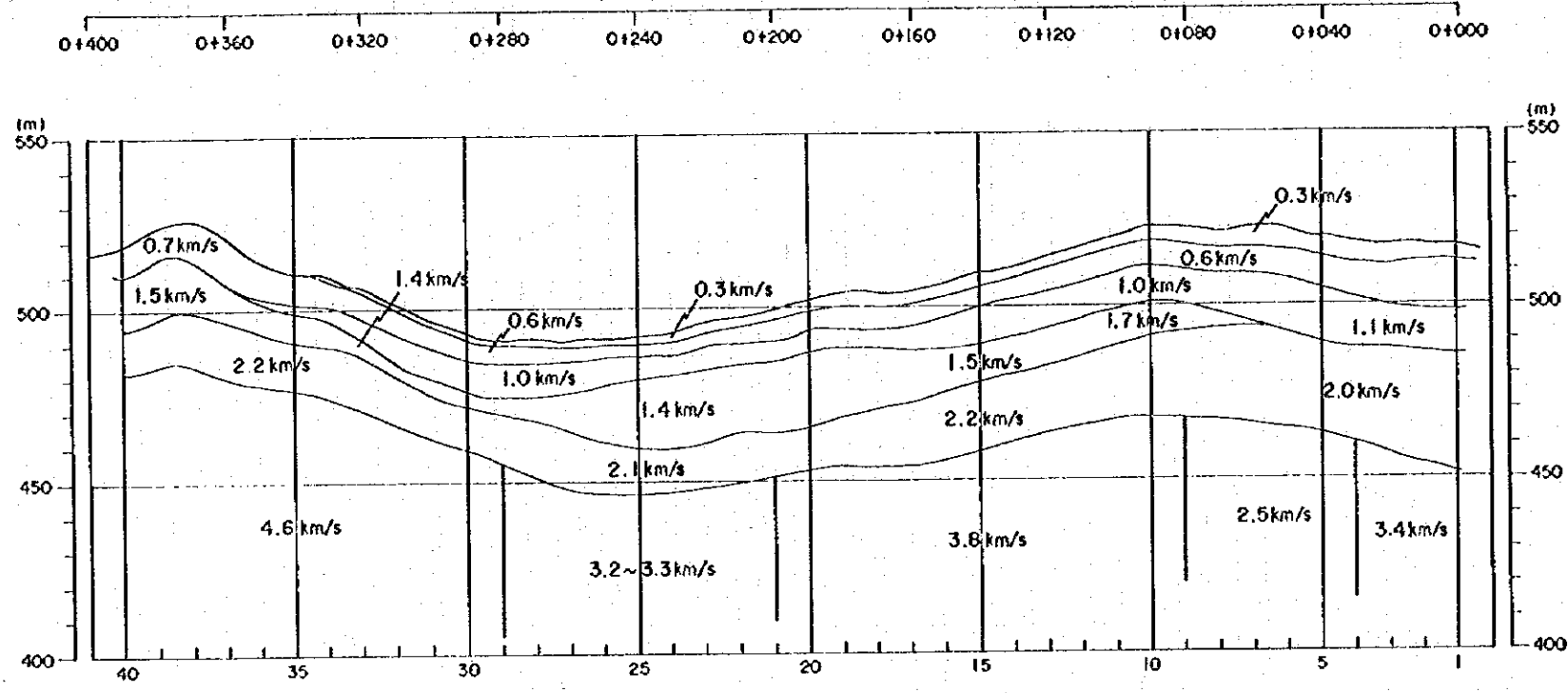
Fig.A-7-2 Interpreted Pprofile Waterway 2500-3400

Fig.A-7-3 Interpreted Pprofile Penstock Route No.1

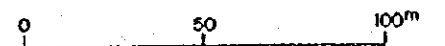
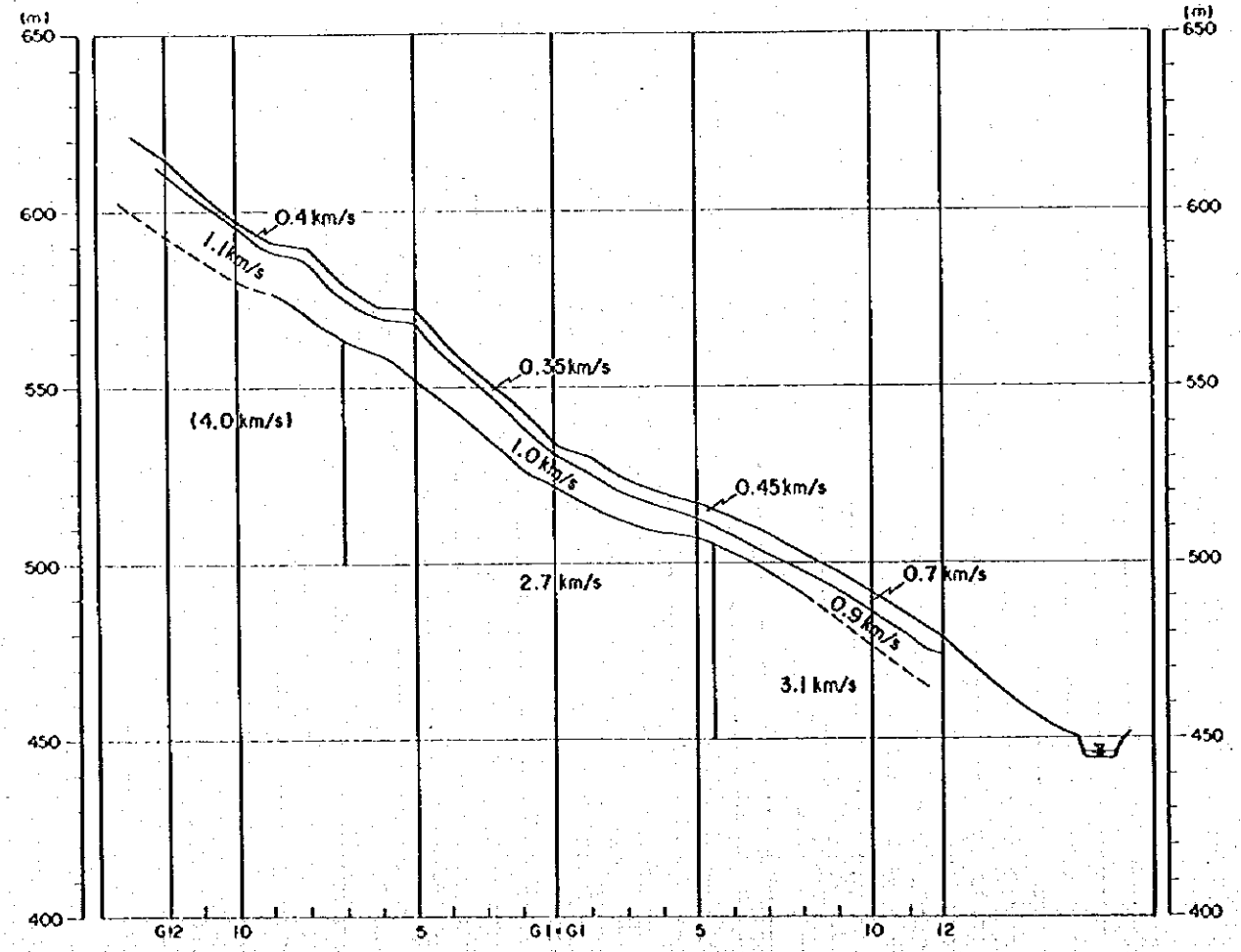
Fig.A-7-4 Interpreted Pprofile Penstock Route No.2

Fig.A-7-5 Interpreted Pprofile PC-1 and PC-2

WATERWAY 0-400



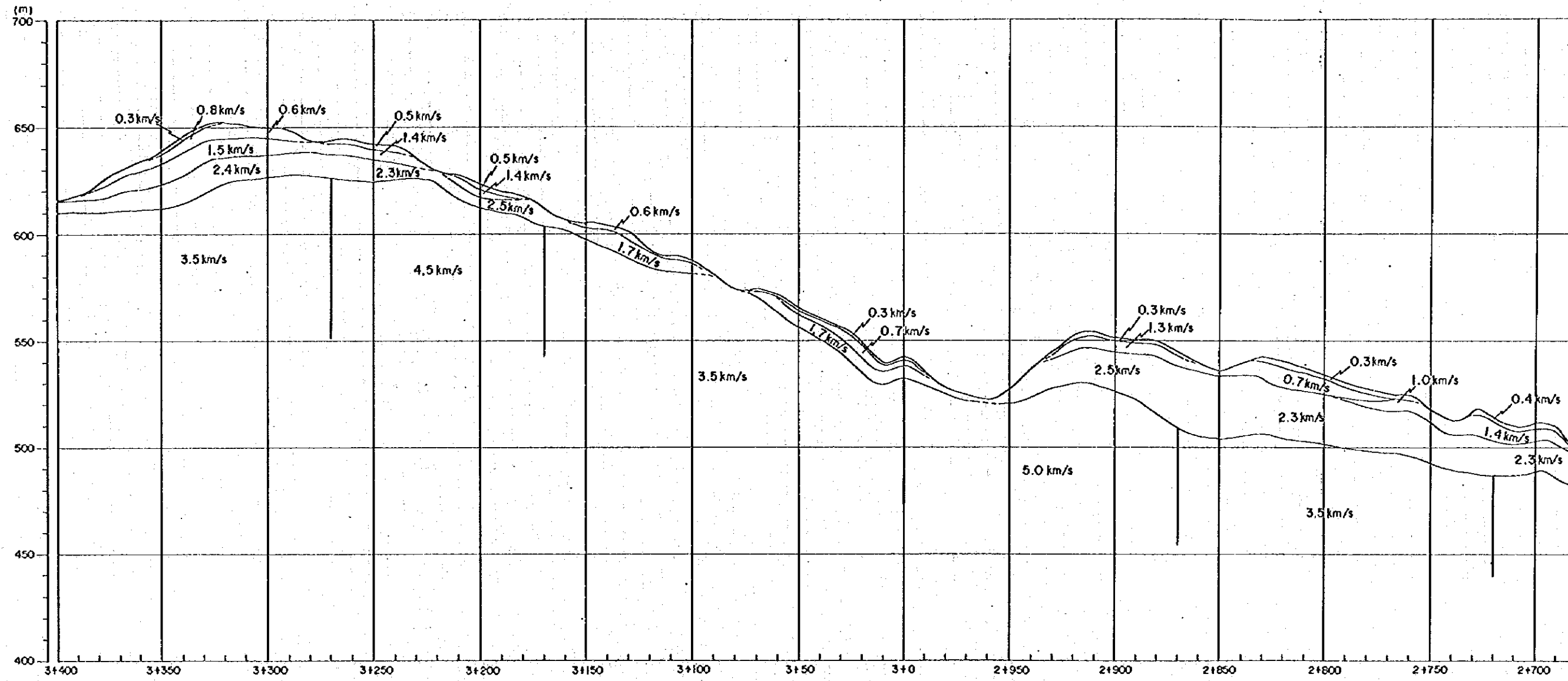
PS 3



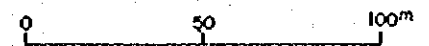
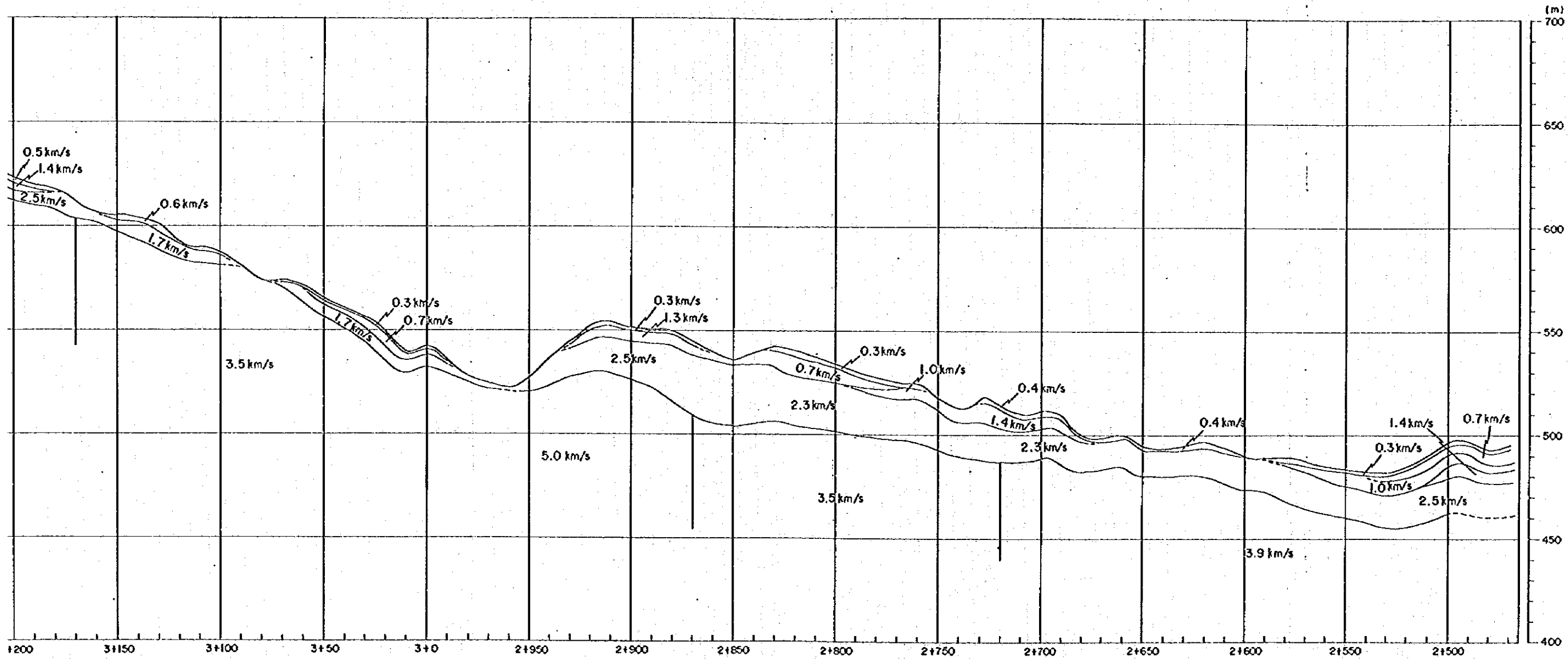
REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Reanalysis of Seismic Prospecting Interpreted Profile PS-3 and Waterway 0-400	
Fig A-7-1	Date :

1-0

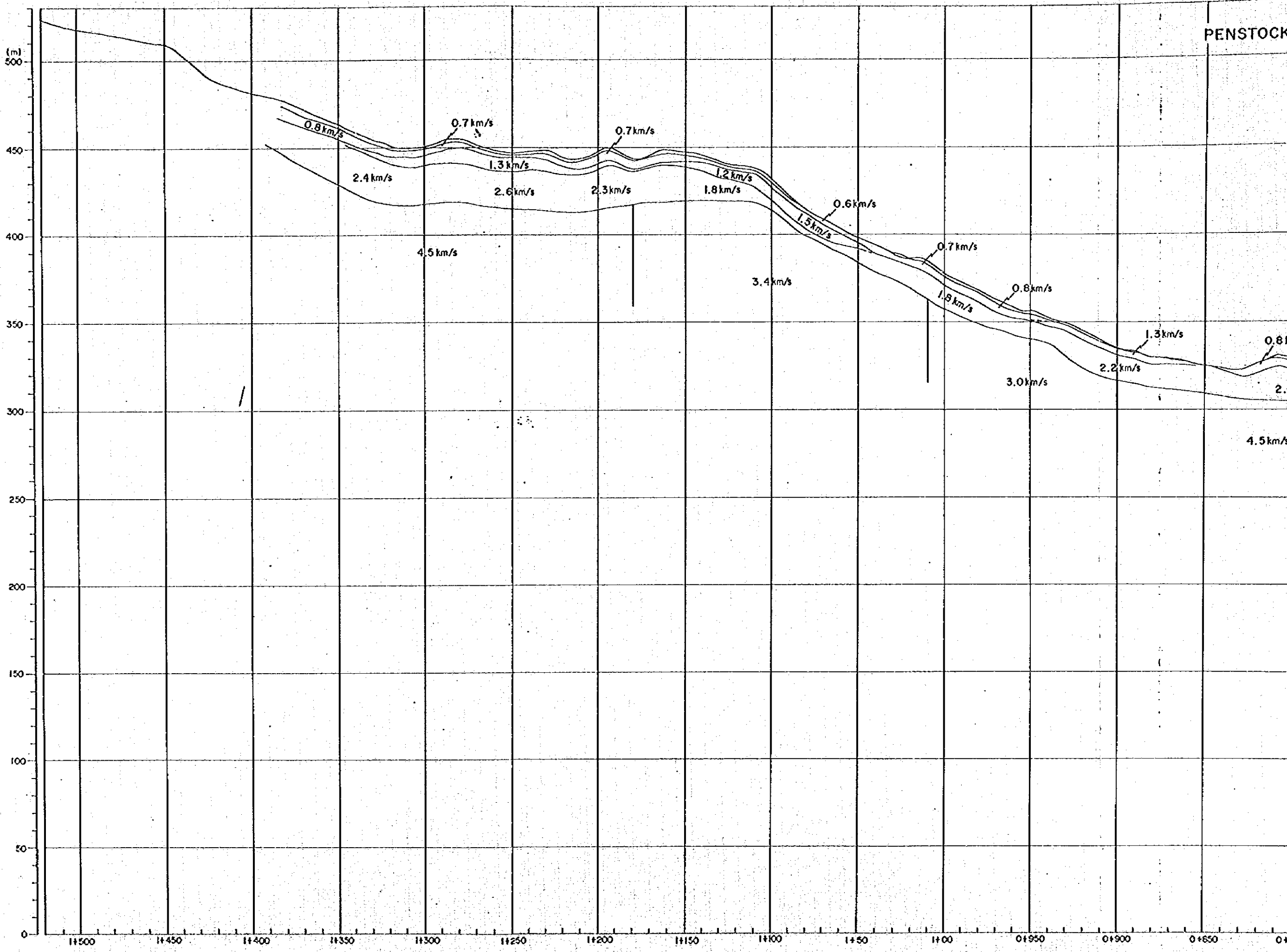
WATERWAY 2500-3400



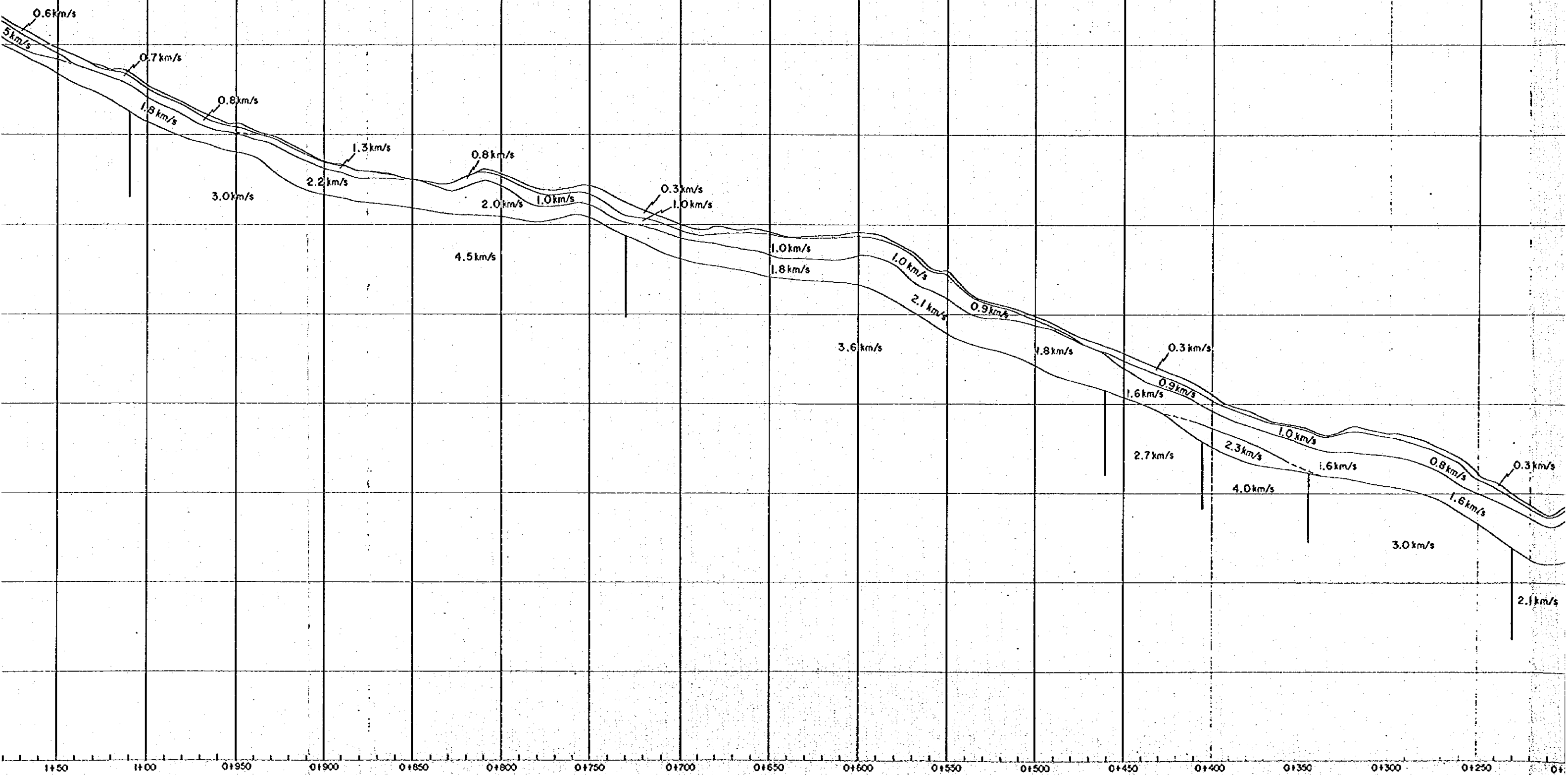
WATERWAY 2500-3400

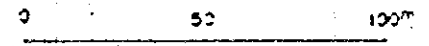
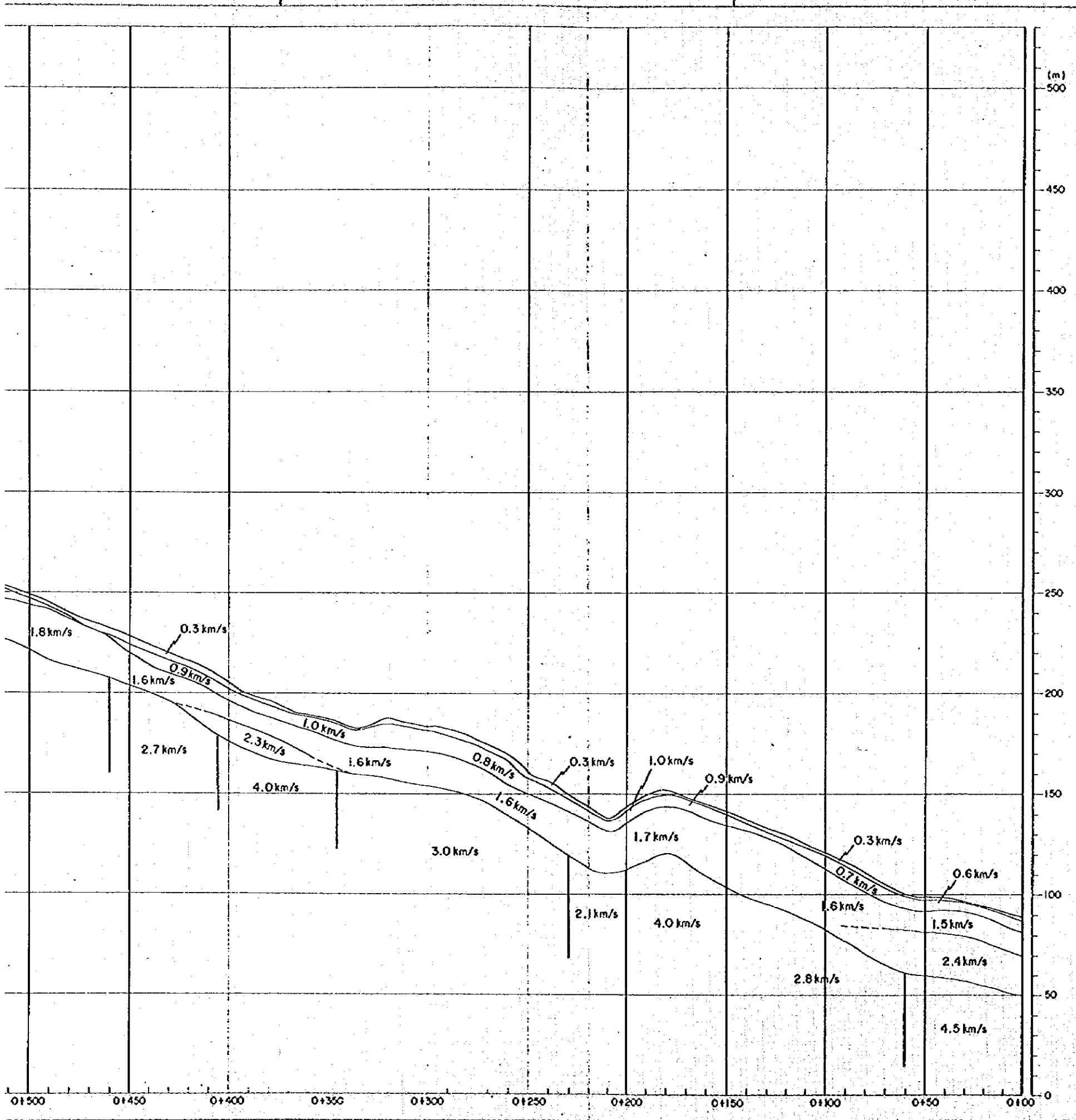


REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Reanalysis of Seismic Prospecting Interpreted Profile Waterway 2500-3400	
Fig.A-7-2	Date:



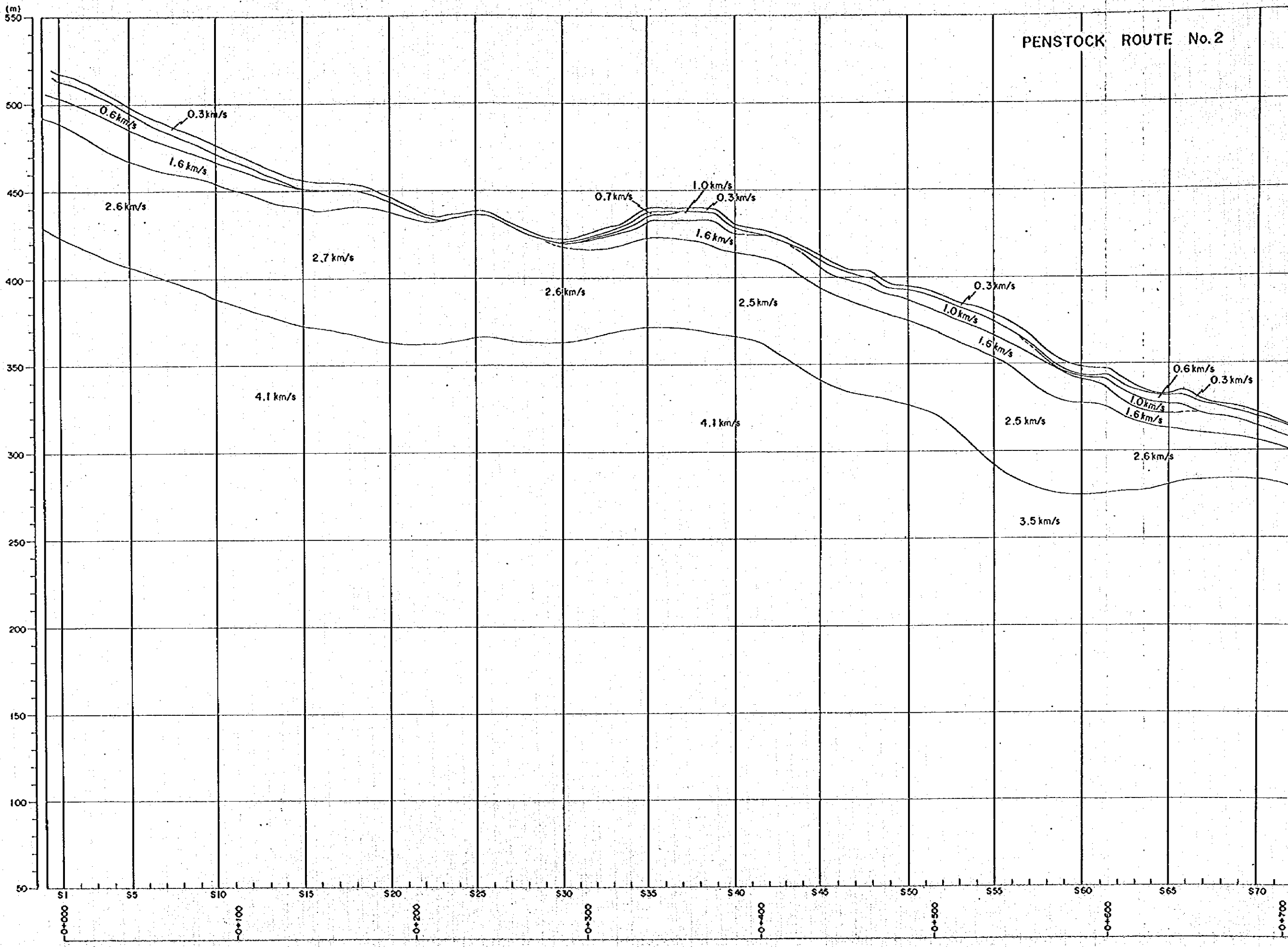
PENSTOCK ROUTE No. 1





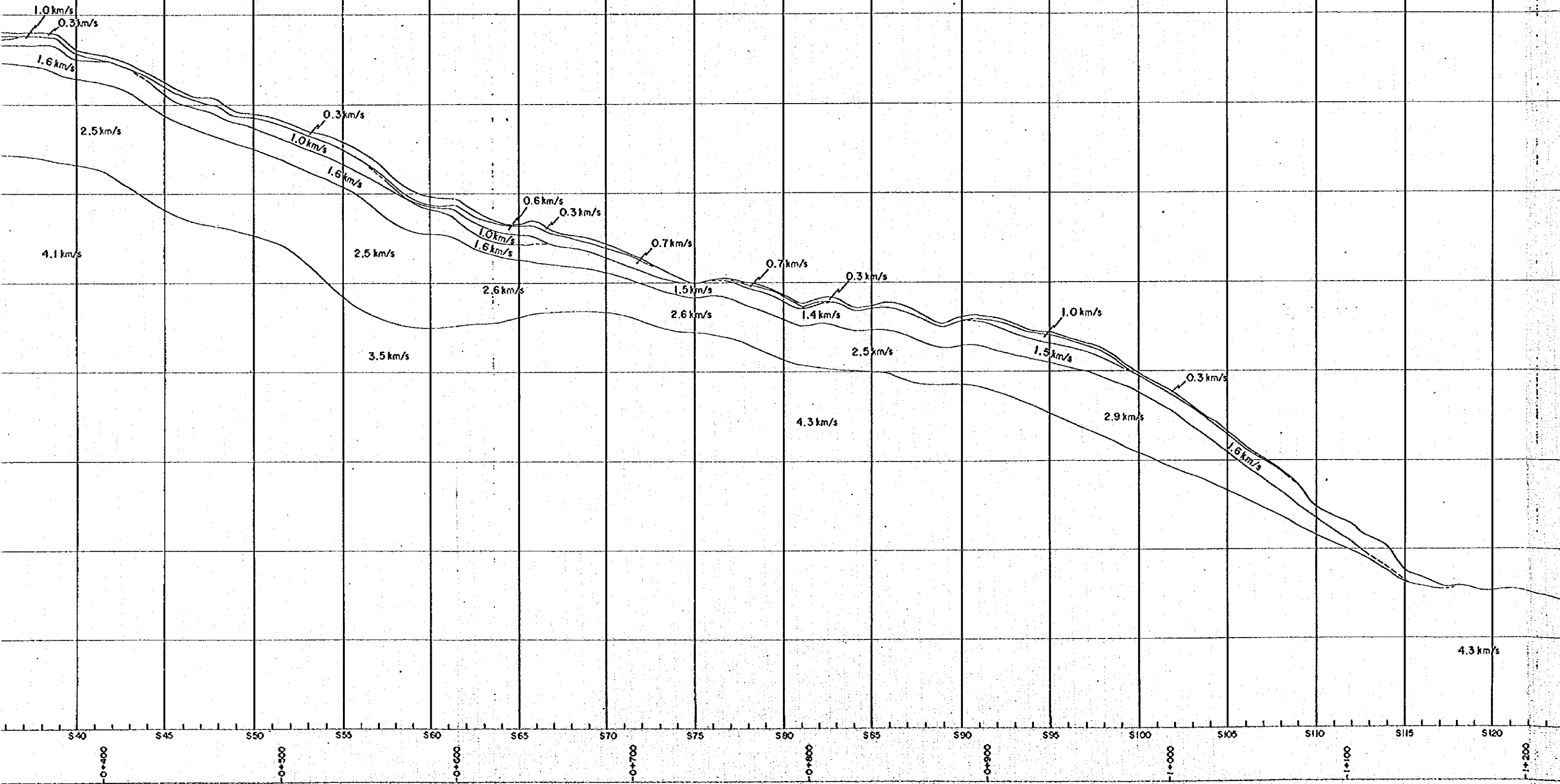
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LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
Reanalysis of Seismic Prospecting Interpreted Profile Penstock Route No.1	
Fig A-73	Date :

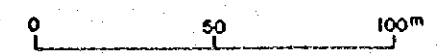
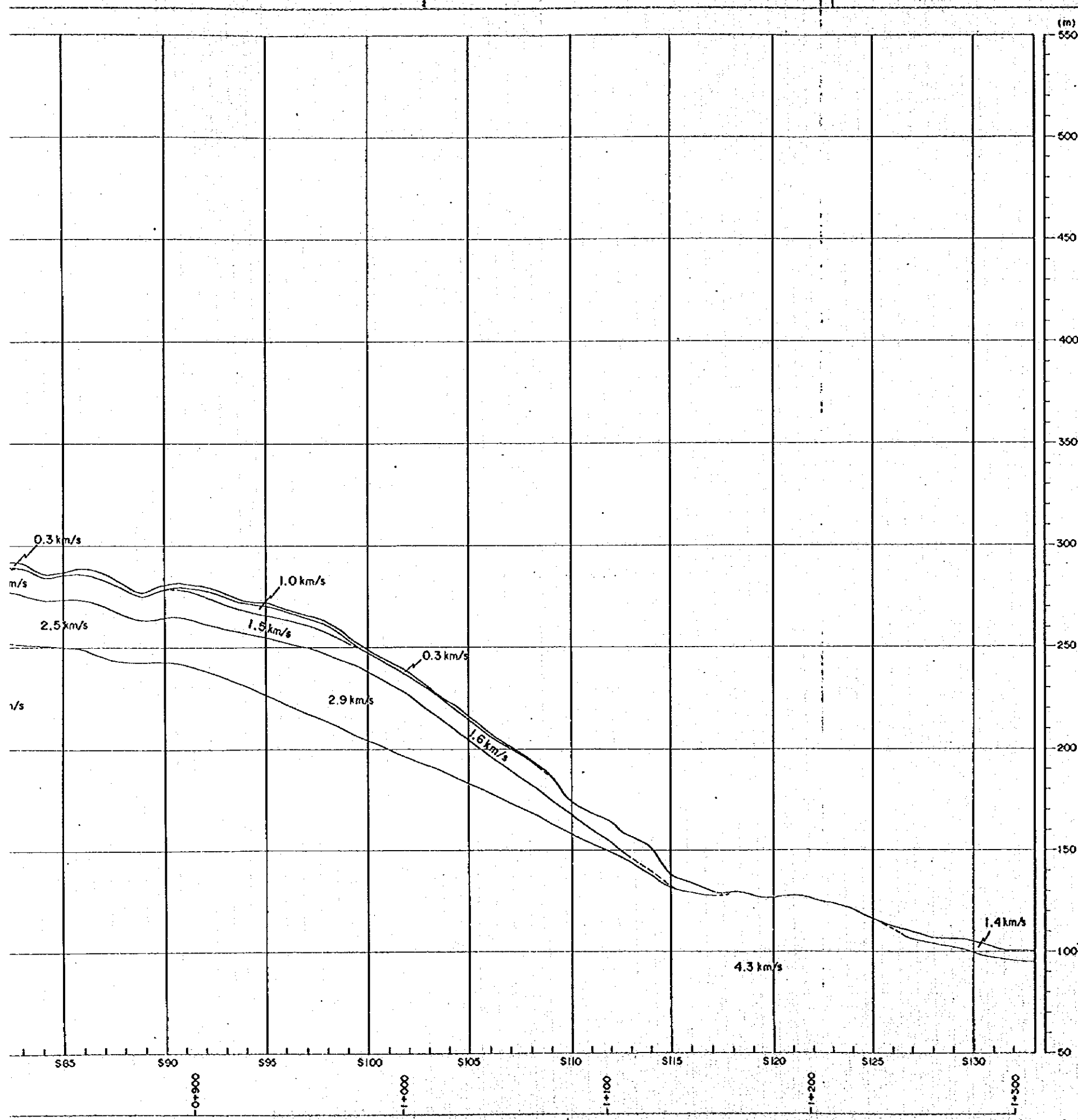
PENSTOCK ROUTE No. 2



7-4

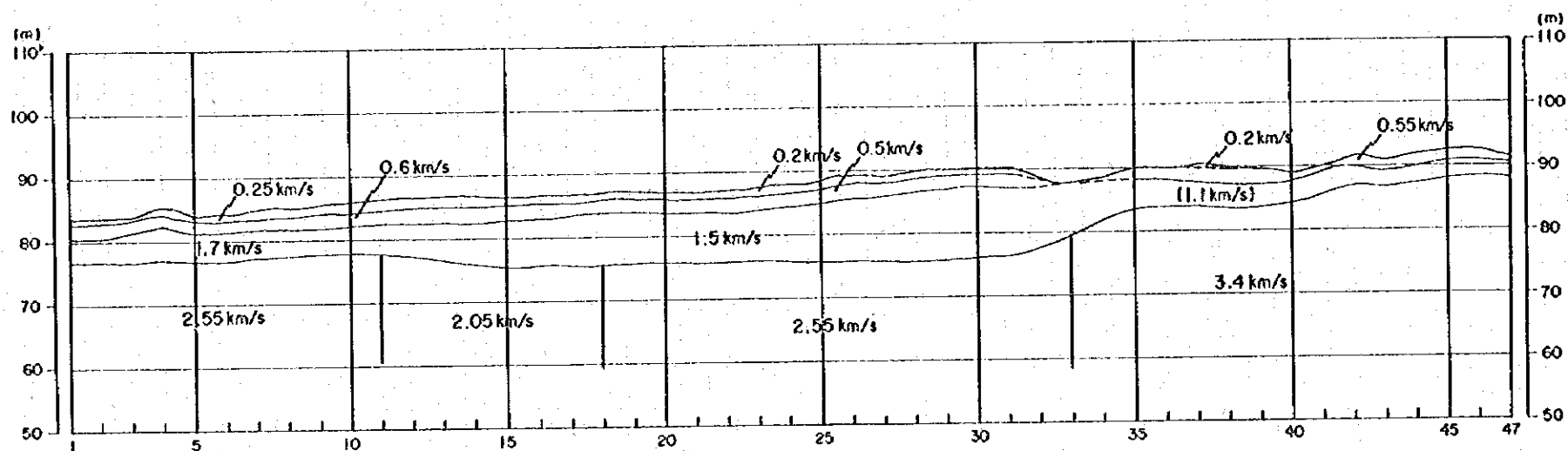
PENSTOCK ROUTE No.2



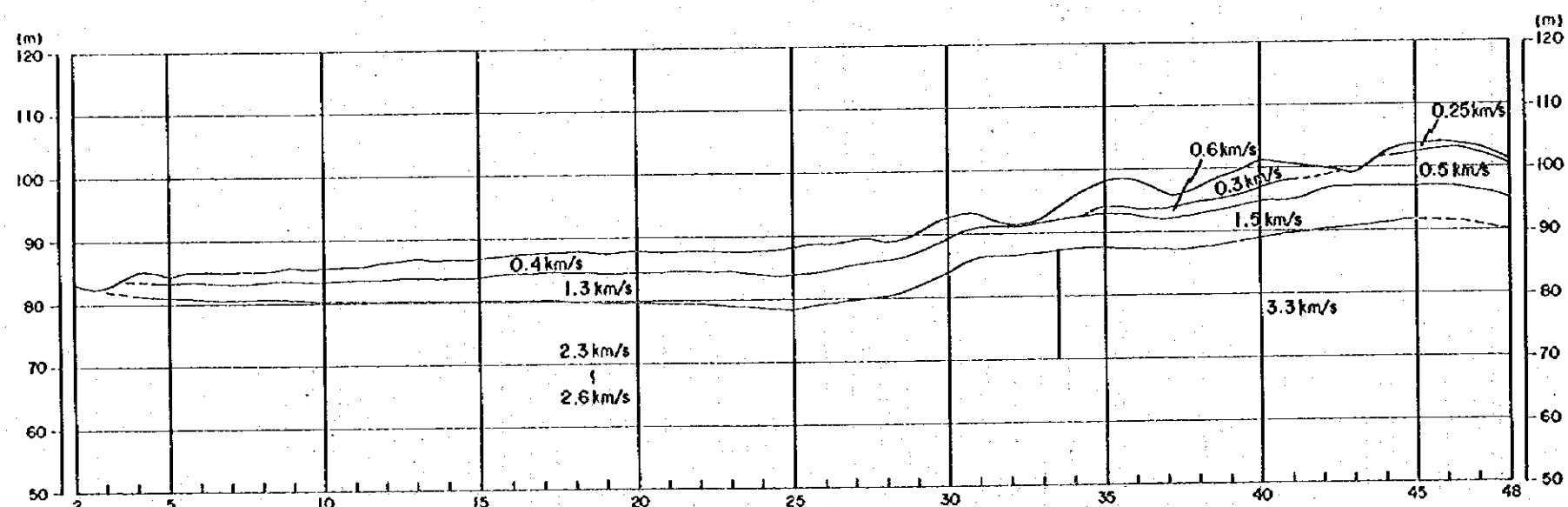


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Reanalysis of Seismic Prospecting Interpreted Pprofile Penstock Route No.2	
Fig.A-7-4	Date :

PC 1



PC 2



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Reanalysis of Seismic Prospecting Interpreted Profile PC-1 and PC-2	
Fig A-75	Date :

A-8 Laboratory Analysis of Rock Samples

Tab.A-8-1 List of Laboratory Analysis of Rock Samples

Tab.A-8-2 Result of Microscopic Observation Sample LLL01
(handspecimen at damsite)

Tab.A-8-3 Result of Microscopic Observation Sample LLL02
(drillcore PHLL3SP 25.3m)

Tab.A-8-4 Result of Microscopic Observation Sample LLL03
(handspecimen at power station site)

Tab.A-8-5 Result of X-ray Analysis of Rock Samples

Tab.A-8-6 Result of Chemical Analysis of Rock Samples

Photo A-8-1 Photograph of Thin Section under Microscope
Sample LLL01 (handspecimen at damsite)

Photo A-8-2 Photograph of Thin Section under Microscope
Sample LLL02 (drillcore PHLL3SP 25.3m)

Photo A-8-3 Photograph of Thin Section under Microscope
Sample LLL03 (handspecimen at power station site)

A-8 Laboratory Analysis of Rock Samples

Tab.A-8-1 List of Laboratory Analysis of Rock Samples

Tab.A-8-2 Result of Microscopic Observation Sample LLL01
(handspecimen at dam site)

Tab.A-8-3 Result of Microscopic Observation Sample LLL02
(drillcore PHLL3SP 25.3m)

Tab.A-8-4 Result of Microscopic Observation Sample LLL03
(handspecimen at power station site)

Tab.A-8-5 Result of X-ray Analysis of Rock Samples

Tab.A-8-6 Result of Chemical Analysis of Rock Samples

Photo A-8-1 Photograph of Thin Section under Microscope
Sample LLL01 (handspecimen at dam site)

Photo A-8-2 Photograph of Thin Section under Microscope
Sample LLL02 (drillcore PHLL3SP 25.3m)

Photo A-8-3 Photograph of Thin Section under Microscope
Sample LLL03 (handspecimen at power station site)

Tab. A-8-1 List of Laboratory Analysis of Rock Samples

Sample No.	Analysis Method	Locality	Rock Name
LLL01	Microscopic Observation	Lower Stream Damsite	Conglomerate
LLL02	Microscopic Observation	PHLL3SP 25.3m	Conglomerate
LLL03	Microscopic Observation	Creek between P/S Site No.1 and No.2	Coarse Sandstone
LLL04	X-ray Analysis	Creek between P/S Site No.1 and No.2	Coarse Sandstone
LLL05	X-ray Analysis	PHLL13CM 45.2m	Marl
LLL06	Chemical Analysis	PHLL13CM 48.25m	Marl

Tab. A-8-2 Microscopic Observation

Sample No. : LLL01

Locality : Lower Stream Damsite Right Bank

Rock Name : Sandstone

Texture : Clastic Texture

Rock Forming Minerals;

Plagioclase: 12%. Size 0.15-0.03mm. Xenomorphic. Clastic grain shaped. Replaced to albite.

Clinopyroxene: 3%. Size 0.8-0.02mm. Xenomorphic. Clastic grain shaped. Sparsely scattered.

Basalt: 25%. Size under .4.1mm. Rounded gravel. Plugged and variolitic shaped.

Tuffaceous mudstone : 8% Size under .2.8mm. Rounded gravel. Muddy or silty .

Altered Minerals;

Plagioclase : 14% Size under .0.5mm. Xenomorphic. Clastic grain or columnar shaped. Replaced to albite.

Chlorite : 8%. Size under .0.1mm. Xenomorphic. Fiber shaped. Light green.

Smectite : 3%. under .0.05mm. Xenomorphic. Fiber shaped. Light greenish brown.

Carbonate minerals : 12%. Size under .0.2mm. Xenomorphic. Irregular grain shaped. Replaced shaped.

Description ;

With lithic fragments of dolerite(under 1%, size under 3.3mm) and vitric fragment (under 1%, size under 1.35mm) , smectite and albitized clay of matrix(15%). Volcanic(basaltic) sandstone with clastic texture, be altered of albite, sericite, chlorite and carbonate minerals.

Tab. A-8-3 Microscopic Observation

Sample No. : LLL02
Locality : PHLL3SP 25.3m
Rock Name : Conglomerate
Texture : Clastic Texture

Rock Forming Minerals;

Clinopyroxene : 1%. Size 0.6-0.03mm. Xenomorphic. Clastic granular.
Pale green colored.

Basalt: 45%. Size under .1.15mm. Rounded gravel. Vitric and interstitial.

Dolerite: 19%. Size under .1.25mm. Rounded gravel. Sub-ophitic texture.

Tuffaceous mudstone : 8% Size under .0.8mm. Rounded gravel. Basaltic .

Altered Minerals;

Plagioclase : 1% Size under .1.15mm. Hypidiomorphic and grain shaped.
Replaced to albite.

Chlorite : 3%. Size under .0.15mm. Xenomorphic. Fiber shaped. Light green colored.

Zeolite : 4%. under .0.45mm. Idiomorphic or xenomorphic. Granular. Cleavage are clear and elongated positive or negative.

Carbonate minerals : 8%. Size under .1.9mm. Vein shaped and paragenetic with zeolite.

Description ;

With micro sized lithic fragments of siliceous mudstone(1%, size under 3.6mm) and matrix clay replaced by carbonate minerals or zeolit.

Volcanic conglomerate with clastic texture , were altered of albite, chlorite, zeolite and carbonate.

Tab. A-8-4 Microscopic Observation

Sample No. : LLL03

Locality : Small creek between Power Station Site No.1 and No.2

Rock Name : Sandstone

Texture : Hyaloclastic Texture

Rock Forming Minerals;

**Plagioclase : 3% Size 0.22 - 0.02mm. Idiomorphic. Columnar and needles.
Partially replaced to albite.**

**Clinopyroxene : 12% Size 1.4-0.01mm. Xenomorphic. Clastic
granular or columnar. Altered to smectite.**

**Orthopyroxene : under 1%. Size under 0.3mm. Xenomorphic. Clastic
granular. Replaced to smectite.**

Altered Minerals;

**Smectite : 65% Size under 0.05mm. Xenomorphic. Fiber or bundle shaped.
Replaced matrix and pyroxene. Olive or greenish brown colored.**

Description ;

**With brecciated lithic fragments (14%, size under 8.5mm) of vitric basalt,
amygdaloidal basalt and scoria. Almost of volcanic glass of groundmass (6%) were
replaced to smectite with interstitial glass.**

Volcanic sandstone with hyaloclastic texture and generally altered to smectite.

Tab. A-8-5 Result of X-ray Analysis of Rock Samples

Sample No.	Species of Analysis	Zeolite					Clay Minerals							Suif. Min.			Carbon. M				Silicate Min	Feldsp			Others					
		Clinoptilolite	Stilbite	Mordenite	Heulandite	Laumontite	Wairakite	Analcime	Smectite	Chlorite/Smectite	Chlorite	Sericite/Smectite	Smectite	Halloysite	Kaolin	Pyrophyllite	Alunite	Anhydrite	Gypsum	Calcite	Dolomite	Rhodochrosite	α-cristobalite	Tridymite	Quartz	Plagioclase	K-feldspar	Pyrite	Magnetite	Pyroxene
LLL04	Q.I.						1	<1	<1	<1										2					4	1				
	No Treat.							R	T	T	T									T										
	EG								M	T	T	U																		
LLL05	HCl							T			T																			
	Q.I.						9	3																						
	No Treat.							T	R	T																				
EG									T	R	T																			
	HCl																													

Q.I.:Quartz Index of whole rock samples Q.I.= $\text{Im} \times 100/\text{Iq}$ R:Rich

M:Medium

L:Little

T:Trace

U:Unidentified

Im:Highest X-ray diffraction peak of a mineral(cps)

Iq:Highest X-ray diffraction peak of genuine quartz(cps)

No Treat:No treatment with direction identified

EG:Ethylene glycol treatment with direction identified

HCl:Hydrochloric acid treatment with direction identified

Tab. A-8-6 Result of Chemical Analysis of Rock Samples

Sample No. : LLL06

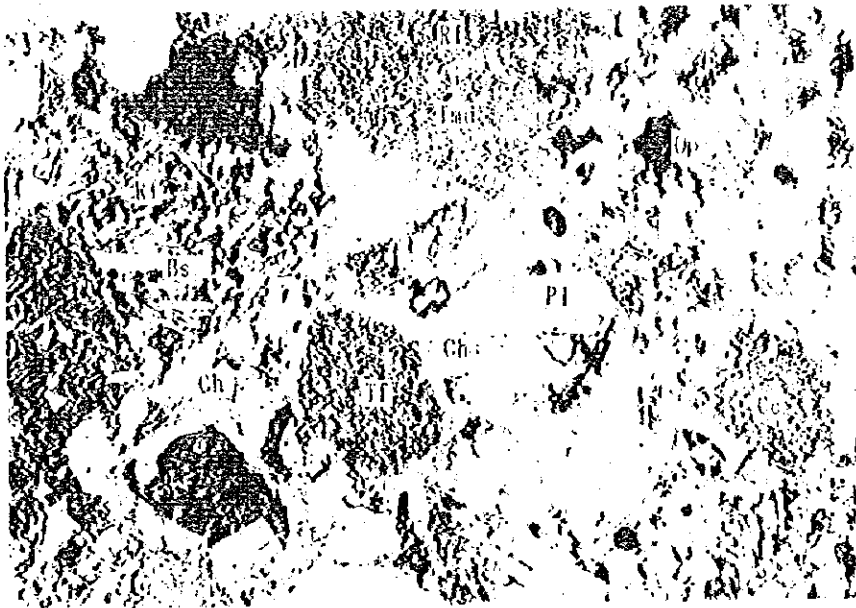
Component	%
SiO ₂	50.42
TiO ₂	0.93
Al ₂ O ₃	14.06
Fe ₂ O ₃	4.96
Feo	3.91
MnO	0.07
NgO	3.52
CaO	7.14
Na ₂ O	1.59
K ₂ O	1.04
P ₂ O ₅	0.13
H ₂ O+	4.82
H ₂ O-	4.21
Total	96.80

Sample No. : LLL01

Locality : Lower Stream Damsite

Rock Name : Conglomerate

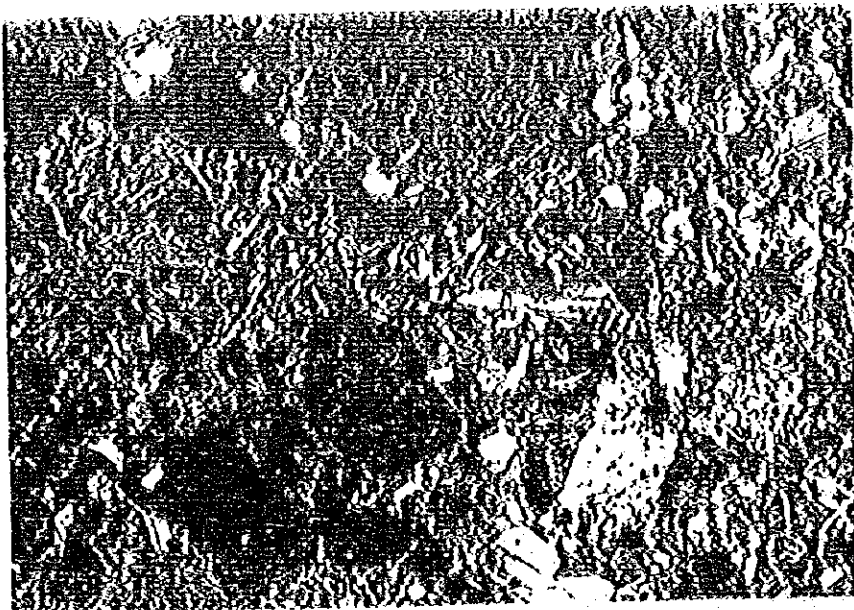
Texture : Clastic Texture



Open Nicol

File No. 44-41 18

Scale 0.5mm



Cross Nicol

File No. 44-41 19

Scale 0.5mm



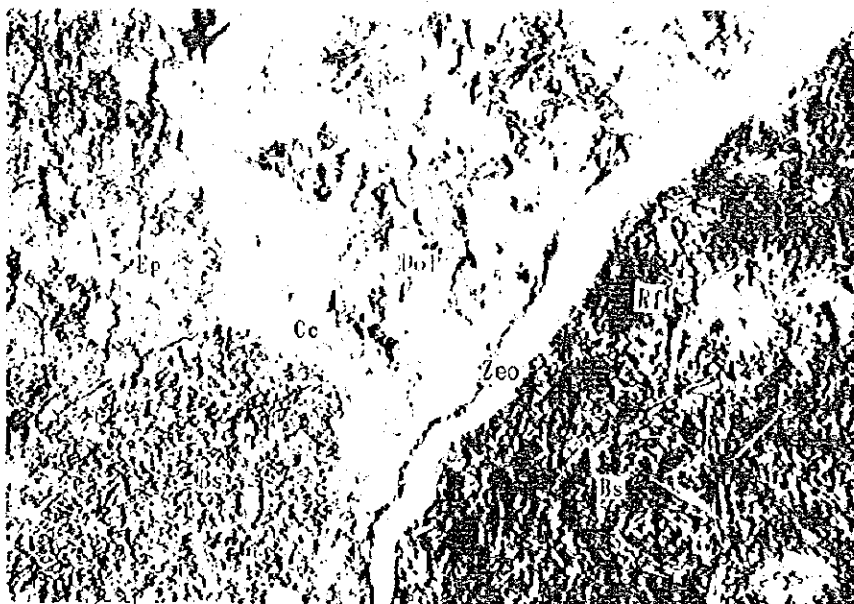
Photo A-8-1 Photograph of Thin Section under Microscope
(Sample LLL01)

Sample No. : LLL02

Locality : PHLL3SP 25.3m

Rock Name : Conglomerate

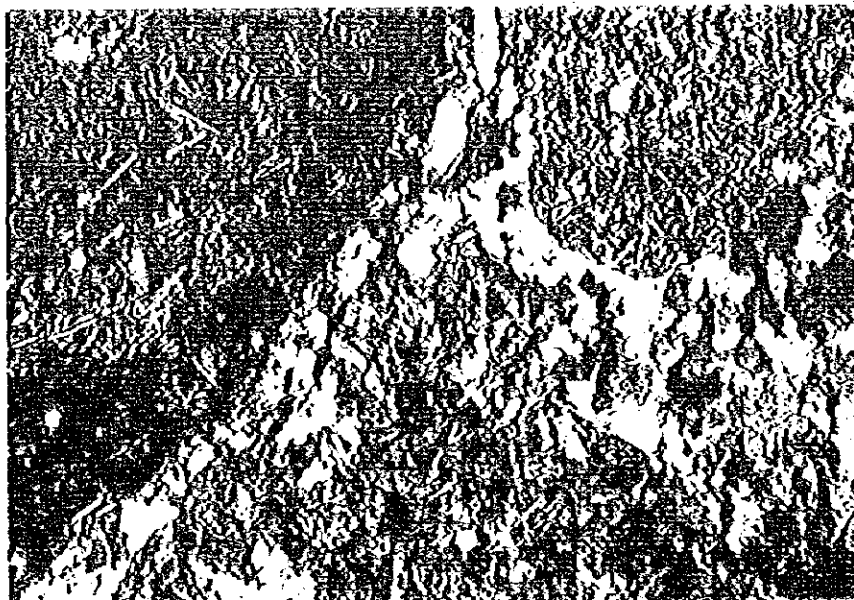
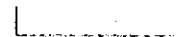
Texture : Clastic Texture



Open Nicol

File No. 44-41 20

Scale 0.5mm



Cross Nicol

File No. 44-41 21

Scale 0.5mm



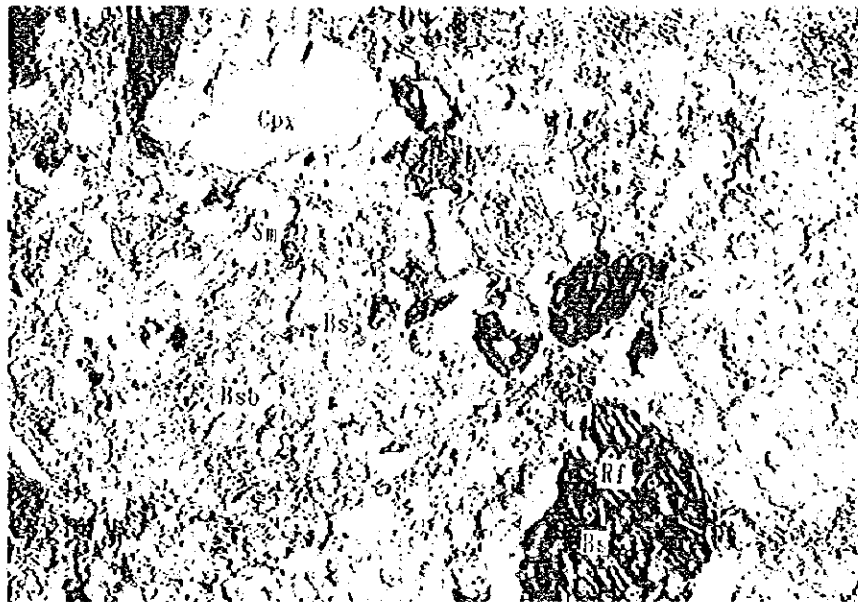
Photo A-8-2 Photograph of Thin Section under Microscope
(Sample LLL02)

Sample No. : LLL03

Locality : Creek between P/S Site No.1 and No.2

Rock Name : Coarse Sandstone

Texture : Clastic Texture



Open Nicol

Film No. 09-98 1

Scale 0.5mm



Cross Nicol

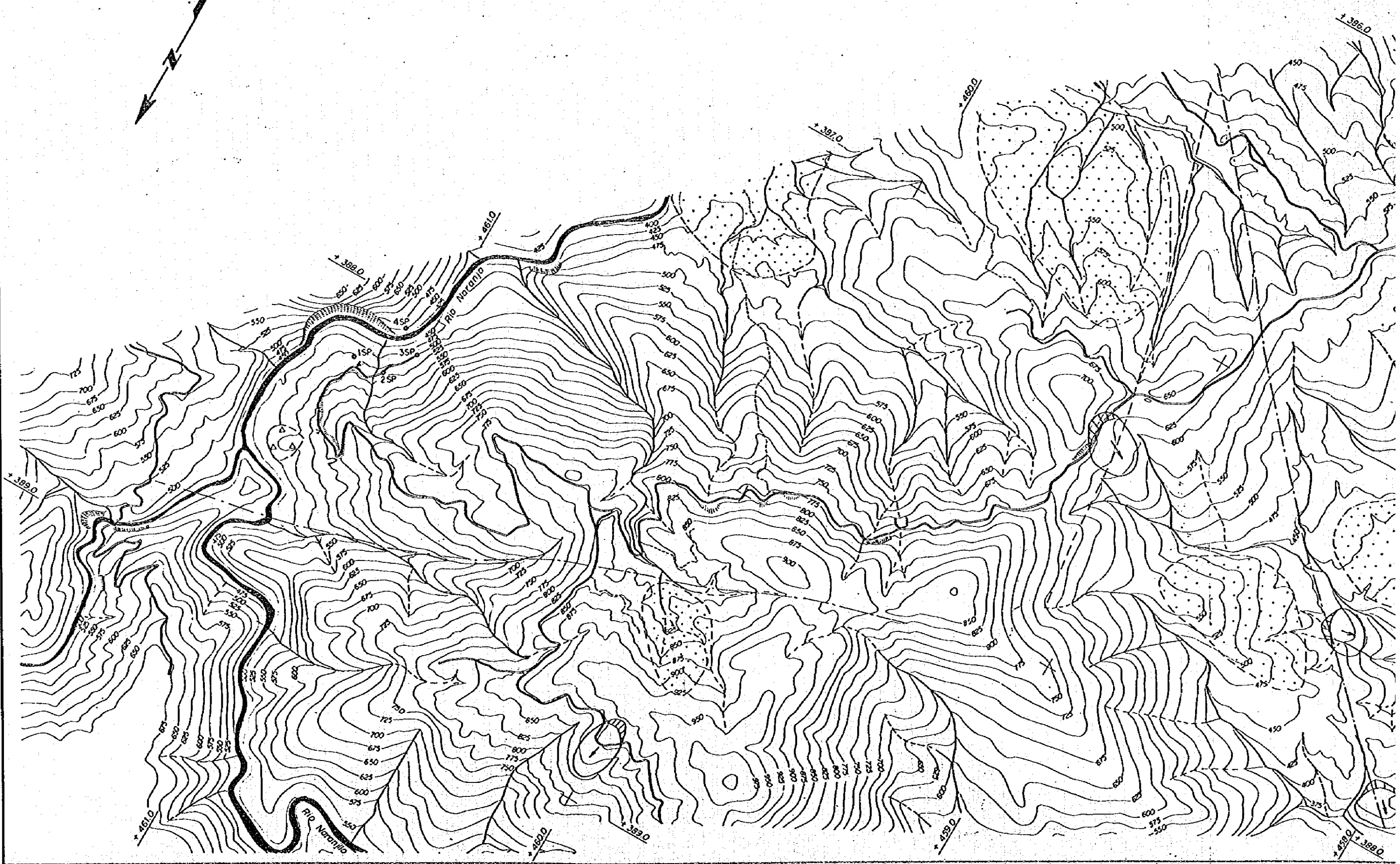
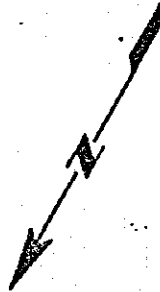
Film No. 09-98 2

Scale 0.5mm

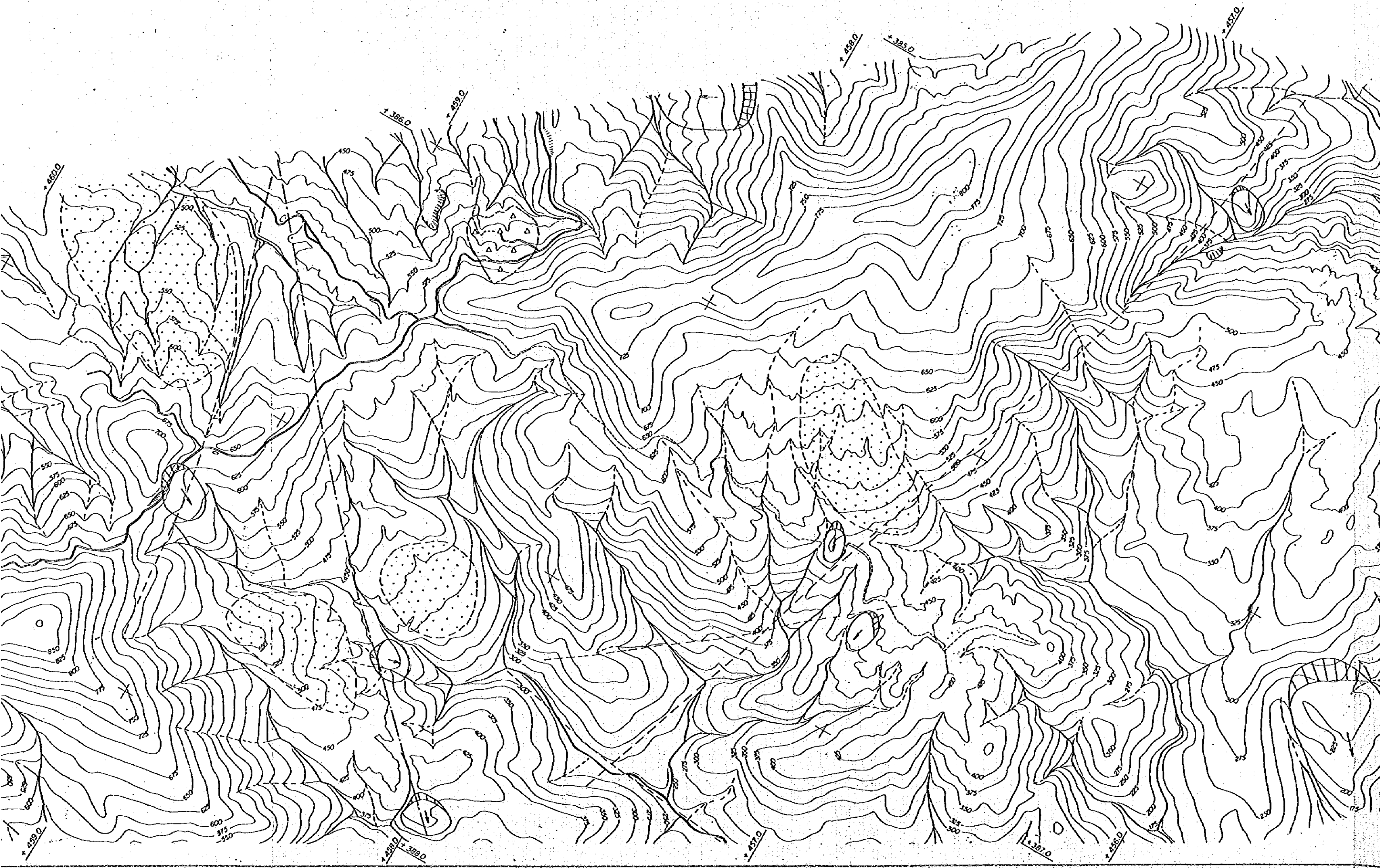
Photo A-8-3 Photograph of Thin Section under Microscope
(Sample LLL03)

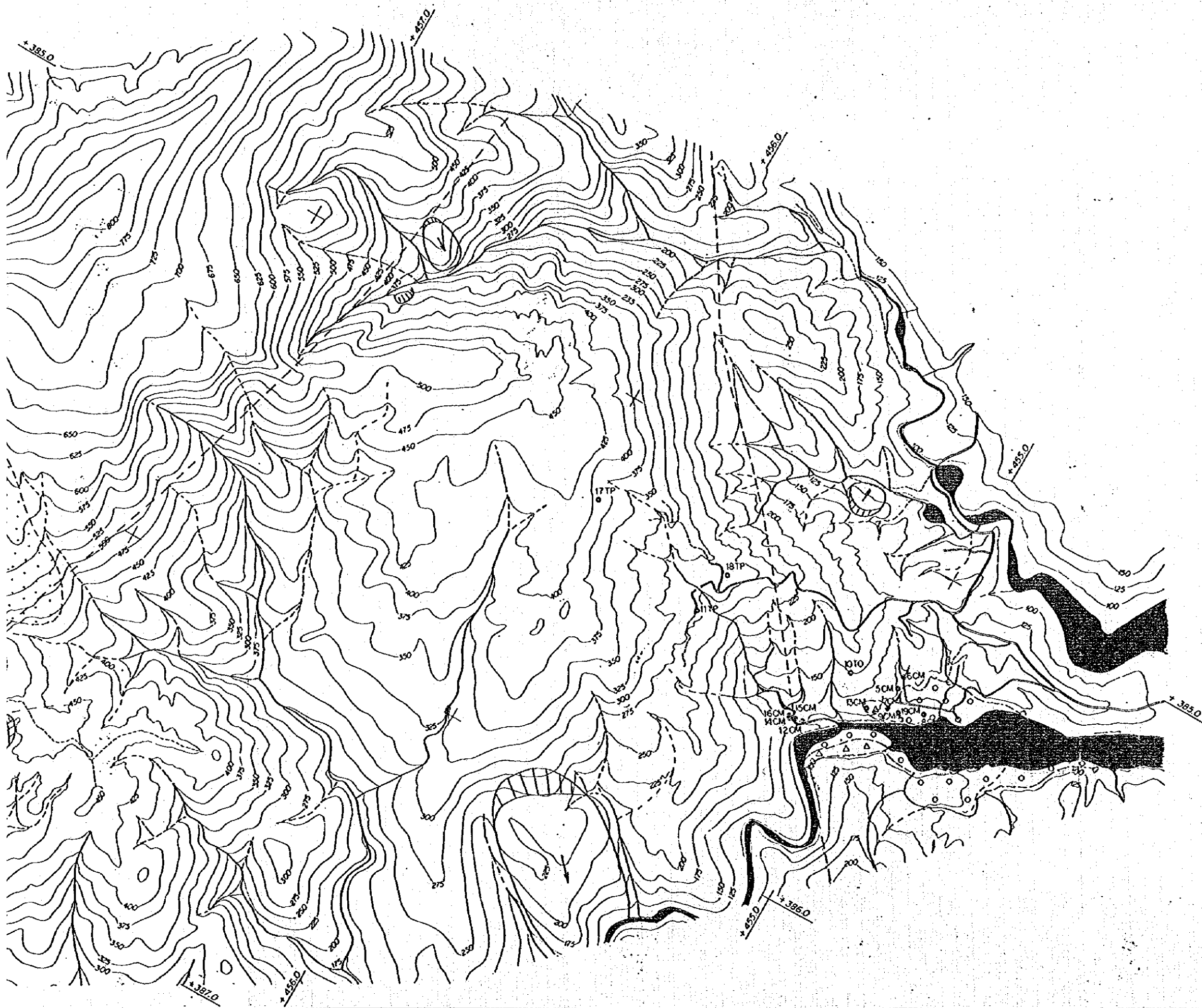
A-9 Aero-photo Ineterpretation

Fig.A-9-1 Aero-photo Ineterpretation of the Project Area



A-9-1





LEGEND

- (Landslide)
- Landslide with clear head scarp
 - Sinking zone
 - Sliding direction
 - Landslide with obscure head scarp
 - Assumed landslide
- (Slope failure)
- Slope failure
 - Slope failure scarp
- (Depositional land form)
- Terrace
 - Fan
 - Talus
 - River-bed
- (Valley)
- Remarkable gully
 - Surface water flow (assumed)
 - outcrop thin deposit
 - No water flow range (assumed)
- (Lineament)
- Lineament assumed to be fault
 - Lineament possible to be fault
 - Other small lineament



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Aero-photo Interpretation	
of the Project Area	
Fig.A-9-1	Date: