ORKUSTOFNUN
Raforkudeild

HRAUNEYJAFOSS 1974

Additional drilling and geological work

by

Snorri Zóphóníasson

Prepared for
LANDSVIRKJUN
THE NATIONAL POWER COMPANY
Mai 1975

OS-ROD 7515

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TABLE OF CONTENTS

LIST OF EXHIBITS

ADDITIONAL DRILLING AND GEOTECHNICAL WORK

In the summer of 1974 some additional boreholes were drilled in the Hrauneyjafoss area in connection with the hydroelectric project. Altogether 12 new core boreholes were completed of which HP-63-64-65-66-67-68 are located on the proposed diversion canal route. At the power house site three core boreholes, HP-69-70-72, and a percussion drillhole, HP-71, were added to the previous pattern, and three core boreholes were also drilled on the tailrace canal route. The percussion drillhole was also encircled with several piezometric holes for observing the drawdown of the groundwater table during pumping. One of the previous holes, HP-57, was deepened by 10 m down to 310 m elevation. All the core boreholes were permeability tested in 3 m sections.

The graphic core logs of the new boreholes are exhibited on Figs 2, 3, 4 where the results of the permeability tests, core recovery, groundwater table and core description are presented. A more detailed description of the core is to be found in the field logs. Photographs of the cores are No. H-11 to H-38 in our drillhole register.

An account of the general and site geology of the area, based on extensive drilling during the summer of 1970 and a few earlier holes along with other field work, can be found in HRAUNEYJAFOSS HYDROELECTRIC PROJECT, Project Planning Report, Volume II, prepared by HARZINT and THORODDSEN AND PARTNERS, April 1971. In Volume I of the same report, chapter III consists of a short account called Project Engineering Geology.

During the summer of 1971 12 boreholes were drilled and further geotechnical work carried out. These are accounted for in a report dated February 1973 : Jónsson, Birgir : HRAUNEYJAFOSS 1971. Drilling and other geotechnical work.

The drilling in 1974 had the main purpose of obtaining still more detailed stratigraphical information to be added to the geological sections of the canal routes and power house site. Most of the new holes were projected into the already prepared sections, which all accompany these notes in revised form under the same heading as before.

The diversion canal extends from Tungnaá through a depression in the Fossalda ridge to the intake structures. From there the penstocks lead to the power house located at the foot of the ridge on its north side. The Fossalda ridge is made of pillow lava covered with glacial deposits ; which are divided into moraine and tillite on grounds of better core recovery in the tillite which constitutes the lower part.

Although the groundmass of the moraine and tillite should be quite watertight, the permeability tests often show great leakage which must be through cracks and perhaps pebbly layers that can be seen in the core. This is especially notable for the tillite as can be seen in many of the core logs.

The revision of the geological sections only brought about minor changes.

Diversion canal :

One new section has been drawn, S-S, based on two previous boreholes, HP-21 and HP-22, and four new ones, HP-63-66-67 and 68. Boreholes HP-64 and HP-65 can be directly projected into section L-L. HP-64 did not alter the section but HP-65 showed lesser depth to pillow lava Hr_1 than previously drawn.

Power house :

HP-69 and HP-72 are directly projectable into section J-J. They revealed the same depth to pillow lava Hr_2 as already drawn. According to section J-J these drill-holes were ewpected to penetrate a snout of pillow lava Hr_1. At 330-340 m a.s.l. the cores from both boreholes contained lots of gravel and fragments of pillow lava, which probably are part of a badly cemented talus lense derived from the pillow lava Hr_1. This lense could in places have similar properties to brecciated pillow lava, mixed and infiltrated with silt and sand. See core logs of holes HP-69-70-72 in Figs 3 and 4 for more information on this formation especially the core recovery which indicates how cemented it is.

HP-70 was drilled at the intersection B-B and I-I and confirmed what had already been drawn.

The deepest of the previously drilled holes at the power house site reached down to 320 m elevation ending in pillow lava Hr_2. In 1974 the depth of HP-57 was increased by 10 m or down to 310 m elevation and HP-72 also reaches that level. They did not go through the pillow lava Hr_2 so its lower level is therefore still unknown.

Boreholes HP-73, HP-74 and HP-75 extended down to the proposed bottom elevation of tailrace canal. A section connecting them was joined to I-I, i.e. I-I-T. The boreholes show a layer of soil on top, underlain by moraine and tillite at bottom.

With regard to the similarities of the geology at Hrauneyjafoss to that at Sigalda a map of the power-house excavation there is included. Almost all the geological phenomena encountered at Sigalda can be expected at Hrauneyjafoss, but here the rock is commonly better consolidated than at Sigalda and is also much less permeable.

As to the workability of rock at Sigalda all types of rock, moraine, tillite and pillow lava, are rippable to a large extent. Only occational minor sections have had to be blasted.

Of these rock types tillite is most expensive in working due to excessive wear of equipment and slower progress. The best blasting results were obtained in basaltic intrusions and very large pillows, but in the tillite the results were poor.

The lenses of gravel in the tillite and at the contact of tillite and móberg should be pointed out. Similar occurrences are likely to be found at Hrauneyjafoss.

At Sigalda the leakage is partly through a fracture upstream of the power-house excavation but a substantial part also takes place through the pillow lava. The fracture acts as a ground-water barrier creating considerable head in ground-water level there. At Hrauneyjafoss on the other hand leakage probably takes place almost solely through fractures.

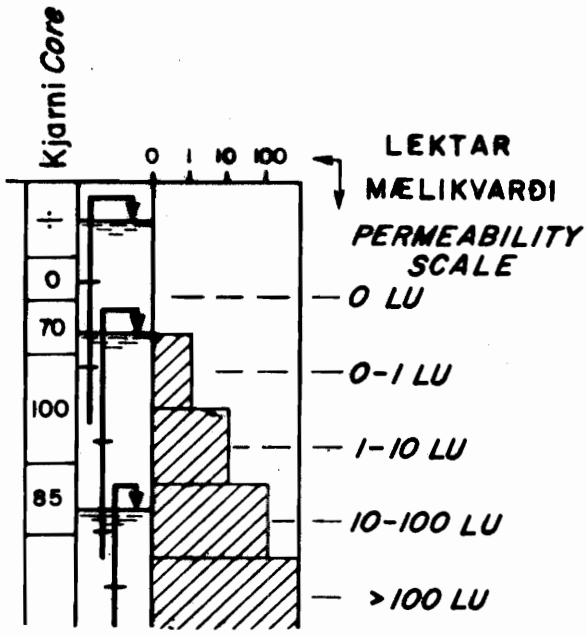
As to the slope stability of the rock it is fairly good at Sigalda as it stands almost vertical, but a continuous falling of small boulders from the walls takes place. Similar experience can be expected at Hrauneyjafoss.

Table 1

LOCATION AND DEPTH OF BOREHOLES

Hole number	Coordinates X	Coordinates Y	Top of casing elevation	Depth m	Bottom of hole el.
HP 57A	560.221.6	411.475.0	362.0	52.0	310.0
" 63	559.756.3	410.848.3	426.4	23.0	403.4
" 64	559.912.4	410.883.4	446.2	41.6	404.6
" 65	559.851.1	410.971.0	423.7	23.7	400.0
" 66	559.816	410.894.2	428.2	28.2	400.0
" 67	559.986.5	411.040.7	422.6	18.3	404.3
" 68	560.114.4	411.215.9	426.0	32.0	394.0
" 69	560.187.7	411.493.3	360.3	42.6	317.7
" 70	560.253.6	411.482.2	361.1	41.6	319.5
" 71	560.210.6	411.476.4	362.6	51.8	310.7
" 72	560.200.5	411.478.0	362.1	52.2	309.9
" 73	560.234.8	411.687.5	350.2	17.9	332.3
" 74	560.232.4	411.891.4	348.1	16.1	332.0
" 75	560.213.2	412.096.4	344.2	13.8	330.4

MYND *Exh.* O	ORKUSTOFNUN Raforkudeild KJARNA-, LEKTAR OG JARÐVATNSÚTSKÝRING *NOTE ON CORE PERMEABILITY AND GROUND WATER*	18/9'70 HT/EK Tnr. 204 B-Ým. Fnr. 9586



LEKTAR-OG JARÐVATNSÚTSKÝRING
NOTE ON PERMEABILITY AND GROUND WATER

Jarðvatnsborð er sýnt með örvum. Neðri endi örvarinnar og þverstrikin sýna holudýpið, þegar jarðvatnsborðið var mælt. Ef jarðvatn breytist ekkert í borun, nær örin í botn.
Ground water levels are shown by arrows. Base of the arrows and the horizontal bars indicate the hole depth when the water level was measured. If no change in level was observed during drilling, the arrow reaches the bottom of the hole.

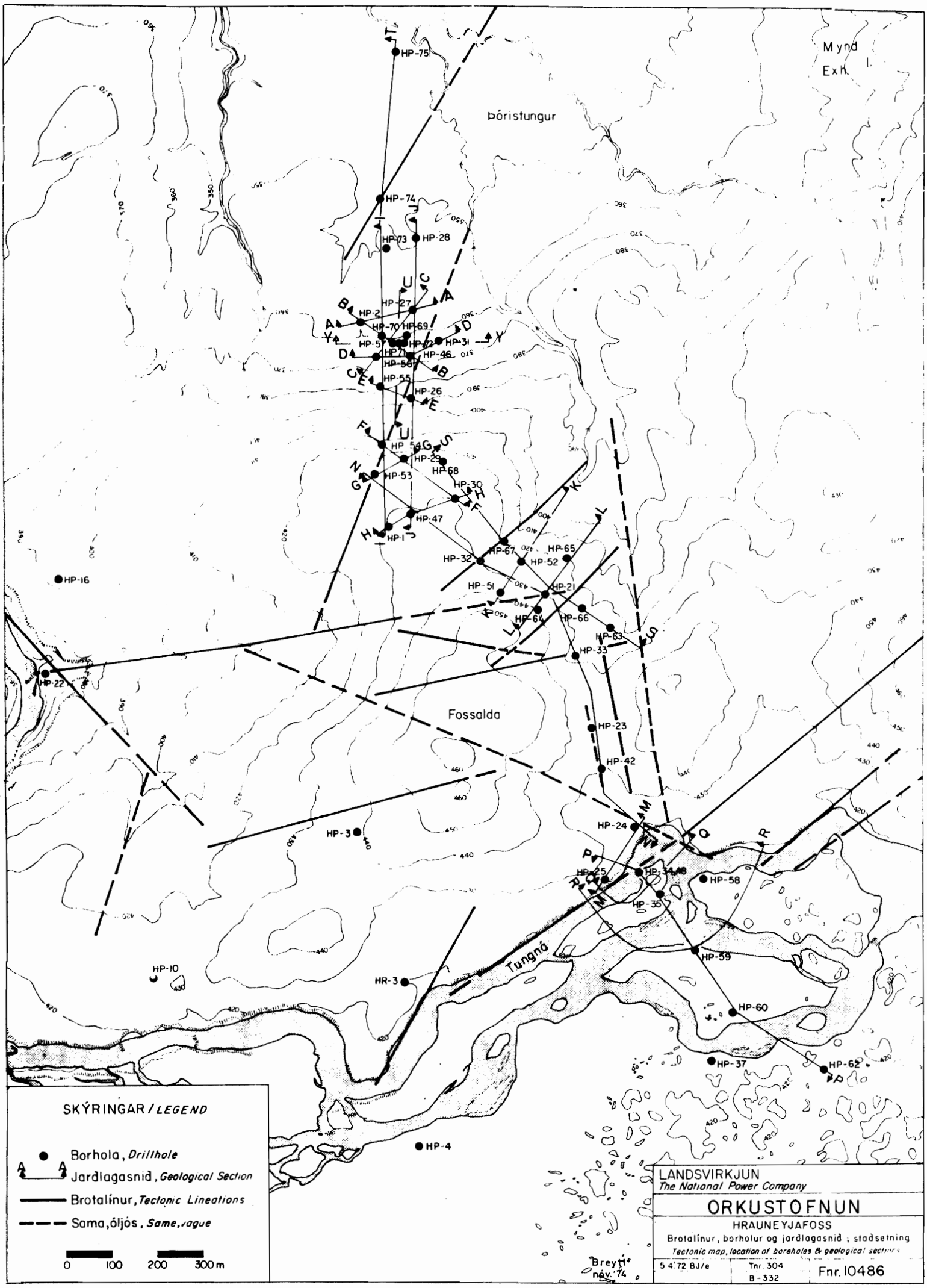
1 LU = Lugeon Unit = 1 l/mín/m í 76 mm Ø holu við þrýsting 10 kg/cm^2
1 LU = Lugeon Unit = 1 l/min/m in 76 mm Ø hole at pressure 10 kg/cm^2

Hæðartölur jarðvatns eru ritaðar smærra letri en hæðartölur bergs, á borholusniðum.

Figures for ground water levels are shown with smaller lettering on graphic core logs.

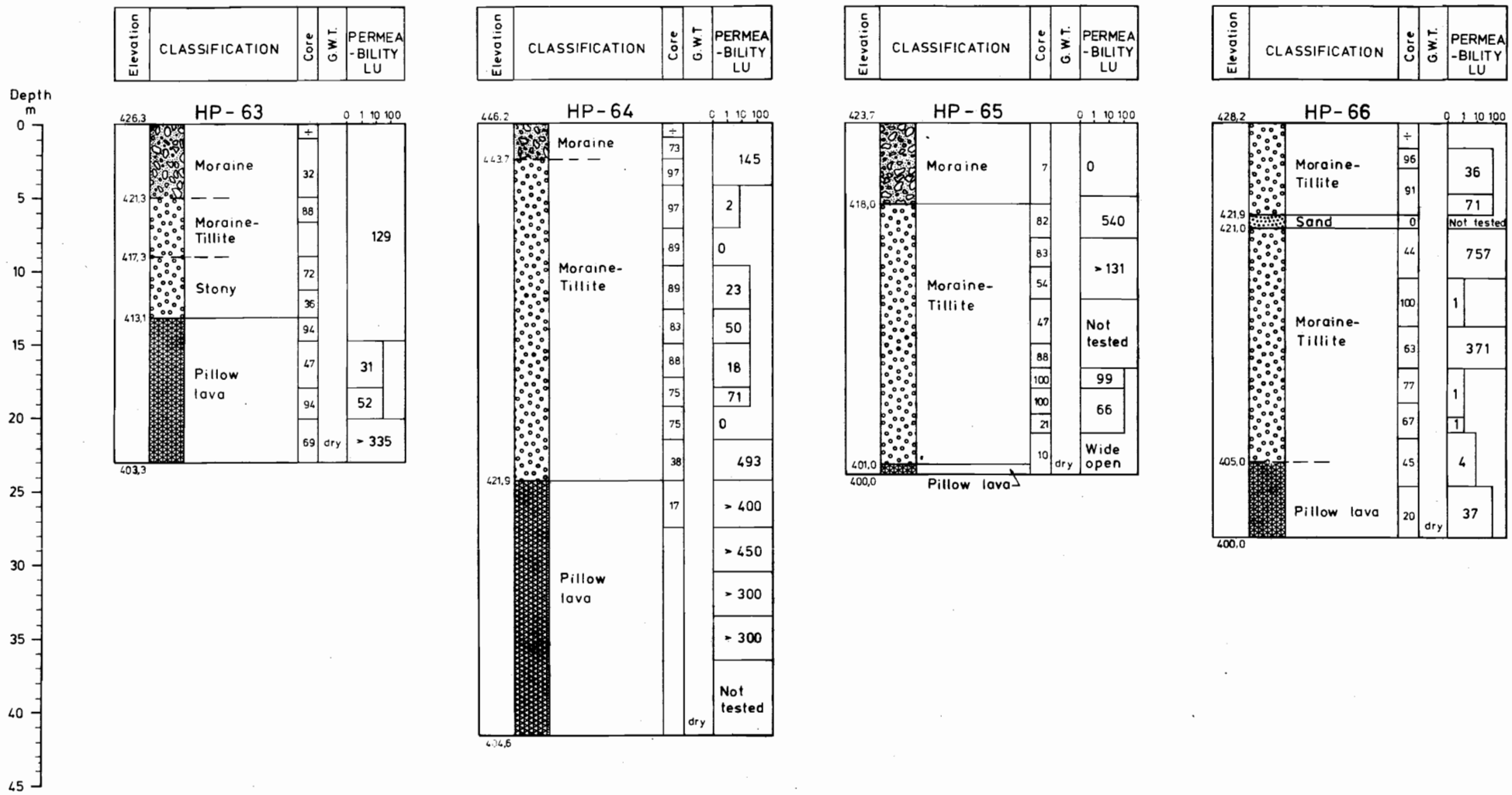
Kjarni: Tölur sýna kjarnaheimtur í %
÷ kjarnataka ekki reynd.

Core: Numbers indicate % core recovery
÷ core sampling not attempted.



VST 74.000.1.06

Exh. 2



LANDSVIRKJUN

HRAUNEYJAFOSS PROJECT
GRAPHIC CORE LOGS

Verk nr. 74.000. Teikn. nr. 1.01

Mælikv.

VERKFRÆÐISTOFA SIGURÐAR THORODDSEN SF.
REYKJAVÍK: ÁRMÚLI 4 SÍMI 81575
AKUREYRI: GLERÁRGATA 30 SÍMI 13540
ÍSAFJÖRÐUR: PÓLGATA 8 SÍMI 3706

	Dags.	Teikn.	Yfirf.
Hönnun	Sept. '74	M.H.	
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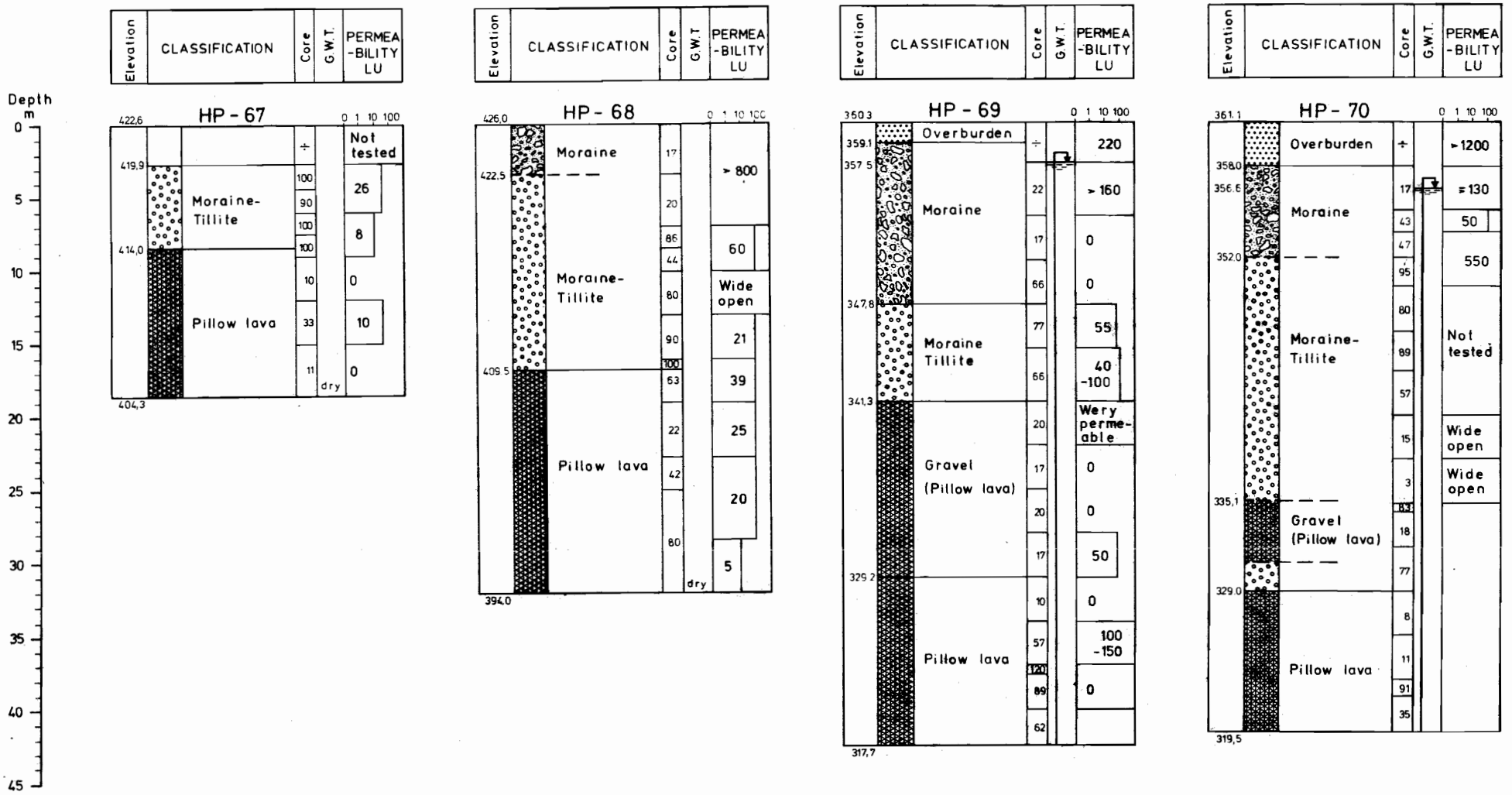
2. breyting			
3. breyting			

Samþ.:



LANDSVIRKJUN

HRAUNEYJAFOSS PROJECT
GRAPHIC CORE LOGS

Verk nr. 74.000. Teikn. nr. 1.02

Mælikv.

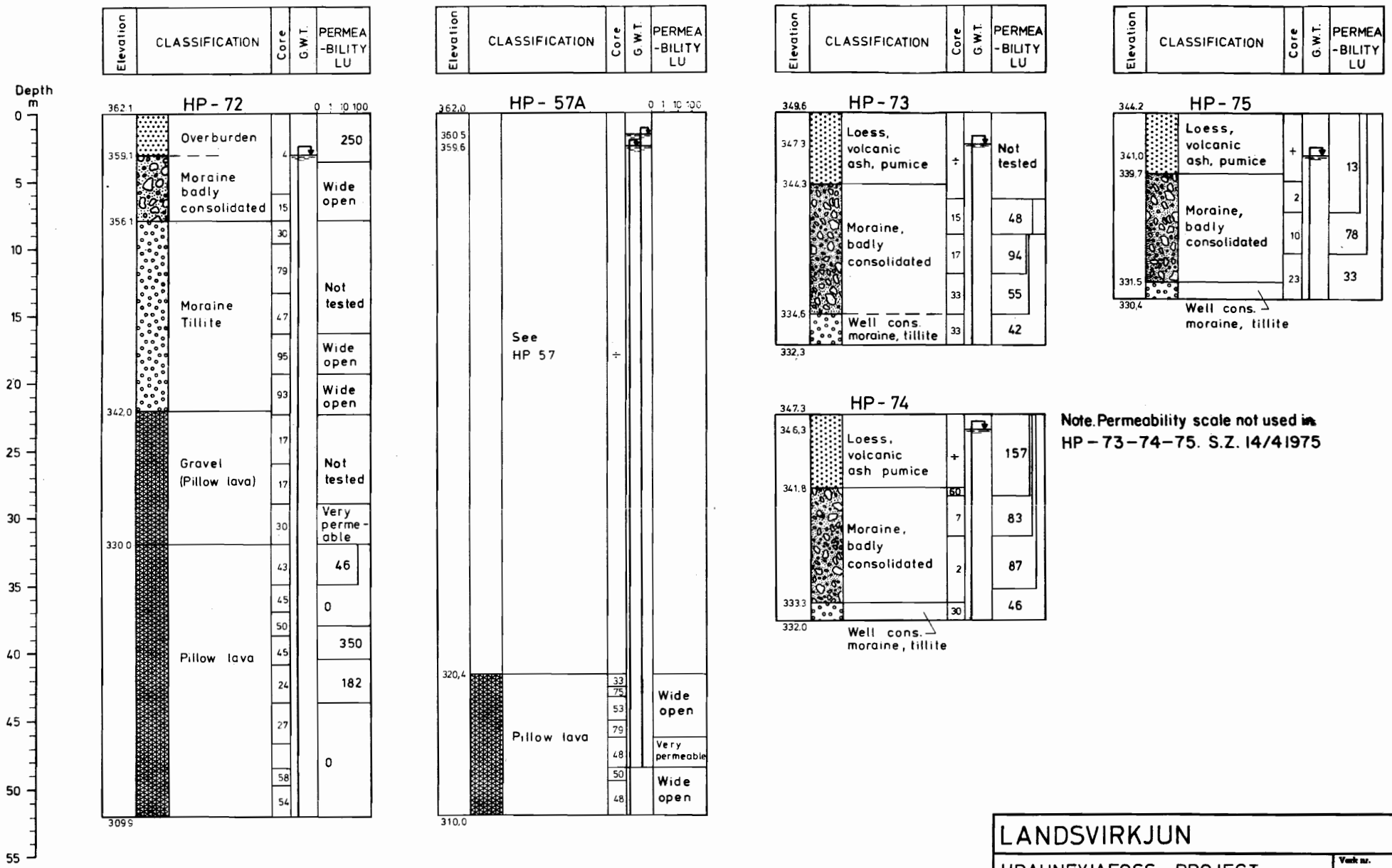
VERKFRÆÐISTOFA SIGURÐAR THORODDSEN SF.
REYKJAVÍK: ÁRMÚLI 4 SÍMI:
AKUREYRI: GLERÁRGATA 30 SÍMI:
ÍSAFJÖRÐUR: PÓLGATA 8 SÍMI:

	Dags.	Teikn.	Tekn.	Yfirf.
Áfangum	Sept. '74		M. H.	
1. breyting	Nov. '74		M. H.	
2. breyting	Marz '75		M.H.	
3. breyting				

Samþ.:

For 10100

Exh. 4



Note. Permeability scale not used in HP – 73 – 74 – 75. S.Z. 14/4 1975

LANDSVIRKJUN

HRAUNEYJAFOSS PROJECT
GRAPHIC CORE LOGS

Verk nr. 74.000. Teikn. nr. 1.03
Mælikv.

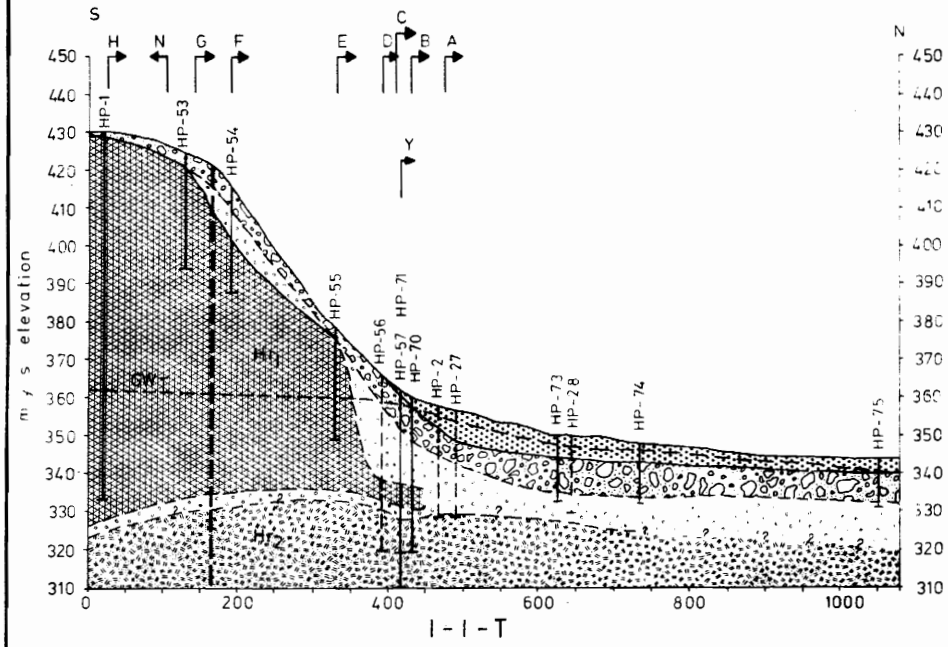
VERKFRÆÐISTOFA SIGURÐAR THORODDSEN SF.
REYKJAVÍK: ÁRMÚLI 4 SÍMI: 81575
AKUREYRI: GLERÁRGATA 30 SÍMI: 22543
ÍSAFJÖRÐUR: PÓLGATA 6 SÍMI: 3788

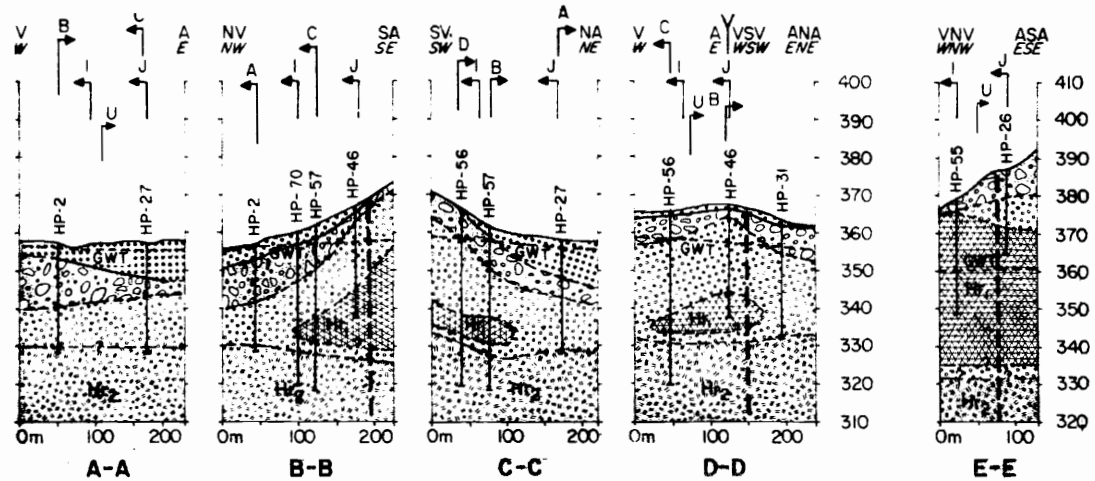
	Dags.	Reikn.	Teikn.	Yfirl.
Hönnun	Sept. '74		M.H.	
1. breyting	Nov. '74		M.H.	
2. breyting	Marz '75		M.H.	
3. breyting				

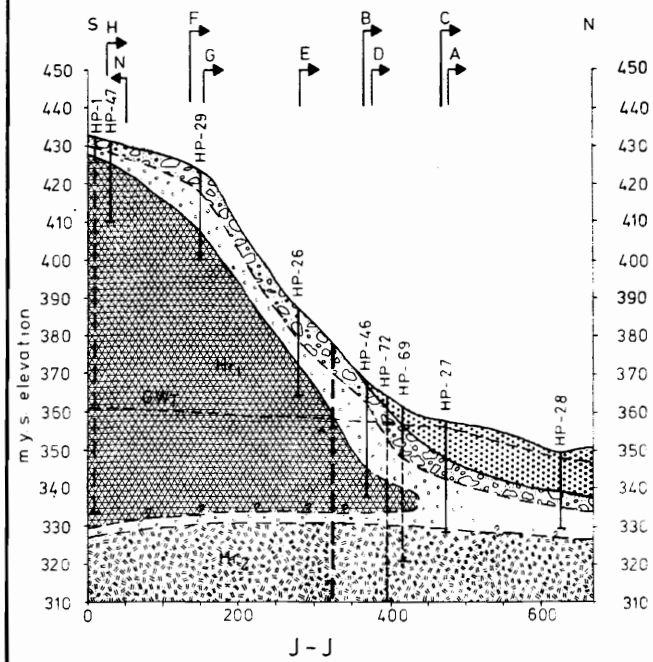
Samþ.:

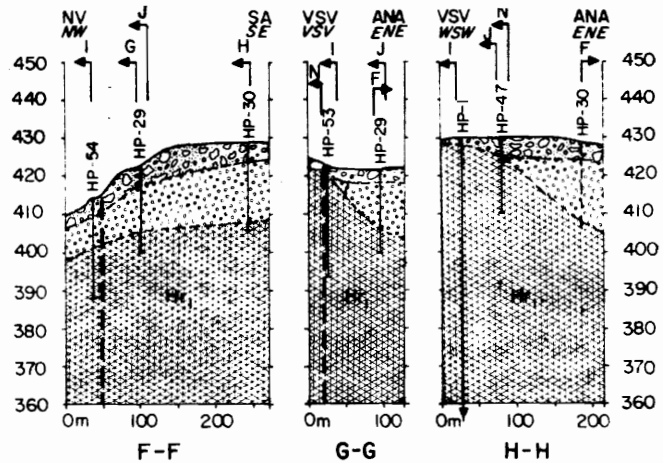
Fgr. 10100

Exh. 5









Revision of ORKUSTOFNUN drwg.
No. Fnr. 10488

LANDSVIRKJUN		
HRAUNEYJAFOSS PROJECT GEOLOGICAL SECTIONS	Verk nr. 74.000	Teikn. nr. 1.07
	Mælikv.	

VERKFRÆÐISTOFA SIGURÐAR THORODDSEN SF.
KJA I ÁRMÚLI 4 SÍMI 81578
A...ÆLYR GLERÁRGATA 36 SÍMI 12543
ÍSAFJÖRÐUR: PÓLGATA 6 SÍMI 4708

	Dags.	Reikn.	Teikn.	Yfirl.
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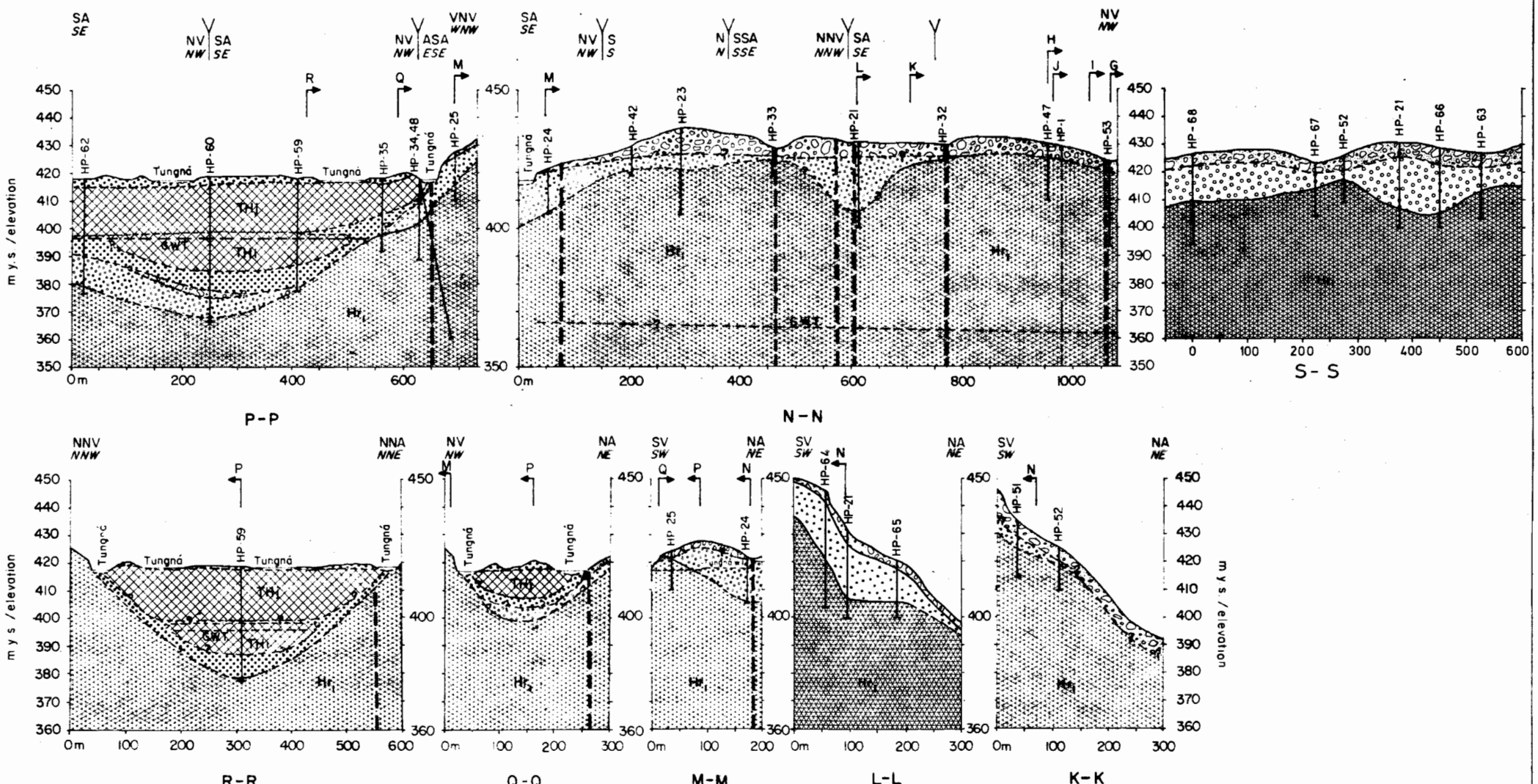
2. breyting				
3. breyting				
Samþ.:				

Mynd
Exh. 6



SKÝRINGAR
LEGEND

- Laust yfirborð og millilög, sand- og gjallkennd / *Overburden and interbeds, sandy and scoriaceous*
- TH Tungnárhraun, stórdílótt basalt / *Tungná lavas, porphyritic basalt*
- Mo/Ti Mórena og jökulberg undir / *Moraine and tillite beneath*
- GWT Jarðvatnsborð / *Ground Water Table*
- Hr_1 / Hr_2 Hrauneyjafossmóberg / *Hrauneyjafoss Móberg Formations*
- Brotalínur / *Tectonic Lineations*
- Borhola / *Drillhole*
- Borhola utan jarðlagasniðs / *Drillhole projected into section*
- Snið breytir stefnu / *Section turns*
- Óviss jarðlagaskil / *Uncertain rock contacts*
- A Snið skerast / *Sections intersect*

Breytt nóv. '74

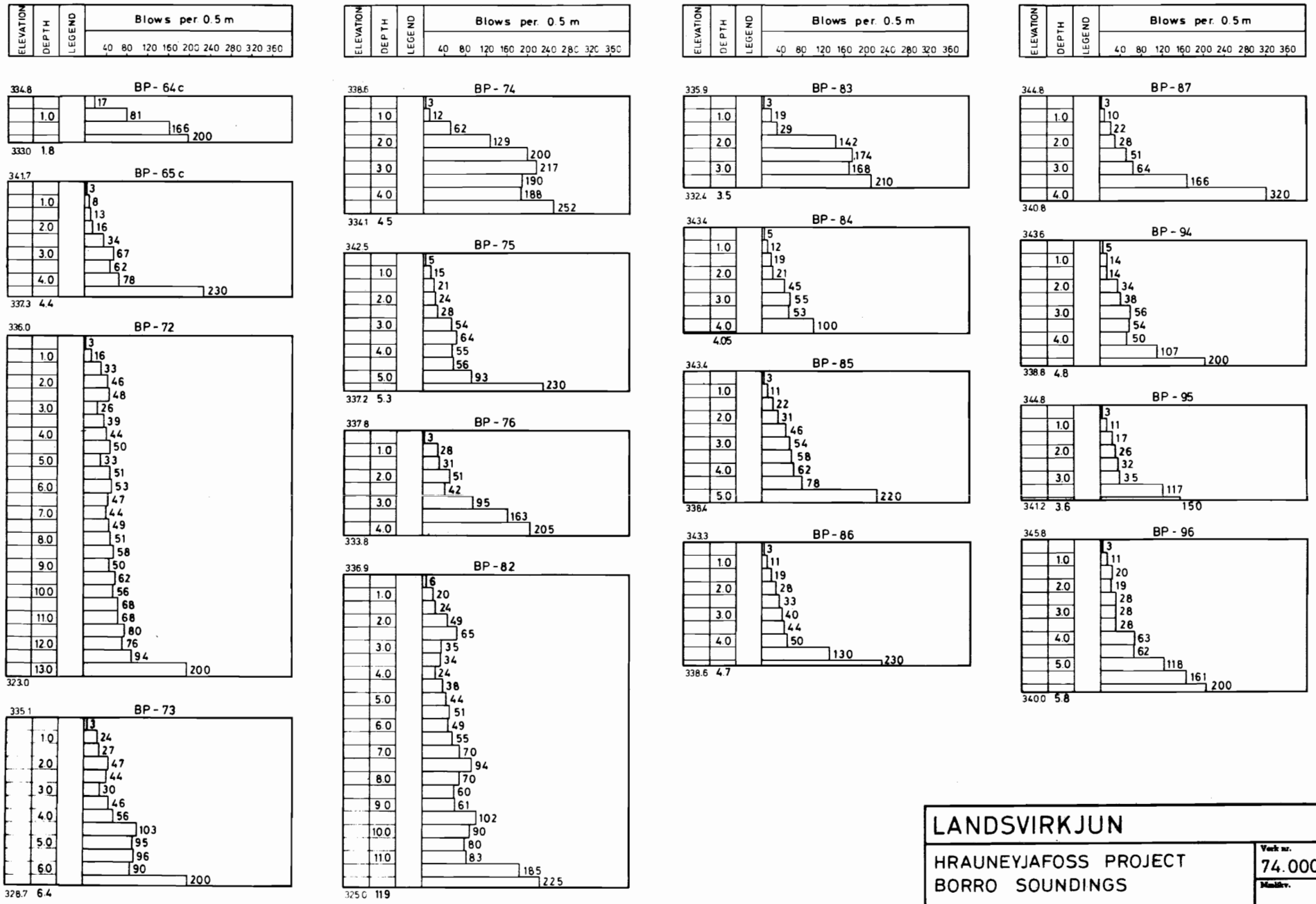
VST 74.000. 1.08

LANDSVIRKJUN
The National Power Company

ORKUSTOFNUN

HRAUNEYJAFOSS
Jarðlagasnið K-K til R-R
Geological Sections K-K to R-R

17 4. BJ/e	Tnr. 305	Fnr. 10487
Blad 1 af 2	B-332	



LANDSVIRKJUN

HRAUNEYJAFOSS PROJECT
BORRO SOUNDINGS

Verk nr. 74.000. Teikn. nr. 1.04

Mælikv.

VERKFRÆÐISTOFA SIGURÐAR THORODDSEN SF.

REYKJAVÍK: ÁRMÚLI 4 SÍMI: 81575
AKUREYRI: GLERÁRGATA 36 SÍMI: 18840
ÍSAFJÖRÐUR: PÓLGATA 4 SÍMI: 3706

	Dags.	Teikn.	Yfirf.
Hönnun	Nóv. 74	M.H.	
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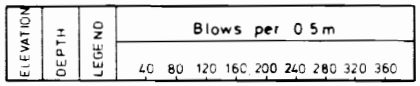
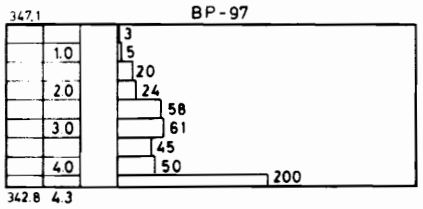
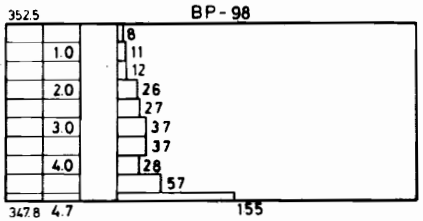
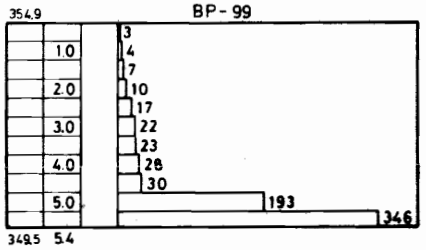
2. breyting			
3. breyting			

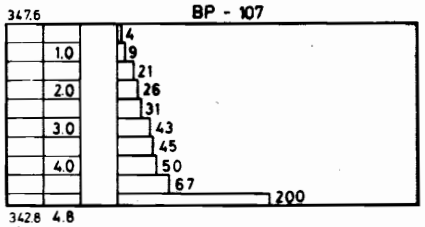
Samþ.

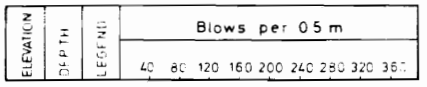


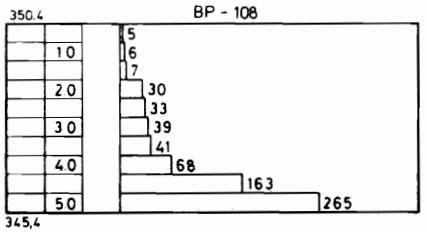


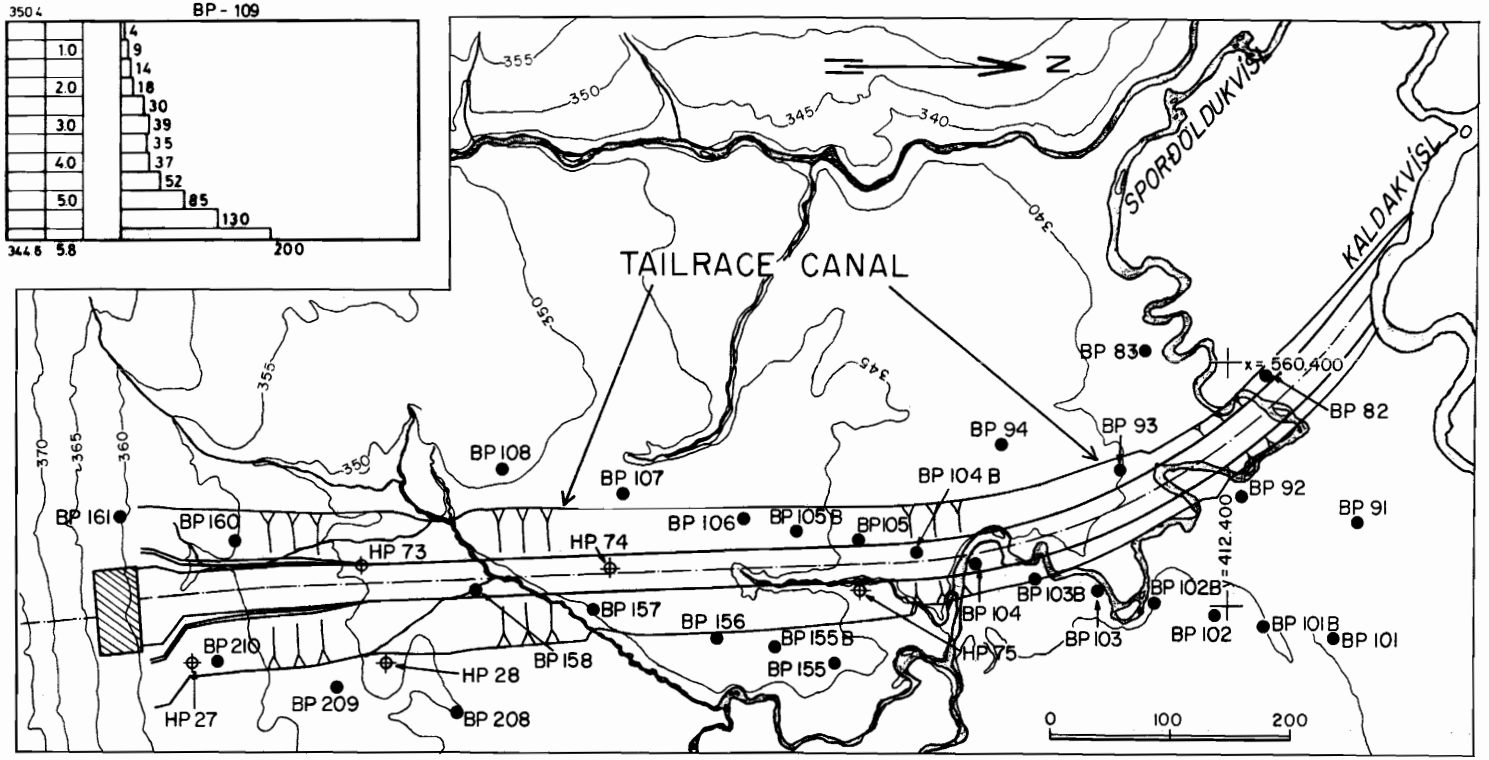












LANDSVIRKJUN

HRAUNEYJAFOSS PROJECT
BORRO SOUNDINGS
AND LOCATION MAP

Verk nr. 74.000. Teikn. nr. 1.05

Mælikv.

VERKFRÆÐISTOFA SIGURÐAR THORODDSEN SF.

REYKJAVÍK: ÁRMÚLI 4 SÍMI 81575
AKUREYRI: GLERÁRGATA 35 SÍMI 12543
ÍSAFJÖRÐUR: PÓLGATA 9 SÍMI 3788

	Dags.	Reikn.	Teikn.	Yfirl.
Hönnun	Nov 74		MH	
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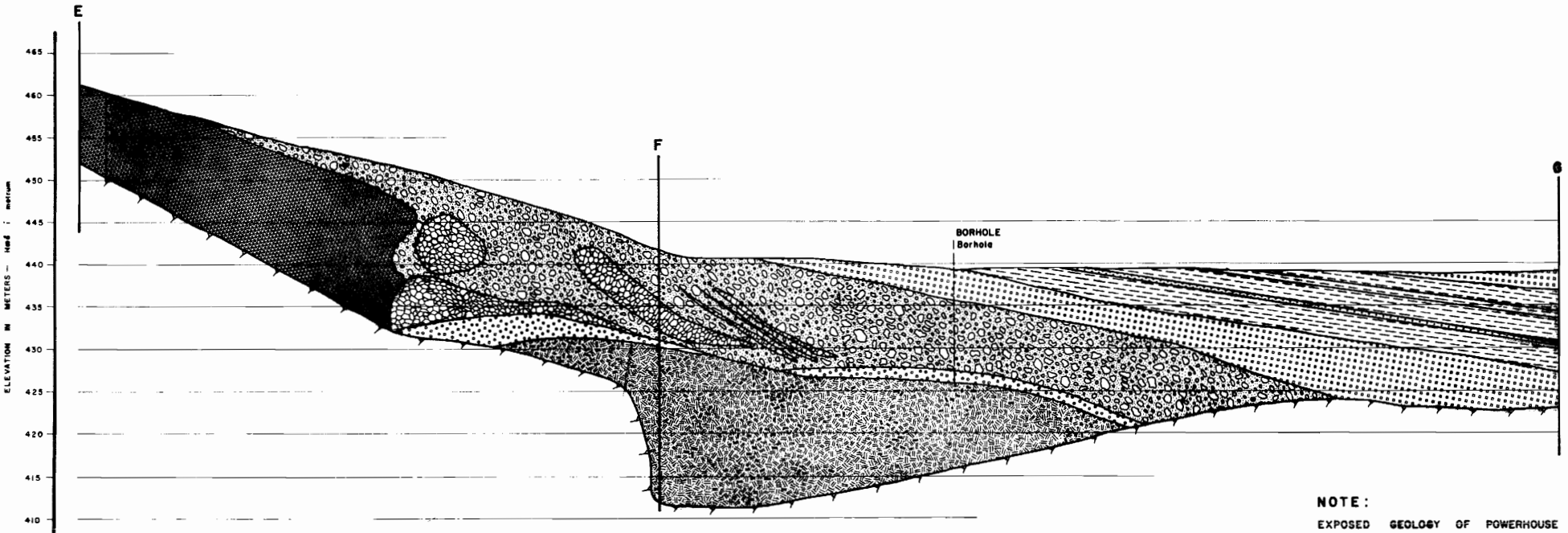
2. breyting				
3. breyting				

Samþ.:



WALL E-F-G — Veggur E-F-G

Scale 0 10 20 meters

NOTE:

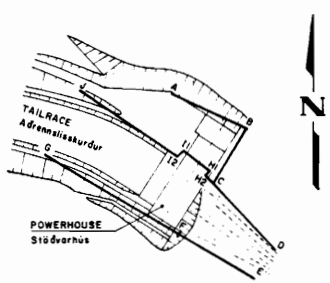
EXPOSED GEOLOGY OF POWERHOUSE EXCAVATION MAPED AND SURVEYED BY N.E.A. GEOLOGIST.

ATHUGASEMDIR:

Jarðlög mæld og kortlögð af jarðfræðingi Orkustofnunar.

LEGEND — Skýringar

- OLDER PILLOW LAVA — Eldra bólstraberg
- YOUNGER PILLOW LAVA (BRECCIA) — Yngra bólstraberg
- OLDER TILLITE — Eldra jökulberg
- YOUNGER TILLITE — Yngra jökulberg
- GRAVEL LENSES — Malarlinsur
- EOLIAN SEDIMENT — Þurrlendisset
- DIATOMIT AND TEPHRA LAYERS — Vatnaset, kísilgúr og öskulög
- H4 LIGHT ASH LAYER FROM HEKLA CA. 4000 YEARS OLD — Ljóst öskulag úr Heklu co. 4000 ára.



KEY PLAN — Lykilmynd

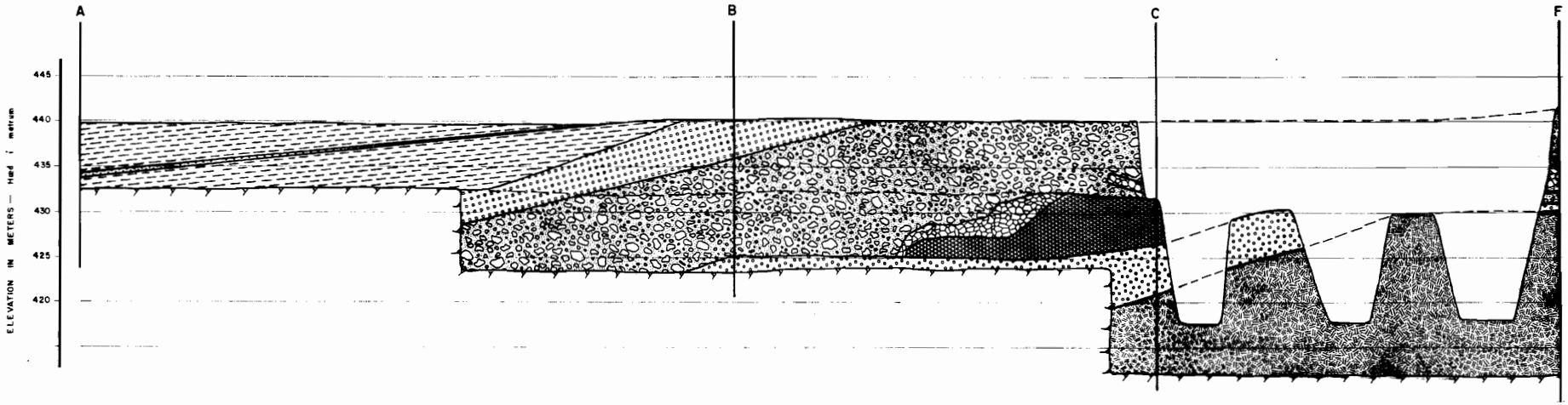
Scale 0 50 100 meters

SHEET 2 OF 3 DWG. NO. S-F-61

SHEET 3 OF 3 DWG. NO. S-F-62

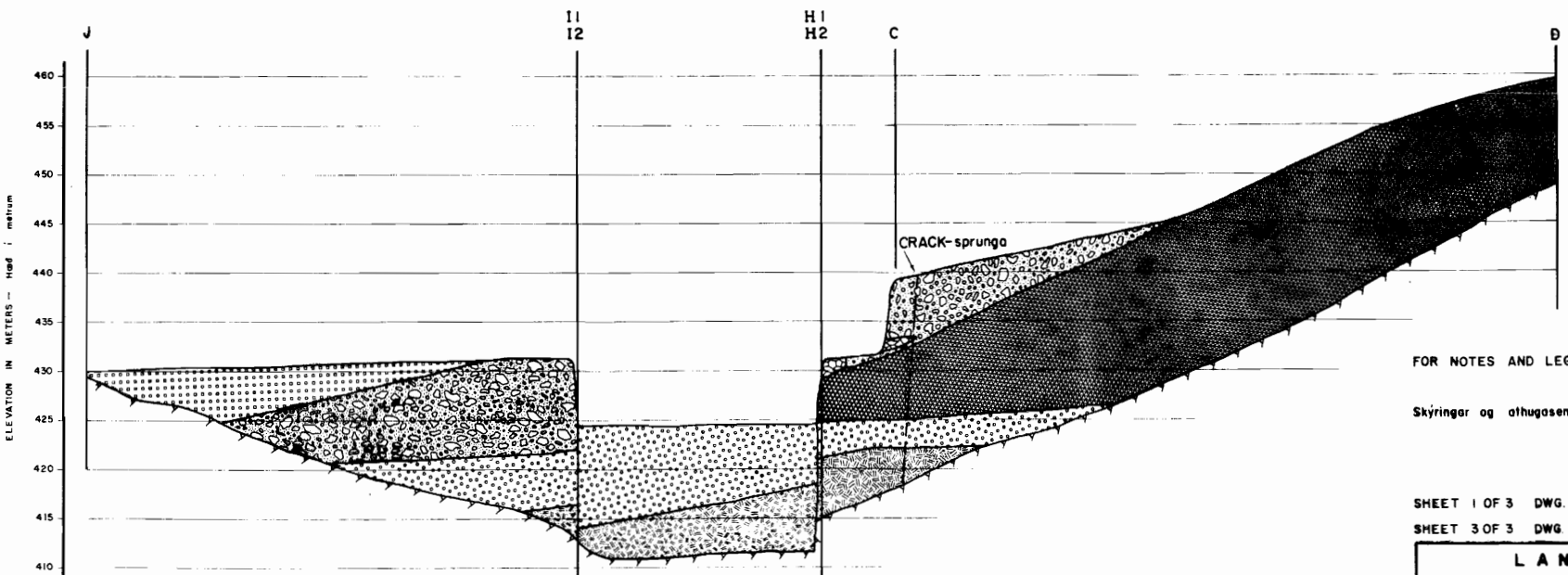
LANDSVIRKJUN THE NATIONAL POWER COMPANY, ICELAND	
SIGALDA PROJECT	GENERAL — Alm.
GEOLOGY OF POWERHOUSE EXCAVATION Jarðfræði í stöðvarhúsgrunni	
SHEET 1 OF 3	Blað 1 af 3
APPROVED: P. Ólafsson	DWG. NO:
DATE: MARCH 75 BY: S.Z. CH: S.T.	S — F — 60

No.	Revision	Date	By	Approved



WALL A-B-C-F — Veggur A-B-C-F

Scale 0 10 20 meters



WALL J-I1,I2-H1,H2-C-D — Veggur J-I1,I2-H1,H2-C-D

Scale 0 10 20 meters

FOR NOTES AND LEGEND SEE SHEET 1 OF 3

Skýringar og athugasemdir sjá blað 1 af 3

SHEET 1 OF 3 DWG. NO. S-F-60

SHEET 3 OF 3 DWG. NO. S-F-62

LANDSVIRKJUN

THE NATIONAL POWER COMPANY, ICELAND

SIGALDA PROJECT	GENERAL — Alm.

GEOLOGY OF POWERHOUSE EXCAVATION

Jarðfræði í stöðvarhúsgrunni

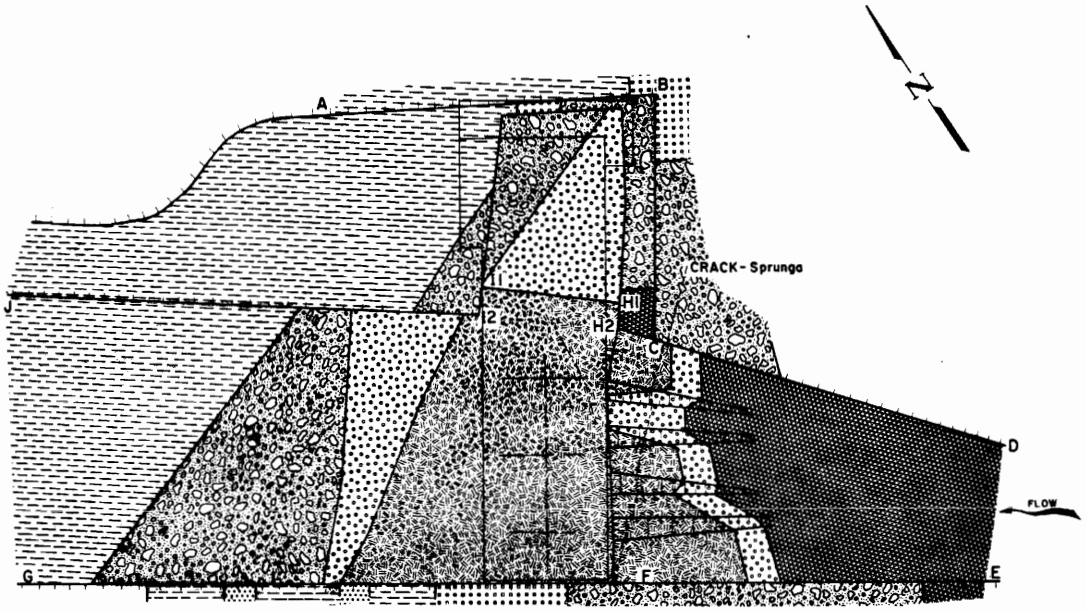
SHEET 2 OF 3 — Blað 2 af 3

No.	Revision	Date	By	Approved

APPROVED: P. Ólafsson

DATE: MARCH. 75. BY: S.Z. CH: P. Á. T.

DWG. NO: S — F — 61



PLAN — Grunnmynd

Scale 0 20 40 meters

FOR NOTES AND LEGEND SEE SHEET 1 OF 3

Skýringar og athugasemdir sjá blad 1 af 3

SHEET 1 OF 3 DWG. NO. S-F-60

SHEET 2 OF 3 DWG. NO. S-F-61

LANDSVIRKJUN

THE NATIONAL POWER COMPANY, ICELAND

SIGALDA PROJECT | GENERAL – Alm.

GEOLOGY OF POWERHOUSE EXCAVATION

Jardfrædi í stödvarhúsgrunni

SHEET 3 OF 3 Blad 3 af 3

APPROVED: P. Olafsson

DATE: MARCH 75 BY: [illegible] CH: [illegible]

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