ORKUSTOFNUN
NATIONAL ENERGY AUTHORITY

THORODDSEN AND PARTNERS

ÞÓRISVATN
GEOLOGICAL REPORT

Volume II

by

Haukur Tómasson geologist NEA
Elsa G. Vilmundardóttir " "
Birgir Jónsson " "

Prepared for

LANDSVIRKJUN
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CHAPTER 3

VATNSFELL

3.1 Introduction.

In the Vatnsfell area the building of outlet works for storage development is under consideration and at the same time a diversion of Þórisós and Kaldakvísl through Lake Þórisvatn to the Tungná river just upstream from Sigalda, where a hydroelectric project is contemplated, probably the uppermost one on the Tungná river. Four main routes are under consideration, but only three of them have been studied geologically in any detail. The routes are: 1. West of Vatnsfell, along the mountain and down into Blautalæna.
2. Through Vatnsfell into Fellsendavötn and Blautukvíslarbotnar.
3. Through the hills east of Vatnsfell to Fellsendavötn and Blautukvíslarbotnar. 4. Through ridges and depressions, still further east, to Litla Fellsendavatn and Blautukvíslarbotnar. Routes 2 and 3 are mainly tunnel routes for a great drawdown of the lake. Route 1 has mainly been studied as a canal route for a small drawdown, but route 4 is a combined tunnel and canal route for an intermediate drawdown. Geologic sections for three of the routes are available but none for route 2, as this one has not been investigated by drilling. On route 1, two holes have been drilled in rock, on route 3, ten holes, and on route 4, four holes. Besides, two holes have been drilled on sites common for two or three of the routes, and 6 holes have been drilled outside the routes for ground water studies and rock exploration between the routes. Some of them give very valuable information to pinpoint the possible routes. Besides drillholes to map ground water, 13 piezometers were driven down in sandfilled depressions and on the shores of Þórisvatn. To investigate depth to bedrock, 223 borro soundings were performed on all possible canal routes.

Finally, bulldozer trenches were excavated in order to examine rippability of the rock and to open up rock where no core was recovered. Some seismic sounding has also been performed in the area.

Exhibits 3.12, 3.13 and 3.14 show the location of core boreholes borro soundings, piezometers, jet drilled holes and trenches. Tables 3.1 to 3.5, respectively, show the depth and location of: All core boreholes in the Vatnsfell area, borro soundings 1962, borro soundings 1967, borro soundings and jet drilled holes in Lake Þórisvatn 1969, and borro soundings on land 1969.

3.2 Geology.

In this area, four formations are encountered. These formations are; a) the Grasatangi formation GTM, which is the oldest one, lying west and south of Vatnsfell b) the Þóristindur pillow lava formation ÞTM, lying east of Vatnsfell, c) the Vatnsfell móberg formation VFM, in Vatnsfell and along the coast east of it, and finally d) a small postglacial lava flow TH (See Exh. 3.01). The Vatnsfell móberg formation is by far the most important one inside the project area, as most of the proposed tunnel routes are lying within this formation and most of the canal routes as well.

The Vatnsfell móberg formation VFM is late glacial eruptive formation. The formation began with a caldera subsidence. The caldera is about 7 km long and 3.5 km wide, elliptically shaped with the long axis in a northeasterly direction. See Exhibit 3.02 This type of caldera is usually initiated by a violent acid eruption. We have not found the products of such an eruption in the Vatnsfell area. This interpretation of the geology of the Vatnsfell area was first proposed after field work was over and renewed field work with this in mind has not been possible because of snow and bad weather conditions. On the other hand, acid rocks are at the western and northern coasts of Þórisvatn and rhyolitic xenoliths are found at craters 4 km to the south of the caldera. A topographic feature, that could be the crater from the eruption that caused the caldera subsidence, is Stóra Fellsendavatn. It is also quite possible that such a topographic feature is to be found in Lake Þórisvatn itself. The caldera has been filled with basaltic eruptive materials except in its northern part which remains in the lake. The eruptions have mainly occurred in craters which are arranged on the concentric fractures of the caldera subsidence. Many of the craters are fairly well preserved and strongly resemble some postglacial craters where phreatic eruptions have taken place. This understanding of the geology really does explain the distribution and classification of different materials inside the formation.

The eruptive materials have been subdivided into 3 members designated V, F and L, each of them with an index from 1 to 3. The V member consists of crater wall material, F corresponds to lava flows and L is crater fillings. Chemically, all the members are of a similar composition, i.e. tholeiitic basalt, but the different products are due to different surface condition during and after the eruption.

The V member is made of móberg, both breccia and tuff, and usually shows some stratification. This member forms the crater walls. Consolidation of this member is much better than that of the other ones and it has also a lower permeability and a good core recovery. In interstices there are usually separate zeolite laths. The móberg is formed in phreatic eruptions beneath a glacier, probably a few hundred meters thick, cf. Grímsvötn in Vatnajökull, which is an active caldera and can be compared to the Vatnsfell caldera. At Grímsvötn the ice thickness is at least 600 meters. In both cases the eruptions have melted through the ice. Most of the material at Vatnsfell has been ejected into the air or into water and deposited near the vents. The depositional environment has been extremely complex. Still, this has usually been in water but at a rapidly changing depth and turbulence. Sometimes the deposition has even been on dry land after much of the meltwater has escaped in a glacier burst. After the deposition, consolidation has taken place due to compaction, by glacier load and through hydrothermal alteration leading to formation of clay and zeolites in interstices, which then act as cementing agents together with hydration of the volcanic ash.

The memeber V is subdivided into three units, mainly based on engineering characteristics of the rock. The best unit from an engineering geological standpoint is V_1. It is a breccia or even pillow breccia with dense finegrained matrix. Core recovery is usually 100%;permeability is low. The leakage is mostly at joints and fractures. Stratification is diffuse and it seems to be thick-bedded.

V-2 is a rather coarse tuff and sometimes breccia. It has an open texture. Separate zeolite laths are prominent in interstices but do not fill them. Layers of volcanic bombs and basalt fragments do occur. Bedding is rather indistinct and the beds are rather thick (0.5-5 m). Core recovery is usually good, 20-100%. Permeability is greater than in V_1 but not very high. The leakage is through the rock itself rather than through fractures.

V_3 is thinbedded tuff (0.5-50 cm) with occasional volcanic bombs. The stratification is distinct and indicates, together with the bombs, that this is formed in a subaerial eruption and deposited in shallow water or even on dry land. Zeolite laths in interstices are also prominent here. Core recovery is not good but usually some.

Besides these three units, reworked tuff, due to glacial erosion, is present. It is usually fine grained, fairly impervious and strong. This is usually only a few meters thick and occurs on the present surface of the member. This type of reworked móberg is called pseudomóberg or pseudopalagonite.

The tricone drilling speed in the V member shows average drilling speed at tunnel depths to be 9 m per hour (see Exhibit 3.03). This indicates a much better induration for the V member than for the others. The average permeability is 12 LU in the tunnel range which is by far the lowest figure for the members in the Vatnsfell formation. See Exhibit 3.04. The seismic velocity is from 1.1 km/sec to 1.6 km/sec in unit V_3 but 2.2 km/sec in unit V_2 above ground water level. Below ground water it has a higher velocity. V_1 probably has a seismic velocity of over 3 km/sec. A test was performed to find out the rippability of the V_1 unit. It proved to be unrippable with a D7 E bulldozer. Tests on compressive strength on samples from the V units gave a figure of 20-60 kg/cm^2.

The V_1 and V_2 units are most likely good tunneling rock. It is even doubtful whether a lining is necessary for unit V_1 and certainly not a structural lining. Unit V_2 is more heterogeneous and there may be weak zones in it which could cause some difficulties. Lining to prevent erosion is essential but structural lining may not be necessary except in weak zones. Unit V_3 is much less desirable tunneling rock but it is not encountered at tunnel depths.

The F member is genetically comparable to lava flows, but due to melt water the magma has solidified into pillow lava, sand or in most cases mixture of both. Most of the flows now at the surface have originated from the craters situated on the second outermost concentric fault, and have flowed outwards, usually a distnace of about a kilometer or so from the craters, cf. Exhibit No. 3.01 and 3.02. Older F units, now buried under crater wall material, are anticipated at some places and traced in drillholes.

The F member is divided into 3 units, i.e. F_1, F_2 and F_3. Unit F_1 is a pillow lava with a regular pillow structure and basaltic veins. Lenses of finegrained sand and sand fillings in interstices between pillows occur in this unit. Unit F_2 is a mixture of pillows and sand and basaltic veins. It is intermittent between the units F_1 and F_3, the latter mostly being sand. There are absolutely no sharp boundaries between these three units and they merge into one another.

F_3 is the most important unit for engineering properties. It consists mainly of tuffaceous sand, a primary volcanic product. There are two types of sand. One is fine grained and has a sedimentary structure. This sand often forms thin lenses between pillows and can have extremely irregular forms and orientation. This sand is derived from the meltwater and deposited during periods of reduced activity of the eruption and then buried under a new lava pulsation. The other type of sand is very coarse and consists of small finegrained and glassy basalt fragments from disintegrated pillows, all extremely fractured and friable. This sand can have the pillow structure preserved which was the case in the upper bulldozer trench (see later in the text) where the individual grains mostly consist of basalt fragments with glassy crust.

There is no noteworthy alteration or hydration traced in the F member. Cementation is almost lacking but friction is high as all grains are extremely angular. The member is very permeable, usually tens to two hundred LU. The lack of cementation and alteration here is probably due to relatively great distance from the vents and also the high permeability which has allowed cold water to penetrate the member immediately after eruption. Even when vents and magma feeders have penetrated the F member, extensive consolidation and alteration has not taken place. The reason is the coarseness of the material and high permeability.

The tricone drilling speed is very variable in the F units. In the pillow lava the drilling speed is very low or 1-2 m per hour. The drilling speed increases with increasing sand content and is commonly about 15 m per hour in F_3. In unit F_2 the drilling speed is in between the other two. Tricone drilling speeds are plotted in Exhibit 3.03.

Permeability for the F units is very high. Average for F_1 and F_2 at tunnel depths is 175 LU but lower for F_3 or 57 LU. The permeability tests are plotted in Exhibit 3.04. The pillow lava is obviously much more permeable than the sand. Most tests are performed above ground water level and this can influence the results as to get a lower permeability than the actual one. We do not know whether this influences the tests for all rock types, but there is no reason to assume this as the pore space differs very much from pillow lava to sand.

Seismic velocity in these units is very low, mostly around 1000 m/sec above ground water level and 1500 m/sec below ground water level. This low seismic velocity indicates that the material is easily rippable with a heavy bulldozer and even with a medium size bulldozer. A ripping test was performed in the pillow lava, unit F_1. 940 m^3 were ripped in 7 hours or 135 m^3/hour with a bulldozer, type D7 E. A test pit was dug with the same dulldozer higher up in unit F_2 mainly, but in that unit thick sand lenses corresponding to F_3 are found. In this trench, one vein of basalt was penetrated with a great difficulty for the bulldozer, but below that is the coarse sand and extremely broken up pillow lava. The bulldozer could excavate this material without ripping. In this trench a sandy zone was reached which is identified in holes VF-9 at elevation 573 m and in VF-22 at elevation 584 m. In the trench the elevation is 580 m. In Exhibit 3.05, there is a sketch map and sections of the bulldozer trenches.

We are still in doubt about the unit F_3, whether it is usually like the fine grained sand or like the coarse grained one. It is probably a mixture of both, but the permeability indicates that there is more of the fine grained sand as it has a permeability of around 57 LU but the pillow lava and the sandy pillow breccia usually has a permeability of around 100-200 LU.

The F units are certainly poor tunneling rocks, especially would the coarse sand be difficult in tunneling. If unit F_3 is mainly made of the fine grained sand it should be a slightly better tunnel rock. In Southern Iceland caves have been excavated in sand above ground water table. Tunneling in this rock is very difficult below ground water level and blasting would deteriorate a large volume around the tunnel and should be avoided if possible during excavation. Support such as guniting is essential soon after excavation. Unit F_1 should be a slightly better tunneling rock due to the fact that it is mostly basalt. But it is very broken up and should not be considered as a good tunneling rock. All F units would need lining, usually structural or otherwise for protection against erosion.

Besides the three regular units of the F member there is tillite on the surface at many places, a very hard and well indurated rock, formed by reworking of the glaciers on the surface of the member. The tillite is grey in colour with fine grained matrix and basalt fragments from the member. It is usually less than 5 m thick and restricted to the surface and is therefore of no significance for the project.

The member L forms the fillings in lakes and depressions which in our case are mostly craters. This material varies in age from glacial to present day. The material is mostly volcanic in origin, tephra from the Vatnsfell volcanism and the younger volcanism east of Vatnsfell. The material is deposited in water and on dry land. The older part and the most voluminous one is deposited in subglacial lakes. These lakes have been fed by hydrothermal melting of the ice and mostly been restricted to the former craters. The material is both derived from the glacier ice and tephra brought up from eruptions near by and gradually deposited by melting of the ice from above and below. This material is clearly stratified as indicated by borro soundings and ground water behaviour. Finer grained beds have accumulated during periods of little or no tephra production. In postglacial time, this filling of the depressions and lakes has continued mostly by airborne material. In the permanent lakes the formation of diatomaceous earth, which is a part of the deposits there, has also taken place.

The L member is subdivided into three units L_1 to L_3. The unit L_1 is defined as sand, not penetrated by borro sounding but yields no core in core drilling. This unit resembles in many respects the unit F_3 but basalt veins are lacking and sedimentary structure is present. This unit is entirely formed subglacially but the other two only partly so. The tricone drilling speed in unit L_1 was 20 m per hour on average and average permeability 58 LU which is practically the same as per unit F_2, but median permeability for the same reach would be somewhat lower for L_1 than for F_3. Seismic sound velocity is 900-1300 m/sec above ground water level but 2600-2700 m/sec below it. A thin layer of perched ground water is not found in the seismic soundings.

Engineering properties of this unit are most likely similar to the F_3 unit. However, the seismic velocity indicates L_1 to be a slightly tougher rock. But the same uncertainty prevails here, as no undisturbed samples were obtained.

The L_2 unit is sand, penetrated by borro soundings. This sand is both postglacial and glacial. The postglacial sand is loose with seismic velocity 300 m/sec. Some consolidation is in the glacial sand and it has a higher seismic velocity. The defined boundary between the units L_1 and L_2 is only related to mechanical properties. The Borro soundings stop on the finer grained harder layers which are not necessarily the same from one sounding to another.

Unit L_3 is related to L_2, but is only deposited in lakes, mainly in Þórisvatn. Its near shore properties are practically the same as for L_2 but it usually contains some diatomaceous earth. At a greater depth, i.e. 30-40 m, it contains much diatomaceous earth together with airborne volcanic ash. This material can easily be excavated with most kinds of excavation instruments. Down to 15 m depth its properties are that of sand, mostly fine grained sand, both for excavation and stability. Below 15 m, and especially below 30 m, the material has some cohesion due to the presence of diatomaceous earth.

3.3 Ground Water.

In chapter 2 some facts about ground water in the Vatnsfell area have already been discussed. In Exhibit 3.06 the ground water potential lines in the Vatnsfell area are mapped. These potential lines are for the permanent ground water table only, but at many places we have perched ground water above this. However, the perched ground water does not carry water long distances but is gradually seeping down into the permanent ground water. Perched ground water is present at Þórisvatn itself and in all the nearby depressions. At some places there is indication of perched ground water in the hills, but its extension is unknown. Holding up the perched ground water are: 1) In many cases a glacially reworked surface of the bedrock. This is probably the case at Þórisvatn. 2) Similar layers of reworked tuff or pillow lava, or large continuous lenses of fine grained sand may be present in hills and cause perched ground water to exist there 3) In the depressions, the relatively impervious layers are most likely fine grained layers formed in relative quiescense of volcanic activity. In these layers glacial silt may be present. From the graph in Exhibit 2.04 it can be concluded that a fairly uniform condition exists in most of the depressions. 4) Perched ground water exists due to fine grained sediments in Þórisvatn and Stóra Fellsendavatn. All these types of perched ground water are found in boreholes and piezometers and the ground water elevation figures at the holes in Exhibit 3.06 give examples of all of them. Example of case 1 is hole VF-1 and VF-5, of case 2, hole VF-1 again and VF-2 and some other holes where higher ground water levels were traced during drilling. Examples of case 3 are the piezometers in the depressions and of case 4, the hole VF-11. In many cases the perched ground water will not yield much water if encountered in excavation except for a brief period at the beginning. At the lakes Þórisvatn and Stóra Fellsendavatn, the uppermost perched ground water is fed by the lakes and it can yield unlimited quantities of water. At other places the perched ground water is only fed by local precipitation.

The bedrock ground water potentials as shown in Exhibit 3.06, show a general gradient of the ground water towards west. Irregularities are mainly in the area between Þórisvatn and Stóra Fellsendavatn. In this area the ground water gradient is smaller than elsewhere. This is due to the impermeable coast of Þórisvatn in the Vatnsfell region and the presence of Stóra Fellsendavatn which keeps the ground water there higher than otherwise would be the case. The F unit in the project area is much more permeable than other units. In this area there is a depression in the ground water table as is obvious from the map.

West of Vatnsfell the map is only based on two drillholes, 0-1 and 0-2. Elsewhere it is estimated. In this area the depth to bedrock ground water is not known. From the available data it seems fairly certain that the lowest bedrock ground water level at the shores of Þórisvatn is at the middle of the relatively impervious coast in the Vatnsfell area. This would be near the hole VF-5 as shown on the map. There the ground water is 33 m lower than the lake level.

In Exhibit 3.07 and 3.08 there are plotted some observations of ground water level in drillholes and piezometers during the latter half of 1969. Ground water measurements were usually done once a week. The ground water generally had a downward trend during June, July and August but a slight upward trend during September and October. The observed amplitude is commonly about 1 m. This amplitude is mostly a part of the seasonal variation which has its peak in the spring thaw in May and is probably lowest in late winter. The amplitude of the seasonal variation is not known, but ground water measurements will be continued throughout one year to study this. The rise in ground water in the fall is probably due to heavy rain during the summer.

Some individual peaks in the ground water level are clearly related to heavy rainfall during the preceeding days. It can be seen by comparing Exhibits 3.07 and 3.08 with 2.05. The individual rain-fall peaks commonly have an amplitude of 25 cm although amplitudes of up to 60 cm do occur. One of the piezometers, P-4, behaves differently as the ground water level there drops continuously with a total drop of 3 m. From the graph in Exhibit 3.07 it is obvious that the condition in this depression is different from most of the others in the Vatnsfell area.

Long term variations in ground water level are not known from the Vatnsfell area but from nearby lavafields, south of Tungná, ground water has been studied occasionally for the last decade. The long term variations can probably be substantially larger than the seasonal ones. Probable magnitude of variation is 3 m or more. The present situation is a low ground water level.

3.4 The Diversion Routes

The four routes described in the introduction will now be described geologically, starting with the westernmost one, route 1, west of Vatnsfell. The geologic section is in Exhibit 3.09, section A-A. The data available for interpreting this section are mostly borro soundings from 1962, when maximum number of blows was much lower than last summer or about 200 blows with 0.5 m drop 1962 agaist 350 blows with 1.0 m drop 1969 both per half a meters run. Therefore the depth to bedrock may not be quite comparable to the other sections. Other data are two drillholes 0-1 and 0-2, on the route, and a seismic sounding.

The section starts at the lake with bedrock which has a high seismic velocity, or about 3000 m/sec. This is interpreted as being the V_1 unit. Above it is a rather thin layer of sand and other lake deposits. The thickness of the sand is only 3-7 m at a distance of 400 m out from the beach. The first depression is a crater, filled with the L_2 unit at the top, perhaps mixed with L_3, but the L_1 unit is most likely beneath. This depression is bordered by V units as should be expected for a crater. In the drillhole 0-2, which is in the crater rim, the V_1 unit was at the top, but in the lower part it is classified as V_2. There it is much more permeable and the core recovery was less. The crater rim rests on older pillow lava, which belongs to the Grasatangi móberg formation. Classified in the same manner as the Vatnsfell formation this pillow lava would mainly be F_1, but a part of it is sandy and would be classified as F_2. Between the crater rim and the pillow lava there is a depression, most likely filled with the L_2 unit. A remote possibility is that this depression is an older crater but this interpretation is rather unlikely. At the bottom of hole 0-1, a considerably older móberg was found, capped by tillite. This rock type is tight and well indurated and is classified as V_1.

This route is mainly proposed for a canal, relatively shallow. Unit L_2 and L_3 certainly can easily be excavated with almost any kind of equipment. The L_1 unit has to be ripped but is easily rippable. The F unit is probably also rippable. The V_1 unit making up bedrock at the lake would most likely need blasting, but otherwise the route seems to be easy in excavation. Even a tunnel through the highest part seems to be in quite acceptable rock. The main uncertainty for such a tunnel is the depression between holes 0-1 and 0-2. Before tunneling condition can be predicted with accuracy, a drillhole is needed there. The main drawback of this route is heavy leakage from it if the waterways are not lined. The leakage from the route would be, at least initially, several m^3/sec. The leakage is lost for power development in the Tungná river.

The downstream end of this route will be on a steeply sloping ground and as the pillow lava is certainly easily eroded, substantial erosion can be expected from there, down to Tungná. This erosion would tend to progress upstream with a possible danger to the control structures.

Route 2 through Vatnsfell has not been investigated. However, drillhole VF-7 is near the south end of that route. This route is for going deep into the lake for a maximum drawdown with a tunnel. The tunnel route is here about 3 km long. At the lake the conditions are most likely favourable as there we are with V_1 and V_2 units covered with a thin debris of large blocks and sand. Vatnsfell itself is made up of many crater rims and the southern end of it probably overlies F units and has very difficult tunneling conditions because of that. Complicated inner structure of the mountain can be expected and this route can not be chosen until after an extensive drilling program has been carried out. Since the holes have to go through the mountain the drilling will be very expensive due to the great depth of the holes. Route 2 has to be compared to the tunneling part of Route 3, where the tunnel would be 2.2 km long. This route is geologically similar to route 2 as we know now, but it is shorter and has already been investigated in some detail.

Section B-B in Exhibit 3.09 is along route 3 and the short sections, G-G, H-H and I-I in Exhibit 3.11 cross the route. Location of the sections is shown in Exhibit 3.01. There are very thick sand layers in the lake with an almost vertical rock wall. The rock wall consists of the tight, impervious V_2 unit, probably reworked by tectonic movements and glaciers. Numerous fractures or small faults are radially arranged from the coast. The chosen route is located as to avoid crossing such faults close to the coast. The faults seem to be fairly impermeable since substantial leakage can not be traced to them. From the rock wall and 1500-1600 m onwards this tunnel route is in the V_2 and V_1 units. In this part of the route, tunneling conditions are usually good. Inflow of water, if the tunnel is located below the ground water table, will be moderate to small, even close to the lake. The ground water is 37.5 m below the lake level at the rock wall and dips towards south and is 43,5 m below the lake level in the southern end of this favourable zone.

There is some indication that less favourable tunneling conditions may be expected where the route lies furthest away from eruption vents. As already stated, hydrothermal alteration along the vents caused much of the consolidation of this material with decreasing effect outwards. Therefore,according to topography, worse conditions can be expected between drillholes VF-13 and VF-14. For much of this part of the route, the tunnel will need some kind of lining. In unit V_1 it is quite possible that lining can be avoided. The lining will be principally for protection against erosion.

The rest of the tunnel route consists of a much worse tunneling rock. About 400-500 m of the rest is in unit F_3 and 100-200 m in F_1. Especially will the F_3 unit be a difficult tunneling rock as it mostly consists of sand with high friction but little consolidation.

Whether the tunneling conditions should be classified as rock tunneling or earth tunneling is not confirmed yet. However, there is some indication that this material is comparable to alluvial sand from finiglacial time in the lowlands, into which numerous caves have been excavated, in most cases centuries ago and many are still in good condition. Also there is a tunnel now in operation at the Sog river in Southern Iceland, which was excavated in móberg rock which yielded no or very little core. This tunneling was certainly difficult but was achieved without prohibitive cost increase. The difficulties may have arisen because the tunnel was partly submerged in ground water and because a conventional blasting technique was used. Excavation without blasting may give much better results in this unit. The real tunneling conditions can not be proved without an adit tunnel to investigate this.

Ground water conditions are favourable as the tunnel will, according to plans, not go down into ground water in this part. Lining of the tunnel is absolutely necessary. and even temporary support, such as guniting, will be needed.

The F_1 pillow lava is a hard rock but extremely broken up. Conventional tunneling technique would be more normal here. Lining is needed and temporary support may be necessary.

From the tunnel portal, a canal has to be excavated through the Fellsendalægð and down into Blautukvíslarbotnar. This part of the waterways is common for route 2 and 3, and even a part of it also for route 4, i.e. the canal through the ridge at Blautukvíslarbotnar. This canal will mostly be in the overburden and in Fellsendalægð no canal may be needed, depending on the drawdown. However, at two places, i.e. through the Skeifuhraun, section E-E Exhibit 3.10, and through the ridge at Blautukvíslarbotnar, section F-F in Exh. 3.10 canals will be needed in any case. The canal through Skeifuhraun has to be blasted, as there we are dealing with massive basalt, except the uppermost one or two meters. At Blautukvíslarbotnar there is pillow lava, mostly unit F_1 or F_2 which probably is rippable by a heavy bulldozer.

No leakage will take place along the tunnel part of this route as it will be lined, nor in the lake at the intake. On the other hand, there could be water loss from Fellsendalægð, but this depends on the depth of the canal. The canal at Blautukvíslarbotnar will, on the other hand, probably tap ground water. The canal through Fellsendalægð can be built in such a manner as to tap the passing ground water flow. In order to do that, the canal has to be deep enough to intersect the ground water table. In this manner, additional discharge could be obtained for the Sigalda and Hrauneyjafoss projects.

Route 4 has in common with routes 2 and 3 the canal through the ridge at Blautukvíslarbotnar, section F-F. Other parts of the route are shown on sections C-C and D-D in Exhibit 3.10. This route is for an intermediate drawdown and goes through 3 ridges and two depressions in between. This route is a combined tunnel and canal route with tunnels through at least some of the ridges and canals in between. At least the first two ridges would preferably be tunneled. In each ridge there is one drillhole and also in Flekavík at the lake.

Flekavík is filled with sand and in the lake there are also thick sand deposits. The thickest sand is along the cliffs towards west. There the sand thickness can reach 30 m. Flekavík itself is also filled with lake deposits, unit L_3, and possibly some L_1 although not shown on the section. The rock below is reworked and relatively tight at the surface and is classified as V_2. Below is the F_3 unit.

The first tunnel route between Flekavík and Innstalaut has complex tunneling conditions with good rock above the tunnel grade, but poor rock conditions at tunnel level. As there is only one hole in the ridge an extrapolation is difficult. However, the tunneling conditions are most likely similar to the ones described for the F_3 unit on route 3. Still, this does depend on the elevation of the tunnel. In drillhole VF-2, the boundary between the F_3 and V_3 units is near the 550 m elevation. The V_3 unit should be a slightly better rock. During drilling perched ground water was recorded at 561 m elevation. It is possible that this ground water is connected with the lake and may therefore yield considerable quantities of water during excavation in the perched ground water.

The tunnel route through the ridge between Innstalaut and Tindslaut has good rock conditions in the ridge itself, but poor rock conditions beneath the ridge. As for the other ridge this is only based on one drillhole. In this hole the boundary between the bad and good conditions is at 543 m elevation. Above this is the V_1 unit, a good tunneling rock, but below the L_1 unit, a very poor tunneling rock. This tunnel would go through the Brandur graben, an active fault zone with a tiny postglacial crater close to the drillhole.

At the eastern end this tunnel would be in pillow lava, probably classified as F_1. Lining is necessary in both the tunnels now described and in the fault zone temporary support is probably needed and also frequently in the tunnel between Flekavík and Innstalaut. In the fault zone the support could be rock bolting.

The third ridge on this route is between Tindslaut and Fellsendalaut. This ridge is so low that in most cases a canal would be planned here. The rock is pillow lava, unit F_1, and can probably be ripped with a heavy bulldozer.

The permanent ground water level on this route is at about 541 m elevation, which is 13 m higher than the mean elevation of the ground water level on route 3. Tunnels can hardly be substantially below ground water level except in the best formations, such as V_1 and V_2 and possibly also in F_1, but there the inflow would be enormous because of the high permeability.

Leakage problems on this route depend on the depth of the waterways and the location of control structures. The control structures can be placed in any of the three ridges. With control structures in the uppermost ridge, the leakage would mainly be from the canal upstream of the control structures. Most likely the excavation of the canal will go through the relatively impervious surface of the bedrock, causing much increased leakage from this area. However, the magnitude of this leakage is likely to be smaller than the leakage expected on route 1. Downstream the leakage depends on the difference in height between the ground water level and the waterways. In most cases this will not be an excessive leakage. With the control sturctures in the second ridge, the same leakage problem is upstream from the first ridge and in addition, a new lake almost 1 km^2 in size is formed in Innstalaut, resting on very permeable ground. The expected leakage is a few kl/sec.

With the control structures at the third ridge another new lake is formed in Tindslaut slightly bigger than in Innstlaut or over 1 km^2 in size. The leakage from this lake should be similar to that expected in the lake in Innstalaut. It is therefore obvious that because of leakage problems the uppermost site for the control structures is the most favourable one but the lower sites can be more favourable because of better foundation.

Most of the leakage from this route is lost for power production in Tungná, unless a canal is excavated into Fellsendalægð as described in connection with route 3.

T A B L E 3.1

LOCATION AND DEPTH OF CORE BOREHOLES

HOLE No.	Co-ordinates		Surface Elevation	Depth	Bottom Elevation
	X	Y		m	
VF-1	544.962	412.134	572.3	40.1	532.2
VF-2	544.694	411.586	604.5 *)	75.0	529.5
VF-3	544.154	410.793	588.4	56.0	532.4
VF-4	544.737	409.763	570.0 *)	41.8	528.2
VF-5	545.748	412.104	576.1	49.5	526.6
VF-6	545.967	411.198	587.3	64.7	522.6
VF-7	547.095	410.230	556.6	37.0	519.6
VF-9	546.332	410.256	582.2	60.7	521.5
VF-10	546.103	411.068	615.1	94.2	520.9
VF-11	545.723	412.130	571.80 571.88 571.98	49.9	522.0
VF-12	546.224	410.640	605.1	83.8	521.3
VF-13	545.936	411.555	632.8	110.2	522.6
VF-14	545. 785	412.001	645.6	120.2	525.4
VF-16	546.438	409.877	553.0	30.6	522.4
VF-17	547.008	408.116	532.2 *)	12.0	520.2
VF-18	547.251	407.036	548.1 *)	27.1	521.0
VF-19	546.079	410.096	573.1	52.3	520.8
VF-20	546.118	410.340	591.5	65.4	526.1
VF-21	548.285	409.623	532.6 *)	17.0	515.6
VF-22	546.290	410.406	596.1	97.0	499.1
VF-23	546.070	411.092	603.5	77.5	526.0
O-1	548.550	411.912	572.6	48.7	523.9
O-2	547.809	412.105	580.2	40.8	539.4
O-3	549.260	415.031	588.6	50.0	538.6

*) Elevation of top of piezometer pipes

VF-2	605.7
VF-4	571.0
VF-17	533.4
VF-18	549.2
VF-21	533.6

TABLE 3.2

LOCATION AND DEPTH OF BORRO SOUNDINGS 1962

Hole No.	Co-ordinates X	Co-ordinates Y	Surface Elevation	Depth m	Bottom Elevation
D1-1	550.456	411.293	526,2	1,9	524,3
D1-2	550.475	411.208	521,5	2,0	519,5
D1-3	550.484	411.158	523,0	1,0	522,0
D2-1	551.764	409.996	516,3	0,6	515,7
D2-2	551,763	410.045	515,3	2,0	513,3
D2-3	551.761	410.128	516,3	0,6	515,7
001	547.039	413.045	571,2	6,1	565,1
002	547.083	413.068	571,6	6,2	565,4
003	547.127	413.092	571,8	4,2	567,6
010	547.141	412.860	571,4	0,2	571,2
011	547.162	412.872	569,6	6,5	562,9
012	547.184	412.883	572,2	0,4	571,8
022	547.281	412.709	568,3	10,6	557,7
032	547.378	412.533	565,7	19,0	546,7
041	547.428	412.342	570,5	15,5	555,0
042	547.474	412.358	570,4	17,3	553,1
043	547.496	412.370	570,3	10,0	560,3
051	547.558	412.173	575,6	10,8	564,8
052	547.570	412.181	574,0	5,7	568,3
053	547.588	412.190	574,6	5,9	568,7
062	547.621	412.092	576,5	16,5	560,0
062A	547.721	412.096	576,6	13,7	562,9
072	547.823	412.101	580,3	3,6	576,7
072A	547.898	412.103	576,6	4,4	572,2
082	547.974	412.104	576,4	5,8	570,6
082A	548.065	412.063	576,1	6,5	569,6
092	548.183	412.011	574,8	21,5	553,3
102	548.328	411.946	573,4	10,2	563,2
112	548.426	411.896	573,9	22,2	551,7
112A	548.468	411.901	573,7	15,8	557,9
132	548.572	411.910	573,6	1,2	572,4
142	548.620	411.877	573,2	0,7	572,5
162	548.791	411.726	567,2	5,2	562,0
201	549.052	411.528	558,6	0,4	558,2
202	549.134	411.533	558,6	2,2	556,4
212	549.216	411.500	557,9	0,5	557,4

TABLE 3.2

LOCATION AND DEPTH OF BORRO SOUNDINGS 1967.

HOLE No.	Co-ordinates		Surface Elevation	Depth	Bottom Elevation
	X	Y		m	
V 1	544.978	412.147	570.8	17.9	552.9
V 2	544.963	412.121	572.1	16.1	556.0
V 3	544.948	412.100	571.7	15.6	556.1
V 4	544.933	412.074	571.9	21.1	550.8
V 5	544.919	412.052	572.2	17.4	554.8
V 6	544.903	412.028	572.6	13.7	558.9
V 7	544.888	412.004	572.9	13.3	559.6
V 8	544.871	411.979	573.7	12.7	561.0
V 9	544.856	411.954	574.8	7.7	567.1
V 10	544.847	411.937	577.0	3.3	573.7
V 11	544.313	411.548	554.8	29.7	525.1
VO11	544.362	411.647	559.4	11.2	548.2
V 12	544.332	411.418	554.3	24.1	530.2
VO12	544.309	411.233	551.6	5.6	546.0
V 13	544.351	411.323	552.7	4.1	548.6
VO13	544.312	411.142	553.2	5.1	548.1
V 14				5.7	
VO14				8.1	
V 15	544.414	411.142	552.7	7.2	545.5
VO15	544.200	410.934	559.9	24.7	535.2
V 16	544.458	411.058	553.0	7.8	545.2
V 17	544.514	410.952	554.7	10.3	544.4
V 18	544.472	411.034	553.8	10.7	543.1
V 19	544.690	410.649	566.4	1.8	564.6
V 20	544.717	410.480	581.8	7.1	574.7
V 21	544.781	410.303	588.6	1.8	586.8
V 22			578.8	0.8	578.0
V 23	545.208	410.033	568.7	5.2	563.5
V 24	545.432	409.804	568.0	2.3	565.7
V101	544.902	411.963	573.4	8.1	565.3
V102	544.882	411.875	575.1	12.2	562.9
V103	544.882	411.774	577.3	9.6	567.7
V104	544.819	411.719	579.5	5.8	573.7

T A B L E 3.4

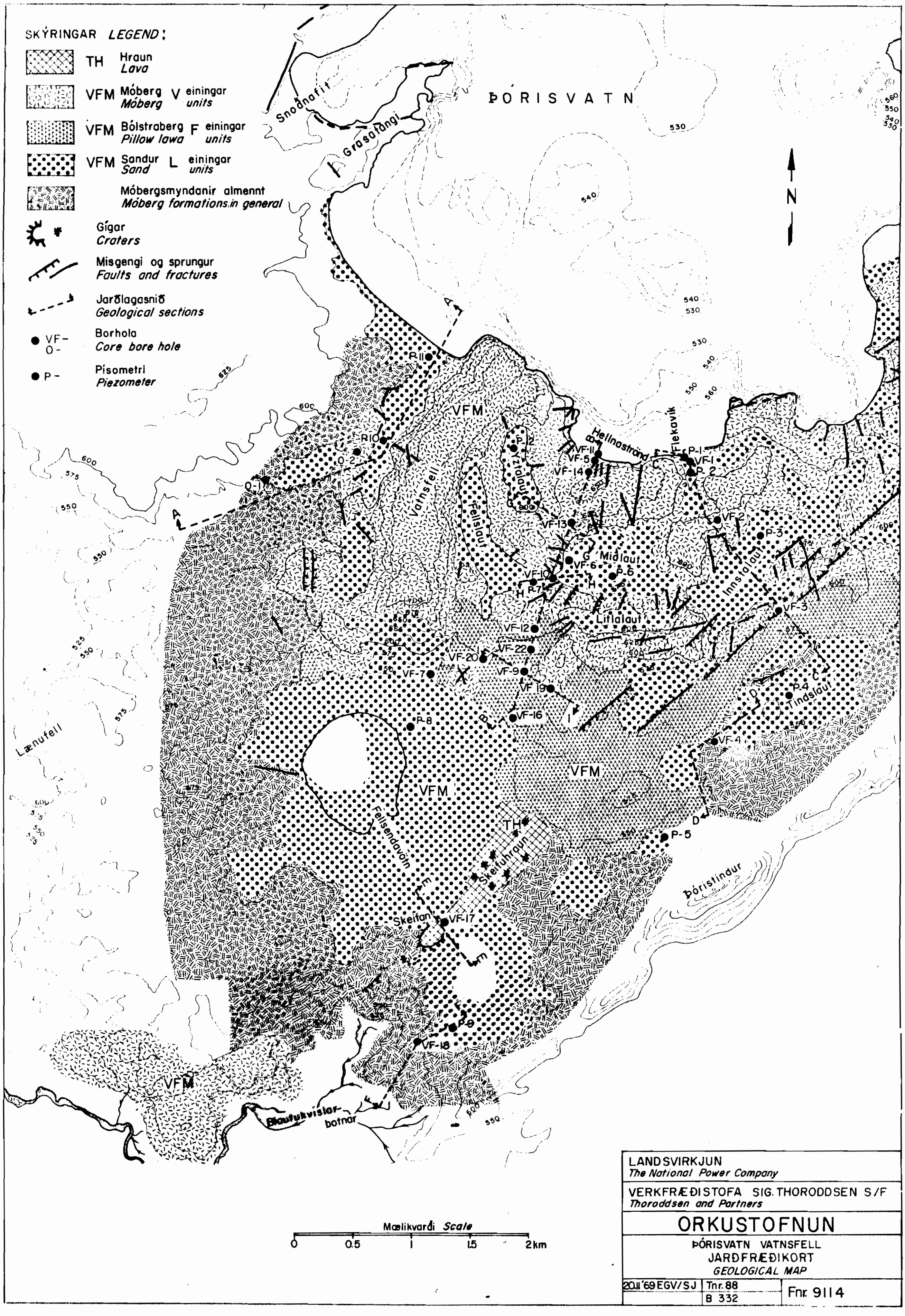
DEPTH AND LOCATION OF BORRO SOUNDINGS AND JET-DRILLED HOLES IN LAKE ÞÓRISVATN 1969

HOLE No.	Co-ordinates		Surface Elevation	Depth	Bottom Elevation
	X	Y		m	
1000	547.031	413.142	568.8	3.7	565.1
1010	546.974	413.223	566.6	3.4	563.2
1020	546.918	413.305	564.1	6.1	558.0
1030	546.860	413.388	561.5	6.1	555.4
1040	546.804	413.470	558.5	6.4	552.1
1050	546.747	413.583	550.9	2.7	548.2
1060	546.691	413.635	547.4	9.2	538.2
1070	546.634	413.717	539.4	6.5	532.9
2025	546.557	413.120	565.4	1.9	563.5
2828	546.378	413.029	562.2	3.2	559.0
3300	545.772	412.173	569.2	27.6	541.6
3000	545.686	412.124	570.3	37.8	532.5
3808	545.471	412.100	567.8	16.8	551.0
4910	545.395	412.140	566.7	35.3	531.4
4707	545.280	412.142	567.4	14.8	552.6
4710	545.300	412.170	566.4	17.2	549.2
4510	545.204	412.200	566.8	34.2	536.9
4304	545.092	412.175	567.9	29.8	537.6
4310	545.110	412.232	566.2	14.7	551.4
4100	545.031	412.152	569.1	15.4	553.7
4110	545.016	412.263	566.0	13.4	551.6
4000	544.984	412.168	569.4	8.7	560.7
4010	545.014	412.263	565.3	13.4	551.9
4020	545.046	412.358	559.8	10.1	549.7
3402	545.588	412.092	(571.2)	38.5	(532.7)
4904	545.376	412.082	567.4	3.8	567.4
3020	545.590	412.300	554.1	3.9	550.2
3030	545.542	412.387	539.9	13.7	529.2
4520	545.235	412.285	542.6	3.3	539.3
4120	545.093	412.343	548.3	5.7	542.6
4130	545.125	412.418	537.9	8.2	529.7
4030	545.077	412.453	538.7	7.1	531.6

T A B L E 3.5

DEPTH AND LOCATION OF BORROSOUNDINGS 1969

Hole No.	Co-ordinates		Surface Elevation	Depth	Bottom Elevation
	X	Y		m	
104A	544.962	412.062	572,9	22,2	550,7
104B	544.947	412.069	572,1	25,4	546,7
104C	544.919	412.083	572,2	8,8	563,4
107A	544.929	411.994	572,8	18,6	554,2
107B	544.902	412.001	572,9	18,7	554,2
107C	544.866	412.017	573,2	12,7	560,5
107D	544.806	412.044	575,3	17,3	558,0
107E	544.714	412.075	573,4	13,4	560,0
107F	544.619	412.129	570,9	13,8	557,1
107G	544.493	412.187	573,2	18,0	555,2
108A	544.903	412.015	573,4	18,6	554,8
109A	544.938	411.870	577,3	16,5	560,8
109B	544.920	411.873	575,9	15,3	560,6
109C	544.901	411.875	575,2	12,8	562,4
109D	544.883	411.878	576,2	11,2	565,0
110A	544.875	411.779	577,3	11,7	565,6
111A	544.921	411.678	580,2	4,2	576,0
111B	544.895	411.689	580,1	1,2	578,9
111C	544.869	411.699	580,1	7,2	572,9
111D	544.842	411.710	580,0	15,8	564,2
111E	544.818	411.720	579,5	8,3	571,2
301A	544.584	411.326	564,8	1,3	563,5
301B	544.516	411.361	561,2	2,7	558,5
302A	544.529	411.256	556,9	8,1	548,8
302B	544.456	411.289	555,9	9,4	546,5
303A	544.470	411.180	553,8	6,7	547,1
303B	544.398	411.215	552,8	5,0	547,8
304A	544.407	411.099	553,3	5,9	547,4
304B	544.339	411.143	553,2	6,5	546,7
305A	544.348	411.024	555,1	8,1	547,0
305B	544.282	411.072	555,5	3,0	552,5
306A	544.287	410.945	557,4	9,3	548,1
306B	544.160	411.045	557,6	7,7	549,9
307B	544.110	410.981	559,1	18,3	535,8
401A	543.932	410.544	561,6	2,1	559,5
401B	543.823	410.567	560,6	2,9	557,7
402A	543.870	410.465	561,4	1,3	560,1
402B	543.760	410.488	556,2	2,9	553,3
403A	543.808	410.388	554,4	4,8	549,6
403B	543.698	410.409	554,8	4,6	550,2
404	543.786	410.277	553,2	4,4	548,8
405	543.889	410.206	551,9	4,7	547,2
406	543.993	410.136	550,6	6,4	544,2
407	544.095	410.065	549,1	16,3	532,8
408	544.196	409.995	548,3	5,4	542,9
408A	544.190	409.985		5,0	
409	544.298	409.924	549,0	2,4	546,6
410	544.392	409.860	550,8	5,8	545,0
411A	544.569	409.851	560,6	5,7	554,9
411B	544.493	409.789	554,2	10,8	543,4
411C	544.420	409.719	553,2	7,4	545,8
412A	544.669	409.786	565,5	1,2	564,3
412B	544.598	409.716	568,4	1,0	567,4
412C	544.529	409.646	567,1	2,6	564,5
501A	545.038	409.520	555,0	18,6	536,4
501B	544.959	409.546	553,7	4,7	549,0
501C	544.890	509.591	557,2	0,7	556,5
502A	545.010	409.446	553,1	2,7	550,4
502B	544.934	409.470	553,5	14,2	539,3
502C	544.865	409.517	558,0	4,7	554,1
503A	544.984	409.369	552,0	2,8	549,2
503B	544.908	409.394	553,1	3,9	549,2
504A	544.958	409.294	552,0	3,2	548,8
504B	544.882	409.321	553,1	9,4	543,7
504C	544.832	409.296	554,3	9,7	544,6
505A	544.931	409.218	555,9	12,2	543,7
505B	544.856	409.245	556,6	13,8	542,8
505C	544.805	409.220	553,7	8,9	544,8
506A	544.905	409.143	545,1	6,2	538,9
506B	544.830	409.169	551,2	9,8	541,4
506C	544.778	409.144	546,2	2,7	543,5
507A	544.877	409.069	544,0	6,0	538,0
507B	544.803	409.094	545,1	3,5	541,4
508	545.213	408.806	540,1	3,1	537,0
509	545.429	408.627	643,2	4,7	538,5
510	545.682	408.644	544,8	6,7	538,1
511	545.927	408.660	546,3	9,2	537,1
512	546.061	408.666	544,7	0,6	544,1
513	546.210	408.563	543,2	0,7	542,5
514	546.431	408.456	541,6	1,5	540,1
515	546.550	408.358	537,2	3,1	533,5
516	546.670	408.194	533,4	15,2	518,2
517	546.912	408.090	532,0	5,0	527,0
518	546.965	408.080	532,3	1,2	531,1
519	547.038	408.159	532,0	1,1	530,9
520	547.090	408.235	531,7	2,0	529,7
521	847.140	408.308	531,6	12,9	518,7
600	545.996	411.193	586,7	31,2	555,5
601	545.843	411.335	583,6	5,6	578,0
601B	545.864	411.301	582,9	12,6	570,3
602	545.885	411.266	582,7	29,2	553,5
603	545.927	411.197	582,4	20,8	561,6
604	545.993	411.144	587,1	17,5	569,6
610	545.769	411.174	577,7	17,8	559,9
611	545.684	411.226	578,0	4,8	573,2
612	545.598	411.278	578,8	7,4	571,4
613	545.514	411.330	579,6	2,2	577,4
614	545.427	411.382	582,5	1,9	580,6
615	545.342	411.433	582,3	3,2	579,1
701	546.190	411.061	594,5	18,2	576,3
702	546.205	411.013	594,0	18,0	576,0
703	546.221	410,964	596,5	8,8	587,7
801A	547.526	410.375	575,2	0,8	574,4
801B	547.135	410.158	567,1	3,0	564,1
801C	546.756	410.106	556,1	1,6	554,5
801D	546.262	410.143	565,1	2,6	563,0
802A	547.522	410.285	556,1	2,0	554,1
802B	547.109	410.073	554,0	3,9	550,1
802C	546.806	410.030	542,5	3,1	539,4
802D	546.327	410.079	560,4	0,5	559,9
803A	547.522	410.195	546,0	7,1	538,9
803B	547.182	410.000	545,4	5,8	539,6
803C	546.854	409.954	538,7	5,3	533,4
803D	546.390	410.016	561,4	0,5	560,9
804A	547.520	410.105	540,3	9,2	531,1
804B	547.205	409.915	540,0	7,2	532,8
804C	546.903	409.878	536,3	4,5	531,8
804D	546.454	409.954	555,6	0,9	554,7
805A	547.519	410.015	536,0	7,9	528,1
805B	547.238	409.830	536,2	6,8	529,4
805C	546.951	409.802	534,7	5,2	529,5
805D	546.517	409.890	543,0	2,2	540,8
806A	546.581	409.827	540,7	9,0	531,7
807D	546.645	409.763	538,7	4,0	534,7
808D	546.709	409.700	537,2	4,9	532,3
901	546.907	407.197	533,4	15,1	518,3
902	547.001	407.156	534,2	6,5	527,7
903	547.098	407.122	537,7	4,4	533,3
904	547.185	407.089	545,7	1,1	544,6
905	547.249	407.038	548,1	3,0	545,1
906	547.296	406.964	544,3	2,2	542,1
907	547.346	406.860	537,9	3,5	534,4
908	547.373	406.782	533,2	1,7	531,5
909	547.388	406.695	528,6	1,0	527,6
910	547.484	406.641	517,2	2,7	514,5
911	547.521	406.626	514,2	1,6	512,6
912	547.572	406.566	512,7	4,1	508,6
Brands-eyri	540.700	415.300	571,5	40.0	531.5


SKÝRINGAR LEGEND:
TH Hraun Lava
VFM Móberg V einingar Móberg units
VFM Bólstraberg F einingar Pillow lawa units
VFM Sandur L einingar Sand units
Móbergsmyndanir almennt Móberg formations in general
Gígar Craters
Misgengi og sprungur Faults and fractures
Jarðlagasnið Geological sections
VF- O- Borhola Core bore hole
P- Písometri Piezometer
ÞÓRISVATN
Snoðnafit
Grasatangi
Hellnaströnd
Flekavík
Vatnsfell
Fellslaut
Miðlaut
Innstalaut
Litlalaut
Tindslaut
Lænufell
Fellsendavötn
Skeifuhraun
Skeifan
Þóristindur
Blautukvíslarbotnar
N
Mælikvarði Scale
0 0.5 1 1.5 2 km
LANDSVIRKJUN
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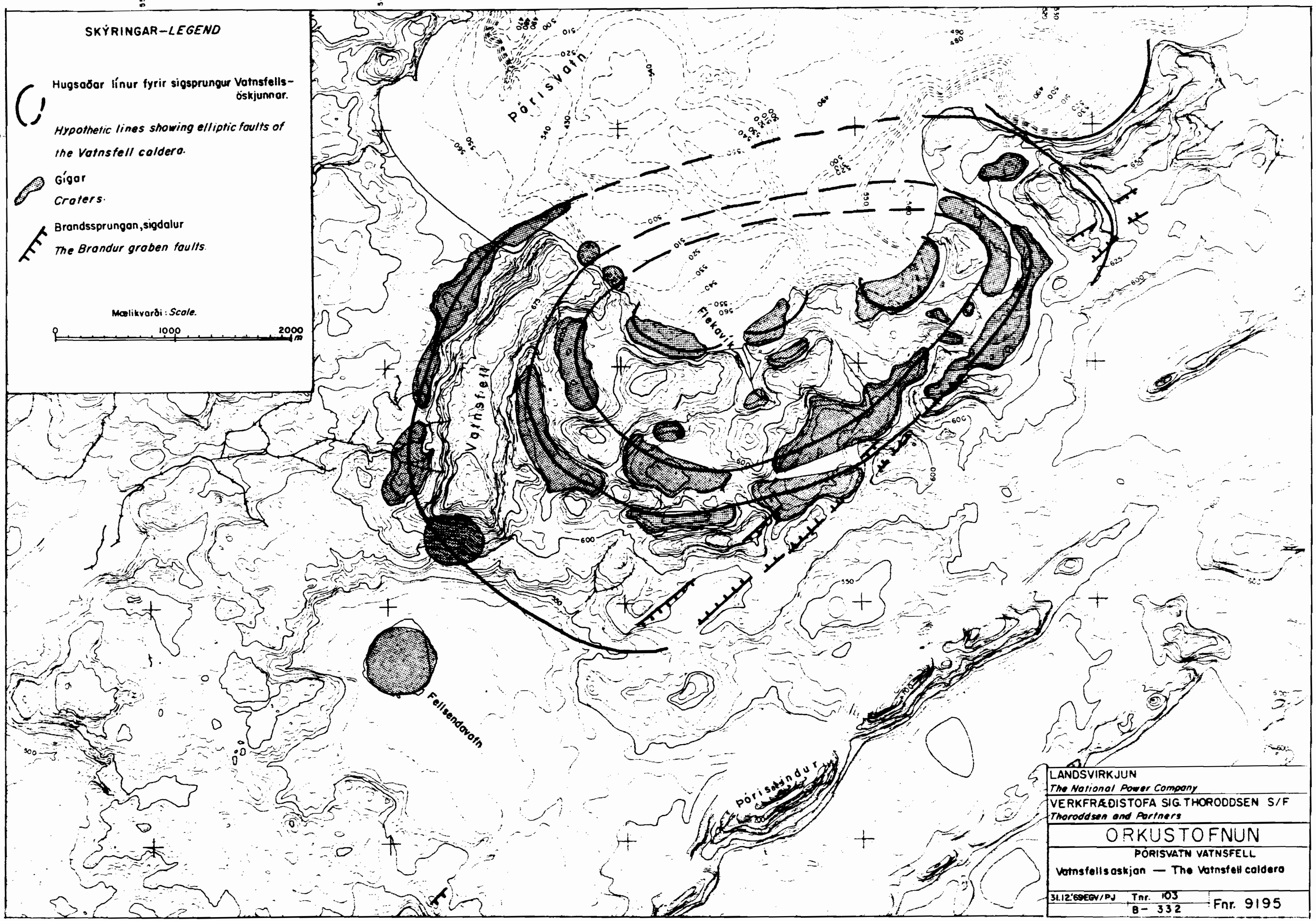
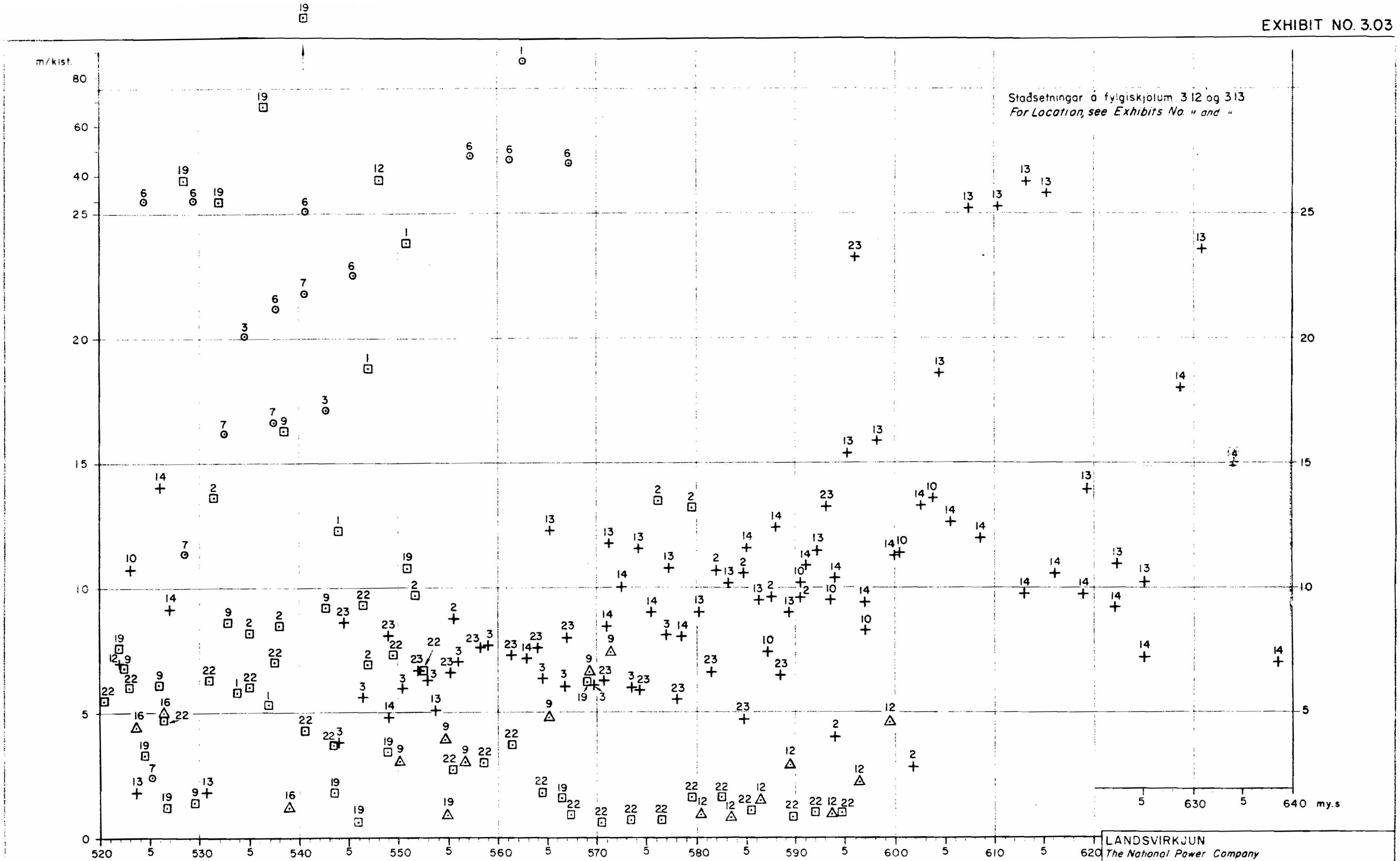
ÞÓRISVATN VATNSFELL
JARÐFRÆÐIKORT
GEOLOGICAL MAP
20.II.'69 EGV/SJ
Tnr. 88
B 332
Fnr. 9114

EXHIBIT NO. 3 0 2





Tákn Symbols	Undirmyndun Member	Meðal borhraði Mean drilling speed
△	$F_1 - F_2$	3 m/klst
+	V	9 — " —
⊡	F_3	15 — " —
⊙	L	20 — " —

Borhraði í hverri holu var reiknaður í m/klst fyrir ca. 3m færur og síðan sett út á móti hæð yfir sjávarmáli til þess að fá samanburð á borhraða í hinum 4 undirmyndunum í 12 VF-borholum á jarðganga- og skurðstæðum. Fundið var meðaltal borhraða í hverri undirmyndun á bilinu 520–550 my.s (sjá töflu). Tölurnar ofan táknanna sýna númer borholanna

The drilling speed in each hole was calculated in m/hour for approx. 3m runs and plotted against elevation for a comparison of drilling speed in the 4 members in 12 VF-boreholes on the tunnel- and canal sites. The mean drilling speed was found for each member at elevation 520-550 m (see chart). The numbers of the boreholes are shown above the symbols.

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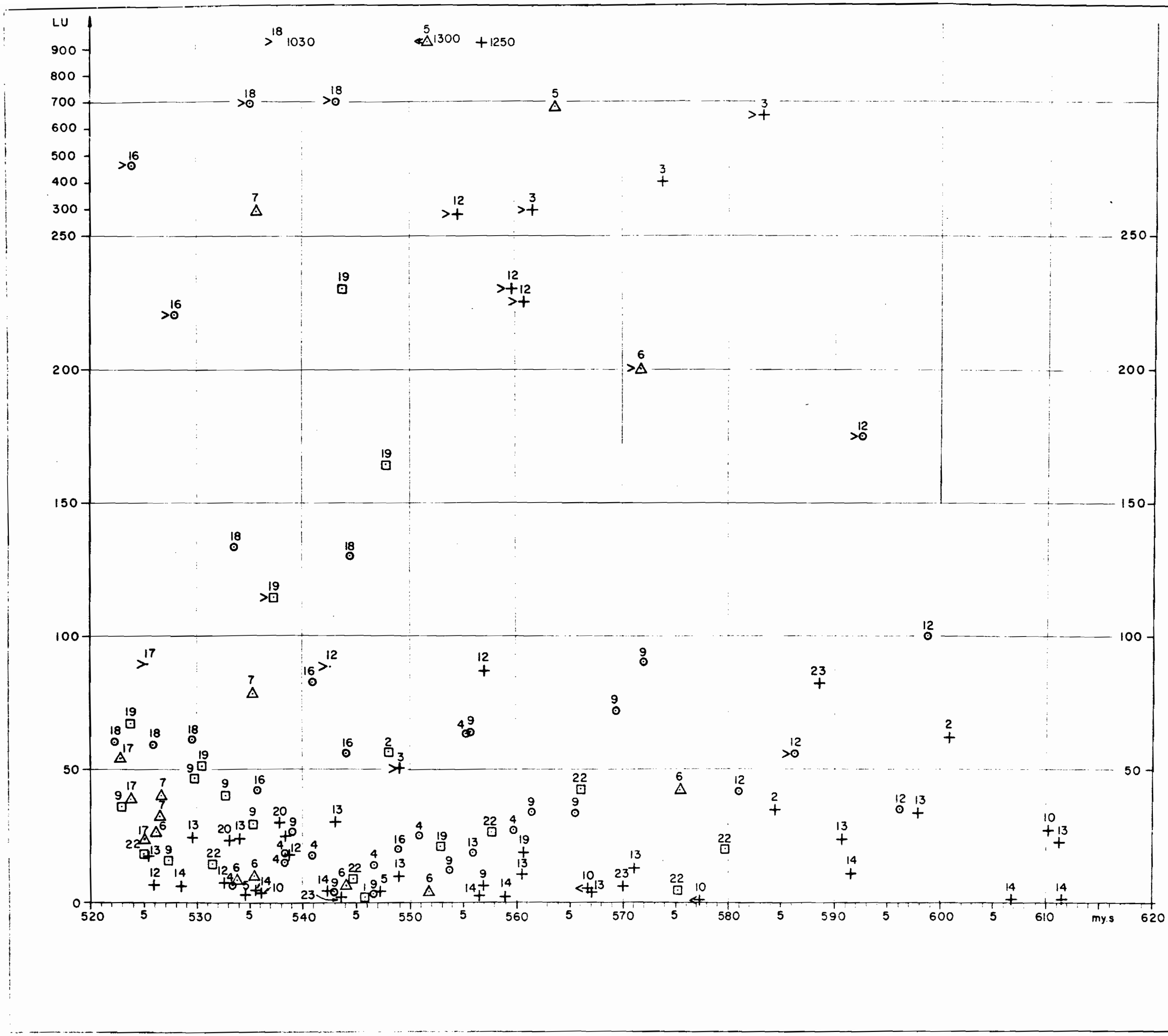
ÞÓRISVATN VATNSFELL
ATHUGUN Á BORHRAÐA MEÐ TANNHJÓLAKRÓNU
STUDIES OF DRILLING SPEED WITH TRICONE

14.11.'69 BA/Gyða | Tnr. 85 | B-332 | Fnr. 9111

EXHIBIT NO. 3.04



SKÝRINGAR *LEGEND:*

Tákn *Symbols*	Undirmyndun *Member*	Meðallekt hverrar undirmyndunar á bilinu 520-550 my.s. *The mean permeability of each member at elevation 520-550m*
+	V	12 LU
⊙	F_1 F_2	175 LU
⊡	F_3	57 LU
△	L	58 LU
>	Meira en *More than*	
<	Minna en *Less than*	

Niðurstöður lektarmælinga í VF borholum. Tekinn er miðpunktur hverrar færu, sem mæld var og reiknuð hæð hans í my.s. Tölurnar fyrir ofan tákna no. kjarnaholu.

The results of permeability testing in VF-boreholes. The elevation of the midpoint of each tested interval is calculated. The numbers of the boreholes are shown above the symbols.

Sjá staðsetningar á fylgiskjölum 3.12 og 3.13
For Locations, – see Exhibits No. " and "

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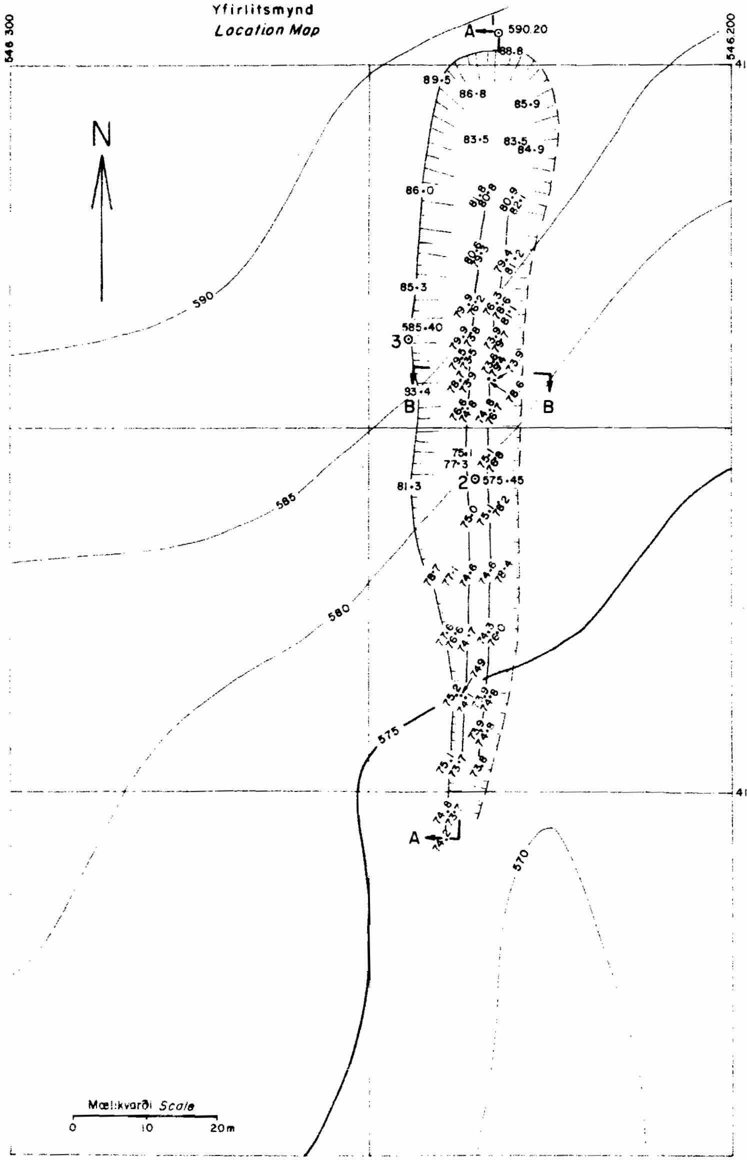
ÞÓRISVATN VATNSFELL
LEKTARMÆLINGAR Í VF BORHOLUM
Permeability tests in VF-Boreholes

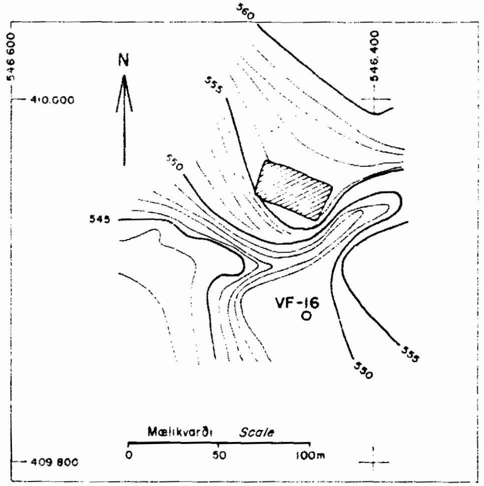
15.11.'69 IK/EK	Tnr 86 B-332	Fnr. 9112

Gryfja í myndun F_2 með töluverðum sandlinsum
Trench in unit F_2 with considerable sand lenses

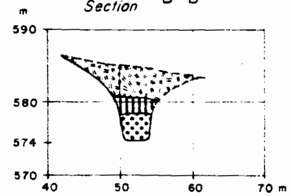
Yfirlitsmynd
Location Map



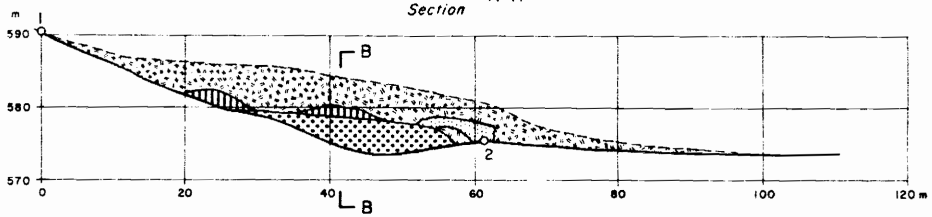
Prufugryfja til rippunnar á bólstrabergi
Test pit for ripping pillow lava



Þversnið B-B
Section



Langsnið A-A
Section



SKÝRINGAR / *LEGEND*

- Bólstrabreksía og bólstraberg / *Pillow breccia and Pillow lava*
- Basalt æð / *Basaltic vein*
- Grófkornóttur sandur og bólstrabrot / *Coarse grained sand with fragmented pillows*
- Fínkornóttur sandur / *Finegrained sand*

Staðsetningar, sjá fylgiskjal 3.12 og 3.13
Locations see Exhibit No. 3.12 and 3.13

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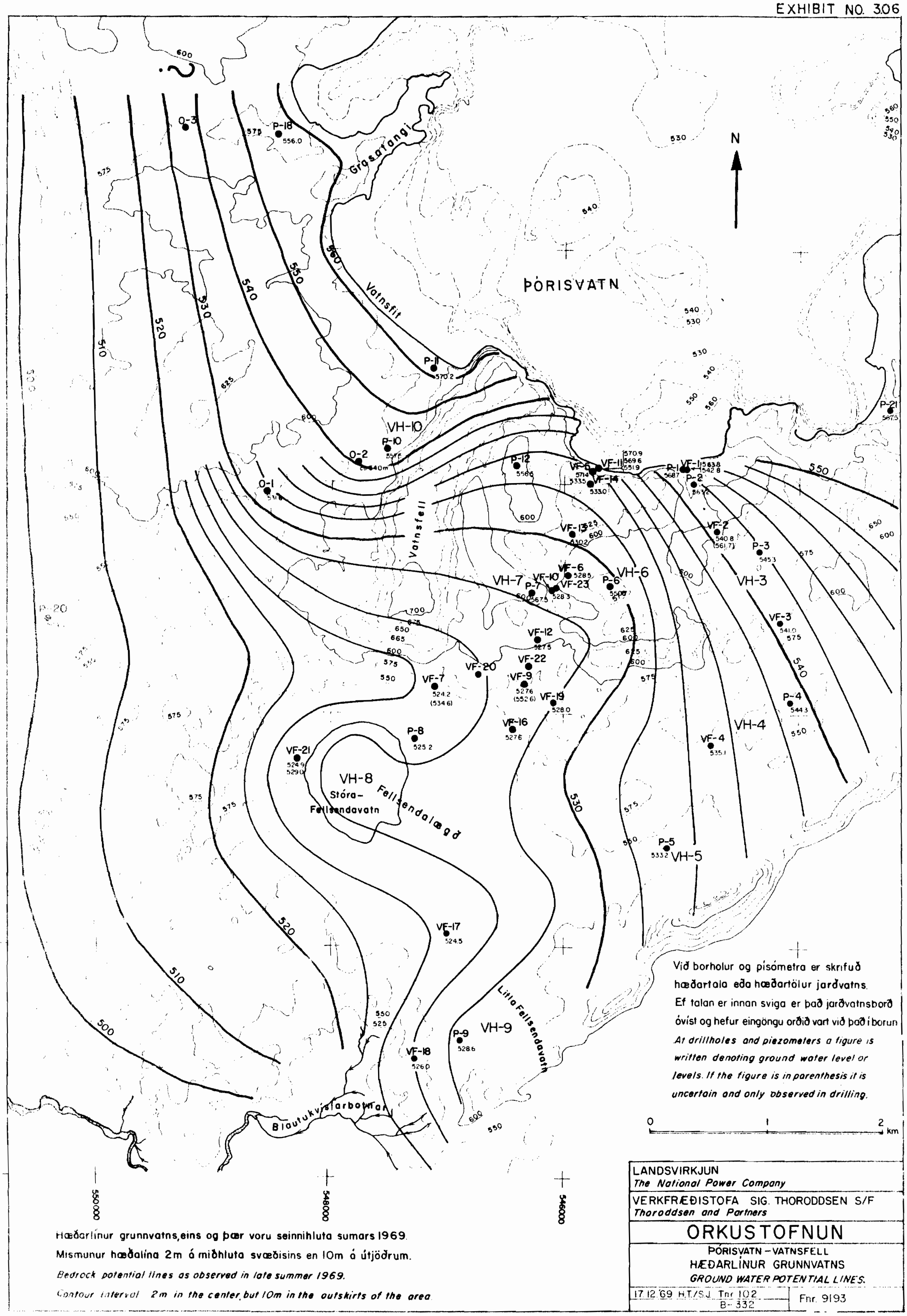
ÞÓRISVATN VATNSFELL RIPPUNAR OG ATHUGUNAR GRYFJUR *RIPPING AND OBSERVATION TRENCHES*	
Jan 1970 HT/Gyða	Tnr 125 B-332
	Fnr 9290



Við borholur og písómetra er skrifuð hæðartala eða hæðartölur jarðvatns. Ef talan er innan sviga er það jarðvatnsborð óvíst og hefur eingöngu orðið vart við það í borun.

At drillholes and piezometers a figure is written denoting ground water level or levels. If the figure is in parenthesis it is uncertain and only observed in drilling.

0 — 1 — 2 km

Hæðarlínur grunnvatns, eins og þær voru seinnihluta sumars 1969.
Mismunur hæðalína 2m á miðhluta svæðisins en 10m á útjöðrum.
Bedrock potential lines as observed in late summer 1969.
Contour interval 2m in the center, but 10m in the outskirts of the area.

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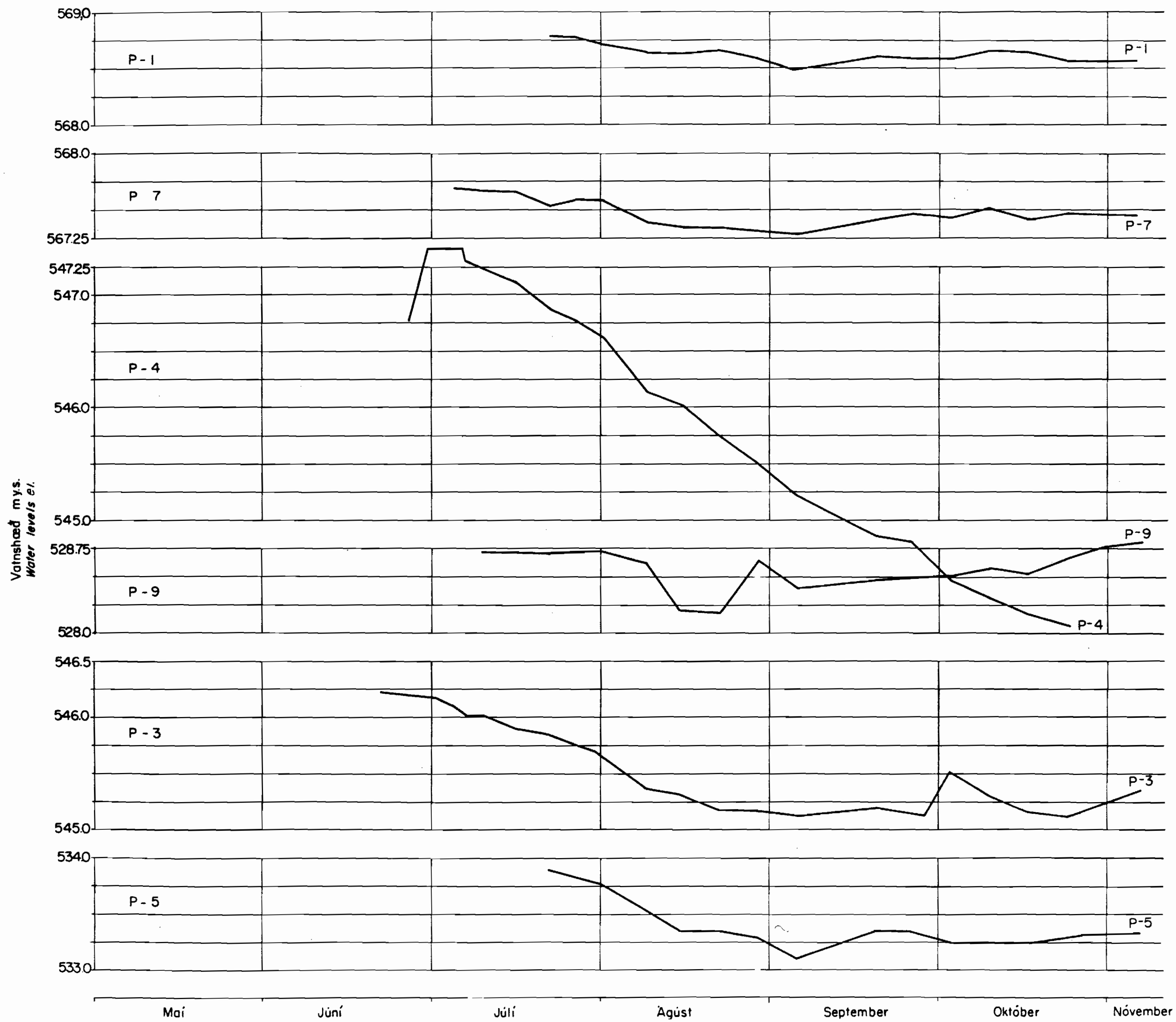
ÞÓRISVATN – VATNSFELL
HÆÐARLÍNUR GRUNNVATNS
GROUND WATER POTENTIAL LINES.

17.12.'69 H.T./S.J. Tnr 102 B-332	Fnr. 9193



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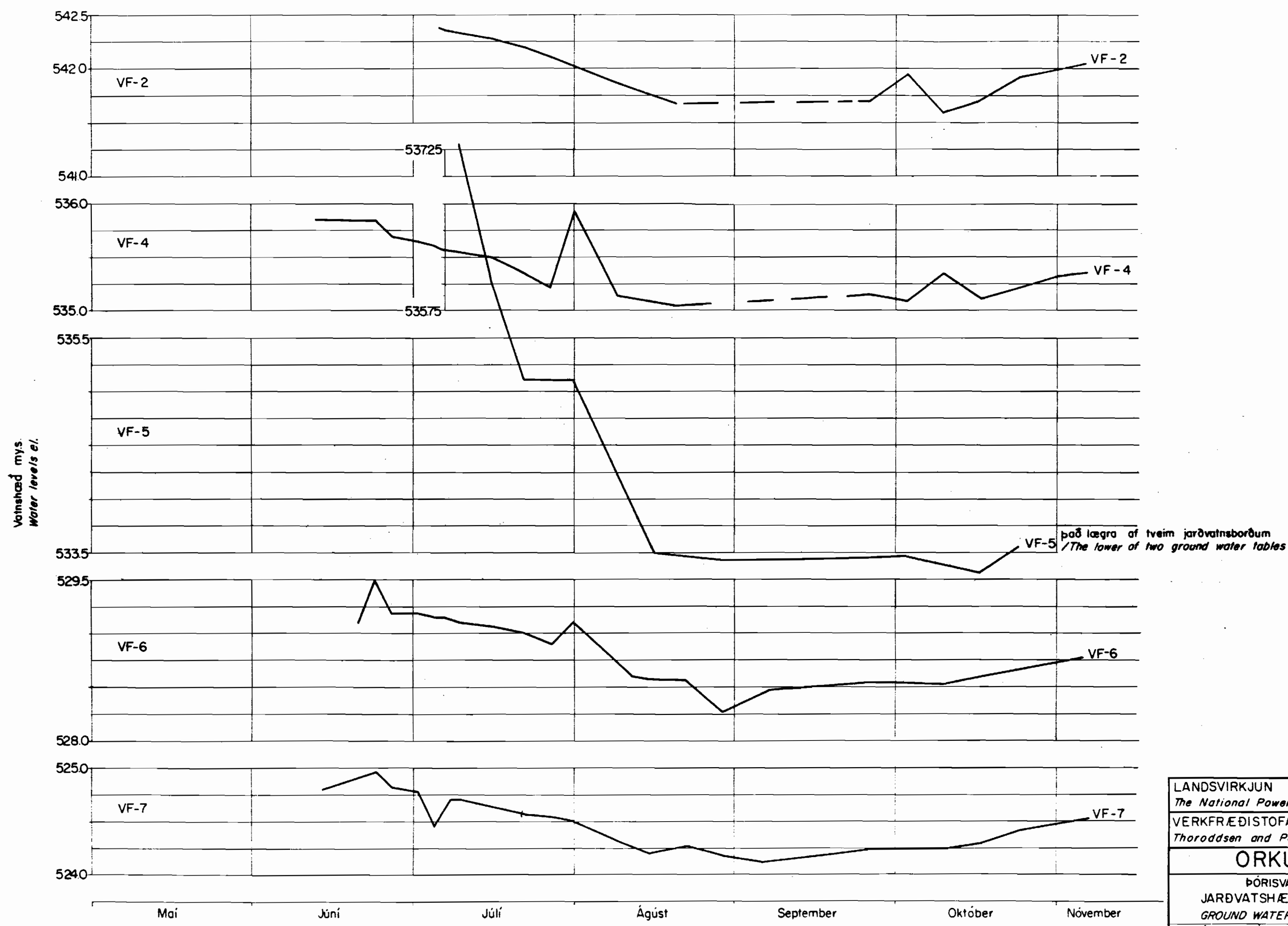
VERKFRÆÐISTOFA SIG THORODDSEN S/F *Thoroddsen and Partners*		
ORKUSTOFNUN		
ÞÓRISVATN VATNSFELL JARÐVATNSHÆÐ Í PÍSÓMETRUM *GROUND WATER LEVELS IN PIEZOMETERS*		
25/11 '69 P.L/S.J.	Tnr. 94 B 332	Fnr. 9125



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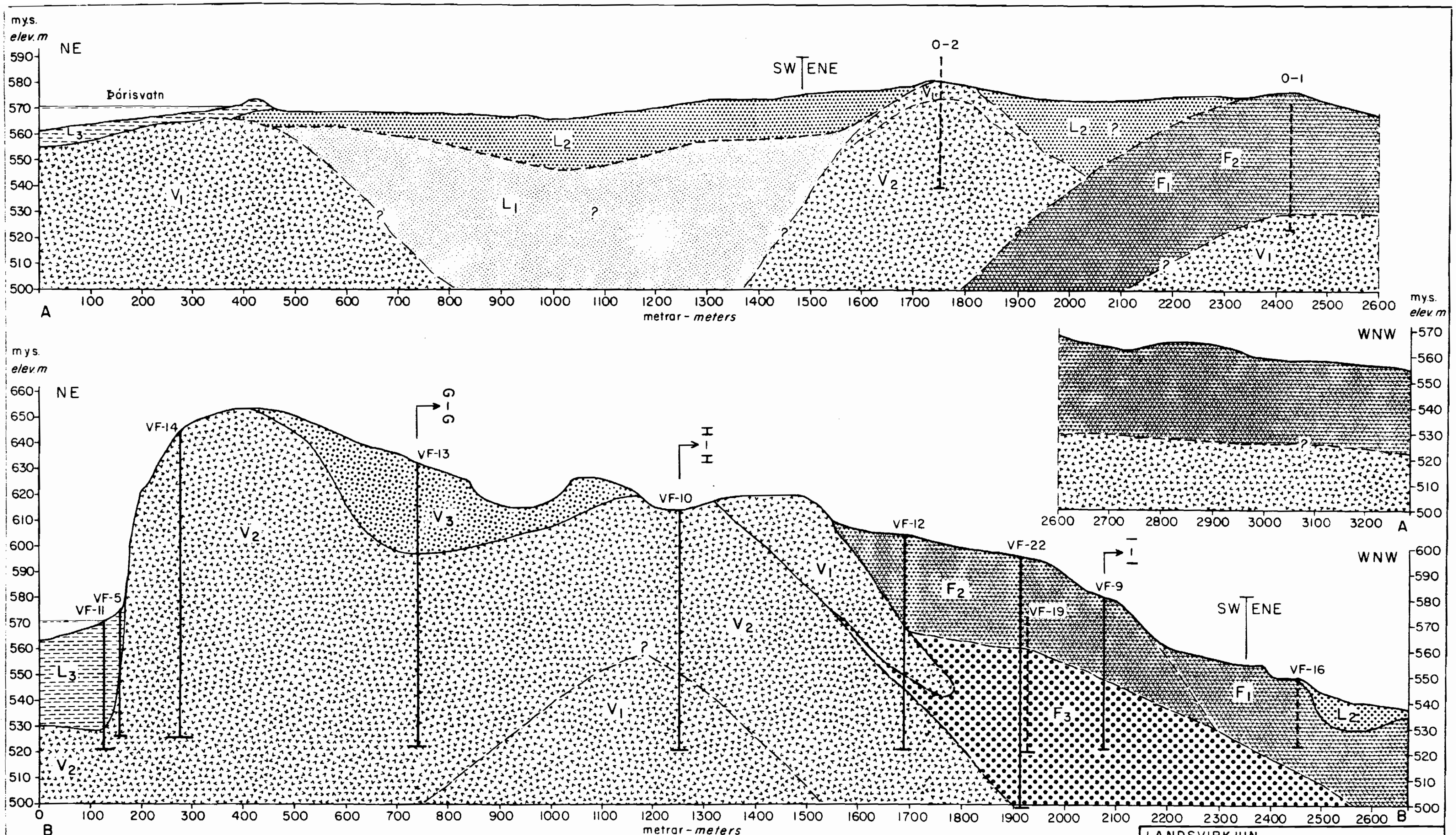
ÞÓRISVATN VATNSFELL JARÐVATSHÆÐ I KJARNABORHOLUM *GROUND WATER IN CORE BOREHOLES*	
8/12 '69 HT/SJ. Tnr. 99 Bb 332	Fnr. 9190



Skýringar, sjá fylgiskj. 3.11
Legend, see Exhibit No 3.11

Staðsetning sjá fylgiskj. 3.01
Location see Exhibit No. 3.01

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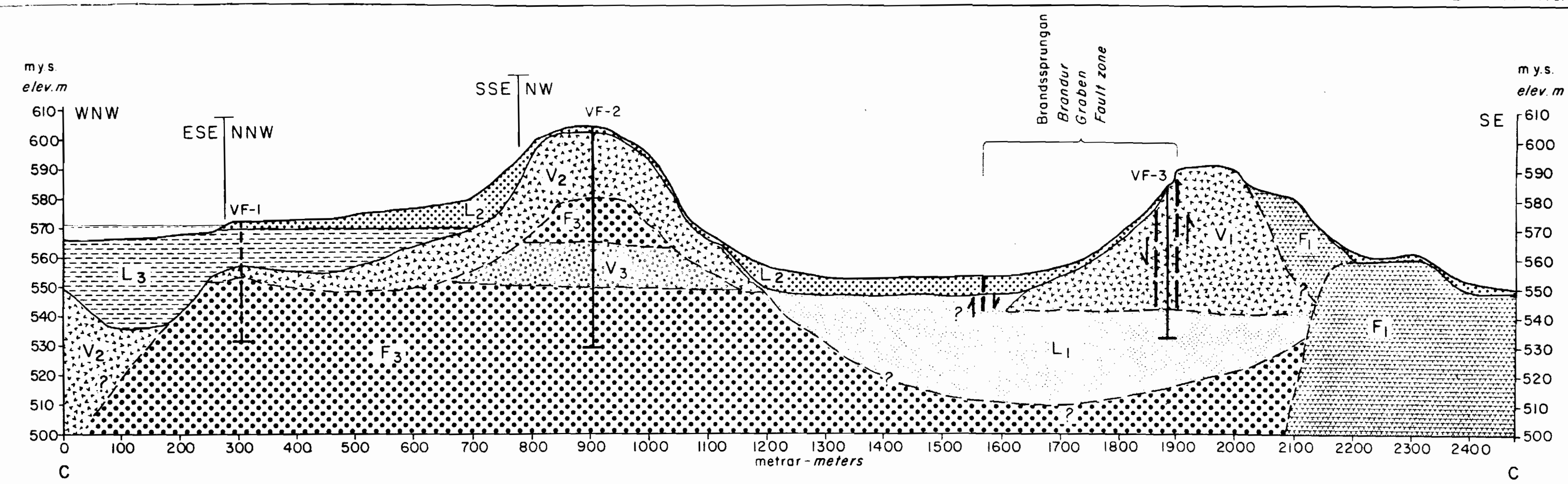
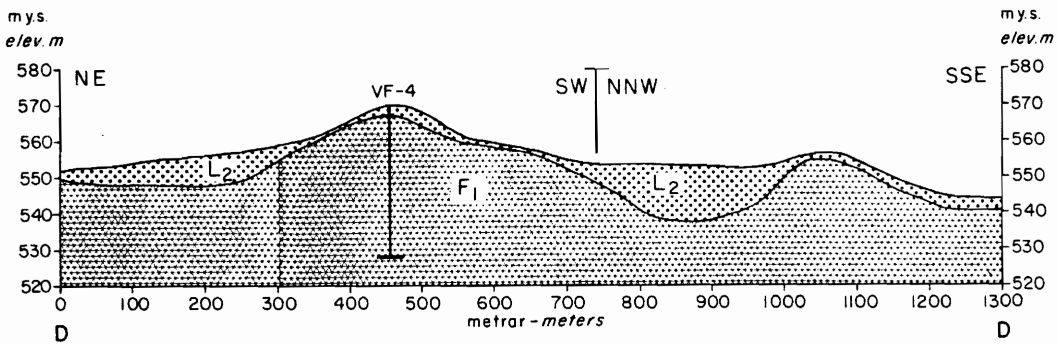
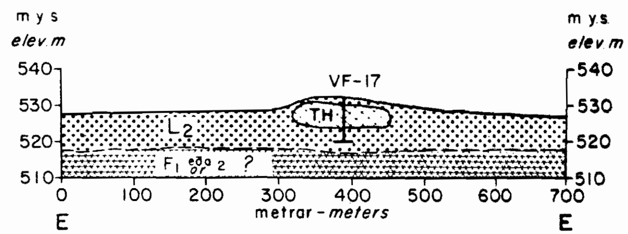
ÞÓRISVATN VATNSFELL
Jarðlagasnið
Geological sections

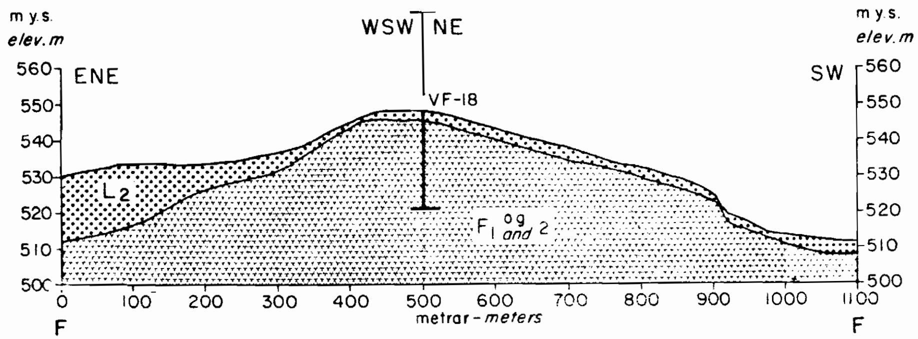
26.11.'69 E.GV/IS.	Tnr. 93	Fnr. 9115
Blað 1 af 3	B-332	

EXHIBIT NO. 3.10









Skýringar, sjá fylgiskj. 3.11
Legend, see Exhibit 3.11

Staðsetnig, sjá fylgiskj. 3.01
Location, see Exhibit 3.01

LANDSVIRKJUN *The National Power Company*
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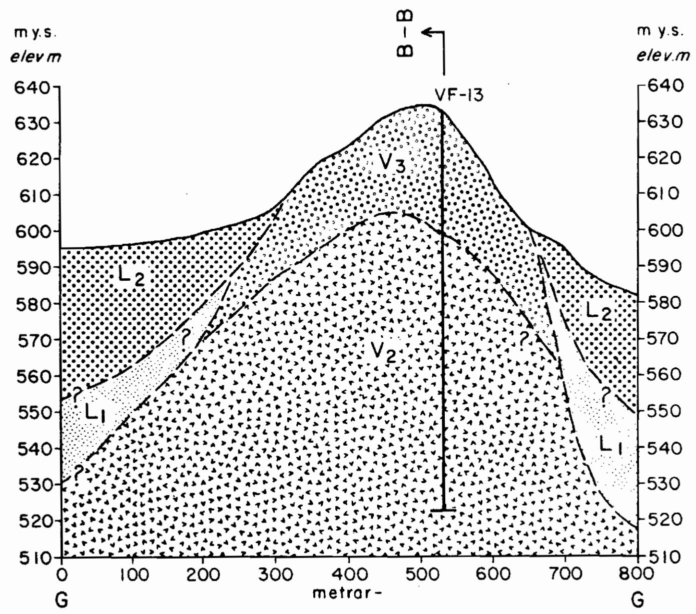
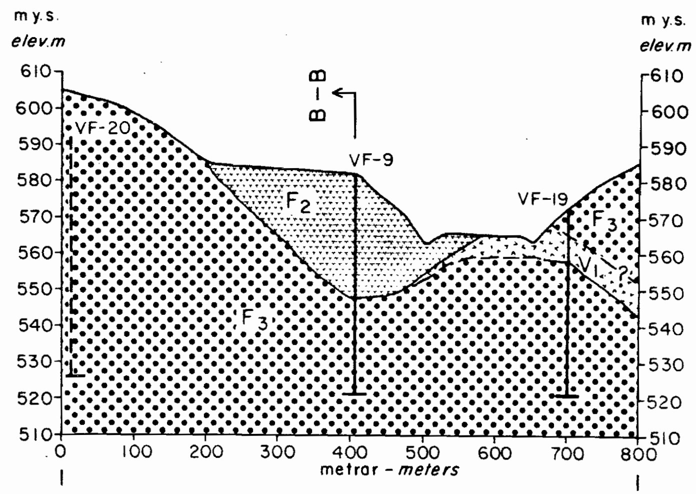
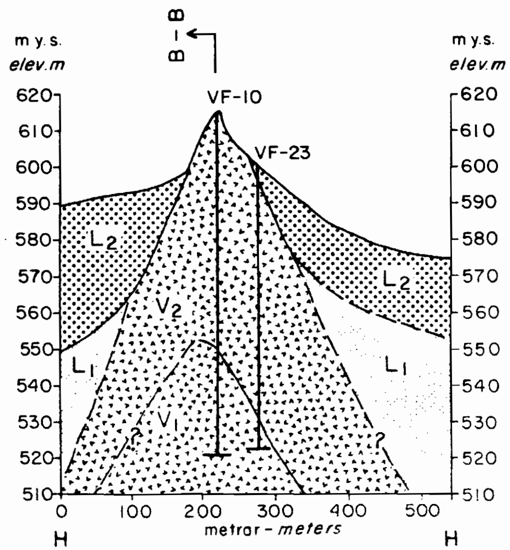
ÞÓRISVATN VATNSFELL Jarðlagasnið *Geological sections*
26.11.69 EGV/IS — Tnr. 93 — Fnr. 9120
Blað 2 of 3 — B-332







SKÝRINGAR – *LEGEND*

- L_1 Túffsandur, vel pakkaður — *Tuffaceous sand, well packed*
- L_2 Sandur, mest aðfokinn vikur og aska — *Sand, mostly winddrifted tephra*
- L_3 Strand og vatnaset — *Beach and lake deposits*
- V_1 Móberg, þétt, fr. fínkornótt — *Móberg, dense, fine grained*
- V_2 Móberg, gropið, og grófkornótt — *Móberg, porous, andcoarse grained*
- V_3 Móberg, gropið, finlagskipt — *Móberg, porous, stratified*
- F_1 Bólstraberg, heillegt — *Regular pillow lava*
- F_2 Bólstraberg, sandríkt og brotið. — *Pillow lava, sand filled and brecciated*
- F_3 Bólstrabreksia mjög sandrík — *Pillow breccia, highly sand filled*

Frh.

- Borhola í jarðlagasniði — *Drill hole located along section*
- Borhola utan við jarðlagasnið — *Drill hole projectet to section*
- Breytt stefna á jarðlagasniði — *Section turns*
- Óviss berglagaskil — *Uncertain rock contacts*

Staðsetning, sjá fylgiskjal 3.01
Location, see Exhibit No. 3.01

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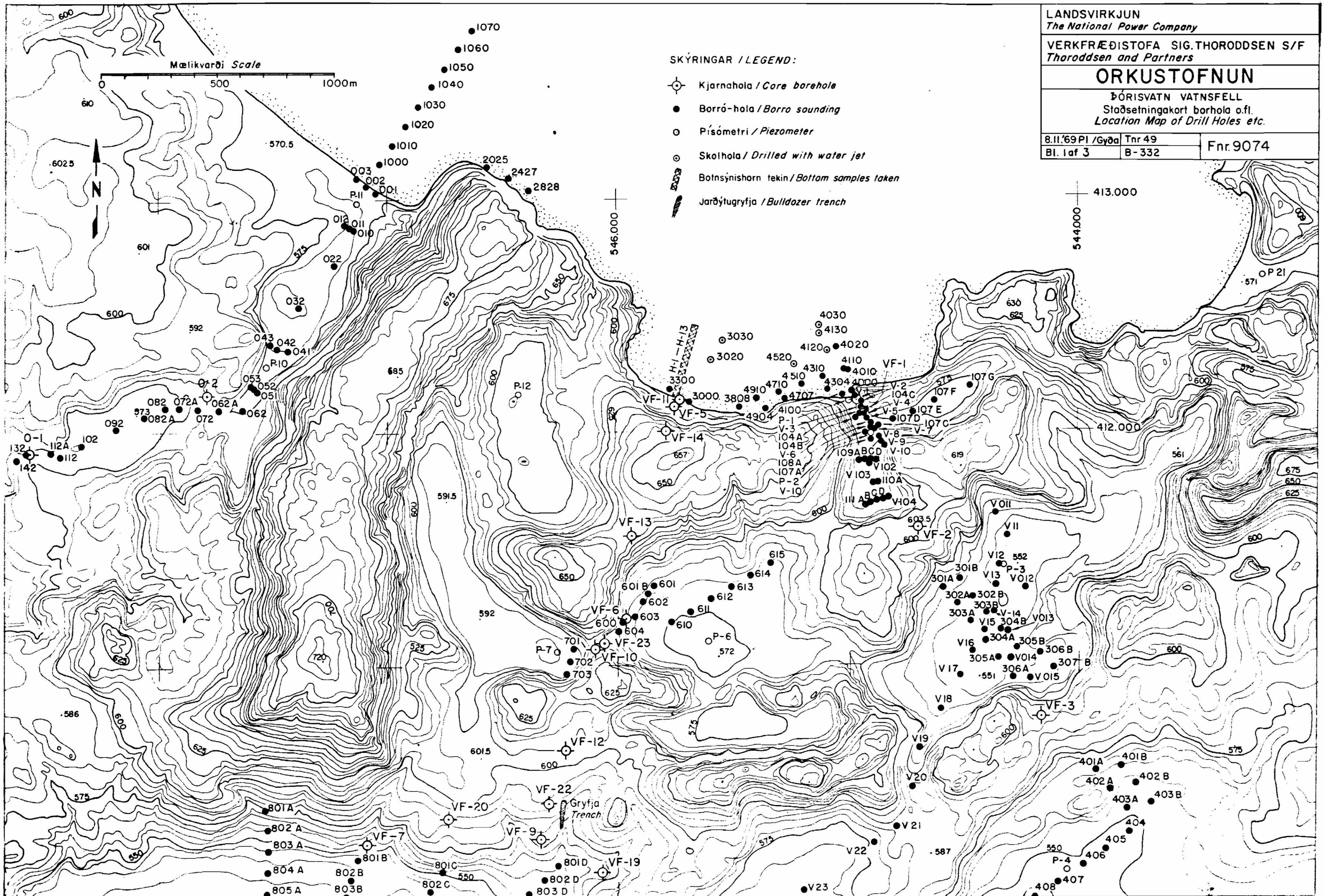
ÞÓRISVATN VATNSFELL
Jarðlagasnið
Geological sections

26.11.'69 EGV/IS | Tnr. 93 | Fnr. 9121
Blað 3 of 3 | B-332

EXHIBIT NO. 3.12



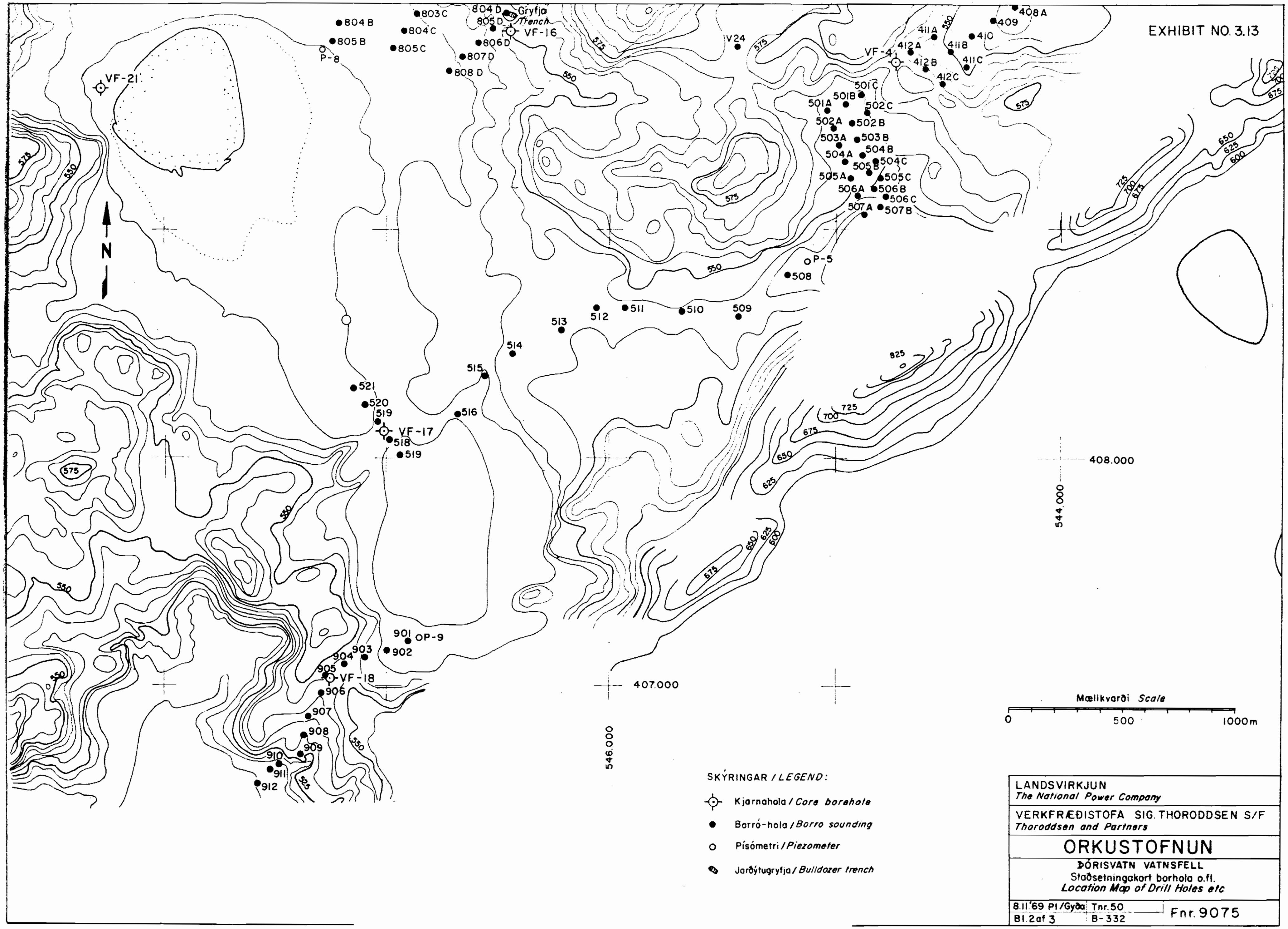


EXHIBIT NO. 3.13
SKÝRINGAR / LEGEND:
Kjarnahola / Core borehole
Borró-hola / Borro sounding
Písómetri / Piezometer
Jarðýtugryfja / Bulldozer trench
Mælikvarði Scale
0 500 1000m
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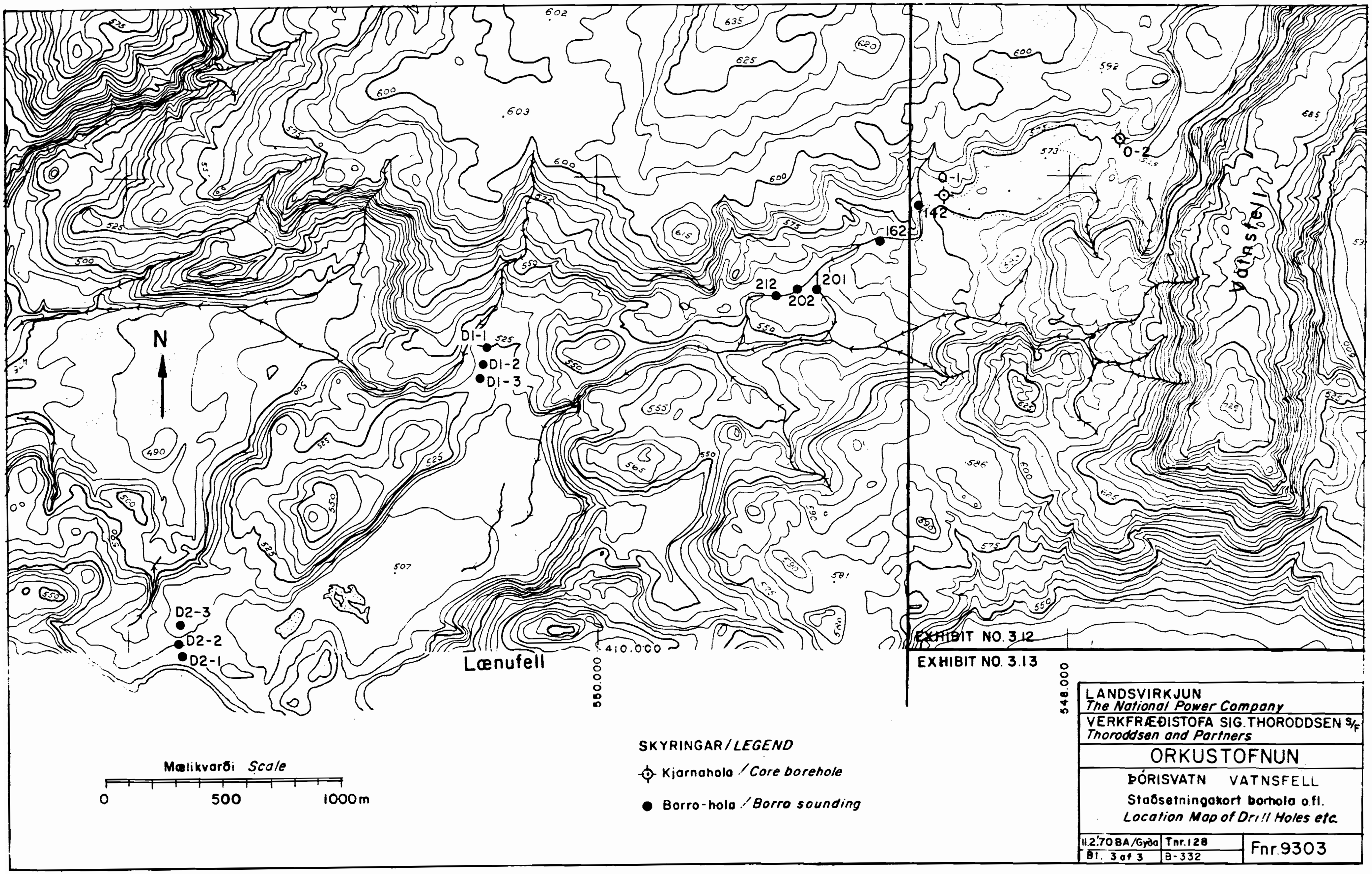
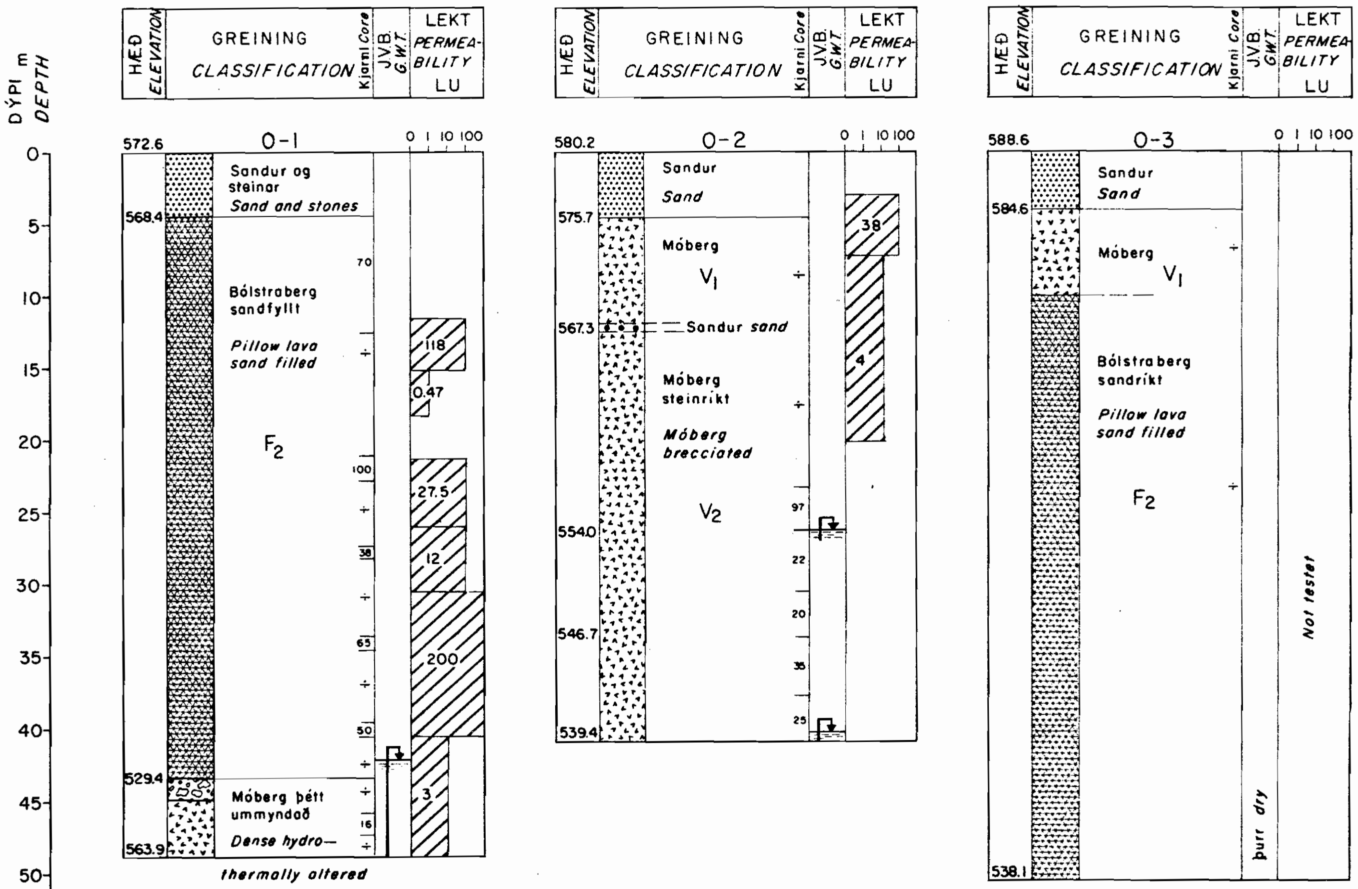
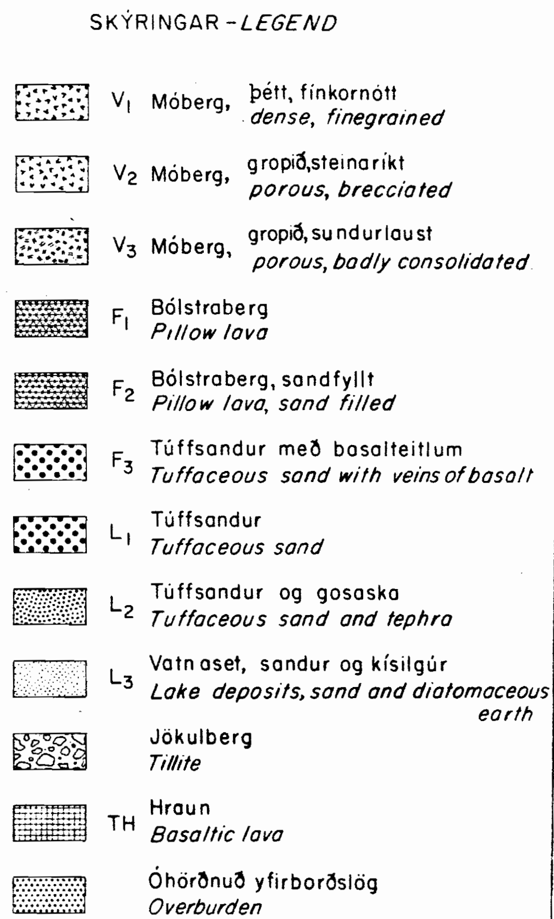
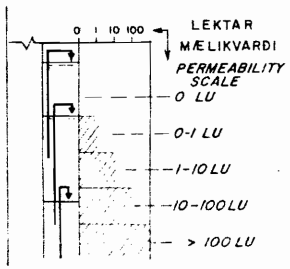
ÞÓRISVATN VATNSFELL
Staðsetningakort borhola o.fl.
Location Map of Drill Holes etc
8.11.'69 Pl/Gyða Tnr. 50
Bl. 2 af 3 B-332
Fnr. 9075
408.000
407.000
544.000
546.000

EXHIBIT NO. 3.14









LEKTAR- OG JARÐVATNS ÚTSKÝRING
NOTE ON PERMEABILITY AND GROUND WATER

Jarðvatnsborð er sýnt með örvum. Neðri endi örvarinnar sýnir holudýpið, þegar jarðvatnsborð breyttist. Jarðvatnsörvunum er raðað frá vinstri til hægri í sömu röð og jarðvatn breytist.
Ef jarðvatn breytist ekkert í borun, nær örin í botn

Ground water levels are shown by arrows. Base of the arrows indicates the hole depth when water level changed. Successive levels shown from left to right in the same sequence as observed during drilling. If no change in level was observed the arrow reaches the hole bottom.

1 LU = Lugeon Unit = 1 l/min/m = 76 mm Ø holu við þrýsting 10 kg/cm²

1 LU = Lugeon Unit = 1 l/min/m = 76 mm Ø hole at pressure 10 kg/cm²

Kjarni: Tölur sýna kjarnaheimtur í %
÷ kjarnataka ekki reynd

Core: Numbers indicate per cent core recovery
÷ core sampling not attempted

Abbreviations: Diat. diatomaceous.
Tuff. tuffaceous.
w. with.

Staðsetning, sjá fylgiskjöl 3.06, 3.12 og 3.14
Location, see Exhibit No 3.06, 3.12 and 3.14

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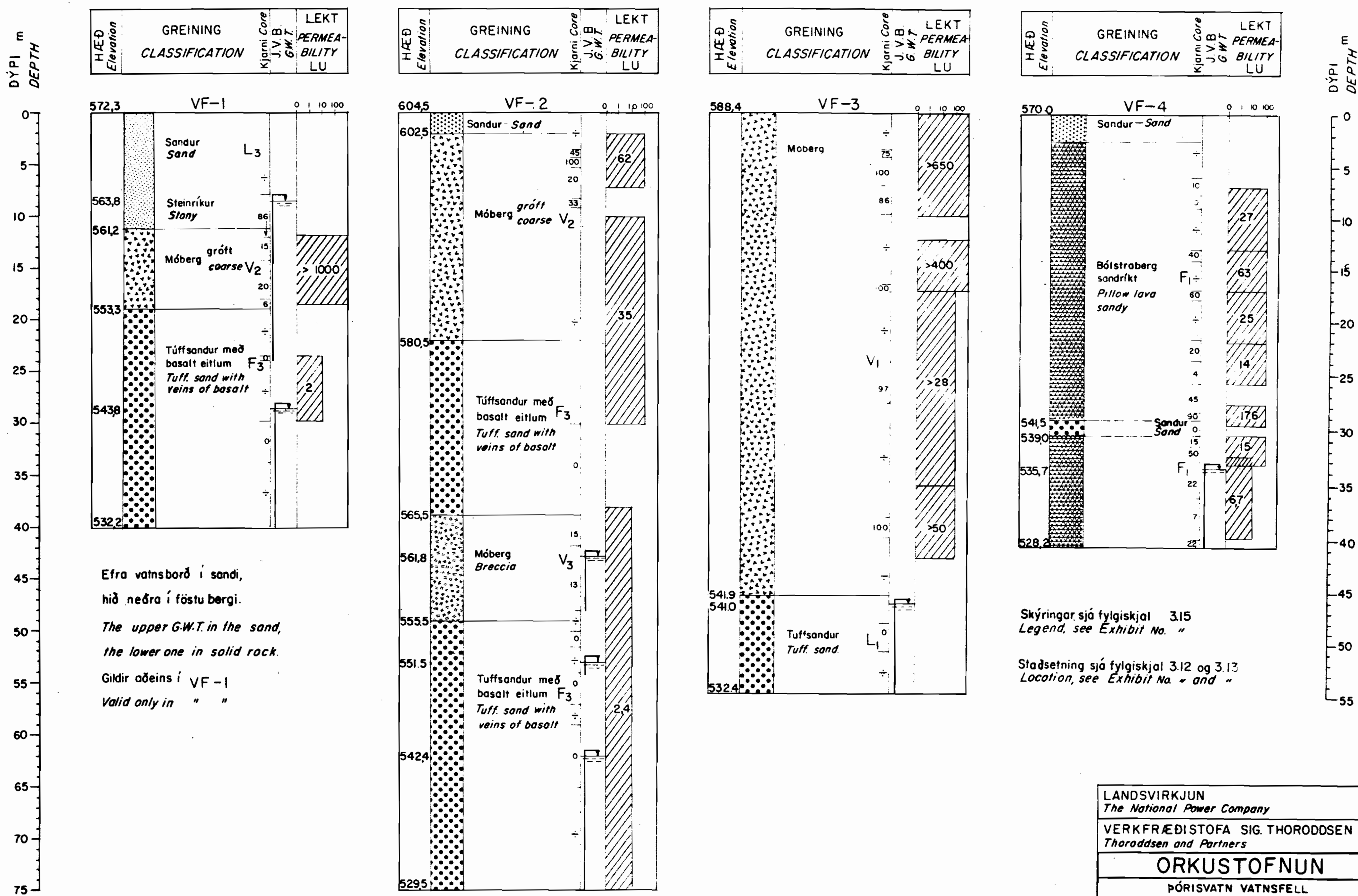
ORKUSTOFNUN
ÞÓRISVATN VATNSFELL SNIÐ AF BORHOLUM 0-1-0-3 *GRAPHIC CORE LOGS*
21.1.'70 EGV/IS · Tnr. 127 · Fnr 9292
Blað 1 af 7 · B-332

EXHIBIT NO. 316



Efra vatnsborð í sandi, hið neðra í föstu bergi.
The upper G.W.T. in the sand, the lower one in solid rock.
Gildir aðeins í VF-1
Valid only in " "

Skýringar sjá fylgiskjal 3.15
Legend, see Exhibit No. "

Staðsetning sjá fylgiskjal 3.12 og 3.13
Location, see Exhibit No. " and "

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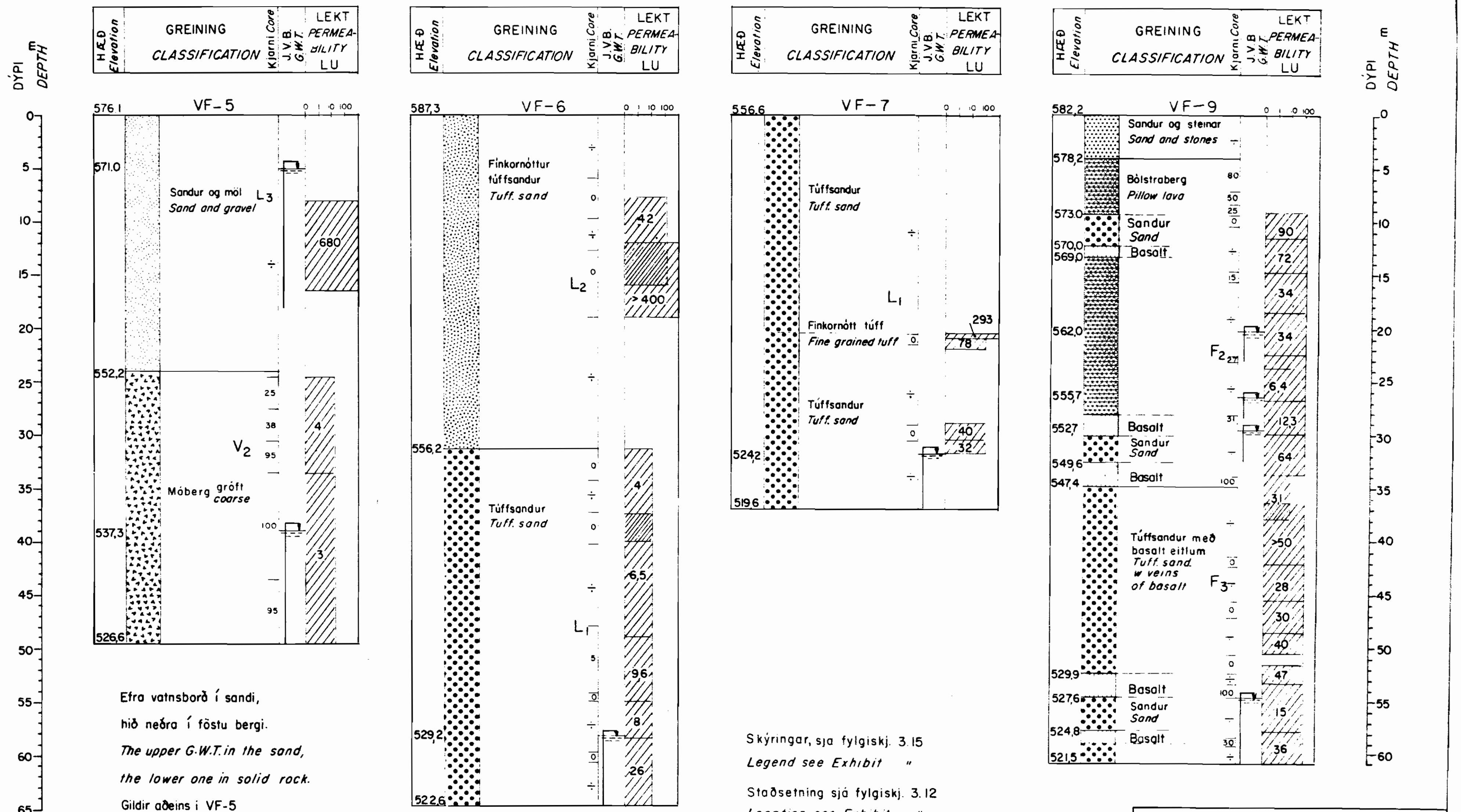
ÞÓRISVATN VATNSFELL
SNIÐ AF BORHOLUM VF-1—VF-4
GRAPHIC CORE LOGS

6.11.'69 BA/EK | Tnr. 36 | Fnr. 9056
Bl. 2 af 7 | Bb-67 B-332

EXHIBIT NO. 3.17



Efra vatnsborð í sandi,
hið neðra í föstu bergi.
The upper G.W.T. in the sand,
the lower one in solid rock.
Gildir aðeins i VF-5
Valid only VF-5

Skýringar, sja fylgiskj. 3.15
Legend see Exhibit "

Staðsetning sjá fylgiskj. 3.12
Location see Exhibit "

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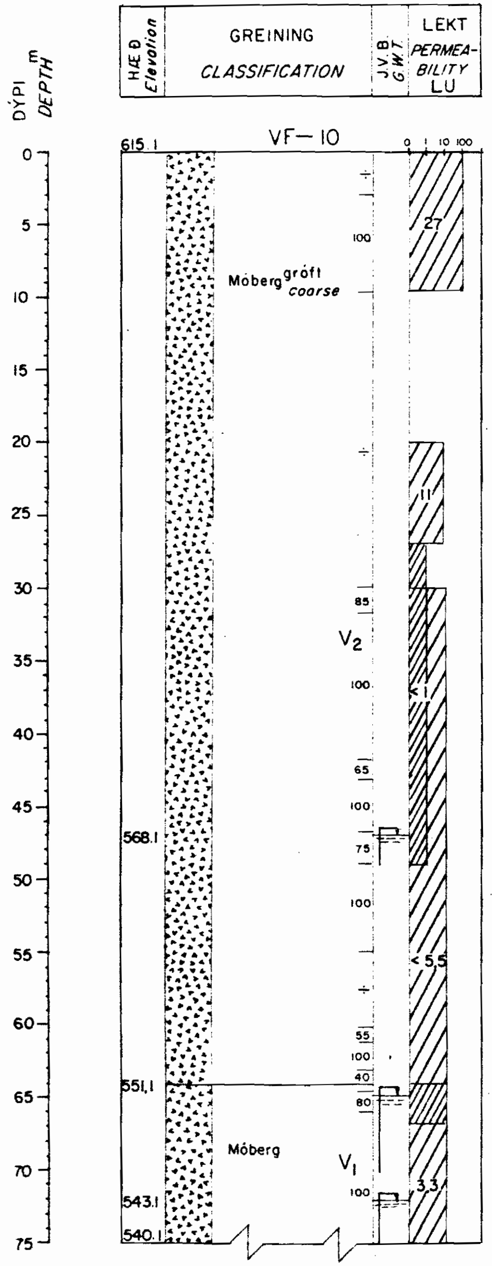
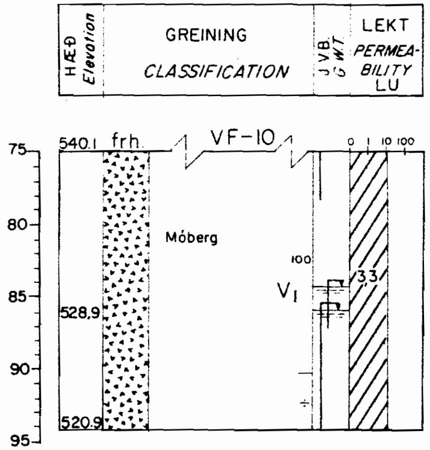
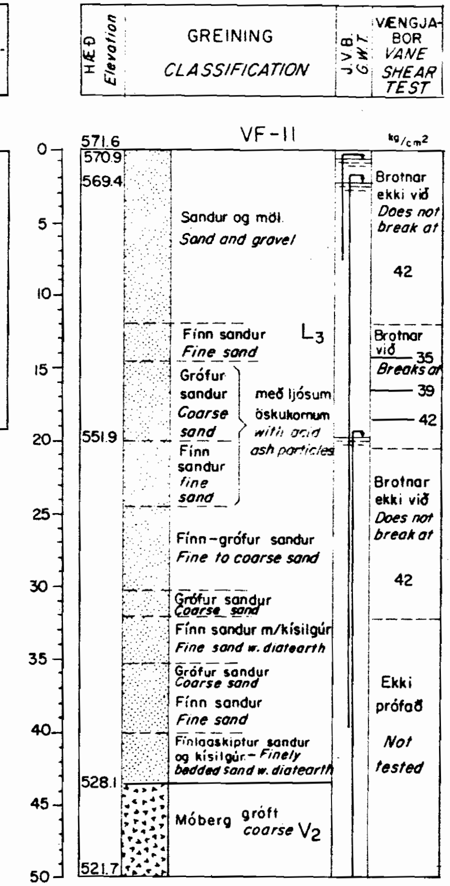
ÞÓRISVATN-VATNSFELL SNIÐ AF BORHOLUM VF-5-VF-9 *GRAPHIC CORE LOGS*	
10.11.'69 BA/Ei Tnr. 37 Bl. 3 af 7 Bb-68 B-332	Fnr 9057





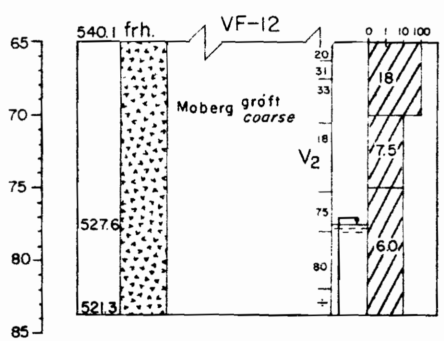


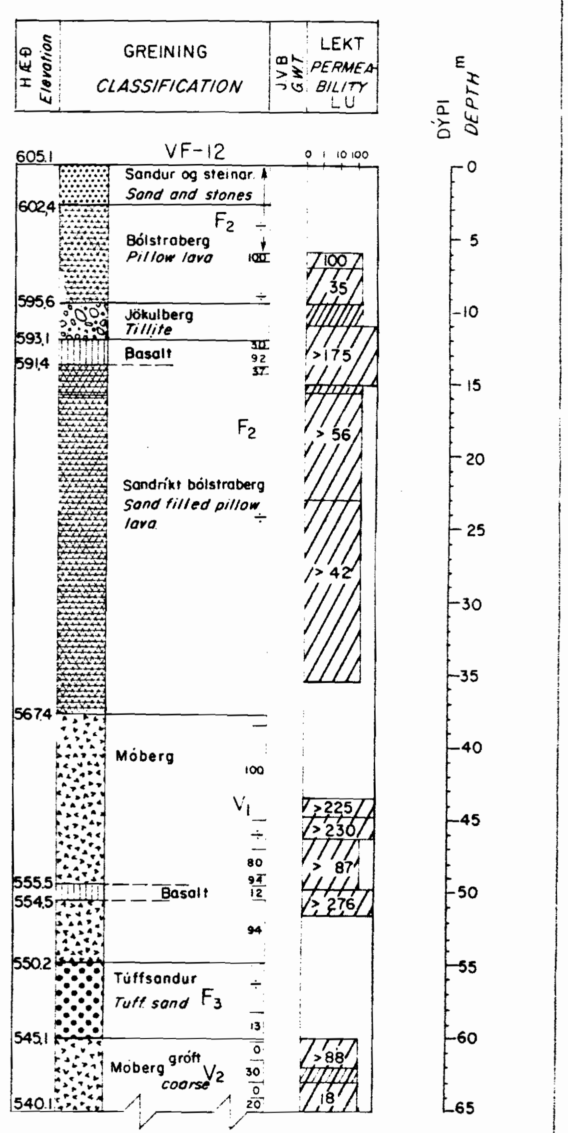
Jarðvatnsborð í VF–11 eru öll mæld eftir að borun lauk og sýna örvarnar hversu langt niður hvert rör nær.

The G.W.T.'s in VF–11 are all measured after the drilling was finished. The arrows show how far down each 3/4" pipe goes.

Skýringar, sjá fylgiskj. 3.15
Legend, see Exhibit "

Staðsetning sjá fylgiskj. 3.12
Location, see Exhibit "





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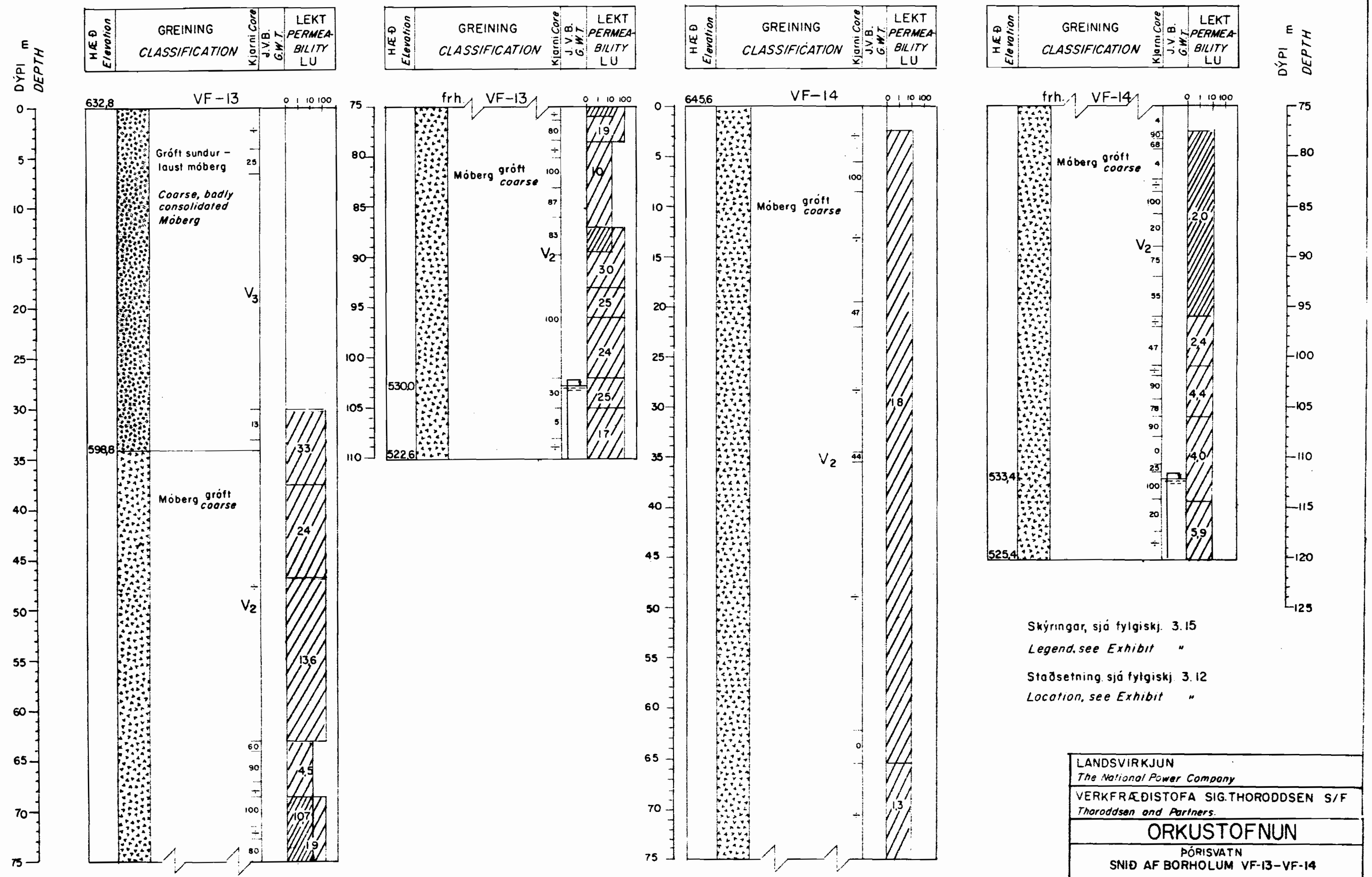
ÞÓRISVATN–VATNSFELL
SNIÐ AF BORHOLUM VF-10–VF-12
GRAPHIC CORE LOGS

8.11.'69 BA/EK	Tnr 38	Fnr. 9058
bl.4 af 7	Bb-69 B-332	



Skýringar, sjá fylgiskj. 3.15
Legend, see Exhibit "

Staðsetning, sjá fylgiskj. 3.12
Location, see Exhibit "

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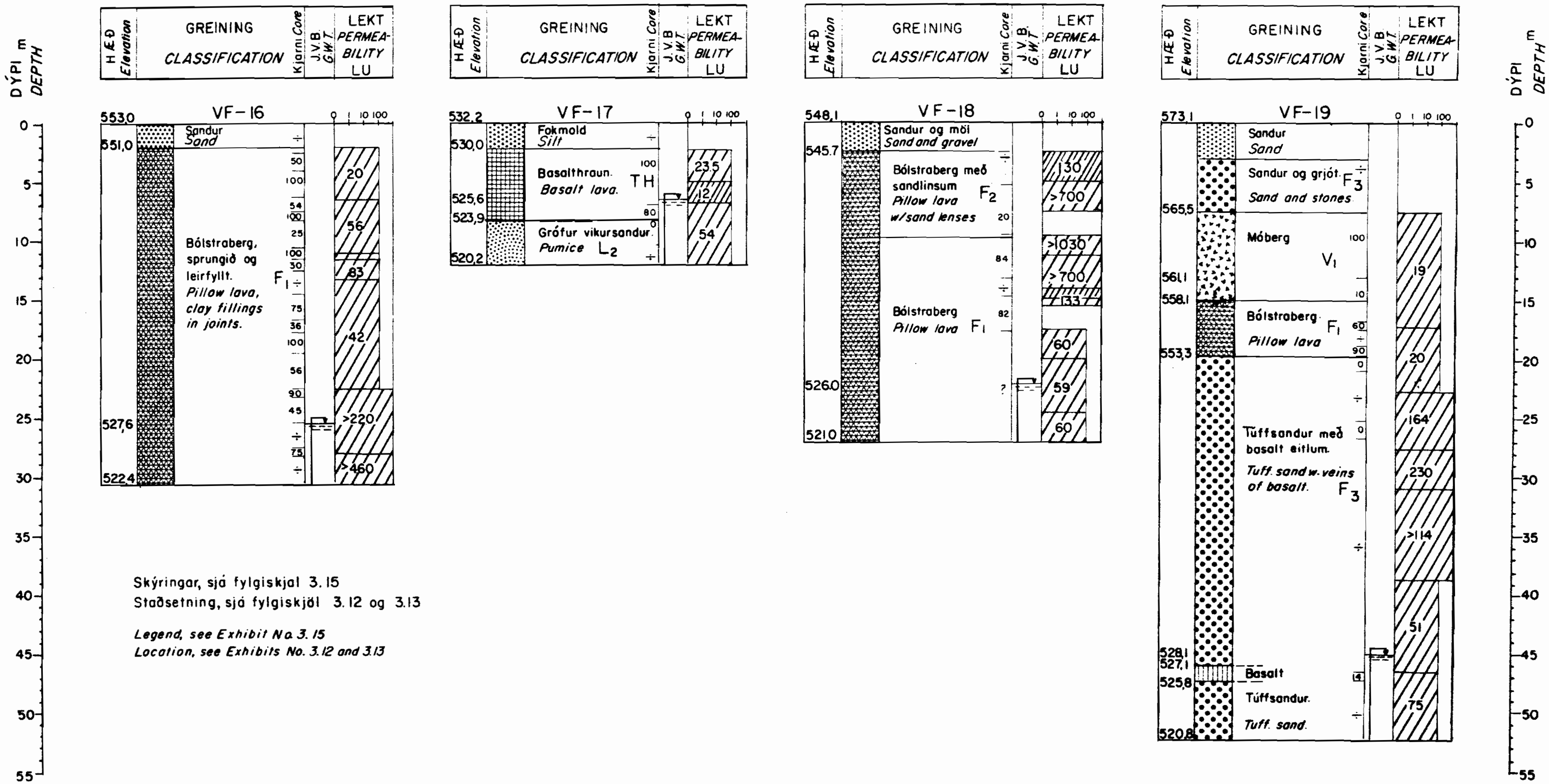
ÞÓRISVATN
SNIÐ AF BORHOLUM VF-13–VF-14
GRAPHIC CORE LOGS.

6.11.'69 BA/EK	Tnr. 39	Fnr. 9059
Bl. 5 of 7	Bb.-70 B-332	

EXHIBIT NO. 3.20



Skýringar, sjá fylgiskjal 3.15
Staðsetning, sjá fylgiskjöl 3.12 og 3.13

Legend, see Exhibit No. 3.15
Location, see Exhibits No. 3.12 and 3.13

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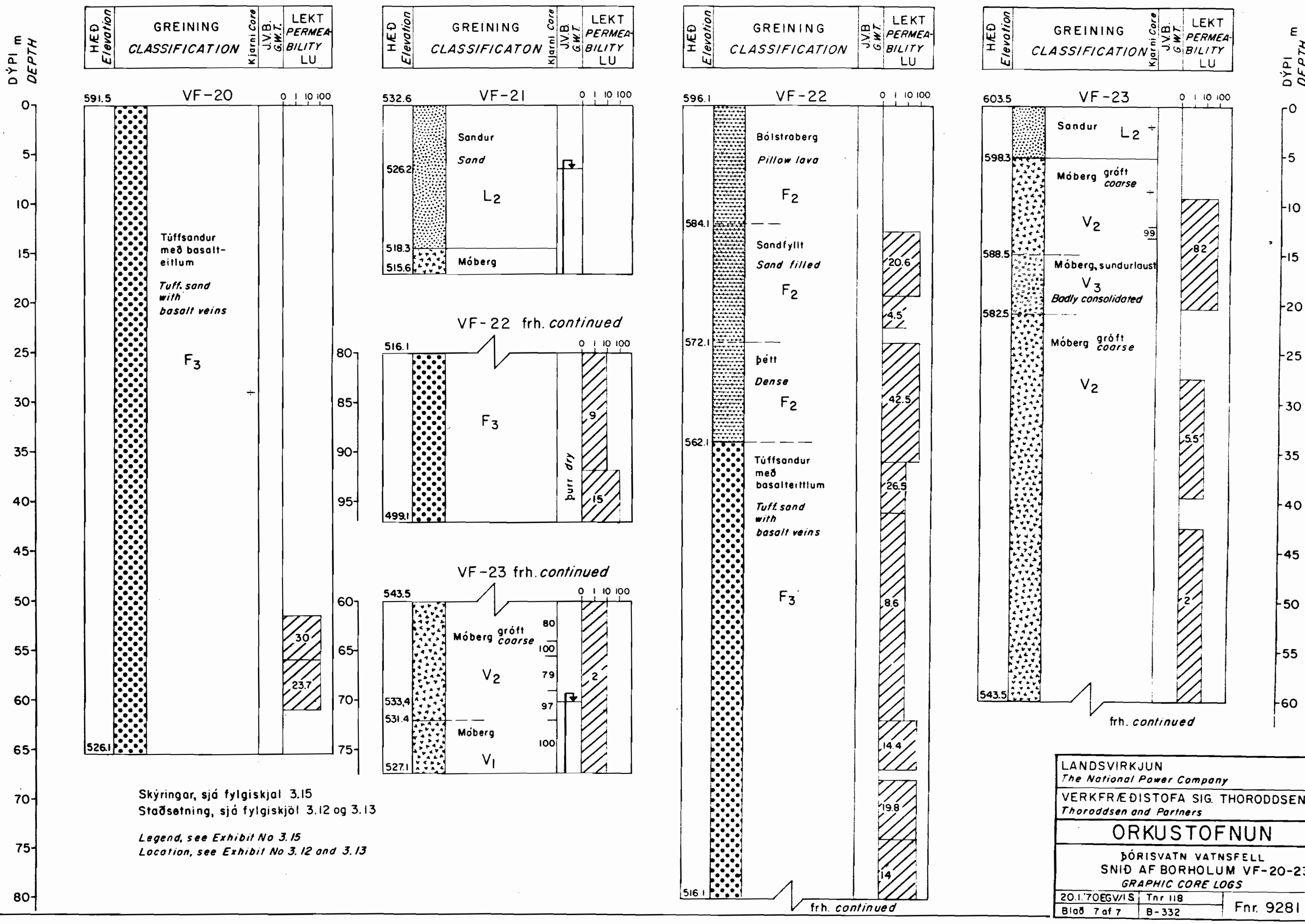
ORKUSTOFNUN	
ÞÓRISVATN VATNSFELL SNIÐ AF BORHOLUM VF-16–VF-19 *GRAPHIC CORE LOGS*	
7.11.'69 BA/EK Tnr. 40	Fnr 9060
Bl 6 of 7 Bb-71 B-332	



Skýringar, sjá fylgiskjal 3.15
Staðsetning, sjá fylgiskjöl 3.12 og 3.13

Legend, see Exhibit No 3.15
Location, see Exhibit No 3.12 and 3.13

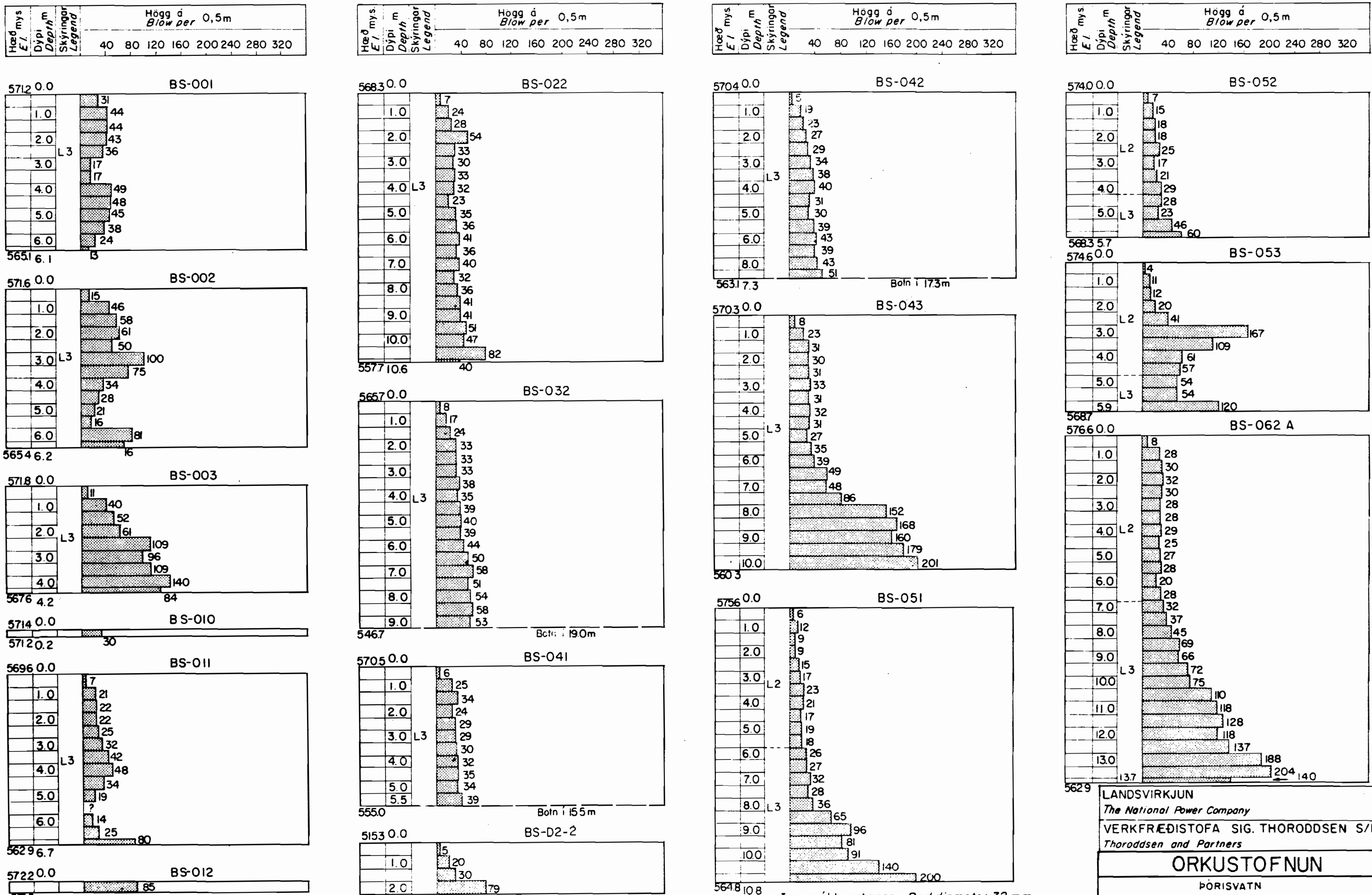
LANDSVIRKJUN
The National Power Company

VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN VATNSFELL
SNIÐ AF BORHOLUM VF-20-23
GRAPHIC CORE LOGS

20.1.'70EGV/IS	Tnr 118	Fnr. 9281
Blað 7 af 7	B-332	



Staðsetningar, sjá fylgiskjöl 3.12 og 3.14
Locations, see Exhibits No. 3.12 and 3.14

Skýringar, sjá fylgiskjal 3.28
Legend, see Exhibit No. 3.28

Þvermál borstanga – *Rod diameter 32 mm*
Þyngd lóðs – *Hammer weight 65 kg*
Fall lóðs – *Hammer drop 0,5 (in 1962 and 1967)*
Fall lóðs – *Hammer drop 1,0 (in 1969)*

LANDSVIRKJUN
The National Power Company

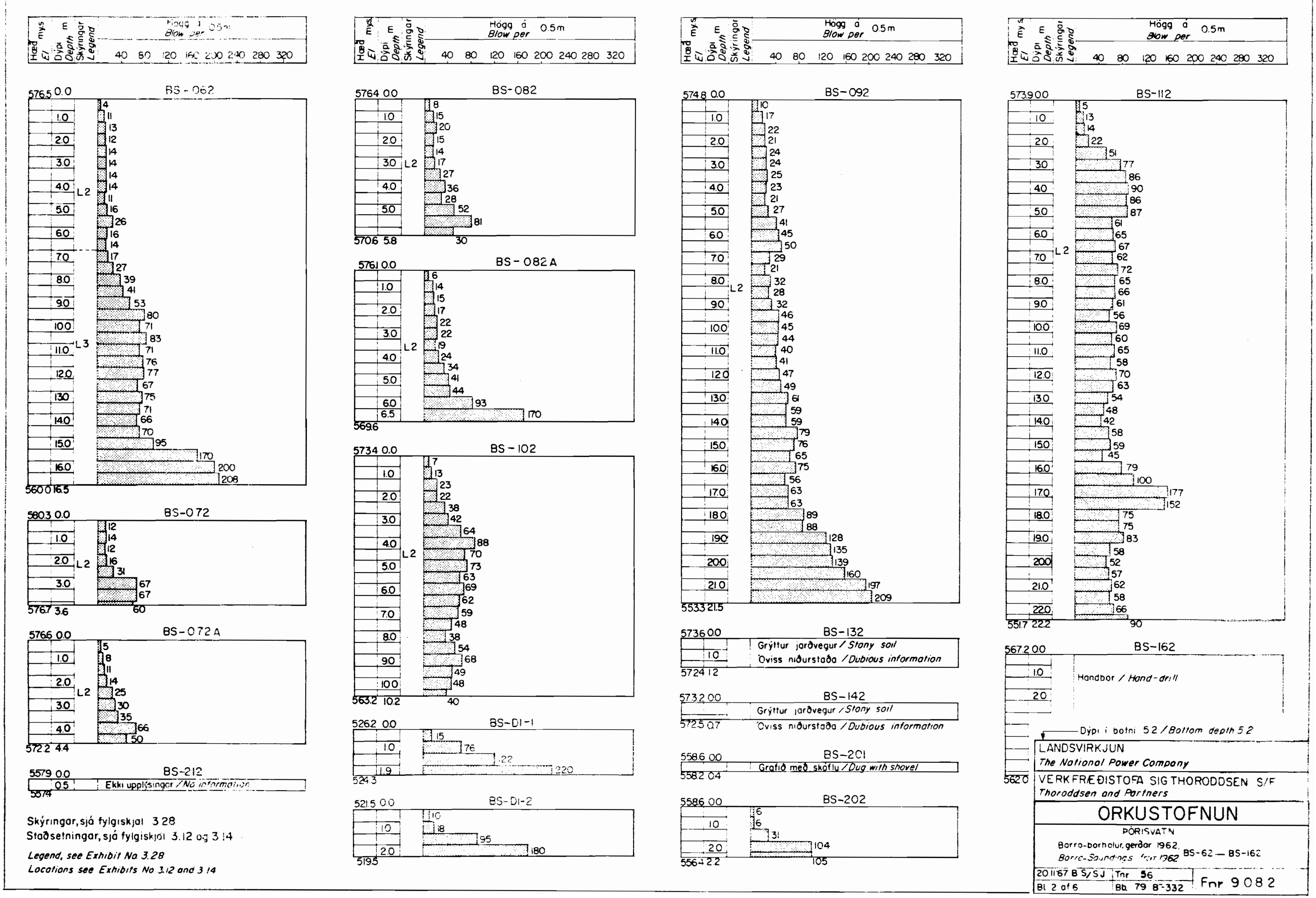
VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

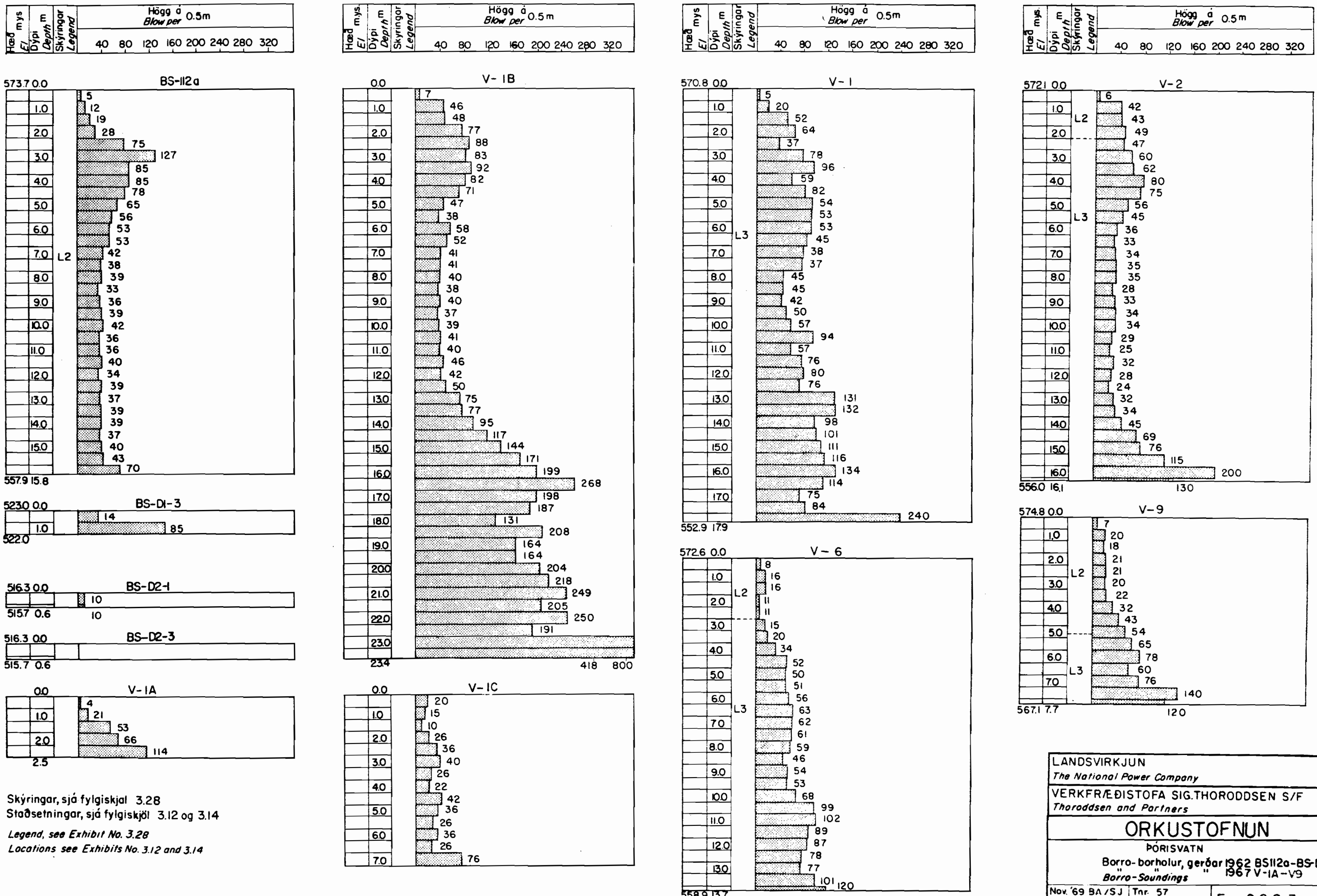
ORKUSTOFNUN

ÞÓRISVATN
Borro - borholur, gerðar 1962
Borro - Soundings from 1962
BS-001-062A

Nov 69 BA/SJ	Tnr. 55	Fnr. 9081
Bl 1 af 6	Bb 78 B-332	

EXHIBIT NO. 323





Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjöl 3.12 og 3.14

Legend, see Exhibit No. 3.28
Locations see Exhibits No. 3.12 and 3.14

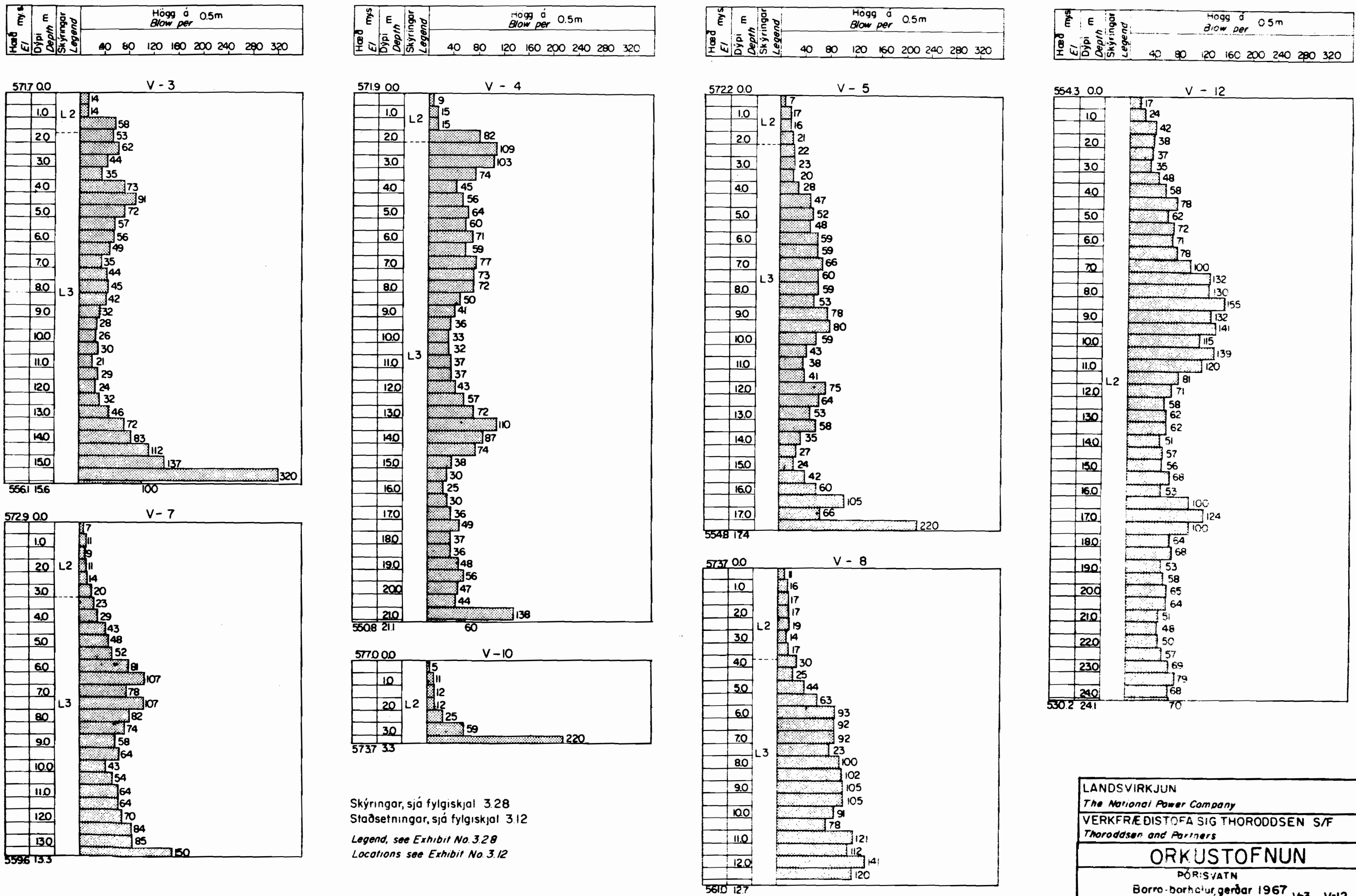
LANDSVIRKJUN
The National Power Company

VERKFRÆÐISTOFA SIG.THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN
Borro-borholur, gerðar 1962 BS112a-BS-D
" " 1967 V-1A-V9
Borro-Soundings

Nov. '69 BA/SJ | Tnr. 57 | Fnr. 9083
Bl. 3. of 6 | Bb. 80 B-332



Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

Legend, see Exhibit No. 3.28
Locations see Exhibit No. 3.12

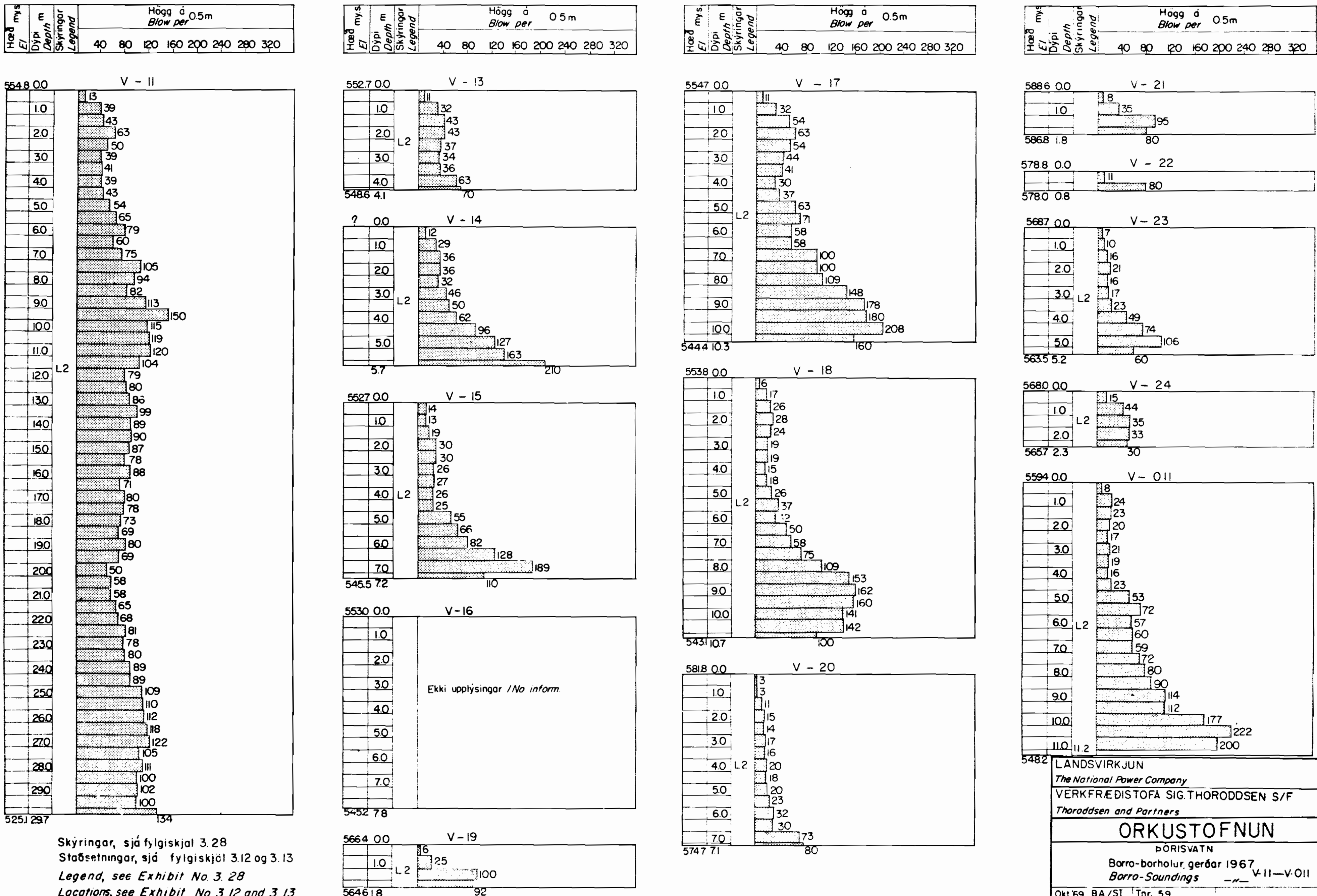
LANDSVIRKJUN
The National Power Company

VERKFRÆDISTOFA SIG THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN
Borra-borholur, gerðar 1967 V-3—V-12
Borra-Soundings -"-

Okt '69 BA/SJ | Tnr. 58 | Fnr. 9084
Bl 4 of 6 | Bb 83 - 8 - 332



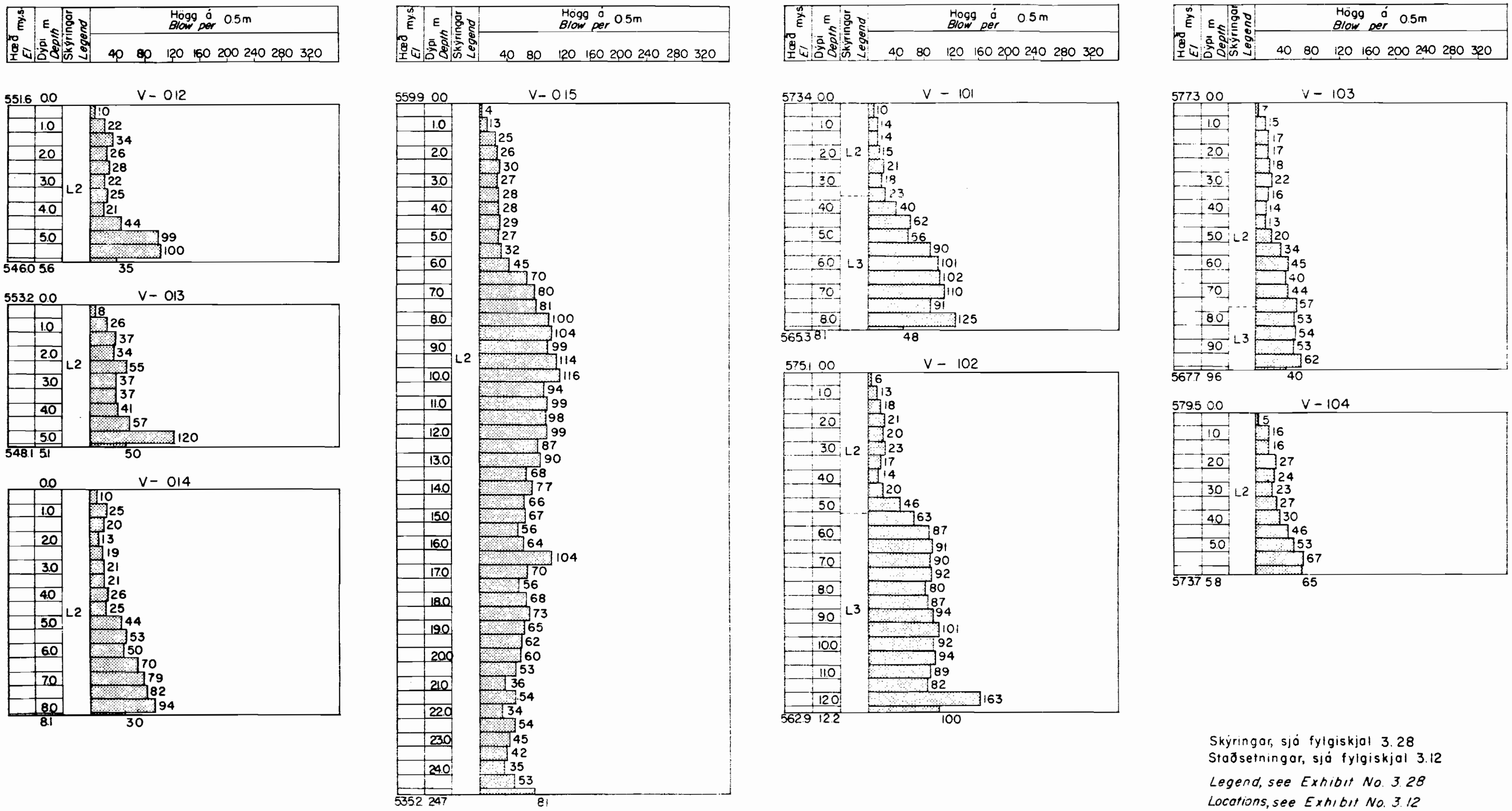
Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjöl 3.12 og 3.13
Legend, see Exhibit No. 3.28
Locations, see Exhibit No. 3.12 and 3.13

LANDSVIRKJUN
The National Power Company
VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN
Borro-borholur, gerðar 1967 V-11—V-011
Borro-Soundings —"—

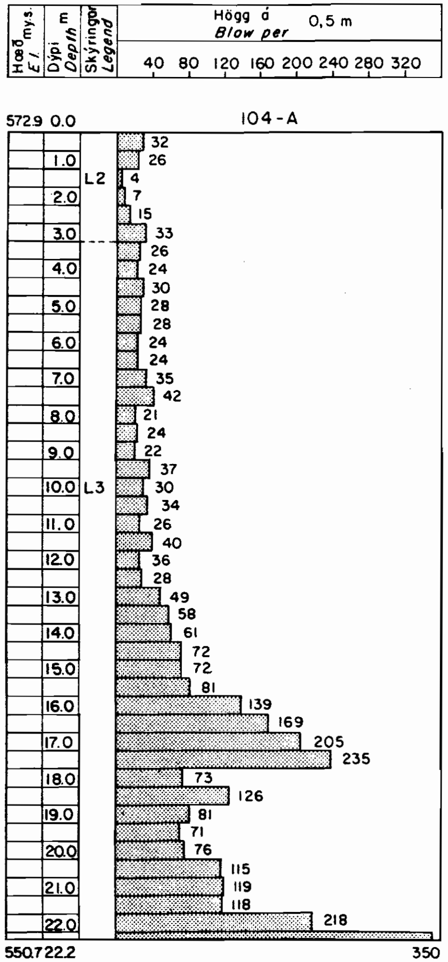
Okt '69 BA/SI	Tnr. 59	Fnr 9085
Bl 5 af 6	Bb 82 B 332	

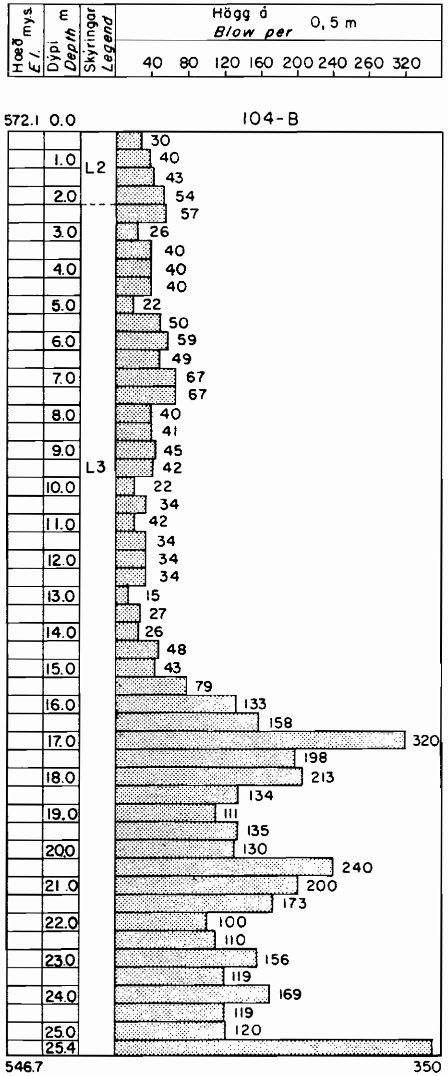


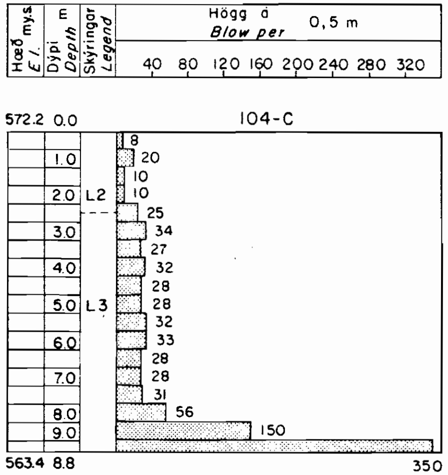
Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

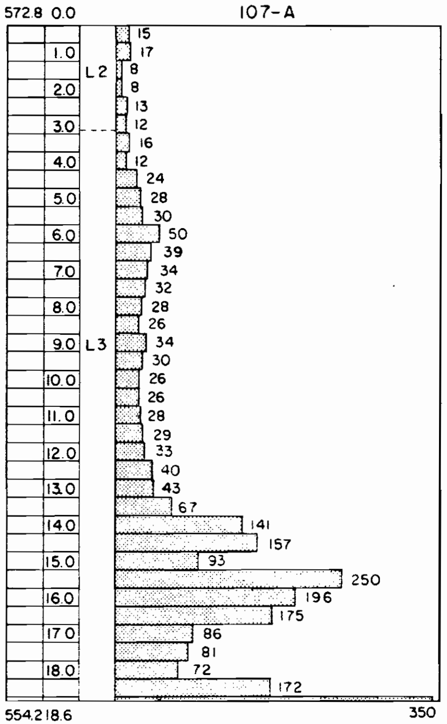
Legend, see Exhibit No. 3.28
Locations, see Exhibit No. 3.12

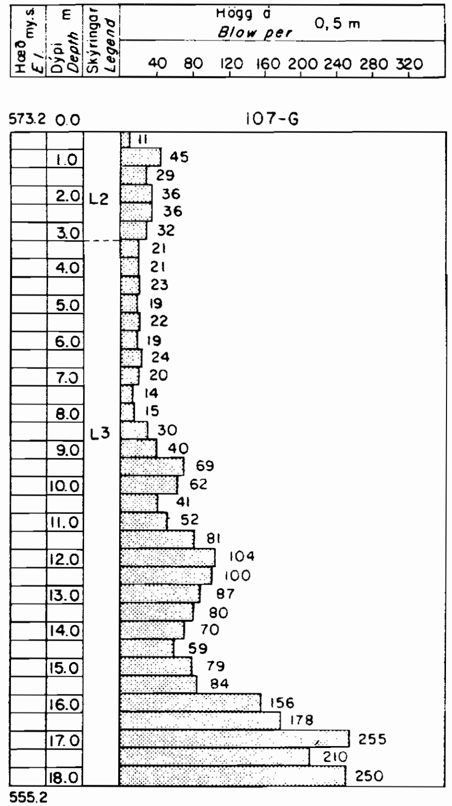
LANDSVIRKJUN *The National Power Company*	
VERKFRÆÐISTOFA SIG.THORODDSEN S/F *Thoroddsen and Partners*	
ORKUSTOFNUN	
ÞÓRISVATN Borro-borholur, borað 1967 *Borro-Soundings* ..	V-012–V104
Okt.'69 BA /SJ Tnr. 60	Fnr. 9086
Bl. 6 af 6 Bb. 83 B-332	











Staðsetningar, sjá fylgiskjal 3.12

Locations, see Exhibit No. 3.12

SKÝRINGAR – *LEGEND*

L2 Sandur, mest aðfokinn vikur og aska
Sand, mostly Winddrifted Tephra

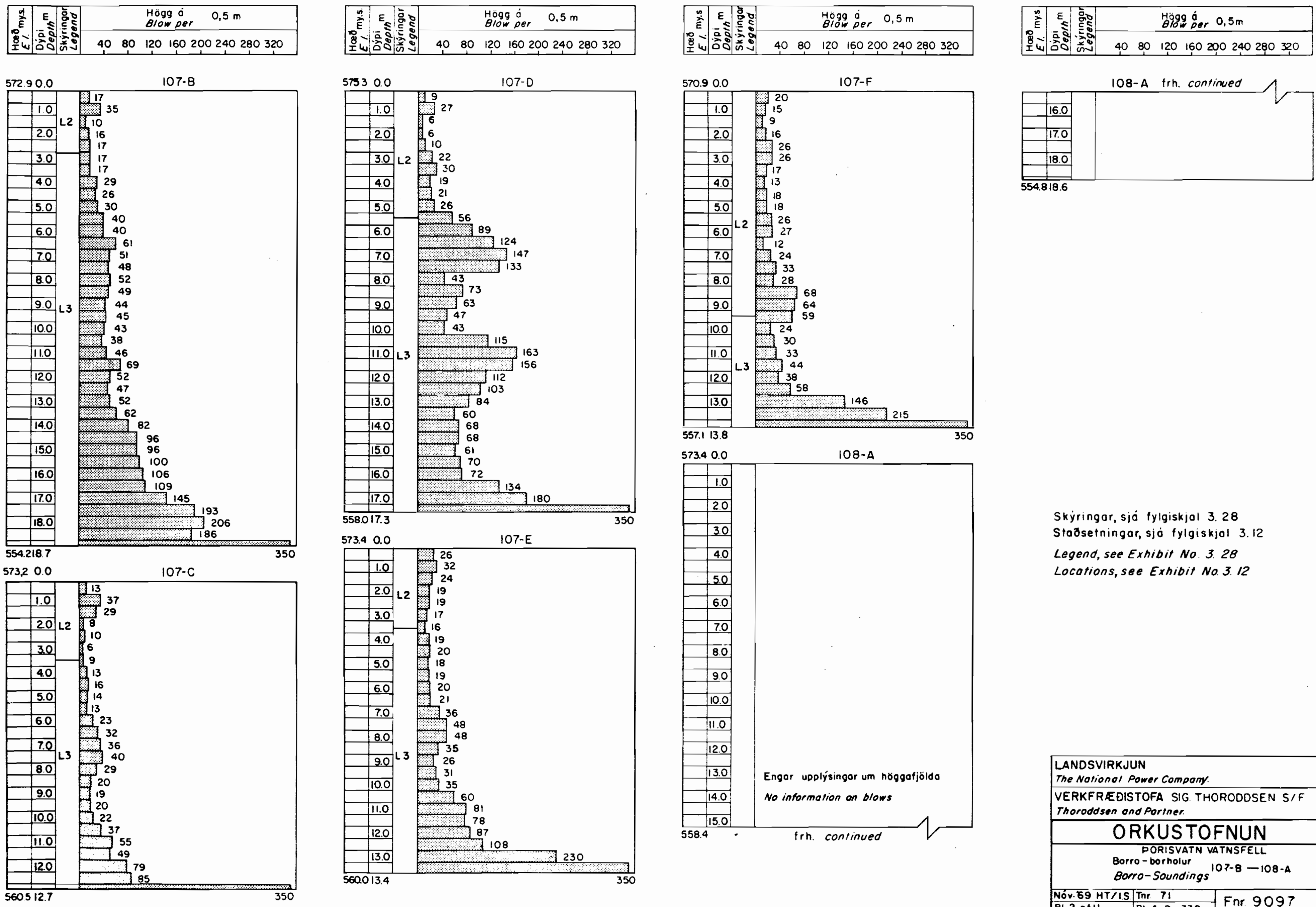
L3 Strandmyndanir og vatnaset
Beach and Lake Deposits

Þvermál borstanga – *Rod diameter 32 mm*

Þyngd lóðs – *Hammer weight 65 kg*

Fall lóðs – *Hammer drop 1 m in 1969*

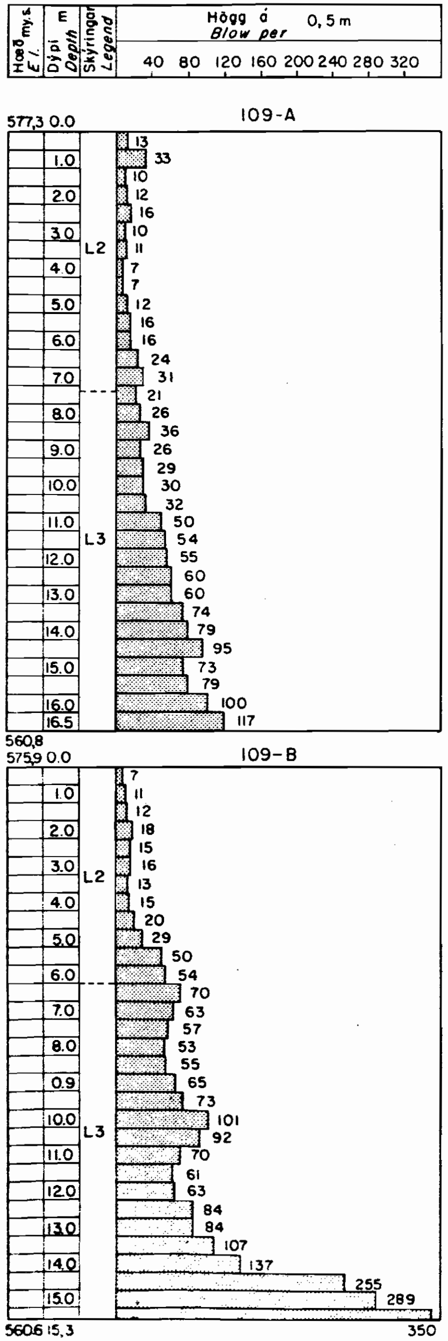
LANDSVIRKJUN *The National Power Company*	
VERKFRÆÐISTOFA SIG. THORODDSEN S/F *Thoroddsen and Partners*	
ORKUSTOFNUN	
ÞÓRISVATN VATNSFELL Borro-borholur *Borro-Soundings* 104-A — 107-G	
Nov. '69. HT/IS	Tnr. 70.
Bl. 1 of 11	Bb3 B-332
Fnr. 9096	

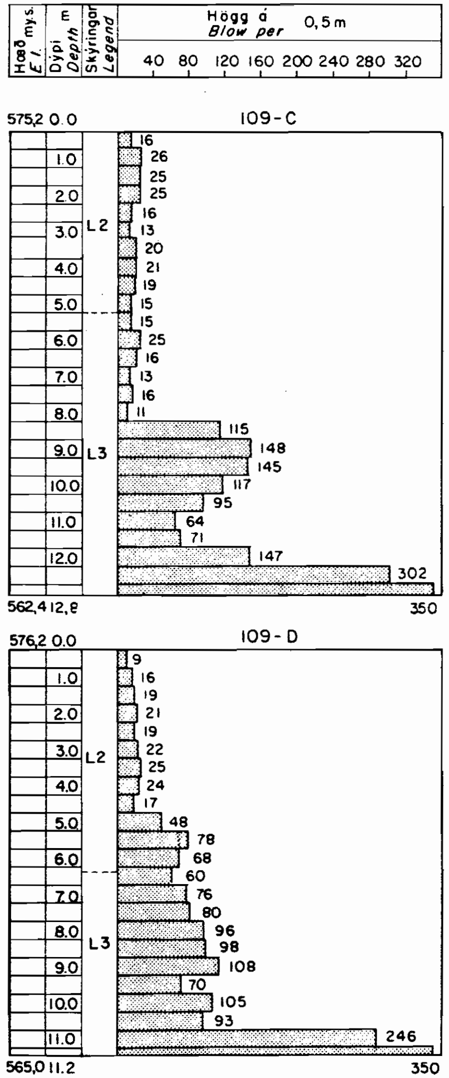


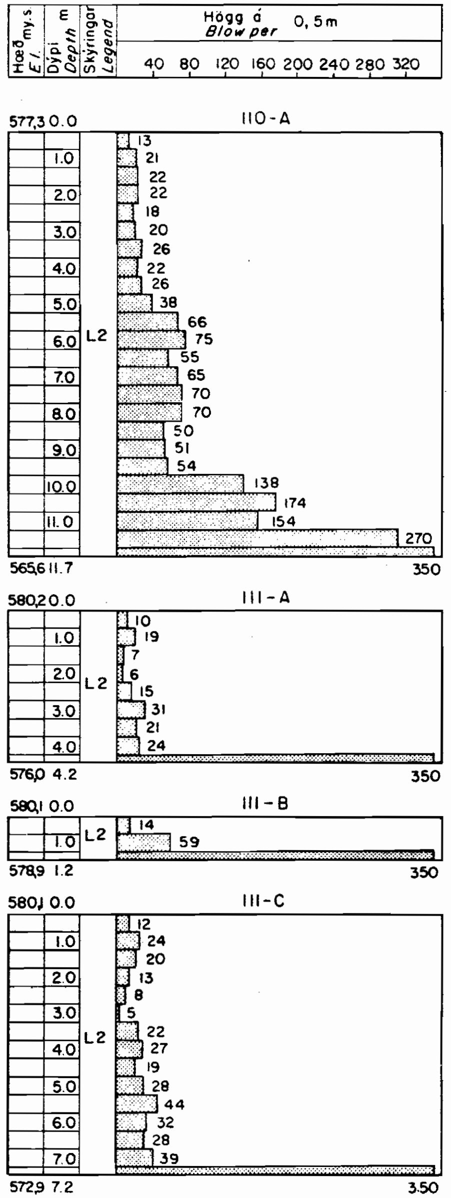
Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

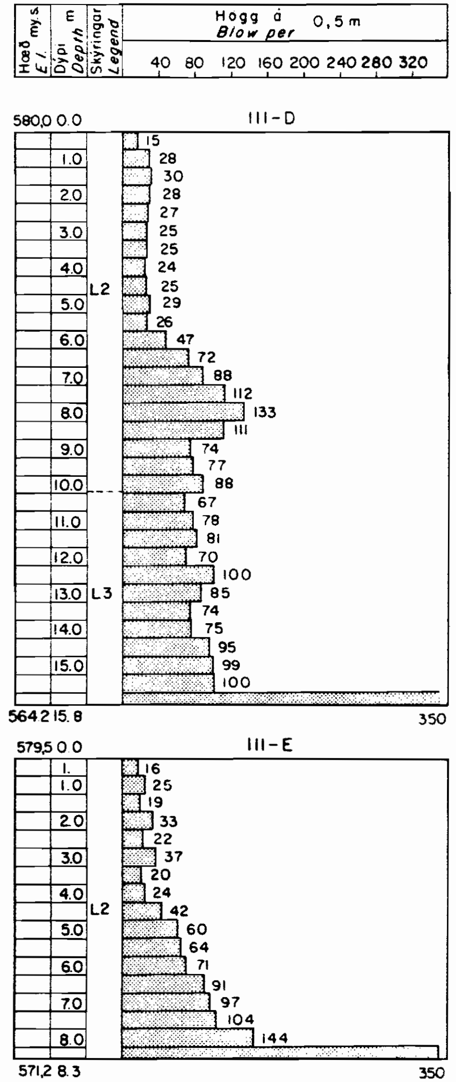
Legend, see Exhibit No. 3.28
Locations, see Exhibit No. 3.12

LANDSVIRKJUN *The National Power Company.*	
VERKFRÆÐISTOFA SIG. THORODDSEN S/F *Thoroddsen and Partner.*	
ORKUSTOFNUN	
ÞÓRISVATN VATNSFELL Borro-borholur *Borro-Soundings* 107-B — 108-A	
Nóv. '69 HT/I.S. | Tnr. 71 | Bl. 2 of 11 | Bb 4 B-332	Fnr. 9097









Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

Legend, see Exhibit No. 3.28
Location, see Exhibit No. 3.12

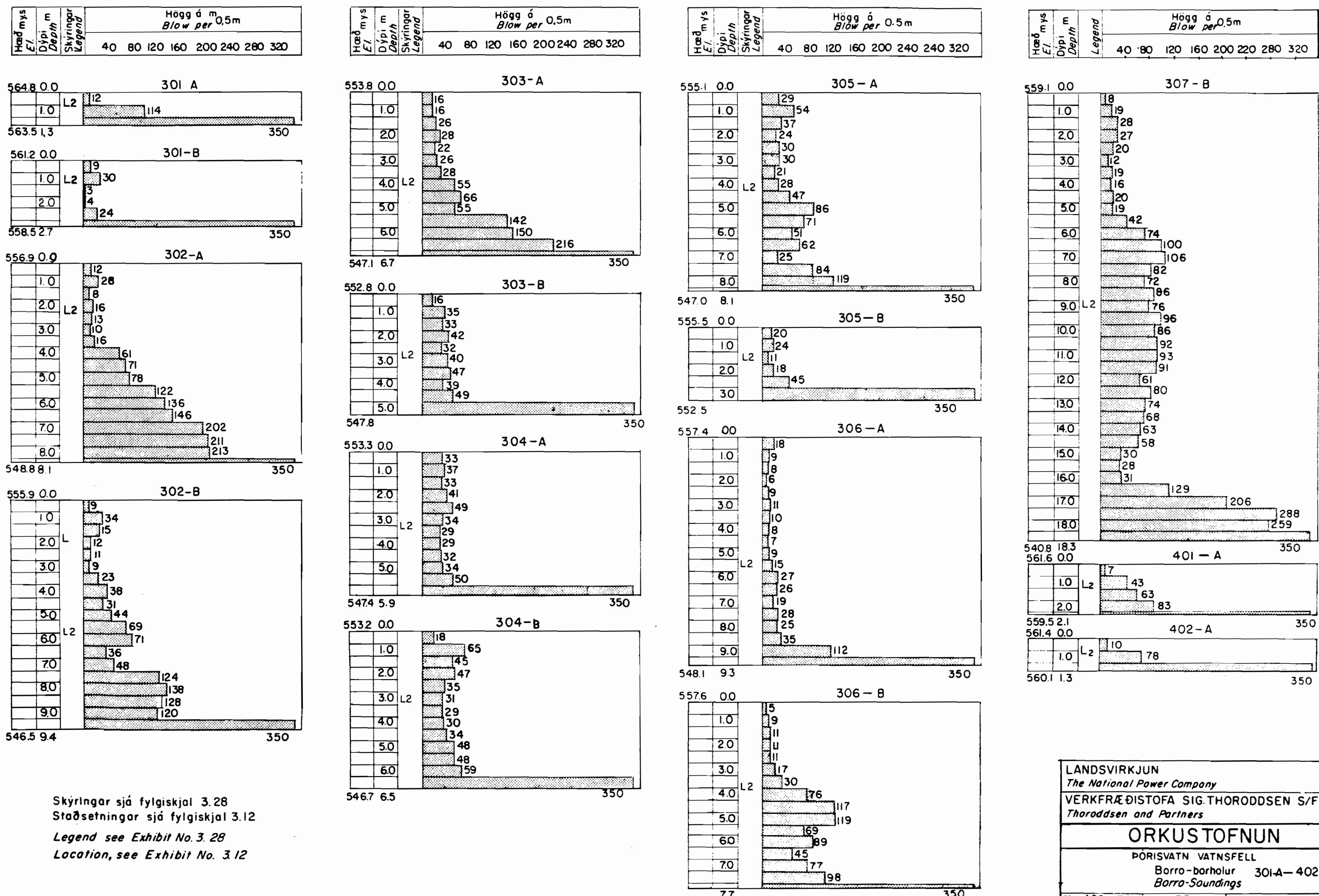
LANDSVIRKJUN
The National Power Company

VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN VATNSFELL
Borro-borholur 109-A — 111-E
Borro-Soundings

Nóv. 69 HT/IS	Tnr. 72	Fnr 9098
Bl. 3 af 11	Bb 95 B-332	



Skýringar sjá fylgiskjal 3.28
Staðsetningar sjá fylgiskjal 3.12

Legend see Exhibit No. 3.28

Location, see Exhibit No. 3.12

LANDSVIRKJUN
The National Power Company

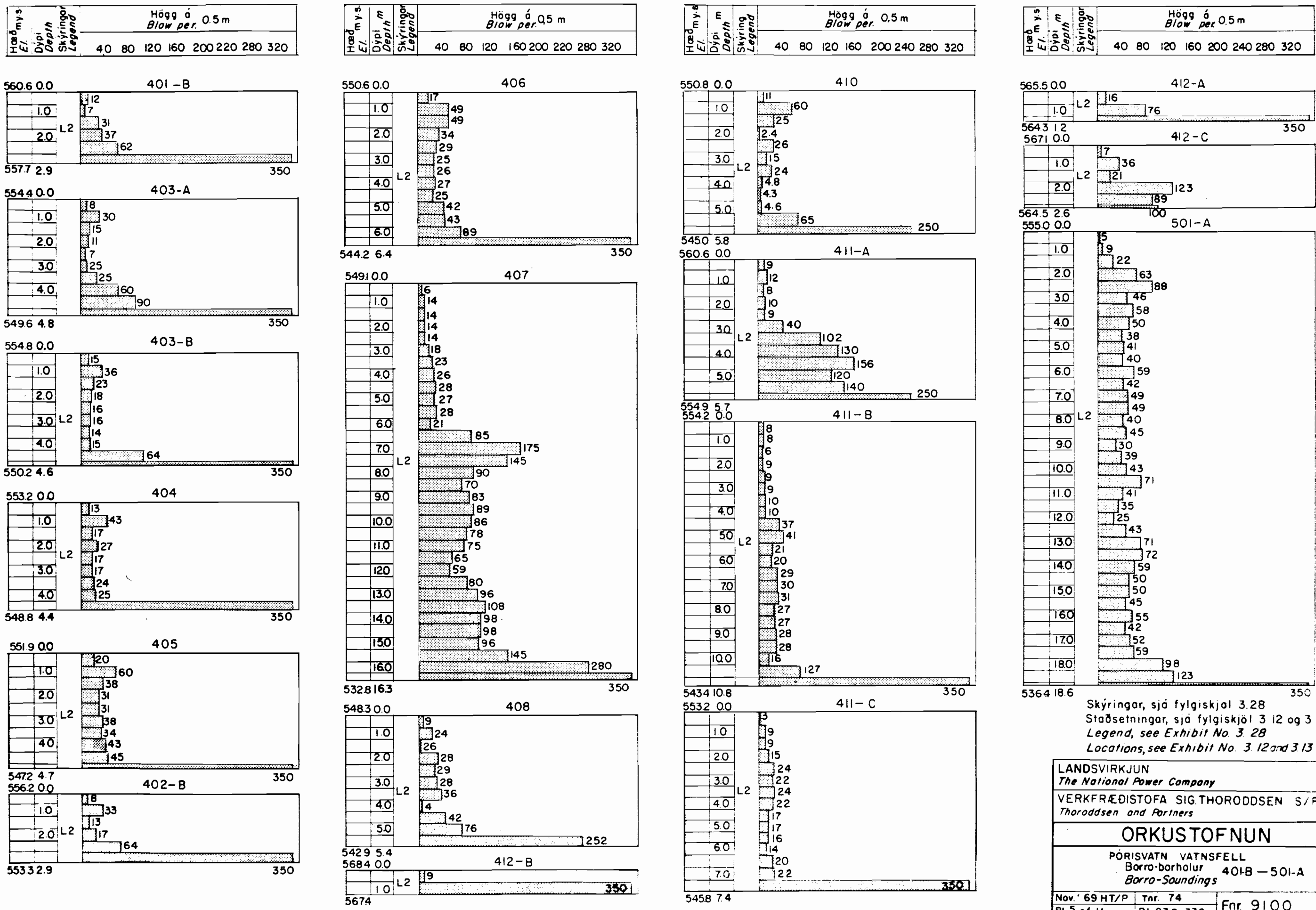
VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN VATNSFELL

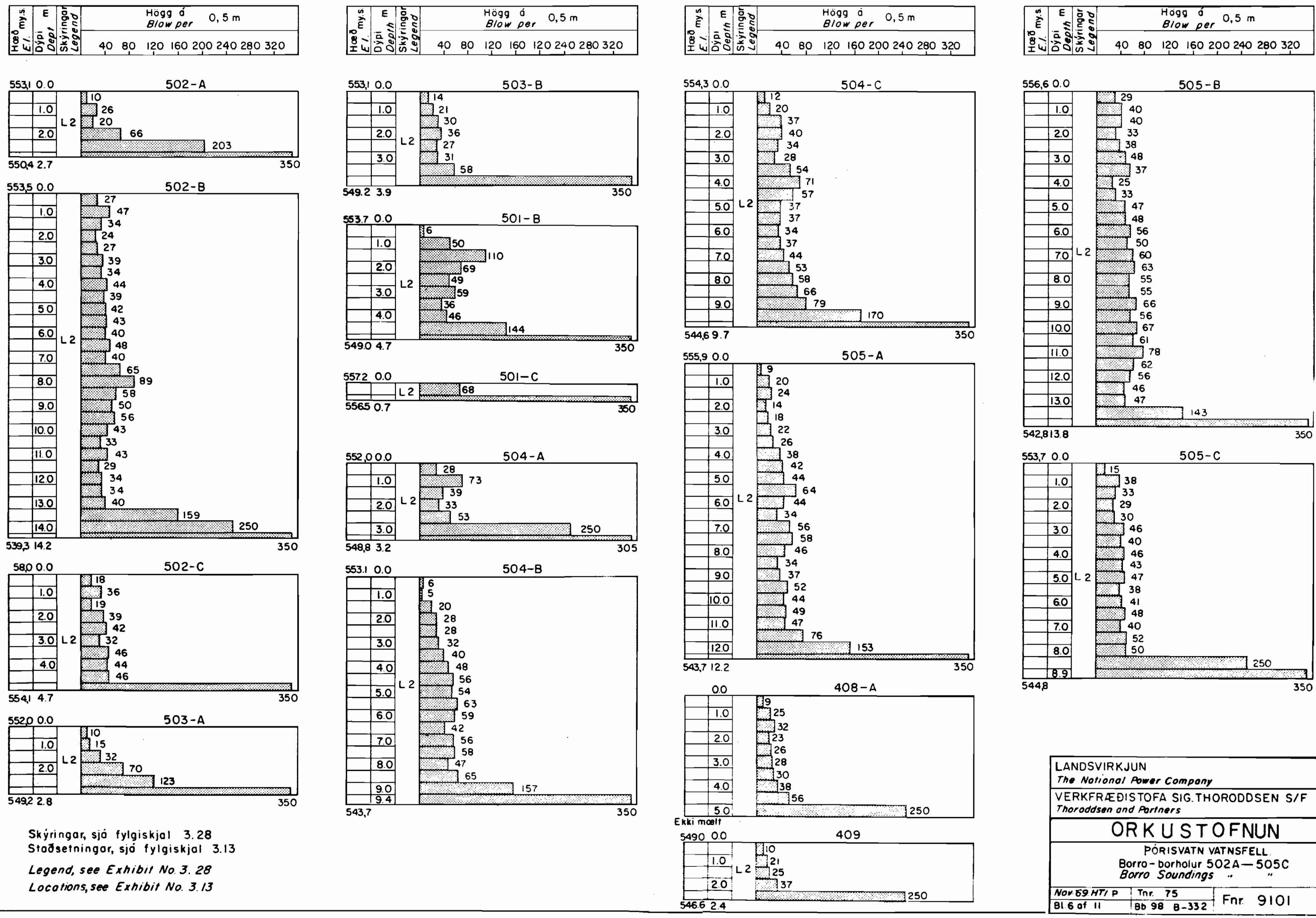
Borro-borholur 301-A—402-A
Borro-Soundings

Nov.'69 HT/P	Tnr. 73	Fnr 9099
Bl. 4 of 11	8b 96 B-332	



Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjöl 3.12 og 3.13
Legend, see Exhibit No. 3.28
Locations, see Exhibit No. 3.12 and 3.13

LANDSVIRKJUN *The National Power Company*	
VERKFRÆÐISTOFA SIG. THORODDSEN S/F *Thoroddsen and Partners*	
ORKUSTOFNUN	
ÞÓRISVATN VATNSFELL Borro-borholur *Borro-Soundings* 401-B — 501-A	
Nov.'69 HT/P / Tnr. 74 / Bl. 5 af 11 / Bb 97 B-332	Fnr. 9100



Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.13

Legend, see Exhibit No. 3. 28
Locations, see Exhibit No. 3. 13

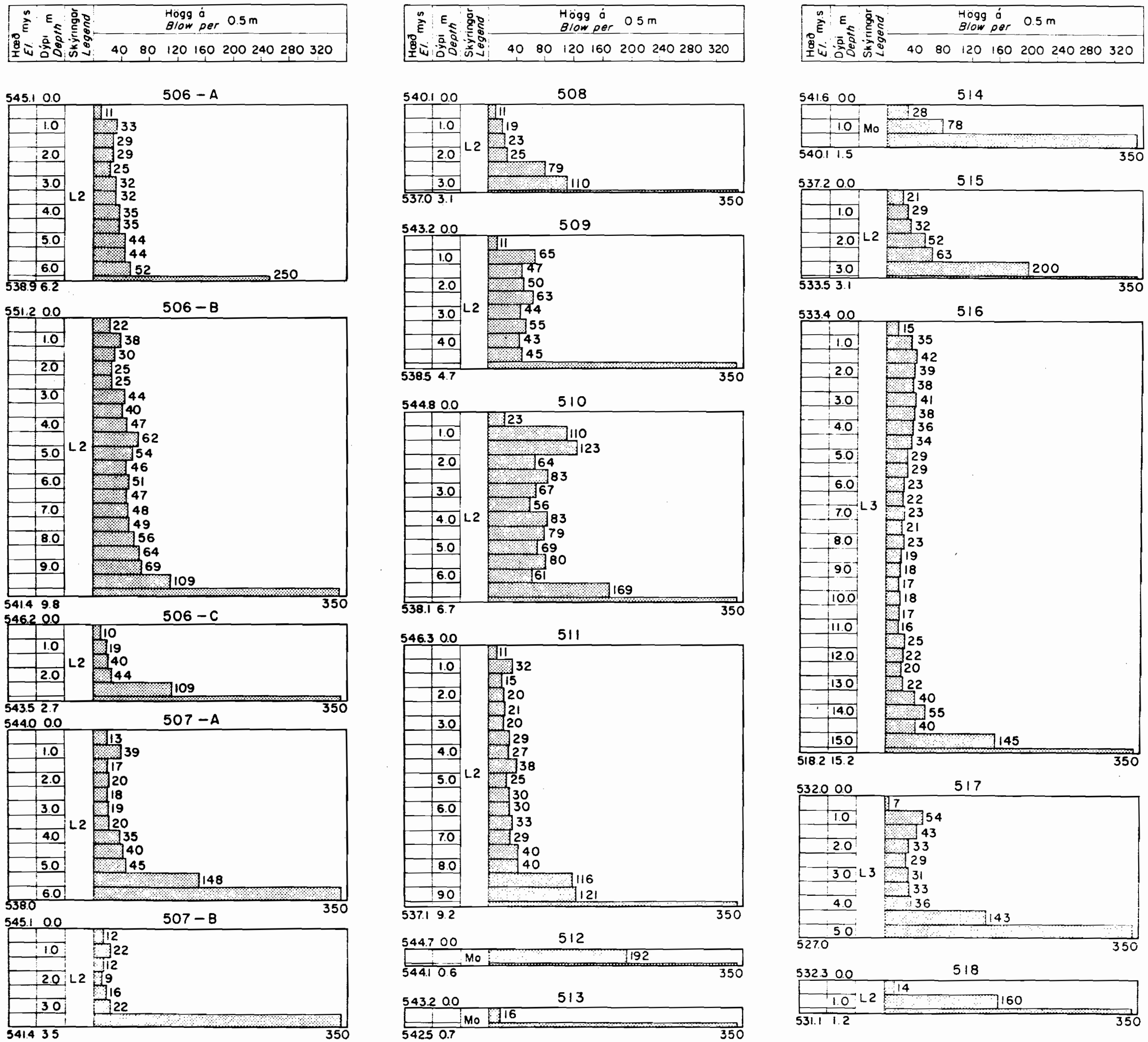
LANDSVIRKJUN
The National Power Company

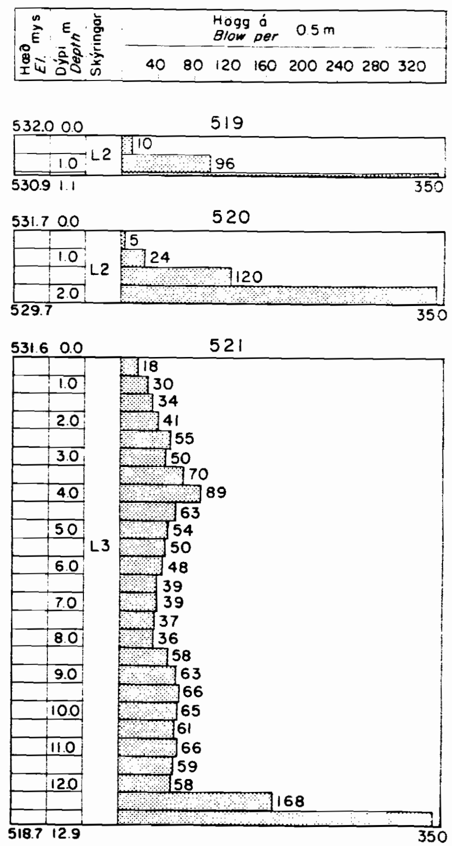
VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN VATNSFELL
Borro-borholur 502A—505C
Borro Soundings " "

Nov 69 HT/ P | Tnr. 75 | Fnr. 9101
Bl. 6 af 11 | Bb 98 B-332





Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.13

Legend, see Exhibit No. 3.28
Locations see Exhibit No. 3.13

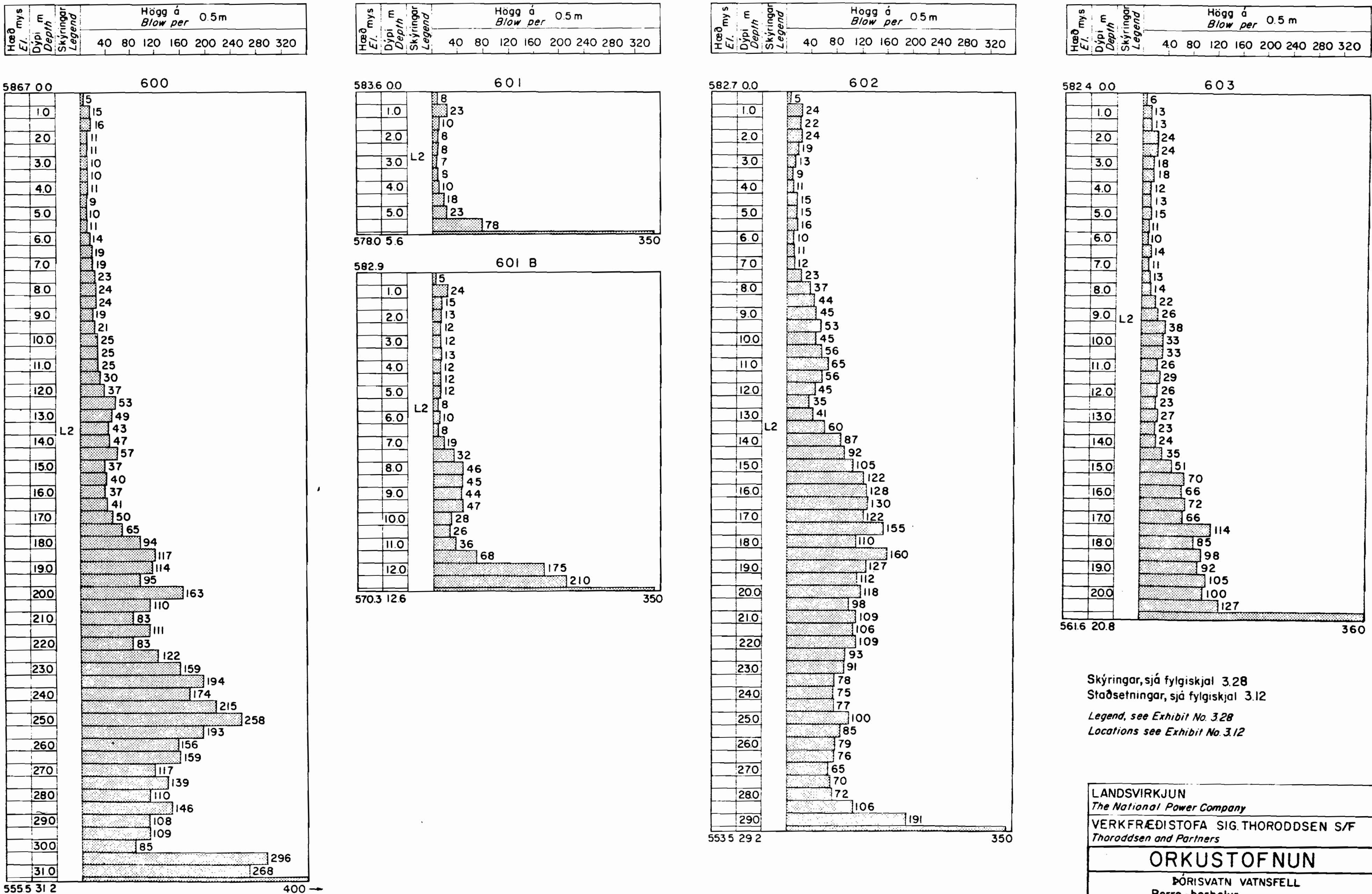
LANDSVIRKJUN
The National Power Company

VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN VATNSFELL
Borro-borholur 502B – 521
Borro-Soundings " "

Okt. '69 HT/Gyða	Tnr. 76	Fnr. 9102
Bl. 7 af 11	Bb. 99 B-332	



Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

Legend, see Exhibit No. 3.28
Locations see Exhibit No. 3.12

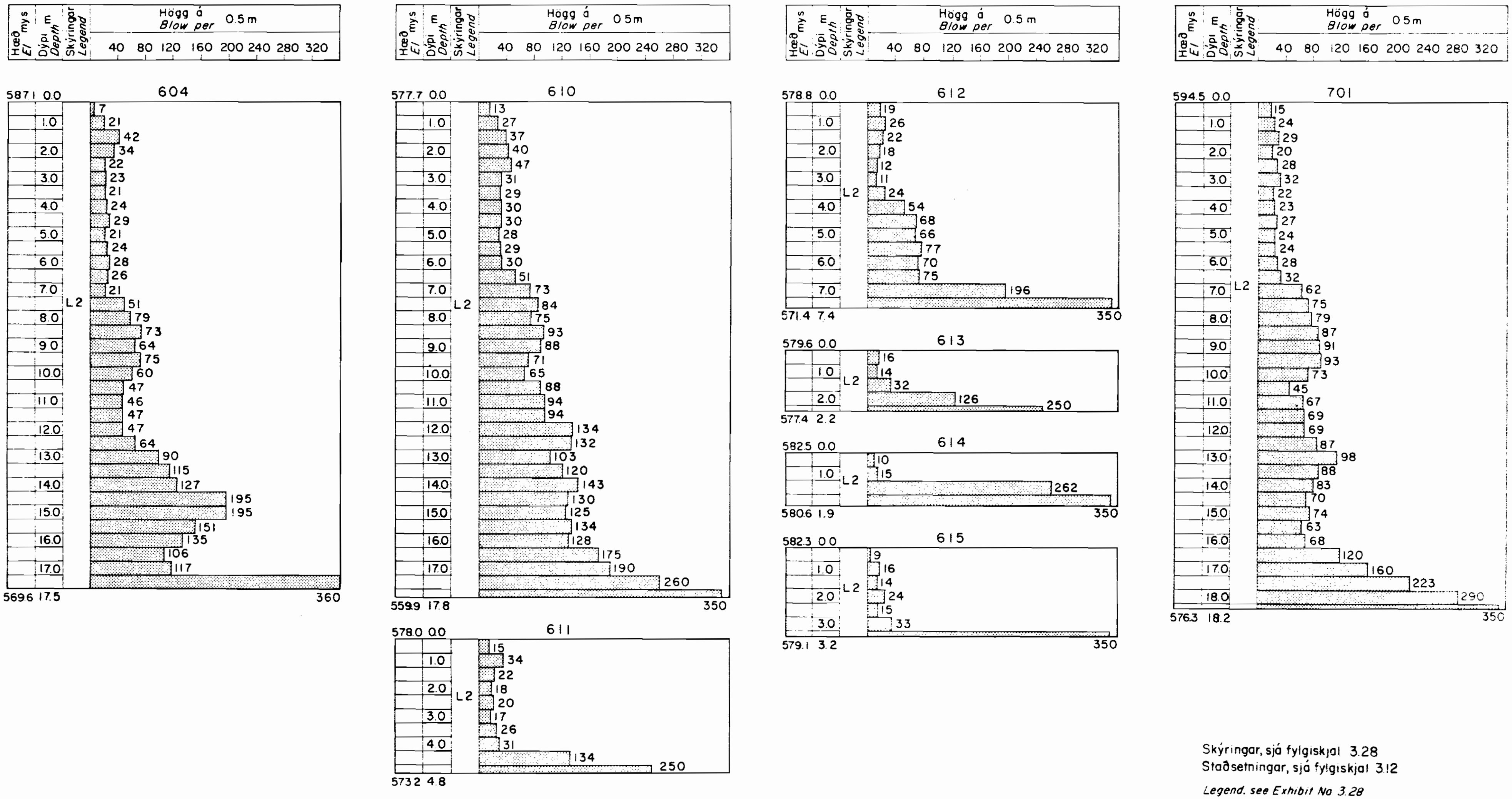
LANDSVIRKJUN
The National Power Company

VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN VATNSFELL
Borro - borholur
Borro - Soundings 600-603

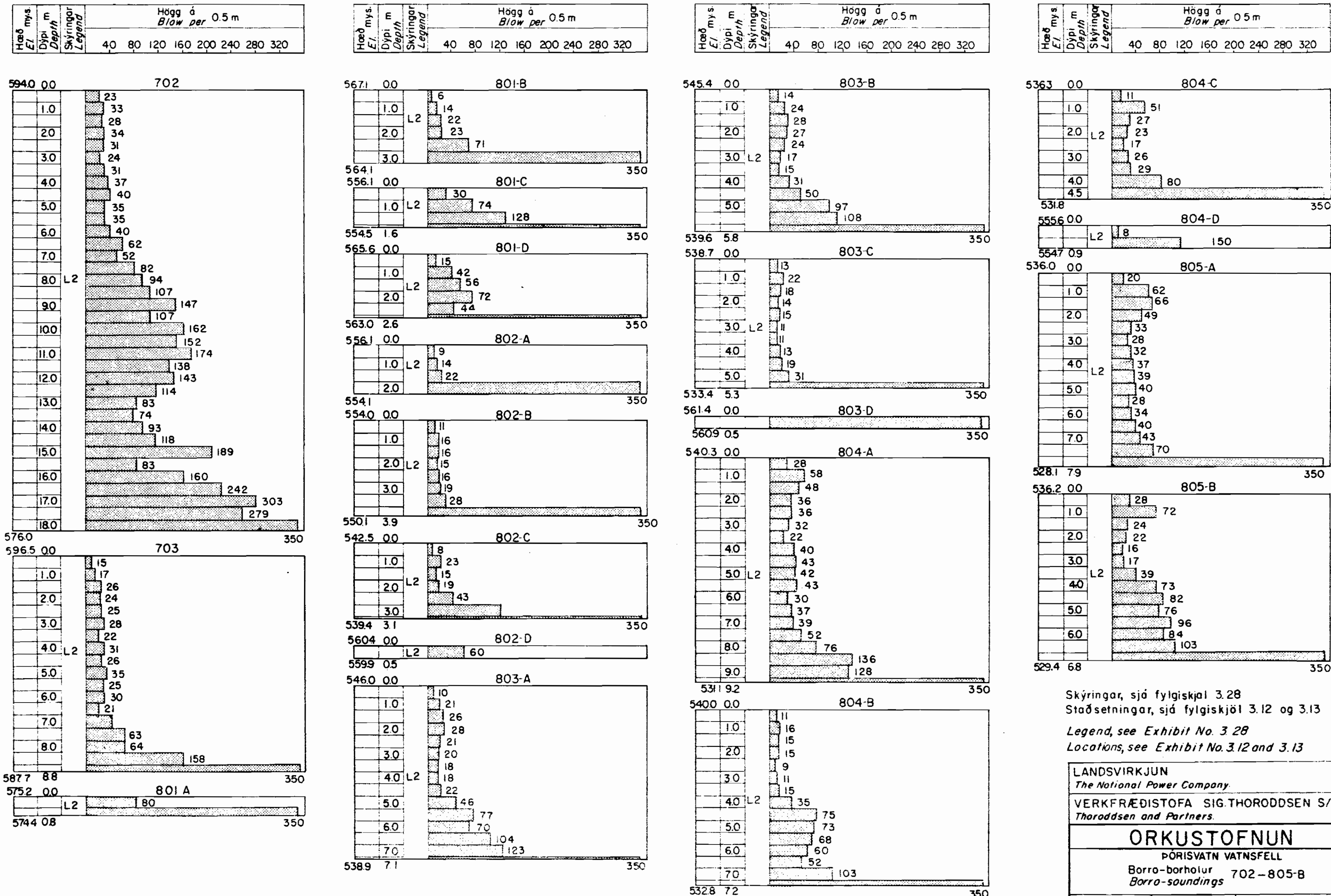
Okt 69 HT/Gyða | Tnr 76 | B-332 | Fnr. 9104



Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

Legend, see Exhibit No 3.28
Locations see Exhibit No 3.12

LANDSVIRKJUN *The National Power Company*
VERKFRÆÐISTOFA SIG THORODDSEN S/F *Thoroddsen and Partners.*
ORKUSTOFNUN
ÞÓRISVATN VATNSFELL Borro-borholur *Borro-Soundings* 604-701
Okt '69 HT/Gyða Tnr. 77 — Bl. 9 af 11 — Bb.100 B-332 — Fnr. 9103



Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjöl 3.12 og 3.13

Legend, see Exhibit No. 3.28
Locations, see Exhibit No. 3.12 and 3.13

LANDSVIRKJUN
The National Power Company

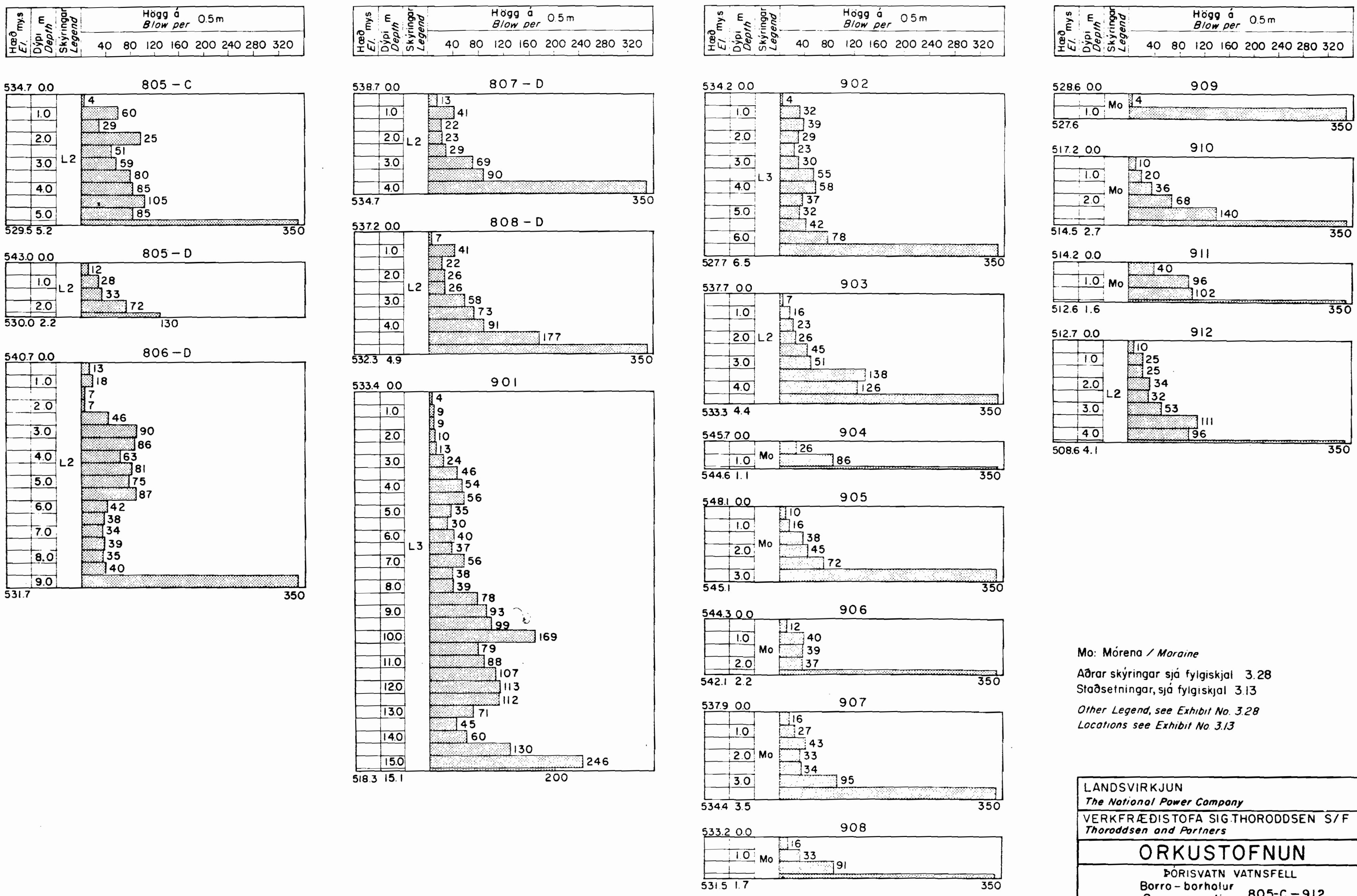
VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN VATNSFELL

Borro-borholur 702–805-B
Borro-soundings

Okt.'69 BA / P	Tnr 79	Fnr 9105
Bl. 10 af 11	Bb102 B-332	



Mo: Mórena / *Moraine*

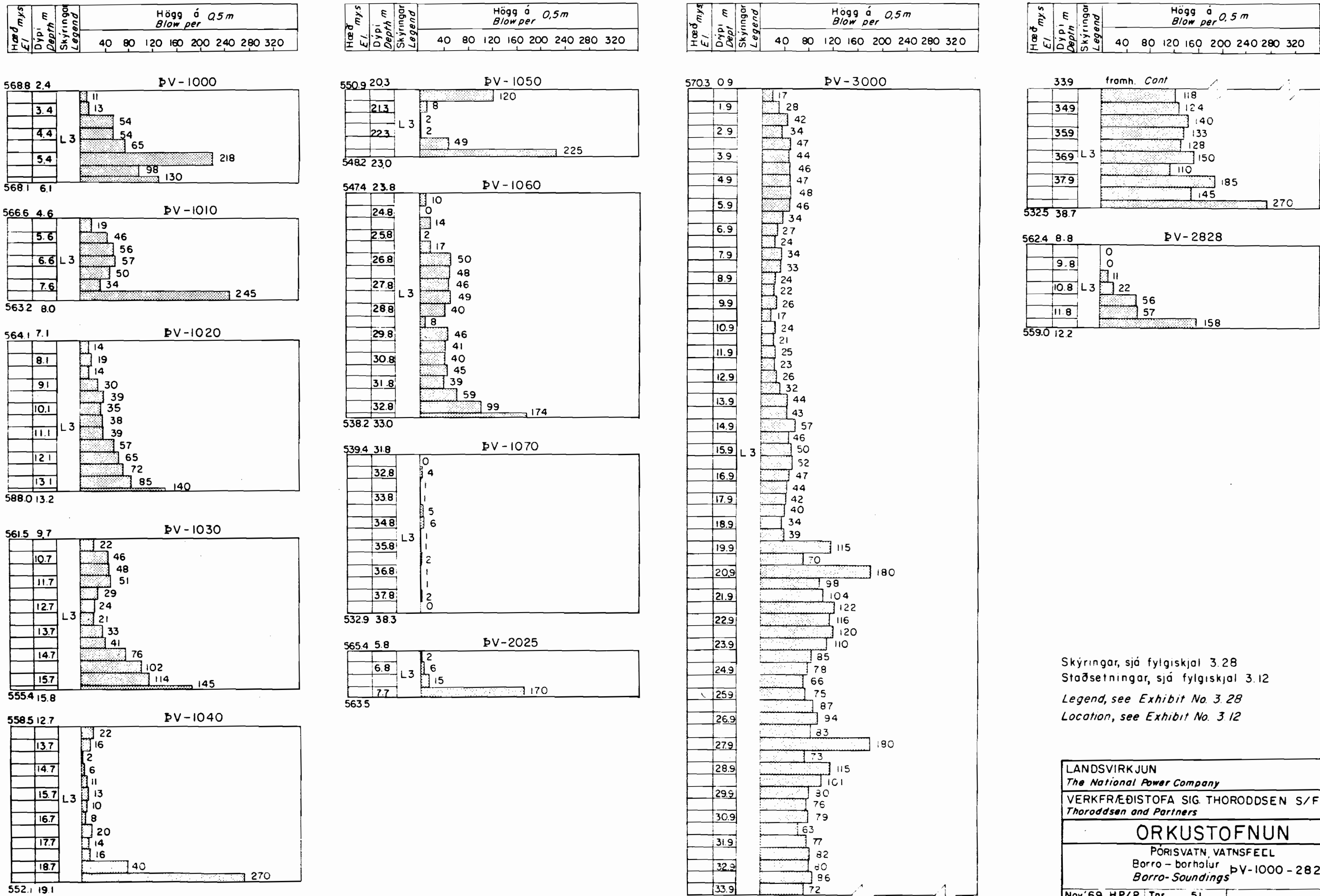
Aðrar skýringar sjá fylgiskjal 3.28

Staðsetningar, sjá fylgiskjal 3.13

Other Legend, see Exhibit No. 3.28

Locations see Exhibit No. 3.13

LANDSVIRKJUN *The National Power Company*	
VERKFRÆÐISTOFA SIG.THORODDSEN S/F *Thoroddsen and Partners*	
ORKUSTOFNUN	
ÞÓRISVATN VATNSFELL Borro - borholur *Borro - soundings* 805-C – 912	
Okt.'69 H T/Gyða · Tnr. 80 · Bl. 11 af 11 · Bb.103 B-332	Fnr. 9106

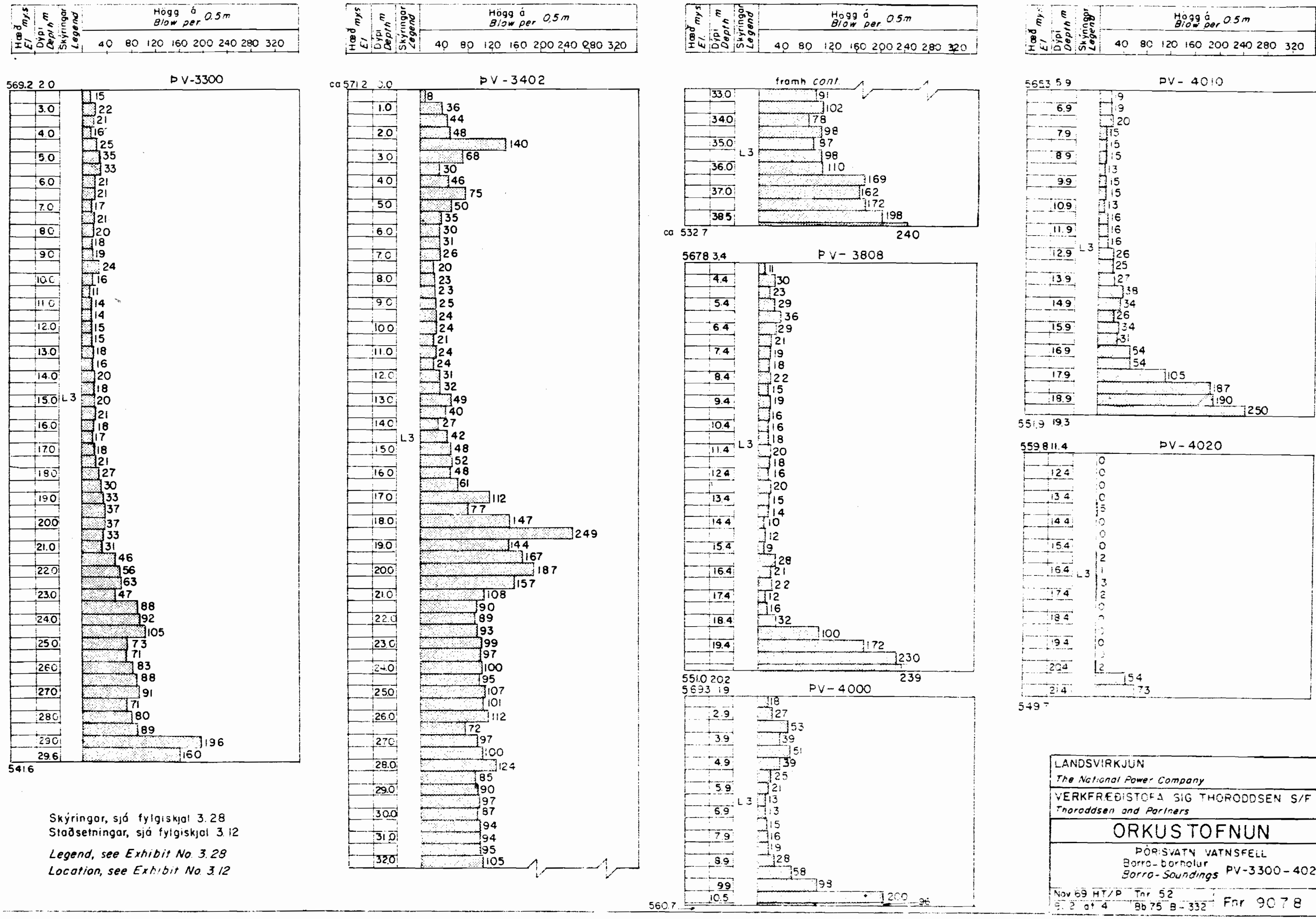


Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

Legend, see Exhibit No. 3.28
Location, see Exhibit No. 3.12

LANDSVIRKJUN *The National Power Company*
VERKFRÆÐISTOFA SIG. THORODDSEN S/F *Thoroddsen and Partners*
ORKUSTOFNUN
ÞÓRISVATN, VATNSFELL Borro – borholur *Borro-Soundings* ÞV-1000-2828
Nov.'69 HP/P Tnr. 51 Bl. 1 of 4 Bb. 74 B.-332 Fnr. 9076

EXHIBIT NO. 3.40



Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

Legend, see Exhibit No. 3.28
Location, see Exhibit No. 3.12

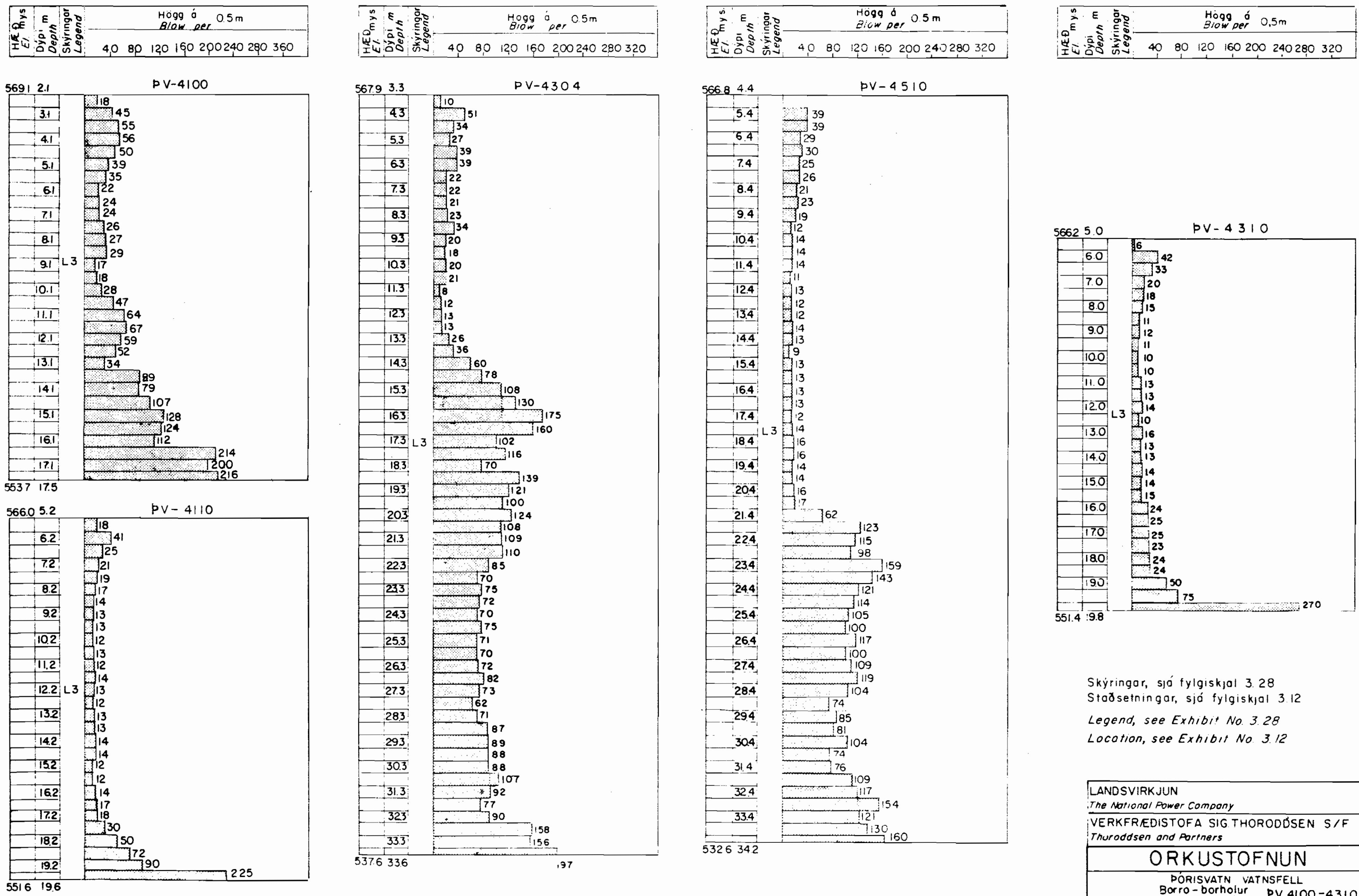
LANDSVIRKJUN
The National Power Company

VERKFRÆÐISTOFA SIG THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN VATNSFELL
Borra-borholur
Borra-Soundings PV-3300-4020

Nov 69 HT/P Tnr 52 Fnr 9078
Bl. 2 af 4 Bb 75 B-332



Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

Legend, see Exhibit No. 3.28
Location, see Exhibit No. 3.12

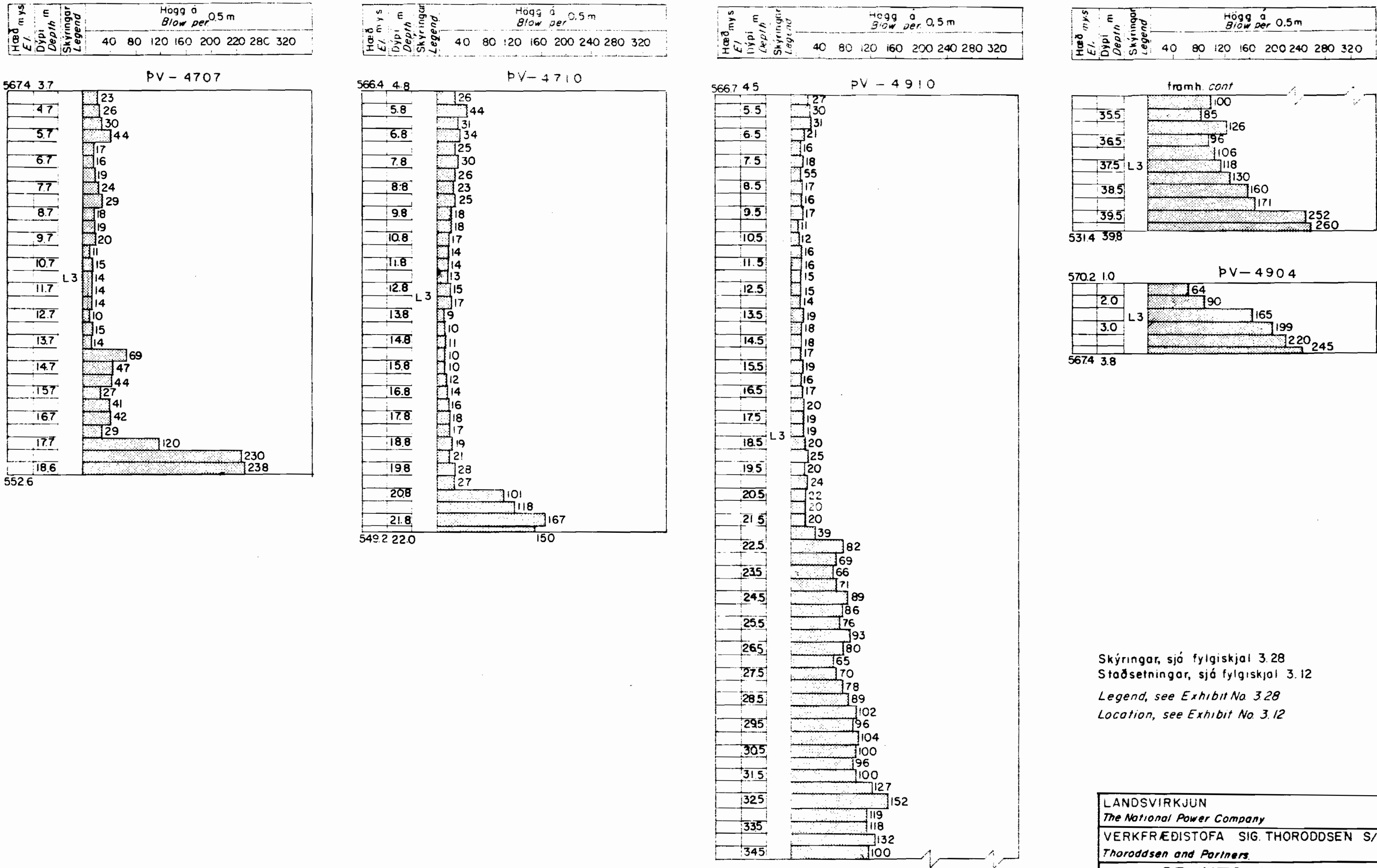
LANDSVIRKJUN
The National Power Company

VERKFRÆÐISTOFA SIG. THORODDSEN S/F
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN VATNSFELL
Borro-borholur ÞV 4100-4310
Borro Soundings

Nov '69 HT/P Tnr. 53 Fnr. 9079
Bl. 3 af 4 Bb 75 B-332



Skýringar, sjá fylgiskjal 3.28
Staðsetningar, sjá fylgiskjal 3.12

Legend, see Exhibit No. 3.28
Location, see Exhibit No. 3.12

LANDSVIRKJUN *The National Power Company*	
VERKFRÆÐISTOFA SIG. THORODDSEN S/F *Thoroddsen and Partners*	
ORKUTOFNUN	
ÞORISVATN VATNSFELL Borro - borholur *Borro-Soundings*	ÞV-4707,4710,4910.
Nov '69 HT/P TNR 54 Bl. 4 af 4 BL-77 B - 332	Fnr. 9080