LV-2015-092

Landsvirkjun

Burfell Wind Farm

Site investigation report

Lykilsíða

Landsvirkjun

Skýrsla LV nr: LV-2015-092 **Dags:** 25.9.2015

Fjöldi síðna: 128 **Upplag:** 3 **Dreifing:**

- ☒ **Birt á vef LV**
- ☒ **Opin**
- ☐ **Takmörkuð til**

Titill: Burfell Wind Farm - Site invesigation report

Höfundar/fyrirtæki: Jónas Þór Ingólfsson, Efla Verkfræðistofa

Verkefnisstjóri: Margrét Arnardóttir

Unnið fyrir: Landsvirkjun

Samvinnuaðilar: Engir

Útdráttur: Í þessari skýrslu er fjallað um jarðkönnun sem var framkvæmd í fyrirhuguðum vindlundi við Búrfell árin 2013 og 2014.
Í desember árið 2013 var borað með bensínknúnum slagbor til að meta þykkt lausra jarðefna á yfirborði svæðisins. Í október og nóvember árið 2014 voru boraðar loftbors- og kjarnaholur til að meta jarðlagaskipan undir lausu jarðlögunum. Að auki voru námur í nágrenninu skoðaðar og sýni tekin.

Lykilorð: Búrfellslundur, kjarnaborun, loftborun, slagborun, námur, jarðkönnun

ISBN nr:

Samþykki verkefnisstjóra Landsvirkjunar

Skýrsla nr. LV–2015–092

Landsvirkjun

Burfell Wind Farm

Site investigation report

September 2015

REPORT - INFORMATION SHEET

Report Title		Report Type	
Búrfell Wind Farm – Site investigations		Geological report	
Project		**Client**	
HAF-60 – Wind farm near Búrfell		Landsvirkjun	
Project Manager – EFLA	**Project Manager / Client Representative**		
Eysteinn Einarsson	Margrét Arnardóttir		
Authors	**Report Nr.**	**Project Nr.**	**Total pages**
Jónas Þór Ingólfsson		1611-159	128

Summary

This report covers the site investigations conducted in the proposed Búrfell Wind Farm area in 2013 and 2014. In December 2013 ram sounding drilling was conducted to evaluate the extent of loose surface overburden. In October and November 2014 core- and percussion drilling was employed in the area in order to explore the bedrock stratigraphy. Also borrow areas in the vicinity were investigated and samples collected.

Keywords

Búrfell wind farm, core drilling, percussion drilling, ram sounding, borrow areas, site investigation

Report status	Report distribution
☒ Draft	☐ Open
☐ Copy editing	☒ With client permission
☐ Final	☐ Confidential

Version history

Nr.	Author		Reviewed		Approval	
	Name	Date	Name	Date	Name	Date
1	Jónas Þór Ingólfsson	22.4.15	Jón Haukur Steingríms	22.4.15		

SUMMARY

This report covers the site investigations conducted in the proposed Búrfell Wind Farm area in 2013 and 2014.

In December 2013 ram sounding was conducted in the Haf area, north of Búrfell in order to obtain overview of the extent of loose surface materials. The drilling revealed varying thickness of the overburden which is mainly made of volcanic ash and pumice (tephra) and aeolian sand, from 1,3 m to 10,5 m.

In October and November of 2014 percussion and core drilling were employed to estimate the thickness and extends of lava layers encountered in previous site investigations in relation to the hydropower projects in Búrfell, Sultartangi and Búðarháls. Three core holes were drilled and 2 holes were drilled with Odex percussion drilling and cuttings samples extracted. The holes showed multiple layers of Holocene porphyritic basalt lava fields, interbedded with tephra or sand layers. Firm evidence for “old” bedrock could not be confirmed within the drilling depth of this campaign. The rock quality of the lava formations was assessed and core samples tested in the laboratory.

Additionally, search for suitable fill material in nearby borrow areas was carried out and samples gathered for laboratory testing with regards to aggregate quality for concrete, road construction and cable backfill material.

TABLE OF CONTENTS

APPENDIX 6 AGGREGATE TESTING

FIGURES

TABLES

1 INTRODUCTION

Landsvirkjun is investigating and planning a potential wind farms in the Þjórsár- and Tungnaár area on the lava fields east of mount Búrfell. This work is a part of research and development project conducted by Landsvirkjun to study the feasibility of wind turbines in Iceland. Geological and geotechnical investigations were performed at the proposed construction area and in neighbouring borrow areas. Two proposals are under consideration, layout 1 and 2 as shown in Figure 1.

Efla Consulting Engineers has supervised the investigations. Árni ehf. carried out core and percussion drilling and Nesey ehf. provided excavator for trial pits and sampling in the borrow areas.

Field investigations were carried out for this project in the years 2013, 2014 and in the beginning of the year 2015. Results from earlier research programs from the hydropower projects in Búrfell, Sultartangi and Búðarháls has revealed great thickness of Holocene (less than 10.000 years old) lavas and unconsolidated interbeds in the area. The stratigraphy of the proposed wind farm area was therefore studied by drilling was in October and November 2014. Previously the thickness of the tephra and loose overburden at the surface had been investigated with ram sounding in late 2013.

This report presents the main findings of these site investigations..

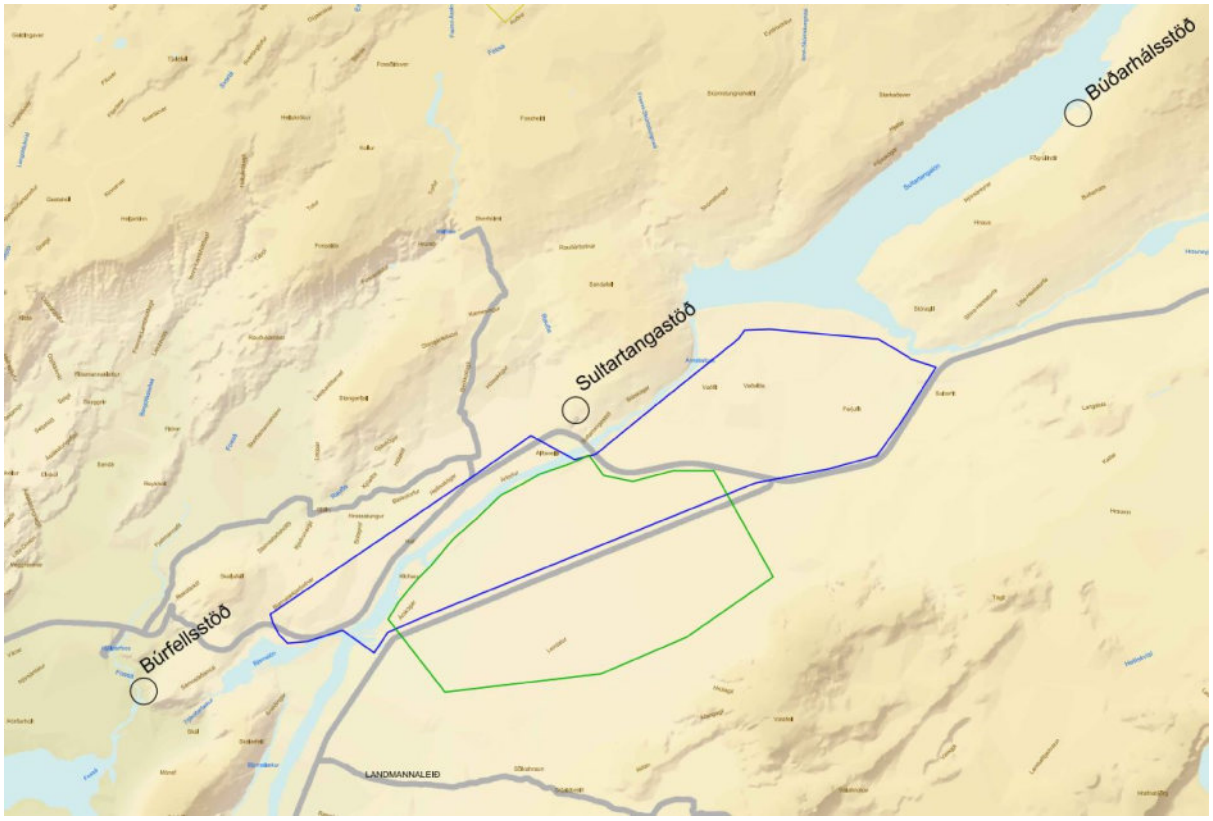


Figure 1: Proposed wind farm areas. Proposal 1 in green and proposal 2 in blue.

2 GEOLOGICAL SETTING

2.1 General geology

The area between Búrfell and Sámsstaðamúli in the west and Valafjall and Sandfell in the east has been greatly affected by volcanism since the ending of last ice age ~10.000 years ago, where two of the most active volcanic systems in Iceland, Hekla and Bárðarbunga, play the largest role.

Since the retreat of the ice age glacier at least 11 lava flows have been recorded from the Veiðivötn fissure swarm of Bárðarbunga volcanic system and 7 of them (Vilmundardóttir,1977) reached the area south of Búðarháls. The lava flows from the Veiðivötn fissure swarm have been collectively named Tungnaárhraun and are clearly distinguishable by abundance of large plagioclase phenochrysts, up to 10 mm dia. The distribution of each flow in Hafið has not been completely mapped, but of the 11 flows of the Tungnaárhraun lavas 6 might have reached the proposed wind farm area. The two youngest flows that can be found there cover most of the plains, the 3000 years old Búrfellshraun being on the surface under loose material; tephra and aeolian sand. The other four flows are likely to have run in channels, as they have not been seen in as many boreholes in the area as the others have. Sölvahraun and Taglgígahraun lavas are the only Holocene lava formations in the Búrfell wind farm area not originating from the Veiðivötn fissure swarm, but from Hekla. They are around 1200 years old and are composed of at least 3 different lava flows each (Vilmundardóttir, Guðmundsson and Snorrason, 1985). Hekla also contributes to the overall strata in the form of tephra interbeds between the other layers, and the loose material on the surface. The total thickness of the Tungaárhraun lavas and interbeds has been estimated to be about 100 m in a section between Búrfell and Sauðafellssalda (Vilmundardóttir, 1976, p.86). The thickness in the plains where the wind farms have been proposed has not been confirmed, as no boreholes have reached bedrock, except ones close to bedrock on surface.

2.1.1 Seismic risk

The proposed area lies within the seismically active region of Iceland, close to the South Iceland Seismic Zone (SISZ). Design parameters for seismic design will be addressed in a separate report, pending ongoing investigation, scheduled for 2015.

2.1.2 Volcanic risk

The proposed areas are almost completely within Holocene lava plains, although the most recent lava flow occurred around 3000 years ago. However, it must be noted that it is still the most likely flow path upon a major event in the Veiðivötn fissure swarm.

More recent and recurring volcanic risk is posed by Hekla volcano, mainly in the form of tephra fallout. As can be seen in Figure 2 the area has been covered on many occasions be tephra from Hekla through the years. In addition to tephra fallout, at least two separate lava flow events have reached Haf, that is Sölvahraun (~1200 years ago) and Taglgígahraun (~1200 years ago). The southern boundary of proposal 1 in Figure 1 lies along the boundary of Sölvahraun and Taglgígahraun is on surface in the NE corner of proposal 2.

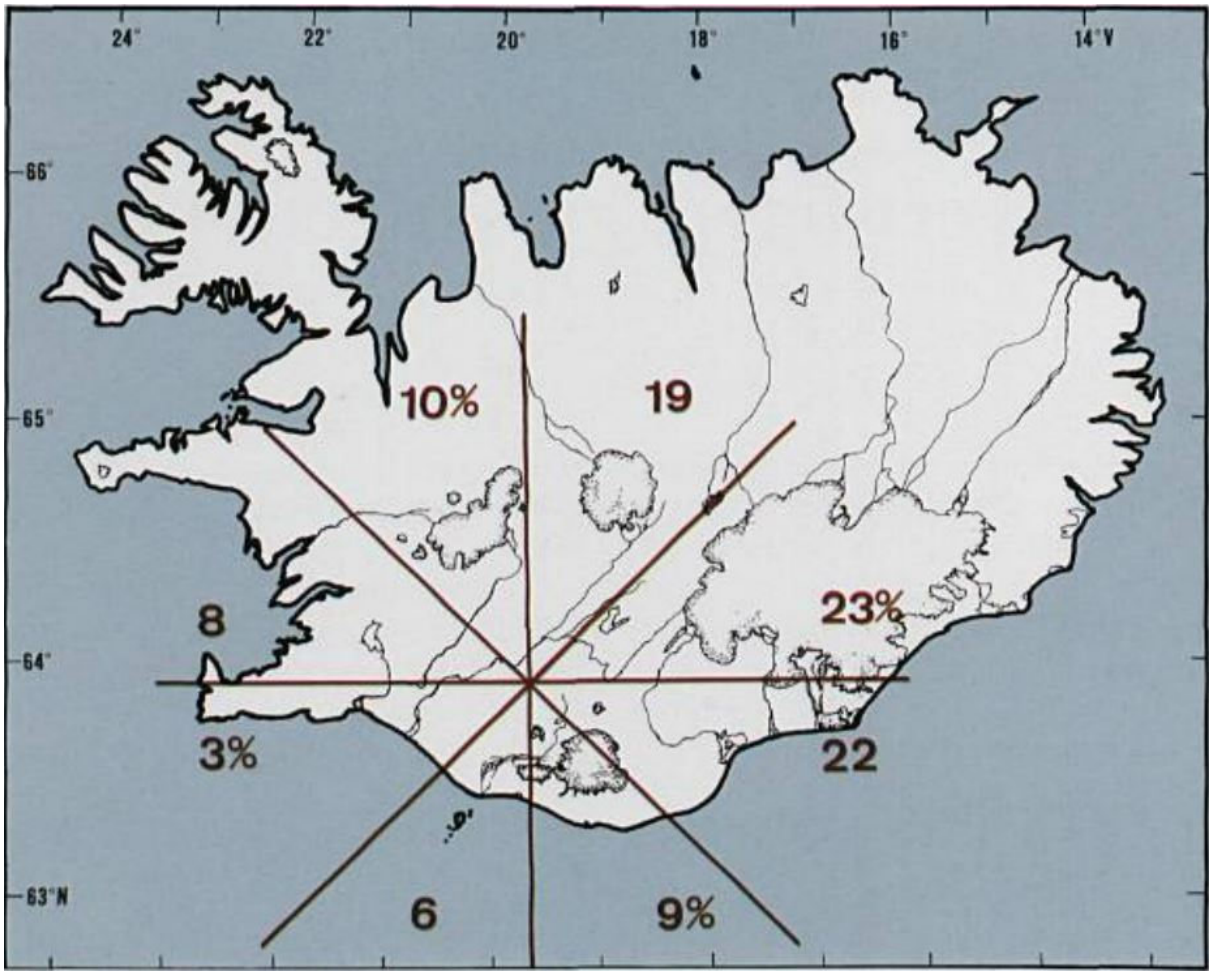


Figure 2: Probability of tephra fallout distribution based on 500hPa wind direction estimates over 20 year period from 1958 – 1977. The proposed are is within the 19% probability sector (Jónsson, 1990).

3 GEOLOGICAL SITE INVESTIGATIONS

3.1 Ram sounding

3.1.1 Execution

A petrol-powered ram sounding drill from Atlas Copco was used for the ram sounding. The drilling rods are 1 m long, have a diameter of 25 mm with a coned drill bit. The penetration rate for each 0,2 m is measured with a stopwatch and registered. When interpreting the ram soundings the following is taken to consideration: Penetration rate, depth to firm ground/bottom and an evaluation of the type of soils which accumulate on the drill rods or in the drill rod notches. Generally, soils are considered to be sufficiently consolidated for road constructions when the penetration rate is ≥ 10 sec for each 0,2 m interval, commonly referred to as “bearing” ground/bottom in the sense of road construction, not as for high load structures. Likewise it is considered that firm, well consolidated ground or bedrock is reached when the penetration rate for each 0,2 m interval is ≥ 60 sec. Bearing and firm ground/bottom are not always confined to layers boundaries. Since soils like silt, sand, gravel and moraine can be loose at the top but become more consolidated and firm with increasing depth. When a penetration rate of 60 sec per 0,2 m interval is reached, the soil at that particular depth is generally well consolidated and compacted and hard to excavate.

The ram sounding survey was planned in a grid of 1x1 km. The sounding locations were chosen with the objective to establish a general overview of the area. Less emphasis was placed on the northeastern parts of the survey area close to Sultartangi Dam and southernmost closest to mount Valafell.
The survey was conducted between 4th – 6th December 2013. The weather conditions were good, but windy with temperatures around -20 °C.

3.1.2 Results

Table 1 shows summarized and interpreted results of the survey while table 2 shows statistical key points of the results. Long drilling times at the surface is due to surface frost. An overview of drillhole locations and results are shown appendix 1. Bore logs of individual drillholes are in appendix 5

Table 1. Interpreted results from ram sounding.

Drillhole ID	X [ÍSN93]	Y [ÍSN93]	Surface [m a.s.l.]	Bearing bottom elevation [m a.s.l.]	Firm bottom (bedrock) elevation [m a.s.l.]	Bearing bottom depth [m]	Firm bottom (bedrock) depth [m]
HC-03	468041	404903	259,3	255,6	255,6	3,7	3,7
HC-04	464506	399953	240,39	236,6	236,6	3,8	3,8
HC-05	465213	400660	243,68	240,9	240,9	2,8	2,8
HC-06	465920	401367	248,05	245,3	245,3	2,8	2,8
HC-08	467342	402821	259,26	249,5	248,8	9,8	10,5
HC-10	468748	404196	259,64	258,5	258,3	1,1	1,3
HC-12	470163	405610	262,7	259,6	259,6	3,1	3,1
HC-13	470870	406317	268,35	266,6	266,6	1,8	1,8
HC-21	467334	401367	253,41	251,0	249,5	2,4	3,9
HC-22	468041	402074	257,14	255,7	255,7	1,4	1,4
HC-24	469455	403488	261,61	258,4	258,0	3,2	3,6
HC-25	470163	404196	264,47	261,1	261,1	3,4	3,4
HC-26	470870	404903	264,38	260,6	260,5	3,8	3,9
HC-28	472284	406317	276,31	273,6	270,6	2,7	5,7
HC-38	470163	402781	263,24	258,0	258,0	5,2	5,2
HC-40	471577	404196	266,97	264,2	263,1	2,8	3,9
HC-41	472284	404903	269,23	264,0	263,7	5,2	5,5
HC-43	473698	406317	284,23	281,8	281,0	2,4	3,2
HC-54	472284	403488	269,11	268,1	267,8	1,0	1,3
HC-57	474405	405610	286,79	284,8	284,7	2,0	2,1

Table 2. Statistical results of ram sounding.

	BB depth [m]	FB depth [m]
Average (20)	3,2	3,6
Standard deviation	1,9	2,1
Min depth / thickness	1,0	1,3
Max depth / thickness	9,8	10,5
Average - 1 standard deviation (16,7% tolerance)	1,3	1,6
Average + 1 standard deviation (83,3 % tolerance)	5,1	5,7

3.1.3 Geological situation, surface

The entire survey area is located on the Búrfellshraun lava field, which is around 3000 years old (Vilmundardóttir, 1977). It is characterized by pseudocraters and flat tephra plains that cover large areas of the lava field. The tephra is mostly ash (<2 mm Ø) and is continuous from the surface down to firm bottom, which is on average at a depth of less than four meters. Minimum depth to firm bottom is at 1,3 meters, whereas maximum depth lies at 10,5 m. Aeolian sands are in the lower part of a few drillholes. Firm bottom is in most cases coarse lava/scoria or solid rock.

3.2 Core drilling

Three holes were drilled in 2014 and core samples retrieved. The holes were drilled with NQ wireline core drilling method. The rock is drilled with round drill bit producing 47,6 mm core secured in the inner tube of the drill string that is pulled up through the hollow drill rods. In all three holes, Odex method was included for drilling casing through layers of loose material between the lava layers. As the stratigraphy of these upper layers is characterized by lava field interbedded with loose tephra, the drilling had to be carried out in multiple stages, shifting between NQ core drilling and Odex drilling with casing to support the loose tephra interbeds and prevent hole collapse. The drilling was therefore more demanding and time consuming compared to normal core drilling in solid bedrock.

The holes are place on a perpendicular line across the longitudinal axisof the proposed wind farm, from north to south.

Hole BFC-02 is located just north of Landvegur Rd.26, about 2 km east of Ísakot.

Hole BFC-03 is located close to the northern boundary of Sölvahraun lava.

Hole BFC-04 is located in Sölvahraun lava, just north of Landmannaleið (Rd. F225).

Each hole is further described below, borehole logs can be seen in appendix 2 and pictures of the cores are presented in appendix 3.

3.2.1 BFC-02

Borehole BFC-02 was drilled from 7th – 18th November 2014. Prior to the drilling it was decided to drill through the Búfellshraun lava (THi), the topmost lava layer, and the underlying unconsolidated interbed with Odex bit and casing, to seal off the loose tephra layers. The hole was drilled with odex to depth of 21 m. The cuttings samples and the drilling rate indicated lava at the depth interval of 3,0-14,5 m and loose material to 18,5 m, where cuttings of pumice were collected. The casing was drilled though the scoria of the second lava layer (THf). The top 4,9 m of the core retrieved were more vesicular and jointed than the rest of the layer. The total thickness of the second lava layer was 29,5 m. At 48,0 m depth, loose material under the lava was entered. It proved impossible to drill with the core equipment so casing drilling was resumed and drilled down to depth of 55,7 m, the last 0,9 m then being in scoria. Samples of the cuttings were collected. The rest of that third lava layer (THe or THd) was drilled with core equipment and. The lava layer was porphyritic basalt, vesicular and jointed in the top and vesicular in the bottom 45 cm. The total thickness of the third lava layer was 5,7 m. Then again entering loose material under the lava. Small cores fragments were retrieved from stones in the loose material with rounded surfaces indicating fluvial origin. Fragments on the last 1 m of the core might be originated from pillow lava formation, there is as well one fragment of hyaloclastite (moberg). However, for full confirmation it would have been necessary to drill deeper. Drilling of the loose layer proved very problematic and it was impossible to continue with the odex drill as well, so drilling was haltered at the final depth of 69,5 m. Three layers of lava and 4 loose interbeds were encountered in the hole, bedrock could not be fully confirmed although there are indications of the older moberg bedrock at 68 m depth.

3.2.2 BFC-03

Borehole BFC-03 was drilled from 15th – 23rd of October 2014. The drilling proved problematic due to the unconsolidated interbeds. The hole caved in repeatedly and the drill string was repeatedly jammed which delayed the drilling operations significantly. Lava, Búrfellshraun (THi) was encountered at 5,4 m depth. It is heavily jointed in the top and bottom and highly permeable, as water pumped down during drilling did not return to the top of the casing from depth of 8 m. The lava was easily drilled and the bottom of it is at 14,1 m. Under that first lava came 4,7 m thick layer of pumice and highly vesicular lava blocks. Almost no samples could be recovered from that layer. The little that came up were fragments from the vesicular lava blocks. In the unconsolidated interbed under the lava drilling was problematic as the drill string repeatedly got jammed. At the depth of 18,8 m drilling rate significantly slowed, indicating intact rock. The core sample extracted was porphyritic basalt, jointed and vesicular in the top scoriaceous layer, but denser as the thickness increased (THd). The bottom was then again similar to the top. The bottom of the second lava was at 35,4 m depth. Under that second lava layer came another layer of loose material where no samples could be extracted. In this layer the drilling became even more difficult and at 39,5 m depth the drill string was completely jammed when trying to pull up. Eventually, the drill string broke and could not be removed from the hole. Drilling of BFC-03 was therefore stopped, at the maximum depth of 39,5 m after going through 2 layers of unconsolidated interbeds and 2 layers of porphyritic basalt lava layers, without reaching the older bedrock.

3.2.3 BFC-04

BFC-04 was drilled in the Sölvahraun lava in order to assess the thickness of it and the underlying interbed, as well as collecting core samples for laboratory testing. Drilling operations started November 19th 2014 and were finished November 22nd 2014. The hole was percussion drilled with 4'' casing to 6 m depth, through overburden of tephra and aeolian sand. Rock was encountered at 4,5 m and cuttings showed scoriaceous basalt. The basalt was cored as it got denser and the casing had been drilled 1,5 m into the lava. The same massive, fine-grained, fresh basalt continued to 26,5 m depth, with occasional ~0,2 m cavities. At 26,5 m an interbed of tephra started and the hole had to be reamed with the 4'' casing all the way to continue the drilling through the unconsolidated interbed, as the core drill string repeatedly got stuck when entering the loose tephra. However, the casing stopped in the interbed as well. Eventually the core drill reached the bottom of the interbed at 32,0 m. Core sample was retrieved from the scoriaceous upper part of the underlying lava, with the characteristics of the Kvíslahraun lava THf. Drilling was stopped at 35 m.

3.3 Percussion drilling

Two holes were drilled with ODEX method percussion drilling, where the casing is pulled down with the drill string and down-the-hole percussion hammer is used for breaking the rock. Samples of the drill cuttings are collected for lithological analysis and the drilling rate is recorded for stratigraphical interpretation.

The percussion drill holes are located across the wind farm area in east – west direction, BFP-03 being by Landvegur (Rd. 26) south of Ísakot and BFP-02 located by the trail to Áfangagil, just west of the embankment that lies between Landvegur and the trail. Borehole logs can be seen in appendix 2.

3.3.1 BFP-02

Borehole BFP-02 was drilled from 10th – 15th of October 2014. The overburden, consisting of tephra, was 4,5 m thick, where Búrfellshraun lava (THi) was encountered. During drilling in the lava, a weld on

the casing broke, so another parallel hole had to be drilled. Drilling of that hole proved problematic as well and at 10 m depth, no cuttings returned to the surface, so yet another borehole was drilled next to the other two. At the third hole the overburden was 4,5 m and the Búrfellshraun lava (THi) was 9 m thick. Under the lava was 3,5 m of unconsolidated sediment of fluvial origin. Under the fluvial sediment, at 17 – 27 m, tephra cuttings emerged, mostly pumice. At 27 m depth cuttings of porphyritic basalt, Kvíslahraun lava (THf), reached surface. At 32,5 m a 1 m drop occurred and cuttings of tephra started emerging again, and continued down to depth of 47 m, where drilling was stopped. As the borehole log differs strongly from the surrounding lithology, it has been excluded from the interpretation in generalized geological profile A-A' in appendix 1.

3.3.2 BFP-03

Borehole BFP-03 was drilled from 7th – 10th of October 2014. The overburden of tephra was 5 m thick above the Búrfellshraun lava (THi), which extends down to depth of 16 m. Under THi, unconsolidated tephra reached down to 19 m depth, and cuttings of scoriaceous porphyritic basalt belonging to Kvíslahraun lava (THf) came up. However, the hole was abandoned at 23 m due to problems in drilling through the loose material, and new hole drilled a few meters away. In the new hole the casing was taken down to 23 m in order to seal off the unconsolidated interbed. The scoriaceous part of THf was 1 m thick and the massive rock reached down to depth of 30,5 m. Unconsolidated sediment under THf reached 35,0 m depth. At 35,0 m drilling times indicated intact rock, most likely THe or THd, according to surrounding stratigraphy. However, no cuttings reached surface, possibly due to cavities in the tephra above. Drilling was stopped at 38,0 m.

4 BORROW AREAS

Quite many quarries and borrow areas have been opened and / or investigated for the large hydroelectric projects in the upper Þjórsá region. In an effort to evaluate where suitable material is located for various applications for the Búrfellslundur Wind farm, samples were acquired from several viable borrow areas in the vicinity of the project area. The field work was carried out on January 28th and 29th 2015. Baldvin Jónbjarnarson from EFLA carried out the sampling in cooperation with the contractor Nesey. Samples were collected from five borrow areas with CAT 325B excavator and shipped in 0,6 m^3 plastic containers to the laboratory.

The location of borrow areas close to proposed Búrfell wind farm areas are shown on Figure 3. Samples were collected from Guðmundareyri, Bjarnalón, Rip-rap Quarry, Glacial deposit and Tungnaá. Earlier, samples had been gathered from the surface sand/tephra at the wind farm area on Haf along with sand samples from Tungnaá.

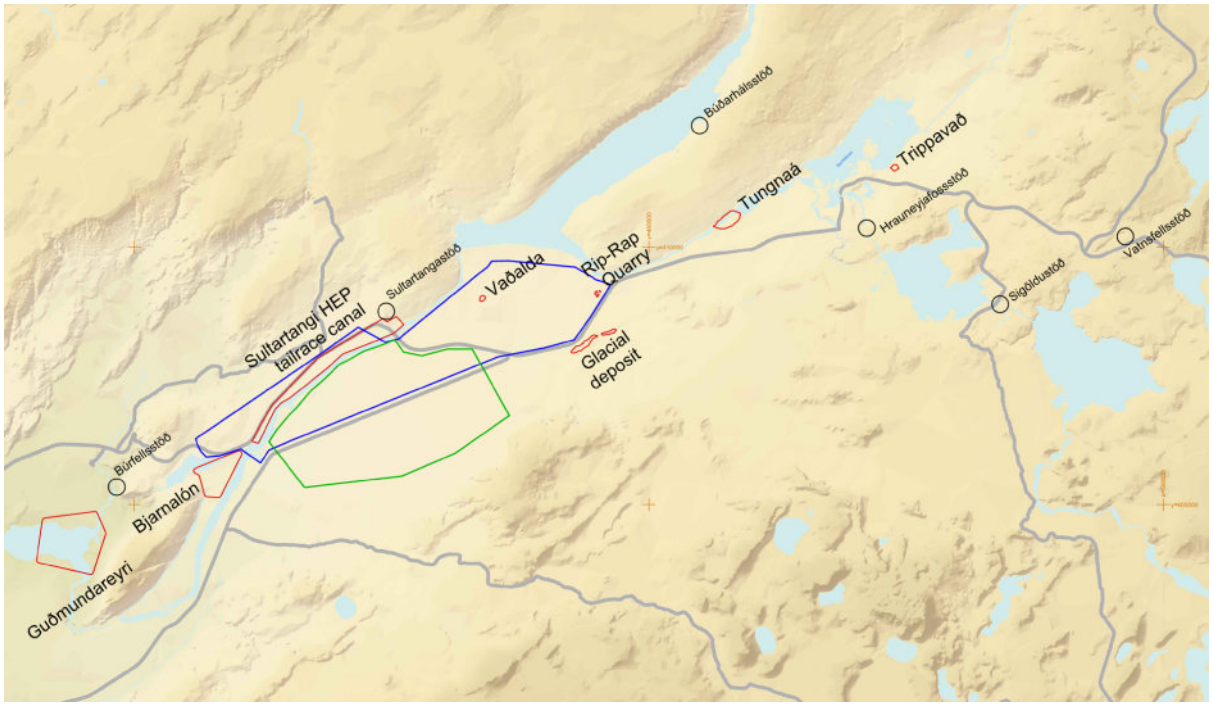


Figure 3: Borrow areas near Búrfell wind farm.

4.1.1 Guðmundareyri

At the junction of the rivers Þjórsá and Fossá below Búrfell are large sandbanks called Guðmundareyri. Four test pits were excavated on the eastern bank. The sandbank has boulders and some vegetation on the surface but under thin layer of sand mixed with organic matter are layers of fluvial sediment made of sandy gravel with occasional layers of tephra.

The first test pit, GE1, was excavated at rather short distance out onto the sandbank. In the top 0,5-1,0 m was sandy mud due to high groundwater level and high content of fines and organic matter.

The second test pit, GE2, was excavated further out on the sandbank. The groundwater table was at 1,5 m and the layer of sand mixed with organic and fine matter was minimal. Two containers of 0,6 m^3 each were collected at this location.

Further out on the sandbar the test pit GE3 was excavated. It was quite similar to GE2 and two plastic bags were collected as to compare the material from the two pits.

The last test pit, GE4, was excavated on a barren area furthest into the sandbank of all the test pits. The groundwater level was at 2,5 m depth but the site was at little higher altitude than the other pits. Two 0,6 m^3 samples were collected.

Transport to the proposed areas is around 20 km, including the steep incline of Sámstaðamúli. This material will be tested for concrete aggregate suitability and for cable backfill. Results of the concrete testing will be addressed in a separate report, still in press.

4.1.2 Tungnaá

The Tungnaá borrow area (Karstens Ø) is located approximately 3-4 km downstream of the Sporðalda dam. The borrow area is relatively large, but the depth of the fluvial deposits has not been estimated. The sandy gravel has been tested with regards to concrete use, not fulfilling requirements for weathering resistance concrete. However, the material can be used and has been accepted in other projects for sub-surface concrete. The material was used during the recent construction of the Búðarháls HEP and Sultartangi HEP.

The borrow area is located approximately 20 km from the centre of the proposed wind farm.

4.1.3 Sultartangi Rip-Rap Quarry

A quarry approx 700 m southeast of Sultartangi dam (figure 2). Material has been produced from a fresh, dense lava field originating from Hekla, most likely for rip-rap embankments of the Sultartangi dam. The lava, where the quarry is located, is quite large and the height of the rock wall is about 5-6 m in the open pit, therefore quite large quantities can still be produced if needed. The quarry is not landscaped or closed and there are some material heaps laying around. A sample was obtained from one of the piles. This material can possibly be used as concrete aggregate, road fill or fill under foundations if needed. However the production includes more processing as blasting and crushing, resulting in increased production cost. Transport to the centre of the wind farm is around 13 km.

4.1.4 Unnamed Glacial deposit

About 5 km northeast of the wind farm is a small glacial deposit with sandy, silty gravel. Manmade piles in the deposit suggest that construction materials have been produced there, but no records of usage have been found. Considering the fine grained nature of the material it could possibly serve as cable backfill material.

4.1.5 Bjarnalón

Great amount of fine sand has been pumped from the bottom of the reservoir through the decades. As the sand is rather fine the only possible use of it could be as cable backfill material, but high content of tephra, vesicular and glassy particles suggest rather high thermal resistivity rendering the material not suitable.

4.1.6 Sultartangi HEP tailrace canal

Excavated material from the tailrace canal is stock piled along the canal. The material is composed of both loose volcanic material and crushed rock from the Búrfellshraun (THi) lava. Long sections of the then proposed tailrace canal shows that the thickness of the lava is greater closer to the Sultartangi power station, thus the fraction of crushed rock is likely to be larger in the piles there (Pétursson, Kristinsson and Hjartarson, 1982). The excavated material from the canal should be more than enough for the fill and the subgrade parts of the roads in the wind farm and, depending on the quality, the sub-base as well. The stock pile along the canal is on the opposite side of Þjórsá river resulting in a average transport distance of 15 km to the centre of the wind farm, assuming that the bridge by Sultartangi power station is used.

4.1.7 Vaðalda

In Vaðalda, rock blocks have been produced for the construction of Sultartangi dam from a quarry in the topmost basalt layer of the hill. Material could be produced for the road construction by blasting and crushing. Distance to the centre of the wind farm is about 12 km.

4.1.8 Trippavað

Trippavað borrow area (figure 1) is a fluvial deposit in Tungnaá, now under water in Sporðalda reservoir. The material has been used and tested as fill material for concrete, just barely fulfilling all requirements. It was used in construction of both Búðarháls HEP and Hrauneyjafoss HEP. Before impoundment of Sporðalda reservoir some 25.000 m^3 were removed and stockpiled on higher ground near Trippavað. The stockpile is on the southeast side of the reservoir, with approx 30 km transport distance to the proposed wind farm area.

4.2 Material needs

The requirements for materials used in road construction are based on the guidelines implemented by the Icelandic Road and Coastal Administration (IRCA). It should be noted that traffic on the service roads planned will be minimal and mainly during construction. The road construction requirements are thus not as demanding as specified in the guide.

Table 3: List of approximate material need, listed by application.

Application	Proposal 1	Proposal 2
	Quantity (m^3)	Quantity (m^3)
Concrete	25.000	25.000
Cable backfill	35.000	45.000
Fill, unspecified material	121.000	202.000
Subgrade	216.000	337.000
Sub-base	210.000	321.000
Basecourse	45.000	65.000

Concrete aggregate: Aggregate used for concrete must be of appropriate grain size distribution. Tests need to be carried out in the laboratory for alkali-aggregate reaction, air-void properties and weathering resistivity (freeze/thaw cycles). Those requirements are difficult to estimate out in the field, so samples need to be collected. Aggregate research for concrete will be presented in separate report.

Cable backfill: The main concern for cable backfill material is the thermal resistivity. The material should be capable of conducting heat generated by the cables away from them to prevent overheating. Generally, thermal resistivity of maximum 1,5-2,5 m*K/w at 5% water content is recommended. Most cable manufacturers do not allow use of crushed material so sedimentary deposits containing aggregates of 0-8 mm in diameter are preferred.

Fill: The main requirement for general fill material is that organic content is less than 3 wt%. Suitable material is abundant in the area.

Subgrade: Material used in the subgrade layer of the roads needs to meet requirements regarding strength and resistance to fragmentation and grain size distribution.

Sub-base: Sub-base material needs to meet requirements regarding petrographic properties, grain size distribution, grain shape and strength and resistance to fragmentation. Depending on the petrographic properties, it might be necessary to carry out freeze-thaw cycle tests. General aggregate size is 0-100 mm.

Basecourse: Basecourse material needs to meet requirements of maximum amount of organic material, grain size distribution, petrographic properties, grain shape and strength and resistance to fragmentation. General aggregate size is 0-32 mm or 0-63 mm.

5 LAB TESTS AND RESULTS

5.1 Rock Quality

The rock mass quality was assessed by applying the Q-system to the core samples, with enhanced values for joint set number, J_n, to account for columnar jointing in the basalt. Overall, the Q value assigned to the core samples ranges from 3 – 32, and is commonly around 20. The basalt is fresh and dense, excluding the occasional scoriaceous parts in the top and the bottom of individual layers. Some silt/clay fillings can be seen in few of the otherwise unaltered joints. Nearly all joints are rough and irregular or undulating. Minor flow and vesicle banding and can be seen in all the lava units, especially Sölvahraun lava. No tectonic fractures were observed. Joints are ranging from 1-4 joints/m in the dense middle parts of the lava units, but reach up to 20 joints/m in the scoria and the scoriaceous parts. The rock quality assessment is detailed in the bore logs in appendix 2

5.2 Unconfined compressive strength (UCS)

The unconfined compressive strength (UCS) was tested on core samples according to ASTM D 2938 – 95 (2002). Total of 36 samples were tested, minimum 3 samples from homogenous parts of each geological unit in order to obtain representative value for both poor and strong zones in the units. The samples were surface dry and saturated when tested. Axial stress was applied at constant rate of 0,5 MPa/s until failure occurred and the load at failure recorded. Table 4 shows the results from each sample as well as dimensions of samples. The results are ranging from moderate to very strong according to ISRM UCS rating chart, the lower values being from the more scoriaceous parts of the lava flows.

Table 4: Results from UCS tests.

Sample ID	Depth in hole [m]	Sample length [mm]	Sample diameter [mm]	Max load [kN]	UCS, σ_c [MPa]	UCS, $\sigma_{c50;2,5}$ [MPa]	ISRM UCS classification	Geological unit	Average UCS of unit, σ_{c50} (Min/Max) [MPa]
BFC2-01	26,3	114,8	47,1	86,4	49,6	43,8	Moderate	Kvíslahraun, TH_f	69,7 (39,2 / 69,6)
BFC2-02	27,2	113,3	47,1	69,8	44,5	39,2	Moderate		
BFC2-03	28,3	113,0	47,1	101,0	58,0	51,0	High		
BFC2-04	35,3	113,8	47,2	191,1	109,2	96,6	High		
BFC2-05	35,5	113,6	47,2	93,4	53,4	47,2	Moderate		
BFC2-06	36,4	114,0	47,2	151,6	86,6	76,7	High		
BFC2-07	39,6	113,8	47,1	169,1	97,1	85,5	High		
BFC2-08	40,4	114,1	47,2	140,9	80,5	71,3	High		
BFC2-09	41,3	114,0	47,2	131,8	75,3	66,7	High		
BFC2-10	45,0	113,8	47,2	182,4	104,2	92,2	High		
BFC2-11	45,8	113,8	47,2	163,2	93,3	82,5	High		
BFC2-12	46,9	113,2	47,3	165,3	94,1	83,5	High		
BFC2-13	59,1	113,8	47,2	107,2	61,3	54,2	High	TH_e eða TH_d	57,4 (54,2 / 61,5)
BFC2-14	59,6	113,8	47,2	111,5	63,7	56,4	High		
BFC2-15	59,9	114,3	47,2	121,5	69,4	61,5	High		

Sample ID	Depth in hole [m]	Sample length [mm]	Sample diameter [mm]	Max load [kN]	UCS, σ_c [MPa]	UCS, $\sigma_{c50;2,5}$ [MPa]	ISRM UCS classification	Geological unit	Average UCS of unit, σ_{c50} (Min/Max) [MPa]
BFC3-01	8,3	113,2	47,3	99,7	56,7	50,3	High	Búrfellshraun, Th_i	80,8 (50,3 / 114,2)
BFC3-02	8,7	113,9	47,3	115,9	66,0	58,6	High		
BFC3-03	9,6	113,9	47,3	174,9	99,5	88,4	High		
BFC3-04	10,5	113,8	47,2	225,9	129,1	114,2	High		
BFC3-05	11,0	113,8	47,3	142,8	81,3	72,2	High		
BFC3-06	11,8	114,1	47,4	200,4	113,6	101,3	High		
BFC3-07	19,4	113,8	47,4	58,4	33,1	29,5	Moderate	Kvíslahraun, TH_f	42,5 (29,5 / 57,4)
BFC3-08	19,9	113,8	47,4	69,2	39,2	35,0	Moderate		
BFC3-09	20,7	113,9	47,4	63,2	35,8	31,9	Moderate		
BFC3-10	25,6	113,9	47,3	89,7	51,0	45,4	Moderate		
BFC3-11	25,8	113,7	47,3	110,7	63,0	55,9	High		
BFC3-12	26,8	113,8	47,3	113,6	64,6	57,4	High		
BFC4-01	9,4	115,2	47,1	214,0	122,8	108,5	High	Sölvahraun	113,4 (83,5 / 180,1)
BFC4-02	9,7	115,1	47,1	271,5	155,8	137,7	Very high		
BFC4-03	11,7	115,1	47,1	208,7	119,8	105,8	High		
BFC4-04	12,2	111,2	47,1	165,8	95,2	83,5	High		
BFC4-05	12,8	111,9	47,1	183,9	105,5	92,7	High		
BFC4-06	13,1	111,9	47,1	174,7	100,3	88,1	High		
BFC4-07	21,2	114,0	47,2	215,5	123,2	109,0	High		
BFC4-08	22,0	114,1	47,2	226,7	129,6	114,7	High		
BFC4-09	23,1	113,9	47,2	356,1	203,5	180,1	Very high		

5.3 Density and water content

Alongside the UCS test, the density and water content of the samples were measured. The density is in the lower range of average density of basalt, ranging from 2730 – 2850 kg/m^3 on average. The water content is relatively low, ranging from 0,5 – 1,8 wt%.

Table 5: Density and water content measurements.

Sample ID	Depth in hole [m]	Geological unit	Sample length [mm]	Sample diameter [mm]	SSD weight [g]	SSD density [kg/m3]	Dry density [kg/m3]	Water content [%]	Average dry density of unit [kg/m3]
BFC2-01	26,3	Kvíslahraun, THf	114,8	47,1	546,7	2733,2	2694,1	1,5	2848,6
BFC2-02	27,2		113,3	47,1	546,1	3073,0	3032,2	1,3	
BFC2-03	28,3		113,0	47,1	558,5	2836,7	2802,6	1,2	
BFC2-04	35,3		113,8	47,2	573,3	2879,2	2860,0	0,7	
BFC2-05	35,5		113,6	47,2	564,1	2837,9	2811,5	0,9	
BFC2-06	36,4		114,0	47,2	573,8	2876,6	2855,5	0,7	
BFC2-07	39,6		113,8	47,1	575,9	2904,5	2885,0	0,7	

Sample ID	Depth in hole [m]	Geological unit	Sample length [mm]	Sample diameter [mm]	SSD weight [g]	SSD density [kg/m3]	Dry density [kg/m3]	Water content [%]	Average dry density of unit [kg/m3]
BFC2-08	40,4		114,1	47,2	570,8	2859,1	2837,4	0,8	
BFC2-09	41,3		114,0	47,2	573,3	2874,1	2853,9	0,7	
BFC2-10	45,0		113,8	47,2	576,1	2893,2	2865,2	1,0	
BFC2-11	45,8		113,8	47,2	572,7	2876,1	2854,2	0,8	
BFC2-12	46,9		113,2	47,3	569,2	2861,6	2831,3	1,1	
BFC2-13	59,1	THe eða THd	113,8	47,2	559,2	2808,3	2785,1	0,8	2786,0
BFC2-14	59,6		113,8	47,2	560,6	2815,4	2793,6	0,8	
BFC2-15	59,9		114,3	47,2	561,1	2805,6	2779,3	0,9	
BFC3-01	8,3	Búrfellshraun, Thi	113,2	47,3	561,0	2820,4	2771,3	1,8	2838,4
BFC3-02	8,7		113,9	47,3	572,9	2862,5	2820,0	1,5	
BFC3-03	9,6		113,9	47,3	577,5	2885,5	2849,7	1,3	
BFC3-04	10,5		113,8	47,2	579,0	2907,8	2873,4	1,2	
BFC3-05	11,0		113,8	47,3	576,7	2884,0	2849,4	1,2	
BFC3-06	11,8		114,1	47,4	583,8	2899,6	2866,7	1,1	
BFC3-07	19,4	Kvíslahraun, THf	113,8	47,4	493,4	2457,0	2413,1	1,8	2824,6
BFC3-08	19,9		113,8	47,4	517,2	2575,5	2533,2	1,7	
BFC3-09	20,7		113,9	47,4	507,6	2525,5	2486,2	1,6	
BFC3-10	25,6		113,9	47,3	571,6	2856,0	2816,8	1,4	
BFC3-11	25,8		113,7	47,3	572,1	2863,5	2825,1	1,4	
BFC3-12	26,8		113,8	47,3	573,8	2869,5	2832,0	1,3	
BFC4-01	9,4	Sölvahraun, HH2	115,2	47,1	556,6	2773,1	2739,3	1,2	2731,6
BFC4-02	9,7		115,1	47,1	557,3	2779,0	2750,2	1,0	
BFC4-03	11,7		115,1	47,1	554,3	2764,0	2729,3	1,3	
BFC4-04	12,2		111,2	47,1	526,8	2719,0	2675,3	1,6	
BFC4-05	12,8		111,9	47,1	535,8	2748,2	2708,3	1,5	
BFC4-06	13,1		111,9	47,1	537,6	2757,4	2716,3	1,5	
BFC4-07	21,2		114,0	47,2	554,7	2780,9	2748,9	1,2	
BFC4-08	22,0		114,1	47,2	553,1	2770,4	2739,1	1,1	
BFC4-09	23,1		113,9	47,2	556,7	2793,3	2778,2	0,5	

5.4 Aggregate research

Thermal resistivity was measured in material from all possible locations, as well as surface sand that was measured to obtain in-situ value. Overall, the thermal properties of the material proved to be poor in all borrow areas. All samples showed higher thermal resistivity values than commonly used reference materials. Samples from Guðmundareyri showed the lowest resistivity of the borrow areas, or ~2 K*m/W at 5% water content.

Petrographical analysis were carried out on two samples from Guðmundareyri and one from Tungnaáreyrar. The samples from Guðmundareyri were from test pits GE2 and GE4. The sample from GE2 showed higher quality regarding concrete fill where 4,7 % of grains were in 3. class, compared to 10,8% in GE4. Apparently, the aggregate quality is lower further out on the sandbank. The difference lies mostly in grains of hyaloclastite in GE4. Both samples consist mostly of fresh basalt of varying vesicularity. The sample from Tungnáreyri was of similar quality as the sample from GE2. Detailed results from the analysis and grain size distribution can be seen in appendix 6.

Table 6: All measurements of thermal resistivity carried out. The surface sand tested is from the locations of corresponding ram sounding drill holes and can be seen on drawing 2 in appendix 1.

Location	Unit	Measurement		
Guðmundareyri	Resistivity [K*m/W]	2,48	2,03	1,93
	Water content [%]	4,1	5,3	6,9
Tungnaáreyrar	Resistivity [K*m/W]	3,68	2,45	1,88
	Water content [%]	1,8	4,6	8,8
Glacial deposit	Resistivity [K*m/W]	2,72	1,16	
	Water content [%]	9,6	17,0	
Bjarnalón	Resistivity [K*m/W]	2,41	1,84	
	Water content [%]	6,6	14,3	
Surface sand HC-06	Resistivity [K*m/W]	1,91		
	Water content [%]	28,1		
Surface sand HC-21	Resistivity [K*m/W]	1,83	1,44	
	Water content [%]	6,3	15,2	

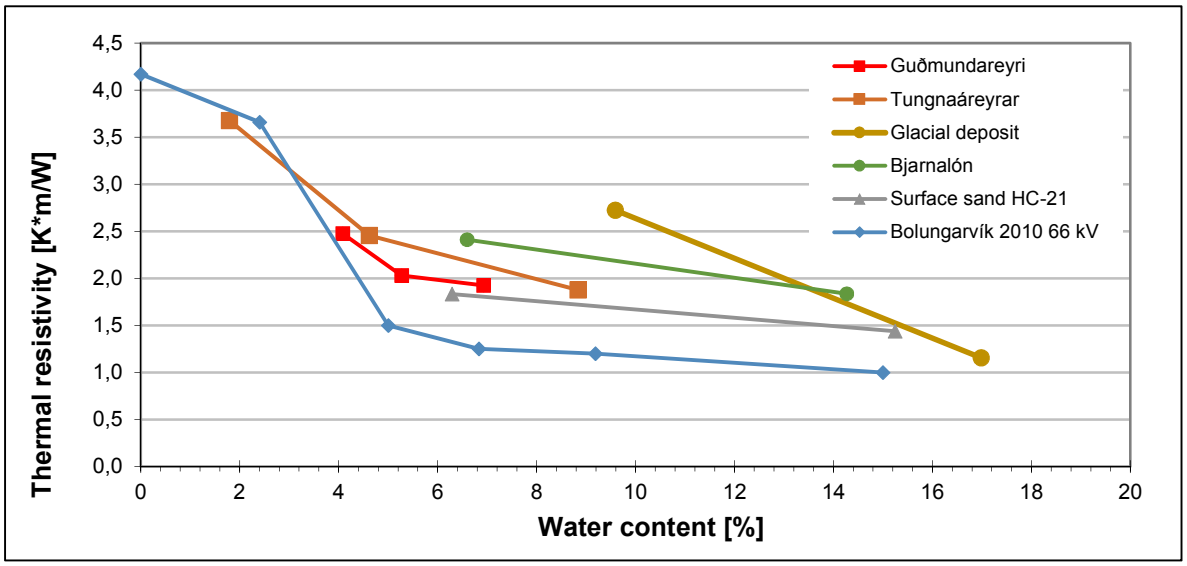


Figure 4: Thermal resistivity measured in samples from borrow areas. The blue line shows reference for backfill material used for Bolungarvík 66kV ground cable in 2010.

6 CONCLUSION AND DISCUSSION

The drilling operations confirmed the extensive thickness of the Holocene lavas and interbeds in the area, or at least 70 m thick strata in the center at BFC-02. Only small amounts of samples could be extracted from the interbeds. Most of it was acidic pumice, but in some fluvial sediment could also be seen. The plains have been built up by massive lava flows and rivers have run in channels in periods between volcanic events. Alongside that formation, thick layers of tephra have been spewed from Hekla, covering the area. Three of the Tungnaá lavas that were encountered in the channel between Búrfell and Sauðafellssalda were encountered in the boreholes, that is THf, THi and either THd or THe.

Búrfellshraun lava, TH_i, is the topmost lava in the majority of the proposed wind farm area. The UCS was tested and is classified as high strength rock, ranging from 50,3 - 114,2 MPa. According to Vilmundardóttir (1977), average thickness in all boreholes to that date was 12,4m. However, in the boreholes in the Haf area, the average thickness is 18,5 m and ranging from 6,8 - 29,1 m. The unconsolidated sediment underlying TH_i is on average 4,3 m in the same boreholes, ranging from 1,5 – 10,1 m. The borehole logs from the earlier site investigations can be seen in appendix 4.

Material needed for road construction is most likely readily available; if not fully in the Sultartangi tailrace canal stockpile, then with material from either Tungnaá borrow area, Vaðalda quarry or the Rip/Rap quarry near Sultartangi dam.

However, material for concrete in the wind turbine foundations and the cable backfill material is of more concern. Material from Trippavað has been approved in tests for concrete production, but barely enough material is accessible and the transport distance is quite long. Ongoing research on concrete aggregate will be presented in separate report.

Although sand is abundant in the area, most of it is aeolian sand, volcanic ash, tephra and pumice, with high thermal resistivity. Alternative solutions might be necessary, like low resistivity additives. That can prove costly with long distance transport and expansive materials.

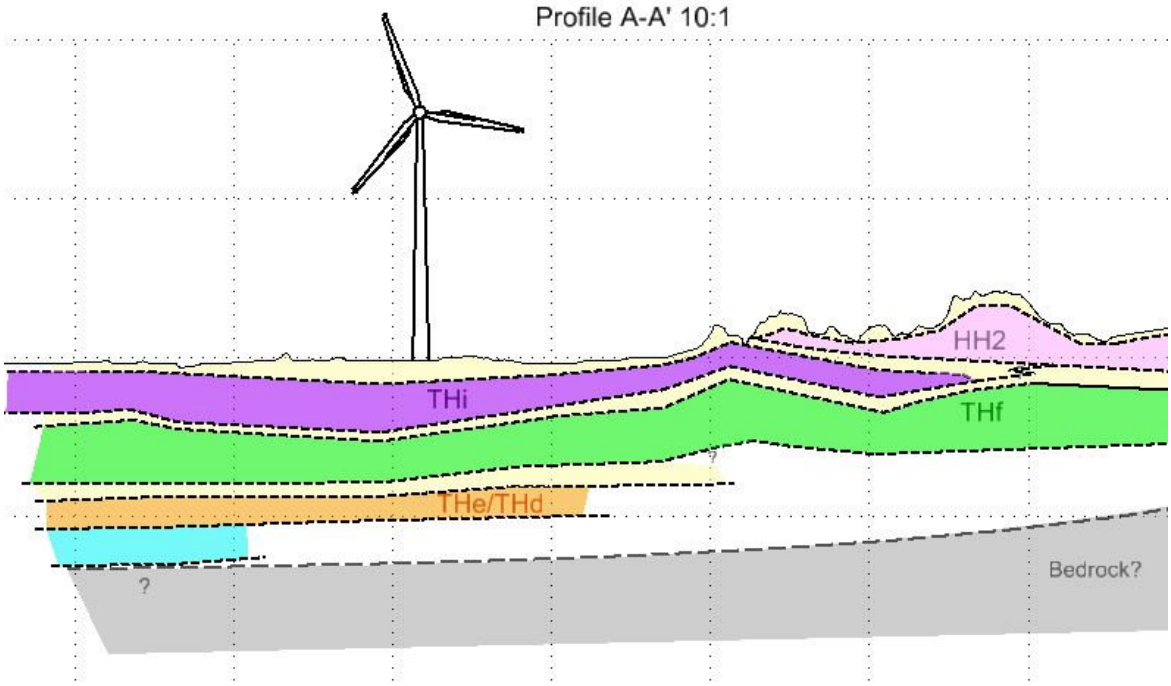


Figure 5: Schematic section of the Holocene lavas above bedrock in the area, with 10x vertical exaggeration. The grid is 500x50 m (w x h). The figure shows Sölvahraun HH2 in pink, Búrfellshraun THi in purple, Kvíslahraun THf in green and THe/THd in orange. The pale yellow is interbed and overburden of tephra and other unconsolidated sediment. As the bedrock was not reached definitively, the depth to it cannot be confirmed. Complete section can be seen in appendix 1.

REFERENCES

ASTM Standard D 2938, 1995 (2002), "Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens," ASTM International, West Conshohocken, PA, 2002.

Guðmundsson, Á., 1996. Sultartangi HEP - Powerhouse area, geological investigations 1996. Jarðfræðistofan ehf for Landsvirkjun. JFS 12-1996. 32 pages.

IRCA. 2014. Efnisrannsóknir of efniskröfur (in Icelandic). IRCA, Reykjavík.

ISRM. The complete ISRM suggested methods for rock characterization, testing and monitorning: 1974-2006. [ed.] Resat Ulusay and John A. Hudson. April 207. Ankara : Elsevier/ISRM, 2007. p. 628. ISBN 978-975-93675-4-1

Kaldal, I. and Víkingsson, S., 1972. Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages

Kaldal, I. og Vilmundardóttir, E.G., 1986. Jarðgrunnskort, Búrfell-Langalda, 3540 J. Orkustofnun, Vatnsorkudeild og Landsvirkjun. Reykjavík.

Jónasson, B., 1980. Sultartangavirkjun. Boranir og jarðlagaskipan á stíflustæði. Orkustofnun. Greinargerð BjJ-80/05. 17 pages.

Jónsson,T., 1990. Hvert liggja gjóskugeirar? *Náttúrufræðingurinn, 60* (2), 103-105.

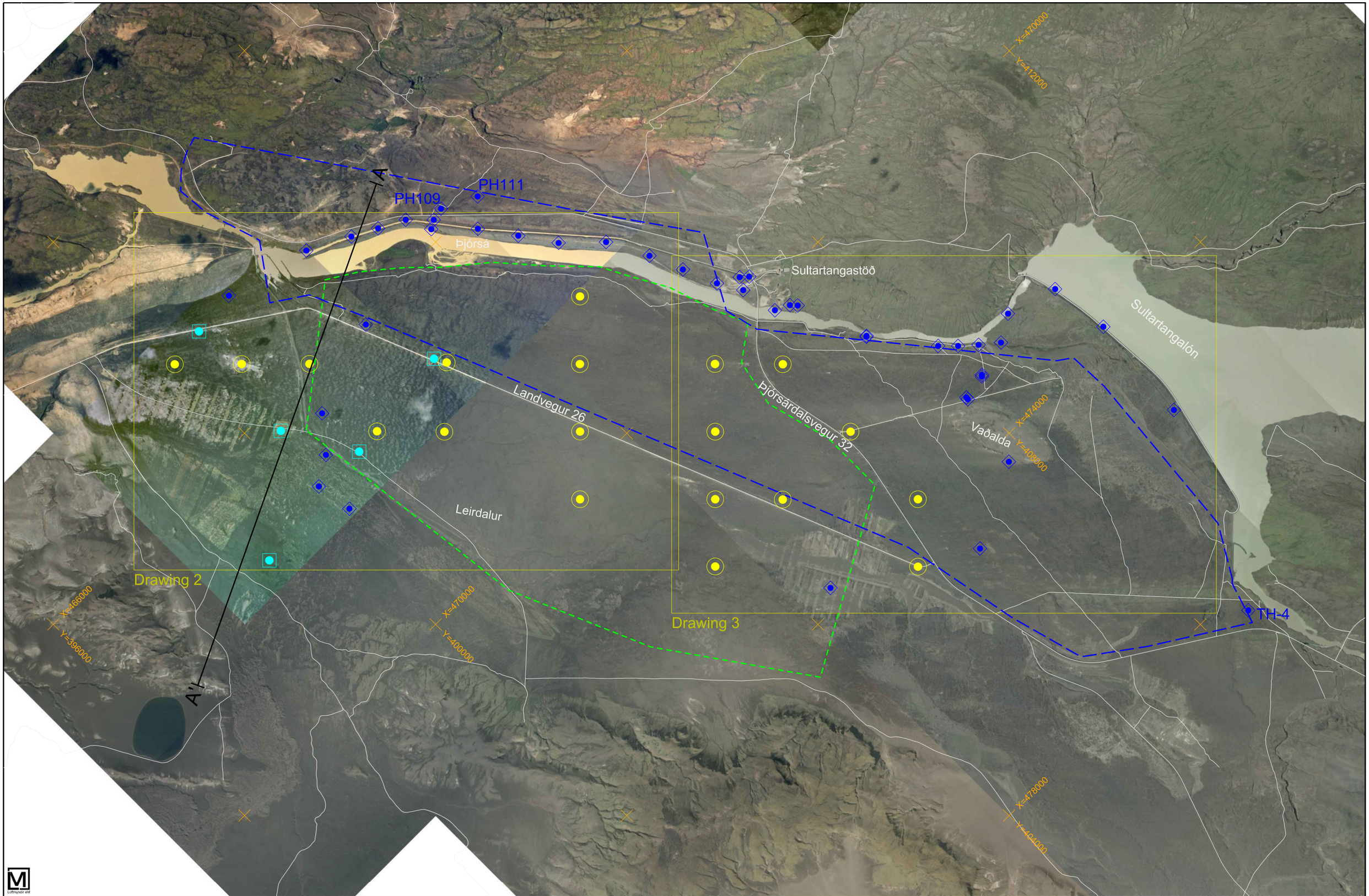
Pétursson, P., Kristinsson, B. and Hjartarson, Á., 1982. Sultartangavirkjun – Frárennslisskurður. Jarðlagalýsingar og grunnvatnsathuganir 1981 (in Icelandic). (OS-82029). Orkustofnun. Reykjavík.

Vilmundardóttir, E.G., 1977. Tungnárhraun: Jarðfræðiskýrsla. (OS-ROD 7702). Orkustofnun. Reykjavík.

Vilmundardóttir, E.G., Guðmundsson, Á. og Snorrason, S.P., 1985. Jarðfræði Búrfells og nágrennis. *Náttúrufræðingurinn, 54* (3-4), 97-113.

APPENDIX 1

DRAWINGS



Legend:

- Ram sounding location Site investigation 12.2013
- Boreholes 2014
- Older borehole location
- Wind farm proposal 1
- Wind farm proposal 2
- Road

0 500 1000 1500 2000 2500 m

Coordinate system: ÍSN93

EFLA CONSULTING ENGINEERS	DATE.	NAME
DESIGN	05.11.2013	BJ
DRAWING	05.03.2015	GEÓ
REVIEW	12.03.2015	BJ
APPROVED		

Landsvirkjun
National Power Company of Iceland

HAF-60 Wind Farm near Búrfell

Site investigation
Ram sounding and boreholes
Overview

CAD file	Scale (A3)	EFLA drawing nr.	Rev.	Page
1611-159_Jardk.dgn	1:50.000	HAF-60 JAR	2	Page 1

Project nr.	Projectleader	Div.	Drawing nr.
1611-159	EE	JAR	1

PH108
PH106
PH105
PH110
PH104
PH103
PH102
PH101
PH100
PH99
PH107
Klofaey
Þjórsá
Ártorfur
LD-02
Árskógar
LD-09
26
BFP-03 | 241,3
39,0 | 202,3
3,7 HC-03 | 259,3
3,7 255,6 | 255,6
3,8 HC-04 | 240,4
3,8 236,6 | 236,6
2,8 HC-05 | 243,7
2,8 240,9 | 240,9
2,8 HC-06 | 248,1
2,8 245,3 | 245,3
BFC-02 | 253,9
39,5 | 184,4
9,8 HC-08 | 259,3
10,5 249,5 | 248,8
1,1 HC-10 | 259,6
1,3 258,5 | 258,3
Landvegur 26
LD-22
BFP-02 | 249,9
47,0 | 202,9
2,4 HC-21 | 253,4
3,9 251,0 | 249,5
1,4 HC-22 | 257,1
1,4 255,7 | 255,7
3,2 HC-24 | 261,6
3,6 258,4 | 258,0
3,4 HC-25 | 264,5
3,4 261,1 | 261,1
LD-23
BFC-03 | 252,9
39,5 | 213,4
LD-21
LANDMANNALEIÐ F225
Leirdalur
5,2 HC-38 | 263,2
5,2 258,0 | 258,0
X=468000
Y=400000
X=470000
Y=402000
BFC-04 | 269,7
35,0 | 234,7

Legend:

- Ram sounding location
  Site investigation 12.2013
  BB depth | Drillhole ID | GL m a.s.l.
  FB depth | BB m a.s.l. | FB m a.s.l.
- GL: Ground Level
  BB: Bearing Bottom
  FB: Firm Bottom
- Borehole location
  Drilled 10.-11.2014
  Borehole ID | GL m a.s.l.
  Depth m | Bottom m a.s.l.
- BFP: Percussion drilled borehole
  BFC: Core borehole
- Older borehole location
- Road

0 200 400 600 800 1000 m

Coordinate system: ÍSN93

	DATE.	NAME
DESIGN	05.11.2013	BJ
DRAWING	29.01.2014	GEÓ
REVIEW	12.03.2015	BJ
APPROVED		

EFLA CONSULTING ENGINEERS

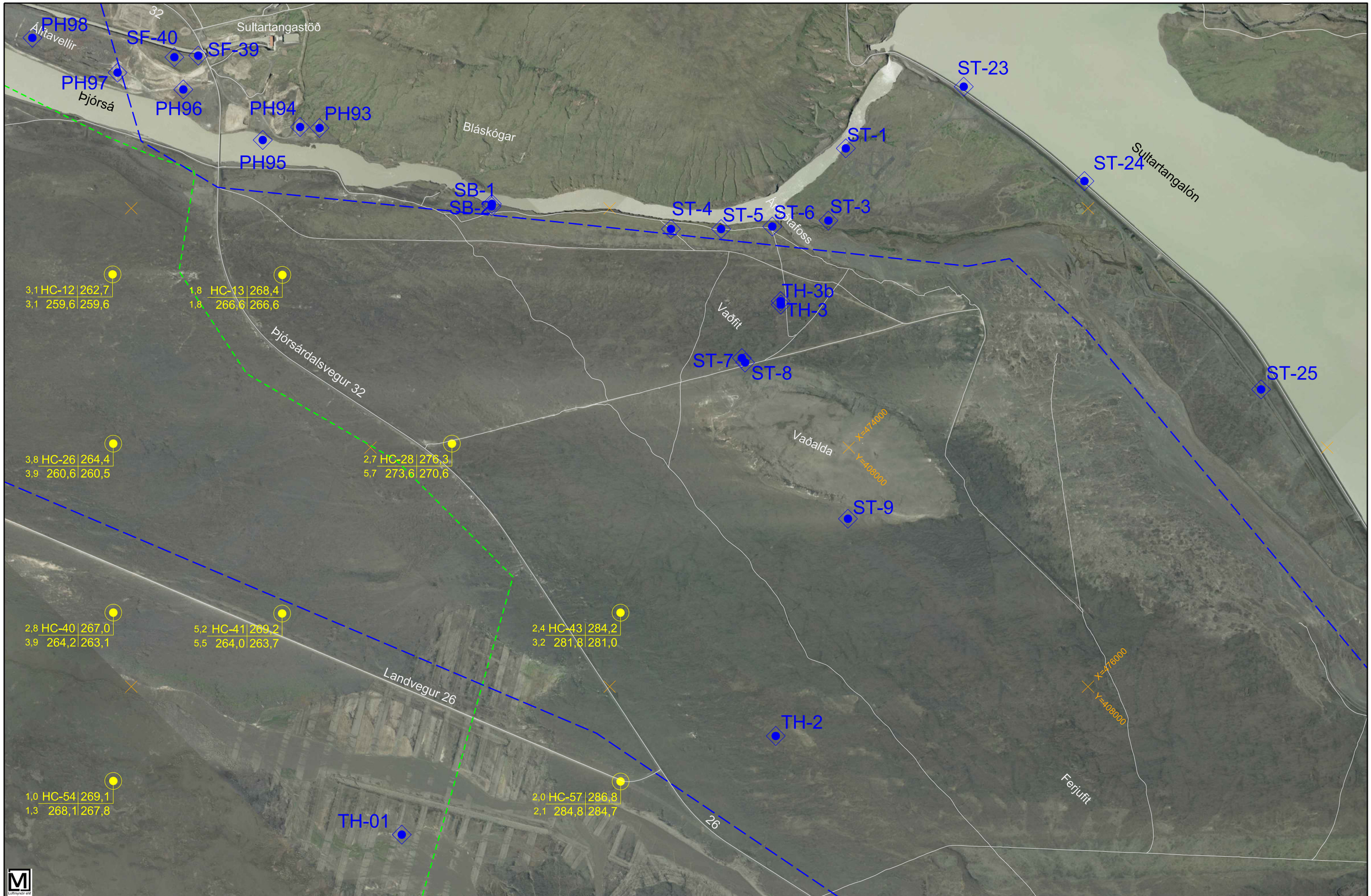
Landsvirkjun
National Power Company of Iceland

HAF-60 Wind Farm near Búrfell

Site investigation
Ram sounding and boreholes

Project nr.	Projectleader	Div.	Drawing nr.
1611-159	EE	JAR	2

CAD file	Scale (A3)	EFLA drawing nr.	Rev.	Page
1611-159_Jardk.dgn	1:20.000	HAF-60 JAR	2	Page 1



Legend:

- Ram sounding location, Site investigation 12.2013
- BB depth | Drillhole ID | GL m a.s.l.
- FB depth | BB m a.s.l. | FB m a.s.l.
- GL: Ground Level; BB: Bearing Bottom; FB: Firm Bottom
- Older borehole location
- Road

0 200 400 600 800 1000 m

Coordinate system: ÍSN93

EFLA CONSULTING ENGINEERS	DATE.	NAME
DESIGN	05.11.2013	BJ
DRAWING	05.03.2015	GEO
REVIEW	12.03.2015	BJ
APPROVED		

Landsvirkjun
National Power Company of Iceland

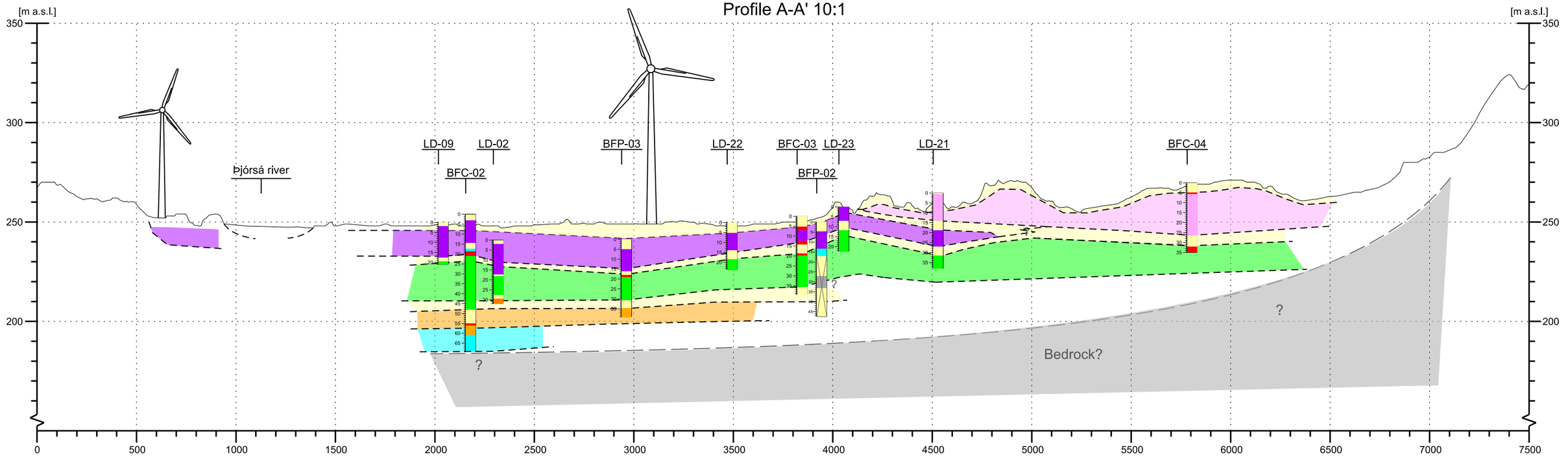
HAF-60 Wind Farm near Búrfell

Site investigation
Ram sounding and boreholes

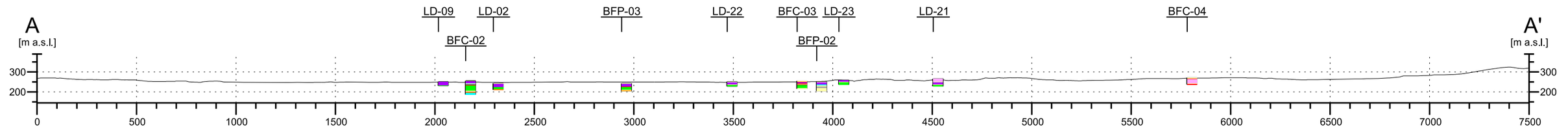
Project nr.	Projectleader	Div.	Drawing nr.
1611-159	EE	JAR	3

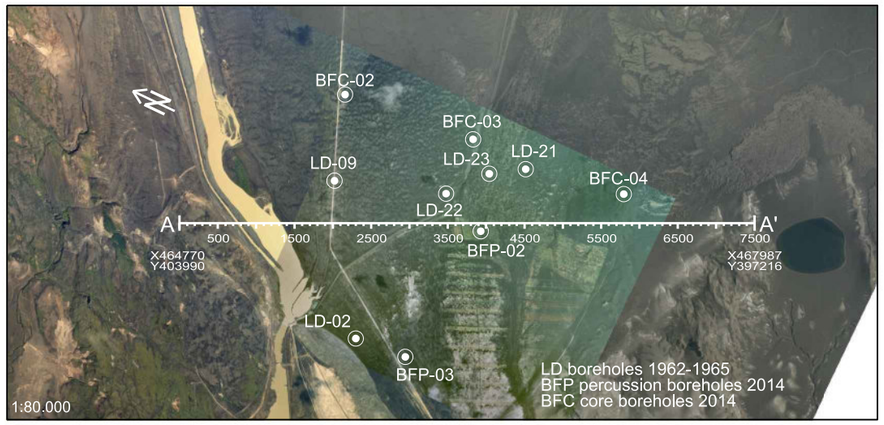
CAD file	Scale (A3)	EFLA drawing nr.	Rev.	Page
1611-159_Jardk.dgn	1:20.000	HAF-60 JAR	2	Page 1

Profile A-A' 10:1



Profile A-A' 1:1





- HH2 Sölvahraun (~1200 a)
- THi Búrfellshraun (~3000 a)
- THf Kvíslahraun (~4500 a)
- THe/THd (~5500 a)
- Scoria
- Tephra / Pumice
- Fluvial sediments

EFLA CONSULTING ENGINEERS

	DATE.	NAME
DESIGN	15.02.2015	GEÓ
DRAWING	15.02.2015	GEÓ
REVIEW	26.02.2015	JHS
APPROVED		

Landsvirkjun
National Power Company of Iceland

HAF-60 Wind Farm near Búrfell

Geological profile A-A´

Project nr.	Projectleader	Div.
1611-159	EE	GEO

CAD file	Scale (A3)	EFLA drawing nr.	Rev.	Page	Drawing nr.
1611-159_Jardk.dgn		HAF-60 JAR 1		Bls. 01	4

APPENDIX 2

BORELOGS

BOREHOLE ID

BFP-02

PAGE 1 /1

Printed 20.4.2015, scale 1:250

DRILLING DATE 10.-15.10.2014

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	HAF-60 Wind Farm near Búrfell			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	GEÓ
COORDINATES	X: 466355,14 Y: 400404,92 Z: 249,91	COORD. SYSTEM	ÍSN93	INCLINATION	0 ° from vertical
CASING Ø ["]	4	CASING AGL [m]	0,25	TOTAL DEPTH [m]	47,5
DRILLED OUTSIDE CASING [m]	17,5	CASING LENGHT [m]	30		
CONTRACTOR	Árni ehf.	OPERATOR	Árni Hjaltason	DRILL RIG	Nemek 407 TS
DRILL BIT	Odex 3 1/2"				

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
249–246	0–4		Tephra and aeolian sand on surface.	
245–239	5–11		THi, Búrfellshraun. Porphyritic basalt.	160 (02:40); 656 (10:56); 274 (04:34); 340 (05:40); 598 (09:58); 1073 (17:53)
236–233	14–17		Sediment, sand.	
232–223	18–27		Tephra and pumice.	53 (00:53); 110 (01:50)
222–217	28–33		THf, Kvíslahraun. Porphyritic basalt, most likely scoria at the top.	
216–203	34–47		Tephra and pumice	170 (02:50); 119 (01:59); 255 (04:15); 122 (02:02); 199 (03:19); 196 (03:16); 194 (03:14); 240 (04:00)

GWL 16., 18. and 20.10.2014 @ 17,45 m depth from casing (17,20 m from surface / 232,7 m a.s.l.).

BOREHOLE ID

BFP-03

PAGE 1 /1

Printed 20.4.2015, scale 1:250

DRILLING DATE 07.-10.2014

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	HAF-60 Wind Farm near Búrfell			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	GEÓ
COORDINATES	X: 464458,19 Y: 400590,06 Z: 241,32	COORD. SYSTEM	ÍSN93	INCLINATION	0 ° from vertical
CASING Ø ["]	4	CASING AGL [m]	0,25	TOTAL DEPTH [m]	39
DRILLED OUTSIDE CASING [m]	16	CASING LENGHT [m]	23		
CONTRACTOR	Árni ehf.	OPERATOR	Árni Hjaltason	DRILL RIG	Nemek 407 TS
DRILL BIT	Odex 3 1/2"				

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
241–203	0–39		Tephra and aeolian sand on surface.	
			THi, Búrfellshraun lava. Light gray porphyritic basalt. Large plagioclase phenocrysts. Slight water inflow at 8,3 m depth. no signs of alteration.	53 (00:53) 232 (03:52) 200 (03:20) 318 (05:18) 355 (05:55) 267 (04:27) 261 (04:21) 342 (05:42) 310 (05:10) 298 (04:58) 338 (05:38)
			Tephra and pumice. Drilling rather difficult due to unconsolidated layer.	60 (01:00)
			Scoria. Porphyritic vesicular basalt. Large plagioclase pehonocrysts.	
			THf, Kvíslahraun lava. Light gray porphyritic basalt. Large plagioclase phenocrysts.	340 (05:40) 290 (04:50) 298 (04:58) 290 (04:50) 286 (04:46) 298 (04:58) 296 (04:56) 210 (03:30)
			Tephra and pumice.	35 (00:35) 90 (01:30)
			No cuttings, drilling stopped. According to drilling time most likely basalt (THe/THd)	180 (03:00) 175 (02:55) 170 (02:50)
			GWL on 18. and 20.10.2014 @14,20 m depth from casing (13,95 m depth from surface / 227,4 m a.s.l.).	

BOREHOLE ID

BFC-02

Printed 22.4.2015, scale 1:250

DRILLING DATE 7.-18.11.2014

BOREHOLE LOG

CORE DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	HAF-60 Wind Farm near Búrfell			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	JÞI/GEÓ
COORDINATES	X: 467204,48 Y: 402761,53 Z: 253,89	COORD. SYSTEM	ÍSN93	CORE Ø [mm]	47
CORE RECOV. (%)	66				
TOTAL DEPTH [m]	69	CASING Ø ["]	6/4	CASING DEPTH [m]	21,0/60,5
CASING AGL [m]	0,2	WITHOUT CASING [m]	8,5	CORE BOX QTY	7
CONTRACTOR	Árni ehf.	OPERATOR	Árni Hjaltason	DRILL RIG	Nemek 407 TS
DRILL BIT	Odex/NQ				

Elev. [m asl]	Depth [m]	Lithol.	Description	UCS	Core recov. (%)	Joints/m	RQD 10 (%)	Q = RQD/Jn x Jr/Ja x Jw/SRF
253–252–251	0–3		Tephra and aeolian sand in surface. Percussion drilled with 6" casing.					
250–240	4–14		THi, Búrfellshraun lava. Light gray porphyritic basalt with plagioclase phenocrysts. Percussion drilled with 6" casing.					
239–237	15–17		Tephra with lava blocks. Percussion drilled with 6" casing					
236	18		Fluvial sediments. Percussion drilled with 6" casing					
235–234	19–20		Scoria. Percussion drilled with 6" casing.					
233–232–231–230–229–228	21–26		THf, Kvíslahraun lava. Light gray porphyritic basalt. Large plagioclase phenochrysts, up to 1 cm dia. Vesicular in the top, vesicles large and elongated. Joint walls unaltered, only occasional surface stains of silt/clay. Minor flow banding.		95	7,7	45	Q=(45/9)*(2-3/1)*(1/1) Q=10-15
227–226–225–224–223–222–221	27–33			44,7 MPa	100	2,8	85	Q=(85/9)*(2-3/1)*(1/1) Q=19-28
220–219–218–217–216–215–214	34–40			73,5 MPa	100	3,6	65	Q=(65/9)*(2-3/1)*(1/1) Q=14-22
213–212–211–210–209–208–207–206	41–48			74,5 MPa 86,1 MPa	100	1,5	95	Q=(95/9)*(2-3/1)*(1/1) Q=21-32
205–204–203–202–201–200	49–53		Tephra. Percussion drilled with 4" casing.					

BOREHOLE ID

BFC-02

Printed 22.4.2015, scale 1:250

PROJECT NR. 1611-159

BOREHOLE LOG

CORE DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

Elev. [m asl]	Depth [m]	Lithol.	Description	UCS	Core recov. (%)	Joints/m	RQD 10 (%)	Q = RQD/Jn x Jr/Ja x Jw/SRF
200	54							
199	55		Scoria. Percussion drilled with 4" casing.					
198	56							
197	57		THe/THd. Porphyritic basalt. Large plagioclase phenochrysts, more abundant than in other layers. Olivine crystals visible. Vesicular in the top 1 m and in the bottom 0,45 m. Silt/clay fillings in fractures, up to 2 mm thick. Minor flow banding. 57,4 MPa		100	3,33	75	Q=(75/12)*(3/2)*(1/1) Q=9
196	58							
195	59							
194	60							
193	61		Tephra and fluvial sediments. Only small bits of core are extracted with rounded edges, including fragments of hyaloclastite.					
192	62							
191	63							
190	64							
189	65							
188	66							
187	67							
186	68		No valid measurement for groundwater table					
185	69		Basalt fragments. Homogenus, dark gray, vesicular basalt with no phenochrysts. Possibly pillow basalt from bedrock but not confirmed.					

BOREHOLE ID

BFC-03

PAGE 1 /1

Printed 20.4.2015, scale 1:250

DRILLING DATE 15.-23.10.2014

BOREHOLE LOG

CORE DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsá-Tungnaá area			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	JÞI/GEÓ
COORDINATES	X: 467392,81 Y: 401006,84 Z: 252,94	COORD. SYSTEM	ÍSN93	CORE Ø [mm]	47
CORE RECOV. (%)	72				
TOTAL DEPTH [m]	39,5	CASING Ø ["]	4	CASING DEPTH [m]	5,4
CASING AGL [m]	0,2	WITHOUT CASING [m]	34,1	CORE BOX QTY	5
CONTRACTOR	Árni ehf.	OPERATOR	Árni Hjaltason	DRILL RIG	Nemek 407 TS
DRILL BIT	Odex/NQ				

Elev. [m asl]	Depth [m]	Lithol.	Description	UCS	Core recov. (%)	Joints/m	RQD 10 (%)	Q = RQD/Jn x Jr/Ja x Jw/SRF
252	0–1		Aeolian sand and tephra in the surface.					
251–247	1–6		Scoriaceous and fractured top of the light gray porphyritic basalt. Plagioclase phenochrysts. Clay coatings/staining on fracture surfaces. Large elongated vesicles.		100	12,0	50	Q=(50/9)*(3/1-2)*(1/1) Q=8-17
247–241	6–12		THi, Búrfellshraun lava. Light gray porphyritic basalt. Large plagioclase phenochrysts.Joint walls generally unaltered, but occasional silt/clay coatings can be seen. Minor flow banding.	65,8 MPa 95,9 MPa	100	4,4	85	Q=(85/9)*(3/1-2)*(1/1) Q=14-28
240–239	13–14		Scoria and consolidated tephra in the lower boundary of the lava.		36	>20	0	Q=(10/12)*(3/1)*(1/1) Q=3
238–235	15–18		Tephra and lava blocks.		9			
234	19		Scoria. Highly fractured. Redish fracture coatings on dark porphyritic basalt. Plagioclase phenocrysts. Top scoria of Kvíslahraun THf.		92	17,5	0	Q=(10/12)*(3/1)*(1/1) Q=3
233–230	20–23		THf, Kvíslahraun lava. Vesicular light gray porphyritic basalt, massive with fracture sones. Joint walls unaltered. Minor flow banding.	32,1 MPa	98	4,17	90	Q=(95/9)*(2-3/1)*(1/1) Q=21-32
229–218	24–35		THf. Massive and dense, light gray porphyritic basalt. Large plagioclase phenochrists and less abundant small olivine crystals. Unalltered joint walls. Minor flow banding.	52,9 MPa	100	2,4	85	Q=(85/9)*(2-3/1)*(1/1) Q=19-28
217–214	36–39		Tephra. No core samples retrieved. GWL on 18., 20., 21.10.2014 @15,36 m depth from casing (15,16 m depth from surface / 237,8 m a.s.l.).					

BOREHOLE ID

BFC-04

PAGE 1 /1

Printed 20.4.2015, scale 1:250

DRILLING DATE 19.-22.11.2014

BOREHOLE LOG

CORE DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

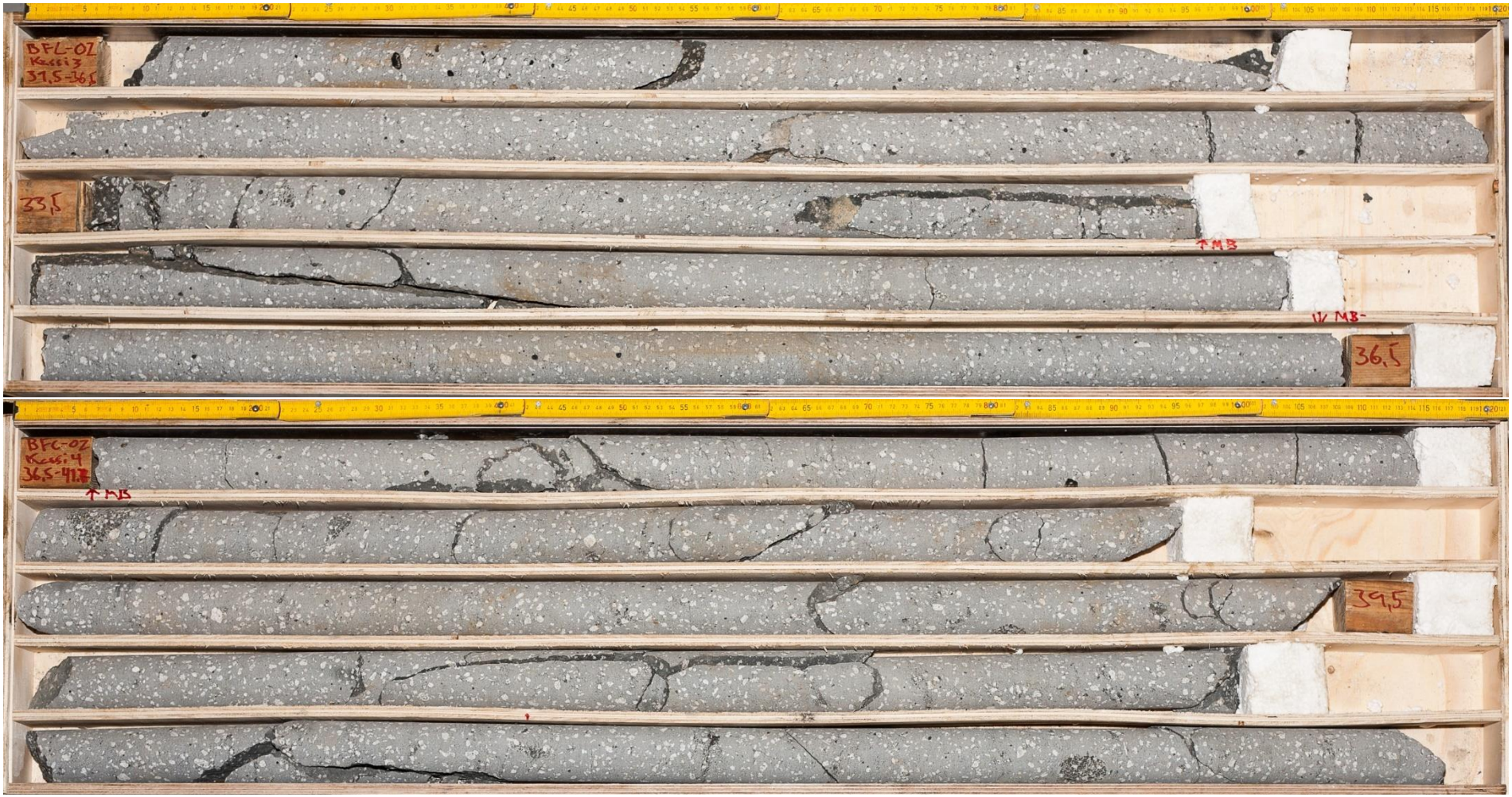
PROJECT	HAF-60 Wind Farm near Búrfell			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	JÞI/GEÓ
COORDINATES	X: 467590,27 Y: 398930,37 Z: 269,71	COORD. SYSTEM	ÍSN93	CORE Ø [mm]	47
CORE RECOV. (%)	77				
TOTAL DEPTH [m]	35	CASING Ø ["]	4	CASING DEPTH [m]	26,4
CASING AGL [m]	0,2	WITHOUT CASING [m]	8,6	CORE BOX QTY	5
CONTRACTOR	Árni ehf.	OPERATOR	Árni Hjaltason	DRILL RIG	Nemek 407 TS
DRILL BIT	Odex/NQ				

Elev. [m asl]	Depth [m]	Lithol.	Description	UCS	Core recov. (%)	Joints/m	RQD 10 (%)	Q = RQD/Jn x Jr/Ja x Jw/SRF
269	0–1		Tephra and aeolian sand in the surface. Percussion drilled with 4" casing.					
268	1–2							
267	2–3							
266	3–4							
265	4–5							
264	5–6		Scoria. Percussion drilled with 4" casing.					
263	6–7		HH2, Sölvahraun lava. Basalt. Percussion drilled with 4" casing.		95	2,4	90	Q=(90/12)*(3/1)*(1/1) Q=23
262	7–8							
261	8–9							
260	9–10		Sölvahraun lava HH2. Dense and massive, light gray fine grained basalt. Occasional surface staining on fracture surfaces. Minor flow banding.					
259	10–11			117,3 MPa				
258	11–12							
257	12–13			88,1 MPa				
256	13–14				97	1,1	95	Q=(95/12)*(3/1)*(1/1) Q=24
255	14–15		GWL on 21.11.2014, 16:00 @14,76 m depth from surface (254,95 m a.s.l.).					
254	15–16							
253	16–17							
252	17–18							
251	18–19							
250	19–20							
249	20–21							
248	21–22				99	3,2	85	Q=(85/12)*(3/1)*(1/1) Q=21
247	22–23			134,6 MPa				
246	23–24							
245	24–25							
244	25–26				81	6,0	70	Q=(70/12)*(3/1)*(1/1) Q=18
243	26–27		HH2. Bottom section of the basalt, slightly more broken and gradually more vesicular with depth. Minor flow banding.					
242	27–28							
241	28–29		Tephra. No samples retrived.		0	0	0	
240	29–30							
239	30–31							
238	31–32							
237	32–33		Basaltic scoria, top of THf, Kvíslahraun lava. Highly fractured porphyritic basalt. Large vesicles.		24	>10	25	Q=(25/12)*(2-3/1)*(1/1) Q=4-6
236	33–34							
235	34–35		THf, Kvíslahraun lava. Vesicular porphyritic basalt, highly fractured. Large plagioclase phenocrysts. Unaltered joint walls.					

APPENDIX 3

PICTURES OF CORE SAMPLES

BFC-02


BFL-07
Kassi 3
33,5
TMB
36,5
BFL-07
Kassi 4
TMB
39,5


BFC-02
Kassi: 5
42,5
45,1
MB
MB
MB
BFC-02
Kassi: 6
MB
48,0
55,7
57,5
MB
MB
MB


BFL-2
60,5
63,5
65,5
65,5

BFC-03


BFC-03
Kassi 3
21.5M
24.5M
30.5M


33,5M
35,4

BFC-04


DFL-04
Box 3
21,5M
MBV
MBV
MBV
MBV
MBV
DFL
04
MDA
24,5
M.
MBV
MDA
MDA
27,5
M.


BFC-04
Box5
35M

APPENDIX 4

BORELOGS FROM EARLIER RESEARCH

BOREHOLE ID

TH-01

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1965

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	HAF			RECORDED BY
COORDINATES	X: 473749.29 Y: 404512.43 Z: 269.5	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 28,4	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
269–242	0–28		Sand and gravel (0–10 m); Pophyritic basalt THe (10–11 m); Sand and gravel (11–17 m); Pophyritic basalt THd (17–25 m); Sand and gravel (25–28 m)	

DATA SOURCE

Elsa G. Vilmundardóttir (1977). Tungnaárhraun. Orkustofnun. OS-ROD-7702. 166 pages.

BOREHOLE ID

TH-02

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1965

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	SE of Vaðalda			RECORDED BY
COORDINATES	X: 474900.70 Y: 406488.35 Z: 289.7	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 48,0	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
289–242	0–48		Overburden	
			Basalt THi Búrfellshraun	
			Interbed, Rhyolitic pumice and basaltic sand	
			Basalt THf Kvíslahraun	
			Interbed, Rhyolitic pumice and basaltic sand	
			Basalt THe	
			Interbed (sand and gravel)	
			Basalt THd	

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID

TH-03

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1965

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi			RECORDED BY
COORDINATES	X: 473117.78 Y: 408313.20 Z: 284.1	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 48,3	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
284–283–282–281–280	0–1–2–3–4		Overburden	
279–278–277–276–275–274–273–272–271–270–269–268–267	5–6–7–8–9–10–11–12–13–14–15–16–17		Basalt THi Búrfellshraun	
266–265–264–263–262–261–260–259	18–19–20–21–22–23–24–25		Loose interbed (sand and gravel)	
258–257–256–255–254–253–252–251–250–249–248–247–246–245–244–243	26–27–28–29–30–31–32–33–34–35–36–37–38–39–40–41		Basalt THf Kvíslahraun	
242–241–240–239–238–237–236	42–43–44–45–46–47–48		Loose interbed (sand and gravel)	

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID

TH-03b

Printed 14.4.2015, scale 1:250

DRILLING DATE 1971

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area		PROJECT NR. 1611-159
LOCATION	Sultartangi		RECORDED BY
COORDINATES	X: 473115,79 Y: 408312,17 Z: 284,2	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 59,5	DRILLED OUTSIDE CASING [m] / CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG / DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
284–230	0–54		Overburden	
			Basalt THi Búrfellshraun	
			Interbed	
			Basalt THf Kvíslahraun	
			Interbed	
			Old bedrock	

BOREHOLE ID

TH-03b

PAGE 2 /2

Printed 14.4.2015, scale 1:250

PROJECT NR. 1611-159

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 [mm:ss] 360
230	54			
229	55			
228	56			
227	57			
226	58			
225	59			

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID	PAGE 1 /1	BOREHOLE LOG	Landsvirkjun
TH-04		PERCUSSION DRILLING	EFLA VERKFRÆÐISTOFA
Printed 22.4.2015, scale 1:250			
DRILLING DATE 1965			

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR.	1611-159
LOCATION	Sultartangi			RECORDED BY	
COORDINATES	X: 478354,61 Y: 408650,05 Z: 300,1	COORD. SYSTEM	ISN93	INCLINATION	0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m]	32,3	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR		DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
300–268	0–32		Overburden Basalt THi Búrfellshraun Loose interbed Old bedrock	

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID

LD-02

PAGE 1 /1

Printed 22.4.2015, scale 1:250

DRILLING DATE 1962

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsá-Tungnaá area			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	
COORDINATES	X: 486272	Y: 393456	Z: 240,9	COORD. SYSTEM	ÍSN93
INCLINATION	0 ° from vertical				
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m]	32	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR		DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
240	0–1		Tephra / pumice	
239–231	2–10		THi, Búrfellshraun lava.	
230–224	11–17			
223	18		Tephra / pumice	
222–214	19–27		THf, Kvíslahraun lava.	
213–212	28–29		Tephra / pumice	
211–209	30–32		THe/THd, lava	

DATA SOURCE

Elsa G. Vilmundardóttir (1977). Tungnárhraun - Jarðfræðiskýrsla. Orkustofnun. OS ROD 7702. 165 pages.

BOREHOLE ID

LD-09

PAGE 1 /1

Printed 22.4.2015, scale 1:250

DRILLING DATE 1962

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsá-Tungnaá area			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	
COORDINATES	X: 486203 Y: 393969 Z: 249,7	COORD. SYSTEM	ÍSN93	INCLINATION	0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m]	21	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR		DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
249	0			
248	1		Tephra / pumice	
247	2		THi, Búrfellshraun lava.	
246	3			
245	4			
244	5			
243	6			
242	7			
241	8			
240	9			
239	10			
238	11			
237	12			
236	13			
235	14			
234	15			
233	16			
232	17			
231	18		Tephra / pumice	
230	19			
229	20		THf, Kvíslahraun lava.	
	21			

DATA SOURCE

Elsa G. Vilmundardóttir (1977). Tungnárhraun - Jarðfræðiskýrsla. Orkustofnun. OS ROD 7702. 165 pages.

BOREHOLE ID	PAGE 1 /1	BOREHOLE LOG	Landsvirkjun
LD-21		PERCUSSION DRILLING	EFLA VERKFRÆÐISTOFA
Printed 22.4.2015, scale 1:250			
DRILLING DATE 1965			

PROJECT	Wind Farms in Thjorsá-Tungnaá area			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	
COORDINATES	X: 486825 Y: 394007 Z: 264,6	COORD. SYSTEM	ÍSN93	INCLINATION	0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m]	39,7	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR		DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
264	0			
263	1		Tephra / pumice	
262	2		HH2, Sölvahraun	
261	3			
260	4			
259	5			
258	6			
257	7			
256	8			
255	9			
254	10			
253	11			
252	12			
251	13			
250	14		Tephra / pumice	
249	15			
248	16			
247	17			
246	18			
245	19		THi, Búrfellshraun lava.	
244	20			
243	21			
242	22			
241	23			
240	24			
239	25			
238	26			
237	27		Tephra / pumice	
236	28			
235	29			
234	30			
233	31			
232	32		THf, Kvíslahraun lava.	
231	33			
230	34			
229	35			
228	36			
227	37			

DATA SOURCE

Elsa G. Vilmundardóttir (1977). Tungnárhraun - Jarðfræðiskýrsla. Orkustofnun. OS ROD 7702. 165 pages.

BOREHOLE ID

LD-22

PAGE 1 /1

Printed 22.4.2015, scale 1:250

DRILLING DATE 1965

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsá-Tungnaá area			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	
COORDINATES	X: 486566	Y: 393927	Z: 249,7	COORD. SYSTEM	ÍSN93
INCLINATION	0 ° from vertical				
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m]	23,7	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR		DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
249	0–1		Tephra / pumice	
248	1–2			
247	2–3			
246	3–4			
245	4–5			
244	5–6			
243	6–7		THi, Búrfellshraun lava.	
242	7–8			
241	8–9			
240	9–10			
239	10–11			
238	11–12			
237	12–13			
236	13–14			
235	14–15		Tephra / pumice	
234	15–16			
233	16–17			
232	17–18			
231	18–19		THf, Kvíslahraun lava.	
230	19–20			
229	20–21			
228	21–22			
227	22–23			
226	23			

DATA SOURCE

Elsa G. Vilmundardóttir (1977). Tungnárhraun - Jarðfræðiskýrsla. Orkustofnun. OS ROD 7702. 165 pages.

BOREHOLE ID

LD-23

PAGE 1 /1

Printed 22.4.2015, scale 1:250

DRILLING DATE 1965

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsá-Tungnaá area			PROJECT NR.	1611-159
LOCATION	Búrfellslundur			RECORDED BY	
COORDINATES	X: 486706	Y: 393992	Z: 257,6	COORD. SYSTEM	ÍSN93
INCLINATION	0 ° from vertical				
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m]	22,4	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR		DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
257	0			
256	1		THi, Búrfellshraun lava.	
255	2			
254	3			
253	4			
252	5			
251	6			
250	7			
249	8		Tephra / pumice	
248	9			
247	10			
246	11			
245	12			
244	13		THf, Kvíslahraun lava.	
243	14			
242	15			
241	16			
240	17			
239	18			
238	19			
237	20			
236	21			
	22			

DATA SOURCE

Elsa G. Vilmundardóttir (1977). Tungnárhraun - Jarðfræðiskýrsla. Orkustofnun. OS ROD 7702. 165 pages.

BOREHOLE ID

SB-01

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1971

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsá - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi			RECORDED BY
COORDINATES	X: 471489.17 Y: 407526.41 Z: 272.1	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 14,2	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
272	0			
271	1		Overburden	
270	2		Basalt THi Búrfellshraun	
269	3			
268	4			
267	5			
266	6			
265	7			
264	8			
263	9		Interbed	
262	10			
261	11			
260	12		Old bedrock	
259	13			
258	14			

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID	PAGE 1 /1	BOREHOLE LOG	Landsvirkjun
SB-02		PERCUSSION DRILLING	EFLA VERKFRÆÐISTOFA
Printed 14.4.2015, scale 1:250			
DRILLING DATE 1971			

PROJECT	Wind Farms in Thjorsá and Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi			RECORDED BY
COORDINATES	X: 471498.36 Y: 407514.56 Z: 271.7	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 16,7	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
271	0		Overburden	
270	1		Basalt THi Búrfellshraun	
269	2			
268	3			
267	4			
266	5			
265	6			
264	7			
263	8			
262	9			
261	10		Interbed	
260	11			
259	12			
258	13			
257	14		Old bedrock	
256	15			
255	16			

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID

SF-39

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1996

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi			RECORDED BY
COORDINATES	X: 469641.74 Y: 406918.17 Z: 267.0	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical	
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 25,6	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m] 6,0
CONTRACTOR RFS		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
267	0			
266	1		Superficial sediments, eolian sand with thin topsoil […].	
265	2			
264	3		Scoriaceous top of the lava	
263	4			
262	5			
261	6		Postglacial lava THi, highly vesicular in the top and gradualli denser downwards	
260	7			
259	8			
258	9			
257	10			
256	11			
255	12			
254	13			
253	14			
252	15			
251	16			
250	17		Most probably mix of sand and scoria fragments, no core recovery […]	
249	18			
248	19			
247	20			
246	21			
245	22			
244	23			
243	24		Olivine basalt […]	
242	25			

DATA SOURCE

Ágúst Guðmundsson (1996). Sultartangi HEP - Powerhouse area, geological investigations 1996. Jarðfræðistofan ehf for Landsvirkjun. JFS 12-1996. 32 pages.

BOREHOLE ID

SF-40

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1996

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi			RECORDED BY
COORDINATES	X: 469548.42 Y: 406811.69 Z: 265.2	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical	
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 24,1	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m] 6,0
CONTRACTOR RFS		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
265–264	0–1		Superficial sediments, eaolian sand with thin topsoil	
264–261	1–4		Scoria gradually becoming solid lava	
261–250	4–15		Postglacial lava THi, Búrfellshraun. Highly vesicular and almost scoriaceous in upper part. [Lower half] Sould basalt with micropores. Plagioclas phenocrysts […]	
250–242	15–23		Sand, black volcanic ash or tephra disintegrates very easily […].	
242	23–24		Olivine basalt […]	

DATA SOURCE

Ágúst Guðmundsson (1996). Sultartangi HEP - Powerhouse area, geological investigations 1996. Jarðfræðistofan ehf for Landsvirkjun. JFS 12-1996. 32 pages.

BOREHOLE ID

ST-01

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1971

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsá - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi			RECORDED BY
COORDINATES	X: 472737.13 Y: 409238.21 Z: 286.9	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 50,0	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
286	0–1		Overburden	
285–283	1–4			
283–261	4–26		Basalt THi Búrfellshraun	
261–258	26–29		Interbed	
257	30		Tillite	
257–237	30–50		Old bedrock	

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID

ST-03

Printed 22.4.2015, scale 1:250

DRILLING DATE 1971

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi			RECORDED BY
COORDINATES	X: 472966,08 Y: 408862,81 Z: 285,6	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 55,3	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
285–232	0–54		Overburden	
			Basalt THi Búrfellshraun	
			Interbed	
			Basalt THf Kvíslahraun	
			Tillite	

BOREHOLE ID

ST-03

Printed 22.4.2015, scale 1:250

PROJECT NR. 1611-159

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 [mm:ss] 360
231	54		Old bedrock	
	55			

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID	PAGE 1 /1	BOREHOLE LOG	Landsvirkjun
ST-04		PERCUSSION DRILLING	EFLA VERKFRÆÐISTOFA
Printed 14.4.2015, scale 1:250			
DRILLING DATE 1971			

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi			RECORDED BY
COORDINATES	X: 472343.02 Y: 408169.94 Z: 282.4	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 28,9	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
282	0		Overburden	
281	1			
280	2		Basalt THi Búrfellshraun	
279	3			
278	4			
277	5			
276	6			
275	7			
274	8			
273	9			
272	10			
271	11			
270	12			
269	13			
268	14			
267	15			
266	16			
265	17			
264	18			
263	19			
262	20			
261	21			
260	22			
259	23			
258	24			
257	25			
256	26		Tillite	
255	27			
254	28		Old bedrock	

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID

ST-05

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1971

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi			RECORDED BY
COORDINATES	X: 472552.72 Y: 408379.26 Z: 284.3	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 35,1	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
284–250	0–35		Overburden	
			Porphyritic basalt THi Búrfellshraun	
			Old bedrock	

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID	PAGE 1 /1	BOREHOLE LOG	Landsvirkjun
ST-06		PERCUSSION DRILLING	EFLA VERKFRÆÐISTOFA
Printed 14.4.2015, scale 1:250			
DRILLING DATE 1971			

PROJECT	Wind Farms in Thjorsa - Tungnaá area	PROJECT NR.	1611-159
LOCATION	Sultartangi	RECORDED BY	
COORDINATES	X: 472756.16 Y: 408604.49 Z: 282.5	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 35,2	DRILLED OUTSIDE CASING [m] / CASING LENGHT [m]
CONTRACTOR	OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
282–248	0–35		Porphyritic basalt THi Búrfellshraun	
257–248	25–35		Tillite	
248	35		Old bedrock	

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID

ST-07

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1971

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Vaðalda			RECORDED BY
COORDINATES	X: 473178.89 Y: 407927.15 Z: 281.1	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 14,2	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
281	0		Porphyritic basalt THi Búrfellshraun	
280	1			
279	2			
278	3			
277	4			
276	5			
275	6			
274	7			
273	8			
272	9			
271	10		Interbed	
270	11			
269	12			
268	13		Old bedrock	
267	14			

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID

ST-08

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1971

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Vaðalda			RECORDED BY
COORDINATES	X: 473210.98 Y: 407921.66 Z: 281.6	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 13,0	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

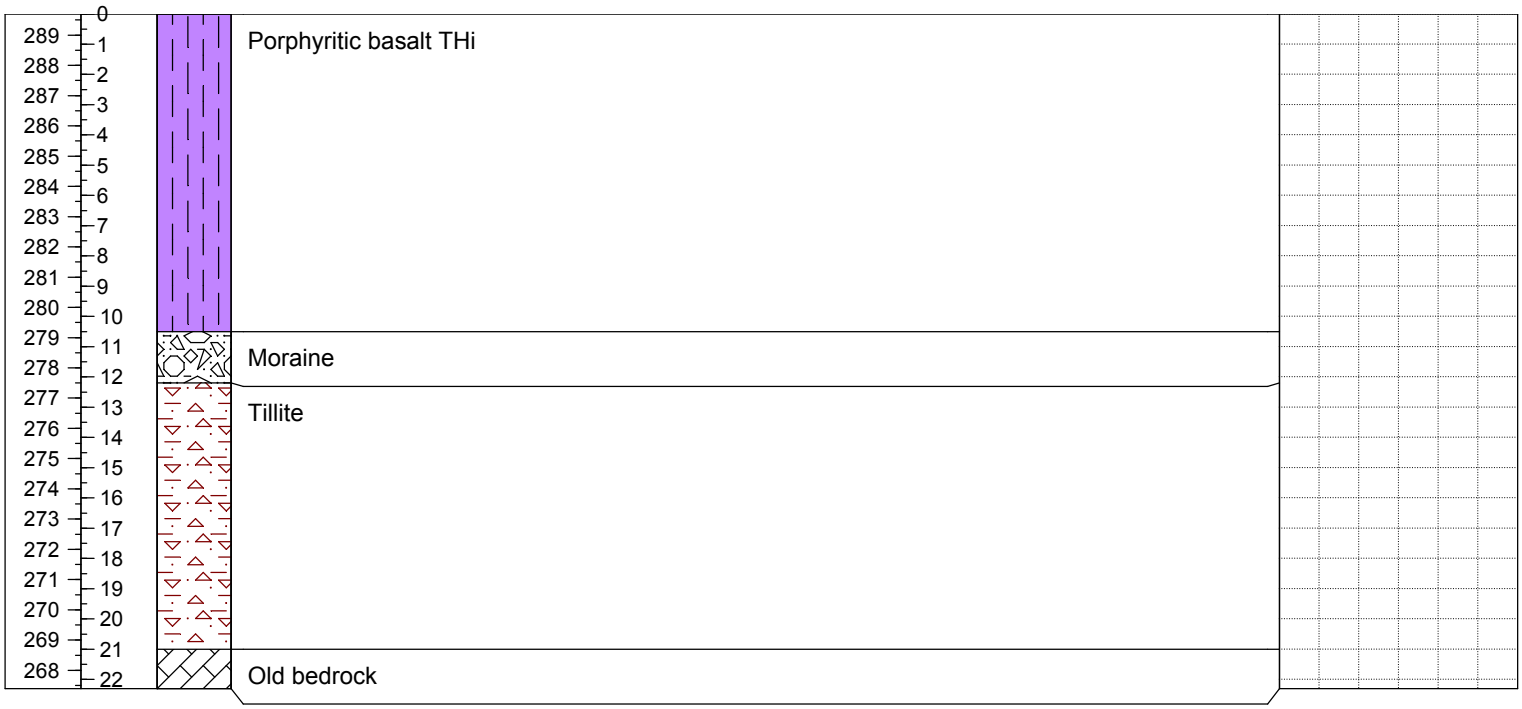
Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
281	0		Porphyritic basalt THi Búrfellshraun	
280	1			
279	2			
278	3			
277	4			
276	5			
275	6			
274	7			
273	8		Interbed	
272	9			
271	10		Old bedrock	
270	11			
269	12			
	13			

DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID	PAGE 1 /1	BOREHOLE LOG	Landsvirkjun
ST-09		PERCUSSION DRILLING	EFLA VERKFRÆÐISTOFA
Printed 22.4.2015, scale 1:250			
DRILLING DATE 1971			

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Vaðalda			RECORDED BY
COORDINATES	X: 474294,53 Y: 407698,79 Z: 289,7	COORD. SYSTEM	ISN93	INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 22,3	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT



DATA SOURCE

Ingibjörg Kaldal og Skúli Víkingsson (1972). Sultartangi - Jarðfræðiskýrsla. Orkustofnun. OS-1972-Sultartangi jarðfræði. 53 pages.

BOREHOLE ID

ST-23

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangastífla			RECORDED BY
COORDINATES	X: 472972.27 Y: 409988.95 Z: 287.8	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 32,5	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
287	0–1		Loose overburden	
286–283	1–5		Scoria	
282–257	6–31		Porphyritic basalt THi Búrfellshraun	
261–258	26–30		Loose sediment	
257–256	31–32		Old bedrock	

DATA SOURCE

Björn Jónasson (1980). Sultartangavirkjun. Boranir og jarðlagaskipan á stíflustæði. Orkustofnun. Greinargerð BjJ-80/05. 17 pages.

BOREHOLE ID

ST-24

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangastífla			RECORDED BY
COORDINATES	X: 473871,54 Y: 410099,19 Z: 288,0	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical	
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 54,0	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
288–234	0–54		Loose overburden	
			Scoria	
			Porphyritic basalt THi Búrfellshraun. Occasional Xenoliths. Very jointed in the top. Vesicular but dense closer to the bottom. Thin siltcoatings in joints. Scoriaceous in the bottom	
			Basalt gravel w. ryol. pebbles	
			Brown, fine-sand	
			Sediment. Fine sand and silt	

DATA SOURCE:
Björn Jónasson (1980). Sultartangavirkjun. Boranir og jarðlagaskipan á stíflustæði. Orkustofnun.

BOREHOLE ID

ST-25

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangastífla			RECORDED BY
COORDINATES	X: 475480.70 Y: 409966.62 Z: 289.2	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical	
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 40,5	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
289–288	0–1		Loose overburden	
288–285	1–5		Scoria	
284–261	5–28		Porphyritic basalt THi Búrfellshraun	
261–249	28–40		Gravel and sand, silty. Alluvial deposits, origninally tephra.	

DATA SOURCE

Björn Jónasson (1980). Sultartangavirkjun. Boranir og jarðlagaskipan á stíflustæði. Orkustofnun. Greinargerð BjJ-80/05. 17 pages.

BOREHOLE ID	PAGE 1 /1	BOREHOLE LOG	Landsvirkjun
PH-93		PERCUSSION DRILLING	EFLA VERKFRÆÐISTOFA
Printed 14.4.2015, scale 1:250			
DRILLING DATE 1980/1981			

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR.	1611-159
LOCATION	Sultartangaskurður			RECORDED BY	
COORDINATES	X: 470451.52 Y: 407122.99 Z: 270.9	COORD. SYSTEM	ISN93	INCLINATION	0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m]	25	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR		DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
270–246	0–25		Aeolian sand	
			Loose overburden	
			Clayey sand	
			Tillite	
			Old bedrock	

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-94

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 470365.75 Y: 407045.63 Z: 264.7	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 30,9	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
264	0			
263	1		Loose overburden	
262	2		Vesicular and dense lava, Búrfellshraun THi	
261	3			
260	4			
259	5			
258	6			
257	7			
256	8			
255	9			
254	10			
253	11			
252	12			
251	13			
250	14			
249	15			
248	16			
247	17			
246	18			
245	19			
244	20			
243	21			
242	22			
241	23			
240	24			
239	25			
238	26			
237	27		Scoria	
236	28			
235	29		Tillite	
234	30		Old bedrock	

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-95

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area		PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður		RECORDED BY
COORDINATES	X: 470264.07 Y: 406835.01 Z: 263.1	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 32,4	DRILLED OUTSIDE CASING [m] / CASING LENGHT [m]
CONTRACTOR	OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
263–262	0–1		Loose overburden	
262–259	1–4		Scoria	
259–241	4–22		Vesicular and dense lava, Búrfellshraun THi	
241–240	22–23		Scoria	
240–238	23–25		Interbed, pumice	
238–231	25–32		Old bedrock?	

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-96

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 469720.96 Y: 406714.42 Z: 261.6	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 32,0	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
261	0		Loose overburden	
260	1			
259	2		Vesicular and dense lava, Búrfellshraun THi	
258	3			
257	4			
256	5			
255	6			
254	7			
253	8			
252	9			
251	10			
250	11			
249	12			
248	13			
247	14			
246	15			
245	16			
244	17			
243	18			
242	19			
241	20			
240	21			
239	22			
238	23			
237	24			
236	25			
235	26			
234	27			
233	28		Pumice	
232	29			
231	30		Old bedrock	
230	31			
	32			

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-97

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area		PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður		RECORDED BY
COORDINATES	X: 469375.19 Y: 406509.94 Z: 259.7	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 26,5	DRILLED OUTSIDE CASING [m] / CASING LENGHT [m]
CONTRACTOR	OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
259	0			
258	1		Loose overburden	
257	2		Scoria	
256	3			
255	4		Vesicular and dense lava, Búrfellshraun THi	
254	5			
253	6			
252	7			
251	8			
250	9			
249	10			
248	11			
247	12			
246	13			
245	14			
244	15			
243	16			
242	17			
241	18			
240	19			
239	20			
238	21			
237	22			
236	23		Scoria	
235	24			
234	25		Pumice	
	26		Old bedrock?	

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-98

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 468873.51 Y: 406299.00 Z: 260.4	COORD. SYSTEM ISN-93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 16,0	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
260	0		Loose overburden	
259	1			
258	2			
257	3		Scoria	
256	4			
255	5		Vesicular and dense lava, Búrfellshraun THi	
254	6			
253	7			
252	8			
251	9			
250	10			
249	11			
248	12			
247	13			
246	14			
245	15			
	16			

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-99

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

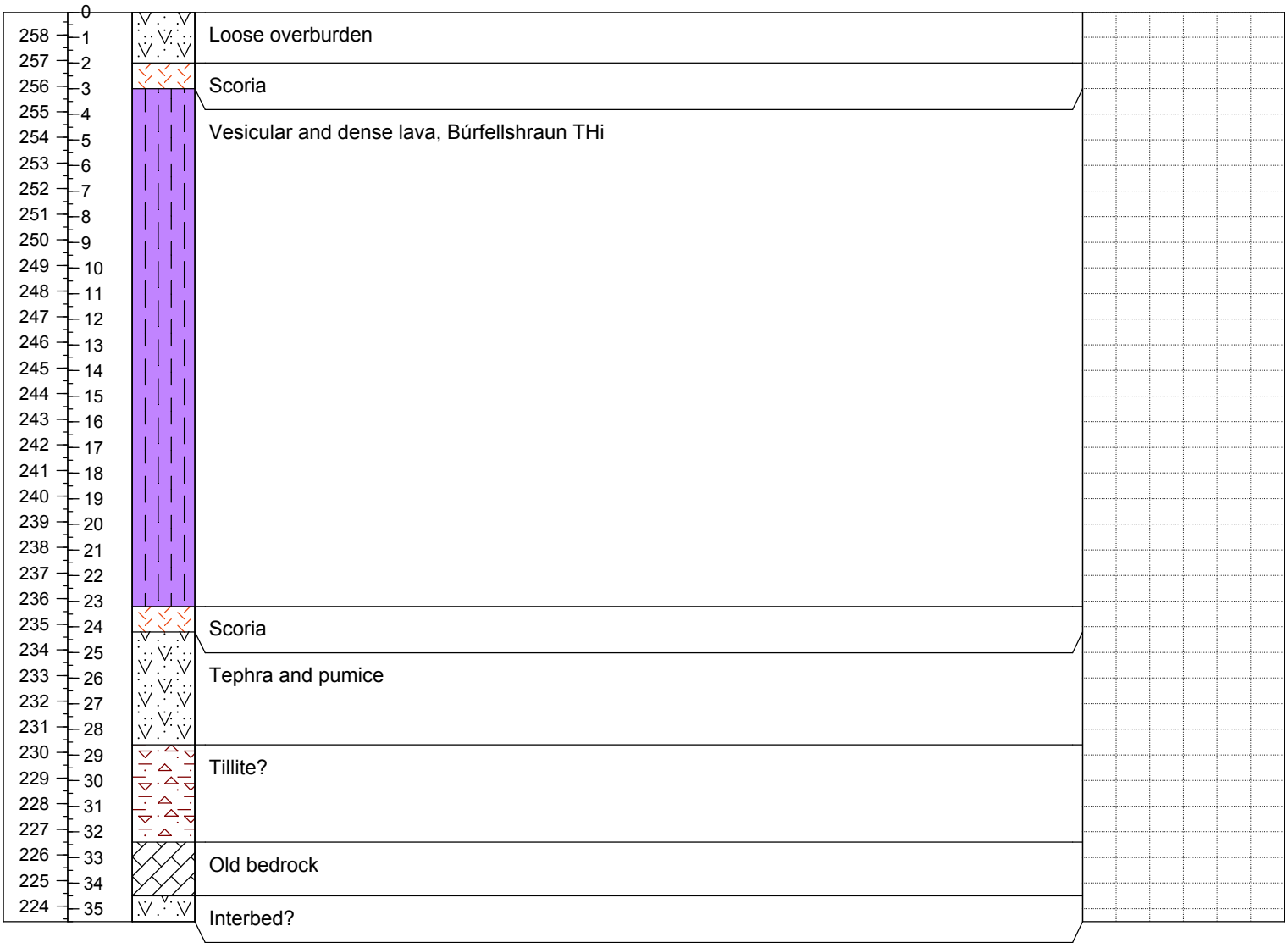
BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area		PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður		RECORDED BY
COORDINATES	X: 468380.75 Y: 406093.20 Z: 258.9	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 35,5	DRILLED OUTSIDE CASING [m] / CASING LENGHT [m]
CONTRACTOR	OPERATOR	DRILL RIG	DRILL BIT



DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-100

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 467782.64 Y: 405782.73 Z: 257.4	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 14,3	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
257	0		Loose overburden	
256	1			
255	2			
254	3			
253	4		Vesicular and dense lava, Búrfellshraun THi	
252	5			
251	6			
250	7			
249	8			
248	9			
247	10			
246	11			
245	12			
244	13			
	14			

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982).Sultartangavirkjun - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-101

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

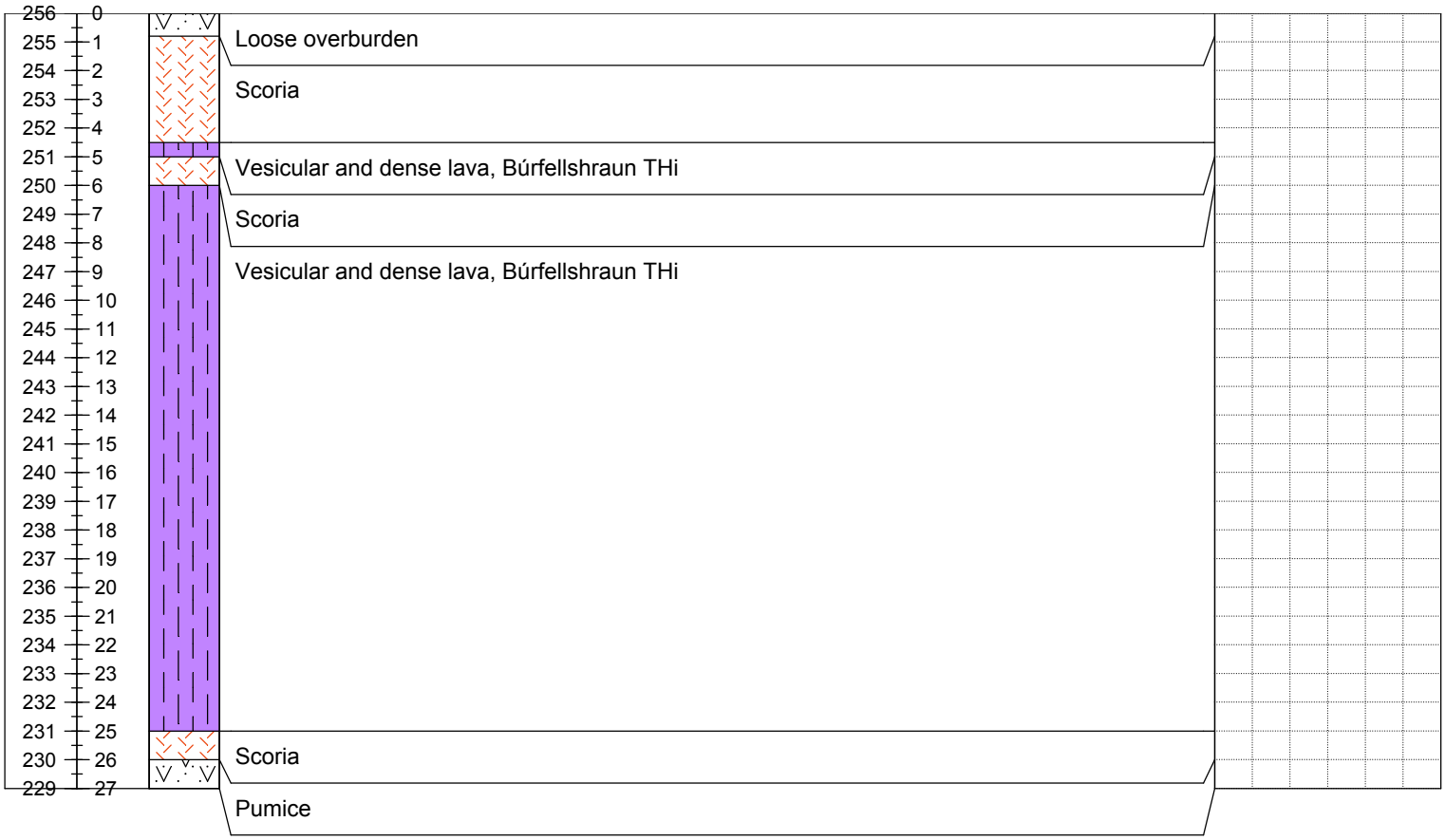
BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area		PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður		RECORDED BY
COORDINATES	X: 467294.63 Y: 405276.99 Z: 256.0	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 27,0	DRILLED OUTSIDE CASING [m] / CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG / DRILL BIT



DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-102

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 466798.10 Y: 404930.13 Z: 256.7	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 16,0	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
256	0		Loose overburden	
255	1			
254	2			
253	3		Vesicular and dense lava, Búrfellshraun THi	
252	4			
251	5		Scoria	
250	6			
249	7		Scoria	
248	8			
247	9		Vesicular and dense lava, Búrfellshraun THi	
246	10			
245	11			
244	12			
243	13			
242	14			
241	15			
	16			

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-103

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area		PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður		RECORDED BY
COORDINATES	X: 466302.64 Y: 404579.28 Z: 255.4	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 29,3	DRILLED OUTSIDE CASING [m] / CASING LENGHT [m]
CONTRACTOR	OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
255–254	0–1		Loose overburden	
253–248	2–7		Scoria	
247–229	8–26		Vesicular and dense lava, Búrfellshraun THi	
228–227	27–29		Pumice	

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID	PAGE 1 /1	BOREHOLE LOG	Landsvirkjun
PH-104		PERCUSSION DRILLING	EFLA VERKFRÆÐISTOFA
Printed 14.4.2015, scale 1:250			
DRILLING DATE 1980/1981			

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR.	1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY	
COORDINATES	X: 465818.40 Y: 404087.60 Z: 252.7		COORD. SYSTEM ISN93	INCLINATION	0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 15,0	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]	
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT	

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
252	0		Loose overburden	
251	1			
250	2			
249	3		Scoria	
248	4			
247	5		Vesicular and dense lava, Búrfellshraun THi	
246	6			
245	7			
244	8			
243	9			
242	10			
241	11			
240	12			
239	13			
238	14			
	15			

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-105

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 465454.04 Y: 403919.83 Z: 252.3	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 26,5	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
252	0			
251	1		Loose overburden	
250	2			
249	3			
248	4			
247	5			
246	6			
245	7			
244	8		Scoria	
243	9			
242	10		Vesicular and dense lava, Búrfellshraun THi	
241	11			
240	12			
239	13			
238	14			
237	15			
236	16			
235	17			
234	18			
233	19			
232	20			
231	21			
230	22			
229	23			
228	24		Pumice	
227	25			
226	26			

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-106

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

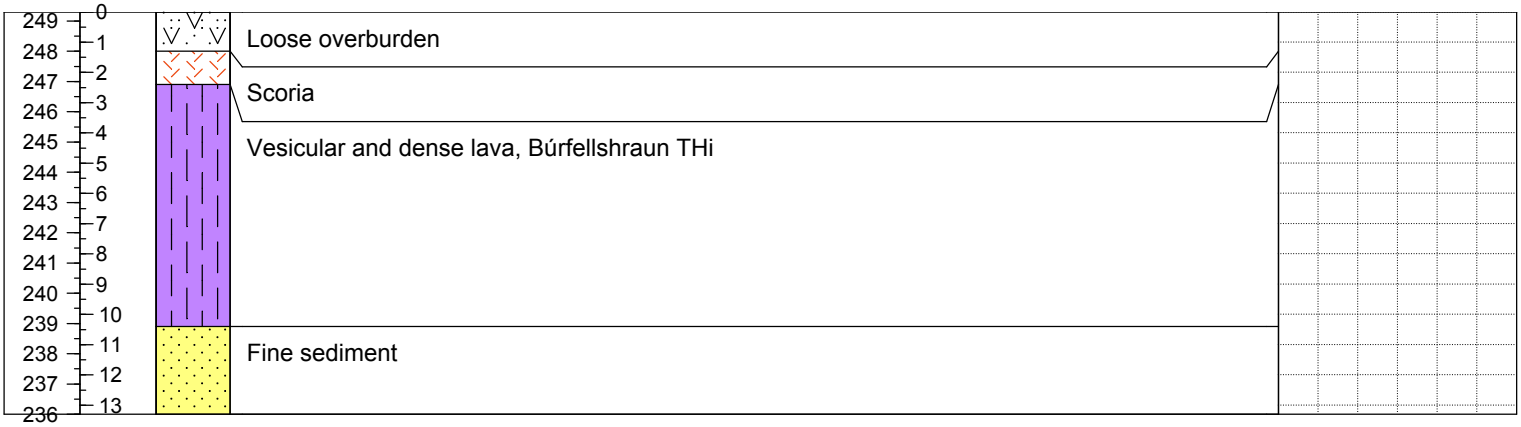
BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 465060.80 Y: 403175.59 Z: 249.3	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 13,3	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT



DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-107

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 464736.57 Y: 402557.44 Z: 246.1	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 21,0	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
246	0			
245	1		Scoria	
244	2			
243	3			
242	4		Vesicular and dense lava, Búrfellshraun THi	
241	5			
240	6			
239	7			
238	8			
237	9			
236	10			
235	11			
234	12		Tillite	
233	13			
232	14		Old bedrock	
231	15			
230	16			
229	17			
228	18			
227	19			
226	20			
	21			

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-108

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 465254.05 Y: 403539.66 Z: 250.7	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 16,4	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
250	0			
249	1		Loose overburden	
248	2			
247	3		Scoria	
246	4			
245	5			
244	6		Vesicular and dense lava, Búrfellshraun THi	
243	7			
242	8			
241	9			
240	10			
239	11			
238	12			
237	13		Scoria	
236	14			
235	15		Sediment	
	16			

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-109

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area		PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður		RECORDED BY
COORDINATES	X: 465706.38 Y: 404404.84 Z: 253.9	COORD. SYSTEM ISN93	INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 29,5	DRILLED OUTSIDE CASING [m] / CASING LENGHT [m]
CONTRACTOR	OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
253	0–1		Loose overburden	
252–251	1–3		Scoria	
250–248	3–6		Scoria	
247–244	6–10		Scoria	
243–225	10–29		Vesicular and dense lava, Búrfellshraun THi	
225	29		Scoria	

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-110

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 465748.44 Y: 404211.50 Z: 253.0	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 23,4	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
253	0			
252	1		Loose overburden	
251	2		Scoria	
250	3			
249	4			
248	5			
247	6			
246	7			
245	8			
244	9		Vesicular and dense lava, Búrfellshraun THi	
243	10			
242	11			
241	12			
240	13			
239	14			
238	15			
237	16			
236	17			
235	18			
234	19			
233	20			
232	21			
231	22			
230	23		Tephra	

DATA SOURCE

Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

BOREHOLE ID

PH-111

PAGE 1 /1

Printed 14.4.2015, scale 1:250

DRILLING DATE 1980/1981

BOREHOLE LOG

PERCUSSION DRILLING

Landsvirkjun

EFLA VERKFRÆÐISTOFA

PROJECT	Wind Farms in Thjorsa - Tungnaá area			PROJECT NR. 1611-159
LOCATION	Sultartangi - Frárennslisskurður			RECORDED BY
COORDINATES	X: 465962.30 Y: 404915.90 Z: 255.4	COORD. SYSTEM ISN93		INCLINATION 0 ° from vertical
CASING Ø ["]	CASING AGL [m]	TOTAL DEPTH [m] 30,5	DRILLED OUTSIDE CASING [m]	CASING LENGHT [m]
CONTRACTOR		OPERATOR	DRILL RIG	DRILL BIT

Elev. [m asl]	Depth [m]	Lithol.	Description	Drilling speed [sec/m] 0 sec (mm:ss) 360
255	0			
254	1		Loose overburden	
253	2			
252	3		Scoria	
251	4			
250	5			
249	6			
248	7			
247	8			
246	9			
245	10			
244	11		Vesicular and dense lava, Búrfellshraun THi	
243	12			
242	13			
241	14			
240	15			
239	16			
238	17			
237	18			
236	19			
235	20			
234	21			
233	22			
232	23			
231	24			
230	25			
229	26			
228	27			
227	28			
226	29			
225	30		Tephra	

DATA SOURCE

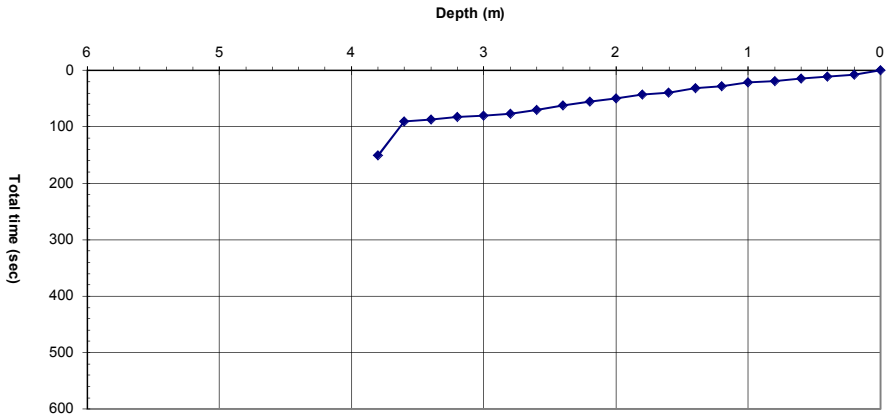
Pétur Pétursson, Bjarni Kristinsson and Árni Hjartarson (1982). Sultartangaskurður - Frárennsliskurður. Orkustofnun. OS82029/VOD19 B. 42 pages.

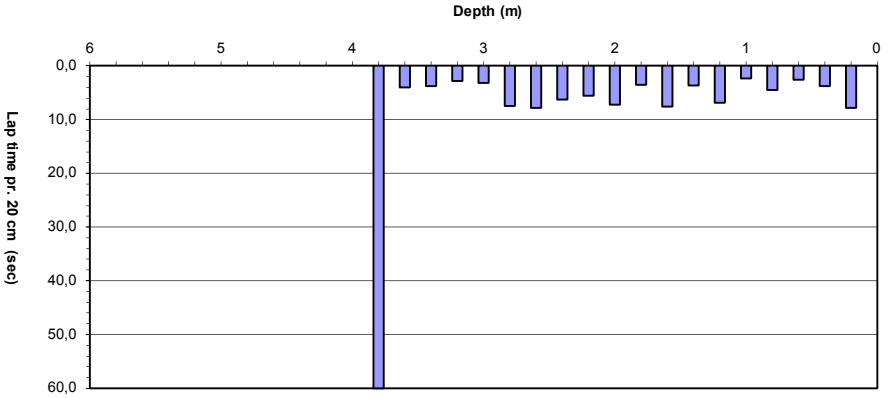
APPENDIX 5

RAM SOUNDING DATA

Ram sounding hole: HC-03 XYZ 468041,934 404903,066 259,3
Date: 5.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	7,8	8
0,40	3,8	12
0,60	2,6	14
0,80	4,5	19
1,00	2,3	21
1,20	6,9	28
1,40	3,7	32
1,60	7,6	39
1,80	3,5	43
2,00	7,2	50
2,20	5,5	55
2,40	6,3	62
2,60	7,8	70
2,80	7,5	77
3,00	3,2	80
3,20	2,8	83
3,40	3,8	87
3,60	4,0	91
3,80	60,0	151
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





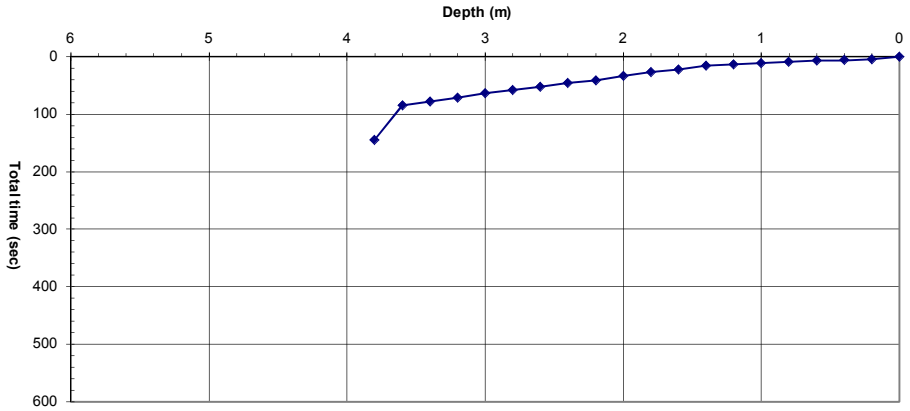
Interpretation

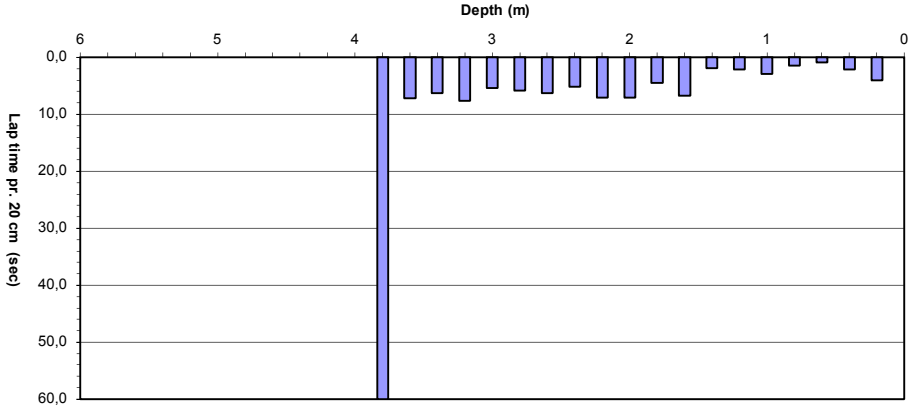
By hand	0,0	m
Organics	0,0	m
Bearing B.	3,7	m
Firm B.	3,7	m
Stop	3,7	m
GWL:	2,7	m

Description
Tephra plain with larger lava rocks on the surface. Sand from the surface down to the bottom. Water below 2,7 m depth. Probably stopped in solid rock.

Ram sounding hole: HC-04 XYZ 464512,542 399954,175 240,39
Date: 4.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	4,1	4
0,40	2,1	6
0,60	0,9	7
0,80	1,5	9
1,00	2,9	12
1,20	2,1	14
1,40	1,9	16
1,60	6,7	22
1,80	4,5	27
2,00	7,1	34
2,20	7,1	41
2,40	5,2	46
2,60	6,3	52
2,80	5,9	58
3,00	5,4	64
3,20	7,6	71
3,40	6,3	78
3,60	7,2	85
3,80	60,0	145
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





Interpretation

By hand	0,0	m
Organics	0,0	m
Bearing B.	3,8	m
Firm B.	3,8	m
Stop	3,8	m
GWL:	3,6	m

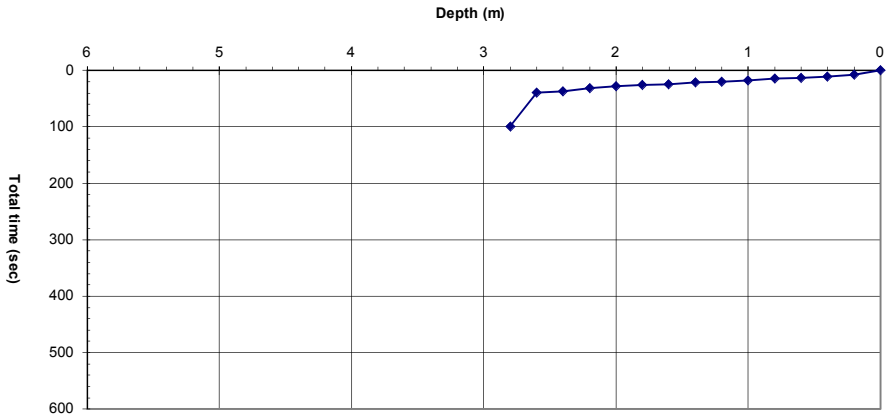
Description
Tephra plain and low hills on the surface. It was difficult to turn the drill just above solid rock, but at the bottom the turning gets easy. Sand from the surface down to the bottom.

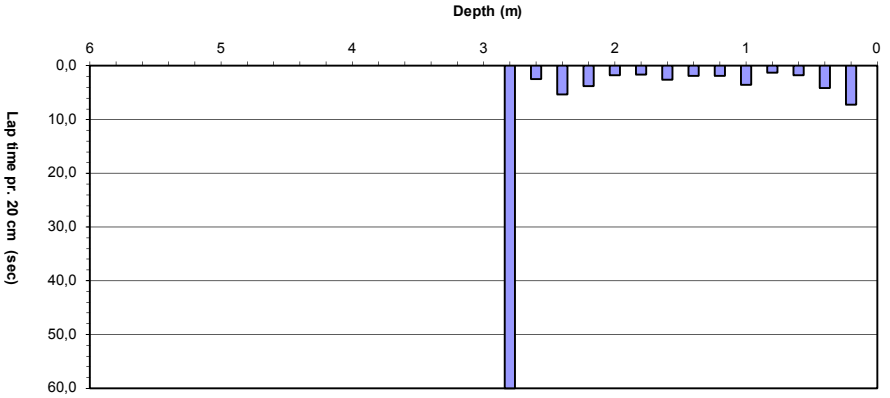
EFLA HF.
GROUND INVESTIGATIONS

RAM SOUNDING DRILL

Ram sounding hole: HC-05 XYZ 465208,924 400657,222 243,68
Date: 4.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	7,2	7
0,40	4,1	11
0,60	1,8	13
0,80	1,3	14
1,00	3,5	18
1,20	1,9	20
1,40	1,9	22
1,60	2,6	24
1,80	1,6	26
2,00	1,7	28
2,20	3,8	31
2,40	5,3	37
2,60	2,4	39
2,80	60,0	99
3,00		
3,20		
3,40		
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





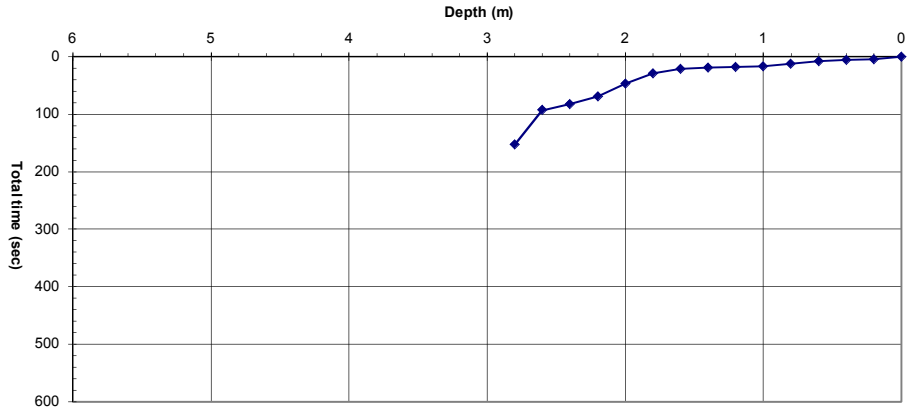
Interpretation

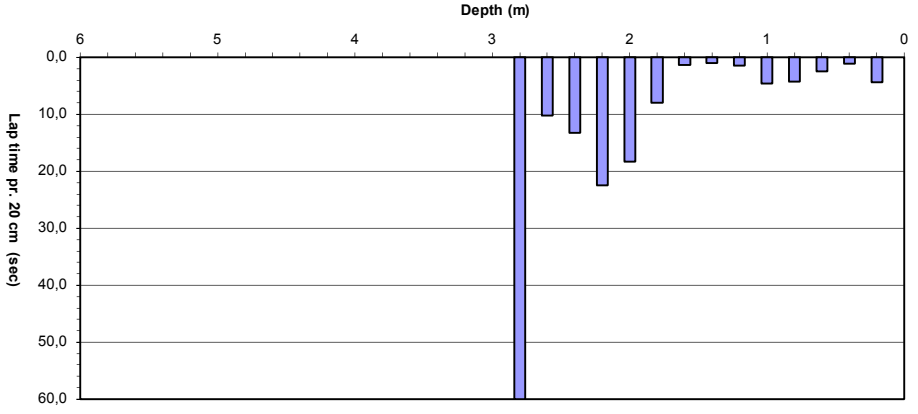
By hand	0,0	m
Organics	0,0	m
Bearing B.	2,8	m
Firm B.	2,8	m
Stop	2,8	m
GWL:	2,3	m

Description
Tephra plain and low hills on the surface with a few pseudocraters protruding the sand. Drill stops rather abruptly on solid rock. Fine aeolian sand and tephra in notches at 1,8 m and 2,8 m depth.

Ram sounding hole: HC-06 XYZ 465916,537 401366,605 248,05
Date: 6.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	4,4	4
0,40	1,1	6
0,60	2,5	8
0,80	4,3	12
1,00	4,6	17
1,20	1,5	18
1,40	1,0	19
1,60	1,4	21
1,80	8,0	29
2,00	18,3	47
2,20	22,5	70
2,40	13,3	83
2,60	10,2	93
2,80	60,0	153
3,00		
3,20		
3,40		
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





Interpretation

By hand	0,0	m
Organics	0,0	m
Bearing B.	2,0	m
Firm B.	2,8	m
Stop	2,8	m
GWL:	-	m

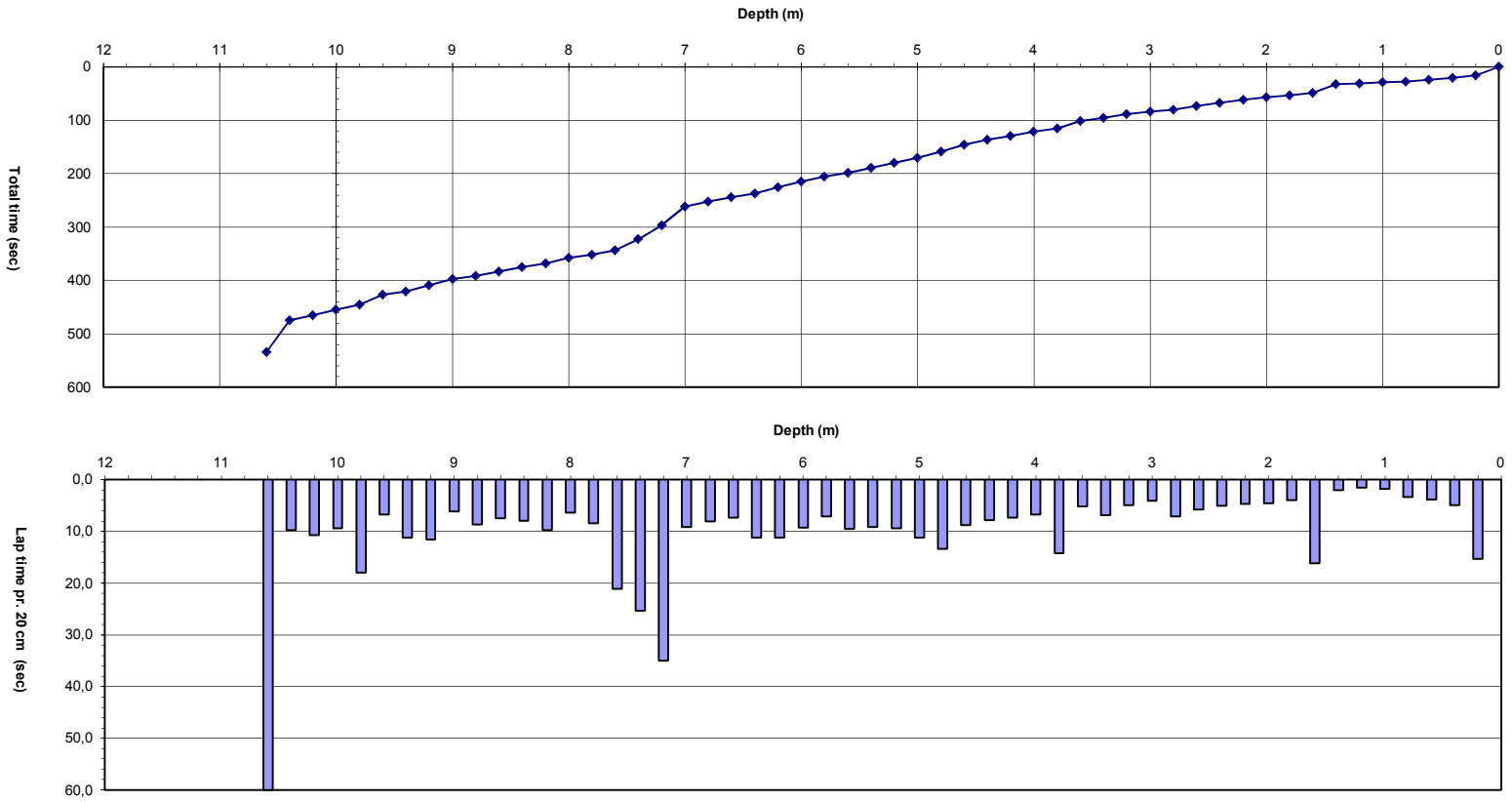
Description
Tephra and lava on the surface. Drill stops quickly, most likely in solid rock. Sand from the surface down to bottom. Silt in drill rod notches near the bottom (probably aeolian sediment). Drilling rods are dry. Gjóskumelur og hraun á yfirborði. Stoppar snögglega, líklega klöpp. Sandur frá yfirborði niður. Silt eða borsalli í hökum í botni. Stál þurr.

EFLA HF.
GROUND INVESTIGATIONS

RAM SOUNDING DRILL

Ram sounding hole: HC-08 XYZ 467337,730 402817,614 259,26
Date: 6.12.2013
Worker: GEÓ, BJ

Depth (m)	Lap time (sec)	Time (sec)
0,0	0,0	0
0,2	15,3	15
0,4	4,9	20
0,6	3,8	24
0,8	3,4	27
1,0	1,8	29
1,2	1,5	31
1,4	2,0	33
1,6	16,1	49
1,8	4,0	53
2,0	4,5	57
2,2	4,7	62
2,4	5,0	67
2,6	5,7	73
2,8	7,1	80
3,0	4,1	84
3,2	4,9	89
3,4	6,8	96
3,6	5,1	101
3,8	14,2	115
4,0	6,7	122
4,2	7,3	129
4,4	7,8	137
4,6	8,8	146
4,8	13,4	159
5,0	11,2	170
5,2	9,4	180
5,4	9,2	189
5,6	9,5	198
5,8	7,1	205
6,0	9,3	215
6,2	11,2	226
6,4	11,2	237
6,6	7,3	244
6,8	8,1	252
7,0	9,2	262
7,2	35,0	297
7,4	25,3	322
7,6	21,1	343
7,8	8,4	351
8,0	6,4	358
8,2	9,8	368
8,4	7,9	376
8,6	7,4	383
8,8	8,7	392
9,0	6,1	398
9,2	11,5	409
9,4	11,2	420
9,6	6,7	427
9,8	17,9	445
10,0	9,4	454
10,2	10,7	465
10,4	9,7	475
10,6	60,0	535
10,8		
11,0		
11,2		
11,4		
11,6		
11,8		
12,0		



Interpretation

By hand	0,0	m
Organics	0,0	m
Bearing B.	9,8	m
Firm B.	10,5	m
Stop	10,5	m
GWL:	-	m

Description

Location of drill hole slightly altered due to a fiber optics cable nearby. Slightly hilly lava on the surface, whereas the depressions between are filled with tephra. Drilling indicates sand from the surface down to the bottom.

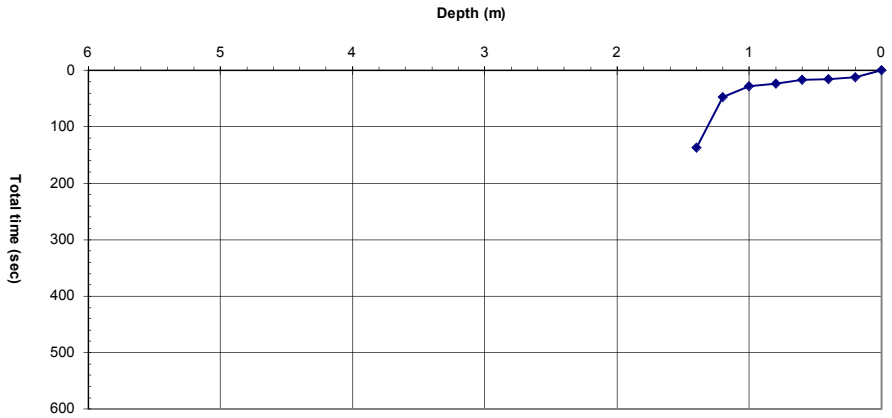
Ram sounding hole: HC-10 XYZ 468747,209 404194,197 259,64
Date: 5.12.2013
Worker: BJ, GEÓ

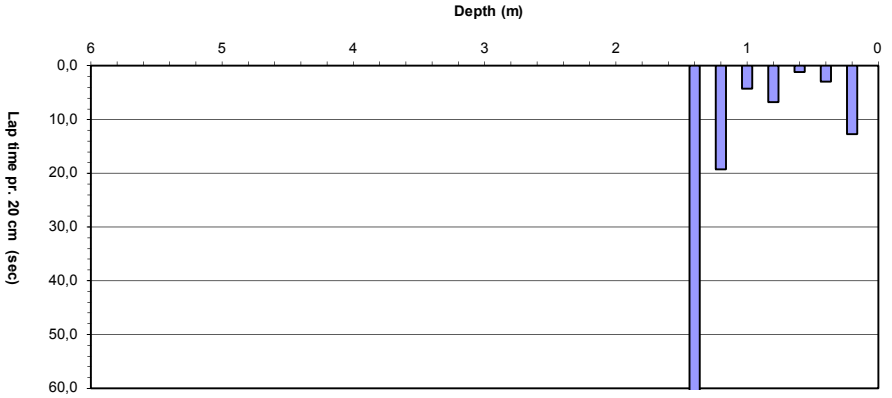
Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	12,7	13
0,40	2,9	16
0,60	1,1	17
0,80	6,7	23
1,00	4,3	28
1,20	19,3	47
1,40	90,0	137
1,60		
1,80		
2,00		
2,20		
2,40		
2,60		
2,80		
3,00		
3,20		
3,40		
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		

Interpretation

By hand	0,0	m
Organics	0,0	m
Bearing B.	1,1	m
Firm B.	1,3	m
Stop	1,3	m
GWL:	-	m

Description
Tephra plain and lava rocks on the surface. Sand from the surface down. Stopped in coarse lava/scoria at the bottom, most likely on a large rock. Not far down to solid rock.





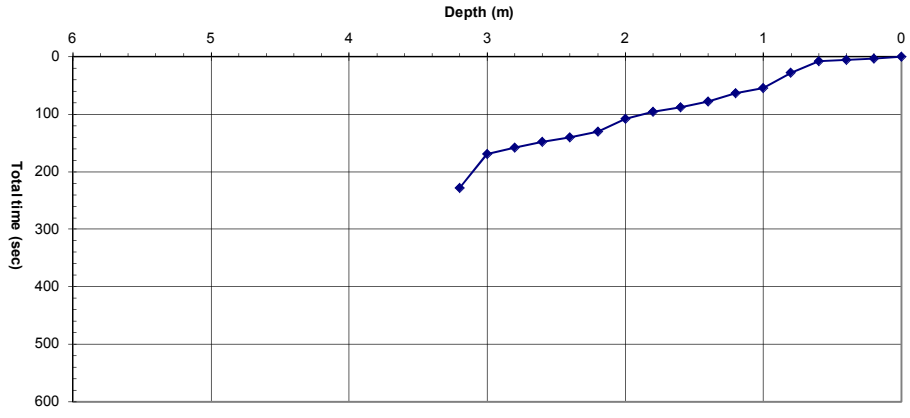
Ram sounding hole: HC-12 XYZ 470160,377 405607,924 262,7
Date: 6.12.2013
Worker: BJ, GEÓ

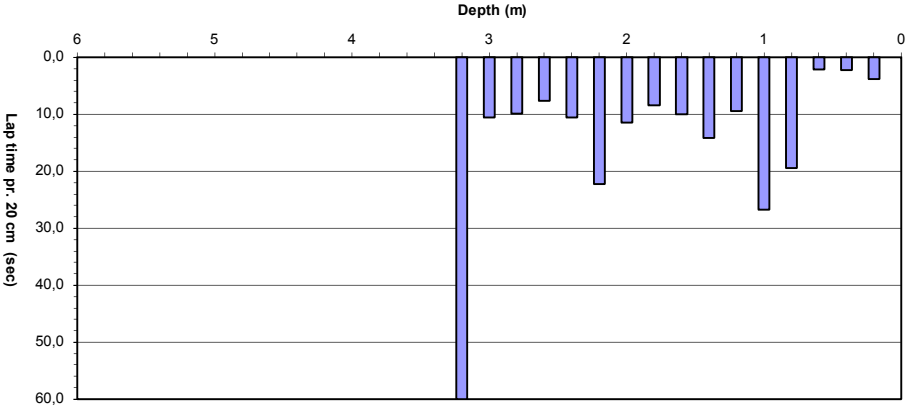
Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	3,8	4
0,40	2,2	6
0,60	2,1	8
0,80	19,5	28
1,00	26,7	54
1,20	9,4	64
1,40	14,2	78
1,60	10,0	88
1,80	8,4	96
2,00	11,5	108
2,20	22,3	130
2,40	10,6	141
2,60	7,7	148
2,80	9,9	158
3,00	10,6	169
3,20	60,0	229
3,40		
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		

Interpretation

By hand	0,0	m
Organics	0,0	m
Bearing B.	3,1	m
Firm B.	3,1	m
Stop	3,1	m
GWL:	2,8	m

Description
Tephra plain and lava rocks on the surface. Rocky below 0,6 m depth. Drill stops suddenly and it is not possible to turn the drill at the end. Drill stopped in solid rock. The two meters of drilling rods at the bottom are bent. Sand/tephra in drill rod notches.





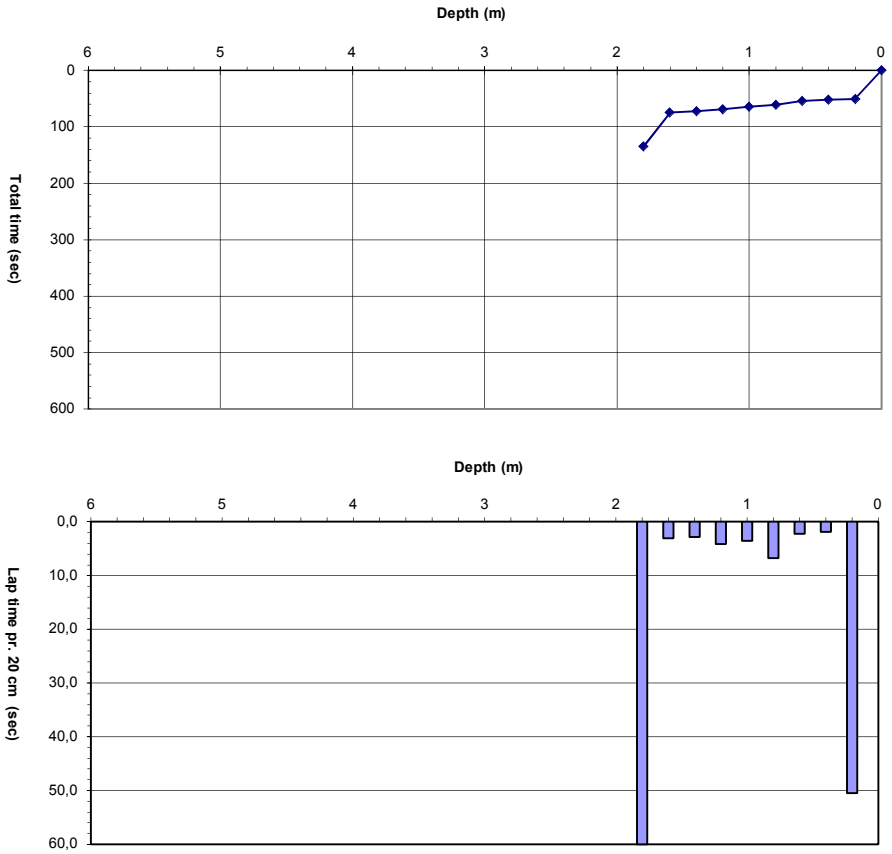
Ram sounding hole: HC-13 XYZ 470872,432 406315,691 268,35
Date: 6.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	50,5	51
0,40	1,9	52
0,60	2,2	55
0,80	6,8	61
1,00	3,5	65
1,20	4,1	69
1,40	2,8	72
1,60	3,1	75
1,80	60,0	135
2,00		
2,20		
2,40		
2,60		
2,80		
3,00		
3,20		
3,40		
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		

Interpretation

By hand	0,0	m
Organics	0,0	m
Bearing B.	1,8	m
Firm B.	1,8	m
Stop	1,8	m
GWL:	-	m

Description
Tephra plain and a few larger lava rocks on the surface. Long drilling time at the surface is due to frost. Sand from the surface down to the bottom.



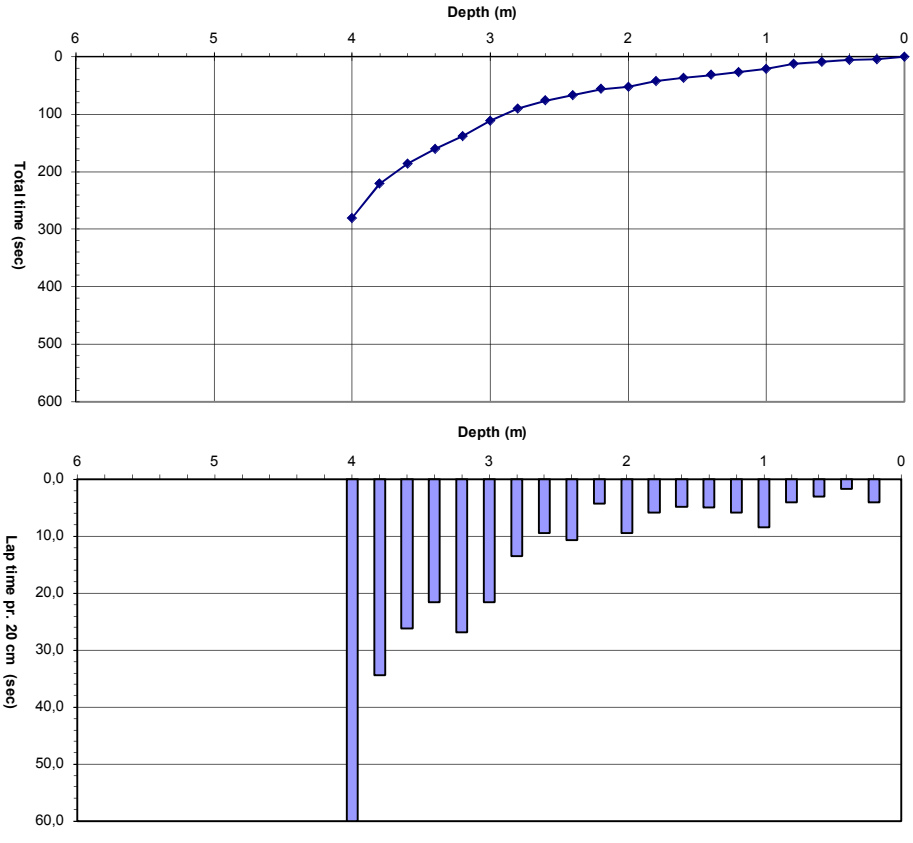
Ram sounding hole: HC-21 XYZ 467328,722 401368,643 253,41
Date: 4.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	4,1	4
0,40	1,7	6
0,60	3,0	9
0,80	4,0	13
1,00	8,4	21
1,20	5,8	27
1,40	4,9	32
1,60	4,8	37
1,80	5,8	43
2,00	9,5	52
2,20	4,3	56
2,40	10,7	67
2,60	9,4	76
2,80	13,5	90
3,00	21,6	112
3,20	26,9	138
3,40	21,6	160
3,60	26,2	186
3,80	34,4	221
4,00	60,0	281
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		

Interpretation

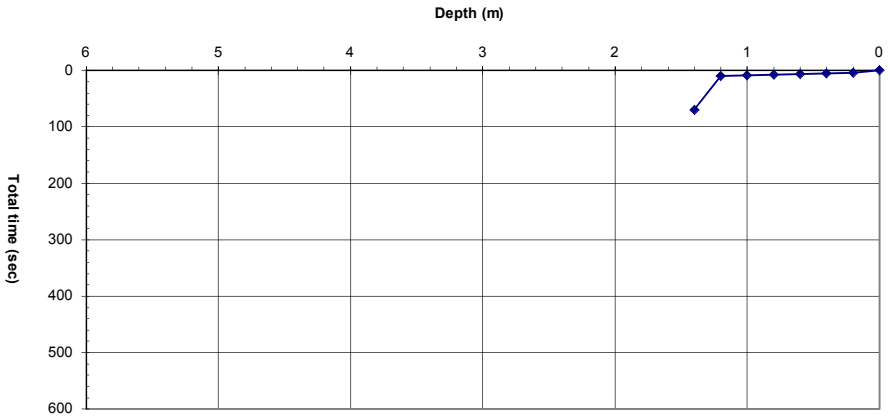
By hand	0,0	m
Organics	0,0	m
Bearing B.	2,4	m
Firm B.	3,9	m
Stop	3,9	m
GWL:	2,0	m

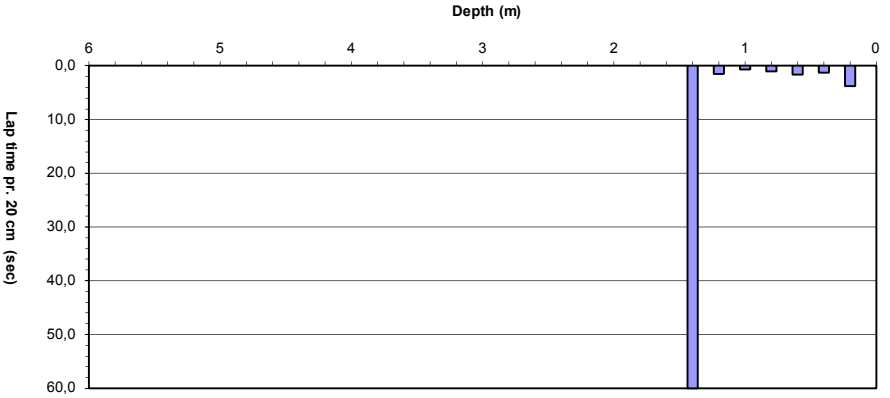
Description
Tephra plain on the surface. Sand and silt below 2,0 m depth down to the bottom. Water at 2,0 m, but dry silt at the bottom (most likely aeolian sediment). It was not possible to turn the drill below 2,4 m depth.



Ram sounding hole: HC-22 XYZ 468038,546 402069,114 257,14
Date: 4.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	3,8	4
0,40	1,3	5
0,60	1,6	7
0,80	1,0	8
1,00	0,7	8
1,20	1,5	10
1,40	60,0	70
1,60		
1,80		
2,00		
2,20		
2,40		
2,60		
2,80		
3,00		
3,20		
3,40		
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





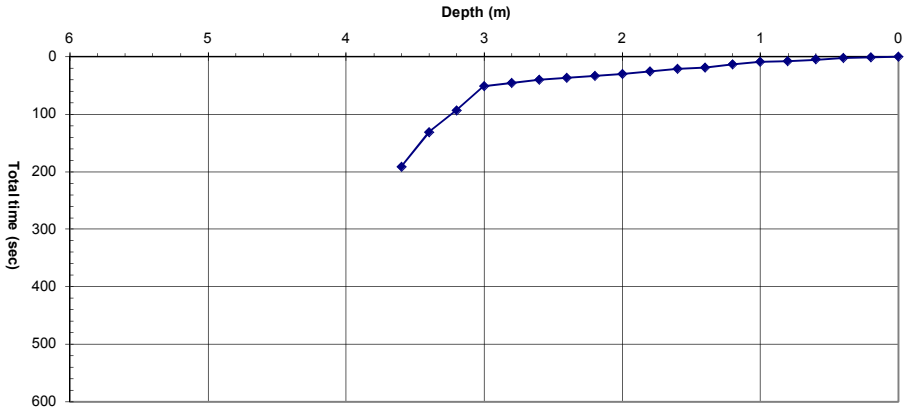
Interpretation

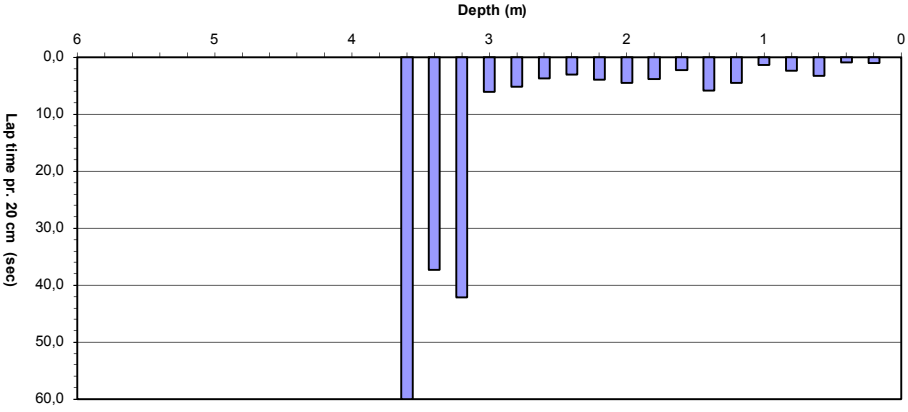
By hand	0,0	m
Organics	0,0	m
Bearing B.	1,4	m
Firm B.	1,4	m
Stop	1,4	m
GWL:	1,0	m

Description
Tephra plain and lava rocks on the surface. Sand from the surface down to bottom. Drill slows down to a halt and stops in solid rock. Drill rods are loose and the tip is hot.

Ram sounding hole: HC-24 XYZ 469455,708 403489,923 261,61
Date: 5.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	1,0	1
0,40	0,9	2
0,60	3,3	5
0,80	2,4	8
1,00	1,3	9
1,20	4,5	13
1,40	5,9	19
1,60	2,3	22
1,80	3,8	25
2,00	4,5	30
2,20	3,9	34
2,40	3,0	37
2,60	3,7	41
2,80	5,2	46
3,00	6,1	52
3,20	42,2	94
3,40	37,3	131
3,60	60,0	191
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





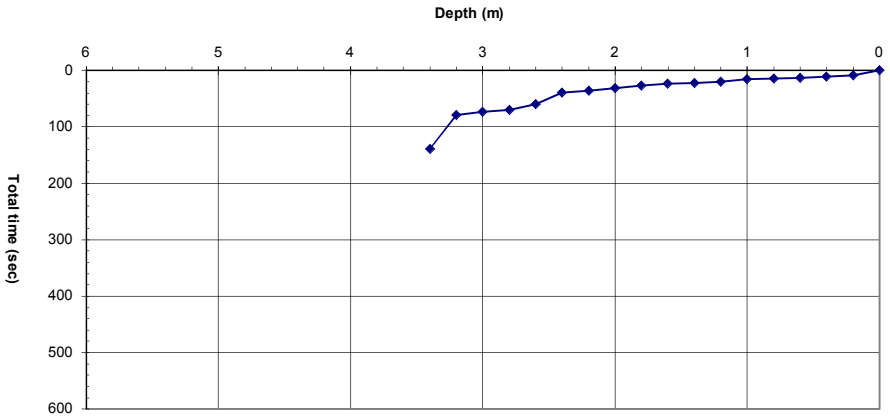
Interpretation

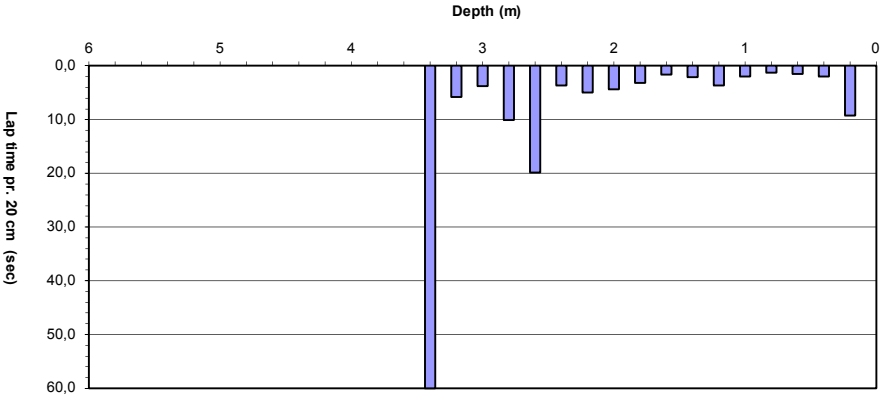
By hand	0,0	m
Organics	0,0	m
Bearing B.	3,2	m
Firm B.	3,6	m
Stop	3,6	m
GWL:	2,6	m

Description
Tephra plain and lava rocks on the surface. It gets more and more difficult to turn the drill with depth and it is not possible at the end. The bottom drill rod is bent and scratched, indicating a possible joint or fracture at the bottom. Fine sand at 2,6 and 3,6 m depth.

Ram sounding hole: HC-25 XYZ 470165,392 404193,785 264,47
Date: 5.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	9,3	9
0,40	2,0	11
0,60	1,5	13
0,80	1,3	14
1,00	2,0	16
1,20	3,7	20
1,40	2,1	22
1,60	1,6	24
1,80	3,2	27
2,00	4,4	31
2,20	4,9	36
2,40	3,7	40
2,60	19,9	60
2,80	10,1	70
3,00	3,8	74
3,20	5,8	79
3,40	60,0	139
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





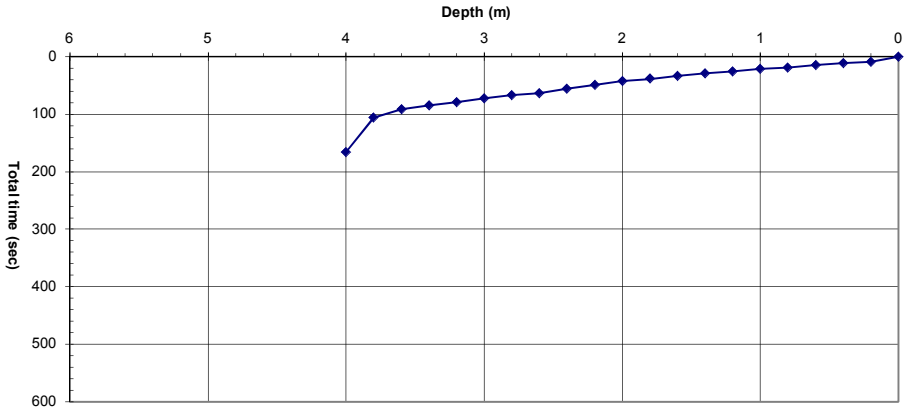
Interpretation

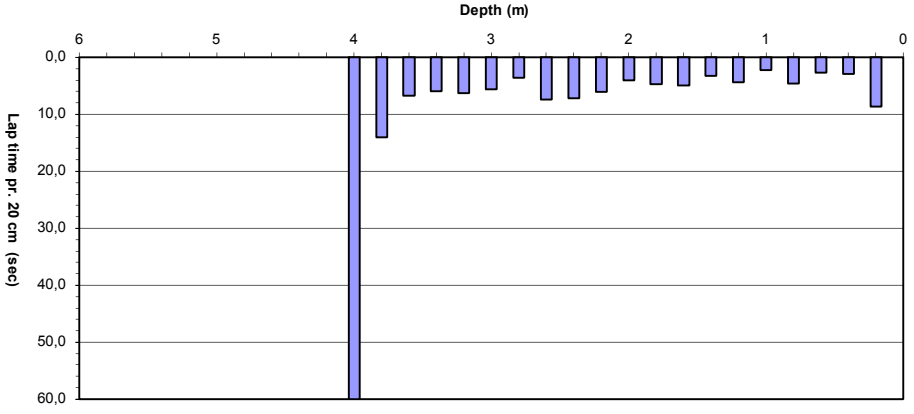
By hand	0,0	m
Organics	0,0	m
Bearing B.	3,4	m
Firm B.	3,4	m
Stop	3,4	m
GWL:	-	m

Description
Tephra plain and lava rocks on the surface. Drilling slows down at 2,6 m depth because of a rock. Dark brown, moist sand in the notches at 2,2 m depth and at the bottom. Most likely course lava / scoria at the bottom.

Ram sounding hole: HC-26 XYZ 470870,732 404903,042 264,38
Date: 6.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	8,7	9
0,40	2,9	12
0,60	2,7	14
0,80	4,6	19
1,00	2,3	21
1,20	4,4	26
1,40	3,3	29
1,60	5,0	34
1,80	4,7	39
2,00	4,1	43
2,20	6,1	49
2,40	7,2	56
2,60	7,4	63
2,80	3,6	67
3,00	5,6	73
3,20	6,3	79
3,40	6,0	85
3,60	6,8	92
3,80	14,1	106
4,00	60,0	166
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





Interpretation

By hand	0,0	m
Organics	0,0	m
Bearing B.	3,8	m
Firm B.	3,9	m
Stop	3,9	m
GWL:	3,3	m

Description
Slightly hilly lava with pseudocraters on the surface, whereas the depressions between are filled with thepra. Sand from the surface down to the bottom.

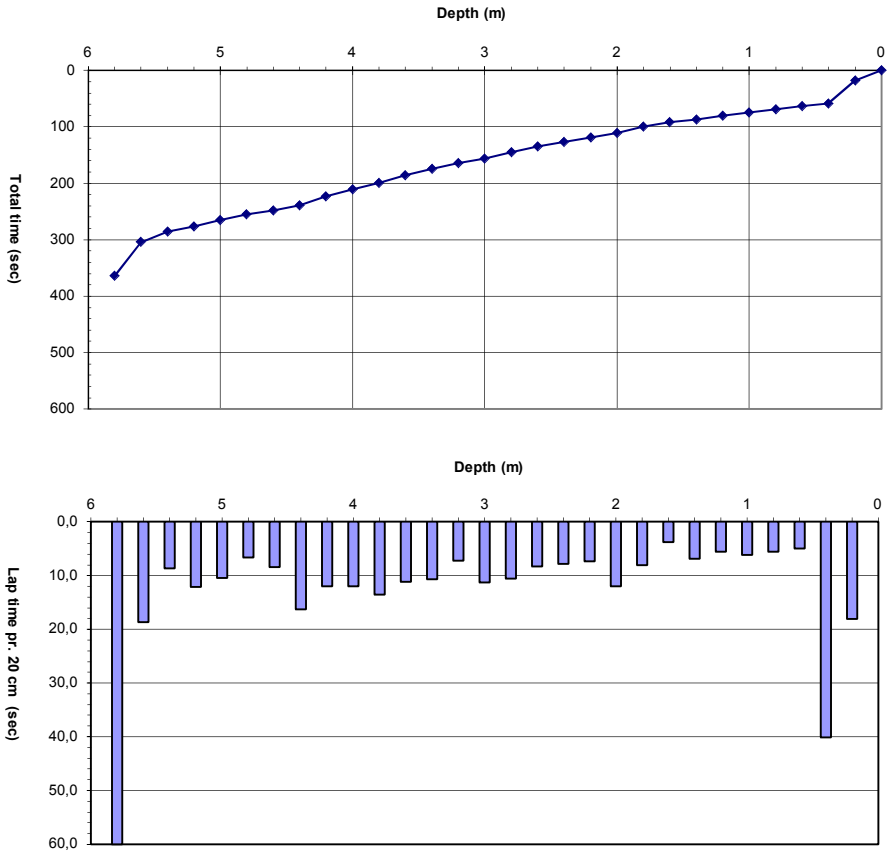
Ram sounding hole: HC-28 XYZ 472286,792 406319,025 276,31
Date: 6.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	18,1	18
0,40	40,1	58
0,60	5,0	63
0,80	5,6	69
1,00	6,2	75
1,20	5,6	81
1,40	6,9	88
1,60	3,8	91
1,80	8,0	99
2,00	12,0	111
2,20	7,4	119
2,40	7,8	127
2,60	8,3	135
2,80	10,6	145
3,00	11,3	157
3,20	7,2	164
3,40	10,7	175
3,60	11,1	186
3,80	13,5	199
4,00	12,0	211
4,20	12,0	223
4,40	16,3	240
4,60	8,4	248
4,80	6,6	255
5,00	10,4	265
5,20	12,1	277
5,40	8,6	286
5,60	18,7	304
5,80	60,0	364
6,00		

Interpretation

By hand	0,0	m
Organics	0,0	m
Bearing B.	2,7	m
Firm B.	5,7	m
Stop	5,7	m
GWL:	4,0	m

Description
Drilled in the centre of an access road - the top three meters are therefore disturbed. Difficult to turn the drill below 3,6 m depth. Fine sand below 4,0 m. Not possible to turn at the end.



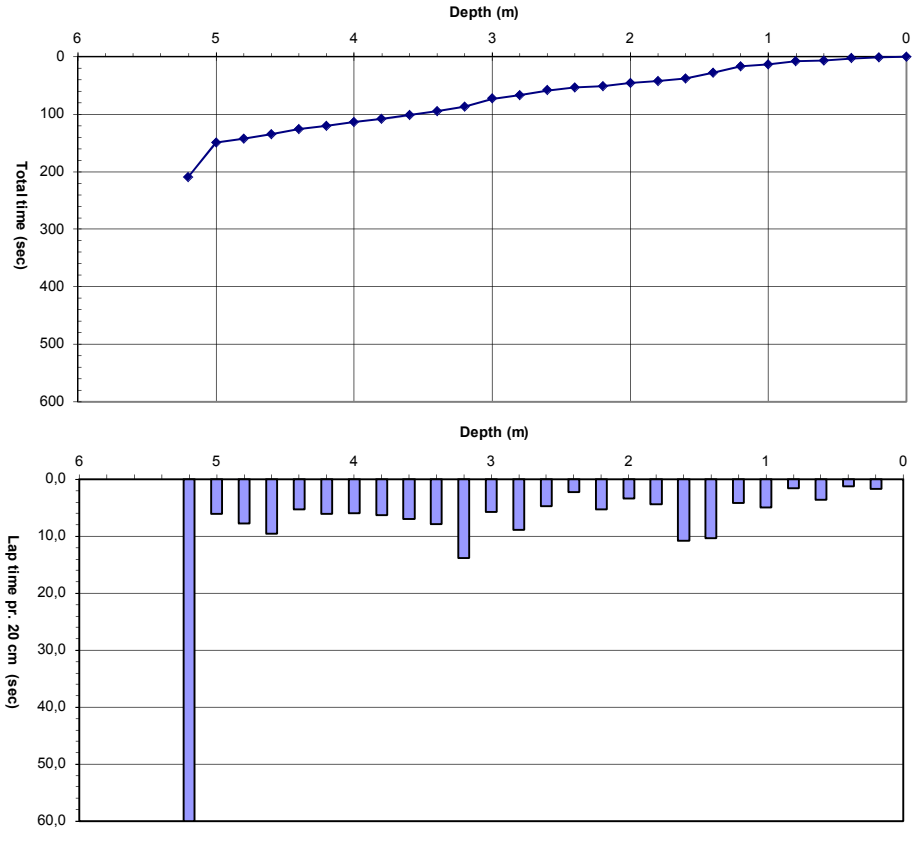
Ram sounding hole: HC-38 XYZ 470163,530 402781,803 263,24
Date: 5.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	1,7	2
0,40	1,2	3
0,60	3,6	7
0,80	1,6	8
1,00	5,0	13
1,20	4,2	17
1,40	10,3	28
1,60	10,8	38
1,80	4,4	43
2,00	3,4	46
2,20	5,3	52
2,40	2,3	54
2,60	4,7	59
2,80	8,9	67
3,00	5,7	73
3,20	13,8	87
3,40	7,9	95
3,60	7,0	102
3,80	6,3	108
4,00	6,0	114
4,20	6,1	120
4,40	5,3	126
4,60	9,6	135
4,80	7,8	143
5,00	6,1	149
5,20	60,0	209
5,40		
5,60		
5,80		
6,00		

Interpretation

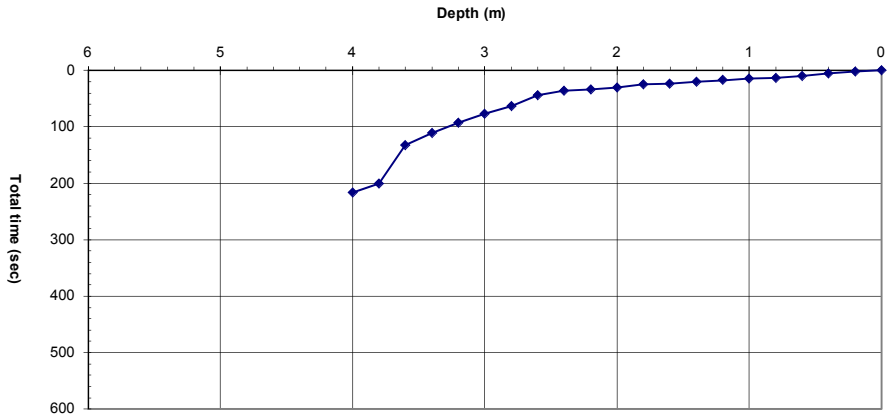
By hand	0,0	m
Organics	0,0	m
Bearing B.	5,2	m
Firm B.	5,2	m
Stop	5,2	m
GWL:	-	m

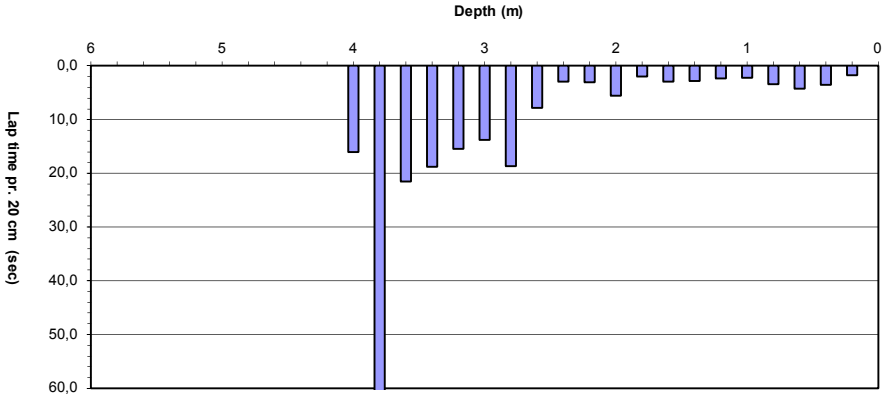
Description
Pseudocraters and lava rocks on the surface, along with thepra (lapilli). Drilled through sand down to the bottom. Not difficult to turn the drill, stopped abruptly in solid rock. Drill rod moist below 1,8 m depth, sand in notches. Groundwater level not certain.



Ram sounding hole: HC-40 XYZ 471577,660 404196,808 266,97
Date: 5.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	1,7	2
0,40	3,5	5
0,60	4,2	9
0,80	3,4	13
1,00	2,2	15
1,20	2,3	17
1,40	2,8	20
1,60	2,9	23
1,80	2,0	25
2,00	5,6	31
2,20	3,0	34
2,40	2,9	37
2,60	7,8	44
2,80	18,7	63
3,00	13,8	77
3,20	15,4	92
3,40	18,8	111
3,60	21,5	133
3,80	68,0	201
4,00	16,0	217
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





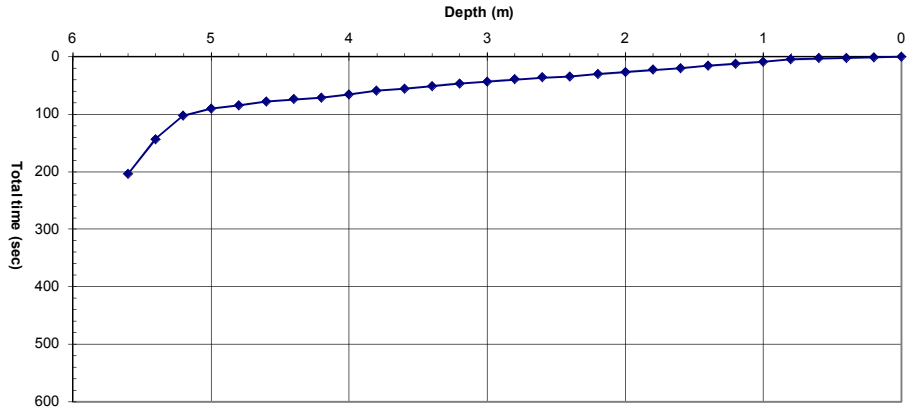
Interpretation

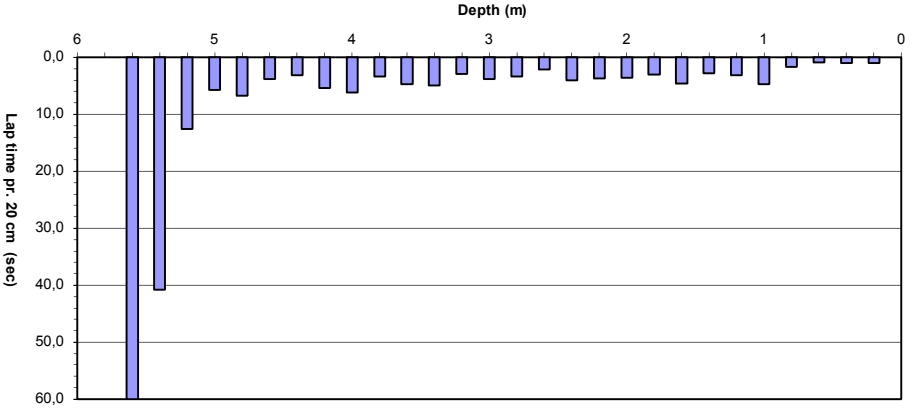
By hand	0,0	m
Organics	0,0	m
Bearing B.	2,8	m
Firm B.	3,9	m
Stop	3,9	m
GWL:	3,8	m

Description
Tephra in a lava field. Pseudocraters and lava rocks protrude from the sand. Not possible to turn the drill below 3,0 m depth. Sand in the bottom notch, drilling rod bent at the tip, slightly warm.

Ram sounding hole: HC-41 XYZ 472287,178 404898,974 269,23
Date: 5.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	1,0	1
0,40	1,0	2
0,60	0,9	3
0,80	1,7	5
1,00	4,7	9
1,20	3,2	13
1,40	2,8	15
1,60	4,6	20
1,80	3,0	23
2,00	3,6	27
2,20	3,7	30
2,40	4,0	34
2,60	2,1	36
2,80	3,4	40
3,00	3,8	44
3,20	2,9	46
3,40	5,0	51
3,60	4,7	56
3,80	3,4	60
4,00	6,2	66
4,20	5,4	71
4,40	3,1	74
4,60	3,8	78
4,80	6,7	85
5,00	5,7	90
5,20	12,6	103
5,40	40,8	144
5,60	60,0	204
5,80		
6,00		





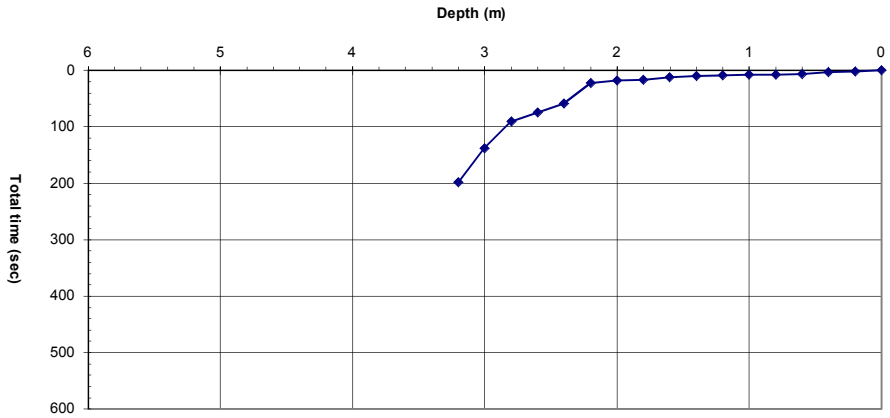
Interpretation

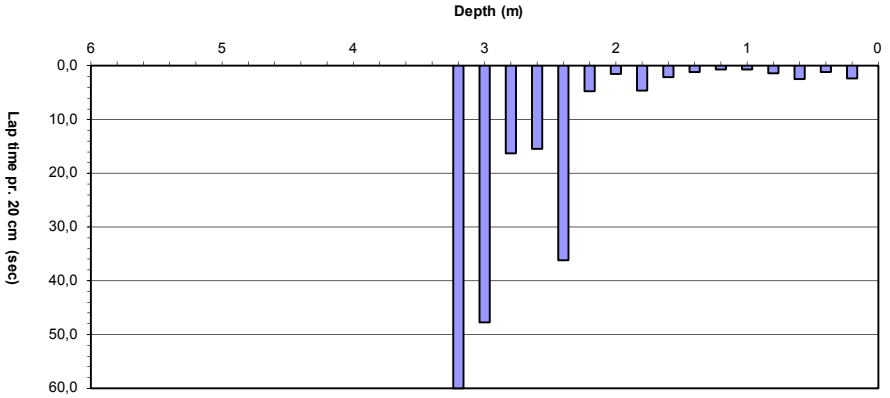
By hand	0,0	m
Organics	0,0	m
Bearing B.	5,2	m
Firm B.	5,5	m
Stop	5,5	m
GWL:	4,8	m

Description
Tephra plain and lava rocks on the surface. It was not possible to turn the drill at the bottom; the drill rod most likely gets stuck in coarse lava / scoria. Sand from the surface down.

Ram sounding hole: HC-43 XYZ 473698,336 406317,137 284,23
Date: 5.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	2,3	2
0,40	1,2	4
0,60	2,5	6
0,80	1,4	7
1,00	0,7	8
1,20	0,7	9
1,40	1,1	10
1,60	2,1	12
1,80	4,6	17
2,00	1,5	18
2,20	4,7	23
2,40	36,2	59
2,60	15,4	74
2,80	16,3	91
3,00	47,7	138
3,20	60,0	198
3,40		
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





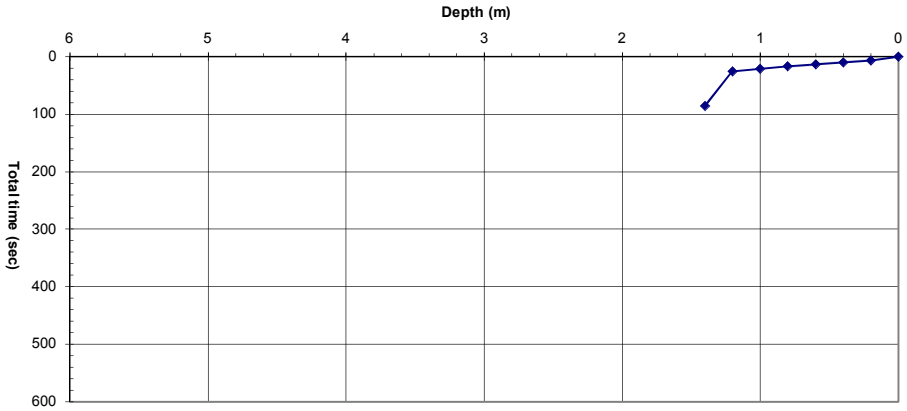
Interpretation

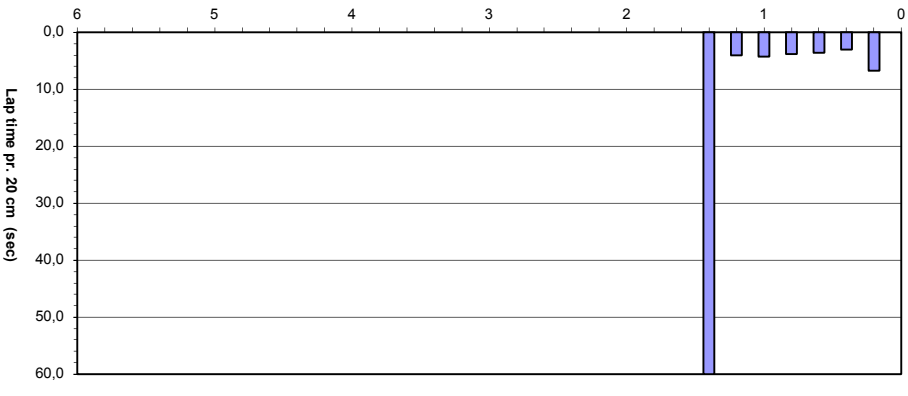
By hand	0,0	m
Organics	0,0	m
Bearing B.	2,4	m
Firm B.	3,2	m
Stop	3,2	m
GWL:	-	m

Description
Tephra plain and lava rocks (up to 60 cm diameter) on the surface. Not possible to turn the drill at the bottom. The tip is warm and dry, coarse sand in the bottom notches.

Ram sounding hole: HC-54 XYZ 472280,996 403493,000 269,11
Date: 6,12,13
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	6,7	7
0,40	3,0	10
0,60	3,6	13
0,80	3,8	17
1,00	4,3	21
1,20	4,1	26
1,40	60,0	86
1,60		
1,80		
2,00		
2,20		
2,40		
2,60		
2,80		
3,00		
3,20		
3,40		
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





Interpretation

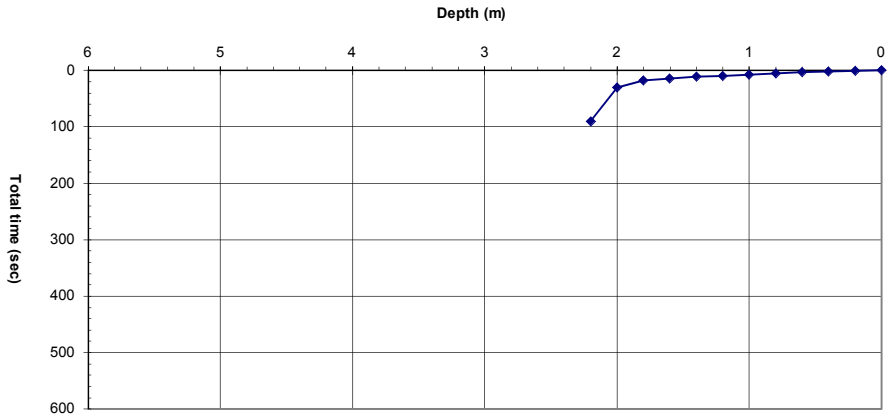
By hand	0,0	m
Organics	0,0	m
Bearing B.	1,0	m
Firm B.	1,3	m
Stop	1,3	m
GWL:	1,0	m

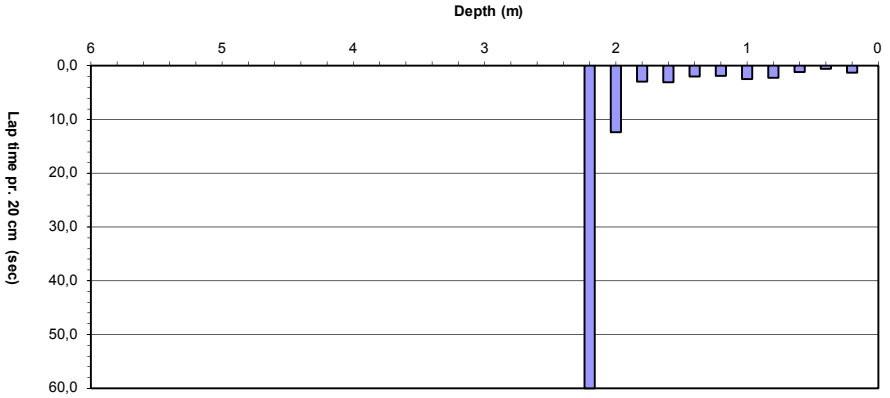
Description
Tephra plain and lava rocks on the surface. Hole drilled around 5 m north of planned location. Drill stops abruptly at the bottom, difficult to turn at the end. Sand in the bottom notches, tip is slightly warm; most likely stopped in solid rock.

RAM SOUNDING DRILL

Ram sounding hole: HC-57 XYZ 474404,537 405611,911 286,79
Date: 5.12.2013
Worker: BJ, GEÓ

Depth (m)	Lap time (sec)	Time (sec)
0,00		0
0,20	1,3	1
0,40	0,6	2
0,60	1,1	3
0,80	2,2	5
1,00	2,5	8
1,20	1,9	10
1,40	2,0	12
1,60	3,1	15
1,80	2,9	18
2,00	12,4	30
2,20	60,0	90
2,40		
2,60		
2,80		
3,00		
3,20		
3,40		
3,60		
3,80		
4,00		
4,20		
4,40		
4,60		
4,80		
5,00		
5,20		
5,40		
5,60		
5,80		
6,00		





Interpretation

By hand	0,0	m
Organics	0,0	m
Bearing B.	2,0	m
Firm B.	2,1	m
Stop	2,1	m
GWL:	1,0	m

Description
Lava, tephra and lava rocks on the surface. Tip is warm, most likely stopped in solid rock.

APPENDIX 6

AGGREGATE TESTING

CONSULTING ENGINEERS
LABORATORY
Höfðabakki 9, 110 Reykjavík
Tel: 412 6000 - Fax: 412 6001
Webpage: www.efla.is - Email: efla@efla.is

Grain size distribution

Customer
Landsvirkjun
Requested by

Project no.
1611-159
Date printed
22.4.2015

Information regarding sample

Sample, source
Möl og sandur Guðmundareyri (GE2)
Sample, marking
Guðmundareyri (GE2)

Project
Vindlundir á Þórsár- og Tungnaársvæði
Sample, type
0-63 mm

Sample no.
586
Index no.
828

Properties

Moisture content	[%]	**11,20%**	Grain density	r_{cm} [Mg/m³]		Flakiness index	FI	
Clay content (< 0.063mm)	[%]	**1,5%**	Saturation	W_{cm} [%]		Surface	[m²/kg]	
Humus	[-]		Bulk density (dry)	[kg/m³]		Clorine	[%]	
Slam	[%]		Bulk density (ssd)	[kg/m³]		Porosity	[%]	

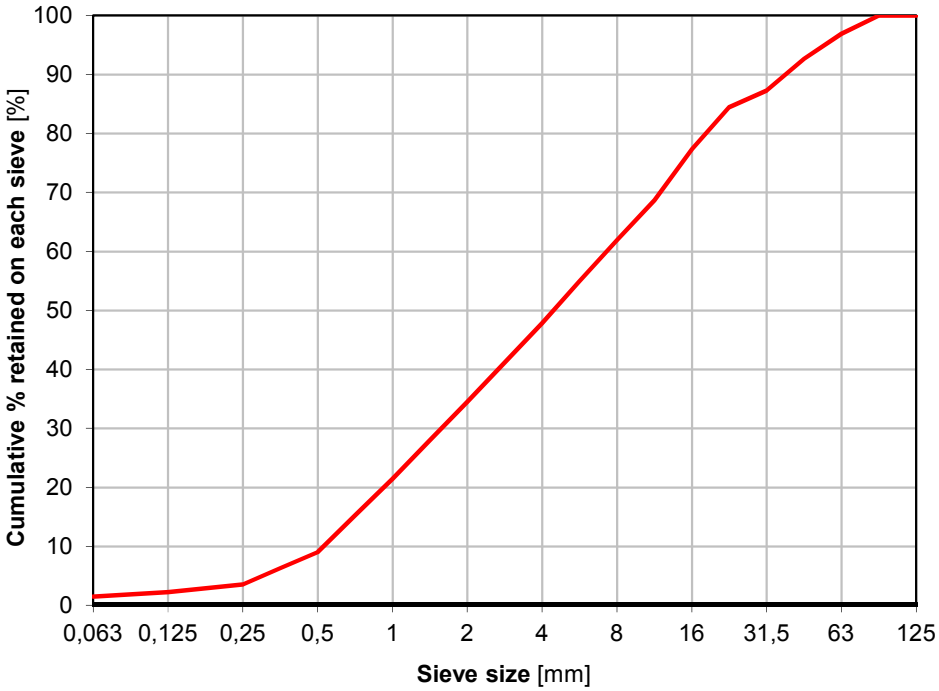
Grain size distribution

Testing standard
ÍST EN 933-1:1997, ÍST EN 933-2
Method **x** Washing and sieving
Dry sieving

Testing date
6.2.2015

Executed by
EÁP

Sieve size	[mm]	0,063	0,125	0,25	0,5	1	2	4	5,6	8	11,2	16	22,4	31,5	45	63	88	125
Guðmundareyri (GE2)	[%]	**1,5**	**2**	**4**	**9**	**21**	**34**	**48**	**55**	**62**	**69**	**77**	**84**	**87**	**93**	**97**	**100**	**100**



Mark lines:
Sample: **1611-159 - Möl og sandur Guðmundareyri (GE2)**

Technical properties

D_{10}	0,53	D_{50}	4,43	**Classification according to U.S.C.S system**	
D_{15}	0,70	D_{60}	7,25	Uniformity coefficient $C_u = D_{60}/D_{10}$ =	13,74
D_{30}	1,58	D_{85}	23,95	Coefficient of gradation $C_c = D_{30}^2/(D_{60}*D_{10})$ =	0,65

Comments

EFLA CONSULTING ENGINEERS
LABORATORY
Höfðabakki 9, 110 Reykjavík
Tel: 412 6000 - Fax: 412 6001
Webpage: www.efla.is - Email: efla@efla.is

Grain size distribution

Customer
Landsvirkjun
Requested by

Project no.
1611-159
Date printed
22.4.2015

Information regarding sample

Sample, source
Möl og sandur Guðmundareyri (GE4)
Sample, marking
Guðmundareyri (GE4)

Project
Vindlundir á Þjórsár- og Tungnaársvæði
Sample, type
0-45 mm

Sample no.
587
Index no.
830

Properties

Moisture content	[%]	**9,29%**	Grain density	r_{cm} [Mg/m³]	Flakiness index	FI
Clay content (< 0.063mm)	[%]	**1,2%**	Saturation	W_{cm} [%]	Surface	[m²/kg]
Humus	[-]		Bulk density (dry)	[kg/m³]	Clorine	[%]
Slam	[%]		Bulk density (ssd)	[kg/m³]	Porosity	[%]

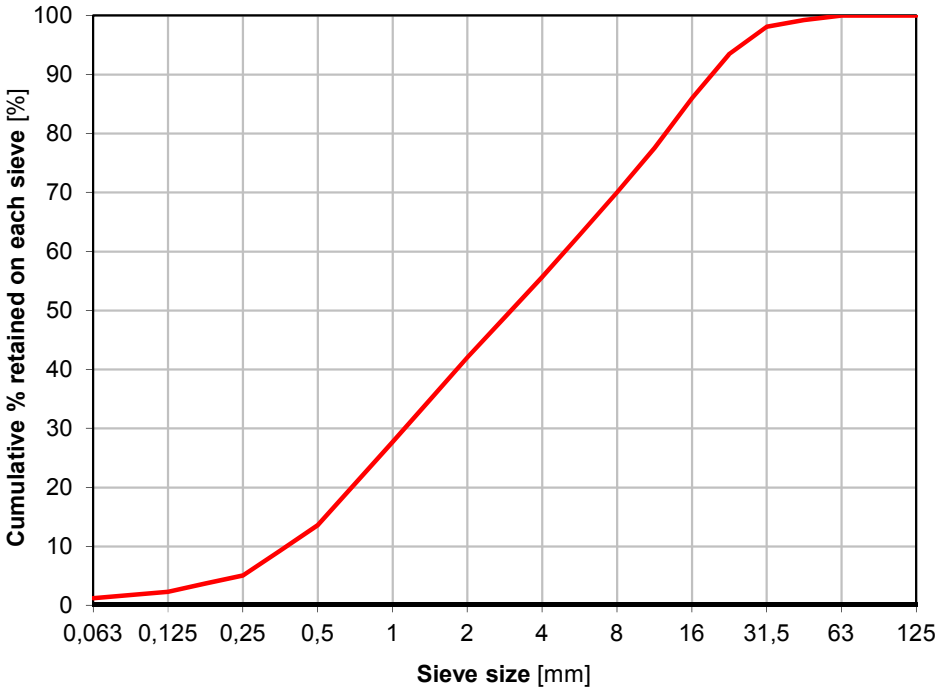
Grain size distribution

Testing standard
ÍST EN 933-1:1997, ÍST EN 933-2
Method **x** Washing and sieving
Dry sieving

Testing date
23.2.2015

Executed by
EÁP

Sieve size	[mm]	0,063	0,125	0,25	0,5	1	2	4	5,6	8	11,2	16	22,4	31,5	45	63	88	125
Guðmundareyri (GE4)	[%]	**1,2**	**2**	**5**	**14**	**28**	**42**	**56**	**63**	**70**	**78**	**86**	**93**	**98**	**99**	**100**	**100**	**100**



Mark lines:
Sample: **1611-159 - Möl og sandur Guðmundareyri (GE4)**

Technical properties

D_{10}	0,37	D_{50}	3,00	**Classification according to U.S.C.S system**	
D_{15}	0,54	D_{60}	4,91	Uniformity coefficient $C_u = D_{60}/D_{10}$ =	13,11
D_{30}	1,12	D_{85}	15,34	Coefficient of gradation $C_c = D_{30}^2/(D_{60}*D_{10})$ =	0,68

Comments

EFLA CONSULTING ENGINEERS
LABORATORY
Höfðabakki 9, 110 Reykjavík
Tel: 412 6000 - Fax: 412 6001
Webpage: www.efla.is - Email: efla@efla.is

Grain size distribution

Customer
Landsvirkjun
Requested by

Project no.
1611-159
Date printed
22.4.2015

Information regarding sample

Sample, source
Möl og sandur Tungnaáreyrar
Sample, marking
Tungnaáreyrar (TÁ1)

Project
Vindlundir á Þjórsár- og Tungnaársvæði
Sample, type
0-63 mm

Sample no.
588
Index no.
831

Properties

Moisture content	[%]	**5,90%**	Grain density	r_{cm} [Mg/m³]	Flakiness index	FI
Clay content (< 0.063mm)	[%]	**2,2%**	Saturation	W_{cm} [%]	Surface	[m²/kg]
Humus	[-]		Bulk density (dry)	[kg/m³]	Clorine	[%]
Slam	[%]		Bulk density (ssd)	[kg/m³]	Porosity	[%]

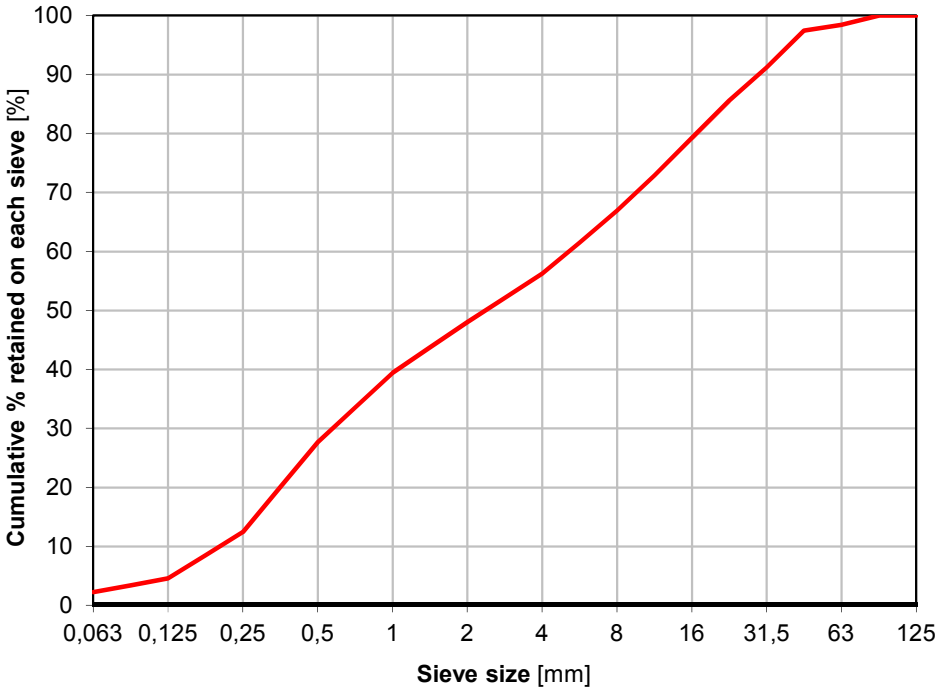
Grain size distribution

Testing standard
ÍST EN 933-1:1997, ÍST EN 933-2
Method **x** Washing and sieving
Dry sieving

Testing date
23.2.2015

Executed by
EÁP

Sieve size	[mm]	0,063	0,125	0,25	0,5	1	2	4	5,6	8	11,2	16	22,4	31,5	45	63	88	125
Tungnaáreyrar (TÁ1)	[%]	**2,2**	**5**	**12**	**28**	**39**	**48**	**56**	**62**	**67**	**73**	**79**	**86**	**91**	**97**	**98**	**100**	**100**



Mark lines:
Sample: **1611-159 - Möl og sandur Tungnaáreyrar**

Technical properties

D_{10}	0,20	D_{50}	2,37	**Classification according to U.S.C.S system**	
D_{15}	0,28	D_{60}	5,09	Uniformity coefficient $C_u = D_{60}/D_{10}$ =	25,20
D_{30}	0,57	D_{85}	21,78	Coefficient of gradation $C_c = D_{30}^2/(D_{60}*D_{10})$ =	0,32

Comments

CONSULTING ENGINEERS
LABORATORY
Höfðabakki 9, 110 Reykjavík
Tel: 412 6000 - Fax: 412 6001
Webpage: www.efla.is - Email: efla@efla.is

Grain size distribution

Customer
Landsvirkjun
Requested by

Project no.
1611-159
Date printed
22.4.2015

Information regarding sample

Sample, source
Jökulruðningur
Sample, marking
Jökulruðningur (GD1)

Project
Vindlundir á Þjórsár- og Tungnaársvæði
Sample, type
0-63 mm

Sample no.
590
Index no.
832

Properties

Moisture content	[%]	**16,19%**	Grain density	r_{cm} [Mg/m³]	Flakiness index	FI
Clay content (< 0.063mm)	[%]	**11,1%**	Saturation	W_{cm} [%]	Surface	[m²/kg]
Humus	[-]		Bulk density (dry)	[kg/m³]	Clorine	[%]
Slam	[%]		Bulk density (ssd)	[kg/m³]	Porosity	[%]

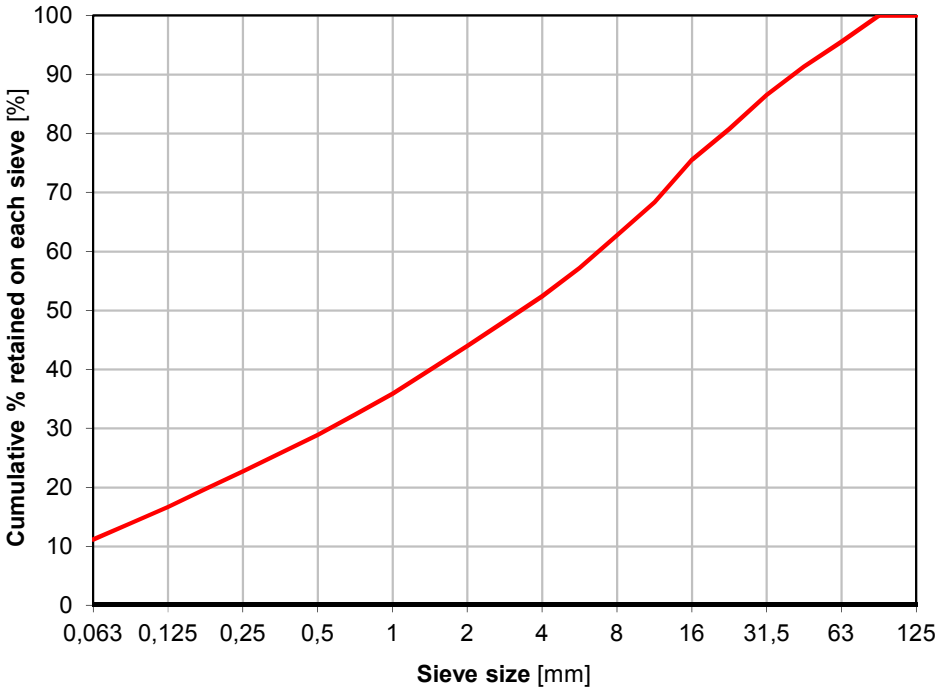
Grain size distribution

Testing standard
ÍST EN 933-1:1997, ÍST EN 933-2
Method **x** Washing and sieving
Dry sieving

Testing date
24.2.2015

Executed by
EÁP

Sieve size	[mm]	0,063	0,125	0,25	0,5	1	2	4	5,6	8	11,2	16	22,4	31,5	45	63	88	125
Jökulruðningur (GD1)	[%]	**11,1**	**17**	**23**	**29**	**36**	**44**	**52**	**57**	**63**	**68**	**76**	**81**	**87**	**91**	**96**	**100**	**100**



Mark lines:
Sample: **1611-159 - Jökulruðningur**

Technical properties

D_{10}	-	D_{50}	3,29	**Classification according to U.S.C.S system**	
D_{15}	0,10	D_{60}	6,70	Uniformity coefficient $C_u = D_{60}/D_{10}$ =	-
D_{30}	0,56	D_{85}	29,10	Coefficient of gradation $C_c = D_{30}^2/(D_{60}*D_{10})$ =	-

Comments

EFLA CONSULTING ENGINEERS
LABORATORY
Höfðabakki 9, 110 Reykjavík
Tel: 412 6000 - Fax: 412 6001
Webpage: www.efla.is - Email: efla@efla.is

Grain size distribution

Customer
Landsvirkjun
Requested by

Project no.
1611-159
Date printed
22.4.2015

Information regarding sample

Sample, source
Sandur
Sample, marking
Bjarnalón (BL1)

Project
Vindlundir á Þjórsár- og Tungnaársvæði
Sample, type
0-8 mm

Sample no.
589
Index no.
829

Properties

Moisture content	[%]	**14,66%**	Grain density	r_{cm} [Mg/m³]		Flakiness index	FI
Clay content (< 0.063mm)	[%]	**1,6%**	Saturation	W_{cm} [%]		Surface	[m²/kg]
Humus	[-]		Bulk density (dry)	[kg/m³]		Clorine	[%]
Slam	[%]		Bulk density (ssd)	[kg/m³]		Porosity	[%]

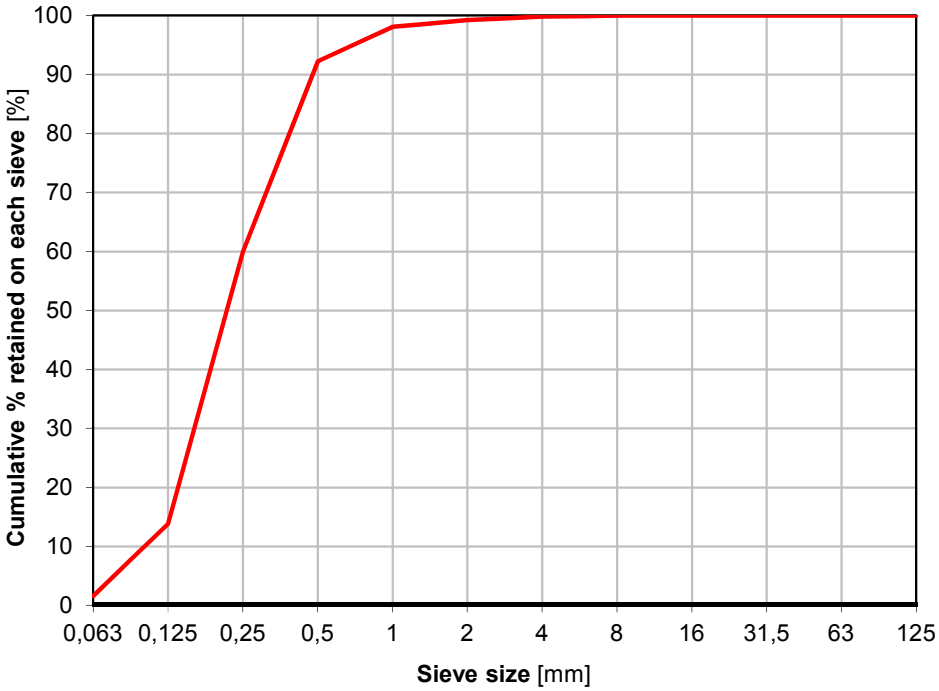
Grain size distribution

Testing standard
ÍST EN 933-1:1997, ÍST EN 933-2
Method **x** Washing and sieving
Dry sieving

Testing date
11.2.2015

Executed by
JÞI

Sieve size	[mm]	0,063	0,125	0,25	0,5	1	2	4	5,6	8	11,2	16	22,4	31,5	45	63	88	125
Bjarnalón (BL1)	[%]	**1,6**	**14**	**60**	**92**	**98**	**99**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**



Mark lines:
Sample: **1611-159 - Sandur**

Technical properties

D_{10}	0,10	D_{50}	0,22	**Classification according to U.S.C.S system**	
D_{15}	0,13	D_{60}	0,25	Uniformity coefficient $C_u = D_{60}/D_{10}$ =	2,49
D_{30}	0,16	D_{85}	0,43	Coefficient of gradation $C_c = D_{30}^2/(D_{60}*D_{10})$ =	1,01

Comments

Aggregate
Petrographical analysis

Laboratory
Hofðabakki 9, 110 Reykjavik
Tel: 412 6000
www.efla.is - efla@efla.is

Customer
Landsvirkjun
Requested by

Project no.
1611-159
Date printed
21.4.2015

Information regarding sample

Sample, marking
Guðmundareyri G1
Project
Búrfell Wind Farm
Sample no.
586
Sample site
Guðmundareyri
Location/coordinates
Date of sampling
29.1.2015
Sampling location
Guðmundareyri GE2
Method of sampling
Excavator
Sample type
River sandbank
Geological information of sample

Results

Test standard	Executed by	Date of test	Grain size analyzed	Analyzed in
ÍST EN 932-3	**JÞI**	**26.2.2015**	**5,6-8,0 mm**	**Hand sample - Stereoscope**

Petrographical type:

Quality group Concrete - Pavement - Base course	No of Grains	%	Rock type - Alteration - Porousity
1 - 1 - 1	176	43,2%	Basalt - fresh - dense
1 - 2 - 1	166	40,8%	Basalt - fresh - vesicular
2 - 3 - 2	8	2,0%	Basalt - fresh - very vesicular
2 - 2 - 2	31	7,6%	Basalt - altered - dense
2 - 2 - 2	7	1,7%	Basalt - altered - vesicular
3 - 3 - 2	7	1,7%	Basalt glass
3 - 3 - 3	12	2,9%	Amygdale
Total:	**407**	**100,0%**	

Quality grouping:

	Concrete %	Pavement %	Base course %
1. class	84,0%	43,2%	85,1%
2. class	11,3%	50,1%	13,2%
3. class	4,7%	6,6%	1,7%
	100,0%	100,0%	100,0%

Shape:

Shape:	81,8% of grains are cubic, 10,7% eru flat, 1,7% flat and elongated and 5,8% cubic and elongated
Roundness:	63,6% of grains are sub-rounded, 14,0% rounded and 22,4% angular
Roughness:	81,8% of grains are smooth and 18,2% are rough

Technical characteristics:

Fines:	The sample has been washed, thus no fines.
Particle strength:	
Humus (visual):	No organic material
Plasticity (visual):	Sample is considered non-plastic

Additional notes:

Aggregate
Petrographical analysis

Laboratory
Hofðabakki 9, 110 Reykjavik
Tel: 412 6000
www.efla.is - efla@efla.is

Customer
Landsvirkjun
Requested by

Project no.
1611-159
Date printed
22.4.2015

Information regarding sample

Sample, marking
Guðmundareyri G2
Project
Búrfell Wind Farm
Sample no.
587
Sample site
Guðmundareyri
Location/coordinates
Date of sampling
29.1.2015
Sampling location
Guðmundareyri GE4
Method of sampling
Excavator
Sample type
River sandbank
Geological information of sample

Results

Test standard	Executed by	Date of test	Grain size analyzed	Analyzed in
ÍST EN 932-3	**JÞI**	**26.2.2015**	**5,6-8,0 mm**	**Hand sample - Stereoscope**

Petrographical type:

Quality group Concrete - Pavement - Base course	No of Grains	%	Rock type - Alteration - Porousity
1 - 1 - 1	173	40,6%	Basalt - fresh - dense
1 - 2 - 1	137	32,2%	Basalt - fresh - vesicular
2 - 3 - 2	9	2,1%	Basalt - fresh - very vesicular
2 - 2 - 2	21	4,9%	Basalt - altered - dense
2 - 2 - 2	33	7,7%	Basalt - altered - vesicular
3 - 3 - 3	20	4,7%	Hyaloclastite
3 - 3 - 2	16	3,8%	Basalt glass
3 - 3 - 3	10	2,3%	Tephra
2 - 2 - 2	7	1,6%	Rhyolite
Total:	**426**	**100,0%**	

Quality grouping:

	Concrete %	Pavement %	Base course %
1. class	72,8%	40,6%	72,8%
2. class	16,4%	46,5%	20,2%
3. class	10,8%	12,9%	7,0%
	100,0%	100,0%	100,0%

Shape:

Shape:	56,6% of grains are cubic, 29,8% eru flat, 4,5% flat and elongated and 9,2% cubic and elongated
Roundness:	67,6% of grains are sub-rounded, 11,7% rounded and 20,7% angular
Roughness:	72,5% of grains are smooth and 27,5% are rough

Technical characteristics:

Fines:	The sample has been washed, thus no fines.
Particle strength:	
Humus (visual):	No organic material
Plasticity (visual):	Sample is considered non-plastic

Additional notes:

Aggregate
Petrographical analysis

Laboratory
Hofðabakki 9, 110 Reykjavik
Tel: 412 6000
www.efla.is - efla@efla.is

Customer
Landsvirkjun
Requested by

Project no.
1611-159
Date printed
22.4.2015

Information regarding sample

Sample, marking
Karstensö
Project
Búrfell Wind Farm
Sample no.
588
Sample site
Tungnaáreyrar
Location/coordinates
Date of sampling
29.1.2015
Sampling location
Tungnaáreyrar
Method of sampling
Excavator
Sample type
River sandbank
Geological information of sample

Results

Test standard	Executed by	Date of test	Grain size analyzed	Analyzed in
ÍST EN 932-3	**JÞI**	**26.2.2015**	**5,6-8,0 mm**	**Hand sample - Stereoscope**

Petrographical type:

Quality group Concrete - Pavement - Base course	No of Grains	%	Rock type - Alteration - Porousity
1 - 1 - 1	123	36,8%	Basalt - fresh - dense
1 - 2 - 1	137	41,0%	Basalt - fresh - vesicular
2 - 3 - 2	3	0,9%	Basalt - fresh - very vesicular
2 - 2 - 2	20	6,0%	Basalt - altered - dense
2 - 2 - 2	25	7,5%	Basalt - altered - vesicular
3 - 3 - 3	8	2,4%	Hyaloclastite
3 - 3 - 2	10	3,0%	Basalt glass
3 - 3 - 2	3	0,9%	Tephra
2 - 2 - 2	5	1,5%	Rhyolite
Total:	**334**	**100,0%**	

Quality grouping:

	Concrete %	Pavement %	Base course %
1. class	79,8%	37,7%	80,2%
2. class	14,7%	55,8%	17,3%
3. class	5,5%	6,4%	2,5%
	100,0%	100,0%	100,0%

Shape:

Shape: 61,4% of grains are cubic, 22,5% eru flat, 3,3% flat and elongated and 12,9% cubic and elongated
Roundness: 62,9% of grains are sub-rounded, 9,9% rounded and 27,2% angular
Roughness: 70,4% of grains are smooth and 29,6% are rough

Technical characteristics:

Fines: The sample has been washed, thus no fines.
Particle strength:
Humus (visual): No organic material
Plasticity (visual): Sample is considered non-plastic

Additional notes:

Landsvirkjun

Háaleitisbraut 68
103 Reykjavik
landsvirkjun.is

landsvirkjun@lv.is
Sími: 515 90 00

Prentað efni