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Holtavirkjun Hydroelectric Project

Ground Investigation Report (GIR)

Landsvirkjun

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Abstract: In this report soil investigation carried out for Holtavirkjun is described.
This includes:
Description of boreholes and test pits.
Laboratory tests.
Proposal on material properties for dam construction core materials based on results from laboratory investigation.
Estimate of construction material quantities in the borrow areas.

Keywords: Soil investigation, boreholes, test pits, borrow areas, laboratory testing and material properties.

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Project manager's signature

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Holtavirkjun
Hydroelectric Project

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1 INTRODUCTION

In the year 2006 soil investigation was carried out for Landsvirkjun for Holtavirkjun Hydroelectric Project in Neðri Þjórsá river. Similar soil conditions are observed in Hvammsvirkjun north of Holtavirkjun and also at Urriðafossvirkjun south of the site. At these sites extensive site investigations have been carried out this year and in 2002 [03] and [20]. The investigation for Holtavirkjun 2006 is a supplementary geotechnical investigation to those north and south of the site, focusing on the soil at the potential dam site and on exploration of construction materials.

2 SCOPE OF WORK

The scope of work was as follows:

- Exploration and laboratory testing of the soil at the dam site.
- Testing of possible construction materials.
- Comparison of test results from Hvammsvirkjun and Urriðafossvirkjun with results from Holtavirkjun for use in defining the soil properties for the Holtavirkjun Project.
- Estimate of the quantities of materials in potential borrow areas.

3 FIELD INVESTIGATION

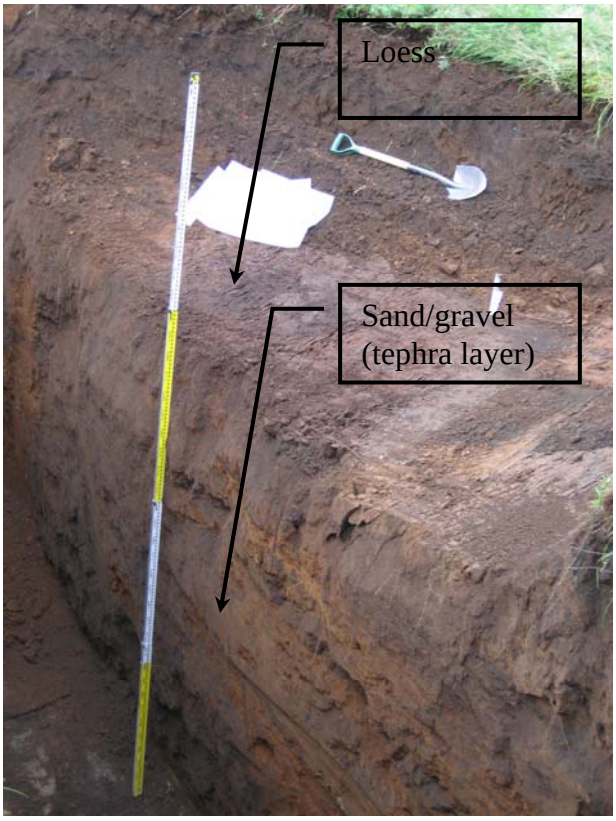
3.1 Coordinates, elevation and depth to scoria in test pits

Coordinates of the test pits were determined with a GPS-equipment (GARMIN GPSmap 60Cx). Ground elevation of the test pits was determined from measured counter lines given in the computer program AutoCAD. Ground elevation and coordinates of test pits and assumed scoria can be found in Appendix A.

3.2 Disturbed samples in test pits

Test pits were excavated by Ræktunarsamband Flóa og Skeiða in August to October 2006. Samples were taken either from the test pit walls or from mixed samples of the excavated material. A total of 88 test pits was excavated at the site. The location of these is shown in Drawing 3 and cross sections with description of the different material layers can be seen in Appendix B. A total of 132 disturbed and undisturbed samples was taken for further laboratory analyses.

Most of the test pits were excavated down to the top of the underlying scoria and the soil thickness according to the test pits varies between 0,1 m and 6,0 m. At the test pits where the depth to the underlying scoria and bedrock is unknown it is noted in Appendix A. Typical test pits in loess and sandy gravel are shown in Figure 1 and 2.



a) Test pit number L19A (at the dam site)
Figure 1

b) Test pit number L21E
Figure 2

A total of 38 test pits was investigated in proposed borrow areas. Piezometers for monitoring the groundwater table were installed in 13 of those test pits. Groundwater table for the period November to December is shown in Appendix E. The depth to groundwater table for that period is between 1,0 and 3,7 m from ground surface.

3.3 Percussion drillhole

The Percussion drilling was performed by Ræktunarsamband Flóa og Skeiða, located as shown on Drawing 3. Depth to assumed scoria and bedrock along the longitudinal section of the planned dam is shown in Drawings 5 and 6 and at the tailrace canal Drawing 7. Further details of the borehole results and quality of the bedrock will be available in planned Geological Report.

4 LABORATORY INVESTIGATION

4.1 General

Laboratory tests 2006 were performed at the Building Research Institute in Reykjavík. Following is a description of each test together with a reference to an appropriate standard testing method. A list of used symbols and abbreviations is provided in Chapter 10.

4.2 Water content

Water content is the ratio between water and dry material after drying at 110°C. The test was performed according to guidelines from [19] (Statens vegvesen. Laboratorieundersøkelser. Retningslinjer. Vanninnhold, 14.426).

4.3 Unit weight

Unit weight is the ratio between the weight and the volume of the sample. The test was performed according to guidelines from [19] (Statens vegvesen. Laboratorieundersøkelser. Retningslinjer. Densitet våt prøve, 14.425).

4.4 Grain size analysis

The grain size distribution was determined according to guidelines from [19] (Statens vegvesen. Laboratorie-undersøkelser. Retningslinjer. Kornfordeling ved våtsigting med slemmeanalyse, 14.434). Results of grain size analyses are shown in Appendix D.

4.5 Specific gravity

The specific gravity was determined on particles less than 16 mm with a pycnometer according to ASTM D 854. No samples were measured from Holtavirkjun but tests from Hvammsvirkjun and Urriðafossvirkjun are assumed to describe the specific gravity of loess at Holtavirkjun. Measured specific gravity for sample from Holtavirkjun BL-1 is 27,61, NG-01 is 27,38 and Urriðafossvirkjun (19-1/20-1) 27,22.

4.6 Compaction test

4.6.1 Standard and Modified Proctor compaction test

Compaction tests were performed according to Standard and Modified Proctor [19] (Statens vegvesen. Laboratorieundersøkelser. Retningslinjer. Standard Proctor, 14.461 and Modified Proctor 14.462). No samples were measured from Holtavirkjun but tests from Hvammsvirkjun and Urriðafossvirkjun are assumed to describe the compaction properties of loess at Holtavirkjun. The test results are shown in Table 4.1, from Hvammsvirkjun (Núpur 2002 [03]) and from Urriðafossvirkjun [20].

Table 4.1. Results from compaction and permeability tests

Material	Sample	Compaction	Opt. water content W_{opt} [%]	Max. dry density γ_{dopt} [kN/m^3]	Permeability, k [cm/sek]
Hvammsvirkj.	NG-01	Stand. Proctor	36,0	12,4	$1\ 10^{-5}$
Hvammsvirkj.	BL-1	Stand. Proctor	34,8	12,9	$5\ 10^{-6}$
Hvammsvirkj.	BL-1	Stand. Proctor	36	12,8	
Hvammsvirkj.	Bl-1	Modif. Proctor	30	14,1	
Urriðafossvk.	19-1/20-1	Stand. Proctor	69	8,3	$5\ 10^{-7}$

4.6.2 Relative density test

As the loess has too high fines content to use the ASTM D4253 for determining the maximum density it was chosen to define the maximum dry density at water content 30% and compaction according to Modified Proctor. The minimum density was determined according to ASTM D4254. Results of calculations of the relative density are shown in Chapter 4.11.

4.7 Permeability test

The test was performed according to "General Procedure in Investigation, Design and Control During Construction of Earth- and Rock Fill Dams in Norway" by Bjørn Kjærnsli, NGI Publ. Nr 80, [15]. No samples were measured from Holtavirkjun but tests from Hvammsvirkjun and Urriðafossvirkjun are assumed to describe the permeability properties of loess at Holtavirkjun. The results from tests of sample from Hvammsvirkjun BL-1, NG-01 and Urriðafossvirkjun (19-1/20-1) are shown in in Table 4.1.

4.8 Oedometer test

The test is performed in order to measure settlement and consolidation with increased loading. The sample was placed in an ordinary test cell consisting of a 2 cm high circular steel cylinder with an area of 20 cm^2. The test sample was cut by the steel cylinder from a larger undisturbed sample. Porous plates are placed below and on top of the specimen to allow drainage. The samples were tested by the step loading method. The tests were based on each load being twice the previous one and the max load being 1600 kPa. The relationship between settlement and time for each load step was measured and between settlement and load as well. For each test it was tried to measure the preconsolidation pressure. The coefficient of consolidation, c_v, is determined by Taylor's square root fitting method. The measured data is interpreted in accordance with Janbu's theory as described in [09]. No tests were performed on samples from Hvammsvirkjun and Holtavirkjun Hydroelectric Projects but four tests on undisturbed samples are available from the Urriðafoss Hydroelectric Project from 2002 [20] and are used for this project.

Over the years extensive test results for silty and organic soil have been collected [10]. In [10] are given graphs based on these results showing the relationship between settlement parameters and water content. In Figures 4.1 and 4.2 both the test results from Urriðafossvirkjun and the upper and lower limits from [10] are shown. From

comparison it can be seen that results for the organic loess are between the limits except two values of r_s.

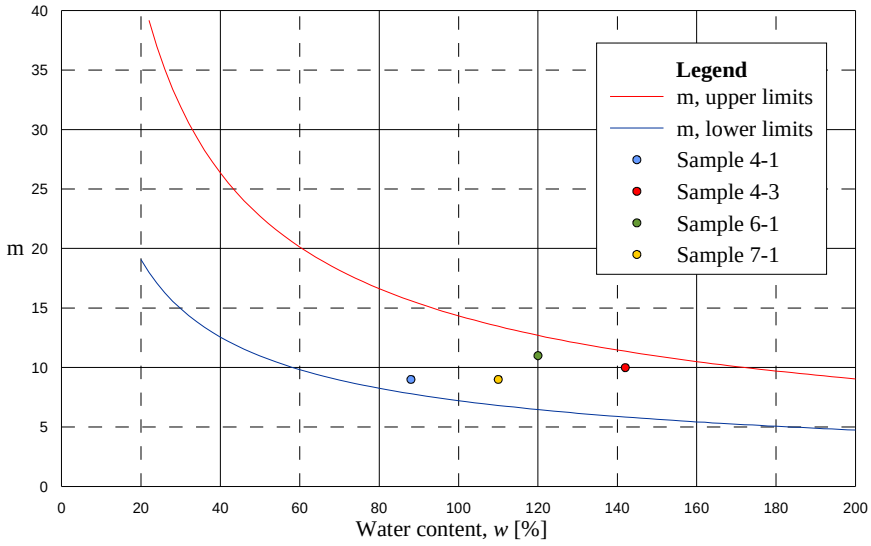


Figure 4.1. Variation of modulus number m (M=mσ) with stress

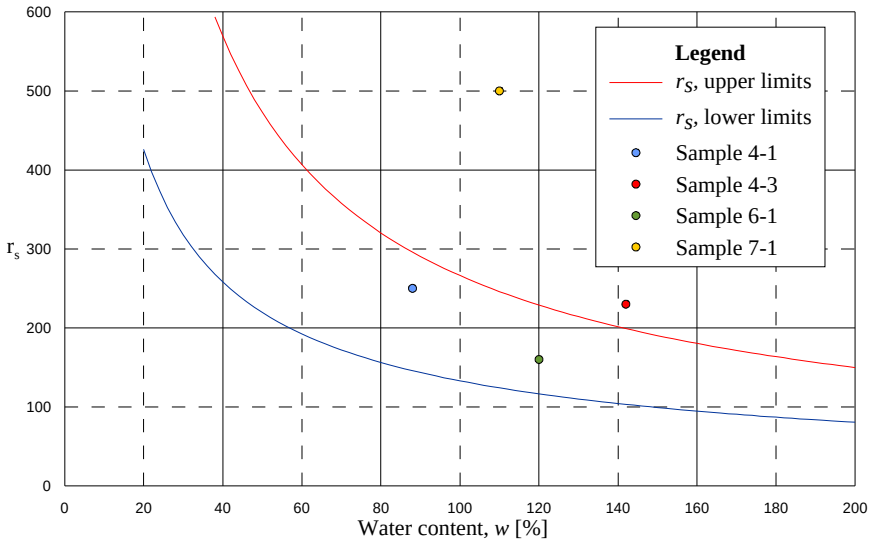


Figure 4.2. Variation of creep number r_s with stress

4.9 Triaxial test

4.9.1 General

No static or dynamic triaxial tests were carried out for Holtavirkjun. It was assumed that results from earlier testing at Hvammsvirkjun [03], Urriðafossvirkjun [20] and Kárahnjúkavirkjun [02] Projects were sufficient to design the small dams and dikes at Holtavirkjun. In Table 4.2 the main soil parameters and in Figure 4.3 the grain size distributions are shown.

Table 4.2. General soil parameters for loess

Site	Sample	Water content w [%]	Dry density γ_d [kN/m^3]	Fines content <0,063 [%]	D_{50} [%]	γ_s
Holtavirkjun	Ho270	50-80	8-9	60	0,04	2,74
Hvammsvirkjun	NG-01	40-47	12,0-12,4	37	0,08	2,74
Hvammsvirkjun	BL-1	35-60	7-10	50	0,06	2,76
Urriðafossvirkjun	UF-BL	92-102	7,1-7,7	73	0,036	2,68
Kárahnjúkavirkjun	GS-4	34	13,9	21	0,105	2,85

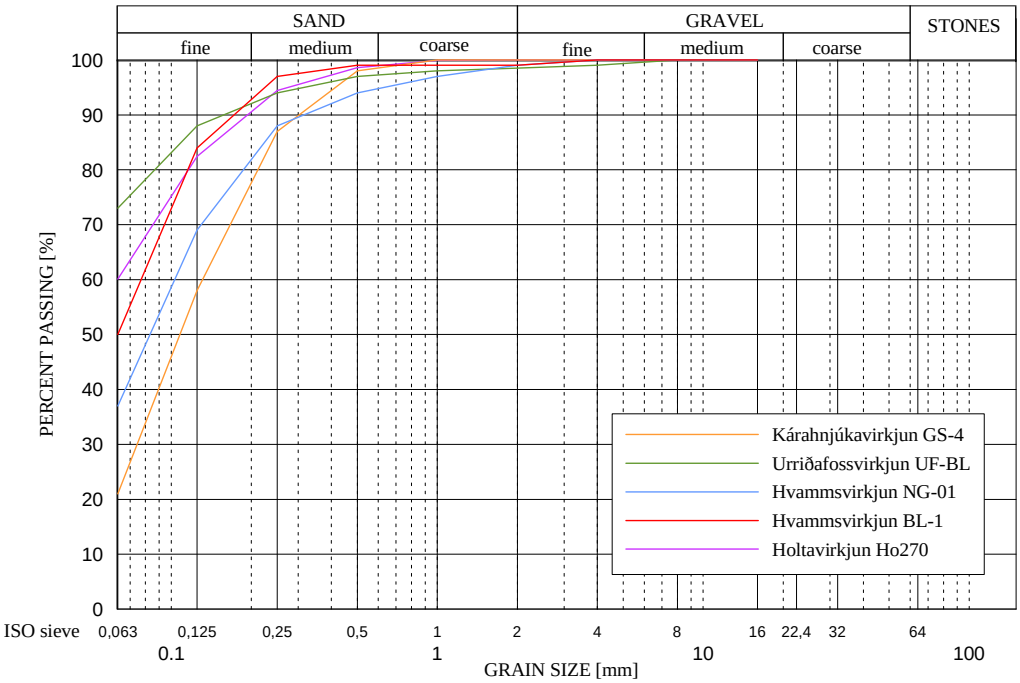


Figure 4.3. Grain size distribution

4.9.2 Static triaxial test

Static triaxial test is carried out to determine the shear strength parameters and the pore pressure parameters of the material. The test was performed according to "General Procedure in Investigation, Design and Control During Construction of Earth- and Rock Fill Dams in Norway" by Bjørn Kjærnsli, NGI Publ. Nr 80, [15]. Tests on loess were performed in 2002 for both Hvammsvirkjun [03] and Urriðafossvirkjun [20] and further testing was not done in 2006.

Samples were tested by UU (unconsolidated undrained) and CIU (consolidated isotropic undrained) tests. The samples were compacted to decided density. The confining pressure in the triaxial cell was built up in steps with monitoring of the pore pressure development in the sample for each step. Having reached the selected cell pressure, the samples were subjected to a back pressure of 200 kPa. All samples were brought to failure under undrained conditions at a rate of strain of approximately 2,5% per hour and a minimum strain of 10%. The pore pressure in the samples was measured as a function of the cell pressure during shearing. The coefficient of

consolidation, c_v was determined by Taylor´s square root fitting method.

Earlier tests on Icelandic coarse materials, such as moraine, sand and gravel, have indicated that cohesion in such materials is negligible. Analyses show that the same applies for the material under investigation and consequently the cohesion was taken as zero when calculating the friction angle. The friction angle was calculated using the following relationship.

$$\text{Sin } \varphi = (\sigma'_1 - \sigma'_3)/(\sigma'_1 + \sigma'_3)$$

Were

φ is the friction angle
σ'_1 is the effective vertical stress
σ'_3 is the effective horizontal stress

No new static triaxial tests were supplemented in year 2006. It was evaluated that results from earlier testing at similar loess from Hvammsvirkjun [03], Urriðafossvirkjun [20] and Kárahnjúkavirkjun [02] Projects were sufficient to design the small dams and dikes in Holtavirkjun. Summary of the test results is shown in Table 4.3 and Figure 4.4.

Table 4.3. Results from static triaxial tests

Site	Sample	w [%]	γ_d [kN/m^3]	D_r [%]	σ'_1 [kN/m^2]	φ [°]	ε [%]
Hvammsvirkjun NG-01 [03]	STR-1	45,3	12,01	(80)	326	44,3	2,0
	STR-2	45,2	12,04	(80)	472	42,4	2,3
	STR-3	44,5	12,09	(80)	645	41,4	2,7
	STR-4	43,6	12,36	(80)	1441	39,3	7,1
Urriðafossvirkjun UF-BL [19]	1	78,2	8,60	(100)	22	49,5	2
	2	80,1	8,27	(70)	70	43	6
	3	81,3	8,15	(70)	46	43,5	4
	4	86,4	7,64	(40)	45	37	6
	5	92,3	7,40	(40)	21	36	6
	6	81,4	8,17	(70)	45	43	5
	9	99,5	7,18	(10)	46	34	12
	10	101,4	7,07	(10)	22	35	12
Kárahnjúkavirkjun GS-4 [02]	1	44,4	12,06	(10)	98	34,9	12,5
	2	41,2	12,66	(30)	265	38,0	2,5
	3	41,4	12,62	(30)	445	37,8	3,5
	4	41,2	12,62	(30)	645	38,8	3,5
	5	39,3	12,99	(30)	1435	37,4	10,0
	6	33,9	14,20	(80)	578	47,4	1,5
	7	34,0	14,17	(80)	1357	44,1	3,0
	8	34,0	14,17	(80)	1383	43,4	2,5
	9	32,7	14,39	(80)	2694	41,2	5,3

( ) Estimated value

Coefficient of consolidation c_v was found to be 30 cm^2/min for NG-01. For sample from GS-4 it was 39 cm^2/min if compacted and 121 cm^2/min if loose. For UF-BL the coefficient was 1 cm^2/min measured in oedometer tests.

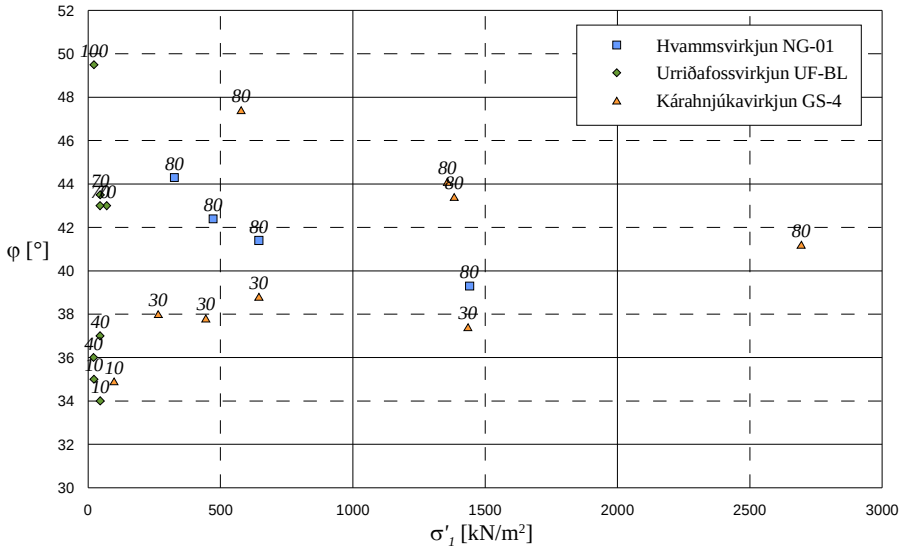


Figure 4.4. Triaxial test results (Dr indicated by a number)

4.9.3 Dynamic triaxial test

No dynamic triaxial tests were supplemented in year 2006. It was evaluated that results from earlier testing at similar loess from Hvammsvirkjun, Urriðafossvirkjun and Kárahnjúkavirkjun Projects were sufficient to design the small dams and dikes at Holtavirkjun. Summary of the test results is shown in Table 4.4 and Figure 4.6.

4.9.3.1 Test sample

A dynamic triaxial testing program was carried out for loess material from Hvammsvirkjun, Urriðafossvirkjun and Kárahnjúkavirkjun Projects.

4.9.3.2 Equipment and procedure

All testing was executed at the Icelandic Building Research Institute in Reykjavík. The eight cyclic triaxial tests performed in this testing program were carried out by using equipment manufactured by the MTS Systems Corporation. In short, the equipment consists of the following components:

- Pneumatic system used to control cell pressure
- Electro-hydraulic closed loop loading system used to control axial load
- Bottom mounted internal load cell for measurement of axial force
- Axial deformation measured by an externally mounted LVDT for measurements of axial deformation
- PC computer running the TestStar II System Software from MTS. The software controls cyclic loading and cell pressure, as well as recording readings of axial load, axial deformation, cell pressure and pore water pressure.

Specimens were manually prepared in the laboratory by using moist tamping and under compaction as described by R.S. Ladd. Water content at compaction and the target density were determined from previously established Standard Proctor

compaction curves. Specimens were backpressure saturated at 400 kPa. Pore water pressure was manually controlled and volume change during consolidation was manually recorded. Degree of saturation was established through measurement of B-value as well as through the phase-relations calculations. All specimens were isotropically consolidated to an effective stress of 50 or 100 kPa prior to cyclic loading. Specimens were maintained in an undrained state (no volume change) during cyclic loading.

Cyclic Stress Ratio, CSR: $$CSR = \frac{\pm \Delta\sigma_{dc}}{2\sigma'_{v,c}}$$

where cyclic stress, $$\pm \Delta\sigma_{d,c} = \frac{\Delta P_c + \Delta P_e}{2A_c}$$

for isotropic stress state $$\sigma'_{v,c} = \sigma'_{3,c}$$

Pore water pressure ratio: $$U = u_{\max} / \sigma'_{v,c}$$

Double amplitude strain: $$\varepsilon_{da} = \frac{\Delta\delta_c - \Delta\delta_e}{H_c} \times 100\%$$

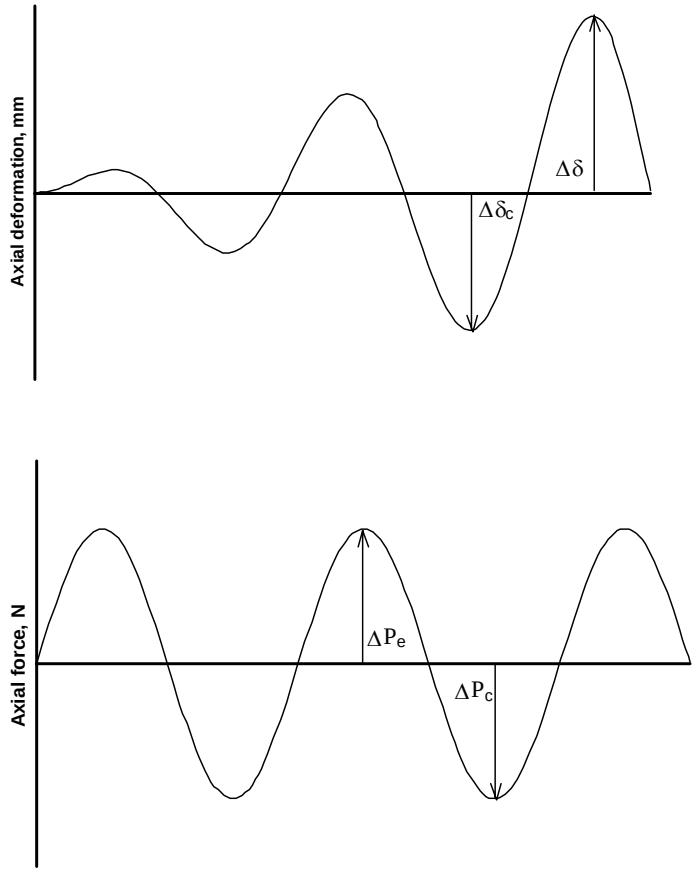


Figure 4.5. Dynamic triaxial test

The MTS system was programmed to apply a sinusoidally varying cyclic stress at a frequency of 1,0 Hz. All tests were stress controlled. Cyclic loading was to be

continued until cyclic double amplitude shear strain of 10% was reached, or a certain time period had passed. The computer software collected 50 readings of axial load, axial deformation, cell pressure and pore water pressure for each cycle of loading.

Data reduction, nomenclature and sign convention is in accordance with ASTM D5311-92. Some of the basic equations are as shown in Figure 4.5.

4.9.3.3 Test results

The test results are presented in both tabular and graphical form. Summary of the test results is shown in Table 4.4 and Figure 4.6.

Table 4.4. Results from dynamic triaxial tests

Site	Sample	w [%]	γ_d [kN/m^3]	D_r [%]	Number of cycles	CSR
Hvammsvirkjun BL-1	1	46,4	12,10	(80)	28	0,561
	2	46,0	12,16	(80)	8	0,772
Hvammsvirkjun NG-01 [03]	1	46,5	12,19	(90)	546	0,406
	2	46,4	12,15	(90)	163	0,507
	3	46,6	12,13	(90)	106	0,608
	4	46,3	12,11	(90)	56	0,710
Urriðafossvirkjun UF-BL [19]	1	92,0	7,67	(80)	203	0,40
	2	91,7	7,70	(80)	18	0,58
	3	92,2	7,67	(80)	8	0,71
	4	99,4	7,17	(50)	5	0,41
	5	102,3	7,07	(50)	12	0,35
Kárahnjúkavirkjun GS-4 [02]	2	34,2	13,93	(85)	1252	0,294
	3	33,9	13,98	(85)	263	0,392
	4	34.1	13,97	(85)	126	0,491

( ) Estimated value

Summary of the test results from double amplitude strain criteria (10 %) is shown in Figure 4.6.

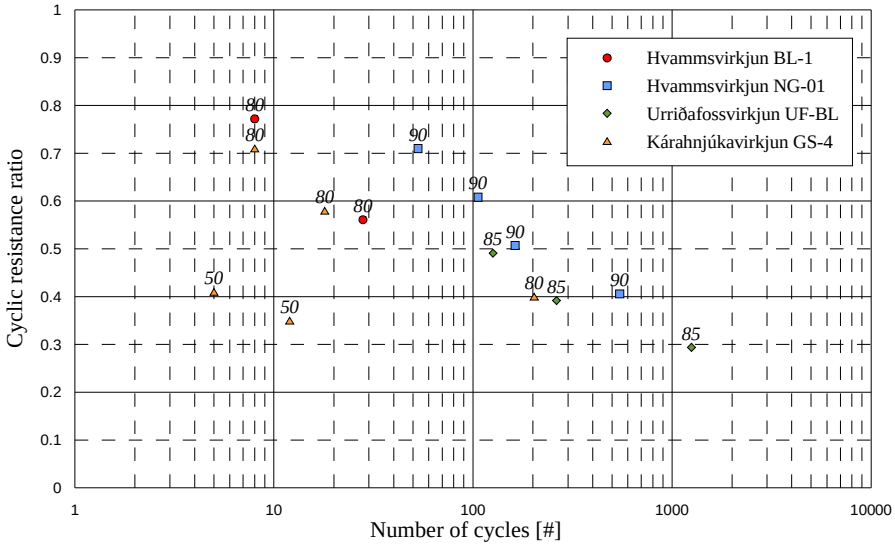


Figure 4.6. Summary of test results from dynamic triaxial tests on loess (Dr indicated by a number)

4.10 Concrete aggregate test

4.10.1 General

Two potential sources for concrete aggregates have been investigated. It is gravel from Guðmundareyri, investigated 1990 [07] and 1991 [08]. The tests were part of an investigation for the Búrfell extension. Results from the tests show that the material from the borrow area was suitable for concrete aggregates. In 2006 preliminary investigations were carried out at Árnes in banks of Árneskvísl river, samples L22B, L22C, L23B, L23C, L23D and Lækur. Location of test pits in Árnes is shown on Drawing 4. In the following test results for concrete aggregates will be described.

4.10.2 Organic matter and percentage of inorganic residue

The test is performed according to ÍST 10. The results are shown in Table 4.5.

Table 4.5. Organic matter and percentage of inorganic residue

Sample	Water content [%]	Organic matter [gr.]	Inorganic residue [%]	Fines content <0,063 mm [%]	USCS
Árnes L22B	8,0	0	6,5	0,6	SP
Árnes L22C	6,6	0	0,9	0,3	GP
Árnes L23B	7,3	0	6,8	0,4	SP
Árnes L23C	8,7	0	2,7	0,3	GP
Árnes L23D	7,2	0	2,6	0,6	SP
Lækur	13,4	0	2	0,8	SP
Guðmundareyri		0	0-3	1	

4.10.3 Petrographical classification

Petrographical classification was performed according to the Building Research Institute standard as described in "Berggreining Rb nr 57 Keldnaholti, Reykjavík 1989". Samples were of grain sizes in the range 4,0-11,2 mm. Summary of the test results is shown in Table 4.6 and of the material classification in Table 4.7.

Table 4.6. Test results

	Árnes						Búrfell Guðmundareyri
	L22B	L22C	L23B	L23C	L23D	Lækur	
Basalt-unaltered-dense	29	40	28	14	25	34	80-87
Basalt-unaltered-porous	29	36	43	42	49	21	
Basalt-altered-dense	1	2	4	1	2	5	
Basalt-scoria	21	12	11	20	12	24	
Rhyolitic	8	2	6	8	3		3-5
Móberg	7	2	3	3	4	14	
Pumic	1	1		3			5
Unclassified rock	4	6	5	9	5	2	

Table 4.7. Quality rating according to petrographical classification

Aggregate	1. class particles	2. class particles	3. class particles
Árnes. L22B	58	10	32
Árnes. L22C	76	8	16
Árnes. L23B	72	12	16
Árnes. L23C	56	12	32
Árnes. L23D	74	7	19
Lækur	54	8	38
Búrfell. Guðmundareyri	80-90	10-15	4-9

According to Alverk 95 specification [21] it is to be preferred that class 3 is ≤ 10% and class 1 is ≥ 60%. Guðmundareyri fulfils these criteria but Árnes and Lækur do not.

4.11 Results from classification soil test

4.11.1 General soil properties

All samples were tested to determine water content. Selected samples were tested to measure grain size, density and specific gravity. The results of the measurements are shown in Table 4.8.

Table 4.8. General soil properties

Test pit	Sample	Depth [m]	Fines <0,06 mm	W [%]	γ [kN/m^3]	γ_s [kN/m^3]
L1A	1-1	1,1-1,3	0,2	8,1		
L1B	1-1	1,1-1,3	0,1	9,4		
L1C	1-1	0,7-0,9	1,1	8,7		
S2A	1-1	1,1-1,3	0,5	11,5		
S3A	1-1	1,0-1,2	0,6	6,7		
S3B	1-1	1,0-1,2	0,0	10,5		
L19A	1-1	1,2-1,35		142,9	10,10	
	1-2	1,2-1,35		145,8	10,10	
	1-3	1,2-1,35	68,6	131,5		26,44
	2-1	2,5-2,7		125,5	9,51	
	2-2	2,5-2,7		123,1	9,19	
	2-3	2,5-2,7	66,2	145,5		28,13
L19B	1-1	1,0-1,2		59,6		
	2-1	2,0-2,2		85,2		
L19C	1-1	1,0-1,2		93,4		
	2-1	2,0-2,2		107,3		
L20A	1-1	0,9-1,0		54,4		
	2-1	1,9-2,1		82,0		
L20B	1-1	2,0-2,2		106,0		
L21A	1-1	1,0-1,2	1,0	8,2		
	2-1	2,0-2,2	0,3	18,5		
L21B	1-1	0,6-0,8	0,4	5,7		
L21D	1-1	0,4-0,6	5,0	8,8		
L21E	1-1	1,1-1,2	0,5	8,4		

Table 4.8. General soil properties, continuation

Test pit	Sample	Depth [m]	Fines <0,06 mm	W [%]	γ [kN/m^3]	γ_s [kN/m^3]
L22A	1-1	1,0-1,2	0,3	7,3		
L22B	1-1	1,0-1,2	0,6	8,0		
	2-1	2-3	0,4	7,3		
L22C	1-1	0,6-0,75	0,3	6,6		
	2-1	1,6-3,9		106,7		
L22D	1-1	1,0-1,2	0,3	4,8		
	2-1	2,0-2,2	0,2	4,2		
L22E	1-1	1,0-1,3	1,4	16,6		
L23A	1-1	1,1-1,3	0,2	14,1		
L23B	1-1	1,1-1,3	0,4	7,3		
L23C	1-1	1,3-1,5	0,3	8,7		
L23D	1-1	1,3-1,5	0,6	7,2		
Lækur	1-1	0,4-0,6	0,8	13,4		
L24A	1-1	0,4-0,5		26,7		
L24B	1-1	0,4-06		28,7		
L25A	1-1	0,6-0,7		8,3		
L25B	1-1	0,6-0,7		23,2		
L26A	1-1	0,5-0,6		33,8		
L26B	1-1	0,4-0,5		33,6		
L27A	1-1	1,0-1,2		105,3		
L27B	1-1	1,0-1,2		63,8		
L28A	1-1	1,0-1,5		92,5	11,91	
	1-2	1,0-1,5		84,3	11,35	
	1-3	1,0-1,5	63,0	81,6		26,98
L28B	1-1	0,6-0,7		72,6		
	2-1	1,5-1,7		89,1		
Ho249	1-1	1,0-1,2		5,5		
Ho250	1-1	3,0-3,2		17,2		
1001	1-1	2,5-2,7		46,3		
Ho256	1-1	1,0-1,2		65,0		
	2-1	2,0-2,1		76,3		
Ho258	1-1	0,7-0,85		53,1	14,03	
	1-2	0,7-0,85		50,2	14,31	
	1-3	0,7-0,85	70,2	58,7		26,94
	2-1	2,0-2,1		111,3	10,70	
	2-2	2,0-2,1		65,1	11,65	
	2-3	2,0-2,1	66,4	138,0		27,54
Ho181	1-1	0,8-1,0		06,5		
	2-1	2,0-2,2		121,0		
Ho260	1-1	1,0-1,2		114,5		
	2-1	2,0-2,2		109,8		
Ho163	1-1	1,0-1,2		64,9		

Table 4.8. General soil properties, continuation

Test pit	Sample	Depth [m]	Fines <0,06 mm	W [%]	γ [kN/m^3]	γ_s [kN/m^3]
Ho160	1-1	1,2-1,3		70,1		
	2-1	2,7-2,9		123,1		
Ho165	1-1	2,0-2,2		50,2		
Ho265	1-1	1,0-1,2		109,7	11,08	
	1-2	1,0-1,2		110,3	11,29	
	1-3	1,0-1,2	66,0	100,1		26,31
	2-1	2,0-2,2		139,0		
Ho266	1-1	0,9-1,0		88,6		
	2-1	2,0-2,2		126,9		
Ho156	1-1	1,0-1,2		52,7		
Ho153	1-1	1,0-1,2		94,7		
	2-1	2,0-2,2		124,4		
Ho175	1-1	0,5-0,7		40,5		
Ho270	1-1	1,0-1,2		65,4	14,22	
	1-2	1,0-1,2		65,7	13,82	
	1-3	1,0-1,2	60,1	78,8		27,43
	2-1	2,0-2,1		47,4		
Ho272	1-1	1,0-1,1		84,3		
	2-1	1,8-2,0		93,0		
	3-1	2,0-2,2		101,6		
Ho274	1-1	1,0-1,2		80,9	11,81	
	1-2	1,0-1,2		73,2	11,83	
	1-3	1,0-1,2	60,7	80,8		27,75
	2-1	3,0-3,2		89,9	12,98	
	2-2	3,0-3,2		89,7	13,07	
	2-3	3,0-3,2	90,4	117,5		27,23
Ho147	1-1	0,6-0,7		130,2		
	2-1	2,0-2,2		111,9		
Ho276	1-1	1,8-2,0		225,4		
	2-1	3,0-3,2		67,0		
Ho207	1-1	1,0-1,2		68,0		
	2-1	2,0-2,1		65,9		
Ho280	1-1	1,0-1,1		106,2		
Ho286	1-1	0,8-0,95		39,4	14,31	
	1-2	0,8-0,95		38,0	14,48	
	1-3	0,8-0,95	65,0	69,0		27,19
	2-1	2,0-2,1		37,2		
	3-1	2,6-2,7		6,2		
Ho288	1-1	1,0-1,2		66,4		
	2-1	2,0-2,2		75,7		

Table 4.8. General soil properties, continuation

Test pit	Sample	Depth [m]	Fines <0,06 mm	W [%]	γ [kN/m^3]	γ_s [kN/m^3]
Ho231	1-1	1,3-1,4		103,8		
Ho290	1-1	1,3-1,45		133,6	11,35	
	1-2	1,3-1,45		133,7	11,28	
	1-3	1,3-1,45	66,2	111,8		26,49
	2-1	1,9-2,0		88,4		
Ho292	1-1	0,5-0,6		100,7		
	2-1	1,5-1,7		82,6		
Ho294	1-1	1,0-1,2		130,4	10,83	
	1-2	1,0-1,2		129,2	11,03	
	1-3	1,0-1,2	65,7	113,5		25,96
	2-1	2,0-2,2		89,2		
Ho239	1-1	1,0-1,1		21,1		
	2-1	2,0-2,2		80,7		
Ho216	1-1	0,6-0,7		60,6		
	2-1	2,0-2,1		113,0		
Ho296	1-1	1,5-1,7		73,4		
Ho218	1-1	0,9-1,1		28,3	14,80	
	1-2	0,9-1,1		33,6	14,46	
	1-3	0,9-1,1	43,7	38,3		27,86
	2-1	1,5-1,7		75,4	11,73	
	2-2	1,5-1,7		60,4	12,65	
	2-3	1,5-1,7	66,9	96,3		26,97
Ho220	1-1	1,0-1,2		68,0		
	2-1	2,0-2,1		65,9		

4.11.2 Dry density and relative density

Selected samples from the test pits were used for measurement of the dry density and relative density. Highest dry density can not be measured according to ASTM standard because of high fines content. Therefore max dry density was selected as dry density at water content 30% and compaction according to Modified Proctor. Schematic descriptions of the symbols are shown in Figure 4.7. Results of the density measurements are shown in Table 4.9.

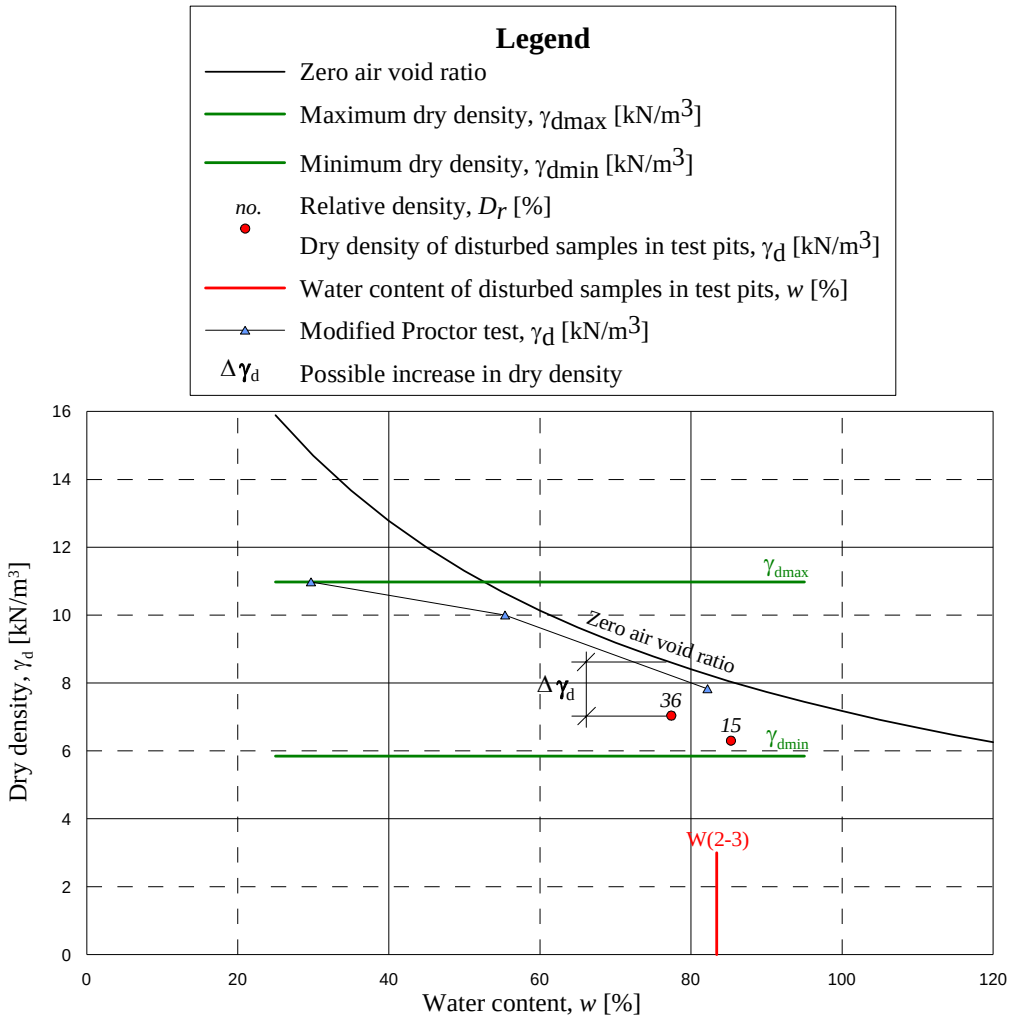


Figure 4.7. Schematic descriptions of the symbols

Table 4.9. Results from dry density measurements

Test pit	Sample	γ_d [kN/m^3]	γ_{dmax} [kN/m^3]	γ_{dmin} [kN/m^3]	Dr [%]	$\Delta\gamma_d$ [kN/m^3]
L19A	1-1	4,16			0	1,40
	1-2	4,11			0	1,30
	1-3		7,97	4,31		
	2-1	4,22			39	1,99
	2-2	4,12			35	2,18
	2-3		6,63	3,42		
L28A	1-1	6,19			6	1,53
	1-2	6,16			5	2,08
	1-3		10,53	6,04		
Ho258	1-1	9,17			55	1,91
	1-2	9,53			62	1,92
	1-3		12,13	7,09		
	2-1	5,06			5	1,72
	2-2	7,05			64	2,81
	2-3		9,41	4,90		
Ho265	1-1	5,28			3	1,50
	1-2	5,37			7	1,37
	1-3		8,74	5,21		
Ho270	1-1	8,59			40	1,23
	1-2	8,34			30	1,45
	1-3		11,55	7,33		
Ho274	1-1	6,53			32	2,02
	1-2	6,83			40	2,32
	1-3		10,07	5,61		
	2-1	6,83			64	1,07
	2-2	6,89			65	1,02
	2-3		9,72	4,46		
Ho286	1-1	10,26			73	2,86
	1-2	10,50			78	2,87
	1-3		11,56	7,88		
Ho290	1-1	4,86			2	0,98
	1-2	4,83			1	1,00
	1-3		8,85	4,81		
Ho294	1-1	4,70			0	1,22
	1-2	4,81			2	1,15
	1-3		8,76	4,76		
Ho218	1-1	11,54			62	4,04
	1-2	10,82			49	3,57
	1-3		14,39	8,74		
	2-1	6,69			48	2,20
	2-2	7,89			74	2,37
	2-3		9,58	5,23		

5 SITE CONDITIONS

5.1 Dam site

Location of the dam according to the Project Planning Report [04] is shown on Drawing 4. Longitudinal section along the dam axis is shown on Drawings 5 and 6 with results from the test pits and boreholes. Depth to bedrock varies between 1 and 5 m. At the top there is a thin layer of organic soil, then op to 4 m thick layer of loess down to a few meters thick layer of scoria on rock. In the upper 1 to 1,5 m of the loess the material is relatively homogeneous but the underlying material has many thin sand layers. The geotechnical properties of the loess layers are shown in Table 5.1.

Table 5.1. Soil properties of loess in the dam foundation

Loess layer	Fines content [%]		Water content [%]		Density [kN/m^3]		Relative density [%]	
	Min/max	Average	Min/max	Average	Min/max	Average	Min/max	Average
Upper part	45/70	62	40/115	82	10,9/14,4	12,8	5/75	37
Lower part	60/90	74	50/140	87	11,2/13,0	12,1	35/61	48

Both the upper and lower part of the loess layer is fine graded, with high water content, low density and is loose (Dr=30%). Groundwater table was not reached in the test pits at the dam site but from the borehole results it is assumed to be in the scoria.

5.2 Tailrace canal

Location of thetTailrace canal according to the Project Planning Report [04] is shown on Drawing 3. Longitudinal section along the canal axis is shown on Drawing 7 with results from the test pits and boreholes. Groundwater table was reached in 1,0 to 1,5 m depth, probably due to influence from Þjórsá river. Depth to hard bottom varies between 10 and 20 m. At the top there is a thin layer of organic soil, then gravelly sand down to hard bottom.

6 BORROW AREA

6.1 General

Location of potential borrow areas is shown on Drawing 8.

6.2 Core

No suitable moraine has been located in the Project area. Therefore an overburden loess material was investigated for use as core material. The results from site, laboratory tests indicate that the material can be difficult to use because of low resistance (CRR) to earthquake. Similar materials have been evaluated as core material at Hvammsvirkjun [05] and Urriðafossvirkjun [20]. The most promising areas with loess are shown on Drawing 8, area around test pits L19 and 20 (not L20C)

and around test pits L26, 27 and 28. In those two areas at least 500.000 m^3 of loess material can be excavated.

6.3 Filter

Possible filter material is gravelly sand. It has been located in area between northern end of the dam and Árneskvísl river and at the tailrace canal river banks. Location of the borrow area is shown on Drawing 8 and there approximately at least 1.000.000 m^3 of filter material are expected to be found.

6.4 Shell

The main shell material is scoria and processed lava. The most promising areas are shown on Drawing 8, area south of test pit L20A and around test pit L20C, there at least 500.000 m^3 of shell material can be excavated.

6.5 Rock

Slope protection material is expected to be available from same borrow area as the shell material.

6.6 Concrete aggregates

Concrete aggregates are available from Guðmundareyri [05]. Preliminary test results indicate that sand from Sandá [05] and Árnes can be used as the sand part in the concrete aggregate production.

7 RECOMMENDATION OF SOIL PROPERTIES

Recommendation of soil properties is shown in Table 7.1 at static loading and in Table 7.2 at earthquake loading.

Table 7.1. Soil properties at static loading

Material properties	**Loess In situ**	**Core Loess**	**Filter Gravelly sand**	**Shell Scoria and rock**	**Slope protection Rock**
Fines content [%]	45-70	45-70			
Water content [%]	40-140	40-60			
Density [%]	11-14	12-14	22	21	22
Relative density [%]	10-50	60	80-100	80-100	80-100
c_v [cm2/min]	40	30			
k [cm/s]	10^{-5}	10^{-5}-10^{-6}			
m (M=mσ)	12	14			
r_s (at 300 MPa)	300	300			
Cohesion [%]	0	0	0	0	0
Friction angle [%]	35	38	45	45	50

It is recommended to use empirical relationships of Gmax for earthquake calculations. The maximum shear modulus Gmax is for example often estimated for sand and gravel as (Seed and Idriss, 1970):

$$Gmax = 220\ K(\sigma_m)^{0,5}$$

Where:

σ_m is the mean principal stress in kN/m^2 (resulting Gmax in kN/m^2)
K is a soil modulus coefficient

Typical K values for gravel range from 80 to 180 (Seed et al 1984). Thus for gravel the maximum shear modulus ranges:

From Gmax= 18.000 $(\sigma_m)^{0,5}$ to Gmax = 40.000 $(\sigma_m)^{0,5}$

It is common to use Gmax = 30.000 $(\sigma_m)^{0,5}$ as average for shell material (compacted gravel) in earth fill dams.

The soil parameters are estimated from these empirical relationships and results from SASW measurements in various soil types [12] and [16].

Table 7.2. Soil properties at earthquake loading

Material properties	**Loess In situ**	**Core Loess**	**Filter Gravel**	**Shell Scoria and rock**	**Slope protection Rock**
Relative density D_r [%]	10-50	60	80-100	80-100	80-100
Density (kN/m^3)	12,5	17	22	21	22
K (Gmax = 220 K$(\sigma_m)^{0,5}$ kPa	10.000	15.000	40.000	40.000	40.000
CRR (Cyclic resistance ratio)	0,30	0,50			

8 CONCLUSION

Supplementary test pits and boreholes in rock were carried out. Location and description of the test pits and the boreholes is presented on drawings and in text.

Disturbed and undisturbed samples were taken for determination of the soil properties at the dam site. Both in situ tests and laboratory tests were performed. The uppermost 2-4 m are loose loess with high water content and low density. Compaction test in a test fill at Hvammsvirkjun [05] in similar loess showed that by compaction the relative density is increased from 40% to 65% which is comparable to medium relative density.

Recommendation of soil properties is shown in Table 7.1 at static loading and in Table 7.2 at earthquake loading.

It is recommended that the probability of liquefaction and displacement of the dam shall be studied carefully as the CRR value is low because of the low density of the loess soil both in situ and as core material in the dam.

The main borrow areas are described in Chapter 5 and on Drawing 8.

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10 SYMBOLS

c_v	Coefficient of consolidation
c	Cohesion
Dr	Relative density
ε	Vertical strain [%]
k	Permeability
n	Porosity
m	Modulus number (Janbu)
r_s	Creep number (Janbu)
u	Pore water pressure
w	Water content
w_{opt}	Optimum water content
γ	Unit weight
γ_d	Dry unit weight
γ_s	Specific gravity
γ_{max}	Max unit weight
γ_{min}	Min unit weight
σ	Effective stress
σ_{1c}	Effective consolidation stress
τ	Shear stress
φ	Friction angle
ASTM	American Society for Testing and Materials
CSR	Cyclic stress ratio
CRR	Cyclic resistance ratio
Gravel	2,0 mm to 60 mm
Sand	0,06 mm to 2,0 mm
Silt	0,002 mm to 0,06 mm
Clay	Finer than 0,002 mm
Fines	Finer than 0,06 mm

DRAWINGS

HOLTAVIRKJUN HYDROELECTRIC PROJECT GENERAL LOCATION MAP 1

URRIÐAFOSSVIRKJUN HYDROELECTRIC PROJECT

HOLTAVIRKJUN HYDROELECTRIC PROJECT

HVAMMSVIRKJUN HYDROELECTRIC PROJECT

N

0 1 2 3 4 km

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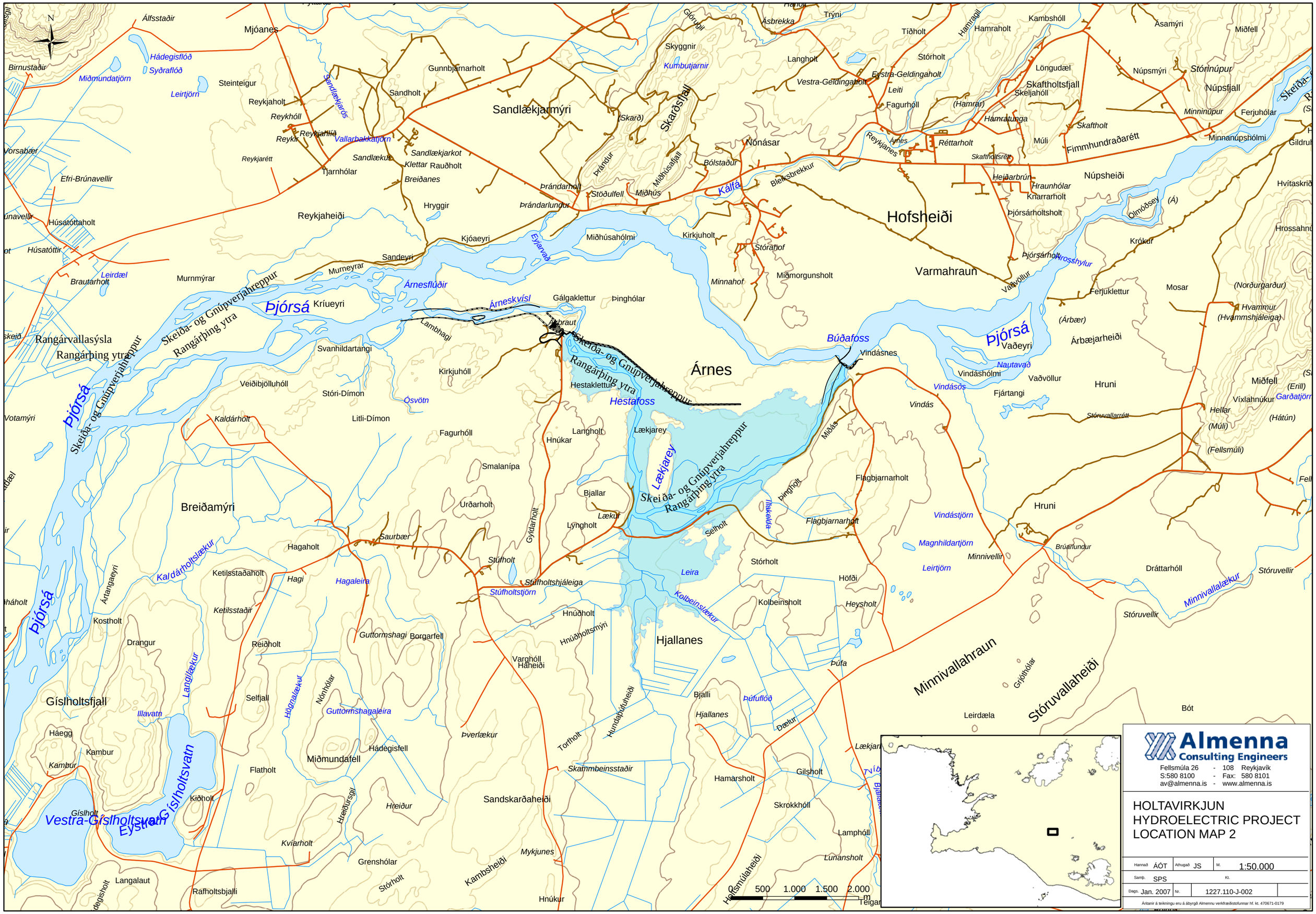
av@almenna.is - www.almenna.is

Hannað	ÁÓT	Athugað	JS	M.	
Samþ.	SPS			Kt.	
Dags.	Des. 2006	Nr.	1227.111-J-001		



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HOLTAVIRKJUN
HYDROELECTRIC PROJECT
LOCATION MAP 2

Hannað ÁÓT	Athugað JS	M.	1:50.000
Samþ. SPS		Kt.	
Dags. Jan. 2007	Nr.	1227.110-J-002	

Legend

- Core hole
- Percussion hole
- Test pits

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HOLTAVIRKJUN HYDROELECTRIC PROJECT LOCATION OF TEST PITS AND BOREHOLES

Hannað	ÁÓT	Athugað	JS	M.	1:20.000
Samþ.	SPS			Kt.	
Dags.	Jan. 2006	Nr.	1227.111-J-003		

N

NK-44 NK-43 NK-45 NK-10 NK-23 NK-11 NK-22 NK-42 NK-40 NK-37 NK-36 NK-45 NK-38 NK-39

S1 S2A S3A S3B

L1A L1B L1C L19A L19B L19C L20A L20B L20C L21D L22A L23A L24A L24B L25A L25B L26A L26B L27A L27B L28A L28B

Ho242 Ho245 Ho250 Ho251 Ho254 Ho256 Ho181 Ho258 Ho160 Ho260 Ho163 Ho165 Ho265 Ho266 Ho153 Ho156 Ho270 Ho147 Ho175 Ho272 Ho207 Ho274 Ho180 Ho276 Ho278 Ho280 Ho282 Ho231 Ho214 Ho394 Ho216 Ho218 Ho220 Ho284 Ho286 Ho288 Ho290 Ho292 Ho222 Ho225 Ho227 Ho229 Ho239 Ho296 Ho298 Ho300

LEGEND:

NK-38 Corehole

NL-46 Percussion drillhole

L24A Test pit

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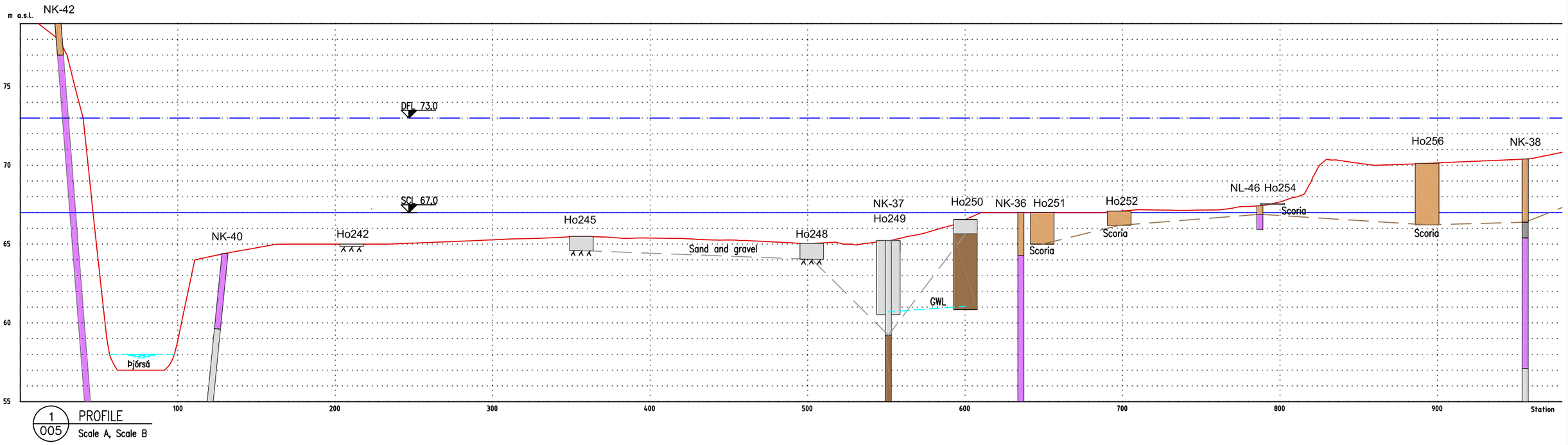
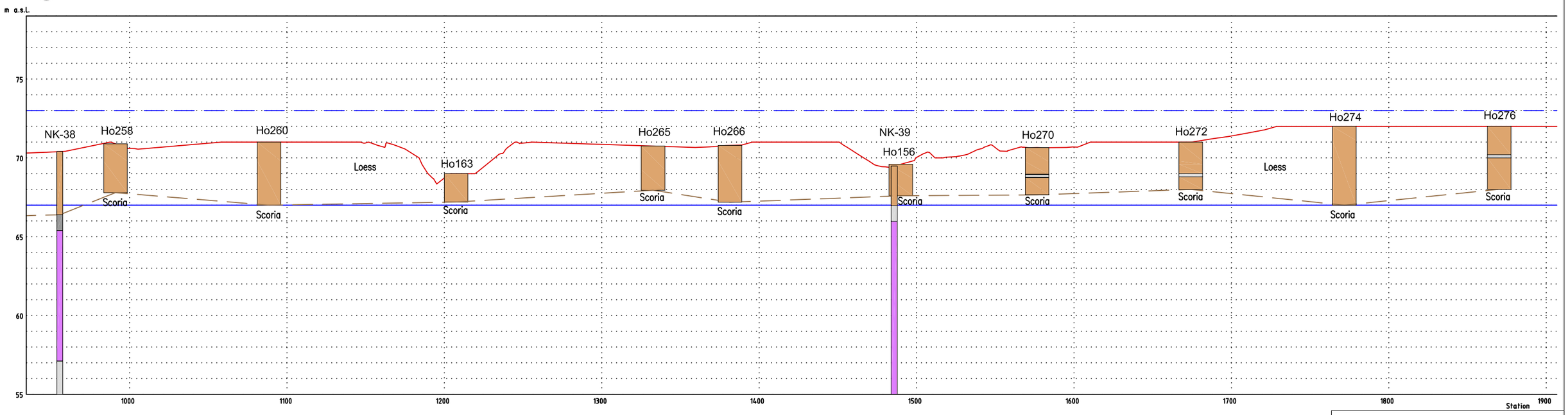
HOLTAVIRKJUN HYDROELECTRIC PROJECT LOCATION OF LONGITUDINAL SECTIONS

Design	HÍ	Checked JS	Scale 1:12500
Appr.	Jón Skúlason		Kt. 281140-7369
Date	Jan. 2007	Nr.	1227.111-J-004



1
005
PROFILE
Scale A, Scale B



LEGEND:

NK-38	Corehole		Loess
NL-11	Percussion drillhole		Scoria
Ho272	Test pit		Basalt
----	Groundwater level		Sand and gravel
DFL	Design flood level		Silt
SCL	Spillway crest level		

Scale A
0 25 50 75 100 125 m

Scale B
0 2,5 5 7,5 10 12,5 m

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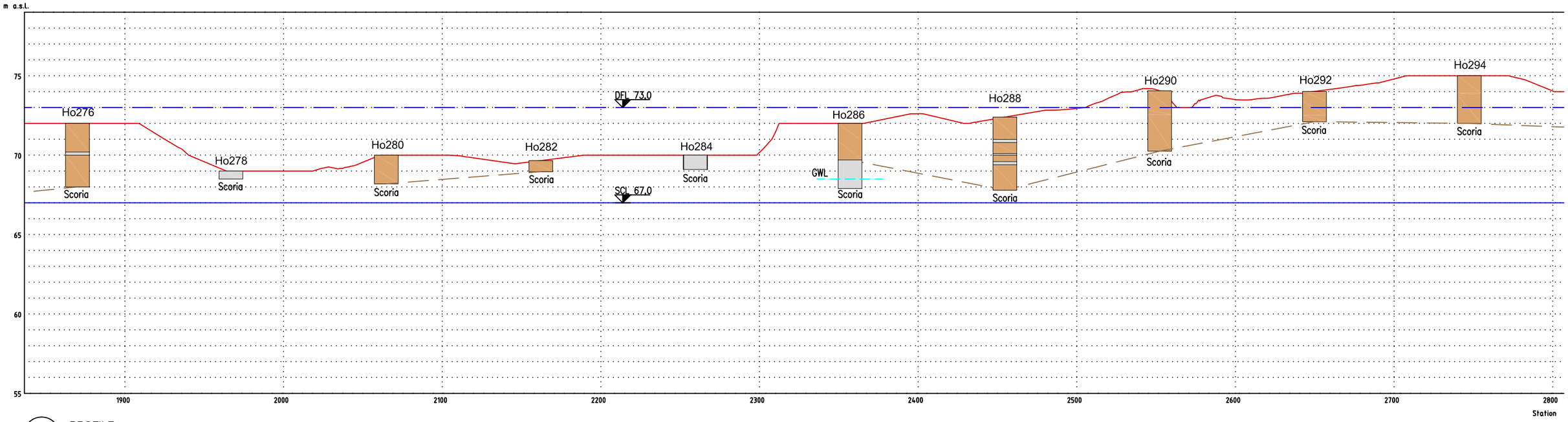
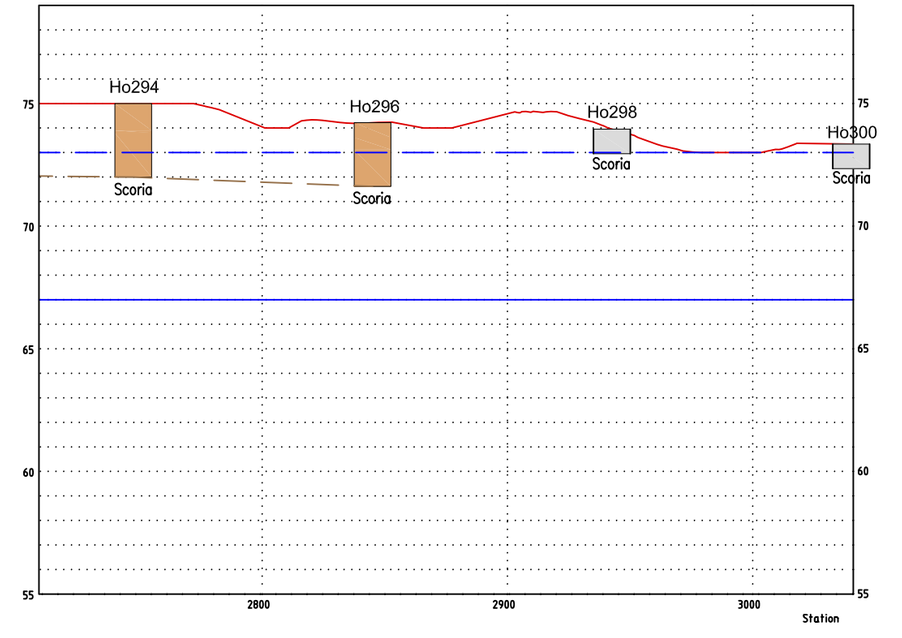
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
LONGITUDINAL SECTION
PROFILE 1, SHEET 1 OF 2

Design	HÍ	Checked	JS
Scale	1:250/1:2500		
Appr.	Jón Skúlason	Kt.	281140-7369
Date	Jan. 2007	No.	1227.111-J-005



1
005
PROFILE
Scale A, Scale B



LEGEND:

Ho272 Test pit

Loess

Sand and gravel

Groundwater level

DFL Design flood level
SCL Spillway crest level

Scale A
0 25 50 75 100 125 m

Scale B
0 2,5 5 7,5 10 12,5 m

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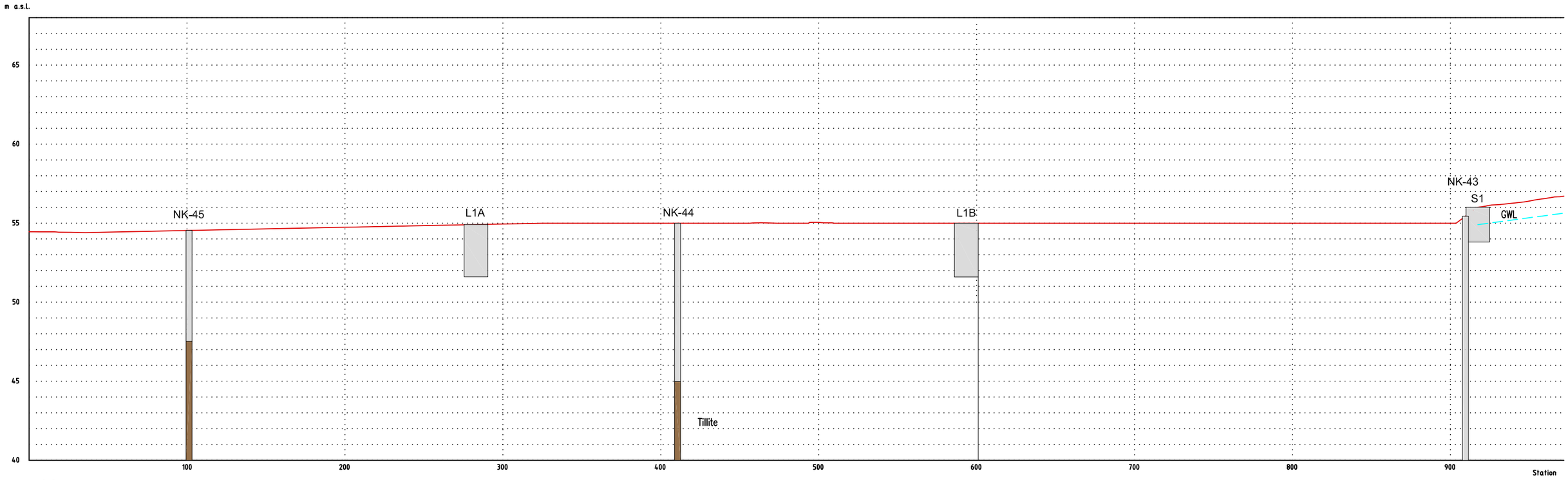
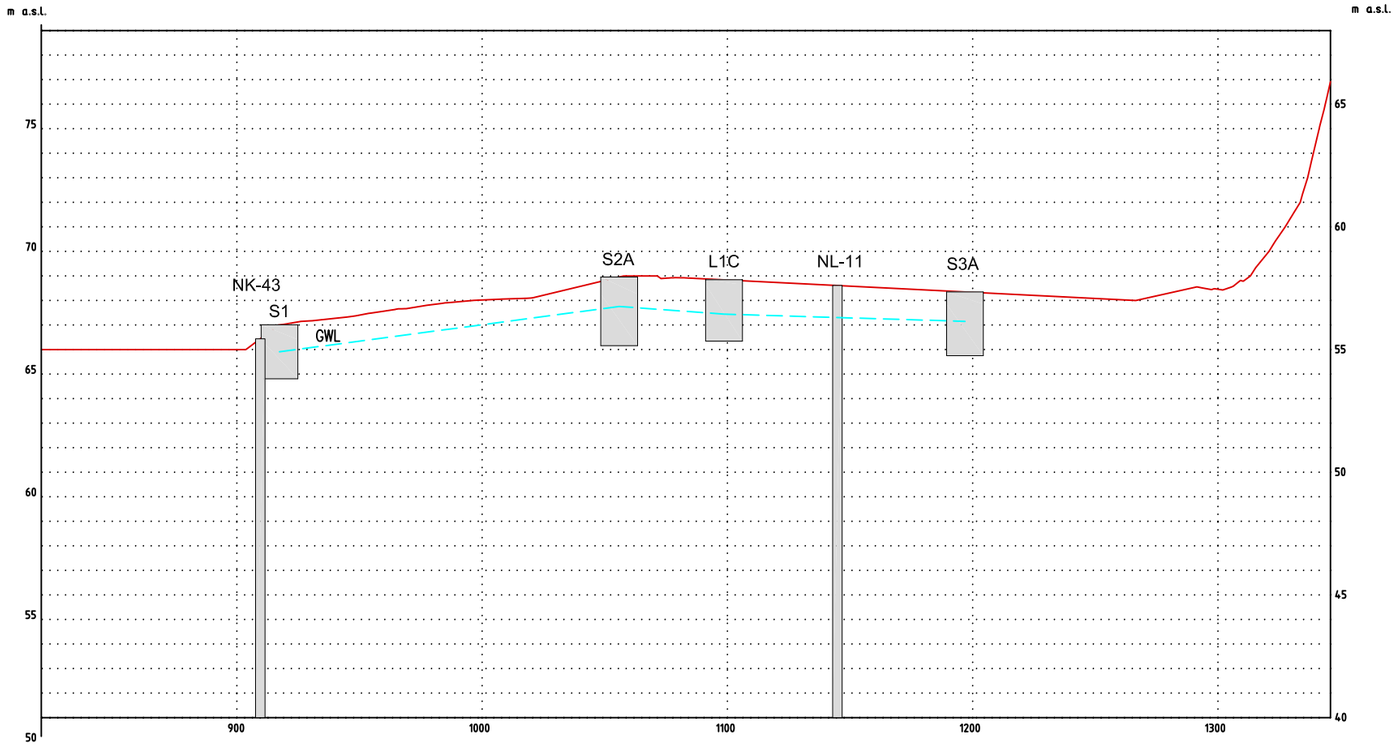
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
LONGITUDINAL SECTION
PROFILE 1, SHEET 2 OF 2

Design HÍ	Checked JS	Scale 1:250/1:2500	
Appr. Jón Skúlason		Kt. 281140-7369	
Date Jan. 2007	No. 1227.111-J-006		



2
005
PROFILE
Scale A, Scale B



LEGEND:

NK-38 Corehole

NL-11 Percussion drillhole

Ho272 Test pit

Groundwater level

Sand and gravel

Silt

Scale A
0 25 50 75 100 125 m

Scale B
0 2,5 5 7,5 10 12,5 m

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HOLTAVIRKJUN
HYDROELECTRIC PROJECT
LONGITUDINAL SECTION
PROFILE 2

Design	HÍ	Checked JS	Scale 1:250/1:2500
Appr.	Jón Skúlason		Kt. 281140-7369
Date	Jan. 2007	No.	1227.111-J-007

N

Borrow area near Laekur

Legend

- Gravel and sand
- Loess
- Rock quarry
- Test pits

0 200 400 600 800 1.000 m

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HOLTAVIRKJUN HYDROELECTRIC PROJECT BORROW AREAS

Hannað	ÁÓT	Athugað JS	M. 1:20.000
Samþ.	SPS		Kt.
Dags.	Jan. 2007	Nr.	1227.111-J-008

APPENDICES

APPENDIX A

HOLTAVIRKJUN HYDROELECTRIC PROJECT

Coordinates, elevations and depth at test pits

Borehole (No.)	Northing (-)	Easting (-)	Elevation (m a.s. l.)	Depth of test pits (m)	Elevation of scoria (m a.s. l.)
Ho147	390309	435157	72,1	2,5	69,6
Ho153	390476	434936	71,0	3,5	67,5
Ho156	390359	434835	69,9	2,0	67,9
Ho160	390658	434725	70,5	4,7	65,8
Ho163	390541	434624	68,7	1,8	66,9
Ho165	390463	434556	70,2	3,0	67,2
Ho175	390290	434791	68,6	1,5	67,1
Ho180	390121	434994	69,2	1,0	68,2
Ho181	390737	434512	70,9	3,0	67,9
Ho207	390240	435384	72,0	3,3	68,7
Ho214	390004	435960	74,1	1,5	72,6
Ho216	390004	436058	74,0	2,2	71,8
Ho218	390004	436156	74,5	2,5	72,0
Ho220	390004	436254	75,0	3,1	71,9
Ho222	389864	435505	71,7	3,3	68,4
Ho225	389866	435647	72,2	4,4	67,8
Ho227	389867	435742	73,4	2,5	70,9
Ho229	389868	435837	73,0	4,6	68,4
Ho231	390019	435711	75,0	2,0	73,0
Ho239	389884	435962	74,8	3,0	71,8
Ho242	390952	433742	65,1	0,2	65,0
Ho245	390898	433878	65,5	0,9	64,6
Ho248	390869	434021	65,0	1,0	64,0
Ho249	390860	434069	65,2	4,7	60,5
Ho250	390851	434117	66,5	6,0	Unknown
Ho251	390842	434165	67,1	2,0	65,1
Ho252	390833	434213	67,1	0,9	66,2
Ho254	390798	434304	67,6	0,1	67,5
Ho256	390746	434386	70,1	3,9	66,2
Ho258	390683	434461	70,6	3,1	67,5
Ho260	390620	434535	70,2	4,0	66,2
Ho265	390463	434722	70,6	2,8	67,8
Ho266	390431	434759	70,7	3,6	67,1
Ho270	390306	434909	70,6	3,0	67,6
Ho272	390244	434984	71,0	3,0	68,0
Ho274	390183	435060	72,2	5,0	67,2
Ho276	390121	435136	71,7	4,0	67,7
Ho278	390060	435212	69,0	0,5	68,5
Ho280	390000	435289	70,0	1,8	68,2
Ho282	389958	435377	69,4	0,7	68,7
Ho284	389934	435471	69,8	0,9	68,9
Ho286	389928	435568	72,7	4,1	68,6
Ho288	389928	435666	72,8	4,6	68,2
Ho290	389929	435763	73,9	3,8	70,1
Ho292	389930	435861	74,0	1,9	72,1
Ho294	389931	435958	75,0	3,0	72,0

HOLTAVIRKJUN HYDROELECTRIC PROJECT

Coordinates, elevations and depth at test pits

Borehole (No.)	Northing (-)	Easting (-)	Elevation (m a.s. l.)	Depth of test pits (m)	Elevation of scoria (m a.s. l.)
Ho296	389932	436056	74,3	2,6	71,7
Ho298	389933	436154	74,0	1,0	73,0
Ho300	389934	436251	73,4	1,0	72,4
1001	390810	434107	65,1	5,0	Unknown
L1A	391227	432509	56,7	3,3	Unknown
L1B	391197	432834	58,0	3,4	Unknown
L1C	391166	433159	57,0	2,5	Unknown
L19A	389689	435174	74,5	4,0	70,5
L19B	389754	435036	74,4	3,4	71,0
L19C	389818	434897	76,4	3,0	73,4
L20A	389641	435011	76,0	3,9	72,1
L20B	389719	434875	75,9	2,8	73,1
L20C	388810	434926	87,4	0,7	86,7
L21A	389790	437071	71,7	4,8	Unknown
L21B	389678	436641	71,1	1,2	69,9
L21C	389566	436212	70,7	0,7	70,0
L21D	389454	435782	69,6	1,0	68,6
L21E	389839	437344	71,7	3,3	Unknown
L22A	389111	435842	70,1	3,0	Unknown
L22B	389202	436194	70,2	5,0	Unknown
L22C	389293	436546	70,7	5,7	Unknown
L22D	389385	436898	71,0	4,2	Unknown
L22E	389480	437237	70,0	3,4	Unknown
L23A	388829	435897	69,6	3,3	Unknown
L23B	388998	436265	70,1	4,1	Unknown
L23C	389116	436596	70,5	3,3	Unknown
L23D	389207	436948	71,1	3,3	Unknown
L24A	390454	434064	61,1	1,1	60,0
L24B	390285	434032	61,8	1,5	60,3
L25A	390601	433912	60,3	1,8	58,5
L25B	390402	433833	60,4	2,3	58,1
L26A	390310	434305	61,6	1,8	59,8
L26B	390267	434155	61,8	1,8	60,0
L27A	390392	435744	72,1	1,6	70,5
L27B	390542	436084	71,2	2,0	69,2
L28A	390671	435607	70,5	2,4	68,1
L28B	390715	435885	72,0	2,0	70,0
S1	391373	433102	55,9	2,2	Unknown
S2A	391341	433260	56,4	2,8	Unknown
S3A	391248	433366	57,2	2,6	Unknown
S3B	391124	433259	57,2	2,7	Unknown
Borrow area near Lækur	388241	435697	69,5	Unknown	Unknown

APPENDIX B

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L1A

Appendix: B | Page: B1

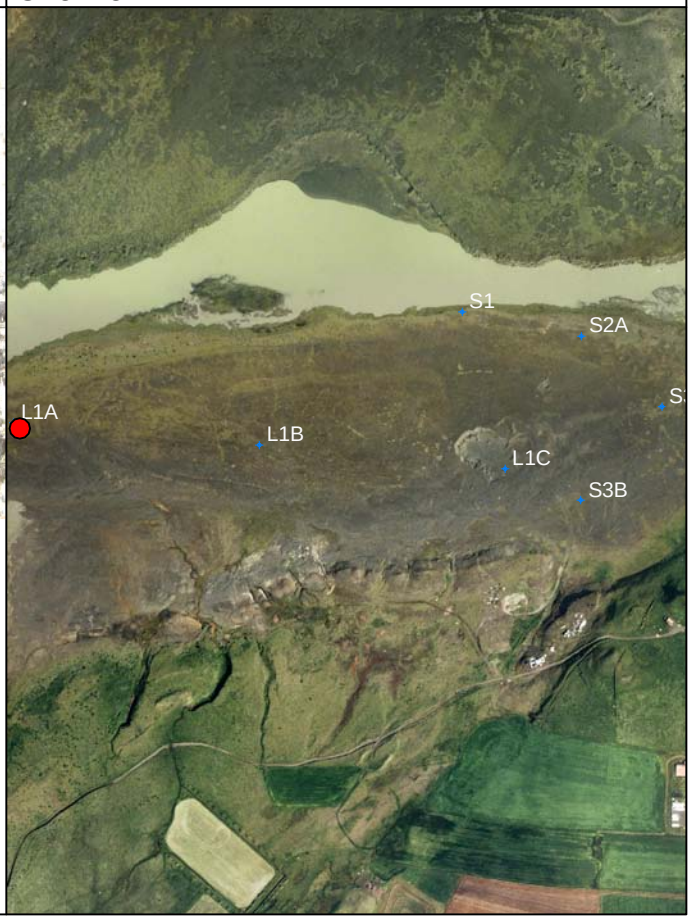
Explored: September 2006 - GÞG

Coordinates: X: 432509 Y: 391227 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
56	1,0	**Sand & gravel** - with organic layers Piezometer installed	1,0				1,1-1,3
55	2,0	**Sand & gravel** from 0,5 m	2,0				
54	3,0		3,0				
53	4,0	**Bottom** at 3,3 m **Bedrock** not found	4,0				
52	5,0		5,0				
51							

Photo:

Overview:



Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L1B

Appendix: B | Page: B2

Explored: September 2006 - GÞG

Coordinates: X: 432834 Y: 391197 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Sand & gravel - with organic layers Piezometer installed					
57	1,0		1,0				1,1-1,3
		Sand & gravel from 0,5 m					
56	2,0		2,0				
55	3,0		3,0				
		Bottom at 3,4 m					
		Bedrock not found					
54	4,0		4,0				
53	5,0		5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L1C

Appendix: B | Page: B3

Explored: September 2006 - GÞG

Coordinates: X: 433159 Y: 391166 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Sand & gravel - with organic layers					
56	1,0	**Sand & gravel** from 0,2 m	1,0				0,7-0,9
		Groundwater table at 1,4 m [22.09.'06]					
55	2,0		2,0				
		Bottom at 2,5 m					
		Bedrock not found					
54	3,0		3,0				
53	4,0		4,0				
52	5,0		5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

S1

Appendix: B | Page: B4

Explored: September 2006 - GÞG

Coordinates: X: 433102 Y: 391373 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
55	1,0	**Sand & gravel** - with organic layers
54	2,0	**Sand & gravel** from 0,6 m Groundwater table at 1,1 m [22.09.'06]
53	3,0	**Bottom** at 2,2 m
52	4,0	**Bedrock** not found
51	5,0	

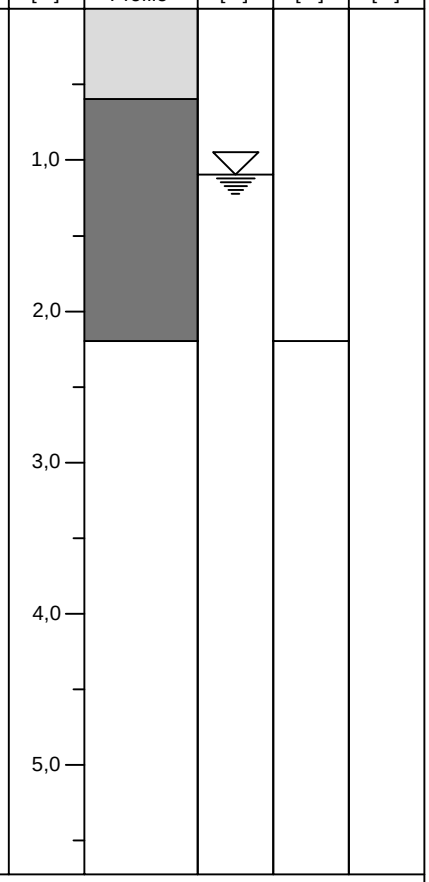


Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

S2A

Appendix: B | Page: B5

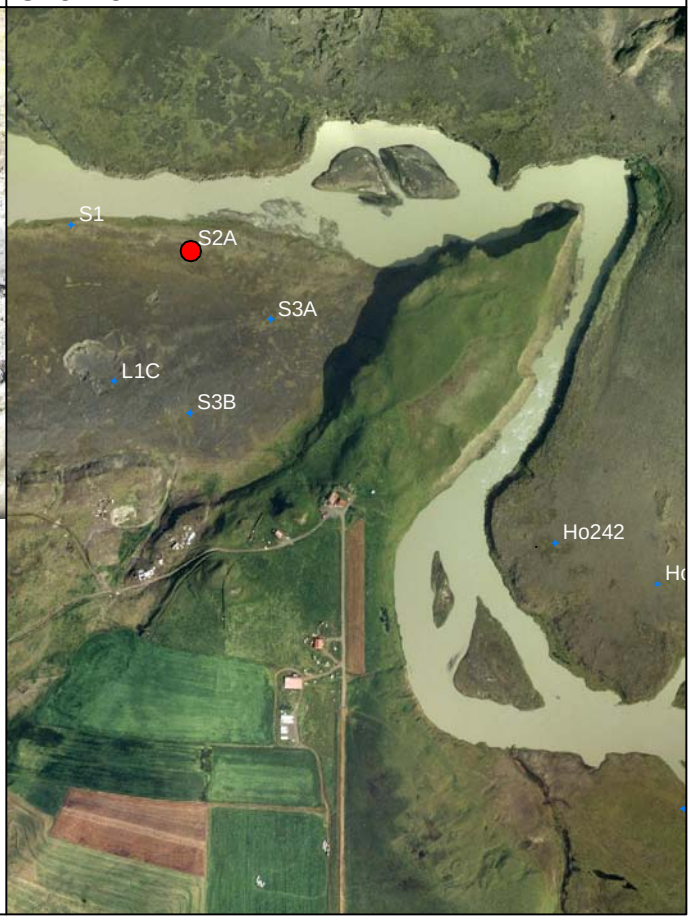
Explored: September 2006 - GÞG

Coordinates: X: 433260 Y: 391341 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
56		**Sand & gravel** - with organic layers					
	1,0	**Sand & gravel** from 0,7 m	1,0				1,1-1,3
55		Groundwater table at 1,2 m [22.09.'06]					
	2,0		2,0				
54							
	3,0	**Bottom** at 2,8 m	3,0				
53		**Bedrock** not found					
	4,0		4,0				
52							
	5,0		5,0				
51							

Photo:

Overview:



Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

S3A

Appendix: B | Page: B6

Explored: September 2006 - GÞG

Coordinates: X: 433366 Y: 391248 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
57		**Sand & gravel** - with organic layers Piezometer installed					
	1,0		1,0				1,1-1,2
56		**Sand & gravel** from 0,5 m					
	2,0		2,0				
55		**Bottom** at 2,6 m					
	3,0	**Bedrock** not found	3,0				
54							
	4,0		4,0				
53							
	5,0		5,0				
52							

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

S3B

Appendix: B | Page: B7

Explored: September 2006 - GÞG

Coordinates: X: 433259 Y: 391124 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
57		**Sand & gravel** - with organic layers Piezometer installed					
	1,0		1,0				1,0-1,2
56		**Sand & gravel** from 0,7 m					
	2,0		2,0				
55		**Bottom** at 2,7 m					
	3,0	**Bedrock** not found	3,0				
54							
	4,0		4,0				
53							
	5,0		5,0				
52							

Photo:

No photo

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L19A

Coordinates: X: 435174 Y: 389689 ISN-93

Appendix: B | Page: B8

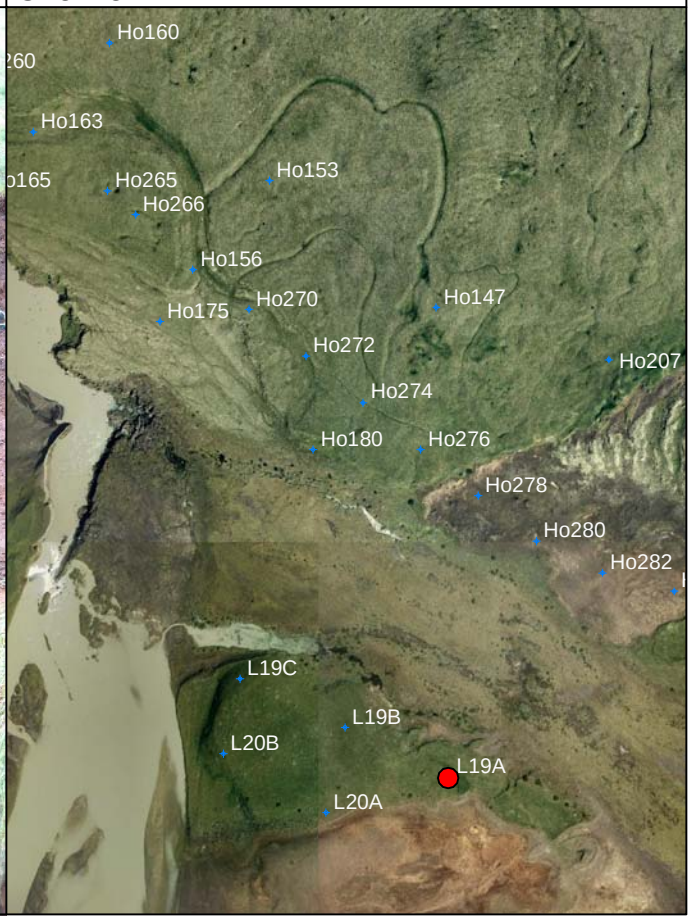
Explored: September 2006 - GÞG

Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
74							
	1,0		1,0				1,2-1,4
73							
	2,0	**Loess**	2,0				
72							2,5-2,7
	3,0		3,0				
71							
	4,0	**Sandstone** at 4,0 m	4,0				
70							
	5,0		5,0				
69							

Photo:

Overview:



Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L19B

Appendix: B | Page: B9

Explored: September 2006 - GÞG

Coordinates: X: 435036 Y: 389754 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
74							
	1,0		1,0				1,0-1,2
73		**Loess**					
	2,0		2,0				2,0-2,2
72							
	3,0		3,0				
71		**Sandstone** at 3,4 m					
	4,0		4,0				
70							
	5,0		5,0				
69							

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L19C

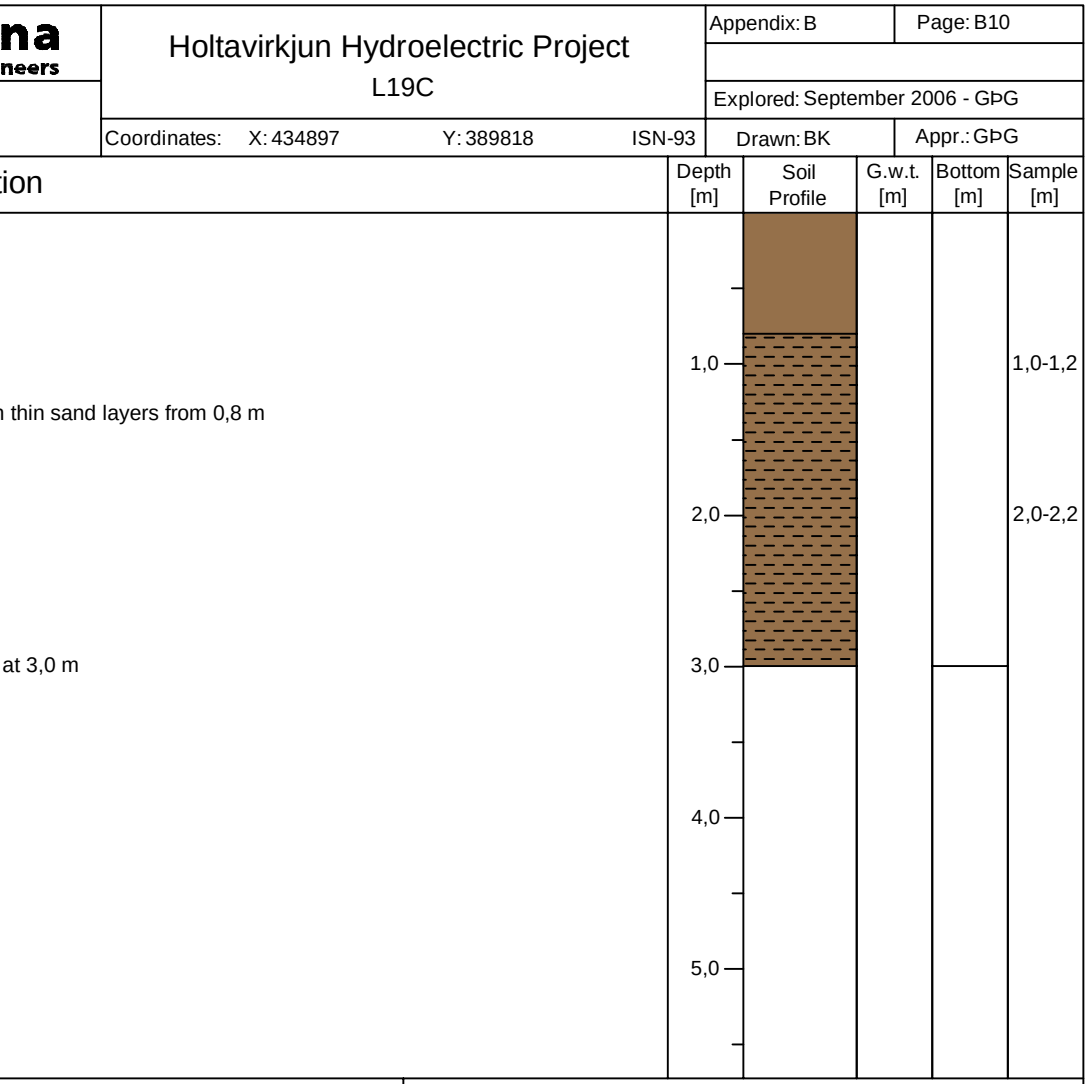
Coordinates: X: 434897 Y: 389818 ISN-93

Appendix: B | Page: B10

Explored: September 2006 - GÞG

Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
76		**Loess**
	1,0	
75		**Loess** - with thin sand layers from 0,8 m
	2,0	
74		
	3,0	**Sandstone** at 3,0 m
73		
	4,0	
72		
	5,0	
71		



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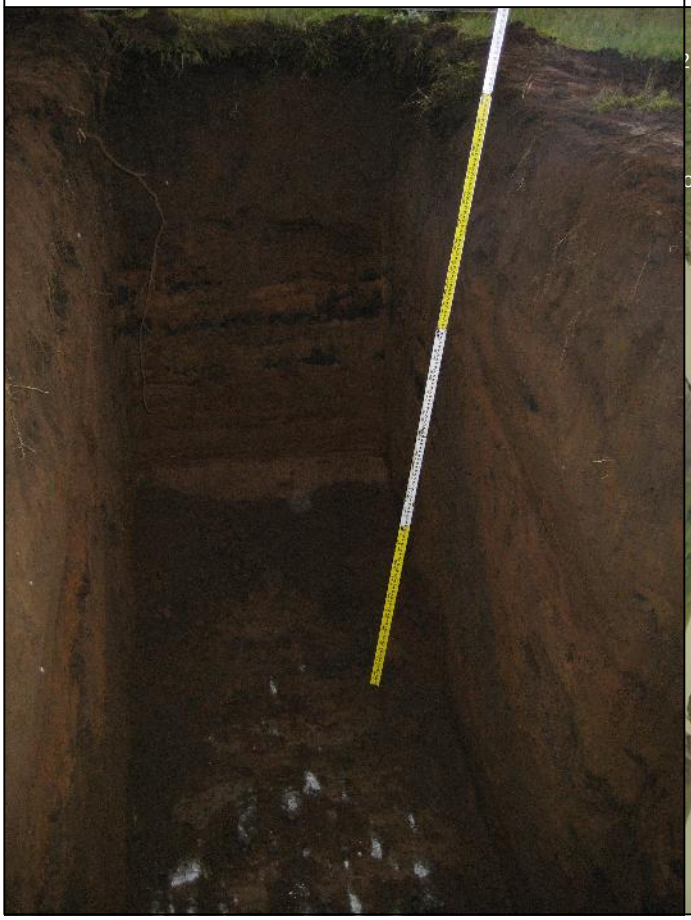


Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L20A

Appendix: B | Page: B11

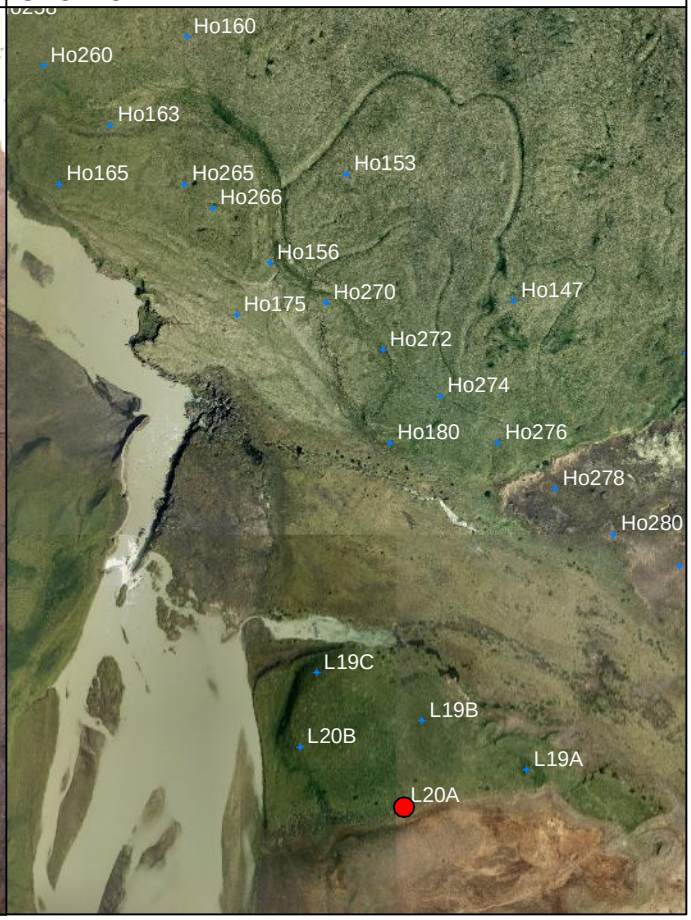
Explored: September 2006 - GÞG

Coordinates: X: 435011 Y: 389641 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
75	1,0	**Loess**	1,0				0,9-1,1
74	2,0	**Loess** - with thin sand layers from 1,2 m	2,0				1,9-2,1
73	3,0		3,0				
72	4,0	**Sandstone** at 3,9 m	4,0				
71	5,0		5,0				

Photo:

Overview:



Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L20B

Appendix: B | Page: B12

Explored: September 2006 - GÞG

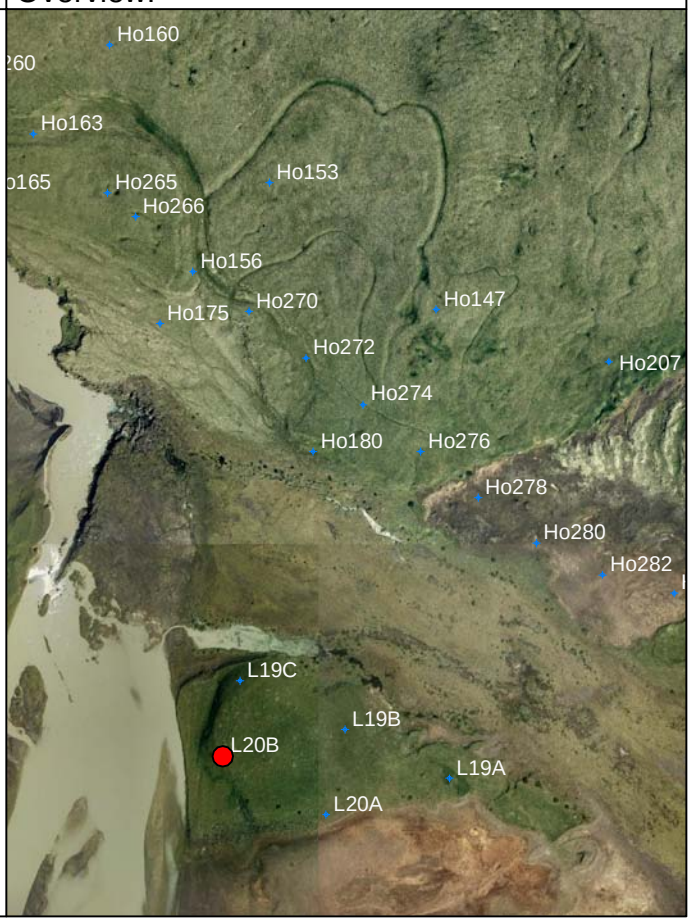
Coordinates: X: 434875 Y: 389719 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
75	1,0	**Loess**	1,0				
74	2,0	**Loess** - with thin sand layers from 1,0 m	2,0				2,0-2,2
73	3,0	**Sandstone** at 2,8 m	3,0				
72	4,0		4,0				
71	5,0		5,0				

Photo:

No photo

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

L20C

Appendix: B | Page: B13

Explored: September 2006 - GÞG

Coordinates: X: 434926 Y: 388810 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
87		**Loess**					
		Sandstone at 0,7 m					
	1,0		1,0				
86							
	2,0		2,0				
85							
	3,0		3,0				
84							
	4,0		4,0				
83							
	5,0		5,0				
82							

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L21A

Appendix: BB | Page: B14

Explored: September 2006 - GÞG

Coordinates: X: 437071 Y: 389790 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
71	1,0	**Sand & gravel** - with organic layers
70	2,0	Groundwater table at 1,5 m [14.09.'06]
69	3,0	**Sand & gravel** from 0,3 m
68	4,0	
67	5,0	**Bottom** at 4,8 m **Bedrock** not found

Depth [m] | Soil Profile | G.w.t. [m] | Bottom [m] | Sample [m]

1,0 — 1,0-1,2

2,0 — 2,0-2,2

3,0

4,0

5,0

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L21B

Appendix: B | Page: B15

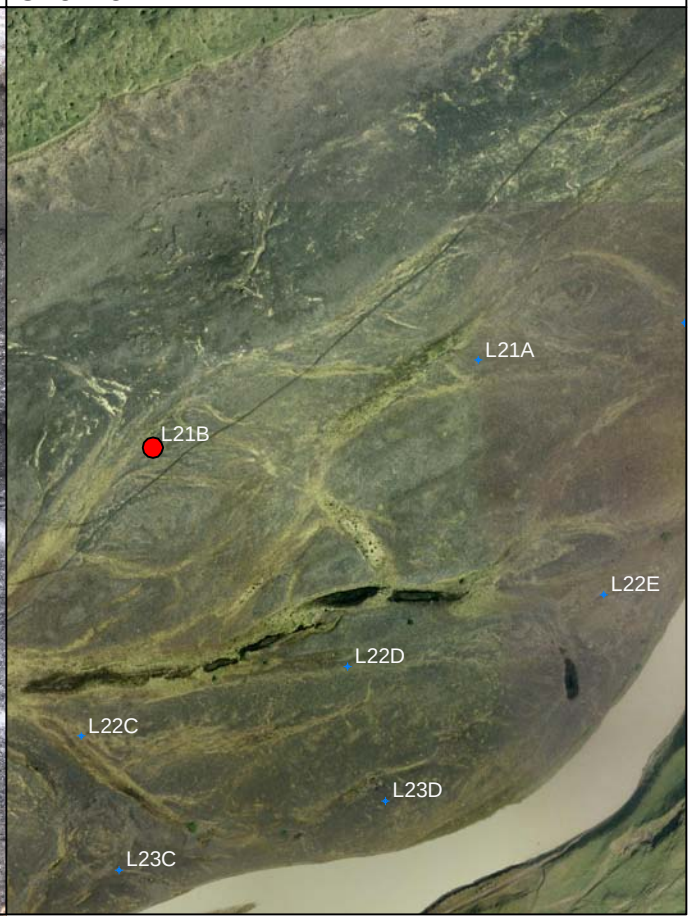
Explored: September 2006 - GÞG

Coordinates: X: 436641 Y: 389678 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
71		**Sand & gravel** - with organic layers					0,6-0,8
		Sand & gravel from 0,4 m					
70	1,0	**Lava** at 1,2 m	1,0				
69	2,0		2,0				
68	3,0		3,0				
67	4,0		4,0				
66	5,0		5,0				

Photo:

Overview:



Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L21C

Appendix: B | Page: B16

Explored: September 2006 - GÞG

Coordinates: X: 436212 Y: 389566 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
70	1,0	**Sand & gravel** - with organic layers **Lava** at 0,7 m	1,0				
69	2,0		2,0				
68	3,0		3,0				
67	4,0		4,0				
66	5,0		5,0				
65							

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L21D

Appendix: B | Page: B17

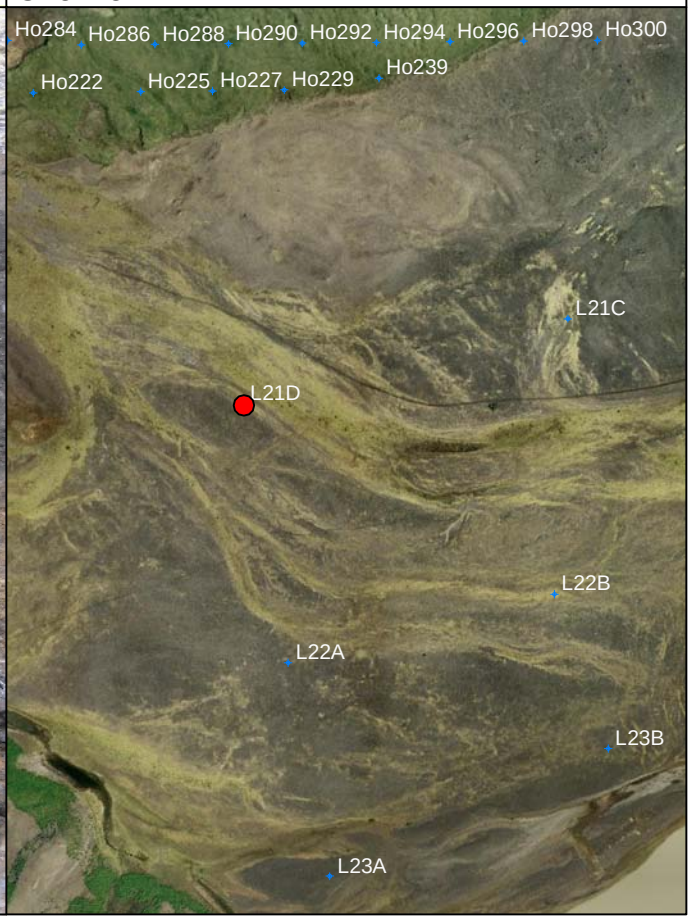
Explored: September 2006 - GÞG

Coordinates: X: 435782 Y: 389454 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
69	0	**Sand & gravel** - with organic layers	0				
		Sand & gravel from 0,2 m					0,4-0,6
	1,0	**Lava** at 1,0 m	1,0				
68	2,0		2,0				
67	3,0		3,0				
66	4,0		4,0				
65	5,0		5,0				
64							

Photo:

Overview:



Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L21E

Appendix: B | Page: B18

Explored: August 2006 - GÞG

Coordinates: X: 437344 Y: 389839 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
71	1,0	**Sand & gravel** - with organic layers Piezometer installed Groundwater table at 1,1 m [18.09.'06]
70	2,0	**Sand & gravel** from 0,7 m
69	3,0	**Bottom** at 3,3 m **Bedrock** not found
68	4,0	
67	5,0	
66		

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L22A

Appendix: B | Page: B19

Explored: September 2006 - GÞG

Coordinates: X: 435842 Y: 389111 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70		
		Sand & gravel - with organic layers Piezometer installed
		Groundwater table at 0,85 m [18.09.'06]
69	1,0	
68	2,0	**Sand & gravel** from 0,4 m
67	3,0	**Bottom** at 3,0 m
		Bedrock not found
66	4,0	
65	5,0	

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L22B

Appendix: B | Page: B20

Explored: September 2006 - GÞG

Coordinates: X: 436194 Y: 389202 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
70							
	1,0	**Sand & gravel** Piezometer installed Groundwater table at 1,2 m [18.09.'06]	1,0				1,0-1,2
69							
	2,0		2,0				2-3
68							
	3,0		3,0				
67							
	4,0		4,0				
66							
	5,0	**Bottom** at 5,0 m **Bedrock** not found	5,0				
65							

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L22C

Appendix: B | Page: B21

Explored: September 2006 - GÞG

Coordinates: X: 436546 Y: 389293 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70	1,0	**Sand & gravel** Piezometer installed Groundwater table at 0,76 m [15.09.'06]
69	2,0	
68	3,0	**Clay & silt** from 1,6 m
67	4,0	
66	5,0	**Sand & gravel** from 3,9 m **Bottom** at 5,7 m **Bedrock** not found

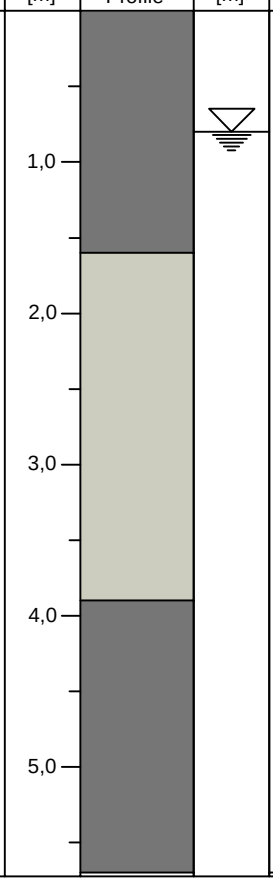


Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L22D

Appendix: B	Page: B22
Explored: September 2006 - GÞG	
Drawn: BK	Appr.: GÞG

Coordinates: X: 436898 Y: 389385 ISN-93

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Sand & gravel - with organic layers Piezometer installed					
70	1,0		1,0				1,0-1,2
		Groundwater table at 1,5 m [14.09.'06]					
69	2,0	**Sand & gravel** from 1,0 m	2,0				2,0-2,2
68	3,0		3,0				
67	4,0	**Bottom** at 4,2 m **Bedrock** not found	4,0				
65	5,0		5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L22E

Appendix: B | Page: B23

Explored: September 2006 - GÞG

Coordinates: X: 437237 Y: 389480 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
		Sand & gravel - with organic layers Piezometer installed
69	1,0	Groundwater table at 0,95 m [14.09.'06]
68	2,0	**Sand & gravel** from 0,7 m
67	3,0	**Bottom** at 3,4 m **Bedrock** not found
66	4,0	
65	5,0	

Depth [m] | Soil Profile | G.w.t. [m] | Bottom [m] | Sample [m]

1,0 — 1,0-1,3

2,0

3,0

4,0

5,0

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L23A

Appendix: B | Page: B24

Explored: September 2006 - GÞG

Coordinates: X: 435897 Y: 388829 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
69		**Sand & gravel** - with organic layers Piezometer installed					
	1,0	Groundwater table at 1,08 m [19.09.'06]	1,0				1,1-1,3
68							
	2,0	**Sand & gravel** from 0,5 m	2,0				
67							
	3,0		3,0				
		Bottom at 3,3 m					
66		**Bedrock** not found					
	4,0		4,0				
65							
	5,0		5,0				
64							

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L23B

Appendix: B | Page: B25

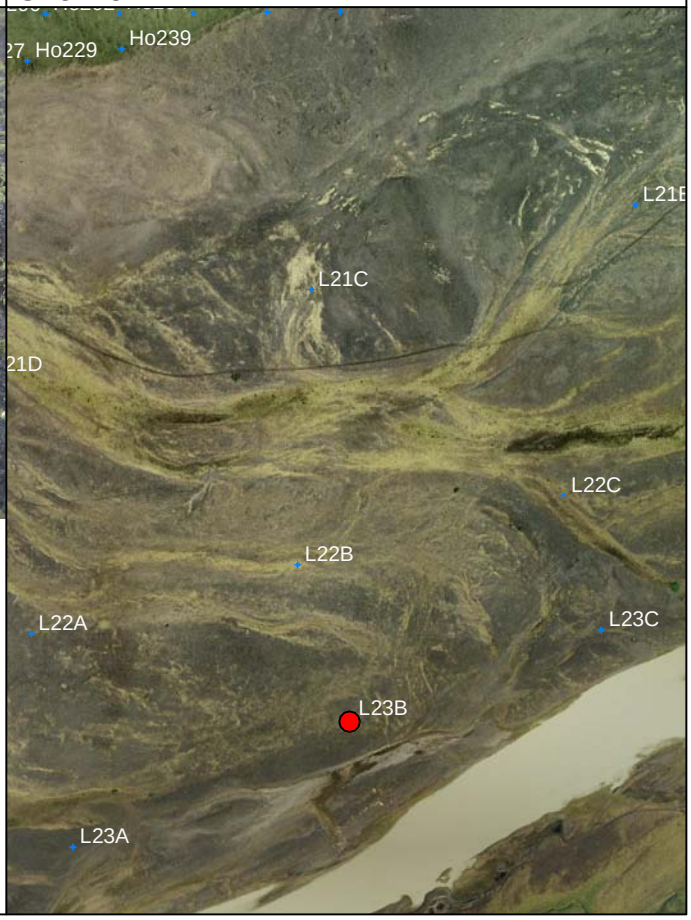
Explored: September 2006 - GÞG

Coordinates: X: 436265 Y: 388998 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
70		**Sand & gravel** - with organic layers					
	1,0		1,0				
69		Groundwater table at 1,12 m [19.09.'06]					1,1-1,3
	2,0		2,0				
68		**Sand & gravel** from 0,6 m					
	3,0		3,0				
67							
	4,0		4,0				
66		**Bottom** at 4,1 m					
		Bedrock not found					
	5,0		5,0				
65							

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

L23C

Appendix: B | Page: B26

Explored: September 2006 - GÞG

Coordinates: X: 436596 Y: 389116 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70		**Sand & gravel** - with organic layers Piezometer installed
	1,0	Groundwater table at 0,92 m [19.09.'06]
69		
	2,0	**Sand & gravel** from 0,5 m
68		
	3,0	
		Bottom at 3,3 m
67		**Bedrock** not found
	4,0	
66		
	5,0	
65		

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L23D

Appendix: B | Page: B27

Explored: September 2006 - GÞG

Coordinates: X: 436948 Y: 389207 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
71		**Sand & gravel** - with organic layers Piezometer installed
	1,0	
70		Groundwater table at 1,4 m [19.09.'06]
	2,0	**Sand & gravel** from 0,5 m
69		
	3,0	
68		**Bottom** at 3,3 m
		Bedrock not found
	4,0	
67		
	5,0	
66		

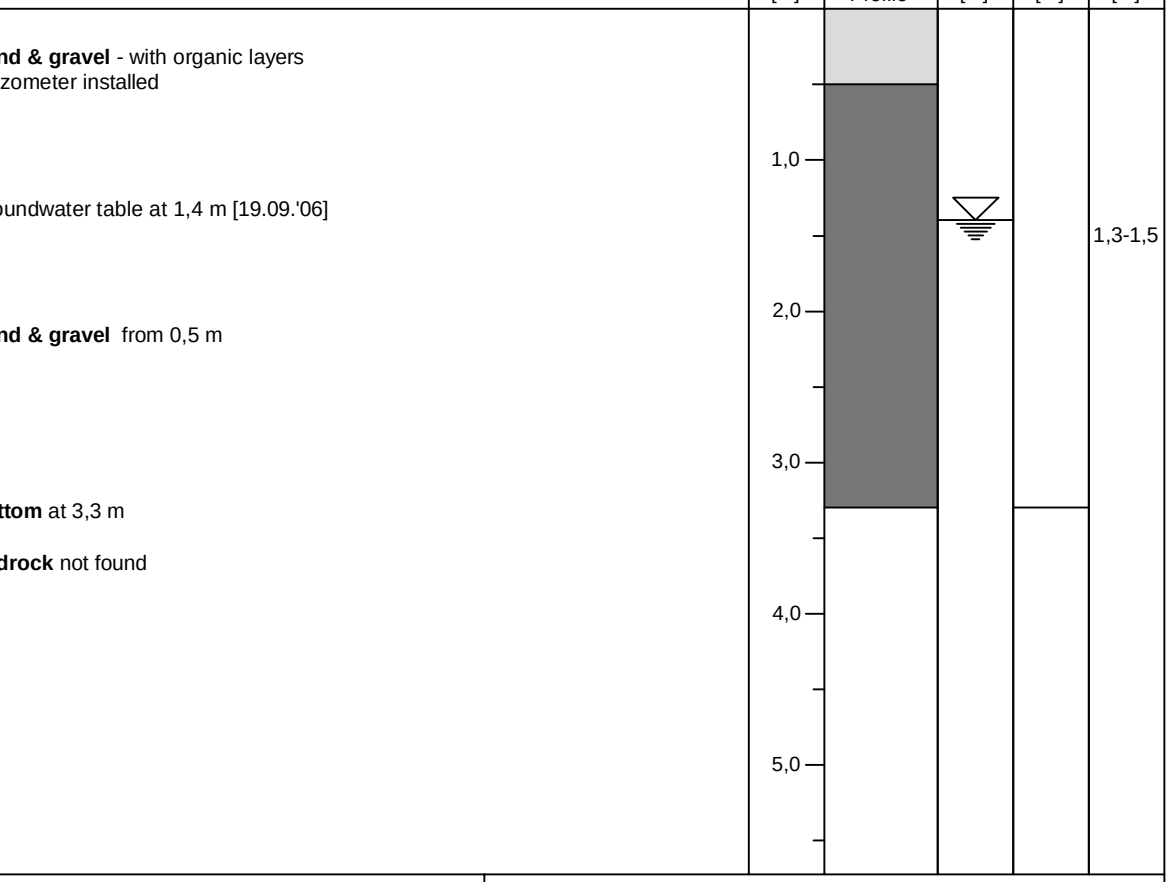


Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Borrow area near Lækur

Appendix: B | Page: B28

Explored: September 2006 - GÞG

Coordinates: X: 435697 Y: 388241 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
69		**Sand & gravel**					0,4-0,6
	1,0		1,0				
68							
	2,0	**Bedrock** not found	2,0				
67							
	3,0		3,0				
66							
	4,0		4,0				
65							
	5,0		5,0				
64							

Photo:

No photo

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L24A

Appendix: B | Page: B29

Explored: September 2006 - GÞG

Coordinates: X: 434064 Y: 390454 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
61		**Sand & gravel** - with organic layers					0,4-0,5
		Groundwater table at 0,8 m [23.09.'06]					
60	1,0	**Sand & gravel** from 0,8 m	1,0				
		Sandstone at 1,1 m					
59	2,0		2,0				
58	3,0		3,0				
57	4,0		4,0				
56	5,0		5,0				

Photo:

No photo

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L24B

Appendix: B | Page: B30

Explored: September 2006 - GÞG

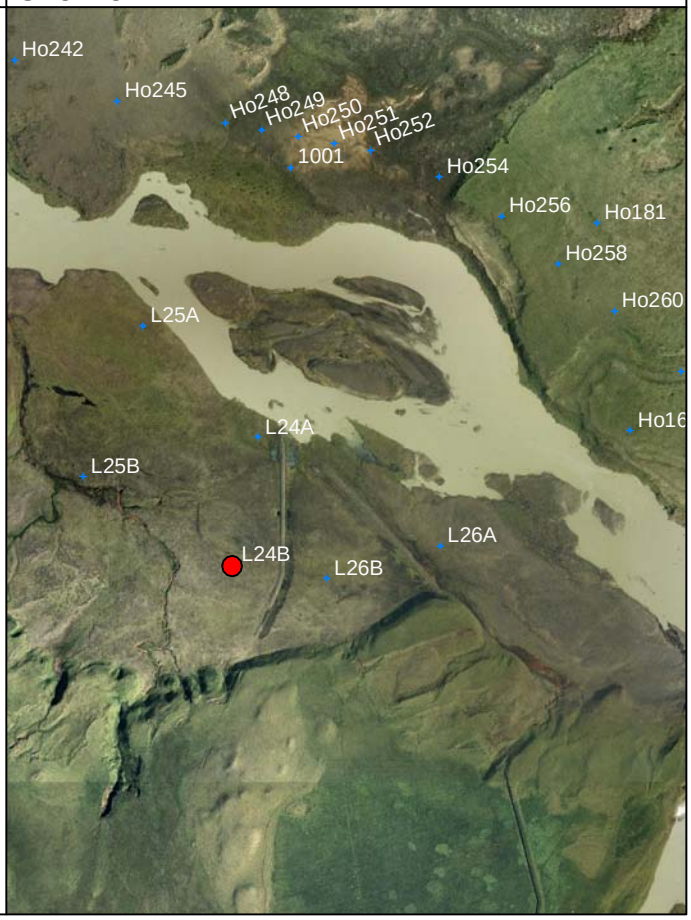
Coordinates: X: 434032 Y: 390285 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
61	1,0	**Sand & gravel** - with organic layers	1,0				0,4-0,6
		Sand & gravel from 0,7 m					
		Sandstone at 1,5 m					
60	2,0		2,0				
59	3,0		3,0				
58	4,0		4,0				
57	5,0		5,0				

Photo:

No photo

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

L25A

Appendix: B | Page: B31

Explored: September 2006 - GÞG

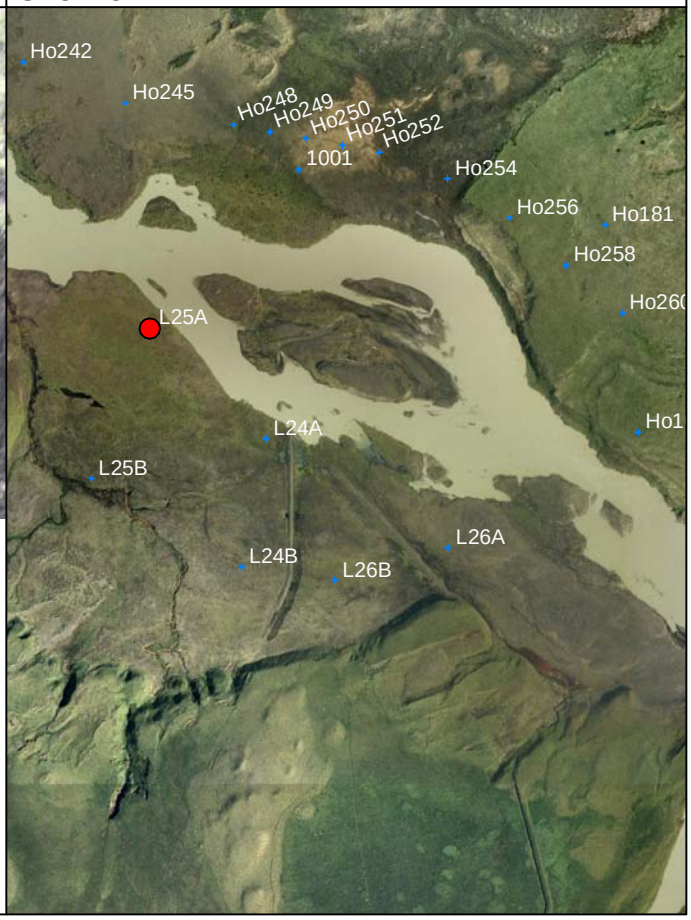
Coordinates: X: 433912 Y: 390601 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
60		**Sand & gravel** - with organic layers
	1,0	
59		**Sand & gravel** from 1,0 m
		Groundwater table at 1,6 m [23.09.'06]
	2,0	**Sandstone** at 1,8 m
58		
	3,0	
57		
	4,0	
56		
	5,0	
55		

Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
1,0				0,6-0,7
2,0				
3,0				
4,0				
5,0				

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

L25B

Appendix: B | Page: B32

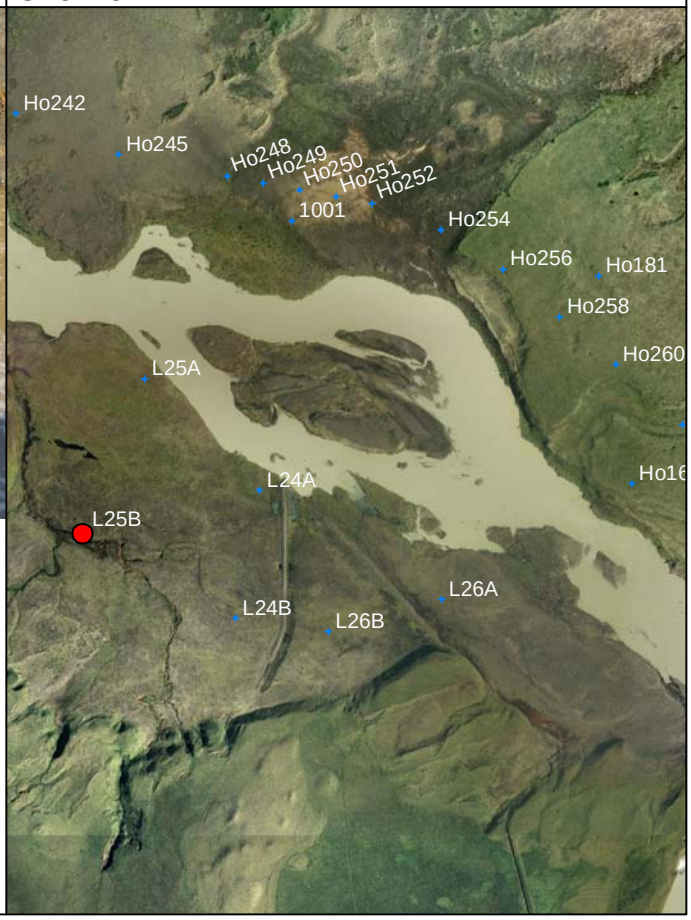
Explored: September 2006 - GÞG

Coordinates: X: 433833 Y: 390402 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
60		**Sand & gravel** - with organic layers					0,6-0,7
	1,0	Groundwater table at 0,8 m [23.09.'06]	1,0				
59		**Sand & gravel** from 0,8 m					
	2,0		2,0				
58		**Sandstone** at 2,3 m					
	3,0		3,0				
57							
	4,0		4,0				
56							
	5,0		5,0				
55							

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

L26A

Appendix: B | Page: B33

Explored: September 2006 - GÞG

Coordinates: X: 434305 Y: 390310 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
61	1,0	**Sand & gravel** - with organic layers Groundwater table at 0,8 m [23.09.'06] **Sand & gravel** from 0,8 m	1,0				0,5-0,6
60	2,0	**Sandstone** at 1,8 m	2,0				
59	3,0		3,0				
58	4,0		4,0				
57	5,0		5,0				
57							

Photo:

No photo

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L26B

Appendix: B | Page: B34

Explored: September 2006 - GÞG

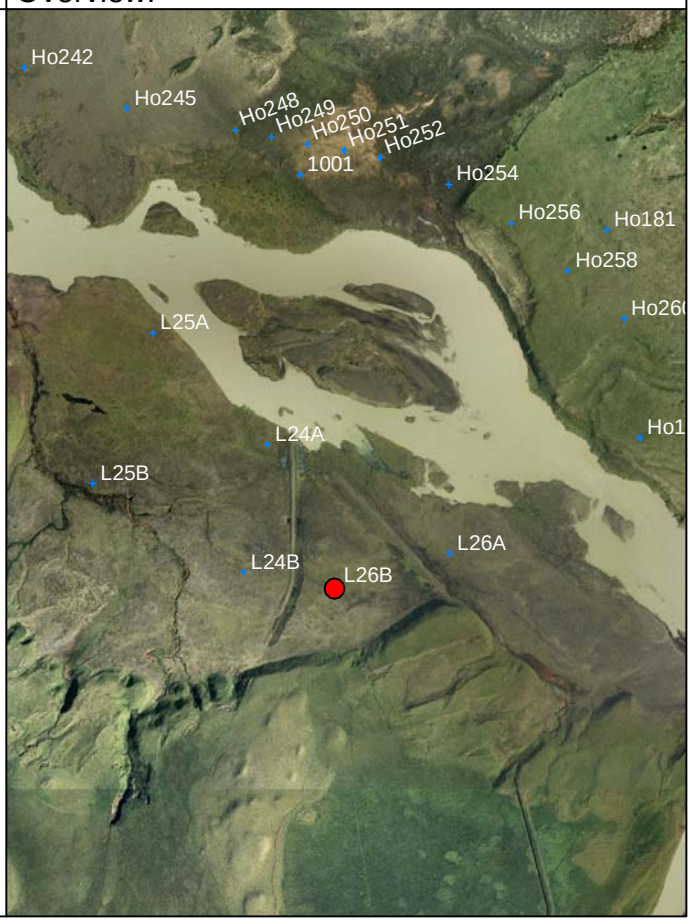
Coordinates: X: 434155 Y: 390267 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
61	1,0	**Sand & gravel** - with organic layers Groundwater table at 0,8 m [23.09.'06]	1,0				0,4-0,5
60	2,0	**Sandstone** at 1,8 m	2,0				
59	3,0		3,0				
58	4,0		4,0				
57	5,0		5,0				

Photo:

No photo

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

L27A

Appendix: B | Page: B35

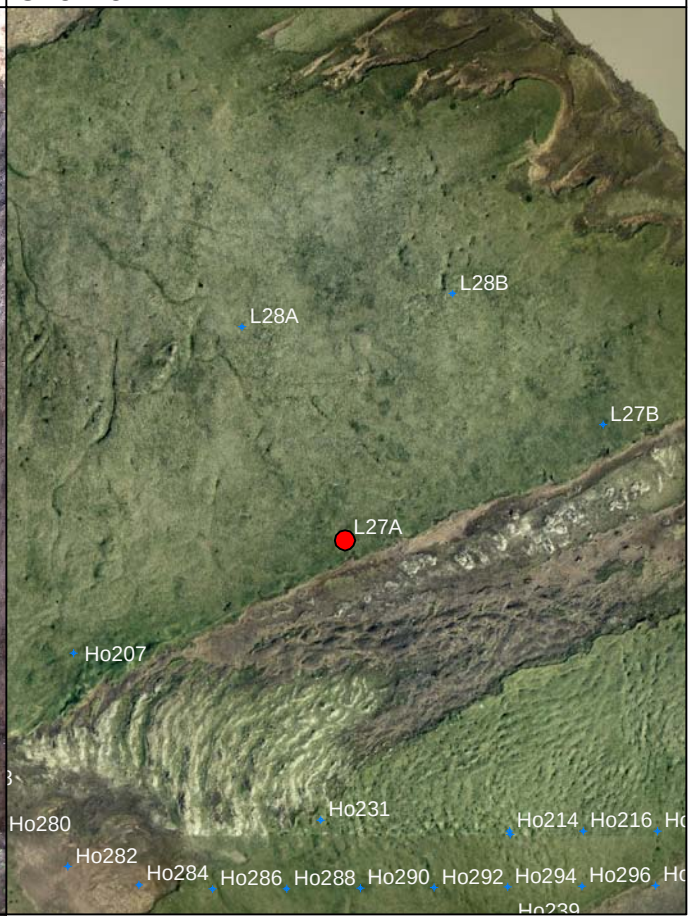
Explored: September 2006 - GÞG

Coordinates: X: 435744 Y: 390392 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
72		**Loess**					
	1,0	**Loess** - with thin sand layers from 0,6m	1,0				1,0-1,2
71		**Scoria/Lava** at 1,6m					
	2,0		2,0				
70							
	3,0		3,0				
69							
	4,0		4,0				
68							
	5,0		5,0				
67							

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

L27B

Appendix: B | Page: B36

Explored: September 2006 - GÞG

Coordinates: X: 436084 Y: 390542 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
71		**Loess**					
		Loess - with thin sand layers from 0,9 m					
	1,0		1,0				1,0-1,2
70							
		Scoria/Lava at 2,0 m					
	2,0		2,0				
69							
	3,0		3,0				
68							
	4,0		4,0				
67							
	5,0		5,0				
66							

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

L28A

Appendix: B | Page: B37

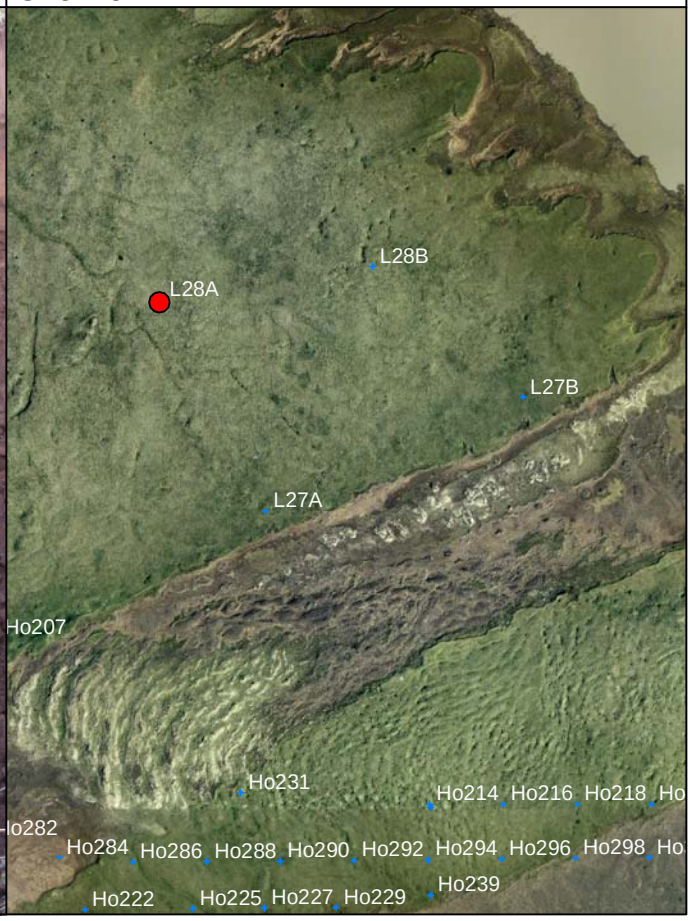
Explored: September 2006 - GÞG

Coordinates: X: 435607 Y: 390671 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
70		**Loess**					
	1,0		1,0				1,0-1,2
69		**Loess** - with thin sand layers from 0,8 m					
	2,0		2,0				
68		**Scoria/Lava** at 2,4 m					
	3,0		3,0				
67							
	4,0		4,0				
66							
	5,0		5,0				
65							

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

L28B

Appendix: B | Page: B38

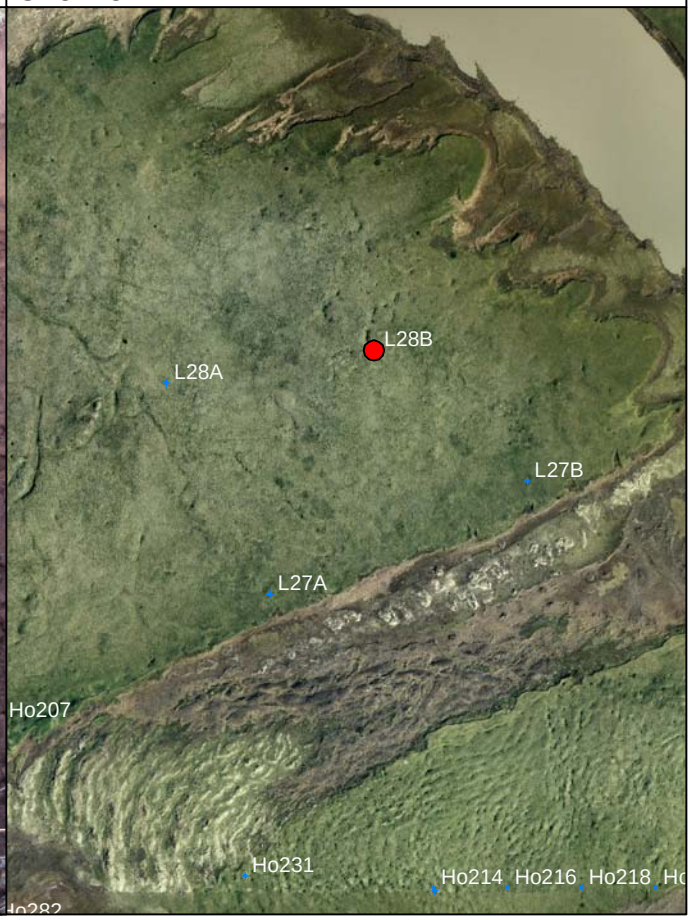
Explored: September 2006 - GÞG

Coordinates: X: 435885 Y: 390715 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Loess					0,6-0,7
71	1,0		1,0				
		Loess - with thin sand layers from 0,8 m					1,5-1,7
70	2,0	**Scoria/Lava** at 2,0 m	2,0				
69	3,0		3,0				
68	4,0		4,0				
67	5,0		5,0				

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho242

Appendix: B | Page: B39

Explored: September 2006 - GÞG

Coordinates: X: 433742 Y: 390952 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
65		**Sand & gravel** - with organic layers **Lava** at 0,15 m					
64	1,0		1,0				
63	2,0		2,0				
62	3,0		3,0				
61	4,0		4,0				
60	5,0		5,0				

Photo:

No photo

Overview:

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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho245

Appendix: B | Page: B40

Explored: August 2006 - GÞG

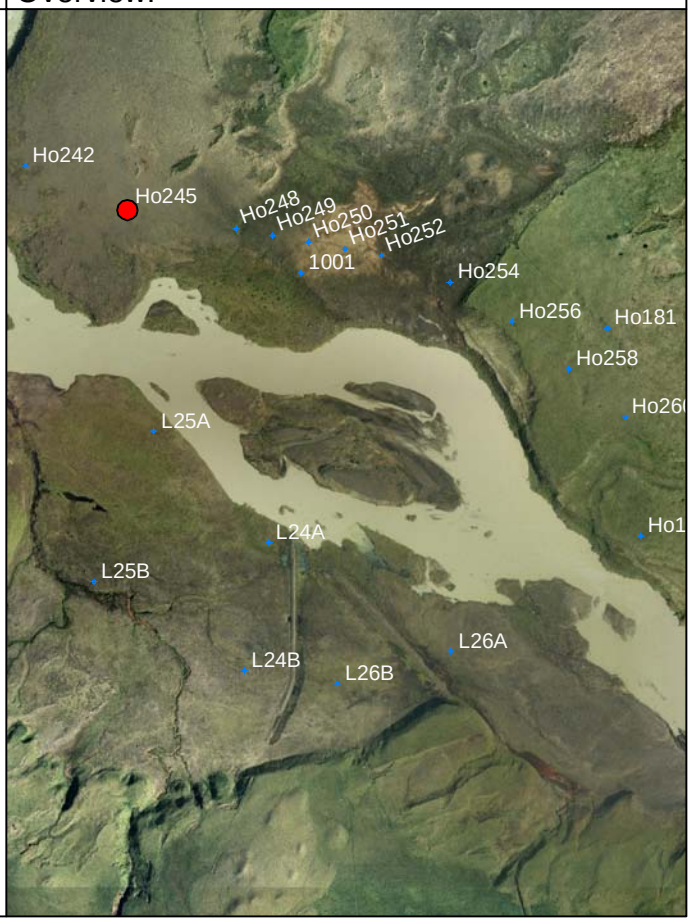
Coordinates: X: 433878 Y: 390898 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
65	1,0	**Sand & gravel** - with organic layers **Lava** at 0,9 m	1,0				
64	2,0		2,0				
63	3,0		3,0				
62	4,0		4,0				
61	5,0		5,0				

Photo:

No photo

Overview:



Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho248

Appendix: B | Page: B41

Explored: September 2006 - GÞG

Coordinates: X: 434021 Y: 390869 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Sand & gravel - with organic layers					
64	1,0	**Lava** at 1,0 m	1,0				
63	2,0		2,0				
62	3,0		3,0				
61	4,0		4,0				
60	5,0		5,0				

Photo:

No photo

Overview:

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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho249

Appendix: B | Page: B42

Explored: September 2006 - GÞG

Coordinates: X: 434069 Y: 390860 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
65		
		Sand & gravel - with organic layers
	1,0	
64		
		Sand & gravel from 0,7 m
	2,0	
63		
	3,0	
62		
		Harsh sand & gravel from 2,8 m
	4,0	
61		
		Groundwater table at 4,7 m
		Bottom at 4,7 m
	5,0	
60		**Bedrock** not found

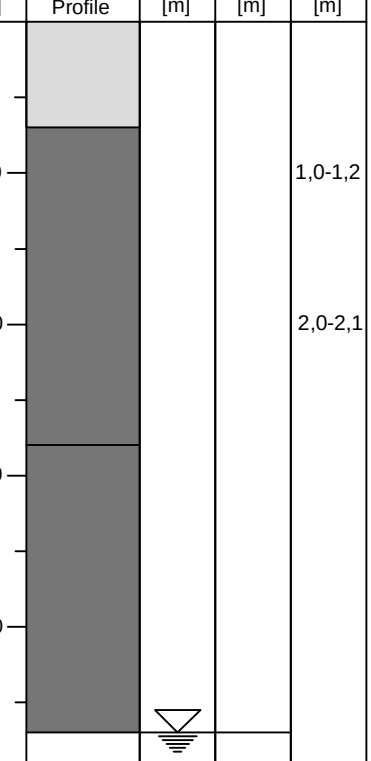

Photo:

No photo

Overview:

Almenna Consulting Engineers

Landsvirkjun

Hvammsvirkjun Hydroelectric Project

Ho250

Appendix: B | Page: B43

Explored: September 2006 - GÞG

Coordinates: X: 434117 Y: 390851 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
66		**Sand & gravel** - with organic layers					
	1,0		1,0				
65							
	2,0		2,0				
64		**Silt & sand** from 0,9 m					
	3,0		3,0				3,0-3,2
63							
	4,0		4,0				
62							
	5,0	Groundwater table at 5,5 m	5,0				
61		**Bottom** at 6,0 m **Bedrock** not found					

Photo:

No photo

Overview:

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Landsvirkjun

Hvammsvirkjun Hydroelectric Project

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Appendix: B | Page: B44

Explored: September 2006 - GÞG

Coordinates: X: 434107 Y: 390810 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
65							
64	1,0	**Sand & gravel** - with organic layers	1,0				
63	2,0		2,0				2,5-2,7
62	3,0		3,0				
61	4,0	**Silt & sand** from 3,0 m	4,0				
60	5,0	Groundwater table at 4,7 m **Bottom** at 5,0 m **Bedrock** not found	5,0				

Photo:

No photo

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho251

Appendix: B | Page: B45

Explored: September 2006 - GÞG

Coordinates: X: 434165 Y: 390842 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
67							
		Loess					
66	1,0		1,0				
	2,0	**Scoria** at 2,0 m	2,0				
65							
	3,0		3,0				
64							
	4,0		4,0				
63							
	5,0		5,0				
62							

Photo:

No photo

Overview:

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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho252

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Explored: September 2006 - GÞG

Coordinates: X: 434213 Y: 390833 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
67		**Loess**					
	1,0	**Scoria/Lava** at 0,9 m	1,0				
66							
	2,0		2,0				
65							
	3,0		3,0				
64							
	4,0		4,0				
63							
	5,0		5,0				
62							

Photo:

No photo

Overview:

Almenna Consulting Engineers

Landsvirkjun

Hvammsvirkjun Hydroelectric Project

Ho254

Appendix: B | Page: B47

Explored: September 2006 - GÞG

Coordinates: X: 434304 Y: 390798 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
67	1,0	**Sand & gravel** - with organic layers **Scoria/Lava** at 0,05 m	1,0				
66	2,0		2,0				
65	3,0		3,0				
64	4,0		4,0				
63	5,0		5,0				
62							

Photo:

No photo

Overview:

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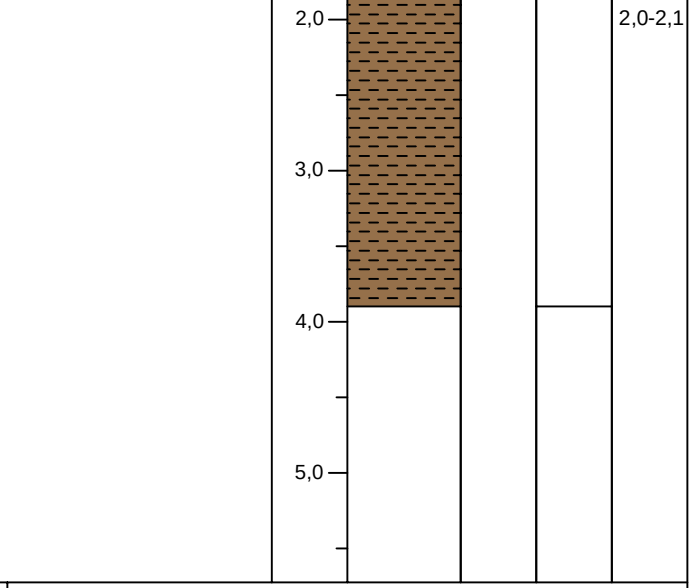
Holtavirkjun Hydroelectric Project

Ho256

Appendix: B	Page: B48		
Explored: September 2006 - GÞG			
Coordinates: X: 434386	Y: 390746	ISN-93	Drawn: BK	Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70		
		Loess
69	1,0	
68	2,0	
		Loess - with thin sand layers from 1,3 m
67	3,0	
		Scoria at 3,9 m
66	4,0	
65	5,0	



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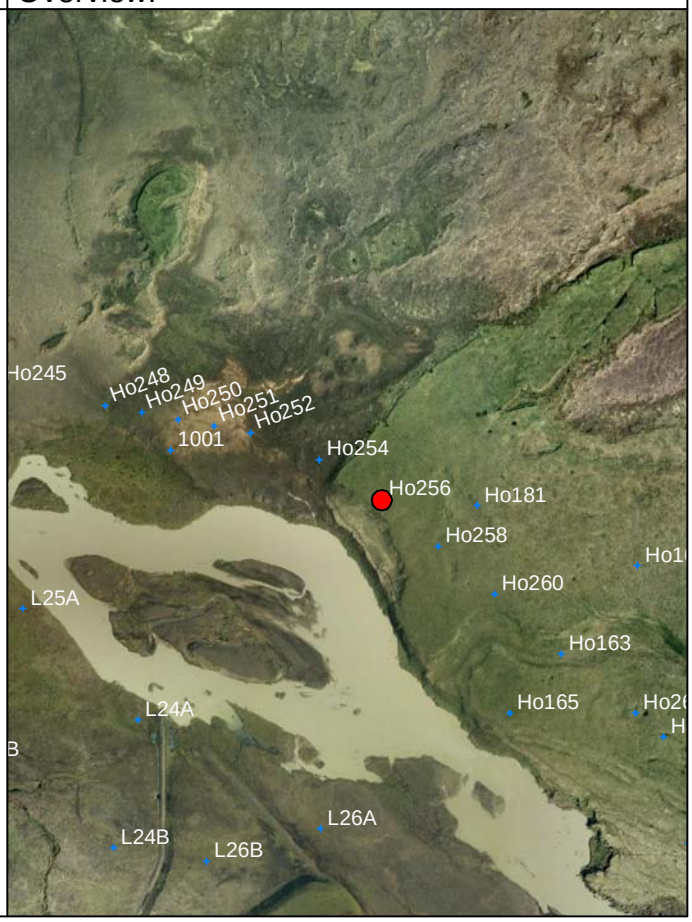
Overview:



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Holtavirkjun Hydroelectric Project

Ho258

Appendix: B | Page: B49

Explored: September 2006 - GÞG

Coordinates: X: 434461 Y: 390683 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70	1,0	**Loess**
69	2,0	**Loess** - with thin sand layers from 1,1 m
68	3,0	**Scoria** at 3,1 m
67	4,0	
66	5,0	
65		

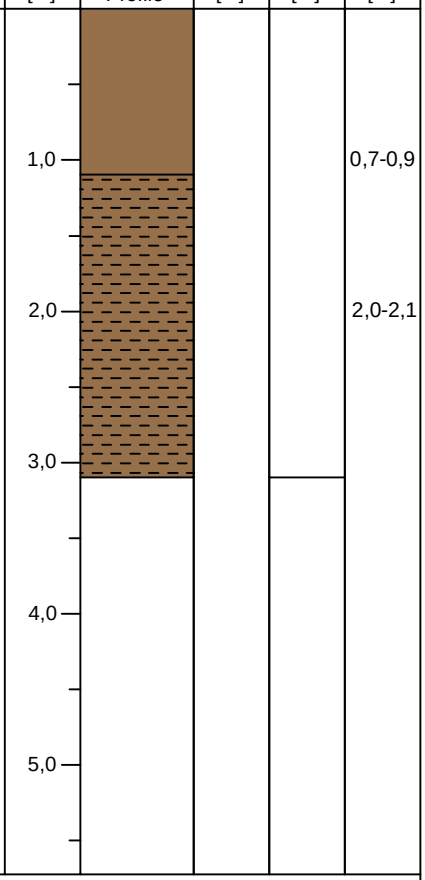

Photo:

No photo

Overview:

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Holtavirkjun Hydroelectric Project

Ho181

Appendix: B | Page: B50

Explored: September 2006 - GÞG

Coordinates: X: 434512 Y: 390737 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70	1,0	**Loess**
69	2,0	**Loess** - with thin sand layers from 1,0 m
68	3,0	**Scoria/Lava** at 3,0 m
67	4,0	
66	5,0	

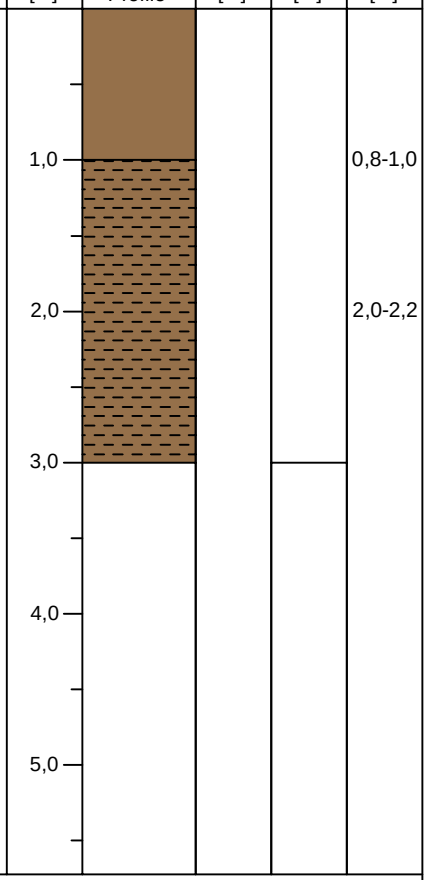

Photo:

No photo

Overview:

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Holtavirkjun Hydroelectric Project

Ho260

Appendix: B | Page: B51

Explored: Septembe 2006 - GÞG

Coordinates: X: 434535 Y: 390620 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70		
		Loess
	1,0	
69		
	2,0	
68		**Loess** - with thin sand layers from 1,2 m
	3,0	
67		
	4,0	**Scoria/Lava** at 4,0 m
66		
	5,0	
65		

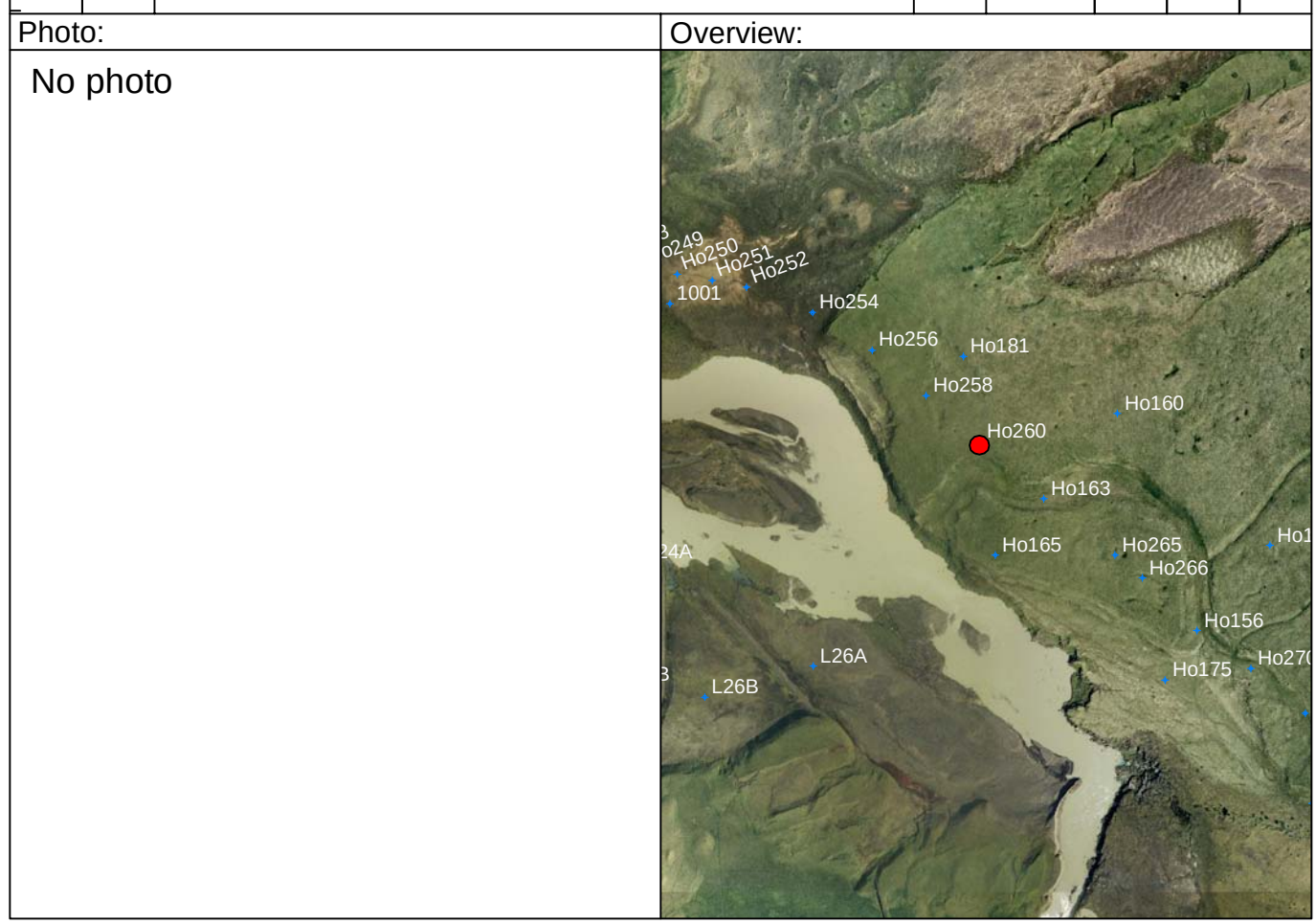

Photo:

No photo

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho163

Appendix: B	Page: B52		
Explored: Septembe 2006 - GÞG			
Coordinates: X: 434624	Y: 390541	ISN-93	Drawn: BK	Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
68	1,0	**Loess**	1,0				1,0-1,2
67	2,0	**Scoria/Lava** at 1,8 m	2,0				
66	3,0		3,0				
65	4,0		4,0				
64	5,0		5,0				

Photo:

No photo

Overview:

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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho160

Appendix: B | Page: B53

Explored: September 2006 - GÞG

Coordinates: X: 434725 Y: 390658 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70		**Loess**
	1,0	
69		
	2,0	
68		**Loess** - with thin sand layers from 1,4 m
	3,0	
67		
	4,0	
66		**Scoria** at 4,7 m
	5,0	
65		

Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
1,0				1,2-1,3
2,0				
3,0				2,7-2,9
4,0				
5,0				

Photo:

No photo

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

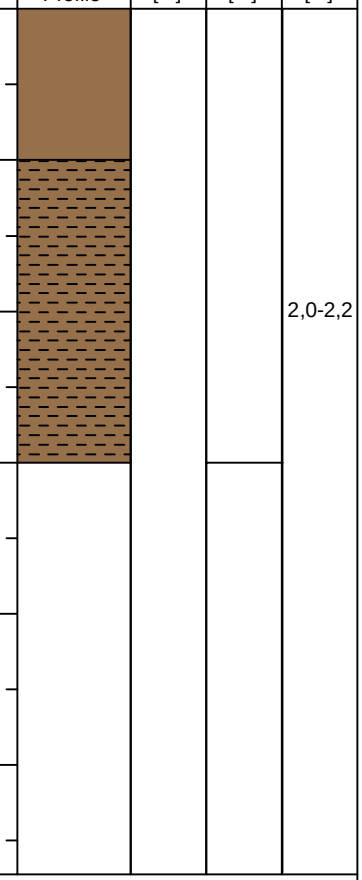
Ho165

Appendix: B | Page: B54

Explored: September 2006 - GÞG

Coordinates: X: 434556 Y: 390463 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70		
		Loess
	1,0	
69		
	2,0	**Loess** - with thin sand layers from 1,0 m
68		
	3,0	**Scoria** at 3,0 m
67		
	4,0	
66		
	5,0	
65		



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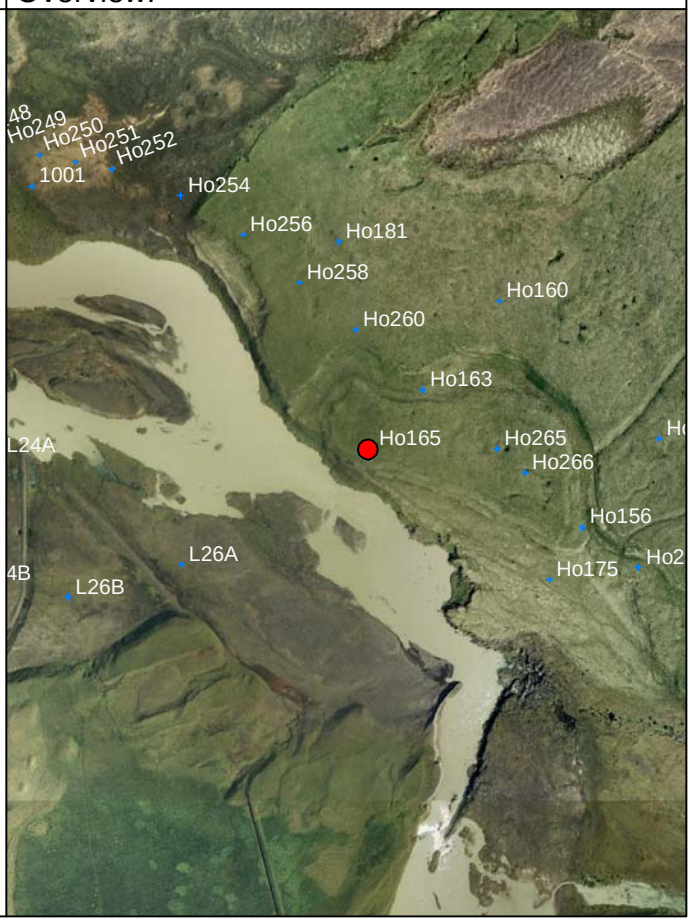
Overview:



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Holtavirkjun Hydroelectric Project

Ho265

Appendix: B | Page: B55

Explored: September 2006 - GÞG

Coordinates: X: 434722 Y: 390463 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70	1,0	**Loess**
69	2,0	**Loess** - with many thin sand layers from 1,5 m
68	3,0	**Scoria** at 2,8 m
67	4,0	
66	5,0	
65		

Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
1,0				1,0-1,2
2,0				2,0-2,2
3,0				
4,0				
5,0				

Photo:

Overview:

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Holtavirkjun Hydroelectric Project

Ho266

Appendix: B | Page: B56

Explored: September 2006 - GÞG

Coordinates: X: 434759 Y: 390431 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
70	1,0	**Loess**	1,0				0,9-1,0
69	2,0	**Loess** - with thin sand layers from 1,0 m	2,0				2,0-2,2
68	3,0		3,0				
67	4,0	**Scoria/Lava** at 3,6 m	4,0				
66	5,0		5,0				

Photo:

Overview:

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Holtavirkjun Hydroelectric Project

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Appendix: B | Page: B57

Explored: September 2006 - GÞG

Coordinates: X: 434835 Y: 390359 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
69	1,0	**Loess**
		Loess - with thin sand layers from 0,9 m
68	2,0	**Scoria/Lava** at 2,0 m
67	3,0	
66	4,0	
65	5,0	

Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
1,0				1,0-1,2
2,0				
3,0				
4,0				
5,0				

Photo:

Overview:

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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho153

Appendix: B | Page: B58

Explored: September 2006 - GÞG

Coordinates: X: 434936 Y: 390476 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Loess					
70	1,0		1,0				1,0-1,2
		Loess - with thin sand layers from 1,2 m					
69	2,0		2,0				2,0-2,2
68	3,0		3,0				
		Scoria/Lava at 3,5 m					
67	4,0		4,0				
66	5,0		5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho175

Appendix: B | Page: B59

Explored: September 2006 - GÞG

Coordinates: X: 434791 Y: 390290 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
68	1,0	**Loess**	1,0				0,5-0,7
67	2,0	**Sand & gravel** from 1,3 m **Scoria/Lava** at 1,5 m	2,0				
66	3,0		3,0				
65	4,0		4,0				
64	5,0		5,0				
63							

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho270

Appendix: B | Page: B60

Explored: Septembe 2006 - GÞG

Coordinates: X: 434909 Y: 390306 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
70	1,0	**Loess**
69	2,0	**Loess** - with thin sand layers from 0,9 m **Sand & gravel** - Tephra layer from 1,7 m to 1,9 m
68	3,0	**Scoria** at 3,0 m
67	4,0	
66	5,0	

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho272

Appendix: B | Page: B61

Explored: Septembe 2006 - GÞG

Coordinates: X: 434984 Y: 390244 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
70	1,0	**Loess**	1,0				1,0-1,1
		Loess - with thin sand layers					
69	2,0	**Sand & gravel** - Tephra layer from 2,0 m to 2,2 m	2,0				1,8-2,0 2,0-2,2
68	3,0	**Scoria** at 3,0 m	3,0				
67	4,0		4,0				
66	5,0		5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho274

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Explored: Septembe 2006 - GÞG

Coordinates: X: 435060 Y: 390183 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
72		
		Loess
	1,0	
71		
	2,0	
70		
		Loess - with thin sand layers from 0,9 m
	3,0	
69		
	4,0	
68		
	5,0	**Scoria/Lava** at 5,0 m
67		

Depth [m] | Soil Profile | G.w.t. [m] | Bottom [m] | Sample [m]

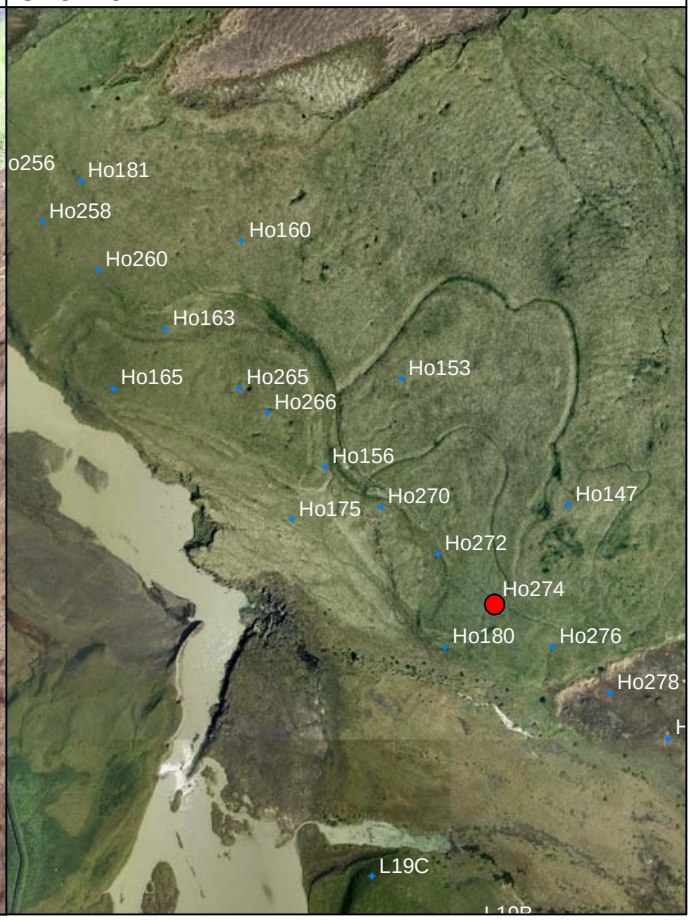
1,0 — 1,0-1,2

3,0 — 3,0-3,2

5,0

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho147

Coordinates: X: 435157 Y: 390309 ISN-93

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Explored: Septembe 2006 - GÞG

Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
72		**Loess**
	1,0	
71		**Loess** - with thin sand layers from 0,7 m
	2,0	
70		**Scoria** at 2,5 m
	3,0	
69		
	4,0	
68		
	5,0	
67		

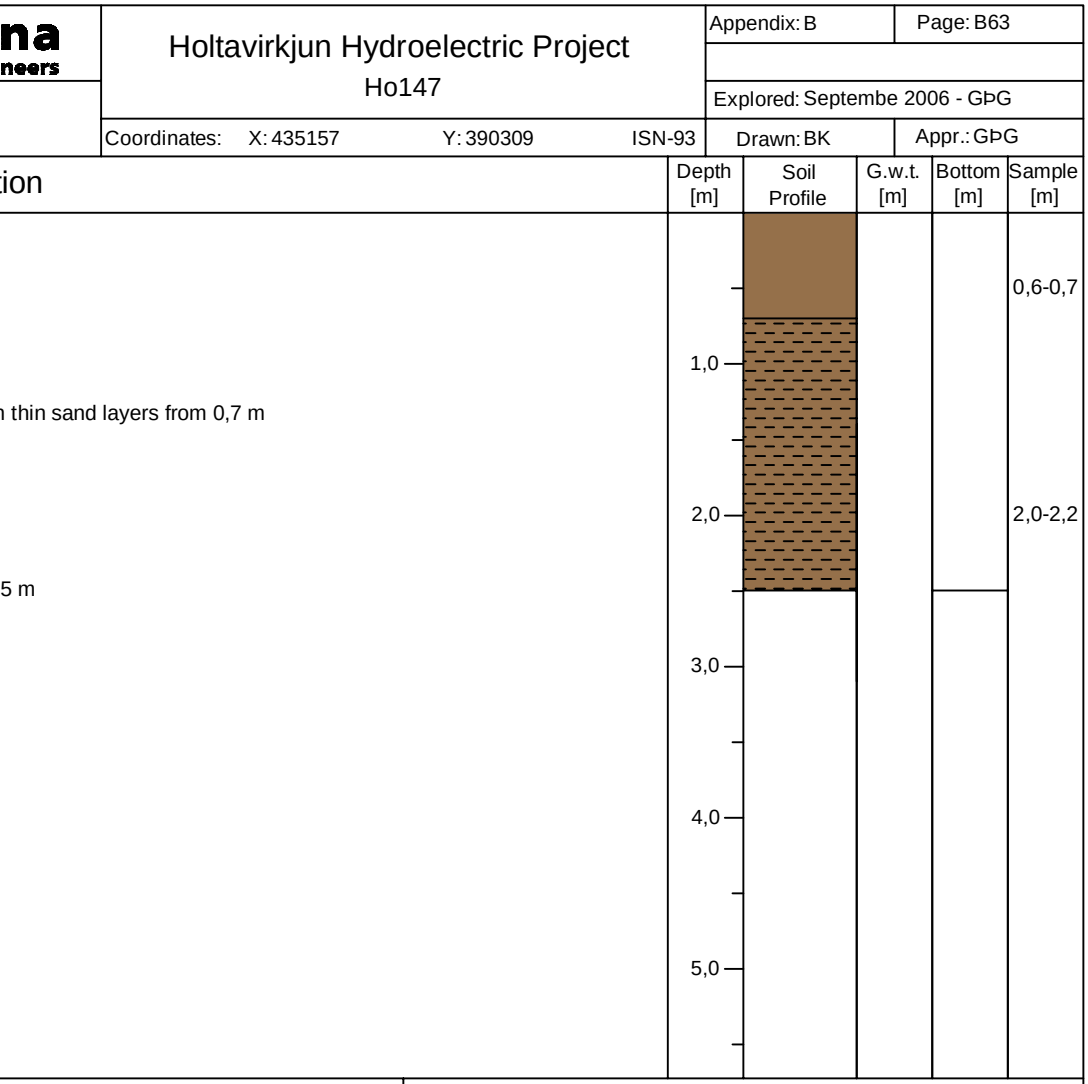

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho180

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Explored: September 2006 - GÞG

Coordinates: X: 434994 Y: 390121 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
69							
		Sand & gravel - with organic layers					
	1,0	**Scoria** at 1,0 m	1,0				
68							
	2,0		2,0				
67							
	3,0		3,0				
66							
	4,0		4,0				
65							
	5,0		5,0				
64							

Photo:

Overview:

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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho276

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Explored: Septembe 2006 - GÞG

Coordinates: X: 435136 Y: 390121 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
71	1,0	**Loess**
70	2,0	**Sand & gravel** - Tephra layer from 1,8 m to 2,0 m
69	3,0	**Loess** - with thin sand layers from 2,0 m
68	4,0	**Scoria** at 4,0 m
67	5,0	
66		

Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
1,0				
2,0				1,8-2,0
3,0				3,0-3,2
4,0				
5,0				

Photo:

Overview:

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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho207

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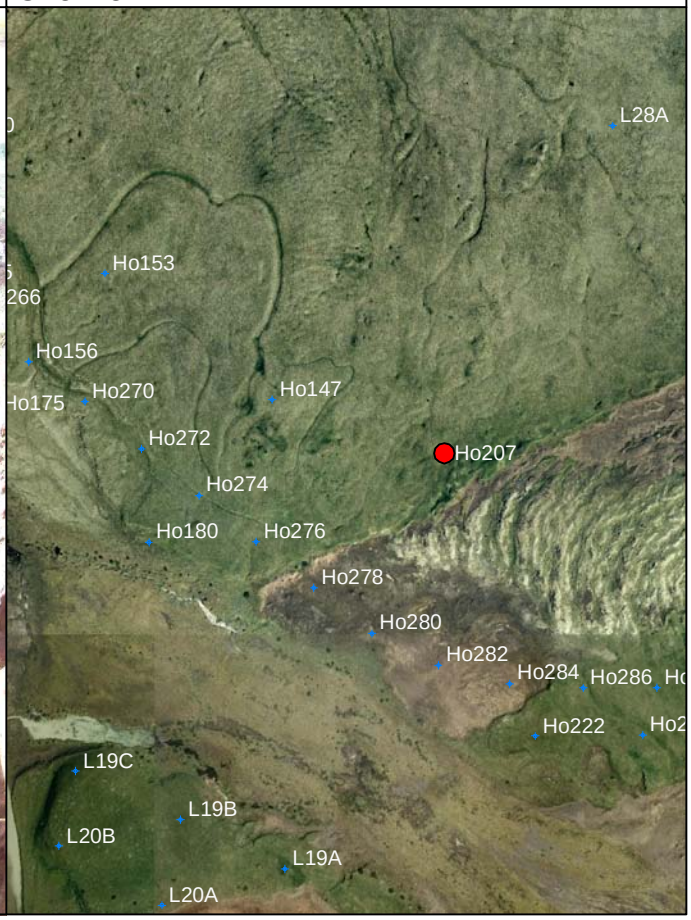
Explored: September 2006 - GÞG

Coordinates: X: 435384 Y: 390240 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
71	1,0	**Loess**	1,0				1,0-1,2
		Loess - with thin sand layers from 1,3 m					
70	2,0		2,0				2,0-2,1
		Sand & gravel - Tephra layer from 2,1 m to 2,6 m					
69	3,0		3,0				
		Scoria at 3,3 m					
68	4,0		4,0				
67	5,0		5,0				

Photo:

Overview:



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Holtavirkjun Hydroelectric Project
Ho278

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Explored: September 2006 - GÞG

Coordinates: X: 435212 Y: 390060 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
68	1,0	**Sand & gravel** - with organic layers **Scoria** at 0,5 m	1,0				
67	2,0		2,0				
66	3,0		3,0				
65	4,0		4,0				
64	5,0		5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho280

Appendix: B | Page: B68

Explored: September 2006 - GÞG

Coordinates: X: 435289 Y: 390000 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Loess					
69	1,0		1,0				1,0-1,1
		Loess - with thin sand layers from 0,8 m					
		Scoria/Lava at 1,8 m					
68	2,0		2,0				
67	3,0		3,0				
66	4,0		4,0				
65	5,0		5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Hvammsvirkjun Hydroelectric Project

Ho282

Appendix: B | Page: B69

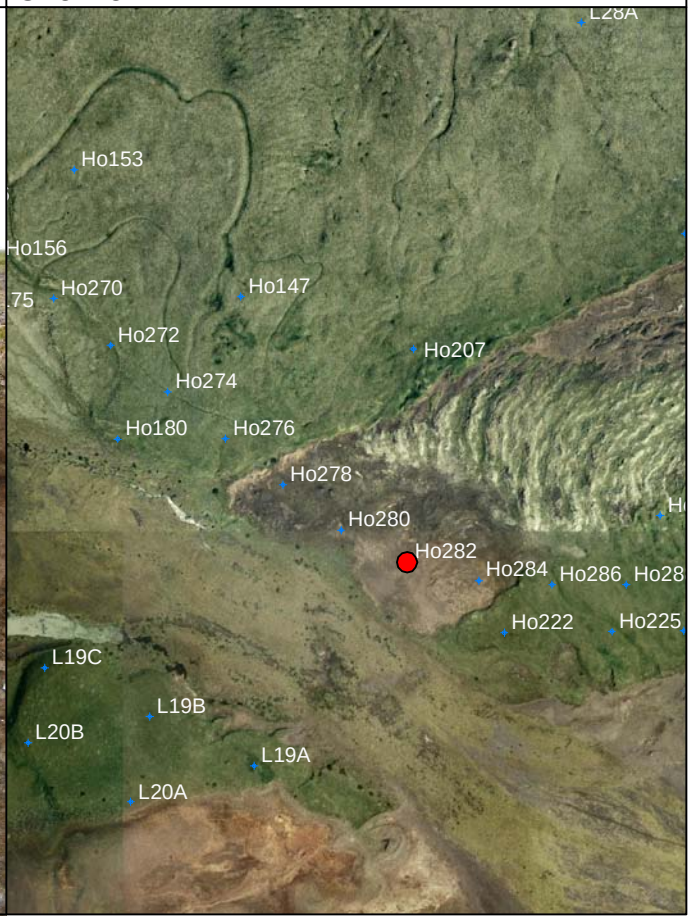
Explored: September 2006 - GÞG

Coordinates: X: 435377 Y: 389958 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
69		**Loess -** with thin sand layers					
	1,0	**Scoria/Lava** at 0,7 m	1,0				
68							
	2,0		2,0				
67							
	3,0		3,0				
66							
	4,0		4,0				
65							
	5,0		5,0				
64							

Photo:

Overview:



Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho284

Appendix: B | Page: B70

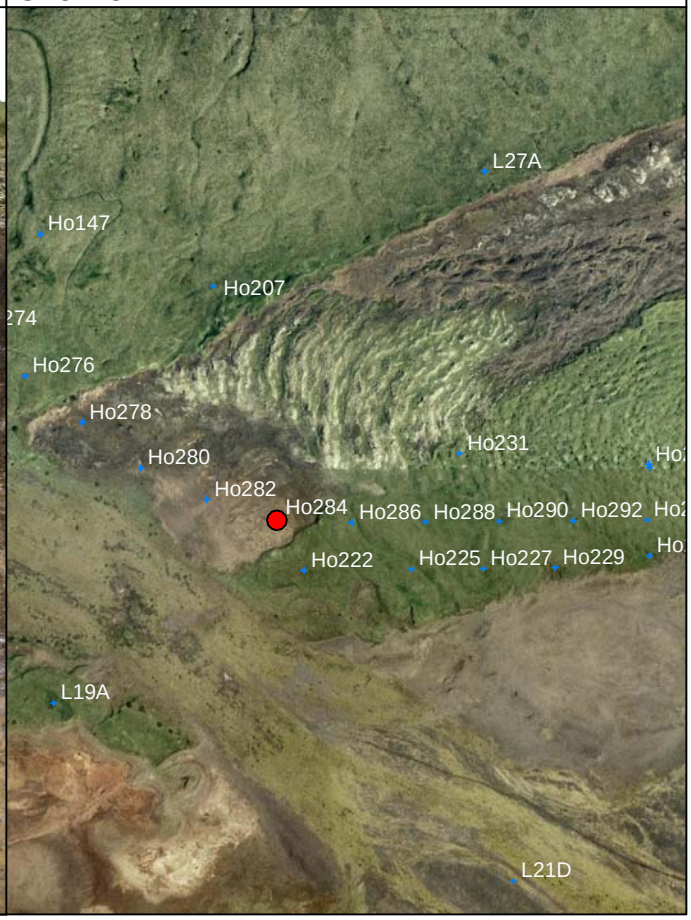
Explored: September 2006 - GÞG

Coordinates: X: 435471 Y: 389934 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
69	1,0	**Sand & gravel** - with organic layers **Scoria/Lava** at 0,9 m	1,0				
68	2,0		2,0				
67	3,0		3,0				
66	4,0		4,0				
65	5,0		5,0				

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho222

Appendix: B | Page: B71

Explored: September 2006 - GÞG

Coordinates: X: 435505 Y: 389864 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
71	1,0	**Loess**
70	2,0	**Loess** - with thin sand layers from 1,2 m
69	3,0	**Scoria/Lava** at 3,3 m
68	4,0	
67	5,0	
66		

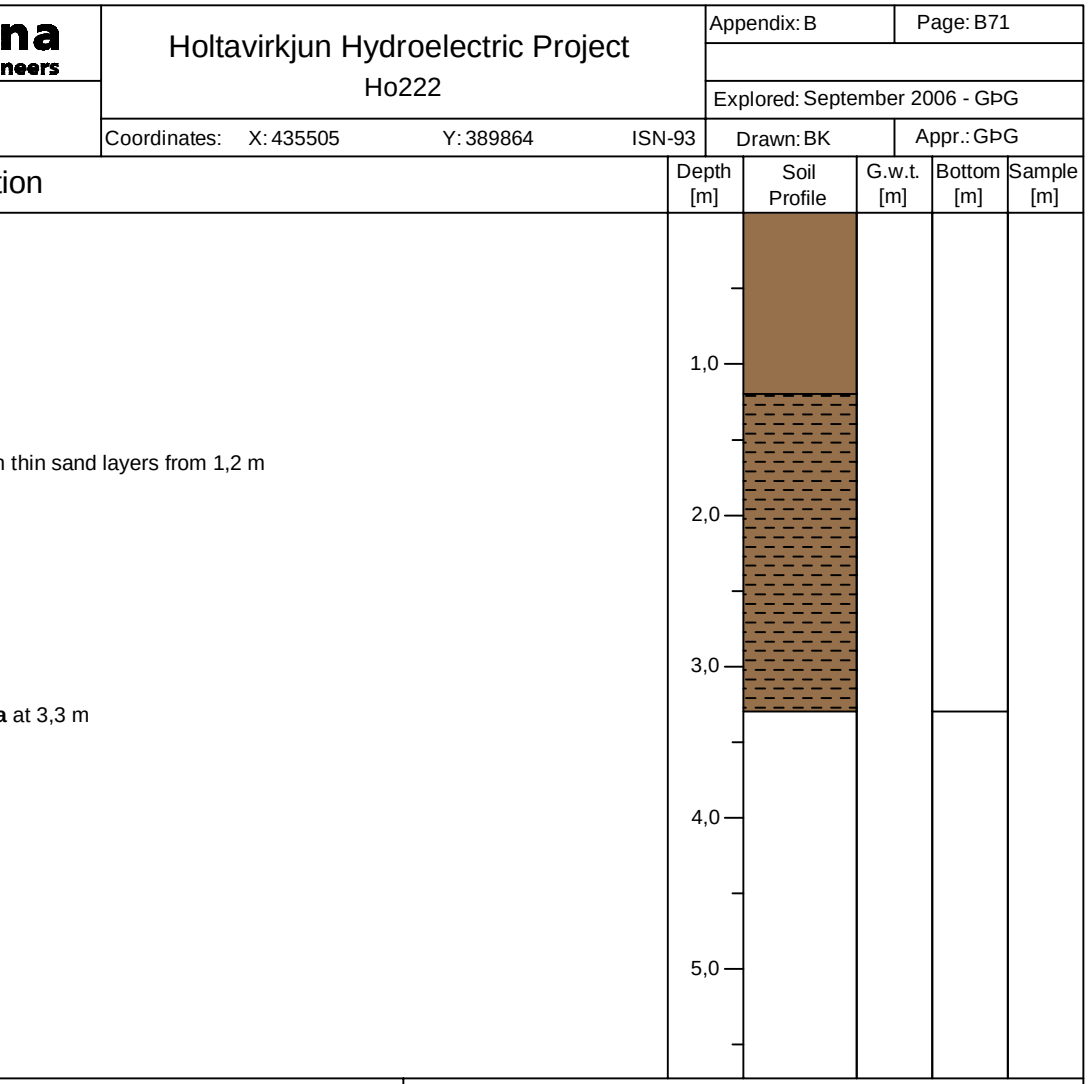
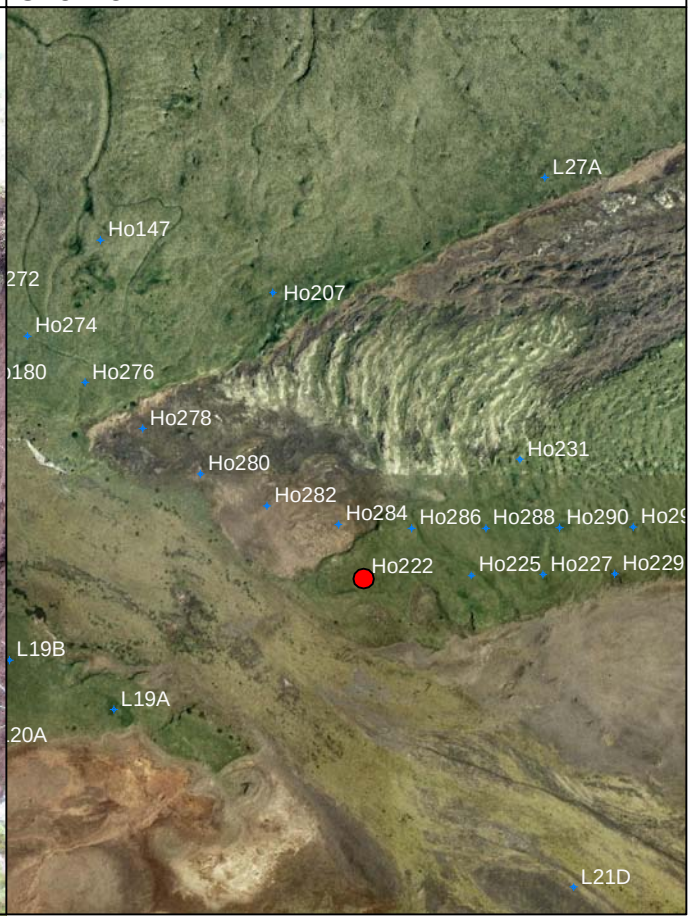


Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho286

Appendix: B | Page: B72

Explored: September 2006 - GÞG

Coordinates: X: 435568 Y: 389928 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
72	1,0	**Loess**
71	2,0	**Loess** - with thin sand layers from 1,1 m
70	3,0	**Sand & gravel** from 2,3 m
69		Groundwater table at 3,5 m
68	4,0	**Scoria** at 4,1 m
67	5,0	

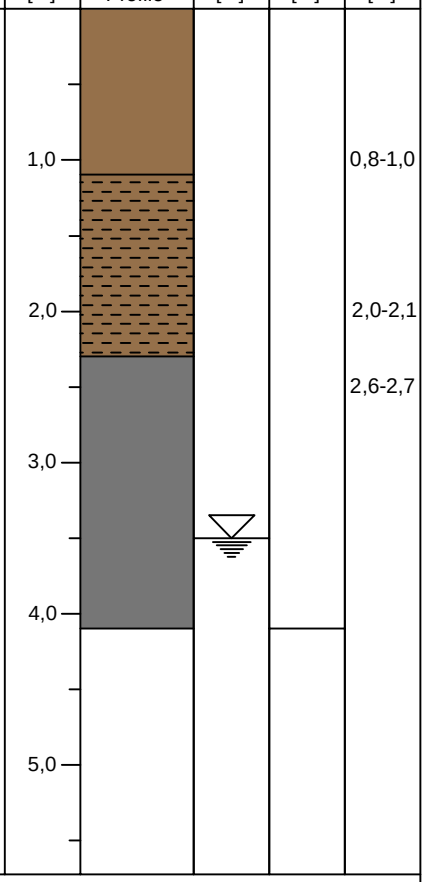


Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho225

Appendix: B | Page: B73

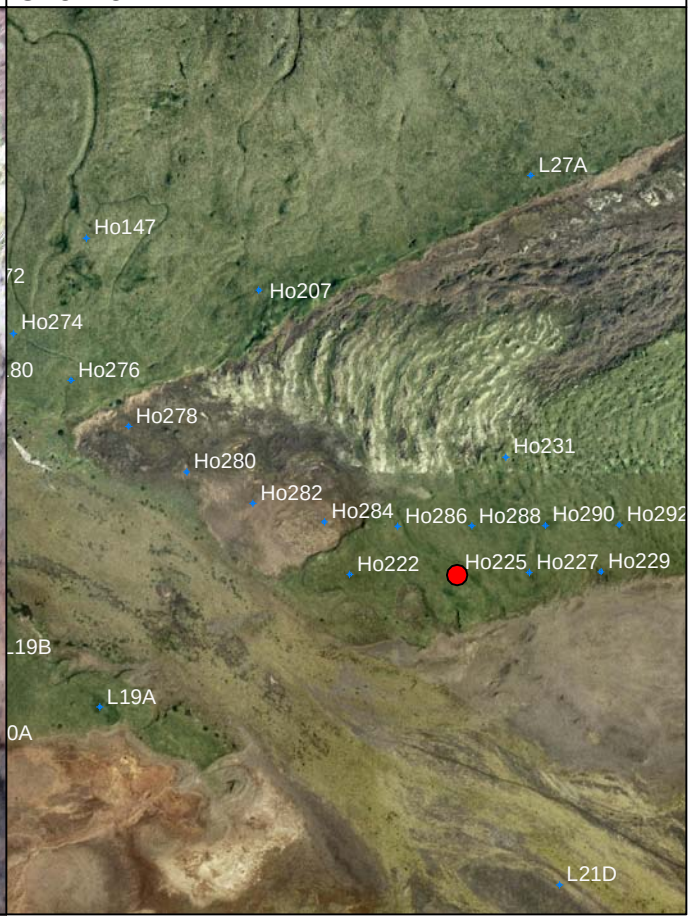
Explored: September 2006 - GÞG

Coordinates: X: 435647 Y: 389866 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
72							
		Loess					
	1,0		1,0				
71							
	2,0	**Loess** - with thin sand layers from 1,2 m	2,0				
70							
	3,0		3,0				
69							
		Sand & gravel from 3,0 m					
	4,0		4,0				
68							
		Scoria at 4,4 m					
	5,0		5,0				
67							

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho288

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Explored: September 2006 - GÞG

Coordinates: X: 435666 Y: 389928 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
72	1,0	**Loess**
71	2,0	**Loess** - with thin sand layers from 1,3 m **Sand & gravel** - Tephra layer from 1,4 m to 1,6 m **Loess** - with thin sand layers
70	3,0	**Fine sand** - Tephra layer from 2,3 m to 2,4 m **Loess** - with thin sand layers **Fine sand** - Tephra layer from 2,8 m to 3,0 m
69	4,0	**Loess** - with thin sand layers from 3,0 m
68	5,0	**Scoria** at 4,6 m

Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
1,0				1,0-1,2
2,0				2,0-2,2
3,0				
4,0				
5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho231

Appendix: B | Page: B75

Explored: September 2006 - GÞG

Coordinates: X: 435711 Y: 390019 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
74	1,0	**Loess**
		Loess - with thin sand layers from 1,2 m
73	2,0	**Scoria** at 2,0 m
72	3,0	
71	4,0	
70	5,0	

Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
1,0				1,3-1,4
2,0				
3,0				
4,0				
5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho290

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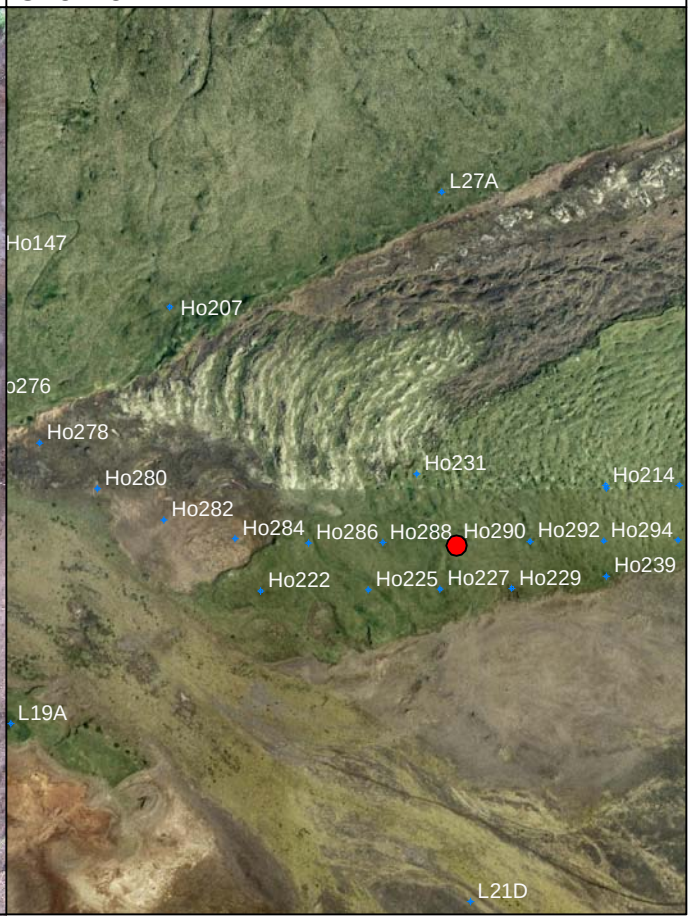
Explored: September 2006 - GÞG

Coordinates: X: 435763 Y: 389929 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
73	1,0	**Loess**	1,0				
							1,3-1,5
72	2,0	**Loess** - with thin sandlayers from 1,2 m	2,0				1,9-2,0
71	3,0		3,0				
		Scoria at 3,8 m					
70	4,0		4,0				
69	5,0		5,0				

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho227

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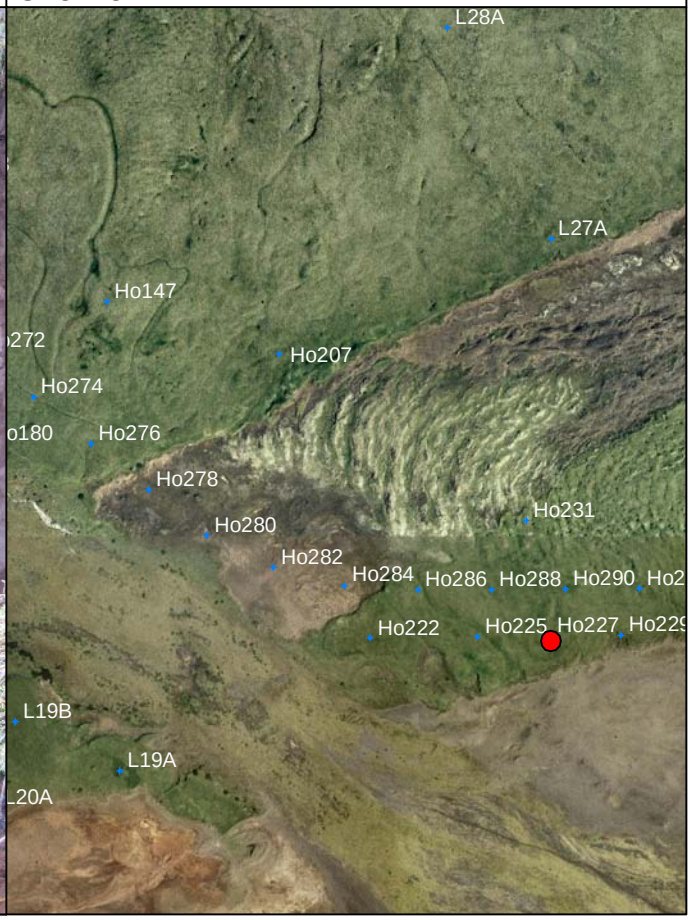
Explored: September 2006 - GÞG

Coordinates: X: 435742 Y: 389867 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
73		**Loess**					
	1,0		1,0				
72		**Loess** - with thin sand layers from 1,0 m					
	2,0		2,0				
71		**Scoria** at 2,5 m					
	3,0		3,0				
70							
	4,0		4,0				
69							
	5,0		5,0				
68							

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho229

Appendix: B | Page: B78

Explored: September 2006 - GÞG

Coordinates: X: 435837 Y: 389868 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
72	1,0	**Loess**
71	2,0	**Loess** - with thin sand layers from 1,0 m
70	3,0	
69	4,0	**Sand & gravel** from 3,0 m
68	5,0	**Scoria** at 4,6 m

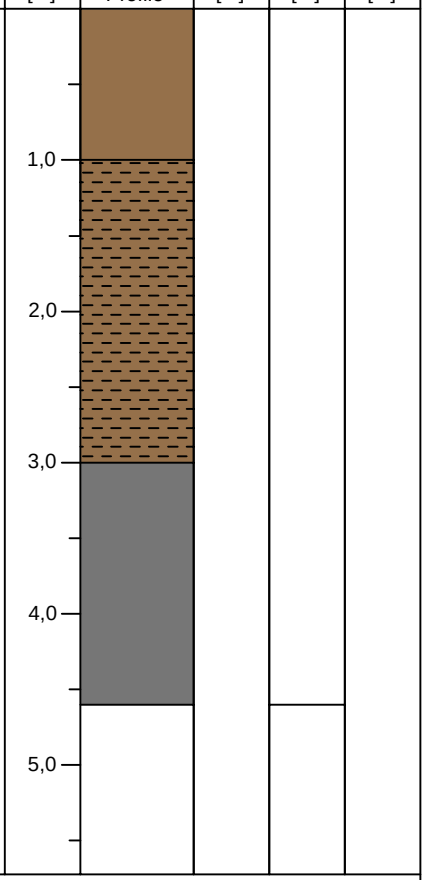
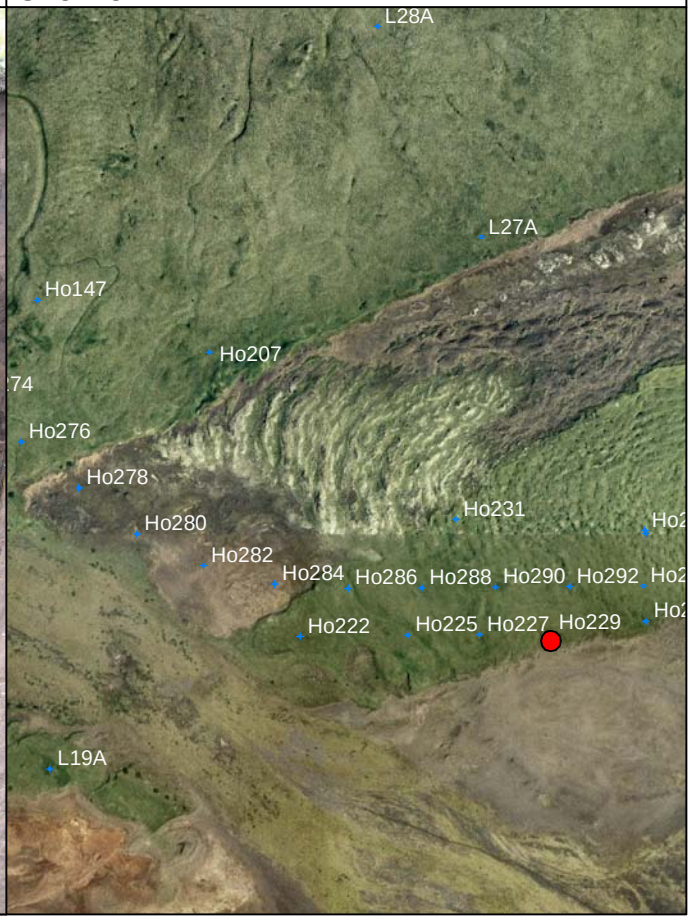


Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho292

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Explored: September 2006 - GÞG

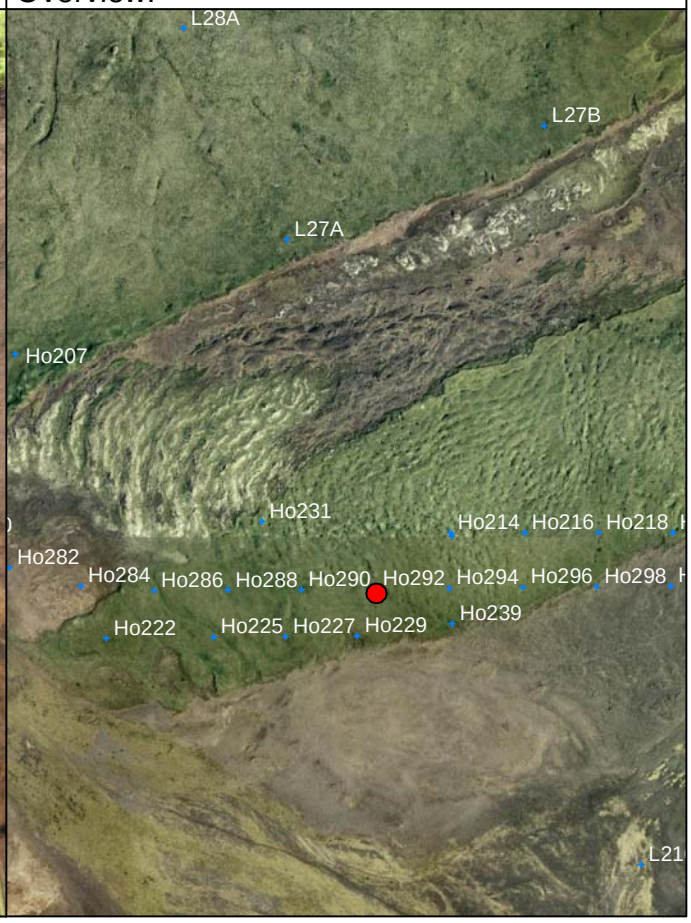
Coordinates: X: 435861 Y: 389930 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description
		Loess
73	1,0	**Loess** - with thin sand layers from 0,6 m
		Scoria at 1,9 m
72	2,0	
71	3,0	
70	4,0	
69	5,0	

Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
1,0				0,5-0,6
				1,5-1,7
2,0				
3,0				
4,0				
5,0				

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho294

Coordinates: X: 435958 Y: 389931 ISN-93

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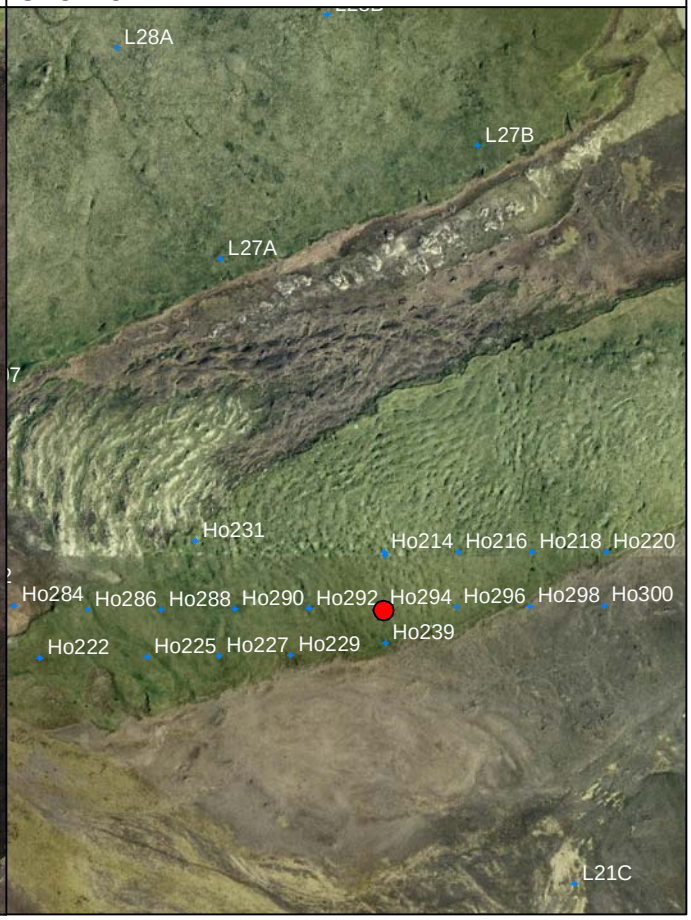
Explored: September 2006 - GÞG

Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
74	1,0	**Loess**	1,0				1,0-1,2
73	2,0	**Loess** - with thin sand layers from 1,2 m	2,0				2,0-2,2
72	3,0	**Scoria** at 3,0 m	3,0				
71	4,0		4,0				
70	5,0		5,0				

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho214

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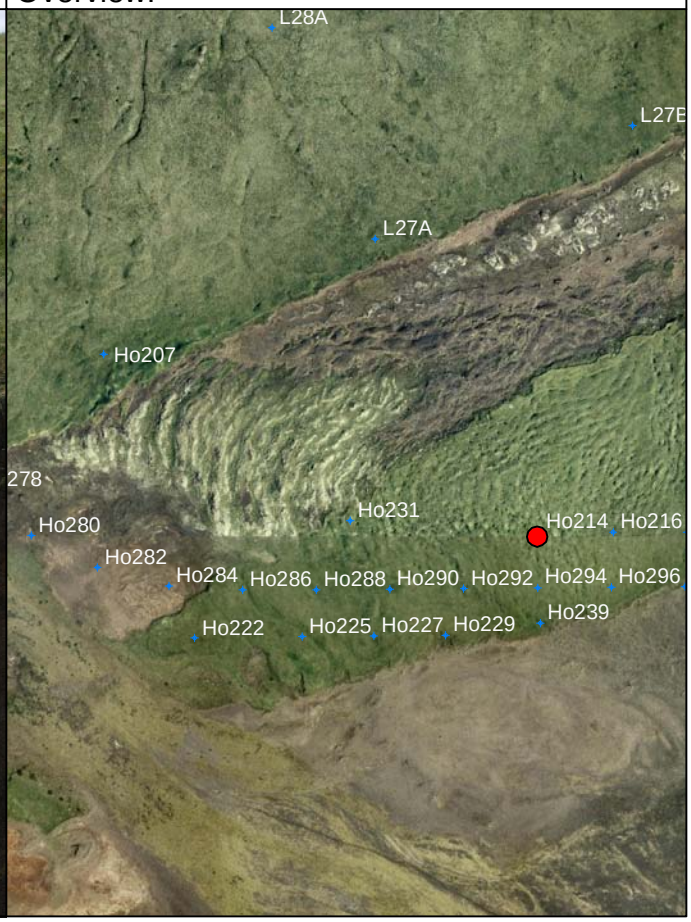
Explored: September 2006 - GÞG

Coordinates: X: 435960 Y: 390004 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
74		**Loess**					
	1,0	**Loess** - with thin sand layers	1,0				
73		**Scoria** at 1,5 m					
	2,0		2,0				
72							
	3,0		3,0				
71							
	4,0		4,0				
70							
	5,0		5,0				
69							

Photo:

Overview:



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Landsvirkjun

Hvammsvirkjun Hydroelectric Project

Ho239

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Explored: September 2006 - GÞG

Coordinates: X: 389884 Y: 435962 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
74	1,0	**Loess**	1,0				1,0-1,1
73	2,0	**Loess** - with thin sand layers from 1,2 m	2,0				2,0-2,2
72	3,0	**Scoria** at 3,0 m	3,0				
71	4,0		4,0				
70	5,0		5,0				

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho216

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Explored: September 2006 - GÞG

Coordinates: X: 436058 Y: 390004 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Loess					0,6-0,7
73	1,0		1,0				
		Loess - with thin sand layers from 0,7 m					
72	2,0		2,0				2,0-2,1
		Scoria at 2,2 m					
71	3,0		3,0				
70	4,0		4,0				
69	5,0		5,0				

Photo:

Overview:

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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho296

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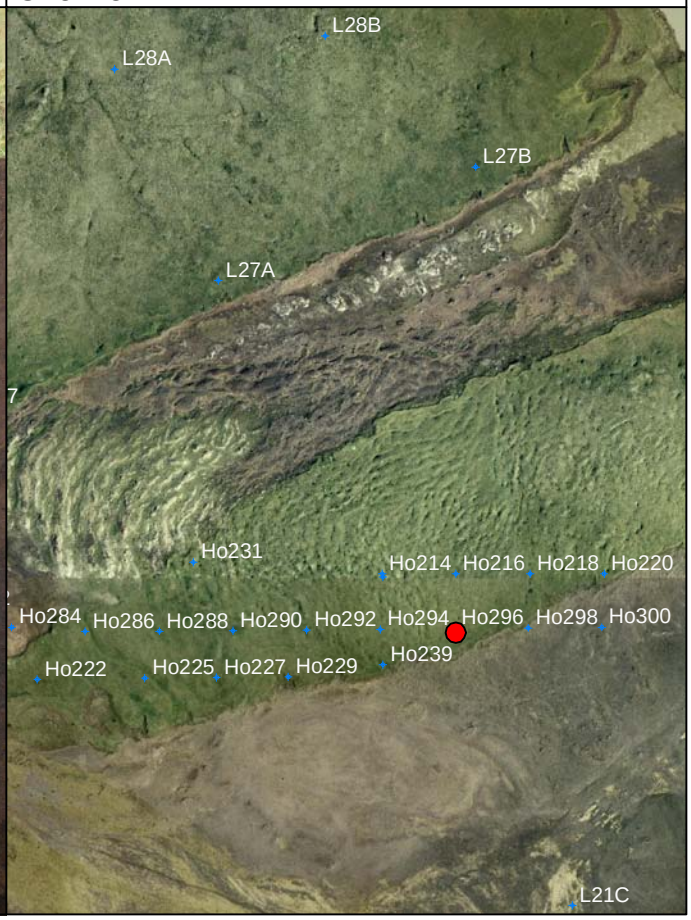
Explored: September 2006 - GÞG

Coordinates: X: 436056 Y: 389932 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
74		**Loess**					
	1,0		1,0				
73		**Loess** - with thin sand layers from 0,6 m					1,5-1,7
	2,0		2,0				
72		**Scoria** at 2,6 m					
	3,0		3,0				
71							
	4,0		4,0				
70							
	5,0		5,0				
69							

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho298

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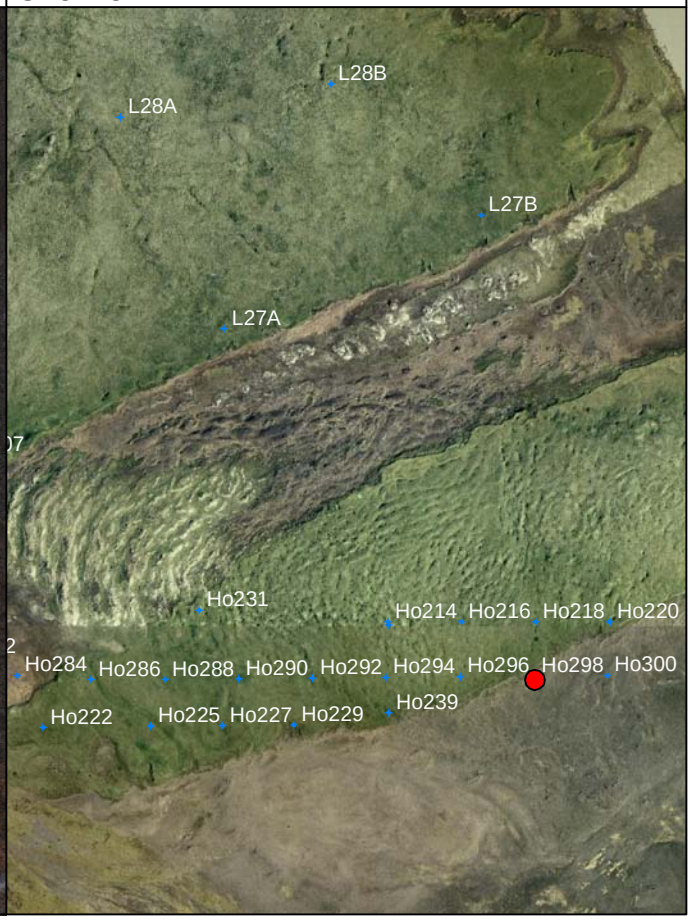
Explored: September 2006 - GÞG

Coordinates: X: 436154 Y: 389933 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Sand & gravel - with organic layers					
73	1,0	**Scoria** at 1,0 m	1,0				
72	2,0		2,0				
71	3,0		3,0				
70	4,0		4,0				
69	5,0		5,0				

Photo:

Overview:



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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho218

Appendix: B | Page: B86

Explored: September 2006 - GÞG

Coordinates: X: 436156 Y: 390004 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
74		**Loess**					
	1,0		1,0				0,9-1,1
73							1,5-1,7
		Loess - with thin sand layers from 1,2 m					
	2,0		2,0				
72		**Scoria** at 2,5 m					
	3,0		3,0				
71							
	4,0		4,0				
70							
	5,0		5,0				
69							

Photo:

Overview:

Almenna Consulting Engineers

Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho220

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Explored: September 2006 - GÞG

Coordinates: X: 436254 Y: 390004 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
		Loess					
74	1,0		1,0				1,0-1,2
		Loess - with thin sand layers from 1,2 m					
73	2,0		2,0				2,0-2,2
72	3,0	**Scoria** at 3,1 m	3,0				
71	4,0		4,0				
70	5,0		5,0				

Photo:

Overview:

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Landsvirkjun

Holtavirkjun Hydroelectric Project

Ho300

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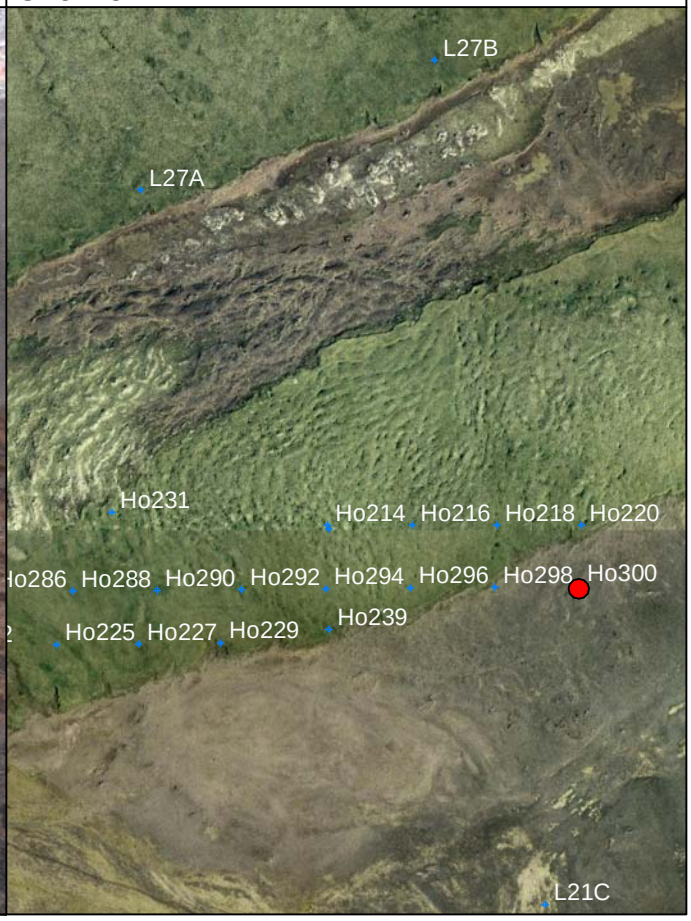
Explored: September 2006 - GÞG

Coordinates: X: 436251 Y: 389934 ISN-93 | Drawn: BK | Appr.: GÞG

Elev. [m.a.s.l.]	Depth [m]	Description	Depth [m]	Soil Profile	G.w.t. [m]	Bottom [m]	Sample [m]
73		**Sand & gravel** - with organic layers					
	1,0	**Scoria** at 1,0 m	1,0				
72							
	2,0		2,0				
71							
	3,0		3,0				
70							
	4,0		4,0				
69							
	5,0		5,0				
68							

Photo:

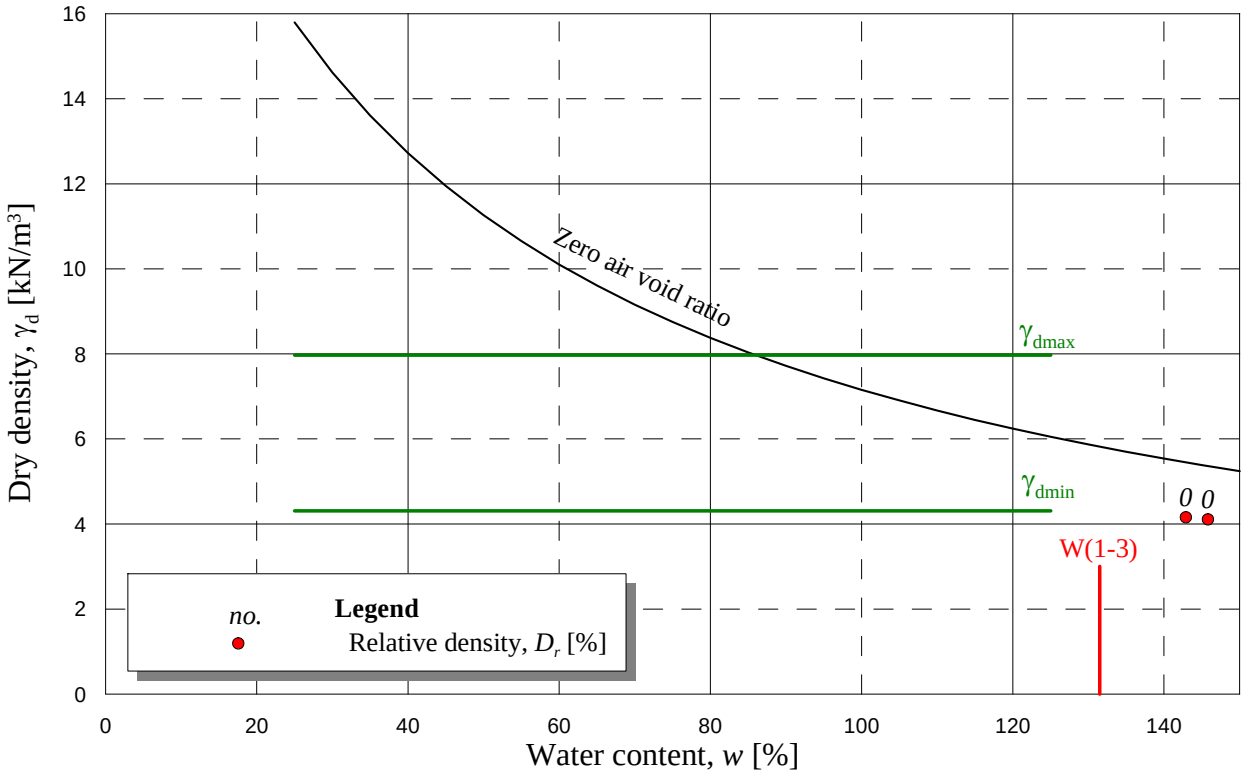
Overview:



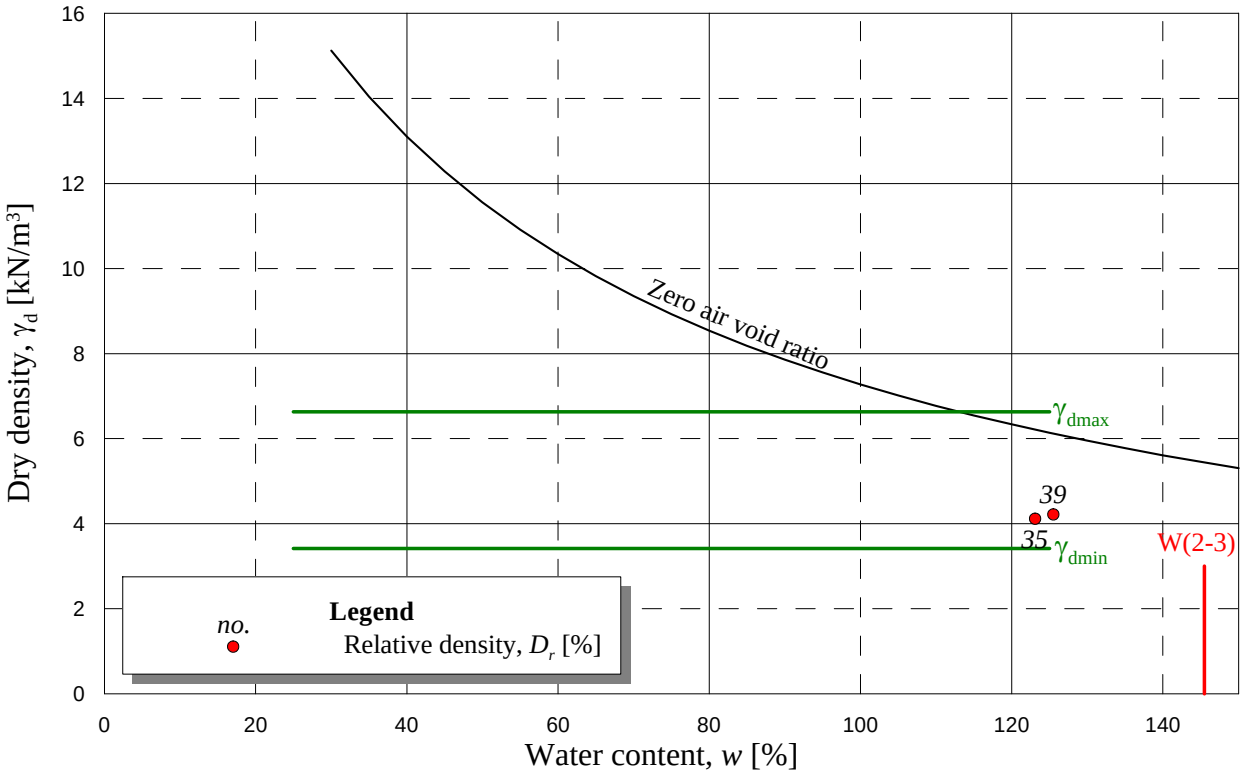
APPENDIX C

HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit L19A

Depth 1,2-1,35 m

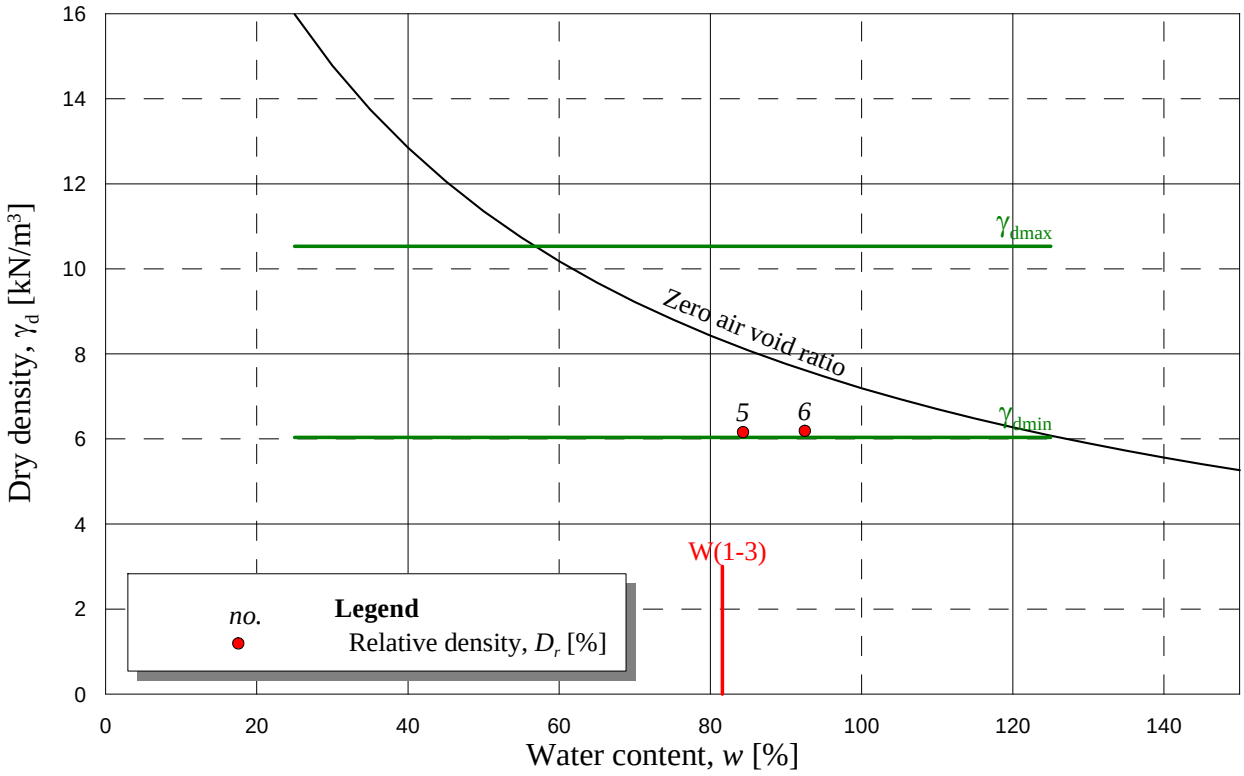


Depth 2,5-2,7 m



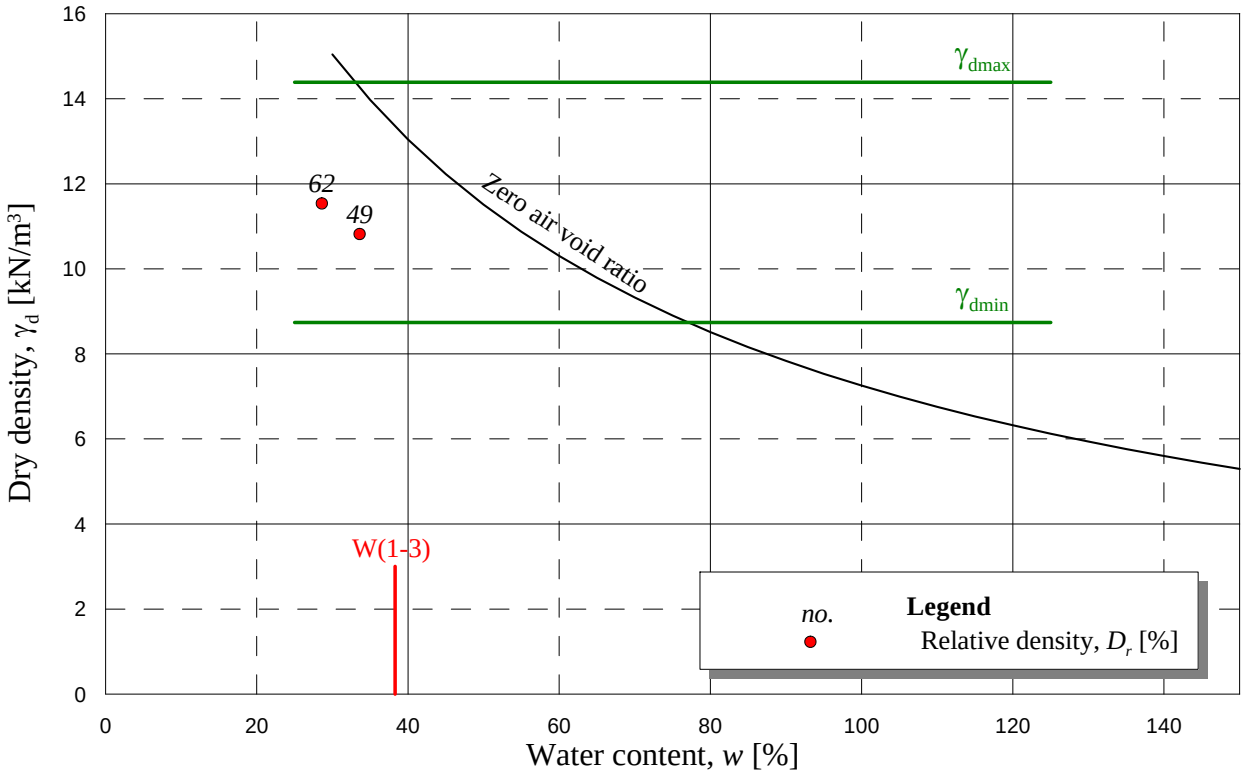
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit L28A

Depth 1,0-1,5 m

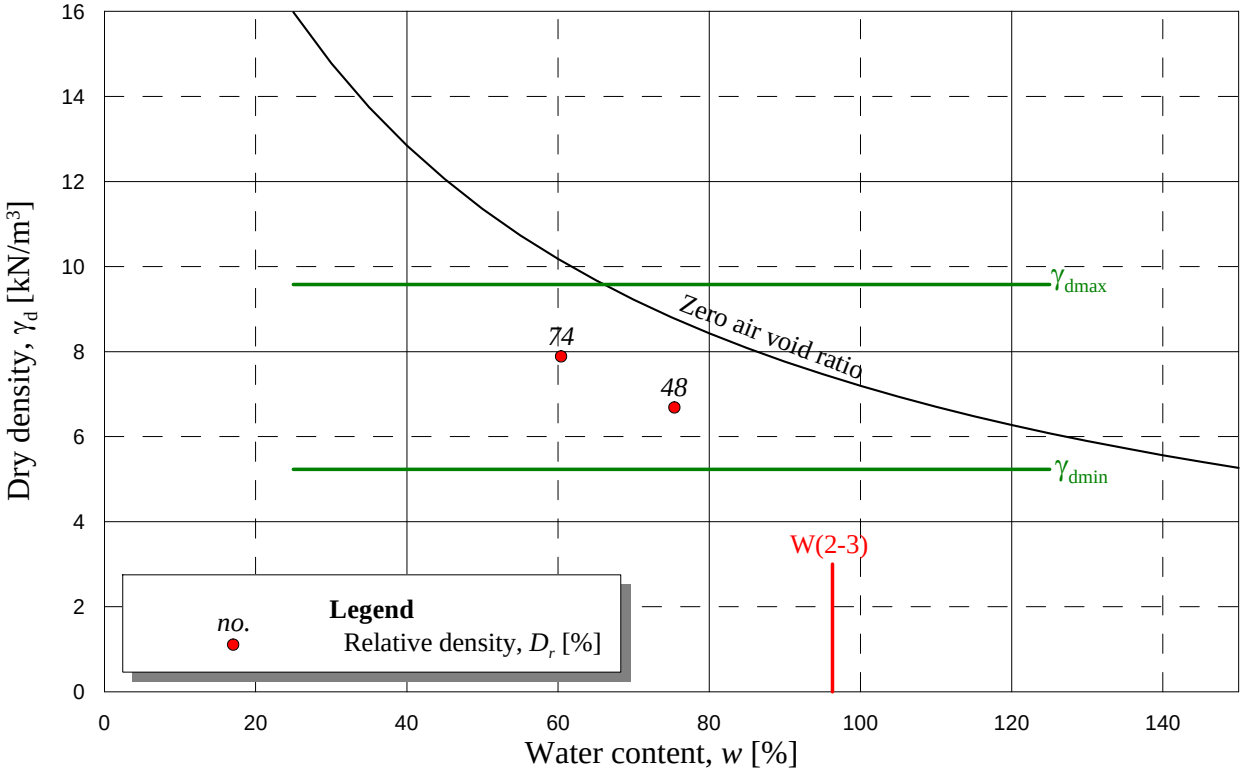


HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit Ho218

Depth 0,9-1,1 m

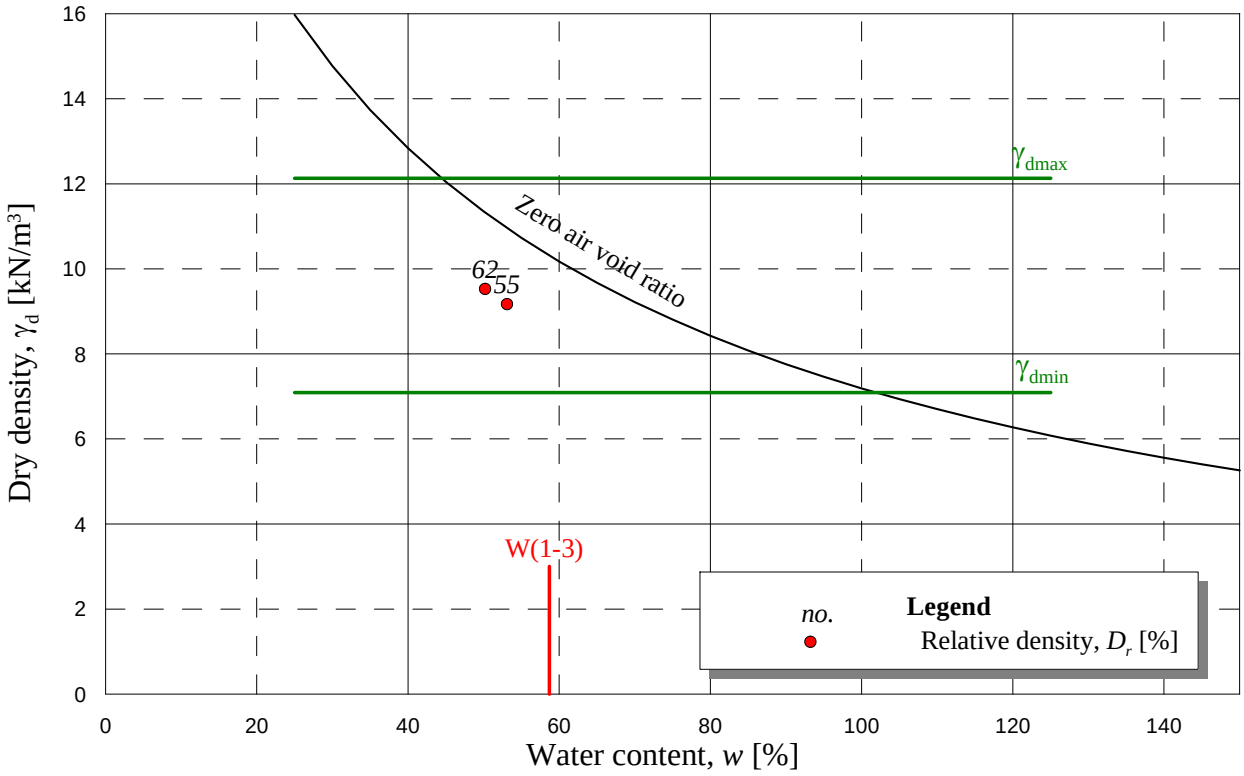


Depth 1,5-1,7 m

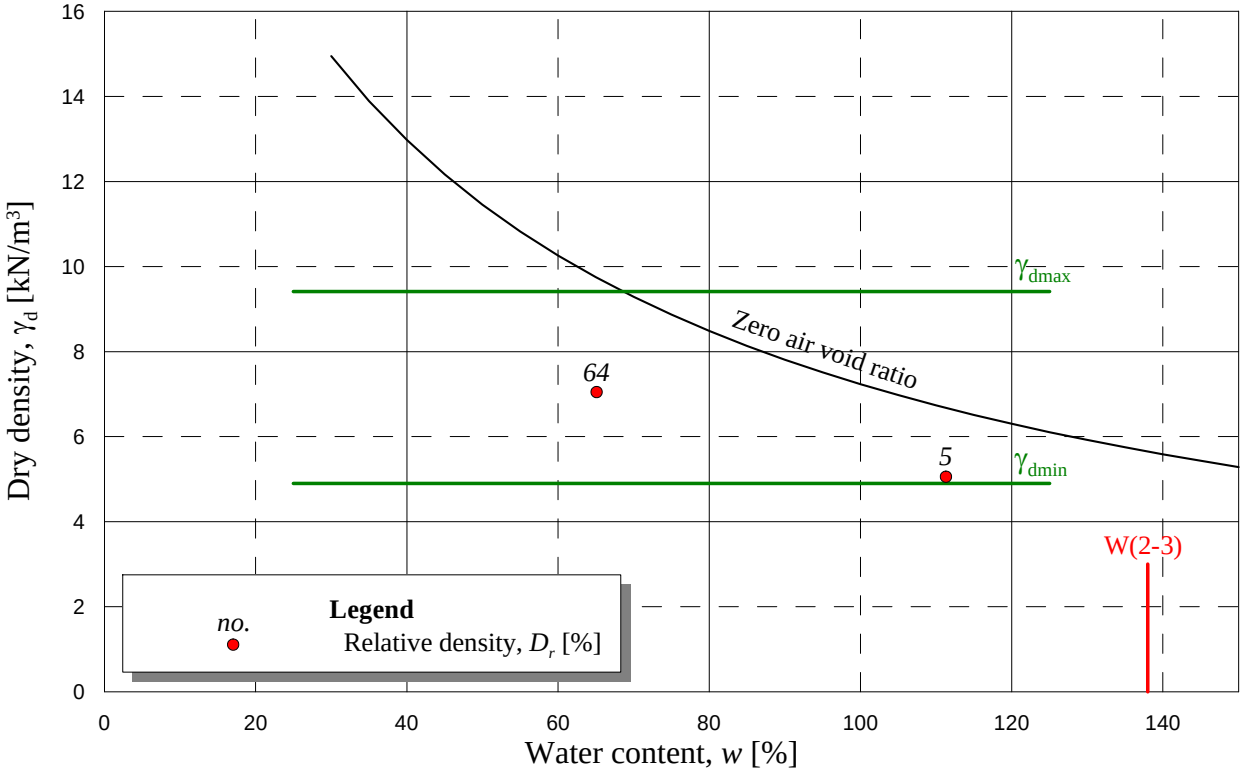


HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit Ho258

Depth 0,7-0,85 m

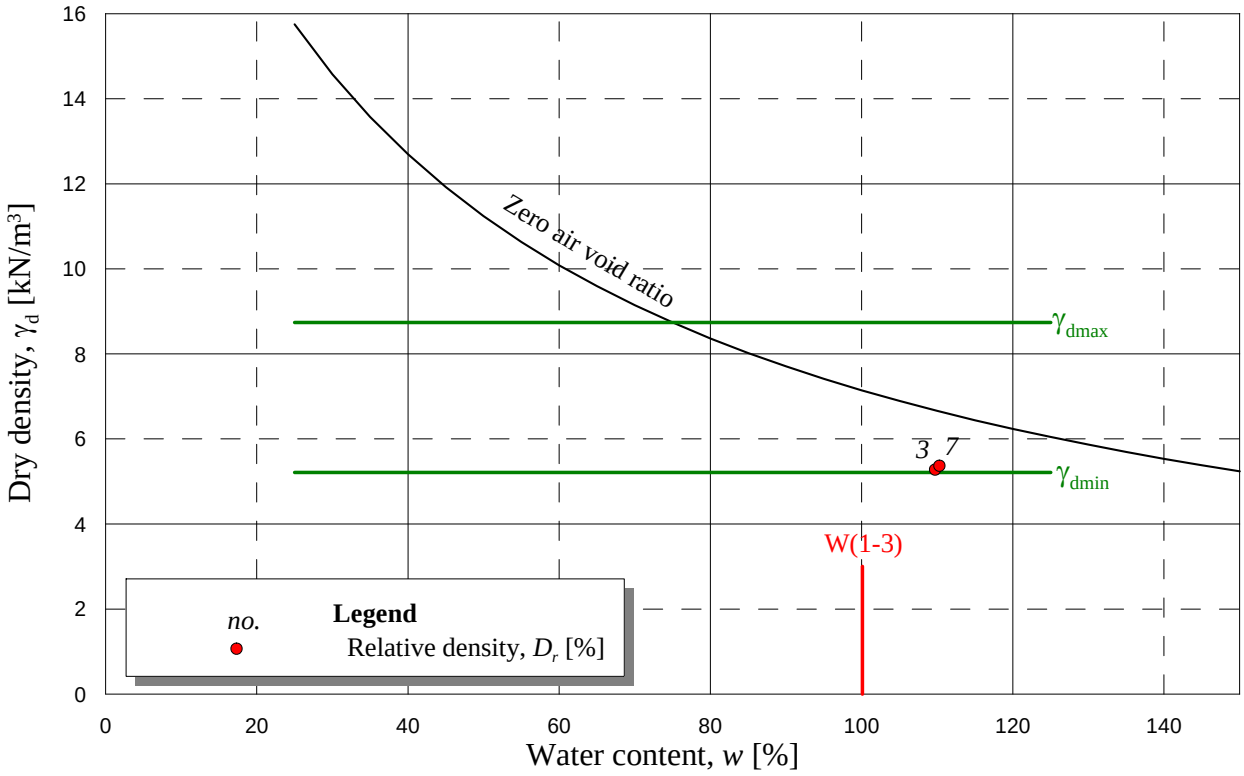


Depth 2,0-2,1 m



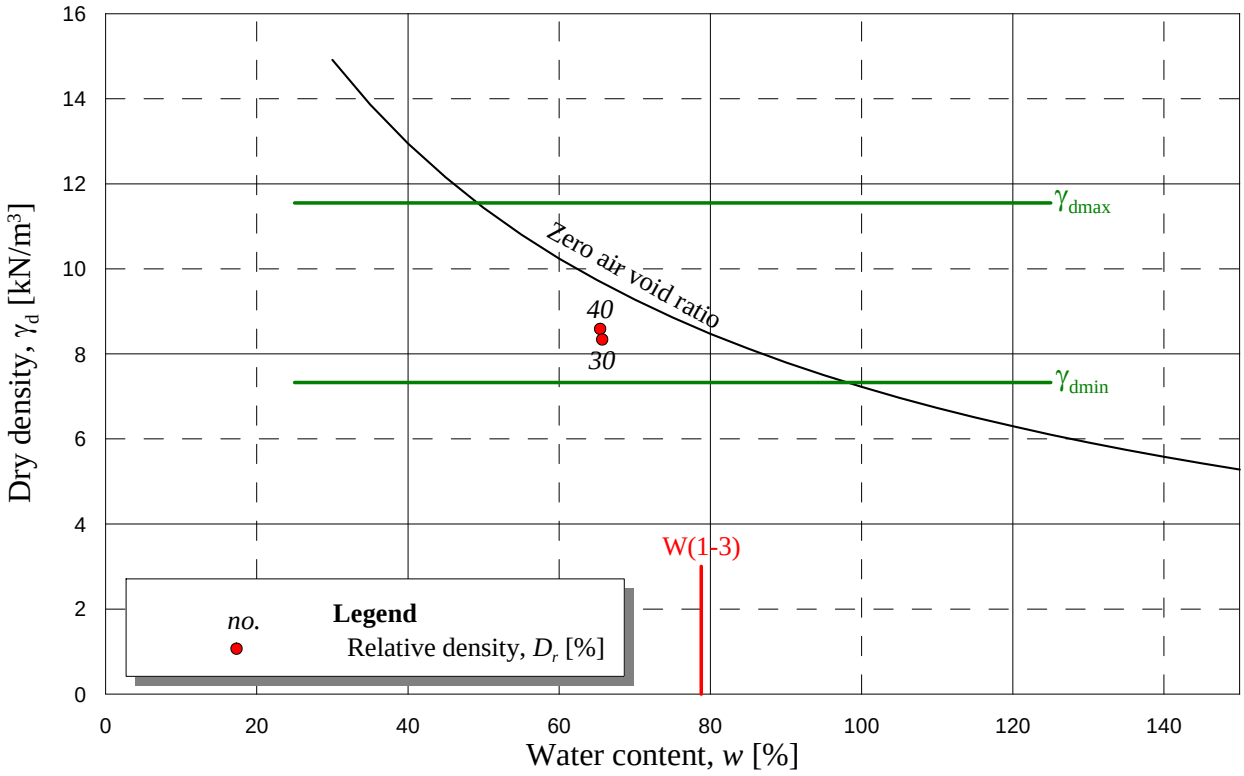
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit Ho265

Depth 1,0-1,2 m



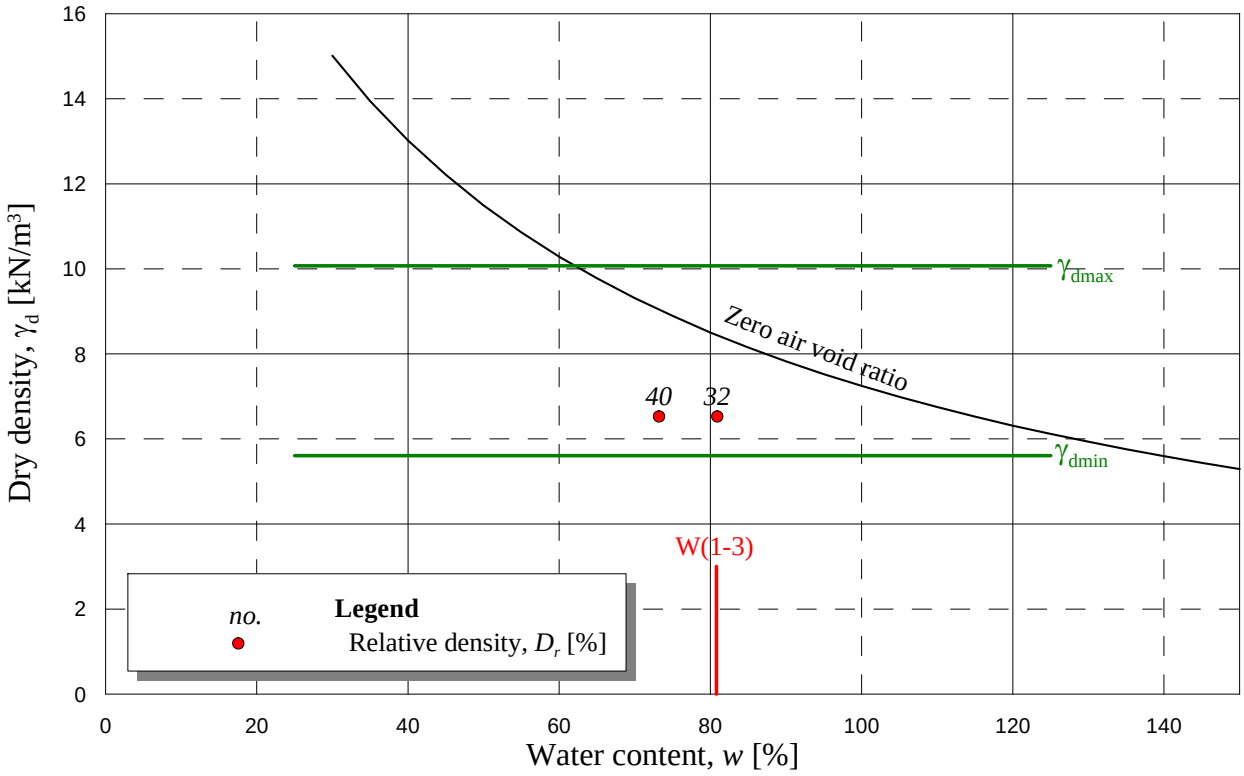
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit Ho270

Depth 1,0-1,2 m

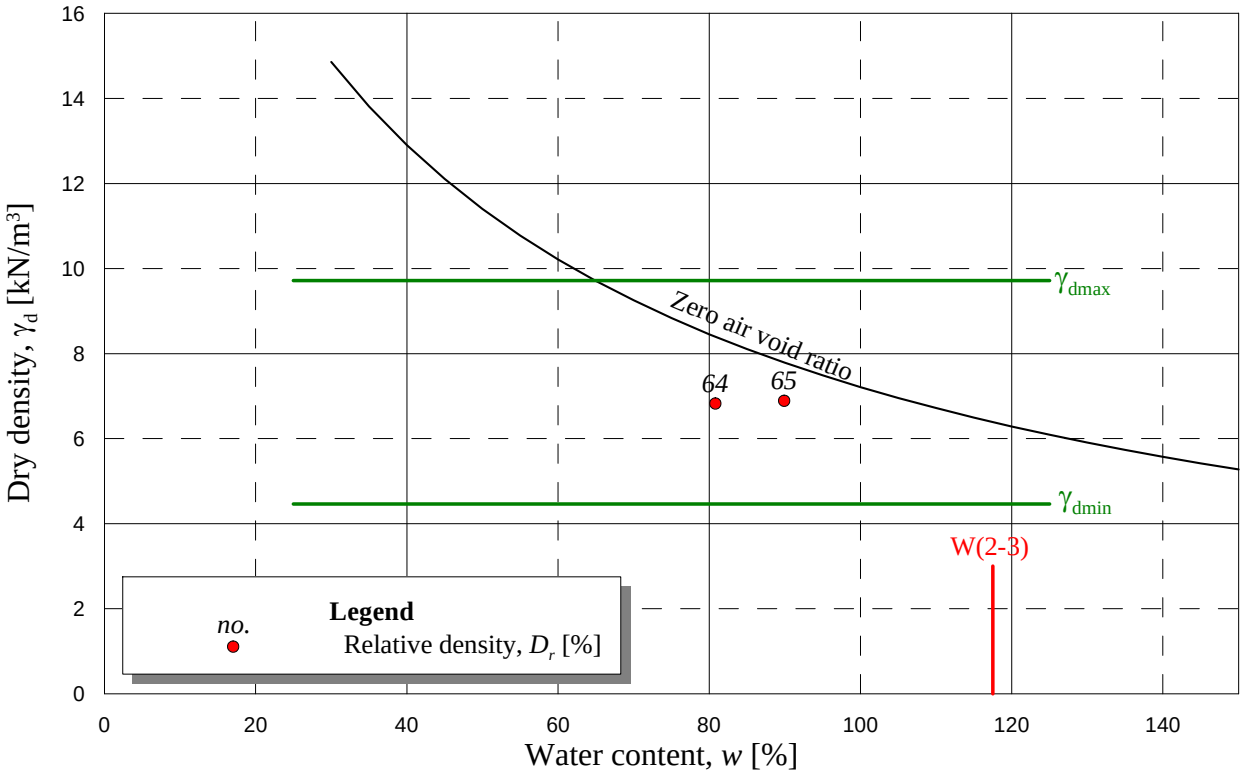


HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit Ho274

Depth 1,0-1,2 m

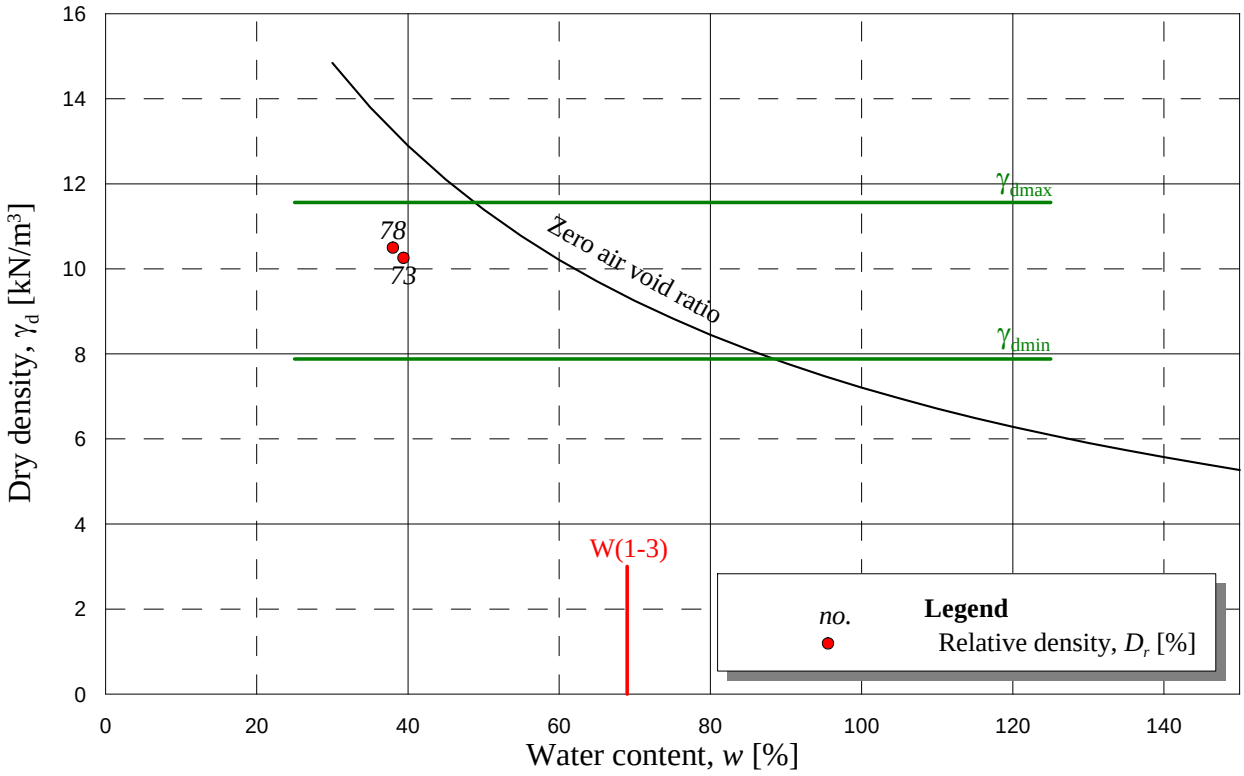


Depth 3,0-3,2 m



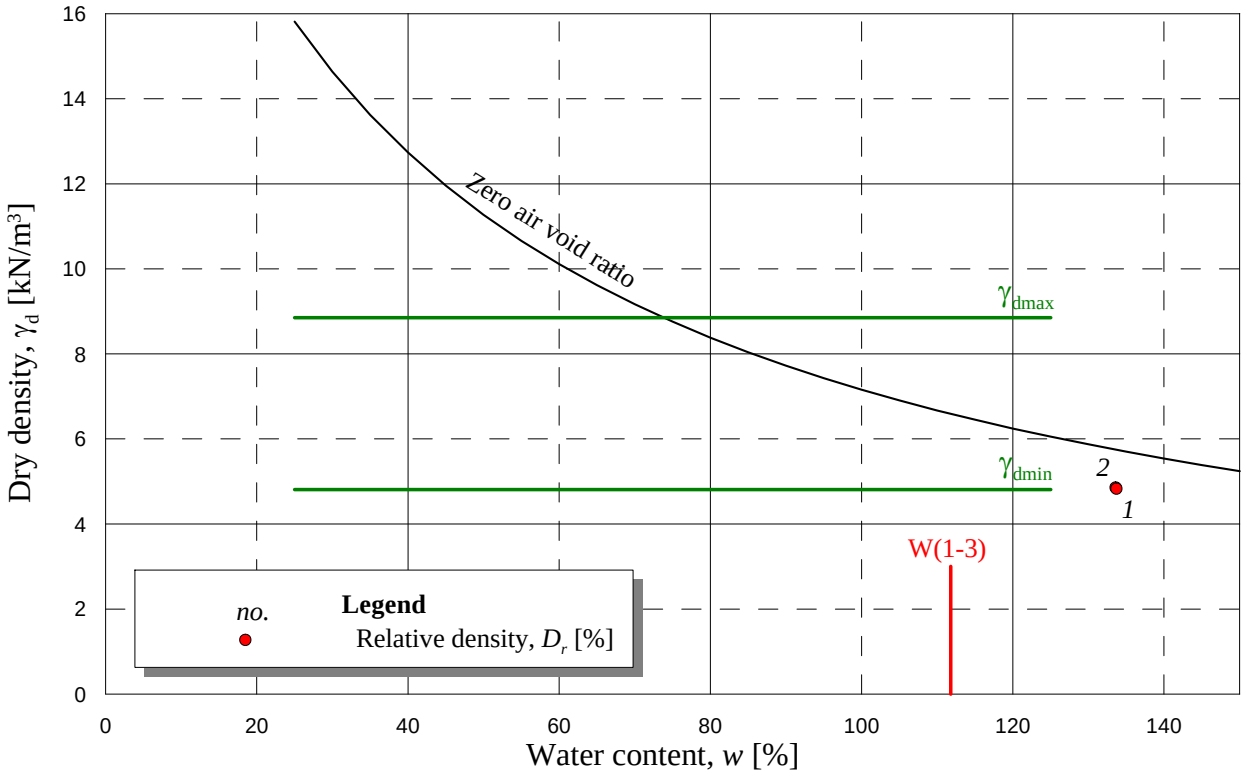
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit Ho286

Depth 0,8-0,95 m



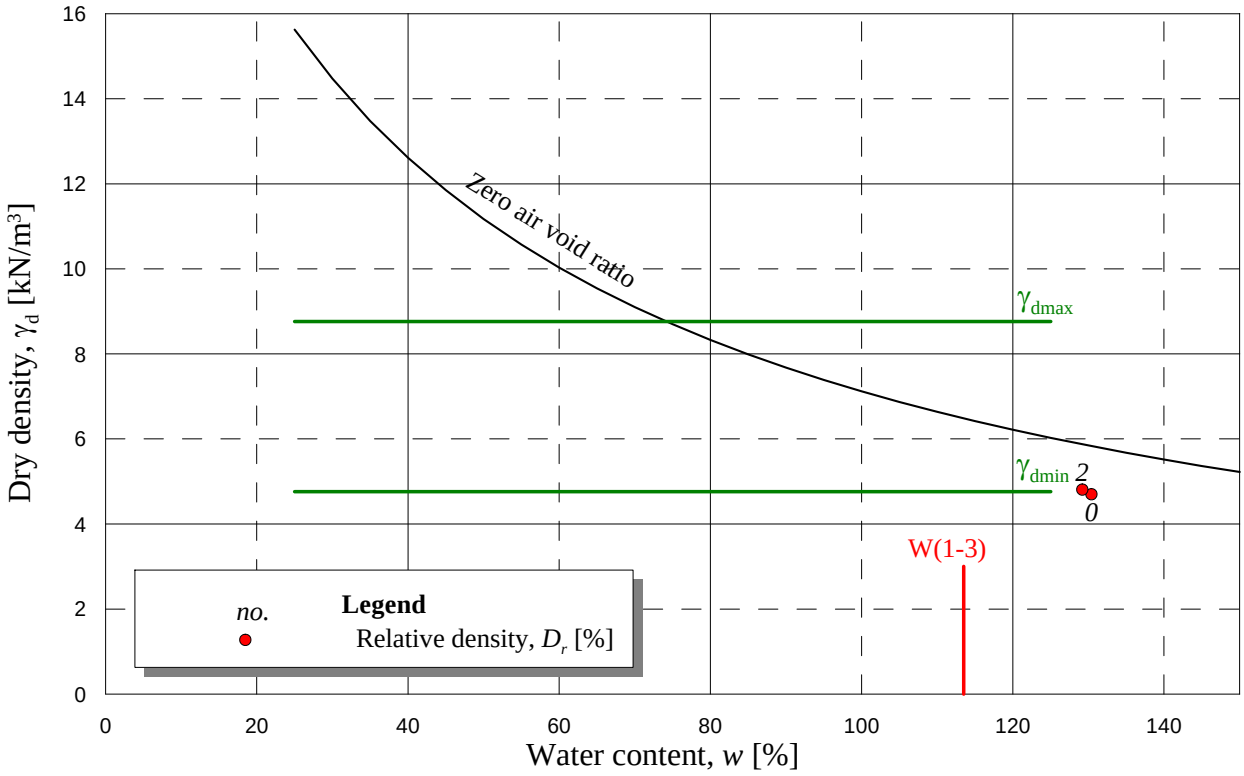
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit Ho290

Depth 1,3-1,45 m



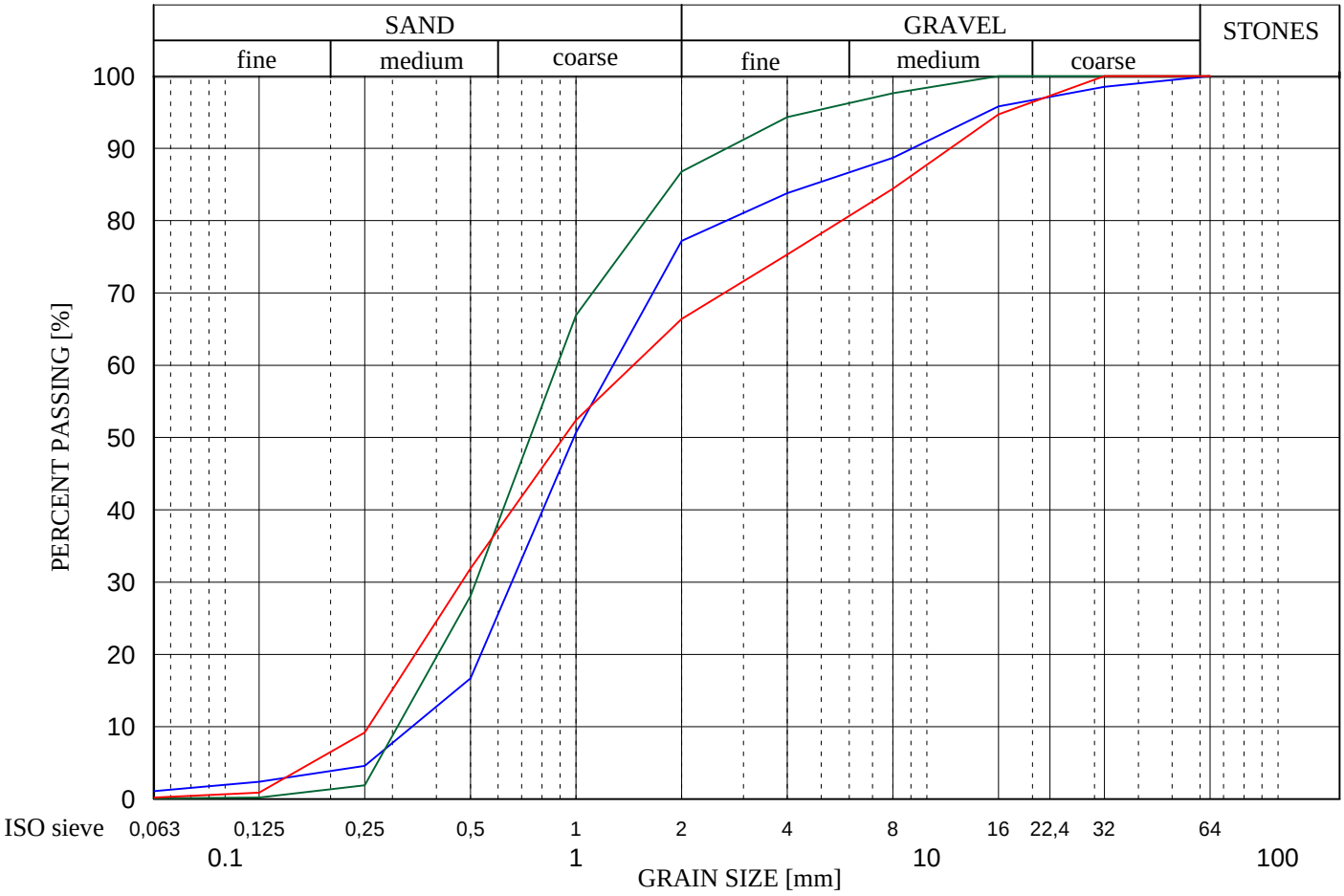
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Water content and density tests
Test pit Ho294

Depth 1,0-1,2 m



APPENDIX D

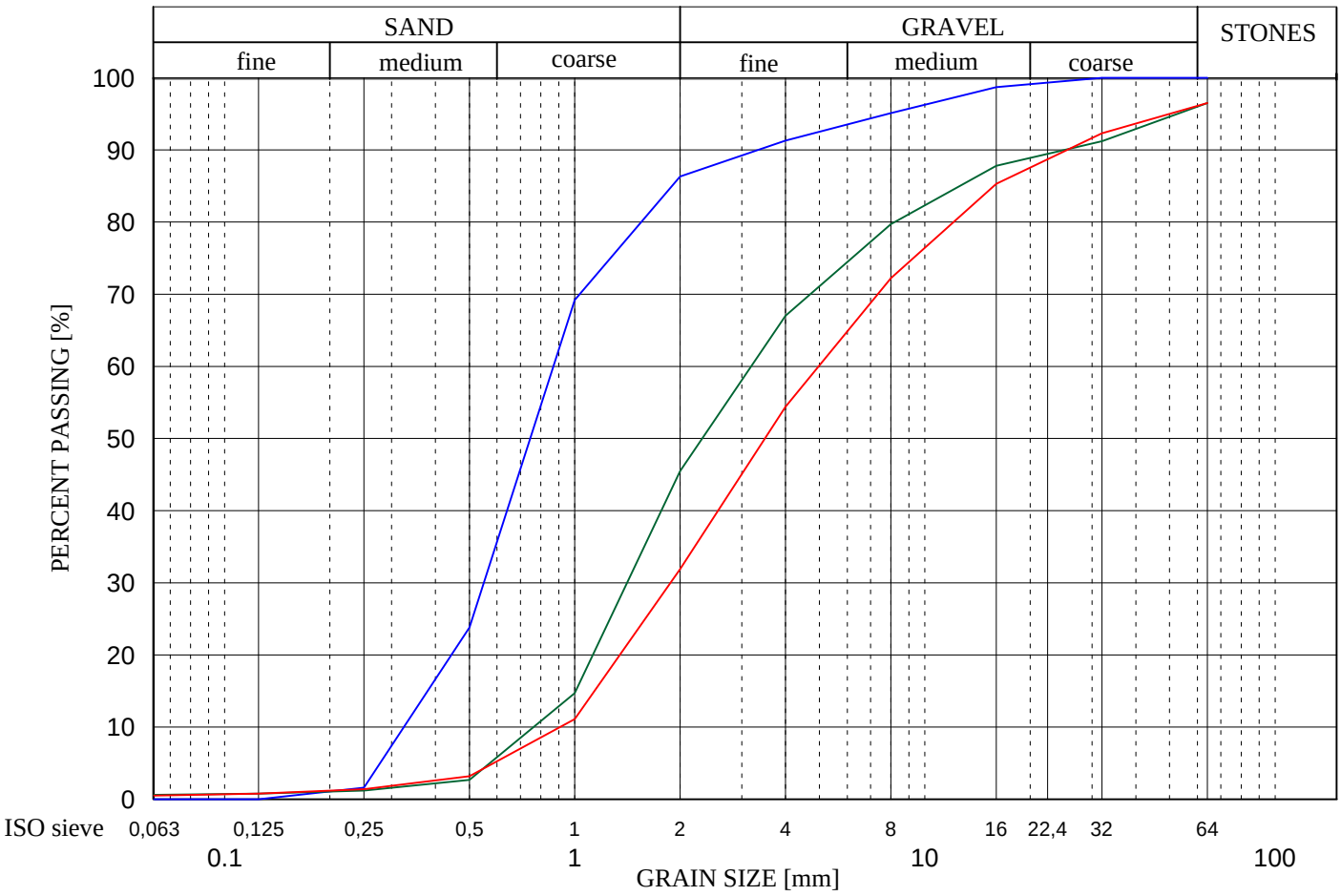
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pits L1A, L1B & L1C



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
L1A, 1,1-1,3m	0	1	9	32	52	66	75	84	95	100	100
L1B, 1,1-1,3m	0	0	2	28	67	87	94	98	100	100	100
L1C, 0,7-0,9m	1	2	5	17	51	77	84	89	96	99	100

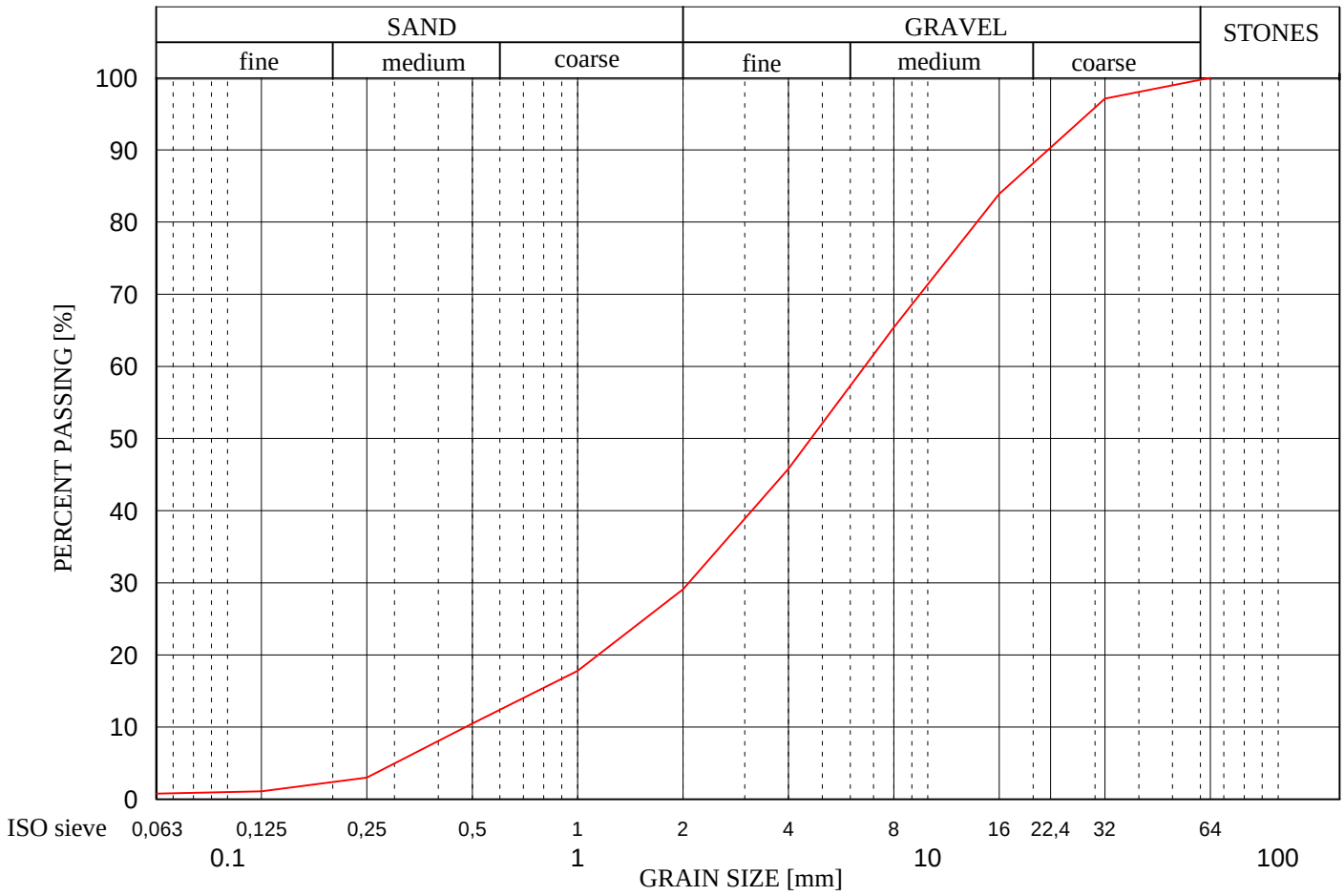
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pits S2A, S3A & S3B



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
S2A, 1,1-1,3m	1	1	1	3	11	32	54	72	85	92	97
S3A, 1,0-1,2m	1	1	1	3	15	46	67	80	88	91	97
S3B, 1,0-1,2m	0	0	2	24	69	86	91	95	99	100	100

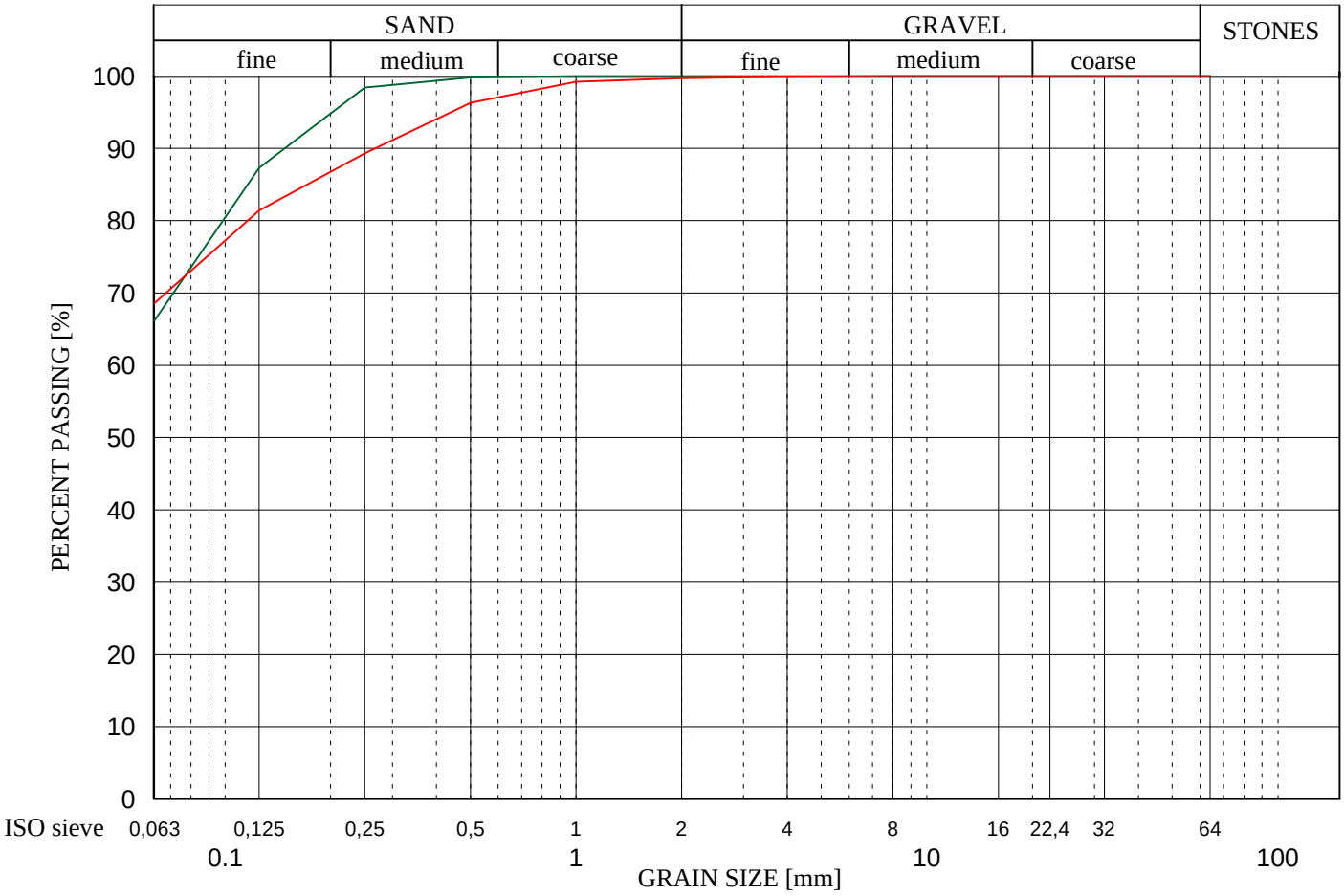
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Borrow area near Lækur



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
Læk. 0,4-0,6m	1	1	3	11	18	29	46	65	84	97	100

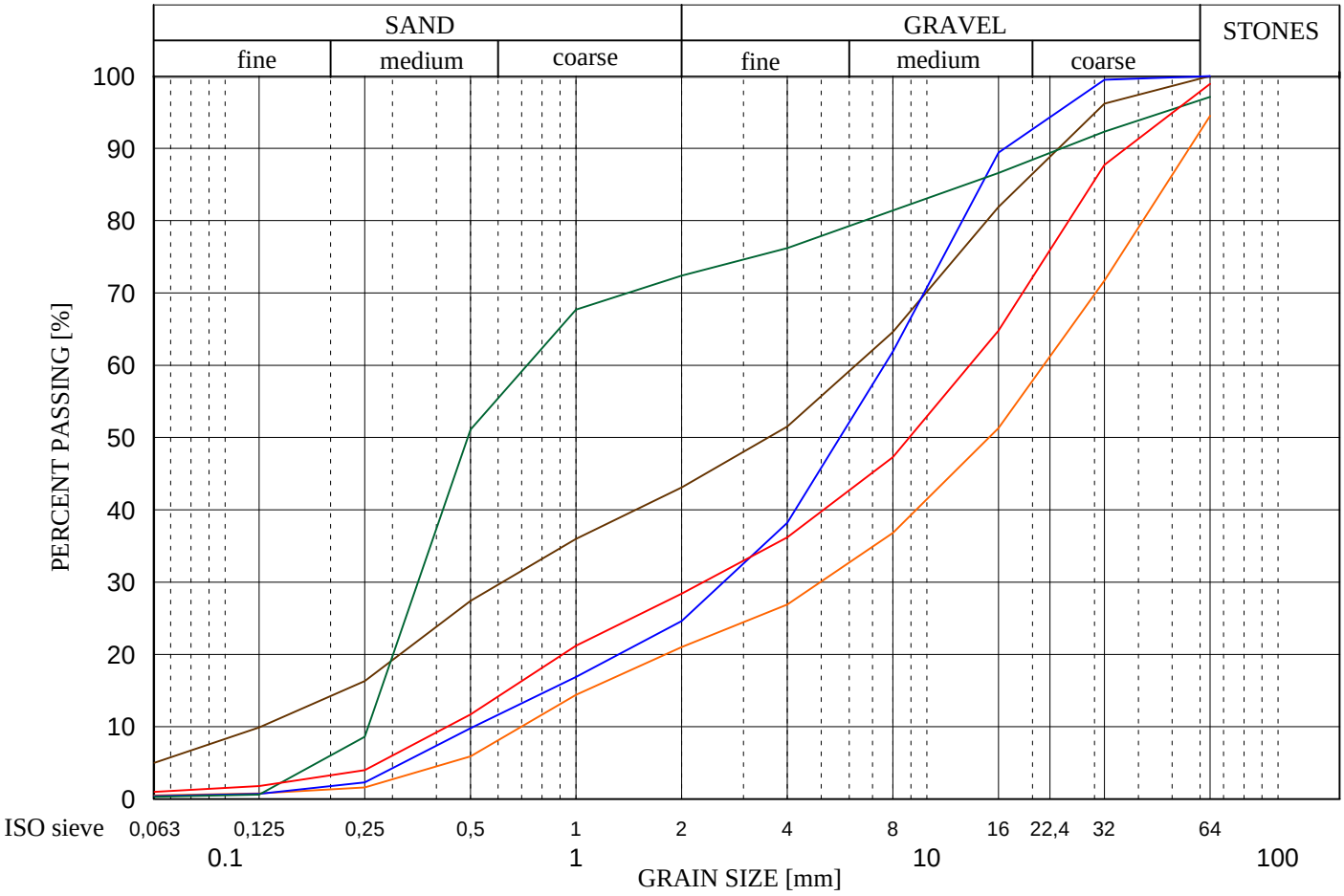
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pit L19A



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
L19A, 1,2-1,35m	69	81	89	96	99	100	100	100	100	100	100
L19A, 2,5-2,7m	66	87	98	100	100	100	100	100	100	100	100

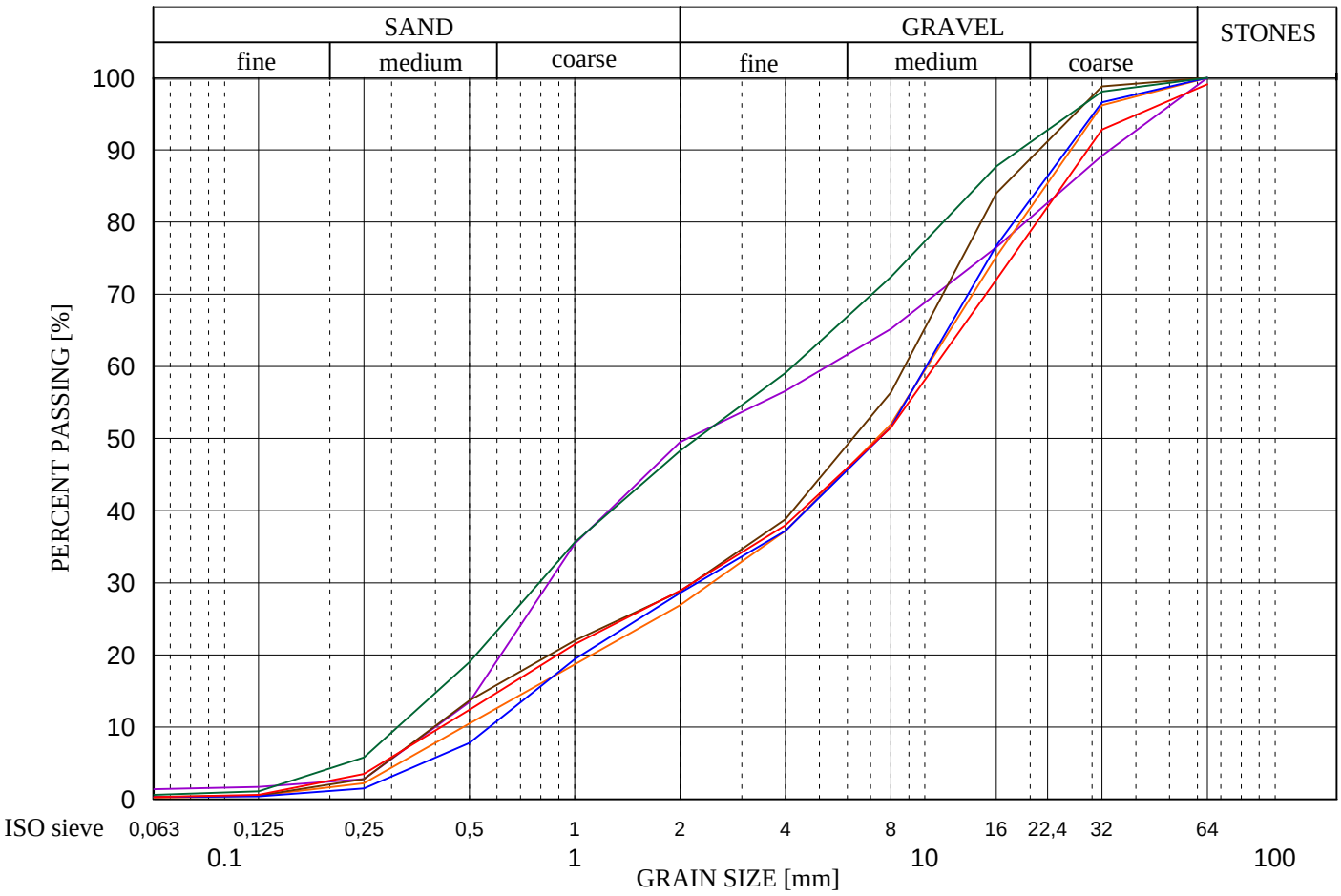
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pits L21A, L21B, L21D & L21E



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
L21A, 1,0-1,2m	1	2	4	12	21	28	36	47	65	88	99
L21A, 2,0-2,2m	0	1	9	51	68	72	76	81	87	92	97
L21B, 0,6-0,8m	0	1	2	10	17	25	38	62	89	100	100
L21D, 0,4-0,6m	5	10	16	27	36	43	52	65	82	96	100
L21E, 1,1-1,2m	1	1	2	6	14	21	27	37	51	72	95

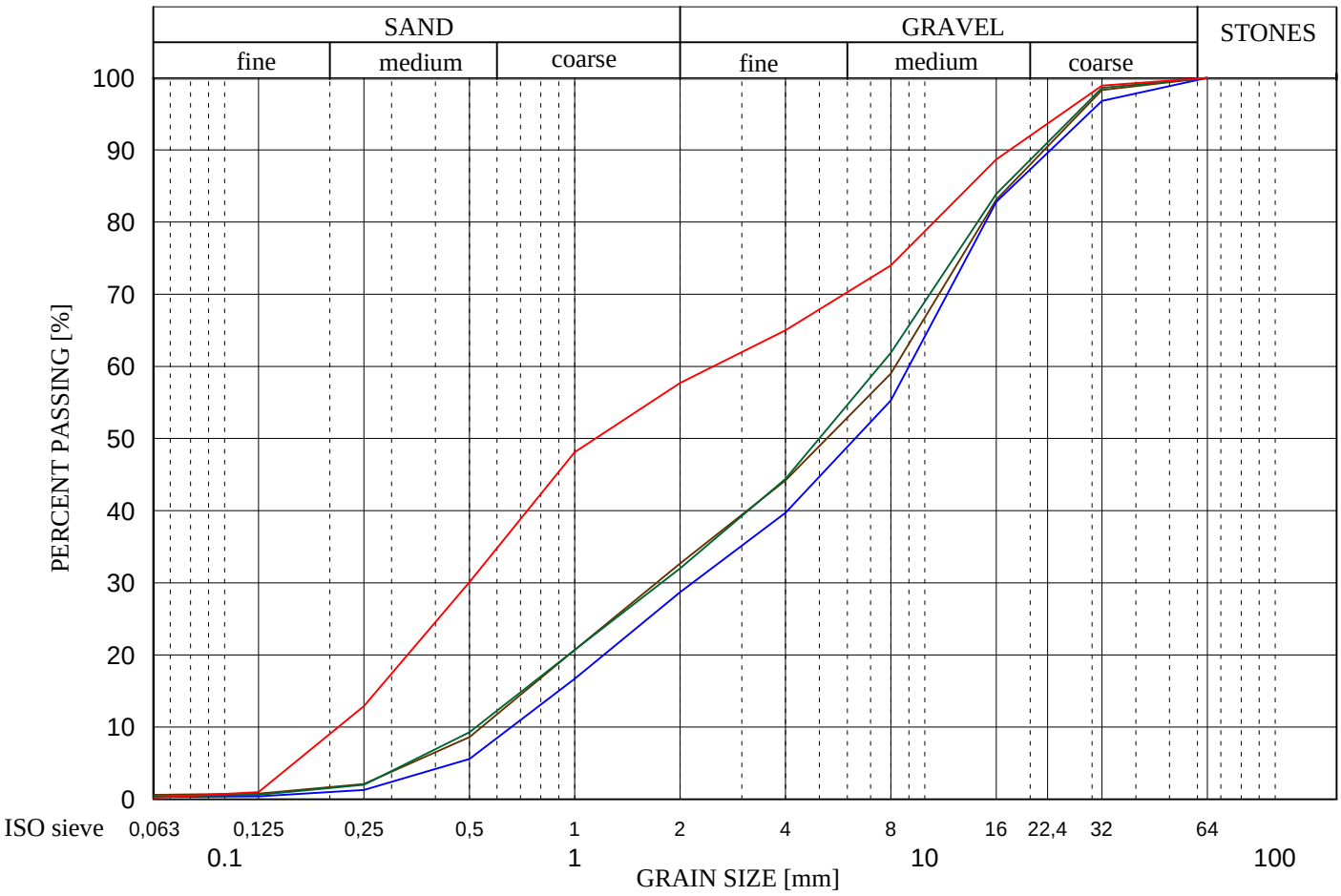
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pits L22A, L22B, L22C, L22D & L22E



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
L22A, 1,0-1,2m	0	1	4	12	22	29	38	52	72	93	99
L22B, 1,0-1,2m	1	1	6	19	36	48	59	72	88	98	100
L22C 0,6-0,75m	0	0	2	8	19	29	37	52	77	97	100
L22D, 1,0-1,2m	0	1	3	14	22	29	39	56	84	99	100
L22D, 2,0-2,2m	0	1	2	11	19	27	37	52	75	96	100
L22E, 1,0-1,3m			2	11	19	27	37	52	75	96	100

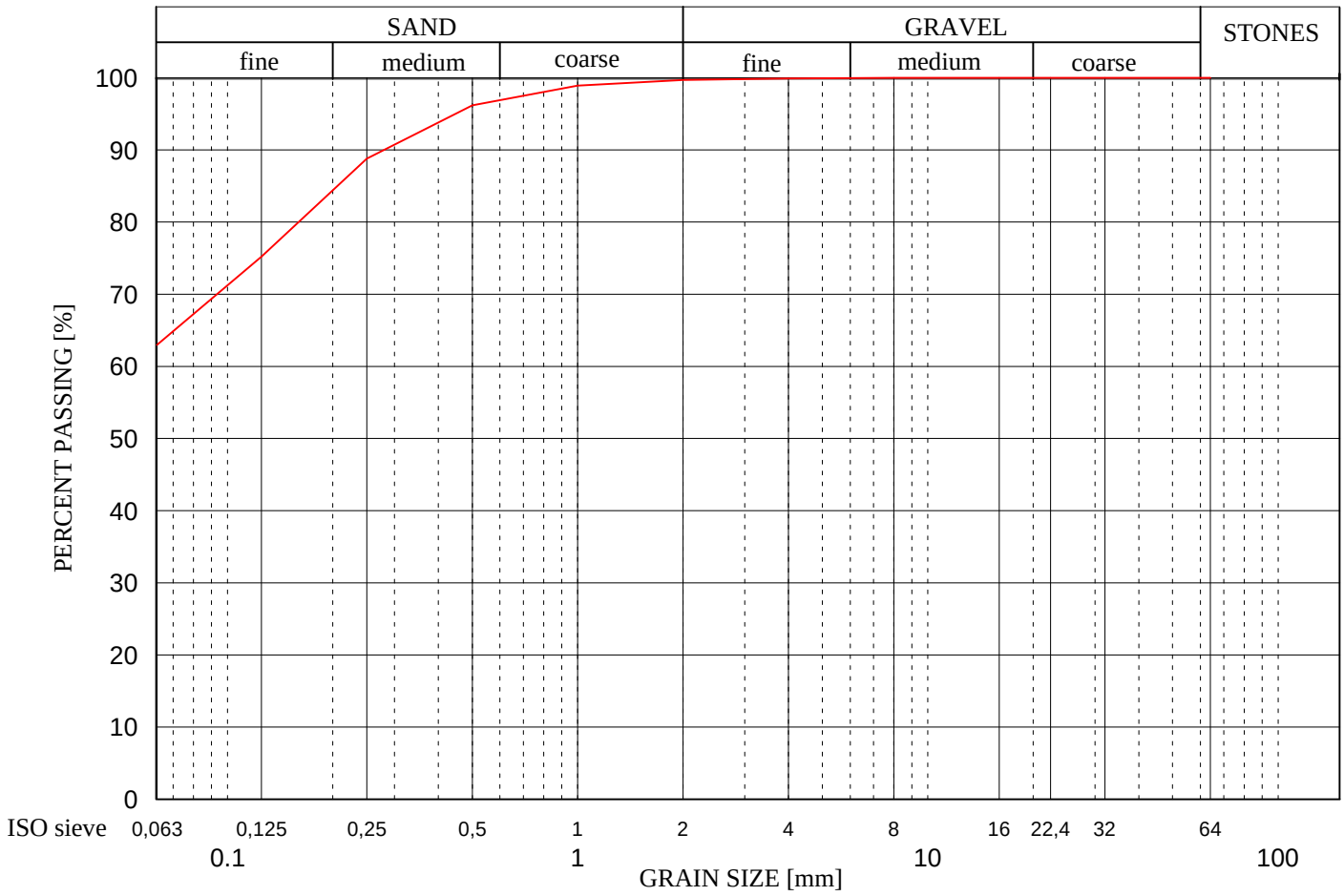
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pits L23A, L23B, L23C & L23D



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
L23A, 1,1-1,3m	0	1	13	30	48	58	65	74	89	99	100
L23B, 1,0-1,3m	0	1	2	9	21	32	44	62	84	99	100
L23C 1,3-1,5m	0	0	1	6	17	29	40	55	83	97	100
L23D, 1,3-1,5m	1	1	2	9	21	33	44	59	83	98	100

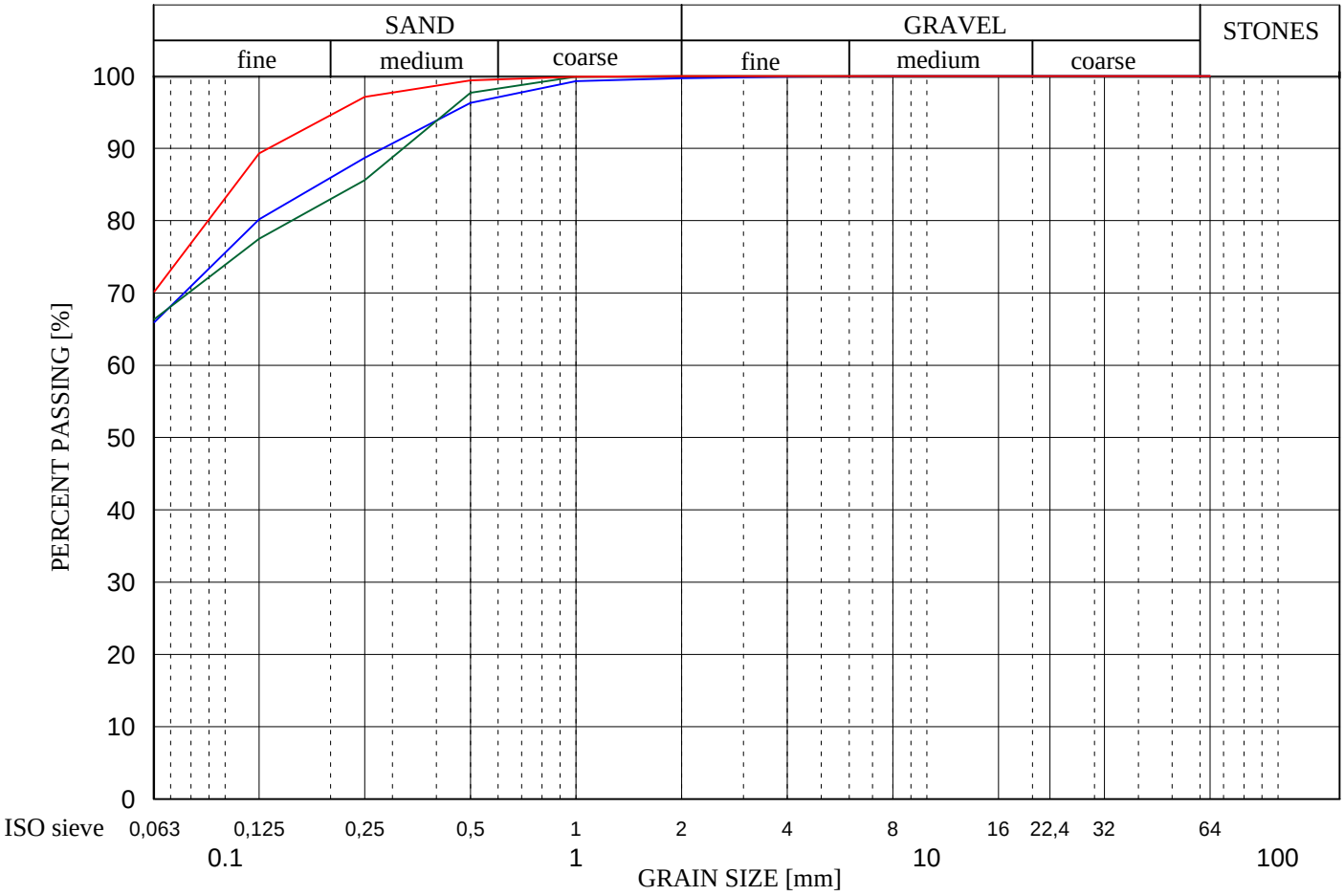
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pit L28A



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
L28A, 1,0-1,5m	63	75	89	96	99	100	100	100	100	100	100

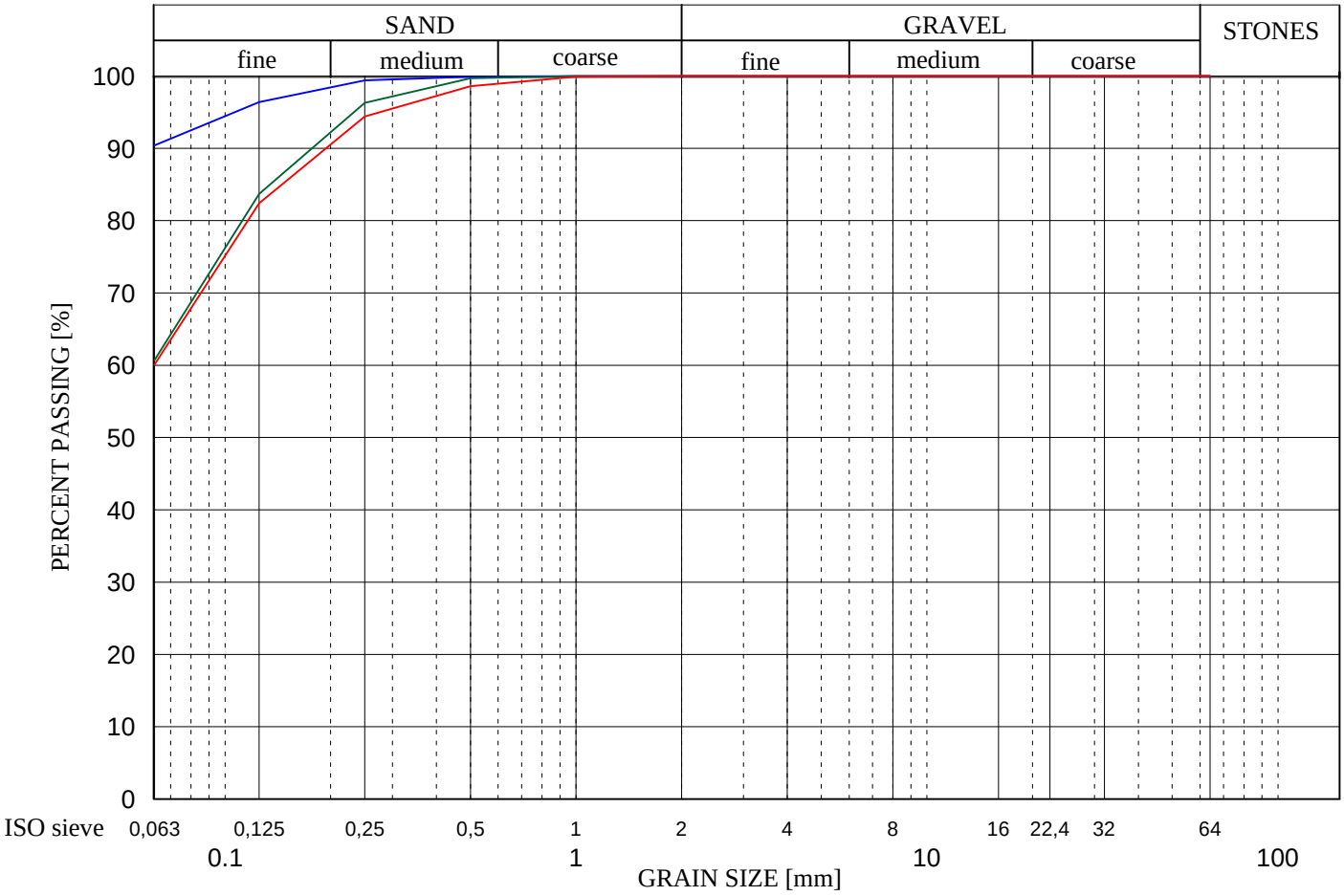
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pits Ho258 & Ho265



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
258, 0,7-0,85m	70	89	97	99	100	100	100	100	100	100	100
258, 2,0-2,1m	66	78	86	98	100	100	100	100	100	100	100
265, 1,0-1,2m	66	80	89	96	99	100	100	100	100	100	100

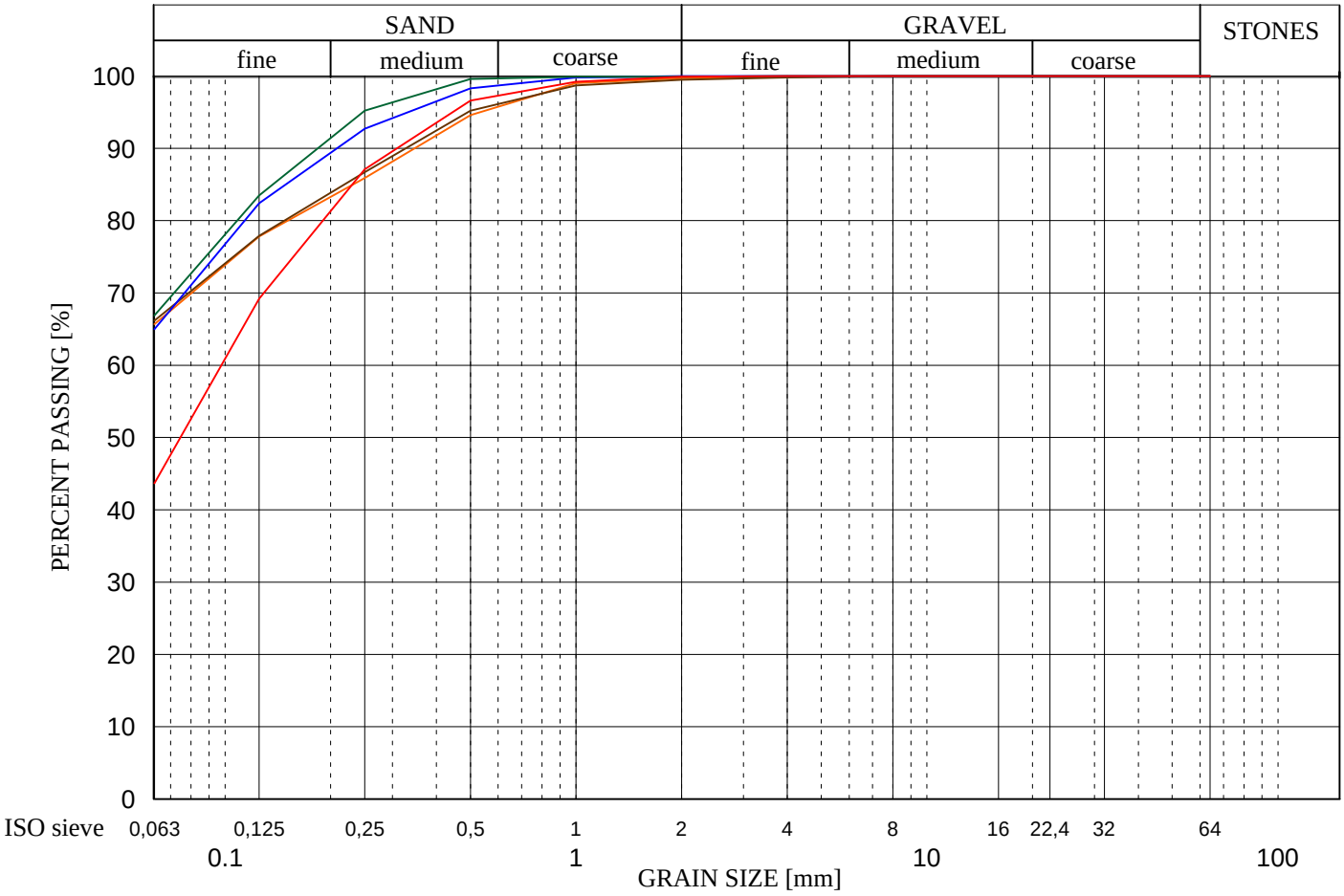
HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pits Ho270 & Ho274



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
270, 1,0-1,2m	60	82	94	99	100	100	100	100	100	100	100
274, 1,0-1,2m	61	84	96	100	100	100	100	100	100	100	100
274, 3,0-3,2m	90	96	99	100	100	100	100	100	100	100	100

HOLTAVIRKJUN
HYDROELECTRIC PROJECT
Grain size distributions
Test pits Ho218, Ho286, Ho290 & Ho294



MEASURED VALUES:

Sieve no.	0,063	0,125	0,25	0,5	1	2	4	8	16	32	64
218, 0,9-1,1m	44	69	87	97	99	100	100	100	100	100	100
218, 1,5-1,7m	67	84	95	100	100	100	100	100	100	100	100
286, 0,8-0,95m	65	82	93	98	100	100	100	100	100	100	100
290, 1,3-1,45	66	78	87	95	99	100	100	100	100	100	100
294, 1,0-1,2m	66	78	86	95	99	100	100	100	100	100	100

APPENDIX E

Groundwater table from piezometer measurements

Borehole (No.)	Elevation (m a. s. l)	Date (dd.mm.yr)	Measured depth (m)	Groundwater table (m a. s. l)
L1A	56,7	2.11.2006	2,3	54,4
L1A	56,7	6.11.2006	2,0	54,8
L1A	56,7	9.11.2006	2,1	54,6
L1A	56,7	9.11.2006	2,3	54,4
L1B	58,0	2.11.2006	2,8	55,2
L1B	58,0	6.11.2006	2,5	55,5
L1B	58,0	9.11.2006	2,7	55,3
L1B	58,0	9.11.2006	2,8	55,2
L21E	71,7	2.11.2006	2,1	69,6
L21E	71,7	4.11.2006	1,9	69,8
L21E	71,7	6.11.2006	1,8	70,0
L21E	71,7	9.11.2006	1,9	69,8
L22A	70,1	2.11.2006	1,5	68,6
L22A	70,1	4.11.2006	1,3	68,8
L22A	70,1	6.11.2006	1,2	68,9
L22A	70,1	9.11.2006	1,3	68,8
L22B	70,2	2.11.2006	2,2	68,0
L22B	70,2	4.11.2006	2,0	68,2
L22B	70,2	6.11.2006	1,8	68,5
L22B	70,2	9.11.2006	1,8	68,5
L22C	70,7	2.11.2006	2,9	67,8
L22C	70,7	4.11.2006	3,7	67,0
L22C	70,7	6.11.2006	2,4	68,2
L22C	70,7	9.11.2006	2,5	68,1
L22D	71,0	2.11.2006	2,9	68,1
L22D	71,0	4.11.2006	2,7	68,3
L22D	71,0	6.11.2006	2,4	68,5
L22D	71,0	9.11.2006	2,5	68,5
L22E	70,0	2.11.2006	1,3	68,7
L22E	70,0	4.11.2006	1,2	68,8
L22E	70,0	6.11.2006	1,1	68,9
L22E	70,0	9.11.2006	1,2	68,8
L23A	69,6	2.11.2006	1,6	68,0
L23A	69,6	4.11.2006	1,5	68,2
L23A	69,6	6.11.2006	1,3	68,3
L23A	69,6	9.11.2006	1,4	68,2
L23C	70,5	2.11.2006	1,3	69,2
L23C	70,5	4.11.2006	1,2	69,3
L23C	70,5	6.11.2006	1,0	69,5
L23C	70,5	9.11.2006	1,1	69,4
L23D	70,1	2.11.2006	2,1	68,0
L23D	70,1	4.11.2006	2,0	68,2
L23D	70,1	6.11.2006	1,9	68,3
L23D	70,1	9.11.2006	2,0	68,2
S3A	57,2	2.11.2006	2,7	54,5
S3A	57,2	6.11.2006	2,6	54,6
S3A	57,2	9.11.2006	2,6	54,6
S3A	57,2	9.11.2006	2,7	54,5
S3B	57,2	2.11.2006	1,6	55,6
S3B	57,2	6.11.2006	1,3	55,9
S3B	57,2	9.11.2006	1,4	55,8
S3B	57,2	9.11.2006	1,6	55,6

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