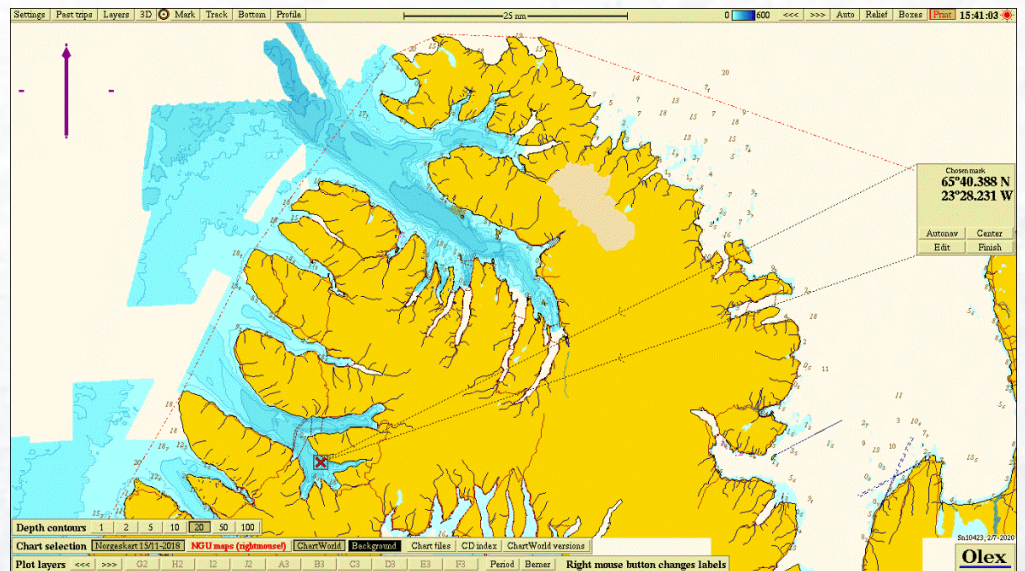




Steinanes, Arnarlax hf.  
B-bottom survey,  
June 2020  
(fallow period)



Information client			
Titel	Steinanes, Arnarlax hf. B-bottom survey, June 2020		
Report number	APN-62254.B01		
Site name	Steinanes	Coordinates site	65°40.388 N 023°28.231 V
County		Municipality	Vesturbyggð
MTB-or estimated max biomass	8.245 tonn	Site manager/contact	Silja Baldvinsdóttir
Client name	Arnarlax hf.		

Biomass/production/status at date of survey			
Biomass at date of survey	0 ton	Feed use	0
Fish type	Salmon	Amount produced	
<b>Type/time of survey</b>	<b>Mark with X</b>	<b>Comments</b>	
At maximal biomass see kap 7.9	<input type="checkbox"/>		
A follow up survey	<input type="checkbox"/>		
Half maximal biomass	<input type="checkbox"/>		
Survey prior to putting out smolt	<input checked="" type="checkbox"/>		
A pre-survey new site	<input type="checkbox"/>		
Other	<input type="checkbox"/>		
Last following period:			

Results from B-survey iht. NS 9410:2016 (main results)			
Parameters and indexes		Parameters and site status	
Gr. II. pH/Eh	1,15	Gr. II. pH/Eh	2
Gr. III. Sensory	0,84	Gr. III. Sensory	1
GR. II + III	0,99	GR. II+ III	1
Date field work	10.06 2020	Date report	03.07.20
<b>Site status (NS 9410:2016):</b>			<b>1</b>

Report writing and project leader	Snorri Gunnarsson	Signature	
Quality control	Arnbór Gústavsson	Signature	

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# Preface

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The survey is carried out according to guidelines in NS 9410:2016 which includes evaluation of sediment, faunal investigation and bottom topography. The environmental survey is regulated by § 35 in the Norwegian «akvakulturdriftsforskriften. The survey also fulfills the requirements regarding bottom surveys in the standard ISO 12878.

The primary objective of a B-survey is to fulfil the requirements regarding maximum biomass survey (MTB) as they are defined in NS9410:2016. There is a requirement of 20 sampling stations within the mooring lines of the fish farm. The estimated max biomass for the current generation farmed salmon at the site Steinanes is 8.245 ton.

The following have participated in the survey:


Snorri Gunnarsson	Akvaplan-niva AS	Prosjektleder.
Snorri Gunnarsson	Akvaplan-niva AS	Fieldwork and Report. Charts (Olex).

The sampling at Steinanes was done 10.06 2020.

## Accredited survey:

The following parts of the survey are done in accordance to accreditation methods:

Sampling and treatment of sediment samples, analysis of samples and evaluations of the results. It should be pointed out that as Icelandic officials have not set standards regarding different parameters based on samplings at Icelandic conditions so the site characters in this report should be interpreted with that disclaimer in mind.

	Akvaplan-niva AS er akkreditert av Norsk Akkreditering for prøvetaking og faglig vurderinger og fortolkninger, akkrediteringsnummer TEST 079. Akkrediteringen er iht. NS-EN ISO/IEC 17025 Akkrediteringen omfatter bla. NS 9410, NS-EN ISO 5667-19 og NS-EN ISO 16665.
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Akvaplan-niva AS thanks Arnarlax hf. and their personnel for the cooperation during the conductance of this site survey.

Kópavogi 3. juli 2020



Snorri Gunnarsson  
Project manager

# 1 Introduction

The sampling date for the present site survey was 10.06 2020 and done by Akvaplan-niva AS contracted by Arnarlax hf. in relation to the company's fish farming activity at the site in Arnarfjörður, Steinanes.

The objective of the B-survey is to document the environmental condition of the local impact zone of the fish farm according to NS 9410:2016 (and ISO 12878) which includes condition of the seabed, faunal evaluation and bottom topography registration.

The survey gives an estimate and evaluation of the site condition regarding organic load and feasibility assessment of the site for fish farming activity.

Figure 1 shows map of the fjord system of Vestfirðir where the site Steinanes is located.

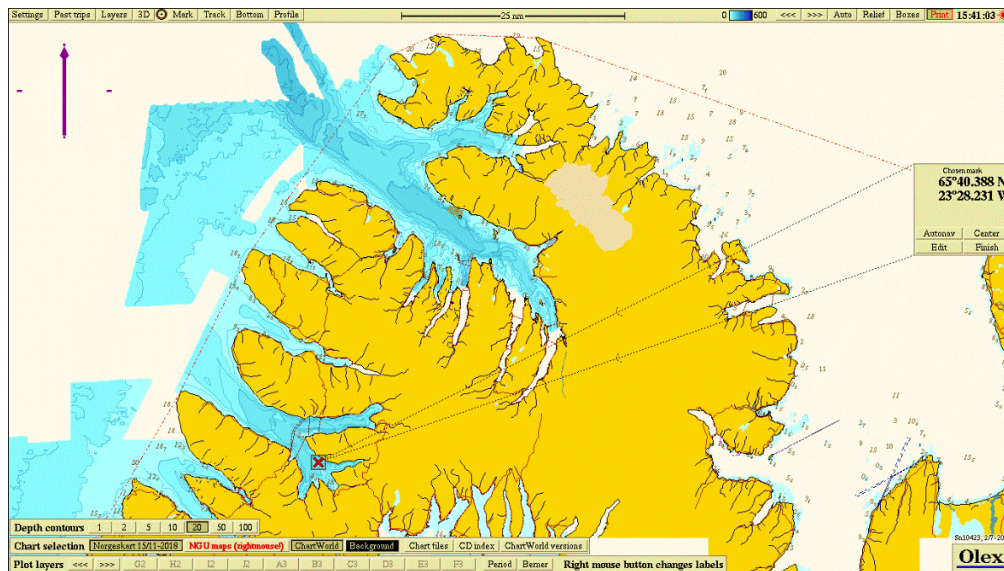


Figure 1. An overview map with the Steinanes site market with a red cross.

## 2 Professional program and methods

---

Environmental monitoring of the impact from the fish farming activities on the seabed is a standardised system. All fish farming sites in the sea are to be regularly assessed. The methods for monitoring in Iceland, are based on description in the ISO 12878 standard and methodology described in the NS 9410:2016 is followed. The Icelandic Environmental agency (Umhverfisstofnun) can also set forward specific requirements regarding frequency of samplings for different fish farming sites that can overrule the requirements in the above-mentioned standards.

The B-survey is a trend study of the benthic conditions at or in close proximity to the fish farming site (local impact zone). Sediment is collected by use of grab (min 250 cm<sup>2</sup>). Each grab sample is investigated with regard to three observation types of benthic characters; faunal parameters, chemical parameters (pH and redox-potential) and a sensory evaluation (gas bobbles, smell, texture, colour and the thickness of the precipitated slam layer in the sediment). The different benthic parameters are given a character on the scale from 1 to 4, according to the scale of the impact on the benthic conditions from organic load, see criteria in table 1. The number of sampling stations are decided based on the estimated max standing biomass for the given year class for farmed fish at the site and it is the weighted average for all the sampling stations that gives the sites condition.

*Table 1. Frequency of category B-research for the location of the farm based on state of the defined farming area.*

Site condition at the time of sampling	Sampling frequency for B-surveys (NS 9410:2016)
1-very good	At next max biomass
2-good	Prior to putting next generation into sea and again at next max biomass.
3-bad	<p>Prior to putting next generation into sea. Based on the site condition prior to putting next generation into sea:</p> <ul style="list-style-type: none"> <li>- Condition 1 – next site survey at next max biomass</li> <li>- Condition 2 – next site survey at next 50% max biomass and at max biomass</li> <li>- Condition 3 – next site survey at next 50% max biomass and at max biomass. Some conditions should apply for farming of next generation at the site</li> </ul> <p>If any of the samples result in character 4 it is a sign of overload.</p>
4-very bad	Overload

### 2.1 Field equipment

The following field equipment was used during the site survey:

Grabb: Van Veen grabb (0,1 m<sup>2</sup>)

Sieve 1 mm: Akvaplan-niva

pH meter: Electrode, YSI Professional Plus

Redox-meter: Electrode, YSI Professional Plus

Position determination– Garmin GPS mapping tool.

Digital camera

## 3 Site description and bottom topography

---

### 3.1 Info site operation

The Steinanes site is located in Arnarfjörður Iceladn about 5.5 km east from Bíldudalur. The cages are lined in a southwest direction from land (227 degrees). The depth under cages ranges from about 62 m closer to land up to about 92 further into the fjord. The more shallower area of the farm is at the northernmost part.

The Steinanes site is has been in fallow state for just over 6 months at the date of sampling. Previously there has been farmed one generations of fish at the site. The fish farm at the site has a single frame 2x7 mooring system with a possibility total of 14 cages, each with 160 m circumference. The planned timing for putting smolts into sea is summer/fall 2020. The first generation at Steinanes was salmon farmed from June 2017 to late fall 2019.

Table 2 shows the production and feed usage for the past generation.

Table 2. Production and feed usage at the site Steinanes, data is based on info given from the fish farmer.

Generation of fish (G)	Production (ton)	Feed usage (ton)
Generation 2017-2019 salmon	8.964	13.704

### 3.2 Present and past site surveys

**Error! Reference source not found.** shows the results and date for previous B-surveys at the site.

Table 3. Past surveys in the local impact zone for Steinanes.

Date of sampling	Report number	Survey type	Overall site status
25.09.2018	APN-60526.01 (Gunnarsson 2020)	Max biomass	2
27.06.2017	Pre farming B survey not published	Pre survey new site	1

### 3.3 Dispersing current

Dominating dispersion current (60 m) is in direction NV (315 degrees) with a slight counter current to SE (135 degrees) (resource, APN project 62191). Average current speed at 60 m is measured to be 4,1 cm/s. Highest current speed is measured to be 14,2 cm/s and 5 % of the measurements are < 1 cm/s.

### 3.4 Position of sampling stations

Description of the stations in the survey is given in Figure 2 and Table 4. Positioning of the stations was chosen based guidance and perimeters described in NS 9410:2016 and the bottom

topography and planned configuration of the farm. Steines site is in Arnarfjörður. Depth at the site is in the range from about 62 to 92 meters. The placement of sampling stations were chosen to give a good picture of the whole local impact zone in the area with cages that were used during previous production cycle. The sampling stations had a depth varying from 55 m to 91 m. The placement of the sampling stations is regarded to be in accordance with the descriptions for survey of local impact zone given in NS 9410:2016.

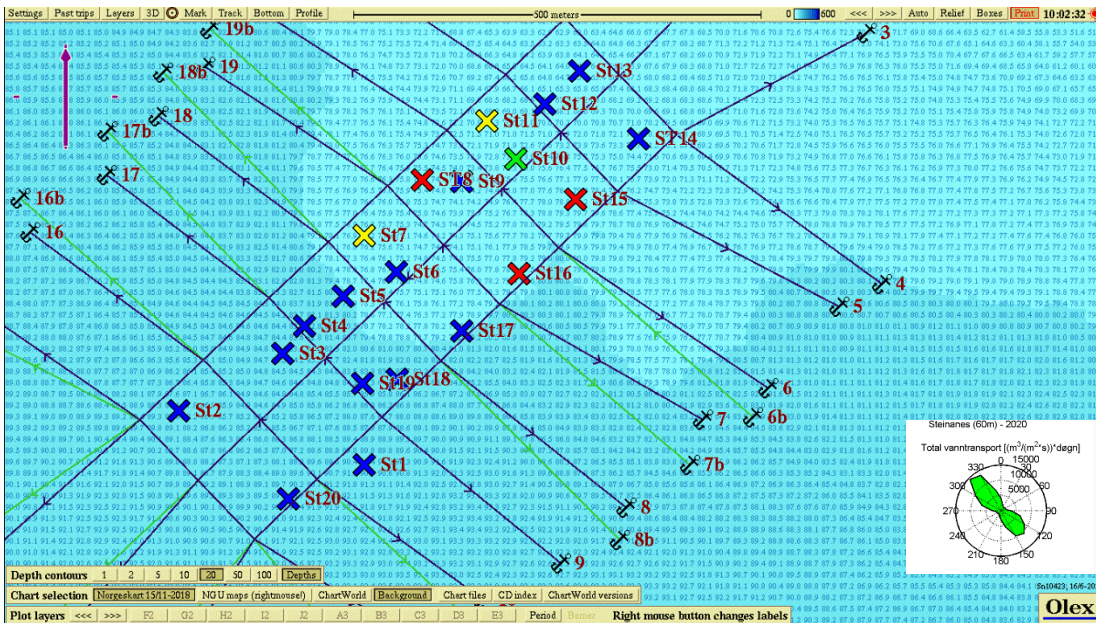


Figure 2. Chart showing depths at the site Steinas. Sampling stations st. 1 – 16 are marked with color codes that describe the condition according to NS 9410:2016, chapter 7.11. Color codes: Blue = very good condition, green = good condition, yellow = bad condition, red = very bad condition.



Table 4. Placement and depth of the sampling stations in the B-survey.

Station number	North	Vest	Depth (m)
St 1	65°40.282	23°28.263	91
St 2	65°40.318	23°28.561	88
St 3	65°40.356	23°28.394	85
St 4	65°40.374	23°28.358	84
St 5	65°40.394	23°28.296	80
St 6	65°40.410	23°28.211	76
St 7	65°40.434	23°28.263	77
St 8	65°40.471	23°28.169	75
St 9	65°40.470	23°28.106	74
St 10	65°40.485	23°28.018	74
St 11	65°40.510	23°28.065	71
St 12	65°40.521	23°27.972	69
St 13	65°40.543	23°27.916	65
St 14	65°40.498	23°27.822	72
St 15	65°40.458	23°27.922	80
St 16	65°40.409	23°28.014	80
St 17	65°40.371	23°28.105	80
St 18	65°40.339	23°28.209	85
St 19	65°40.336	23°28.265	86
St 20	65°40.260	23°28.384	91

## 4 Results

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Results for the different parameters are given in Table 5. The overall site condition was 1 «very good» and is the result of the weighed average for all sampling stations. The results were however a little bit mixed from one station to another ranging from very good to very bad. Overall the condition for group II parameters (pH/Eh) was 2 or «good» and overall the condition for group III parameters (sensory) and average group II + III parameters (mean value) was 1 «very good». A complete filled sampling sheet with calculations for each parameter is attached.

*Table 5. Results from the classifications of the local impact zone of the fish farm Steinanes in June 2020.*

Parameter	Condition
Group II - parameters (pH/Eh)	2
Group III – parameters, (sensory)	1
Group II + III – parameters (mean value)	1
Site condition	1

There were collected valid sediment samples at fifteen stations out of the twenty sampled i.e. five stations were assigned as hard bottom. This indicates that in general there is soft bottom in the whole local impact zone. The sediment type consisted mainly of clay and silt.

For the group II parameters (pH/redox), fourteen out of twenty stations had conditions 1 «very good», four stations had conditions 3 «bad» and two stations had conditions 4 «very bad». For sensory parameters (group III) thirteen out of twenty stations had condition 1 «very good», five stations had condition 2 «good» and two stations had condition 4 «very bad». For combined parameters II and III (pH/redox and sensory) fourteen out of twenty stations had condition 1 «very good», one station had conditions 2 «good», two stations had conditions 3 « bad» and three stations had conditions 4 «very bad». Animals were present in all soft bottom samples except three stations (stations 8, 11 and 15) mainly in the form of polychaetes. Gas bubbles were detected in two grab samples in stations 15 and 16.

## 5 Conclusion

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Based on the criteria given in NS 9410:2016 the fish farming site has been assigned a site condition 1 «very good» at the date of sampling. A total of 37 grabs were taken with Van Veen grab (0,1 m<sup>2</sup>), divided on 20 stations placed around the Steinanes local impact zone. ». For combined parameters II and III (pH/redox and sensory) fourteen out of twenty stations had condition 1 «very good», one station had conditions 2 «good», two stations had conditions 3 «bad» and three stations had conditions 4 «very bad».

This survey in the local impact zone is done at fallow period after over six month resting period. Despite the overall very good condition at the Steinanes site during the fallow period it should be pointed out that the condition is varying with four stations out of the twenty with condition very bad. This indicates a some level of organic load mainly northern part of the Steinanes site. The previous B-survey during max biomass resulted in overall condition 2 «good» (Gunnarsson 2020). The conditions seem therefore to have overall improved at the site even though parts of the site in the present survey still have significant organic load.

**The site is assigned a condition factor 1 "Very good" according to calculations based on methodology described in NS 9410:2016 and sample sheet Table B.1 and B.2 (se chapter 7 Appendix).**

## 6 References

---

Forskrift om drift av akvakulturanlegg (akvakulturdriftsforskriften) §§ 35 og 36.

Gunnarsson, S. 2020 (revised edition). Arnarlax hf, B-undersøkelse, Steinanes (undersøkelse ved maksimal belastning. Akvaplan-niva AS rapport nr. 60526.01.

ISO 5667-19:2004. Guidance on sampling of marine sediments.

ISO 12878:2012. Environmental monitoring of the impacts from marine finfish farms on soft bottom.

Norsk Standard NS 9410:2016. Miljøovervåking av bunnpåvirkning fra marine akvakulturanlegg.

Steinanes Miljøundersøkelser type B, by av Akvaplan-niva AS sommer 2017 (not published data).

[www.fiskeridir.no](http://www.fiskeridir.no)

# 7 Appendix:

## 7.1 Sheet (B.1 og B.2) NS 9410:2016

Sample scheme B.1												
Company		Arnarlax										
Site:		Steinanes, brakklegging										
Fieldworker:		Snorri Gunnarson (SGU)										
Date:		10.06 2020										
Site no.:												
Gr	Parameter	Point	Sample number									
	Bottom type: S (soft) eller H (hard)		1	2	3	4	5	6	7	8	9	10
			S	S	S	S	S	H	S	S	H	S
I	Animals > 1mm	Yes (0) No (1)	0	0	0	0	0		0	1		0
II	pH	value	7,7	7,5	7,4	7,7	7,4		6,9	6,6		7,0
		ORP	54	43	20	45	54		-290	-241		-250
	Eh (mV)	plus ref. verdi	254	243	220	245	254		-90	-41		-50
		from figure	0	0	0	0	0	0	3	5	0	3
	pH/Eh	from figure	0	0	0	0	0	0	3	5	0	3
		Status station		1	1	1	1	1	1	3	4	1
		Buffer-temp		C			Sea temp			C		
		pH sea		ORP sea			mV			Reference electrode		
				mV			mV			200,0 mV		
	III	Gas bubbles	Yes (4) No (0)	0	0	0	0	0	0	0	0	0
Colour		Light/grey (0)	0	0	0	0	0	0			0	
		Brown/black (2)							2	2		2
Smell		None (0)	0	0	0	0	0	0			0	
		Light (2)							2			2
		Strong (4)								4		
Consistency		Solid (0)	0	0	0	0	0	0		0	0	0
		Soft (2)							2			
		Aqueous (4)										
Grab volume (v)		v < 1/4 (0)			0		0	0	0	0	0	0
		1/4 < v < 3/4 (1)				1						
		v > 3/4 (2)	2	2								
Thickness of sledge (t)		t < 2 cm (0)	0	0	0	0	0	0			0	
		2 < t < 8 cm (1)							1	1		1
		t > 8 cm (2)										
	Sum		2,0	2,0	0,0	1,0	0,0	0,0	7,0	7,0	0,0	5,0
	Corrected (*0,22)		0,4	0,4	0,0	0,2	0,0	0,0	1,5	1,5	0,0	1,1
	Status station		1	1	1	1	1	1	2	2	1	2
Average group II & III			0,2	0,2	0,0	0,1	0,0	0,0	2,3	3,3	0,0	2,1
Status station			1	1	1	1	1	1	3	4	1	2
Grab ID	K-3											
pH/ Eh ID	YSI-Professional plus											

## Sample scheme B.1

Company:	Arnarlax
Site:	Eyri
Fieldworker:	Snorri Gunnarsson (SGU)

Date:	05.03 2020
Site no.:	0

Gr	Parameter	Point	Sample number								Index				
			11	12	13	14	15	16	17	18	19	20	S%	H%	
	Bottom type: S (soft) or H (hard)		S	H	S	S	H	H					69	31	
I	Animals > 1mm	Yes (0) No (1)	0		0	0									
II	pH	value	7,7		7,8	7,8									
	Eh (mV)	ORP	64		64	67									
		plus ref. verdi	264		264	267									
	pH/Eh	from figure	0	0	0	0	0	0					0,19		
	Status station			1	1	1	1	1	1						
	Status group II			1	Buffer temp	0,0 C		Sea temp	0,0 C		Sediment temp	0,0 C			
	pH sea	0	ORP sea	0 mV		Eh sea	mV		Reference electrode	200 mV					
	Gas bubbles	Yes (4) No (0)	0	0	0	0	0	0							
	Colour	Light/grey (0)	0	0	0	0	0	0							
		Brown/black (2)													
Smell	None (0)	0	0	0	0	0	0								
	Light (2)														
	Strong (4)														
Consistency	Solid (0)	0	0	0	0	0	0								
	Soft (2)														
	Aqueous (4)														
Grab volume (v)	v < 1/4 (0)		0		0	0	0								
	1/4 < v < 3/4 (1)	1													
	v > 3/4 (2)			2											
Thickness of sledge (t)	t < 2 cm (0)	0	0	0	0	0	0								
	2 < t < 8 cm (1)														
	t > 8 cm (2)														
Sum			1,0	0,0	2,0	0,0	0,0	0,0							
Corrected (*0,22)			0,2	0,0	0,4	0,0	0,0	0,0					0,63		
Status station			1	1	1	1	1	1							
Status group III			1												
Average group II & III			0,1	0,0	0,2	0,0	0,0	0,0					0,41		
Status station			1	1	1	1	1	1							
Status group II & III			1												

pH/Eh		
Corr.sum		
Index		
Average		
< 1,1		1
1,1 - <2,1		2
2,1 - <3,1		3
≥3,1		4

Status site: **1**

Grab ID	K-22
pH / Eh ID	Ysi professional plus

## Sample scheme B.1

Company:	Arnarlax
Site:	Steinanes, brakklegging
Fieldworker:	Snorri Gunnarson (SGU)

Date:	10.06 2020
Site no.:	0

Gr	Parameter	Point	Sample number										Index	
			11	12	13	14	15	16	17	18	19	20	S%	H%
	Bottom type: S (soft) or H (hard)		S	S	H	S	S	S	S	S	H	H	75	25
I	Animals > 1mm	Yes (0) No (1)	1	0		0	1	0	0	0				
II	pH	value	7,0	7,8		7,5	6,8	6,8	7,8	7,2				
	Eh (mV)	ORP	-216	5		63	-230	-250	105	-130				
		plus ref. verdi	-16	205		263	-30	-50	305	70				
	pH/Eh	from figure	3	0	0	0	3	5	0	1	0	0	1,15	
	Status station			3	1	1	1	3	4	1	1	1	1	
	Status group II			2	Buffer temp	0,0 C	Sea temp	0,0 C	Sediment temp	0,0 C				
	pH sea		0	ORP sea	0 mV	Eh sea	mV	Reference electrode	200 mV					
	III	Gas bubbles	Yes (4) No (0)	0	0	0	0	4	4	0	0	0	0	
		Colour	Light/grey (0)			0				0		0	0	
			Brown/black (2)	2	2		2	2	2		2			
Smell		None (0)		0	0	0			0		0	0		
		Light (2)								2				
		Strong (4)	4				4	4						
Consistency		Solid (0)		0	0	0			0	0	0	0		
		Soft (2)	2				2							
		Aqueous (4)						4						
Grab volume (v)		v < 1/4 (0)	0	0	0	0					0	0		
		1/4 < v < 3/4 (1)							1	1				
		v > 3/4 (2)					2	2						
Thickness of sledge (t)		t < 2 cm (0)	0	0	0	0			0	0	0	0		
		2 < t < 8 cm (1)					2	2						
		t > 8 cm (2)												
Sum			8,0	2,0	0,0	2,0	16,0	18,0	1,0	5,0	0,0	0,0		
Corrected (*0,22)			1,8	0,4	0,0	0,4	3,5	4,0	0,2	1,1	0,0	0,0	0,84	
Status station			2	1	1	1	4	4	1	2	1	1		
Status group III			1											
Average group II & III			2,4	0,2	0,0	0,2	3,3	4,5	0,1	1,1	0,0	0,0	0,99	
Status station			3	1	1	1	4	4	1	1	1	1		
Status group II & III			1											
pH/Eh														
Corr.sum														
Index														
Average														
< 1,1													1	
1,1 - <2,1													2	
2,1 - <3,1													3	
≥3,1													4	
Status site:													1	
Grab ID	K-3													
pH / Eh ID	YSI-Professional plus													

## Sample scheme B.2

Company:	Arnarlax	Date:	10.06 2020
Site:	Steinanes, brakklegging	Site no.:	0
Fieldworker:	Snorri Gunnarson (SGU)		

Sample number	1	2	3	4	5	6	7	8	9	10
Depth (m)										
Number of trials	2	3	2	3	1	3	2	2	3	1
Gas bubbles (in sample)	No	No	No	No	No		No	No		No
Sediment type	Clay	X	X	X	X	X		X	X	X
	Silt									
	Sand				X					
	Gravel					X		X	X	X
	Shellsand									
Reef										
Rocky bottom (cobbles, boulders)										
Echinodermata, count										
Crustaceans, count										
Molluscs, count										
Polychaetes, count	>50	>50	>50	>50	>10		>5			2
Other animals, count										
<i>Beggiatoa</i>										
Feed										
Faeces										
Comments										
Grab	Area [m <sup>2</sup> ]						Grab ID			K-3
	page 3 of 4 pages									













## Sample scheme B.2


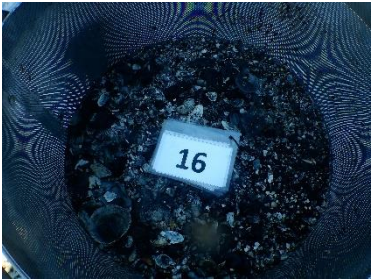




Company:		Arnarlax									
Site:		Steinanes, brakklegging									
Fieldworker:		Snorri Gunnarson (SGU)									
Date:		10.06 2020									
Site no.:		0									
Sample number		11	12	13	14	15	16	17	18	19	20
Depth (m)											
Number of trials		1	1	3	1	1	1	1	1	3	3
Gas bubbles (in sample)		No	No		No	No	No	No	No		
Sediment type	Clay	X	X		X	X	X	X	X		
	Silt										
	Sand										
	Gravel	X	X		X	X	X	X	X		
	Shellsand										
Reef											
Rocky bottom (cobble, boulders)											
Echinodermata, count											
Crustaceans, count											
Molluscs, count			>10		>20		3	>20	4		
Polychaetes, count											
Other animals, count											
<i>Beggiatoa</i>											
Feed											
Faeces											
Comments											
Grab	Area [m <sup>2</sup> ]	0				Grab ID	K-3				
Signature fieldworker:											

## 7.2 Pictures of samples at Steinanes

<p><i>St 1</i></p>		
<p><i>St 2</i></p>		
<p><i>St 3</i></p>	<p>NA</p>	
<p><i>St 4</i></p>		
<p><i>St 5</i></p>		

<i>St 6</i>	NA	NA
<i>St 7</i>	NA	
<i>St 8</i>		
<i>St 9</i>	NA	NA
<i>St 10</i>		

<i>St 11</i>		
<i>St 12</i>	NA	NA
<i>St 13</i>	NA	NA
<i>St 14</i>		NA
<i>St 15</i>		

<i>St 16</i>		
<i>St 17</i>		
<i>St 18</i>		
<i>St 19</i>	NA	NA
<i>St 20</i>	NA	NA

### 7.3 Bottom topography and 3D view

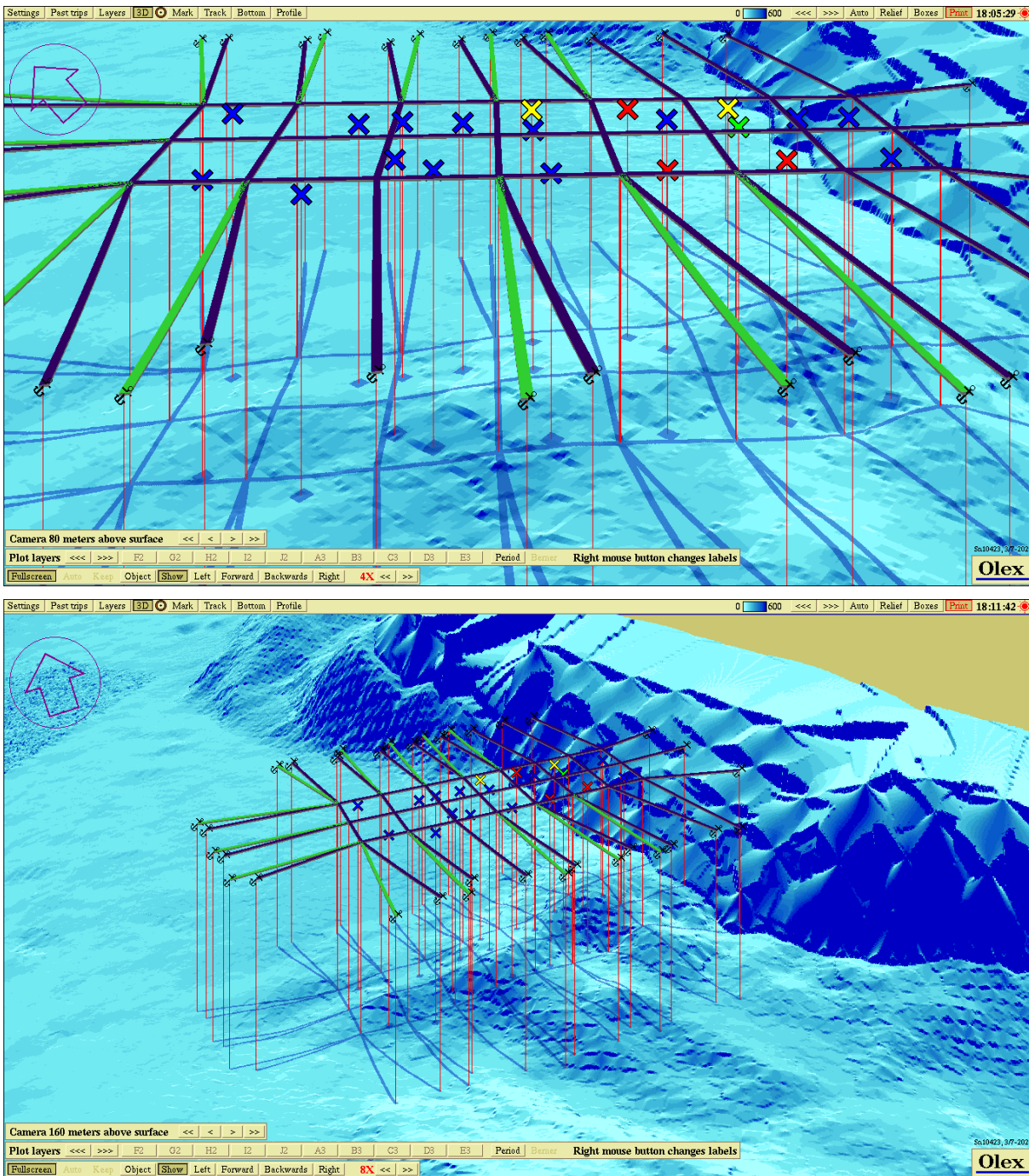


Figure 3. Showing bottom topography 3D at Steinanes with each sampling station according to info in figure 2 and Table 3. Two pictures shown w