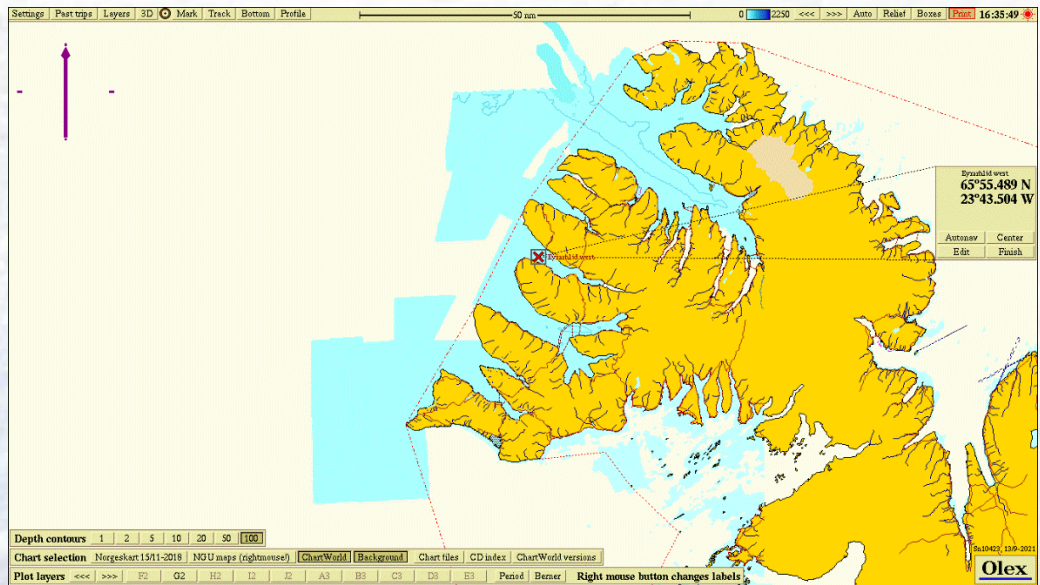


Eyrarhlíð II, Arctic Sea Farm
B-bottom survey,
April 2021
(pre-survey)



Information client			
Title	Eyrarhlíð II, Arctic Sea Farm. B-bottom survey, April 2021 (pre survey)		
Report number	APN-63091.B01		
Site name	Eyrarhlíð II	Coordinates site	65°55.489 N 023°43.504 V
County	Ísafjarðarbær	Municipality	Ísafjarðarbær
MTB-or estimated max biomass	4.805 ton	Site manager/contact	Steinunn Guðný Einarsdóttir
Client name	Arctic Sea Farm		

Biomass/production/status at date of survey			
Biomass at date of survey	0 ton	Feed use	0
Fish type	Salmon	Amount produced	
Type/time of survey	Mark with X	Comments	
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 type="checkbox"/>		
A pre-survey new site	<input checked="" 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	0,00	Gr. II. pH/Eh	1
Gr. III. Sensory	0,15	Gr. III. Sensory	1
GR. II + III	0,08	GR. II+ III	1
Date field work	15.04 2021	Date report	22.09.21
Site status (NS 9410:2016):			1



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

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Preface

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 bottom survey in the local impact zone as they are defined in NS9410:2016. This B survey is undertaken prior to put fish at a new fish farming area and therefore a pre-survey. Therefore a total of 10 sampling stations within the mooring lines of the fish farm were sampled. The estimated max biomass for the first generation farmed salmon at the site Eyrarhlíð II is 4.805 ton.

The following have participated in the survey:


Snorri Gunnarsson	Akvaplan-niva AS	Prosjektleder.
Snorri Gunnarsson	Akvaplan-niva AS	Fieldwork and Report. Charts (Olex).
Arnþór Gústavsson	Akvaplan-niva AS	Quality assurance

The sampling at Eyrarhlíð II was done 15.04 2021.

Accredited survey:


The following parts of the survey are done in accordance with 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 Arctic Sea Farm and their personnel for the cooperation during the conductance of this site survey.

Kópavogi 22. september 2021


Snorri Gunnarsson
Project manager

1 Introduction

The sampling date for the present site survey was 15.04 2021 and done by Akvaplan-niva AS contracted by Arctic Sea Farm in relation to the company's fish farming activity at the site Eyrarhlíð II in Dýrafjörður, Ísafjarðabær municipality.

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 impact assessment of the site from fish farming activity.

Figure 1 shows map of the fjord system of southern part of Vestfirðir where the site Eyrarhlíð II is located.

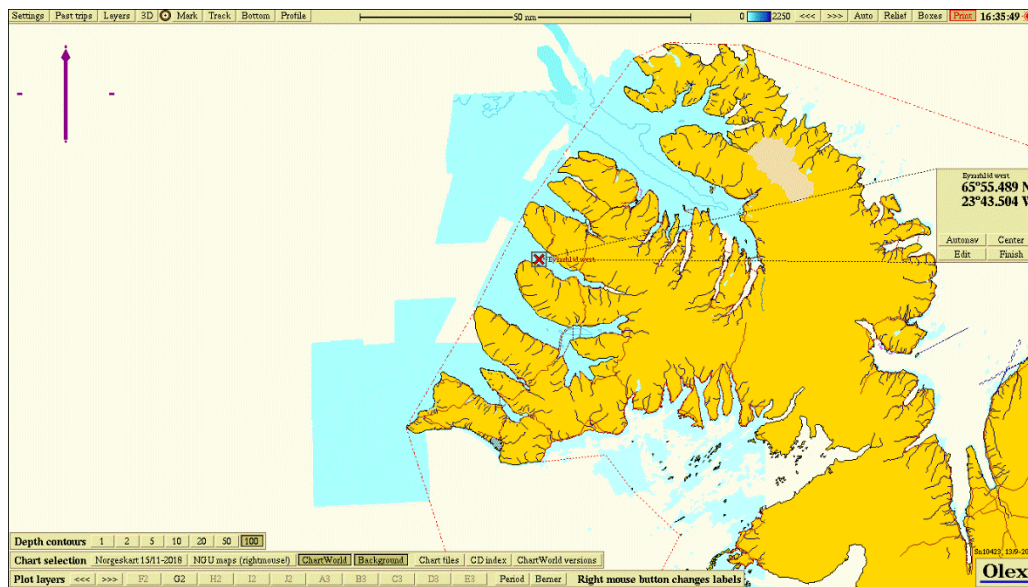


Figure 1. An overview map with the Eyrarhlíð II site marked by its name with a red cross.

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 cm²). 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 bubbles, 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 (see Table 1), according to the scale of the impact on the benthic conditions from organic load, see criteria in table 1 and it is the weighted average for all the sampling stations that gives the sites condition. 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.

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"> - Condition 1 – next site survey at next max biomass - Condition 2 – next site survey at next 50% max biomass and at max biomass - 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 <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 (0,025 m²)

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 Eyrarhlíð II site is located in Dýrafjörður about 11 km west from Þingeyri. The cages are lined in a north-western direction from land (289 degrees). The depth under cages ranges from about 36 - 44 m.

Eyrarhlíð II is a new site with plan of putting out first generation fish early summer 2021. The fish farm at the site is a one frame mooring system with a 2 x 7 cages, total 14 cages each with 160 m circumference.

Table 2 shows the production and feed usage for the present and or past generations.

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

Generation of fish (G)	Production (ton)	Feed usage (ton)
New site no previous generations		

3.2 Present and past site surveys

No previous B-surveys as Eyrarhlíð II is a new site with plan of putting out first generation fish early summer 2021.

Table 3. Past site studies for Eyrarhlíð II site

Date of sampling	Report number	Survey type	Overall site status

3.3 Dispersing current

Measurement of dispersing current was done at the site in August – September 2019 measurements at 39 m depth (Gustavsson, 2019). Dominating current (39 m) is in direction south-east (130 degrees) with a smaller counter current in north-west direction. Average current speed is measured to be 5.9 cm/s. Highest current speed is measured to be 26.7 cm/s and 3.4 % of the measurements are < 1 cm/s.

3.4 Position of sampling stations

Description of the 10 stations in the survey is given in figure 2 and table 4. Positioning of the stations was chosen based on guidance and perimeters described in NS 9410:2016 and spread around the periphery of the cages. At the site the typical depth in the local impact zone is in the range from 36 – 44 m, with a trend for deeper area into the fjord. The placement of sampling stations was chosen to give a good picture of the condition of the whole local impact zone. It is important to evaluate the status in both the deeper and shallower parts of the local impact zone of the fish farm. The sampling stations had a depth varying from 39 to 43 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.

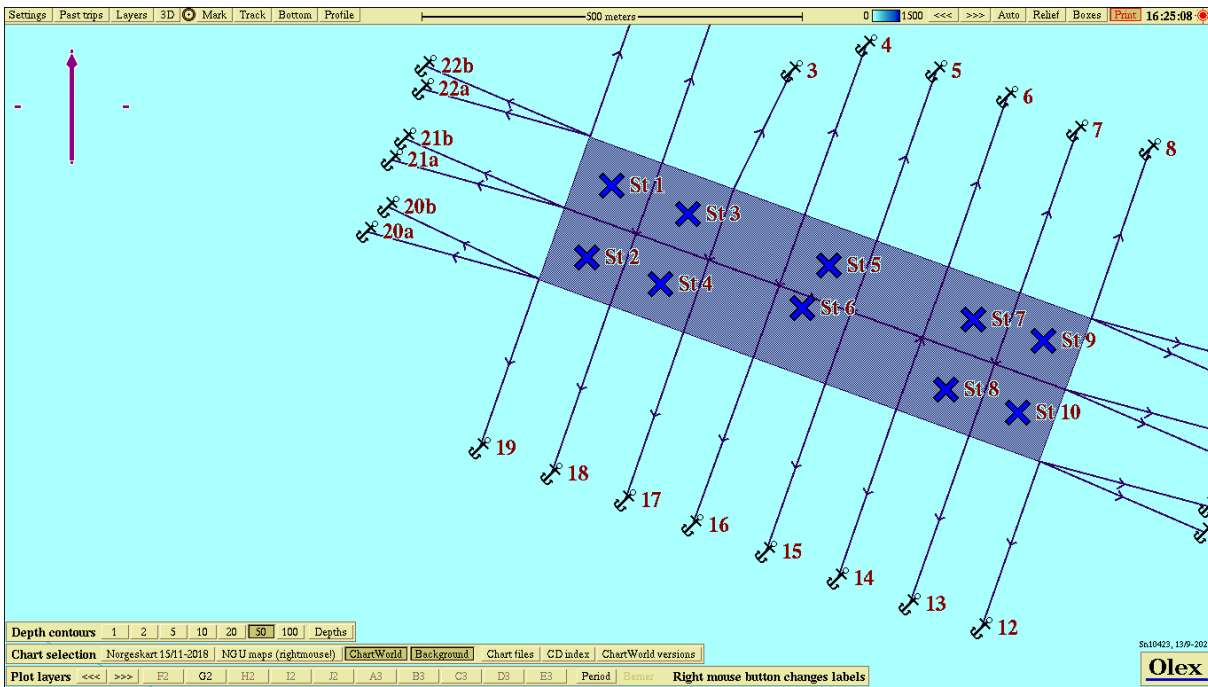


Figure 2. Chart showing depths at the site Eyrarhlíð II. Sampling stations st. 1 – 10 are marked with color codes that describe the condition according to NS 9410:2016, chapter 7.11. Color codes: Blue = very good condition, green = good condition, yellow = bad condition, red = very bad condition.

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

Station number	North	West	Depth (m)
St 1	65°5.570	23°43.864	41
St 2	65°5.519	23°43.907	39
St 3	65°5.550	23°43.731	41
St 4	65°5.500	23°43.779	41
St 5	65°5.513	23°43.485	42
St 6	65°5.483	23°43.532	43
St 7	65°5.475	23°43.235	43
St 8	65°5.425	23°43.282	41
St 9	65°55.460	23°43.112	43
St 10	65°55.409	23°43.157	42

4 Results

Results for the different parameters are given in Table 5. The overall site condition is 1 «very good». The status for group II (pH/Eh) was 1 «very good», status group III parameters (sensory) was 1 «very good» and average group II + III parameters is status 1 «very good». A complete filled sampling sheet with calculations for each parameter is attached in appendix.

Table 5. Results from the classifications of the local impact zone of the fish farm.

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

There were collected valid sediment samples at all the ten sampling stations. This indicates that in general there is soft bottom in the local impact zone. The sediment type consisted mainly of clay in the whole farming area with some substantial amount of crushed shells. For the group II parameters (pH/Eh), all ten stations had conditions 1 «very good». For sensory parameters (group III) all ten stations had condition 1 «very good». For combined parameters II and III (pH/redox and sensory) all ten stations had status 1 «very good». Animals were present in all the ten soft bottom samples mainly in the form of polychaetes.

5 Conclusion

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 10 grabs were taken with Van Veen grab (0,01 m²), divided on 10 stations placed around the 14 cages that are planned to be operated at the Eyrarhlíð II site during the first production cycle.

For combined parameters II and III (pH/redox and sensory) all ten stations had status 1 «very good». Animals were present in all soft bottom samples.

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.

Gustavsson, A. 2019. Arctic Sea Farm hf, measurement of spread current at Eyrarhlíð, fall 2019. Akvaplan-niva AS project nr. 61426.

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.

www.fiskeridir.no


7 Appendix:

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











Sample scheme B.1														
Company:		Arctic Sea Farm								Date:		15.04 2021		
Site:		Eyrarhlíð west/pre-survey								Site no.:				
Fieldworker:		Snorri Gunnarsson												
Gr	Parameter	Point	Sample number										Index	
			1	2	3	4	5	6	7	8	9	10	S%	H%
	Bottom type: S (soft) or H (hard)		S	S	S	S	S	S	S	S	S	S	100	0
I	Animals > 1mm	Yes (0) No (1)	0	0	0	0	0	0	0	0	0	0		
II	pH	value	7,8	7,7	7,7	7,6	7,7	7,7	7,7	7,7	7,6	7,6		
	Eh (mV)	ORP	110	97	95	79	40	58	78	101	103	107		
		plus ref. value	310	297	295	279	240	258	278	301	303	307		
	pH/Eh	from figure	0	0	0	0	0	0	0	0	0	0	0,00	
	Status station		1	1	1	1	1	1	1	1	1	1		
	Status group II		1	Buffer temp	5,0 C		Sea temp	2,2 C		Sediment temp	1,6 C			
	pH sea	8,01	ORP sea	161 mV		Eh sea	361 mV		Reference electrode	200 mV				
III	Gas bubbles	Yes (4) No (0)	0	0	0	0	0	0	0	0	0	0		
	Colour	Light/grey (0)	0	0	0	0	0	0	0	0	0	0		
		Brown/black (2)												
	Smell	None (0)	0	0	0	0	0	0	0	0	0	0		
		Light (2)												
		Strong (4)												
	Consistency	Solid (0)	0	0	0	0	0	0	0	0	0	0		
		Soft (2)												
		Aqueous (4)												
	Grab - volume (v)	v < 1/4 (0)					0	0	0	0	0			
		1/4 < v < 3/4 (1)			1	1						1		
		v > 3/4 (2)	2	2										
	Thickness of sludge (t)	t < 2 cm (0)	0	0	0	0	0	0	0	0	0	0		
		2 < t < 8 cm (1)												
		t > 8 cm (2)												
	Sum		2,0	2,0	1,0	1,0	0,0	0,0	0,0	0,0	0,0	1,0		
	Corrected (**0,22)		0,4	0,4	0,2	0,2	0,0	0,0	0,0	0,0	0,0	0,2	0,15	
	Status station		1	1	1	1	1	1	1	1	1	1		
	Status group III		1											
	Average group II & III		0,2	0,2	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,1	0,08	
	Status station		1	1	1	1	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		
Grabb ID		K-22												
pH/Eh ID		YSI professional plus												










Sample Scheme B.2

Company:	Arctic Sea Farm	Date:	15.04 2021
Site:	Eyrarhlíð west/pre-survey	Site no.:	0
Fieldworker:	Snorri Gunnarsson		

Sample number	1	2	3	4	5	6	7	8	9	10
Depth (m)	41	39	41	41	42	43	43	41	43	42
Number of trials	1	1	1	1	1	1	1	1	1	1
Gas bubbles (in sample)	No	No	No	No	No	No	No	No	No	No
Sediment type	Clay	X	X	X	X	X	X	X	X	X
	Silt									
	Sand									
	Gravel									
	Shellsand					X	X	X	X	X
Reef										
Rocky bottom (cobbles, boulders)										
Echinodermata, count	2	1				1	3	1		
Crustaceans, count										
Molluscs, count	1	1	1	3		3	1	3	4	2
Polychaetes, count	>50	>50	>20	>50	>20	>10	>20	>50	>50	>50
Other animals, count										
Beggiatoa										
Feed										
Faeces										
Comments	Stations 5, 6 and 7 some crushed shells (small sample in grab). Grabs at station 5 10 were somewhat washed due to shells blocking the grab to fully close.									
Grab	Area [m ²]							Grab ID		K-22
Signature fieldworker:						page 2 of 2 pages				

7.2 Pictures of samples at Eyrarhlíð II

<i>St 1</i>	 A photograph of a sample container, likely a bucket, filled with dark, muddy sediment. A white label with the number '1' is placed in the center of the sediment.	 A close-up photograph of the sample from St 1, showing a dark, silty material with some small, light-colored particles. A white label with the number '1' is visible in the center.
<i>St 2</i>	 A photograph of a sample container with an orange interior. A person wearing blue gloves is holding a white label with the number '2' next to a large, irregular, light-colored sediment sample.	 A close-up photograph of the sample from St 2, showing a dark, silty material with some small, light-colored particles. A white label with the number '2' is visible in the center.
<i>St 3</i>	 A photograph of a sample container with an orange interior. A person wearing blue gloves is holding a white label with the number '3' next to a large, irregular, light-colored sediment sample.	 A close-up photograph of the sample from St 3, showing a dark, silty material with some small, light-colored particles. A white label with the number '3' is visible in the center.
<i>St 4</i>	 A photograph of a sample container with an orange interior. A person wearing blue gloves is holding a white label with the number '4' next to a large, irregular, light-colored sediment sample.	 A close-up photograph of the sample from St 4, showing a dark, silty material with some small, light-colored particles. A white label with the number '4' is visible in the center.
<i>St 5</i>	 A photograph of a sample container with an orange interior. A person wearing blue gloves is holding a white label with the number '5' next to a large, irregular, light-colored sediment sample.	 A close-up photograph of the sample from St 5, showing a dark, silty material with some small, light-colored particles. A white label with the number '5' is visible in the center.

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

7.3 Bottom topography and 3D view

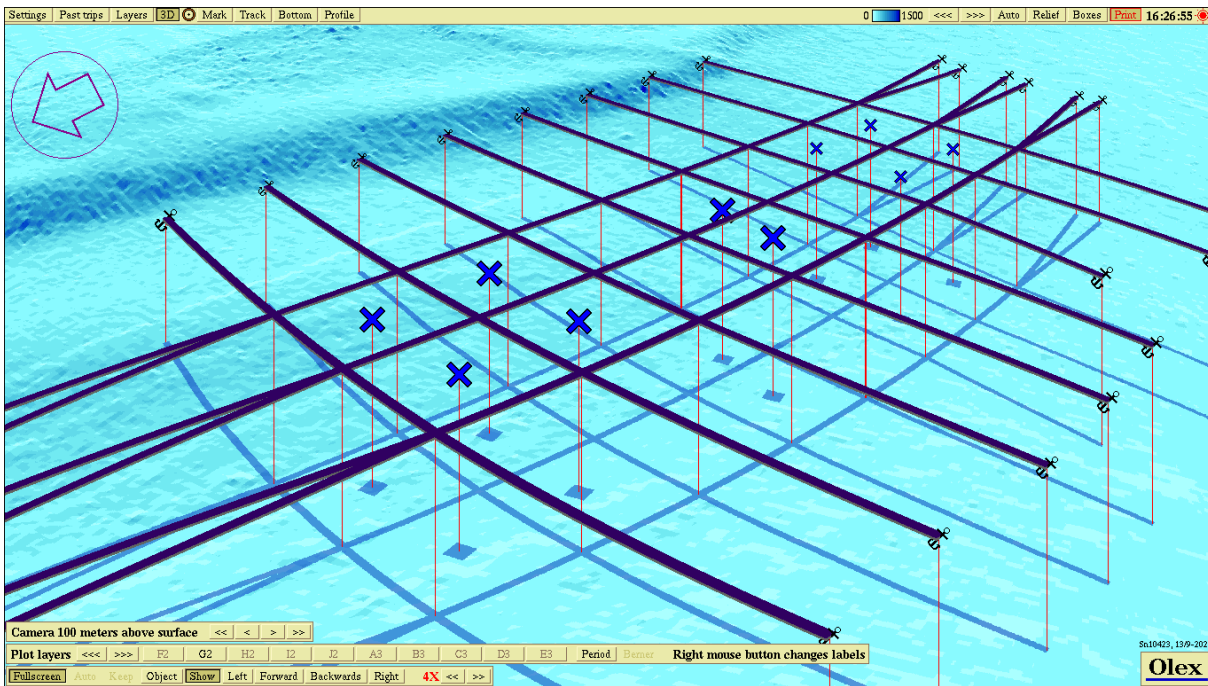


Figure 3. Showing bottom topography 3D at Eyrarhlíð II with each sampling station according to info in figure 2 and Table 3.