Akvaplan niva

Rapport Report

Laugardalur 2, Arnarlax
B survey,
January 2024
(max biomass)

NORSK
AKKREDITERING
TEST 079

Akvaplan-niva AS: APN 65629.B01

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Information client			
Title	Laugardalur 2, Arnarlax. B survey (max biomass, January 2024		
Report number	APN-65629.B01		
Site name	Laugardalur 2	Coordinates site	65°38,744N 23°54,668V
County	Tálknafjörður	Municipality	Tálknafjörður
MTB-or estimated max biomass	2.262 tonnes	Site manager/contact	Silja Baldvinsdóttir
Client name	Arnarlax		

Biomass/production/status at date of survey			
Biomass at date of survey	2.176 t	Feed use	3.297 t
Fish type	Salmon	Amount produced	1.573 t
Type/time of survey		Comments	
At maximal biomass see kap 7.9	☒	First generation in a new frame at the Laugardalur site referred to as Laugardalur 2 (approx. 400m SA from the older frame referred to as Laugardalur).	
A follow up survey	☐		
Half maximal biomass	☐		
Survey prior to putting out smolt	☐		
A pre-survey new site	☐		
Other	☐		
Last fallowing period:			

Results from B-survey according to NS 9410:2016 (main results)			
Parameters and indexes		**Parameters and site status**	
Gr. II. pH/Eh	0,10	Gr. II. pH/Eh	1
Gr. III. Sensory	0,70	Gr. III. Sensory	1
GR. II + III	0,40	GR. II+ III	1
Date fieldwork	23.01 2024	**Date report**	02.02 2024
Site status (NS 9410:2016):			**1**

Report writing and project leader	Snorri Gunnarsson	Signature	
Quality control	Rikke Stabell	Signature	

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Preface

The B-survey is carried out in accordance with the Norwegian standard NS 9410:2016 - "Environmental monitoring of benthic impact from marine fish farms". Impact assessment is based on sediment condition (chemistry, sensory & presence/absence of fauna). The environmental survey is regulated by § 35 in the Norwegian "akvakulturdriftsforskriften". The survey also fulfills the requirements regarding seabed surveys outlined in the standard ISO 12878.

The primary objective of a B-survey is to assess the benthic impact beneath and in the close vicinity (near zone) of a marine fish farm by applying methods, thresholds and classifications as defined in NS9410:2016.

The following have participated in the survey:

Snorri Gunnarsson	Akvaplan-niva AS	Project leader.
Snorri Gunnarsson	Akvaplan-niva AS	Fieldwork and Report. Charts (Olex).
Rikke Stabell	Akvaplan-niva AS	Quality assurance

The sampling at Laugardalur 2 was done 23.01 2024.

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. Thresholds and classifications of assessment criteria applied in this report are based on Norwegian environmental conditions as Iceland specific criteria have yet not been developed. This should be taken into consideration when reviewing site status.

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.

Akvaplan-niva AS thanks Arnarlax and their personnel for the cooperation during the conductance of this site survey.

Kópavogur 02.02 2024

Snorri Gunnarsson
Project manager

1 Introduction

Sampling was undertaken on 29.09.2023 by Akvaplan-niva AS, who has been contracted by Arnarlax in relation to the company's fish farming activity at the site Laugardalur 2 in Tálknafjörður.

The objective of the B-survey is to document the environmental condition in the near zone (beneath and in the close vicinity) of a fish farm by evaluating sediment condition (chemistry, sensory & presence/absence of fauna) as defined in NS 9410:2016 (and ISO 12878). The B-survey is a tool for trend monitoring and allows to assess the status of organic enrichment beneath the net pens at various stages of the production cycle.

The survey was undertaken at the time of max biomass of current production cycle. Sampling stations in this survey are placed within the near zone of the current farm location. This the first generation farmed in a new frame at the Laugardalur site, referred to as Laugardalur 2 placed about 400 m SA from the older frame referred to as Laugardalur). Laugardalur 2 has an estimated max. biomass of 2.262 ton for current generation farmed fish (Rolf Ørjan Nordli, personal reference) and thus a total of 10 stations were sampled.

Figure 1 shows a map of the Tálknafjörður in Vestfirðir where Laugardalur 2 is located (Laugardalur 2 in upper right corner).

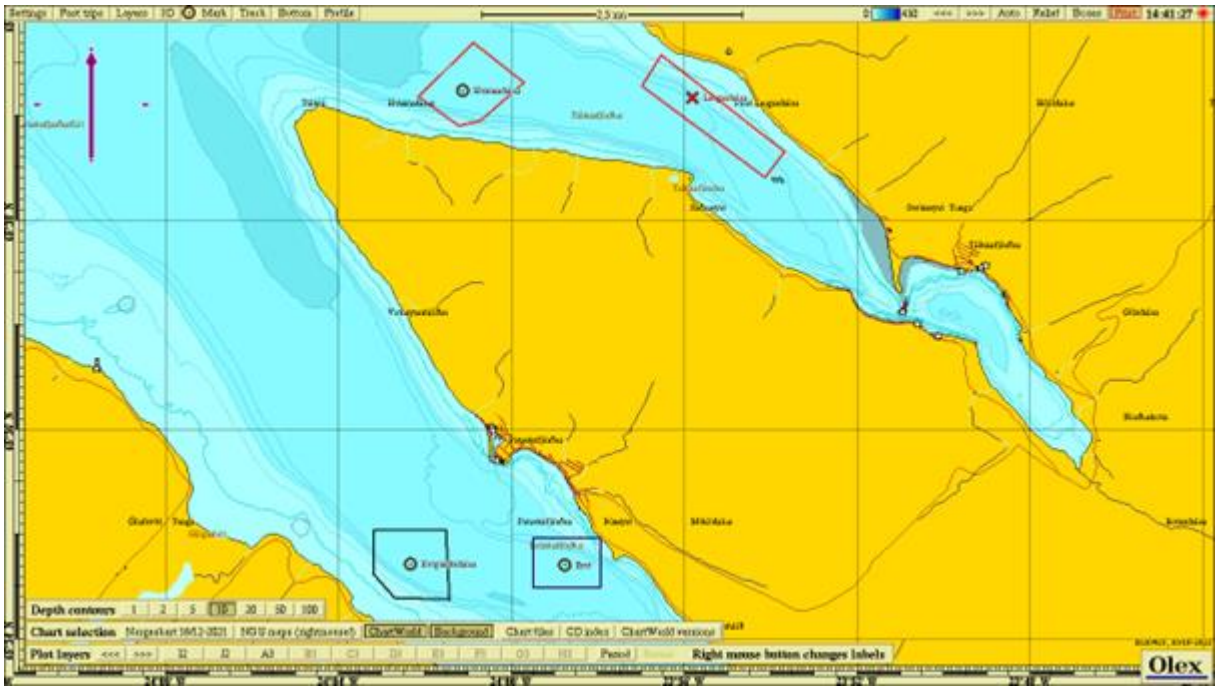

Figure 1. An overview map where Laugardalur 2 farm is marked. Other fish farming areas in the nearest vicinity (Tálknafjörður and Patreksförður) are also shown.

2 Methods

Monitoring of the environmental impact of fish farming activities on the seabed is standardised and regulated. All fish farming sites in the sea are to be regularly assessed. This B-survey follows guidelines and methods outlined in NS 9410:2016 and ISO 12878. The Icelandic Environmental agency (Umhverfisstofnun) can also set specific requirements regarding frequency of surveys for different fish farming sites, which can overrule the above-mentioned standards.

The B-survey is a trend monitoring tool with the focus on sediment condition (benthic impact) beneath and in the close vicinity of the fish cages (near zone). Sediment is collected using a grab (min 250 cm^2). Sediment condition for each sample is assessed using three indicators: sediment chemistry (pH and redox potential), sensory evaluation (gas bubbles, smell, texture, color and thickness of sludge) and the presence or absence of fauna. The performance of these indicators against predefined thresholds categorizes the farming locations into four different site conditions (see Table 1), which are used to determine the sampling frequency.

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	Prior to putting next generation into sea. Based on the site condition prior to putting next generation into sea: - 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 If any of the samples result in character 4 it is a sign of overload.
4-very bad	Overload

2.1 Field equipment

The following field equipment was used during the site survey:
Grab: Van Veen grab 0,1 m^2
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 Study site, production and survey design

3.1 Study site and production

Laugardalur 2 is located in the northern side of Tálknafjörður, approximately 3 nm northwest of the town of Tálknafjörður. The installed frame is suited for up to 8 net-pens with a circumference of 160 m. The frame is positioned in north- northwest direction from land (297°) with depth below the cages ranging from 42 to 50 m.
This is the first-generation farmed fish at the site Laugardalur 2 after the frame was installed in summer 2022. Laugardalur 2 is placed at a farming site Laugardalur where there is and has been a fish farm referred to as Laugardalur with 14 net pens and currently the fifth generation farmed salmon is being reared there. The Laugardalur 2 frame is placed about 400 m SA from the Laugardalur frame.

The output of smolts at Laugardalur 2 was in the summer and fall 2022. At the date of the B-survey the standing biomass was 2.176 tons.

Table 2 shows the production and feed usage for previous and current generation to sampling date.

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

Generation of fish (G)	Production (tonnes)	Feed usage (tonnes)
Generation 2022- 23.01 2024	1.573	3.297

3.2 Present and past site surveys

There are now previous B surveys at the Laugardalur 2 site.

3.3 Hydrodynamic conditions

Current measurements were undertaken in March-April 2019 at 42 m, which is the dispersing depth for Laugardalur site (Heggem, 2019). The dominating current at 42 m is in north-westerly direction (315 degrees) with a counter current in opposite direction (Figure 2). Average current speed is 4.2 cm/s. Highest current speed is measured to be 21,2 cm/s and 8.2 % of the measurements are zero current.

3.4 Survey design

The placement of the 10 sampling stations is shown in Figure 2 with positions listed in Table 3. Stations are distributed within the near zone of the new frame position following criteria outlined in NS 9410:2016. The typical depth in the local impact zone is in the range from 42 – 50 m, with the deepest waters being located in the northern part of the frame area (from land into the fjord). Sampling stations were placed to represent the varied environmental conditions within the near zone and cover thus both the deeper and shallower areas. During the present production cycle 6 cages were used at the site. Therefore, the 10 stations sampled were distributed with emphasis around these 6 cages according to guidance in NS 9410, chapter 7.6.

The sampling stations had a depth varying from 44 to 48 m. The placement of sampling stations is regarded to be in accordance with the requirements outlined in NS 9410:2016.

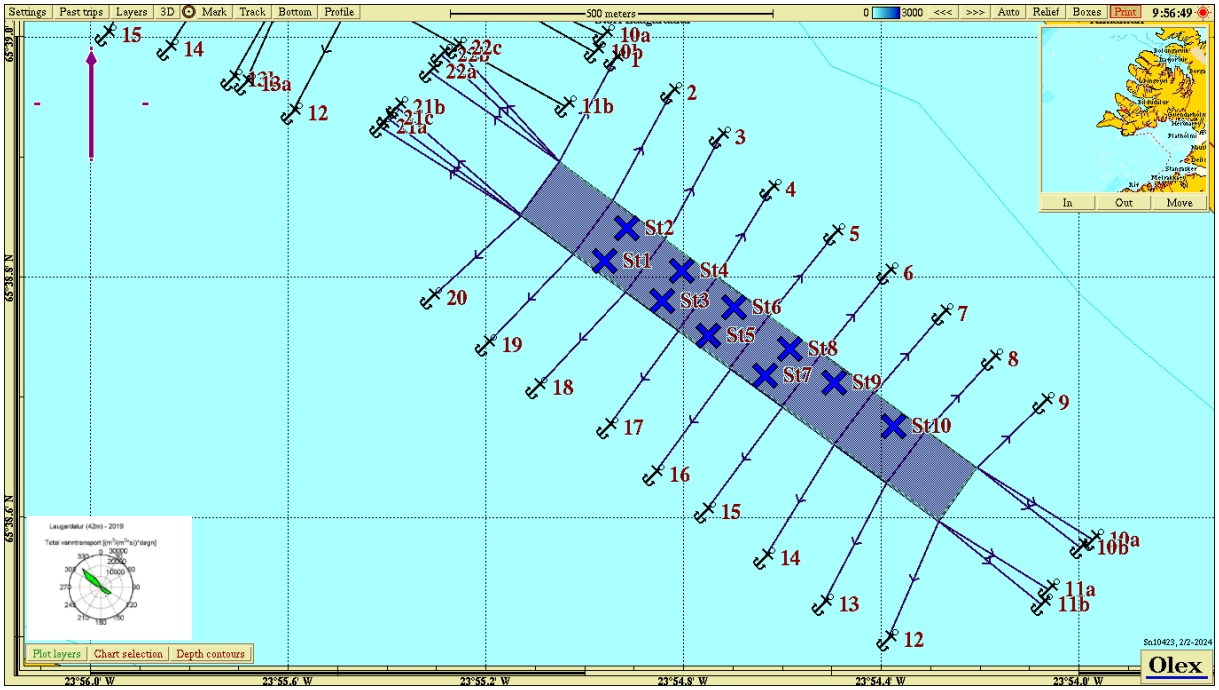

Figure 2. Site specific map of Laugardalur 2 showing frame, mooring lines and farming area. Sampling stations st. 1-10 are marked with blue crosses. The color of each cross represents the environmental condition at the respective station following the classification as outlined in NS 9410:2016, chapter 7.11. Color codes: Blue = very good, green = good, yellow = bad, red = very bad. Ocean current rose placed in the lower left corner shows main current direction at 60 m (Heggem, 2019).

Table 3. Position and depth of the sampling stations in the B-survey.

Station number	North	West	Depth (m)
St 1	65°38,813	23°54,959	48
St 2	65°38,840	23°54,915	48
St 3	65°38,780	23°54,842	48
St 4	65°38,804	23°54,803	47
St 5	65°38,750	23°54,750	47
St 6	65°38,774	23°54,698	46
St 7	65°38,717	23°54,935	46
St 8	65°38,740	23°54,585	46
St 9	65°38,711	23°54,494	45
St 10	65°38,675	23°54,375	44

4 Results

Results for the different parameters are given in Table 4. The completed fieldwork sampling sheet with calculations for each parameter is attached in appendix.

Table 4. Results from the parameter classifications in the near 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**

Substrate was collected at all 10 sampling stations (100% soft bottom). Sediment samples consisted mainly of mud in all parts of the local impact zone with some substantial amount of black algae. Fauna was recorded at all stations with polychaetes being most prominent. No signs of out-gassing were observed at any of the sampling stations. The substrate was of light/grey colour at all sampling stations. No smell of H_2S was at four sampling stations and light smell at six stations. Feed particles were observed at four stations (st. 3, 4, 6 and 7), faeces at one station (st. 2).

Based on the classification of sediment chemistry (ph/Eh) and the sensory assessments all ten stations of this survey received status 1 – "very good" (Figure 2). Overall, the index score for parameter III (sensory parameters) was lower than the index score for the parameter II (pH/Eh), or 0,70 for parameter III but 0,10 for parameter II.

Taken together the site receives the environmental status was 1 – "good" (average group II-III index =0.40).

5 Conclusion

Applying the indicator thresholds and classification outlined in NS 9410:2016 it is shown that Laugardalur 2 receives overall site status 1 – "very good" at the time of this B survey. Samples were collected with a Van Veen grab (0,1 m^2) at 10 stations distributed around the 6 cages, that were used for farming salmon during present production cycle. All ten sampling stations received status 1 – "very good".

The survey was undertaken during the time of max biomass for the present production cycle. The results indicate that overall, there is relatively little organic load in the local impact zone. However, there was feed visible in the sediment samples at four stations and some faeces at one station. There is some slight inconsistency in the score for parameters III (sensory) having higher index score than the parameter II (pH/redox) but both parameter have the overall condition 1 (very good).

There are no previous B-surveys prior to putting out current generation farmed fish at the new frame at the Laugardalur site referred to as Laugardalur 2 (placed about 400 m SA from the older frame "Laugardalur").

Following the criteria outlined in NS 9410:2016 the site receives the status 1 - "very good".

6 References

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

Heggem, T., 2019. Arnarlax hf. Strømmålinger Laugardalur. Spredningsstrøm 42 m. APN report 61178.01. 10 s.

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 akvakultur-anlegg.

Personal reference. Rolf Ørjan Nordli, Chief operation officer, Arnarlax. 2024

7 Appendix

7.1 Survey data sheet (B.1 & B.2), NS 9410:2016.

Sample scheme B.1

Company:	Arnarlax	Date:	23.01 2024
Site:	Laugardalur 2	Site no.:	tem.Lokalitet
Fieldworker:	SGU		

Gr	Parameter	Point	Sample number 1	2	3	4	5	6	7	8	9	10	Index 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	7.65	7.48	7.65	7.46	7.53	7.48	7.58	7.62	7.71	7.51		
	Eh (mV)	ORP	-51	-73	-35	-83	-81	-61	-21	-120	143	-22		
		plus ref. value	149	127	165	117	119	139	179	80	343	178		
	pH/Eh	from figure	0	0	0	0	0	0	0	1	0	0	0.10	
		Status station	1	1	1	1	1	1	1	1	1	1		
		Status group II	1	Buffer temp	7.6 C		Sea temp	2.5 C		Sediment temp	2.3 C			
		pH sea 8	ORP sea	130 mV		Eh sea	330 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			
		Light (2)		2	2	2	2	2				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)												
		1/4 < v < 3/4 (1)												
		v > 3/4 (2)	2	2	2	2	2	2	2	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	4.0	4.0	4.0	4.0	4.0	2.0	2.0	2.0	4.0		
		Corrected (*0,22)	0.4	0.9	0.9	0.9	0.9	0.9	0.4	0.4	0.4	0.9	0.70	
		Status station	1	1	1	1	1	1	1	1	1	1		
		Status group III	1											
		Average group II & III	0.2	0.4	0.4	0.4	0.4	0.4	0.2	0.7	0.2	0.4	0.40	
		Status station	1	1	1	1	1	1	1	1	1	1		
		Status group II & III	1											

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

Status site: 1

Grabb ID	K-3
pH / Eh ID	Ysi professional plus

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Sample Scheme B.2

Company:	Arnarlax	Date:	23.01 2024
Site:	Laugardalur 2	Site no.:	-
Fieldworker:	Snorri Gunnarsson		

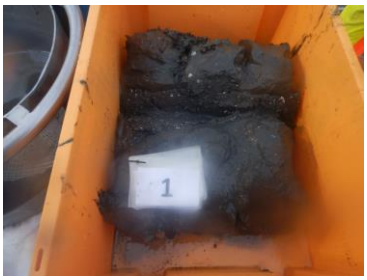
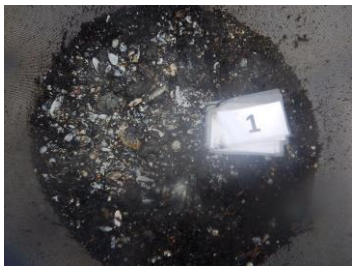
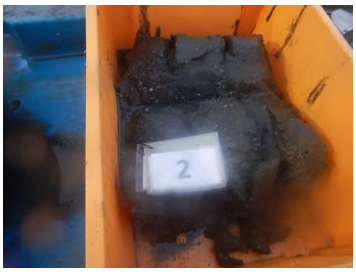
Sample number		1	2	3	4	5	6	7	8	9	10
Depth (m)		48	48	48	47	47	46	46	46	45	44
Number of trials		1	1	1	1	1	1	1	1	1	1
Gas bubbles (in sample)		No	No	No	No	No	No	No	No	No	No
Sediment type	Clay	X	X	X	X	X	X	X	X	X	X
	Silt						X	X	X	X	X
	Sand				X						
	Gravel										
	Shellsand										
Reef											
Rocky bottom (cobbles, boulders)											
Echinodermata, count									6		
Crustaceans, count											
Molluscs, count		5									
Polychaetes, count		>100	>100	>50	>100	>50	>100	>50	>50	>50	>50
Other animals, count											
Beggiatoa											
Feed				X	X		X	X			
Faeces			X								

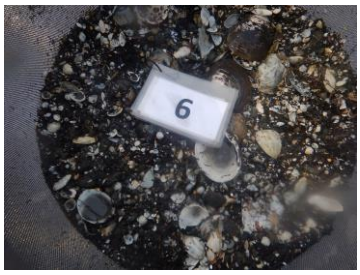
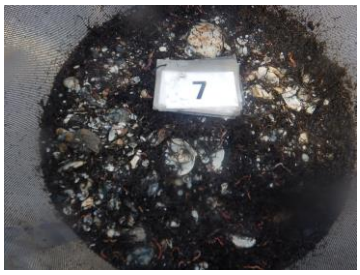
Comments: St-3 to 9 some amount black alge in sample.

Grab	Area [m^2]	0.1	Grab ID	K-3

Signature fieldworker: Snorri Gunnarsson

7.2 Pictures of samples at Laugardalur 2.

St 1		
St 2		
St 3		
St 4		

St 5		
St 6		
St 7		
St 8		
St 9		

St 10		

7.3 Bottom topography and 3D view

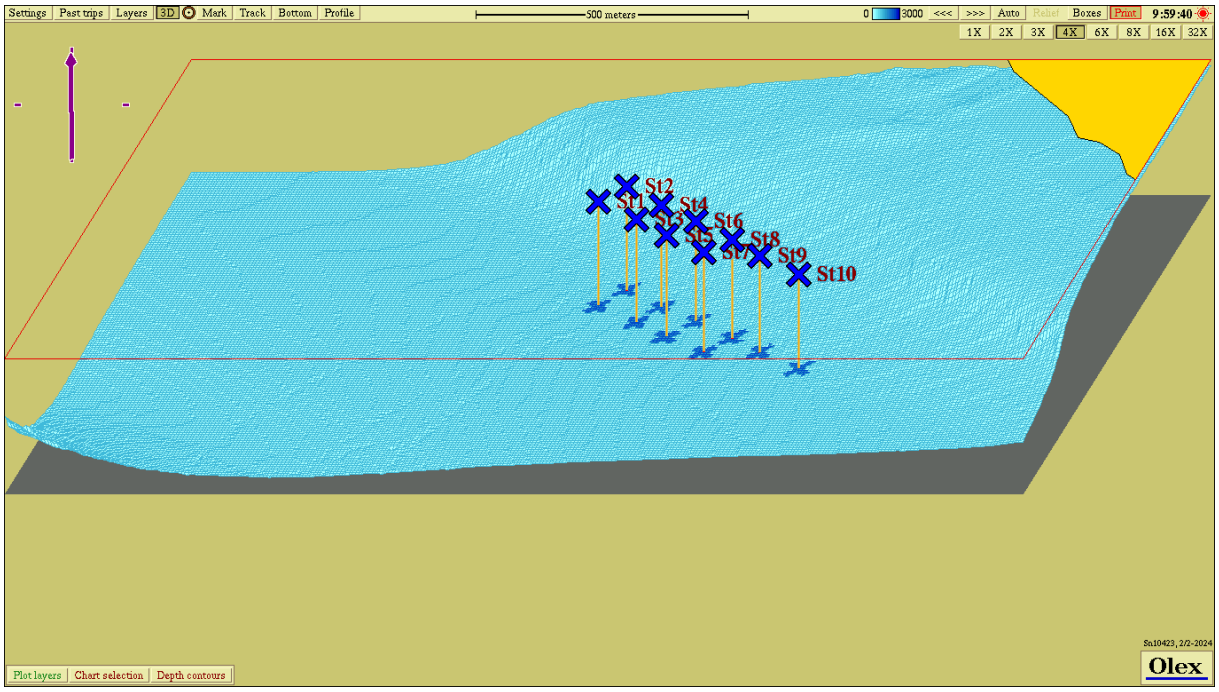


Figure 3. Bottom topography in 3D at Laugardalur 2 with each sampling station according to info in Figure 1 and Table 3.