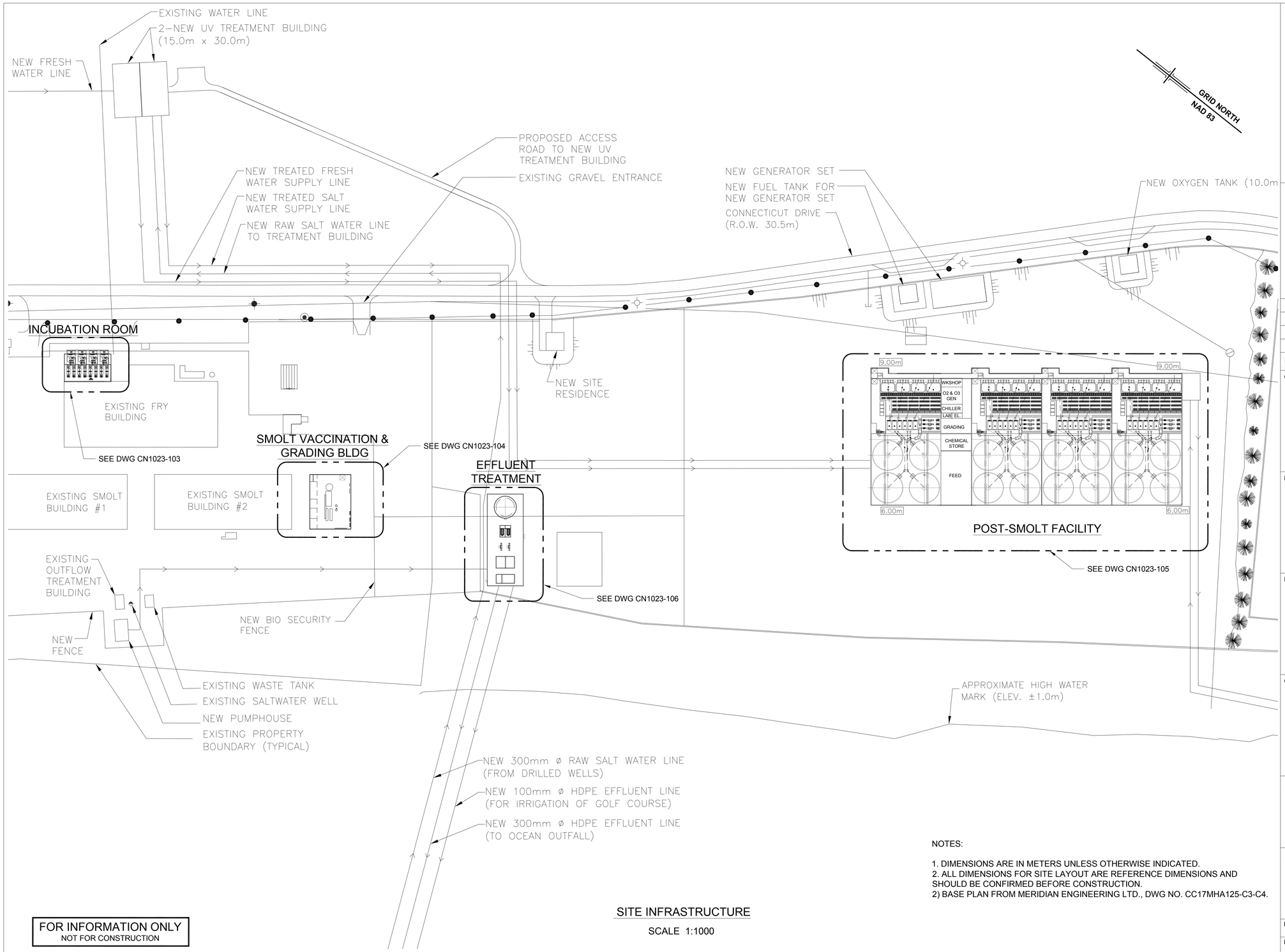
APPENDIX G: PROJECT DESIGN DRAWINGS



FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SITE INFRASTRUCTURE

SCALE 1:1000

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS OTHERWISE INDICATED.
2. ALL DIMENSIONS FOR SITE LAYOUT ARE REFERENCE DIMENSIONS AND SHOULD BE CONFIRMED BEFORE CONSTRUCTION.
2) BASE PLAN FROM MERIDIAN ENGINEERING LTD., DWG NO. CC17MHA125-C3-C4.

Owner

marineharvest

No.	Revision	Date
C	ISSUED FOR INFO	05JUL18
B	ISSUED FOR INFO	27JUN18
A	ISSUED FOR INFO	15MAR18

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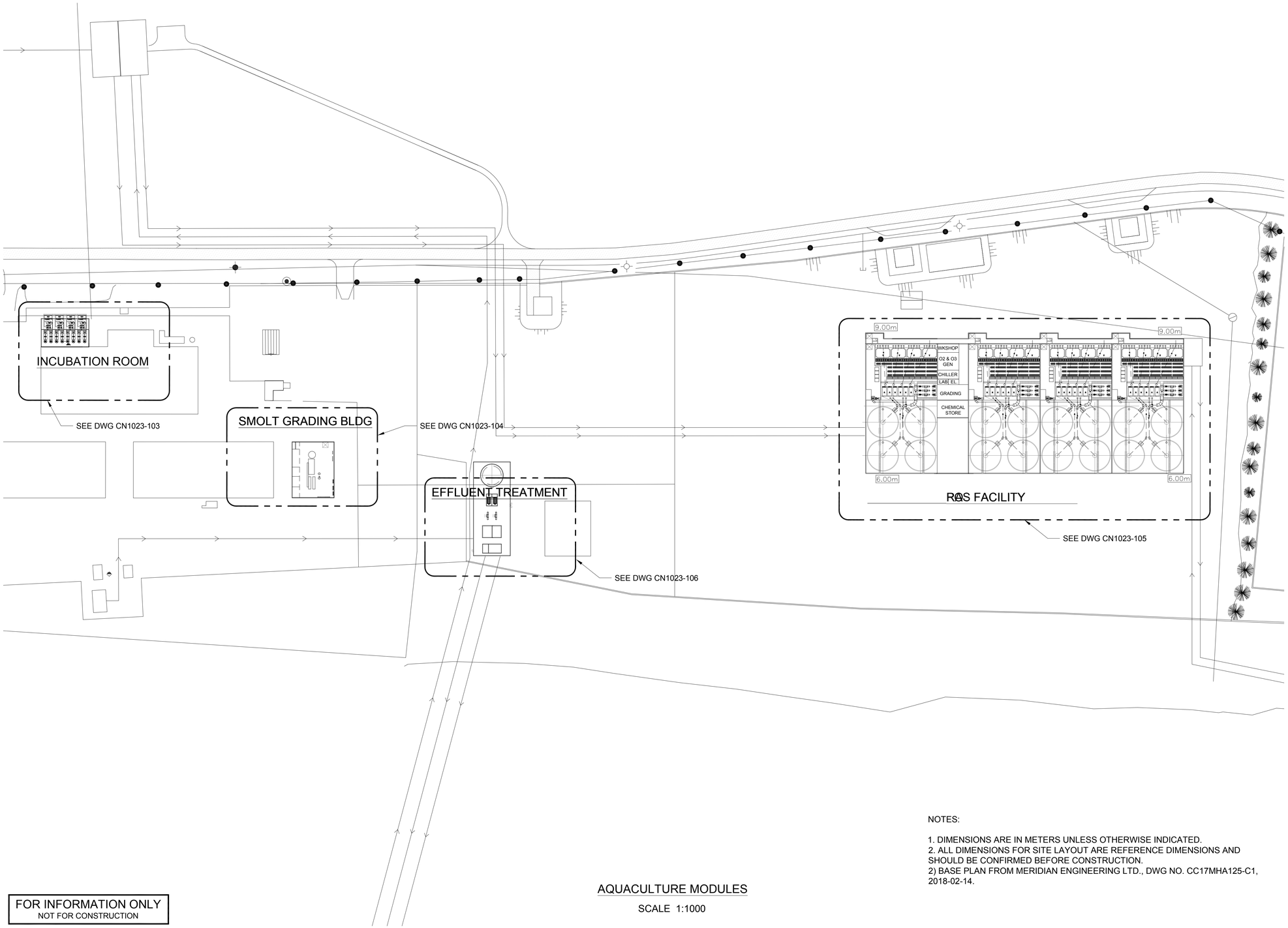
Project

INDIAN HEAD HATCHERY EXPANSION

Drawing

SITE INFRASTRUCTURE

Drawing File Name:	CN1023-101_.04.dwg
Drawing No.	CN1023-101
Project No.:	CC17MHA125 CN1023
Scale:	AS NOTED
Designed By:	BB
Drawn By:	KCG
Checked By:	
Approved By:	
Date:	18/06/14
Sheet	1 of 1



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AQUACULTURE MODULES

SCALE 1:1000

NOTES:

1. DIMENSIONS ARE IN METERS UNLESS OTHERWISE INDICATED.
2. ALL DIMENSIONS FOR SITE LAYOUT ARE REFERENCE DIMENSIONS AND SHOULD BE CONFIRMED BEFORE CONSTRUCTION.
2) BASE PLAN FROM MERIDIAN ENGINEERING LTD., DWG NO. CC17MHA125-C1, 2018-02-14.

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25.4 mm

DRAWING IS ISSUED AS 610x915 MM [24"x36". IF LINE SHOWN ABOVE IS NOT 25.4 MM [1"] LONG, ACTUAL SCALE DIFFERS FROM STATED SCALE.

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B	ISSUED FOR INFO	27JUN18
A	ISSUED FOR INFO	15MAR18

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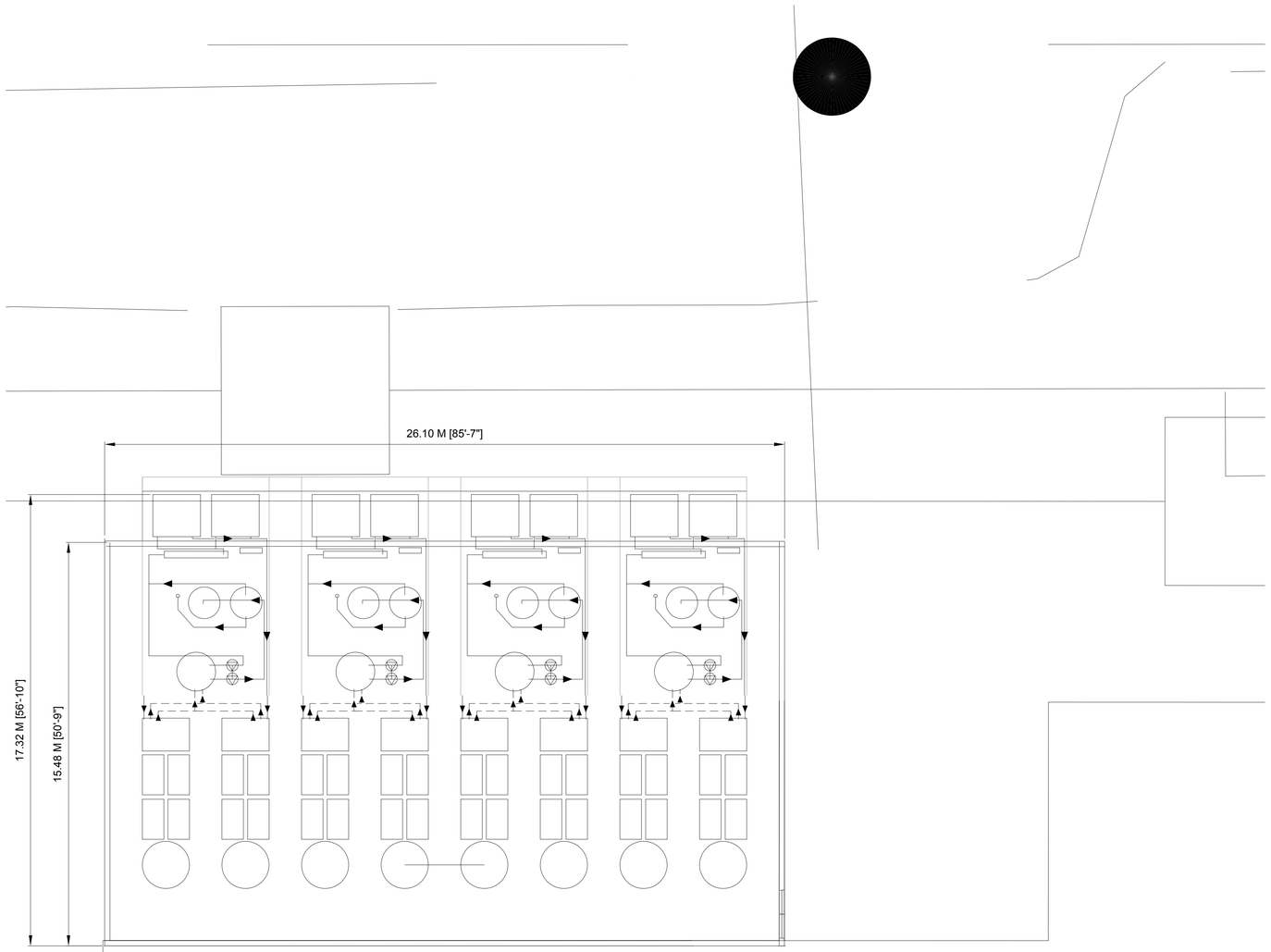
INDIAN HEAD HATCHERY EXPANSION

Drawing

AQUACULTURE MODULES

Drawing File Name:	CN1023-101_.04.DWG
Drawing No.	CN1023-102
Project No.:	CC17MHA125 CN1023
Scale:	AS NOTED
Designed By:	BB
Drawn By:	KCG
Checked By:	
Approved By:	
Date:	18/06/14
Sheet	1 of 1



BUILDING LAYOUT: INCUBATION MODULES
SCALE 1:100

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Owner

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25.4 mm

DRAWING IS ISSUED AS 610x915 MM [24"x36". IF LINE SHOWN ABOVE IS NOT 25.4 MM [1"] LONG, ACTUAL SCALE DIFFERS FROM STATED SCALE.

No.	Revision	Date
C	ISSUED FOR INFO	05JUL18
B	ISSUED FOR INFO	27JUN18
A	ISSUED FOR INFO	15MAR18

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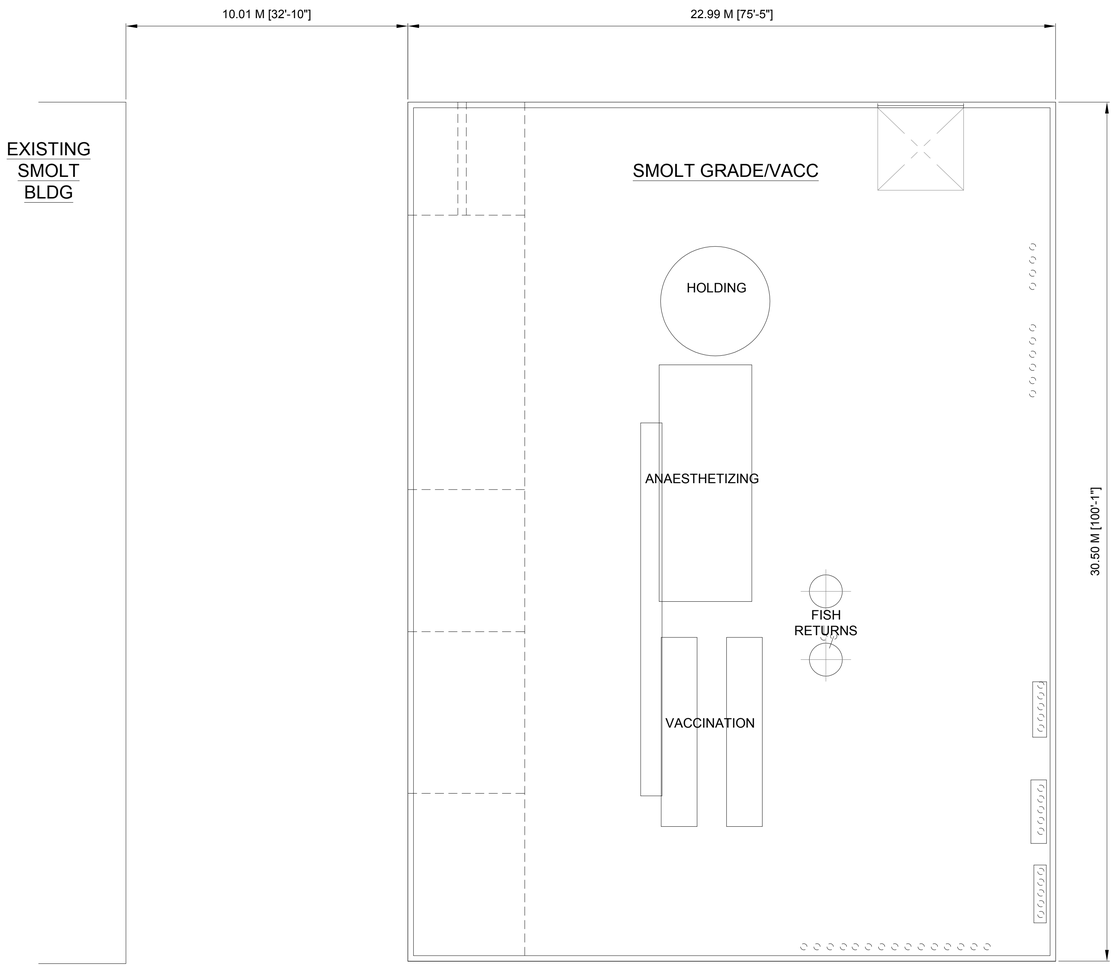
INDIAN HEAD HATCHERY EXPANSION

Drawing

INCUBATION MODULE

Drawing File Name:	CN1023-101_.04.DWG
Drawing No.	CN1023-103
Project No.: CC17MHA125 CN1023	Scale: AS NOTED
Designed By: BB	Drawn By: KCG
Checked By:	Approved By:
Date: 18/06/14	Sheet 1 of 1



BUILDING LAYOUT: SMOLT GRADING & VACCINATION
SCALE 1:100

FOR INFORMATION ONLY
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Owner

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25.4 mm

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A	ISSUED FOR INFO	15MAR18

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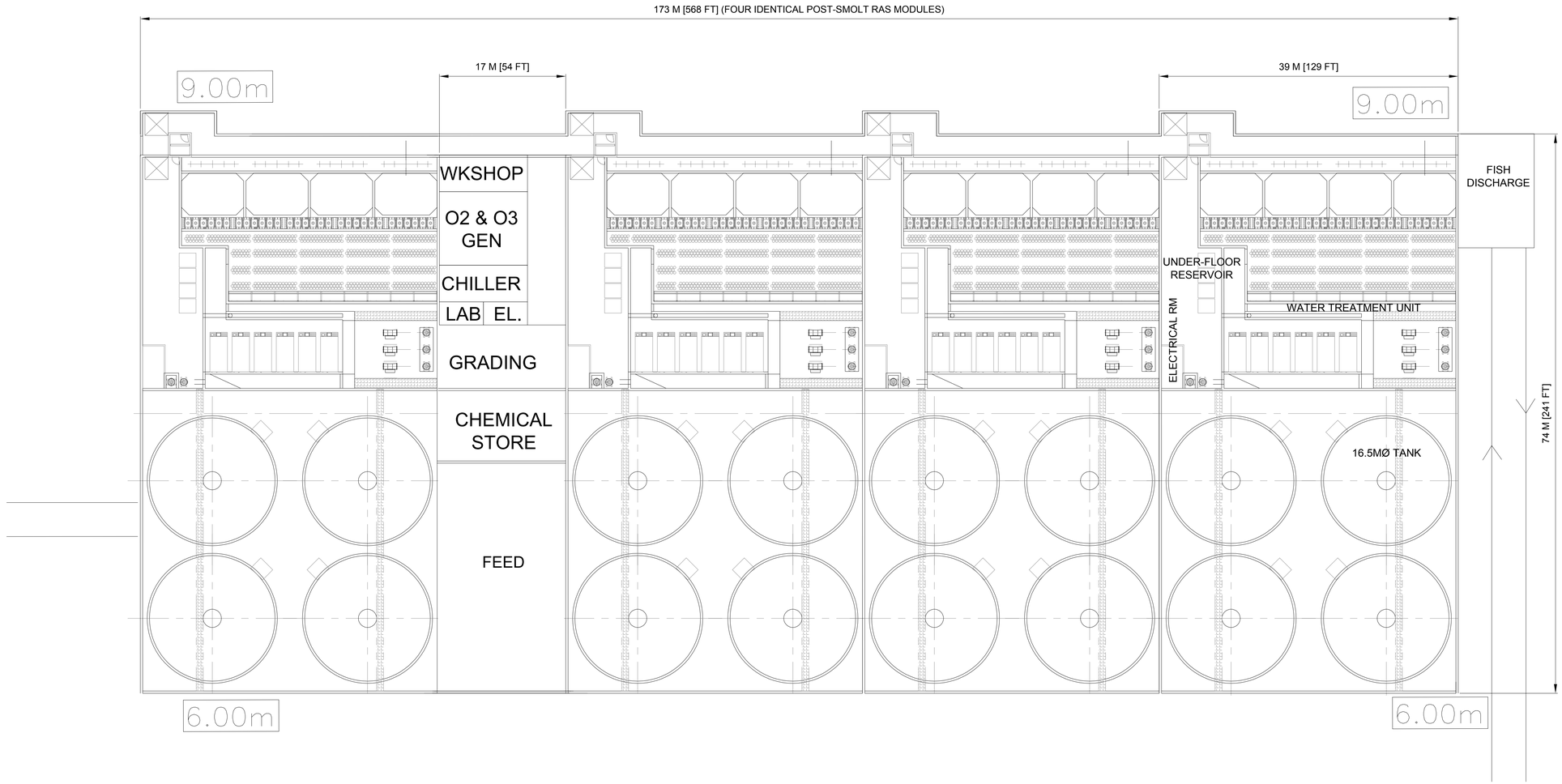
INDIAN HEAD HATCHERY EXPANSION

Drawing

SMOLT GRADING & VACCINATION

Drawing File Name:	CN1023-101_.04.DWG
Drawing No.	CN1023-104
Project No.: CC17MHA125 CN1023	Scale: AS NOTED
Designed By: BB	Drawn By: KCG
Checked By:	Approved By:
Date: 18/06/14	Sheet 1 of 1



BUILDING LAYOUT: MODULAR RAS PRODUCTION UNITS
SCALE 1:300

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25.4 mm

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No.	Revision	Date
F	ISSUED FOR INFO	05JUL18
E	ISSUED FOR INFO	27JUN18
D	ISSUED FOR INFO	18MAY18
C	ISSUED FOR INFO	17MAY18
B	ISSUED FOR INFO	25APR18
A	ISSUED FOR INFO	15MAR18

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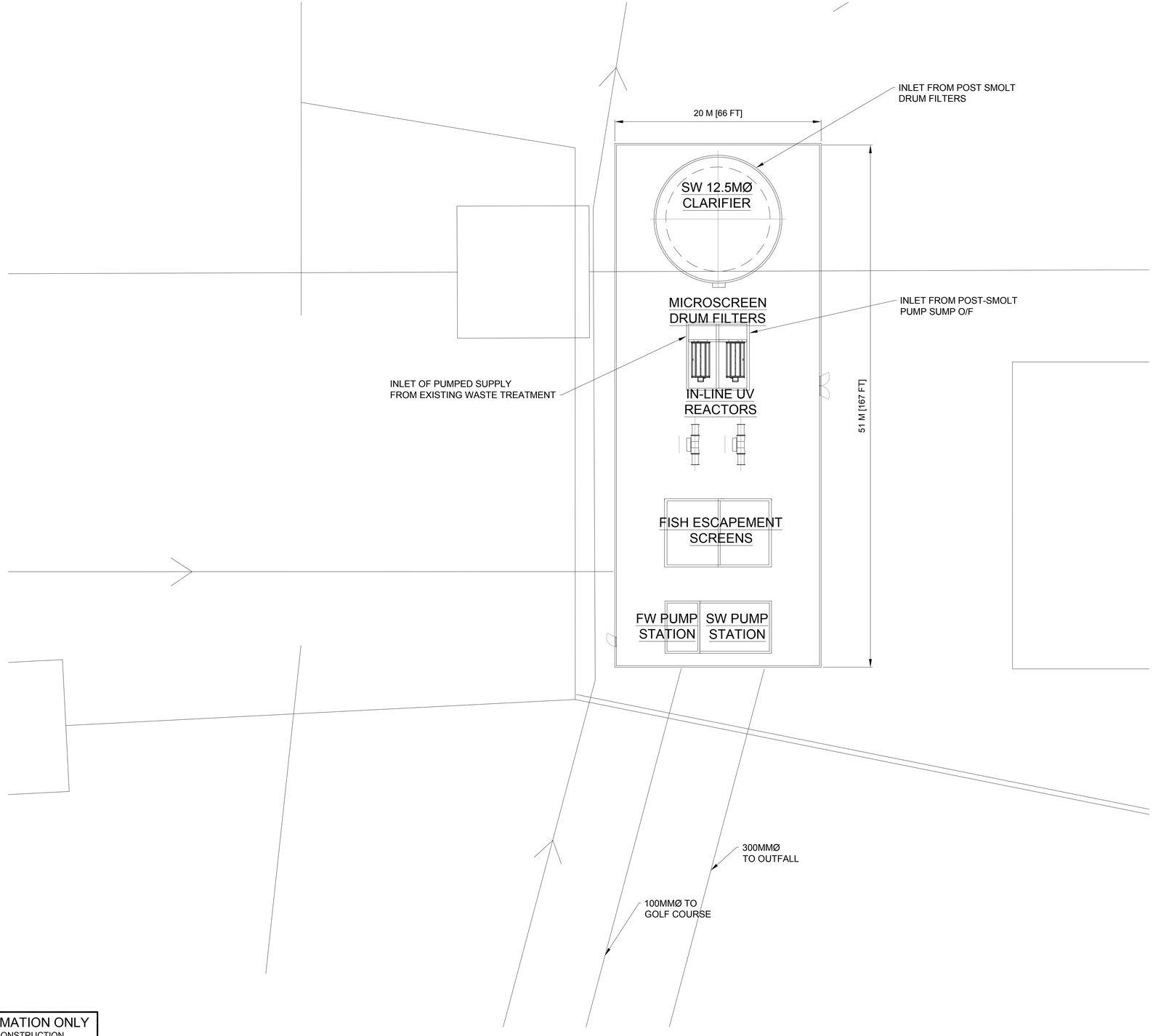
INDIAN HEAD HATCHERY EXPANSION

Drawing

MODULES

Drawing File Name:	CN1023-101_.04.DWG		
Drawing No.	CN1023-105		
Project No.:	CC17MHA125 CN1023	Scale:	AS NOTED
Designed By:	BB	Drawn By:	KCG
Checked By:		Approved By:	
Date:	18/06/14	Sheet 1 of 1	



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BUILDING LAYOUT: EFFLUENT TREATMENT
SCALE 1:200

Owner

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B	ISSUED FOR INFO	27JUN18
A	ISSUED FOR INFO	15MAR18

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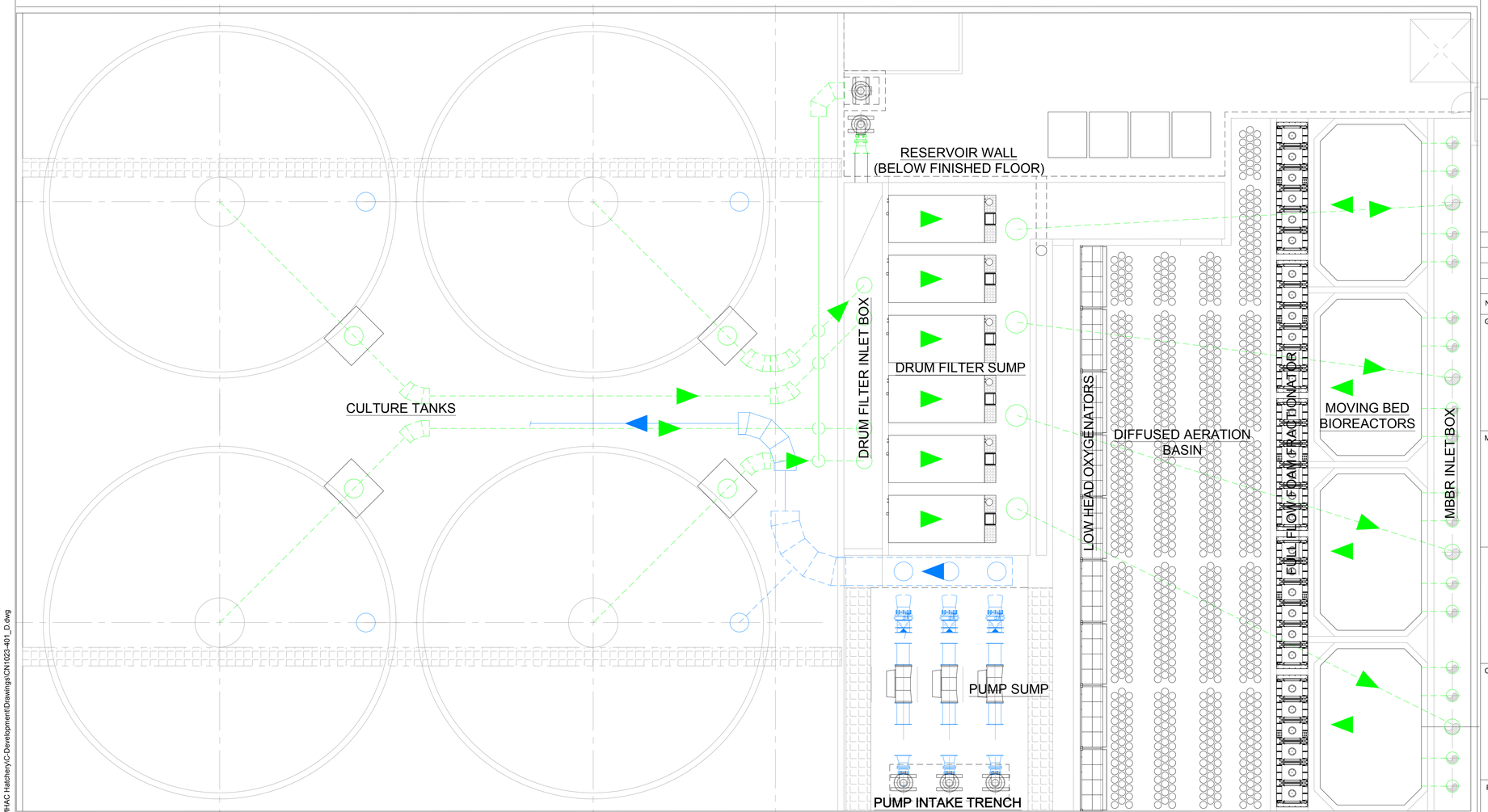
INDIAN HEAD HATCHERY EXPANSION

Drawing

EFFLUENT TREATMENT

Drawing File Name:	CN1023-101_.04.DWG
Drawing No.	CN1023-106
Project No.:	CC17MHA125 CN1023
Scale:	AS NOTED
Designed By:	BB
Drawn By:	KCG
Checked By:	
Approved By:	
Date:	18/06/14
Sheet	1 of 1



PLUMBING & EQUIP'T LAYOUT: MODULAR RAS PRODUCTION SHEET 1
SCALE 1:100

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GRID NORTH,
NAD 83 (REF)

N:\Nanaimo\Public\Projects\Marine Harvest Atlantic Canada\Stephenville, NF\MHAC Hatchery\C-Development\Drawings\CN1023-401_D.dwg

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No.	Revision	Date
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C	ISSUED FOR INFO	27JUN18
B	ISSUED FOR INFO	04JUN18
A	ISSUED FOR INFO	31MAY18

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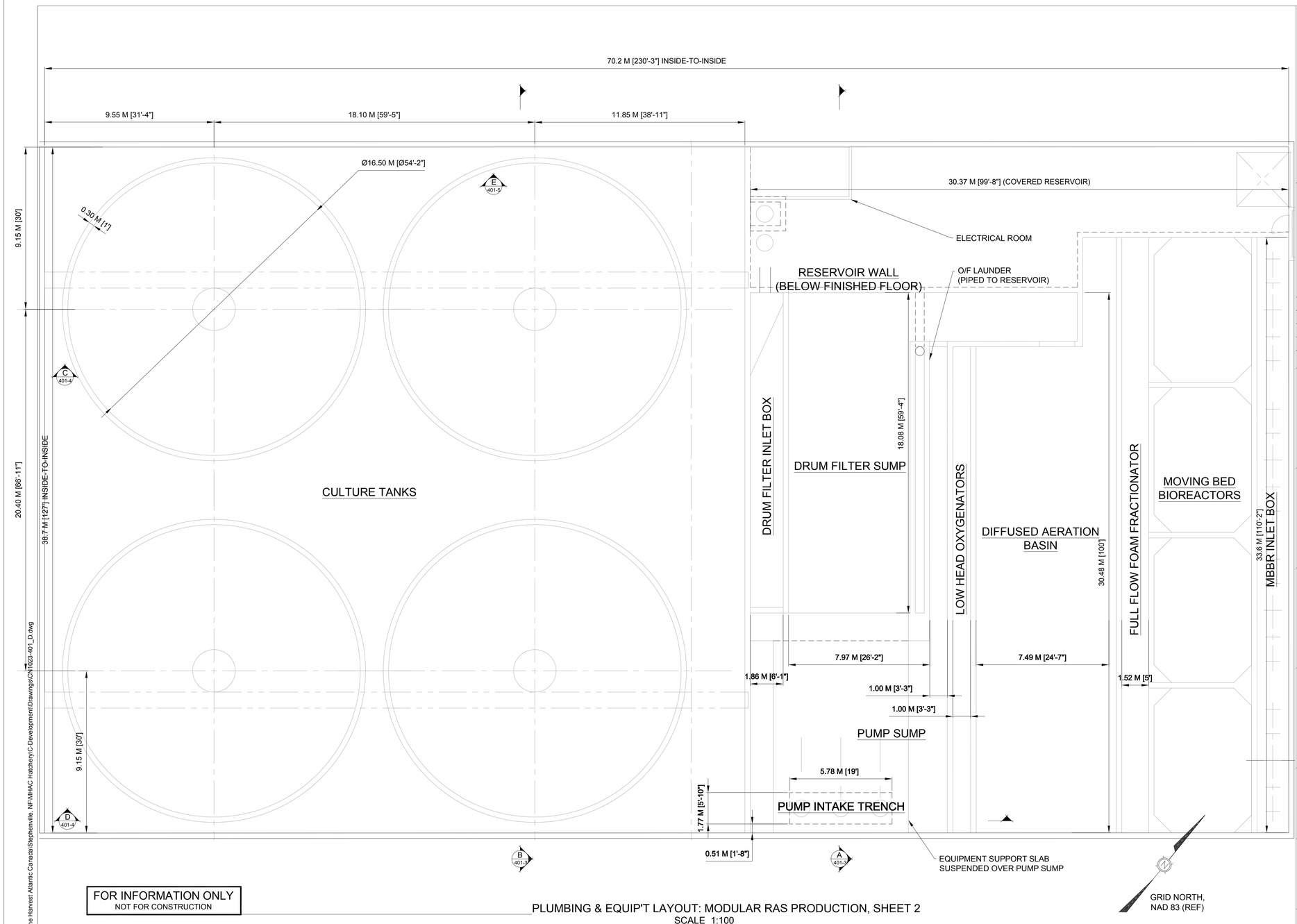
Project

INDIAN HEAD HATCHERY EXPANSION

Drawing

MODULE LAYOUT, SHEET 1

Drawing File Name:	CN1023-401
Drawing No.	CN1023-401-1
Project No.:	CC17MHA125 CN1023
Scale:	1:100
Designed By:	BB
Drawn By:	KCG
Checked By:	
Approved By:	
Date:	18/06/26
Sheet	1 of 5



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PLUMBING & EQUIP'T LAYOUT: MODULAR RAS PRODUCTION, SHEET 2
SCALE 1:100

N:\Nanaimo\Public\Projects\Marine Harvest Atlantic Canada\Stephenville, NF\MHAC Hatchery\C-Development\Drawings\CN1023-401_D.dwg

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25.4 mm

DRAWING IS ISSUED AS 610x915 MM [24"x36"]. IF LINE SHOWN ABOVE IS NOT 25.4 MM [1"] LONG, ACTUAL SCALE DIFFERS FROM STATED SCALE.

No.	Revision	Date
D	ISSUED FOR INFO	05JUL18
C	ISSUED FOR INFO	27JUN18
B	ISSUED FOR INFO	04JUN18
A	ISSUED FOR INFO	31MAY18

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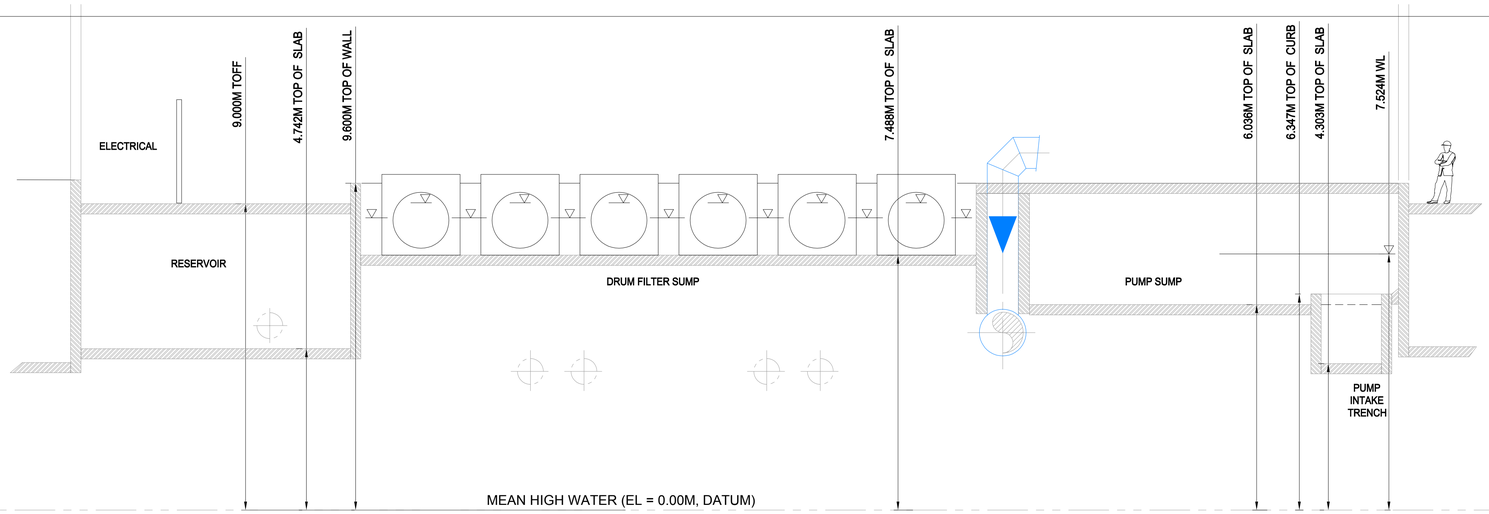
INDIAN HEAD HATCHERY EXPANSION

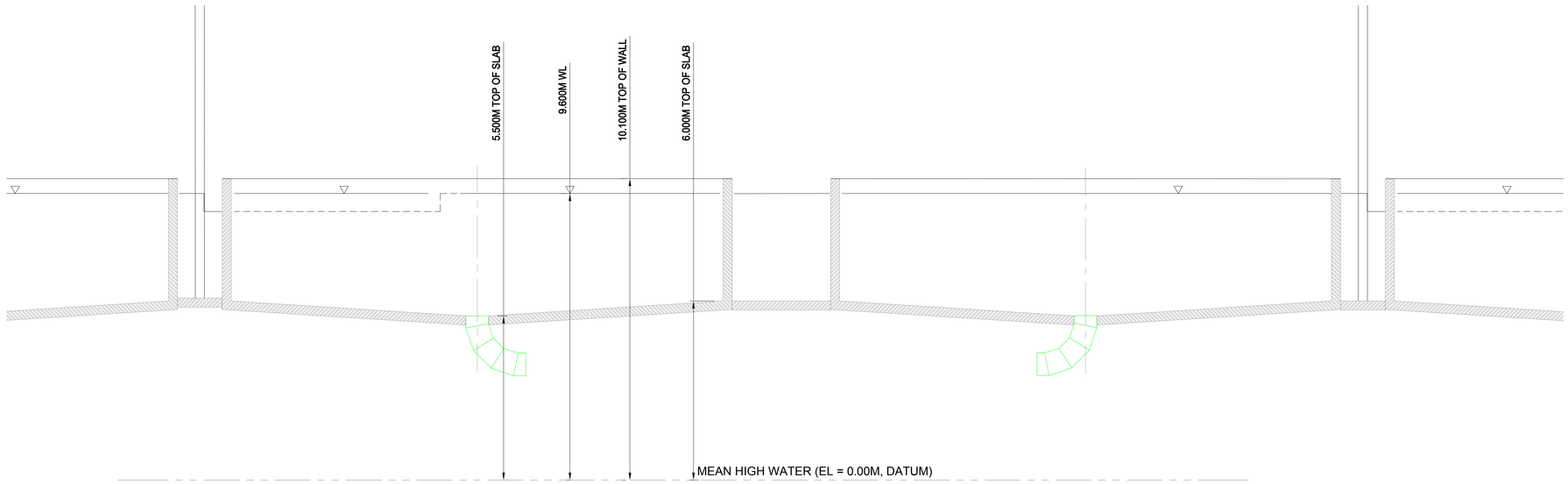
Drawing

MODULE LAYOUT, SHEET 2

Drawing File Name: CN1023-401	
Drawing No. CN1023-401-2	
Project No.: CC17MHA125 CN1023	Scale: 1:100
Designed By: BB	Drawn By: KCG
Checked By:	Approved By:
Date: 18/06/26	Sheet 2 of 5



SECTION A-A



SECTION B-B

FOR INFORMATION ONLY
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PLUMBING & EQUIP'T LAYOUT: MODULAR RAS PRODUCTION, SHEET 3
SCALE 1:75

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Owner

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No.	Revision	Date
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C	ISSUED FOR INFO	27JUN18
B	ISSUED FOR INFO	04JUN18
A	ISSUED FOR INFO	31MAY18

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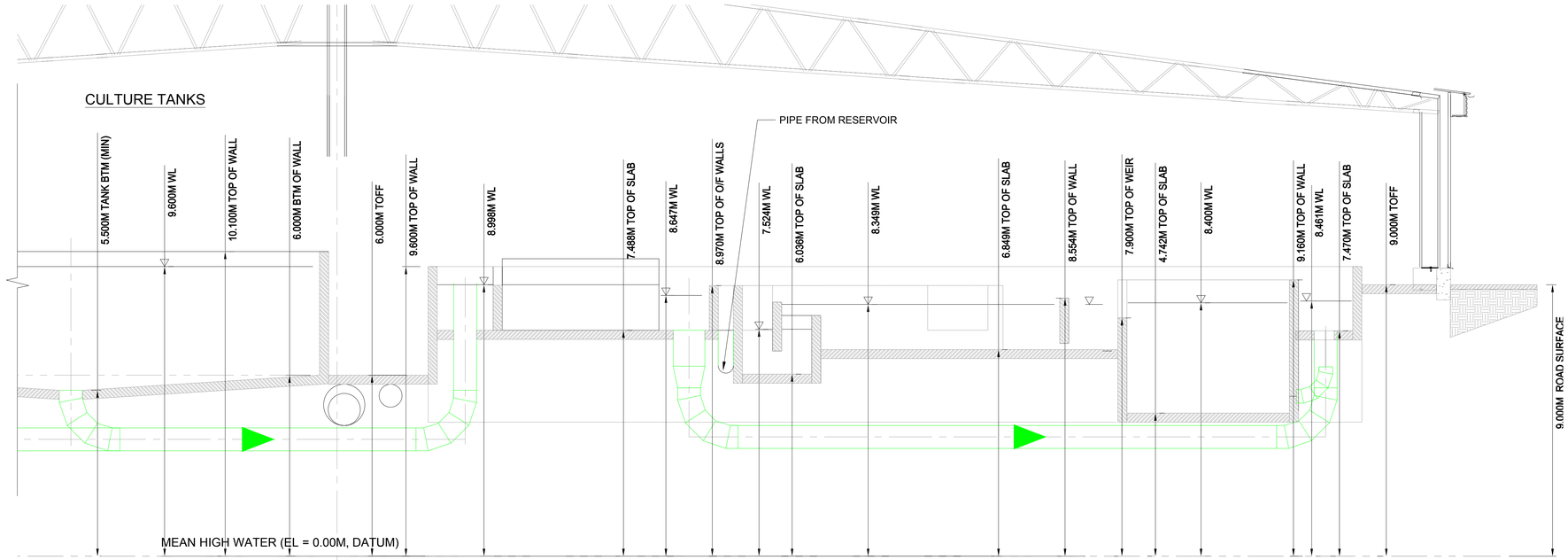
Project

INDIAN HEAD HATCHERY EXPANSION

Drawing

MODULE LAYOUT, SHEET 3

Drawing File Name: CN1023-401	
Drawing No. CN1023-401-3	
Project No.: CC17MHA125 CN1023	Scale: 1:100
Designed By: BB	Drawn By: KCG
Checked By:	Approved By:
Date: 18/06/26	Sheet 3 of 5



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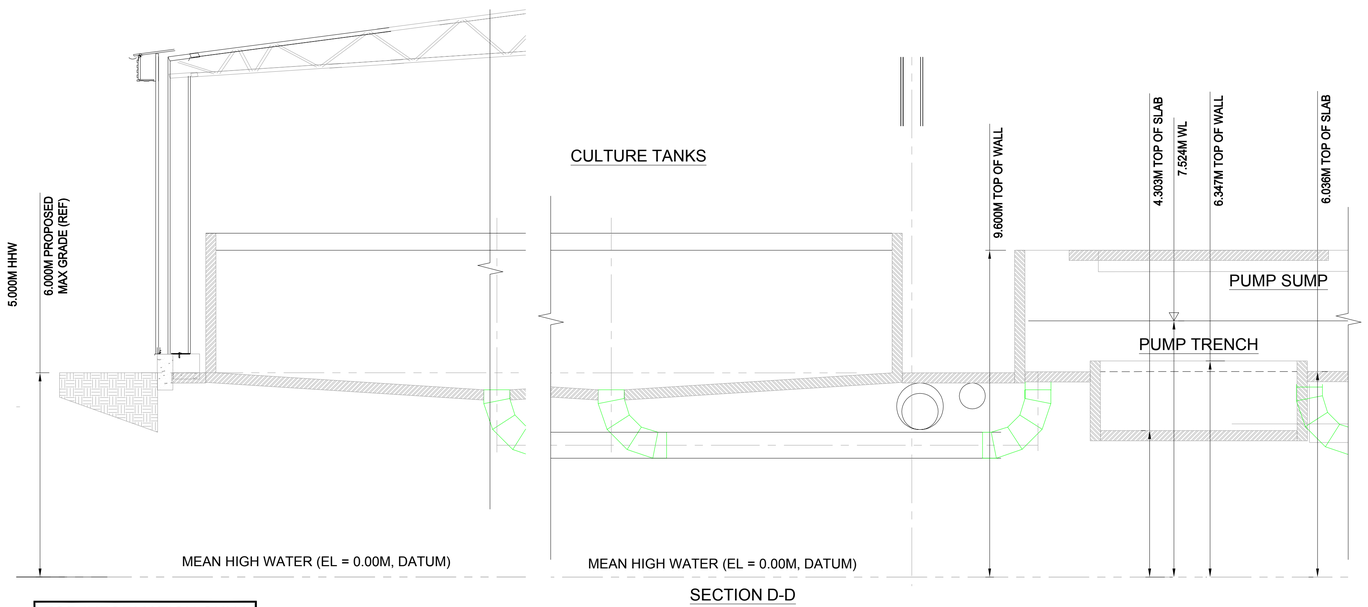

SECTION D-D

FOR INFORMATION ONLY
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PLUMBING & EQUIP'T LAYOUT: MODULAR RAS PRODUCTION, SHEET 4
SCALE 1:75

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Owner

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25.4 mm

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No.	Revision	Date
D	ISSUED FOR INFO	05JUL18
C	ISSUED FOR INFO	27JUN18
B	ISSUED FOR INFO	04JUN18
A	ISSUED FOR INFO	31MAY18

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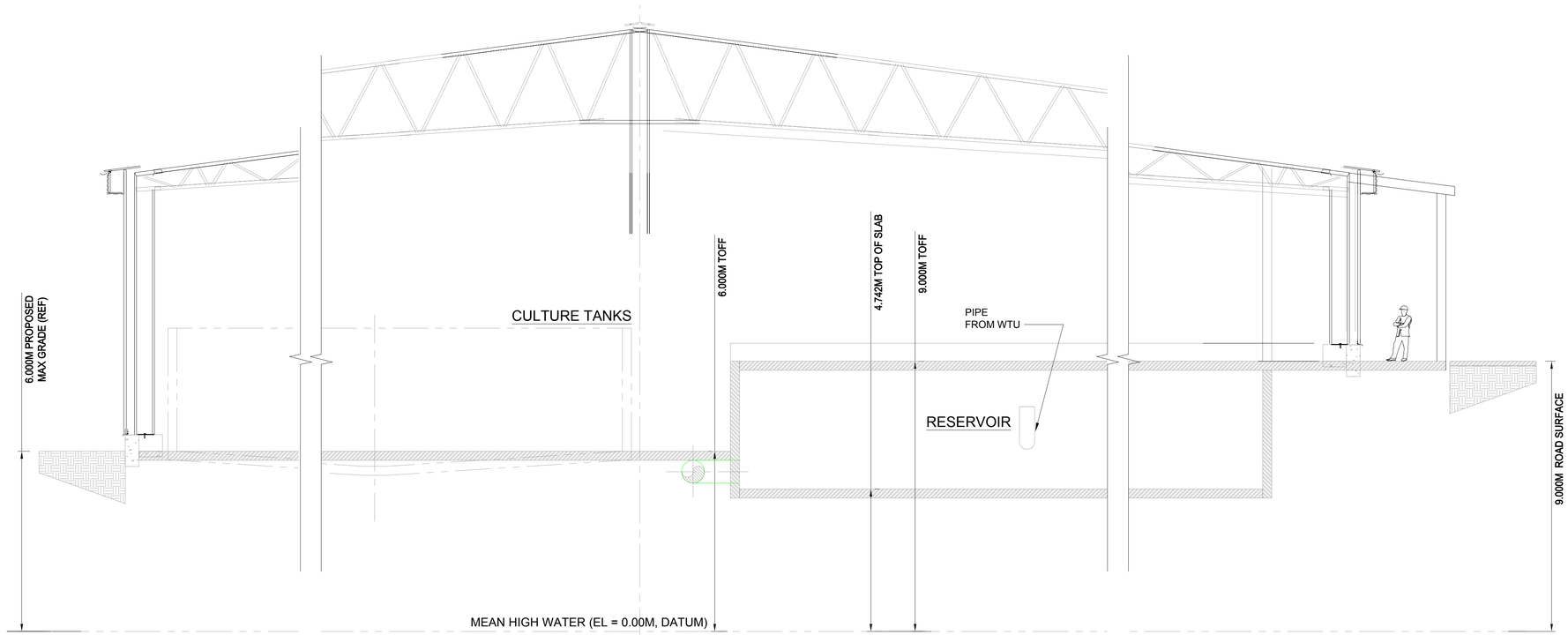
INDIAN HEAD HATCHERY EXPANSION

Drawing

MODULE LAYOUT, SHEET 4

Drawing File Name: CN1023-401	
Drawing No. CN1023-401-4	
Project No.: CC17MHA125 CN1023	Scale: 1:100
Designed By: BB	Drawn By: KCG
Checked By:	Approved By:
Date: 18/06/26	Sheet 4 of 5



SECTION E-E

FOR INFORMATION ONLY
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PLUMBING & EQUIP'T LAYOUT: MODULAR RAS PRODUCTION, SHEET 5
SCALE 1:75

N:\Nanaimo\Public\Projects\Marine Harvest Atlantic Canada\Stephenville, NF\MHAC Hatchery\C-Development\Drawings\CN1023-401_D.dwg

Owner

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25.4 mm

DRAWING IS ISSUED AS 610x915 MM [24"x36"]. IF LINE SHOWN ABOVE IS NOT 25.4 MM [1"] LONG, ACTUAL SCALE DIFFERS FROM STATED SCALE.

No.	Revision	Date
D	ISSUED FOR INFO	05JUL18
C	ISSUED FOR INFO	27JUN18
B	ISSUED FOR INFO	04JUN18
A	ISSUED FOR INFO	31MAY18

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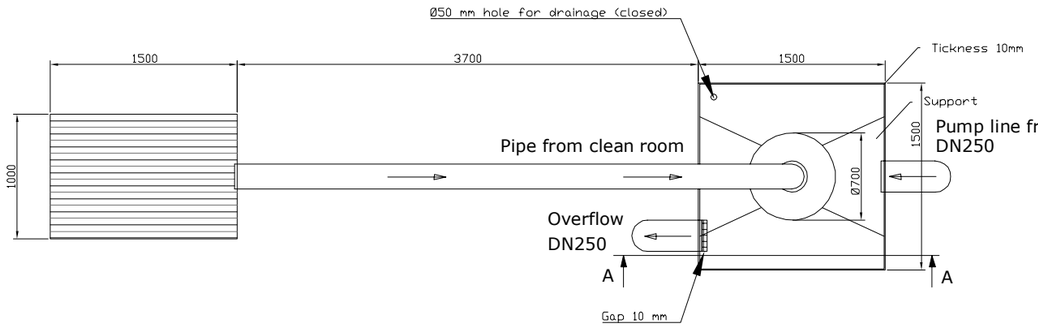
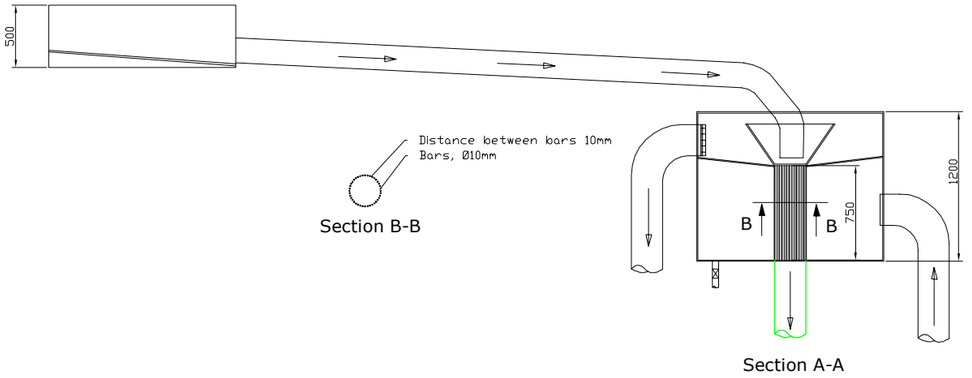
INDIAN HEAD HATCHERY EXPANSION

Drawing

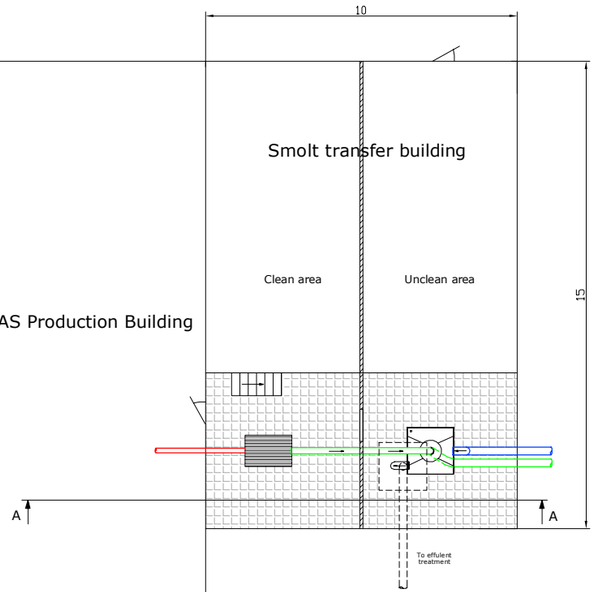
MODULE LAYOUT, SHEET 5

Drawing File Name:	CN1023-401		
Drawing No.	CN1023-401-5		
Project No.:	CC17MHA125 CN1023	Scale:	1:100
Designed By:	BB	Drawn By:	KCG
Checked By:		Approved By:	
Date:	18/06/26	Sheet 5 of 5	

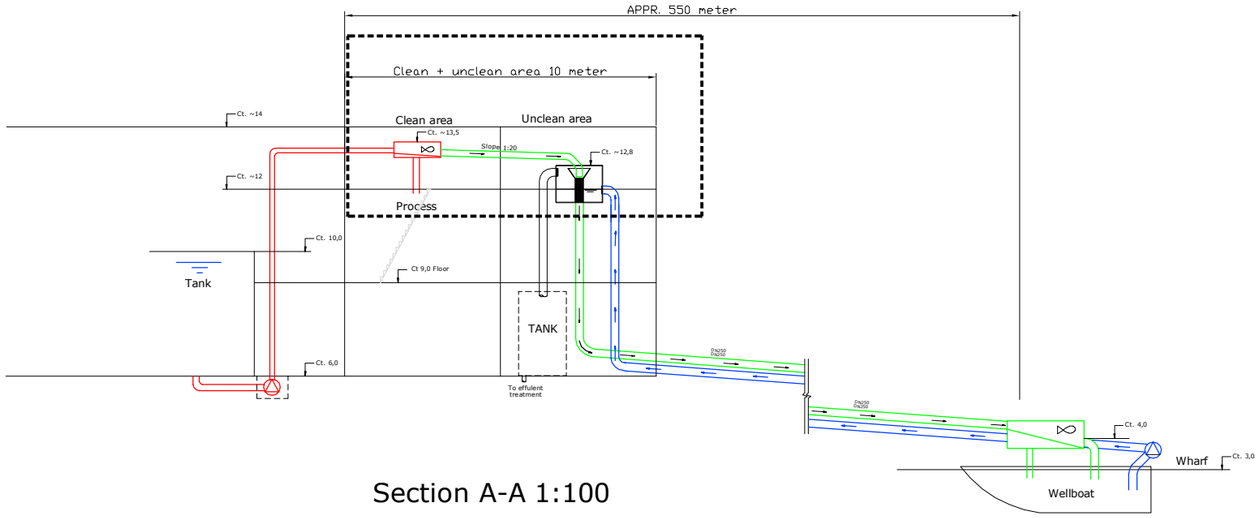




Detail A



Plan 1:100



Section A-A 1:100

Calculated head loss: 6,4 meters
(Head reserve 1,2 meters)
(Velocity 1,5 m/s, pipe inner diameter SDR11 205mm)

LOCATION:

Smolt transfer building (10 X 15m)

LEGEND

- SMOLT DISCHARGE LINE
- WATER SUPPORT LINE
- INTERNAL PROCESS LINE

Revisjon	Endringer	Dato	Tegnet	Kontrollert	Godkj
1	Plan of buildings added	27.06.2018	THTA	GTD	C

Sketch

RAMBØLL

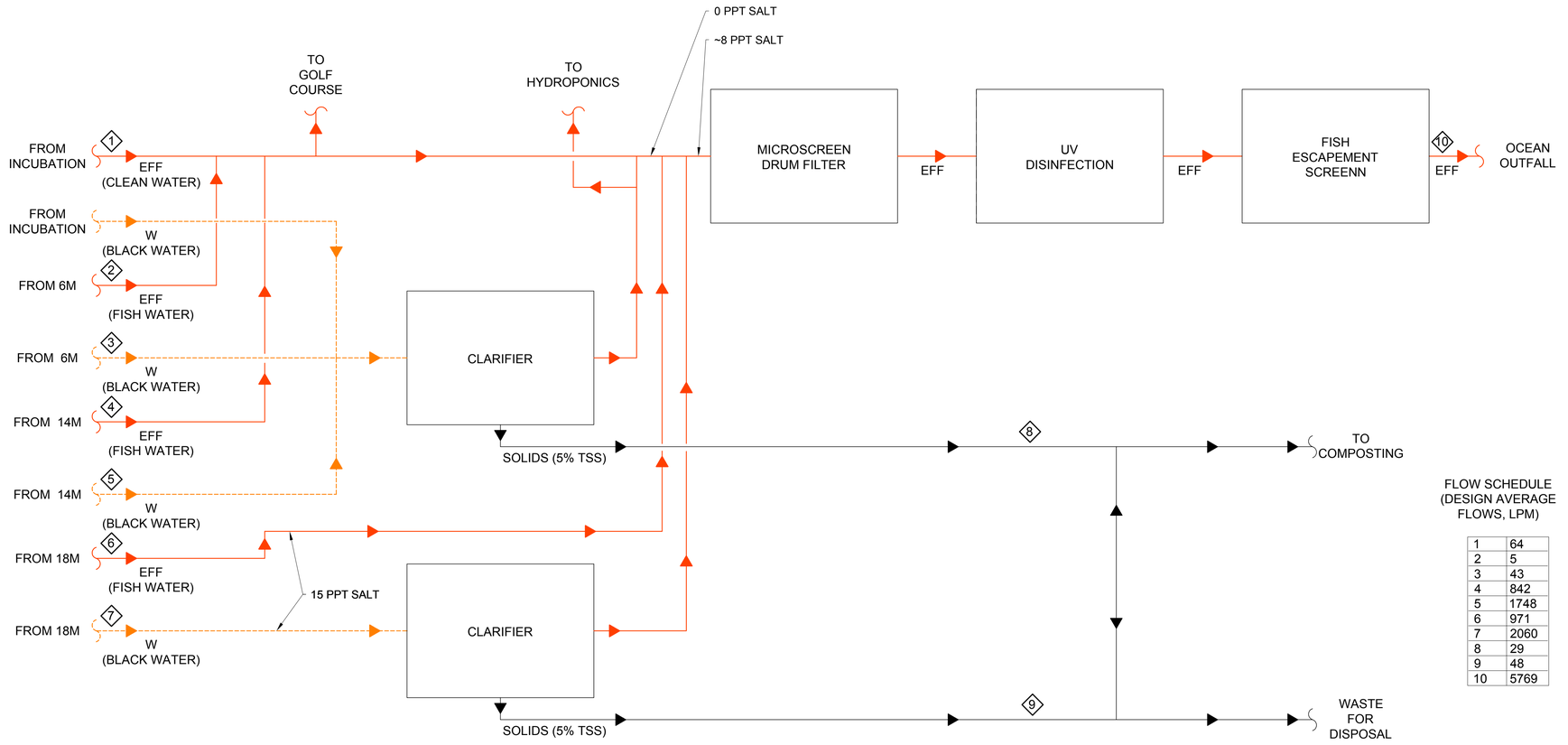
Rambøll Norge AS - Region Midt-Norge
P.b. 9420 Sluppen - 7493 TRONDHEIM - Tel 73 84 10 00 - Fax 73 84 10 60

Northern Harvest Indian Head hatcery expension

DATO: 18.04..2018
TEGN: THTA
KONTR: SHN
Rambøll prosjekt: 1350028313
Rambøll Kontrollnr: THTA
Filnavn: Lay. GH.dwg
Målestokk: 1:50

Principle
Smolt transfer building and delivery

Komplekks | Bygg | Etasje | Fag | System | Type | Løpenummer: H010 | Revisjon: 1 | Ark



FLOW SCHEDULE (DESIGN AVERAGE FLOWS, LPM)

1	64
2	5
3	43
4	842
5	1748
6	971
7	2060
8	29
9	48
10	5769

AQUACULTURE WATER SYSTEM: PROCESS FLOW DIAGRAM, EFFLUENT TREATMENT

SCALE: NOT TO SCALE

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NO.	DATE:	REVISION
A	15MAR18	ISSUED FOR INFORMATION

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MARINE HARVEST ATLANTIC CANADA

STEPHENVILLE HATCHERY
AQUACULTURE WATER SYSTEM
PROCESS FLOW DIAGRAM: EFFLUENT

DESIGNED:	DRAWN:	CHECKED:
BB	KCG	–
DATE:	SCALE:	APP'D:
21NOV14	AS NOTED	–
DWG. NO.		REV:
CN1023-601-7		A

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APPENDIX H: SALTWATER SUPPLY AND LINES

Please note that these reports were commissioned by MHAC prior to the purchase of NHS.

1. Saltwater Monitoring Well Report 3113-010
2. Sonar-DCPTs, Port of Stephenville 3113-008

Fracflow Consultants Inc.

Environmental, Hydrogeological and
Geotechnical Engineering Consultants

TECHNICAL MEMORANDUM

TO: Marine Harvest Atlantic Canada FFC-NL-3113-010

FROM: Fracflow Consultants Inc.

DATE: June 25, 2018

SUBJECT: Salt Water Monitoring Wells, Stephenville, NL

1.0 INTRODUCTION

Two monitoring wells (FHS1 and FHS2) were drilled (**Figure 1**) between the paved highway and the southern edge of the golf course to determine if the overburden and water chemistry were suitable for the development of one or more saltwater production wells to supply saline water, by inducing sea water intrusion, for the Marine Harvest Atlantic Canada (MHAC) proposed fish hatchery/aquaculture operation in Stephenville, NL. The two boreholes were augered to approximately 20 m of depth with the collection of split spoon soil samples and then DCPTs were driven out the bottom of the augers to determine the soil type or soil properties at depth. Once the DCPTs were completed, piezometers were installed in the boreholes - one piezometer at approximately 20 m of depth and the second piezometer at approximately 3 m of depth. Water samples were collected from each piezometer with the deeper piezometers being sampled a second time after a more aggressive purging of the well. The augering, DCPTs and water sampling were completed between March and May 2018. This document provides the well logs, the soil descriptions, the water chemistry data and the permeability values that were computed from the grain size data.

2.0 Overburden Characteristics

The boreholes logs are provided in **Appendix A**. Borehole FHS1 intersected a 1.0 to 2.0 m thick layer of silty clay between 17 and 19 m below ground surface. A DCPT was then driven out the bottom of the augers at approximately 19 m bgs and low blow counts were measured down to 21 m below ground surface. The DCPT in FHS1 was driven to approximately 37 m bgs but did not encounter any additional zones with low blow counts. The low blow counts indicate that a layer of clay or silty clay is present at this depth and that the overburden material below 21 m bgs is primarly fine to medium sand with minor amounts of gravel. The sieve analysis for the two SPT samples from the 19 m to 21 m interval show that the grain size of the material is 90% to 100% in the silt to clay range.

FHS2 was drilled approximately 600 m east of FHS1, close to the golf course garage. FHS2 was augered to 19.6 m bgs but did not encounter any obvious low blow count zones. A DCPT was then driven out the bottom of the auger to a depth of approximately 28 m bgs. A low blow count zone was encountered between 24 m and 27 m bgs, indicating the presence of a softer silty or clay layer at this depth interval. The high blow counts above and below this zone indicate that the material at the depths above and below the soft layer is primarily medium sand to gravel.

The grain size data for the samples from both saltwater monitoring wells are provided in **Appendix B**. The grain size data were used to compute the hydraulic conductivity values for the selected soil samples using the Hazen method (Fetter, 2001) as,

$$K = C(d_{10})^2$$

where K is hydraulic conductivity (cm/s), d_{10} is the effective grain size (cm), and C is a coefficient based on the table shown in **Tables 1a** and **1b**. The method is generally applicable for sand with the effective grain size ranged from 0.01 cm to 0.3 cm.

The grain size data confirm the presence of a low permeability layer in borehole FHS1. The grain size data also show that the permeability of the overburden in FHS2 is higher than that found in FHS1 at the same depth below the ground surface. Based on the grain size data from the upper 20 m of both boreholes, this section of the aquifer is expected to have lower well yields than those measured in the Marine Harvest production test well. However, the computed K values still indicate that a properly constructed and developed well will have well yields in the range of 1,200 to 1,600 litres per minute or greater based on the available drawdown.

It is recommended that a salt water test well be constructed approximately 100 m to 150 m west to northwest (**Figure 1**) of borehole FHS2. **Figure 2** shows the proposed construction procedures for this test well which is designed to allow aquifer tests to be completed on both the upper part of the aquifer and the lower part of the aquifer, separately. Composite soil samples will be collected during the drilling of this test well at 1.5 m intervals, visually assessed, and the location and depths of the well screen sections, the solid riser sections and the casing pull-back depths will be decided based on the estimated grain size distributions for the collected samples. **Figure 1** shows the location of this salt water test well as well as the location of two additional potential production wells.

3.0 Monitoring Well Construction

Monitoring wells were constructed in both FHS1 and FHS2 boreholes. Construction of the monitoring well assembly in FHS1 was preceded by pulling the 250 mm augers back to approximately 15.2 m bgs to avoid the layer of fine sand and the large clay layer at about 19 m bgs. Once the required depth was reached a 50 mm screen and riser assembly (piezometer) was lowered into the borehole through the augers, consisting of 4.6 m of screen and 12.2 m of riser with a bottom end cap and a J-Plug seal at the top of the riser. Sections of augers were removed

1.5 m at a time up to 9.6 m bgs and a 0.6 m section of bentonite was added to reduce the permeability parallel to the borehole and to prevent short-circuiting. The augers were then removed and a 25 mm piezometer well was installed using a pointed cap. The details of the two piezometers in FHS1 are provided in the well log in **Appendix A**. Bentonite was added to the top of the borehole to prevent surface water from draining down to the screened interval of this upper piezometer.

The same procedure was followed in constructing a monitoring well in the FHS2 borehole. The details of each piezometer in this borehole are provided in the well log for FHS2 in **Appendix A**.

4.0 Groundwater Chemistry

Water samples were collected from the shallow and deep piezometers in FHS1 on April 10, 2018, after purging approximately 10 to 15 well volumes. Normally, boreholes or monitoring wells are purged until at least three well volumes have been removed. The shallow and deep piezometers in monitoring well FHS2 were sampled on April 14, 2018 after purging each piezometer approximately 10 to 15 well volumes. The deep piezometers in each monitoring well were sampled again on May 23, 2018, after purging the deep piezometers by more than 2,000 to 3,000 litres. The laboratory data for each set of water samples are presented in **Tables 2a ,b, c** and **d**; **Tables 3a, b, c,** and **d**; and **Tables 4a, b, c** and **d**. The laboratory data have been referenced to both the CCME Marine Aquatic Life (MAL) guidelines values and the Fresh Water Aquatic Life (FWAL) guidelines (**Table 5**). The laboratory data are presented in **Appendix C**.

Figure 3 shows the relationship on a standard trilinear diagram between the major ions in the water samples and typical seawater (after Hem, 1989). In general, the trilinear diagram shows that the major ion distributions of the deep groundwater samples reflect a strong marine influence. Long-term groundwater production from either of the two well locations, between 15 and 25 m, will result in increased salinity.

Figure 4 shows the relationship between total metals and dissolved metals relative to turbidity for the initial set of water samples from FHS1 and FHS2. This plot suggests that incomplete well development is partly responsible for the elevated turbidity and high concentrations of total metals. However, the elevated colour and high charge balance errors reported for the two shallow groundwater samples (especially FHS2-1) are probably also associated with oxidation of ferrous iron and floc formation in the un-preserved aliquots of the samples. The additional analytical data from the May 23, 2018, sampling of the deep piezometers with the large purge volumes confirm that incomplete well development was partly responsible for the elevated turbidity and high concentrations of total metals. The additional well development has produced groundwater with substantially lower turbidity and lower total and dissolved metals.

The initial water samples had unusually high concentrations of total copper, lead, zinc, but also titanium and vanadium suggesting the suspended materials that entered the wells were mineralized and not necessarily a result of contamination. Iron, titanium and vanadium are typical metals associated with deposits of magnetite and ilmentite in western Newfoundland.

Boron at FSH2 is high in the deep sample, FSH2-2, and that metal is a typical landfill contaminant, but it is also present in seawater at concentrations of up to 4,500 µg/L.

An important question to address is what will happen with the metals concentrations over time. As expected, the binary plot (**Figure 4**) shows a strong positive correlation between turbidity and total metals and one can expect the total metals to decrease in a properly constructed and developed well that produces groundwater with a low turbidity. The initial water samples showed a weak negative correlation between turbidity and dissolved metals. In particular, the deep groundwater sample from FSH2-2 had the lowest turbidity and the highest concentration of dissolved metals (as a sum total). However, the May 23, 2018 data for the deep piezometer in FSH2 show that additional development and low turbidity correlated positively with a reduction in dissolved metals loading. While there is some concern with the iron and aluminum concentrations, it is expected that with a large production well and long term pumping, the water chemistry will approach that of sea water since the production wells will be close to the open ocean and there is no elevated area on the up-stream side to produce a thick freshwater lense. The reduction in fluid conductance and TDS values between the water samples that were collected in April and the water samples that were collected in late May, 2018, reflect the use of brackish water and seawater to flush out the up-coning sand from the augers during drilling. For this site, the relatively flat topography extends back more than a kilometre from the ocean with the saltwater of the harbour forming a hydraulic boundary on the opposite side of the golf course which should produce a relatively thin freshwater lense of between 40 to 60 m below ground surface. The water samples were all collected above the known clay layers.

Figure 2 shows the proposed design for a test well. This well is designed to allow the well yield and water chemistry below the clay layer to be tested during a long term pumping of the aquifer which is expected to induce sea water intrusion and rapid thinning of the freshwater lense. If the well can be constructed as designed and if the water chemistry is unacceptable, the bottom section of the well screen below the clay layer will be sealed, the casing retracted to expose the upper section of the well screen and the aquifer above the clay layer then evaluated for well yield and water chemistry. If necessary, barrier wells can be installed to provide a stable salinity from the salt water production wells. **Figure 1** shows the proposed locations for three saltwater production wells.

Reference

Fetter, C.W., 2001, *Applied Hydrogeology*. Fourth Edition, Prentice Hall.

Hem, J. D., 1989. Study and Interpretation of Chemical Characteristics of Natural Waters. 3rd Edition, U.S. Geological Survey Water Supply Paper 2254.

Table 1a. Hydraulic conductivity calculation from the grain size distribution data using Hazen method for split spoon samples from borehole FHS1.

Sample ID	d_{10} mm	d_{10} cm	d_{60} mm	$C^{(1)}$ --	K cm/s	K m/s	C_{min} --	C_{max} --	K_{min} cm/s	K_{max} cm/s
FHS1-SS16	0.075	0.0075	0.29	60	**3.38E-03**	**3.38E-05**	40	80	2.25E-03	4.50E-03
FHS1-SS17	0.08	0.008	0.21	60	**3.84E-03**	**3.84E-05**	40	80	2.56E-03	5.12E-03
FHS1-SS18	0.07	0.007	0.19	60	**2.94E-03**	**2.94E-05**	40	80	1.96E-03	3.92E-03
FHS1-SS19	0.075	0.0075	0.16	60	**3.38E-03**	**3.38E-05**	40	80	2.25E-03	4.50E-03
FHS1-SS20	0.001	0.0001	0.001	60	**6.00E-07**	**6.00E-09**	40	60	4.00E-07	6.00E-07
FHS1-SS21	0.001	0.0001	0.001	60	**6.00E-07**	**6.00E-09**	40	60	4.00E-07	6.00E-07

Note: (1) Table for coefficient ***C*** by *Hazen* (1911).

40 - 80	Very fine sand, poorly sorted
40 - 80	Fine sand with appreciable fines
80 - 120	Medium sand, well sorted
80 - 120	Coarse sand, poorly sorted
120 - 150	Coarse sand, well sorted, clean

Table 1b. Hydraulic conductivity calculation from the grain size distribution data using Hazen method for split spoon soil samples from borehole FHS2.

Sample ID	d_{10} mm	d_{10} cm	d_{60} mm	$C^{(1)}$ --	K cm/s	K m/s	C_{min} --	C_{max} --	K_{min} cm/s	K_{max} cm/s
FHS2-SS6	0.075	0.0075	0.39	80	**4.50E-03**	**4.50E-05**	40	120	2.25E-03	6.75E-03
FHS2-SS11	0.11	0.011	0.31	60	**7.26E-03**	**7.26E-05**	40	80	4.84E-03	9.68E-03
FHS2-SS12	0.11	0.011	0.36	60	**7.26E-03**	**7.26E-05**	40	80	4.84E-03	9.68E-03
FHS2-SS13	0.075	0.0075	0.21	60	**3.38E-03**	**3.38E-05**	40	80	2.25E-03	4.50E-03
FHS2-SS14	0.085	0.0085	0.19	60	**4.34E-03**	**4.34E-05**	40	80	2.89E-03	5.78E-03
FHS2-SS15	0.075	0.0075	0.19	60	**3.38E-03**	**3.38E-05**	40	80	2.25E-03	4.50E-03

Note: (1) Table for coefficient ***C*** by *Hazen* (1911).

40 - 80	Very fine sand, poorly sorted
40 - 80	Fine sand with appreciable fines
80 - 120	Medium sand, well sorted
80 - 120	Coarse sand, poorly sorted
120 - 150	Coarse sand, well sorted, clean

Table 2a Analytical results of low level BTEX/TPH in water samples from the FHS1 salt water monitoring well for the April 10, 2018 sampling event, Stephenville, NL.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**CCME FWAL**	**CCME MAL**	**3113-FHS1-1.0-WS1**	**3113-FHS1-2.0-WS1**
Sampling Date				**04/10/2018**	**04/10/2018**
AGAT ID				**9178171**	**9178204**
Petroleum Hydrocarbons					
Benzene	mg/L	0.370	0.11	<0.001	<0.001
Toluene	mg/L	0.002	0.215	<0.001	<0.001
Ethylbenzene	mg/L	0.09	0.025	<0.001	<0.001
Xylene (Total)	mg/L			<0.001	<0.001
C6-C10 (less BTEX)	mg/L			<0.01	<0.01
>C10-C16 Hydrocarbons	mg/L			<0.05	<0.05
>C16-C21 Hydrocarbons	mg/L			0.07	0.06
>C21-C32 Hydrocarbons	mg/L			0.24	0.12
Modified TPH (Tier 1) *	mg/L	20		0.3	0.2
Resemblance Comment				LR	LR
Return to Baseline at C32				Y	Y
Surrogate Recovery (%)					
Isobutylbenzene - EPH	%			83	91
Isobutylbenzene - VPH	%			117	108
n-Dotriacontane - EPH	%			90	93

Comments:
- CCME FWAL, CCME MAL (accessed via st-ts.ccme.ca - most current version)
- * PIRI Tier 1 GW Residential Non-Potable Coarse Jan 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- Resemblance Comment Key:

FOF - Fuel Oil Fraction
FR - Product in Fuel Oil Range
GF - Gasoline Fraction
GR - Product in Gasoline Range
LOF - Lube Oil Fraction
LR - Lube Range
NA - Not Applicable
NR - No Resemblance
UC - Unidentified Compounds
WFOF - Weathered Fuel Oil Fraction
WGF - Weathered Gasoline Fraction

Table 2b Analytical results of dissolved metals in water samples from the FHS1 salt water monitoring well for the April 10, 2018 sampling event, Stephenville, NL.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113-FHS1-1.0-WS1**	**3113-FHS1-2.0-WS1**
Sampling Date				**04/10/2018**	**04/10/2018**
AGAT ID				**9178171**	**9178204**
Dissolved Metals					
Dissolved Aluminum	ug/L	Variable	5	21	17
Dissolved Antimony	ug/L		2	<2	<2
Dissolved Arsenic	ug/L	5	2	**26**	**29**
Dissolved Barium	ug/L		5	350	534
Dissolved Beryllium	ug/L		2	<2	<2
Dissolved Bismuth	ug/L		2	<2	<2
Dissolved Boron	ug/L	29000, 1500	5	695	749
Dissolved Cadmium	ug/L	1.0, 0.09	0.017	0.06	<0.017
Dissolved Chromium	ug/L		1	4	3
Dissolved Cobalt	ug/L		1	2	<1
Dissolved Copper	ug/L	Equation	2	5	5
Dissolved Iron	ug/L	300	50	**372**	**4800**
Dissolved Lead	ug/L	Equation	0.5	0.9	<0.5
Dissolved Manganese	ug/L		2	1370	1080
Dissolved Molybdenum	ug/L	73	2	29	8
Dissolved Nickel	ug/L	Equation	2	7	6
Dissolved Selenium	ug/L	1.0	1	**5**	1
Dissolved Silver	ug/L	0.25	0.1	<0.1	<0.1
Dissolved Strontium	ug/L		5	1580	1470
Dissolved Thallium	ug/L	0.8	0.1	<0.1	<0.1
Dissolved Tin	ug/L		2	<2	<2
Dissolved Titanium	ug/L		2	5	5
Dissolved Uranium	ug/L	33, 15	0.1	0.9	0.9
Dissolved Vanadium	ug/L		2	20	23
Dissolved Zinc	ug/L	30	5	9	7

Comments:
- CCME FWAL - update 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard
- Analysis completed on a filtered sample.

Table 2c Analytical results of standard water analysis in water samples from the FHS1 salt water monitoring well for the April 10, 2018 sampling event, Stephenville, NL.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113-FHS1-1.0-WS1**	**3113-FHS1-2.0-WS1**
Sampling Date				**04/10/2018**	**04/10/2018**
AGAT ID				**9178171**	**9178204**
Standard Water Analysis					
pH		6.5-9.0		7.88	7.77
Reactive Silica as SiO2	mg/L		0.5	4.7	8.8
Chloride	mg/L	640, 120	50	3660	3670
Fluoride	mg/L	0.12	0.12	<0.12	<0.12
Sulphate	mg/L		100	497	494
Alkalinity	mg/L		5	195	180
True Color	TCU	Narrative	5	16	28
Turbidity	NTU	Narrative	0.1	13100	2120
Electrical Conductivity	umho/cm		1	11200	11400
Nitrate + Nitrite as N	mg/L		0.05	<0.05	<0.05
Nitrate as N	mg/L	550, 13	2.5	<2.5	<2.5
Nitrite as N	mg/L	0.06	2.5	<2.5	<2.5
Ammonia as N	mg/L	Fact Sheet	0.03	0.31	0.87
Total Organic Carbon	mg/L		0.5	8.9	1.7
Ortho-Phosphate as P	mg/L		0.01	<0.01	0.01
Total Sodium	mg/L		0.1	1720	1820
Total Potassium	mg/L		0.1	67.2	60.9
Total Calcium	mg/L		0.1	599	223
Total Magnesium	mg/L		0.1	267	209
Bicarb. Alkalinity (as CaCO3)	mg/L		5	195	180
Carb. Alkalinity (as CaCO3)	mg/L		10	<10	<10
Hydroxide	mg/L		5	<5	<5
Calculated TDS	mg/L		1	7300	6660
Hardness	mg/L			2600	1420
Langelier Index (@20C)	NA			1.17	0.6
Langelier Index (@ 4C)	NA			0.85	0.28
Saturation pH (@ 20C)	NA			6.71	7.17
Saturation pH (@ 4C)	NA			7.03	7.49
Anion Sum	me/L			117	117
Cation sum	me/L			152	113
% Difference/ Ion Balance (NS)	%			12.8	1.8
Ratios					
Na/Cl				0.47	0.50
Ca/Mg				2.2	1.1

Comments:
- CCME FWAL - update 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard

Table 2d Analytical results of total metals in water samples from the FHS1 salt water monitoring well for the April 10, 2018 sampling event, Stephenville, NL.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113-FHS1-1.0-WS1**	**3113-FHS1-2.0-WS1**
Sampling Date				**04/10/2018**	**04/10/2018**
AGAT ID				**9178171**	**9178204**
Total Metals					
Total Aluminum	ug/L	Variable	5	138000	18700
Total Antimony	ug/L		2	<2	<2
Total Arsenic	ug/L	5	2	**14**	**6**
Total Barium	ug/L		5	1110	628
Total Beryllium	ug/L		2	5	<2
Total Bismuth	ug/L		2	<2	<2
Total Boron	ug/L	29000, 1500	5	371	654
Total Cadmium	ug/L	1.0, 0.09	0.017	1.14	0.153
Total Chromium	ug/L		1	622	95
Total Cobalt	ug/L		1	149	23
Total Copper	ug/L	Equation	1	649	51
Total Iron	ug/L	300	50	**224000**	**57500**
Total Lead	ug/L	Equation	0.5	95.3	12.5
Total Manganese	ug/L		2	6280	2510
Total Molybdenum	ug/L	73	2	37	10
Total Nickel	ug/L	Equation	2	319	44
Total Phosphorous	mg/L	Fact Sheet	0.02	4.21	0.32
Total Selenium	ug/L	1	1	**5**	**2**
Total Silver	ug/L	0.25	0.1	0.4	<0.1
Total Strontium	ug/L		5	2710	1580
Total Thallium	ug/L	0.8	0.1	0.2	<0.1
Total Tin	ug/L		2	5	<2
Total Titanium	ug/L		2	3970	1290
Total Uranium	ug/L	33, 15	0.1	8.3	2.3
Total Vanadium	ug/L		2	483	121
Total Zinc	ug/L	30	5	**955**	**81**

Comments:
- CCME FWAL - update 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard

Table 3a Analytical results of low level BTEX/TPH in water samples from the FHS2 salt water monitoring well for the April 14, 2018 sampling event, Stephenville, NL.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**CCME FWAL**	**CCME MAL**	**3113-FHS2-1.25-WS1**	**3113-FHS2-2.0-WS1**
Sampling Date				**04/14/2018**	**04/14/2018**
AGAT ID				**9184011**	**9184169**
Petroleum Hydrocarbons					
Benzene	mg/L	0.370	0.11	<0.001	<0.001
Toluene	mg/L	0.002	0.215	<0.001	<0.001
Ethylbenzene	mg/L	0.09	0.025	<0.001	<0.001
Xylene (Total)	mg/L			<0.001	<0.001
C6-C10 (less BTEX)	mg/L			<0.01	<0.01
>C10-C16 Hydrocarbons	mg/L			<0.05	<0.05
>C16-C21 Hydrocarbons	mg/L			<0.05	<0.05
>C21-C32 Hydrocarbons	mg/L			0.04	0.07
Modified TPH (Tier 1) *	mg/L	20		<0.1	<0.1
Resemblance Comment				UC	UC
Return to Baseline at C32				Y	Y
Surrogate Recovery (%)					
Isobutylbenzene - EPH	%			70	78
Isobutylbenzene - VPH	%			107	113
n-Dotriacontane - EPH	%			70	75

Comments:
- CCME FWAL, CCME MAL (accessed via st-ts.ccme.ca - most current version)
- * PIRI Tier 1 GW Residential Non-Potable Coarse Jan 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- Resemblance Comment Key:

FOF - Fuel Oil Fraction
FR - Product in Fuel Oil Range
GF - Gasoline Fraction
GR - Product in Gasoline Range
LOF - Lube Oil Fraction
LR - Lube Range
NA - Not Applicable
NR - No Resemblance
UC - Unidentified Compounds
WFOF - Weathered Fuel Oil Fraction
WGF - Weathered Gasoline Fraction

Table 3b Analytical results of dissolved metals in water sample from the FHS2 salt water monitoring well for the April 14, 2018 sampling event, Stephenville, NL.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113-FHS2-1.25-WS1**	**3113-FHS2-2.0-WS1**
Sampling Date				**04/14/2018**	**04/14/2018**
AGAT ID				**9184011**	**9184169**
Dissolved Metals					
Dissolved Aluminum	ug/L	Variable	5	20	10
Dissolved Antimony	ug/L		2	<2	<2
Dissolved Arsenic	ug/L	5	2	**16**	**39**
Dissolved Barium	ug/L		5	68	168
Dissolved Beryllium	ug/L		2	<2	<2
Dissolved Bismuth	ug/L		2	<2	<2
Dissolved Boron	ug/L	29000, 1500	5	382	1240
Dissolved Cadmium	ug/L	1.0, 0.09	0.09	<0.09	<0.09
Dissolved Chromium	ug/L		1	4	4
Dissolved Cobalt	ug/L		1	<1	<1
Dissolved Copper	ug/L	Equation	2	3	5
Dissolved Iron	ug/L	300	50	**705**	**4110**
Dissolved Lead	ug/L	Equation	0.5	1.2	0.6
Dissolved Manganese	ug/L		2	1050	1080
Dissolved Molybdenum	ug/L	73	2	10	17
Dissolved Nickel	ug/L	Equation	2	5	6
Dissolved Selenium	ug/L	1.0	1	**2**	**2**
Dissolved Silver	ug/L	0.25	0.1	<0.1	<0.1
Dissolved Strontium	ug/L		5	868	2220
Dissolved Thallium	ug/L	0.8	0.1	<0.1	<0.1
Dissolved Tin	ug/L		2	<2	<2
Dissolved Titanium	ug/L		2	2	6
Dissolved Uranium	ug/L	33, 15	0.1	0.2	0.3
Dissolved Vanadium	ug/L		2	16	32
Dissolved Zinc	ug/L	30	5	11	8

Comments:
- CCME FWAL - update 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard
- Analysis completed on a filtered sample.

Table 3c Analytical results of standard water analysis in water sample from the FHS2 salt water monitoring well for the April 14, 2018 sampling event, Stephenville, NL.

Project 3113 - Stephenville Sampling Program						
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113-FHS2-1.25-WS1**	**RDL**	**3113-FHS2-2.0-WS1**
Sampling Date				**04/14/2018**		**04/14/2018**
AGAT ID				**9184011**		**9184169**
Standard Water Analysis						
pH		6.5-9.0		7.88		7.79
Reactive Silica as SiO2	mg/L		0.5	4.6	0.5	6.6
Chloride	mg/L	640, 120	30	1720	100	4640
Fluoride	mg/L	0.12	0.12	**0.28**	0.12	<0.12
Sulphate	mg/L		60	237	200	619
Alkalinity	mg/L		5	264	5	186
True Color	TCU	Narrative	5	10	5	9
Turbidity	NTU	Narrative	0.1	3420	0.1	140
Electrical Conductivity	umho/cm		1	6000	1	14400
Nitrate + Nitrite as N	mg/L		0.05	2.1	0.05	<0.05
Nitrate as N	mg/L	550, 13	1.5	2.1	5	<5
Nitrite as N	mg/L	0.06	1.5	<1.5	5	<5
Ammonia as N	mg/L	Fact Sheet	0.03	0.13	0.03	0.47
Total Organic Carbon	mg/L		0.5	2	0.5	5
Ortho-Phosphate as P	mg/L		0.01	0.01	0.01	<0.01
Total Sodium	mg/L		0.1	1470	0.1	3010
Total Potassium	mg/L		0.1	57.3	0.1	108
Total Calcium	mg/L		0.1	305	0.1	198
Total Magnesium	mg/L		0.1	201	0.1	329
Bicarb. Alkalinity (as CaCO3)	mg/L		5	264	5	186
Carb. Alkalinity (as CaCO3)	mg/L		10	<10	10	<10
Hydroxide	mg/L		5	<5	5	<5
Calculated TDS	mg/L		1	4220	1	9030
Hardness	mg/L			1590		1850
Langelier Index (@20C)	NA			1.04		0.57
Langelier Index (@ 4C)	NA			0.72		0.25
Saturation pH (@ 20C)	NA			6.84		7.22
Saturation pH (@ 4C)	NA			7.16		7.54
Anion Sum	me/L			58.9		147
Cation sum	me/L			101		172
% Difference/ Ion Balance (NS)	%			26.3		7.5
Ratios						
Na/Cl				0.85		0.65
Ca/Mg				1.5		0.6

Comments:
- CCME FWAL - update 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard

Table 3d Analytical results of total metals in water samples from the FHS2 salt water monitoring well for the April 14, 2018 sampling event, Stephenville, NL.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113-FHS2-1.25-WS1**	**3113-FHS2-2.0-WS1**
Sampling Date				**04/14/2018**	**04/14/2018**
AGAT ID				**9184011**	**9184169**
Total Metals					
Total Aluminum	ug/L	Variable	5	21100	4720
Total Antimony	ug/L		2	<2	<2
Total Arsenic	ug/L	5	2	**23**	**37**
Total Barium	ug/L		5	173	191
Total Beryllium	ug/L		2	<2	<2
Total Bismuth	ug/L		2	<2	<2
Total Boron	ug/L	29000, 1500	5	564	1240
Total Cadmium	ug/L	1.0, 0.09	0.09	0.33	<0.09
Total Chromium	ug/L		1	66	14
Total Cobalt	ug/L		1	18	4
Total Copper	ug/L	Equation	1	78	16
Total Iron	ug/L	300	50	**34100**	**12300**
Total Lead	ug/L	Equation	0.5	17.7	2.8
Total Manganese	ug/L		2	3370	1300
Total Molybdenum	ug/L	73	2	11	19
Total Nickel	ug/L	Equation	2	48	14
Total Phosphorous	mg/L	Fact Sheet	0.02	0.44	0.13
Total Selenium	ug/L	1	1	**2**	**3**
Total Silver	ug/L	0.25	0.1	<0.1	<0.1
Total Strontium	ug/L		5	1290	2130
Total Thallium	ug/L	0.8	0.1	<0.1	<0.1
Total Tin	ug/L		2	<2	<2
Total Titanium	ug/L		2	623	190
Total Uranium	ug/L	33, 15	0.1	1.7	0.5
Total Vanadium	ug/L		2	71	38
Total Zinc	ug/L	30	5	**81**	23

Comments:
- CCME FWAL - update 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard

Table 4a Analytical results of low level BTEX/TPH in water samples from the FHS1 and FHS2 salt water monitoring wells for the May 23, 2018 sampling event, Stephenville, NL,based on purging in excess of 2,000 litres.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**CCME FWAL**	**CCME MAL**	**3113-FHS1-2.0-WS2**	**3113-FHS2-2.0-WS2**
Sampling Date				**05/23/2018**	**05/23/2018**
AGAT ID				**9268674**	**9268753**
Petroleum Hydrocarbons					
Benzene	mg/L	0.370	0.11	<0.001	<0.001
Toluene	mg/L	0.002	0.215	<0.001	<0.001
Ethylbenzene	mg/L	0.09	0.025	<0.001	<0.001
Xylene (Total)	mg/L			<0.001	<0.001
C6-C10 (less BTEX)	mg/L			<0.01	<0.01
>C10-C16 Hydrocarbons	mg/L			<0.05	<0.05
>C16-C21 Hydrocarbons	mg/L			<0.05	<0.05
>C21-C32 Hydrocarbons	mg/L			0.12	0.07
Modified TPH (Tier 1) *	mg/L	20		0.1	<0.1
Resemblance Comment				LR	LR
Return to Baseline at C32				Y	Y
Surrogate Recovery (%)					
Isobutylbenzene - EPH	%			77	N/A
Isobutylbenzene - VPH	%			106	103
n-Dotriacontane - EPH	%			92	76

Comments:
- CCME FWAL, CCME MAL (accessed via st-ts.ccme.ca - most current version)
- * PIRI Tier 1 GW Residential Non-Potable Coarse Jan 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- Resemblance Comment Key:

FOF - Fuel Oil Fraction
FR - Product in Fuel Oil Range
GF - Gasoline Fraction
GR - Product in Gasoline Range
LOF - Lube Oil Fraction
LR - Lube Range
NA - Not Applicable
NR - No Resemblance
UC - Unidentified Compounds
WFOF - Weathered Fuel Oil Fraction
WGF - Weathered Gasoline Fraction

Table 4b Analytical results of dissolved metals in water samples from the FHS1 and FHS2 salt water monitoring wells for the May 23, 2018 sampling event, Stephenville, NL,based on purging in excess of 2,000 litres.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113-FHS1-2.0-WS2**	**3113-FHS2-2.0-WS2**
Sampling Date				**05/23/2018**	**05/23/2018**
AGAT ID				**9268674**	**9268753**
Dissolved Metals					
Dissolved Aluminum	ug/L	Variable	5	12	137
Dissolved Antimony	ug/L		2	<2	<2
Dissolved Arsenic	ug/L	5	2	3	<2
Dissolved Barium	ug/L		5	33	25
Dissolved Beryllium	ug/L		2	<2	<2
Dissolved Bismuth	ug/L		2	<2	<2
Dissolved Boron	ug/L	29000, 1500	5	59	108
Dissolved Cadmium	ug/L	1.0, 0.09	0.09	<0.09	<0.09
Dissolved Chromium	ug/L		1	3	6
Dissolved Cobalt	ug/L		1	<1	<1
Dissolved Copper	ug/L	Equation	2	<2	<2
Dissolved Iron	ug/L	300	50	**516**	**1680**
Dissolved Lead	ug/L	Equation	0.5	<0.5	<0.5
Dissolved Manganese	ug/L		2	204	701
Dissolved Molybdenum	ug/L	72	2	<2	<2
Dissolved Nickel	ug/L	Equation	2	<2	3
Dissolved Selenium	ug/L	1.0	1	<1	2
Dissolved Silver	ug/L	0.25	0.1	<0.1	<0.1
Dissolved Strontium	ug/L		5	153	205
Dissolved Thallium	ug/L	0.8	0.1	<0.1	<0.1
Dissolved Tin	ug/L		2	<2	<2
Dissolved Titanium	ug/L		2	<2	4
Dissolved Uranium	ug/L	33, 15	0.1	0.4	0.1
Dissolved Vanadium	ug/L		2	<2	3
Dissolved Zinc	ug/L	30	5	10	7

Comments:
- CCME FWAL - update 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard
- Analysis completed on a filtered sample.

Table 4c Analytical results of standard water analysis in water samples from the FHS1 and FHS2 salt water monitoring wells for the May 23, 2018 sampling event, Stephenville, NL,based on purging in excess of 2,000 litres.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113-FHS1-2.0-WS2**	**3113-FHS2-2.0-WS2**
Sampling Date				**05/23/2018**	**05/23/2018**
AGAT ID				**9268674**	**9268753**
Standard Water Analysis					
pH		6.5-9.0		8.24	8.23
Reactive Silica as SiO2	mg/L		0.5	15.3	8.5
Chloride	mg/L	640, 120	5	34	333
Fluoride	mg/L	0.12	0.12	<0.12	<0.12
Sulphate	mg/L		2	6	37
Alkalinity	mg/L		5	223	220
True Color	TCU	Narrative	5	15	16
Turbidity	NTU	Narrative	0.1	7.6	30.3
Electrical Conductivity	umho/cm		1	572	1500
Nitrate + Nitrite as N	mg/L		0.05	0.07	0.69
Nitrate as N	mg/L	550, 13	0.05	<0.05	<0.05
Nitrite as N	mg/L	0.06	0.05	**0.07**	**0.69**
Ammonia as N	mg/L	Fact Sheet	0.03	0.21	0.27
Total Organic Carbon	mg/L		0.5	8.8	11.3
Ortho-Phosphate as P	mg/L		0.01	<0.01	<0.01
Total Sodium	mg/L		0.1	43.8	198
Total Potassium	mg/L		0.1	10.1	13.3
Total Calcium	mg/L		0.1	33.4	63.6
Total Magnesium	mg/L		0.1	26.7	36.6
Bicarb. Alkalinity (as CaCO3)	mg/L		5	223	220
Carb. Alkalinity (as CaCO3)	mg/L		10	<10	<10
Hydroxide	mg/L		5	<5	<5
Calculated TDS	mg/L		1	290	822
Hardness	mg/L			193	310
Langelier Index (@20C)	NA			0.48	0.7
Langelier Index (@ 4C)	NA			0.16	0.38
Saturation pH (@ 20C)	NA			7.76	7.53
Saturation pH (@ 4C)	NA			8.08	7.85
Anion Sum	me/L			5.55	14.6
Cation sum	me/L			6.1	15.4
% Difference/ Ion Balance (NS)	%			4.8	2.7
Ratios					
Na/Cl				1.29	0.59
Ca/Mg				1.3	1.7

Comments:
- CCME FWAL - update 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard

Table 4d Analytical results of total metals in water samples from the FHS1 and FHS2 salt water monitoring wells for the May 23, 2018 sampling event, Stephenville, NL,based on purging in excess of 2,000 litres.

Project 3113 - Stephenville Sampling Program					
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113-FHS1-2.0-WS2**	**3113-FHS2-2.0-WS2**
Sampling Date				**05/23/2018**	**05/23/2018**
AGAT ID				**9268674**	**9268753**
Total Metals					
Total Aluminum	ug/L	Variable	5	166	989
Total Antimony	ug/L		2	<2	<2
Total Arsenic	ug/L	5	2	3	2
Total Barium	ug/L		5	39	31
Total Beryllium	ug/L		2	<2	<2
Total Bismuth	ug/L		2	<2	<2
Total Boron	ug/L	29000, 1500	5	61	108
Total Cadmium	ug/L	1.0, 0.09	0.09	<0.09	<0.09
Total Chromium	ug/L		1	<1	4
Total Cobalt	ug/L		1	<1	<1
Total Copper	ug/L	Equation	1	<1	3
Total Iron	ug/L	300	50	**1170**	**3650**
Total Lead	ug/L	Equation	0.5	<0.5	0.7
Total Manganese	ug/L		2	212	834
Total Molybdenum	ug/L	73	2	<2	<2
Total Nickel	ug/L	Equation	2	<2	5
Total Phosphorous	mg/L	Fact Sheet	0.02	0.03	0.06
Total Selenium	ug/L	1	1	<1	<1
Total Silver	ug/L	0.25	0.1	<0.1	<0.1
Total Strontium	ug/L		5	175	257
Total Thallium	ug/L	0.8	0.1	<0.1	<0.1
Total Tin	ug/L		2	<2	<2
Total Titanium	ug/L		2	12	72
Total Uranium	ug/L	33, 15	0.1	0.5	0.2
Total Vanadium	ug/L		2	<2	6
Total Zinc	ug/L	30	5	11	10
Total Mercury	ug/L	0.026	0.026	<0.026	<0.026

Comments:
- CCME FWAL - update 2015
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard

Figure 1 Location of existing monitoring wells and potential salt water wells.

Project No. 3113	Document Reference FFC-NL-3113-010
Location Stephenville, NL	Date June 2018

FFC

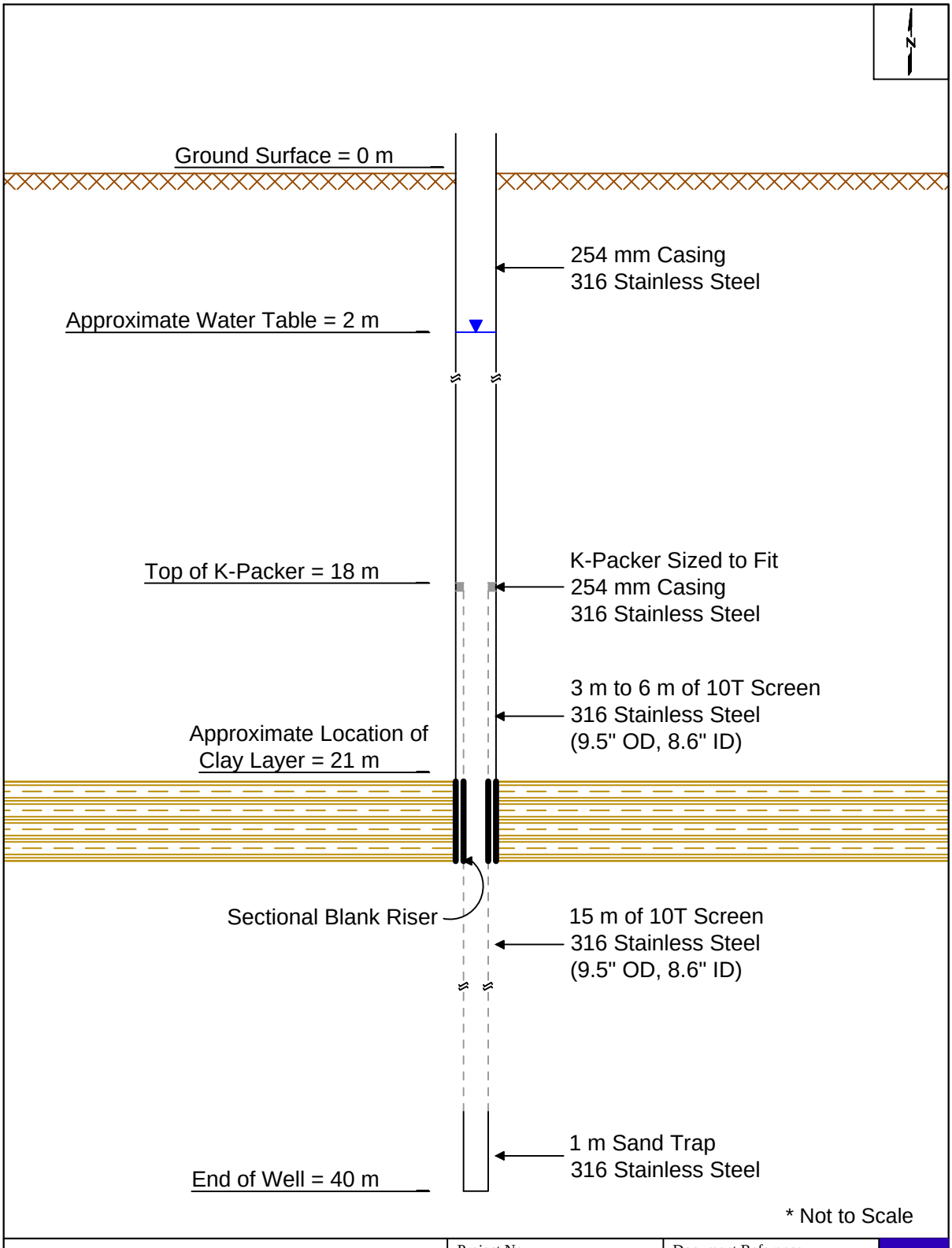

Figure 2 Salt water well design schematic.

Project No.	Document Reference
3113	FFC-NL-3113-010
Location	Date
Stephenville, NL	June 2018

FFC

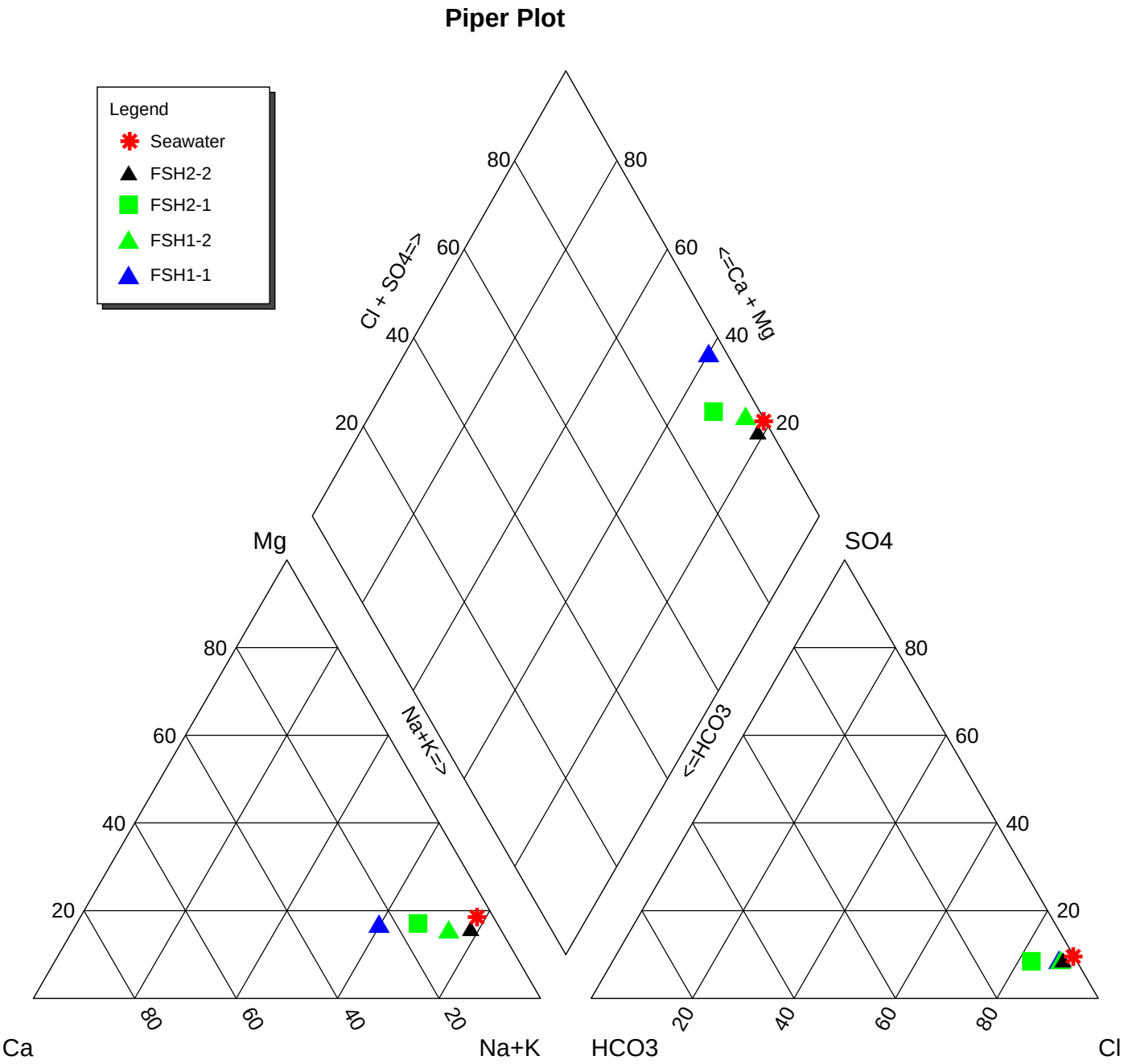

Figure 3 Trilinear plot of groundwater samples from FSH1 and FSH2 relative to typical seawater.

	PROJECT: Hydrogeological assessment	PROJECT NO: 3113
	CLIENT: Marine Harvest	DATE: April 2018

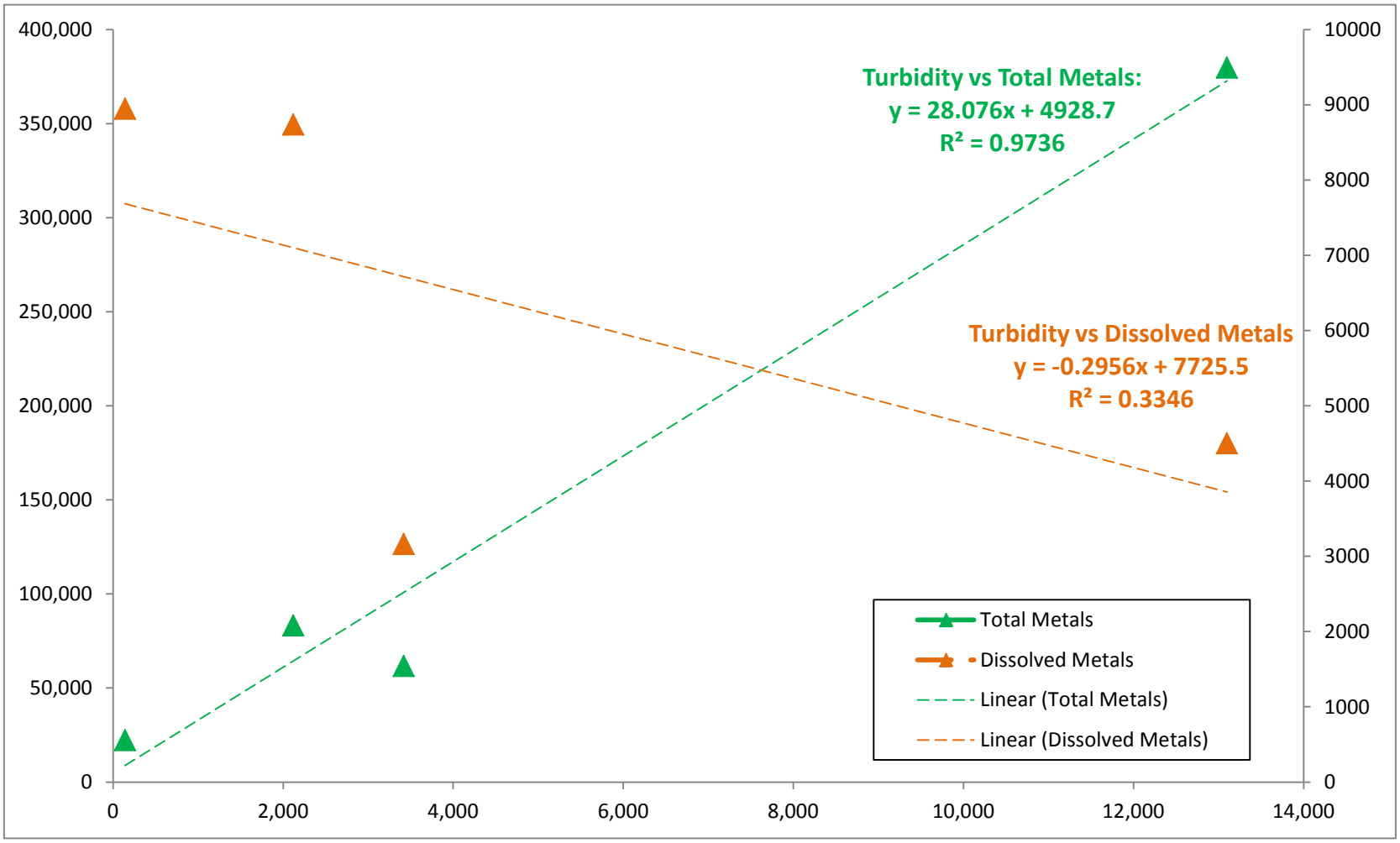

Figure 4 Relationship between total metals and dissolved metals relative to turbidity at FSH1 and FSH2.

Project No.	Scale
31113	As shown
Location	Date
Stephenville, NL	June 2018

FFC

APPENDIX A

Borehole and DCPT Logs

Project: Geotechnical/Environmental Assessment

Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS1

Project No: 3113

Date: April 5, 2018

SUBSURFACE PROFILE				SAMPLE								
Depth (ft / m)	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample Sequence	"N" Value	Recovery (%)	% Fines	Standard Penetration Test "N" Value per 300 mm (20 – 60)	Well Data - Deep	Well Data - Shallow	Well Description
0 / 0		Ground Surface (GS)	0									
0 – 3 / 0 – 1		Augering	-1.43	OB	--							Cement packing from 0 m to 0.10 m Native sand packing from 0.10 m to 0.46 m Bentonite packing from 0.46 m to 0.81 m
3 – 7 / 1 – 2		SPT: 10 / 14 / 10 / 7 / 9 Gravelly sand	-2.19	SS	1	24	28					
7 – 8 / 2		Augering	-2.47	OB	--							0.03 m dia riser from 0 m to 1.50 m
8 – 10 / 2 – 3		SPT: 7 / 8 / 13 / 17 / 11 Gravelly sand with rock fragments	-3.23	SS	2	21	40					
10 – 12 / 3		Augering	-3.87	OB	--							0.03 m dia screen from 1.50 m to 4.00 m
12 – 15 / 3 – 4		SPT: 10 / 30 / 26 / 40 / 47 Medium sand with gravel and fines	-4.64	SS	3	56	45					Screw-on cap
15 – 17 / 4 – 5		SPT: 39 / 47 / 42 / 48 Fine to medium sand with gravel	-5.24	SS	4	89	58					Native sand packing from 0.81 m to 9.14 m
17 – 18 / 5		SPT: 30 / 95 / 107 for 0.09 m (Refusal) Very fine to medium sand with gravel and rock fragments	-5.64	SS	5	202						
18 – 19 / 5		Augering	-6.06	OB	--							0.05 m dia riser from 0 m to 11.08 m
19 – 21 / 5 – 6		SPT: 50 for 0.01 m (Refusal) Rock fragments		OB	--							
21 – 22 / 6		Augering	-6.78									
22 – 23 / 6							47					

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Fax: (709) 753-5101

Drilling Method: Hollow Stem Augering

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

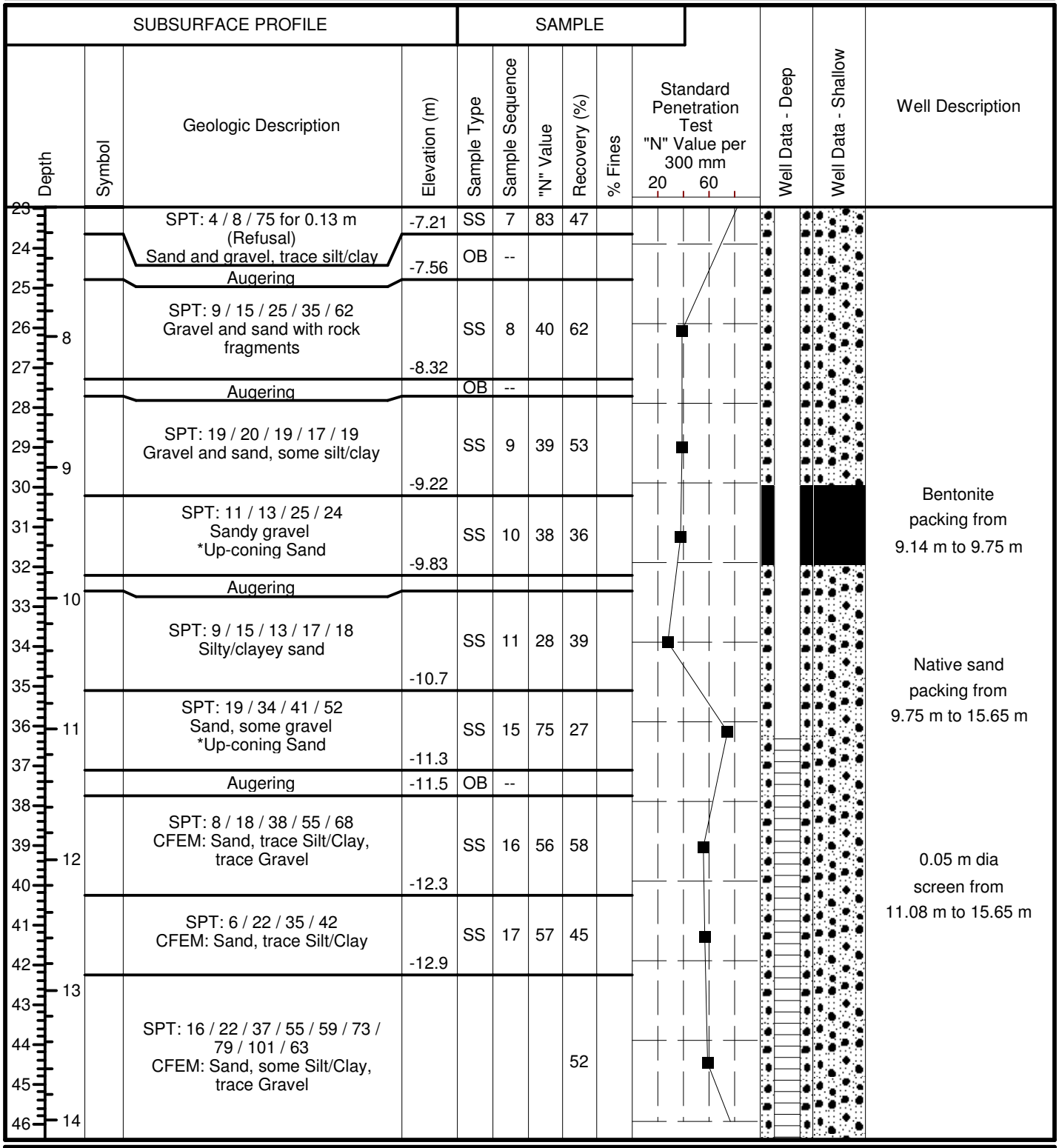
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS1

Project No: 3113

Date: April 5, 2018



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Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

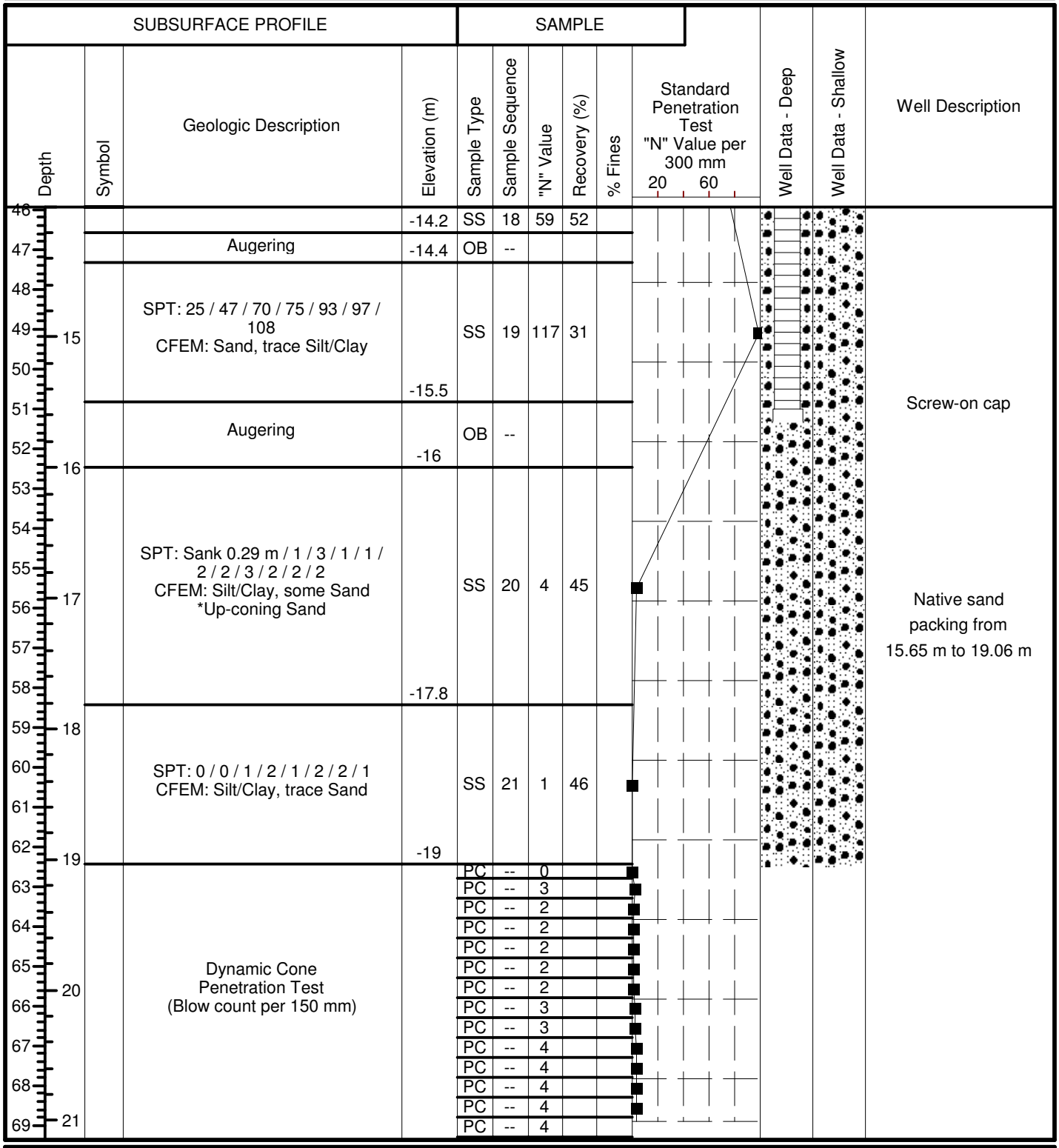
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS1

Project No: 3113

Date: April 5, 2018



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Project: Geotechnical/Environmental Assessment

Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS1

Project No: 3113

Date: April 5, 2018

SUBSURFACE PROFILE				SAMPLE								
Depth	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample Sequence	"N" Value	Recovery (%)	% Fines	Standard Penetration Test "N" Value per 300 mm (20 – 60)	Well Data - Deep	Well Data - Shallow	Well Description
69				PC	--	4						
				PC	--	5						
70				PC	--	6						
				PC	--	12						
71				PC	--	15						
				PC	--	16						
72	22			PC	--	13						
				PC	--	11						
73				PC	--	16						
				PC	--	13						
74				PC	--	13						
				PC	--	14						
75				PC	--	13						
	23			PC	--	10						
76				PC	--	12						
				PC	--	15						
77				PC	--	17						
				PC	--	18						
78				PC	--	14						
				PC	--	15						
79	24			PC	--	13						
		Dynamic Cone Penetration Test (Blow count per 150 mm)		PC	--	14						
80				PC	--	16						
				PC	--	17						
81				PC	--	17						
				PC	--	17						
82	25			PC	--	15						
				PC	--	17						
83				PC	--	17						
				PC	--	20						
84				PC	--	19						
				PC	--	21						
85				PC	--	21						
	26			PC	--	23						
86				PC	--	19						
				PC	--	28						
87				PC	--	26						
				PC	--	22						
88				PC	--	25						
	27			PC	--	24						
89				PC	--	24						
				PC	--	28						
90				PC	--	27						
				PC	--	29						
91				PC	--	33						
				PC	--	41						
92	28			PC	--	43						

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Drilling Method: Hollow Stem Augering

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS1

Project No: 3113

Date: April 5, 2018

SUBSURFACE PROFILE				SAMPLE								
Depth	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample Sequence	"N" Value	Recovery (%)	% Fines	Standard Penetration Test "N" Value per 300 mm (20 60)	Well Data - Deep	Well Data - Shallow	Well Description
92				PC	--	43						
92				PC	--	38						
93				PC	--	52						
94				PC	--	54						
95	29			PC	--	50						
95				PC	--	46						
96				PC	--	60						
97				PC	--	68						
97				PC	--	67						
98				PC	--	60						
98	30			PC	--	74						
99				PC	--	67						
99				PC	--	71						
00				PC	--	66						
00				PC	--	71						
01				PC	--	67						
01	31			PC	--	90						
02				PC	--	88						
02				PC	--	73						
03		Dynamic Cone Penetration Test (Blow count per 150 mm)		PC	--	49						
03				PC	--	53						
04				PC	--	43						
04				PC	--	41						
05	32			PC	--	43						
05				PC	--	42						
06				PC	--	43						
06				PC	--	44						
07				PC	--	51						
07				PC	--	54						
08				PC	--	54						
08	33			PC	--	79						
09				PC	--	70						
09				PC	--	68						
10				PC	--	62						
10				PC	--	56						
11				PC	--	53						
11	34			PC	--	51						
12				PC	--	52						
12				PC	--	53						
13				PC	--	54						
13				PC	--	58						
14				PC	--	66						
14				PC	--	98						
15	35			PC	--	97						
15				PC	--	97						
				PC	--	70						
				PC	--	62						

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Drilling Method: Hollow Stem Augering

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS1

Project No: 3113

Date: April 5, 2018

SUBSURFACE PROFILE				SAMPLE								
Depth	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample Sequence	"N" Value	Recovery (%)	% Fines	Standard Penetration Test "N" Value per 300 mm (20 60)	Well Data - Deep	Well Data - Shallow	Well Description
15				PC	--	62						
16				PC	--	60						
17				PC	--	52						
18	36	Dynamic Cone Penetration Test (Blow count per 150 mm)		PC	--	67						
19				PC	--	107						
20				PC	--	117						
21				PC	--	94						
22	37		-37	PC	--	112						
23		End of Borehole		PC	--	118						
24				PC	--	136						
25	38			PC	--	123						
26				PC	--	145						
27				PC	--	142						
28	39											
29												
30												
31	40											
32												
33												
34	41											
35												
36												
37												
	42											

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Drilling Method: Hollow Stem Augering

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS2

Project No: 3113

Date: April 7, 2018

SUBSURFACE PROFILE				SAMPLE								
Depth (ft / m)	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample Sequence	"N" Value	Recovery (%)	% Fines	Standard Penetration Test "N" Value per 300 mm (20 – 60)	Well Data - Deep	Well Data - Shallow	Well Description
0 / 0		Ground Surface (GS)	0									
0 – 3 / 0 – 1		Augering	-1.5	OB	--							Cement packing from 0 m to 0.10 m Native sand packing from 0.10 m to 0.36 m Bentonite packing from 0.36 m to 0.97 m
6 – 7 / 2		SPT: 3 / 4 / 5 / 6 Sand	-2.11	SS	1	9	23					
7 – 8		Augering	-2.48	OB	--							0.03 m dia riser from 0.00 m to 1.00 m
9 – 10 / 3		SPT: 12 / 21 / 19 / 21 Sand, some gravel	-3.09	SS	2	40	29					
10 – 12 / 3		Augering	-3.87	OB	--							0.03 m dia screen from 1.00 m to 4.00 m
13 – 15 / 4		SPT: Sank for 0.15 m / 4 / 8 / 13 / 16 / 20 Gravelly sand * Up-coning Sand	-4.79	SS	3	12	11					Screw-on cap
16 – 17 / 5		Augering	-5.47	OB	--							Native sand packing from 0.97 m to 7.01 m
18 – 19		SPT: 9 / 39 / 72 / 52 for 0.0 m (Refusal) Sand, some gravel	-5.93	SS	4	111	56					
19 – 20 / 6		Augering	-6.98	OB	--							0.05 m dia riser from 0.00 m to 9.92 m
23												

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Project: Geotechnical/Environmental Assessment

Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS2

Project No: 3113

Date: April 7, 2018

SUBSURFACE PROFILE				SAMPLE								
Depth	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample Sequence	"N" Value	Recovery (%)	% Fines	Standard Penetration Test "N" Value per 300 mm (20 – 60)	Well Data - Deep	Well Data - Shallow	Well Description
23		SPT: 9 / 51 for 0.1 m (Refusal) Sand, rock fragments	-7.26	SS	5	38	73					Bentonite packing from 7.01 m to 7.62 m
24		Augering	-7.59	OB	--							
25		SPT: 14 / 50 / 50 for 0.1 m (Refusal) CFEM: Gravelly Sand, trace Silt/Clay	-8.32	SS	6	100	44					
26	8											
27		Augering		OB	--							
28		SPT: 15 / 46 / 35 / 35 / 43 Gravelly sand, some silt/clay	-9.16	SS	7	81	57					Native sand packing from 7.62 m to 20.05 m
29	9											
30		SPT: 23 / 45 / 48 / 42 / 44 Sand, some gravel, trace silt/clay *Up-coning Sand	-9.93	SS	8	93	50					
31												
32												
33	10	SPT: 8 / 17 / 21 / 19 / 26 Silty/clayey sand, some gravel	-10.7	SS	9	29	46					
34												
35												
36	11	SPT: 13 / 16 / 13 / 28 / 33 Sand, some gravel, trace silt/clay	-11.4	SS	10	29	27					
37												
38		SPT: 3 / 13 / 32 / 36 / 47 / 80 CFEM: Sand, trace Gravel, trace Silt/Clay	-12.4	SS	11	45	36					0.05 m dia screen from 9.92 m to 16.02 m
39	12											
40												
41		Augering	-12.9	OB	--							
42												
43	13	SPT: 4 / 6 / 14 / 27 / 33 / 36 / 40 / 48 CFEM: Sand, trace Gravel, trace Silt/Clay	-14.1	SS	12	20	33					
44												
45												
46	14											

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Project: Geotechnical/Environmental Assessment

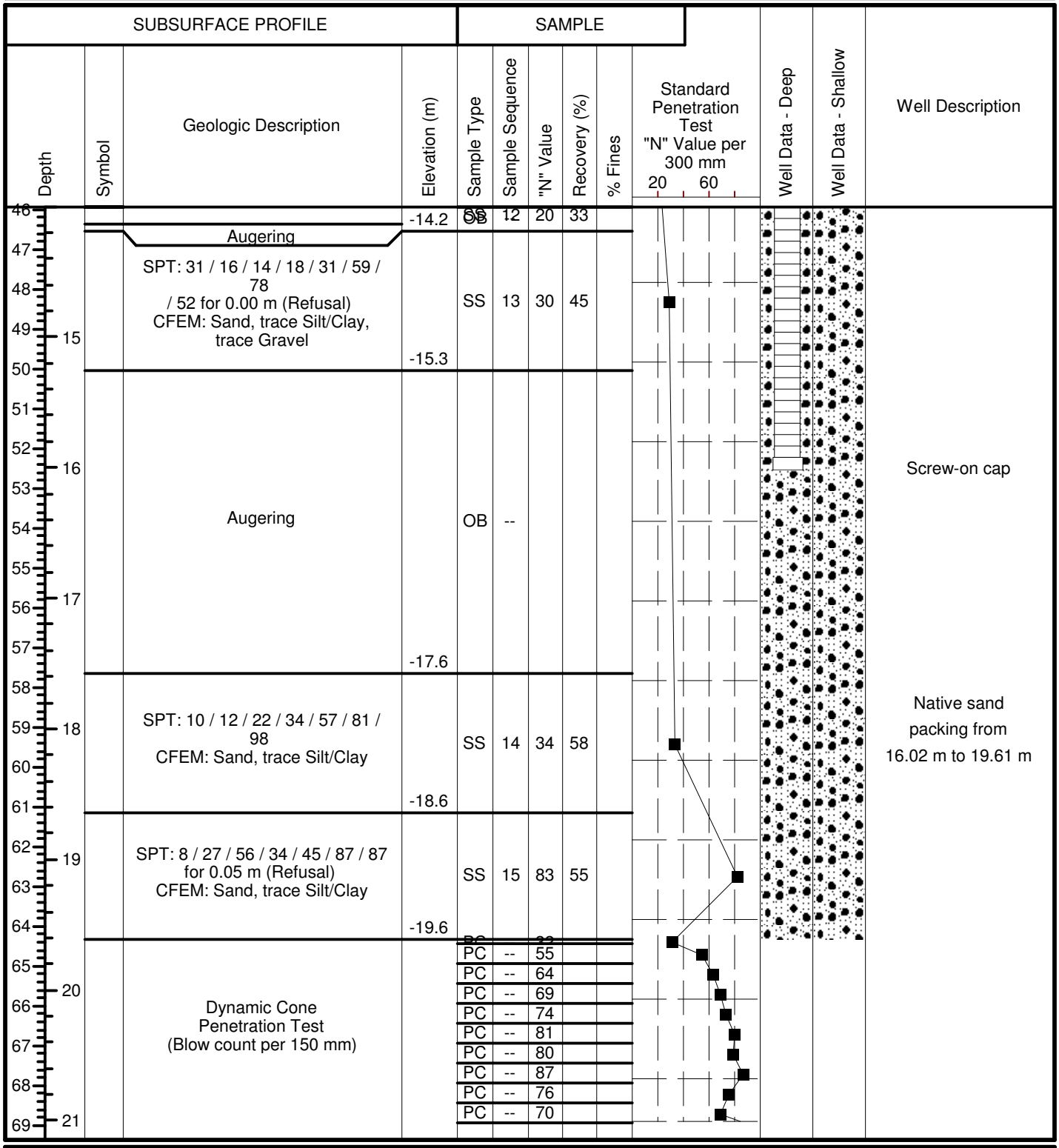
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS2

Project No: 3113

Date: April 7, 2018



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Project: Geotechnical/Environmental Assessment

Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS2

Project No: 3113

Date: April 7, 2018

SUBSURFACE PROFILE				SAMPLE								
Depth	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample Sequence	"N" Value	Recovery (%)	% Fines	Standard Penetration Test "N" Value per 300 mm (20 60)	Well Data - Deep	Well Data - Shallow	Well Description
69				PC	--	110						
70				PC	--	159						
71				PC	--	84						
72	22			PC	--	89						
73				PC	--	81						
74				PC	--	96						
75	23			PC	--	91						
76				PC	--	71						
77				PC	--	63						
78				PC	--	60						
79	24			PC	--	65						
80		Dynamic Cone Penetration Test (Blow count per 150 mm)		PC	--	60						
81				PC	--	57						
82	25			PC	--	55						
83				PC	--	65						
84				PC	--	46						
85	26			PC	--	36						
86				PC	--	45						
87				PC	--	31						
88				PC	--	38						
89	27			PC	--	44						
90				PC	--	35						
91				PC	--	31						
92	28			PC	--	28						
				PC	--	29						
				PC	--	25						
				PC	--	21						
				PC	--	25						
				PC	--	25						
				PC	--	25						
				PC	--	37						
				PC	--	41						
				PC	--	37						
				PC	--	35						
				PC	--	46						
				PC	--	43						
				PC	--	40						
				PC	--	46						
				PC	--	52						
				PC	--	59						
				PC	--	82						
				PC	--	105						
				PC	--	124						
				PC	--	160						
				PC	--	165						
				PC	--	172						

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Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of Monitoring Well: FHS2

Project No: 3113

Date: April 7, 2018

SUBSURFACE PROFILE				SAMPLE								
Depth	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample Sequence	"N" Value	Recovery (%)	% Fines	Standard Penetration Test "N" Value per 300 mm (20 60)	Well Data - Deep	Well Data - Shallow	Well Description
92			-28.2	PC	--	161						
		End of Borehole										
93												
94												
95												
29												
96												
97												
98												
30												
99												
00												
01												
31												
02												
03												
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10												
11												
34												
12												
13												
14												
15												
35												

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Datum: Geodetic

APPENDIX B

Grain Size Analysis

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

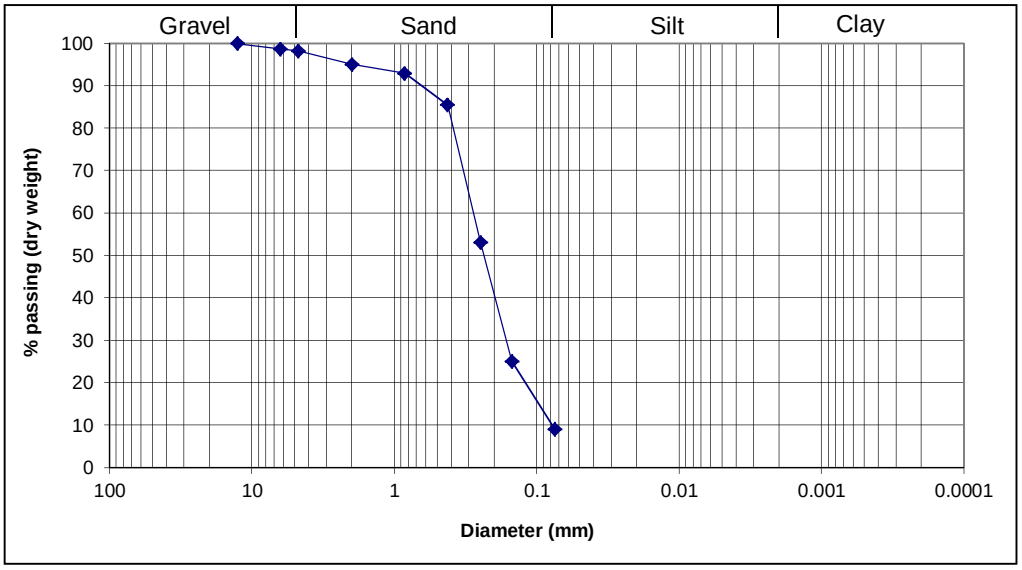
Sample No. : FHS1-SS16

Depth below GS : 11.51 - 12.28 m
(37.69 - 40.19 ft)

Sieve Analysis

Dry weight of sample (g) = 357.58

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	0.00	0.00	0.00	100.00
1/4"	6.35	4.44	1.24	1.24	98.76
4	4.76	1.68	0.47	1.71	98.29
10	2.00	11.37	3.18	4.89	95.11
20	0.85	7.69	2.15	7.04	92.96
40	0.425	26.56	7.43	14.47	85.53
60	0.25	115.85	32.40	46.87	53.13
100	0.15	100.37	28.07	74.94	25.06
200	0.075	57.11	15.97	90.91	9.09
pan	---	32.51	9.09	100.00	---
		357.58			



D_{10} = 0.077

D_{30} = 0.165 Cu = 3.64

D_{60} = 0.28 Cc = 1.26

USCS: SP-SM (Poorly graded sand with silt) or SP-SC (Poorly graded sand with clay)

R_{200} = 90.91 % Gravel = 1.71

R_4 = 1.71 % Sand = 89.20

R_4/R_{200} = 0.02 % Silt & Clay = 9.09

SF = 89.20 % Clay = NA

GF = 1.71 **CFEM:** Sand, trace Silt/Clay, trace Gravel

Moisture Content (%): 12.14

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

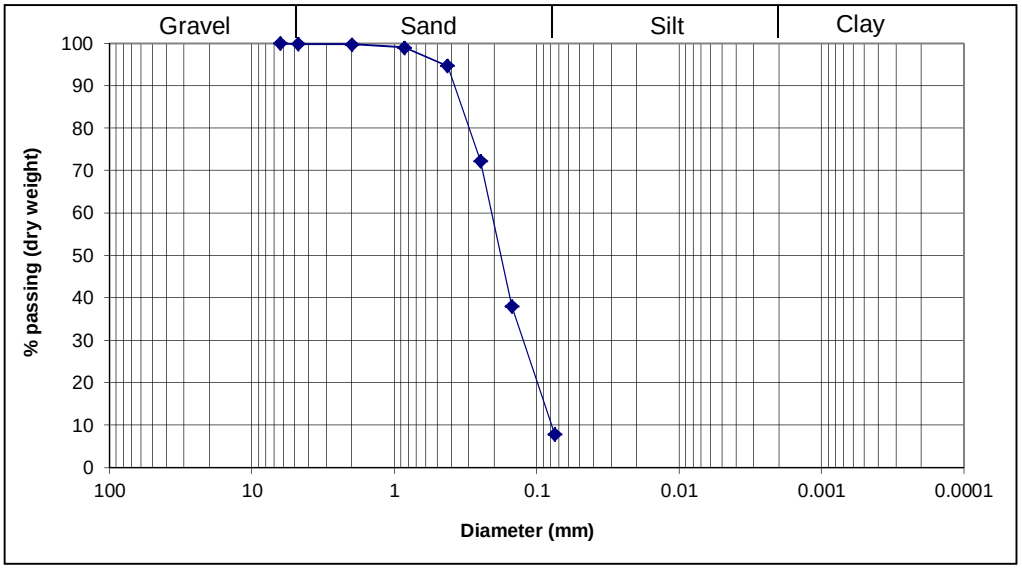
Sample No. : FHS1-SS17

Depth below GS : 12.28 - 12.88 m
(40.27 - 42.27 ft)

Sieve Analysis

Dry weight of sample (g) = 350.59

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	-	-		
1/4"	6.35	0.00	0.00	0.00	100.00
4	4.76	0.52	0.15	0.15	99.85
10	2.00	0.46	0.13	0.28	99.72
20	0.85	2.39	0.68	0.96	99.04
40	0.425	15.18	4.33	5.29	94.71
60	0.25	78.52	22.40	27.69	72.31
100	0.15	120.09	34.25	61.94	38.06
200	0.075	105.61	30.12	92.06	7.94
pan	---	27.82	7.94	100.00	---
		350.59			



D_{10} = 0.078

D_{30} = 0.125

D_{60} = 0.21

Cu = 2.69

Cc = 0.95

USCS: SP-SM (Poorly graded sand with silt) or SP-SC (Poorly graded sand with clay)

R_{200} = 92.06

R_4 = 0.15

R_4/R_{200} = 0.00

SF = 91.92

GF = 0.15

% Gravel = 0.15

% Sand = 91.92

% Silt & Clay = 7.94

% Clay = NA

CFEM: Sand, trace Silt/Clay

Moisture Content (%): 15.20

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

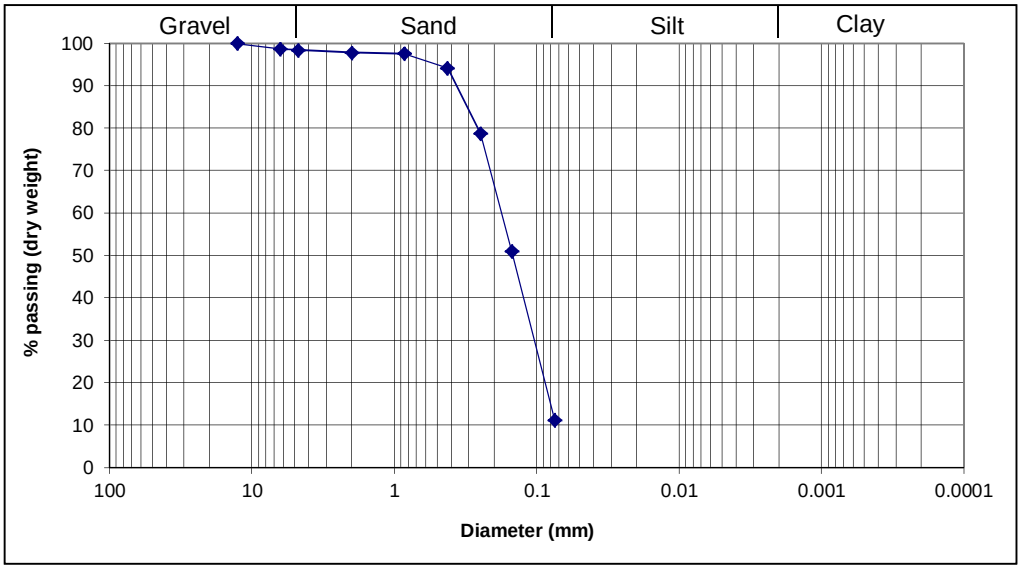
Sample No. : FHS1-SS18-2

Depth below GS : 12.88 - 14.20 m
(42.27 - 46.60 ft)

Sieve Analysis

Dry weight of sample (g) = 350.73

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	0.00	0.00	0.00	100.00
1/4"	6.35	4.69	1.34	1.34	98.66
4	4.76	0.74	0.21	1.55	98.45
10	2.00	2.09	0.60	2.14	97.86
20	0.85	1.04	0.30	2.44	97.56
40	0.425	11.82	3.37	5.81	94.19
60	0.25	54.12	15.43	21.24	78.76
100	0.15	97.41	27.77	49.01	50.99
200	0.075	139.31	39.72	88.73	11.27
pan	---	39.51	11.27	100.00	---
		350.73			



D_{10} = 0.072

D_{30} = 0.105 Cu = 2.50

D_{60} = 0.18 Cc = 0.85

USCS: SP-SM (Poorly graded sand with silt) or SP-SC (Poorly graded sand with clay)

R_{200} = 88.73 % Gravel = 1.55

R_4 = 1.55 % Sand = 87.19

R_4/R_{200} = 0.02 % Silt & Clay = 11.27

SF = 87.19 % Clay = NA

GF = 1.55 **CFEM:** Sand, some Silt/Clay, trace Gravel

Moisture Content (%): 15.26

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

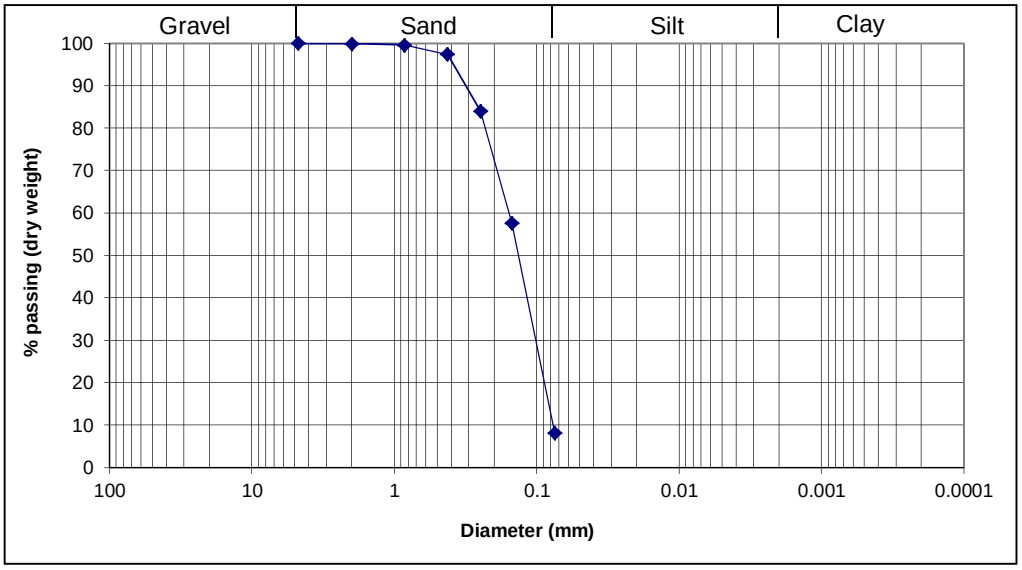
Sample No. : FHS1-SS19

Depth below GS : 14.43 - 15.50 m
(47.36 - 50.85 ft)

Sieve Analysis

Dry weight of sample (g) = 360.05

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	-	-		
1/4"	6.35	-	-		
4	4.76	0.00	0.00	0.00	100.00
10	2.00	0.38	0.11	0.11	99.89
20	0.85	0.99	0.27	0.38	99.62
40	0.425	7.92	2.20	2.58	97.42
60	0.25	47.85	13.29	15.87	84.13
100	0.15	95.24	26.45	42.32	57.68
200	0.075	178.22	49.50	91.82	8.18
pan	---	29.45	8.18	100.00	---
		360.05			



D_{10} = 0.076

D_{30} = 0.1

D_{60} = 0.16

Cu = 2.11

Cc = 0.82

USCS: SP-SM (Poorly graded sand with silt) or SP-SC (Poorly graded sand with clay)

R_{200} = 91.82

R_4 = 0.00

R_4/R_{200} = 0.00

SF = 91.82

GF = 0.00

% Gravel = 0.00

% Sand = 91.82

% Silt & Clay = 8.18

% Clay = NA

CFEM: Sand, trace Silt/Clay

Moisture Content (%): 16.76

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

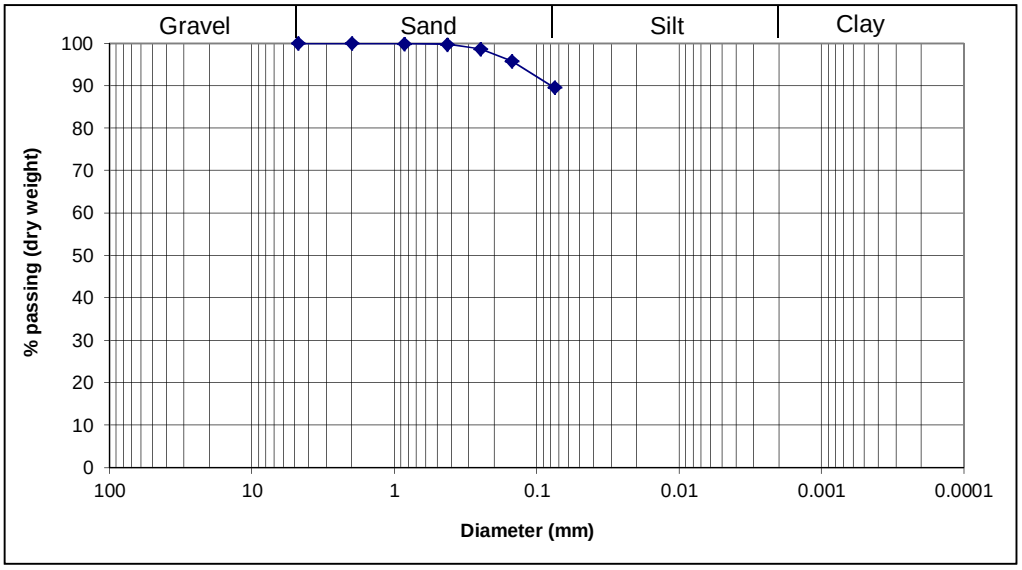
Sample No. : FHS1-SS20-2

Depth below GS : 16.29 - 17.81 m
(53.44 - 58.44 ft)

Sieve Analysis

Dry weight of sample (g) = 270.50

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	-	-		
1/4"	6.35	-	-		
4	4.76	0.00	0.00	0.00	100.00
10	2.00	0.00	0.00	0.00	100.00
20	0.85	0.12	0.04	0.04	99.96
40	0.425	0.39	0.14	0.19	99.81
60	0.25	3.02	1.12	1.30	98.70
100	0.15	7.74	2.86	4.17	95.83
200	0.075	16.93	6.26	10.43	89.57
pan	---	242.30	89.57	100.00	---
		270.50			



D_{10} = NA

D_{30} = NA

D_{60} = NA

Cu = NA

Cc = NA

USCS: CL (Lean clay) or ML (Silt) or CL-ML (Silty clay)

R_{200} = 10.43

R_4 = 0.00

R_4/R_{200} = 0.00

SF = 10.43

GF = 0.00

% Gravel = 0.00

% Sand = 10.43

% Silt & Clay = 89.57

% Clay = NA

CFEM: Silt/Clay, some Sand

Moisture Content (%): 32.59

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

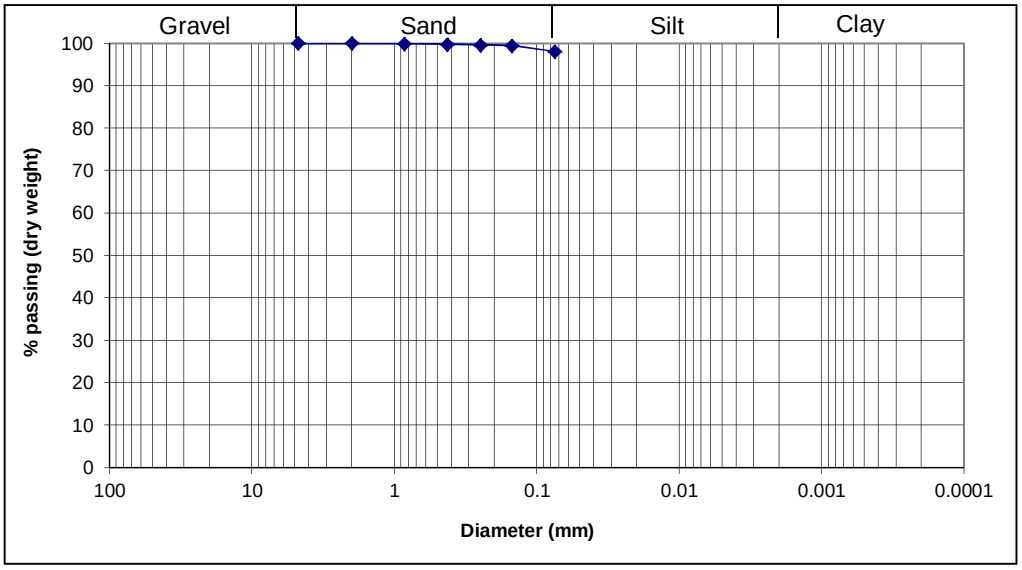
Sample No. : FHS1-SS21-2

Depth below GS : 17.81 - 19.30 m
(58.44 - 62.44 ft)

Sieve Analysis

Dry weight of sample (g) = 285.80

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	-	-		
1/4"	6.35	-	-		
4	4.76	0.00	0.00	0.00	100.00
10	2.00	0.00	0.00	0.00	100.00
20	0.85	0.15	0.05	0.05	99.95
40	0.425	0.46	0.16	0.21	99.79
60	0.25	0.46	0.16	0.37	99.63
100	0.15	0.55	0.19	0.57	99.43
200	0.075	3.70	1.29	1.86	98.14
pan	---	280.48	98.14	100.00	---
		285.80			



D_{10} = NA

D_{30} = NA

D_{60} = NA

Cu = NA

Cc = NA

USCS: CL (Lean clay) or ML (Silt) or CL-ML (Silty clay)

R_{200} = 1.86

R_4 = 0.00

R_4/R_{200} = 0.00

SF = 1.86

GF = 0.00

% Gravel = 0.00

% Sand = 1.86

% Silt & Clay = 98.14

% Clay = NA

CFEM: Silt/Clay, trace Sand

Moisture Content (%): 32.73

GRAIN SIZE ANALYSIS

Project : 3113- Stephenville, NL

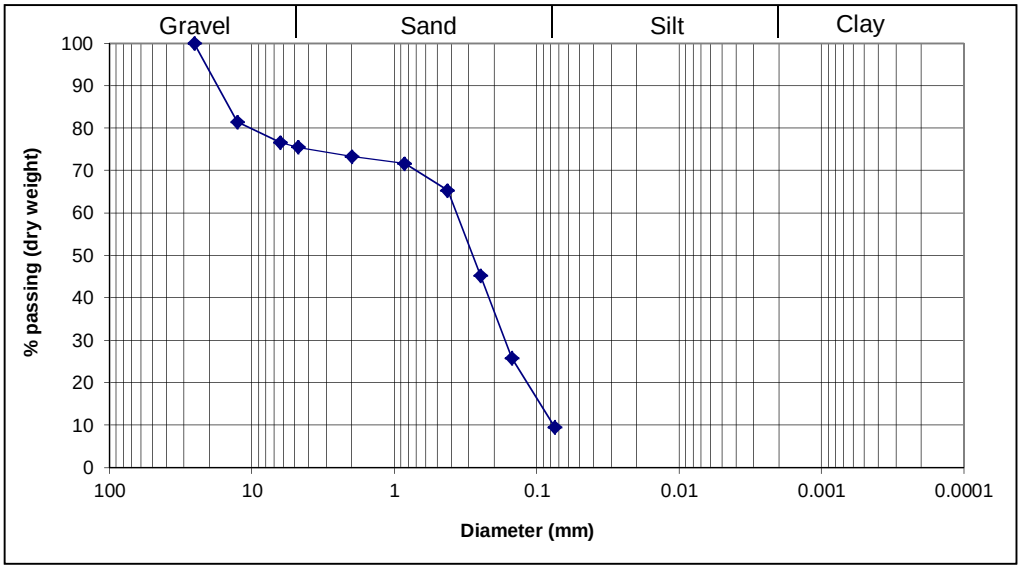
Sample No. : FHS2-SS6

Depth below GS : 7.60 - 8.32 m
(24.92 - 27.29 ft)

Sieve Analysis

Dry weight of sample (g) = 375.42

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	69.43	18.49	18.49	81.51
1/4"	6.35	17.96	4.78	23.28	76.72
4	4.76	4.33	1.15	24.43	75.57
10	2.00	8.44	2.25	26.68	73.32
20	0.85	5.88	1.57	28.25	71.75
40	0.425	23.79	6.34	34.58	65.42
60	0.25	75.30	20.06	54.64	45.36
100	0.15	73.27	19.52	74.16	25.84
200	0.075	61.07	16.27	90.42	9.58
pan	---	35.95	9.58	100.00	---
		375.42			



D_{10} = 0.075

D_{30} = 0.175

D_{60} = 0.38

Cu = 5.07

Cc = 1.07

USCS: SP-SM (Poorly graded sand with silt and gravel) or SP-SC (Poorly graded sand with clay and gravel)

R_{200} = 90.42

R_4 = 24.43

R_4/R_{200} = 0.27

SF = 65.99

GF = 24.43

% Gravel = 24.43

% Sand = 65.99

% Silt & Clay = 9.58

% Clay = NA

CFEM: Gravelly Sand, trace Silt/Clay

Moisture Content (%): 16.88

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

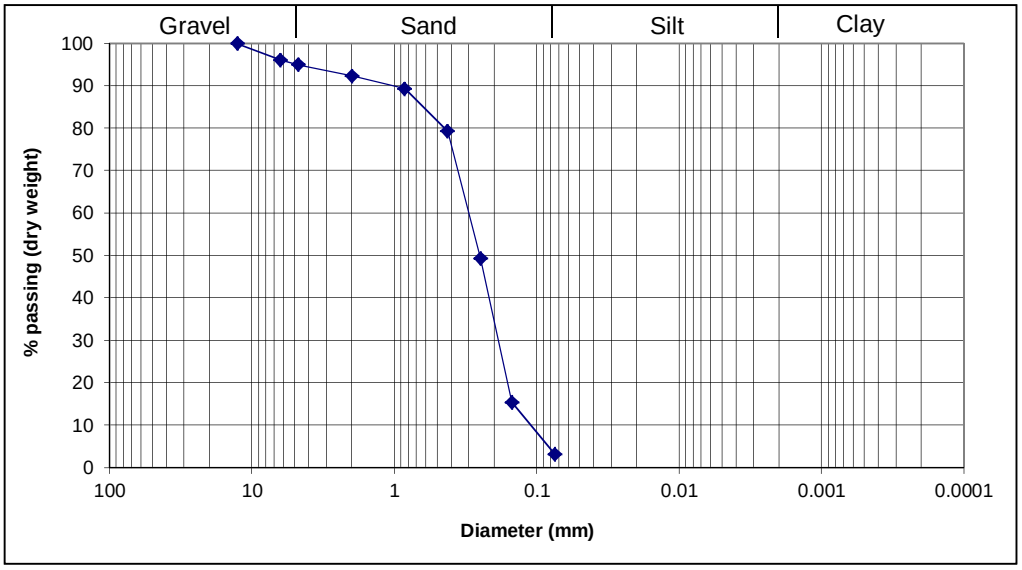
Sample No. : FHS2-SS11

Depth below GS : 11.45 - 12.36 m
(37.56- 40.56 ft)

Sieve Analysis

Dry weight of sample (g) = 328.71

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	0.00	0.00	0.00	100.00
1/4"	6.35	12.71	3.87	3.87	96.13
4	4.76	3.65	1.11	4.98	95.02
10	2.00	8.78	2.67	7.65	92.35
20	0.85	9.94	3.02	10.67	89.33
40	0.425	32.82	9.98	20.66	79.34
60	0.25	98.52	29.97	50.63	49.37
100	0.15	111.59	33.95	84.58	15.42
200	0.075	40.07	12.19	96.77	3.23
pan	---	10.63	3.23	100.00	---
		328.71			



D_{10} = 0.11

D_{30} = 0.19

D_{60} = 0.31

Cu = 2.82

Cc = 1.06

USCS: SP (Poorly graded sand)

R_{200} = 96.77

R_4 = 4.98

R_4/R_{200} = 0.05

SF = 91.79

GF = 4.98

% Gravel = 4.98

% Sand = 91.79

% Silt & Clay = 3.23

% Clay = NA

CFEM: Sand, trace Gravel, trace Silt/Clay

Moisture Content (%): 19.96

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

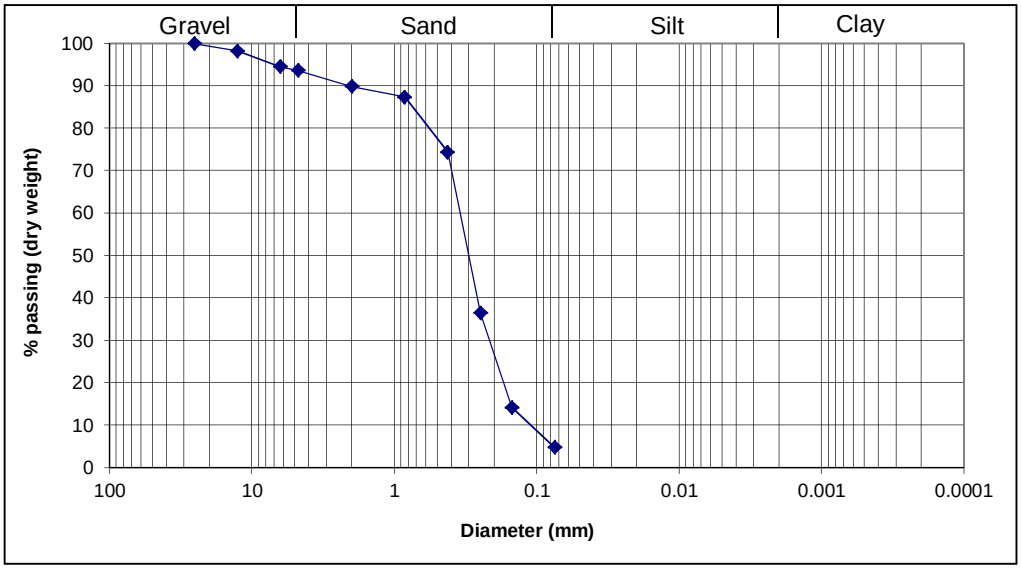
Sample No. : FHS2-SS12

Depth below GS : 12.92 - 14.14 m
(42.40 - 46.39 ft)

Sieve Analysis

Dry weight of sample (g) = 344.13

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	6.07	1.76	1.76	98.24
1/4"	6.35	12.60	3.66	5.43	94.57
4	4.76	3.23	0.94	6.36	93.64
10	2.00	12.89	3.75	10.11	89.89
20	0.85	8.76	2.55	12.66	87.34
40	0.425	44.33	12.88	25.54	74.46
60	0.25	130.61	37.95	63.49	36.51
100	0.15	76.64	22.27	85.76	14.24
200	0.075	32.40	9.42	95.18	4.82
pan	---	16.60	4.82	100.00	---
		344.13			



D_{10} = 0.11

D_{30} = 0.22

D_{60} = 0.35

Cu = 3.18

Cc = 1.26

USCS: SP (Poorly graded sand)

R_{200} = 95.18

R_4 = 6.36

R_4/R_{200} = 0.07

SF = 88.81

GF = 6.36

% Gravel = 6.36

% Sand = 88.81

% Silt & Clay = 4.82

% Clay = NA

CFEM: Sand, trace Gravel, trace Silt/Clay

Moisture Content (%): 17.97

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

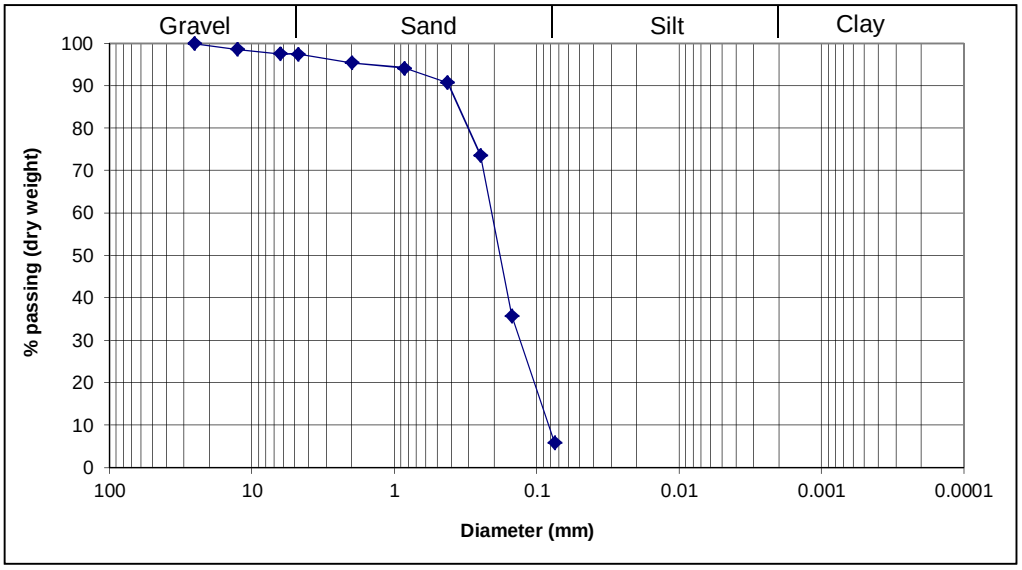
Sample No. : FHS2-SS13

Depth below GS : 14.19 - 15.26 m
(46.56 - 50.06 ft)

Sieve Analysis

Dry weight of sample (g) = 349.77

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	4.77	1.36	1.36	98.64
1/4"	6.35	3.64	1.04	2.40	97.60
4	4.76	0.30	0.09	2.49	97.51
10	2.00	7.13	2.04	4.53	95.47
20	0.85	4.62	1.32	5.85	94.15
40	0.425	11.74	3.36	9.21	90.79
60	0.25	59.73	17.08	26.28	73.72
100	0.15	132.38	37.85	64.13	35.87
200	0.075	104.88	29.99	94.12	5.88
pan	---	20.58	5.88	100.00	---
		349.77			



D_{10} = 0.082

D_{30} = 0.13

D_{60} = 0.21

Cu = 2.56

Cc = 0.98

USCS: SP-SM (Poorly graded sand with silt) or SP-SC (Poorly graded sand with clay)

R_{200} = 94.12

R_4 = 2.49

R_4/R_{200} = 0.03

SF = 91.63

GF = 2.49

% Gravel = 2.49

% Sand = 91.63

% Silt & Clay = 5.88

% Clay = NA

CFEM: Sand, trace Silt/Clay, trace Gravel

Moisture Content (%): 19.06

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

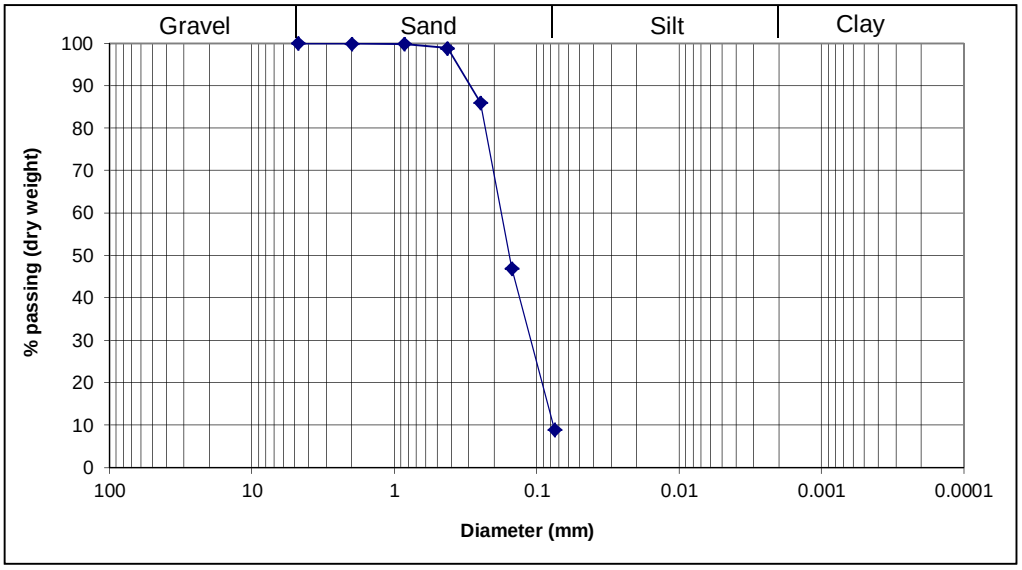
Sample No. : FHS2-SS14

Depth below GS : 17.58 - 18.64 m
(57.67 - 61.17 ft)

Sieve Analysis

Dry weight of sample (g) = 352.77

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	-	-		
1/4"	6.35	-	-		
4	4.76	0.00	0.00	0.00	100.00
10	2.00	0.20	0.06	0.06	99.94
20	0.85	0.44	0.12	0.18	99.82
40	0.425	3.45	0.98	1.16	98.84
60	0.25	45.20	12.81	13.97	86.03
100	0.15	137.76	39.05	53.02	46.98
200	0.075	134.35	38.08	91.11	8.89
pan	---	31.37	8.89	100.00	---
		352.77			



D_{10} = 0.076

D_{30} = 0.11

D_{60} = 0.18

Cu = 2.37

Cc = 0.88

USCS: SP-SM (Poorly graded sand with silt) or SP-SC (Poorly graded sand with clay)

R_{200} = 91.11

R_4 = 0.00

R_4/R_{200} = 0.00

SF = 91.11

GF = 0.00

% Gravel = 0.00

% Sand = 91.11

% Silt & Clay = 8.89

% Clay = NA

CFEM: Sand, trace Silt/Clay

Moisture Content (%): 17.79

GRAIN SIZE ANALYSIS

Project : 3113 - Stephenville, NL

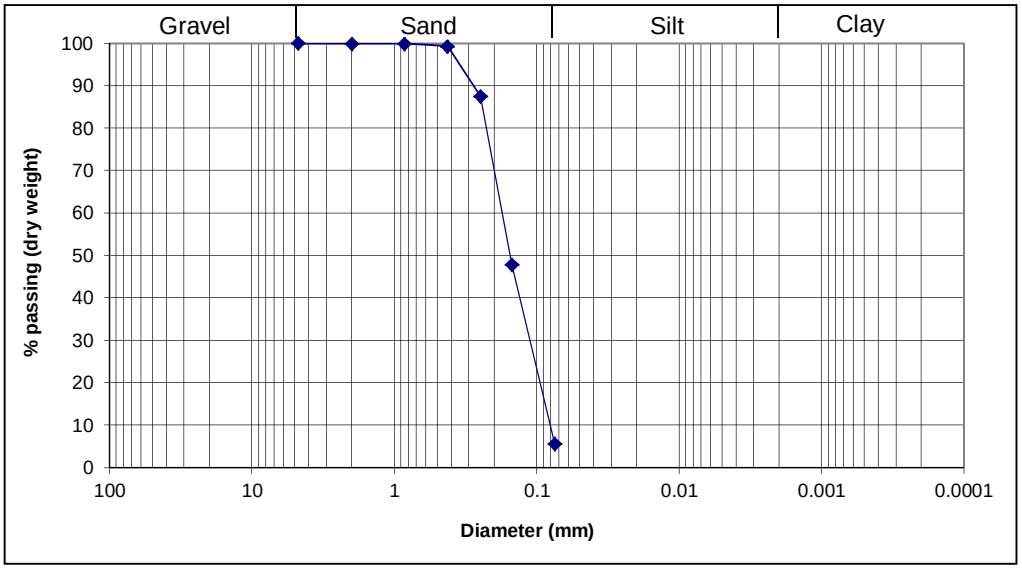
Sample No. : FHS2-SS15

Depth below GS : 18.64 - 19.61 m
(61.17 - 64.33 ft)

Sieve Analysis

Dry weight of sample (g) = 335.54

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	-	-		
1/4"	6.35	-	-		
4	4.76	0.01	0.00	0.00	100.00
10	2.00	0.20	0.06	0.06	99.94
20	0.85	0.25	0.07	0.14	99.86
40	0.425	1.96	0.58	0.72	99.28
60	0.25	39.42	11.75	12.47	87.53
100	0.15	132.99	39.63	52.10	47.90
200	0.075	141.75	42.25	94.35	5.65
pan	---	18.96	5.65	100.00	---
		335.54			



D_{10} = 0.08

D_{30} = 0.11

D_{60} = 0.175

Cu = 2.19

Cc = 0.86

USCS: SP-SM (Poorly graded sand with silt) or SP-SC (Poorly graded sand with clay)

R_{200} = 94.35

R_4 = 0.00

R_4/R_{200} = 0.00

SF = 94.35

GF = 0.00

% Gravel = 0.00

% Sand = 94.35

% Silt & Clay = 5.65

% Clay = NA

CFEM: Sand, trace Silt/Clay

Moisture Content (%): 19.81

APPENDIX C

Laboratory Analyses

AGAT Laboratories

57 Old Pennywell Road, Unit I
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http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS
154 MAJOR'S PATH
ST. JOHN'S PATH, NL A1A5A1
(709) 739-7270

ATTENTION TO: John Gale

PROJECT: 3113 - Stephenville

AGAT WORK ORDER: 18K328511

TRACE ORGANICS REVIEWED BY: Amy Hunter, Trace Organics Supervisor, B.Sc.

WATER ANALYSIS REVIEWED BY: Laura Baker, Inorganics Data Reporter

DATE REPORTED: Apr 20, 2018

PAGES (INCLUDING COVER): 16

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (709)747-8573

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Atlantic RBCA Tier 1 Hydrocarbons in Water (Version 3.0)

DATE RECEIVED: 2018-04-12

DATE REPORTED: 2018-04-20

					3113-FHS1-1.	3113-FHS1-2.
				SAMPLE DESCRIPTION:	0-WS1	0-WS1
				SAMPLE TYPE:	Water	Water
				DATE SAMPLED:	2018-04-10	2018-04-10
Parameter	**Unit**	**G / S: A**	**G / S: B**	**RDL**	**9178171**	**9178204**
Benzene	mg/L	0.370	2.6	0.001	<0.001[<A]	<0.001[<A]
Toluene	mg/L	0.002	20	0.001	<0.001[<A]	<0.001[<A]
Ethylbenzene	mg/L	0.09	20	0.001	<0.001[<A]	<0.001[<A]
Xylene (Total)	mg/L		20	0.002	<0.002[<B]	<0.002[<B]
C6-C10 (less BTEX)	mg/L			0.01	<0.01	<0.01
>C10-C16 Hydrocarbons	mg/L			0.05	<0.05	<0.05
>C16-C21 Hydrocarbons	mg/L			0.10	<0.10	<0.10
>C21-C32 Hydrocarbons	mg/L			0.1	0.24	0.12
Modified TPH (Tier 1)	mg/L		20	0.1	0.2[<B]	0.1[<B]
Resemblance Comment					LR	LR
Return to Baseline at C32					Y	Y
Surrogate	**Unit**	**Acceptable Limits**				
Isobutylbenzene - EPH	%	70-130			83	91
Isobutylbenzene - VPH	%	70-130			117	108
n-Dotriacontane - EPH	%	70-130			90	93

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to CCME FWAL - update 2015, B Refers to PIRI Tier 1 GW Residential Non-Potable Coarse Jan 2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9178171-9178204 Resemblance Comment Key:
GF - Gasoline Fraction
WGF - Weathered Gasoline Fraction
GR - Product in Gasoline Range
FOF - Fuel Oil Fraction
WFOF - Weathered Fuel Oil Fraction
FR - Product in Fuel Oil Range
LOF - Lube Oil Fraction
LR - Lube Range
UC - Unidentified Compounds
NR - No Resemblance
NA - Not Applicable

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Dissolved Metals

DATE RECEIVED: 2018-04-12

DATE REPORTED: 2018-04-20

Parameter	Unit	G / S	RDL	3113-FHS1-1. 0-WS1 Water 2018-04-10 9178171	3113-FHS1-2. 0-WS1 Water 2018-04-10 9178204
Dissolved Aluminum	ug/L	Variable	5	21	17
Dissolved Antimony	ug/L		2	<2	<2
Dissolved Arsenic	ug/L	5	2	**26**	**29**
Dissolved Barium	ug/L		5	350	534
Dissolved Beryllium	ug/L		2	<2	<2
Dissolved Bismuth	ug/L		2	<2	<2
Dissolved Boron	ug/L	29000,	5	695	749
Dissolved Cadmium	ug/L	1.0, 0.09	0.017	0.060	<0.017
Dissolved Chromium	ug/L		1	4	3
Dissolved Cobalt	ug/L		1	2	<1
Dissolved Copper	ug/L	Equation	2	5	5
Dissolved Iron	ug/L	300	50	**372**	**4800**
Dissolved Lead	ug/L	Equation	0.5	0.9	<0.5
Dissolved Manganese	ug/L		2	1370	1080
Dissolved Molybdenum	ug/L	73	2	29	8
Dissolved Nickel	ug/L	Equation	2	7	6
Dissolved Selenium	ug/L	1.0	1	**5**	1
Dissolved Silver	ug/L	0.25	0.1	<0.1	<0.1
Dissolved Strontium	ug/L		5	1580	1470
Dissolved Thallium	ug/L	0.8	0.1	<0.1	<0.1
Dissolved Tin	ug/L		2	<2	<2
Dissolved Titanium	ug/L		2	5	5
Dissolved Uranium	ug/L	33, 15	0.1	0.9	0.9
Dissolved Vanadium	ug/L		2	20	23
Dissolved Zinc	ug/L	30	5	9	7

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME FWAL - update 2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9178171-9178204 Analysis completed on a filtered sample.

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2018-04-12

DATE REPORTED: 2018-04-20

Parameter	Unit	G / S	RDL	3113-FHS1-1. 0-WS1 Water 2018-04-10 9178171	3113-FHS1-2. 0-WS1 Water 2018-04-10 9178204
pH		6.5-9.0		7.88	7.77
Reactive Silica as SiO2	mg/L		0.5	4.7	8.8
Chloride	mg/L	640, 120	50	**3660**	**3670**
Fluoride	mg/L	0.12	0.12	<0.12	<0.12
Sulphate	mg/L		100	497	494
Alkalinity	mg/L		5	195	180
True Color	TCU	Narrative	5	16	28
Turbidity	NTU	Narrative	0.1	13100	2120
Electrical Conductivity	umho/cm		1	11200	11400
Nitrate + Nitrite as N	mg/L		0.05	<0.05	<0.05
Nitrate as N	mg/L	550, 13	2.5	<2.5	<2.5
Nitrite as N	mg/L	0.06	**2.5**	<2.5	<2.5
Ammonia as N	mg/L	Fact Sheet	0.03	0.31	0.87
Total Organic Carbon	mg/L		0.5	8.9	1.7
Ortho-Phosphate as P	mg/L		0.01	<0.01	0.01
Total Sodium	mg/L		0.1	1720	1820
Total Potassium	mg/L		0.1	67.2	60.9
Total Calcium	mg/L		0.1	599	223
Total Magnesium	mg/L		0.1	267	209
Bicarb. Alkalinity (as CaCO3)	mg/L		5	195	180
Carb. Alkalinity (as CaCO3)	mg/L		10	<10	<10
Hydroxide	mg/L		5	<5	<5
Calculated TDS	mg/L		1	7300	6660
Hardness	mg/L			2600	1420
Langelier Index (@20C)	NA			1.17	0.60
Langelier Index (@ 4C)	NA			0.85	0.28
Saturation pH (@ 20C)	NA			6.71	7.17
Saturation pH (@ 4C)	NA			7.03	7.49
Anion Sum	me/L			117	117

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2018-04-12

DATE REPORTED: 2018-04-20

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION: 3113-FHS1-1. 0-WS1 / SAMPLE TYPE: Water / DATE SAMPLED: 2018-04-10 / 9178171	SAMPLE DESCRIPTION: 3113-FHS1-2. 0-WS1 / SAMPLE TYPE: Water / DATE SAMPLED: 2018-04-10 / 9178204
Cation sum	me/L			152	113
% Difference/ Ion Balance (NS)	%			12.8	1.8
Total Aluminum	ug/L	Variable	5	138000	18700
Total Antimony	ug/L		2	<2	<2
Total Arsenic	ug/L	5	2	**14**	**6**
Total Barium	ug/L		5	1110	628
Total Beryllium	ug/L		2	5	<2
Total Bismuth	ug/L		2	<2	<2
Total Boron	ug/L	29000,	5	371	654
Total Cadmium	ug/L	1.0, 0.09	0.017	**1.14**	0.153
Total Chromium	ug/L		1	622	95
Total Cobalt	ug/L		1	149	23
Total Copper	ug/L	Equation	1	649	51
Total Iron	ug/L	300	50	**224000**	**57500**
Total Lead	ug/L	Equation	0.5	95.3	12.5
Total Manganese	ug/L		2	6280	2510
Total Molybdenum	ug/L	73	2	37	10
Total Nickel	ug/L	Equation	2	319	44
Total Phosphorous	mg/L	Fact Sheet	0.02	4.21	0.32
Total Selenium	ug/L	1	1	**5**	**2**
Total Silver	ug/L	0.25	0.1	**0.4**	<0.1
Total Strontium	ug/L		5	2710	1580
Total Thallium	ug/L	0.8	0.1	0.2	<0.1
Total Tin	ug/L		2	5	<2
Total Titanium	ug/L		2	3970	1290
Total Uranium	ug/L	33, 15	0.1	8.3	2.3
Total Vanadium	ug/L		2	483	121
Total Zinc	ug/L	30	5	**955**	**81**

Certified By: Laura Baker

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2018-04-12

DATE REPORTED: 2018-04-20

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME FWAL - update 2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9178171 Ion Balance is biased high, contributing parameters have been confirmed.

Certified By:

AGAT Laboratories

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Guideline Violation

AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Arsenic	ug/L	5	26
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Iron	ug/L	300	372
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Selenium	ug/L	1.0	5
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Chloride	mg/L	640, 120	3660
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Arsenic	ug/L	5	14
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Cadmium	ug/L	1.0, 0.09	1.14
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Iron	ug/L	300	224000
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Selenium	ug/L	1	5
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Silver	ug/L	0.25	0.4
9178171	3113-FHS1-1.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Zinc	ug/L	30	955
9178204	3113-FHS1-2.0-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Arsenic	ug/L	5	29
9178204	3113-FHS1-2.0-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Iron	ug/L	300	4800
9178204	3113-FHS1-2.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Chloride	mg/L	640, 120	3670
9178204	3113-FHS1-2.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Arsenic	ug/L	5	6
9178204	3113-FHS1-2.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Iron	ug/L	300	57500
9178204	3113-FHS1-2.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Selenium	ug/L	1	2
9178204	3113-FHS1-2.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Zinc	ug/L	30	81

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

ATTENTION TO: John Gale

SAMPLING SITE:

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Trace Organics Analysis

RPT Date: Apr 20, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Atlantic RBCA Tier 1 Hydrocarbons in Water (Version 3.0)															
Benzene	1	9173997	< 0.001	< 0.001	NA	< 0.001	81%	70%	130%	99%	70%	130%	NA		
Toluene	1	9173997	< 0.001	< 0.001	NA	< 0.001	87%	70%	130%	95%	70%	130%	NA		
Ethylbenzene	1	9173997	< 0.001	< 0.001	NA	< 0.001	93%	70%	130%	97%	70%	130%	NA		
Xylene (Total)	1	9173997	< 0.002	< 0.002	NA	< 0.002	95%	70%	130%	104%	70%	130%	NA		
C6-C10 (less BTEX)	1	9173997	< 0.01	< 0.01	NA	< 0.01	90%	70%	130%	89%	70%	130%	92%	70%	130%
>C10-C16 Hydrocarbons	1	-99999	< 0.05	< 0.05	NA	< 0.05	105%	70%	130%	119%	70%	130%	83%	70%	130%
>C16-C21 Hydrocarbons	1	-99999	< 0.10	< 0.10	NA	< 0.10	108%	70%	130%	119%	70%	130%	83%	70%	130%
>C21-C32 Hydrocarbons	1	-99999	<0.1	<0.1	NA	< 0.1	101%	70%	130%	119%	70%	130%	83%	70%	130%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.
If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:

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Water Analysis

RPT Date: Apr 20, 2018

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Standard Water Analysis + Total Metals															
pH	9178352		7.80	7.82	0.3%	<	101%	80%	120%	NA	80%	120%	NA	80%	120%
Reactive Silica as SiO2	1	9185988	6.1	6.1	0.0%	< 0.5	120%	80%	120%		80%	120%	103%	80%	120%
Chloride	9183776		42	43	2.3%	< 1	87%	80%	120%	NA	80%	120%	NA	80%	120%
Fluoride	9178348		1.15	1.17	1.3%	< 0.12	110%	80%	120%	NA	80%	120%	NA	80%	120%
Sulphate	9183776		23	24	2.4%	< 2	105%	80%	120%	NA	80%	120%	NA	80%	120%
Alkalinity	9178352		58	58	0.1%	< 5	97%	80%	120%	NA	80%	120%	NA	80%	120%
True Color	9180324		32	29	9.8%	< 5	105%	80%	120%	NA			NA		
Turbidity	9180324		0.9	1.1	12.1%	< 0.1	101%	80%	120%	NA			NA		
Electrical Conductivity	9178352		2040	2040	0.1%	< 1	104%	80%	120%	NA	80%	120%	NA	80%	120%
Nitrate as N	9178348		0.13	0.08	NA	< 0.05	95%	80%	120%	NA	80%	120%	100%	80%	120%
Nitrite as N	9178348		<0.05	<0.05	NA	< 0.05	100%	80%	120%	NA	80%	120%	109%	80%	120%
Ammonia as N	1	9175341	1.76	1.79	1.7%	< 0.03	90%	80%	120%		80%	120%	80%	80%	120%
Total Organic Carbon	1	9176775	0.9	0.7	NA	< 0.5	97%	80%	120%		80%	120%	88%	80%	120%
Ortho-Phosphate as P	1	9185988	0.02	0.02	NA	< 0.01	100%	80%	120%		80%	120%	109%	80%	120%
Total Sodium	9180410		5.8	5.9	2.2%	< 0.1	92%	80%	120%	91%	80%	120%	94%	70%	130%
Total Potassium	9180410		0.9	0.8	2.4%	< 0.1	100%	80%	120%	102%	80%	120%	93%	70%	130%
Total Calcium	9180410		48.5	48.6	0.2%	< 0.1	107%	80%	120%	101%	80%	120%	98%	70%	130%
Total Magnesium	9180410		9.4	9.7	3.4%	< 0.1	94%	80%	120%	94%	80%	120%	98%	80%	120%
Bicarb. Alkalinity (as CaCO3)	9178352		58	58	0.1%	< 5	NA	80%	120%	NA	80%	120%	NA	80%	120%
Carb. Alkalinity (as CaCO3)	9178352		<10	<10	NA	< 10	NA	80%	120%	NA	80%	120%	NA	80%	120%
Hydroxide	9178352		<5	<5	NA	< 5	NA	80%	120%	NA	80%	120%	NA	80%	120%
Total Aluminum	9180410		<5	<5	NA	< 5	92%	80%	120%	95%	80%	120%	73%	70%	130%
Total Antimony	9180410		<2	<2	NA	< 2	92%	80%	120%	102%	80%	120%	99%	70%	130%
Total Arsenic	9180410		7	7	NA	< 2	100%	80%	120%	93%	80%	120%	99%	70%	130%
Total Barium	9180410		6	6	NA	< 5	101%	80%	120%	95%	80%	120%	101%	70%	130%
Total Beryllium	9180410		<2	<2	NA	< 2	115%	80%	120%	110%	80%	120%	103%	70%	130%
Total Bismuth	9180410		<2	<2	NA	< 2	99%	80%	120%	100%	80%	120%	98%	70%	130%
Total Boron	9180410		8	7	NA	< 5	114%	80%	120%	109%	80%	120%	94%	70%	130%
Total Cadmium	9180410		0.044	0.045	NA	< 0.017	100%	80%	120%	96%	80%	120%	94%	70%	130%
Total Chromium	9180410		<1	<1	NA	< 1	110%	80%	120%	107%	80%	120%	120%	70%	130%
Total Cobalt	9180410		17	16	4.3%	< 1	107%	80%	120%	103%	80%	120%	100%	70%	130%
Total Copper	9180410		12	10	15.6%	< 1	108%	80%	120%	105%	80%	120%	99%	70%	130%
Total Iron	9180410		572	572	0.1%	< 50	107%	80%	120%	105%	80%	120%	99%	70%	130%
Total Lead	9180410		0.7	0.7	NA	< 0.5	109%	80%	120%	101%	80%	120%	99%	70%	130%
Total Manganese	9180410		1120	1110	1.7%	< 2	111%	80%	120%	108%	80%	120%	101%	70%	130%
Total Molybdenum	9180410		<2	<2	NA	< 2	94%	80%	120%	91%	80%	120%	110%	70%	130%
Total Nickel	9180410		19	22	11.9%	< 2	83%	80%	120%	81%	80%	120%	90%	70%	130%
Total Phosphorous	9180410		<0.02	<0.02	NA	< 0.02	94%	80%	120%	82%	80%	120%	80%	70%	130%
Total Selenium	9180410		1	1	NA	< 1	97%	80%	120%	94%	80%	120%	97%	70%	130%

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AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

ATTENTION TO: John Gale

SAMPLING SITE:

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Water Analysis (Continued)

RPT Date: Apr 20, 2018

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Total Silver	9180410		<0.1	<0.1	NA	< 0.1	97%	80%	120%	98%	80%	120%	93%	70%	130%
Total Strontium	9180410		129	127	1.1%	< 5	105%	80%	120%	103%	80%	120%	99%	70%	130%
Total Thallium	9180410		<0.1	<0.1	NA	< 0.1	107%	80%	120%	103%	80%	120%	102%	70%	130%
Total Tin	9180410		<2	<2	NA	< 2	94%	80%	120%	92%	80%	120%	94%	70%	130%
Total Titanium	9180410		<2	<2	NA	< 2	100%	80%	120%	100%	80%	120%	90%	70%	130%
Total Uranium	9180410		0.3	0.3	NA	< 0.1	103%	80%	120%	97%	80%	120%	99%	70%	130%
Total Vanadium	9180410		<2	<2	NA	< 2	106%	80%	120%	105%	80%	120%	116%	70%	130%
Total Zinc	9180410		41	41	0.2%	< 5	108%	80%	120%	107%	80%	120%	99%	70%	130%

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Dissolved Metals

Dissolved Aluminum	9178204	9178204	17	10	NA	< 5	106%	80%	120%	107%	80%	120%	109%	70%	130%
Dissolved Antimony	9178204	9178204	<2	<2	NA	< 2	105%	80%	120%	109%	80%	120%	101%	70%	130%
Dissolved Arsenic	9178204	9178204	29	28	3.9%	< 2	98%	80%	120%	101%	80%	120%	NA	70%	130%
Dissolved Barium	9178204	9178204	534	526	1.6%	< 5	96%	80%	120%	97%	80%	120%	NA	70%	130%
Dissolved Beryllium	9178204	9178204	<2	<2	NA	< 2	107%	80%	120%	112%	80%	120%	95%	70%	130%
Dissolved Bismuth	9178204	9178204	<2	<2	NA	< 2	101%	80%	120%	106%	80%	120%	70%	70%	130%
Dissolved Boron	9178204	9178204	749	765	2.2%	< 5	107%	80%	120%	107%	80%	120%	NA	70%	130%
Dissolved Cadmium	9178204	9178204	<0.017	<0.017	NA	< 0.017	101%	80%	120%	99%	80%	120%	77%	70%	130%
Dissolved Chromium	9178204	9178204	3	3	NA	< 1	102%	80%	120%	100%	80%	120%	83%	70%	130%
Dissolved Cobalt	9178204	9178204	<1	<1	NA	< 1	103%	80%	120%	101%	80%	120%	85%	70%	130%
Dissolved Copper	9178204	9178204	5	5	NA	< 2	104%	80%	120%	102%	80%	120%	76%	70%	130%
Dissolved Iron	9178204	9178204	4800	4860	1.4%	< 50	102%	80%	120%	100%	80%	120%	NA	70%	130%
Dissolved Lead	9178204	9178204	<0.5	<0.5	NA	< 0.5	98%	80%	120%	99%	80%	120%	77%	70%	130%
Dissolved Manganese	9178204	9178204	1080	1100	1.1%	< 2	102%	80%	120%	100%	80%	120%	NA	70%	130%
Dissolved Molybdenum	9178204	9178204	8	8	NA	< 2	101%	80%	120%	97%	80%	120%	NA	70%	130%
Dissolved Nickel	9178204	9178204	6	5	NA	< 2	101%	80%	120%	91%	80%	120%	70%	70%	130%
Dissolved Selenium	9178204	9178204	1	1	NA	< 1	98%	80%	120%	100%	80%	120%	NA	70%	130%
Dissolved Silver	9178204	9178204	<0.1	<0.1	NA	< 0.1	102%	80%	120%	98%	80%	120%	80%	70%	130%
Dissolved Strontium	9178204	9178204	1470	1440	2.0%	< 5	98%	80%	120%	93%	80%	120%	NA	70%	130%
Dissolved Thallium	9178204	9178204	<0.1	<0.1	NA	< 0.1	98%	80%	120%	103%	80%	120%	88%	70%	130%
Dissolved Tin	9178204	9178204	<2	<2	NA	< 2	96%	80%	120%	95%	80%	120%	94%	70%	130%
Dissolved Titanium	9178204	9178204	5	5	NA	< 2	108%	80%	120%	106%	80%	120%	89%	70%	130%
Dissolved Uranium	9178204	9178204	0.9	0.9	1.1%	< 0.1	97%	80%	120%	97%	80%	120%	93%	70%	130%
Dissolved Vanadium	9178204	9178204	23	22	5.1%	< 2	91%	80%	120%	92%	80%	120%	NA	70%	130%
Dissolved Zinc	9178204	9178204	7	6	NA	< 5	101%	80%	120%	101%	80%	120%	70%	70%	130%

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

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Quality Assurance

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AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Water Analysis (Continued)

RPT Date: Apr 20, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

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Method Summary

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Toluene	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Ethylbenzene	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Xylene (Total)	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
C6-C10 (less BTEX)	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
>C10-C16 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
>C16-C21 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
>C21-C32 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Modified TPH (Tier 1)	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	CALCULATION
Resemblance Comment	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS/FID
Return to Baseline at C32	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Isobutylbenzene - EPH	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Isobutylbenzene - VPH	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
n-Dotriacontane - EPH	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Dissolved Aluminum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Antimony	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Arsenic	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Barium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Beryllium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Bismuth	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Boron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Cadmium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Chromium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Cobalt	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Copper	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Iron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Lead	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Manganese	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Molybdenum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Nickel	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Selenium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Silver	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Strontium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Thallium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Tin	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Titanium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Uranium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Vanadium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Zinc	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
pH	INOR-121-6001	SM 4500 H+B	PC TITRATE
Reactive Silica as SiO2	INORG-121-6028	SM 4110 B	COLORIMETER
Chloride	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Fluoride	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH

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Method Summary

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Alkalinity	INOR-121-6001	SM 2320 B	
True Color	INORG-121-6014	EPA 110.2	NEPHELOMETER
Turbidity	INOR-121-6022	SM 2130 B	NEPHELOMETER
Electrical Conductivity	INOR-121-6001	SM 2510 B	PC TITRATE
Nitrate + Nitrite as N	INORG-121-6005	SM 4110 B	CALCULATION
Nitrate as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INORG-121-6003	SM 4500-NH3 G	COLORIMETER
Total Organic Carbon	INORG-121-6026	SM 5310 B	TOC ANALYZER
Ortho-Phosphate as P	INORG-121-6005	SM 4110 B	COLORIMETER
Total Sodium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Potassium	MET121-6104 & MET-121-6105	SM 3125	ICP-MS
Total Calcium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Magnesium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Bicarb. Alkalinity (as CaCO3)	INORG-121-6001	SM 2320 B	PC TITRATE
Carb. Alkalinity (as CaCO3)	INORG-121-6001	SM 2320 B	PC TITRATE
Hydroxide	INORG-121-6001	SM 2320 B	PC-TITRATE
Calculated TDS	CALCULATION	SM 1030E	CALCULATION
Hardness	CALCULATION	SM 2340B	CALCULATION
Langelier Index (@20C)	CALCULATION	CALCULATION	CALCULATION
Langelier Index (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 20C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Anion Sum	CALCULATION	SM 1030E	CALCULATION
Cation sum	CALCULATION	SM 1030E	CALCULATION
% Difference/ Ion Balance (NS)	CALCULATION	SM 1030E	CALCULATION
Total Aluminum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Antimony	MET121-6104 & MET-121-6105	SM 3125	ICP-MS
Total Arsenic	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Barium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Beryllium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Bismuth	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Boron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Cadmium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Chromium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Cobalt	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Copper	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Iron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS

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Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K328511

PROJECT: 3113 - Stephenville

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Lead	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Manganese	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Molybdenum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Nickel	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Phosphorous	MET-121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Selenium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Silver	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Strontium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Thallium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Tin	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Titanium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Uranium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Vanadium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Zinc	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS

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Chain of Custody Record

Laboratory Use Only

Arrival Condition: ☑ Good ☐ Poor (see notes)
Arrival Temperature: 9.5°C
Hold Time:
AGAT Job Number: 1816328511

Notes:

Report Information

Company: Fracflow Consultants Inc. (NL)
Contact: John Gale
Address: 154 Major's Path
St. John's, NL
Phone: 709-739-7270 Fax: 709-753-5101
Client Project #: 3113 - Stephenville
AGAT Quotation: S/O
Please Note: If quotation number is not provided client will be billed full price for analysis.

Report Information (Please print):

1. Name: John Gale (john_ffc@nfld.net)
   Email: Eunjeong Seok (eunjeong_ffc@nfld.net)
2. Name: Karen Andrews (karen_ffc@nfld.net)
   Email:

Report Format

☐ Single Sample per page
☑ Multiple Sample per page
☑ Excel Format Included
☐ Export:

Turnaround Time Required (TAT)

Regular TAT ☑ 5 to 7 working days
Rush TAT ☐ Same day ☐ 1 day ☐ 2 days ☐ 3 days
Date Required:

Invoice To Same Yes ☑ / No ☐

Company:
Contact: Karen Andrews (karen_ffc@nfld.net)
Address:
Phone: Fax:
PO/Credit Card#: 3883

Regulatory Requirements (Check):

☑ List Guidelines on Report ☐ Do not list Guidelines on Report
☑ PIRI
☑ Tier 1 ☐ Res ☐ Pot ☑ Coarse
☐ Tier 2 ☐ Com ☑ N/Pot ☐ Fine
☐ Gas ☐ Fuel ☐ Lube

☑ CCME ☐ CDWQ
☐ Industrial ☐ NSEQS-Cont Sites
☐ Commercial
☐ Res/Park ☐ HRM 101
☐ Agricultural ☐ Storm Water
☑ FWAL ☐ Waste Water
☐ Sediment ☐ Other

Drinking Water Sample: ☐ Yes ☑ No **Salt Water Sample:** ☐ Yes ☑ No
Reg. No.:

Sample Identification	Date/Time Sampled	Sample Matrix	# Containers	Comments – Site/Sample Info. Sample Containment
3113-FHS1-1.0-WS1	April 10, 2018	Water	9	1x500, 3x100, 2x250, 3x40
				Diss. Metal filtered
3113-FHS1-2.0-WS1	April 10, 2018	Water	9	1x500, 3x100, 2x250, 3x40
				Diss. Metal filtered

Field Filtered/Preserved	Standard Water Analysis	Metals: ☑ Total ☐ Diss ☐ Available	Mercury	☐ BOD ☐ CBOD	Grain Size (coarse/fine)	☐ TOC - Miss ☐ FOC - Miss	Phosphates (total as P205)	Chromium (Tri & Hexavalent)	Phenols	Tier 1: TPH/BTEX (PIRI) ☑ low level	Tier 2: TPH/BTEX Fractionation	CCME-CWS TPH/BTEX	VOC	Oil & Grease (TOG)	BNAE EPA 625 - Miss	PAH	PCB	Marine Sediment Package	Dioxins & Furans	Fecal Coliform ☐ MPN ☐ MF	Other:	Other:	Hazardous (Y/N)
	✓	✓								✓													
	✓	✓								✓													

Samples Relinquished By (Print Name):	Date/Time	Samples Received By (Print Name):	Date/Time
Shawn Thompson	18/04/12	Samantha Murphy	11:20AM
Samples Relinquished By (Sign):	Date/Time	Samples Received By (Sign):	Date/Time
	11:2 (		Apr 12/18

Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page 1 of 2

N°: FFC-~~ProjNo~~-COC-09
3113

Document ID: DIV-133-1501.002

Date revised January 2016

AGAT Laboratories

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CLIENT NAME: FRACFLOW CONSULTANTS
154 MAJOR'S PATH
ST. JOHN'S PATH, NL A1A5A1
(709) 739-7270

ATTENTION TO: John Gale

PROJECT: 3113 - Stephenville, NL

AGAT WORK ORDER: 18K329467

TRACE ORGANICS REVIEWED BY: Amy Hunter, Trace Organics Supervisor, B.Sc.

WATER ANALYSIS REVIEWED BY: Jason Coughtrey, Inorganics Supervisor

DATE REPORTED: Apr 24, 2018

PAGES (INCLUDING COVER): 15

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (709)747-8573

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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Certificate of Analysis

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Atlantic RBCA Tier 1 Hydrocarbons in Water - Low Level

DATE RECEIVED: 2018-04-16

DATE REPORTED: 2018-04-20

				3113-FHS2-1.	3113-FHS2-2.
		SAMPLE DESCRIPTION:		25-WS1	0-WS1
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2018-04-14	2018-04-14
Parameter	Unit	G / S	RDL	9184011	9184169
Benzene	mg/L		0.001	<0.001	<0.001
Toluene	mg/L		0.001	<0.001	<0.001
Ethylbenzene	mg/L		0.001	<0.001	<0.001
Xylene (Total)	mg/L		0.001	<0.001	<0.001
C6-C10 (less BTEX)	mg/L		0.01	<0.01	<0.01
>C10-C16 Hydrocarbons	mg/L		0.05	<0.05	<0.05
>C16-C21 Hydrocarbons	mg/L		0.05	<0.05	<0.05
>C21-C32 Hydrocarbons	mg/L		0.01	0.04	0.07
Modified TPH (Tier 1)	mg/L		0.1	<0.1	<0.1
Resemblance Comment				UC	UC
Return to Baseline at C32				Y	Y
Surrogate	Unit	Acceptable Limits			
Isobutylbenzene - EPH	%	70-130		70	78
Isobutylbenzene - VPH	%	70-130		107	113
n-Dotriacontane - EPH	%	70-130		70	75

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9184011-9184169 Resemblance Comment Key:
GF - Gasoline Fraction
WGF - Weathered Gasoline Fraction
GR - Product in Gasoline Range
FOF - Fuel Oil Fraction
WFOF - Weathered Fuel Oil Fraction
FR - Product in Fuel Oil Range
LOF - Lube Oil Fraction
LR - Lube Range
UC - Unidentified Compounds
NR - No Resemblance
NA - Not Applicable

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Dissolved Metals

DATE RECEIVED: 2018-04-16

DATE REPORTED: 2018-04-17

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION: 3113-FHS2-1. 25-WS1	SAMPLE DESCRIPTION: 3113-FHS2-2. 0-WS1
				SAMPLE TYPE: Water	SAMPLE TYPE: Water
				DATE SAMPLED: 2018-04-14	DATE SAMPLED: 2018-04-14
				9184011	9184169
Dissolved Aluminum	ug/L	Variable	5	20	10
Dissolved Antimony	ug/L		2	<2	<2
Dissolved Arsenic	ug/L	5	2	16	39
Dissolved Barium	ug/L		5	68	168
Dissolved Beryllium	ug/L		2	<2	<2
Dissolved Bismuth	ug/L		2	<2	<2
Dissolved Boron	ug/L	29000,	5	382	1240
Dissolved Cadmium	ug/L	1.0, 0.09	0.09	<0.09	<0.09
Dissolved Chromium	ug/L		1	4	4
Dissolved Cobalt	ug/L		1	<1	<1
Dissolved Copper	ug/L	Equation	2	3	5
Dissolved Iron	ug/L	300	50	705	4110
Dissolved Lead	ug/L	Equation	0.5	1.2	0.6
Dissolved Manganese	ug/L		2	1050	1080
Dissolved Molybdenum	ug/L	73	2	10	17
Dissolved Nickel	ug/L	Equation	2	5	6
Dissolved Selenium	ug/L	1.0	1	2	2
Dissolved Silver	ug/L	0.25	0.1	<0.1	<0.1
Dissolved Strontium	ug/L		5	868	2220
Dissolved Thallium	ug/L	0.8	0.1	<0.1	<0.1
Dissolved Tin	ug/L		2	<2	<2
Dissolved Titanium	ug/L		2	2	6
Dissolved Uranium	ug/L	33, 15	0.1	0.2	0.3
Dissolved Vanadium	ug/L		2	16	32
Dissolved Zinc	ug/L	30	5	11	8

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME FWAL - update 2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9184011-9184169 Analysis completed on a filtered sample.

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2018-04-16

DATE REPORTED: 2018-04-23

				3113-FHS2-1.		3113-FHS2-2.
		SAMPLE DESCRIPTION:		25-WS1		0-WS1
		SAMPLE TYPE:		Water		Water
		DATE SAMPLED:		2018-04-14		2018-04-14
Parameter	Unit	G / S	RDL	9184011	RDL	9184169
pH		6.5-9.0		7.88		7.79
Reactive Silica as SiO2	mg/L		0.5	4.6	0.5	6.6
Chloride	mg/L	640, 120	30	1720	100	4640
Fluoride	mg/L	0.12	0.12	0.28	0.12	<0.12
Sulphate	mg/L		60	237	200	619
Alkalinity	mg/L		5	264	5	186
True Color	TCU	Narrative	5	10	5	9
Turbidity	NTU	Narrative	0.1	3420	0.1	140
Electrical Conductivity	umho/cm		1	6000	1	14400
Nitrate + Nitrite as N	mg/L		0.05	2.10	0.05	<0.05
Nitrate as N	mg/L	550, 13	1.5	2.1	5	<5
Nitrite as N	mg/L	0.06	1.5	<1.5	5	<5
Ammonia as N	mg/L	Fact Sheet	0.03	0.13	0.03	0.47
Total Organic Carbon	mg/L		0.5	2.0	0.5	5.0
Ortho-Phosphate as P	mg/L		0.01	0.01	0.01	<0.01
Total Sodium	mg/L		0.1	1470	0.1	3010
Total Potassium	mg/L		0.1	57.3	0.1	108
Total Calcium	mg/L		0.1	305	0.1	198
Total Magnesium	mg/L		0.1	201	0.1	329
Bicarb. Alkalinity (as CaCO3)	mg/L		5	264	5	186
Carb. Alkalinity (as CaCO3)	mg/L		10	<10	10	<10
Hydroxide	mg/L		5	<5	5	<5
Calculated TDS	mg/L		1	4220	1	9030
Hardness	mg/L			1590		1850
Langelier Index (@20C)	NA			1.04		0.57
Langelier Index (@ 4C)	NA			0.72		0.25
Saturation pH (@ 20C)	NA			6.84		7.22
Saturation pH (@ 4C)	NA			7.16		7.54
Anion Sum	me/L			58.9		147

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Certificate of Analysis

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2018-04-16

DATE REPORTED: 2018-04-23

				3113-FHS2-1.		3113-FHS2-2.
		SAMPLE DESCRIPTION:		25-WS1		0-WS1
		SAMPLE TYPE:		Water		Water
		DATE SAMPLED:		2018-04-14		2018-04-14
Parameter	Unit	G / S	RDL	9184011	RDL	9184169
Cation sum	me/L			101		172
% Difference/ Ion Balance (NS)	%			26.3		7.5
Total Aluminum	ug/L	Variable	5	21100	5	4720
Total Antimony	ug/L		2	<2	2	<2
Total Arsenic	ug/L	5	2	23	2	37
Total Barium	ug/L		5	173	5	191
Total Beryllium	ug/L		2	<2	2	<2
Total Bismuth	ug/L		2	<2	2	<2
Total Boron	ug/L	29000,	5	564	5	1240
Total Cadmium	ug/L	1.0, 0.09	0.09	0.33	0.09	<0.09
Total Chromium	ug/L		1	66	1	14
Total Cobalt	ug/L		1	18	1	4
Total Copper	ug/L	Equation	1	78	1	16
Total Iron	ug/L	300	50	34100	50	12300
Total Lead	ug/L	Equation	0.5	17.7	0.5	2.8
Total Manganese	ug/L		2	3370	2	1300
Total Molybdenum	ug/L	73	2	11	2	19
Total Nickel	ug/L	Equation	2	48	2	14
Total Phosphorous	mg/L	Fact Sheet	0.02	0.44	0.02	0.13
Total Selenium	ug/L	1	1	2	1	3
Total Silver	ug/L	0.25	0.1	<0.1	0.1	<0.1
Total Strontium	ug/L		5	1290	5	2130
Total Thallium	ug/L	0.8	0.1	<0.1	0.1	<0.1
Total Tin	ug/L		2	<2	2	<2
Total Titanium	ug/L		2	623	2	190
Total Uranium	ug/L	33, 15	0.1	1.7	0.1	0.5
Total Vanadium	ug/L		2	71	2	38
Total Zinc	ug/L	30	5	81	5	23

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2018-04-16

DATE REPORTED: 2018-04-23

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME FWAL - update 2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9184011 Ion Balance is greater than 10% due to the fact that samples are digested for total metals and any particulates in the water could be increasing the concentrations of certain elements.

Certified By:

AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

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CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
9184011	3113-FHS2-1.25-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Arsenic	ug/L	5	16
9184011	3113-FHS2-1.25-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Iron	ug/L	300	705
9184011	3113-FHS2-1.25-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Selenium	ug/L	1.0	2
9184011	3113-FHS2-1.25-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Chloride	mg/L	640, 120	1720
9184011	3113-FHS2-1.25-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Fluoride	mg/L	0.12	0.28
9184011	3113-FHS2-1.25-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Arsenic	ug/L	5	23
9184011	3113-FHS2-1.25-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Iron	ug/L	300	34100
9184011	3113-FHS2-1.25-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Selenium	ug/L	1	2
9184011	3113-FHS2-1.25-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Zinc	ug/L	30	81
9184169	3113-FHS2-2.0-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Arsenic	ug/L	5	39
9184169	3113-FHS2-2.0-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Iron	ug/L	300	4110
9184169	3113-FHS2-2.0-WS1	NS-CCME FWAL	Dissolved Metals	Dissolved Selenium	ug/L	1.0	2
9184169	3113-FHS2-2.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Chloride	mg/L	640, 120	4640
9184169	3113-FHS2-2.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Arsenic	ug/L	5	37
9184169	3113-FHS2-2.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Iron	ug/L	300	12300
9184169	3113-FHS2-2.0-WS1	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Selenium	ug/L	1	3

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date:			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Atlantic RBCA Tier 1 Hydrocarbons in Water - Low Level															
Benzene	1	9179115	< 0.001	< 0.001	NA	< 0.001	106%	70%	130%	109%	70%	130%	NA		
Toluene	1	9179115	< 0.001	< 0.001	NA	< 0.001	107%	70%	130%	110%	70%	130%	NA		
Ethylbenzene	1	9179115	< 0.001	< 0.001	NA	< 0.001	104%	70%	130%	110%	70%	130%	NA		
Xylene (Total)	1	9179115	< 0.001	< 0.001	NA	< 0.001	105%	70%	130%	113%	70%	130%	NA		
C6-C10 (less BTEX)	1	9179115	< 0.01	< 0.01	NA	< 0.01	112%	70%	130%	109%	70%	130%	117%	70%	130%
>C10-C16 Hydrocarbons	1	9185310	<0.05	0.10	NA	< 0.05	94%	70%	130%	109%	70%	130%	76%	70%	130%
>C16-C21 Hydrocarbons	1	9185310	< 0.05	< 0.05	NA	< 0.05	89%	70%	130%	109%	70%	130%	76%	70%	130%
>C21-C32 Hydrocarbons	1	9185310	0.01	0.05	NA	< 0.01	82%	70%	130%	109%	70%	130%	76%	70%	130%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.
If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS
AGAT WORK ORDER: 18K329467
PROJECT: 3113 - Stephenville, NL
ATTENTION TO: John Gale
SAMPLING SITE:
SAMPLED BY:

Water Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Standard Water Analysis + Total Metals															
pH	9186049		6.93	6.93	0.0%	<	101%	80%	120%	NA	80%	120%	NA	80%	120%
Reactive Silica as SiO2	1	9171700	4.8	4.8	0.0%	< 0.5	83%	80%	120%		80%	120%	80%	80%	120%
Fluoride	9183776		0.41	0.42	NA	< 0.12	102%	80%	120%	NA	80%	120%	84%	80%	120%
Alkalinity	9186049		7	6	NA	< 5	97%	80%	120%	NA	80%	120%	NA	80%	120%
True Color	9187671		5	<5	NA	< 5	110%	80%	120%	NA			NA		
Turbidity	9180324		0.9	1.1	12.1%	< 0.1	101%	80%	120%	NA			NA		
Electrical Conductivity	9186049		35	35	0.0%	< 1	101%	80%	120%	NA	80%	120%	NA	80%	120%
Ammonia as N	1	9192885	<0.03	<0.03	NA	< 0.03	80%	80%	120%		80%	120%	106%	80%	120%
Total Organic Carbon	1	9174675	1	0.50	NA	< 0.5	100%	80%	120%		80%	120%	120%	80%	120%
Ortho-Phosphate as P	1	9171700	0.01	0.01	NA	< 0.01	120%	80%	120%		80%	120%	105%	80%	120%
Total Sodium	9185391		23.7	24.4	2.9%	< 0.1	120%	80%	120%	120%	80%	120%	NA	70%	130%
Total Potassium	9185391		1.6	1.6	0.7%	< 0.1	113%	80%	120%	107%	80%	120%	NA	70%	130%
Total Calcium	9185391		44.8	47.9	6.6%	< 0.1	103%	80%	120%	104%	80%	120%	NA	70%	130%
Total Magnesium	9185391		5.2	5.0	3.8%	< 0.1	114%	80%	120%	112%	80%	120%	NA	80%	120%
Bicarb. Alkalinity (as CaCO3)	9186049		7	6	NA	< 5	NA	80%	120%	NA	80%	120%	NA	80%	120%
Carb. Alkalinity (as CaCO3)	9186049		<10	<10	NA	< 10	NA	80%	120%	NA	80%	120%	NA	80%	120%
Hydroxide	9186049		<5	<5	NA	< 5	NA	80%	120%	NA	80%	120%	NA	80%	120%
Total Aluminum	9185391		5	5	NA	< 5	113%	80%	120%	109%	80%	120%	97%	70%	130%
Total Antimony	9185391		<2	<2	NA	< 2	95%	80%	120%	108%	80%	120%	98%	70%	130%
Total Arsenic	9185391		18	17	0.7%	< 2	98%	80%	120%	99%	80%	120%	NA	70%	130%
Total Barium	9185391		73	72	0.5%	< 5	105%	80%	120%	102%	80%	120%	NA	70%	130%
Total Beryllium	9185391		<2	<2	NA	< 2	119%	80%	120%	118%	80%	120%	99%	70%	130%
Total Bismuth	9185391		<2	<2	NA	< 2	98%	80%	120%	103%	80%	120%	90%	70%	130%
Total Boron	9185391		17	17	NA	< 5	114%	80%	120%	116%	80%	120%	102%	70%	130%
Total Cadmium	9185391		0.14	0.13	NA	< 0.09	98%	80%	120%	98%	80%	120%	89%	70%	130%
Total Chromium	9185391		<1	<1	NA	< 1	94%	80%	120%	93%	80%	120%	87%	70%	130%
Total Cobalt	9185391		<1	<1	NA	< 1	98%	80%	120%	100%	80%	120%	92%	70%	130%
Total Copper	9185391		7	7	1.8%	< 1	105%	80%	120%	105%	80%	120%	94%	70%	130%
Total Iron	9185391		352	336	4.6%	< 50	97%	80%	120%	97%	80%	120%	NA	70%	130%
Total Lead	9185391		11.5	11.2	2.7%	< 0.5	102%	80%	120%	100%	80%	120%	NA	70%	130%
Total Manganese	9185391		14	14	1.0%	< 2	94%	80%	120%	95%	80%	120%	NA	70%	130%
Total Molybdenum	9185391		<2	<2	NA	< 2	108%	80%	120%	109%	80%	120%	108%	70%	130%
Total Nickel	9185391		<2	<2	NA	< 2	93%	80%	120%	88%	80%	120%	90%	70%	130%
Total Phosphorous	9185391		0.03	0.02	NA	< 0.02	118%	80%	120%	120%	80%	120%	79%	70%	130%
Total Selenium	9185391		<1	<1	NA	< 1	91%	80%	120%	107%	80%	120%	88%	70%	130%
Total Silver	9185391		<0.1	<0.1	NA	< 0.1	97%	80%	120%	109%	80%	120%	94%	70%	130%
Total Strontium	9185391		209	225	7.5%	< 5	101%	80%	120%	103%	80%	120%	NA	70%	130%
Total Thallium	9185391		<0.1	<0.1	NA	< 0.1	104%	80%	120%	105%	80%	120%	96%	70%	130%
Total Tin	9185391		<2	<2	NA	< 2	98%	80%	120%	100%	80%	120%	95%	70%	130%

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS
AGAT WORK ORDER: 18K329467
PROJECT: 3113 - Stephenville, NL
ATTENTION TO: John Gale
SAMPLING SITE:
SAMPLED BY:

Water Analysis (Continued)

RPT Date:			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Total Titanium	9185391		<2	<2	NA	< 2	112%	80%	120%	107%	80%	120%	88%	70%	130%
Total Uranium	9185391		3.6	3.6	1.8%	< 0.1	96%	80%	120%	93%	80%	120%	NA	70%	130%
Total Vanadium	9185391		<2	<2	NA	< 2	89%	80%	120%	90%	80%	120%	85%	70%	130%
Total Zinc	9185391		9	8	NA	< 5	96%	80%	120%	95%	80%	120%	79%	70%	130%
Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.															
Dissolved Metals															
Dissolved Aluminum	9178204		17	10	NA	< 5	106%	80%	120%	107%	80%	120%	109%	70%	130%
Dissolved Antimony	9178204		<2	<2	NA	< 2	105%	80%	120%	109%	80%	120%	101%	70%	130%
Dissolved Arsenic	9178204		29	28	3.9%	< 2	98%	80%	120%	101%	80%	120%	NA	70%	130%
Dissolved Barium	9178204		534	526	1.6%	< 5	96%	80%	120%	97%	80%	120%	NA	70%	130%
Dissolved Beryllium	9178204		<2	<2	NA	< 2	107%	80%	120%	112%	80%	120%	95%	70%	130%
Dissolved Bismuth	9178204		<2	<2	NA	< 2	101%	80%	120%	106%	80%	120%	70%	70%	130%
Dissolved Boron	9178204		749	765	2.2%	< 5	107%	80%	120%	107%	80%	120%	NA	70%	130%
Dissolved Cadmium	9178204		<0.09	<0.09	NA	< 0.09	101%	80%	120%	99%	80%	120%	77%	70%	130%
Dissolved Chromium	9178204		3	3	NA	< 1	102%	80%	120%	100%	80%	120%	83%	70%	130%
Dissolved Cobalt	9178204		<1	<1	NA	< 1	103%	80%	120%	101%	80%	120%	85%	70%	130%
Dissolved Copper	9178204		5	5	NA	< 2	104%	80%	120%	102%	80%	120%	76%	70%	130%
Dissolved Iron	9178204		4800	4860	1.4%	< 50	102%	80%	120%	100%	80%	120%	NA	70%	130%
Dissolved Lead	9178204		<0.5	<0.5	NA	< 0.5	98%	80%	120%	99%	80%	120%	77%	70%	130%
Dissolved Manganese	9178204		1080	1100	1.1%	< 2	102%	80%	120%	100%	80%	120%	NA	70%	130%
Dissolved Molybdenum	9178204		8	8	NA	< 2	101%	80%	120%	97%	80%	120%	NA	70%	130%
Dissolved Nickel	9178204		6	5	NA	< 2	101%	80%	120%	91%	80%	120%	70%	70%	130%
Dissolved Selenium	9178204		1	1	NA	< 1	98%	80%	120%	100%	80%	120%	NA	70%	130%
Dissolved Silver	9178204		<0.1	<0.1	NA	< 0.1	102%	80%	120%	98%	80%	120%	80%	70%	130%
Dissolved Strontium	9178204		1470	1440	2.0%	< 5	98%	80%	120%	93%	80%	120%	NA	70%	130%
Dissolved Thallium	9178204		<0.1	<0.1	NA	< 0.1	98%	80%	120%	103%	80%	120%	88%	70%	130%
Dissolved Tin	9178204		<2	<2	NA	< 2	96%	80%	120%	95%	80%	120%	94%	70%	130%
Dissolved Titanium	9178204		5	5	NA	< 2	108%	80%	120%	106%	80%	120%	89%	70%	130%
Dissolved Uranium	9178204		0.9	0.9	1.1%	< 0.1	97%	80%	120%	97%	80%	120%	93%	70%	130%
Dissolved Vanadium	9178204		23	22	5.1%	< 2	91%	80%	120%	92%	80%	120%	NA	70%	130%
Dissolved Zinc	9178204		7	6	NA	< 5	101%	80%	120%	101%	80%	120%	70%	70%	130%

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:

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Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Toluene	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Ethylbenzene	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Xylene (Total)	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
C6-C10 (less BTEX)	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
>C10-C16 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
>C16-C21 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
>C21-C32 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Modified TPH (Tier 1)	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	CALCULATION
Resemblance Comment	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS/FID
Return to Baseline at C32	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Isobutylbenzene - EPH	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Isobutylbenzene - VPH	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
n-Dotriacontane - EPH	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID

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Method Summary

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AGAT WORK ORDER: 18K329467
PROJECT: 3113 - Stephenville, NL
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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Dissolved Aluminum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Antimony	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Arsenic	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Barium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Beryllium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Bismuth	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Boron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Cadmium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Chromium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Cobalt	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Copper	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Iron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Lead	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Manganese	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Molybdenum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Nickel	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Selenium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Silver	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Strontium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Thallium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Tin	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Titanium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Uranium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Vanadium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Zinc	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
pH	INOR-121-6001	SM 4500 H+B	PC TITRATE
Reactive Silica as SiO2	INORG-121-6028	SM 4110 B	COLORIMETER
Chloride	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Fluoride	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH

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Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Alkalinity	INOR-121-6001	SM 2320 B	
True Color	INOR-121-6014	SM 2120 C	NEPHELOMETER
Turbidity	INOR-121-6022	SM 2130 B	NEPHELOMETER
Electrical Conductivity	INOR-121-6001	SM 2510 B	PC TITRATE
Nitrate + Nitrite as N	INORG-121-6005	SM 4110 B	CALCULATION
Nitrate as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INORG-121-6003	SM 4500-NH3 G	COLORIMETER
Total Organic Carbon	INORG-121-6026	SM 5310 B	TOC ANALYZER
Ortho-Phosphate as P	INORG-121-6005	SM 4110 B	COLORIMETER
Total Sodium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Potassium	MET121-6104 & MET-121-6105	SM 3125	ICP-MS
Total Calcium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Magnesium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Bicarb. Alkalinity (as CaCO3)	INORG-121-6001	SM 2320 B	PC TITRATE
Carb. Alkalinity (as CaCO3)	INORG-121-6001	SM 2320 B	PC TITRATE
Hydroxide	INORG-121-6001	SM 2320 B	PC-TITRATE
Calculated TDS	CALCULATION	SM 1030E	CALCULATION
Hardness	CALCULATION	SM 2340B	CALCULATION
Langelier Index (@20C)	CALCULATION	CALCULATION	CALCULATION
Langelier Index (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 20C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Anion Sum	CALCULATION	SM 1030E	CALCULATION
Cation sum	CALCULATION	SM 1030E	CALCULATION
% Difference/ Ion Balance (NS)	CALCULATION	SM 1030E	CALCULATION
Total Aluminum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Antimony	MET121-6104 & MET-121-6105	SM 3125	ICP-MS
Total Arsenic	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Barium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Beryllium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Bismuth	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Boron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Cadmium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Chromium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Cobalt	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Copper	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Iron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS

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Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K329467

PROJECT: 3113 - Stephenville, NL

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Lead	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Manganese	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Molybdenum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Nickel	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Phosphorous	MET-121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Selenium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Silver	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Strontium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Thallium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Tin	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Titanium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Uranium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Vanadium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Zinc	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS

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Chain of Custody Record

Laboratory Use Only
Arrival Condition: ☐ Good ☐ Poor (see notes)
Arrival Temperature: 5.9
Hold Time:
AGAT Job Number: 18K329467
Notes:

Report Information
Company: Fracflow Consultants Inc. (NL)
Contact: John Gale
Address: 154 Major's Path
St. John's, NL
Phone: 709-739-7270 Fax: 709-753-5101
Client Project #: 3113 - Stephenville, NL
AGAT Quotation: S/O
Please Note: If quotation number is not provided client will be billed full price for analysis.

Report Information (Please print):
1. Name: John Gale (john_ffc@nfld.net)
Email: Eunjeong Seok (eunjeong_ffc@nfld.net)
2. Name: Karen Andrews (karen_ffc@nfld.net)
Email:

Report Format
☐ Single Sample per page
☑ Multiple Sample per page
☑ Excel Format Included
☐ Export:

Turnaround Time Required (TAT)
Regular TAT ☑ 5 to 7 working days
Rush TAT ☐ Same day ☐ 1 day ☐ 2 days ☐ 3 days
Date Required:

Invoice To Same Yes ☑ / No ☐
Company:
Contact: Karen Andrews (karen_ffc@nfld.net)
Address:
Phone: Fax:
PO/Credit Card#: 3885

Regulatory Requirements (Check):
☑ List Guidelines on Report ☐ Do not list Guidelines on Report
☑ PIRI
☑ Tier 1 ☐ Res ☐ Pot ☑ Coarse
☐ Tier 2 ☐ Com ☑ N/Pot ☐ Fine
☐ Gas ☐ Fuel ☐ Lube
☑ CCME ☐ CDWQ
☐ Industrial ☐ NSEQS-Cont Sites
☐ Commercial ☐ HRM 101
☐ Res/Park ☐ Storm Water
☐ Agricultural ☐ Waste Water
☑ FWAL
☐ Sediment ☐ Other

Drinking Water Sample: ☐ Yes ☑ No **Salt Water Sample:** ☐ Yes ☑ No
Reg. No.:

Sample Identification	Date/Time Sampled	Sample Matrix	# Containers	Comments – Site/Sample Info. Sample Containment	Field Filtered/Preserved	Standard Water Analysis	Metals: ☒ Total ☐ Diss ☐ Available	Mercury	☐ BOD ☐ CBOD	Grain Size (coarse/fine)	☐ TOC - Miss ☐ FOC - Miss	Phosphates (total as P2O5)	Chromium (Tri & Hexavalent)	Phenols	Tier 1: TPH/BTEX (PIRI) ☒ low level	Tier 2: TPH/BTEX Fractionation	CCME-CWS TPH/BTEX	VOC	Oil & Grease (TOG)	BNAE EPA 625 - Miss	PAH	PCB	Marine Sediment Package	Dioxins & Furans	Fecal Coliform ☐ MPN ☐ MF	Other:	Other:	Hazardous (Y/N)
3113-FHS2-1.25-WS1	April 14, 2018	Water	9	1x500, 3x100, 2x250, 3x40		✓	✓								✓												
				Diss. Metal filtered																								
3113-FHS2-2.0-WS1	April 14, 2018	Water	9	1x500, 3x100, 2x250, 3x40		✓	✓								✓												
				Diss. Metal filtered																								

Samples Relinquished By (Print Name): Shawn Thompson
Date/Time: April 16, 2018
Samples Relinquished By (Sign):
Date/Time: 2:45
Samples Received By (Print Name):
Date/Time: 04/16/2018
Samples Received By (Sign):
Date/Time: 12:45

Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page 1 of 1
N°: FFC-3113-COC-10

Document ID: DRV-133-15013002
Date revised: January 2015

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CLIENT NAME: FRACFLOW CONSULTANTS
154 MAJOR'S PATH
ST. JOHN'S PATH, NL A1A5A1
(709) 739-7270

ATTENTION TO: John Gale

PROJECT: 3113-Stephenville

AGAT WORK ORDER: 18K342738

TRACE ORGANICS REVIEWED BY: Amy Hunter, Trace Organics Supervisor, B.Sc.

WATER ANALYSIS REVIEWED BY: Jason Coughtrey, Inorganics Supervisor

DATE REPORTED: Jun 07, 2018

PAGES (INCLUDING COVER): 18

VERSION*: 2

Should you require any information regarding this analysis please contact your client services representative at (709)747-8573

*NOTES
VERSION 2:V2 supersedes V1 - updated report. Issued June 7, 2018.

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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Certificate of Analysis

AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Atlantic RBCA Tier 1 Hydrocarbons in Water - Low Level

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-07

				3113-FHS1-2.	3113-FHS2-2.
SAMPLE DESCRIPTION:				0-WS2	0-WS2
SAMPLE TYPE:				Water	Water
DATE SAMPLED:				2018-05-23	2018-05-23
Parameter	Unit	G / S	RDL	9268674	9268753
Benzene	mg/L		0.001	<0.001	<0.001
Toluene	mg/L		0.001	<0.001	<0.001
Ethylbenzene	mg/L		0.001	<0.001	<0.001
Xylene (Total)	mg/L		0.001	<0.001	<0.001
C6-C10 (less BTEX)	mg/L		0.01	<0.01	<0.01
>C10-C16 Hydrocarbons	mg/L		0.05	<0.05	<0.05
>C16-C21 Hydrocarbons	mg/L		0.05	<0.05	<0.05
>C21-C32 Hydrocarbons	mg/L		0.01	0.12	0.07
Modified TPH (Tier 1)	mg/L		0.1	0.1	<0.1
Resemblance Comment				LR	LR
Return to Baseline at C32				Y	Y
Surrogate	Unit	Acceptable Limits			
Isobutylbenzene - EPH	%	70-130		77	N/A
Isobutylbenzene - VPH	%	70-130		106	103
n-Dotriacontane - EPH	%	70-130		92	76

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Atlantic RBCA Tier 1 Hydrocarbons in Water - Low Level

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-07

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9268674 Resemblance Comment Key:
GF - Gasoline Fraction
WGF - Weathered Gasoline Fraction
GR - Product in Gasoline Range
FOF - Fuel Oil Fraction
WFOF - Weathered Fuel Oil Fraction
FR - Product in Fuel Oil Range
LOF - Lube Oil Fraction
LR - Lube Range
UC - Unidentified Compounds
NR - No Resemblance
NA - Not Applicable

9268753 EPH surrogate NA due to matrix interference.
Resemblance Comment Key:
GF - Gasoline Fraction
WGF - Weathered Gasoline Fraction
GR - Product in Gasoline Range
FOF - Fuel Oil Fraction
WFOF - Weathered Fuel Oil Fraction
FR - Product in Fuel Oil Range
LOF - Lube Oil Fraction
LR - Lube Range
UC - Unidentified Compounds
NR - No Resemblance
NA - Not Applicable

Certified By:

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AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Dissolved Metals

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-07

Parameter	Unit	G / S	RDL	3113-FHS1-2. 0-WS2 Water 2018-05-23 9268674	3113-FHS2-2. 0-WS2 Water 2018-05-23 9268753
Dissolved Aluminum	ug/L	Variable	5	12	137
Dissolved Antimony	ug/L		2	<2	<2
Dissolved Arsenic	ug/L	5	2	3	<2
Dissolved Barium	ug/L		5	33	25
Dissolved Beryllium	ug/L		2	<2	<2
Dissolved Bismuth	ug/L		2	<2	<2
Dissolved Boron	ug/L	29000,	5	59	108
Dissolved Cadmium	ug/L	1.0, 0.09	0.09	<0.09	<0.09
Dissolved Chromium	ug/L		1	3	6
Dissolved Cobalt	ug/L		1	<1	<1
Dissolved Copper	ug/L	Equation	2	<2	<2
Dissolved Iron	ug/L	300	50	516	1680
Dissolved Lead	ug/L	Equation	0.5	<0.5	<0.5
Dissolved Manganese	ug/L		2	204	701
Dissolved Molybdenum	ug/L	73	2	<2	<2
Dissolved Nickel	ug/L	Equation	2	<2	3
Dissolved Selenium	ug/L	1.0	1	<1	2
Dissolved Silver	ug/L	0.25	0.1	<0.1	<0.1
Dissolved Strontium	ug/L		5	153	205
Dissolved Thallium	ug/L	0.8	0.1	<0.1	<0.1
Dissolved Tin	ug/L		2	<2	<2
Dissolved Titanium	ug/L		2	<2	4
Dissolved Uranium	ug/L	33, 15	0.1	0.4	0.1
Dissolved Vanadium	ug/L		2	<2	3
Dissolved Zinc	ug/L	30	5	10	7

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME FWAL - update 2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9268674-9268753 Analysis completed on a filtered sample.

Certified By:

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AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Mercury Analysis in Water (Total)

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-07

				SAMPLE DESCRIPTION:	3113-FHS1-2. 0-WS2	3113-FHS2-2. 0-WS2
				SAMPLE TYPE:	Water	Water
				DATE SAMPLED:	2018-05-23	2018-05-23
Parameter	Unit	G / S	RDL		9268674	9268753
Total Mercury	ug/L	0.026	0.026		<0.026	<0.026

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME FWAL - update 2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

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AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-07

Parameter	Unit	G / S	RDL	3113-FHS1-2. 0-WS2 Water 2018-05-23 9268674	3113-FHS2-2. 0-WS2 Water 2018-05-23 9268753
pH		6.5-9.0		8.24	8.23
Reactive Silica as SiO2	mg/L		0.5	15.3	8.5
Chloride	mg/L	640, 120	5	34	333
Fluoride	mg/L	0.12	0.12	<0.12	<0.12
Sulphate	mg/L		2	6	37
Alkalinity	mg/L		5	223	220
True Color	TCU	Narrative	5	15	16
Turbidity	NTU	Narrative	0.1	7.6	30.3
Electrical Conductivity	umho/cm		1	572	1500
Nitrate + Nitrite as N	mg/L		0.05	0.07	0.69
Nitrate as N	mg/L	550, 13	0.05	<0.05	<0.05
Nitrite as N	mg/L	0.06	0.05	0.07	0.69
Ammonia as N	mg/L	Fact Sheet	0.03	0.21	0.27
Total Organic Carbon	mg/L		0.5	8.8	11.3
Ortho-Phosphate as P	mg/L		0.01	<0.01	<0.01
Total Sodium	mg/L		0.1	43.8	198
Total Potassium	mg/L		0.1	10.1	13.3
Total Calcium	mg/L		0.1	33.4	63.6
Total Magnesium	mg/L		0.1	26.7	36.6
Bicarb. Alkalinity (as CaCO3)	mg/L		5	223	220
Carb. Alkalinity (as CaCO3)	mg/L		10	<10	<10
Hydroxide	mg/L		5	<5	<5
Calculated TDS	mg/L		1	290	822
Hardness	mg/L			193	310
Langelier Index (@20C)	NA			0.48	0.70
Langelier Index (@ 4C)	NA			0.16	0.38
Saturation pH (@ 20C)	NA			7.76	7.53
Saturation pH (@ 4C)	NA			8.08	7.85
Anion Sum	me/L			5.55	14.6

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AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-07

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION: 3113-FHS1-2. 0-WS2 SAMPLE TYPE: Water DATE SAMPLED: 2018-05-23 9268674	SAMPLE DESCRIPTION: 3113-FHS2-2. 0-WS2 SAMPLE TYPE: Water DATE SAMPLED: 2018-05-23 9268753
Cation sum	me/L			6.10	15.4
% Difference/ Ion Balance (NS)	%			4.8	2.7
Total Aluminum	ug/L	Variable	5	166	989
Total Antimony	ug/L		2	<2	<2
Total Arsenic	ug/L	5	2	3	2
Total Barium	ug/L		5	39	31
Total Beryllium	ug/L		2	<2	<2
Total Bismuth	ug/L		2	<2	<2
Total Boron	ug/L	29000,	5	61	108
Total Cadmium	ug/L	1.0, 0.09	0.09	<0.09	<0.09
Total Chromium	ug/L		1	<1	4
Total Cobalt	ug/L		1	<1	<1
Total Copper	ug/L	Equation	1	<1	3
Total Iron	ug/L	300	50	1170	3650
Total Lead	ug/L	Equation	0.5	<0.5	0.7
Total Manganese	ug/L		2	212	834
Total Molybdenum	ug/L	73	2	<2	<2
Total Nickel	ug/L	Equation	2	<2	5
Total Phosphorous	mg/L	Fact Sheet	0.02	0.03	0.06
Total Selenium	ug/L	1	1	<1	<1
Total Silver	ug/L	0.25	0.1	<0.1	<0.1
Total Strontium	ug/L		5	175	257
Total Thallium	ug/L	0.8	0.1	<0.1	<0.1
Total Tin	ug/L		2	<2	<2
Total Titanium	ug/L		2	12	72
Total Uranium	ug/L	33, 15	0.1	0.5	0.2
Total Vanadium	ug/L		2	<2	6
Total Zinc	ug/L	30	5	11	10

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Standard Water Analysis + Total Metals

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-07

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME FWAL - update 2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Certified By:

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Guideline Violation

AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

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CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
9268674	3113-FHS1-2.0-WS2	NS-CCME FWAL	Dissolved Metals	Dissolved Iron	ug/L	300	516
9268674	3113-FHS1-2.0-WS2	NS-CCME FWAL	Standard Water Analysis + Total Metals	Nitrite as N	mg/L	0.06	0.07
9268674	3113-FHS1-2.0-WS2	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Iron	ug/L	300	1170
9268753	3113-FHS2-2.0-WS2	NS-CCME FWAL	Dissolved Metals	Dissolved Iron	ug/L	300	1680
9268753	3113-FHS2-2.0-WS2	NS-CCME FWAL	Dissolved Metals	Dissolved Selenium	ug/L	1.0	2
9268753	3113-FHS2-2.0-WS2	NS-CCME FWAL	Standard Water Analysis + Total Metals	Nitrite as N	mg/L	0.06	0.69
9268753	3113-FHS2-2.0-WS2	NS-CCME FWAL	Standard Water Analysis + Total Metals	Total Iron	ug/L	300	3650

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date: Jun 07, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Atlantic RBCA Tier 1 Hydrocarbons in Water - Low Level															
Benzene	1	9258156	< 0.001	< 0.001	NA	< 0.001	90%	70%	130%	117%	70%	130%	NA		
Toluene	1	9258156	< 0.001	< 0.001	NA	< 0.001	86%	70%	130%	114%	70%	130%	NA		
Ethylbenzene	1	9258156	< 0.001	< 0.001	NA	< 0.001	88%	70%	130%	108%	70%	130%	NA		
Xylene (Total)	1	9258156	< 0.001	< 0.001	NA	< 0.001	86%	70%	130%	111%	70%	130%	NA		
C6-C10 (less BTEX)	1	9258156	< 0.01	< 0.01	NA	< 0.01	106%	70%	130%	104%	70%	130%	NA	70%	130%
>C10-C16 Hydrocarbons	1	9264889	< 0.05	< 0.05	NA	< 0.05	109%	70%	130%	118%	70%	130%	NA	70%	130%
>C16-C21 Hydrocarbons	1	9264889	0.05	0.06	NA	< 0.05	108%	70%	130%	118%	70%	130%	NA	70%	130%
>C21-C32 Hydrocarbons	1	9264889	0.02	0.04	NA	< 0.01	119%	70%	130%	118%	70%	130%	NA	70%	130%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.
If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS
AGAT WORK ORDER: 18K342738
PROJECT: 3113-Stephenville
ATTENTION TO: John Gale
SAMPLING SITE:
SAMPLED BY:

Water Analysis

RPT Date: Jun 07, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Standard Water Analysis + Total Metals															
pH	9269739		7.53	7.46	0.9%	<	102%	80%	120%	NA	80%	120%	NA	80%	120%
Reactive Silica as SiO2	1	9269718	16.3	17.1	4.8%	< 0.5	117%	80%	120%		80%	120%	103%	80%	120%
Chloride	9274248		2	3	NA	< 1	89%	80%	120%	NA	80%	120%	93%	80%	120%
Fluoride	9269031		0.17	0.17	NA	< 0.12	96%	80%	120%	NA	80%	120%	98%	80%	120%
Sulphate	9269031		24	24	0.2%	< 2	100%	80%	120%	NA	80%	120%	NA	80%	120%
Alkalinity	9269739		184	184	0.1%	< 5	94%	80%	120%	NA	80%	120%	NA	80%	120%
True Color	9268209		8	9	NA	< 5	95%	80%	120%	NA			NA		
Turbidity	9268980		2.9	2.8	4.2%	< 0.1	99%	80%	120%	NA			NA		
Electrical Conductivity	9269739		1770	1770	0.2%	< 1	103%	80%	120%	NA	80%	120%	NA	80%	120%
Nitrate as N	9269031		<0.05	<0.05	NA	< 0.05	91%	80%	120%	NA	80%	120%	95%	80%	120%
Nitrite as N	9269031		<0.05	<0.05	NA	< 0.05	87%	80%	120%	NA	80%	120%	99%	80%	120%
Ammonia as N	1	9269031	<0.05	<0.05	NA	< 0.03	100%	80%	120%		80%	120%	94%	80%	120%
Total Organic Carbon	9269031		1.4	1.6	NA	< 0.5	84%	80%	120%	NA	80%	120%	93%	80%	120%
Ortho-Phosphate as P	1	9269718	<0.01	<0.01	NA	< 0.01	103%	80%	120%		80%	120%	102%	80%	120%
Total Sodium	9273245		853	873	2.3%	< 0.1	100%	80%	120%	103%	80%	120%	NA	70%	130%
Total Potassium	9273245		20.4	21.3	3.9%	< 0.1	108%	80%	120%	114%	80%	120%	NA	70%	130%
Total Calcium	9273245		46.5	48.2	3.6%	< 0.1	103%	80%	120%	111%	80%	120%	NA	70%	130%
Total Magnesium	9273245		60.7	63.9	5.1%	< 0.1	101%	80%	120%	104%	80%	120%	NA	80%	120%
Bicarb. Alkalinity (as CaCO3)	9269739		184	184	0.1%	< 5	NA	80%	120%	NA	80%	120%	NA	80%	120%
Carb. Alkalinity (as CaCO3)	9269739		<10	<10	NA	< 10	NA	80%	120%	NA	80%	120%	NA	80%	120%
Hydroxide	9269739		<5	<5	NA	< 5	NA	80%	120%	NA	80%	120%	NA	80%	120%
Total Aluminum	9273245		1040	1110	6.9%	< 5	103%	80%	120%	110%	80%	120%	NA	70%	130%
Total Antimony	9273245		<2	<2	NA	< 2	95%	80%	120%	112%	80%	120%	118%	70%	130%
Total Arsenic	9273245		6	6	NA	< 2	97%	80%	120%	102%	80%	120%	NA	70%	130%
Total Barium	9273245		49	56	12.8%	< 5	94%	80%	120%	98%	80%	120%	NA	70%	130%
Total Beryllium	9273245		<2	<2	NA	< 2	110%	80%	120%	112%	80%	120%	101%	70%	130%
Total Bismuth	9273245		<2	<2	NA	< 2	105%	80%	120%	113%	80%	120%	83%	70%	130%
Total Boron	9273245		200	211	5.7%	< 5	103%	80%	120%	106%	80%	120%	NA	70%	130%
Total Cadmium	9273245		0.55	0.60	9.2%	< 0.09	95%	80%	120%	101%	80%	120%	94%	70%	130%
Total Chromium	9273245		5	5	NA	< 1	102%	80%	120%	109%	80%	120%	110%	70%	130%
Total Cobalt	9273245		1	2	NA	< 1	103%	80%	120%	108%	80%	120%	110%	70%	130%
Total Copper	9273245		40	41	4.4%	< 1	108%	80%	120%	116%	80%	120%	NA	70%	130%
Total Iron	9273245		1930	2060	6.6%	< 50	106%	80%	120%	116%	80%	120%	NA	70%	130%
Total Lead	9273245		11.2	11.5	2.7%	< 0.5	104%	80%	120%	110%	80%	120%	NA	70%	130%
Total Manganese	9273245		167	172	2.6%	< 2	107%	80%	120%	113%	80%	120%	NA	70%	130%
Total Molybdenum	9273245		<2	<2	NA	< 2	110%	80%	120%	120%	80%	120%	86%	70%	130%
Total Nickel	9273245		10	11	9.3%	< 2	102%	80%	120%	111%	80%	120%	100%	70%	130%
Total Phosphorous	9273245		0.70	0.76	8.4%	< 0.02	104%	80%	120%	107%	80%	120%	NA	70%	130%
Total Selenium	9273245		<1	<1	NA	< 1	105%	80%	120%	100%	80%	120%	88%	70%	130%

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS
AGAT WORK ORDER: 18K342738
PROJECT: 3113-Stephenville
ATTENTION TO: John Gale
SAMPLING SITE:
SAMPLED BY:

Water Analysis (Continued)

RPT Date: Jun 07, 2018

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Total Silver	9273245		<0.1	<0.1	NA	< 0.1	106%	80%	120%	113%	80%	120%	89%	70%	130%
Total Strontium	9273245		469	480	2.4%	< 5	112%	80%	120%	119%	80%	120%	NA	70%	130%
Total Thallium	9273245		<0.1	<0.1	NA	< 0.1	106%	80%	120%	114%	80%	120%	75%	70%	130%
Total Tin	9273245		<2	<2	NA	< 2	96%	80%	120%	105%	80%	120%	97%	70%	130%
Total Titanium	9273245		38	40	5.0%	< 2	104%	80%	120%	111%	80%	120%	NA	70%	130%
Total Uranium	9273245		0.8	0.8	3.6%	< 0.1	104%	80%	120%	108%	80%	120%	103%	70%	130%
Total Vanadium	9273245		10	9	NA	< 2	98%	80%	120%	106%	80%	120%	NA	70%	130%
Total Zinc	9273245		54	56	3.5%	< 5	107%	80%	120%	113%	80%	120%	NA	70%	130%
Dissolved Metals															
Dissolved Aluminum	9268753	9268753	137	147	7.0%	< 5	91%	80%	120%	94%	80%	120%	NA	70%	130%
Dissolved Antimony	9268753	9268753	<2	<2	NA	< 2	90%	80%	120%	92%	80%	120%	101%	70%	130%
Dissolved Arsenic	9268753	9268753	<2	2	NA	< 2	90%	80%	120%	87%	80%	120%	114%	70%	130%
Dissolved Barium	9268753	9268753	25	25	NA	< 5	93%	80%	120%	91%	80%	120%	NA	70%	130%
Dissolved Beryllium	9268753	9268753	<2	<2	NA	< 2	100%	80%	120%	99%	80%	120%	100%	70%	130%
Dissolved Bismuth	9268753	9268753	<2	<2	NA	< 2	99%	80%	120%	101%	80%	120%	NA	70%	130%
Dissolved Boron	9268753	9268753	108	105	2.8%	< 5	100%	80%	120%	93%	80%	120%	NA	70%	130%
Dissolved Cadmium	9268753	9268753	<0.09	<0.09	NA	< 0.09	95%	80%	120%	92%	80%	120%	94%	70%	130%
Dissolved Chromium	9268753	9268753	6	6	0.4%	< 1	94%	80%	120%	88%	80%	120%	NA	70%	130%
Dissolved Cobalt	9268753	9268753	<1	<1	NA	< 1	106%	80%	120%	102%	80%	120%	103%	70%	130%
Dissolved Copper	9268753	9268753	<2	<2	NA	< 2	101%	80%	120%	98%	80%	120%	87%	70%	130%
Dissolved Iron	9268753	9268753	1680	1750	4.3%	< 50	100%	80%	120%	93%	80%	120%	NA	70%	130%
Dissolved Lead	9268753	9268753	<0.5	<0.5	NA	< 0.5	96%	80%	120%	95%	80%	120%	82%	70%	130%
Dissolved Manganese	9268753	9268753	701	697	0.6%	< 2	97%	80%	120%	96%	80%	120%	NA	70%	130%
Dissolved Molybdenum	9268753	9268753	<2	<2	NA	< 2	86%	80%	120%	87%	80%	120%	81%	70%	130%
Dissolved Nickel	9268753	9268753	3	3	NA	< 2	100%	80%	120%	98%	80%	120%	94%	70%	130%
Dissolved Selenium	9268753	9268753	2	3	NA	< 1	85%	80%	120%	85%	80%	120%	NA	70%	130%
Dissolved Silver	9268753	9268753	<0.1	<0.1	NA	< 0.1	96%	80%	120%	95%	80%	120%	70%	70%	130%
Dissolved Strontium	9268753	9268753	205	200	2.5%	< 5	87%	80%	120%	89%	80%	120%	NA	70%	130%
Dissolved Thallium	9268753	9268753	<0.1	<0.1	NA	< 0.1	98%	80%	120%	99%	80%	120%	88%	70%	130%
Dissolved Tin	9268753	9268753	<2	<2	NA	< 2	92%	80%	120%	91%	80%	120%	86%	70%	130%
Dissolved Titanium	9268753	9268753	4	5	NA	< 2	100%	80%	120%	101%	80%	120%	NA	70%	130%
Dissolved Uranium	9268753	9268753	0.1	0.1	NA	< 0.1	94%	80%	120%	92%	80%	120%	94%	70%	130%
Dissolved Vanadium	9268753	9268753	3	4	NA	< 2	89%	80%	120%	86%	80%	120%	115%	70%	130%
Dissolved Zinc	9268753	9268753	7	7	NA	< 5	107%	80%	120%	104%	80%	120%	111%	70%	130%
Mercury Analysis in Water (Total)															
Total Mercury	1	9269730	<0.026	<0.026	NA	< 0.026	93%	80%	120%		80%	120%	95%	80%	120%

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Water Analysis (Continued)

RPT Date: Jun 07, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:

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Method Summary

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Toluene	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Ethylbenzene	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
Xylene (Total)	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
C6-C10 (less BTEX)	VOL-120-5010	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
>C10-C16 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
>C16-C21 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
>C21-C32 Hydrocarbons	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Modified TPH (Tier 1)	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	CALCULATION
Resemblance Comment	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS/FID
Return to Baseline at C32	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Isobutylbenzene - EPH	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID
Isobutylbenzene - VPH	VOL-120-5013	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/MS
n-Dotriacontane - EPH	ORG-120-5101	Atlantic RBCA Guidelines for Laboratories Tier 1	GC/FID

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SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Dissolved Aluminum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Antimony	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Arsenic	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Barium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Beryllium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Bismuth	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Boron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Cadmium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Chromium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Cobalt	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Copper	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Iron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Lead	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Manganese	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Molybdenum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Nickel	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Selenium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Silver	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Strontium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Thallium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Tin	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Titanium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Uranium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Vanadium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Dissolved Zinc	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Mercury	MET-121-6100 & MET-121-6107	SM 3112 B	CV/AA
pH	INOR-121-6001	SM 4500 H+B	PC TITRATE
Reactive Silica as SiO2	INORG-121-6028	SM 4110 B	COLORIMETER
Chloride	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH

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Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Fluoride	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Alkalinity	INOR-121-6001	SM 2320 B	
True Color	INOR-121-6014	SM 2120 C	NEPHELOMETER
Turbidity	INOR-121-6022	SM 2130 B	NEPHELOMETER
Electrical Conductivity	INOR-121-6001	SM 2510 B	PC TITRATE
Nitrate + Nitrite as N	INORG-121-6005	SM 4110 B	CALCULATION
Nitrate as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INORG-121-6005	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INORG-121-6003	SM 4500-NH3 G	COLORIMETER
Total Organic Carbon	INORG-121-6026	SM 5310 B	TOC ANALYZER
Ortho-Phosphate as P	INORG-121-6005	SM 4110 B	COLORIMETER
Total Sodium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Potassium	MET121-6104 & MET-121-6105	SM 3125	ICP-MS
Total Calcium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Magnesium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Bicarb. Alkalinity (as CaCO3)	INORG-121-6001	SM 2320 B	PC TITRATE
Carb. Alkalinity (as CaCO3)	INORG-121-6001	SM 2320 B	PC TITRATE
Hydroxide	INORG-121-6001	SM 2320 B	PC-TITRATE
Calculated TDS	CALCULATION	SM 1030E	CALCULATION
Hardness	CALCULATION	SM 2340B	CALCULATION
Langelier Index (@20C)	CALCULATION	CALCULATION	CALCULATION
Langelier Index (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 20C)	CALCULATION	CALCULATION	CALCULATION
Saturation pH (@ 4C)	CALCULATION	CALCULATION	CALCULATION
Anion Sum	CALCULATION	SM 1030E	CALCULATION
Cation sum	CALCULATION	SM 1030E	CALCULATION
% Difference/ Ion Balance (NS)	CALCULATION	SM 1030E	CALCULATION
Total Aluminum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Antimony	MET121-6104 & MET-121-6105	SM 3125	ICP-MS
Total Arsenic	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Barium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Beryllium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Bismuth	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Boron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Cadmium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Chromium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Cobalt	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS

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AGAT WORK ORDER: 18K342738

PROJECT: 3113-Stephenville

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Copper	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Iron	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Lead	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Manganese	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Molybdenum	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Nickel	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Phosphorous	MET-121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Selenium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Silver	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Strontium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Thallium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Tin	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Titanium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Uranium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Vanadium	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS
Total Zinc	MET121-6104 & MET-121-6105	modified from SM 3125/SM 3030 B/SM 3030 D	ICP-MS

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Chain of Custody Record

Laboratory Use Only
Arrival Condition: ☑ Good ☐ Poor (see notes)
Arrival Temperature: 6.9
Hold Time:
AGAT Job Number: 18K342738
Notes:

Report Information
Company: Fracflow Consultants Inc. (NL)
Contact: John Gale
Address: 154 Major's Path
St. John's, NL
Phone: 709-739-7270 Fax: 709-753-5101
Client Project #: 3113-Stephenville
AGAT Quotation: S/O
Please Note: If quotation number is not provided client will be billed full price for analysis.

Report Information (Please print):
1. Name: John Gale (john_ffc@nfld.net)
Email: Eunjeong Seok (eunjeong_ffc@nfld.net)
2. Name: Karen Andrews (karen_ffc@nfld.net)
Email:

Report Format
☐ Single Sample per page
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☑ Excel Format Included
☐ Export:

Turnaround Time Required (TAT)
Regular TAT ☑ 5 to 7 working days
Rush TAT ☐ Same day ☐ 1 day ☐ 2 days ☐ 3 days
Date Required:

Invoice To Same Yes ☑ / No ☐
Company:
Contact: Karen Andrews (karen_ffc@nfld.net)
Address:
Phone: Fax:
PO/Credit Card#: 3895

Regulatory Requirements (Check):
☑ List Guidelines on Report ☐ Do not list Guidelines on Report
☑ PIRI
☑ Tier 1 ☐ Res ☐ Pot ☑ Coarse
☐ Tier 2 ☐ Com ☑ N/Pot ☐ Fine
☐ Gas ☐ Fuel ☐ Lube
☑ CCME ☐ CDWQ
☐ Industrial ☐ NSEQS-Cont Sites
☐ Commercial ☐ HRM 101
☐ Res/Park ☐ Storm Water
☐ Agricultural ☐ Waste Water
☑ FWAL ☐ Other
☐ Sediment

Drinking Water Sample: ☐ Yes ☑ No **Salt Water Sample:** ☐ Yes ☑ No
Reg. No.:

Sample Identification	Date/Time Sampled	Sample Matrix	# Containers	Comments – Site/Sample Info. Sample Containment	Field Filtered/Preserved	Standard Water Analysis	Metals: ☑ Total ☐ Diss ☐ Available	Mercury	☐ BOD ☐ CBOD	Grain Size (coarse/fine)	☐ TOC - Miss ☐ FOC - Miss	Phosphates (total as P2O5)	Chromium (Tri & Hexavalent)	Phenols	Tier 1: TPH/BTEX (PIRI) ☑ low level	Tier 2: TPH/BTEX Fractionation	CCME-CWS TPH/BTEX	VOC	Oil & Grease (TOG)	BNAE EPA 625 - Miss	PAH	PCB	Marine Sediment Package	Dioxins & Furans	Fecal Coliform ☐ MPN ☐ MF	Other:	Other:	Hazardous (Y/N)
3113-FHS1-WS2	May 23, 2018	Water	9	1x500, 3x100, 2x250, 3x40		✓	✓	✓							✓													
				Diss. Metal filtered																								
3113-FHS2-WS2	May 23, 2018	Water	9	1x500, 3x100, 2x250, 3x40		✓	✓	✓							✓													
				Diss. Metal filtered																								

Samples Relinquished By (Print Name): Shawn Thompson
Date/Time: 18/05/25
Samples Received By (Print Name): Lana Cameron
Date/Time: May 25/18
Samples Relinquished By (Sign):
Date/Time: 13:05
Samples Received By (Sign):
Date/Time: 1:05

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

N°: FFC-3113-COC-11

Fracflow Consultants Inc.

Environmental, Hydrogeological and
Geotechnical Engineering Consultants

TECHNICAL MEMORANDUM

TO: Dean Guest, Marine Harvest Atlantic Canada FFC-NL-3113-008

FROM: Fracflow Consultants Inc.

DATE: June 12, 2018

SUBJECT: **Sonar and DCPT Investigations of the Harbour Bottom along Proposed Pipeline Route – Port of Stephenville.**

1. Background

Marine Harvest Atlantic Canada proposes to construct one or more pipelines across the Port of Stephenville within the corridor outlined by Meridian Engineering (**Figure 1**). It is proposed that the pipeline or pipelines will be floated across the harbour and then fixed to the harbour bottom using weights or collars distributed along the pipelines. The presence of soft sediments on the harbour bottom and variability in the thickness of the soft sediments will determine how the anchors must be placed to avoid excessive bending stresses during placement and during any recovery or maintenance activities.

Fracflow extracted a series of way-points (**Figure 2**) along three lines, one on each side of the proposed pipeline corridor and one along the middle of the corridor, and used those GPS way-points to map sonar profiles along those three lines (**Figure 3**). In addition, 14 Direct Cone Penetration Tests (DCPTs) were driven (**Figure 3**) to determine the presence of and thickness of soft sediments on the harbour bottom and the depth to firm ground conditions. DCPTs are conducting by recording the number of blow-counts, produced by dropping a 63.5 kg hammer with a free fall of 760 mm, required to drive the DCPT each150 mm. A DCPT is not applicable to clay but was used in this case to delineate the depth to firm ground conditions as defined by blow counts for the purposes of determining how far the weighted pipelines would sink into the harbour bottom over time.

Three marine sediments samples (**Figure 3**) were also collected from the harbour bottom using a grab sampler and analyzed for available metals and Polycyclic Aromatic Hydrocarbons (PAHs) in the event that pipeline placement and maintenance activities might create suspended material.

2. Sonar Images

The three sonar profiles are labeled Sonar001, Sonar002 and Sonar003 (**Figure 3**). The sonar profiles (**Figures 4a, 4b, 4c, 4d, 4e** for Sonar001) all show distances in metres starting from 0.0 m near the shore area adjacent to the golf course and ending at approximately1,350 m on the shore next to the boundary between the Northern Harvest property and the Port of Stephenville property. The location of each DCPT has been offset and located on the nearest sonar line. Each profile shows the tide level relative to Low Natural Tide (LNT). All three profiles (**Figures 4** for Sonar001**, 5** for Sonar002 and **6** for Sonar003) are similar with a rough bottom (approximately 20 cm in surface relief) which is considered to be vegetation for the first 500 m to 600 m for water depths that are at or above the 3 m (LNT) level. The next 500 m to 650 m, in the deeper water, is characterized by a relatively smooth harbour bottom which is followed by a rapid rise of the harbour bottom up to the gravel beach over the last 100 m. There is no evidence in the three sonar profiles of any large objects on the harbour bottom.

The coordinates for the start and end points for each profile are provided in **Table 1**.

3. Depth and Thickness of Soft Sediment

The DCPT logs are provided in **Appendix A**. **Figure 7** is a summary plot that shows the depth of the soft sediment or that part of the marine sediment column where the DCPT sank under its own weight and that of the drop hammer (63.5 kg), plus the thickness where the blow counts were less than 2 for a 150 mm drive. The blow counts in the logs could not be recorded until the DCPT string stopped sinking under its own weight and the logs show those sections where the DCPT moved more than 150 mm under one blow of the drop hammer. For design purposes, the firm ground for pipe placement should be considered to start at the depth where the blow counts were at least 2 per 150 mm. All of the DCPTs were terminated when the blow counts were consistently 8 per 150 mm or greater.

Figure 7 shows that the water is deeper and the very soft sediment thicker in the profile section that is within the 200 to 300 m of the shoreline at the Northern Harvest and Port of Stephenville property boundary. In those areas the bottom of the soft sediment layer is approximately 10 m below LNT.

The depth and variability in soft sediment thickness have to be considered when designing the spacing of the pipeline anchors. The blow counts in the DCPT logs are the data that need to be referenced for overall bearing capacity or resistance to pipeline sinking under the design weights.

4. Marine Sediments

Three soil samples were collected using a grab sampler and submitted for analysis of available metals and PAHs. The sample locations are shown on **Figure 3** and are numbered relative to the

DCPT location at which each sample was collected (PC2-GS, PC10-GS and PC14-GS). The laboratory data are provided in **Appendix B** and are tabulated in **Tables 2** and **3**.

The soft marine sediments are primarily sticky clay as evidenced by the thick coating of marine sediment that was still sticking to the DCPT rods when they were recovered at each DCPT location.

The available metals and PAHs show a general pattern of decreasing metal levels as the distance from the Northern Harvest and Port of Stephenville property boundary increases.

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
FRACFLOW CONSULTANTS INC.
To practice Professional Engineering
in Newfoundland and Labrador.
Permit No. as issued by APEGN D0169
which is valid for the year 2018.

REGISTERED PROFESSIONAL ENGINEER
JOHN B. GALE
SIGNATURE
June 12, 2018
DATE
PROVINCE OF NEWFOUNDLAND

Table 1 Coordinates for each profile, east to west, UTM Zone 21, Port of Stephenville, NL.

Sonar Profile	Start		End	
	Easting	Northing	Easting	Northing
Sonar001	385598.687	5376865.658	386916.384	5377111.411
Sonar002	385611.060	5376826.532	386927.709	5377077.351
Sonar003	385623.181	5376810.432	386960.551	5377066.562

Table 2 Analytical results of available metals in soil samples for Stephenville, NL.

Project 3113 - Stephenville Sampling Program						
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113F-PC2-GS-0Z**	**3113F-PC10-GS-0Z**	**3113F-PC14-GS-0Z**
Sampling Date				**05/21/2018**	**05/21/2018**	**05/21/2018**
AGAT ID				**9268803**	**9268804**	**9268805**
Available Metals in Soil						
Aluminum	mg/kg		10	9580	13900	14900
Antimony	mg/kg		1	<1	<1	<1
Arsenic	mg/kg		1	6	11	11
Barium	mg/kg		5	15	31	32
Beryllium	mg/kg		2	<2	<2	<2
Boron	mg/kg		2	23	91	105
Cadmium	mg/kg		0.3	<0.3	0.7	0.8
Chromium	mg/kg		2	30	38	40
Cobalt	mg/kg		1	9	9	10
Copper	mg/kg		2	12	25	29
Iron	mg/kg		50	19000	23700	24000
Lead	mg/kg		0.5	4.9	13.4	13.2
Lithium	mg/kg		5	17	18	20
Manganese	mg/kg		2	250	263	261
Molybdenum	mg/kg		2	12	7	10
Nickel	mg/kg		2	29	33	36
Selenium	mg/kg		1	<1	<1	<1
Silver	mg/kg		0.5	<0.5	<0.5	<0.5
Strontium	mg/kg		5	24	63	137
Thallium	mg/kg		0.1	<0.1	0.2	0.2
Tin	mg/kg		2	2	2	<2
Uranium	mg/kg		0.1	1.3	2.4	4.2
Vanadium	mg/kg		2	41	58	57
Zinc	mg/kg		5	53	73	175
Mercury	mg/kg		0.05	<0.05	<0.05	<0.05
Inorganics						
% Moisture	%			48	79	74

Comments:
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard
- Results are based on the dry weight of the soil.

Table 3 Analytical results of Polychclic Aromatic Hydrocarbons in soil samples, Stephenville, NL.

Project 3113 - Stephenville Sampling Program						
Fracflow Sample ID	**Units**	**G / S**	**RDL**	**3113F-PC2-GS-0Z**	**3113F-PC10-GS-0Z**	**3113F-PC14-GS-0Z**
Sampling Date				**5/21/2018**	**5/21/2018**	**5/21/2018**
AGAT ID				**9268803**	**9268804**	**9268805**
Polychclic Aromatic Hydrocarbons						
1-Methylnaphthalene	mg/kg		0.05	<0.05	<0.05	<0.05
2-Methylnaphthalene	mg/kg		0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg		0.00671	<0.00671	<0.00671	<0.00671
Acenaphthylene	mg/kg		0.004	<0.004	<0.004	<0.004
Acridine	mg/kg		0.05	<0.05	<0.05	<0.05
Anthracene	mg/kg		0.03	<0.03	<0.03	<0.03
Benzo(a)anthracene	mg/kg		0.01	<0.01	<0.01	0.02
Benzo(a)pyrene	mg/kg		0.01	<0.01	<0.01	0.02
Benzo(b)fluoranthene	mg/kg		0.05	<0.05	<0.05	<0.05
Benzo(b+j)fluoranthene	mg/kg		0.1	<0.1	<0.1	<0.1
Benzo(e)pyrene	mg/kg		0.05	<0.05	<0.05	<0.05
Benzo(ghi)perylene	mg/kg		0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	mg/kg		0.01	<0.01	0.01	0.05
Chrysene	mg/kg		0.01	<0.01	<0.01	0.03
Dibenzo(a,h)anthracene	mg/kg		0.006	<0.006	<0.006	<0.006
Fluoranthene	mg/kg		0.05	<0.05	<0.05	<0.05
Fluorene	mg/kg		0.01	<0.01	<0.01	<0.01
Indeno(1,2,3)pyrene	mg/kg		0.01	<0.01	<0.01	<0.01
Naphthalene	mg/kg		0.01	<0.01	0.02	0.02
Perylene	mg/kg		0.05	<0.05	<0.05	0.08
Phenanthrene	mg/kg		0.03	<0.03	<0.03	0.03
Pyrene	mg/kg		0.05	<0.05	<0.05	<0.05
Quinoline	mg/kg		0.05	<0.05	<0.05	<0.05
Surrogate Recovery (%)						
Nitrobenzene-d5	%			96	52	91
2-Fluorobiphenyl	%			101	50	93
Terphenyl-d14	%			69	NA	80

Comments:
- **Bold/Shaded** - Exceeds Guideline/Standard
- RDL - Reported Detection Limit;
- G / S - Guideline / Standard

Figure 1

SITE PLAN

Owner

marine harvest

No.	Revision	Date

Prime Consultant

RAMBOLL

Mechanical / Process Consultant

PENTAIR
AQUATIC ECO-SYSTEMS®
PR AQUA™

Geotechnical Consultant

Fracflow Consultants Inc.
Environmental, Hydrogeological and Geotechnical Engineering Consultants

Civil / Structural Consultant

Meridian Engineering Inc.
10 THOMPSON STREET
CLARENVILLE NL
A5A 1Y9
TEL (709) 466-2700
FAX (709) 466-3090

Project

MARINE HARVEST
ATLANTIC CANADA
NEWFOUNDLAND
HATCHERY

Drawing

PROPOSED
EFFLUENT LINE

Drawing File Name: CC17MHA125-SK2.DWG

Drawing No. SK-2

Project No.: CC17MHA125	Scale: N.T.S.
Designed By: S.S.	Drawn By: P.M.
Checked By:	Approved By:
Date: 18/04/18	Sheet 1 of 1

Figure 2 Extracted way-points along three lines, one on each side of the proposed pipeline corridor and one along the middle of the corridor.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

Figure 3 Track of the sonar survey along the proposed location of the pipe lines and location of dynamic cone penetration tests (DCPTs).

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

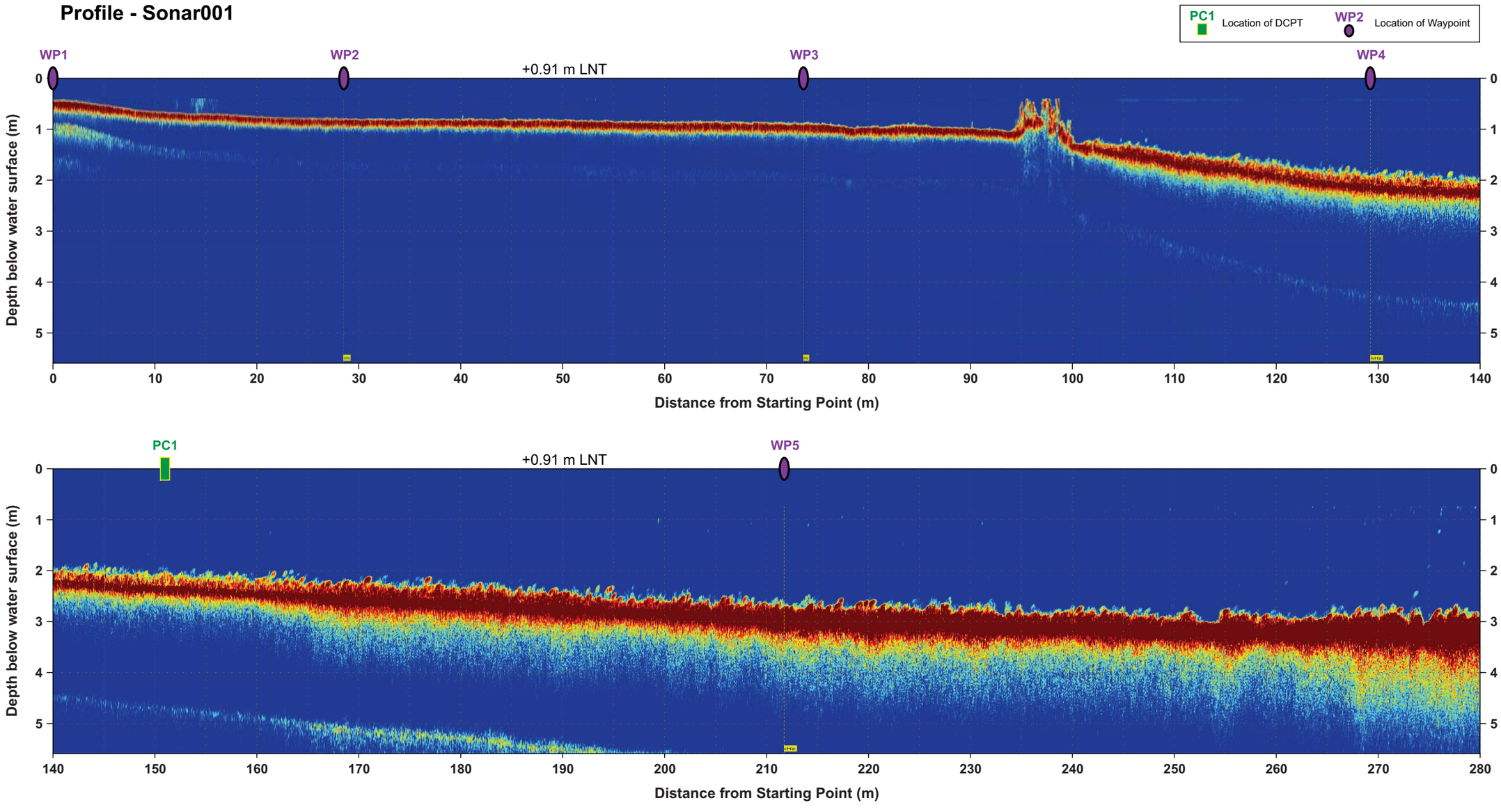
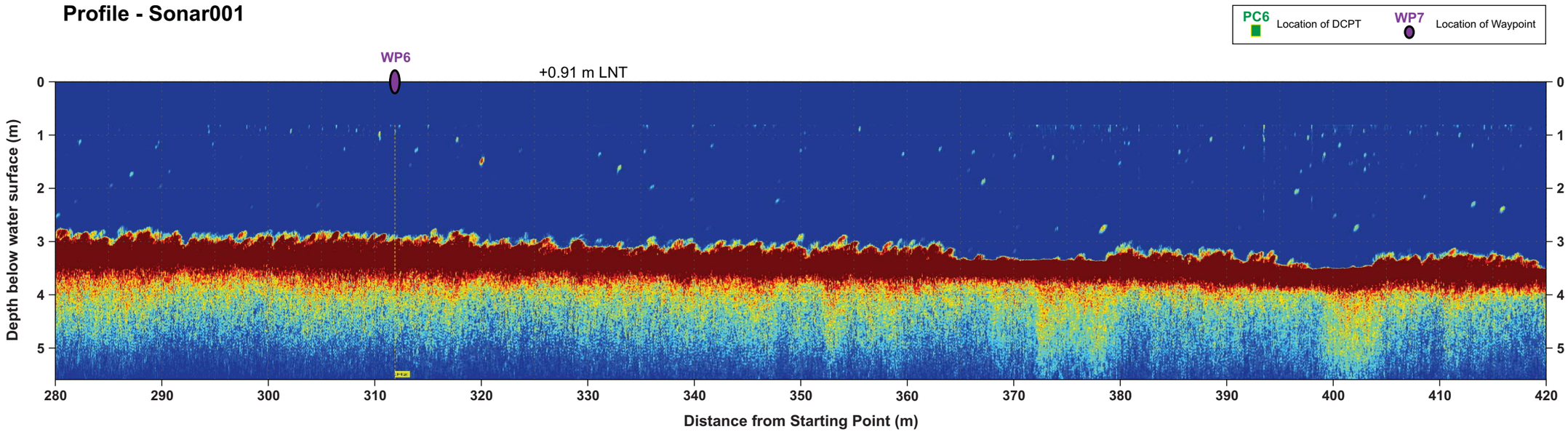


Figure 4a Sonar survey profile for ‘Sonar001' and the elevation of the water surface in the profile is 0.91 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

Profile - Sonar001



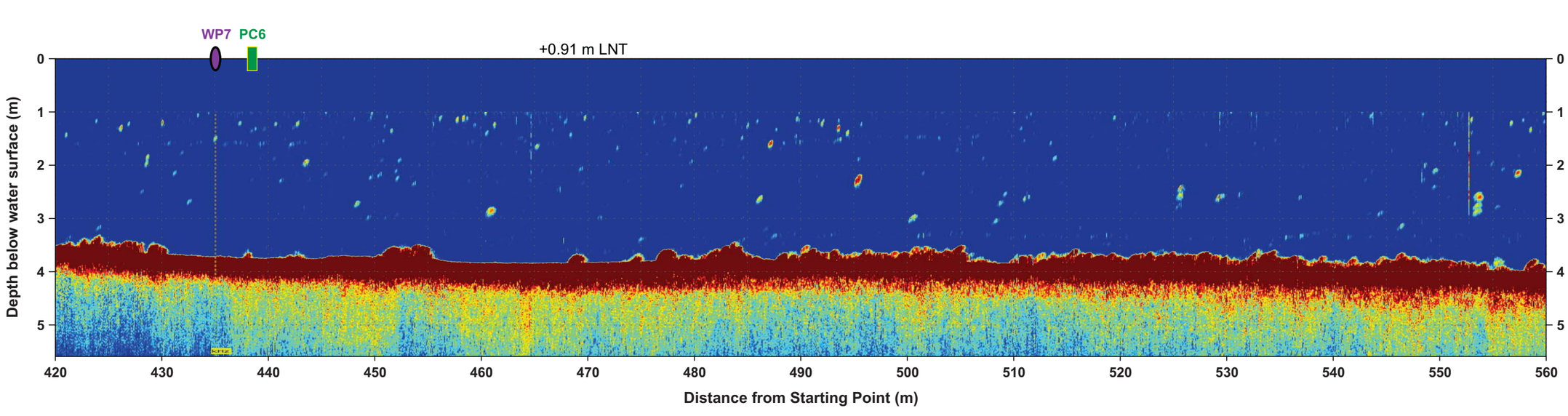


Figure 4b Sonar survey profile for ‘Sonar001' and the elevation of the water surface in the profile is 0.91 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

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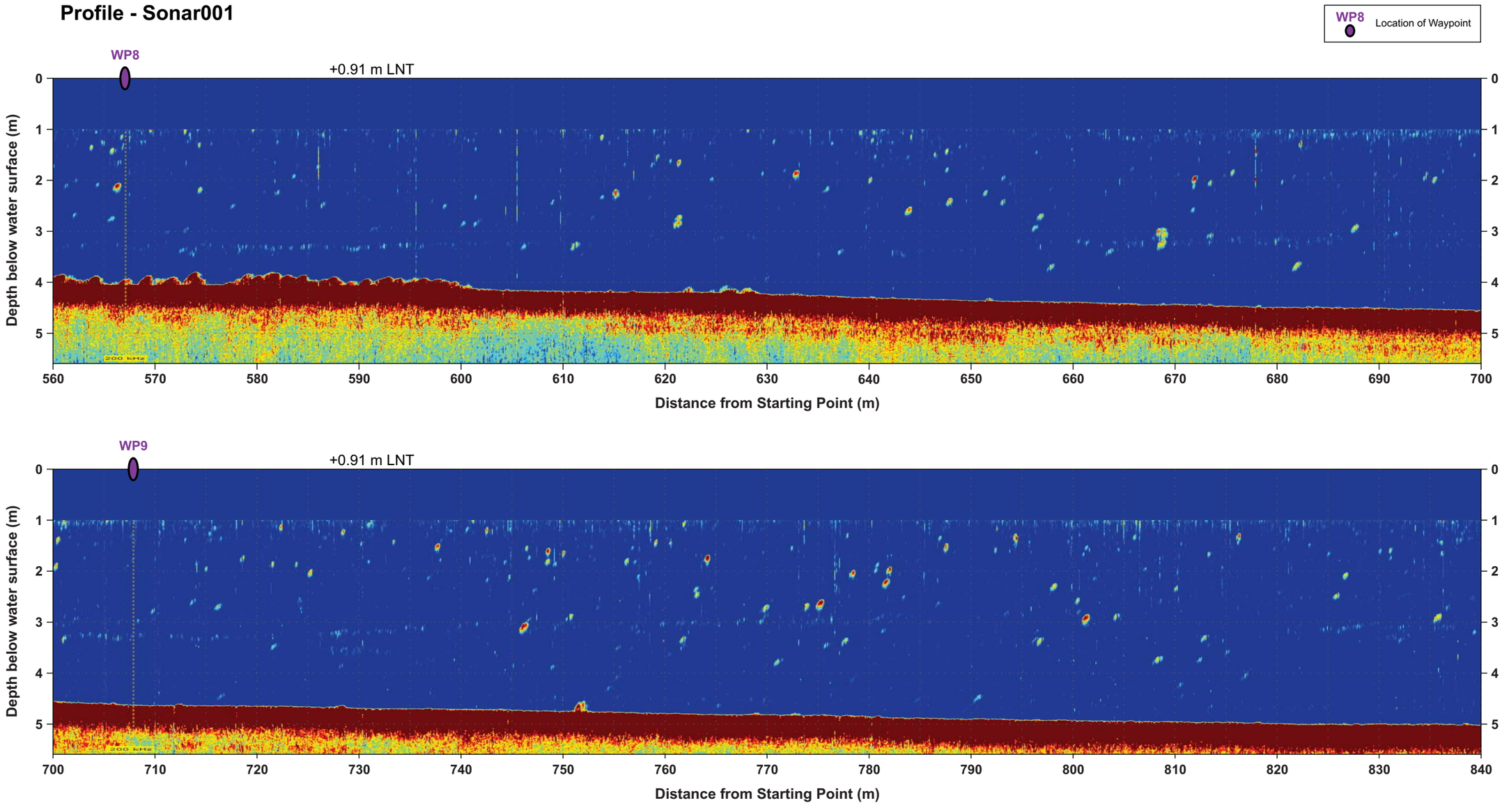


Figure 4c Sonar survey profile for ‘Sonar001' and the elevation of the water surface in the profile is 0.91 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

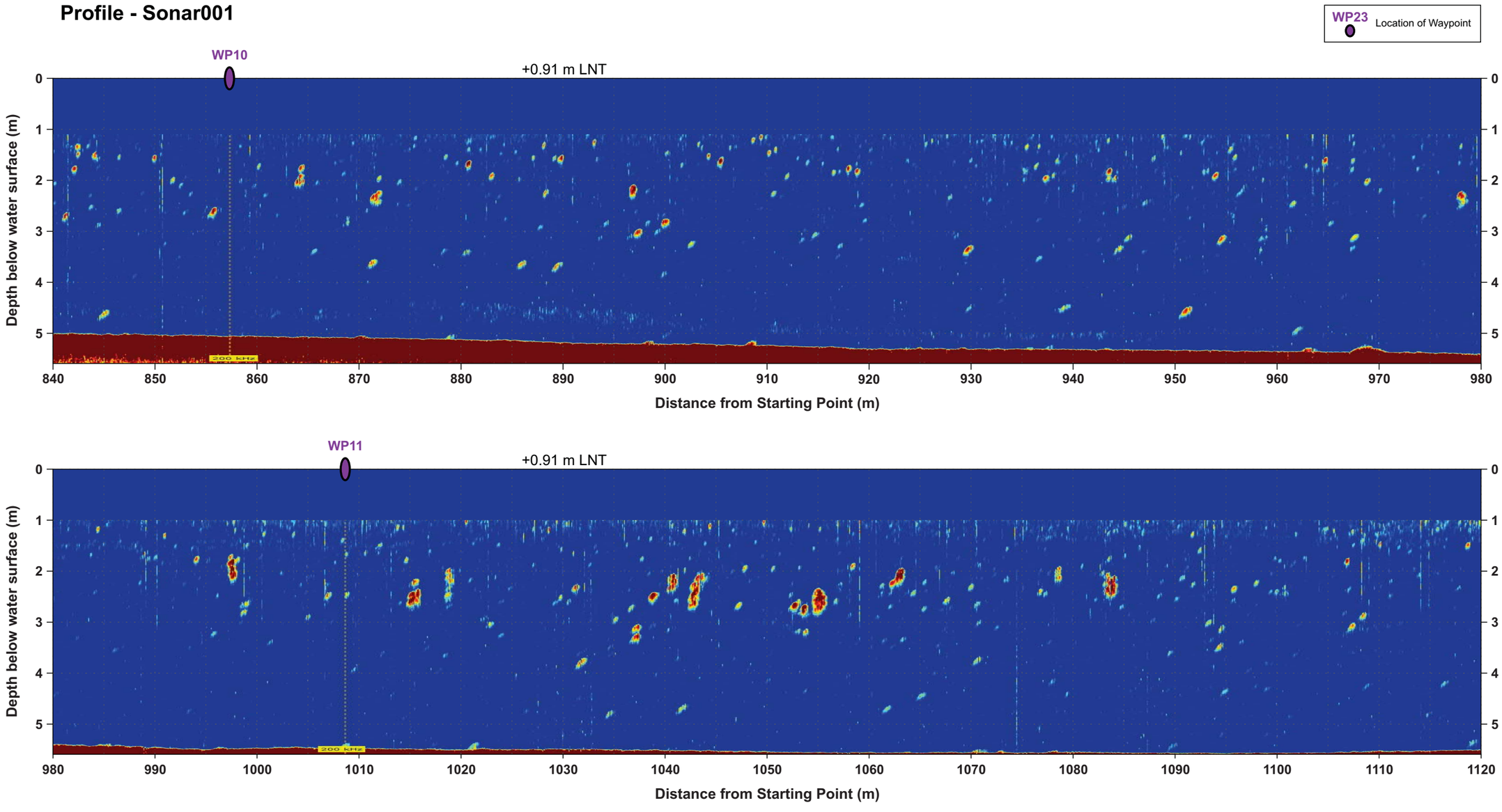


Figure 4d Sonar survey profile for ‘Sonar001' and the elevation of the water surface in the profile is 0.91 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

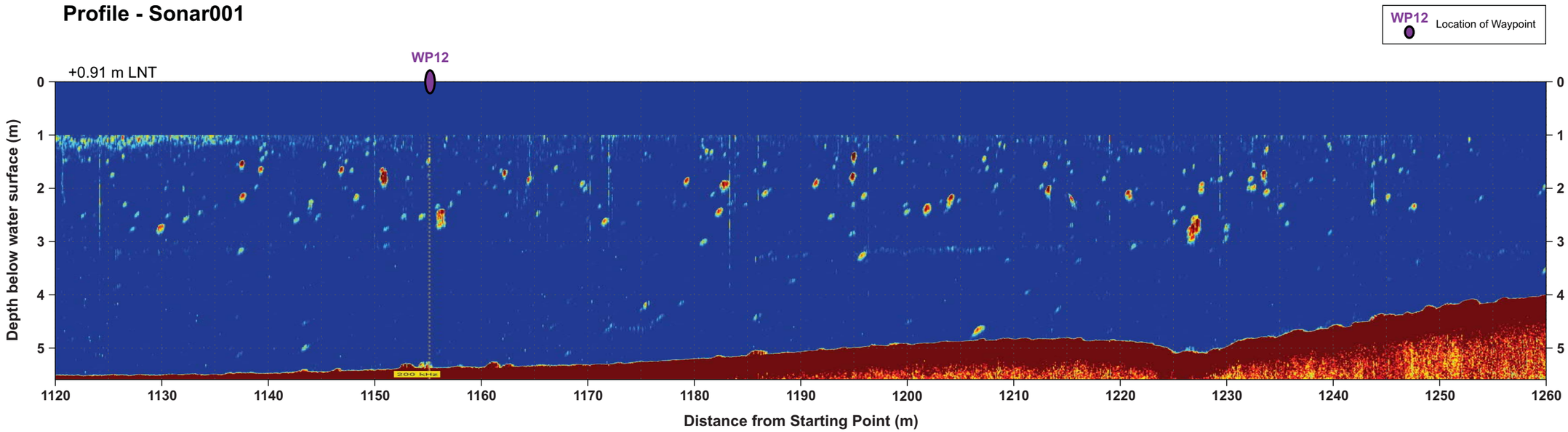


Figure 4e Sonar survey profile for ‘Sonar001' and the elevation of the water surface in the profile is 0.91 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

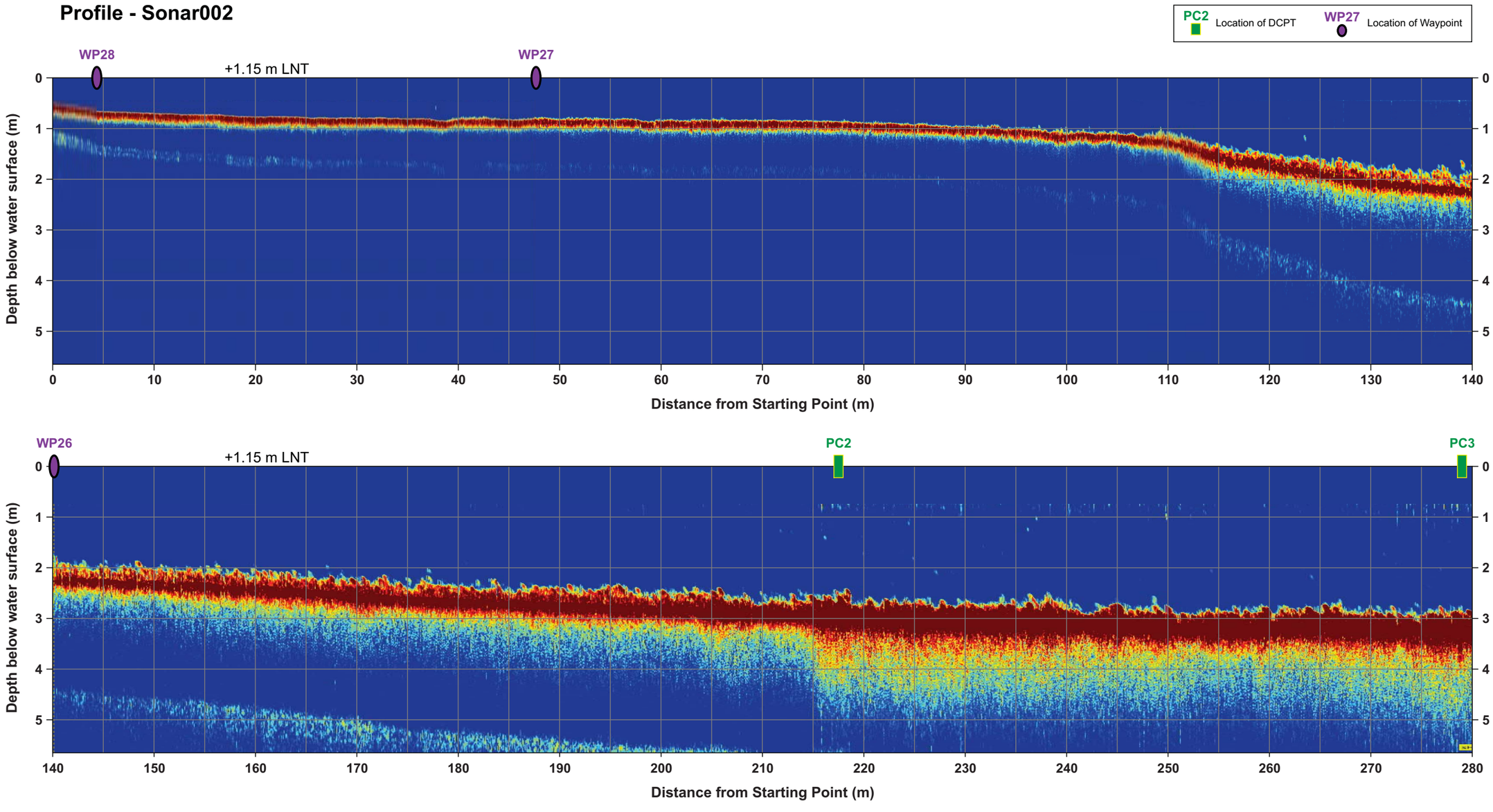


Figure 5a Sonar survey profile for ‘Sonar002' and the elevation of the water surface in the profile is 1.15 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

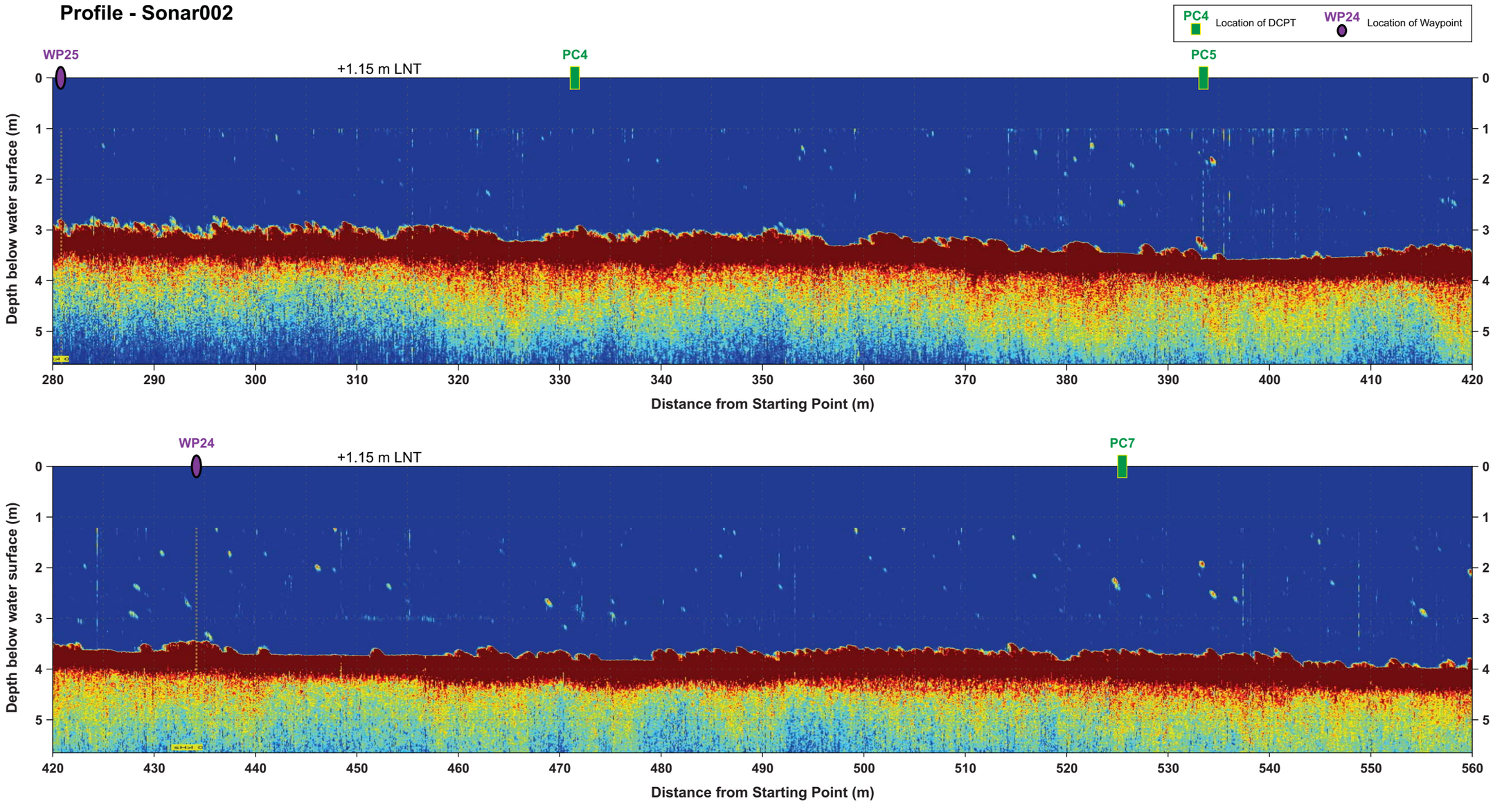
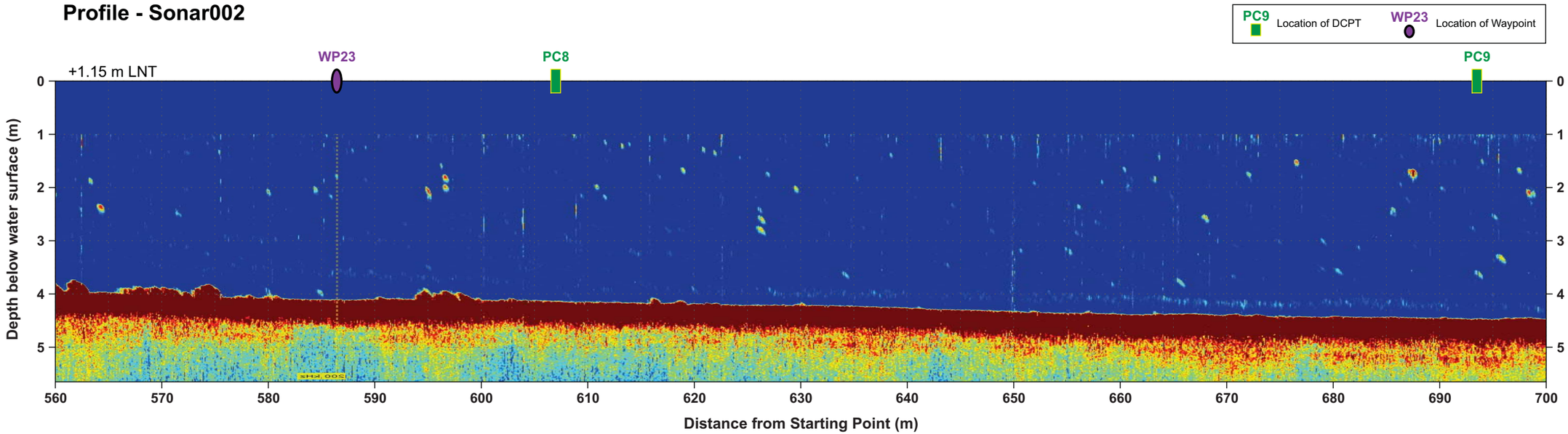


Figure 5b Sonar survey profile for ‘Sonar002' and the elevation of the water surface in the profile is 1.15 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

Profile - Sonar002



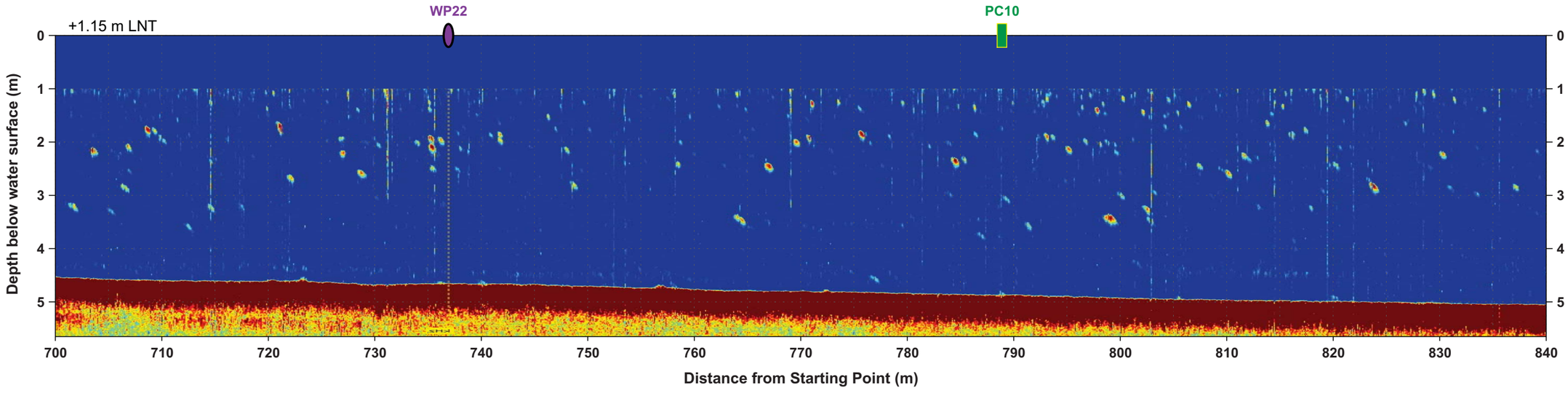


Figure 5c Sonar survey profile for ‘Sonar002' and the elevation of the water surface in the profile is 1.15 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

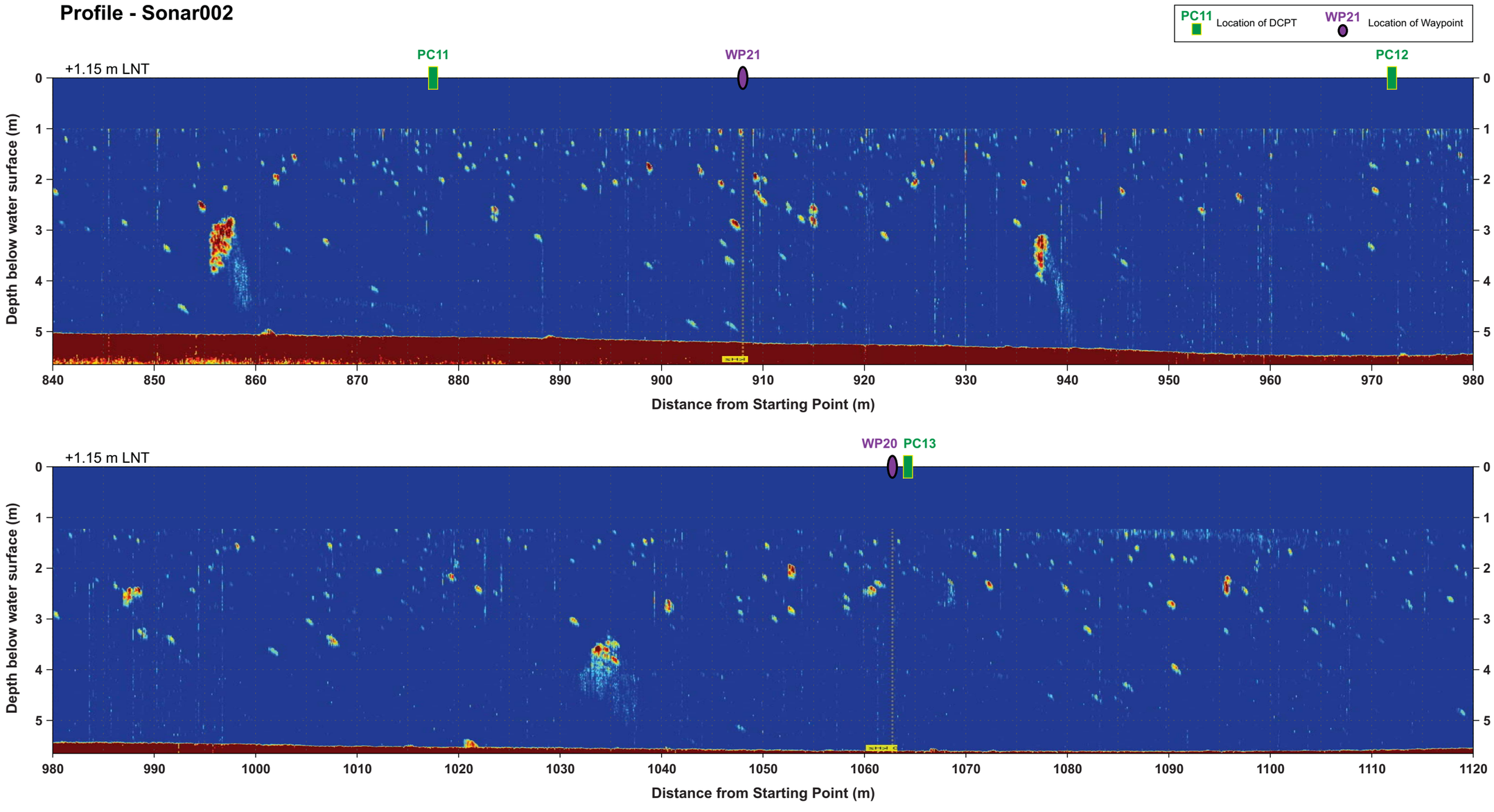
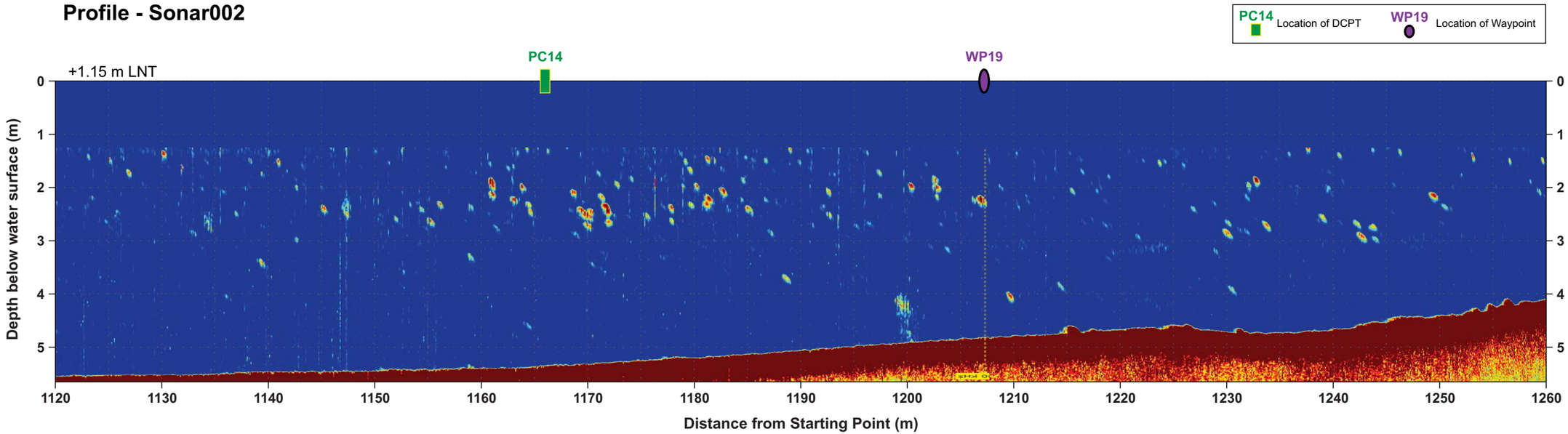


Figure 5d Sonar survey profile for ‘Sonar002' and the elevation of the water surface in the profile is 1.15 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

Profile - Sonar002



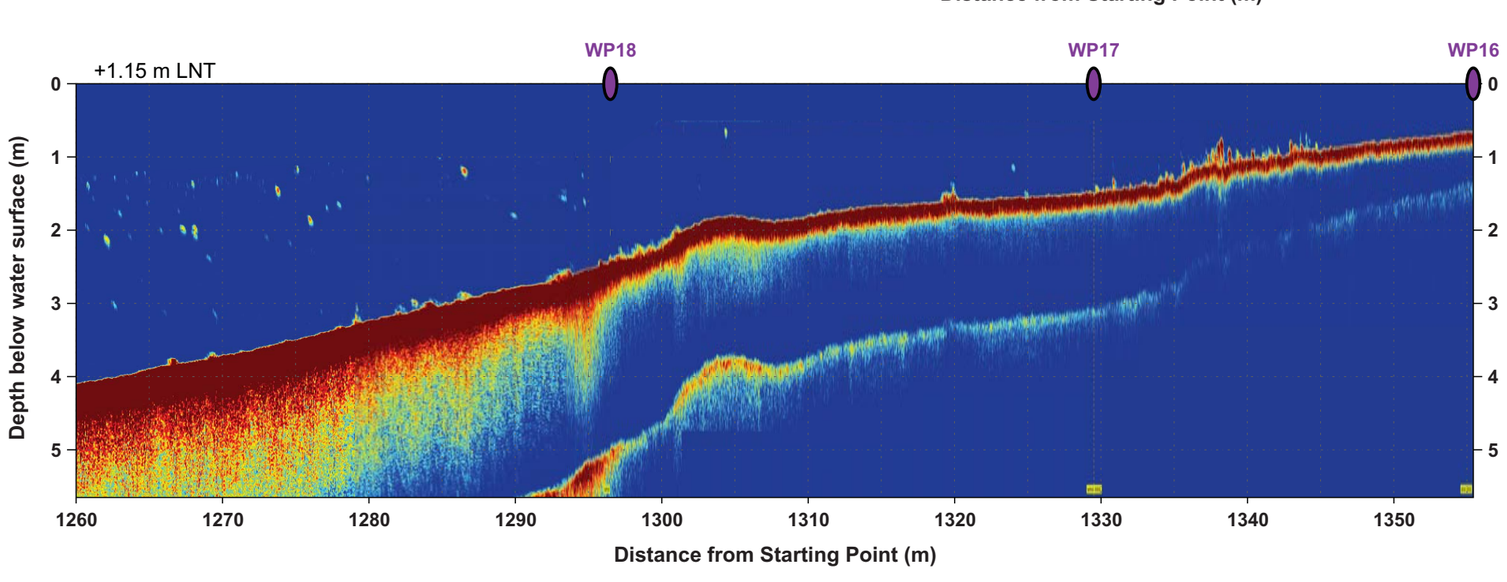


Figure 5e Sonar survey profile for ‘Sonar002' and the elevation of the water surface in the profile is 1.15 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

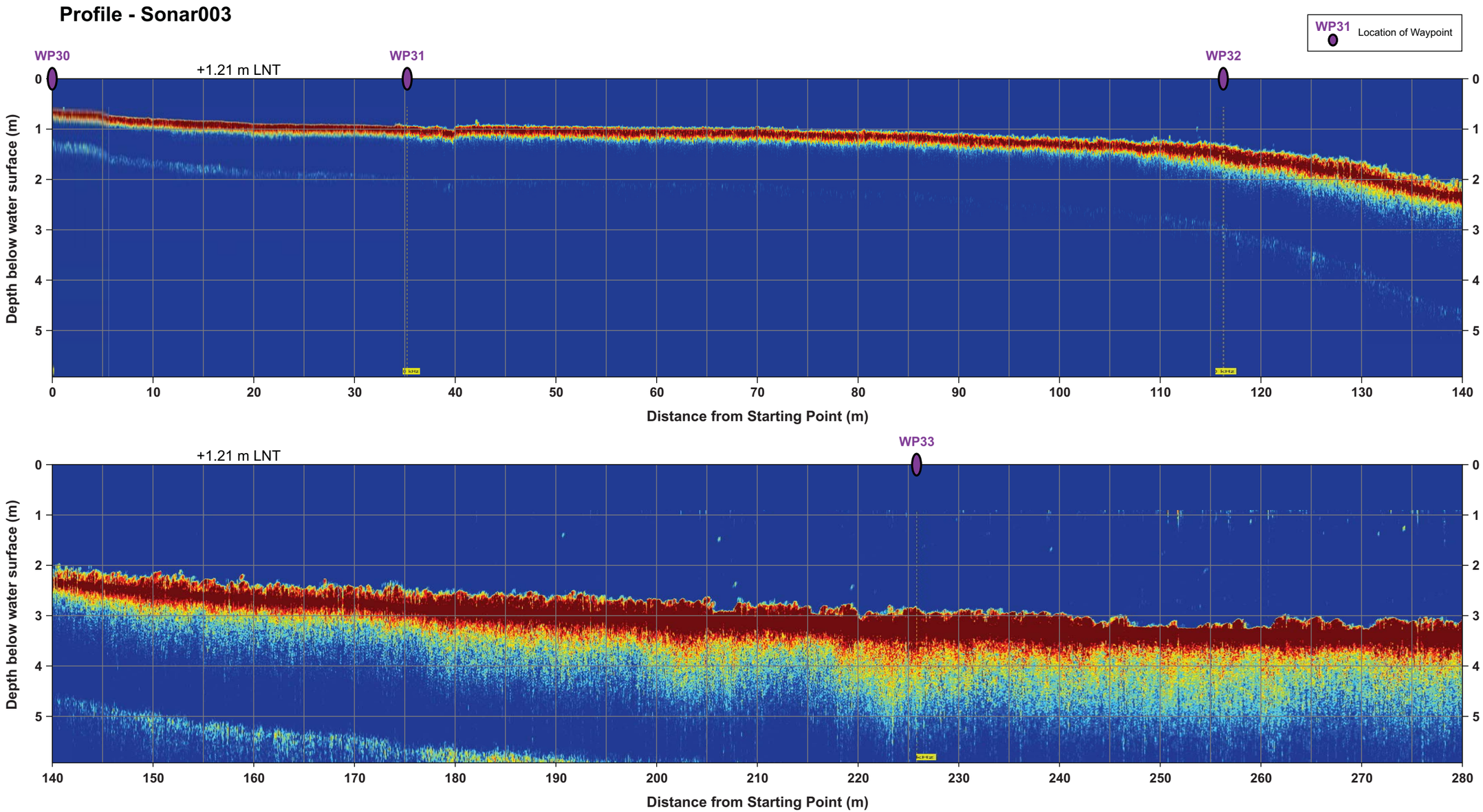


Figure 6a Sonar survey profile for ‘Sonar003' and the elevation of the water surface in the profile is 1.21 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

Profile - Sonar003

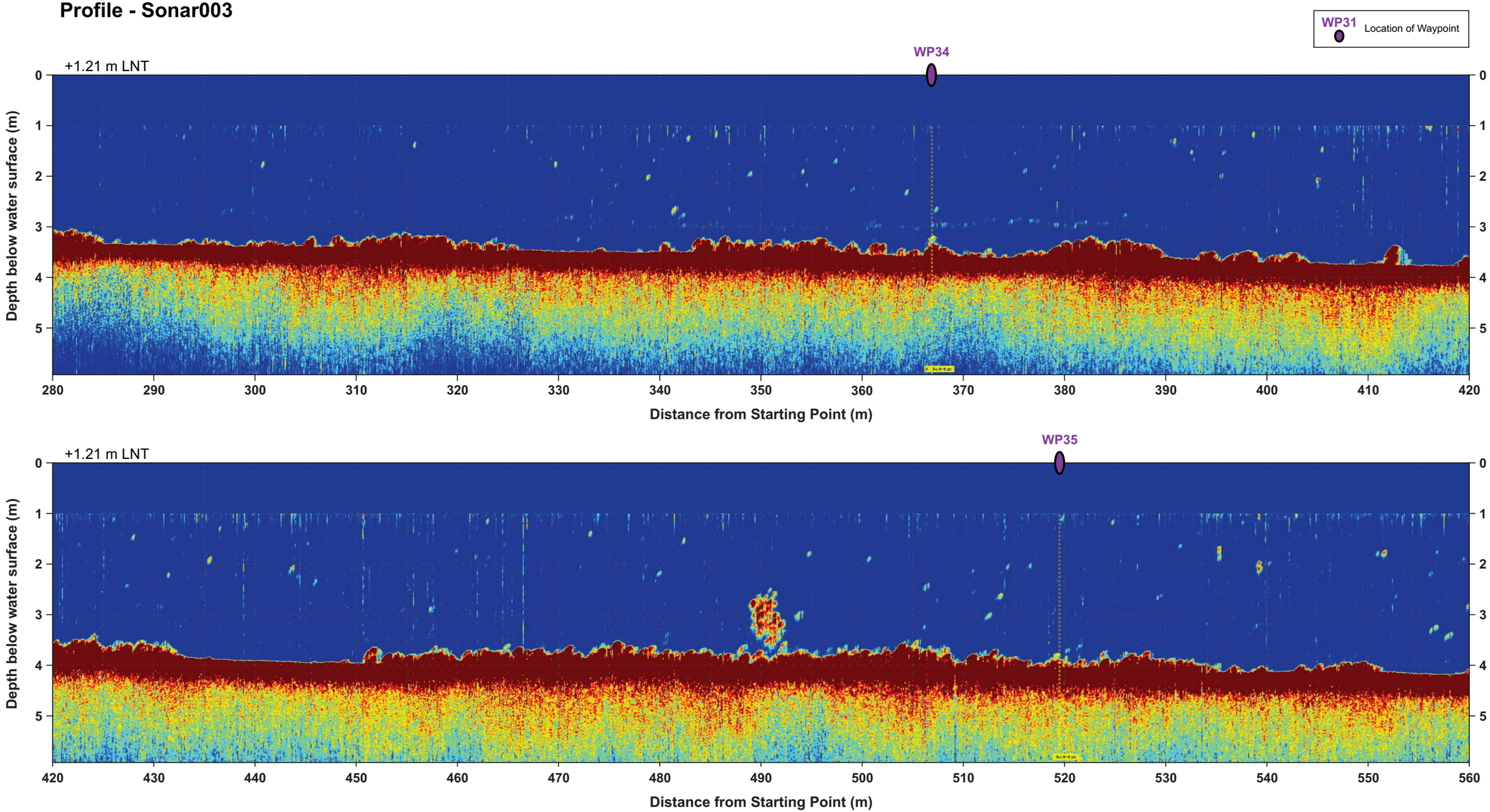


Figure 6b Sonar survey profile for ‘Sonar003' and the elevation of the water surface in the profile is 1.21 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

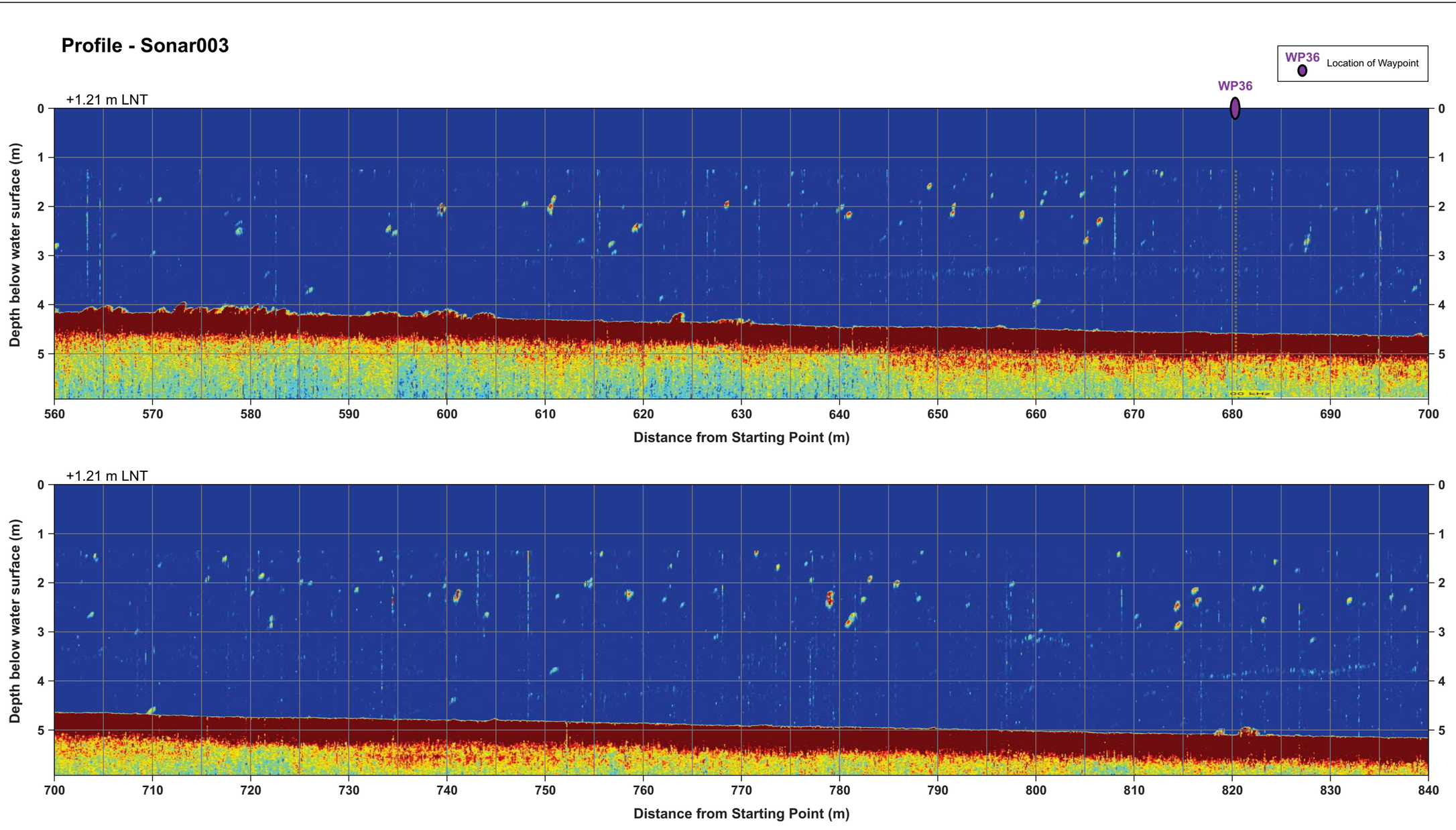


Figure 6c Sonar survey profile for ‘Sonar003' and the elevation of the water surface in the profile is 1.21 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

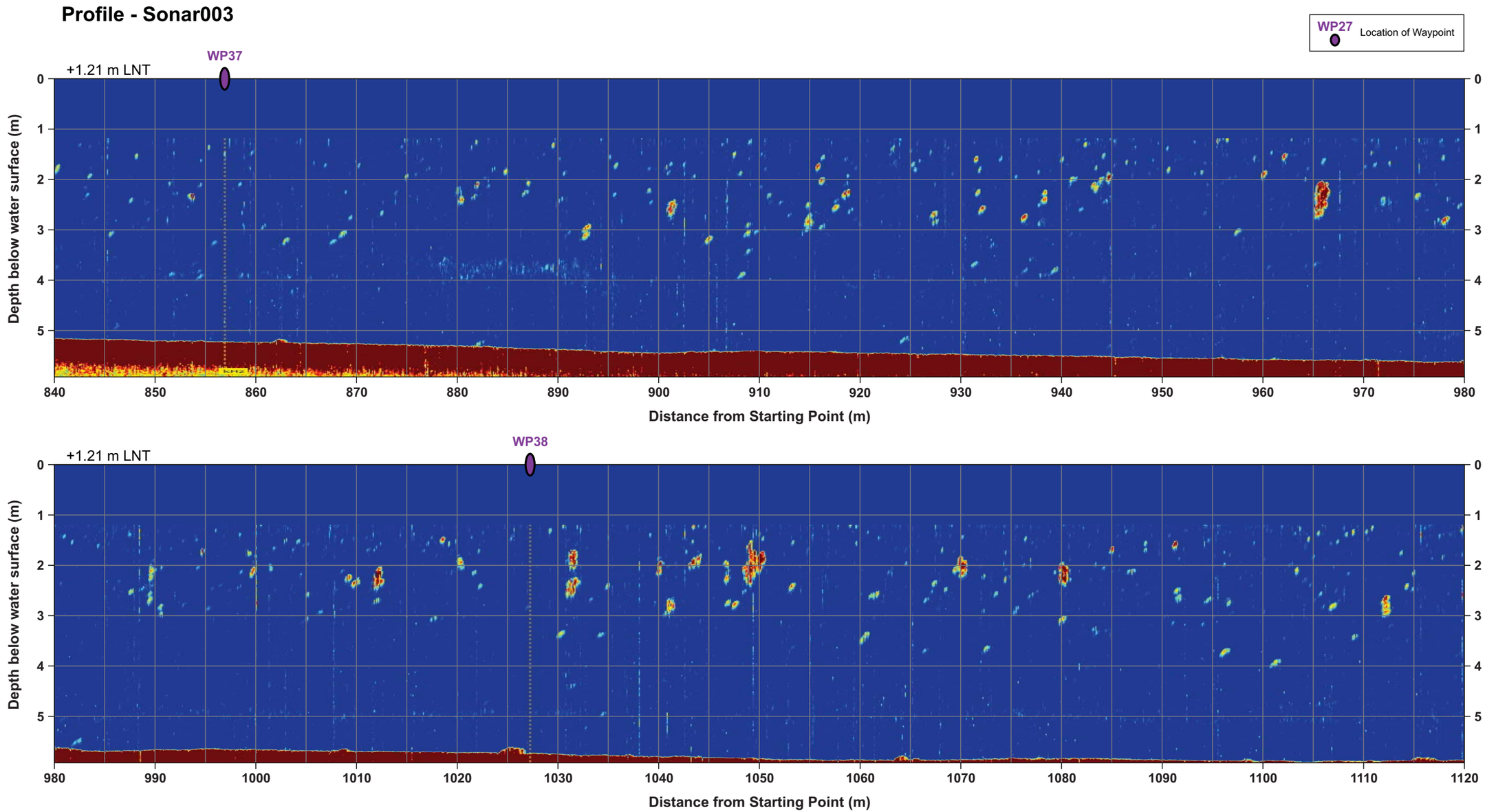


Figure 6d Sonar survey profile for ‘Sonar003' and the elevation of the water surface in the profile is 1.21 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

Profile - Sonar003

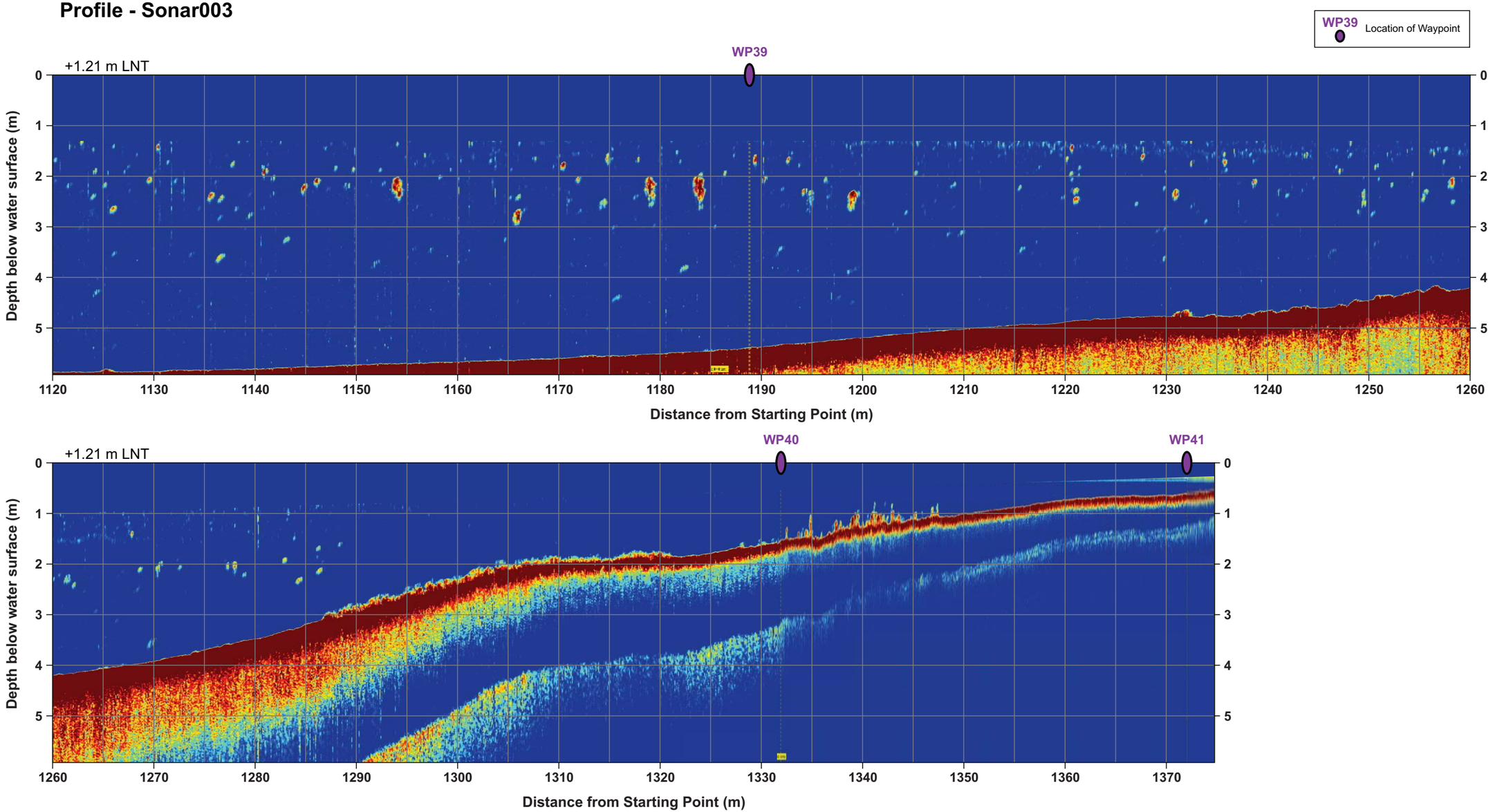
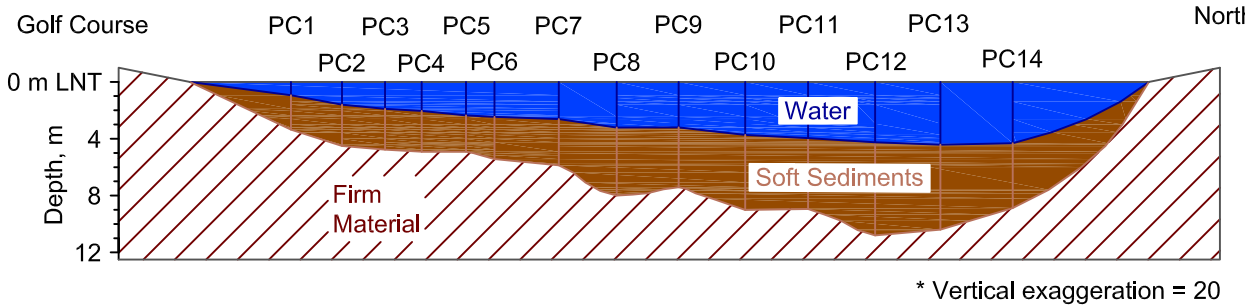
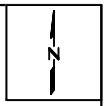


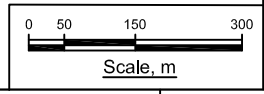
Figure 6e Sonar survey profile for ‘Sonar003' and the elevation of the water surface in the profile is 1.21 m above LNT.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC







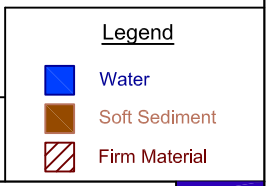


Figure 7 Port of Stephenville cross section.

Project No.	Document Reference
3113	FFC-NL-3113-008
Location	Date
Stephenville, NL	June 2018

FFC

APPENDIX A

DCPT Logs

Project: Geotechnical/Environmental Assessment

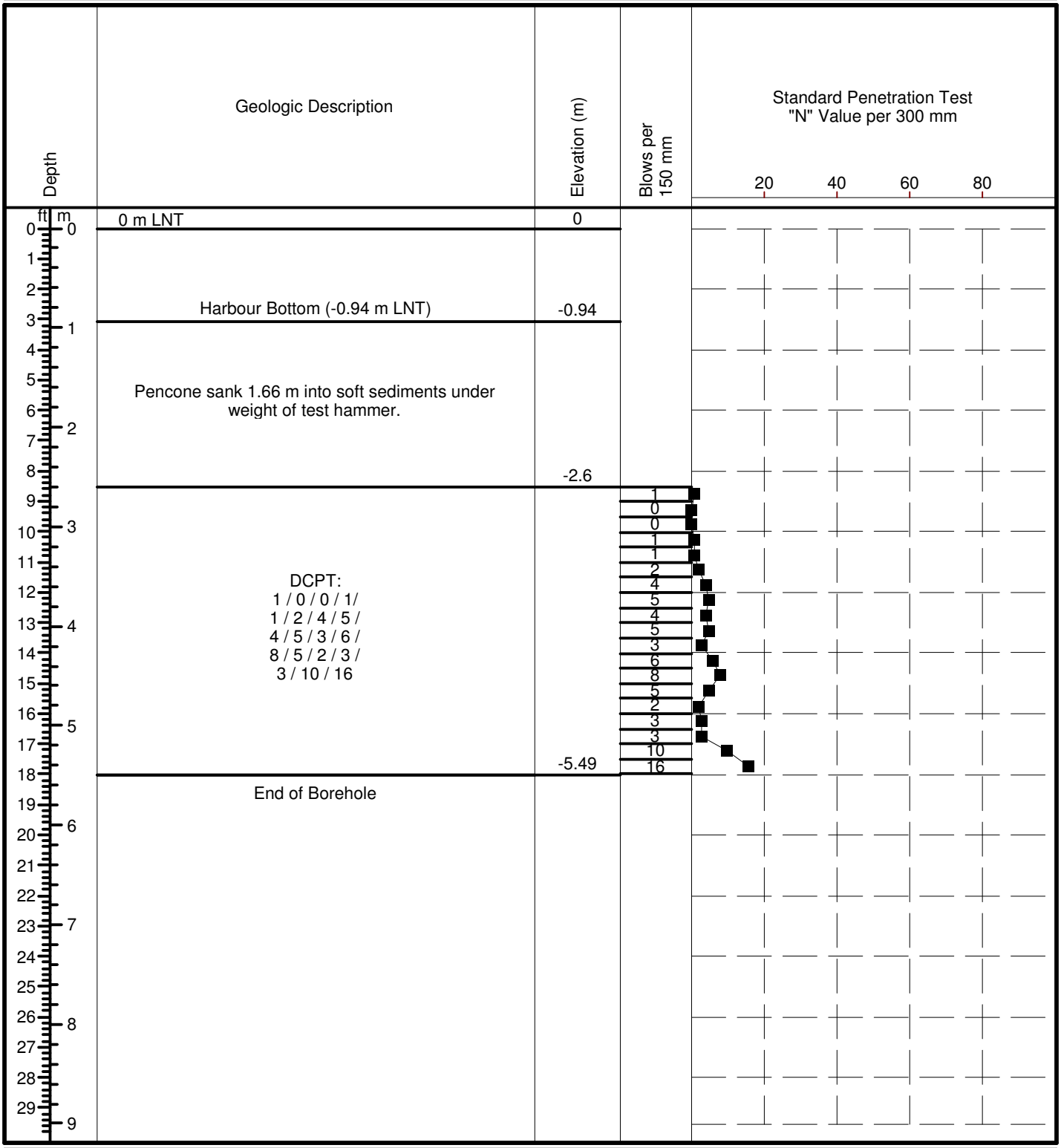
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC1

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 1

Project: Geotechnical/Environmental Assessment

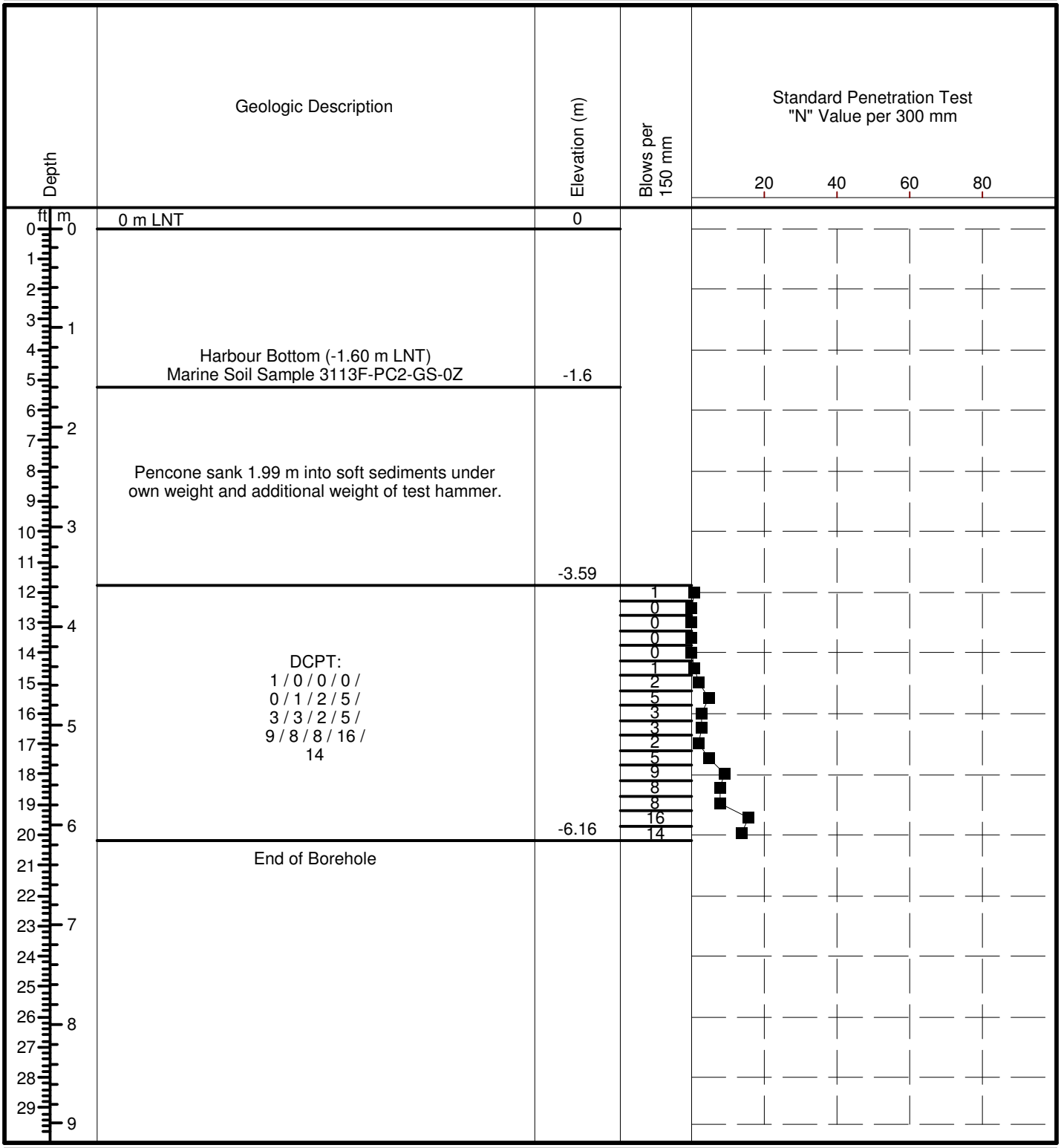
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC2

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynmaic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 1

Project: Geotechnical/Environmental Assessment

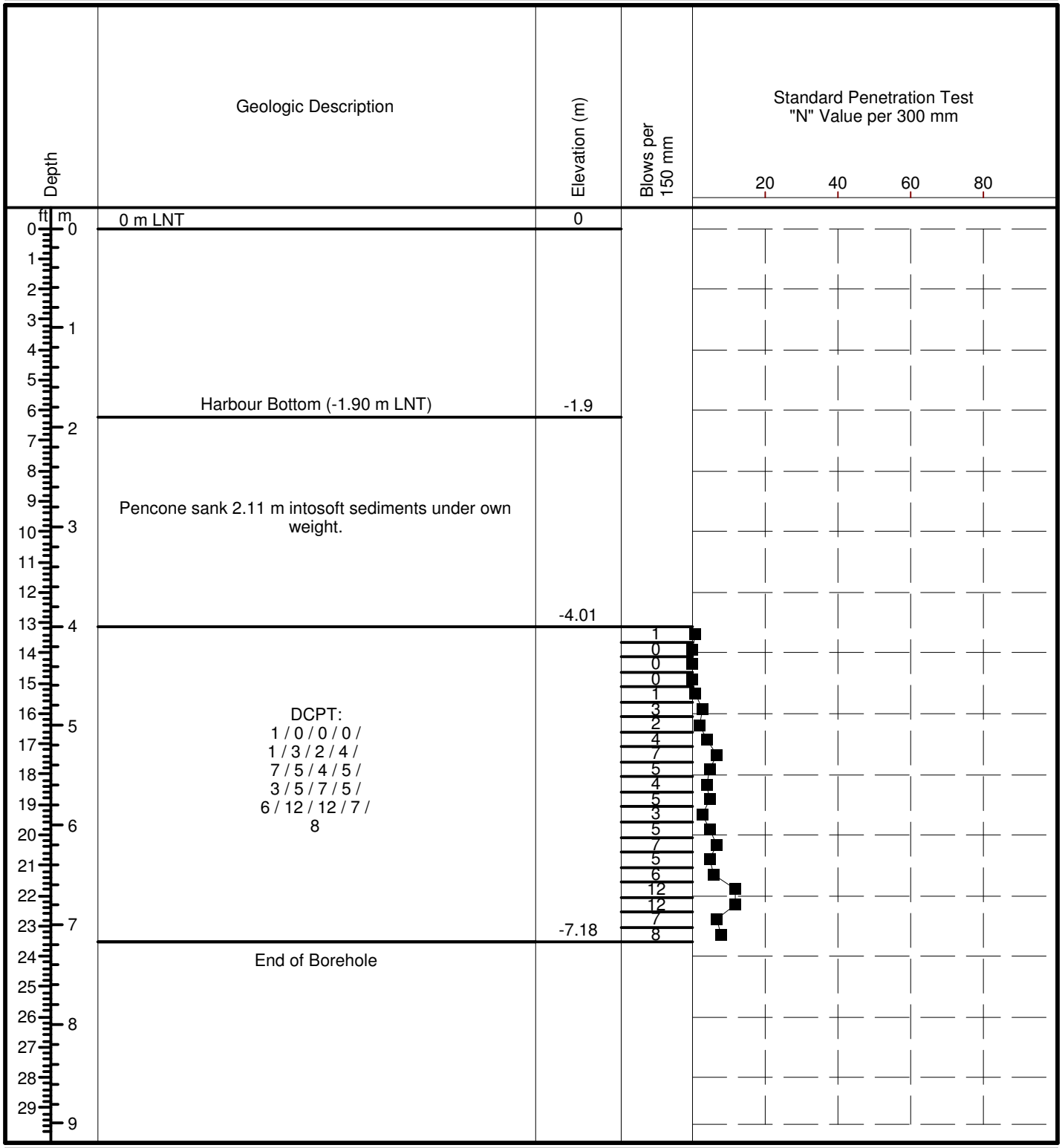
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC3

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 1

Project: Geotechnical/Environmental Assessment

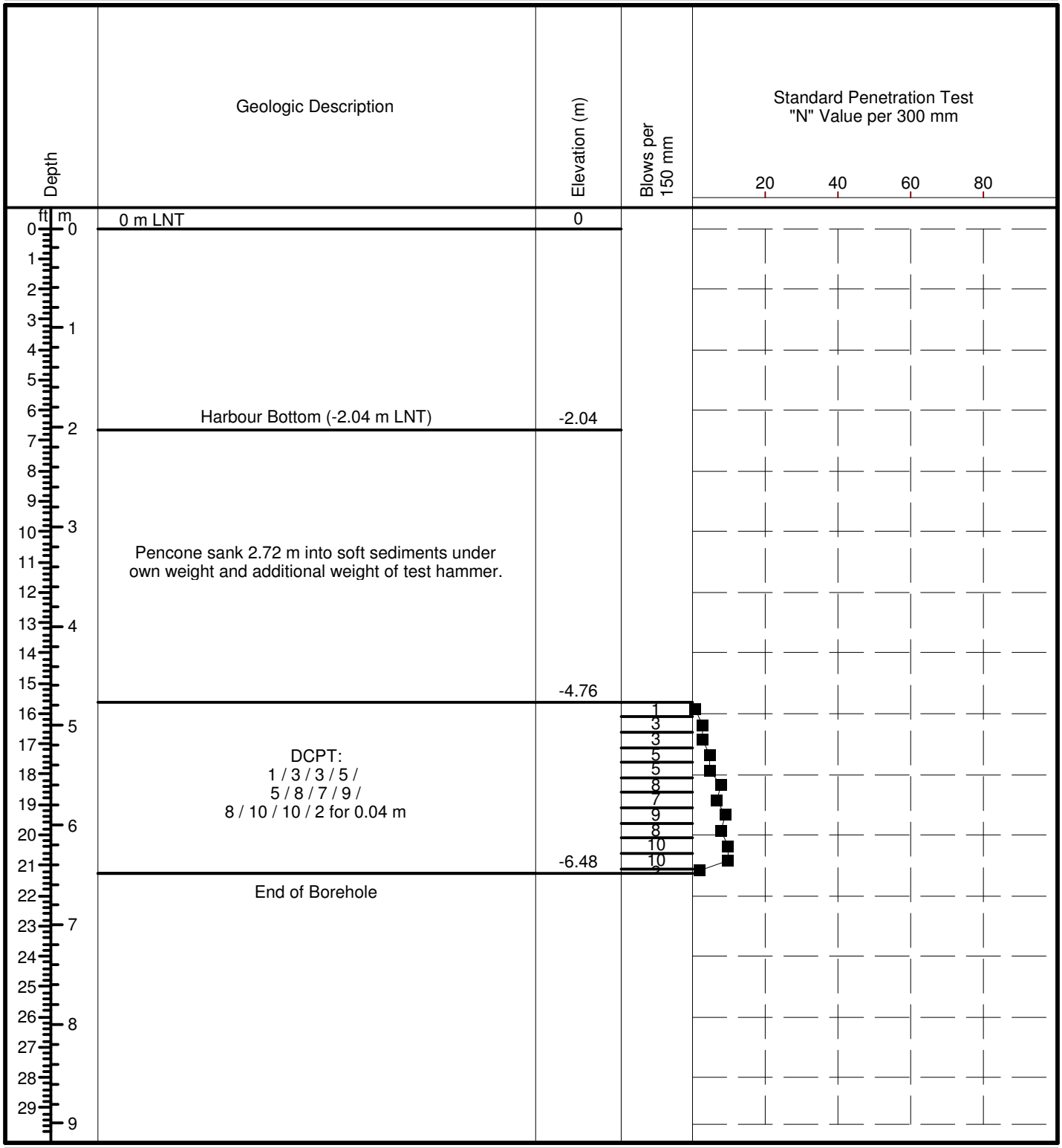
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC4

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 1

Project: Geotechnical/Environmental Assessment

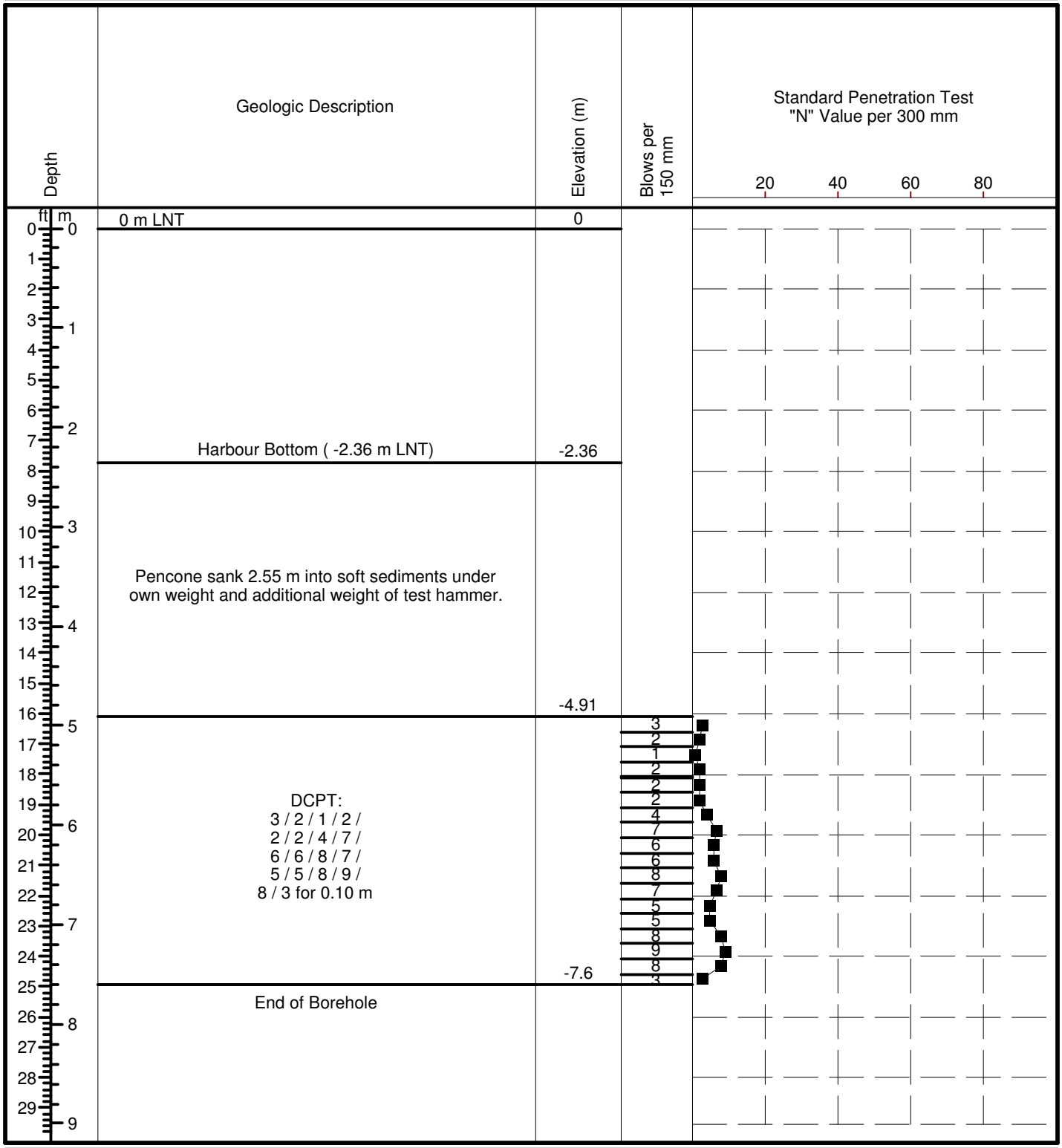
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC5

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 1

Project: Geotechnical/Environmental Assessment

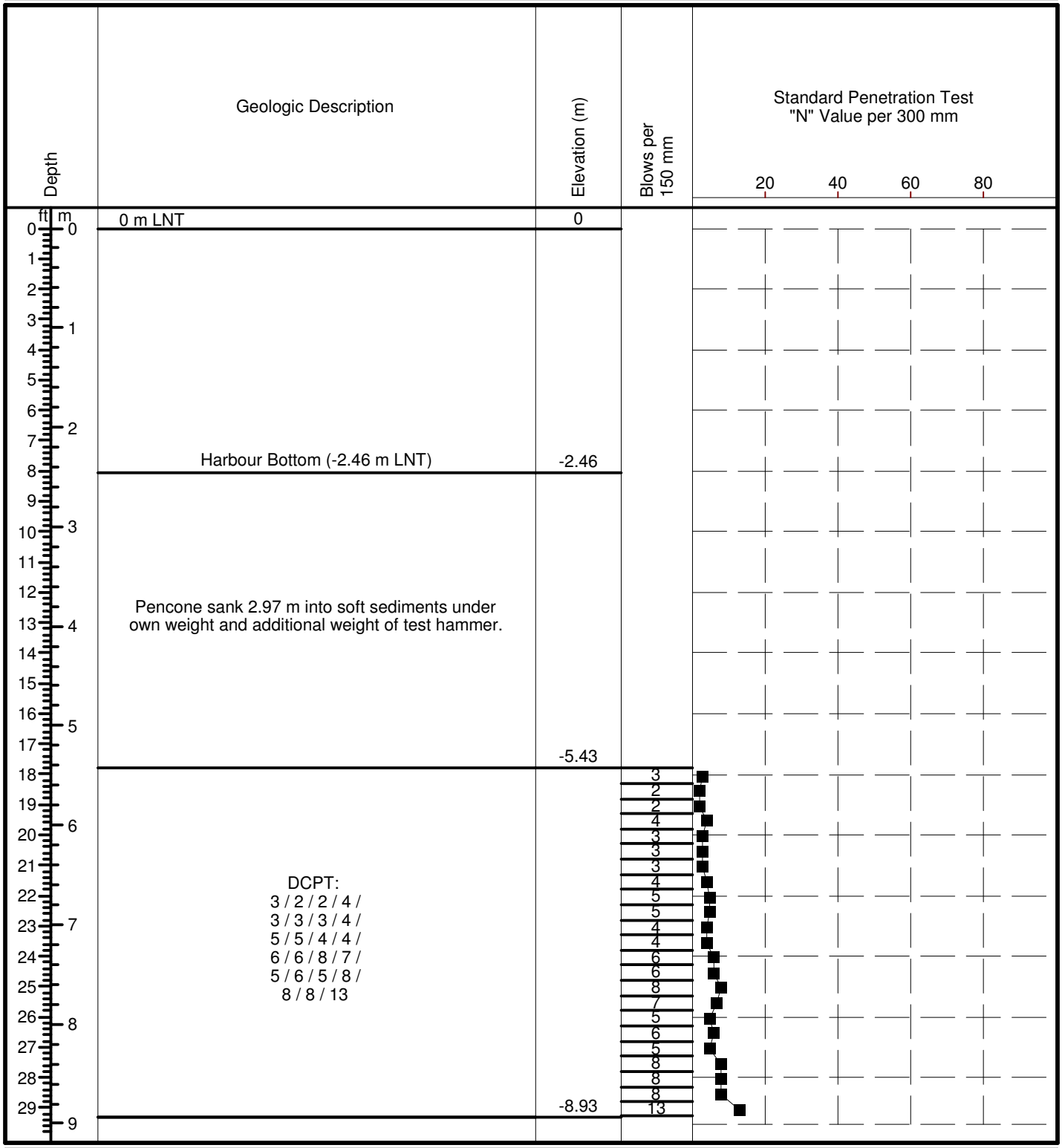
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC6

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 1

Project: Geotechnical/Environmental Assessment

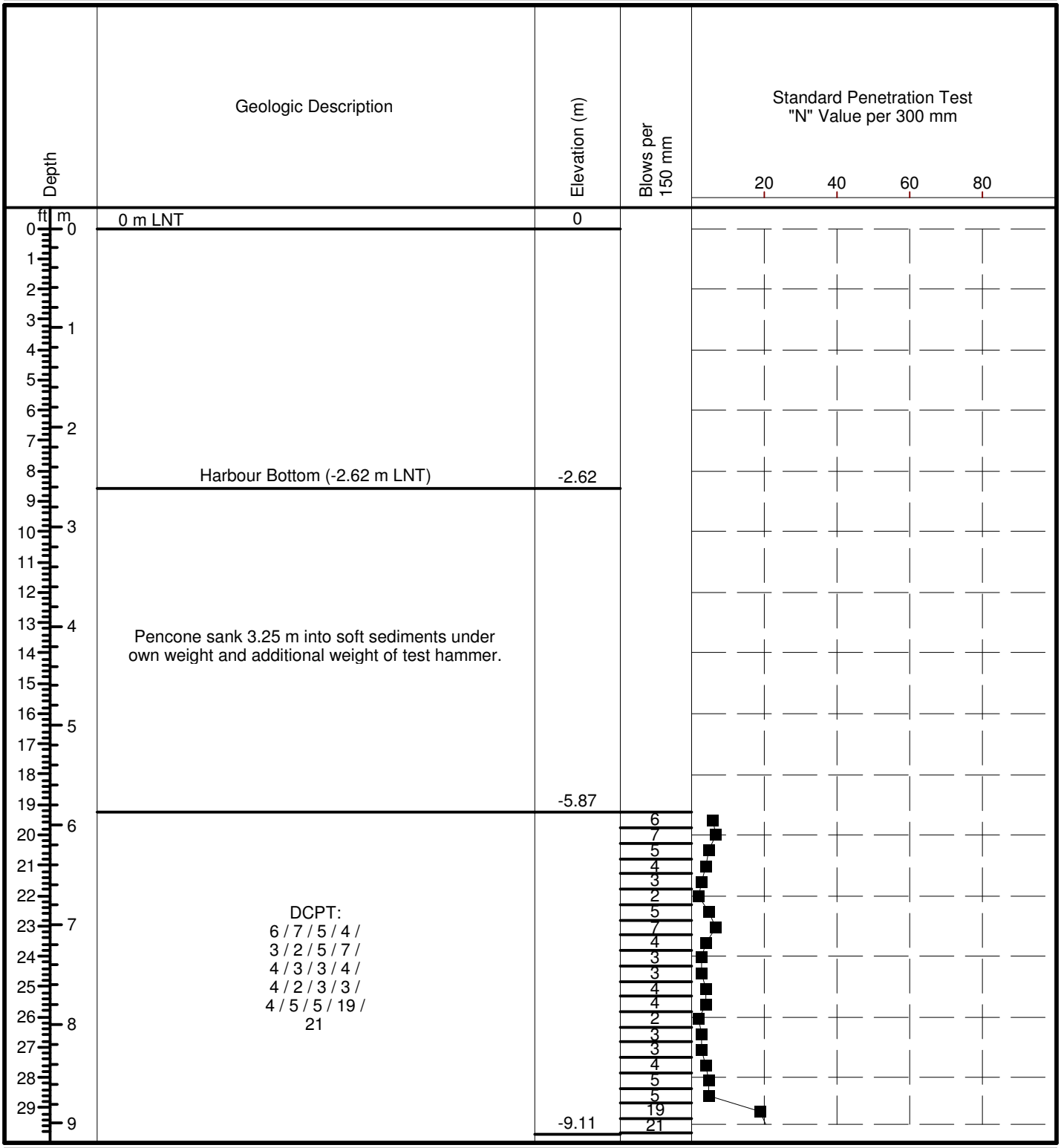
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC7

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

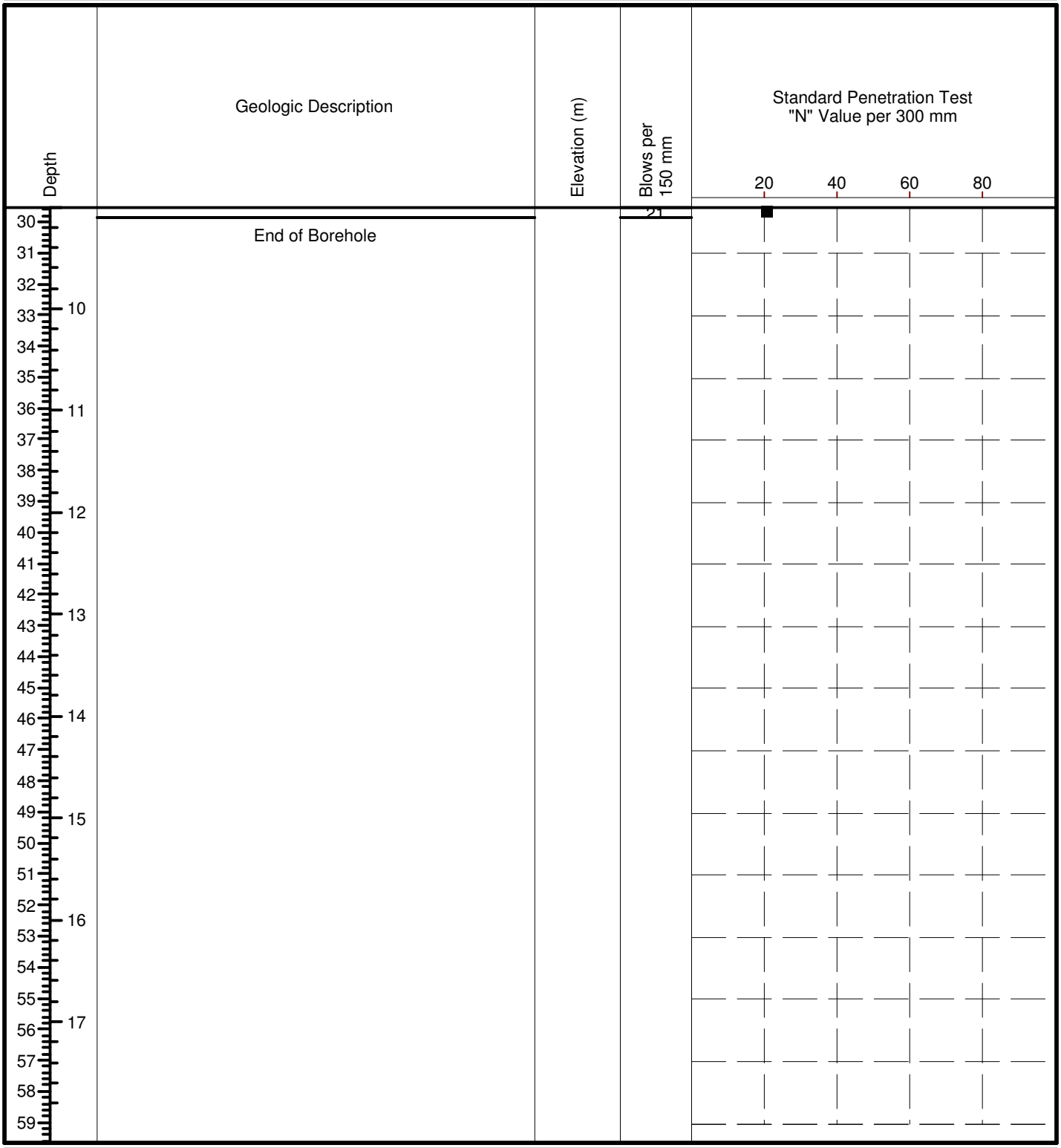
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC7

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

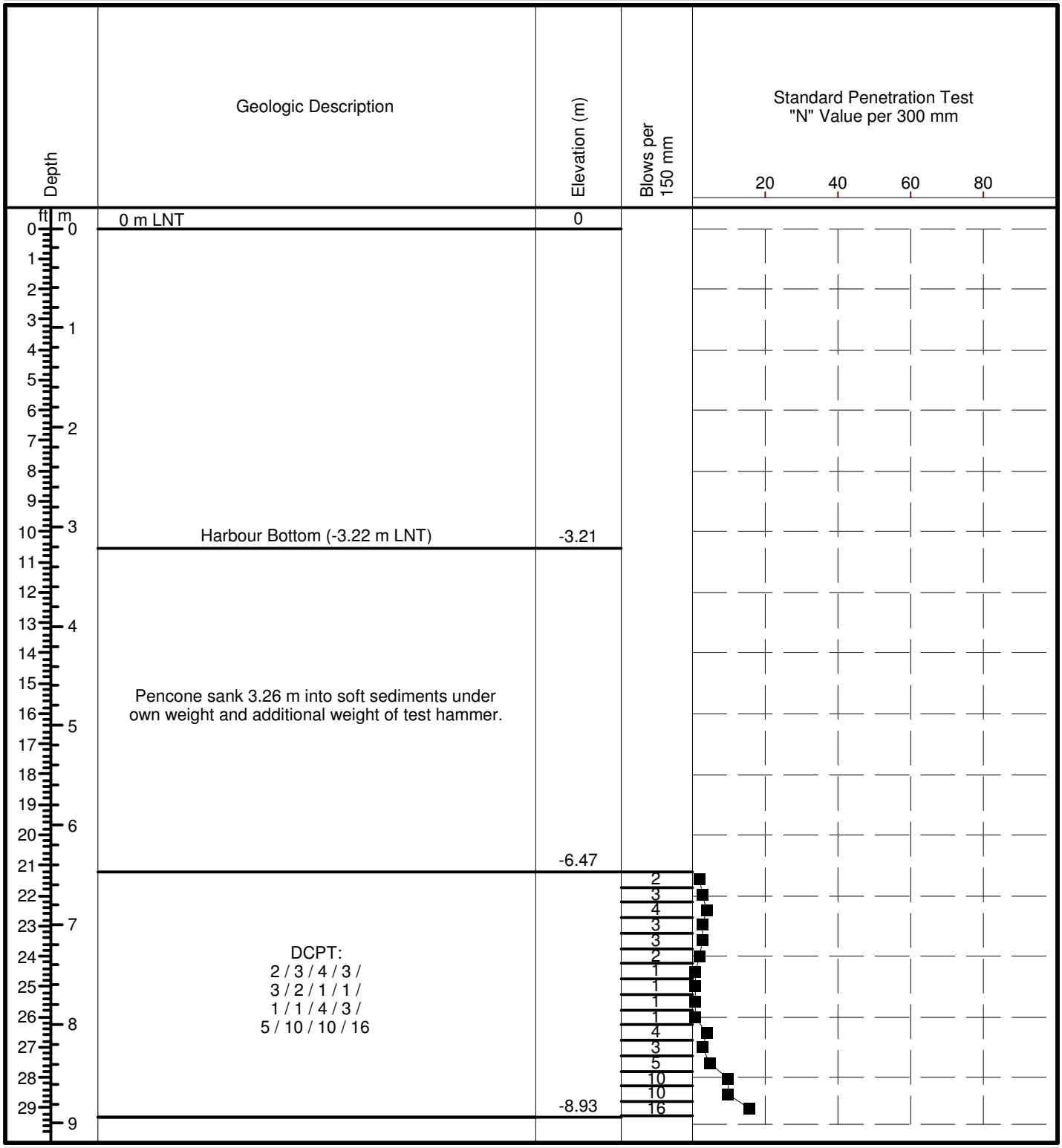
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC8

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 1

Project: Geotechnical/Enviornmental Assessment

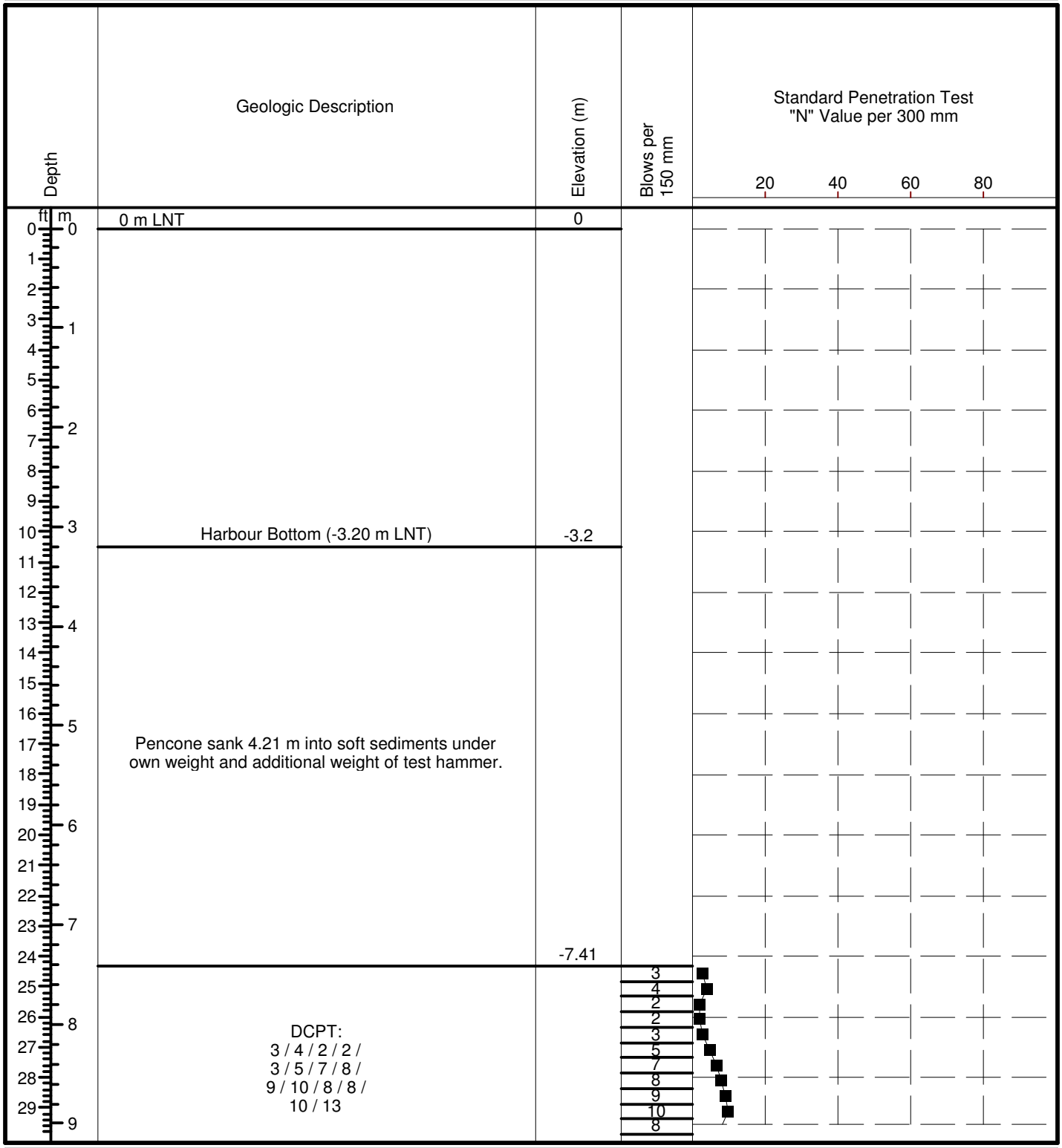
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC9

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Enviornmental Assessment

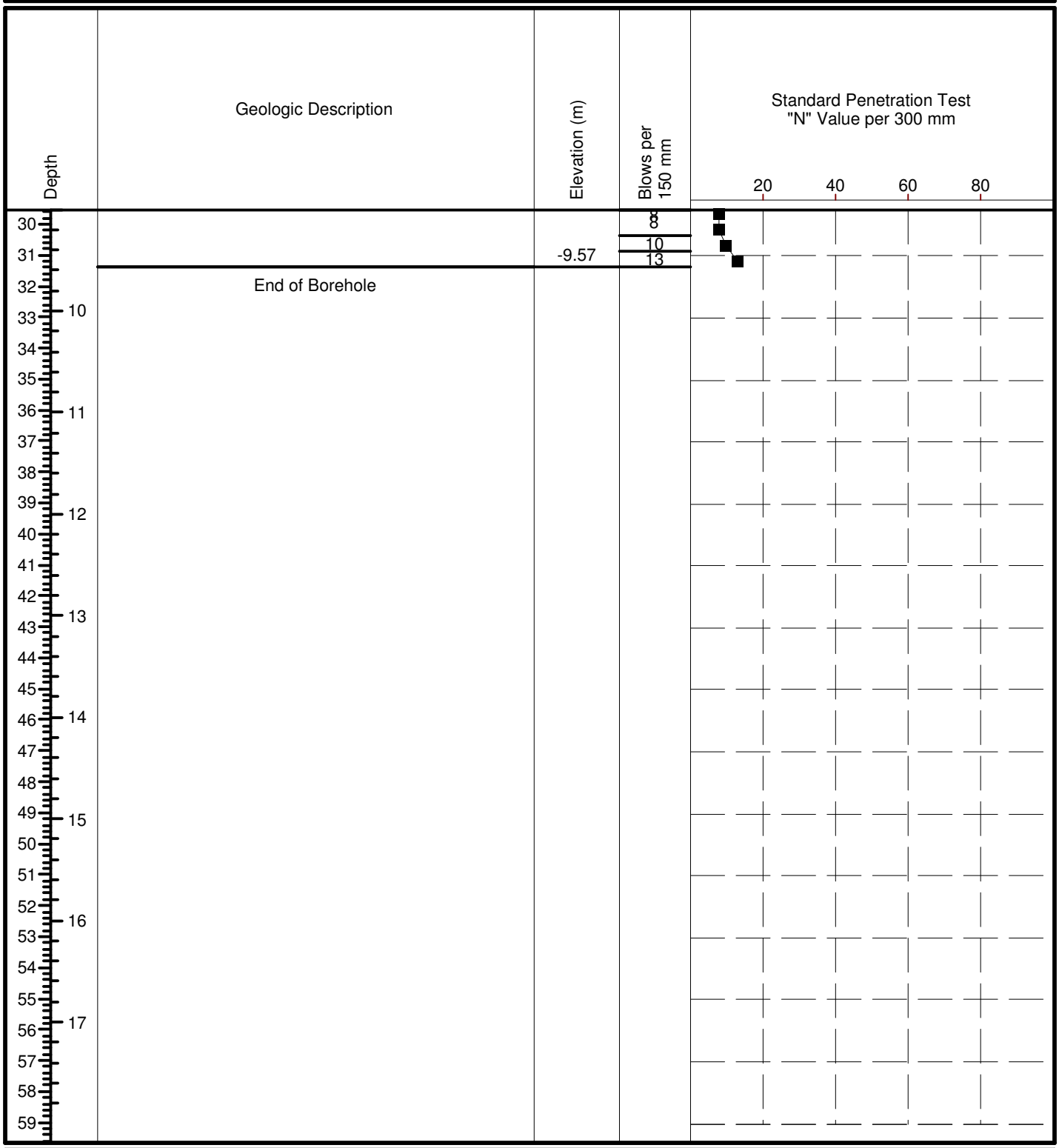
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC9

Project No: 3113

Date: May 19, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

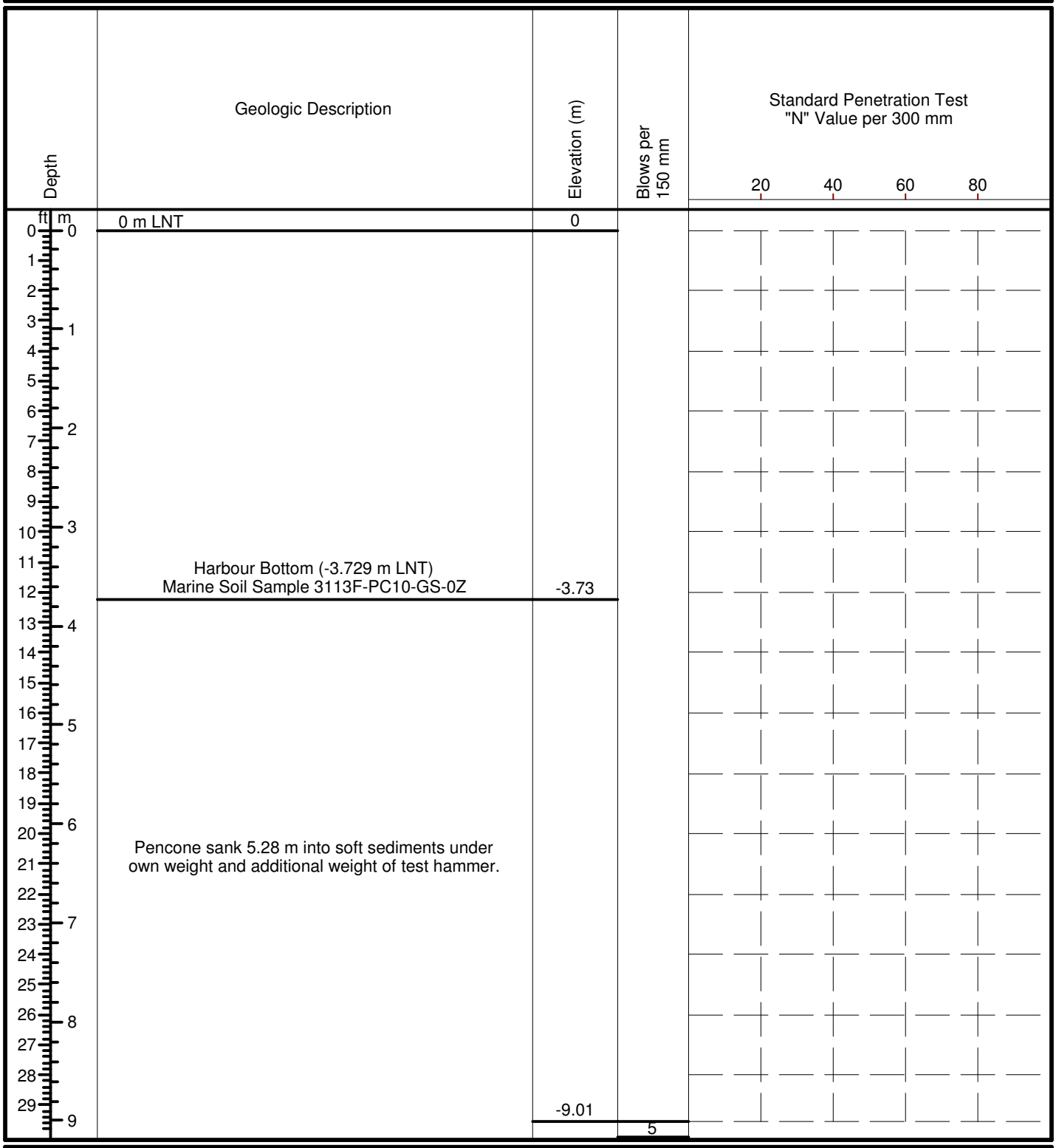
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC10

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

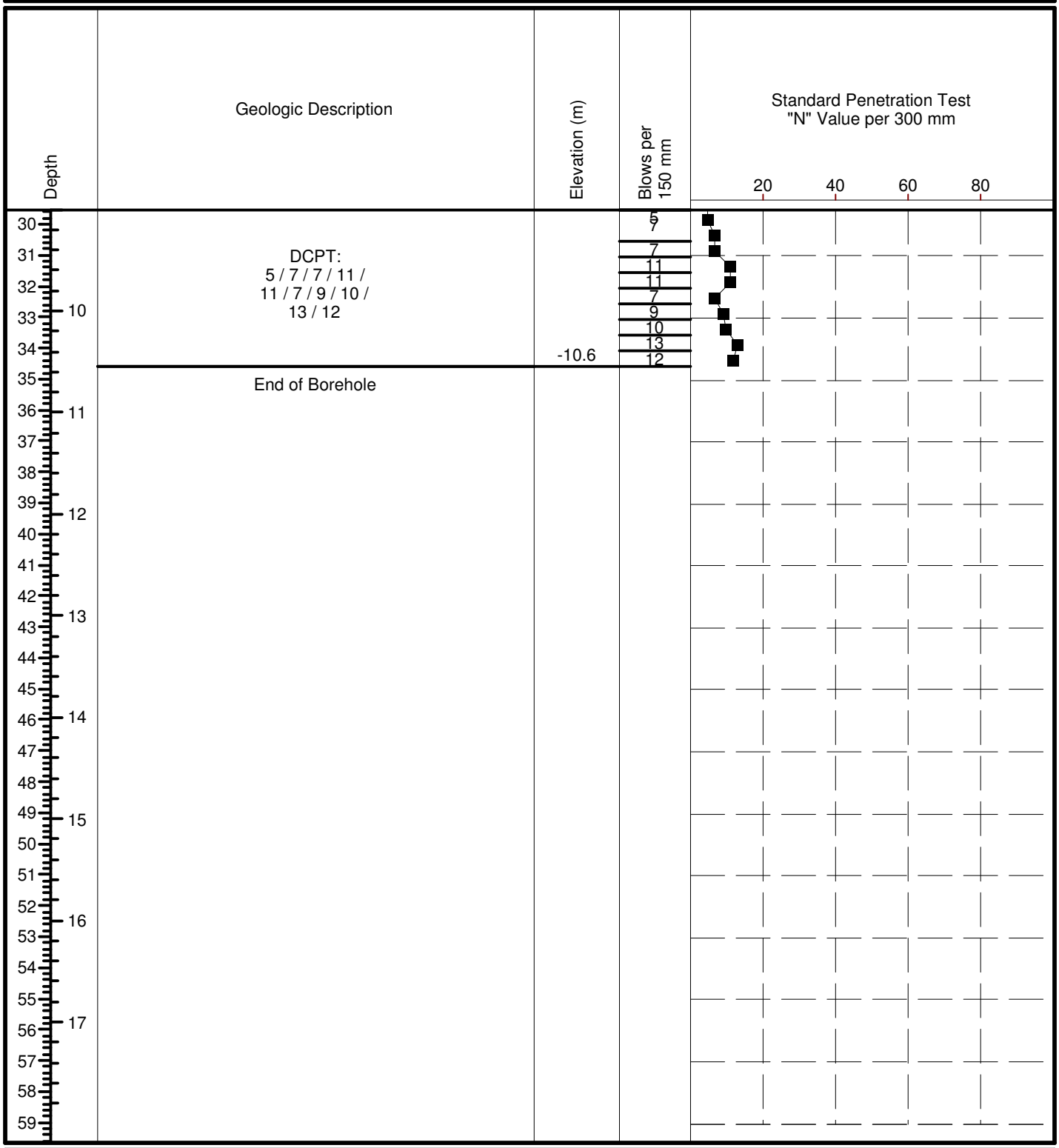
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC10

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

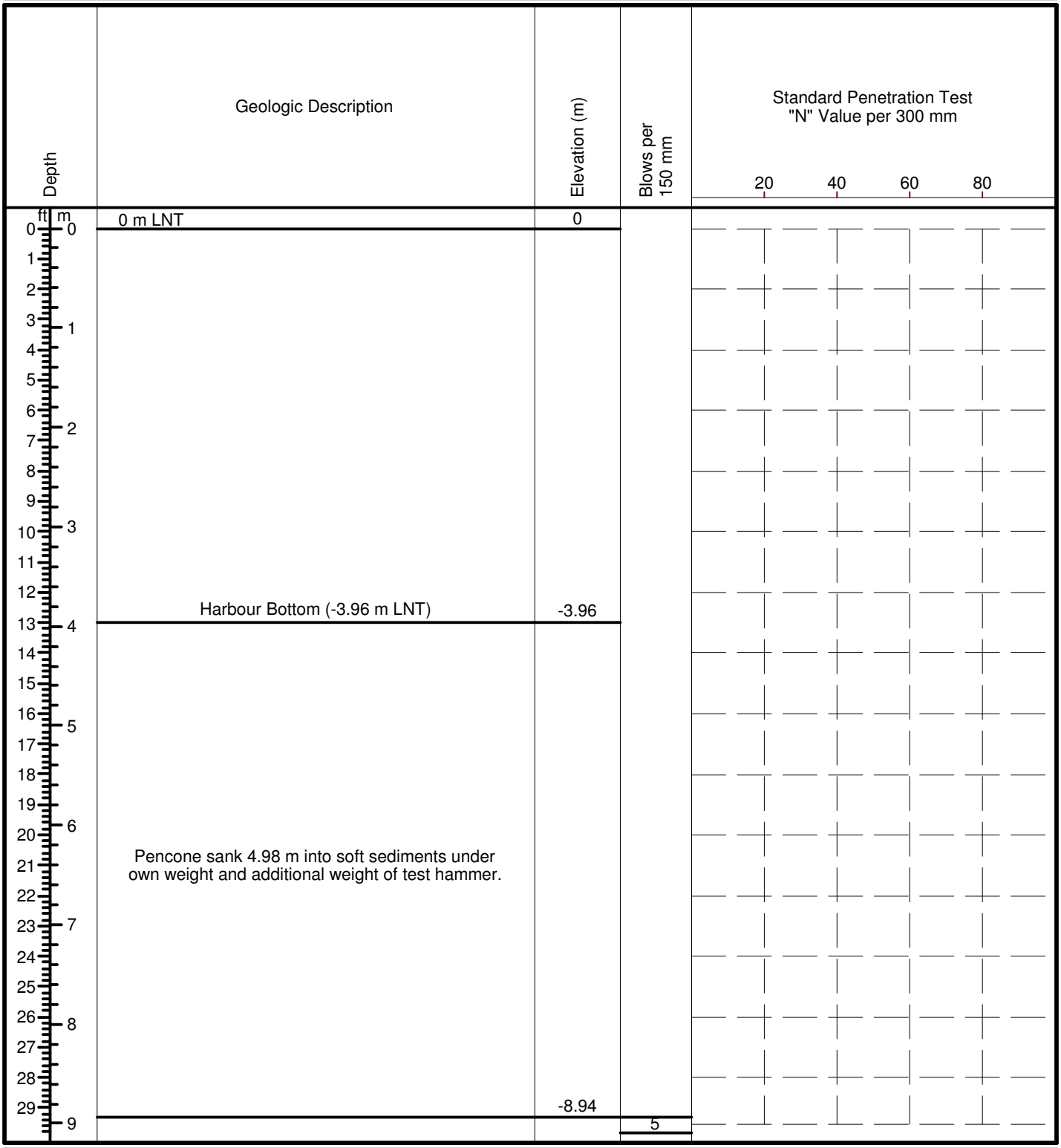
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC11

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

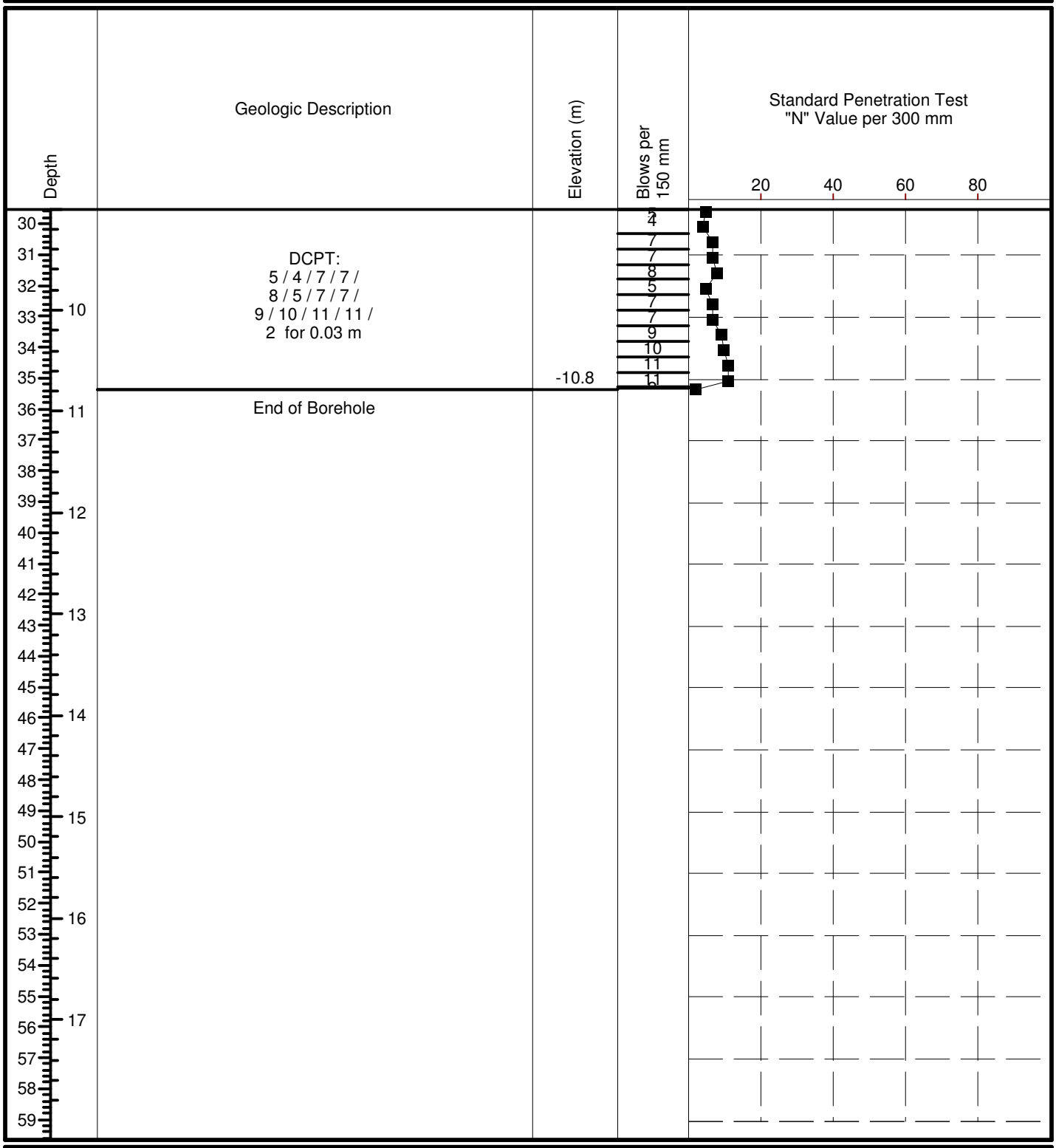
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC11

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

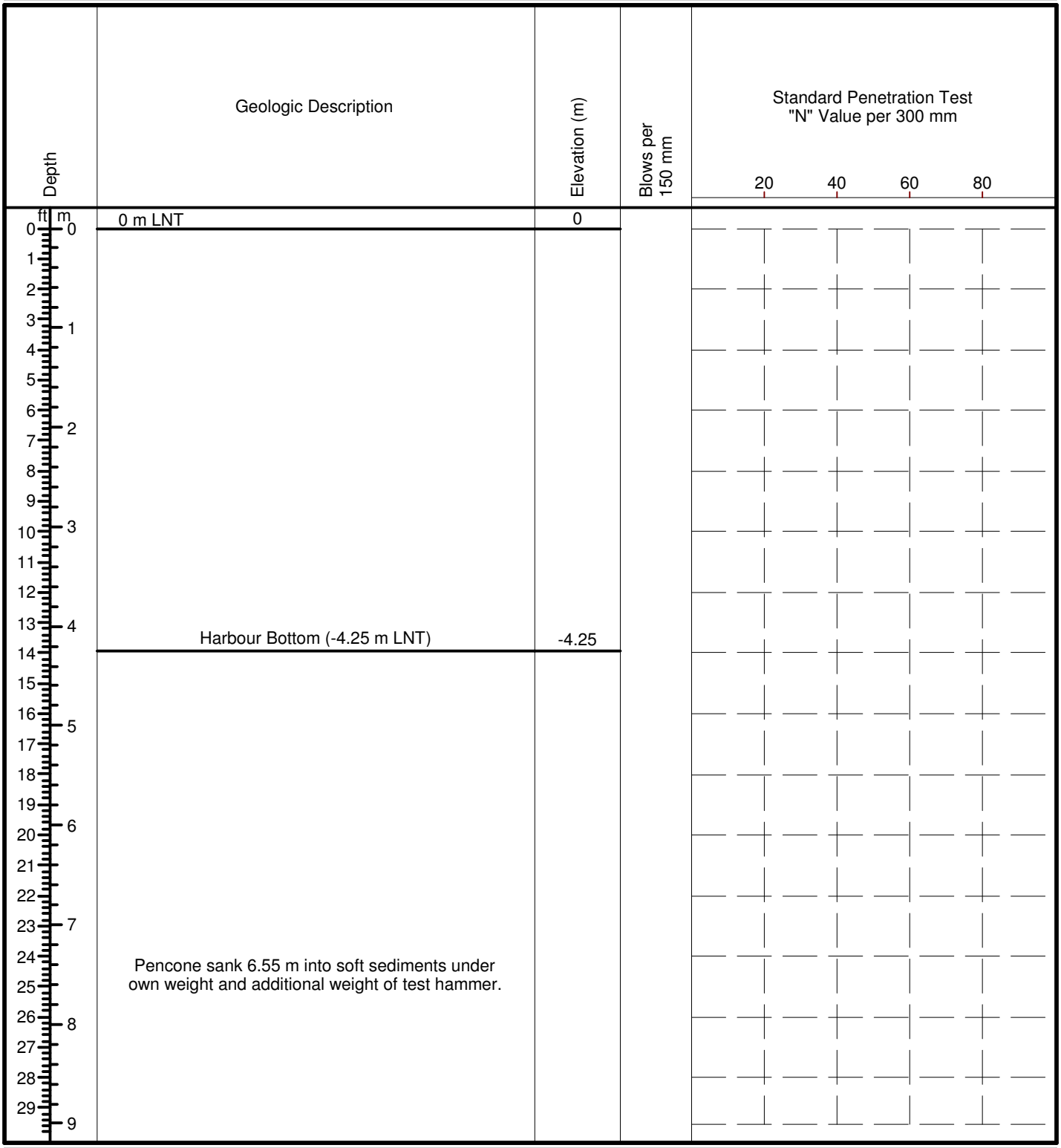
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC12

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

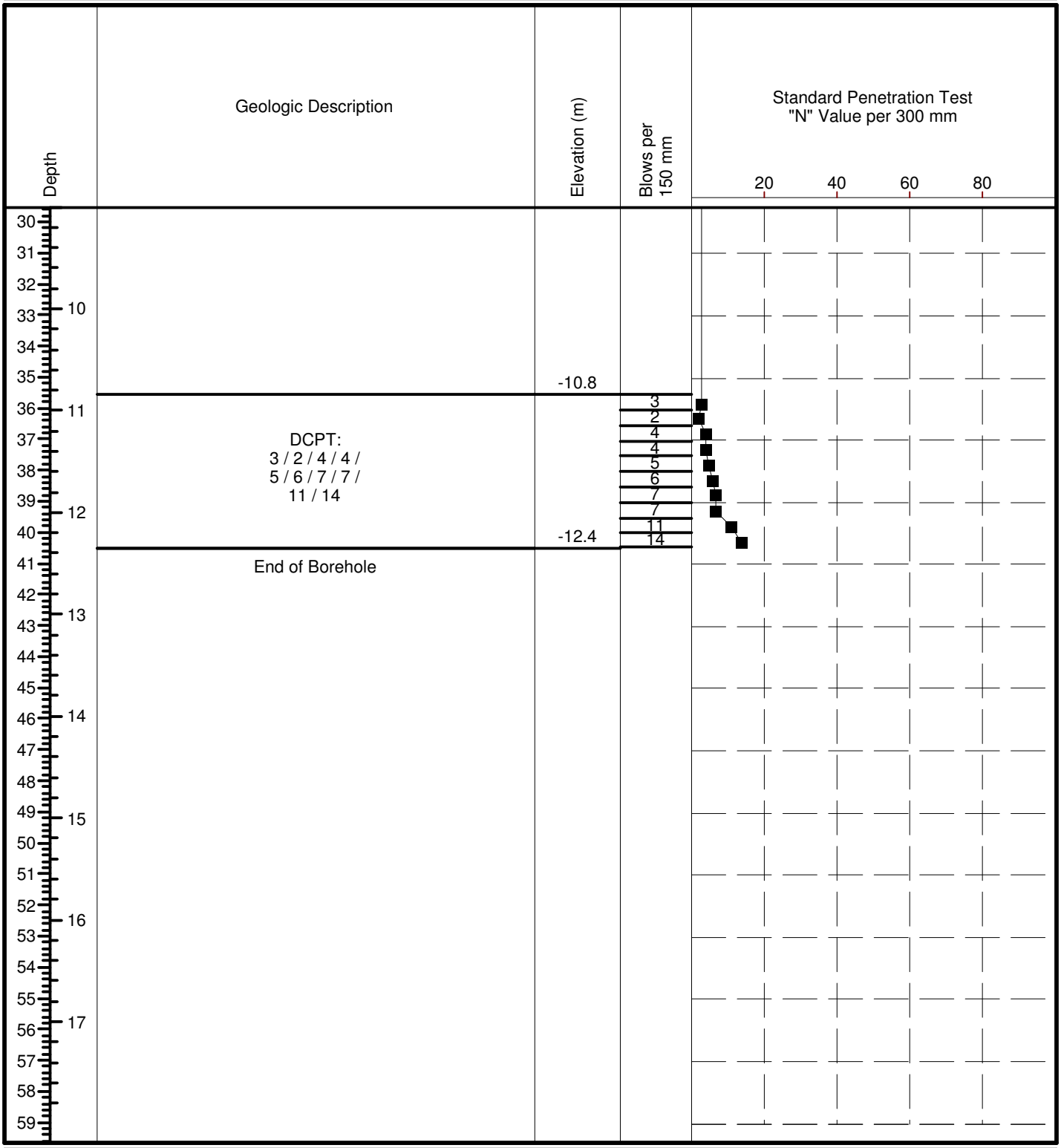
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC12

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

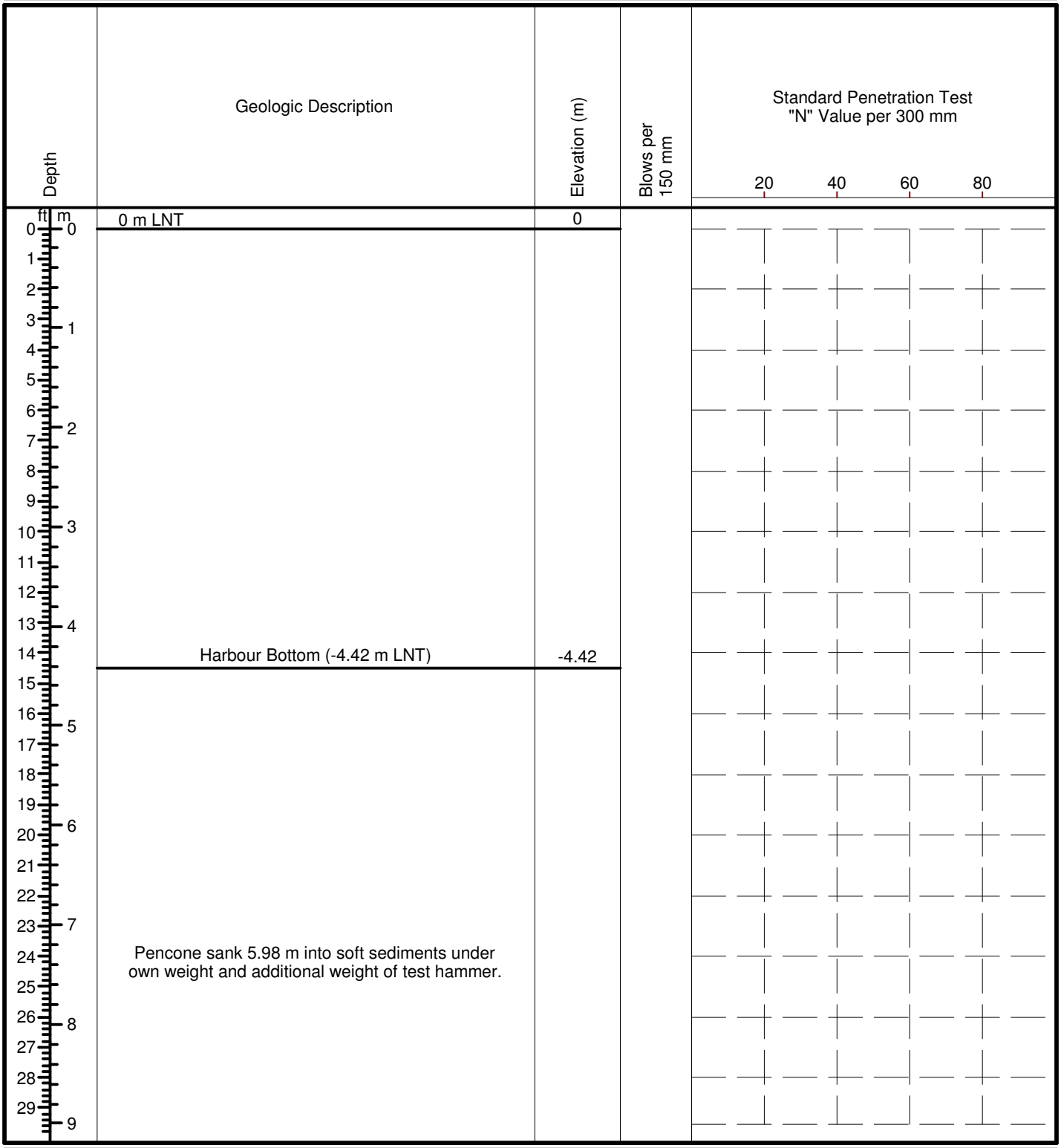
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC13

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

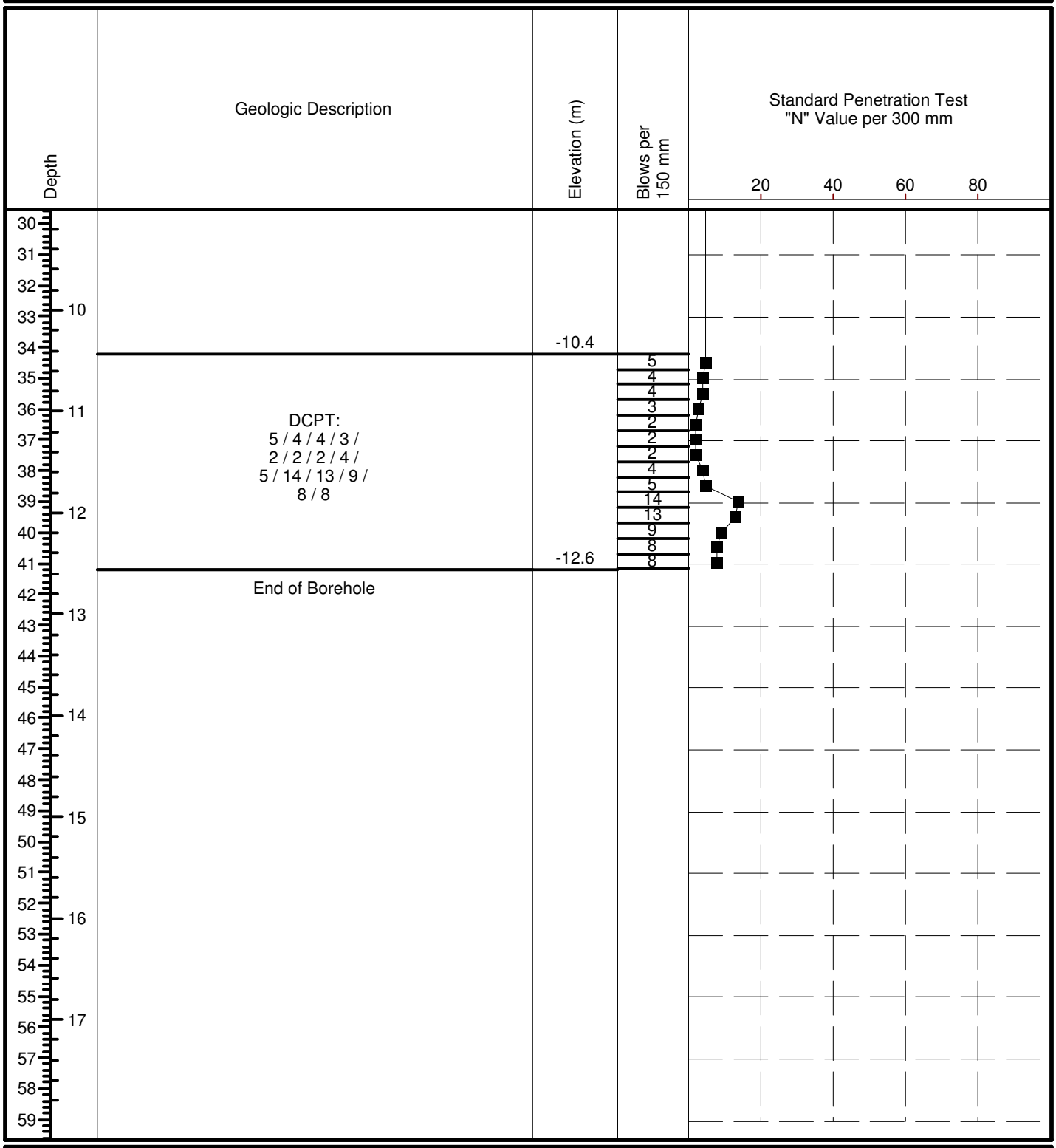
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC13

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

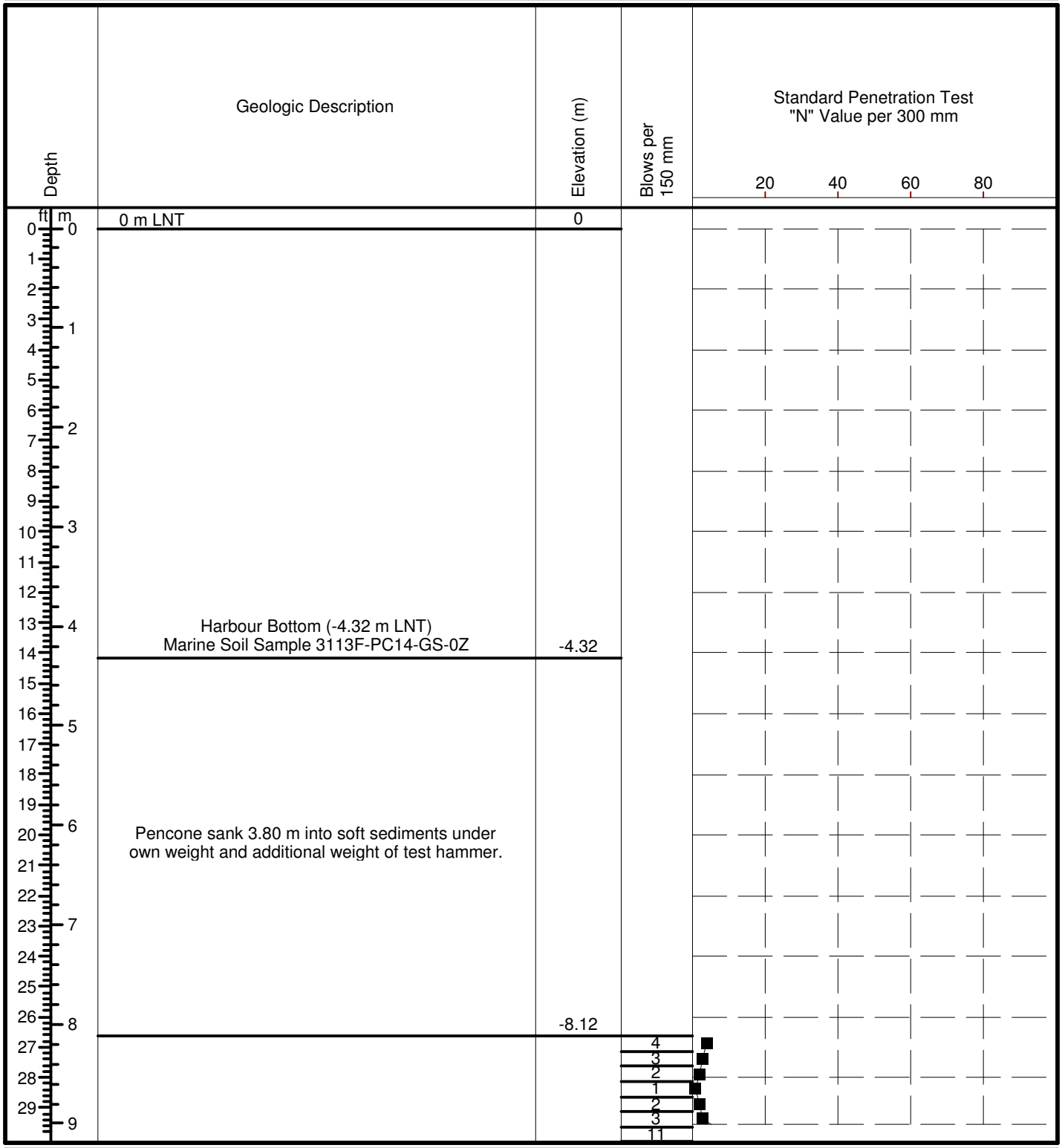
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC14

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Project: Geotechnical/Environmental Assessment

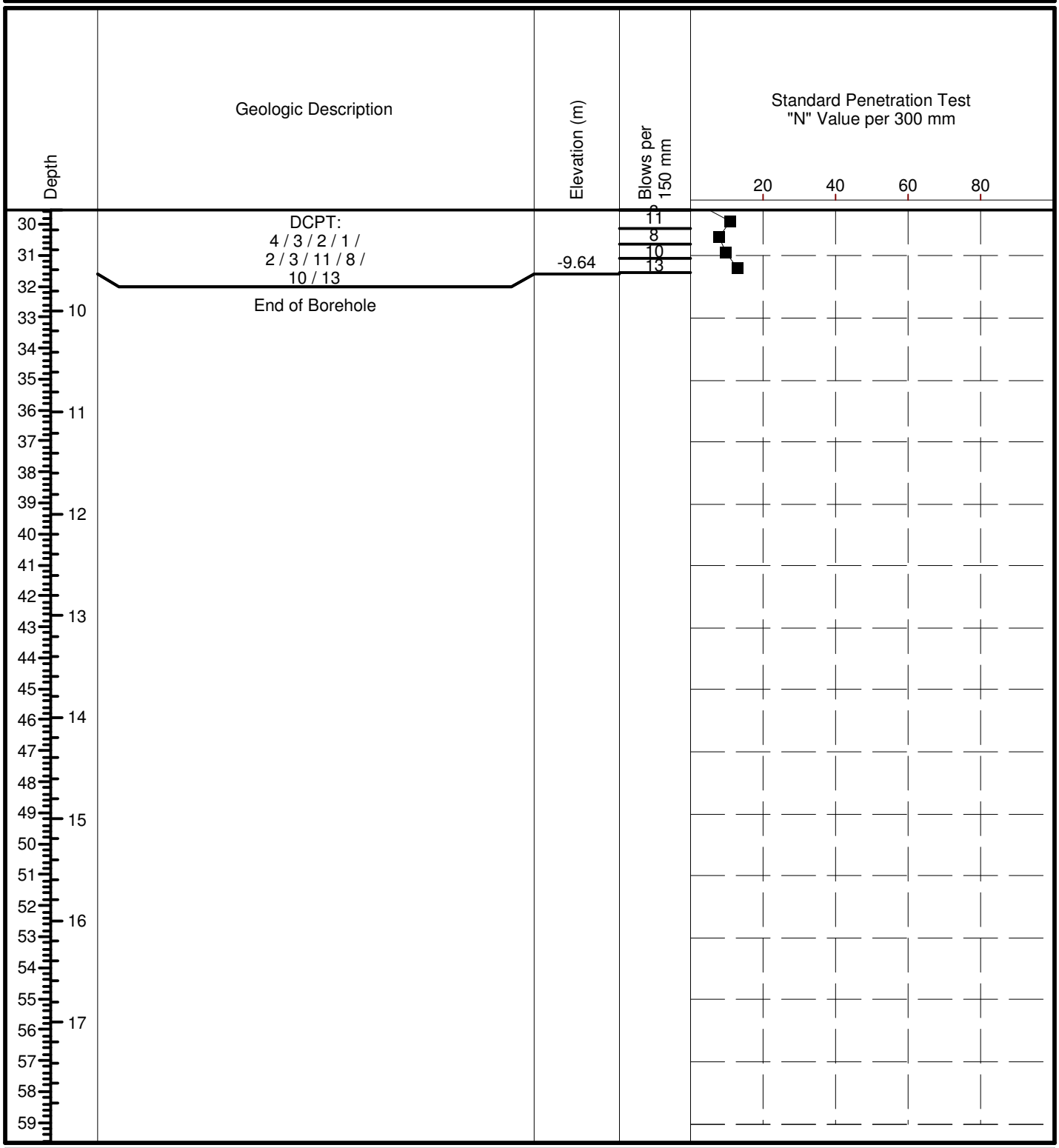
Client: Marine Harvest Atlantic Canada

Location: Stephenville, NL

Log of DCPT: PC14

Project No: 3113

Date: May 21, 2018



Fracflow Consultants Inc.
154 Major's Path
St. John's, NL A1A 5A1
Phone: (709) 739-7270
Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

APPENDIX B

Laboratory Analyses

AGAT Laboratories

57 Old Pennywell Road, Unit I
St. John's, NL
CANADA A1E 6A8
TEL (709)747-8573
FAX (709 747-2139
http://www.agatlabs.com

CLIENT NAME: FRACFLOW CONSULTANTS
154 MAJOR'S PATH
ST. JOHN'S PATH, NL A1A5A1
(709) 739-7270

ATTENTION TO: John Gale

PROJECT: 3113-Stephenville

AGAT WORK ORDER: 18K342748

SOIL ANALYSIS REVIEWED BY: Laura Baker, Inorganics Data Reporter

TRACE ORGANICS REVIEWED BY: Kelly Hogue, B.Sc, P.Chem, Operations Manager

DATE REPORTED: Jun 04, 2018

PAGES (INCLUDING COVER): 12

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (709)747-8573

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

57 Old Pennywell Road, Unit I
St. John's, NL
CANADA A1E 6A8
TEL (709)747-8573
FAX (709 747-2139
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18K342748

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Available Metals in Soil

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-04

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION: 3113F-PC2-GS-0Z	3113F-PC10-GS-0Z	3113F-PC14-GS-0Z
				SAMPLE TYPE: Soil	Soil	Soil
				DATE SAMPLED: 2018-05-21	2018-05-21	2018-05-21
				9268803	9268804	9268805
Aluminum	mg/kg		10	9580	13900	14900
Antimony	mg/kg		1	<1	<1	<1
Arsenic	mg/kg		1	6	11	11
Barium	mg/kg		5	15	31	32
Beryllium	mg/kg		2	<2	<2	<2
Boron	mg/kg		2	23	91	105
Cadmium	mg/kg		0.3	<0.3	0.7	0.8
Chromium	mg/kg		2	30	38	40
Cobalt	mg/kg		1	9	9	10
Copper	mg/kg		2	12	25	29
Iron	mg/kg		50	19000	23700	24000
Lead	mg/kg		0.5	4.9	13.4	13.2
Lithium	mg/kg		5	17	18	20
Manganese	mg/kg		2	250	263	261
Molybdenum	mg/kg		2	12	7	10
Nickel	mg/kg		2	29	33	36
Selenium	mg/kg		1	<1	<1	<1
Silver	mg/kg		0.5	<0.5	<0.5	<0.5
Strontium	mg/kg		5	24	63	137
Thallium	mg/kg		0.1	<0.1	0.2	0.2
Tin	mg/kg		2	2	2	<2
Uranium	mg/kg		0.1	1.3	2.4	4.2
Vanadium	mg/kg		2	41	58	57
Zinc	mg/kg		5	53	73	175

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9268803-9268805 Results are based on the dry weight of the sample.

Certified By: Laura Baker

AGAT Laboratories

57 Old Pennywell Road, Unit I
St. John's, NL
CANADA A1E 6A8
TEL (709)747-8573
FAX (709 747-2139
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18K342748

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Mercury Analysis in Soil

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-04

SAMPLE DESCRIPTION:				3113F-PC2-GS-0Z	3113F-PC10-GS-0Z	3113F-PC14-GS-0Z
SAMPLE TYPE:				Soil	Soil	Soil
DATE SAMPLED:				2018-05-21	2018-05-21	2018-05-21
Parameter	Unit	G / S	RDL	9268803	9268804	9268805
Mercury	mg/kg		0.05	<0.05	<0.05	<0.05

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9268803-9268805 Results are based on the dry weight of the soil.

Certified By:

AGAT Laboratories

57 Old Pennywell Road, Unit I
St. John's, NL
CANADA A1E 6A8
TEL (709)747-8573
FAX (709 747-2139
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18K342748

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Moisture

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-04

Parameter	Unit	G / S	RDL	3113F-PC2-GS-0Z Soil 2018-05-21 9268803	3113F-PC10-GS-0Z Soil 2018-05-21 9268804	3113F-PC14-GS-0Z Soil 2018-05-21 9268805
% Moisture	%			48	79	74

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Kelly Hogue

AGAT Laboratories

57 Old Pennywell Road, Unit I
St. John's, NL
CANADA A1E 6A8
TEL (709)747-8573
FAX (709 747-2139
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18K342748

PROJECT: 3113-Stephenville

CLIENT NAME: FRACFLOW CONSULTANTS

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Polycyclic Aromatic Hydrocarbons in Soil

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-04

				3113F-PC2-GS-0Z	3113F-PC10-GS-0Z	3113F-PC14-GS-0Z
SAMPLE DESCRIPTION:						
SAMPLE TYPE:				Soil	Soil	Soil
DATE SAMPLED:				2018-05-21	2018-05-21	2018-05-21
Parameter	Unit	G / S	RDL	9268803	9268804	9268805
1-Methylnaphthalene	mg/kg		0.05	<0.05	<0.05	<0.05
2-Methylnaphthalene	mg/kg		0.01	<0.01	<0.01	<0.01
Acenaphthene	mg/kg		0.00671	<0.00671	<0.00671	<0.00671
Acenaphthylene	mg/kg		0.004	<0.004	<0.004	<0.004
Acridine	mg/kg		0.05	<0.05	<0.05	<0.05
Anthracene	mg/kg		0.03	<0.03	<0.03	<0.03
Benzo(a)anthracene	mg/kg		0.01	<0.01	<0.01	0.02
Benzo(a)pyrene	mg/kg		0.01	<0.01	<0.01	0.02
Benzo(b)fluoranthene	mg/kg		0.05	<0.05	<0.05	<0.05
Benzo(b+j)fluoranthene	mg/kg		0.1	<0.1	<0.1	<0.1
Benzo(e)pyrene	mg/kg		0.05	<0.05	<0.05	<0.05
Benzo(ghi)perylene	mg/kg		0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	mg/kg		0.01	<0.01	0.01	0.05
Chrysene	mg/kg		0.01	<0.01	<0.01	0.03
Dibenzo(a,h)anthracene	mg/kg		0.006	<0.006	<0.006	<0.006
Fluoranthene	mg/kg		0.05	<0.05	<0.05	<0.05
Fluorene	mg/kg		0.01	<0.01	<0.01	<0.01
Indeno(1,2,3)pyrene	mg/kg		0.01	<0.01	<0.01	<0.01
Naphthalene	mg/kg		0.01	<0.01	0.02	0.02
Perylene	mg/kg		0.05	<0.05	<0.05	0.08
Phenanthrene	mg/kg		0.03	<0.03	<0.03	0.03
Pyrene	mg/kg		0.05	<0.05	<0.05	<0.05
Quinoline	mg/kg		0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits				
Nitrobenzene-d5	%	50-140		96	52	91
2-Fluorobiphenyl	%	50-140		101	50	93
Terphenyl-d14	%	50-140		69	NA	80

Certified By: Kelly Hogue

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 18K342748

PROJECT: 3113-Stephenville

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Polycyclic Aromatic Hydrocarbons in Soil

DATE RECEIVED: 2018-05-25

DATE REPORTED: 2018-06-04

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9268803-9268805 Results are based on the dry weight of the soil.

Benzo(b)fluoranthene may include contributions from benzo(j)fluoranthene, if also present in the sample.

Certified By: Kelly Hogue

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K342748

PROJECT: 3113-Stephenville

ATTENTION TO: John Gale

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Jun 04, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Available Metals in Soil															
Aluminum	9275620		10900	10900	0.1%	< 10	105%	80%	120%	105%	80%	120%	110%	70%	130%
Antimony	9275620		<1	<1	NA	< 1	92%	80%	120%	104%	80%	120%	NA	70%	130%
Arsenic	9275620		45	41	9.8%	< 1	97%	80%	120%	97%	80%	120%	93%	70%	130%
Barium	9275620		136	140	2.9%	< 5	97%	80%	120%	101%	80%	120%	84%	70%	130%
Beryllium	9275620		<2	<2	NA	< 2	110%	80%	120%	111%	80%	120%	96%	70%	130%
Boron	9275620		<2	<2	NA	< 2	106%	80%	120%	106%	80%	120%	90%	70%	130%
Cadmium	9275620		<0.3	<0.3	NA	< 0.3	97%	80%	120%	99%	80%	120%	94%	70%	130%
Chromium	9275620		17	17	0.0%	< 2	100%	80%	120%	102%	80%	120%	103%	70%	130%
Cobalt	9275620		5	5	0.0%	< 1	98%	80%	120%	100%	80%	120%	97%	70%	130%
Copper	9275620		47	58	NA	< 2	103%	80%	120%	102%	80%	120%	86%	70%	130%
Iron	9275620		60800	58100	4.5%	< 50	101%	80%	120%	105%	80%	120%	102%	70%	130%
Lead	9275620		196	201	2.2%	< 0.5	100%	80%	120%	104%	80%	120%	93%	70%	130%
Lithium	9275620		25	27	6.3%	< 5	109%	70%	130%	112%	70%	130%	104%	70%	130%
Manganese	9275620		233	240	2.8%	< 2	99%	80%	120%	102%	80%	120%	104%	70%	130%
Molybdenum	9275620		4	4	NA	< 2	94%	80%	120%	99%	80%	120%	85%	70%	130%
Nickel	9275620		11	11	2.9%	< 2	105%	80%	120%	101%	80%	120%	97%	70%	130%
Selenium	9275620		<1	1	NA	< 1	102%	80%	120%	102%	80%	120%	79%	70%	130%
Silver	9275620		<0.5	<0.5	NA	< 0.5	100%	80%	120%	103%	80%	120%	70%	70%	130%
Strontium	9275620		10	10	NA	< 5	97%	80%	120%	99%	80%	120%	94%	70%	130%
Thallium	9275620		0.1	0.1	NA	< 0.1	102%	80%	120%	110%	80%	120%	70%	70%	130%
Tin	9275620		8	5	NA	< 2	95%	80%	120%	99%	80%	120%	81%	70%	130%
Uranium	9275620		1.4	1.4	2.4%	< 0.1	99%	80%	120%	102%	80%	120%	105%	70%	130%
Vanadium	9275620		16	17	5.1%	< 2	96%	80%	120%	98%	80%	120%	105%	70%	130%
Zinc	9275620		76	81	6.1%	< 5	99%	80%	120%	100%	80%	120%	99%	70%	130%
Mercury Analysis in Soil															
Mercury	1	9268803	<0.05	<0.05	NA	< 0.05	81%	70%	130%	NA	70%	130%	98%	70%	130%

Certified By:

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Quality Assurance

CLIENT NAME: FRACFLOW CONSULTANTS
AGAT WORK ORDER: 18K342748
PROJECT: 3113-Stephenville
ATTENTION TO: John Gale
SAMPLING SITE:
SAMPLED BY:

Trace Organics Analysis

RPT Date: Jun 04, 2018

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Polycyclic Aromatic Hydrocarbons in Soil															
1-Methylnaphthalene	1	9268251	5.39	6.21	14.0%	< 0.05	99%	50%	140%	84%	50%	140%	NA	50%	140%
2-Methylnaphthalene	1	9268251	7.62	8.53	11.0%	< 0.01	97%	50%	140%	81%	50%	140%	NA	50%	140%
Acenaphthene	1	9268251	2.99	3.40	13.0%	< 0.00671	98%	50%	140%	81%	50%	140%	NA	50%	140%
Acenaphthylene	1	9268251	<0.004	<0.004	0.0%	< 0.004	94%	50%	140%	78%	50%	140%	NA	50%	140%
Acridine	1	9268251	0.81	0.86	6.0%	< 0.05	51%	50%	140%	52%	50%	140%	NA	50%	140%
Anthracene	1	9268251	1.95	2.47	24.0%	< 0.03	78%	50%	140%	61%	50%	140%	NA	50%	140%
Benzo(a)anthracene	1	9268251	1.77	2.73	43.0%	< 0.01	88%	50%	140%	62%	50%	140%	NA	50%	140%
Benzo(a)pyrene	1	9268251	1.35	2.16	46.0%	< 0.01	100%	50%	140%	71%	50%	140%	NA	50%	140%
Benzo(b)fluoranthene	1	9268251	1.08	2.23	69.0%	< 0.05	103%	50%	140%	93%	50%	140%	NA	50%	140%
Benzo(b+j)fluoranthene	1	9268251	1.85	3.11	51.0%	< 0.1	82%	50%	140%	87%	50%	140%	NA	50%	140%
Benzo(e)pyrene	1	9268251	1.57	2.24	35.0%	< 0.05	130%	50%	140%	109%	50%	140%	NA	50%	140%
Benzo(ghi)perylene	1	9268251	0.74	1.02	32.0%	< 0.01	82%	50%	140%	66%	50%	140%	NA	50%	140%
Benzo(k)fluoranthene	1	9268251	0.69	1.11	47.0%	< 0.01	105%	50%	140%	79%	50%	140%	NA	50%	140%
Chrysene	1	9268251	2.36	3.41	36.0%	< 0.01	94%	50%	140%	77%	50%	140%	NA	50%	140%
Dibenzo(a,h)anthracene	1	9268251	0.191	0.326	52.0%	< 0.006	63%	50%	140%	55%	50%	140%	NA	50%	140%
Fluoranthene	1	9268251	4.28	7.15	50.0%	< 0.05	91%	50%	140%	72%	50%	140%	NA	50%	140%
Fluorene	1	9268251	3.12	3.62	15.0%	< 0.01	92%	50%	140%	75%	50%	140%	NA	50%	140%
Indeno(1,2,3)pyrene	1	9268251	0.38	0.74	64.0%	< 0.01	68%	50%	140%	56%	50%	140%	NA	50%	140%
Naphthalene	1	9268251	10.9	11.5	5.0%	< 0.01	103%	50%	140%	88%	50%	140%	NA	50%	140%
Perylene	1	9268251	0.19	0.36	62.0%	< 0.05	106%	50%	140%	99%	50%	140%	NA	50%	140%
Phenanthrene	1	9268251	9.54	11.3	17.0%	< 0.03	97%	50%	140%	81%	50%	140%	NA	50%	140%
Pyrene	1	9268251	5.17	7.40	35.0%	< 0.05	89%	50%	140%	72%	50%	140%	NA	50%	140%
Quinoline	1	9268251	0.22	0.27	20.0%	< 0.05	69%	50%	140%	72%	50%	140%	NA	50%	140%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.
PAH surrogate not vailbale (NA) due to matrix interference.

Polycyclic Aromatic Hydrocarbons in Soil															
1-Methylnaphthalene	1	9265398	< 0.05	< 0.05	NA	< 0.05	96%	50%	140%	90%	50%	140%	NA	50%	140%
2-Methylnaphthalene	1	9265398	< 0.01	< 0.01	NA	< 0.01	92%	50%	140%	86%	50%	140%	NA	50%	140%
Acenaphthene	1	9265398	< 0.00671	< 0.00671	NA	< 0.00671	94%	50%	140%	87%	50%	140%	NA	50%	140%
Acenaphthylene	1	9265398	< 0.004	< 0.004	NA	< 0.004	87%	50%	140%	79%	50%	140%	NA	50%	140%
Acridine	1	9265398	< 0.05	< 0.05	NA	< 0.05	50%	50%	140%	50%	50%	140%	NA	50%	140%
Anthracene	1	9265398	< 0.03	< 0.03	NA	< 0.03	66%	50%	140%	62%	50%	140%	NA	50%	140%
Benzo(a)anthracene	1	9265398	< 0.01	< 0.01	NA	< 0.01	72%	50%	140%	65%	50%	140%	NA	50%	140%
Benzo(a)pyrene	1	9265398	< 0.01	< 0.01	NA	< 0.01	86%	50%	140%	75%	50%	140%	NA	50%	140%
Benzo(b)fluoranthene	1	9265398	< 0.05	< 0.05	NA	< 0.05	121%	50%	140%	118%	50%	140%	NA	50%	140%
Benzo(b+j)fluoranthene	1	9265398	< 0.1	< 0.1	NA	< 0.1	121%	50%	140%	120%	50%	140%	NA	50%	140%
Benzo(e)pyrene	1	9265398	< 0.05	< 0.05	NA	< 0.05	129%	50%	140%	106%	50%	140%	NA	50%	140%
Benzo(ghi)perylene	1	9265398	< 0.01	< 0.01	NA	< 0.01	67%	50%	140%	60%	50%	140%	NA	50%	140%
Benzo(k)fluoranthene	1	9265398	< 0.01	< 0.01	NA	< 0.01	99%	50%	140%	109%	50%	140%	NA	50%	140%

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Quality Assurance

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AGAT WORK ORDER: 18K342748
PROJECT: 3113-Stephenville
ATTENTION TO: John Gale
SAMPLING SITE:
SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: Jun 04, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Chrysene	1	9265398	< 0.01	< 0.01	NA	< 0.01	96%	50%	140%	84%	50%	140%	NA	50%	140%
Dibenzo(a,h)anthracene	1	9265398	< 0.006	< 0.006	NA	< 0.006	51%	50%	140%	51%	50%	140%	NA	50%	140%
Fluoranthene	1	9265398	< 0.05	< 0.05	NA	< 0.05	78%	50%	140%	76%	50%	140%	NA	50%	140%
Fluorene	1	9265398	< 0.01	< 0.01	NA	< 0.01	79%	50%	140%	71%	50%	140%	NA	50%	140%
Indeno(1,2,3)pyrene	1	9265398	< 0.01	< 0.01	NA	< 0.01	55%	50%	140%	65%	50%	140%	NA	50%	140%
Naphthalene	1	9265398	< 0.01	< 0.01	NA	< 0.01	103%	50%	140%	95%	50%	140%	NA	50%	140%
Perylene	1	9265398	< 0.05	< 0.05	NA	< 0.05	118%	50%	140%	106%	50%	140%	NA	50%	140%
Phenanthrene	1	9265398	< 0.03	< 0.03	NA	< 0.03	99%	50%	140%	90%	50%	140%	NA	50%	140%
Pyrene	1	9265398	< 0.05	< 0.05	NA	< 0.05	79%	50%	140%	75%	50%	140%	NA	50%	140%
Quinoline	1	9265398	< 0.05	< 0.05	NA	< 0.05	66%	50%	140%	68%	50%	140%	NA	50%	140%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.
PAH surrogate not vailbale (NA) due to matrix interference.

Certified By: Kelly Hogue

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Method Summary

CLIENT NAME: FRACFLOW CONSULTANTS

AGAT WORK ORDER: 18K342748

PROJECT: 3113-Stephenville

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SAMPLING SITE:

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Aluminum	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Antimony	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Arsenic	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Barium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Beryllium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Boron	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Cadmium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Chromium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Cobalt	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Copper	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Iron	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Lead	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP-MS
Lithium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP-MS
Manganese	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Molybdenum	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Nickel	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Selenium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Silver	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Strontium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Thallium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Tin	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Uranium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Vanadium	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Zinc	MET-121-6105 & MET-121-6103	EPA SW 846 6020A/3050B & SM 3125	ICP/MS
Mercury	INOR-121-6101 & INOR-121-6107	Based on EPA 245.5 & SM 3112B	CV/AA

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Method Summary

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PROJECT: 3113-Stephenville

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SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
% Moisture		Calculation	GRAVIMETRIC
1-Methylnaphthalene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
2-Methylnaphthalene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Acenaphthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Acenaphthylene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Acridine	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Anthracene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Benzo(a)anthracene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Benzo(a)pyrene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Benzo(b)fluoranthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Benzo(b+j)fluoranthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Benzo(e)pyrene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Benzo(ghi)perylene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Benzo(k)fluoranthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Chrysene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Dibenzo(a,h)anthracene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Fluoranthene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Fluorene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Indeno(1,2,3)pyrene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Naphthalene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Perylene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Phenanthrene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Pyrene	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Quinoline	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Nitrobenzene-d5	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
2-Fluorobiphenyl	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS
Terphenyl-d14	ORG-120-5104	EPA SW846/3541/3510/8270C	GC/MS

AGAT Laboratories

Unit 122 • 11 Morris Drive
Dartmouth, NS
B3B 1M2
webearth.agatlabs.com • www.agatlabs.com
P: 902.468.8718 • F: 902.468.8924

Chain of Custody Record

Laboratory Use Only
Arrival Condition: ☑ Good ☐ Poor (see notes)
Arrival Temperature: 9.9 8.9
Hold Time:
AGAT Job Number:
Notes:

Report Information
Company: Fracflow Consultants Inc. (NL)
Contact: John Gale
Address: 154 Major's Path
St. John's, NL
Phone: 709-739-7270 Fax: 709-753-5101
Client Project #: 3113 - Stephenville
AGAT Quotation: S/O
Please Note: If quotation number is not provided client will be billed full price for analysis.

Report Information (Please print):
1. Name: John Gale (john_ffc@nfld.net)
Email: Eunjeong Seok (eunjeong_ffc@nfld.net)
2. Name: Karen Andrews (karen_ffc@nfld.net)
Email:

Report Format
☐ Single Sample per page
☑ Multiple Sample per page
☑ Excel Format Included
☐ Export:

Turnaround Time Required (TAT)
Regular TAT ☑ 5 to 7 working days
Rush TAT ☐ Same day ☐ 1 day ☐ 2 days ☐ 3 days
Date Required:

Invoice To Same Yes ☑ / No ☐
Company:
Contact: Karen Andrews (karen_ffc@nfld.net)
Address:
Phone: Fax:
PO/Credit Card#: 3895

Regulatory Requirements (Check):
☑ List Guidelines on Report ☐ Do not list Guidelines on Report
☑ PIRI
☑ Tier 1 ☐ Res ☐ Pot ☑ Coarse
☐ Tier 2 ☐ Com ☑ N/Pot ☐ Fine
☐ Gas ☐ Fuel ☐ Lube
☑ CCME ☐ CDWQ
☐ Industrial ☐ NSEQS-Cont Sites
☐ Commercial ☐ HRM 101
☐ Res/Park ☐ Storm Water
☐ Agricultural ☐ Waste Water
☑ FWAL
☐ Sediment ☐ Other

Drinking Water Sample: ☐ Yes ☑ No **Salt Water Sample:** ☐ Yes ☑ No
Reg. No.:

Sample Identification	Date/Time Sampled	Sample Matrix	# Containers	Comments – Site/Sample Info. Sample Containment
3113F-PC2-GS-0Z	May 19, 2018	Soil	4	2x40, 2x250 - 40ml vials with preservative
3113F-PC10-GS-0Z	May 21, 2018	Soil	4	2x40, 2x250 - 40ml vials with preservative
3113F-PC14-GS-0Z	May 21, 2018	Soil	5	2x40, 3x250 - 40ml vials with preservative

Field Filtered/Preserved	Standard Water Analysis	Metals: ☐ Total ☐ Diss ☒ Available	Mercury	☐ BOD ☐ CBOD	Grain Size (coarse/fine)	☐ TOC - Miss ☐ FOC - Miss	Phosphates (total as P2O5)	Chromium (Tri & Hexavalent)	Phenols	Tier 1: TPH/BTEX (PIRI) ☐ low level	Tier 2: TPH/BTEX Fractionation	CCME-CWS TPH/BTEX	VOC	Oil & Grease (TOG)	BNAE EPA 625 - Miss	PAH	PCB	Marine Sediment Package	Dioxins & Furans	Fecal Coliform ☐ MPN ☐ MF	Other:	Other:	Hazardous (Y/N)
		✓	✓							✓						✓							
		✓	✓							✓						✓							
		✓	✓							✓						✓							

Samples Relinquished By (Print Name): Shawn Thompson
Date/Time: 18/05/25
Samples Relinquished By (Sign):
Date/Time: 13:05
Samples Received By (Print Name): Lana Cameron
Date/Time: May 25/18
Samples Received By (Sign):
Date/Time: 1:05

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

N°: FFC-3113-COC-11

Document ID: DW-133-1501-002
Date revised: January 2016

APPENDIX I: SURVEYS FOR LAND PURCHASES AND EASEMENTS

Land Acquisitions or Easements Required for the Project, from Sections 3.1.4 and 3.1.5

OWNER	AGREEMENT TYPE	PURPOSE	DRAWING NUMBER[1]
Town of Stephenville	PURCHASE	Modular RAS Production Site	SV-CD-MARINE-1A
Town of Stephenville	PURCHASE	Water Treatment Facility	SV-CD-MARINE-1
Town of Stephenville	EASEMENT	Freshwater Wells	MHAC-6
Town of Stephenville	EASEMENT	Freshwater Lines	MHAC-2
Town of Stephenville	EASEMENT	Modular RAS Production Site	SV-CD-FFLOW-B
Town of Stephenville	EASEMENT	Modular RAS Production Site	SV-CD-FFLOW-A
Port of Stephenville	LEASE	Fish Transport Line	MHAC-3
Port of Stephenville	LEASE	Saltwater Influent Line, Effluent Lines	MHAC-1
Port of Stephenville	LEASE	Saltwater Influent Line, Effluent Lines	SV-CD-FFLOW-1
Stephenville Airport Authority	EASEMENT	Effluent Lines	MHAC-5
Seaside Links Golf Course	EASEMENT ON LEASE	Saltwater Influent Line, Effluent Lines	MHAC-4

[1]Refers to drawing number in Appendix I: Surveys for Land Purchases and Easements

Description

Easement survey for Marine Harvest Atlantic Canada Inc.

Property of Stephenville Airport Corporation

Connecticut Drive, Stephenville, NL.

All that piece or parcel of land situate, lying and being west of Connecticut Drive, Stephenville, Province of Newfoundland and Labrador, abutted and bounded as follows;

That is to say, beginning at a point, said point being the most northwesterly corner of the lot; having Grid Co-ordinates (NAD 83) N5377235.862; E300929.225;

Running thence from the above described point of beginning by property of Stephenville Airport Corporation N72°18'27"E distance 223.812 metres;

Thence by property of the Port of Stephenville S21°20'03"E distance 30.061 metres;

Thence by property of Stephenville Airport Corporation S72°18'27"W distance 215.002 metres;

Thence by property of Harmon Seaside Links N37°21'18"W distance 31.858 metres to the point of beginning; containing 6582 square metres as shown and delineated on attached Drawing No. MHAC-5.

All bearings refer to Grid North (NAD 83)

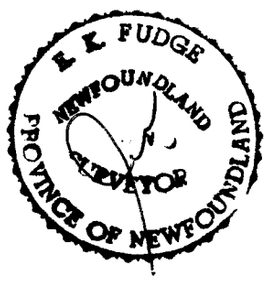
Enos K. Fudge

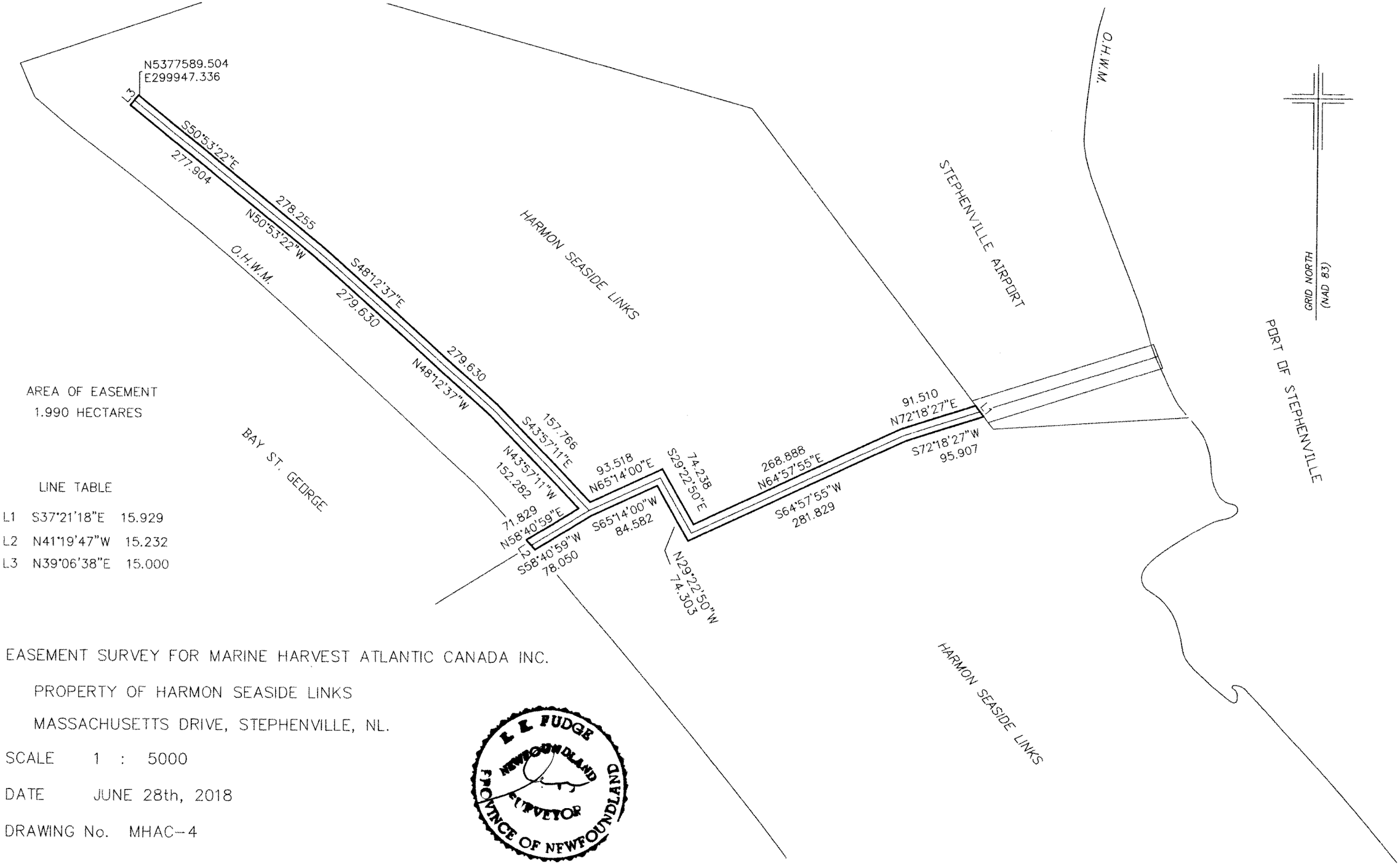
Newfoundland Land Surveyor

Enos Fudge Surveys

MHAC-5

June 28th, 2018





AREA OF EASEMENT
1.990 HECTARES

LINE TABLE

L1	S37°21'18"E	15.929
L2	N41°19'47"W	15.232
L3	N39°06'38"E	15.000

EASEMENT SURVEY FOR MARINE HARVEST ATLANTIC CANADA INC.

PROPERTY OF HARMON SEASIDE LINKS

MASSACHUSETTS DRIVE, STEPHENVILLE, NL.

SCALE 1 : 5000

DATE JUNE 28th, 2018

DRAWING No. MHAC-4

L.L. FUDGE
NEWFOUNDLAND
SURVEYOR
PROVINCE OF NFWFOUNDLAND

Description

Easement survey for Marine Harvest Atlantic Canada Inc.

Property of Harmon Seaside Links

Massachusetts Drive, Stephenville, NL.

All that piece or parcel of land situate, lying and being east of Massachusetts Drive, Stephenville, Province of Newfoundland and Labrador, abutted and bounded as follows;

That is to say, beginning at a point, said point being the most northeasterly corner of the lot; having Grid Co-ordinates (NAD 83) N5377589.504; E299947.336;

Running thence from the above described point of beginning by property of Harmon Seaside Links S50°53'22"E distance 278.255 metres; S48°12'37"E distance 279.630 metres; S43°57'11"E distance 157.766 metres; N65°14'00"E distance 93.518 metres; S29°22'50"E distance 74.238 metres; N64°57'55"E distance 268.888 metres and N72°18'27"E distance 91.510 metres;

Thence by property of the Stephenville Airport S37°21'18"E distance 15.929 metres;

Thence by property of Harmon Seaside Links S72°18'27"W distance 95.907 metres; S64°57'55"W distance 281.829 metres; N29°22'50"W distance 74.303 metres; S65°14'00"W distance 84.582 metres and S58°40'59"W distance 78.050 metres;

Thence by the waters of Bay St. George N41°19'47"W distance 15.232 metres;

Thence by property of Harmon Seaside Links N58°40'59"E distance 71.829 metres; N43°57'11"W distance 152.282 metres; N48°12'37"W distance 279.630 metres; N50°53'22"W distance 277.904 metres and N39°06'38"E distance 15.000 metres to the point of beginning; containing 1.990 hectares as shown and delineated on attached Drawing No. MHAC-4.

All bearings refer to Grid North (NAD 83)

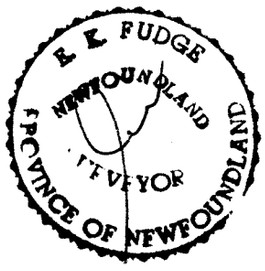
Enos K. Fudge

Newfoundland Land Surveyor

Enos Fudge Surveys

MHAC-4

June 28th, 2018



Description

Easement survey for Marine Harvest Atlantic Canada Inc.

Property of the Port of Stephenville

Stephenville, NL.

All that piece or parcel of land situate, lying and being west of Connecticut Drive, Stephenville, Province of Newfoundland and Labrador, abutted and bounded as follows;

That is to say, beginning at a point, said point being the most northwesterly corner of the lot; having Grid Co-ordinates (NAD 83) N5377336.579; E301129.681;

Running thence from the above described point of beginning by the waters of the Port of Stephenville N74°21'50"E distance 1320.276 metres;

Thence running by property of Northern Harvest S34°27'50"E distance 105.653 metres;

Thence by the waters of the Port of Stephenville S74°21'50"W distance 1344.395 metres;

Thence running by property of Stephenville Airport Corporation N21°20'03"W distance 100.497 metres to the point of beginning; containing 13.404 hectares as shown and delineated on attached Drawing No. MHAC-1.

All bearings refer to Grid North (NAD 83)

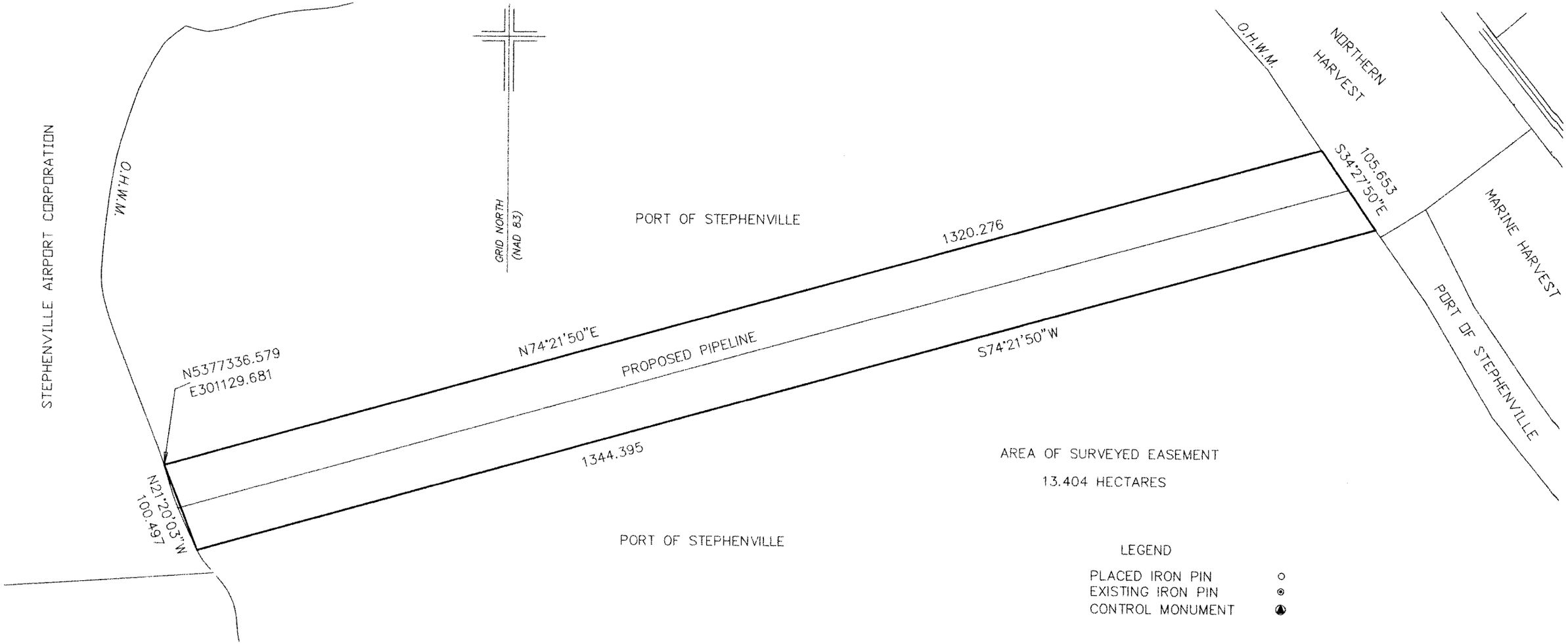
Enos K. Fudge

Newfoundland Land Surveyor

Enos Fudge Surveys

MHAC-1

June 21st, 2018



EASEMENT SURVEY FOR MARINE HARVEST ATLANTIC CANADA INC.

PROPERTY OF THE PORT OF STEPHENVILLE

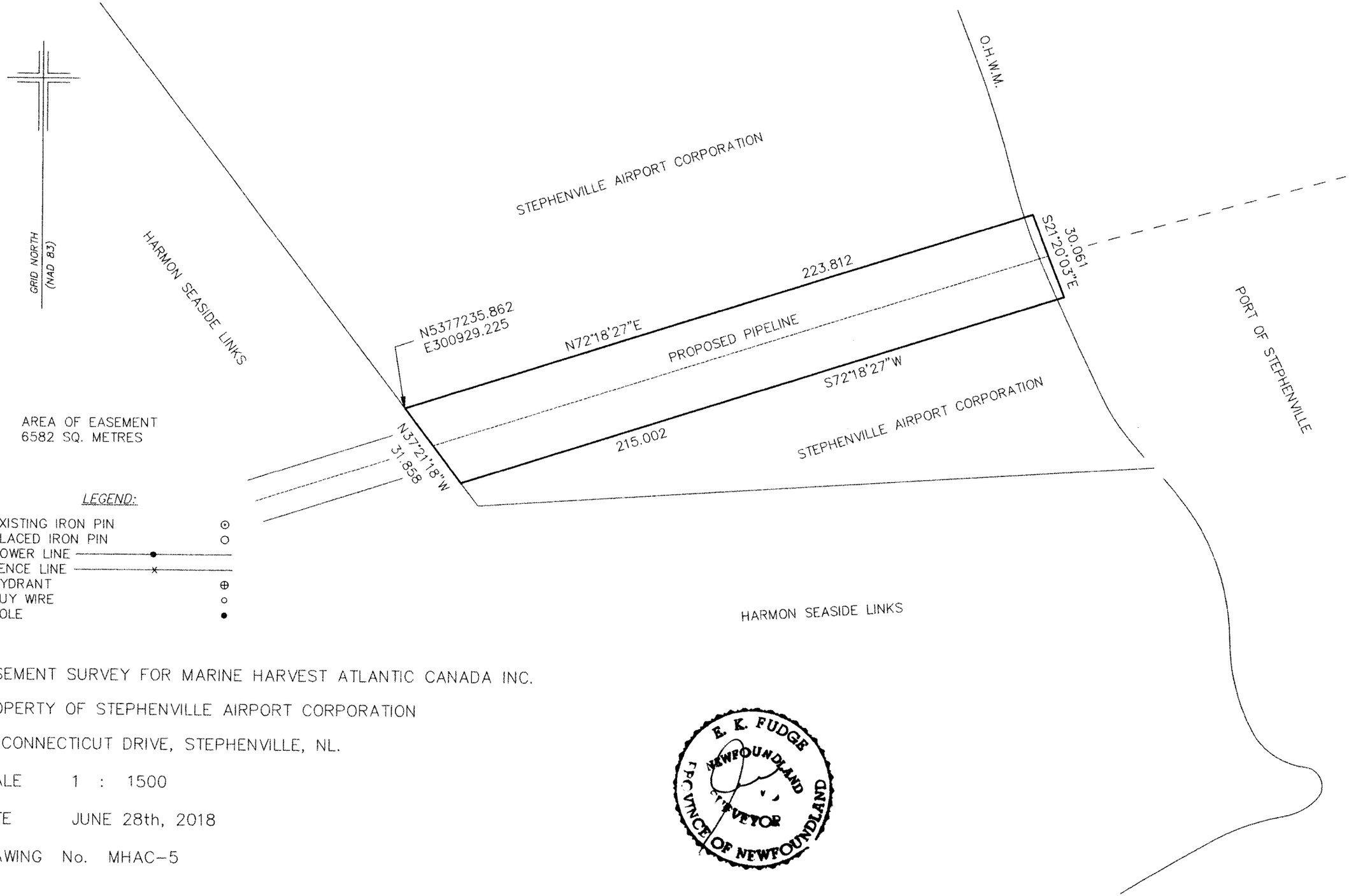
STEPHENVILLE, NL.

SCALE 1 : 5000

DATE JUNE 21st, 2018

DRAWING No. MHAC–1

E. K. FUDGE
NEWFOUNDLAND
SURVEYOR
PROVINCE OF NEWFOUNDLAND



EASEMENT SURVEY FOR MARINE HARVEST ATLANTIC CANADA INC.

PROPERTY OF STEPHENVILLE AIRPORT CORPORATION

CONNECTICUT DRIVE, STEPHENVILLE, NL.

SCALE 1 : 1500

DATE JUNE 28th, 2018

DRAWING No. MHAC-5

E. K. FUDGE
NEWFOUNDLAND
SURVEYOR
PROVINCE OF NEWFOUNDLAND

Description

Easement survey for Marine Harvest Atlantic Canada Inc.

Property of Town of Stephenville

Connecticut Drive, Stephenville, NL.

All that piece or parcel of land situate, lying and being east of Connecticut Drive, Stephenville, Province of Newfoundland and Labrador, abutted and bounded as follows;

That is to say, beginning at a point, said point being the most northeasterly corner of the lot; having Grid Co-ordinates (NAD 83) N5378778.420; E303288.147;

Running thence from the above described point of beginning along the southeasterly limits of a gravel road off Connecticut Drive S27°56'44"W distance 188.912 metres; following the arc of a clockwise curve (radius 110.874 metres) having a chord bearing S62°53'51"W distance 121.906 metres; N81°16'55"W distance 287.759 metres; N81°59'56"w distance 146.066 metres;

Thence along the southeasterly limits of Connecticut Drive S58°25'04"W distance 249.035 metres; S63°18'36"W distance 25.006 metres; S67°32'19"W distance 34.854 metres; S71°19'53"W distance 163.816 metres; following the arc of a counterclockwise curve (radius 111.260 metres) having a chord bearing S08°36'57"W distance 195.457 metres; S51°43'21"E distance 100.648 metres; S49°55'19"E distance 128.498 metres; and S38°20'58"E distance 178.093 metres;

Thence to the centerline of Connecticut Drive (30.480 metres wide) S51°39'02"W distance 15.240 metres;

Thence running along the centerline of Connecticut Drive N38°20'58"W disdance 176.549 metres; N49°55'19"W distance 126.714 metres; N51°43'21"W distance 100.409 metres; following the arc of a clockwise curve (radius 126.497 metres) distance 222.245 metres; N71°19'53"E distance 163.323 metres; N67°32'19"E distance 33.769 metres; N63°18'36"E distance 23.801 metres and N58°25'04"E distance 253.868 metres;

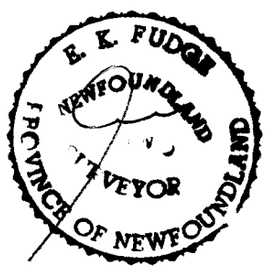
Thence running along the centerline of a gravel road east of Connecticut Drive S81°59'56"E distance 150.531 metres; S81°16'55"E distance 288.313 metres; following the arc of a counterclockwise curve (radius 95.634 metres) having a chord bearing N62°53'51"E distance 105.149 metres and N27°56'44"E distance 184.999 metres;

Thence running by land of the Town of Stephenville S74↑856'52"E distance 15.628 metres to the point of beginning; containing 2.854 hectares as shown and delineated on attached Drawing No. MHAC-2.

All bearings refer to Grid North (NAD 83)

Enos K. Fudge

Newfoundland Land Surveyor



Enos Fudge Surveys

MHAC-2

June 21st, 2018

Description
Easement survey for Marine Harvest Atlantic Canada Inc.
Property of the Town of Stephenville
Connecticut Drive, Stephenville, NL.

All that piece or parcel of land situate, lying and being east of Connecticut Drive, Stephenville, Province of Newfoundland and Labrador, abutted and bounded as follows;

That is to say, beginning at a point, said point being the most southwesterly corner of the lot; having Grid Co-ordinates (NAD 83) N5378383.095; E303104.969;

Running thence from the above described point of beginning by property of Town of Stephenville N01°23'22"W distance 80.000 metres; N88°36'28"E distance 25.000 metres and N01°23'22"W distance 94.012 metres;

Thence along the southerly limits of a gravel road (R.O.W. 30.48 metres wide) following the arc of a counterclockwise curve having a chord bearing N70°02'38"E distance 31.647 metres;

Thence by property of the Town of Stephenville S01°23'22"E distance 104.088 metres; N88°36'28"E distance 25.000 metres; S01°23'22"E distance 80.000 metres and S88°36'28"W distance 80.000 metres to the point of beginning; containing 9348 square metres as shown and delineated as Lot No. 1 on attached Drawing No. MHAC-6.

Also all that piece or parcel of land situate, lying and being east of Connecticut Drive, Stephenville, Province of Newfoundland and Labrador, abutted and bounded as follows;

That is to say beginning at a point, said point being the most northeasterly corner of the lot; having Grid co-ordinates (NAD 83) N5378680.946; E303326.763;

Running thence from the above described point of beginning by property of the Town of Stephenville S27°56'44"W distance 80.000 metres and N66°10'50"W distance 80.000 metres;

Thence along the easterly limits of a gravel N27°56'44"E distance 80.000 metres;

Thence by land of the Town of Stephenville S66°10'50"E distance 80.000 metres to the point of beginning; containing 6383 square metres as shown and delineated as Lot No. 2 on Drawing No. MHAC-6.

Also all that piece or parcel of land situate,lying and being east of Connecticut Drive, Stephenville, Province of Newfoundland and Labrador, abutted and bounded as follows;

That is to say beginning at a point, said point being the most northwesterly corner of the lot; having Grid co-ordinates (NAD 83) N5378861.120; E303288.675;

Running thence from the above described point of beginning by property of the Town of Stephenville S74°56'52"E distance 80.000 metres and S15°03'08"W distance 80.000 metres;

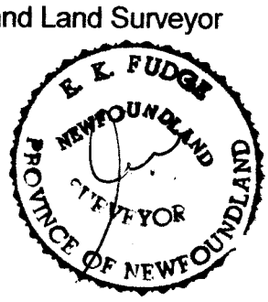
Thence by property of the Town of Stephenville N74°56'52"W distance 80.000 metres and N15°03'08"E distance 80.000 metres to the point of beginning; containing 6400 square metres as shown and delineated as Lot No. 3 on Drawing No. MHAC-6.

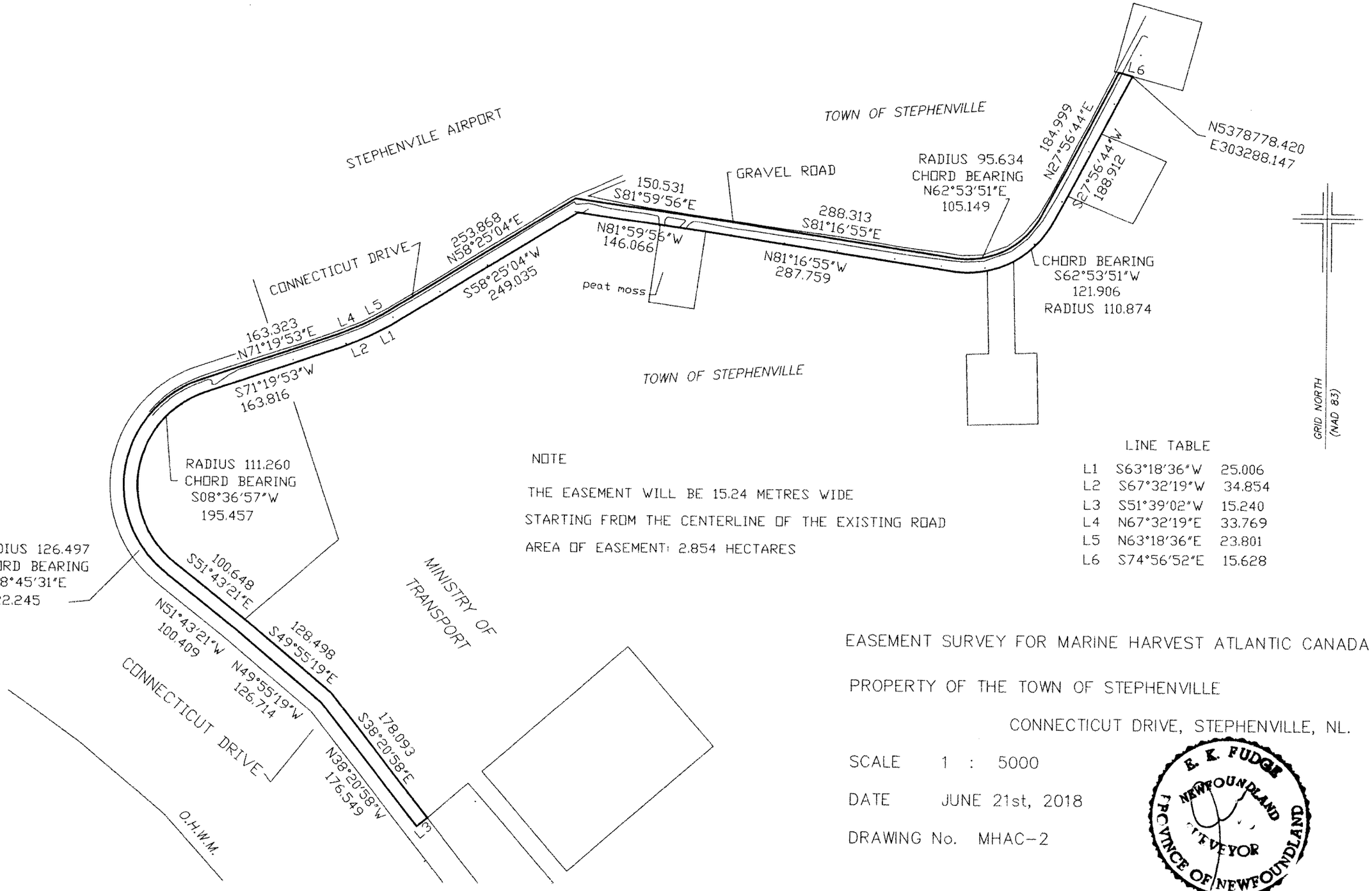
All bearings refer to Grid North (NAD 83)

Enos K. Fudge

Newfoundland Land Surveyor

Enos Fudge Surveys
MHAC-6
June 30th, 2018





NOTE

THE EASEMENT WILL BE 15.24 METRES WIDE

STARTING FROM THE CENTERLINE OF THE EXISTING ROAD

AREA OF EASEMENT: 2.854 HECTARES

LINE TABLE

L1	S63°18'36"W	25.006
L2	S67°32'19"W	34.854
L3	S51°39'02"W	15.240
L4	N67°32'19"E	33.769
L5	N63°18'36"E	23.801
L6	S74°56'52"E	15.628

EASEMENT SURVEY FOR MARINE HARVEST ATLANTIC CANADA INC.

PROPERTY OF THE TOWN OF STEPHENVILLE

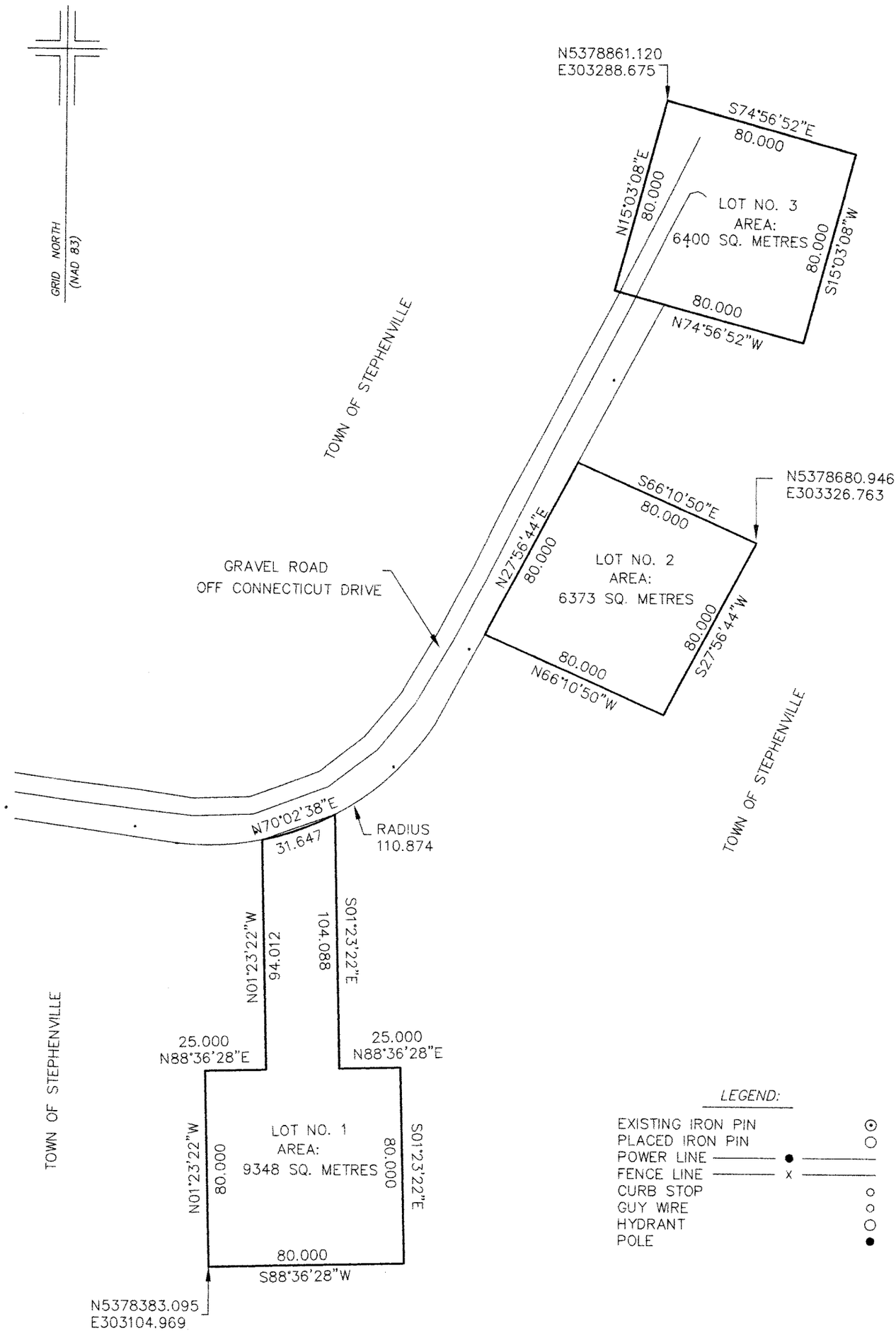
CONNECTICUT DRIVE, STEPHENVILLE, NL.

SCALE 1 : 5000

DATE JUNE 21st, 2018

DRAWING No. MHAC-2

E. K. FUDGE
NEWFOUNDLAND
SURVEYOR
PROVINCE OF NEWFOUNDLAND



EASEMENT SURVEY FOR MARINE HARVEST ATLANTIC CANADA INC.

PROPERTY OF THE TOWN OF STEPHENVILLE

CONNECTICUT DRIVE, STEPHENVILLE, NL.

SCALE 1 : 2000

DATE JUNE 30th, 2018

DRAWING No. MHAC-6

L. E. FUDGE
NEWFOUNDLAND
SURVEYOR
PROVINCE OF NEWFOUNDLAND

Description

Easement survey for Marine Harvest Atlantic Canada Inc.

Property of the Port of Stephenville

Stephenville, NL.

All that piece or parcel of land situate, lying and being west of Connecticut Drive, Stephenville, Province of Newfoundland and Labrador, abutted and bounded as follows;

That is to say, beginning at a point, said point being the most northwesterly corner of the lot; having Grid Co-ordinates (NAD 83) N5377219.518; E302724.490;

Running thence from the above described point of beginning by property of the Port of Stephenville N37°53'38"E distance 53.025 metres;

Thence by property of Marine Harvest Atlantic Canada S35°46'51"E distance 15.630 metres;

Thence running by property of the Port of Stephenville S37°53'38"W distance 38.681 metres and S29°13'19"E distance 168.427 metres;

Thence by property of N.L.H.C. S07°25'32"W distance 98.156 metres;

Thence by property of the Port of Stephenville S27°00'38"E distance 113.745 metres and S58°22'09"W distance 15.049 metres;

Thence continuing by property of the Port of Stephenville N27°00'38"W distance 119.606 metres; N07°25'32"E distance 97.837 metres and N29°13'19"W distance 173.410 metres to the point of beginning; containing 6471 sq. metres as shown and delineated on attached Drawing No. MHAC-3.

All bearings refer to Grid North (NAD 83)

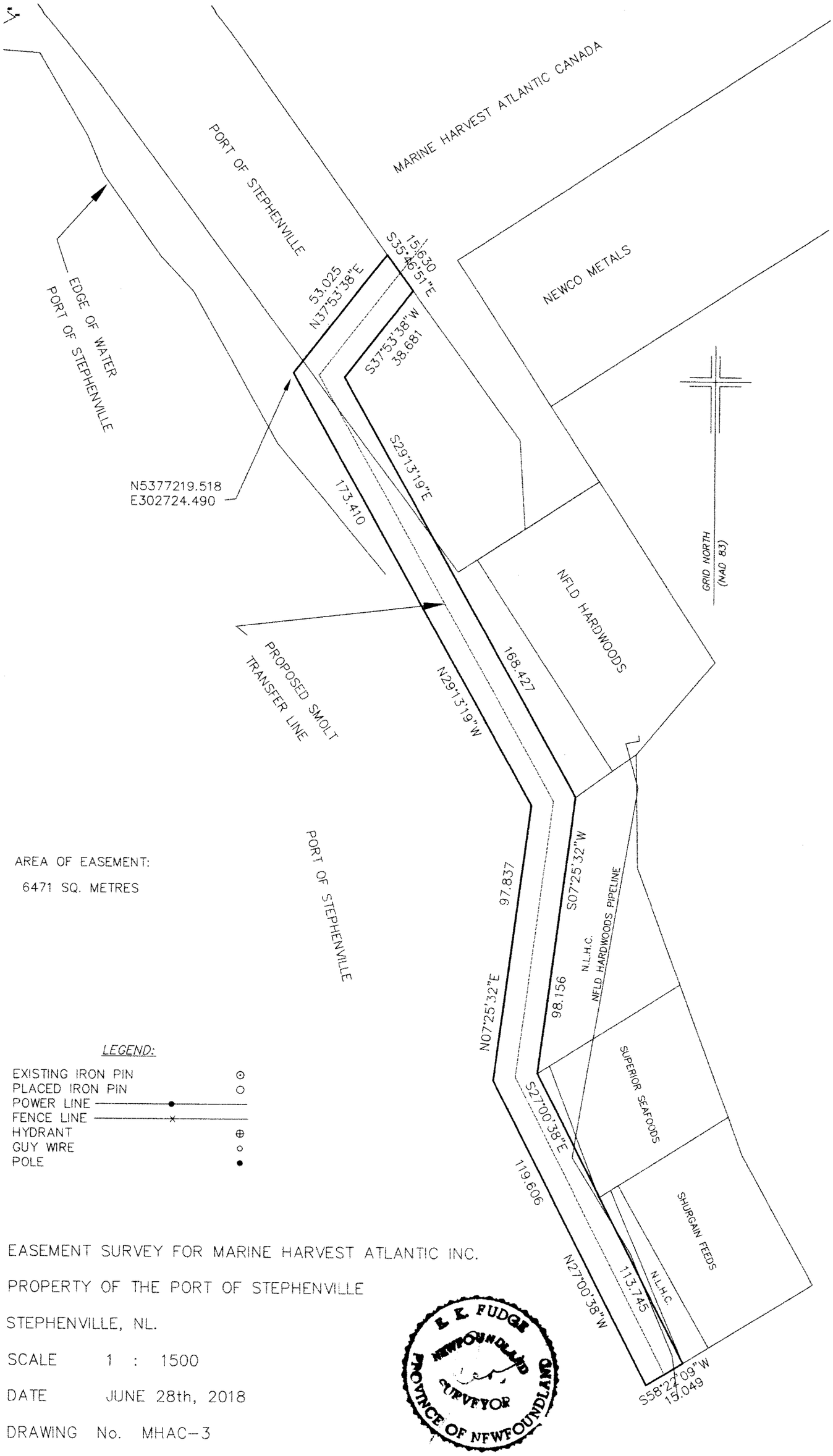
Enos K. Fudge

Newfoundland Land Surveyor

Enos Fudge Surveys

MHAC-3

June 28th, 2018



AREA OF EASEMENT:

6471 SQ. METRES

LEGEND:

EXISTING IRON PIN	⊙
PLACED IRON PIN	○
POWER LINE	—●—
FENCE LINE	—×—
HYDRANT	⊕
GUY WIRE	∘
POLE	●

EASEMENT SURVEY FOR MARINE HARVEST ATLANTIC INC.

PROPERTY OF THE PORT OF STEPHENVILLE

STEPHENVILLE, NL.

SCALE 1 : 1500

DATE JUNE 28th, 2018

DRAWING No. MHAC-3

E. E. FUDGE
NEWFOUNDLAND
SURVEYOR
PROVINCE OF NEWFOUNDLAND

Description

Land of the Town of Stephenville

Connecticut Drive, Stephenville, NL.

All that piece or parcel of land situate, lying and being west of Connecticut Drive, Stephenville, Province of Newfoundland and Labrador, abutted and bounded as follows;

That is to say, beginning at a point, said point being the most northeasterly corner of the lot; having Grid Co-ordinates (NAD 83) N5377719.181; E302629.832;

Running thence from the above described point of beginning along the westerly limits of Connecticut Drive S38°18'54"E distance 65.945 metres; S43°26'15"E distance 139.553 metres; S45°52'44"E distance 208.173 metres and following the arc of a clockwise curve (radius 204.753 m) having a chord bearing S35°50'51"E distance 62.145 metres;

Thence running by property leased to Newco Metals S56°58'37"W distance 203.769 metres;

Thence running by property leased to Newco Metals and property of Newco Metals S33°01'56"E distance 92.642 metres;

Thence running by property of NFLD Hardwoods S56°59'01"W distance 31.046 metres;

Thence running by property of Port of Stephenville N03°27'51"W distance 31.377 metres; N36°05'51"W distance 57.760 metres; N35°46'51"W distance 111.330 metres; N36°55'51"W distance 108.280 metres; N34°40'51"w distance 124.750 metres and N26°55'05"W distance 36.327 metres;

Thence running by property of the Town of Stephenville N51°43'07"E distance 52.930 metres and N26°55'05"W distance 82.647 metres;

Thence running by property of Northern Harvest N51°43'07"E distance 93.106 metres to the point of beginning; containing 8.598 hectares as shown and delineated on attached Drawing No. SV-CD-MARINE-1A.

All bearings refer to Grid North (NAD 83)

Enos K. Fudge

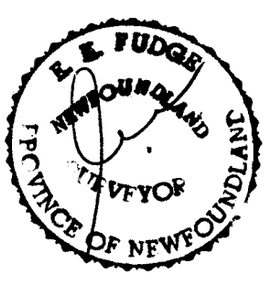
Newfoundland Land Surveyor

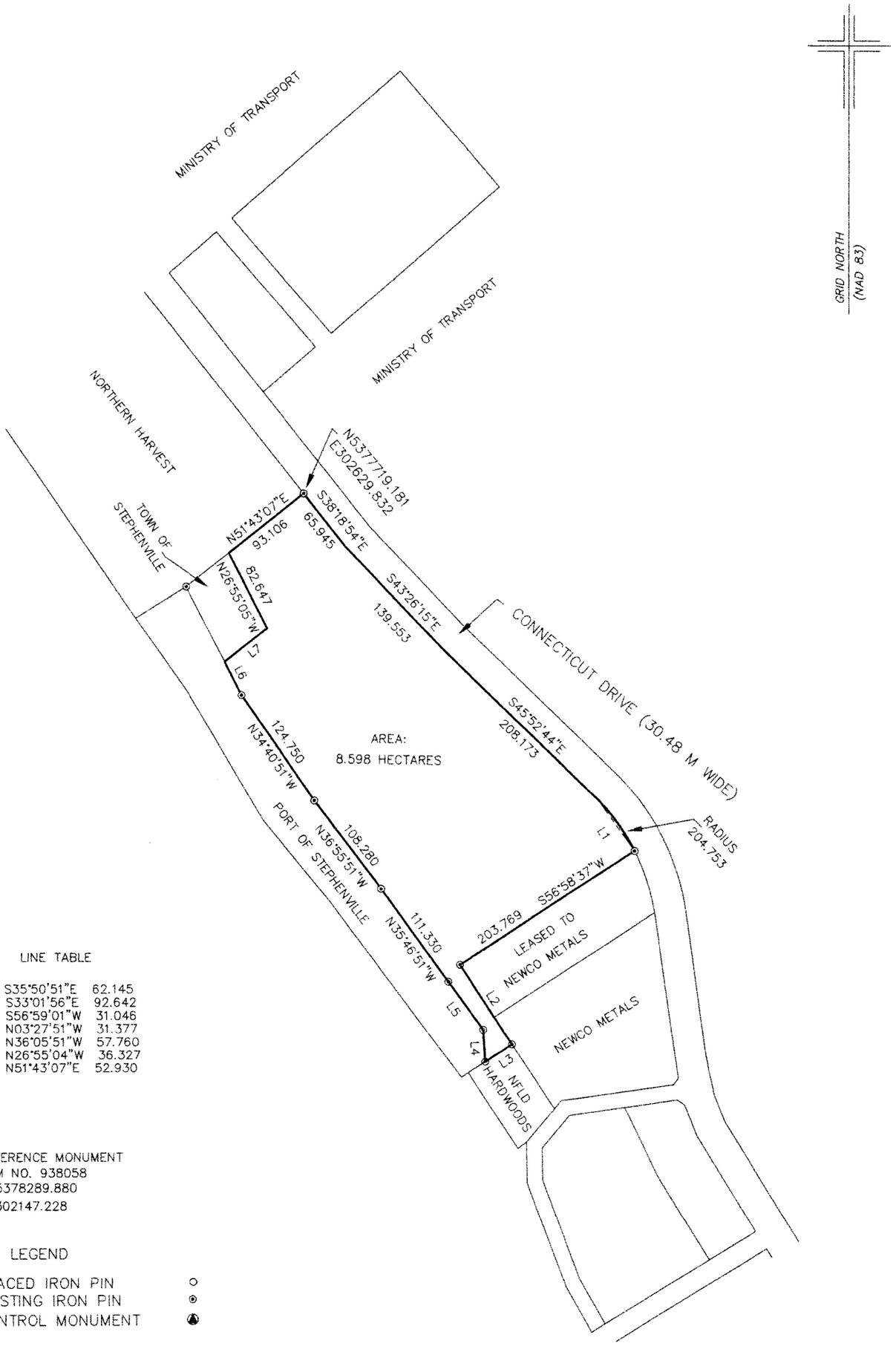
Enos Fudge Surveys

SV-CD-MARINE-1A

December 15th, 2017

Revised: July 6th, 2018





LINE TABLE

L1	S35°50'51"E	62.145
L2	S33°01'56"E	92.642
L3	S56°59'01"W	31.046
L4	N03°27'51"W	31.377
L5	N36°05'51"W	57.760
L6	N26°55'04"W	36.327
L7	N51°43'07"E	52.930

REFERENCE MONUMENT
CM NO. 938058
N5378289.880
E302147.228

LEGEND

PLACED IRON PIN ○
EXISTING IRON PIN ◉
CONTROL MONUMENT ◭

E. K. FUDGE
NEWFOUNDLAND
SURVEYOR
PROVINCE OF NEWFOUNDLAND

LAND SURVEY FOR THE TOWN OF STEPHENVILLE

CONNECTICUT DRIVE, STEPHENVILLE, NL.

SCALE 1 : 5000

DATE DECEMBER 15th, 2017

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Appendices