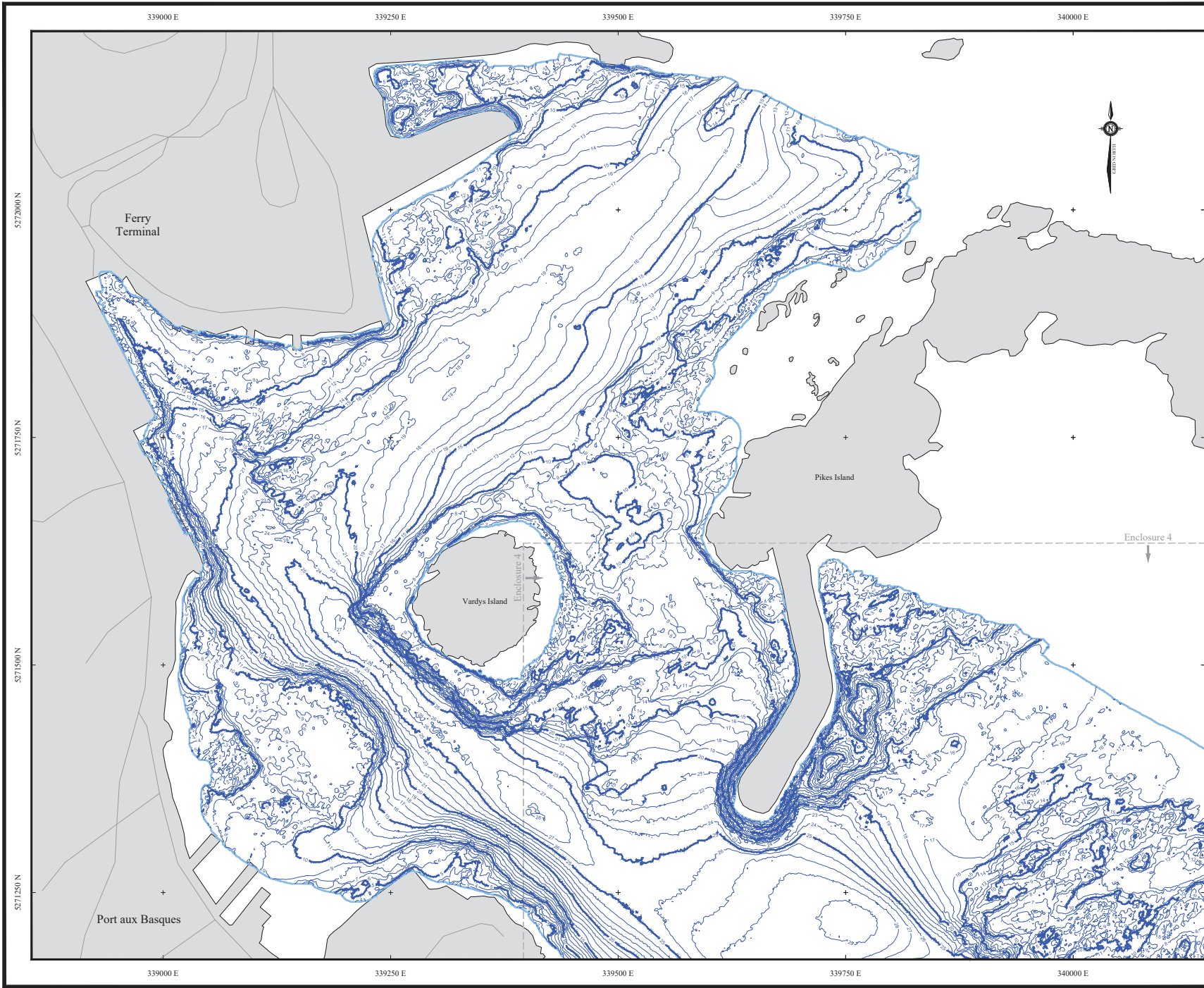




KEY MAP

LEGEND

- Bathymetric contour (1 m interval)
- Bathymetric contour (5 m interval)
- Multi-beam data output
- Adjacent enclosure boundary
- UTM Gridline

GEODETIC PARAMETERS

Horizontal Datum	NAD 83 CSRS	Projection	UTM Zone 21
Vertical Datum	Chart Datum	Units	Meters

SCALE

Horizontal Scale (metres)

1 : 1500

CLIENT

NOTES

CSR conducted the hydrographic and geophysical survey from January 20 to January 30, 2020.

HYDROGRAPHIC SURVEY EQUIPMENT

Vessel: StarLine / Bowditch RP-240

Survey Software: StarLine / Bowditch RP-240

Multi-beam Software: Pinnacle / Vantage L1

Transducer: VEM TEC-APL Hemisphere V300 (CHRS)

Station Sensor: SVP (Hansen 2.1)

Heading: SVP (Hansen 2.1) Hemisphere V300 (CHRS)

Multi-beam Echo-sounder: Ranco T200

Water Column: AIMS Micro-N SVP and Odom Digital Pro

Tide Gauge: Ralco C20

Bottom Recorder: Fathly 200 Binnacle (400-10000 Hz), Applied Acoustics / CSP-300 Power Supply, Moisturemeter with GeoSpectrum M3 Hydrophones

BATHYMETRY

Multi-beam data were recorded continuously along survey lines using a Ranco T200 multi-beam echosounder along 200 metre track segments at 200 kHz. The depth of vessel in water at the time of the survey was recorded using an AIMS Oceanographic SVP. Sound velocity through the water column was acquired with an Odom Digital Pro. The survey was conducted using VEM TEC-APL Hemisphere V300 (CHRS) Hemisphere V300 (CHRS) were obtained for CHRS Port and Binnacle Unit Station (1605) and also equipped with a CSP tide gauge deployed during the survey and installed in Chart datum.

The multi-beam data were post-processed using CARIS HIPS/SHIPS software and exported as a 1 m x 1 m CHRS outline file. The exported data set was superimposed onto a 1 m x 1 m grid cells of 1 m x 1 m was established based on a living interpolation algorithm. Contours were generated at 1 metre intervals based on the gridded data.

The data represents results at the time of the survey and can only be considered as indicating the conditions at that time.

BACKGROUND

Maple were obtained from <https://map.canada.ca/coords/index-en.html>. The coastline was digitized from Google Earth Pro and is considered approximate.

CSR GEOSURVEYS LTD.

341 MYRA ROAD, PORTERS LAKE, NOVA SCOTIA
CANADA B1H 1G2
Tel: (902) 827-4200 Fax: (902) 827-2002
Email: info@csr-marine.com

ENGINEERING & ENVIRONMENTAL GEOPHYSICS

PAB Vardy's Island - Navigation Improvements

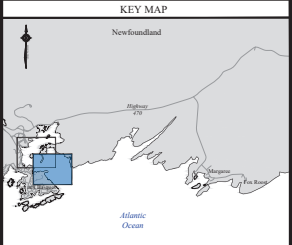
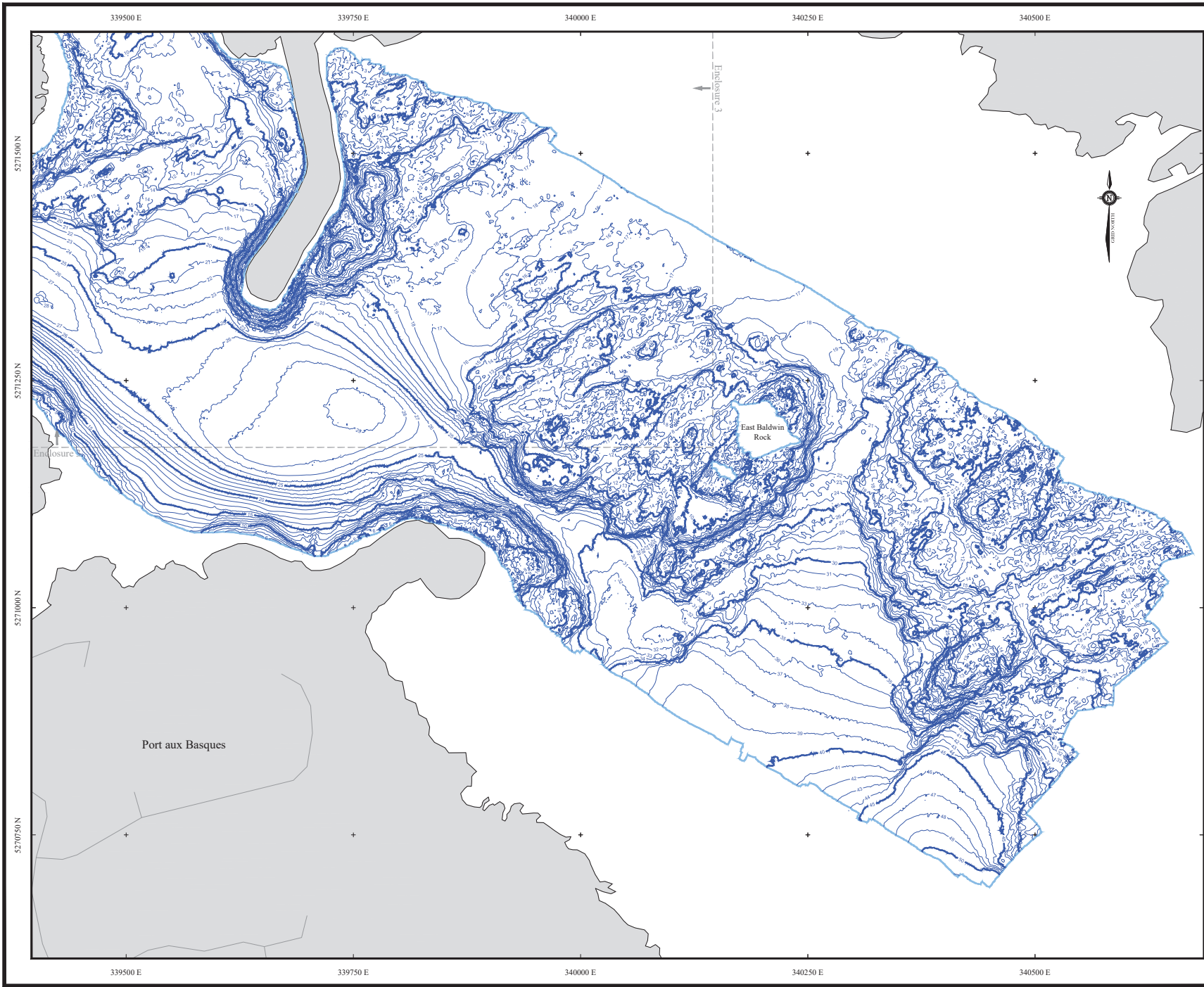
Port aux Basques, Newfoundland

Bathymetric Contour Chart (North)

Enclosure 3

REV	DATE	REVISIONS	INTERPRETER	CHECKED	DATE
1	2020-02-20	Initial	AD	AD	20
2	2020-02-20	Final	AD	AD	20

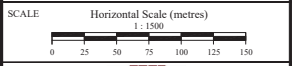
SCALE: 1:1500 PROJECTION: UTM Zone 21
CSR PROJECT # 1945 FILE: 1945_B0_20201006.dwg



- LEGEND**
- Bathymetric contour (1 m interval)
 - Bathymetric contour (5 m interval)
 - Multi-beam data output
 - Adjacent enclosure boundary
 - UTM Gridline

GEODETTIC PARAMETERS

Horizontal Datum: NAD 83 / CHRS
Vertical Datum: Chart Datum
Projection: UTM
Zone: 18N



NOTES

CSR conducted the hydrographic and geophysical survey from January 20 to January 30, 2020.

HYDROGRAPHIC SURVEY EQUIPMENT

Vessel: Starship / Bowditch RP-240
Survey Software: Starline / Starline U3
Multi-beam Software: Starline / VME-RTS-APS, Hemisphere V310 / GNSS
Position Sensor: SVP (Hakon 2.1)
Heading: SVP (Hakon 2.1), Hemisphere V310 / GNSS
Multi-beam Echo-sounder: Ricon T200
Acoustic Sensor: AEM, Micro-N SVP and Odom Digital Pro
Tide Gauge: Ricon T200
Bottom Recorder: Echosound / 200 Bouncer (400-10000 Hz), Applied Acoustics / CIP-100 Power Supply, Measurement with GeoPacem 300 Hydrophones

BATHYMETRY

Bathymetric data were recorded continuously along survey lines using a Ricon T200 multi-beam echosounder with 200 beam heads operating at 200 kHz. The swath of sound in water at the maximum was controlled with an AEM Oceanographic SVP. Sound velocity through the water column was acquired with an Odom Digital Pro. The survey was conducted using VME-RTS-APS real-time survey techniques. Observed water levels were obtained for CTS Port aux Basques Low Water (1985) and also acquired with a CTS tide gauge deployed during the survey and recorded in Chart datum.

The multi-beam data were post-processed using CARIS HIPS/SHIPS software and exported as a 1 m x 1 m x 1 m CUBE surface file. The exported data set was superimposed onto a 1 m x 1 m grid cells of 1 m x 1 m were established based on a living interpolation algorithm. Contours were generated at 1 metre intervals based on the gridded data.

Flow data represents results at the time of the survey and can only be considered as indicating the conditions at that time.

BACKGROUND

Base maps were obtained from <https://map.canada.ca/cov/index-en.html>. The coastline was digitized from Google Earth Pro and is considered approximate.

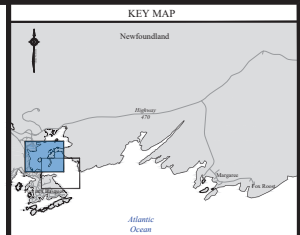
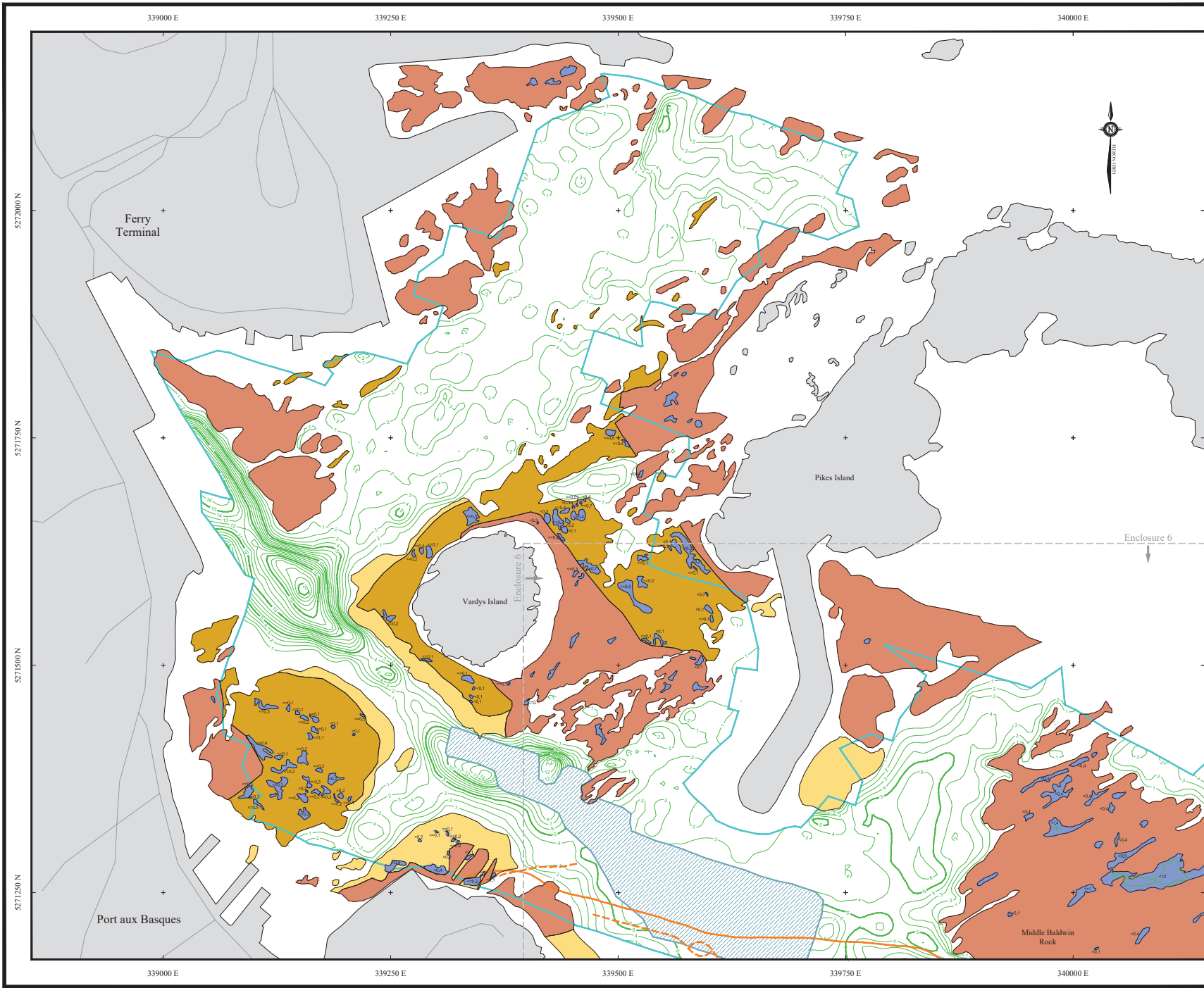
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341 MYRA ROAD, PORTERS LAKE, NOVA SCOTIA
CANADA B1H 1G2
Tel: (902) 827-4200 Fax: (902) 827-2002
Email: info@csr-marine.com

ENGINEERING & ENVIRONMENTAL GEOPHYSICS

PAB Vardy's Island - Navigation Improvements
Port aux Basques, Newfoundland
Bathymetric Contour Chart (South)
Enclosure 4

REV	DATE	REMARKS	INTERPRETER	CHECKED	DATE
01	10/10/2020	Issue	AD	JB	
02	10/10/2020	Issue	AD	JB	

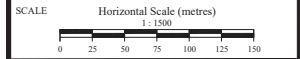
SCALE: 1:1500 PRODUCTION: UTM Zone 18N
CSR PROJECT # 1945 FILE: 1945_B0_20201004.dwg



- LEGEND**
- Sediment thickness isopachs (1 m interval)
 - Sediment thickness isopachs (5 m interval)
 - Sub-bottom data extent
 - Pipeline tracks
 - Abandoned Pipe
 - Adjacent enclosure boundary
 - UTM Gridline
 - Bathymetry at seabed (may include sediment patches)
 - Bathymetry with local sediment veneer (generally <0.2m)
 - Bathymetry - Bathymetry at seabed with local sediment veneer
 - Undifferentiated Sediment (thickness labelled in metres where data is available)
 - Area of visible acoustic basement reflections

GEODETIC PARAMETERS

Horizontal Datum: NAD 83 / CHRS
Vertical Datum: Chart Datum
Projection: UTM Zone 21
Units: Metres



NOTES

CSM conducted the hydrographic and geophysical survey from January 20 to January 30, 2020.

HYDROGRAPHIC SURVEY EQUIPMENT

Vessel: *Surfstar* (Bathymetry RP-240)
Survey Software: *Hydrosurvey*
Positioning: *Trimble V90 RTK-GPS, Hemisphere V930 GNSS*
Motion Sensor: *IMU (Hansen 2.1)*
Heaveing: *IMU (Hansen 2.1)*
Motion Compensation: *Rainbow 2000*
Waterman: *AMS, Micro-N, SVP and Oden Digital Pro*
Tide Gauge: *Realtek 200*
Bottom Reflection: *Edgetech 200*
Bathymetry: *400-10000 Hz, Applied Acoustics CSP-300*
Power Supply: *MarineMaster with Geoprecision MP Hydrophones*

PROCESSING AND INTERPRETATION

Sub-bottom data was recorded along survey lines throughout the survey site using an EG&M 2000 Bottom system.

The bathymetry data were post processed using COBRA Survey Engine 4.3 software. The acoustic bathymetry (contoured top of bedrock) was output using a subbottom sound velocity of 1500 m/s and the sediment thickness above acoustic basement (up to 10 m) was output.

The reported data set was imported into Surfer 17 and grid cells of 5 m x 5 m were established based on a kriging interpolation algorithm. Sediment thickness isopachs were generated at 1 metre intervals based on the gridded data.

The area of no visible acoustic basement reflections was caused by the decreased penetration of the seismic energy due to the coarse nature of the underlying Oceanic crust.

Sedimented bathymetry and pipe locations were interpreted from multibeam water data along with areas of undifferentiated sediment within the surficial bathymetry areas. Sediment thickness of these areas were determined from the sub-bottom data and named after probes where available. Probe positions and sediment thickness were obtained from CHSL.

This chart represents results at the time of the survey and can only be considered as indicating the conditions at that time. Geophysical surveying is a science using method that may not detect all surface or sub-surface features of interest or concern.

BACKGROUND

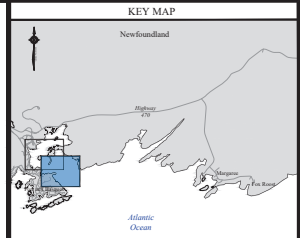
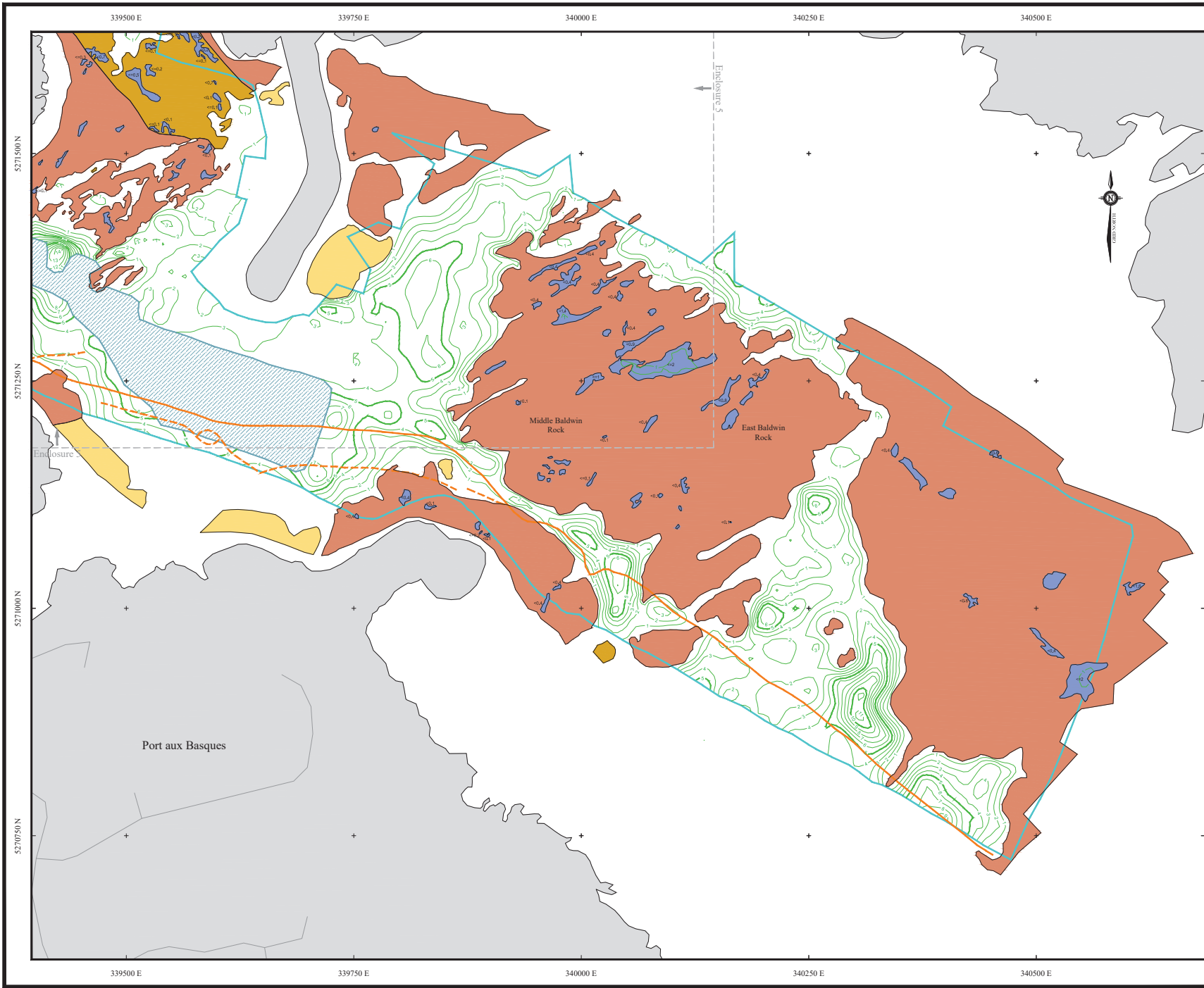
Probe were obtained from: <https://map.canada.ca/en/index.cfm>. The coastline was digitized from Google Earth Pro and is considered approximate.

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341 MYRA ROAD, PORTERS LAKE, NOVA SCOTIA
CANADA B1H 1G2
Tel: (902) 827-4200 Fax: (902) 827-2002
Email: info@csr-marine.com

ENGINEERING & ENVIRONMENTAL GEOPHYSICS
FAB Vardys's Island - Navigation Improvements
Port aux Basques, Newfoundland
Surficial Bedrock Geology & Acoustic Basement Isopach Map (North)
Enclosure 5

REV	DATE	REVISIONS	INTERPRETER	CHECKED	BY
1	12/10/2019	Initial	MS	MS	MS
2	12/10/2019	Initial	MS	MS	MS
3	12/10/2019	Initial	MS	MS	MS
4	12/10/2019	Initial	MS	MS	MS

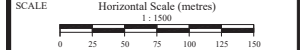
SCALE: 1:1500
PRODUCTION: UTM Zone 21
CSR PROJECT #: 1945
FILE: 1945_A01_20201004.dwg



- LEGEND**
- Sediment thickness isopachs (1 to 10 m)
 - Sediment thickness isopachs (17 to 20 m)
 - Sub-bottom data extent
 - Pipeline tracks
 - Abandoned Pipe
 - Adjacent enclosure boundary
 - UTM Gridline
 - Bathymetry at seabed (may include sediment patches)
 - Bathymetry with local sediment veneer (generally <0.2m)
 - Bathymetry with local sediment veneer (unidentified sediment thicknesses labelled in metres where data is available)
 - Area of visible acoustic basement reflections

GEODETTIC PARAMETERS

Horizontal Datum: NAD 83 / CHRS
Vertical Datum: Chart Datum
Projection: UTM Zone 21
Units: Metres



NOTES

CSM conducted the hydrographic and geophysical survey from January 20 to January 30, 2020.

HYDROGRAPHIC SURVEY EQUIPMENT

Vessel: Starship (Dredge/RP-240)
Survey Software: HYPACK
Positioning: Real-time Kinematic (RTK) GPS, Hemisphere V530 GNSS
Motion Sensor: SIMU (Harris 210)
Sounding: SIMU (Harris 210), Hemisphere V530 GNSS
Bathymetry: Raman 2200
Multibeam Echosounder: AIMS, Micro-N-SVP and Odom Digital Pro
Tide Gauge: FIMAT, 200 Brouwer (400-1000 Hz), Applied Acoustics CSP-300 Power Supply, Measurement with GeoPacSpectrum M3 Hydrophones

PROCESSING AND INTERPRETATION

Sub-bottom data were processed using COBA Survey Engine 4.3 software. The acoustic basement (horizontal top of bedrock) was output using a subbottom sound velocity of 1600 m/s and the sediment thickness above acoustic basement (TBL) was output.

The bathymetry data were post-processed using COBA Survey Engine 4.3 software. The acoustic basement (horizontal top of bedrock) was output using a subbottom sound velocity of 1600 m/s and the sediment thickness above acoustic basement (TBL) was output.

The expected data set was imported into Surfer 17 and grid cells of 5 m x 5 m were established based on a kriging interpolation algorithm. Sediment thickness isopachs were generated at 1 metre intervals based on the gridded data.

The area of no visible acoustic basement reflections was caused by the decreased penetration of the seismic energy due to the coarse nature of the underlying Oceanic crust.

Sediment thickness areas and pipe locations were interpreted from multibeam sonar data along with areas of sedimentation within the surficial bathymetry areas. Sediment thickness of these areas were determined from the sub-bottom data and manual depth probe where available. Probe positions and sediment thickness were obtained from CHCL.

This chart represents results at the time of the survey and can only be considered as indicating the conditions at that time. Geophysical surveying is a remote sensing method that may not detect all surface or sub-surface features of interest or concern.

BACKGROUND

Profile were obtained from <https://map.canada.ca/en/index-en.html>. The coastline was digitized from Google Earth Pro and is considered approximate.

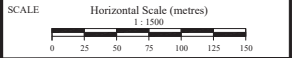
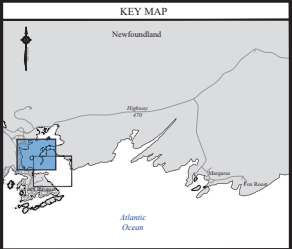
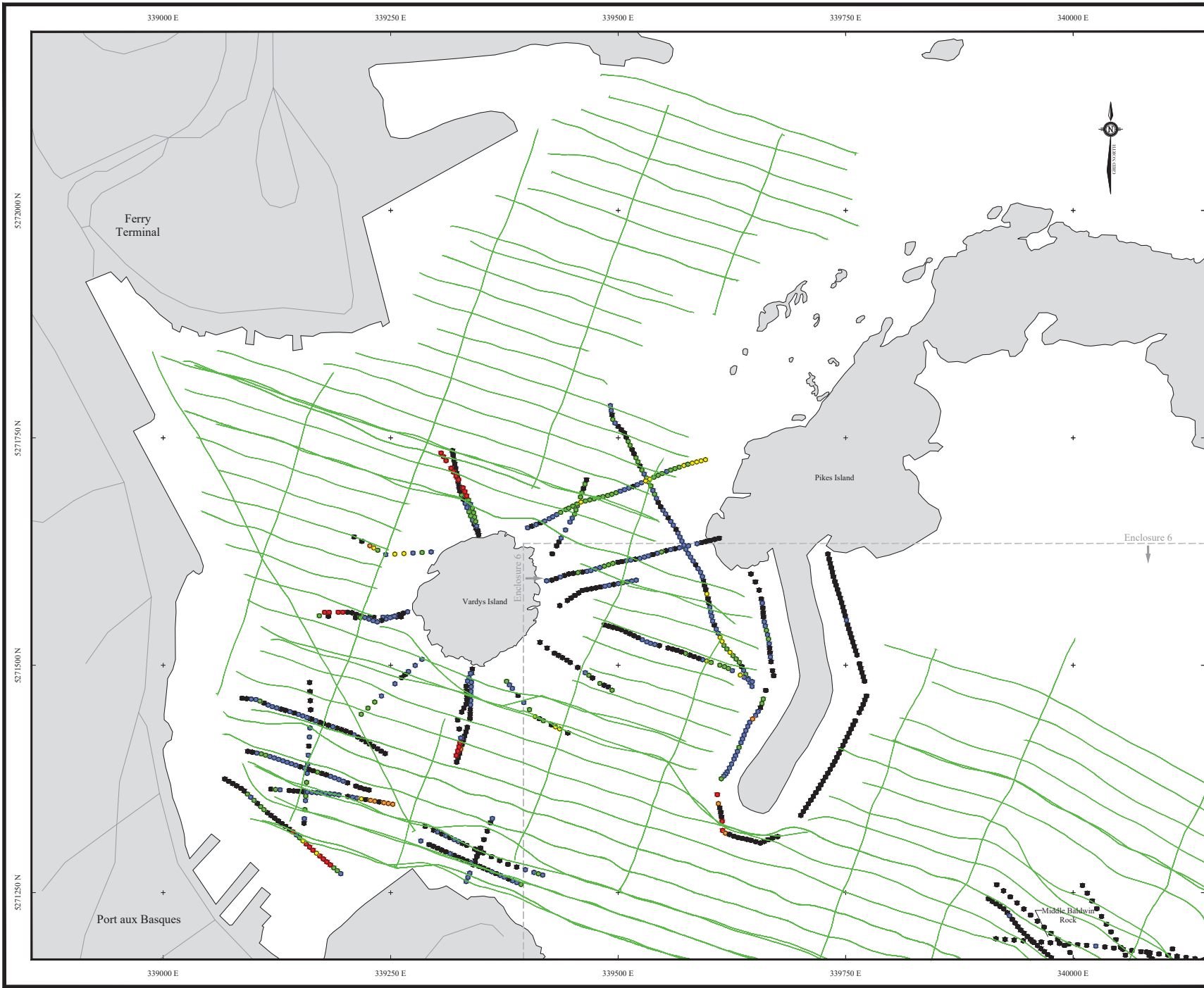
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341 MYRA ROAD, PORTERS LAKE, NOVA SCOTIA
CANADA B1H 1G2
Tel: (902) 827-4200 Fax: (902) 827-2002
Email: info@csr-marine.com

ENGINEERING & ENVIRONMENTAL GEOPHYSICS

FAB Vardy's Island - Navigation Improvements
Port aux Basques, Newfoundland
Surficial Bedrock Geology & Acoustic Basement Isopach Map (South)
Enclosure 6

REV	DATE	REMARKS	INTERPRETER	CHECKED
01	10/10/2020	Initial	MS	MS
02	10/10/2020	Revised	MS	MS
03	10/10/2020	Revised	MS	MS
04	10/10/2020	Revised	MS	MS

SCALE: 1:1500
PRODUCTION: UTM Zone 21
FILE: 1445_AIR_20201006.dwg



NOTES

CSR conducted the hydrographic and geophysical survey from January 20 to January 30, 2020.

HYDROGRAPHIC SURVEY EQUIPMENT

Vessel: Starliner (Endurance 24-240)
Survey Software: HYPACK
Multibeam Software: HYPACK / Echosound
Positioning: Trimble V90 RTK-GPS, Hemisphere V330 GNSS
Motion Sensor: SIMU (Hansen 2.1)
Heave: SIMU (Hansen 2.1), Hemisphere V330 GNSS
Heave: Racer 2200
Multibeam Echo-sounder: Acon Micro-N SVP and Odom Digital Pro
SVP: Odom
Tide Gauge: Racer 2200
Bottom Reflection: Fathom 200 (400-10000 Hz), Applied Acoustics CSP-300 Power Supply, Measurement with GeoSpectrum M3 Hydrophones

Sub-bottom data were recorded along survey lines throughout the survey site using an EG&M 2400 Bottom System. The trackline on this map represents the survey vessel's route during the collection of the sub-bottom data.

The positions and sufficient thickness of the manual diver probe locations on this map were obtained from CHSL.

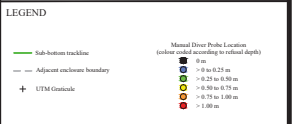
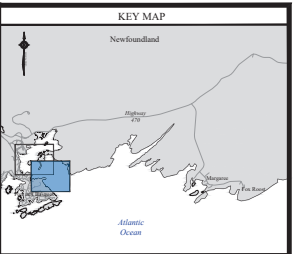
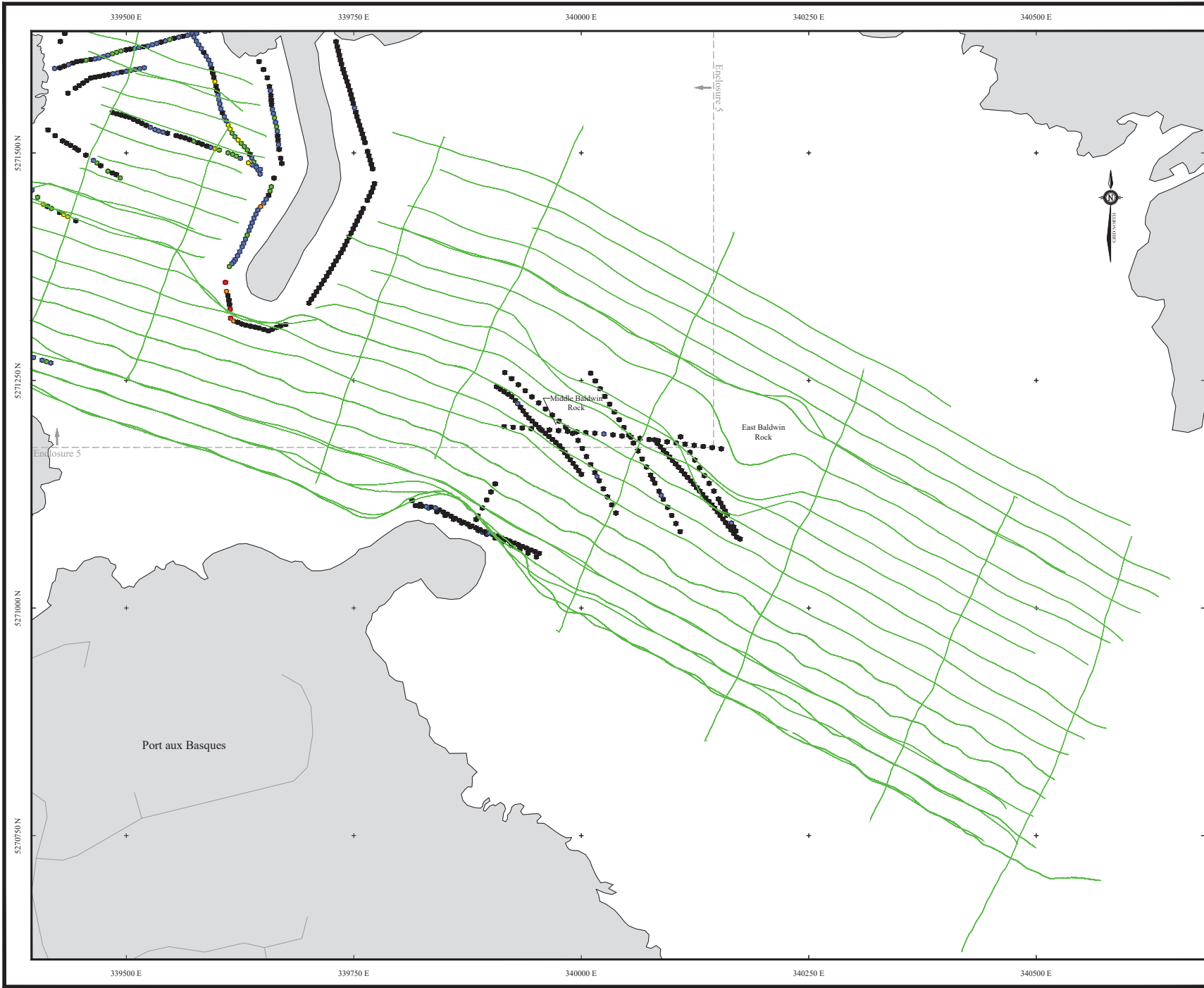
BACKGROUND
Roads were obtained from <https://maps.canada.ca/en/index.html>. The coastline was digitized from Google Earth Pro and is considered approximate.

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341 MYRA ROAD, PORTERS LAKE, NOVA SCOTIA
CANADA B1H 1G2
Tel: (902) 827-4200 Fax: (902) 827-2002
Email: info@csr-marine.com

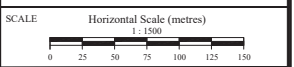
ENGINEERING & ENVIRONMENTAL GEOPHYSICS
PAB Vardy's Island - Navigation Improvements
Port aux Basques, Newfoundland
Sub-bottom Trackline and Probe Location Map (North)
Enclosure 7

REV	DATE	REVISIONS	INTERPRETER	CHECKED	DATE
1	2020-01-30	Initial	MS	MS	20
2	2020-01-30	Final	MS	MS	20
3	2020-01-30	Final	MS	MS	20

SCALE: 1:1500
PROJECTION: UTM Zone 21
CSR PROJECT # 1945
FILE: 1945_19_2020106.dwg



GEODETIC PARAMETERS			
Horizontal Datum	NAD 83 / ITRF	Projection	UTM Zone 21
Vertical Datum	Chart Datum	Units	Meters



NOTES

CSR conducted the hydrographic and geophysical survey from January 20 to January 30, 2020.

HYDROGRAPHIC SURVEY EQUIPMENT

Vessel: Starship (Boatlength 24.6m)
Survey Software: HYPACK
Navigation: Garmin VMT-400, Hemisphere V530 GNSS
Position Sensor: SVP (Hakon 2.1)
Depth: SVP (Hakon 2.1), Hemisphere V530 GNSS
Hydrophone: RDS
Multibeam Echo Sounder: Axiom N-SVP and Odom Digital Pro
Water Column: Axiom N-SVP and Odom Digital Pro
Tide Gauge: RDS
Bottom Reflection: RDS

Sub-bottom data were recorded along survey lines throughout the survey site using an EG&M 2400 Benthos system. The tracklines on this map represent the survey vessel's route during the collection of the sub-bottom data.

The positions and sufficient thickness of the manual diver probes displayed on this map were obtained from CGL.

BACKGROUND

Reefs were obtained from <https://maps.canada.ca/en/index.html>. The coastline was digitized from Google Earth Pro and is considered approximate.

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341 MYRA ROAD, PORTERS LAKE, NOVA SCOTIA
CANADA B1H 1G2
Tel: (902) 827-4200 Fax: (902) 827-2002
Email: info@csr-marine.com

ENGINEERING & ENVIRONMENTAL GEOPHYSICS

FAB Vardy's Island - Navigation Improvements
Port aux Basques, Newfoundland
Sub-bottom Trackline and Probe Location Map (South)
Enclosure 8

REV	DATE	REVISIONS	INTERPRETER	CHECKED	DATE
01	2020.01.20	Issue	MS	MS	20
02	2020.01.20	Issue	MS	MS	20

SCALE: 1:1500 PROJECTION: UTM Zone 21
CSR PROJECT #: 1945 FILE: 1945_19_2020106.dwg