FINAL FIELD REPORT

2018 NEARSHORE
ST. LAWRENCE RIVER SURVEY

CHSDIR Project Number: 4800094
File Number: 4902210

GIANNI DI FRANCO
A/HYDROGRAPHER-IN-CHARGE

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INTRODUCTION

The 2018 Nearshore St. Lawrence Survey was conducted in accordance with the Nearshore Pillar of Canada's Ocean Protection Plan. The Canadian Hydrographic Service using a small vessel based multibeam echo sounder system, will continue to collect high-resolution, full bottom coverage bathymetry, topographic data and tidal/current data via hydrographic surveys such as this, to produce new charts in paper and digital format to replace/augment existing products in the target areas.

The Canadian Hydrographic Service produces the nautical charts for the St. Lawrence River in both Canada and the United States of America. As a result, hydrographic collaboration between both countries was achieved through a memorandum of understanding which enabled the conduct of a modern hydrographic survey by Canada in waters subject to the jurisdiction of the United States of America. [1]

This survey provided connecting passageways between previously collected, high-resolution, full bottom coverage bathymetric data. This will assist the work being done to create and build upon corridors to provide mariners a more efficient network of high quality, modern data, through nautical charts that ultimately protect lives, property and the marine environment.

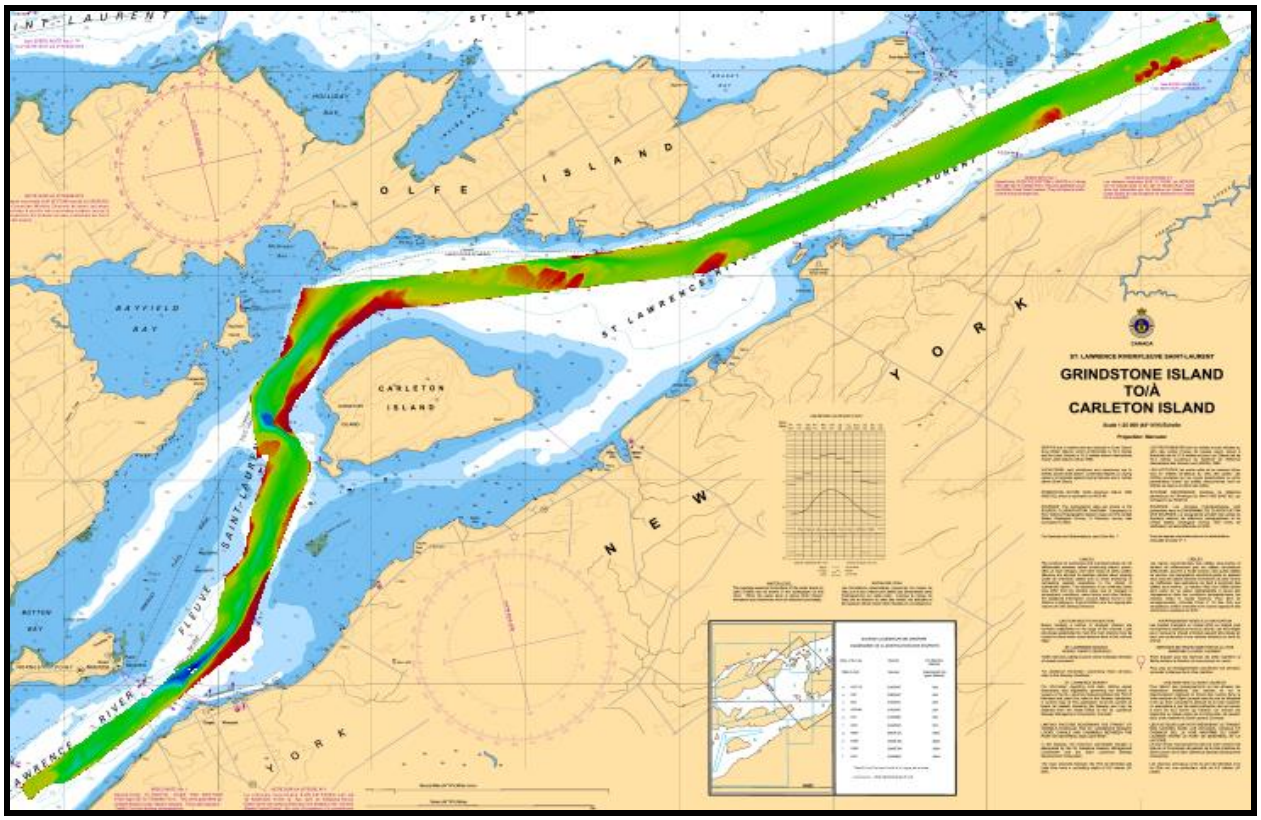
SURVEY OVERVIEW

Bathymetric Surveys were conducted throughout this 18-day mission in three key areas, designated through CHS where gaps remained within the sounding database when featuring high-resolution, full bottom coverage bathymetry.

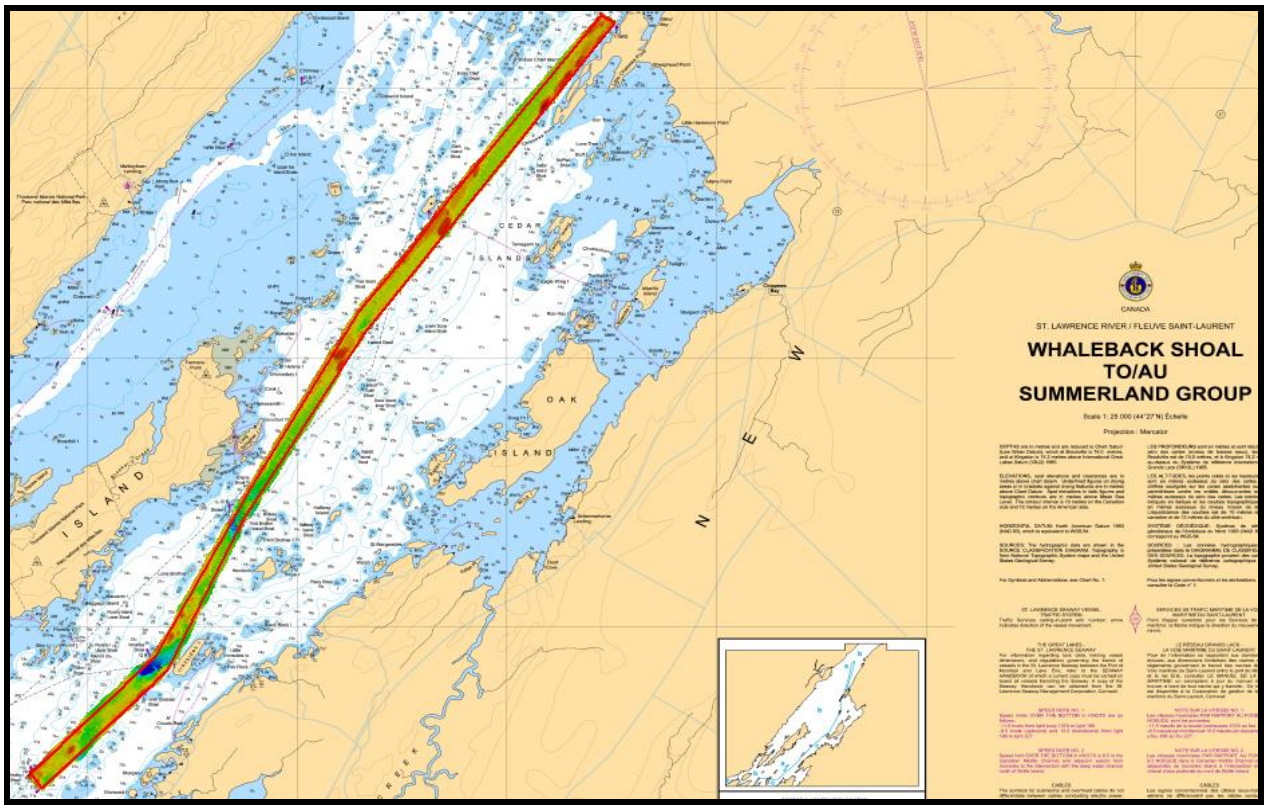
Figure 1 – Survey Site Overview

St. Lawrence River	***Figure***
Kingston Block	1a
Ironsides Block	1b
SLR Block	1c

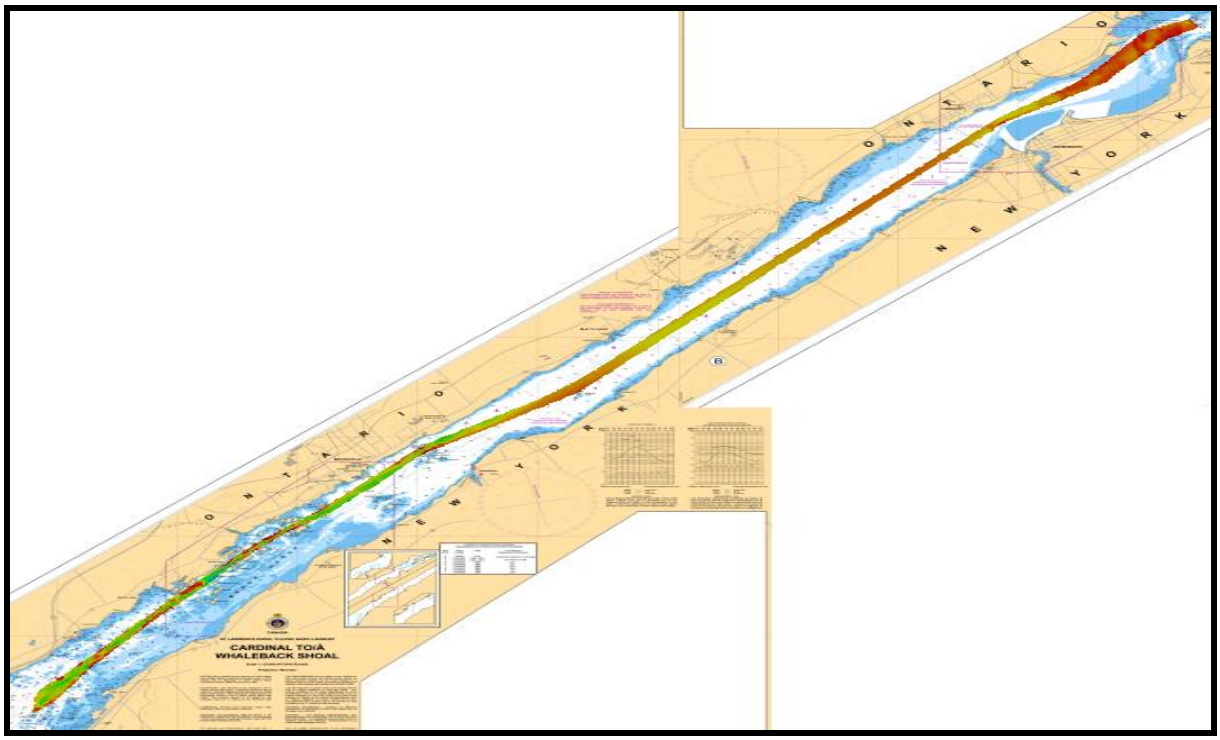
[1] NOS MOA 2018-043/Annex #1/11702



Kingston Block Coverage – ***Figure 1a – St. Lawrence River, CHS Chart 1438/1439***



Ironsides Block Coverage – ***Figure 1b - St. Lawrence River, CHS Chart 1437***



SLR Block Coverage – ***Figure 1c - St. Lawrence River, CHS Chart 1435***

LIST OF STAFF

Name	Position	Dates
Gianni Di Franco	Hydrographer-in-charge	7 to 24 August
Andrew Seko	MDH- Data Processor	7 to 24 August
Brandon Parsons	MDH- Launch Hydrographer	7 to 24 August
Wayne Logan	Launch Coxswain	7 to 24 August
Anthony Natolino	Electronics Technician	7 to 24 August

Figure 2 – CSL Bockmaster, St. Lawrence River
Left to Right: B. Parsons, G. Di Franco, A. Seko, W. Logan and A. Natolino

DESCRIPTION OF SURVEY VESSELS & ACQUISITION EQUIPMENT

Figure 3 – CSL Bockmaster, Sault Canal ***(photo by A. Leyzack)***

PLATFORM	HYDROGRAPHIC CAPACITY
CSL Bockmaster 8.9m, Hydrographic (Catamaran) Launch by Kanter Marine	• Kongsberg EM2040C (Compact), hull-mounted Shallow Water (200-400kHz) Multibeam Sonar System. • Kongsberg Seafloor Information System (SIS) 4.3.2 for sonar interface, navigation and data logging. • Applanix POS/MV V5 Positioning System with Zephyr II GNSS antennae. • Applied Micro Systems Limited (AML) MVP 30 Moving Vessel Profile System augmented with Micro SV (surface sound speed sensor) and AML Minos sound velocity probes. • *Petite Ponar* sediment grab sampler.

Figure 4 – Trimble R7, PPK GPS Reference Stations; Left to Right: Station TALL (Brockville), Station TINP (Mallorytown) and Station HIFD (Howe Island Ferry Dock)

LAND BASED COMPONENT	HYDROGRAPHIC EQUIPMENT
PPK GNSS – Base Stations (see **Horizontal Control** Section) Virtual PPK Base Stations	• Trimble R7 GNSS Receivers with Zephyr II, Geodetic antennae.

DATA PROCESSING	HYDROGRAPHIC SOFTWARE
PPK GNSS Navigation – CSL Bockmaster	• Applanix POSPAC MMS 7.1
Sonar Data Cleaning and Validation	• CARIS HIPS 9.1.5 • CARIS Base Editor 4.4
GNSS Control	• Trimble, Convert-to-RINEX 3.5 utility for GNSS data reformatting. • NRCan online tools: PPP and TRX
Sound Velocity Profiles	• Applied Microsystems Ltd (AML) SeaCast 4.4, sound velocity profile (proprietary to Kongsberg .asvp) data conversion software.

HORIZONTAL CONTROL

Primary horizontal control for the purpose of establishing kinematic GNSS reference stations were established using 24 hours of raw GPS L1/L2 observations processed with Natural Resources Canada (NRCan) Precise Point Positioning (PPP) web-based service. Positions were output directly to the 2010 epoch of NAD83 Canadian Spatial Reference System (CSRS) and then transformed to International Terrestrial Reference Frame 2008 (ITRF08) 2010 epoch using the NRCan TRX web application.

An attempt was made to utilize some existing survey benchmarks; however, temporary locations were used instead for various reasons. For station TALL, the nearest benchmark was elevated and in a high traffic area. The benchmark in the vicinity of station PRES was paved over at the Canadian Coast Guard Prescott base. For TINP, the location in the database was incorrect, placing the benchmark location within the river, it could not be found. No benchmark existed in the prime location needed for HIFD. Temporary control station markers were established at Tall Ships Marina in Brockville, at Prescott on the Canadian Coast Guard's base, Thousand Islands National Park in Mallorytown and on the Howe Island Ferry Dock just north of Howe Island on the mainland.

Control Point	Location	Marker # (Unique #)	Latitude (North)	Longitude (West)	Elevation above Chart Datum	Ellipsoid Height
TALL	Tall Ships Marina	Temporary Nail	42°35'12.968"	75°40'57.202"	-----	41.998m
PRES	Prescott CG Base	Temporary Nail	42°42'22.810"	75°30'59.321"	-----	42.438m
TINP	Thousand Island National Park	Temporary Nail	44°27'04.643"	75°51'32.677"	-----	41.900m
HIFD	Howe Island Ferry Dock	Temporary Nail	44°16'39.206"	76°19'38.470"	-----	40.381m

Figure 5 – Table of Survey Control used for PPK GNSS base stations (co-ordinates and ellipsoid heights in ITRF08_2010).

WATER LEVEL REDUCTIONS AND DATUMS

Soundings were reduced to chart datum by GPS Tide. This methodology converts and reduces the observed ellipsoidal height of each sounding to a depth below chart datum using a CVD model of the separation between the ellipsoid and chart datum.

The separation models used for this survey were:

HyVSEP_IGLD85_ITRF082010_LakeOntario.xyz;
SEP_ITRF_NAVD88_CD_KINGSTON_EPOCH20100101.xyz;
SEP_ITRF_NAVD88_CD_KINGSTON_IROQUOIS_EPOCH20100101.xyz;

Reference surface checks were also performed to obtain absolute and relative accuracies. The absolute vertical accuracy of the system was obtained by re-surveying a section of the St. Lawrence previously surveyed in 2013. Upon completion, a *difference surface* was created through Hips/Sips, and then computed for an average difference. The results between the 2013, CSL Merlin, R2Sonic survey 4013501_A when compared to this survey revealed a difference of only 1.2mm.

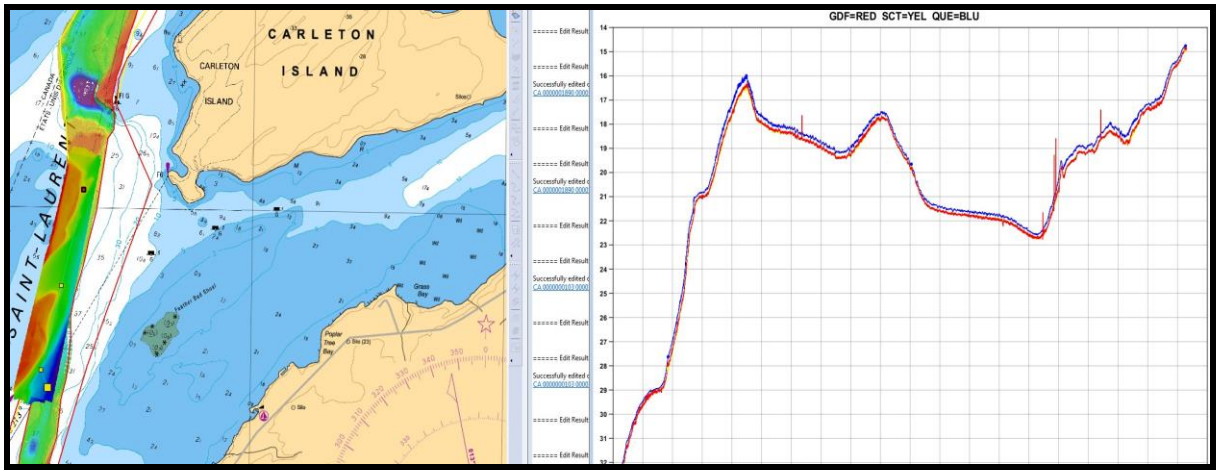


Figure 6 – left showcases location of comparison, right graph showcases the differences

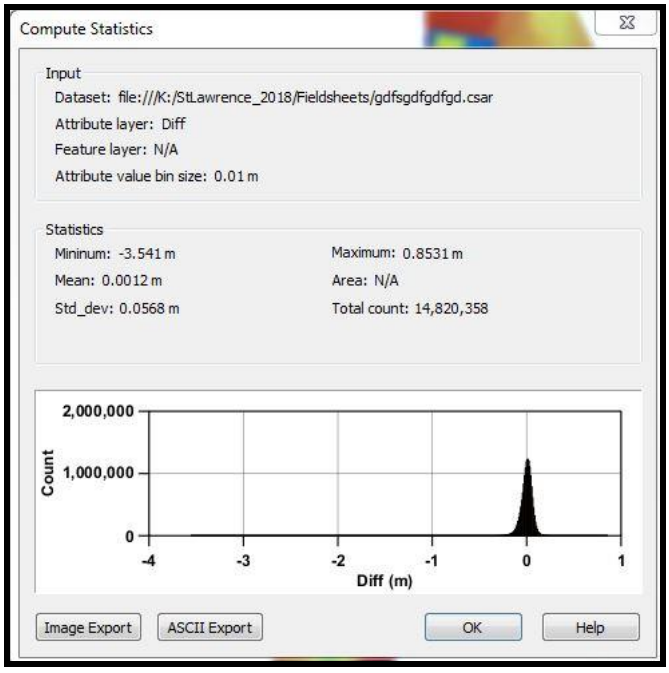


Figure 7 – Computed Statistics graph which showcases the average difference; 1.2 mm

CHRONOLOGY OF SIGNIFICANT EVENTS

7-12 August
Brockville to Johnstown, ON.

Overview:
Production survey on St. Lawrence River (SLR), survey block ranged from Whaleback Shoal to Johnstown, ON. Our base of operation was Brockville, ON. The *CSL Bockmaster* was based out of Tall Ships Landing (TSL) Marina, while also docking at the Prescott Canadian Coast Guard Base. The survey team consisted of Andrew Seko (Processor), Brandon Parsons (Hydrographer), Tony Natolino (Electronic Technician), Wayne Logan (Coxswain) and Gianni Di Franco (A/Hydrographer in Charge).

Details:
7 August- Sunny clear sky, high heat and high humidity, light to nil wind. Survey team traveled from Burlington to the TSL Marina, where a rendezvous was scheduled with Land Tug (Marine Services) and MacGregor Crane Service Ltd. Upon arrival, it was confirmed that with the large pedestrian, vehicle and vessel traffic, a new location was needed to safely splash the *Bockmaster*. Brockville Yacht Club were happy to assist. Di Franco established A PPK GNSS base station (TALL) at in a secure low traffic area adjacent to the TSL fuel dock. *Bockmaster* fueled, upon completion and subsequent initial startup of the generator, Logan noticed it leaking oil. Contact was made with Gilberts Marina. With location of the Brockville water level gauge (14400) adjacent to the fuel dock, and having access to shore power, *Bockmaster* attempted to float the gauge while awaiting the arrival of the mechanic. However, POS was showing an error in Attitude, and with no working generator to enable the vessel to get moving to lock onto single, the float was unsuccessful. The mechanic eventually diagnosed an overfilling of oil as the issue with generator. Excess oil was pumped out, and generator was operational by end of day.

Figure 8 – Successful crane lift at the Brockville Yacht Club

8 August- Overcast morning, developed into heavy rain throughout the day, light to nil wind. *Bockmaster* commenced survey on the SLR block. *Bockmaster* ordered to utilize the "line cnt." feature in SIS to separate 30 min lines in two, this maximized survey time by eliminating turns where applicable. Ordered to never exceed 12kts combined Survey Speed + water current + drum speed, when the MVP30 tow fish is deployed, and to be pulled out when adjacent to any obstructions. *Bockmaster* ordered to make QC checks on integrity of cable and tow fish throughout each day. Vessel averaged 6.5 to 8 kts in a 2kts current, with a drum speed at 40% (<2kts). Logan and Parsons encountered *Bockmaster* slightly leaking water from ceiling due to high rainfall. *Bockmaster* completed section of block from Butternut Bay to Brockville.

9 August- Clear morning, few light showers developed into afternoon, light to nil wind. *Bockmaster* continued survey in center of block from Brockville to Blakeys Point. Contact made with Chris Devries of the Prescott CCG base, acquired access and permission to utilize property. Di Franco/Natolino establish a PPK GNSS base station (PRES) on site, and *Bockmaster* ordered to end day at CCG base as a slip was also established. Seko encountered Bug in Hips/Sips 10.2, CARIS made aware of issue.

10 August- Sunny clear sky, hot and humid, Northern light to winds. Crew departed Brockville for Prescott. *Bockmaster* departed from Prescott CCG base, issues with Prescott Marina sent *Bockmaster* to fuel up at St. Lawrence Marina. *Bockmaster* continued to survey Northern Section of Block. Parsons noticed high concentrations of Kelp in the work area becoming problematic due to interference with the microSVP. *Bockmaster* continually losing time maneuvering to shake of excess kelp from sensor.

11 August- Sunny clear sky, hot and humid, light Northern winds. Natolino, Parsons and Logan departed Brockville for Prescott. Seko revealed SVP casts remained consistent, *Bockmaster* ordered to cut frequency of casts. *Bockmaster* completed final section of SLR block. High concentrations of kelp still hindered microSVP, Logan and Parsons are adapted as needed.

12 August- Sunny clear sky, Northern light winds, *Bockmaster* fueled up to start the day. With approval to survey in US water, survey team ordered to complete new extensions of SLR block into US waters. The afternoon saw Northeastern winds pick up to 8kts with gusts of 11kts. Heavy kelp in survey area slowed progress of *Bockmaster*. With delay, Natolino ordered to tear down PPK GNSS base station (TALL) in Brockville, to enable Di Franco to set up a PPK GNSS basestation at the 1000 Islands Provincial Park in Mallorytown. Doing so in order to satisfy the remaining south section of the SLR block extensions, as well as in range for the future Ironsides block. *Bockmaster* encountered irreversible errors on microSVP. With no success maneuvering vessel to restart sensor errors, and moderate breeze affecting stability to check sensor at sea, *Bockmaster* ordered to return to TSL marina. Natolino discovered kelp lodged into the tip of the sensor at end of day.

Technical Notes:

- Best practice to double check all fluid levels after outside work has been done.
- MVP30 to never exceed 12kts combined Survey Speed + water current + drum speed
- MVP30 maximum drum speed is 4kts, optimal setting 40%.
- HIPS/SIPS 10.2 Surface filter inappropriately processes even when canceled

13-19 August
Brockville to Kingston, ON.

Overview:
Production survey on St. Lawrence River (SLR) continued. Expansion of the SLR working block that ranged from Whaleback Shoal to Johnstown into US waters was completed. *CSL Bockmaster* refloated Brockville Station and shifted dockage to Rockport. Ironsides block completed next, followed by another move to base *Bockmaster* out of Gananoque. Survey of the Kingston block had commenced.

Details:
13 August- Sunny clear sky, light to nil wind. Natolino departed for Prescot Canadian Coast Guard (CCG) base to start logging basestation (PRES). *Bockmaster* departed Tall Ship Landing (TSL) Marina and ordered to float Brockville water level gauge (14400). *Bockmaster* ordered to complete final extensions of SLR block into US waters, splitters, and to then finish the referred to revisory work at the Cole Shoal Lighthouse. Revisory work requested for the shoreline of the Port of Ogdensburg was unable to be completed. After repeated attempts in past week to contact Steve Lawrence Director of Operations for the Ogdensburg Bridge and Port Authority (OBPA) proved unsuccessful, Di Franco unable to confirm that proposed shoreline and dredging work scheduled for completion in the summer of 2018 was in fact complete. Cole Shoal Lighthouse had been confirmed by Logan that as a result of that fire, could no longer be used as an aide to navigation. Logan deemed it a hazard to navigation. *Bockmaster* ordered to return TSL to fuel up and drop data to be evaluated before proceeding to Ironsides block. *Bockmaster* given green light to proceed to Ironsides block after fueling. Natolino ordered to tear down PPK GNSS base station (PRES). *Bockmaster* ordered to end day at Andress Boat Works marina in Rockport, ON.

Figure 9 – The Ruins of the Cole Shoal Lighthouse.

14 August- Overcast morning, cloud cover and sunshine developed into overcast sky with rain from afternoon on. Light to nil wind increased as day progressed. *Bockmaster* continued survey on the Ironsides block. *Bockmaster* encountered divers in work area, forced to divert. Seaweeds very heavy in area, continued struggling with microSVP. Parsons notes that patches of floating grass were noticeable throughout work area. Di Franco contacted the County of Frontenac, informing them of our want to set up PPK GNSS base station on west end of the Howe Island Ferry dock. Di Franco and Natolino set up (HIFD) station in prime location that covered the entire Kingston block. *Bockmaster* encountered generator shutdown as intake was clogged with seaweed. *Bockmaster* ordered to return to Rockport. Contact made with Gilberts Marina, Nelson Gilbert arrived to flush out intake valve of any debris and weeds. With local knowledge, he advised it is the worst time of year for seaweed, and there is nothing more we could do to mitigate this issue.

15 August- Clear morning, light winds and sunny. Showers developed into afternoon with a pop-up thunder and lightning storm with torrential rain and hail to end the day. *Bockmaster* completed Ironsides block. *Bockmaster* ordered to return to Rockport to drop off data for evaluation before proceeding to Kingston block. Logan and Parsons ordered to complete the Small Vessel Compliance Report and Marine Facility Information forms while waiting. After evaluation, Di Franco gave the green light to proceed to Kingston block and proceed to Gananoque Municipal Marina (GMM) at end of day. Upon reconnaissance of GMM, Brennan Marine informed us that the swing bridge which separates the GMM from Brennan Marine's gasoline fuel dock is not readily operational. Di Franco attempted to contact Town of Gananoque but failed to get any response. Natolino was advised to go 3 km west to evaluate Clark's Marina which services dockage, fuel and a travel lift. Chart showed 0.6-meter sounding at mouth of channel. Di Franco contacted Clark's marina, they have repeatedly asked for chart to be updated, claim that they have had vessels with 2 meter plus draft using marina for decades. Di Franco contacted CHS Operation Manager Scott Youngblut to confirm permission to cautiously enter channel while logging multibeam to ensure safe passage for *Bockmaster* into Clark's Marina for fuel up next morning. Parsons informed Di Franco that strong weather warnings were being advised in survey area. Logan returned to GMM at first sight of lightning. Weather so severe, Natolino unable to tear down (TINP) station at the Thousand Islands National Park in Mallorytown.

Figure 10 – Singer Castle on Dark Island; centrally located to Ironside survey block

16 August- Sunny clear sky, light to nil winds. With permission granted, *Bockmaster* ordered to proceed to Clark's Marina, cautiously enter channel while logging to ensure safe navigation. After safely arriving at the fuel dock, Parsons reported seeing depths as shoal as 0.5 meters. Logan ordered to critically evaluate the sites dockage, fuel and travel lift. Logan had concerns in regards to seaweed, debris but mostly high concentrations of sediment damaging outboard engines. Logan advised that the location not ideal for fuel and dockage due of the concerns mentioned above. *Bockmaster* ordered to proceed to Kingston block. Paul McMunn, Manager of Public Works for Gananoque returned my call, he advised that the Township would be happy to assist, a schedule was worked out to have bridge swung open every other morning to enable a safe passage to fuel dock at Brennan Marine. Bridge will be left open and traffic diverted until *Bockmaster* completes fuel.

Figure 11 – Left; Logan cleaning out kelp/grass clogging the intake. An ongoing nuisance

17 August- Overcast, rain with light to nil winds. *Bockmaster* continued survey of the Kingston block. Di Franco contacted Survey paused to assist Anouk Masters with her examination. Survey resumed back to Kingston block. Parsons noticed slight fraying on MVP cable, Natolino taped up 3inch section. During the end of day commute, Natolino, Parsons and Logan hit traffic jam on 401 series highway and were stuck for over two hours.

18 August- Sunny, clear skies, winds coming out of north-east at 13kts with gusts to 18kts, *Bockmaster* to fuel up at Brennan Marine, Town of Gananoque assisted with Swing Bridge. *Bockmaster* continued survey of Kingston block. Di Franco Notice to Shipping (NTS) quality control revealed dangerous depths shoaler then charted values on 1438. C2103/18 was issued though the Marine Communications and Traffic Services. ***(See figure-14 pg.18)***

19 August- Sunny, clear skies, winds coming out of west at 6kts with gusts to 9kts, *Bockmaster* continues survey of Kingston block. Quality check of MVP30 all good, Bockmaster reported that all systems and equipment are working well. Contact made with George Horne of Horne's Ferry, Di Franco received permission for *Bockmaster* to use dock at Point Alexandria if needed. *Bockmaster* found a PFD on transit to Marina, call was made to coast guard to advise, they were already aware.

Technical Notes:

- Parsons notice errors with microSVP, mitigate loss of data with Logan assistance.
- Seko noticed issues with speed/lag issues on CPU, video card update required for fix.

20-24 August
Brockville to Kingston, ON.

Overview:
Production survey completed when remaining section of Kingston Block partially filled. *CSL Bockmaster* shifting dockage location from Gananoque Municipal Marina, to Thousand Islands Boat Museum, to its final destination at Kingston Marina. Priority line south of Kingston Harbour covered. Office packed up, PPK GNSS (HIFD) Station taken down and *Bockmaster* demobilized, cleaned, and prepped for future crane pickup and Land Tug delivery to CCIW.

Figure 12 – Water Street Swing Bridge, Gananoque ON.

Details:
20 August- Sunny clear sky, hot with 6 kts wind, gusts as high as 10 kts. *Bockmaster* fueled up, Gananoque assisted with swing bridge. Continued work on the Kingston block. Parsons encountered issues with MVP30, cable continued to chafe the metal block. Issue forced Parsons and Logan to protect chafed area with electrical tape at Natolino's request, due to distance of survey. Working in larger areas of consistent deeper depths, Parsons encountered issues with the amount of cable available, and what was needed to properly profile the work area. Natolino and Di Franco planned with Lang Tug, Kingston Marina and CCIW's boat shop, to compose a plan that will return Bockmaster to CCIW.

21 August- Overcast, rain with 12 kts with gusts up to 16kts. CHS Director for Central and Arctic Chris Marshall arrived into town for a site visit. Marshall and Di Franco joined Parsons and Logan on the *Bockmaster* for a full day on the water. *Bockmaster* continued survey of the Kingston block. *Bockmaster* gets stopped by the United States Border Patrol, all documentation was in place for vessel, our work objectives and individually with passports. Upon approaching *Bockmaster* and reading the decals they were satisfied enabled the survey to continue.

Figure 13 – United States Border Patrol

22 August- Partly cloudy, high westerly winds at 14 kts with gusts up to 22 kts. *Bockmaster* fueled up, Gananoque assisted with swing bridge. Continued work in the Kingston block. Wind becoming a factor as *Bockmaster* moved closer to end of block. West end of Kingston block deemed too rough by Logan, *Bockmaster* to return to Gananoque slightly earlier than end of day

23 August- Sunny, north westerly winds at 6 kts with increasing speeds and gusts of 18 kts by end of day. *Bockmaster* continued to work in the Kingston block final south west section. As a result of it being the last full survey day, Parsons ordered to ensure that by end of day no gaps remained, that data coverage was seamless, and that it extended to the end of block. Ordered to Kingston Marina at end of day due to proximity. *Bockmaster* air-conditioner no longer working. Wind and fuel level become a concern near end of day. *Bockmaster* ordered to change plan, returned to Gananoque as result of a safer sheltered passage to marina at end of day. Gananoque municipal marina was unable to find room available for dockage as a result of last minute change of plans. Di Franco arranged dockage with the Thousand Islands Boat Museum at final hour to ensure safe dockage for *Bockmaster*. Di Franco contacted Mike Prior to arrange an extra bridge opening for August 24th.

24 August- Sunny and clear, slight westerly wind increasing throughout the day. *Bockmaster* set to fuel up. After filling the generator, only half of port side fuel tank was filled before Brennan Marina ran out of fuel. With Brennan marina unable to resupply for another 3 hours, limited time, no other viable marina options and a limited amount of fuel, Di Franco ordered team to fill Jerry cans and to refuel *Bockmaster* manually. When fueled enough for a safe transit to Kingston, *Bockmaster* was on its way. Loss of time inhibited our opportunity to return to the Kingston block as scheduled. *Bockmaster* was still able to survey priority line outside of Kingston harbour. Kingston block while not as wide as desired, steps taken on the 23rd ensured that the final product would be sufficiently delivered.

Technical Notes:

- New location of frame housing for MVP30
    - should mitigate chafing of line
    - should ensure safer deployment/retrieval of Tow Fish.
- Height of *Bockmaster* seats in relation to steering wheel and workstation limits the shock absorption capability, hampering ergonomics, possibly limiting productivity.
- Roof of *Bockmaster* leaking during heavy rainfall needs to be investigated
- SIS being so automated had difficulty providing clean data with constant variations in depth and the surface of seafloor.
- Hips/Sips 10.2 vs 9.1.5 found various bugs associated with 10.2, some limiting productivity, further investigation needed.
- *Bockmaster* and Natolino phone could be upgraded. When working in the south, smartphone capabilities and communication proved to be valuable in ensuring optimal product delivery. There were many instances where personal smartphones were used while on the *Bockmaster*, and instances where it was difficult to communicate with Natolino.

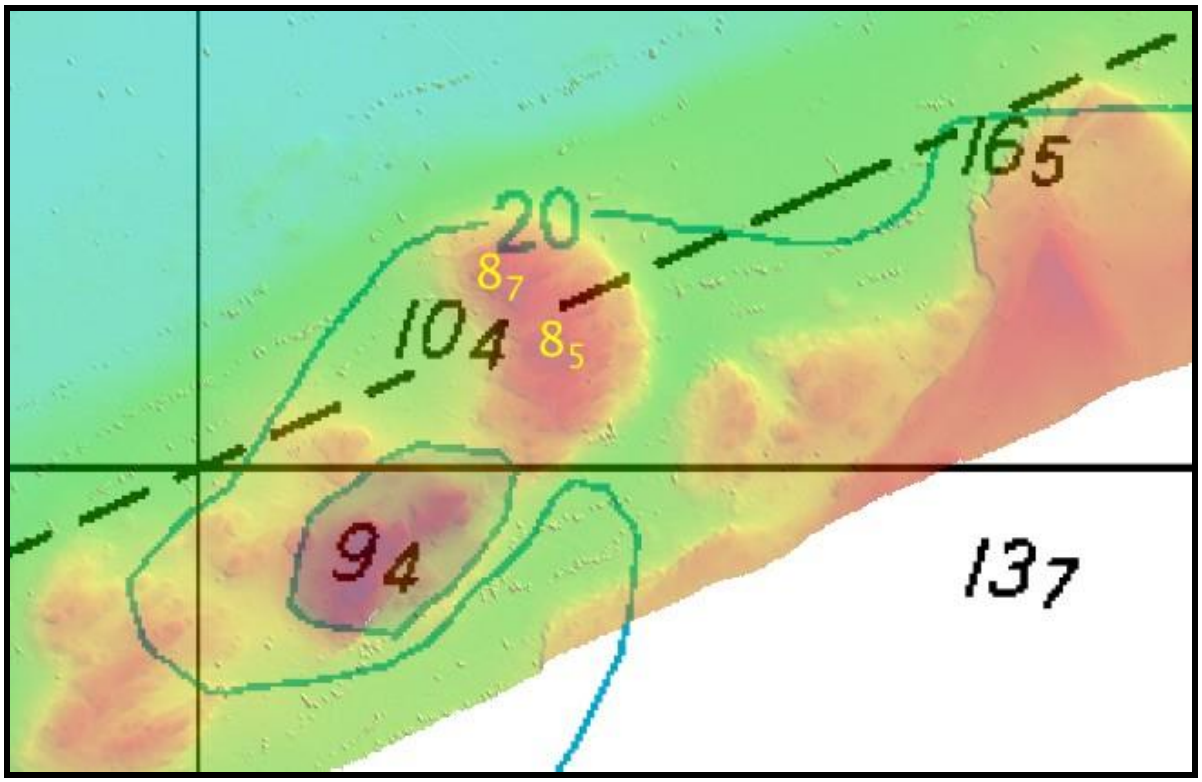


Figure 14 – NTS C2103/18 revealing dangerous depths shoaler than charted values on chart 1438. On October 5, 2018, the Notice to Shipping had been cancelled and replaced by Notice to Mariners 6604443.

DATA PROCESSING

Bathymetric and navigation data were post processed, merged and cleaned on site as data was collected. Raw GNSS navigation data was post processed using POSPac MMS using an IN-Fusion Single Base Solution to compute smoothed best estimate trajectory (SBET) navigation. SBET navigation was applied to cleaned bathymetry using CARIS HIPS software and exported to Bathymetric surface Associated with Statistical Error (BASE) in CARIS Spatial Archive Raster (.csar) format.

GPS Tide results from SBET navigation were validated by comparison of bathymetric surfaces fixed to different base stations and to predicted and observed tides (see Water Level Reductions and Datums section). Post survey analysis indicated CHS Special Order was achieved with an S-57 Category Zone of Confidence (CATZOC) A.

SURVEY DELIVERABLES

1. Three (3), 0.5m grid, bathymetric surfaces:

CHSDIR File Number	Project Area(s) Surveyed
4014189_001	SLR
4014189_002	Ironsides
4014189_003	Kingston

2. Water-level observations (file 4902208_5)
3. SBET Navigation (file 4902208_6
4. GNSS Base Station Data (file 4902207)
5. Sound velocity profile (SVP) data (file 4902206_2)
6. Final Field Report (file 4902210)

SURVEY STATISTICS

Statistics:	**Total**
- Control stations occupied	4
- Benchmark/Hz control recovered	0
- Notices to Shipping issued[2]	1
- Calibration checks	2
- SVP casts	627
- Line kilometers sounded	1310.8
- Square kilometers sounded	56

[2] NOTSHIP C2103/18 was cancelled and replaced by NOTMAR 6604443

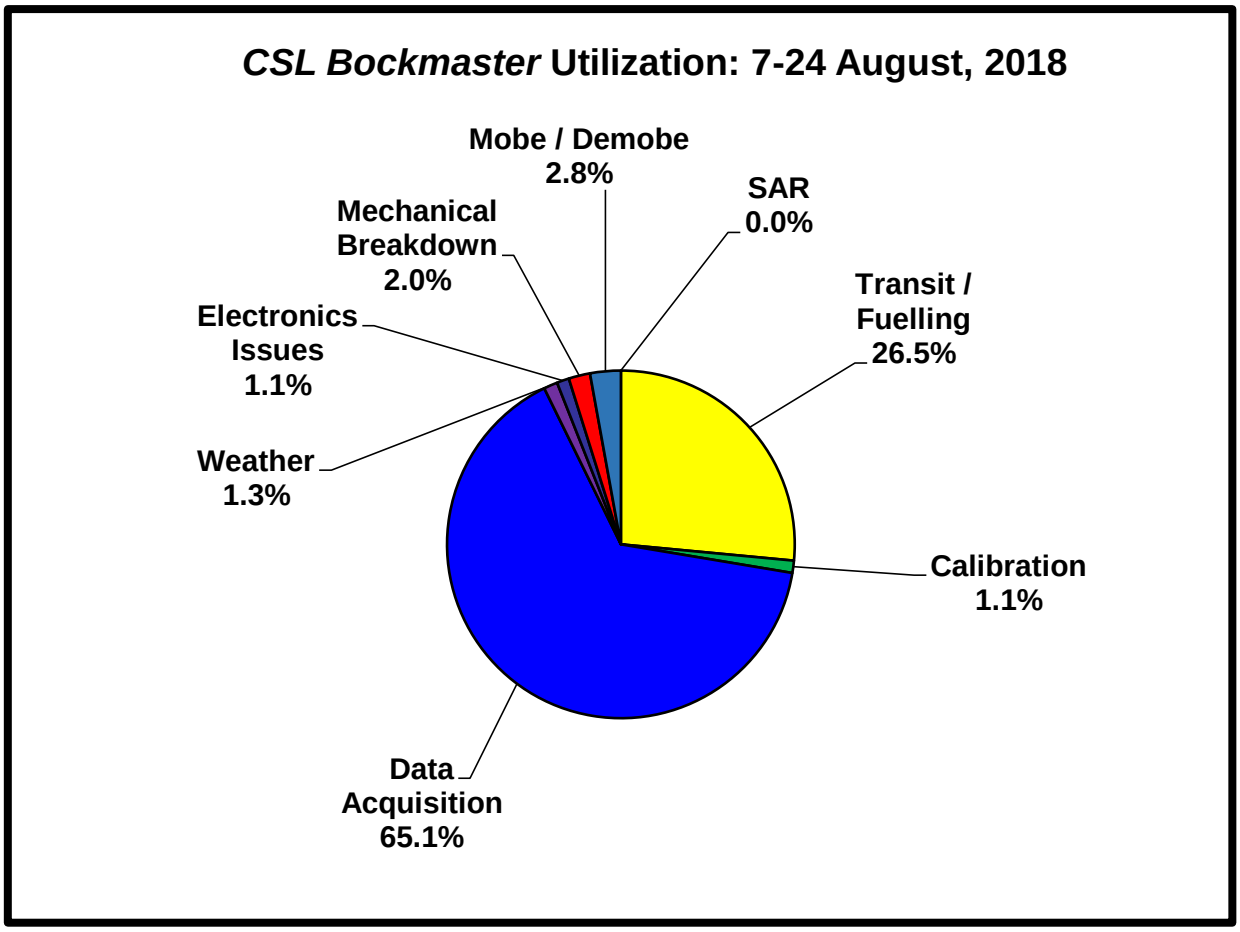


Figure 15: Vessel Time Utilization

OCCUPATIONAL HEALTH AND SAFETY

Within DFO it is the responsibility of managers and supervisors to provide a healthy and safe working environment, and it is the responsibility of the workers to perform their duties in accordance to established safe work procedures. In this regard CHS has established Task Hazard Analysis documentation related to hydrographic field activities. While in the field CHS employees are subject to these processes and are supervised by the Hydrographer in Charge (HIC). During this survey, Brandon Parsons served as safety representative and worked collaboratively with HIC to manage a safe workplace and the safe operation of equipment.

There was one incident during the respective survey operations that required a HOIR. The coxswain experienced a fall during transit in some rougher than normal sea and weather conditions. The incident was immediately reported to senior management, and properly documented. Conditions as such are normal for this type of work, and the proper steps were taken in order to address the situation. Logan insisted he was fit to complete the survey.

RECOMMENDATIONS

30 Minute Lines

A protocol for data logging was established during 2018 waterways survey and put into play for the entire nearshore survey. The purpose of this was to increase productivity by lessening the amount of operational time lost due to turns. In doing so, we must also keep in mind the potential of data volume loss should a system or component fail during the collection of each line. As such, a 30 minute elapsed logging time cut at the 15 minute mark (using the "*Line CNT*" tool in SIS) per survey line was found to serve as an acceptable balance between the distance of each line, sound velocity cast intervals and operator monotony.

Planning Polygon Linework and Scale

When using Kongsberg SIS for survey navigation, geo-tiffs with specific project area limits are superimposed upon raster chart background images. While zooming in to show survey coverage on the geo-tiff image, project area limit line work tended to become exaggerated. The overstated line width could result in production time loss from redundant survey coverage. Post survey analysis has determined that geo-tiffs created at a scale of 25000 – would provide sufficient and legible chart detail while minimizing graphical scale distortion.

Ensure 200% Coverage is Maintained

To ensure sufficient data redundancy needed for a CUBE solution satisfactory to CHS Special Order results, it is essential that 200% overlap in data coverage be maintained. In other words, the outer beams of an adjacent survey line must overlap the nadir beam of the previous line.

MVP installation

The A/HIC supports the opinion of survey team members who believe the current Moving Vessel Profiler (MVP) configuration poses an occupational health and safety risk. As described in the previous section of this report, the layout of the system on the aft deck has presented some ergonomic challenges in addition to the following concerns:

- Bushings have failed in the davit base and as such the davit wobbles in its base and is difficult to turn. Metal to metal wearing down will continue to worsen over time.
- The metered sheave used in the davit is a specialized one-off unit in order to satisfy this current of center instalment. No spares exist in the event it is damaged or fails.
- This sheave is also contributing to the fraying damage to the line itself.
- The davit must be turned inboard when coming alongside, reach poses a safety hazard to personnel on other platforms and/or metered sheave could be damaged if struck.
- Off centered towing increases steering difficulty for coxswain
- Off center position will assist smother casts and retrievals, limiting bunching.

The recommended solution is to re-mount the MVP winch mid-ships aft, running the tow cable through the more common off-the-shelf MVP A-frame/sheave assembly.

MVP30 Protocol

It is imperative to know and understand the stresses that can put the MVP tow fish and cable at risk of damage and property loss. The major at risk issues when using the MVP are;

A) Loss of Tow Fish (snag, cable break)
B) Loss of Tow Fish (speed in water putting stress on locking mechanism)
C) Damage to Cable (Line bunching/constant abrasion/cable fraying)

	MVP30	
Speed (knots)	Depth Obtained (m)	Cycle Time (min.)
0	125	2.6
1	105	2.5
2	90	2.3
3	80	2.2
4	73	2.1
5	66	2.1
6	60	2.0
7	56	1.9
8	51	1.8
9	47	1.7
10	42	1.7
11	35	1.6
12	30	1.6
Dimensions w/o boom (m)	0.7 x 0.3	
Weight (kg)	120	
System	Electrical	
Power (hp)	1.5	
Cable	125m	

(Figure 16) - Speed and Depth limits for MVP30

As a result, the survey team should be aware of key factors;

A) Know the speed of the vessel when towing the fish

B) Know the speed of the current when towing the fish

C) The Speed dial on the MVP30 at its maximum will add 4kts of speed onto the stress of the tow fish
   i. Best practice sets speed at 40-50% (2kts)

D) Do not exceed the total combined speed of the vessel + current + MVP winch speed, all in relation to the depths from the chart to the left. (***Figure 16)***

E) If winch begins to bunch up the cable on its return, the speed dial will need to increase in order to retrieve a slack line
   i. Keep in mind, in strong currents, this will change with each line direction.

F) Know your area; depths, shoals, hazards to navigation
   i. Use appropriate caution when towing

Sync SVP Equipment

Test to ensure that the Micro SV, Tow Fish Sensor and all back up Minos all have profiles that are in sync. Testing against each other will verify the equipment is calibrated and functioning properly.

Working in USA waters

When lodging, fueling and docking in Canada, but surveying in US waters, transit time could be considerable in some sections of the St. Lawrence River, especially during off seasons. Seeking out options to be able to at the very least fuel up in the US could save valuable time and money for future surveys.

CONCLUSIONS

Prior to commencing 2018 production surveys, a vessel reference survey was performed with laser scanning technology[3]. The accuracy of this methodology has been proven on previous CHS vessels to resolve subtle changes to sensor locations (+/- 2mm) and rotations (<0.05°), eliminating any uncertainty introduced by conventional vessel survey techniques. With the 2018 relocation of the sonar transducer and 2017 changes to GNSS antenna mounts, CSL *Bockmaster* was prime for re-survey. A subsequent reference surface check over the Welland Canal Lock 1 (lower) sill found depths measured by *Bockmaster* to be within 0.020m of published (Topo survey) values which meets CHS Special Order accuracy in Seaway project depths. Further reference surface checks found a similar order of agreement with CHS bathymetry from the 2017 project year.

Several efficiencies were realized during the 2018 survey:

- Hull mounted transducer allowed for an average 2 knot increase in survey vessel speed and agility to reduce transit time between project areas.
- 30 minute survey lines reduced time lost due to turns.
- MVP30 protocol

ACKNOWLEDGEMENTS

The author would like to acknowledge the survey teams unwavering commitment, support and effort put forth during these eighteen days. Both the surveyor and electronic support teams had heightened focus which enabled us to accomplish the task at hand, and more importantly build on it to bring back much more usable data then what was initially expected. Our team welcomed their responsibilities, followed instructions, provided valuable feedback and worked well together to ensure we were always surveying at an optimal rate. The assistance, confidence and trust shown from senior management must also be acknowledged. As well as the hard work done by our Tides, Currents and Water Levels during the execution of this project.

This project benefited from additional operation support from DFO-Coast Guard for the use of their facilities at Prescott, ON for docking and basestation purposes.

Lastly, a special thanks goes out to Paul McMunn, Manager of Public Works for Gananoque. The assistance of his team was crucial to the timely completion of our survey. Their efforts to have the swing bridge operational so we could access fuel was not only appreciated, but vitally important, saving our survey time and money in the process.

[3] Vessel reference survey was performed under contract F2919-160032 by Cansel Imaging Services