



# RV Investigator Voyage Plan

Voyage #:	IN2019_V07				
Voyage title:	RAN Hydrographic and Maritime Heritage Surveys				
Mobilisation:	Hobart, Wednesday, 10 April 2019				
Depart:	Hobart, 0800 Thursday, 11 April 2019				
Return:	Hobart, 1000 Tuesday, 23 April 2019				
Demobilisation:	Hobart, Tuesday, 23 April 2019				
Voyage Manager:	Max McGuire Contact details: Max.Mcguire@csiro.au +61 477 397 439				
Chief Scientist:	Emily Jateff				
Affiliation:	Australian National Maritime MuseumContact details:emily.jateff@sea.m +61 448 588 374				

Version	0.01	Review Date	June 2018	Approved		Review Date	Apr 2020
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## **Scientific objectives**

1) Conduct a modern survey in the primary shipping route through Bass Strait for the Australian Hydrographic Office (AHO). This survey will facilitate safe navigation for international and coastal shipping and improve confidence for subsurface navigation in Bass Strait.

2) Undertake mapping of historic shipwreck sites, in partnership with Heritage Victoria and the Australian National Maritime Museum (ANMM).

The primary activity of the GSM investigation of historic shipwreck sites is to conduct surveys of the purported site of SS *Federal*, to provide positive identification of the site and ensure its protection in future. This will be supplemented by opportunistic deployments of the drop camera (supported by SIT) in the event that the shipwreck is located. The location of shipwreck SS *Federal* was reported to Heritage Victoria by sport divers in 2012. Unfortunately, the provided coordinates were insufficient to narrow down the location. Subsequent attempts to communicate with the finders have been unsuccessful. Accurate location of SS *Federal* is a priority for Heritage Victoria in order to ensure adequate preservation and protection of this historic site into the future, in accordance with relevant heritage shipwreck protective legislation.

Activities may also include opportunistic survey of three 'unidentified targets' located between the AHO mapping area and the search area for SS *Federal*. Aims are to positively identify these sites as cultural heritage targets (shipwrecks) via GSM and drop camera investigation, if time allows.

3) Training of Marine National Facility Operations and Support Team personnel in several routine and new underway and deployed systems, including:

- Multibeam patch test calibrations and backscatter calibration lines.
- Commissioning and trialling of new Brenke sled, Seaspy magnetometer (ahead of IN2019\_V04) and RapidCAST SVP.
- Triaxus, CTD casts, multicorer, Smith Mac grab.

4) Seabird and marine mammal observations (Dr Eric Woehler, University of Tasmania): This project will collect data to quantify the variability in the distribution and abundance of seabirds in the marine environment around Australia. The project will examine the relationships between physical oceanographic features and their use as seabird feeding areas.

The study also seeks to identify species assemblages, or associations, in the species of seabirds observed that are persistent over time. The project will collect new data for seabirds around Australia, for which there are very few (and in many cases, nil) data. The project will use standard survey methods to ensure compatibility with existing data sets for the same species in other areas.

Observations of marine mammals will also be shared with researchers to facilitate greater understanding of the role of oceanographic processes in the spatial and temporal distribution of marine mammals at sea around Australia.

The project will also provide a context to current research efforts tracking seabirds and marine mammals, which are often constrained to a relatively low number of instrumented individuals relative to the population as a whole.

## **Voyage objectives**

Listed below are the voyage objectives for both the survey and training components of the voyage, in order of priority:

## 1) AHO Survey of Bass Strait

- Completion of mapping of Sub Area A within Bass Strait (outstanding from IN2018\_C01): ~24 hours using EM710.
- The GSM Hydrographic Survey Procedure for the original survey is included in Appendix B. This procedure is current for the completion of the survey being undertaken on this voyage, apart from the following variations:
  - The Kongsberg EM710-MK2 Multibeam Echosounder (MBES) will be used to complete the survey, instead of the Kongsberg EM2040c (Dual Head) Multibeam Echosounder (MBES) used for the original survey during IN2018\_C01.
  - The survey area differs in that it includes only the portion of Sub Area A which was left incomplete during the IN2018\_C01 voyage (see Figure 1). As such, timings will vary from the original procedure.
  - Sediment sampling using the Smith Mac grab will not occur during this survey.
- The Survey Instruction (SI003) is included in Appendix C.



**Figure 1:** AHO Survey Area A. The hollow section contained within the pink polygon (in the SE corner) is the section to be mapped during IN2019\_V07 (SI003).

## 2) Historic Shipwreck Surveys

Conduct surveys of the purported site of SS *Federal* and opportunistic survey of three unidentified targets (see Figure 2 for survey targets).

- Multibeam survey of SS *Federal* (38°06.95'S, 148°43.867'E, depth 115m) as the priority search area.
- Multibeam survey of three unidentified targets:
  - o 38°32.983'S, 147°12.5167'E, depth unknown
  - o 38°57.35'S, 146°59.233'E, depth unknown
  - o 38°48.7667'S, 146°30.433'E, depth unknown
- Multibeam survey of SS *Queensland*, which doubles as a multibeam calibration target.
- Approximate hours available for survey areas to be identified by GSM.
- Actual line plans for the search areas will be plotted while on board, taking into consideration prevailing weather conditions.
- Includes opportunistic deployment of the drop camera, in the event that a shipwreck is located and conditions are suitable.
- Drop camera deployment to be prioritised for SS *Federal* site, where possible. At least **two hours** for drop camera deployment is preferred to enable maximum image coverage. Full image coverage of the site would allow production of a photogrammetric site plan.



Figure 2: Map indicating shipwreck target locations and other areas of operation for IN2019\_V07.

## 3) Training and Equipment Trialling

MNF Data Acquisition and Processing (DAP) and Seagoing Instrumentation (SIT) teams:

- CTD casts including hydrochemistry analysis. Test altimeter operation during very shallow (~80m) CTD cast (conduct in area with existing bathymetry data).
- Triaxus tows.
- Operation of ADCPs.
- Drop camera deployment (potentially at located shipwreck sites).

MNF Geophysical Survey and Mapping (GSM) team:

- Multibeam patch test calibrations: one in shallow water and one in deep water; approximately 6 hours required for each.
- Multibeam backscatter calibration lines: conduct during transit into and out of Storm Bay.
- Deployment of RapidCAST SVP and development of associated Standard Operating Procedures (SOPs) for its use: can occur while underway (at a slightly reduced speed).
- Trialling of new Seaspy magnetometer prior to IN2019\_V04: each deployment will occur by hand during daylight hours, take approximately 30-45 mins and can occur while underway (at a slightly reduced speed). Includes the following:
  - Comparison of data quality across a range of towing speeds, from low speeds to maximum speed.
  - Assessment of whether magnetometer can be deployed concurrently with other towed equipment e.g. Triaxus.

MNF Field Operations (FO) team:

- Trialling of the new Brenke sled system.
- Training of new personnel in the deployment of other equipment, including the multicorer and possibly, the Smith Mac grab.

MNF Hydrochemistry team:

• CTD casts including hydrochemistry analysis. At least 3-5 shallow CTDs and 3-5 CTDs conducted at depths of >3000 m, with a maximum of 2 CTDs per 24 hours.

MNF Ship Management Group:

• Training of new personnel in the Voyage Manager role and general vessel operations.

## 4) Seabird and Marine Mammal Observations

#### Equipment and operations

Seabird at sea data will be collected according to the method described by the BIOMASS Working Party on Bird Ecology. This method has been used by Australian Antarctic Division (AAD) personnel since 1980/81 and reflects the standard protocol for obtaining seabird at sea data.

Observations will be made continuously while the vessel is underway during daylight hours from the specifically designed Observation Deck on board *Investigator*.

Briefly, all seabirds within a 300 m forward quadrant will be recorded, with details of their ages (where identifiable) and behaviours (such as feeding, sitting on water etc.). By using standard methods, the data collected on these voyages will be able to be integrated with other datasets

collected adjacent with, or in overlapping areas (e.g. Australian Antarctic Division surveys 1980/81 onwards).

Observations of marine mammals are also included (in the absence of dedicated marine mammal observers) using standard protocols. Observation of marine debris are also recorded.

Data will be entered in real time on laptops connected to the ship's oceanographic and GPS system to automatically record abiotic and biotic data alongside seabird observational records. Standardised methods of data collection ensure continuity and compatibility with extant data for the same species elsewhere and with similar studies of other species.

No equipment is required, apart from access to the Observation Deck on Level 7.

### Areas of interest

The seabird observation program is passive and has no influence on the ship track.

### <u>Timing</u>

The observation program is undertaken continuously during daylight hours from *Investigator*.

## **Operational Risk Management**

### **Operating in the Traffic Separation Zone:**

In order to mitigate the potential risks of operating within a traffic separation zone, ASP will be in direct communication with the Australian Maritime Safety Authority (AMSA) in order to implement the necessary control measures required for this voyage. ASP's primary measures of risk mitigation are;

- 1. ASP have notified the Australian Hydrographic Office of the intended details of the operation. From this notification, the UKHO will distribute the information through their weekly Notice to Mariners service.
- 24-48 hours prior to the commencement of operations, ASP will notify AMSA's Joint Rescue Coordination Centre (JRCC) who will issue an AUSCOAST warning to all vessels in the area. ASP will continue to liaise with the JRCC for the duration of any planned operation within a traffic separation scheme.
- 3. The vessel shall display all correct day shapes and lights to indicate her status to other vessels. The vessel's AIS data will also reflect her status throughout the operation.
- 4. The vessel's bridge crew have prepared an internal risk assessment to identify and mitigate all potential navigational hazards which may be encountered during the operation.

## Training and Equipment Trialling:

The key challenges around completion of personnel training and equipment trialling will be managing safe operations involving new and inexperienced personnel and new and previously untested equipment. A number of high risk activities have been identified and will be mitigated as follows:

• Write detailed Safe Work Instructions (SWIs) for all new equipment / operations and review and update SWIs for existing equipment / operations relevant to the voyage;

- Complete a Voyage Specific Risk Management Plan (VSRMP) as an overarching risk management document, tailored to the particular activities being undertaken during the voyage and identifying needs for any further procedures and controls;
- Follow ASP Standard Operating Procedures and JSA's throughout the voyage;
- Conduct detailed inductions, toolbox meetings and briefings with all personnel, including new and inexperienced personnel;
- Maintain exclusion zones around wires under tension during equipment deployment / retrieval;
- Ensure all personnel wear appropriate PPE during all deck operations;
- Ensure extra Field Operations personnel are available for operations involving more extensive manual handling e.g. coring.

Several planned operations have been identified as potentially high risk work and will therefore trigger MNF procedures for potentially high risk operations. These operations are listed in the below table:

Equipment	Activity	Risk management
Magnetometer (new	Deck operations, deployment,	Modify/develop SWI
equipment)	towing, recovery	Toolbox meeting
		Pre-deployment risk assessment
		Appropriate PPE for back deck
RapidCAST SVP (new	Deck operations, deployment,	Develop SWI
equipment)	towing, recovery	Toolbox meeting
		Pre-deployment risk assessment
		Appropriate PPE for back deck
Brenke sled (new	Deck operations, deployment,	Modify/develop SWI
equipment)	towing, recovery	Toolbox meeting
		Pre-deployment risk assessment
		Appropriate PPE for back deck

## **Media Activities**

The MNF will seek to pursue opportunities that arise during the voyage to promote the science, scientists and ship, via conventional and social media channels, in consultation and/or collaboration with the relevant ship user.

Organisation	Activities	Timing	Responsible person
MNF, ANMM	Collaborative and opportunistic media engagement around shipwreck surveys with Heritage Victoria / ANMM. Potential live cross to ANMM.		Emily Jateff (ANMM) Matt Marrison (CSIRO MNF)

## Overall activity plan including details for first 24 hours of voyage

## Wednesday 10<sup>th</sup> April

• Mobilise all equipment on board RV Investigator.

## Thursday 11<sup>th</sup> April

- Depart Princes Wharf 4 at 0800 and transit to Storm Bay (approximately 2.5 hours).
- Conduct very shallow CTD cast in a mapped area (~80 m water depth) to test altimeter operation (~20 minutes).
- Deploy the Triaxus and tow during transit to the multibeam calibration site Deep (EM122) (approximately 9 hours). Conduct multibeam calibration lines while on transit to Deep (EM122).
- Recover the Triaxus and conduct a deep CTD cast, commencing at approximately 2200 and concluding at approximately 0100 on Friday 12<sup>th</sup> April.

## Friday 12<sup>th</sup> April

- From 0100 to 0700, conduct multibeam patch test calibrations in the same area.
- Following calibration, conduct a deep CTD cast and then commence transit to AHO Area A\_1, arriving at approximately 1200 on Saturday 13<sup>th</sup> April.

## Saturday 13<sup>th</sup> April

- Following arrival at AHO Area A\_1 at 1200, conduct multibeam patch test calibrations over the SS *Queensland*, concluding at approximately 1800.
- Conduct a shallow CTD cast (outside of the Beagle Commonwealth Marine Reserve), concluding at 1930 and then commence AHO mapping (24 hours allocated), from 1930 on Saturday 13<sup>th</sup> April to 1930 on Sunday 14<sup>th</sup> April. During surveying, the RapidCAST SVP will be deployed.

## Sunday 14<sup>th</sup> April

• Following completion of AHO mapping at 1930, commence transit to the site of the SS *Federal* (11 hour transit time). Deploy the magnetometer during transit.

## Monday 15<sup>th</sup> April

- Following arrival at the site of the SS *Federal* at around 0630, conduct a shallow CTD cast, concluding at around 0800.
- Conduct Brenke sled and multicorer deployments (6 hours each).
- At 2000, commence 12 hours of shipwreck surveys, concluding at 0800 on Tuesday 16<sup>th</sup> April.

## Tuesday 16<sup>th</sup> April

• At 0800, conduct Brenke sled and multicorer deployments (6 hours each), followed by a shallow CTD cast, concluding at around 2130.

## Tuesday 16<sup>th</sup> April – Friday 19<sup>th</sup> April

• From 2130 on Tuesday 16<sup>th</sup> April to 0930 on Friday 19<sup>th</sup> April, conduct 60 hours of shipwreck surveys.

#### Friday 19<sup>th</sup> April

• At 0930, conduct a shallow CTD cast, followed by a further 34 hours of shipwreck surveys, concluding at 2100 on Saturday 20<sup>th</sup> April.

### Saturday 20<sup>th</sup> April

• At 2100, conduct a shallow CTD cast.

### Saturday 20<sup>th</sup> April – Monday 22<sup>nd</sup> April

• Following CTD cast, deploy the Triaxus and commence transit to Deep (EM122) (28 hour transit time), arriving at around 0330 on Monday 22<sup>nd</sup> April. Deploy the magnetometer during transit (after Triaxus has been retrieved).

## Monday 22<sup>nd</sup> April

- Following arrival at Deep (EM122), conduct a deep CTD cast (3 hours), followed by Brenke sled and multicorer deployments (6 hours each).
- Conduct a further deep CTD cast (3 hours), commencing at 1930.
- At 2230, commence transit back to Hobart (11.5 hours). Conduct multibeam calibration lines while transiting to Storm Bay.

### Tuesday 23<sup>rd</sup> April

- Arrive at Princes Wharf 4 at 1000.
- Demobilisation.

## Voyage track example



**Figure 3:** Voyage track for IN2019\_V07 (white line). Potential shipwreck sites are shown as light blue waypoints. The AHO mapping area and multibeam calibration target (the wreck of the SS *Queensland*) are shown as pink waypoints. Note: voyage track is in clockwise direction.

	Decimal Latitude	Decimal Longitude	Depth (m)	Distance (nm)	Total Distance (nm)	Steaming time (hrs)	Total Steam (hrs)
Hobart	42° 52.2	147° 21.0					
Storm Bay	42° 58.32	147° 22.85		8	8	2.5	2.5
Deep (EM122)	43° 3.985'S	148° 34.323'E	~2500	74	82	9	11.5
SS Queensland	39° 6.500'S	146° 43.814'E	~57	280	362	26	37.5
AHO mapping area	39° 13.620'S	146° 41.940'E	~66	8	370	1	38.5
SS Federal	38°06.95'S	148°43.867'E	~110	116	486	11	49.5
Deep (EM122)	43° 3.985'S	148° 34.323'E	~2500	300	786	28	77.5
Hobart	42° 52.2	147° 21.0		80	866	11.5	89

## Waypoints and stations

## **CTD Configuration**

	Please select:
Fundamentals:	
• Which CTD rosette to be used for this voyage (24 Niskin bottles or 36):	36
Likely total number of casts:	7-10
Likely maximum depth of deepest cast:	>3000m
Lowered ADCP required:	
Instrumentation (maximum 6 auxiliary channels in addition to 2x DO):	
2x pumped Temperature, Conductivity, Dissolved Oxygen circuits:	(Standard)
Altimeter (required if operating anywhere near the sea floor):	X
PAR Sensor (Biospherical QCP-2300):	
Transmissometer (Wetlabs C-Star 25cm):	
<ul> <li>Fluorometer – Chlorophyll-a (Chelsea Aquatracka III – 430/685nm):</li> </ul>	
<ul> <li>Fluorometer – CDOM (Wetlabs FLCDOM – 370/460nm)</li> </ul>	
Nephelometer (Seapoint Turbidity Meter)	
ECO-Triplet (Chlorophyll-a, CDOM & backscatter – maximum depth 2000m)	
Hydrochemistry Analyses:	
Salinity	X
Dissolved Oxygen	X
Nutrients: Nitrate	X

	Please select:
Nutrients: Phosphate	Х
Nutrients: Silicate	Х
Nutrients: Nitrite	Х
Nutrients: Ammonia (special request after discussion with hydrochemistry)	Х

## **Time estimates**

The following time estimates are based on a steaming speed of 11 knots.

Please include estimates of time for periods in between all activities noted below.

Date	Time	Activity	Duration	Location
Wednesday 10/4/2019	0800	Mobilise: • 36 bottle CTD		Princes Wharf 4, Hobart
		<ul> <li>Triaxus</li> <li>RapidCAST SVP</li> <li>Multicorer</li> <li>Brenke sled</li> <li>Magnetometer</li> <li>Smith Mag grade</li> </ul>	8 hrs	
Thursday	0800	Siniti Mac grab	25 hr	Transit
11/4/2019	1030	<ul> <li>Very shallow CTD cast (in ~80 m water depth) to test altimeter operation (~30 minute duration)</li> <li>Deploy Triaxus</li> </ul>	0.5 hr	Storm Bay
1200		<ul> <li>Transit to Deep (EM122)</li> <li>Conduct multibeam calibration lines while on transit</li> </ul>	9 hr	Transit
	2100	<ul> <li>Arrive at Deep (EM122)</li> <li>Retrieve Triaxus</li> </ul>	1 hr	Deep (EM122)
	2200	Deep CTD cast	3 hr	Deep (EM122)
Friday	0100	Conduct multibeam patch test calibrations	6 hr	Deep (EM122)
12/4/2019	0700	Deep CTD cast	3 hr	Deep (EM122)
	1000	Commence transit to AHO Area A_1	26 hr	Transit
Saturday 13/4/2019	1200	<ul> <li>Arrive at AHO Area A_1</li> <li>Commence multibeam patch test calibrations on wreck of SS <i>Queensland</i></li> </ul>		AHO Area A_1
	1800	Shallow CTD cast (outside Beagle CMR)	1.5 hr	AHO Area A_1
	1930	<ul><li>Conduct AHO mapping</li><li>RapidCAST SVP deployment/s</li></ul>	24 hr	AHO Area A_1
Sunday 14/4/2019	1930	<ul> <li>Commence transit to site of SS <i>Federal</i></li> <li>Conduct magnetometer deployment/s during transit</li> </ul>	11 hr	Transit

Date	Time	Activity	Duration	Location
Monday	0630	Shallow CTD cast	1.5 hr	SS Federal site
15/4/2019	0800	Brenke sled deployment	6 hr	SS Federal site
	1400	Multicorer deployment	6 hr	SS Federal site
	2000	Commence shipwreck surveys	12 hr	SS Federal site
Tuesday	0800	Brenke sled deployment	6 hr	SS Federal site
16/4/2019	1400	Multicorer deployment	6 hr	SS Federal site
	2000	Shallow CTD cast	1.5 hr	SS Federal site
Tuesday 16/4/2019 – Friday 19/4/2019	2130	Shipwreck surveys	60 hr	SS <i>Federal</i> site
Friday 19/4/2019	0930	Shallow CTD cast	1.5 hr	SS Federal site
Friday 19/4/2019 – Saturday 20/4/2019	1100	Shipwreck surveys	34 hr	SS <i>Federal</i> site
Saturday	2100	Shallow CTD cast	1.5 hr	SS Federal site
20/4/2019		Deploy Triaxus	1 hr	
Saturday	2330	Transit to Deep (EM122)	28 hr	Transit
20/4/2019 – Monday		Retrieve Triaxus (after approximately 12 hour tow)	1 hr	
22/4/2019		<ul> <li>Magnetometer deployment/s</li> </ul>		
Monday	0430	Conduct deep CTD cast	3 hr	Deep (EM122)
22/4/2019	0730	Brenke sled deployment	6 hr	Deep (EM122)
	1330	Multicorer deployment	6 hr	Deep (EM122)
	1930	Conduct deep CTD cast	3 hr	Deep (EM122)
	2230	Commence transit to Hobart	11.5 hr	Transit
Tuesday 23/4/2019	1000	Arrive at Princes Wharf 4, Hobart		Princes Wharf 4

## **Piggy-Back Projects**

The **Australian Microbiome Initiative** is a continental-scale, collaborative project aspiring to characterise the diversity and ecosystem service provision of the microorganisms inhabiting natural Australian ecosystems. The mission of the Australian Microbiome (AM) project is to develop a comprehensive, publicly-accessible database of microbial diversity across a geographically expansive and diverse range of Australian terrestrial and aquatic ecosystems. In terms of pelagic ecosystems, the Project aims to make these observations at long-term temporal scales (IMOS NRS; repeated voyage transects) and large spatial scales (voyages). Details on the AM Initiative can be found here: <a href="https://www.australianmicrobiome.com/">https://www.australianmicrobiome.com/</a>. Genomics data generated from samples collected on previous MNF voyages has been contributed to the AM. All data (raw and processed) is made publicly available through a data portal

(https://data.bioplatforms.com/organization/about/australian-microbiome) and we are working

with the Data Centre to reflect the availability of previously obtained genomics data that is in the AM in the future.

Samples that we make available for inclusion in the AM must be accompanied by rich contextual/metadata that comes with the full suite of hydrochemistry. Samples will be collected during existing CTD casts conducted for Hydrochemistry personnel training purposes, and as such, the AM will not require any deviation from the existing Voyage Plan.

The Project aims to utilise the collection of any samples from CTD casts at the same depths (preferably from the same bottle) that hydrochemical analyses are occurring and where the data will become available.

Sampling consists of:

- 2 L filtered through a peristaltic pump with 8 heads. Therefore up to 8 samples can be filtered at once, onto a sterivex filter. Samples will be stored at -80° C.
- Surface, mixed layer and bottom depths are of most interest; though if there are other depths being analysed during deep casts, these are of interest to the Project too.

## **Permits**

• A portion of the AHO survey will be conducted within the Beagle Commonwealth Marine Reserve and operation of acoustic underway systems will be covered by the RV *Investigator's* blanket Parks Australia permit (permit number: PA2018-00005-1).

## Signature

Your name	Emily Jateff	
Title	Chief Scientist	
Signature	RE	
Date:	(insert date) 24 MOR 19	

## **Appendix A**

## Scientific equipment and facilities provided by the Marine National Facility

Some equipment items on the list may not be available at the time of sailing. Applicants will be notified directly of any changes. Indicate what equipment and facilities you require from the Marine National Facility by placing an **X** in the relevant box.

### (i) Standard laboratories and facilities

Name	Essential	Desirable	Notes/Comments
Aerosol Sampling Lab			
Air Chemistry Lab			
Preservation Lab			
Constant Temperature Lab			Please indicate the required setpoint temperature
Underway Seawater Analysis Laboratory			
GP Wet Lab (Dirty)	Х		Field Operations. Lab custodian: Mark Lewis
GP Wet Lab (Clean)			
GP Dry Lab (Clean)			
Sheltered Science Area	Х		Field Operations
Observation deck 07 level	Х		Seabird observations
Walk in Freezer			
Blast Freezer			
Ultra-Low Temperature Freezer (-80°C) X2	Х		Required for storage of filtered CTD water samples
Walk in Cool Room			
Salt water ice machine			

## (ii) Specialised laboratory and facilities (may require additional support)

Name	Essential	Desirable	Notes/Comments
Modular Radiation Laboratory			
Modular Trace Metal Laboratory (TM1-blue)			
Modular Trace Metal Laboratory (TM2-white)			Cannot be overstacked
Trace metal rosette and bottles			• 10 foot container
Modular Hazchem Locker			
Deck incubators			
Stabilised Platform Container			
Clothing container			• The use of this container will be identified by MNF

## (iii) Standard laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments
CTD - Seabird 911 with 36 Bottle Rosette	Х		
CTD - Seabird 911 with 24 Bottle Rosette			
Lowered ADCP			
Sonardyne USBL System			
Milli-Q System			
Laboratory Incubators			
Heavy Duty Electronic Balance (80kg)			
Medium Duty Electronic Balance (15kg/5g resolution)			
Light Duty Electronic Balance (3kg/1g resolution)			
Surface Net (mouth area 1m^2)			Please specify 335 micron, 500 micron, or 1,000 micron mesh
Bongo Net (not instrumented) ring diameter 485mm 0.018m^2			• 500 micron mesh only
Smith Mac grab	Х		Opportunistic training deployments

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## (iii) Standard laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments
Dissecting Microscopes (x4)			Please specify number required

## (iv) Specialised laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments (These items may require additional MNF support staff)
TRIAXUS – Underway Profiling CTD	X		Triaxus is a pilotable towed vehicle capable of carrying a variety of instrumentation. Constant depth towing or undulating profiles (e.g. cyclic depth pattern from 10m to 200m) are possible. Towing speed depends on the tow profile, instrumentation payload and prevailing conditions. Typically, undulations from the surface to 200m are possible at 8knt, with slower speeds for deeper profiles and faster for constant-depth towing. Maximum achievable depth typically 300m Usual instrumentation: SBE9plus (pressure sensor and communication hub) and dual pumped temperature/conductivity/dissolved oxygen circuits. Usual auxiliary instrumentation includes an ECO-Triplet (ChI, CDOM, backscatter), transmissometer, PAR sensor, and Laser Optical Plankton Counter.
Desired towing profile:			
Additional instrumentation: (Please supply, make and model and datasheets. Also a contact person for discussion on integration.			
Continuous Plankton Recorder (CPR)			
Deep towed camera			
Piston Coring System			
Gravity Coring System			
Multi Corer	Х		
Kasten Corer			
XBT System			• 2 per day provided

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## (iv) Specialised laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments (These items may require additional MNF support staff)
Trace Metal Rosette and bottles			
Sherman epibenthic sled			
Trace- metal in-situ pumps (x6)			See non-MNF owned section below for additional 2 units
Rock Dredges			
EZ Net (maximum of 10 nets for depth stratified sampling. Mouth area of 1m^2)			• Please specify 335 micron, 500 micron, or 1,000 micron mesh
Rock saw			Requires trained science personnel
Portable pot hauler			
Beam Trawl			
Pelagic trawl system (net, doors)			Contact MNF to discuss net and mesh dimensions
Demersal trawl system (net, doors)			Contact MNF to discuss net and mesh dimensions
MIDOC (multiple opening/closing codend system for pelagic trawl)			
Stern Ramp (please select exposed OR installed)	Ramp Exposed	Deck covers installed	
		Х	
Trawl monitoring instrumentation (ITI) (2,000m depth limit)			
Radiosonde Receiver System			
Seaspy Magnetometer	Х		New item of equipment
RapidCAST SVP	Х		New item of equipment
Brenke sled	Х		New item of equipment
Drop camera	Х		For opportunistic deployment during shipwreck surveys

## (v) Equipment and sampling gear requiring external support (may require additional support from applicants)

Name	Essential	Desirable	Please give this careful consideration, as there is no guarantee that these resources will be available unless specifically requested. Liaise with your Voyage Operations Manager as required. Additional staff may be required for these activities.
Seismic compressors			
Seismic acquisition system			

## (vi) Underway systems

## Acoustic Underway Systems

Name	Essential	Desirable	Notes/Comments
75kHz ADCP	Х		
150kHz ADCP	Х		
Multi Beam echo sounder EM122 12kHz (100m to full ocean depth)	Х		
Multi Beam echo sounder EM710 70-100kHz (0-1000m approx.)	Х		
Sub-Bottom Profiler SBP120			
Scientific Echo Sounders EK60 (6 bands, 18kHz-333kHz)			
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)			
Omnidirectional Echo Sounder SH90			
Gravity Meter			

## Atmospheric Underway Sensors

Name	Essential	Desirable	Notes/Comments
Nephelometer			
Multi Angle Absorption Photometer (MAAP)			
Scanning Mobility Particle Sizer (SMPS)			
Radon detector			
Ozone detector			
Condensation Particle Counter (CPC)			
Picarro spectrometer (analysis of CO <sub>2</sub> /CH <sub>4</sub> /H <sub>2</sub> O)			
Aerodyne spectrometer (analysis of N <sub>2</sub> O/CO/H <sub>2</sub> O)			
Cloud Condensation Nuclei (CCN)			
Polarimetric Weather Radar			

## Underway Seawater Systems and Instrumentation

Name	Essential	Desirable	Notes/Comments
Thermosalinograph			
Fluorometer			
Optode			
pCO2			

### Seawater systems

Name	Essential	Desirable	Notes/Comments
Trace metal clean seawater supply			
Scientific clean seawater supplied to laboratories			
Raw seawater available on deck and in laboratories.			

## Non MNF Owned Equipment which may be accessed

Name	Essential	Desirable	Please give this careful consideration, as there is no guarantee that these resources will be available unless specifically requested. Liaise with Voyage Operations Manager as required. Additional staff may be required for these activities.
D & N Francis winch			13mm electro-optical cable
Box Corer			
UTAS In-Situ Pumps (x2)			
EM2040			Shallow water multibeam echosounder system

# **Special Requests – MNF Scientific Equipment and Facilities**

• Require MNF coring container be mobilised and located on the Aft Deck (main) inboard slot.

**Appendix B – GSM Hydrographic Survey Procedure** 

# GEOPHYSICAL SURVEY & MAPPING (GSM) Hydrographic Survey Procedure

Voyage: IN2018\_C01 Australian Hydrographic Office Hogan Group Hydrographic Survey – Bass Strait

## - 24 -

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## **1.** Document Control

## **Revision History**

Revision	Description of Change	Author	Date
0	Draft	Stuart Edwards	27-02-2018
1	Updated procedure	Stuart Edwards	11-04-2018

## 2. Introduction

The Australian Hydrographic Office (AHO) has secured sea time on board the CSIRO research vessel *RV Investigator* under a User Funded Voyage Agreement. This voyage will carry out a hydrographic survey in the Bass Strait (Area SI002), for nautical charting purposes, during May/June 2018. The survey will be carried out on board RV *Investigator* by members of the Geophysical Survey & Mapping (GSM) team.

There are two survey areas, Area A (approx. 283nm<sup>2</sup>) is south of the Anser Group, Area B (approx. 36.8nm<sup>2</sup>) is to the North of the Hogan Group. Water depths within the survey area are approx. in the range 50-75m.

The survey will be conducted using a Kongsberg EM2040c (Dual Head) Multibeam Echosounder (MBES) as the primary instrument. The EM2040c MBES is a high resolution seabed mapping system, capable of meeting all International Hydrographic Organisation (IHO) standards, this system has transmit and receive beamwidths of 1° and is capable of being operated between frequencies of 200-400KHz. This system is operated by the CSIRO Shallow Survey Internal Facility (SSIF) and will be mobilised to the RV *Investigator* for this project.

A Kongsberg EM710-MK2 Multibeam Echosounder (MBES) will be operated as the secondary instrument. The EM710-MK2 MBES is a high resolution seabed mapping system, capable of meeting all IHO standards. The EM710-MK2 is operated and permanently mobilised on board RV *Investigator* can transmit and receive beamwidths of 0.5° and 1° respectively and is capable of operating between frequencies of 40-100KHz.

Hydrographic data collected, will be processed on board RV *Investigator* using Caris HIPS/SIPS software. The data will be made available to the AHO upon completion of the project.

This survey will be carried out to IHO Order 1A standards, as per IHO SP-44 5<sup>th</sup> Edition.

The figure below outlines the extent of the survey area.





## 3. Itinerary

MOBILISE	DATE	
Hobart	Monday 28 <sup>th</sup> May	
DEPART	DATE	TIME
Hobart	Tuesday 28 <sup>th</sup> May	1700
ARRIVE	DATE	TIME
Hobart	Friday 8 <sup>th</sup> June	0800
DEMOBILISE	DATE	
Hobart	Friday 8 <sup>th</sup> June	

Table 1 - Voyage Itinerary

Transit from Hobart to and from the SE corner of the proposed survey area is approx. 30 hrs. The passage plan supplied by RV *Investigator* marine crew, ASP, is contained in Appendix A.

## 4. **Operations**

## 4.1 Mobilisation / Demobilisation

Mobilisation of the RV *Investigator* will be undertaken alongside the CSIRO Wharf PW4 in Hobart on the 28th May, 2018. All survey systems required for the voyage will be declared operational by the GSM team leader to the CSIRO Voyage Operations Manager (VOM)/Voyage Manager (VM) prior to departure.

Upon completion of the survey, the vessel will transit back to Hobart for demobilisation.

## 4.2 Survey Calibrations

Details of the calibration activities relevant to this hydrographic survey, on board RV *Investigator* are outlined below.

Further verifications of the vessel positioning system will be undertaken in Hobart prior to departure of IN2018\_C01

Multibeam patch tests will be conducted over the wreck of the SS *Queensland* prior to commencing survey activities.

### 4.2.1 MBES Calibration (Patch Tests)

The EM710-MK2 MBES was last calibrated during the RV *Investigator* trials and calibration voyages in December 2017. A MBES patch test was conducted on 29 January, 2015 on voyage IN2017\_E04, in location 43°15.94'S 148°00.29'E approx. 150m water depth, to the south of Tasman Island.

The MBES patch test ran lines to resolve for any residual Pitch, Roll and Heading misalignments between the EM710-MK2 transducer and the vessel Motion Reference Unit (MRU). The following values were determined.

PATCH TEST VALUES		
PITCH	-0.17°	
ROLL	+0.02°	
YAW	-0.03°	

Table 2 - EM710 Patch Test Values

Both the EM2040c and EM710-Mk2 will be recalibrated prior to commencing survey operations. It is proposed that calibrations will be undertaken over the wreck of the SS QLD which lies in close proximity to the survey area in location 39°06.500'S 146°43.814'E. This wreck was investigated during the IN2017\_C02 survey of the Hogan Group.

## 4.2.2 Vessel Sensor Offsets & Orientations

Offsets on board the RV *Investigator* were measured during dimensional control surveys conducted by Parker Maritime and the CSIRO GSM Team. The offsets relevant to the correct operation of the MBES systems are summarised below.

SENSOR OFFSETS

SENSOR	X OFFSET (M) (+Stbd)	Y OFFSET (M) (+Fwd)	Z OFFSET (M) (+Down)
MRU 5+	0.00	0.00	0.00
MRU 5+ (Drop Keel)	1.308	2.760	8.387
Stbd GNSS Ae	-0.040	-6.257	-31.315
Port GNSS Ae	-4.037	-6.299	-31.411
EM710 Rx	-4.877	8.792	7.738
EM710 Tx	-4.001	10.216	7.740
EM2040c	1.308	2.820	8.557
Waterline			0.339
SENSOR ORIENTATIONS	5		
SENSOR	PITCH (°)	ROLL (°)	YAW (°)
MRU5+ <sup>1</sup>	-0.11	0.22	359.10
MRU 5+ (Drop Keel) <sup>2</sup>	0.00	0.00	0.00
EM710 Rx	-0.33	0.56	0.16
EM710 Tx	0.24	0.13	0.02
EM2040c <sup>2</sup>	0.00	±40.00	0.00

#### Table 3 - MBES Offsets & Orientations

### 4.2.3 Seapath 330+ Verification

The Seapath 330+ system on board RV *Investigator* provides DGNSS positioning, attitude and heading data to the MBES systems. Fugro Starfix G2 orbit and clock corrections are received from a global network of reference station, Starfix G2 corrections utilise Precise Point Positioning (PPP) technology, which results in positional accuracy at the decimetre level.

Recent verifications of the performance of the Seapath 330+ system were undertaken on 08 December, 2016 while the vessel was in dry dock in Garden Island, Sydney. Terrestrial observations were taken from established survey control marks to the GNSS antennas and to targets setup on the vessel centreline. The results of the verification are summarised below:

SENSOR	MEAN LINEAR MISCLOSE (M)	STANDARD DEVIATION (M)
DGNSS ANTENNA	0.21	0.03
SENSOR	HEADING CORRECTION (°)	STANDARD DEVIATION (°)
DGNSS BASELINE	-0.10	0.15

Table 4 - Seapath 330+ Verification Dec 2016

Please note following successful commissioning prior to this voyage an Applanix POSMV Wavemaster will be used in place of the Seapath 330+, details in section 4.2.5 below.

#### 4.2.4 Sound Velocity Profilers Wet Test

A Valeport Monitor Sound Velocity Profiler (SVP) will be utilised on board RV *Investigator* to provide accurate information on the changes in seawater sound velocity through the water column. Prior to departure, a pressure, temperature and sound speed computation will be

<sup>&</sup>lt;sup>1</sup> Please note that the orientation of the MRU5+ is compensated for in the Seapath itself. They are listed here for information purposes. The remaining orientation errors are compensated for by the patch test.

<sup>&</sup>lt;sup>2</sup> The MRU within the drop keel is mounted directly above the MBES transducer. As such the installation orientations will be small and can be compensated for directly by the patch test.

performed. The data will be downloaded using the Datalog Express Software and a verification that the instrument is operating correctly will be done by comparing the surface sound velocity to the AML SVP that is installed in port drop keel.

A Teledyne RapidCast SVP is due to be commissioned prior to this voyage, please see details in section 4.2.5 below.

### 4.2.5 New Hydrographic Equipment

The Marine National Facility (MNF) have purchased several key items of hydrographic survey equipment since the last AHO charter on board RV *Investigator*. This is in an attempt to improve the quality of data obtainable and provide a more efficient survey platform. These equipment items are:

- 1. Applanix POSMV Oceanmaster position and orientation system.
- 2. Teledyne RapidCast Underway Sound Velocity Profiler (SVP).

Both these items will be commissioned and declared operational prior to IN2018\_C01 commencing.

## 4.3 Survey Operations

Hydrographic survey operations will be conducted in accordance to the IHO Standards and methods listed below.

It is expected that there will be approx. 9 days 'on station' to complete the survey.

Regular weather forecasts will be obtained and will be used as a guide to plan survey operations.

Due to the close proximity of the survey area to the vessel traffic separation scheme, south of Wilsons Promontory and in the Bass Strait, ASP will liaise with AMSA to issue an AUSCOAST warning for the duration of the survey.

Survey lines have been planned in consultation with RV *Investigator's* bridge team, ASP ship management.

#### 4.3.1 Survey Standards

Survey operations will be to IHO Order 1A standards. As per the IHO Standards for Hydrographic Surveys (S-44), Order 1A is defined as:

"Intended for those areas where the sea is sufficiently shallow to allow natural or man-made features on the seabed to be a concern to the type of surface shipping expected to transit the area but where the under-keel clearance is less critical than for Special Order. Because man-made or natural features may exist that are of concern to surface shipping, a full sea floor search is required, however, the size of the feature to be detected is larger than for Special Order. Underkeel clearance becomes less critical as depth increases so the size of the feature to be detected by the full sea floor search is increased in areas where the water depth is greater than 40 metres. Order 1a surveys may be limited to water shallower than100 metres."

The maximum allowable Total Horizontal Uncertainty (THU) for an Order 1A Survey in an average water depth of 60m is ±8m (5m + 5% depth).

The maximum allowable Total Vertical Uncertainty (TVU) for an Order 1A Survey in an average water depth of 60m is ± 0.93m (  $\pm \sqrt{a^2} + (b \times d)^2$ , a=0.5, b=0.013, d=60)

Both the THU & TVU are quoted at the 95% confidence level.

A full seafloor search is required and survey lines will be planned to give 100% bottom coverage. **The seafloor search must resolve cubic features larger than 6m** (10% of depth).

The quoted system RMS accuracy for the Kongsberg EM systems on board RV *Investigator* is expected to be better than:

EM2040c		EM710 – MK2	
SD in % of WD	Angle from Nadir	SD in % of WD	Angle from Nadir
0.10	0-45°	0.20	0-45°
0.15	45-60°	0.30	45-60°
0.30	60-70°	0.50	60-70°

Table 5 - EM Quoted Accuracies

#### 4.3.2 Survey Coordinates

The boundary coordinates of the survey area (taken from .shp file as supplied by the AHO) are reproduced below:

	LATITUDE	LONGITUDE
Area A_1 (SE Corner)	39°13.994'S	146°47.452'E
Area A_2	39°04.204'S	146°44.701'E
Area A_3	39°05.930'S	146°33.432'E
Area A_4	39°10.454'S	146°19.234'E
Area A_5	39°13.122′S	146°02.133'E
Area A_6	39°22.703'S	146°12.065'E
Area A_7	39°19.024'S	146°29.427'E
Area A_8	39°14.752'S	146°29.524'E
Area A_9	39°14.630'S	146°22.194'E
Area A_10	39°13.479'S	146°22.177'E
Area A_11	39°11.498'S	146°24.998'E
Area A_12	39°11.614′S	146°31.688'E
Area A_13	39°14.067′S	146°33.318′E

Table 6 - Survey Area A Coordinates

	LATITUDE	LONGITUDE
Area B_1 (SE Corner)	38°52.436′S	147°32.671'E
Area B_2	38°51.008′S	147°32.157'E
Area B_3	38°59.486'S	147°01.792'E
Area B_4	39°00.881'S	147°02.205'E

Table 7 - Survey Area B Coordinates

Survey area A is 974.44 km<sup>2</sup> equating to 283 nm<sup>2</sup>, Survey area B is 126.11 km<sup>2</sup> equating to 36.8 nm<sup>2</sup>

#### 4.3.3 Survey Line Plan

The survey line plan has been calculated using the following parameters.

- Area A divided in 3 sections, sub areas A,B,C
  - Sub Area A average depth of 65m

- o Sub Area B average depth of 60m
- o Sub Area C average depth of 72m
- Area B average depth of 60m
- Survey Speed 8 Knots
- Line Overlap of 30%
- Expected swath width of 9-10 times water depth

Expected swath width has been based on a combination of, manufacturers specifications, theoretical calculations based on expected oceanographic conditions and seabed type and experience of using this particular multibeam system in similar conditions for an AHO survey in 2017.

Using these parameters the line spacing for each survey area are detailed in the below table:

Survey Area	Line Spacing	Lines Required	Survey Time Req (Hrs)
A_Sub Area A	455m	15	19.07
A_Sub Area B	420m	44	54.17
A Sub Area C	504m	40	69.54
A_XLines	5000m	14	13.70
В	420m	6	18.89
B_XLines	5000m	9	1.83
		Total Time (Hrs)	177.2

Table 8 - Line Planning Parameters

At vessel speed of 8 knots the time to run all lines within the specified survey areas is 177.2 hours. This does not include time for line turns.

A total of 128 lines are required to fill survey area SI002 at variable line spacing listed in table 8

The GSM team will liaise with the vessel Bridge team during the survey to establish the most efficient pattern of completing the proposed lines (such as surveying every 3<sup>rd</sup>/4<sup>th</sup> line in a 'leap-frog' pattern).

The survey line plan will be exported from QINSy in ASCII format and converted into a .rux file to be loaded into the bridge ECDIS.

Figure below from QINSy showing the planned survey lines.



Figure 2 – Survey Area A Proposed Line Plan



Figure 3 - Survey Area B Proposed Line Plan

### 4.3.4 Data Acquisition

During acquisition of MBES data in the survey area, RV *Investigator* operations room will be manned at all times. The surveyor on watch will monitor and control the acquisition of MBES data. The surveyor on watch will have the following responsibilities:

- Ensuring the EM2040c/EM710-MK2 is operating correctly and the data being acquired is quality controlled.
- Liaising with the vessel bridge team as to the order of lines to be surveyed.
- Maintaining a log of survey operations and events.
- Ensuring current Sound Velocity Profiles are loaded into the MBES systems.

### 4.3.5 Sound Velocity Profiles

Sound Velocity Profiles will be collected using a Valeport Monitor Sound Velocity Profiler (SVP) at intervals no greater than 6 hours for the duration of the survey.

The SVP will be configured with the Datalog Express software, fitted with switch plug to enable internal recording and then deployed on an appropriate winch.

The ASP vessel crew are responsible for driving the winch. Therefore the surveyor on watch will communicate with them the depth the SVP is to be lowered to.

Upon retrieval the data will be downloaded from the probe and processed & converted from Valeport (.000) format to Kongsberg (.asvp) format using DORIS SVP software.

#### 4.3.6 Data Processing

Multibeam data will be logged in Kongsberg \*.all format and will be converted for processing within Caris HIPS/SIPS (version 10.2.4). Once the data is converted it will be analysed and any outliers removed within the swath editor. Tide files will be loaded and TPU (Total Propagated Uncertainty) computed. The data will then be merged and CUBE surfaces generated at the highest possible resolution. The CUBE hypotheses can then be examined and any further data processing completed within the subset editor.

## 4.3.7 Tidal Reduction

Tidal reduction of data will be accomplished by the following means:

- DGNSS Tides computed from the Applanix POSMV/Seapath 330+ using Fugro G2+ corrections.
- Predicted tides for East Monceuor Island (ANTT Tide Station 60615)

The computation of DGNSS tides on board RV *Investigator* is completed by using the Mean Sea Surface (MSS) software provided by Fugro. The MSS software logs GRS80 ellipsoidal heights from the Seapath 330+ in addition to vessel attitude from the MRU5+.

MSS provides time-stamped data in an .fbf file. Time, Latitude, Longitude and a Smoothed Water Line (Ellipsoidal) height value are extracted from the file and modified in a spreadsheet. This can then be run through the AusCoast VDT tool to reduce to the level of Lowest Astronomical Tide (LAT).

## 4.3.8 Seabed Topography

Multibeam backscatter data will be recorded for the duration of the survey from both the EM710 Mk2 and the EM2040c. Both MBES will have their frequency/pulse mode constrained for the duration of the survey.

Mosaics of recorded multibeam backscatter information will be created within the Fledermaus Geocoder Toolbox (FMGT). FMGT allows visualisation and analysis of multibeam backscatter data in addition to the processing of the sonar files into mosaics. FMGT processing is largely automated however the steps required to construct the mosaics are outlined below:

- 1. Adjust and extract the backscatter data and perform radiometric corrections based on sonar type and bottom topography.
- 2. Filtering, angle varying gain (AVG) adjustments, anti-aliasing of the backscatter data.
- 3. Creation of mosaic at highest possible resolution.

Angle vs Range Analysis (ARA) can be conducted to provide a method of seafloor characterisation. ARA compares the actual backscatter response to expected response curves for a wide range of seafloor types, based within the Jackson mathematical model.

Seabed sampling will also be conducted using a Smith McIntyre grab sampler. Grab sampling will be obtained at regular spacing across the survey area and where possible grabs will be obtained at the following locations, a seabed sample log will be maintained.

- 1. Banks, shoals and seamounts and in channels between them.
- 2. To ground truth MBES backscatter information, especially where changes in the nature of the seafloor are apparent.

## 4.4 Reporting

## 4.4.5 Daily Report

The GSM team leader will provide a daily report to the VM on board the RV *Investigator*, this information may then be disseminated in the daily VM sitrep. The information provided by the GSM team leader will include:

- A breakdown of survey activities over the past 24 hours, including actual line km surveyed.
- Planned survey activities for the upcoming 24 hours.
- Revised ETA (if required) for completion of survey.
- Any pertinent features identified.

## 4.4.6 Final Report

A final survey report will be rendered to the AHO within 30 days of demobilisation. The report will include the following sections:

- Executive Summary
- Survey Operations
- Data Processing
- Vessel Configuration
- Calibrations & Checks
- Geodetic Parameters

## 4.4.7 Survey Data

The data will be transferred to the AHO in the following format:

- Caris HIPS/SIPS (HDCS) Folder Structure
- ESRI Raster (.asc)
- ASCII gridded (.xyz)
- Acquisition (eLOG) logs (.txt)
- Processing logs (.xlsx)
- SVP files (.000/.asvp)
- MSS logging (.fbf converted to .csv)
- Tide files (.tid)
- Kongsberg PFreeheave (Delayed Heave) (.srh)

## 5. Geodetic Parameters

The Applanix POSMV/Seapath 330+ system on board RV *Investigator* is referenced to the International Terrestrial Reference Frame (ITRF2014).

The Global Positioning System (GPS) is referenced to the World Geodetic System 1984 (WGS84). Many providers of satellite positioning services however have receivers which output referenced to the International Terrestrial Reference Frame (ITRF). Due to continual refinement of the WGS84 reference frame, the WGS84 and ITRF2014 reference frame are considered to be the same.

## 5.1 ITRF2014 Datum & Projection

DATUM DESCRIPTION	
Datum	ITRF2014 (Epoch 2014.0)
Ellipsoid	Geodetic Reference System 1980 (GRS80)
Semi-major Axis (a)	6 378 137.000m
Semi-minor Axis (b)	6 356 752.314m
Eccentricity Squared (e <sup>2</sup> )	0.006 694 380
Flattening (1/f)	298.257 222 101
Projection Type	Universal Transverse Mercator (UTM)
UTM Zone	55
Central Meridian	147° East
Scale Factor at CM	0.9996
False Easting	500 000m
False Northing	10 000 000m
Latitude of Origin	0° (Equator)

#### Table 9 - Horizontal Datum & Projection

## 5.2 Vertical Datum

DATUM DESCRIPTION	
Datum	Lowest Astronomical Tide (LAT)
Table 10 Vertical Datum	

Table 10 - Vertical Datum

## 6. Equipment Specifications

#### **Positioning Systems**

Applanix POSMV Oceanmaster DGNSS Receiver utilising Fugro G2+ PPP corrections (Primary)

Kongsberg Seapath 330+ DGNSS Receiver utilising Fugro G2+ PPP corrections (Secondary)

Heading & Attitude Systems Applanix POSMV Oceanmaster (Primary)

Kongsberg Seapath 330+ DGNSS Heading Sensor/Kongsberg Seapath MRU5+ (Secondary)

Konsgberg Seatex MRU5+ Motion Sensor

Geophysical Systems Kongsberg EM2040c (Dual Head) MBES

Kongsberg EM710-MK2 MBES

Oceanographic Systems Valeport Monitor SVP

Data Processing/Software

QINSy Survey Positioning System

Caris HIPS/SIPS

Fugro MSS Logging

## 7. Personnel

Tegan Sime – MNF Voyage Operations Manager (VOM) Brett Muir – MNF Voyage Manager (VM) Stuart Edwards – GSM Team Leader / Hydrographic Surveyor (SIC) Matt Boyd – Hydrographic Surveyor / Data Processor Amy Nau – Hydrographic Surveyor / Data Processor Phil Van Den Bossche – Hydrographic Surveyor / Geophysicst Craig Davey - Hydrographic Surveyor / Data Processor

## 8. Distribution

Electronic copies of this survey procedure have been distributed for comment as follows:

MNF Facilities Program Director MNF Operations Team GSM Team Members ASP Ship Management (RV *Investigator* Master & 2/O) Australian Hydrographic Office



1

BN2869165 Survey Instruction (SI) 003 Hydro 003/19

## SURVEY INSTRUCTION (SI): 003

## BASS STRAIT



RV Investigator 11-24 Apr 19

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#### AMENDMENT RECORD

Status	Description	Date
Version 1.0	Initial issue. Re-issue of outstanding area from SI 002.	07 Feb 2019

This Survey Instruction is issued under the authority of:

wendy.stewar Date: 2019.02.13 10:19:55 t +11'00'

WP Stewart Lieutenant Commander, RAN Deputy Director Hydrographic Plans and Standards

Australian Hydrographic Office 8 Station Street, Wollongong NSW 2500

#### 1 PROJECT SPECIFICATION

1.1 Survey Standards		Requirement
1.1.1	Order of Survey	IHO S44 Order 1a
1.1.2	Coverage Requirements	Full bathymetric coverage is required

1.2	Survey Area	Requirement
1.2.1	General Description of Each Survey Area	The survey area consists of an approximately 11 x 1.5 NM polygon in the vicinity of Wilsons Promontory and the charted traffic separation scheme area. The survey abuts existing MBES surveys south-east of the Monceour Islands, and adjoining data collected by RV <i>Investigator</i> during SI 001 and SI 002.
		The survey area comprises of waters classified as ZOC B from 1988 HMAS Moresby (II) survey, with charted depths generally between 65 - 70 metres.
		The area has not been surveyed using modern equipment, therefore anomalies may be expected; however, due to the high amount of traffic that transits the area, dangers to navigation are considered unlikely.
1.2.2	Purpose	To facilitate safe navigation of international and coastal shipping. This survey will also improve confidence for subsurface navigation in Bass Strait.
		The overall focus for this survey is to conduct a modern survey in the primary shipping route through Bass Strait.
1.2.3	Charts Affected	AU440146 and AUS 802





#### 2 PROJECT REQUIREMENTS

2.1	Positioning and Horizontal Control	Requirement
2.1.1	Horizontal Datum	Datum: WGS 84 Spheroid: GRS 80 Projection: UTM Zone 55 South (CM 147°E)
2.1.2	Positioning	Quality of GNSS solution is to be monitored throughout all survey operations. A secondary positioning system is to be used and regularly compared with the primary positioning system.
		Definitive statements are to be made regarding the horizontal accuracy achieved (i.e. TPU(H) Horizontal ±2.0m at 95% CL) for each area of differing survey quality.
2.1.3	Additional Positioning Requirements	Not required
2.1.4	Extension of Existing Control	Not required

2.2 Vertical Control		Requirement	
2.2.1	Sounding Datum	Sounding Datum to approximate LAT	
2.2.2	Reduction of Soundings	Soundings should be reduced to approximate LAT using-predicted tides for East Monceour Island (ANTT Tide Station 60615) as per SI 002. Definitive statements are to be made regarding the vertical accuracy achieved (i.e. TPU(V) Vertical ±0.5m at 95% CL) for each area of differing survey quality.	
2.2.3	List of Tidal Infrastructure	Not required	
2.2.4	List of Current Meters	Not required	
2.2.5	Tidal Anomalies and Freshwater springs	Any tidal anomalies observed are to be reported in your report of survey.	
2.2.6	AUSTIDE Details	Port 60615 39° 13' S 146° 35' E East Monceour Island	

2.3	Bathymetry	Requirement
2.3.1	Data Requirements	Full bathymetric coverage for all depths. Backscatter: Required Ensure sufficient overlap is achieved with adjacent survey SI 002 to meet feature detection requirements (i.e. density of soundings).

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2.3 Bathymetry		Requirement
2.3.2	Wreck Investigations and Disproving Searches	There are no known wrecks within the survey area; however uncharted wrecks may exist. Any wrecks detected are to be investigated.
2.3.3	Passage Sounding	Not required
2.3.4	Channels and Recommended Tracks	Any dangers to surface navigation identified within or immediately adjacent to the survey area should be delineated.

2.4	Views, Conspicuous Objects and Coastline	Requirement
2.4.1	Obtaining Coastline Data	Not required
2.4.2	Conspicuous Objects	Not required
2.4.3	Views	Not required

2.5 Seabed Topography		Requirement	
2.5.1	Bottom Sampling	Seabed sampling should be completed at regular spacing across the survey area. Where possible, samples should be obtained:	
		a. On all banks, shoals and seamounts, particularly where these are likely to be unstable, and in the channels between them;	
		<li>b. Where required to ground truth the interpretation of SSS or backscatter data, especially where changes in the nature of the seafloor are apparent; and</li>	
8	8	c. All samples taken shall be recorded on the Seabed Sample Log.	
2.5.2	Side Scan Sonar (SSS) / Backscatter Mosaics	Required All areas where MBES backscatter / SSS data has been collected are to have a SSS mosaic produced.	
2.5.3	Additional Tasks	Nil	

2.6	Miscellaneous Requirements	Requirement
2.6.1	Aids to Navigation	Updates to charted Navigation Marks are to be submitted using form AH 103.
2. <mark>6.2</mark>	Amendments to Sailing Directions	Not required
2.6.3	Additional Tasks	Nil

2.7	Oceanographic and Meteorological Observations	Requirement	
2.7.1	Sound Velocity	Regular sound velocity measurements will be required for the operation of the survey system and should be retained for rendering as oceanographic data. Down casts and up casts are to be maintained separately. If the combined cast is used for sounding reduction these should also be provided separately.	
2.7.2	Secchi Disc	Required Daily water clarity and colour observations via Secchi Disc or Transmisiometer should be taken. These observations are to be recorded in the Secchi Disc Log.	
2.7.3	Bioluminescence	Not required	
2.7.4	Meteorological	Required Hourly weather observations from the ship's automated weather station should be recorded for the duration of the survey.	
2.7.5	Salinity	Required	
2.7.6	Magnetometer	Not required	
2.7.7	Deployment of Argo Buoys	Not required	
2.7.8	Deployment of Gliders	Not required	
2.7.9	Additional Tasks	Not required	

#### 3 DELIVERABLES

3.1	Required Deliverables	Note	
3.1.1	Digital Data Packs	Survey Reports, Correspondence and Documents Pack: - Progress Reports (SITREPs) - Report of Survey - Any pertinent correspondence	
		Quality Assurance Data Pack: - All calibration and validation data - Vessel Configuration Report - 3D positional data quality assurance - All processing logs / checks - List of all survey personnel with sample signatures	
		Bathymetric Data Pack: - Raw sounding data	

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3.1	Required Deliverables	Note
		<ul> <li>Processed sounding data</li> <li>Sound velocity profile data</li> <li>Side scan sonar data</li> <li>Backscatter / SSS mosaic</li> <li>Seabed texture layer</li> </ul>
		Tidal Data Pack: - Tidal data utilised for reduction of soundings
		Ancillary Data Pack: - Oceanographic observations - Navigation mark and publication amendments ( <i>if required</i> ) - Views ( <i>if required</i> ) - Copies of any submitted Hydrographic Notes
3.1.2	Hydrographic Note	Any Hydrographic Note (Form AH102 - F_05_51_AA217160) produced in the execution of this survey is to be emailed to the AHO at <u>datacentre@hydro.gov.au</u>
3.1.3	Report of Survey (ROS)	The Report of Survey and associated Data Packs are to be rendered to the AHO by the 08/06/2019.
3.1.4	Resolution of Final Survey Data	Final Survey Data is to be rendered as a <u>finalised</u> CARIS .csar surface at 2 metre resolution.