RV *Investigator* Voyage Plan

Voyage #:	**IN2021_E01**
Voyage title:	**Equipment Calibrations 2021**
Mobilisation:	Friday 29 October – Monday 1 November, Hobart PW04, 0800hrs
Medical testing:	Monday 8 November 2021, Hobart PW04, 0800hrs
Depart:	**Wednesday 10 November 2021, Hobart PW04, 1000hrs**
Return:	**Sunday, 14 November 2021, Hobart PW04, 1400hrs**
Demobilisation:	Monday, 15 November 2021, Hobart PW04, 0800hrs
Voyage Delivery Coordinator	David Flynn
Voyage Manager:	John Hooper
Technical Lead:	Jason Fazey
Affiliation:	CSIRO – MNF

Scope Of Works: Both Voyages:

Team	Activities Targeted	Time Requested / Required	Limitations / Constraints / Requirements	Day / Night Operations	Ideal Water Depth Operations	Comments:
Field Operations (FO)	Giant Piston Coring (TRIPLEX) / Core Handling (OSIL)	12hrs Core Handler Handshake Tests + 12hrs Deep Core Winch Spool Check + 12hrs ea. x 4-5 cores.	Coring Staff: 1 day 'on' then 1 day 'off' requested. Off-ship contact with OSIL for core handling. On-ship advice required from geoscientist (GA). Full compliment 6 FO staff	Daylight only	*Deeper operations take longer, ideal target 1500–3000m, dependant on sub-bottom profile interpretation from GA	*** FO will assist preparations to deploy trawl gear – however to be lead by ASP.
Geophysical Survey and Mapping (GSM)	EK60/80 Calibrations	12hrs (Stationary)	Other activities occurring at same time may impact calibration	Daylight preferred, night operations OK	Known locations targeted (Storm Bay)	EK60 + 80 Stationiary Calibrations can occur simultaneously in good weather and daylight (12hrs only)
	Patch Testing (Sound Velocity CTD casts)	8hrs (mobile)		N/A	Known Locations Targeted >3000m	Flat / Shallow gradient bathymetry required
	Reference Surface Checks (EM122 & EM710)	8hrs (Reciprocal Lines)		N/A	Known Locations Targeted >3000m	Flat / Shallow to mid water gradient bathymetry required
	Drop Keel Calibrations	2hrs (Stop/Start)	Ad Hoc	N/A	>1500m water depth (mimic transit)	Opportunistic testing between stations

Team	Activities Targeted	Time Requested / Required	Limitations / Constraints / Requirements	Day / Night Operations	Ideal Water Depth Operations	Comments:
Geophysical Survey and Mapping (GSM) cont'd	Opportunistic Mapping	Ad Hoc	Ad Hoc	N/A	N/A	N/A
Australian Antarctic Division Geophysical Survey and Mapping team	AAD participants will participating on th is voyage under the CAST (Centre for Antarctic and Southern Ocean Technology) collaboration effort (https://www.cast-collaboration.org.au/). They will build capacity and transferable skills under the auspices of MNF GSM which will apply to their commissioning of RSV *Nuyina*. They will be working closely with MNF GSM, assisting and overseeing various aspects relating *to Investigator's* system calibrations and mapping processes.					
Data Acquisition and Processing (DAP)	New & Existing Staff cross-training + PABX Phone Upgrade Testing Misc. upgrades/tests	0hrs	N/A	N/A	N/A	No dedicated ship time required or system outages/interruptions expected.
Seagoing Instrumentation Team (SIT)	Sea Surface Temperature Radiometer (ISAR)	0hrs	Support Equip. in bridge	N/A	N/A	Access to port bridge wing while underway (conditions permitting).

Voyage objectives

The primary voyage objective for these voyages, are for the Marine National Facility (MNF) to calibrate and commission new, upgraded and existing critical equipment (with sea trials and personnel training) onboard *RV Investigator* for upcoming voyages in the 2021 schedule and beyond.

Specifically, work will focus on the seagoing testing and trials of MNF's new Giant Piston Corer with 24m maximum barrel length capability, principally supported by the Geophysical Survey and Mapping team and marine geoscientists from UTAS.

Ancilliary Objectives (Piggybacks)

1) A small contingent of scientists will advise on QAQC for collection of piston coring samples. The scientific advisors have supported voyage planning by advising appropriate sites of interest that target reduced risks to equipment and personnel, aid commissioning and gain scientific insight, notable thanks to Alix Post and Scott Nichol from Geoscience Australia. Due to traveling restrictions, Martin Jutzeler and Acacia Clark have agreed to fill in this QAQC role onboard the voyage. If cores are successful and of scientific value, they will be provided to the scientific advisors for analysis post voyage in accordance with CSIRO's Data and Sample Management Policy.

2) A 2nd Sea Surface Temperature Radiometer (ISAR) installed on port bridge wing for comparison to existing 1st ISAR unit. Requires running cable & conduit into bridge in port period (IN2021_P05_01) lead by Nicole Morgan from SIT.

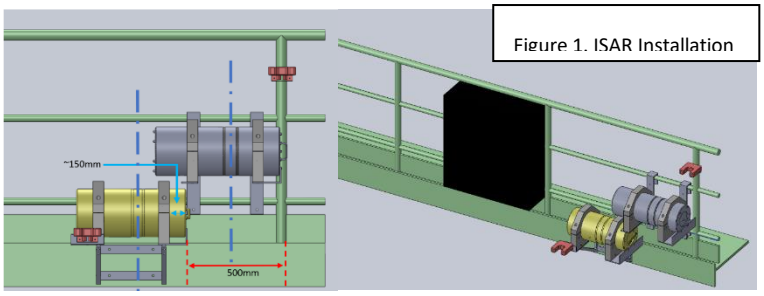
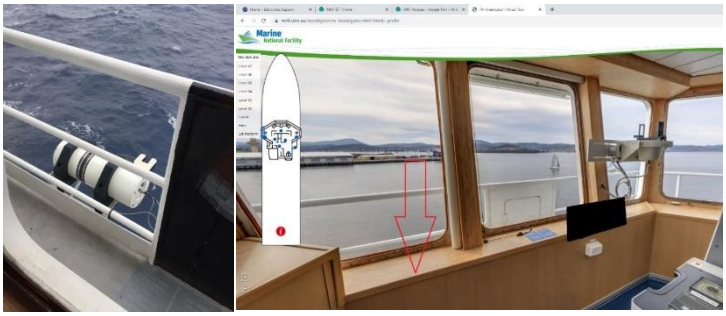


Figure 1. ISAR Installation



3) 2x participants from the Australian Antarctic Division (AAD) are seconded to our Geophysical Survey and Mapping team to undertake familiarisation training with RV Investigators' acoustic calibrations and operations, given their similarity to new equipment onboard RSV Nuyina, arriving Oct 2021.

4) Underway aerosol particulate CO^2 sensor upgrade & replacement, testing & monitoring underway by Craig Neill from O&A.

Voyage Risk Assessment (VRA)

A Voyage Specific Risk Assessment (VSRA) has been created for each trials and calibration voyage of 2021. ASP has a number Job Safety Environment Analyses (JSEAs) that ensure each voyage's risks have been identified and appropriately controlled. ASP also maintains a service contract with the Original Equipment Manufacturer (OEM) RAPP MacGregor and Ocean Scientific International Ltd. (OSIL), contracted to provide ongoing OEM support with regard to maintenance, calibration, and equipment repairs. This is undertaken with a RAPP Technician onboard during this trials and calibration voyage.

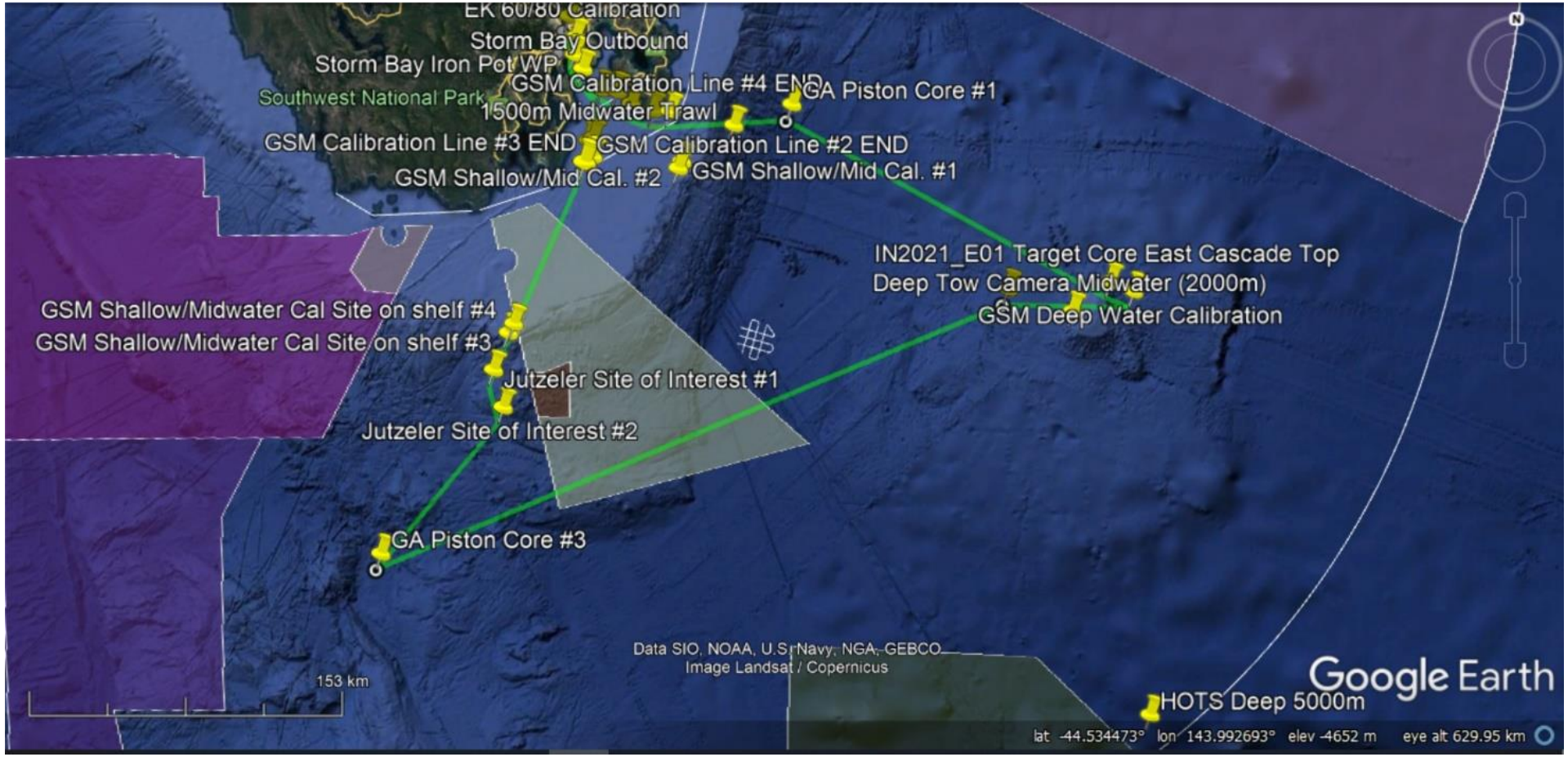
Overall Activity Plan First 96hrs of Voyage

The following initial activity plan is indicative only. For further and more accurate detail, refer to the: "at sea task activity schedule". Due to the dynamic nature of trials, calibrations and sea state/weather, alternative activities will be undertaken as required.

Day	Date	Time	Activity
Monday	8 Nov	0800-0900	Participant Phase 3 Test
Tuesday	9 Nov	All day	Mobilisation
Wednesday	10 Nov	0800	Sail from PW04 Hobart at ~0800hrs. Commence ~2hr piloted transit through Derwent Eastuary.
Wednesday	10 nov	1000	CPH/GPC testing and familiarisation Commence EK60/80 calibration
Thursday	11 Nov	0700	Commence Piston Coring activities

Voyage track example

Figure 1. IN2021_E01 proposed voyage track in Green, with track waypoints and commonwealth marine parks shown.



Waypoints, stations & time estimates

Waypoints and Steaming Times

SITE / WAYPOINT	LATITUDE DD	LONGITUDE DD	DISTANCE (NM)	TOTAL DISTANCE (NM)	STEAMING TIME (HRS)	TOTAL STEAM (HRS)
IN2021_E01						
Hobart Princes Wharf #04	-42.88644	147.33872	0	0	0	0.0
GSM Derwent Calibration Site	-42.97317	147.37933	6	6	0.6	2
Storm Bay OUTBOUND	-43.10639	147.42485	15	21	1.5	3.5
GSM Backscatter Cal Line 1 Start	-43.19897	147.62530		21	0	
GSM Backscatter Cal Line 1 End	-43.24843	147.71020		21	0	
GSM Backscatter Cal Line 4 Start	-43.27570	147.83500		21	0	
GSM Backscatter Cal Line 4 End	-43.27700	147.93470	20	41	2	5.5
GS Station #1	-43.23360	148.63117	30	71	3	8.5
Hobart Princes Wharf #04	-42.88644	147.33872	70	141	7	15.5

Proposed Activity Plan (4/11/2021)

Waypoint	Activity	Depth (m)	Dist (nm)	Transit (hrs)	On Station (Hrs)	Time (activity end)
Hobart Princes Wharf #04	ETD Hobart PW4 at 0800hrs					10/11/2021 8:00
Pilot Transit EK60/80 site	Arrive Derwent Cal site		6	2		10/11/2021 10:00
GSM Derwent Calibration Site	CPH/GPC early trials and RAs	30m			7	10/11/2021 17:00
Night Operations	EK60/80 Calibration				12	11/11/2021 5:00
Storm Bay OUTBOUND	Transit to area with 40m depth	40m	15	2		11/11/2021 7:00
	CPH and Giant Piston Corer 'wet test' practice (no deploy)				10	11/11/2021 17:00
GA Station #1	Transit to GA Station 1 via back scatter calibration lines 1/4					11/11/2021 22:00
GA Station #1	Corer Winch Spooling Tests/ GSM Mapping (option to calibrate 122 time permitting)				8	12/11/2021 6:00

Waypoint	Activity	Depth (m)	Dist (nm)	Transit (hrs)	On Station (Hrs)	Time (activity end)
GA Station #1	Coring 13m known recovery.	3200m			12	12/11/2021 18:00
TBC	Perform GSM callibrations/Seafloor Mapping			12		13/11/2021 6:00
GA Station #1	CPH/GPC Trials inlcuding coring	3200m			12	13/11/2021 18:00
Hobart Princes Wharf #04	Return to Hobart vi Back Scatter Calibration lines 1/4		70	8		14/11/2021 2:00

CTD Configuration

Note: No CTD casts 'test' or 'genuine' are planned on this voyage.

Permits & Notifications

- Australian Marine Parks blanket permit (Permit Number: **PA2020-00041-2**; 24 June 2020 to 20 August 2023) covers the MNF for all planned underway science activities within commonwealth marine parks, as listed in this voyage plan. No other activities requiring further permits are planned within commonwealth marine parks for this voyage (e.g. rock dredging, hydrabios net sampling, CTD water retention.

Signature

Your name	Jason Fazey
Title	Technical Lead
Signature	Jason Fazey
Date:	8 November 2021

List of additional figures and documents

a. Appendix A: Selected MNF Equipment List
b. Special Requests MNF Scientific Equipment and Facilities
c. Appendix B: User Supplied Equipment

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.

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Aerosol Sampling Lab		• Please indicate the intended activity in this lab
Air Chemistry Lab		• Please indicate the intended activity in this lab
Preservation Lab		• Please indicate the intended activity in this lab
Constant Temperature Lab (Min temp: 2°C / Max temp 35°C)	X	• Storage of extruded successful cores • 4°C as desired setpoint for temperature
Underway Seawater Analysis Laboratory	X	• PC02 (Carbon Dioxide Sensor) Calibration and Testing of new sensor underway
GP Wet Lab (Dirty)	X	• General Acitivites
GP Wet Lab (Clean)		• Please indicate the intended activity in this lab
GP Dry Lab (Clean)		• Please indicate the intended activity in this lab
Sheltered Science Area	X	• Core Cutting, Extruding, Handling.
Observation Deck 07 Level		• Please indicate the intended activity in this area
Internal Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >20m^3		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature
Clean Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >2.5m^3 Co-located within the Internal freezer and separated by a door		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature
Blast Freezer (Dirty Wet lab) (Min temp -30°C / Max temp 0°C)		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Internal volume >1.5m^3 Capable of reducing the temperature of 150kg of water from +20C to -30C in one hour.		
Cool Room (Dirty Wet lab) (Min temp 0^{o}C / Max temp 10^{o}C)		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature
Ultra-Low Temperature Freezers x2 (Main Deck) Min temp -80^{o}C / Max temp -80^{o}C)		• Please indicate the intended activity in this area
YODA Freezers (x2) (Clean Dry lab) (Min temp -20^{o}C / Max temp 10^{o}C)		• Please specify if both or only one are needed • Please indicate the intended activity in this area • Please indicate the required setpoint temperature

MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Modular Isotope Laboratory			If nominated, additional processes to be completed.
Trace Metal Niskin Sampling Container (TM1-blue)			
Trace Metal Seawater Analysis Laboratory (TM2-white)			Cannot be overstacked
Trace Metal Rosette and Niskin Storage Container			10-foot container
Modular Hazchem Locker			
Stabilised Platform Container			Please indicate what instruments are to be installed in the container Cannot be overstacked
Clothing Container			The use of this container will be identified by MNF

STANDARD SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
CTD - Seabird 911 with 36 Bottle Rosette			N/A
CTD - Seabird 911 with 24 Bottle Rosette			N/A
Lowered ADCP			
Continuous Plankton Recorder (CPR)			

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
TRIAXUS – Underway Profiling CTD			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 the surface 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 (Chl, CDOM, backscatter), transmissometer, PAR sensor, and Laser Optical Plankton Counter. Contact MNF for further details on other instrumentation and capability.
Desired towing profile:			
Additional instrumentation: (please supply, make and model and datasheets and a contact person for discussion on integration)			
Piston Coring System	X		
Gravity Coring System		X	
Multi Corer			

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
Kasten Corer	X		New Kasten Core system running from piston core cradle (rather than stern deployment)
Smith Mac Grab	X		
Rock Dredges			
Rock Saw			Requires trained science personnel
Seaspy Magnetometer	X		
Portable Pot Hauler			
Equipment to measure seawater sound velocity/CTD:	X		
XBT System	X		2 per day provided
Valeport Rapid SV	X		
Valeport Rapid CTD	X		
Valeport SVX2			
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)			See non-MNF owned section below for additional 2 units
Deep Towed Camera	X		
Drop Camera			
Sherman Epibenthic Sled			
Brenke Sled			
EZ Net (Multiple net system, 1m x 1m)			Please specify 335-micron, 500-micron, or 1,000-micron mesh
Hydro-Bios MultiNet (1m x 1m)			Please specify 335-micron, 500-micron, or 1,000-micron mesh
Surface Net (1m x 1m)			Please specify 335-micron, 500-micron, or 1,000-micron mesh
Bongo Net 485mm diameter			500 micron mesh only
Beam Trawl			
MIDOC			Multiple opening/closing net system with cod ends- suitable for pelagic trawls
Pelagic Trawl System (net, doors)	X		Contact MNF to discuss net and mesh dimensions
Demersal Trawl System (net, doors)			Contact MNF to discuss net and mesh dimensions

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
RMT-8 (Rectangular Midwater Trawl) Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.			8m2 mouth area Tow speed ≤2 knots
RMT-16 (Rectangular Midwater Trawl) Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.			16m2 mouth area Tow speed ≤2 knots
Trawl Monitoring Instrumentation (ITI) (2,000m depth limit)			MNF to identify this need, dependent on pelagic or demersal trawling requirement
Stern ramp	**INSTALLED**		MNF to identify this requirement

RESEARCH SUPPORT INFRASTRUCTURE			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Salt Water Ice Machine (Dirty Wet lab)			
Radiosonde Receiver System			
Laboratory Incubators (Clean Dry lab)			
Deck Incubators			Temperature controlled deck incubators
Milli-Q System			
Sonardyne USBL System			

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS				
MICROSCOPES:				NOTES/COMMENTS
BRAND / MODEL	TYPE	ESSENTIAL	DESIRABLE	Refer to the “MNF microscopes procedure” for more information
Leica / M80	Dissecting			
Leica / M80	Dissecting			
Leica /MZ6	Dissecting			
Olympus / CH	Compound			
Olympus /CH	Compound			
Leica / MTU282	Camera tube			
Adapters for tube / Nikon	Pentax			
Ring Light *2 / MEB121	LED			
Heavy Duty Electronic Balance (80kg)				
Medium Duty Electronic Balance (15kg/5g resolution)				
Light Duty Electronic Balance (3kg/1g resolution)				

Underway systems

ACOUSTIC UNDERWAY SYSTEMS			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
75kHz ADCP			
150kHz ADCP			
Multi Beam Echo Sounder EM122 12kHz (100m to full ocean depth)	X		
Multi Beam Echo Sounder EM710 70-100kHz (0-1000m approx.)	X		
Sub-Bottom Profiler SBP120	X		
Scientific Narrowband Echo Sounders EK60 (6 bands, 18kHz-333kHz)	X		EK60s will be onboard for use as a backup for EK80s and set in narrowband mode Quantitative measurements from scientific echosounders requires sphere calibration in the watermass of sampling

ACOUSTIC UNDERWAY SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Scientific Narrowband/Broadband Echo Sounders EK80 (6 bands, 18kHz-333kHz)	X		EK80s will be used in narrowband mode unless otherwise requested Quantitative measurements from scientific echosounders requires sphere calibration in the watermass of sampling
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)			
Omnidirectional Echo Sounder SH90			
Gravity Meter	X		

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_2/CH_4/H_2O)			
Aerodyne Spectrometer (analysis of N_2O/CO/H_2O)			
Cloud Condensation Nuclei (CCN)			
Polarimetric Weather Radar			

UNDERWAY SEAWATER SYSTEMS AND INSTRUMENTATION			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Thermosalinograph			
Fluorometer			
Optode			
pCO2	X		PC02 (Carbon Dioxide Sensor) Calibration and Testing of new sensor underway

SEAWATER SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace metal clean seawater supply	X		
Scientific clean seawater supplied to laboratories	X		Required for Hydrochemistry comparison of nutrient analysers
Raw seawater available on deck and in laboratories	X		

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			

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 YOUR VOYAGE OPERATIONS MANAGER AS REQUIRED. ADDITIONAL STAFF MAY BE REQUIRED FOR THESE ACTIVITIES.**
D & N Francis winch			15mm electro-optical cable
Box Corer	X		New box corer to be trailed and calibrated
UTAS In-Situ Pumps (x2)			
EM2040			Shallow water multibeam echosounder system

Appendix B

User Supplied Equipment

Item name	Weight	Dimensions	Location on Vessel
ISAR #2	23kg	230mm x 700mm tube	Port bridge Wing
CTD 24 bottle spare rosette	154kg no weights	1800mm x 1500mm	Sheltered Sceince
HOTS	815kg per Km (7.8km total)	19mm Diamater x 8km Length. Spooled to General Purpose Winch	1st Platform (Below Deck) General Purpose Winch Room
GPC	30 Tonnes	20m^3	Inboard Starboard Gunnels (Core Handler), Back Deck Corer head & sheaves.
MTMS	30kg each pelecan case	"2x 100cm x 30cm x 40cm"	Bridge and Trawl Equipment Storage
CO2 spectrometer	15 kg	case 80x53x34 cm instrument 44x44x20 cm	underway seawater lab
CO2 spectrometer	10 kg	50 x 32 x 17 cm	underway seawater lab
CO2 spectrometer	10 kg	50 x 32 x 17 cm	underway seawater lab
panel PC	5 kg	case 59 x 35 x 24 cm PC 40x40x10 cm	underway seawater lab
ISAR #2	23kg	230mm x 700mm tube	Port bridge Wing
CTD 24 bottle spare rosette	154kg no weights	1800mm x 1500mm	Sheltered Sceince
GPC	30 Tonnes	20m^3	Inboard Starboard Gunnels (Core Handler), Back Deck Corer head & sheaves.

Appendix C

Hazardous Materials Manifest

No hazardous materials are to be taken or used onboard.