RV *Investigator* Voyage Plan

VOYAGE #:	IN2021_V02
Voyage title:	**SOTS: Southern Ocean Time Series automated moorings for climate and carbon cycle studies southwest of Tasmania**
Mobilisation:	Hobart, Thursday April 8 – Sunday April 11, 2021
Medical clearance	Hobart, Monday April 12, 2021
Depart:	Hobart, ~1300 Wednesday April 14, 2021
Return:	Hobart, Tuesday April 27, 2021
Demobilisation:	Hobart, Wednesday April 28, 2021
Voyage Manager:	Max McGuire
Chief Scientist:	Elizabeth H. Shadwick
Affiliation:	CSIRO/AAPP
Alternate Chief Scientist:	Eric Schulz
Affiliation:	BoM

Scientific objectives

The Southern Ocean has a predominant role in the movement of heat and carbon dioxide into the ocean interior moderating Earth's average surface climate. The IMOS SOTS sub-facility uses a set of two automated moorings to measure these processes under extreme conditions, where they are most intense and have been least studied. The atmosphere-ocean exchanges occur on many timescales, from daily insolation cycles to ocean basin decadal oscillations and thus high frequency observations sustained over many years are required. The current context of anthropogenic forcing of rapid climate change adds urgency to the work.

The primary objective is to first deploy a new set of SOTS moorings (SOFS-9 and SAZ-22) and then recover the existing SOTS moorings (SOFS-8 and SAZ-21). Each of the SOTS moorings delivers to specific aspects of the atmosphere-ocean exchanges:

- the SAZ sediment trap mooring collects samples to quantify the transfer of carbon and other nutrients to the ocean interior by sinking particles and investigate their ecological controls.
- the Southern Ocean Flux Station (SOFS) mooring measures meteorological and ocean properties important to air-sea exchanges, ocean stratification, waves, currents and biological productivity and ecosystem structure. Water samples are collected for more detailed nutrient and plankton investigations after recovery.

Ancillary work will obtain supporting information on atmospheric and oceanographic conditions using CTD casts, underway measurements, Triaxus towed body, Continuous Plankton Recorder and autonomous profiling Biogeochemical-Argo floats, and potentially casts of a bio-optical sensor package.

Voyage objectives

1. Deploy SOFS-10 meteorology/biogeochemistry mooring
2. Deploy SAZ-23 sediment trap mooring
3. Recover SOFS-9 meteorology/biogeochemistry mooring
4. Recover SAZ-22 sediment trap mooring
5. Do CTDs (2 casts to 2250m, 1 cast to 4550m) at the SOTS site, including collecting samples for nutrients, oxygen, dissolved inorganic carbon, alkalinity, and particulate matter analyses
6. Ship meteorological observations at SOFS buoy for comparisons
7. Tow MacArtney Triaxus on transit to SOTS site
8. Tow CPR on return to Hobart
9. Carry out underway air and water sampling and sensor measurements, including bio-optics and bio-acoustics
10. Deploy 2-3 Biogeochemical-Argo autonomous profiling floats at the SOTS site, potentially augmented by casts of a bio-optical sensor package.

Voyage Risk Assessment (VRA)

This voyage has undergone a comprehensive risk assessment process.

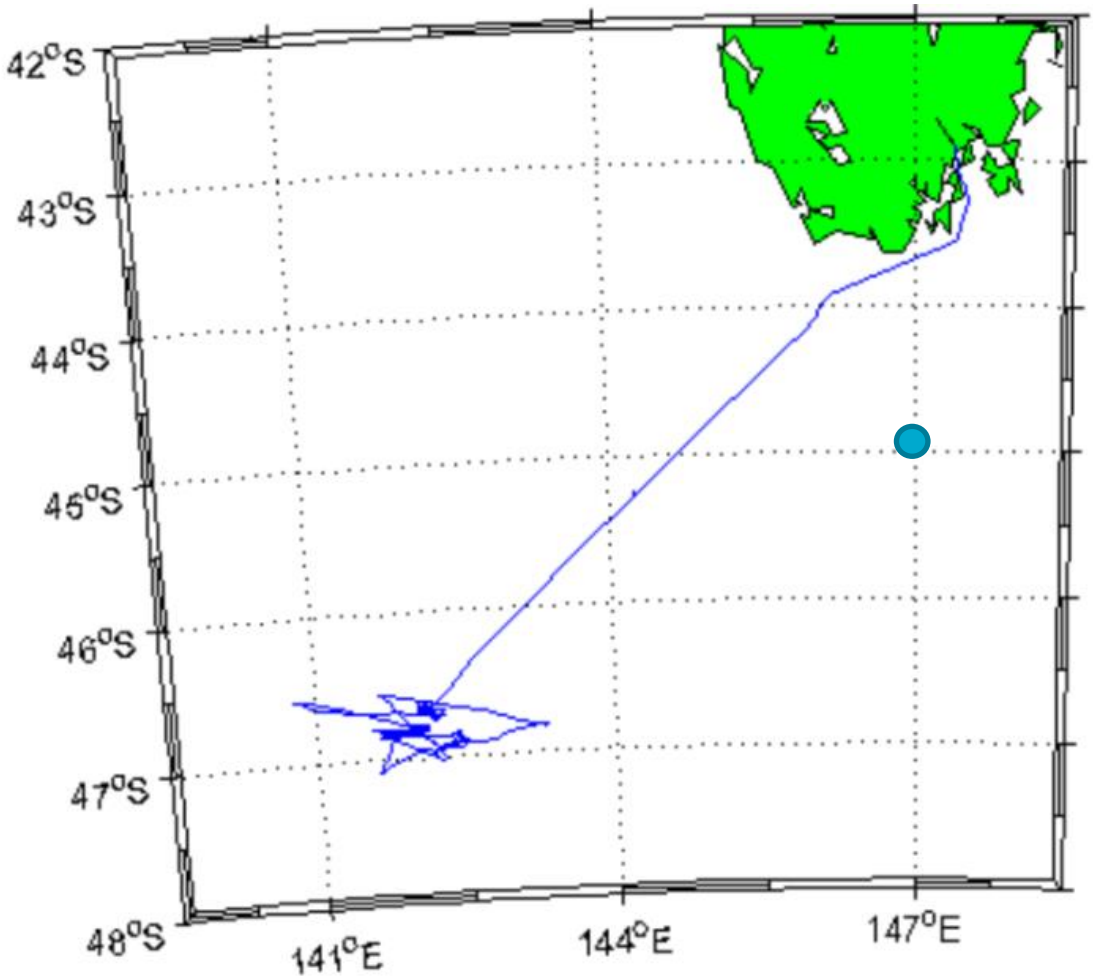
Media Activities

ORGANISATION	ACTIVITIES	TIMING	RESPONSIBLE PERSON
CSIRO, UTAS, UTS	Media engagement TBC	TBC	TBC

Overall activity plan including details for first 96 hours of voyage

Thu-Fri 8-9	Apr	Mobilise: • SOTS: Load CSIRO winch and mooring containers (SAZ van and Half-Height) and other mooring gear (SOFS-10 large float, anchors) to main trawl deck. Spool moorings to winches. • SOTS: Load lab equipment and begin internal labs setup • SOTS: Load Triaxus • Media activity on and around vessel?
Mon 12	Apr	Medical Testing
Wed 14	Apr	Depart Muster drill for all science party In Adventure or Storm Bay, test all of following: mooring anchor dual lift, CTD, Bongo net system, Triaxus (block to be installed on A-frame). Depart Storm Bay as soon as above tests complete (not later than 1400) When in deep enough begin Triaxus tow to cross EAC jet (target start-point 45S,147E: way-point to be updated based on satellite imagery in advance of departure)
Thu 15	Apr	Transit waypoint and head to SOTS site towing Triaxus and performing underway sensor observations. Hold Mooring Procedures Familiarization Meeting with Science Party, Master, Mates and Crew
Fri 16	Apr	~1000 Arrive SOTS site

Voyage track example



Waypoints and stations

	Decimal Latitude	Decimal Longitude	Distance (nm)	Total Distance (nm)	Steaming time (hrs)	Total Steam (hrs)
Hobart	42.87	147.35				
Storm Bay	43.33	147.350	28	28	2.5	2.5
SOTS (nominal)	46.80	142	311	340	28	48
Hobart	42.87	147.35	352	749	32	68

Locations of moorings to be recovered

Mooring	Latitude	Longitude	Depth
SOFS-9 anchor triangulation	46° 59.09’ S 46.98476°S	141° 48.70’ E 141.81169°E	4209 m
SAZ-22 anchor triangulation	46° 47.14'S 46.7857040 °S	141° 48.02'E 141.80028°E	4663 m

Target locations for mooring deployments

Mooring	Latitude	Longitude	Depth
SOFS-10 target	46.996579 °S	142.284321 °E	4540 m
SAZ-23 target	46.7937 °S	141.8160 °E	4550 m

CTD Configuration

	PLEASE SELECT:
Fundamentals:	
Which CTD rosette to be used for this voyage (24 or 36 Niskin bottles):	36
Likely total number of casts:	4
Likely maximum depth of deepest cast:	4550m
Lowered ADCP required:	no
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):	
PAR Sensor (Biospherical QCP-2300):	yes
Transmissometer (Wetlabs C-Star 25cm):	yes
Fluorometer – Chlorophyll-a (Chelsea Aquatracka III – 430/685nm):	
Fluorometer – CDOM (Wetlabs FLCDOM – 370/460nm)	
Nephelometer (Seapoint Turbidity Meter)	
ECO-Triplet (Chlorophyll-a, CDOM & backscatter – maximum depth 2000m)	yes

	PLEASE SELECT:
Hydrochemistry Analyses:	
Salinity	108
Dissolved Oxygen	108
Nutrients: Nitrate	108
Nutrients: Phosphate	108
Nutrients: Silicate	108
Nutrients: Nitrite	108
Nutrients: Ammonia (special request after discussion with hydrochemistry)	

We plan to collect dissolved inorganic carbon, alkalinity, particulate organic carbon, pigments, eDNA, and phytoplankton taxonomy samples from the 2 shallow (600 m), 1 mid-depth (2250 m) and 1 deep cast (4500m); we require hydrochemistry analyses for all CTDs (i.e., 4x24 = 96), as well as from ~ 12 underway samples to calibrate/validate the Triaxus sensors.

Time estimates

Note: As your voyage departs from/returns to Hobart, there is a requirement for MNF GSM to conduct calibration lines of Storm Bay (outgoing and incoming). These lines are surveyed to calibrate and build a time series dataset to monitor backscatter data from the multibeam echosounders. The ship is requested to remain steady on a survey speed of 8 knots for a period of approximately 15 minutes. Please allow for these calibrations in your Time Estimates.

Date	Month	Activity
Thu - Fri 8-9	Apr	Mobilise
Mon 12	Apr	Pre-voyage medical clearance
Wed 14	Apr	Depart (dependant on medical clearance results) Muster drill for all science party In Adventure or Storm Bay, test all of following: mooring anchor dual lift, Bongo net system, CTD, Triaxus. Begin transit to SOTS Deploy Triaxus as soon water is 1000m deep
Thu 15	Apr	Transit to SOTS towing Triaxus and perform underway sensor observations. Hold Mooring Procedures Familiarization Meeting with Science Party, Master, Mates and Crew
Fri 16	Apr	~0600 - 1000 Arrive SOTS site (dependant on weather conditions)

Date	Month	Activity
		0800-1300 SOTS: CTD cast to 600m (pre-deployment calibration of SOFS-10 sensors) 1300-1800 Ship-buoy met comparison at SOFS-9 1630-1700 SOFS-10 Deployment Meeting 1800-2200 Ship drift assessment at SOFS-10 site
Sat 17	Apr	0400-0600 Reposition ship to SOFS-10 deployment start (~18 miles down-weather; to be refined from ship drift assessment) 0645 SOTS: Toolbox on Bridge for SOFS-10 mooring deployment 0600-2000 SOTS: Deploy SOFS-10 mooring 2000-2400 SOTS: Triangulate SOFS-10 anchor, collect ship sensor observations close to SOFS-10
Sun 18	Apr	Rest Day: Collect ship sensor observations close to SOFS-10 0800-1200 CTD Cast to 4550m (pre-deployment calibration of SAZ-23 sensors) 1000-1500 Spool on SAZ-23 1500-1900: ISP Cast to 1500m
Mon 19	Apr	0400-0600 SOTS: Transit to SAZ-23 deployment start (12 miles down-weather from target) 0645 SOTS: Toolbox on Bridge for SAZ-23 mooring deployment 0600-1500 SOTS: Deploy SAZ-23 mooring 1500-1800 SOTS: Triangulate SAZ-23 anchor location 1900-2300: ISP Cast to 1500m
Tue 20	Apr	0400-0600 Transit to SAZ-22 recovery site (1 mile down-weather from anchor location) 0645 Toolbox on Bridge for SAZ-22 mooring recovery 0600-1800 Recover SAZ-22mooring 1900-2300: ISP Cast to 1500m
Wed 21	Apr	0600-0800 SOTS: Transit to SOFS-9 site 0800-1800 SOTS: Spool off SAZ-22 mooring –deck ops only 0800-1200 SOTS: Ship-buoy met comparison at SOFS-9 1200-1600 SOTS: CTD cast to 2250m 1600-2200 SOTS: Ship-buoy met comparison at SOFS-9

Date	Month	Activity
Thu 22	Apr	0400-0600 SOTS: Transit to SOFS-9 recovery site (1 mile down-weather from anchor location) 0645 SOTS: Toolbox on Bridge for SOFS-9 mooring recovery 0600-2000 Recover SOFS-9 2200-2400 CTD cast to 2250 m (post-recovery calibration of SOFS-9 and SAZ-22 sensors)
Fri 23	Apr	Bad weather allowance
Sat 24	Apr	Bad weather allowance
Sun 25	Apr	Bad weather allowance 2400: Depart SOTS site
Sun 26	Apr	Transit to Hobart towing CPR
Tue 27	Apr	Arrive Hobart
Wed 28	Apr	Demobilisation

Supplementary projects

UTS: Katherina Petrou

The primary goal of this project is to obtain community and species-specific estimates of silica production within mixed natural phytoplankton communities along a latitudinal gradient of Eastern Australia. Therefore, there are two specific aims of this project:

1. To determine bulk rates of silicification in phytoplankton communities from latitudinally distinct bioregions (SOTS providing a southern-most site).
2. To evaluate species-specific silicification to identify the heavy weights within the community.

With this information in hand we can start to build a more complete picture of silicon cycling in regionally distinct oceanographic waters of Australia.

Water sampling: We will collect 10L seawater from chl max and 10L from surface from one of the CTD casts at each of the two SOTS sites. If a DCM (deep chl max) is detected, we would like to also to sample 10L from that depth. CTD sampling will be done via silicon tubing into a carboy. Sampling can be done after hydrochemistry sampling is completed.

UTAS: Zanna Chase

Quantification of dust deposition to the ocean using thorium isotopes in seawater and aerosol sampling. This piggyback project is part of an ARC Discovery Project (CIs Zanna Chase, Andrew Bowie and Peter Strutton, UTAS) entitled 'Dust to the ocean: does it really increase productivity?" The purpose of the larger project and of this piggyback is to quantify dust deposition to the ocean and its chemical and ecological impact by using new geochemical techniques. The SOTS site is unique in the Southern Hemisphere because we can compare

a number of different methods to estimate dust deposition and can also look at interannual variability in dust deposition.

In terms of national benefit, mineral dust is an important, yet difficult to quantify source of nutrients to the ocean. This project will deliver more accurate estimates of dust deposition to the ocean around Australia, a region where dust models perform poorly. The expected benefit of the project includes better dust models used to predict future changes in dust deposition to the ocean. Accurate dust predictions are critical for predicting future ocean fish production and carbon uptake.

Priority 1 is to collect filtered seawater samples (10L) from a depth profile at the SOTS site. Ideally the full water column depth, but if time is limited the upper 1,500m. These samples will be analysed for 230Th and 232Th concentrations at UTAS. We would also retain sample aliquots for possible future analysis of rare earth elements and Nd isotope composition, pending further funding. For this we would need the CTD-rosette (36 bottle ideally), a laminar flow bench and milli-Q water, all MNF-supplied. We would supply jerry-cans for sampling, storage boxes for the jerry-cans, cartridge filters, and HCl for acidification.

Priority 2 is to collect aerosol samples using the ship's aerosol sampling apparatus. These samples would be analysed for labile and total bioactive trace metals, as well as 232Th, at UTAS. For this we would need the MNF aerosol sampling lab. We would supply filters and storage containers for filters.

Priority 3 is to collect seawater particulates using in-situ pumps. These samples would be analysed for 230Th and 232Th concentrations at UTAS as well as particulate organic carbon, inorganic carbon and opal. For this we would need the MNF and UTAS ISPs. We would supply filters, batteries and storage containers for filters.

The three sample types provide three independent measures of dust flux.

CSIRO MNF: Field Operations:

Bongo net system **trials** will be conducted in shallow protected waters and deeper Southern Ocean waters. These will be carried out with deployment over the stern Via the A-frame attached to the towed body wire. The towed body wire and Bongo net system will be ready to go on departure of pw4, with the Bongo net as first deployment then the towed body wire could be disconnected and then reconnected onto TRIAXUS whilst other tests are carried out.

CSIRO O&A: Craig Neill

- Install a NOAA-built ASV-CO2 system in a flow through housing for comparison with the ship's underway system. ASV-CO2 is basically the next generation MApCO2, but built to fit saildrones as well as buoys. We have a new agreement with NOAA/PMEL where they will share their firmware and build plans, as well as a couple of instruments, and we will evaluate them, provide feedback and start the process of upgrading our MApCO2 fleet to ASV-CO2 internals.
- Major software upgrade for the ship's underway pCO2 system.
- Further testing of the new LI-7815 detector, mainly using atmospheric air.
- Preparing the UW lab and pCO2 system for integration of an LI-7815 (mounting, plumbing, cabling) that has been requested through MNF capex.

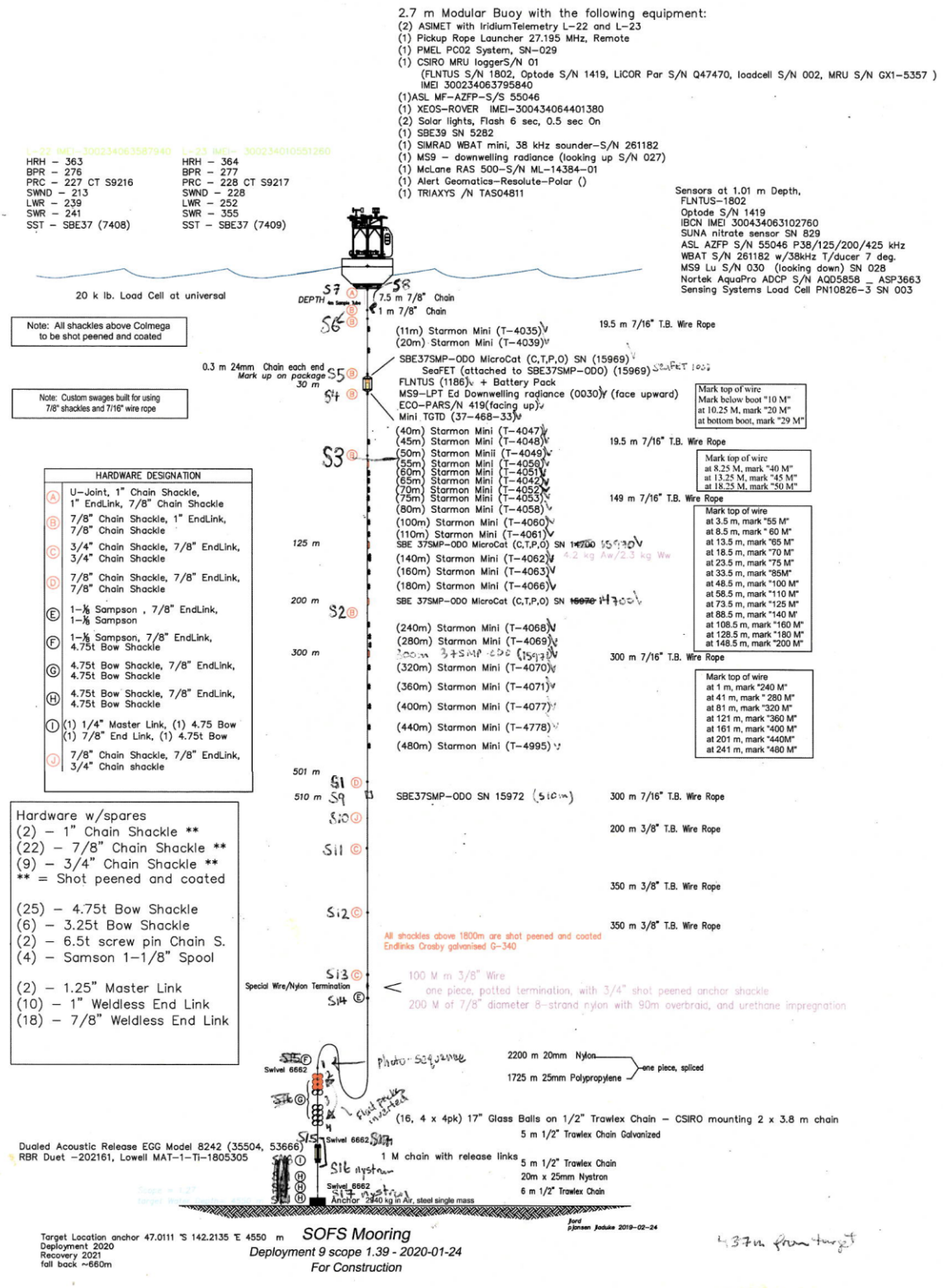
Permits

- PA2018-00005-1

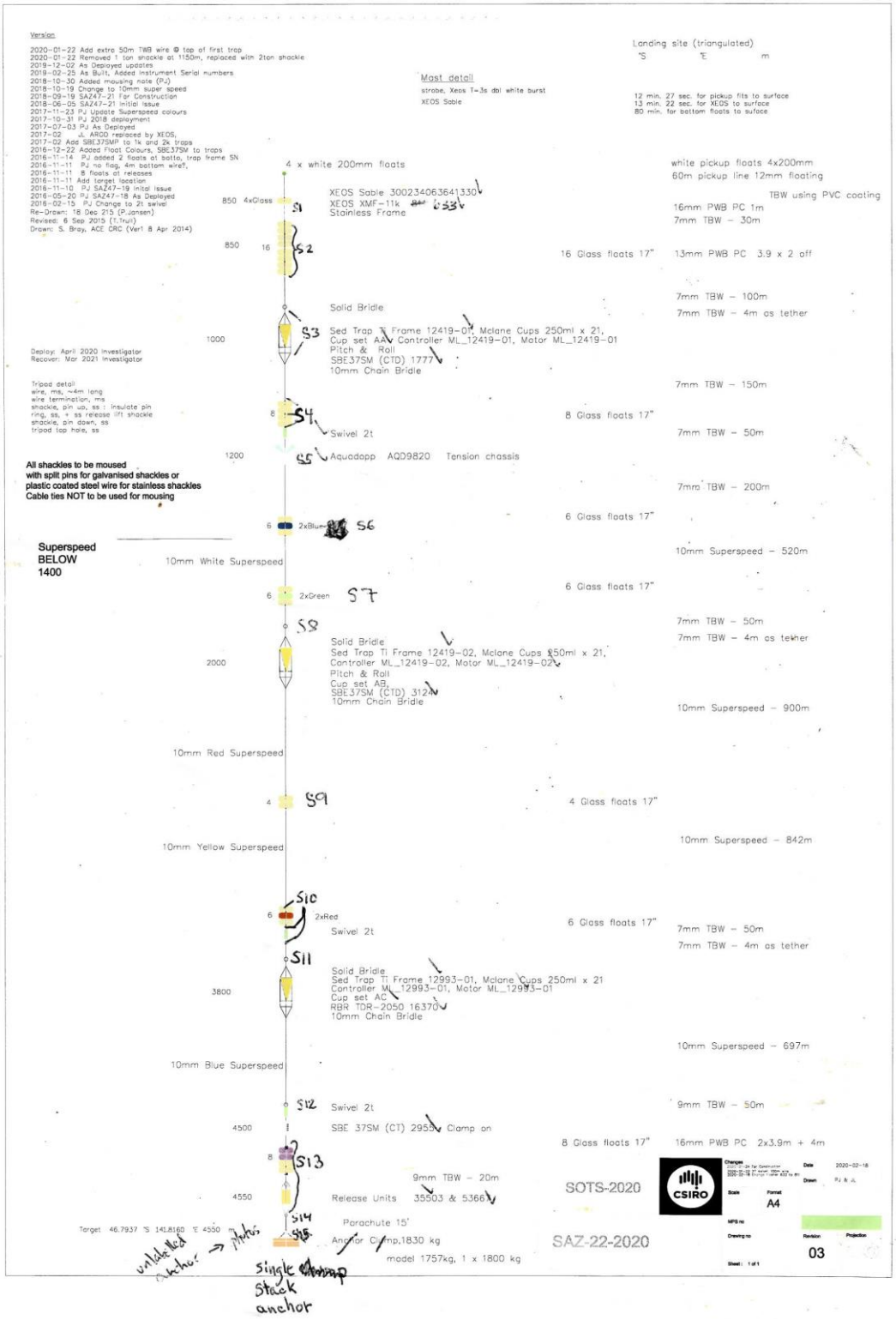
Superseded - PA2018-00005-1 sigr

List of additional figures and documents

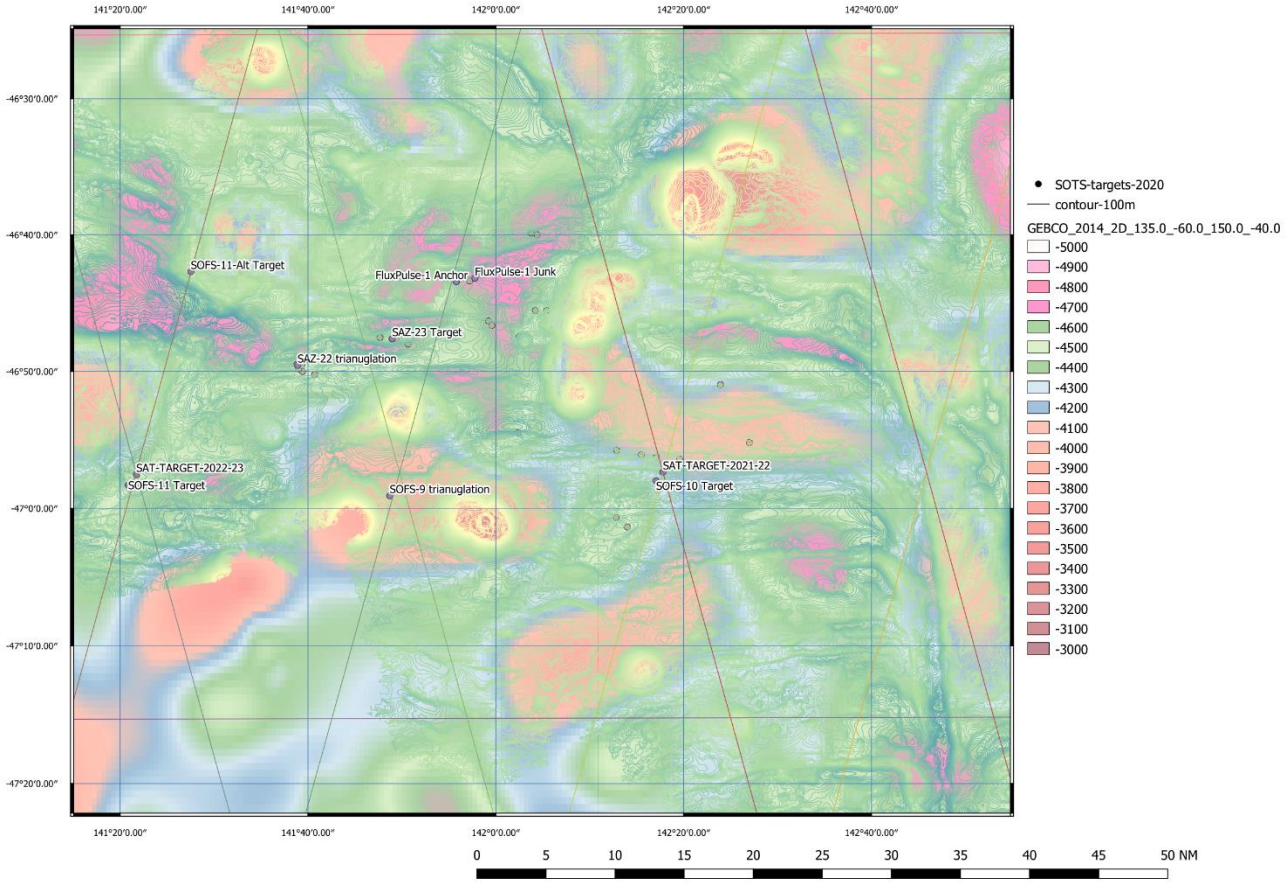
SOFS-9 As Deployed



SAZ-22 As Deployed



Map of Mooring Locations



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	x	• Please indicate the intended activity in this lab
Air Chemistry Lab	x	• Please indicate the intended activity in this lab
Preservation Lab	x	• Please indicate the intended activity in this lab
Constant Temperature Lab (Min temp: 2°C / Max temp 35°C)	x	• Please indicate the intended activity in this lab • Please indicate the required setpoint temperature
Underway Seawater Analysis Laboratory	x	• Please indicate the intended activity in this lab
GP Wet Lab (Dirty)	x	• Please indicate the intended activity in this lab
GP Wet Lab (Clean)	x	• Please indicate the intended activity in this lab
GP Dry Lab (Clean)	x	• Please indicate the intended activity in this lab
Sheltered Science Area	x	• Please indicate the intended activity in this area
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)		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Volume: >2.5m^3 Co-located within the Internal freezer and separated by a door		
Blast Freezer (Dirty Wet lab) (Min temp -30^{o}C / Max temp 0^{o}C) Internal volume >1.5m^3 Capable of reducing the temperature of 150kg of water from +20C to -30C in one hour.	x	• Please indicate the intended activity in this area • Please indicate the required setpoint temperature
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)	x	• 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

MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
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	X		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	x		With PAR, Transmissometer & user supplied FLBB
CTD - Seabird 911 with 24 Bottle Rosette		x	
Lowered ADCP			
Continuous Plankton Recorder (CPR)	x		

SPECIALISED 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 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

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
			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)			• SUNA nitrate sensor (to be used on the Triaxus) •
Piston Coring System			
Gravity Coring System			
Multi Corer			
Kasten Corer			
Smith Mac Grab			
Rock Dredges			
Rock Saw			Requires trained science personnel
Seaspy Magnetometer			
Portable Pot Hauler			

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
Equipment to measure seawater sound velocity/CTD:			
XBT System			2 per day provided
Valeport Rapid SV			
Valeport Rapid CTD			
Valeport SVX2			
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)	x		See non-MNF owned section below for additional 2 units
Deep Towed Camera			
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)			Contact MNF to discuss net and mesh dimensions

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
Demersal Trawl System (net, doors)			Contact MNF to discuss net and mesh dimensions
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)	x		
Deck Incubators			Temperature controlled deck incubators
Milli-Q System			

RESEARCH SUPPORT INFRASTRUCTURE			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
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)			
Multi Beam Echo Sounder EM710 70-100kHz (0-1000m approx.)			
Sub-Bottom Profiler SBP120			
Scientific Narrowband Echo Sounders EK60 (6 bands, 18kHz-333kHz)			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
Scientific Narrowband/Broadband Echo Sounders EK80 (6 bands, 18kHz-333kHz)			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			

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	x		
Fluorometer	x		
Optode	x		
pCO2	x		

SEAWATER SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace metal clean seawater supply			
Scientific clean seawater supplied to laboratories	x		Plan to run the EIMS (O2/Ar) system in the underway lab
Raw seawater available on deck and in laboratories			

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			
UTAS In-Situ Pumps (x2)	x		
EM2040			Shallow water multibeam echosounder system

Appendix B

User Supplied Equipment

The table below will include information provided by the Chief Scientist / Principal Investigators in the '*Equipment Manifest-user supplied voyage specific'* document. The Chief Scientist will co-ordinate the completion of this Manifest with all PIs and forward the completed document to the Voyage Operations Manager.

NOTE: User supplied equipment will remain the responsibility of the science party throughout the voyage. The MNF technicians and ship's crew endeavour to assist wherever possible, however the MNF take no responsibility for the pre-deployment checks or repairs and maintenance of this equipment

This information will also be used for the mobilisation list and deck plan for the voyage.

Owner	**Item Name**	**Weight**	**Dimensions**	**Location on Vessel**
Elizabeth Shadwick / CSIRO moorings	Bullhorn mooring fairlead	100 kg	1m	Main deck
Elizabeth Shadwick / CSIRO moorings	Mooring winch	1.5 tonne	2x1x1.5 m	Main deck / Sheltered Science Area
Elizabeth Shadwick / CSIRO moorings	Half height open top moorings container	5 tonnes	20ft	Main deck
Elizabeth Shadwick / CSIRO moorings	SOFS float and recovery cradle	2.5 tonnes	3x3 m	Main deck
Elizabeth Shadwick / CSIRO moorings	Mooring anchor stacks	8 tonnes	3x1 m	Main deck
Elizabeth Shadwick / CSIRO moorings	Full height container for storing and working on sediment traps	4.5 tonnes	20ft	Main deck
Elizabeth Shadwick / CSIRO moorings	6 cage pallets of mooring equipment	500kg per cage	1 x 2 m each	Main deck
Elizabeth Shadwick / CSIRO moorings	Hand held and deck mounted pneumatic line throwers (grappling gun)	50 kg	0.5 m	Sheltered Science Area
Elizabeth Shadwick / CSIRO moorings	Video cameras	0.5kg	0.1 m2	Main deck
Elizabeth Shadwick / CSIRO moorings	Acoustic release deck unit	5kg	0.5 m2	Operations Room
Elizabeth Shadwick / CSIRO moorings	FLBB sensor	10 kg	1 m2	CTD room
Elizabeth Shadwick / CSIRO moorings	EIMS O2/Ar System	20 kg	1 m2	Underway Seawater Lab
Elizabeth Shadwick / CSIRO moorings	EIMS Spares	20 kg	3 x 1m3	Clean Dry lab
Elizabeth Shadwick / CSIRO moorings	POC particle filtration system	5 kg	1 m bench space	Clean Dry lab
Elizabeth Shadwick / SOTS	SUNA nitrate sensor	10 kg	0.2 m2	Sheltered Science Area

Owner	Item Name	Weight	Dimensions	Location on Vessel
Lev Bodrossey	eDNA cartridge filtration system	20 kg	1 m bench space	CTD room
Andrew Bowie	Air Sampling Pump Controller (from MNF)	4 kg	0.2 m3	Aerosol lab
Andrew Bowie	Aerosol sampling system (UTAS/CSIRO)	15 kg	1 m bench space	Aerosol lab
Andrew Bowie	Laminar flow hood (UTAS)	30 kg	1 m bench space	Aerosol lab
Andrew Bowie	Sampling bottles and filters (UTAS)	10 kg	0.5 m3	Aerosol lab
Andrew Bowie	Precipitation (Rain) Sampler	10 kg	1 m3	to be installed on 05 level outside of bridge equipment room (no power required)
Andrew Bowie	Laboratory ware and equipment	20 kg	0.5 m3	Clean dry lab
Andrew Bowie	In situ McLane pumps (x5)	180 kg	3 m3	Sheltered science area / 10foot TMR container
Zanna Chase	2 boxes of lab consumables	25 kg each	1m3 x 2	Clean Dry lab
Zanna Chase	30L carboy 1, to be filled with seawater	35 kg	0.5 m3	temp controlled room or clean dry lab
Zanna Chase	30L carboy 2, to be filled with seawater	35 kg	0.5 m3	temp controlled room or clean dry lab
Zanna Chase	crates to store 10L seawater samples: 13 total, each holding 4 samples	50 kg each x 13 boxes	699x497x424(L W H)	Clean Dry lab and temp controlled room
Alyson Theseira	PAM fluorometer	10kg	600x400x300 (1 box)	Clean Dry lab
Alyson Theseira	3 nallys of lab consumables/Sample bottles	20kg each	700x50x50	Clean Dry lab
Alyson Theseira	Carboys for 10L seawater samples: 3	Empty	10L	Clean Dry lab and temp controlled room

Appendix D

Hazardous Materials Manifest

Responsible Person	Hazardous Material Name
Shadwick	mercuric chloride saturated solution
Shadwick	mercuric chloride seawater brine
Shadwick	Ethanol
Shadwick	Ethanol
Jansen	partially depleted lithium batteries
Jansen	Triton X 100
Meyerink	Hydrochloric Acid
Meyerink	Hydrochloric Acid (6M)
Theseira /Petrou	Glutaraldehyde (25%)
Theseira /Petrou	Dimethyl sulfoxide (DMSO)
Theseira /Petrou	Ethanol
Theseira /Petrou	Lysosensor fluorescent probe
Theseira /Petrou	Lugol's