RV *Investigator* Voyage Plan

VOYAGE #:	**IN2026_V05**		
Version Number:	FINAL		
Voyage title:	Next Generation of Ocean LiDAR		
Mobilisation:	MNF Mobilisation: Brisbane, 23-25 August 2026		
	Science Team Mobilisation: Brisbane, 25-26 August 2026		
Depart:	Brisbane, 1200 Thursday 27 August 2026		
Return:	Brisbane, 0800 Monday 7 September 2026		
Demobilisation:	Science Demobilisation: Brisbane, Monday 7 September 2026		
	MNF demobilisation: Brisbane, 8 September 2026		
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Chief Scientist:	Prof. Helen Pask		
Affiliation:	Macquarie University		
Principal Investigators: (original application)	David Antoine – Curtin University Judith Dawes – Macquarie University Dennis Delic – DTSG James Downes – Macquarie University Regina Dunford – Macquarie University Weilin Hou – ONRG Alice Howie - Macquarie University Cedric Jamet – Université du Littoral Côte d'Opale Ondrej Kitzler – Macquarie University Joyce Mau – DTSG Paul Molino - DSTG Vincent Raoult – Griffith University David Spence – Macquarie University		

Scientific objectives

Ocean LiDAR is nationally important in providing information about the water column. It is a dual-use technology, vital for national security and providing oceanographic and environmental intelligence about ocean and coastal waters. DSTG led the development of bathymetric ocean LiDAR in Australia in the 1990s, with the LADS system flown around Australia for decades acquiring the data which now forms the basis of our electronic charts. There is a pressing need to develop the next generation of ocean LiDAR which will enable ocean profiling, extracting additional information about the water column: turbidity, phytoplankton pigments, bubbles, internal waves and so on.

This RV *Investigator* voyage will enable ocean profiling LiDARs developed at Macquarie University to be tested in clear ocean waters. A key challenge limiting the development of ocean profiling LiDARs has been in acquiring in-water data to test the inversion algorithms which extract data from LiDAR signals about how temperature, salinity, absorption, scattering, chlorophyll, bubbles etc vary with depth. We will meet this challenge, as we plan to combine satellite data, measure in-situ water properties, and make LiDAR measurements, all simultaneously during the voyage.

In addition to the above, we will investigate the effect of underwater disturbances on LiDAR returns and in-situ water measurements. We will also investigate, for the first time to our knowledge, whether laser beams, similar to those used in LiDAR, impact the behaviour of marine animals.

Our science team includes instrument scientists from a variety of organisations who will bring unique instruments on board to collect data that supports or complements our primary project goal.

Our voyage track will take us through various regions that are classed as High Priority for Parks Australia, and RV *Investigator* will undertake bathymetric surveys as we transit these regions.

Specific objectives, together with the key investigators associated with them, are as follows:

Objective 1: Test several research-grade LiDARs, built at Macquarie University, in coastal and ocean waters having a variety of depths and vertical oceanographic structures, including where the mixed layer depth, chlorophyll layer and thermocline are within our LiDAR range. We will evaluate LiDAR performance and constraints under relevant conditions (eg. day/night, coastal/open, stationary/underway, sea state), collect data sets relevant to end users, and generally assess the technology.

Relevant activities: Operating marine LiDAR

Key investigators: Spence, Kitzler, Pask, Downes

Objective 2: Measure depth-resolved in-situ-water properties and radiometric data by deploying sensor packages and a radiometer from RV *Investigator*. The main purposes here are to validate LiDAR measurements of water properties, and to provide high-quality local input data for our computational models that (a) simulate LiDAR returns and (b) enable the extraction physical water properties from optical data. The suite of instruments deployed will include some novel instruments developed by members of the Science Team, including a non-commercial instrument for high precision thermometry.

Relevant activities: Deploying sensor packages into the sea; above water deployment of DALEC radiometer;

Key Investigators: Antoine, Rehm

Objective 3: Investigate the effect of underwater disturbances on LiDAR returns and in-situ measurements. Here the goal is to use a ROV (BlueROV2, approx. 12kg) to perturb the properties of the water column at various distances below the surface at locations beneath the LiDAR and the sensor packages.

Relevant activities: deployment of ROV with the intent of actively disturbing the water column; Operating a marine LiDAR; deploying sensor package

Key investigators: Williamson, Antoine, Pask

Objective 4: Investigate whether laser light (same exposure levels as used for the LiDAR) affects the behaviour of nearby marine animals. Specifically, we will use imaging sonar to detect fishes, elasmobranchs, cetaceans, and pinnipeds to depths of 100 m in the presence and absence of the LiDAR (or laser beam), and we will use a ROV with cameras (for ground truthing), to compare our video with that of the imaging sonar

Relevant activities: Operating a marine LiDAR (actually an RGB laser that serves as a proxy laser beam); Deploying a ROV with video camera

Key investigators: Williamson, Raoult

Objective 5: Evaluate various instrumentation and methods relating to LiDAR and Phytoplankton studies. Of note are the PALS LiDAR for range-resolved, time-resolved imaging of underwater environments, a variable-pathlength transmissometer which quantifies backscattering at 180degrees, camera-based instrumentation for quantifying sea state, and various investigations of plankton.

Relevant activities: Operating a marine LiDAR; deploying a Triaxus with Laser optical particle counting unit; Deploying a sensor package; collecting and processing water samples

Key investigators: Dalgleish, Artlett, Antoine

Voyage objectives

During the voyage, the following activities will be conducted. (Lead persons on board are also indicated)

LiDAR testing (*Pask, Kitzler, Spence, Downes*): This will take place early in the voyage, once the RV *Investigator* is in clear water. We will systematically investigate the effects of various LiDAR configurations and environmental conditions (day/night, coastal/open, stationary/underway and sea state) in terms of signal quality (signal to noise ratios, range, etc). The location for this testing may be informed by what satellite ocean colour observations from preceding days tell us about the water properties, along with undulating Triaxus measurements of temperature, salinity and chlorophyll. An important outcome from this testing is to establish the LiDAR parameters for each instrument that are most suited to these waters, and to identify any constraints or limitations.

LiDAR data collection (*Pask, Kitzler, Spence, Downes*): Using our various instruments will take place throughout the remainder of the voyage, in a range of locations where we might expect a range of vertical structures – for example around seamounts, in different latitudes where the mixed layer depth and thermocline might occur at different depths that are/are not accessible to our LiDAR. Data collection will take place primarily at night and while stationary, and we will collect Raman, elastic and fluorescence LiDAR data sets using our various instruments. A key goal is to resolve the mixed layer depth, chlorophyll layer and thermocline, which vary with latitude. Where possible, our measurements will be compared to pre-voyage simulations end on-voyage simulations that use data collected by on-board sensors.

Deployment of Campbell Scientific CS225 Temperature string (*Pask, Downes, Taylor):* Located in close proximity to the LiDAR on Deck 1 would provide continuous logging of the temperature of the water column down to around 50m below Deck 1. It would provide the best validation data for our LiDAR measurements of temperature. The temperature string has 36 sensors placed 1m apart, and the upper 14m has no sensors. The string is connected to a datalogger and power source and will be fully supported by the LiDAR team.

Deployment of Sensor package (*Antoine, Rehm*): This will take place periodically at the same location as stationary LiDAR measurements. Measurements include temperature and salinity, optical backscattering at 6 wavelengths, hyperspectral absorption and attenuation, chlorophyll fluorescence, and hyperspectral downward irradiance and upward radiance at nadir. The sensor package from Curtin University will include a rare Beta-pi instrument (developed by Dr Fraser Dalgleish) that measures 180deg backscattering (highly relevant to LiDAR studies).

Relevant data (absorption and scattering coefficients, volume backscattering, chlorophyll concentration) will be input to the Monte-Carlo model. Comparing simulated and actual returns is vital to our experimental design. Temperature and salinity profiles will be compared to those determined using Raman LiDAR, and other measurements will be used to refine the inversion algorithms that extract water properties from LiDAR returns.

The DALEC (Dynamic Above Water Radiance and Irradiance Collector) (*Antoine, Klonowski*): This will be deployed to measure upwelling and downwelling irradiance. It is an autonomous sea-going hyperspectral radiometer designed to continuously measure above water ocean reflectance during ship transit. It measures light in visible wavelengths coming from the sea and sky.

The DALEC will provide the LiDAR team with information about ambient light incident on and exiting the water surface. It will be installed at the end of a boom on RV *Investigator's* foredeck and connected through cable to a control laptop located in the air chemistry lab on Deck 2. The instrument will be deployed on the starboard or port utility booms located on the RV *Investigator*'s foredeck depending on the ships course relative to the sun.

The radiometer is effectively recording the same data that ocean colour satellites do, but at more wavelengths, and observing a smaller footprint (2 m diameter vs 4 km width of a satellite pixel). This provides a semi-continuous 'satellite record' that can be used to test, compare and improve satellite algorithms. It has been deployed previously on RV *Investigator*.

CTD measurements including sample collection (*Antoine, Pask,* RV *Investigator personnel*): We anticipate two CTD casts each day, one at each station. Four additional instruments will be attached to the CTD: CSTAR 470 and 530 transmissometers (provided by MQ), both having 25cm pathlength which will complement the 650nm transmissometer already on the CTD. The fixed number of data channels means it may be necessary to remove some of standard instruments: most likely the PAR sensor and Altimeter, noting that the altimeter will likely be required at Frederick reef due to the shallower water there (in which case it will be used in place of one of the fluorosensors or a DO sensor).

Water will be collected from RV *Investigator* deployed CTD/rosette sampling system and immediately filtered. The filters are then flash frozen using liquid nitrogen and then stored in the -80°C freezers until returning to port. Then they will be again transferred into a specific "dry shipper" (special type of liquid nitrogen Dewar designed for transport) that will be immediately picked up from the ship to be sent (flown) overseas for analyses. We will not need any nutrient based hydrochemistry analysis.

Triaxus Measurements including LOPC… (Spence, Dalgleish, Antoine): We plan to tow the Triaxus in the 3 hours (3-6pm) prior to each night measurement station in order to assess Mixed Layer Depth (MLD), temperature, salinity and other oceanographic parameters. This data, particularly the MLD and temperature, will be used to select a suitable site for night measurements. If an attractive site is found early in this period, we will stop and await nightfall. Otherwise, we will stop at 6pm and commence Night measurements.

Persistent Autonomous LiDAR (PAL) (Dalgleish): With a different excitation wavelength, temporal modality, and polarisation capabilities, the LiDAR outputs under a range of parameters can be compared to outputs from the MQ LiDAR in a mutually beneficial way.

Underwater Turbulence and Ship wake studies (Williamson, Pask, Spence, Antoine): On at least three occasions the Macquarie ROV (BlueROV2, 12kg) will be used to create an underwater disturbance at various depths, to explore the effects on LiDAR returns and in-situ measurements. Of particular interest is how long effects persist once the source of the disturbance is deactivated. RV *Investigator* will be stationary during these activities. On a few separate occasions, most likely just prior or just after the night LiDAR sessions, we will ask RV *Investigator* to circle around and cross its wake so that we can test our ability to detect a wake. If successful, we'll ask the ship to re-cross several times so we can answer the question – for how long does this ship wake remain visible to our LiDAR.

Deploying a multi-wavelength laser (Williamson, Downes): This will be used to investigate whether laser light affects the behaviour of nearby marine animals. Imaging sonar will be used to detect fishes, elasmobranchs, cetaceans, and pinnipeds to depths of 100 m in the presence and absence of the LiDAR. To ground-truth our data we will deploy an ROV with cameras and compare our video with that of the imaging sonar. Data from shallow and deep waters will be analysed to address the effects of the LiDAR beams: (1) does the presence of organisms change? (2) Do the behaviours of the organisms change (e.g. travel deeper, change direction)? (3) Are the densities and compositions of fish schools impacted? This study can be carried out day or night and is contingent on marine animals being present. Suitable reef and seamount locations have been identified.

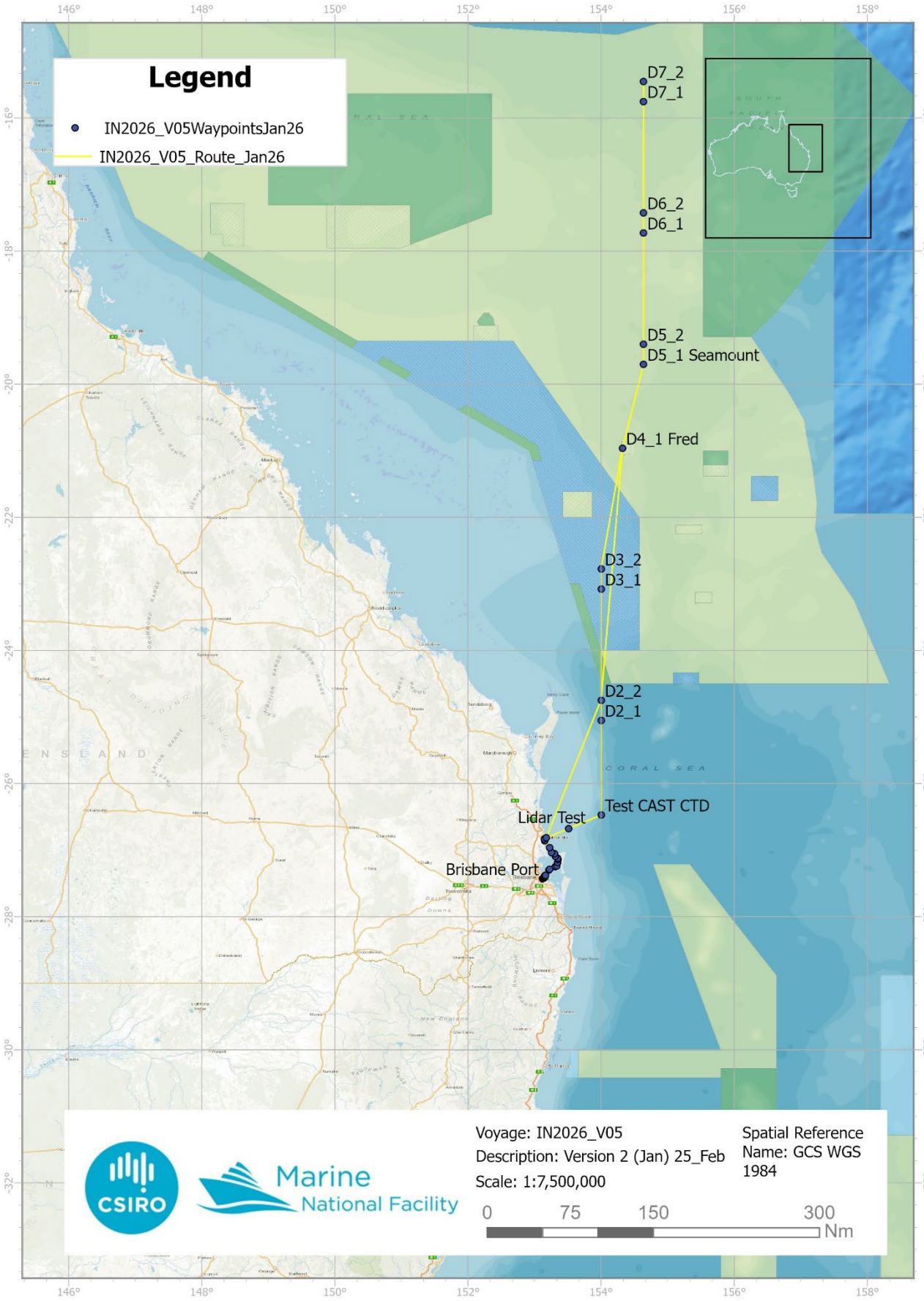
Contingency time. It is noted that bad weather, gear problems or seasickness could impact the success of our voyage. The proposed voyage track has us carrying out most of our studies while travelling North to the maximum extent possible given the available time. However, in the event that adverse factors arise, we will

be able to steam north to the maximum extent planned (approx. 20˚S) and collect most of our data on the southbound leg.

Activity plan for first 72 hours of voyage

Date	Activity
25/08/2026	MOBILISATION DAY 1
0800	MNF Equipment setup
0900	Science team arrive
0930	Science equipment load
0945	Contractor Inductions (Science party)
1400	Science party will test fit LiDAR and sensor packages
1700	Science team finish setup and disembark
26/08/2026	MOBILISATION DAY 2
	Final science equipment lifts
0800	MNF Equipment setup
0900	Science team arrive and onboarding (cage lift of luggage)
0930	Seagoing Inductions
1000	Cabin access
1100	Lab Inductions
1130	Lab setup
1300	Pre-start meetings
	Science team onboard overnight
27/08/2026	VOYAGE DAY 1
0900	MNF teams onboarding
1000	VM Briefing. Includes Laser briefing from Chief Scientist
1030	Muster
1100	Final setup, Prestarts, Take 5s
1200	Departure
1400	Senior Management Team Meeting
1845	Station 1 (D1)- test deployment of LiDARs, ROV, sensor package (CTD) testing

Voyage track



Waypoints and stations

Shallow locations and seamounts: We plan to operate at or close to a number of seamounts or reef structures which feature rapid shelving or shallow waters (<100m, ideally <50m) in order to test the bathymetric capabilities of the LiDAR and to maximise the likelihood of finding high fish populations. Frederick Reef appears to be the most suitable shallow reef location and will be visited early and late in the voyage. We will also be visiting seamount locations which may offer higher fish numbers and interesting/distinct vertical water structures.

Possible perturbations to voyage route: During the voyage, recent satellite and oceanographic data will be reviewed with a view to identifying regions that have the clearest water (for LiDAR measurements) and a variety of trophic environments (for sample collection + *in situ* measurements). Large deviations from planned route are not anticipated.

SITE (D=DAY, N=NIGHT)	DEGREES LATITUDE	DEGREES LONGITUDE	DISTANCE (NM)	TOTAL DISTANCE (NM)	STEAMING TIME (HRS)	TOTAL STEAM (HRS)
Brisbane Port	-27.4311	153.1194	0	0	0	0
PBG	-26.8170	153.1747	47	47	*4.7*	*4.7*
Lidar Test Site	-26.6753	153.5119	20	67	*2*	*6.7*
CTD Test Cast	-26.4736	154.0000	28.9	95.9	*2.89*	*9.59*
D2_1 (D)	-25.0526	154.0000	85	180.9	*8.5*	*18.09*
D2_2 (N)	-24.7517	154.0000	18	198.9	*3*	*21.09*
D3_1 (D)	-23.0795	154.0000	100	298.9	*10*	*31.09*
D3_2 (N)	-22.7785	154.0000	18	316.9	*3*	*34.09*
D4_1 Frederick Reef (D/N)	-20.9631	154.3201	110	426.9	*11*	*45.09*
D5_1 (D)	-19.7030	154.6374	78	504.9	*7.8*	*52.89*
D5_2 (N)	-19.4019	154.6374	18	522.9	*3*	*55.89*
D6_1 (D)	-17.7287	154.6374	100	622.9	*10*	*65.89*
D6_2 (N)	-17.4275	154.6374	18	640.9	*3*	*68.89*
D7_1 (D)	-15.7540	154.6374	100	740.9	*10*	*78.89*
D7_2 (N)	-15.4527	154.6374	18	758.9	*3*	*81.89*
D6_2 (D)	-17.4275	154.6374	118	876.9	*11.8*	*93.69*
D6_1 (N)	-17.7287	154.6374	18	894.9	*3*	*96.69*
D5_2 (D)	-19.4019	154.6374	100	994.9	*10*	*106.69*
D5_1 (N)	-19.7030	154.6374	18	1012.9	*3*	*109.69*
D4_1 (D/N)	-20.9631	154.3201	78	1090.9	*7.8*	*117.49*
D2_2	-24.7517	154.0000	227.23	1318.13	*22.723*	*140.213*

SITE (D=DAY, N=NIGHT)	DEGREES LATITUDE	DEGREES LONGITUDE	DISTANCE (NM)	TOTAL DISTANCE (NM)	STEAMING TIME (HRS)	TOTAL STEAM (HRS)
PBG	-26.8170	153.1747	132.14	1450.27	*13.214*	*153.427*
Brisbane	-27.4311	153.1194	47	1497.27	*4.7*	*158.127*

Time estimates

Operations are planned to follow a semi-regular sequence of events each day:

Day measurements (Approx. 10:00-14:00 hours)

- Prepare and deploy then recover sensor package (2 hours)
- Prepare and deploy then recover CTD (1 hours)
- Filter, flash freeze and store water samples
- Sensor package may be deployed at other times during LiDAR measurements
- Deploy ROV and undertake marine behaviour studies (simops with sensor package and CTD deployment)
- Some LiDAR activities during this time (simops with sensor package and CTD deployment)

Deploy Triaxus and Steam at 6kts (Approx. 14:00-18:00 hours including deploy/retrieve time)

- Deploy Triaxus and monitor data, looking for favourable location to deploy LiDAR
- While underway, complete any CTD/water sample processing
- Clean ROV and sensors as needed

Night measurements (Approx. 18:00-24:00 hours)

- Operate LiDAR (5-6 hours)
- Deploy sensor package approx 19:00 hours and recover (simops with LiDAR and ROV)
- Deploy CTD approx. 21:00 hours (simops with LiDAR and ROV)
- Deploy ROV and undertake marine behaviour studies

During periods of transit the following activities will be completed: Review data, analyse results, servicing and maintenance as required. Housekeeping, including data audit and Team meeting at 10am. Prepare for next Station.

SITE	DATE	TIME	ACTIVITY
Brisbane Port	27/08/2026	12:00	• Depart
Lidar Test Site	27/08/2026	18:45	• Equipment checks
Transit to CTD Test Cast	27/08/2026	21:45	
CTD Test Cast	28/08/2026	00:30	• CTD test Cast (1000m)
Transit to D2_1	28/08/2026	01:30	• Deploy Dalec 0600 during transit
D2_1 Lidar Day time	28/08/2026	10:00	• Lidar Operations • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Triaxus to D2_2	28/08/2026	14:00	• Triaxus
D2_2 Night Ops	28/08/2026	18:00	• Lidar Operations • Recover Dalec • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Transit to D3_1	29/08/2026	00:00	• Deploy Dalec 0600
D3_1 Lidar Day	29/08/2026	10:00	• Lidar Operations • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Triaxus to D3_2	29/08/2026	14:00	• Triaxus
D3_2 Night Ops	29/08/2026	18:00	• Lidar Operations • Recover Dalec • Deploy Curtin Sensor Pack, Deploy CTD(<500m)
Transit to D4_1	29/08/2026	23:00	• Deploy Dalec 0600
D4_1 _Frederick	30/08/2026	10:00	• Lidar Operations (Day/Night) • Recover Dalec • Deploy Curtin Sensor Pack Deploy CTD x2 (day/night), (<500m)
Transit to D5_1	31/08/2026	02:00	• Deploy Dalec 0600
D5_1 Lidar Day Ops	31/08/2026	10:00	• Lidar Operations • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Triaxus to D5_2	31/08/2026	14:00	• Triaxus
D5_2 Night Ops	31/08/2026	18:00	• Lidar Operations • Recover Dalec • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Transit to D6_1	31/08/2026	00:00	• Deploy Dalec 0600
D6_1 Lidar Day Ops	1/09/2026	10:00	• Lidar Operations • Deploy Curtin Sensor Pack, Deploy CTD (<500m)

SITE	DATE	TIME	ACTIVITY
Triaxus to D6_2	1/09/2026	14:00	• Triaxus
D6_2 Night Ops	1/09/2026	18:00	• Lidar Operations • Recover Dalec • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Transit to D7_1	1/09/2026	00:00	• Deploy Dalec 0600
D7_1 Day Ops	2/09/2026	10:00	• Lidar Operations • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Triaxus to D7_2	2/09/2026	14:00	• Triaxus
D7_2 Night Ops	2/09/2026	18:00	• Lidar Operations • Recover Dalec • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Deploy ARGO and Transit to D6_2	2/09/2026	22:15	• Deploy Dalec 0600
D6_2 Day Ops	3/09/2026	10:00	• Lidar Operations • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Triaxus to D6_1	3/09/2026	14:00	• Triaxus
D6_1 Night Ops	3/09/2026	18:00	• Lidar Operations • Recover Dalec • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Transit to D5_2	4/09/2026	00:00	• Deploy Dalec 0600
D5_2 Day Ops	4/09/2026	10:00	• Lidar Operations • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Triaxus to D5_1	4/09/2026	14:00	• Triaxus
D5_1 Night Ops	4/09/2026	18:00	• Lidar Operations • Recover Dalec • Deploy Curtin Sensor Pack, Deploy CTD (<500m)
Transit to D4_1 Frederick	5/09/2026	00:00	• Deploy Dalec 0600
D4_1 Day/Night Ops	5/09/2026	08:00	• Lidar Operations (Day/Night) • Recover Dalec • Deploy Curtin Sensor Pack Deploy CTD x2 (day/night) (<500m)
Transit to D2_2	5/09/2026	15:00	No Ops scheduled (possible underway measurements) | Pack Down Equipment
D2_2	06/09/2026	14:00	Pack Down Equipment

SITE	DATE	TIME	ACTIVITY
PBG	7/09/2026	03:20	
Brisbane Port	7/09/2026	08:00	

Piggyback projects

1. Evaluation of novel LiDAR instruments. PALS (Persistent Autonomous LiDAR Sensor) - Principal Investigators: Helen Pask (MQU), Fraser Dalgleish (BeamSea Associates) Ondrej Kitzler 26/1234

The PALS (Persistent Autonomous LiDAR Sensor) is a fieldable, unattended active optical profiler to be deployed from RV *Investigator* alongside the Macquarie (MQ) LiDAR and a coordinated suite of in-situ measurements (CTD, water sampling, Triaxus, and ROV-based marine-life and turbulence studies). PALS will deliver time-resolved, range-resolved profiles of water-column scattering and attenuation using polarization-resolved elastic backscatter at 532nm and a near-field water Raman channel (~650nm). The combined elastic/Raman design supports robust retrievals of particulate beam attenuation Cp (532) and backscatter-derived structure metrics (including depolarisation) that are sensitive to particle type and morphology (phytoplankton functional groups, mineral grains, and microbubble fields).

PALS will be deployed on the auxiliary instrument mount on RV *Investigator's* Starboard drop keel.

Operating persistently from a moving platform, PALS will extend episodic ship sampling into continuous context, capturing rapid changes driven by diel cycles, mixing events, and interactions with reef and seamount structures. Co-deployment with MQ LiDAR over the same water masses enables direct intercomparison across different excitation wavelengths, temporal modalities, receiver fields-of-view and processing approaches, improving confidence in water-column products and informing next-generation ocean LiDAR instrumentation. With low pulse energy (<1mJ), 8Hz repetition, beam divergence and platform motion, exposure risks to marine fauna are expected to be negligible within established laser-safety frameworks.

2. Global Marine Biodiversity Observations (GLOMBO): Autonomous Genomic Sampling Systems - Principal Investigators: Sahan Jayasinghe (CSIRO)

Environmental DNA (eDNA) is transforming marine biology by enabling large-scale, cost-effective biodiversity assessments that are far less resource-intensive than traditional survey methods. By analysing eDNA, scientists can gain a more comprehensive understanding of species distribution, abundance, and ecosystem health.

Requires no berth

The current project aims to develop and deploy an autonomous eDNA sampling system that can be seamlessly integrated into the RV *Investigator*'s underway seawater system. The onboard Seagoing Instrumentation Team will be supporting the project during the voyage.

3. Deployment of Argo floats including Australian core, deep, and BGC, and floats from international partners. Gabriella Semolini Pilo 26-1238

The International Argo program aims to monitor subsurface ocean properties of the global ocean – delivering data in real-time to support operational services, and in delayed-mode to underpin climate

research. Argo Australia collaborates with over 30 other countries to implement and maintain this global ocean observing program. Argo Australia is a major player, maintaining 10% of the global array.

During IN2026_V05 one standard Argo float will be deployed at 15.45Sm 154.6 E (Waypoint D7_2).

Requires no berth

4. Developing Jonathan, an on vessel automated seabird detector Carlie Devine 26-1247

The objective of this project is to collect seabird counts using an automatic on-vessel seabird edge detector in coastal and open ocean environments.

Planned activities include:

1. Installation of a camera, data storage for video, and processing unit into the RV *Investigator* electrical system prior to IN2025_V06.
2. During IN2025_V06 the camera, processor will operate while RV *Investigator* is underway. The system will be supervised remotely from Hobart with DAP support on the vessel. A daily csv report and mp4 trip files will be saved to system hardware and backed up by DAP, indicating the number of seabirds detected at specific time intervals throughout daylight hours.

The expected outcome of this project is to bring together the hardware and software needed for an on-vessel seabird Edge detector that will provide a running count of seabirds seen by a fixed camera over the course of a day on a sea-going vessel. Successful development of such a system will be the first step in providing more comprehensive and detailed baseline environmental data.

This project has the appropriate CWLLA AEC approval in place.

Requires no berth

Permits

Australian Marine Parks

This voyage will traverse through the Coral Sea Marine Park (CSMP) and has permits to operate and deploy voyage specific equipment. Science Research Activities will be conducted under the MNF CSMP Permit (PA2020-00041-5) and a permit issued to Macquarie University (PA2026-00025-1). Allowances have been made in permitting to enter alternative zones where adjustments to the planned voyage route are required due to unforeseeable events (weather etc)

Planned Coral Sea Marine Park Areas	**Permit - Voyage Activity**
National Park IUCNII (Zone 25)	**PA2020-00041-5 (MNF)**: CTD profilers, Triaxus, Acoustic Systems- MBE's, bioacoustics sounders, and ADCP's, Atmospheric and Seawater Underway Sensors and Instrumentation. **PA2026-00025-1 (Macquarie University)**: Operating marine LiDAR, Sensor Package, DALEC Radiometer, ROV, and Drone deployments.
Special Purpose Zone (Trawl) IUCN VII (Zone 26)	
Habitat Protection Zone IUCN VI (Zone 28)	
Habitat Protection Zone (Reefs) IUCN IV (Zone 17) *Frederick Reef*	
Alternative Coral Sea Marine Park Areas	
National Park IUCNII (Zones 11 and 27)	

Habitat Protection Zone IUCN VI (Zones 15,17 and 18)	

- No XBTs are permitted in Marine Parks, however Rapid Cast operations are permitted.
- The vessel has a Standard Operating Procedure (SOP) to manage interactions with cetaceans, which will impact the collection of data associated with the ship's acoustic systems. All cetacean sightings within Marine Parks will be documented and reported back to Marine Parks as part of the post voyage notification.

Access to Biological Resources

Professor David Antoine. Permit number AU-COM2026-029

Description of action: To collect biological material being phytoplankton samples to undertake pigment analysis in Coral Sea Marine Park and adjacent Commonwealth marine area

Commonwealth area: Coral Sea Marine Park and adjacent Commonwealth marine area

Biological resources: Phytoplankton samples from seawater

Animal Ethics

Title of the project: Remote observations of fishes including sharks and rays. Jane Williamson.
Purpose: 4 - Research: Human or Animal Biology.
Aims: To use remote and non-invasive tracking devices to assess the number, behaviour and movement of fishes in a range of habitats.
Animal Research Authority: Online Project ID 5233. Macquarie University Animal Ethics Committee. Full Approval Duration: 14 March 2019 to 14 March 2029.

Signature

Your name	Helen Pask
Title	Chief Scientist
Signature	Helen Pask
Date:	12 March 2026

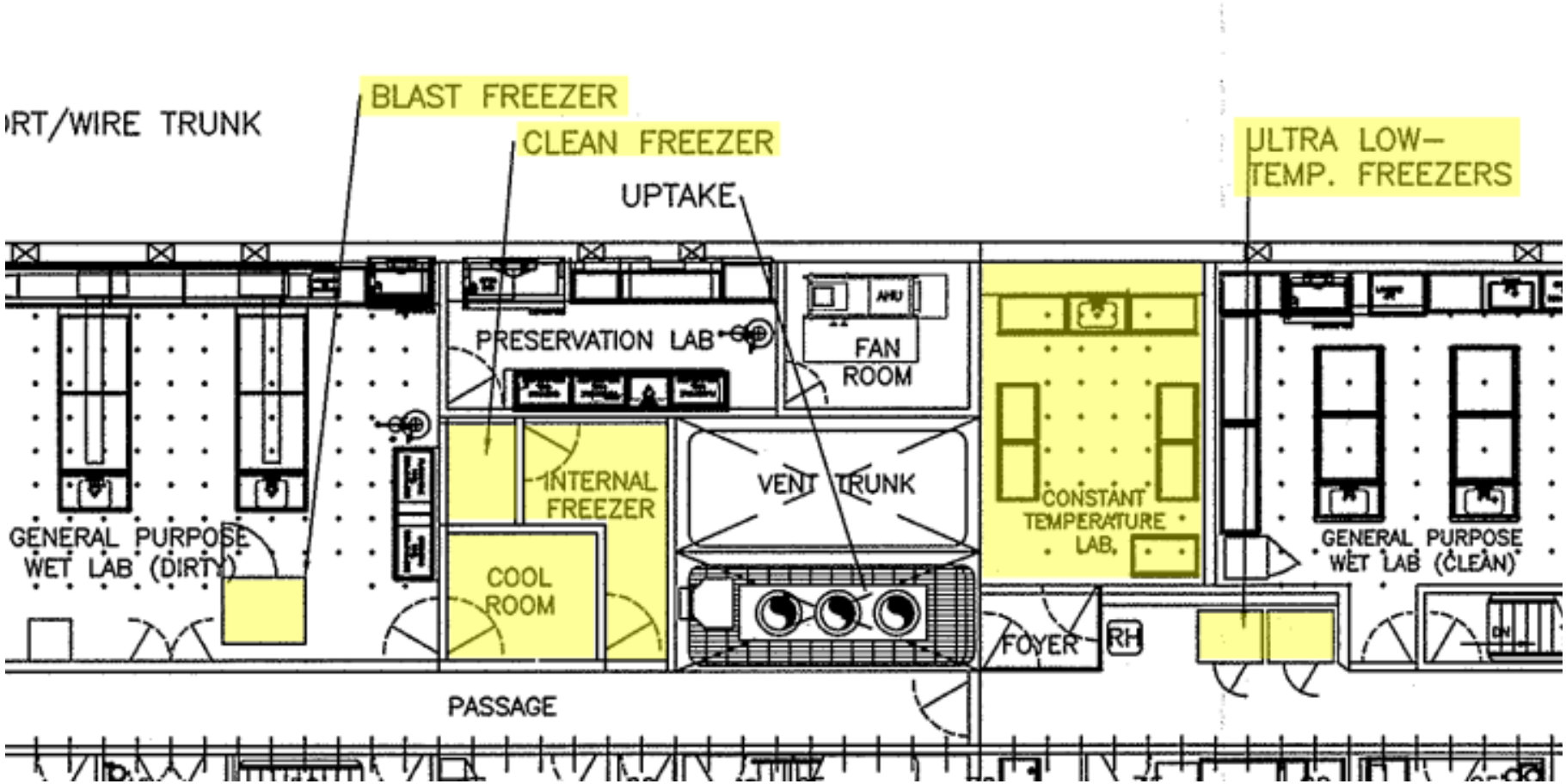
Appendix A

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		
Air Chemistry Lab	X	• Storing and servicing marine LiDARs
Preservation Lab		
Constant Temperature Lab (Min temp: ~4°C / Max temp ~35°C)		
Underway Seawater Analysis Laboratory		
GP Wet Lab (Dirty)	X	• Adhoc working space
GP Wet Lab (Clean)	X	• Clean ROV, calibrate sensors • Filtering water samples • Flash freezing of filtered water samples using LN2
GP Dry Lab (Clean)	X	• Alternative space to service LiDAR
Sheltered Science Area	X	• Wash down ROV
Observation Deck 07 Level		
Internal Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >20m^3		

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
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		
Blast Freezer (Dirty Wet lab) (Min temp -30°C / Max temp 0°C) 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°C / Max temp 10°C)		
Ultra-Low Temperature Freezers x2 (Main Deck) Min temp -80°C / Max temp -80°C)	X	• Storing flash frozen water samples
YODA Freezers (x2) (Clean Dry lab) (Min temp -20°C / Max temp 10°C)		



MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Modular Isotope Laboratory			
Trace Metal Niskin Sampling Container (TM1-blue - 20ft)			

MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace Metal Seawater Analysis Laboratory (TM2-white - 20ft)			
Trace Metal Rosette and Niskin Storage Container			
Modular Hazchem Locker			
Stabilised Platform Container			
Clothing Container			

STANDARD SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Continuous Plankton Recorder (CPR)			

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 for deeper profiles and faster for constant-depth towing. Maximum achievable depth typically 300m to a distance of approximately 1.5km from the ship. Triaxus is normally configured with the following sensors as a minimum:

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
			• Dual temperature, conductivity and dissolved oxygen (SBE9plus and dual pumped temperature/conductivity/dissolved oxygen circuits) • PAR • Chlorophyll-A, CDROM, optical backscatter (Eco-triplet – 2000m Max) • Plankton counter (Laser Optical Plankton Counter) • Transmissometer 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			
Gravity Coring System			
Multi Corer			
Kasten Corer			
Smith Mac Grab			
Rock Dredges			
Rock Saw			
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:		X	Would be interesting to have this as continuous data to complement Triaxxus and CTD measurements. But not if it requires steaming at low speed.
XBT System			
Valeport Rapid SV			
Valeport Rapid CTD			
Valeport SVX2			
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)			
Deep Towed Camera			
Drop Camera			
Sherman Epibenthic Sled			
Brenke Sled			
Hydro-Bios MultiNet (Mammoth) (1m x 1m)			
Surface Net (1m x 1m)			
Bongo Net			
Beam Trawl			
MIDOC			
Pelagic Trawl System (net, doors)			
Demersal Trawl System (net, doors)			

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.			
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.			
Trawl Monitoring Instrumentation (ITI) (2,000m depth limit)			
Stern ramp		**INSTALLED**	

RESEARCH SUPPORT INFRASTRUCTURE			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Saltwater Ice Machine (Dirty Wet lab)			
Radiosonde Receiver System			
Laboratory Incubators (Clean Dry lab)			
Deck Incubators			
Milli-Q System	X		Used to calibrate LiDAR and potentially other sensors
Sonardyne USBL System			

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS				
MICROSCOPES:				NOTES/COMMENTS
BRAND / MODEL	TYPE	ESSENTIAL	DESIRABLE	
Leica / M80	Dissecting		X	Used to examine instrument components; general
Leica / M80	Dissecting			
Leica /MZ6	Dissecting			
Olympus / CH	Compound		X	Used to examine instrument components; general
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			

ACOUSTIC UNDERWAY SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Multi Beam Echo Sounder EM2040-MKII 200-700kHz (0 – 250m approx.)			
Multi Beam Echo Sounder EM124 12kHz (100m to full ocean depth)			
Multi Beam Echo Sounder EM712 70-100kHz (0 –1000-m approx.)			
Sub-Bottom Profiler SBP29			
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 Jane wanting to use Imaging Sonar to monitor fish activity – not sure which Sounder is most appropriate to be qualitative ? EK80 seems best fit, but others may be useful in knowing when we're encountering biological action.
Multibeam Scientific Echo Sounder ME70 (70100 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)			

ATMOSPHERIC UNDERWAY SENSORS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
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			
Filter Aerosol Sampling units (FAS) x 3			

UNDERWAY SEAWATER SYSTEMS AND INSTRUMENTATION			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Thermosalinograph		X	It would be nice to have this data on surface temp and salinity if it's easy to acquire
Fluorometer			
Optode			
pCO2			

SEAWATER SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace metal clean seawater supply			

SEAWATER SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Scientific clean seawater supplied to laboratories	X		Will be used for LiDAR calibration and calibrating other sensors
Raw seawater available on deck and in laboratories	X		May occasionally be used for LiDAR calibration and testing

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 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			
UTAS In-Situ Pumps (x2)			

CTD configuration

Note #1: On every departure a test CTD is to be undertaken, ideally 24 hours prior to the first planned CTD cast. This requirement is a single cast to a minimum of 1000m, firing half the bottles at the maximum depth of the cast, followed by firing of the remaining bottles near the chlorophyll maximum (requiring one stop on the retrieval). This test CTD is essential to the MNF Hydrochemistry team and supports the training of samplers, testing of Niskin bottles, collection of a tracking standard for the voyage, and ongoing quality and uncertainty calculations. Please allow for this cast in your voyage's Time Estimates (approximately 1 hour).

The MNF CTD is a Seabird 911 system with a variety of auxiliary sensors, installed on either a 24 or 36 bottle Niskin frame.

The science party may be required to assist with sampling the Niskin bottles, preparing the bottles for deployment and for setting up and logging each deployment of the CTD. Training will be given by the MNF DAP and hydrochemistry teams on board.

Plan for the following maximum rate of analyses based on 2 Hydrochemists:

- 48 nutrients, 48 dissolved oxygen, 48 salinity analyses per 24 hours; OR
- 72 nutrient, 36 dissolved oxygen, 36 salinity analyses per 24 hours; OR
- 160 nutrient analyses (only) per 24 hours.

	PLEASE SELECT:
Fundamentals	
Which CTD rosette to be used for this voyage (24 or 36 Niskin bottles):	24
Likely total number of casts:	2/day
Likely maximum depth of deepest cast:	400 m
Standard CTD Configuration - Instrumentation (maximum 6 auxiliary channels plus 2 x DO) 6000m	
1 x SBE9+ (CTD) 2 x SBE3P Temperature Sensors 2 x SBE4C Conductivity Sensors 2 x SBE5T pumps	Yes
2 x SBE43 Dissolved Oxygen Sensors	Yes
1 x Tritech PA200/500 Altimeter	
1 x Biospherical QCP2300HP PAR Sensor	
1 x Wetlabs C-Star 25cm Transmissometer	Yes
1 x Wetlabs ECO FLCDRTD Fluorometer – CDOM (370/460nm)	Yes
1 x Wetlabs ECO FLBBRTD Fluorometer – Chlorophyll-a & Backscatter (2 x channels - 470/695nm)	Yes
Alternative Instruments (Instruments highlighted in grey can be substituted from standard configuration)	
Seapoint Turbidity Meter – Nephelometer	
Seabird SUNA – Ultraviolet Nitrate Analyzer (**Serial Connection - 2000m**)	
Standard LADCP Configuration – Instrumentation: 6000m	

	PLEASE SELECT:
1 x Teledyne 300 kHz LADCP (Slave - Up) 1 x Teledyne 150 kHz LADCP (Master - Down) 1 x 48V Deep Sea Battery	
Alternative LADCP Configuration - Instrumentation: 6000m	
1 x Teledyne 300 kHz LADCP (Slave - Up) 1 x Teledyne 300 kHz LADCP (Master - Down) 1 x 48V Deep Sea Battery	
Hydrochemistry Analyses	
Salinity – (For calibration of some instruments.)	Yes
Dissolved Oxygen – (For calibration of some instruments.)	Yes
Nutrients: Nitrate	
Nutrients: Phosphate	
Nutrients: Silicate	
Nutrients: Nitrite	
Nutrients: Ammonia	

Please note any special requests – such as special sampling that is intended to be performed by the science party (e.g. sampling for dissolved gases, radioisotopes, etc.); or any user-supplied instrumentation to be fitted to the CTD frame; etc.