Supplementary information for FORM 1

General description of permitted activity

Description of methods to be used to undertake the activity:

*Sites within the marine reserve will be collected under existing permits.

Research Area	Marine Science Research (MSR) Activity	Method Proposed to conduct MSR Activity
Bathymetry	Bathymetry (measurement of water depth) mapping within a bounding box just north of Raoul Island to just south of L'Esperance and Colville ridge to the eastern edge of the Kermadec Trech (see coordinates below): Latitude (North to South): 26.390° to 32.039° Longitude (West to East): 179.094° to -175.941° These coordinates are in the World Geodetic System (WGS84) This is an indicative description of the proposed mapping area. The actual mapped areas will be within these boundaries.	Seismic activity will not be used. Multi beam and sonar equipment on the ships will be used to map bathymetry and the sea floor.
Geology	a) Collect information at all submersible dive sites. b) Specific interest at the March 2021 earthquake site due east of Raoul Island. Will make observations of any slips as a result of the earthquake. c) Collect sediment samples and cores at the earthquake site.	Submersibles will make video observations. Submersibles and landers will collect core samples.
Oceanography	Collecting data on water currents and temperatures.	Sensors attached to buoys and ship instruments will allow remote sampling.
Deep water oceanography	Water sampling and water chemistry.	CTDs will be used at various depths to collect data on conductivity, temperature and depth. Water chemistry will be analysed in the lab. Niskin bottles will be used on the landers visualised by the submersibles to collect water samples.
Deep water geology	Sediment cores from seabed.	Obtained using landers.
Deep water	eDNA sampling. If sponges are present, they will be sampled for eDNA as well.	Uses the same core samples and water samples as above.
Deep water geology	Sediment traps at various depths (e.g. 10,000m). Leave traps for three weeks and recollect.	Small scale sediment traps attached to moorings.
Deep water	Video recording and High Definition (HD) imaging and 360 HD video recording during submersible dives.	Camera and video equipment. This will not be live streamed, but collected on the submersibles.
Deep water human influence	Microplastic presence in sediments and in deep filter feeders.	Uses the same core samples as above.
Deep water exploration	Search for remains of *HROV Nereus*, lost at 9,900m at Kermadec Trench in 2014.	Get push cores using submersible arms or use a sediment collector.

	Sediment samples also will be taken if the wreck is found.	
Deep water	Sampling of pumice bed from L'Havre eruption in 2012.	Methods: • Sediment grabbers or sediment cores taken by the submersible. • Samples retained on the landers. • Push cores with butterfly valve on top of core tube.
Marine biodiversity	Marine mammal research of resident bottlenose dolphins and migrating humpback whales: • Skin samples • Population information • Fluke and fin identification • Recording of whale and dolphin sound and song And any other megafauna and marine mammals observed.	All activities associated with marine mammals will be conducted under a DOC permit by experienced scientists. Equipment used: • Nets • Cameras • Hydrophones
*Intertidal	Collections of: • Seaweeds • Fishes • Invertebrates • Bacteria • Foraminifera	Hand collected on scuba or free diving. Crustose seaweed may need to be chiselled from rock. These will be small samples. Sediment cores of small volumes will be used to collect small organisms.
*Intertidal	3D photo transects	Methods: • Drone footage at low tide. • Photogrammetry at high tide. • Establish monitoring programme using identified plots.
*Shallow water	Plankton sampling.	Using plankton nets: • Vertical tows. • Surface tows. • Neuston nets. Light traps: • Use at night off ships.
*Shallow water	Plankton, invertebrate and fish sampling.	Night lighting: • Done in shallow and deep water areas. • Hand collections using nets. Light traps • Deployed overnight. • Deployment and retrieval done from vessel or tender. • Mooring used to anchor light traps. SMURFS (Standard Monitoring Units for the Recruitment of Fishes): • Deployed for 14 days • Deployment and retrieval done via scuba or free diving. • Mooring used to anchor SMURFS.
*Shallow water	Long term monitoring of subtidal plots.	Artificial Reef Monitoring (ARM)

		• Deployed for 1,2,5 years • Deployment and retrieval done from vessel or tender. • Mooring used to anchor ARMs.
*Shallow water	3D photo transects	Methods: • Photogrammetry. Establish monitoring programme using identified plots.
*Shallow water	Collections of: • Seaweeds • Fishes • Invertebrates • Bacteria • Foraminifera	Hand collected on scuba or free diving. A small number (<30 per species) invertebrates will be collected for spawning experiments done in lab. A small number (<30 per species) invertebrates will be collected for gut content analysis in lab.
*Shallow water	Collection of environmental data (e.g. temperature, salinity etc).	Installation of environmental data loggers . • Deployed for 1-5 years • Deployment and retrieval done via scuba. • Can be attached using drill and anchors, epoxy or moorings depending on the location.
Mesophotic-shelf	Collection of: a) Sediment cores b) Video footage c) Fish collections d) Seaweeds, fishes, invertebrates, bacteria, formanifera	Methods: a) Sediment cores on submersible held by landers b) BRUVs (Baited Remote Underwater Video) using landers c) Baited traps (fish tubes with rubber caps) d) Suction sampling or submersible arms
Mesophotic-shelf	Video transects.	Remotely Operated Underwater Vehicle (ROV) if one is available or a submersible.
Mesophotic	Rhodolith sampling (mostly 30-150m).	Rhodolith beds are classified as a sensitive environment. We will use submersible arms to collect targeted samples to minimise seafloor and rhodolith bed disturbance.
*Intermediate depths	Collection of: a) Sediment cores b) Video footage c) Fish collections d) Fishes, invertebrates, bacteria, formanifera	Methods used at 200-1000m: a) Sediment cores on submersible held by landers b) BRUVs (Baited Remote Underwater Video) using landers c) Baited traps (fish tubes with rubber caps) d) Suction sampling or submersible arms

Timing of permitted activity

Timetable for Expedition:

Vessel name	Key operations						
Pressure Drop	Transit Auckland to Rangitāhua	Mapping and submersible activities	Transit Rangitāhua to Auckland				
	10-12 Oct	12 Oct- 4 Nov	5-7 Nov				
	2.5 day transit		2.5 day transit				
Dapple	Transit Auckland to Raoul Island	Support mana whenua landing activities	Science and submersible activities	Transit Rangitāhua to Auckland	Transit Auckland to Rangitāhua	Science and submersible activities	Transit Rangitāhua to Auckland
	5-6 Oct	6-8 Oct	9-17 Oct	18-19 Oct	21-22 Oct	23 Oct- 1 Nov	2-3 Nov
	1.5 day transit			These dates are subject to change			1.5 day transit
The Beast	Transit Auckland to Raoul Island	Mana whenua on Raoul Island	Transit Raoul Island to Auckland	Transit Auckland to Rangitāhua	Science activities	Transit Rangitāhua to Auckland	
	3-5 Oct	6-8 Oct	9-11 Oct	13-15 Oct	16-30 Oct	31 Oct- 2 Nov	
	2.5 day transit	3 days on island	2.5 day transit	2.5 day transit		2.5 day transit	

*Please note that dates may change at any time.

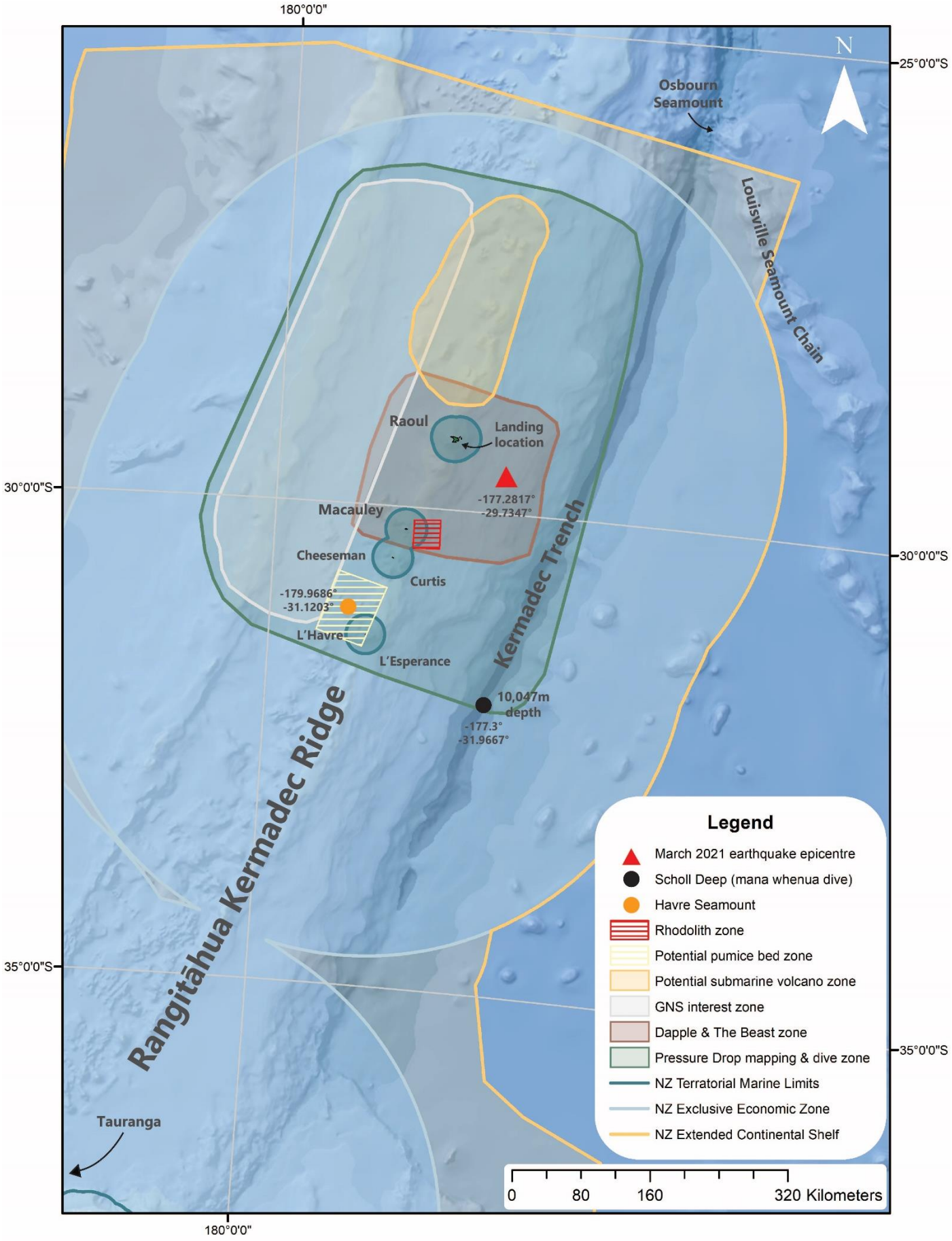
Location of permitted activity

Co-ordinates of area where activity will be undertaken:

There is a boundary box within which all MSR activities will take place:
Latitude (North to South): 26.390° to 32.039°
Longitude (West to East): 179.094° to -175.941°

These coordinates are in the World Geodetic System (WGS84)

Map:


180°0'0"
25°0'0"S
30°0'0"S
35°0'0"S
N
Osbourn Seamount
Louisville Seamount Chain
Raoul
Landing location
-177.2817°
-29.7347°
Macauley
Cheeseman
Curtis
-179.9686°
-31.1203°
L'Havre
L'Esperance
Kermadec Trench
10,047m depth
-177.3°
-31.9667°
Rangitāhua Kermadec Ridge
Tauranga
Legend
March 2021 earthquake epicentre
Scholl Deep (mana whenua dive)
Havre Seamount
Rhodolith zone
Potential pumice bed zone
Potential submarine volcano zone
GNS interest zone
Dapple & The Beast zone
Pressure Drop mapping & dive zone
NZ Terratorial Marine Limits
NZ Exclusive Economic Zone
NZ Extended Continental Shelf
0
80
160
320 Kilometers

Describe the current state of the area and the surrounding environment, including any known sensitive environments:

Rangitāhua is a unique region of diverse environments due to its subtropical climate and seismically active islands and seafloor. Known geologically and biologically significant areas include submarine volcanoes, seamounts, ridges and trenches.

The coastal areas of Rangitāhua (30m or less) are well documented and sampled. Many parts of the Rangitāhua region remain unsampled and unexplored. Due to the limited sampling depths of submersibles and ROVs that have operated in the region, there is a bias towards depths down to 1500m. Below this depth, sampling opportunities have been limited. Combined with little knowledge of long-term changes in the environment and biodiversity due to only a few monitoring programmes, our knowledge of the Rangitāhua region environments is poor.

Significant environmental and biological knowledge gaps exist across the region. Of particular interest for this Expedition is exploration and sampling opportunities across the Kermadec Trench, Kermadec Ridge, Colville Ridge and the seamounts north of Raoul Island.

The scope of the sampling depths with access to up to 11,000m allows us to assess environments and biodiversity unknown to Aotearoa. With this in mind, we anticipate coming across sensitive environments of scientific interest.

Known sensitive environments include:

- Hard coral covered areas (gorgonian corals are dominant).
- Rhodolith beds (as indicated in the proposed sampling area on the map).
- Hydrothermal vents (usually found at seamounts and calderas). Vents also include invertebrate aggregations of echinoderms, bivalves, gastropods, crustacea and worms.

Describe the likely effects of the activity on the environment:

Minor impacts are expected due to the sampling methods proposed. This Expedition will not sample using trawling, dredging, or large fishing nets. This will minimise the environmental damage at the sampling sites. Potential environmental effects due to sampling methods and mitigation efforts are described below:

Science activity or sampling method	Possible environmental effect	Mitigation steps
Bathymetry using multi-beam surveying	Pressurised waves are used to receive bounce back from the seabed to measure water depth.	Frequencies used must be outside the echolocation range of cetaceans. Particularly at low frequencies. The frequencies used for mapping will be checked by Rochelle Constantine (marine mammal expert and researcher for the *Te Mana o Rangitāhua* project) to ensure cetaceans are not affected. Seismic surveying will not be used.
Sediment sampling using trays, cores, traps	Small scale damage on seabeds.	The sediment collecting equipment will be small (<1m area). Corers will be used if the seafloor is soft. Limited sampling will occur at each site (≤10 samples).
Collections from encountered sensitive environments. This includes rhodolith sampling.	Small scale damage in sensitive environments.	The sample collecting equipment will be small (<1m area). Corers will be used if the seafloor is soft. Limited sampling will occur at each site (≤10 samples).
Collecting specimens with submersible arms	Submersible arms will be used to collect targeted samples.	Because these samples are targeted, this will minimise environmental damage.

Hand collections of algae, fish, invertebrates	Fauna classed in sensitive environments will be removed.	Only targeted small amounts will be collected of any species.
Sponge collections	Small, targeted collections for eDNA analysis.	This will be done either by hand or submersible arms.
Photogrammetry	Video transects causing damage to seafloor.	Image capture is done 1-2m above the seafloor.
Marine mammal photos, song recording and skin samples	Negative impact on marine mammals.	A Marine Mammal Observer (MMO) who has been to Rangitāhua and worked with cetaceans before will conduct all operations.
Artificial reef monitoring (ARM)	Release of toxins and clearance of reef organisms.	Use of stable, environmentally friendly materials. The attachment mechanism will either be saltwater appropriate putty or drilled into the reef. These plots will be small scale to ensure minimal damage to the reef.
Suction sampling for fish and invertebrates	Removal of fauna and loose sediment from the reef.	Suction sampling sites will be done intermittently across reef sites.
Reef life disturbance from scuba diving hand sampling	Removal of flora and fauna.	Targeted sampling and good diving techniques to minimise environmental damage.
Introduction of invasive species	From ship hulls and ballast water.	Ship hulls will be cleaned and documentation checked by DOC.
Baited traps	For BRUVs, bait is used to attract prey which is captured on video. The set up can cause some crushing of benthos.	Efforts (as much as possible) will be made to place the traps in areas clear of sensitive fauna.
Data loggers attached to reef or attached to mooring sitting on seabed	As above.	As above.
Collection of oceanographic data and water sampling	Risk of seabed damage from equipment.	CTD equipment and Niskin bottles will not touch the seabed.
Use of submersibles and landers	Discharge of ballast and release of weight into the environment.	Lander drop weights. 1 x 120kg raw steel weight per deployment. DSV Limiting Factor drop weights. 200-250kg raw steel drop weight per dive. Cthulu does not discharge ballast underwater. It adjusts it's ballast on the waters surface.

Other information

Particulars of vessel:	
Name:	DSSV Pressure Drop
Type/Class:	Motor- conversion/ deep submergence support vessel (DSSV)
Nationality (Flag State):	Marshal Islands
Identification Number (IMO/Lloyds No.):	8833867
Website for diagram & specifications:	https://fivedeeps.com/home/technology/vessel/

Owner:	Caladan Oceanic
Operator:	Caladan Oceanic
Overall length (meters):	68.28m
Maximum draught (meters):	5m
Displacement/Gross tonnage:	1914 GT
Propulsion:	Diesel electric
Cruising & maximum speed:	9kn and 11kn
Call sign:	V7SV6
INMARSAT number and method and capability of communication (including emergency frequencies):	453844338. Iridium: +881677772651
Name of master:	[redacted]
Number of crew:	30
Number of scientists on board:	12
Relevant documents required by international conventions and regulations:	Attached: Cargo Ship Safety Cert, Certificate of Registry, Insurance.
Other relevant information:	Official Number; 7520. MMSI; 538007520

Particulars of vessel:	
Name:	MY Dapple
Type/Class:	Motor
Nationality (Flag State):	Marshall Islands
Identification Number (IMO/Lloyds No.):	9650028
Website for diagram & specifications:	N/A
Owner:	DE LA MANCHA CO
Operator:	DE LA MANCHA CO
Overall length (meters):	67.15m
Maximum draught (meters):	4m
Displacement/Gross tonnage:	1143 GT
Propulsion:	Diesel
Cruising & maximum speed:	16kn and 22kn
Call sign:	V7CR4
INMARSAT number and method and capability of communication (including emergency frequencies):	INMARSAT:453839336, 453839337 VOIP: +1 954 3721029, +1 954 372 1066

	Fleet500: +870 773 702 443
Name of master:	Phil Carter
Number of crew:	19
Number of scientists on board:	1
Relevant documents required by international conventions and regulations:	Marshall Islands Registered
Other relevant information:	MMSI:538 070 967

Particulars of vessel:	
Name:	The Beast
Type/Class:	Motor
Nationality (Flag State):	New Zealand
Identification Number (IMO/Lloyds No.):	9815599
Website for diagram & specifications:	https://www.37southyachtcharter.com/yachts/the-beast
Owner:	TB Marine Ltd
Operator:	TB Marine Ltd
Overall length (meters):	39.2m
Maximum draught (meters):	2.5m
Displacement/Gross tonnage:	493 GT
Propulsion:	Diesel
Cruising & maximum speed:	10kn and 13kn
Call sign:	ZMX7757
INMARSAT number and method and capability of communication (including emergency frequencies):	VoIP: +64 (0)9 930 8511 Sat phone: +870 773 245 597 VSat data
Name of master:	[redacted]
Number of crew:	8
Number of scientists on board:	TBC
Relevant documents required by international conventions and regulations:	NZ owned and registered vessel. In unlimited MOSS Survey.
Other relevant information:	

Particulars of Human Occupied Vehicle (HOV):

Name:	DSV Limiting Factor
Manufacturer and make/model:	Submersible- Triton 36000/2
Nationality (Flag state):	N/A
Website for diagram & specifications:	https://fivedeeps.com/home/technology/sub/
Owner:	Caladan Oceanic
Operator:	Caladan Oceanic
Overall length (meters):	4.6m
Displacement/Gross tonnage:	11.7T dry weight
Cruising & Maximum speed:	3kn
Range/Endurance:	16+ hours
Method and capability of communication (including emergency frequencies):	Surface; VHF, Iridium. Sub surface: UQC/Acoustic modem (data, text, voice)
Details of sensor packages:	CTD. HD cameras. 4k Camera.
Other relevant information:	Registration # G155103, DNVGL Certificate # 1398491-20HH
Particulars of Human Occupied Vehicle (HOV):	
Name:	Cthulhu
Manufacturer and make/model:	Submersible- Triton 3300/3 MKI
Nationality (Flag state):	Cayman Islands
Website for diagram & specifications:	http://tritonsubs.com/subs/t3300-3/
Owner:	DE LA MANCHA CO
Operator:	DE LA MANCHA CO
Overall length (meters):	4.0
Displacement/Gross tonnage:	4.8
Cruising & Maximum speed:	3kn
Range/Endurance:	12 hours
Method and capability of communication (including emergency frequencies):	Surface: VHF, Sub Surface: UQC/Acoustic modem (data, voice)
Details of sensor packages:	CTD. HD Cameras. 4k Camera
Other relevant information:	DNV-GL: n1422595-III

Other craft in the project, including its use:
On board DSSV Pressure Drop:

Hadal Landers (full ocean depth – autonomous) ‘Flere’, ‘Skaff’, ‘Closp’. Serve as navigation and communication aids for DSV Limiting Factor, as well as being equipped with lights, camera, CTD and acoustic modem.

Multi-beam echo sounder (Kongsberg EM-124).