



Environmental Habitat Investigation on the Sediments Surrounding South Stulaigh Proposed Fish Farm Site, South Uist

September 2019

Stulaigh South Habitat and Maerl Assessment

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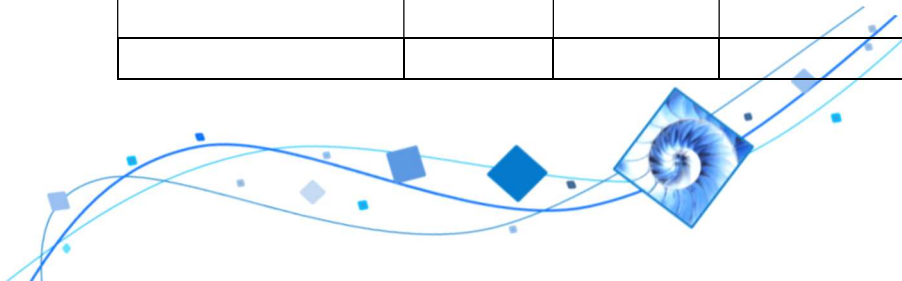


Table of Contents

1	Overview	4
2	Introduction	4
3	Scope of Work.....	5
4	Survey Geodesy.....	5
5	Field Operations.....	6
5.1	Environmental Survey Operations	7
5.2	Seabed Sampling.....	7
6	Survey Equipment.....	10
6.1	Towed High Definition Video	10
6.2	Drop-down Video System	12
6.3	Survey Positioning and Surface Navigation	12
7	Methods.....	13
7.1	Habitat Assessment and Maerl Coverage.....	13
8	Environmental Habitats	14
8.1	Bedrock	16
8.2	Mixed Sediment.....	17
8.3	Coarse Sand.....	18
8.4	Fine to Medium Sand.....	19
9	Maerl Coverage.....	23
10	Conclusion.....	27
11	Bibliography	28
	Appendix I – Environmental Survey Operations	29
	Appendix II – Seabed Photographic Positions and Maerl Coverage.....	30
	Appendix III – Service Warranty.....	41

Tables

Table 4.1 Geodetic Parameters.....	6
Table 5.1 Summarised Operational Timings	7
Table 5.2 Survey Challenges	8
Table 5.3 Survey Data Acquired.....	10
Table 8.1 Seabed Substrate Categories Identified.....	14
Table 8.2 SACFOR Abundance Scale	21
Table 9.1 Examples of Live Maerl Coverage	24

Figures

Figure 2.1 Potential Maerl Beds around Stulaigh (Isle of South Uist).....	5
Figure 5.1 Survey Lines at Stulaigh South	9
Figure 6.1 Towed Camera System.....	11
Figure 6.2 Surface View and Overlay	11
Figure 6.3 Drop-Down Video (DDV) System	12
Figure 8.1 Summary of Habitats at each Seabed Image Location around the South Stulaigh Survey Area	15
Figure 8.2 Example Images of Exposed Bedrock Habitat.....	16
Figure 8.3 Example Images of Mixed Sediment Habitat Variation	17
Figure 8.4 Example Images of Coarse Sand Habitat	18
Figure 8.5 Example Images of a Fine to Medium Sand Habitat.....	22
Figure 9.1 Maerl Coverage at each Seabed Image Location around the Stulaigh Fish Farm	26

Glossary

Abbreviation	Meaning
BSL	Benthic Solutions Limited
COG	Course Over Ground
CR.MCR.EcCr	Habitat code: Echinoderms and Crustose Communities
DDV	Drop-down Video
EOL	Camera End of Line
HD	High Definition video quality
LED	Light Emitting Diode
SD	Standard Definition video quality
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SOG	Speed Over Ground
SOL	Camera Start of Line
SS.SCS	Habitat code: Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)
SS.SMP.Mrl	Habitat code: Maerl beds
SS.SMu.CfiMu.SpNMeg	Habitat code: Seapens and burrowing megafauna in circalittoral fine mud
SS.SMu.CsaMu	Habitat code: Circalittoral sandy mud
SS.SMx	Habitat code: Sublittoral mixed sediment

1 Overview

Client:	MOWI Limited
Project:	Stulaigh Maerl Assessment
Contractor:	Benthic Solutions Ltd (BSL)
Contractor Reference:	1935
Survey Areas:	South Uist, South of Stulaigh Island area
Survey Type:	Visual survey for Maerl and Habitat type
Survey Period:	18/09/2019 – 19/09/2019
Survey Vessel:	Farm Vessel <i>Beinn Mhor</i>
Survey Equipment:	BSL HD video camera with live feed, Towed lightweight sled and drop-down frame, dGPS system and overlay.
Client Project Manager:	[REDACTED]
BSL Project Manager:	[REDACTED]

2 Introduction

The proposed Stulaigh South fish farm is in the very early stages of planning, however, preliminary screening by MOWI highlighted the possibility of maerl beds within the area. Maerl beds are considered a Scottish Priority Marine Feature habitat and have been recorded to the south and east of Stulaigh Island, as well as in the channel separating the island from South Uist (Figure 2.1; SNH, 2019). As the final position of the fish farm site has not yet been decided, a general assessment was carried out to investigate habitat variation and maerl distribution in the area south of Stulaigh Island and the channel separating the island from South Uist. This habitat assessment data will then inform the baseline assessment when the position of the site is finalised.

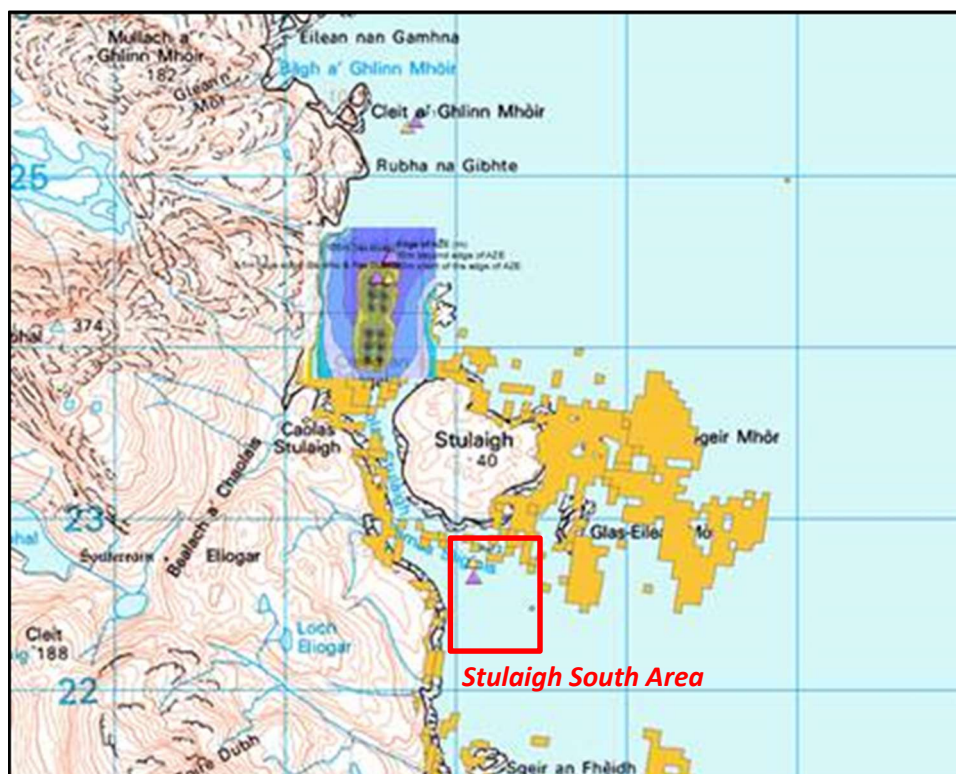


Figure 2.1 Potential Maerl Beds around Stulaigh (Isle of South Uist)

3 Scope of Work

In September 2019, MOWI Limited commissioned Benthic Solutions Limited (BSL) to complete several high-quality video inspection lines of approximately 2.5 to 3km length orientated east to west and north to south across the proposed South Stulaigh fish farm site. One line of approximately 2.5km was also surveyed along the channel between Stulaigh Island and South Uist. The water depth across the survey area varied from approximately 10m to 50m.

The main objectives of the survey were:

- To provide video confirmation for the presence/absence of maerl beds in these survey areas;
- If observed, the coverage and density of maerl (alive and dead) was to be recorded;
- To provide a basic assessment of the habitats and sediment types within the survey area.

4 Survey Geodesy

The geodetic parameters used are provided below in Table 4.1.

Table 4.1 Geodetic Parameters

Required Datum	
Reference Spheroid	OSGB36
Projection Parameters	
Projection	Transverse Mercator
Central Meridian	-2.0000
Scale Factor	0.9996
Latitude of Natural Origin	49.0000
False Easting	400,000m
False Northing	-100,000m
Scale Factor at Origin	0.9996 at CM

Client supplied information was given in both geographical (Latitude and Longitude) as well as British Grid (OSGB36)

5 Field Operations

The work scope was completed by BSL aboard the farm work vessel *Beinn Mhor* on a day-working basis. The vessel was mobilised for the environmental survey at the MOWI site location in Lochboisdale, South Uist, before transiting to the existing Stulaigh farm site north of Stulaigh Island. Survey operations were carried out at Stulaigh over a two-day period prior to demobilising alongside in Lochboisdale.

A summary of the different operational components of the survey are outlined in Table 5.1 below.

Table 5.1 Summarised Operational Timings

Date	Activity	Details of Activity
16/09/2019	Personnel Travel	Survey package loaded and driven from Norfolk to the North
17/09/2019	Personnel Travel	Survey team travel across to South Uist on the Mallaig ferry and visit the vessel alongside in Lochboisdale. Equipment mobilisation delayed to following morning
18/09/2019	Mobilisation	08:00-10:00 Survey team visit site for farm induction and mobilise vessel with the equipment. Navigation package installed and frames made ready for operations. Transit to Stulaigh farm location
	Operations	10:00- 12:50. Three attempts at initial cage edge lines. However poor vessel control meant that these were aborted due to the fouling anchor lines, or not controlling vessel speed along the appropriate line
		12:50-13:30 Line 1 completed when fouled on Stulaigh Island Reef
		13:42-14:40 Line 3 completed. Two sections carried out due to poor line keeping from vessel and creel line
		15:24-15:34 Line 2 completed. Two sections punctuated by reef east of the cage group
		15:38-16:26 Line 4 completed south of the group and along the channel. Carried out in three sections punctuated by fouling on mooring line and reef at the northern end of the channel
16:26-17:50 Transit to Lochboisdale.		
19/09/2019	Operations	08:00- 08:55 Transit from Lochboisdale.
		08:55-09:36 South Stulaigh Line #1
		09:43-10:38 South Stulaigh Line #2
		11:00-11:44 South Stulaigh Line #3
		12:01-12:56 South Stulaigh Line #4
		12:56-13:43 Reconfigure camera to drop-down frame
		13:43-13:50 DDV Cage Edge
		13:55-13:58 DDV Mooring Edge
		14:02-14:05 DDV Channel 1
		14:09-14:12 DDV Channel 2
		14:17-14:19 DDV Channel 3
		14:24-14:27 DDV Channel 4
		14:32-14:35 DDV Channel 5
14:44-14:47 DDV Channel 6		
14:47-16:00 Demobilisation of vessel alongside Lochboisdale		
20/09/2019	Demobilisation	Personnel travel back to Norfolk via early Mallaig ferry

Item in grey do not relate to the South Stulaigh survey

5.1 Environmental Survey Operations

5.2 Seabed Sampling

Visual survey operations were carried out using a high definition drop-down camera system towed along the seabed. The scope of the survey was to carry out a maerl and habitat assessment

encompassing any potential zone of impact for the proposed South Stulaigh farm area. These were based on the following:

- One survey line (Survey Line #4) south of the North Stulaigh cage edge down the centre of the channel separating Stulaigh Island from the main island of South Uist;
- One survey line (Stulaigh S #4) running south from the southern extent of Stulaigh Island for approximately 3km;
- Three survey lines (Stulaigh S #1/#2/#3) oriented east to west approximately 2.5km in length, extending offshore from the southern line (Stulaigh S #4).

The prevailing weather conditions and water clarity were good. However, operations were impacted by a number of challenges found within the survey area as outlined below in Table 5.2.

Table 5.2 Survey Challenges

Issue	Challenge
Subsurface rocks	Survey lines along the seabed periodically encountered small rock outcrops and, on occasion, large boulders. In these instances, the sled was configured to ride over the top but had to be recovered occasionally where a vertical surface was encountered, or the frame was fouled with kelp and other debris.
Vessel line running	Survey lines were run at very slow speed (1-2 knots), to maintain good quality video of the seabed. However, this created challenges manoeuvring the vessel, particularly close into the cage group when bordered by the mooring lines. As a result, mooring lines were fouled on several occasions, so survey lines were often split into multiple sections.

A summary of the survey lines is outlined in Figure 5.1. In total, three lines were run to the east of the 3km southerly line extending from the south end of Stulaigh Island, each reaching between 2.3 and 2.8km. These three lines commenced from points along survey line Stulaigh S #4 and were separated by between 800m and 1km. Survey line Stulaigh S #4 was punctuated by a single recovery of the camera system to the surface due to vessel positioning issues, however, survey lines Stulaigh S #1, #2, and #3 were run without interruption. Survey line #4 was run to the north of the group and followed the centre of the channel separating Stulaigh Island from South Uist. This line was a total of 2.4km long starting from the existing Stulaigh northern farm cage edge but was interrupted due to fouling on the mooring line and encountering a large rocky reef cutting across the northern part of the channel.

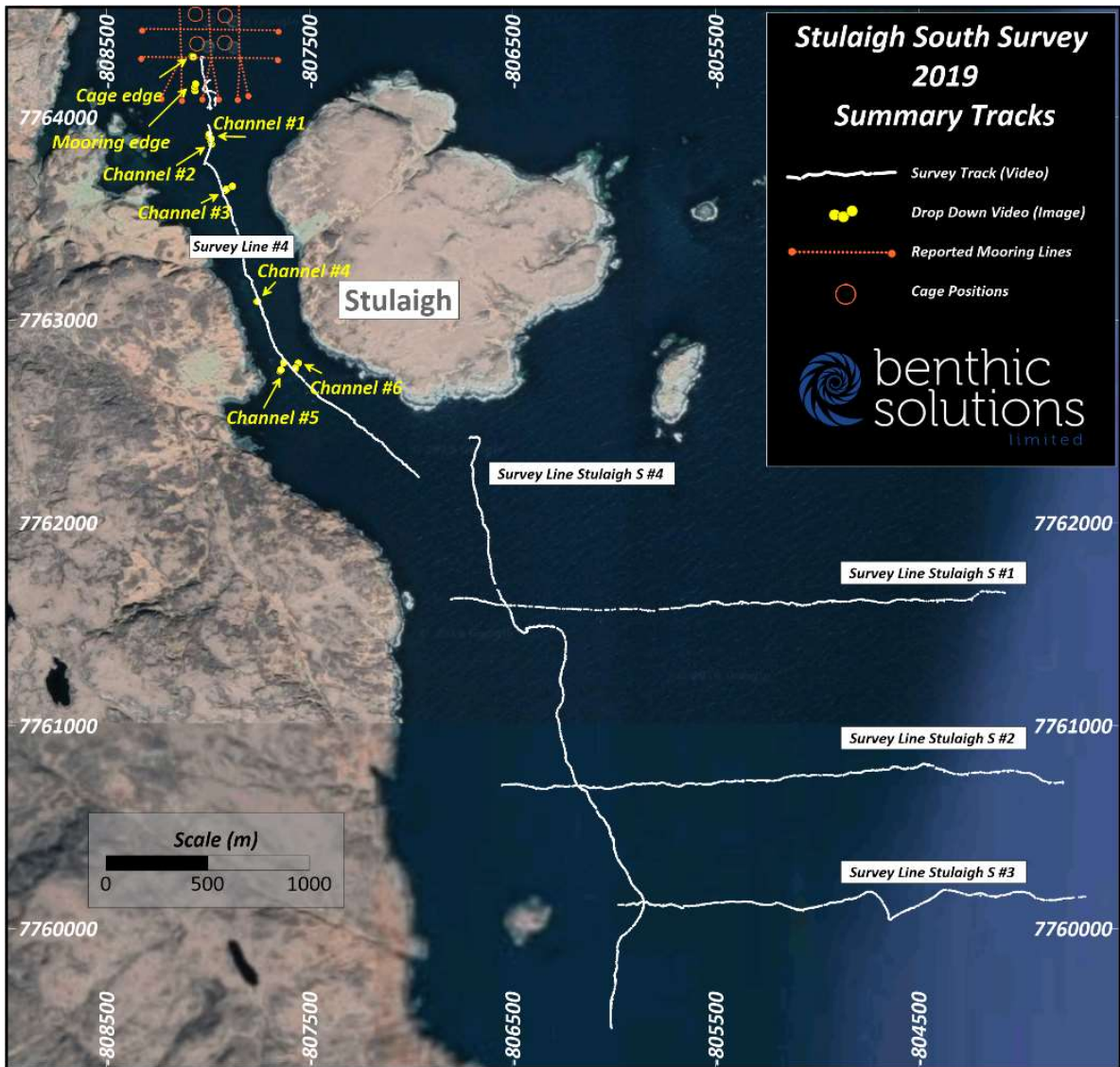


Figure 5.1 Survey Lines at Stulaigh South

On completion of the towed long lines, the equipment was reconfigured into a drop-down video (DDV) configuration to provide greater clarity of the seabed where maerl was observed. An additional eight DDV locations were established along survey line #4 relating to the Cage Edge, Mooring Edge (approximately 120m further south), and six other locations further south of the cage group ranging from 400m to 1,600m. A summary of the recovered video data is outlined in Table 5.3.

Table 5.3 Survey Data Acquired

Transect	Date		Time	Latitude	Longitude	HD/SD Video	Video duration (mins)	No. Screen-shots
Stulaigh S #1	19/09/19	SOL	08:58	57°10.9650N	007°14.8580W	Yes/Yes	45	26
		EOL	09:37	57°10.9745N	007°13.3875W			
Stulaigh S #2	19/09/19	SOL	09:56	57°10.6966N	007°14.7225W	Yes/Yes	45	17
		EOL	10:39	57°10.6997N	007°13.2339W			
Stulaigh S #3	19/09/19	SOL	10:38	57°10.5240N	007°14.4131W	Yes/Yes	44	21
		EOL	11:44	57°10.5363N	007°13.1618W			
Stulaigh S #4	19/09/19	SOL	12:02	57°11.1973N	007°14.8094W	Yes/Yes	55	31
		EOL	12:56	57°10.3469N	007°14.4312W			
Stulaigh 4	18/09/19	SOL	15:39	57°11.7130N	007°15.5116W	Yes/Yes	3	4
		EOL	15:41	57°11.6830N	007°15.4985W			
Stulaigh 4-2	18/09/19	SOL	15:51	57°11.6503N	007°15.5025W	Yes/Yes	14	21
		EOL	16:02	57°11.4477N	007°15.4053W			
Stulaigh 4-3	18/09/19	SOL	16:06	57°11.4048N	007°15.3731W	Yes/Yes	21	36
		EOL	16:26	57°11.1438N	007°14.9541W			
Cage Edge	19/09/19	First fix	13:43	57°11.7480N	007°15.5452W	Yes/Yes	2 Drops	3
Mooring Edge	19/09/19	First fix	13:55	57°11.6987N	007°15.5379W	Yes/Yes	2 Drops	3
Channel #1	19/09/19	First fix	14:02	57°11.6336N	007°15.5030W	Yes/Yes	2 Drops	3
Channel #2	19/09/19	First fix	14:09	57°11.6218N	007°15.4942W	Yes/Yes	2 Drops	3
Channel #3	19/09/19	First fix	14:17	57°11.5546N	007°15.4586W	Yes/Yes	5 Drops	3
Channel #4	19/09/19	First fix	14:24	57°11.3948N	007°15.3735W	Yes/Yes	5 Drops	3
Channel #5	19/09/19	First fix	14:32	57°11.2944N	007°15.3121W	Yes/Yes	6 Drops	4
Channel #6	19/09/19	First fix	14:44	57°11.2973N	007°15.2716W	Yes/Yes	5 Drops	4

SOL = camera start of line

EOL = camera end of line

6 Survey Equipment

6.1 Towed High Definition Video

The majority of the survey was carried out using Benthic Solutions' 'Live Feed HD Video Camera System' fitted onto a lightweight tow-frame (Figure 6.1). This consists of a small stainless-steel tow-frame and chain bridle fitted to the camera system with an isometric downward viewing angle (approximately 45°) 1m from the seabed and illuminated by a 2000lux LED light and twin parallel scaling lasers (10cm separation).



Figure 6.1 Towed Camera System

The system is lowered to the seabed and towed at an optimal speed of 0.5 to 1 knot (0.25 to 0.54m/sec). As the vessel struggled to maintain any steering at this speed, faster speeds of up to 2 knots (1m/sec) were encountered during the survey. The unit was maintained at, or just above, the seabed, for the majority of the footage along the line. Periods where the seabed was not visible were limited to sections where the seabed deepened quickly, or when the frame was partially recovered to traverse a reef feature. One other period with no seabed visibility occurred on line Stulaigh S #4 due to repositioning of the vessel.

The seabed and orientation of the equipment was continuously monitored from the surface where the tow cable was adjusted using a capstan to ensure contact with the seabed. This surface video feed was annotated with vessel speed and position and recorded separately to the high definition video data (Figure 6.2). Both datasets are time-stamped for later harmonisation. Details of the camera system are outlined in Appendix I.



Figure 6.2 Surface View and Overlay

6.2 Drop-down Video System

On completion of the towed video lines, the Benthic Solutions 'Live Feed HD Video Camera System' was reconfigured onto a smaller drop-down frame in order to provide closer static images of the seabed in areas where maerl was observed (Figure 6.3). This was exclusively within the channel separating Stulaigh Island and South Uist. For this, the same camera equipment was used, but the smaller frame meant that the camera was closer to the seabed (approximately 50cm). This was also configured into an isometric downward viewing angle (approximately 45°).



Figure 6.3 Drop-Down Video (DDV) System

6.3 Survey Positioning and Surface Navigation

Surface positioning was acquired using a differential GPS system with an external antenna located behind the wheelhouse, close to the deployment location of the seabed frame. The data string was continuously recorded and monitored using a computer, whilst a further string was overlaid directly onto the video recording system for annotation on the standard definition targeting video file (as shown in Figure 6.2). The overlay string also indicated time, date, speed over ground (SOG) and course over ground (COG).

7 Methods

7.1 Habitat Assessment and Maerl Coverage

The habitat assessment was based on the screenshots that were captured from the HD video footage (Table 5.3). The sediment type in each screenshot was used as a basis for habitat determination, while the species composition was used to define suspected variation (biotopes) within the general habitat. Once the main habitat types had been categorised, screenshots were analysed to estimate the percentage of sediment covered by live and dead maerl thalli (Appendix II).

Current Scottish Natural Heritage (SNH) guidance defines a maerl bed as *“Accumulations of maerl where there is at least 20% coverage of dead or live maerl thalli. The 20% cover of maerl substrates has to extend over an area of at least 5 m x 5 m (whether continuous or in discrete patches / rows). Areas of the seabed where the substrate is made up of broken maerl gravel may also be considered maerl beds, albeit degraded ones, when there is at least 5% cover of live maerl material >1 cm in size”* (SNH, 2019). In line with this guidance, each screenshot was assigned to a class of percentage of coverage (no maerl, <5%, <20%, <50% and >50%).

8 Environmental Habitats

A detailed review of the seabed photography data confirmed the presence of four main sediment types. Habitats ranged from exposed bedrock, to mixed sandy gravel, coarse sand and fine to medium sand. The sediments within the channel separating Stulaigh Island and South Uist consisted of a heterogeneous patchwork of coarse sand and sandy gravel, while the sediments in the survey area to the south of Stulaigh Island mostly comprised coarse sands interspersed with bedrock exposures. An area of fine to medium sand was also observed on survey line Stulaigh S #4 immediately south of Stulaigh Island. All substrate categories are described in Table 8.1 below. The matrix of photographs and ascribed categories is given in full in Appendix II.

Table 8.1 Seabed Substrate Categories Identified

Substrate Category	Description
Bedrock	This exists as extensive reefs showing relief of up to several metres above the surrounding sediments and localised outcrops of small boulders. Mostly covered by encrusting species including red calcareous algae and sessile epifauna including crinoids, barnacles and occasional <i>Laminaria</i> spp.
Mixed Sandy Gravel	Silty sands overlying mixed gravels, cobbles and shell. Mixed biotopes based on mobile sands and more stable coarser gravels. Dead maerl rubble and live maerl aggregations present in the channel south of the cages.
Coarse Sand	An intermediate sediment type found within the channel between South Uist and Stulaigh Island, and common to the south of Stulaigh Island, where the base sediment is influenced by shell debris. Live and dead maerl thalli were observed in association with this sediment type where it occurred in the channel.
Fine to Medium Sand	Low energy, bioturbated, silty sand found on line Stulaigh S #4, south of Stulaigh Island. This sediment was very superficial in places and is often sub-cropped by mixed sediments.

Using the above categories, it was possible to delimit the survey lines into sections of different substrate types (Figure 8.1). At the southern edge of the North Stulaigh cages, the sediment was composed of silty sands overlying mixed shelly gravel becoming coarser to the south with boulders and exposed bedrock visible at the mooring edge (Figure 8.1). Further south, in the channel, the seabed was characterised by mixed sediments which consisted of areas of dead maerl rubble and living maerl aggregations. In addition, multiple sections of the channel (approximately 50m to 90m in length) contained areas of exposed bedrock colonised by *Laminaria* spp. The sediment immediately south of Stulaigh Island was composed of fine to medium sand with evidence of bioturbation, interspersed with coarse sand and exposed bedrock (Figure 8.1). Survey lines running east to west in the South Stulaigh survey area (Stulaigh S #1, #2, and #3) showed mainly coarse sands with occasional patches of exposed bedrock. (Figure 8.1).

Building upon the substrate classification process, the photographs were further examined to identify the species and biotopes corresponding to each of the four main substrate types. The identified biotopes are described in the following sections along with example photographs.

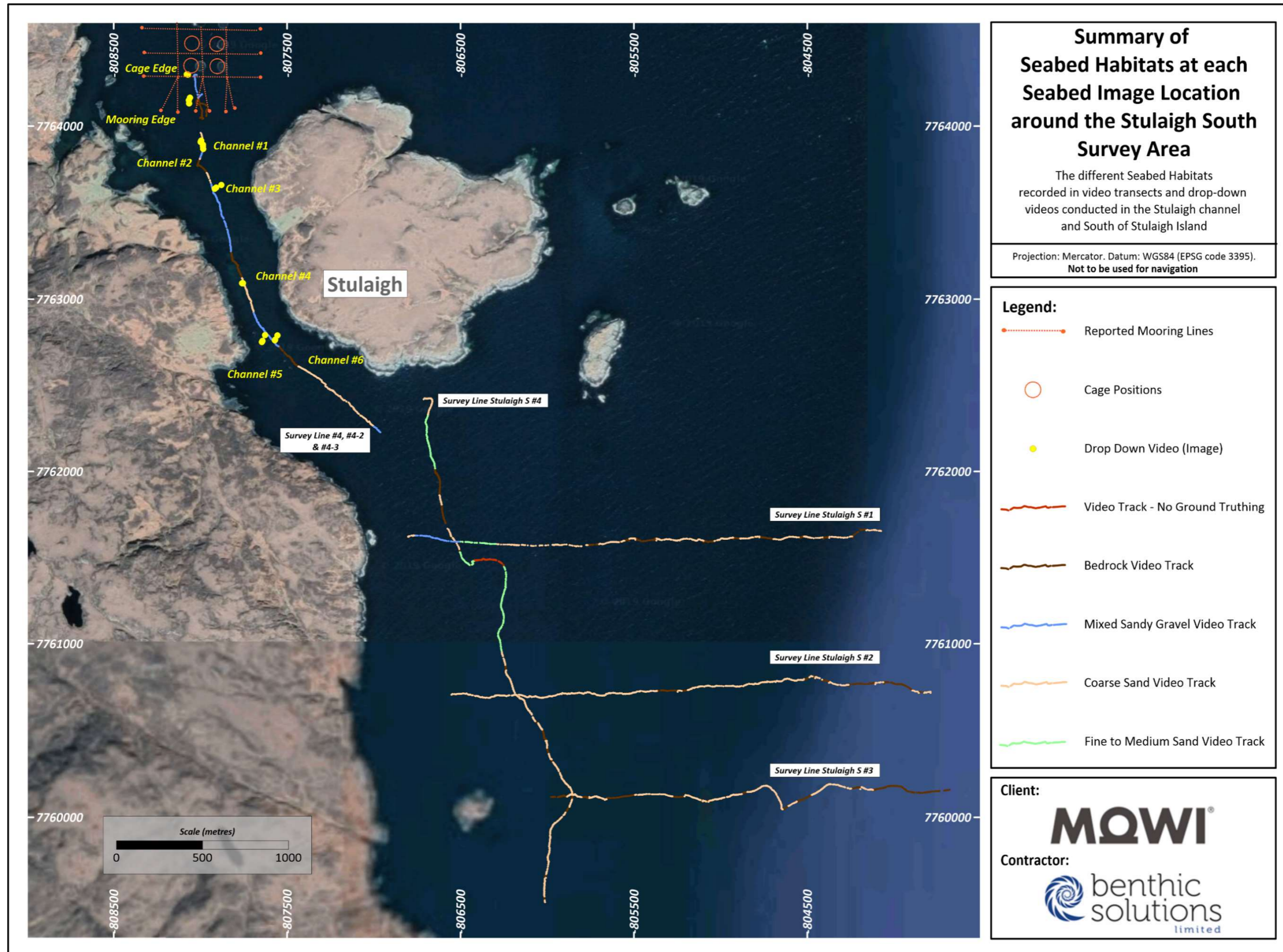


Figure 8.1 Summary of Habitats at each Seabed Image Location around the South Stulaigh Survey Area

8.1 Bedrock

Bedrock exposures were recorded within sections of the channel separating South Uist and Stulaigh Island (survey lines #4, #4-2, #4-3; Figure 8.1), and on all survey lines to the south of Stulaigh island (Figure 8.1). This substrate type was generally recorded as a continuous structure with numerous fractures and elevated up to several meters above the surrounding seabed. In small sections the bedrock exposure consisted of boulders that had been eroded from the main structure. Rocky faces were colonised by dense epifaunal assemblages suggesting a relatively diverse community. The combination of the habitat and faunal community is best described by the biotope of CR.MCR.EcCr – echinoderms and crustose communities. The biotope is dominated by echinoderms and algal crusts on wave-exposed and tide-swept circalittoral bedrock and boulders. Conspicuous epifauna included the crinoids *Antedon* spp., the solitary cup coral *Caryophyllia* (*Caryophyllia*) *smithii*, hydroid spp. (turf), Rhodophyta spp. (foliose and crustose forms), and the kelp *Laminaria* spp. In deeper areas, algal crusts were generally replaced with high densities of barnacles (*Cirripedia* spp.). Mobile fauna was common on the exposed bedrock and included the crustaceans *Munida rugosa* and *Liocarcinus depurator*, and the echinoderms *Henricia* sp., *Porania pulvillus*, *Asterias rubens* and *Marthasterias glacialis*.



Figure 8.2 Example Images of Exposed Bedrock Habitat

Given the elevation and extent of the bedrock formations the areas delineated would likely classify as JNCC Annex I reefs, which are described as occurring “where bedrock or stable boulders and cobbles arise from the surrounding seabed creating a habitat that is colonised by many different marine animals and plants. Rocky reefs can be very variable in terms of both their structure and the communities they support. They provide a home to many species such as corals, sponges and sea squirts as well as giving shelter to fish and crustaceans such as lobsters and crabs” (JNCC,2016). From the recorded video data, the elevation of the bedrock observed in the Stulaigh South survey area does not appear to exceed 5m, although coverage of rock regularly exceeds 95% of the viewed area, and as such these patches would likely be mostly classified as medium reef habitat. It should be noted

however, that due to the gentle sloping nature of some bedrock exposure and the lack of geophysical data available, an accurate estimate of elevation above seabed was difficult to ascertain and as such the true elevation of these reefs cannot be confidently defined. As illustrated in Figure 8.2, the bedrock exposures observed during the current campaign were colonised by encrusting red calcareous algae, barnacles and kelp (*Laminaria* spp.), with associated communities of the sea urchin *Echinus esculentus* within the channel.

8.2 Mixed Sediment

Mixed sediments composed of muddy gravelly sand with pebbles and shells (predominantly *Turritella*) were recorded in the middle section of the channel and along the most westerly section of the survey line Stulaigh S #1 (Figure 8.1). Rocky substrate provided attachment points for *Laminaria* spp. holdfasts which subsequently supported bryozoan epiphytes such as *Membranipora membranacea* and the grazing echinoderm, *Echinus esculentus*. This broad substrate type also included areas of fine to medium sand surface sediments overlying coarse sediments, where conspicuous fauna included but was not limited to: *Luidia ciliaris*, *Munida rugosa*, *Antedon* spp., filamentous and foliose Rhodophyta spp., Ophiuroidea spp., *Pecten maximus*, and free swimming Gobiidae and Pleuronectiformes. This habitat-type generally conformed to the biotope ‘sublittoral mixed sediments’ (SS.SMx) with example images presented in Figure 8.3.

Dead and live maerl were also constituents of the mixed sediment habitat forming pockets of ‘maerl bed’ habitat (SS.SMP.Mrl) in the channel but were absent from lines south of Stulaigh Island (Appendix II). Larger aggregations of living maerl were typically limited to the channel separating South Uist and Stulaigh Island, approximately 1km south of the cage edge. The presence of aggregations of live maerl in this area likely relate to the sheltered nature of the channel when compared to the more exposed environment south of the island (Figure 8.1).

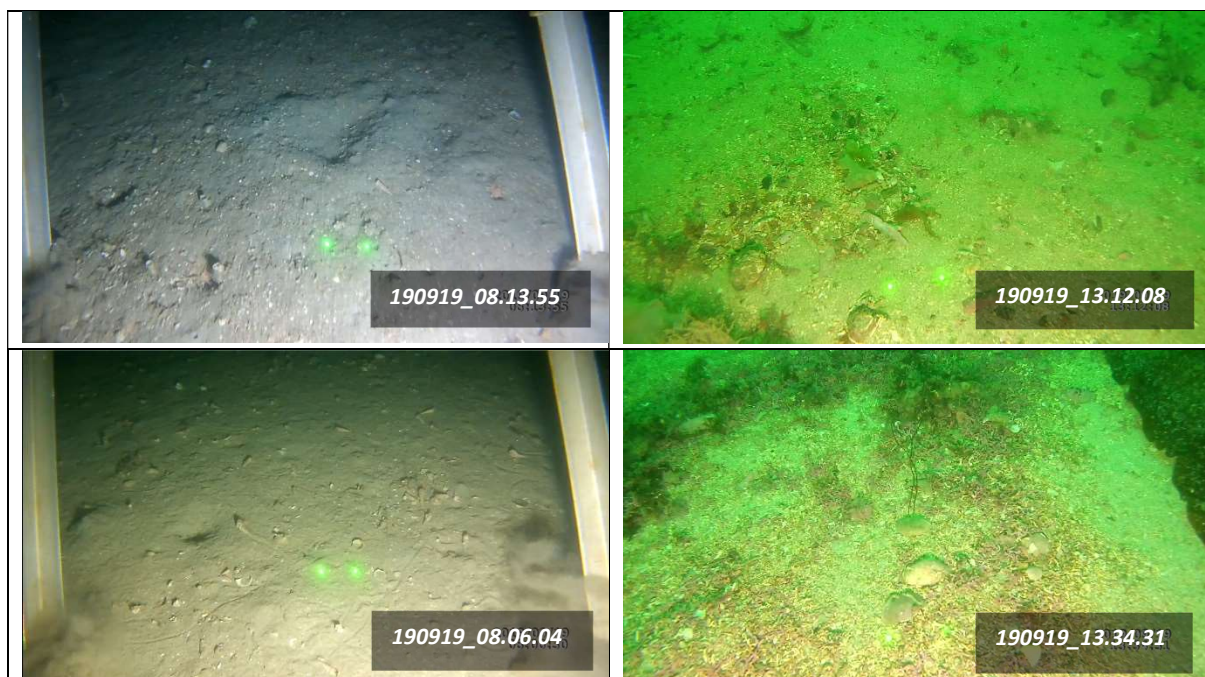


Figure 8.3 Example Images of Mixed Sediment Habitat Variation

8.3 Coarse Sand

This sediment type was well represented throughout the survey area and was composed of fragmented shell and/or dead maerl with occasional patches of live maerl in the southern channel close to station Channel #4 (approximately 1km from the mooring edge; Figure 8.1). Conspicuous fauna were similar to that observed in the mixed sediment substratum, including: the tube-dwelling anemone *Cerianthus lloydii*, the king scallop *Pecten maximus*, accumulation of *Laminaria saccharina* detritus, foliose Rhodophyta sp., sea stars *Henricia* sp. and *Luidia ciliaris*, and the crustaceans *Cancer pagurus* and *Munida rugosa*. The substrate type and associated fauna is illustrated in Figure 8.4 and is best described by the biotope 'circalittoral coarse sediment' (SS.SCS.CCS). The biotope may be characterised by robust infaunal polychaetes such as *Mediomastus fragilis* and *Lumbrineris* spp.; however, no grab sampling was undertaken to enable a more detailed biotope description. Sporadic patches of maerl were present only within the channel and were again assigned to the biotope SS.SMP.Mrl.

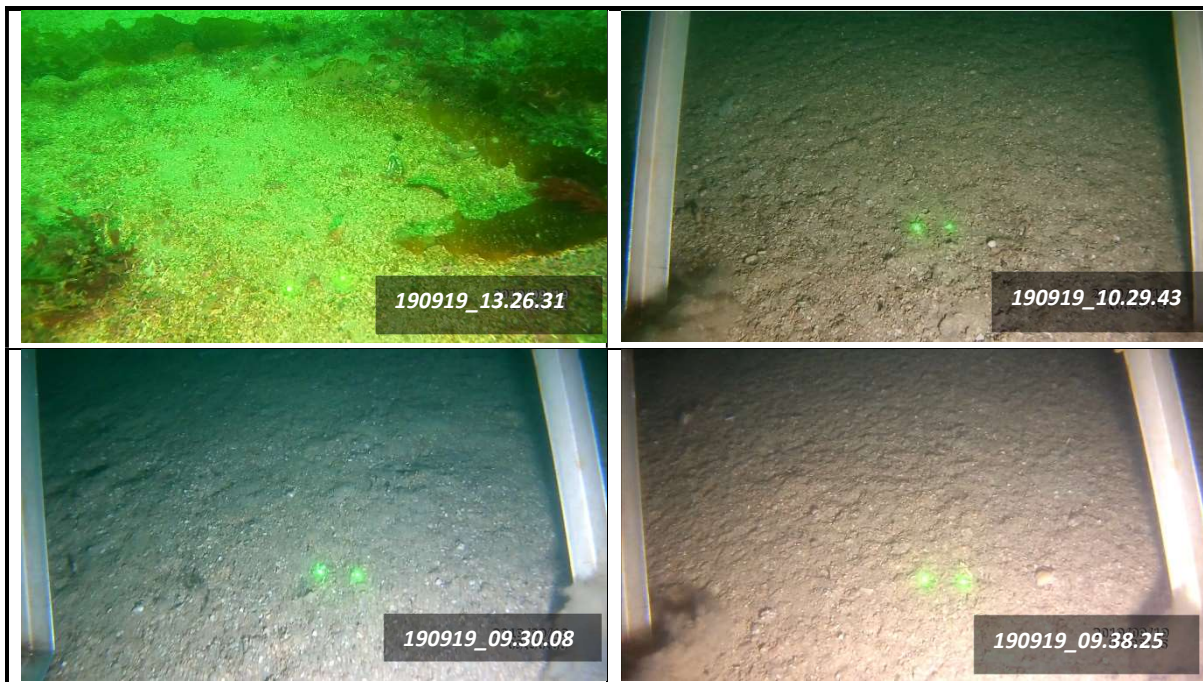


Figure 8.4 Example Images of Coarse Sand Habitat

8.4 Fine to Medium Sand

This sediment type was found exclusively in the northwest corner of the Stulaigh south survey area, on lines Stulaigh S #4 and Stulaigh S #1, although it was also noted during the North Stulaigh survey (Figure 8.1). It consisted of fine to medium sand with minor proportions of shell fragments and was characterised by bioturbation and “lebensspuren” (Figure 8.5). The faunal community was generally impoverished, with relatively few conspicuous fauna recorded including: *Turritella communis*, *Munida rugosa*, Ophiuroidea spp., *Luidia ciliaris*, *Porania pulvillus*, and *Pecten maximus*. Maerl was absent from the fine to medium sand habitat.

The silty sand habitat recorded is well described by the biotope SS.SMu.CSaMu - circalittoral sandy mud. The observed presence of burrowing macrofauna and the bioturbated nature of the seabed may indicate the sediment type incorporates elements of the biotope of SS.SMu.CFiMu.SpnMeg – seapens and burrowing megafauna in circalittoral fine mud. The seapens and burrowing megafauna in circalittoral fine mud biotope may be further classified as the UKBAP ‘mud habitats in deep water’ priority habitat (UKBAP, 2008) and the OSPAR Commission ‘seapens and burrowing megafauna communities’ threatened and/or declining habitat (OSPAR, 2010), which are defined as follows:

“Mud habitats in deep water (circalittoral muds) occur below 20-30m in many areas of the UK’s marine environment, including marine inlets such as sea lochs. The relatively stable conditions associated with deep mud habitats often lead to the establishment of communities of burrowing megafaunal species where bathyal species may occur with coastal species. The burrowing megafaunal species include burrowing crustaceans such as Nephrops norvegicus and Callinassa subterranea. The mud habitats in deep water can also support seapen populations and communities with Amphiura spp.” (UKBAP, 2008).

“Plains of fine mud, at water depths ranging from 15-200m or more, which are heavily bioturbated by burrowing megafauna with burrows and mounds typically forming a prominent feature of the sediment surface. The habitat may include conspicuous populations of seapens, typically Virgularia mirabilis and Pennatula phosphorea. The burrowing crustaceans present may include Nephrops norvegicus, Calocaris macandreae or Callinassa subterranea. In the deeper fjordic lochs which are protected by an entrance sill, the tall seapen Funiculina quadrangularis may also be present. The burrowing activity of megafauna creates a complex habitat, providing deep oxygen penetration. This habitat occurs extensively in sheltered basins of fjords, sea lochs, voes and in deeper offshore waters such as the North Sea and Irish Sea basins” (OSPAR, 2010).

The environmental conditions described by both the UKBAP and OSPAR habitats are commensurate with that recorded immediately south of Stulaigh Island, where silty sands and burrows were prevalent. The general absence of seapens (none recorded for the Southern survey area and a single individual recorded in channel line #4) from the habitat may not negate the classification, as while burrowing megafauna is an essential element of the habitat, seapens may, and by extension may not, be present (JNCC, 2014). According to JNCC (2014) guidance, burrowing species or burrows should be present at a SACFOR density of at least ‘frequent’ for a habitat to be classified as ‘Seapen and burrowing megafauna communities’ (

Table 8.2).

Table 8.2 SACFOR Abundance Scale

Cover (%)	Crust/ Meadow	Massive/ Turf	<1cm	1-3cm	3-15cm	>15cm	Density	
>80%	S		S	-	-	-	>1/0.001m ² (1x1 cm)	>10,000/m ²
40-79%	A	S	A	S	-	-	1-9/0.001m ²	1000-9999/m ²
20-39%	C	A	C	A	S	-	1-9 / 0.01m ² (10 x 10 cm)	100-999/m ²
10-19%	F	C	F	C	A	S	1-9 / 0.1m ²	10-99/m ²
5-9%	O	F	O	F	C	A	1-9/m ²	
1-5% or density	R	O	R	O	F	C	1-9 / 10m ² (3.16 x 3.16m)	
<1% or density	-	R	-	R	O	F	1-9 / 100m ² (10 x 10m)	
	-	-	-	-	R	O	1-9 / 1000m ² (31.6 x 31.6m)	
	-	-	-	-	-	R	<1/1000m ²	

Key

S	A	C	F	O	R
Super-abundant	Abundant	Common	Frequent	Occasional	Rare

Notes:

- Whenever an attached species covers the substratum and percentage cover can be estimated, that scale should be used in preference to the density scale.
- Use the massive/turf percentage cover scale for all species, excepting those given under crust/meadow.
- Where two or more layers exist, for instance foliose algae overgrowing crustose algae, total percentage cover can be over 100% and abundance grade will reflect this.
- Percentage cover of littoral species, particularly the furoid algae, must be estimated when the tide is out.
- Use quadrats as reference frames for counting, particularly when density is borderline between two of the scale.
- Some extrapolation of the scales may be necessary to estimate abundance for restricted habitats such as rockpools.
- The species (as listed above) take precedence over their actual size in deciding which scale to use.

When species (such as those associated with algae, hydroid and bryozoan turf or on rocks and shells) are incidentally collected (i.e. collected with other species that were superficially collected for identification) and no meaningful abundance can be assigned to them, they should be noted as present.

Five screengrabs containing the highest densities of burrows were assessed for burrow coverage per square meter using the SACFOR scale, all of which were recorded on transect Stulaigh S #4. The lowest density of burrows observed in these images was 18 burrows/m² and the maximum 48 burrows/m², with an average of 30 burrows/m² across the five images.

The burrow openings measured approximately 1-3cm in diameter however as no fauna was observed directly inhabiting the burrows, the size of the organism responsible for them is unknown. Although not directly observed in the still images used for assessment, numerous squat lobsters (*Munida* sp.) were recorded on the video, which would fall under the 3-15cm size category, and the horizontal nature of the burrows is characteristic of those created by burrowing crustaceans. As such, the 3-15cm size class has been used for calculation of the SACFOR abundance for the screengrabs.

When this size value was applied, the an average SACFOR density recorded was ‘Abundant’, with the calculated densities for all individual screengrabs falling into this category. As a result, it can be considered that the ‘seapen and burrowing megafauna communities’ habitat may be present within the Stulaigh South survey area as the burrow densities exceeded the minimum requirement of ‘Frequent’ on the SACFOR scale. It is important to note that although the fine to medium sand habitat was observed extensively on line Stulaigh S #4, and in a small section of Stulaigh S #1, high densities of burrows were only observed in a short section approximately 300m in length directly south of Stulaigh Island.

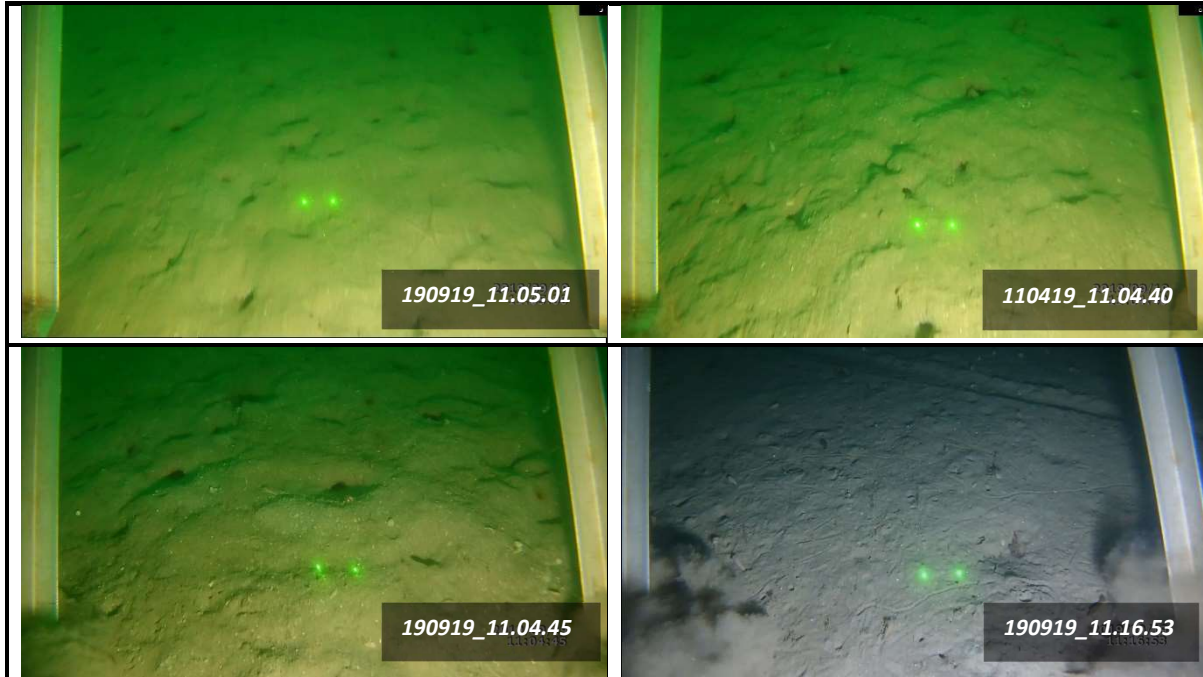


Figure 8.5 Example Images of a Fine to Medium Sand Habitat






9 Maerl Coverage

The screenshots from the survey area were further examined to estimate the distribution and abundance of dead and live maerl thalli. Within the Stulaigh South survey area, this was limited to the southern sector of the channel separating South Uist and Stulaigh Island in areas classified as mobile coarse sands and mixed sediments (Figure 9.1). No live or dead maerl was observed on lines Stulaigh S #1 to #4. In order to assess the coverage and health of maerl the seabed screenshots were reviewed and assigned to the following categories:

- Nil (maerl absent);
- Dead (where dead maerl debris/gravels are recorded);
- <5% (occasional branches recorded);
- <20% (maerl aggregations are noted as distinct patches, usually associated with sediment hollows, ripple troughs or sheltered parts of the seabed);
- <50% (maerl recorded in extended thalli form and covering a larger area);
- >50% (significant coverage by foliose form sometimes in multiple layers with notable low-level relief above the natural sediment level).

Example screenshots with accompanying maerl coverage percentages are shown Table 9.1.

Table 9.1 Examples of Live Maerl Coverage

Screenshot	Live Maerl Coverage
	<p>0% (Line Stulaigh S #4)</p>
	<p><5% (Channel #4)</p>
	<p><20% (Channel #5)</p>
	<p><50% (Line #4-3)</p>
	<p>>50% (Channel #5)</p>

No evidence of maerl was observed in any of the video data acquired on the Stulaigh S lines (Stulaigh S #1 to #4), with the only recorded maerl occurring in the channel between Stulaigh Island and South Uist (Figure 9.1). The distribution of maerl thalli appears to be related to the sediment type with denser aggregations occurring in mixed and coarse sandy sediment when compared to areas of fine-medium sand and exposed bedrock. The absence of maerl in similar sediments within the Stulaigh South survey lines also suggests that a sheltering effect from Stulaigh Island is a contributing factor to the presence of maerl within the channel.

The camera transect through the channel south of the Stulaigh fish farm (survey line #4, #4-2, #4-3) recorded the presence of living and dead maerl thalli (Figure 9.1). The 61 screenshots along this transect showed a high variability in maerl coverage, alternating between no maerl and >50% coverage. This variability may be explained by the presence of numerous sediment changes along the transect with the seabed transitioning between mixed sediment and areas of rocky reef (Figure 8.1). Small patches of dead maerl rubble (<5% to <20%) were observed approximately 330m south of the cage edge. In contrast, the greatest coverage was found at the southern extent of the channel where two screenshots at station Channel #5 recorded over 50% live maerl coverage (Figure 9.1; Appendix II). The maerl coverage by extended thalli form at Channel #5 existed as multiple layers with dead maerl visible as part of the underlying structure. The maerl aggregation in this part of the channel covered a length of at least 200m and given the percentage cover, the structure would be considered a maerl bed under current SNH guidelines (SNH, 2019). Maerl beds are predominantly associated with sheltered areas of granular sediments, which may explain the aggregations observed within the channel between the two islands (Figure 9.1).

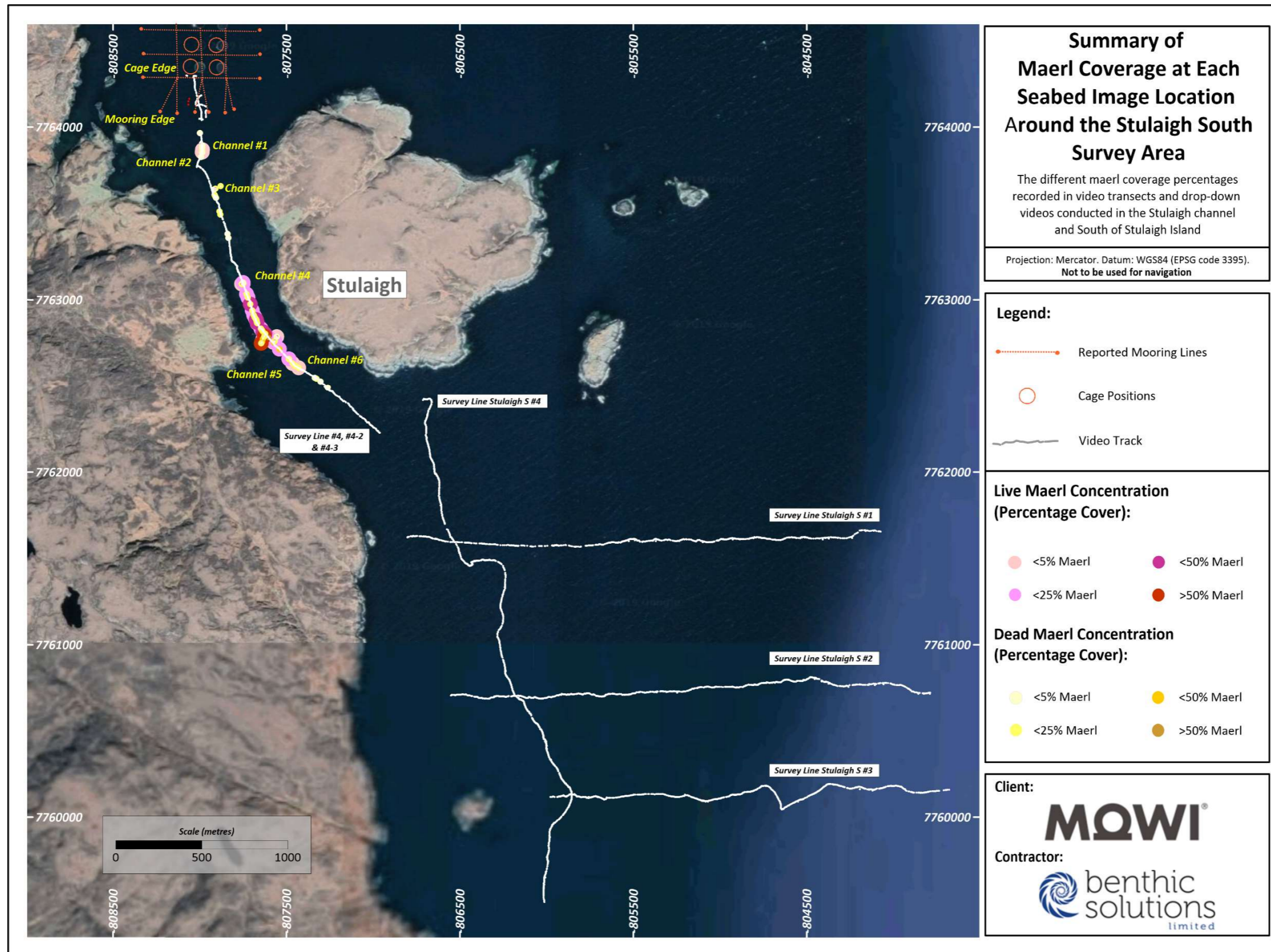


Figure 9.1 Maerl Coverage at each Seabed Image Location around the Stulaigh Fish Farm

10 Conclusion

This survey was conducted at the request of MOWI to provide coverage of the Stulaigh South area to assess the presence of maerl and different seabed habitats. This data was acquired aid fish farm site selection and to inform the later formal baseline assessment. Three high-quality video inspection lines of approximately 2.5 to 3km length and orientated east to west, and one 3km line orientated north to south were conducted over the proposed South Stulaigh fish farm site to examine habitat variation and maerl distribution within the survey area. A further 2.5km video inspection line was undertaken in the channel between Stulaigh Island and South Uist. Four main habitat/sediment types were identified relating to: bedrock, mixed sediment, coarse sand, and fine-medium sand. While bedrock, which would classify as an Annex I reef, supported a diverse epifaunal community with clear differences among rock patches, fine-medium sand was characterised by bioturbation. The presence of burrowing macrofauna and the bioturbated nature of the fine-medium sand indicates some affinity to the UKBAP ‘mud habitats in deep water’ priority habitat and the OSPAR Commission ‘seapens and burrowing megafauna communities’ threatened and declining habitat. Assessment of burrow densities further supports potential classification of the aforementioned UKBAP and OSPAR habitats.

This report provides evidence of the absence of maerl beds within the surveyed area south of Stulaigh Island, however, maerl was observed in the channel between Stulaigh and South Uist. Maerl coverage was greatest in the mixed sandy gravel sediment with dense aggregations identified toward the southern extent of the channel, approximately 1.4km from the southern cage edge of the north Stulaigh fish farm, and 800m from the nearest survey line in the Stulaigh south grid. The maerl aggregation in this part of the channel covered a section of the transect of at least 200m in length with >20% coverage of live foliose maerl increasing to >50% at DDV station Channel #5. As such, this maerl aggregation would be considered a maerl bed under current SNH guidance. Maerl was completely absent in habitats classified as bedrock and fine to medium sand along all five survey lines.

11 Bibliography

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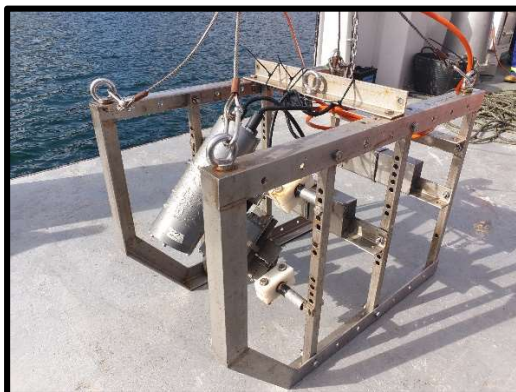
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Appendix I – Environmental Survey Operations

Seabed Photography and Video

Seabed video acquisition was performed using a BSL HD video camera system with live feed. The systems were deployed over the stern of the vessel using the vertical drop-down frame and lowered to the seabed. The systems were mounted in mini tow-sled frame. HD video footage was recorded and stored within the camera system until recovery, when the footage could be downloaded. Live video stream was available during the operations with the BSL HD video camera and it was used primarily to assist with targeting of the camera. Video footage was recorded continuously throughout each transect in both high definition and a lower streaming quality. Screenshots from the HD video were acquired when the frame landed on the seafloor.



Camera System Configuration

The key acquisition parameters of the system used are as follows:

Standard Features	Comment
Light source	2000 lumens LED array lamp with scaling lasers (6cm)
Framing Video Used	720 x 540 resolution video camera
HD Video Format	1080p (1920 x 1080 pixels @30fps)
Manufacturer	BSL

Appendix II – Seabed Photographic Positions and Maerl Coverage

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395														Megaripples			
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence					
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%	<20%		<50%	>50%	
Stulaigh South #1	190919_07.58.05	57° 10.9657 N	007° 14.8566 W	-806800	7761626			X		X										
Stulaigh South #1	190919_07.58.56	57° 10.9665 N	007° 14.8341 W	-806759	7761628		X			X										
Stulaigh South #1	190919_08.02.58	57° 10.9561 N	007° 14.6994 W	-806509	7761593	X				X										
Stulaigh South #1	190919_08.06.30	57° 10.9513 N	007° 14.5627 W	-806255	7761576		X			X										
Stulaigh South #1	190919_08.13.20	57° 10.9499 N	007° 14.2861 W	-805742	7761572				X	X										
Stulaigh South #1	190919_08.13.55	57° 10.9508 N	007° 14.2627 W	-805698	7761575		X			X										
Stulaigh South #1	190919_08.15.50	57° 10.9546 N	007° 14.1998 W	-805582	7761588				X	X										
Stulaigh South #1	190919_08.16.10	57° 10.9553 N	007° 14.1876 W	-805559	7761590		X			X										
Stulaigh South #1	190919_08.16.23	57° 10.9563 N	007° 14.1815 W	-805548	7761594				X	X										
Stulaigh South #1	190919_08.17.02	57° 10.9592 N	007° 14.1646 W	-805516	7761603		X			X										
Stulaigh South #1	190919_08.17.57	57° 10.9567 N	007° 14.1297 W	-805452	7761595				X	X										
Stulaigh South #1	190919_08.19.19	57° 10.9576 N	007° 14.0733 W	-805347	7761598		X			X										
Stulaigh South #1	190919_08.22.53	57° 10.9558 N	007° 13.9371 W	-805094	7761592				X	X										
Stulaigh South #1	190919_08.23.56	57° 10.9570 N	007° 13.8953 W	-805017	7761596		X			X										
Stulaigh South #1	190919_08.25.30	57° 10.9607 N	007° 13.8348 W	-804904	7761609				X	X										
Stulaigh South #1	190919_08.26.27	57° 10.9614 N	007° 13.9743 W	-805163	7761611					X										
Stulaigh South #1	190919_08.26.47	57° 10.9634 N	007° 13.7805 W	-804804	7761618				X	X										
Stulaigh South #1	190919_08.26.55	57° 10.9637 N	007° 13.7763 W	-804796	7761619		X			X										
Stulaigh South #1	190919_08.27.21	57° 10.9633 N	007° 13.7598 W	-804765	7761617				X	X										

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395														Megaripples			
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence					
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%	<20%		<50%	>50%	
Stulaigh South #1	190919_08.28.25	57° 10.9600 N	007° 13.7185 W	-804689	7761606		X			X										
Stulaigh South #1	190919_08.30.43	57° 10.9629 N	007° 13.6381 W	-804540	7761616				X	X										
Stulaigh South #1	190919_08.31.16	57° 10.9639 N	007° 13.6204 W	-804507	7761620		X			X										
Stulaigh South #1	190919_08.32.46	57° 10.9617 N	007° 13.5592 W	-804393	7761612				X	X										
Stulaigh South #1	190919_08.33.41	57° 10.9614 N	007° 13.5166 W	-804314	7761611		X			X										
Stulaigh South #1	190919_08.34.38	57° 10.9651 N	007° 13.4716 W	-804231	7761624				X	X										
Stulaigh South #1	190919_08.35.56	57° 10.9754 N	007° 13.4327 W	-804158	7761659		X			X										
Stulaigh South #2	190919_08.56.07	57° 10.6968 N	007° 14.7220 W	-806551	7760707		X			X										
Stulaigh South #2	190919_09.17.04	57° 10.7023 N	007° 14.0714 W	-805343	7760726				X	X										
Stulaigh South #2	190919_09.18.39	57° 10.7008 N	007° 14.0114 W	-805232	7760721		X			X										
Stulaigh South #2	190919_09.18.57	57° 10.7005 N	007° 13.9979 W	-805207	7760720				X	X										
Stulaigh South #2	190919_09.19.26	57° 10.7030 N	007° 13.9829 W	-805179	7760728		X			X										
Stulaigh South #2	190919_09.29.18	57° 10.7168 N	007° 13.6246 W	-804514	7760775				X	X										
Stulaigh South #2	190919_09.30.08	57° 10.7234 N	007° 13.6044 W	-804477	7760798		X			X										
Stulaigh South #2	190919_09.30.24	57° 10.7245 N	007° 13.5959 W	-804461	7760802				X	X										
Stulaigh South #2	190919_09.30.30	57° 10.7245 N	007° 13.5923 W	-804455	7760802		X			X										
Stulaigh South #2	190919_09.31.13	57° 10.7187 N	007° 13.5626 W	-804399	7760782				X	X										
Stulaigh South #2	190919_09.31.50	57° 10.7149 N	007° 13.5397 W	-804357	7760769		X			X										
Stulaigh South #2	190919_09.33.13	57° 10.7117 N	007° 13.4833 W	-804252	7760758				X	X										

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395														Megaripples			
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence					
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%	<20%		<50%	>50%	
Stulaigh South #2	190919_09.35.01	57° 10.7141 N	007° 13.4037 W	-804105	7760766		X			X										
Stulaigh South #2	190919_09.35.38	57° 10.7157 N	007° 13.3759 W	-804053	7760772				X	X										
Stulaigh South #2	190919_09.37.52	57° 10.7013 N	007° 13.2812 W	-803877	7760722		X			X										
Stulaigh South #2	190919_09.38.08	57° 10.6997 N	007° 13.2700 W	-803857	7760717				X	X										
Stulaigh South #2	190919_09.38.25	57° 10.6994 N	007° 13.2562 W	-803831	7760716		X			X										
Stulaigh South #3	190919_10.04.51	57° 10.5239 N	007° 14.4082 W	-805968	7760116				X	X										
Stulaigh South #3	190919_10.07.58	57° 10.5253 N	007° 14.3273 W	-805818	7760121		X			X										
Stulaigh South #3	190919_10.08.32	57° 10.5242 N	007° 14.3109 W	-805788	7760117				X	X										
Stulaigh South #3	190919_10.10.59	57° 10.5230 N	007° 14.2419 W	-805660	7760113		X			X										
Stulaigh South #3	190919_10.11.08	57° 10.5227 N	007° 14.2383 W	-805653	7760112				X	X										
Stulaigh South #3	190919_10.14.17	57° 10.5277 N	007° 14.1525 W	-805494	7760129		X			X										
Stulaigh South #3	190919_10.17.37	57° 10.5249 N	007° 14.0354 W	-805277	7760120				X	X										
Stulaigh South #3	190919_10.18.47	57° 10.5253 N	007° 14.9983 W	-807063	7760121		X			X										
Stulaigh South #3	190919_10.19.57	57° 10.5172 N	007° 14.9437 W	-806962	7760094				X	X										
Stulaigh South #3	190919_10.20.16	57° 10.5161 N	007° 13.9336 W	-805088	7760090		X			X										
Stulaigh South #3	190919_10.20.19	57° 10.5161 N	007° 13.9314 W	-805084	7760090				X	X										
Stulaigh South #3	190919_10.20.37	57° 10.5163 N	007° 13.9199 W	-805062	7760090		X			X										
Stulaigh South #3	190919_10.23.41	57° 10.5279 N	007° 13.8180 W	-804873	7760130				X	X										
Stulaigh South #3	190919_10.24.23	57° 10.5307 N	007° 13.9758 W	-805166	7760140		X			X										

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395														Megaripples			
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence					
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%	<20%		<50%	>50%	
Stulaigh South #3	190919_10.28.49	57° 10.5017 N	007° 13.6959 W	-804647	7760041				X	X										
Stulaigh South #3	190919_10.29.43	57° 10.5084 N	007° 13.6752 W	-804608	7760063		X			X										
Stulaigh South #3	190919_10.31.05	57° 10.5190 N	007° 13.6322 W	-804529	7760100				X	X										
Stulaigh South #3	190919_10.32.23	57° 10.5277 N	007° 13.5988 W	-804467	7760129		X			X										
Stulaigh South #3	190919_10.36.28	57° 10.5349 N	007° 13.4749 W	-804237	7760154				X	X										
Stulaigh South #3	190919_10.37.37	57° 10.5356 N	007° 13.4397 W	-804171	7760156		X			X										
Stulaigh South #3	190919_10.38.23	57° 10.5349 N	007° 13.4095 W	-804115	7760154				X	X										
Stulaigh South #4	190919_11.04.22	57° 11.1743 N	007° 14.7945 W	-806685	7762338		X			X										
Stulaigh South #4	190919_11.04.45	57° 11.1683 N	007° 14.7973 W	-806690	7762318	X				X										
Stulaigh South #4	190919_11.09.43	57° 11.0782 N	007° 14.9944 W	-807056	7762010				X	X										
Stulaigh South #4	190919_11.12.08	57° 11.0335 N	007° 14.7601 W	-806621	7761857		X			X										
Stulaigh South #4	190919_11.13.54	57° 10.9950 N	007° 14.7469 W	-806597	7761726				X	X										
Stulaigh South #4	190919_11.14.42	57° 10.9784 N	007° 14.7354 W	-806575	7761669		X			X										
Stulaigh South #4	190919_11.15.20	57° 10.9646 N	007° 14.7243 W	-806555	7761622				X	X										
Stulaigh South #4	190919_11.16.00	57° 10.9551 N	007° 14.7127 W	-806533	7761589		X			X										
Stulaigh South #4	190919_11.16.31	57° 10.9481 N	007° 14.6990 W	-806508	7761566				X	X										
Stulaigh South #4	190919_11.16.53	57° 10.9326 N	007° 14.6946 W	-806500	7761513	X				X										
Stulaigh South #4	190919_11.18.20	57° 10.9129 N	007° 14.6628 W	-806441	7761445				X	X										
Stulaigh South #4	190919_11.18.42	57° 10.9150 N	007° 14.6581 W	-806432	7761452	X				X										

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395														Megaripples			
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence					
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%	<20%		<50%	>50%	
Stulaigh South #4	190919_11.28.09	57° 10.8034 N	007° 14.5750 W	-806278	7761071				X	X										
Stulaigh South #4	190919_11.30.22	57° 10.7485 N	007° 14.5559 W	-806242	7760884		X			X										
Stulaigh South #4	190919_11.30.38	57° 10.7429 N	007° 14.5547 W	-806240	7760865				X	X										
Stulaigh South #4	190919_11.31.00	57° 10.7373 N	007° 14.5547 W	-806240	7760845		X			X										
Stulaigh South #4	190919_11.36.59	57° 10.6511 N	007° 14.4618 W	-806068	7760551				X	X										
Stulaigh South #4	190919_11.37.23	57° 10.6481 N	007° 14.4536 W	-806053	7760541		X			X										
Stulaigh South #4	190919_11.39.10	57° 10.6234 N	007° 14.4322 W	-806013	7760456				X	X										
Stulaigh South #4	190919_11.39.45	57° 10.6186 N	007° 14.4299 W	-806009	7760440		X			X										
Stulaigh South #4	190919_11.40.46	57° 10.6065 N	007° 14.4238 W	-805997	7760399				X	X										
Stulaigh South #4	190919_11.41.43	57° 10.5870 N	007° 14.4124 W	-805976	7760332		X			X										
Stulaigh South #4	190919_11.41.44	57° 10.5866 N	007° 14.4119 W	-805975	7760331				X	X										
Stulaigh South #4	190919_11.42.23	57° 10.5775 N	007° 14.4006 W	-805954	7760299		X			X										
Stulaigh South #4	190919_11.45.35	57° 10.5278 N	007° 14.3469 W	-805855	7760130				X	X										
Stulaigh South #4	190919_11.46.07	57° 10.5202 N	007° 14.3479 W	-805856	7760104		X			X										
Stulaigh South #4	190919_11.46.51	57° 10.5066 N	007° 14.3557 W	-805871	7760057				X	X										
Stulaigh South #4	190919_11.47.18	57° 10.4985 N	007° 14.3649 W	-805888	7760030		X			X										
Stulaigh South #4	190919_11.54.22	57° 10.3912 N	007° 14.4269 W	-806003	7759663				X	X										
Stulaigh South #4	190919_11.54.34	57° 10.3873 N	007° 14.4299 W	-806009	7759650		X			X										
Stulaigh South #4	190919_11.56.30	57° 10.3519 N	007° 14.4324 W	-806013	7759529				X	X										

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395														Megaripples		
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence				
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%	<20%		<50%	>50%
Line 4	180919_14.40.12	57° 11.7130 N	007° 15.5116 W	-808015	7764179			X		X									
Line 4	180919_14.40.21	57° 11.7091 N	007° 15.5104 W	-808013	7764166			X		X									
Line 4	180919_14.40.41	57° 11.7030 N	007° 15.5081 W	-808009	7764145				X	X									
Line 4	180919_14.41.31	57° 11.6875 N	007° 15.4997 W	-807993	7764092			X		X									
Line 4-2	180919_14.52.11	57° 11.6503 N	007° 15.5025 W	-807999	7763965			X			X								
Line 4-2	180919_14.53.12	57° 11.6221 N	007° 15.4951 W	-807985	7763869			X				X			X				
Line 4-2	180919_14.53.24	57° 11.6180 N	007° 15.4953 W	-807985	7763855			X				X			X				
Line 4-2	180919_14.53.26	57° 11.6173 N	007° 15.4953 W	-807985	7763852			X			X								
Line 4-2	180919_14.53.48	57° 11.6099 N	007° 15.4993 W	-807993	7763827			X			X								
Line 4-2	180919_14.54.22	57° 11.5989 N	007° 15.5097 W	-808012	7763789				X	X									
Line 4-2	180919_14.54.58	57° 11.5899 N	007° 15.5141 W	-808020	7763759				X	X									
Line 4-2	180919_14.55.46	57° 11.5907 N	007° 15.5022 W	-807998	7763761				X	X									
Line 4-2	180919_14.56.18	57° 11.5813 N	007° 15.4841 W	-807964	7763729		X			X									
Line 4-2	180919_14.56.34	57° 11.5753 N	007° 15.4774 W	-807952	7763709		X			X									
Line 4-2	180919_14.56.47	57° 11.5699 N	007° 15.4735 W	-807945	7763690		X			X									
Line 4-2	180919_14.57.23	57° 11.5460 N	007° 15.4573 W	-807915	7763609		X					X							
Line 4-2	180919_14.57.58	57° 11.5443 N	007° 15.4557 W	-807912	7763603		X					X							
Line 4-2	180919_14.58.01	57° 11.5437 N	007° 15.4552 W	-807911	7763601		X					X							
Line 4-2	180919_14.59.10	57° 11.5407 N	007° 15.4523 W	-807905	7763590		X				X								
Line 4-2	180919_14.59.23	57° 11.5177 N	007° 15.4416 W	-807886	7763512		X					X							
Line 4-2	180919_14.59.44	57° 11.5126 N	007° 15.4389 W	-807881	7763494		X					X							
Line 4-2	180919_15.00.43	57° 11.4906 N	007° 15.4214 W	-807848	7763419			X		X									

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395														Megaripples			
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence					
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%	<20%		<50%	>50%	
Line 4-2	180919_15.01.13	57° 11.4797 N	007° 15.4170 W	-807840	7763382		X				X									
Line 4-2	180919_15.01.35	57° 11.4726 N	007° 15.4142 W	-807835	7763358		X				X									
Line 4-2	180919_15.02.13	57° 11.4601 N	007° 15.4100 W	-807827	7763315		X			X										
Line 4-3	180919_15.06.36	57° 11.3970 N	007° 15.3689 W	-807751	7763099		X				X						X			
Line 4-3	180919_15.06.43	57° 11.3953 N	007° 15.3678 W	-807749	7763094		X					X								
Line 4-3	180919_15.07.50	57° 11.3779 N	007° 15.3584 W	-807731	7763034		X					X								
Line 4-3	180919_15.07.53	57° 11.3775 N	007° 15.3582 W	-807731	7763033		X						X				X			
Line 4-3	180919_15.08.25	57° 11.3717 N	007° 15.3538 W	-807723	7763013		X					X					X			
Line 4-3	180919_15.09.09	57° 11.3607 N	007° 15.3460 W	-807708	7762975		X					X						X		
Line 4-3	180919_15.09.54	57° 11.3497 N	007° 15.3398 W	-807697	7762938		X					X					X			
Line 4-3	180919_15.10.24	57° 11.3421 N	007° 15.3355 W	-807689	7762912		X					X					X			
Line 4-3	180919_15.10.38	57° 11.3386 N	007° 15.3322 W	-807683	7762900		X					X					X			
Line 4-3	180919_15.10.48	57° 11.3363 N	007° 15.3302 W	-807679	7762892		X					X					X			
Line 4-3	180919_15.10.57	57° 11.3342 N	007° 15.3278 W	-807674	7762885		X					X						X		
Line 4-3	180919_15.11.06	57° 11.3318 N	007° 15.3264 W	-807672	7762877		X					X						X		
Line 4-3	180919_15.11.14	57° 11.3299 N	007° 15.3257 W	-807671	7762870		X					X						X		
Line 4-3	180919_15.11.21	57° 11.3284 N	007° 15.3251 W	-807669	7762865		X					X					X			
Line 4-3	180919_15.12.04	57° 11.3194 N	007° 15.3135 W	-807648	7762834		X					X					X			
Line 4-3	180919_15.12.25	57° 11.3160 N	007° 15.3092 W	-807640	7762823		X					X					X			
Line 4-3	180919_15.12.37	57° 11.3137 N	007° 15.3065 W	-807635	7762815		X						X					X		
Line 4-3	180919_15.12.55	57° 11.3102 N	007° 15.3003 W	-807623	7762803		X					X						X		
Line 4-3	180919_15.13.16	57° 11.3038 N	007° 15.2893 W	-807603	7762781		X						X				X			

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395														Megaripples		
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence				
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%	<20%		<50%	>50%
Line 4-3	180919_13.14.42	57° 11.2845 N	007° 15.2557 W	-807541	7762715		X						X				X		
Line 4-3	180919_19.15.59	57° 11.2679 N	007° 15.2262 W	-807486	7762658		X					X					X		
Line 4-3	180919_15.16.01	57° 11.2674 N	007° 15.2255 W	-807485	7762657		X					X				X			
Line 4-3	180919_15.16.41	57° 11.2600 N	007° 15.2149 W	-807465	7762631		X					X				X			
Line 4-3	180919_15.17.07	57° 11.2558 N	007° 15.2057 W	-807448	7762617		X					X							
Line 4-3	180919_15.17.24	57° 11.2529 N	007° 15.1958 W	-807430	7762607			X				X				X			
Line 4-3	180919_15.17.30	57° 11.2520 N	007° 15.1925 W	-807423	7762604				X	X									
Line 4-3	180919_15.18.18	57° 11.2451 N	007° 15.1726 W	-807387	7762580				X	X									
Line 4-3	180919_15.18.30	57° 11.2436 N	007° 15.1691 W	-807380	7762575				X	X									
Line 4-3	180919_15.19.30	57° 11.2359 N	007° 15.1460 W	-807337	7762549			X			X								
Line 4-3	180919_15.19.42	57° 11.2344 N	007° 15.1403 W	-807327	7762544			X				X							
Line 4-3	180919_15.20.11	57° 11.2294 N	007° 15.1279 W	-807304	7762527			X			X								
Line 4-3	180919_15.21.04	57° 11.2187 N	007° 15.1054 W	-807262	7762490		X				X								
Line 4-3	180919_15.21.46	57° 11.2149 N	007° 15.0973 W	-807247	7762477		X			X	X								
Line 4-3	180919_15.23.56	57° 11.1835 N	007° 15.0339 W	-807129	7762370		X			X									
Line 4-3	180919_15.25.14	57° 11.1670 N	007° 15.9988 W	-807064	7762313		X			X									
Line 4-3	180919_15.21.46	57° 11.1494 N	007° 14.9645 W	-807000	7762253		X			X									
Channel 1	190919_13.04.28	57° 11.6336 N	007° 15.5030 W	-808000	7763908				X	X									
Channel 1	190919_13.04.50	57° 11.6343 N	007° 15.5017 W	-807997	7763910		X			X									
Channel 1	190919_13.05.20	57° 11.6357 N	007° 15.5004 W	-807995	7763915		X			X									
Channel 2	190919_13.11.37	57° 11.6218 N	007° 15.4942 W	-807983	7763868			X		X									

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395														Megaripples			
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence					
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%	<20%		<50%	>50%	
Channel 2	180919_13.12.08	57° 11.6260 N	007° 15.4958 W	-807986	7763882			X			X									
Channel 2	190919_13.12.37	57° 11.6292 N	007° 15.4953 W	-807985	7763893			X			X									
Channel 3	190919_13.18.31	57° 11.5546 N	007° 15.4586 W	-807917	7763638		X				X									
Channel 3	190919_13.18.49	57° 11.5563 N	007° 15.4542 W	-807909	7763644			X				X								
Channel 3	190919_13.19.43	57° 11.5605 N	007° 15.4380 W	-807879	7763658			X				X								
Channel 4	190919_13.26.31	57° 11.3948 N	007° 15.3735 W	-807759	7763092		X					X			X					
Channel 4	190919_13.26.52	57° 11.3947 N	007° 15.3715 W	-807756	7763092		X					X			X					
Channel 4	190919_13.27.11	57° 11.3952 N	007° 15.3690 W	-807751	7763093		X					X			X					
Channel 5	190919_13.34.05	57° 11.2943 N	007° 15.3122 W	-807646	7762748			X				X							X	
Channel 5	190919_13.34.31	57° 11.2964 N	007° 15.3100 W	-807641	7762756			X					X			X				
Channel 5	190919_13.35.17	57° 11.3016 N	007° 15.3067 W	-807635	7762773		X						X			X				
Channel 5	190919_13.35.58	57° 11.3063 N	007° 15.3021 W	-807627	7762789			X				X							X	
Channel 6	190919_13.45.50	57° 11.2973 N	007° 15.2716 W	-807570	7762759			X					X			X				
Channel 6	190919_13.47.24	57° 11.3057 N	007° 15.2635 W	-807555	7762787			X			X				X					
Channel 6	190919_13.46.18	57° 11.2983 N	007° 15.2704 W	-807568	7762762			X				X				X				
Channel 6	190919_13.45.28	57° 11.2962 N	007° 15.2743 W	-807575	7762755			X					X		X					
Cage Edge	190919_12.46.36	57° 11.7480 N	007° 15.5452 W	-808078	7764299			X		X										
Cage Edge	190919_12.50.04	57° 11.7475 N	007° 15.5420 W	-808072	7764297			X		X										
Cage Edge	190919_12.50.41	57° 11.7475 N	007° 15.5428 W	-808073	7764297			X		X										

Geodetic Parameters			Projection: Mercator, Datum: WGS84, EPSG Code: 3395													Megaripples			
Station / Transect Line	Photo	Latitude	Longitude	Final position X	Final position Y	Physical Habitat				No maerl	Dead Maerl Presence				Live Maerl Presence				
						Fine Medium sand (Silty Sand)	Coarse Sand (Shelly Silty Sand)	Mixed Sediment (Rocky Silty Sand)	Bedrock Exposure		<5%	<20%	<50%	>50%	<5%		<20%	<50%	>50%
Mooring Edge	190919_12.57.37	57° 11.6987 N	007° 15.5379 W	-808064	7764130			X		X									
Mooring Edge	190919_12.58.06	57° 11.7043 N	007° 15.5388 W	-808066	7764150			X		X									
Mooring Edge	190919_12.58.33	57° 11.7085 N	007° 15.5358 W	-808060	7764164		X			X									

Appendix III – Service Warranty

This report, with its associated works and services, has been designed solely to meet the requirements of the contract agreed with you, our client. If used in other circumstances, some or all of the results may not be valid and we can accept no liability for such use. Such circumstances include different or changed objectives, use by third parties, or changes to, for example, site conditions or legislation occurring after completion of the work. In case of doubt, please consult Benthic Solutions Limited.