



Ocean Ecology

Marine Surveys, Analysis & Consultancy

West Gigha Proposed Baseline Visual Seabed Survey Technical Report

REF: OEL_SSCARG0821_TCR



Details

Version	Date	Description	Author(s)	Reviewed By	Approved By
V01	21/07/2022	Client Submission			
V02	25/07/2022	Revised Submission			
V03	02/08/2022	Revised Submission			

Updates

Section	Description	Page
V02	Legend in all maps amended to indicate mixing zone. One row in table 1 deleted as incorrect, section 5.2 added to report on epibiotal community	various
V03	Changed company name to Bakkafrost Scotland throughout the text and on maps	various

Contents

List of Figures	4
List of Tables	4
List of Plates.....	4
Abbreviations	5
Executive Summary.....	6
1. Introduction.....	8
1.1. Site Information	8
1.1.1. Site Details	8
1.1.2. Designations	10
2. Review of Existing Data.....	12
2.1. Survey Data	12
2.2. Bathymetry Data.....	12
2.3. Subsea Infrastructure.....	12
2.3.1. GeMS PMF Species and Habitat Datasets.....	12
2.3.2. EUNIS Habitats.....	12
2.3.3. Habitats Directive (Annex I Habitats).....	13
3. Survey Design.....	15
4. Methods.....	17
4.1. Survey Methods.....	17
4.2. Equipment.....	17
4.2.1. Seabed Imagery Collection	17
4.2.1.1. Camera System	17
4.2.1.2. Camera Deployment.....	18
4.2.1.3. Navigation Equipment.....	18
4.2.1.4. Navigation Software	18
4.3. Project Parameters	19
4.3.1. Horizontal Reference systems.....	19
4.3.2. Unit Format and Conversions	19
4.3.3. Seabed Imagery Analysis.....	20
5. Results.....	21
5.1. Seabed Imagery	21
5.2. Habitat Mapping	25
6. Discussion	28
7. References.....	29

List of Figures

Figure 1 Proposed pen locations of the West Gigha salmon pen fish farm overlain on existing bathymetric data available for the site downloaded from EMODNET.	9
Figure 2 Location of marine protected areas in the vicinity of the proposed West Gigha salmon pen fish farm.	11
Figure 3 Existing habitat mapping across the proposed West Gigha salmon farm with overlay of recorded habitats and features of conservation importance.....	14
Figure 4 West Gigha baseline visual seabed survey summary of Drop-Down Camera transects across the proposed West Gigha salmon pen fish farm site.....	16
Figure 5 Habitat map of EUNIS classifications for each image taken during West Gigha baseline visual seabed survey with EUNIS predicted habitat map layer (EMODNET) for reference.....	23
Figure 6 Annex I reef habitats and PMFs identified across the West Gigha baseline visual seabed survey area.....	24
Figure 7 Habitat map across the proposed West Gigha salmon farm survey area.	27

List of Tables

Table 1 Proposed site details for the West Gigha salmon farm.....	8
Table 2 Details and rationale for the proposed West Gigha DDC transects (WGS84 UTM zone 30).	15
Table 4 Equipment list utilised onboard the <i>Melisa</i>	17
Table 5 Project horizontal geodetic parameters.....	19
Table 6 Project horizontal projection parameters.....	19
Table 7 Project unit format and convention details.....	19
Table 8 Characteristics of stony reef (Irving, 2009).	20
Table 10 Summary of the EUNIS classifications assigned during the West Gigha salmon farm survey 2022.	26

List of Plates

Plate 1 Survey vessel BS fish farm service vessel, <i>Melisa</i>	17
Plate 2 Example seabed imagery representative of the dominant EUNIS habitats/biotopes identified across the proposed salmon farm site.	22
Plate 3 Example images of habitats supporting a diverse epibiotal community across the proposed West Gigha salmon farm site.....	25

Abbreviations

BS	Bakkafrost Scotland
BIIGLE	Bio-Image Indexing and Graphical Labelling Environment
BSH	Broadscale Habitat
CAR	Controlled Activities Regulations
CES	Crown Estate Scotland
DDC	Drop Down Camera
dGPS	Differential Global Positioning System
EC	European Commission
EMODnet	European Marine Observation and Data Network
EUNIS	European Nature Information System
GPS	Global Positioning System
ISS	Initial Site Survey
JNCC	Joint Nature Conservation Committee
LOA	Lease Option Agreement
MBES	Multibeam Echosounder
MNCR	Marine Nature Conservation Review of Great Britain
MPA	Marine Protected Area
NMBAQC	Northeast Atlantic Marine Biological Analytical Quality Control Scheme
OEL	Ocean Ecology Limited
PMF	Priority Marine Features
PPS	Pulse Per Second
RTK	Real-Time Kinematic
SAC	Special Area of Conservation
SBAS	Satellite-Based Augmentation System
SEPA	Scottish Environment Protection Agency
UKHO	United Kingdom Hydrographic Office
UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator

Executive Summary

Ocean Ecology Limited (OEL) were commissioned by Bakkafrost Scotland (BS) to conduct an Initial Site Survey (ISS) of the proposed West Gigha salmon pen fish farm located off the western shores of the Isle of Gigha on the West coast of Scotland.

Survey Strategy

A drop-down camera (DDC) survey was conducted on the 1st- 2nd June 2021. High-definition seabed imagery was then collected along five pre-determined transects using a DDC system as a means of confirming the seabed habitats present and assessing for the presence/absence of Priority Marine Features (PMFs). Transects were selected to allow for the optimum vessel and camera use while covering as many varied depths and potential habitats as possible.

EUNIS Habitats / Biotopes

European nature information system (EUNIS) classifications known to be in the vicinity of the West Gigha salmon farm include A.3.1 – '*Atlantic and Mediterranean high energy infralittoral rock*', A4.1 – '*Atlantic and Mediterranean high energy circalittoral rock*', A4.2 – '*Atlantic and Mediterranean moderate energy circalittoral rock*', and A5.14 – '*Circalittoral coarse sediment*'.

EUNIS habitats identified across the five transects were A3.1 – '*Atlantic and Mediterranean high energy infralittoral rock*', A3.122 – '*Laminaria saccharina and/or Saccorhiza polyschides on exposed infralittoral rock*', A4.1 – '*Atlantic and Mediterranean high energy circalittoral rock*', A4.13 – '*Mixed faunal turf communities on circalittoral rock*', A5.2 – '*Sublittoral sand*', A5.26 – '*Circalittoral muddy sand*', A5.3 – '*Subtidal Mud*', A5.35 – '*Circalittoral sandy mud*', A5.4 – '*Sublittoral mud*', A5.44 – '*Circalittoral mixed sediments*', A5.441 – '*Cerianthus lloydii and other burrowing anemones in circalittoral muddy mixed sediment*', A5.5 – '*Subtidal Macrophyte Dominated Sediment*', and A5.521 – '*Laminaria saccharina and red seaweeds on infralittoral sediments*'.

Annex I Habitats

Existing data for the target area did not identify Annex I reefs within the proposed West Gigha salmon farm site. Annex I reef habitat is afforded protection under the European Commission (EC) Habitats Directive (92/44/EEC) when designated as a feature within a Special Area of Conservation (SAC). In Scotland, the Habitats Directive is translated into specific legal obligations by the Conservation Regulations 1994, which has been amended in 2017 following EU exit.

However, seabed images collected at transects T_02 and T_03 provided evidence of the presence of Annex I bedrock reef, corresponding to EUNIS classifications A4.2 – '*Atlantic and Mediterranean moderate energy circalittoral rock*', A4.21 – '*Echinoderms and crustose communities on circalittoral rock*', A4.2146 – '*Caryophyllia smithii with faunal and algal crusts on moderately wave-exposed circalittoral rock*', A4.2121 – '*Brittlestars overlying coralline crusts, Parasmittina trispinosa and Caryophyllia smithii on wave exposed circalittoral rock*'. These Annex I bedrock reef habitats found in the baseline survey were not included within the predicted habitat map (EMODnet) for the proposed area. This highlights the importance of completing baseline visual seabed surveys.

Other Features of Interest

The Priority Marine Feature (PMF) Habitat 'Kelp and seaweed communities on sublittoral sediment' was identified in 42 seabed images and subsequently mapped across the proposed West Gigha salmon farm site in < 20 m water depth. However, no PMF species were observed.

1. Introduction

Bakkafrost Scotland (BS) (previously known as The Scottish Salmon Company) is a salmon farming company established in 2009 and operates several salmon farms in Scotland. Their current sites all have a Lease Option Agreement (LOA) from Crown Estate Scotland (CES) and a Scottish Environment Protection Agency (SEPA) Controlled Activities Regulations (CAR) discharge licence.

BS have chosen another potential site to build, install, and operate a new salmon farm. The proposed site is West of the Isle of Gigha, West coast of Scotland. As part of the SEPA pre-screening process, BS is required to undertake an Initial Site Survey (ISS). The main aims of the ISS are to:

- Identify any protected habitats or species within the proposed farm area.
- Provide an assessment of the existing environmental status of the seabed, including existing impacts.
- Address any potential risks identified in the wider area.

1.1. Site Information

1.1.1. Site Details

The proposed West Gigha salmon farm site is located off the western shores of the Isle of Gigha on the west coast of Scotland and will consist of 8 enclosures (Table 1 and Figure 1). The enclosures will be located in water depths of approximately 40-45 m and will be aligned in two parallel rows.

Table 1 Proposed site details for the West Gigha salmon farm.

Site details	Description
Site name	West Gigha
Site address	West Gigha, Scotland
Proposed no. of enclosures and size	Two parallel rows of 4 enclosures (8 in total), 160 m surface circumference in a 120 m grid.

BS currently hold two offshore salmon pen fish farm site off the eastern coast of Gigha named East Tarbert Bay which is composed of 12 x 120 m circular pens and Druimyeon Bay which is composed of 16 x 100 m circular pens. There are also other forms of aquaculture present on the island including Gigha Halibut which operates a land-based system pumping water straight from the Atlantic into tanks and produces approx. 75 tonnes of fish per year.

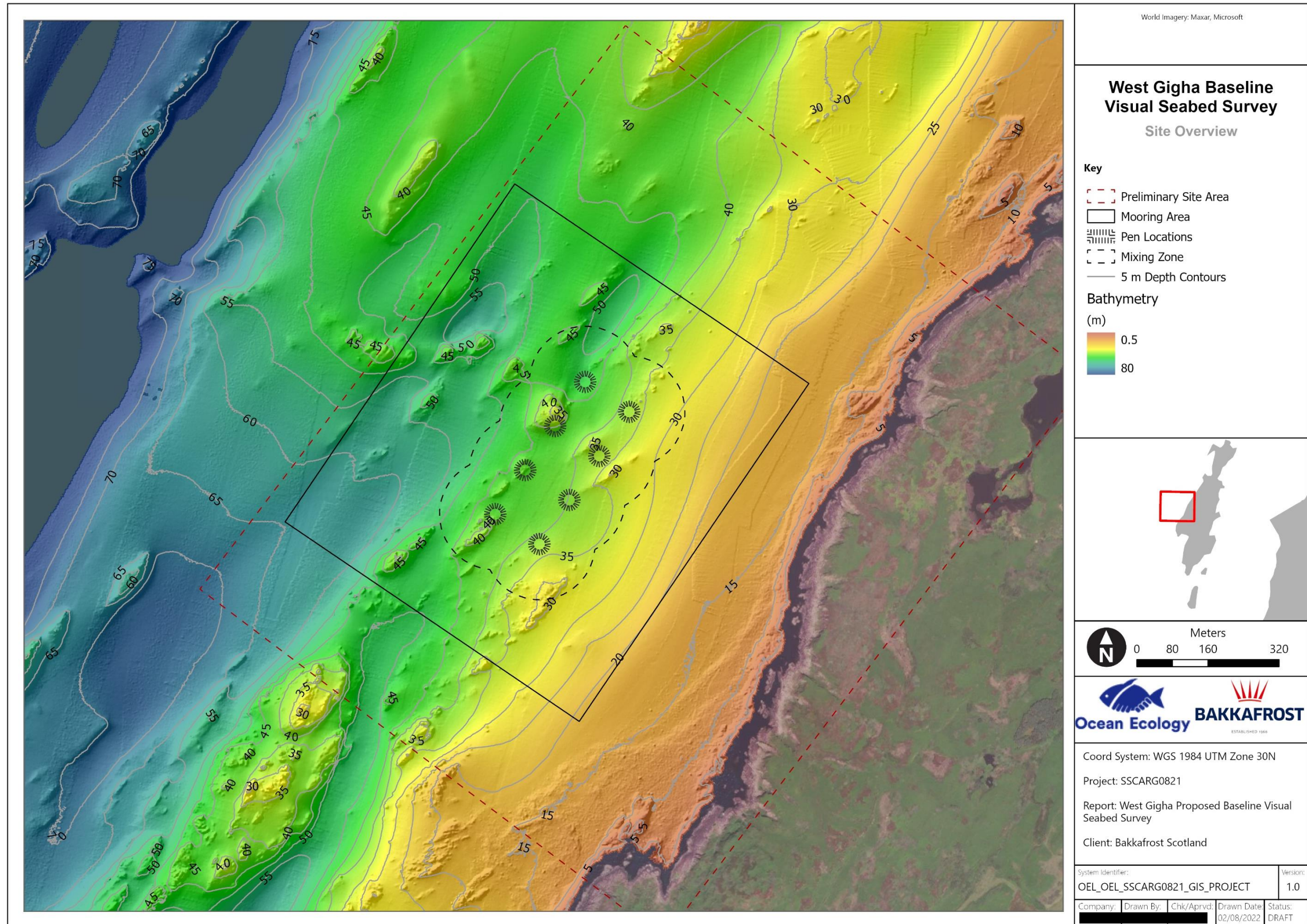


Figure 1 Proposed pen locations of the West Gigha salmon pen fish farm overlain on existing bathymetric data available for the site downloaded from EMODNET.

1.1.2. Designations

The proposed site of the West Gigha salmon farm is situated in Fish Disease Management Area 18b. The proposed site lies within the Sound of Gigha Special Protected Area (SPA) and is approximately 6.5 km south of the Inner Hebrides and the Minches Special Area of Conservation (SAC). The South-East Islay Skerries SAC lies approximately 14.5 km west of the proposed site. All designated sites within the vicinity of the West Gigha salmon farm are described below and presented in Figure 2.

Sound of Gigha SPA

Sound of Gigha SPA is designated for the protection of four bird species: great northern diver (*Gavia immer*), Slavonian grebe (*Podiceps auratus*), common eider (*Somateria mollissima mollissima*) and red-breasted merganser (*Mergus serrator*). Conservation objectives for this site are to maintain qualifying features in 'favourable condition' and to 'make and appropriate contribution to achieving Favourable Conservation Status'.

South-East Islay Skerries SAC

South-East Islay Skerries SAC was designated with Annex II species (1365) harbour seal (*Phoca vitulina*) as the primary reason for selection of this site (Figure 2 and Figure 3). The skerries consist of islands and rugged coastline of the island of Islay and host a nationally important population of harbour seal, representing between 1.5% and 2% of the total UK population. These coastline areas are used as important pupping, moulting, and haul-out sites for this harbour seal population.

Inner Hebrides and the Minches SAC and Loch Sunart to Sound of Jura MPA

The Inner Hebrides and the Minches SAC was designated to protect harbour porpoise (*Phocoena phocoena*) on the west coast of Scotland. It is the second largest MPA for harbour porpoise in Europe, extending from Stornoway to Crinan.

Loch Sunart to Sound of Jura MPA is designated for the protection of critically endangered Flapper skate (common skate) *Dipturus batis*. This large MPA restricts fishing gear in the area to static gear only (creels for langoustine (*Nephrops norvegicus*), brown crab (*Cancer pagurus*), and lobster (*Homarus gammarus*). The use of mobile trawl and gears used to target scallop are restricted to only small area designations to allow for local vessels to work in restrictive weather conditions.

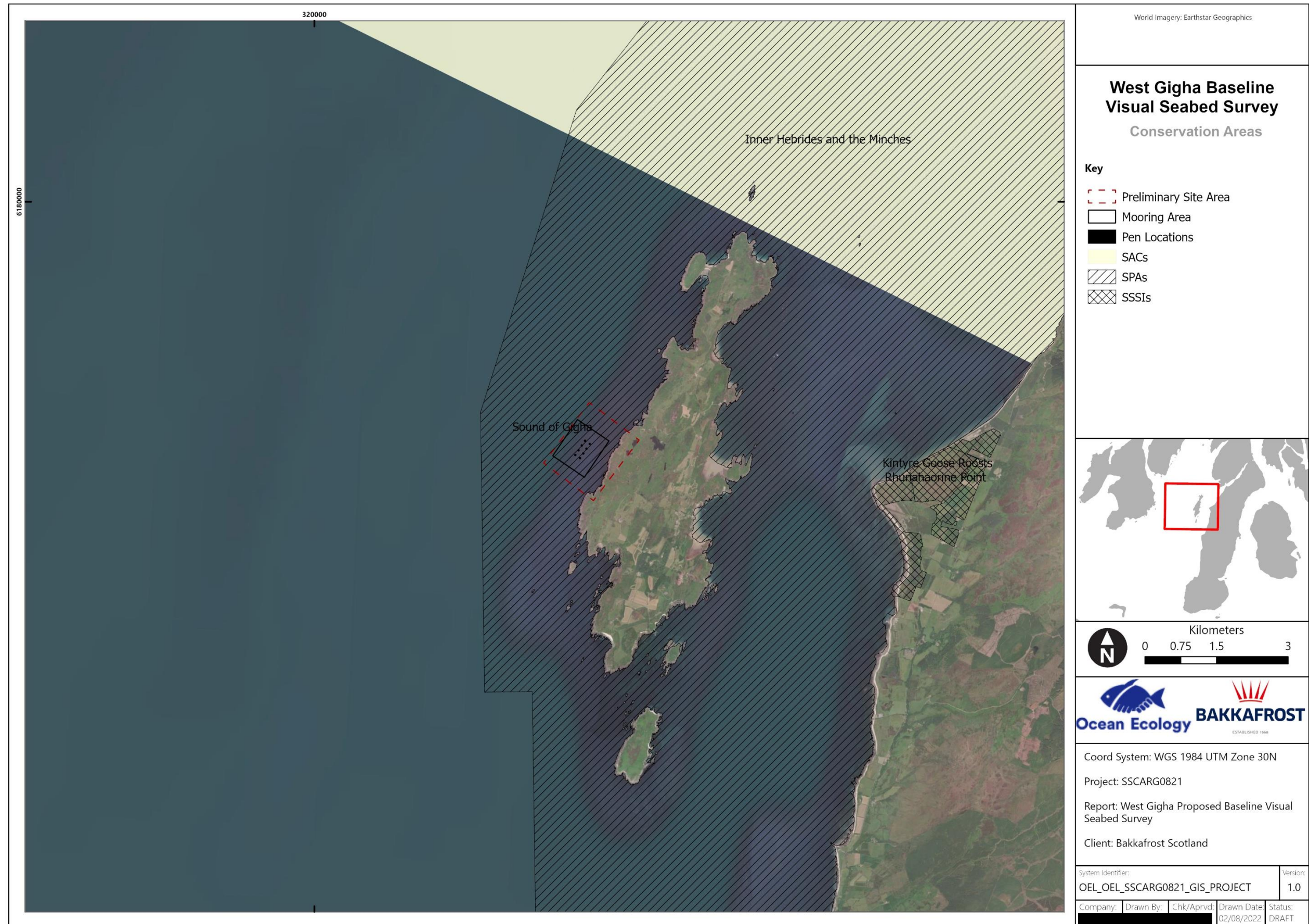


Figure 2 Location of marine protected areas in the vicinity of the proposed West Gigha salmon pen fish farm.

2. Review of Existing Data

2.1. Survey Data

Whilst existing data is available for the general area, there is a paucity of data pertaining specifically to the habitats and species within the immediate vicinity of the proposed West Gigha salmon pen fish farm. The following section including Figure 3, summarises the findings of all currently available data for the area.

2.2. Bathymetry Data

Partial multibeam echosounder (MBES) bathymetry data coverage for the West Gigha site is available at 2 m and 4 m resolution. These two datasets were combined at 4 m resolution to provide full coverage of the preliminary site area as presented in Figure 1 and Figure 4. The data is available via the [UK Hydrographic Office \(UKHO\) ADMIRALTY Marine Data Portal](#) and the Marine Environment Data Network ([MEDIN](#)).

2.3. Subsea Infrastructure

There is no known notable subsea structure within the preliminary site area.

2.3.1. GeMS PMF Species and Habitat Datasets

Collation of species line records contributing to the [Geodatabase of Marine features adjacent to Scotland \(GeMS\)](#). Records are attributed as to their qualification as protected features of protected areas within the Scottish MPA network. Where appropriate, typical record details include status as Scottish PMF or Annex II Species, scientific name, abundance details, date, date range, year, status, accuracy, determiner, and details of where the records are sourced from and intellectual property ownership. There are no PMFs currently recorded at the proposed West coast of Gigha site. The PMF species harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) have been recorded around the Isle of Gigha and are likely to be active in the vicinity of the proposed farm (Figure 3).

2.3.2. EUNIS Habitats

European nature information system (EUNIS) classifications in the vicinity of the West Gigha salmon farm identified during these surveys are presented in Figure 3. Within the proposed mooring area and pen sites exist the EUNIS habitat A5.14 – '*Circalittoral coarse sediment*'. Within the proposed site boundary there are also A4.1 – '*Atlantic and Mediterranean high energy circalittoral rock*', A3.1 – '*Atlantic and Mediterranean high energy infralittoral rock*', A3.2 – '*Atlantic and Mediterranean moderate energy infralittoral rock*', and A5.15 '*Sublittoral coarse sediment in variable salinity (estuaries)*' Figure 3.

There are no PMF habitats or PMF species that fall within the proposed site area. PMF species grey seal and harbour seal are found further to the North and South of the site and common skate found further offshore to the West.

2.3.3. Habitats Directive (Annex I Habitats)

Annex I reef habitat is afforded protection under the European Commission (EC) Habitats Directive (92/44/EEC) when designated as a feature within a SAC. In Scotland, the Habitats Directive is translated into specific legal obligations by the Conservation Regulations 1994, which has been amended in 2017 following EU exit. Data obtained from EMODnet of surveys and displayed in Figure 3 indicates there are no Annex I reef habitat within the proposed West Gigha site.

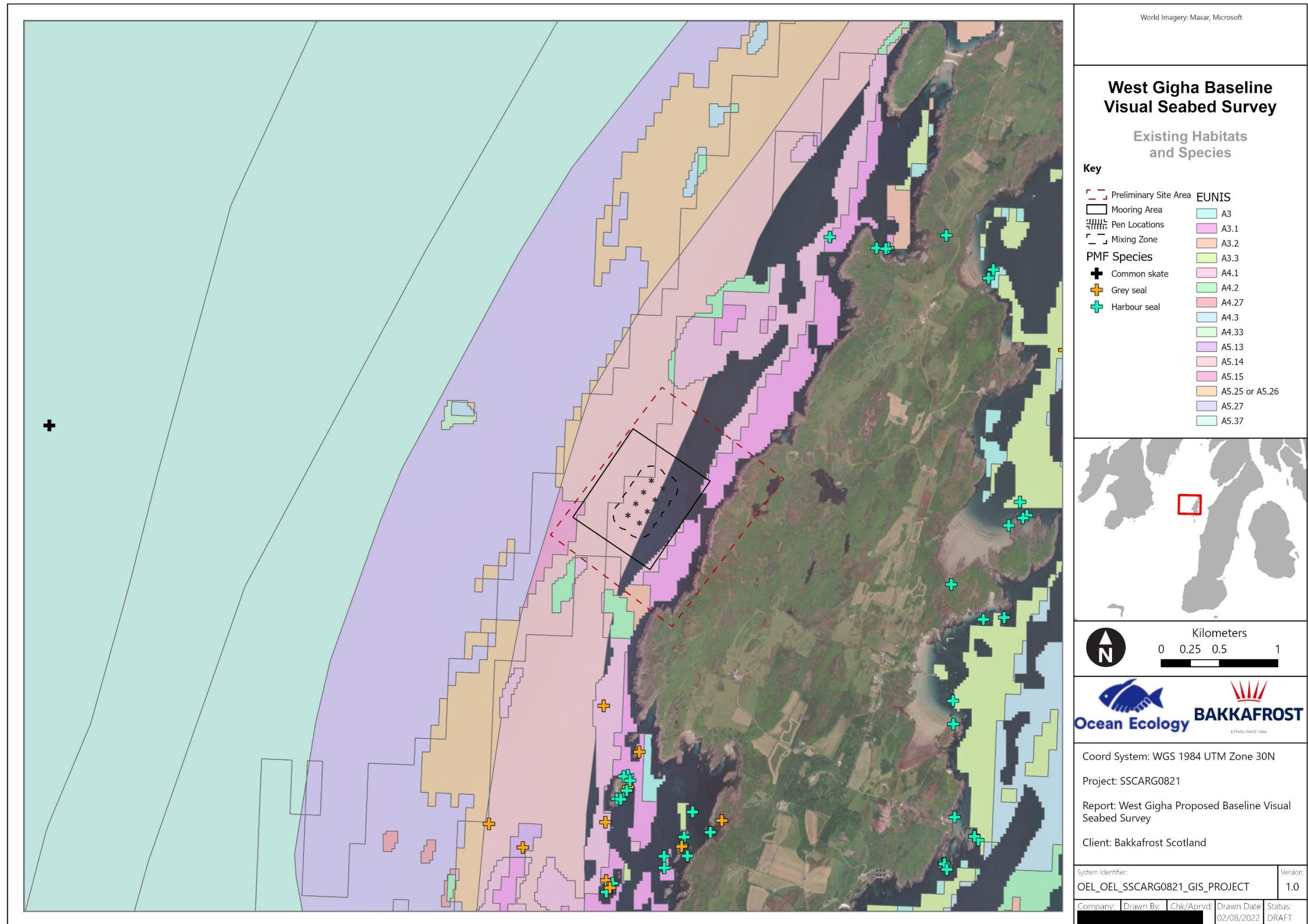


Figure 3 Existing habitat mapping across the proposed West Gigha salmon farm with overlay of recorded habitats and features of conservation importance.

3. Survey Design

3.1. Proposed Sampling Array

As part of the ISS, seabed imagery was collected along pre-determined transects using a drop-down camera (DDC) system deployed from the dedicated fish farm service vessel *Melisa* as a means of assessing for the presence/absence of PMFs within the West Gigha salmon farm boundary area. Transects were selected to allow for the optimum vessel and camera use while covering as many varied depths and potential habitats as possible (Figure 4 and Table 2).

The transects were 1150 m in length. Combined, the seabed imagery collected along these transects is meant to provide a thorough ground-truthing of the proposed area (Figure 4).

Table 2 Details and rationale for the proposed West Gigha DDC transects (WGS84 UTM zone 30).

West Gigha Visual Seabed Survey						
Transect	Transect Start		Transect Finish		Distance (m)	Bearing (°)
	X	Y	X	Y		
1	162298	649996	163981	650924	1150	35.5
2	162452	649883	163133	650813	1150	35.5
3	162604	649770	163284	650703	1150	35.5
4	162756	649658	163437	650594	1150	35.5
5	162897	649555	163583	650486	1150	35.5

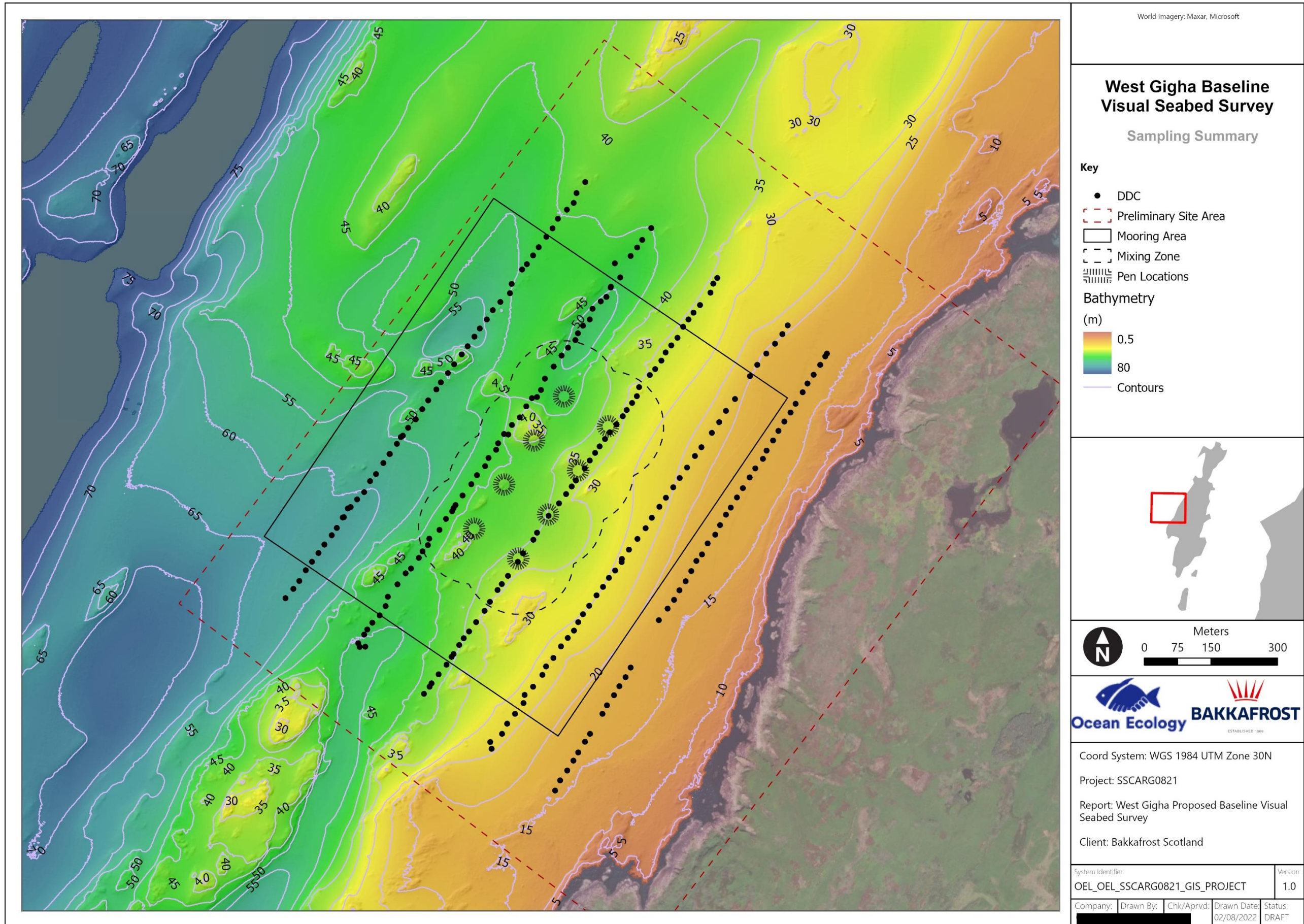


Figure 4 West Gigha baseline visual seabed survey summary of Drop-Down Camera transects across the proposed West Gigha salmon pen fish farm site.

4. Methods

4.1. Survey Methods

The survey was undertaken aboard the fish farm service vessel *Melisa* (Plate 1). *Melisa* is a fish farm service vessel which was specifically laid out for deployment of seabed survey equipment.



Plate 1 Survey vessel BS fish farm service vessel, *Melisa*.

4.2. Equipment

Table 3 Equipment list utilised onboard the *Melisa*.

Equipment	Model
Camera System	High Definition (HD) video and stills drop-down camera system
dGPS	Hemisphere V104s GPS Compass
Gyro Compass	Hemisphere V104s GPS Compass
Navigation Software	Hypack (MBES) & EIVA NaviPac (DDC)
MBES	EIVA NaviPac

4.2.1. Seabed Imagery Collection

4.2.1.1. Camera System

At each location, video and still imagery were collected throughout the deployment using OEL's height-adjustable freshwater housing camera system providing a variety of options for view, lighting, and focal length to maximise data quality with respect to prevailing conditions. Video footage was digitally overlaid with information including project, date, time and dGPS position (as a minimum) and recorded in a digital format to 5 MB. A laser scaling array projected into the field of view to provide a method for determining scale.

4.2.1.2. Camera Deployment

The camera frame was deployed using a capstan and deck crane on the deck of the *Melisa*. During deployment, video signal was monitored on-board the vessel to assess quality of the footage and adjust as necessary. A breakdown of deployment is summarised below:

The camera was deployed to the seabed over the target location and slowly 'flown' just above the seabed along to obtain both continuous video footage and still images representative of the target location. The footage was viewed in real-time by the onboard OEL ecologist via an umbilical. The camera was flown (or a bed-hopping approach was used where visibility/tide did not allow) above the seabed during camera transects to obtain continuous video of the seabed and allow for high quality still images to be taken at 5 to 10 m intervals.

4.2.1.3. Navigation Equipment

The vessel was equipped with a Hemisphere V104s Global Positioning System (GPS) compass system that provided an accurate offset position of the sampling equipment when deployed from the stern.

The Hemisphere V104s's internal GPS receiver automatically searches for and uses a minimum of 4 GPS satellites and manages the navigation information required for position to within 3 m 95% accuracy. Since there is some error in the GPS data calculations, the V104s also automatically tracks a Satellite-Based Augmentation System (SBAS) differential correction to improve its position accuracy to better than 1.0 m 95%.

4.2.1.4. Navigation Software

A vessel-based positioning system was employed utilizing EIVA NaviPac V4.2 software to ensure the accurate positioning of the vessel and camera system. A navigation screen, displaying EIVA Helmsman Display was provided at the helm position of the vessel for the Officer on Watch as well as for the ecologist/surveyor in the wheelhouse.

4.3. Project Parameters

4.3.1. Horizontal Reference systems

Table 4 Project horizontal geodetic parameters.

Parameter	Value
Datum	World Geodetic System 1984
Ellipsoid	World Geodetic System 1984
Spheroid	World Geodetic System 1984
Semi Major Axis (m)	6378137.0
Semi Minor Axis (m)	6356752.314245719
Inverse Flattening (1/f)	298.257223563
Angular unit	Degree

Table 5 Project horizontal projection parameters.

Parameter	Value
Projection	Universal Transverse Mercator (UTM) Zone 30N
Longitude at Central Meridian	003° 00.000000' E
Latitude of Origin	000° 00.000000' N
False Northing and Easting (m)	0; 500,000
Scale Factor	0.9996
Linear Unit	Metre
Time Datum	Universal Time Coordinated (UTC)

4.3.2. Unit Format and Conversions

The following units were used throughout this project and were expressed using the following conventions.

Table 6 Project unit format and convention details.

Unit Formats and Conventions	
Geographical Coordinates	Latitude N DD° MM.mmmmmm' to 6 decimal places. Longitude E/W DD° MM.mmmmmm' to 6 decimal places.
Grid Coordinates	Meters in the following format: Easting EEE EEE.eee m to 3 decimal places. Northing NNN NNN.nnn m to 3 decimal places.
Linear distances	Meters to 1 decimal places.
Kilometre Point (KP) distances	Kilometres to 2 decimal places.
Offset measurement sign conventions	Meters in the following format: 'Y' is positive forward 'X' is positive to starboard 'Z' values are positives upwards from the waterline
Time	Local unless otherwise stated.

4.4. Seabed Imagery Analysis

All seabed imagery analysis was undertaken using the Bio-Image Indexing and Graphical Labelling Environment ([BIIGLE](#)) annotation platform (Langenkämper et al., 2017) and in consideration of the JNCC epibiota remote monitoring interpretation guidelines (Turner et al., 2016) and the latest [NMBAQC/JNCC Epibiota Quality Assurance Framework \(QAF\) guidance](#) and [identification protocols](#). All images were subject to a “Tier 1” analysis. The “Tier 1” level included labels such as image quality, broad scale habitat (BSH), EUNIS habitat, features of conservation interest (FOCI), PMFs. In addition, an Annex I reef assessment and a PMFs assessment were also undertaken for all images analysed. A full reef habitat assessment was conducted on all images to determine whether habitats met the definitions of Annex I stony reef habitats as detailed in Table 7.

All digital still images of the seabed obtained during the survey were analysed to aid in the identification and delineation of EUNIS habitats and PMFs.

Table 7 Characteristics of stony reef (Irving, 2009).

Characteristic	'Reefiness'			
	Not a Reef	Low	Medium	High
Composition (proportion of boulders/cobbles (> 64 mm))	< 10 %	10 - 40 % matrix supported	40 - 95 %	> 95 % clast-supported
Elevation	Flat seabed	< 64 mm	64 mm - 5 m	> 5 m
Extent	< 25 m ²	> 25 m ²		
Biota	Dominated by infaunal species	> 80 % of species present composed of epibiotal species		

4.5. Habitat Mapping

All habitat mapping was undertaken in ESRI ArcPro Version 2.9.3 by a habitat mapping specialist and reviewed by a secondary senior environmental scientist. This involved overlaying EUNIS classifications and habitat assessment scores (e. g., Annex I reef, PMFs) assigned to each sampling location where seabed imagery was collected on the available bathymetry data (see Section 2.2) and the existing EMODnet mapping to delineate polygons representative of similar bedform. However, as bathymetry data was available at a resolution that did not allow for an in-depth review of seabed topography, confidence in the delineation of polygons and their extent was overall low. Confidence scores were assigned to each polygon with a score of one where seabed imagery was available and of zero where no imagery was available and polygons were drawn based on expert judgement and existing bathymetry data and EMODnet mapping.

5. Results

5.1. Seabed Imagery

DDC sampling was successfully conducted along the five transects, resulting in a total of 253 HD still images collected across the proposed West Gigha salmon pen fish farm. DDC image result logs can be found in Appendix I and Appendix II which also hold full result logs of Annex I Reef Assessment.

The main assessment was conducted using still images captured during the DDC deployments. Example seabed imagery of the dominant EUNIS habitats/biotopes recorded along each transect are presented in Plate 2.

The BSHs identified in seabed imagery taken across all stations includes A3.1 – '*Atlantic and Mediterranean high energy infralittoral rock*', A3.122 – '*Laminaria saccharina and/or Saccorhiza polyschides on exposed infralittoral rock*', A4.1 – '*Atlantic and Mediterranean high energy circalittoral rock*', A4.13 – '*Mixed faunal turf communities on circalittoral rock*', A4.2 – '*Atlantic and Mediterranean moderate energy circalittoral rock*', A5.2 – '*Sublittoral sand*', A5.26 – '*Circalittoral muddy sand*', A5.3 – '*Subtidal Mud*', A5.35 – '*Circalittoral sandy mud*', A5.4 – '*Sublittoral mud*', A5.44 – '*Circalittoral mixed sediments*', A5.441 – '*Cerianthus lloydii and other burrowing anemones in circalittoral muddy mixed sediment*', A5.5 – '*Subtidal Macrophyte Dominated Sediment*', and A5.521 – '*Laminaria saccharina and red seaweeds on infralittoral sediments*' (Figure 5). Habitats found directly under some of the proposed pen sites included A5.44 – '*Circalittoral mixed sediments*' (Figure 5).

Images along transects T_02 and T_03 provided evidence of the presence of Annex I bedrock reef, corresponding to EUNIS classifications A4.21 – '*Echinoderms and crustose communities on circalittoral rock*', A4.2121 – '*Brittlestars overlying coralline crusts, Parasmittina trispinosa and Caryophyllia smithii on wave-exposed circalittoral rock*', and A4.2146 – '*Caryophyllia smithii with faunal and algal crusts on moderately wave-exposed circalittoral rock*' (Figure 6). These Annex I bedrock reef habitats found in the baseline survey were not included within the predicted habitat map (EMODNET) for the proposed area. This highlights the importance of baseline visual seabed surveys.

The PMF '*Kelp and seaweed communities on sublittoral sediment*' was identified in 42 seabed images and subsequently mapped across the proposed West Gigha salmon farm in < 20m water depths. No PMF species were observed (Figure 6).

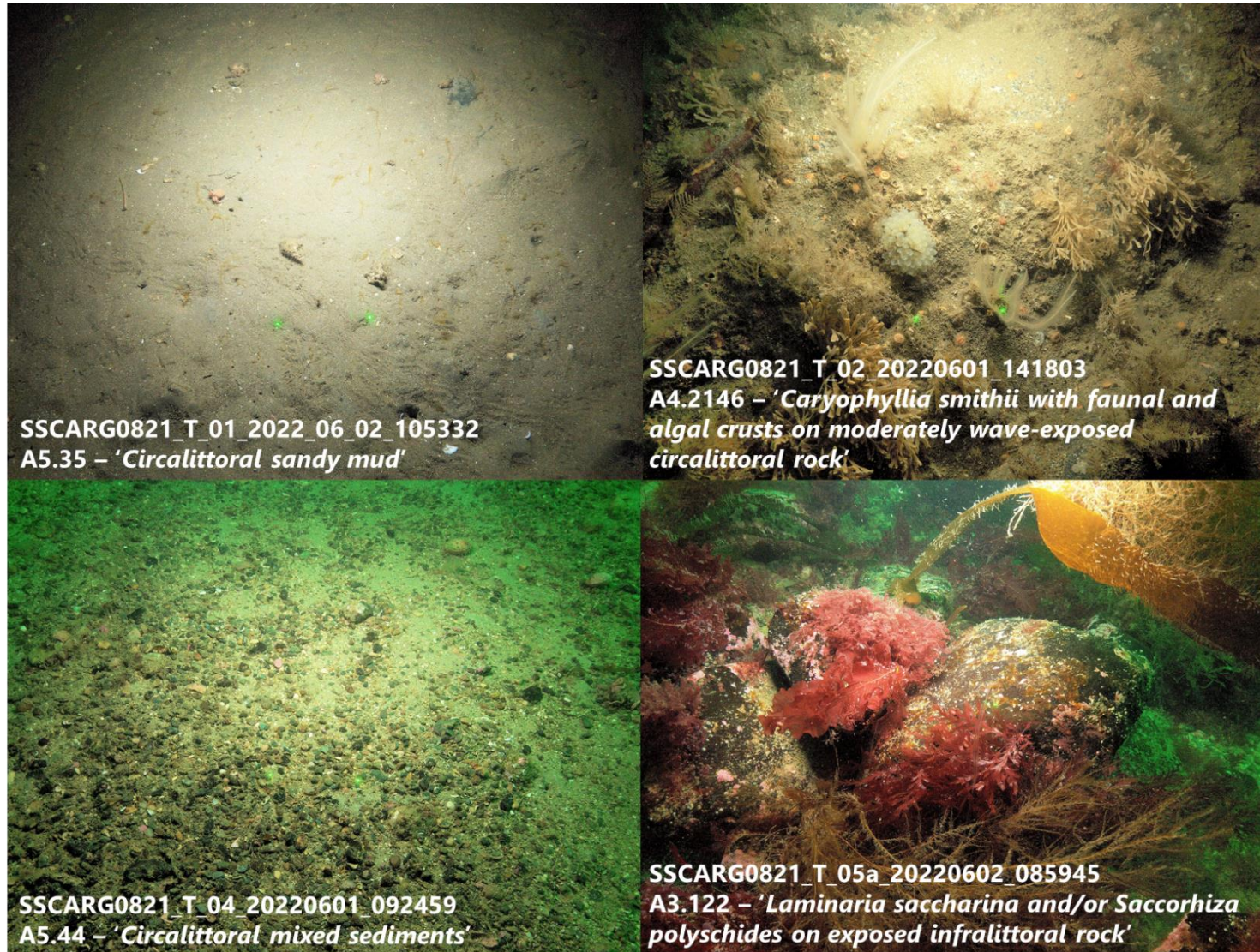


Plate 2 Example seabed imagery representative of the dominant EUNIS habitats/biotopes identified across the proposed salmon farm site.

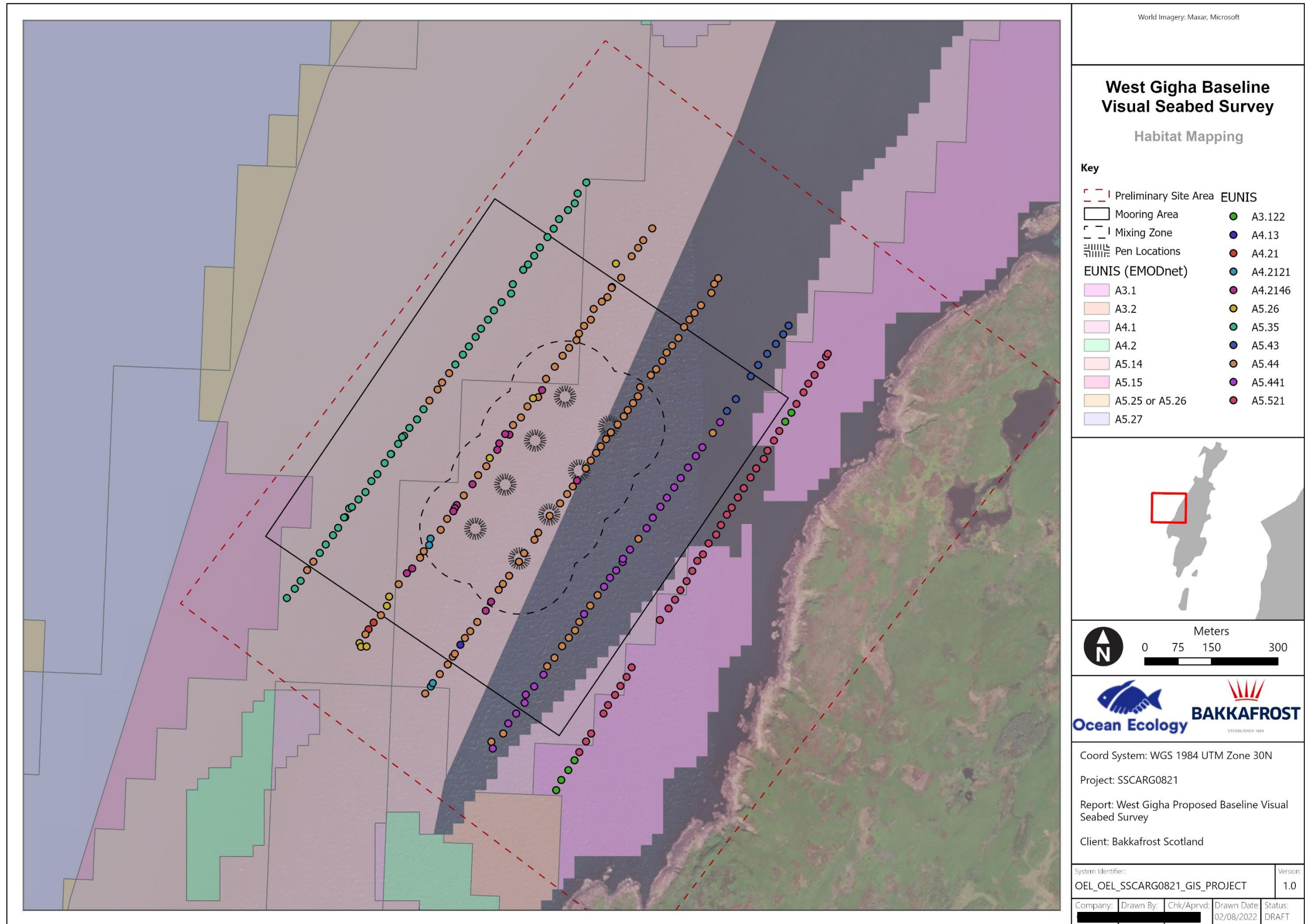


Figure 5 Habitat map of EUNIS classifications for each image taken during West Gigha baseline visual seabed survey with EUNIS predicted habitat map layer (EMODNET) for reference.

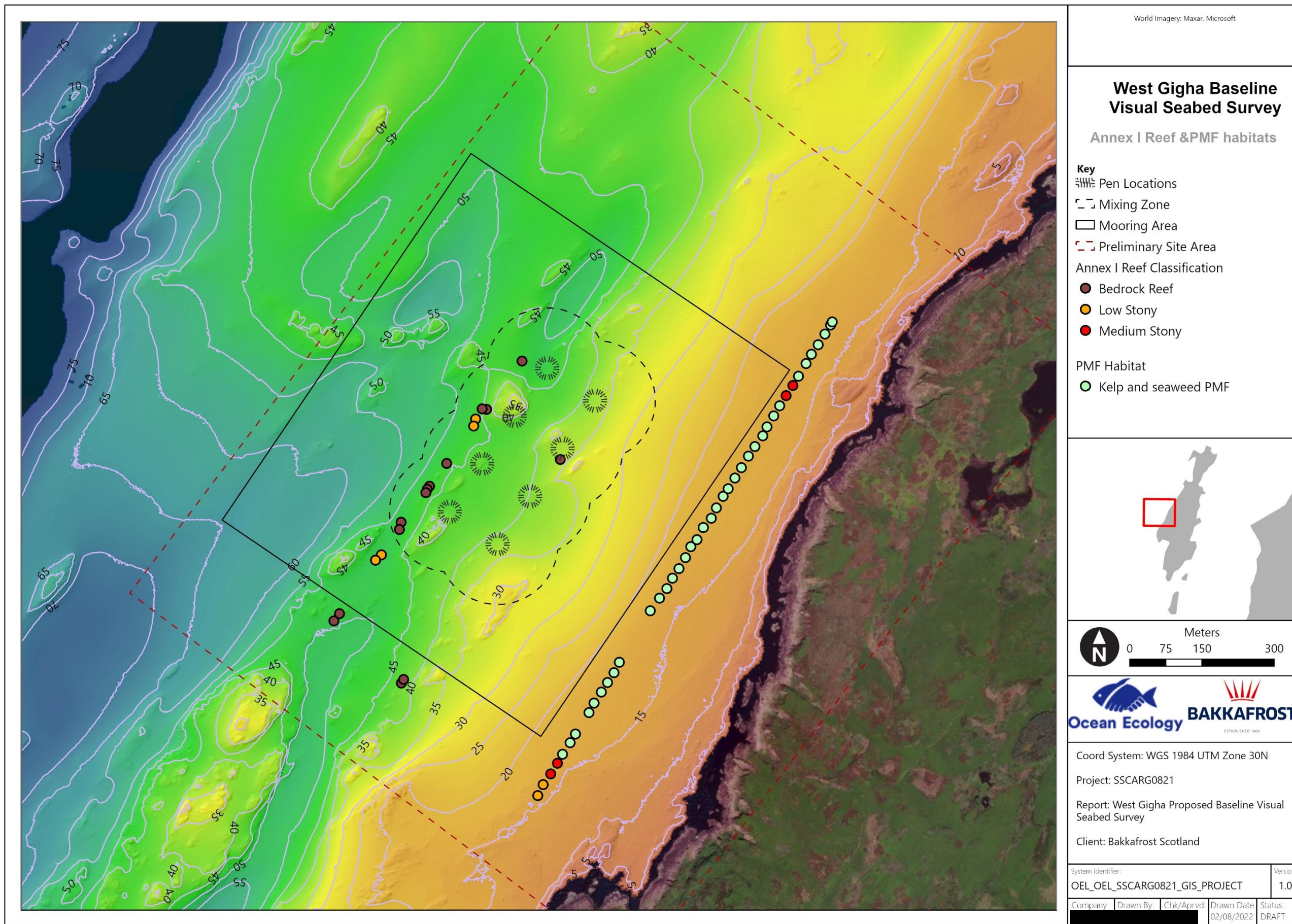


Figure 6 Annex I reef habitats and PMFs identified across the West Gigha baseline visual seabed survey area.

5.2. Conspicuous Epibiota

The epibiotal community varied largely across the survey area. The deeper muddy sand habitats (EUNIS A5.35) across transect T_01 showed a sparse level of epibiota with a small number of hermit crabs (Paguridae), *Ophiura* sp. and *Aporrhais pespelecani* being observed. The mixed sediment habitats (EUNIS A5.44) across transects T_02, T_03 and T_04 were dominated by clumps of hydroids, mostly Sertulariidae and *Nemertesia ramosa*. Additionally, a large area of the mixed sediment at transect T_04 (EUNIS A5.441) showed a high abundance of *Cerianthus lloydii*.

Outcrops of rock and/or reefs along transects T_02, T_03 and T_04 showed a diversity of epibiota containing ascidians (*Botryllus schlosseri*, *Ascidia* sp., *Diazona violacea*), hydroids, Flustridae, Echinoderms (*Luidia ciliaris*, *Echinus esculentus*) and *Caryophyllia smithii*. The shallower depths at transect T_05a allowed for a diversity of seaweeds to grow on the sediment and the areas of reef. This included red and brown seaweeds of varying morphotypes, as well as species of kelp (*Saccharina latissima*, *Saccorhiza polyschides*). Presence / Absence data for epibiota can be found in Appendix III.

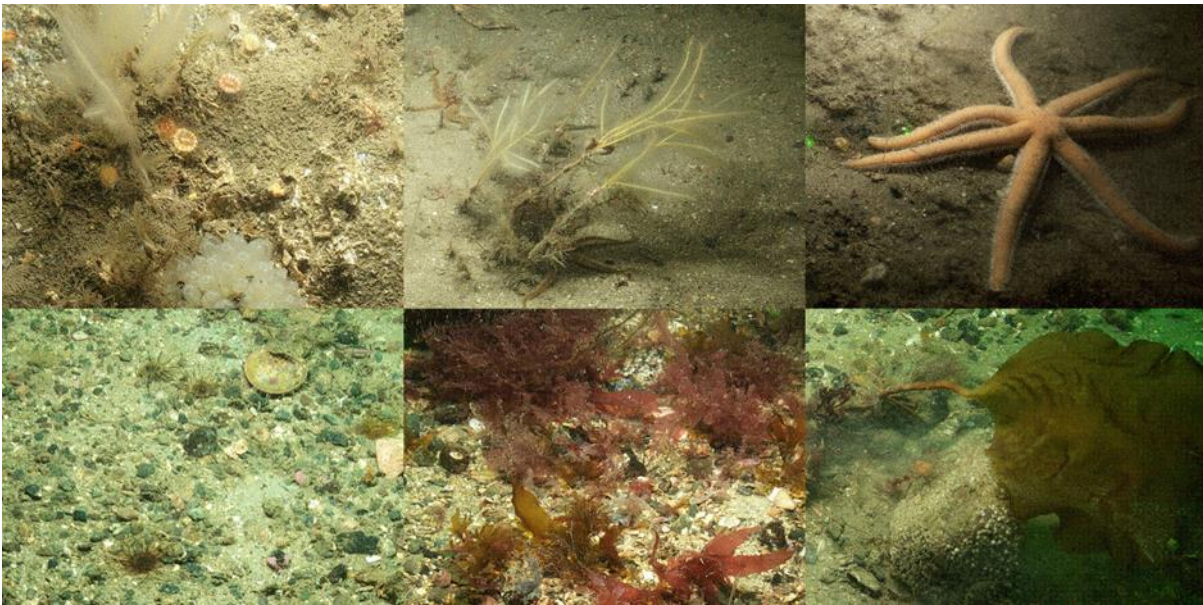


Plate 3 Example images of habitats supporting a diverse epibiotal community across the proposed West Gigha salmon farm site.

5.3. Habitat Mapping

To map the principal habitats that occurred throughout the proposed West Gigha salmon farm, a full interrogation of available bathymetric data (see Section 2.2) and predictive mapping was undertaken in combination with seabed imagery collected along all 5 transects.

The main habitats identified across the proposed West Gigha salmon farm at which seabed imagery were obtained are listed in Table 8. The distribution and extent of the habitats identified across the proposed West Gigha salmon farm based on all the available data are presented in Figure 7 habitat map. All habitat / biotope mapping is provided in shapefile (.shp) format as Appendix IV.

Table 8 Summary of EUNIS classifications assigned during the West Gigha baseline habitat survey 2022.

Transect	BSH	EUNIS Code	PMF	Annex I reef
T_01	A5.3, A5.4	A5.35, A5.44		Not a reef
T_02	A4.2, A5.2, A5.4	A4.21, A4.2121, A4.2146, A5.26, A5.44		Bedrock Reef, Low Stony
T_03	A4.1, A4.2, A5.4	A4.13, A4.2121, A4.2146, A5.44		Bedrock Reef
T_04	A5.4	A5.43, A5.44, A5.441		Not a reef
T_05a	A3.1, A5.5	A3.122, A5.521	Kelp and seaweed communities on sublittoral sediment.	Low Stony, Medium Stony

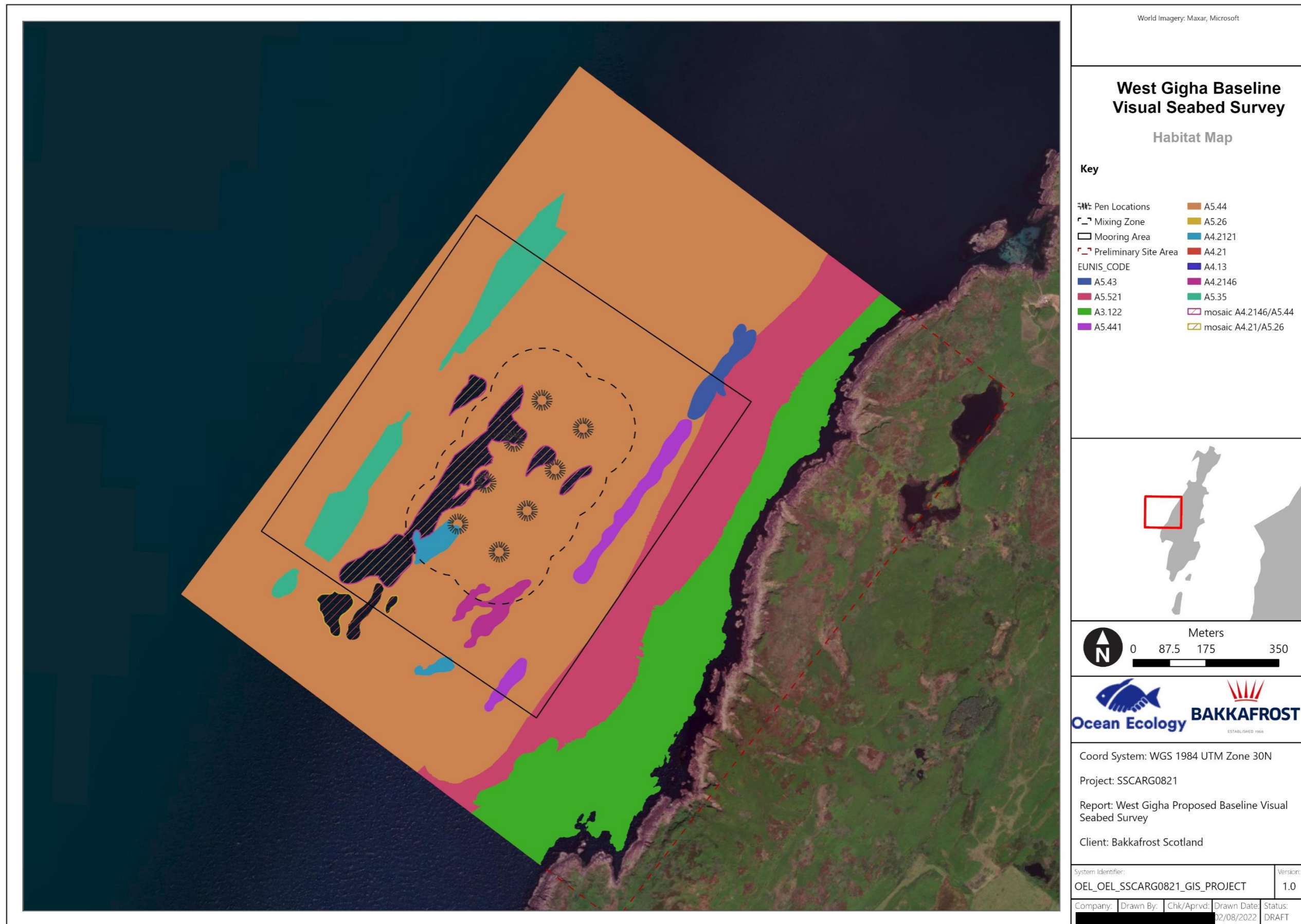


Figure 7 Habitat map across the proposed West Gigha salmon farm survey area.

6. Discussion

This report presents the findings and habitat mapping outputs of the West Gigha salmon pen fish farm survey 2022. The survey involved the collection of seabed imagery across 5 high priority (T_01 to T_05) transects within the survey area. The key objective was to map the distribution and extent of BSHs, biotopes and life forms present with a focus on confirming the presence/absence of any habitats and/or features of conservation interest / PMFs across the West Gigha salmon farm survey area.

The BSHs and biotopes identified in the seabed imagery across all stations are listed within Section 5.1 and mapped in Figure 5 and Figure 7. Images along transects T_02 and T_03 provided evidence of the presence of Annex I bedrock reef (Figure 6), corresponding to EUNIS classifications A4.21 – '*Echinoderms and crustose communities on circalittoral rock*', A4.2121 – '*Brittlestars overlying coralline crusts, Parasmittina trispinosa and Caryophyllia smithii on wave-exposed circalittoral rock*', and A4.2146 – '*Caryophyllia smithii with faunal and algal crusts on moderately wave-exposed circalittoral rock*' (Figure 5). These Annex I bedrock reef habitats found in the baseline survey were not included within the predicted habitat map (EMODnet) for the proposed area, which instead classed them as A5.14 – '*Circalittoral coarse sediment*'. This highlights the importance of completing baseline visual seabed surveys. The confidence in defining the extent of these reef locations is however low as the bathymetry data available did not allow for an accurate assessment of topographic highs which would normally be used to map bedrock features.

The PMF habitat '*Kelp and seaweed communities on sublittoral sediment*' was identified in 42 seabed images and subsequently mapped across the proposed West Gigha salmon farm in < 20 m water depths (Figure 6). '*Kelp and seaweed communities on sublittoral sediment*' can support a wide range of associated fauna including burrowing polychaete worms and bivalves, hermit crabs, crabs, starfish, fish and grazing top shells. This habitat can be sensitive to substrate loss, changes in water flow/wave exposure and/or deoxygenation. Anthropogenic pressures on this habitat include climate change, coastal development, and bottom trawling. This feature was not included within the predicted habitat map (EMODnet) which instead mapped the area as a BSH A3.1, once again confirming the importance of completing these baseline surveys. Due to the low resolution of the bathymetry data, a low confidence score was assigned when assessing the extent of this PMF. No PMF species were observed.

7. References

- Irving, R. (2009). *The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. JNCC Rep No 432:44.*
- Langenkämper, D., Zurowietz, M., Schoening, T., & Nattkemper, T. W. (2017). BIIGLE 2.0 - Browsing and Annotating Large Marine Image Collections. *Frontiers in Marine Science*, 4, 83. <https://doi.org/10.3389/fmars.2017.00083>
- Turner, J. A., Hitchin, R., Verling, E., & van Rein, H. (2016). *Epibiota remote monitoring from digital imagery: Interpretation guidelines* (Issue June).