

Balliemeanoch Pumped Storage Hydro

Environmental Impact Assessment
Report

Volume 5: Appendices
Appendix 8.1: Balliemeanoch Jetty
Development Intertidal Benthic Survey
Report

ILI (Borders PSH) Ltd

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Balliemeanoch Jetty Development Intertidal Benthic Survey Report

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Abbreviations

CAA	Civil Aviation Authority
DEM	Digital Elevation Model
EUNIS	European Nature Information System
GPS	Global Positioning System
GSD	Ground-Sampling Distance
INNS	Invasive Non-Native Species
JNCC	Joint Nature Conservation Committee
MNCR	Marine Habitat Classification for Britain and Ireland
NCMPA	Nature Conservation Marine Protected Area
OEL	Ocean Ecology Ltd
PfCO	Permission for Commercial Operations
PMF	Priority Marine Features
RMSE	Root Mean Square Errors
RPO	Remote Pilot Qualification
UAV	Unmanned Aerial Vehicle

1. Non-Technical Summary

This report presents the results of the intertidal survey conducted at the site of the proposed Balliemanoich jetty development in Inverary, Loch Fyne. The key aim of this survey was to gather detailed information to inform subsequent habitat / biotope mapping to characterise the habitats and associated communities within the proposed development site.

The survey took place within the intertidal zone of the middle section of Loch Fyne, Scotland, between Lochgilphead and Inveraray. This survey involved the collection of Unmanned Aerial Vehicle (UAV) imagery which was accompanied by a Phase I walkover habitat and species assessment.

A range of broadscale littoral rock and sediment habitats and associated algal communities were identified within the intertidal zone of the proposed site but primarily the intertidal zone consisted of the EUNIS broad scale habitat A1.3 'Low Energy Littoral Rock'. Cobbles were the dominant substrate throughout the intertidal zone but areas of sandy mud, muddy sandy gravel and bedrock were also observed.

Target notes were taken at 24 locations across the intertidal zone. The Bladder wrack (*Fucus vesiculosus*) was observed in high density as well as the sea lettuce (*Ulva intestinalis*) whilst the channelled wrack (*Pelvetia canaliculata*) was sparsely distributed. No Priority Marine Features (PMF) were observed.

2. Introduction

2.1. Project Overview

AECOM commissioned Ocean Ecology Limited (OEL) to undertake subtidal benthic ecology and intertidal Unmanned Aerial Vehicle (UAV) and Phase I walkover surveys at the site of the proposed Balliemanoach jetty development in Inveraray, Loch Fyne (Figure 1). The survey area includes the shallow subtidal down to water depths of 6 m and intertidal foreshore with drying heights of 1-2 m. Beyond the survey area the subtidal extends into the deep water of the loch in excess of 100 m.

This report outlines the design and implementation of the intertidal element of this survey, comprising the collection of UAV imagery and Phase I walkover survey, as well as briefly describing some of the key findings.

2.2. Background Information

The survey site is located within the middle section of Loch Fyne, Scotland, between Lochgilphead and Inveraray. Water depths range from 6m to >100m. The survey area is thought to be dominated by soft sediments, with fine mud toward the middle of the loch. To the eastern shore of the loch, there are patches of cobbles and pebbles overlain with shell. Gravel and fine sediment are also reported to around 5 to 10 m depth along the eastern edge of the survey area.

The proposed site is situated within both the Upper Loch Fyne and Loch Goil Nature Conservation Marine Protected Area (NCMPA), and a Shellfish Water Protected Area. Loch Fyne is a Marine Management Area-Area Code 19a and Locational Guideline Area Category 3.

2.2.1. Upper Loch Fyne and Loch Goil NCMPA

The Upper Loch Fyne and Loch Goil NCMPA supports a range of protected features and habitats including burrowed mud, flame shells beds, horse mussel beds, sublittoral mud and specific mixed sediment communities. These features are distributed throughout the area and have led to the current nature conservation designation of the area. This marine conservation designation protects the area with the aim of recovering the flame shell beds and conserving all other features of interest within the area.

2.3. Aims and Objectives

The primary aim of this survey was to characterise the benthic habitats and species across the intertidal areas of the proposed development site via:

- UAV mapping to cover the intertidal extent of the proposed development boundary and its environs (blue area in Figure 1)
- Undertaking a Phase 1 intertidal walkover survey at the site to ground truth the UAV data and characterise the habitats and species present.

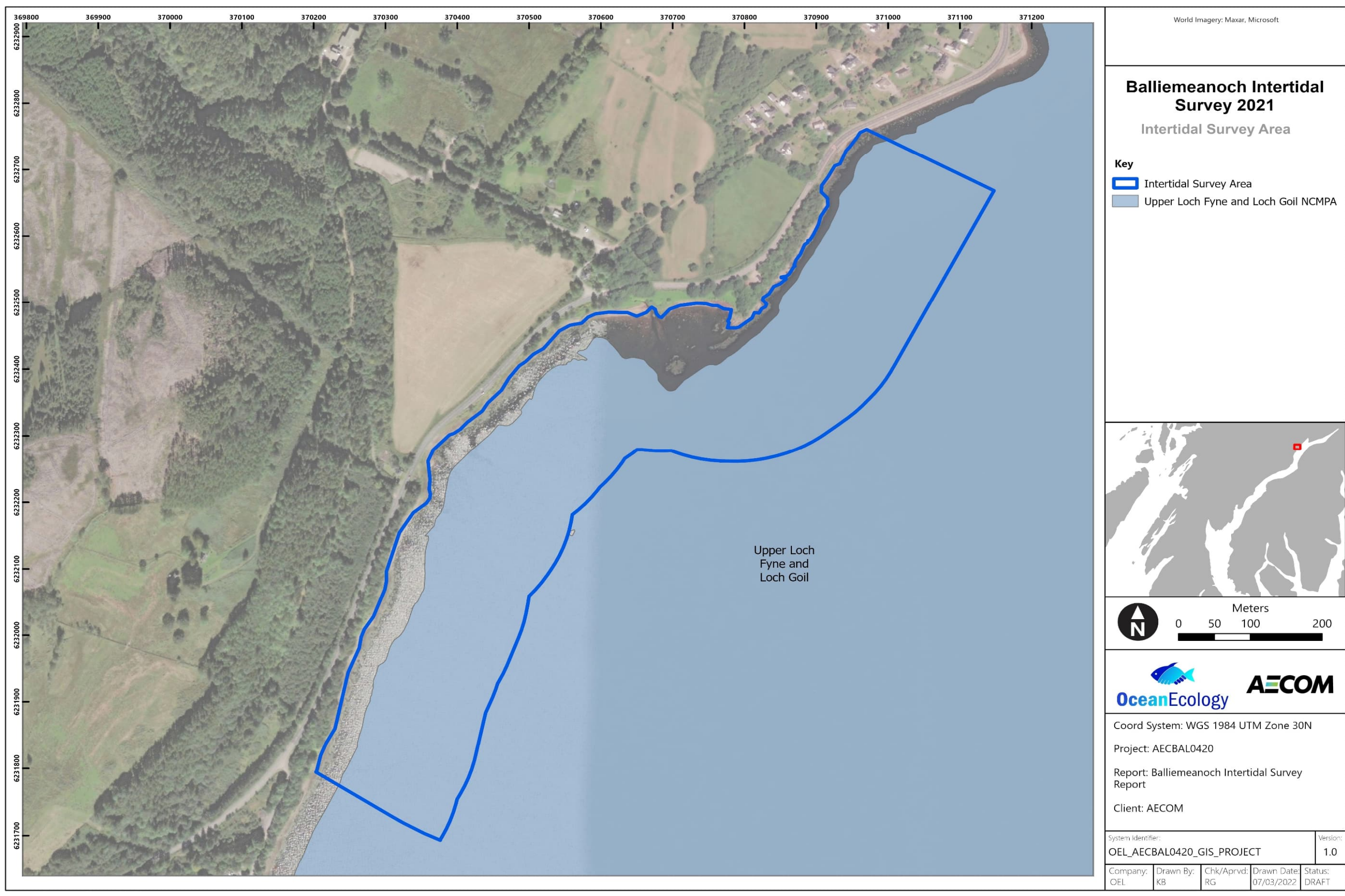


Figure 1 Intertidal survey area at the proposed Balliemanoch Jetty Development Site.

3. Survey Methods

3.1. Survey Design

The intertidal survey covered an area of 298,604 m² and included a UAV flight and a Phase I walkover survey of the entire area. The UAV flight was undertaken to collect high-resolution imagery at low water and the walkover survey was undertaken as a means of collecting ground-truthing information on the habitats and species present to inform subsequent habitat / biotope mapping of the site.

3.2. Field Methods

3.2.1. UAV Mapping

The UAV mapping was carried out in consideration of the Joint Nature Conservation Committee (JNCC) guidance for use of UAVs in marine benthic monitoring (Crabb et al. 2019). All flights were conducted by OELs Qualified UAV Pilots (RPOs) under its Permission for Commercial Operations (PFCO) (CAA ID: 2654) granted by the Civil Aviation Authority (CAA). The UAV used was a DJI Phantom 4 multi-rotor quadcopter and all flights were pre-planned using Drone Deploy software to achieve an orthomosaic Ground-Sampling Distance (GSD) of 2.73 cm/px with an accuracy¹ of 1.75 m. Line orientation was determined within Drone Deploy to maximise survey efficiency.

3.2.2. Phase 1 Walkover Survey

The Phase I walkover was undertaken using ESRI ArcCollector on a Bad Elf GPS & GLONASS (2.5 m accuracy) enabled tablet device in line guidance in the Marine Monitoring Handbook (Davies et al. 2001), CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn et al. 2006) and the latest guidance for characterising intertidal rocky shore and sediment habitats (NRW 2019a b). During the walkover survey, biotopes were identified according to the EUNIS habitat classification system in line with relevant guidance (Parry 2019) and correlated to the Marine Habitat Classification for Britain and Ireland (MNCRI). Detailed survey log and field notes are provided in Appendix I.

Representative examples of each habitat / biotope encountered were photographed. Additionally, the presence / distribution of any features of conservation interest was to be recorded using photographs and GPS fixes if encountered. The presence of any Invasive Non-Native Species (INNS) was also to be noted and their location recorded. Other information recorded included general site conditions, sediment type and characteristics, topography and evidence of any anthropogenic pressures.

¹ Measured as Root Mean Square Errors (RMSE)

Target notes were taken at any notable change in habitat / substrate and identified the presence of any notable features. These were accompanied by GPS fixes and close-up photographs of each feature, along with general site photographs. Aspect images to the North, East, South and West from each sample location were also taken. All field photographs are provided as Appendix II.

3.3. Analysis

3.3.1. UAV Imagery Analysis

Following initial screening to remove any erroneous images, all images collected during the UAV mapping flights were 'stitched' together to generate orthomosaic and Digital Elevation Model (DEM) outputs for the intertidal survey areas using Drone Deploy software ().

4. Results

4.1. Survey Progress

The UAV flight and Phase 1 walkover surveys were both undertaken on the 27th August 2021. Table 1 provides a summary of the sampling undertaken and the information collected during the survey.

Table 1 Summary of sampling undertaken and information collected during the intertidal survey

Sampling	Balliemanoach intertidal
Target Notes	24
UAV imagery	495 images

4.2. UAV Survey

UAV mapping was undertaken at the proposed development site over low water on the 27th August 2021. The UAV flight successfully captured 495 high-resolution nadir images across a coverage area of 0.3 km² to produce a high resolution orthomosaic model (GSD = 2.73 cm/px) and DEM (GSD = 10.91 cm/px) () with an average RMSE accuracy level of 1.75 m.

Example of UAV images are provided in Error! Reference source not found. and the full orthomosaic and DEM outputs are presented in . The processed UAV imagery outputs including orthomosaic, elevation model and UAV imagery processing report are provided as Appendix III.

4.3. Phase I intertidal Walkover

In total, target notes were taken at 24 locations (Figure 3) All geographic information collected during the Phase I walkover survey is provided as an ArcGIS geodatabase in Appendix IV.



Plate 1 Example of UAV imagery collected across the proposed Balliemeanoch Jetty Development Site.

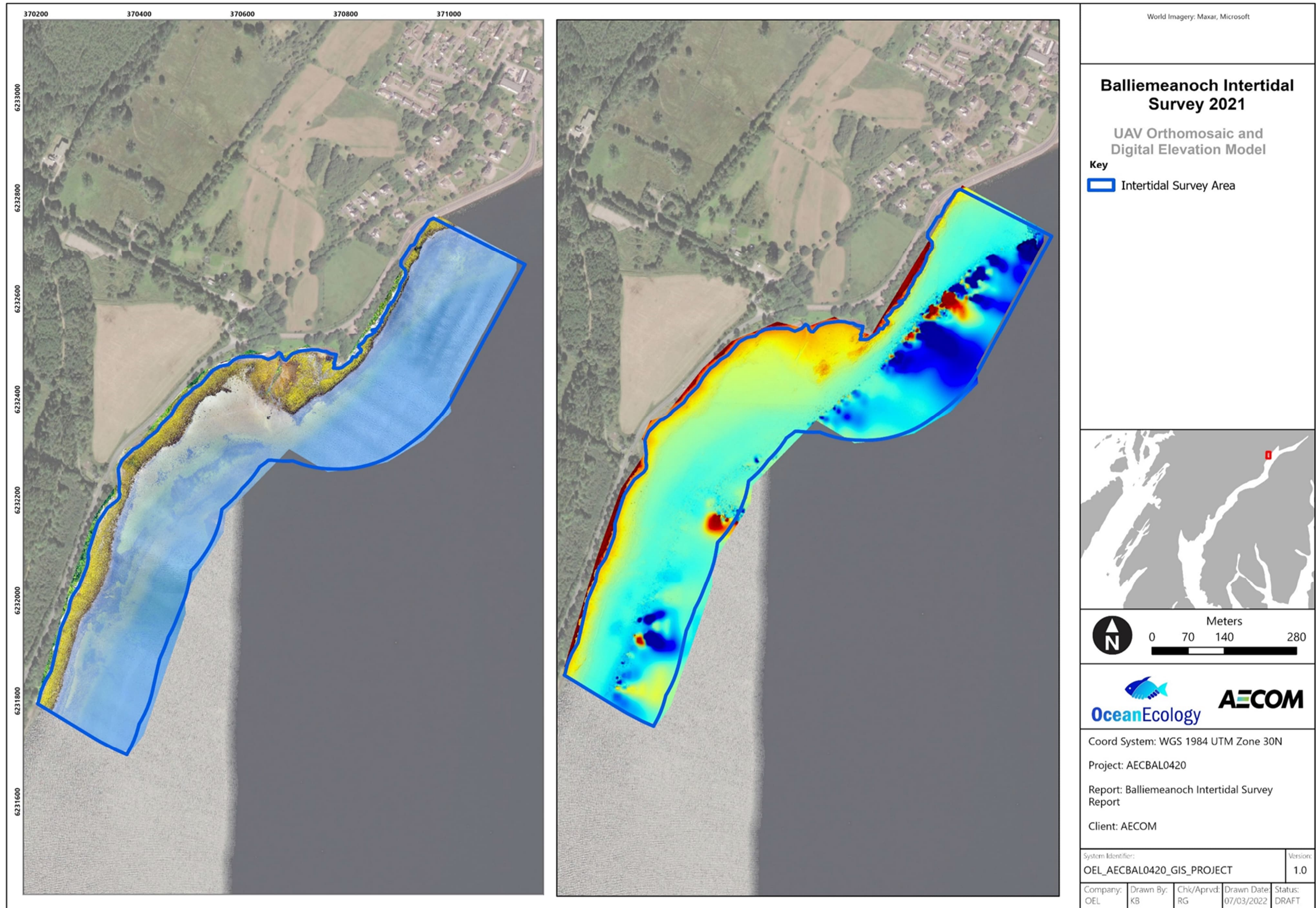


Figure 2 UAV orthomosaic (left) and Digital Elevation Model (DEM) (right) generated from the UAV imagery collected during the intertidal survey of the proposed Balliemanoach Jetty Development Site.



Figure 3 Location of target notes at the proposed Balliemeanoch Jetty Development Site.

4.4. Habitat Overview

The intertidal area within the proposed development site presented a range of broadscale littoral rock and sediment habitats with varied associated algal communities typical of intertidal areas. A summary of EUNIS classifications recorded during the intertidal survey is provided in Table 2.

Table 2 Key EUNIS classifications recorded at the proposed Balliemeanoch Jetty Development Site

EUNIS BSH	EUNIS Code	EUNIS Description
A1.3	A1.311	<i>Pelvetia canaliculata</i> on sheltered littoral fringe rock
	A1.312	<i>Fucus spiralis</i> on sheltered upper eulittoral rock
	A1.3142	<i>Ascophyllum nodosum</i> on full salinity mid eulittoral mixed substrata
	A1.3151	<i>Fucus serratus</i> on full salinity sheltered lower eulittoral rock
	A1.322	<i>Fucus spiralis</i> on sheltered variable salinity upper eulittoral rock
	A1.324	<i>Ascophyllum nodosum</i> and <i>Fucus vesiculosus</i> on variable salinity mid eulittoral rock
A1.4	A1.421	Green seaweeds (<i>Enteromorpha</i> spp. and <i>Cladophora</i> spp.) in shallow upper shore rockpools
	A1.451	<i>Enteromorpha</i> spp. on freshwater-influenced and/or unstable upper eulittoral rock
A2.1	A2.111	Barren littoral shingle
A2.2	-	Littoral sand and muddy sand
B3.1	-	Supralittoral rock (lichen or splash zone)

5. References

- Crabb M, Wright P, Hymphrey O, Johnson G, Rush S, van Rein H, Hinchin H (2019) Unmanned Aerial Vehicles for use in marine monitoring. 1–36.
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- NRW (2019a) GN030a Benthic habitat assessment guidance for marine developments and activities: A guide to characterising and monitoring intertidal rocky shore habitats and rockpools. 1–46.
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- Wyn G, Brazier P, Birch K., Bunker A, Cooke A, Jones M, Lough N (2006) CCW Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey.

