Ocean Ecology

Marine Surveys, Analysis & Consultancy

Holyhead Waterfront Development

Intertidal Benthic Habitat Mapping Survey 2020

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Details

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Contents

1. Non-Technical Summary

This report presents the findings of an intertidal survey conducted in August 2020 aimed at characterising and mapping the benthic habitats present along the Holyhead foreshore as part of a series of characterisation surveys for the Holyhead Waterfront Development. Phase I and Phase II walkover surveys were undertaken, supplemented by the collection of Unmanned Aerial Vehicle (UAV) aerial imagery.

The intertidal area between Soldiers Point and the Irish Ferries freight terminal was found to be complex and highly variable with steeply sloping bedrock, flat expanses of rock and stable substrate, representative of Annex I reef and interspersed coarse / mixed sediments. Rock habitats were dominated by fucoids and representative of low to medium exposure environments. *F. spiralis* was the most abundant species in the high shore, although *P. canaliculata* was found alongside it. The mid shore was dominated by *F. vesiculosus* and *A. nodosum*, often interchanging dominance depending on the degree of shelter, whilst *F. serratus* dominated the lower shore.

The intertidal area is heavily impacted by anthropogenic sources including extensive areas of sea defence, water accessways (e.g. piers, jetties and slipways) and several sources of freshwater run-off.

2. Introduction

2.1. Project Background

It is understood that Conygar Ltd. is proposing to development an area of the Holyhead coastal frontage, known as the Holyhead Waterfront Development. A previous marine ecology survey was undertaken in 2009 to inform an Environmental Impact Assessment (EIA), which was submitted to the Isle of Anglesey County Council in 2010, in support of an application for outline planning permission.

Ocean Ecology Limited (OEL) was commissioned by Royal HaskoningDHV to conduct a programme of marine survey work, required to update the 2009 survey, taking account of change to the Proposed Development and also to provide geotechnical data on the soft surface sediments.

2.2. Objectives

As part of this survey programme, OEL were commissioned to undertake an intertidal Phase I walkover survey and Phase II sampling (quadrats) of the intertidal section of the proposed waterfront development area to a) establish the main benthic habitats present and b) characterise the associated marine biological communities. The survey area stretched from Soldiers Point at the most southerly end of Holyhead breakwater in the west to the Irish Ferries freight terminal in the east, equating to approximately 1.5 km of foreshore (Figure 1).

This report provides a summary of the survey methodologies employed and a description of the habitats encountered during the survey. Habitats were determined through the collection of Unmanned Aerial Vehicle (UAV) imagery, Phase I walkover and Phase II quadrat interpretation allowing for the determination of EUNIS habitats and biotopes (where possible) and subsequent creation of full coverage mapping across the survey area.

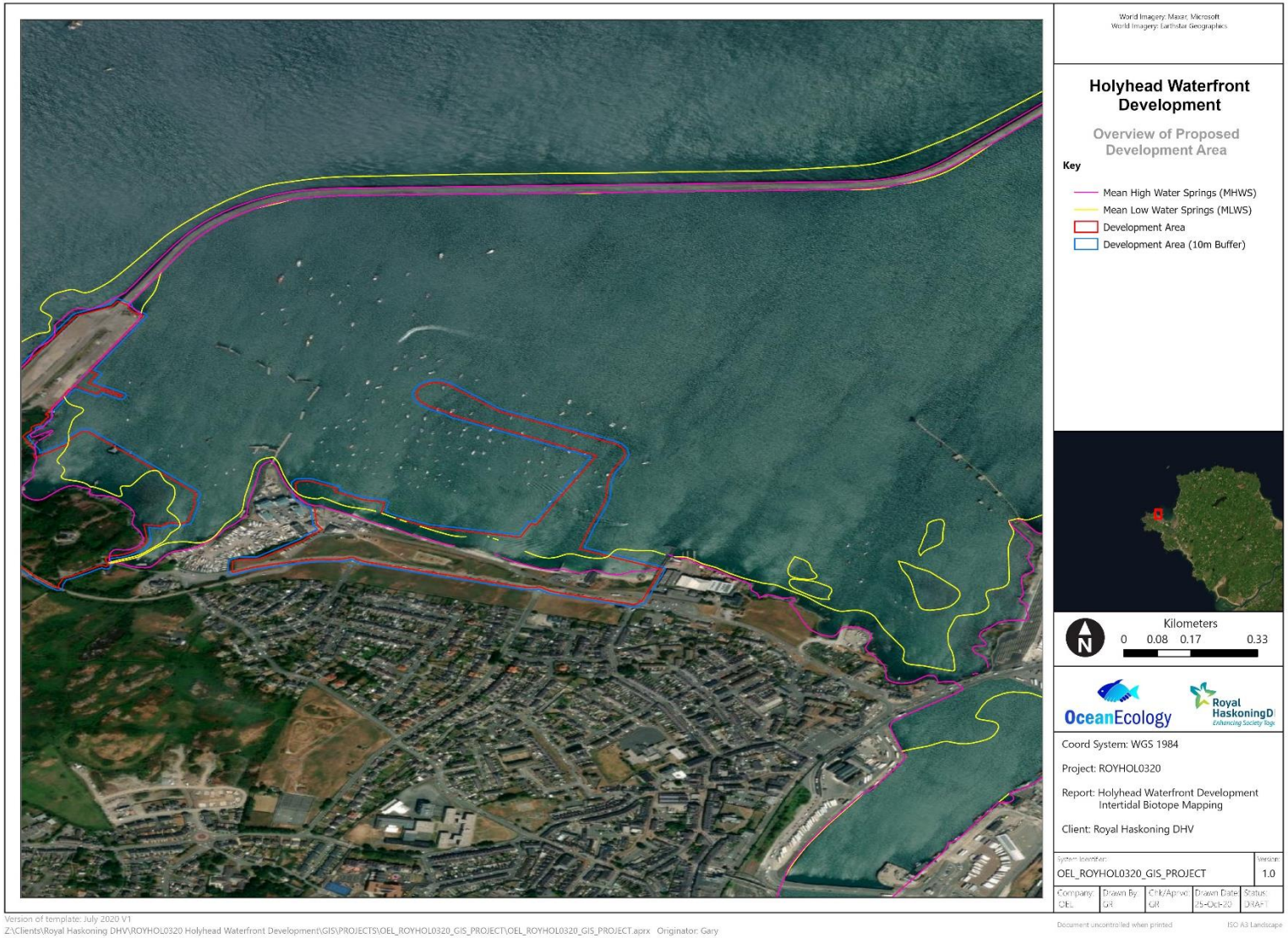

Figure 1 Overview of Holyhead Waterfront Development area showing extent of intertidal survey area from Soldiers Point to Irish Ferries freight terminal.

2.3. Current Understanding

Existing intertidal habitat mapping (EMODnet) suggests the habitats present within Holyhead Waterfront Development area consist of a mix of intertidal coarse sediments, mixed sediments and rocky shore environments. The eastern and western parts of the survey area are thought to be dominated by rocky shore (EUNIS A1.1 – 1.3) whilst the central area, running along the promenade is thought to be dominated by sand and gravel beaches (EUNIS A2.1) with patches of rock (EUNIS A1.1-1.3) and areas of artificial hard substrate with associated epibenthic communities.

The intertidal area is heavily impacted by anthropogenic sources including extensive areas of sea defence, water accessways (e.g. piers, jetties and slipways) and several sources of freshwater run-off. Holyhead marina and yacht club are located within the western section of the intertidal area, Holyhead boatyard is located in the central section and the Irish Ferries freight terminal lines the upper shore of the eastern intertidal areas.

The intertidal survey area lies within the Anglesey Terns (Morwenoliaid Ynys Môn) Special Protection Area (SPA) which has been designated to protect breeding tern colonies and their foraging areas and within the North Anglesey Marine (Gogledd Môn Forol) Special Area of Conservation (SAC).

3. Methods

3.1. Survey Design

The Phase I intertidal survey covered the entirety of the proposed development area from Soldiers Point in the west to the Irish Ferries freight terminal in the east from Mean Low Water Springs (MLWS) to Mean High Water Springs (MHWS) (as shown in Figure 1). A UAV survey was undertaken to collect high-resolution imagery across the survey area at low water. Additionally, a total of 44 quadrats and 189 target notes were undertaken across the survey area to further supplement the Phase I walkover survey and UAV imagery and inform detailed biotope mapping.

3.2. Survey Methods

3.2.1. Phase I Walkover Survey

The Phase I intertidal survey was undertaken during spring tides using ESRI ArcCollector on a GPS enabled tablet device in line with guidance in the Marine Monitoring Handbook (Marine Monitoring Handbook March 2001 2001), CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn et al. 2006) and 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 (and correlated to the MNCR biotopes) and, where possible, boundaries of habitats/biotopes were tracked as polygons in ArcCollector.

Representative examples of each habitat/biotope encountered were photographed. Additionally, the distribution of any features of conservation interest were recorded using photographs and GPS fixes where encountered. The presence of any invasive non-native species (INNS) (e.g. *Crepidula fornicata*) was also noted and their location recorded. Other information recorded included general site conditions, sediment surface features, sediment type and characteristics, topography and anthropogenic pressures.

3.2.2. 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 (RPQs) under its Permission for Commercial Operations (PfCO) (CAA ID: 2654) granted by the Civil Aviation Authority (CAA)[1]. The UAV used was a DJI Phantom 4 multi-rotor quadcopter. The flight(s) were pre-planned using in Drone Deploy software to achieve an orthomosaic Ground-Sampling Distance (GSD) of 1-3 cm/px with an accuracy[2] of 5-10 m.

1 Ocean Ecology's UAV aerial survey operations comply with all UK legislation regarding commercial use of Small Unmanned Aerial Systems (sUAS). This requires that Ocean Ecology hold a CAA PfCO, Liability Insurance, a CAA approved Operational Manual and Qualified UAV Pilots (RPQs).

[2] Measured as Root Mean Square Errors (RMSE).

3.2.3. Target Notes

Target notes were taken at any notable change in habitat / substrate and to identify the presence of any notable features (e.g. intertidal rockpools). These were accompanied by GPS fixes and close up photographs of key features along with general site photographs.

3.2.4. Phase II Quadrat Sampling

ESRI ArcCollector was used on a GPS enabled tablet device to navigate between targeted quadrat sampling stations located across areas of hard substrate throughout the survey area to adequately sample the range of different hard substrate biotopes present.

Areas representative of each key hard substrate habitat at different tidal heights were assessed by recording the epibiotal taxa present in randomly placed 0.25 m^2 (0.5 m x 0.5 m) quadrats. Identification was taken to species level where possible and undertaken in the field. Any cryptic taxa that was not identified in the field was retained and identified in the laboratory.

At each quadrat location the substrate was subject to a visual inspection and observations of colour, smell, texture and presence of surface features (accretions, algae, fauna, etc.) recorded. A high-resolution photograph was taken directly above the quadrat (in plan view) for subsequent analysis, and a further four photographs were taken in a north, east, south and west orientation.

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 area using Drone Deploy software. The outputs were then used as base maps in GIS to facilitate subsequent habitat/biotope mapping by visual interrogation and delineation of boundaries.

3.3.2. EUNIS Classification Mapping

EUNIS habitats and biotopes were identified in consideration of JNCC guidance on assigning benthic biotopes (Parry 2019) to allow the communities to be mapped and allow comparison with existing data. All habitat/biotope determination was undertaken through consideration of the following:

- Existing habitat mapping (derived from EMODnet)
- UAV imagery interpretation
- Review and interpretation of target field notes and quadrat imagery
- General site imagery

4. Results

4.1. Survey Progress

This intertidal survey programme was split into three distinct areas (West, Mid and East) and was undertaken over three spring low tides between the 4th and 7th August 2020. Table 1 provides a summary of the sampling undertaken and information collected during the survey. Plate 1 provides an overview of the shore at different sites across the survey area.

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

Sampling	Intertidal Survey Area
Quadrats	44
Target Notes	189
UAV imagery	614 high resolution images

Plate 1 Left: Western intertidal area looking east towards the marina showing rocky shore dominated by EUNIS biotope A1.324 Mid: Central intertidal area looking west towards marina showing the EUNIS biotope A1.214 and sediment habitat A2.11 Right: Eastern intertidal showing rocky shore dominated by EUNIS biotope A1.324 with freight terminal in the background.

4.2. UAV Survey

UAV mapping of the proposed Holyhead Waterfront development survey area was undertaken over a 90-minute period around low water on August 3rd, 2020. The survey was split into three independent flights to cover the west, east and central extent of the survey with a total flight duration across all three flights of 44 minutes. Flight height was maintained at 65m for all areas and weather conditions (e.g. wind / precipitation) remained favourable for data collection throughout.

The UAV survey successfully captured over 610 high-resolution nadir images across a coverage area of 363,018 m^2 to produce a high resolution orthomosaic model (GSD = 2.89 cm/px) and DEM (GSD = 11.56 cm/px) with an average RSME accuracy level of 1.7m.

Orthomosaic and DEM results from the UAV survey are presented in Figure 2 to Figure 4.

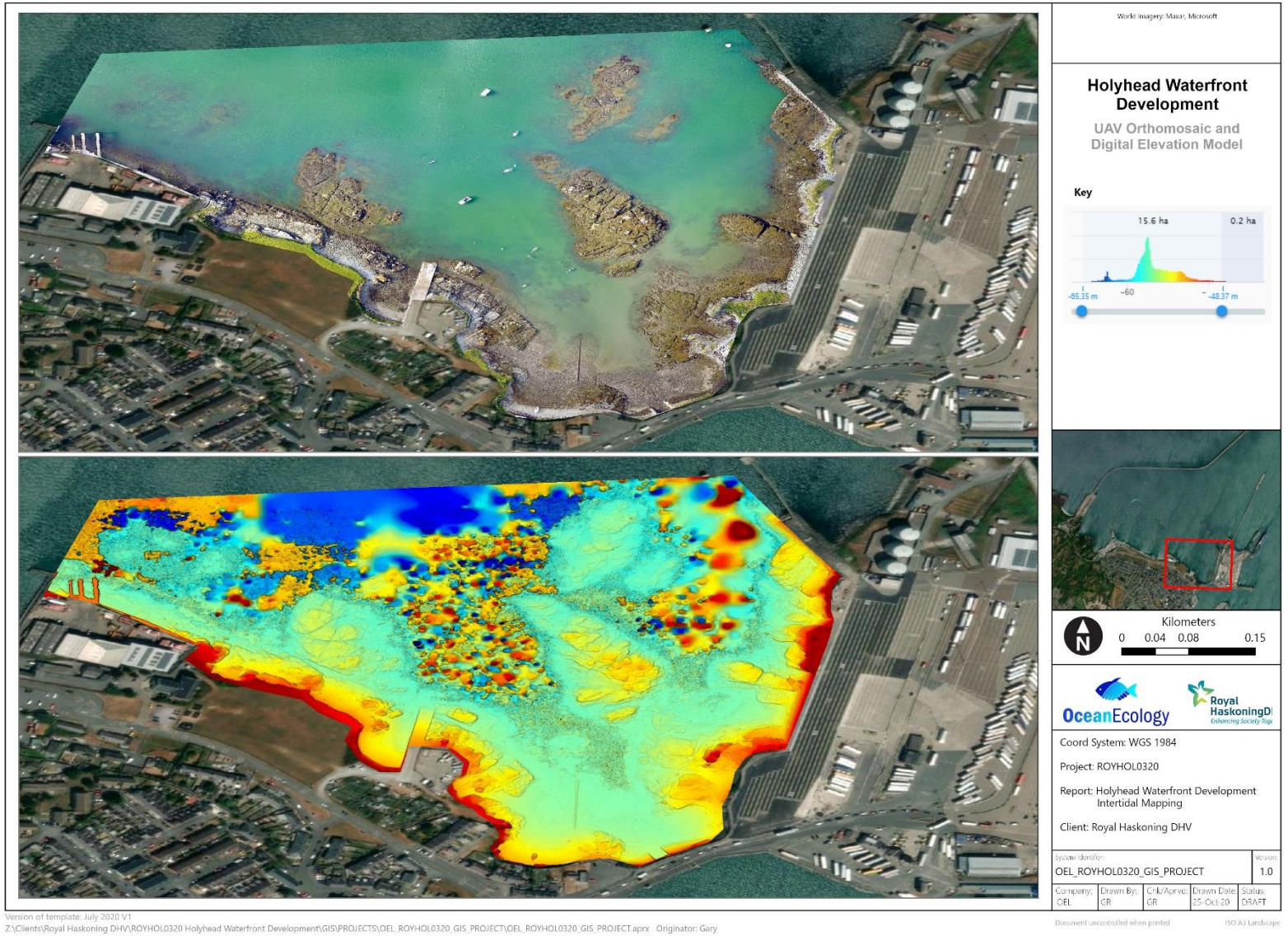

Figure 2 UAV orthomosaic and Digital Elevation Model (DEM) data collected during the Holyhead Waterfront development survey (East).

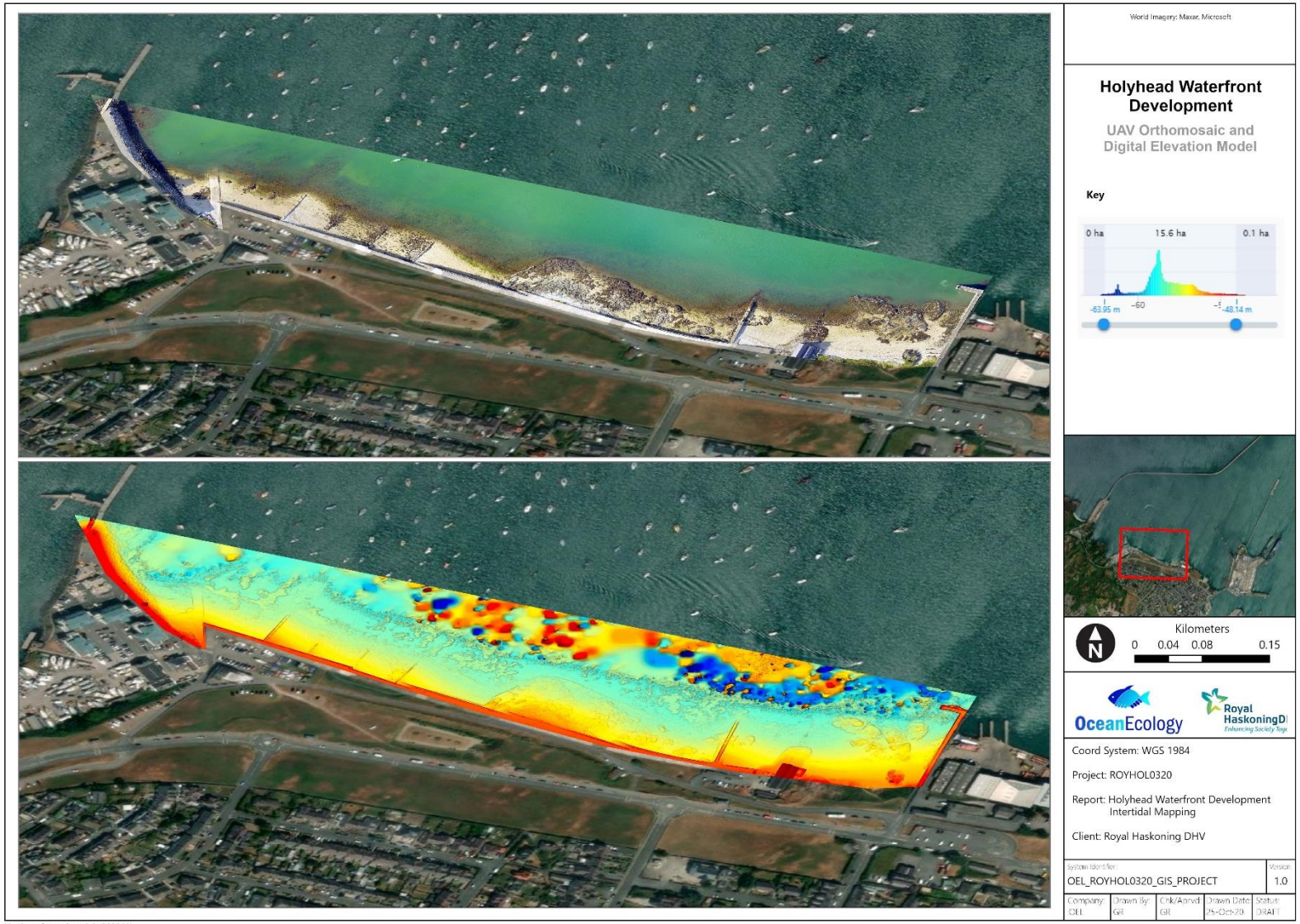

Figure 3 UAV orthomosaic and Digital Elevation Model (DEM) data collected during the Holyhead Waterfront development survey (Mid).

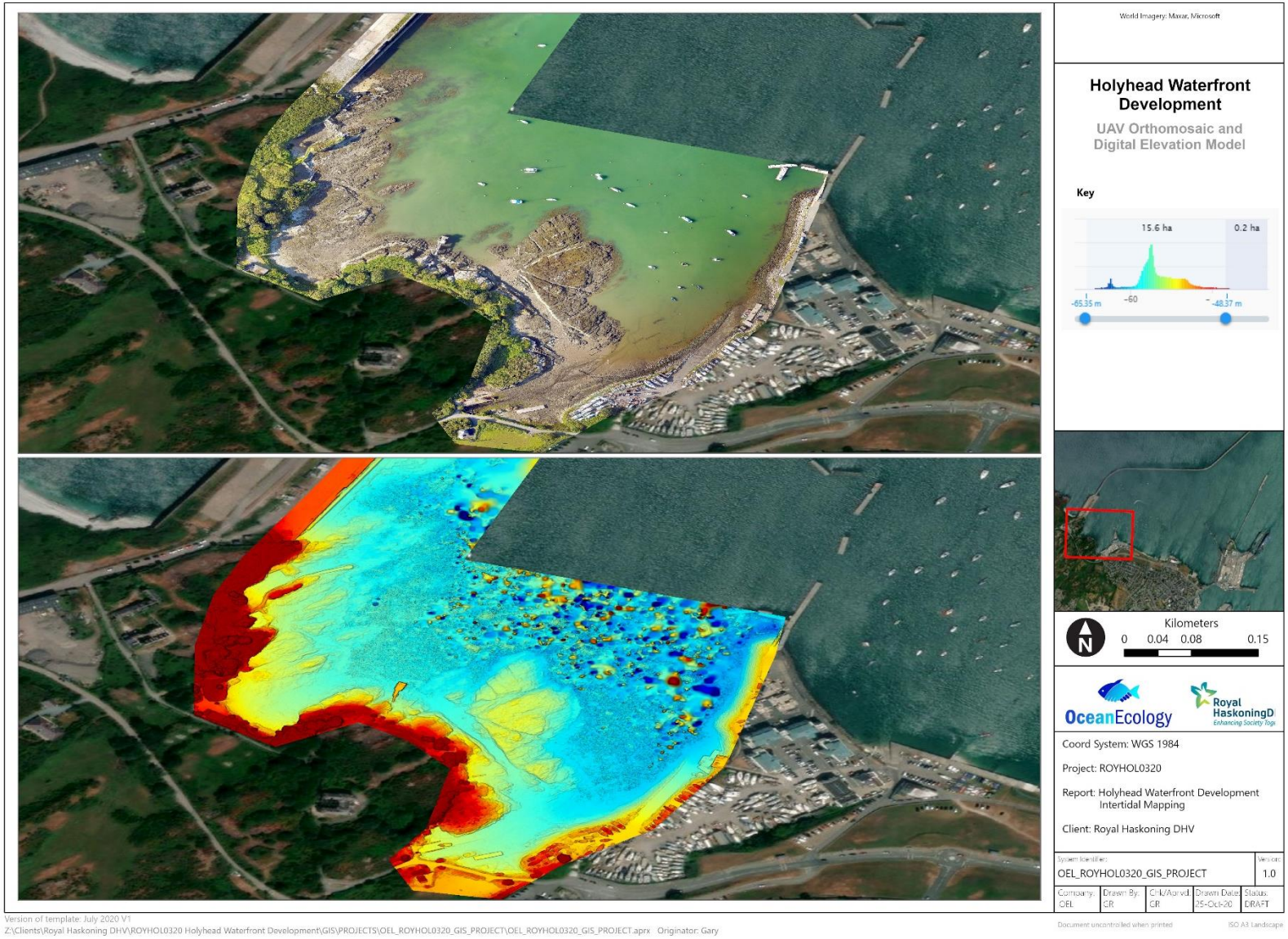

Figure 4 UAV orthomosaic and Digital Elevation Model (DEM) data collected during the Holyhead Waterfront development survey (West).

4.3. Site Overview

The topography and level of exposure / energy differed considerably across the survey area due to the variable aspect of the shoreline and the variety of anthropogenic influences such as the breakwater, marina and ferry terminal which all offer differing levels of shelter.

The western intertidal area between Soldiers Point and the rip rap sea defence for the marina is complex. This area exhibits a number of gullies extending from the lower shore up to the upper shore which is backed by rock walls and sea defence with vegetation. This section of the survey area has extensive intertidal expanses in sections and also affords some raised intertidal areas cut off from mid tide to form islets within the sheltered bay. This extensive intertidal area is dominated by low to medium energy biotopes. The mid-section of the survey area stretches from the marina to Holyhead boat yard and is a narrow and gently arcing section of intertidal area dominated by a gently sloping, seawall-backed shingle and gravel shoreline with occasional areas of rock habitats with associated fucoids. The eastern section lies adjacent to the Irish Ferries freight terminal and is a complex mosaic of rocky shore platforms, isolated intertidal islets and stable mixed substrate / mixed sediment environment. Similar to the western reaches, an extensive intertidal area allows for large areas of mid-shore, sheltered environment species such as *Fucus vesiculosus* and *Ascophllyum nodosum*.

4.4. Habitat/Biotope Mapping

There was a total of 29 unique biotopes (EUNIS level 4 or above) from a total of nine broadscale habitats (BSH) (Table 2). Biotopes have been mapped in Figure 5 to Figure **9**.

The intertidal survey area was found to support a wide variety of moderate energy littoral rock (A1.2) and low energy littoral rock (A1.3) biotopes interspersed with discrete patches of littoral mixed sediment (A2.4) and littoral coarse sediment (A2.1), notably A2.11 shingle (pebble) and gravel shores. Notable zonation was noted in the rocky shore habitats and this gradation down the shore typically followed that of other moderately exposed to low exposure shores. The upper shore generally characterised by *'B3.11 Lichens or small green algae on supralittoral and littoral fringe rock'*, the mid shore characterised by *'A1.31 Fucoids on sheltered marine shores'* and *'A1.32 Fucoids in variable salinity'* and the lower shore characterised by *Fucus serratus*.

Below the supralittoral zone, a narrow band of *Pelvetia canaliculata* (A1.211 / A1.311) graded into a wider band dominated by *Fucus spiralis* (A1.212 / A1.312). The middle shore was dominated almost entirely by the biotope *'A1.324 [Ascophyllum nodosum] and [Fucus vesiculosus] on variable salinity mid eulittoral rock'* with areas of vertical rock face or exposed rock characterised by the biotope *'A1.113 [Semibalanus balanoides] on exposed to moderately exposed or vertical sheltered eulittoral rock'*. The lower shore was dominated by *F. serratus* (A1.214 & A1.315) and particularly between the marina and Holyhead boatyard, *'A1.2141 [Fucus serratus] and red seaweeds on moderately exposed lower eulittoral rock'* and *'A1.45 Ephemeral green or red seaweeds (freshwater or sand-influenced) on nonmobile substrata'*. Incidental occurrences of the biotope *'A1.125*

[Mastocarpus stellatus] and [Chondrus crispus] on very exposed to moderately exposed lower eulittoral rock' were also noted along this more exposed stretch of the foreshore. Notably in the western area between Holyhead boatyard and the Irish Ferries terminal, very sheltered bedrock areas were characterised by the biotope *'A1.314 [Ascophyllum nodosum] on very sheltered mid eulittoral rock',* interspersed with large areas of stable mixed substrata (cobble and boulder), dominated by the biotope *'A1.3132 [Fucus vesiculosus] on mid eulittoral mixed substrata'*. Rockpools of varying sizes and supporting a range of communities were ubiquitous across the site typical of *'A1.41 Communities of littoral rockpools'*.

All areas of littoral rock biotopes within the intertidal area were representative of Annex I bedrock reef as mapped in Figure 5 to Figure **9**.

It was noted that the intertidal area is heavily anthropogenically influenced with large areas of the foreshore area either made up by or at least fringed by artificial defences consisting of rock armours and riprap, slipways and piers or jetties. Artificial substrate was either bare or with Balanoidea, limpets and dogwhelk. Several sources of freshwater run-off were identified including a significant stream into the intertidal zone in the westernmost area, adjacent to the marina (Figure 5). This area was dominated by the biotopes *'A1.327 [Fucus ceranoides] on reduced salinity eulittoral rock'* and *'A1.451 [Enteromorpha] spp. on freshwater influenced and/or unstable upper eulittoral rock'*.

Table 2 Key biotopes recorded during the intertidal survey of the Holyhead Waterfront Development area.

EUNIS BSH	EUNIS Code	EUNIS Description
A1.1	A1.113	[Semibalanus balanoides] on exposed to moderately exposed or vertical sheltered eulittoral rock
	A1.1131	[Semibalanus balanoides], [Patella vulgata] and [Littorina] spp. on exposed to moderately exposed or vertical sheltered eulittoral rock
	A1.125	[Mastocarpus stellatus] and [Chondrus crispus] on very exposed to moderately exposed lower eulittoral rock
A1.2	-	Moderate energy littoral rock
	A1.211	[Pelvetia canaliculata] and barnacles on moderately exposed littoral fringe rock
	A1.212	[Fucus spiralis] on full salinity exposed to moderately exposed upper eulittoral rock
	A1.213	[Fucus vesiculosus] and barnacle mosaics on moderately exposed mid eulittoral rock
	A1.214	[Fucus serratus] on moderately exposed lower eulittoral rock
	A1.2141	[Fucus serratus] and red seaweeds on moderately exposed lower eulittoral rock
A1.3	-	Low energy littoral rock
	A1.31	Fucoids on sheltered marine shores
	A1.311	[Pelvetia canaliculata] on sheltered littoral fringe rock
	A1.312	[Fucus spiralis] on sheltered upper eulittoral rock
	A1.313	[Fucus vesiculosus] on moderately exposed to sheltered mid eulittoral rock
	A1.3132	[Fucus vesiculosus] on mid eulittoral mixed substrata
	A1.314	[Ascophyllum nodosum] on very sheltered mid eulittoral rock
	A1.315	[Fucus serratus] on sheltered lower eulittoral rock
	A1.3152	[Fucus serratus] on full salinity lower eulittoral mixed substrata
	A1.321	[Pelvetia canaliculata] on sheltered variable salinity littoral fringe rock
	A1.322	[Fucus spiralis] on sheltered variable salinity upper eulittoral rock
	A1.323	[Fucus vesiculosus] on variable salinity mid eulittoral boulders and stable mixed substrata
	A1.324	[Ascophyllum nodosum] and [Fucus vesiculosus] on variable salinity mid eulittoral rock
	A1.327	[Fucus ceranoides] on reduced salinity eulittoral rock
A1.4	A1.42	Communities of rockpools in the supralittoral zone
	A1.45	Ephemeral green or red seaweeds (freshwater or sand-influenced) on nonmobile substrata
	A1.451	[Enteromorpha] spp. on freshwater influenced and/or unstable upper eulittoral rock
A2.1	A2.11	Shingle (pebble) and gravel shores
A2.2	A2.22	Barren or amphipod-dominated mobile sand shores
A2.3	-	Littoral mud
A2.4	-	Littoral mixed sediments
B3.1	-	Supralittoral rock (lichen or splash zone)
	B3.11	Lichens or small green algae on supralittoral and littoral fringe rock
	B3.111	Yellow and grey lichens on supralittoral rock
	B3.113	[Verrucaria maura] on littoral fringe rock
Artificial Substrate		

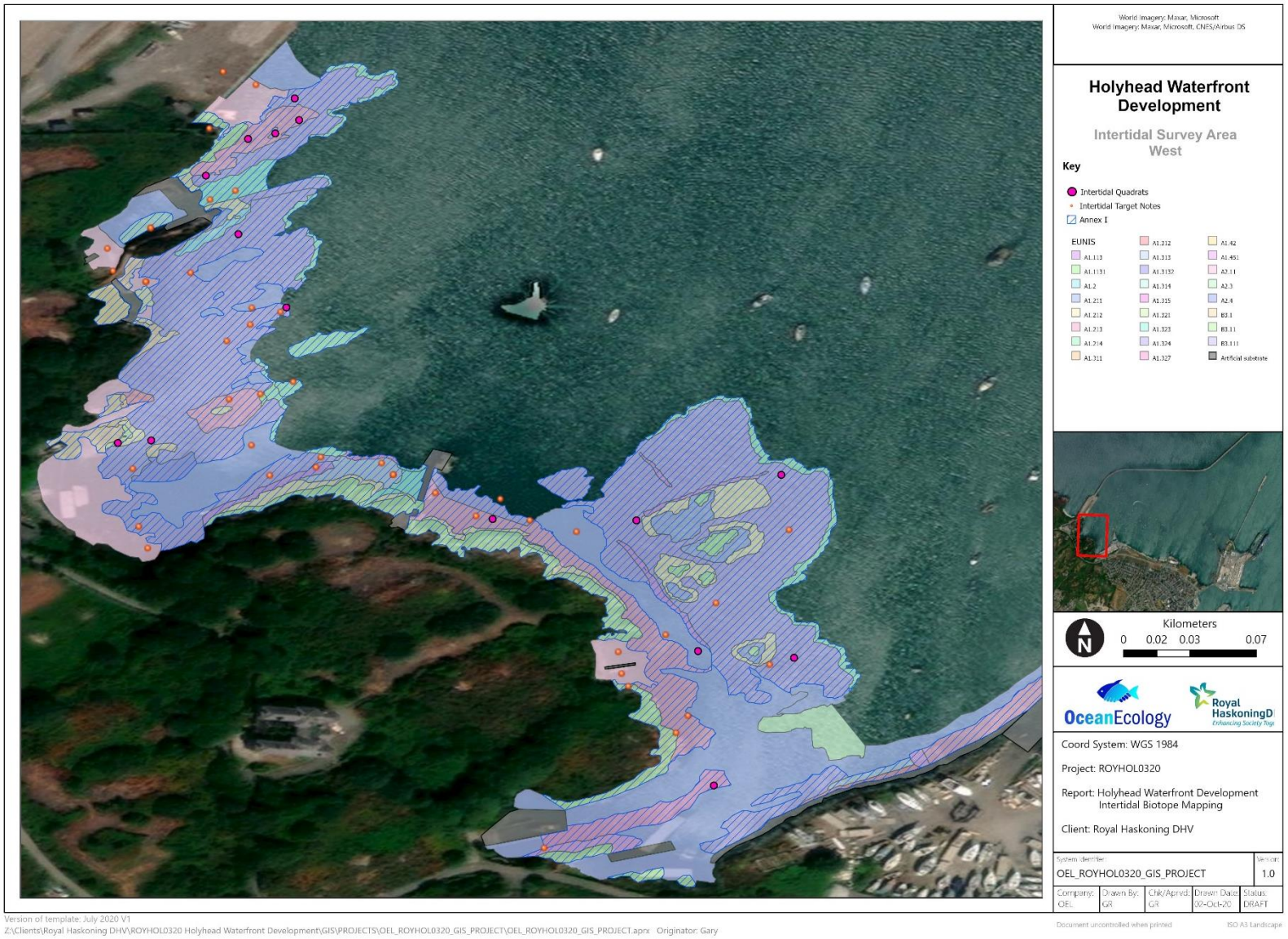

Figure 5 EUNIS biotope mapping, Annex I extent and sampling locations during the Holyhead intertidal survey (West).

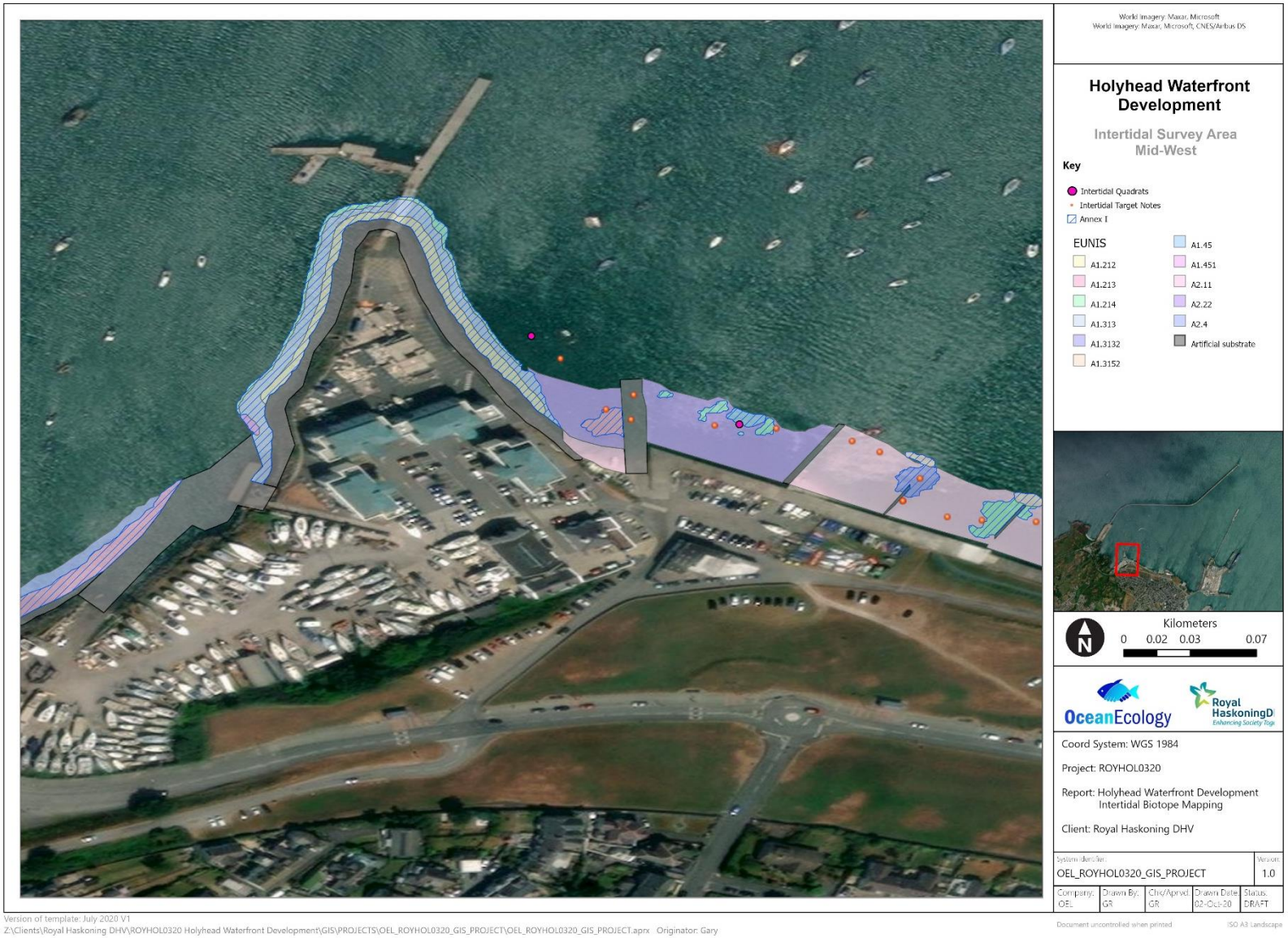

Figure 6 EUNIS biotope mapping, Annex I extent and sampling locations during the Holyhead intertidal survey (Mid-West).

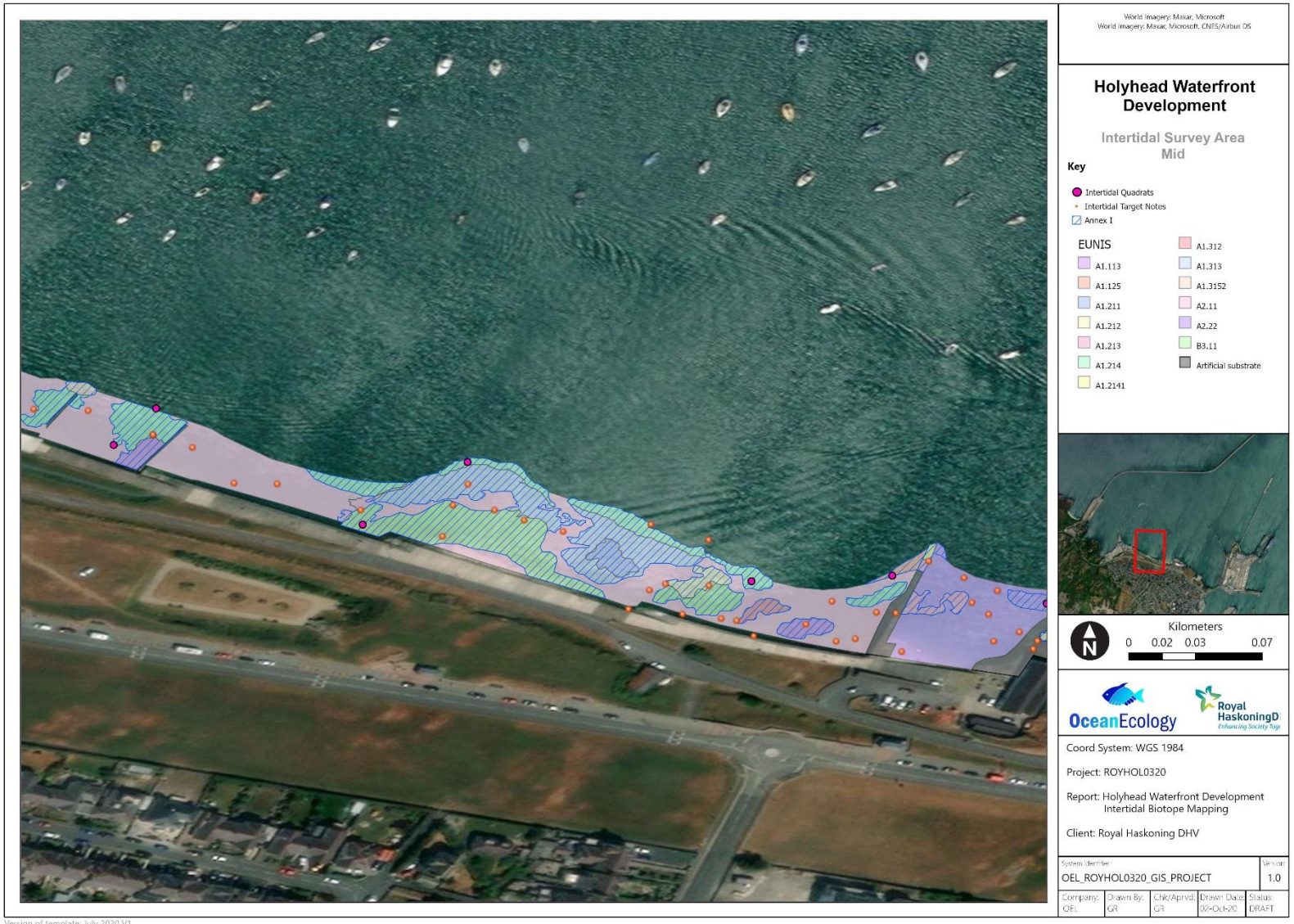

Figure 7 EUNIS biotope mapping, Annex I extent and sampling locations during the Holyhead intertidal survey (Mid).

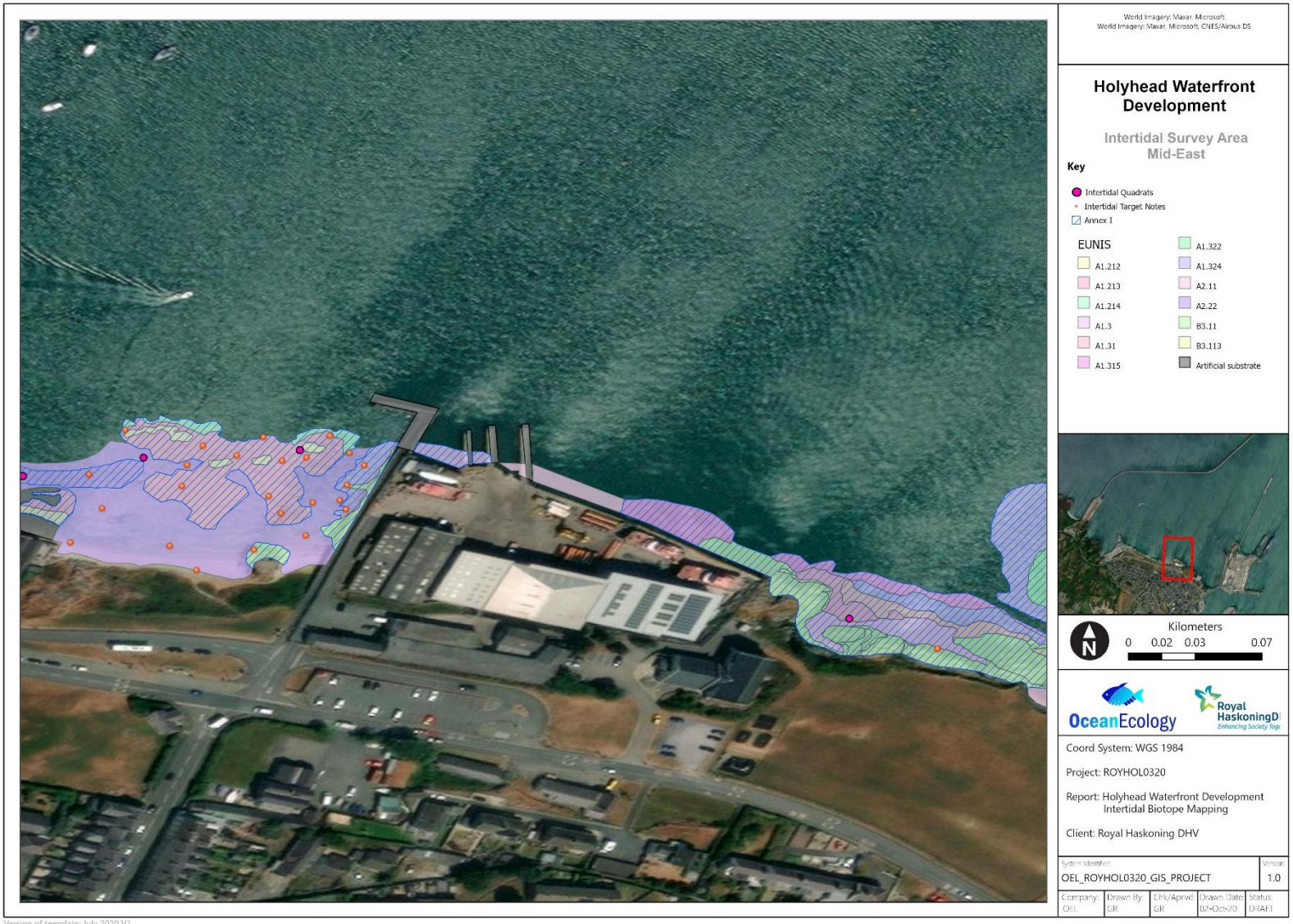

Figure 8 EUNIS biotope mapping, Annex I extent and sampling locations during the Holyhead intertidal survey (Mid-East).

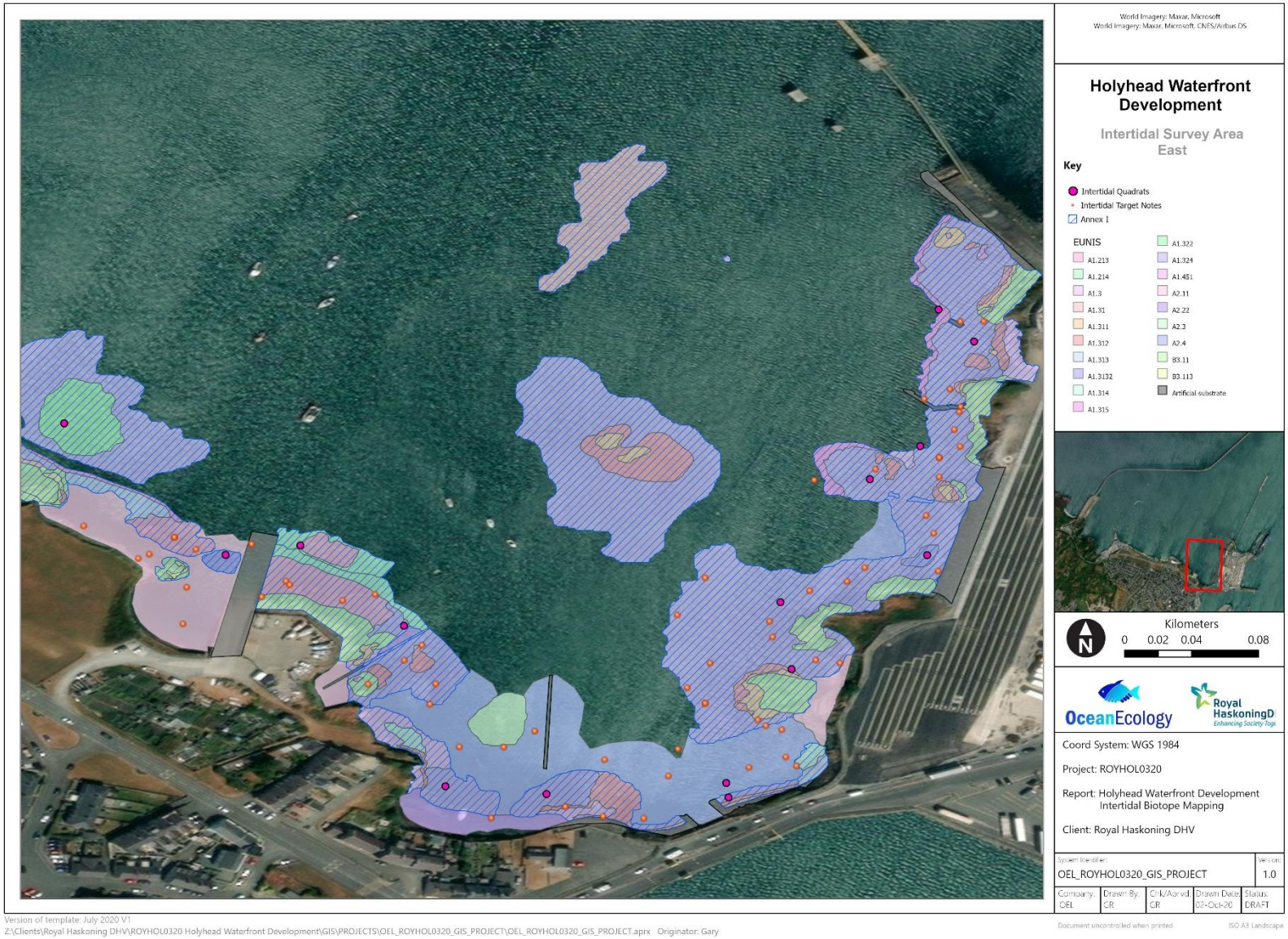

Figure 9 EUNIS biotope mapping, Annex I extent and sampling locations during the Holyhead intertidal survey (East).

4.5. Features of Interest

There is potential for some of the specialist biotopes described by (Wyn et al. 2006) to be present across the Holyhead intertidal area. Areas dominated by the fucoid, *F. serratus* were characteristic of the biotopes *'A1.2141 [Fucus serratus] and red seaweeds on moderately exposed lower eulittoral rock'*, as recorded during the survey and *'A1.2142 [Fucus serratus] and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders'*, considered likely in areas were *F. serratus* was recorded on stable substrata. This biotope is considered an Annex I habitat and representative of 'Intertidal Underboulder Communities' and therefore a habitat of 'principal importance' under Section 42 of the Natural Environment and Rural Communities (NERC) Act 2006'.

There were also several littoral rock pools noted across the rocky shore in the north of the survey area. Due to their ubiquitous nature and the limited time available during a single low tide period, it was only possible to map and assess a small number of rock pools within the survey area. In general, the pools were deemed to be representative of the biotopes A1.411. One large rockpool formed from artificial substrate was mapped in the western intertidal area as *'A1.42 Communities of rockpools in the supralittoral zone'* (Figure 5). Various algal species, were present along with a significant amount of anthropogenic debris.

5. Discussion

This report presents the findings of intertidal surveys conducted between Soldiers Point and the Irish Ferries freight terminal in Holyhead as part of a series of characterisation surveys for the Holyhead Waterfront Development. This intertidal survey programme was split into three distinct areas (West, Mid and East) and was undertaken over three spring low tides between the 4th and 7th August. These surveys were aimed at establishing the main habitats present in the vicinity of the proposed development and involved UAV mapping and Phase I walkover surveying accompanied by quadrat sampling to gather more detailed information on the benthic communities present for biotope mapping purposes.

The biotopes present generally aligned with the physical characteristics of the shoreline, topography and the degree of exposure with zonation present throughout, notably in the eastern and western areas where rocky shore habitats are prevalent. The survey area is complex and highly variable with steeply sloping bedrock, flat expanses of rock and stable substrate and interspersed coarse / mixed sediments. *F. spiralis* was the most abundant species in the high shore, although *P. canaliculata* was also prevalent. The mid shore was dominated by *F. vesiculosus* and *A. nodosum*, often interchanging dominance depending on the degree of shelter and *F. serratus* dominated the lower shore.

It should be noted that all littoral rock biotopes encountered were representative of Annex I reef habitat whilst 'Intertidal Underboulder Communities' were considered highly likely in areas dominated by *F. serratus* which is prevalent throughout the mid to lower shore in this area. Along with rockpools, which were ubiquitous across the site, it was not deemed possible to map the distribution of these habitats without returning to the sites over multiple low tide periods.

Some areas could not be accessed on foot during the survey either through man-made structures causing obstruction or as a result of the several intertidal islets within the survey area. Biotope mapping in these areas was restricted to lower confidence interpretation of the UAV aerial imagery only. It should be noted that the collection of aerial imagery through the use of UAV is now deemed as standard practice for intertidal habitat mapping surveys facilitating higher accuracy biotope and feature mapping than can be achieved by walkover surveying. Given the minimal additional cost and reduced health and safety risks, it is recommended that any future intertidal surveys at these sites are supported by UAV mapping methodologies.

6. References

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