Distribution and Extent of *Zostera* beds: Roa Island and Foulney Island

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Holly Latham

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Natural England Project manager

Holly Latham

Author

Holly Latham

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Contents

1. Introduction

Background

1.1 Seagrass habitats are protected at local, national and international levels; they are listed as named components of Annex 1 features under the EU Habitats Directive, as features of Sites of Special Scientific Interest (SSSIs) within the intertidal, as supporting habitats for Ramsar wetlands and Special Protection Areas (SPAs) and as Features of Conservation Interest (FOCI) in Marine Conservation Zones (MCZs). Seagrass beds are listed as under threat in all OSPAR regions and declines have been reported in the UK for both *Zostera marina* and *Z. noltii* (OSPAR 2009). Seagrass beds are highly productive habitats and provide important spawning, nursery and refuge areas for fish, as well as stabilising sediment, contributing to primary productivity and providing a food source for overwintering wildfowl.

1.2 The seagrass (*Zostera*) beds in the south Walney Channel are an important feature of the intertidal mudflats and sandflats of Morecambe Bay. Seagrass beds are nationally rare and those in the Walney Channel represent the only example of this habitat in Northwest England[1]. Seagrass beds are a key feature of the South Walney and Piel Channel Flats Site of Special Scientific Interest (SSSI) and Morecambe Bay Special Area of Conservation (SAC), as well as a supporting habitat of the Special Protection Area (SPA).

1.3 Roa and Foulney Islands are located in the north-western corner of Morecambe Bay, on the south Cumbria coastline. The two islands are connected to the mainland by embankments and stretch out into the Piel or Walney Channel. The islands lie within the Morecambe Bay European Marine Site (EMS) comprising the Morecambe Bay Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar Site. The area is also part of the South Walney and Piel Channel Flats Site of Special Scientific Interest (SSSI). Roa Island is connected via a road to the mainland and supports a small residential community and boating club; Foulney Island is an uninhabited shingle spit supporting a colony of breeding terns and is an important waterfowl roost site.

1.4 Historical survey data for *Zostera* within the southern Walney Channel is available in the form of the Natural History Museum's 1998 Report (Tittley et al, 1998), which surveyed all areas of *Zostera* in the southern Walney Channel – Roosecote Bay, Roa Island, Foulney Island, Rampside Sands and Wylock Marsh. Recent surveys (AMEC 2012; APEM 2007, 2008, 2009 and 2010) have established the extent, bed composition, shoot

[1] While this report was being written a small bed of *Zostera noltii* (<10m^2) was found in the Ravenglass Estuary, Cumbria (MESL Drigg Coast SAC, Ravenglass Estuary Intertidal Survey, 2015).

density and presence of associated epifauna and flora of eelgrass (*Zostera sp.*) beds to the northwest of Roa Island and on the eastern shore of Walney Island; but due to the commercial, targeted nature of these surveys several areas previously identified to support *Zostera* beds were not surveyed at this time.

1.5 Two species of seagrass have been previously recorded in surveys of the area – dwarf eelgrass *Zostera noltii* and narrow-leaved eelgrass *Zostera angustifolia.* There is currently some dispute over the existence of *Zostera angustifolia* as a separate species; whilst it is currently accepted as such in the World Register of Marine Species (WoRMS) general consensus is that *Z. angustifolia* is a variant of *Z. marina*, *Zostera marina* var *angustifolia.* There is also some dispute over *Zostera noltii*, with the nomenclature for this species undergoing review (Jackson et al., 2013). For the purposes of clarity within this report the two species will be referred to as *Zostera noltii* and *Zostera angustifolia.*

1.6 This survey aimed to establish the distribution and extent of *Zostera noltii* and *Zostera angustifolia* within areas of north Morecambe Bay where knowledge is currently lacking, primarily in the bay between Roa Island and Foulney Island and along the northern shore of the Foulney Island. There is the potential for *Zostera beds* in these areas not to be adequately protected in these areas due to gaps and low confidence in the available knowledge and this survey aims to ensure an accurate assessment of its distribution and condition. Methods comparative to those used in the previous AMEC and APEM surveys were used, bringing our understanding of the *Zostera* beds in this area in line with wider, more recently surveyed areas.

2. Survey location

2.1 Roa Island and Foulney Island are located in the north-west corner of Morecambe Bay, jutting out from mainland Cumbria into the Irish Sea.

2.2 The survey was undertaken across two locations:

1) On the sandflats between Roa Island and Foulney Island, for continuity this will be referred to throughout the report as 'Roa Island bay', and;
2) Along the northern shore of Foulney Island on Rampside sands.

The survey areas are accessible from Roa Island, the car park off Roa Island Road

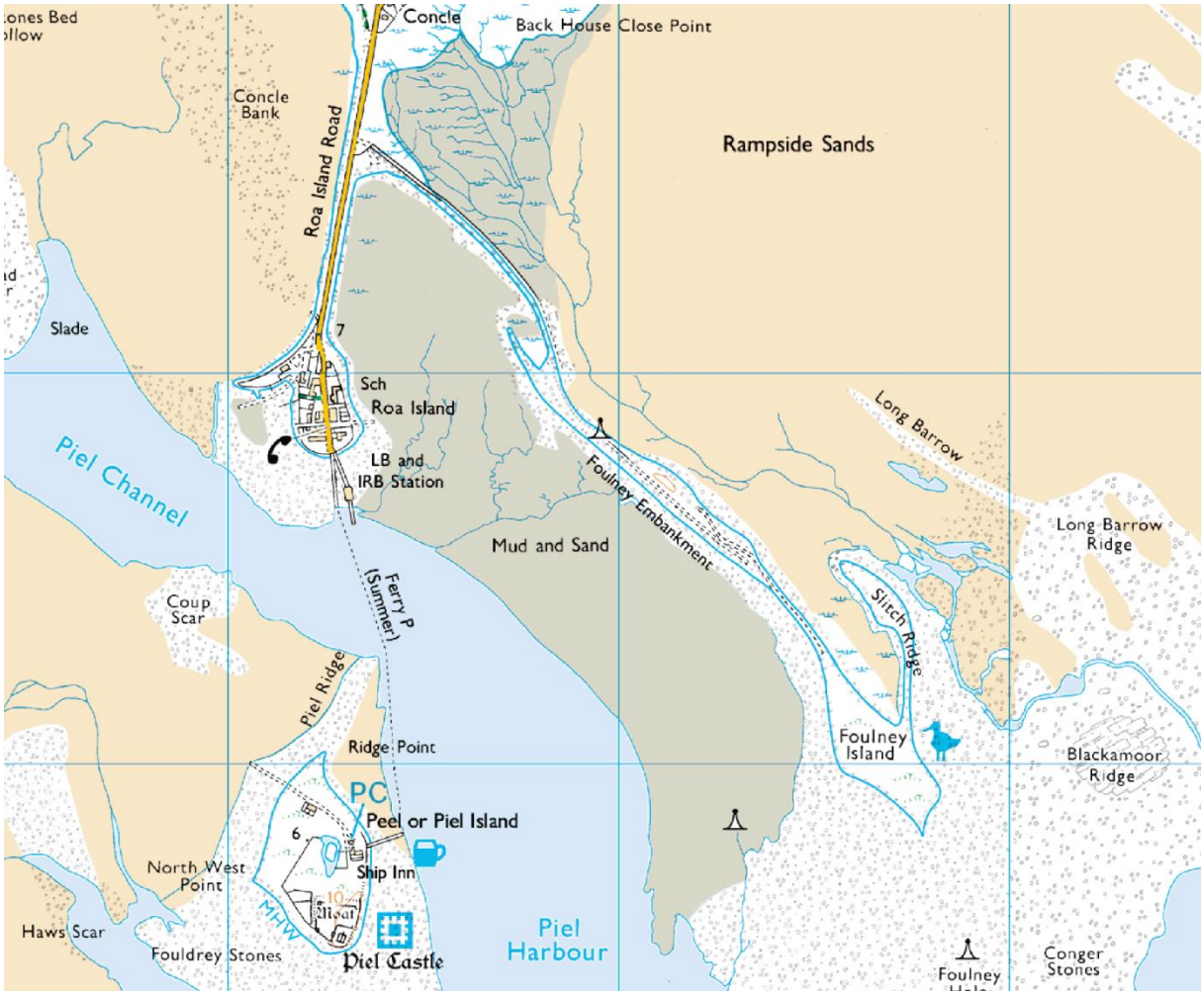

Figure 1: Overview of Roa Island and Foulney Island. Access to the *Zostera* beds is via Roa Island, the car park off Roa Island Road at the base of Foulney Embankment or via the track on Foulney Island.

3. Survey methodology

Comparison of survey methodologies

3.1 Surveys have been conducted recently on other *Zostera* beds local to Roa Island as part of commercial projects in this area. A complete survey of all *Zostera* beds within Morecambe Bay EMS was last completed in 1998 by the Natural History Museum (Tittley et al. 1998) and this is the latest available data covering the areas specific to this survey.

Environment Agency WTD monitoring standards

3.2 Intertidal seagrass monitoring is conducted by the Environment Agency (EA) as part of their Water Framework Directive (WFD) monitoring responsibilities, the guidance for which is outlined in the EA Operational Instruction 214_07 “Intertidal seagrass monitoring for Water Framework Directive (WFD) purposes”.

3.3 The standard monitoring metrics for the EA WFD intertidal *Zostera* surveys are taxonomic composition, shoot density and bed extent (Table 1); however the operational instructions also specify that additional information on the health of the bed should be recorded. This includes notes on the health of the *Zostera* shoots, the presence of opportunistic macrophyte cover, any obvious ‘blow-outs’ (bare areas caused by physical disturbance) and evidence of anthropogenic influence. Shoot density is recorded as a percentage cover estimate, along with cover of bare sediment and of other plant/ algal species. The recording of additional species is optional, for example the presence of lugworm casts.

3.4 The Environment Agency survey design involves the placement of quadrats randomly within the *Zostera* bed, in groups of at least 3 located within discrete patches. The number and placement of quadrats is variable, but must be considered representative of the bed.

Table 1: Environment Agency monitoring metrics for WFD monitoring of Seagrass beds.

Monitoring metrics	Method of survey
Taxonomic composition	Seagrass species present *(Zostera noltii, Zostera angustifolia)*
Shoot density	Measured as the estimated percentage cover of seagrass, an appropriate sized quadrant randomly placed.
Bed extent	Measured as the area cover in hectares of: • the continuous bed, deemed to have >5% shoot density; • and, where possible, the <5% shoot density area.

3.5 The Natural History Museum 1998 survey was conducted to map *Zostera* distribution and provide monitoring and management recommendations for the *Zostera* beds within the Walney Channel. Natural England specified the objectives for this survey.

3.6 The survey design consisted of a 100m by 100m grid, overlain on the survey area. Within this grid, appropriate 100m^2 squares were visited and the presence or absence of *Zostera* was recorded, the occurrence of narrow- (*Zostera noltii)* and wide-leaved (*Zostera angustifolia*) forms were noted, as was the presence of *Spartina anglica*.

APEM United Utilities surveys (2007-2010)

3.7 The APEM United Utilities surveys of the Roosecote sands *Zostera* beds were conducted as a result of concern over the condition of the beds in relation to the influence of the Barrow Waste Water Treatment Works (WWTW) outfall which currently discharges onto Roosecote Sands, north of Roa Island. Annual monitoring of the *Zostera* beds was conducted between 2007 and 2010 (APEM, 2007; 2008; 2009; 2010). The most recent APEM survey was conducted between the 21st and 24th September 2010.

3.8 The APEM surveys used a combination of aerial photography and intertidal walkover surveys to assess the distribution of *Zostera*. Aerial surveys provided an initial extent estimate, while walkover surveys provided quantitative ground-truthing throughout the study area. The intertidal walkover survey was conducted over a 75m x 75m grid, drawn over the aerial survey output, with monitoring sites located at each intersection. The survey design incorporated control sites and 'influenced' sites to meet its remit to detect influence from the WWTW outfall.

3.9 At each of the monitoring sites a 1m^2 quadrat was deployed and the following information was recorded:

1) Species of *Zostera* and/ or macroalgae present;
2) Density of *Zostera*/ macroalgae, recorded as percentage cover[2];
3) Presence or absence of *Zostera noltii* and *Z. angustifolia* within 10m of the quadrat;
4) Percentage of the quadrat underwater;
5) Condition of the *Zostera* and;
6) Photographic record of the quadrat.

3.10 Any additional features of interest were recorded as waypoints. Sediment samples were collected at 22 monitoring sites and particle size analysis was undertaken to assess potential linkages between sediment type and presence of *Zostera*.

[2] Percentage cover was estimated by 2 field scientists with an acceptable error of ±5%.

AMEC gateway survey (2012)

3.11 A survey of *Zostera* on the intertidal areas bordering the Walney Channel was undertaken by AMEC on behalf of Gateway Storage Company Ltd (Gateway) to inform the Environmental Impact Assessment (EIA) for a proposed development in the Walney Channel area.

3.12 The AMEC Gateway *Zostera* surveys aimed to establish the distribution of *Zostera* within and adjacent to the proposed construction area. To achieve this the proposed area was overlaid with a 100m by 100m grid, with sampling points located at the intersections. At each sampling station the following data was collected using a $1m^2$ quadrat:

1) *Zostera* coverage as a percentage, where the percentage cover was less than 5% the number of plants present was recorded as one, few or many (see Braun-Blanquet 1972);
2) Cover of opportunistic algal species;
3) Cover of mussel crumble (small aggregations of mussels, cockles and shell debris) and;
4) Presence of associated epifaunal species.

Natural England pre-survey visit / extent mapping (2013)

3.13 An initial walkover of the survey areas was conducted by Natural England staff on the 21st August 2013. This work served to establishing the continued presence of *Zostera* within the survey area, allowed initial extent polygons to be drawn around the main bed areas and identified the areas to be included in the sampling grid for the subsequent survey.

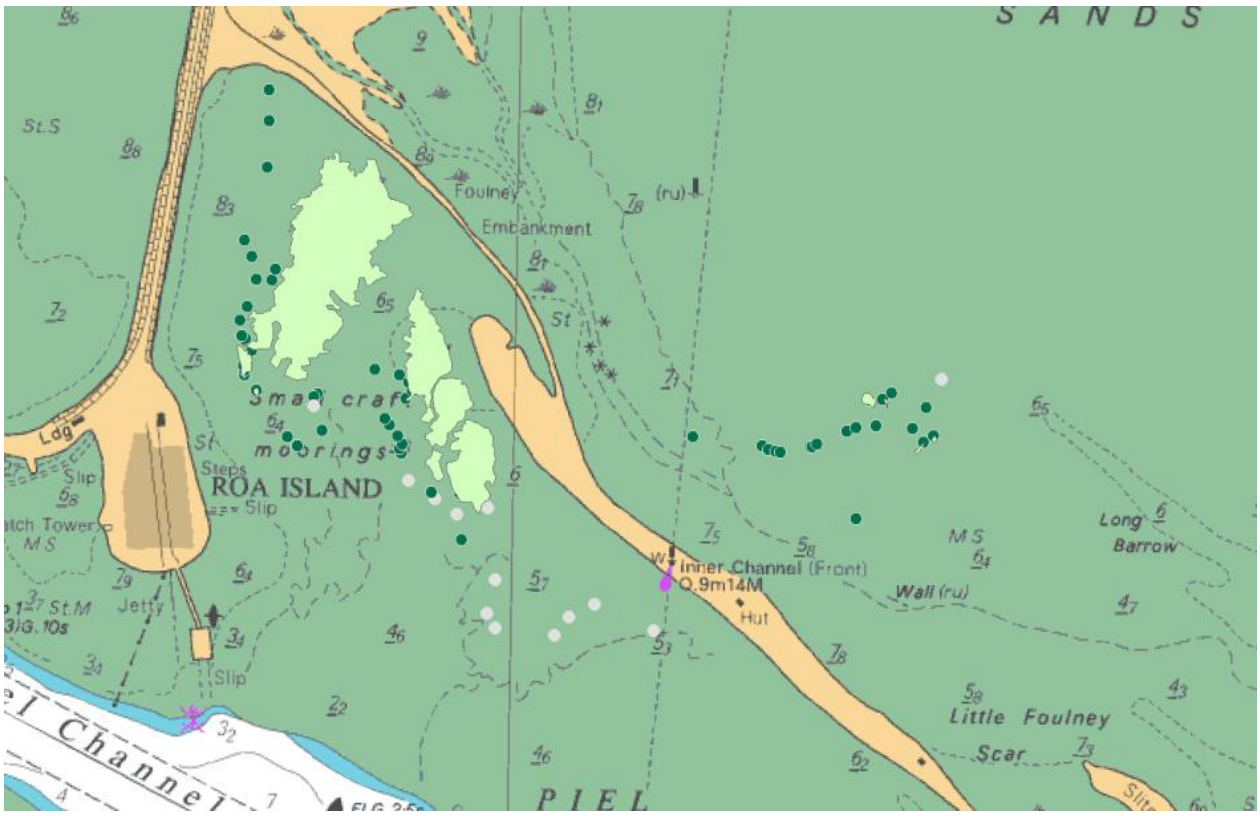

Figure 2: Initial walkover waypoints for *Zostera* presence (dark green circles) and absence (grey circles) and polygons around the main *Zostera noltii* beds (pale green polygons).

Consents, licences and permissions

3.14 Access permissions were acquired from the landowners, Boughton Estate and Roa Island Boating Club.

3.15 The survey did not require the collection of specimens or samples and no license was required under the Wildlife and Countryside Act 1981.

3.16 No operations were conducted that were likely to damage the special interest of the South Walney and Piel Channel Flats SSSI, therefore no SSSI consent was required.

3.17 A Habitats Regulation Assessment was completed to assess for potential Likely Significant Effect (LSE) on the European Marine Site (EMS). The assessment concluded that the project was not likely to have a significant effect on the European Marine Site features. No further assessment was required.

Survey dates

3.18 The survey was conducted over spring low tides on the 5th and 6th September 2013. The survey dates fall within the anticipated peak bloom period for *Zostera*, August and early September, as indicated by Foden & Brazier (2001).

Survey methodology

3.19 A 75m by 75m grid was arranged over the area of survey, guided by the outputs from the pre-survey walkover. This resulted in a grid containing 154 intersects: 56 between Roa Island and Foulney and 98 north-east of Foulney Island. The location of the intersects were identified using ArcMap Geographical Information Software (GIS) and exported as an Excel file, allowing them to be uploaded onto GPS units for use in the field.

3.20 At each intersect a $1m^2$ quadrat with internal divisions was placed on the intertidal. Within the $1m^2$ quadrat the following information was recorded:

1) Percentage cover of *Zostera* species, where this was less than 5% the number of *Zostera* plants was recorded;
2) Presence of *Zostera* within 10m of the quadrat;
3) Percentage cover of bare sediment;
4) Percentage cover of any creeks, channels or standing water;
5) Percentage cover of macroalgae;
6) Percentage cover of *Spartina*, where this was less than 5%, the number of *Spartina* plants was recorded;
7) Condition of the *Zostera* present in the quadrat;
8) Presence of blow outs or anthropogenic influences within the quadrat;
9) Presence of signs of life within the sediment (e.g. mounds, casts, siphons), and;
10) Presence of any notable additional/ associated species

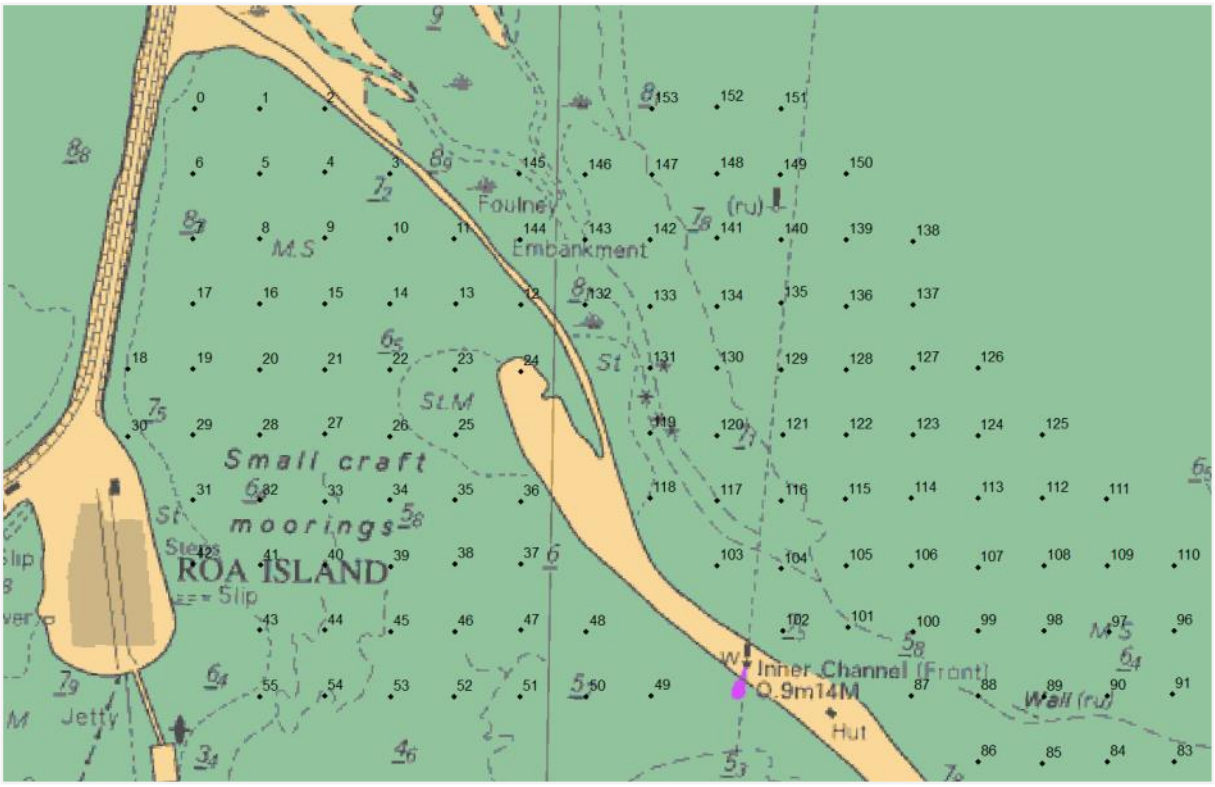

Figure 3 Grid intercept points in the northern section of the survey area. A total of 153 grid intercept points were created on a 75 metre separation grid; these are shown overlaid on Admiralty Charts of the area. The grid was designed to cover all potential areas of *Zostera* local to Roa and Foulney Islands (excluding west of Roa).

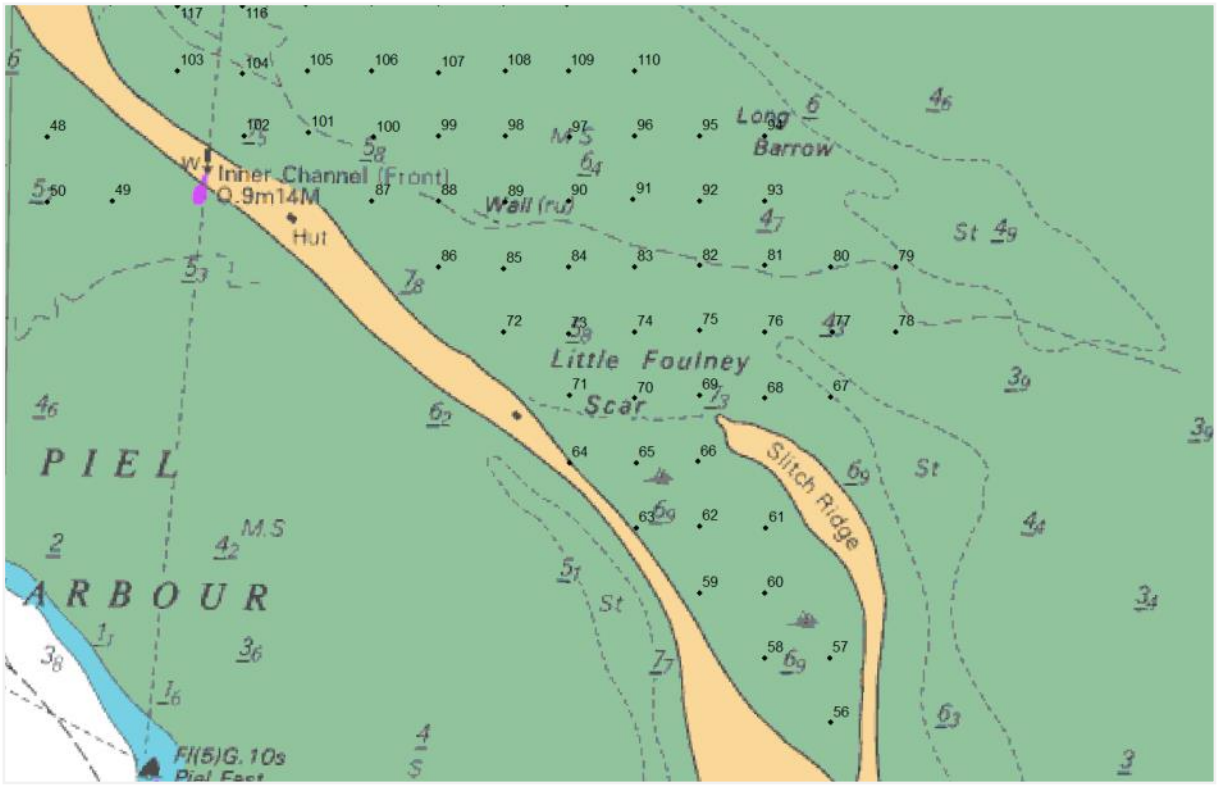

Figure 4: Grid intercept points (75 x 75m grid) in the southern section of the survey area (around Slitch ridge). A total of 153 grid intercept points were created on a 75 metre separation grid; these are shown overlaid on Admiralty Charts of the area. The grid was designed to cover all potential areas of *Zostera* local to Roa and Foulney Islands (excluding west of Roa).

3.21 All percentage cover estimates were agreed by both surveyors. Photographs were taken of each quadrat sub-section (¼) and photo references recorded. A copy of the survey recording sheet and an example of the quadrat photographs are included (Appendix 1 and 2).

Non-native species

3.22 Several non-native species have been recorded in the vicinity of the Walney Channel, including *Crassostrea gigas, Sargassum muticum, Elminius modestus and Botrylloides violaceous.* The 'check, clean, dry' principle was followed for all survey equipment to prevent transfer from previous survey locations. No non-native species were seen on this survey.

3.23 Further guidance to prevent the spread of non-natives is available from the GB Non-Native Species Secretariat (GBNNS, 2011).

4. Results

Zostera extent and distribution

4.1 During the pre-survey site visit and survey fieldwork surveyors were able to map the extents of the largest *Zostera noltii* beds within the survey area; these are mapped in Figure 5. Several large beds were present to the north and east of the bay between Roa Island and Foulney Island. A large bed was also present in Slitch bay, between Slitch Ridge and Foulney Embankment; this was mapped separately on the 6th September 2013.

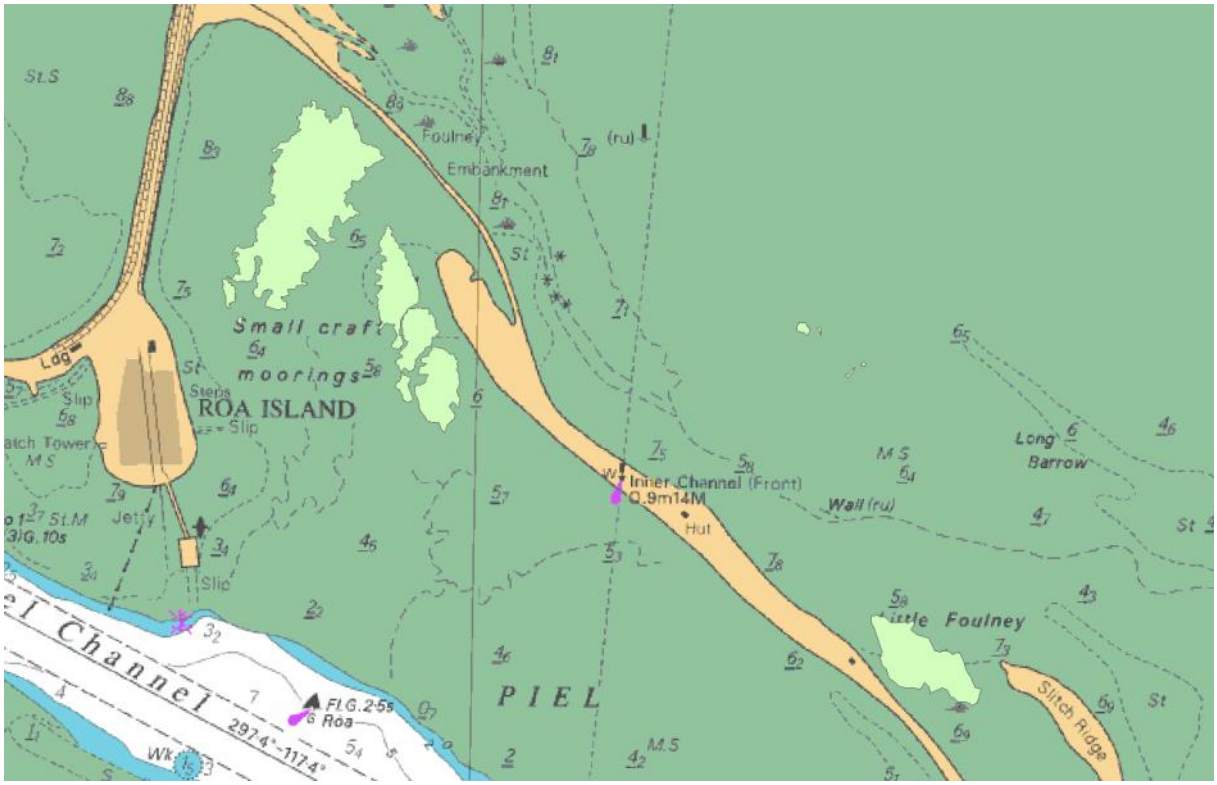

Figure 5: Areas of *Zostera noltii* bed (pale green polygons). These were mapped by walking the perimeter of the main areas of *Zostera noltii* bed around Roa and Foulney Islands. Some smaller areas of *Zostera noltii* bed are present that are not mapped here.

4.2 The *Zostera noltii* beds mapped and presented in Figure 5 cover an area of 6.197 ha. This includes 5 main beds (Table 2) and represents the majority of bed area; some additional smaller beds were also recorded (Figure 5) but all were less than 0.06 ha. When walking the bed perimeters, surveyors were instructed to judge >5% cover as a 'bed'. For *Z. noltii* the beds often ended abruptly, quickly changing from dense, >50% cover, to bare sediment making the edge relatively easy to distinguish and follow.

Table 2: *Zostera noltii* bed areas in hectares (ha).

***Zostera noltii* bed**	**Area (ha)**
Slitch Bay	1.143
Roa Bay North	3.314
West of Foulney 1	0.672
West of Foulney 2	0.451
West of Foulney 3	0.617
	6.197

Figure 6: Environment Agency oblique aerial photography of Slitch Bay entrance, taken in March 2008. The *Zostera noltii* bed is present on the flat sand between Slitch ridge (front left) and Foulney Embankment. It is likely not visible here as the photography was taken early in the year, prior to the start of the growth season.

4.3 *Zostera angustifolia* occurs in channels and shallow pools, not in distinct beds in the way *Z. noltii* does, although it is often found associated with *Z. noltii* bed. This made it unfeasible to map in the same way as could be done for *Z. noltii;* however recording the presence of *Zostera* within 10m of the quadrat location gives a good indication of its distribution over the intertidal.

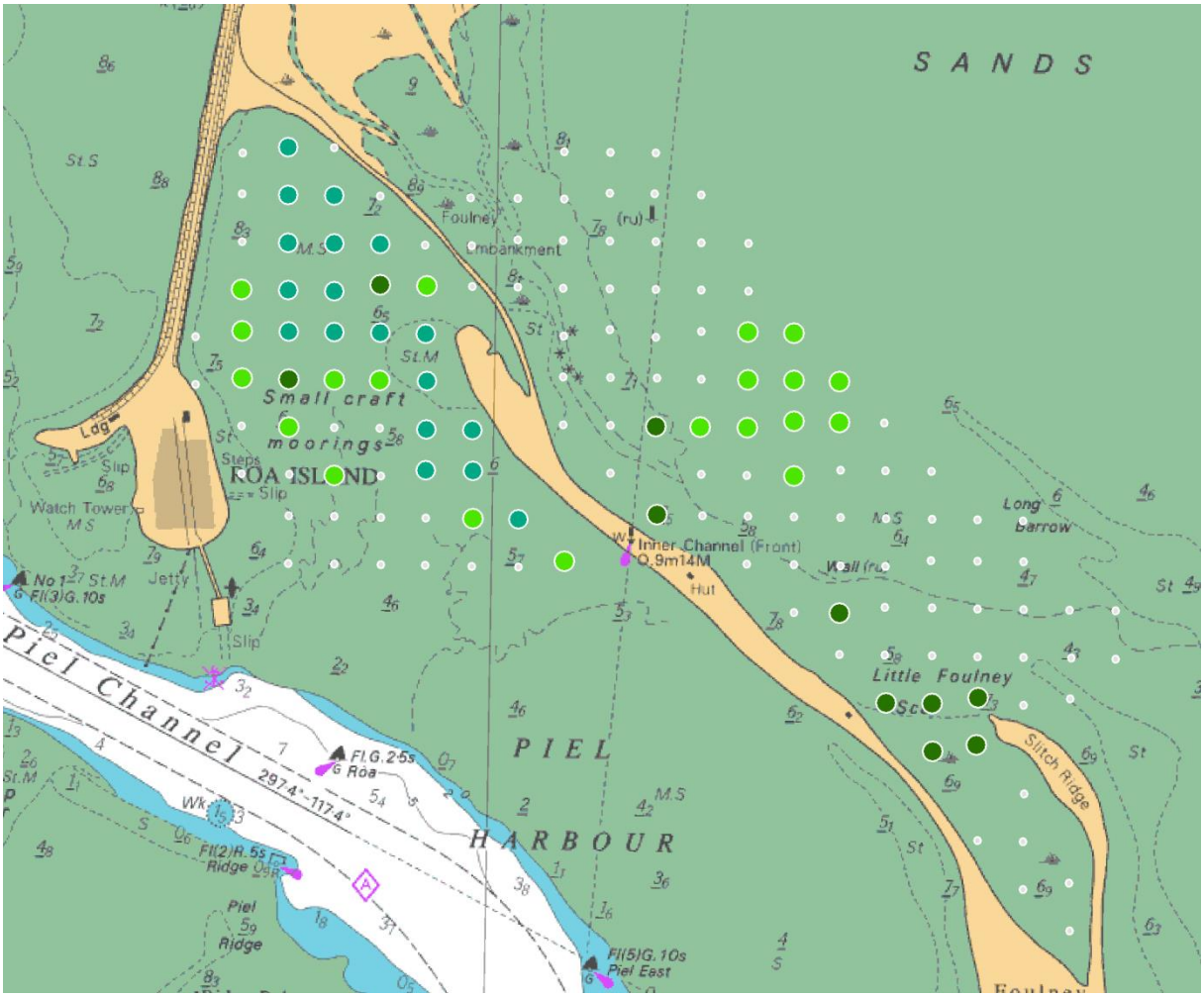

Figure 7: Presence/ absence records for *Zostera noltii* (dark green), *Zostera angustifolia* (bright green) and both *Zostera* species (blue-green) across the survey areas.

4.4 Out of 149 quadrats completed at grid intercepts, 10 contained *Zostera noltii* and 7 contained *Zostera angustifolia*; however 28 and 38 quadrats respectively had *Z. noltii and Z. angustifolia* within 10m of the grid intercept (Figure 7). The additional records of the presence/ absence of *Zostera* within 10m of the grid intercept clarifies that the extent of *Zostera* is considerably greater than extent indicated by the bed mapping and grid quadrats.

4.5 Distribution of *Zostera noltii* indicated by the presence within the vicinity of the grid points largely matches the areas outlined by the mapped polygons; however it does

identify several outliners around the main bed areas, supporting the observations of surveyors that there are smaller outlying beds. *Zostera angustifolia* is distributed widely across the survey area and often associated with *Z. noltii*, with the exception of the Slitch Bay bed.

Zostera cover and condition

4.6 *Zostera* cover was recorded within the fixed location quadrats at the grid intercepts and as part of WFD randomly allocated sites. *Zostera noltii* cover was generally high with a mean of 67% cover, where quadrats contained *Zostera;* within the WFD quadrats where *Zostera noltii* was recorded, this is higher with a mean of 74% cover (s.d=23.5). Both values qualify the areas of *Z noltii* as a bed, with densities providing over 5% and 30% cover (OSPAR, 2009).

4.7 The condition of both species of *Zostera* was generally recorded as 'good' and lush coverage was present. Some blackening of the *Zostera*, an indication of poor health, was present and recorded at 12 grid intercepts. These were not restricted to any one particular area of the beds and occurred close to Roa Island, alongside the west of Foulney, on the sparse *Zostera* east of Foulney and one record in the Slitch bay *Zostera noltii* bed.

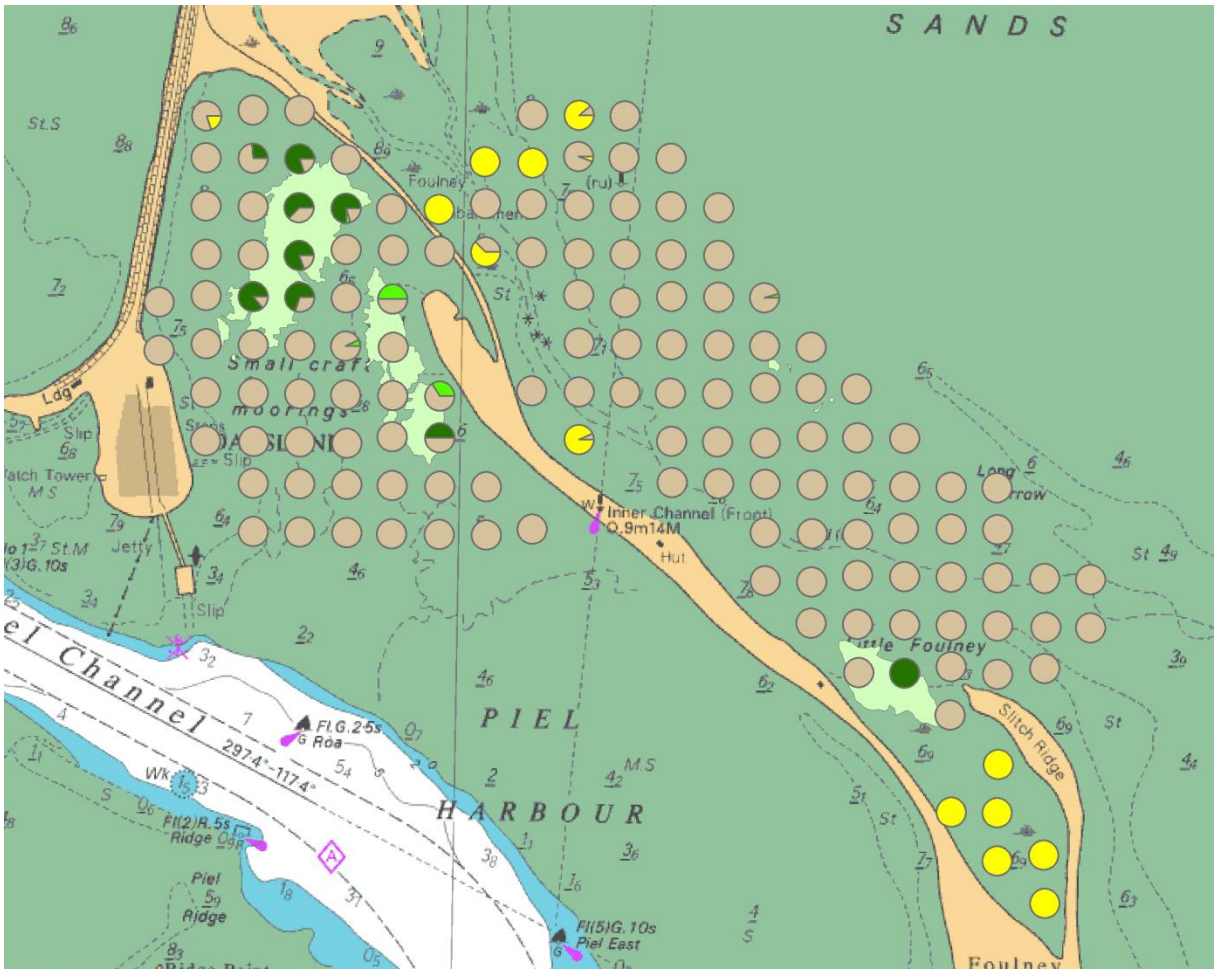

Figure 8: Percentage cover of *Zostera* spp. at the grid intercept points. Dark green = *Zostera noltii,* Bright green = *Zostera angustifolia,* Yellow = *Spartina,* Brown = *Sediment.*

Distribution and Extent of *Zostera* beds: Roa Island and Foulney Island

5. Discussion

5.1 The *Zostera noltii* beds around the Roa and Foulney Islands extend to 6.197 ha and represent a large proportion of the upper shore intertidal sediment within this area. The recent Gateway/ AMEC 2012 survey recorded the extent of *Zostera noltii* on Roosecote Sands, Concle Bank and Snab Sands at 7 ha (0.07 km^2), 22 ha (0.22 km^2) and 5.5 ha (0.055 km^2) respectively. This indicated a total area of *Zostera noltii* beds of 34.5ha (0.345km^2) was recorded on these areas in 2012. This survey was designed to supplement the existing information and provide evidence for 2 areas of seagrass not considered as part of the 2012 work: Roa Island bay and north of Foulney Island. The results of this survey indicate an additional 6.197 ha (0.06197 km^2) of *Zostera noltii* bed is present on these areas, giving a total extent for *Zostera noltii* beds within Morecambe Bay SAC at 40.697 ha (0.40697 km^2).

5.2 Several smaller *Zostera noltii* beds were present within the survey areas which were not fully mapped due to time restrictions. This included an area out on Rampside Sands, around the edges of the *Zostera* in the Roa Island bay and an area at the far north in Roa Island bay; therefore the figure calculated above should be considered to be an underestimate of the full extent of *Zostera noltii* beds. *Zostera angustifolia* was not present in beds, only interspersed in channels and pools around the *Z. noltii* beds; therefore an estimate for extent was not feasible.

5.3 The distributions of the two *Zostera* species were mapped, as percentage covers at specific grid intercepts and as presence/ absence within 10m of those grid intercepts indicating the overall area in which *Zostera* is present. A visual comparison of the current distribution (presence within 10m) of the two *Zostera* species with the previous NHM survey, which mapped the presence or absence of *Zostera noltii* and *Z. angustifolia* within 100m x 100m squares, indicates a similar distribution of *Zostera* across the intertidal sediments around Roa and Foulney Islands (Figure 9).

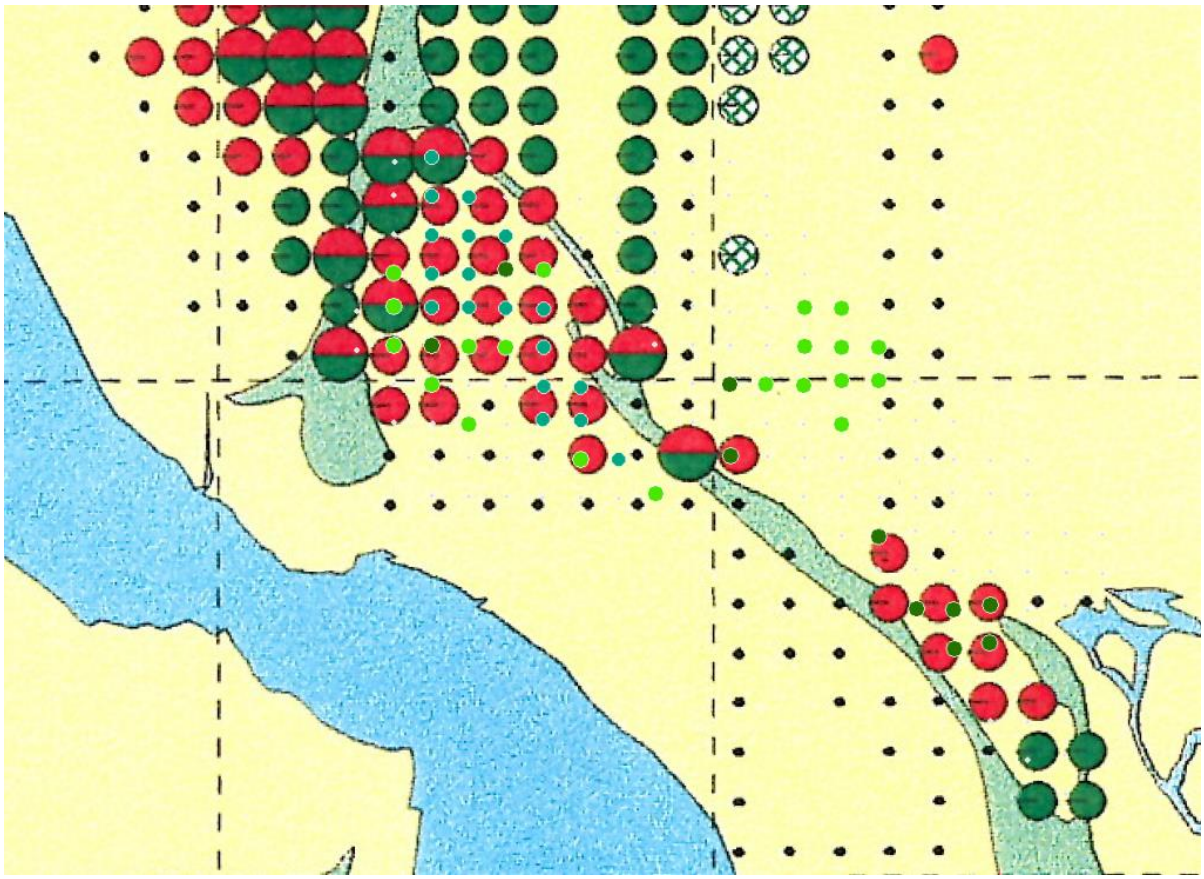

Figure 9: The 2013 presence/ absence (within 10m) data overlaid on to the 1998 NHM mapped output (presence/ absence within 100m x 100m squares) indicates a broadly similar distribution of *Zostera* on the intertidal areas around Roa and Foulney Islands. 2013 Natural England data is shown as smaller green circles. The 1998 NHM data is shown as larger circles, where a red circle indicates *Zostera* present/ *Spartina* absent, a half red/ half green circle indicates *Zostera* present/ *Spartina* present and a green circle indicates *Zostera* absent/ *Spartina* present. The area of patchy *Zostera* out on Rampside Sands (shown above by a cluster of light green circles) lies between the areas surveyed previously as part of the NHM work.

5.4 A gap in the survey coverage of the 1998 NHM work on Rampside Sands was present on Rampside Sands in an area where this survey indicated patchy small beds of *Zostera noltii* (Figure 5) and occasional Z. angustifolia (Figure 9). As this area was not surveyed previously it is not possible to comment on the potential changes in extent and distribution of *Zostera* in this area as its previous status is unknown. Due to the paucity of data on the wider distribution of *Zostera* on Rampside Sands it has not been included in North Western Inshore Fisheries and Conservation Authority (NW IFCA) proposed Byelaw 6 to exclude bait-digging activities from *Zostera* beds within the EMS. The *Zostera noltii*

bed within Slitch bay, which was recorded in the 1998 survey and was mapped during this survey, is to be included[3].

Potential impacts

5.5 Small areas of bed were present outside of the main *Zostera noltii* beds. This wider distribution of *Zostera* is clearly shown by the recording of '*Zostera* within 10m'. There is some concern that the presence of mooring on the *Zostera* will lead to fragmentation of the bed, supported by scientific studies that indicate that fragmentation may occur around boat moorings (e.g. Walker et al., 1989; Hastings, 1995; Collins, Suonpaa & Mallinson, 2010); however this study was not designed to query whether this was the case here. Further work and interpretation would be necessary to address this.

5.6 The boat moorings within the bay between Roa and Foulney Island are not formally managed and are all privately owned by individuals. There is concern that the moorings could impact the *Zostera* bed, particularly if new moorings were introduced in the main bed areas. It is hoped that this survey can be used to provide information to boat owners on the distribution of *Zostera* within the bay and to prevent damage to the dense beds within the area.

5.7 *Spartina* species are fast-growing saltmarsh 'cord-grasses' that are a primary coloniser of intertidal mud, stabilising sediment and allowing later colonisation by other saltmarsh species. Large areas of *Spartina* are present in Slitch bay and in the northern corner of the Roa Island bay and these may, in areas, be accreting. There is the potential for pioneer saltmarsh to accumulate and out-compete existing *Zostera* beds; this appears to have occurred in Slitch Bay when comparing this survey with the 1998 NHM data. Further monitoring would be required to establish if there is likely to be any loss of *Zostera* bed to *Spartina* colonisation.

[3] North Western Inshore Fisheries and Conservation Authority Draft Byelaw 6 as of December 2013.

6. Conclusion

6.1 No figure for the extent of *Zostera* bed was given in the 1998 NHM survey; therefore no comparison of extent can be made. Estimates from the mapping completed as part of this survey indicate that an area of *Zostera noltii* bed of at least 6.197 ha was present in the area surveyed as part of this work and that, in combination with work completed in the most recent survey of the wider Piel Channel area, a minimum of a further 34.5 ha is present on the intertidal mud and sandflats.

6.2 The distribution of *Zostera* across the survey area broadly matches with the distribution indicated by the 1998 NHM survey. Some gaps were present in the previous survey and this work provides a baseline for these areas.

6.3 The *Zostera* beds within the survey area are generally in good condition with relatively high cover of *Zostera noltii* within the beds and low instances of blackening/ wasting on the *Zostera.* Due to the relatively urban nature of the Walney Channel and its importance for recreational use there is the potential for multiple negative impacts on the *Zostera* beds in this area.

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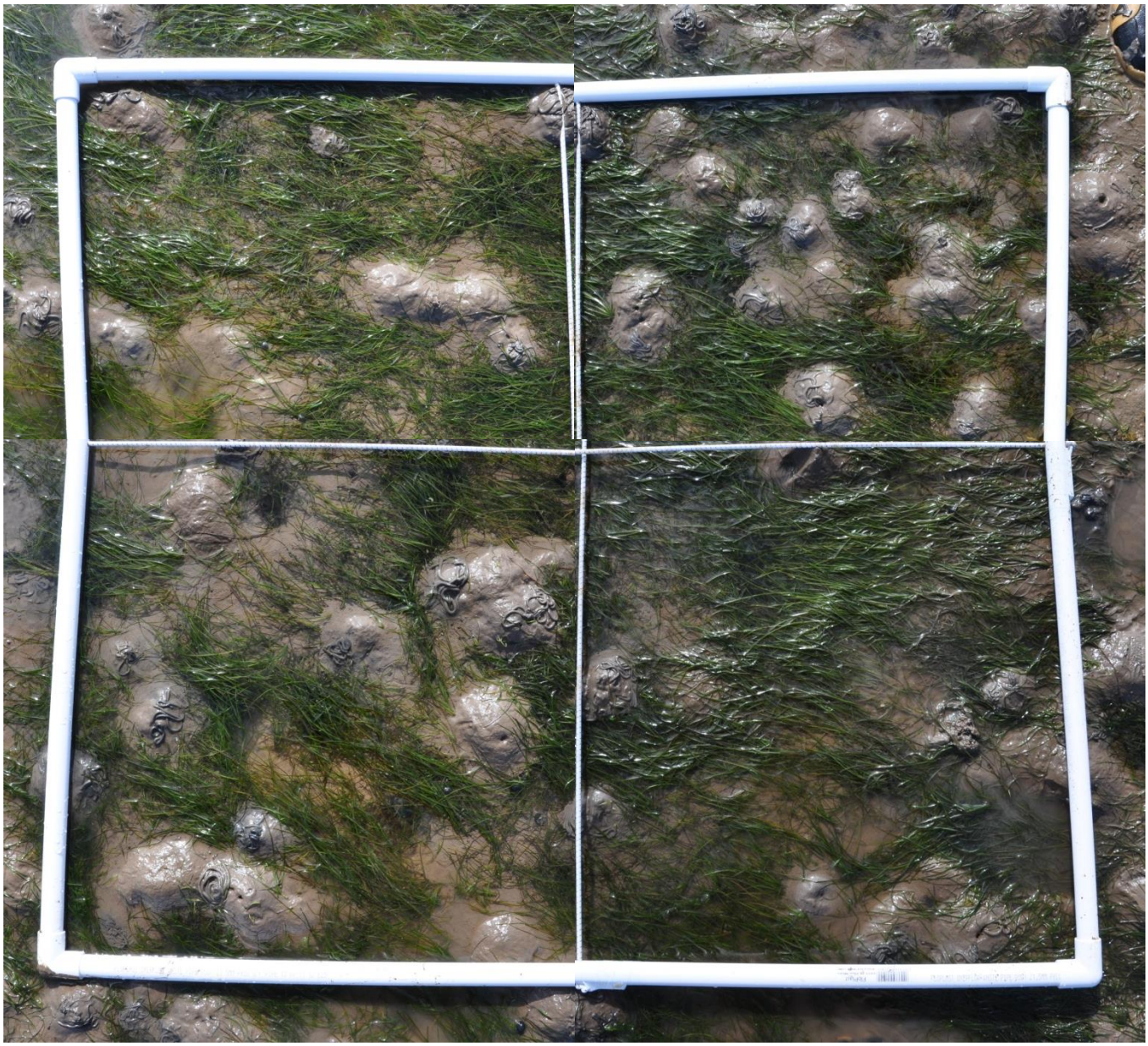
8. Appendices

Appendix 1: Survey Recording Sheet

NE Roa and Foulney Island Zostera Survey
Recorders:
Dates: Thursday 5th September 2013, Friday 6th September 2013
Tide times: Thurs 12.15 (HW), 18.44 (LW); Fri 12.48 (HW), 19.18 (LW)

Quadrat No.	WPT No.	Zostera noltii (% (No.))	Zostera angustifolia (% (No.))	Zostera Condition (Good/ Blackened)	Blow outs (P/A)	Anthropogenic Influence	Macrophyte Cover (%)	Spartina Cover (% (No.))	Additional species	Bare sediment (%)	Channels/ Creeks (C) or Standing Water (S) (%)	Mounds/ Casts/ Siphons (P/A)	Sample Reference	Photo Reference(s)

Appendix 2: Example quadrat photographs



Composite image of quadrat at grid intercept #4 (Photos: DSC0082, DSC0083, DSC0084, DSC0085)

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