Appendix A9.1 Marine Ecology Reports

Report Title
Marine Ecology Supporting Information
Phase II Ireland's Eye Reef Survey
Baldoyle Estuary Baseline Habitat Survey
Whelk Survey Report
Juvenile Fish Survey 2015
Juvenile Fish Survey 2017

IRISH WATER

GREATER DUBLIN DRAINAGE

MARINE ECOLOGY

SUPPORTING INFORMATION

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Contents

Contents 2
1. Marine Benthos 4
1.1. Introduction 4
1.2. Survey Timings and Objectives 4
1.3. Benthic Survey Operations 4
1.4. Physico-chemical Results 5
1.5. Macro-invertebrate Community 10
1.6. Epifaunal Community 15
2. Zookplankton Samples 17
3. Baldoyle Estuary Walkover 19
3.1. Previous Survey Data 19
3.2. Field Walkover Survey 21
4. Fisheries Information for the Fingal Region 24
4.1. Species with Defined Spawning and Nursery Grounds 24
4.2. Species of Conservation Interest 25
4.3. Diadromous Migratory Species 26
4.4. Elasmobranchs 26
4.5. Other Species of Conservation Interest 27
4.6. Shellfish 29
4.7. Commercial Marine Fish and Shellfish 32
4.8. Recreational Fisheries 34
4.9. Estuarine Fisheries 34
Appendix I – Macro invertebrate Community 2012, 2013 and 2017 .....
Appendix II Reef Survey Report .....
Appendix III Baldoyle Bay Walk Over Survey .....
Appendix IV – RPS Whelk Survey 2015 .....
Appendix V – ASU Greater Dublin Drainage Juvenile Fish Survey 2015 .....
Appendix VI – ASU Greater Dublin Drainage Juvenile Fish Survey 2017 .....

List of Figures

Figure 1 Summary of Marine Survey Operations for the Proposed GDD Outfall 6

Figure 2 Macro-Invertebrate Distribution by Phylum (Stations 4 and 11, between surveys in 2012 and 2017) 11

Figure 3 Macro-invertebrate Multi-dimensional Scaling Plot of Repeated Sites Surveyed in 2012, 2013 and 2017 13

Figure 4 Macro-invertebrate Multi-dimensional Scaling Plot against Sediment Changes 14

Figure 5 Distribution of Epifaunal Species 15

Figure 6 Habitat Map of the Annex I Habitats of Baldoyle Estuary prepared. 22

Figure 7 Inshore Shellfish Grounds along the Fingal Coast 33

List of Tables

Table 1 Benthic Survey operations for the Outfall Location on the Proposed Greater Dublin Drainage Scheme 4

Table 2 Benthic sample locations, rational and acquisition summary (BSL, 2012, 2013 & 2017 and Causeway Geotech 2015) 7

Table 3 Summary of sediment type and particle size analysis acquired during the marine ecological surveys (2012 & 2017) and Goetechnics (2015). 8

Table 4 Summary of Sediment Chemistry (Surface grab samples 2012 and 2013. Subsurface Vibrocore samples 2015) 9

Table 5 Macro-invertebrate Primary and Univariate Diversity Indices by Station (2012, 2013 and 2017): 12

Table 6 Species Responsible for Dissimilarity between (A) 2012 and 2013 and (B) 2013 and 2017 Surveys 14

Table 7 Zooplankton Species List and Abundance (2012 and 2017) 18

Table 8 Spawning Periods of Key Species 24

Table 9 Diadromous Fish Species of Conservation Importance 26

Table 10 Elasmobranch Fish Species of Conservation Importance 27

Table 11 Other Fish Species of Conservation Importance 27

Table 12 Principal Species of Shellfish Recorded 29

Table 13 Summary of Local Shellfish Fisheries in Northern Fingal 33

Table 14 Fish Recorded in Rogerstown and Broadmeadow Estuaries (King and Green 2003) 35

1. Marine Benthos

1.1. Introduction

RPS, on behalf of Irish Water, commissioned Benthic Solutions Limited (BSL) to carry out a series of benthic survey assessments at, and around the proposed Outfall Pipeline and surrounding environment. These surveys aimed to identify benthic ecological environment of the sub-tidal habitats, macro-invertebrate communities, sediment types and water quality along the Fingal coastline between in the vicinity of planned construction operations over three survey periods (2012, 2013 and 2017).

1.2. Survey Timings and Objectives

A detailed marine environmental survey was carried along the proposed Outfall Pipeline and surrounding environments by Benthic Solutions Limited (BSL) over four survey periods as follows:

- Broad survey assessment of benthic conditions between Dublin Bay and Skerries in August 2012 (29 sampling stations);
- Repeat of the August 2012 survey in December 2012 (29 sampling stations); and
- Assessment of 8 sampling stations focused along the proposed Outfall Pipeline in July 2013
- A repeat of the 2013 survey over 8 sampling stations in August 2017.

The timings of these studies were established to encompass the seasonal maxima for the marine benthos (i.e. both established and recently settled communities) and the seasonal extremes within the water quality. The surveys included an assessment of the macro-invertebrate communities and habitat types at all selected locations, along with some water quality profiling and sampling. Physico-chemical parameters of the shallow marine sediments were recorded during each of these surveys using grab sampling.

1.3. Benthic Survey Operations

Field operations were carried out off the Fingal coastline on four separate occasions and the data combined for this report. These survey trips are summarised in Table 1 and Figure 1.

Year	Month	Survey Dates	Survey vessel	Operations completed
2012	August	31.07-05.08.12	Seekat	30 benthic stations, 3 water quality and vertical plankton
2012	December	07.12.12	Panalia	3 water quality
2013	July	15-18.07.13	Seekat	8 benthic stations, 3 water quality and vertical plankton
2017	August	09-10.08.17	Sharpshooter	8 benthic stations, 2 water quality and vertical plankton

Table 1 Benthic Survey operations for the Outfall Location on the Proposed Greater Dublin Drainage Scheme

All surveys were carried out using inshore survey vessels fitted with accurate differential global positioning systems with an accuracy of 1m. Benthic samples of the seabed were acquired using a Day Grab sampler with a sampling area of 0.1m^2, with duplicated replicates processed for macro-invertebrate benthos larger than 500µm at each station. Only 25 of the original 29 stations were successfully sampled using the grab due to the presence of coarse gravelly sediments at some stations, although all of these sites were located outside the proposed Outfall Pipeline. Recovered material was processed on-board the vessel using a *Wilson* Autosiever and the recovered residues

fixed and stained using a 10% formal saline solutions and Rose Bengal dye. These were later transferred to 70% alcohol at the laboratory during taxonomic analysis. Samples were then sorted under a microscope into phylum level (e.g. Annelida, Mollusca, Crustacea, and Echinodermata) and then identified to species level where possible.

A third benthic sample was collected at each station for sedimentological analyses (granulometry and chemical determination). Samples were acquired in the field directly from the undisturbed surface of the grab sampler by means of an inspection/access hatch and the surface 5cm assessed for full particle size distribution. Approximately half of the regional sites and all of the 2013 grabs were in addition analysed for contamination; later analysed for total hydrocarbons, heavy & trace metals, the volatile organic compounds benzene, toluene, ethylbenzene, and xylenes (collectively known as BTEX), organic carbon, polychlorinated biphenyls (PCBs) and organo tins. These data were combined with similar chemical analysis carried out from seven vibrocore samples, also recovered along the proposed outfall and recovered as part of the geotechnical site investigation.

In addition to seabed sampling, the benthos was also assessed using a drop down camera at 29 regional locations and repeated at the eight outfall locations in 2013, in order to identify the base sediment type and the presence of larger conspicuous fauna (not sampled by the grab). Unfortunately, due to inclement weather and high suspended sediments during the time of the earlier studies, the clarity of the images was limited at some sites. This was the only data acquired at four of the regional survey sites where coarse geology prevailed and the grab sampler failed to achieve sufficient penetration to acquire an acceptable sample. This is a common limitation in coarse sediment areas. Typically, the absence of finer sediments will reduce the significance of both sediment related invertebrates as well as natural and/or contaminants chemical levels on the seabed. All video data provided sufficient information to carry out a broad habitat assessment at all locations.

A summary of benthic and sediment samples that were acquired from 23 of the 29 sampling sites along and in the vicinity of the proposed Outfall Pipeline are combined into Table 2.

1.4. Physico-chemical Results

Particle size analysis for the benthic studies was carried out by BSL using a traditional granulometric analytical approach approved under the UK National Marine Biological Analytical Quality Control scheme, to which BSL is a participant. This is based on a combination of dry sieving of coarser materials (greater than 2mm) and laser diffraction of sands and fines (below 63µm). Data were analysed to a high resolution and classified using a combination of the Wentworth scale (Wentworth, 1922) for mean and dominant particle sizes, and Folk (Folk, 1954) for a combination of the different proportions of muds, sands and gravels as a whole. Results are summarised for all sites in Table 3. Sediment chemistry analysis was carried out by the Environmental Sciences Group (in Bretby UK) for the benthic samples and RPS (Moutainheath, UK) for the vibrocore samples. These data were also combined and are summarised in Table 4.

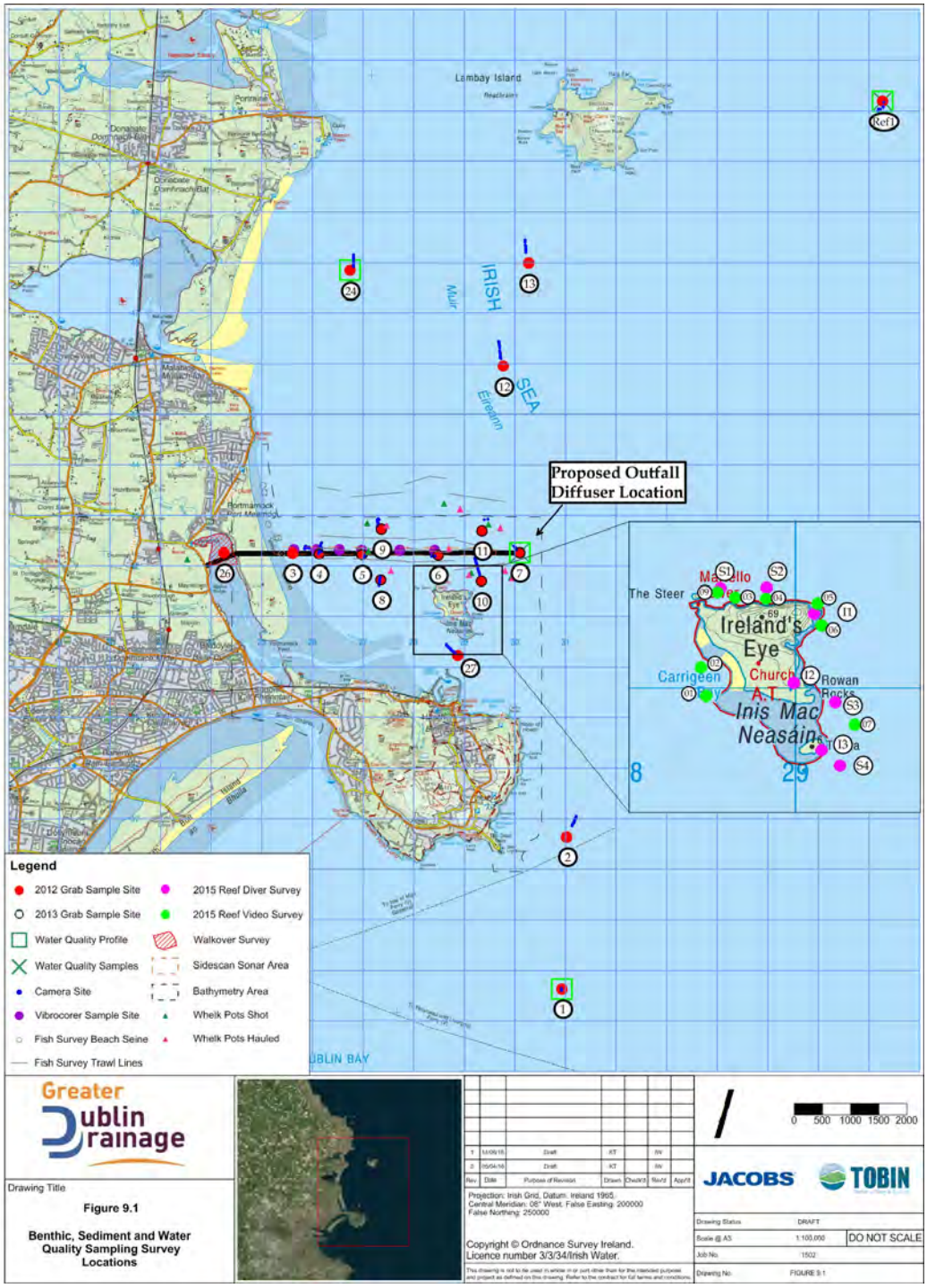

Figure 1 Summary of Marine Survey Operations for the Proposed GDD Outfall

Site Name	Easting	Northing	Rational & Sediment Type	Water Depth	Sampler*	Sediment Profile	Camera	CTD**
REF1†	337268	251194	Reference: sand	35 m	Grab	Surface	✓	✓†
ES1	330930	233633	Habitat: sandwaves with coarse sand	30 m	Grab	Surface	✓	✓
ES2†	331022	236637	Habitat: rocky, cobbles/coarse material	30 m	-	-	✓†	-
ES3	325609	242245	Outfall: sand	0 m	Grab	Surface	✓†	-
ES4†‡	326134	242237	Outfall: sand	2 m	Grab	Surface	✓†‡	-
ES5†‡	326979	242226	Outfall: flat sandy mud , light gravel,	5 m	Grab	Surface	✓†‡	-
ES6†‡	328489	242214	Outfall: sand	10 m	Grab	Surface	✓†‡	-
ES7†‡	330095	242257	Outfall: fine Sand	20 m	Grab	Surface	✓†‡	✓†‡
ES8†‡	327355	241722	Outfall 500 m S: gravelly sand	5 m	Grab	Surface	✓†‡	-
ES9†‡	327366	242722	Outfall 500 m N: sand	5 m	Grab	Surface	✓†‡	-
ES10†‡	329337	241694	Outfall 500 m S: pebbles/shelly gravel	10 m	Grab	Surface	✓†‡	-
ES11†‡	329351	242694	Outfall 500 m N: sand	10 m	Grab	Surface	✓†‡	-
ES12†	329772	245947	Tidal excursion north: light rippled sand	11 m	Grab	Surface	✓†	-
ES13	330271	247991	Tidal excursion south: light rippled sand	5 m	-	-	✓	-
ES24	326738	247841	Habitat: Coarse/rocky cobbles	10 m	-	-	✓	✓
ES27†	328866	240219	Habitat: Rocks	10 m	-	-	✓†	-
VC2	325628	242320	Dense grey silty fine sand with occasional shells	2.8 m	Vibrocore	10/80 cm	-	-
VC3	326077	242322	Dense grey silty fine sand with occasional shells.	5.5 m	Vibrocore	10/80 cm	-	-
VC4	326528	242311	Dense grey silty fine sand with occasional shells. Very shelly layer 0.35 to 0.55 m	6.7 m	Vibrocore	10/80 cm	-	-
VC5	326979	242309	Dense grey silty fine sand with occasional shell fragments.	7 m	Vibrocore	10/80 cm	-	-
VC6	327429	242308	Dense grey silty fine sand with occasional shells.	8.3 m	Vibrocore	10/80 cm	-	-
VC7	327728	242303	Dense grey silty fine sand with occasional shells.	9.6 m	Vibrocore	10/120 cm	-	-
VC8	328414	242303	Grey silty fine sand. Dense grey silty, fine to coarse gravel, fine to coarse sand with high shell content 10 to 40 cm	15.5 m	Vibrocore	10 cm	-	-

* Grab samples acquired 3 x fauna replicates and of physico-chemistry samples.

** CTD = water column conductivity, temperature and depth. † Re-surveyed in July 2013, ‡ Re-surveyed in July 2017

Table 2 Benthic sample locations, rational and acquisition summary (BSL, 2012, 2013 & 2017 and Causeway Geotech 2015)

Site Depth (cm)	Mean Size		Sorting	Skewness	Kurtosis	% Fines (<63 µm)	% Sands	% Gravel (>2 mm)	Classification
	mm	phi							
REF1 (0)	0.064	3.97	2.36	0.61	0.73	35.5%	64.6%	0.0%	Muddy Sand
ES1 (0)	0.418	1.26	0.50	0.01	0.92	0.0%	100.0%	0.0%	Sand
ES3 (0)	0.160	2.65	0.41	0.00	0.98	0.0%	100.0%	0.0%	Sand
ES4 (0)	0.128	2.97	1.10	0.46	2.80	12.7%	87.3%	0.0%	Muddy Sand
ES5 (0)	0.088	3.51	1.65	0.59	2.19	18.2%	81.9%	0.0%	Muddy Sand
ES6 (0)	0.212	2.24	1.28	0.37	2.39	11.4%	88.6%	0.0%	Muddy Sand
ES7(0)	0.079	3.66	2.26	0.52	1.12	27.8%	72.2%	0.0%	Muddy Sand
ES8 (0)	0.071	3.81	1.85	0.62	1.85	22.8%	77.2%	0.0%	Muddy Sand
ES9 (0)	0.075	3.73	1.94	0.53	1.80	23.5%	76.6%	0.0%	Muddy Sand
ES10 (0)	0.079	3.66	10.08	-0.66	2.20	21.3%	52.8%	26.0%	Gravelly Muddy Sand
ES11 (0)	0.046	4.44	5.44	-0.10	2.85	39.1%	49.5%	11.5%	Gravelly Muddy Sand
ES12 (0)	0.206	2.28	0.55	0.13	1.16	4.5%	95.5%	0.0%	Sand
VC2 (0)	0.216	2.21	0.45	0.009	1.03	0.0%	100%	0.0%	Sand
(80)	0.209	2.26	0.45	0.012	1.01	0.0%	100%	0.0%	Sand
VC3 (0)	0.199	2.330.453	0.79	0.275	1.72	5.2%	94.8%	0.0%	Sand
(80)	0.220	2.18	0.52	-0.023	0.99	0.0%	100%	0.0%	Sand
VC4 (0)	0.164	2.61	1.07	0.398	2.53	8.5%	91.5%	0.0%	Sand
(80)	0.165	2.60	0.86	0.318	1.95	5.9%	94.2%	0.0%	Sand
VC5 (0)	0.183	2.45	0.60	0.128	1.10	4.4%	95.7%	0.0%	Sand
(80)	0.189	2.41	0.78	0.262	1.70	5.2%	94.9%	0.0%	Sand
VC6 (0)	0.139	2.84	1.10	0.339	1.83	11.1%	88.9%	0.0%	Muddy Sand
(80)	0.203	2.30	0.99	0.351	2.27	7.4%	92.6%	0.0%	Sand
VC7 (0)	0.178	2.49	1.24	0.457	2.46	13.7%	86.3%	0.0%	Muddy Sand
(120)	0.233	2.11	0.60	0.085	1.12	3.7%	96.3%	0.0%	Sand
VC8 (0)	0.838	0.26	1.97	0.022	1.07	5.2%	68.6%	26.2	Gravelly Sand*

* some possible washout of fines during recovery

Table 3 Summary of sediment type and particle size analysis acquired during the marine ecological surveys (2012 & 2017) and Goetechnics (2015).

Parameter	Unit	2012 Survey (4 sites)		2013 Survey (8 sites)		2015 Survey (6 sites) 0.8-1.2 m depth		Ecotoxicological Assessment Criteria	
		Range	Mean	Range	Mean	Range	mean	Lower Limit	Upper Limit
Arsenic	mg/kg	4.5 - 6.3	5.2	4.1 - 7	5.8	4.73 - 6.66	5.9	1	10
Copper	mg/kg	11.1 - 14	12.9	9.2 - 14.5	11.7	3.76 - 5.79	4.3	5	50
Lead	mg/kg	11.7 - 17.1	14.0	11.8 - 20.2	15.4	7.95 - 14.2	9.8	5	50
Tin	mg/kg	1.2 - 3.6	2.3	1.3 - 3.5	2.2	-	-	-	-
Aluminium	g/kg	14.6 - 19.1	17.0	15.2 - 21.4	18.4	14.0 - 18.3	15.7	-	-
Barium	mg/kg	149 - 178	161.8	143 - 177	158.4	-	-	-	-
Iron	g/kg	9.0 - 14.2	11.8	1.5 - 14400	10.4	-	-	-	-
Cadmium	mg/kg	0.2 - 1	0.5	0 - 0.6	0.3	0.11 - 0.17	0.1	0.1	1
Chromium	mg/kg	27.4 - 37.2	32.1	23.4 - 36.5	29.8	27.2 - 44.2	33.3	10	100
Nickel	mg/kg	8.7 - 14.1	11.0	9 - 17.6	12.0	7.4 - 11.1	9.4	5	50
Vanadium	mg/kg	30.6 - 48.6	40.1	36.6 - 56.3	46.3	-	-	-	-
Zinc	mg/kg	28.6 - 41.2	35.8	31.1 - 47.5	39.7	33.1 - 51.6	37.4	50	500
Mercury	mg/kg	0.02 - 0.04	0.0	0.02 - 0.03	0.0	0.01 - 0.02	0.02	0.05	0.5
Dibutyl Tin	ug/kg	24 - 160	76.3	20 - 110	67.1	<5	<5	-	-
Tributyl tin	ug/kg	<5	<5	<20	<20	<2	<2	0.005	0.05
Total Hydrocarbons	mg/kg	11 - 44	29.0	18 - 29	22.3	<10	<10	-	-
PCB (7 congeners)	µg/kg	<5	<5	<5	<5	<0.2	<0.2	1	10
Toluene	µg/kg	<5	<5	<5	<5	-	-	-	-
Benzene	µg/kg	<1	<1	<1	<1	-	-	-	-
Ethyl Benzene	µg/kg	<2	<2	<2	<2	-	-	-	-
Xylenes	µg/kg	<6	<6	<6	<6	-	-	-	-
m/p Xylenes	µg/kg	<4	<4	<4	<4	-	-	-	-
o Xylene	µg/kg	<2	<2	<2	<2	-	-	-	-
PAH 16 USEPA/compound	µg/kg	<80	<80	<80	<80	4.2 - 14.3	7.4	50	500
Total PAHs	mg/kg	<1280	<1280	<1280	<1280	94 - 155	117		

Table 4 Summary of Sediment Chemistry (Surface grab samples 2012 and 2013. Subsurface Vibrocore samples 2015)

1.5. Macro-invertebrate Community

A macro-invertebrate analysis was carried out on duplicate replicates over a large area benthic program with 24 stations surveyed in 2012 and a further eight stations repeated around the proposed Outfall Pipeline in 2013 and again in 2017 (Table 2 and Figure 1). The survey was carried out during the summer months to convey a maximum population after the annual recruitment by recently settled juveniles. Sites represented the proposed Outfall Pipeline, as well as sediment changes within the vicinity of the project and within a full tidal excursion (or maximum distance travelled by surface water over a full tidal cyle) from the diffuser location. The sediments in the area of the proposed Outfall Pipeline, as described above, were generally sandy with varying influence from a coarser gravel component towards the east. Macrofaunal samples were processed in the field using a 500µm mesh size. For all three survey campaigns, the macrofaunal taxonomy of all recovered fauna identified almost 16 thousand individuals from the 63 grab samples analysed. A matrix of faunal data for each sample is listed in Appendix I. For ease of presentation and comparison, the survey sites was rationalised to a dataset within close proximity of the proposed Outfall Pipeline, a total of 57 samples. Here, over 11,000 individuals were recorded from 245 different species. Of the species recorded, 92 were classified as epifaunal in nature, with 199 infaunal species consisting of 67 annelids accounting for 47.5% of the total individuals. The molluscs were represented by 46 species (27.8% of individuals), the crustaceans by 52 species (but only 12.2% of individuals) whilst echinoderms were represented by 14 species (8.7% of individuals). All other groups (i.e. turbellaria, nematoda, nemertea, cnidaria, chlicerata, porifera and chaetognatha) accounted for the remaining 3%, or 11 species. The population along the proposed Outfall Pipeline indicated a number of community changes relative to the change in sediment type, with sands providing the dominant habitat to the west, becoming mixed with gravelly muddy sands and sandy gravels dominating the seabed at the shelf break and towards the east. A distribution of these different taxa are presented for Station 4 (sands) to the west and Station 11 (gravelly muddy sands) to the east, in Figure 2, with a separation of the data by survey year.

Separated from the final macro-invertebrate analysis were damaged (fragmented), epifaunal and juvenile species. Only 4 juvenile species were recorded for the whole survey in 2012, 2013 and 2017, although in 2012 Station 27, located south of Ireland's Eye, recorded a seed mussel bed (*Modiolus modiolus*), with very high numbers of recently settled individuals. Juveniles are often excluded from community analyses due to their high mortality prior to reaching maturity and difficulties in distinguishing species of the same genus. Consequently, they tend to induce a recruitment spike at certain times of the year due to rapid settlement and colonisation, but are essentially an ephemeral part of the population masking the underlying trends within the mature adults. Other mussel beds (in particular those of the blue mussel (*Mytilus edulis)*) have been recorded in areas to the west of Ireland's Eye and can be considered a potentially sensitive habitat to impact from smothering. When found in dense aggregations, this biotope creates an important biogenic reef habitat encouraging high biodiversity. These can be designated as an Annex 1 habitat under the European Habitats Directive. No Annex 1 habitats were recorded within the proposed Outfall Pipeline.

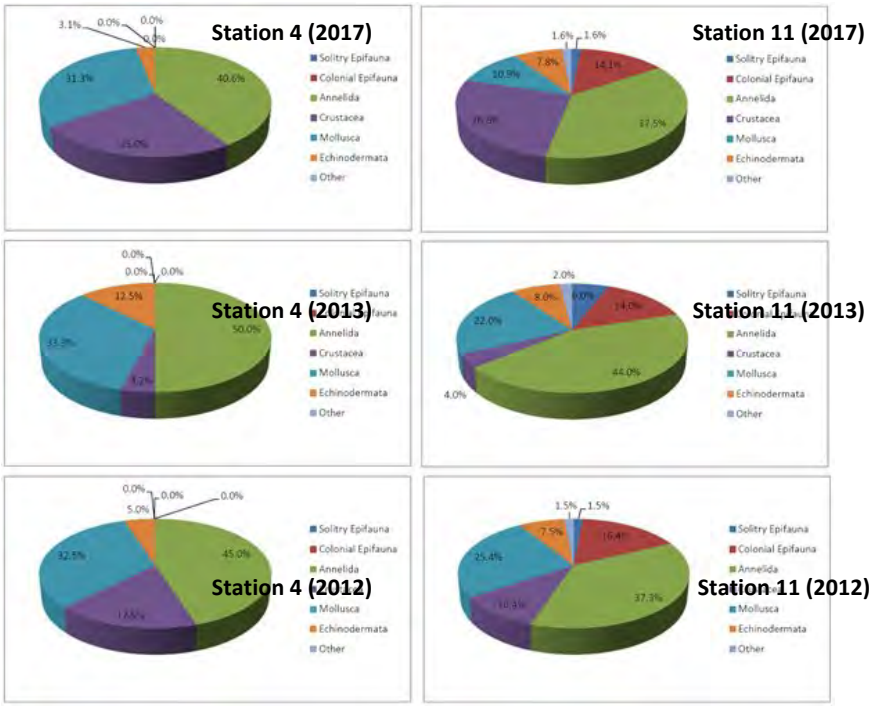

Figure 2 Macro-Invertebrate Distribution by Phylum (Stations 4 and 11, between surveys in 2012 and 2017)

The benthic community recorded in this area was diverse and typical for a mixed inshore sediment environment with both infaunal deposit feeders and surface living epifaunal species both well represented. When the surveys were combined, the overall population was dominated by polychaete worm (a segmented annelid), closely followed by the molluscs, in particular the bivalves. The molluscs represented four of the top 10 numerical species, whilst annelids were also represented by four species, the ophiuroid *Amphiura filiformis* and the crustacean *Pseudocuma longirostris*. Polychaetes were dominated by *Capitomastus minimus* (particularly in 2017) *Owenia fusiformis*, *Lagis koreni* and *Cirratulus cirratus* whilst the molluscs were *Kurtiella bidentata*, *Fabulina fabula*, *Thracia phaseolina and Abra alba*.

When combined surveys were ordered into rank dominance, the main distribution of these species altered slightly although seven of the top 10 numerical species are included within the top ten ranked species. Here, the mollusc *F. fabula* is the most consistent species with a further two other molluscs (*A.alba, K. bidentata* and *T. phaseolina*) recorded in the top six behind the polychaete *C.minimus*. This species community is very similar to communities recorded in the early 1970s (Walker & Rees 1980). A close resemblance to the shallow Venus or Boreal offshore sand association and the Boreal offshore muddy sand association (Jones 1950; Thorson 1957) indicates that a significant stability within the marine sediments has been maintained in this area over several decades.

The primary and univariate parameters are listed for stations (0.2m^2) in Table 5. The number of individuals recorded during this study was quite consistent within the survey area, although the medium sands of Station 1, in Dublin Bay indicated a low number of both species and individuals in 2012. A median for the survey was 47 species and 372 individuals per station area. The median diversity was at a moderate level overall (at 4.10), although this parameter varied by station ranging from a low diversity of 2.92 recorded in Dublin Bay (Station 1 in 2012), to a very high diversity of

5.37 in the same year recorded on the mixed gravely sands at Station 10, due south of the proposed Marine Diffuser location. This reflects the varying sediments and biological niches available in these two quite different sediment types. The Pielou's Equitability was also moderately low with a median of 0.76, indicative of relatively low species dominance within the population, whilst Margalef's Index (Species Richness) equally indicated relatively low species dominance with a median of 7.76 by station. This reflects slight variability, indicative of some community separation by some sites and between survey years. Simpson's Diversity was consistent with a median of 0.89. Overall, these stations reflect a relatively consistent community with a moderate diversity and abundance, but a subtle change between 2012 and 2013. Benthic environments are naturally dynamic with biological population constantly varying between years due to the different success rates by some species during larval recruitment. This affects the relative dominance of key species between survey years and would be expected to continue to change constantly in the survey area.

Station	Survey Year	Number of Species per 0.2m^2 (S)	Number of Individuals per 0.2m^2 (N)	Richness (Margalef)	Evenness (Pielou's Evenness)	Shannon-Wiener Diversity	Simpsons Diversity (1-Lambda')
4	2012	42	858	6.070	0.6854	3.696	0.8757
	2013	26	281	4.434	0.8110	3.812	0.8915
	2017	34	226	6.088	0.7025	3.574	0.8567
5	2012	57	678	8.590	0.7272	4.242	0.9052
	2013	44	241	7.840	0.8443	4.609	0.9395
	2017	42	135	8.358	0.8727	4.706	0.9479
6	2012	57	303	9.801	0.8216	4.792	0.9334
	2013	37	176	6.963	0.8094	4.217	0.9181
	2017	36	170	6.815	0.7646	3.953	0.8569
7	2012	65	367	10.840	0.8052	4.849	0.9350
	2013	54	383	8.911	0.7149	4.114	0.8852
	2017	79	561	12.32	0.6829	4.305	0.843
8	2012	63	895	9.122	0.6423	3.839	0.8513
	2013	39	276	6.761	0.7438	3.932	0.8786
	2017	54	244	9.641	0.8711	5.013	0.9614
9	2012	57	372	9.461	0.8145	4.751	0.9344
	2013	47	503	7.395	0.5720	3.177	0.7193
	2017	52	288	9.006	0.8370	4.771	0.9485
10	2012	72	471	11.540	0.8702	5.369	0.9657
	2013	61	482	9.712	0.7615	4.517	0.9004
	2017	47	226	8.486	0.7354	4.085	0.8909
11	2012	59	496	9.345	0.7168	4.217	0.8979
	2013	43	316	7.297	0.7365	3.996	0.8730
	2017	63	790	9.293	0.5098	3.047	0.7076

Table 5 Macro-invertebrate Primary and Univariate Diversity Indices by Station (2012, 2013 and 2017):

The moderate diversity reflects a high number of species for the relatively high numbers of individuals overall, although the numbers of individuals varied between sites and slightly between years. The most dominant individual species by site was the polychaete *C.minimus* which had a mean abundance of 2000 individuals per m^2, although this was recorded at maximum density of 2,300 Ind/m^2 (for the station 11 in 2017). Only 16% of the 247 species recorded were represented, on average, by more than one specimen per grab sample (i.e.>10 Ind/m^2), whilst 16% of species were represented by only a single specimen over all three surveys (a cumulative sample area of 5.7m^2).

To provide a more thorough examination of the macrofaunal community, multivariate analyses were performed upon the aggregated station for all three datasets using Plymouth Routines in Multivariate Ecological Research software (PRIMER; Clarke & Warwick 1994) to illustrate data trends. Unlike univariate parameters, multivariate analyses preserve the identity of the different

species by assigning a similarity or dissimilarity between the samples. The analyses were undertaken on square-root transformed data.

An inter-annual comparison was carried out comparing the results of the sites immediately surrounding the proposed Outfall Pipeline and Marine Diffuser and demonstrated using a multi-dimensional scaling plot shown in Figure 3 Macro-invertebrate Multi-dimensional Scaling Plot of Repeated Sites Surveyed in 2012, 2013 and 2017. Results show a slight variation the 2012 and 2013 survey years. An analyses of similarity (ANOSIM) showed these differences to be significant, however with only a small degree of differences (R: 0.346, p=0.006). This indicates that there is a considerable amount of overlapping between the faunal compositions of the two years, so that fundamentally, despite some differences, these population communities were very similar. A similarity percentage (SIMPER) test of these data revealed an average dissimilarity of 63.7% between the 2012 and 2013, mainly attributed to higher abundances of more dominant species recorded in 2012. The top five species recorded and their contributory percentages are given in the Table 6a. In 2017, this dissimilarity increased to 66.5% with the change in top five species given in Table 6b.

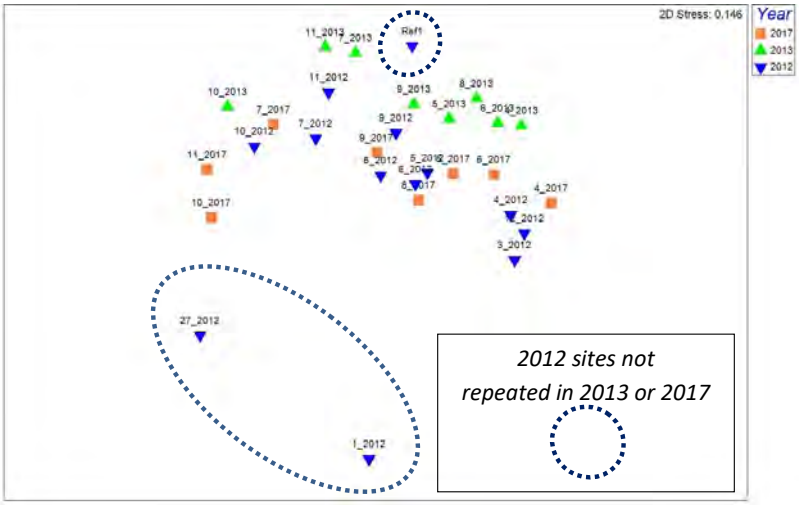

Figure 3 Macro-invertebrate Multi-dimensional Scaling Plot of Repeated Sites Surveyed in 2012, 2013 and 2017

(A) Species	Phylum	Average Abundance 2013	Average Abundance 2012	Contributory difference (%)
Pseudocuma longirostris	Crustacea	0	4.92	3.3
Owenia fusiformis	Annelida	2.22	6.18	3.12
Amphiura filiformis	Echinodermata	2.91	3.25	2.84
Thracia phaseolina	Mollusca	2.61	4.45	2.7
Lagis koreni	Annelida	4.19	3.79	2.62

(B) Species	Phylum	Average Abundance 2017	Average Abundance 2013	Contributory difference (%)
Capitomastus minimus	Annelida	6.70	1.90	4.13
Lagis koreni	Annelida	0.61	4.19	3.12
Lanice conchilega	Annelida	0.93	4.01	2.73
Fabulina fabula	Mollusca	3.13	2.43	2.53
Abra alba	Mollusca	2.11	5.02	2.51

Table 6 Species Responsible for Dissimilarity between (A) 2012 and 2013 and (B) 2013 and 2017 Surveys

The distribution of key phylogenetic groups between survey years is shown in Figure 2. This separates the surveys into two stations which represent sands to the west of the outfall (Station 4) and muddy sandy gravels (Station 11) just north of the proposed Marine Diffuser. Results show that whilst some variations exist between survey years, shown above, the greatest variations in species richness between stations is predominantly a result in habitat change across the area. At both sites, annelids were the dominant fauna type followed by molluscs, crustaceans and then echinoderms, by both richness and abundance. The greater variation was recorded at Station 11, having a notably higher epifaunal component owing to the gravel substrate. Furthermore, the numbers of crustacea appeared to fall in 2013, but recovered again in the later survey. Comparison of survey years showed that the richness crustacea decreased significantly in 2013 for both sandy and gravelly substrates, whilst the richness of echinoderms dropped significantly in the sandy substrate but remained consistent on the coarser sediments over all three years. As all three surveys were conducted in the same season (summer), these observed inter-annual differences observed demonstrate the natural temporal shift in community structure with changes in the dominance of certain species.

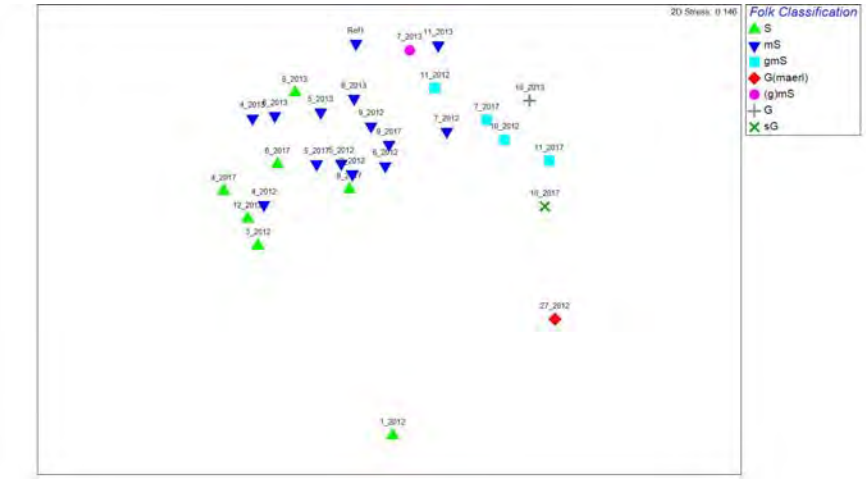

Figure 4 Macro-invertebrate Multi-dimensional Scaling Plot against Sediment Changes

A demonstration of the strength in variation within the biological community by sediment type is shown in the multi-dimensional scaling plot in Figure 4. Here, the faunal community from both replicate samples are analysed by station, with habitat denomination given using the folk classification. This shows faunal groupings of both survey years clustering together, but separating by sediment type. This separation is supported by an ANOSIM test which permuted a result of R: 0.692, (p=0.001) for comparable stations, indicating a significantly high separation within the benthic community by sediment type. The species responsible for these separations was analysed using SIMPER. Results showed that muddy sandy gravel separated from the other sediment types due to higher counts of the brittlestar *Amphiura filiformis* and polychaete *Scalibregma inflatum*. Muddy sand separated out due to relatively high counts of the polychaetes *Lagis koreni* and *Owenia fusiformis*. Stations with the sand classifications differed due to lower species dominance compared with other sediment types although the polycheate *Magelona mirabilis* was recorded in relatively high counts. The edible mussel (*Mytilus edulis*) and swimming crab (*Liocarcinus depurator*) were responsible for most of the differences recorded in the maerl gravel found on the southern side of Ireland's Eye Island (surveyed in 2012 only).

1.6. Epifaunal Community

Observations made during the taxonomy and via by seabed photography have identified a significant epifaunal community within many of the stations surveyed, particularly those to the east of the route relating to the coarser gravels. Taxonomic records showed that both solitary and colonial species of epifauna were recorded during the benthic survey, with as many of 23 different species recorded at Station 10, located within the mixed gravelly sediments. Figure 5 shows the numbers of species recorded relative to the infaunal biology, with epifaunal species represented in all sites surveyed over the three periods.

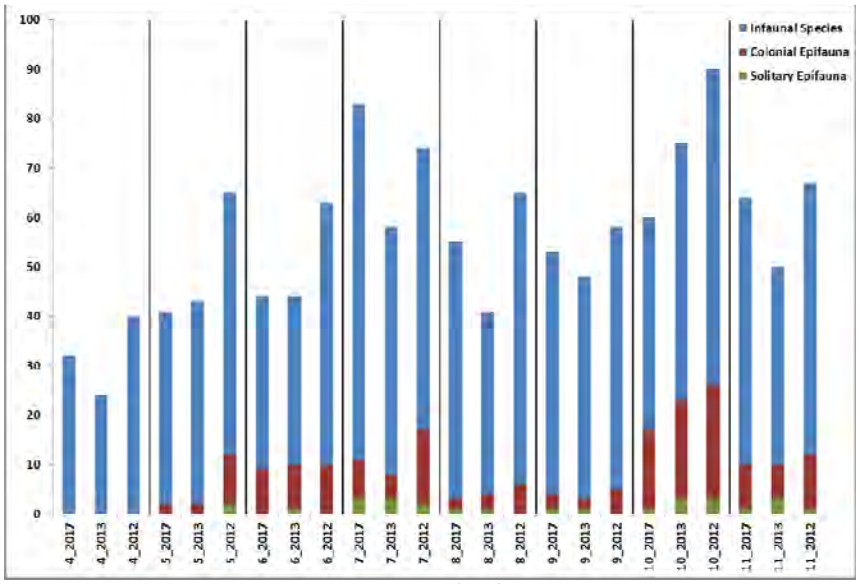

Figure 5 Distribution of Epifaunal Species

From all surveys, these samples recorded a large number of epifaunal species were recorded, dominated by 24 species of bryozoan, 27 species of cnideria, six species of sponge a kamtozoan. One of the most dominant groups were bryozoans with *Conopeum reticulum* the most common, but none were recorded in large numbers. Most of the bryozoan were upright branching or "turf"

forming species, e.g. *Bugula* spp., *Crisia* spp., *Alcyonidium diaphanum*, *Flustra foliacea, Vesicularia spinosa* and *Scrupocellaria scruposa*. The sponge fauna was relatively sparse. *Cliona celata* was found boring within shells whilst *Dysidea fragilis* is a ubiquitous species around the Irish coast, and can range from small crusts to large massive specimens. *Scypha ciliata* often settles on other epibenthic species and none of the species was commonly found due to the generally sandy substrate at most sites sampled.

The most dense coverage by epifauna was by the hydroids, which were relatively well developed, especially *Laomedea flexuosa* and *Sertularia cupressina* which were recorded over half of the sites. Some larger species, such as *Hydrallmania falcata* and *Halecium* spp. acted as settlement surface for smaller creeping species such as *Campanularia hincksii* and *Clytia hemisphaerica*. Many of the Hydroids were heavily settled with very juvenile *Mytilus* and *Modiolus* mussels.

Another species previously of note was the presence of biogenic maerl sand in isolated patches at Station 27, south of Ireland's Eye Island. This in coralline red algae which can create a diverse biological community at the seabed through sediment modification and habitat creation, although only isolated pockets of mostly dead debris were recorded using seabed photography at this station (in 2012). The presence of maerl has been previously recorded by the GSI as part of the INFOMAR project in this area of Dublin Bay. As this was on the opposite side of Ireland Eye to the proposed pipeline route, this was not surveyed again in 2013 or 2017.

In addition to coarse sediments recorded along the proposed outfall, the intertidal and sub-tidal reefs of the Ireland's Eye SAC are recorded approximately 1.6km to the south. These features have been surveyed separately and are described in detail in a separate report (Appendix II).

2. Zookplankton Samples

Semi-quantitative samples of large zooplankton were taken during the benthic sampling campaign in 2012, both summer and winter (>250 µm) and again in 2017 over high and low water periods. Samples were acquired using a vertical tow technique where a trawl net is hauled vertically from the seabed to the surface and the complete water sample rinsed and fixed in 4% formalin prior to the taxonomy and enumeration in the laboratory. Samples here were processed at Plymouth Marine laboratory. The results are given in Table 7.

Sample results showed the presence of zooplankton all year around, although the major contributors (such as the decapods and copepods) were more abundant in the summer months. The reference station indicated much greater numbers in the summer (at 681 individuals per m^3) than recorded at the outfall location (maximum of 57 ind/m^3 in the summer and 99.8 ind/m^3 in the winter 2012. This is interpreted as a result of the deeper water-depth recorded at the reference site, with the majority of zooplankton species recorded in deeper waters during daylight hours where they are less prone to predation. Data from 2017 at the proposed diffuser location indicated a higher abundance than the same site in 2012, increasing to 365 to 408 ind/m^3 between high and low water periods. The most dominant species were consistently the copepods *Acartia clausi*, *Centropages hamatus* and *Temora longicornis* between survey years, although up to 27 different species were recorded in each of the samples overall.

Phyla	Species	Ref1		Station 7 (Marine Diffuser 2012)		Station 7 (Marine Diffuser 2017)	
		Aug	Dec	Aug	Dec	HW	LW
Algae	*Noctiluca scintillans*	+		+	+	6167	12480
Chaetognatha	*Sagitta* sp.	19	5	1	22	1	
Arachnida	*Acarid mite*					16	
Decapoda	Decapod zoea	2		11			
	Brachyuran zoea			17		13	11
	Pinnotheres pisum zoea						
	Caridea zoea					16	1
	Porcellanidae zoea	11		49		3	4
	Pisidia longicornis					16	2
	Brachyuran megalopa	12		10			1
Mysid					3	1	
Cumacean			1	3	2		3
Gammarid amphipod					7	1	
Mollusca	Gastropod larvae				1		2
	Littorina littorea eggs			1			16
	Bivalve larvae			5	1	48	48
Echinodermata	Ophiuroidea post larvae	20		2		1	
Polychaeta	Terribelida larvae					4	1
	Aphroditiformea larvae					3	1
	Magellonid larvae					16	2
	Polychaete		1	2	1		
	Tomopteris helgolandica	15		2			1
Barnacle nauplii	Cirripede cyprid			2	1	16	2
Cladocera	*Evadne nordmanni*	40		1		16	
	Podon intermedius	20				16	
	Pleopsis polyphemoides					48	32
Bryozoa	*Cyphonautes* larvae		2		1	1	
Chordata	Appendicularia	260	8	11	11	16	3
	Fish larvae	1		1		1	
Foraminifera (benthic)		20				17	
Isopoda	*Gnathia* sp.				1	1	
Copepoda	*Acartia clausi*	1040	73		103	688	704
	Diaixis hibernica		1				
	Centropages hamatus	1540	7	62	15	400	320
	Calanus spp. stages 1-4	40	2		2		1
	Calanus helgolandicus stages 5-6	20	4		1		
	Paracalanus parvus adult		5		1		
	Pseudocalanus elongatus adult	240	107		93		
	Para/Pseudocalanus stages 1-5	240	69	1	28		
	Temora longicornis	1120	60	23	89	224	256
	Isais clavipes						1
	Alteutha sp.			11		16	2
	Longipedia sp.	20		7	1		
	Corycaeus anglicus		3	1	1		
	Siphonostomatoida copepod (parasitic)	1		1	1		
	Monstrilla sp. (copepod)				6		
	Harpacticoid benthic unidentified						16
	Copepod nauplii			1			
Cnidaria	*Clytia hemisphaerica*		2			4	2
Ctenophora							1
Species		**20**	**16**	**23**	**23**	**27**	**24**
Abundance		**4681**	**350**	**225**	**392**	**1603**	**1433**
Depth		**35**	**35**	**20**	**20**	**20**	**20**
Abundance per m^3		**681.15**	**50.93**	**57.3**	**99.82**	**408**	**365**

Table 7 Zooplankton Species List and Abundance (2012 and 2017)

3. Baldoyle Estuary Walkover

3.1. Previous Survey Data

Fingal County Council commissioned a survey of coastal habitats in the county in 2004. Phase I of the study involved the mapping of all coastal habitats within the County. Phase II of the survey involved a study of the coastal vegetation communities within the county boundaries. Rare, threatened or legally protected flora were also recorded. The Baldoyle Estuary was surveyed as part of the survey of the Portmarnock area. During the survey the salt marsh habitat was described as follows:

> "The salt marsh that extends eastward from Portmarnock is clearly differentiated into an upper zone, (CM1) with abundant stands of *Juncus maritimus* and a lower zone of middle and lower saltmarsh (CM2). *Atriplex portulacoides* is a strong associate of *Juncus maritimus* in this area. A number of stands of *Oenanthe lachenalii* occur on the interface between upper and lower salt marsh, often where there is some evidence of irrigation by percolating freshwater. A number of large stands of *Phragmites australis* also occur at the upper end of the saltmarsh near the road where there is a natural fall in the land from the adjoining course and former agricultural areas".

The salt marsh vegetation was described as follows:

> "The salt marsh vegetation of the area lying to the west of the peninsula in its upper zones resembles *Juncus maritimus – Triglochin maritima* community with an abundance of *Atriplex portulacoides* forming a distinct compact layer close to the road. Below that a variety of mixed patches of Puccinellia maritima salt-marsh community, mixed with *Atriplex portulacoides*, *Festuca rubra* and *Juncus gerardii* salt-marsh communities occur in close proximity".

The Baldoyle Estuary was further surveyed over several days in June 2006 as part of a national saltmarsh monitoring project commissioned by NPWS. The survey developed a monitoring methodology based on the JNCC guidelines for saltmarshes, which was based on vegetation surveys and assessments of threats and management practices and adapted for Irish saltmarsh habitats.
A detailed habitat map for the site and descriptions of the Annex I habitats present were outlined in the NPWS Saltmarsh Monitoring Project report (Mc Corry and Ryle, 2009). The habitat map showing the distribution and extent of Annex I habitats produced by Mc Corry and Ryle are presented below on **Error! Reference source not found.**. Mc Corry and Ryle (2009) describe the estuary as follows:

> "Saltmarshes mainly occur in the northern part of the estuary, on both sides of the estuarine-river channel. Other small areas of saltmarsh occur along the western side, at the end of Portmarnock Point and along the southern side of the estuary adjacent to Sutton Dart Station. Another small saltmarsh/brackish marsh area occurs along the Mayne River, which flows into the western side of the estuary. This area contains the rare grass species Borrer's Saltmarsh-grass (*Puccinellia fasciculata*), a species listed on the Flora Protection Order. Baldoyle Estuary also includes a dune system at Portmarnock Point. The conservation status of the sand dune habitats were assessed by the Coastal Monitoring Project in 2004.
>
> Three Annex I habitats, Salicornia flats, Atlantic salt meadows (ASM) and Mediterranean salt meadows (MSM), are found at this site. All three habitats are listed as qualifying interests for the Baldoyle Estuary cSAC. *Spartina* swards are also present at this site. Nearly the entire saltmarsh habitat is situated within the cSAC. There are some exclusions at the southern end of Portmarnock Spit. Some of the ASM is located outside the cSAC due to the exclusion of the golf course.

Most of the site is also a National Nature Reserve that is managed by NPWS. The saltmarsh located at the southern end of Portmarnock Spit is excluded from the nature reserve. The estuary is also designated as a SPA due to its importance for wintering waders and wildfowl, including internationally important numbers of brent geese".

The Annex I habitats within the site are described by Mc Corry and Ryle as follows:

Atlantic Salt Meadow (H1330)
The largest area of ASM is located in the north-west part of the estuary. This area contains several zones of ASM saltmarsh vegetation. The lower zone is dominated by sea purslane with frequent common saltmarsh-grass and occasional greater sea-spurrey and lax-flowered sea lavender. This zone is quite narrow in places and is most frequent along the northern side of this area. There is generally a distinct boundary with the adjacent *Spartina* swards. The lower zone has frequent clumps of common cordgrass spread through it. Within Area 1 there is a low-lying area that was formerly a small bay containing mudflats. This area now contains *Spartina* swards and lower zone ASM with frequent cover of common cordgrass. Common cordgrass within the ASM may reach 40%. Lower marsh ASM vegetation dominated by sea purslane has developed along the edges of the Sluice River channel.

Higher up on the marsh there is a mid-marsh zone dominated by sea pink and sea plantain. Other species present in this zone include sea aster, lax-flowered sea lavender and red fescue. This area has frequent large salt pans and a complex creek network. Common cordgrass is frequent in this zone within salt pans but it becomes less frequent towards the back of the marsh. This species has also infilled some small creeks within this area. This area contains the best developed topography present at the site. Upper saltmarsh vegetation is dominated by saltmarsh rush along the landward boundary and adjacent to the MSM also in this area. The ASM generally transitions to rank grassland or scrub above the high water mark.

There is a generally narrow band of ASM located in Area 4 in the north-east of the estuary. This band of saltmarsh is situated between *Spartina* swards and an embankment along the road or further north with brackish vegetation located at the landward side. There are patches of MSM vegetation scattered along this band of saltmarsh. The ASM vegetation in the northern section is generally dominated by red fescue. The topography is quite uneven. Common cordgrass is present in the pans and as clumps within the ASM vegetation.

Mediterranean Salt Meadows (H1410)
MSM is characterised by clumps of sea rush. It is found on small scattered clumps in a generally narrow band (1-20 m) along the landward side of most of the saltmarsh. The habitat may be represented by clumps only 1-2 m wide. Its distribution breaks up in places and clumps become isolated from each other. It also forms a mosaic with ASM in places where there are small scattered clumps of sea rush mixed with ASM vegetation that forms a narrow zone of saltmarsh.

Sea rush forms large clumps in places and though it may not actually dominate the cover (cover varies from 30-75%), it is the most characteristic and obvious part of the vegetation. Many of the clumps have other saltmarsh species colonising these clumps and this reduces the actual overall cover of sea rush. Sea purslane is found quite frequently amongst these clumps with red fescue. Other species found occasionally include saltmarsh rush, sea arrowgrass, sea aster, sea plantain, sea pink, creeping bent grass, common scurvy grass and lax-flowered sea lavender.
One notable aspect of the distribution of sea rush is that it is sometimes found to the seaward side of ASM vegetation and adjacent to the *Spartina* sward. This occurs in the narrow bands of

ASM/MSM mosaic. Common saltmarsh-grass and lax-flowered sea lavender are found within this vegetation associated with the clumps of sea rush. This zone also contains pans infilled with common saltmarsh-grass. The ASM and MSM were mapped as a mosaic as the saltmarsh is quite narrow and it would be difficult to map the two habitats separately. This saltmarsh on the western side of the estuary transitions to rank grassland dominated by Twitch.

***Spartina* Swards**

Spartina swards are the most extensive habitat at this site. This habitat is not listed as a qualifying interest for this site. These swards are quite mature and developed quite quickly during and soon after the 1950's (O'Reilly & Pantin, 1957). There has not been much significant change since this period. This habitat is usually characterised by a high stem density of common cordgrass. There are small amounts of common saltmarsh-grass, lax-flowered sea lavender and greater sea-spurrey within the sward, particularly closer to the landward boundary. These swards are quite mature and a complex creek structure has developed in the swards. The development of these swards has significantly narrowed the upper part of the Sluice River channel in the north-western corner of the estuary.

There is still a distinctive boundary between the ASM and the *Spartina* sward along much of the boundary with a low saltmarsh cliff situated along the border. Sometimes the ASM/*Spartina* sward boundary follows the exact lower boundary of the saltmarsh. This indicates that the *Spartina* sward has predominately developed on intertidal mudflats. In other places the boundary is less distinct and there is a gradual transition from dense *Spartina* sward to a mosaic of *Spartina* sward and ASM and then to isolated clumps of common cordgrass situated within the ASM.

Much of the *Spartina* sward located on the southern part of the estuary contains a mosaic of isolated clumps and mudflats at the seaward edge of the denser sward. There are actually signs of recent dieback along the seaward side of the sward lower down in the estuary (within the areas mapped as *Spartina* clump/mudflat mosaic). Some clumps have died back and are being eroded. There are no signs of glasswort amongst the clumps of common cordgrass forming the clump/mudflat mosaic, seaward of the denser swards.

Conservation Status

Overall, the site was deemed by Mc Corry and Ryle to be in favourable conservation status. The habitat map showing the distribution and extent of Annex I habitats produced by Mc Corry and Ryle are presented above on **Error! Reference source not found.**.

3.2. Field Walkover Survey

As part of the field assessment operations, the saltmarsh area and estuary immediately surrounding the Baldoyle estuary was surveyed using a field walk-over survey over the inter-tidal area of the route to confirm information from previous coastal habitat mapping previously carried out in the Baldoyle estuary area.

The site was visited in November 2013 and the habitat mapping and descriptions prepared by Mc Corry and Ryle (2009) were reviewed in the field in relation to the current conditions at the site and the proposed Outfall Pipeline route. The GIS shapefiles prepared by Mc Corry and Ryle (2009) were used in the field in conjunction with aerial photographs. This allowed for an accurate assessment in the field of the extent of habitat types as previously described and mapped and to document any

changes in same. A photographic record of the habitats recorded was also made and geo-tagged. A selection of site photographs is presented in Appendix III.

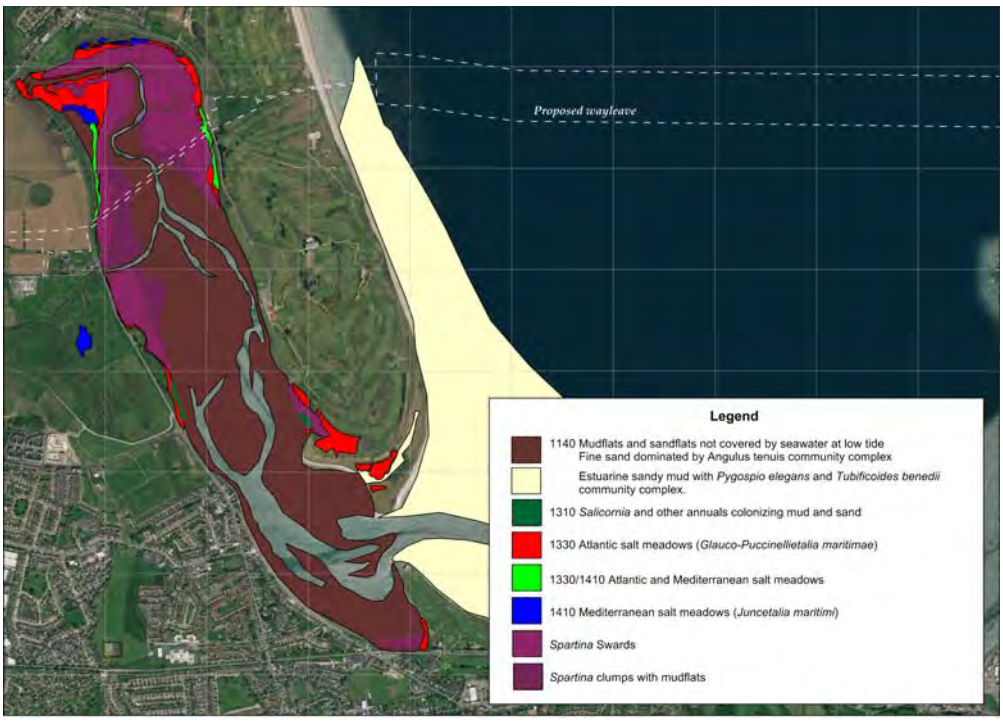

Figure 6 **Habitat Map of the Annex I Habitats of Baldoyle Estuary prepared.**

Proposed Outfall Pipeline - Eastern Side

The eastern section of the proposed Outfall Pipeline crosses an area of the estuary near the public car park for the Portmarnock beach and dune system/entrance to Portmarnock Golf Club. At this side of the estuary the Outfall Pipeline crosses a grassy embankment, which is mown and maintained by Fingal County Council adjoining the public road, before reaching a band 20 to 30m wide in places of a mosaic of ASM and MSM. To the north of the Outfall Pipeline is an area of ASM (see Chapter 11 of the EIAR (Volume 3)). These areas grade into extensive swards of *Spartina,* which extend towards the centre of the estuary where they become broken up and form a mosaic of clumps of *Spartina* and mudflats.

At the upper extent of the saltmarsh the vegetation is dominated by creeping bent grass (*Agrostis stolonifera*), with occasional sea beet (*Beta maritima*), sea rush (*Juncus maritimus*), red fescue (*Festuca rubra*), sea purslane (*Halimione portulacoides*), common scurvy grass (*Cochlearia officinalis*) and sea pink (*Armeria maritima*).

These grade into an area of middle marsh with occasional pans and creeks which are dominated by sea pink, sea plantain (*Plantago maritima*), lax-flowered sea lavender (*Limonium humile*) and sea aster (*Aster tripolium*) with occasional stands of saltmeadow rush (*Juncus gerardii*) and sea rush, whilst areas with higher inundation of the tide (lower marsh) contain sea arrow grass (*Triglochin maritima*), common scurvy grass and sea purslane. This then grades into areas of dense stands of

common cordgrass (*Spartina anglica*) which dominate the mudflats and creeks with occasional *Enteromorpha*.

North of the main crossing point for the Outfall Pipeline is an area with better defined pans and creeks that more closely approximates pure ASM and a stand of common reed (*Phragmites australis*) is present near where the road turns back to the west.

Proposed Outfall Pipeline - Western Side

The western section of the Outfall Pipeline crosses an area of the estuary near the Mayne River. The western side of the route contains a much narrower band of saltmarsh vegetation, which is backed by an area of rank grassland adjoining the road. Species recorded here include creeping bent, thistles (*Cirsium arvense* and *Cirsium vulgaris*), docks (*Rumex* sp.), tall fescue (*Festuca arundinacea*), bush vetch (*Vicia sepium*), nettle (*Urtica dioica*) and common comfrey (*Symphytum officinale*). Below this is a narrow band of a mosaic of ASM and MSM, which is no more than 1-4m wide. The main species recorded here include sea beet, sea purslane and sea arrowgrass interspersed with stands of common cordgrass. These become more dominant forming a *Spartina* sward for approximately 30 to 40m before breaking up into a mosaic of clumps of *Spartina* and open mudflats.

The band of saltmarsh vegetation tapers off to the south towards the Mayne River and occasional sparse patches of sea aster, common scurvy grass, glasswort (*Salicornia* sp.) and common cordgrass are present on the open muds. Backing this is a stone wall with scattered sea aster, lax-flowered sea lavender, sea arrowgrass and sea beet.

Overall, the habitats at Baldoyle Estuary do not appear to have undergone any significant changes in quality or extent at the proposed location of the outfall pipe since the 2006 surveys conducted by NPWS. The boundaries of the Annex I habitats as mapped by Mc Corry and Ryle have not changed significantly since that time and the vegetation composition at the proposed Outfall Pipeline appears to have remained broadly similar.

Some of the species recorded in the earlier 2004 surveys by Doogue *et al.* such as *Atriplex portulacoides*, *Juncus gerardii* and *Oenanthe lachenalii* were not encountered at the proposed outfall pipeline but may be present further north within the estuary where a greater extent of saltmarsh vegetation is present**.**

4. Fisheries Information for the Fingal Region

4.1. Species with Defined Spawning and Nursery Grounds

A number of fish species have defined spawning and nursery grounds within the area of the proposed Outfall Pipeline. These species are detailed in Table 8 based on the data provided in Ellis *et al.* (2010, 2012) and Coull *et al.* (1998). It should be noted that additional species may utilise the proposed Outfall Pipeline area as spawning and/or nursery grounds, although these are not expected to be significant enough to be affected by the proposed project. These are outlined in two dedicated fisheries assessments carried out for the development area by ASU in 2015 and 2017. The ecology of the principal fish species identified during these sampling operations is described later in this section.

Coull *et al*. (1998) and Ellis *et al.* (2010, 2012) are acknowledged to be the standards, presenting data illustrating the widest potential distribution of common fish spawning and nursery areas in the British Isles (including the proposed development area). These publications identify broad areas used as spawning and nursery grounds; however they do not define exact boundaries. This must be considered given the relatively small footprint of the proposed Outfall Pipeline. Further to this, Ellis *et al.* (2010, 2012) have defined spawning grounds using the grid rectangles where ichthyoplankton (eggs and larvae of fish) surveys have been carried out, therefore these areas are unlikely to represent specific spawning grounds. In addition, the data presented by Coull *et al.* (1998) is accumulated from a number of literature and research sources, much of which is considered historic. The spawning periods described in all three publications reflect the maximum duration of spawning for a specific species and/or stock, and as such, is unlikely to represent localised spawning events which may be much shorter-lived.

Spawning	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Nursery
Anglerfish													
Cod		*	*										
Haddock													
Herring													
Horse mackerel					*	*							
Lemon sole													
Ling													
Mackerel					*	*							
Plaice	*	*											
Sandeel													
Sole				*									
Sprat					*	*							
Whiting													
Spotted ray				?	*	*	*	?					
Thornback ray				*	*	*	*	*					
Spurdog	Viviparous species - gravid females can be present year-round												
Tope	Viviparous species - gravid females can be present year-round												

	High Intensity		Low Intensity		Intensity Unknown	*	Peak Spawning

Table 8 Spawning Periods of Key Species

4.2. Species of Conservation Interest

The three species of lampreys (Petromyzontidae) that occur in Ireland are listed under Annex II of the EC Habitats Directive, and Kelly and King (2001) summarised their distribution in Irish waters. While the brook lamprey (*Lampetra planeri*) is recorded from the Boyne and Liffey catchments (to the north and south of the proposed outfall location, respectively), this species is exclusively found in freshwater. The river lamprey (*L. fluviatilis*), which is anadromous (i.e. uses coastal/marine habitat and then ascends rivers to spawn), are the least widely reported of the three species in Ireland, although it is recorded from the lower Boyne river to the north, contributing to its SAC status. The sea lamprey (*Petromyzon marinus*) is also anadromous and this species is more widely distributed in Ireland, although it is not recorded in the Boyne or the Liffey catchments (Kelly and King, 2001). Shad are related to herring, and are also anadromous; both the allis (*Alosa alosa)* and twaite shad *A. fallax* occur in Ireland and are designated as Annex II species. Four SACs in Ireland have been designated based on their importance to shad, although these are all in the south of the country (King and Roche, 2008); shad are not regularly recorded in the area of the proposed outfall. The smelt (*Osmerus eperlanus)*, an anadromous Irish Red Data book species, has not been recorded from the east coast of the Republic of Ireland (Quigley *et al.,* 2004).

Both salmon (*Salmo salar*, an EC Habitats Directive Annex II species) and sea trout (*S. trutta* morpha *trutta*) are anadromous and occur in rivers and coastal waters throughout Ireland. Both species are of great importance to recreational and commercial fisheries. The inshore areas of the proposed marine outfall are likely to be used by both species, given that important rivers exist relatively nearby: for example, the River Boyne, 35km to the north of the proposed outfall location, is designated an SAC partly based on the presence of salmon and is renowned as a salmon and sea trout fishing river. Nearby rivers to the development site have the following salmonid status (see Chapter 10 on Freshwater):

- The Sluice River (IE_EA_09_1532) and its tributaries constitute a salmonid system. The system (main channel and tributaries) supports brown trout (*S. trutta*) throughout and eels (*Anguilla anguilla*) in its lower reaches (in addition to other fish species). It should be highlighted that recent surveys of the Sluice have recorded the presence of brown trout at least as far upstream as the Abbeyville Estate.

- The Mayne River (IE_EA_09_1428) and tributaries including the Cuckoo Stream are currently a non-salmonid system due to a combination of factors namely impassable barriers and historically poor water and habitat quality. The Mayne River is included as part of the WFD fish monitoring programme. The survey in 2011 (outlined in Chapter 11) recorded only two fish species, three-spined stickleback (*Gasterosteus aculeatus* L.) and eels (*Anguilla anguilla* L.). However, as water quality has been noted as improving and IFI is currently assessing the viability of a salmonid reintroduction programme. Local developers have installed and configured instream features in compliance with salmonid waters requirements as per 'best practice' for this river.

- The Santry River (IE_EA_09_1507) is a non-salmonid system due to impassable features located at the lower end of the system. Water quality is also under significant pressure due to urbanisation in the catchment. IFI's policy is to maintain watercourses in their open natural state in order to prevent habitat loss; preserve biological diversity and aid in pollution detection.

- The Tolka River and its tributaries is an important salmonid system under significant ecological pressure from urbanisation. The system supports a resident population of brown trout (*Salmo trutta* L.), a migratory population of sea trout and Atlantic salmon (*Salmo salar* L.), and the

system also supports eels and river lamprey (*Lampetra fluviatilis* L.) (Gretta Hannigan IFI pers comm. 2015).

- In addition to these inshore species, a number of offshore species of conservation interest have been recorded from the area, including the basking shark (*Cetorhinus maximus*, Berrow 2008), which is more common in the western Irish Sea, and the sunfish (*Mola mola*).

4.3. Diadromous Migratory Species

A number of diadromous species of conservation importance may utilise the area of the proposed Outfall Pipeline during migration or when foraging are listed in Table 9.

Common Name	Scientific Name	Conservation Status				
		Bern Convention	Habitat Directive	OSPAR	IUCN Red List	UK BAP
Allis shad	*Alosa alosa*	✓	✓	✓	Least Concern	✓
Twaite shad	*Alosa fallax*	✓	✓	-	Least Concern	✓
European eel	*Anguilla anguilla*	-	-	✓	Critically Endangered	✓
River lamprey	*Lampetra fluviatilis*	✓	✓	-	Least Concern	✓
Salmon	*Salmo salar*	*	✓	✓	Least Concern	✓
Sea trout	*Salmo trutta*	-	-	-	Least Concern	✓

* Only salmon found in freshwater are listed for conservation status under the Bern Convention.

Table 9 Diadromous Fish Species of Conservation Importance

4.4. Elasmobranchs

Most elasmobranchs (sharks, skates and rays) are considered slow growing and late maturing with a low rate of reproduction (fecundity) when compared with other bony fishes (Camhi *et al.,* 1998; Musick and Bonfil, 2005). They are therefore sensitive to commercial exploitation through their resultant slow rate of stock increase (Musick and Musick, 2011). The principal species with conservation designations and/or declining stocks potentially occurring within the vicinity of the proposed Outfall Pipeline are detailed below in Table 10.

Common Name	Scientific Name	Conservation Status			
		Bern Convention	OSPAR	IUCN Red List	UK BAP
Tope	*Galeorhinus galeus*	-	-	Vulnerable	✓
Spurdog	*Squalus acanthias*	-	✓	Vulnerable	✓
Lesser-spotted dogfish	*Scyliorhinus canicula*	-	-	Least Concern	-
Nursehound	*Scyliorhinus stellaris*	-	-	Near Threatened	-
Starry smoothhound	*Mustelus asterias*	-	-	Least Concern	-
Common smoothhound	*Mustelus mustelus*	-	-	Vulnerable	-
Common thresher shark	*Alopias vulpinus*	-	-	Vulnerable	-
Leafscale gulper shark	*Centrophorus squamosus*	-	✓	Vulnerable	✓
Basking shark	*Cetorhinus maximus*	✓	✓	Vulnerable	✓
Porbeagle shark	*Lamna nasus*	✓	✓	Vulnerable	✓
Spotted ray	*Raja montagui*	-	✓	Least Concern	-
Thornback ray	*Raja clavata*	-	*	Near Threatened	-

Common skate	*Dipturus batis*	-	✓	Critically Endangered	✓

* Thornback rays occur in the area but are not considered under threat and/or in decline here

Table 10 Elasmobranch Fish Species of Conservation Importance

4.5. Other Species of Conservation Interest

A number of commercially exploited species which are expected to be present within the proposed Outfall Pipeline area are listed under UK BAP, OSPAR, IUCN Red List and the Bern Convention and are therefore of conservation interest. A list of relevant species and their designations is given below in Table 11.

Sand goby (*P. minutus*) and common goby (*P. microps*) are not commercially exploited, and are also of conservation interest. Both species are listed under the Bern Convention (Appendix II), and relatively high numbers of what was assumed to be sand goby in the field (may possibly be common goby) were found in both the scientific 2 m beam trawl survey and the beach seine survey.

Common Name	Scientific Name	Conservation Status			
		Bern Convention	OSPAR	IUCN Red List	UK BAP
Lesser sandeel	*Ammodytes marinus*	-	-	-	✓
Small sandeel	*Ammodytes tobianus*	-	-	Data Deficient	-
Herring	*Clupea harengus*	-	-	Least Concern	✓
Cod	*Gadus morhua*	-	✓	Vulnerable	✓
Whiting	*Merlangius merlangus*	-	-	Least Concern	✓
Plaice	*Pleuronectes platessa*	-	-	Least Concern	✓
Sole	*Solea solea*	-	-	Data Deficient	✓
Turbot	*Scophthalmus maximus*	-	-	Near Threatened*	-
Mackerel	*Scomber scombrus*	-	-	Least Concern	✓
Horse mackerel	*Trachurus trachurus*	-	-	Vulnerable	✓
Anglerfish	*Lophius piscatorius*	-	-	Least Concern	✓
Haddock	*Melanogrammus aeglefinus*	-	-	Vulnerable	-
Sand goby	*Pomatoschistus minutus*	✓	-	Least Concern	-
Common goby	*Pomatoschistus microps*	✓	-	Least Concern	-

* Mediterranean only

Table 11 Other Fish Species of Conservation Importance

Species such as herring, sprat and sand eel are considered key prey species for many predators such as marine mammals, piscivorous fish and birds (Furness, 2002; Pitcher and Wyche, 1982; ICES, 2006, 2006b). Cod are known to prey upon small members of the Gadidae family (*Trisopterus* spp.), whiting, various flatfish, herring and sandeel (Arnett and Whelan, 2001). There are also records of juvenile plaice in the stomachs of cod, whiting, saithe (*Pollachius virens*), pollack (*P. pollachius*) and older plaice (Nash and Geffen, 2000). This suggests that the high intensive plaice nursery ground in the area of the proposed Outfall Pipeline may be of some importance as a feeding area for other commercial fish species.

Of non-commercial species, the sand goby (*P. minutus*), common dragonet (*Callionomys lyra*), dab (*L. limanda*) pogge (*Agonus cataphractus*), pipefish (*Syngnathus rostellatus*, *S. acus, Nerophis ophidion*), scaldfish (*Arnoglossus laterna*), solenette (*Buglossidium luteum*), butterfish (*Pholis gunnellus*), flounder (*Platichthys flesus*), poor cod (*Trisopterus minutus*) and grey gurnard (*Eutrigla gurnardus*) were caught during the 2015 and 2017 fish surveys (see Appendices IV-VI). Gobies are thought to comprise an important component of the localised fish assemblage although they are not

commercially important. Sand goby were the second most commonly caught species in 2015 and third most abundant in 2-17 forboth the trawl and seine net surveys. Further details on the species and their assemblage to the proprosed Outfall Pipeline location are included in Fish Surveys reported separately.

4.6. Shellfish

The site-specific survey data indicated a total of 18 species of shellfish recorded in surveys surrounding the survey area. Six of these were recorded in the targeted whelk survey (RPS, 2015) and ten of which were recorded as bycatch from the beach seine net survey, three of which were also recorded in the aforementioned survey (Table 12). An additional five shellfish species were also noted as commercially targeted by fishermen in the area (Marine Institute, 2013). Shellfish species that are commercially targeted in the area are: European lobster (*Homarus gammarus*), brown crab (*Cancer pagurus*), velvet crab (*Necora puber*), common shrimp (*Palaemon serratus*), common whelk (*Buccinum undatum*), great scallop (*Pecten maximus*), razor clam (*Ensis siliqua*) and the blue mussel (*Mytilus edulis*). All species are targeted with static fishing gear, with the exception of scallops, mussels and razor clams, which are fished with mobile gear.

Common Name	Scientific Name	Conservation Status				Survey*
		Bern Convention	OSPAR	IUCN Red List	UK BAP	
European lobster	*Homarus gammarus*	✓	-	Least concern	-	MI
Brown crab	*Cancer pagurus*	-	-	na	-	RPS & ASU
Green crab **	*Carcinus maenas*	-	-	na	-	RPS & ASU
Harbour crab**	*Liocarcinus depurator*	-	-	na	-	RPS & ASU
Scorpion spider crab**	*Inachus dorsettensis*	-	-	na	-	RPS
Velvet swimming crab	*Necora puber*	-	-	na	-	ASU
Risso's crab**	*Xantho pilipes*	-	-	na	-	ASU
Small spider crab**	Majoidea	-	-	na	-	ASU
Hermit crab**	*Pagurus bernhardus*	-	-	na	-	ASU
Rock shrimp**	*Palaemon elegans*	-	-	na	-	RPS
Brown shrimp**	*Crangon crangon*	-	-	na	-	ASU
Aesop shrimp**	*Pandalus montagui*	-	-	na	-	ASU
Common shrimp	*Palaemon serratus*	-	-	na	-	MI
Common whelk	*Buccinum undatum*	-	-	na	-	MI, RPS & ASU
Queen scallop**	*Aequipecten opercularis*	-	-	na	-	ASU
Great scallop	*Pecten maximus*	-	-	na	-	MI
Razor clam	*Ensis siliqua*	-	-	na	-	MI
Blue mussel	*Mytilus edulis* (in beds)	?	?	na	?	MI

* Survey references: MI = Marine Institute, 2013; RPS = RPS, 2015; ASU = Aquatic Services Unit, 2015 or 2017.

** Present as bycatch and not Commercially fished

na not assessed by the IUCN

Table 12 Principal Species of Shellfish Recorded

The common whelk fishery off the east coast of Ireland is composed of 4 sectors (Dublin, Arklow, Courtown and Wexford) and occupies approximately 2,000 km^2, of which the Dublin sector (vessels from Dun Laoghaire and Howth) records to lowest landing densities. The main Dublin Whelk fishing grounds are the sandbank areas near the Kish Bank, additionally results for the 2013 survey conducted around the proposed Outfall Pipeline route show the whelk abundance to be positively correlated with water depth, with 45-56% of whelks sampled considered mature adults (RPS, 2015.

The mussel seed fishery is restricted to 70 days per year and occurs in very limited areas. No mussel bycatch was recorded in fishery surveys performed or were conspicuous in sidescan sonar data acquired over the proposed route, however beds have been recorded on “sand banks and on coarse current swept sediments and rocky habitat” (Marine Institute, 2013), at the base of the north-west

sub-littoral reef on Ireland's Eye (BSL 2015a) or as a seedbed of the horse mussel (*Modiolus modiolus*) on the maerl sands immediately outside Howth harbour (BSL, 2012). There is only a small scale coastal scallop fishery in this region with vessels operating from Kilkeel, Dundalk and Howth/Dun Laoghaire, each are under 15 m beam length and carry up to 12 dredges each (Marine Institute, 2013).

European lobster (*Homarus gammarus*)

Unlike other decapods, European lobsters do not perform large regular migrations but tend to make localised movements related to competition and habitat change. Females reach sexual maturity at around 75-80 mm carapace length (CL), males slightly smaller, at approximately the age of 7 years (lifespan approximately 15-20 years). Reproduction takes place in summer, linked with the moulting cycle, whilst spawning takes place an average of 11.4 months later, although this is temperature dependant (Branford, 1978). Females can also retain sperm while eggs are being laid (Prodöhl *et al.*, 2006). Juveniles hatch as pelagic larvae for 14-20 days and undergo four developmental stages. Very little is known about the early benthic phase of the European lobster which settles at around 5 to 7 mm CL, and specimens are generally scarce up to 40 mm CL (Prodöhl *et al.*, 2006). Unlike the American lobster (*H. americanus*) that favours soft sediment to burrow in during early benthic phase, it is expected *H. gammarus* will favour coarser sediments during this stage. This species may be found on the deeper section of the proposed route.

Brown crab (*Cancer pagurus*)

In late spring sexually mature brown crabs, around 10 years old (lifespan approximately 20 years) move inshore to moult and mate. Females store this sperm and in late summer move offshore (up to 200 nautical miles away) where their egg are fertilised in the winter. Females externally incubate the eggs in dug out pits and in rocky reefs, they rarely move or feed during this period. In late spring/early summer eggs are released into the water column as planktonic larvae. The remain pelagic for approximately two months before settling in intertidal areas where they remain in rocky shores for 2 to 3 years before migrating to deeper waters. Females generally move against prevailing currents during incubation to ensure larvae drift back to appropriate nursery grounds (Sussex IFCA, 2016). This species will be found on the deeper section of the proposed outfall pipeline.

Velvet swimming crab (*Necora puber*)

The reproductive cycle occurs all year round with main copulation present in late winter to early summer (February to June). Velvet swimming crabs are sexually mature, at around one year old, approximately 50 mm carapace width (lifespan approximately 10 years). Copulation coincides with moulting of females that externally incubate the eggs buried in sand. The largest spawning event is in late spring/late summer (April to August) where eggs are released into the water column as planktonic larvae. The females can have two brood per year while spawning and resting, whilst males can be found throughout the year (Norman & Jones, 1993; Waleed *et al.,* 1995). This species will be found on the deeper section of the proposed outfall pipeline.

Common shrimp (*Palaemon serratus*)

Reproduction occurs between November and June of sexually mature specimens, one year old (two-year lifespan). Male fertilise eggs as they leave females to brood these for around four months in deeper waters before they return to the shallows when the eggs hatch as planktonic larvae. These will eventually settle on substrate in July or August (Kelly *et al.*, 2008; Rodriguez, 1981). This species will be found throughout the route of the proposed outfall pipeline, predominantly in the central area..

Common whelk (*Buccinum undatum*)

In summer to late autumn (temperature dependant), sexually mature whelks (60 to 90mm shell height, generally two to three years old) mate through internal fertilisation. A decrease in water temperature below 9ºC (usually in November) induces group spawning which can continue until April. Up to 2000 capsules can be laid which can contain up to 3,000 eggs of which only 1% per capsule will mature and hatch, usually around February to March time. Juveniles hatch as miniature adults with no larval stage and have a life expectancy of around 10 years (Sussex IFCA, 2016). This species will be found throughout the route of the proposed outfall pipeline.

Blue mussel (*Mytilus edulis*)

From April to September broadcast fertilisation occurs in sexually mature specimens (one to two years old) with fertilised eggs developing into free-living trochophore larva and further metamorphosing to pediveliger in 20 to 60 days where the first settlement is undertaken in filamentous substrata, before moving to secondary settlement through bysso-pelagic drifting where they develop to adults. Pediveliger can delay settlement if the right substrata is not found; however, they become less selective with time. Lower temperatures can also delay larval metamorphosis. Life span of the blue mussel is approximately 18-24 years (Tyler Walters, 2008). This species may found on the deeper section of the proposed route although no reefs were recorded.

Razor clam (*Ensis siliqua*)

From January to July broadcast fertilisation occurs in sexually mature specimens (one years old, >100 mm length) with fertilised eggs developing into free-living trochophore larva, settlement is generally one month, before they develop to adults. There are six stages to its reproductive maturity with *E. silique* generally remaining gonochoristic with a 1:1 male:female ratio recorded in the Irish sea however a very small incidence of hermaphroditism has been recorded (Cross *et al.,* 2014). Life span of this species is approximately 10 to 20 years. (Henderson & Richardson, 1994). This species will be found throughout the route, predominantly in shallower sandy sections of the proposed route.

Great scallop (*Pecten maximus*)

Unlike the abovementioned dioecious species the great scallop is hermaphroditic and performs external fertilisation when sexually mature at around two years old (lifespan approximately 20 years). Spawning periods vary spatially and temporal however for this region the spawning periods is expected to range from April to September (Beaumont *et al*., 1993). After 24-48 hours of fertilisation eggs develop into free-living larvae for around 30 days, before attaching to suitable substrate by a byssal thread. Growth then continues until winter when it general ceases. This species may be found on along the proposed route, although no direct observaitons of this have been recorded.

Species of Conservation Interest

Of the shellfish species recorded it is only the European lobster (*H. gammarus*) that, as a species, is of conservational interest. However where found in high densities the blue mussel (*M. edulis*) can form beds that are a UKBAP habitat and the biotope "Intertidal *M.edulis* Beds on Mixed & Sandy Sediments" are listed by OSPAR commission as in threatened or in decline where they occur in the Celtic Seas. Smothering through siltation and physical damage are ranked as medium and high threats to this habitat as were heavy metal pollution and introduction of microbial pathogens, respectively. The blue mussel along with the larger horse mussel (*M. modiolus*), can also be found in large aggregations to form biogenic reefs which are designated as an Annex I habitat under the EC Habitats Directive, although these have not been recorded within close proximity of the proposed outfall.

The European lobster is listed in appendix III of the Bern Convention as a protected fauna species. This species is listed as least concern on the IUCN red list with a stable population and is not listed as EC Habitats Directive Annex II species. The fishery is currently managed in the UK with a minimum landing size of 87 mm CL, and it is strictly forbidden to land buried females. Numerous regions successfully manage the stocks with schemes such as V-notching and introduction of maximum landing sizes; however, no such schemes are currently in place within the survey area.

Key Species within the Food Web

The shellfish community within the Celtic Sea remains an important component of the ecosystem. Shellfish are among the prey items for many consumers, particularly in juvenile form. While many crustaceans themselves are predators, fish and birds also apply significant predation pressures within this food web. Despite the hard exoskeleton of crustaceans, they become particularly vulnerable to predation when between moults, and often hide shortly after a moulting period, from a few hours to several weeks (Fahy, 2006).

Filter feeding bivalves are mainly predated upon by birds, starfish, malacostraca (crabs and lobsters) and whelks. Of particular conservational note is the avian predators the common scoter (*Melanitta nigra*) that preys solely on molluscs, particularly mussels and razor clams, and winters on the east coast of Ireland. The common scoter is a recorded in the ICUN red least as least concern and is also a UK BAP species; however, it is not listed in Annex I of the EU Birds directive of threatened species which covers the republic of Ireland. The common whelk has no planktonic form but remains predated on throughout its life cycle and is an important food source for crabs, starfish, cod and other fish species such as elasmobranchs. The empty shells are also frequently inhabited by hermit crabs (Sussex IFCA, 2016).

4.7. Commercial Marine Fish and Shellfish

Landings registered with the International Commission for the Exploration of the Sea ICES (International Council for the Exploration of the Sea) in the Dublin Bay area recorded an average of 3.79 tonnes of demersal fish, 0.12 tonnes of pelagic fish and 9 tonnes of shellfish for this stretch of coastline between Wicklow and Lambay island between 2006 and 2008 (Marine Institute, 2010). Overall, the demersal fishery is dominated by shellfish as bottom trawling is generally poor. This is partially due to the extended areas of hard ground recorded within the survey area.

Fishing activity in the Irish inshore section is from vessels targeting razor clams (with the majority also able to target cockles) and those operating static gear, specifically potting for crab and lobster. Razor clam vessels active in the area are from home ports between Dundalk in the north down to Howth in the south, and number more than 30. In addition to the razor clam fishery, there are a small number of local boats who target shellfish on ground north of Lambay Island throughout the year for different gears. The whelk fishery is a small fishery but has been growing in recent years with the interest from overseas markets (Korea). Some boats are known to land in Howth and Dublin, but the majority of the fishery is south of 53°10' (Fahy *et al.,* 2005). It should be noted that the proposed outfall lies outside designated shellfish waters under the Irish Shellfish Regulations (SI 200/1994). All of these inshore fisheries are summarised and in Table 13 and in Figure 7.

Dredging is restricted inshore (as defined by the Sea-Fisheries Protection Authority (SFPA)). However, fishermen have previously stated that the activity often occur in grounds in between designated dredging sites. As the activity is mostly concentrated in small areas, the result is that the seabed can be excavated to depths of 30 cm.

Species	No. of Boats	Season
Brown (edible) crab (*Cancer pagurus*)	4	June to December
Velvet swimming crab (*Necora puber*)	11* 4	All year : These boats fish brown crab later in the summer and velvets for only part of the season
European lobster (*Homarus gammarus*)	4-5	All year round
Whelk (Buccinum undatum)	Unknown	Summer through to later autumn
Razor clam *(Ensis* sp.)	Unknown	October to April
Shrimp (*Palaemon serratus*)	4	September to February

** All of the boats that target velvet crab would also have a bi-catch of lobster and brown crab.*

Table 13 Summary of Local Shellfish Fisheries in Northern Fingal

Figure 7 Inshore Shellfish Grounds along the Fingal Coast

4.8. Recreational Fisheries

Another important fishery in the region is that of recreational fishing. Angling is very active along the Fingal coastline with fishing from beaches, harbours, piers, and from boats both close to shore and offshore over wrecks and reefs (Ecoserve, 2006). Balbriggan, Skerries, Loughshinny and Rush are all boat angling venues where small boats can be launched to fish around Lambay Island (three miles to the south-east) and over Rockabill grounds. Species caught include spurdog, ray, conger, dogfish, dab, codling, whiting, pollack, coalfish, wrasse and an occasional ling and tope. Balbriggan, Skerries and Loughshinny are also good shore angling locations and have recorded catches of mullet, mackerel (in season) and flatfish, whilst bass can be caught of the beach at Rush following an easterly blow. Small boats can be launched at Balbriggan to fish the Cardy Rock area and the grounds out to and around the Rockabill Lighthouse. Codling, dogfish, dab, spurdog, whiting, pollack and wrasse are the most common species.

Near the proposed outfall, there is notable Angling activity at Howth Harbour at the East and West Pier where whiting, pollack, coalfish and codling can be caught during summer and autumn. Small boats can be launched for general ground fishing around Ireland's Eye and on the Kish Bank. Species to be expected are coalfish, pollack, whiting, dogfish, mackerel and flatfish. To the east of the harbour is Balscadden Rocks where rock fishing takes place for mackerel (in season), plaice, dabs, dogfish, pouting, whiting and codling. At the Baily, mackerel (in season), coalfish, plaice, dab, dogfish, wrasse and whiting have been recorded. At Red Rock in Sutton, bass and flatfish have all been recorded.

The Velvet Strand in Portmarnock is an important shore angling venue. Around the Martello Tower occasional bass and flounder can be fished for from the rocks, whilst the beach at the strand is used for distance casting and will produce dogfish and occasional codling and whiting in the Autumn.

4.9. Estuarine Fisheries

Many species avail of the highly productive nature of many estuaries and their use will vary with the seasons. Some fish species can be found in the estuaries the whole year round. Other fish are migratory, travelling through estuaries from the sea to reach spawning grounds in freshwater, such as salmon and lamprey, while others, such as eel, migrate down estuaries to the sea. The proposed outfall is close to Baldoyle Estuary, or Rogerstown estuary in the north. Between the two is the Malahide, Broadmeadow estuary. A total of 24 species or taxa were recorded, from this and the Rogerstown estuary by King & Green in 2003.

A summary of these is listed in Table 14 annotated with their status within this water body. These are broken down as:

- ER: estuarine residents - species considered to spend all, or the majority of, their life cycle in the estuary;
- MJ: marine juveniles - marine fish that have residency in an estuary as juveniles but may spend the rest of their life cycle at sea;
- MS: marine seasonal - species that move into estuaries on a seasonal basis and may not be present all year round (unlike the Marine Juveniles);
- MA: marine adventitious - functional group reflects an opportunistic or haphazard movement from the marine area into coastal or estuarine waters; and

- CA: catadromous fish - those that spend part of their life cycle in fresh water and part at sea. Thus fish of this group use estuaries as a transit route between river and sea.

Species	Common Name	Functional
Platichthys flesus	Flounder	ER
Gobio spp.	Goby species	ER
Spinachia spinachia	15-spined stickleback	ER
Myoxocephalus scorpius	Short-spined sea scorpion	ER
Syngnathus sp.	Pipefish	ER
Pholis gunnellus	Butterfish	ER
Agonus cataphractus	Hooknose or pogge	ER
Pleuronectes platessa	Plaice	MJ
Atherina presbyter	Atherine	MJ
Dicentrarchus labrax	Bass	MJ
Pollachius pollachius	Pollack	MJ
Gadus morhua	Cod (codling)	MJ
Spondyliosoma cantharus	Black sea bream	MJ
Sprattus sprattus/Clupea harengus	Sprat/herring	MS
Crenimugil labrosus	Thick-lipped grey mullet	MS
Liza auratus	Golden mullet	MS
Ciliata mustela	5-bearded rockling	MS
Labrus bergylta	Ballan wrasse	MA
Blennius gattorugine	Tompot blenny	MA
Scyliorhinus canicula	Lesser-spotted dogfish	MA
Ammodytes tobianus	Sandeel	ER/MA
Liza ramada	Thin-lipped grey mullet	CA
Gasterosteus aculeatus	3-spined stickleback	CA
Anguilla anguilla	Eel	CA

Table 14 Fish Recorded in Rogerstown and Broadmeadow Estuaries (King and Green 2003)

Appendix I – Macro invertebrate Community 2012, 2013 and 2017

Macro-Invertebrate Communites

CODE	Phylum	Genus	Species	4a 2017	4b 2017	5a 2017	5b 2017	6a 2017	6b 2017	7a 2017	7b 2017	8a 2017	8b 2017	9a 2017	9b 2017	10a 2017	10b 2017	11a 2017	11b 2017
D632	Coelenterata	Cerianthus	lloydii																3
D766	Coelenterata	Edwardsia	claparedii																1
D775	Coelenterata	Peachia	hastata																
D713	Coelenterata	Sagartia	elegans													1	1	1	2
D715	Coelenterata	Sagartia	troglodytes																2
D722	Coelenterata	Sagartiogeton	undatus																
D618	Coelenterata	Virgularia	mirabilis																
F2	Turbellaria	Turbellaria	indet																
G1	Nemertea	Nemertea	spp	1		2				4	9			4	6	6	2	3	5
HD1	Nematoda	Nematoda .	indet.																
P1139	Polychaeta	Ampharete	lindstroemi			1					4	2	3	1		3	3	4	2
P1102	Polychaeta	Amphictene	auricoma								2	1	1					1	1
P141	Polychaeta	Anaitides	groenlandica																
P144	Polychaeta	Anaitides	maculata																
P724	Polychaeta	Aonides	oxycephala								2							2	1
P725	Polychaeta	Aonides	paucibranchiata																
P824	Polychaeta	Aphelochaeta	marioni																
P19	Polychaeta	Aphrodita	aculeata								1								
P588	Polychaeta	Arabella	iricolor																
P677	Polychaeta	Aricidea	minuta							2					1				
P912	Polychaeta	Capitomastus	minimus				5	1	1	102	109	9	2	12	16	38	9	170	230
P831	Polychaeta	Caulleriella	zetlandica							2	1	1	1						
P833	Polychaeta	Chaetozone	gibber	1		1		2	2										
P834	Polychaeta	Chaetozone	setosa		1		1						1						
P1267	Polychaeta	Chone	duneri														1		1
P836	Polychaeta	Cirratulus	cirratus		1		2	3		1	1	5		10	6	1	1	1	2
P878	Polychaeta	Diplocirrus	glaucus			2				2	1	3			1			2	1
P118	Polychaeta	Eteone	longa								1								
P161	Polychaeta	Eulalia	viridis																
P164	Polychaeta	Eumida	bahusiensis								1								
P167	Polychaeta	Eumida	sanguinea																
P1189	Polychaeta	Eupolymnia	nebulosa																
P259	Polychaeta	Glycera	gigantea	1	3		1	5	3			10	10	1	1			1	2
P260	Polychaeta	Glycera	lapidum	3							2	2	3		2				1
P271	Polychaeta	Goniada	maculata		1					1	3								
P501	Polychaeta	Harmothoe	frag.							1	1	1				2	2		
P64	Polychaeta	Harmothoe	imbricata										1						
P65	Polychaeta	Harmothoe	impar																
P17	Polychaeta	Heteromastus	filiformis																
P1334	Polychaeta	Hydroides	norvegica																
P1107	Polychaeta	Lagis	koreni			1				1	1			4	2				
P1195	Polychaeta	Lanice	conchilega			2		1			5			2					2
P82	Polychaeta	Lepidonotus	squamatum											1		1	1		4
P693	Polychaeta	Levinsenia	gracilis																
P577	Polychaeta	Lumbrineris	fragilis								3						1	7	3
P579	Polychaeta	Lumbrineris	gracilis							2								1	2
P804	Polychaeta	Magelona	alleni							1	5							4	5
P807	Polychaeta	Magelona	mirabilis	30	25	2	1	4	3			2	2	1					
P938	Polychaeta	Maldanid	frag.				1			1		1				1	1	1	2
P1124	Polychaeta	Melinna	palmata			1	1			26	20	16	3	2	1	1		95	44
P1094	Polychaeta	Myriochele	sp.							2	2	1	2		1				
P568	Polychaeta	Nematonereis	unicornis																
P496	Polychaeta	Nephtys	caeca																
P498	Polychaeta	Nephtys	cirrosa		2	3	3					8	1	8	2				
P499	Polychaeta	Nephtys	hombergi				1	1	4	2	1		1		4	1		1	2
P476	Polychaeta	Nereis	pelagica														1		
P921	Polychaeta	Notomastus	latericeus							3	1	1	4	3	4				1
P1001	Polychaeta	Ophelia	limacina																
P1014	Polychaeta	Ophelina	acuminata							2									
P1098	Polychaeta	Owenia	fusiformis		1					5					2				2
P885	Polychaeta	Pherusa	plumosa																
P180	Polychaeta	Phyllodoce	laminosa				1				1	1			2				
P92	Polychaeta	Pholoe	inornata			1				6	1			2	1	3	7	1	2
P718	Polychaeta	Poecilochaetus	serpens																
P1029	Polychaeta	Polyphysia	crassa																
P1341	Polychaeta	Pomatoceros	triqueter													32	17	14	16
P1316	Polychaeta	Potamilla	reniformis									1					1		1
P765	Polychaeta	Prionospio	fallax									1		1					
P774	Polychaeta	Pseudopolydora	pulchra	1								1							
P1320	Polychaeta	Sabella	pavonina																
P1117	Polychaeta	Sabellaria	spinulosa																
P1027	Polychaeta	Scalibregma	inflatum						7	15	22			3	3	1	3	14	28
P781	Polychaeta	Scolelepis	foliosa					3				5	3						
P672	Polychaeta	Scoloplos	armiger		1		1	1		1	2						1		
P291	Polychaeta	Sphaerodorum	flavum							1									2
P107	Polychaeta	Sthenelais	boa																
P108	Polychaeta	Sthenelais	jeffreysii	1	2		1	1			1	1		1	1	1	1	1	
P104	Polychaeta	Sigalion	mathildae	1		1			1	3	3		1						
P794	Polychaeta	Spiophanes	bombyx				1			1	1	4	6	5	1				
P796	Polychaeta	Spiophanes	kroyeri																
P360	Polychaeta	Syllis	gracilis							1							1		
P1099	Polychaeta	Terebellid	fragment																
P1175	Polychaeta	Terebellides	stroemi							1	2							1	
P1490	Oligochaeta	Tubificoides	benedeni																

Macro-Invertebrate Communites

CODE	Phylum	Genus	Species	4a 2017	4b 2017	5a 2017	5b 2017	6a 2017	6b 2017	7a 2017	7b 2017	8a 2017	8b 2017	9a 2017	9b 2017	10a 2017	10b 2017	11a 2017	11b 2017
ZA5	Phoronidea	Phoronis	muelleri								2								1
N17	Sipunculida	Golfingia	vulgaris								1								
N36	Sipunculida	Onchnesoma	squamatum																
N34	Sipunculida	Phascolion	strombus																
N28	Sipunculida	Thysanocardia	procera																
S498	Crustacea	Abludomelita	obtusata							2	1							1	1
S275	Crustacea	Acidostoma	obesum				1												1
S427	Crustacea	Ampelisca	brevicornis			6	7		1	1	11	2	5	4	6	8	7	3	4
S429	Crustacea	Ampelisca	diadema								1				1				
S432	Crustacea	Ampelisca	macrocephala	1															
S97	Crustacea	Amphipoda	frag.	1									2				1		2
S579	Crustacea	Aora	gracilis							3	8		1			3	21	1	4
S360	Crustacea	Argissa	hamatipes																
S411	Crustacea	Atylus	guttatus																
S456	Crustacea	Bathyporeia	pelagica	5	1			1			1								
S459	Crustacea	Bathyporeia	tenuipes	3				2											
S1196	Crustacea	Bodotria	pulchella							8	4			1		1		1	2
S1197	Crustacea	Bodotria	scorpioides								1						2		
S1485	Crustacea	Brachiura	zoea									1		1					
S646	Crustacea	Caprella	linearis			2				3	4					3		4	3
S506	Crustacea	Cheirocratus	sundevalli																
R152	Crustacea	Copepoda	indet.									1					1		1
S610	Crustacea	Corophium	bonnelli															1	
S1552	Crustacea	Corystes	cassivelaunus				1												
S1383	Crustacea	Crangon	crangon																
S186	Crustacea	Cressa	dubia							1	3						3		8
S415	Crustacea	Dexamine	spinosa		1						1								
S1251	Crustacea	Diastylis	laevis			1					11		1					1	
S1252	Crustacea	Diastylis	lucifera					1											
S1254	Crustacea	Diastylis	rugosa							1									
S374	Crustacea	Epimeria	cornigera														1		
S1206	Crustacea	Eudorella	emarginata							1	1								
S1208	Crustacea	Eudorella	truncatula							1									1
S1478	Crustacea	Galathea	strigosa																
S793	Crustacea	Gnathia	praniza								1								
S254	Crustacea	Harpinia	antennaria							8	1						2	11	7
S1350	Crustacea	Hippolyte	varians																
S296	Crustacea	Hippomedon	denticulata							2									
S1202	Crustacea	Iphinoe	trispinosa	3	2	2		1				1		1					
S892	Crustacea	Janira	maculosa																3
S569	Crustacea	Jassa	falcata														1		
S177	Crustacea	Leucothoe	incisa																
S1580	Crustacea	Liocarcinus	depurator																1
S1581	Crustacea	Liocarcinus	holsatus		1												2		2
S1584	Crustacea	Liocarcinus	pusillus																
S1515	Crustacea	Maja	squinado juv.																
S1251	Crustacea	Monoculodes	carinatus	1				1	1	2		1						1	1
S1589	Crustacea	Necora puber	puber juv.																
R2412	Crustacea	Ostracoda	indet.					1		1	3	1			1		1	2	1
S1457	Crustacea	Pagurus	bernhardus																
S1319	Crustacea	Palaemon	serratus																
S326	Crustacea	Perrierella	audouiniana							3	2					1	6		1
S1482	Crustacea	Pisidia	longicornis												1				
S133	Crustacea	Pontocrates	altamarinus																
S1363	Crustacea	Processa	canaliculatum																
S1235	Crustacea	Pseudocuma	longirostris	16	7		9					3	3	3					
S659	Crustacea	Pseudoproctella	phasma																
S618	Crustacea	Siphonoecetes	kroyerianus																
S213	Crustacea	Stenothoe	marina																
S1142	Crustacea	Tanaopsis	graciloides								3						2		
S336	Crustacea	Tmetonyx	cicada																
S1360	Crustacea	Thoralus	cranchi																
S1153	Crustacea	Typhlotanais	brevicornis																
S249	Crustacea	Urothoe	marina								1								
S140	Crustacea	Westwoodilla	caecula																
Q15	Chelicerata	Achelia	echinata																
Q29	Chelicerata	Endeis	spinosa																
Q7	Chelicerata	Nymphon	gracile															1	
W2059	Mollusca	Abra	alba	2		4	2	3	6			14	5	9	9	1	1		
W2061	Mollusca	Abra	nitida		4			4			2	7	10	17	15		2	1	2
W2062	Mollusca	Abra	prismatica																
W1943	Mollusca	Acanthocardia	aculeata							1									
W1006	Mollusca	Acteon	tornatilis																
W1519	Mollusca	Antalis	entalis																
W1773	Mollusca	Aequipecten	opercularis								1								
W1363	Mollusca	Cadlina	laevis																
W1961	Mollusca	Cerastoderma	edule																
W9	Mollusca	Chaetoderma	nitidulum																
W2098	Mollusca	Chamelea	gallina							1	1					1			
W2100	Mollusca	Clausinella	fasciata		2	1	1		1				1		1				
W2239	Mollusca	Cochlodesma	praetenue	4	4	6	2	2	1						1	1			
W2157	Mollusca	Corbula	gibba									1	1						
W1028	Mollusca	Cylichna	cylindracea																
W2091	Mollusca	Circomphalus	casina		1		1					2	3		4				
W2041	Mollusca	Donax	vittatus																

CODE	Phylum	Genus	Species	4a 2017	4b 2017	5a 2017	5b 2017	6a 2017	6b 2017	7a 2017	7b 2017	8a 2017	8b 2017	9a 2017	9b 2017	10a 2017	10b 2017	11a 2017	11b 2017
W2130	Mollusca	Dosinia	exoleta																
W1999	Mollusca	Ensis	ensis		1	2	3	5	1		1	4	3	17	15	1			
W2019	Mollusca	Fabulina	fabula	28	29	18	4	57	4			10	6		1				
W2051	Mollusca	Gari	fervensis								1								
W65	Mollusca	Hanleya	hanleyi																1
W2166	Mollusca	Hiatella	arctica																
W410	Mollusca	Hyala	vitrea																
W1906	Mollusca	Kurtiella	bidentata				1				3		1	7	4			2	
W54	Mollusca	Leptochiton	cancellatus							1									
W1984	Mollusca	Lutraria	lutraria																
W2029	Mollusca	Macoma	balthica																
W1972	Mollusca	Mactra	stultorum			4	1		1			1			1				
W1698	Mollusca	Modiolus	juv																
W2021	Mollusca	Moerella	donacina													1			
W2150	Mollusca	Mya	truncata																
W2139	Mollusca	Mysia	undata									1						1	
W1695	Mollusca	Mytilus	edulis																1
W1569	Mollusca	Nucula	nitidosa	1		1		5	3			5		5	5				
W1570	Mollusca	Nucula	nucleus	4	2	4	1	3	2			4	2	3	3				
W1571	Mollusca	Nucula	sulcata	1	1			2	4			1		1			1		
	Mollusca	Nudibranchia	unid														1		
W2006	Mollusca	Phaxas	pellucidus				3	1											
W1038	Mollusca	Philine	aperta																
W491	Mollusca	Polinices	pulchellus												1				
W1975	Mollusca	Spisula	elliptica																
W1977	Mollusca	Spisula	solida									1	2	1	2				
W1902	Mollusca	Tellimya	ferruginosa						1	3		1							1
W2231	Mollusca	Thracia	phaseolina	5	16	1	1			1		7	2	2		1		2	
W1837	Mollusca	Thyasira	flexuosa					1		2		2		6	10				
W1934	Mollusca	Tridonta	montagui									1					1		
	Echinodermata	Amphipholis	squamata								1								1
ZB252	Echinodermata	Amphiura	chiajei							1	6						1		
ZB154	Echinodermata	Amphiura	filiformis						2	6	11			1				1	4
ZB100	Echinodermata	Antedon	bifida																
ZB100	Echinodermata	Asterias	rubens													1			
ZB223	Echinodermata	Echinocardium	cordatum				1	1	1	1		1		2					
ZB296	Echinodermata	Leptosynapta	inhaerens																
ZB23	Echinodermata	Luidia	sarsi														1		
ZB104	Echinodermata	Martasterias	glacialis								1								
ZB167	Echinodermata	Ophiocten	affinis		4	3	2	6		7	8	1	3	1	1		3	4	2
ZB168	Echinodermata	Ophiura	albida																
ZB170	Echinodermata	Ophiura	ophiura			2	1		1		1	1		2	4				1
ZB172	Echinodermata	Ophiura	sarsi																
ZB124	Echinodermata	Ophiotrix	fragilis							4									4
ZB121	Echinodermata	Ophiuroidea	juv					1	3			2		3					
ZB193	Echinodermata	Psammechinus	miliaris														3	1	
ZD81	Tunicata	Corella	parallelogramma																
ZD120	Tunicata	Dendrodoa	grossularia							3									
ZD140	Tunicata	Pyura	squamulosa																
ZG444	Pisces	Ammodytes	tobianus																
ZG578	Pisces	Pleuronectes	platessa																
L29	Chaetognatha	Spadella	cephaloptera																

Epifaunal Species

C133	Porifera	Scypha	ciliata																
C133	Porifera	Clathrina	coriacea																
C480	Porifera	Cliona	celata																
C1670	Porifera	Dysidea	fragilis							+	+								
C1420	Porifera	Haliclona	frag.																
D409	Coelenterata	Abietinaria	abietina																
D481	Coelenterata	Aglaophenia	pluma													+			
D597	Coelenterata	Alcyonidium	digitatum														+		+
D257	Coelenterata	Bougainvillia	ramosa						+										
D348	Coelenterata	Calycella	syringa																
D494	Coelenterata	Campanularia	hincksii														+		
D503	Coelenterata	Clythia	hemisphaerica							+	+		+						
D422	Coelenterata	Dynamena	pumila																
D227	Coelenterata	Eudendrium	ramosum								+				+		+		
D392	Coelenterata	Halecium	halecinum																
D399	Coelenterata	Halecium	tenellum																
D424	Coelenterata	Hydrallmania	falcata					+		+					+	+	+		+
D386	Coelenterata	Lafoea	dumosa																
D515	Coelenterata	Laomedea	flexuosa				+	+			+				+		+		
D336	Coelenterata	Lovenella	clausa																
D520	Coelenterata	Obelia	geniculata																
D463	Coelenterata	Nemertesia	antennina					+			+					+	+		
D464	Coelenterata	Nemertesia	ramosa																
D240	Coelenterata	Perigonimus	repens																
D469	Coelenterata	Plumularia	setacea										+						
D430	Coelenterata	Sertularella	polyzonias																
D435	Coelenterata	Sertularia	cuppressina				+		+	+	+	+	+	+	+	+	+		+
R77	Crustacea	Balanus	crenatus																

CODE	Phylum	Genus	Species	4a 2017	4b 2017	5a 2017	5b 2017	6a 2017	6b 2017	7a 2017	7b 2017	8a 2017	8b 2017	9a 2017	9b 2017	10a 2017	10b 2017	11a 2017	11b 2017
Y76	Bryozoa	Alcyonidium	diaphanum						+							+	+		
Y78	Bryozoa	Alcyonidium	hirsutum																
Y80	Bryozoa	Alcyonidium	mytili													+			
Y81	Bryozoa	Alcyonidium	parasiticum							+	+						+		
Y256	Bryozoa	Bicellariella	ciliata														+		
Y243	Bryozoa	Bugula	flabellata																
Y246	Bryozoa	Bugula	plumosa																
Y300	Bryozoa	Cellaria	fistulosa							+	+								
Y495	Bryozoa	Cellepora	pumicosa																
Y337	Bryozoa	Celleporella	hyalina																
Y172	Bryozoa	Conopeum	reticulum						+	+	+					+	+		
Y16	Bryozoa	Crisia	denticulata																
Y44	Bryozoa	Crisia	eburnea																
Y19	Bryozoa	Crisia	ramosa																
Y8	Bryozoa	Crisidia	cornuta																
Y411	Bryozoa	Cryptosula	pallasiana																
Y178	Bryozoa	Electra	pilosa													+			
Y364	Bryozoa	Escharella	immersa															+	
Y358	Bryozoa	Escharoides	coccinea																
Y165	Bryozoa	Eucratea	loricata					+									+		
Y483	Bryozoa	Fenestrulina	malusii																
Y187	Bryozoa	Flustra	foliacea																
Y414	Bryozoa	Hippoporina	pertusa													+			+
Y279	Bryozoa	Scrupocellaria	scruposa						+								+	+	
Y131	Bryozoa	Vesicularia	spinosa					+											
Y112	Bryozoa	Walkeria	uva																
K46	Kamptozoa	Pedicellina	cernua								+								

New for 2017

New for 2013

CODE	Phylum	Genus	Species	4a 2013	4b 2013	5a 2013	5b 2013	6a 2013	6b 2013	7a 2013	7b 2013	8a 2013	8b 2013	9a 2013	9b 2013	10a 2013	10b 2013	11a 2013	11b 2013
D632	Coelenterata	Cerianthus	lloydii						1							1			
D766	Coelenterata	Edwardsia	claparedii				1												
D775	Coelenterata	Peachia	hastata																
D713	Coelenterata	Sagartia	elegans														3		
D715	Coelenterata	Sagartia	troglodytes																
D722	Coelenterata	Sagartiogeton	undatus													5	2		
D618	Coelenterata	Virgularia	mirabilis																
F2	Turbellaria	Turbellaria	indet													1		3	
G1	Nemertea	Nemertea	spp		1	4			1	3	3	1	1	3	5	11	4	5	12
HD1	Nematoda	Nematoda .	indet.																
P1139	Polychaeta	Ampharete	lindstroemi																
P1102	Polychaeta	Amphictene	auricoma																2
P141	Polychaeta	Anaitides	groenlandica																
P144	Polychaeta	Anaitides	maculata			1	2						2		2				
P724	Polychaeta	Aonides	oxycephala																
P725	Polychaeta	Aonides	paucibranchiata																
P824	Polychaeta	Aphelochaeta	marioni																
P19	Polychaeta	Aphrodita	aculeata												1				
P588	Polychaeta	Arabella	iricolor								1								
P677	Polychaeta	Aricidea	minuta															1	
P912	Polychaeta	Capitomastus	minimus					2			3			7	5		33	4	4
P831	Polychaeta	Caulleriella	zetlandica								1								
P833	Polychaeta	Chaetozone	gibber																
P834	Polychaeta	Chaetozone	setosa	3	3		4	13	5				2		1				
P1267	Polychaeta	Chone	duneri																
P836	Polychaeta	Cirratulus	cirratus		1	10	3					33	4	2	2	1			
P878	Polychaeta	Diplocirrus	glaucus							2	2			1					1
P118	Polychaeta	Eteone	longa						1								2		
P161	Polychaeta	Eulalia	viridis																
P164	Polychaeta	Eumida	bahusiensis										3	2					
P167	Polychaeta	Eumida	sanguinea									1	1			4			
P1189	Polychaeta	Eupolymnia	nebulosa																
P259	Polychaeta	Glycera	gigantea		3	1		3			1	1	1		1				1
P260	Polychaeta	Glycera	lapidum				1												
P271	Polychaeta	Goniada	maculata			2		2	1	3		1			1			1	
P501	Polychaeta	Harmothoe	frag.							1						6	1		
P64	Polychaeta	Harmothoe	imbricata																
P65	Polychaeta	Harmothoe	impar			1												1	
P17	Polychaeta	Heteromastus	filiformis						1	1									
P1334	Polychaeta	Hydroides	norvegica														3		
P1107	Polychaeta	Lagis	koreni	3	2	17	18	1			2	7	21	151	104			3	
P1195	Polychaeta	Lanice	conchilega	4	11	12	12	3	2		3	11	66	15	6	27	9		
P82	Polychaeta	Lepidonotus	squamatum													1	7		
P693	Polychaeta	Levinsenia	gracilis																
P577	Polychaeta	Lumbrineris	fragilis								1						2	1	3
P579	Polychaeta	Lumbrineris	gracilis							9			1		2				
P804	Polychaeta	Magelona	alleni								1							13	1
P807	Polychaeta	Magelona	mirabilis	5	5	2	4	3				4		2	1				
P938	Polychaeta	Maldanid	frag.														3		
P1124	Polychaeta	Melinna	palmata													5			16
P1094	Polychaeta	Myriochele	sp.											1					
P568	Polychaeta	Nematonereis	unicornis																
P496	Polychaeta	Nephtys	caeca																
P498	Polychaeta	Nephtys	cirrosa		1	1	1	2	2		2			3	4	3	7	1	
P499	Polychaeta	Nephtys	hombergi				2		1					2	1	2	6		1
P476	Polychaeta	Nereis	pelagica								1								1
P921	Polychaeta	Notomastus	latericeus			3				1	2	1			2	1	1		
P1001	Polychaeta	Ophelia	limacina																
P1014	Polychaeta	Ophelina	acuminata								1								
P1098	Polychaeta	Owenia	fusiformis	2	29	9	9	1	1	1	1	3		3	1	1	1		
P885	Polychaeta	Pherusa	plumosa															1	1
P180	Polychaeta	Phyllodoce	laminosa	1		1	1				3		2				4		1
P92	Polychaeta	Pholoe	inornata			1			1	6	7	3		2	3	4	7	2	2
P718	Polychaeta	Poecilochaetus	serpens																
P1029	Polychaeta	Polyphysia	crassa																
P1341	Polychaeta	Pomatoceros	triqueter													11	3		
P1316	Polychaeta	Potamilla	reniformis																
P765	Polychaeta	Prionospio	fallax					1											
P774	Polychaeta	Pseudopolydora	pulchra											1		5	3		
P1320	Polychaeta	Sabella	pavonina																
P1117	Polychaeta	Sabellaria	spinulosa														1		
P1027	Polychaeta	Scalibregma	inflatum							39	36					7	8		12
P781	Polychaeta	Scolelepis	foliosa					2				1		1		1			
P672	Polychaeta	Scoloplos	armiger	1	1	2		1				2	7		4	1		3	
P291	Polychaeta	Sphaerodorum	flavum																
P107	Polychaeta	Sthenelais	boa													2			
P108	Polychaeta	Sthenelais	jeffreysii							2				2	1	5	1	1	
P104	Polychaeta	Sigalion	mathildae	4	7	2	2												
P794	Polychaeta	Spiophanes	bombyx	4	3	1		5	3	2	3	8	2	6	1		2		1
P796	Polychaeta	Spiophanes	kroyeri								1								
P360	Polychaeta	Syllis	gracilis														4		
P1099	Polychaeta	Terebellid	fragment																
P1175	Polychaeta	Terebellides	stroemi			1	1										2		1
P1490	Oligochaeta	Tubificoides	benedeni																

CODE	Phylum	Genus	Species	4a 2013	4b 2013	5a 2013	5b 2013	6a 2013	6b 2013	7a 2013	7b 2013	8a 2013	8b 2013	9a 2013	9b 2013	10a 2013	10b 2013	11a 2013	11b 2013
ZA5	Phoronidea	Phoronis	muelleri							7	1						1		
N17	Sipunculida	Golfingia	vulgaris																
N36	Sipunculida	Onchnesoma	squamatum																
N34	Sipunculida	Phascolion	strombus																
N28	Sipunculida	Thysanocardia	procera																
S498	Crustacea	Abludomelita	obtusata																
S275	Crustacea	Acidostoma	obesum																
S427	Crustacea	Ampelisca	brevicornis	3	5	4	3			2		6	16	3				1	
S429	Crustacea	Ampelisca	diadema																
S432	Crustacea	Ampelisca	macrocephala													7	11		
S97	Crustacea	Amphipoda	frag.																
S579	Crustacea	Aora	gracilis													8	3		
S360	Crustacea	Argissa	hamatipes																
S411	Crustacea	Atylus	guttatus							1									
S456	Crustacea	Bathyporeia	pelagica					1	1										
S459	Crustacea	Bathyporeia	tenuipes																
S1196	Crustacea	Bodotria	pulchella																
S1197	Crustacea	Bodotria	scorpioides				2	1		1								1	
S1485	Crustacea	Brachiura	zoea																
S646	Crustacea	Caprella	linearis																
S506	Crustacea	Cheirocratus	sundevalli																
R152	Crustacea	Copepoda	indet.																
S610	Crustacea	Corophium	bonnelli																
S1552	Crustacea	Corystes	cassivelaunus			1	1					1	1						
S1383	Crustacea	Crangon	crangon																
S186	Crustacea	Cressa	dubia																
S415	Crustacea	Dexamine	spinosa																
S1251	Crustacea	Diastylis	laevis					1					1	1					
S1252	Crustacea	Diastylis	lucifera																
S1254	Crustacea	Diastylis	rugosa																
S374	Crustacea	Epimeria	cornigera								1								
S1206	Crustacea	Eudorella	emarginata																
S1208	Crustacea	Eudorella	truncatula																
S1478	Crustacea	Galathea	strigosa																
S793	Crustacea	Gnathia	praniza																
S254	Crustacea	Harpinia	antennaria							1									
S1350	Crustacea	Hippolyte	varians																
S296	Crustacea	Hippomedon	denticulata			2													
S1202	Crustacea	Iphinoe	trispinosa					1	1										
S892	Crustacea	Janira	maculosa																
S569	Crustacea	Jassa	falcata								1					9			
S177	Crustacea	Leucothoe	incisa													2			
S1580	Crustacea	Liocarcinus	depurator																
S1581	Crustacea	Liocarcinus	holsatus																
S1584	Crustacea	Liocarcinus	pusillus																
S1515	Crustacea	Maja	squinado juv.																
S1251	Crustacea	Monoculodes	carinatus																
S1589	Crustacea	Necora puber	puber juv.																
R2412	Crustacea	Ostracoda	indet.																
S1457	Crustacea	Pagurus	bernhardus																
S1319	Crustacea	Palaemon	serratus														1		
S326	Crustacea	Perrierella	audouiniana																
S1482	Crustacea	Pisidia	longicornis													3			
S133	Crustacea	Pontocrates	altamarinus																
S1363	Crustacea	Processa	canaliculatum																
S1235	Crustacea	Pseudocuma	longirostris																
S659	Crustacea	Pseudoproctella	phasma																
S618	Crustacea	Siphonoecetes	kroyerianus													7			
S213	Crustacea	Stenothoe	marina																
S1142	Crustacea	Tanaopsis	graciloides													1	2		
S336	Crustacea	Tmetonyx	cicada																
S1360	Crustacea	Thoralus	cranchi													1			
S1153	Crustacea	Typhlotanais	brevicornis							1									
S249	Crustacea	Urothoe	marina									1							
S140	Crustacea	Westwoodilla	caecula																
Q15	Chelicerata	Achelia	echinata																
Q29	Chelicerata	Endeis	spinosa																
Q7	Chelicerata	Nymphon	gracile													1	2		
W2059	Mollusca	Abra	alba	5	3	4	3	8	11	2	6	2	2	33	34	113	20	26	7
W2061	Mollusca	Abra	nitida				1			1			3						
W2062	Mollusca	Abra	prismatica																
W1943	Mollusca	Acanthocardia	aculeata				2						1	2	1				2
W1006	Mollusca	Acteon	tornatilis																
W1519	Mollusca	Antalis	entalis																
W1773	Mollusca	Aequipecten	opercularis																
W1363	Mollusca	Cadlina	laevis													1			
W1961	Mollusca	Cerastoderma	edule																
W9	Mollusca	Chaetoderma	nitidulum																
W2098	Mollusca	Chamelea	gallina									1							3
W2100	Mollusca	Clausinella	fasciata	6	6	1			1	2	1		1					4	1
W2239	Mollusca	Cochlodesma	praetenue								3		1			7	7		1
W2157	Mollusca	Corbula	gibba																
W1028	Mollusca	Cylichna	cylindracea																
W2091	Mollusca	Circomphalus	casina									1							
W2041	Mollusca	Donax	vittatus																

CODE	Phylum	Genus	Species	4a 2013	4b 2013	5a 2013	5b 2013	6a 2013	6b 2013	7a 2013	7b 2013	8a 2013	8b 2013	9a 2013	9b 2013	10a 2013	10b 2013	11a 2013	11b 2013
W2130	Mollusca	Dosinia	exoleta							3					1			2	2
W1999	Mollusca	Ensis	ensis			1				1				1	1				
W2019	Mollusca	Fabulina	fabula	8	14	7	6	16	9	1		2	2	7	3				
W2051	Mollusca	Gari	fervensis																
W65	Mollusca	Hanleya	hanleyi													1			
W2166	Mollusca	Hiatella	arctica														1		
W410	Mollusca	Hyala	vitrea																
W1906	Mollusca	Kurtiella	bidentata		2	9	2	2		22	32	2		5	8	3		12	10
W54	Mollusca	Leptochiton	cancellatus																
W1984	Mollusca	Lutraria	lutraria																
W2029	Mollusca	Macoma	balthica																
W1972	Mollusca	Mactra	stultorum																
W1698	Mollusca	Modiolus	juv																
W2021	Mollusca	Moerella	donacina																
W2150	Mollusca	Mya	truncata																
W2139	Mollusca	Mysia	undata																
W1695	Mollusca	Mytilus	edulis					1								8	22	1	
W1569	Mollusca	Nucula	nitidosa	8	6	12	2	1	3	2			8	3	1				
W1570	Mollusca	Nucula	nucleus	34	36	10	7	14	13				7	11	2	1			
W1571	Mollusca	Nucula	sulcata		7	2	1	3	5		2			1		1			
	Mollusca	Nudibranchia	unid							5									
W2006	Mollusca	Phaxas	pellucidus	2	2	5	7		2		2	8	6	7				1	
W1038	Mollusca	Philine	aperta				1												
W491	Mollusca	Polinices	pulchellus							1									
W1975	Mollusca	Spisula	elliptica																
W1977	Mollusca	Spisula	solida			1				1	1			1					
W1902	Mollusca	Tellimya	ferruginosa						1	4	2			1	2	1			7
W2231	Mollusca	Thracia	phaseolina	17	16	1	2	7	8	4	7	4	1		1			6	3
W1837	Mollusca	Thyasira	flexuosa						1	4				1		4	1	5	10
W1934	Mollusca	Tridonta	montagui																
	Echinodermata	Amphipholis	squamata																
ZB252	Echinodermata	Amphiura	chiajei	2		4	1	3	1	8	13	1		3	1	1		1	4
ZB154	Echinodermata	Amphiura	filiformis			1				32	52			2	3	1		40	58
ZB100	Echinodermata	Antedon	bifida																
ZB100	Echinodermata	Asterias	rubens																
ZB223	Echinodermata	Echinocardium	cordatum	1		2		1		4		1		1	1			3	3
ZB296	Echinodermata	Leptosynapta	inhaerens												1				
ZB23	Echinodermata	Luidia	sarsi																
ZB104	Echinodermata	Martasterias	glacialis																
ZB167	Echinodermata	Ophiocten	affinis	3	1		1					5	1	4	3	1	1		1
ZB168	Echinodermata	Ophiura	albida																
ZB170	Echinodermata	Ophiura	ophiura							1	1			1					
ZB172	Echinodermata	Ophiura	sarsi													4			
ZB124	Echinodermata	Ophiotrix	fragilis													4	1		
ZB121	Echinodermata	Ophiuroidea	juv																
ZB193	Echinodermata	Psammechinus	miliaris													1			
ZD81	Tunicata	Corella	parallelogramma													2			
ZD120	Tunicata	Dendrodoa	grossularia							3									
ZD140	Tunicata	Pyura	squamulosa																
ZG444	Pisces	Ammodytes	tobianus																
ZG578	Pisces	Pleuronectes	platessa															1	
L29	Chaetognatha	Spadella	cephaloptera																

Epifaunal Species

C133	Porifera	Scypha	ciliata													1	1		
C133	Porifera	Clathrina	coriacea													+			
C480	Porifera	Cliona	celata																
C1670	Porifera	Dysidea	fragilis																
C1420	Porifera	Haliclona	frag.												+				
D409	Coelenterata	Abietinaria	abietina					+		+					+			+	
D481	Coelenterata	Aglaophenia	pluma																
D597	Coelenterata	Alcyonidium	digitatum																
D257	Coelenterata	Bougainvillia	ramosa																
D348	Coelenterata	Calycella	syringa														+		
D494	Coelenterata	Campanularia	hincksii																
D503	Coelenterata	Clythia	hemisphaerica							+	+		+						+
D422	Coelenterata	Dynamena	pumila																
D227	Coelenterata	Eudendrium	ramosum						+	+				+	+	+			+
D392	Coelenterata	Halecium	halecinum														+		
D399	Coelenterata	Halecium	tenellum					+								+	+		
D424	Coelenterata	Hydrallmania	falcata							+				+	+	+	+		+
D386	Coelenterata	Lafoea	dumosa																+
D515	Coelenterata	Laomedea	flexuosa					+	+	+	+	+					+		+
D336	Coelenterata	Lovenella	clausa																+
D520	Coelenterata	Obelia	geniculata									+				+			
D463	Coelenterata	Nemertesia	antennina																
D464	Coelenterata	Nemertesia	ramosa																
D240	Coelenterata	Perigonimus	repens																
D469	Coelenterata	Plumularia	setacea																
D430	Coelenterata	Sertularella	polyzonias													+			+
D435	Coelenterata	Sertularia	cuppressina				+	+	+	+	+	+	+	+	+	+		+	+
R77	Crustacea	Balanus	crenatus													+			

CODE	Phylum	Genus	Species	4a 2013	4b 2013	5a 2013	5b 2013	6a 2013	6b 2013	7a 2013	7b 2013	8a 2013	8b 2013	9a 2013	9b 2013	10a 2013	10b 2013	11a 2013	11b 2013
Y76	Bryozoa	Alcyonidium	diaphanum					+		+						+			+
Y78	Bryozoa	Alcyonidium	hirsutum																
Y80	Bryozoa	Alcyonidium	mytili																
Y81	Bryozoa	Alcyonidium	parasiticum					+								+	+		
Y256	Bryozoa	Bicellariella	ciliata						+							+			
Y243	Bryozoa	Bugula	flabellata														+		
Y246	Bryozoa	Bugula	plumosa																
Y300	Bryozoa	Cellaria	fistulosa					+		+	+								+
Y495	Bryozoa	Cellepora	pumicosa																
Y337	Bryozoa	Celleporella	hyalina													+			
Y172	Bryozoa	Conopeum	reticulum					+	+	+	+					+	+		+
Y16	Bryozoa	Crisia	denticulata						+							+			
Y44	Bryozoa	Crisia	eburnea																
Y19	Bryozoa	Crisia	ramosa																
Y8	Bryozoa	Crisidia	cornuta																
Y411	Bryozoa	Cryptosula	pallasiana														+		
Y178	Bryozoa	Electra	pilosa													+	+		
Y364	Bryozoa	Escharella	immersa																
Y358	Bryozoa	Escharoides	coccinea																
Y165	Bryozoa	Eucratea	loricata																
Y483	Bryozoa	Fenestrulina	malusii																
Y187	Bryozoa	Flustra	foliacea														+		
Y414	Bryozoa	Hippoporina	pertusa																
Y279	Bryozoa	Scrupocellaria	scruposa													+			
Y131	Bryozoa	Vesicularia	spinosa																
Y112	Bryozoa	Walkeria	uva																
K46	Kamptozoa	Pedicellina	cernua													+			

New for 2017

New for 2013

Macro-Invertebrate Communites

CODE	Phylum	Genus	Species	Ref1a 2012	Ref1b 2012	1a 2012	1b 2012	3a 2012	3b 2012	4a 2012	4b 2012	5a 2012	5b 2012	6a 2012	6b 2012	7a 2012	7b 2012	8a 2012	8b 2012
D632	Coelenterata	Cerianthus	lloydii														1		
D766	Coelenterata	Edwardsia	claparedii	9	7							1		1			1		
D775	Coelenterata	Peachia	hastata																
D713	Coelenterata	Sagartia	elegans													1			
D715	Coelenterata	Sagartia	troglodytes																
D722	Coelenterata	Sagartiogeton	undatus																
D618	Coelenterata	Virgularia	mirabilis																
F2	Turbellaria	Turbellaria	indet																
G1	Nemertea	Nemertea	spp	2	1	1	4	3		1	1	8	3	5	1		14	3	2
HD1	Nematoda	Nematoda .	indet.																
P1139	Polychaeta	Ampharete	lindstroemi							2		3				1		1	1
P1102	Polychaeta	Amphictene	auricoma																
P141	Polychaeta	Anaitides	groenlandica																
P144	Polychaeta	Anaitides	maculata									1						1	1
P724	Polychaeta	Aonides	oxycephala													1			
P725	Polychaeta	Aonides	paucibranchiata						2										
P824	Polychaeta	Aphelochaeta	marioni																
P19	Polychaeta	Aphrodita	aculeata																
P588	Polychaeta	Arabella	iricolor																
P677	Polychaeta	Aricidea	minuta																
P912	Polychaeta	Capitomastus	minimus		2									33	1	10	29		
P831	Polychaeta	Caulleriella	zetlandica		1														
P833	Polychaeta	Chaetozone	gibber	1	3			4	3	13	27	23		16	41		2	1	
P834	Polychaeta	Chaetozone	setosa																
P1267	Polychaeta	Chone	duneri								1								
P836	Polychaeta	Cirratulus	cirratus	1	1		2	4	1	3	4	22	7	8	1	5	4	212	78
P878	Polychaeta	Diplocirrus	glaucus	3	5													2	
P118	Polychaeta	Eteone	longa					1				3		1	4	4	1	2	1
P161	Polychaeta	Eulalia	viridis										1	1			2		
P164	Polychaeta	Eumida	bahusiensis										2				2		
P167	Polychaeta	Eumida	sanguinea		3						2	1	1						
P1189	Polychaeta	Eupolymnia	nebulosa																
P259	Polychaeta	Glycera	gigantea							1		2		1					2
P260	Polychaeta	Glycera	lapidum	1	1			7	5	11	10	2		2	8	2	2	2	4
P271	Polychaeta	Goniada	maculata		1					1						2	2	5	2
P501	Polychaeta	Harmothoe	frag.									1							
P64	Polychaeta	Harmothoe	imbricata							1									
P65	Polychaeta	Harmothoe	impar									1				2			
P17	Polychaeta	Heteromastus	filiformis																
P1334	Polychaeta	Hydroides	norvegica																
P1107	Polychaeta	Lagis	koreni	6	5						3	7	5	12	2		2	1	3
P1195	Polychaeta	Lanice	conchilega				1					2	1			1		2	
P82	Polychaeta	Lepidonotus	squamatum															1	1
P693	Polychaeta	Levinsenia	gracilis											5	1		5		
P577	Polychaeta	Lumbrineris	fragilis		1											3	12		
P579	Polychaeta	Lumbrineris	gracilis		3											5	5		
P804	Polychaeta	Magelona	alleni									1		2		5	4	1	
P807	Polychaeta	Magelona	mirabilis		2			10	5	12	39	9	2		7			12	10
P938	Polychaeta	Maldanid	frag.										1						
P1124	Polychaeta	Melinna	palmata									1		5			1	15	4
P1094	Polychaeta	Myriochele	sp.		1									2			4		2
P568	Polychaeta	Nematonereis	unicornis		1									2					
P496	Polychaeta	Nephtys	caeca																
P498	Polychaeta	Nephtys	cirrosa				5	1	3	1	3	3	1	3		2			2
P499	Polychaeta	Nephtys	hombergi	4	5	4	1	2				1	3	1	1	2	3	3	2
P476	Polychaeta	Nereis	pelagica																
P921	Polychaeta	Notomastus	latericeus									2			2	1	1	6	1
P1001	Polychaeta	Ophelia	limacina			1													
P1014	Polychaeta	Ophelina	acuminata	1									1	3				1	
P1098	Polychaeta	Owenia	fusiformis	21	9			10	7	54	58	110	9	4	2		2	30	103
P885	Polychaeta	Pherusa	plumosa															1	
P180	Polychaeta	Phyllodoce	laminosa									1	1	4			2		
P92	Polychaeta	Pholoe	inornata	4	14				1		4	1	5	6		2	13	2	
P718	Polychaeta	Poecilochaetus	serpens																
P1029	Polychaeta	Polyphysia	crassa																
P1341	Polychaeta	Pomatoceros	triqueter																
P1316	Polychaeta	Potamilla	reniformis																
P765	Polychaeta	Prionospio	fallax			1						1	3			2	1	2	1
P774	Polychaeta	Pseudopolydora	pulchra																
P1320	Polychaeta	Sabella	pavonina																
P1117	Polychaeta	Sabellaria	spinulosa																
P1027	Polychaeta	Scalibregma	inflatum											2		31	17	2	1
P781	Polychaeta	Scolelepis	foliosa					3		1	3	2	1		2				3
P672	Polychaeta	Scoloplos	armiger					18	16	8	6	1			3			1	
P291	Polychaeta	Sphaerodorum	flavum																
P107	Polychaeta	Sthenelais	boa	1	1			1		2	4	1			1	2	1	5	1
P108	Polychaeta	Sthenelais	jeffreysii																
P104	Polychaeta	Sigalion	mathildae							8								1	2
P794	Polychaeta	Spiophanes	bombyx	2	3				4	5	6	11	1	1			4	9	10
P796	Polychaeta	Spiophanes	kroyeri																
P360	Polychaeta	Syllis	gracilis																1
P1099	Polychaeta	Terebellid	fragment																
P1175	Polychaeta	Terebellides	stroemi													1	1		1
P1490	Oligochaeta	Tubificoides	benedeni																

CODE	Phylum	Genus	Species	Ref1a 2012	Ref1b 2012	1a 2012	1b 2012	3a 2012	3b 2012	4a 2012	4b 2012	5a 2012	5b 2012	6a 2012	6b 2012	7a 2012	7b 2012	8a 2012	8b 2012
ZA5	Phoronidea	Phoronis	muelleri	43	32										2	5		1	1
N17	Sipunculida	Golfingia	vulgaris																
N36	Sipunculida	Onchnesoma	squamatum																
N34	Sipunculida	Phascolion	strombus																
N28	Sipunculida	Thysanocardia	procera	2															
S498	Crustacea	Abludomelita	obtusata																
S275	Crustacea	Acidostoma	obesum																
S427	Crustacea	Ampelisca	brevicornis	1						12	22	15		1	1	2		14	
S429	Crustacea	Ampelisca	diadema																
S432	Crustacea	Ampelisca	macrocephala																
S97	Crustacea	Amphipoda	frag.										1						
S579	Crustacea	Aora	gracilis													2			
S360	Crustacea	Argissa	hamatipes																
S411	Crustacea	Atylus	guttatus																
S456	Crustacea	Bathyporeia	pelagica																
S459	Crustacea	Bathyporeia	tenuipes					4	4		2								
S1196	Crustacea	Bodotria	pulchella											1					
S1197	Crustacea	Bodotria	scorpioides											1					
S1485	Crustacea	Brachiura	zoea									1							
S646	Crustacea	Caprella	linearis					1		1	4	6	3			1	3	3	2
S506	Crustacea	Cheirocratus	sundevalli																
R152	Crustacea	Copepoda	indet.												1				
S610	Crustacea	Corophium	bonnelli																
S1552	Crustacea	Corystes	cassivelaunus																
S1383	Crustacea	Crangon	crangon																
S186	Crustacea	Cressa	dubia																
S415	Crustacea	Dexamine	spinosa																
S1251	Crustacea	Diastylis	laevis	4	4							1	2						
S1252	Crustacea	Diastylis	lucifera																
S1254	Crustacea	Diastylis	rugosa																1
S374	Crustacea	Epimeria	cornigera																
S1206	Crustacea	Eudorella	emarginata																
S1208	Crustacea	Eudorella	truncatula														1		
S1478	Crustacea	Galathea	strigosa																
S793	Crustacea	Gnathia	praniza																
S254	Crustacea	Harpinia	antennaria	1															
S1350	Crustacea	Hippolyte	varians																
S296	Crustacea	Hippomedon	denticulata																
S1202	Crustacea	Iphinoe	trispinosa							4	5	4	3	5	5				5
S892	Crustacea	Janira	maculosa																
S569	Crustacea	Jassa	falcata																
S177	Crustacea	Leucothoe	incisa																
S1580	Crustacea	Liocarcinus	depurator														1		
S1581	Crustacea	Liocarcinus	holsatus															1	
S1584	Crustacea	Liocarcinus	pusillus																
S1515	Crustacea	Maja	squinado juv.													1			
S1251	Crustacea	Monoculodes	carinatus					8	4	7	2	3	2	2	1	2	1		3
S1589	Crustacea	Necora puber	puber juv.																
R2412	Crustacea	Ostracoda	indet.											1		1	1		
S1457	Crustacea	Pagurus	bernhardus																
S1319	Crustacea	Palaemon	serratus																
S326	Crustacea	Perrierella	audouiniana																
S1482	Crustacea	Pisidia	longicornis																
S133	Crustacea	Pontocrates	altamarinus						11		5								
S1363	Crustacea	Processa	canaliculatum		1										1				
S1235	Crustacea	Pseudocuma	longirostris		2			3	2	68	115	57	68		4		2	16	61
S659	Crustacea	Pseudoproctella	phasma																
S618	Crustacea	Siphonoecetes	kroyerianus																
S213	Crustacea	Stenothoe	marina																
S1142	Crustacea	Tanaopsis	graciloides													1	1		
S336	Crustacea	Tmetonyx	cicada													2			1
S1360	Crustacea	Thoralus	cranchi																
S1153	Crustacea	Typhlotanais	brevicornis																
S249	Crustacea	Urothoe	marina																
S140	Crustacea	Westwoodilla	caecula																
Q15	Chelicerata	Achelia	echinata																
Q29	Chelicerata	Endeis	spinosa		1														
Q7	Chelicerata	Nymphon	gracile																
W2059	Mollusca	Abra	alba	1	4							3	3	10	2	1	4	3	2
W2061	Mollusca	Abra	nitida									9			1	1	1	3	6
W2062	Mollusca	Abra	prismatica																
W1943	Mollusca	Acanthocardia	aculeata										1						
W1006	Mollusca	Acteon	tornatilis																
W1519	Mollusca	Antalis	entalis	4	5														
W1773	Mollusca	Aequipecten	opercularis																
W1363	Mollusca	Cadlina	laevis																
W1961	Mollusca	Cerastoderma	edule												1				
W9	Mollusca	Chaetoderma	nitidulum	2															
W2098	Mollusca	Chamelea	gallina								2							1	
W2100	Mollusca	Clausinella	fasciata	2						2	2		2					4	2
W2239	Mollusca	Cochlodesma	praetenue		1				1										
W2157	Mollusca	Corbula	gibba																
W1028	Mollusca	Cylichna	cylindracea	5	2														
W2091	Mollusca	Circomphalus	casina		1			1						3					
W2041	Mollusca	Donax	vittatus						1										

CODE	Phylum	Genus	Species	Ref1a 2012	Ref1b 2012	1a 2012	1b 2012	3a 2012	3b 2012	4a 2012	4b 2012	5a 2012	5b 2012	6a 2012	6b 2012	7a 2012	7b 2012	8a 2012	8b 2012
W2130	Mollusca	Dosinia	exoleta		1												1		
W1999	Mollusca	Ensis	ensis	4	3						1	21	11	1	1	1	3	10	14
W2019	Mollusca	Fabulina	fabula					12	16	46	47	26	24	3	9	1		19	58
W2051	Mollusca	Gari	fervensis		1				1					1					
W65	Mollusca	Hanleya	hanleyi																
W2166	Mollusca	Hiatella	arctica																
W410	Mollusca	Hyala	vitrea							1									
W1906	Mollusca	Kurtiella	bidentata	53	88	3						7	8		2	12	10	7	7
W54	Mollusca	Leptochiton	cancellatus																
W1984	Mollusca	Lutraria	lutraria																
W2029	Mollusca	Macoma	balthica																
W1972	Mollusca	Mactra	stultorum	2				1	1	4	4	2		1		2		5	3
W1698	Mollusca	Modiolus	juv			6													1
W2021	Mollusca	Moerella	donacina																
W2150	Mollusca	Mya	truncata		1			2		2	1	3		7	2	2	2	2	1
W2139	Mollusca	Mysia	undata									1							
W1695	Mollusca	Mytilus	edulis																
W1569	Mollusca	Nucula	nitidosa	1	7			1		4					1			1	
W1570	Mollusca	Nucula	nucleus	20	24			3	2	12	3	3	4		1	1	1	5	1
W1571	Mollusca	Nucula	sulcata		3					2	1		1						
	Mollusca	Nudibranchia	unid																
W2006	Mollusca	Phaxas	pellucidus	1	1					1		1		1		1			
W1038	Mollusca	Philine	aperta										1						
W491	Mollusca	Polinices	pulchellus	1													1		
W1975	Mollusca	Spisula	elliptica																
W1977	Mollusca	Spisula	solida															1	
W1902	Mollusca	Tellimya	ferruginosa	1														1	
W2231	Mollusca	Thracia	phaseolina	4	2			2		76	97	46	38	2				29	22
W1837	Mollusca	Thyasira	flexuosa	4	4						1	7	4	5		3	2	1	
W1934	Mollusca	Tridonta	montagui														1		
	Echinodermata	Amphipholis	squamata																
ZB252	Echinodermata	Amphiura	chiajei							2	1	1			1	2	1		1
ZB154	Echinodermata	Amphiura	filiformis	107	141									13	8	25	31		
ZB100	Echinodermata	Antedon	bifida																
ZB100	Echinodermata	Asterias	rubens															1	
ZB223	Echinodermata	Echinocardium	cordatum	8	13							2					1	2	2
ZB296	Echinodermata	Leptosynapta	inhaerens													2		2	
ZB23	Echinodermata	Luidia	sarsi																
ZB104	Echinodermata	Martasterias	glacialis																
ZB167	Echinodermata	Ophiocten	affinis	1					2		4	6	9					6	
ZB168	Echinodermata	Ophiura	albida																
ZB170	Echinodermata	Ophiura	ophiura											1		2			
ZB172	Echinodermata	Ophiura	sarsi																
ZB124	Echinodermata	Ophiotrix	fragilis										1	3		2		1	
ZB121	Echinodermata	Ophiuroidea	juv				1			24	24	22			2				11
ZB193	Echinodermata	Psammechinus	miliaris																
ZD81	Tunicata	Corella	parallelogramma																
ZD120	Tunicata	Dendrodoa	grossularia														1		
ZD140	Tunicata	Pyura	squamulosa																
ZG444	Pisces	Ammodytes	tobianus			1	2												
ZG578	Pisces	Pleuronectes	platessa																
L29	Chaetognatha	Spadella	cephaloptera																

Epifaunal Species

C133	Porifera	Scypha	ciliata																
C133	Porifera	Clathrina	coriacea																
C480	Porifera	Cliona	celata														+		
C1670	Porifera	Dysidea	fragilis																
C1420	Porifera	Haliclona	frag.																
D409	Coelenterata	Abietinaria	abietina		+							+					+		
D481	Coelenterata	Aglaophenia	pluma																
D597	Coelenterata	Alcyonidium	digitatum																
D257	Coelenterata	Bougainvillia	ramosa																
D348	Coelenterata	Calycella	syringa																
D494	Coelenterata	Campanularia	hincksii																
D503	Coelenterata	Clythia	hemisphaerica										+			+			
D422	Coelenterata	Dynamena	pumila																
D227	Coelenterata	Eudendrium	ramosum										+						
D392	Coelenterata	Halecium	halecinum										+	+	+		+	+	
D399	Coelenterata	Halecium	tenellum																
D424	Coelenterata	Hydrallmania	falcata									+	+	+		+		+	+
D386	Coelenterata	Lafoea	dumosa										+						
D515	Coelenterata	Laomedea	flexuosa				+					+	+	+	+	+		+	+
D336	Coelenterata	Lovenella	clausa		+														
D520	Coelenterata	Obelia	geniculata																+
D463	Coelenterata	Nemertesia	antennina									+			+	+		+	
D464	Coelenterata	Nemertesia	ramosa																
D240	Coelenterata	Perigonimus	repens	+															
D469	Coelenterata	Plumularia	setacea																
D430	Coelenterata	Sertularella	polyzonias																
D435	Coelenterata	Sertularia	cuppressina									+	+	+	+	+	+	+	+
R77	Crustacea	Balanus	crenatus																

CODE	Phylum	Genus	Species	Ref1a 2012	Ref1b 2012	1a 2012	1b 2012	3a 2012	3b 2012	4a 2012	4b 2012	5a 2012	5b 2012	6a 2012	6b 2012	7a 2012	7b 2012	8a 2012	8b 2012
Y76	Bryozoa	Alcyonidium	diaphanum												+	+			
Y78	Bryozoa	Alcyonidium	hirsutum																
Y80	Bryozoa	Alcyonidium	mytili																
Y81	Bryozoa	Alcyonidium	parasiticum												+	+			
Y256	Bryozoa	Bicellariella	ciliata																
Y243	Bryozoa	Bugula	flabellata																
Y246	Bryozoa	Bugula	plumosa																
Y300	Bryozoa	Cellaria	fistulosa		+											+	+		
Y495	Bryozoa	Cellepora	pumicosa																
Y337	Bryozoa	Celleporella	hyalina																
Y172	Bryozoa	Conopeum	reticulum													+	+		
Y16	Bryozoa	Crisia	denticulata											+		+			
Y44	Bryozoa	Crisia	eburnea																
Y19	Bryozoa	Crisia	ramosa																
Y8	Bryozoa	Crisidia	cornuta																
Y411	Bryozoa	Cryptosula	pallasiana																
Y178	Bryozoa	Electra	pilosa										+	+	+				
Y364	Bryozoa	Escharella	immersa																
Y358	Bryozoa	Escharoides	coccinea																
Y165	Bryozoa	Eucratea	loricata																
Y483	Bryozoa	Fenestrulina	malusii																
Y187	Bryozoa	Flustra	foliacea													+			
Y414	Bryozoa	Hippoporina	pertusa																
Y279	Bryozoa	Scrupocellaria	scruposa										+		+				
Y131	Bryozoa	Vesicularia	spinosa									+				+			
Y112	Bryozoa	Walkeria	uva																
K46	Kamptozoa	Pedicellina	cernua																

New for 2017

New for 2013

Macro-Invertebrate Communites

CODE	Phylum	Genus	Species	9a 2012	9b 2012	10a 2012	10b 2012	11a 2012	11b 2012	12a 2012	12b 2012	14a 2012	14b 2012	15a 2012	15b 2012	16a 2012	16b 2012	17a 2012	17b 2012
D632	Coelenterata	Cerianthus	lloydii			3	6												
D766	Coelenterata	Edwardsia	claparedii						1										
D775	Coelenterata	Peachia	hastata																
D713	Coelenterata	Sagartia	elegans			12	10												
D715	Coelenterata	Sagartia	troglodytes																
D722	Coelenterata	Sagartiogeton	undatus				1												
D618	Coelenterata	Virgularia	mirabilis																
F2	Turbellaria	Turbellaria	indet																
G1	Nemertea	Nemertea	spp	5	7	13	19		10		1	1		3	1	3	1	2	5
HD1	Nematoda	Nematoda .	indet.									3			1				
P1139	Polychaeta	Ampharete	lindstroemi			8	11											1	
P1102	Polychaeta	Amphictene	auricoma																
P141	Polychaeta	Anaitides	groenlandica																
P144	Polychaeta	Anaitides	maculata																
P724	Polychaeta	Aonides	oxycephala			2	1	1								1			
P725	Polychaeta	Aonides	paucibranchiata		1														
P824	Polychaeta	Aphelochaeta	marioni	1															
P19	Polychaeta	Aphrodita	aculeata																
P588	Polychaeta	Arabella	iricolor					1											
P677	Polychaeta	Aricidea	minuta						1										
P912	Polychaeta	Capitomastus	minimus		3		6	3	2										
P831	Polychaeta	Caulleriella	zetlandica	3														2	
P833	Polychaeta	Chaetozone	gibber	7	5					16	31	1	4		3	22	23	12	10
P834	Polychaeta	Chaetozone	setosa																
P1267	Polychaeta	Chone	duneri																
P836	Polychaeta	Cirratulus	cirratus	6	7			1	1									9	8
P878	Polychaeta	Diplocirrus	glaucus			1	1	2	5									1	5
P118	Polychaeta	Eteone	longa	2			4				1							1	1
P161	Polychaeta	Eulalia	viridis				1												
P164	Polychaeta	Eumida	bahusiensis																
P167	Polychaeta	Eumida	sanguinea	1		3	1	1	1										
P1189	Polychaeta	Eupolymnia	nebulosa						1										
P259	Polychaeta	Glycera	gigantea	1											2			1	
P260	Polychaeta	Glycera	lapidum	2			3	1	2	2	1	1	1	12	5	5	7	3	1
P271	Polychaeta	Goniada	maculata						1				1		1		1	3	
P501	Polychaeta	Harmothoe	frag.		2	2	3						1				1	1	
P64	Polychaeta	Harmothoe	imbricata																
P65	Polychaeta	Harmothoe	impar	1	1	1					1								2
P17	Polychaeta	Heteromastus	filiformis																
P1334	Polychaeta	Hydroides	norvegica																
P1107	Polychaeta	Lagis	koreni	27	30	1	7	4	54		2	1	1	22	6	15	14	35	4
P1195	Polychaeta	Lanice	conchilega			3	1				1			1					
P82	Polychaeta	Lepidonotus	squamatum			3													
P693	Polychaeta	Levinsenia	gracilis																
P577	Polychaeta	Lumbrineris	fragilis			1	3		3										1
P579	Polychaeta	Lumbrineris	gracilis			6	11	4	2										
P804	Polychaeta	Magelona	alleni				4	3	4										
P807	Polychaeta	Magelona	mirabilis		2		1			36	42	22	22	109	296	151	165	10	1
P938	Polychaeta	Maldanid	frag.																
P1124	Polychaeta	Melinna	palmata	3		6	18	41	29										1
P1094	Polychaeta	Myriochele	sp.			1												1	
P568	Polychaeta	Nematonereis	unicornis			1													
P496	Polychaeta	Nephtys	caeca		1														
P498	Polychaeta	Nephtys	cirrosa			3			2	2	5	9	8			3	3		2
P499	Polychaeta	Nephtys	hombergi	2	2	3	2	3	2		2			1	13	2		5	
P476	Polychaeta	Nereis	pelagica		1			1	1										
P921	Polychaeta	Notomastus	latericeus	1	2	2	3		1										2
P1001	Polychaeta	Ophelia	limacina																
P1014	Polychaeta	Ophelina	acuminata	1							1								
P1098	Polychaeta	Owenia	fusiformis	47	9	6	2	3	2	1		1		104		1		19	3
P885	Polychaeta	Pherusa	plumosa										1						
P180	Polychaeta	Phyllodoce	laminosa		3			1							1		1	1	1
P92	Polychaeta	Pholoe	inornata	1	3	13	21	13	32			1			1	1	2	3	11
P718	Polychaeta	Poecilochaetus	serpens																
P1029	Polychaeta	Polyphysia	crassa		1														
P1341	Polychaeta	Pomatoceros	triqueter			2	4												
P1316	Polychaeta	Potamilla	reniformis																
P765	Polychaeta	Prionospio	fallax		3														
P774	Polychaeta	Pseudopolydora	pulchra			2	1												
P1320	Polychaeta	Sabella	pavonina																
P1117	Polychaeta	Sabellaria	spinulosa																
P1027	Polychaeta	Scalibregma	inflatum	1		10	10	9	12									1	4
P781	Polychaeta	Scolelepis	foliosa									2	1	1	8		1	4	
P672	Polychaeta	Scoloplos	armiger							2	1		1			1	1		
P291	Polychaeta	Sphaerodorum	flavum																
P107	Polychaeta	Sthenelais	boa		4	6	1	1	1	1	2	1	3	1	1		2		2
P108	Polychaeta	Sthenelais	jeffreysii																
P104	Polychaeta	Sigalion	mathildae			1				1									
P794	Polychaeta	Spiophanes	bombyx	2	2					1	5	3	5			2	6	7	
P796	Polychaeta	Spiophanes	kroyeri																
P360	Polychaeta	Syllis	gracilis		1	1													
P1099	Polychaeta	Terebellid	fragment																
P1175	Polychaeta	Terebellides	stroemi				3	2											2
P1490	Oligochaeta	Tubificoides	benedeni																

Macro-Invertebrate Communites

CODE	Phylum	Genus	Species	9a 2012	9b 2012	10a 2012	10b 2012	11a 2012	11b 2012	12a 2012	12b 2012	14a 2012	14b 2012	15a 2012	15b 2012	16a 2012	16b 2012	17a 2012	17b 2012
ZA5	Phoronidea	Phoronis	muelleri	3		8	3	1	8										
N17	Sipunculida	Golfingia	vulgaris				1												
N36	Sipunculida	Onchnesoma	squamatum					1											
N34	Sipunculida	Phascolion	strombus																
N28	Sipunculida	Thysanocardia	procera																
S498	Crustacea	Abludomelita	obtusata		1														
S275	Crustacea	Acidostoma	obesum																
S427	Crustacea	Ampelisca	brevicornis	2		11	13							10	6	8	5	5	3
S429	Crustacea	Ampelisca	diadema			9	4												
S432	Crustacea	Ampelisca	macrocephala																
S97	Crustacea	Amphipoda	frag.			1	2						2			1			
S579	Crustacea	Aora	gracilis			18	13												
S360	Crustacea	Argissa	hamatipes																
S411	Crustacea	Atylus	guttatus																
S456	Crustacea	Bathyporeia	pelagica																
S459	Crustacea	Bathyporeia	tenuipes							36	1	14	12			2		1	
S1196	Crustacea	Bodotria	pulchella															4	
S1197	Crustacea	Bodotria	scorpioides				8											1	
S1485	Crustacea	Brachiura	zoea	1	1	2	1								1				1
S646	Crustacea	Caprella	linearis	1		4	2	3	1	2	1			2	3		1	2	
S506	Crustacea	Cheirocratus	sundevalli																
R152	Crustacea	Copepoda	indet.														1		
S610	Crustacea	Corophium	bonnelli																
S1552	Crustacea	Corystes	cassivelaunus																
S1383	Crustacea	Crangon	crangon			1									1	1			
S186	Crustacea	Cressa	dubia																
S415	Crustacea	Dexamine	spinosa																
S1251	Crustacea	Diastylis	laevis	1	1		2	1		1		1						3	
S1252	Crustacea	Diastylis	lucifera																
S1254	Crustacea	Diastylis	rugosa													2		1	
S374	Crustacea	Epimeria	cornigera				3												
S1206	Crustacea	Eudorella	emarginata																
S1208	Crustacea	Eudorella	truncatula				1	1										1	
S1478	Crustacea	Galathea	strigosa																
S793	Crustacea	Gnathia	praniza				1												
S254	Crustacea	Harpinia	antennaria			1		2									6	1	9
S1350	Crustacea	Hippolyte	varians																
S296	Crustacea	Hippomedon	denticulata																
S1202	Crustacea	Iphinoe	trispinosa	1	2					2	3	1	1		3	5	4		
S892	Crustacea	Janira	maculosa																
S569	Crustacea	Jassa	falcata																
S177	Crustacea	Leucothoe	incisa																
S1580	Crustacea	Liocarcinus	depurator			7	4												
S1581	Crustacea	Liocarcinus	holsatus												1	1			
S1584	Crustacea	Liocarcinus	pusillus								1								
S1515	Crustacea	Maja	squinado juv.																
S1251	Crustacea	Monoculodes	carinatus					1	1	7	28	3	16		12	6	3	2	3
S1589	Crustacea	Necora puber	puber juv.			2													
R2412	Crustacea	Ostracoda	indet.				5	1		1								1	1
S1457	Crustacea	Pagurus	bernhardus																
S1319	Crustacea	Palaemon	serratus																
S326	Crustacea	Perrierella	audouiniana																
S1482	Crustacea	Pisidia	longicornis			1	3												
S133	Crustacea	Pontocrates	altamarinus											6					
S1363	Crustacea	Processa	canaliculatum																
S1235	Crustacea	Pseudocuma	longirostris	6						4	9	12	8	16	33	46	52	38	1
S659	Crustacea	Pseudoproctella	phasma																
S618	Crustacea	Siphonoecetes	kroyerianus			2	1											2	
S213	Crustacea	Stenothoe	marina			1	1												
S1142	Crustacea	Tanaopsis	graciloides			1	3	3											
S336	Crustacea	Tmetonyx	cicada								1				2				
S1360	Crustacea	Thoralus	cranchi																
S1153	Crustacea	Typhlotanais	brevicornis																
S249	Crustacea	Urothoe	marina									1							
S140	Crustacea	Westwoodilla	caecula								2	3	3			1	1		
Q15	Chelicerata	Achelia	echinata				1												
Q29	Chelicerata	Endeis	spinosa																
Q7	Chelicerata	Nymphon	gracile				1												
W2059	Mollusca	Abra	alba	3	3	10	8	6	3			2				3	1	22	1
W2061	Mollusca	Abra	nitida	1	4				2									2	
W2062	Mollusca	Abra	prismatica																
W1943	Mollusca	Acanthocardia	aculeata	2				1	2										
W1006	Mollusca	Acteon	tornatilis							2				1					
W1519	Mollusca	Antalis	entalis					1											
W1773	Mollusca	Aequipecten	opercularis																
W1363	Mollusca	Cadlina	laevis																
W1961	Mollusca	Cerastoderma	edule	1	1														
W9	Mollusca	Chaetoderma	nitidulum																
W2098	Mollusca	Chamelea	gallina																
W2100	Mollusca	Clausinella	fasciata					2	1		2		4			8	7		1
W2239	Mollusca	Cochlodesma	praetenue		4	2	2	1		2	2						1		
W2157	Mollusca	Corbula	gibba													1		1	
W1028	Mollusca	Cylichna	cylindracea									1							1
W2091	Mollusca	Circomphalus	casina																
W2041	Mollusca	Donax	vittatus											2	4		1		

CODE	Phylum	Genus	Species	9a 2012	9b 2012	10a 2012	10b 2012	11a 2012	11b 2012	12a 2012	12b 2012	14a 2012	14b 2012	15a 2012	15b 2012	16a 2012	16b 2012	17a 2012	17b 2012
W2130	Mollusca	Dosinia	exoleta						1			1						1	2
W1999	Mollusca	Ensis	ensis	17	8			9		2	2	4	1	6	1	20	20		3
W2019	Mollusca	Fabulina	fabula	7	9			1		14	31	41	56	14	20	41	47	16	4
W2051	Mollusca	Gari	fervensis								2							2	
W65	Mollusca	Hanleya	hanleyi																
W2166	Mollusca	Hiatella	arctica				1	1											
W410	Mollusca	Hyala	vitrea																1
W1906	Mollusca	Kurtiella	bidentata	13	5	4	10	12	14			1			2			14	22
W54	Mollusca	Leptochiton	cancellatus			1													
W1984	Mollusca	Lutraria	lutraria			1													
W2029	Mollusca	Macoma	balthica																
W1972	Mollusca	Mactra	stultorum	2	1	1			1	4	3	2	3	1	3	9			
W1698	Mollusca	Modiolus	juv		1	35	30										1		
W2021	Mollusca	Moerella	donacina																
W2150	Mollusca	Mya	truncata					3											4
W2139	Mollusca	Mysia	undata		1														
W1695	Mollusca	Mytilus	edulis																
W1569	Mollusca	Nucula	nitidosa								1	2			4	3	6	18	
W1570	Mollusca	Nucula	nucleus	1			1		1	3	7	23	12				19	15	5
W1571	Mollusca	Nucula	sulcata				1		1		1				1	5	2	1	
	Mollusca	Nudibranchia	unid			3	1												
W2006	Mollusca	Phaxas	pellucidus	3	11				5								1	1	1
W1038	Mollusca	Philine	aperta																
W491	Mollusca	Polinices	pulchellus								1								
W1975	Mollusca	Spisula	elliptica																
W1977	Mollusca	Spisula	solida																
W1902	Mollusca	Tellimya	ferruginosa		2														4
W2231	Mollusca	Thracia	phaseolina	8	6			1		53	36	5	8	3		8	8	3	9
W1837	Mollusca	Thyasira	flexuosa	8	4	2	4	6	2										1
W1934	Mollusca	Tridonta	montagui																
	Echinodermata	Amphipholis	squamata																
ZB252	Echinodermata	Amphiura	chiajei		3			2	11									1	33
ZB154	Echinodermata	Amphiura	filiformis	6	5			40	73		2					1		27	28
ZB100	Echinodermata	Antedon	bifida			2													
ZB100	Echinodermata	Asterias	rubens			3	1												
ZB223	Echinodermata	Echinocardium	cordatum	4	3			2		6	2	4	4						1
ZB296	Echinodermata	Leptosynapta	inhaerens																3
ZB23	Echinodermata	Luidia	sarsi																
ZB104	Echinodermata	Martasterias	glacialis																
ZB167	Echinodermata	Ophiocten	affinis	1		3	2	1				1	1						
ZB168	Echinodermata	Ophiura	albida																
ZB170	Echinodermata	Ophiura	ophiura					1											
ZB172	Echinodermata	Ophiura	sarsi																
ZB124	Echinodermata	Ophiotrix	fragilis		3	1													
ZB121	Echinodermata	Ophiuroidea	juv	29						11	38	3	1		4	24	23	31	2
ZB193	Echinodermata	Psammechinus	miliaris																
ZD81	Tunicata	Corella	parallelogramma																
ZD120	Tunicata	Dendrodoa	grossularia																
ZD140	Tunicata	Pyura	squamulosa																
ZG444	Pisces	Ammodytes	tobianus												1				
ZG578	Pisces	Pleuronectes	platessa																
L29	Chaetognatha	Spadella	cephaloptera										1						

Epifaunal Species

C133	Porifera	Scypha	ciliata																
C133	Porifera	Clathrina	coriacea																
C480	Porifera	Cliona	celata			+	+		+										
C1670	Porifera	Dysidea	fragilis				+												
C1420	Porifera	Haliclona	frag.																
D409	Coelenterata	Abietinaria	abietina					+	+					+					
D481	Coelenterata	Aglaophenia	pluma																
D597	Coelenterata	Alcyonidium	digitatum			+	+												
D257	Coelenterata	Bougainvillia	ramosa				+												
D348	Coelenterata	Calycella	syringa																
D494	Coelenterata	Campanularia	hincksii			+													
D503	Coelenterata	Clythia	hemisphaerica				+		+				+						+
D422	Coelenterata	Dynamena	pumila																
D227	Coelenterata	Eudendrium	ramosum				+												
D392	Coelenterata	Halecium	halecinum	+		+	+		+			+						+	+
D399	Coelenterata	Halecium	tenellum																
D424	Coelenterata	Hydrallmania	falcata		+	+	+	+					+						+
D386	Coelenterata	Lafoea	dumosa																
D515	Coelenterata	Laomedea	flexuosa	+	+	+	+	+	+	+	+	+	+	+	+	+			
D336	Coelenterata	Lovenella	clausa								+	+	+		+			+	
D520	Coelenterata	Obelia	geniculata				+			+			+						
D463	Coelenterata	Nemertesia	antennina		+		+			+	+								
D464	Coelenterata	Nemertesia	ramosa											+					
D240	Coelenterata	Perigonimus	repens																
D469	Coelenterata	Plumularia	setacea																
D430	Coelenterata	Sertularella	polyzonias																
D435	Coelenterata	Sertularia	cuppressina	+	+	+	+	+	+		+	+	+		+	+		+	+
R77	Crustacea	Balanus	crenatus																

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Y76	Bryozoa	Alcyonidium	diaphanum			+	+												
Y78	Bryozoa	Alcyonidium	hirsutum			+													
Y80	Bryozoa	Alcyonidium	mytili																
Y81	Bryozoa	Alcyonidium	parasiticum			+	+		+										
Y256	Bryozoa	Bicellariella	ciliata																
Y243	Bryozoa	Bugula	flabellata			+	+												
Y246	Bryozoa	Bugula	plumosa										+						
Y300	Bryozoa	Cellaria	fistulosa					+	+										
Y495	Bryozoa	Cellepora	pumicosa			+													
Y337	Bryozoa	Celleporella	hyalina																
Y172	Bryozoa	Conopeum	reticulum			+	+												
Y16	Bryozoa	Crisia	denticulata																
Y44	Bryozoa	Crisia	eburnea																
Y19	Bryozoa	Crisia	ramosa																
Y8	Bryozoa	Crisidia	cornuta																
Y411	Bryozoa	Cryptosula	pallasiana																
Y178	Bryozoa	Electra	pilosa			+	+	+					+						
Y364	Bryozoa	Escharella	immersa			+	+												
Y358	Bryozoa	Escharoides	coccinea																
Y165	Bryozoa	Eucratea	loricata																
Y483	Bryozoa	Fenestrulina	malusii					+											
Y187	Bryozoa	Flustra	foliacea			+	+												
Y414	Bryozoa	Hippoporina	pertusa			+	+												
Y279	Bryozoa	Scrupocellaria	scruposa										+						
Y131	Bryozoa	Vesicularia	spinosa						+		+								
Y112	Bryozoa	Walkeria	uva				+												
K46	Kamptozoa	Pedicellina	cernua			+													

New for 2017

New for 2013

Macro-Invertebrate Communites

CODE	Phylum	Genus	Species	18a 2012	18b 2012	19a 2012	19b 2012	20a 2012	20b 2012	21a 2012	21b 2012	22a 2012	22b 2012	23a 2012	23b 2012	27a 2012	29a 2012	29b 2012
D632	Coelenterata	Cerianthus	lloydii											4	1			
D766	Coelenterata	Edwardsia	claparedii	1	1							1					8	2
D775	Coelenterata	Peachia	hastata													2		
D713	Coelenterata	Sagartia	elegans											2	4	1		
D715	Coelenterata	Sagartia	troglodytes															
D722	Coelenterata	Sagartiogeton	undatus											2				
D618	Coelenterata	Virgularia	mirabilis															1
F2	Turbellaria	Turbellaria	indet	1														
G1	Nemertea	Nemertea	spp	4	7	1	2	1	8	4	6	6	6	9	4	2	1	4
HD1	Nematoda	Nematoda .	indet.						1									
P1139	Polychaeta	Ampharete	lindstroemi									1		4	2	2		
P1102	Polychaeta	Amphictene	auricoma	2						1							1	
P141	Polychaeta	Anaitides	groenlandica								1							
P144	Polychaeta	Anaitides	maculata													1		1
P724	Polychaeta	Aonides	oxycephala															
P725	Polychaeta	Aonides	paucibranchiata															
P824	Polychaeta	Aphelochaeta	marioni									4						
P19	Polychaeta	Aphrodita	aculeata															
P588	Polychaeta	Arabella	iricolor															
P677	Polychaeta	Aricidea	minuta															
P912	Polychaeta	Capitomastus	minimus	3								4				31		
P831	Polychaeta	Caulleriella	zetlandica	1						1	1							1
P833	Polychaeta	Chaetozone	gibber	3	2	33	29	35	29	19	15	6	1				1	
P834	Polychaeta	Chaetozone	setosa										4				4	
P1267	Polychaeta	Chone	duneri															
P836	Polychaeta	Cirratulus	cirratus	3	4				1	2	16	6		1				3
P878	Polychaeta	Diplocirrus	glaucus	21	10				1	2	7	5	9				18	7
P118	Polychaeta	Eteone	longa			1	1		1	3			2			2		
P161	Polychaeta	Eulalia	viridis															
P164	Polychaeta	Eumida	bahusiensis	2						1								
P167	Polychaeta	Eumida	sanguinea		1		1				2	1	1		1	1	1	
P1189	Polychaeta	Eupolymnia	nebulosa															
P259	Polychaeta	Glycera	gigantea			2		2					1	3			1	
P260	Polychaeta	Glycera	lapidum			7	4	3	2	3	1			2		6		
P271	Polychaeta	Goniada	maculata							2		1		2	1			
P501	Polychaeta	Harmothoe	frag.											2		6		
P64	Polychaeta	Harmothoe	imbricata															
P65	Polychaeta	Harmothoe	impar									1						
P17	Polychaeta	Heteromastus	filiformis															
P1334	Polychaeta	Hydroides	norvegica															
P1107	Polychaeta	Lagis	koreni	7	6	20	14	22	126	21	12	8	6	4			18	6
P1195	Polychaeta	Lanice	conchilega					1		1			2					
P82	Polychaeta	Lepidonotus	squamatum															
P693	Polychaeta	Levinsenia	gracilis		4													
P577	Polychaeta	Lumbrineris	fragilis	2	1							1	1	2	10		4	
P579	Polychaeta	Lumbrineris	gracilis							1			2	16			2	
P804	Polychaeta	Magelona	alleni	1	2					1	3	7	2	4	2		3	1
P807	Polychaeta	Magelona	mirabilis	2		121	13	36	19	2	5						1	
P938	Polychaeta	Maldanid	frag.										1					
P1124	Polychaeta	Melinna	palmata		3						1	2		6	1			
P1094	Polychaeta	Myriochele	sp.												1		1	
P568	Polychaeta	Nematonereis	unicornis															
P496	Polychaeta	Nephtys	caeca															
P498	Polychaeta	Nephtys	cirrosa	1		2	4	2	5			1			3			1
P499	Polychaeta	Nephtys	hombergi	4	6		1	2	2	3	2	2	1	1		1	6	4
P476	Polychaeta	Nereis	pelagica									1						
P921	Polychaeta	Notomastus	latericeus		4						2	1		3			1	
P1001	Polychaeta	Ophelia	limacina															
P1014	Polychaeta	Ophelina	acuminata									2		1	1			
P1098	Polychaeta	Owenia	fusiformis	2	8		1	2	1	7	13	3		12	7		1	7
P885	Polychaeta	Pherusa	plumosa															
P180	Polychaeta	Phyllodoce	laminosa		2			2										
P92	Polychaeta	Pholoe	inornata	33	28	3	6	1	2	21	19	23	13	4	6	1	32	27
P718	Polychaeta	Poecilochaetus	serpens			1	1	1	1									
P1029	Polychaeta	Polyphysia	crassa															
P1341	Polychaeta	Pomatoceros	triqueter											3	1	1		
P1316	Polychaeta	Potamilla	reniformis															
P765	Polychaeta	Prionospio	fallax															
P774	Polychaeta	Pseudopolydora	pulchra									1						
P1320	Polychaeta	Sabella	pavonina															1
P1117	Polychaeta	Sabellaria	spinulosa															
P1027	Polychaeta	Scalibregma	inflatum	2	6						1	2	14	38	11		3	4
P781	Polychaeta	Scolelepis	foliosa				2		7				2					2
P672	Polychaeta	Scoloplos	armiger				2							1				
P291	Polychaeta	Sphaerodorum	flavum															
P107	Polychaeta	Sthenelais	boa	1	1	1	1	4	4	3	4	4	7	4		2	2	1
P108	Polychaeta	Sthenelais	jeffreysii															
P104	Polychaeta	Sigalion	mathildae															
P794	Polychaeta	Spiophanes	bombyx	1	1	7	4	3	6		1	1	5				1	1
P796	Polychaeta	Spiophanes	kroyeri															
P360	Polychaeta	Syllis	gracilis	1			2			1						1		1
P1099	Polychaeta	Terebellid	fragment							1								
P1175	Polychaeta	Terebellides	stroemi	1	1						1		1	3	1			
P1490	Oligochaeta	Tubificoides	benedeni			1												

Macro-Invertebrate Communites

CODE	Phylum	Genus	Species	18a 2012	18b 2012	19a 2012	19b 2012	20a 2012	20b 2012	21a 2012	21b 2012	22a 2012	22b 2012	23a 2012	23b 2012	27a 2012	29a 2012	29b 2012
ZA5	Phoronidea	Phoronis	muelleri	35	4			1	1	3	13		2	8	2		56	43
N17	Sipunculida	Golfingia	vulgaris															
N36	Sipunculida	Onchnesoma	squamatum															
N34	Sipunculida	Phascolion	strombus														1	
N28	Sipunculida	Thysanocardia	procera														1	
S498	Crustacea	Abludomelita	obtusata															
S275	Crustacea	Acidostoma	obesum											1				
S427	Crustacea	Ampelisca	brevicornis			2	7	1	17	4	6	2	2		2	3	2	1
S429	Crustacea	Ampelisca	diadema															
S432	Crustacea	Ampelisca	macrocephala															
S97	Crustacea	Amphipoda	frag.						2					1				
S579	Crustacea	Aora	gracilis										5	11	19	1		
S360	Crustacea	Argissa	hamatipes								1							
S411	Crustacea	Atylus	guttatus															
S456	Crustacea	Bathyporeia	pelagica															
S459	Crustacea	Bathyporeia	tenuipes			1	3											
S1196	Crustacea	Bodotria	pulchella			1	2			3	2	1						
S1197	Crustacea	Bodotria	scorpioides		1									12		7		
S1485	Crustacea	Brachiura	zoea			1		1				1		1	1	3		
S646	Crustacea	Caprella	linearis			3	2	2	1	2		1	2	1	1	6	1	1
S506	Crustacea	Cheirocratus	sundevalli											1				
R152	Crustacea	Copepoda	indet.															
S610	Crustacea	Corophium	bonnelli															
S1552	Crustacea	Corystes	cassivelaunus													1		
S1383	Crustacea	Crangon	crangon						1							2		
S186	Crustacea	Cressa	dubia															
S415	Crustacea	Dexamine	spinosa															
S1251	Crustacea	Diastylis	laevis	3		1				1	6			3	4		1	
S1252	Crustacea	Diastylis	lucifera															
S1254	Crustacea	Diastylis	rugosa								1							2
S374	Crustacea	Epimeria	cornigera											2		1		
S1206	Crustacea	Eudorella	emarginata															
S1208	Crustacea	Eudorella	truncatula	1	1					6	1	2	3				1	
S1478	Crustacea	Galathea	strigosa											1	1			
S793	Crustacea	Gnathia	praniza															
S254	Crustacea	Harpinia	antennaria	8	8					4	11	21	11				1	
S1350	Crustacea	Hippolyte	varians			1				1	1			2				
S296	Crustacea	Hippomedon	denticulata															
S1202	Crustacea	Iphinoe	trispinosa			4	2	3				1						
S892	Crustacea	Janira	maculosa															
S569	Crustacea	Jassa	falcata															
S177	Crustacea	Leucothoe	incisa															
S1580	Crustacea	Liocarcinus	depurator											3		19		1
S1581	Crustacea	Liocarcinus	holsatus	1	2		2						1		1	1		
S1584	Crustacea	Liocarcinus	pusillus															
S1515	Crustacea	Maja	squinado juv.													2		
S1251	Crustacea	Monoculodes	carinatus			4	11	3									2	
S1589	Crustacea	Necora puber	puber juv.													11		
R2412	Crustacea	Ostracoda	indet.						1		1			2				
S1457	Crustacea	Pagurus	bernhardus												1			
S1319	Crustacea	Palaemon	serratus															
S326	Crustacea	Perrierella	audouiniana															
S1482	Crustacea	Pisidia	longicornis											1	11			
S133	Crustacea	Pontocrates	altamarinus			1							1					
S1363	Crustacea	Processa	canaliculatum									2						1
S1235	Crustacea	Pseudocuma	longirostris	14		23	18	22	15	5	4		5			1		2
S659	Crustacea	Pseudoproctella	phasma												11			
S618	Crustacea	Siphonoecetes	kroyerianus												1			
S213	Crustacea	Stenothoe	marina			1									1			
S1142	Crustacea	Tanaopsis	graciloides	2									1	2				
S336	Crustacea	Tmetonyx	cicada								3			1				
S1360	Crustacea	Thoralus	cranchi															
S1153	Crustacea	Typhlotanais	brevicornis															
S249	Crustacea	Urothoe	marina															
S140	Crustacea	Westwoodilla	caecula															
Q15	Chelicerata	Achelia	echinata													2		
Q29	Chelicerata	Endeis	spinosa												3			
Q7	Chelicerata	Nymphon	gracile												2			
W2059	Mollusca	Abra	alba	12	8	16	6	4	36	16	4	9	4	2	2		8	26
W2061	Mollusca	Abra	nitida			1	1	2	2					1				3
W2062	Mollusca	Abra	prismatica													1		
W1943	Mollusca	Acanthocardia	aculeata															
W1006	Mollusca	Acteon	tornatilis			2												
W1519	Mollusca	Antalis	entalis														5	
W1773	Mollusca	Aequipecten	opercularis															
W1363	Mollusca	Cadlina	laevis															
W1961	Mollusca	Cerastoderma	edule											1				
W9	Mollusca	Chaetoderma	nitidulum															
W2098	Mollusca	Chamelea	gallina			1												
W2100	Mollusca	Clausinella	fasciata	1	3	3	5	6				5	2					1
W2239	Mollusca	Cochlodesma	praetenue		2			2	1	3	1	2	1		1			
W2157	Mollusca	Corbula	gibba	1								1						
W1028	Mollusca	Cylichna	cylindracea	1						1							3	
W2091	Mollusca	Circomphalus	casina														1	
W2041	Mollusca	Donax	vittatus															

Macro-Invertebrate Communites

CODE	Phylum	Genus	Species	18a 2012	18b 2012	19a 2012	19b 2012	20a 2012	20b 2012	21a 2012	21b 2012	22a 2012	22b 2012	23a 2012	23b 2012	27a 2012	29a 2012	29b 2012
W2130	Mollusca	Dosinia	exoleta	3	3					2	1	2					3	
W1999	Mollusca	Ensis	ensis	5	5	4	9	9	26	14	8	6	4				5	6
W2019	Mollusca	Fabulina	fabula			65	37	34	15		6	1	5				1	
W2051	Mollusca	Gari	fervensis			1	1	2										
W65	Mollusca	Hanleya	hanleyi															
W2166	Mollusca	Hiatella	arctica															
W410	Mollusca	Hyala	vitrea															
W1906	Mollusca	Kurtiella	bidentata	99	123	1	2	1	4	41	68	44	18	4	4	3	87	118
W54	Mollusca	Leptochiton	cancellatus															
W1984	Mollusca	Lutraria	lutraria															
W2029	Mollusca	Macoma	balthica													5		
W1972	Mollusca	Mactra	stultorum			4	7	2	14	1	2	1	1			3		
W1698	Mollusca	Modiolus	juv			3		2	1				3	12	80	E3500		
W2021	Mollusca	Moerella	donacina													2		
W2150	Mollusca	Mya	truncata	5	2	1			1	7	17	6					1	2
W2139	Mollusca	Mysia	undata									2						1
W1695	Mollusca	Mytilus	edulis													57		
W1569	Mollusca	Nucula	nitidosa	1		3	8	11	28	1		1					2	5
W1570	Mollusca	Nucula	nucleus	4	4	47	39	59	53	6	5	11	1	1			10	32
W1571	Mollusca	Nucula	sulcata		1	2	4	2	4	2	1		1				1	1
	Mollusca	Nudibranchia	unid															
W2006	Mollusca	Phaxas	pellucidus					1	2			4	1					1
W1038	Mollusca	Philine	aperta										1					
W491	Mollusca	Polinices	pulchellus														1	
W1975	Mollusca	Spisula	elliptica										1			2		
W1977	Mollusca	Spisula	solida															
W1902	Mollusca	Tellimya	ferruginosa														2	1
W2231	Mollusca	Thracia	phaseolina	22	14	18	16	14	17	36	33	3	5				6	3
W1837	Mollusca	Thyasira	flexuosa	5	4				1	5	8	9	2	5	3		14	16
W1934	Mollusca	Tridonta	montagui														1	
	Echinodermata	Amphipholis	squamata															
ZB252	Echinodermata	Amphiura	chiajei	2	3					9	8							
ZB154	Echinodermata	Amphiura	filiformis	142	124				5	31	59	78	32	4	1		150	205
ZB100	Echinodermata	Antedon	bifida															
ZB100	Echinodermata	Asterias	rubens											1				
ZB223	Echinodermata	Echinocardium	cordatum	4	2	3		1	2		2	1	3				14	13
ZB296	Echinodermata	Leptosynapta	inhaerens									1	1					
ZB23	Echinodermata	Luidia	sarsi															
ZB104	Echinodermata	Martasterias	glacialis															
ZB167	Echinodermata	Ophiocten	affinis								1			16	45			
ZB168	Echinodermata	Ophiura	albida											1	11			
ZB170	Echinodermata	Ophiura	ophiura									1						
ZB172	Echinodermata	Ophiura	sarsi															
ZB124	Echinodermata	Ophiotrix	fragilis					1					1					
ZB121	Echinodermata	Ophiuroidea	juv			61	36	18	21	26	23		10					
ZB193	Echinodermata	Psammechinus	miliaris												1			
ZD81	Tunicata	Corella	parallelogramma															
ZD120	Tunicata	Dendrodoa	grossularia												1			
ZD140	Tunicata	Pyura	squamulosa												1			
ZG444	Pisces	Ammodytes	tobianus															
ZG578	Pisces	Pleuronectes	platessa															
L29	Chaetognatha	Spadella	cephaloptera															

Epifaunal Species

C133	Porifera	Scypha	ciliata												+			
C133	Porifera	Clathrina	coriacea															
C480	Porifera	Cliona	celata															
C1670	Porifera	Dysidea	fragilis															
C1420	Porifera	Haliclona	frag.															
D409	Coelenterata	Abietinaria	abietina												+			+
D481	Coelenterata	Aglaophenia	pluma															
D597	Coelenterata	Alcyonidium	digitatum												+			
D257	Coelenterata	Bougainvillia	ramosa															
D348	Coelenterata	Calycella	syringa															
D494	Coelenterata	Campanularia	hincksii															
D503	Coelenterata	Clythia	hemisphaerica	+	+						+	+	+				+	+
D422	Coelenterata	Dynamena	pumila							+								
D227	Coelenterata	Eudendrium	ramosum									+		+				
D392	Coelenterata	Halecium	halecinum			+							+			+		
D399	Coelenterata	Halecium	tenellum															
D424	Coelenterata	Hydrallmania	falcata	+					+					+	+			
D386	Coelenterata	Lafoea	dumosa															
D515	Coelenterata	Laomedea	flexuosa			+	+		+		+	+	+	+	+		+	+
D336	Coelenterata	Lovenella	clausa	+	+			+		+			+		+		+	
D520	Coelenterata	Obelia	geniculata										+			+		
D463	Coelenterata	Nemertesia	antennina				+		+		+		+		+			
D464	Coelenterata	Nemertesia	ramosa															
D240	Coelenterata	Perigonimus	repens														+	
D469	Coelenterata	Plumularia	setacea															
D430	Coelenterata	Sertularella	polyzonias						+					+				
D435	Coelenterata	Sertularia	cuppressina			+	+	+	+	+	+	+	+		+	+		+
R77	Crustacea	Balanus	crenatus															

CODE	Phylum	Genus	Species	18a 2012	18b 2012	19a 2012	19b 2012	20a 2012	20b 2012	21a 2012	21b 2012	22a 2012	22b 2012	23a 2012	23b 2012	27a 2012	29a 2012	29b 2012
Y76	Bryozoa	Alcyonidium	diaphanum											+	+			
Y78	Bryozoa	Alcyonidium	hirsutum															
Y80	Bryozoa	Alcyonidium	mytili															
Y81	Bryozoa	Alcyonidium	parasiticum							+			+	+	+	+	+	
Y256	Bryozoa	Bicellariella	ciliata															
Y243	Bryozoa	Bugula	flabellata									+				+		
Y246	Bryozoa	Bugula	plumosa															
Y300	Bryozoa	Cellaria	fistulosa											+	+		+	+
Y495	Bryozoa	Cellepora	pumicosa															
Y337	Bryozoa	Celleporella	hyalina															
Y172	Bryozoa	Conopeum	reticulum								+		+	+	+	+		
Y16	Bryozoa	Crisia	denticulata												+			
Y44	Bryozoa	Crisia	eburnea												+			
Y19	Bryozoa	Crisia	ramosa										+		+			
Y8	Bryozoa	Crisidia	cornuta										+					
Y411	Bryozoa	Cryptosula	pallasiana															
Y178	Bryozoa	Electra	pilosa	+									+			+		
Y364	Bryozoa	Escharella	immersa												+			
Y358	Bryozoa	Escharoides	coccinea													+		
Y165	Bryozoa	Eucratea	loricata															
Y483	Bryozoa	Fenestrulina	malusii															
Y187	Bryozoa	Flustra	foliacea								+		+		+	+		
Y414	Bryozoa	Hippoporina	pertusa															
Y279	Bryozoa	Scrupocellaria	scruposa												+	+		
Y131	Bryozoa	Vesicularia	spinosa															
Y112	Bryozoa	Walkeria	uva															
K46	Kamptozoa	Pedicellina	cernua															

New for 2017

New for 2013

Appendix II Reef Survey Report

IRISH WATER

GREATER DUBLIN DRAINAGE

PHASE II IRELAND'S EYE REEF SURVEY

Date of Survey:
30/06/2015 - 02/07/2015

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Disclaimer:
This report has been produced in line with the requirements and objectives of the scope of work and contractual terms between Benthic Solutions Limited and the Client. The results are based upon expert interpretation. All interpretation and opinions contained herein are provided based upon the data collated as part of the survey, and other data provided by the Client and available within the public domain.

Contents

Contents 1
1. Executive Summary 4
2. Scope of Work 6
3. Historical Data 7
4. Site Selection 8
5. Field Operations Summary observations 10
6. Results and Discussion 11
6.1. Biotope Classification 11
6.1.1. Littoral Station 1 11
6.1.2. Littoral Station 2 13
6.1.3. Littoral Station 3 17
6.1.4. Sublittoral Station 1 20
6.1.5. Sublittoral Station 2 23
6.1.6. Sublittoral Station 3 28
6.1.7. Sublittoral Station 4 31
6.2. Univariate Analyses 35
6.3. Multivariate Analyses 37
6.3.1. Littoral Stations 37
6.3.2. Sublittoral Stations 38
7. Conclusion 40
8. References 41

List of Figures

Figure 2.1 Ireland's Eye Marine Community Types Designated by Rockabill to Dalkey Island SAC 6

Figure 4.1 Composite Topography/Bathymetry of Irelands Eye with Proposed Survey Locations for Sublittoral Transects (lines) and Littoral Coastlines (Stars) 9

Figure 6.1 Littoral Zones and Biotopes for Station L1 12

Figure 6.2 Littoral Zones and Biotopes for Station L2 15

Figure 6.3 Littoral Zones and Biotopes for Station L3 18

Figure 6.4 Sublittoral Zones and Biotopes for Station S1 21

Figure 6.5 Sublittoral Zones and Biotopes for Station S2 25

Figure 6.6 Sublittoral Zones and Biotopes for Station S3 29

Figure 6.7 Sublittoral Zones and Biotopes for Station S4 33

Figure 6.8 Distribution of Species per Phyla and Station 36

Figure 6.9 Dendrogram of Biotopes Recorded at the Littoral Stations 37

Figure 6.10 MDS of Biotopes Recorded at the Littoral Stations 38

Figure 6.11 Dendrogram of Biotopes Recorded at the Sublittoral Stations 39

Figure 6.12 MDS of Biotopes Recorded at the Sublittoral Stations 39

List of Tables

Table 2.1 Rockabill to Dalkey Island SAC Conservation Objectives 6

Table 4.1 Proposed Littoral and Sublittoral Locations 8

Table 5.1 Chronological Sequence of Field Operations 10

Table 6.1 Species List for Station L1 with SACFOR Abundance Classifications for Each Biotope 13

Table 6.2 Species List for Station L2 with SACFOR Abundance Classifications for Each Biotope 16

Table 6.3 Species List for Station L3 with SACFOR Abundance Classifications for each Biotope 18

Table 6.4 Species List for Station S1 with SACFOR Abundance Classifications for Each Biotope 22

Table 6.5 Species List for Station S2 with SACFOR Abundance Classifications for each Biotope 25

Table 6.6 Species List for Station S3 with SACFOR Abundance Classifications for Each Biotope 30

Table 6.7 Species List for Station S4 with SACFOR Abundance Classifications for Each Biotope 33

Table 6.8 Number of Species per Phyla and Station 36

Abbreviations

Abbreviation	Meaning
ASML	Aquatic Survey and Monitoring Limited
BSL	Benthic Solutions Limited
CR.HCR.XFa.ByErSp.Sag	Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept ciraclittoral rock
CR.HCR.XFa.FluCoAs	*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock
GDD	Greater Dublin Drainage
CR.HCR.XFa.FluCoAs.Paur	*Polyclinum aurantium* and *Flustra foliacea* on sand-scoured tide-swept moderately wave-exposed circalittoral rock
IR.HIR.KFaR.FoR	Foliose red seaweeds on exposed lower infralittoral rock
IR.HIR.KFaR.FoR.Dic	Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock
IR.MIR.KR.Ldig	*Laminaria digitata* on moderately exposed sublittoral fringe rock
IR.MIR.KR.Ldig.Ldig	*Laminaria digitata* on moderately exposed sublittoral fringe bedrock
LR.FLR.Lic.Pra	*Prasiola stipitata* on nitrate-enriched supralittoral or littoral fringe rock
LR.HLR.FR.Coff	*Corallina officinalis* on exposed to moderately exposed lower eulittoral rock
LR.HLR.FR.Mas	*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock
LR.HLR.MusB	Mussel and/or barnacle communities
LR.HLR.MusB.Cht	*Chthamalus* spp. on exposed eulittoral rock
LR.HLR.MusB.Sem	*Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock
LR.LLR.F.Asc.FS	*Ascophyllum nodosum* on full salinity mid eulittoral rock
LR.MLR.BF.Fser.R	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock
LR.MLR.BF.FspiB	*Fucus spiralis* on exposed to moderately exposed upper eulittoral rock
MDS	Multi-Dimensional Scaling
MERC	Marine and Environmental Resource Conservation Consultants
MNCR	Marine Nature Conservation Review
MDS	Multi-Dimensional Scaling
NPWS	National Parks & Wildlife Service
ODM	Ordnance Datum Malin
PRIMER	Plymouth Routines In Multivariate Ecological Research
RIB	Rigid-Inflatable Boat
SAC	Special Areas of Conservation
SACFOR	Superabundant, Abundant, Common, Frequent, Occasional and Rare
SD	Standard Deviation

1. Executive Summary

The Irelands Eye is a small uninhabited islands located to the north of Howth head, located within the Rockabill to Dalkey Island Special Area of Conservations (site code 3000), and is designated for Annex 1 qualifying interest Reefs. As the site is within close proximity to the proposed GDD outfall, these interests may be subject to plume effects from suspended sediment during parts of the construction operation whilst dredging or be impacted by the outfall plume itself. Field operations to acquire a detailed assessment of these qualifying habitats was carried out and completed successfully at three littoral and four sublittoral stations between the 30th June and 2nd of July 2015. These were based on a generic assessment of biotopes using the standard (Marine Nature Conservation Review) MNCR-style format. Identification and abundance of conspicuous fauna and flora were scaled onsite using the SACFOR scheme (e.g. superabundant, abundant, common, frequent, occasional and rare).

In the littoral zone, the biotopes '*Corallina officinalis* on exposed to moderately exposed lower eulittoral rock/*Laminaria digitata* on moderately exposed sublittoral fringe rock (*LR.HLR.FR.Coff/IR.MIR.KR.Ldig)* usually emerged from the sublittoral, followed by a zone covered by seaweeds to a faunally dominated shore consisting of limpets, barnacles and littorinids.

The sublittoral stations were characterised by *Laminaria digitata* forests in the shallower part (*IR.MIR.KR.Ldig.Ldig*) and were usually replaced by the biotope 'Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock' (*IR.HIR.KFaR.FoR.Dic)*. The deeper extend was dominated by a 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock' (*CR.HCR.XFa.ByErSp.Sag*) or in the case of Sublittoral Station 2 '*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock' (*CR.HCR.XFa.FluCoAs*). The deeper biotope at Sublittoral Station 4 was categorised as a possible '*Polyclinum aurantium* and *Flustra foliacea* on sand scoured tide-swept moderately wave-exposed circalittoral rock' (*HCR.XFa.FluCoAs.Paur*), probably due to the increased sedimentation noted at this station.

Univariate analyses showed clear differences between the littoral and sublittoral stations in terms of species richness with twice as many species recorded from the sublittoral area (88.3±19.2SD as opposed to 44.7±11.6SD). Both littoral and sublittoral environments indicated moderately high species diversity. Multivariate analyses revealed statistical separation of biotopes with the vertical zonation of the fauna (by water depth or height on the foreshore) constituting the dominant community patterns observed.

No species of particular nature conservation interest were noted during the any of the surveys and no rare or particularly fragile biotopes were recorded. However natural siltation

levels were high in the sublittoral environment, a fact that has not appeared to have a significant impact to the biological diversity in this area. Whilst, siltation levels are high in the sublittoral environment, a significant increase in suspended sediment, particularly during the summer months during peak algal growth, might cause some damage to the algal biotopes present through reduced light penetration and availability. However, the moderately strong tidal currents experienced in this area are sufficient to prevent the deposition of significant silt material which might degrade the sublittoral benthic biotopes through smothering and burial of the infralittoral and circalittoral communities. No species of particular conservational interest were noted during the surveys and no rare or fragile biotopes recorded.

2. Scope of Work

The proposed outfall route of the Greater Dublin Drainage (GDD) scheme, terminates at the diffuser location 1km north-east of Ireland's Eye, and falls within the Rockabill to Dalkey Island SAC. The conservation objectives of the Rockabill to Dalkey Island SAC include Annex I qualifying Reefs (Figure 2.1). To maintain the favourable conservation conditions of these Reefs within the SAC, the following criteria are proposed by NPWS (as outlined in Table 2.1).

Table 2.1 Rockabill to Dalkey Island SAC Conservation Objectives

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent area is stable or increasing, subject to natural processes. See Figure 2.1	Habitat area estimated as 182ha using 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a, b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0)
Habitat distribution	Occurrence	Distribution is stable or increasing, subject to natural processes. See Figure 2.1	Distribution derived from 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a, b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0).
Community structure	Biological composition	Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex. See Figure 2.1	Reef community mapping based on 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a, b).

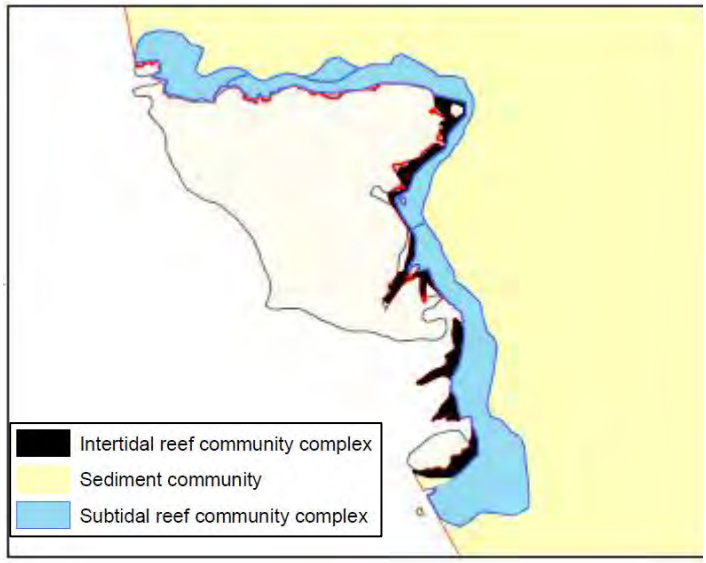


Figure 2.1 Ireland's Eye Marine Community Types Designated by Rockabill to Dalkey Island SAC

3. Historical Data

Within the Rockabill to Dalkey Island SAC, two community types were recorded within the Annex I habitat, namely the Intertidal reef community complex and the Subtidal reef community complex (Reefs 1170). Intertidal and subtidal surveys were undertaken in 2010 and 2011 (MERC, 2010, MERC 2012a and MERC 2012b). These data were used to determine the physical and biological nature of the Annex I habitat. Estimated areas of each community type within the Annex I habitat, are based on interpolation, and are shown in Figure 2.1.

The development of a community complex target arises when an area possesses similar abiotic features but records a number of biological communities that are not regarded as being sufficiently stable and/or distinct temporally or spatially to become the focus of conservation efforts. In this case, examination of the available data from Rockabill to Dalkey Island SAC identified a number of biological communities whose species composition overlapped significantly. Such biological communities are grouped together into what experts consider are sufficiently stable units (i.e. a complex) for conservation targets.

INTERTIDAL REEF COMMUNITY COMPLEX

This reef community complex is recorded on the eastern and southern shores of Ireland's Eye immediately south of the proposed outfall route and diffuser location. The exposure regime of the complex ranges from exposed to 'moderately exposed' reef for Ireland's Eye. The substrate here is that of flat and sloping bedrock, cobbles and boulders. Vertical cliff faces are found on the north and northeast shores of Ireland's Eye.

SUBTIDAL REEF COMMUNITY COMPLEX

This reef community complex is recorded off the northern, eastern and southern shores of Ireland's Eye immediately south of the proposed outfall route and diffuser location. The substrate ranges from that of flat and sloping bedrock, to bedrock with boulders and also a mosaic of cobbles and boulders. Vertical rock walls occur on the north and east of Ireland's Eye, whilst the northern reaches of the island both show sediment scouring and a thin veneer of silt on the reefs.

In general, previous surveys (MERC 2010, MERC 2012a and MERC 2012b) noted that where the reef was subjected to the effects of sediment, either through scouring or settlement of silt, low numbers of species and individuals were found.

4. Site Selection

Following a review and combination of existing and surveyed bathymetric datasets, the locations for sublittoral and littoral survey locations was based on a combination of seabed topography, and site exposure. A total of four sublittoral locations and three littoral locations were established for survey operations (outlined in Table 4.1, and presented in Figure 4.1).

Table 4.1 Proposed Littoral and Sublittoral Locations

Site	Transect	Easting	Northing	Description	Depth (ODM)
S1	Start	728470.3	741625.0	Sublittoral: Northwest stack and discrete sublittoral reef feature	-12.1
	End	728369.1	741589.2		0.34
S2	Start	728745.5	741626.2	Sublittoral: Standard slope with boulder field at base	-13.99
	End	728752.9	741526.2		1.13
S3	Start	729161.4	740937.5	Sublittoral: Exposed southeast island pinnacles	-11.81
	End	729060.2	740969.6		0.26
S4	Start	729187.4	740556.2	Sublittoral: Exposed southeast islet pinnacles	-10.50
	End	729102.2	740624.0		0.01
L1		729033.1	741472.4	Littoral: Exposed northeast channel between stack	0.04
L2		728910.9	741053.5	Littoral: Sheltered southeast inlet	0.80
L3		729077.5	740648.7	Littoral: Exposed southeast islet rocky coast	0.98

Geodesy based on Irish National Grid and vertical datum of Ordnance datum Malin Head (ODM)

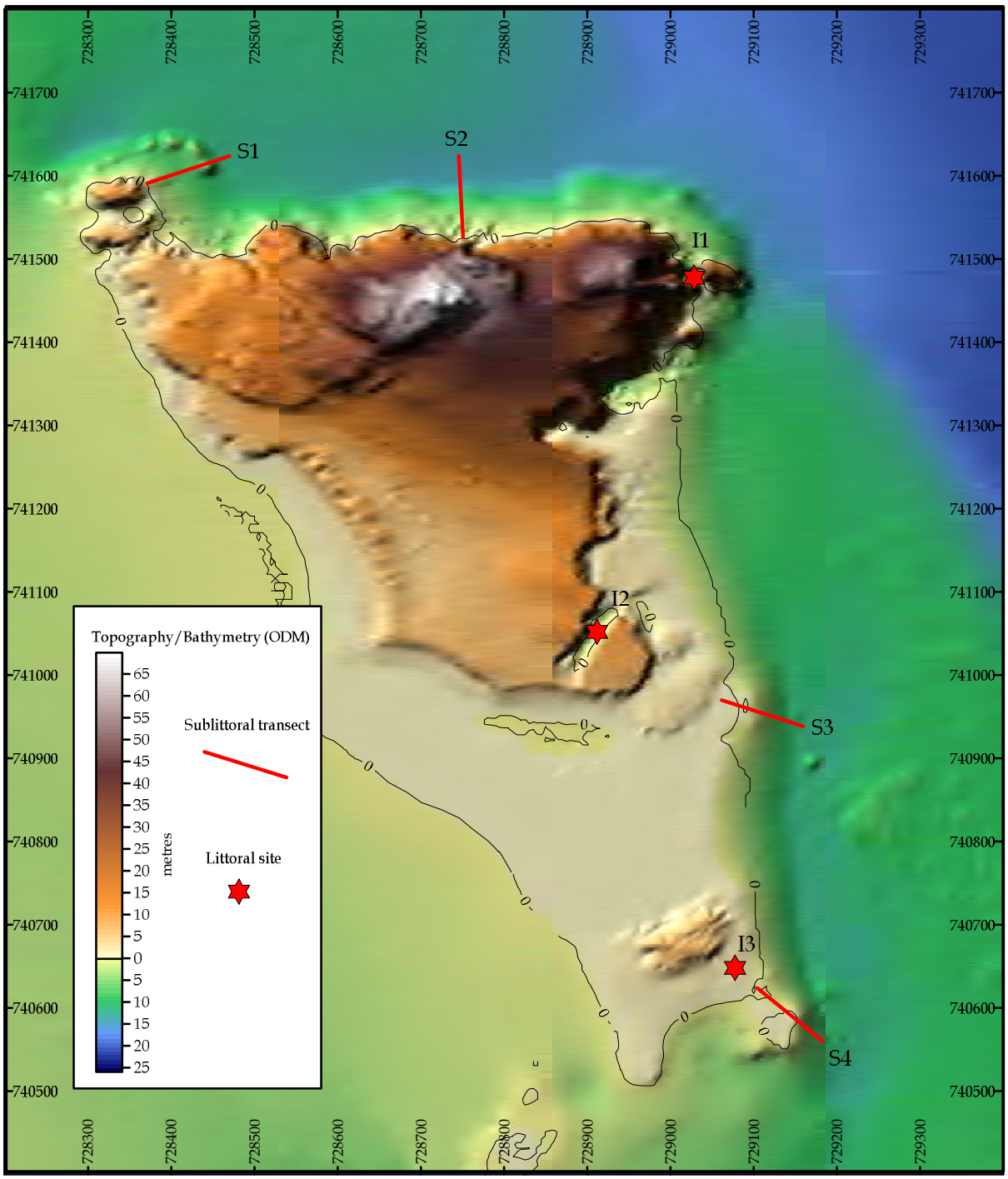


Figure 4.1 Composite Topography/Bathymetry of Irelands Eye with Proposed Survey Locations for Sublittoral Transects (lines) and Littoral Coastlines (Stars)

5. Field Operations Summary observations

Field survey operations were completed successfully at all proposed locations between the 30th June and 2nd of July 2015. A four man dive team, made up from representatives from both MERC and ASML, was mobilised to site on the 29th June, with operations carried out from an 8m RIB. Weather remained good throughout the survey period, with only localised periods of marginal winds occurring on a couple of days. Consequently operations were spread between the dive sites (four in total) and inter-tidal (three in total), to make the best use of the prevailing conditions.

A summary of the field operations is outlined in Table 5.1.

Table 5.1 Chronological Sequence of Field Operations

Day	Date	Operations	Comment
1	29/06/15	Mobilisation to Howth	ASML mobilised. MERC launched the 8m RIB service vessel locally (Howth harbour).
2	30/06/15	Ops: Diving and intertidal	2 diving sites and 1 intertidal completed.
3	01/07/15	Ops: Diving and intertidal	IW of BSL travels to site for oversight. 1 diving site and 1 intertidal site completed.
4	02/07/15	Ops: Diving and intertidal	1 dive site completed in the morning and 1 intertidal site completed in the afternoon. Vessel recovered and survey personnel demobilised. IW onsite for oversight.
5	03/07/15	Demobilisation from Howth	ASML team demobilised back to the UK.

Field operations were based on a generic assessment of biotopes using the standard MNCR-style (Marine Nature Conservation Review) format. Identification and abundance was scaled onsite using the SACFOR (e.g. superabundant, abundant, common, frequent, occasional and rare) scale on all the conspicuous flora and fauna within each biotope encountered. Taxa that could not be readily identified were removed and later identified under a microscope back at the field laboratory (i.e hotel).

During the intertidal survey, sites were selected from aerial photography to present different exposures and the vertical profiles completed along all of the lower, middle and upper shorelines at these locations. Each biological zone was photographed and surveyed. The floral and faunal taxa were identified and abundance scale values allocated also using the SACFOR protocol on all the conspicuous species in each biotope encountered.

6. Results and Discussion

This survey has collected semi-quantitative data from two moderately exposed littoral stations (L1 and L3) and a sheltered station (L2). L1 is slightly modified by shading, wave surge and nitrogenous enrichment and the L3 upper shore biotope was similarly enriched by roosting seabirds. In the sublittoral, four stations (S1 to S4) were investigated of which all were found to be heavily silted, but were moderately diverse. The photographs and data presented herein may act as a comparison, against which future gross changes could be qualitatively assessed.

In order to determine any significant differences between the stations surveyed, the SACFOR scale was additionally categorised from 1 (rare) to 6 (superabundant). Basic statistical analyses as well as multi-dimensional statistical techniques were applied to the dataset to present the data as a cluster diagram and MDS plot. While useful to present general trends within the datasets, due to the semi quantitative nature of the SACFOR classifications, not too much reliance should be placed on the statistical analyses.

6.1. Biotope Classification

6.1.1. Littoral Station 1

Littoral Station 1 was located in the gully between the northeast stack and the main island, and was characterised by a typically exposed shore, with the exposure to wave action amplified by the effect of surge through the gully. There was also an effect of shading which was apparent in a reduced algal component. The order of the biotopes ran from an algae dominated *LR.HLR.FR.Coff/IR.MIR.KR.Ldig* (vi) through the lower middle shore *LR.HLR.FR.Mas* (v) to a faunally dominated *LR.HLR.MusB.Sem* (iv) in the upper middle shore. Then through the barnacles *LR.HLR.MusB.Cht* (iii), followed by a LR.HLR.MusB (ii) *Porphyra* sp. band to a nitrate enriched *LR.FLR.Lic.Pra* (i) zone in the supralittoral where the copious bird droppings from the nesting and roosting seabirds made their impact on the littoral ecology.

Photographs from each littoral zone/biotope are shown in Figure 6.1, while a full species list with the SACFOR classification is presented in Table 6.1.

vi: *LR.HLR.FR.Coff/IR.MIR.KR.Ldig*

v: *LR.HLR.FR.Mas*

iv: *LR.HLR.MusB.Sem*

iii: *LR.HLR.MusB.Cht*

ii: *LR.HLR.MusB*

i: *LR.FLR.Lic.Pra*

Figure 6.1 Littoral Zones and Biotopes for Station L1

Table 6.1 Species List for Station L1 with SACFOR Abundance Classifications for Each Biotope

MCS Code	Taxa	L1					
		vi	v	iv	iii	ii	i
	Porifera						
C05230	*Hymeniacidon perlevis*	R					
	Cnidaria						
D11510	*Actinia equina*			O			
	Annelida						
P23040	*Spirobranchus triqueter*	F					
P02770	*Eulalia viridis*	F					
	Arthropda						
R00720	*Chthamalus montagui*				F	R	
R01080	*Semibalanus balanoides*	A	C		S	R	
S26900	*Carcinus maenas*	R					
	Mollusca						
W00500	Polyplacophora	O					
W01340	*Patella vulgata*	C	A	F	C		
W02390	*Lacuna pallidula*		O				
W02500	*Littorina littorea*		C				
W02520	*Melarhaphe neritoides*				R	R	
W02630	*Littorina saxatilis*				R	R	
W08170	*Nucella lapillus*			R			
W16500	*Mytilus edulis*	O	R	R			
	Bryozoa						
Y06780	*Electra pilosa*	O					
	Rhodophyta						
ZM00900	*Porphyra umbilicalis*					A	R
ZM02420	*Palmaria palmata*	R	O	R			
ZM03790	*Hildenbrandia rubra*	O					
ZM03840	Corallinaceae (enc)	A					
ZM04010	*Corallina caespitosa*		R				
ZM06050	*Mastocarpus*			R			
ZM06050	*Mastocarpus stellatus*	C	S	A	R		
ZM07510	*Lomentaria articulata*	R	R				
ZM08240	*Ceramium shuttleworthianum*		R	R	R	R	
ZM09900	*Membranoptera alata*	R					
ZM10800	*Osmundea pinnatifida*		R				
ZM11170	*Polysiphonia fucoides*		R				
	Ochrophyta						
ZR06320	*Laminaria digitata*	S					
	Chlorophyta						
ZS02400	*Ulva* sp. (flat)	R	R			R	
ZS02890	*Prasiola stipitata*						A
ZS03560	*Cladophora rupestris*		F			R	
	Ascomycota						
	Verrucaria maura					C	F

6.1.2. Littoral Station 2

The shore at Littoral Station 2 was a more sheltered inlet on the east coast of the island. The protection from wave action afforded by the sheltering intertidal reef has allowed a series of algal dominated biotopes to develop. Initially the *LR.HLR.FR.Coff/IR.MIR.KR.Ldig* (v)

emerged from the sublittoral and passes through a typical *Fucus serratus* and red seaweeds *LR.MLR.BF.Fser.R* (iv) zone, to an *Ascophyllum nodosum* and *Fucus vesiculosus* *LR.LLR.F.Asc.FS* (iii) biotope. Above this the spiral wrack and channel wrack mixed together and form an *LR.MLR.BF.FspiB* (ii) biotope with limpets, barnacles and littorinids found amongst the algae. This shore finished with a typical lichen zone dominated by the nitrophilous yellow lichen *Xanthoria parietina* and the green algae *Pasiola stipitata* *LR.FLR.Lic.Pra* (i) previously seen at station L1.

Photographs from each littoral zone/biotope are shown in Figure 6.2, while a full species list with SACFOR classification is presented in Table 6.2.

v: *LR.HLR.FR.Coff/IR.MIR.KR.Ldig*, iv: *LR.MLR.BF.Fser.R* and iii: *LR.LLR.F.Asc.FS*

ii: *LR.MLR.BF.FspiB*

i: *LR.FLR.Lic.Pra*

Figure 6.2 Littoral Zones and Biotopes for Station L2

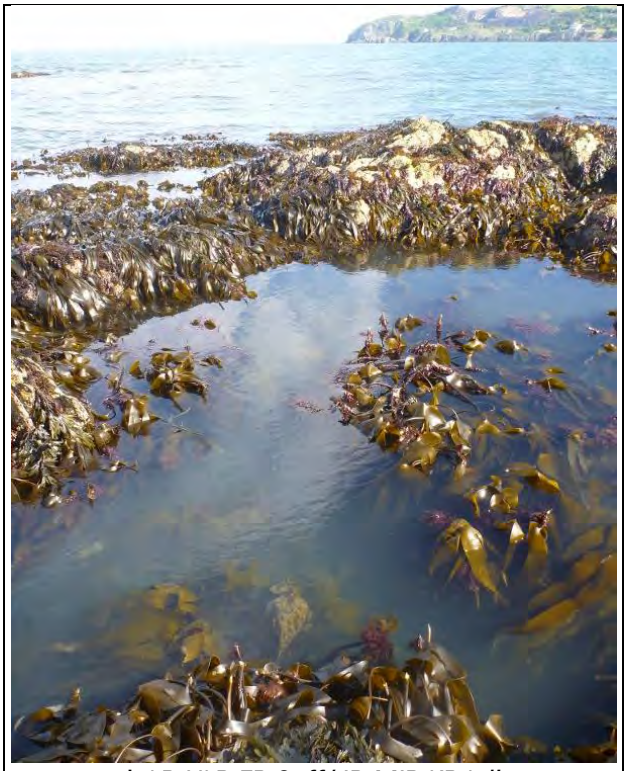
Table 6.2 Species List for Station L2 with SACFOR Abundance Classifications for Each Biotope

MCS Code	Taxa	L2				
		i	ii	iii	iv	v
	Annelida					
P23040	*Spirobranchus triqueter*					R
	Arthropoda					
R01080	*Semibalanus balanoides*	R		O	O	
R01200	*Austrominius modestus*		R			
S01660	Amphipoda		R	R		
	Anurida maritima		R	R		
	Mollusca					
W01340	*Patella vulgata*		R	O	O	
W02500	*Littorina littorea*			R		
W02630	*Littorina saxatilis*			R		
W08170	*Nucella lapillus*				R	
	Bryozoa					
Y01390	*Alcyonidium hirsutum*			R		
Y06780	*Electra pilosa*					R
	Rhodophyta					
ZM00900	*Porphyra umbilicalis*		R			
ZM01160	*Rhodothamniella floridula*				R	
ZM02160	*Gelidium spinosum*				R	
ZM02420	*Palmaria palmata*			R	O	F
ZM03840	Corallinaceae (enc)			O		
ZM06050	*Mastocarpus stellatus*			O	C	
ZM07510	*Lomentaria articulata*				O	
ZM08240	*Ceramium shuttleworthianum*			R	R	
ZM08830	*Plumaria plumosa*				R	
ZM09850	*Hypoglossum hypoglossoides*					R
ZM09900	*Membranoptera alata*				R	
ZM10780	*Osmundea hybrida*				R	
ZM11150	*Vertebrata lanosa*			F		
	Ochrophyta					
ZR02490	*Elachista fucicola*				O	
ZR06320	*Laminaria digitata*					S
ZR06640	*Ascophyllum nodosum*			S	R	
ZR06740	*Fucus serratus*			R	S	
ZR06750	*Fucus spiralis*		C			
ZR06760	*Fucus vesiculosus*			F	R	
ZR06810	*Pelvetia canaliculata*		C			
	Chorophyta					
ZS02400	*Ulva* sp. (tubular)			O		
ZS02400	*Ulva* sp. (flat)		R		R	
ZS02890	*Prasiola stipitata*	C				
ZS03400	*Cladophora albida*			R		
ZS03560	*Cladophora rupestris*			R		
	Ascomycota					
	Verrucaria maura	F	O		R	
	Caloplaca thallincola	A				
	Caloplaca marina	O				
	Tephromela atra var. atra	R				
	Xanthoria parietina	R				
	Tracheophyta					
	Armeria maritima	R				

6.1.3. Littoral Station 3

Littoral Station 3 was located at the southeast tip of the island partially separated from the main island by a connecting intertidal reef. Here the type and order of the biotopes up to the shore from the low tide level were somewhat similar to those of station L1, with the addition of several other common algae species, probably present due to the improved light regime on the open coast. The order of the biotopes again ran up from an algae dominated *LR.HLR.FR.Coff/IR.MIR.KR.Ldig* (vi), *Laminaria digitata* forest (with occasional *L. hyperborea*) with frequent patches of red algae dominated by coralline crusts. The lower middleshore was dominated by *Fucus serratus, Osmundea pinnatifida* and *Mastocarpus stellatus LR.HLR.FR.Mas* (v) and this continued into to a faunally dominated middle shore of *LR.HLR.MusB.Sem* (iv), limpets, and *Semibalanus balanoides* barnacles, with a patchy canopy of the bladderless 'Bladder wrack' *Fucus evesiculosus.* Above this mixed algae and barnacle biotope, a barnacle dominated zone of *LR.HLR.MusB.Cht* (iii) was found, with all three common native littoral barnacle species present (the two *Chthamalus* and one *Semibalanus* species). Above this biotope, as with station L1, there was a *LR.HLR.MusB* (ii) *Porphyra sp.* and *Verrucaria maura* band with sparse barnacles and littorinids sheltered in the crevices. Finally, at the top of the shore, there was another nitrate enriched *LR.FLR.Lic.Pra* (i) *Prasiola stipitata* zone found in the supralittoral.

Photographs from each littoral zone/biotope are shown in Figure 6.3, while a full species list with SACFOR classification is presented in Table 6.3.



vi: *LR.HLR.FR.Coff/ IR.MIR.KR.Ldig*

v: *LR.HLR.FR.Mas*

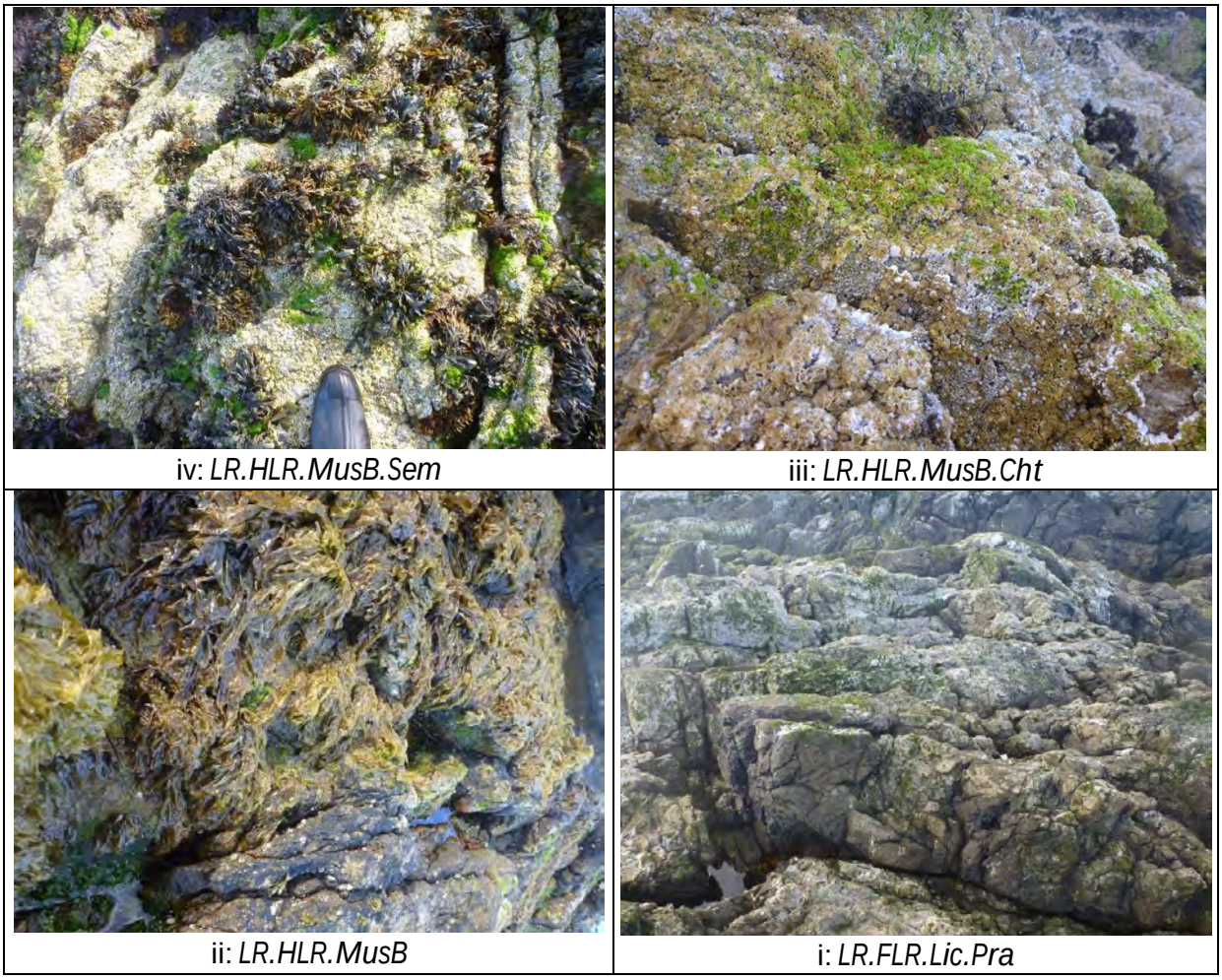


Figure 6.3 Littoral Zones and Biotopes for Station L3

Table 6.3 Species List for Station L3 with SACFOR Abundance Classifications for each Biotope

MCS Code	Taxa	L3					
		i	ii	iii	iv	v	vi
	Porifera						
C04840	*Halichondria panicea*						R
C05230	*Hymeniacidon perlevis*						R
	Cnidaria						
D06480	*Dynamena pumila*						R
	Annelida						
P23020	*Spirobranchus* sp.						R
	Arthropoda						
R00720	*Chthamalus montagui*		R	O			
R00730	*Chthamalus stellatus*			R			
R01080	*Semibalanus balanoides*			S	S	A	A
R01100	*Balanus crenatus*						O
R01200	*Austrominius modestus*				F	R	
R01940	Copepoda (in small pools)		P*				
S26460	*Cancer pagurus*						O
S26900	*Carcinus maenas*						O
	Mollusca						
W00740	*Lepidochitona cinerea*					R	
W01320	*Patella depressa*					F	

MCS Code	Taxa	L3					
		i	ii	iii	iv	v	vi
W01340	*Patella vulgata*			C	C	C	F
W02520	*Melarhaphe neritoides*		R	C			
W02562	*Littorina obtusata/ mariae*					O	
W02630	*Littorina saxatilus*	R	R	C			
W07360	*Trivia* sp.						R
W08170	*Nucella lapillus*				F		
W16500	*Mytilus edulis*			R	R		
	Bryozoa						
Y06640	*Membranipora*						O
Y06780	*Electra pilosa*						F
Y08720	*Bugulina flabellata*						R
	Chordata						
ZD00060	*Clavelina lepadiformis*						R
	Rhodophyta						
ZM00020	Rhodophyceae						R
ZM00870	*Porphyra linearis*			F			
ZM00900	*Porphyra umbilicalis*	R	A				
ZM02420	*Palmaria palmata*				O	R	F
ZM02660	*Dumontia contorta*				R	R	
ZM03790	*Hildenbrandia rubra*		O		R	O	
ZM03840	Corallinaceae (enc)				R	O	C
ZM04010	*Corallina caespitosa*					R	
ZM04040	*Corallina officinalis*					R	
ZM06050	*Mastocarpus*					R	
ZM06050	*Mastocarpus stellatus*		R	R	O	C	O
ZM07510	*Lomentaria articulata*					R	R
ZM08239	*Ceramium secundatum*					R	
ZM08240	*Ceramium shuttleworthianum*				R	R	
ZM09850	*Hypoglossum hypoglossoides*						R
ZM09900	*Membranoptera alata*						O
ZM10120	*Phycodrys rubens*						R
ZM10800	*Osmundea pinnatifida*				O	C	
	Ochrophyta						
ZR02810	*Leathesia marina*					R	
ZR06320	*Laminaria digitata*						A
ZR06330	*Laminaria hyperborea*						F
ZR06740	*Fucus serratus*					A	
ZR06760	*Fucus vesiculosus*					O	
ZR06760	*Fucus evesiculosus*			R	A		
	Chlorophyta						
ZS02400	*Ulva* sp. (tubular)				C		
ZS02400	*Ulva* sp. (flat)		O	F		O	R
ZS02890	*Prasiola stipitata*	A					
ZS03400	*Cladophora albida*					R	
ZS03560	*Cladophora rupestris*				R	O	O
	Ascomycota						
	Verrucaria mucosa					O	
	Verrucaria maura	F	A	O			
	Lichina pygmaea		R				

6.1.4. Sublittoral Station 1

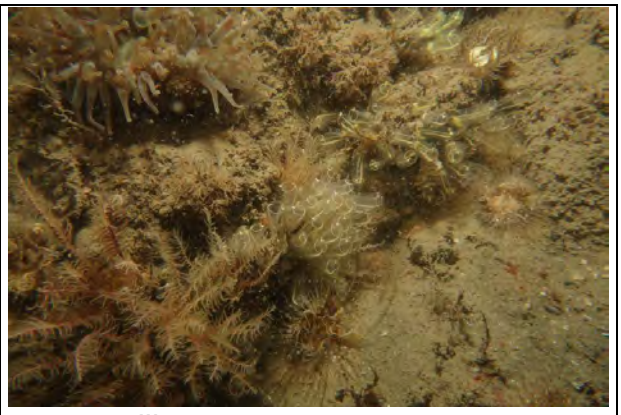
This station was situated off the north-west corner of the island and here the reef ran on to the muddy gravel at approximately 10.5m ODM. The rock surface in this vicinity was found to be considerably silted. Just above the sediment interface this biotope was found to be dominated by the feather-star *Antedon bifida*, the plumose anemone *Metridium dianthus*, the common starfish and the barnacle *Balanus crenatus.* Other anemones such as *Sagartia elegans* and *Urticina felina*, the soft coral *Alcyonium digitatum* were also frequently encountered along with several sponge species (*Haliclona simulans*, *Suberites ficus, Halichondria panicea* and *Amphilectus fucorum).* The hydroids (*Obelia dichotoma*) and bryozoans (*Flustra foliacea* and *Scrupocellaria* spp.) were also common and the overall biotope make-up was similar to the *CR.HCR.XFa.ByErSp.Sag* biotope – a 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock'.

Above this community, the next biotope (ii) lay between 6-6.5m ODM and here the foliose algae began to colonise the rock surface. This biotope was also heavily silted. This biotope was characterised by the foliose brown algae *Dictyota dichotoma* and the foliose red algae *Delesseria sanguinea* with numerous other small foliose species encountered as well, along with the occasional large sugar kelp plant, *Saccharina latissima*. The faunal component of this biotope was characterised by the anemones *Urticina felina* and *Sagartia elegans,* with the brittle-star *Ophiothrix fragilis,* the hydroids *Obelia* spp., mussels, *Balanus crenatus* and *Pomatoceros* spp. all of which were found within the silty sward. The biotope was situated close to a *IR.HIR.KFaR.FoR.Dic* or Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock.

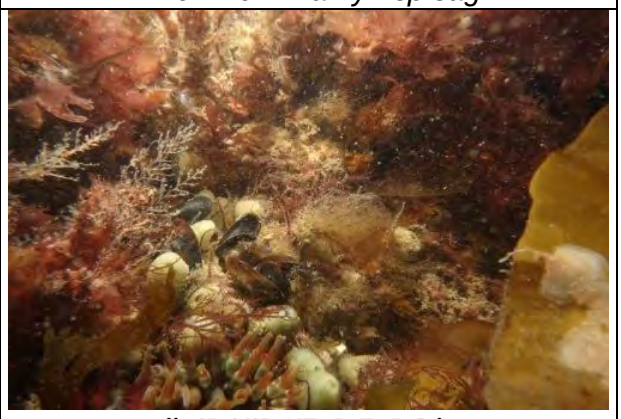
The final biotope encountered at S1 above the foliose algal zone, was a zone of stunted *Laminaria digitata* kelp plants, with several other foliose red algae, such as *Palmaria palmata* and *Delesseria sanguinea.* Beneath these algae, crusts of mussels and barnacles were found, often being predated by the common starfish *Asterias rubens*. A probable biotope for this assemblage is *IR.MIR.KR.Ldig.Ldig*.

Photographs from each littoral zone/biotope are shown in Figure 6.4, while a full species list with SACFOR classification is presented in Table 6.4.


iii: *CR.HCR.XFa.ByErSp.Sag*


iii: *CR.HCR.XFa.ByErSp.Sag*


iii: *CR.HCR.XFa.ByErSp.Sag*


ii: *IR.HIR.KFaR.FoR.Dic*


ii: *IR.HIR.KFaR.FoR.Dic*


i: *IR.MIR.KR.Ldig.Ldig*

Figure 6.4 Sublittoral Zones and Biotopes for Station S1

Table 6.4 Species List for Station S1 with SACFOR Abundance Classifications for Each Biotope

MCS Code	Taxa	S1		
		i	ii	iii
	Porifera			
C00350	*Sycon ciliatum*	F	R	
C02210	*Suberites ficus*			R
C04840	*Halichondria panicea*	R	O	O
C05960	*Amphilectus fucorum*		O	O
C08630	*Haliclona simulans*		F	O
	Red sponge crust		R	
	Cnidaria			
D01440	*Tubularia indivisa*			O
D06760	*Sertularia argentea*			O
D07300	*Obelia dichotoma*		O	O
D07310	*Obelia geniculata*	F	O	R
D10240	*Alcyonium digitatum*		C	C
D11580	*Anemonia viridis*		F	
D11680	*Urticina felina*	O	C	A
D12250	*Metridium dianthus*		C	C
D12310	*Sagartia elegans*	O	C	C
D13700	*Caryophyllia smithii*			R
	Annelida			
P23040	*Spirobranchus triqueter*	F	O	
	Arthropda			
R01100	*Balanus crenatus*		C	S
S25020	*Pisidia longicornis*		R	R
S26460	*Cancer pagurus*		F	
S26720	*Necora puber*	F	A	C
	Mollusca			
W12740	*Doto coronata*		O	O
W14030	*Doris pseudoargus*	R		
W16500	*Mytilus edulis*	S	R	
	Bryozoa			
Y06640	*Membranipora membranaceae*	F		
Y06780	*Electra pilosa*	F		
Y06940	*Flustra foliacea*			O
Y08360	*Scrupocellaria* sp.			F
Y08720	*Bugulina flabellata*			R
	Echinodermata			
ZB00110	*Antedon bifida*		C	S
ZB01900	*Asterias rubens*	C	A	C
ZB02350	*Ophiothrix fragilis*			O
ZB02680	*Ophiactis balli*			R
ZB03000	*Amphipholis squamata*		R	
	Chordata			
ZD00060	*Clavelina lepadiformis*	O	R	C
ZD00460	*Morchellium argus*	O	R	R
ZD00640	*Aplidium punctum*	O	R	R
ZD02090	*Botryllus schlosseri*		R	
ZG01500	Gadidae	P	R	
ZG04380	*Taurulus bubalis*	R	R	
ZG07050	Gobiidae	R		

MCS Code	Taxa	S1		
		i	ii	iii
	Rhodophyta			
ZM02080	*Bonnemaisonia asparagoides*	O	O	
ZM03230	*Callophyllis laciniata*	O		
ZM04040	*Corallina officinalis*	R		
ZM06310	*Plocamium cartilagineum*	O	O	
ZM06820	*Calliblepharis ciliata*	R	R	
ZM06880	*Cystoclonium purpureum*	O	F	
ZM06930	*Rhodophyllis divaricata*	O	F	
ZM08070	*Ceramium* sp.	O	O	
ZM08460	*Halurus flosculosus*		R	
ZM09500	*Cryptopleura ramosa*	F	R	
ZM09550	*Delesseria sanguinea*	F	F	
ZM09850	*Hypoglossum hypoglossoides*	O	O	
ZM09900	*Membranoptera alata*	R		
	Brogniartella byssoides	O		
ZM10120	*Phycodrys rubens*	R	F	
ZM10180	*Erythroglossum laciniatum*		R	
ZM11050	*Polysiphonia elongata*		R	
	Ochrophyta			
ZR04570	*Dictyota dichotoma*	R	C	
ZR04780	*Taonia atomaria*		R	
ZR04970	*Desmarestia aculeata*	O	O	
ZR04990	*Desmarestia ligulata*	R		
ZR05000	*Desmarestia viridis*	R		
ZR06320	*Laminaria digitata*	S		
ZR06360	*Saccharina latissima*	O	R	
	Chlorophyta			
ZS02400	*Ulva* sp. (flat)	R		
ZS03920	*Bryopsis plumosa*	R		

6.1.5. Sublittoral Station 2

This station was situated in the middle of the north coast of the island and again, there was evidence of a heavy silt burden. Here, the deeper sediment plains gave way to a steeply inclined reef at a depth of circa 15.5m ODM. The reef is initially broken, with deposits of muddy gravel lying between boulders and outcrops of sloping bedrock. The biotope on these outcrops was dominated by the bryozoans *Flustra foliacea, Scupocellaria* sp. and *Bugulina flabellata.* Other sub-dominant taxa of note were the hydroid *Nemertesia antennina* and the soft coral *Alcyonium digitatum,* frequent erect sponges *Hymeniacidon perlevis*, *Amphilectus fucorum* and *Haliclona simulans*, the hydroids *Nemertesia antennina* and *Obelia dichotoma* as well as the tunicate *Clavelina lepadiformis.* A possible biotope tag for this assemblage was *CR.HCR.XFa.FluCoAs*, or *Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock.

Above this biotope, at 8.5m ODM, the *Dictyota* and foliose red algae biotope was again found, as recorded at station L1. However, several new algal species were noted such as

Rhodymenia holmesii, Sphondylothamnion multifidum and *Apoglossum ruscifolium* amongst the sward. Several new species of fish were also noted in this biotope, such as the ling (*Molva molva*), the black goby (*Gobius niger*) as well as the Greater pipefish (*Syngnathus acus*). Hence, the biotope was found to be close to *IR.HIR.KFaR.FoR.Dic* or Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock.

As with station L1, above the foliose algal zone, there was again a zone of stunted *Laminaria digitata* kelp plants, with numerous foliose red algae, mussels and starfish. The biotope being *IR.MIR.KR.Ldig.Ldig* or *Laminaria digitata* on moderately exposed sublittoral fringe rock.

Photographs from each littoral zone/biotope are shown in Figure 6.5, while a full species list with SACFOR classification is presented in Table 6.5.

iii: *CR.HCR.XFa.FluCoAs*

iii: *CR.HCR.XFa.FluCoAs*

iii: *CR.HCR.XFa.FluCoAs*

iii: *CR.HCR.XFa.FluCoAs*

ii: *IR.HIR.KFaR.FoR.Dic*

ii: *IR.HIR.KFaR.FoR.Dic*

i: *IR.MIR.KR.Ldig.Ldig*

i: *IR.MIR.KR.Ldig.Ldig*

Figure 6.5 Sublittoral Zones and Biotopes for Station S2

Table 6.5 Species List for Station S2 with SACFOR Abundance Classifications for each Biotope

MCS Code	Taxa	S2		
		i	ii	iii
	Porifera			
C00350	*Sycon ciliatum*	F		F
C02210	*Suberites ficus*		R	R
C04810	*Halichondria bowerbanki*			O
C04840	*Halichondria panicea*	F		
C05230	*Hymeniacidon perlevis*	O	F	F
C05960	*Amphilectus fucorum*	O	F	F
C06420	*Myxilla* sp.	R		R
C06840	*Iophon hyndmani*		O	
C08630	*Haliclona simulans*		F	F
	Cnidaria			
D01440	*Tubularia indivisa*			R
D05260	*Halecium halecinum*		O	O
D05500	*Aglaophenia* sp.		R	R
D05780	*Halopteris catharina*			F
D05970	*Nemertesia antennina*		F	F
D05990	*Nemertesia ramosa*		O	R
D06690	*Sertularella polyzonias*			O
D06760	*Sertularia argentea*	R		
D07300	*Obelia dichotoma*	O	F	F
D07310	*Obelia geniculata*	F		
D07320	*Obelia longissima*			O

MCS Code	Taxa	S2		
		i	ii	iii
D10240	*Alcyonium digitatum*	F	C	F
D11680	*Urticina felina*			R
D12310	*Sagartia elegans*		R	R
	Annelida			
P23020	*Spirobranchus* sp.			F
P23040	*Spirobranchus triqueter*	F	R	
	Arthropoda			
R01090	*Balanus balanus*		R	O
R01100	*Balanus crenatus*	C	F	O
S01660	Amphipoda	C	C	F
S10700	Caprellidae	C	C	
S22100	*Palaemon serratus*	O	F	F
S23220	*Pandalus montagui*	F		
S23600	*Homarus gammarus*			R
S24650	*Pagurus bernhardus*			R
S25850	*Macropodia rostrata*	O	O	
S26460	*Cancer pagurus*	R	O	O
S26720	*Necora puber*	O	O	O
S26900	*Carcinus maenas*	O		
	Mollusca			
W12720	*Doto* sp.		R	R
	Diapharodoris luteocincta			R
W16500	*Mytilus edulis*	C		
	Bryozoa			
Y00030	Crisiidae	F	O	O
Y01370	*Alcyonidium diaphanum*		F	F
Y06640	*Membranipora* sp.	C		
Y06780	*Electra pilosa*	A	F	
Y06940	*Flustra foliacea*		F	C
Y07050	*Chartella papyracea*		R	O
Y07100	*Securiflustra securifrons*		R	
Y08360	*Scrupocellaria* sp.	F	C	
Y08410	*Scrupocellaria scruposa*			A
Y08530	*Bicellariella ciliata*			O
Y08720	*Bugulina flabellata*	R	O	C
Y08750	*Bugulina plumosa*			R
	Echinodermata			
ZB00110	*Antedon bifida*	R	O	O
ZB01900	*Asterias rubens*	C	C	C
ZB02350	*Ophiothrix fragilis*	C		O
ZB03620	*Echinus esculentus*	R	R	O
ZB04950	*Thyone fusus*		O	
	Chordata			
ZD00060	*Clavelina lepadiformis*	R	F	F
ZD00640	*Aplidium punctum*	R	O	O
ZD01880	*Polycarpa scuba*			O
ZD01940	*Dendrodoa grossularia*		R	R
ZD02090	*Botryllus schlosseri*	R	R	
ZG01500	Gadidae		R	R
ZG01960	*Molva molva*		R	

MCS Code	Taxa	S2		
		i	ii	iii
ZG03760	*Syngnathus acus*		R	
ZG04340	*Myoxocephalus scorpius*			R
ZG06050	*Ctenolabrus rupestris*		R	
ZG07000	*Callionymus lyra*		R	O
ZG07050	Gobiidae			R
ZG07230	*Gobius niger*		R	R
ZG07440	*Pomatoschistus pictus*			R
	Rhodophyta			
ZM02080	*Bonnemaisonia asparagoides*	O	R	
ZM02420	*Palmaria palmata*	O		
ZM02560	*Dilsea carnosa*	O	R	
ZM03230	*Callophyllis laciniata*	O	R	
ZM03840	Corallinaceae (enc)	F	O	
ZM05840	*Phyllophora crispa*	F	O	
ZM05860	*Phyllophora pseudoceranoides*	C		
ZM06110	*Chondrus crispus*	C		
ZM06310	*Plocamium cartilagineum*	F	O	
ZM06820	*Calliblepharis ciliata*	F	A	
ZM06880	*Cystoclonium purpureum*		O	
ZM06930	*Rhodophyllis divaricata*		F	
ZM07230	*Rhodymenia holmesii*		C	
ZM07530	*Lomentaria orcadensis*	R	R	
ZM07860	*Aglaothamnion tenuissimum*		R	
ZM08239	*Ceramium secundatum*		R	
ZM08460	*Halurus flosculosus*	R		
ZM09230	*Sphondylothamnion multifidum*		R	
ZM09400	*Apoglossum ruscifolium*		R	
ZM09500	*Cryptopleura ramosa*	F	C	
ZM09550	*Delesseria sanguinea*	F	F	
ZM09850	*Hypoglossum hypoglossoides*		C	
ZM09900	*Membranoptera alata*	O		
ZM10120	*Phycodrys rubens*	F	F	
ZM10180	*Erythroglossum laciniatum*		F	
ZM10390	*Heterosiphonia plumosa*	R	R	
	Brogniartella byssoides	O	O	
ZM11050	*Polysiphonia elongata*		R	
ZM11170	*Polysiphonia fucoides*		R	
ZM11370	*Pterosiphonia parasitica*		R	
	Ochrophyta			
ZR04570	*Dictyota dichotoma*	F	C	
ZR04780	*Taonia atomaria*		R	
ZR04970	*Desmarestia aculeata*	O		
ZR04990	*Desmarestia ligulata*	F		
ZR06310	*Laminaria sporelings*		R	
ZR06320	*Laminaria digitata*	S		
ZR06330	*Laminaria hyperborea*	A		
ZR06360	*Saccharina latissima*	C		

6.1.6. Sublittoral Station 3

This station was located off the east coast of the island, slightly south of station L2. It was exposed to the easterly winds and therefore moderately exposed to wave action. The reef appeared out of the sediment at approximately 13.5m ODM and slopes gently up towards the island. Again, the reef was heavily silted and the initial biotope was dominated by erect sponges and hydroids, with species of note being *Haliclona simulans, Halichondria panicea* and *Nemertesia antennina.* Also dominant were the hydrozoan *Halecium halecinum*, *Alcyonium digitatum,* the anemones *Sagartia elegans* and *Urticina felina*, whilst the decapods, *Palaemon serratus, Cancer pagurus, Macropodia rostrata* and *Necora puber* were frequent constituent in this zone. The overall biotope make-up of this biotope was similar to the *CR.HCR.XFa.ByErSp.Sag* biotope – a 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock'.

Above this biotope at 8.5m ODM was the *Dictyota dichotoma* and foliose red algal assemblage previously found at S1 and S2. Here the silt still formed a thick covering and the *Dictyota* was possibly less abundant and hence several more delicate red algae were more prominent, such as *Rhodymenia ardissonei*, *Phycodrys rubens* and *Apoglossum ruscifolium*. As a result the community was possibly more similar to the *IR.HIR.KFaR.FoR* biotope or Foliose red seaweeds on exposed lower infralittoral rock.

Finally at station S3 from 6.5m ODM upwards was a kelp zone with a dense understory of foliose red algae and barnacles. Dominant red algae included *Ploccamium cartilagineum*, *Delesseria sanguinea* and *Cryptopleura ramosa*, whilst the foliose brown algae were dominated by *Desmarestia spp*. and *Ectocarpaceae* indet. Although the dominant kelp was *Laminaria digitata, L. hyperborea* was present in the kelp forest. Hence the biotope was consistent with S1 and S2, being *IR.MIR.KR.Ldig.Ldig* or *Laminaria digitata* on moderately exposed sublittoral fringe rock.

Photographs from each littoral zone/biotope are shown in Figure 6.6, while a full species list with SACFOR classification is presented in Table 6.6.

iii: *CR.HCR.XFa.ByErSp.Sag*

iii: *CR.HCR.XFa.ByErSp.Sag*

ii: *IR.HIR.KFaR.FoR*

ii: *IR.HIR.KFaR.FoR*

i: *IR.MIR.KR.Ldig.Ldig*

Figure 6.6 Sublittoral Zones and Biotopes for Station S3

Table 6.6 Species List for Station S3 with SACFOR Abundance Classifications for Each Biotope

MCS Code	Taxa	S3		
		i	ii	iii
	Porifera			
C00350	*Sycon ciliatum*			R
C02210	*Suberites ficus*		R	R
C04810	*Halichondria bowerbanki*			R
C04840	*Halichondria panicea*	O	R	O
C05230	*Hymeniacidon perlevis*	O		
C05960	*Amphilectus fucorum*		R	R
C06450	*Myxilla incrustans*		R	
C06780	*Iophon nigricans*		R	R
C08630	*Haliclona simulans*		R	A
	Cnidaria			
D01440	*Tubularia indivisa*	R	R	
D05260	*Halecium halecinum*		R	O
D05970	*Nemertesia antennina*	R	R	C
D05990	*Nemertesia ramosa*		R	R
D06760	*Sertularia argentea*		R	
D07300	*Obelia dichotoma*		R	
D07310	*Obelia geniculata*	F		O
D07430	*Rhizocaullus verticillatus*		R	R
D10240	*Alcyonium digitatum*		F	C
D11580	*Anemonia viridis*	O		
D11680	*Urticina felina*		R	F
D12310	*Sagartia elegans*	O	F	C
	Nemertea			
G00780	*Lineus longissimus*			R
	Annelida			
P23040	*Spirobranchus triqueter*	O	F	O
	Arthropoda			
R01090	*Balanus balanus*	R	R	R
R01100	*Balanus crenatus*	C	C	R
S01660	Amphipoda			O
S22100	*Palaemon serratus*	O	C	C
S23220	*Pandalus montagui*	R		
S23600	*Homarus gammarus*	R		R
S25020	*Pisidia longicornis*		O	
S25850	*Macropodia rostrata*	O	C	A
S26460	*Cancer pagurus*	C	F	R
S26720	*Necora puber*	A	C	A
S26900	*Carcinus maenas*	C		
	Mollusca			
W16500	*Mytilus edulis*	R	O	
	Bryozoa			
Y00001	Bryozoa		O	O
Y01370	*Alcyonidium diaphanum*		C	C
Y06640	*Membranipora* sp.	O		
Y06780	*Electra pilosa*	O		
Y06940	*Flustra foliacea*		O	R
Y07050	*Chartella papyracea*		O	

MCS Code	Taxa	S3		
		i	ii	iii
Y08790	*Bugulina turbinata*			O
	Echinodermata			
ZB00110	*Antedon bifida*	R	O	C
ZB01900	*Asterias rubens*	C	C	C
ZB02350	*Ophiothrix fragilis*	R		
	Chordata			
ZD00060	*Clavelina lepadiformis*		F	F
ZD00460	*Morchellium argus*			R
ZD00640	*Aplidium punctum*	R	R	O
ZD01940	*Dendrodoa grossularia*	R	F	C
ZG02080	*Pollachius pollachius*	R	R	R
ZG04380	*Taurulus bubalis*	R	R	R
ZG07050	Gobiidae	R	O	R
ZG07400	*Pomatoschistus*		R	R
	Rhodophyta			
ZM02420	*Palmaria palmata*	O		
ZM03840	Corallinaceae (enc)	F	O	
ZM04040	*Corallina officinalis*	R		
ZM06310	*Plocamium cartilagineum*	C		
ZM06820	*Calliblepharis ciliata*	R		
ZM06880	*Cystoclonium purpureum*	R		
ZM07230	*Rhodymenia holmesii*		R	
ZM07260	*Rhodymenia ardissonei*		R	
ZM07510	*Lomentaria articulata*	R		
ZM08239	*Ceramium secundatum*		R	
ZM09400	*Apoglossum ruscifolium*		R	
ZM09500	*Cryptopleura ramosa*	A	R	
ZM09550	*Delesseria sanguinea*	A	R	
ZM09850	*Hypoglossum hypoglossoides*	R	R	
ZM09900	*Membranoptera alata*	R		
ZM10120	*Phycodrys rubens*		R	
ZM10180	*Erythroglossum laciniatum*	F		
ZM11050	*Polysiphonia elongata*	R	R	
	Ochrophyta			
	Chrysophyceae	A		
ZR00030	Ectocarpaceae indet.	C		
ZR04570	*Dictyota dichotoma*	O	F	
ZR04970	*Desmarestia aculeata*	R		
ZR04990	*Desmarestia ligulata*	O		
ZR06320	*Laminaria digitata*	A		
ZR06330	*Laminaria hyperborea*	R		

6.1.7. Sublittoral Station 4

This station was located off the south east corner of the island, adjacent to station L3. The reef emerged out of the sediment at approximately 14.9m ODM and rose at a shallow angle towards the shore. Initially the reef sloped shore-wards relatively smoothly and latterly in a series of steep ridges and gullies. Again the silt covering was significant but where rock

surfaces were less impacted by siltation, the community was again relatively rich, comprising of encrusting assemblages of hydroids and bryozoans with frequent erect sponges and anemones. The deepest reef biotope (iii) were dominated by the anemones *Urticina felina* and *Metridium dianthus* and the bryozoans *Flustra foliacea*, *Bugulina flabellata* and *Scrupocellaria* spp., whilst the sponges *Halichondria bowerbanki, Amphilectus fucorum* and *Haliclona simulans* were also present. Several ascidian species also occurred in the biotope, *Polycarpa scuba* and *Dendrodoa grossularia* being the most common along with *Polyclinum aurantium* and *Aplidium punctum* which were also present. The biotope therefore could be *HCR.XFa.FluCoAs.Paur* – '*Polyclinum aurantium* and *Flustra foliacea* on sand scoured tide-swept moderately wave-exposed circalittoral rock'. This difference from the other stations was probably brought about by the increased sedimentation regime noted at this station.

Above this biotope, at 9m ODM, was the *Dictyota dichotoma* and foliose red algal assemblage previously found at S1 and S2. Here again the silt still formed a thick covering but the *Dictyota* was accompanied by numerous small foliose red algal species, such as *Hypoglossum hypoglossoides, Erythroglossum laciniatum* and *Rhodomenia holmesii.* On the vertical faces, *Schottera nicaensis* was noted and the delicate brown algae *Taonia atomaria* was also recorded. Beneath the silt, a crust of the solitary ascidian *Dendrodoa grossularia* and the barnacle *Balanus crenatus* was found along with the frequent clumps of sponges, hydroids and bryozoans. The less common sponge *Hemimycale columella* was evident for the first time in this biotope, as shown in the photo below. However, the biotope was still found to be close to *IR.HIR.KFaR.FoR.Dic* or Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock.

Above the foliose algal zone, the *Laminaria digitata* forest was again present, with understorey dominants of *Phyllophora crispa* and *Chondrus crispus*, amongst a crust of mussels and the barnacle *Balanus crenatus*. The bryozoans *Electra pilosa* and *Membranipora membranaceae* were frequently recorded on the algal thalli and *Asterias rubens* was also present, feeding on the mussels. Occasional sugar kelp plants of *Saccarhina lattissima* were also noted within the kelp forest, however the biotope would still be recorded as *IR.MIR.KR.Ldig.Ldig* or *Laminaria digitata* on moderately exposed sublittoral fringe rock.

Photographs from each littoral zone/biotope are shown in Figure 6.7, while a full species list with SACFOR classification is presented in Table 6.7.

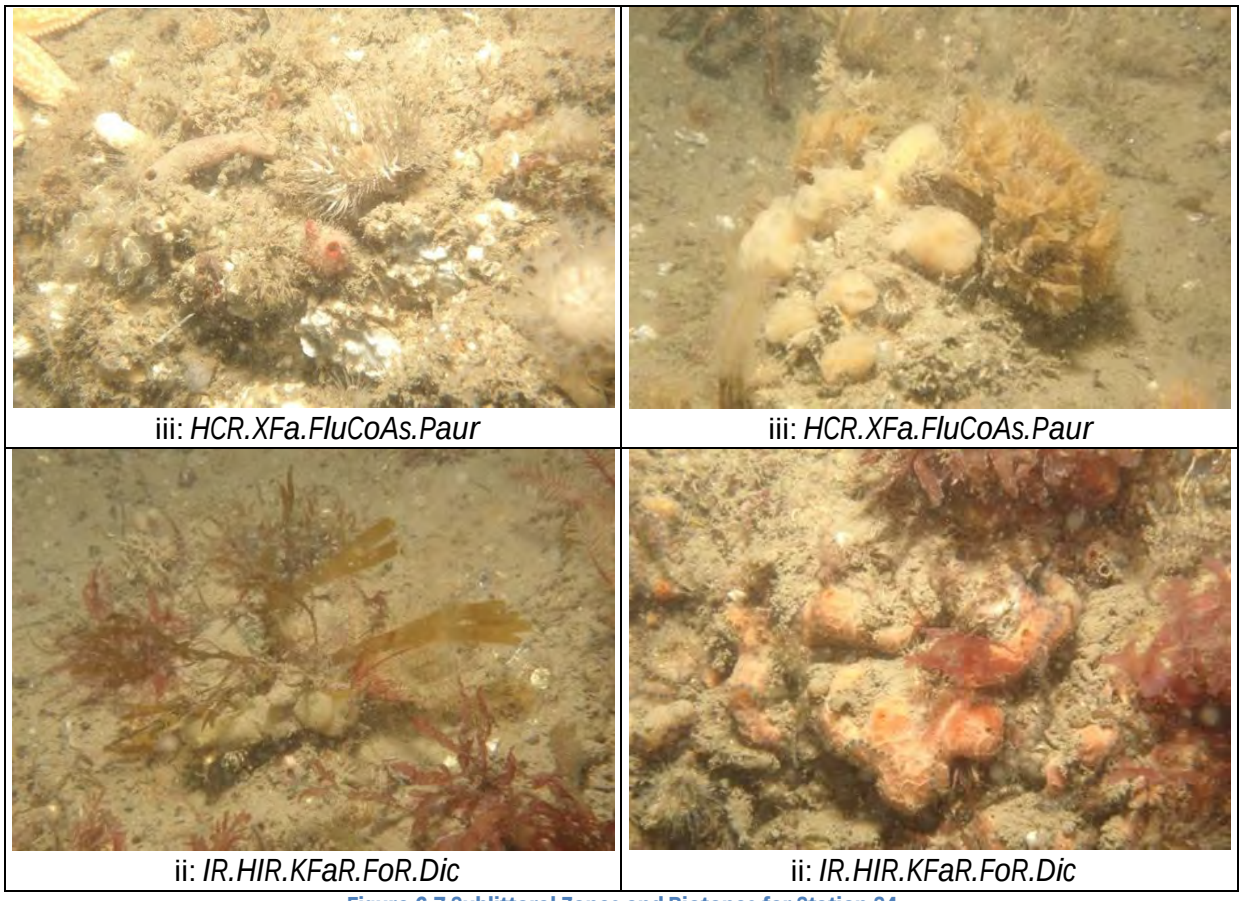


Figure 6.7 Sublittoral Zones and Biotopes for Station S4

Table 6.7 Species List for Station S4 with SACFOR Abundance Classifications for Each Biotope

MCS Code	Taxa	S4		
		i	ii	iii
	Porifera			
C00350	*Sycon ciliatum*	O	O	
C02210	*Suberites ficus*		R	R
C04810	*Halichondria bowerbanki*		O	O
C04840	*Halichondria panicea*	F	O	
C05230	*Hymeniacidon perlevis*	F		
C05960	*Amphilectus fucorum*		O	O
C06450	*Myxilla incrustans*	R		
C06780	*Iophon nigricans*		O	O
C07750	*Hemimycale columella*		R	
C08630	*Haliclona simulans*		F	F
C08900	*Dysidea fragilis*			R
	Red sponge crust		O	
	Cnidaria			
D05260	*Halecium halecinum*			O
D05780	*Halopteris catharina*		O	O
D05970	*Nemertesia antennina*		O	F
D05990	*Nemertesia ramosa*		O	O
D06690	*Sertularella polyzonias*			O
D06760	*Sertularia argentea*			R
D07300	*Obelia dichotoma*	O	F	F
D07310	*Obelia geniculata*	O		

MCS Code	Taxa	S4		
		i	ii	iii
D07430	*Rhizocaullus verticillatus*			O
D10240	*Alcyonium digitatum*	O	C	F
D11680	*Urticina felina*	R	F	C
D12250	*Metridium dianthus*		O	C
D12310	*Sagartia elegans*	R	F	F
D12480	*Sagartiogeton undatus*			R
	Annelida			
P23040	*Spirobranchus triqueter*	R		
P20310	*Lanice conchilega*		O	O
P23090	*Serpula vermicularis*		O	
	Arthropoda			
R01090	*Balanus balanus*		R	C
R01100	*Balanus crenatus*	C	F	C
S01660	Amphipoda		F	F
S23600	*Homarus gammarus*			R
S24650	*Pagurus bernhardus*			O
S25850	*Macropodia rostrata*			F
S26460	*Cancer pagurus*	O	F	F
S26690	*Liocarcinus depurator*			O
S26720	*Necora puber*	F	C	C
	Mollusca			
W14030	*Doris pseudoargus*		R	
W16500	*Mytilus edulis*	F		O
	Bryozoa			
Y00030	Crisiidae	F	F	F
Y01370	*Alcyonidium diaphanum*	F	F	F
Y06640	*Membranipora* sp.	F		
Y06780	*Electra pilosa*	C	O	
Y06940	*Flustra foliacea*		O	O
Y08360	*Scrupocellaria*		F	F
Y08530	*Bicellariella ciliata*			O
Y08720	*Bugulina flabellata*		O	F
	Porifera			
ZB00110	*Antedon bifida*	O	F	R
ZB01900	*Asterias rubens*	C	C	C
ZB02350	*Ophiothrix fragilis*			O
ZB02680	*Ophiactis balli*		O	O
ZB02780	*Ophiopholis aculeata*		O	O
ZB03000	*Amphipholis squamata*		O	R
	Chordata			
ZD00060	*Clavelina lepadiformis*	O	O	O
ZD00340	*Polyclinum aurantium*			O
ZD00640	*Aplidium punctum*	F	O	O
ZD00680	Didemnidae indet.			R
ZD01880	*Polycarpa scuba*		R	R
ZD01940	*Dendrodoa grossularia*		F	O
ZD02090	*Botryllus schlosseri*	O	R	
ZD02140	*Botrylloides leachii*	R		
	Rhodophyta			
ZM02080	*Bonnemaisonia asparagoides*		O	

MCS Code	Taxa	S4		
		i	ii	iii
ZM02420	*Palmaria palmata*	F		
ZM02560	*Dilsea carnosa*		O	
ZM03230	*Callophyllis laciniata*	O	O	
ZM03840	Corallinaceae (enc)	F		
ZM04040	*Corallina officinalis*	O		
ZM05840	*Phyllophora crispa*	F	F	
ZM05860	*Phyllophora pseudoceranoides*	F		
ZM05940	*Schottera nicaeensis*		O	
ZM06110	*Chondrus crispus*	F		
ZM06310	*Plocamium cartilagineum*	F	O	
ZM06820	*Calliblepharis ciliata*		R	
ZM06880	*Cystoclonium purpureum*	F	F	
ZM06930	*Rhodophyllis divaricata*		F	
ZM07230	*Rhodomenia holmesii*		F	R
ZM07530	*Lomentaria orcadensis*		R	
ZM08070	*Ceramium* sp.	O	O	
ZM08460	*Halurus flosculosus*		R	
ZM09500	*Cryptopleura ramosa*	O	F	
ZM09550	*Delesseria sanguinea*	F	F	
ZM09850	*Hypoglossum hypoglossoides*		F	
ZM10120	*Phycodrys rubens*	F		
ZM10180	*Erythroglossum laciniatum*		F	
	Brogniartella byssoides	O	F	
ZM11160	*Polysiphonia nigra*		R	
	Ochrophyta			
	Chrysophyceae	A		
ZR00030	Ectocarpaceae indet.	C		
ZR04570	*Dictyota dichotoma*	C	C	
ZR04780	*Taonia atomaria*		R	
ZR04970	*Desmarestia aculeata*	O	R	
ZR04990	*Desmarestia ligulata*	R		
ZR05000	*Desmarestia viridis*	R	R	
ZR06310	*Laminaria sporelings*		O	R
ZR06320	*Laminaria digitata*	S		
ZR06330	*Laminaria hyperborea*	O		
ZR06360	*Saccharina latissima*	F		
ZS03920	*Bryopsis plumosa*		R	

6.2. Univariate Analyses

Univariate analyses revealed clear differences between the number of species from the littoral and sublittoral stations. As expected, species richness was on average higher (twice as high) in the sublittoral stations (88.3±19.2SD) compared to the numbers found in the littoral stations (44.7±11.6SD; Table 6.8 & Figure 6.8). Nemerteans and echinoderms were restricted to the sublittoral stations whereas Ascomycota and Tracheophyta were only recorded in the littoral zones. The highest species richness was encountered at Sublittoral

Station S2 (109 species) with the lowest number of species being counted at Littoral Station L1 (34 species).

Table 6.8 Number of Species per Phyla and Station

Phylum	Littoral Station			Sublittoral Station			
	L1	L2	L3	S1	S2	S3	S4
Porifera	1	0	2	6	9	9	12
Cnidaria	1	0	1	10	14	12	14
Nemertea	0	0	0	0	0	1	0
Annelida	2	1	1	1	2	1	3
Arthropoda	3	4	8	4	12	11	9
Mollusca	9	5	9	3	3	1	2
Bryozoa	1	2	3	5	12	7	8
Echinodermata	0	0	0	5	5	3	6
Chordata	0	0	1	7	14	8	8
Rhodophyta	12	13	18	17	30	18	25
Ochrophyta	1	7	6	7	8	7	11
Chlorophyta	3	5	5	2	0	0	1
Ascomycota	1	5	3	0	0	0	0
Tracheophyta	0	1	0	0	0	0	0
TOTAL	**34**	**43**	**57**	**67**	**109**	**78**	**99**
Average	**44.7**			**88.3**			
Standard Deviation	**11.6**			**19.2**			

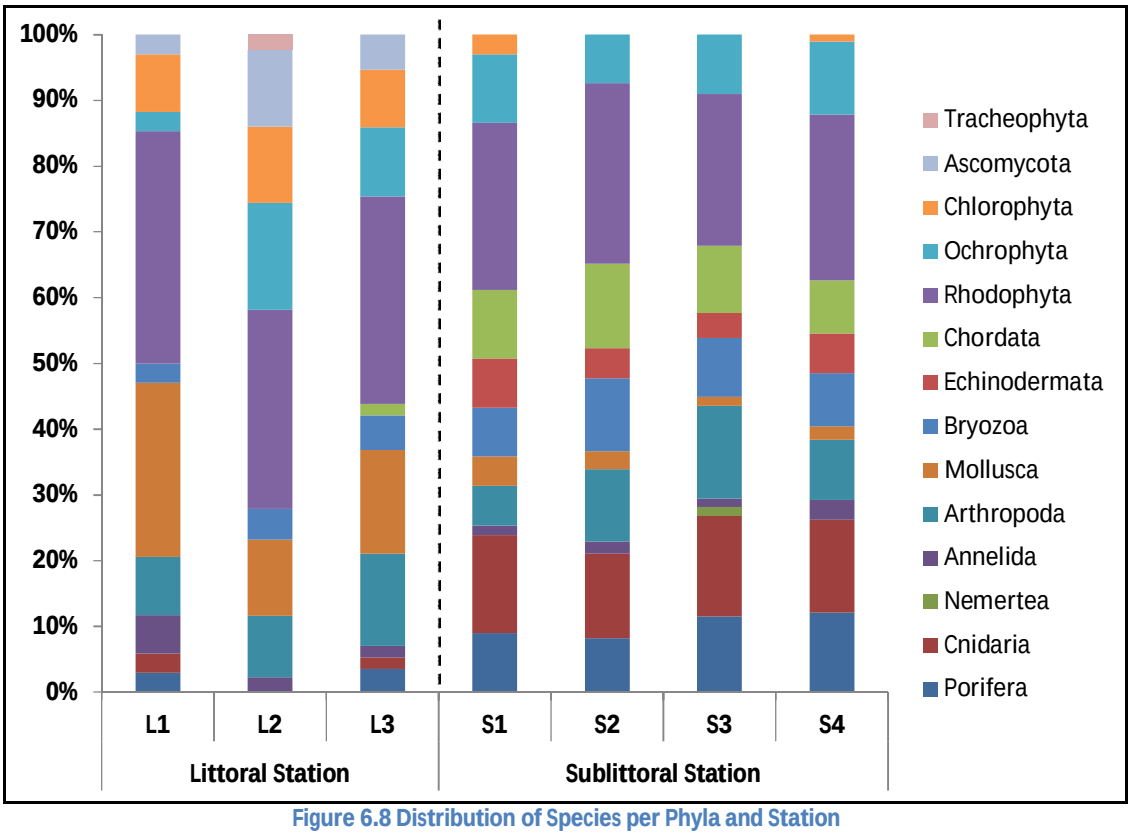


Figure 6.8 Distribution of Species per Phyla and Station

6.3. Multivariate Analyses

6.3.1. Littoral Stations

Multivariate analyses (PRIMER; Clarke and Warwick, 1994) of the littoral stations indicated some statistical separation of biotopes such as *LR.FLR.Lic.Pra* and *LR.HLR.FR.Coff/IR.MIR.KR.Ldig.* While the biotopes *LR.HLR.MusB.Sem, LR.HLR.FR.Mas, LR.LLR.F.Asc.FS* and *LR.MLR.BF.Fser.R* could not be statistically distinguished (Figure 6.9).

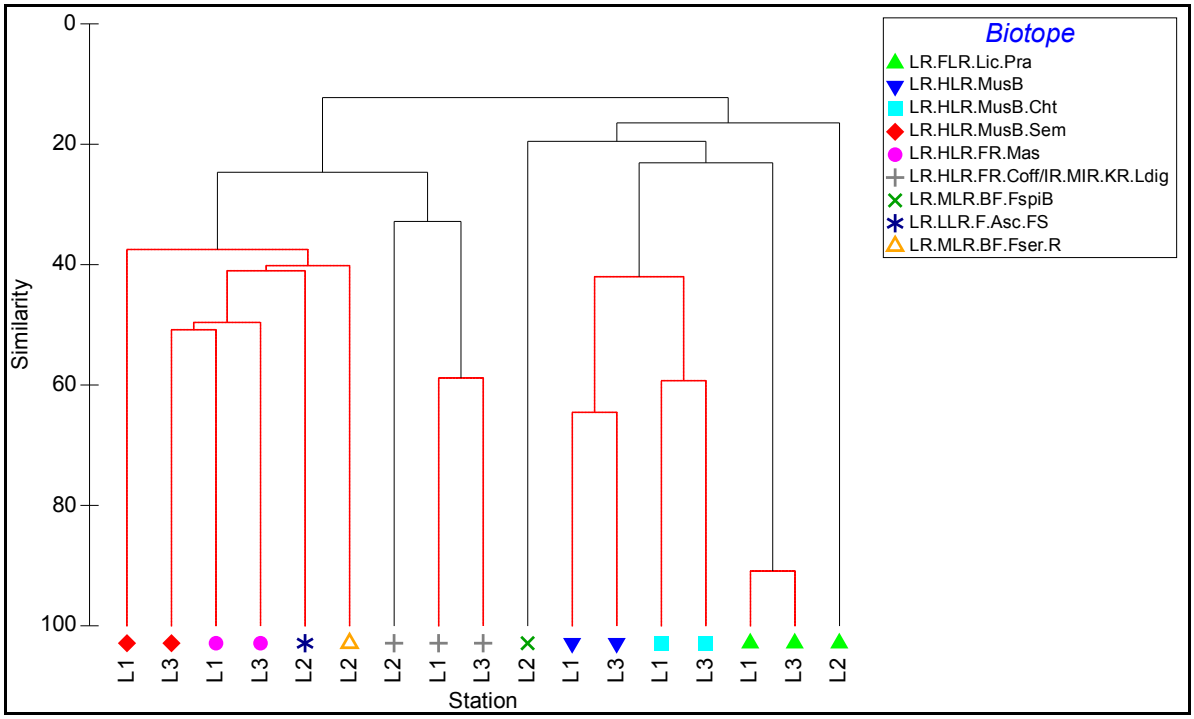


Figure 6.9 Dendrogram of Biotopes Recorded at the Littoral Stations

The MDS plot indicated that throughout the Littoral stations, greater similarities existed between the exposed stations L1 and L3, than compared with the more sheltered station L2, although vertical zonation indicated similar biotopes throughout all three stations (Figure 6.10). Station L2 was located within a gully where water movement/wave exposure was limited to the northeast direction only area and probably responsible for the absence of sponge and cnidarian species.

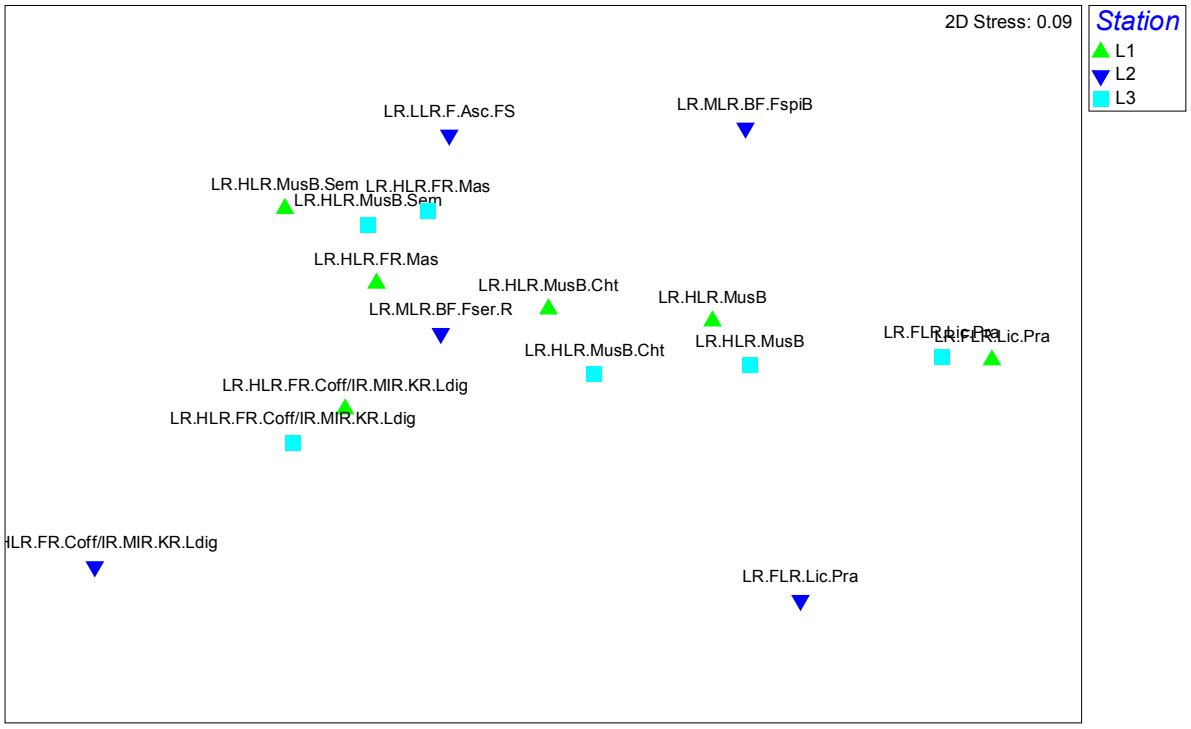


Figure 6.10 MDS of Biotopes Recorded at the Littoral Stations

6.3.2. Sublittoral Stations

All four stations in the sublittoral areas were characterised by *Laminaria digitata* forest in the shallows (*IR.MIR.KR.Ldig.Ldig*), below this zone, three of the four stations recorded the biotope *IR.HIR.KFaR.FoR.Dic.* The deepest extent of the reef was the most variable, with three different biotopes recorded at the four stations, with only Sublittoral Stations S1 and S3 characterised by the same biotope of 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock'.

The cluster and MDS plot for the sublittoral stations indicated some statistical separation of biotopes, most notably that of *IR.MIR.KR.Ldig.Ldig*, with all four occurrences being statistically indistinguishable (Figure 6.11). Stations S2 and S4 showed statistical separation of biotopes from the other stations, whilst these two stations were also statistically indeterminate within each depth zone (Figure 6.12). The subtle variations in biotope composition geographically is probably due to differences within the seabed profiles and morphology.

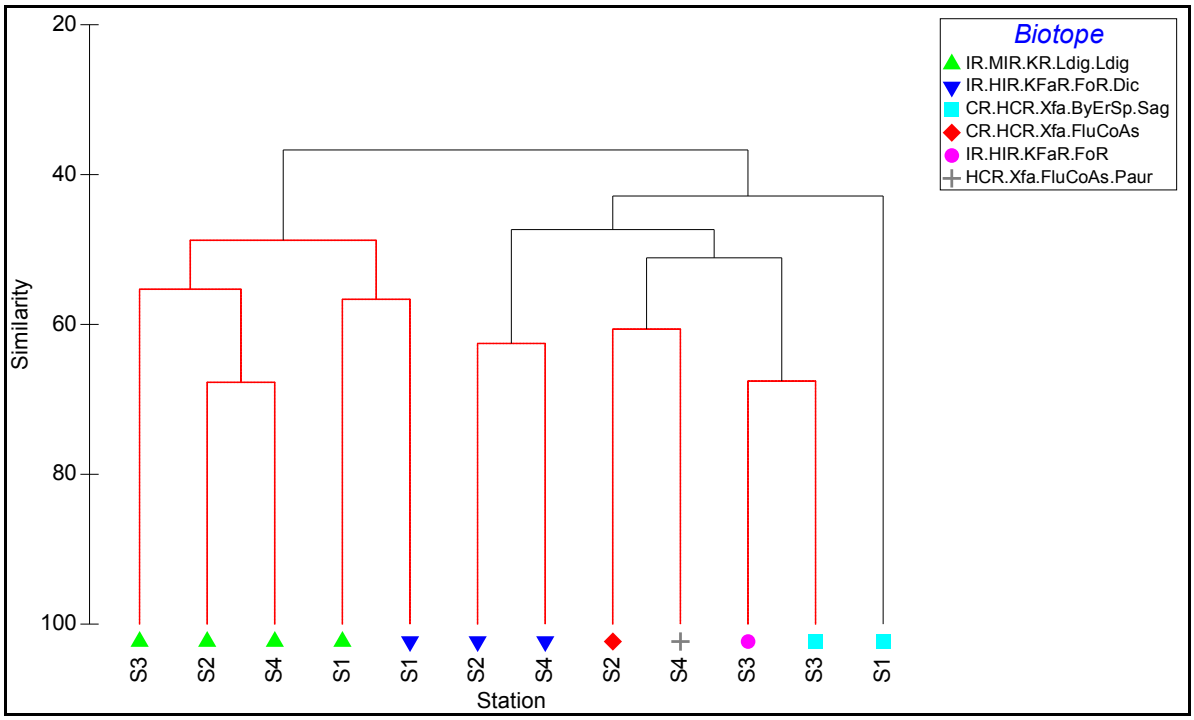


Figure 6.11 Dendrogram of Biotopes Recorded at the Sublittoral Stations

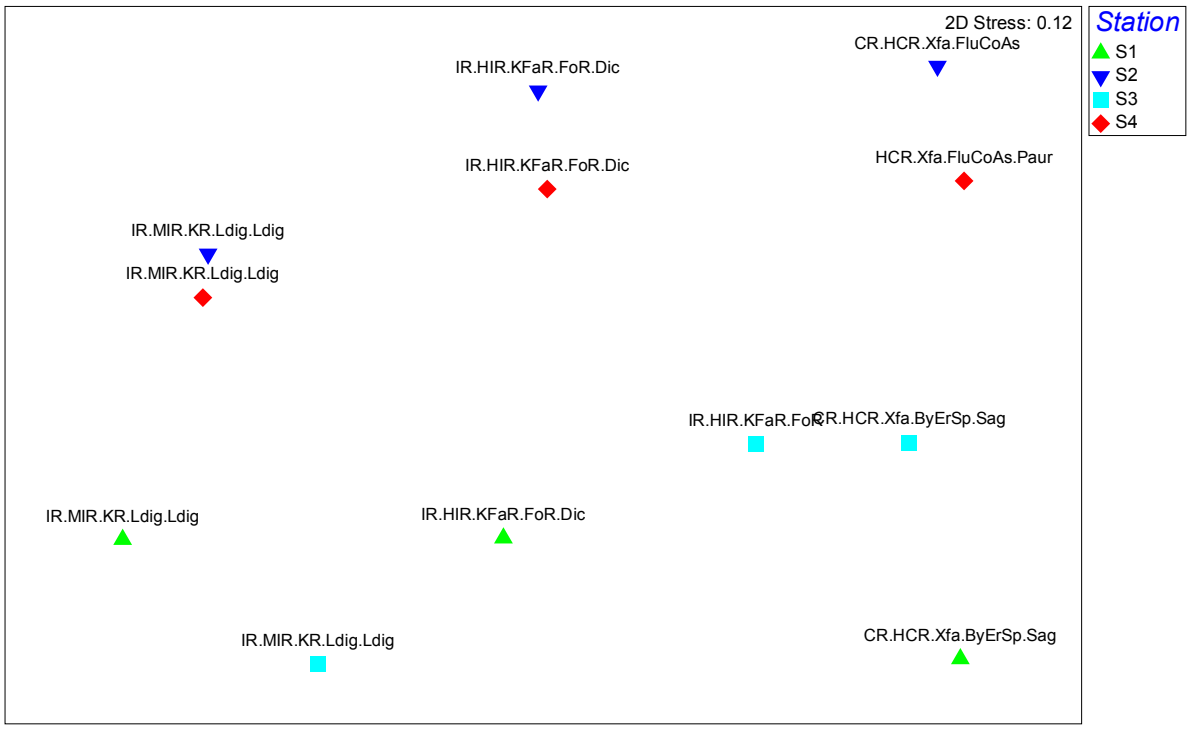


Figure 6.12 MDS of Biotopes Recorded at the Sublittoral Stations

7. Conclusion

The results showed clear separation between the littoral and sublittoral stations in terms of species composition and biotopes with on average of twice as many species found in the sublittoral environment. This survey has collected semi-quantitative data from two moderately exposed littoral sites (L1 and L3) and a sheltered site (L2). L1 was slightly modified by shading, wave surge and nitrogenous enrichment and the L3 uppershore biotope was similarly enriched by roosting seabirds. The photographs and data collected may act as a comparison, against which future gross changes could be qualitatively assessed.

In the sublittoral zone, four sites were surveyed and similar semi-quantitative data collected along with photographs. Overall, all sublittoral environments indicated the presence of significant siltation in the deeper zones. However, the faunal populations of both littoral and sublittoral zones showed well represented and moderately diverse habitats containing many of the common species found along the Irish Sea coastline. Stations S2 and S3 indicated greater habitats similarity recorded within their vertical zonation.

The result of a moderately high diversity is similar to that recorded in the macro-invertebrate population previously recorded within the soft sediments north of this island as part of the outfall route baseline surveys (BSL, 2013), and is probably indicative for the survey area as a whole. The presence of significant siltation at all locations within the survey would indicate that this phenomenon is ubiquitous in the waters surrounding this island and has subsequently created a habitat with limited sensitivity to suspended sediments in this area. Whilst, siltation levels are high in the sublittoral environment a significant increase in suspended sediment, particularly during the summer months during peak algal growth, might cause some damage to the algal biotopes present through reduced light penetration and availability. However, the moderately strong tidal currents experienced in this area are sufficient to prevent the deposition of significant silt material which might degrade the sublittoral benthic biotopes through smothering and burial of the infralittoral and circalittoral communities. No species of particular conservational interest were noted during the surveys and no rare or fragile biotopes recorded.

8. References

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Greater Dublin Drainage

Ireland Eye Reef Survey

Irish Water

SUMMARY REPORT

Revision0

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BSL Reference Project 1502.2
Date 15th July 2015

Table of Contents

1. Objective 3
2. Historical Data 4
3. Site selection 4
4. Field Operations Summary observations 6
5. Summary Observations 7
5.1 Intertidal 7
5.2 Subtidal 10

List of Tables

Table 1 Rockabill to Dalkey Island SAC Conservation Objectives 3
Table 2: Proposed Littoral and Sublittoral Locations 5
Table 3: Operational Summary 6

List of Figures

Figure 1 Ireland Eye Marine Community Types designated by Rockabill to Dalkey Island SAC 3
Figure 2 Proposed Survey locations for Sublitroral transects (lines) and Littoral coastlines (Stars) weithin the Irelands Eye SAC 5
Figure 3 Intertidal zones for LS1 lower (top), middle (middle) and upper shores (bottom) 7
Figure 4 Intertidal LS2 middle to upper shore zones 8
Figure 5 Intertidal zones for LS3 lower (top) to middle (bottom) shore 9
Figure 6 Lower sections of sublittoral transect S1 10
Figure 7 Upper holdfast area of sublittoral transect S1 11
Figure 8 Silt dominated lower section of sublittoral transect S2 12

1. Objective

The proposed outfall route of the Greater Dublin Drainage (GDD) scheme, terminates at the diffuser location 1km north-east of Ireland's Eye, and falls within the Rockabill to Dalkey Island SAC. The conservation objectives of the Rockabill to Dalkey Island SAC include Annex I qualifying Reefs (Figure 1). To maintain the favourable conservation conditions these Reefs within the SAC, the following criteria are proposed by NPWS (as outlined in Table 1).

Attribute	Measure	Target	Notes
1170 Reefs			
Habitat area	Hectares	The permanent area is stable or increasing, subject to natural processes. See figure 1	Habitat area estimated as 182ha using 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a,b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0)
Habitat distribution	Occurrence	Distribution is stable or increasing, subject to natural processes. See figure 1	Distribution derived from 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a,b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0).
Community structure	Biological composition	Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex. See figure 1	Reef community mapping based on 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a, b).

Table 1 Rockabill to Dalkey Island SAC Conservation Objectives

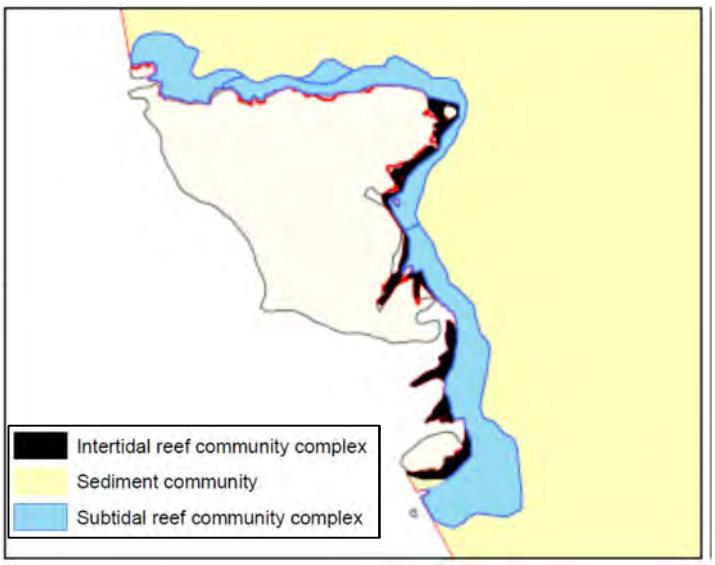


Figure 1 Ireland Eye Marine Community Types designated by Rockabill to Dalkey Island SAC

2. Historical Data

Within the Rockabill to Dalkey Island SAC, two community types were recorded within the Annex I habitat, namely Intertidal reef community complex and Subtidal reef community complex (Reefs 1170). Intertidal and subtidal surveys were undertaken in 2010 and 2011 (MERC, 2010, MERC 2012a and MERC, 2012b). These data were used to determine the physical and biological nature of the Annex I habitat. Estimated areas of each community type within the Annex I habitat, are based on interpolation, and are shown in figure 1.

The development of a community complex target arises when an area possesses similar abiotic features but records a number of biological communities that are not regarded as being sufficiently stable and/or distinct temporally or spatially to become the focus of conservation efforts. In this case, examination of the available data from Rockabill to Dalkey Island SAC identified a number of biological communities whose species composition overlapped significantly. Such biological communities are grouped together into what experts consider are sufficiently stable units (i.e. a complex) for conservation targets.

INTERTIDAL REEF COMMUNITY COMPLEX
This reef community complex is recorded on the eastern and southern shores of Ireland's Eye immediately south of the proposed outfall route and diffuser location. The exposure regime of the complex ranges from exposed to 'moderately exposed' reef for Ireland's Eye. The substrate here is that of flat and sloping bedrock, cobbles and boulders. Vertical cliff faces are found on the north and northeast shores of Ireland's Eye.

SUBTIDAL REEF COMMUNITY COMPLEX
This reef community complex is recorded off the northern, eastern and southern shores of Ireland's Eye immediately south of the proposed outfall route and diffuser location. The substrate ranges from that of flat and sloping bedrock, to bedrock with boulders and also a mosaic of cobbles and boulders. Vertical rock walls occur on the north and east of Ireland's Eye, whilst the northern reaches of the island both show sediment scouring and a thin veneer of silt on the reefs.

In general, previous surveys (MERC 2010, MERC 2012a and MERC, 2012b) noted that where the reef was subjected to the effects of sediment, either through scouring or settlement of silt, low numbers of species and individuals occurred.

3. Site selection

Following a review and combination of existing and surveyed bathymetric datasets, the locations for sublittoral and littoral survey locations was based on a combination of seabed topography, sand site exposure. A total of 4 sublittoral locations and 3 littoral locations were established for survey operations. This are summarised as follows:

Site	Transect	Easting	Northing	Description	Depth (ODM)
S1	start	728470.3	741625	Sublittoral: Northwest stack and discrete sublittoral reef feature.	12.1
	end	728369.1	741589.2		0.34
S2	start	728745.5	741626.2	Sublittoral: Standard slope with boulder field at base	13.99
	end	728752.9	741526.2		1.13
S3	start	729161.4	740937.5	Sublittoral: Exposed southeast island pinnacles	11.81
	end	729060.2	740969.6		0.26
S4	start	729187.4	740556.2	Sublittoral: Exposed southeast islet pinnacles	10.5
	end	729102.2	740624		0.01
I1		729033.1	741472.4	Littoral: Exposed northeast channel between stack	0.04
I2		728910.9	741053.5	Littoral: Sheltered southeast inlet	0.8
I3		729077.5	740648.7	Littoral: Exposed southeast islet rocky coast	0.98

Table 2: Proposed Littoral and Sublittoral Locations

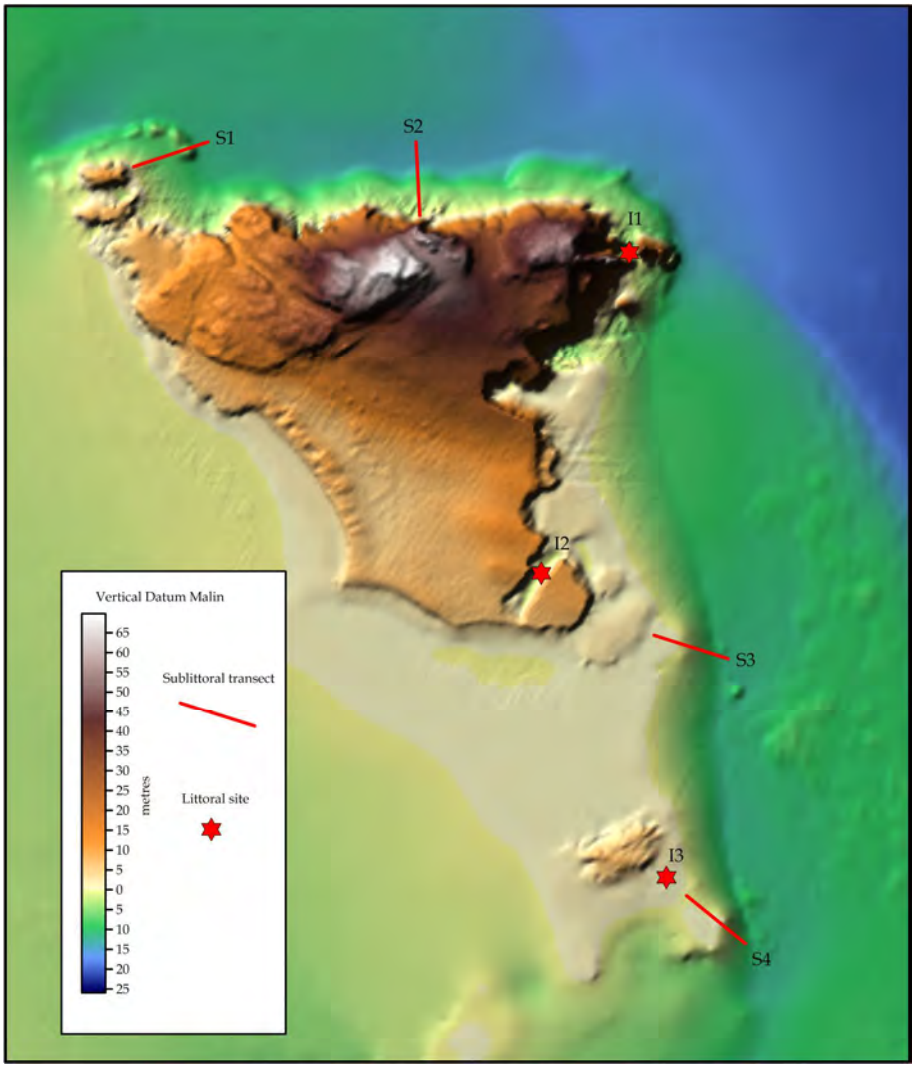


Figure 2 Proposed Survey locations for Sublittoral transects (lines) and Littoral coastlines (Stars) within the Irelands Eye SAC

4. Field Operations Summary observations

Field survey operations were completed successfully at all proposed locations between the 30th June and 2nd of July. A four man dive team, made up from representatives from both MERC and ASML, was mobilised to site on the 29th June, with operations carried out from an 8m RIB. Weather remained good throughout the survey period, with only localised periods of marginal winds occurring on a couple of days. Consequently operations were spread between the dive sites (4 in total) and inter-tidal (3 in total), to make the best use of the prevailing conditions.

A summary of the field operations is outlined in table 2.

Day	Date	Operations	Comment
1	29/06/15	Mobilisation to Howth	ASML mobilised. MERC launched the 8m RIB service vessel locally (Howth harbour).
2	30/06/15	Ops: Diving and intertidal	2 diving sites and 1 intertidal completed.
3	01/07/15	Ops: Diving and intertidal	IW of BSL travels to site for oversight. 1 diving site and 1 intertidal site completed.
4	02/07/15	Ops: Diving and intertidal	1 diver site completed in the morning and 1 intertidal site completed in the afternoon. Vessel recovered and survey personnel demobilised. IW onsite for oversight.
5	03/07/15	Demobilisation from Howth	ASML team demobilised back to the UK.

Table 3: Operational Summary

Field operations were based on a generic assessment of biotopes using the standard (Marine Nature Conservation Review) MNCR-style format. Identification and abundance was scaled onsite using the SACFOR (e.g. superabundant, abundant, common, frequent, ocassional and rare) on all the conspicuous fauna and flora within each biotope encountered. Taxa that could not be readily identified we removed and later identified under a microscope back at the field laboratory (hotel).

During the intertidal survey, sites were selected from aerial photography to present different exposures and the vertical profiles completed along all of the lower, middle and upper shorelines at these locations. Each biological zone was photographed and surveyed. The faunal and floral taxa were identified and abundance scale values allocated also using the SACFOR protocol on all the conspicuous species in each biotope encountered.

5. Summary Observations

5.1 Intertidal

Littoral Site 1 in the gully between northeast stack and the main island is a typically exposed shore, with the exposure to wave action, amplified by the effect of surge through the gap. There is also an effect of shading which is apparent in a reduced algal component. The order of the biotopes runs from algae dominated *LR.HLR.FR.Coff/ IR.MIR.KR.Ldig* through the lower middle shore *LR.HLR.FR.Mas* to a faunally dominated *LR.HLR.MusB.Sem* in the upper middle shore. Then through the barnacles *LR.HLR.MusB.Cht*, followed by a *Porphyra sp.* band to a nitrate enriched *LR.FLR.Lic.Pra* zone in the supralittoral where the copious bird droppings from the nesting and roosting seabirds make their impact on the littoral ecology.

Figure 3 Intertidal zones for LS1 lower (top), middle (middle) and upper shores (bottom)

The shore at **Littoral Site 2** is a more sheltered inlet on the east coast of the island. The protection from wave action afforded by the sheltering intertidal reef has allowed a series of algal dominated biotopes to develop. Initially the *LR.HLR.FR.Coff/ IR.MIR.KR.Ldig* emerges from the sublittoral and passes through a typical *Fucus serratus* and red seaweeds *LR.MLR.BF.Fser.R* zone, to an *Ascophyllum nodosum* and *Fucus vesiculosus LR.LLR.F.Asc.FS* biotope. Above this the spiral wrack and channel wrack mix to form an *LR.MLR.BF.FspiB* biotope with limpets barnacles and littorinids found amongst the algae. This shore finishes with a typical lichen zone dominated by the nitrophilous yellow lichen *Xanthoria parietina* and the green alga *Pasiola stipitata.*

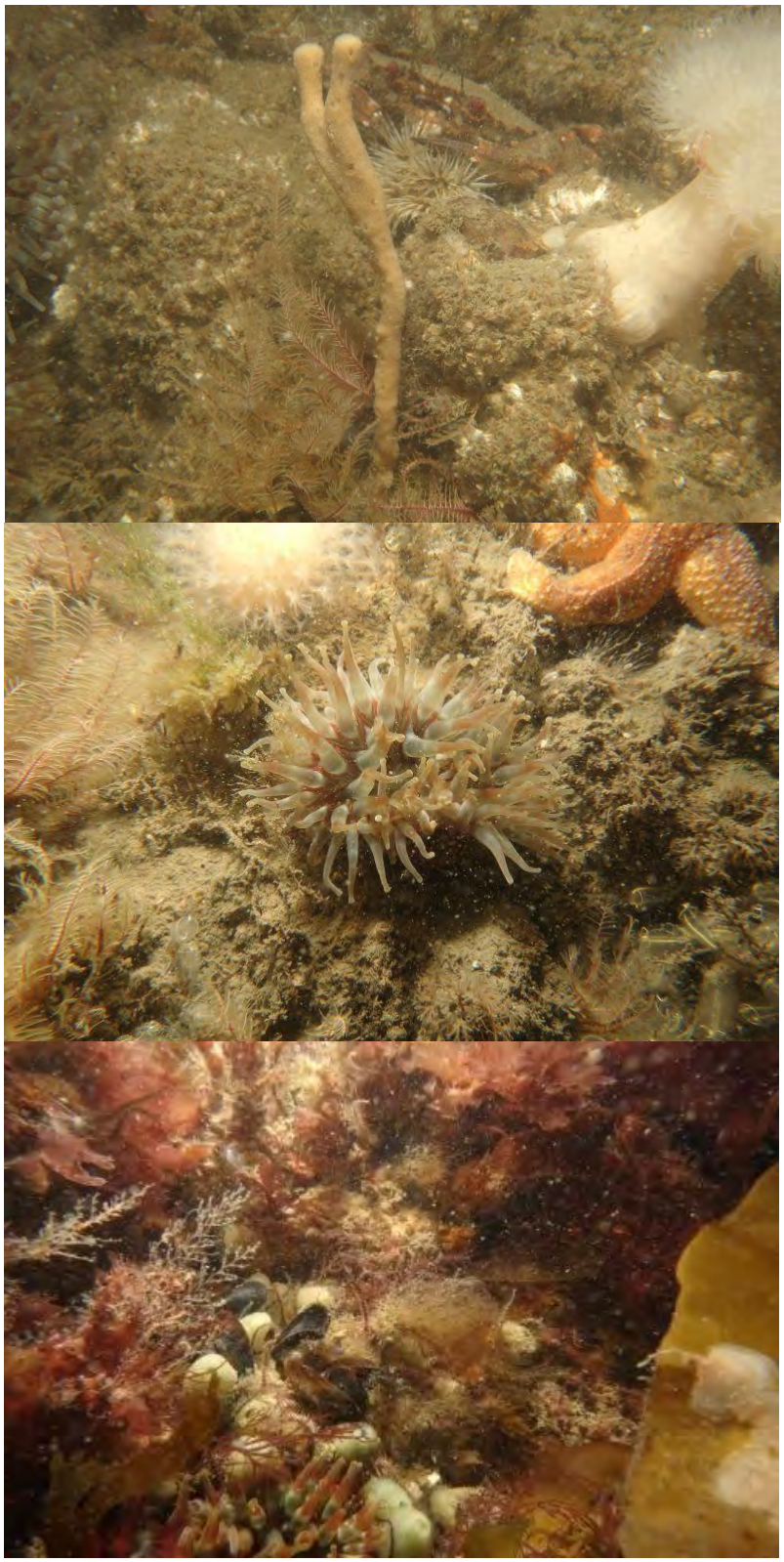
Figure 4 Intertidal LS2 middle to upper shore zones

Littoral Site 3 lies at the southeast tip of the island partially separated from the main island by a connecting intertidal reef. Here the type and order of the biotopes up the shore from low tide level are somewhat similar to those of littoral site 1, with the addition of the several common algae. *Fucus serratus* occurs with the Mastocarpus stellatus in the lower shore and *Fucus vesiculosus var. linearis* occurs in the middle-shore with the limpets, barnacles whilst there is less *Mastocarpus stellatus* which dominated this biotope at site 1.

Figure 5 Intertidal zones for LS3 lower (top) to middle (bottom) shore

5.2 Subtidal

At **Sublittoral Site 1,** the reef ran on to the muddy gravel at approximately 8m BCD, here the rock surface was heavily silted and the community was dominated by the feather-star *Antedon bifida*, the plumose anemone *Metridium senile*, common starfish and the barnacle *Balanus crenatus.* Other anemones *Sagartia elegans, Alcyonium digitatum* and *Urticina felina* were frequently encountered with several sponges (*Haliclona simulans*, *Suberites ficus, Halichondria panicea* and *Esperiopsis fucorum)* hydroids (Obelia dichotoma) and bryozoans (Flustra foliacea and Scrupocellaria spp) were also common. The biotope here possibly being similar to CR.HCR.XFa.ByErSp.Sag.



Above this biotope the foliose algae began to colonise at 3.5-4m BCD and this silty biotope (possibly IR.HIR.KFaR.FoR.Dic) was characterised by *Dictyota dichotoma* and *Delesseria sanguinea* with numerous other small foliose species encountered along with the occasional sugar kelp plant *Saccharina latissima*. Fauna in this biotope were characterised by *Urticina felina, Sagartia elegans, Ophiothrix fragilis, Obelia spp.*, mussels, *Balanus crenatus* and *Pomatoceros*

Figure 6 Lower sections of sublittoral transect S1

Figure 7 Upper holdfast area of sublittoral transect S1

spp. all found within the silty sward.

Above the foliose algal zone, there was a zone of stunted *Laminaria digitata* kelp plants, with several foliose red algae, such as *Palmaria palmata* and *Delesseria sanguinea* along with mussels and common starfish. Probable biotope IR.MIR.KR.Ldig.Ldig.

At **Sublittoral Site 2** there was also a heavy silt burden and at depths of 13m BCD where the reef gave way to muddy gravel, the boulders and outcrops were dominated by *Flustra foliacea, Nemertesia antennina, Alcyonidium diaphanum* and crissiids, with frequent erect sponges, hydroids and *Clavelina lepadiformis*.
Biotope: CR.HCR.XFa.FluCoAs

Above this at 6m BCD the *Dictyota* biotope and foliose red algae was found as at Sublittoral Site 1, though with several new algal species noted such as *Rhodymenia holmesii.* As with Sublittoral site 1, above the foliose algae, there was the zone of stunted Laminaria digitata kelp plants, with several foliose red algae, mussels and starfish.
Biotope IR.MIR.KR.Ldig.Ldig

Figure 8 Silt dominated lower section of sublittoral transect S2

Sublittoral sites 3 and 4 both followed the same pattern as Sublittoral site 2 with perhaps heavier siltation, but similar biotopes.

Overall, all sublittoral environments indicated the presence of significant siltation in the deeper zones. However, the faunal populations of both littoral and sublittoral zones indicated well represented and diverse habitats containing many of the common species found along the Irish Sea coastline. This high diversity was similar to that recorded in the macro-invertebrate population previously recorded within the soft sediments north of this island, and is therefore probably indicative for the survey area as a whole.

Appendix III Baldoyle Bay Walk Over Survey

Greater Dublin Drainage Scheme

Baldoyle Estuary
Baseline Habitat Survey

FINAL REPORT

November 2013

by

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for

EACS - Ecological Advisory and Consultancy Services

on behalf of Benthic Solutions Ltd.

Greater Dublin Drainage Scheme

Baldoyle Estuary
Baseline Habitat Survey

Table of Contents

1. INTRODUCTION 3
2. METHODOLOGY 4
   2.1 Desk Study 4
   2.2 European and National Conservation Designations 4
   2.3 Flora Protection Order (1999) 6
3. RECEIVING ENVIRONMENT 7
   3.1 Review of the Fingal County Council 2004 Survey 7
   3.2 Review of the National Parks and Wildlife Service 2006 Survey 9
   3.3 2013 Survey 13
      3.3.1 Outfall Pipeline Route - Eastern Side: 13
      3.3.2 Outfall Pipeline Route - Western Side: 14
4. CONCLUSIONS 15
5. REFERENCES 16
6. APPENDIX I – PHOTOGRAPHIC RECORD 18

Title	**Greater Dublin Drainage Scheme** **Baldoyle Estuary** **Baseline Habitat Survey** **FINAL REPORT** **November 2013**		
Issue /Rev. No	**Author**	**Reviewed / checked**	**Issue Date**
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Greater Dublin Drainage Scheme

Baldoyle Estuary
Baseline Habitat Survey

1. INTRODUCTION

Faith Wilson Ecological Consultant was appointed by EACS – Ecological Advisory and Consultancy Services, on behalf of Benthic Solutions Ltd., to conduct a baseline habitat and botanical survey of the area of Baldoyle Estuary which is to be crossed by an outfall pipeline, part of the Greater Dublin Drainage Scheme, as illustrated on **Figure 1** below.

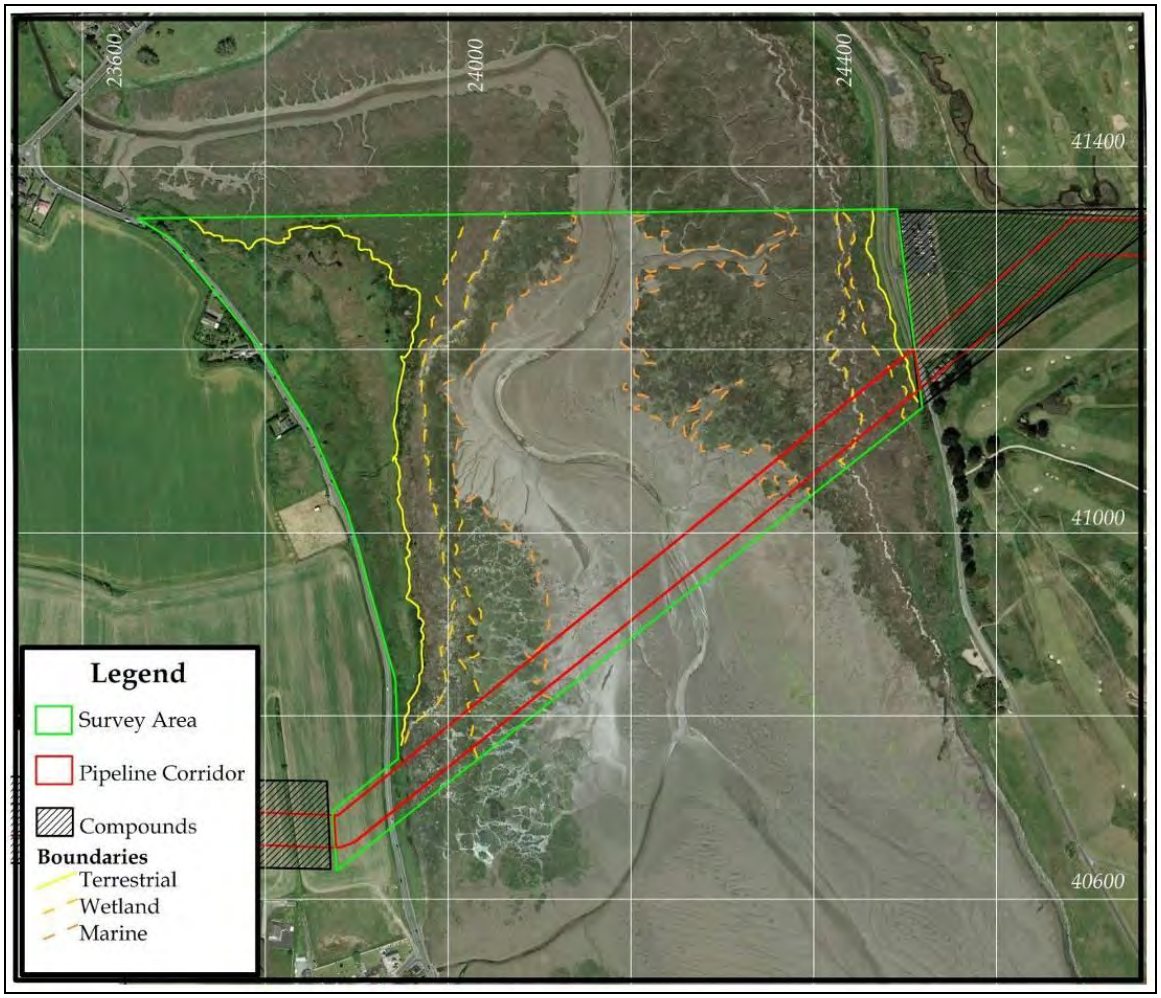

Figure 1. Study area at Baldoyle Estuary.

2. METHODOLOGY

2.1 Desk Study

A desk study was carried out to collate the available information on the ecological environment at Baldoyle Estuary potentially impacted by the proposed development.

The National Parks and Wildlife Service (NPWS) of the Department of Arts, Heritage and the Gaeltacht (DAHG) database of designated conservation areas and NPWS records of rare and protected plant species were checked with regard to the location of the lands at Baldoyle. Consultation was also made with NPWS regarding GIS datasets containing habitat information and other material of relevance.

The most recent study on this site available from NPWS is the Saltmarsh Monitoring Survey which was conducted during 2006 – 2008 (Mc Corry & Ryle (2009)).

Information on surveys conducted by the Biodiversity and Heritage sections of Fingal County Council of coastal habitats in the area (Fingal County Council (2004)) were also reviewed.

2.2 European and National Conservation Designations

The estuary at Baldoyle is subject to designation as a Special Area of Conservation (SAC), a Special Protection Area (for birds) (SPA) and a proposed Natural Heritage Area (pNHA).

SACs are sites of international significance that have been identified by NPWS and submitted for designation to the EU. SAC is a statutory designation, which has a legal basis under the EU Habitats Directive (92/43/EEC) as transposed into Irish law initially through the European Communities (Natural Habitats) Regulations, 1997 - now superseded by the EU Birds and Habitats Regulations (SI 477, 2011). The main implication of this designation is that any project likely to have a significant adverse impact on the integrity of the SAC may only be carried out for "*imperative reasons of overriding public interest, including those of a social or economic nature*". (EU Habitats Directive - Article 6(4)).

SPA is a statutory designation, which has a legal basis under the EU Birds Directive (79/409/EEC). The primary objective of SPAs is to maintain or enhance the favourable conservation status of the birds for which the SPAs have been designated. This is also encompassed by the Birds and Habitats Regulations (SI 477, 2011)

Proposed NHAs are also habitats or sites of interest to wildlife that have been identified by NPWS. NHAs are protected under the Wildlife (Amendment) Act, 2000, from the date they are formally proposed. NHA is a statutory designation according to the Wildlife (Amended) Act, 2000 and requires consultation with NPWS if any development impacts on a pNHA.

The qualifying interests for which these sites - Baldoyle Bay SAC/SPA/pNHA – have been selected are presented below in **Table 2.2.1**.

Table 2.2.1. Nature Conservation Designations at Baldoyle Bay.

Site Code	**Site Name and Designation**	**Conservation Interest** ***Priority Habitats are indicated with an asterisk***
004016	Baldoyle Bay SPA	• Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] • Shelduck (*Tadorna tadorna*) [A048] • Ringed Plover (*Charadrius hiaticula*) [A137] • Golden Plover (*Pluvialis apricaria*) [A140] • Grey Plover (*Pluvialis squatarola*) [A141] • Bar-tailed Godwit (*Limosa lapponica*) [A157] • Wetlands & Waterbirds [A999]
000199	Baldoyle Bay SAC	• (1140) Mudflats and sandflats not covered by seawater at low tide • (1310) *Salicornia* and other annuals colonizing mud and sand • (1330) Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) • (1410) Mediterranean salt meadows (*Juncetalia maritimi*)
000199	Baldoyle Bay pNHA	• As above for the SAC/SPA • Borrer's Saltmarsh-grass (*Puccinellia fasciculata*) • Meadow Barley (*Hordeum secalinum*).

Conservation Objectives:
Detailed site management plans have been prepared for Baldoyle Estuary SAC and SPA. A summary of the conservation objectives, in relation to their qualifying interests, for Baldoyle Estuary SAC and SPA are summarised below in **Table 2.2.2**.

Table 2.2.2. Conservation Objectives for Baldoyle Bay.

Site Code:	Summarised Conservation Objectives
Baldoyle Bay SPA 004016	To maintain the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA: • [wintering] *Branta bernicla hrota* • [wintering] *Tadorna tadorna* • [wintering] *Charadrius hiaticula* • [wintering] *Pluvialis squatarola* • [wintering] *Limosa lapponica* To maintain the favourable conservation condition of the wetland habitat in Baldoyle Bay SPA
Baldoyle Bay SAC 000199	To maintain the favourable conservation condition of the Annex I habitats for which the SAC has been selected: • Mudflats and sandflats not covered by seawater at low tide [1140] • *Salicornia* and other annuals colonizing mud and sand [1310] • Spartina swards (*Spartinion maritimae*) [1320] • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] • Mediterranean salt meadows (*Juncetalia maritimi*) [1410]

2.3 Flora Protection Order (1999)

Baldoyle Estuary supports populations of two species protected under the Flora Protection Order (1999). These are Borrer's Saltmarsh-grass (*Puccinellia fasciculata*) and Meadow Barley (*Hordeum secalinum*). Populations of these species have not been reported from the area of the pipeline crossing route.

3. RECEIVING ENVIRONMENT

3.1 Review of the Fingal County Council 2004 Survey

Fingal County Council commissioned a survey of coastal habitats in the county in 2004. Phase I of the study involved the mapping of all coastal habitats within the County. Phase II of the survey involved a study of the coastal vegetation communities within the county boundaries. Rare, threatened or legally protected flora were also recorded.

The objectives of the study were:

- To locate, survey and accurately map the different coastal habitats in County Fingal.
- To produce a list of characteristic plant species for each coastal habitat type.
- To produce a list of the natural and semi-natural vegetation found along the coast.
- To locate and record the position of legally protected, rare or threatened flora of the Fingal coast using Geographical Positioning Systems (GPS).
- To identify areas of floristic importance along the coast.
- To produce recommendations for the conservation of species and their habitats for inclusion in the Fingal Biodiversity Action Plans.

The surveys were conducted by Declan Doogue, Deborah Tiernan and Hans Visser (Fingal County Council (2004)). Baldoyle Estuary was surveyed as part of the survey of the Portmarnock area and the salt marsh habitats are described as follows:

> "The salt marsh that extends eastward from Portmarnock is clearly differentiated into an upper zone, (**CM1**) with abundant stands of *Juncus maritimus* and a lower zone of middle and lower saltmarsh (**CM2**). *Atriplex portulacoides* is a strong associate of *Juncus maritimus* in this area. A number of stands of *Oenanthe lachenalii* occur on the interface between upper and lower salt marsh, often where there is some evidence of irrigation by percolating freshwater. A number of large stands of *Phragmites australis* also occur at the upper end of the saltmarsh near the road where there is a natural fall in the land from the adjoining course and former agricultural areas. Colgan did not record this conspicuous nutrient-demanding species from the area and its increase in many sites along the Dublin coast may be indicative of ground water enrichment".

The salt marsh vegetation is described as follows:

> "The salt marsh vegetation of the area lying to the west of the peninsula in its upper zones resembles *Juncus maritimus – Triglochin maritima* community with an abundance of *Atriplex portulacoides* forming a distinct compact layer close to the road. Below that a

variety of mixed patches of *Puccinellia maritima* salt-marsh community, mixed with *Atriplex portulacoides, Festuca rubra* and *Juncus gerardii* salt-marsh communities occur in close proximity".

The habitat map produced as part of the survey is presented below on **Figure 2**.

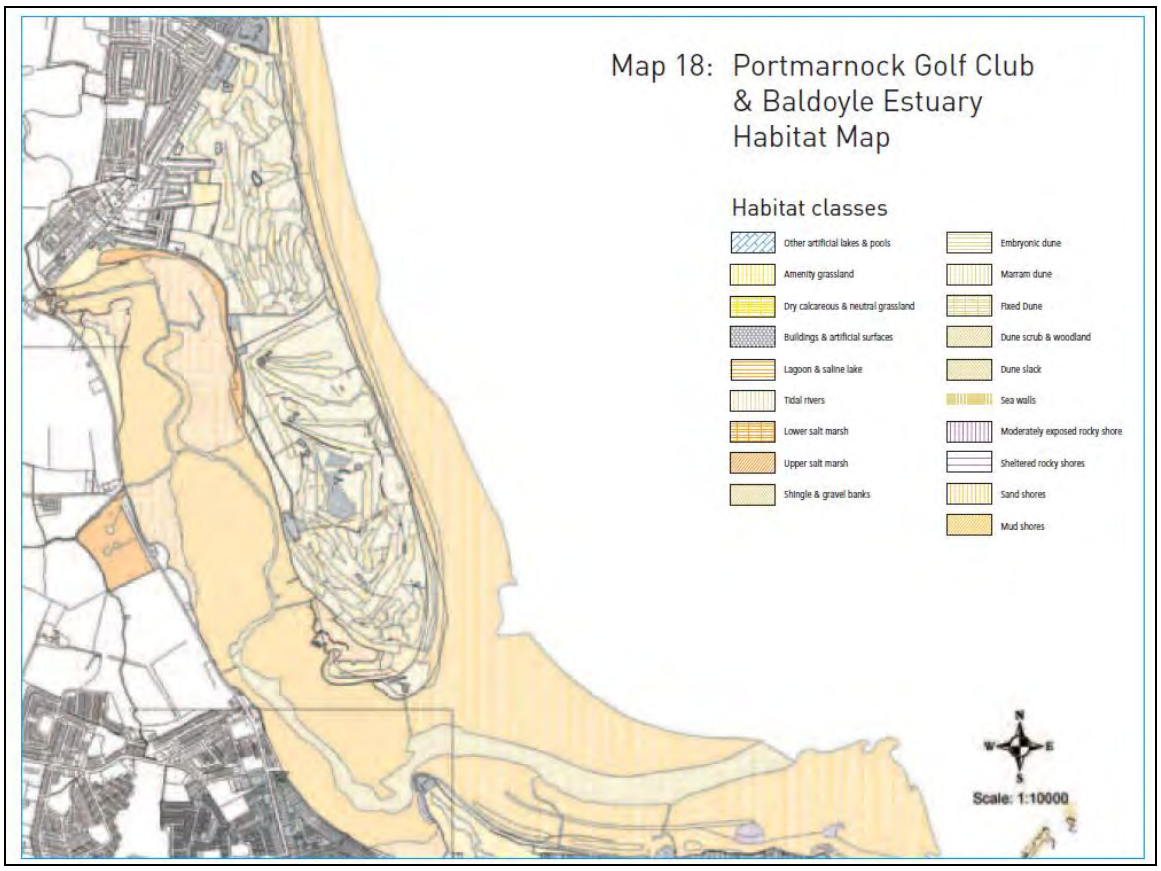

Figure 2. Habitat Map of the Portmarnock Peninsula showing the habitats described using Fossitt (2000) prepared as part of the Fingal County Council Coastal habitat survey (Fingal County Council (2004).

3.2 Review of the National Parks and Wildlife Service 2006 Survey

The Baldoyle Estuary was surveyed over several days in June 2006 as part of a national saltmarsh monitoring project commissioned by National Parks and Wildlife Service. The survey developed a monitoring methodology based on the JNCC guidelines for saltmarshes, which was based on vegetation surveys and assessments of threats and management practices. This methodology was adapted for Irish saltmarsh habitats. Baldoyle Estuary was surveyed by the project team in 2006.

A detailed habitat map for the site (available both in hard copy and as GIS shapefiles) and descriptions of the Annex I habitats present were outlined in the NPWS Saltmarsh Monitoring Project report (Mc Corry and Ryle (2009)).

Mc Corry and Ryle (2009) describe the estuary as follows:

> "Baldoyle Estuary is located in County Dublin to the north of Baldoyle Village and to the south of Portmarnock. This is a small estuary of the River Sluice and is orientated north-south and dominated by intertidal mud and sand flats. It is enclosed by a large sand dune system on the east side. Saltmarshes mainly occur in the northern part of the estuary, on both sides of the estuarine-river channel. Other small areas of saltmarsh occur along the western side, at the end of Portmarnock Point and along the southern side of the estuary adjacent to Sutton Dart Station. Another small saltmarsh/brackish marsh area occurs along the Mayne River, which flows into the western side of the estuary. This area contains the rare grass species Borrer's Saltmarsh-grass (*Puccinellia fasciculata*), a species listed on the Flora Protection Order. Baldoyle Estuary also includes a dune system at Portmarnock Point. The conservation status of the sand dune habitats were assessed by the Coastal Monitoring Project in 2004.
>
> Three Annex I habitats, *Salicornia* flats, Atlantic salt meadows (ASM) and Mediterranean salt meadows (MSM), are found at this site. All three habitats are listed as qualifying interests for the Baldoyle Estuary cSAC. *Spartina* swards are also present at this site. Nearly all of the saltmarsh habitat is situated within the cSAC. There are some exclusions at the southern end of Portmarnock Spit. Some of the ASM is located outside the cSAC due to the exclusion of the golf course.
>
> Most of the site is also a National Nature Reserve that is managed by NPWS. The saltmarsh located at the southern end of Portmarnock Spit is excluded from the nature reserve. The estuary is also designated as a SPA due to its importance for wintering waders and wildfowl, including internationally important numbers of Brent Geese".

The Annex I habitats within the site are described by Mc Corry and Ryle as follows:

Atlantic Salt Meadow (H1330)

"The largest area of ASM is located in the north-west part of the estuary. This area contains several zones of ASM saltmarsh vegetation. The lower zone is dominated by Sea Purslane with frequent Common Saltmarsh-grass and occasional Greater Sea Spurrey and Lax-flowered Sea Lavender. This zone is quite narrow in places and is most frequent along the northern side of this area. There is generally a distinct boundary with the adjacent *Spartina* swards. The lower zone has frequent clumps of Common Cordgrass spread through it. Within Area 1 there is a low-lying area that was formerly a small bay containing mudflats. This area now contains *Spartina* swards and lower zone ASM with frequent cover of Common Cordgrass. Common Cordgrass within the ASM may reach 40%. Lower marsh ASM vegetation dominated by Sea Purslane has developed along the edges of the Sluice River channel.

Higher up on the marsh there is a mid marsh zone dominated by Sea Pink and Sea Plantain. Other species present in this zone include Sea Aster, Lax-flowered Sea Lavender and Red Fescue. This area has frequent large salt pans and a complex creek network. Common Cordgrass is frequent in this zone within salt pans but it becomes less frequent towards the back of the marsh. This species has also infilled some small creeks within this area. This area contains the best developed topography present at the site. Upper saltmarsh vegetation is dominated by Saltmarsh Rush along the landward boundary and adjacent to the MSM also in this area. The ASM generally transitions to rank grassland or scrub above the high water mark.

There is a generally narrow band of ASM located in Area 4 in the north-east of the estuary. This band of saltmarsh is situated between *Spartina* swards and an embankment along the road or further north with brackish vegetation located at the landward side. There are patches of MSM vegetation scattered along this band of saltmarsh. The ASM vegetation in the northern section is generally dominated by Red Fescue. The topography is quite uneven. Common Cordgrass is present in the pans and as clumps within the ASM vegetation."

Mediterranean Salt Meadows (H1410)

"This habitat is characterised by clumps of Sea Rush. It is found on small scattered clumps in a generally narrow band (1-20 m) along the landward side of most of the saltmarsh. The habitat may be represented by clumps only 1-2 m wide. Its distribution breaks up in places and clumps become isolated from each other. It also forms a mosaic with ASM in places where there are small scattered clumps of Sea Rush mixed with ASM vegetation that forms a narrow zone of saltmarsh.

Sea Rush forms large clumps in places and though it may not actually dominate the cover (cover varies from 30-75%), it is the most characteristic and obvious part of the vegetation. Many of the clumps have other saltmarsh species colonising these clumps and this reduces the actual overall cover of Sea Rush. Sea Purslane is found quite frequently amongst these clumps with Red Fescue. Other species found occasionally include Saltmarsh Rush, Sea Arrowgrass, Sea Aster, Sea Plantain, Sea Pink, Creeping Bent grass, Common Scurvy Grass and Lax-flowered Sea Lavender.

One notable aspect of the distribution of Sea Rush is that it is sometimes found to the seaward side of ASM vegetation and adjacent to the Spartina sward. This occurs in the narrow bands of ASM/MSM mosaic. Common Saltmarsh-grass and Lax-flowered Sea Lavender are found within this vegetation associated with the clumps of Sea Rush. This zone also contains pans infilled with common Saltmarsh-grass. The ASM and MSM were mapped as a mosaic as the saltmarsh is quite narrow and it would be difficult to map the two habitats separately. This saltmarsh on the western side of the estuary transitions to rank grassland dominated by Twitch."

***Spartina* Swards**

"*Spartina* swards are the most extensive habitat at this site. This habitat is not listed as a qualifying interest for this site. These swards are quite mature and developed quite quickly during and soon after the 1950's (O'Reilly & Pantin 1957). There has not been much significant change since this period. This habitat is usually characterised by a high stem density of Common Cordgrass. There are small amounts of Common Saltmarsh-grass, Lax-flowered Sea Lavender and Greater Sea-spurrey within the sward, particularly closer to the landward boundary. These swards are quite mature and a complex creek structure has developed in the swards. The development of these swards has significantly narrowed the upper part of the Sluice River channel in the north-western corner of the estuary.

There is still a distinctive boundary between the ASM and the *Spartina* sward along much of the boundary with a low saltmarsh cliff situated along the border.

Sometimes the ASM/*Spartina* sward boundary follows the exact lower boundary of the saltmarsh marked on the 2nd edition 6 inch map, as indicated from the GPS. This indicates that the *Spartina* sward has predominately developed on intertidal mudflats.

In other places the boundary is less distinct and there is a gradual transition from dense *Spartina* sward to a mosaic of *Spartina* sward and ASM and then to isolated clumps of Common Cordgrass situated within the ASM.

Much of the Spartina sward located on the southern part of the estuary contains a mosaic of isolated clumps and mudflats at the seaward edge of the denser sward. There are actually signs of recent dieback along the seaward side of the sward lower down in the estuary (within the areas mapped as Spartina clump/mudflat mosaic). Some clumps have died back and are being eroded. There are no signs of Glasswort amongst the clumps of Common Cordgrass forming the clump/mudflat mosaic, seaward of the denser swards."

Conservation Status

Overall, the site was deemed by Mc Corry and Ryle to be in favourable conservation status.

The habitat map showing the distribution and extent of Annex I habitats produced by Mc Corry and Ryle are presented below on **Figure 3**.

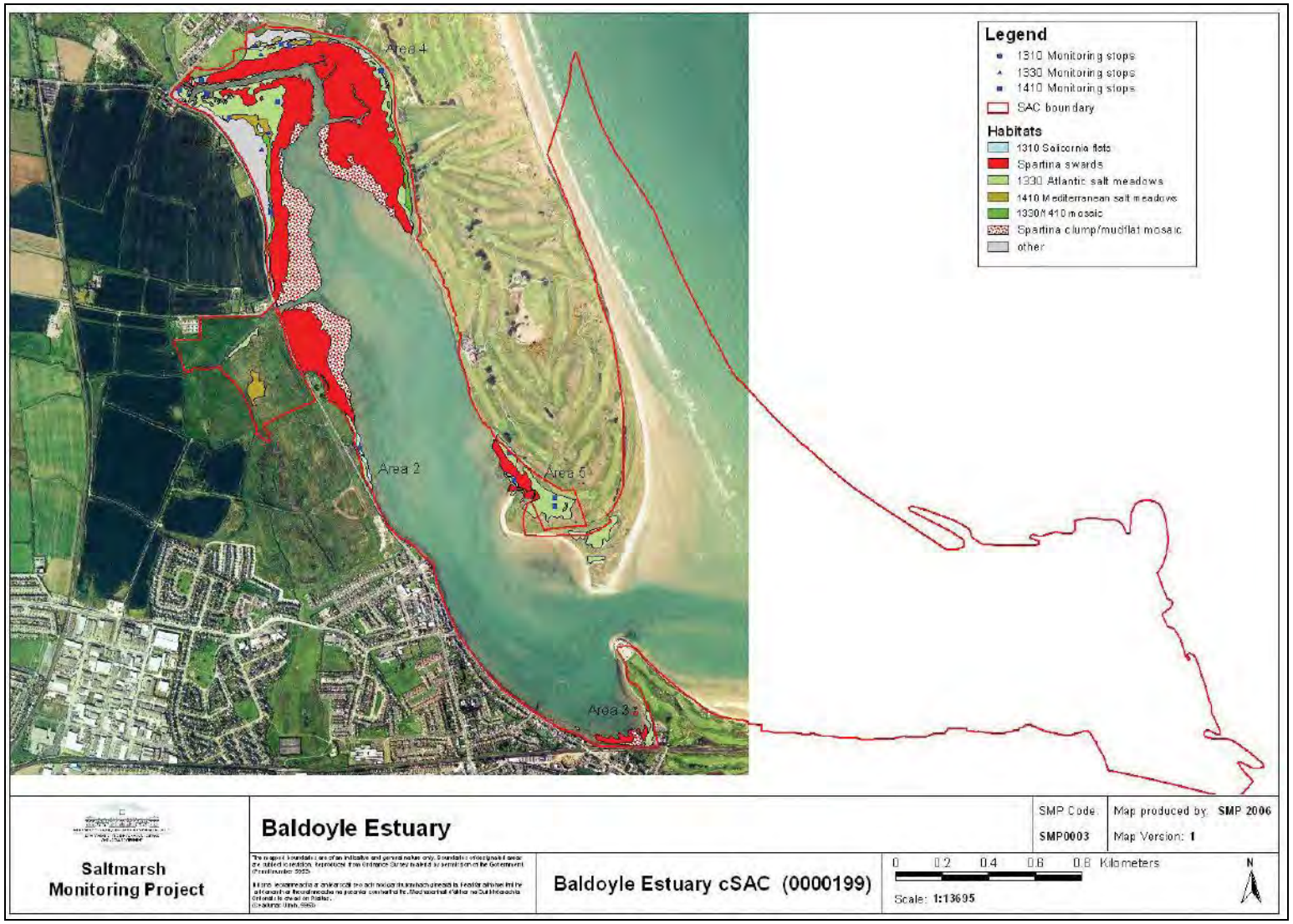

Figure 3. Habitat Map of the Annex I Habitats of Baldoyle Estuary prepared by Mc Corry and Ryle (2009).

3.3 2013 Survey

The site was visited on the 13th November 2013 by Faith Wilson at which time the habitat mapping prepared by Mc Corry and Ryle (2009) and their descriptions of habitats were reviewed in the field in relation to the current conditions at the site and the proposed outfall pipeline route. The GIS shapefiles prepared by Mc Corry and Ryle (2009) were loaded onto an IPad using an Irish National Grid projection, and underlain by Google Maps satellite imagery. This allowed for an accurate assessment in the field of the extent of habitat types as previously described and mapped and to document any changes in same. A photographic record of the habitats recorded was also made using the IPad, which enables all photographs to be accurately geo-tagged. A selection of site photographs is presented in **Appendix 1**.

3.3.1 Outfall Pipeline Route - Eastern Side:

The eastern section of the pipeline crosses an area of the estuary near the public car park for the Portmarnock beach and dune system/entrance to Portmarnock Golf Club, which was described within the Mc Corry and Ryle (2009) report as Area 4 as follows:

> "Saltmarsh to the north and north-east of the river channel in the north-east corner of the estuary is dominated by *Spartina* swards (Area 4). A band of mainly ASM occurs to the landward side, widening in places. Sea Rush (*Juncus maritimus*) is present in this area and some of the larger patches are classified as Mediterranean salt meadow.
>
> Atlantic salt meadow continues around the eastern side of the estuary and eventually narrows to form a very narrow band to the landward side of the *Spartina* sward. The ASM widens out somewhat to the south of the entrance to Portmarnock Golf Club".

At this side of the estuary the outfall pipeline crosses a grassy embankment, which is mown and maintained by Fingal County Council adjoining the public road, before reaching a band 20-30m wide in places of a mosaic of Atlantic salt-meadow (ASM) and Mediterranean salt-meadow (MSM). To the north of the pipeline route is an area of Atlantic salt-meadow (ASM). These areas grade into extensive swards of *Spartina* which extend towards the centre of the estuary where they become broken up, forming a mosaic of clumps of *Spartina* and mudflats.

At the upper extent of the saltmarsh the vegetation is dominated by Creeping Bent Grass (*Agrostis stolonifera*), with occasional Sea Beet (B*eta maritima*), Sea Rush (*Juncus maritimus*), Red Fescue (*Festuca rubra*), Sea Purslane (*Halimione portulacoides*), Common Scurvy Grass (*Cochlearia officinalis*) and Sea Pink (*Armeria maritima*).

These grade into an area of middle marsh with occasional pans and creeks which are dominated by Sea Pink, Sea Plantain (*Plantago maritima*), Lax-flowered Sea Lavender (*Limonium humile*) and Sea Aster (*Aster tripolium*) with occasional stands of Saltmeadow Rush (*Juncus gerardii*) and Sea Rush, whilst areas with higher inundation of the tide (lower marsh) contain Sea Arrow Grass (*Triglochin maritima*), Common Scurvy Grass and Sea Purslane. This then grades into areas of dense stands of Common Cord-grass (*Spartina anglica*) which dominate the mudflats and creeks with occasional *Enteromorpha*.

North of the main crossing point for the pipeline is an area with better defined pans and creeks that more closely approximates pure Atlantic Salt Meadows and a stand of Common Reed (*Phragmites australis*) is present near where the road turns back to the west.

3.3.2 Outfall Pipeline Route - Western Side:

The western section of the outfall pipeline crosses an area of the estuary near the Mayne River described within the Mc Corry and Ryle (2009) report as Area 1 as follows:

> "The main area (Area 1) occurs in the north-west corner of the estuary and to the south of the estuarine river channel. This area contains the largest area of Atlantic salt-meadow (ASM) and contains a general band of Mediterranean salt-meadow (MSM) (widening to form patches in places and disappearing in other areas) on its landward side. There is extensive *Spartina* sward formation on the seaward side, along the river channel and into the estuary. **The saltmarsh habitats narrow towards the south and ASM and MSM eventually develop into a narrow band of vegetation to the landward side of *Spartina* sward.** The *Spartina* sward continues to the south of the Mayne Bridge, with only a narrow band of ASM vegetation occurring to its landward side".

The section of the outfall pipeline route at the western end affects the section of Area 1 highlighted in bold in the above description.

The western side of the route contains a much narrower band of saltmarsh vegetation, which is backed by an area of rank grassland adjoining the road. Species recorded here include Creeping Bent, thistles (*Cirsium arvense* and *Cirsium vulgaris*), Docks (*Rumex* sp.), Tall Fescue (*Festuca arundinacea*), Bush Vetch (*Vicia sepium*), Nettle (*Urtica dioica*) and Common Comfrey (*Symphytum officinale*).

Below this is a narrow band of a mosaic of Atlantic salt-meadow (ASM) and Mediterranean salt-meadow (MSM), which is no more than 1-4m wide. The main species recorded here include Sea Beet, Sea Purslane and Sea Arrowgrass interspersed with stands of Common Cord Grass. These become more dominant

forming a *Spartina* sward for approximately 30-40m before breaking up into a mosaic of clumps of *Spartina* and open mudflats.

The band of saltmarsh vegetation tapers off to the south towards the Mayne River and occasional sparse patches of Sea Aster, Common Scurvy Grass, Glasswort (*Salicornia* sp.) and Common Cord-grass are present on the open muds. Backing this is a stone wall with scattered Sea Aster, Lax-flowered Sea Lavender, Sea Arrowgrass and Sea Beet.

4. CONCLUSIONS

The habitats at Baldoyle Estuary do not appear to have undergone any significant changes in quality or extent at the proposed location of the outfall pipe since the 2006 surveys conducted by NPWS. The boundaries of the Annex I habitats as mapped by Mc Corry and Ryle have not changed significantly since that time and the vegetation composition at the proposed outfall pipeline route appears to have remained broadly similar.

Some of the species recorded in the earlier 2004 surveys by Doogue *et al.*, such as *Atriplex portulacoides*, *Juncus gerardii* and *Oenanthe lachenalii* were not encountered at the proposed outfall route but may be present further north within the estuary where a greater extent of saltmarsh vegetation is present.

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6. APPENDIX I – PHOTOGRAPHIC RECORD

Plate 1. Eastern edge of proposed outfall pipe crossing point, bounded to the east by the grassy embankment and public road.

Plate 2. Mosaic of Atlantic Salt Meadow and Mediterranean Salt Meadows habitats on the eastern side of the site.

Plate 3. Open pans and creeks are occasional in the eastern section of the outfall pipeline route.

Plate 4. Mosaic of Atlantic Salt Meadow and Mediterranean Salt Meadow habitats on the eastern side of the site with stands of Common Cordgrass.

Plate 5. Extensive stands of Common Cordgrass are a feature of this site on the eastern side of the proposed crossing point.

Plate 7. In some locations the boundary between the mosaic of ASM/MSM and *Spartina* stands is well defined.

Plate 8. Stands of Common Cordgrass and occasional patches of *Enteromorpha* along creeks on the eastern side of the site.

Plate 9. Rank grassland adjoining the road and saltmarsh vegetation near the outfall pipe route on the western side of the site.

Plate 10. A very small band of a mosaic of ASM/MSW vegetation is present on the western side of the site.

Plate 11. Extensive swards of Common Cordgrass are also a feature of the western side of the site.

Plate 12. Towards the Mayne River Estuary a mosaic of clumps of Common Cordgrass and open mudflats are present.

Plate 13. Towards the Mayne River Estuary a stonewall backs the mosaic of Common Cordgrass and open mudflats.

Plate 14. Mayne River estuary to the south of the outfall pipe route on the western side of the site.

Appendix IV – RPS Whelk Survey 2015

Greater Dublin Drainage

Whelk Survey Report

Document Control Sheet

Client:	Jacobs
Project Title:	Greater Dublin Drainage – Specialist Ecology Services
Document Title:	Whelk Survey Report
Document No:	MDE1046ARP1001

Text Pages:	16	Appendices:	0

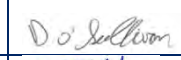
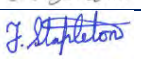
Rev.	Status	Date	Author(s)		Reviewed By		Approved By	
F01	Final	26th November 2015	DOS		JM		CC	
			FS					
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TABLE OF CONTENTS

1 INTRODUCTION 2
2 BACKGROUND AND WHELK FISHERY 3
3 SURVEY OBJECTIVES 5
4 METHODOLOGY 6
4.1 FIELD LOG SUMMARY 9
4.2 DATA ANALYSIS 9
5 RESULTS 10
6 DISCUSSION 14
7 CONCLUSIONS 15
8 REFERENCES 16

LIST OF FIGURES

Figure 1.1 – Proposed Location of Outfall Pipeline 2
Figure 2.1 – The distribution of the south west Irish Sea whelk fishery (from Fahy *et al*., 2005). 3
Figure 3.1 – Common whelk (*Buccinum undatum*) 5
Figure 4.1 – Charter skipper's vessel (in red) used for the whelk survey, Atlantic Freedom S78. 6
Figure 4.2 – Whelk pots (left) and sorting grate (right). 7
Figure 4.3 – Example of a measuring board (image courtesy of manufacturer) 8
Figure 4.4 – Measurement of the total length with calipers (image taken from Lawler, 2014) 8
Figure 5.1 – Deployment and retrieval locations of pot strings. 11
Figure 5.2 – Length Frequency (mm) of whelk sampled. 13

LIST OF TABLES

Table 5.1 – Positions and depths of whelk pots (in WGS84, degrees decimal minutes) 10
Table 5.2 – Total weight of whelk caught and sampled. 11
Table 5.3 – Composition of the sampled catch 12
Table 5.4 – Pearson correlation matrix for whelk catch rate (i.e. abundance and weight) versus haul depth (p values included in parenthesis; * denotes significant correlation) 13

1 INTRODUCTION

The Greater Dublin Drainage Project (GDD) is the proposed development of a new regional wastewater treatment facility for the greater Dublin area. The GDD involves a new wastewater treatment plant at Clonshaugh; an underground orbital sewer and two pumping stations; and an outfall pipeline discharging to the Irish Sea (1km north-east of Ireland's Eye; **Figure 1.1**). The project is vital to safeguard public health, improve and protect the environment, and facilitate employment, social progress and economic growth in the wider Dublin Region.

RPS was commissioned by Jacobs to undertake a Common whelk (*Buccinum undatum*) survey in the Irish Sea, just north of Howth, Co. Dublin, to support the environmental assessment and planning application of the GDD. The study area of the whelk survey was the proposed outfall pipeline and adjacent area (**Figure 1.1**).

As part of consultation meetings undertaken by Jacobs with the Sea Fisheries Protection Agency (SFPA) for the proposed application, a programme of fisheries surveys were recommended including a whelk survey. Hence, the whelk survey forms part of the Environmental Impact Statement (EIS) and planning application for the GDD project (envisaged to be submitted in late 2016).

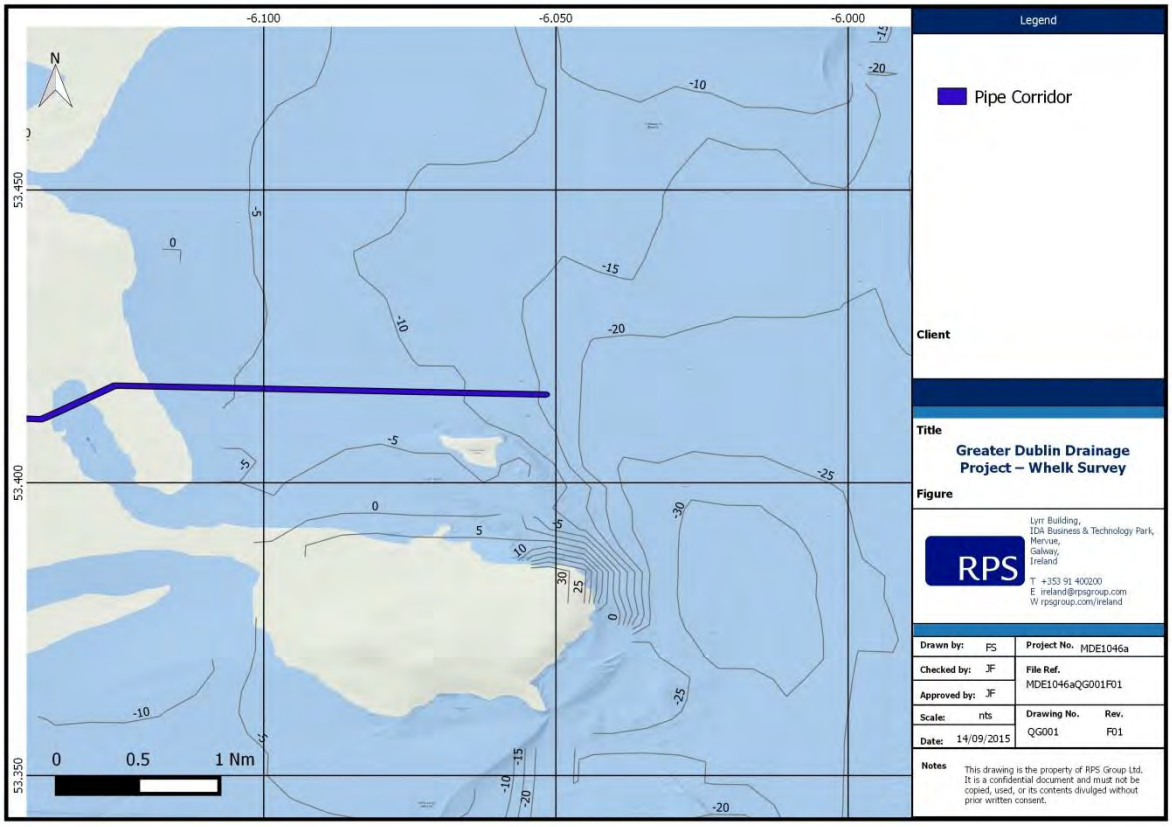

Figure 1.1 – Proposed Location of Outfall Pipeline.

2 BACKGROUND AND WHELK FISHERY

In the waters north of Howth and along much of the east coast of Ireland, there is an active whelk fishery. RPS conducted an assessment of the available literature and landings reporting for the fishery in the development of this report for the Greater Dublin Drainage project. The Common whelk (*Buccinum undatum*) fishery primarily takes place within 5 nautical miles of the coast for the majority of the south west Irish Sea whelk fishery (Fahy *et al*., 2005) (**Figure 2.1**). Whelks are most abundant on banks of sand and aggregate, which are washed by strong north-south tidal currents. Aggregate banks in the northern half of the fishery extend further offshore and fishing also takes place here up to 10 nautical miles from the coast.

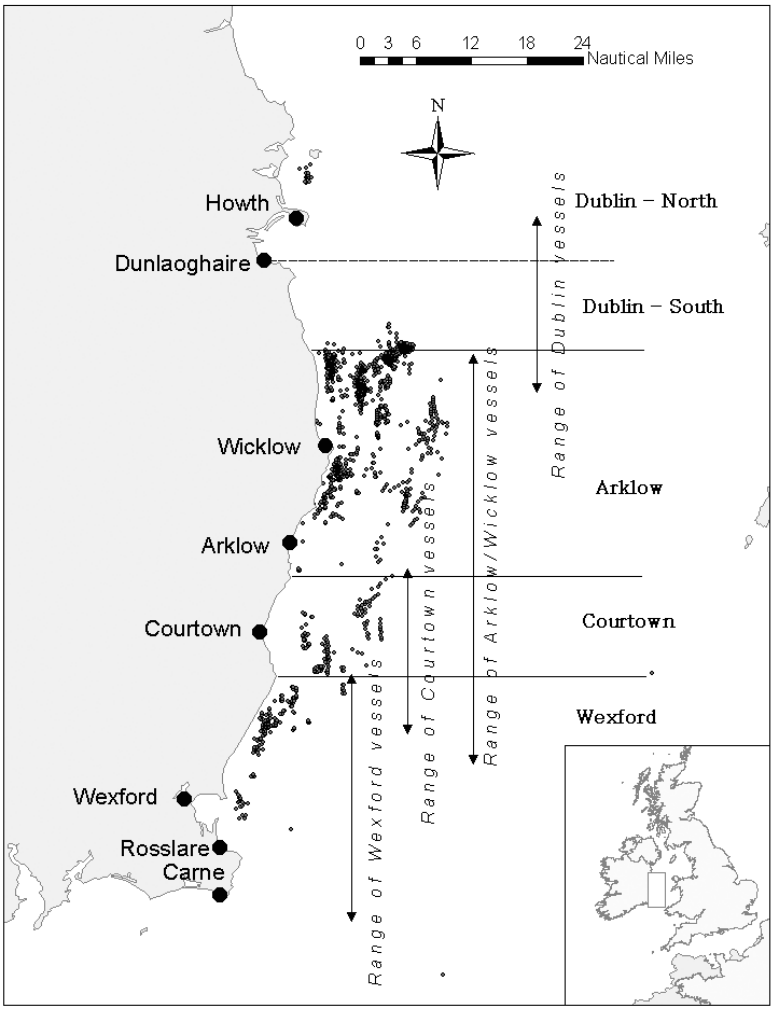

Figure 2.1 – The distribution of the south west Irish Sea whelk fishery (from Fahy *et al*., 2005).

The Common whelk fishery off the Ireland east coast occupies approximately 2,000 km², 1,800 km² of which is in the south west (Fahy *et al*., 2008). The fishery had an estimated turnover of €18 million in 2003 and employed 250 persons, directly and indirectly, in catching and processing (Fahy *et al*., 2005). The number of whelk fishing vessels in the south west Irish Sea fishery has varied between 40 and 80 since the mid-1990s.

The majority of whelk fishing boats range in size from less than 10 to 15 m in length and fish close to ports where they land the whelks. The south west Irish Sea whelk fishery is composed of four sectors: Dublin, Arklow, Courtown and Wexford. Of these sectors the Dublin sector (vessels from Dun Laoghaire and Howth) supports the lowest densities of whelk landed (Fahy *et al*., 2000). The Dublin sector supports a small number of fishing vessels with much of the activity occurring in and around the sandbank areas near the Kish Bank and within the north of Dublin Bay.

3 SURVEY OBJECTIVES

The primary aim of this study was to carry out a targeted whelk survey in conjunction with a whelk fisherman on his vessel just north of Ireland's Eye to obtain meaningful data on the whelk population in and around the proposed pipeline route to provide information on the species and the fisheries resource. To do this, whelk pots were deployed and used to recover whelk samples (**Figure 3.1**) at nine locations in Dublin Bay. Catches were processed and a length frequency data was recorded to identify broad size classes. This report on the survey results will provide data on the whelk population in the vicinity of the pipeline route.

Figure 3.1 – Common whelk (*Buccinum undatum*).

4 METHODOLOGY

The survey was conducted between Tuesday 22nd and Friday 25th of September 2015 towards the end of the neap tide period. The scope of the whelk survey was discussed with the Sea Fisheries Protection Authority (SFPA) and the methodology used for carrying out the sampling is outlined below.

A number of stations were chosen in consultation with the charter skipper reflecting how and where whelk fishermen would normally deploy gear (whelk pots and strings). A survey grid was chosen with the charter skipper along the pipeline at suitable depths at which whelks are known to occur.

The following deployments were carried out from the charter skipper's vessel (**Figure 4.1**):

- Hauls 1 – 3: 3 strings deployed along the pipeline with an East to West heading,
- Hauls 4 – 6: 3 strings positioed south of the pipeline as a control with an East to West heading, and
- Hauls 7 – 9: 3 strings placed north of the pipeline as an additional control with an East to West heading.

Each string comprised of 50 whelk pots. The shooting and hauling position for each string was recorded when the first and last pots were deployed and recovered. Depth at shooting and hauling locations were averaged to give a mean depth for the haul/string.

Figure 4.1 – Charter skipper's vessel (in red) used for the whelk survey, Atlantic Freedom S78.

Figure 4.2 – Whelk pots (left) and sorting grate (right).

Whelk Pot Method:

- Each pot was baited with brown crab (Cancer *pagurus*) and dogfish (*Scyliorhinus* species),
- After deployment the string of pots (**Figure 4.2**) were left to soak for up to 24 hours before hauling and processing the catch through the sorting grate (**Figure 4.2**),
- In every tenth pot the following details were recorded to process the catch:
    - Total length (mm) of all whelk,
    - Weight of all whelk sampled, and
    - Identification and number of individuals of all other species.
- Total weight of whelk landed per string was also recorded.

Whelks were measured using a measuring board and calipers (**Figures 4.3 and 4.4**). The total length (**Figure 4.4**) was recorded for each whelk sampled. The weight of the catch in haul 1 and haul 2 was recorded using a weighing scales, and used to estimate the catches recovered in haul 3 to haul 9. The total weight of the whelk caught was estimated with the charter skipper at the time of catch and then later confirmed once the whelk were weighed at market. Information and comments from the charter skipper are also incorporated into the findings of this report.

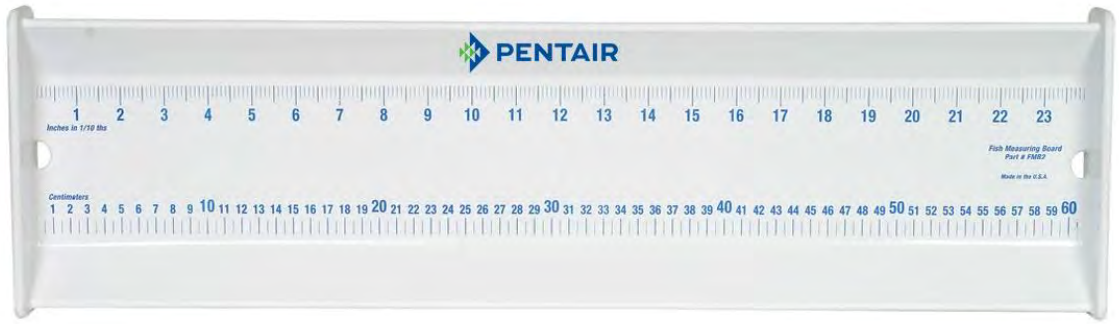

Figure 4.3 – Example of a measuring board (image courtesy of manufacturer)

Figure 4.4 – Measurement of the total length with calipers (image taken from Lawler, 2014)

4.1 FIELD LOG SUMMARY

A brief account of activities that took place on each day of the survey is presented below.

Day 1 – Tuesday 22nd September – whelk pots (3 strings of 50 pots) were transported to the survey location along the pipeline (**Figures 1.1 and 5.1**) and left to soak for 24hrs before being hauled and processed (as above) the next day.

Day 2 – Wednesday 23nd September – whelk pots were hauled, rebaited and then redeployed at the southern control location. Concurrent to this the catch was processed and biological details of whelks recorded.

Day 3 – Wednesday 24th September – whelk pots were hauled, rebaited and then redeployed at the northern control location. Concurrent to this the catch was processed and biological details of whelks recorded.

Day 4 – Wednesday 25th September – whelk pots were hauled, rebaited and then redeployed at another location for commercial fishing purposes. Concurrent to this the catch was processed and biological details of whelks recorded.

4.2 DATA ANALYSIS

Length frequency of the whelk catch for the entire survey (i.e. 9 strings of 50 pots) was presented diagrammatically using frequency distribution graphs.

The relationship between whelk catch rates (i.e. abundance and weight) and water depth was investigated using Pearson correlation analysis. Pearson correlation coefficient (r), a continuous variable between +1 and −1 (inclusive), is a measure of the linear correlation between two variables. An r value of +1 indicates total positive correlation between the variables, while an *r* value of −1 indicates total negative correlation and 0 indicates no correlation.

5 RESULTS

The results section presents all information recorded for the duration of the survey in various formats. The location and mean depths at which strings of pots were deployed is presented in **Table 5.1**.

Table 5.1 – Positions and depths of whelk pots (in WGS84, degrees decimal minutes)

Haul No.	Location	Shooting Position		Hauling Position		Depth (m)
		Latitude	Longitude	Latitude	Longitude	
1	Pipeline (Nearshore)	53° 24.942' N	6° 05.345' W	53° 24.935' N	6° 05.148' W	6.4
2	Pipeline (Middle)	53° 24.901´ N	6° 08.580' W	53° 24.944' N	6° 03.908' W	15.5
3	Pipeline (Offshore/ End)	53° 24.901' N	6° 03.375' W	53° 24.610' N	6° 02.800' W	20.1
4	South Control (Nearshore)	53° 24.680' N	6° 05.460' W	53° 24.725' N	6° 04.957' W	6.4
5	South Control (Middle)	53° 24.677' N	6° 03.520' W	53° 24.660' N	6° 03.566' W	20.3
6	South Control (Offshore/ End)	53° 24.613' N	6° 02.822' W	53° 24.694' N	6° 02.922' W	24.1
7	North Control (Nearshore)	53° 25.235' N	6° 05.352' W	53° 25.205' N	6° 05.003' W	9.1
8	North Control (Middle)	53° 25.422' N	6° 03.970' W	53° 25.364' N	6° 03.695' W	19.2
9	North Control (Offshore/ End)	53° 25.188' N	6° 03.195' W	53° 25.151' N	6° 02.986' W	22.9

Figure 5.1 illustrates where pots were deployed and recovered in relation to the pipeline survey area. **Table 5.2** shows the weight (kg) of whelks caught and sampled during the survey.

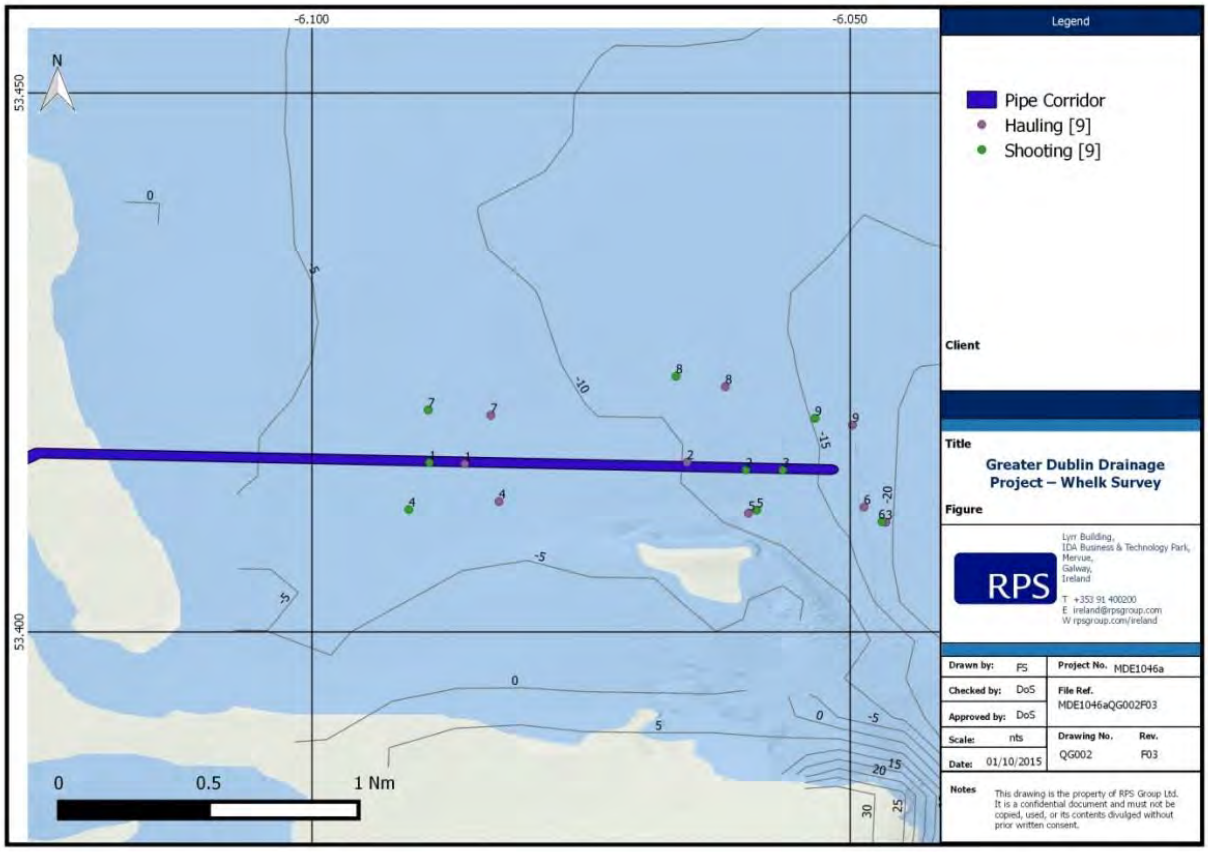

Figure 5.1 – Deployment and retrieval locations of pot strings.

Table 5.2 – Total weight of whelk caught and sampled.

Haul No.	Location	Total Weight (kg) of Whelk Sampled	Total Weight (kg) of Whelk Caught
1	Pipeline	0.3	5.4
2		5.8	46.0
3		4.7	41.0
4	Southern Location	0.2	6.5
5		9.0	62.0
6		11.0	81.0
7	Northern Location	6.5	78.0
8		4.0	44.0
9		4.5	40.0
Totals	**All Locations**	**46.0**	**403.9**

The catch composition of the sampled catch is presented in **Table 5.3** and outlines the species caught and number of species sampled during the 4 day survey.

Table 5.3 – Composition of the sampled catch.

Species Name	Total No. Sampled	Haul 1	Haul 2	Haul 3	Haul 4	Haul 5	Haul 6	Haul 7	Haul 8	Haul 9
Common Whelk (*Buccinum undatum*)	1116	13	133	171	12	119	216	149	141	162
Green Crab (*Carcinus maenus*)	71	17	0	1	17	34	0	2	0	0
Swimming Crab (*Liocarcinus depurator*)	7	0	0	2	0	1	1	1	0	2
Scorpion Spider Crab (*Inachus dorsettensis*)	2	1	0	0	1	0	0	0	0	0
Common Starfish (*Asterias rubens*)	133	7	11	27	16	22	18	9	9	14
Green Sea Urchin (*Psammechinus miliaris*)	7	0	3	0	0	1	3	0	0	0
Rock Shrimp (Palaemon elegans)	1	0	0	0	0	0	0	0	0	1
Ling (*Molva molva*)	2	0	1	0	0	1	0	0	0	0
Cod (*Gadus morhua*)	1	0	1	0	0	0	0	0	0	0

The length frequency of the whelks sampled is presented in **Figure 5.2** and indicates a number of possible age classes. There is a wide range in length frequencies which is consistent with previous studies and analyses of the whelk population in this area (Fahy *et al*., 2000 & 2005). Another characteristic observed in the data was that the whelks were quite large, again a feature of whelk caught in this area that is corroborated by Fahy *et al*., 2000.

Sexual maturity in Common whelk is highly variable and the size at which whelks become sexually mature shows high regional variation (Fahy *et al*., 2000 & Lawler 2014). In the Marine Institute study, Fahy *et al.,* 2005, whelk >70 mm were regarded as fully mature and contributing to spawning. Fahy *et al*., 2000, described that the widest representation of age groups occurred in the Dublin and Wexford sectors.

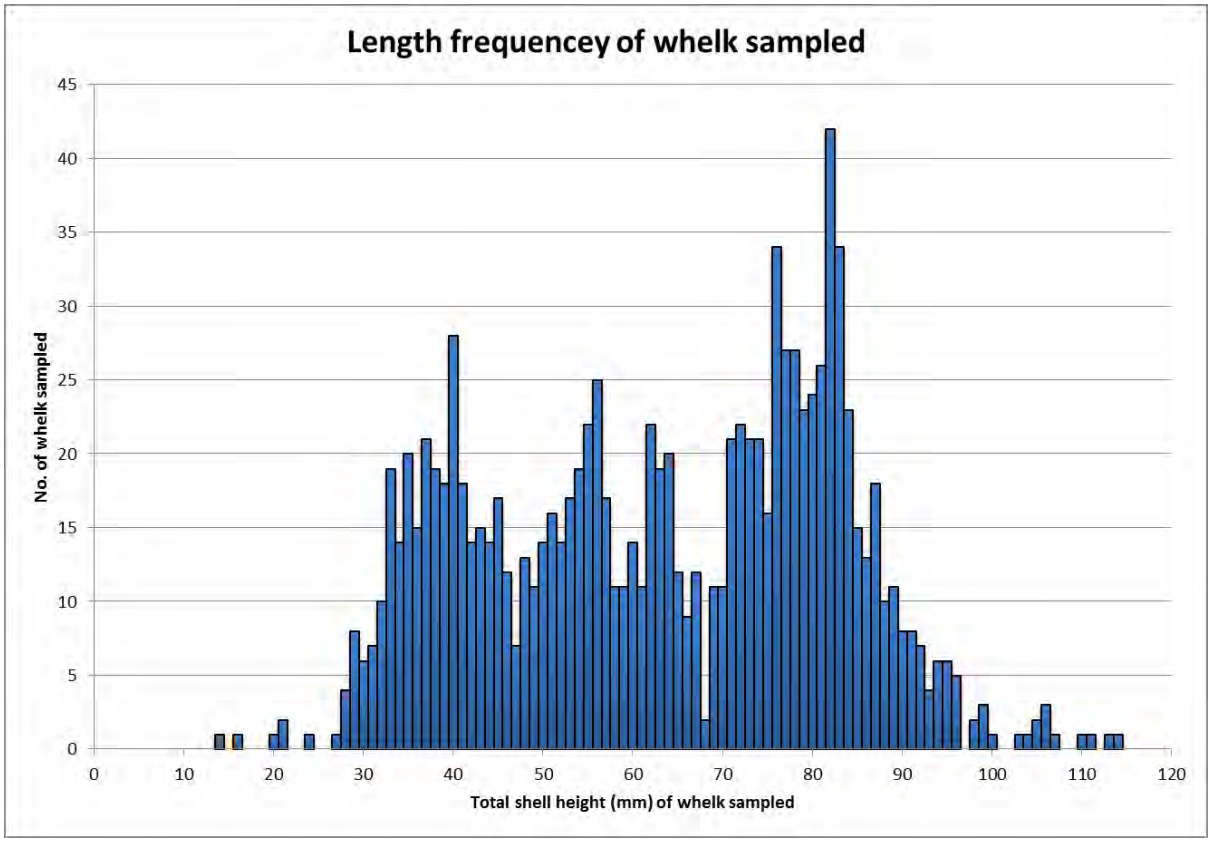

Figure 5.2 – Length Frequency (mm) of whelk sampled.

Pearson analysis indicated significant positive correlation between increasing water depth and whelk abundance (r = 0.836; p = 0.005) while whelk weight was not significantly correlated with increasing water depth (r = 0.554; p = 0.122). Finally, whelk abundance was significantly correlated with whelk weight (r = 0.836; p = 0.005).

Table 5.4 – Pearson correlation matrix for whelk catch rate (i.e. abundance and weight) versus haul depth (p values included in parenthesis; * denotes significant correlation).

	Haul Depth	Whelk catch weight
Whelk catch weight	*r* = 0.554 (*p* = 0.122)	
Whelk catch abundance	*r* = 0.829 (*p* = 0.006)*	*r* = 0.836 (*p* = 0.005)*

6 DISCUSSION

The whelk survey took place over the planned survey dates from Tuesday 22nd to Friday 25th September 2015. The survey results provide data on the whelk population on the pipeline route and at two adjacent locations and will contribute towards the compilation of the planning application for the Greater Dublin Drainage project.

The primary aim of this study was to carry out a targeted whelk survey in conjunction with the appointed whelk fisherman to obtain meaningful data on the whelk population in and around the proposed pipeline route. To satisfy these requirements, whelk samples were processed by measuring their total length, presented in a length frequency diagram to highlight variation in abundance across size classes (**Figure 5.2**).

The survey took place at depths ranging from 6 – 24 metres deep (**Table 5.1**) and involved 3 deployments along the proposed pipeline route as well as 6 control strings, 3 located north and 3 located south of the pipeline (**Figure 5.1**).

The catch was largely made up of Common whelk (*Buccinum undatum*) with relatively little bycatch. There was a total of 1116 whelk measured for the duration of the survey. The composition of bycatch varied without trend across the haul sites. Overall the survey bycatch comprised of 133 Common Starfish (*Asterias rubens*), 71 Green Crab (*Carcinus maenus*) and a small number of other species (**Table 5.3**). The total weight of the whelk sampled was 46 kg out of a total weight landed of 403.6 kg (**Table 5.2**).

It can be clearly seen from **Table 5.2** that the weight of whelk caught in the north (mean weight across 3 strings = 54 kg) and south (49.83 kg mean weight) were similar and much greater than that caught along the pipeline route (30.80 kg mean weight).

The length frequency of the whelk sampled during the survey (**Figure 5.2)** shows a wide ranging length frequency with a mode of 82mm (42 individuals measured). The largest whelk measured was at 114mm and the smallest was recorded at 14mm. The prevalence of large whelks, variability in lengths and large range exhibited in the whelks sampled is consistent with the results reported for the Dublin sector in assessments for the southwest Irish Sea whelk fishery (Fahy *et al*., 2000 & 2005).

It has been reported that the onset of maturity for whelk in the Irish Sea is between 60 – 70mm in length (Kideys *et al.,* 1993). Over 56% of the whelks sampled were over 60mm in length and if the upper limit of 70mm in length is used the proportion rises to close to 45%. Therefore, between 45% and 56% of the whelks sampled could be considered fully mature adults. This figure makes up a significant component of the whelk population surveyed.

Pearson analysis indicated significant positive correlation between increasing water depth and whelk abundance ($r = 0.836$; $p = 0.005$) while whelk weight was not significantly correlated with increasing water depth ($r = 0.554$; $p = 0.122$). Finally, whelk abundance was significantly correlated with whelk weight ($r = 0.836$; $p = 0.005$).

This study provides a snapshot view of the resources in the vicinity of the pipeline and a short baseline characterisation survey of the whelk population for the proposed development area.

7 CONCLUSIONS

In September 2015, RPS conducted a whelk survey in the area of the Greater Dublin Drainage proposed marine pipeline route to provide baseline information on the whelk population and abundance in the vicinity and the fisheries resource.

The survey was successful in obtaining meaningful data over the four day survey period. In total 1116 individual whelks were sampled and processed during the survey and their total length recorded to provide length frequency data that was consistent with previous studies.

The whelk resource surveyed on the proposed pipeline route showed similarities to that of the north and south locations. However, in general the weight of the whelk catch caught along the proposed pipeline route was less than that caught to the north and south. This suggests that the proposed pipeline route has a normal whelk population for the area and that there is local variability present.

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Appendix V – ASU Greater Dublin Drainage Juvenile Fish Survey 2015

Greater Dublin Drainage
Juvenile Fish Survey

(September 2015)

Commissioned by: RPS on behalf of Irish Water

Carrie out by: Aquatic Services Unit

December 2015

Introduction & Brief

The Aquatic Services Unit (ASU) were commissioned by RPS on behalf of Irish Water to undertake a juvenile fish survey in the vicinity of the proposed outfall pipeline route for the Greater Dublin Drainage Scheme. In fulfilment of project ASU proposed to undertake a trawling survey in the subtidal area and a beach seine net survey in the adjoining sandy intertidal. The survey area is immediately north of Ireland's Eye and offshore from the Portmarnock golf courses in north County Dublin. The surveys were undertaken in September 2015 during calm weather conditions.

Survey Design

Trawling

Trawling was undertaken along 4 roughly parallel lines running out at right angles to the shore. Along each line 4 separate trawls were taken, Trawl 1 closest to the shore and Trawl 4 farthest seaward. The most southerly line was denoted as 'South' (S) and was situated approximately 200m to the south of the proposed pipeline route, the line along the pipe itself was named 'Pipe' (P), the next line 200m north was designated as 'North' (N) and a control site 'Control' (C) lay 1km farther north. Along each of these lines the 4 trawls were termed S1, S2, S3 and S4, for example for the 4 trawls running along the southern line the inner most one was denoted as (S1) and the outermost one (S4) (Table 1, Figure 1).

Samples were taken using a 2m beam trawl pulled by a small fishing vessel. The beam trawl used had a mesh size of 11mm. Trawls were generally 1-2km in length and hauled at a speed of 1 ½ knots. Trawling was undertaken on two dates, 17th & 18th of September 2015 and all fish were enumerated and measured on board, while epibenthic invertebrates such as crabs and starfish were either counted or weighed, also on board. All trawl material was returned overboard after recording, the majority still apparently viable. Gobies were all belonging to the *Pomatoschistus* genus and all those examined were Sand goby (*P. minutus*) and while it is believed that 100% were belonging to this species, we cannot rule out the possibility that a small number may have been either *P. microps* (Common goby) or a related member of the *minutus* group. All bar a single pipefish were *Syngnathus*, either *S. rostellatus* - Nilsson's pipefish or small *S. acus* (Greater pipefish). The only exception was a single Worm pipefish (*Nerophis ophidion*). Juvenile herring and sprat were not distinguished in the few taken in the trawl, although some were preserved from the beach seine samples and later confirmed in the lab.

Beach Seining

A 45m beach seine was used to sample at 4 locations along the Portmarnock shore south from the village and roughly opposite the respective trawl lines. The 'Control' site was closest to Portmarnock village and 1km north of the pipeline the other 3 sites were named Pipe Centre, Pipe South and Pipe North.

Table 1 and Figure 1 shows the positions of the trawl lines and beach seining positions. It is important to note that while every effort was made to sample the exact symmetric positions, a certain amount of variation is apparent which in the case of the trawls related to tidal currents etc. and in the case of

the day 1 and day 2 seining positions (denoted as D1 and D2 respectively in Figure 1) related to the fact that the tide was significantly farther down the shore at low tide when the dawn samples were taken on day 2. In addition, shoreline irregularities in terms of shallow sandbars also needed to be avoided to ensure optimal functioning of the beach seine. Positions were recoded using a Trimble ProXRS GPS for trawls and Garmin 72 hand-held GPS for beach seines.

Table 1 Beam trawl and Seine Net locations.

Date	Station	Co-ordinates (Irish National Grid)		Station	Co-ordinates (Irish National Grid)	
		Easting (m)	Northing (m)		Easting (m)	Northing (m)
		Trawl locations			Trawl Location	
26/09/2015	Seine_North_D1	325128	242821			
26/09/2015	Seine_South_D1	325404	242248			
26/09/2015	Seine_Centre_D1	325284	242563			
26/09/2015	Seine_Control_D1	325052	243447			
27/09/2015	Seine_Control_D2	325027	243589			
27/09/2015	Seine_Centre_D2	325329	242556			
18/09/2015	P1 in	326749	242316	P1 out	326098	242358
17/09/2015	P2 in	326854	242350	P2 out	327988	242299
17/09/2015	P3 in	328695	242264	P3 out	327874	242349
17/09/2015	P4 in	328722	242298	P4 out	329409	242382
18/09/2015	S1 in	326628	242146	S1 out	326083	242141
17/09/2015	S2 in	327893	242087	S2 out	326796	242146
17/09/2015	S3 in	328788	242101	S3 out	327873	242074
18/09/2015	S4 in	329798	242047	S4 out	328810	241923
18/09/2015	N1 in	326772	242567	N1 out	326124	242600
17/09/2015	N2 in	327872	242547	N2 out	326711	242558
17/09/2015	N3 in	327907	242510	N3 out	328832	242559
17/09/2015	N4 in	328812	242513	N4 out	329714	242314
18/09/2015	C1 in	326525	243492	C1 out	326095	243549
18/09/2015	C2 in	327789	243459	C2 out	326778	243370
18/09/2015	C3 in	328643	243734	C3 out	327821	243616
18/09/2015	C4 in	329789	243274	C4 out	328702	243431

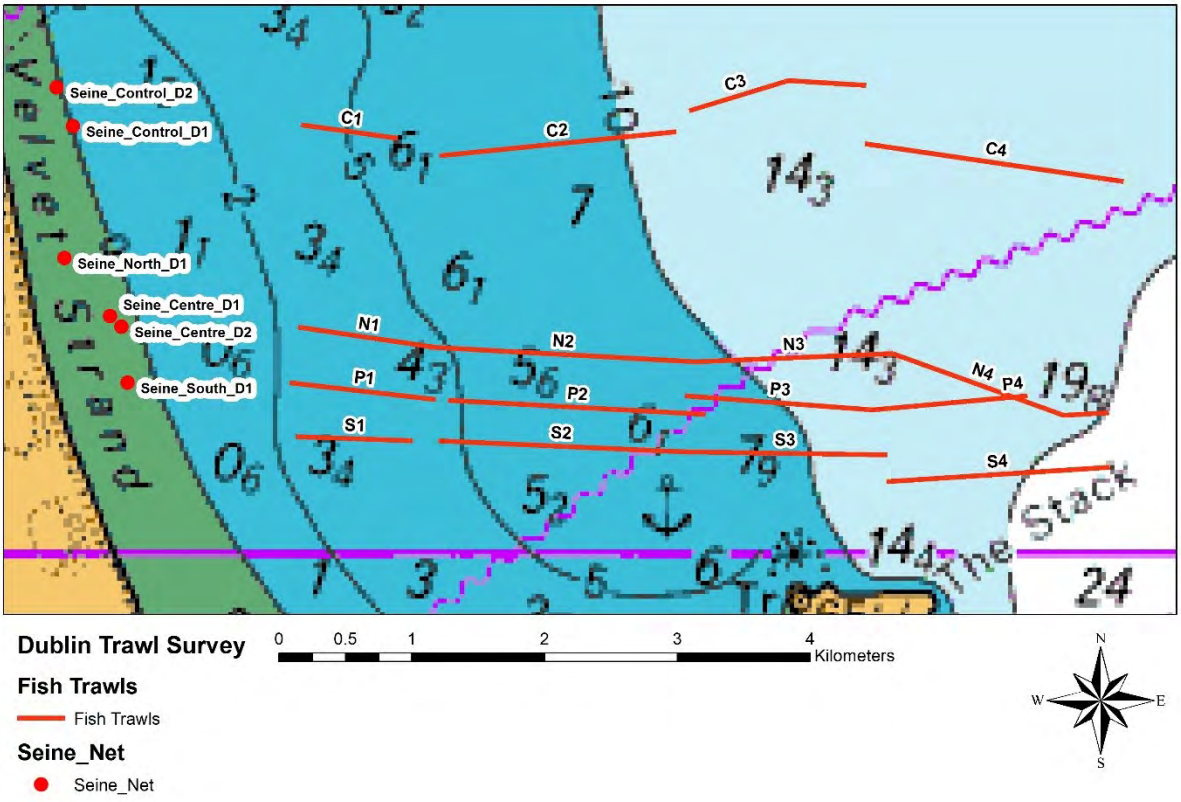

Figure 1 Trawl tracks and beach seine positions

Results

Trawls - Fish

Table 2 lists the fish species caught in order of decreasing total abundance. Table 3 presents the abundance of each fish species in each trawl, while Table 4 gives total numbers of fish and invertebrate species in each trawl, the total invertebrate and fish species per trawl and the total fish abundance per trawl. Table 5 lists the epibenthic invertebrates present in each trawl and their number or weight in each case. Figure 2 shows the summarised fish data graphically and Appendix 1 contains a photo of each trawl catch.

A minimum of 18 species of fish were taken in the trawls (Table 2). Of these only about half were common and effectively ubiquitous (Table 3), namely plaice, dab, sand goby, whiting, dragonet, pipefish and thornback ray, all of which stood a more or less equal chance of been taken in any of the trawls. The remaining species were less evenly spread. This could have to do with habitat preferences, seasonal factors, general scarcity in inshore waters or their particular swimming habits etc. Herring and sprat for example are pelagic species normally higher in the water column and also very clumped, i.e. forming shoals, so often absent from bottom trawls. Species such as haddock and scald fish tend to be commoner in deeper water. Others such as butterfish tend to be associated with harder ground and may be more common over bottoms with greater amounts of shell or gravel. The depth of the sampling stations is also likely to have some slight influence on the distribution of some species, although comparatively speaking the depth range of the survey was fairly modest, with the deeper stations on the seaward side between 10 and 20m deep.

Each of the 4 trawl lines i.e. South, Pipe, North and Control returned similar results in terms of dominant fish and invertebrates. However, in the outer trawls of each line i.e. S4, P4, N4 and C4), particularly in the first three listed, there is a subtle shift in the ratios of the most abundant species (see Figure 2). Moreover there is a tendency for the outer sites to have a higher combined diversity of fish and invertebrates (Table 4). This is believed to relate to a combination of the slightly deeper and more offshore positions and also because it is believed that the substrates are more diverse especially in the south eastern corners of the survey area, where it is surmised that there may be a higher shell or gravel content in what is clearly otherwise a sand-dominated bottom.

In terms of invertebrates, the most ubiquitous species was the common starfish (*Asterias rubens*), which was by far the most abundant no fish species taken in trawls, reflecting it's propensity for preying on burrowing bivalve molluscs which would be widespread in this sandy system (Table 5). Also prominent were the brittle star *Ophiura* sp., *Liocarcinus* crabs, small spider crabs, brown shrimp (*Crangon*) and Aesop shrimp (*Pandulus montagui*). Overall, there was a higher invertebrate diversity associated on average with the outer trawls (Table 4) and this is believed to reflect a more diverse range of substrate patches in these areas.

In terms of the epibenthic communities encountered in the trawls, these bear a strong resemblance to the *Pleuronectes-Limanda* assemblage described by Ellis *et al.,* (2000) as being typical of shallower depths (<20m) along the western and eastern sides of the Irish Sea. It also has some similarities in the outer trawl sites with the *Microchirus-Pagurus* assemblage described in the same paper as occurring in slightly deeper waters.

In terms of fisheries importance the area is an important nursery area for plaice, dab and whiting all of which have some commercial importance, particularly plaice and whiting and this is likely to be the

case along the entire east coast in similarly shallow inshore waters from Louth to Wexford. Thornback ray which is also important commercially appear to utilise this area heavily also. Other species, less important from a commercial standpoint but ecologically significant within the overall food chain, include sand goby, dragonet and poor cod. It should be noted also that the pelagic species sprat and herring are likely to heavily use these waters on a seasonal basis even though they were very poorly represented in beam trawls. By the same token, sandeel, which bury by day in the substrate would be unlikely to be caught by this method, however, the species is likely to be widespread also in this area. Larger specimens of several of the species captured and other larger mobile species such as lesser-spotted dogfish would be expected to be present in the area but be able to evade capture by the beam trawl.

Table 2 A list of the fish species taken in trawls listed in order of decreasing abundance.

	Common name	**Scientific name**	**Total Numbers**
1	Plaice	*Pleuronectes platessa*	280
2	Sand Goby	*Pomatoschistus minutus*	255
3	Dab	*Limanda limanda*	244
4	Dragonet	*Callionomys lyra*	55
5	Whiting	*Merlangius merlangus*	54
6	Thornback	*Raja clavata*	12
7	Pogge	*Agonus cataphractus*	12
8	Poor Cod	*Trisopterus minutus*	12
9	Pipefish	*Syngnathus rostellatus / S. acus*	8
10	Scaldfish	*Arnoglossus laterna*	5
11	Solenette	*Buglossidium luteum*	4
12	Haddock	*Melanogrammus aegelfinus*	3
13	Butterfish	*Pholis gunnellus*	3
14	Cod	*Gadus moruha*	3
15	Herring / Sprat	*Clupea harengus/Sprattus sprattus*	3
16	Gurnard (grey)	*Eutrigla gurnardus*	1
17	Worm pipefish	*Necrophis ophidion*	1
18	Megrim ??	*Lepidorhombus whiffiagonis*	1

Table 3 The number of each of fish species taken in each trawl. S=south, P = pipe, N = north and C = control. 1 = inner line of trawls, 4 = outer line (see Figure 1 for positions).

Dab

	S	P	N	C
1	3	3	10	4
2	36	8	11	24
3	24	32	11	41
4	6	3	4	24

Plaice

	S	P	N	C
1	5	6	10	5
2	29	43	46	22
3	15	12	8	24
4				55

Goby

	S	P	N	C
1	12	10	22	17
2	54	25	39	29
3	17	5	10	5
4	1		5	4

Whiting

	S	P	N	C
1			2	3
2	1	8	6	
3	1			11
4	7	6	5	4

Dragonet

	S	P	N	C
1				1
2	1	3	5	4
3	4	2	2	2
4	13	3	7	8

Thornback Ray

	S	P	N	C
1	1			2
2			2	
3	2			1
4				4

Pipefish

	S	P	N	C
1		1	2	
2		2	1	
3		1		
4				1

Pogge

	S	P	N	C
1				
2				
3	1		5	
4	1	1	4	

Poor Cod

	S	P	N	C
1				
2				
3			4	
4	5	3		

Solenette

	S	P	N	C
1				
2			1	
3				2
4				1

Scaldfish

	S	P	N	C
1				
2		2	2	
3				
4				1

Haddock

	S	P	N	C
1				
2				
3				1
4	1			1

Butterfish

	S	P	N	C
1				
2				
3	1			
4		2		

Cod

	S	P	N	C
1				
2				
3				
4	1	2		

Herring / Sprat

	S	P	N	C
1			1	
2				
3				2
4				

Gurnard

	S	P	N	C
1				
2				
3				1
4				

Table 4 Total numbers of fish and invertebrate species in each trawl, the total invertebrate and fish species per trawl and total fish abundance per trawl. S=south, P = pipe, N = north and C = control. 1 = inner line of trawls, 4 = outer line (see Figure 1 for positions).

Fish: Number of species

	S	P	N	C
1	4	4	6	6
2	5	7	9	5
3	5	5	6	9
4	8	7	5	10

Invertebrates: Number of species

	S	P	N	C
1	4	3	4	3
2	7	4	6	7
3	7	4	9	6
4	9	14	13	9

Total Species (Fish & Invertebrates)

	S	P	N	C
1	8	7	10	9
2	12	11	15	12
3	12	9	15	15
4	17	21	18	19

Fish: Total Abundances

1	S	P	N	C
2	21	20	47	32
3	121	91	113	79
4	65	52	40	90
	35	20	25	103

Table 5 The number of weight of each invertebrate taken in each trawl. S=south, P = pipe, N = north and C = control. 1 = inner line of trawls, 4 = outer line (see Figure 1 for positions). + = present

Common starfish (Asterias)

	S	P	N	C
1	(380g)	4	1	1
2	(1005g)	(200g)	(650g)	(250g)
3	4	2	4	(450g)
4	2	2	20 (450)	(1250g)

Brittle star (Ophiura)

	S	P	N	C
1	3	3	5	5
2	5	6	22	11
3	2		12	40
4		3	39	69

Brittle star (Ophiothrix)

	S	P	N	C
1				
2				
3				
4		2	13	

Urchin (Psammechinus)

	S	P	N	C
1				
2	1		1	
3	4			
4	1		3	

Urchin (Echinus)

	S	P	N	C
1				
2				
3				
4		1		

Brown shrimp (Crangon)

	S	P	N	C
1			2	2
2			+	2
3	2		2	7
4	6	3	10	

Aesop shrimp (Pandulus)

	S	P	N	C
1				
2	1			
3	12		21	
4	17	26		4

Green crab (Carcinus)

	S	P	N	C
1				
2				
3		1		
4				

Edible crab (Cancer)

	S	P	N	C
1				
2				
3				
4		1		

Harbour Crab (Liocarcinus)

	S	P	N	C
1				
2	1		1	3
3	3	2	1	
4	1		3	5

Velvet crab (Necora)

	S	P	N	C
1				
2				
3				
4	1			

Risso's crab (Xantho)

	S	P	N	C
1				
2				
3				
4		1		

Small spider crabs (Hyas-type)

	S	P	N	C
1	1		3	3
2	1	6	6	4
3	4	1		2
4		8	4	1

Hermit crab (Pagurus)

	S	P	N	C
1				
2				
3				
4			1	

Soft coral (Alcyonium)

	S	P	N	C
1				
2				1
3	1		4	
4		4	4	

Bryozoan (Alcyonidium)

	S	P	N	C
1				
2				
3			2	7
4	1	4	2	20

Bryozoan (Flustra)

	S	P	N	C
1				
2				
3				
4		+	+	+

Sea slugs (Nudibranchs)

	S	P	N	C
1				
2				
3				
4		+	+	

Table 5 contd:

Queen scallop (Aequipecten)

	S	P	N	C
1				
2				
3				
4		1	1	

Cuttlefish (Sepiola)

	S	P	N	C
1				
2				
3			+	
4			+	+

Squid (Loligo)

	S	P	N	C
1	1	1		
2	2	1		1
3			2	
4				

Sea mouse (Aphrodite)

	S	P	N	C
1				
2				
3				1
4	1			1

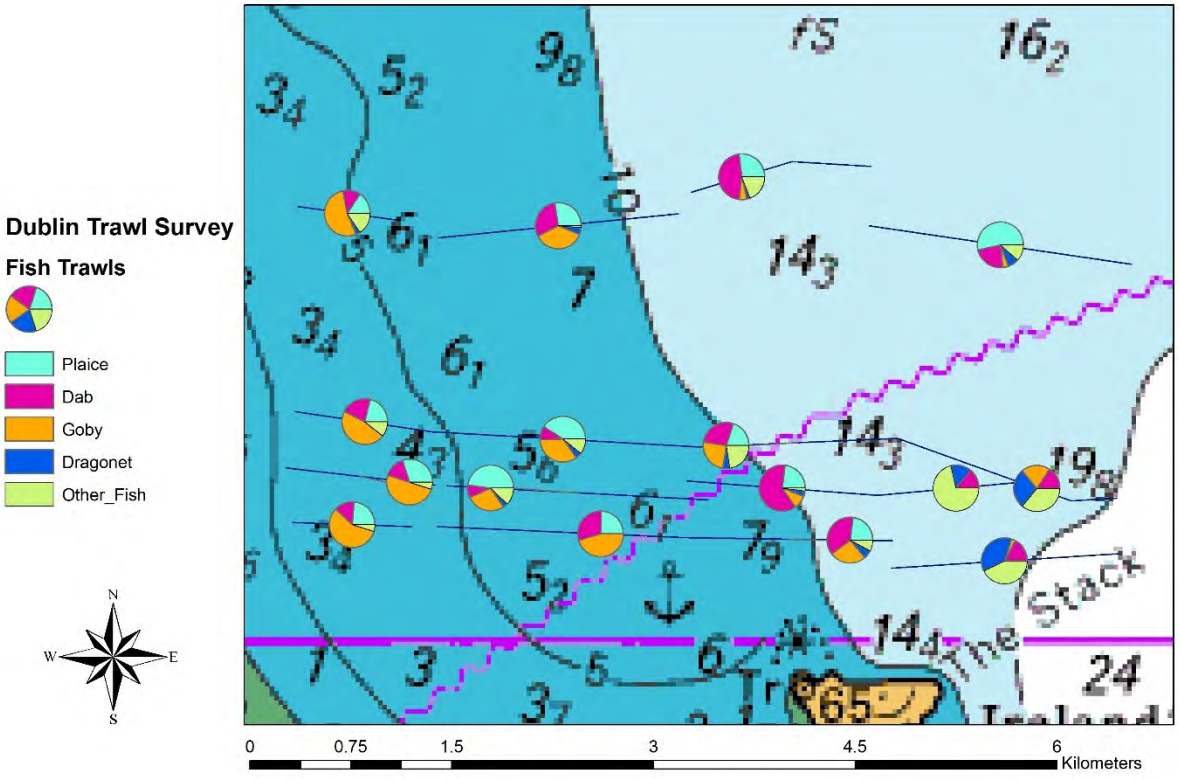

Figure 2 Relative abundance of main fish species and 'other' fish at the 16 surveyed trawl locations. September 17th & 18th 2015.

Beach Seines

Table 6 lists the full fish taken in decreasing order of overall abundance in the beach seines, while Table 7 presents a list abundance/weight landed in each fish and invertebrate species taken in individual net hauls. Four of the beach seines, were taken during the afternoon of September 26th at low tide (i.e. Control, North, Centre and South) and 2 were taken the following morning just before dawn i.e. at the Control and Centre sites. The 2 dark-phase samples were to establish if there were any notable differences in catch that might be attributable to time of day. The relative dominance of each fish species is also presented in Figure 3 while the total abundance of brown shrimp (*Crangon*) is presented in Figure 4. Note that herring and sprat were not separately identified in a few of the net hauls and in these the combined figures have been given as Herring/Sprat. It would appear, based on the samples which were identified to species that herring were generally in the majority.

The data shows that in terms of fish plaice, sand goby, herring, sand eel and sprat dominated in that order. Overall, as expected the total number of species is less than what were taken in the trawls and this is to be expected due to the uniformity of the habitat type throughout the area and the very shallow inshore location. A striking difference between the trawl and beach seine catches is the virtual complete absence of dab from the beach seine hauls. In terms of invertebrates the high volumes of *Crangon* are notable and the complete absence of the starfish *Asterias rubens*. The single striking night-time / day-time difference in the beach seines was the complete absence of crabs during the day time and their dominance in terms of biomass during the late night/dawn period; *Crango*n also appeared to be favoured in the night/dawn samples although this may not be statistically significant. The absence of crabs in such shallow water (generally <1.5m) during the day, may be a strategy to avoid avian predators. Another feature of the daytime/night-time sampling was the presence of a few larger plaice and flounder in the night-time samples and this may also be down to a predator avoidance strategy.

While sandeel were taken in some numbers during the daytime, the species normally remains submerged in the sediment during the day and it is suggested that their presence in day-time samples may be because they were disturbed by the weighted bottom-line of the net as it was passed over them but there may be other behavioural factors at play also. Sandeel were the only species observed to wriggle out through the meshes of the net after it was hauled and therefore the numbers captured are an underestimate of what was present.

Table 6 Fish species captured in beach seines in decreasing order of abundance (September 26th & 27th, 2015)

	Common name	***Scientific name***	**Abundance**
1	Plaice	*Pleuronectes platessa*	1046
2	Sand Goby	*Pomatoschistus minutus*	447
3	Herring	*Clupea harengus*	256
3	Herring/Sprat		134
4	Sandeel	*Ammodytes tobianus*	97
5	Sprat	*Sprattus sprattus*	47
6	Flounder	*Platichthys flesus*	9
7	Pipefish	*S. rostellatus/S. acus*	4
8	Dab	*Limanda limanda*	1
9	Turbot	*Scophthalamus maximus*	1

Table 7 Abundance of fish and invertebrates in each beach-seine haul along the Portmarnock shore (September 26th & 27th, 2015)

Daytime Samples (26-9-15)					**Dawn Samples (27-9-15)**	
	16:40	**15:21**	**15:53**	**16:00**	**05:58**	**05:30**
Fish (Numbers)	**Control**	**Pipe North**	**Pipe Centre**	**Pipe South**	**Control**	**Pipe Centre**
Plaice	43	284	78	85	178	378
Flounder		1			3	5
Turbot		1				
Dab					1	
Sand goby	3	39	50	166	21	168
Herring/Sprat	50	43	41			
Herring				123	62	71
Sprat				3	27	17
Sandeel	3	4	13	76	1	
Pipefish					4	
Invertebrates (weight)						
Crangon (kg)	0.7	1.7	0.7	1.5	1.95	3.2
Crabs (kg)					3.35	5.53

Figure 3 Fish relative abundance in seine net hauls September 26th (D1) and 27th (D2) 2015

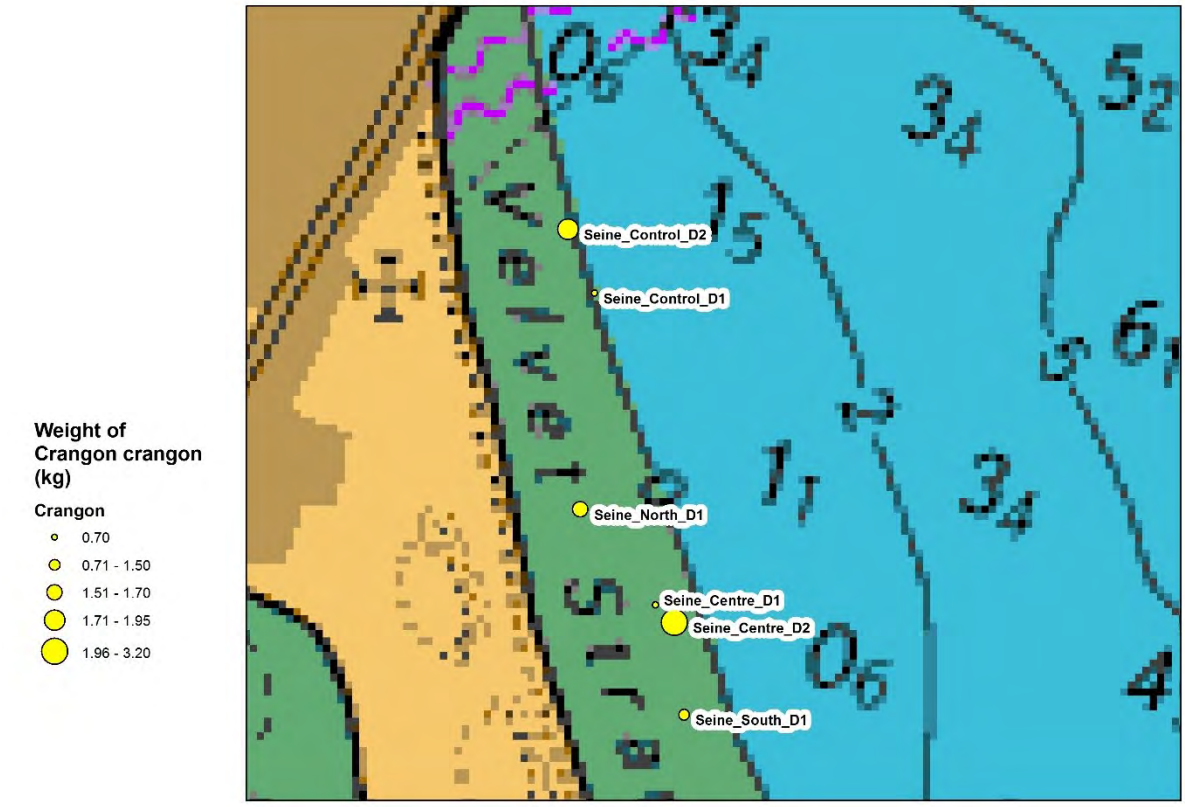

Figure 4 Crangon abundance (kg) in seine net hauls September 26th (D1) and 27th (D2) 2015

Fish Size Distribution

The size- distribution of each of the main species captured are presented in graphical form (Figure 5 – 13). There wasn't anything particularly noteworthy in these data but it does provide a good baseline for the species involved based on the time of year of capture and the locations i.e. on the beach and in deeper water, using two different methods of capture. One interesting comparison in the data is that between plaice taken in beach seines and in trawls, with those taken in the trawls having a greater proportion of slightly larger fish (Figures 5 & 6) suggesting that as the fish get a bit larger they move steadily away from the shallows. There were also slight differences noticeable in the size distribution of sand goby taken in both sets of gear (Figures 7 & 8)

Overall Conclusions

The survey clearly shows that the fish and invertebrate assemblages encountered on the survey are typical for what would be expected in a relatively shallow environment over sand in fully saline waters. The epibenthic community encountered bears a strong resemblance to that previously described for shallow inshore areas of the Irish Sea by Ellis *et al.,* (2000). Crucially, each of the 4 trawl survey lines returned communities that were generally very similar with only minor local or incidental variation which is most likely attributable to local patchiness in the distribution to bottom habitats. The same can be said of the beach seining results which shows the same community at each site dominated by a relatively small list of fish and mobile invertebrates. Some daytime/night-time variability was also noted in the beach seine survey.

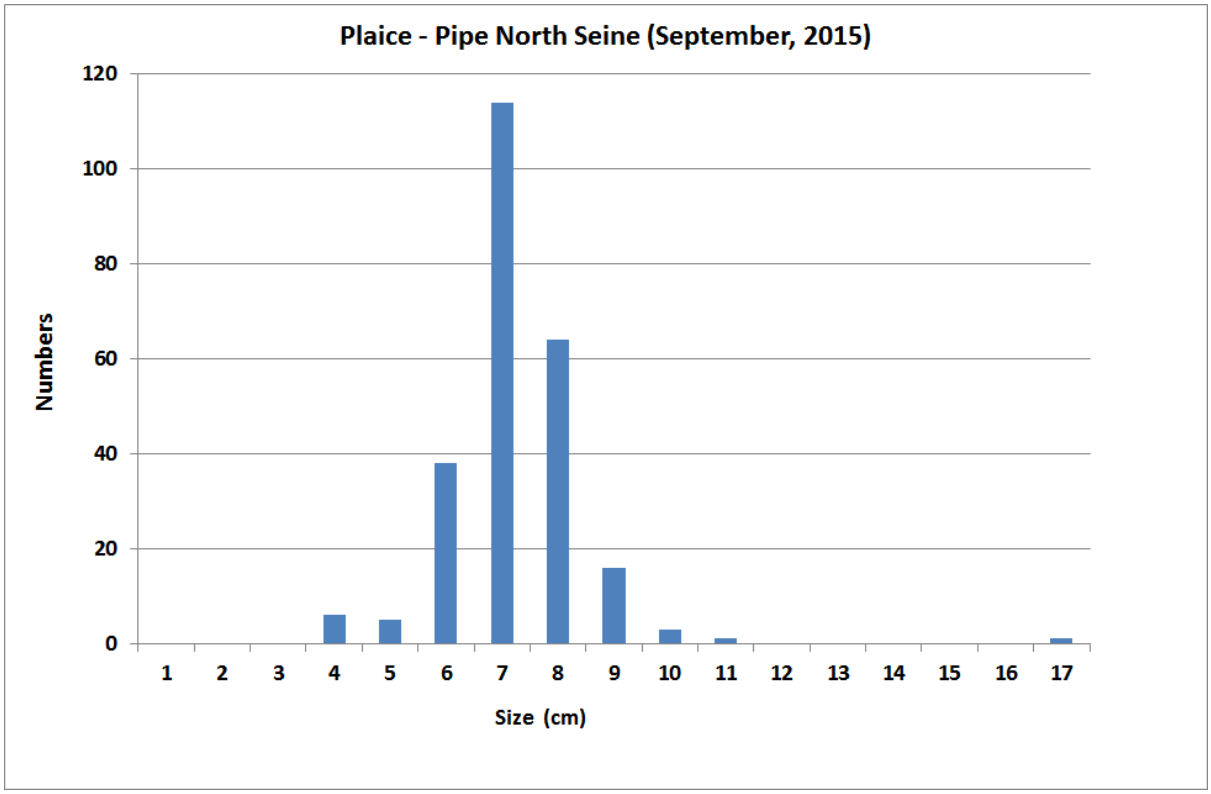

Figure 5 Size distribution of plaice taken in a beach seine September 26th, 2015

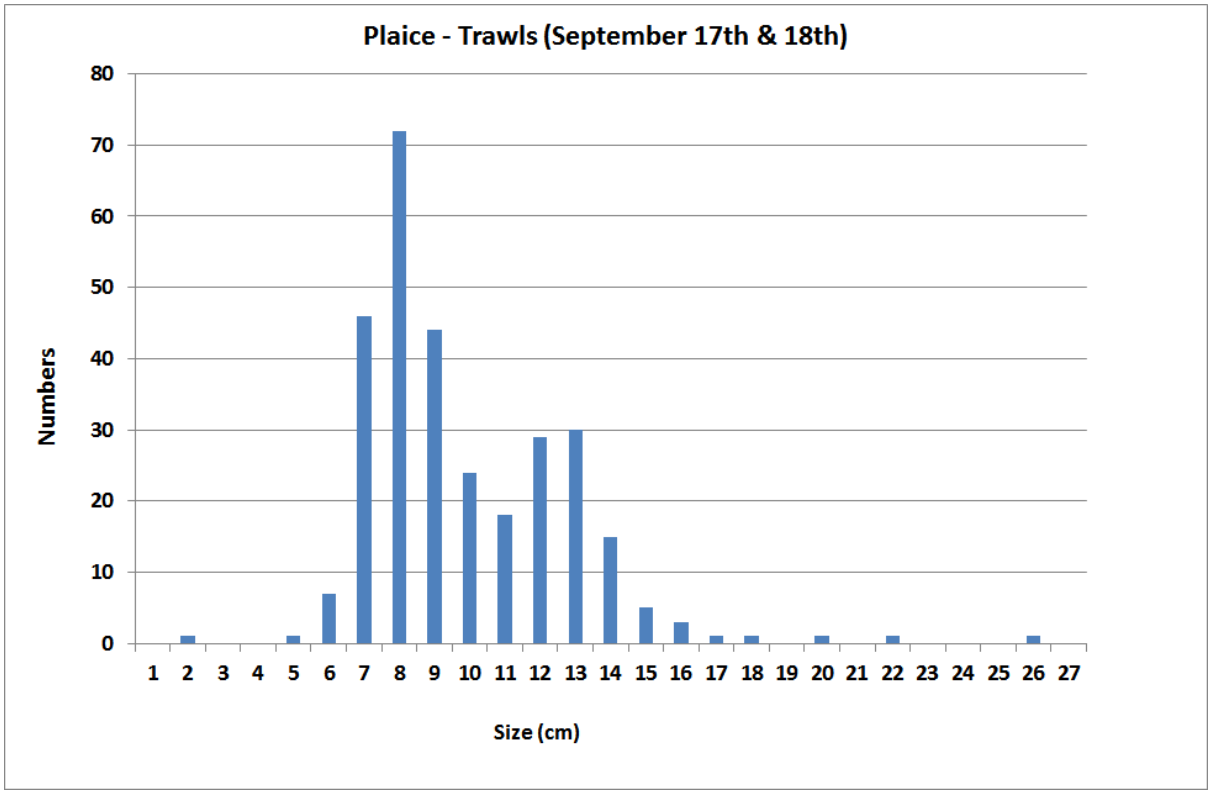

Figure 6 Size distribution of plaice taken in all beam trawls - September 17th & 18th 2015

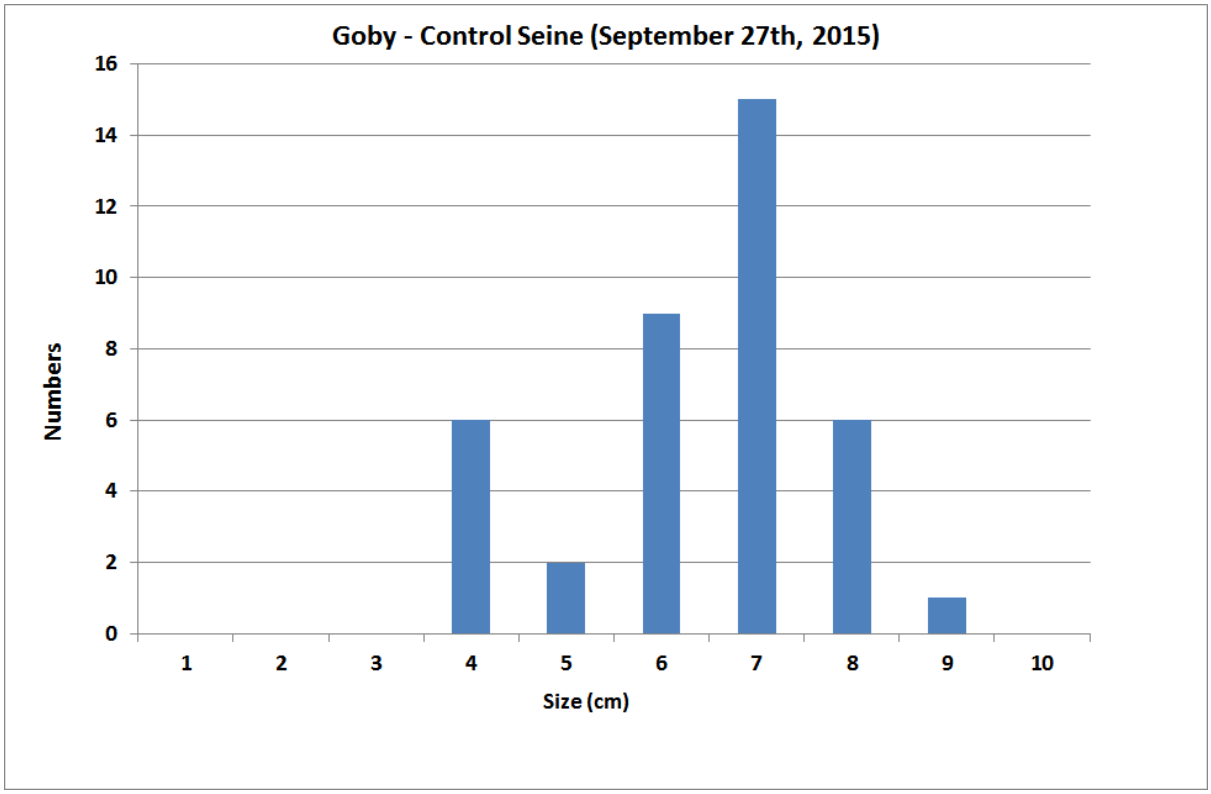

Figure 7 Size distribution of sand goby taken in a beach seine September 27th, 2015

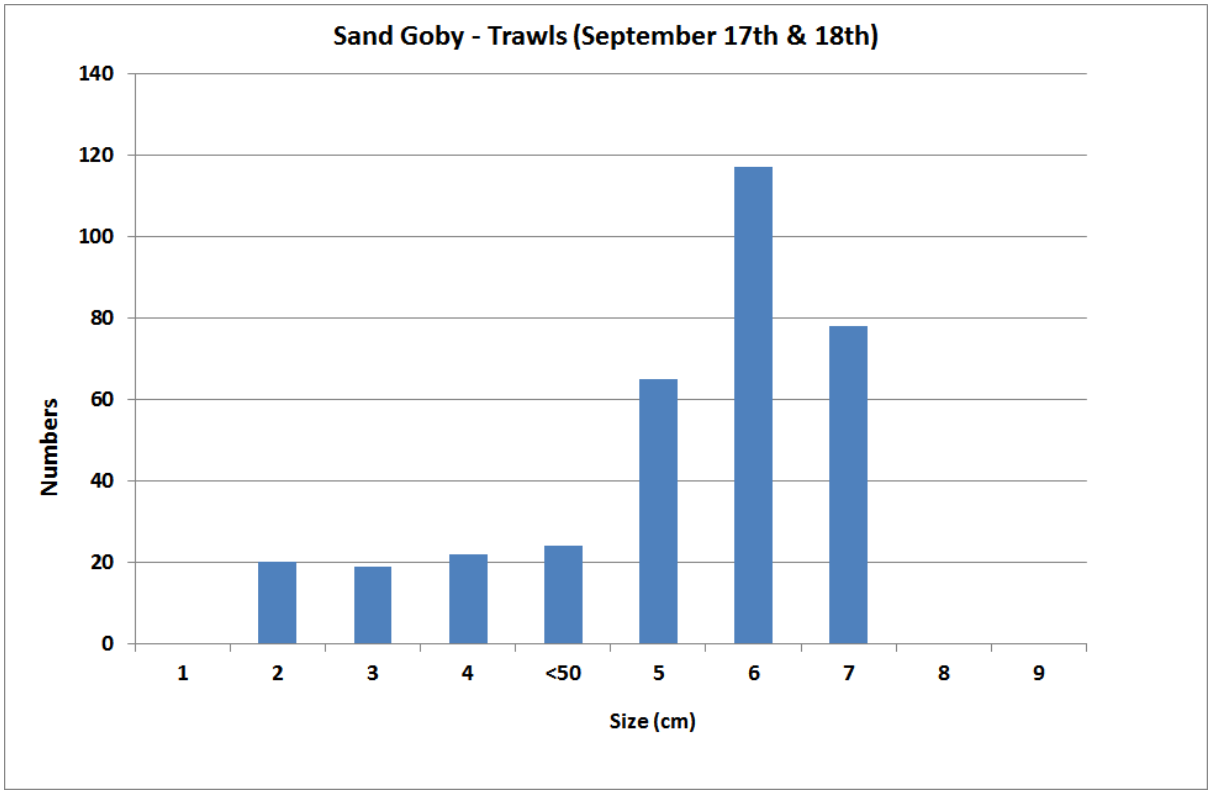

Figure 8 Size distribution of sand goby taken in all beam trawls September 17th and 18th 2015

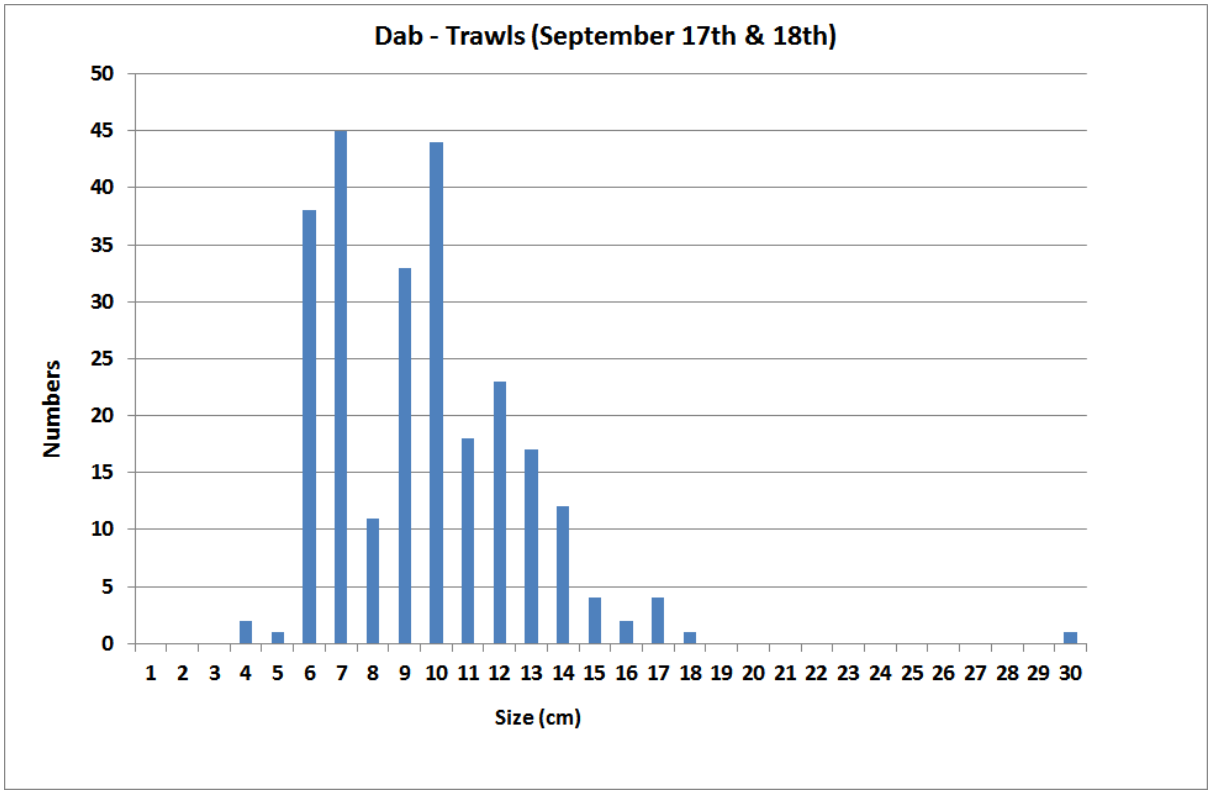

Figure 9 Size distribution of dab taken in all beam trawls September 17th and 18th 2015

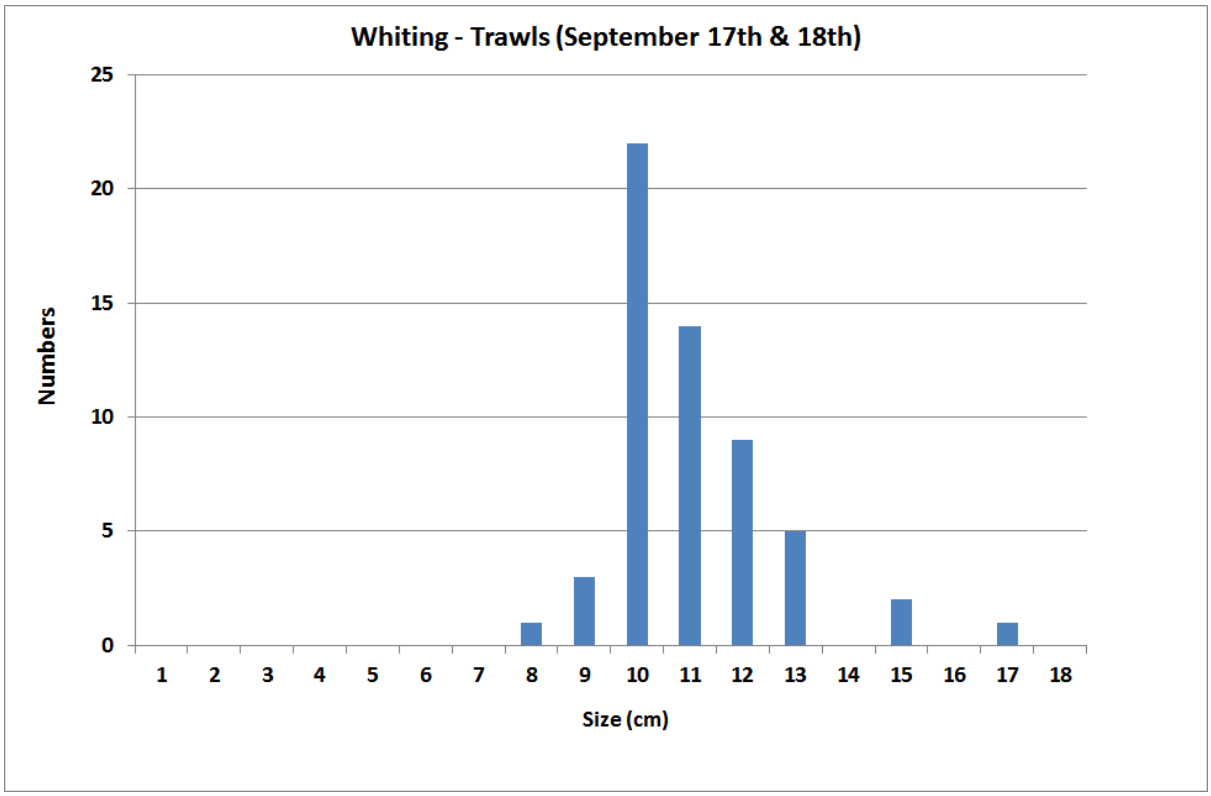

Figure 10 Size distribution of whiting taken in all beam trawls September 17th and 18th 2015

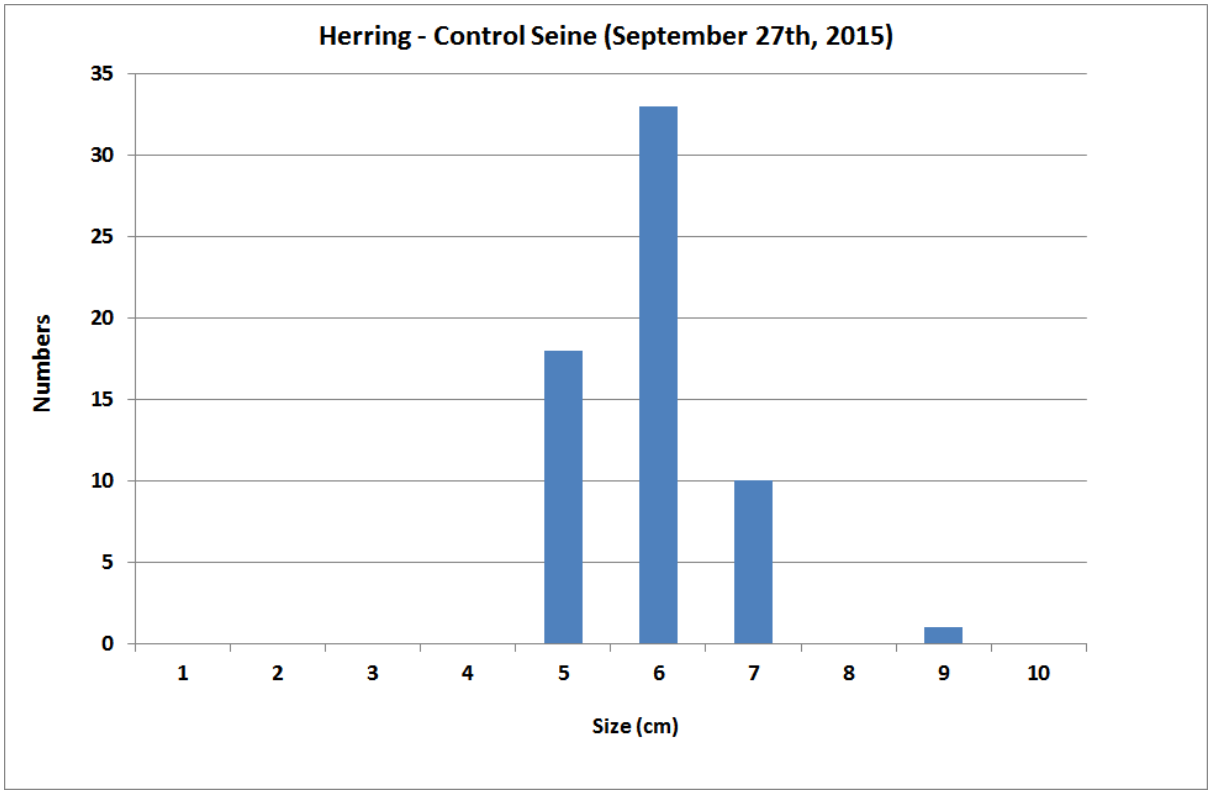

Figure 11 Size distribution of herring taken in a beach seine September 27th, 2015

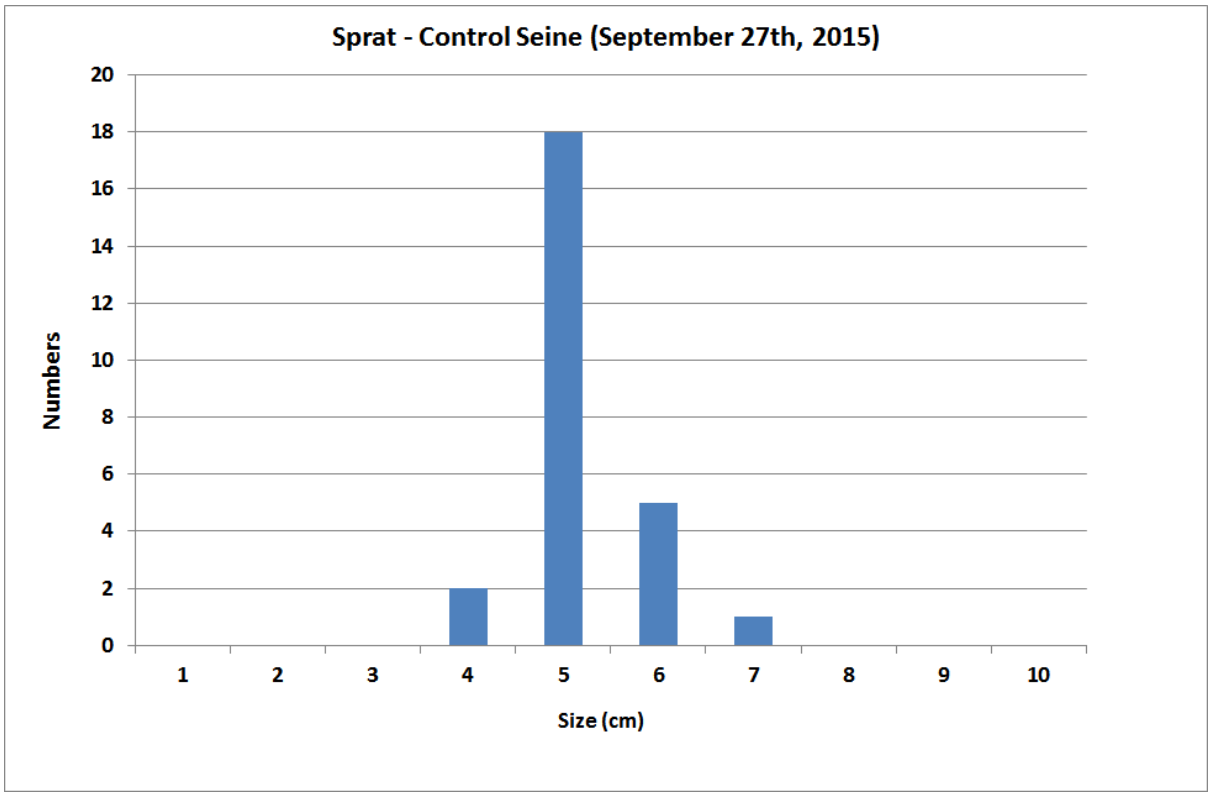

Figure 12 Size distribution of sprat taken in a beach seine September 27th, 2015

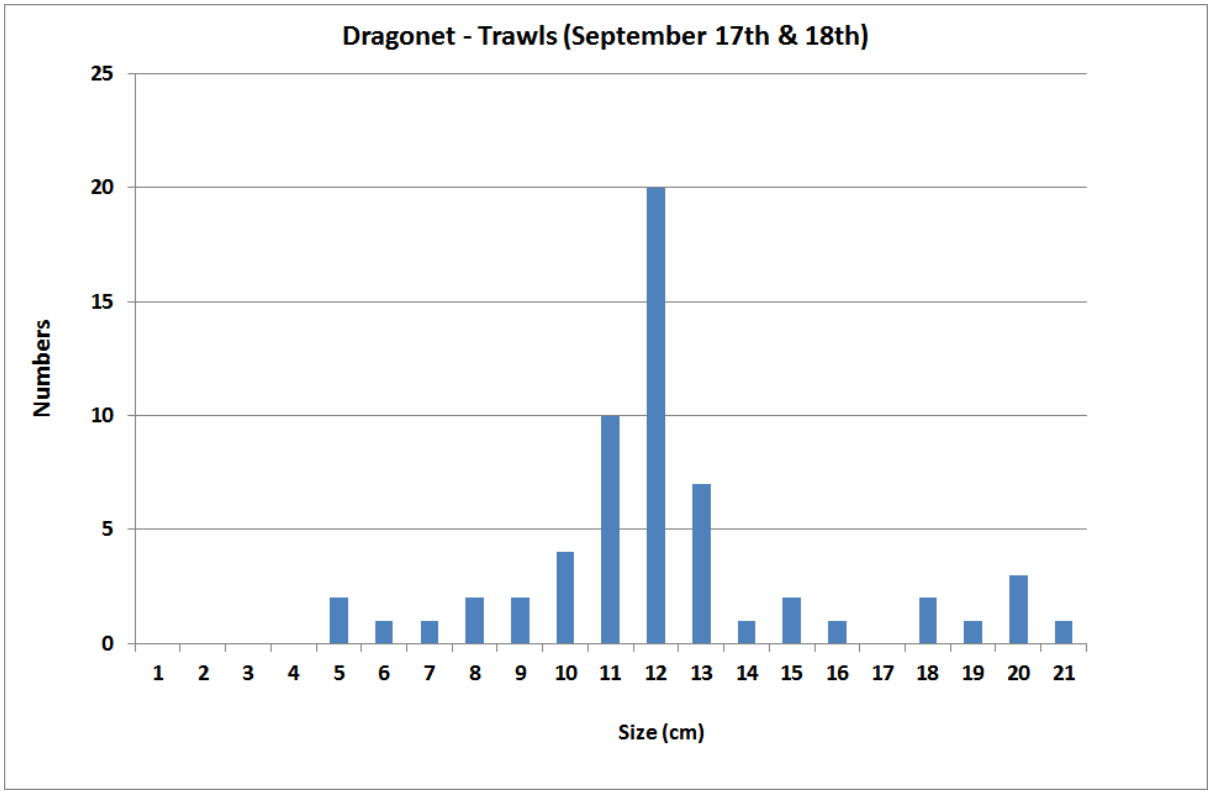

Figure 13 Size distribution of dragonet taken in all beam trawls September 17th and 18th 2015

References

Ellis, J. R., Rogers S. I., and S. M. Freeman (2000) Demersal Assemblages in the Irish Sea, St George's Channel and Bristol Channel. Estuarine, *Coastal and Shelf Science* (51) 299-315.

Appendix 1 Photographs of trawl catches

S1

S2

S3

S4

P1

P2

P3

P4

N2 (there was no photo taken at N1)

N4

C1

C2

C3

C4

Appendix VI – ASU Greater Dublin Drainage Juvenile Fish Survey 2017

Greater Dublin Drainage
Juvenile Fish Survey

(September 2017)

Commissioned by: RPS on behalf of Irish Water

Carrie out by: Aquatic Services Unit

November 2017

Introduction & Brief

The Aquatic Services Unit (ASU) were commissioned by RPS on behalf of Irish Water to undertake a juvenile fish survey in the vicinity of the proposed outfall pipeline for the Greater Dublin Drainage Project. In fulfilment of project ASU proposed to undertake a trawling survey in the subtidal area and a beach seine net survey in the adjoining sandy intertidal. The survey area is immediately north of Ireland's Eye and offshore from the Portmarnock golf courses in north County Dublin. The surveys were undertaken in September 2017 during neap tides. This survey was a repeat of the same survey undertaken in 2015 with some modifications designed to assess deeper sites.

Survey Design

Trawling

Trawling was undertaken along 4 roughly parallel lines running out at right angles to the shore. Along each line 3 separate trawls were taken, Trawl 2 closest to the shore and Trawl 4 farthest seaward. The most southerly line was denoted as 'South' (S) and was situated approximately 200m to the south of the proposed pipeline, the line along the pipeline itself was named 'Pipe' (P), the next line 200m north was designated as 'North' (N) and a control site 'Control' (C) lay 1km farther north. Along each of these lines the 3 trawls were termed S2, S3 and S4, for example for the 3 trawls running along the southern line the inner most one was denoted as (S2) and the outermost one (S4). In addition 4 deeper water trawls were taken running parallel to the shore, 2 situated 500m off the end of the outfall of the proposed pipeline 1 running south (D500m Sth) and one running north from the centre point (D500m Nrt). 2 more trawls were run exactly parallel to these but a farther 500m off shore (east), denoted as D1km Sth and D1km Nrt. These latter 4 trawls were added to those taken in the 2015 survey, with the 4 inner trawls from that survey (S1, P1, N1 and C1) dropped for this survey. (Table 1, Figure 1). Note that a trawl was not completed at N4 because there were too many fishermen's pots laid in the area of the trawl path at the time.

Samples were taken using a 2m beam trawl pulled by a small fishing vessel. The beam trawl used had a mesh size of 11mm. Trawls were generally 1km in length and hauled at a speed of 2.5 knots. Trawling was undertaken on September 29th 2017 just over one week later than the dates of the 2015 survey. All fish captured were enumerated and measured on board, while epibenthic invertebrates such as crabs, shrimp, and starfish etc. were in most cases placed in large sealed buckets and processed on shore within 24hrs. Individual specimens were either counted (generally for species present in smaller numbers) or weighed when specimens were very small and very numerous. Colonial species were denotes as present (P) or colonies were counted. Specimens were generally either counted or weighed, also on board. Gobies were all belonging to the *Pomatoschistus* genus and all those examined were Sand goby (*P. minutus*) and while it is believed that 100% were belonging to this species, we cannot rule out the possibility that a small number may have been closely related species of the same genus. Sprat and herring were not speciated during the trawling exercise. However, the numbers of either species were very low (16 specimens in total); they were fully speciated in the seine samples. Pipe fish were all either *Syngnathus acus* (Greater) or *S. rostellatus* (Nilsson's) but were not separated, either in trawls or in beach seines. All fish were dumped back overboard after processing and some at least are likely to have survived.

Beach Seining

A 30m beach seine was used to sample at 4 locations along the Portmarnock shore south from the village and roughly opposite the respective trawl lines. The 'Control' site was closest to Portmarnock village and 1km north of the pipeline the other 3 sites were named Pipe Centre, Pipe South and Pipe North.

Table 1 and Figure 1 shows the positions of the trawl lines and beach seining positions. Note that the actual position of P2, when plotted ended up closer to shore than intended, being similar in position to P1 in the 2015 survey. In addition, shoreline irregularities in terms of shallow sandbars also needed to be avoided to ensure optimal functioning of the beach seine. Positions were recoded using a Garmin H72 hand held GPS for trawls beach seines.

Table 1 Beam trawl (19-9-2017) and beach seine (26 & 27 – 9-2017) locations

Trawl Code	Position (IN)	Position (Out)	Duration	Distance (m)	Speed (knots)
P2	N53 24 56.4 W6 05 45.7	N53 24 51.4 W6 06 34.8	00:12:58	924	2.3
P3	N53 24 57.4 W6 04 35.1	N53 24 55.8 W6 03 47.9	00:12:48	879	2.2
P4	N53 24 56.9 W6 04 39.5	N53 24 59.0 W6 03 16.2	00:19:45	1543	2.5
S2	N53 24 48.7 W6 04 50.0	N53 24 52.4 W6 05 39.5	00:09:30	923	3.1
S3	N53 24 48.5 W6 03 52.0	N53 24 48.8 W6 04 40.5	00:11:00	900	2.7
S4	N53 24 43.3 W6 03 43.4	N53 24 45.3 W6 02 52.9	00:10:00	940	3.0
N2	N53 25 06.3 W6 05 37.2	N53 25 04.0 W6 04 37.1	00:14:24	1116	2.5
N3	N53 25 03.0 W6 04 33.9	N53 25 03.5 W6 03 49.3	00:10:09	830	2.6
C2	N53 25 33.1 W6 04 44.5	N53 25 31.0 W6 05 38.1	00:11:15	999	2.9
C3	N53 25 40.5 W6 04 02.9	N53 25 38.4 W6 04 40.6	00:08:06	707	2.8
C4	N53 25 28.2 W6 03 02.8	N53 25 33.0 W6 03 54.0	00:11:02	959	2.8
D500 South	N53 24 23.2 W6 02 45.3	N53 24 55.7 W6 02 42.6	00:11:36	1020	2.8
D500 North	N53 24 59.6 W6 02 42.7	N53 25 28.7 W6 02 40.2	00:09:08	905	3.2
D1km North	N53 25 20.8 W6 02 15.1	N53 24 54.4 W6 02 13.0	00:13:53	963	2.2
D1km South	N53 24 49.8 W6 02 18.2	N53 24 21.9 W6 02 18.8	00:10:42	856	2.6
Seine Codes					
Control - Night	N53 25 40.851	W6 7 16.197	n/a	n/a	n/a
Control - Day	N53 25 32.074	W6 7 13.497	n/a	n/a	n/a
North-Night	N53 25 16.434	W6 7 8.447	n/a	n/a	n/a
North Day	N53 25 13.507	W6 7 5.435	n/a	n/a	n/a
Centre - Night	N53 25 3.707	W6 7 1.482	n/a	n/a	n/a
Centre-Day	N53 25 5.600	W6 7 2.53	n/a	n/a	n/a
South - Night	N 53 24 55.777	W6 6 57.067	n/a	n/a	n/a

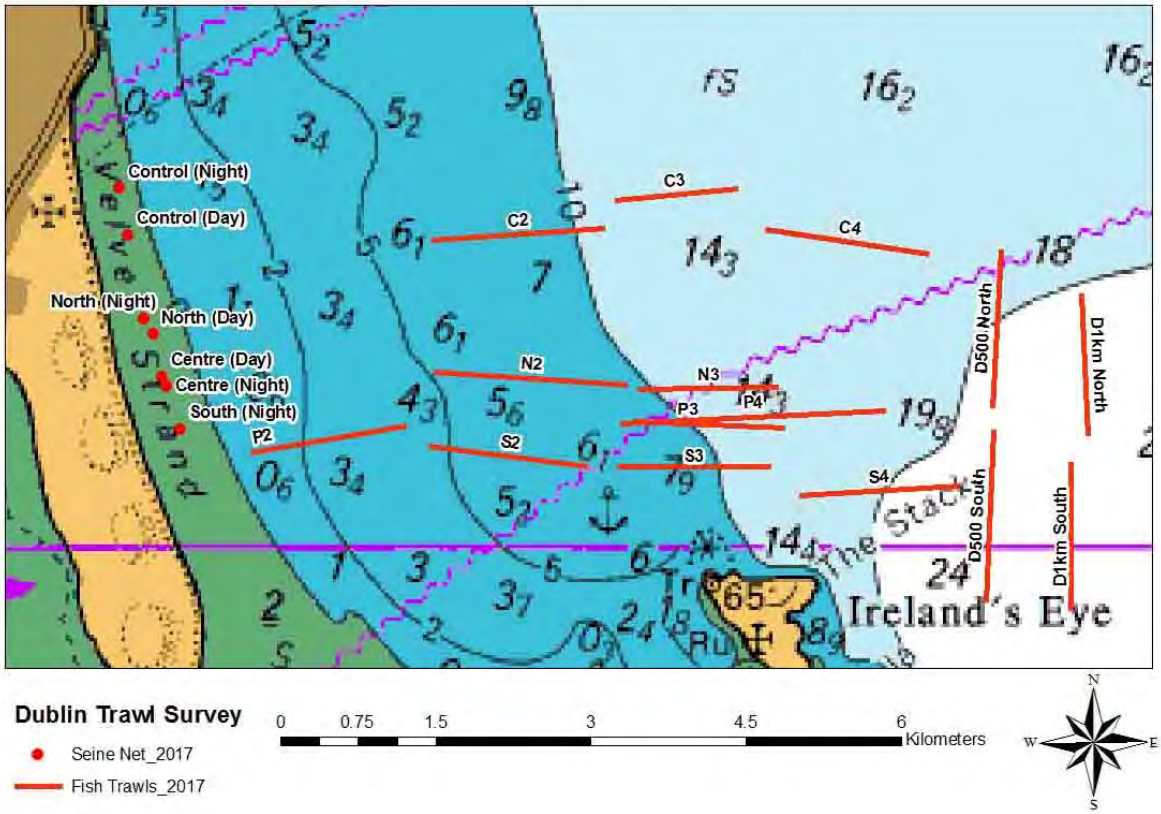

Figure 1 Trawl tracks and beach seine positions 2017 fisheries survey

Results

Trawls - Fish

Table 2 lists the fish species caught in order of decreasing total abundance. Table 3 presents the abundance of each fish species in each trawl, while Table 4 gives total numbers of fish and invertebrate species in each trawl, the total invertebrate and fish species per trawl (as a general measure of diversity) and the total fish abundance per trawl. Table 5 lists the epibenthic invertebrates present in each trawl and their number or weight in each case. Figure 2 shows the summarised fish data graphically and Appendix 1 contains a photo of each trawl catch and a seine net catch.

A minimum of 23 species of fish were taken in the trawls (Table 2). Of these only about a third were numerically common and effectively ubiquitous (Table 3), namely plaice, dab, sand goby, whiting, dragonet, pipefish gurnard and pogge, all of which stood a similar chance of been taken in any of the inner trawls, whereas the 4 deeper trawls all designated with D, tended to have fewer numbers and species of fish present in catches. The remaining species were less evenly spread. This could have to do with their relative abundance in general in the area, habitat preferences, seasonal factors, general scarcity in inshore waters or their particular swimming habits etc. Herring and sprat for example are pelagic species normally higher in the water column and also very clumped, i.e. forming shoals, so their presence in trawls may be a matter of chance.

Most trawls were dominated numerically by just 4 species, plaice, dab, goby and dragonet, which together constituted more than 75% of the catch at most sites (Figure 2). The exceptions to this

trend were generally sites with small catches, e.g. N2, which was dominated by pipefish and D1km Sth, which only contained 2 fish. It is notable that sand goby are most dominant in the 3 inner trawls, C2, P2 and S2. In terms of overall fish diversity, the highest species numbers were recorded along the southern trawls (S2-S4) and the Pipe trawls (P2-P4), with slightly lower numbers along the North and Control Trawls. This may suggest a somewhat more diverse range of microhabitats at sites with higher species numbers.

In terms of invertebrates the most widespread species included swimming crabs (*Liocarcinus* spp.), small spider crabs (Majiid species), *Crangon* (2 species), Aesops prawn (*Pandulus mantagui*), hermit crab (*Pagurus bernhardus*), common starfish (*Asterias rubens*), brittle stars (*Ophiura* spp in particular and *Ophiothrix*) and the soft coral Deadman's fingers (*Alcyonium digitatum*). Also prominent but generally more spatially restricted were green urchin (Psammechinus miliaris), queen scallop (*Aquipecten opercularis*), whelk (*Buccinum undatum*).

Some of the combinations of invertebrate species and densities within certain catches infer particular habitat types at those sites e.g. a combination of high densities of *Ophiura* brittle stars, Necklace shells, and sea potato (*Echinocardium cordatum*) at the Control trawls C2, C3 and C4, may be pointing to a more uniformly sandy or muddy sand habitat at these sites. In contrast, higher densities of a combination of queen scallop, green urchin, Aesop's shrimp, Deadman's fingers and bryozoan/hydroids at the deeper sites and the middle and outer sites of S3, S4, P3, P4, D500m Sth would infer a coarser element within the substrate. However, only a drop-down video survey would allow a precise habitat assessment.

In terms of overall epibenthic invertebrate diversity most sites had very similar diversity (Table) with the 4 deeper outer trawls having somewhat lower diversity than the inner trawls.

In terms of the epibenthic communities encountered in the trawls, these bear a strong resemblance to the *Pleuronectes-Limanda* assemblage described by Ellis *et al.,* (2000) as being typical of shallower depths (<20m) along the western and eastern sides of the Irish Sea. It also has some similarities in the outer trawl sites with the *Microchirus-Pagurus* assemblage described in the same paper as occurring in slightly deeper waters.

In terms of fisheries importance the area can be described as nursery area for several species that were taken in this survey, namely, herring, plaice, whiting, cod and thornback ray. Ellis et al 2012 classifies the area where the survey was carried out as a high intensity nursery area for cod, whiting and herring and as a low intensity nursery area for thorn back ray (*Raja clavata*), and plaice. Other species, less important from a commercial standpoint but ecologically significant within the overall food chain, include sand goby, dragonet, gurnard and gadoids including *Trisopterus* species in particular. It should be noted also that the pelagic species sprat are likely to heavily use these waters on a seasonal basis even though they were very poorly represented in beam trawls. Larger specimens of several of the species captured and other larger mobile species such as lesser-spotted dogfish and smooth hound would be expected to be present in the area but be able to evade capture by the beam trawl.

Table 2 A list of the fish species taken in trawls listed in order of decreasing abundance.

2017 Rank	Common name	Scientific Name	Total Numbers
1	Dragonet	*Callionomys lyra*	294
2	Dab	*Limanda limanda*	251
3	Sand Goby	*Pomatoschistus minutus*	204
4	Plaice	*Pleuronectes platessa*	175
5	Grey Gurnard	*Eutrigla gurnardus*	32
6	Whiting	*Merlangius merlangus*	29
7	Pipefish (Nilsson's/Greater)	*Syngnathus rostellatus/S. acus*	28
8	Spratt/Herring	*Clupea harengus/Sprattus sprattus*	16
9	Pogge	*Agonus cataphractus*	13
10	Cod	*Gadus moruha*	9
11	5-Bearded Rockling	*Ciliata mustela*	5
12	Scaldfish	*Arnoglossus laterna*	4
13	Thornback Ray	*Raja clavata*	4
14	Poor cod	*Trisopterus minutus*	3
15	Butterfish	*Pholis gunnellus*	3
16	Lesser Spotted dog fish	*Scyliorhinus canicula*	3
17	Sole	*Solea solea*	2
18-23	Megrim	*Lepidorhombus whiffiagonis*	1
18-23	Lemon sole	*Microstomus kitt*	1
18-23	Solonette	*Buglossidium luteum*	1
18-23	Pouting	*Trisopterus luscus*	1
18-23	Sea-snail	*Liparis liparis*	1
18-23	Smooth hound	*Mustela sp.*	1

Table 3 The number of each of fish species taken in each trawl. S=south, P = pipe, N = north and C = control, D500 south = 500m from end of proposed outlet from pipe trawling north-south direction south of the line of the pipe with D500m north the same but trawling north of the pipe. D1km south and D1km north are the same as the D500m pair but 500m farther east. 2 = inner line of trawls, 4 = outer line (see Figure 1 for all trawl lines). The white cells indicate the absence of a species and the pink cell denotes N4 which remained unfished due to the presence a high density of static gear at the site (i.e. fishing pots).

	Dragonet				Dab			
	S	P	N	C	S	P	N	C
2	43	3		58	54	19		34
3	8	57	5	29	30	38	4	17
4	3	36		36	3	26		18
D500m (sth & nrth)	8		7		2		4	
D1Km (sth & nrth)			1		1		1	
	Goby				Plaice			
	S	P	N	C	S	P	N	C
2	60	45	1	63	26	17		18
3	4	19	1	6	12	35	3	9
4		3			5	8		28
D500m (sth & nrth)	1		1		1		12	
D1Km (sth & nrth)							1	
	Gurnard				Whiting			
	S	P	N	C	S	P	N	C
2	4	5	5	5	1	4	1	2
3	2	4		2	2	1		3
4				5				5
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Pipe fish				Spratt/Herring			
	S	P	N	C	S	P	N	C
2	1		12	1	2	2	2	9
3	1	11		1		1		
4								
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Pogge				Cod			
	S	P	N	C	S	P	N	C
2	2		1		3			
3	1	2	4			5		
4	2					1		
D500m (sth & nrth)	1							
D1Km (sth & nrth)								
	Rockling				Scaldfish			
	S	P	N	C	S	P	N	C
2			1					3
3		3						
4	1							
D500m (sth & nrth)								1
D1Km (sth & nrth)								
	Thornback Ray				Poor Cod			
	S	P	N	C	S	P	N	C
2	1		3					
3						3		
4								
D500m (sth & nrth)								
D1Km (sth & nrth)								

Table 3 continued:

	Butterfish				Lesser Spotted Dogfish			
	S	P	N	C	S	P	N	C
2					3			
3	1	1						
4	1							
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Sole				**Megrim**			
	S	P	N	C	S	P	N	C
2								
3	1							1
4								
D500m (sth & nrth)				1				
D1Km (sth & nrth)								
	Lemon sole				**Solenette**			
	S	P	N	C	S	P	N	C
2					1			
3								
4	1							
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Sea Snail				**Smooth Hound**			
	S	P	N	C	S	P	N	C
2					1			
3		1						
4								
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Pouting							
	S	P	N	C				
2								
3		1						
4								
D500m (sth & nrth)								
D1Km (sth & nrth)								

Table 4 Total numbers of fish and invertebrate species in each trawl, the total invertebrate and fish species per trawl and total fish abundance per trawl. S=south, P = pipe, N = north and C = control, D500 south = 500m from end of proposed outlet from pipe trawling north-south direction south of the line of the pipe with D500m north the same but trawling north of the pipe. D1km south and D1km north are the same as the D500m pair but 500m farther east. 2 = inner line of trawls, 4 = outer line (see Figure 1 for all trawl lines). The pink cell denotes N4 which remained unfished due to the presence a high density of static gear at the site (i.e. fishing pots).

Fish: Number of species				
	S	**P**	**N**	**C**
2	13	7	8	9
3	10	15	5	8
4	7	5		5
D500m (sth & nrth)	5		5	
D1Km (sth & nrth)	1		3	
Invertebrates: Number of taxa				
	S	**P**	**N**	**C**
2	11	10	16	14
3	15	13	14	19
4	14	14		15
D500m (sth & nrth)	10		7	
D1Km (sth & nrth)	9		7	
Total Taxa Count (Fish & Invertebrates)				
	S	**P**	**N**	**C**
2	24	17	24	23
3	25	28	19	27
4	21	19		20
D500m (sth & nrth)	15		12	
D1Km (sth & nrth)	10		10	
Fish: Total Abundances				
	S	**P**	**N**	**C**
2	202	95	27	193
3	62	182	17	70
4	16	74		100
D500m (sth & nrth)	13		26	
D1Km (sth & nrth)	1		3	

Table 5-The number or weight of each invertebrate taken in each trawl. S=south, P = pipe, N = north and C = control, D500 south = 500m from end of proposed outlet from pipe trawling north-south direction south of the line of the pipe with D500m north the same but trawling north of the pipe. D1km south and D1km north are the same as the D500m pair but 500m farther east. 2 = inner line of trawls, 4 = outer line (see Figure 1 for all trawl lines). The white cells indicate the absence of a species and the pink cell denotes N4 which remained unfished due to the presence a high density of static gear at the site (i.e. fishing pots).

	Shore Crab (Carcinus maenas)				Liocarcinus spp (swimming crabs)			
	S	P	N	C	S	P	N	C
2	1			1	14	10	89	15
3	2			60	6	24	13	42
4		1			11	19		13
D500m (sth & nrth)						2		1
D1Km (sth & nrth)						2		
	Velvet Crab (Necorus puber)				Hermit crab (Pagurus bernhardus)			
	S	P	N	C	S	P	N	C
2					4	1		31
3		1			5	6		9
4					2	3		
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Brown crab (Cancer pagurus)				Masked crab (Corystes cassivelaunus)			
	S	P	N	C	S	P	N	C
2			1				5	
3								
4								
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Small spider crabs (Majidae spp)				Aesop shrimp (Pandulus montagui)			
	S	P	N	C	S	P	N	C
2	8	4	28	7	4.6 (g)	1.5 (g)	8 (g)	12 (g)
3	7		13	15	98 (g)	240 (g)	92 (g)	
4	14	26		11	240 (g)	70 (g)		7 (g)
D500m (sth & nrth)	77		8		135 (g)		3 (g)	
D1Km (sth & nrth)	6		27		9 (g)		7 (g)	
	Crangon crangon/C. allmani				Prawn (Palaemon serratus)			
	S	P	N	C	S	P	N	C
2	13 (g)	110 (g)	7 (g)	20 (g)				1
3	30 (g)	5 (g)	27 (g)	45 (g)				
4	38 (g)	8.4 (g)		15 (g)		1		
D500m (sth & nrth)	49 (g)							
D1Km (sth & nrth)	11 (g)		13 (g)					
	Common starfish (Asteria rubens)				Brittle stars (Ophiura spp)			
	S	P	N	C	S	P	N	C
2	2	11	37	32	36 (g)	22 9g)	500 (g)	500 (g)
3	10	44	19	60	60 (g)	39 (g)	40 (g)	1250 (g)
4	11	13			10 (g)	16 (g)		1200 (g)
D500m (sth & nrth)	44		31					
D1Km (sth & nrth)	7		15					

Table 5 contd:

	Brittle stars (Ophiothrix)				Common sea urchin (Echinus esculentus)			
	S	P	N	C	S	P	N	C
2	1							
3			3	3		1		
4	12			11				
D500m (sth & nrth)	101		6					
D1Km (sth & nrth)	17		18					
	Green sea urchin (Psammechinus miliaris)				Sea potatoe (Echinocardium cordatum)			
	S	P	N	C	S	P	N	C
2			4					1
3		140	95	1				2
4	77	20		8				5
D500m (sth & nrth)	5							
D1Km (sth & nrth)								
	Sea mouse (Aphrodita aculeata)				Whelk (Buccinum undatum)			
	S	P	N	C	S	P	N	C
2				1			4	7
3	1	2		1	1		5	6
4				5				6
D500m (sth & nrth)	1							5
D1Km (sth & nrth)	1							
	Necklace shell (Euspira/Natica)				Lobe shell (Philine)			
	S	P	N	C	S	P	N	C
2			5	3		1		
3				11	1			1
4				6		1		1
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Sea slug (Nudibranch)				Queen scallop (Aquipecten opercularis)			
	S	P	N	C	S	P	N	C
2		1					35 (g)	
3		1					230 (g)	
4	3				1000 (g)	70 (g)		
D500m (sth & nrth)					300 (g)			
D1Km (sth & nrth)								

Table 5 contd:

	Rayed trough shell (Mactra stultorum)				Spiny Cockle (Acanthocardia)			
	S	P	N	C	S	P	N	C
2			1				1	
3								
4								1
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Cuttlefish (Sepiola atlantica)				Squid (Loligo forbessi)			
	S	P	N	C	S	P	N	C
2					3			
3				1	1			2
4								
D500m (sth & nrth)								
D1Km (sth & nrth)								
	Sea anenome indet				Deadman's Fingers (Alcyonium digitatum			
	S	P	N	C	S	P	N	C
2		1			2		4	
3				1	4	8	28	3
4				2	17	12		5
D500m (sth & nrth)						9		1
D1Km (sth & nrth)						5		1
	Flustra				Alyconidium gelatinosum			
	S	P	N	C	S	P	N	C
2								
3			P		6		6	1
4					2			1
D500m (sth & nrth)						8		
D1Km (sth & nrth)			P					
	Branched Bryozoans/Hydroids indet				Sea squirt (Mogula citrina)			
	S	P	N	C	S	P	N	C
2			P					
3	P	P					1	
4	P	P						
D500m (sth & nrth)								
D1Km (sth & nrth)	P							
	Sea squirt (Acidian indet)							
	S	P	N	C				
2				2				
3								
4								
D500m (sth & nrth)								
D1Km (sth & nrth)								

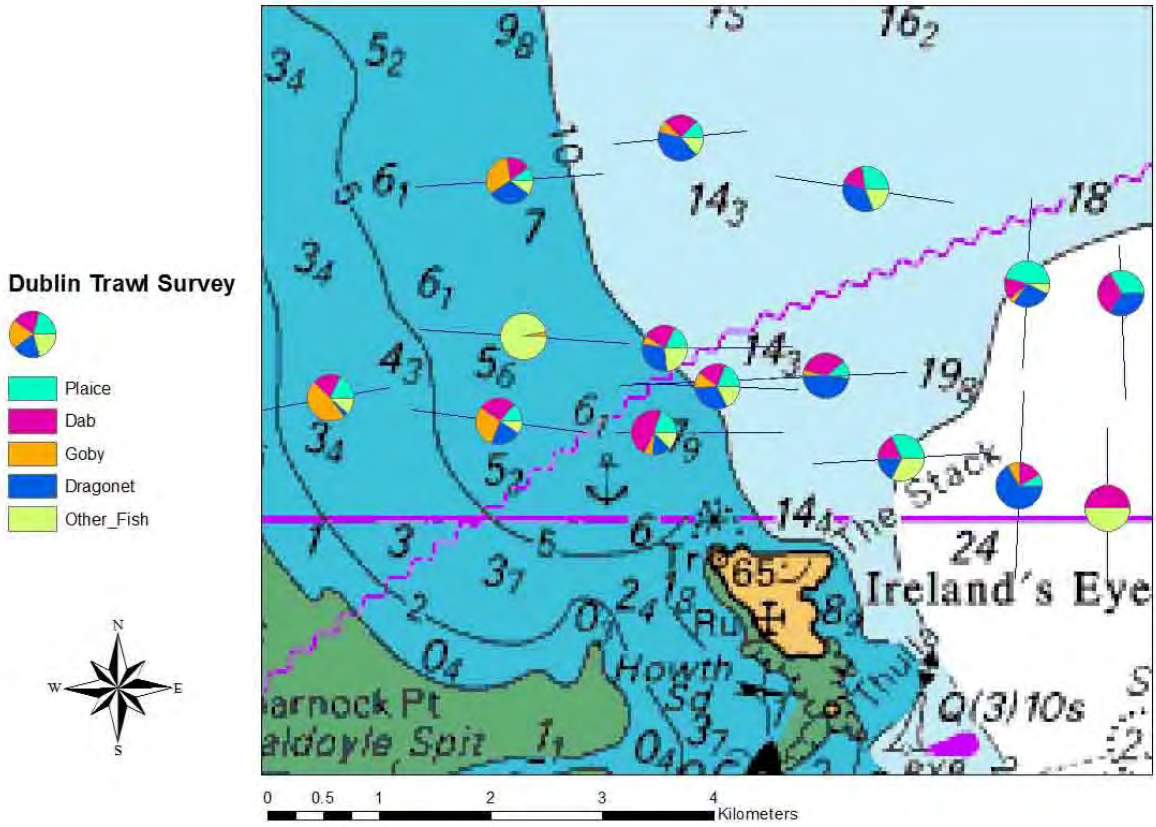

Figure 2 Relative abundance of main fish species and 'other' fish at the 16 surveyed trawl locations. September 29th 2017.

Beach Seines

Table 6 lists the fish taken in decreasing order of overall abundance in the beach seines, while Table 7 presents a list abundance/weight landed in each fish and invertebrate species taken in individual net hauls. Four of the beach seines, were taken on the night of the 26th between 22:30 and 00:10, (South, Centre, North and Control) while the following day 3 more samples were taken between 10:25 and 11:09 (Centre, North and Control) in the morning (Figure 1 and Table 1). This was there same approach taken in 2015 and designed to see if there would be an obvious day/night difference in catch composition.

The data shows that in terms of fish, sprat, plaice and sand goby dominated in that order. Overall the total number of species (13) is less than what were taken in the trawls and this is to be expected due to the uniformity of the habitat type throughout the area and the very shallow inshore location. A striking difference between the trawl and beach seine catches is the virtual complete absence of dab from the beach seine hauls. In terms of invertebrates only Crangon was present in any numbers and generally in much lower numbers than in the 2015 survey.

Table 6 A list of the 13 fish species captured in beach seines in decreasing order of abundance (September 26th & 27th, 2017)

Common Name	Scientific Name	Total Number
Sprat	*Sprattus sprattus*	357
Plaice	*Pleuronectes platessa*	212
Goby	*Pomatoschistus minutus*	199
Herring	*Clupea harengus*	13
Whiting	*Merlangius merlangus*	12
Brill	*Scophthalmus rhombus*	9
Flounder	*Platichthys flesus*	7
Turbot	*Scophthalamus maximus*	6
Lesser sand eel	*Ammodytes tobianus*	4
Sea scorpion	*Taurulus bubalis*	2
Lesser weaver	*Echiichthys vipera*	2
Sand smelt	*Atherina presbyter*	1
Smooth hound	*Mustela sp.*	1

Table 7 Abundance of fish and invertebrates in each beach-seine haul along the Portmarnock shore (September 26th & 27th, 2017). Blank cells denote absence of that species from a catch

Night 26/9/17	Centre (Night)	Centre (Day)	North (Night)	North (Day)	South (Night)	Control (Night)	Control (Day)
Day 27/9/17	23:12	10:25	23:40	10:42	22:36	00:08	11:09
Fish Numbers							
Plaice	99	5	17	5	66	9	11
Flounder	4		1		2		
Turbot			1	4		1	
Brill		3	4	1	1		
Goby	94	1	23		69	11	1
Whiting	6				3	3	
Sea scorpion					2		
Lesser sand eel			1	1	2		
Sprat	35	226	16	22	37	8	13
Herring	2	3		5		1	2
Sand Smelt	1						
Lesser Weaver		1	1				
Smooth Hound	1						
Invertebrate numbers or weight							
Crangon crangon	231g	80g	147g	72.4g	389g	51g	74g
Liocarcinus sp.	2				2		
Carcinus maenas					2		
Total Fish Species	**8**	**6**	**8**	**6**	**8**	**6**	**4**
Total Fish Numbers	**242**	**239**	**64**	**38**	**182**	**33**	**27**

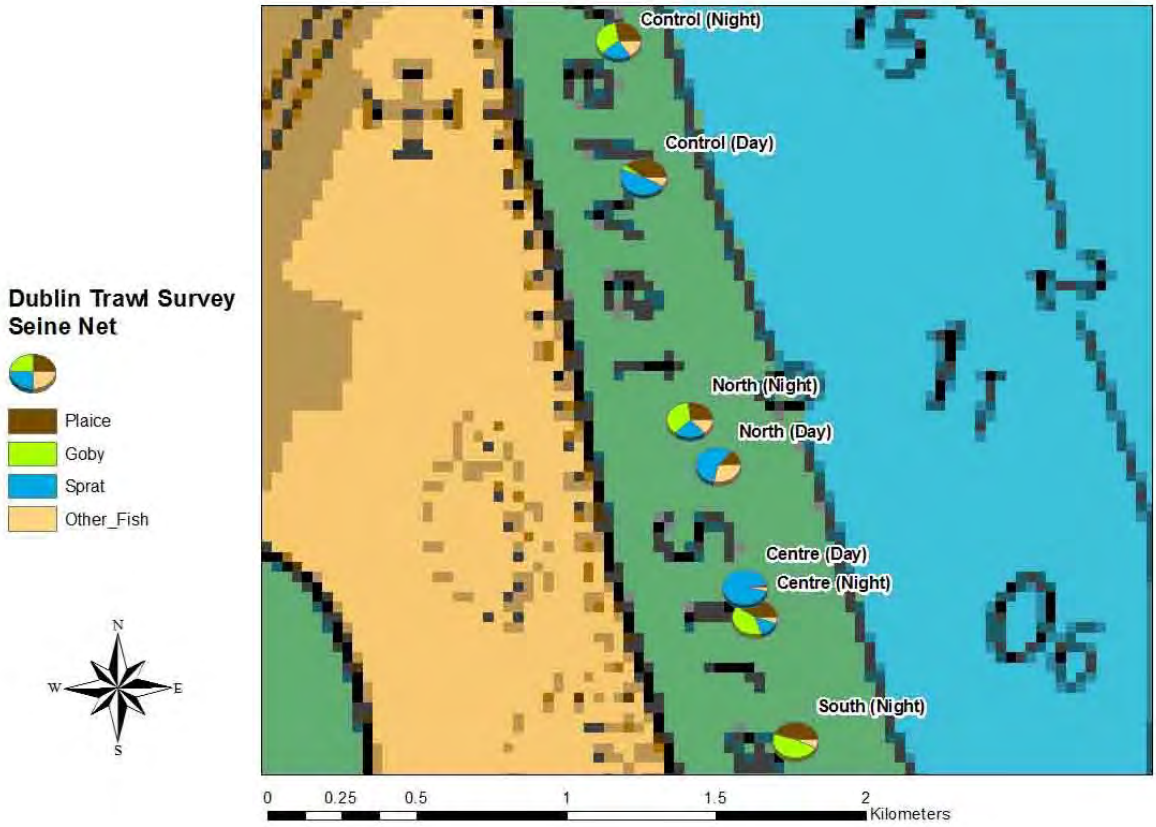

Figure 3 Fish relative abundance in seine net hauls September 26th and 27th2017

Fish Size Distribution

The size- distribution of each of the main species captured are presented in graphical form (Figure 4 – 10). There wasn't anything particularly noteworthy in these data but it does provide a good baseline for the species involved based on the time of year of capture and the locations i.e. on the beach and in deeper water, using two different methods of capture. One interesting comparison in the data is that between plaice taken in beach seines and in trawls, with those taken in the trawls having a greater proportion of larger fish (Figures 4 & 5) suggesting that as the fish get a bit larger they move steadily away from the shallows. There was very little difference in the size distribution of sand goby taken in beach seines and in trawls with very marginally more larger sized fish in the trawls.

Comparisons between the 2015 and 2017 surveys

Overall, the 2017 survey findings are very similar to those in the 2015 survey which was undertaken at more or less exactly the same time of the year. In the trawl data there are a few noteworthy points. In terms of fish abundance both surveys returned very similar numbers with 956 caught in 2015 and 1081 in 2017. Furthermore all the common species were common in both surveys. However, there were a number of noteworthy differences. For example grey gurnard (*Eutrigla gurnardus*) was far more common and widespread in the 2017 survey compared the 2015 survey, occurring in 8 trawls in the current survey compared to 1 in 2015. Also, dragonet jumped to top spot in terms of abundance in 2017 at 294 individuals compared to 55 in 2015. The other difference

between the surveys was the increase in abundance of several invertebrates in the 2017 trawls e.g. *Ophiura* brittle stars, green urchin, swimming crabs (*Liocarcinus* spp), Crangon (*C crangon* and *C. allmani*), Aesop's shrimp (*Pandulus montagui*), queen scallop (*Aquipecten opercularis*), among others. The reason for these differences isn't immediately apparent but probably relate to a variety of factors including interannual variation in abundance of certain species as well as sampling related variability among others.

The beach seining results produced very similar results in both years except that the overall numbers of fish taken was substantially down i.e. 825 in 2017 compared to 2042 in 2015. The biggest drop was in plaice whose numbers were down about 5 fold, with a lesser shift in gobies whose numbers were halved. Herring / sprat were present in similar numbers between the 2 surveys. Lesser sand eel were virtually absent in the 2017 survey with just 4 present compared to 97 in 2015. There were also significant changes in the numbers of invertebrates with crangon down from about 10kg to 1kg and crabs down by even more. There a couple of explanations for these trends. Firstly beach seining is highly variable and depending on local variations in the bottom topography, current and wave action, there can be quite variable catches and this is likely to have been a factor in this case also. However, another very important matter was that in 2015 there was an intensive razor clam fishery being conducted immediately off shore at the time. This method of fishing leaves a lot of dead and damaged benthos on the bottom and this could easily explain why there was such a very dense crab and shrimp population taken in the 2015 beach seine survey compared to the equivalent 2017 catches.

None of the differences outlined above for either the trawling or beach seining results substantially alters our assessment of the nature of the dominant fish and invertebrate communities within the survey area.

Overall Conclusions

The survey clearly shows that the fish and invertebrate assemblages encountered on the survey are typical for what would be expected in a relatively shallow environment over sand or sand mixed with coarser substrate in fully saline waters. The epibenthic community encountered bears a strong resemblance to that previously described for shallow inshore areas of the Irish Sea by Ellis *et al.,* (2000). The invertebrate assemblages in trawls point to two main community types one dominated by sand and sandy mud and another dominated by species more typical of bottom habitats with coarser substrate within the sand. However the boundary between these two types isn't clear and the likelihood is that there is a great deal of local patchiness. Broadly speaking however, the inner sites and the control sites to the north seem to be more sand or much sand dominated, while the outer and deeper sites appear to have assemblages with coarser elements. These spatial variations however would require video work to verify. The beach seining results show the same community at each site dominated by a relatively small list of fish and mobile invertebrates.

Ellis et al 2012 indicate that the study area is within a larger area which is an important nursery ground for several of the fish species taken in this survey including thorn back ray, plaice, cod, whiting and herring. The survey results support this as the majority of individuals collected were below reproductive size i.e. they were still juveniles.

Overall, the 2017 survey returned very similar results to the 2015 survey with the same dominant species, invertebrate and fish in most cases. There were variations in the dominance and abundance of several fish and invertebrate species between both surveys that may be explained by natural

interannual variability in the abundance of species, variability in sampling and the influence, certainly on aspects of the beach seining results, from the razor clam fishery which was open in 2015 but closed in 2017.

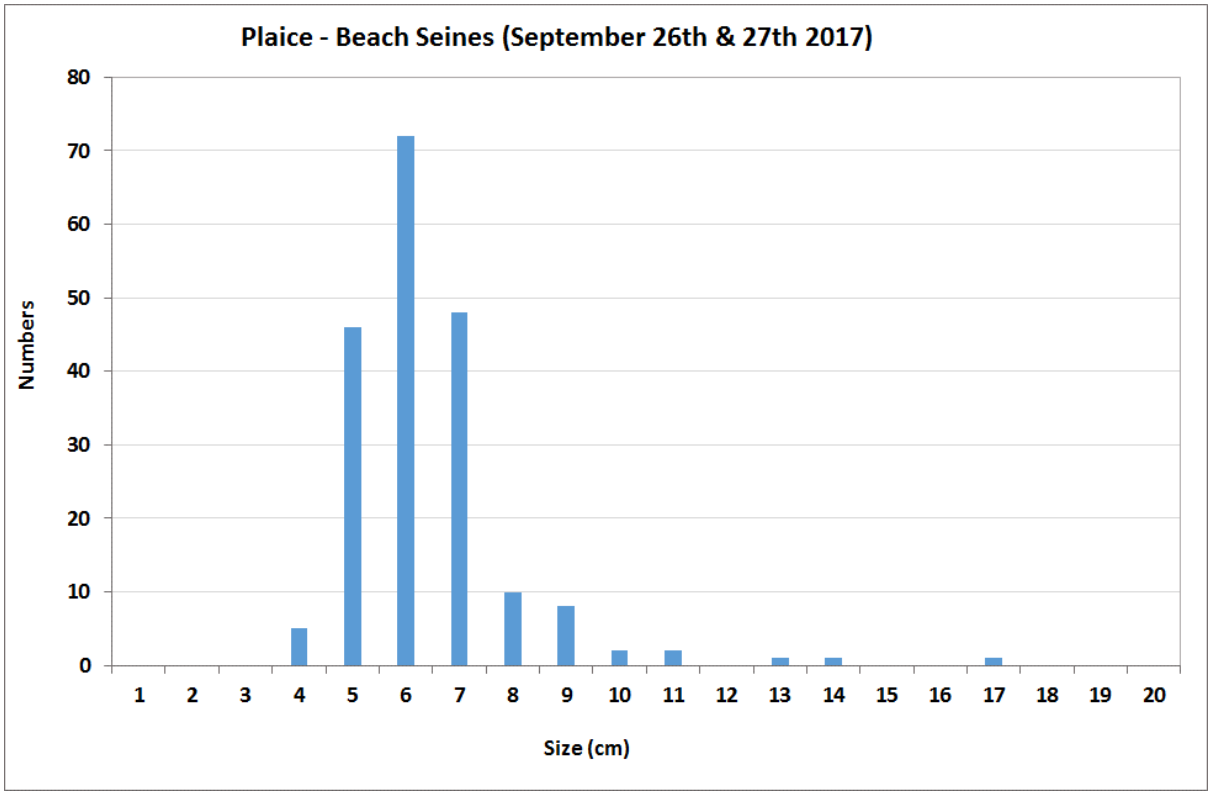

Figure 4 Size distribution of plaice taken in a beach seine - September 26th & 27th 2017

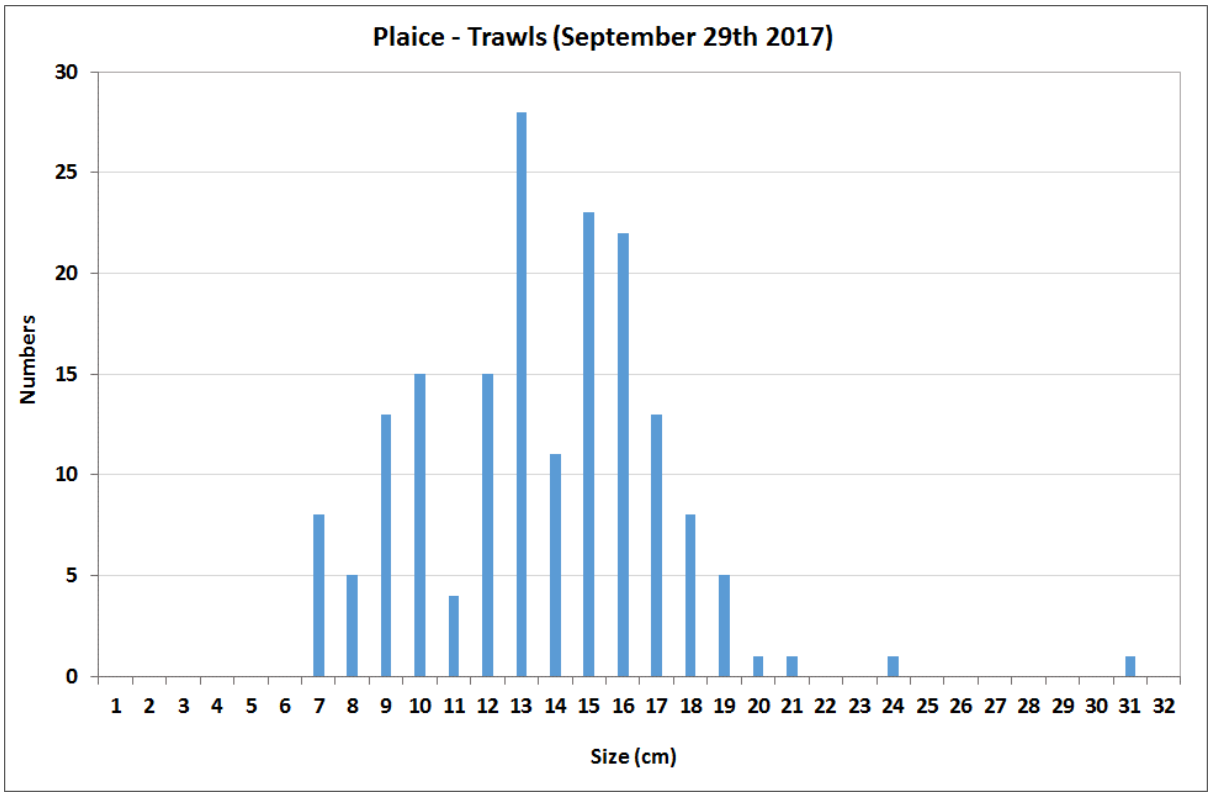

Figure 5 Size distribution of plaice taken in beam trawls - September 29th 2017

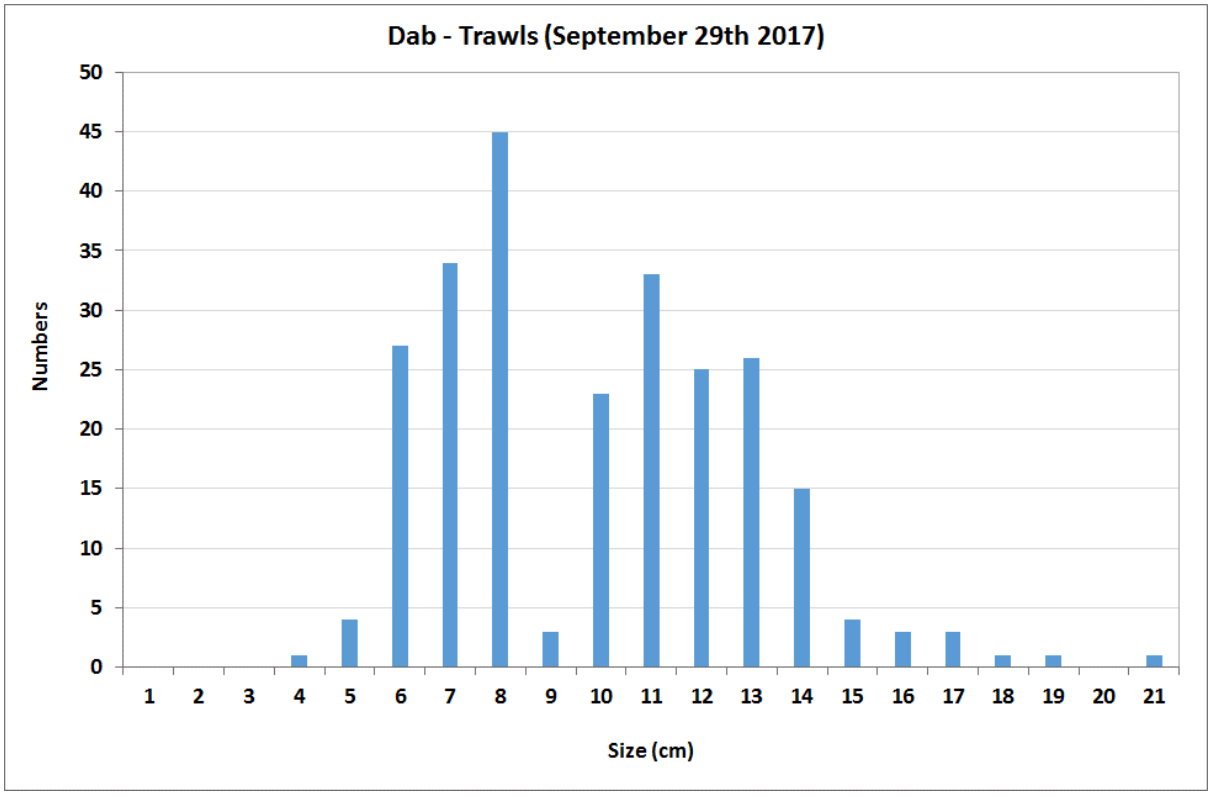

Figure 6 Size distribution of plaice taken in beam trawls - September 29th 2017

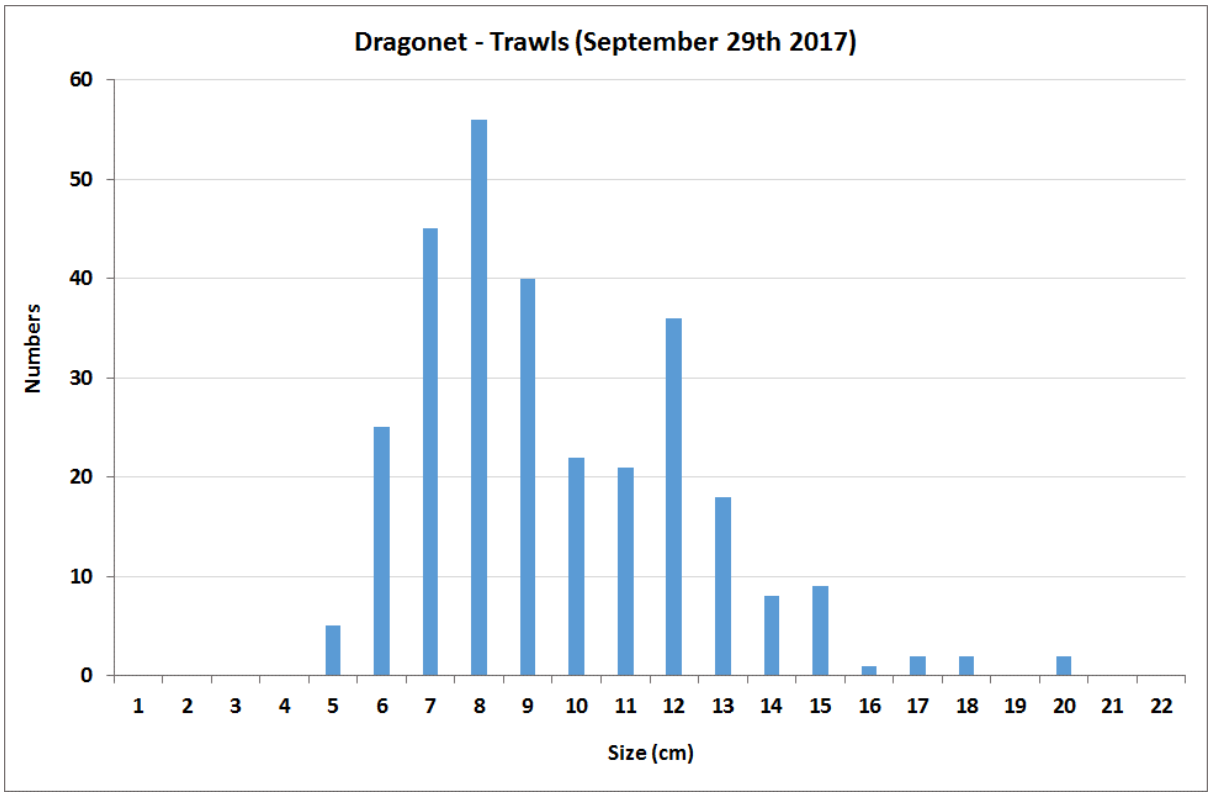

Figure 7 Size distribution of plaice taken in beam trawls - September 29th 2017

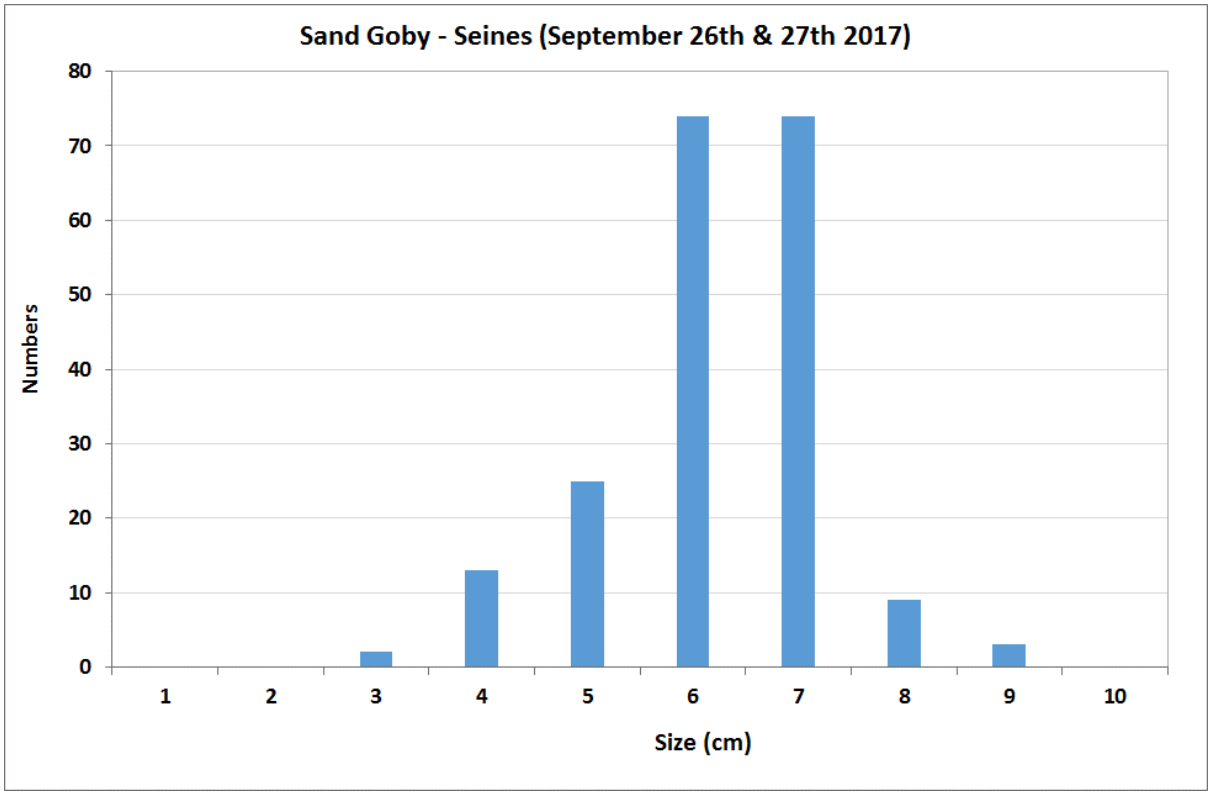

Figure 8 Size distribution of plaice taken in a beach seine - September 26th & 27th 2017

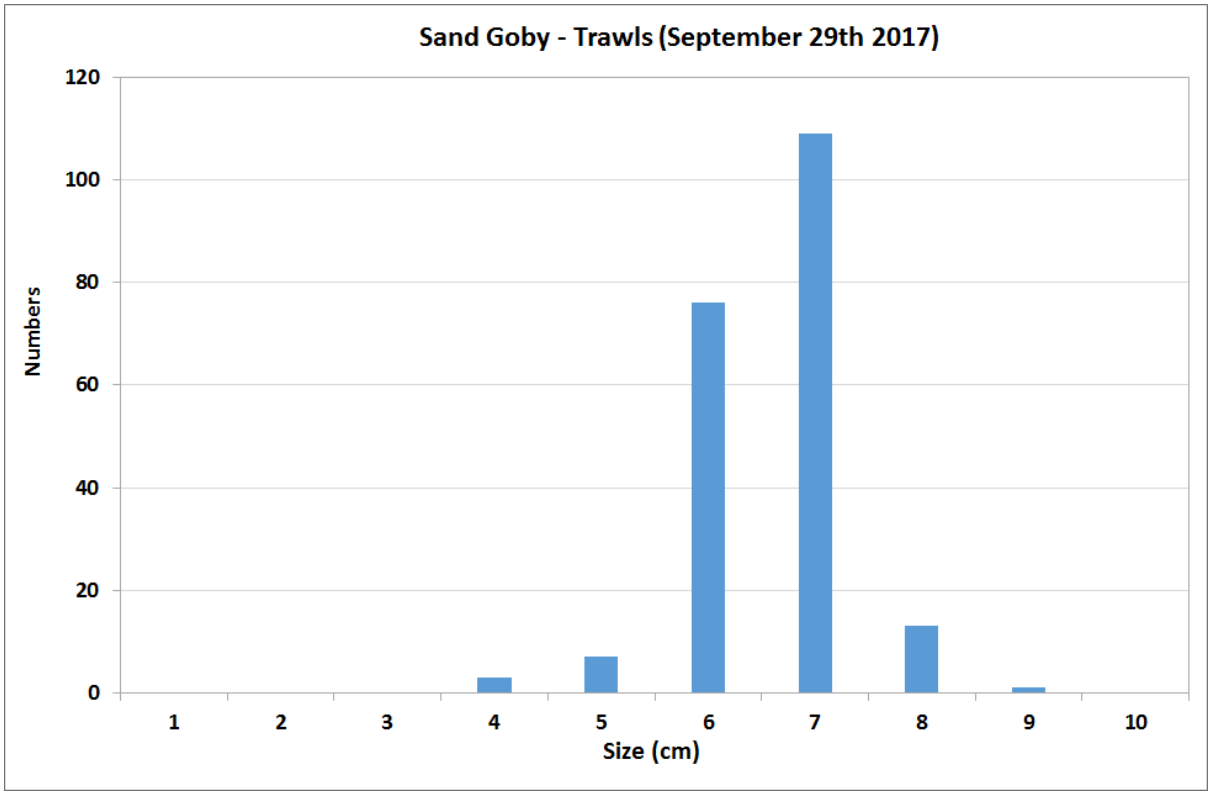

Figure 9 Size distribution of plaice taken in beam trawls - September 29th 2017

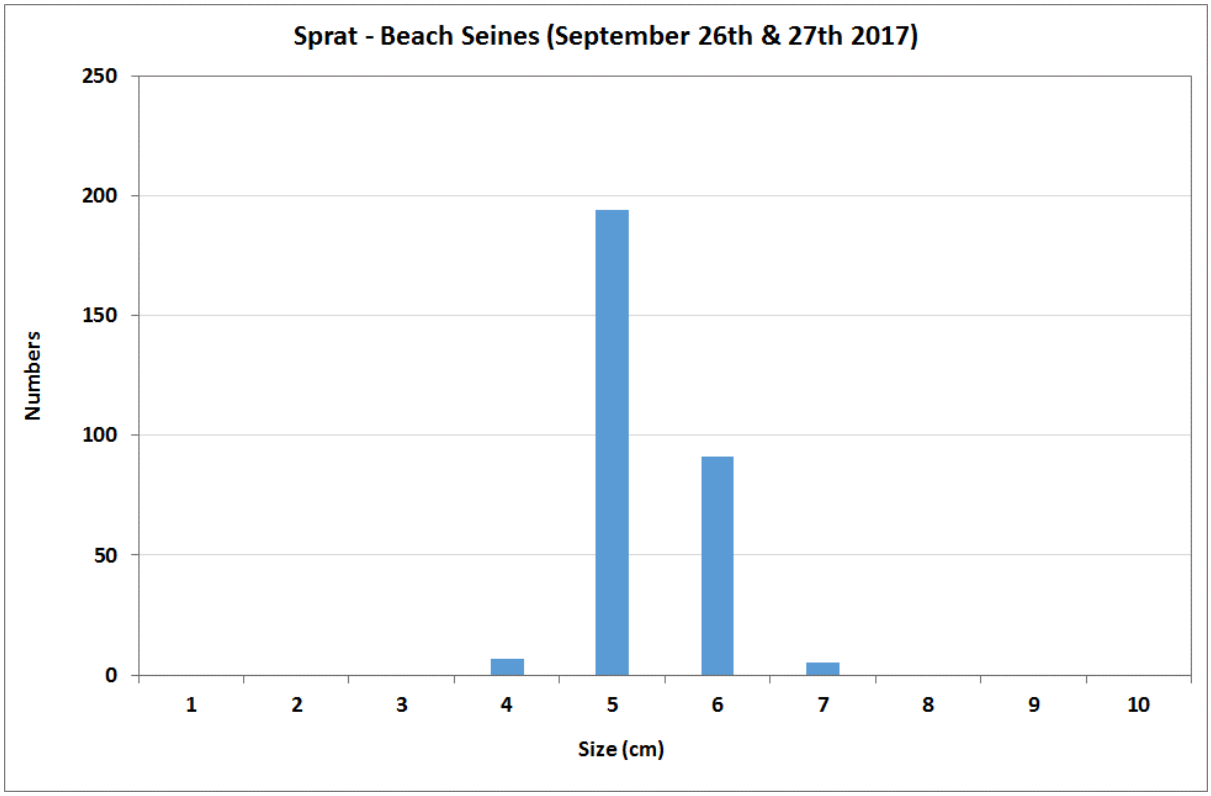

Figure 10 Size distribution of plaice taken in a beach seine - September 26th & 27th 2017

References

Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J. (1012) Spawning and Nursery Grounds of Selected Fish in UK waters. Sci. Ser. Tech. Rep. Cefas, Lowestoft, 147:56pp.

Ellis, J. R., Rogers S. I., and S. M. Freeman (2000) Demersal Assemblages in the Irish Sea, St George's Channel and Bristol Channel. Estuarine, *Coastal and Shelf Science* (51) 299-315.

Appendix 1 Photographs of trawl catches and beach seining

S2

S3

S4

P2

P3

P4

N2

N3

C2

C2

C3

C4

D500m Sth

D500m Nrt

D1km Sth

D1km Nrt

Seine Contents – Night South (26/9/17)

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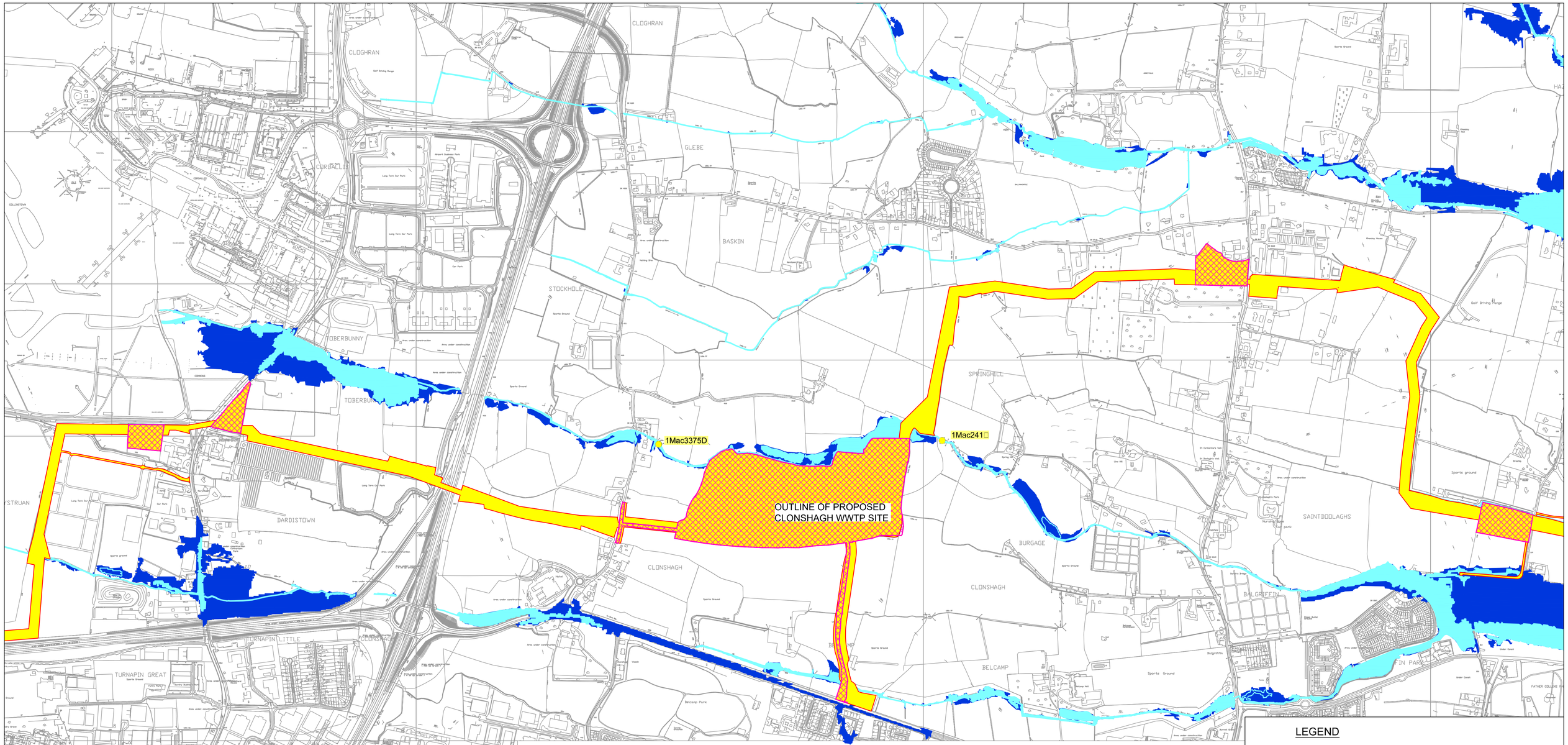
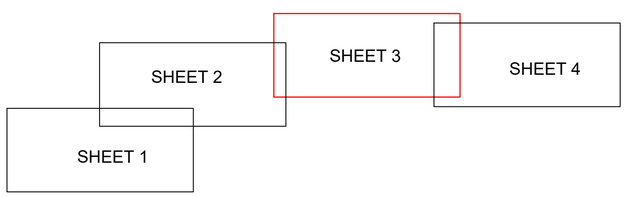


Node Label	1□ AEP EVENT Water Level □mOD□	1□ AEP EVENT Flow (m³/s)	0.1□ AEP EVENT Water Level □mOD□	0.1□ AEP EVENT Flow (m³/s)
1Mac3775D	43.□1		43.91	
1Mac241□	33.87		34.22	
	MINIMUM CONFIDENCE		LOW CONFIDENCE	

LEGEND

- WAYLEAVES EXTENTS
- CONSTRUCTION COMPOUNDS
- 100year CS FLUVIAL FINAL
- 1,000year CS FLUVIAL FINAL

KEY INDEX:

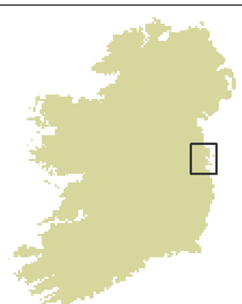


Greater Dublin Drainage

Drawing Title:

Greater Dublin Drainage Scheme

PIPE CORRIDOR & 100 / 1000 year
FLUVIAL FLOOD AREA
SHEET 3



Rev.	Date	Purpose of Revision	Drawn	Check'd	Rev'd	Appr'd
B.	20-04-18	REVISED WAYLEAVE ROUTE	UF	DMcG	-	-
A.	08-08-13	FOR INFORMATION	UF	AMC	-	-

N W E S

100m 0m 100m 200m 300m 400m 500m

JACOBS TOBIN Patrick J. Tobin & Co. Ltd. BARRY & PARTNERS

Drawing Status: FOR INFORMATION

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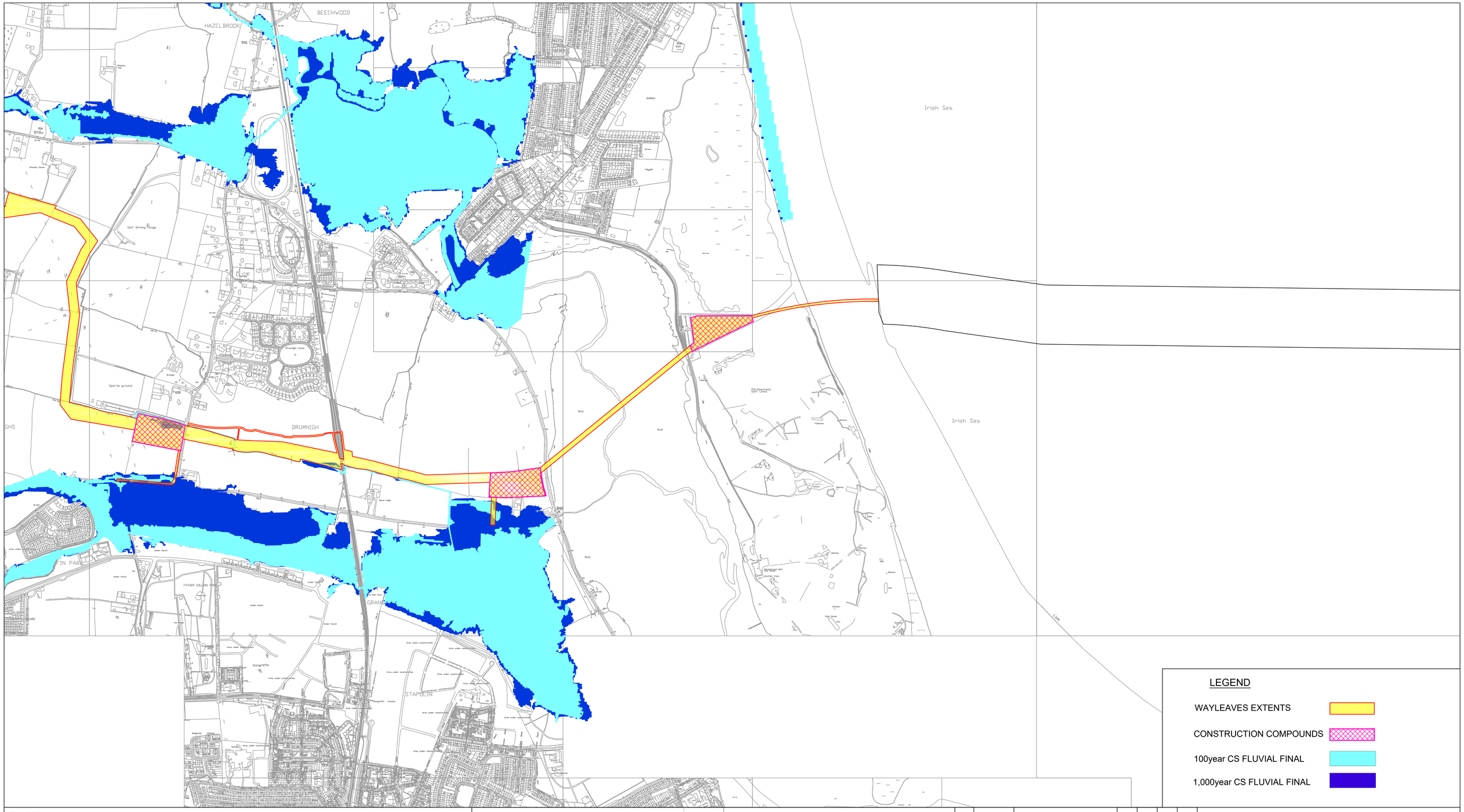
Drawing No: Y11143-C-202



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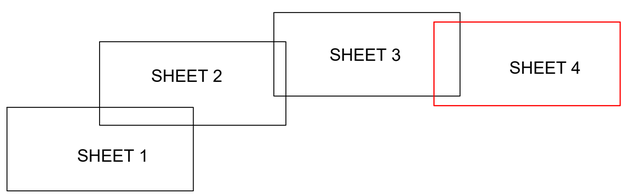
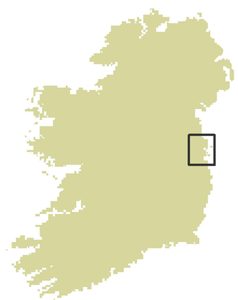


Greater Dublin Drainage

Drawing Title:

Greater Dublin Drainage Scheme

PIPE CORRIDOR & 100 / 1000 year FLUVIAL FLOOD AREA
SHEET 4



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B.	20-04-18	REVISED WAYLEAVE ROUTE	UF	DMcG	-	-
A.	08-08-13	FOR INFORMATION	UF	AMC	-	-

N W E S

100m 0m 100m 200m 300m 400m 500m

JACOBS™ TOBIN Patrick J. Tobin & Co. Ltd. BARRY & PARTNERS

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Scale: 1:15,000@ A3 1:7,500@ A1

Job No: Y11143

Drawing No:

Y11143-C-203

OUTLINE OF PROPOSED
CLONSHAGH WWTP SITE

CLONSHAGH

Sports Ground

Spring Hill

Union Bay

LEGEND

- WAYLEAVES EXTENTS
- CONSTRUCTION COMPOUNDS
- 100year CS FLUVIAL FINAL
- 1,000year CS FLUVIAL FINAL

KEY INDEX:

Greater Dublin Drainage

Drawing Title:

Greater Dublin Drainage Scheme

PIPE CORRIDOR & 100 / 1000 year
FLUVIAL FLOOD AREA
CLONSHAGH WWTP

Rev.	Date	Purpose of Revision	Drawn	Check'd	Rev'd	Appr'd
B.	20-04-18	REVISED WAYLEAVE ROUTE	UF	DMcG	-	-
A.	08-08-13	FOR INFORMATION	UF	AMC	-	-

N W E S

25m 0m 25m 50m 75m 100m

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