Appendix A12.1
Aquatic Survery Results

Subtidal and Intertidal Ecological Survey of Dodder September 2022

Produced by

AQUAFACT International Services Ltd

On behalf of

Dublin County Council

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1. Introduction

Dublin City Council commissioned AQUAFACT International Services Ltd. to carry out an intertidal and benthic subtidal survey of the Dodder River, in the vicinity of the proposed Dodder Bridge where the Dodder River joins the Liffey Estuary. As part of the Dublin City Council Dodder Bridge project, it has been proposed that eco-engineering interventions would be incorporated into the design of the construction. In order to ascertain the potential pool of species available within the surrounding area and to specifically target these species through the provision of specific habitats/interventions, the current surveys were commissioned to investigate the surrounding structures and subtidal habitats. This area was previously sampled in 2019 & 2020 (AQUAFACT), and 2001 (EcoServe, 2001). Figure 1.1 shows the location of the survey area.

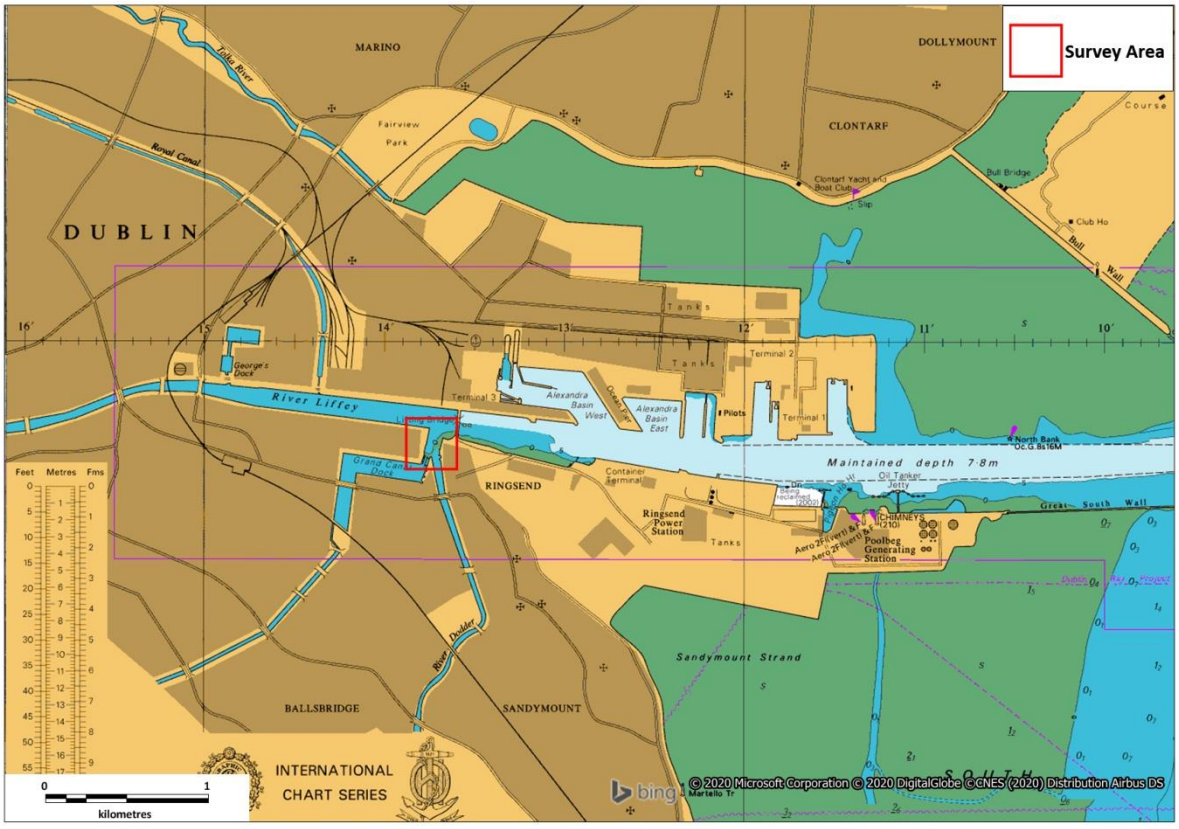

Figure 1.1: Location of Dodder Bridge Project and Survey Area.

2. Methodology

2.1. Intertidal Survey Techniques

All intertidal fieldwork took place on the 22nd of September 2022. Low water on the day was 1.60m at 15:13. Sampling was carried out around low water and the coordinates of each station were recorded on site using a hand-held Garmin GPS (Geographical Positioning System) accurate to within 3 metres. Figure 2.1 shows the locations of the intertidal stations and Table 2.1 contains the station coordinates. For most of the intertidal stations (Stations I1, I2, I3 and I7), surveying involved the examination and photographic recording of vertical wall structures and the zonation of flora and fauna present. Three stations (I4, I5 and I6) consisted of a vertical wall above an exposed intertidal mud shore which were assessed in the same manner.

Table 2.1: Intertidal Station coordinates.

Station	Easting	Northing	Longitude	Latitude
I-1	317879	234250	-6.23052	53.34556
I-2	317889	234185	-6.23040	53.34498
I-3	317915	234071	-6.23005	53.34395
I-4	317970	234022	-6.22925	53.34349
I-5	317963	234120	-6.22931	53.34438
I-6	318046	234198	-6.22804	53.34506
I-7	318074	234282	-6.22759	53.34581

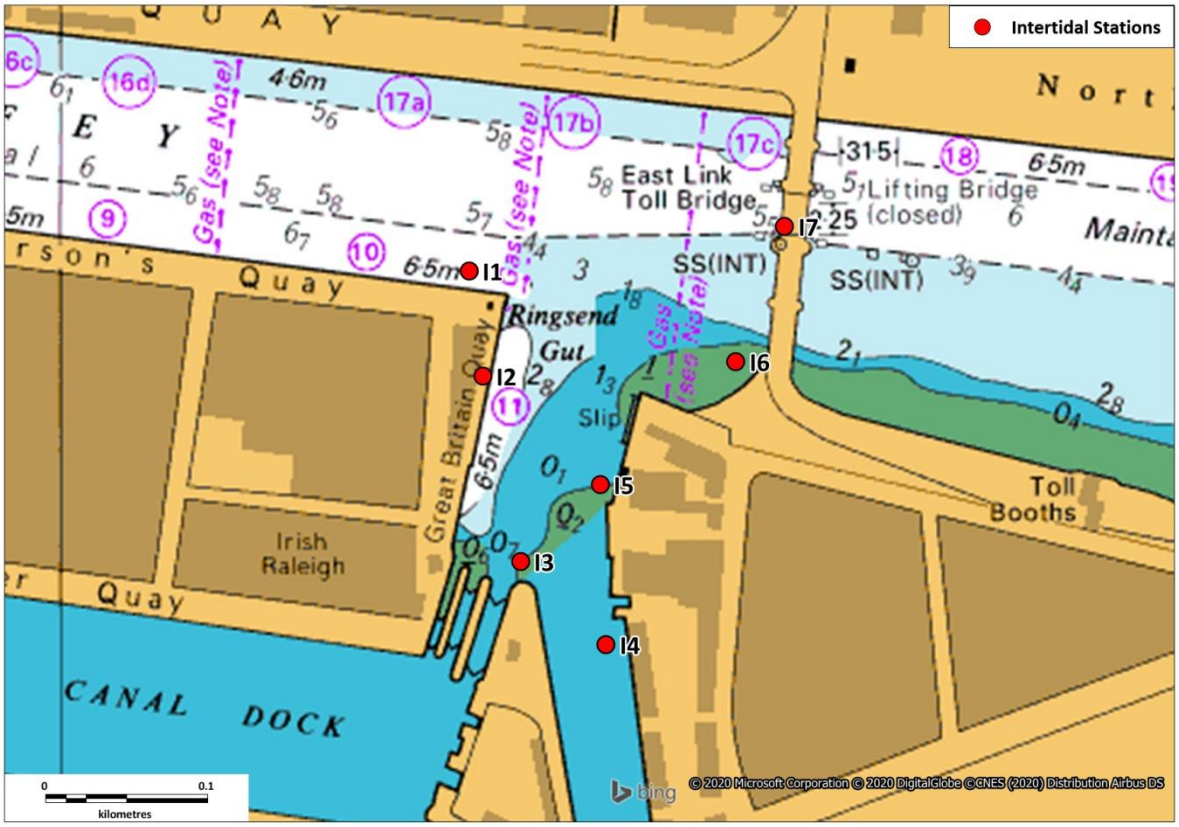

Figure 2.1: Intertidal Survey Locations.

2.1. Subtidal Survey Techniques

To carry out the subtidal benthic assessment of the survey area in the vicinity of the proposed Dodder Bridge, AQUAFACT sampled a total of 8 stations (3 replicates at each station). Sampling took place on the 21st of September 2022 from AQUAFACT's RIB (Rigid Inflatable Boat). River state was calm with a light (11kt) southerly breeze. Figure 2.2 shows the location of the grab stations sampled on the 21st of September and Table 2.2 shows the station coordinates.

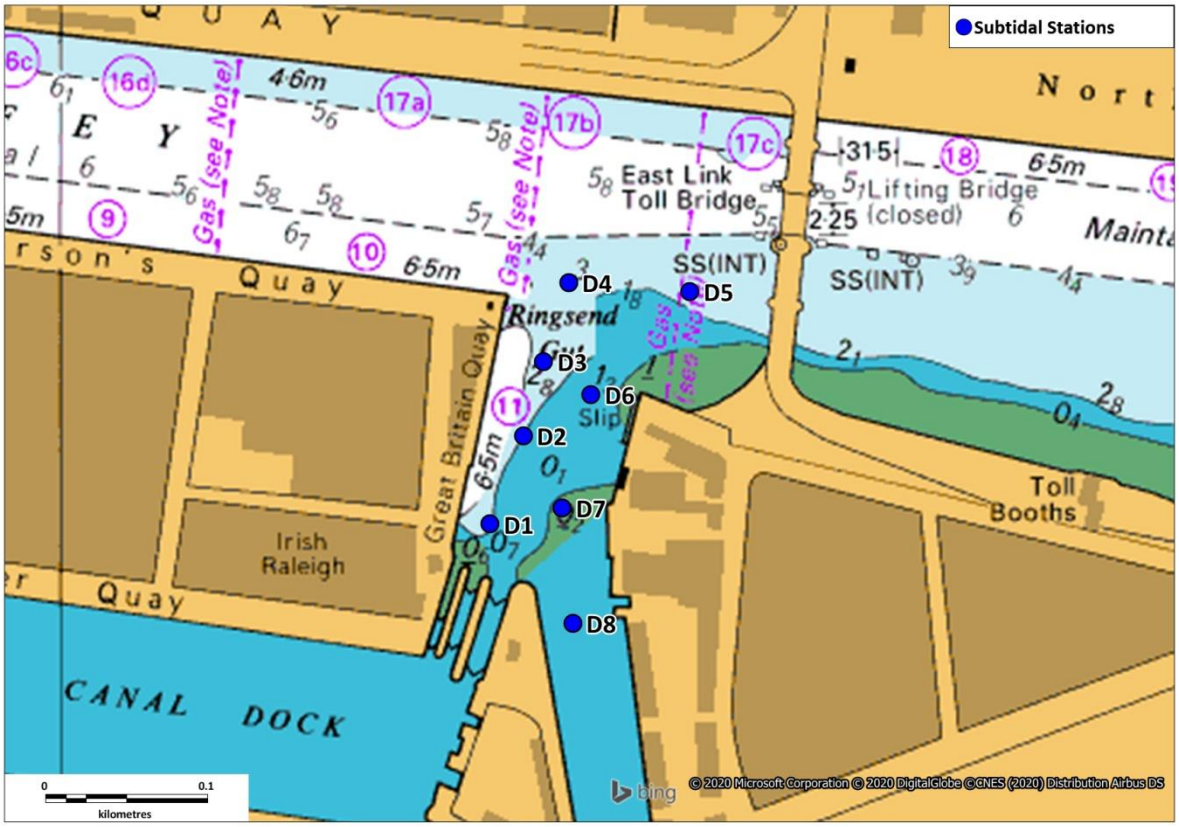

Figure 2.2: Subtidal grab stations.

Table 2.2: Subtidal grab station coordinates.

Station	Easting	Northing	Longitude	Latitude
D1	317896	234094	-6.23033	53.34416
D2	317915	234149	-6.23002	53.34465
D3	317927	234195	-6.22983	53.34506
D4	317941	234245	-6.2296	53.3455
D5	318016	234241	-6.22847	53.34545
D6	317957	234176	-6.22939	53.34488
D7	317940	234105	-6.22966	53.34425
D8	317949	234034	-6.22956	53.34361

AQUAFACT has in-house standard operational procedures for benthic sampling and these were followed for this project. Additionally, the NMBAQC 'Guidelines for processing marine microbenthic invertebrate samples' (Worsfold, T. and Hall, D., 2010) were adhered to.

A 0.025m^2 Van Veen grab was used to sample the grab sites. On arrival at each sampling station, the vessel location was recorded using DGPS (Differential Global Positioning Systems; latitude/longitude). Additional information such as date, time, site name, sample code and depth were recorded in a data sheet.

Three replicate grab samples were taken at each of the eight stations for faunal analysis and a fourth sample was collected for sediment grain size and organic carbon analysis. The grab deployment and recovery rates did not exceed one metre/sec. This was to ensure minimal interference with the sediment surface as the grab descended. Upon retrieval of the grab a description of the sediment type was noted in the sample data sheet. Notes were also made on colour, texture, smell and presence of animals. The grab sampler was cleaned between stations to prevent cross contamination.

The samples collected for faunal analysis were carefully and gently sieved on a 1mm mesh sieve as a sediment water suspension for the retention of fauna. Great care was taken during the sieving process in order to minimise damage to taxa such as spionids, scale worms, phyllodocids and amphipods. The sample residue was carefully flushed into a pre-labelled (internally and externally) container from below. Each label contained the sample code and date. The samples were stained with Eosin-briebrich scarlet and fixed in 4% w/v buffered formaldehyde solution upon returning to the laboratory. These samples were preserved in 70% alcohol prior to processing.

2.1.1. Sample Processing

All faunal samples were placed in an illuminated shallow white tray and sorted first by eye to remove large specimens and then sorted under a stereo microscope (x 10 magnification). Following the removal of larger specimens, the samples were placed into Petri dishes, approximately one-half teaspoon at a time and sorted using a binocular microscope at x25 magnification.

The fauna was sorted into four main groups: Polychaeta, Mollusca, Crustacea and others. The ‘others’ group consisted of echinoderms, nematodes, nemerteans, cnidarians and other lesser phyla. The fauna were maintained in stabilised 70% industrial methylated spirit (IMS) following retrieval and identified to species level where practical using a binocular microscope, a compound microscope and all relevant taxonomic keys. After identification and enumeration, specimens were separated and stored to species level.

The sediment granulometric analysis was carried out by AQUAFACT using the traditional granulometric approach. Traditional analysis involved the dry sieving of approximately 100g of sediment using a series of Wentworth graded sieves. The process involved the separation of the sediment fractions by passing them through a series of sieves. Each sieve retained a fraction of the sediment, which were later weighed, and a percentage of the total was calculated. Table 2.3 shows the classification of sediment particle size ranges into size classes. Sieves, which corresponded to the range of particle sizes (Table 2.3), were used in the analysis.

The additional sediment samples collected from the faunal stations had their organic carbon analysis performed by ALS Laboratories in Loughrea using the Loss on Ignition method.

Table 2.3: The classification of sediment particle size ranges into size classes (adapted from Buchanan, 1984).

Range of Particle Size	Classification	Phi Unit
<63µm	Silt/Clay	>4 Ø
63-125 µm	Very Fine Sand	4 Ø, 3.5 Ø
125-250 µm	Fine Sand	3 Ø, 2.5 Ø
250-500 µm	Medium Sand	2 Ø, 1.5 Ø
500-1000 µm	Coarse Sand	1 Ø, 1.5 Ø
1000-2000 µm (1 – 2mm)	Very Coarse Sand	0 Ø, -0.5 Ø
2000 – 4000 µm (2 – 4mm)	Very Fine Gravel	-1 Ø, -1.5 Ø
4000 -8000 µm (4 – 8mm)	Fine Gravel	-2 Ø, -2.5 Ø
8 -64 mm	Medium, Coarse & Very Coarse Gravel	-3 Ø to -5.5 Ø
64 – 256 mm	Cobble	-6 Ø to -7.5 Ø
>256 mm	Boulder	< -8 Ø

2.2. Subtidal Faunal Data Analysis

Statistical evaluation of the faunal data was undertaken using PRIMER v.6 (Plymouth Routines in Ecological Research). Using PRIMER, the faunal data was used to produce a range of univariate indices. Univariate indices are designed to condense species data in a sample into a single coefficient that provides quantitative estimates of biological variability (Heip *et al*., 1998; Clarke and Warwick, 2001). Univariate indices can be categorised as primary or derived indices.

Primary biological indices used in the current study include:

1. Number of taxa (S) in the samples and

2. Number of individuals (N) in the samples.

Derived biological indices, which are calculated based on the relative abundance of species in samples, used in the study include:

1) Margalef's species richness index (D) (Margalef, 1958),

$$D = \frac{S - 1}{\log_2 N}$$

where: N is the number of individuals

S is the number of species

2) Pielou's Evenness index (J) (Pielou, 1977)

$$J = \frac{H'(observed)}{H'_{max}}$$

where: H'_{max} is the maximum possible diversity, which could be achieved if all species were equally abundant (= $\log_2 S$)

3) Shannon-Wiener diversity index (H') (Pielou, 1977)

$$H' = -\sum_{i=1}^{S} p_i (\log_2 p_i)$$

where: p_I is the proportion of the total count accounted for by the i^{th} taxa

4) Simpson's Diversity Index (Simpson, 1949)

$$1-\lambda' = 1-\{\Sigma_i N_i(N_i-1)\} / \{N(N-1)\}$$

where N is the number of individuals of species i.

5) The Shannon-Wiener based Effective Number of Species (ENS) (Hill, 1973; Jost, 2006)

$$H = \exp(H')$$

where H' is the Shannon-Wiener diversity index.

Species richness is a measure of the total number of species present for a given number of individuals. Pielou's evenness is a measure of how evenly the individuals are distributed among different species. The Shannon-Wiener index incorporates species richness and the evenness component of diversity (Shannon & Weaver, 1949). Simpson's index is a more explicit measure of the latter, *i.e.,* the

proportional numerical dominance of species in the sample (Simpson, 1949). The Shannon-Wiener index diversity index is converted to ENS to reflect 'true diversities' (Hill, 1973, Jost, 2006) that can then be compared across communities (MacArthur, 1965; Jost, 2006). The ENS is equivalent to the number of equally abundant species that would be needed in each sample to give the same value of a diversity index, *i.e.,* Shannon-Wiener Diversity index. The ENS behaves as one would intuitively expect when diversity is doubled or halved, while other standard indices of diversity do not (Jost, 2006). If the ENS of one community is twice that of another, then it can be said that that community is twice as diverse as the other.

The PRIMER programme (Clarke & Warwick, 2001) was used to carry out multivariate analyses on the station-by-station faunal data. All species/abundance data from the grab surveys was fourth root transformed and used to prepare a Bray-Curtis similarity matrix in PRIMER ®. The fourth root transformation was used to allow the rarer species to play a part in the similarity calculation. All species/abundance data from the samples was used to prepare a Bray-Curtis similarity matrix. The similarity matrix was then be used in classification/cluster analysis. The aim of this analysis was to find "natural groupings' of samples, *i.e.,* samples within a group that are more similar to each other, than they are similar to samples in different groups (Clarke & Warwick, *loc. cit.*). The PRIMER programme CLUSTER carried out this analysis by successively fusing the samples into groups and the groups into larger clusters, beginning with the highest mutual similarities then gradually reducing the similarity level at which groups are formed. The result was represented graphically in a dendrogram, the x-axis representing the full set of samples and the y-axis representing similarity levels at which two samples/groups are said to have fused. SIMPROF (Similarity Profile) permutation tests were incorporated into the CLUSTER analysis to identify statistically significant evidence of genuine clusters in samples which are *a priori* unstructured.

The Bray-Curtis similarity matrix was also subjected to a non-metric multi-dimensional scaling (MDS) algorithm (Kruskal & Wish, 1978), using the PRIMER programme MDS. This programme produced an ordination, which is a map of the samples in two- or three-dimensions, whereby the placement of samples reflects the similarity of their biological communities, rather than their simple geographical location (Clarke & Warwick, 2001). Regarding stress values, they give an indication of how well the multi-dimensional similarity matrix is represented by the two-dimensional plot. They are calculated by comparing the interpoint distances in the similarity matrix with the corresponding interpoint distances on the 2-d plot. Perfect or near perfect matches are rare in field data, especially in the

absence of a single overriding forcing factor such as an organic enrichment gradient. Stress values increase, not only with the reducing dimensionality (lack of clear forcing structure), but also with increasing quantity of data (it is a sum of the squares type regression coefficient). Clarke & Warwick (*loc. cit*.) have provided a classification of the reliability of MDS plots based on stress values, having compiled simulation studies of stress value behaviour and archived empirical data. This classification generally holds well for 2-d ordinations of the type used in this study. Their classification is given below:

- Stress value < 0.05: Excellent representation of the data with no prospect of misinterpretation.
- Stress value < 0.10: Good representation, no real prospect of misinterpretation of overall structure, but very fine detail may be misleading in compact subgroups.
- Stress value < 0.20: This provides a useful 2-d picture, but detail may be misinterpreted particularly nearing 0.20.
- Stress value 0.20 to 0.30: This should be viewed with scepticism, particularly in the upper part of the range, and discarded for a small to moderate number of points such as < 50.
- Stress values > 0.30: The data points are close to being randomly distributed in the 2-d ordination and not representative of the underlying similarity matrix.

Each stress value must be interpreted both in terms of its absolute value and the number of data points. In the case of this study, the moderate number of data points indicates that the stress value can be interpreted directly. While the above classification is arbitrary, it does provide a framework that has proved effective in this type of analysis.

The species, which are responsible for the grouping of samples in cluster and ordination analyses, were identified using the PRIMER programme SIMPER (Clarke & Warwick, 2001). This programme determined the percentage contribution of each species to the dissimilarity/similarity within and between each sample group.

To assess the benthic ecological quality of the community, the AZTI Marine Biotic Index (AMBI) was calculated on the survey results. AMBI offers a 'pollution or disturbance classification' which represents the benthic community health (*sensu* Grall & Glémarec, 1997). Individuals are put into one of five ecological sensitivity groups (Group I - very sensitive to disturbance/pollution; Group II - indifferent to disturbance/pollution; Group III - tolerant to disturbance/pollution; Group IV - second-

order opportunists and Group V - first order opportunists) and the AMBI score is calculated as a weighted average of the sensitivity scores of each replicate sample. Assemblages with high proportions of sensitive taxa are indicative of areas with low levels of disturbance and stations dominated by opportunistic taxa reflect impacted areas.

3. Results

3.1. Intertidal Results

3.1.1. Station I-1

This station is located along the quay wall of Sir John Rogerson's Quay and can be seen in Figure 3.1. Additional photographs are presented in Appendix 1. The species recorded at this location are typical of rocky shore biotopes and are commonly found in estuaries on the East coast of Ireland. The zonation of the quay wall here is like that found by EcoServe (2001) in an adjacent location (and subsequently by AQUAFACT (2020)) and consists of a band of green *Enteromorpha* spp. above a broad zone of the horned wrack, *Fucus ceranoides,* with the barnacle *Austrominius modestus.* Beneath this zone of *F. ceranoides* there is a distinct algal band of red filamentous algae, identified as *Rhodothamniella* spp. in previous surveys. *Fucus ceranoides* is more tolerant of reduced salinity than other fucoids and tends to replace them towards the upper reaches of estuaries and sea lochs or in areas of freshwater influence. The habitat here corresponds with the JNCC biotope 'LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock' (EUNIS code: A1.327). This biotope is often found on artificial substrata such as sea defence or bridge supports (Perry & Budd, 2016).

Figure 3.1: Intertidal station I-1.

3.1.2. Station I-2

This intertidal station was located on the quay wall of Great Britain Quay and can be seen in Figure 3.2. Additional photographs are presented in Appendix 1. The zonation and species present are the same at outlined for station I-1 above and the biotope corresponds to JNCC 'LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock' (EUNIS code: A1.327).

Figure 3.2: Intertidal station I-2.

3.1.3. Station I-3

This intertidal station is located adjacent to the Grand Canal Docks lock gates and can be seen in Figure 3.3. Additional photographs are presented in Appendix 1. The zonation and species present are the same at outlined for station I-1 above and the biotope corresponds to JNCC 'LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock' (EUNIS code: A1.327).

Figure 3.3: Intertidal station I-3.

3.1.4. Station I-4

This intertidal station is located on the exposed shore of the Dodder behind O'Rahilly House Flats and can be seen in Figure 3.4. Additional photographs are presented in Appendix 1. At the top of the shore is a vertical concrete wall with the typical green algal growth seen at the other stations. From the base of this wall the exposed shore here is of gravel and muds with protruding wood and concrete structures. The middle shore has abundant coverage of *Fucus ceranoides* attached to the hard structures, and this cover is patchier in the lower shore. The lower shore to subtidal sediment corresponds to the JNCC biotopes 'SS.SMu.SMuBVS.CapTubi *Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment' (EUNIS code A5.325) and 'SS.SMu.ISaMu.Cap *Capitella capitata* in enriched sublittoral muddy sediments' (EUNIS code A5.336). These subtidal biotopes are particularly associated with abundance of first order opportunistic species and may be

associated with organically enriched and polluted sediments and have been recorded from the subtidal station D8 as outlined in section 3.2.2 below.

Figure 3.4: Intertidal station I-4.

3.1.5. Station I-5

This intertidal station is located on the exposed shore of the Dodder River close to the mouth of the river and can be seen in Figure 3.5. Additional photographs are presented in Appendix 1. The top of the shore is a vertical stone quay wall with the wooden and iron skeleton of a walkway above. The vertical zonation of the wall is like that found in the previous quay wall stations above with a JNCC 'LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock' (EUNIS code: A1.327) biotope. At the bottom of the wall the muddy gravelly sediment shore extends little to no algal cover.

Figure 3.5: Intertidal station I-5.

3.1.6. Station I-6

This intertidal station is located on the southern shore of the Liffey Estuary, beside a jetty walkway, and can be seen in Figure 3.6. Additional photographs are presented in Appendix 1. The shore is composed of rock armour boulders. The zonation of these boulders includes an upper shore band of green *Enteromorpha* spp. followed by a band of *Fucus ceranoides.* The mid shore is covered by a band of Knotted wrack, *Ascophyllum nodosum* on the rock armour boulders, though this is submerged in the images presented in this report. At the bottom of the rock armour the muddy gravelly shore extends into the subtidal with little to no algal coverage. The biotope here exhibits elements of JNCC biotope 'LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock' (EUNIS code: A1.327) biotope and 'LR.LLR.FVS.AscVS *Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity on mid eulittoral rock' (EUNIS code A1.324).

Figure 3.6: Intertidal station I-6.

3.1.7. Station I-7.

This intertidal station is located at the central concrete foundation of the Tom Clarke Bridge across the Liffey Estuary and can be seen in Figure 3.7. Additional photographs are presented in Appendix 1. The zonation and species present are the same at outlined for station I-1 above and the biotope corresponds to JNCC 'LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock' (EUNIS code: A1.327).

Figure 3.7: Intertidal station I-7.

3.2. Subtidal Biological Results

The taxonomic identification of the benthic infauna across all eight grab stations sampled in the Dodder survey area yielded a total count of 33 taxa ascribed to 5 phyla. The 33 taxa consisted of 1,013 individuals. Of the 32 taxa recorded, 16 were identified to species level. The remaining 17 could not be identified to species level as they were either juveniles, partial, damaged, or indeterminate samples. Appendix 1 shows the faunal abundances from the sampled sites.

Of the 33 taxa present, 1 was a nematode (roundworm), 1 was a nemertean (ribbon worms), 12 were annelids (segmented worms), 11 were arthropods (crabs, shrimps, insects) and 4 were molluscs (gastropods and bivalves).

3.2.1. Univariate Analysis

Univariate statistical analyses were carried out on the combined replicate station-by-station faunal data. The following parameters were calculated and can be seen in Table 3.1: taxon numbers, number of individuals, Margelef's richness, Pielou's evenness, Shannon-Wiener diversity, Simpson's Diversity and Effective Number of Species. Taxon numbers ranged from 3 (D3) to 16 (D1). Number of individuals ranged from 3 (D3) to 782 (D7). Margalef's richness ranged from 1.44 (D2) to 3.44 (D1). Pielou's evenness ranged from 0.5 (D7) to 1 (D3). Shannon-Wiener diversity ranged from 0.91 (D2) to 2.37 (D1). Simpson's diversity ranged from 0.45 (D2) to 1 (D3). Effective Species Number ranged from 2.48 (D2) to 10.72 (D1), indicating that station D1 is over 4.3 times as diverse as D2. Figure 3.8 shows these community indices in graphical form.

Table 3.1: Univariate measures of community structure.

Station	No. Taxa	No. Individuals	Margalef's Richness	Pielou's Evenness	Shannon-Wiener Diversity	Effective Species Number	Simpson's Diversity
	N	S	d	J'	H'(loge)	exp(H')	1-lambda
D1	16	78	3.44	0.86	2.37	10.72	0.89
D2	5	16	1.44	0.56	0.91	2.48	0.45
D3	3	3	1.82	1.00	1.10	3.00	1.00
D4	7	27	1.82	0.75	1.46	4.33	0.72
D5	5	7	2.06	0.96	1.55	4.71	0.90
D6	12	81	2.50	0.60	1.48	4.39	0.62
D7	13	782	1.80	0.50	1.27	3.56	0.63
D8	7	19	2.04	0.84	1.63	5.11	0.79

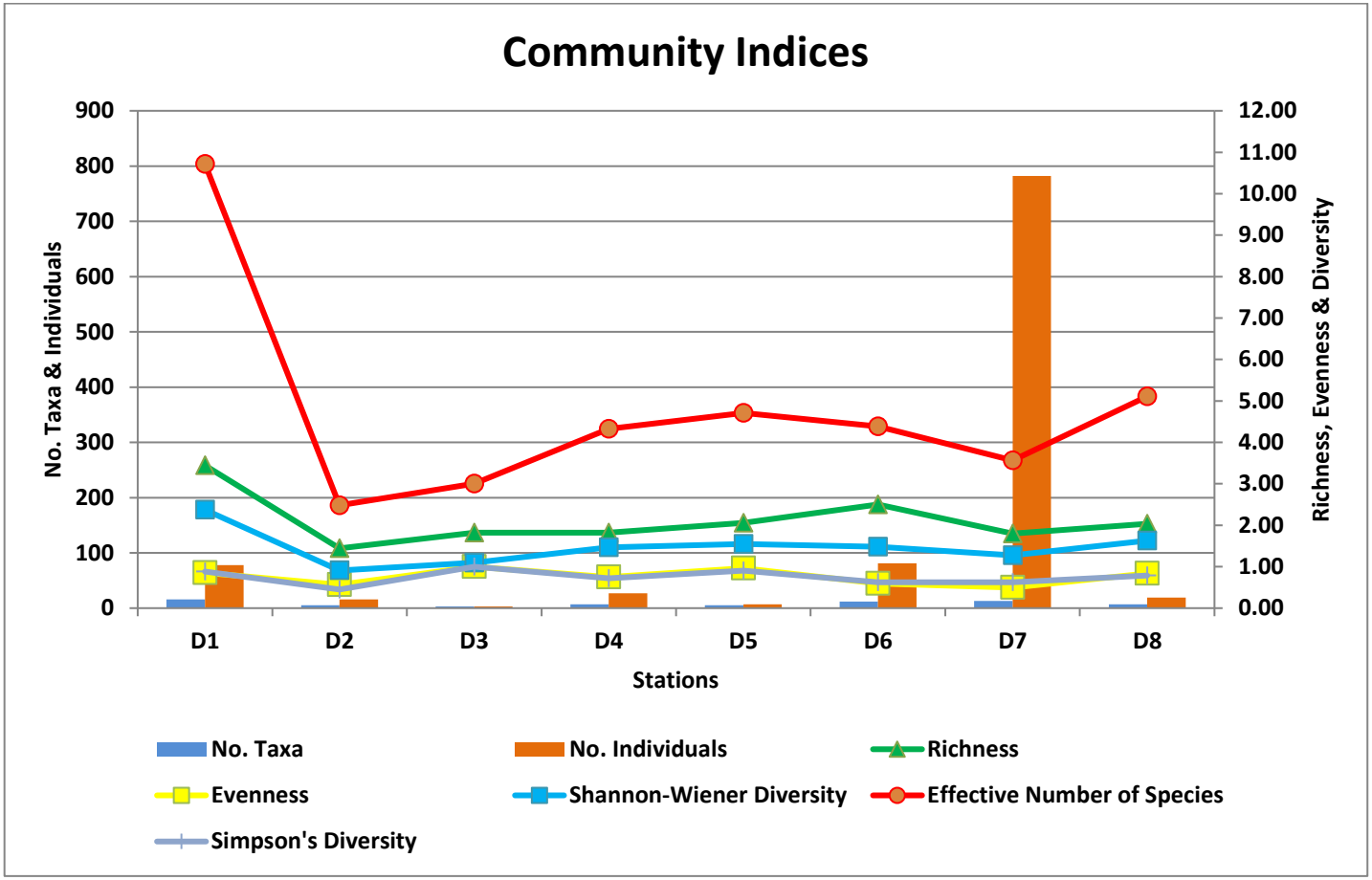

Figure 3.8: Community diversity indices.

3.2.2. Multivariate Analysis

Multivariate statistical analyses were carried out on the combined station-by-station faunal data. The dendrogram and the MDS plot can be seen in Figures 3.9 and 3.10 respectively. SIMPROF analysis could not significantly differentiate between each of the stations. The stress level on the MDS plot indicates that this is a useful representation of the data.

Within the fauna of the 8 stations, there were 33 taxa, with 15 taxa occurring twice or less. 5 taxa accounted for 87.76% of the faunal abundance: the oligochaetes *Tubificoides benedii* (514 individuals, 50.74% abundance), *Tubificoides diazi* (185 individuals, 18.26% abundance), and *Tubificoides* sp. (damaged) (113 individuals 11.15% abundance), the polychaete *Capitella* sp. complex (51 individuals, 5.03% abundance), and the gastropod *Peringia ulvae* (26 individuals, 2.57% abundance).

Tubificoides benedii, T. diazi, Tubificoides sp., and *Capitella* sp. complex are all first order opportunistic deposit feeders that proliferate in reduced/organically enriched sediments. *Peringia ulvae* are tolerant of disturbance, they occur under normal conditions, but their populations are stimulated by organic enrichment.

All the stations can be described as exhibiting characteristics of the JNCC biotopes 'SS.SMu.SMuBVS.CapTubi *Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment' (EUNIS code A5.325) and 'SS.SMu.ISaMu.Cap *Capitella capitata* in enriched sublittoral muddy sediments' (EUNIS code A5.336). These biotopes are particularly associated with abundance of first order opportunistic species and may be associated with organically enriched and polluted sediments.

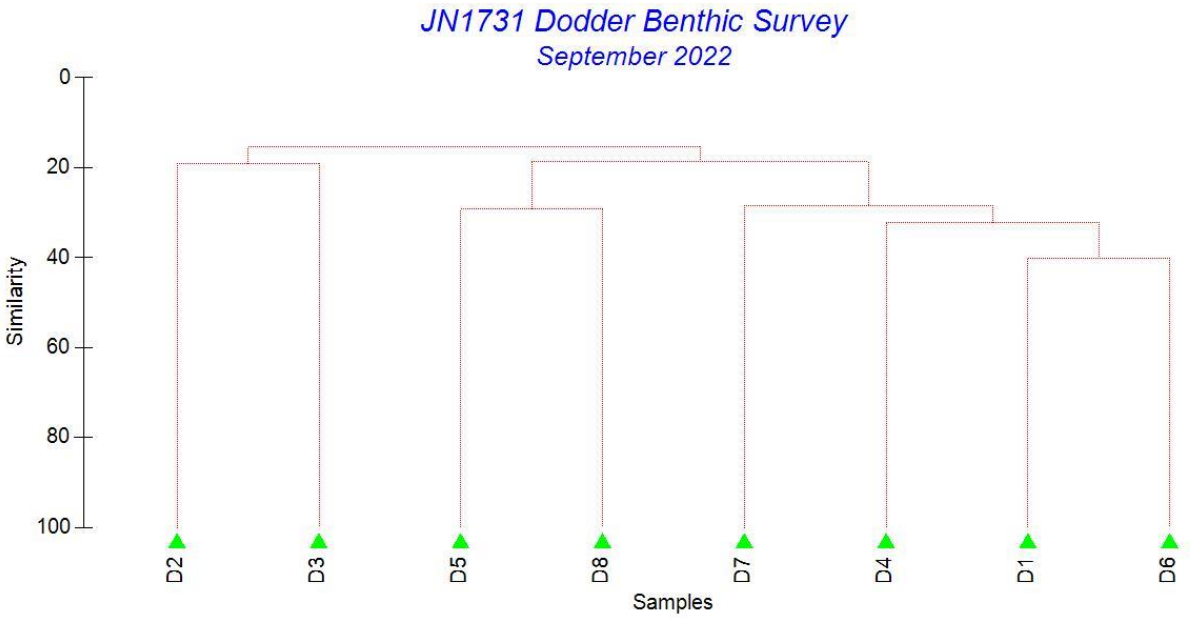

Figure 3.9: Dendrogram produced from cluster analysis.

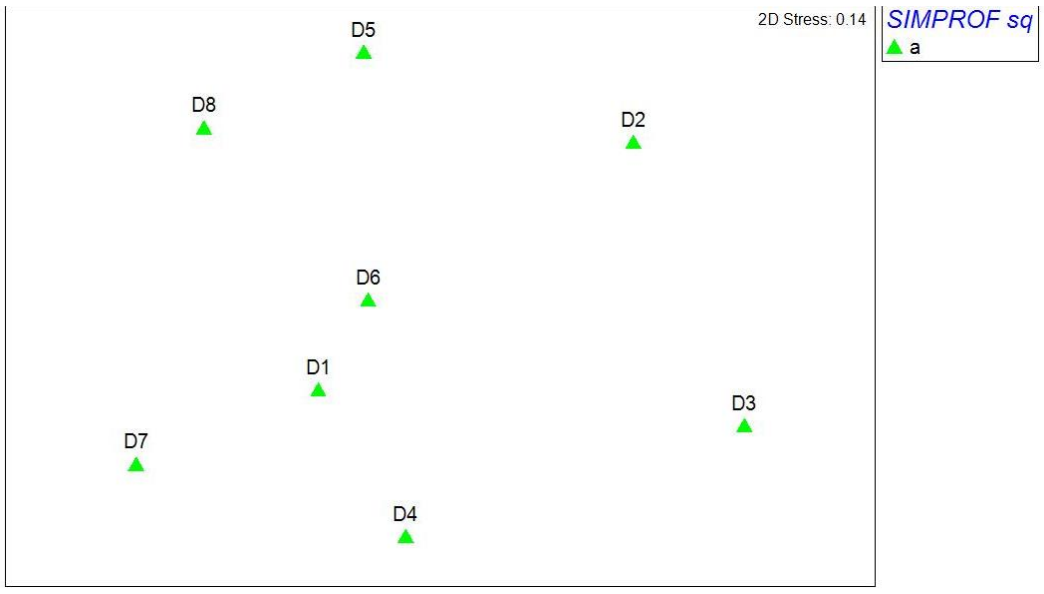

Figure 3.10: MDS plot.

Table 3.3 shows the mean AMBI results from the analysis of the replicate samples. Three stations were classified as heavily disturbed (D1, D6 and D7). Five stations were described as moderately disturbed (D2, D3, D4, D5, and D8). The heavily disturbed stations had an abundance of opportunistic species that thrive in polluted/disturbed sediments. The moderately disturbed stations had a high abundance

of species tolerant to disturbance/pollution. The AMBI result are presented in a histogram in Figure 3.11.

Table 3.2: AMBI Results.

Stations	I (%)	II (%)	III (%)	IV (%)	V (%)	Mean AMBI	BI from Mean AMBI	Disturbance Classification
D1	1.6	1.6	23	0	73.8	5.139	5	Heavily disturbed
D2	0	0	33.3	0	66.7	5	4	Moderately disturbed
D3	0	0	50	0	50	4.5	4	Moderately disturbed
D4	0	0	48.1	3.7	48.1	4.5	4	Moderately disturbed
D5	14.3	14.3	0	0	71.4	4.5	4	Moderately disturbed
D6	0	6.6	19.7	0	73.7	5.112	5	Heavily disturbed
D7	0.1	0	3.1	0	96.8	5.9	6	Heavily disturbed
D8	9.1	0	18.2	0	72.7	4.909	4	Moderately disturbed

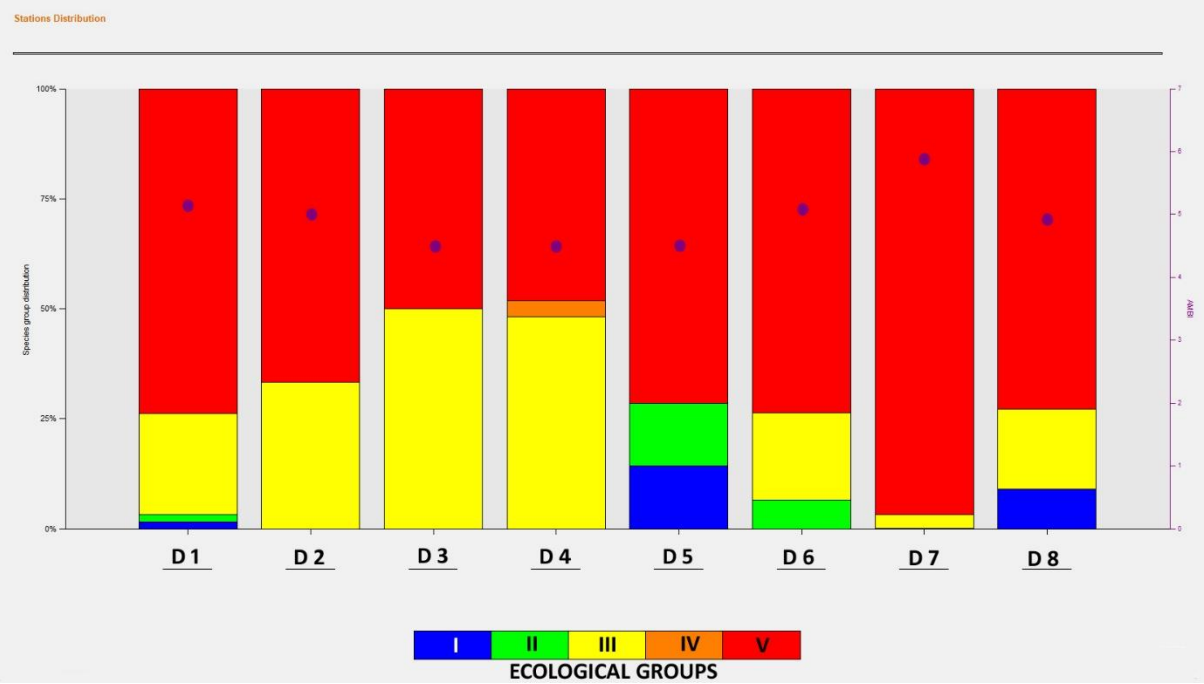

Figure 3.11: Histogram of AMBI results.

3.3. Sediment Results

Table 3.4 shows the sediment characteristics of the faunal stations in surveyed in the Dodder while Appendix 3 presents the sieve reports from each station.

The sediment sampled within the survey area of the Dodder was classified as slightly gravelly muddy sand, gravelly muddy sand and gravelly sand according to Folk (1954). No medium gravel-boulders were recorded. Highest levels of fine gravel and very fine gravel were observed at D8 (49.9% and 17.3% respectively). Highest levels of very coarse sand and coarse sand were found at D2 (19.4% and 17.5% respectively). Highest levels of medium sand were recorded at D4 (17%). Highest levels of fine sand were recorded at D7 (30.5%). Highest levels of very fine sand were found at D6 (28.8%). Highest levels of and silt/clay were recorded at D5 (30.4%). Figure 3.12 shows the breakdown of sediment composition at each station and Figure 3.13 illustrates the sediment type according to Folk (1954).

Organic matter values ranged from 8.83% (D7) to 18.05% (D2). These values are not unusual considering the large amounts of leaf litter, twigs and detritus found in the samples. All the grab stations exhibited signs of anoxic conditions with a strong odour of hydrogen sulphide in all samples returned.

Table 3.3: Sediment characteristics of the faunal stations sampled in the Dodder.

Station	>8mm	Fine Gravel (>4mm)	Very Fine Gravel (2-4mm)	Very Coarse Sand (1-2mm)	Coarse Sand (0.5-1mm)	Medium Sand (0.25-0.5mm)	Fine Sand (125-250mm)	Very Fine Sand (62.5-125mm)	Silt-Clay (<63mm)	Folk (1954)	% LOI
D1	0	30.4	8.6	11.2	13.1	11.5	10.7	6.6	8	Gravelly muddy sand	14.55
D2	0	3.6	9.5	19.4	17.5	13.8	11.3	9.4	15.5	Gravelly muddy sand	18.05
D3	0	1.5	3.3	8.5	10.8	14.8	16.4	18.9	25.7	Slightly gravelly muddy sand	14.55
D4	0	0.9	5.3	12.9	14.9	17	13	12.2	23.7	Gravelly muddy sand	13.25
D5	0	0.3	2.1	8.1	12.5	16	14.9	15.7	30.4	Slightly gravelly muddy sand	11
D6	0	1.2	2.7	5.9	8.7	11.1	16.1	28.8	25.5	Slightly gravelly muddy sand	9.22
D7	0	0.2	2	4.6	7.3	14	30.5	24.3	17	Slightly gravelly muddy sand	8.83
D8	0	49.9	17.3	12.7	9.9	5.6	2.3	1.3	1.1	Sandy gravel	13.35

Figure 3.12: A breakdown of sediment type at each station.

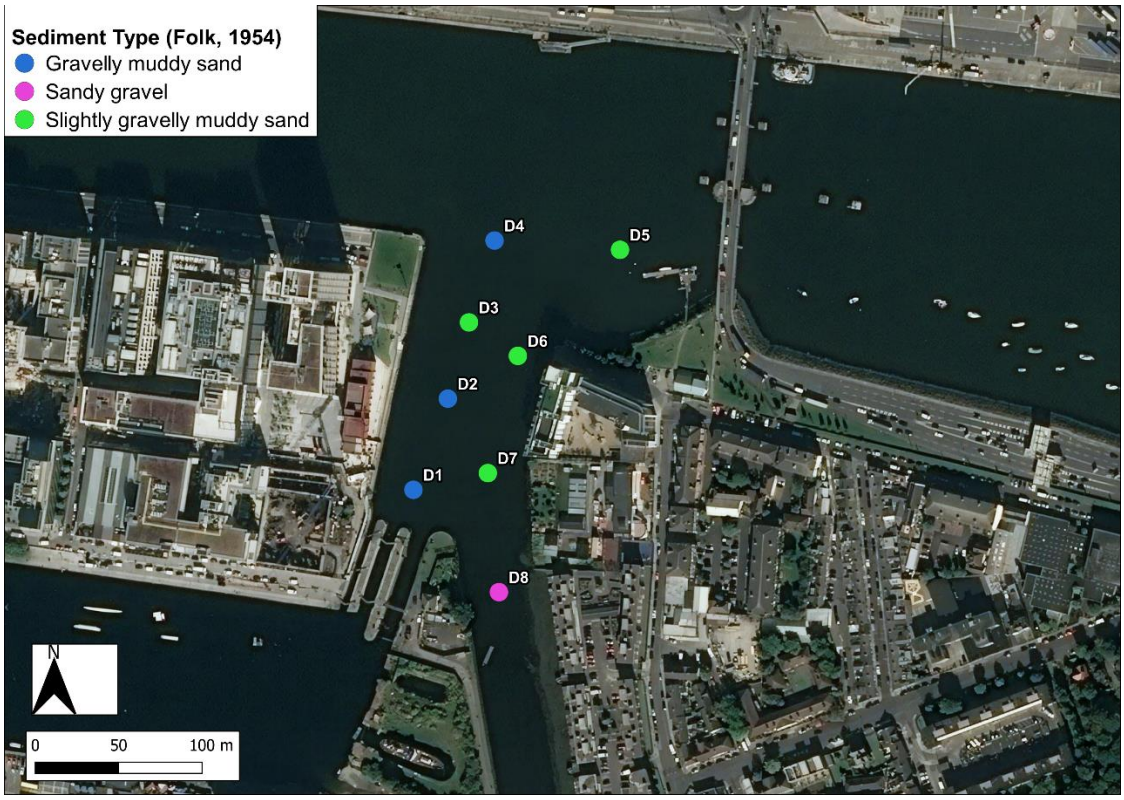

Figure 3.13: Sediment type (Folk, 1954) in the Dodder, April 2020.

4. Discussion

The results of the intertidal survey indicate that the biotopes/ habitats present in the study area can be described as belonging to the JNCC biotope 'LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock' (EUNIS code: A1.327). This biotope is often found on artificial substrata such as sea defences or bridge supports and is present in most of the intertidal stations surveyed where vertical stone or concrete wall or hard structure can describe the intertidal substrate. This reduced salinity community includes fewer species when compared to open coast fucoid dominated shores. A second biotope type was recorded at station I-6 which exhibits elements of 'LR.LLR.FVS.Fcer' but also 'LR.LLR.FVS.AscVS *Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity on mid eulittoral rock' (EUNIS code A1.324). This biotope typically occurs in more exposed locations and less variable salinity locations than *Fucus ceranoides* dominated biotopes and biodiversity is higher.

The subtidal grab survey indicates that the seabed conditions at all the stations in the survey area are in a very poor condition. Results from the organic carbon analyses were high which is common in such locations and all stations had a considerable amount of leaf litter. The anoxic conditions of the sediments, evidenced by the strong odour of hydrogen sulphide, make it a very difficult habitat for most infaunal taxa to exist in and this is reflected in the low number of species and equally low number of individuals.

Multivariate analysis of the faunal data could not differentiate significantly between the 8 stations. All the habitats of the subtidal stations can be said to exhibit elements of the JNCC biotopes 'SS.SMu.SMuBVS.CapTubi *Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment' (EUNIS code A5.325) and 'SS.SMu.ISaMu.Cap *Capitella capitata* in enriched sublittoral muddy sediments' (EUNIS code A5.336). These biotopes are particularly associated with abundance of first order opportunistic species and may be associated with organically enriched and polluted sediments. AMBI results indicate that 3 stations are heavily polluted, and 5 stations are moderately polluted. The heavily disturbed stations had an abundance of opportunistic species that thrive in polluted/disturbed sediments. The moderately disturbed stations had a high abundance of species tolerant to disturbance/pollution.

Appendix 3 presents a comparison between the 2022 and 2020 results. One-way ANOVA shows that there was no significant difference between the univariate community analysis between the two years.

One of the aims of the survey was to look at the pool of species present within the surrounding area and to specifically target these species through the provision of specific habitats/interventions. However, as the results of the faunal analyses show, biodiversity levels both in the intertidal and the subtidal habitats are very low. Remediation of the sedimentary conditions to allow for re-colonisation by a wider variety of species, if considered, will not be successful as the sediments will quickly become organically enriched.

5. References

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Committee.[05 September 2019] http://www. nmbaqcs. org/media/1175/nmbaqc-inv-prp-v10-june2010. pdf.

Appendix 1

Intertidal Photographs

Intertidal Station 1

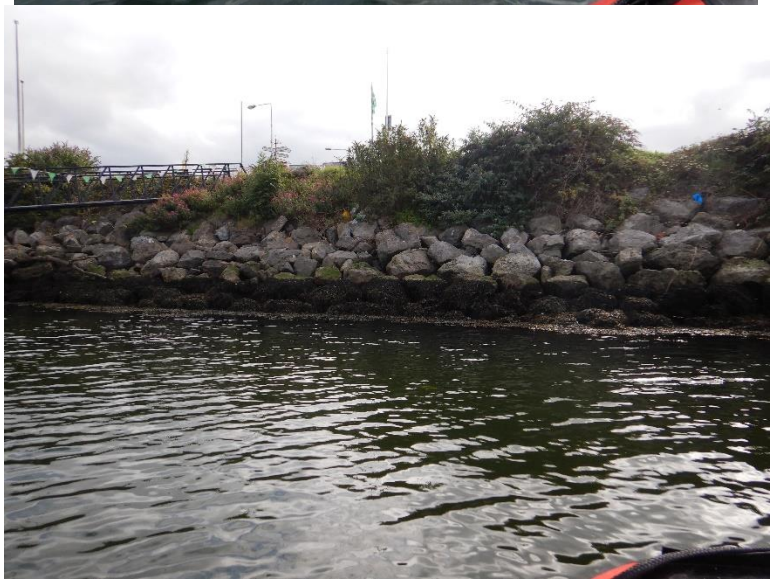
Intertidal Station 2

Intertidal Station 3

Intertidal Station 4

Intertidal Station 5

Intertidal Station 6



Intertidal Station 7

Appendix 2

Species List

JN 1731 Dodder									
Station	**AphiaID**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**
PORIFERA	558	0	0	0	0	0	0	0	0
Porifera	558	0	0	0	0	0	0	0	0
NEMATODA	799	0	0	0	0	0	0	0	0
Nematoda	799	7	0	1	5	0	1	8	0
NEMERTEA	152391	0	0	0	0	0	0	0	0
Nemertea (indet)	152391	0	0	0	0	0	1	0	0
ANNELIDA	882	0	0	0	0	0	0	0	0
POLYCHAETA	883	0	0	0	0	0	0	0	0
PHYLLODOCIDA	892	0	0	0	0	0	0	0	0
Nereididae	22496	0	0	0	0	0	0	0	0
Hediste diversicolor	152302	2	0	0	0	0	0	1	1
SPIONIDA	889	0	0	0	0	0	0	0	0
Spionidae	913	0	0	0	0	0	0	0	0
Malacoceros vulgaris	131134	3	0	0	0	0	0	0	0
Pygospio elegans	131170	0	0	0	0	0	0	1	0
Streblospio shrubsolii	131193	0	0	0	0	0	0	5	0
CAPITELLIDA	890	0	0	0	0	0	0	0	0
Capitellidae	921	0	0	0	0	0	0	0	0
Capitella sp. complex	129211	0	0	0	0	2	2	45	2
TEREBELLIDA	900	0	0	0	0	0	0	0	0
Cirratulidae	919	0	0	0	0	0	0	0	0
Cirratulidae (partial/damaged)	919	0	0	0	1	0	0	0	0
Ampharetidae	981	0	0	0	0	0	0	0	0
Ampharetidae (partial/damaged)	981	0	0	0	0	0	0	0	1
OLIGOCHAETA	2036	0	0	0	0	0	0	0	0
Oligochaeta	2036	0	0	0	0	0	0	0	0
HAPLOTAXIDA	2118	0	0	0	0	0	0	0	0
TUBIFICIDA	1511829	0	0	0	0	0	0	0	0
Tubificoides sp. (damaged)	137393	8	0	1	0	2	4	98	0
Tubificoides brownae	137572	0	1	0	0	0	1	0	4
Tubificoides diazi	137574	2	0	0	0	0	0	183	0
Tubificoides benedii	137571	20	1	0	13	1	48	429	2
Naididae	2039	0	0	0	0	0	0	0	0
Paranais litoralis	137485	2	0	0	0	0	1	1	0
Enchytraeidae	2038	10	0	0	0	0	0	0	0
ARTHROPODA	1065	0	0	0	0	0	0	0	0
CHELICERATA	1274	0	0	0	0	0	0	0	0
ARACHNIDA	1300	0	0	0	0	0	0	0	0
ACARI	292684	0	0	0	0	0	0	0	0
Acari	292684	1	0	0	0	0	0	0	0
CRUSTACEA	1066	0	0	0	0	0	0	0	0
CIRRIPEDIA	1082	0	0	0	0	0	0	0	0
Balanidae	106057	0	0	0	0	0	0	0	0
Balanus crenatus	106215	9	0	0	0	0	0	0	8

JN 1731 Dodder									
Station	**AphiaID**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**
COPEPODA	1080	0	0	0	0	0	0	0	0
HARPACTICOIDA	1102	0	0	0	0	0	0	0	0
Miraciidae	115163	0	0	0	0	0	0	0	0
Bulbamphiascus imus	115930	4	0	0	0	0	0	0	0
MALACOSTRACA	1071	0	0	0	0	0	0	0	0
AMPHIPODA	1135	0	0	0	0	0	0	0	0
Oedicerotidae	101400	0	0	0	0	0	0	0	0
Perioculodes longimanus	102915	0	0	0	0	1	0	0	0
Lysianassidae	101395	0	0	0	0	0	0	0	0
Socarnes erythrophthalmus	148560	0	0	0	0	0	1	0	0
Gammaridae	101383	0	0	0	0	0	0	0	0
Gammarus sp. (damaged)	101537	4	0	0	0	0	0	0	0
Photidae	148558	0	0	0	0	0	0	0	0
Photis longicaudata	102383	0	0	0	0	1	0	1	0
Carcinidae	557511	0	0	0	0	0	0	0	0
Carcinus maenas	107381	0	1	0	1	0	0	1	0
INSECTA	1307	0	0	0	0	0	0	0	0
DIPTERA	118088	0	0	0	0	0	0	0	0
Pediciidae		0	0	0	0	0	0	0	0
Dicranota sp.		0	1	0	0	0	0	0	0
Chironomidae	118100	0	0	0	0	0	0	0	0
Chironomidae	118100	1	0	0	0	0	0	0	0
Insecta	1307	0	0	0	0	0	0	0	0
Coleoptera larvae (Elmidae)	118085	3	12	1	0	0	5	0	0
MOLLUSCA	51	0	0	0	0	0	0	0	0
GASTROPODA	101	0	0	0	0	0	0	0	0
LITTORINIMORPHA	382213	0	0	0	0	0	0	0	0
Hydrobiidae	120	0	0	0	0	0	0	0	0
Peringia ulvae	151628	0	0	0	5	0	12	8	1
BIVALVIA	105	0	0	0	0	0	0	0	0
Bivalvia sp.	105	0	0	0	0	0	0	1	0
MYTILIDA	210	0	0	0	0	0	0	0	0
Mytilidae	211	0	0	0	0	0	0	0	0
Mytilidae (juv)	211	0	0	0	1	0	0	0	0
CARDIIDA	869602	0	0	0	0	0	0	0	0
Cardiidae	229	0	0	0	0	0	0	0	0
Cerastoderma edule	138998	0	0	0	1	0	0	0	0
Semelidae	1781	0	0	0	0	0	0	0	0
Abra sp. (juv)	138474	0	0	0	0	0	1	0	0
VENERIDA	217	0	0	0	0	0	0	0	0
Veneridae	243	0	0	0	0	0	0	0	0
Veneridae (juv)	243	1	0	0	0	0	0	0	0
MYIDA	245	0	0	0	0	0	0	0	0
Myidae	247	0	0	0	0	0	0	0	0
Mya sp.	138211	1	0	0	0	0	4	0	0

Appendix 3

Survey Comparison 2022 v 2020

2022 Stations	No. Taxa	No. Individuals	Margalef's Richness	Pielou's Evenness	Shannon-Wiener Diversity	Effective Species Number	Simpson's Diversity
	N	S	d	J'	H'(loge)	exp(H')	1-lambda
D1	16	78	3.44	0.86	2.37	10.72	0.89
D2	5	16	1.44	0.56	0.91	2.48	0.45
D3	3	3	1.82	1.00	1.10	3.00	1.00
D4	7	27	1.82	0.75	1.46	4.33	0.72
D5	5	7	2.06	0.96	1.55	4.71	0.90
D6	12	81	2.50	0.60	1.48	4.39	0.62
D7	13	782	1.80	0.50	1.27	3.56	0.63
D8	7	19	2.04	0.84	1.63	5.11	0.79

2020 Stations	No. Taxa	No. Individuals	Margalef's Richness	Pielou's Evenness	Shannon-Wiener Diversity	Effective Species Number	Simpson's Diversity
	N	S	d	J'	H'(loge)	exp(H')	1-lambda
D1	12	300	1.93	0.37	0.93	2.53	0.37
D2	13	92	2.65	0.87	2.23	9.32	0.88
D3	10	108	1.92	0.62	1.43	4.17	0.69
D4	14	1839	1.73	0.14	0.38	1.47	0.13
D5	7	60	1.47	0.55	1.07	2.92	0.51
D6	16	656	2.31	0.55	1.52	4.58	0.70
D7	16	749	2.27	0.49	1.36	3.89	0.67
D8	9	1145	1.14	0.16	0.34	1.41	0.13

Null Hypothesis: There is no difference between the means						
Anova: Single Factor						
No. Taxa						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
2020	8	97	12.125	10.69643		
2022	8	68	8.5	21.14286		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	52.5625	1	52.5625	3.301739	0.09067	4.60011
Within Groups	222.875	14	15.91964			
Total	275.4375	15				
Conclusion: if F > F crit, we reject the null hypothesis. This is not the case, 3.3 < 4.6. The means of the two populations are equal.						
Anova: Single Factor						
No. Individuals						
SUMMARY						

Groups	*Count*	*Sum*	*Average*	*Variance*		
2020	8	4949	618.625	390919.4		
2022	8	1013	126.625	71043.13		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	968256	1	968256	4.191924	0.059862	4.60011
Within Groups	3233738	14	230981.3			
Total	4201994	15				
Anova: Single Factor						
Richness						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
2020	8	15.41418	1.926773	0.238586		
2022	8	16.92441	2.115551	0.37822		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.142549	1	0.142549	0.462218	0.507676	4.60011
Within Groups	4.317643	14	0.308403			
Total	4.460192	15				
Anova: Single Factor						
Evenness						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
2020	8	9.264087	1.158011	0.389673		
2022	8	11.77504	1.47188	0.191175		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.394056	1	0.394056	1.356832	0.263552	4.60011
Within Groups	4.065932	14	0.290424			
Total	4.459988	15				
Anova: Single Factor						
Shannon-Wiener						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		

2020	8	9.264087	1.158011	0.389673		
2022	8	11.77504	1.47188	0.191175		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.394056	1	0.394056	1.356832	0.263552	4.60011
Within Groups	4.065932	14	0.290424			
Total	4.459988	15				
Anova: Single Factor						
Effective Number of Species						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
2020	8	30.28212	3.785265	6.392152		
2022	8	38.29883	4.787354	6.52291		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	4.016727	1	4.016727	0.622022	0.443448	4.60011
Within Groups	90.40543	14	6.457531			
Total	94.42216	15				
Anova: Single Factor						
Simpson's Diversity						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
2020	8	4.08335	0.510419	0.076313		
2022	8	6.001669	0.750209	0.032669		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.229997	1	0.229997	4.220822	0.059093	4.60011
Within Groups	0.762873	14	0.054491			
Total	0.99287	15				

Potential Impacts on the Aquatic Habitats of the River Dodder Estuary in Relation to the Dublin Public Transportation Opening Bridge Project

Produced by

AQUAFACT International Services Ltd

On behalf of

Scott Cawley

November 2020

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Report Approval Sheet

Client	Scott Cawley Ltd.
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Job Number	JN1624
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2	Final	20.11.2020	JN1624 Dodder Public Transport Bridge Report. Final	M Costelloe	B. O'Connor

AQUAFACT

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1. Introduction

Scott Cawley Ltd. commissioned AQUAFACT International Services Ltd. on behalf of Dublin City Council to assess the impacts on the surrounding marine aquatic ecology of the proposed Dodder Transport Bridge where the Dodder River joins the Liffey. The purpose of the proposed new bridge is to improve the pedestrian, cyclist and public transportation accessibility between the Poolbeg Peninsula and the rest of the city and to allow the development of the proposed Poolbeg West Strategic Development Zone (SDZ). Details of the proposed development are included as Appendix 1, its location shown in Figure 1.1.

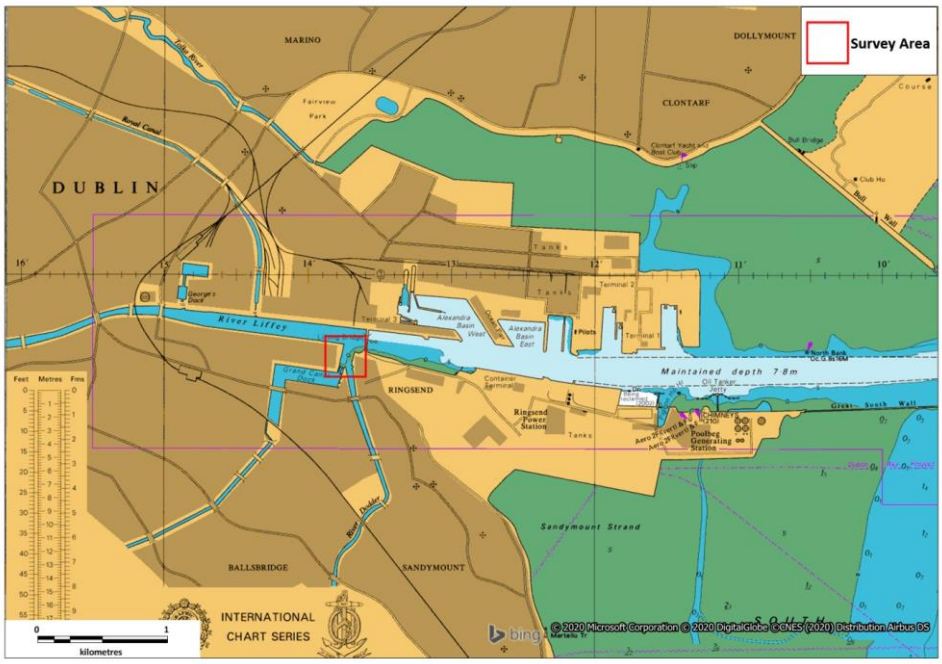

Figure 1-1: Location of Dodder Bridge Project.

The subtidal and intertidal habitats in the vicinity of the proposed development were previously surveyed in 2019 and again in 2020 by AQUAFACT International Services Ltd. (AQUAFACT, 2019 & 2020). The potential impact of the proposed development on the described habitats are assessed against the results of these surveys. In addition, a survey of the fish species in the vicinity of the proposed bridge was undertaken in November 2020 following the approach outlined for transitional waters under the Water Framework Directive (WFD Common Implementation Strategy, 2003) to assess the potential impact on fish species.

2. Dodder River Marine Aquatic Habitats

2.1. Dodder River

The Dodder River rises on the northern slopes of Kippure Mountain (max. height *ca* 760 m) in the Wicklow Mountains where base geology is granite. The river is formed from several small streams in the course of its descent to the lower, flatter areas of its catchment. It is *ca* 26 kilometres long and its total catchment (estimates vary from *ca* 120 – *ca* 160 km²) area is presented in Figure 1.2. In the Greater Dublin area, it passes through the suburbs of Tallaght and Firhouse, along by Templeogue, Rathfarnham, Rathgar, Milltown, Clonskeagh, Donnybrook, Ballsbridge and past Sandymount, before entering the Liffey near Ringsend.

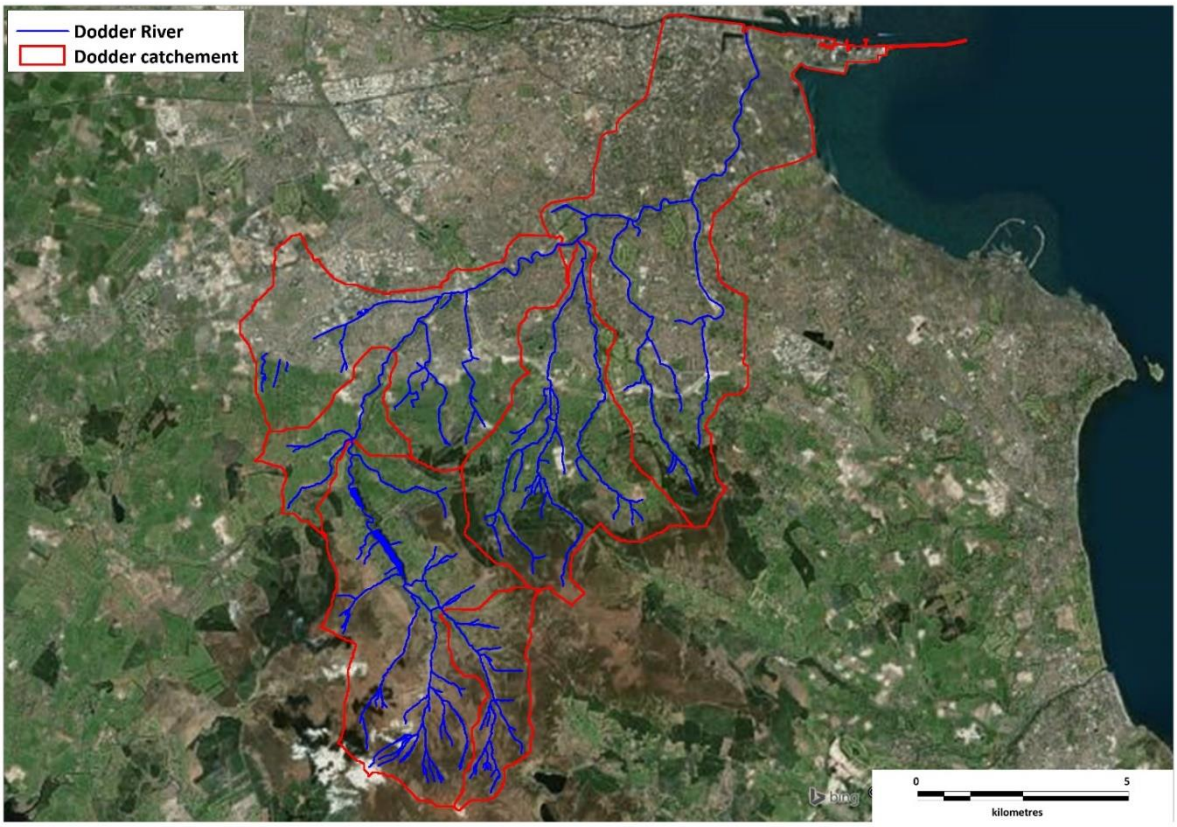

Figure 2-1 Dodder River Catchment.

Historically, water quality (as Q values) in the lower reaches of the river has been in decline since the 1970's (ERU, 1992; EPA, 2018) with sampling stations at Dodder Road, Milltown Bridge, Ballsbridge and Lansdowne Road Bridge being as low as 1 to 3 out of a maximum score of 5 (ERU, 1992) and being described as poor by the EPA (2018). BOD values of the river are as high as 8.9 mg/l (ERU, 1992).

2.2. Intertidal Environment

The locations of the AQUAFACT intertidal stations described in 2020 are presented in Figure 2.2.

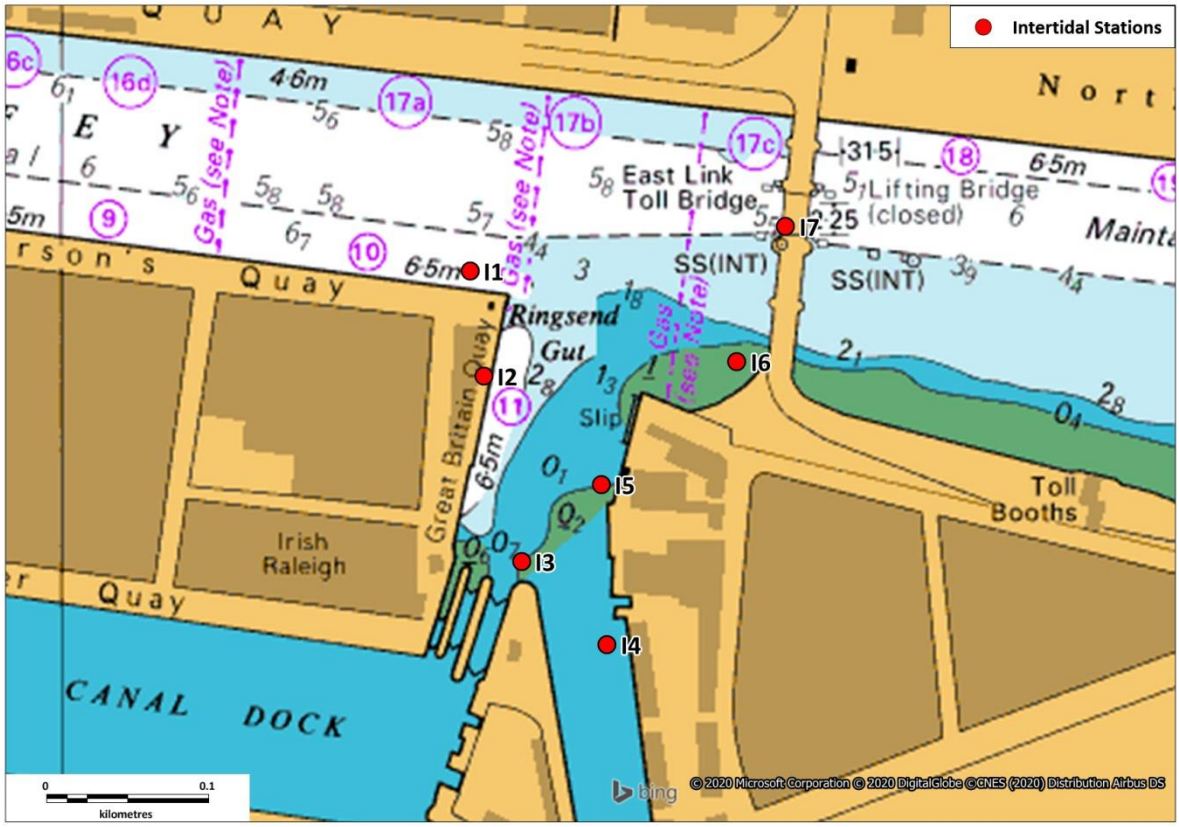

Figure 2-2 Intertidal locations. 1st April 2020.

These stations were predominantly vertical wall surfaces (Figure 2.3) and the species recorded are typical of rocky shore biotopes that are commonly found in estuaries on the East coast of Ireland. The zonation of the quay wall is similar to that found by EcoServe (2001) in an adjacent location and consists of a band of green *Enteromorpha* spp. above a broad zone of the horned wrack, *Fucus ceranoides* with the barnacle *Austrominius modestus.* Beneath this zone of *F. ceranoides* there is a distinct algal band of red filamentous algae, identified as *Rhodothamniella* spp. in previous surveys. *Fucus ceranoides* is more tolerant of reduced salinity than other fucoids and tends to replace them

towards the upper reaches of estuaries and sea lochs or in areas of freshwater influence. The habitat here corresponds with the JNCC biotope 'LR.LLR.FVS.Fcer *Fucus ceranoides* on reduced salinity eulittoral rock' (EUNIS code: A1.327). This biotope is often found on artificial substrata such as sea defence or bridge supports (Perry & Budd, 2016) and is present in most of the intertidal stations surveyed where vertical stone or concrete wall or hard structure can describe the intertidal substrate. This reduced salinity community includes fewer species when compared to open coast fucoid dominated shores. A second biotope type was recorded outside the Dodder River at station I-6 (see Figure 2.2), which exhibit elements of 'LR.LLR.FVS.Fcer' but also 'LR.LLR.FVS.AscVS *Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity on mid eulittoral rock' (EUNIS code A1.324) (Figure 2-4). This biotope typically occurs in more exposed location and less variable salinity locations than *Fucus ceranoides* dominated biotopes and biodiversity is higher.

Figure 2-3 Vertical Intertidal Habitat.

Figure 2-4 Rock Armour Intertidal Habitat.

In addition to vertical intertidal habitats, there is an exposed shore behind O'Rahilly House Flats (see Station I4, Figure 2.1). At the top of the shore is a vertical concrete wall with the typical green algal growth seen at the other stations. From the base of this wall the exposed shore here is of gravel and muds with protruding wood and concrete structures (Figure 2.5). The middle shore has abundant coverage of *Fucus ceranoides* attached to the hard structures, and this cover is patchier in the lower shore. The lower shore to subtidal sediment is similar to the JNCC biotope 'SS.SMu.SMuBVS.CapTubi *Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment' (EUNIS code A5.325) and 'SS.SMu.ISaMu.Cap *Capitella capitata* in enriched sublittoral muddy sediments' (EUNIS code A5.336). These biotopes are particularly associated with abundance of first order opportunistic species and may be associated with organically enriched and polluted sediments.

Figure 2-5 Intertidal Shore.

There is a small area of shore that is exposed at low water adjacent to this on the Liffey side that is clear of algae (Figure 2-6). Although samples were not taken directly from this area due to access difficulties, the species composition of the grabs taken in the immediate sublittoral at its lower edge would indicate it would be classified as A2.323 - *Tubificoides benedii* and other oligochaetes in littoral mud.

Figure 2-6 Intertidal Shore.

This biotope is found in very sheltered conditions and subject to reduced salinity. An anoxic layer is usually present within the upper 3 cm of the sediment. The infaunal community is extremely poor, consisting almost exclusively of oligochaetes, including *Tubificoides benedii* and, more rarely, *Heterochaeta costata*. The only polychaete species that may occur is *Capitella capitata*, which may be common. *Vaucheria* species may form a film on the sediment surface along such creeks, and juvenile shore crabs *Carcinus maenas* may be common. At the very upper end of estuaries, the oligochaetes *Limnodrilus* spp. and *Tubifex tubifex* may be found.

2.3. Subtidal Environment

The stations sampled in 2019 and 2020 in the vicinity of the proposed bridge are shown in Figures 2-7 and 2-8, respectively.

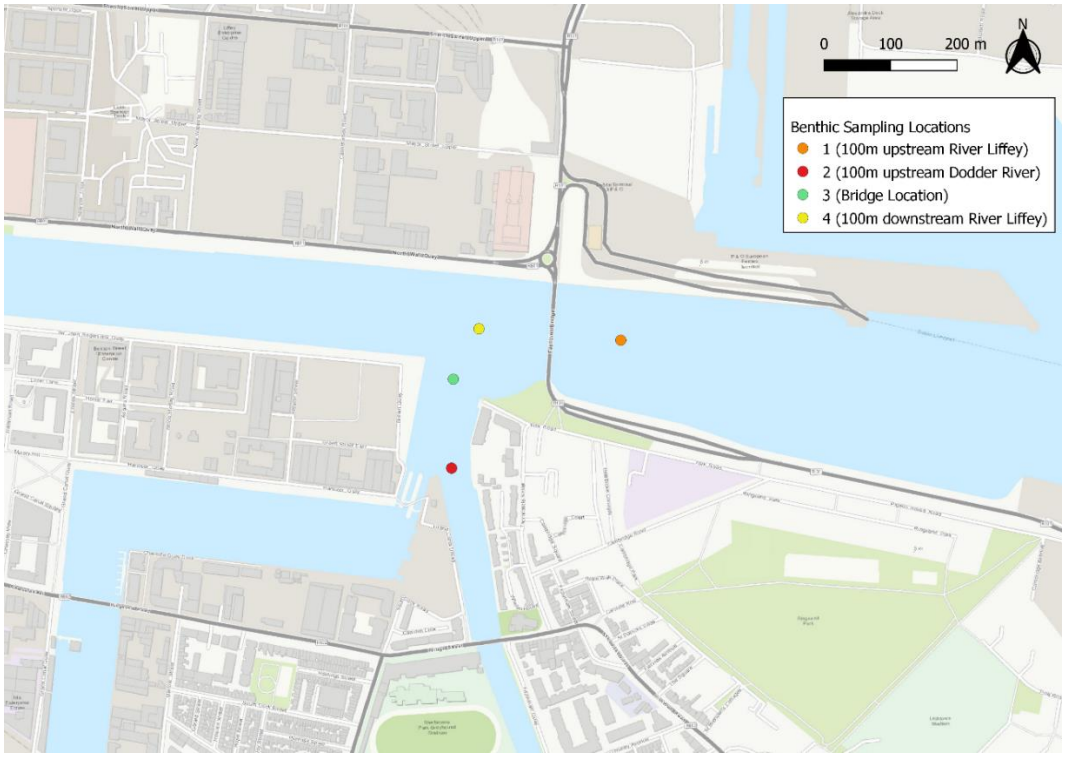

Figure 2-7 Subtidal Stations sampled in 2019.

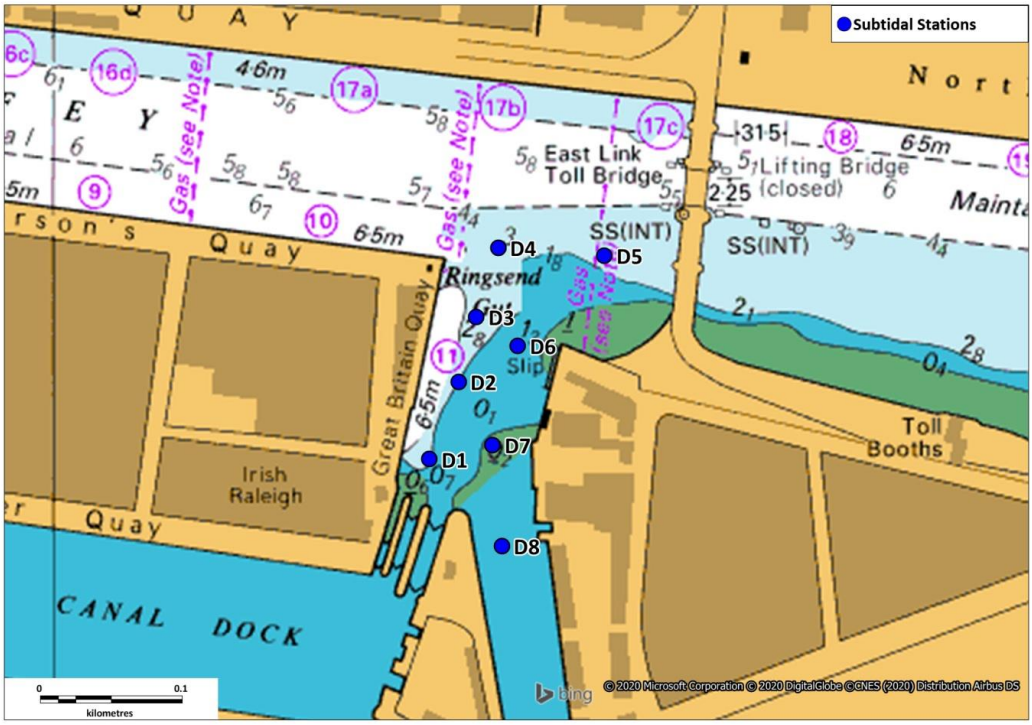

Figure 2-8 Subtidal Stations sampled in 2020.

2.3.1. Sedimentary Environment

The sediment sampled within the survey area of the Dodder was classified as slightly gravelly muddy sand, gravelly muddy sand and gravelly sand according to Folk (1954). No medium gravel-boulders were recorded.

Organic matter values ranged from 9.4% to 25.9%. These values are not unusual considering the large amounts of leaf litter found in the samples. All of the grab stations exhibited signs of anoxic conditions with a strong odour of hydrogen sulphide in all samples returned.

2.3.2. Subtidal Biological Results

13 taxa were recovered from the samples collected during the 2019 survey and these included nematodes, 7 polychaete taxa, 3 oligochaete taxa and 2 bivalve genera. Except for nematodes at all stations and *Capitella* at Station 3, numbers of individuals were low.

The taxonomic identification of the benthic infauna across all 8 grab stations sampled in the 2020 survey area yielded a total count of 32 taxa ascribed to 5 phyla. The 32 taxa consisted of 4,949 individuals. Of the 34 taxa present, 1 was a nematode (roundworm), 1 was a nemertean (ribbon worms), 17 were annelids (segmented worms), 9 were arthropods (crabs, shrimps, insects) and 4 were molluscs (gastropods and bivalves). Analysis of the replicate samples indicated that three stations were classified as heavily disturbed (D3, D5 and D6), three stations were described as moderately disturbed (D1, D2 and D7), while 2 were slightly disturbed (D4 and D8). The slightly disturbed stations had a high abundance of species tolerant to disturbance/pollution. The heavily disturbed stations had an abundance of opportunistic species that thrive in polluted/disturbed sediments.

The subtidal grab surveys indicate that the seabed conditions from this area is in a very poor condition. The anoxic conditions of the sediments, evidenced by the strong odour of hydrogen sulphide, make it a very difficult habitat for most infaunal taxa to exist in and this is reflected in the low number of species and equally low number of specimens.

Multivariate analysis of the faunal data identified two significant groupings among the 8 stations sampled in 2020. Stations D3 and D5 made up the first group and were dominated by first order opportunistic species that thrive in polluted conditions. Taxa such as *Capitella,* that are known to be able to occur in high numbers in anoxic/hypoxic sediments, were low in abundance, which reinforces the AMBI results from these two stations that indicated they were heavily disturbed. The second group (containing stations D1, D2, D4, D6, D7 and D8) were also dominated by first order opportunistic species such as the polychaeta *Capitella* sp. complex and the oligochaete *Tubificoides benedii*, their abundance being elevated at a number of stations indicating their exploitation of the polluted/organically enriched environment. All of the habitats of the subtidal stations can be said to exhibit elements of the JNCC biotopes 'SS.SMu.SMuBVS.CapTubi *Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment' (EUNIS code A5.325) and 'SS.SMu.ISaMu.Cap *Capitella capitata* in enriched sublittoral muddy sediments' (EUNIS code A5.336). These biotopes are particularly associated with abundance of first order opportunistic species and may be associated with organically enriched and polluted sediments.

2.4. Fish Species

Fish species that are known to occur in the Dodder River include both brook and river lamprey (*Lampetra planeri* and *L. fluviatilis*) (River Dodder Habitats Management plan, 2008), brown trout (*Salmo trutta*), sea trout (*Salmo trutta morpha trutta*), stone loach (*Barbatula barbatula*), three-spined stickleback (*Gasterosteus aculeatus*) and eel (*Anguilla anguilla*). Salmon (*Salmo salar*) have been recorded in the river's lower course (IFI website).

Results from the fish survey recently completed from the Dodder estuary (Appendix 2) found that the fish species recovered from the survey area are in line with what would be expected. IFI carried out fish surveys in the River Liffey in 2008 and 2010 (Kelly *et al.,* 2008, 2010) and utilising a WFD classification tool (Harrison and Whitfield, 2004), assigned an overall ecological classification of moderate to the Liffey survey areas based on the fish species present. A similar ecological classification can be applied to the Dodder estuary based on the fish species present. However, the additional information collected from the beam trawls such as high levels of leaf litter that is incorporated into the sediment, discarded cans and other anthropogenic derived litter and anoxic sediments suggest that the ecological classification is at the lower end of moderate or low, which would be confirmed if incorporating data recorded from benthic samples taken from the area (AQUAFACT 2019, 2020).

3. Discussion

The results of the benthic and intertidal surveys carried out in the vicinity of the proposed site for a new bridge crossing over the Dodder indicate that the both environments are in a very poor condition. The anoxic conditions of the sediments make it a very difficult habitat for most infaunal taxa to exist and this is reflected in the low number of species and equally low number of specimens. This is further highlighted by taxa such as *Capitella* that is known to be able to occur in high numbers in anoxic/hypoxic sediments, being absent or occurring in low numbers from a number of stations.

The green crab, *Carcinus maenas*, was the most abundant species recorded during the fish survey carried out in the vicinity of the propose bridge across the River Dodder. This species can tolerate a wide range of environmental conditions (*e.g.*, temperature, salinity, oxygen) whereby it can alter its physiology and other responses to match local conditions and can continue to function even in extreme hypoxia by a variety of mechanisms (McMahon, 1988). Six fish species were recorded in low numbers and the water body can be classified as moderate to low ecological status based on these findings.

In summary, none of the species and habitats recorded in the various surveys in the vicinity of the proposed development are of conservation importance or interest. Overall, they are typical of organically enriched or physically disturbed habitats in areas of reduced salinity with relatively low species richness.

Given these poor sedimentary conditions and very low faunal abundances, the construction of a bridge at this location is not considered to have any negative impact on the ecology of the sea bed in this part of the River Dodder and at the edge of the River Liffey.

The presence of a bridge across the Dodder River is unlikely to have an impact on fish species present or passing through the area. However, it is possible that fish species may be impacted during the construction phase. Fish are sensitive to noise and vibration and construction activities could cause avoidance reactions and possibly delay fish migration. However, there have been very few studies on the effects of anthropogenic sounds on the behaviour of wild fish although a number of studies have investigated the response of caged fish to noise output, particularly relating to pile driving. For a fish

to avoid noise disturbance, it first has to recognise that the noise is present. Harding *et al.* (2016) concurred with the findings of Hawkins & Johnstone (1978) in that Atlantic salmon (*Salmo salar*) does not appear to have sensitive hearing relative to many other marine fish species, including gadoids (*e.g.*, Atlantic cod, *Gadus morhua*) and clupeids (*e.g.*, herring, *Clupea harengus*) when conducting an enclosed study with smolt and adults. They concluded that this was likely due to a lack of secondary hearing modifications linking the swim bladder to the auditory system. Flatfish such as dab and plaice along with eel and mullet are also insensitive to certain noises due to their mechanism of hearing. In a follow on behavioural experiment, Harding *et al.* (2016) found that there was no clear evidence of a startle response in relation to playback of individual hammer strikes from the noise of the piling. In a previous study, although using a different noise stimulus, juvenile Atlantic salmon failed to display avoidance behaviours in response to a 150 Hz sound, 30 dB above defined awareness reaction thresholds (Knudsen e*t al*., 1992). Similarly, juvenile coho salmon displayed no avoidance behaviour from exposure to a real impact-piling event when positioned in cages close to the noise source (Ruggerone *et al*., 2008). In their physiological experiment Harding *et al (loc. cit)* proposed that marine-phase Atlantic salmon do not experience a change in active metabolic rate (AMR), using oxygen consumption as a proxy, when exposed to pile driving noise. Using an alteration in AMR as an indicator of stress, this would suggest the cohort of Atlantic salmon did not perceive the pile driving playback noise as a stressor.

There are several published studies which support the proposition that fish may respond to increased anthropogenic noise by avoidance. All of these studies tend to rely on indirect evidence. For example Engas *et al*. (1996) reported significantly reduced cod catches (~50% on average) in a wide area around seismic testing using air guns (source sound level of 253dB). A study of a power station in Belgium where loud sounds (178dB) were generated every 0.2 seconds to deter fish from being entrained in the cooling water intake reported a significant reduction in the numbers of certain fish species, including herring, sprat and bass, entering the cooling water intake compared to when there was no output from the acoustic deterrent. Other less sensitive species such as dab and river lamprey did not show any significant before-after decrease (Maes *et al.,* 2004).

Although wild fish may respond differently to noise compared to captured fish, it is probable that the construction phase of the development will have little impact on the resident or migratory fish entering the Dodder River. It should also be stated that the construction phase would be a short-term operation and that any environmental impacts would also be short-term. However, as a mitigation

measure in order to minimise the effects of the construction phase on migrating Atlantic salmon, piling and other sources of significant underwater noise will be limited to periods when juvenile stage salmonoids are not passing through the vicinity of the proposed development. In addition, activities that produce significant underwater noise should not be undertaken during the night, thus limiting the effects of noise on the movements of populations of migratory fish in the area *i.e.* they will be able to migrate undisturbed for a minimum of 8 hours during night-time hours.

In-river works have the potential to re-suspend sediments which will then be transport downstream to enter the sea *via* the River Liffey. All such works must be designed to minimise this potential impact. Similarly, all work that is to be carried out on the river bank must be carried out in such a way as to minimise the potential for events such as diesel or concrete spillages, run off of water with suspended sediment loadings or any accidental spillage.

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Appendix 1 Dodder Public Transport Opening Bridge

WHAT HAPPENS NEXT?

The design of the proposed bridge will be developed, modified and refined as a result of consultation, including public consultation and submissions and feedback from stakeholders; further detailed investigations, including environmental, land, and geotechnical surveys; ongoing refinement of the design and assessments by the various environmental and technical specialists.

Over the coming months the Project Team will undertake all of the various environmental and technical assessments whilst continuing to develop the design of the bridge with the objective of seeking to avoid, reduce and remedy potential impacts. This process will culminate in the publication of the Statutory Orders and the applicable environmental reports in accordance with the relevant legislation for the development consent process.

STAGE	PERIOD
Public Consultation	Q1 2018
Design Development And Environmental Assessments	Q1-Q4 2018

Contact Information

If you have any observations or submissions to make relating to the bridge design as shown please mark them 'Dodder Public Transportation Opening Bridge' and forward them on or before Friday 16th of March 2018 to:

Post: Attn: Kevin Crotty
Road Design and Construction Division
Dublin City Council
Civic Offices
Wood Quay
Dublin 8

Phone: (01) 222 3066

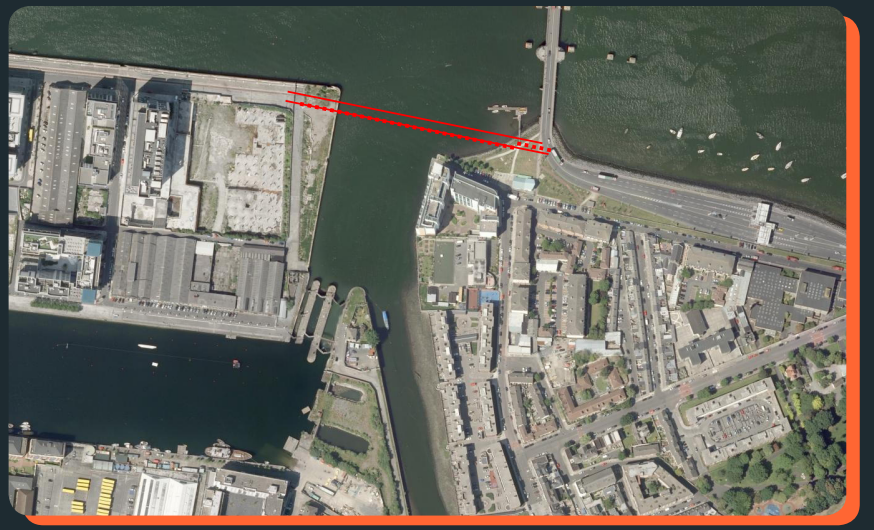
Email: ROADCON@dublincity.ie

If you are unable to attend the Public Consultation events, all of the material will be on display at the above address and will be available on the project website at:

https://consultation.dublincity.ie/

DODDER PUBLIC TRANSPORTATION OPENING BRIDGE

Public Consultation | February 2018



Dublin City Council has commenced the planning and design of the Dodder Public Transportation Opening Bridge. The scheme comprises a new public transportation opening bridge over the River Dodder at its confluence with the River Liffey along with the construction of approach roads associated with the bridge; the construction of a new control building; the provision of a new club house and facilities for St Patrick's Boat Club; the reclamation of land to the west of Tom Clarke Bridge to facilitate the build; the landscaping of the area between York Road/Thorncastle street and the R131 over the extents of the project.

The purpose of the proposed bridge is to improve the pedestrian, cyclist and public transportation accessibility between the Poolbeg Peninsula and the rest of the city and to allow the development of the proposed Poolbeg West Strategic Development Zone (SDZ). The bridge will be capable of opening to allow the passage of river traffic up and down stream. The Dodder Public Transportation Opening Bridge will connect Sir John Rogerson's Quay to a new junction with the East Link Road (R131) in Ringsend.

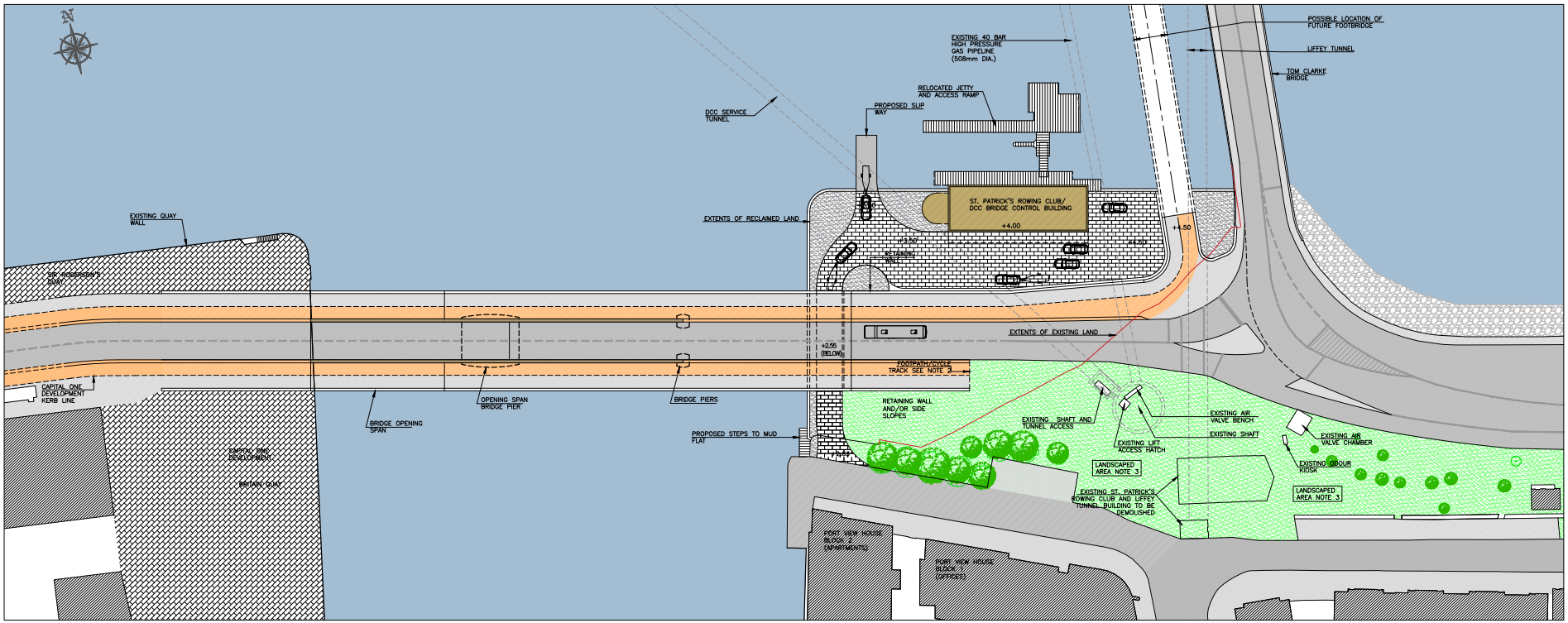
The bridge will accommodate pedestrians, cyclists, taxis and public buses. In addition, the proposed bridge will be able to accommodate a light rail system (LUAS) at some future date, whilst private cars will be prohibited from using the bridge.

RPS ROD ROUGHAN & O'DONOVAN

Rebuilding Ireland

Údarás Náisiúnta Iompair National Transport Authority

Comhairle Cathrach Bhaile Átha Cliath Dublin City Council



PROJECT GENERAL LAYOUT – PLAN

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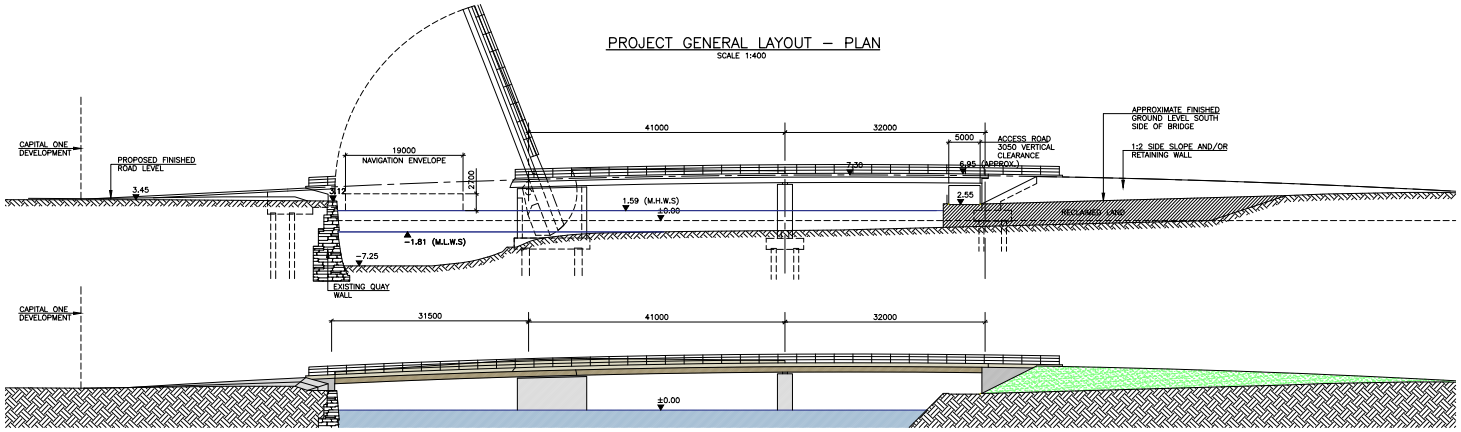
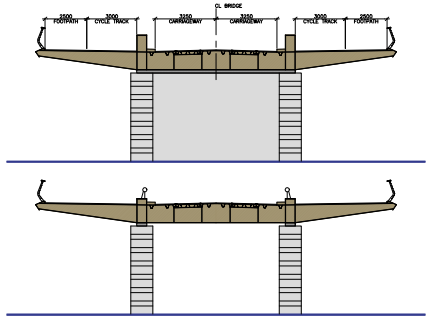


BRIDGE – SOUTH ELEVATION

SCALE 1:400



BRIDGE PIER – ELEVATIONS

SCALE NTS

NOTES:

1. ALL PROPOSED LEVELS ARE SHOWN INDICATIVELY ONLY.
2. FOOTPATH AND CYCLE TRACK TIE IN ARRANGEMENT AT RINGSEND STILL TO BE FINALISED.
3. LANDSCAPING INDICATIVE ONLY.

Appendix 2 Dublin Public Transport Project Fish Survey

Dublin Public Transportation Project

Fish Survey

Produced by

AQUAFACT International Services Ltd

On behalf of

Scott Cawley

November 2020

AQUAFACT INTERNATIONAL SERVICES LTD.
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Report Approval Sheet

Client	Scott Cawley
Report Title	Dublin Public Transport Project Fish Survey
Job Number	JN1624
Report Status	Final
Issue Date	16.11.2020

Rev	Status	Issue Date	Document File Name	Author (s)	Approved by:
1	Draft	12/11/2020	JN1624 Dodder Fish Survey Draft 2020	Kevin Mc Caffrey	Mark Costelloe
2	Final	16/11/2020	JN1624 Dodder Fish Survey Draft 2020	Kevin Mc Caffrey	Mark Costelloe

AQUAFACT

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1. Introduction

AQUAFACT International Services Ltd. was commissioned by Scott Cawley Ltd. to carry out a fish survey of the Dodder Estuary as part of Dublin City Council's Dublin Public Transportation Opening Bridge project. The project is to include the construction of an opening bridge over the River Dodder at its confluence with the Liffey. There is also planned reclamation of land west of Tom Clarke Bridge for construction of the bridge and a control building. A Section 14 licence was granted (see Appendix 1) to proceed with the survey that was carried out on the 4th and 5th November 2020.

The aim of this study was to assess the diversity and abundance of fish species in the Dodder Estuary, focusing on the lower Dodder Estuary where it runs into the River Liffey and the site of the proposed new bridge (Figure 2.1).

2. Methodology

2.1. Fish Survey

The proposed method to sample the fish population at the mouth of the Liffey followed the approach outlined for transitional waters under the Water Framework Directive (WFD Common Implementation Strategy, 2003). The locations of the fish survey stations are shown in Figure 2.1. with the coordinates presented in Table 2.1.

A seine net (dimensions of 43 x 4 m with mesh of size 25 mm and 12.5 in its wings) was deployed at four sites during the low water period of the tidal cycle. Three replicates were taken at each site. The net was deployed using a boat and buoy, the buoy being attached to a towing line, while the net was fed from the boat in an arc until both towing lines met; the net was then hauled into the boat. Where the shore was suitable, a person stood on shore and held the towing line while the boat fed out the net arcing back around to the shore. The net was then hauled up onto the shore. Seine nets were deployed on the 5th November 2020.

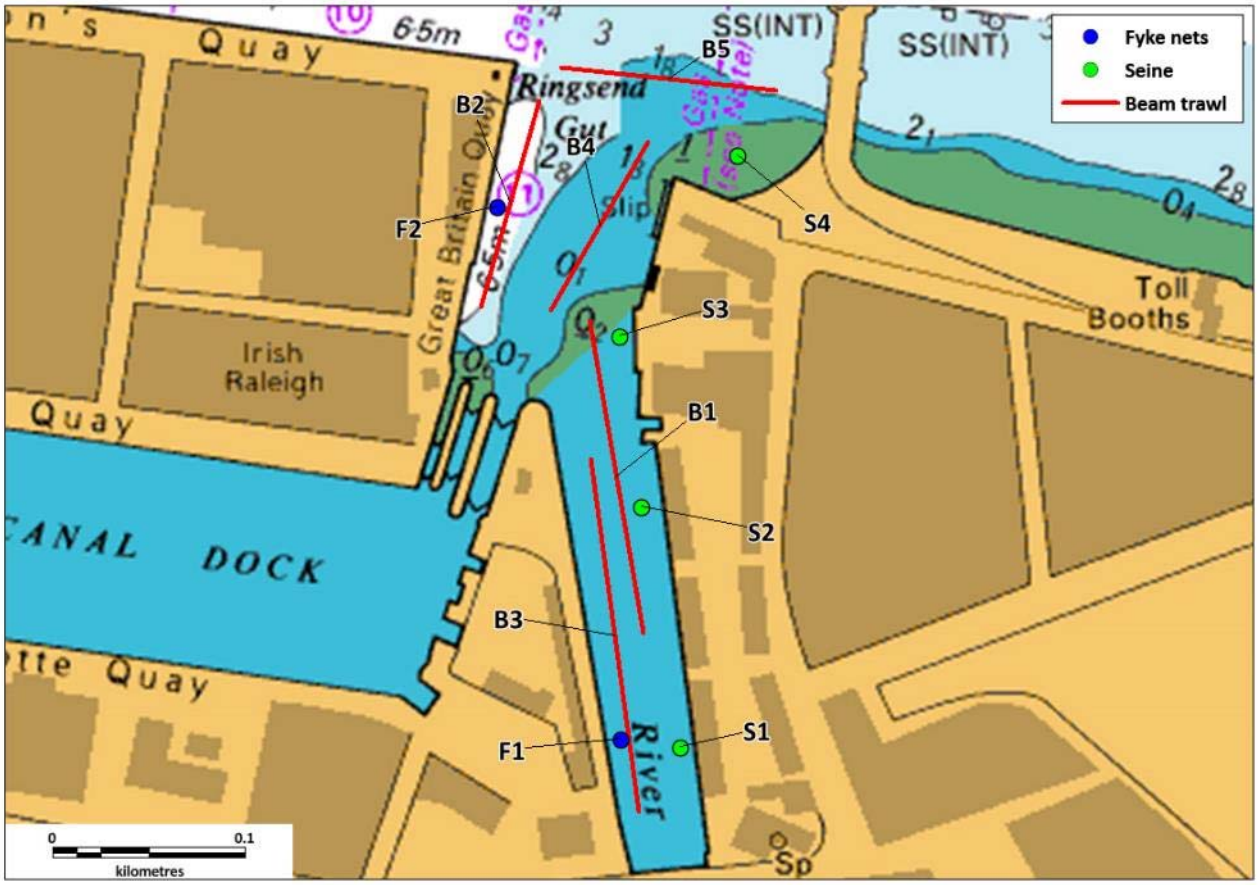


Figure 2.1: Fish survey station locations

Five sites where sampled by beam trawl. The beam trawls were deployed from the back of the boat and towed for approximately 100m before being hauled into the boat by hand. Beam trawls were deployed on the 4th November 2020.

Fyke nets (15m in length with a 0.8m diameter front hoop, joined by an 8m leader with a 10mm square mesh) were used at two stations. The fyke nets were set parallel to the riverbank on the 4th November 2020 and staked open with a stake at the end of either wing. The nets were left overnight and recovered the following day.

Fish species recovered from each of the fishing methods were identified, counted and measured directly after capture and were then released before leaving the site.

Water quality parameters were recorded at the centre of the site (B4 location, Figure 2.1) as a profile of the water column by means of a Hydrolab DS5x sonde. Parameters recorded included temperature, salinity, conductivity, dissolved oxygen, and pH (See Figure 2.1 for location).

Table 2:1: Sampling Locations (4-5/11/20).

Station	Latitude	Longitude
Seine 1	-6.228878	53.342194
Seine 2	-6.229186	53.343328
Seine 3	-6.229356	53.344132
Seine 4	-6.228433	53.344982
Fyke net 1	-6.229348	53.342235
Fyke net 2	-6.230319	53.34474
Beam trawl 1 Start	-6.229169	53.342725
Beam trawl 1 End	-6.229603	53.344202
Beam trawl 2 Start	-6.230007	53.345234
Beam trawl 2 End	-6.230439	53.344275
Beam trawl 3 Start	-6.229582	53.343545
Beam trawl 3 end	-6.229178	53.341899
Beam trawl 4 Start	-6.22914	53.345053
Beam trawl 4 End	-6.229915	53.344239
Beam trawl 5 Start	-6.228122	53.345282
Beam trawl 5 End	-6.229825	53.345385

3. Results

3.1. Fish Survey

In total, six species of fish were recorded during the survey. All six were caught by the seining method, zero using fyke nets and two using the beam trawls. In addition to the fish species, large quantities of shore crab (*Carcinus maenas*) were caught in the fyke nets while shore crab and shrimp were recorded in the seine and beam trawls. Table 3.1 presents the full species abundance list and Appendix 2 presents photos of the species caught from the various fishing methods.

3.1.1. Seine

The highest Species richness was recorded at Seine 3 which recorded 5 species. Species richness for the seining stations ranged from 1 (Station 4) to 5 (station 3) species. However, as station 4 was location on rock armouring it was only sampled once due to health and safety concerns. Abundance was highest at Seine 1 (27) and lowest at Seine 4 (4). Common goby (*Pomatoschistus microps)* was the most abundant species followed by three-spined stickleback (*Gasterosteus aculeatus)*. Table 3.1 presents the results from the seine nets.

Table 3:1: Fish species abundance for all fishing methods (4-5/11/20).

Scientific name	Common Name	Seine 1	Seine 2	Seine 3	Seine 4	Fyke 1	Fyke 2	Beam 1	Beam 2	Beam 3	Beam 4	Beam 5
Pomatoschistus microps	Common goby	10	14	15				11	5	3		3
Pleuronectes platessa	Plaice	1		1				7	2			1
Gasterosteus aculeatus	Stickleback	13	7	1	4							
Platichthys flesus	Flounder			1								
Mugilidae	Grey mullet			7								
Rutilus	Roach	3	3									
Crangon crangon	Brown shrimp		1					4		1	1	
Carcinus maenas	Shore crab		1			100+	20	5	14	1	3	5

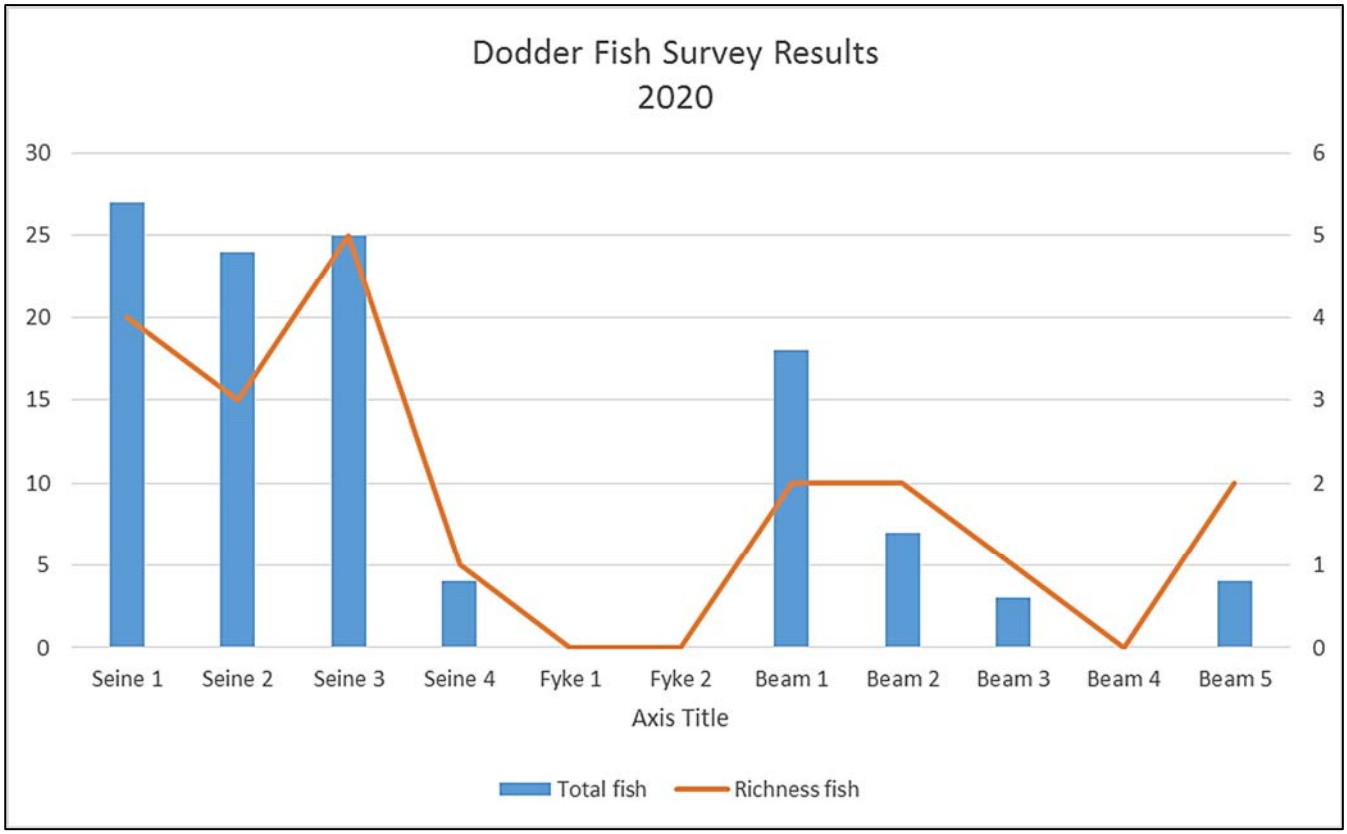


Figure 3.1: Abundance and species richness for seining, fyke net and beam trawl stations

3.1.2. Beam Trawl

Two species of fish were caught in the beam trawls, the common goby (*P. microps*) and plaice (*Pleuronectes platessa)*. Both species were recorded at stations 1, 2 and 5. Only common goby was recorded at station 3 and no fish species were recorded at station 4.

3.1.3. Fyke Nets

A large number of shore crabs (*C. maenas)* were record in both fyke nets (Figure 3.2). No fish species were present.

Figure 3.2: High abundance of crab in fyke nets.

3.1.4. Physical and chemical data

Table 3.2 presents the water quality parameters measured through the water column. Salinity ranged from 2.19 PSU at the surface to 29.13 PSU off bottom while oxygen values were all close to full saturation. Temperature ranged from 8.63 ˚C in the relatively fresh water at the surface to 11.33 ˚C in the saline water close to the bottom.

Table 3:2: Physiochemical Data.

Depth	Temperature	Salinity	Conductivity	Dissolved oxygen		pH
m	˚C	PSU	mS/cm	mg/l	% saturation	units
0.20	8.63	2.19	4.023	10.37	98.0	7.20
0.83	9.03	5.26	9.323	10.01	97.4	7.03
0.97	9.40	8.46	15.21	9.63	96.5	7.17
1.51	11.33	29.13	44.95	7.93	94.7	7.93

4. Discussion

The fish species record in the survey are in line with what would be expected. IFI carried out two fish surveys in the area in 2008 and 2010 (IFI, 2008, 2010). These surveys split the Liffey estuary into upper and lower sampling areas with the confluence of the Dodder estuary with the Liffey located in the lower area. The results of the current survey align well with IFI surveys with similar species recorded. Utilising a WFD classification tool, IFI assigned an overall ecological classification of moderate to the Liffey survey areas based on the fish species present. A similar ecological classification can be applied to the Dodder estuary based on the fish species present. However, the additional information collected from the beam trawls such as high levels of leaf litter that is incorporated into the sediment, discarded cans and other anthropogenic derived litter, suggest that the ecological classification is at the lower end of moderate, which would be confirmed if incorporating benthic data from the area (AQUAFACT 2019, 2020) .

5. References

Inland Fisheries Ireland (2008). Sampling Fish for the Water Framework Directive: Transitional Waters 2010, Liffey Estuary.

Inland Fisheries Ireland (2010). Sampling Fish for the Water Framework Directive: Transitional Waters 2010, Liffey Estuary.

WFD Common Implementation Strategy (2003). Guidance on monitoring for the Water Framework Directive. Water Framework Directive Common Implementation Strategy, Working Group 2.7, Monitoring.

Appendix 1

Section 14 Licence

An Roinn Comhshaoil,
Aeráide agus Cumarsáide
Department of the Environment,
Climate and Communications

CERTIFICATE OF AUTHORISATION UNDER SECTION 14 OF THE FISHERIES (CONSOLIDATION) ACT, 1959 AS SUBSTITUTED BY SECTION 4 OF THE FISHERIES (AMENDMENT) ACT, 1962.

The Minister for Environment, Climate and Communications in exercise of the powers conferred on him by Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962 hereby authorises:
Mr Kevin McCaffrey, AQUAFACT International Services Ltd, 12 Kilkerrin Park, Liosbaun, Tuam Road, Galway City, and or person(s) nominated by him to undertake a transitional water survey of the Dodder estuary, in Dublin. The application is being made to assess the potential impact of building a new footbridge over the River Dodder.

This authorisation is granted subject to the following conditions:

1. This authorisation shall not confer on the holder thereof, independently of the conditions therein;

   (a) any rights or title which the holder would not have had if this Authorisation had not been given, or;

   (b) any authority in any way to interfere with or infringe the lawful rights of any other person.

2. This authorisation is issued to and valid for use by Mr Kevin McCaffrey, Aquafact International Services Ltd, and or person(s) nominated by him.

3. This authorisation is valid to 30th November 2020.

4. The transitional water survey must be carried out during suitable weather and flow conditions.

Teach Leamháin, Bóthar Ghleann an Iarla, An Cabhán, H12 A8H7
Elm House, Earlsvale Road, Cavan, H12 A8H7
T +353 1 678 2000 | 1890 44 99 00
www.gov.ie/decc

5. Inland Fisheries Ireland- Dublin (IFI Eastern River Basin District Director, Brian Beckett and IFI Fisheries Environmental Officer, Gretta Hannigan) must be notified at least five working days in advance of the actual commencement date of the survey.

   brian.beckett@fisheriesireland.ie /gretta.hannigan@fisheriesireland.ie

   Tel: 353 (0)1 2787022

6. As part of the survey the following details should be e-mailed to the contacts above: the County, Site Number, River Name, Townland and Irish Grid Reference as well as mobile telephone contact details for the relevant on-site supervisory personnel.

7. The consultants have provided a map showing the proposed sampling sites. These sites are not located in an SAC. They include:

   - Four seine netting sites.
   - Three beam trawling sites.
   - Two fyke netting sites.

8. IFI requests that, in carrying out this survey, the consultant follows the multi-method WFD methodology for sampling transitional waters (CEN, 2005; Coates et al., 2007; Harrison and Kelly, 2013).

9. In the event that the proposed survey is cancelled the relevant IFI office should be notified, initially by telephone and subsequently by e-mail. An indication of the proposed re-commencement date of the electrofishing/netting operation should also be advised.

10. No fish of any species should be sacrificed during the survey. . The number of fish killed (if any) is to be kept to an absolute minimum and the ERBD (IFI) and Citywest IFI are to be informed of any fish mortalities immediately after the survey. (it is noted that the application commits to returning fish to the water).

11. Aquafact have not referenced biosecurity in their application. All equipment should be disinfected prior to and after use to prevent the spread of disease, parasites or invasive species and must strictly comply with IFI's Biosecurity measure (http://www.fisheriesireland.ie/Biosecurity/biosecurity-protocol-for-field-survey-work.html) and as directed by an officer of IFI.

12. The field operatives should be mindful of the potential occurrence of invasive alien species. If invasive species are encountered, the field operatives should record their presence; indicate their abundance and extent of occurrence, along with a geo-reference in their report material submitted to IFI.

13. All survey equipment must be available for inspection by an IFI officer and An Garda Siochana if required.

14. A standard template for reporting data to IFI is attached. IFI request that a report and the data collected (in the attached standard IFI format) be provided, within 30 days of completion of the survey, in electronic format to Sandra.Doyle@fisheriesireland.ie. The report is to include mortality data and a full account of qualitative/quantitative results related to the fish sampled. These data will not be made publically available, for a period of three years, without the permission of the applicant.

15. IFI request that any European sea bass, eels or lamprey captured in the survey be measured (total length in mm is standard). This information should also be included on the IFI reporting template.

16. IFI recommends that the applicant informs fishery owners and local angling clubs of their plans for the work where relevant. The applicant must also seek permission from landowners to cross land, where relevant.

17. When doing anything pursuant to this authorisation, the holder shall, if requested by any person affected, produce this authorisation to that person.

18. Failure to comply with any of the conditions of this Authorisation may result in revocation of this Authorisation without payment of compensation to the holder.

19. The holder of this Authorisation shall indemnify and keep indemnified the State, the Minister for Environment, Climate and Communications and the Minister for Finance against any claims, arising in any manner whatsoever in connection with the user of the fishing gear or in the exercise of the permission hereby granted.

20. Notwithstanding the foregoing, this Authorisation may be revoked or amended by the Minister for Environment, Climate and Communications without the payment of compensation to the holder on giving one week's notice in writing to the holder if he considers it necessary in the public interest to do so.

Dated this 30 October 2020

For the Minister for Environment, Climate and Communications.

Una Ward

An officer authorised on that behalf by the said Minister

Notes on References

References
CEN, 2005. Water Quality - Guidance on the scope and selection of fish sampling methods; European Committee for Standarization. CEN EN 14962.

Coates, S., Waugh, A., Anwar, A., Robson, M., 2007. Efficacy of a multi-metric fish index as an analysis tool for the transitional fish component of the Water Framework Directive. Mar. Pollut. Bull. 55.

Harrison, T.D., Kelly, F., 2013. Development of an estuarine multi-metric fish index and its application to Irish transitional waters. Ecol. Indic. 34, 494–506.

Notes on Covid 19

1. It is the responsibility of the holder of this Authorisation to ensure that all works/actions undertaken by, or on behalf of, the holder comply with national measures in relation to Covid-19. This includes all protocols set out in the Government's Roadmap for the Return to Society and Business (the Roadmap) and all advice of the National Public Health Emergency Team (NPHET)

2. It is the responsibility of the holder to ensure any work practices are consistent with updates to phases of the Roadmap and updates to NPHET advices.

Appendix 2

Photo Log


Beam Trawl 1


Beam Trawl 2


Beam Trawl 3


Beam Trawl 4


Beam Trawl 5


Fyke 1


Seine 1 - 1


Seine 1-2


Seine 1-3

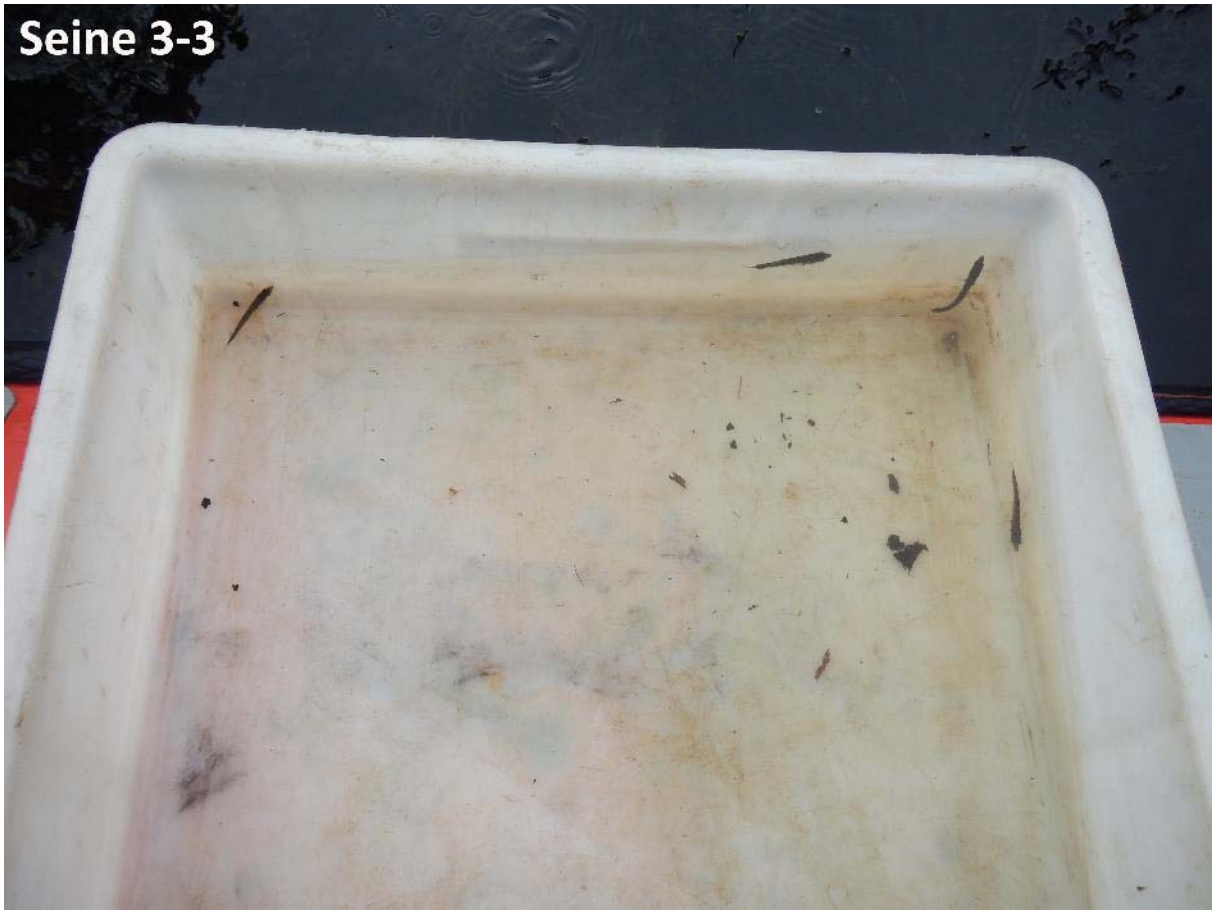

Seine 2-1

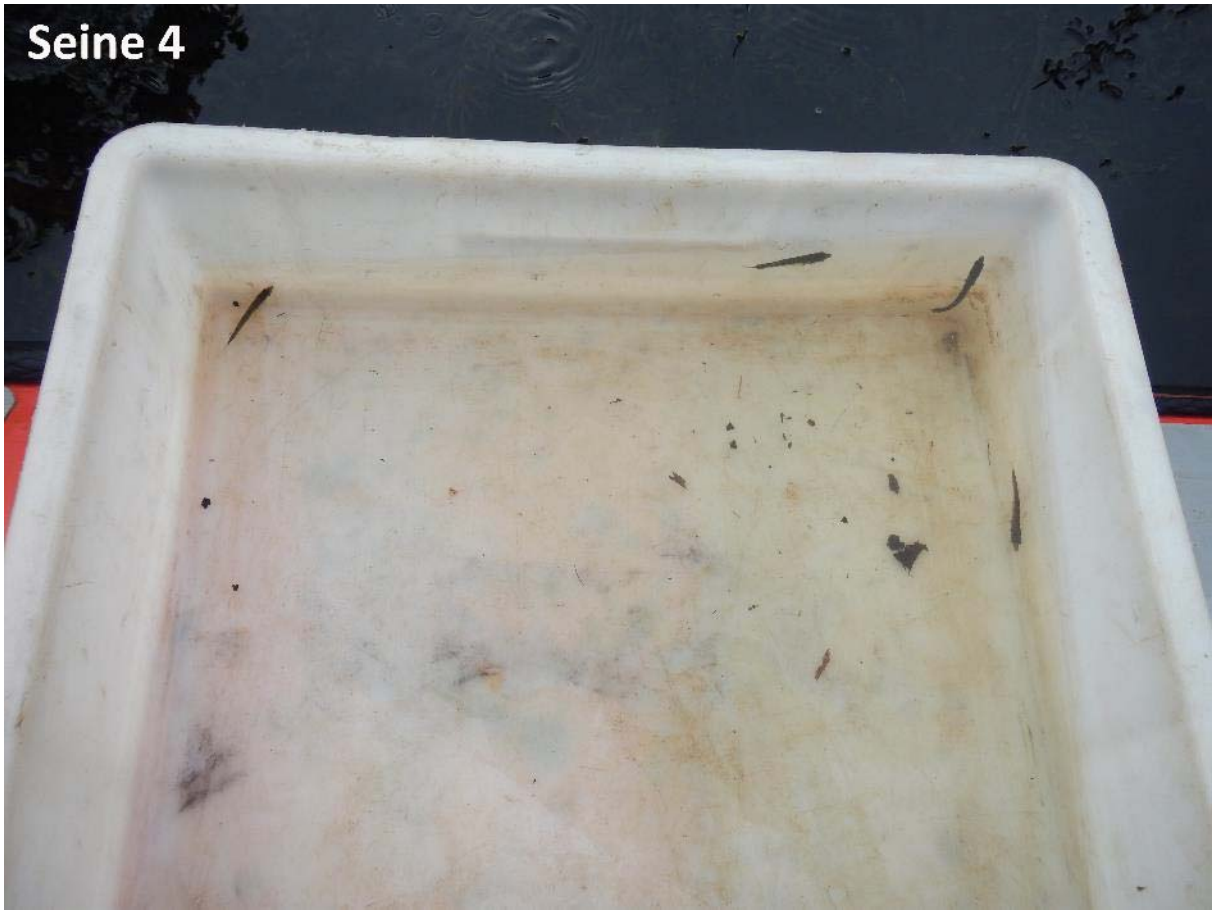

Seine 2-2


Seine 2-3


Seine 3-1


Seine 3-2


Seine 3-3


Seine 4


Common Goby
CM
10
20


Plaice
CM
10
20


Grey Mullet
10
20
30


Roach
10
20


Flounder
CM
10
20