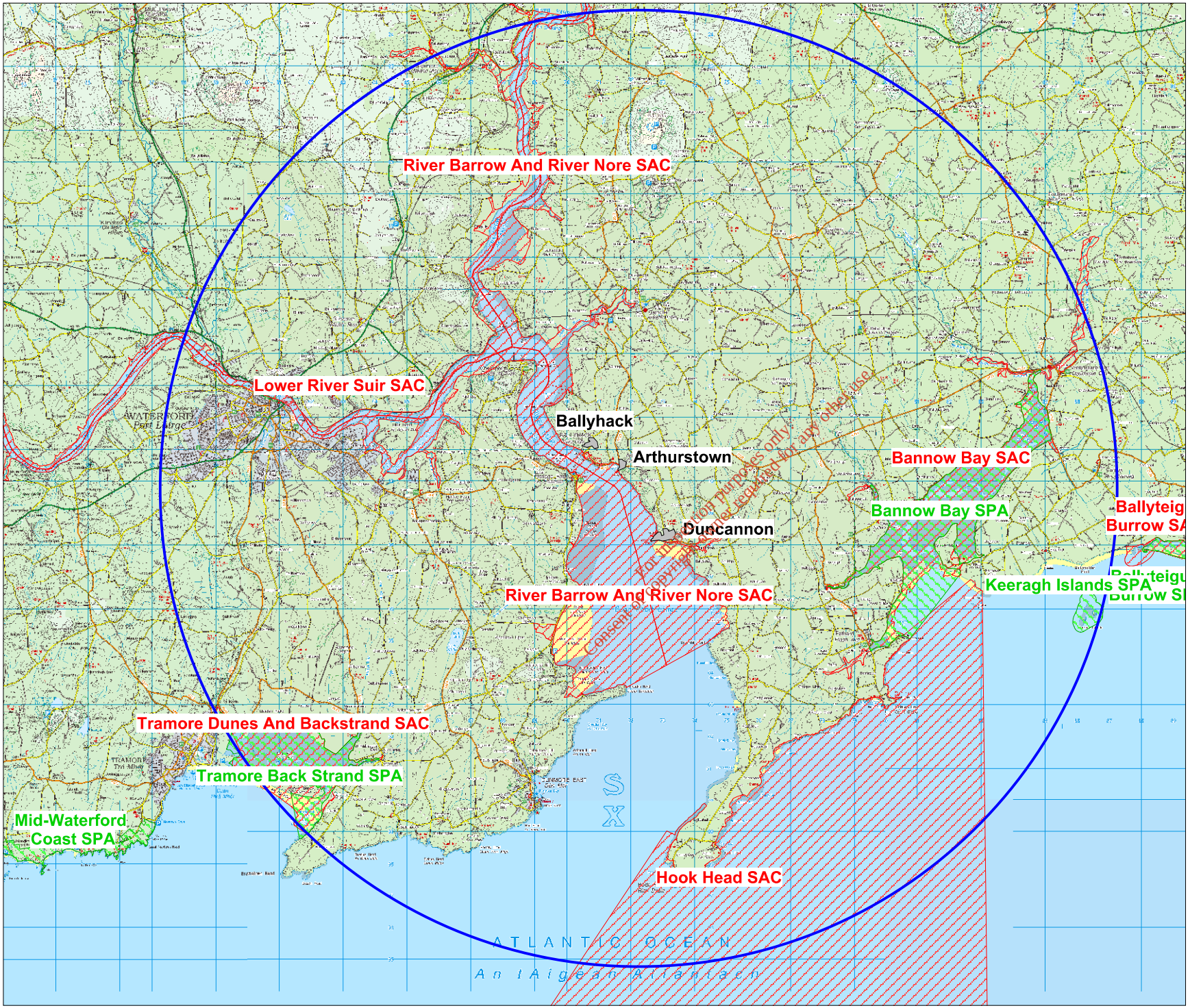
APPENDIX B - Environmental Drawings



NOTES

Figured dimensions only to be taken from this drawing
All dimensions to be checked on site.

All Maps are Referenced to Irish National Grid (I.N.G.)

Key to Map Features

- 15km Buffer Zone
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Study Areas

Rev:	Description:	Drawn:	Ch'kd:	Date:

Client:

Irish Water

Client Representative:

AECOM
JENNINGS O'DONOVAN & PARTNERS
CONSULTING ENGINEERS

Project:

UTAS Wexford - Arthurstown/Ballyhack/Duncannon

Stage:

Stage II Appropriate Assessment

Drawing Title:

Environmental Designation Areas

Drawn By:	CG	Date:	April 2018
Checked By:	MS	Date:	April 2018
Scales:	NTS		
Drawing No.	5636/AA Stage 2/ABD/Figure 1	Revision:	

NOTES

Figured dimensions only to be taken from this drawing
All dimensions to be checked on site.

All Maps are Referenced to Irish National Grid (I.N.G.)
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Key To Map Features

- Special Area of Conservation (SAC)
- Proposed Pumping Station
- Proposed Wastewater Treatment Plant site (WwTP)
- Proposed Wastewater Rising Main
- Proposed Effluent Gravity Main
- Proposed Gravity Main
- Existing Arthurstown Outfall
- Watercourses

Rev:	Description:	Drawn:	Ch'kd:	Date:

Client:

Irish Water

Client Representative:

AECOM
JENNINGS O'DONOVAN & PARTNERS
CONSULTING ENGINEERS

Project:

UTAS Wexford - Arthurstown/Ballyhack/Duncannon

Stage:

Stage II Appropriate Assessment

Drawing Title:

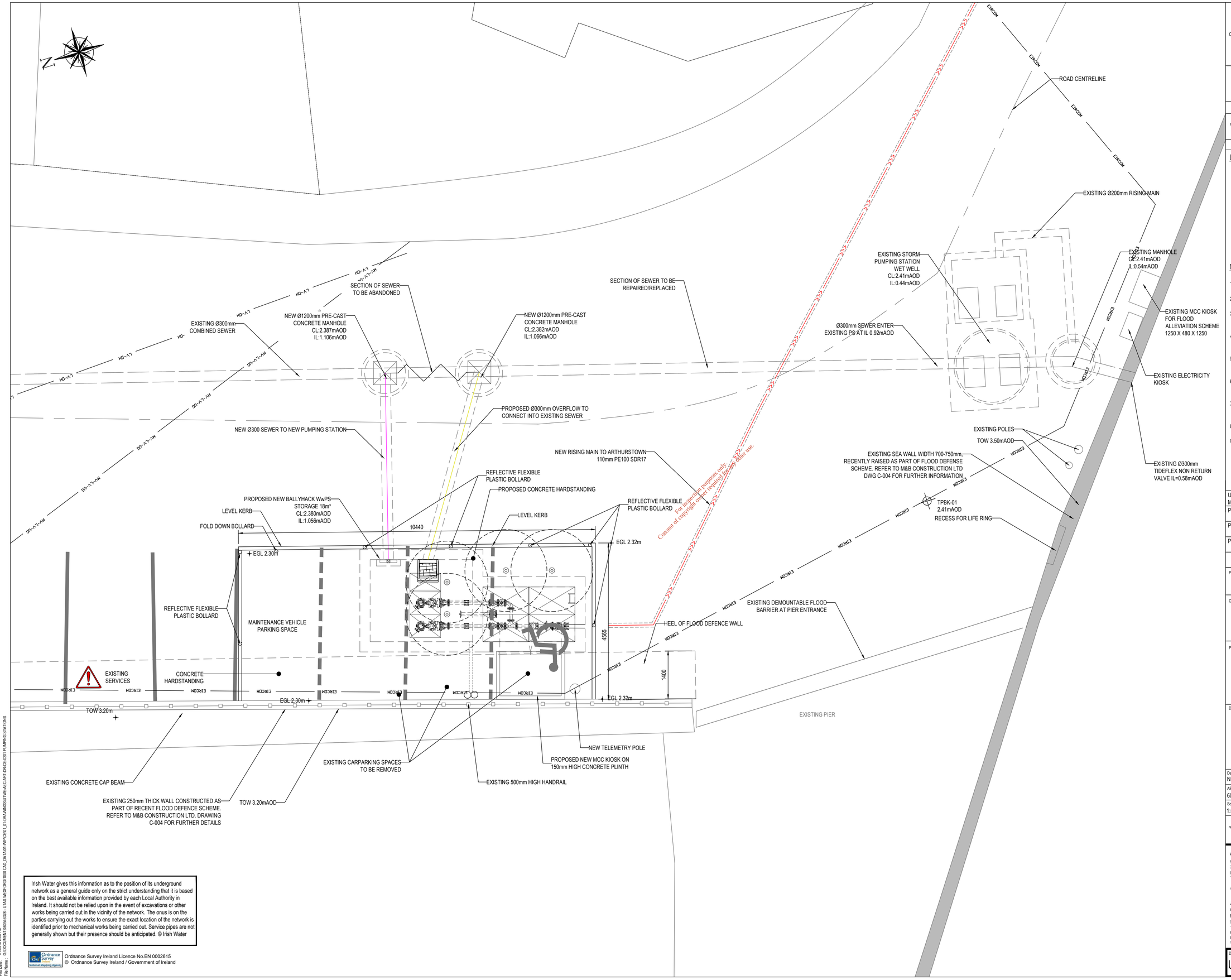
Surface Water Features

Drawn By:	CG	Date:	April 2018
Checked By:	MS	Date:	April 2018
Scales:	NTS		

Drawing No.: 5636/AA Stage 2/ABD/Figure 2

Revision:

APPENDIX C - Ballyhack Main Pumping Station – Site Layout



Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

CONSTRUCTION RISKS	1. Working near high voltage power lines 2. Erection of traffic management 3. Work on public roads 4. Work near open water 5. Working on an existing flood defense wall 6. Falling from height 7. Works occurring in a pedestrian location 8. Damage to services
MAINTENANCE / CLEANING RISK	9. Manual handling of equipment 10. Access to underground chambers 11. Access to site 12. Falling from height 13. Structural Failure
DEMOLITION RISKS	12. Working near an existing flood defense wall

In addition to the hazard/risks normally associated with the types of work detailed on this drawing take note of above. It is assumed that all works on this drawing will be carried out by a competent contractor working, where appropriate, to an appropriate method statement.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

LEGEND:

- PROPOSED INLET
- PROPOSED OVERFLOW
- EXISTING SEWER
- PROPOSED RISING MAIN

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.
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6. FOR DETAILS OF REINSTATEMENT AND BEDDING TO I.W STANDARD DETAIL STD-WW-07 ON IW-CDS-5030-01.
7. FOR DETAILS OF EXISTING WALL REFER TO M&B CONSTRUCTION Ltd. DRAWINGS 14025-C-002 TO 014
8. ALL WET WELL AND VALVE CHAMBER COVERS TO BE ASSISTED LIFT COVERS.
9. THE LOCATION OF ANY SERVICES SHOWN ON THE DRAWING ARE BASED ON THE INFORMATION AVAILABLE AND ARE GIVEN AS INDICATIVE. THE ACTUAL POSITION OF ANY UTILITIES SHOWN OR ANY ADDITIONAL SERVICES MUST BE VERIFIED AND ESTABLISHED ON SITE BEFORE WORK COMMENCES.

Revision Details	By	Check	Date	Suffix
UPDATED BASED ON WORKSHOP 4 MINUTES 13/12/17	NMcE	AM	02.01.18	P3
PRELIMINARY	NMcE	AM	14.11.17	P2
PRELIMINARY	NMcE	AM	18.08.17	P1
PRELIMINARY	NMcE	AM	07.07.17	P0

Purpose of issue: PRELIMINARY

Client: UISCE ÉIREANN - IRISH WATER

Project Title: UTAS WEXFORD ARTHURSTOWN IW PROJECT No. 10015231

Drawing Title: BALLYHACK PUMPING STATION SITE PLAN

Designed	Drawn	Checked	Approved	Date
NMcE	NMcE	AM	AB	JUNE 2017

AECOM Internal Project No. 60546328

Scale @ A1: 1:50

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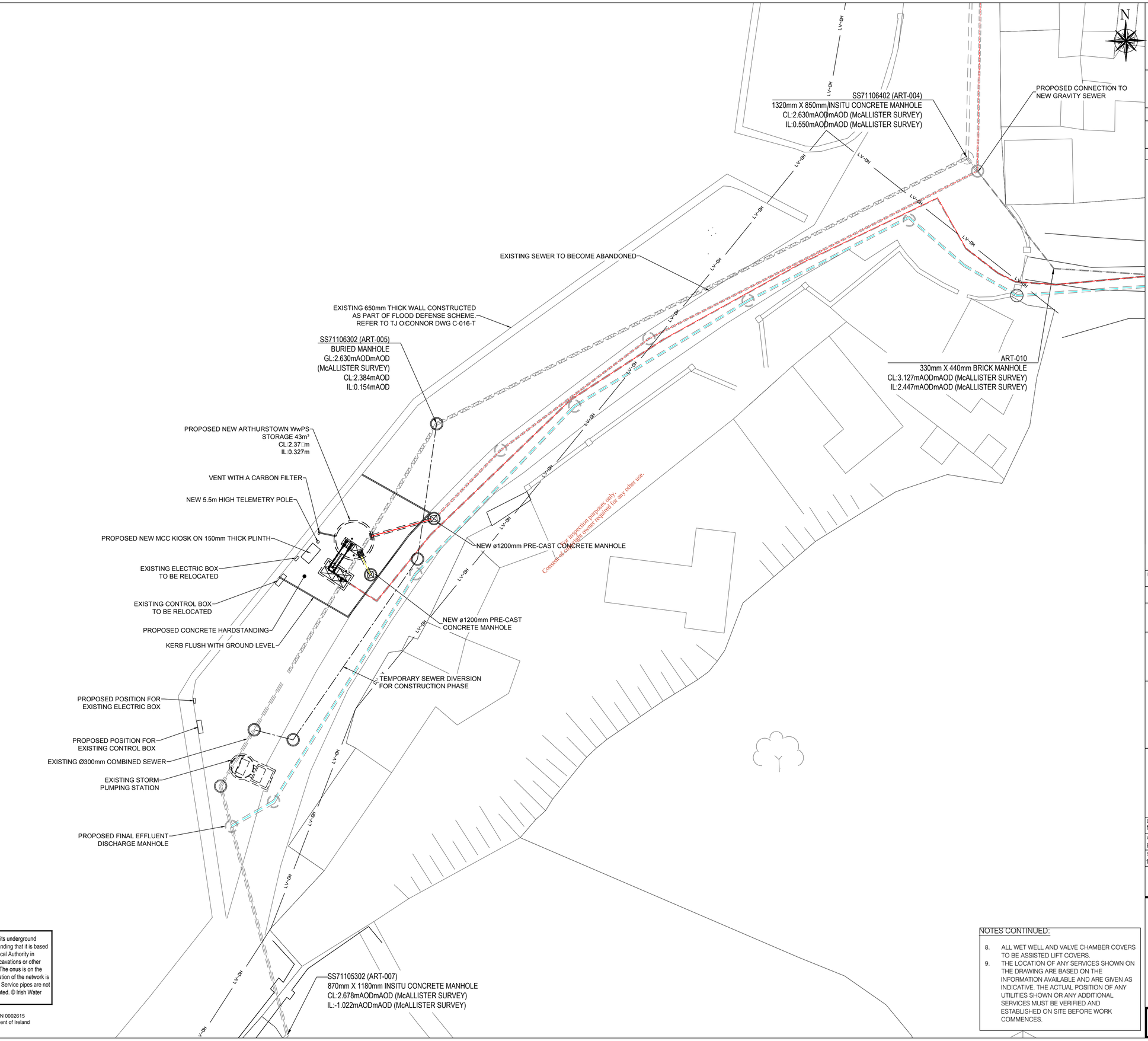
Drawing Number: UTWE-AEC-ART-DR-CE-0201 Rev: P3

Plot Date: 14/2018 2:08 PM
File Name: C:\DOCUMENTS\60546328 - UTAS WEXFORD\1000 CAD_DATA\0-WIP\CED\1.0\1-DR\AWINGS\UTWE-AEC-ART-DR-CE-0201 PUMPING STATIONS

APPENDIX D - Arthurstown Main Pumping Station – Site Layout



CONSTRUCTION RISKS	1. Working near high voltage power lines 2. Erection of traffic management 3. Work near open water 4. Working on sewers and valves 5. Falling from height 6. Works occurring in a pedestrian location 7. Damage to services 8. Working near an existing flood defense wall
MAINTENANCE / CLEANING RISK	9. Manual handling of equipment 10. Access to underground chambers 11. Access to site 12. Falling from height 13. Structural Failure
DEMOLITION RISKS	12. Working near an existing flood defense wall

In addition to the hazard/risks normally associated with the types of work detailed on this drawing take note of above. It is assumed that all works on this drawing will be carried out by a competent contractor working, where appropriate, to an appropriate method statement.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

LEGEND:

- PROPOSED OVERFLOW SEWER
- PROPOSED RISING MAIN
- PROPOSED GRAVITY SEWER
- PROPOSED FINAL EFFLUENT SEWER
- EXISTING SEWER
- TEMPORARY SEWER DIVERSION
- SEWER TO BE ABANDONED

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.
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5. FOR SITE INVESTIGATION DETAILS REFER TO PGL REPORTS PC 9014_01, PC 9014_06 AND PC 9014_BK.
6. FOR DETAILS OF REINSTATEMENT AND BEDDING TO I.W STANDARD DETAIL STD-WW-07 ON IW-CDS-5030-01.
7. FOR DETAILS OF EXISTING WALL REFER TO M&B CONSTRUCTION Ltd. DRAWINGS 14025-C-011-T TO 025-T

NOTES CONTINUED:

8. ALL WET WELL AND VALVE CHAMBER COVERS TO BE ASSISTED LIFT COVERS.
9. THE LOCATION OF ANY SERVICES SHOWN ON THE DRAWING ARE BASED ON THE INFORMATION AVAILABLE AND ARE GIVEN AS INDICATIVE. THE ACTUAL POSITION OF ANY UTILITIES SHOWN OR ANY ADDITIONAL SERVICES MUST BE VERIFIED AND ESTABLISHED ON SITE BEFORE WORK COMMENCES.

Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

UPDATED PUMPING STATION LAYOUT	GA / AM	13.08.18	P4
Revision Details	By / Check	Date	Suffix

Purpose of issue: PRELIMINARY

Client: UISCE ÉIREANN ÉIRIANN WATER

Project Title: UTAS WEXFORD ARTHURSTOWN IW PROJECT NO.10015231

Drawing Title: ARTHURSTOWN PUMPING STATION SITE PLAN

Designed	Drawn	Checked	Approved	Date
NMcE	NMcE	AM	AB	JUNE 2017

AECOM Internal Project No.: 60546328

Scale @ A1: 1:100

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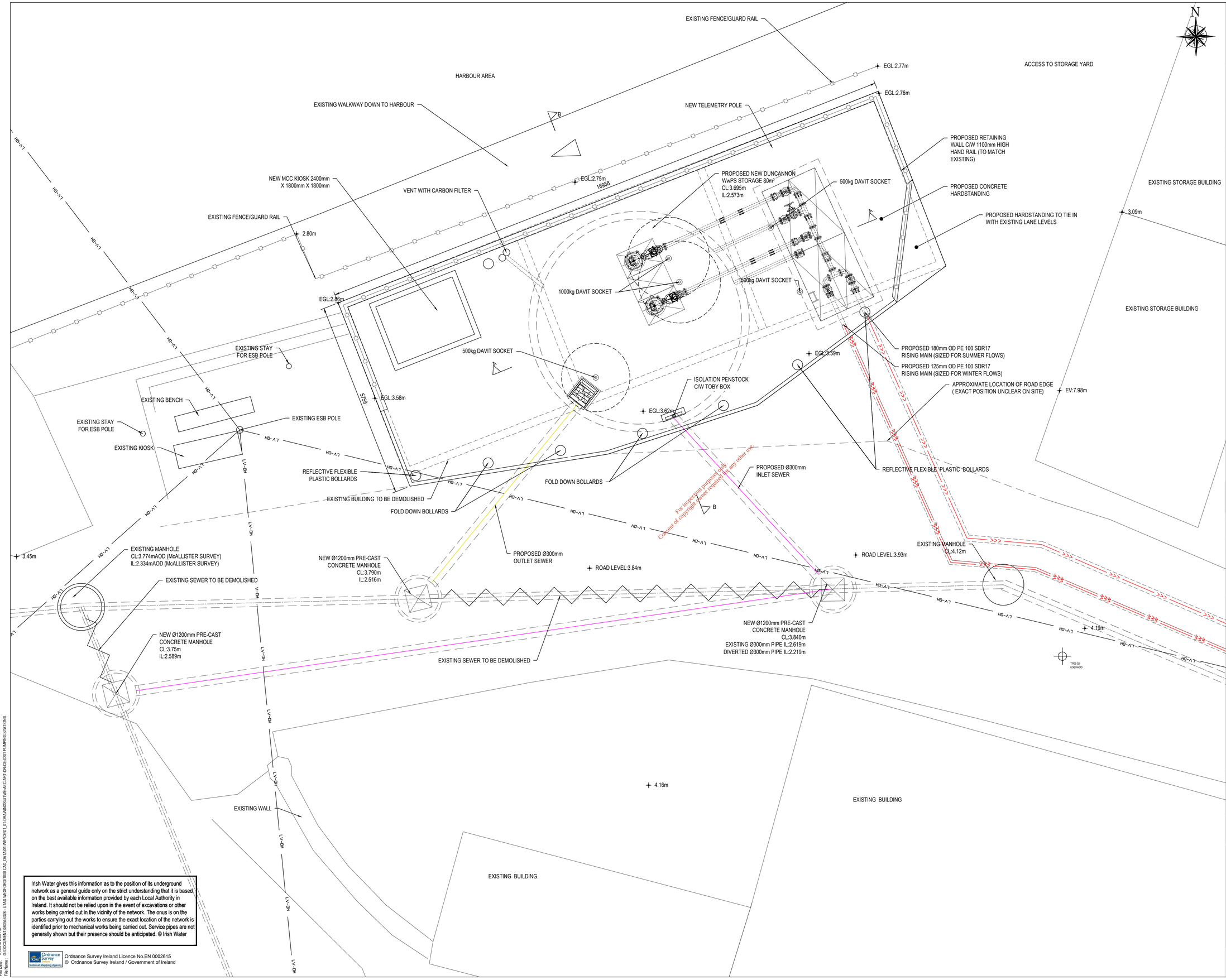
Drawing Number: UTWE-AEC-ART-DR-CE-0203 | Rev: P4

Plot Date: - 8/13/2018 9:25 AM
File Name: - I:\BE-MAN-001\CIVIL\DATA\DOCUMENTS\60546328 - UTAS WEXFORD\1000\CAD_DATA\01-WIP\CE\01_01-DRAWINGS\UTWE-AEC-ART-DR-CE-0201-0208 PUMPING STATIONS

APPENDIX D - Duncannon Main Pumping Station – Site Layout



Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

CONSTRUCTION RISKS	1. Working near high voltage power lines 2. Erection of traffic management 3. Work near open water 4. Working on sewers and valves 5. Falling from height 6. Damage to services 7. Works occurring in a pedestrian location
MAINTENANCE / CLEANING RISK	8. Manual handling of equipment 9. Falling from height 10. Access to the site 11. Structural failure
DEMOLITION RISKS	12. Demolition of existing building 13. Working near an existing flood defense wall

In addition to the hazard/risks normally associated with the types of work detailed on this drawing take note of above. It is assumed that all works on this drawing will be carried out by a competent contractor working, where appropriate, to an appropriate method statement.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

LEGEND:

- PROPOSED 300mm OVERFLOW SEWER
- PROPOSED 300mm INLET SEWER
- PROPOSED RISING MAIN
- PROPOSED GRAVITY SEWER
- EXISTING SEWER

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.
2. DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.
3. ALL DIMENSIONS ARE IN MILLIMETRES. ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE PROJECT HEALTH AND SAFETY FILE FOR ANY IDENTIFIED POTENTIAL RISKS.
5. FOR SITE INVESTIGATION DETAILS REFER TO PGL REPORTS PC 9014_01, PC 9014_06 AND PC 9014_BK.
6. FOR DETAILS OF REINSTATEMENT AND BEDDING TO I.W STANDARD DETAIL STD-WW-07 ON IW-CDS-5030-01.
7. ALL WET WELL AND VALVE CHAMBER COVERS TO BE ASSISTED LIFT COVERS.
8. THE LOCATION OF ANY SERVICES SHOWN ON THE DRAWING ARE BASED ON THE INFORMATION AVAILABLE AND ARE GIVEN AS INDICATIVE. THE ACTUAL POSITION OF ANY UTILITIES SHOWN OR ANY ADDITIONAL SERVICES MUST BE VERIFIED AND ESTABLISHED ON SITE BEFORE WORK COMMENCES.

Revision Details	By / Check	Date	Suffix
UPDATED BASED ON WORKSHOP 4 MINUTES 13/12/17	NMcE / AM	02.01.18	P3
TWIN RISING MAIN ADDED	NMcE / AM	30.11.17	P2
PRELIMINARY	NMcE / AM	14.11.17	P1
PRELIMINARY	NMcE / AM	18.08.17	P0

Purpose of issue: PRELIMINARY

Client: UISCE ÉIREANN : IRISH WATER

Project Title: UTAS WEXFORD ARTHURSTOWN IW PROJECT NO. 10015231

Drawing Title: DUNCANNON PUMPING STATION SITE PLAN

Designed	Drawn	Checked	Approved	Date
NMcE	NK	NMcE	AB	JUNE 2017

AECOM Internal Project No.: 60546328

Scale @ A1: 1:50

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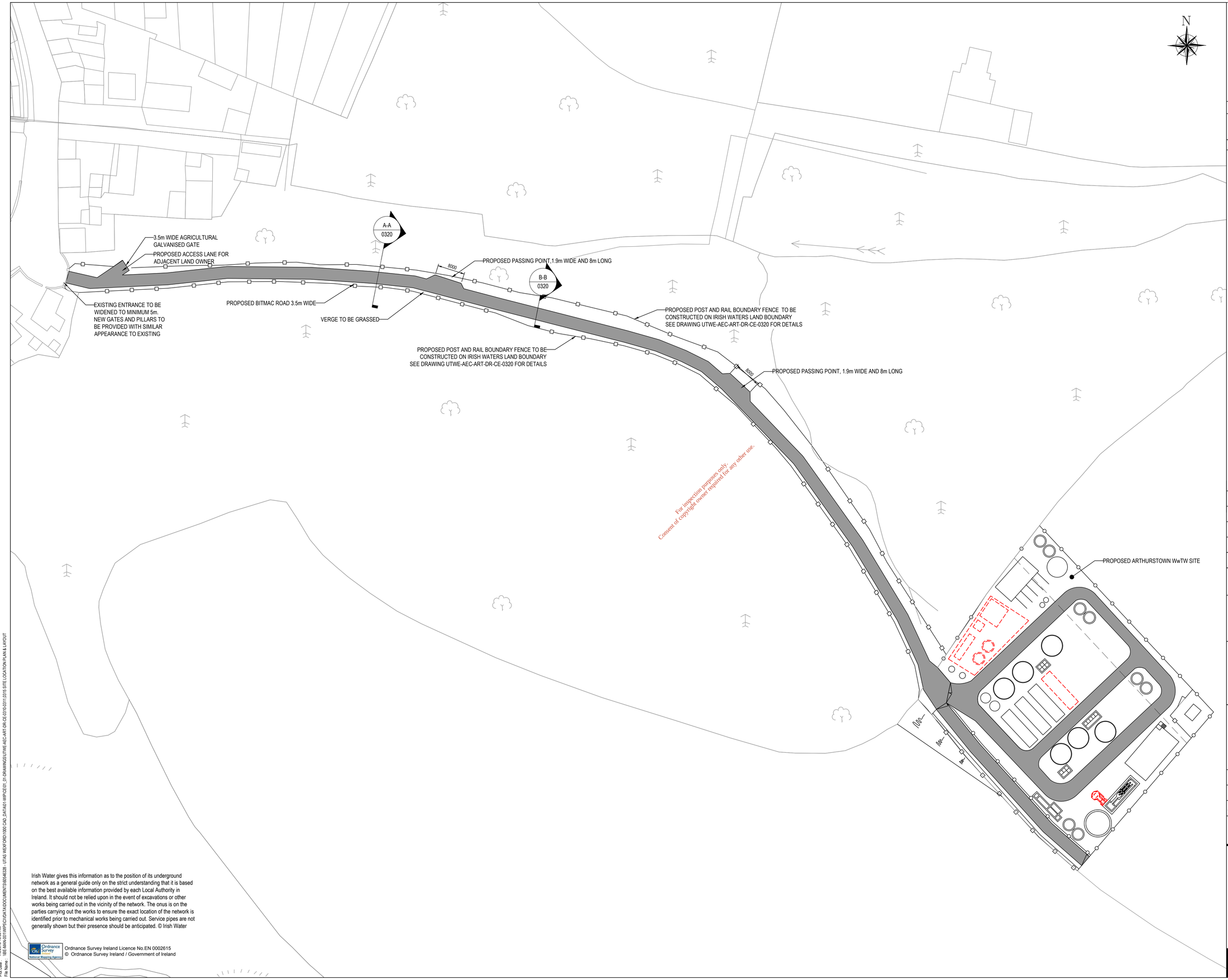
Drawing Number: UTWE-AEC-ART-DR-CE-0205

Rev: P3

Plot Date: 14/2/2018 2:50 PM
File Name: G:\DOCUMENTS\60546328 - UTAS WEXFORD\1000 CAD_DATA\01-WIP\CE\01_01-DRAWINGS\UTWE-AEC-ART-DR-CE-0201 PUMPING STATIONS

APPENDIX F - Arthurstown Wastewater Treatment Plant – Site Layout



Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

CONSTRUCTION RISKS	MAINTENANCE / CLEANING RISK	DEMOLITION RISKS

In addition to the hazard/risks normally associated with the types of work detailed on this drawing take note of above. It is assumed that all works on this drawing will be carried out by a competent contractor working, where appropriate, to an appropriate method statement.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

LEGEND:

INTERIM SOLUTION

FUTURE SOLUTION

NOTES

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6. FOR DETAILS OF REINSTATEMENT AND BEDDING TO I.W STANDARD DETAIL STD-WW-07 ON IW-CDS-5030-01.

Revision Details	By / Check	Date	Suffix
MINOR AMENDMENTS	NMcE / AM	05/07/18	P6
MINOR AMENDMENTS	NMcE / AM	08/05/18	P5
AMENDED BASED ON IRISH WATER COMMENTS 28/02/18	NMcE / AM	12/04/18	P4
AMENDED BASED ON WORKSHOP 4 MINUTES 13/12/17	NMcE / AM	03/01/18	P3

Purpose of issue

PRELIMINARY

Client

UISCE ÉIREANN : IRISH WATER

Project Title

UTAS WEXFORD
ARTHURSTOWN
IW PROJECT NO. 10015231

Drawing Title

ARTHURSTOWN WWTP
SITE LOCATION PLAN

Designed	Drawn	Checked	Approved	Date
NMcE	NMcE	AM	AB	JUNE 2017

AECOM Internal Project No.
60546328

Scale @ A1
1:500

AECOM
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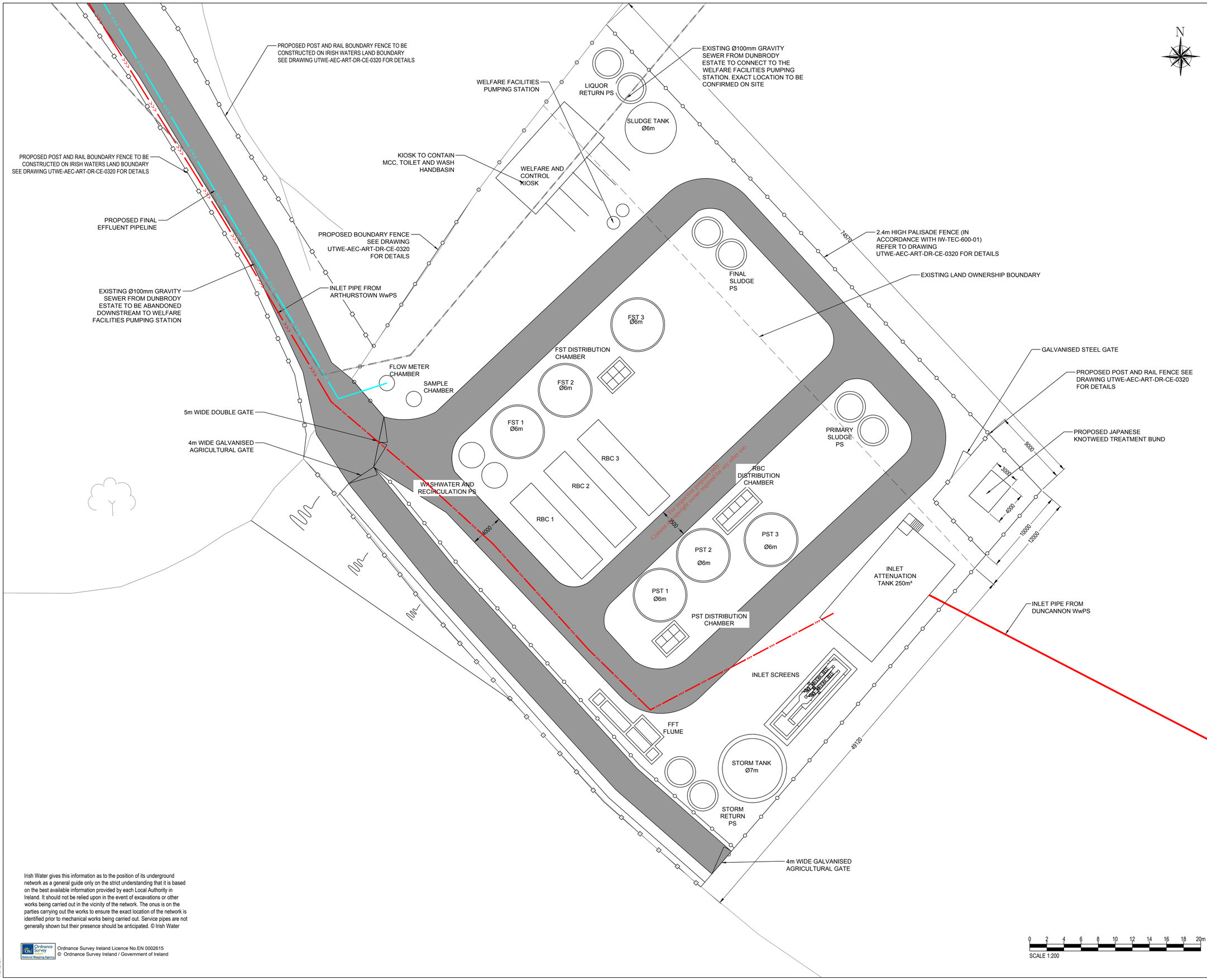
Drawing Number
UTWE-AEC-ART-DR-CE-0310

Rev
P6

Plot Date: 7/5/2018 10:36 AM
File Name: \\IE6-MAN-001\WIP$\CIVDATA\DOCUMENTS\60546328 - UTAS WEXFORD\100\ CAD_DATA\01-WIP\CE\01_01-DRAWINGS\UTWE-AEC-ART-DR-CE-0310-0311.0315 SITE LOCATION PLAN & LAYOUT



Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

CONSTRUCTION RISKS	MAINTENANCE / CLEANING RISK	DEMOLITION RISKS

In addition to the hazard/risks normally associated with the types of work detailed on this drawing take note of above. It is assumed that all works on this drawing will be carried out by a competent contractor working, where appropriate, to an appropriate method statement.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

LEGEND:

NOTES

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6. FOR DETAILS OF REINSTATEMENT AND BEDDING TO I.W STANDARD DETAIL STD-WW-07 ON IW-CDS-5030-01.

Revision Details	By / Check	Date	Suffix
MINOR AMENDMENTS	NMcE / AM	05/07/18	P3
MINOR AMENDMENTS	NMcE / AM	16/05/18	P2
AMENDED BASED ON IRISH WATER COMMENTS 28/02/18	NMcE / AM	12/04/18	P1
PRELIMINARY	NMcE / AM	03/01/18	P0

Purpose of issue

PRELIMINARY

Client

UISCE ÉIREANN : IRISH WATER

Project Title

UTAS WEXFORD
ARTHURSTOWN
IW PROJECT NO. 10015231

Drawing Title

ARTHURSTOWN WWTP
SITE LAYOUT SHOWING WORKS TO BE COMPLETED UNDER THIS SCHEME

Designed	Drawn	Checked	Approved	Date
NMcE	NMcE	AM	AB	JUNE 2017

AECOM Internal Project No.
60546328

Scale @ A1
1:200

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Drawing Number
UTWE-AEC-ART-DR-CE-0315

Rev
P3

Plot Date: 7/5/2018 10:42 AM
File Name: IBE-MAN-001\WIP\CIVIL\DATA\DOCUMENTS\60546328 - UTAS WEXFORD\1000 CAD_DATA\01.WIP\CE\01_01-DRAWINGS\UTWE-AEC-ART-DR-CE-0310-0311-0315 SITE LOCATION PLAN & LAYOUT

APPENDIX G – Marine Benthic Survey

Marine Benthic Survey in the vicinity of Arthurstown, Ballyhack and Duncannon Wastewater Treatment Plant Discharge Locations Waterford Estuary, Co. Wexford

Produced by

AQUAFACT International Services Ltd

On behalf of

Irish Water

December 2017

AQUAFACT INTERNATIONAL SERVICES LTD.,
12 KILKERRIN PARK,
LIOSBAUN, TUAM ROAD
GALWAY .
www.aquafact.ie

info@aquafact.ie

tel +353 (0) 91 756812

Table of Contents

List of Figures

List of Tables

List of Appendices

1. Introduction

AQUAFACT International Services Ltd. were commissioned by AECOM and Jennings O'Donovan on behalf of Irish Water to carry out a benthic assessment in the vicinity of discharge pipes located at Arthurstown, Ballyhack and Duncannon as part of an upgrade to the Wastewater Treatment Plants in the area. AECOM and Jennings O'Donovan were appointed by Irish Water to progress the Untreated Agglomeration Study (UTAS) Wexford agglomerations in order to bring these sites into compliance with the Urban Wastewater Treatment Directive (Figure 1.1).

The project objective is to provide the detailed design, procurement and management of wastewater treatment systems capable of providing appropriate treatment for the agglomerations within UTAS Wexford.

The study location is defined by the existing and potential future wastewater collection network serving the villages of Arthurstown, Ballyhack and Duncannon in County Wexford. The three villages are located in the southwest of County Wexford and each is adjacent to Waterford Harbour.

It is proposed to combine all three villages and treat the wastewater in a new Wastewater Treatment Plant to be located between Arthurstown and Duncannon. The combined effluent will discharge using the existing outfall at Arthurstown.

The purpose of AQUAFACT's benthic survey was to determine the benthic communities in the vicinity of the three current outfall sites, upstream and downstream of the initial mixing zone of the outfalls and at a reference station representative of conditions outside of any potential influence of the current discharges. As the distance between Ballyhack and Arthurstown is approximately 1 km, a single station located mid may between the outfalls cwas taken to be representative of the downstream station for Ballyhack and the upstream Arthurstown station. A map, outlining the location of the required sampling points, was supplied to Aquafact prior to sampling (Figure 1.2)

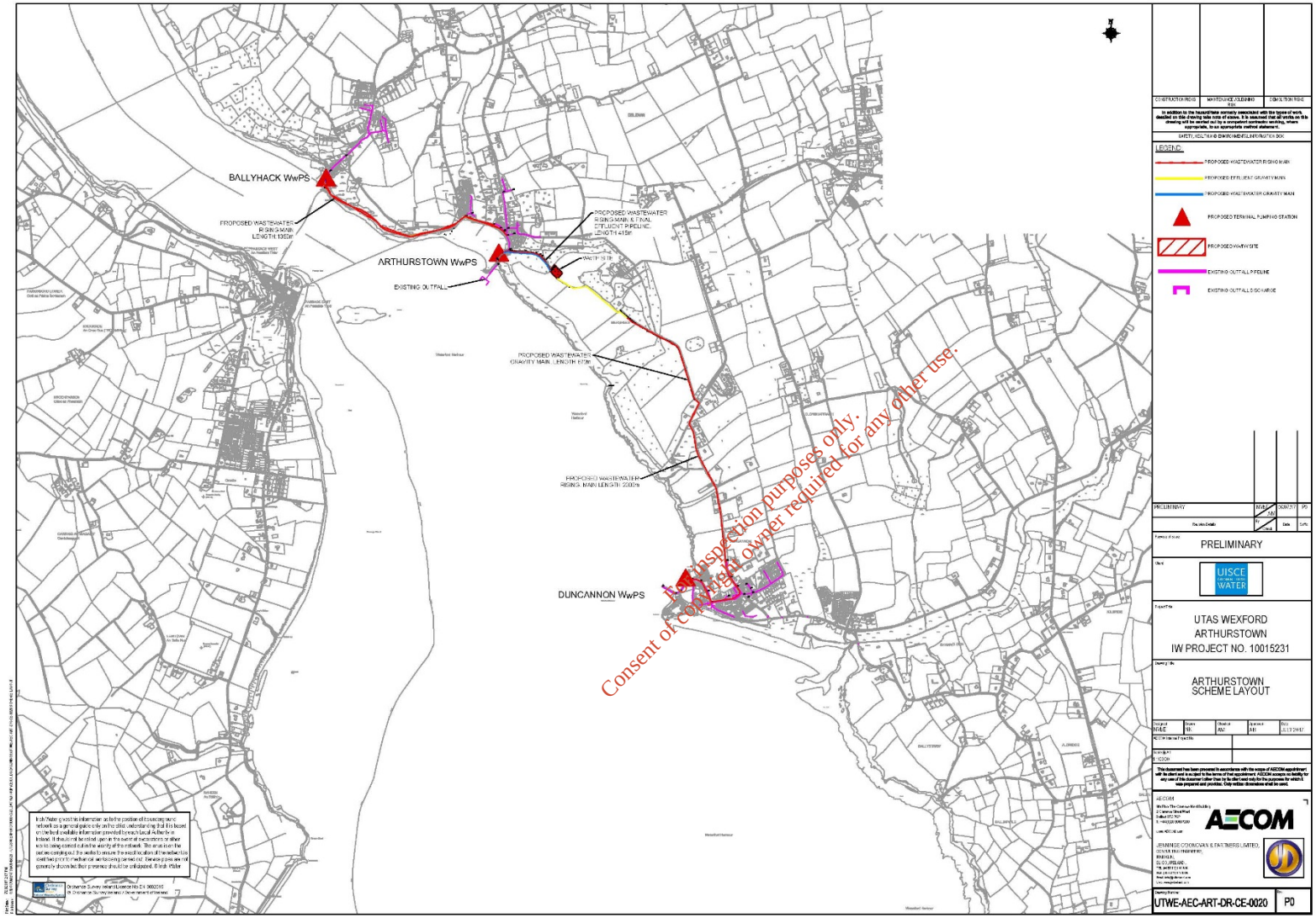

Figure 1.1: Location of existing outfall locations and proposed scheme.

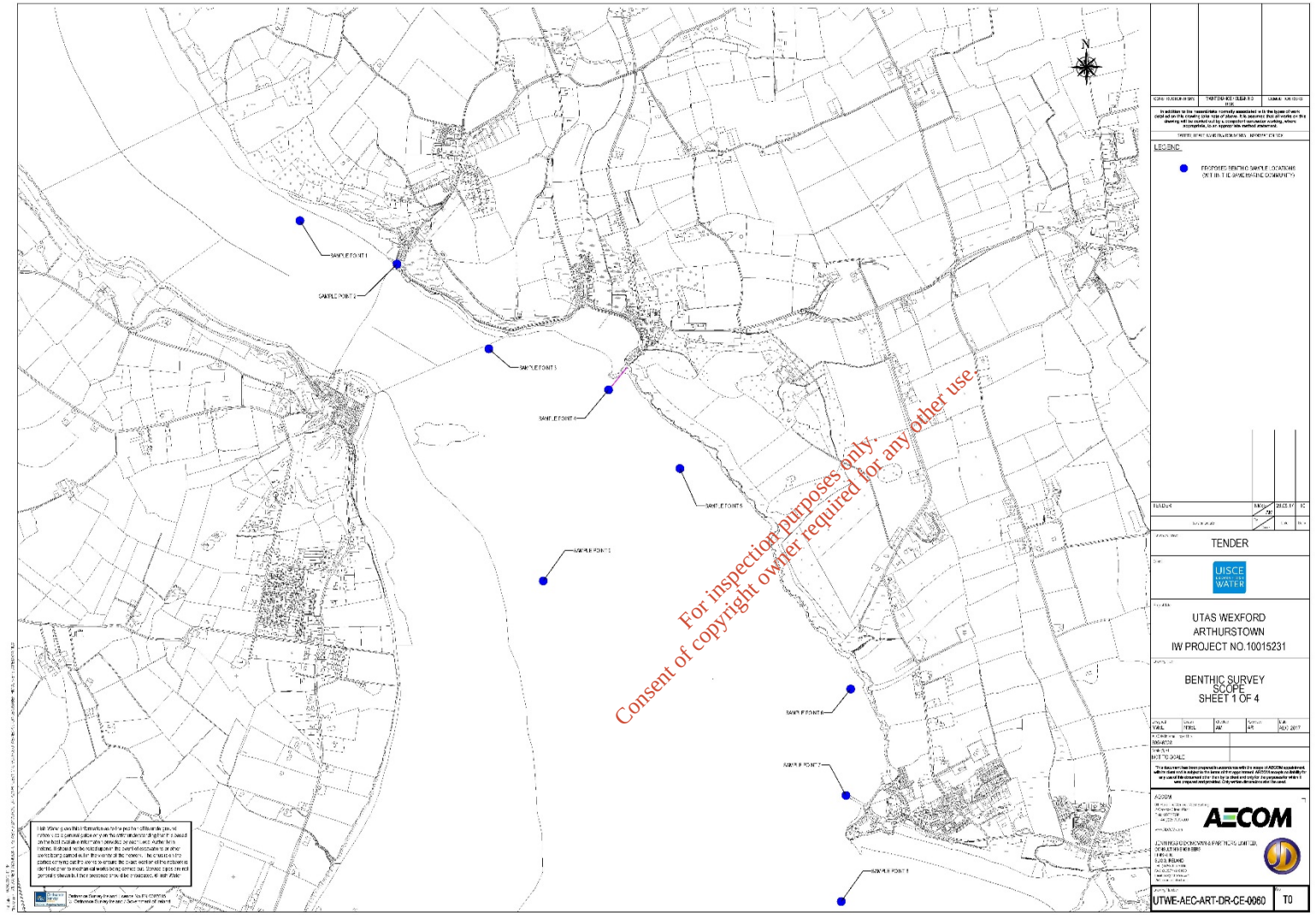

Figure 1.2: Proposed location of the sampling points for the Arthurstown, Ballyhack and Duncannon benthic survey.

2. Materials & Methods

All survey work was carried out on the 29th September 2017. Weather conditions on the day were moderate with a relatively strong westerly wind (F4-5) hampering sampling. However, all samples were collected successfully at each of the stations.

To carry out the subtidal benthic assessment in the vicinity of the outfall locations, AQUAFACT sampled a total of 9 stations using the preferred locations as outlined in Figure 1.2 as a guide. Where samples couldn't be taken successfully due to coarse ground, the station was relocated as close to the original point as possible where the seafloor was more suitable to obtain samples (the relocated sites included Station 5 downstream of Arthurstown, Station 7 outfall location Duncannon and Station 8 downstream Duncannon). Figure 2.1 shows the locations where successful faunal samples were obtained for each of the subtidal stations while Table 2.1 presents the station coordinates and water depth. The stations were located within the S*and to muddy fine sand community complex* as documented by NPWS (2011). Figure 2.2 shows the stations locations in relation to the NPWS (2011) habitats.

Sampling took place on the 29th September 2017 from AQUAFACT's 6.8m Lencraft RIB. AQUAFACT has in-house standard operational procedures for benthic sampling and these were followed for this project. Additionally, the MESH report on "Recommended Standard methods and procedures" was 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 (latitude/longitude). Additional information such as date, time, site name, sample code and depth were recorded in a data sheet.

Five replicate grab samples were taken at each of the stations for faunal analysis and a sixth sample was collected for sediment grain size analysis. The grab deployment and recovery rates did not exceed 1 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 and redox depth was noted in the sample data sheet. Notes were also made on colour, texture, smell and presence of animals.

The samples collected for faunal analysis were carefully and gently sieved on a 1 mm 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 ultimately preserved in 70% alcohol prior to processing.

Figure 2.1: Location of the grab stations sampled on the 29th September 2017.

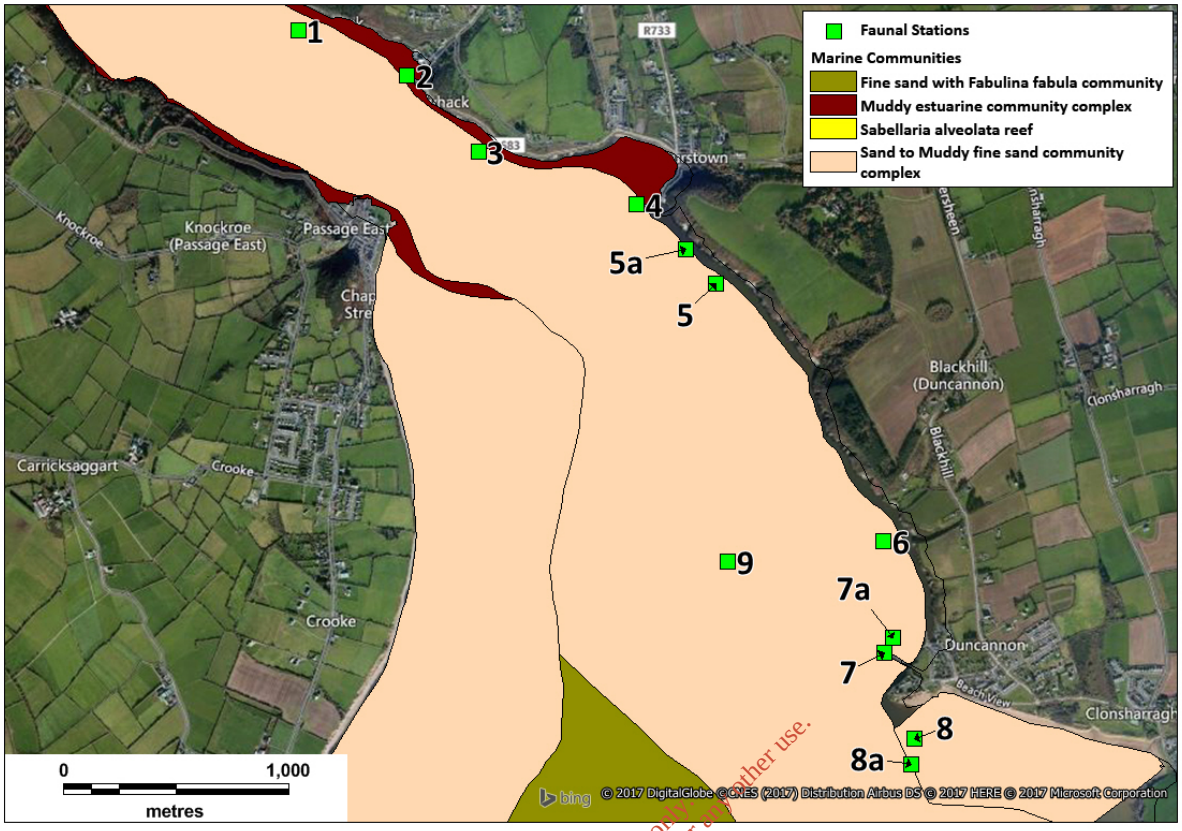

Figure 2.2: Location of the grab stations in relation to the habitat types (NPWS, 2011a; b).

Table 2.1: Station coordinates and depths at the grab stations.

Station	Longitude	Latitude	Depth (m)	Distance from Outfall (m)
1	-6.97647	52.24701	3.5	537
2	-6.96934	52.24496	3.2	10
3	-6.96474	52.24219	7.5	450
4	-6.95442	52.24008	3.1	20
5	-6.94925	52.23691	5.3	470
5a	-6.95127	52.23831	5.3	220
6	-6.93835	52.22664	4.5	495
7	-6.93833	52.2222	4.1	10
7a	-6.93772	52.2228	4.2	80
8	-6.93639	52.21878	2.9	450
8a	-6.93659	52.21777	3.1	553
9	-6.94851	52.22585	3.5	na

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 2.2 shows the classification of sediment particle size ranges into size classes. Sieves, which corresponded to the range of particle sizes (Table 2.2), were used in the analysis. Appendix 1 provides the detailed granulometric methodology.

Table 2.2: 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

2.1.2. Data Analysis

Statistical evaluation of the faunal data was undertaken using PRIMER v.6 (Plymouth Routines in Ecological Research). The faunal returns from all five replicates were totalled prior to analysis. Univariate statistics in the form of diversity indices were calculated. Numbers of species and numbers of individuals per sample were be calculated and the following diversity indices were utilised:

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.

Species richness is a measure of the total number of species present for a given number of individuals. Evenness is a measure of how evenly the individuals are distributed among different species. The Shannon-Wiener index incorporates both species richness and the evenness component of diversity (Shannon & Weaver, 1949) and 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 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 in order to allow the intermediate abundant species and 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 be 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). With regard to 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 more or less 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, 1994). This programme determined the percentage contribution of each species to the dissimilarity/similarity within and between each sample group.

In order to assess the benthic ecological quality of the community, the AZTI Marine Biotic Index (AMBI) was calculated on each replicate sample. AMBI offers a 'pollution or disturbance classification' which represents the benthic community health (*sensu* Grall & Glémarec, 1997). All epifauna and planktonic taxa are removed prior to analysis. 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/pollution and stations dominated by opportunistic taxa reflect impacted areas. Table 2.3 shows the AMBI values and their equivalences (after Borja *et al.,* 2000).

Table 2.3: Summary of the AMBI values and their equivalences (after Borja *et al.*, 2000 modified from Grall & Glémarec, 1997).

AMBI Value (BC = Biotic Coefficient)	Dominating Ecological Group	Benthic Community Health	Site Pollution Classification
0.0 < BC ≤ 0.2	I	Normal	Unpolluted
0.2 < BC ≤ 1.2		Impoverished	
1.2 < BC ≤ 3.3	III	Unbalanced	Slightly Polluted
3.3 < BC ≤ 4.3	IV - V	Transitional to Polluted	Moderately Polluted
4.3 < BC ≤ 5.0		Polluted	
5.0 < BC ≤ 5.5	V	Transitional to Heavy Pollution	Heavily Polluted
5.5 < BC ≤ 6.0		Heavily Polluted	
7.0	Azoic	Azoic	Extremely Polluted

3. Results

3.1. Fauna

The taxonomic identification of the benthic infauna across all 9 grab stations sampled in Waterford Harbour on 29th September yielded a total count of 75 taxa ascribed to 7 phyla. Seven of the 75 taxa could not be enumerated as they were colonial species (bryozoans and hydroids). The remaining 68 taxa consisted of 2,865 individuals. Of the 75 taxa recorded, 53 were identified to species level. The remaining 22 could not be identified to species level as they were either juveniles, partial/damaged or indeterminate. Appendix 2 shows the faunal abundances from the sampled sites.

Of the 75 taxa present, 4 were cnidarians (corals, anemones, jellyfish *etc*), 1 was a nematode (roundworm), 35 were annelids (segmented worms), 1 was a chelicerate (sea spiders), 19 were crustaceans (crabs, shrimps, prawns), 10 were molluscs (mussels, cockles, snails etc.) and 1 was a chironomid (non-biting midges).

3.1.1.1. Univariate Analysis

Univariate statistical analyses were carried out on the combined station-by-station faunal data. The colonial species were removed from the data set prior to analysis. The following parameters were calculated and can be seen in Table 3.1: taxon numbers, number of individuals, richness, evenness, Shannon-Weiner diversity and Simpson's Diversity. Taxon numbers ranged from 10 (Station 6 and Station 8a) to 44 (Station 5a). Number of individuals ranged from 40 (Sattion 8a) to 1115 (Station 5a). Richness ranged from 1.76 (Station 2) to 6.13 (Station 5a). Evenness ranged from 0.13 (Station 2) to 0.78 (Station 8a). Shannon-Weiner diversity ranged from 0.32 (Station 2) to 2.32 (Station 3). Simpson's diversity ranged from 0.11 (Station 2) to 0.83 (Station 3). Figure 3.1 presents these community indices in graphical form.

Table 3.1: Univariate measures of community structure.

Station	No. Taxa	No. Individuals	Richness	Evenness	Shannon-Weiner Diversity	Simpson's Diversity
1	12	58	2.71	0.62	1.54	0.64
2	12	512	1.76	0.13	0.32	0.11
3	25	189	4.58	0.72	2.32	0.83
4	31	467	4.88	0.66	2.27	0.79
5a	44	1115	6.13	0.55	2.10	0.75
6	10	54	2.26	0.74	1.71	0.76
7a	18	371	2.87	0.43	1.23	0.46
8a	10	40	2.44	0.78	1.79	0.80
9	12	59	2.70	0.69	1.72	0.73

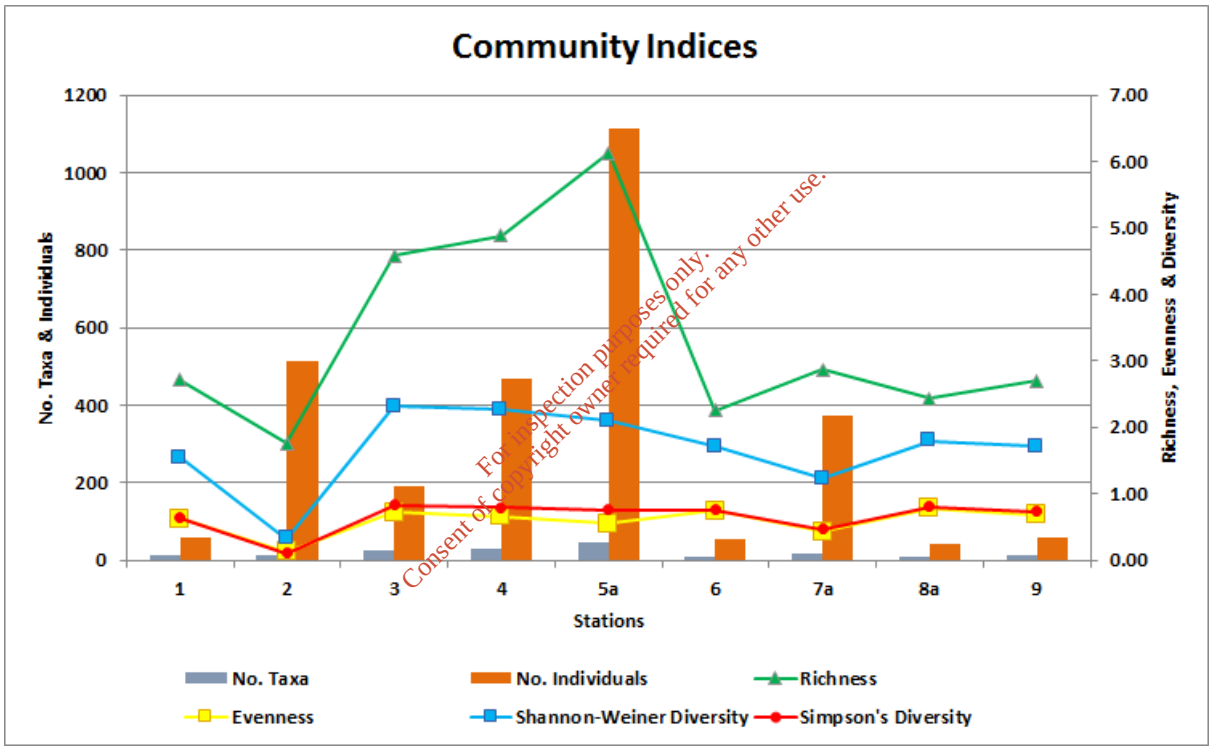

Figure 3.1: Community diversity indices.

3.1.1.2. Multivariate Analysis

The same data set used above for the univariate analyses was also used for the multivariate analyses. The dendrogram and the MDS plot can be seen in Figures 3.2 and 3.3 respectively. SIMPROF analysis revealed 3 statistically significant groupings between the 9 stations (the samples connected by red lines cannot be significantly differentiated). The stress level on the MDS plot indicates a good representation of the data.

Group a separated from Groups b and c at a 23.35% similarity level and Groups b and c separated

from each other at a 34.31% similarity level.

Group a contained Station 9 (Reference). This group contained 12 taxa comprising 59 individuals. Of the 12 taxa, 8 were present twice or less. Four species accounted for almost 85% of the faunal abundance of this group; the amphipod *Bathyporeia elegans* (28 individuals, 47.5% abundance) and the polychaetes *Nephtys* sp. (10 individuals, 17% abundance), *Scoloplos (Scoloplos) armiger* (7 individuals, 11.9% abundance) and *Nephtys hombergii* (5 individuals, 8.5% abundance). SIMPER analysis could not be carried out for this group because it only contained 1 station. Species richness and diversity were low at this station. *Bathyporeia elegans* is very sensitive to organic enrichment and present under unpolluted conditions. *Nephtys hombergii* and *Nephtys* sp. are indifferent to enrichment, always present in low densities with non-significant variations over time. *Scoloplos (Scoloplos) armiger* is species tolerant to excess organic matter enrichment, but their populations are stimulated by organic enrichment. This station represented a less faunally diverse version of the sand to muddy fine sand community described by NPWS (2011b) containing low number of *Bathyporeria elegans, Nephtys* sp. and *Scoloplos (Scoloplos) armiger.*

Group b contained Stations 3, 4, 5a and 7a and had a within group similarity level of 49.07%. This group contained 60 taxa comprising 2,142 individuals. Of the 60 taxa, 3 were colonial species and 21 species were present twice or less. Four species accounted for just over 62% of the faunal abundance of this group; the polychaete Cirratulidae (529 individuals, 24.7% abundance), the amphipod *Corophium volutator* 352 individuals, 16.4% abundance), the oligochaete *Tubificoides benedii* (257 individuals, 12% abundance) and the barnacle *Balanus crenatus* (201 individuals, 9.4% abundance). SIMPER analysis revealed that *Tubificoides benedii* and *Scoloplos (Scoloplos) armiger* were the characterising species of this group. Table 3.2 shows the full SIMPER results. Species richness and diversity was relatively high in this group. In addition to epifaunal barnacles, this group also contained bryozoans, hydroids and encrusting worms on the coarse gravel fraction of the sediment. *Balanus crenatus* are indifferent to enrichment, always present in low densities with non-significant variations over time. *Corophium volutator* and *Scoloplos (Scoloplos) armiger* are species tolerant to excess organic matter enrichment, but their populations are stimulated by organic enrichment. Cirratulidae are second order opportunists which are typical of slight to pronounced unbalanced situations. *Tubificoides benedii* is a first order opportunistic species which proliferates in reduced sediments. This group resembles the sand to muddy fine sand community described by NPWS (2011b) but also contains elements of the muddy estuarine community complex. This community may represent a transition zone between the two. This group contains *Corophium*

volutator and *Tubificoides benedii* representative of the latter community and *Crangon crangon, Cumopsis goodsiri, Scoloplos armiger, Nephtys hombergii, Cerastoderma edule* and *Limecola balthica* which are representative of the former community.

Group c contained stations 1, 2, 6 and 8a and had a within group similarity level of 45.77%. This group contained 27 taxa comprising 664 individuals. Of the 27 taxa, 4 were colonial species and 14 species were present twice or less. Three species accounted for just over 88% of the faunal abundance of this group; the oligochaete *Tubificoides pseudogaster* agg. (519 individuals, 78.2% abundance), the polychaete *Nephtys hombergii* (42 individuals, 6.3% abundance) and the amphipod *Corophium volutator* (24 individuals, 3.6% abundance). SIMPER analysis revealed that *Corophium volutator* and *Nephtys* sp. were the characterising species of this group. Table 3.2 shows the full SIMPER results. Species richness and diversity was relatively low in this group. This group also contained bryozoans and hydroids on the coarse gravel fraction of the sediment. *Nephtys hombergii* and *Nephtys* sp. are indifferent to enrichment, always present in low densities with non-significant variations over time. *Corophium volutator* are tolerant to excess organic matter enrichment, but their populations are stimulated by organic enrichment. *Tubificoides pseudogaster* is a first order opportunistic species which proliferates in reduced sediments. This group resembles the muddy estuarine community complex described by NPWS (2011b) as it contains *Corophium volutator, Nephtys hombergii, Tubificoides pseudogaster* agg., *Limecola balthica* and *Capitella* sp.

One species of note is the cryptogenic amphipod *Monocorophium ascherusicum*. This species has long been known from the south of England but has only recently been recorded from Irish waters. Daniels *et al.* (2009) recorded it from Malahide Marina in 2007 and it was subsequently recorded in Carrickfergus Marina, Belfast Lough in 2012 (Minchin & Nunn, 2013). This record from Waterford represents an increase in its range in Ireland. Daniels *et al.* (2009) consider recreational boat traffic the most likely vector for its spread.

Table 3.3 shows the AMBI results from the analysis of the samples. Four stations were classified as moderately disturbed (1 to 4) and four stations were classified as slightly disturbed (5 to 8). The Reference Station 9 was classified as undisturbed. The moderately disturbed stations were dominated by opportunistic species which thrive in reduced sediments (Group V; 55.2% on average). The slightly disturbed stations were dominated by species that are tolerant to excess organic matter enrichment (Group III, 45.8%) and the undisturbed station was dominated by species sensitive to organic enrichment (Group I, 57.6%). Appendix 3 shows the detailed station results.

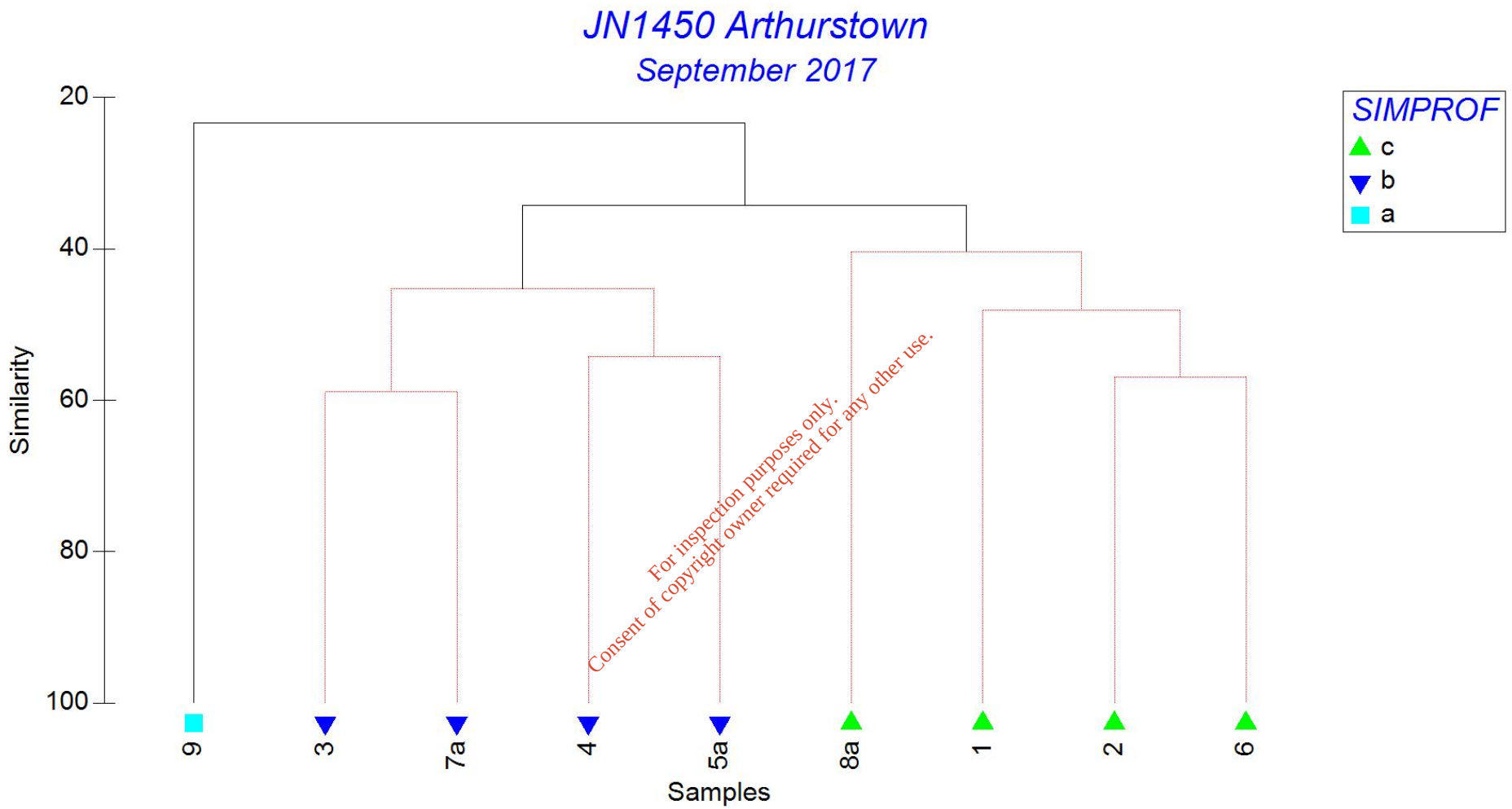

Figure 3.2: Dendrogram produced from Cluster analysis.

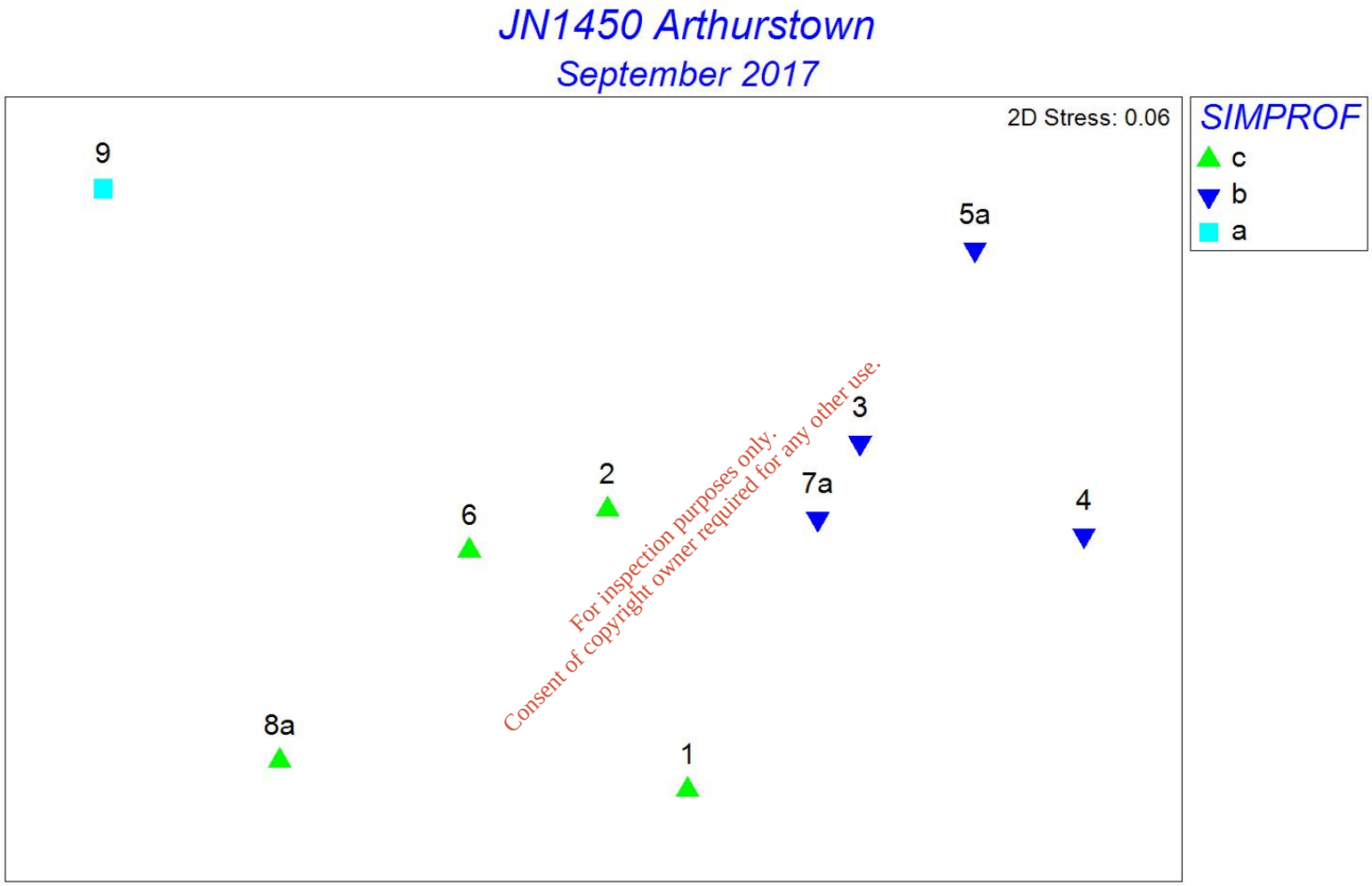

Figure 3.3: MDS plot.

Table 3.2: SIMPER Results

Group a Less than 2 samples in group					
Group b Average similarity: 49.07					
Species	**Av.Abund**	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**
Tubificoides benedii	2.5	4.49	5.61	9.14	9.14
Nephtys sp. (juv/damaged)	1.63	3.39	3.67	6.91	16.05
Nephtys hombergii	1.67	3.39	2.46	6.91	22.96
Austrominius modestus	2.04	3.39	3.76	6.9	29.86
Pygospio elegans	1.57	3.01	2.65	6.14	36
Tubificoides pseudogaster agg.	1.41	2.73	2.57	5.57	41.57
Corophium volutator	2.19	2.73	0.75	5.55	47.12
Cirratulidae (damaged)	2.2	2.57	4.26	5.25	52.37
Limecola balthica	1.14	2.51	3.61	5.12	57.49
Phyllodocidae (damaged)	1.2	2.49	4.61	5.07	62.55
Balanus crenatus	1.98	2.26	0.89	4.6	67.15
Nematoda	1.56	1.62	0.83	3.3	70.45
Polydora calcarea	1.11	1.52	0.9	3.1	73.55
Melita palmata	1.27	1.33	0.88	2.72	76.27
Mytilidae (juv)	1	1.28	0.82	2.61	78.88
Mya sp. (juv)	1.26	1.26	0.9	2.57	81.45
Cerastoderma edule	1.21	1.16	0.9	2.37	83.82
Carcinus maenas	1.01	1.08	0.91	2.19	86.01
Spirobranchus lamarcki	1.03	1.05	0.88	2.13	88.14
Tharyx killariensis	0.88	1.04	0.9	2.12	90.27
Group c Average similarity: 45.77					
Species	**Av.Abund**	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**
Corophium volutator	1.53	9.63	6.1	21.04	21.04
Nephtys hombergii	1.66	9.1	4.06	19.88	40.92
Nephtys sp. (juv/damaged)	1.3	7.53	5.99	16.45	57.37
Tubificoides benedii	2.07	5.14	0.83	11.24	68.61
Cerastoderma edule	1.02	3.88	0.9	8.47	77.08
Cirratulidae (damaged)	0.75	3.45	0.91	7.54	84.62
Limecola balthica	0.78	1.61	0.41	3.52	88.14
Cumopsis goodsir	0.5	1.2	0.41	2.62	90.76

Table 3.3: AMBI Results.

Station	I (%)	II (%)	III (%)	IV (%)	V (%)	Not Assigned (%)	AMBI	BI	Disturbance / Pollution Classification
1	3.4	19	10.3	0	67.2	0	4.443	4	Moderately disturbed
2	0.4	2.7	2.1	0.2	94.5	0	4.286	3	Moderately disturbed
3	1.7	26.1	56.8	4	11.4	6.9	3.318	3	Moderately disturbed
4	4.3	20.3	19.9	7.8	47.7	0.9	3.311	3	Moderately disturbed
5a	5.2	32.7	11.8	46.4	3.8	0.8	3	2	Slightly disturbed
6	0	64.2	30.2	1.9	3.8	1.9	2.219	2	Slightly disturbed
7a	0.3	14.5	79.7	0.5	4.9	1.6	2.88	2	Slightly disturbed
8a	20.5	15.4	61.5	2.6	0	2.5	3.142	2	Slightly disturbed
9	57.6	27.1	15.3	0	0	0	0.883	1	Undisturbed

3.1.2. Sediment

Table 3.4 shows the sediment characteristics of the faunal stations sampled at Arthurstown. Station 5a contained the highest percentage of fine gravel (7.6%), very fine gravel (8%) and very coarse sand (13%). Station 7a contained the highest percentage of coarse sand (9.7%). Station 6 contained the highest percentage of medium sand (10.6%). Station 8a contained the highest percentage of fine sand (68.3%). Station 2 had the highest percentage of very fine sand (60.1%) and station 4 had the highest percentage of silt-clay (48.6%). The sediment sampled was classified according to Folk (1954) as sand, muddy sand, slightly gravelly muddy sand, slightly gravelly sandy mud and gravelly muddy sand. Figure 3.4 shows the grain size distribution at each station. Figure 3.5 shows the sediment type according to Folk (1954).

Table 3.4: Sediment characteristics of the faunal stations sampled at Arthurstown.

Station	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)
1	0.9	1.4	4.3	6.0	5.3	9.5	42.4	30.3	Slightly gravelly muddy sand
2	0.0	0.3	0.9	1.3	1.8	8.4	60.1	27.2	Muddy sand
3	1.9	0.1	1.1	0.2	0.4	13.1	51.4	31.9	Slightly gravelly muddy sand
4	0.9	2.1	4.4	6.9	6.7	8.5	21.9	48.6	Slightly gravelly sandy mud
5a	7.6	8	13	9.2	6.3	8.3	25.9	21.8	Gravelly muddy sand
6	0	0.4	4.5	9.5	10.6	10.7	17.2	47.1	Muddy sand
7a	0	2.6	6.6	9.7	10.3	10.8	21.7	38.1	Slightly gravelly muddy sand
8a	0	0.1	0.2	0.4	7.2	68.3	23.5	0.3	Sand
9	0	0	0	0	0.4	55.6	42.9	1.1	Sand

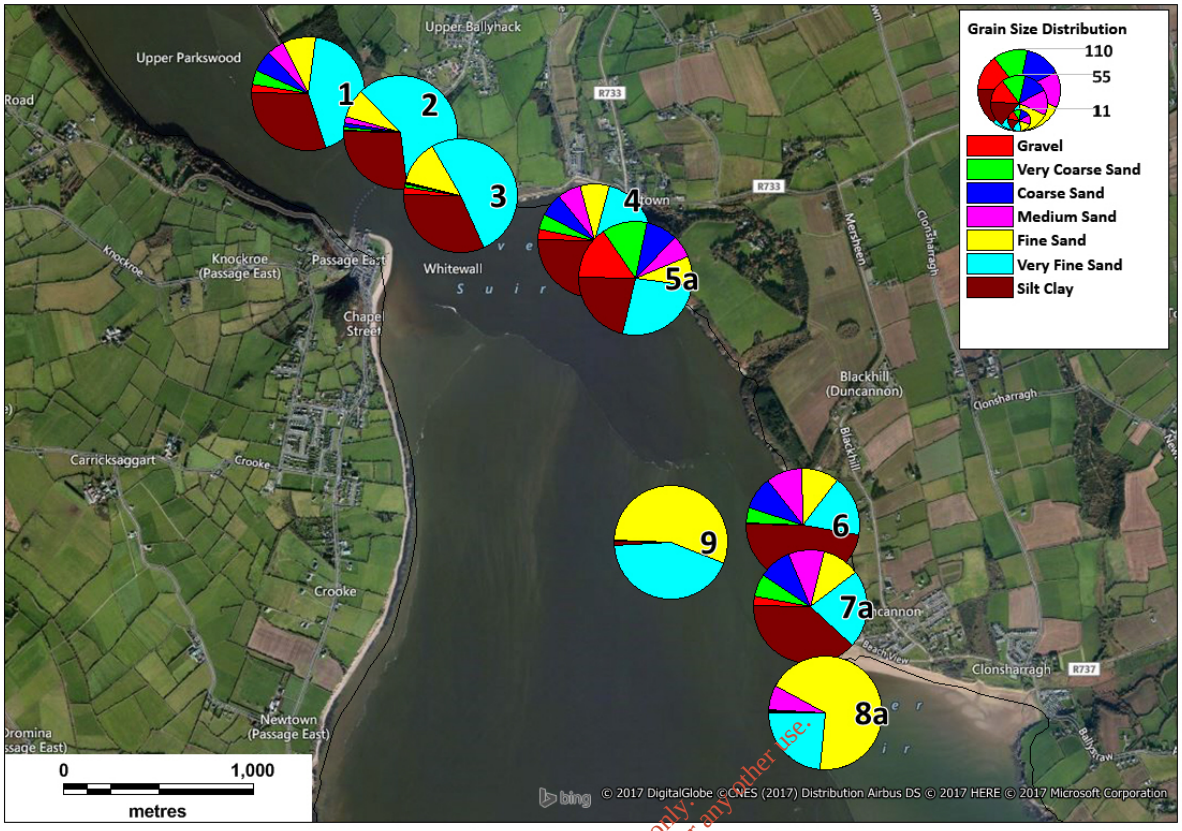

Figure 3.4: A breakdown of sediment type at each station at Arthurstown.

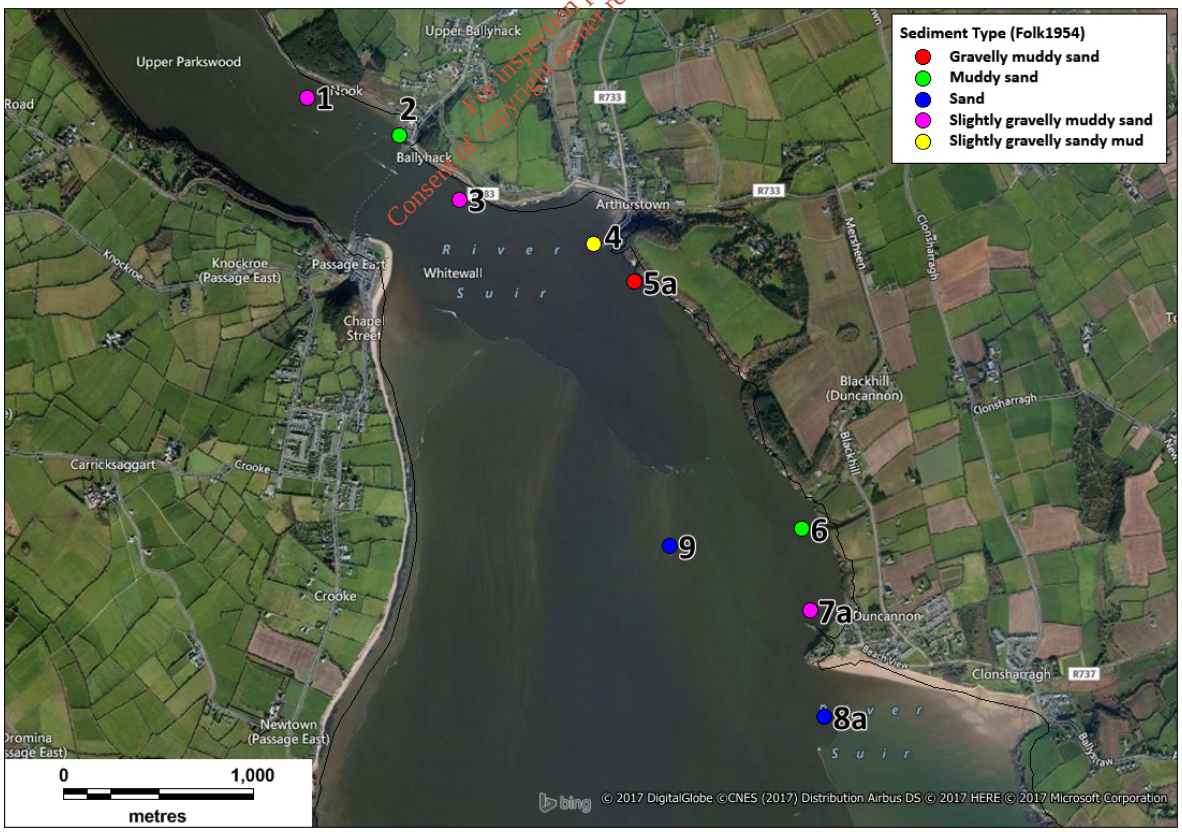

Figure 3.5: Sediment type according to Folk (1954) at Arthurstown.

4. Discussion

The stations sampled along this part of Waterford Estuary are located within the River Barrow and River Nore SAC (Site Code: IE002162). This site consists of the freshwater stretches of the Barrow and Nore River catchments as far upstream as the Slieve Bloom Mountains, and it also includes the tidal elements and estuary as far downstream as Creadaun Head in Waterford. The estuary and the other E.U. Habitats Directive Annex I habitats within it form a large component of the site. Extensive areas of intertidal flats, comprised of substrates ranging from fine, silty mud to coarse sand with pebbles/stones are present. Good quality intertidal sand and mudflats have developed on a linear shelf on the western side of Waterford Harbour, extending for over 6 km from north to south between Passage East and Creadaun Head, and in places are over 1 km wide. The sediments are mostly firm sands, though grade into muddy sands towards the upper shore. They have a typical macro-invertebrate fauna, characterised by polychaetes and bivalves.

The stations sampled during the present survey are located in the sand to muddy fine sand community complex as described by the NPWS but the majority of the stations were also located close to the muddy estuarine community complex and the faunal composition have elements of both community types. The faunal composition typically fall within the EUNIS classification ***Nephtys hombergii* and *Tubificoides* spp. in variable salinity infralittoral soft mud (A5.323).** This community type is typically found in variable salinity soft infralittoral mud and sandy mud characterised by the polychaete *Nephtys hombergii* and oligochaetes of the genus *Tubificoides*. Other characterising species that may be present are the polychaetes *Streblospio shrubsolii* and *Aphelochaeta marioni*, and the cumacean *Diastylis rathkei typica*.

Based on their faunal composition, the stations separate into 3 statistically different groups, the separation predominantly due to the acceptable level of organic enrichment recorded within the grouping. The Reference station (Station 9) formed a group of its own and contained faunal elements that are sensitive to organic enrichment and was classified as undisturbed. The other two groups contained species that are indifferent to or are tolerant to organic enrichment. AMBI scores indicated that the four stations furthest upstream (Stations 1, 2, 3 and 4), that include the outfall locations at Ballyhack and Arthurstown, were moderately disturbed while the four stations downstream of Arthurstown that included the three stations around Duncannon, were slightly disturbed.

Although the upper stations are classified as being moderately impacted there is no suggestion that the outfall at any of the locations are impacting on the benthos. On the day of the survey, there was no visible evidence of impact from any of the three outfalls (e.g. plumes, foul oudour etc.) and station groupings did not reflect distance from the outfall. It is probable that the recorded community is a reflection of the hydrographic conditions experienced at these stations. The four upstream stations are located in the relatively sheltered narrow part of the current study area while the other stations are located along the eastern shore south of Duncannon as the estuary expands into an open bay that is exposed to winds from the south and west resulting in a more dynamic environment.

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Appendix 1

Sediment Grain Size Methodology

Granulometry

1. Approximately 25g of dried sediment is weighed out and placed in a labelled 1L glass beaker to which 100 ml of a 6 percent hydrogen peroxide solution was then added. This was allowed to stand overnight in a fume hood.
2. The beaker is placed on a hot plate and heated gently. Small quantities of hydrogen peroxide are added to the beaker until there is no further reaction. This peroxide treatment removes any organic material from the sediment which can interfere with grain size determination.
3. The beaker is then emptied of sediment and rinsed into a. 63µm sieve. This is then washed with distilled water to remove any residual hydrogen peroxide. The sample retained on the sieve is then carefully washed back into the glass beaker up to a volume of approximately 250ml of distilled water.
4. 10ml of sodium hexametaphosphate solution is added to the beaker and this solution is stirred for ten minutes and then allowed to stand overnight. This treatment helps to dissociate the clay particles from one another.
5. The beaker with the sediment and sodium hexametaphosphate solution is washed and rinsed into a 63µm sieve. The retained sample is carefully washed from the sieve into a labelled aluminium tray and placed in an oven for drying at 100ºC for 24 hours.
6. When dry this sediment is sieved through a series of graduated sieves ranging from 4 mm down to 63µm for 10 minutes using an automated column shaker. The fraction of sediment retained in each of the different sized sieves is weighed and recorded.
7. The silt/clay fraction is determined by subtracting all weighed fractions from the initial starting weight of sediment as the less than 63µm fraction was lost during the various washing stages.

Appendix 2

Faunal Abundances

Station	AphiaID	1-A	1-B	1-C	1-D	1-E	2-A	2-B	2-C	2-D	2-E	3-A	3-B	3-C	3-D	3-E	4-A	4-B	4-C	4-D	4-E	5a-A	5a-B
CNIDARIA	1267																						
HYDROZOA	1337																						
LEPTOTHECATA	13552																						
Sertulariidae	1614																						
Hydrallmania falcata	117890			+																			
Sertularia argentea	117912		+																				
Dynamena pumila	117888														+								
ANTHOZOA	1292																						
ACTINIARIA	1360																						
Actiniaria (indet)	1360																						2
NEMATODA	799																						
Nematoda	799						1					15							66				
ANNELIDA	882																						
POLYCHAETA	883																						
PHYLLODOCIDA	892																						
Pholoidae	941																						
Pholoe inornata	130601																	2					
Sigalionidae	943																						
Sthenelais sp. (damaged)	129595																						1
Phyllodocidae	931																						
Phyllodocidae (damaged)	931											1							2				
Eteone longa agg.	130616																					1	4
Eumida bahusiensis	130641																	1					
Phyllodoce mucosa	334512														1								1
Glyceridae	952																						
Glycera sp. (damaged)	129296												2										
Glycera tridactyla	130130									1							1					3	4
Sphaerodoridae	957																						
Euritmia sp. (indet)	129599																						
Myrianida prolifera	238200																						
Nephtyidae	956																						
Nephtys sp. (juv/damaged)	129370	1	1						1			2	3	1			1			1	1	1	3

Station	AphiaID	1-A	1-B	1-C	1-D	1-E	2-A	2-B	2-C	2-D	2-E	3-A	3-B	3-C	3-D	3-E	4-A	4-B	4-C	4-D	4-E	5a-A	5a-B
Nephtys cirrosa	130357																						
Nephtys hombergii	130359		1	2	2	2	2	5		1	3	4	1	1						7	7		
ORBINIIDA	884																						
Orbiniidae	902																						
Orbinia sp.	129420																						
Scoloplos (Scoloplos) armiger	334772																					4	13
Paraonidae	903																						
Aricidea (Arcidea) minuta	730747																						
SPIONIDA	889																						
Spionidae	913																						
Polydora sp. (damaged)	129619											1											
Polydora calcarea	852065											4						5	12				
Pygospio elegans	131170											4			2		1						
Streblospio shrubsolii	131193																		2		1		
Magelonidae	914																						
Magelona filiformis	130268																						
CAPITELLIDA	890																						
Capitellidae	921																						
Capitella sp. complex	129211		1															1	12			5	
Mediomastus fragilis	129892											4											1
Arenicolidae	922																						
Arenicola marina	129868																						
TEREBELLIDA	900																						
Cirratulidae	919																						
Cirratulidae (damaged)	919									1		1					3	7	7			139	67
Tharyx killariensis	152269											1					1	1					3
Sabellariidae	979																						
Sabellaria alveolata	130866																	1					
Sabellaria spinulosa	130867																		2				1
Ampharetidae	981																						
Ampharete sp. (damaged)	129155											1											
Ampharete lindstroemi	129781																					2	1

Station	AphiaID	1-A	1-B	1-C	1-D	1-E	2-A	2-B	2-C	2-D	2-E	3-A	3-B	3-C	3-D	3-E	4-A	4-B	4-C	4-D	4-E	5a-A	5a-B
agg.																							
SABELLIDA	901																						
Serpulidae	988																						
Spirobranchus sp. (damaged)	129582																	1					
Spirobranchus lamarcki	560033	1																	20				
OLIGOCHAETA	2036																						
HAPLOTAXIDA	2118																						
Tubificidae	2040																						
Tubificoides pseudogaster agg.	137582		3			1			1			2						2	8		1	1	
Tubificoides benedii	137571	4	16	5	4	5	4	468	5	3	3	7	4	7			28	62	107			5	9
Tubificoides galiciensis	137576																						
ARTHROPODA	1065																						
CHELICERATA	1274																						
PYCNOGONIDA	1302																						
PANTOPODA	1358																						
Ammotheidae	1562																						
Achelia sp. (damaged)	134568											1											
CRUSTACEA	1066																						
CIRRIPEDIA	1082																						
SESSILIA	106033																						
Archaeobalanidae	106056																						
Austrominius modestus	712167											11							3			9	120
Balanidae	106057																						
Balanus balanus	106213											19						4			3		
Balanus crenatus	106215																6		24			2	97
AMPHIPODA	1135																						
Amphipoda (damaged)	1135																						
Oedicerotidae	101400																						
Perioculodes longimanus	102915																						
Urothoidae	101412																						
Urothoe brevicornis	103226																						
Pontoporeiidae	101406																						

Station	AphiaID	1-A	1-B	1-C	1-D	1-E	2-A	2-B	2-C	2-D	2-E	3-A	3-B	3-C	3-D	3-E	4-A	4-B	4-C	4-D	4-E	5a-A	5a-B
Bathyporeia sp. (damaged)	101742														1								
Bathyporeia elegans	103058								1						1								
Melitidae	101397																						
Melitidae (damaged)	101397																						
Melita palmata	102843				1					1							8	6	3			2	3
Isaeidae	101388																						
Microprotopus maculatus	102380																						
Corophiidae	101376																						
Corophiidae (damaged)	101376																	1		1			
Monocorophium acherusicum	225814																2		5				1
Corophium volutator	102101			3		1		2	1				20		26	25							2
ISOPODA	1131																						
Sphaeromatidae	118277																						
Lekanesphaera monodi	118956																		7				1
CUMACEA	1137																						
Bodotriidae	110378																						
Cumopsis goodsir	110465		1																				
DECAPODA	1130																						
Crangonidae	106782																						
Crangon crangon	107552		1																				
BRACHYURA	106673																						
Brachyura (juv)	106673																						
Carcinidae	557511																						
Carcinus maenas	107381											1					2	4	3				2
MOLLUSCA	51																						
BIVALVIA	105																						
Bivalvia sp. (damaged)	105																						
MYTILIDA	210																						
Mytilidae	211																						
Mytilidae (juv)	211											3		8									
CARDIIDA	869602																						
Cardiidae	229																						

Station	AphiaID	1-A	1-B	1-C	1-D	1-E	2-A	2-B	2-C	2-D	2-E	3-A	3-B	3-C	3-D	3-E	4-A	4-B	4-C	4-D	4-E	5a-A	5a-B
Cerastoderma edule	138998			1													4					5	10
Tellinidae	235																						
Macomangulus tenuis	878470																						
Fabulina fabula	146907																						
Limecola balthica	880017						2			2	3	1	1							1		1	1
Semelidae	1781																						
Scrobicularia plana	141424																			1			
VENERIDA	217																						
Veneridae	243																						
Veneridae (juv)	243																						1
MYIDA	245																						
Myidae	247																						
Mya sp. (juv)	138211							1				1	1					2	1		2	8	6
Hiatellidae	251																						
Hiatella arctica	140103																						1
BRYOZOA	146142																						
STENOLAEMATA	1794																						
CYCLOSTOMATIDA	110724																						
Crisiidae	110806																						
Crisidia cornuta	111706		+																				
Crisia eburnea	111696		+																				
GYMNOLAEMATA	1795																						
CTENOSTOMATIDA	110723																						
Vesiculariidae	110802																						
Amathia gracilis	851589														+								+
CHEILOSTOMATIDA	110722																						
Membraniporidae	110762																						
Conopeum reticulum	111351											+							+		+	+	+
ARTHROPODA	1065																						
INSECTA	1307																						
DIPTERA	118088																						
Chironomidae	118100																						
Chironomidae (larvae)	118100		1																				

Station	AphiaID	5a-C	5a-D	5a-E	6-A	6-B	6-C	6-D	6-E	7a-A	7a-B	7a-C	7a-D	7a-E	8a-A	8a-B	8a-C	8a-D	8a-E	9-A	W9-B	W9-C	W9-D	W9-E
CNIDARIA	1267																							
HYDROZOA	1337																							
LEPTOTHECATA	13552																							
Sertulariidae	1614																							
Hydrallmania falcata	117890																							
Sertularia argentea	117912																							
Dynamena pumila	117888																							
ANTHOZOA	1292																							
ACTINIARIA	1360																							
Actiniaria (indet)	1360	1	1																					
NEMATODA	799																							
Nematoda	799	1	3		1																			
ANNELIDA	882																							
POLYCHAETA	883																							
PHYLLODOCIDA	892																							
Pholoidae	941																							
Pholoe inornata	130601																							
Sigalionidae	943																							
Sthenelais sp. (damaged)	129595																							
Phyllodocidae	931																							
Phyllodocidae (damaged)	931		4									1	1											
Eteone longa agg.	130616	3																					1	
Eumida bahusiensis	130641																							
Phyllodoce mucosa	334512		1																					
Glyceridae	952																							
Glycera sp. (damaged)	129296																							
Glycera tridactyla	130130	3		3																				
Sphaerodoridae	957																							
Euritmia sp. (indet)	129599			1																				
Myrianida prolifera	238200	1																						
Nephtyidae	956																							
Nephtys sp.	129370	3		4	3	1	1	4	2	4	1	5		1		1		1			4	1	1	4

Station	AphiaID	5a-C	5a-D	5a-E	6-A	6-B	6-C	6-D	6-E	7a-A	7a-B	7a-C	7a-D	7a-E	8a-A	8a-B	8a-C	8a-D	8a-E	9-A	W9-B	W9-C	W9-D	W9-E
(juv/damaged)																								
Nephtys cirrosa	130357															2								
Nephtys hombergii	130359	2			4	3	4	7	5	1	3	4		8	1					1	1	2	1	
ORBINIIDA	884																							
Orbiniidae	902																							
Orbinia sp.	129420																						1	
Scoloplos (Scoloplos) armiger	334772	15		12			1				1	1		1							3	1	1	2
Paraonidae	903																							
Aricidea (Arcidea) minuta	730747																				1			
SPIONIDA	889																							
Spionidae	913																							
Polydora sp. (damaged)	129619																							
Polydora calcarea	852065											1												
Pygospio elegans	131170		5	4								15												
Streblospio shrubsolii	131193																							
Magelonidae	914																							
Magelona filiformis	130268																						1	
CAPITELLIDA	890																							
Capitellidae	921																							
Capitella sp. complex	129211	2	1	1																				
Mediomastus fragilis	129892																							
Arenicolidae	922																							
Arenicola marina	129868		1																					
TEREBELLIDA	900																							
Cirratulidae	919																							
Cirratulidae (damaged)	919	46	3	255			1				1						1							
Tharyx killariensis	152269																							
Sabellariidae	979																							
Sabellaria alveolata	130866																							
Sabellaria spinulosa	130867	2																						
Ampharetidae	981																							

Station	AphiaID	5a-C	5a-D	5a-E	6-A	6-B	6-C	6-D	6-E	7a-A	7a-B	7a-C	7a-D	7a-E	8a-A	8a-B	8a-C	8a-D	8a-E	9-A	W9-B	W9-C	W9-D	W9-E
Ampharete sp. (damaged)	129155											2												
Ampharete lindstroemi agg.	129781	4	2																					
SABELLIDA	901																							
Serpulidae	988																							
Spirobranchus sp. (damaged)	129582																							
Spirobranchus lamarcki	560033	1										1												
OLIGOCHAETA	2036																							
HAPLOTAXIDA	2118																							
Tubificidae	2040																							
Tubificoides pseudogaster agg.	137582											7												
Tubificoides benedii	137571	6		11	1	1				1	2	6		2										
Tubificoides galiciensis	137576			1																				
ARTHROPODA	1065																							
CHELICERATA	1274																							
PYCNOGONIDA	1302																							
PANTOPODA	1358																							
Ammotheidae	1562																							
Achelia sp. (damaged)	134568																							
CRUSTACEA	1066																							
CIRRIPEDIA	1082																							
SESSILIA	106033																							
Archaeobalanidae	106056																							
Austrominius modestus	712167	13										6												
Balanidae	106057																							
Balanus balanus	106213																							
Balanus crenatus	106215	23	17	13								19												
AMPHIPODA	1135																							
Amphipoda (damaged)	1135																	1						
Oedicerotidae	101400																							

Station	AphiaID	5a-C	5a-D	5a-E	6-A	6-B	6-C	6-D	6-E	7a-A	7a-B	7a-C	7a-D	7a-E	8a-A	8a-B	8a-C	8a-D	8a-E	9-A	W9-B	W9-C	W9-D	W9-E
Perioculodes longimanus	102915																						1	
Urothoidae	101412																							
Urothoe brevicornis	103226			1																				
Pontoporeiidae	101406																							
Bathyporeia sp. (damaged)	101742																							
Bathyporeia elegans	103058			18												3	1	4		3	7	10	4	4
Melitidae	101397																							
Melitidae (damaged)	101397		2																					
Melita palmata	102843	1	8	3								1												
Isaeidae	101388																							
Microprotopus maculatus	102380		1																					
Corophiidae	101376																							
Corophiidae (damaged)	101376																							
Monocorophium acherusicum	225814		10																					
Corophium volutator	102101	8		1	1	3		1	8	2	2	86	110	70			5	5						
ISOPODA	1131																							
Sphaeromatidae	118277																							
Lekanesphaera monodi	118956	3																						
CUMACEA	1137																							
Bodotriidae	110378																							
Cumopsis goodsir	110465			1											1									
DECAPODA	1130																							
Crangonidae	106782																							
Crangon crangon	107552																							
BRACHYURA	106673																							
Brachyura (juv)	106673	1																						
Carcinidae	557511																							
Carcinus maenas	107381			1													1							
MOLLUSCA	51																							
BIVALVIA	105																							

Station	AphiaID	5a-C	5a-D	5a-E	6-A	6-B	6-C	6-D	6-E	7a-A	7a-B	7a-C	7a-D	7a-E	8a-A	8a-B	8a-C	8a-D	8a-E	9-A	W9-B	W9-C	W9-D	W9-E
Bivalvia sp. (damaged)	105				1																			
MYTILIDA	210																							
Mytilidae	211																							
Mytilidae (juv)	211		1									2												
CARDIIDA	869602																							
Cardiidae	229																							
Cerastoderma edule	138998	11	1	7			1		1					1	5	2	3	3						
Tellinidae	235																							
Macomangulus tenuis	878470																						1	
Fabulina fabula	146907																				1		1	
Limecola balthica	880017				1	1	1	1	1			2								1				
Semelidae	1781																							
Scrobicularia plana	141424	1																						
VENERIDA	217																							
Veneridae	243																							
Veneridae (juv)	243	3	4																					
MYIDA	245																							
Myidae	247																							
Mya sp. (juv)	138211	16																						
Hiatellidae	251																							
Hiatella arctica	140103																							
BRYOZOA	146142																							
STENOLAEMATA	1794																							
CYCLOSTOMATIDA	110724																							
Crisiidae	110806																							
Crisidia cornuta	111706																							
Crisia eburnea	111696																							
GYMNOLAEMATA	1795																							
CTENOSTOMATIDA	110723																							
Vesiculariidae	110802																							
Amathia gracilis	851589									+		+												
CHEILOSTOMATIDA	110722																							
Membraniporidae	110762																							
Conopeum reticulum	111351	+								+		+												

Station	AphiaID	5a-C	5a-D	5a-E	6-A	6-B	6-C	6-D	6-E	7a-A	7a-B	7a-C	7a-D	7a-E	8a-A	8a-B	8a-C	8a-D	8a-E	9-A	W9-B	W9-C	W9-D	W9-E
ARTHROPODA	1065																							
INSECTA	1307																							
DIPTERA	118088																							
Chironomidae	118100																							
Chironomidae (larvae)	118100																							

Appendix 3

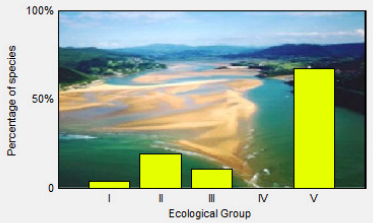
AMBI Results

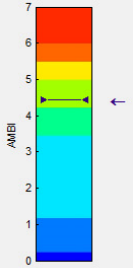
Station W1

(5 replicates)

AMBI	Biotic Index	Disturbance Classification
4.443	4	Moderately disturbed

Station Results





Soft-Bottom Benthos

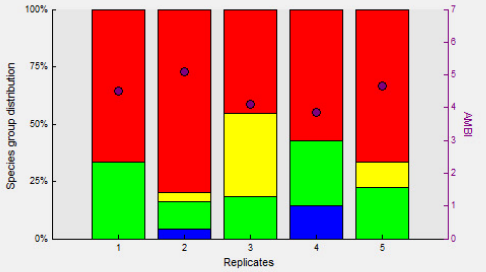
total station

Total Population :	58.0
Indexed Population :	58.0
% Not assigned :	0.0
Number of taxa :	12

Population	Taxa
2.0	Nephtys sp. (II)
7.0	Nephtys hombergii (II)
1.0	Capitella sp. (V)
1.0	Spirobranchus lamarcki (II)
4.0	Tubificoides pseudogaster (V)
34.0	Tubificoides benedii (V)
1.0	Melita palmata (I)
4.0	Corophium volutator (III)
1.0	Cumopsis goodsir (II)
1.0	Crangon crangon (I)
1.0	Cerastoderma edule (III)
1.0	CHIRONOMIDAE (III)

Replicate Details

Rep.	%I	%II	%III	%IV	%V	AMBI	BI	Disturbance Classification
1	0.0	33.3	0.0	0.0	66.7	4.500	4	Moderately disturbed
2	4.0	12.0	4.0	0.0	80.0	5.100	5	Heavily disturbed
3	0.0	18.2	36.4	0.0	45.5	4.091	3	Moderately disturbed
4	14.3	28.6	0.0	0.0	57.1	3.857	3	Moderately disturbed
5	0.0	22.2	11.1	0.0	66.7	4.667	4	Moderately disturbed



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Stations

I II III IV V

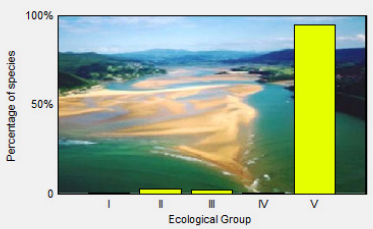
Ecological groups

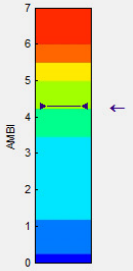
Station W2

(5 replicates)

AMBI	Biotic Index	Disturbance Classification
4.286	3	Moderately disturbed

Station Results





Soft-Bottom Benthos

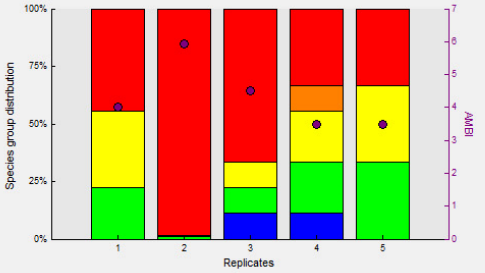
total station

Total Population :	512.0
Indexed Population :	512.0
% Not assigned :	0.0
Number of taxa :	12

Population	Taxa
1.0	NEMATODA (III)
1.0	Glycera tridactyla (II)
1.0	Nephtys sp. (II)
11.0	Nephtys hombergii (II)
1.0	CIRRATULIDAE (IV)
1.0	Tubificoides pseudogaster (V)
483.0	Tubificoides benedii (V)
1.0	Bathyporeia elegans (I)
1.0	Melita palmata (I)
3.0	Corophium volutator (III)
7.0	Limecola balthica (III)
1.0	Mya sp. (II)

Replicate Details

Rep.	%I	%II	%III	%IV	%V	AMBI	BI	Disturbance Classification
1	0.0	22.2	33.3	0.0	44.4	4.000	3	Moderately disturbed
2	0.0	1.3	0.4	0.0	98.3	5.931	6	Heavily disturbed
3	11.1	11.1	11.1	0.0	66.7	4.500	4	Moderately disturbed
4	11.1	22.2	22.2	11.1	33.3	3.500	3	Moderately disturbed
5	0.0	33.3	33.3	0.0	33.3	3.500	3	Moderately disturbed



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Stations

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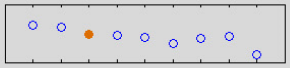
Ecological groups

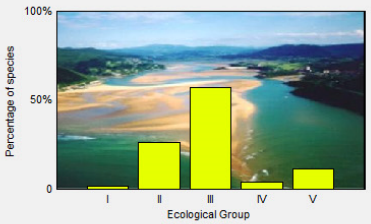
Station W3

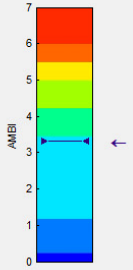
(5 replicates)



AMBI	Biotic Index	Disturbance Classification
3.318	3	Moderately disturbed

Station Results





Soft-Bottom Benthos

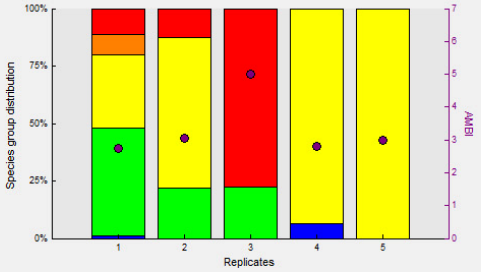
total station

Total Population :	189.0
Indexed Population :	176.0
% Not assigned :	6.9
Number of taxa :	25

Population	Taxa
15.0	NEMATODA (III)
1.0	Phyllodocidae (damaged) (Not assigned)
1.0	Phyllodoce mucosa (III)
2.0	Glycera sp. (II)
6.0	Nephtys sp. (II)
6.0	Nephtys hombergii (II)
1.0	Polydora sp. (IV)
4.0	Polydora ciliata (IV)
6.0	Pygospio elegans (III)
4.0	Mediomastus fragilis (III)
1.0	CIRRATULIDAE (IV)
1.0	Tharyx killariensis (IV)
1.0	Ampharete sp. (damaged) (Not assigned)
2.0	Tubificoides pseudogaster (V)

Replicate Details

Rep.	%I	%II	%III	%IV	%V	AMBI	BI	Disturbance Classification
1	1.3	46.8	31.6	8.9	11.4	2.734	2	Slightly disturbed
2	0.0	21.9	65.6	0.0	12.5	3.047	2	Slightly disturbed
3	0.0	22.2	0.0	0.0	77.8	5.000	4	Moderately disturbed
4	6.5	0.0	93.5	0.0	0.0	2.806	2	Slightly disturbed
5	0.0	0.0	100.0	0.0	0.0	3.000	2	Slightly disturbed



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Stations

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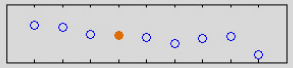
Ecological groups

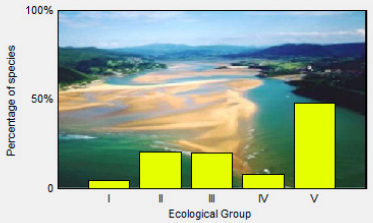
Station W4

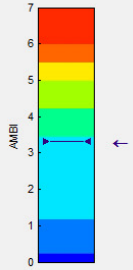
(5 replicates)



AMBI	Biotic Index	Disturbance Classification
3.311	3	Moderately disturbed

Station Results





Soft-Bottom Benthos

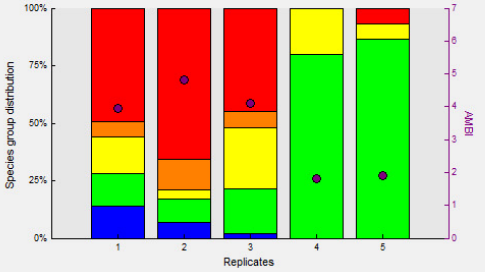
total station

Total Population :	467.0
Indexed Population :	463.0
% Not assigned :	0.9
Number of taxa :	31

Population	Taxa
66.0	NEMATODA (III)
2.0	Pholoe inornata (II)
2.0	Phyllodocidae (damaged) (Not assigned)
1.0	Eumida bahusiensis (II)
1.0	Glycera tridactyla (II)
3.0	Nephtys sp. (II)
14.0	Nephtys hombergii (II)
17.0	Polydora ciliata (IV)
1.0	Pygospio elegans (III)
3.0	Streblospio shrubsolii (III)
13.0	Capitella sp. (V)
17.0	CIRRATULIDAE (IV)
2.0	Tharyx killariensis (IV)
1.0	Sabellaria alveolata (I)

Replicate Details

Rep.	%I	%II	%III	%IV	%V	AMBI	BI	Disturbance Classification
1	14.0	14.0	15.8	7.0	49.1	3.947	3	Moderately disturbed
2	7.1	10.1	4.0	13.1	65.7	4.803	4	Moderately disturbed
3	1.8	19.5	27.0	6.7	45.0	4.106	3	Moderately disturbed
4	0.0	80.0	20.0	0.0	0.0	1.800	2	Slightly disturbed
5	0.0	86.7	6.7	0.0	6.7	1.900	2	Slightly disturbed



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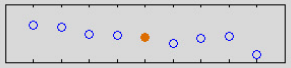
Stations

I II III IV V

Ecological groups

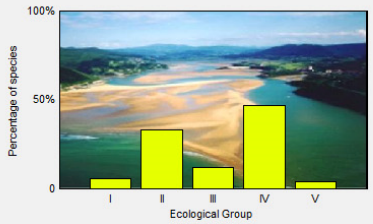
Station W5

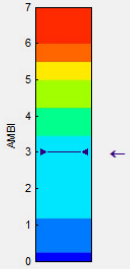
(5 replicates)



AMBI	Biotic Index	Disturbance Classification
3.000	2	Slightly disturbed

Station Results





Soft-Bottom Benthos

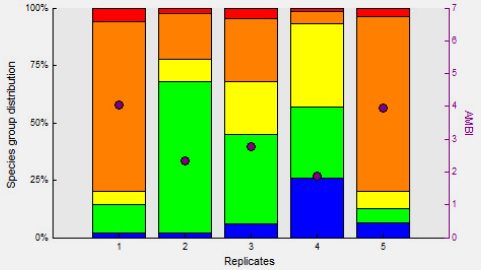
total station

Total Population :	1115.0
Indexed Population :	1106.0
% Not assigned :	0.8
Number of taxa :	44

Population	Taxa
4.0	ACTINIARIA (II)
4.0	NEMATODA (III)
1.0	Sthenelais sp. (II)
4.0	Phyllodocidae (damaged) (Not assigned)
8.0	Eteone longa (III)
2.0	Phyllodoce mucosa (III)
13.0	Glycera tridactyla (II)
1.0	Euritmia sp. (indet) (Not assigned)
1.0	Myrianida prolifera (II)
11.0	Nephtys sp. (II)
2.0	Nephtys hombergii (II)
44.0	Scoloplos armiger (III)
9.0	Pygospio elegans (III)
9.0	Capitella sp. (V)

Replicate Details

Rep.	%I	%II	%III	%IV	%V	AMBI	BI	Disturbance Classification
1	2.1	12.2	5.9	73.9	5.9	4.037	3	Moderately disturbed
2	2.0	65.9	9.9	19.7	2.5	2.324	2	Slightly disturbed
3	5.9	39.1	23.1	27.2	4.7	2.787	2	Slightly disturbed
4	25.9	31.0	36.2	5.2	1.7	1.888	2	Slightly disturbed
5	6.5	6.3	7.4	75.9	3.9	3.964	3	Moderately disturbed



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Stations

I II III IV V

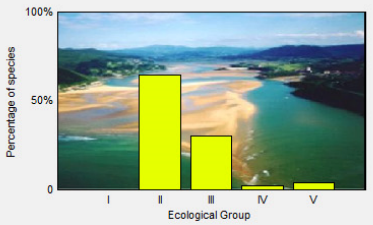
Ecological groups

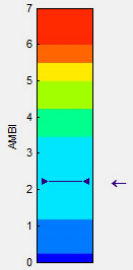
Station W6

(5 replicates)

AMBI	Biotic Index	Disturbance Classification
2.219	2	Slightly disturbed

Station Results





Soft-Bottom Benthos

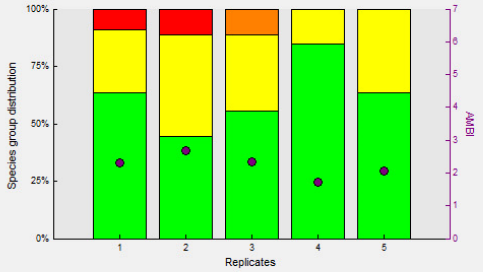
total station

Total Population :	54.0
Indexed Population :	53.0
% Not assigned :	1.9
Number of taxa :	10

Population	Taxa
1.0	NEMATODA (III)
11.0	Nephtys sp. (II)
23.0	Nephtys hombergii (II)
1.0	Scoloplos armiger (III)
1.0	CIRRATULIDAE (IV)
2.0	Tubificoides benedii (V)
7.0	Corophium volutator (III)
1.0	Bivalvia sp. (damaged) (Not assigned)
2.0	Cerastoderma edule (III)
5.0	Limecola balthica (III)

Replicate Details

Rep.	%I	%II	%III	%IV	%V	AMBI	BI	Disturbance Classification
1	0.0	63.6	27.3	0.0	9.1	2.318	2	Slightly disturbed
2	0.0	44.4	44.4	0.0	11.1	2.667	2	Slightly disturbed
3	0.0	55.6	33.3	11.1	0.0	2.333	2	Slightly disturbed
4	0.0	84.6	15.4	0.0	0.0	1.731	2	Slightly disturbed
5	0.0	63.6	36.4	0.0	0.0	2.045	2	Slightly disturbed



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Stations

I II III IV V

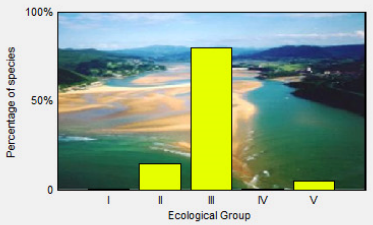
Ecological groups

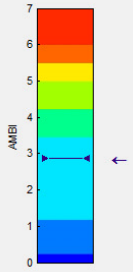
Station W7

(5 replicates)

AMBI	Biotic Index	Disturbance Classification
2.880	2	Slightly disturbed

Station Results





Soft-Bottom Benthos

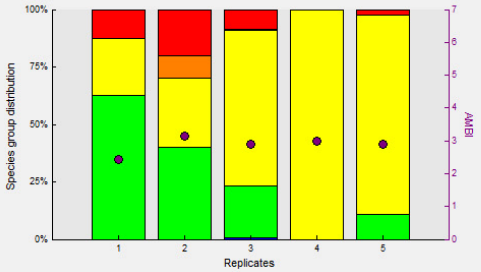
total station

Total Population :	371.0
Indexed Population :	365.0
% Not assigned :	1.6
Number of taxa :	18

Population	Taxa
2.0	Phyllodocidae (damaged) (Not assigned)
11.0	Nephtys sp. (II)
16.0	Nephtys hombergii (II)
3.0	Scoloplos armiger (III)
1.0	Polydora ciliata (IV)
15.0	Pygospio elegans (III)
1.0	CIRRATULIDAE (IV)
2.0	Ampharete sp. (damaged) (Not assigned)
1.0	Spirobranchus lamarcki (II)
7.0	Tubificoides pseudogaster (V)
11.0	Tubificoides benedii (V)
6.0	Austrominius modestus (II)
19.0	Balanus trigonus (II)
1.0	Melita palmata (I)

Replicate Details

Rep.	%I	%II	%III	%IV	%V	AMBI	BI	Disturbance Classification
1	0.0	62.5	25.0	0.0	12.5	2.438	2	Slightly disturbed
2	0.0	40.0	30.0	10.0	20.0	3.150	2	Slightly disturbed
3	0.6	22.7	67.5	0.6	8.4	2.903	2	Slightly disturbed
4	0.0	0.0	100.0	0.0	0.0	3.000	2	Slightly disturbed
5	0.0	10.8	86.7	0.0	2.4	2.910	2	Slightly disturbed



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Stations

I II III IV V

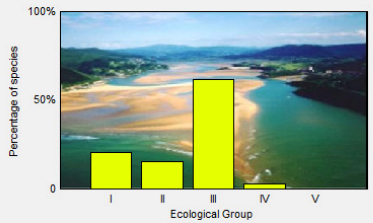
Ecological groups

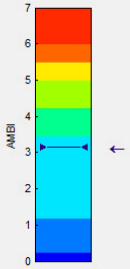
Station W8

(5 replicates)

AMBI	Biotic Index	Disturbance Classification
3.142	2	Slightly disturbed

Station Results





Soft-Bottom Benthos

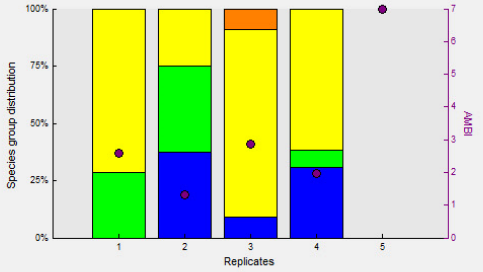
total station

Total Population :	40.0
Indexed Population :	39.0
% Not assigned :	2.5
Number of taxa :	10

Population	Taxa
2.0	Nephtys sp. (II)
2.0	Nephtys cirrosa (II)
1.0	Nephtys hombergii (II)
1.0	CIRRATULIDAE (IV)
1.0	Amphipoda (damaged) (Not assigned)
8.0	Bathyporeia elegans (I)
10.0	Corophium volutator (III)
1.0	Cumopsis goodsir (II)
1.0	Carcinus maenas (III)
13.0	Cerastoderma edule (III)

Replicate Details

Rep.	%I	%II	%III	%IV	%V	AMBI	BI	Disturbance Classification
1	0.0	28.6	71.4	0.0	0.0	2.571	2	Slightly disturbed
2	37.5	37.5	25.0	0.0	0.0	1.313	2	Slightly disturbed
3	9.1	0.0	81.8	9.1	0.0	2.864	2	Slightly disturbed
4	30.8	7.7	61.5	0.0	0.0	1.962	2	Slightly disturbed
5	0.0	0.0	0.0	0.0	0.0	7.000	7	Extremely disturbed



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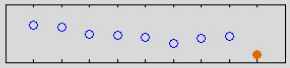
Stations

Ecological groups

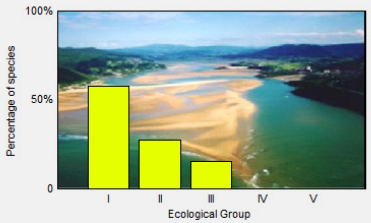
Station W9

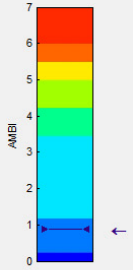
(5 replicates)



AMBI	Biotic Index	Disturbance Classification
0.883	1	Undisturbed

Station Results





Soft-Bottom Benthos

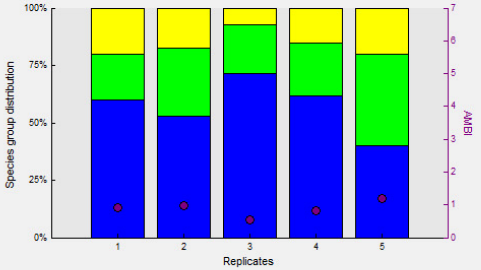
total station

Total Population :	59.0
Indexed Population :	59.0
% Not assigned :	0.0
Number of taxa :	12

Population	Taxa
1.0	Eteone longa (III)
10.0	Nephtys sp. (II)
5.0	Nephtys hombergii (II)
1.0	Orbinia sp. (I)
7.0	Scoloplos armiger (III)
1.0	Aricidea minuta (I)
1.0	Magelona filiformis (I)
1.0	Perioculodes longimanus (II)
28.0	Bathyporeia elegans (I)
1.0	Macomangulus tenuis (I)
2.0	Fabulina fabula (I)
1.0	Limecola balthica (III)

Replicate Details

Rep.	%I	%II	%III	%IV	%V	AMBI	BI	Disturbance Classification
1	60.0	20.0	20.0	0.0	0.0	0.900	1	Undisturbed
2	52.9	29.4	17.6	0.0	0.0	0.971	1	Undisturbed
3	71.4	21.4	7.1	0.0	0.0	0.536	1	Undisturbed
4	61.5	23.1	15.4	0.0	0.0	0.808	1	Undisturbed
5	40.0	40.0	20.0	0.0	0.0	1.200	1	Undisturbed



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