Irish Water

Arklow Waste Water Treatment Plant - Site Investigation

Supporting Information for Foreshore License Application - Marine Based Site Investigation

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1 Introduction

This information supports a foreshore licence application for marine site investigation works in Arklow bay and the estuary of the Avoca River. The works are required for the design and construction of a proposed outfall, 900m long, in the bay and an intake pipe crossing the Avoca River. The intake and outfall are to form part of the construction of a new waste water treatment plant on the site of an old gypsum factory.

It is intended to undertake archaeological, ecological and geotechnical marine site investigation to support the above works.

The site investigation can be broken down as follows:

1) Archaeological Surveys
   - Side scan sonar (captures the surface of the seabed)
   - Sub Bottom Sonar (gathers data on the upper layers of seabed)
2) Archaeological Dive Survey
   - Of the River Avoca Quay Walls
3) Ecological Survey
   - 13 Benthic stations, 3 in estuary
4) Geotechnical Investigation
   - Geophysical survey using seismic reflection and refraction
   - 10 cable percussion boreholes followed by rotary core drilling (GBRS)

1.1 Location of Marine Site Investigation Works

The locations and extent of the proposed marine site investigation works is shown in drawing number 247825-00-G001.

The coordinates (ITM) of the extent of area of the proposed marine site investigation works are summarised in Table 1 below.

Table 1: Coordinates of extent of marine SI works (ITM)

Easting (ITM)	Northing (ITM)
325348	173260
325428	173039
32670	173350

1.2 Indicative Timing of Works

It is envisaged that the archaeological geophysical survey, archaeological dive survey, ecological survey, geotechnical geophysics survey and geotechnical intrusive marine site investigation works will be tendered as separate packages. A start date between May and September of this year is anticipated, subject to the approval of the Foreshore License application, appointment of a suitable contractor and suitable weather conditions. In order to allow for unforeseen delays, we seek approval of a Foreshore Licence for the period until **31 December 2016**.

1.2.1 Duration of Works

Mobilisation of appropriate plant and equipment for marine site investigation works can be timely.

We envisage a period of approximately 8 to 12 weeks for mobilisation of the equipment following appointment of a suitable contractor for each package tendered. We anticipate the following duration for site works for the marine site investigation works and geophysical surveys:

Archaeological geophysical surveys

There is approximately 20 hectares of seabed to be surveyed for this project.

Archaeological Dive Survey.

Approximately 1400m of quay wall and 3.12 ha of seabed are to be inspected in the dive survey. The duration of this survey will be subject to suitable weather, tidal and river conditions.

Ecological survey

There are 13 benthic sampling station proposed. Two grab samples are to be taken at each location, one for sediment sampling and one for invertebrate fauna. These will be taken in conjunction with the borehole installation.

Geotechnical geophysical survey

There is approximately 20 hectares of seabed to be surveyed for this project. This survey will be carried out before the installation of boreholes commences and shall be used to advise the final location of the boreholes.

Geotechnical Intrusive Marine Site Investigation

10 no. boreholes will be required for the geotechnical marine site investigation. Indicative locations are shown in drawing number 247825-00-G001. However, these may vary depending on the results of the geophysical survey. Borehole installation is expected to take 6 to 8 weeks in total, subject to suitable weather conditions.

As some of the works are expected to be run concurrently, it is anticipated that the total duration of the works shall be 8 to 10 weeks, subject to weather conditions.

2 Description of Proposed Works

The works proposed are as follows:

2.1 Archaeological Surveys

2.1.1 Specification of Fieldwork

The survey specification must conform to the DAHG's recommendations for marine geophysical survey for archaeological purposes. In addition, the archaeological marine geophysical survey should be carried out across the project area at a spacing of no less than 20m line spacing E/W + 100m line-spacing N/S.

The specific survey techniques required are:

- Bathymetry
- Side-scan sonar
- Marine Magnetometry
- Sub-Bottom Profiling

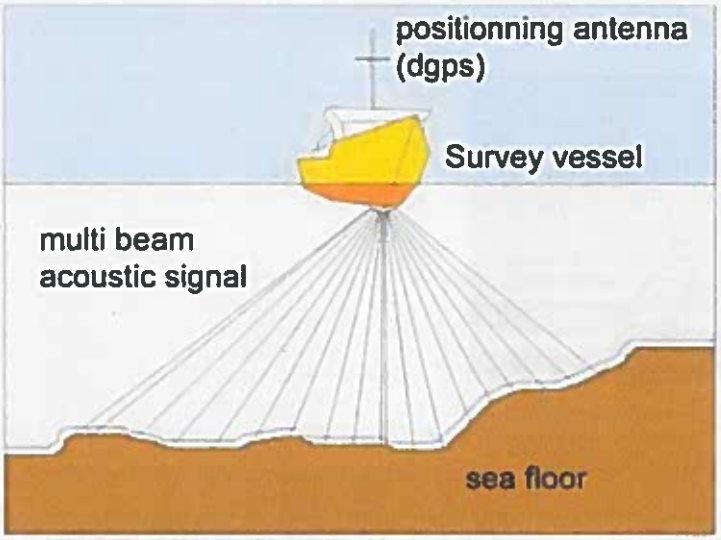
These surveys will be carried out for the 20 hectare area shown in drawing number 247825-00-G001. A typical survey vessel is shown in Figure 1. The survey vessel will manoeuvre to obtain full coverage of the survey area. The appointed vessel will mobilise and de-mobilise on a daily basis to/from Dublin Port. This will be dependent on berth availability.

Figure 1: Typical Survey Boat - Typical dimensions 10 m to 12 m length

2.1.2 Bathymetry

An echosounder or similar will be used to provide a contour map of the seabed. A typical equipment set-up diagram is show in Figure 2.

Figure 2: Typical Equipment Set-up for a bathymetric survey



2.1.3 Side Scan Sonar:

Side scan sonar is used to locate and identify potential sonic "anomalies" within the seabed. These may be natural, such as a rock outcrop, or man-made, such as a shipwreck.

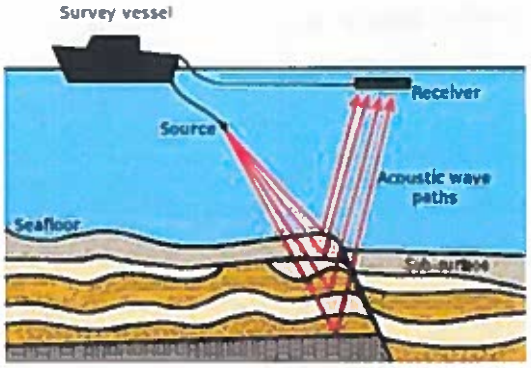
The survey is carried out using a sonar device attached to a vessel that emits fan-shaped pulses down toward the seafloor across a wide angle perpendicular to the path of the sensor through the water. The intensity of the acoustic reflections from the seafloor of this fan-shaped beam is recorded in a series of cross-track slices. When stitched together along the direction of motion, these slices form an image of the sea bottom within the swath (coverage width) of the beam.

2.1.4 Marine Magnetometry

Marine magnetometry is used to locate and identify ferrous objects on or buried in the seabed within the range of the magnometer. This device precisely measures the earth's magnetic field and detects any anomalies, which represent ferrous objects such as lost anchors, sunken ships and buried pipes.

The typical equipment set-up for this survey type is shown in Figure 3

Figure 3: Typical equipment set-up for magnetometer and side scan sonar survey



2.1.5 Sub-bottom Profiler:

A sub bottom profiler survey will provide vertical profiles of the upper layers of the seabed along selected survey lines. It gives an indication of possible ground conditions and buried objects below seabed level for an approximate depth of up to 10m.

It uses powerful low frequency echo-sounders to provide profiles of the upper layers of the ocean bottom. These systems are particularly useful for the detection of palaeo-landscapes and channels.

2.2 Archaeological Dive Survey

An underwater archaeological survey of the River Avoca Quay Walls and potential siphon crossing points is proposed. The location of this is shown in drawing number 247825-00-G001.

The approximate coordinates for the dive survey area are

Table 2: Dive Survey Area Coordinates

Description	Easting	Northing
Area Outline 1	324694.5	173473.43
Area Outline 2	324797.5	173580.93
Area Outline 3	325226.52	173064.61
Area Outline 4	325179.91	172998.81

2.3 Ecological Survey – Benthic Sampling

Following the completion of the desktop study and scoping report, a detailed field survey will be carried out to gather up-to-date ecological data on the study area to augment the data collected as part of the desk study. Where recent surveys have stations within the study area this information will be used to assess the current status of the benthos in that area. It is estimated that 13 benthic stations will be examined for fauna and sediment (3 within the estuary and 10 outside).

One grab will be taken to collect data on the invertebrate fauna and a second to obtain a sample for sediment analysis using a Van Veen type grab sampler or similar.

Grab samples are similar to grab buckets on land and tend to be either hydraulically or manually operated. These would be deployed from the platform set up for site investigation (See Section 2.4.3) via on-board cranes.

There are many different types of tools used to recover samples, the method used will depend on water depth, currents and sample size required. Typical tools include a Van Veen type grab sampler, shown in Figure 4.

The macroinvertebrate samples will be sieved on-board the survey vessel (MV Sharpshooter) using a seawater hose and a 1 mm sieve, with the residue placed in labelled container, fixed with formalin and transported back to the laboratory for processing.

Figure 4: Van veen grab sampler

Small Van Veen - 36 x 28cm

Large Van Veen - 70 x 36cm.

The preliminary locations of the proposed benthic sampling points are listed in Table 1 below and shown in drawing number 247825-00-G001.

Table 3: Benthic Sampling Points

Station	X	Y	Description
1	326304	173350	Outfall
2	326297	173101	250 m S
3	325889	173271	400 m W
4	326549	173347	250 m E
5	326359	173589	250 m NE
6	326227	172548	800 m S
7	326578	174097	800 m NE
8	327071	173344	800 m E
9	326248	171313	2000 m S
10	327101	175168	2000 m N

Station	X	Y	Description
11	325182	173046	Lower estuary
12	325044	173201	Mid estuary
13	324870	173400	Upper estuary

2.4 Geotechnical Investigations

2.4.1 Offshore Geophysical Survey

The objectives of the proposed survey are to map the type and thickness of the sediment layers, determine sediment stiffness, map the depth to bedrock, map variation in bedrock type and rock quality and determine engineering parameters across the study area shown in drawing number 247825-00-G001.

These works will involve a number of different geophysical methods, including seismic reflection and refraction methods. The equipment used will be similar to that discussed in Section 2.1 above.

The findings of the geophysical survey will influence the final location of the offshore ground investigation locations.

2.4.2 Geotechnical Testing and Sampling

The marine ground investigation works will extend across the study area of the proposed marine outfall, as shown in Figure 1. The provisional locations of the 10 proposed boreholes are included in this image. The marine ground investigation will comprise of the collection of sediment and bedrock cores. These works will provide a greater understanding of the benthic (sea floor, the sediment surface and sub-surface layers) and bedrock character along the proposed outfall route. Cable percussion boreholes will be also carried out in the area followed by rotary core drilling at the same location to obtain samples of the firm to hard cohesive sediments and bedrock cores.

Further investigations are also anticipated in the river estuary, with the relevant area show in drawing number 247825-00-G001. These investigations will be carried out to look at possible crossing points for the siphon.

The anticipated locations of the boreholes required are shown in Table 4. Note that these may change depending on the results of the geophysical surveys.

Table 4: Marine site investigation boreholes required – Provisional Locations

Number	Location	Borehole Depth	X	Y
BH01	Estuary	25m	325105.66	173068.66
BH02	Estuary	25m	325149.15	173094.89
BH03	Arklow Bay	25m	325371.96	173274.93
BH04	Arklow Bay	25m	325415.72	173160.03
BH05	Arklow Bay	25m	325453.41	173054.39

Number	Location	Borehole Depth	X	Y
BH06	Arklow Bay	25m	325636.81	173289.43
BH07	Arklow Bay	25m	325665.67	173126.62
BH08	Arklow Bay	25m	325842.93	173264.04
BH09	Arklow Bay	25m	326059.27	173303.67
BH10	Arklow Bay	25m	326270	173350

2.4.3 Proposed Equipment and Methodology

It is envisages that the installation of boreholes will be carried out from equipment mounted on a stable platform, for example a jack-up barge, floating pontoon or similar.

Jack Up Barge

The jack-up barge is a type of mobile platform that consists of a buoyant hull fitted with a number of spud legs, capable of raising its hull using a hydraulic jacking system. The barge will be fully equipped with all specialist plant and tools required for the site investigation. Figure 5 illustrates a typical jack-up barge being used for similar marine geotechnical investigation.

The jack-up barge is manoeuvred from one location to the next by way of a dedicated tug boat. Once on location the platform level is raised to the required elevation above the sea surface, its legs supported by the seabed, before testing and sampling can begin. The barge then remains in location for the duration of that borehole installation.

Figure 5: Jack-up barge

Floating Pontoon

The floating pontoon is normally constructed of individual elements making it modular in design. It can be assembled with a moon pool configuration allowing for a cable percussive rig to be set up in the centre of the pontoon. The pontoon will be fully equipped with all specialist plant and tools required for the site investigation. Figure 6 illustrates a typical floating pontoon being used for marine geotechnical investigation.

The pontoon is manoeuvred from one location to the next by way of a dedicated tug boat. Once on location, the pontoon is fixed in place by the deployment of anchors or spuds. For locations closer to the quay side, the pontoon may be moored to the quay wall, whichever arrangement is more suitable, before the soil investigation works can begin

Figure 6: Floating Pontoon

It is likely that the platform used will be mobilise and de-mobilise to/from Arklow Harbour. Personnel will transfer to and from the platform via a dedicated transfer boat.

Sampling will be performed by use of a cable percussive rig for the surface soil samples, and a rotary coring rig when rock is encountered.

When using the cable percussive rig, disturbed and undisturbed sample recovery is obtained by means of either self-weight or mechanical penetration of cutting tools and hollow tubes into the ground and withdrawing the resulting core.

Rotary coring to obtain samples is by way of wire-line, double-tube or triple-tube core barrels. Depending on the set up, the outer core barrel rotates and the core is obtained within the inner barrel and brought up the surface for removal.

When bedrock is encountered, the cable percussive rig will be replaced with a rotary coring rig to recover rock cores for testing.

All marine plant will be fit for purpose and certified where required and navigation aid lightning will be used on all vessels and plant. The geotechnical investigation works will be coordinated around shipping activities. An exclusion zone will be allocated around the jack-up barge or floating pontoon to demarcate working areas. Navigation is to be undertaken with clearance of Arklow Harbour Authorities and appropriate notices to mariners will be issued to inform the locations of the investigation works.