Cork City Council

Cork Docklands North and South Quays Maritime Usage Licence Application Attachment 3.1 Description of the proposed Maritime Usage

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AQUAFACT REF: P20039

2026

COMMERCIAL IN CONFIDENCE

AQUAFACT
APEM Group

Client:	**Cork City Council**
Address:	**City Hall, 1-2 Angleasea Street, Cork T21T997**
Reference no:	**P20039**
Date of issue:	**30/07/2026**
Version Number:	**Final**

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Tax Reference Number:	9773384O
Tax Clearance Number:	559674

Report Approval Sheet

Client	Cork City Council
Report Title	Cork Docklands North and South Quays Maritime Usage Licence Application Attachment 3.1 Description of the proposed Maritime Usage
Job Number	P20039
Report Status	Final
Issue Date	30/07/2026
Report Type	MUL – Description of the proposed maritime usage

Rev	Status	Issue Date	File Name	Author(s)	Approved By
1	Draft	27/07/2026	Attachment 3.1 Description of the proposed Maritime Usage_CDSNQ_v1	NMC, BD	AL
2	Final	30/07/2026	Attachment 3.1 Description of the proposed Maritime Usage_CDSNQ_final	NMC, BD	AL

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List of Acronyms/ Glossary

ABBREVIATION	DESCRIPTION
AA	Appropriate Assessment
AOI	Area of Interest
BIM	Building Information Modelling
BRE	Building Research Establishment
BS	British Standard
CCIC	Cork City Council
CCW	Countryside Council for Wales
CWMF	Capital Works Management Framework
DAS	Dumping at Sea
DGPS	Differential Global Positioning System
EDM	Electronic Distance Measurement
EIAR	Environmental Impact Assessment Report
EPSG	European Petroleum Survey Group
EUNIS	European Nature Information System
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HRA	Habitats Regulations Assessment
HWM	High Water Mark
HWL	High Water Level
IHO	International Hydrographic Organization
ITM	Irish Transverse Mercator
JNCC	Joint Nature Conservation Committee
LED	Light Emitting Diode
LIDAR	Light Detection and Ranging
LOI	Loss on Ignition

ABBREVIATION	DESCRIPTION
MARA	Maritime Area Regulatory Authority
MBES	Multibeam Echo Sounder
MM	Mott MacDonald
MLWS	Mean Low Water Spring
MNCR	Marine Nature Conservation Review
MUL	Maritime Usage Licence
OPW	Office of Public Works
PSA	Particle Size Analysis
RGB	Red, Green, Blue
RIB	Rigid Inflatable Boat
ROV	Remotely Operated Vehicle
RTK	Real Time Kinematic
SBES	Single Beam Echo Sounder
SCUBA	Self Contained Underwater Breathing Apparatus
SPA	Special Protection Area
SSBL	Super Short Baseline
TOC	Total Organic Carbon
UAV	Unmanned Aerial Vehicle
USBL	Ultra Short Baseline

1. Introduction

1.1. Background

Mott MacDonald (MM) has been appointed by Cork City Council (CCiC) to provide consultancy services for the Cork Docklands North and South Quays Projects in Cork City, Co. Cork, Ireland. The Cork Docklands South Quays is located within the South Docks and Marina Park area and extends from Kennedy Quay to Blackrock Village, approximately 3.4 km along the River Lee. The associated North Quays works comprise structural-only surveys at Horgan's Quay, the Turning Basin and North Deep-Water Quay.

Cork City Council aims to deliver a high-quality public realm scheme that will transform the Cork North and South Docklands into accessible urban spaces, improving connections with the wider city. The projects will enhance the riverfront environment by improving pedestrian and cycling infrastructure, enabling outdoor recreational use, and improving access to the river frontage. The proposed works also address the condition of existing quay walls and jetties, including repair or replacement of structures and integration of flood defence infrastructure.

Cork City Council is applying for a Maritime Usage Licence (MUL) to facilitate site investigation surveys within the River Lee. These investigations are required to inform the design and engineering assessment of quay walls, jetties and associated infrastructure within the project area. The MUL is being sought solely to facilitate marine and intertidal site investigation surveys associated with the proposed Cork Docklands South Quays Public Realm Project and the Cork North Quays structural survey works.

1.2. Site location

The surveys proposed by the Applicant will be undertaken within the River Lee to the east of Cork City, within the townlands of Cullentra and Killown. The proposed Maritime Usage Licence application area is approximately 113.46 hectares and is shown in **Figure 1-1**.

The proposed Maritime Usage Licence application area encompasses sections of the River Lee adjacent to the southern bank between Kennedy Quay and Blackrock Village, together with the northern bank at Horgan's Quay, the Turning Basin and North Deep-Water Quay adjacent to Kent Station and Lower Glanmire Road. The application covers both the South Quays site investigation surveys, and the North Quays structural survey works within a single integrated survey area. The precise locations of survey activities may vary within the application area depending on site conditions, access constraints and survey methodology at the time of investigation. Indicative sampling and inspection locations are therefore provided and may be adjusted within

reasonable limits to reflect operational and safety requirements, while remaining within the boundaries of the MUL application area.

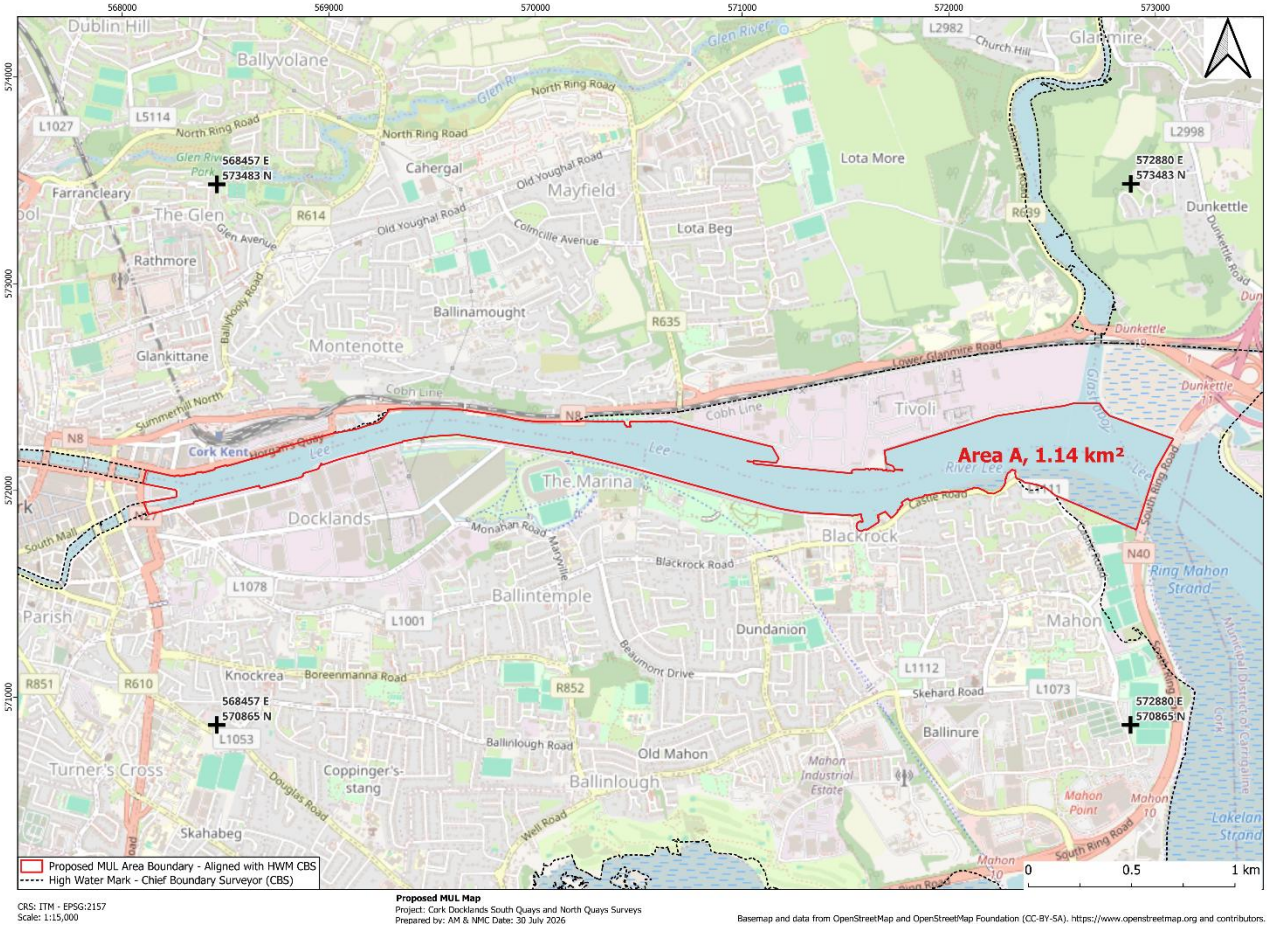

Figure 1-1 Proposed MUL area map.

2. Proposed Maritime Usage overview

The proposed maritime usage relates to a programme of site investigation surveys required to characterise existing infrastructure, riverbed conditions and environmental baseline conditions within the River Lee. The surveys proposed within the marine environment (below the Ordnance Survey High Water Mark) include:

- Structural surveys
- Archaeological surveys
- Ecological surveys

The Cork Docklands South Quays survey scope includes structural, archaeological and ecological surveys. Additional structural survey works associated with the North Quays area are located at Horgan's Quay, the

Turning Basin, and North Deep-Water Quay. No additional archaeological or ecological surveys are proposed as part of the North Quays structural survey scope.

The survey methodologies described in this document represent the anticipated types of investigation required to support the projects. The precise survey methods, equipment and sampling locations may vary slightly depending on survey contractor methodologies, tidal conditions, access constraints and safety considerations at the time of survey.

Any such variations will remain within the scope of the survey types described in this document and will be undertaken within the boundaries of the MUL application area. Any such changes will be discussed with MARA prior to their undertaking. The proposed MUL duration is 12 months for both the South Quays survey programme and the North Quays survey programme and may be undertaken concurrently or at separate times. They will require separate periods to complete depending on access constraints, tidal conditions, weather, health and safety requirements, contractor availability and other operational limitations

3. Structural surveys

The South Quays structural surveys relate to quay walls, jetties and associated infrastructure assets within the Cork Docklands South Quays project area and are intended to establish baseline information on the structural condition, geometry and integrity of the existing waterfront structures, including above-water and below-water elements where access permits. The additional North Quays structural surveys relate to quay wall structures at Horgan's Quay, the Turning Basin and North Deep-Water Quay, and are intended to assess existing quay wall faces, suspended slabs, wall toe conditions and any evidence of scour, undermining, cracking, displacement or other structural deterioration.

3.1. South Quays structural surveys

A suite of structural surveys is proposed to collect integrated above-water and below-water data along approximately 2 km of River Lee quay walls, jetties and associated infrastructure assets within the Cork Docklands North and South Quays projects area. These investigations will support asset mapping and structural condition assessment of existing quay walls, jetties and riverbed infrastructure. The surveys will combine a range of techniques to generate high-resolution and geospatially accurate datasets describing the condition and geometry of structures both above and below the waterline.

The suite of structural surveys proposed includes:

- Visual inspection survey
- Drone survey

- Concrete investigations
- Structural steelwork investigations
- Riverbed and Jetty Material Sampling
- Hydraulic survey of the River Lee
- ROV Underwater Camera Survey
- ROV Sonar/Echo/Magnetometer/LiDAR Survey
- Bathymetric Survey

These investigations may be undertaken using a combination of boat-based survey platforms, unmanned aerial vehicles, remotely operated vehicles and other specialist survey equipment depending on site conditions and survey contractor methodologies.

3.1.1. Visual inspection survey

A visual inspection survey will be undertaken to document the condition of quay walls, jetties and associated structural elements within the survey area.

The inspection will systematically record:

- Construction details and materials
- Element dimensions
- General condition
- Defects including cracks, spalling, corrosion, and deformation
- Deterioration mechanisms

Inspections may be undertaken from a small survey vessel such as a rigid inflatable boat (RIB) or similar platform to allow close visual inspection of quay walls and the underside of jetty structures.

High-resolution digital photographs will be collected during the inspection to document the condition of structures and any observed defects. Photographs will be referenced to specific locations along the quay walls and jetties.

Indicative inspection locations are provided in **Table 3-1**. These locations represent approximate intervals along the quay structures and may be refined during the survey to ensure appropriate coverage of the structures.

Table 3-1 List of structures to be visually inspected

LOCATION/ELEMENT	AREA / LENGTH
SOUTH JETTIES	Every 100 m
SOUTH DEEPWATER BERTH	Every 100 m
FORD/DUNLOP JETTIES	Every 100 m
ESB JETTIES	Every 100 m
MARINA WEST	Every 100 m
MARINA EAST	Every 100 m

3.1.2. Drone survey

The objective of the drone photogrammetry survey is to acquire high-resolution point cloud, 3D models and imagery data covering the Cork Docklands quay walls, jetties, and associated structures. The resulting datasets will support detailed condition assessment of structural elements (including cracks, voids, damage, and anomalies) and provide geospatially accurate information for integration into BIM models and correlation with below-water survey data. This dataset will also be used to measure verticality of the Cork Docklands quay walls. Consistent lighting conditions will be ensured to enable accurate structural inspection and heritage documentation for the shadowed areas and under-deck structures. All works will be carried out during the day. Coverage of difficult-to-access areas will be ensured using UAV and boat-assisted operations. The Area of Interest (AoI) for the Drone photogrammetry survey includes (**Figure 3-1**):

- Above water retaining walls, quay walls, jetties, and under-deck structures.
- Accessible sections of the River Lee and adjacent infrastructure.
- 50m buffer from the south riverbank
- South Jetties
- South Deepwater Berth
- Ford/Dunlop Jetties
- ESB Jetties
- Marina West
- Marina East

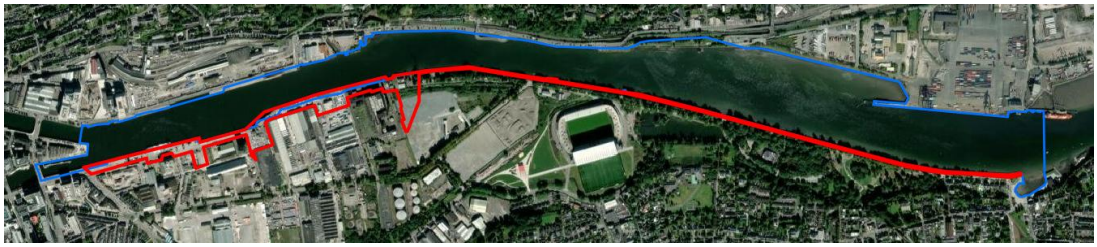

Figure 3-1 Area of interest for drone survey (red boundary).

3.1.2.1. Potential removal of vegetation for drone survey

Limited vegetation clearance may be required at a small number of locations on quay walls, jetty walls or other in-river structures to facilitate clear visual inspection of structural surfaces during the drone survey. Where present, vegetation can obscure the condition of masonry, concrete or structural joints and may therefore require trimming or removal to allow accurate assessment of structural condition.

Any vegetation clearance would be highly localised and limited to small areas where structural inspection is required, typically affecting only small patches of vegetation (generally a few square metres) at discrete locations where vegetation growth is obscuring the structure. Widespread or systematic vegetation removal is not proposed as part of the survey works.

Vegetation removal, where required, will only be undertaken following completion of the ecological surveys associated with the projects. Any clearance will be carried out under the supervision of a suitably qualified ecologist to ensure that no protected species, including species protected under the Habitats Directive such as otter, or nesting birds, are impacted.

Where ecological sensitivities are identified, vegetation will be retained where possible and alternative inspection methods will be considered. Any vegetation clearance will therefore be minimised and restricted to the smallest area necessary to allow the required structural inspection.

3.1.3. Concrete investigations

Targeted concrete investigations will be undertaken at representative locations along quay walls, jetties and associated structures within the survey area in order to assess the condition and structural properties of existing concrete elements. These investigations will provide information on material strength, durability and deterioration mechanisms affecting existing infrastructure.

Concrete investigations will include concrete core extraction and compressive strength testing, chloride content analysis and half-cell potential testing. Sampling locations are distributed across six structural areas

within the project corridor: South Jetties, South Deepwater Berth, Ford/Dunlop Jetties, ESB Jetties, Marina West and Marina East.

Across the survey area, a total of 24 sampling locations have been identified where concrete condition testing will be undertaken. These include locations where testing will occur at the top of structures as well as locations where sampling will be undertaken at soffit level or on quay wall faces where access allows.

At locations where full structural testing is undertaken, up to three samples may be taken from different structural elements including the top slab, soffit and quay wall face. At other locations, testing will be limited to the upper structural surface where this provides sufficient representation of structural condition.

The indicative sampling locations are provided in **Table 3-2**. The precise positions may be adjusted slightly during the survey to account for structural configuration, access and safety considerations while remaining within the areas described.

Table 3-2 Sample numbers and locations for concrete testing.

LOCATION REFERENCE	ELEMENT	CORES (NO.)	CHLORIDE (NO.)	HALF-CELL (M²)	LONGITUDE	LATITUDE
[CT-01]	*South Jetties*	*At 3 no locations -*				
		Top of slab	*Top of slab*	*Top of slab*		
					-8.4602634	*51.89871*
		Soffit level	*Soffit level*	*Soffit level*	*-8.4582785*	*51.899019*
					-8.4559407	*51.899397*
		Quay wall	*Quay wall*	*Quay wall*		
[CT-02]	*South Deepwater Berth*	*Top of structure – 5 no samples along full length*	*Top of structure – 5 no samples along full length*	*Top of structure – 5 no samples along full length*	*-8.4551157*	*51.899394*
					-8.4546066	*51.899485*
					-8.4539234	*51.899604*
					-8.4532215	*51.899725*
					-8.4526577	*51.899815*
[CT-03]	*Ford/Dunlop Jetties*	*At 3 no locations -*				
		Top of slab	*Top of slab*	*Top of slab*		
					-8.4522559	*51.899935*
		Soffit level	*Soffit level*	*Soffit level*	*-8.4514518*	*51.900367*
					-8.4492339	*51.900867*
		Quay wall	*Quay wall*	*Quay wall*		
[CT-04]	*ESB Jetties*	*At 3 no locations -*				
		Top of slab	*Top of slab*	*Top of slab*		
					-8.4476581	*51.901118*
		Soffit level	*Soffit level*	*Soffit level*	*-8.4467343*	*51.901264*
					-8.4459334	*51.90139*
		Quay wall	*Quay wall*	*Quay wall*		
[CT-05]	*Marina West*	*Top of structure – 5 no samples along full length*	*Top of structure – 5 no samples along full length*	*Top of structure – 5 no samples along full length*	*-8.443392*	*51.901653*
					-8.4399456	*51.901617*
					-8.4368026	*51.9013*
					-8.4320801	*51.900794*

LOCATION REFERENCE	ELEMENT	CORES (NO.)	CHLORIDE (NO.)	HALF-CELL (M²)	LONGITUDE	LATITUDE
					-8.4291723	*51.90035*
[CT-06]	*Marina East*	*Top of structure – 5 no samples along full length*	*Top of structure – 5 no samples along full length*	*Top of structure – 5 no samples along full length*	*-8.426989*	*51.899979*
					-8.4231577	*51.899322*
					-8.4199398	*51.898804*
					-8.4169414	*51.898416*
					-8.4133717	*51.898356*

3.1.3.1. Concrete core extraction and compressive strength testing

Concrete core extraction will be undertaken to determine in-situ compressive strength and structural condition of existing concrete elements. Testing will be carried out in accordance with the following standards where applicable:

- BS EN 12504-1:2009 – Testing concrete in structures: Cored specimens
- BS EN 12390-3:2019 – Compressive strength testing
- BS EN 13791:2019 – Assessment of in-situ compressive strength

At locations where coring is undertaken, cores may be collected from the top surface of structures, from soffit locations beneath jetties and from quay wall faces where access is possible. Sampling locations have been identified across the six structural areas within the project corridor.

At the South Jetties, Ford/Dunlop Jetties and ESB Jetties, three testing locations have been identified at each structure. At each of these locations, cores may be extracted from up to three structural elements including the top slab, soffit and quay wall face where access allows.

At the South Deepwater Berth, Marina West and Marina East structures, five testing locations have been identified along the length of each structure. At these locations, testing will focus on the top surface of the structure.

In total, concrete condition testing will be undertaken at 24 locations across the survey area.

Concrete cores may be extracted using rotary diamond coring equipment. Prior to coring, reinforcement locations may be identified using an electromagnetic covermeter or similar detection equipment in order to minimise the risk of damaging reinforcing steel.

Typical core diameters may be approximately 100 mm or greater depending on aggregate size, with core lengths determined by the thickness of the structural element.

Extracted cores will be prepared and tested in an accredited laboratory to determine compressive strength. Test results will provide individual core strengths, mean strength values, standard deviation and characteristic strength assessments in accordance with the relevant standards.

Core extraction locations will be repaired following sampling to restore the integrity of the structure.

3.1.3.2. Chloride context analysis

Chloride content analysis will be undertaken at the same sampling locations as concrete coring in order to assess the potential for reinforcement corrosion within structural elements.

Testing will be undertaken in accordance with relevant standards including BS 1881-124:2015 and BRE Digest 444:2005.

Powder samples will be collected using a rotary percussion drill fitted with a tungsten carbide bit. Sampling will typically be undertaken dry to avoid leaching of chlorides.

At each sampling location, powder samples may be collected at multiple depths within the concrete cover zone. These may include a surface layer sample, a mid-cover depth sample and a sample collected close to reinforcement depth.

Samples will be collected in sealed containers and labelled with location reference and sampling depth before being transported to an accredited laboratory for analysis.

3.1.3.3. Half-Cell Potential testing

Half-cell potential testing will be undertaken at the same sampling locations as concrete coring in order to assess the likelihood of reinforcement corrosion.

Testing will be conducted using suitable electrochemical equipment such as a copper/copper sulphate reference electrode or equivalent.

Measurements will be taken across defined areas of concrete surfaces at each test location. The results will be used to identify areas where reinforcement corrosion may be active and to support interpretation of concrete durability and structural condition.

3.1.3.4. Additional testing

Additional investigations may be undertaken where required to further characterise concrete condition.

Rebound hammer testing may be undertaken in accordance with BS EN 12504-2:2012 to provide indicative estimates of surface concrete strength. Multiple readings may be taken at each test location.

Covermeter surveys may be undertaken to determine reinforcement location, spacing and cover depth within structural elements. These surveys will also assist in selecting appropriate locations for coring.

Carbonation depth testing may be carried out using phenolphthalein indicator solution in accordance with BS EN 14630:2006.

Where appropriate, petrographic examination of selected concrete samples may be undertaken in accordance with BS EN 12407:2007 to assess concrete composition, aggregate characteristics and deterioration mechanisms.

3.1.4. Structural steelwork investigations

Targeted investigations of structural steel elements will be undertaken where steel components are present within quay wall or jetty structures.

These investigations will focus on steel structures at the South Jetties, Ford/Dunlop Jetties and ESB Jetties. Steel investigations are not required at the South Deepwater Berth, Marina West or Marina East structures as steel elements relevant to the investigation scope are not present.

At each of the three applicable structures, three sampling locations have been identified, resulting in a total of nine steel investigation locations across the survey area (**Table 3-3**).

Investigations will include dimensional surveys of structural elements and the extraction of steel samples for tensile testing.

Table 3-3 Steel sampling locations and sample numbers.

ELEMENT	DIMENSIONAL SURVEY (NO.)	TENSILE SAMPLES (NO.)	LONGITUDE	LATITUDE
SOUTH JETTIES	*3 no samples*	*3 no samples*	*-8.4602634*	*51.89871*
			-8.4582785	*51.899019*
			-8.4559407	*51.899397*
FORD/DUNLOP JETTIES	*3 no samples*	*3 no samples*	*-8.4522559*	*51.899935*
			-8.4514518	*51.900367*
			-8.4492339	*51.900867*
ESB JETTIES	*3 no samples*	*3 no samples*	*-8.4476581*	*51.901118*
			-8.4467343	*51.901264*

		-8.4459334	*51.90139*

3.1.4.1. Dimensional survey and condition assessment

A dimensional survey and condition assessment will be undertaken at the identified steel investigation locations. At each location, steel structural elements will be inspected to record member dimensions, structural configuration and evidence of corrosion, deterioration or damage. Measurements may be taken using appropriate survey equipment and documented using photographs and location references.

3.1.4.2. Steel tensile testing

Steel samples will be extracted from selected structural elements for laboratory tensile testing at the same nine investigation locations. Laboratory testing will determine material properties including yield strength, ultimate tensile strength and elongation characteristics. Results will be compared with relevant structural steel standards, for example BS EN 10025, to inform assessment of structural capacity. Sample extraction locations will be repaired following sampling to maintain structural integrity.

3.1.5. Riverbed sampling

Limited riverbed sediment sampling will be undertaken to characterise riverbed material within the survey area and to support structural and environmental assessment of the project.

Three sediment grab samples will be collected from the River Lee riverbed at representative locations within the central channel of the survey area.

Sampling will be undertaken from a survey vessel using a grab sampler deployed to the riverbed.

The three sampling locations are identified as MMRB01, MMRB02 and MMRB03. Each sample will be collected from the upper sediment layer between 0 m and 1 m depth.

The indicative sampling coordinates are as follows (Table 3-4):

Table 3-4 Riverbed grab sample locations

SAMPLE ID	SAMPLE DESCRIPTION	LONGITUDE	LATITUDE
MMRB01	Grab sample of river bed	-8.451938	51.900179

MMRB02	Grab sample of river bed	-8.451401	51.900497
MMRB03	Grab sample of river bed	-8.449653	51.900824

Sampling locations may be adjusted slightly during survey operations depending on site conditions and access. Collected samples may be analysed to determine sediment composition and physical characteristics relevant to engineering and environmental assessment.

3.1.6. Hydraulic survey

A hydraulic survey of the River Lee will be undertaken using boat-based access, with water samples and flow measurements collected at two locations within the central channel near the easternmost and westernmost boundaries of the Maritime Usage Licence (MUL) area. The measurements to be taken at each sampling location are:

- Current Speed
- Current Direction
- Solubility
- Suspended Solids
- Water Temperature

The speed and direction of the water flow (tidal stream and current) will be measured at 95% confidence level as defined in Table 2 of International Hydrographic Organization Standards for Hydrographic Surveys (IHO, 2020). All measurements shall be made on both spring and neap tides and shall be taken through the water column at 10-minute intervals in the locations specified.

3.1.7. ROV underwater camera survey

An underwater structural inspection survey will be undertaken using a remotely operated vehicle (ROV) to capture high-resolution video and still imagery of submerged quay walls, jetties, under-jetty areas, associated structures and the adjacent riverbed within the survey area.

The purpose of this survey is to document the current condition and configuration of underwater infrastructure along the River Lee within the Cork Docklands South Quays project area. The imagery collected

will support structural condition assessments of quay walls and jetties and provide a detailed visual record of submerged structures and riverbed features.

The ROV will be equipped with high-definition video cameras and still image capture systems capable of recording high-resolution imagery of underwater structures. The survey platform will also be fitted with integrated lighting systems, including diffuse LED lighting rigs, to ensure consistent illumination of structural surfaces. This lighting arrangement allows features such as masonry textures, joints and surface defects to be clearly captured in areas that are naturally shaded, particularly beneath jetty decks and along vertical quay wall faces.

The use of integrated lighting and high-resolution imaging will ensure that submerged structures are documented to a consistent standard, allowing a continuous record of the condition of structures from the riverbed to the quay crest when combined with above-water inspection and drone survey datasets. All survey work will be carried out during the day. The survey will capture imagery suitable for:

- structural condition assessment of quay walls and jetty structures, including identification of cracks, spalling, corrosion and marine growth
- documentation of construction details and material characteristics relevant to heritage conservation records
- identification of obstructions or anomalies associated with quay walls, jetties or the riverbed, including collapsed masonry or debris
- identification of locations that may require further inspection by diver or additional survey methods

3.1.7.1. Area of interest

The area of interest for the ROV underwater camera survey covers the Cork Docklands South Quays project area within the River Lee. The survey will focus on submerged sections of quay walls, jetties and associated structures as well as the adjacent riverbed areas where these structures interact with the riverbed environment. The area of interest includes:

- the River Lee riverbed within the survey corridor
- submerged and intertidal portions of quay walls
- submerged jetty structures and under-jetty areas
- accessible sections of the River Lee and adjacent infrastructure

Key structures within the survey area include:

- South Jetties

- South Deepwater Berth
- Ford/Dunlop Jetties
- ESB Jetties
- Marina West
- Marina East

The survey will aim to achieve comprehensive visual coverage of the riverbed, submerged quay wall faces, jetty structures and under-jetty areas within the accessible portions of the survey area. The ROV survey will capture imagery of all visible structural features and anomalies in order to support the overall structural condition assessment of the infrastructure within the project area.

3.1.8. ROV sonar, echo, magnetometer and LiDAR survey

A suite of underwater geophysical surveys will be undertaken using sonar, echo sounding, magnetometer and LiDAR systems to collect high-resolution spatial data describing the riverbed, quay walls, jetties and associated structures within the survey area.

The purpose of these surveys is to generate accurate geospatial datasets describing the geometry and condition of underwater structures and the surrounding riverbed. These datasets will support structural condition assessments of quay walls and jetties, including the identification of defects such as cracks, voids, damage or structural anomalies.

The surveys will also assist in identifying obstructions or features that may be associated with the condition of existing infrastructure, such as collapsed masonry or debris on the riverbed.

The geophysical survey datasets will provide high relative and absolute positional accuracy and will allow measurements of quay wall geometry and verticality. These datasets will also assist in identifying areas that may require additional inspection, including targeted diver surveys where appropriate.

Data collected from sonar, echo sounder, magnetometer and LiDAR systems will be integrated to produce a continuous and geospatially accurate dataset describing underwater structures and riverbed features across the survey area. These datasets will be compatible with the outputs of the above-water drone survey and may be incorporated into project geospatial datasets and building information modelling (BIM) environments.

Table 3-5 Specifications of the ROV Sonar, Echo, Magnetometer and LiDAR survey

SURVEY TYPE	PURPOSE	APPLICATIONS	KEY FEATURES	PRIMARY OUTPUT
SONAR (SIDE-SCAN / SUB-BOTTOM PROFILER)	Acoustic imaging of the riverbed and submerged structures.	Identification of seabed features, sediment types, obstructions, buried objects and infrastructure.	Produces acoustic imagery and backscatter data of seabed features.	High-resolution acoustic imagery.
ECHO SOUNDING (SBES / MBES)	Measurement of water depth and riverbed bathymetry.	Bathymetric mapping and identification of seabed gradients and features.	Uses acoustic pulses to measure depth; MBES provides wide swath coverage.	Bathymetric depth datasets and terrain models.
MAGNETOMETER	Detection of ferrous objects and magnetic anomalies.	Identification of metallic debris, buried infrastructure or archaeological features.	Measures variations in the Earth's magnetic field; typically towed behind a survey vessel.	Magnetic anomaly location datasets.

3.1.8.1. Area of Interest

The area of interest for the geophysical surveys includes the River Lee riverbed and submerged sections of quay walls, jetties and associated structures within the Cork Docklands South Quays project area (**Figure 3-2**). The survey area includes:

- River Lee riverbed and adjacent submerged structures
- Submerged and intertidal portions of quay walls
- Under-jetty faces and associated structural elements
- Accessible sections of the River Lee and adjacent infrastructure

Key structures within the survey area include:

- South Jetties
- South Deepwater Berth
- Ford/Dunlop Jetties
- ESB Jetties
- Marina West
- Marina East

The surveys will aim to provide comprehensive coverage of the riverbed and submerged structural elements within the accessible portions of the survey corridor. Data acquisition will document visible features and anomalies associated with the riverbed and structural assets.

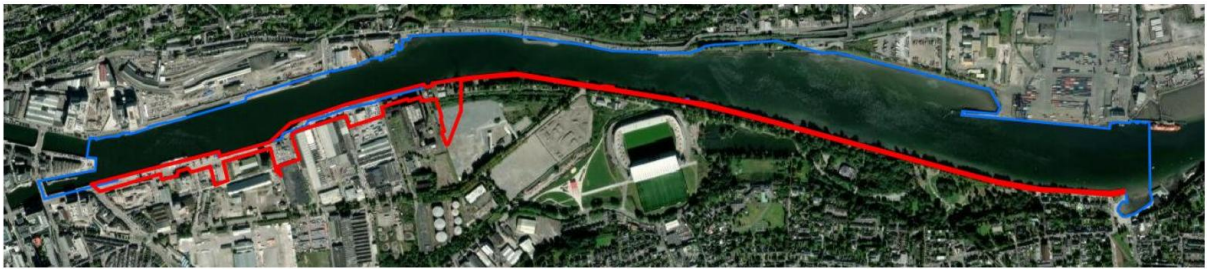

Figure 3-2 Area of interest for ROV sonar, echo, magnometer and LIDAR survey. Red boundary = jetty & Quay structures. Blue boundary = Riverbed survey area.

3.1.8.2. Echo Sounder Survey

Bathymetric surveys of the River Lee will be undertaken using multibeam echo sounder systems to generate high-resolution depth data and three-dimensional models of the riverbed and adjacent structures.

Survey data collection may be undertaken at lower tidal levels where practicable in order to maximise exposure of structural features and reduce the distance between the survey platform and the structures being mapped.

Multibeam echo sounder systems used for the survey may have beam widths of approximately 0.3 x 0.6 degrees or similar specifications suitable for high-resolution bathymetric mapping.

Data acquisition will typically be undertaken at vessel speeds appropriate for the sensor type in order to ensure full coverage of the survey area. The resulting point cloud datasets may be processed to generate bathymetric grids with resolutions greater than approximately 1 cm.

Survey lines may be run parallel to quay wall structures and riverbed features to achieve efficient and accurate coverage of the survey area. Where appropriate, survey lines may be collected in opposing directions to support data quality checks and repeatability.

Additional bathymetric measurements using a single beam echo sounder may be collected at approximately 2 m intervals to support validation of multibeam bathymetric datasets.

3.1.8.3. Side Scan Sonar details

Side-scan sonar surveys may be undertaken to generate high-resolution acoustic imagery of the riverbed and submerged objects.

High-frequency sonar systems operating in the approximate range of 600–1200 kHz may be used in order to produce detailed imagery with resolutions of approximately 1–3 cm. These images allow identification of small objects and features on the riverbed, including debris, obstructions or structural elements associated with quay walls and jetties.

Sonar systems will be integrated with positioning systems such as GNSS, inertial navigation systems and acoustic positioning systems to allow accurate georeferencing of sonar imagery.

These positioning systems enable both relative and absolute positional accuracy of sonar datasets, typically within approximately 10–30 cm.

3.1.8.4. Magnetometer details

A magnetometer survey may be undertaken to identify ferrous objects or magnetic anomalies within or beneath the riverbed.

Magnetometer systems measure variations in the Earth's magnetic field and can detect metallic objects such as anchors, cables, buried infrastructure or debris.

Magnetometers are typically towed behind the survey vessel in order to reduce interference from the vessel and survey equipment.

The survey will record magnetic anomalies and positional data using integrated navigation systems such as RTK GNSS and inertial navigation systems, allowing accurate mapping of detected anomalies.

Environmental conditions during the survey, including wind, tidal conditions and water state, may be recorded as part of the survey documentation.

Survey line spacing and overlap will allow confirmation of detected anomalies and accurate determination of their position.

3.1.8.5. LiDAR details

Where appropriate, underwater LiDAR systems may be used to collect high-density spatial datasets describing the geometry of submerged structures. LiDAR systems emit laser pulses and measure the return signal to generate dense point cloud datasets. Typical LiDAR datasets may achieve point densities of approximately 500 points per square metre or greater, with relative horizontal and vertical accuracies of approximately ±1 cm and absolute accuracies of approximately ±2 cm. Data acquisition may include overlapping survey passes of approximately 30 percent or greater to ensure complete coverage and minimise data gaps. The resulting point cloud datasets may be colourised using RGB imagery collected from integrated cameras and may include LiDAR intensity values which assist in differentiating surface materials. These datasets will provide detailed spatial representation of vertical structural faces, including quay walls, undercuts and submerged structural elements where accessible.

3.1.9. Bathymetric survey

A bathymetric survey will be undertaken within the River Lee to map the riverbed morphology and provide accurate depth measurements across the Maritime Usage Licence (MUL) area. The survey will support engineering assessment of quay walls and riverbed conditions and will also assist in identifying features or anomalies that may require further investigation.

The bathymetric survey will be undertaken in accordance with the Office of Public Works Specification for Surveying Services Version 3.2, November 2019 (OPW, 2019) and the Standards for Hydrographic Surveys Special Publication No. 44 published by the International Hydrographic Organization (IHO, 2020), or a comparable recognised hydrographic survey standard.

Survey points will typically be recorded at intervals of approximately 2 m along survey lines, with survey lines spaced at approximately 25 m intervals running perpendicular to the riverbanks. Where rapid changes in riverbed level or morphology are observed, additional survey points may be recorded to accurately capture changes in the riverbed profile.

Where practicable, the bathymetric survey coverage may extend towards the High Water Level (HWL) in order to capture the transition between the riverbed and the base of quay walls and riverbank structures.

Survey data will be processed and reviewed during survey operations where possible in order to identify features or anomalies that may require additional investigation. Target survey accuracy will typically include a minimum horizontal accuracy of approximately ±500 mm and a minimum vertical accuracy of approximately ±100 mm. Survey operations will be undertaken using appropriate environmental protection measures to

minimise disturbance to the surrounding environment and to avoid pollution of the river, drainage channels or adjacent watercourses.

Prior to undertaking the geophysical survey works, an application for a Detection Device Licence will be submitted to the Licensing Section of the National Monuments Service. A survey Method Statement will accompany this application and will also be provided to the Underwater Archaeology Unit of the National Monuments Service to ensure that the proposed survey methodologies are consistent with archaeological guidance and licensing requirements. Processing of the Detection Device Licence by the National Monuments Service typically requires approximately 10 to 15 working days.

3.1.9.1. River bathymetry

Bathymetric data will be collected across the area illustrated in **Figure 3-3**.

The survey will record riverbed levels at a resolution sufficient to identify the principal features of the riverbed morphology. A typical data spacing of approximately 1–2 m will be used to ensure that major changes in riverbed profile are captured. The survey will be undertaken in accordance with the Office of Public Works Specification for Surveying Services, Version 3.2, November 2019 (OPW, 2019).

In addition to mapping the riverbed profile, the bathymetric datasets will assist in identifying features or anomalies of potential archaeological interest. Interpretation of survey data will follow the guidance presented by the National Monuments Service and relevant archaeological geophysical survey guidance (e.g. Plets, 2013).

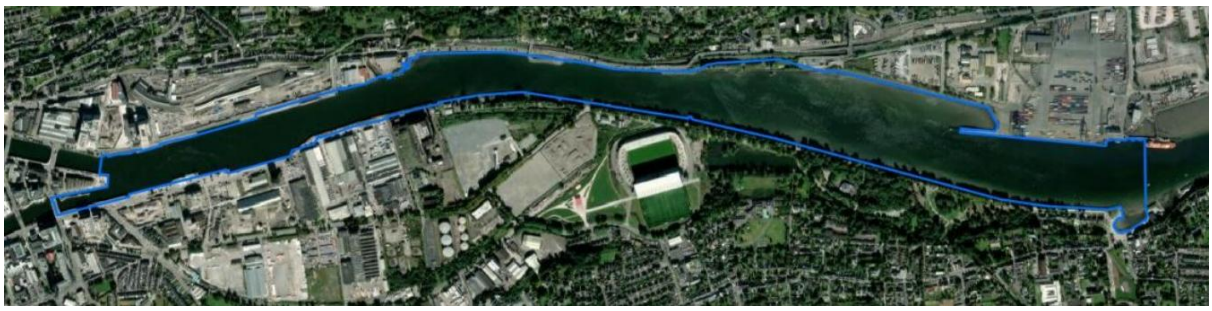

Figure 3-3 Bathymetry survey coverage within the MUL area

3.1.9.2. Sub-Bottom Profiling

A sub-bottom profiling survey may also be undertaken within the survey area in order to characterise subsurface sediment layers beneath the riverbed. This information supports engineering assessment of

ground conditions and may also assist in identifying potential deposits of submerged prehistoric or palaeoenvironmental interest from an archaeological perspective.

Sub-bottom profiling systems capable of resolving fine sediment layers may be used. Chirp sub-bottom profiling systems are commonly used for this type of survey as they provide high-resolution imaging of shallow subsurface sediments.

Sub-bottom profiling data will be collected using a suitable positioning system such as Differential GNSS (DGPS) or an equivalent positioning solution integrated with the survey equipment.

Survey data will typically be collected at vessel speeds of approximately 3–4 knots along multiple survey lines across the survey area. Survey line spacing will typically not exceed approximately 30 m, with additional crosslines collected at intervals of approximately 100 m where survey conditions allow. These crosslines assist in validating data quality and ensuring consistent coverage of the survey area.

The resulting datasets will provide information on subsurface sediment structure and may also highlight features of archaeological or geological interest beneath the riverbed.

3.2. North Quays structural surveys

Structural surveys are proposed along the Cork North Quays area at Horgan's Quay, the Turning Basin, and North Deep-Water Quay. The purpose of these surveys is to assess the current structural condition and integrity of the quay walls, including accessible above-water elements and submerged structural elements. The surveys will identify existing defects, deterioration, damage, evidence of scour or undermining, and any risk to structural stability.

The North Quays structural surveys will cover the full extent of the quay walls at Horgan's Quay, the Turning Basin and North Deep-Water Quay. The survey area includes the River Lee waterfront, quay edge and suspended quay slab, with the western extent adjoining the Kent Station compound and the eastern extent extending beyond the McMahons property boundary along Lower Glanmire Road. The site extents are shown in Appendix A of the structural survey specification.

The North Quays Survey Scope includes:

- Above-water visual and physical inspection;
- Diver-led underwater structural survey;
- Underwater photography and video recording;
- Hammer sounding and other non- destructive testing, where required;

- Above water concrete core extraction at a minimum of two locations per structure;
- Underwater concrete sampling, coring, chipping only where the inspection findings indicate a specific requirement;
- Additional material testing and investigation, where required;
- Sonar / echo sounding where required to assess riverbed profile and scour at the wall toe; and
- Slit trenches to the rear of the quay wall as a contingent investigation only where existing construction records are insufficient to verify the quay wall construction.

Above-water inspections will be undertaken from land, the quay wall or suitable access equipment where practicable. A survey vessel will be required to inspect suspended or overhanging quay wall sections and the underside of suspended slabs where these elements cannot be safely accessed or viewed from above. The diver-led underwater survey will be supported from a vessel, and any required sonar / echo sounding survey will also be vessel-based.

Dynamic positioning or temporary mooring arrangements are expected to be used rather than seabed anchoring where practicable. The final vessel-positioning, mooring or anchoring arrangements will be confirmed in the appointed contractor's Diving Project Plan and Risk Assessment.

The desk study and initial above-water inspection will inform the detailed underwater inspection and intrusive sampling scope. The final survey methodology, access arrangements, underwater sampling locations and quantities, tidal requirements and contractor programme will be confirmed following appointment of the Structural Surveyor.

The surveys will inform assessment of the quay walls in the context of the Cork North Docks scheme, including the proposed change in quayside use and proposed raising of finished ground levels.

3.2.1. Above water visual and physical inspection

An above-water visual and physical inspection will be undertaken along all visible and accessible elements of the quay walls at Horgan's Quay, the Turning Basin, and North Deep-Water Quay. Inspection of suspended or overhanging quay wall faces, and the underside of suspended slabs will be undertaken from a suitable survey vessel where these elements cannot be safely accessed or viewed from land or the quay deck. The inspection will include the full length and height of the visible quay wall face from water level to the top of coping, where access allows.

The inspection will include, but may not be limited to:

- Quay wall faces from water level to top or coping;
- Quay deck surfaces;
- Coping stones or concrete coping beams;
- Upstand structures;
- Drainage features and/ or weepholes;
- Bollards, ladders, mooring fixings and associated ironmongery;
- Exposed reinforcement, corroded steel or exposed tie rods at or above water level; and
- Areas showing settlement, rotation, displacement, cracking or loss of fill behind the wall face.

The inspection will record the general condition of the structures and identify visible defects such as cracking, spalling, delamination, carbonation, chloride-induced corrosion, exposed reinforcement, corroded steel, exposed tie rods, settlement, displacement, rotation, differential movement, loss of fill and other evidence of deterioration or structural distress.

High-resolution digital photographs will be collected during the inspection to document the condition of the quay walls and associated structural elements. Defects will be recorded using a standardised defect coding system and referenced to specific locations along the quay walls.

3.2.2. Underwater structural survey

A diver-led, vessel-supported underwater structural survey will be undertaken by suitably qualified commercial divers experienced in structural inspection works. The underwater survey will cover the submerged elements of the quay walls from the waterline to the seabed / harbour bed, where access and visibility allow.

The underwater survey will include inspection of:

- The full submerged quay wall face from water surface to base;
- the wall toe and any apron, scour protection or founding conditions at the base of the wall;
- exposed tie rods, anchor bolts or tensioning systems at or below water level;
- piled elements or sheet piling forming part of the quay structure below water;
- any relieving platform, suspended slab or underwater soffit forming part of the structure;
- underwater fixings, fenders and cathodic protection systems, where present;
- marine growth where it affects inspection or obscures structural condition; and
- any evidence of scour, undermining or loss of seabed material at the toe of the wall.

The underwater survey may include close visual inspection, underwater photography and video recording, hammer sounding, and measurement of exposed reinforcement cover or profile using underwater callipers or cover meter equivalents where practicable.

Underwater photography and video footage will be used to provide a visual record of submerged structural elements and notable defects. Hammer sounding may be undertaken to identify potential delamination, voids or debonded areas in concrete surfaces.

3.2.2.1. Area of Interest

The area of interest for the underwater structural survey includes the submerged elements of the quay walls at Horgan's Quay, the Turning Basin, and North Deep-Water Quay. The survey will focus on submerged quay wall faces from the waterline to the seabed / harbour bed, the wall toe, any apron or scour protection, founding conditions, exposed tie rods, anchor bolts, tensioning systems, piled or sheet-piled elements, relieving platforms, suspended slabs, underwater soffits, underwater fixings, fenders and areas where scour, undermining or loss of seabed material is identified.

3.2.3. Material testing and investigation

Material testing and investigation may be undertaken to characterise the structural materials and condition of the quay wall construction. The final scope of material testing will be confirmed by the appointed structural surveyor and may include both non-intrusive and intrusive investigations.

Material testing may include:

- Concrete core extraction;
- Visual and physical assessment of exposed masonry, mortar joints, or stone construction.
- Rebound hammer testing;
- Cover meter or electromagnetic cover survey;
- Half-cell potential survey;
- Ground penetrating radar to map reinforcement layout, voids behind the wall face and wall thickness where access permits;
- Underwater ultrasonic pulse velocity testing where access allows; and
- Laboratory testing of samples by an accredited laboratory.

Slit trenches to the rear of the quay wall are a contingent investigation only and will only be required where available construction records are insufficient to verify the quay wall construction. Any such investigation will be subject to access, safety requirements, landowner permissions and final contractor methodology.

3.2.3.1. Concrete core extraction and compressive strength testing

Above-water concrete core extraction will be undertaken at a minimum of two locations per structure for compressive strength testing. The final locations will be selected by the appointed Structural Surveyor, taking account of structural configuration, accessibility and the need to avoid reinforcement where practicable.

Underwater concrete sampling, coring or chipping will only be undertaken where the findings of the above-water and underwater inspections indicate a specific need, such as evidence of deterioration, exposed reinforcement or uncertainty regarding construction or material properties. The number and location of underwater samples will be proposed by the appointed Structural Surveyor and agreed with the Employer.

Prior to coring, reinforcement locations may be identified using a cover meter, electromagnetic cover survey or similar detection equipment in order to minimise the risk of damaging reinforcement. Extracted cores will be prepared and tested in an accredited laboratory to determine compressive strength and, where required, other durability parameters. Core extraction locations will be repaired following sampling.

Any concrete core spoil and cutting water generated during the works will be contained and disposed of in accordance with applicable waste management requirements. No hydraulic oil, fuel, concrete debris, cutting water or other contaminants will be discharged to the water environment.

3.2.3.2. Additional testing

Additional testing may be undertaken where required to further characterise the condition of the quay wall materials. This may include rebound hammer testing, cover meter or electromagnetic cover survey, half-cell potential testing, ground-penetrating radar, underwater ultrasonic pulse velocity testing, carbonation depth testing, chloride content analysis and visual or physical assessment of masonry, mortar joints or stone construction.

3.2.4. Sonar / echo sounding survey

A multibeam echo sounder or single-beam sonar survey may be undertaken at the wall toe to determine the riverbed profile and assess the extent of scour or undermining, where this information is not already available.

The purpose of this survey would be to identify riverbed levels, scour, loss of seabed material, obstructions or other features relevant to the structural condition of the quay wall toe and founding conditions. Where required, the sonar / echo sounding survey will be undertaken from a survey vessel using a multibeam echo sounder or single-beam sonar system.

3.2.4.1. Area of Interest

The area of interest for the sonar / echo sounding survey, where required, will comprise the riverbed immediately adjacent to the quay wall toe along Horgan's Quay, the Turning Basin and North Deep-Water Quay. The survey will focus on identifying the riverbed profile, wall toe conditions, scour extent, undermining, loss of seabed material, obstructions or other features relevant to the structural condition of the quay wall foundations.

4. Archaeological surveys

A programme of archaeological surveys will be undertaken within the scheme boundary shown in **Figure 4-1** and **Figure 4-2**, and will apply to the South Quays only. The survey programme will comprise intertidal archaeological survey, archaeological metal detecting survey, archaeological wade survey, archaeological dive survey and underwater archaeological geophysical survey. These investigations will identify, record and assess any archaeological features, artefacts or deposits present within the survey area, and will inform the archaeological baseline for the Cork Docklands North and South Quays projects. The surveys will be carried out in accordance with relevant archaeological standards and, where applicable, the licensing requirements of the National Monuments Service.

The primary archaeological survey tasks proposed for the project are summarised in **Table 4-1**.

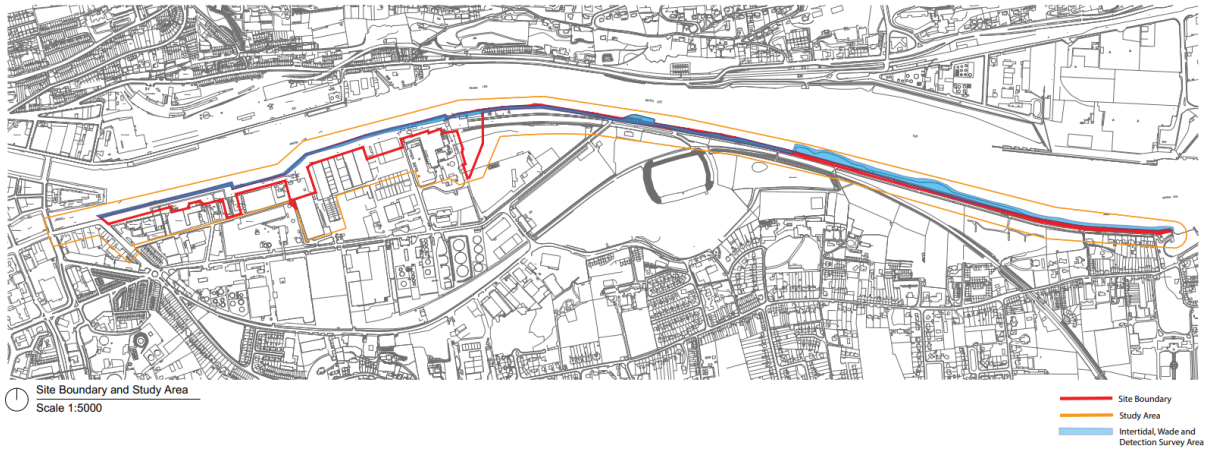

Figure 4-1 Archaeological intertidal, wade and metal detection survey area

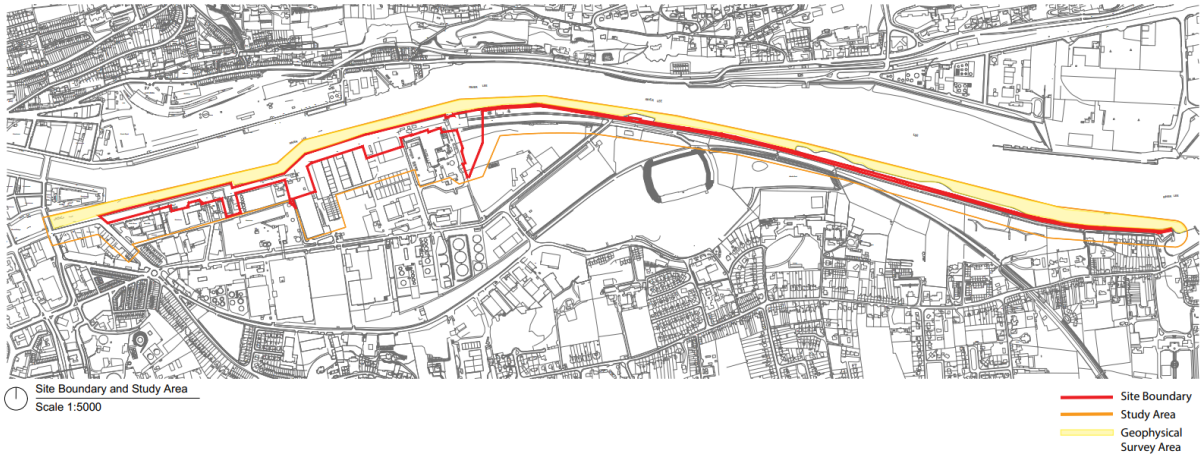

Figure 4-2 Archaeological geophysical survey area.

Table 4-1 Archaeological survey overview

ITEM	SURVEY EXTENT
ARCHAEOLOGICAL METAL DETECTING SURVEY WITH SURVEY REPORTING AND PROVISION OF ASSOCIATED SURVEY OUTPUTS	Figure 4-1
ARCHAEOLOGICAL WADE SURVEY WITH SURVEY REPORTING AND PROVISION OF ASSOCIATED SURVEY OUTPUTS	Figure 4-1
ARCHAEOLOGICAL DIVE SURVEY WITH SURVEY REPORTING AND PROVISION OF ASSOCIATED SURVEY OUTPUTS	Figure 4-1
UNDERWATER ARCHAEOLOGICAL GEOPHYSICAL SURVEY WITH SURVEY REPORTING AND PROVISION OF ASSOCIATED SURVEY OUTPUTS	Figure 4-2

4.1. Intertidal Archaeology survey

Intertidal archaeological surveys are typically undertaken where proposed works may interact with or occur adjacent to the shoreline or intertidal environment. An archaeological assessment of the riverbed margins and associated quay walls will therefore be undertaken within the intertidal survey area shown in **Figure 4-1**.

The survey will involve a systematic visual inspection of exposed intertidal riverbed areas, quay walls and associated maritime infrastructure within the survey area shown in **Figure 4-1**. The inspection will be undertaken at low water where possible in order to maximise visibility of the intertidal zone.

During the survey, a written and photographic record will be compiled of any archaeological features, deposits or artefacts encountered. The location of any identified features will be recorded using suitable positioning methods such as GPS.

A walkover, wade and archaeological metal detecting survey may also be undertaken across the foreshore (the area between the high and low tide marks) within the intertidal survey area shown in **Figure 4-1** where access and ground conditions allow.

The survey area shown in **Figure 4-1** will be systematically inspected at low water in order to identify any evidence of archaeological remains, including structures, features, deposits or archaeological objects located within, on or adjacent to the intertidal zone. Where archaeological remains or artefacts are identified, they will be described, recorded and photographed, and their location and spatial extent documented. The condition of any identified remains will also be recorded.

Survey coverage will extend across the full intertidal survey area shown in **Figure 4-1** where access and site conditions allow. In some locations, survey coverage may be limited by immovable obstacles, structural constraints or areas that are unsuitable for survey. Where such constraints are encountered they will be documented and their locations recorded.

Intertidal surveys are typically undertaken in conjunction with archaeological wade surveys and archaeological metal detecting surveys in order to maximise coverage of the intertidal zone.

Locations of archaeological remains or objects identified during the survey will be recorded using suitable positioning methods such as EDM or DGPS. Archaeological features or objects will be photographed in situ using appropriate scales and orientation markers. Where submerged remains or objects are observed, photography may be undertaken using a bathyscope or an underwater digital camera.

Where constraints or obstacles prevent completion of the survey in specific locations, these limitations will be recorded and mapped.

Spatial datasets generated during the survey may be incorporated into project geospatial outputs and digital drawings. Where required, AutoCAD datasets may be prepared in formats compatible with BIM requirements under the Capital Works Management Framework (CWMF), including use of the Uniclass classification system.

4.1.1. Quay wall survey

As part of the intertidal archaeology survey, a detailed record and assessment of the quay walls and their immediate surroundings will be undertaken across the project area shown in **Figure 4-1**.

This work will involve the preparation of detailed photographic records and scaled drawings of quay walls, wharfs and associated structures in order to document the built character and form of the quayside environment. The survey will also assist in identifying construction phases, structural characteristics and any features of archaeological or architectural interest.

The survey will produce a baseline record of the quay walls and associated structures within the survey area shown in **Figure 4-1**. This record will support future conservation assessment and may assist in identifying areas requiring repair or structural intervention. The information collected will also inform the engineering and design development of the project.

Where required, access to quay walls and associated structures may be obtained using appropriate methods such as boat-based inspection or drone survey. All survey activities will be undertaken in accordance with relevant health and safety requirements and appropriate site access arrangements.

4.2. Archaeological metal detecting survey

An archaeological metal detecting survey may be undertaken within the survey area under licence issued in accordance with Section 2(2) of the National Monuments (Amendment) Act 1987.

Prior to undertaking the survey, a method statement will be prepared describing the proposed survey approach and operational procedures. This method statement will support the application for a metal detection licence to the National Monuments Service and will be developed in consultation with the relevant Local Authority Archaeologist where appropriate.

The metal detecting survey will focus on identifying and recording the location of ferrous and non-ferrous metal objects contained within or on the surface of intertidal sediments on the foreshore.

Metal detecting surveys are typically undertaken in conjunction with intertidal archaeological surveys and archaeological wade surveys in order to maximise the identification of archaeological material within the intertidal environment.

The primary objective of the metal detecting survey is to identify and record the presence and location of metallic artefacts or materials within the proposed development area. The results will contribute to an understanding of the distribution and density of metal finds within the survey area.

The survey will be undertaken using metal detecting equipment suitable for use in foreshore environments. Suitable equipment may include waterproof metal detectors such as Minelab or J. W. Fisher systems, or equivalent instruments designed for archaeological survey in intertidal conditions.

4.3. Archaeological wade survey

A walkover, wade and archaeological metal detecting survey may be undertaken across the foreshore area (the area between the high and low tide marks) within the proposed development area where access and site conditions allow. Archaeological metal detecting will be undertaken under licence issued in accordance with Section 2(2) of the National Monuments (Amendment) Act 1987.

Prior to the survey being undertaken, a method statement will be prepared outlining the proposed survey methodology and operational procedures. This document will support the application for a metal detection licence to the National Monuments Service and will be developed in consultation with the relevant Local Authority Archaeologist where appropriate.

The foreshore survey area will be systematically inspected at low water where possible in order to identify any evidence of archaeological remains, including structures, features, deposits or artefacts located within, on or adjacent to the foreshore.

Where archaeological remains or objects are identified, they will be described, recorded and photographed, and their location and spatial extent documented. The condition of any identified remains will also be recorded.

Survey coverage will extend across the entire foreshore survey area where this can reasonably be achieved. In some locations, survey coverage may be limited by immovable obstacles, structural constraints or areas that are unsuitable for safe access. Where such constraints occur, they will be recorded as part of the survey documentation.

4.4. Archaeological dive survey

An archaeological dive survey will be undertaken within the survey area under a licence issued by the National Monuments Service. Prior to the survey being undertaken, a method statement will be prepared outlining the proposed survey methodology and operational procedures. This method statement will support the application for a dive survey licence from the National Monuments Service and may be developed in consultation with the relevant Local Authority Archaeologist where appropriate.

The dive survey will be undertaken using appropriate diving equipment suitable for underwater archaeological investigations. This may include breathing apparatus such as commercial SCUBA equipment or surface-supplied diving systems, together with associated equipment such as compressors, dive panels, lifelines and other safety systems typically used for professional diving operations. The survey will be undertaken by a team of suitably qualified underwater archaeologists who are experienced in both diving operations and underwater archaeological investigation.

Each underwater survey area will be systematically inspected by archaeological divers in order to identify any evidence of archaeological remains, including structures, features, deposits or artefacts located on or within the bed of the water body. Visual inspection may be supplemented by the use of an underwater metal detector where appropriate.

Several survey techniques may be used to achieve systematic coverage of the survey area. These may include circular search patterns undertaken from a fixed point such as a weighted surface buoy, survey grids established using baseline measurements to facilitate jackstay survey methods, or other appropriate survey techniques that allow comprehensive visual and metal detection inspection of the required area.

Where underwater metal detecting is undertaken, a suitable underwater metal detector will be used and the location and extent of any structures, deposits or artefacts identified will be mapped and recorded.

Details of the equipment and instruments proposed for use during the dive survey will be included in the method statement prepared to support the licence application.

The underwater survey will typically extend across the areas of the waterbody that may be affected by the proposed scheme. Where archaeological remains or objects are identified, their locations will be recorded using suitable positioning methods.

Position fixing may be achieved through diver-to-surface communications linked to a survey baseline, underwater acoustic positioning systems such as ultra-short baseline (USBL) or super-short baseline (SSBL)

systems connected to an onboard computer, or by using a surface marker buoy that can be georeferenced using handheld GPS or DGPS from a support vessel.

Archaeological remains or artefacts identified during the survey will be photographed in situ using underwater digital still cameras and/or underwater video equipment. Where appropriate, underwater photogrammetry techniques may also be used to record archaeological features in detail.

The topography of the riverbed or seabed within the survey area may also be recorded in plan and section where required, typically at scales such as 1:50 or 1:20 depending on site conditions and the size of the recorded features.

Survey datasets will be recorded in Irish Transverse Mercator (ITM) coordinates (EPSG 2157) and referenced to recognised vertical datum levels such as Ordnance Datum Malin Head or equivalent OPW data where available.

4.5. Archaeological geophysical survey

An underwater archaeological geophysical survey will be undertaken within the survey area to identify potential archaeological features, deposits or objects located on or beneath the riverbed. The survey approach draws on guidance contained in the Draft Requirements for a Geophysical Survey for Archaeological Purposes issued by the Underwater Archaeology Unit of the National Monuments Service, Department of Housing, Local Government and Heritage, and will be refined through consultation with the National Monuments Service where appropriate.

Under Section 2(1)(b) of the National Monuments (Amendment) Act 1987, the use of a detection device for the purpose of searching for archaeological objects requires the consent of the Minister. The archaeological geophysical survey will therefore be undertaken under licence issued by the National Monuments Service. A method statement describing the proposed survey methodology, equipment and operational procedures will accompany the licence application and will be prepared in consultation with the Project Archaeologist and the National Monuments Service where appropriate.

A detailed desktop study will inform the design and scope of the geophysical survey. Geophysical survey techniques will be used to identify archaeological material located on or beneath the riverbed and to detect features or anomalies that could indicate the presence of archaeological remains. The survey will employ a combination of geophysical detection techniques including side-scan sonar, magnetometer survey, echo

sounding and sub-bottom profiling in order to provide comprehensive coverage of the riverbed and subsurface sediments.

Side-scan sonar will be used to map the riverbed using acoustic beams that generate high-resolution imagery of the seabed surface. This technique allows identification of objects, debris, structural features and sediment patterns located on the riverbed. For archaeological survey purposes, side-scan sonar systems will operate at frequencies of approximately 410–500 kHz in order to achieve the resolution required to identify small features or objects of archaeological interest. Survey line spacing will typically be approximately 50 m, with overlapping swaths used where necessary to ensure full coverage of the survey area.

Magnetometer survey will be undertaken in conjunction with side-scan sonar to detect ferrous material located on or beneath the riverbed. Magnetometers measure variations in the Earth's magnetic field and allow identification of metallic objects such as anchors, cables, wreck material or other debris that may not be visible in acoustic imagery. Proton or caesium vapour magnetometers will typically be used for archaeological geophysical surveys and will operate with positioning systems such as Differential GPS (DGPS) to provide accurate spatial referencing of detected anomalies.

Echo sounding will also form part of the archaeological geophysical survey. Single-beam echo sounders measure water depth directly beneath the survey vessel and provide bathymetric depth measurements, while multibeam echo sounders emit a fan-shaped array of acoustic beams that provide high-resolution mapping of the riverbed. Multibeam echo sounding will be used to generate detailed bathymetric models of the riverbed and to identify morphological features or anomalies that could indicate archaeological material.

Multibeam survey operations will be undertaken from a survey vessel or unmanned surface vehicle using hydrographic survey equipment including multibeam echo sounder systems, sound velocity sensors and sound velocity profilers used to account for variations in water column conditions. Integrated GNSS and inertial navigation systems will be used to provide accurate positioning and motion correction for the survey platform. Survey lines will typically be run parallel to the shoreline or to the local seabed morphology in order to optimise coverage of the survey area. Vessel speeds during multibeam data acquisition will generally be maintained at relatively low speeds, typically around 2.5 knots or less, in order to maintain data quality and resolution. Survey line spacing will be designed relative to water depth to ensure appropriate overlap of multibeam swaths and complete coverage of the survey area.

Sub-bottom profiling will be undertaken to investigate sediment layers beneath the riverbed. Sub-bottom profiling systems use acoustic or seismic techniques to image subsurface stratigraphy and can identify sediment layers, buried objects or palaeoenvironmental features located beneath the riverbed. Chirp sub-bottom profiling systems will be used for this investigation as they provide high-resolution imaging of shallow

sediment layers and allow identification of stratigraphic changes that may indicate buried archaeological material. These systems will operate in conjunction with positioning systems such as DGPS in order to accurately georeference the survey data.

Survey positioning information will be recorded using National Grid references supported by latitude and longitude coordinates. Track plots of survey coverage will be recorded during geophysical survey operations and displayed on location charts showing the survey area and track lines. Geophysical surveys will be undertaken by suitably qualified personnel with experience in hydrographic or geophysical survey techniques, with interpretation of potential archaeological anomalies undertaken by specialists experienced in underwater archaeological geophysics where required.

5. Ecological surveys

Marine ecological surveys will be undertaken to support the Maritime Usage Licence (MUL) application for the Cork Docklands North and South Quays Project on the South Quays only. The proposed project includes public realm improvements, flood defence works, quay wall repair and waterfront enhancement along the southern bank of the River Lee.

Elements of the project and associated site investigation surveys are proposed to take place below the High Water Mark (HWM) along the southern bank of the River Lee. Intertidal and subtidal ecological surveys will therefore be undertaken to characterise the existing benthic environment within the survey area and to identify any ecological sensitivities relevant to the proposed in-river investigations.

The ecological survey programme will include intertidal habitat survey and targeted ecological observations within the intertidal and nearshore areas of the River Lee. These surveys will provide baseline information on intertidal habitats and associated biological communities present within the study area. The information gathered will support the identification of ecological sensitivities and inform appropriate mitigation measures associated with the proposed survey works and any future project activities.

Given that some survey activities may require boat-based access to quay walls and structures at river level, targeted checks for signs of otter will also be undertaken in areas that may be inaccessible from land. These observations will focus on identifying any evidence of otter activity along quay structures, river margins and other suitable resting or access locations within the survey area.

The ecological surveys will focus on the intertidal and nearshore areas of the River Lee along the southern bank of the project corridor. The survey area lies within the wider Cork Harbour estuarine system and partially

overlaps with the Cork Harbour Special Protection Area (SPA 004030). This SPA is designated for a range of wintering waterbird species that rely on intertidal mudflat and sandflat habitats for foraging.

The ecological survey programme has therefore been designed to provide sufficient baseline information on habitats and ecological receptors within the survey area to support consideration of potential interactions with the conservation objectives of Cork Harbour SPA and the Lower Lee Estuary. A map of the ecological survey area is shown in **Figure 5-1**. Further details of each ecological survey element are provided below.

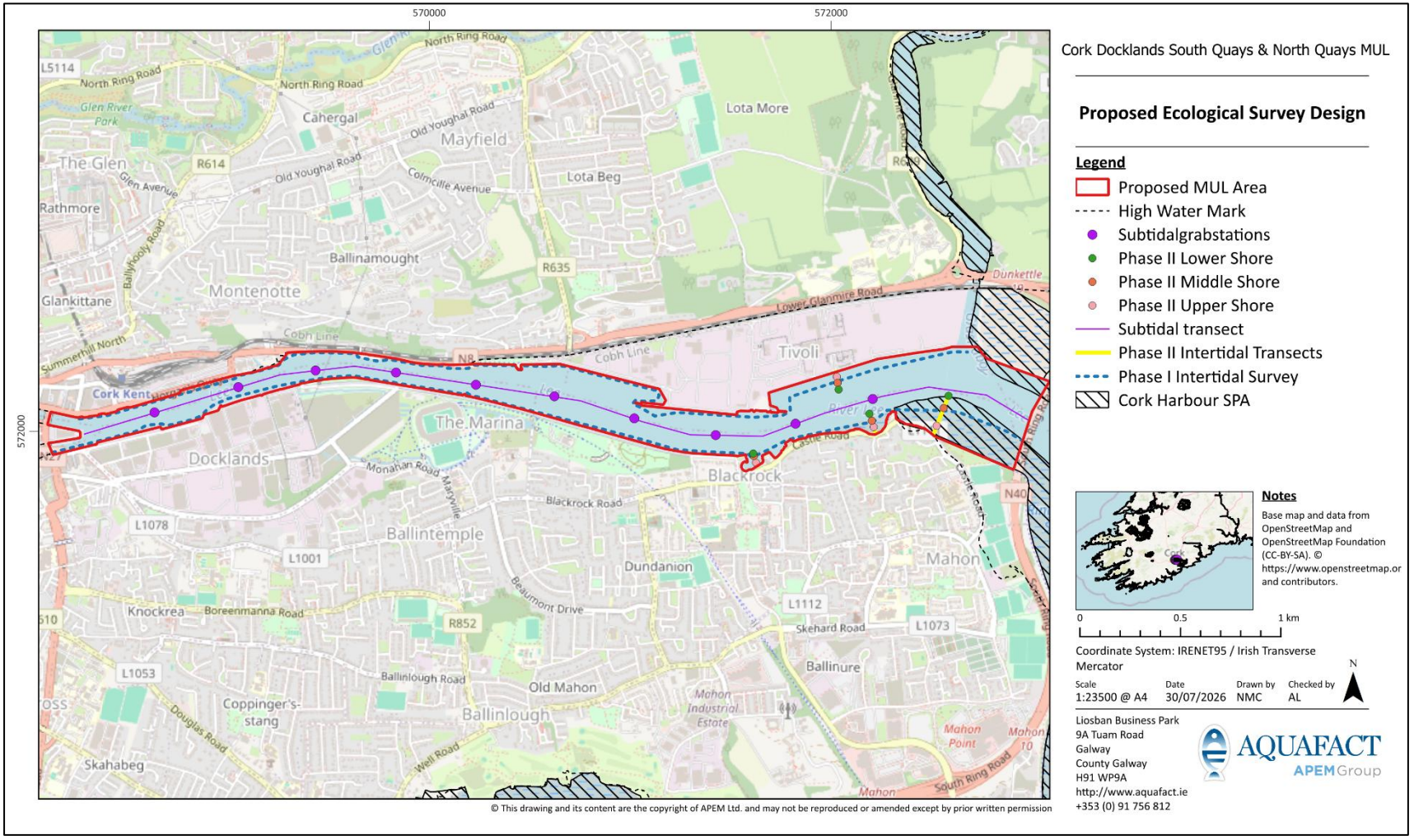

Figure 5-1 Proposed Ecological survey design

5.1. Intertidal survey

5.1.1. Intertidal survey phase I

A Phase I intertidal survey will be undertaken along both the north and south banks of the River Lee within the South Quays study area, covering an approximate total length of 10 km from Lapp's Island to the west to the east of Blackrock Castle along the southern bank and to the eastern shoreline of Tivoli Industrial estate on the northern bank (Northern transect: 4.98 km Southern transect: 5.03 km).

The survey will follow the Marine Nature Conservation Review (MNCR) Phase I methodology and will be undertaken, where practicable, during mean low water spring (MLWS) tidal conditions to maximise exposure of the intertidal zone and facilitate habitat characterisation. The survey will be informed by relevant best-practice guidance, including the Common Standards Monitoring Guidance for Intertidal Habitats (JNCC, 2004), Littoral Sediments Habitats Procedural Guidance (Version 4, August 2004), the CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn et al., 2000), and the Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites (Ware & Kenny, 2011).

Where the intertidal zone is safely accessible on foot (predominantly along the northern bank of the River Lee), the Phase I survey will be undertaken as a walkover survey. Where the riverside comprises vertical or near-vertical quay walls and the intertidal zone is not safely accessible (predominantly along the southern bank), intertidal habitats will be characterised using high-quality oblique photography and visual assessment from a survey vessel. This approach will allow the extent and nature of intertidal habitats to be recorded safely while maintaining methodological consistency across the study area.

Intertidal biotopes will be identified and classified in accordance with the EUNIS and JNCC Marine Habitat Classification systems. Key attributes, including dominant species, substrate type, sediment characteristics, exposure, and evidence of anthropogenic influence, will be recorded. Observations will be georeferenced using handheld GPS and supported by high-resolution photographs and detailed field notes. Habitat extents and biotope boundaries will be mapped in the field and subsequently digitised using GIS to produce intertidal habitat maps.

Attention will be given to intertidal habitats of relevance to SPA qualifying interests, particularly those supporting benthic prey resources for wintering waterbirds. Where present, such features will be documented and mapped to inform the assessment of ecological sensitivity.

Survey outputs will include a dedicated section within the intertidal survey report describing survey methods, intertidal biotope distribution, ecological observations and mapped outputs, together with associated GIS files

and metadata. All work will be undertaken by experienced marine ecologists and will be subject to internal quality assurance procedures.

5.1.2. Intertidal survey phase II

A Phase II quantitative intertidal transect survey will be undertaken to characterise middle and lower shore intertidal habitats within the study area. The survey will follow the methodologies set out in the *Marine Monitoring Handbook Procedural Guidance* No. 3-1 (*Intertidal Biotope Recording*; Wyn & Brazier, 2001) and No. 3-6 (*Intertidal Core Sampling*; Dalkin & Barnett, 2001). Photographic records will be taken, as appropriate, to support habitat characterisation and reporting.

A total of four Phase II intertidal transects will be surveyed, located towards the eastern end of the study area where there is soft intertidal ground. Each transect will extend across the upper, middle and lower shore, where feasible.

Due to the presence of fine, soft mudflat sediments and limited safe access in parts of the intertidal zone, Phase II sampling will be undertaken from a vessel at high water. Sampling will be carried out using a 0.025 m^2 Van Veen grab deployed from the appointed contractor's rigid inflatable boat (RIB). The vessel will be operated by suitably qualified personnel in accordance with relevant marine safety regulations.

At each transect, sampling will be undertaken at three shore levels (upper, middle and lower shore). Triplicate grab samples will be collected at each shore level for benthic macrofaunal analysis, together with one additional grab sample per station for sediment particle size analysis (PSA) and organic carbon analysis. The depth of any anoxic layer will be recorded for each sample.

During the Phase II survey, a Fifish V6 Expert ROV will be deployed along each transect to document middle and lower shore intertidal habitats, covering approximately 50 m per transect (dependant on the length of the intertidal zone at each transect location). Video footage will be reviewed at the appointed contractor's offices to support intertidal biotope classification, with salient features recorded and supplemented by still imagery where appropriate.

All faunal samples will be preserved in 4% buffered formalin in clearly labelled containers. Sediment samples for PSA and organic carbon analysis will be retained in separate labelled containers.

Where features of conservation interest are identified, their extent will be mapped using GPS to inform the assessment of ecological sensitivity.

Sampling station locations will be recorded using a hand-held GPS unit (accuracy ±3 - 5 m) and documented in the survey notebook. Photographs will be taken at each station to aid sediment characterisation, and any

evidence of anthropogenic disturbance (e.g. bait digging, fishing activity or coastal defence structures) will be recorded, measured where relevant, and photographed.

5.1.3. Particle Size Analysis (PSA)

Particle size analysis (PSA) will be undertaken by the appointed contractor using standard granulometric techniques for 12 sediment samples. The appointed contractor should hold all necessary laboratory equipment, including Wentworth graded sieves, a Retsch EasySieve system, GRADISTAT software, hydrogen peroxide, sodium hexametaphosphate, drying ovens, mixers and calibrated electronic balances. The appointed contractor shall have extensive experience in sediment analysis for intertidal and subtidal benthic surveys.

Sediment samples will be processed as follows:

Frozen sediment samples (collected in freezer bags or tubs) will be allowed to defrost overnight in the laboratory prior to processing. Ambient samples will be processed on receipt.

Each wet sediment sample will be transferred to a labelled container and dried in a dehydrator or oven at approximately 50°C for 24–48 hours until constant weight is achieved.

Dried sediments will be passed through a Wentworth series of analytical sieves (>8000 µm to 63 µm; single phi intervals) using a Retsch EasySieve system. The mass of sediment retained on each sieve will be weighed and recorded. Where sediments are particularly coarse, samples will first be passed through an 8 mm sieve, with the retained fraction weighed separately. The remaining fraction (<8 mm) will then be processed through the EasySieve.

The following particle size fractions will be reported:

<63 µm, 63–125 µm, 125–250 µm, 250–500 µm, 500–1000 µm, 1000–2000 µm, 2000–4000 µm and 4000–8000 µm. Results will be analysed and classified using the Folk sediment classification scheme.

5.1.4. Sediment Organic carbon

Following drying, organic carbon analysis will be carried out for 12 samples by a certified laboratory using the Loss on Ignition (LOI) Technique.

5.1.5. Benthic invertebrate faunal data analysis

36 samples will be collected for benthic invertebrate faunal analysis for the phase II intertidal survey.

5.2. Subtidal survey

A subtidal benthic survey will be undertaken within the main river Lee channel within the study area, extending for approximately 4 km, to characterise subtidal sediments and benthic fauna at the South Quays sites only.

The subtidal benthic survey will be undertaken to characterise benthic habitats and associated macrofaunal communities within the subtidal area of the study site and to provide baseline ecological information to inform the Maritime Usage Licence (MUL) application and any subsequent environmental assessment.

Subtidal sampling will be carried out at a series of pre-defined sampling stations spaced at approximately 400 m intervals along the study area, resulting in approximately 10 subtidal sampling stations, subject to final station positioning and site access constraints.

At each sampling station, duplicate benthic faunal samples will be collected using an appropriate grab sampler (e.g. duplicate 0.025m^2 Van Veen grab), subject to substrate suitability and water depth.

Each faunal sample will be sieved within 24hrs of retrieval through a 1.0 mm mesh, with retained material preserved in buffered formalin and later transferred to industrial methylated spirits for laboratory analysis. Macrofaunal samples will be processed to species level where practicable, and abundance data will be used to describe community composition and diversity.

In addition to faunal sampling, one sediment sample per station will be collected for Particle Size Analysis (PSA)**.** PSA samples will be analysed to determine sediment grain size distribution, supporting habitat classification and interpretation of the benthic community data.

Where feasible, sediment sub-samples may also be retained for additional sediment parameters (e.g. organic content), subject to laboratory requirements and regulatory consultation.

All sampling locations will be recorded using differential GPS. The results of the subtidal survey will be used to classify subtidal habitats in accordance with relevant guidance and to identify any ecological sensitivities within the study area.

Table 5-1 Sample numbers for Intertidal and subtidal surveys

SURVEY ELEMENT	NO. SHORELINES / TRANSECTS / STATIONS	SAMPLE REPLICATES	TOTAL SAMPLES	FAUNAL ANALYSIS SAMPLES	PSA/TOC SAMPLES
INTERTIDAL PHASE I (QUALITATIVE)	2 shorelines (~ 10 km each)	0	0	0	0

INTERTIDAL PHASE II (BOAT, VAN VEEN)	4 transects	4 grabs per 3 x shore level	48	36	12
SUBTIDAL BENTHIC (BOAT, VAN VEEN)	10 stations	3 grabs per station	30	20	10

5.3. Otter survey

Otter (*Lutra lutra*) is a European Protected Species listed under Annex IV of the Habitats Directive and is known to utilise riverine and estuarine environments, including heavily modified urban waterways.

Given the requirement for boat-based access to undertake intertidal and subtidal surveys along the South Quays, a targeted otter survey is proposed to assess the potential presence of otter in areas of the quay that are inaccessible by foot, particularly at river level below the High-Water Mark.

5.3.1. Otter survey methodology

The otter survey will comprise a boat-based visual inspection of quay walls, river margins and associated structures within the entirety of the MUL area, undertaken at suitable tidal states to allow effective inspection of potential otter habitat features.

The survey will focus on the identification and recording of evidence of otter presence, including holts, couches, spraints and feeding remains. In addition, the suitability of quay structures, river margins and associated features for use by otters for resting, sheltering and commuting will be assessed.

Survey effort will be targeted primarily at areas that cannot be safely accessed from the shoreline**,** ensuring that otherwise inaccessible habitat features are adequately assessed. All observations will be recorded and used to inform an evaluation of otter activity and habitat use within the study area. The otter survey area will comprise the entirety of the MUL area as outlined in Attachment 3.4 which accompanies this application.