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Preliminary Site Assessment

Site 17 Francis Street - Harold's Cross 110 kV (July 2011 – November 2014)

Electricity Supply Board

Project number: PR-427640_ACM_RP_ENV_007_5

10 January 2020

Quality Information

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The site reconnaissance consisted of a general external inspection of the site aimed at identifying potential sources of ground contamination affecting the site. An environmental compliance audit and/or detailed structural inspection of existing buildings were outside the project brief. Similarly, the site visit excluded detailed

consideration of the ecological or archaeological aspects of the site, and if such are believed to be of potential significance then it is recommended that specialist advice is sought.

Any risks identified in this Report are perceived risks, based on the information reviewed during the desk study and therefore partially based on conjecture from available information. The study is limited by the non-intrusive nature of the work and actual risks can only be assessed following a physical investigation of the site.

It should be noted that the effects of ground and water borne contamination on the environment are constantly under review, and authoritative guidance values are potentially subject to change. The conclusions presented herein are based on the guidance values available at the time this Report was prepared, however, no liability by AECOM can be accepted for the retrospective effects of any changes or amendments to these values.

The opinions expressed in this report and the comments and recommendations given are based on a desk assessment of readily available information and an initial site reconnaissance by an AECOM employee. At this stage intrusive investigations have yet to be undertaken at site to establish actual ground and groundwater conditions and to provide data for an assessment of the geo-environmental status of the site.

Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

Reference to historical Ordnance Survey (OS) maps and/or data provides invaluable information regarding the land use history of a site. However, it should be noted that historical evidence will be incomplete for the period pre-dating the first edition and between the release of successive maps and/or data.

Certain statements made in the Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. AECOM specifically does not guarantee or warrant any estimate or projections contained in this Report.

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Table of Contents

ABBREVIATIONS

AECOM	AECOM Ireland Limited
APEC	Area of Potential Environmental Concern
bgl	Below Ground Level
BH	Borehole
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CSM	Conceptual Site Model
ESB	Electricity Supply Board
EPA	Environmental Protection Agency
GSI	Geological Survey Ireland
IEL	Industrial Emissions Licence
IPC	Integrated Pollution Control
ITM	Irish Transverse Mercator
km	Kilometre
kV	Kilovolt
LAB	Linear Alkyl Benzene
m OD	Metres above Ordnance Datum
NHA	Natural Heritage Areas
NAPL	Non-Aqueous Phase Liquid
NPWS	National Park and Wildlife Service
NWCPO	National Waste Collection Permit Office
OECD	Organisation for Economic Co-operation and Development
OPW	Office of Public Works
OSI	Ordnance Survey Ireland
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCOC	Potential Constituents of Concern
pNHA	Proposed Natural Heritage Area
PSA	Preliminary Site Assessment
RFP	Request for Proposal
SAC	Special Area of Conservation
SDS	Safety Data Sheet
SIDS	Screening Information Datasets
SPA	Special Protection Area
TPH	Total Petroleum Hydrocarbons
WAC	Waste Acceptance Criteria
WFD	Water Framework Directive

EXECUTIVE SUMMARY

Introduction

AECOM Ireland Limited (AECOM) completed a Preliminary Site Assessment (PSA) of a cable fluid leak location at the terminations in the Harold's Cross Station on the Francis Street to Harold's Cross cable section, Dublin 6 (the site).

ESB Networks operates and maintains a network of High Voltage (HV) underground cables of over 1,600 kilometres (km) across Ireland, of which approximately 175 km are insulated by a cable fluid. The majority of the fluid filled cables are located in urban settings across Dublin City and Cork City. The remainder are located outside these areas with limited numbers of fluid filled cables in other counties.

The length of each cable route varies and cable routes frequently extend across county boundaries. The cable fluid acts as an electrical insulator and aids the conduction of heat away from the conductor allowing the cable to be run more efficiently. Fluid filled cables are largely located in urban/suburban areas and so are particularly vulnerable to third party interference or damage. Over time cables can develop leaks due to corrosion / fracture/ defects in the cable sheath and in joints and terminations. When such leaks occur there is potential for pollution to occur to surface water, groundwater, soils and ecology.

A leak was identified by ESB at the site in July 2011 and repaired in November 2014. AECOM understand that the fluid type lost from the cable was a mixture of linear alkyl benzene (LAB) and mineral oil based products.

Objective

The assessment reported herein comprises the first step of Stage 1: Site Characterisation & Assessment – Preliminary Site Assessment (PSA) and was carried out in accordance with *EPA Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites (July 2013),* and specifically the Guideline Template for Preliminary Site Assessment Report. This guidance draws on the *EPA Code of Practice (CoP), Code of Reference for Unregulated Waste Disposal Sites (2007*) and *UK Environment Agency, Model Procedures for the Management of Land Contamination, Contaminated Land Report (CLR) 11 (September 2004).*

In terms of the data requirement for PSA reports, both the EPA CoP and CLR 11 outline that the findings of this initial risk assessment stage are largely based on desk-study information and a site walkover to identify potential pollutant linkages, which are then evaluated using appropriate criteria.

As such, the objective of the PSA reported herein is to:

- Identify potential contamination sources (i.e. the cable fluid), pathways (i.e. breathing in vapours, movement through made ground / soil) and receptors (i.e. who/what will be affected) and the likely interactions between each element;
- Assess the potential severity of the hazard and the sensitivity of the receptor (ranging from minor to severe);
- Assess the likelihood that a risk will occur (ranging from unlikely to high likelihood); and
- Develop a preliminary conceptual site model (CSM) based on an overall assessment of each of these elements above.

The preliminary CSM will then be used to identify potential risks to human health (site users and/or nearby residents) and controlled waters (i.e. groundwater and surface water) which may be associated with a fluid leak from the identified location. It should be noted that this stage of the risk assessment process is based mostly on qualitative information sources and identification of a potential risk at this stage does not necessarily indicate the presence of a risk, but rather the need for further assessment.

A table cross referencing the template headings from the EPA Guidance Template and where the corresponding information is reported herein is presented in Appendix B.

Assessment Findings

Based on the findings of the desktop study, the overall environmental sensitivity of the site is considered to be moderate. Identified sensitive receptors within 1 km of the site include:

- The Grand Canal located 50 m north of the site, although this may be protected by low permeability clay (natural and/or engineered when the canal was constructed);
- The Poddle river located approximately 200 m to the east of the site, which discharges to the River Liffey, although this may be protected by low permeability clay deposits which are likely to be encountered beneath the site; and
- The groundwater aquifer beneath the site, although this may also be protected by low permeability clay deposits which are likely to be encountered beneath the site.

It is estimated that 14,617 litres of cable fluid was released between July 2011 and November 2014. It is assumed, based on information provided to AECOM by ESB, that the fluid lost was a mixture of LAB and mineral oil based products. Due to its high biodegradability, lower volatility and low solubility, it is considered that LABs are of less concern for adverse environmental impact than mineral oil based products. Given that there is potential for a mixture of both types of cable fluids to have been used at this site, potential contaminants of concern have been identified.

A summary of the source audit findings is as follows:

Area of Potential Environmental Concern

Number	APEC	Potential Contaminants of Concern	Potential Media Impacted
1	Leak at (17) Francis Street - Harold's Cross – Ringsend 110 kV (July 2011 – November 2014)	LABs TPH BTEX VOCs SVOCs PCBs	Soil Groundwater Soil Vapour Ground Gas

The preliminary conceptual site model (CSM) developed for the site looked at potential source-pathway-receptor linkages identified during the assessment works and identified a moderate potential risk to the following receptors:

- Site users due to the potential for ground gas generation resulting from degradation of NAPL (if present); and
- Shallow groundwater due to potential impact to groundwater chemistry from the presence of NAPL and associated biodegradation products.

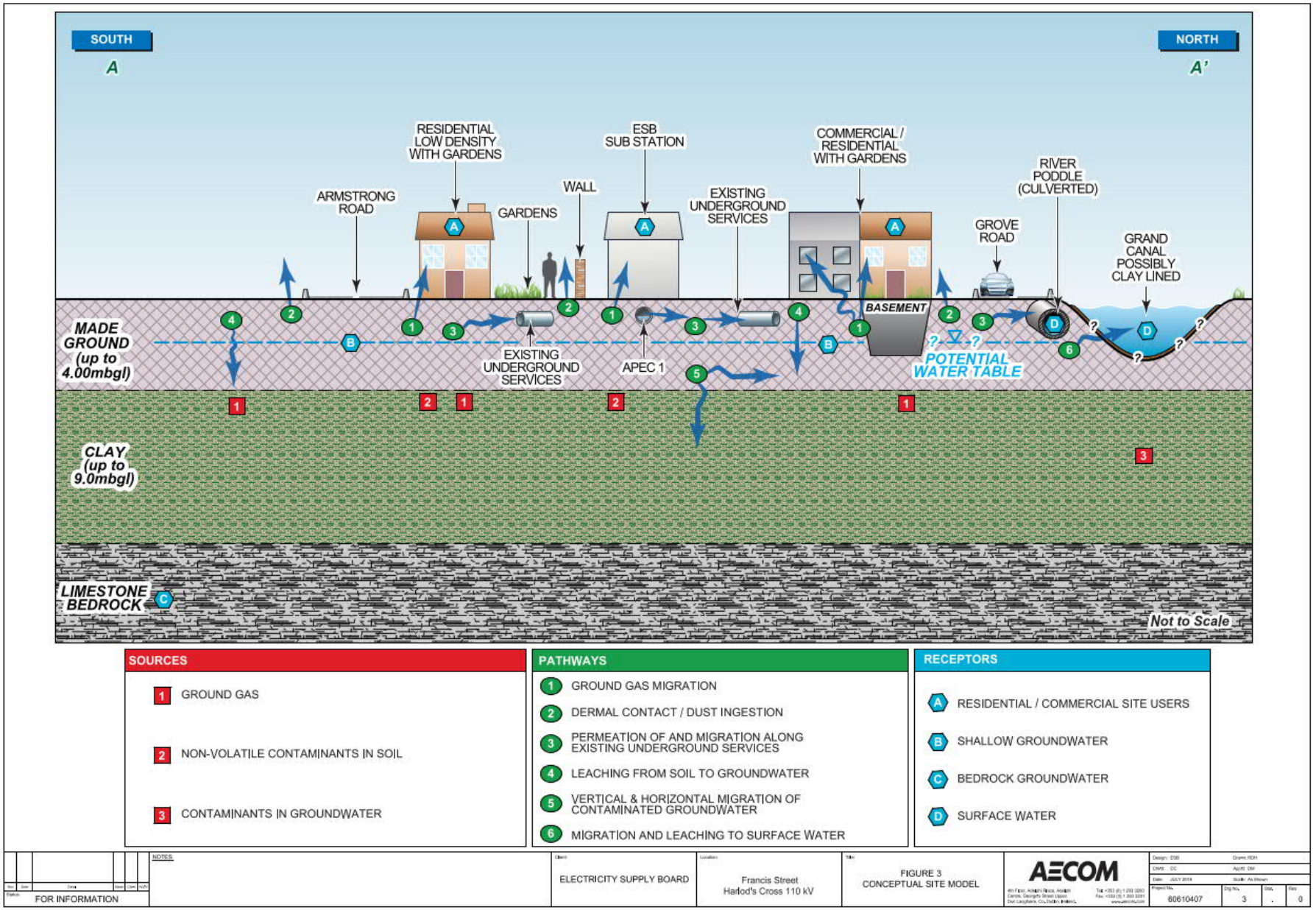
A low to moderate risk was identified to site users from the potential for vapour migration from mineral oil based cable fluid.

Potential risk to the Grand Canal was considered to be low to moderate given that canals are generally lined with impermeable materials which would prevent the migration of NAPL into the canal from groundwater. A low to moderate risk was identified to the nearby Poddle River via potential migration of cable fluid along preferential pathways (such as surface water drains and existing underground services) and groundwater. In addition, potential impact to the deeper groundwater aquifer was considered to be low to moderate due to the geology beneath the site.

Risks associated with other potential source-pathway-receptor linkages were considered to be low.

The risk assessment completed herein is preliminary in nature as it can only be based on an evaluation of qualitative data sources (i.e. not on intrusive site investigation works). Consequently, identification of potential risk does not necessarily indicate a risk to a receptor, rather that further assessment may be required to investigate assumptions made in the CSM and quantify whether a potential risk actually exists. Generally, where a low or very low risk has been identified further assessment may not be deemed necessary to assess a particular SPR linkage, although further

assessment may be deemed to be required to investigate CSM assumptions where the potential risk is considered to be low or very low due to the sensitivity of the receptor.


SOUTH
A
NORTH
A'
RESIDENTIAL LOW DENSITY WITH GARDENS
ESB SUB STATION
COMMERCIAL / RESIDENTIAL WITH GARDENS
RIVER PODDLE (CULVERTED)
ARMSTRONG ROAD
GARDENS
WALL
EXISTING UNDERGROUND SERVICES
GROVE ROAD
GRAND CANAL POSSIBLY CLAY LINED
BASEMENT
MADE GROUND (up to 4.00mbgl)
EXISTING UNDERGROUND SERVICES
APEC 1
POTENTIAL WATER TABLE
CLAY (up to 9.0mbgl)
LIMESTONE BEDROCK
Not to Scale
SOURCES
1 GROUND GAS
2 NON-VOLATILE CONTAMINANTS IN SOIL
3 CONTAMINANTS IN GROUNDWATER
PATHWAYS
1 GROUND GAS MIGRATION
2 DERMAL CONTACT / DUST INGESTION
3 PERMEATION OF AND MIGRATION ALONG EXISTING UNDERGROUND SERVICES
4 LEACHING FROM SOIL TO GROUNDWATER
5 VERTICAL & HORIZONTAL MIGRATION OF CONTAMINATED GROUNDWATER
6 MIGRATION AND LEACHING TO SURFACE WATER
RECEPTORS
A RESIDENTIAL / COMMERCIAL SITE USERS
B SHALLOW GROUNDWATER
C BEDROCK GROUNDWATER
D SURFACE WATER
NOTES:
FOR INFORMATION
ELECTRICITY SUPPLY BOARD
Francis Street
Harlod's Cross 110 kV
FIGURE 3
CONCEPTUAL SITE MODEL
AECOM
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EPA Contaminated Land and Groundwater Risk Assessment Methodology

Table 1. EPA Methodology

Stage	Methodology	Report Reference	Report Date	Status
Stage 1: Site Characterisation and Assessment				
1.1	Preliminary Site Assessment	PR-427640_ACM_RP_ENV_007	10 January 2020	Final
1.2	Detailed Site Assessment			
1.3	Quantitative Risk Assessment			
Stage 2: Corrective Action and Feasibility Design				
2.1	Outline Corrective Action Strategy			
2.2	Feasibility Study and Outline Design			
2.3	Detailed Design			
2.4	Final Strategy and Implementation Plan			
Stage 3: Corrective Action Implementation and Aftercare				
3.1	Enabling Works			
3.2	Corrective Action Implementation and Verification			
3.3	Aftercare			

Source: EPA Guidance on the Management of Contaminated Land at EPA Sites

1. Introduction

AECOM Ireland Limited (AECOM) is pleased to present this preliminary site assessment (PSA) completed on behalf of Electricity Supply Board (ESB) for a site adjacent to an ESB substation at Harold's Cross, Dublin 6, Ireland (the site).

This report was commissioned by ESB under a request for proposal (RFP) issued on 26 June 2019 (Ref. Qd-354120-01R460_002-001-001) and carried out in accordance with AECOM proposal reference PR-427640_ACM_PL_ENV_001_3, dated 03 July 2019. AECOM understand that ESB has undertaken these works on behalf of ESB Networks.

1.1 Project Background

ESB Networks operates and maintains a network of High Voltage (HV) underground cables of over 1,600 kilometres (km) across Ireland, of which approximately 175 km are insulated by a cable fluid. The majority of the fluid filled cables are located in urban settings across Dublin City and Cork City. The remainder are located outside these areas with limited numbers of fluid filled cables in other counties.

The length of each cable route varies and cable routes frequently extend across county boundaries. The cable fluid acts as an electrical insulator and aids the conduction of heat away from the conductor allowing the cable to be run more efficiently. Fluid filled cables are largely located in urban/suburban areas and so are particularly vulnerable to third party interference or damage. Over time cables can develop leaks due to corrosion/fracture/defects in the cable sheath and in joints and terminations. When such leaks occur there is potential for pollution to occur to surface water, groundwater, soils and ecology.

A leak was identified by ESB at the site in July 2011 and repaired in November 2014. AECOM understand that the fluid type lost from the cable was a mixture of linear alkyl benzene (LAB) and mineral oil based products.

The site location is presented in Figure 1 and the site layout showing the site is presented in Figure 2.

1.2 Project Objective

The assessment reported herein comprises the first step of Stage 1: Site Characterisation & Assessment – Preliminary Site Assessment (PSA) and was carried out in accordance with *EPA Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites (July 2013),* and specifically the Guideline Template for Preliminary Site Assessment Report. This guidance draws on the *EPA Code of Practice (CoP), Code of Reference for Unregulated Waste Disposal Sites (2007*) and *UK Environment Agency, Model Procedures for the Management of Land Contamination, Contaminated Land Report (CLR) 11 (September 2004).*

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- Develop a preliminary conceptual site model (CSM) based on an overall assessment of each of these elements above.

The preliminary CSM will then be used to identify potential risks to human health (site users and/or nearby residents) and controlled waters (i.e. groundwater and surface water) which may be

associated with a fluid leak from the identified location. It should be noted that this stage of the risk assessment process is based mostly on qualitative information sources and identification of a potential risk at this stage does not necessarily indicate the presence of a risk, but rather the need for further assessment.

A table cross referencing the template headings from the EPA Guidance Template and where the corresponding information is reported herein is presented in Appendix B.

2. Scope of Work

To achieve the above objective, the following scope of work was undertaken:

- A site walkover by AECOM staff (completed on 11 July 2019);
- A desktop review of site history to identify areas of potential environmental concern (APECs);
- A desktop review of publicly available information regarding the site's environmental setting and sensitivity, including:
  - Geological Survey of Ireland (GSI) Groundwater Public Viewer Maps (https://dcenr.maps.arcgis.com/apps/MapSeries), accessed 04 & 15 July 2019;
  - EPA Geoportal Site (https://gis.epa.ie/EPAMaps), accessed 04 &15 July 2019;
  - EPA Incidents Database (https://www.epa.ie/newsandevents/incidents/recent/), accessed 04 July 2019;
  - Ordnance Survey of Ireland (OSI) (http://geohive.ie), accessed 04 July 2019;
  - Glucksman Map Library, Trinity College, Dublin, accessed 17 July 2019;
  - Office of Public Works (OPW) Flood Maps (http://www.floodinfo.ie), accessed 04 July 2019;
  - National Parks and Wildlife Service (NPWS) (http://webgis.npws.ie/npwsviewer/), accessed 04 July 2019;
  - National Waste Collection Permit Office (NWCPO) website http://www.nwcpo.ie/, accessed 04 July 2019;
- A review of information provided by ESB in the RFP; and
- Data assessment and reporting.

3. Environmental Setting

3.1 Topography

The site is located 50 m south of the Grand Canal in the Harold's Cross area of Dublin's south inner city, Dublin 6 (ITM 714875 732371). The north and south banks of the Grand Canal are low-lying at approximately 23 m above ordnance datum (m OD), where the surrounding topography is generally flat and urbanised.

3.2 Geology

The Teagasc Soils Map indicates that the site is underlain by made ground. The Quaternary geology of the site as mapped by the GSI is comprised of till derived from the underlying limestone bedrock.

The GSI Bedrock Geology Map (scale 1:100,000) indicates that the site is underlain by dark limestone and shale of the Lucan Formation. The formation comprises dark-grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. The beds are predominantly fine-grained distal turbidites in the north Dublin Basin. The formation ranges from 300 m to 800 m in thickness.

A number of geotechnical records are located within the vicinity of the site. Immediately adjacent to the site on the south bank of the Grand Canal on the Harold's Cross Road (ITM 714838 732386), nine cable percussion borehole records (R961) show the stratigraphic sequence as being fill/made ground varying in depth from 0.7 metres below ground level (m bgl) to 4.35 m bgl, underlain by stiff grey, silty,

gravelly clay to a maximum depth of 8.6 m. Bedrock was recorded as 'presumed' in seven of the boreholes ranging in depths from 2.6 m bgl to 8.6 m bgl.

3.3 Hydrology

3.3.1 Surface Water Features

The site lies within the lower catchment of the River Liffey and Dublin Bay, which covers an area of 1,624 km^2.

The closest surface water body to the site is the Grand Canal (a proposed Natural Heritage Area (pNHA), Site Code 002104) located 50 m north of the leak location. The canal flows to the east and discharges to the River Liffey Estuary approximately 1.7 km northeast of the site, which flows into South Dublin Bay (an SAC). This comprises the following protected sites:

- South Dublin Bay Special Area of Conservation (SAC) (Site Code 000210);
- South Dublin Bay and River Tolka Special Protection Area (SPA) (Site Code 004024); and
- South Dublin Bay proposed Natural Heritage Area (pNHA) (Site Code 000210).

As impervious materials are generally used to line canals during construction, it is not considered likely that the Grand Canal is in hydrological continuity with groundwater in the area.

The Poddle River is the closest natural surface water feature to the site and is culverted along its course in the vicinity of the site. It is located approximately 200 m to the west of the site where it flows in a northerly direction before discharging into the River Liffey. Given the relatively short distance between the leak location and the Poddle River, it is considered that there may potential for an indirect connection via migration along preferential flow pathways (such as surface water drains and along utilities).

Given their proximity to the site, both the Grand Canal and the Poddle River are considered to be sensitive surface water receptors.

3.3.2 Surface Water Quality

The Grand Canal, which bounds the site to the south, is referred to as an Artificial Water Body (AWB) by the EPA under the Water Framework Directive (WFD). Waterways Ireland assess the biological quality of the Grand Canal, which along the section adjacent to the site during the period 2015 – 2017 was classified as 'Good' quality[1].

The WFD status of the Poddle River is characterised as 'at risk' of not meeting its WFD objectives. The most recent reported EPA water quality status of the Poddle River (monitoring station 'The Priory' Kimmage Road) is a Q Value of 3 and a rating 'Poor'.

The WFD status of both the upper and lower sections of the Liffey Estuary (classified as a Transitional Water Body) is 'Moderate' and 'at risk' of not meeting WFD objectives. The most recent reported EPA water quality status of the River Liffey (monitoring station 'Island bridge UCD boat club) is a Q Value of 3 and a rating 'Poor'.

3.3.3 Flooding

According to OPW Flood Maps, the site locality does not lie within the "River – Low Probability", "River – Medium Probability" or "River – High Probability" modelled extent of land that might be flooded by rivers in a moderate to very extreme event. However, the surrounding area to the south of the site lies within the "River – Low Probability", "River – Medium Probability" and "River – High Probability" in the Harold's Cross Mount Jerome Cemetery vicinity.

The area is not in close proximity to the extent of land affected by coastal flood events.

[1] EPA, *Water Quality in 2017, An Indicators Report*, 2018

3.4 Hydrogeology

3.4.1 Aquifer Classification

According to the GSI, the bedrock aquifer beneath the site is classified as a Locally Important Aquifer. The bedrock underlying the site is moderately productive in local zones. The soil permeability in the surrounding area is low; consequently the groundwater recharge in this aquifer is estimated by the GSI to be approximately 60 millimetres/year (mm/yr).

Regional groundwater flow direction is likely to be to the north and northeast towards the River Liffey and South Dublin Bay. A more detailed site assessment would be required to assess the local groundwater flow regime.

According to the GSI wells and springs database there are no springs and one groundwater well located within 1 km of the site. The well is located approximately 850 m to the east of the site and is recorded as domestic use with an 'good' yield of 109 m^3/day.

The site is not mapped as being located within a Source Protection Area for either a public water supply or a group water supply scheme.

3.4.2 Groundwater Vulnerability

The GSI National Groundwater Vulnerability Mapping identified some spatial variation in groundwater vulnerabilities within the site area, varying from moderate to high to extreme in small localised zones. The site itself is classified as moderate; however, 50 m southwest, the localised area (100 m in diameter) is classified as high to extreme. The variation in vulnerability classification correlates to the variable depth and nature of overburden.

3.4.3 Groundwater Quality

Groundwater beneath the site is part of the Dublin Groundwater Body (IE_EA_G_008) which, according to the EPA website, is classified as having 'Good' status and is characterised as being not at risk.

3.5 Natural Habitats and Protected Species

The Grand Canal is located approximately 750 m south of the site and is a pNHA.

The River Liffey is located approximately 980 m north of the site. The River Liffey flows easterly into South Dublin Bay (an SAC, SPA and pNHA). Site Codes for each of these protected areas are provided in Section 3.3.1.

There are no other protected areas within 1 km of the site.

3.6 Regulatory Database Search

3.6.1 National Waste Collection Permit Office

The National Waste Collection Permit Office (NWCPO) website was reviewed to identify authorised waste facilities within the jurisdiction of Dublin City County Council in the vicinity of the site. The NWCPO website indicated that there are two waste permitted facilities within 1 km of the site as summarised in Table 2 below.

Table 2 Dublin City County Council Waste Permitted Facilities within 1 km of the site

Authorisation Number	Facility Name	Location	Waste Activity
WFP-DC-11-0022-02	Mullen Scrap	31 & 32 Upper Clanbrassil Street Dublin 8	Scrap metal recycling
WFP-DC-11-0028-02	Mitchell Taylor Exports Limited	Newmarket Dublin 8	Edible oil and fat

3.6.2 Storm Water Discharges

Two Irish Water storm water overflow discharge locations have been identified within 1 km of the site, as summarised in Table 3 below.

Table 3. Storm Water Discharges

Emission ID	Name	Register No.
TPEFF0700D0034SW166	Ringsend	D0034-01
TPEFF0700D0034SW227	Ringsend	D0034-01

3.6.3 EPA Licensing

The EPA database of Industrial Licence (IE), Integrated Pollution Control (IPC) and Waste licences was consulted and there is one IEL facility within 1 km of the site.

Table 4 EPA Licenced Facilities within 1 km of the Site

IE Register Number	Facility Name	Location	Distance to Site	Activity
P0305-01, IE, Licensed	B.G. Flexible Packaging Limited	South Circular Road, Dolphin's Barn, Dublin 8, Dublin	1 km northeast	Industry

According to the EPA website, there have been no reported environmental incidents within the vicinity of the site from at least 2010.

3.7 Environmental Sensitivity

The overall environmental sensitivity of the site is considered to be moderate. Identified sensitive receptors within 1 km of the site include:

- The Grand Canal located 50 m north of the site, although this may be protected by low permeability clay (natural and/or engineered when the canal was constructed);
- The Poddle river located approximately 200 m to the east of the site, although this may be protected by low permeability clay deposits which are likely to be encountered beneath the site; and
- The groundwater aquifer beneath the site, although this may also be protected by low permeability clay deposits which are likely to be encountered beneath the site.

4. Source Audit Findings

4.1 Site Description

The site is located in the Harold's Cross area of Dublin's south inner city. The site consists of a 200 m section of a 110kV fluid filled cable beneath Harold's Cross Road and Parnell Road (see Figure 2). This is part of a cable installed in 1964, which is 2.2 km in its entire length. The location of the leak for this site is indicated to be within the ESB substation at Harold's Cross, situated 50 m south of the Grand Canal (ITM 714873 732359), at cable joint No.1 or Joint No.7.

No visual evidence of impact from the cable fluid release was noted in the publicly accessible areas during the site walkover.

4.2 Surrounding Land Use

Land use in the immediate area of the site is predominantly residential and commercial, in a heavily urbanised area of South Dublin. One bridge crossing is located adjacent to the site (Emmet Bridge) crossing the Grand Canal and connecting Harold's Cross Road (south) to Clanbrassil Street Upper (north).

The site locality is zoned for several uses under the Dublin City Development Plan 2016-2022 including industrial, enterprise, employment, general community services, facility uses, residential and recreational uses.

Table 5 Surrounding Land Use

Location	Description
North	The surrounding land use to the north is predominantly commercial and residential. Commercial buildings include office buildings, cafes, restaurants, bars and shops. Smaller, typically terraced and semi-detached, residential buildings are interspersed. "Gordons Drive In Fuel Depot and Home Heating Oil" premises are located on northern side of the Grand Canal to the north of the site. The Dublin Liberties Distillery and the Teeling Whiskey Distillery are located approximate 1 km north of the site. Griffith College and Griffith Conference Centre are located 100 m north of the site off South Circular Road.
East	The surrounding land use to the east is predominantly commercial and residential. Immediately east of the site are the terraced dwellings of 'Harold's Cross Cottages', beyond these lie the Cathal Brugha Barracks and St. Mary's College Senior School located approximately 600 m from the site. To the east of the site, on the north side of the Grand Canal, residential buildings include terraced and semi-detached buildings are located, while commercial buildings include restaurants, shops, offices and museums.
South	The surrounding land use to the south is predominantly residential and commercial. Residential buildings are typically terraced and semi-detached. Commercial buildings include shops, bars, and restaurants. Sporting grounds and parks are located south of the site (Portobello GAA Club, Kenilworth Bowling Club). Mount Jerome Cemetery and Crematorium is located approximate 500 m south of the site, with the cemetery covering an approximate area of 0.185 sq. km.
West	The surrounding land use to the west is predominantly residential and commercial. Residential buildings are typically terraced or semi-detached. Properties 1-7, located on Parnell Road to the west of the site, have basements; no other basements were observed during the site walkover. Commercial buildings include offices, shops, restaurant and bars. An Applegreen Service Station is located 350 m west of the site on Parnell Road, on the south bank of the Grand Canal. There is an ESB Depot located approximately 350 m from the site on 6 Parnell Avenue. Coombe Women's Hospital is located 1 km to the northwest of the site.

4.3 Historic Site Review

4.3.1 Historic Maps and Aerial Photograph Review

A review of historical maps and aerial photographs available from OSI, Glucksman Map Library (Trinity College Dublin) and Google Earth was completed. A summary of the findings of land use within a 1 km radius is presented in Table 6.

Table 6 Historic Map and Aerial Photograph Review

Year	Description
1829 to 1842 (OSI)	The site and the immediate area appear to be partially developed. Green fields with low to moderate residential development characterises the area to the northeast and northwest. Approximately 200 m to the northwest of the site is the historical Richmond Penitentiary. An historical glue and cotton factory can be seen approximately 600 m northwest of the site in green field areas. A reservoir can be seen approximately 300 m northeast of the site and is recorded as the "City Basin". A small water body can be seen adjacent to this basin in Portobello Gardens. The area to the north of the site is predominantly occupied by green fields and gardens with residential buildings seen along Clanbrassil Street Upper. The land use to the south is characterised by low to moderate residential development with the densest residential buildings seen along Harold's Cross Road. The remaining land is predominantly green fields, parks and woodlands. Approximately 200 m southeast of the site is the Portobello Barracks. Two small water bodies, approximately 30 - 60m wide, are seen approximately 100 m southwest of the site. Mount Jerome Cemetery is seen approximately 500 m to the southwest of the site.
1865 (1:2,500) Trinity Maps	The site is developed with a roadway to the east that runs north to south over the Grand Canal by Clanbrassil Bridge. Jessamine Cottage is located to the south of the site. Mount Drummond Avenue is also to the south, running west to the southeast Portobello Barracks is located to the southeast of the site.

Year	Description
1882 (Five feet to one statute mile) Trinity Maps	Wharton Terrace is immediately to the north. Southwest of the site is Greenmount Distillery; west of the Greenmount Distillery is an industrial development estate. Patent Brick Works is located to the east of the site. There are no other major changes compared to the previous historical map.
1907 (Five feet to one statute mile) Trinity Maps	Greenmount Distillery is replaced by the Greenmount Oil Works and there is a tank located on this site. To the west of the Greenmount Oil Works is Greenmount Spinning Manufactory. Clanbrassil Bridge is now Harold's Cross Bridge.
1936 (1:1.250) Trinity Maps	There are no major changes from the previous historical maps. There is a tramway to the east of the site. Harold's Cross Bridge is now Robert Emmet Bridge. Greenmount Spinning Manufactory is now the Greenmount & Boyne Weaving Manufactory. There are three covered tanks in Portobello Barracks.
1968 (1:1,000) Trinity Maps	There are no major changes compared to the previous historical map. The road running to the east is now labelled Harold's Cross Road. Portobello Barracks is now the Cathal Brugha Barracks.
1988 (1:1,000) Trinity Maps	The only significant change on this map is that there is now an electricity substation located at the site.
1888 to 1913 (OSI)	There are significant developments from the previous historical maps, most notably the increase in residential housing and urban development. To the north of the immediate site sees an increase in residential housing and a reduction in suburban gardens and green fields. New residential buildings are typically terraced. The historical Richmond Penitentiary is now recorded as the Wellington Barracks approximately 200 m northwest of the site. Grenville Tobacco and Snuff Manufactory is located 900 m northwest of the site. The surrounding land to the south of the site also sees an increase in residential buildings with some green fields and woodlands remaining. Mount Jerome Cemetery is seen approximately 500 m southwest of the site.
1995 (OSI)	Significant urban development can be seen in the 1995 aerial photos when compared to the historical maps, with a notable increase in commercial and residential development to the south of the site and the Grand Canal. To the north of the site and the Grand Canal, sees a further reduction in parks and green field areas, with a further increase in residential housing and commercial buildings. Historic park lands and green field areas are now occupied by residential and commercial buildings. The Grand Canal water course appears unchanged to present day.
2000 (OSI)	There are little to no changes of urban development in the immediate vicinity of the site seen in the 2000 aerial photos. The surrounding land appears unchanged, with the north and south surrounding land remaining heavily urbanised with residential and commercial buildings. The Grand Canal appears unchanged to present day.
2005 (OSI)	Very few changes appear to have taken place at the site between 2000 and 2005 in relation to urban development. The most notable development is the appearance of the Residents Hall of Griffith College Dublin located 200 m northwest of the site on the north banks of the Grand Canal. Approximately 60 m north of the site is the development of the Portobello Wharf apartments. The north and south surrounding land remains heavily urbanised with commercial and residential buildings.
2012 (Google Earth)	Limited changes appear to have taken place at the site between 2005 and 2012 with the immediate vicinity remaining unchanged and heavily urbanized with residential and commercial development.

4.4 Potential Sources

4.4.1 Cable Fluid Source

Information on the potential fluid released was provided in the ESB RFP document. Typically, fluid filled cables are installed in trenches approximately 1.2 m deep, 1.1 m wide and the depth to the top of the cable is typically 0.9 m – 1 m. The cables are typically surrounded by 0.35 m of sand and then the trench is backfilled with either clause 804 fill or trench arisings.

Based on information from the GSI, it is likely that the cable on this site is installed within sand and backfilled with made ground, therefore leaked fluid is likely to have migrated through either the sand surround or made ground (if sufficient permeability).

It is estimated that 14,617 litres of cable fluid was released between July 2011 and November 2014. It is assumed, based on records and Safety Data Sheets (SDS) provided to AECOM by ESB, that the fluid lost was a mixture of the following cable fluid products:

- 'T 3788' manufactured by H&R ESP Ltd of Milton Keynes in the UK;
- 'Masse 106' produced by Felten & Guilleaume Energietechnik AG in Germany; and
- Shell Diala Cable Oil.

T 3788 is a low viscosity blend of linear alkyl benzenes (LABs) (CAS # 67774-74-7). Shell Diala Cable Oil has the same CAS # as T 3788, so is essentially the same product but made by a different manufacturer. The SDS for Masse 106 does not give its CAS # or details of its composition but states that it is a blend of highly refined mineral oils and additives.

4.4.1.1 Linear Alkyl Benzenes

Physical and Chemical Properties

LABs have side alkyl chains of 10-13 carbon atoms in length attached to a benzene ring. The alkyl chain may be attached to the benzene ring at any position except the terminal (end) position. As LABs are a mixture, their precise physio-chemical properties are dependent upon the components of the mixture, but they are generally colourless, oily liquids, less dense than water, with very low aqueous solubility and low volatility. Their potential spreading in the ground will therefore be similar to other light non-aqueous phase liquids (LNAPL) but with very little mass loss due to volatilisation or dissolution.

Information relating to the nature and toxicity of linear alkyl benzenes has been primarily sourced from the following documents:

- Safety Data Sheet (SDS) for T 3788;
- European Union Risk Assessment Report, Benzene, C10-13 alkyl derivatives, 20 June 1997; and
- Organisation for Economic Co-operation and Development (OECD) Screening Information Datasets (SIDS) Initial Assessment Reports for High Production Volume Chemicals, United Nations Environment Programme, Chemicals Branch, May 2002.

The table below summarises the basic physical and chemical properties of LABs.

Table 7 Linear Alkyl Benzene Physical and Chemical Properties

Property	Description
Molecular Weight	239-243 g/mol
Melting Point	<-70^{o}C
Boiling Point	251-320^{o}C @ 1 atm (OECD)
Vapour Pressure @ 25^{o}C	6.5 x 10^{-5} kPa (OECD)
Aqueous Solubility	0.041 mg/L (OECD)
Henry's Law Constant	9.34 x 10^{-4} atm-m^3/mol (OECD)
Density	0.86 @ 20^{o}C
Flash Point	140^{o}C
Explosive Properties	None

LAB (C12) has a calculated octanol-water partition coefficient (Koc) of 2.2x10^4 and is classified by the EU risk assessment as a high adsorptive substance.

Degradation

The OECD SIDS (2002) review concluded that LABs undergo "rapid primary biodegradation in natural waters and complete mineralisation by micro-organisms under aerobic conditions". A measured half-

life in water of four to nine days was reported. Microorganisms in sewage sludge and soil were reported to rapidly and completely biodegrade LABs. Anaerobic biodegradation was inferred to occur, but at a slow rate.

Degradation in soil is expected to occur but to be slower than in surface water due to the much slower mixing and the limited availability of oxygen. Where oxygen is available, aerobic degradation would occur at the fringes of a body of LNAPL in the soil/groundwater, producing elevated carbon dioxide levels in the soil and potentially elevated alkalinity in the groundwater. In the absence of oxygen, anaerobic degradation may occur by methanogenesis or by reduction of sulphate, nitrate, ferric iron (Fe^{3+}) and manganese (Mn^{3+}). These processes could lead to reducing conditions in the groundwater, with depleted concentrations of sulphate (SO_4^-) and nitrate (NO_3^-) and increased concentrations of dissolved methane (CH_4), ferrous iron (Fe^{2+}) and dissolved manganese (Mn^{2+}). Such conditions would be expected to occur close to the LNAPL body and locally downgradient. With increased distance from the LNAPL, mixing with the surrounding groundwater and aeration from seasonal fluctuations and groundwater recharge would gradually allow ambient (most likely oxidised) conditions to be re-established.

Toxicity

According to the OECD review, LABs were assessed to be not acutely toxic to human health. Data from repeat exposure, reproductive and genotoxicity studies also indicated a low potential for toxic effects. The OECD concluded that “Linear alkyl benzenes do not present any significant acute or sub-chronic health effects by various exposure routes. LAB is not teratogenic (i.e. causing birth defects) and does not produce selective reproductive toxicity.”

Laboratory studies have shown that repeated exposure to LABs may be irritating to the skin, and the SDS recommends the use of gloves when handling LABs. The low vapour pressure of LABs limits the potential for exposure via inhalation, and this is not expected to be a significant exposure route at normal temperatures.

Eco-toxicity studies reviewed by the OECD found no acute toxic effects on aquatic species tested at concentrations up to and exceeding solubility limits. The only exception to this was for the water flea Daphnia magna. No data was available regarding terrestrial eco-toxicity studies.

Due to its high biodegradability and rapid metabolism, the OECD concluded that LABs were of little concern for adverse environmental impact. The OECD and EU reviews of LABs both concluded that LABs were a low priority for further investigation.

4.4.1.2 Masse 106 Mineral Oil

Information on Masse 106 has been obtained from a Safety Data Sheet (SDS) dated 1995 provided by ESB.

Physical and Chemical Properties

Masse 106 is understood to be a blend of highly refined mineral oils and additives. The SDS does not provide information on the identity of the mineral oils or additives, or on their proportions within the oil.

The SDS states that containers of Masse 106 should be kept tightly closed and in a well-ventilated space and that it should be used only in well-ventilated areas. This suggests that Masse 106 may contain volatile components.

The table below summarises information from the SDS for Masse 106.

Table 8 Masse 106 Physical and Chemical Properties

Property	Description
Vapour Pressure @ 20°C	<0.01 hPa
Aqueous Solubility	negligible
Density	888 kg/m^3

Property	Description
Flash Point	145°C
Flammability range	0.6% volume to 6.5% volume
Kinematic viscosity@ 40°C	8.5 mm^2/s

Based on these properties, Masse 106 would behave as a relatively viscous LNAPL in the ground. The SDS states that if the product enters soil it will be adsorbed to soil particles and not be mobile.

Degradation

The SDS for Masse 106 indicates that it is not readily biodegradable. Nevertheless, as it is expected to be comprised mainly of petroleum hydrocarbon compounds, gradual degradation is expected to occur, especially in water. The rate of biodegradation is likely to depend on the availability of oxygen and of favourable geochemical conditions. As with LABs and with other petroleum hydrocarbons, where oxygen is available, aerobic degradation would be expected to occur at the fringes of a body of LNAPL in the soil/groundwater, producing elevated carbon dioxide levels in the soil and potentially elevated alkalinity in the groundwater. In the absence of oxygen, anaerobic degradation may occur by methanogenesis or by reduction of sulphate, nitrate, ferric iron (Fe^{3+}) and manganese (Mn^{3+}). These processes could lead to reducing conditions in the groundwater, with depleted concentrations of sulphate (SO_4^-) and nitrate (NO_3^-) and increased concentrations of dissolved methane (CH_4), ferrous iron (Fe^{2+}) and dissolved manganese (Mn^{2+}). Such conditions would be expected to occur close to the LNAPL body and locally downgradient. With increased distance from the LNAPL, mixing with the surrounding groundwater and aeration from seasonal fluctuations and groundwater recharge would gradually allow ambient (most likely oxidised) conditions to be re-established.

Toxicity

The 1995 SDS for Masse 106 states that the components of the preparation are not expected to impart hazardous properties to the product. Whilst this suggests the product is not hazardous, it is noted that standards for hazard assessment and SDS production have evolved since 1995 and therefore the information cannot be relied upon with full confidence in relation to current standards for hazard assessment.

The SDS indicates that Masse 106 is expected to be practically non-toxic to aquatic organisms.

In relation to human toxicity, the SDS gives the following information:

- It is expected to be slightly irritant, so all forms of skin contact should be minimised. It is not expected to be a skin sensitiser.
- Respiratory protection is not normally required but it should be used only in well-ventilated spaces. It is based on mineral oils and other components not known to be carcinogenic.

4.4.1.3 Conclusion

Based on the above, underground leakage of LABs is not likely to lead to significant issues from dissolved hydrocarbons or vapours. Although the components of Masse 106 are not known and its aqueous solubility is stated on the SDS as “negligible”, it is unclear what this means in the context of dissolution of components from a NAPL. Based on the requirement for it to be used only in well-ventilated spaces, it appears that Masse 106 contains some relatively volatile components.

The main concern from LABs and a concern also for mineral oils such as Masse 106 is the potential for them to migrate and spread as a LNAPL, downwards through unsaturated soil that is present and then laterally in the vicinity of the groundwater table. The extent of LNAPL migration will depend on the properties of the surrounding soil and on the saturation and pressure distribution within the LNAPL. These in turn would depend on the quantity of cable fluid lost and the timescale over which the leakage occurred.

Vapour impacts are considered to be unlikely from LABs but could be of concern for Masse 106.

Degradation of the cable fluid may lead to the generation of ground gas (including carbon dioxide and methane) and affect groundwater chemistry in the vicinity and locally downgradient of the LNAPL.

Given that a mixture of LABs and a mineral oil based cable fluid have been used in the past, potential contaminants of concern associated with mineral oil based fluids would include the following:

- Total Petroleum Hydrocarbons (TPH);
- Benzene, toluene, ethylbenzene and xylene (BTEX) compounds;
- Volatile organic compounds (VOCs);
- Semi volatile organic compounds (SVOCs); and
- Polychlorinated biphenyls (PCBs).

4.4.2 Potential Off-Site Sources of Contamination

Based on a review of historic maps and the current site setting, land use surrounding the site has been principally residential and commercial. The following potential off-site sources of contamination have been identified as part of the assessment works completed:

- Petrol station and ESB depot present along Parnell Road along the southern side of the cable route and to the west of the leak site;
- Gordon's fuel depot on northern side of the Grand Canal;
- Historic Barracks to the east and west of the site;
- Fill materials (understood to be up to 4.35 m bgl) present in the surrounding area; and
- Fuel / chemicals (e.g. for back-up generators) present in commercial buildings around the site.

4.5 Source Audit Summary

Based on the assessment works completed, the primary APEC for this site comprises the leak location identified by ESB. This is presented in Figure 2 and a description is provided in Table 9.

Table 9 Area of Potential Environmental Concern

Number	APEC	Potential Contaminants of Concern	Potential Media Impacted
1	Leak at (17) Francis street - Harold's Cross 110 kV (July 2011 – November 2014)	LABs TPH BTEX VOCs SVOCs PCBs	Soil Groundwater Soil Vapour Ground Gas

Other potential off-site sources have also been identified based on the type of activity. However, no information is available for these sites therefore the only APEC assessed herein is the leak site at the ESB substation.

5. Conceptual Site Model

A preliminary Conceptual Site Model (CSM) has been developed identifying potential contaminant sources, contaminant migration pathways and potential receptors.

In the context of land contamination, there are three essential elements to any risk:

1. A **source** – a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of controlled waters;
2. A **receptor** – in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body; and
3. A **pathway** – a route or means by which a receptor can be exposed to, or affected by, a contaminant.

Each of these elements can exist independently, but they create a risk only where they are linked together, so that a particular contaminant affects a particular receptor through a particular pathway. This kind of linked combination of contaminant–pathway–receptor is described as a pollutant linkage. The preliminary CSM was developed to describe viable source-pathway-receptor (SPR) linkages for the site, which are presented in Table 14 below.

By considering potential SPR linkages, an assessment of the human health and controlled water risks is made with reference to the significance and degree of the risk. The risk assessment has been undertaken with reference to BS10175-2011 + A2 2017 and CIRIA Document C552: 'Contaminated Land Risk assessment - A Guide to Good Practice' (2001).

The preliminary risk assessment completed for this site is based on consideration of whether a potential source of contamination can reach a receptor, and hence whether it is of major or minor significance. Considering that assessment works are still at preliminary stage and no intrusive investigation work has been completed, development of the preliminary CSM and assessment of potential risk is based on information provided by ESB on the nature of the leak, and on the AECOM site reconnaissance and desk based study. As such, only a qualitative assessment can be made around potential risks to receptors. This means that identification of potential risk does not necessarily indicate a risk to a receptor, rather that further assessment may be required to investigate assumptions made in the CSM and quantify whether a potential risk actually exists.

5.1 Qualitative Risk Assessment Methodology

A qualitative risk assessment has been carried out by assessing the severity of the potential consequence, taking into account both the potential severity of the hazard and the sensitivity of the target, based on the categories given in Table 10below.

Table 10 Potential Hazard Severity Definition

Category	Definition
Severe	Acute risks to human health, catastrophic damage to buildings/property, major pollution of controlled waters.
Medium	Chronic risk to human health, pollution of sensitive controlled waters, significant effects on sensitive ecosystems or species, significant damage to buildings or structures.
Mild	Pollution of non-sensitive waters, minor damage to buildings or structures.
Minor	Requirement for protective equipment during site works to mitigate health effects, damage to non-sensitive ecosystems or species.

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given in Table 11 below.

Table 11 Probability of Risk Definition

Category	Definition
High likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor.
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term.
Low likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable.

The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard as shown in the table below.

Table 12 Level of Risk for Potential Hazard Definition

	Potential Severity			
Probability of Risk	Severe	Medium	Mild	Minor
High	Very high	High	Moderate	Low/Moderate
Likely	High	Moderate	Low/Moderate	Low
Low	Moderate	Low/Moderate	Low	Very low
Unlikely	Low/Moderate	Low	Very low	Very low

A description of the levels of risk outlined in Table 12 is provided in the following table:

Table 13 Description of the Classified Risks and Likely Action Required

Level of Risk	Description
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in substantial liability. Urgent investigation and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required and remedial works may be necessary in the short term and are likely over the long term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild, if realised.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

5.2 Preliminary CSM Assumptions

Based on the findings of the desktop study, and information provide in the RFP by ESB, the following assumptions were made in development of the CSM:

- The fluid assumed (based on records provided) to have leaked from the cable is a mixture of LAB and a mineral oil based cable fluid;
- The leak is assumed to have occurred at a depth less than 2 m below ground;
- The geology beneath the site is assumed to comprise approximately 4.35 m of made ground underlain by clay up to a depth of 8.6 m bgl. Limestone bedrock is assumed to be present at a depth of approximately 8.6 m bgl;
- Groundwater is assumed to be present at relatively shallow depths within the made ground;
- It is assumed that the Grand Canal adjacent to the site is lined with a low permeability material such as clay, as was commonly used from the 1700s to early 20th Century to prevent leakage from the canal and thus loss of water level restricting navigation;
- It is assumed that there is no direct connection between the site and surface water bodies, however there may be an indirect connection with the Poddle River given its close proximity;
- Other below ground utilities including mains water are assumed to be present in the vicinity of the site; and
- It is assumed that commercial buildings adjacent to the site have no basements but that some residential properties to the west do.

The preliminary CSM is presented graphically in Figure 3.

Table 14 Conceptual Site Model

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
LAB / Volatile TPH and VOC concentrations in soils	Inhalation of vapours which have migrated from the ground to above ground buildings and basements.	Site users in a commercial/low to high density residential scenario.	Medium	Low Likelihood	Low / Moderate	Based on records provided, a mixture of LAB and mineral oil is assumed to be the cable fluid used. The low vapour pressure of LABs limits the potential for exposure via inhalation, and this is not expected to be a significant exposure route at normal temperatures. It is considered that there is a low to moderate risk from the inhalation of vapours from potential mineral oil-based products present beneath the site. Further assessment would be required to fully evaluate this potential risk.
NAPL and non-volatile TPH, VOC, SVOC and PCB concentrations in soils	Soil and dust ingestion from near surface soils. Dermal contact with near surface soils. Inhalation of fugitive dust from near surface soils. Ingestion of soils via consumption of vegetables grown in near surface soils.	Site users in a commercial/low to high density residential with plant uptake scenario.	Medium	Unlikely	Low	Based on the volume of cable fluid released and the assumed mixture of cable fluid used in the past, it is possible that a mineral based cable fluid may have migrated beneath low density residential houses with gardens or public open space adjacent to the canal. Given the likely depth to the cable, surface soils are unlikely to be affected and exposure via this pathways is not considered likely.
		Intrusive site workers.	Minor	Likely	Low	Workers carrying out intrusive works adjacent to the site may come into contact with mineral oil based NAPL and impacted soil, meaning there will be a requirement to wear personal protective equipment to mitigate against potential impacts. Given the relatively low toxicity of LABs (assessed to be not acutely toxic), exposure to LABs is not considered to represent a significant risk.
NAPL and TPH, VOC, SVOC and PCB concentrations in soils	Migration of ground gas generated from the degradation of the cable fluid to above ground buildings.	Site users in an industrial/commercial/low to high density residential scenario.	Severe	Low Likelihood	Moderate	If a significant source of NAPL (LAB or mineral oil) is present on groundwater, there is potential for ground gas to be generated from degradation processes. The likelihood of ground gas being generated in significant quantities is considered to be low, however given the potential severity of the impact, further assessment would be required to fully evaluate this potential risk.

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
NAPL and TPH, VOC, SVOC and PCB concentrations in soils	Permeation of LAB NAPL through plastic water supply pipes.	Site users in a commercial/low to high density residential with plant uptake scenario.	Medium	Unlikely	Low	Public water mains likely to be present in the vicinity of the leak, servicing commercial and residential properties have the potential to be impacted. With respect to LABs, the WHO drinking water guideline (DWG) for the relevant aromatic fraction[2] is 0.09 mg/l and as the solubility limit of LAB is 0.041 mg/L (OECD) i.e. less than the DWG, LAB cannot dissolve into the water supply above this level. Furthermore, water will be moving rapidly in the pipe under pressurised conditions making it unlikely to reach the solubility limit. In respect of the potential presence of mineral oil, the aqueous solubility of the known product used (Masse 106) is stated on the SDS as "negligible". It is unclear what this means in the context of dissolution of components from a NAPL ESB has consulted with Irish Water (statutory body responsible for water supply) regarding the potential risk for cable fluid present in the vicinity of water supply pipes. Following review of their records, AECOM understands that Irish Water do not have concerns regarding impact of water supplies from cable fluid leaks. It is therefore considered that the potential risk of a pollutant linkage being present is low. As a precaution, investigation works should be carried out as part of future assessment works to further assess this source-pathway-receptor linkage.
NAPL and TPH, VOC, SVOC and PCB concentrations in soils	Migration of potential contaminants along preferential flow pathways such as underground services and permeable backfill around the electricity cable.	Nearby surface water bodies including the Poddle River and Grand Canal.	Medium	Low Likelihood	Low / Moderate	It is understood that the leak at this location was repaired in November 2014. Given that there was no evidence of impact along the canal during the site walkover and no reported incidents of cable fluid release, it is likely that NAPL released from the cable has stabilised over the 5-year period since the leak was repaired. However, given the potential indirect connection between the site and the Poddle River, the risk to nearby surface waters is considered to be low to moderate.

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
NAPL and TPH, VOC, SVOC and PCB concentrations in soils	Migration of potential contaminants along preferential flow pathways such as underground services and permeable backfill around the electricity cable, and consequently vapour inhalation and / or ingestion, dermal contact.	Site users in a commercial/low to high density residential with plant uptake scenario.	Medium	Low Likelihood	Low / Moderate	Likely to be a high concentration of services present in the vicinity of the leak given the urban setting. If the soil / made ground around the leak is generally clay, the leaking fluid will likely have migrated mainly along any permeable backfill around the cable. The cable fluids used are likely to absorb strongly to aquifer materials (made ground and clay), consequently the potential for migration over significant distances is considered to be low to moderate. Further assessment would be required to fully evaluate this potential risk.
NAPL	Migration in saturated and unsaturated soil.	Groundwater beneath the site.	Medium	Likely	Moderate	Considering the volume of cable fluid released over the 39-month leak period, it is considered highly likely that shallow groundwater has been impacted. Impacts could occur due to the presence of NAPL and associated biodegradation products. Further works would be required to assess for the presence of NAPL in the vicinity of the leak location and fully evaluate this potential risk.
Dissolved phase leaching from NAPL or from soils containing elevated concentrations of TPH, VOCs, SVOCs and PCBs	Leaching from soil to groundwater. Vertical and horizontal migration of contaminants through groundwater. Horizontal migration of contaminants through groundwater to nearby surface water receptors.	Groundwater in superficial deposits beneath the site.	Medium	Likely	Moderate	Considering the volume of cable fluid released over the 39-month leak period, it is considered highly likely that shallow groundwater has been impacted. Further assessment would be required to quantify any impact from the presence dissolved phase contamination in groundwater.
LAB, TPH, VOC, SVOC and PCB concentrations in groundwater		Groundwater in limestone bedrock aquifer beneath the site.	Medium	Low Likelihood	Low / Moderate	Information on the local geology indicates the presence of underlying stiff clay, which would reduce vertical migration of groundwater to the bedrock aquifer. Further assessment would be required to fully evaluate this potential risk.

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
		Nearby surface water bodies including the Poddle River and Grand Canal.	Medium	Low Likelihood	Low / Moderate	The volume of cable fluid released could cause pollution of the Poddle River and Grand Canal. The potential risk to the Poddle River via this pathway is considered low to moderate given the potential indirect connection between the site and the Poddle River. Given the canal is likely lined with impermeable material, the likelihood of horizontal migration through to the canal waters is considered low. In addition, no evidence of impact from the cable fluid release was noted during the site walkover, with strong vegetation growth observed along the canal banks. Further assessment would be required to fully evaluate this potential risk.

6. Conclusions

AECOM completed a Preliminary Site Assessment of the site located beneath Harold's Cross Road and Parnell Road, Dublin 6. The objective of the works was to identify potential risks to human health and controlled waters that may be associated with a fluid leak from the identified location.

Based on the findings of the desktop study, the overall environmental sensitivity of the site is considered to be moderate. Identified sensitive receptors within 1 km of the site include:

- The Grand Canal located 50 m north of the site, although this may be protected by low permeability clay (natural and/or engineered when the canal was constructed);
- The Poddle river located approximately 200 m to the east of the site, although this may be protected by low permeability clay deposits which are likely to be encountered beneath the site; and
- The groundwater aquifer beneath the site, although this may also be protected by low permeability clay deposits which are likely to be encountered beneath the site.

It is estimated that 14,617 litres of cable fluid was released between July 2011 and November 2014. It is assumed, based on information provided to AECOM by ESB, that the fluid lost was a mixture of LAB and mineral oil based products. Due to its high biodegradability, lower volatility and low solubility, it is considered that LABs are of less concern for adverse environmental impact than mineral oil based products. Given that there is potential for a mixture of both types of cable fluids to have been used at this site, potential contaminants of concern have been identified. A summary of the source audit findings is as follows:

Table 15 Area of Potential Environmental Concern

Number	APEC	Potential Contaminants of Concern	Potential Media Impacted
1	Leak at (17) Francis Street - Harold's Cross – Ringsend 110 kV (July 2011 – November 2014)	LABs TPH BTEX VOCs SVOCs PCBs	Soil Groundwater Soil Vapour Ground Gas

The preliminary CSM developed for the site looked at potential source-pathway-receptor linkages identified during the assessment works and identified a moderate potential risk to the following receptors:

- Site users due to the potential for ground gas generation resulting from degradation of NAPL (if present); and
- Shallow groundwater due to potential impact to groundwater chemistry from the presence of NAPL and associated biodegradation products.

A low to moderate risk was identified to site users from the potential for vapour migration from mineral oil based cable fluid.

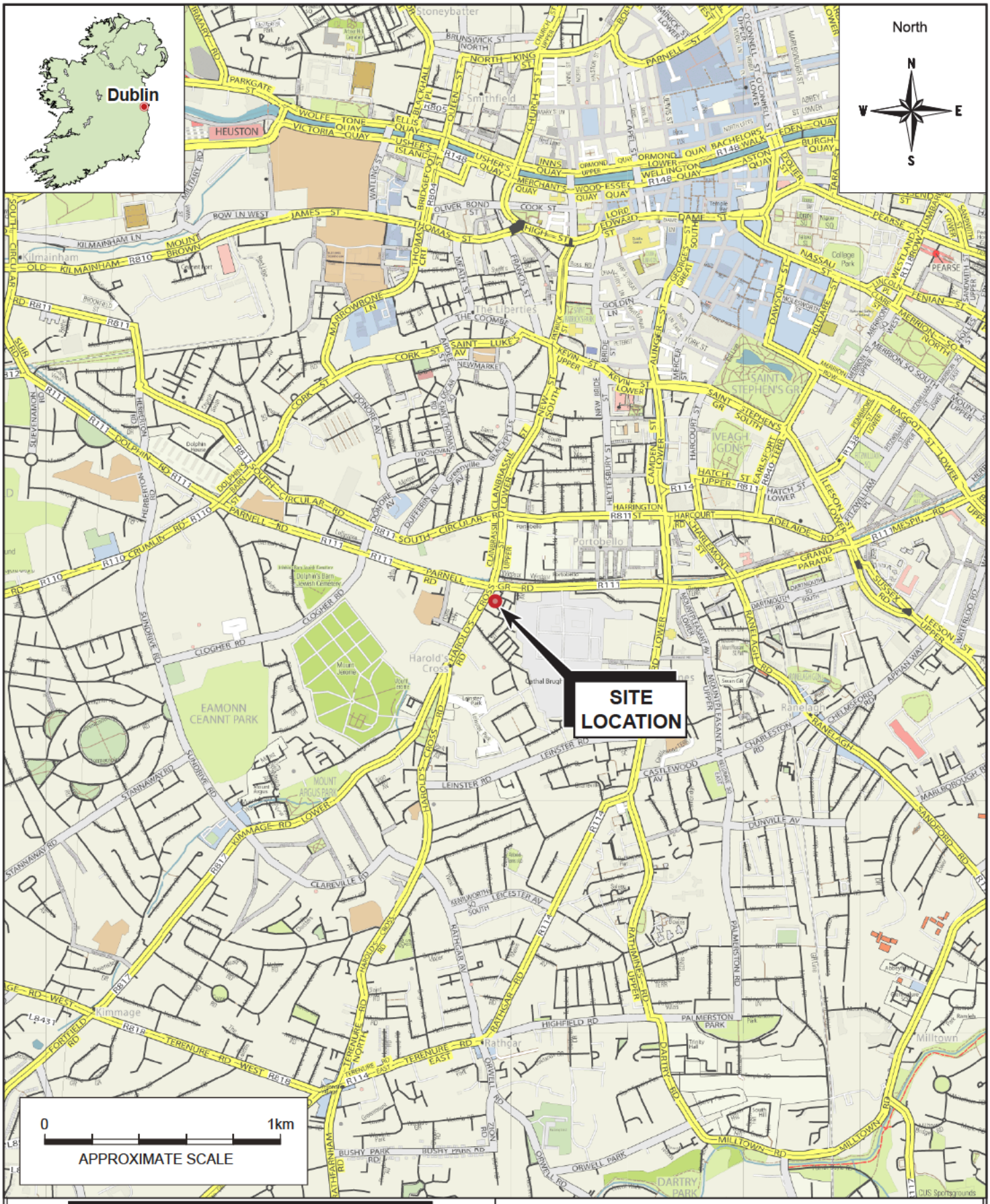
Potential risk to the Grand Canal was considered to be low to moderate given that canals are generally lined with impermeable materials which would prevent the migration of NAPL into the canal from groundwater. A low to moderate risk was identified to the nearby Poddle River via potential migration of cable fluid along preferential pathways (such as surface water drains and existing underground services) and groundwater. In addition, potential impact to the deeper groundwater aquifer was considered to be low to moderate due to the geology beneath the site.

Risks associated with other potential source-pathway-receptor linkages were considered to be low.

The risk assessment completed herein is preliminary in nature as it can only be based on an evaluation of qualitative data sources (i.e. not on intrusive site investigation works). Consequently, identification of potential risk does not necessarily indicate a risk to a receptor, rather that further assessment may be required to investigate assumptions made in the CSM and quantify whether a

potential risk actually exists. Generally, where a low or very low risk has been identified further assessment may not be deemed necessary to assess a particular SPR linkage, although further assessment may be deemed to be required to investigate CSM assumptions where the potential risk is considered to be low or very low due to the sensitivity of the receptor.

Figures



Client

ELECTRICITY SUPPLY BOARD

Location

SITE 17
Francis Street
Harlod's Cross 110 kV

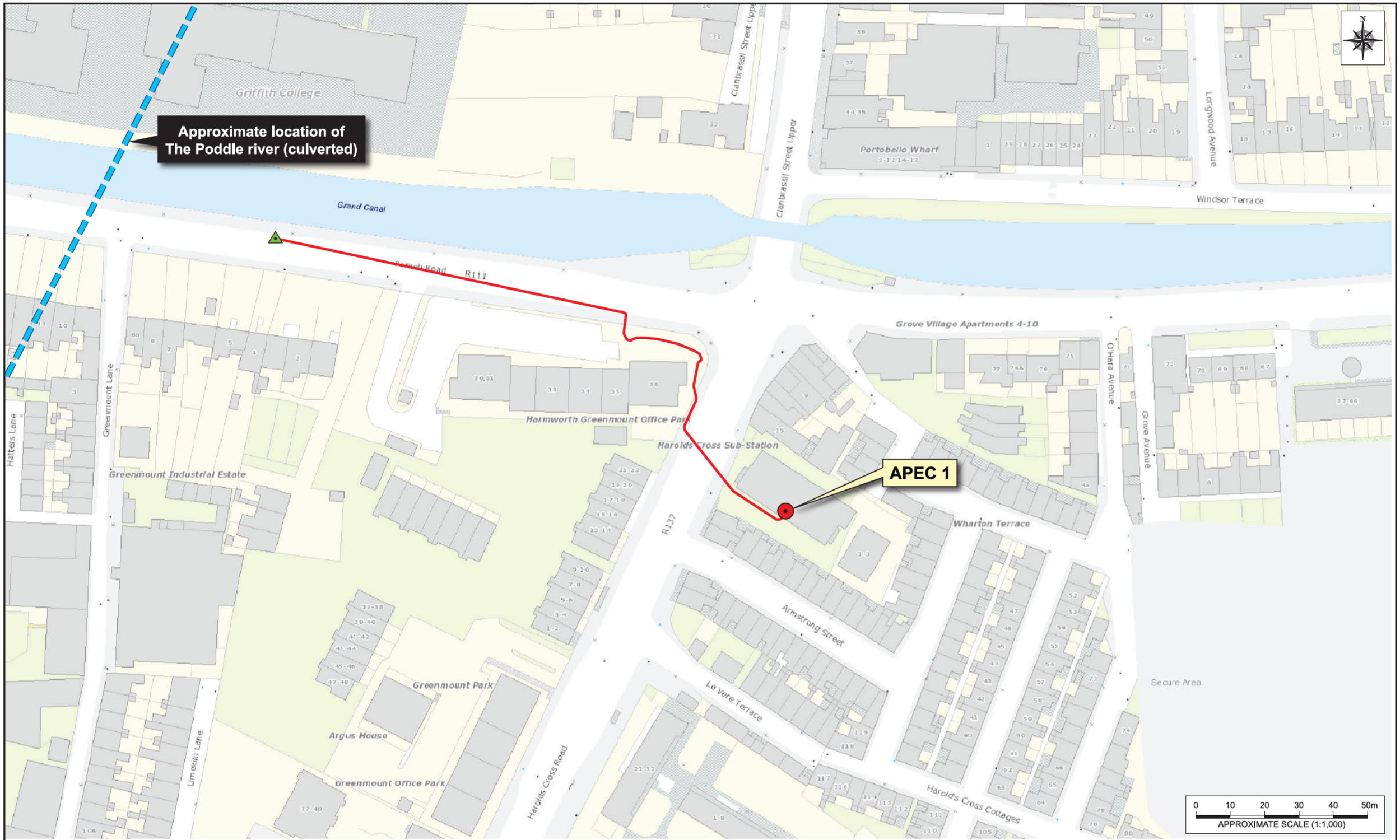
Drawing Title

FIGURE 1 - SITE LOCATION MAP

AECOM

4TH FLOOR, ADELPHI PLAZA, ADELPHI CENTRE, GEORGE'S STREET UPPER,
DUN LAOGHAIRE, CO. DUBLIN, IRELAND. T+353 (0)1 238 3100, F +353 (0)1 238 3199

DRAWN	ILLUSTRATED	CHECKED	APPROVED	DATE
RH		CC	DM	JULY 19
SCALE	Job No.			REV.
N.T.S	60610407			0



KEY:

- Leak Location
- 200 m marker from Leak Location
- Joint Section of Leak

NOTES:

Rev	Date	Detail	Made	Chk'd	App'd

Status: FOR INFORMATION

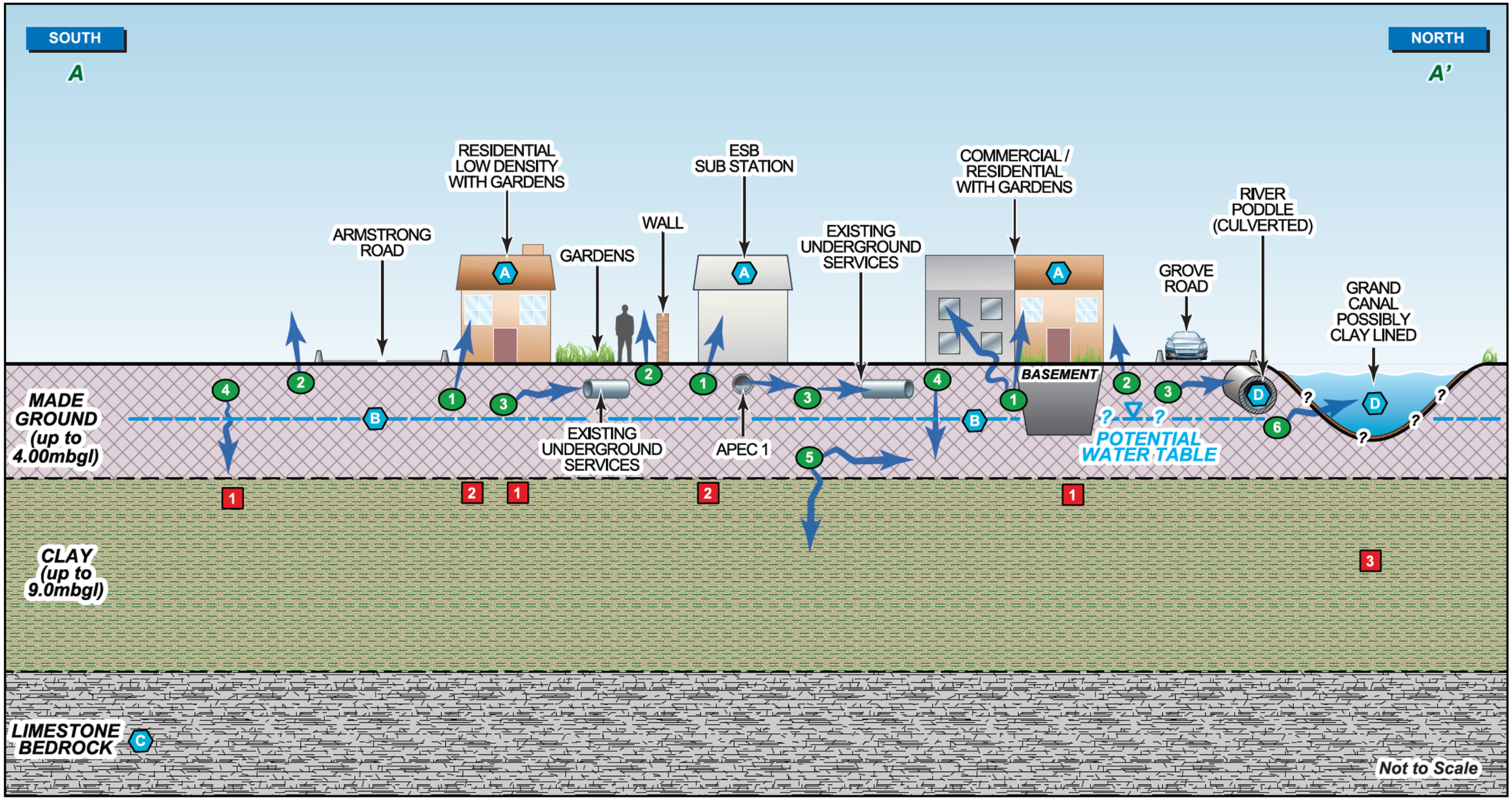
Client: ELECTRICITY SUPPLY BOARD

Location: Francis Street
Harlod's Cross 110 kV

Title: FIGURE 2
SITE LAYOUT PLAN

AECOM
4th Floor, Adelphi Plaza, Adelphi Centre, George's Street Upper, Dun Laoghaire, Co. Dublin, Ireland.
Tel: +353 (0) 1 293 3200
Fax: +353 (0) 1 293 3201
www.aecom.com

Design: ESB	Drawn: RDH		
Chk'd: CC	App'd: DM		
Date: JULY 2019	Scale: As Shown		
Project No. 60610407	Drg No. 2	Stat. -	Rev: 0



SOURCES

1. GROUND GAS
2. NON-VOLATILE CONTAMINANTS IN SOIL
3. CONTAMINANTS IN GROUNDWATER

PATHWAYS

1. GROUND GAS MIGRATION
2. DERMAL CONTACT / DUST INGESTION
3. PERMEATION OF AND MIGRATION ALONG EXISTING UNDERGROUND SERVICES
4. LEACHING FROM SOIL TO GROUNDWATER
5. VERTICAL & HORIZONTAL MIGRATION OF CONTAMINATED GROUNDWATER
6. MIGRATION AND LEACHING TO SURFACE WATER

RECEPTORS

- A RESIDENTIAL / COMMERCIAL SITE USERS
- B SHALLOW GROUNDWATER
- C BEDROCK GROUNDWATER
- D SURFACE WATER

Rev	Date	Detail	Made	Chk'd	App'd

Status: FOR INFORMATION

NOTES:

Client: ELECTRICITY SUPPLY BOARD

Location: Francis Street Harlod's Cross 110 kV

Title: FIGURE 3 CONCEPTUAL SITE MODEL

AECOM
4th Floor, Adelphi Plaza, Adelphi Centre, George's Street Upper, Dun Laoghaire, Co. Dublin, Ireland.
Tel: +353 (0) 1 293 3200
Fax: +353 (0) 1 293 3201
www.aecom.com

Design: ESB	Drawn: RDH		
Chk'd: CC	App'd: DM		
Date: JULY 2019	Scale: As Shown		
Project No. 60610407	Drg No. 3	Stat. -	Rev: 0

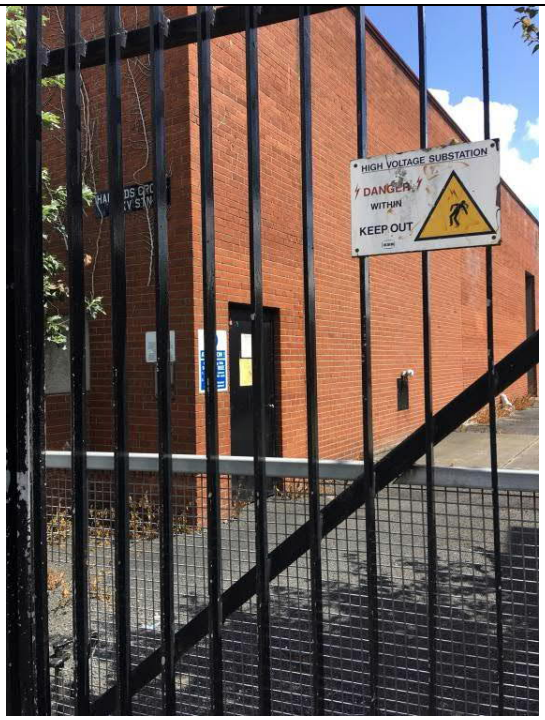
Appendix A Site Photographs

AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site: 17 Francis Street – Harold's Cross 110 kV	**Project No.** PR-427640

Date:
11 July 2019



Description

Facing east on R137. Substation building has no access.

Date:
11 July 2019

Description:

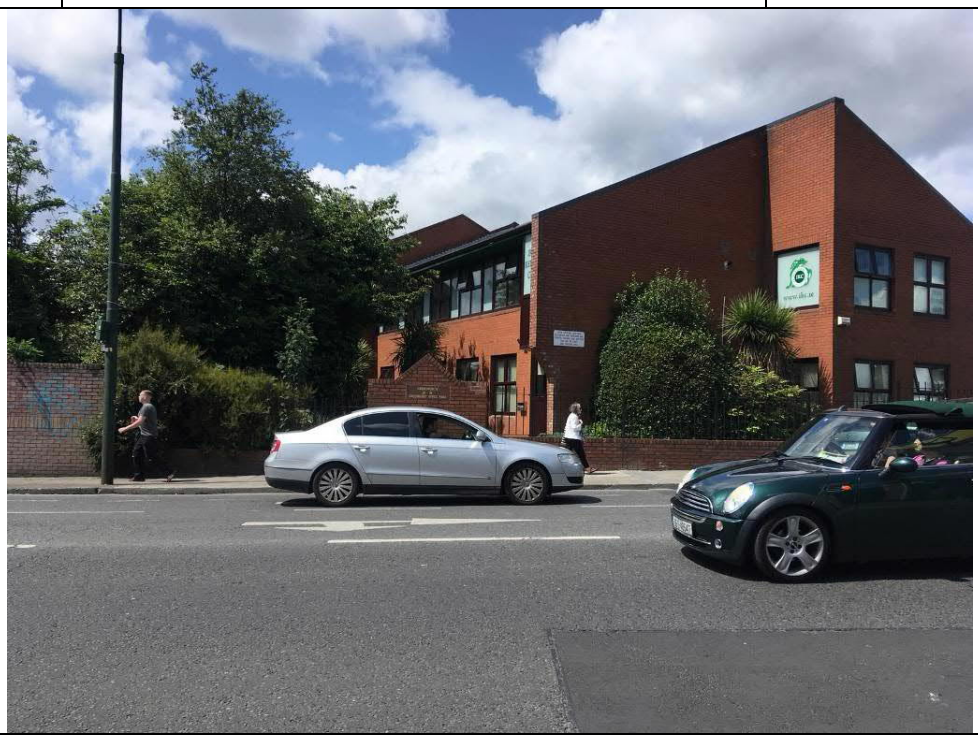
Facing east on R137. Substation building has no access.

AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site: 17 Francis Street – Harold's Cross 110 kV	**Project No.** PR-427640

Date:
11 July 2019



Description

Facing west across from the indicative leak location. R137 bounds the site with commercial and residential properties. Unlikely that the commercial properties have underground parking as there is a vast private area for parking above ground.

Date:
11 July 2019

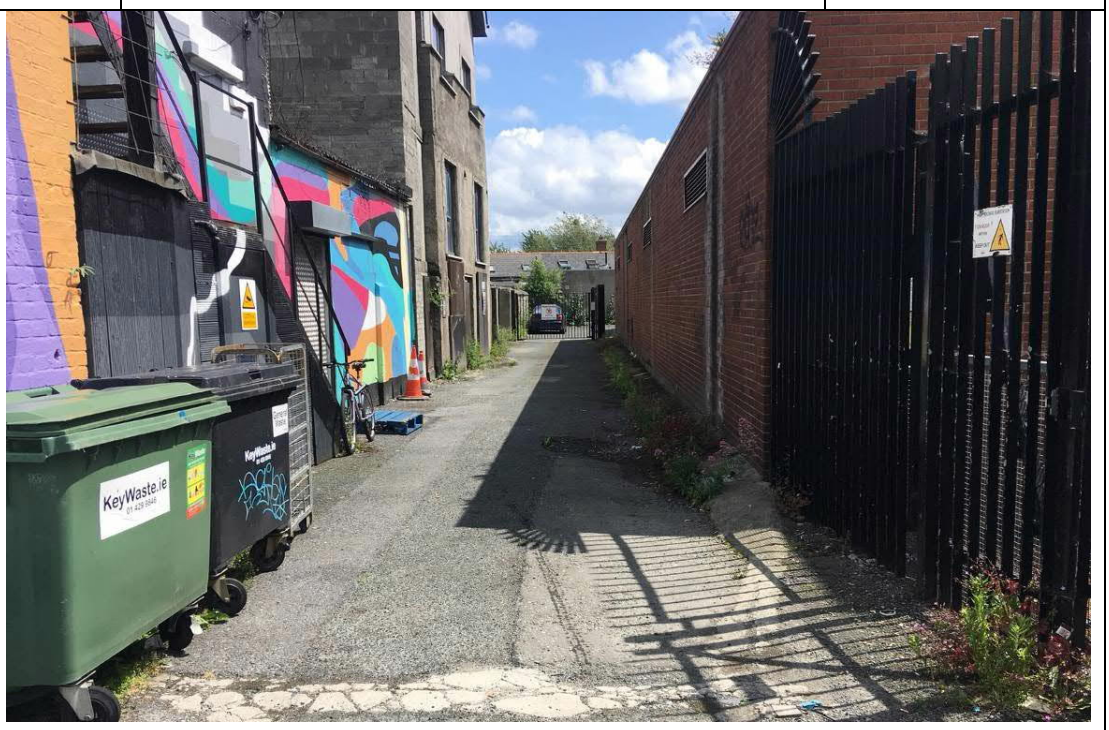
Description:

Facing south showing the area is dominated by residential properties.

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site: 17 Francis Street – Harold's Cross 110 kV	**Project No.** PR-427640

Date:
11 July 2019



Description

The site is bound to the north by an alley. A car park is noted, bounding the site to the east

Date:
11 July 2019

Description:

Mix use properties; residential and commercial, immediately bound the site to the north.

AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site: 17 Francis Street – Harold's Cross 110 kV	**Project No.** PR-427640

Date:
11 July 2019

Description

Eireann Telecom and water main noted running along Parnen Road (R111).

Date:
11 July 2019

Description:

Grand Canal is situated north of the leak location.

AECOM

PHOTOGRAPHIC LOG

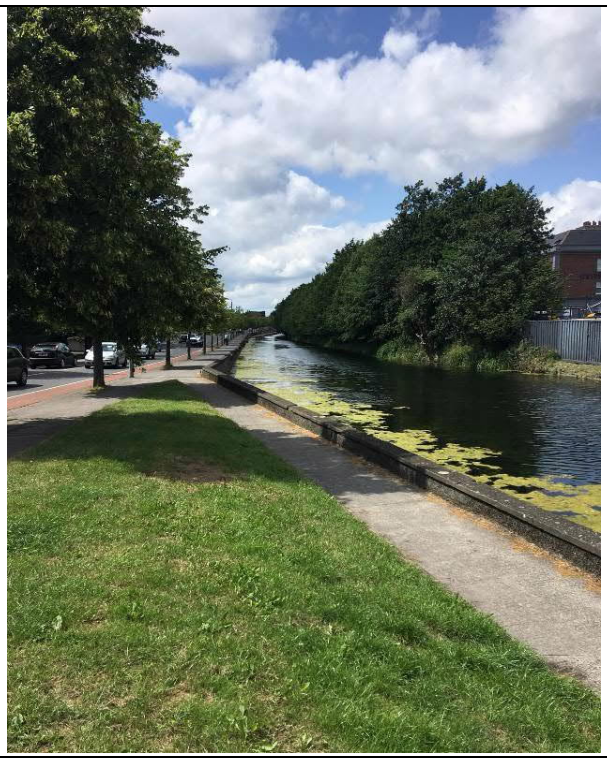
Client Name: ESB	**Site Location:** Site: 17 Francis Street – Harold's Cross 110 kV	**Project No.** PR-427640

Date:
11 July 2019

Description

Further north, across Grand Canal '*Gordons Drive In Fuel Depot. Home Heating Oil*' is located. The area comprises of a main sales shop, multiple areas storing presumed gas cylinders, fuel truck parking and a number of portakabins.

Date:
11 July 2019



Description:

North of the site (photo: looking west), trees and green space are commonly noted along the boundary of Grand Canal

AECOM

PHOTOGRAPHIC LOG

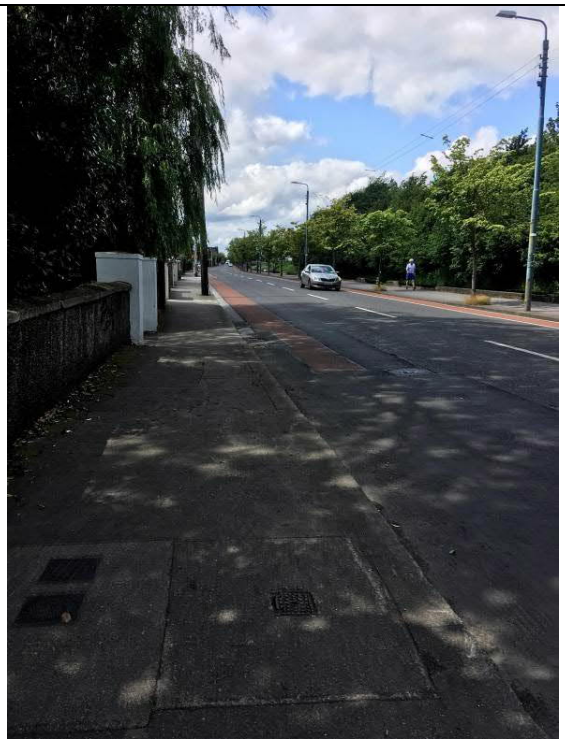
Client Name: ESB	**Site Location:** Site: 17 Francis Street – Harold's Cross 110 kV	**Project No.** PR-427640

Date:
11 July 2019

Description

Properties (2 – 7) located on Parnell Road (R111) have one story below ground level. After number two (2), none of the properties extended below ground level.

Date:
11 July 2019



Description:

Facing west along Parnell Road (R111).

Appendix B PSA Template Report Table of Contents Cross Reference

EPA Template Table of Contents	Production Area Preliminary Site Assessment Report
Executive Summary	Executive Summary
1. Introduction	Section 1
1.1 Project Contractual Basis & Personnel Involved	Section 1
1.2 Background Information	Section 1.1
1.3 Project Objectives	Section 1.2
1.4 Scope of Works	Section 2
2. Source Audit Findings	Section 4
2.1 Current Site Operations	Section 4.1 to Section 4.2
2.2 Previous Site Operations	Section 4.3
2.3 Chemicals of Potential Concern	Section 4.4
3. Site Environmental Setting	Section 3
3.1 General Introduction	Section 3
3.2 Regional Geology and Hydrogeology	Section 3.2 and Section 3.4
3.3 Site Geology and Hydrogeology	Section 3.2 and Section 3.4
3.4 Summary of Previous Site Sampling and Monitoring Data	Not Applicable
4. Summary and Conclusions	Section 6
4.1 Summary and Conclusions	Section 6
4.2 Recommended Way Forward	Separate Cover Letter
5. References	Throughout Text