Verde Environmental Consultants

Preliminary Site Assessment Report for Dennehy's Cross, Cork City

ESB Site Ref: 61

Dennehy's Cross – Liberty Street 38 kV

March 2020

Project Title:	ESB Networks Historic Fluid Filled Cable Loss Environmental Assessment
Licence No:	N/A
Project No:	52582
Contract No:	52582 Stage 1
Report Ref:	Stage 1 Preliminary Site Assessment Report for Dennehy's Cross, Cork City. ESB Ref: 61 Dennehy's Cross – Liberty Street 38 kV
Status:	Final
Client:	ESB Networks
Client Details:	ESB Networks Engineering & Major Projects One Dublin Airport Central Dublin Airport Cloghran Co Dublin
Issued By:	Verde Environmental Consultants Ltd, E7 Network Enterprise Park, Kilcoole, Co Wicklow, A63 KV04.

Document Production/Approval Record

	Name	Signature	Date	Position	% Input
Prepared by (consultant)	[redacted]		06/03/2020	Senior Environmental Consultant	60
Contributed by (consultant)	[redacted]		06/03/2020	Risk Assessor Specialist	20
Approved by (consultant)	[redacted]		06/03/2020	Operations Director	20

LIMITATION

This report represents the results of a site inspection and desk study research conducted at the above referenced site. Best practice was followed at all times and within the limitations stated. This report is the property of Verde Environmental Consultants Limited (Verde) and cannot be used, copied or given to any third party without the explicit prior approval or agreement of Verde.

This report is intended as a preliminary stage assessment of the site in question and, as such, all assessments and analysis of the environmental aspects of the site, whilst based of the best-available data and information, are theoretical and conservative in nature. Any risks identified within this report are entirely potential in nature and based on the most-conservative risk analysis scenario and the available information. This is in-keeping with best practice guidelines and does not necessarily reflect the actual environmental scenario on site. Further environmental information, as it becomes available, would likely change the assessments and analysis contained within this report.

TABLE OF CONTENTS

FIGURES

APPENDICES

EXECUTIVE SUMMARY

This preliminary environmental site assessment consists of a review of the potential environmental impact associated with a suspected hydrocarbon leak from a power cable at Dennehy's Cross in Cork City (ESB Site Ref: 61 Dennehy's Cross – Liberty Street 38 kV). There was an approximate volume of 11,772 litres of cable fluid consisting of linear alkyl benzene (LAB) mixed with Mineral Oil (MO) lost to ground from the leak point in question. The leak occurred in 2001 approximately 240m east of Dennehy's Cross junction, at the location. The leak was repaired in 2004 after an approximate period of 40-months at leak-rate of 295l/month.

This report is intended as a preliminary stage assessment of the site in question and, as such, all assessments and analysis of the environmental aspects of the site, whilst based of the best-available data and information, are theoretical and conservative in nature. Any risks identified within this report are entirely potential in nature and based on the most-conservative risk analysis scenario and the available information. This is in-keeping with best practice guidelines and does not necessarily reflect the actual environmental scenario on site. Further environmental information, as it becomes available, would likely change the assessments and analysis contained within this report.

The leak point is situated in a residential area on a busy road, with house housing being 20m from the indicative leak point. The Glasheen River runs from south to north under Glasheen Bridge, within 5m of the indicated leak point. The route of the Glasheen River is bordered by a long green area which runs between Glasheen Road and Magazine Road. Utility maps and site walkover observations suggest there are abundant service lines including foul sewerage, gas, communication and water lines along the entirety of the cable route. It is likely that there are numerous unmapped minor services along the route also.

This area of Cork is seen to have a similar land use in the 6-inch Cassini historical maps (1830's – 1940's) to today with residential, greenfield parks, ecclesiastical buildings and schools. The exception to this is the record of several local chemical and textile industries in the 19th and 20th centuries. The land in the area is largely zoned for residential, recreational, local services and institutional uses with some local retail premises.

The cable section and leak point are underlain by regionally important groundwater aquifers in the form of the Cork Red Marble Formation, Waulsortian Limestones and Little Island Formations. The vulnerability is High to Extreme indicating that bedrock is likely to be relatively close to surface (0-5metres) and that the subsoils are moderately permeability made ground subsoils, which provide a limited level of natural protection to the underlying bedrock aquifer. Under the Water Framework Directive, the groundwater body (CorkCity_2) beneath the site is of good status but is at risk of deterioration in the future. Groundwater in the bedrock aquifer may be locally, semi-confined by the subsoils with groundwater flow direction in a northerly direction following site topography towards the Upper Lee Estuary.

The nearest surface watercourse is the Glasheen River; which flows under Glasheen Bridge and is located less than 5m east of the leak point. The Glasheen River flows from the south, past the leak point, into the Curragheen River 400m to the north; where it then flows into the Upper Lee Estuary 410m to the northeast. This section of the Glasheen River has not been assigned a risk or quality status under the Water Framework Database.

There are no mapped groundwater wells within 1000m of the leak site in the GSI well database. A series of ground investigation boreholes are recorded 635m to the northwest of the leak site, associated with the County Hall development.

There are no designated areas of conservation or "European Sites" within 1km of the site; the nearest being the Cork Lough proposed Natural Heritage Area (pNHA) 1km to the west of the leak site. The Lee Valley pNHA is located 1.5km to the northwest of the leak site also.

At the time of reporting, Irish Water have examined all available drinking water quality sample data and have concluded that there is no evidence that COPCs from the leak site have infiltrated the local drinking water supply. This evaluation is based on a review of all samples taken from customer-points, between 2014 and 2019; which showed no evidence that the COPCs (PAHs and Benzenes) were present in the water supply at levels above drinking water standards (PAHs: 0.1µg/L; Benzene: 1.0µg/L). These results (which are from samples taken at the customer tap) would not indicate that leaks from oil filled cables have contaminated the drinking water supply for these areas, or at least to an extent where any contamination arising has resulted in a breach of the parametric value for PAHs and Benzene (Appendix F).

Based on the known cable leak point, contaminants of potential concern (COPC) fate and transport and hydrogeological desk study information the CSM has the following initial key findings for human health and environmental risks;

There is a potentially Low risk posed by LAB and MO from contact with suspected contamination in the soil and groundwater through;

- direct dermal/inhalation and ingestion contact to residents or other building users;
- dermal/inhalation and ingestion pathways to construction workers which can be managed by appropriate use of PPE and H&S procedures;
- ingestion contact with suspected contamination in the soil and groundwater through permeation of contamination through plastic water pipes.

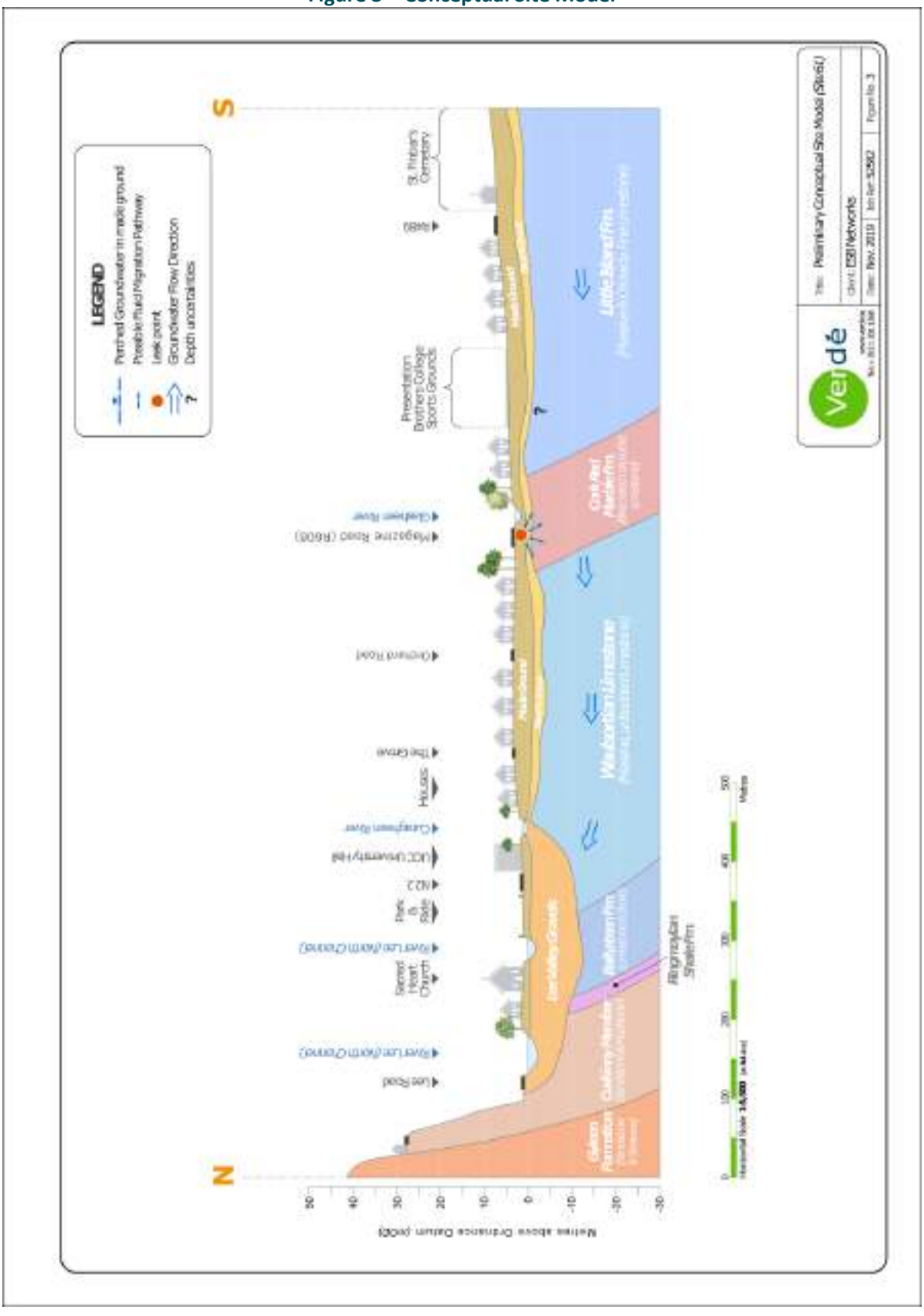
There is a Low/Moderate potential risk posed by LAB and MO in suspected contamination in the soil and groundwater through;

- hydrocarbon vapours in preferential pathways such as services ducts to residents or other building users
- leaching to shallow groundwater given the contaminant properties of low mobility and high sorption to soil, with rare shallow groundwater unlikely to be a viable groundwater resource in the residential urban setting.

There is a potentially Moderate risk posed by LAB and MO in suspected contamination in the soil and groundwater through;

- hydrocarbon migration into the adjacent watercourse and the downstream Curragheen River and Upper Lee Estuary given the short distance to the culverted Glasheen River which poses a potential pollutant linkage between the leak site and the surface water receptors.
- hydrocarbon migration to the underlying aquifer given the possible connection to shallow groundwater, or directly to bedrock, through shallow rock in the area indicated by the high to Extreme vulnerability.

Figure 3 – Conceptual Site Model



	EPA Contaminated Land & Groundwater Risk Assessment Methodology	Report Reference	Report Date	Status
	STAGE 1: SITE CHARACTERISATION & ASSESSMENT			
1.1	**PRELIMINARY SITE ASSESSMENT**	Preliminary Report, Verde, Ref: 52582	6th March 2020	Final
1.2	**DETAILED SITE ASSESSMENT**			
1.3	**QUANTITATIVE RISK ASSESSMENT**			
	STAGE 2: CORRECTIVE ACTION FEASIBILITY & DESIGN			
2.1	**OUTLINE CORRECTIVE ACTION STRATEGY**			
2.2	**FEASIBILITY STUDY & OUTLINE DESIGN**			
2.3	**DETAILED DESIGN**			
2.4	**FINAL STRATEGY & IMPLEMENTATION PLAN**			
	STAGE 3: CORRECTIVE ACTION IMPLEMENTATION & AFTERCARE			
3.1	**ENABLING WORKS**			
3.2	**CORRECTIVE ACTION IMPLEMENTATION & VERIFICATION**			
3.3	**AFTERCARE**			

1. INTRODUCTION

1.1. PROJECT CONTRACTUAL BASIS AND PERSONNEL INVOLVED

Verde Environmental Consultants, (Verde) was commissioned by ESB Engineering & Major Projects to undertake Preliminary Risk Assessments along a section of cable where there was leakage of cable fluid and where works were proposed to remove the cable and install new service ducts. This report focuses on a hydrocarbon leak from a 38 kV power cable located Dennehy's Cross, on the southern side of Cork City.

In preparation of cable replacement works; a site investigation was undertaken by a Verde Environmental Consultant on 15th of November 2019 to examine the area of the known cable leak point in relation to any observed evidence of contamination and surrounding land uses and sensitive human health and environmental receptors.

A site location map for the leak point is presented in Figure 1 with a detailed map on the cable route and leak location presented in an ESB map in Appendix A.

1.2. BACKGROUND INFORMATION

The ESB 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.

This preliminary environmental site assessment consists of a review of the potential environmental impact associated with a cable fluid leak from a 38 kV power cable at Dennehy's Cross in Cork City (ESB Site Ref: 61 Dennehy's Cross – Liberty Street 38 kV).

The leak is reported to have begun in 2001; with an approximate volume of 11,772 litres (l) of linear alkyl benzene (LAB) mixed with mineral oil (MO) leaking from a 38kV cable at a rate of 295l/month over a period of forty months. The leak was repaired in November 2004.

Details on the physical and chemical aspects of the hydrocarbon products used as Insulating Fluids in the cables are discussed in Section 2.3 below.

1.3. PROJECT OBJECTIVES

The project objective was to determine the potential risks to human health and the environment at the leak location and potential areas of impact. As requested by ESB, a risk-based approach has been applied to this assessment. This risk-based approach is also recommended in the best practice documents produced by the EPA on Management of Contaminated Land & Groundwater at EPA Licenced Sites published in 2013. Note, however, that the leak point in question is not an EPA licensed site. Although the scope of this guidance specifically applies to licensed sites, the approach presented is consistent with UK and mainland European best-practice guidance in the assessment and management of potentially contaminated land. It is therefore considered to be a robust basis for the assessment of the subject site.

This report has been prepared in accordance with the EPA guideline reporting template for Preliminary Site Assessments under the EPA Contaminated Land & Groundwater Risk Assessment Methodology.

1.4. SCOPE OF WORKS

In order to complete the assessment and meet the objective of the brief the following scope of works was completed:

- A desk study review of available historical, geological and hydrogeological and environmental sensitivity information for the site. The desk study includes an assessment of historical land uses. Information on site utility services from various providers was examined together with detailed information on the cable route with a known leak point on the ESB cable, such as cable ends or joints.
- Site walkover to undertake a detailed site inspection to establish as much information as possible regarding site operations, activities, observed evidence of contamination and land use to include detailed site notes and photographs.
- Prepare a report in accordance with best practice guidance, in that the information gathered will be used to develop a preliminary conceptual model for the site.

1.5. SCOPE OF ANALYSIS AND CONCLUSIONS

This report is intended as a preliminary stage assessment of the site in question and, as such, all assessments and analysis of the environmental aspects of the site, whilst based of the best-available data and information, are theoretical and conservative in nature. Any risks identified within this report are entirely potential in nature and based on the most-conservative risk analysis scenario and the available information. This is in-keeping with best practice guidelines and does not necessarily reflect the actual environmental scenario on site. Further environmental information, as it becomes available, would likely change the assessments and analysis contained within this report.

As such, the reader is encouraged to view the findings, conclusions and recommendations contained within this report as the most-conservative, theoretically possible environmental scenario; and not necessarily the actual scenario currently persisting on the site question.

2. SOURCE AUDIT FINDINGS – PRODUCTION & OPERATIONAL HISTORY

2.1. CURRENT SITE OPERATIONS

The leak point (ESB Ref: Joint 61) is located 250m east of the Dennehy's Cross junction in a mixed residential, commercial and greenspace/recreational area dominated by residential properties together with small open recreational playing grounds as presented in the map in Appendix A.

The leak point is situated in a residential area with house fronts being approximately 25m from the indicative leak point. There are also small, roadside, green spaces near the leak site and a school's playing grounds (Presentation Brother's RFC) within 100m of the leak point. Approximately 120m to the east of the leak point is Orchard Garden's residential development which also contains several retail premises on its ground floor.

The ESB cable runs along the eastern side of Glasheen River from the south of Magazine Road; where it then turns to the east and proceeds down the southern side of Magazine Road, as presented in in Appendix C. There are numerous buried services under the concrete footpath along Magazine Road and residential properties, as presented in Appendix C.

The leak point was located on the eastern side of the road as presented in Photograph 1 in Appendix C. On initial site walkover in November 2019, there was no physical evidence of hydrocarbon contamination on the surface in terms of oil odours/staining or impact to vegetation with healthy looking trees and hedges.

The Glasheen River bridge is located immediately to the east (<5m) of the leak point; where the river passes from south to north underneath Magazine Road (Photo 4 in Appendix C). At the time of the site walkover in November 2019, the river passing under the bridge was seen to be of low flow and somewhat stagnant. It was observed that some sort of culverted diversion of the river approximately 30m south of the bridge. This grated diversion channel was seen to be taking the majority of the river's flow along an unknown path to the north. It is likely that this channel re-joins the river to the immediate east of Orchard Garden's.

The known presence of moderately permeable made ground and highly permeable sand blinding around the power cable together with the presence of other underground services along the roadway indicates there is a moderate to high potential for preferential lateral migration of COPCs from the leak point along the underground services routes.

2.2. PREVIOUS SITE OPERATIONS

This area of Cork is seen to have changed land use greatly from the rural, agricultural zoning seen in the 6-inch Cassini historical maps (1830's – 1940's) to the current urban residential setting today with residential, greenfield parks and roadways; as show in Appendix B. Further details on the site history are presented in section 3.2.

2.3. CONTAMINANTS OF POTENTIAL CONCERN (COPC)

The fluid in the power cable is a mixture of two components Mineral Oil and Linear Alkyl Benzenes (T3788). Material safety data sheets (MSDS) for the fluids are included in Appendix D and further detail on their physical, fate and transport and toxicological properties provided below.

2.3.1 Linear Alkyl Benzenes

Linear Alkyl Benzene is a benzene compound with a side alkyl chain of 10-13 carbon atoms in length. The following presents relevant information on its Fate and Transport in the environment.

- low solubility, which means it doesn't mix with water easily;
- low to moderate volatility with the MSDS providing that the compound should not present an inhalation hazard under ambient conditions and that exposure to vapour or oil mists may irritate the mucous membranes and cause dizziness, headaches and nausea;
- Strongly absorbs to soil and combined with its low solubility means it generally has low mobility in the water environment;
- Its preference in soil will be to remain as free product or sorb to soil with a smaller proportion in the vapour phase;
- It will form a Light Non-Aqueous Phase Liquid (LNAPL) on water;
- It is readily biodegradable under aerobic conditions in both water and soil, with a half-life in soils of 15.3 days and less than 28 days in water. Half-life is the time required for a quantity to reduce to half of its initial value;
- Does not bio accumulate;
- The Predicted No Effect Concentration (PNEC) is the concentration of a chemical which marks the limit below which, no adverse effects of exposure in an ecosystem are measured. LAB is toxic to the water environment with a PNEC aqua (freshwater) of 0.001mg/l: PNEC soil terrestrial organisms of 0.329mg/kg and PNEC sediment of 1.65mg/kg for freshwater sediment and 0.165mg/kg for marine sediments.

2.3.2 Mineral Oil

In scientific terminology, the term mineral oil tends to be non-specific in that it can refer to a substance which contains varying substances depending on its manufacture process.

Mineral oils are manufactured from petroleum with about 10-25% comprising of additives which can include antioxidants, metal deactivators, detergents, dispersants, corrosion inhibitor etc. Their composition will also have changed over time and, in the context of cable fluid, will vary according to when cables were installed. In summary, the following characteristics have been identified:

- Physical properties can vary widely being defined by the crude oil source, carbon number distribution, boiling range and viscosity.
- Mineral oils are refined from petroleum crude oils, and are complex mixtures of straight- and branched chain paraffinic, naphthenic, and aromatic hydrocarbons with 15 or more carbons and boiling points in the range of 300°C to 600°C.
- Are insoluble in water and alcohol, but soluble in benzene, chloroform, ether, carbon disulfide and petroleum ether. They have ranging viscosities.

- Mineral oils from paraffinic crude oils are characterised by high wax content, high natural viscosity index, and relatively low aromatic hydrocarbon content. Naphthenic crude oils are generally low in wax content and relatively high in cyclo-paraffins and aromatic hydrocarbons. All crude oils contain some polycyclic aromatic hydrocarbons, and the proportions and types of these compounds in the finished mineral oils are determined primarily by the refining process.
- In the past, many mineral oils were only mildly refined and contained significant levels of polycyclic aromatic hydrocarbons (PAHs). Acid treatment was initially used to remove PAHs and other impurities and to improve the technical properties of the finished oils. In recent decades, acid treatment has largely been replaced by extensive refining with solvent extraction and/or hydro-treatment, which has further reduced the level of PAHs and other contaminants.
- In conclusion to the above, due to mineral oils likely varying composition, its physical, fate and transport and toxicological properties are best determined through consideration of the TPH CWG framework which characterises petroleum hydrocarbons according to the number of carbons. For a mineral oil, carbon fractions of C_{15} and above are relevant and PAHs. Additives may also be wide ranging and so their characteristics can be determined by the presence of analysed volatile and semi-volatile organic compounds.
- Mineral oil as represented by TPH hydrocarbon fractions of C_{15} and greater have a very low mobility and low degradation half lives. They therefore have the potential to persist in the environment.
- The longer carbon chain lengths also mean that mineral oil will have a relatively low volatility, with carbon fractions of greater than C_{16} not being considered to be volatile.
- The MSDS for Masse 106 (the Mineral Oil leaked from the cable) has identified that the product if it enters soil will be absorbed to soil particles and so will not be mobile. It has the potential to bio-accumulate. The MSDS also identifies that the product is expected to be non-toxic to aquatic organisms and that toxicologically it is not toxic and not carcinogenic. However more recently studies such as those for TPH CWG, have published health criteria values for carbon range $C_{16\text{-}35}$ and along with potential additives potential impacts to human health and the environment will need to be considered.

3. SITE ENVIRONMENTAL SETTING

3.1. GENERAL INTRODUCTION

The area of interest is a section of 38 kV cable Dennehy's Cross in Cork City extending south from the intersection of Magazine Road and Glasheen River; and eastwards along Magazine Road. This section of cable suffered a leak at a cable joint in 2001, approximately 240m east of the Dennehy's Cross junction. The main land use in this area is primarily residential, retail and institutional/recreational with some green areas along the route of Glasheen River and Magazine Road. The Presentation Brother's College institutional sports grounds on the south side of Magazine Road comprises a large outdoor recreation area. Also to the south of the road is a small commercial estate with various premises. Approximately 100m to the west of the leak site, is the Orchard Gardens residential and retail development.

The land in the area is zoned for various uses. To the north of the leak site, the land is zoned as a Landscape Preservation Zone, to the south the land is zoned as Sports Grounds and Public Open Space; and the areas surrounding Dennehy's junction is zoned as a Local Centre; as presented in the Cork City Council Development Plan map in Appendix B.

3.2. SITE HISTORY

Primary sources used to research the history of the site included available extracts from historical Ordnance Survey Ireland (OSI) maps, aerial photographs and planning information from Myplan.ie.

The maps consulted include the OSI 6-inch historic maps from 1837 to 1842, the OSI 25-inch historical maps surveyed between 1888 and 1913 and the OSI 6-inch Cassini map surveyed in early 20th century. Table 3.2 below gives further details of the site history and the land use of the surrounding area.

Table 3.1 – Site History

History	**National Monuments Service:** The closest structure to the leak point is a NIAH listed structure 15m to the north which is noted as an 1860's-1900's manor house on "Bishop-Mills Lands". This house is located on the larger demesne that defines the north side of Magazine Road. There are several other NIAH and National Monument structures listed within 500m of the leak point; including country houses, souterrains and houses. (Appendix B)
	Historic Mapping: <u>OSI 6 inch map (Black and White) (1837-1842):</u> The general road layout resembles that of present times with respect to Dennehy's Cross and Magazine Road, with similar roadside buildings and layout. The general land use appears to be largely agricultural in nature with a much lower density of development than the modern setting. The most notable difference is the noted presence of the Brookfield Chemical Works and Glasheen Spinning Mill to the north; along the Glasheen River.

	Also noted to the immediate east of the site is Brook Lodge and an apparent quarry pit or earthworks. OSI 25 inch map (Black and White) (1888-1913): This map appears to show much the same semi-urban/rural layout as the previous maps. There is added detail of the apparent expansion of the Brookfield Chemical Works to the north. There is also the additional note that the Glasheen Spinning Mill is "in ruins". A Gravel Pit is noted to the immediate southwest of the leak point. Cassini 6 inch (1830-1930): This map appears to show a broadly similar layout to the area as the 25-inch (Black and White) maps previously discussed. The main notable difference seen is that there is significantly more residential, terraced housing developed at the time of these maps; suggesting that the Cassini series was completed at a later date to the aforementioned 25-inch maps. Significant development appears to have occurred on all of the main roadways in the area around "Lower Glasheen" and Dennehy's Cross. The Brookfield Chemical Works is not visible on the map. Recent History (1940's Onwards): The ESB power cable is reported to have been laid in the area in 1968.
Aerial Photos	Aerial Photo 1995: The road lay out and position of residential properties remains largely the same as present times. It appears that the Orchard Gardens development is not yet in place and a small commercial area exists on the site. Aerial Photo 2000: The site and its surroundings remain largely similar to the previous image. Aerial Photo 2005: The site and its surroundings remain largely similar to the previous image. Digital Globe (2011-2013): The site and its immediate surroundings remain largely unchanged. The Orchard Gardens development is now visible at Dennehy's Cross.

3.3. REGIONAL GEOLOGY AND HYDROGEOLOGY

The site is situated on a geological boundary which us underlain by red, brecciated calcilutite limestone of the Cork Red Marble Formation (GSI) and the massive unbedded lime mudstones of the Waulsortian Limestones. The bedrock geology at the site is overlain by subsoils comprising Made Ground (Teagasc).

The nearest surface watercourse is the Glasheen River; which flows under Glasheen Bridge and is located less than 5m from the leak point. The Glasheen River flows from the south, past the leak point, into the Curragheen River 400m to the north; where it then flows into the Upper Lee Estuary 410m to the northeast. This section of the Glasheen River has not been assigned a risk or quality status under the Water Framework Database. The Upper Lee Estuary is located approximately 650m to the north, also downgradient of the site.

The cable section and leak point are underlain by regionally important groundwater aquifers in the form of the Cork Red Marble Formation, Waulsortian Limestones and Little Island Formations. The vulnerability is High to Extreme indicating that bedrock is likely to be relatively close to surface (0-5metres) and that the subsoils are moderately permeable made ground subsoils, which provide a limited level of natural protection to the underlying bedrock aquifer. Under the Water Framework Directive, the groundwater body (CorkCity_2) beneath the site is of good status but is at risk of deterioration in the future. Groundwater in the bedrock aquifer may be locally, semi-confined by the subsoils with groundwater flow direction in a northerly direction following site topography towards the Upper Lee Estuary

The following information sources were consulted as part of this desk-based research and the relevant information has been compiled in Table 3.2 below.

- Cork City Council (Planning and Environment Sections)
- Ordnance Survey Ireland (historic map series)
- National Monuments Service (protected structures)
- Dept. of the Environment, Community and Local Government
- Geological Survey of Ireland
- Environmental Protection Agency data bases
- National Parks and Wildlife Services
- Office of Public Works (flood maps)

Table 3.2 – Site Physical Setting

Feature	Details & Comments
Topography	The site itself steeply dips gently to the north along Victoria Cross, becoming relatively flat at the road junction with the N22; proximal to the River Lee. The regional topography of the area slopes gently to the north toward the River Lee.
Geology	**Overburden:** The GSI and EPA databases describe the soils at the site as Made Ground with the subsoils in the area consisting of Urban deposits with small areas of river alluvium likely next to the Glasheen River.

	Solid Geology: The site is situated on a geological boundary which us underlain by red, brecciated calcilutite limestone of the Cork Red Marble Formation (GSI) and the massive unbedded lime mudstones of the Waulsortian Limestones.
Hydrogeology	**Regional Classification:** The cable section and leak point are underlain by regionally important groundwater aquifers in the form of the Cork Red Marble Formation, Waulsortian Limestones and Little Island Formations. The vulnerability is High to Extreme indicating that bedrock is likely to be relatively close to surface (0-5metres) and that the subsoils are moderately permeable made ground subsoils, which provide a limited level of natural protection to the underlying bedrock aquifer. Under the Water Framework Directive, the groundwater body (CorkCity_2) beneath the site is of good status but is at risk of deterioration in the future. Groundwater in the bedrock aquifer may be locally, semi-confined by the subsoils with groundwater flow direction in a northerly direction following site topography towards the Upper Lee Estuary.
	Vulnerability: The GSI vulnerability map for the area describes the aquifer as having a vulnerability rating of High to Extreme across the site. Based on the Aquifer Vulnerability Mapping Guidelines provided by the GSI, this indicates that bedrock could be encountered in the upper 0 to 5 metres (mBGL). This was confirmed from geotechnical drilling works in the area where the bedrock is within 5.5 to 6.5mBGL in the central and southern areas of the site. The drilling reports show Made Ground/Fill to an average depth of 4.1mBGL underlain by a stiff to hard clay with boulder clay identified in several boreholes. However, geotechnical reports and trial pit excavations in the northern areas of the site show that bedrock in the northern areas of the cable section is close to surface locally with 0-1m of overburden. This is reflected in the extreme vulnerability in the north of the site. A similar feature of extreme vulnerability is noted at the southern extent of the cable assessment section where it appears bedrock is close to surface.
	Groundwater Body: Under the Water Framework Directive (WFD) the groundwater body beneath the site is CorkCity_1 (code: IE_SW_G_030) and is categorised as having Good status, an Overall Objective of Protect and an Overall Risk of At Risk.
	Well Search: There are no mapped groundwater wells within 1000m of the leak site in the GSI well database. A series of ground investigation boreholes are recorded 635m to the northwest of the leak site, associated with the County Hall development.
Hydrology	**Surface Water Courses/Abstractions:** The nearest surface watercourse is the Glasheen River; which flows under Glasheen Bridge and is located less than 5m from the leak point. The Glasheen River flows from the south, past the leak point, into the Curragheen River 400m to the north; where it then flows into the Upper Lee Estuary 410m to the northeast. This section of the Glasheen River has not been assigned a risk or quality status under the Water Framework Database. The Upper Lee Estuary is located approximately 650m to the north, also downgradient of the site.

Geotechnical	A series of boreholes are recorded in association with the construction of the County Hall development approximately 500-600m northwest of the leak point. These boreholes describe a sequence of fluvio-glacial sediments overlain by thin layers of Made Ground; as is typical of the Lee River Valley. Another series of boreholes is recorded approximately 500m to the east of the leak point, associated with the Bon Secours Sisters Convent. These boreholes describe a generally thinner development of glacio-fluvial sediments; typical of the extremities of the Lee river Valley, with bedrock near surface and the Lee Valley Gravels largely absent. The schematic depiction of these sequences is presented in Figure 3.
Protected Areas	**Nearest Areas of Conservation** There are no designated areas of conservation or "European Sites" within 1km of the site; the nearest being the Cork Lough proposed Natural Heritage Area (pNHA) 1km to the west of the leak site. The Lee Valley pNHA is located 1.5km to the northwest of the leak site also.
Flooding	According to OPW flood mapping the site does not appear to be at risk of any coastal, fluvial or pluvial flooding.

3.4. SITE GEOLOGY AND HYDROGEOLOGY

The details of the typical cable and trench dimensions for a fluid filled cable includes the following;

- Depth to the base of trench 1200mm
- Depth to top of cable 900mm-1000mm
- Thickness of sand surrounding a cable 350mm
- Width of trench 1100mm
- Backfill can be either arisings or Clause 804.

According to the GSI Database the site is situated on a geological boundary which us underlain by red, brecciated calcilutite limestone of the Cork Red Marble Formation (GSI) and the massive unbedded lime mudstones of the Waulsortian Limestones. These formations are overlain by Made Ground with the subsoils in the area consisting of Urban deposits with small areas of river alluvium likely next to the Glasheen River. The overburden is thought to be up to approximately 5mBGL, but typically 1-4m thick; as indicated by the high and extreme groundwater vulnerability rating. There is a paucity of geotechnical data in the area of the site; with the nearest geotechnical boreholes in the GSI database being 450m to the east of the leak site and 540m to the northwest.

The topography of the area as obtained from the EPA/OSi database show the leak point (ESB Ref: 61) is located at approximately 5-10 meters above the ordnance datum (mOD) with a gentle gradient towards the Lee Estuary to the North. These topographic contours are orientated approximately northwest-southeast which infers that the groundwater flow direction is likely to be in a northwest to north direction, as presented in Figure 2 and within the CSM in Figures 3 and 4.

3.5. SUMMARY OF PREVIOUS SITE SAMPLING AND MONITORING DATA

There is no available soil/vapour or groundwater quality information from the area in the vicinity of the cable leak point.

At the time of reporting, Irish Water have examined all available drinking water quality sample data and have concluded that there is no evidence that COPCs from the leak site have infiltrated the local drinking water supply. This evaluation is based on a review of all samples taken from customer-points, between 2014 and 2019; which showed no evidence that the COPCs (PAHs and Benzenes) were present in the water supply at levels above drinking water standards (PAHs: 0.1µg/L; Benzene: 1.0µg/L). These results (which are from samples taken at the customer tap) would not indicate that leaks from oil filled cables have contaminated the drinking water supply for these areas, or at least to an extent where any contamination arising has resulted in a breach of the parametric value for PAHs and Benzene (Appendix F).

A summary of the Environmental and Human Health Pollutant Linkages for the COPC in relation to the known leak point details and available desk study information is presented in Section 4.0 and summarised below.

For the COPC the following can be determined;

- **Linear Alkyl Benzenes (LAB)** is of low mobility and strongly absorbs to soil. It has low to moderate volatility and will remain largely as free product or sorb to soil/fill material. It is readily biodegradable in aerobic conditions and does not bio-accumulate.

- **Mineral Oils** are refined from petroleum crude oils and are complex mixtures of straight- and branched hydrocarbons and are insoluble in water. Mineral oil with hydrocarbon fractions of C15 and greater have a very low mobility and low degradation half-lives. They therefore have the potential to persist in the environment. The longer carbon chain lengths also mean that mineral oil will have a relatively low volatility.

4. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1. PRELIMINARY QUALITATIVE RISK ASSESSMENT (PQRA)

4.1.1 Risk Assessment Methodology

Currently there is no specific legislation addressing contaminated land in Ireland and therefore this report has been prepared considering the most relevant guidance published by the Irish Environmental Protection Agency (EPA) and the UK Environment Agency (EA) guidance, specifically as follows:

1. Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites, EPA 2013;
2. Model Procedures for the Management of Land Contamination – Contaminated Land Report (CLR 11), UK EA 2004.

Both approaches advocate a risk-based assessment when dealing with contaminated land and groundwater issues and this is considered as best practice.

Current surface water and groundwater pollution legislation is taken into account for these assessments as required under the Water Framework Directive, Directive 2000/60/EC, that was adopted in 2000 as a single piece of legislation covering rivers, lakes, groundwater and transitional (estuarine) and coastal waters and includes heavily modified and artificial waterbodies. Its objectives are to prevent further deterioration of and to protect, enhance and restore the status of all bodies of water with the aim of achieving at least good status.

It was given effect in Ireland under the European Communities (Water Policy) Regulations 2003 as amended, the European Communities Objectives (Surface Waters) Regulations 2009, as amended and the European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended. These Water Policy Regulations govern the shape of the WFD characterisation, monitoring and status assessment programmes.

A critical element of the risk assessment process is the establishment of a Conceptual Site Model (CSM) for the land and groundwater environment. A CSM describes the potential sources of contamination at a site, the migration pathways it may follow and the receptors it could impact. If complete source-pathway-receptor scenarios exist, then there is a potential pollutant linkage that needs to be characterised and assessed (via formal risk assessment). The CSM is updated as more information is gathered from subsequent desk studies and site investigations with a preliminary CSM presented in Figures 3 and 4.

4.2. OUTLINE SITE CONCEPTUAL MODEL

On the basis of the desk study and site walkover, a number of possible pollutant linkages have been identified for this site. Based on available information the outline site conceptual model is presented in Tables 4.1 and 4.2 below which considers possible pollutant linkages for the site.

Table 4.1 – Outline Site Conceptual Model (Environmental and Human Health)

Source	Pathway	Receptor	Potential Pollutant Linkage (Y/N)	Discussion
Human Health				
Historical leak of cable fluid from underground electricity cable comprising of an approximate volume of 11,772 litres of linear alkyl benzene (LAB) mixed with mineral oil (MO) 2001 to 2004. PCOCs include: TPH fractions, Speciated PAHs Mineral Oil SVOCs VOCs	LAB and MO volatilisation from soil, groundwater and LNAPL into soil pore spaces (Vapour Phase in unsaturated soils), upward migration into houses & other properties to indoor air and then inhalation	Residents & other commercial or retail building users	Y	There are residential properties within 25m of the leak point. Two schools are located within 165m of the leak point. Potential vapour phase migration may preferentially focus along utility service lines and through more permeable made ground soils and or sand/gravel fractions of soils if present (backfill).
	LAB and MO partitioning to soil (sorbed phase), groundwater (dissolved phase) and as NAPL (free phase). Then direct dermal contact/ingestion of soils and or dusts, inhalation of soil dusts / ingestion of home grown produce	Residents & other commercial or retail building users	Y	There are residential properties within 25m of the leak point. The cable source of leak is at a depth of 0.9-1.2m and so direct contact and ingestion pathways are unlikely to be viable unless groundwater levels are near ground surface bringing contamination upwards into shallow soils where direct contact is possible.
	LAB and MO partitioning to soil (sorbed phase), groundwater (dissolved phase) and as NAPL (free phase). Then permeation through plastic potable water supply pipes and ingestion	Nearby residents	Y	The water supply pipes could potentially run through contaminated zones. LAB and MO have the potential to permeate through the wall of plastic supply pipes and also through joins and gaskets. Research has not identified proven instances where this has occurred elsewhere. Any permeating compounds would be diluted depending on water flows in the pipe. A WHO drinking water standard for hydrocarbons >C10 is 0.09mg/l which exceeds the LAB theoretical solubility limit of 0.041mg/l. So, unless NAPL is present within the pipe then this WHO drinking water

				standard would not be exceeded.
	LAB and MO volatilisation from soil, groundwater and LNAPL into soil pore spaces (Vapour Phase in unsaturated soils), upward migration to outdoor air and then inhalation	Workers undertaking any subsurface works	Y	Unlikely to be significant as workers exposed in outdoor air where vapours cannot accumulate to high concentrations. Also, risks are localised areas of contamination which can be managed with the correct PPE and H&S procedures.
	LAB and MO partitioning to soil (sorbed phase), groundwater (dissolved phase) and as NAPL (free phase). Then direct dermal contact/ingestion of soils and or dusts, inhalation of soil dusts	Workers undertaking any subsurface works	Y	Unlikely to be significant as contamination is likely to be localised and can be managed with the correct PPE and H&S procedures.
Environmental – Water Receptors				
Historical leak of cable fluid from underground electricity cable comprising of an approximate volume of 11,772 litres of linear alkyl benzene (LAB) mixed with mineral oil (MO) 2001 to 2004. PCOCs include: TPH fractions, Speciated PAHs Mineral Oil SVOCs VOCs	LAB and MO partitioning to soil (sorbed phase) and as NAPL in soil pore spaces, that then can leach downwards to groundwater in shallow made ground and clayey subsoils	Shallow groundwater	Y	LAB and MO present in soils as sorbed and NAPL phases can leach downwards with infiltrating rainwater and soil water movements to groundwater. In groundwater will form LNAPL due to low solubility. There may also be limited dissolved concentrations.
	LAB and MO direct downward migration as NAPL until reaches shallow groundwater where forms LNAPL and with a limited dissolved plume based on low solubilities, then lateral migrations towards surface waters	Glasheen River and Upper Lee Estuary	Y	The Glasheen River approximately 0-5m to the east. There is a potential linkage between the leak point and the river in the form of both the open and culverted river sections that the leak point is adjacent to. The River Bride then drains into the Upper Lee Estuary.
	LAB and MO migration downwards through glacial till to sandstone-siltstone bedrock aquifer and then lateral migration	Limestone Aquifer / Groundwater Users	Y	There are no groundwater wells recorded within 1000m of the leak point. The status and use of the well are not known. The surrounding properties are serviced by mains water. The shallow bedrock presents a potential direct link to bedrock.

4.3. POLLUTANT LINKAGE ASSESSMENT

As outlined in Tables 4.1 above a number of possible pollutant linkages were identified, which have been further risk assessed with reference to BS10175:2011 and CIRIA Document C552: Contaminated Land Risk assessment 'A Guide to Good Practice'. The risk assessment has been carried out by assessing the severity of the potential consequences, taking into account both the potential severity of the hazard and the sensitivity of the target, based on categories given in Table 4.2 below.

Table 4.2 - Potential Hazard Severity Definition

CATEGORY	DEFINITIONS
Severe	Acute risks to human health, catastrophic damage to buildings, major risk to an environmental receptor such as a river
Medium	Chronic risk to human health, pollution of sensitive environmental receptor, significant damage to buildings and 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 4.3 below.

Table 4.3 - Probability of Risk Definition

CATEGORY	DEFINITIONS
High likelihood	Pollutant linkages 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 and improbable

The potential severity of the risk and 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 presented in Table 4.4 below.

Table 4.4 - Level of Risk for Potential Hazard Definition

PROBABILITY OF RISK	POTENTIAL SEVERITY			
	Severe	Medium	Mild	Minor
High likelihood	Very high	High	Moderate	Low/Moderate
Likely	High	Moderate	Low/Moderate	Low
Low likelihood	Moderate	Low/Moderate	Low	Very low
Unlikely	Low/Moderate	Low	Very Low	Very low

The assessment is discussed below in terms of plausible pollutant linkages.

The pollutant linkages of Linear Alkyl Benzene and Mineral Oil in the shallow soils/groundwater and nearby receptors are summarised in Tables 4.5 below.

Table 4.5 - Pollutant Linkage Assessment for Linear Alkyl Benzene and Mineral Oil

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk Level	Comments
Human Health						
Historical leak of cable fluid from underground electricity cable comprising of an approximate volume of 11,772 litres of linear alkyl benzene (LAB) mixed with mineral oil (MO) 2001 to 2004. PCOCs include: TPH fractions, Speciated PAHs Mineral Oil SVOCs VOCs	LAB and MO volatilisation from soil, groundwater and LNAPL into soil pore spaces (Vapour Phase in unsaturated soils), upward migration into houses & other properties to indoor air and then inhalation	Residents & other commercial or retail building users	Medium	Low Likelihood	Low/Moderate	LAB & MO have the potential to migrate along preferential pathways such as service trenches. Outside of preferential pathways, contamination will strongly sorb to soil, has low mobility, readily biodegrades in both soil and water and does not exist readily in the vapour-phase. Mineral oil is less biodegradable therefore has a greater tendency to accumulate and may present a greater risk. Given the distance of <25m to residences and the quantity of reported oil loss (11,772l) the potential risk to residents is low/moderate.
	LAB and MO partitioning to soil (sorbed phase), groundwater (dissolved phase) and as NAPL (free phase). Then direct dermal contact/ingestion of soils and or dusts, inhalation of soil dusts / ingestion of home	Residents & other commercial or retail building users	Medium	Unlikely	Low	The cable source of leak is at a depth of 0.9m and so direct contact and ingestion pathways are unlikely to be viable unless groundwater levels are near ground surface or capillary action brings contamination upwards into shallow soils where direct contact is possible. The contamination is also located under the

	grown produce					road and concrete surface in an area not known to flood.
	LAB and MO partitioning to soil (sorbed phase), groundwater (dissolved phase) and as NAPL (free phase). Then permeation through plastic potable water supply pipes and ingestion	Nearby residents and other users of the water mains.	Medium	Unlikely	Low	Water supply pipes are thought to be present above power cable and the leaked cable fluid has low potential to permeate plastic water supply pipes. For this reason, the potential risk is Low. Also, Irish Water reviews of sampling data and subsequent risk assessments suggest that there has been no impact to potable water pipes based on the absence of COPC detections and the high-pressure nature of supply pipes. Risk rating may change if evidence of dynamic hydrological regime is observed or significant free phase product is observed proximal to pipe.
	LAB and MO volatilisation from soil, groundwater and LNAPL into soil pore spaces (Vapour Phase in unsaturated soils), upward migration to outdoor air and then inhalation	Workers undertaking any subsurface works	Medium	Unlikely	Low	Potential risk to workers from localised areas of contamination and vapours is unlikely due to low volatility and exposure in outdoor air, if it does occur it will be short term and can be managed with the correct PPE and H&S procedures.
	LAB and MO partitioning to soil (sorbed phase), groundwater (dissolved phase) and as NAPL (free phase). Then direct dermal	Workers undertaking any subsurface works	Medium	Unlikely	Low	Potential risk to workers from localised areas of contamination will be short term and can be managed with the correct PPE and H&S procedures.

	contact/ingestion of soils and or dusts, inhalation of soil dusts					
Environmental – Water Receptors						
Historical leak of cable fluid from underground electricity cable comprising of an approximate volume of 11,772 litres of linear alkyl benzene (LAB) mixed with mineral oil (MO) 2001 to 2004.	LAB and MO partitioning to soil (sorbed phase) and as NAPL in soil pore spaces, that then can leach downwards to groundwater in shallow made ground and glacial till soils	Shallow groundwater	Mild	Likely	Low/Moderate	Potentially Low/Moderate risk due to alkyl benzene contamination strongly absorbs to soil, has low mobility, readily biodegrades in both soil and water. Mineral oil is less biodegradable therefore has a greater tendency to accumulate and may present a greater risk. Rare shallow groundwater in made ground and sandy subsoils is unlikely to be used as an actual resource due to low water volumes and location in a residential urban area. Overall potential risk is low/moderate.
PCOCs include: TPH fractions, Speciated PAHs Mineral Oil SVOCs, VOCs,	LAB & MO migration downwards through glacial till to Sandstone/siltstone bedrock aquifer and then lateral migration	Limestone bedrock aquifer / Groundwater Users	Medium	Likely	Moderate	Has the potential to migrate downwards in thin made ground/at-surface bedrock. The contamination will strongly sorb to soil, has low mobility, readily biodegrades in both soil and water (LAB). Mineral oil is less biodegradable therefore has a greater tendency to accumulate and may present a greater risk. The underlying aquifer is also regionally important. In locations where overburden is thin or absent, the risk is higher, hence the potential risk is

						Moderate.
	LAB and MO direct downward migration as NAPL until reaches shallow groundwater where forms LNAPL and with a limited dissolved plume based on low solubilities, then lateral migrations towards surface waters	Glasheen River and Upper Lee Estuary	Medium	Likely	Moderate	Has the potential to migrate in shallow groundwater in made and sandy ground as well as directly from leak point. The contamination will strongly sorb to soil and has low mobility. There was a significant loss (11,772L) from the cable which is likely to be transmitted to the adjacent environmental receptor from the leak point considering the proximity and potential direct pathway. Potential hydrological connection between Glasheen River and downstream protected sites.

4.4. SUMMARY OF PRELIMINARY QUANTITATIVE RISK ASSESSMENT (PQRA)

A desktop study and site walkover were conducted at the Dennehy's Cross Site in Cork City after there was a volume of 11,772 litres of linear alkyl benzene mixed with mineral oil lost from the cable at an approximate rate of 295L/month for approximately 40 months. The leak began in 2001 and was repaired in 2004. Results of the PQRA are summarised below:

4.4.1 Human Health:

- There is a Low/Moderate potential risk posed by LAB and MO vapours in suspected contamination in the soil and groundwater through preferential pathways such as services ducts to residents or other building users;
- There is a Low potential risk posed by LAB and MO from contact with suspected contamination in the soil and groundwater through direct dermal/inhalation and ingestion contact to residents or other building users;
- There is a Low potential risk posed by LAB and MO contact from ingestion contact with suspected contamination in the soil and groundwater through permeation of contamination through plastic water pipes;
- There is a Low potential risk to construction workers from dermal/inhalation and ingestion pathways which can be managed by appropriate use of PPE and H&S procedures.

4.4.2 Environmental:

- There is a Low/Moderate potential risk posed by LAB and MO to shallow groundwater from suspected contamination in the shallow made ground and clay subsoils given the contaminant properties of low mobility and high sorption to soil, with shallow groundwater in made ground and sandy subsoils unlikely to be used as an actual resource due to low water volumes and location in a residential urban area
- There is a Moderate potential risk posed by LAB and MO to the Glasheen River and the Upper Lee Estuary from the suspected contamination given the contaminant properties of low mobility and high sorption to soil coupled with the close proximity of the Glasheen River to the leak point.
- There is a Moderate potential risk posed by LAB and MO to the underlying Limestone Bedrock Aquifer given the high to extreme vulnerability and observed shallow/outcropping bedrock in the area.

4.5. SUMMARY AND CONCLUSIONS

This preliminary environmental site assessment consists of a review of the potential environmental impact associated with a suspected hydrocarbon leak from a power cable at Dennehy's Cross in Cork City (ESB Site Ref: 61 Dennehy's Cross – Liberty Street 38 kV).

There was an approximate volume of 11,772 litres of cable fluid consisting of linear alkyl benzene (LAB) mixed with Mineral Oil (MO) lost to ground from the leak point in question. The leak occurred in 2001 and was repaired in November 2004; approximately 240m east of Dennehy's Cross junction.

The leak point is situated in a residential area on a busy road, with house housing being 20m from the indicative leak point. The Glasheen River runs from south to north under Glasheen Bridge, within 5m of the indicated leak point. The route of the Glasheen River is bordered by a long green area which runs between Glasheen Road and Magazine Road. Utility maps and site walkover observations suggest there are abundant service lines including foul sewerage, gas, communication and water lines along the entirety of the cable route. It is likely that there are numerous unmapped minor services along the route also.

The cable section and leak point are underlain by regionally important groundwater aquifers in the form of the Cork Red Marble Formation, Waulsortian Limestones and Little Island Formations. The vulnerability is High to Extreme indicating that bedrock is likely to be relatively close to surface (0-5metres) and that the subsoils are moderately permeability made ground subsoils, which provide a limited level of natural protection to the underlying bedrock aquifer. Under the Water Framework Directive, the groundwater body (CorkCity_2) beneath the site is of good status but is at risk of deterioration in the future. Groundwater in the bedrock aquifer may be locally, semi-confined by the subsoils with groundwater flow in a northerly direction following site topography towards the Upper Lee Estuary.

The nearest surface watercourse is the Glasheen River; which flows under Glasheen Bridge and is located less than 5m to the east of the leak point. The Glasheen River flows from the south, past the leak point, into the Curragheen River 400m to the north; where it then flows into the Upper Lee Estuary 410m to the northeast. This section of the Glasheen River has not been assigned a risk or quality status under the Water Framework Database.

There are no mapped groundwater wells within 1000m of the leak site in the GSI well database. A series of ground investigation boreholes are recorded 635m to the northwest of the leak site, associated with the County Hall development.

There are no designated areas of conservation or “European Sites” within 1km of the site; the nearest being the Cork Lough proposed Natural Heritage Area (pNHA) 1km to the west of the leak site. The Lee Valley pNHA is located 1.5km to the northwest of the leak site also.

Based on the known cable leak point, COPC fate and transport and hydrogeological desk study information the CSM has the following initial key findings for human health and environmental risks;

There is a potentially Low risk posed by LAB and MO from contact with suspected contamination in the soil and groundwater through;

- direct dermal/inhalation and ingestion contact to residents or other building users;
- dermal/inhalation and ingestion pathways to construction workers which can be managed by appropriate use of PPE and H&S procedures;
- ingestion contact with suspected contamination in the soil and groundwater through permeation of contamination through plastic water pipes or through low-pressure infiltration of possible soil contamination into water pipes via nearby breaks or leaks;

There is a Low/Moderate potential risk posed by LAB and MO in suspected contamination in the soil and groundwater through;

- hydrocarbon vapours in preferential pathways such as services ducts to residents or other building users

- leaching to shallow groundwater given the contaminant properties of low mobility and high sorption to soil, with rare shallow groundwater unlikely to be a viable groundwater resource in the residential urban setting.

There is a potentially Moderate risk posed by LAB and MO in suspected contamination in the soil and groundwater through;

- hydrocarbon migration into the adjacent watercourse and the downstream Curragheen River and Upper Lee Estuary given the short distance to the culverted Glasheen River which poses a potential pollutant linkage between the leak site and the surface water receptors.
- hydrocarbon migration to the underlying aquifer given the possible connection to shallow groundwater, or directly to bedrock, through shallow rock in the area indicated by the high to Extreme vulnerability.

5. REFERENCES

- Investigation of potentially contaminated sites – Code of Practice, BS 10175:2011 + A2 2017, published by BSI, 2017.
- Code of Practice for Site Investigations, BS 5930:2015, published by BSI, 2015.
- "Model Procedures for the Management of land Contamination" Contaminated Land Report 11 (CLR 11), published by the UK Environment Agency & DEFRA, 2004, being withdrawn shortly to be replaced with online guidance called Land Contamination Risk Management (LCRM).
- Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites, EPA 2013.
- Guidance on Authorisation of Discharges to Groundwater, published by the EPA (Ireland) in December 2011.
- Petroleum Products in Drinking-water Background document for development of WHO Guidelines for Drinking-water Quality, World Health Organization 2008.
- MSDS for T3788 and REACH database for C10-C13 Linear Alkyl Benzenes CAS No. 67774-74-4 - https://echa.europa.eu/registration-dossier/-/registered-dossier/15763/6/1.
- Mineral Oils: Untreated and Mildly Treated. Report on Carcinogens 14th Edition. National Toxicology Programme https://ntp.niehs.nih.gov/ntp/roc/content/profiles/mineraloils.pdf.
- Petroleum Hydrocarbons in Groundwater. Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies. CLAIRE 2017.
- IARC Monograph 100F - MINERAL OILS, UNTREATED OR MILDLY TREATED - https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100F-19.pdf.
- The LQM/CIEH S4ULs for Human Health Risk Assessment, Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3484, All rights reserved, November 2014.
- European Standard (BS EN 858-1:2002 and BS EN 858-2:200)3; for the design, use, selection, installation, operation and maintenance of prefabricated oil separators.
- Towards setting guideline values for the protection of groundwater in Ireland, interim report, Environmental Protection Agency, 2003.
- European Communities Environmental Objectives (Groundwater) Regulations, 2010, S.I. No.9 of 2010.
- European Union Environmental Objectives (Surface Waters) (amendment) Regulations 2015, European Communities Environmental Objectives (Surface Waters) Regulations 2009.
- http://www.epa.ie/pubs/advice/drinkingwater/drinkingwatersupplies.
- National Authority for Occupational Safety and Health 2011 Code of Practice for in support of the Safety, Health and Welfare at Work (Chemical Agents) Regulations, 2001.
- European Union Risk Assessment Report. Benzene C_{10-13} Alkyl Derivs, 1st Priority List, Volume 3. European Commission – Joint Research Centre Institute for Health and Consumer Protection European Chemicals Bureau (ECB), 1999.
- European Commission. Guidance Document for the implementation of the European PRTR, May 2006.
- Classification of Hazardous and Non-Hazardous Substances in Groundwater 2010, EPA 2010.

oo0oo

Respectfully submitted

On behalf of Verde Environmental Consultants

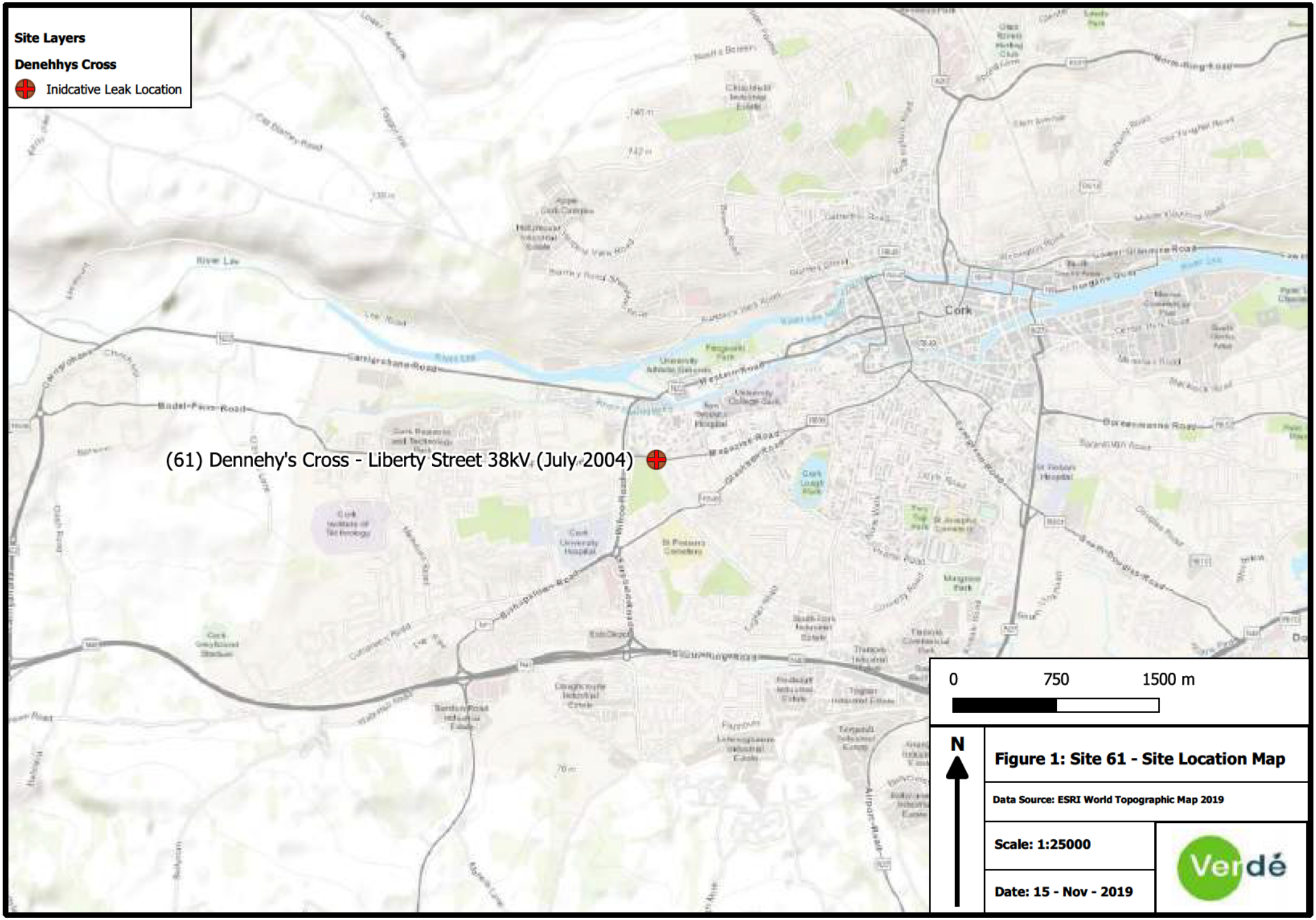
[redacted]

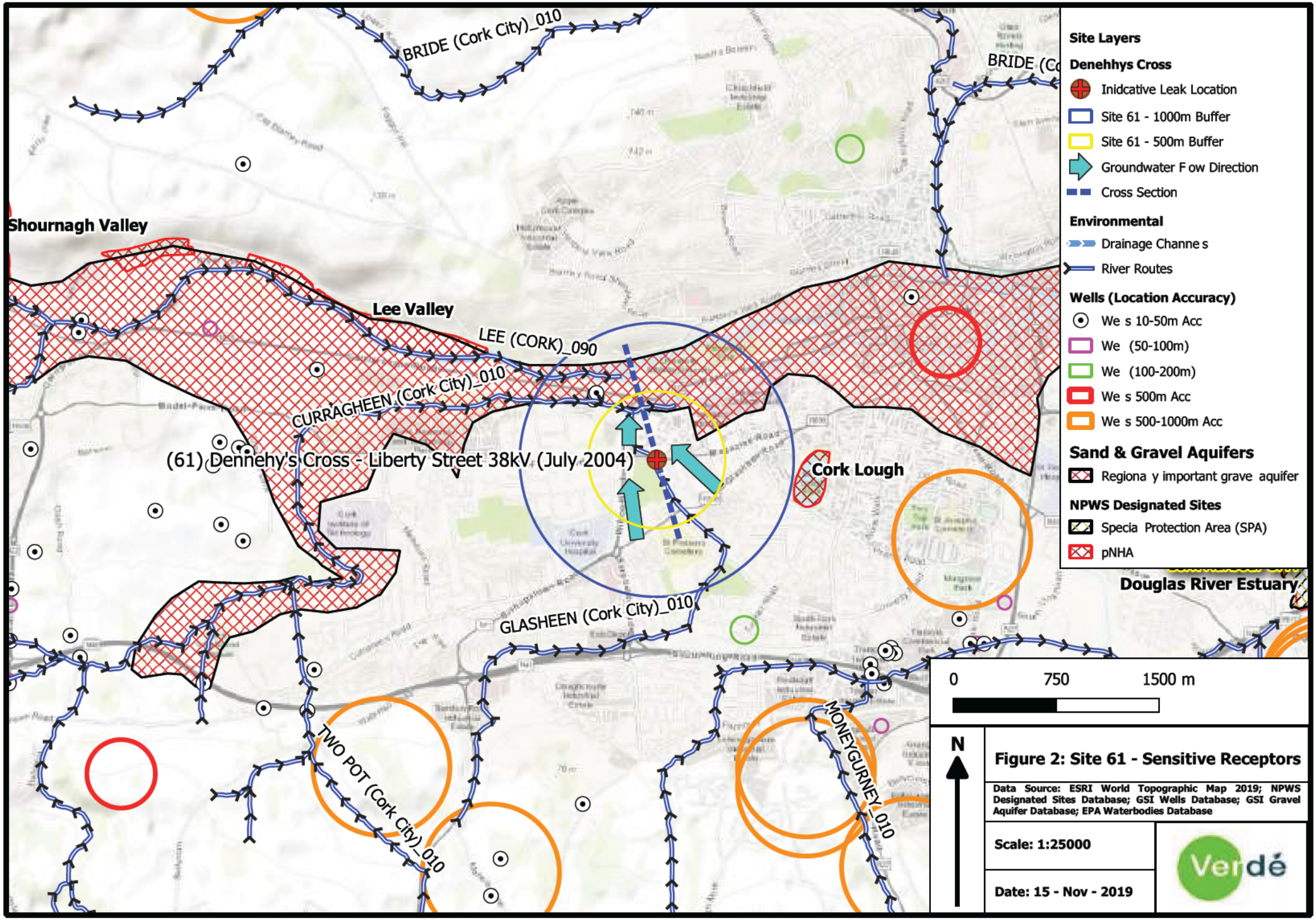
SENIOR ENVIRONEMENTAL CONSULTANT

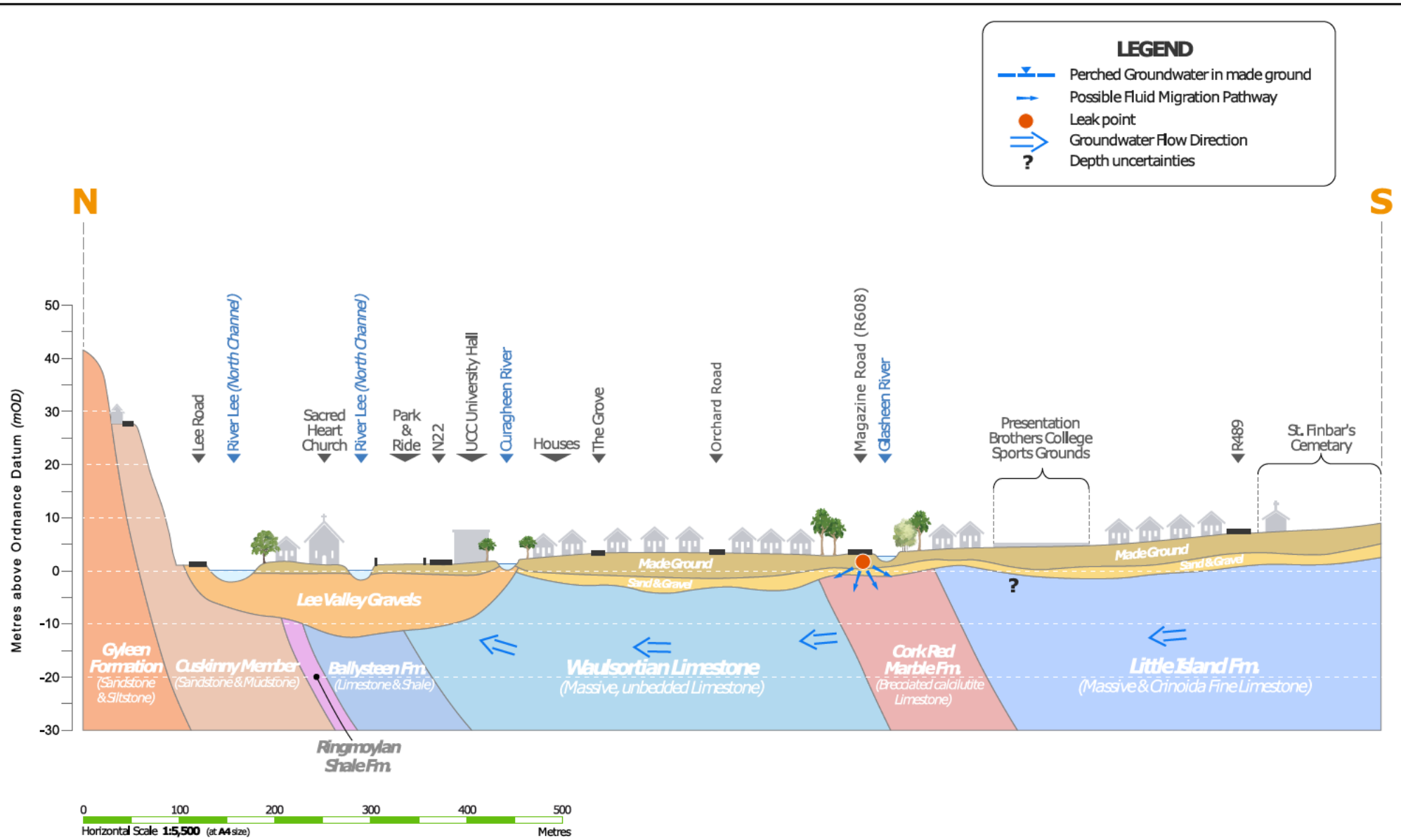
[redacted]

PROJECT DIRECTOR

FIGURES


Site Layers
Denehhys Cross
Inidcative Leak Location
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Cork
0
750
1500 m
N
Figure 1: Site 61 - Site Location Map
Data Source: ESRI World Topographic Map 2019
Scale: 1:25000
Date: 15 - Nov - 2019
Verdé


BRIDE (Cork City)_010
Shournagh Valley
Lee Valley
LEE (CORK)_090
CURRAGHEEN (Cork City)_010
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Cork Lough
Douglas River Estuary
GLASHEEN (Cork City)_010
TWO POT (Cork City)_010
MONEYGURNEY_010
Site Layers
Denehhys Cross
Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
Groundwater F ow Direction
Cross Section
Environmental
Drainage Channe s
River Routes
Wells (Location Accuracy)
We s 10-50m Acc
We (50-100m)
We (100-200m)
We s 500m Acc
We s 500-1000m Acc
Sand & Gravel Aquifers
Regiona y important grave aquifer
NPWS Designated Sites
Specia Protection Area (SPA)
pNHA
0
750
1500 m
N
Figure 2: Site 61 - Sensitive Receptors
Data Source: ESRI World Topographic Map 2019; NPWS Designated Sites Database; GSI Wells Database; GSI Gravel Aquifer Database; EPA Waterbodies Database
Scale: 1:25000
Date: 15 - Nov - 2019
Verdé

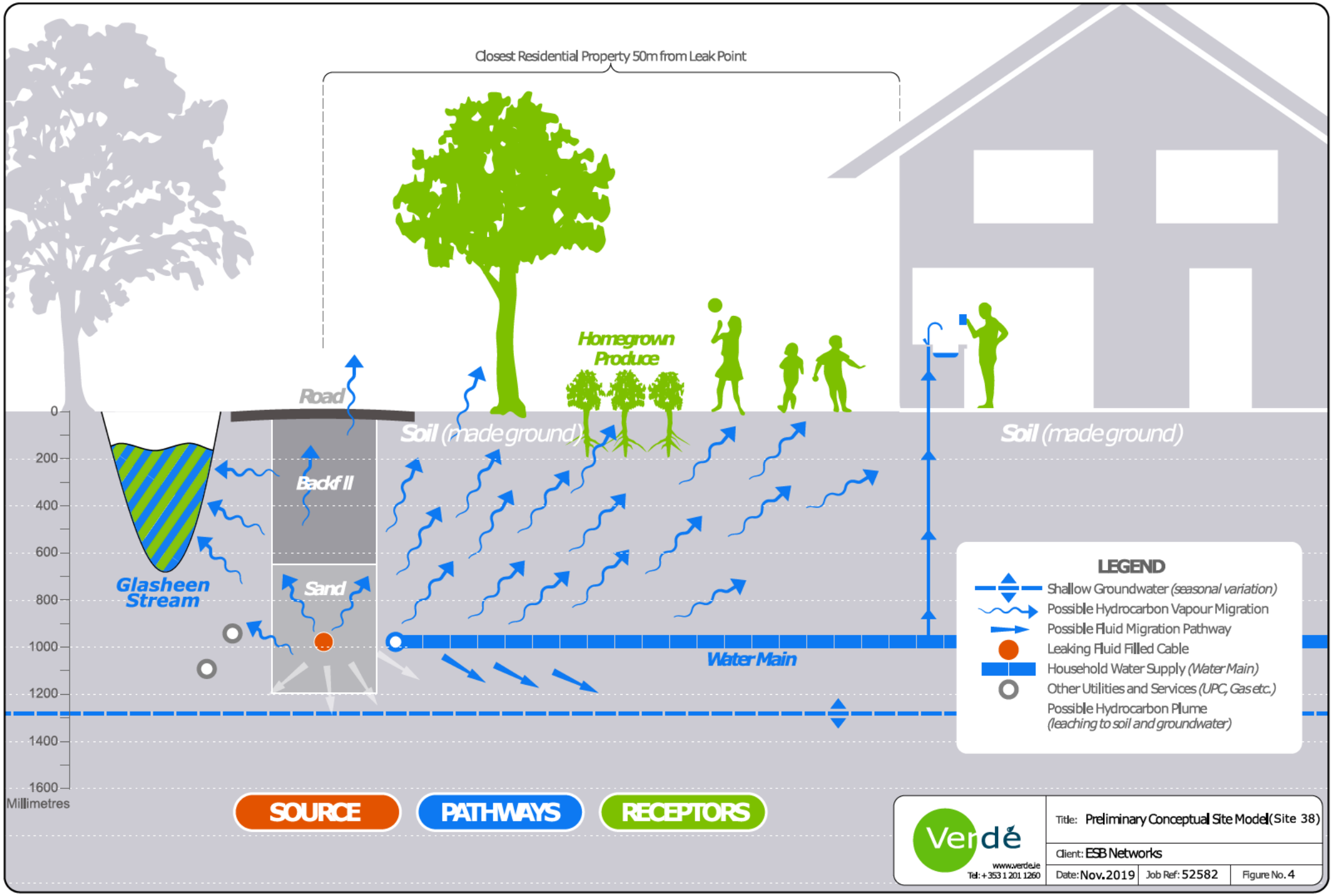


Verdé
www.verde.ie
Tel: +353 1 201 1260

Title: Preliminary Conceptual Site Model (Site 61)

Client: ESB Networks

Date: Nov. 2019 | Job Ref: 52582 | Figure No. 3



Verdé
www.verde.ie
Tel: +353 1 201 1260

Title: Preliminary Conceptual Site Model (Site 38)

Client: ESB Networks

Date: Nov. 2019 | Job Ref: 52582 | Figure No. 4

APPENDIX A

ESB SITE LAYOUT PLAN WITH INDICATIVE CABLE FLUID LEAKAGE LOCATION

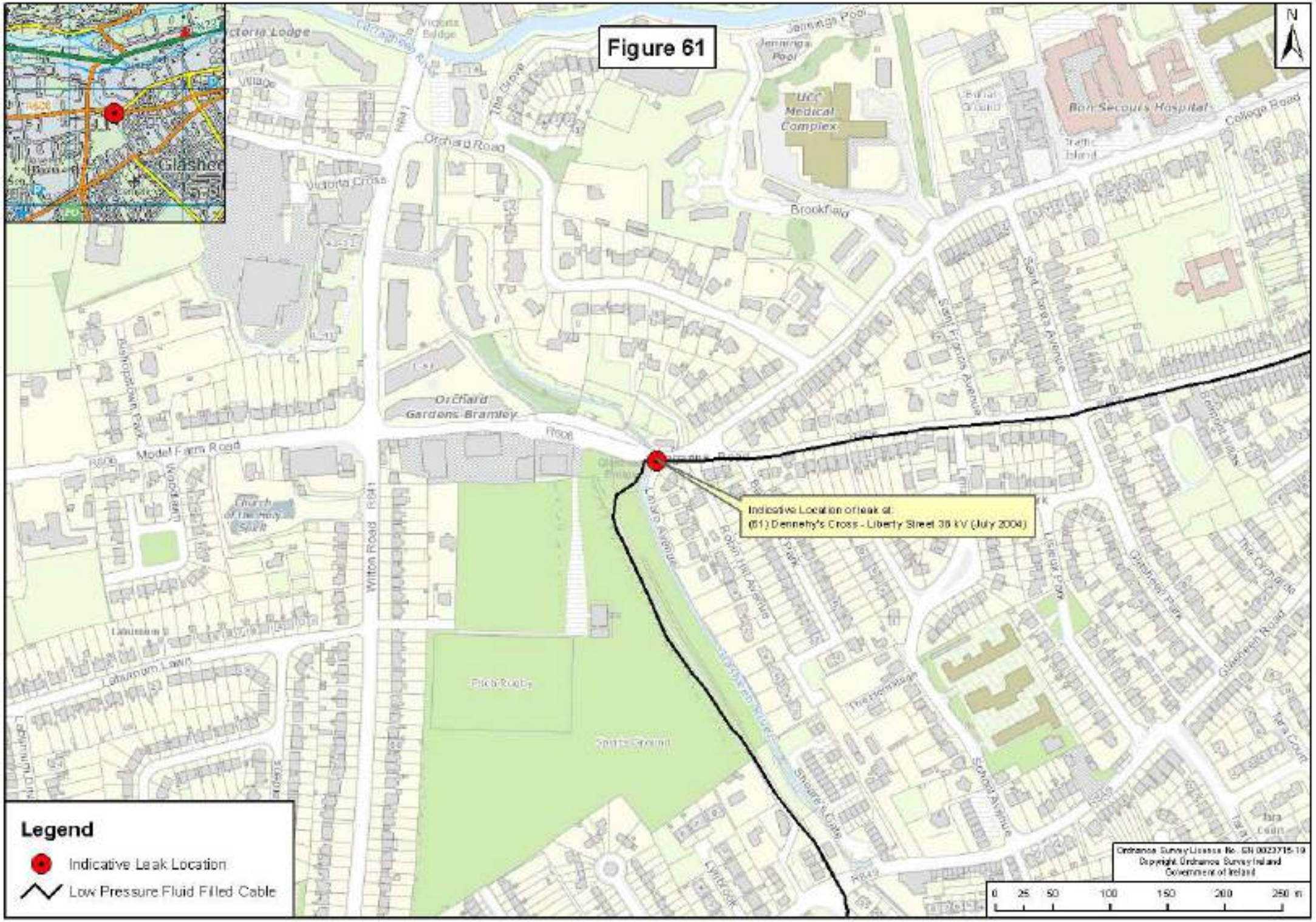
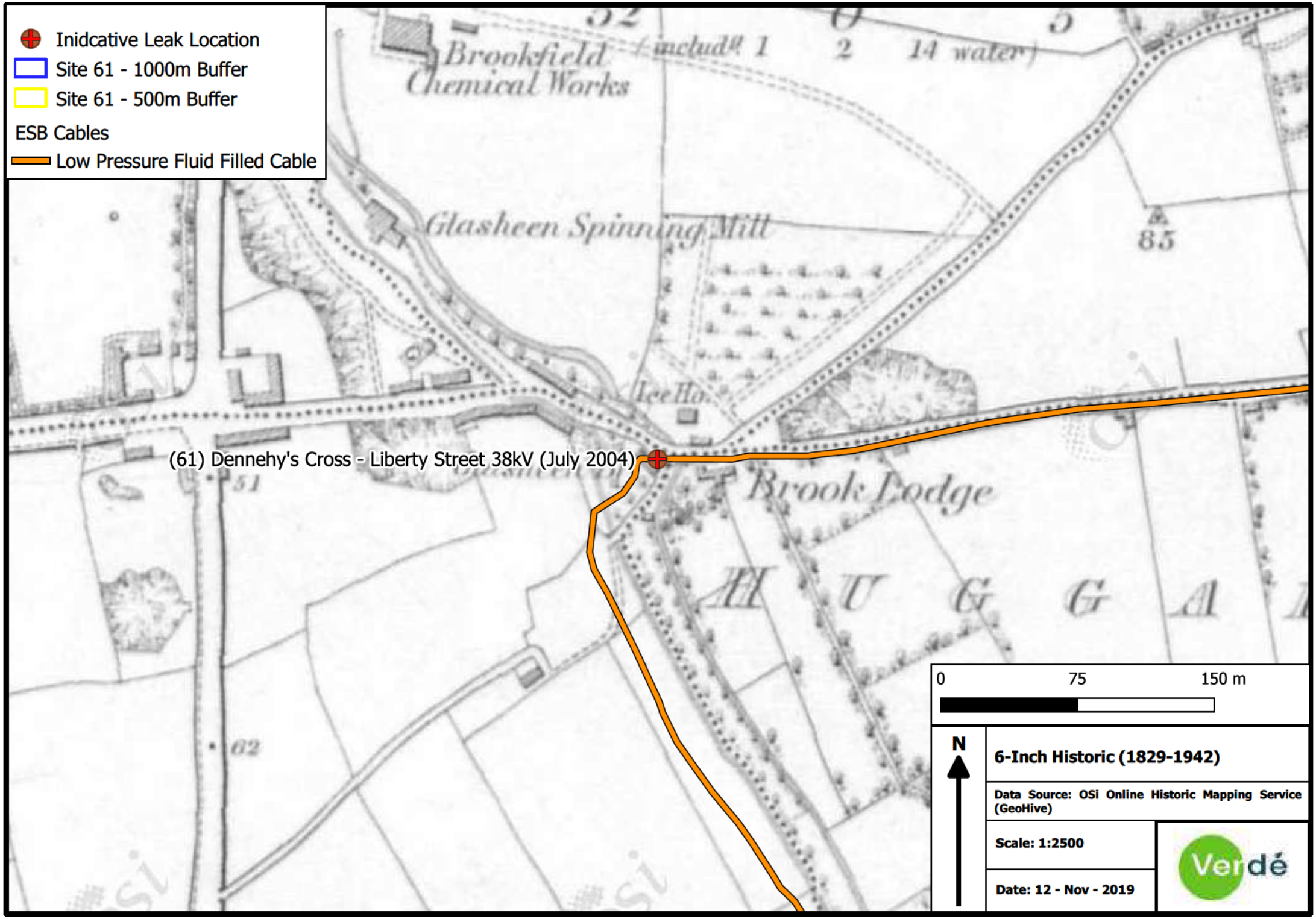
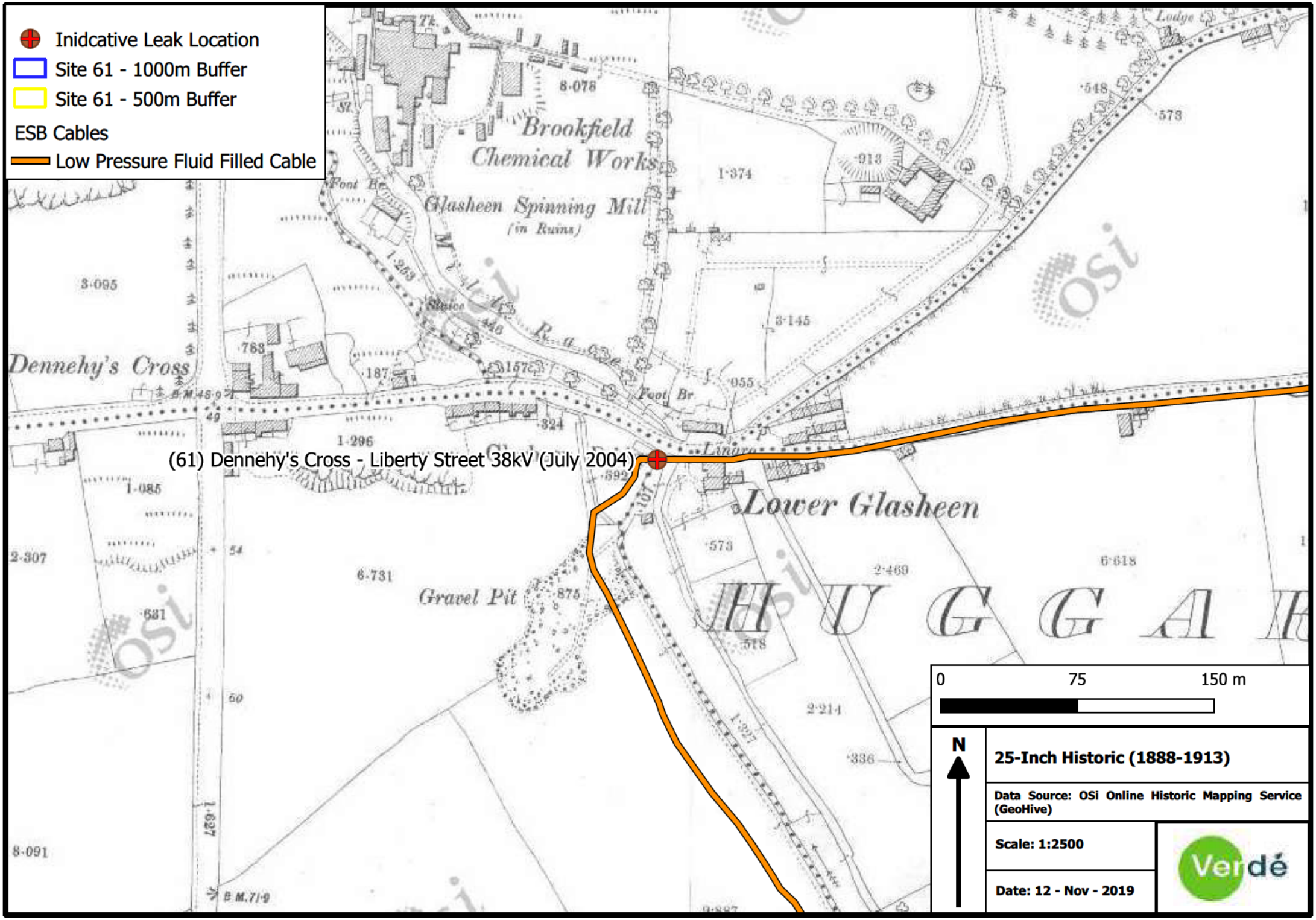


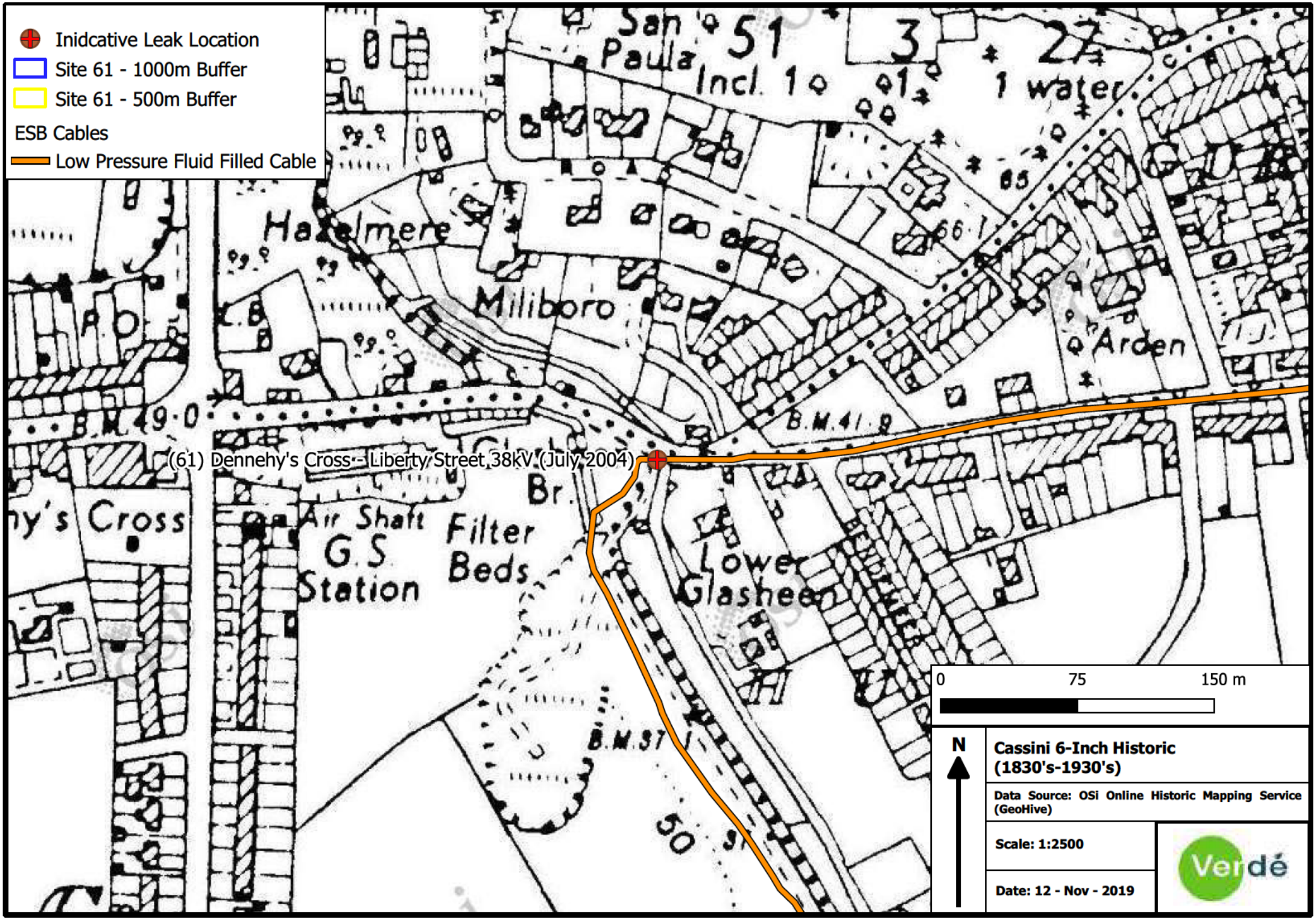
Figure 61
Indicative Location of leak at:
(61) Dennehy's Cross - Liberty Street 38 kV (July 2004)
Legend
Indicative Leak Location
Low Pressure Fluid Filled Cable
Orchard Road
Model Farm Road
Wilton Road
Brookfield
College Road
Bon Secours Hospital
UCC Medical Complex
Orchard Gardens Bramley
Victoria Cross
Victoria Lodge
Glasheen
Jennings Pool
Ordnance Survey Licence No. EN 0023715-19
Copyright Ordnance Survey Ireland
Government of Ireland
0 25 50 100 150 200 250 m
N

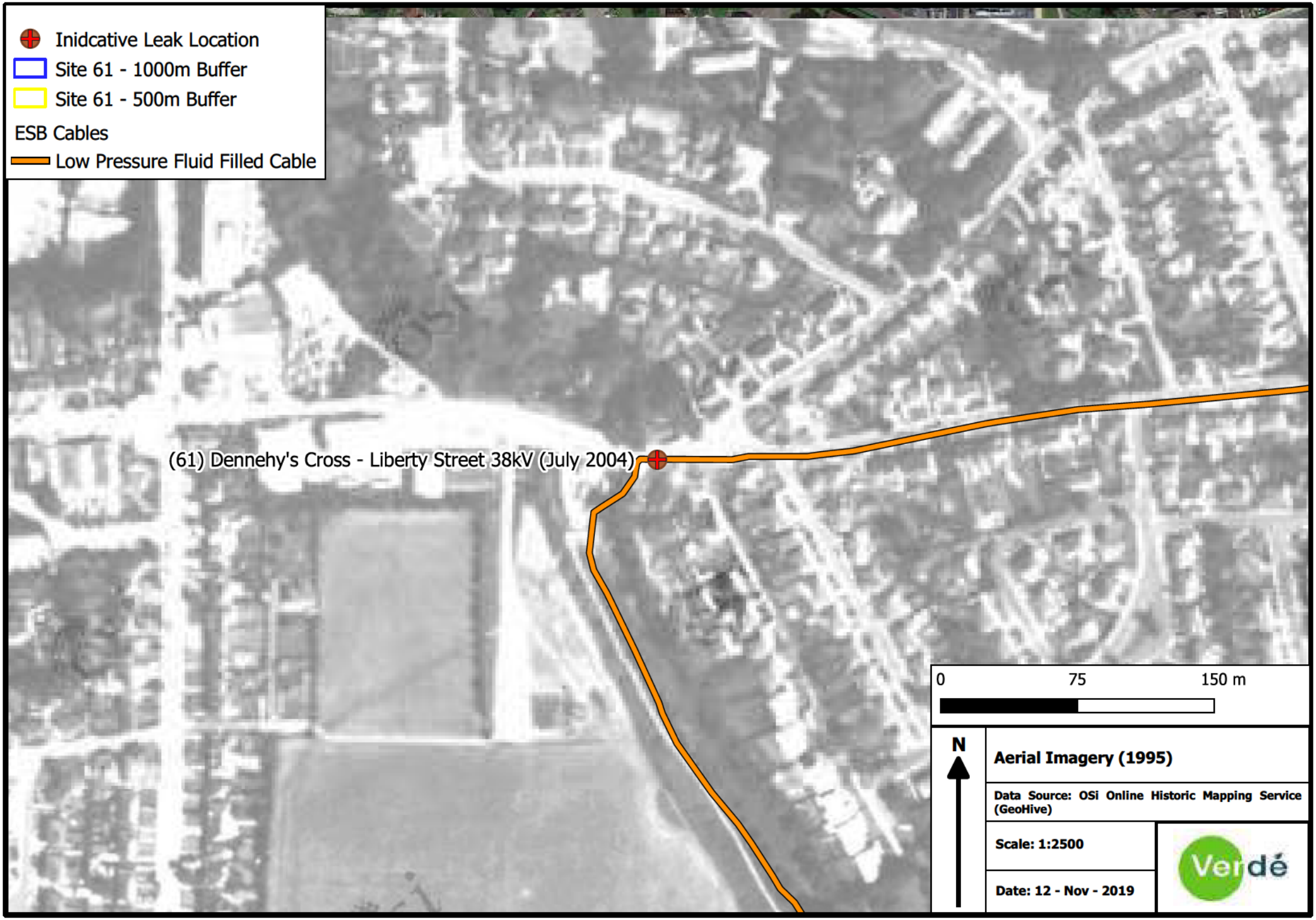
APPENDIX B

DESK STUDY MAPS


Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure Fluid Filled Cable
Brookfield Chemical Works
Glasheen Spinning Mill
Brook Lodge
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
0
75
150 m
N
6-Inch Historic (1829-1942)
Data Source: OSi Online Historic Mapping Service (GeoHive)
Scale: 1:2500
Date: 12 - Nov - 2019
Verdé


Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure Fluid Filled Cable
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Brookfield Chemical Works
Glasheen Spinning Mill
(in Ruins)
Dennehy's Cross
Lower Glasheen
Gravel Pit
Foot Br
Sluice
Lodge
0
75
150 m
N
25-Inch Historic (1888-1913)
Data Source: OSi Online Historic Mapping Service (GeoHive)
Scale: 1:2500
Date: 12 - Nov - 2019
Verdé

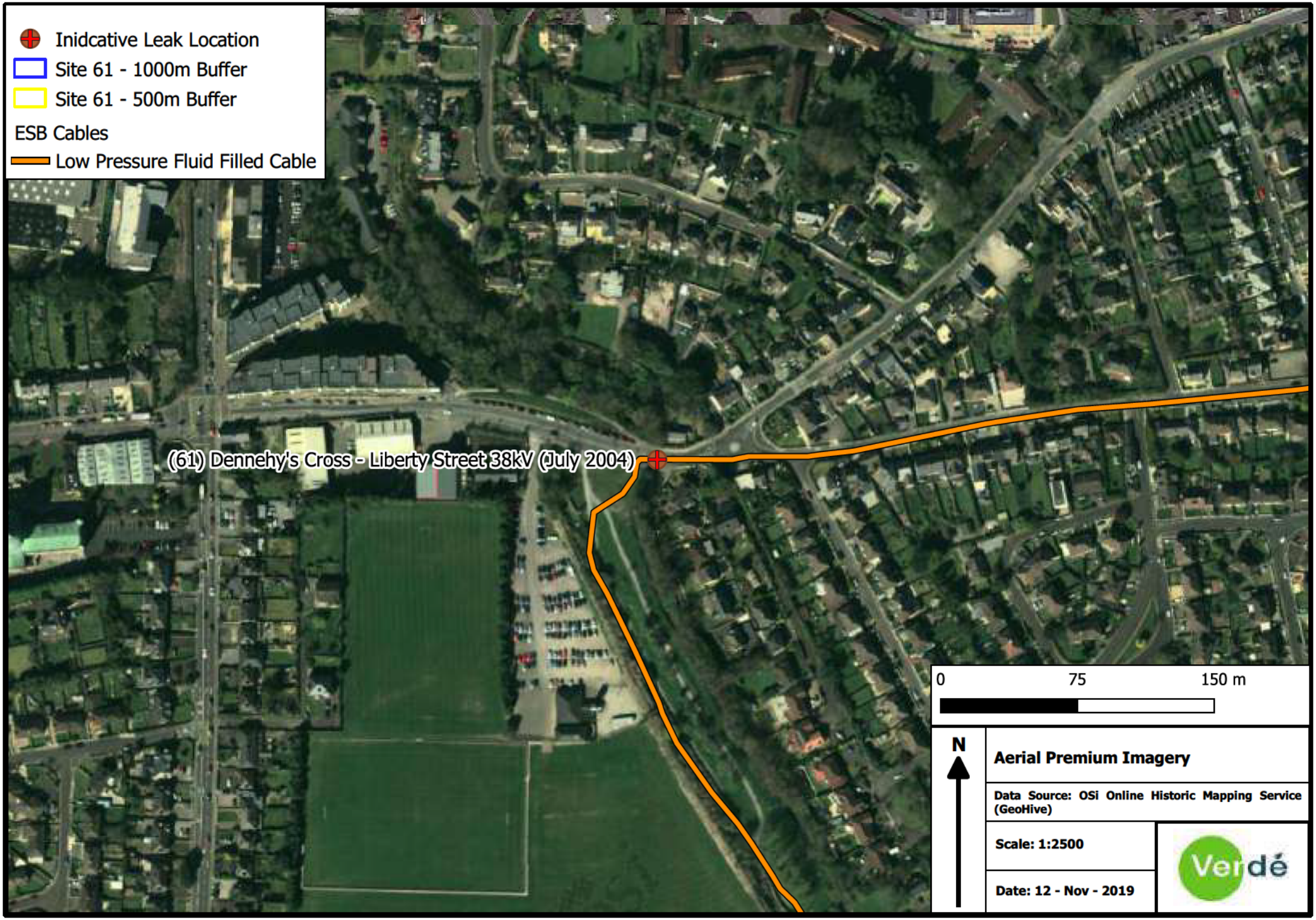

Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure Fluid Filled Cable
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Hazelmere
Miliboro
Arden
Lower Glashee
Air Shaft
Filter Beds
G.S. Station
Cross
B.M. 49·0
B.M. 41·8
B.M. 37·1
0
75
150 m
N
Cassini 6-Inch Historic (1830's-1930's)
Data Source: OSi Online Historic Mapping Service (GeoHive)
Scale: 1:2500
Date: 12 - Nov - 2019
Verdé

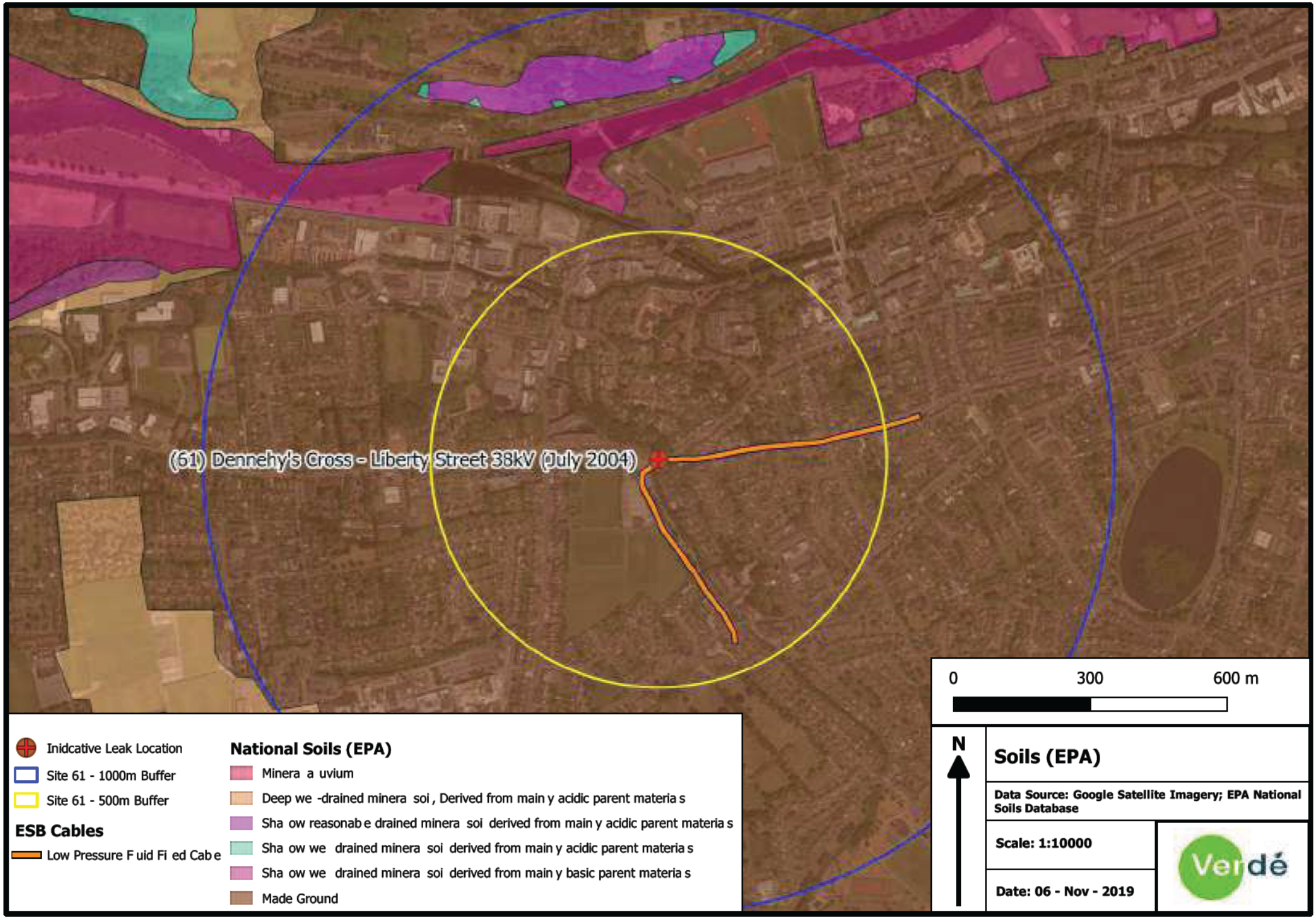

Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure Fluid Filled Cable
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
0
75
150 m
N
Aerial Imagery (1995)
Data Source: OSi Online Historic Mapping Service (GeoHive)
Scale: 1:2500
Date: 12 - Nov - 2019
Verdé

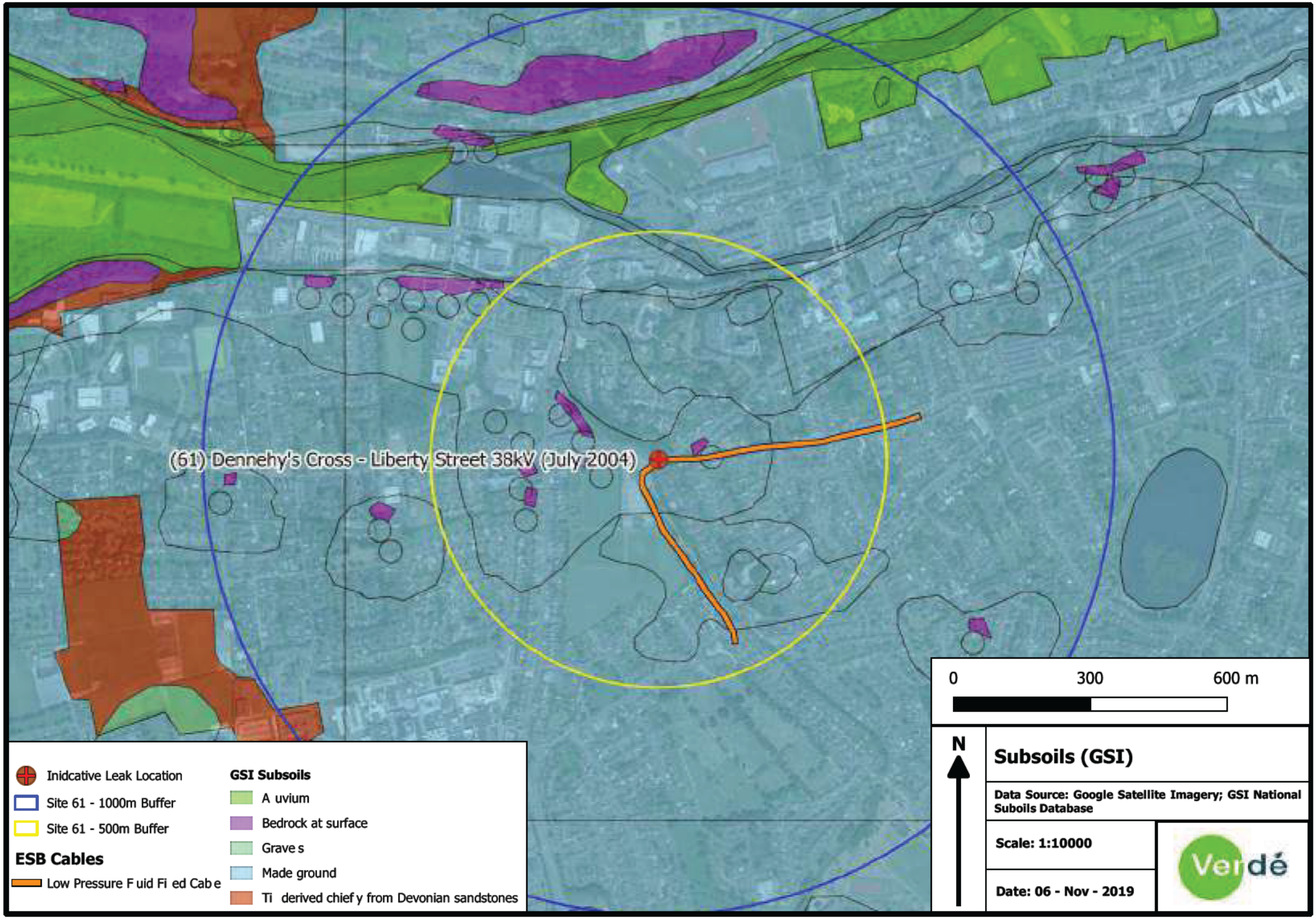

Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure Fluid Filled Cable
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
0
75
150 m
N
Aerial Imagery (2000)
Data Source: OSi Online Historic Mapping Service (GeoHive)
Scale: 1:2500
Date: 12 - Nov - 2019
Verdé

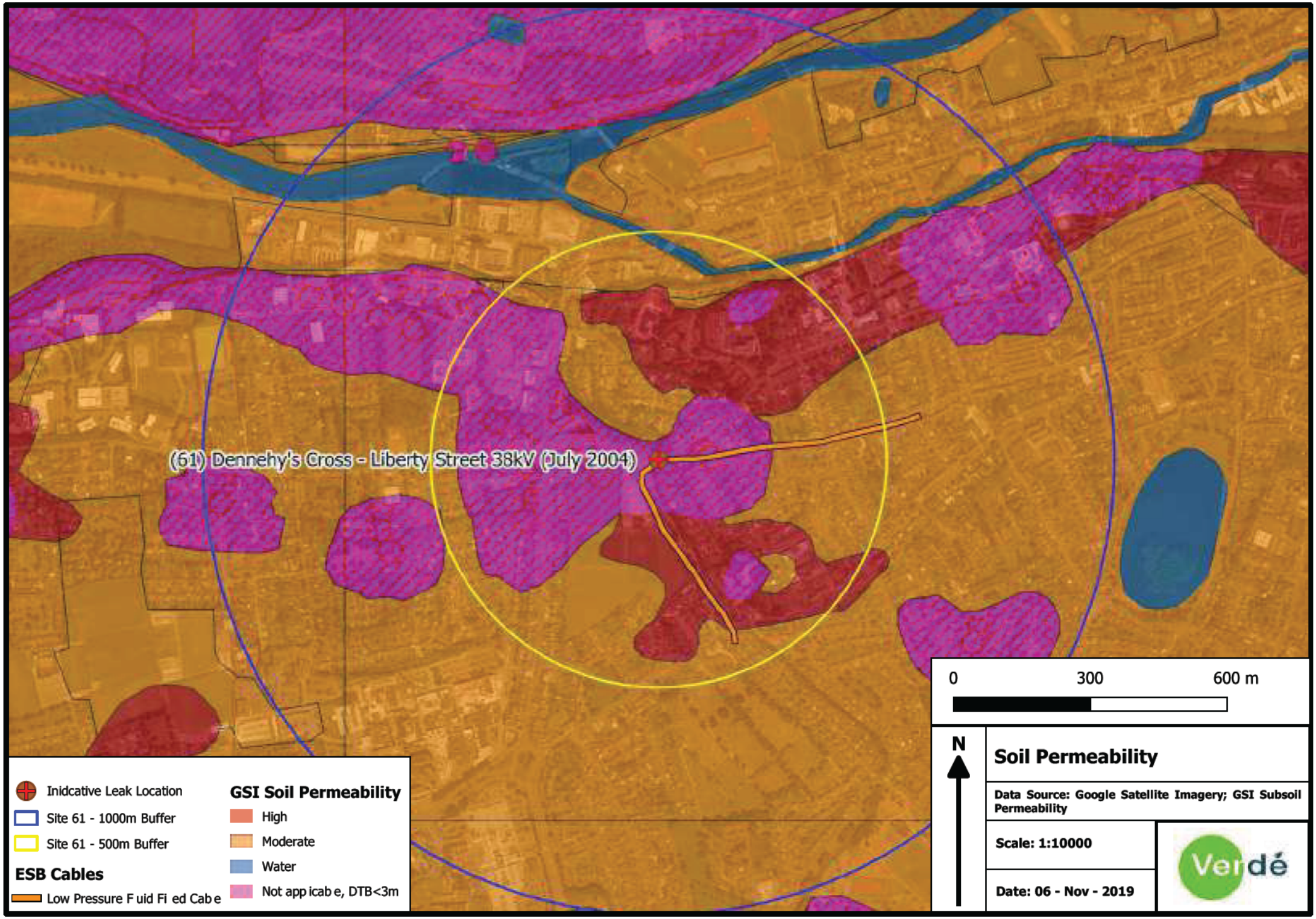

Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure Fluid Filled Cable
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
0
75
150 m
N
Aerial Imagery (2005)
Data Source: OSi Online Historic Mapping Service (GeoHive)
Scale: 1:2500
Date: 12 - Nov - 2019
Verdé

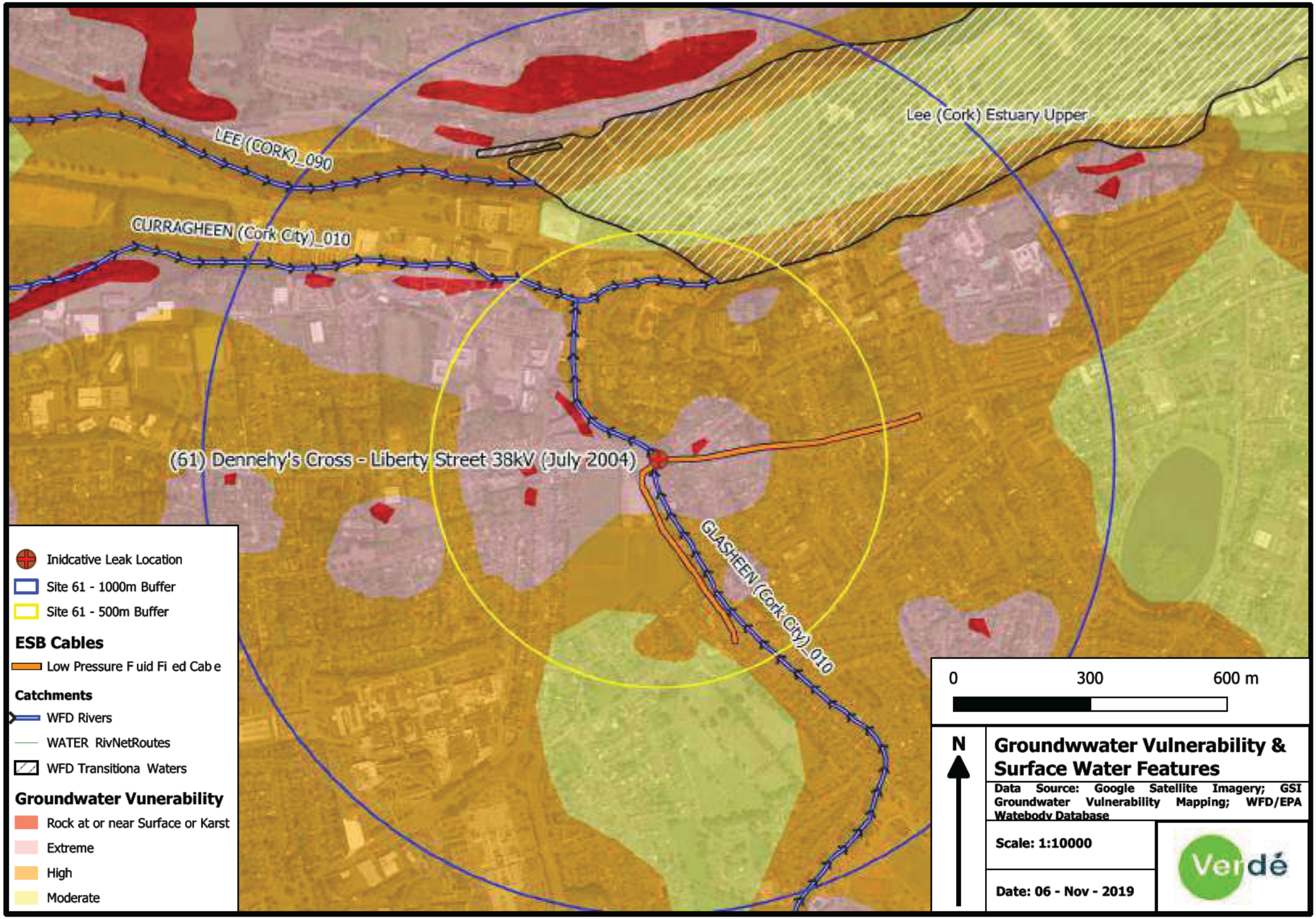

Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure Fluid Filled Cable
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
0
75
150 m
N
Digital Globe Aerial Imagery
Data Source: OSi Online Historic Mapping Service (GeoHive)
Scale: 1:2500
Date: 12 - Nov - 2019
Verdé

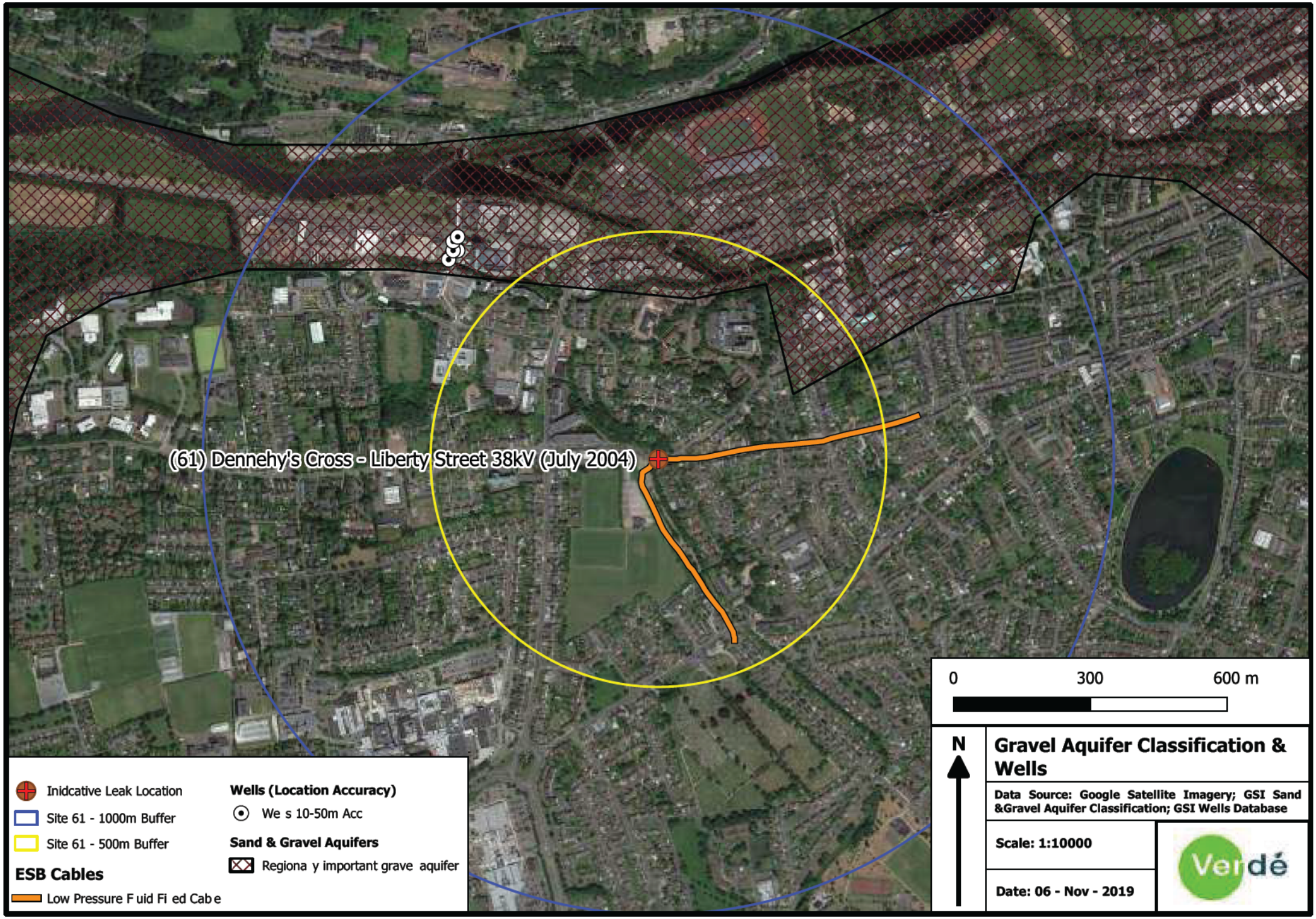

Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure Fluid Filled Cable
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
0
75
150 m
N
Aerial Premium Imagery
Data Source: OSi Online Historic Mapping Service (GeoHive)
Scale: 1:2500
Date: 12 - Nov - 2019
Verdé

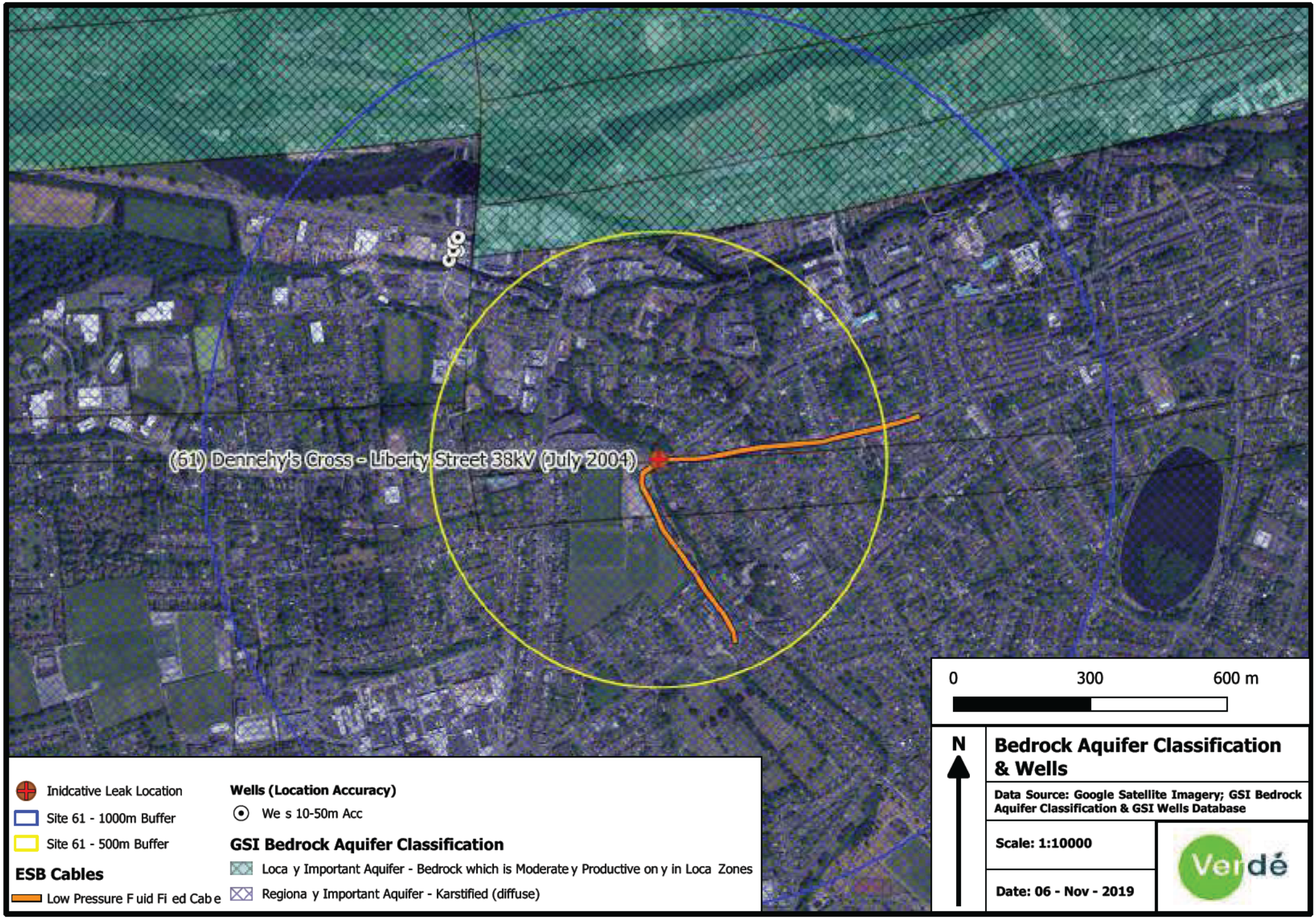

(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure F uid Fi ed Cab e
National Soils (EPA)
Minera a uvium
Deep we -drained minera soi , Derived from main y acidic parent materia s
Sha ow reasonab e drained minera soi derived from main y acidic parent materia s
Sha ow we drained minera soi derived from main y acidic parent materia s
Sha ow we drained minera soi derived from main y basic parent materia s
Made Ground
0
300
600 m
N
Soils (EPA)
Data Source: Google Satellite Imagery; EPA National Soils Database
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé

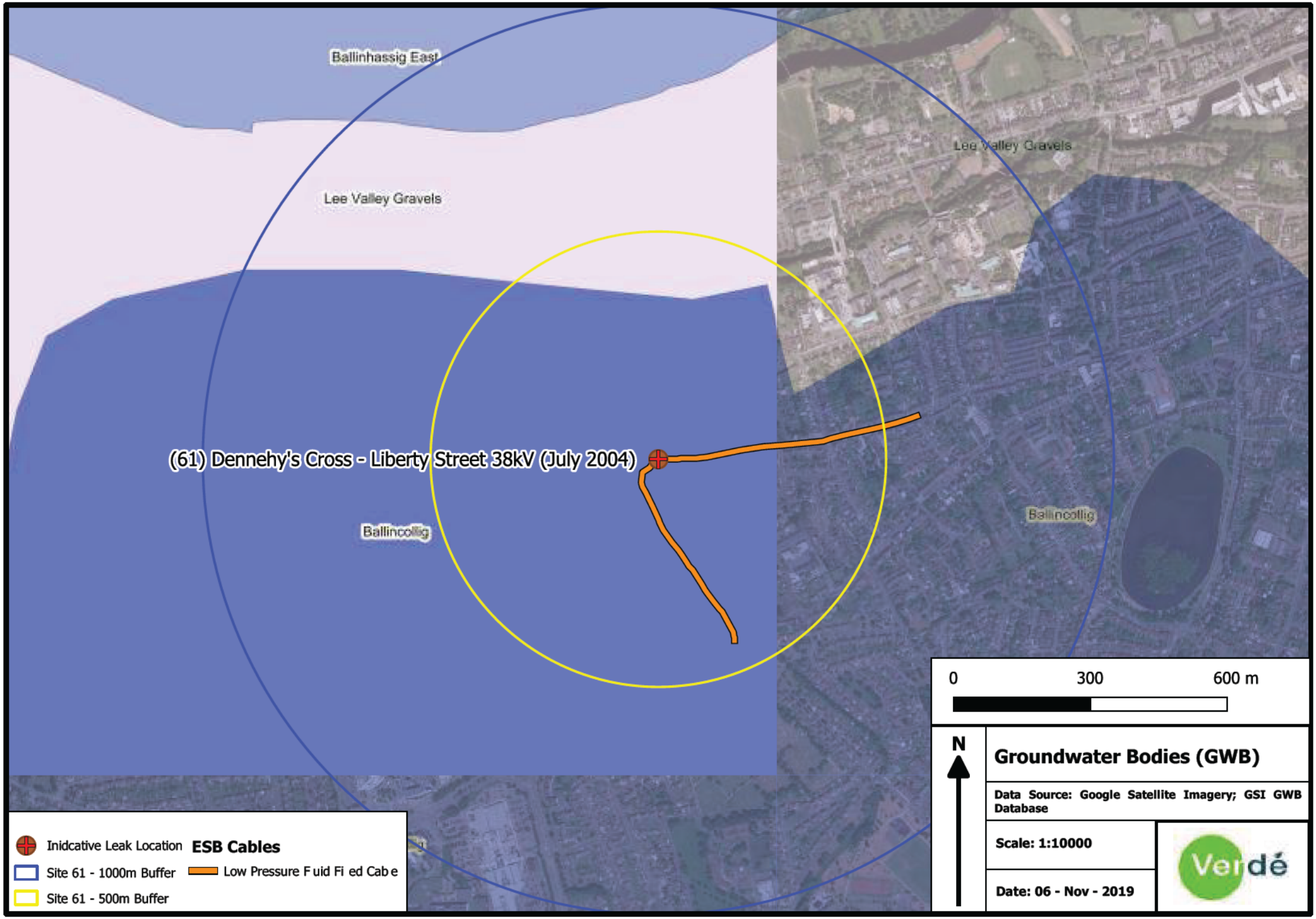

(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure F uid Fi ed Cab e
GSI Subsoils
A uvium
Bedrock at surface
Grave s
Made ground
Ti derived chief y from Devonian sandstones
0
300
600 m
N
Subsoils (GSI)
Data Source: Google Satellite Imagery; GSI National Suboils Database
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé

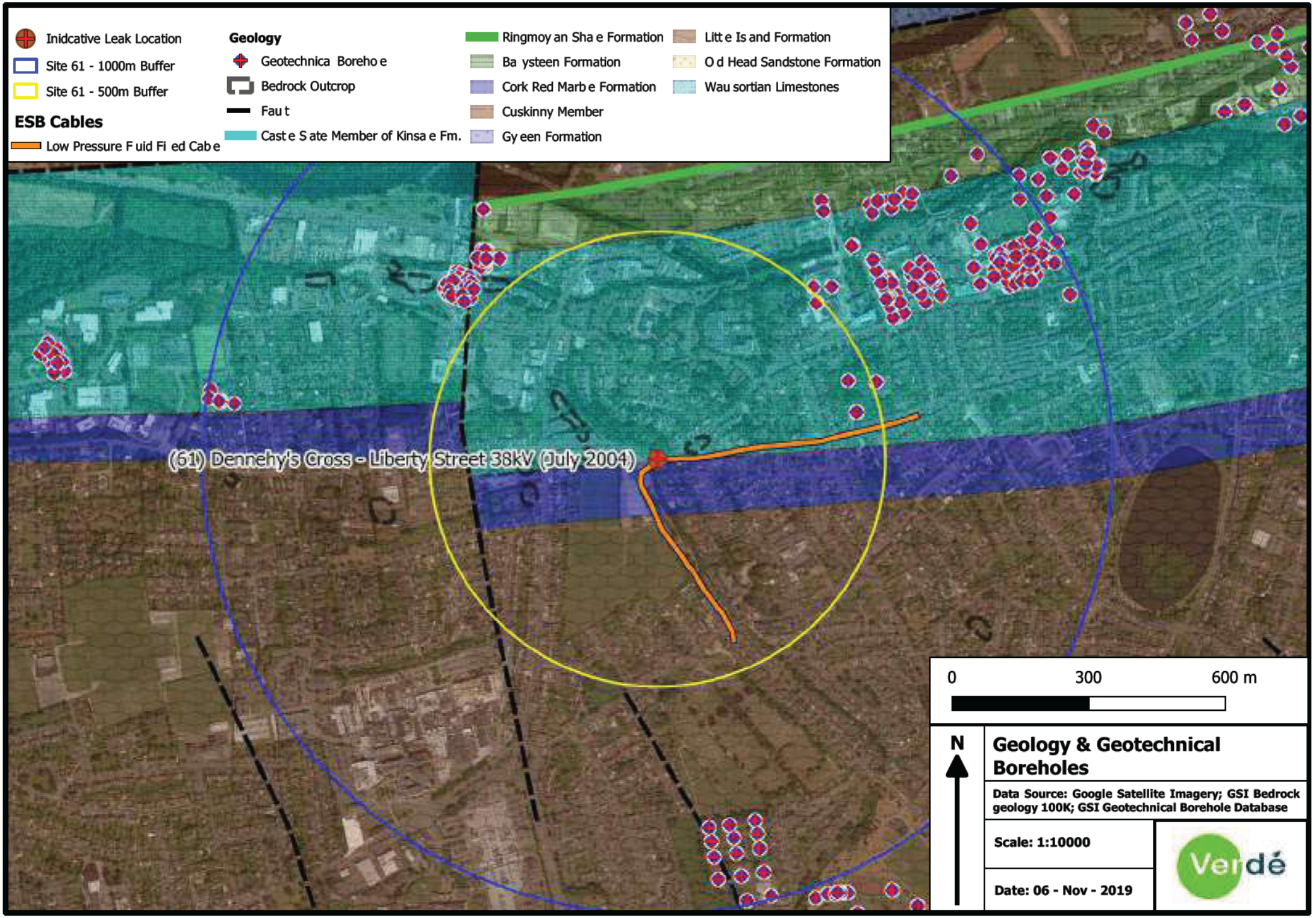

(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure F uid Fi ed Cab e
GSI Soil Permeability
High
Moderate
Water
Not app icab e, DTB<3m
0
300
600 m
N
Soil Permeability
Data Source: Google Satellite Imagery; GSI Subsoil Permeability
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé


LEE (CORK)_090
CURRAGHEEN (Cork City)_010
Lee (Cork) Estuary Upper
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
GLASHEEN (Cork City)_010
Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure F uid Fi ed Cab e
Catchments
WFD Rivers
WATER RivNetRoutes
WFD Transitiona Waters
Groundwater Vunerability
Rock at or near Surface or Karst
Extreme
High
Moderate
0
300
600 m
N
Groundwwater Vulnerability & Surface Water Features
Data Source: Google Satellite Imagery; GSI Groundwater Vulnerability Mapping; WFD/EPA Watebody Database
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé


(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure F uid Fi ed Cab e
Wells (Location Accuracy)
We s 10-50m Acc
Sand & Gravel Aquifers
Regiona y important grave aquifer
0
300
600 m
N
Gravel Aquifer Classification & Wells
Data Source: Google Satellite Imagery; GSI Sand &Gravel Aquifer Classification; GSI Wells Database
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé


(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure F uid Fi ed Cab e
Wells (Location Accuracy)
We s 10-50m Acc
GSI Bedrock Aquifer Classification
Loca y Important Aquifer - Bedrock which is Moderate y Productive on y in Loca Zones
Regiona y Important Aquifer - Karstified (diffuse)
0
300
600 m
N
Bedrock Aquifer Classification & Wells
Data Source: Google Satellite Imagery; GSI Bedrock Aquifer Classification & GSI Wells Database
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé


Ballinhassig East
Lee Valley Gravels
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Ballincollig
Lee Valley Gravels
Ballincollig
Inidcative Leak Location
ESB Cables
Site 61 - 1000m Buffer
Low Pressure F uid Fi ed Cab e
Site 61 - 500m Buffer
0
300
600 m
N
Groundwater Bodies (GWB)
Data Source: Google Satellite Imagery; GSI GWB Database
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé

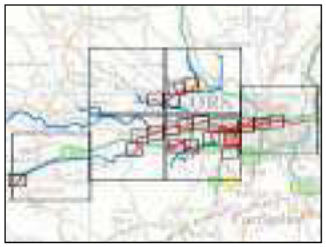

Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure F uid Fi ed Cab e
Geology
Geotechnica Boreho e
Bedrock Outcrop
Fau t
Cast e S ate Member of Kinsa e Fm.
Ringmoy an Sha e Formation
Ba ysteen Formation
Cork Red Marb e Formation
Cuskinny Member
Gy een Formation
Litt e Is and Formation
O d Head Sandstone Formation
Wau sortian Limestones
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
0
300
600 m
N
Geology & Geotechnical Boreholes
Data Source: Google Satellite Imagery; GSI Bedrock geology 100K; GSI Geotechnical Borehole Database
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé

Node Label	Water Level (mOD) per AEP		
	WL 10%	WL 1%	WL 0.1%
8GLA_156	4.95	5.31	5.50
8GLA_478	8.10	8.31	8.45
8GLA_679	8.41	8.64	8.78
8GLA_857	8.89	9.21	9.45
8GLA_1080	9.17	9.60	9.88
8GLA_1358	9.45	9.77	10.00
8GLA_1496	9.54	9.86	10.10
8GLA_1601	9.56	9.88	10.11
8GLA_1731	9.71	10.09	10.44

8GLA_156
8GLA_478
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
8GLA_679
8GLA_857
8GLA_1080
8GLA_1358
8GLA_1496
8GLA_1601
8GLA_1731

0.1 0.05 0 0.1 0.2 0.3 0.4 Kilometres

Location Plan :



EXTENT MAP

Legend:

- 10 % AEP Flood Extent (1 in 10 chance in any given year)
- 1 % AEP Flood Extent (1 in 100 chance in any given year)
- 0.1 % AEP Flood Extent (1 in 1000 chance in any given year)
- Defended area
- High Confidence (<20m) (10% AEP)
- Medium Confidence (<40m) (10% AEP)
- Low Confidence (>40m) (10% and 0.1% AEP)
- High Confidence (<20m) (1% AEP)
- Medium Confidence (<40m) (1% AEP)
- Low Confidence (>40m) (1% AEP)
- River Centreline
- Node Point
- 8GLA_376 Node Label (refer to table)

USER NOTE :

USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF A BOUND VOLUME, IT SHOULD NOT BE USED FOR ANY PURPOSE.

Halcrow
www.halcrow.com
Halcrow Group Ireland
3A Eastgate Road
Eastgate
Little Island
Cork
Ireland

OPW
Office of Public Works
17-19 Lower Hatch Street
Dublin 2
Ireland

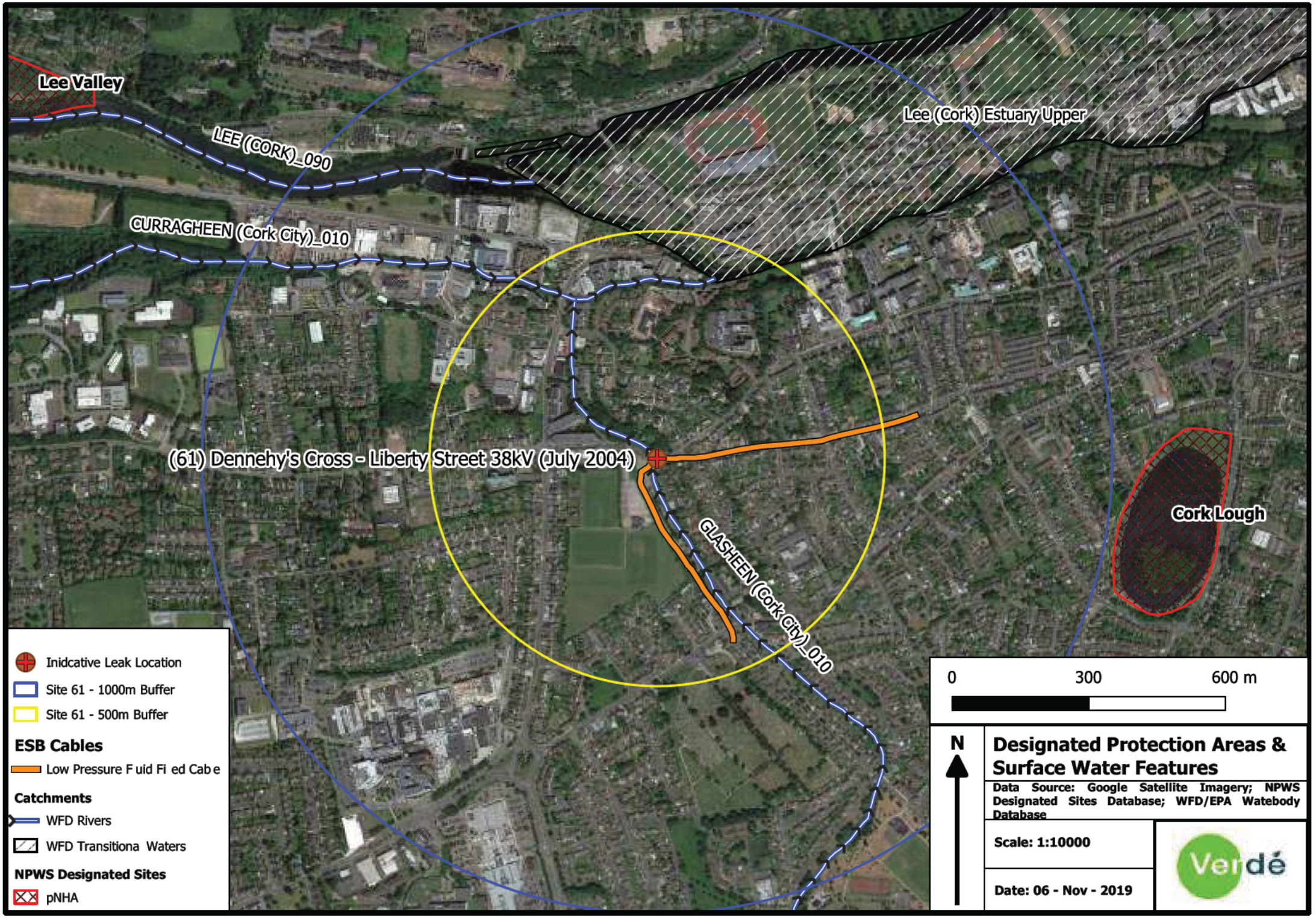
Project :
LEE CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT STUDY

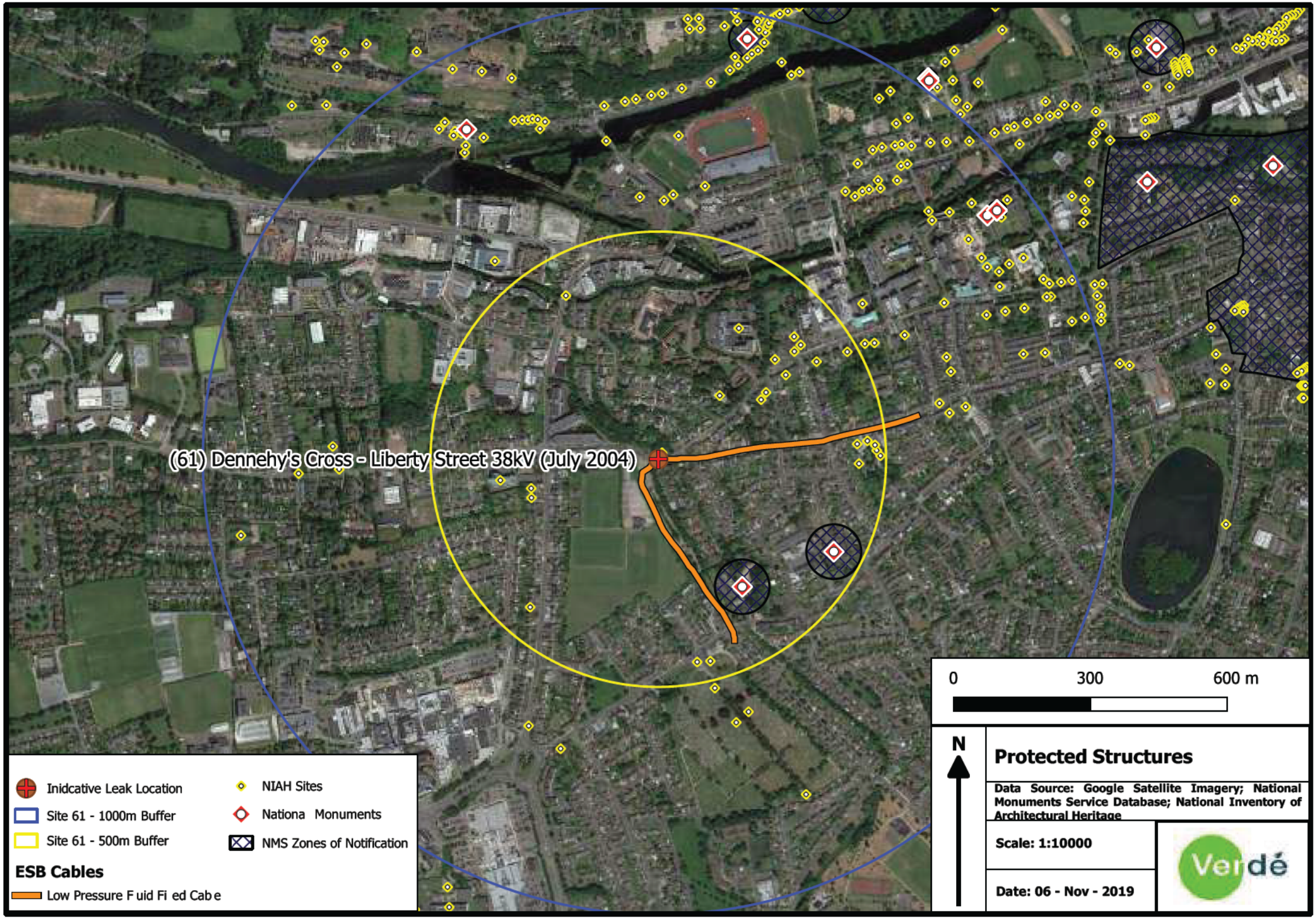
Map :
CORK CITY

Map Type :	FLOOD EXTENT		
Source :	FLUVIAL FLOODING		
Map area :	URBAN AREA		
Scenario :	CURRENT		
Figure By :	Valeria Medina	Date :	26 October 2012
Checked By :	Ricardo Santaella	Date :	26 October 2012
Approved By :	Clare Dewar	Date :	26 October 2012

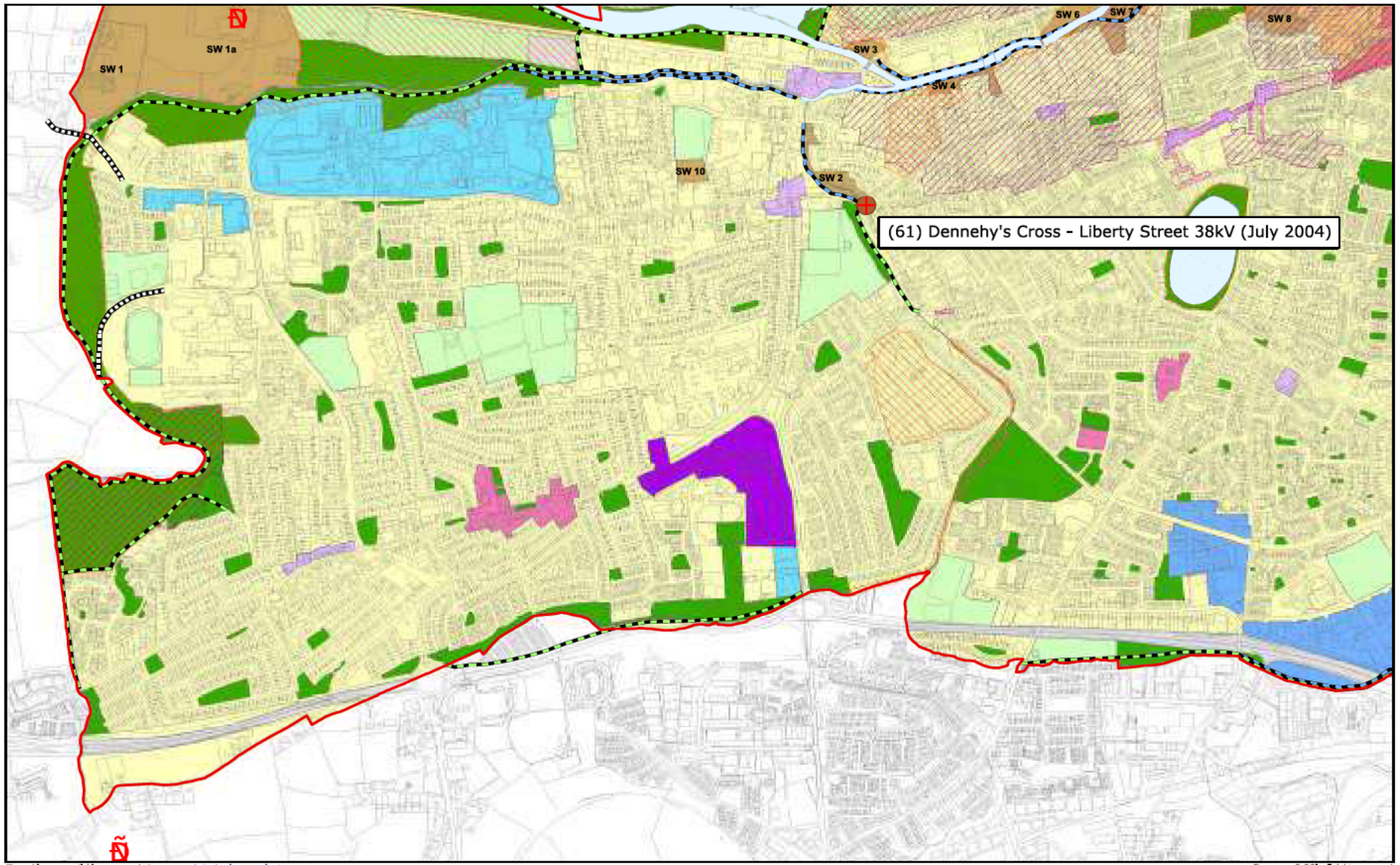
Figure No. : M8/UA/EXT/CURS/017
Revision : 1

Drawing Scale : 1:5,000
Plot Scale : 1:1 @ A3


Lee Valley
LEE (CORK)_090
Lee (Cork) Estuary Upper
CURRAGHEEN (Cork City)_010
(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
GLASHEEN (Cork City)_010
Cork Lough
Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure F uid Fi ed Cab e
Catchments
WFD Rivers
WFD Transitiona Waters
NPWS Designated Sites
pNHA
0
300
600 m
N
Designated Protection Areas & Surface Water Features
Data Source: Google Satellite Imagery; NPWS Designated Sites Database; WFD/EPA Watebody Database
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé


(61) Dennehy's Cross - Liberty Street 38kV (July 2004)
Inidcative Leak Location
Site 61 - 1000m Buffer
Site 61 - 500m Buffer
ESB Cables
Low Pressure F uid Fi ed Cab e
NIAH Sites
Nationa Monuments
NMS Zones of Notification
0
300
600 m
N
Protected Structures
Data Source: Google Satellite Imagery; National Monuments Service Database; National Inventory of Architectural Heritage
Scale: 1:10000
Date: 06 - Nov - 2019
Verdé

MAP 8 - South Western Suburbs Objectives



Zoomable map available on our website: www.corkcitydevelopmentplan.ie

- LAPEtcBoundaries
- Areas of High Landscape Value
- Architectural Conservation Areas
- Historic Street Character Areas
- 2-City Centre Commercial Core Area
- 3-Inner City Residential Neighbourhood
- 4-Residential, Local Services and Institutional Uses
- 5-Light Industry and Related Uses
- 7-Business and Technology
- 8-District Centres
- 9-Neighbourhood Centres
- 10-Local Centres
- 12-Landscape Preservation Zones
- 13-Sports Grounds
- 14-Public Open Space
- 15-Public Infrastructure and Utilities
- 19-Rivers/Water Bodies Protection
- Traveller Accommodation
- New or Realigned Streets
- Amenity Routes
- Proposed New Amenity Routes/Upgrades
- SEVESO Site

APPENDIX C

SITE PHOTOGRAPHS

Photo 1. Photo looking east of indicated location of known leak point (ESB Ref: 61) located on eastern side of Glasheen Bridge and River. It is thought that the leak point coincides with the east side of Glasheen Bridge.

Photo 2. Photo looking east towards indicated location of known leak point (ESB Ref: 61). Note the position of the leak point (background on road); a small electrical cabinet and Glasheen River.

Photo 3. Photo looking north from Glasheen River park area, towards Glasheen Bridge and cable leak point. Note the small concrete weir (dry) and debris at entrance to bridge. Near-stagnant flow. A 2-3" diameter pipe/cable of unknown purpose was seen to follow River and pass under the bridge.

Photo 4. View, looking south, of Glasheen River (35m from leak point) showing the location of the diverted channel of the River and associated diversion/treatment/pumping channel and grate. Note that the bulk of flow on the river was flowing into this grate.

Photo 5. Photo, looking south, from the route of the Glasheen River (left) showing it's route from the south and associated green area.

Photo 7. Image showing the route of the Glasheen River to the north side of Magazine Road, at the boundary of the large private estate. The leak point is towards the roundabout in the rear-right background.

Photo 8. Image, looking west from the area of the leak point, showing the location of the Orchard Gardens apartment complex. Note that the open section of the Glasheen River flows on the north side of the wall seen in the right of this image.

APPENDIX D

MSDS FOR COPC

1. LINEAR ALKYL BENZENES

2. MINERAL OIL

MATERIAL SAFETY DATA SHEET

1: IDENTIFICATION OF THE SUBSTANCE / PREPARATION AND OF THE COMPANY / UNDERTAKING

Product Name: T 3788

Application: Hollow-core Energy Cable Saturant

Company: H&R ESP Ltd.

Address: Matrix House
North 4th Street
Milton Keynes, MK9 1NJ
United Kingdom

Telephone: +44 (0)1908 351 111 Fax: +44 (0)1908 351122

2: COMPOSITION / INFORMATION ON INGREDIENTS

Composition: Low viscosity compound based on a blend of linear alkyl benzenes that have side alkyl chains of 10 – 13 carbon atoms in length.

Synonyms: Linear Alkyl Benzenes
Alkyl C10-C13, benzenes
Benzene, C10-13-alkyl-deriv.
Detergent Alkylate

Composition	EINECS number	CAS number	Symbol letters	Risk numbers	Concentration range
C10 – C13 Linear Alkyl Benzenes	267-051-0	67774-74-7	Not regulated		100%

All constituents of this product are listed in EINECS (European Inventory of Existing Commercial Chemical Substances) or ELINCS (European List of Notified Chemical Substances) or are exempt.

3: HAZARDS IDENTIFICATION

Classification of preparation: This product is not classified as a dangerous substance / preparation in accordance with The Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (CHIP3).

Physical and Chemical Properties: Not classified as flammable, but will burn. Avoid contact with strong oxidisers.

Health Effects

Skin:	Contact with the skin may cause irritation. Prolonged or repeated skin contact may cause drying of the skin, progressing to dermatitis. Symptoms may include itching, discolouration, swelling and blistering.
Eyes:	Contact with the eyes may cause irritation. Symptoms may include reddening, swelling and impaired vision.
Ingestion:	Ingestion of small amounts may cause nausea and vomiting.
Inhalation:	Due to low volatility, this product should not present an inhalation hazard under ambient conditions. Exposure to vapour or mineral oil mists may irritate the mucous membranes and cause dizziness, headaches and nausea.

Environmental Effects

No specific hazards under normal use conditions.

4: FIRST AID MEASURES

Inhalation:	Remove from further exposure. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance and call a doctor. If breathing has stopped, administer artificial respiration.
Skin contact:	Remove contaminated clothing and wash affected skin with soap and water. If persistent irritation occurs, obtain medical attention. If high pressure injection injuries occur, obtain medical attention immediately.
Eye contact:	Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.
Ingestion:	Wash out mouth with water and obtain medical attention. DO NOT INDUCE VOMITING.

5: FIRE FIGHTING MEASURES

Suitable extinguishing media:	Carbon dioxide (CO_2), dry chemical, foam or water spray.
Unsuitable extinguishing media:	Do not use water jets.
Special exposure hazards:	Combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates and gases, including carbon monoxide, and unidentified organic and inorganic compounds.
Special protective equipment:	Proper protective equipment including breathing apparatus must be worn when approaching a fire in a confined space.

6: ACCIDENTAL RELEASE MEASURES

Personal Precautions:	Spilt product presents a significant slip hazard. Remove any sources of heat.
Environmental Precautions:	Prevent from spreading or entering into drains, sewers and watercourses by using inert absorbent material or other appropriate barriers. Inform local authorities if this cannot be prevented.
Methods for cleaning up:	Absorb liquid with inert absorbent material. Sweep up and remove to a suitable, clearly marked container for disposal in accordance with local and national regulations

7: HANDLING AND STORAGE

Handling:	Do not eat, drink or smoke whilst using this product. To avoid the possibility of skin disorders repeated or prolonged contact with products of this type must be avoided. It is essential to maintain a high standard of personal hygiene.
Storage:	Store in a cool place away from sources of heat and out of direct sunlight to avoid pressure build up. Do not store near oxidisers.

Handling and Storage Materials and Coatings

Suitable:	Carbon steel, baked epoxy or Phenolic coatings, aluminium.
Unsuitable:	Natural rubber, Butyl rubber

8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits:	Not established.
Engineering control measures:	Use of local exhaust ventilation is recommended whenever this product is used in a confined space, is heated above ambient temperatures, or is agitated.
Hygiene measures:	Wash hands before eating, drinking, smoking and using the toilet. Gloves should be washed before being removed.
Respiratory Protection:	Normally not required if adequate ventilation is in place. Where concentrations in air may exceed the limits given in this section, it is recommended to use a half mask respirator to protect from over exposure by inhalation. Suitable filter material depends on the amount and type of chemicals being handled, but filter material suitable for organic vapours may be considered for use.
Hand Protection:	When handling this product it is recommended to wear chemical resistant gloves. Suggested materials for protective gloves include: PVC, Neoprene or similar.
Eye Protection:	Wear eye protection such as safety glasses, chemical goggles, or face shield if engineering controls or work practices are not adequate to prevent eye contact. Have suitable eye wash water available.

Skin Protection:	Wear impervious protective clothing to prevent skin contact. Selection of protective clothing may include gloves, apron, boots, and complete facial protection depending on operations conducted.

9: PHYSICAL AND CHEMICAL PROPERTIES

General Information

Appearance:	Clear, colourless liquid
Odour:	Mild petroleum odour

Health, safety and environmental information

pH:	Not determined
Boiling point/range:	280℃
Flash point:	>135℃
Flammability:	Non flammable
Explosive properties:	Not explosive
Oxidising properties:	Not applicable
Vapour pressure at 20℃:	<0.02 kPa
Density:	0.86 g/cm^{-3} at 20℃ typical
Solubility in water:	Insoluble
Kinematic Viscosity at 20℃:	4.0 – 4.5 cSt (4.0 – 4.5 mm^2/s) typical
Vapour density (Air=1):	>1
Evaporation rate:	Not determined

Other information

Pour point:	-60℃ typical
Expansion coefficient:	0.0007 /℃ typical
Neutralisation value:	0.03 mg KOH g^{-1} maximum

10: STABILITY AND REACTIVITY

Chemical stability:	This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure and will not polymerise.
Conditions to avoid:	Temperatures above 140℃
Materials to avoid:	Strong oxidising agents, such as liquid chlorine, concentrated oxygen, sodium hypochlorite, calcium hypochlorite, peroxides etc, as this may present an explosion hazard.
Hazardous decomposition products:	Carbon monoxide and irritant fumes may be generated if this product is burned in an enclosed space.

11: TOXICOLOGICAL INFORMATION

Basis for assessment:	Toxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the toxicology of similar products.
Acute toxicity:	Oral LD50 expected to be >5000 mg/kg (rat) Inhalation LC50/4hr expected to be >1.8 mg/l (rat) Dermal LD50 expected to be >2000 mg/kg (rabbit)
Corrosivity/irritation:	
Eye:	May be slightly irritant
Skin:	May be slightly irritant
Respiratory tract:	If mists are inhaled, slight irritation of the respiratory tract may occur
Skin sensitisation:	Not expected to be a skin sensitiser
Repeated-dose toxicity:	Prolonged and/or repeated contact may lead to irritation and possibly dermatitis, especially under conditions of poor personal hygiene.
Mutagenicity:	Not expected to be a mutagen.
Carcinogenicity:	Not expected to be a carcinogen.
Reproductive toxicity:	The preparation has not been assessed at all for this end-point, so its hazardous property in this regard is not known.

12: ECOLOGICAL INFORMATION

Basis for assessment:	Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the ecotoxicology of similar products.
Ecotoxicity:	Poorly soluble mixture. Product is not expected to be ecotoxic to fish/daphinia/algae, or sewage bacteria. This preparation is expected to be removed in a wastewater treatment facility
Mobility:	Liquid under most environmental conditions. Floats on water. If it enters soil, it will adsorb to soil particles and will not be mobile.
Persistence and degradability:	Readily biodegradable. Soils degradation – half life approx. 15 days. Natural waters degradation – half life approx. 4 – 9 days.
Bioaccumulative potential:	May have the potential to bioaccumulate

13: DISPOSAL CONSIDERATIONS

Disposal must be in accordance with local and national legislation.

Unused Product:	Dispose of through an authorised waste contractor to a licensed site. May be incinerated.
Used/Contaminated Product:	Dispose of through an authorised waste contractor to a licensed site. May be incinerated.
Packaging:	Dispose of through an authorised waste contractor. May be steam cleaned and recycled.

14: TRANSPORT INFORMATION

This product is not classified as dangerous for transport.

15: REGULATORY INFORMATION

Classification/Symbol: Not Regulated

This preparation is not classified as Dangerous according to EU Directives

This safety data sheet is intended to assist in compliance with the following UK legislation:

- Chemicals (Hazard Information and Packaging for Supply) Regulations 2002
- Control of Substances Hazardous to Health Regulations 2002.
- Health and Safety at Work, etc. Act 1974.
- Environmental Protection Act 1990
- Environmental Protection (Duty of Care) Regs. 1991
- COSHH essentials: Easy steps to control chemicals. Control of Substances Hazardous to Health Regulations

Further Guidance
The following guidance notes are available from HMSO or HSE.

Occupational exposure limits (EH 40). Effects of mineral oil on the skin (SHW 397).
Preventing dermatitis at work (INDG 233)
A step by step guide to COSHH assessment (HSG 97)
Assessing and managing risks at work from skin exposure to chemical agents (HSG 205)
The selection, use and maintenance of respiratory protective equipment: A practical guide (HSG 53)
Relevant EC Directives:

- Dangerous Substances Directive (DSD)
- Dangerous Preparations Directive (DPD)
- Safety Data Sheets Directive (SDSD)
- Health & Safety Framework Directive

16: OTHER INFORMATION

This data sheet was prepared in accordance with Commission Directive 2001/58/ECand SI 2002 No. 1689 (CHIP 3)

Key References:

- Chemicals (Hazard Information and Packaging for Supply) Regulations 2002
- The compilation of safety data sheets. Approved Code of Practice (third edition)
- Approved supply list (7th Edition). Information approved for the classification and labelling of substances and preparations dangerous for supply. Chemicals (Hazard Information and Packaging for Supply) Regulations 2002
- Approved classification and labelling guide. Chemicals (Hazard Information and Packaging for Supply) Regulations 2002. Guidance on regulations (Fifth edition).
- EH40/2005 Workplace Exposure Limits 2005
- COSHH essentials: Easy steps to control chemicals. Control of Substances Hazardous to Health Regulations
- European Inventory of Existing Commercial Substances (EINECS)

The data and advice given apply when the product is sold for the stated application or applications. The product is not sold as suitable for any other application. Use of the product for applications other than as stated in this sheet may give rise to risks not mentioned in this sheet. You should not use the product other than for the stated application or applications without seeking advice from us.

If you have purchased the product for supply to a third party for use at work, it is your duty to take all necessary steps to secure that any person handling or using this product is provided with the information in this sheet.

If you are an employer, it is your duty to tell your employees and others who may be affected of any hazards described in this sheet and of any precautions that should be taken.

We believe, in good faith and to the best of our knowledge that the preceding information is accurate. However, we give no guarantee or warranty in this respect. The information provided herein may not be adequate for all individuals and/or all situations. The purchaser/user of the product remains responsible for storing, using or dealing with the product safely and in accordance with all applicable laws and regulations.

Safety Data Sheet
(93/112/EC)

Date of edition: October 1995

1. Identification of Substance/Preparation and Company

Product name:
Masse 106
Supplier:
FELTEN & GUILLEAUME Energietechnik AG
Schanzenstraße 24-30
51063 Köln
Emergency telephone number: 0221/676-3333

2. Composition/Information on Ingredients

Blend of highly refined mineral oils and additives.
On the basis of available information, the components of this preparation are not expected to impart hazardous properties to this product.

3. Hazards Identifikation

Human Health Hazards

If swallowed, aspiration into the lungs may cause chemical pneumonitis.
Prolonged or repeated exposure may give rise to dermatitis.
No specific hazards under normal use conditions.

Safety hazards

The preparation contains mineral oil, for which an exposure limit for oil mist applies.

Environmental hazards

Avoid spillage.
The product is not readily biodegradable.

4. First Aid Measures

Inhalation

Remove to fresh air.
If breathing but unconscious, place in the recovery position.
If breathing has stopped, apply artificial respiration.
Medical attention is to be obtained immediately.

Skin

Remove contaminated clothing and wash affected skin with soap and water.

If high pressure injection injuries occur, obtain medical attention immediately.

Eye

Rinse immediately with plenty of water for ar least 10 minutes and seek medical advice.

Ingestion

Do not induce vomiting.
Aspiration into the lungs may occur directly or following ingestion. This can cause chemical pneumonitis which may be fatal.
If breathing but unconscious, place in the recovery position.
If breathing has stopped, apply artificial respiration.
Medical attention is to be obtained immediately.

Advice to physicians

Treat symptomatically

5. Fire Fighting Measures

Extinguishing media

Foam, dry chemical powder, carbon dioxide, sand or earth.

Safety Data Sheet
(93/112/EC)

Date of edition: October 1995

Product name: Masse 106

5. Fire Fighting Measures (continued)

Unsuitable extinguishing media

Do not use water in a jet

Specific hazards

- Combustion is likely to give rise to a complex mixture of gases and airborne particulates, including carbon monoxide, oxides of sulphur and unidentified organic and inorganic compounds.

6. Accidental Release Measures

Personal precautions

Ventilate contaminated area thoroughly.

Minimise contact with skin.

Environmental precautions

Prevent further leakage or spillage and prevent from entering drains.

Prevent from spreading or entering into drains, ditches or rivers by using sand, earth or other appropriate barriers.

Clean-up methods

Absorb or contain liquid with sand, earth or spill control material.

Shovel into a suitable, clearly marked container for disposal or reclamation in accordance with local regulations.

7. Handling and Storage

Handling

When using do not eat or drink.

When handling product in drums, safety footwear should be worn and proper handling equipment should be used

Prevent spillages.

Storage

Keep container tightly closed and in a well ventilated place. Avoid direct sunlight, heat sources and strong oxidising agents.

Recommended materials: mild steel, high density polyethylene for containers or container linings.

8. Exposure Controls/Personal Protection

Engineering control measures

Use only in well ventilated areas.

Occupational exposure standards

Component name	Limit type	Value/Unit	Other information
Oil mist	8 h TWA	5 mg/m³	ACGIH
	10 min STEL	10 mg/m³	ACGIH

Respiratory Protection

Not normally required.

If oil mist cannot be controlled, a respirator fitted with an organic vapour cartrige combined with a particulate prefilter should be used.

Hand Protection

PVC or nitril rubber gloves if splashes are likely to occur and if applicable.

Eye Protection

Safety spectacles

Body Protection

Minimise all forms of skin contact.

Safety Data Sheet
(93/112/EC)

Date of edition: October 1995

Product name: Masse 106

8. Exposure Controls and Personal Protection (continued)

Hygiene measures

Don't keep oily rags in your pockets.

Wash hands before eating and drinking.

9. Physical and Chemical Properties

form	liquid	
colour	yellow	
pourpoint	< -60°C	DIN ISO 3016
flashpoint	145°C	DIN 51758
flammability - lower limit (vol%)	0,6	
flammability - upper limit (vol%)	6,5	
vapour pressure (20°C)	< 0,01 hPa	
density (15°C)	888 kg/m³	DIN 51757
solubility in water (20°C)	negligible	
n-octanol/water partition coeff	na	
kinematic viscosity (40°C)	8,5 mm²/s	DIN 51562

10. Stability/Reactivity

Stability

stable under normal use conditions

Materials to avoid

strong oxidising agents

Hazardous decomposition products

Hazardous decomposition products are not expected to form during nonnal storage.

11. Toxicological Information

Toxicological Data:

Acute toxicity - oral

LD 50 is expected to be > 2000 mg/kg.

Irritation of skin, irritation of eye

The product is expected to be slightly irritant.

Sensitisation of skin

The produkt is not expected to be a skin sensitiser.

Prolonged and/or repeated contact

Prolonged/repeated contact may cause defatting of the skin, which can lead to dermatitis and may make the skin more susceptible to irritation and penetration by other materials.

Carcinogenicity

Product is based on mineral oils of types shown to be non-carcinogenic in animal skin-painting studies. Other components are not known to be associated with carcinogenic effects.

Other information

Aspiration into the lungs may occur directly or following ingestion. This can cause chemical pneumonitis which may be fatal.

Information given is based on a knowledge of the toxicology of similar products.

Safety Data Sheet
(93/112/EC)

Date of edition: October 1995

Product name: Masse 106

12. Ecological Information

Basis for assessment

Information given is based on data on the components and the ecotoxicology of similar products.

Mobility

Product floats on water. It is liquid under most environmental conditions.
If it enters soil, it will be adsorbed to soil particles and will not be mobile.
Product has the potential to bioaccumulate.

Ecotoxicity

Product is expected to be practically non-toxic to aquatic organisms, LC/EC50 > 100 mg/L.

13. Disposal Considerations

Product

Precautions: Dispose to licensed disposal contractor.
Waste disposal Nr. (D): 54106

Container disposal

Drain container thoroughly.
Dispose to licensed disposal contractor.

Recomanded cleaning procedure

Cleaning by disposal contractor

14. Transport Information

Product is not dangerous for conveyance under UN, IMO, ADR/RID and IATA/ICAO codes. (According ADR/RID regulations from 1.1.1995)

15. Regulatory Information

Classification

The Product is not classified as dangerous under EC criteria.

16. Other Information

Additional informations

Concawe Report 5/87 Health Aspects of Lubricants.

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should therefore not be construed as guaranteeing any specific property of the product.

Material Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

Material Name : **Shell Diala Cable Oil**
Uses : Insulating oil.
Product Code : 001D8369

Manufacturer/Supplier : **Shell UK Oil Products Limited**
PO BOX 3
Ellesmere Port
CH65 4HB
United Kingdom

Telephone : +44 (0) 151-350-4000
Fax : +44 (0) 151-350-4000
Email Contact for MSDS : If you have any enquiries about the content of this MSDS please email lubricantSDS@shell.com

Emergency Telephone Number : +44-(0) 151-350-4595

2. HAZARDS IDENTIFICATION

EC Classification : Harmful.

Health Hazards : Repeated exposure may cause skin dryness or cracking. Harmful: may cause lung damage if swallowed.

Signs and Symptoms : If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever. The onset of respiratory symptoms may be delayed for several hours after exposure. Defatting dermatitis signs and symptoms may include a burning sensation and/or a dried/cracked appearance. Ingestion may result in nausea, vomiting and/or diarrhoea.

Safety Hazards : Not classified as flammable but will burn.
Environmental Hazards : Not classified as dangerous for the environment.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Preparation Description : Alkyl benzene.

Hazardous Components

Chemical Identity	CAS	EINECS	Symbol(s)	R-phrase(s)	Conc.
Benzene, C10-C13 alkyl derivitives	67774-74-7	267-051-0	Xn	R65; R66	90.00 - 100.00 %

Additional Information : Refer to chapter 16 for full text of EC R-phrases.

4. FIRST AID MEASURES

Inhalation	:	No treatment necessary under normal conditions of use. If symptoms persist, obtain medical advice.
Skin Contact	:	Remove contaminated clothing. Flush exposed area with water and follow by washing with soap if available. If persistent irritation occurs, obtain medical attention.
Eye Contact	:	Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.
Ingestion	:	If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. If any of the following delayed signs and symptoms appear within the next 6 hours, transport to the nearest medical facility: fever greater than 101° F (37° C), shortness of breath, chest congestion or continued coughing or wheezing.
Advice to Physician	:	Treat symptomatically. Potential for chemical pneumonitis. Consider: gastric lavage with protected airway, administration of activated charcoal. Call a doctor or poison control center for guidance.

5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

Specific Hazards	:	Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide. Unidentified organic and inorganic compounds.
Suitable Extinguishing Media	:	Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
Unsuitable Extinguishing Media	:	Do not use water in a jet.
Protective Equipment for Firefighters	:	Proper protective equipment including breathing apparatus must be worn when approaching a fire in a confined space.

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. See Chapter 13 for information on disposal. Observe the relevant local and international regulations.

Protective measures	:	Avoid contact with skin and eyes. Use appropriate containment to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers.
Clean Up Methods	:	Slippery when spilt. Avoid accidents, clean up immediately. Prevent from spreading by making a barrier with sand, earth or other containment material. Reclaim liquid directly or in an absorbent. Soak up residue with an absorbent such as clay, sand or other suitable material and dispose of properly.
Additional Advice	:	Local authorities should be advised if significant spillages

cannot be contained.

7. HANDLING AND STORAGE

General Precautions	:	Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.
Handling	:	Avoid prolonged or repeated contact with skin. Avoid inhaling vapour and/or mists. When handling product in drums, safety footwear should be worn and proper handling equipment should be used.
Storage	:	Keep container tightly closed and in a cool, well-ventilated place. Use properly labelled and closeable containers. Storage Temperature: 0 - 50°C / 32 - 122°F The storage of this product may be subject to the Control of Pollution (Oil Storage) (England) Regulations. Further guidance maybe obtained from the local environmental agency office.
Recommended Materials	:	For containers or container linings, use mild steel or high density polyethylene.
Unsuitable Materials	:	PVC.
Additional Information	:	Polyethylene containers should not be exposed to high temperatures because of possible risk of distortion. Exposure to this product should be reduced as low as reasonably practicable. Reference should be made to the Health and Safety Executive's publication "COSHH Essentials".

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

If the American Conference of Governmental Industrial Hygienists (ACGIH) value is provided on this document, it is provided for information only.

Occupational Exposure Limits

Exposure Controls	:	The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Adequate ventilation to control airborne concentrations. Where material is heated, sprayed or mist formed, there is greater potential for airborne concentrations to be generated.
Personal Protective Equipment	:	Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.
Respiratory Protection	:	No respiratory protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid breathing of material. If engineering controls do not maintain airborne

		concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Select a filter suitable for combined particulate/organic gases and vapours [boiling point >65 °C (149 °F)] meeting EN141.
Hand Protection	:	Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: PVC, neoprene or nitrile rubber gloves. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended.
Eye Protection	:	Wear safety glasses or full face shield if splashes are likely to occur. Approved to EU Standard EN166.
Protective Clothing	:	Skin protection not ordinarily required beyond standard issue work clothes. It is good practice to wear chemical resistant gloves.
Monitoring Methods	:	Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate.
Environmental Exposure Controls	:	Minimise release to the environment. An environmental assessment must be made to ensure compliance with local environmental legislation.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Colourless. Liquid at room temperature.
Odour	:	Slight hydrocarbon.
pH	:	Not applicable.
Initial Boiling Point and Boiling Range	:	> 280 °C / 536 °F estimated value(s)
Pour point	:	< -60 °C / -76 °F Data not available
Flash point	:	Typical 140 °C / 284 °F (PMCC / ASTM D93)
Upper / lower Flammability or Explosion limits	:	Typical 1 - 10 %(V)
Auto-ignition temperature	:	> 320 °C / 608 °F
Vapour pressure	:	< 0.5 Pa at 20 °C / 68 °F (estimated value(s))
Density	:	Typical 857 kg/m3 at 20 °C / 68 °F
Water solubility	:	Negligible.
n-octanol/water partition coefficient (log Pow)	:	> 6 (based on information on similar products)
Kinematic viscosity	:	Typical 4.2 mm2/s at 40 °C / 104 °F
Vapour density (air=1)	:	> 1 (estimated value(s))
Evaporation rate (nBuAc=1)	:	Data not available

10. STABILITY AND REACTIVITY

Stability	:	Stable.
Conditions to Avoid	:	Extremes of temperature and direct sunlight.
Materials to Avoid	:	Strong oxidising agents.
Hazardous Decomposition Products	:	Hazardous decomposition products are not expected to form during normal storage.

11. TOXICOLOGICAL INFORMATION

Basis for Assessment	:	Information given is based on data on the components and the toxicology of similar products.
Acute Oral Toxicity	:	Expected to be of low toxicity: LD50 > 5000 mg/kg , Rat Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal.
Acute Dermal Toxicity	:	Expected to be of low toxicity: LD50 > 5000 mg/kg , Rabbit
Acute Inhalation Toxicity	:	Not considered to be an inhalation hazard under normal conditions of use.
Skin Irritation	:	Expected to be slightly irritating. Repeated exposure may cause skin dryness or cracking.
Eye Irritation	:	Expected to be slightly irritating.
Respiratory Irritation	:	Inhalation of vapours or mists may cause irritation.
Sensitisation	:	Not expected to be a skin sensitiser.
Repeated Dose Toxicity	:	Not expected to be a hazard.
Mutagenicity	:	Not considered a mutagenic hazard.
Carcinogenicity	:	Components are not known to be associated with carcinogenic effects.
Reproductive and Developmental Toxicity	:	Not expected to be a hazard.
Additional Information	:	Used oils may contain harmful impurities that have accumulated during use. The concentration of such impurities will depend on use and they may present risks to health and the environment on disposal. ALL used oil should be handled with caution and skin contact avoided as far as possible.

12. ECOLOGICAL INFORMATION

Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the ecotoxicology of similar products.

Acute Toxicity	:	Poorly soluble mixture. May cause physical fouling of aquatic organisms. Expected to be practically non toxic: LL/EL/IL50 > 100 mg/l (to aquatic organisms) (LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract).
Mobility	:	Liquid under most environmental conditions. Floats on water. If it enters soil, it will adsorb to soil particles and will not be mobile.
Persistence/degradability	:	Expected to be inherently biodegradable.
Bioaccumulation	:	Has the potential to bioaccumulate.
Other Adverse Effects	:	Product is a mixture of non-volatile components, which are not

expected to be released to air in any significant quantities. Not expected to have ozone depletion potential, photochemical ozone creation potential or global warming potential.

13. DISPOSAL CONSIDERATIONS

Material Disposal	:	Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses.
Container Disposal	:	Dispose in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.
Local Legislation	:	Disposal should be in accordance with applicable regional, national, and local laws and regulations. EU Waste Disposal Code (EWC): 13 03 08 synthetic insulating and heat transmission oils. Classification of waste is always the responsibility of the end user. Hazardous Waste (England and Wales) Regulations 2005.

14. TRANSPORT INFORMATION

ADR
This material is not classified as dangerous under ADR regulations.

RID
This material is not classified as dangerous under RID regulations.

ADNR
This material is not classified as dangerous under ADNR regulations.

IMDG
This material is not classified as dangerous under IMDG regulations.

IATA (Country variations may apply)
This material is not classified as dangerous under IATA regulations.

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

EC Classification	:	Harmful.
EC Symbols	:	Xn Harmful.
EC Risk Phrases	:	R65 Harmful: may cause lung damage if swallowed. R66 Repeated exposure may cause skin dryness or cracking.
EC Safety Phrases	:	S62 If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.

Chemical Inventory Status

EINECS	:	All components listed or polymer exempt.
TSCA	:	All components listed.
Classification triggering components	:	Contains alkyl benzene derivatives.
Other Information	:	Environmental Protection Act 1990 (as amended). Health and Safety at Work Act 1974. Consumers Protection Act 1987. Control of Pollution Act 1974. Environmental Act 1995. Factories Act 1961. Carriage of Dangerous Goods by Road and Rail (Classification, Packaging and Labelling) Regulations. Chemicals (Hazard Information and Packaging for Supply) Regulations 2002. Control of Substances Hazardous to Health Regulations 1994 (as amended). Road Traffic (Carriage of Dangerous Substances in Packages) Regulations. Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations. Road Traffic (Carriage of Dangerous Substances in Road Tankers in Tank Containers) Regulations. Road Traffic (Training of Drivers of Vehicles Carrying Dangerous Goods) Regulations. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations. Health and Safety (First Aid) Regulations 1981. Personal Protective Equipment (EC Directive) Regulations 1992. Personal Protective Equipment at Work Regulations 1992.

16. OTHER INFORMATION

R-phrase(s)

R65	Harmful: may cause lung damage if swallowed.
R66	Repeated exposure may cause skin dryness or cracking.

MSDS Version Number	:	1.0
MSDS Effective Date	:	16.09.2010
MSDS Revisions	:	A vertical bar (|) in the left margin indicates an amendment from the previous version.
MSDS Regulation	:	Regulation 1907/2006/EC
MSDS Distribution	:	The information in this document should be made available to all who may handle the product.
Disclaimer	:	This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

APPENDIX E

WATER FRAMEWORK DIRECTIVE RIVER AND GROUNDWATER BODY MAPS

Full Report for Waterbody CorkCity_2

River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The WaterMaps viewer is an integral part of the River Basin Management Plan and provides access to information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland.

The following report provides summary plan information about the selected waterbody (indicated by the pin in the map above) relating to its status, risks, objectives, and measures proposed to retain status where this is adequate, or improve it where necessary. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries [transitional waters], and coastal waters), or to groundwaters. Other relevant information not included in this report can be viewed using the WaterMaps viewer, including areas listed in the Register of Protected Areas.

You will find brief notes at the bottom of some of the individual report sheets that will help you in interpreting the information presented. More detailed information can be obtained in relation to all aspects of the RBMPs at www.wfdireland.ie.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'Our Plan'

Summary Information:

Water Management Unit:	N/A
WaterBody Category:	Groundwater Waterbody
WaterBody Name:	CorkCity_2
WaterBody Code:	IE_SW_G_031
Overall Status:	Good
Overall Objective:	Protect
Overall Risk:	1a At Risk
Heavily Modified:	No

south western river basin district

Report data based upon final RBMP, 2009-2015.

The information provided above is a summary of the principal findings related to the selected waterbody. Further details and explanation of individual elements of the report are outlined in the following pages.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Chemical and Quantitative Status Report

Water Management Unit:	N/A
WaterBody Category:	Groundwater Waterbody
WaterBody Name:	CorkCity_2
WaterBody Code:	IE_SW_G_031
Overall Status Result:	Good
Heavily Modified:	No

south western river basin district

	Status Element Description	Result
	Status information	
INS	Status associated with saline intrusion into groundwater	GS-HC
DWS	Status associated with exceedances of water quality above specific standards	GS-HC
DS	Chemical status of groundwater due to pressure from diffuse sources of pollution	GS-LC
CLS	Chemical status of groundwater due to pressure from contaminated soil or land.	GS-HC
MS	Chemical status of groundwater due to pressure from mine sites (active or closed).	GS-HC
UAS	Chemical status of groundwater due to pressures from urban areas	GS-LC
GWS	General groundwater quality status	GS-LC
RPS	Status associated with MRP loading to rivers	GS-LC
TNS	Status associated with nitrate loading to transitional and coastal waters	GS-LC
SWS	Overall status associated with nutrient loadings to rivers and transitional and coastal waters	GS-LC
SQS	Status associated with dependant surface water quantitative status	GS-HC
GDS	Groundwater dependant terrestrial ecosystems status	GS-HC
QSO	Quantitative status overall	GS-HC
CSO	Chemical status overall	GS-LC
OS	Overall status	Good

GS -HC : Good status High Confidence
GS- LC : Good status Low Confidence
n/a - not assessed

Status
By 'Status' we mean the condition of the water in the waterbody. It is defined by its chemical status and quantitative status, whichever is worse. Groundwaters are ranked in one of 2 status classes: Good or Poor.

You can read more about status and how it is measured in our RBMP Document Library at www.wfdireland.ie (Directory 15 Status).

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Risk Report

Water Management Unit: N/A

WaterBody Category: Groundwater Waterbody

WaterBody Name: CorkCity_2

WaterBody Code: IE_SW_G_031

Overall Risk Result: 1a At Risk

Heavily Modified: No

south western river basin district

	Risk Test Description	Risk
	Groundwater Dependent Terrestrial Ecosystems	
TE	GWDTE Risk	N/A
	Groundwater Quality	
DIF	Diffuse Elements (General) Risk	N/A
DW	Drinking Waters Risk	N/A
INT	Intrusions Risk	N/A
WB	Water Balance Risk	N/A
	Groundwater Quality (General)	
GQ	General Groundwater Quality Risk	N/A
	Groundwater Quality (Point Risk)	
CL	Contaminated Land Risk	N/A
LF	Landfill Risk	N/A
MI	Mine Risk	N/A
QY	Quarry Risk	N/A
UR	Urban Risk	N/A
UW	UWWT Risk	N/A
	GW Diffuse Risk Sources	
WB3	Mobile Nutrients (NO3)	N/A
WB4	Mobile Chemicals	N/A
WB5	Clustered OSWTSs and leaking urban sewerage systems	N/A
	GW Hydrology	
WB1	Water balance - Abstraction	N/A
WB2	Abstraction - Intrusion	N/A

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

	GW Point Risk Sources		
WB10	Risk from Point sources of pollution - Contaminated Land		N/A
WB11	Risk from Point sources of pollution - Trade Effluent Discharges		N/A
WB12	Risk from Point sources of pollution - Urban Wastewater Discharges		N/A
WB6	Risk from Point sources of pollution - Mines		N/A
WB7	Risk from Point sources of pollution - Quarries		N/A
WB8	Risk from Point sources of pollution - Landfills		N/A
WB9	Risk from Point sources of pollution - Oil Industry Infrastructure		N/A
	Overall Risk		
RA	Groundwater Overall - Worst Case		N/A
	Risk information		
CLR	Contaminated land risk	2b	Not At Risk
DR	Risk of groundwater due to pressure from diffuse sources of pollution	1a	At Risk
DWR	Risk associated with exceedances of water quality above specific standards	2b	Not At Risk
GDR	Groundwater dependant terrestrial ecosystems risk	2b	Not At Risk
GWR	General groundwater quality risk	1a	At Risk
INR	Risk associated with saline intrusion into groundwater	2b	Not At Risk
LR	Risk due to landfills sites/old closed dump sites	2b	Not At Risk
MR	Mines risk	2b	Not At Risk
NULL	Diffuse nitrates from agriculture risk		N/A
QR	Risk due to quarries	2b	Not At Risk
RA	Revised risk assessment	1a	At Risk
RPR	Risk associated with MRP loading to rivers	1a	At Risk
SQR	Risk associated with dependant surface water quantitative status	2b	Not At Risk
SWR	Overall risk associated with nutrient loadings to rivers and transitional and coastal waters	1a	At Risk
TNR	Risk associated with nitrate loading to transitional and coastal waters	1a	At Risk
UAR	Risk of groundwater due to pressures from urban areas	1b	Probably At Risk
UWR	Risk due to direct discharges of urban wastewater	2b	Not At Risk

Risk
By 'risk' we mean the risk that a waterbody will not achieve good ecological or good chemical status/potential at least by 2015. To examine risk the various pressures acting on the waterbody were identified along with any evidence of impact on water status. Depending on the extent of the pressure and its potential for impact, and the amount of information available, the risk to the water body was placed in one of four categories: 1a at risk; 1b probably at risk; 2a probably not at risk; 2b not at risk. Note that '2008' after the risk category means that the risk assessment was revised in 2008. All other risks were determined as part of an earlier risk assessment in 2005.

You can read more about risk assessment in our 'WFD Risk Assessment Update' document in the RBMP document I brary, and other documents at www.wfdireland.ie (Directory 31 Risk Assessments).

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Objectives Report

Water Management Unit: N/A

WaterBody Category: Groundwater Waterbody

WaterBody Name: CorkCity_2

WaterBody Code: IE_SW_G_031

Overall Objective: Protect

Heavily Modified: No

south western river basin district

	Objectives Description	Result
	Extended timescale information	
E1	Extended deadlines due to agricultural P	No Status
E2	Extended deadlines due to agricultural N	No Status
E3	Extended deadlines due to mines	No Status
E4	Extended deadlines due to urban areas	No Status
E5	Extended deadlines due to contaminated lands	No Status
EO	Extended deadlines - overall	No Status
	Objectives information	
OB1	Prevent deterioration objective	Protect
OB2	Restore at least good status objective	No Status
OB3	Reduce chemical pollution objective	No Status
OB4	Protected areas objective	No Status
OBO	Overall objectives - objective	Protect

Extended timescales
Extended timescales have been set for certain waters due to technical, economic, environmental or recovery constraints. Extended timescales are usually of one planning cycle (6 years, to 2021) but in some cases are two planning cycles (to 2027).

Objectives
In general, we are required to ensure that our waters achieve at least good status/potential by 2015, and that their status does not deteriorate. Having identified the status of waters (this is given earlier in this report), the next stage is to set objectives for waters. Objectives consider waters that require protection from deterioration as well as waters that require restoration and the timescales needed for recovery. Four default objectives have been set initially:-

Prevent Deterioration
Restore Good Status
Reduce Chemical Pollution
Achieve Protected Areas Objectives

These objectives have been refined based on the measures available to achieve them, the latter's likely effectiveness, and consideration of cost-effective combinations of measures. Where it is considered necessary extended deadlines have been set for achieving objectives in 2021 or 2027.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'Our Plan'

Measures Report

Water Management Unit: N/A

WaterBody Category: Groundwater Waterbody

WaterBody Name: CorkCity_2

WaterBody Code: IE_SW_G_031

Heavily Modified: No

south western river basin district

	Measures Description	Applicable
BC	Total number of basic measures which apply to this waterbody	26
BW	Directive - Bathing Waters Directive	No
BIR	Directive - Birds Directive	Yes
HAB	Directive - Habitats Directive	No
DW	Directive - Drinking Waters Directive	Yes
MAE	Directive - Major Accidents and Emergencies Directive	Yes
EIA	Directive - Environmental Impact Assessment Directive	Yes
SS	Directive - Sewage Sludge Directive	Yes
UWT	Directive - Urban Waste Water Treatment Directive	Yes
PPP	Directive - Plant Protection Products Directive	Yes
NIT	Directive - Nitrates Directive	Yes
IPC	Directive - Integrated Pollution Prevention Control Directive	Yes
CR	Other Stipulated Measure - Cost recovery for water use	Yes
SUS	Other Stipulated Measure - Promotion of efficient and sustainable water use	Yes
DWS	Other Stipulated Measure - Protection of drinking water sources	Yes
ABS	Other Stipulated Measure - Control of abstraction and impoundment	Yes
POI	Other Stipulated Measure - Control of point source discharges	Yes
DIF	Other Stipulated Measure - Control of diffuse source discharges	Yes
GW	Other Stipulated Measure - Authorisation of discharges to groundwaters	Yes
PS	Other Stipulated Measure - Control of priority substances	Yes
MOD	Other Stipulated Measure - Controls on physical modifications to surface waters	Yes
OA	Other Stipulated Measure - Controls on other activities impacting on water status	Yes
AP	Other Stipulated Measure - Prevention or reduction of the impact of accidental pollution incidents	Yes
OTS	On-site waste water treatment systems	Yes
FPM	Freshwater Pearl Mussel sub-basin plan	No
SHE	Shellfish Pollution Reduction Plan	Yes
IPR	IPPC licences requiring review	Yes
WPR	Water Pollution Act licences requiring review	Yes
FOR	Forestry guidelines and regulations	Yes

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

HQW	Protect high quality waters	Yes

Measures
Measures are necessary to ensure that we meet the objectives set out in the previous page of this report. Many measures are already provided for in national legislation and must be implemented. Other measures have been recently introduced or are under preparation. A range of additional potential measures are also being considered but require further development. Any agreed additional measures can be introduced through the update of Water Management Unit Action Plans during the implementation process.

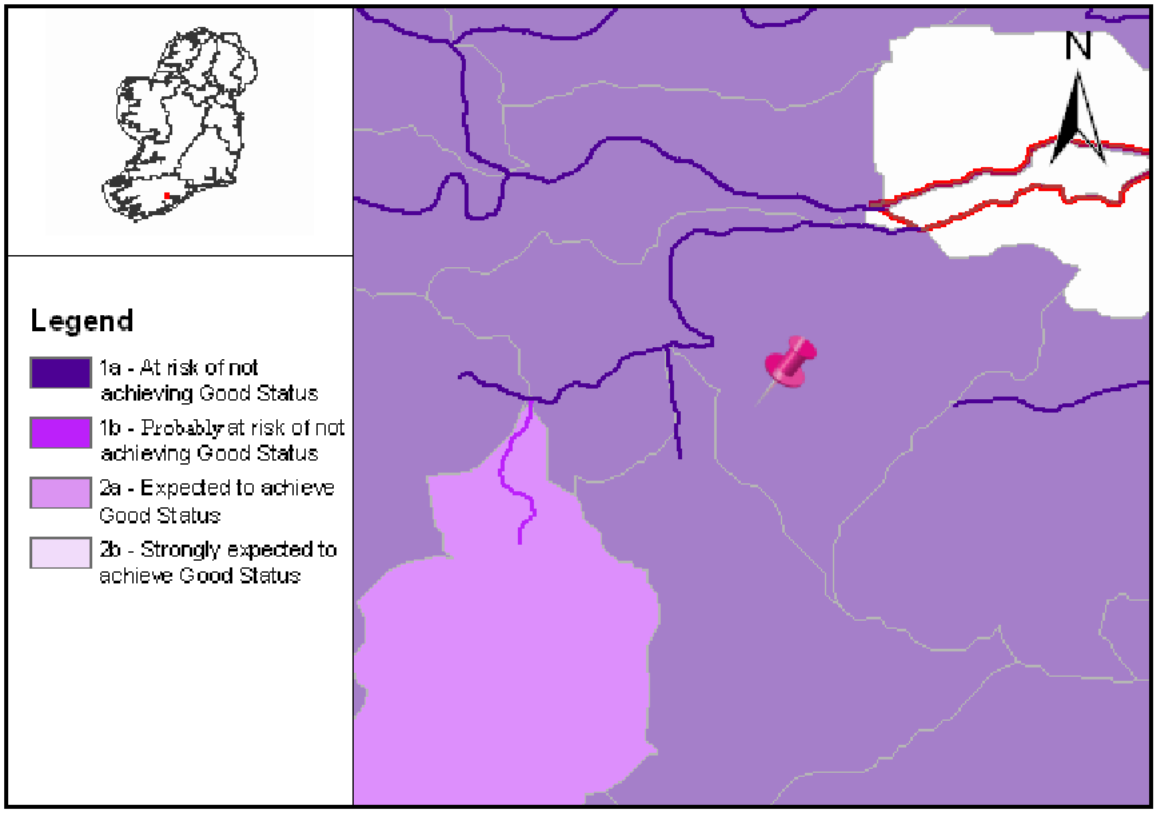
You can read more about Basic Measures in 'River Basin Planning Guidance' and in other documents in our RBMP Document Library at www.wfdireland.ie.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Full Report for Waterbody Curragheen, Trib of Lee



River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The WaterMaps viewer is an integral part of the River Basin Management Plan and provides access to information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland.

The following report provides summary plan information about the selected waterbody (indicated by the pin in the map above) relating to its status, risks, objectives, and measures proposed to retain status where this is adequate, or improve it where necessary. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries [transitional waters], and coastal waters), or to groundwaters. Other relevant information not included in this report can be viewed using the WaterMaps viewer, including areas listed in the Register of Protected Areas.

You will find brief notes at the bottom of some of the individual report sheets that will help you in interpreting the information presented. More detailed information can be obtained in relation to all aspects of the RBMPs at www.wfdireland.ie.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Summary Information:

Water Management Unit:	IE_SW_LowerLee/Owenboy
WaterBody Category:	River Waterbody
WaterBody Name:	Curragheen, Trib of Lee
WaterBody Code:	IE_SW_19_1744
Overall Status:	Poor
Overall Objective:	Restore_2021
Overall Risk:	1a At Risk
Heavily Modified:	No

south western river basin district

Report data based upon final RBMP, 2009-2015.

The information provided above is a summary of the principal findings related to the selected waterbody. Further details and explanation of individual elements of the report are outlined in the following pages.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Status Report

Water Management Unit:	IE_SW_LowerLee/Owenboy
WaterBody Category:	River Waterbody
WaterBody Name:	Curragheen, Trib of Lee
WaterBody Code:	IE_SW_19_1744
Overall Status Result:	Poor
Heavily Modified:	No

south western river basin district

	Status Element Description	Result
	Status information	
Q	Macroinvertebrate status	N/A
PC	General physico-chemical status	N/A
FPQ	Freshwater Pearl Mussel / Macroinvertebrate status	N/A
DIA	Diatoms status	N/A
HYM	Hydromorphology status	N/A
FIS	Fish status	Poor
SP	Specific Pollutants status (SP)	N/A
ES	Overall ecological status	Poor
CS	Overall chemical status (PAS)	n/a
EXT	Extrapolated status	N/A
MON	Monitored water body	YES
DON	Donor water bodies	N/A

n/a - not assessed

Status
By 'Status' we mean the condition of the water in the waterbody. It is defined by its chemical status and its ecological status, whichever is worse. Waters are ranked in one of 5 status classes: High, Good, Moderate, Poor, Bad. However, not all waterbodies have been monitored, and in such cases the status of a similar nearby waterbody has been used (extrapolated) to assign status. If this has been done the first line of the status report shows the code of the waterbody used to extrapolate.

You can read more about status and how it is measured in our RBMP Document Library at www.wfdireland.ie (Directory 15 Status).

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Risk Report

Water Management Unit: IE_SW_LowerLee/Owenboy

WaterBody Category: River Waterbody

WaterBody Name: Curragheen, Trib of Lee

WaterBody Code: IE_SW_19_1744

Overall Risk Result: 1a At Risk

Heavily Modified: No

south western river basin district

	Risk Test Description		Risk
	Diffuse Risk Sources		
RD1	EPA diffuse model (2008)	1a	At Risk
RD2a	Road Wash - Soluble Copper	2b	Not At Risk
RD2b	Road Wash - Total Zinc	2b	Not At Risk
RD2c	Road Wash - Total Hydrocarbons	2b	Not At Risk
RD3	Railways	2b	Not At Risk
RD4a	Forestry - Acidification (2008)	2b	Not At Risk
RD4b	Forestry - Suspended Solids (2008)	2b	Not At Risk
RD4c	Forestry - Eutrophication (2008)	2a	Probably Not At Risk
RD5	Overall Unsewered (2008)	2b	Not At Risk
RD5a	Unsewered Areas - Pathogens (2008)	2a	Probably Not At Risk
RD5b	Unsewered Phosphorus (2008)	2b	Not At Risk
RD6a	Arable	2b	Not At Risk
RD6b	Sheep Dip	2b	Not At Risk
RD6c	Forestry - Dangerous Substances	2b	Not At Risk
RDO	Diffuse Overall -Worst Case (2008)	1a	At Risk
	Hydrology		
RHY1	Water balance - Abstraction	2b	Not At Risk
	Morphological Risk Sources		
RM1	Channelisation (2008)	1a	At Risk
RM2	Embankments (2008)	2b	Not At Risk
RM3	Impoundments	2b	Not At Risk
RM4	Water Regulation	2b	Not At Risk
RM5	Intensive Landuse		N/A
RMO	Morphology Overall - Worst Case (2008)	1a	At Risk
	Overall Risk		
RA	Rivers Overall - Worst Case (2008)	1a	At Risk

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

	Point Risk Sources		
RP1	WWTPs (2008)	2b	Not At Risk
RP2	CSOs	1b	Probably At Risk
RP3	IPPCs (2008)	2b	Not At Risk
RP4	Section 4s (2008)	2b	Not At Risk
RP5	WTPs/Mines/Quarries/Landfills		N/A
RPO	Overall Risk from Point Sources - Worst Case (2008)	1b	Probably At Risk
	Q Value		
Q	EPA Q rating and Margaritifera Assessment		N/A
	Q/RDI or Point/Diffuse		
QPD	Q class/EPA Diffuse Model or worst case of Point and Diffuse (2008)	1a	At Risk
	Rivers Direct Impacts		
RDI1	Rivers Direct Impacts - Dangerous Substances		N/A

Risk
By 'risk' we mean the risk that a waterbody will not achieve good ecological or good chemical status/potential at least by 2015. To examine risk the various pressures acting on the waterbody were identified along with any evidence of impact on water status. Depending on the extent of the pressure and its potential for impact, and the amount of information available, the risk to the water body was placed in one of four categories: 1a at risk; 1b probably at risk; 2a probably not at risk; 2b not at risk. Note that '2008' after the risk category means that the risk assessment was revised in 2008. All other risks were determined as part of an earlier risk assessment in 2005.

You can read more about risk assessment in our 'WFD Risk Assessment Update' document in the RBMP document library, and other documents at www.wfdireland.ie (Directory 31 Risk Assessments).

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Objectives Report

Water Management Unit: IE_SW_LowerLee/Owenboy

WaterBody Category: River Waterbody

WaterBody Name: Curragheen, Trib of Lee

WaterBody Code: IE_SW_19_1744

Overall Objective: Restore_2021

Heavily Modified: No

	Objectives Description	Result
	Extended timescale information	
E1	Extended timescales due to time requirements to upgrade WWTP discharges	No Status
E2	Extended timescales due to delayed recovery of chemical pollution and chemical status failures	No Status
E3	Extended timescales due to delayed recovery following reduction in agricultural nutrient losses	No Status
E4	Extended timescales due to delayed recovery from physical modifications and physical damage	No Status
E5	Extended timescales due to delayed recovery following implementing forestry acidification measures	No Status
E6	Extended timescales due to physical recovery timescales at mines and contaminated sites	No Status
E7	Extended timescales due to delayed recovery of highly impacted sites	No Status
E8	Extended timescales due to delayed recovery following reduction in agricultural nutrient losses	No Status
E9	Extended timescales due to delayed recovery from nitrogen losses to estuaries	2021
E10	Extended timescales due to delayed recovery following reduction in agricultural nutrient losses	No Status
E11	Extended timescales due to delayed recovery from physical modifications and physical damage (overgrazing)	No Status
E12	Extended timescales due to delayed recovery from physical modifications and physical damage (channelisation)	No Status
E13	Extended timescales from Northern Ireland Environment Agency	No Status
EOV	Overall extended timescale - combination of all extended timescales fields	2021
E14	Extended timescales due to the presence of Freshwater Pearl Mussel populations	No Status
EX15	Extended timescales due to highly impacted sites	No Status

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

	Objectives information	
OB1	Prevent deterioration objective	No Status
OB2	Restore at least good status objective	Restore_2021
OB3	Reduce chemical pollution objective	No Status
OB4	Protected areas objective	No Status
OB5	Northern Ireland Environment Agency objective	No Status
OBO	Overall objectives	Restore_2021

Extended timescales
Extended timescales have been set for certain waters due to technical, economic, environmental or recovery constraints. Extended timescales are usually of one planning cycle (6 years, to 2021) but in some cases are two planning cycles (to 2027).

Objectives
In general, we are required to ensure that our waters achieve at least good status/potential by 2015, and that their status does not deteriorate. Having identified the status of waters (this is given earlier in this report), the next stage is to set objectives for waters. Objectives consider waters that require protection from deterioration as well as waters that require restoration and the timescales needed for recovery. Four default objectives have been set initially:-

Prevent Deterioration
Restore Good Status
Reduce Chemical Pollution
Achieve Protected Areas Objectives

These objectives have been refined based on the measures available to achieve them, the latter's likely effectiveness, and consideration of cost-effective combinations of measures. Where it is considered necessary extended deadlines have been set for achieving objectives in 2021 or 2027.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Measures Report

Water Management Unit: IE_SW_LowerLee/Owenboy

WaterBody Category: River Waterbody

WaterBody Name: Curragheen, Trib of Lee

WaterBody Code: IE_SW_19_1744

Heavily Modified: No

south western river basin district

	Measures Description	Applicable
BC	Total number of basic measures which apply to this waterbody	21
BW	Directive - Bathing Waters Directive	No
BIR	Directive - Birds Directive	No
HAB	Directive - Habitats Directive	No
DW	Directive - Drinking Waters Directive	No
MAE	Directive - Major Accidents and Emergencies Directive	Yes
EIA	Directive - Environmental Impact Assessment Directive	Yes
SS	Directive - Sewage Sludge Directive	Yes
UWT	Directive - Urban Waste Water Treatment Directive	Yes
PPP	Directive - Plant Protection Products Directive	Yes
NIT	Directive - Nitrates Directive	Yes
IPC	Directive - Integrated Pollution Prevention Control Directive	Yes
CR	Other Stipulated Measure - Cost recovery for water use	Yes
SUS	Other Stipulated Measure - Promotion of efficient and sustainable water use	Yes
DWS	Other Stipulated Measure - Protection of drinking water sources	Yes
ABS	Other Stipulated Measure - Control of abstraction and impoundment	Yes
POI	Other Stipulated Measure - Control of point source discharges	Yes
DIF	Other Stipulated Measure - Control of diffuse source discharges	Yes
PS	Other Stipulated Measure - Control of priority substances	Yes
MOD	Other Stipulated Measure - Controls on physical modifications to surface waters	Yes
OA	Other Stipulated Measure - Controls on other activities impacting on water status	Yes
AP	Other Stipulated Measure - Prevention or reduction of the impact of accidental pollution incidents	Yes
TP1	WSIP - Agglomerations with treatment plants requiring capital works	No
TP2	WSIP - Agglomerations with treatment plants requiring further investigation prior to capital works	No
TP3	WSIP - Agglomerations requiring the implementation of actions identified in Shellfish PRPs	No
TP4	WSIP - Agglomerations with treatment plants requiring improved operational performance	No
TP5	WSIP - Agglomerations requiring investigation of CSOs	No

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

TP6	WSIP - Agglomerations where exisitng treatment capacity is currently adequate but predicted loadings would result in overloading	No
OTS	On-site waste water treatment systems	Yes
FPM	Freshwater Pearl Mussel sub-basin plan	No
SHE	Shellfish Pollution Reduction Plan	Yes
IPR	IPPC licences requiring review	No
WPR	Water Pollution Act licences requiring review	No
FOR	Forestry guidelines and regulations	Yes
CH1	Chanelisation measures	No
CH2	Chanelisation investigations	Yes
OG	Overgrazing measures	No
HQW	Protect high quality waters	No

Measures
Measures are necessary to ensure that we meet the objectives set out in the previous page of this report. Many measures are already provided for in national legislation and must be implemented. Other measures have been recently introduced or are under preparation. A range of additional potential measures are also being considered but require further development. Any agreed additional measures can be introduced through the update of Water Management Unit Action Plans during the implementation process.

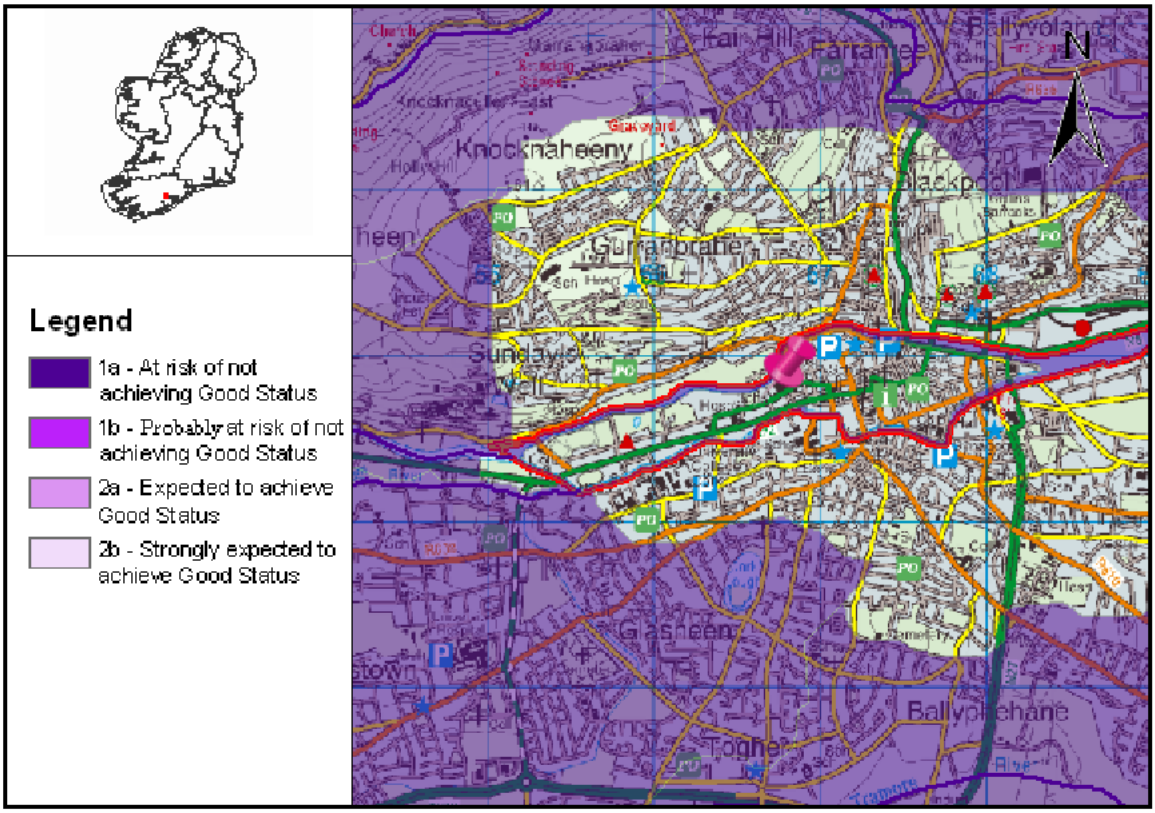
You can read more about Basic Measures in 'River Basin Planning Guidance' and in other documents in our RBMP Document Library at www.wfdireland.ie.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Full Report for Waterbody Lee (Cork) Estuary Upper



River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The WaterMaps viewer is an integral part of the River Basin Management Plan and provides access to information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland.

The following report provides summary plan information about the selected waterbody (indicated by the pin in the map above) relating to its status, risks, objectives, and measures proposed to retain status where this is adequate, or improve it where necessary. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries [transitional waters], and coastal waters), or to groundwaters. Other relevant information not included in this report can be viewed using the WaterMaps viewer, including areas listed in the Register of Protected Areas.

You will find brief notes at the bottom of some of the individual report sheets that will help you in interpreting the information presented. More detailed information can be obtained in relation to all aspects of the RBMPs at www.wfdireland.ie.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'Our Plan'

Summary Information:

Water Management Unit:	N/A
WaterBody Category:	Transitional Waterbody
WaterBody Name:	Lee (Cork) Estuary Upper
WaterBody Code:	IE_SW_060_0950
Overall Status:	Moderate
Overall Objective:	Restore 2021
Overall Risk:	1a At Risk
Heavily Modified:	No
	Report data based upon final RBMP, 2009-2015.

south western river basin district

The information provided above is a summary of the principal findings related to the selected waterbody. Further details and explanation of individual elements of the report are outlined in the following pages.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'Our Plan'

Status Report

Water Management Unit:	N/A
WaterBody Category:	Transitional Waterbody
WaterBody Name:	Lee (Cork) Estuary Upper
WaterBody Code:	IE_SW_060_0950
Overall Status Result:	Moderate
Heavily Modified:	No

south western river basin district

	Status Element Description	Result
	Status information	
DIN	Dissolved Inorganic Nitrogen status	Moderate
MRP	Molybdate Reactive Phosphorus status	Good
DO	Dissolved oxygen as per cent saturation status	Moderate
BOD	Biochemical Oxygen Demand (5-days) status	High
PHY	Macroalgae - phytobiomass status	High
OPP	Macroalgae - opportunistic algae status	N/A
RSL	Macroalgae - reduced species list status	N/A
ANG	Angiosperms - Seagrass and Saltmarsh status	N/A
BIN	Benthic Invertebrates status	N/A
FIS	Fish status	Poor
HYD	Hydrology status	N/A
MOR	Morphology status	Less than Good
SP	Specific Pollutant Status	N/A
PAS	Overall protected area status	Less than good
ES	Ecological Status	Moderate
CS	Chemical Status	N/A
SWS	Surface Water Status	N/A
EXT	Extrapolated status	N/A
DON	Donor water bodies	N/A

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

n/a - not assessed

Status
By 'Status' we mean the condition of the water in the waterbody. It is defined by its chemical status and its ecological status, whichever is worse. Waters are ranked in one of 5 status classes: High, Good, Moderate, Poor, Bad. However, not all waterbodies have been monitored, and in such cases the status of a similar nearby waterbody has been used (extrapolated) to assign status. If this has been done the first line of the status report shows the code of the waterbody used to extrapolate.

You can read more about status and how it is measured in our RBMP Document Library at www.wfdireland.ie (Directory 15 Status).

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Risk Report

Water Management Unit: N/A

WaterBody Category: Transitional Waterbody

WaterBody Name: Lee (Cork) Estuary Upper

WaterBody Code: IE_SW_060_0950

Overall Risk Result: 1a At Risk

Heavily Modified: No

south western river basin district

	Risk Test Description		Risk
	Hydrology		
THY1	Water balance - Abstraction	1a	At Risk
	Marine Direct Impacts		
TMDI 1	Dangerous Substances		N/A
TMDI 2	OSPAR	1a	At Risk
TMDI 3	UWWT Regs Designations	1a	At Risk
TMDI O	Marine Direct Impacts Overall - Worst Case	1a	At Risk
	Morphological Risk Sources		
TM1	Channelisation		N/A
TM2	Deposition		N/A
TM3	Coastal Defences		N/A
TM4	Impoundments		N/A
TM5a	Built Structures - Port Tonnage		N/A
TM5b	Built Structures - Industrial Intakes		N/A
TM6	Intensive Landuse		N/A
TMO	Morphology Overall - Worst Case		N/A
TMO	Overall (MIMAS) Morphological Risk - Worst Case (2008)		N/A
	Overall Risk		
RA	Transitional Overall - Worst CaseOverall (MIMAS) Morphological Risk - Worst Case (2008)	1a	At Risk
	Point / MDI Worst Case		
TPOL	Worst case of Point Overall and MDI OverallOverall (MIMAS) Morphological Risk - Worst Case (2008)	1a	At Risk

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

	Point Risk Sources		
TP1	WWTPs (2008)	2b	Not At Risk
TP2	CSOs	1b	Probably At Risk
TP3	IPPCs (2008)	2b	Not At Risk
TP4	Section 4s (2008)	2b	Not At Risk
TP5	WTPs/Mines/Quarries/Landfills		N/A
TPO	Overall Risk from Point Sources - Worst Case (2008)	1b	Probably At Risk

Risk
By 'risk' we mean the risk that a waterbody will not achieve good ecological or good chemical status/potential at least by 2015. To examine risk the various pressures acting on the waterbody were identified along with any evidence of impact on water status. Depending on the extent of the pressure and its potential for impact, and the amount of information available, the risk to the water body was placed in one of four categories: 1a at risk; 1b probably at risk; 2a probably not at risk; 2b not at risk. Note that '2008' after the risk category means that the risk assessment was revised in 2008. All other risks were determined as part of an earlier risk assessment in 2005.

You can read more about risk assessment in our 'WFD Risk Assessment Update' document in the RBMP document I brary, and other documents at www.wfdireland.ie (Directory 31 Risk Assessments).

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Objectives Report

Water Management Unit: N/A

WaterBody Category: Transitional Waterbody

WaterBody Name: Lee (Cork) Estuary Upper

WaterBody Code: IE_SW_060_0950

Overall Objective: Restore 2021

Heavily Modified: No

	Objectives Description	Result
	Extended timescale information	
E1	Extended timescales due to time requirements to upgrade WWTP discharges	No Status
E2	Extended timescales due to delayed recovery of chemical pollution and chemical status failures	No Status
E3	Extended timescales due to winter dissolved nitrogen exceedances	2021
E4	Extended timescales due to time requirements for status recovery	No Status
E5	Extended timescales from Northern Ireland Environment Agency	No Status
E0V	Overall extended timescale - combination of all extended timescales fields	2021
	Objectives information	
OB1	Prevent deterioration objective	No Status
OB2	Restore at least good status objective	No Status
OB3	Reduce chemical pollution objective	No Status
OB4	Protected areas objective	Restore 2021
OBO	Overall objectives	Restore 2021

Extended timescales
Extended timescales have been set for certain waters due to technical, economic, environmental or recovery constraints. Extended timescales are usually of one planning cycle (6 years, to 2021) but in some cases are two planning cycles (to 2027).

Objectives
In general, we are required to ensure that our waters achieve at least good status/potential by 2015, and that their status does not deteriorate. Having identified the status of waters (this is given earlier in this report), the next stage is to set objectives for waters. Objectives consider waters that require protection from deterioration as well as waters that require restoration and the timescales needed for recovery. Four default objectives have been set initially:-

Prevent Deterioration
Restore Good Status
Reduce Chemical Pollution
Achieve Protected Areas Objectives

These objectives have been refined based on the measures available to achieve them, the latter's likely effectiveness, and consideration of cost-effective combinations of measures. Where it is considered necessary extended deadlines have been set for achieving objectives in 2021 or 2027.

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

water matters
'our Plan'

Measures Report

Water Management Unit: N/A

WaterBody Category: Transitional Waterbody

WaterBody Name: Lee (Cork) Estuary Upper

WaterBody Code: IE_SW_060_0950

Heavily Modified: No

south western

	Measures Description	Applicable
BC	Total number of basic measures which apply to this waterbody	14
BW	Directive - Bathing Waters Directive	No
BIR	Directive - Birds Directive	No
HAB	Directive - Habitats Directive	No
MAE	Directive - Major Accidents and Emergencies Directive	Yes
EIA	Directive - Environmental Impact Assessment Directive	Yes
UWT	Directive - Urban Waste Water Treatment Directive	No
PPP	Directive - Plant Protection Products Directive	Yes
NIT	Directive - Nitrates Directive	Yes
IPC	Directive - Integrated Pollution Prevention Control Directive	Yes
POI	Other Stipulated Measure - Control of point source discharges	Yes
DIF	Other Stipulated Measure - Control of diffuse source discharges	Yes
PS	Other Stipulated Measure - Control of priority substances	Yes
MOD	Other Stipulated Measure - Controls on physical modifications to surface waters	Yes
OA	Other Stipulated Measure - Controls on other activities impacting on water status	Yes
AP	Other Stipulated Measure - Prevention or reduction of the impact of accidental pollution incidents	Yes
TP1	WSIP - Agglomerations with treatment plants requiring capital works	No
TP2	WSIP - Agglomerations with treatment plants requiring further investigation prior to capital works	No
TP3	WSIP - Agglomerations requiring the implementation of actions identified in Shellfish PRPs	No
TP4	WSIP - Agglomerations with treatment plants requiring improved operational performance	No
TP5	WSIP - Agglomerations requiring investigation of CSOs	No
TP6	WSIP - Agglomerations where exisitng treatment capacity is currently adequate but predicted loadings would result in overloading	No
OTS	On-site waste water treatment systems	Yes
SHE	Shellfish Pollution Reduction Plan	No
IPR	IPPC licences requiring review	Yes
WPR	Water Pollution Act licences requiring review	Yes

Date Reported to Europe:July 2010

Date Report Created 29/11/2019

HQW	Protect high quality waters	No

Measures
Measures are necessary to ensure that we meet the objectives set out in the previous page of this report. Many measures are already provided for in national legislation and must be implemented. Other measures have been recently introduced or are under preparation. A range of additional potential measures are also being considered but require further development. Any agreed additional measures can be introduced through the update of Water Management Unit Action Plans during the implementation process.

You can read more about Basic Measures in 'River Basin Planning Guidance' and in other documents in our RBMP Document Library at www.wfdireland.ie.

Ballincollig GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
19 Cork Co. Co.	**Rivers:** Bride, Lee, Glasheen, Tramore. **Lakes:** Ovens, Quarry, Cork.	Douglas River Estuary (001046), Cork Lough (001081), Ballincollig Cave (001249)	70.2

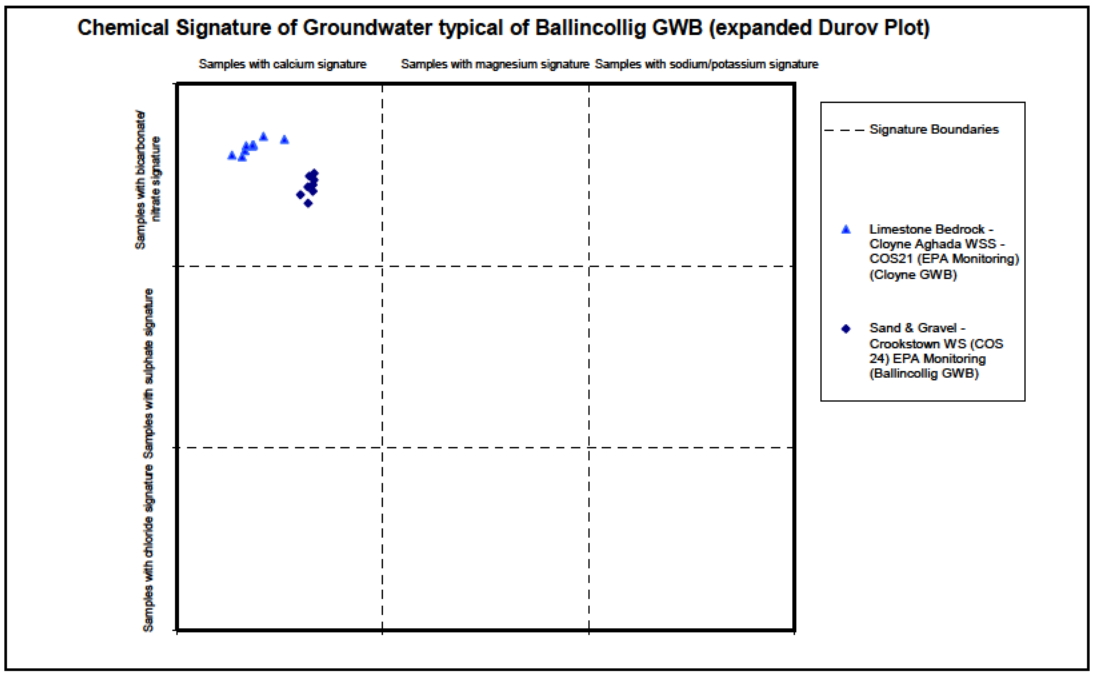
Topography	This GWB occupies the floor of an elongate E-W to ENE-WSW valley extending west from Cork City. The valley is bounded to the north and south by parallel E-W ridges of the Ballinhassig GWB. The valley floor is generally flat to gently undulating. Ground elevations range 5-60 m AOD, being lowest in the east of the body, generally < 30 m OD. West of Ovens ground elevations range 40-60 m OD. Part of the valley floor is the River Lee flood plain, which joins the valley just west of Ballincollig and flows eastwards along the northern edge of the body, and its tributary the River Bride which flows eastwards across the western half of the body.	
Geology and Aquifers	**Aquifer categories**	The main aquifer category in this GWB is: **Rk^d**: Regionally important karstified aquifer dominated by diffuse flow. Some narrow areas around the margins of the body have an aquifer category of: **Ll:** Locally important aquifer, moderately productive only in local zones
	Main aquifer lithologies	The main aquifer lithology in this GWB is Dinantian Pure Unbedded Limestones. Small areas of Pure Bedded Limestones (1.3 km^2) also occur. Areas of Dinantian Lower Impure Limestones and Dinantian Mudstones and Sandstones (Cork Group) and Dinantian Old Red Sandstones occur along the margins of the body, in particular along the north of the body.
	Key structures	During the Variscan Orogeny, rocks in the region were compressed from the south into a series of folds on E-W axes. Subsequent erosion stripped the more soluble limestones from the fold crests or ridges (anticlines) exposing the harder, more resistant sandstones underneath. The limestones were preserved in the fold troughs (synclines) which today line elongate E-W trending valleys separated by sandstone ridges. This GWB lies in the west of the Cork Syncline. Extensive fracturing and faulting accompanied the folding of the rocks. The ridges and valleys are cut by series of shear faults trending approximately N-S and a series of thrust faults with a general E-W trend. The major N-S shear faults are paralleled by a very well developed system of vertical or near-vertical N-S joints which are very evident in exposures in quarries and caves in east Cork. These joints are commonly spaced at intervals of about 0.5 to 2 metres (Wright, 1979).
	Key properties	The pure unbedded limestones of South Munster are highly productive. Faults and joints were enlarged by karstification as groundwater moved through the limestones. There are numerous surface karst features in these limestones, (e.g. swallow holes, collapse features and closed depressions) and extensive cave systems (e.g. Carrigtohill, Midleton and Cloyne). The strong structural influence on karstification is demonstrated by cave plans from southeast Cork (e.g. Poulnahorka Caves, Castlemartyr) where the main passages or 'galleries' have developed along N-S joints in the order of 1 to 6 metres apart (Wright 1979). Transmissivity in the pure unbedded limestones can range up to a few thousand m^2/d. Pumping tests in the same rock type in the Cloyne GWB east of Cork Harbour gave a range of transmissivity of 200 to over 2000 m^2/day, and 900 - 13,000 m^2/d for a water supply borehole near Dungarvan, Co Waterford (Dungarvan GWB, SERBD). Groundwater gradients within the pure unbedded limestones are low, around 0.001-0.002. (Wright & Gately 2002). In this GWB several wells with 'Excellent' yields (>400 m^3/d) occur as well as many wells with 'Good' yields (100-400 m^3/d). In 1978, the large Castlemore Quarry, approx. 750 m northeast of Crookstown, was reported to be pumping out over 300,000 m^3/day, an indication of the productivity of the limestones in the area. The Dinantian Mudstones and Sandstones (Cork Group) less productive and transmissivities are significantly lower. The transmissivity values calculated from pumping test data for a County Council Source at Robert's Cove in the same rock type as that occurring in this GWB (Cuskinny Member of Kinsale Formation KNcu) range between 10 and 13 m^2/d. This borehole lies close to a localised fault zone where transmissivity is likely to be at the high end of expected range. Along the northern side of the body, particularly along the Lee Valley, but also further west along the Bride river valley, deep sand and gravel deposits occur. They vary in depth across the Lee and Bride valley areas from several metres to approximately 40 m thick. In many places they are overlain by a layer of alluvium. Estimates of permeability from particle size analyses of sand and gravel deposits in the west of the body near Crookstown were approximately 50 m/d. Assuming an aquifer thickness of 10 metres, this gives a transmissivity of 500 m^2/d. Porosity is estimated at 0.03. Hydraulic gradient of the sand and gravel has been estimated to be in the order of 0.001 (Kelly & Wright 2002 –Crookstown). The overlying sand and gravel deposits are in hydraulic continuity with the underlying bedrock and will provide the bedrock aquifers with additional storage.

	Thickness	The Dinantian Pure Unbedded Limestones in this area are 500-600 m thick (Sleeman & Pracht, 1994). Most groundwater flow may occur in an epikarstic layer a couple of metres thick and in a zone of interconnected solutionally-enlarged fissures and conduits that extends approximately 30 m below this. However deeper flows can occur. Boreholes which intersect major zones of fissuring at depth have been observed in Waulsortian Limestone at Cloyne, Co Cork (Cloyne GWB), where a major zone of fissuring occurs at approximately 41 m below ground level, i.e. approximately 20 m below OD and at Ringaskiddy (Carrigaline GWB), where major water inflows occur down to 40m below OD (Wright, 1979). In this GWB a borehole at Togher in Cork City encountered a major fissure at 34-36 m bgl and in a borehole in Ballyphehane, also in the south of the city, water entries were recorded at 14, 57.6, 59.1, 60.7, 63.4, 67.1 m bgl, representing major water bearing fissures. In the past sea level is estimated to have been approximately 50-60 m below present day OD, the level to which the now infilled channel of the River Lee was eroded (Farrington, 1959) enabling karstification at depth. Today the limestones in this region are an example of a drowned karst terrain. In the Dinantian Mudstones and Sandstones (Cork Group) that occur at the margins of this GWB, most groundwater flow occurs in an upper weathered layer of a few metres and a zone of interconnected fissures often not extending more than 15 m from the top of the rock, although occasional deep inflows associated with major faults can be encountered. Impure limestones are also much less susceptible to karstification.
Overlying Strata	**Lithologies**	This GWB is overlain by alluvium, sand and gravel deposits and some glacial till. There are large areas of alluvium in the west of the body, north of Crookstown and west of Kilcrea Abbey. The limited drilling records for the area indicate that the alluvium overlies fluvioglacial gravel. Teagasc mapping identifies a large sand/gravel deposit west of Ovens, and a smaller sand/gravel deposit south of Castlemore. Further east, along the River Lee flood plain on the northern side of the body, sand and gravel deposits are covered by layers of till and alluvium. Areas of rock outcrop and shallow rock are common in the east of the body south of the River Lee flood plain. The urban area of Cork City and its suburbs, and associated paved areas, occupy a large area in the east of the body. Alluvium is generally considered to be of 'moderate' permeability while sand and gravel deposits are 'high' permeability. Glacial tills in this area are also considered to be of 'moderate' permeability. *Subsoil Types identified in Ballincollig GWB by Teagasc Parent Material Mapping (Draft) Alluvium (A); Sandstone sands and gravels (Devonian & Carboniferous) (GDSs) & (GDCSs); Made Ground (Made); Estuarine sediments (silts/clays) (Mesc); Rock outcrop and rock close to surface (Rck); Till – Devonian Sandstone Till (TDSs).*
	Thickness	Subsoil depth varies considerably within this GWB. In the eastern half of the body, the River Lee flows along the northern side of the body. Available data indicate that depth to bedrock in the river flood plain generally ranges 10-30 m. Depths of 50 m have been recorded in site investigations in Cork City. To the south of the River Lee flood plain, frequent areas of rock and shallow rock occur. Away from rock outcrop subsoil depths of up to 10 m are generally encountered although isolated areas of deeper subsoil also occur. The underlying pure unbedded limestone in this valley is highly karstified and likely to have a very irregular bedrock surface, hence subsoil depths can be highly variable within short distances. In the west of the body, areas of rock outcrop and shallow rock are less frequent, but depth to bedrock data are sparse. Around Castlemore there is a small area where subsoil is generally <3 m and some isolated areas of outcrop occur towards the southern margin of the body. Elsewhere in the west of the body subsoils are expected to be >3 m and it is likely that fluvioglacial deposits of >10 m occur in many areas. At Crookstown WS borehole, bedrock is >28 m bgl.
	% area aquifer near surface	
	Vulnerability	Most of the area is of High Vulnerability. Frequent areas of Extreme Vulnerability occur in the east of the body where rock outcrop and shallow rock are common. Some small areas of Moderate Vulnerability occur in the west of the body. 'High' permeability subsoils (sand and gravel deposits) >3 m deep are classed as High Vulnerability irrespective of thickness (DELG/EPA/GSI, 1999).
Recharge	**Main recharge mechanisms**	The sandstone ridges to the north and south of this GWB (Ballinhassig GWB) provide abundant runoff which recharges the limestone aquifer in the valley. A small volume of groundwater may cross as through-flow from the sandstones into this GWB. In the GWB itself both point and diffuse recharge will occur. Swallowholes and caves allow point recharge to the karstified aquifer. Diffuse recharge will occur over the entire GWB. The sand and gravel deposits provide a highly permeable pathway for recharge, and can also augment storage in the aquifer. The 'moderate' permeability alluvium that overlays much of the west of the body will generally not restrict percolation of recharge. The large urban area of Cork City and associated extensive paved areas may restrict recharge to the underlying aquifer in that area.
	Est. recharge rates	

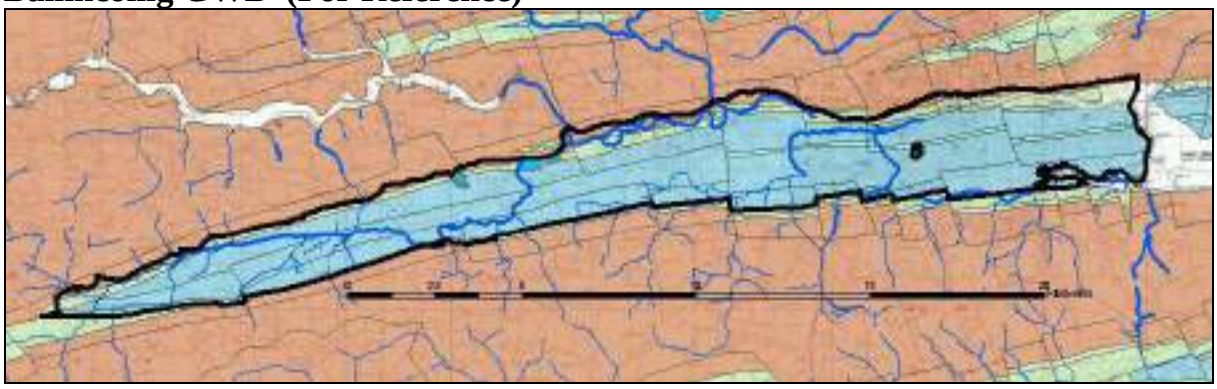
Discharge	**Large springs and high yielding wells (m^3/d)**	*Note The following data need to be checked and updated by RBD Project Consultants.* Data from GSI Well Database: Togher-Southern Fruit (576 m3/d) Cork Milk Products-Ballyphehane (1528 m3/d) Additional data from EPA Groundwater Sources List: Ballyphehane-Co-op (1528 m3/d) Lunham Bros, Tramore Rd (455 m3/d) Cork City, Beamish and Crawford (573 m3/d)
	Main discharge mechanisms	Groundwater discharges to the rivers and streams crossing the GWB or through sands and gravels that are in hydraulic continuity with the rivers.
	Hydrochemical Signature	There are currently no EPA Representative Monitoring Points in the bedrock aquifer in this GWB. Data from other GWBs with similar limestone bedrock indicate that the groundwater will be dominated by calcium and bicarbonate ions. Hardness is likely to range from moderately hard to very hard (200 mg/l to >400 mg/l (as $CaCO_3$)). Groundwater alkalinity will be high, up to 400 mg/l (as $CaCO_3$). Like hardness and alkalinity, electrical conductivities (EC) can vary greatly. Typical limestone water conductivities are 500-700 µS/cm. Chloride levels in groundwater in this body can be elevated near the coast. The pure limestone bedrock is highly karstified. Where overlying strata are thin or absent, as in the southeastern quarter of the body, microbial pollution can travel very quickly from the surface into the groundwater system due to the high level of interaction between groundwater and surface water in karstic aquifers. The bedrock aquifer in this body is overlain by extensive sand and gravel deposits. Data from Crookstown WS, which abstracts from gravel deposits in the west of the body, show hardness ranging 96-108 mg/l (as $CaCO_3$), alkalinity 57-88 mg/l (as $CaCO_3$) and EC 282-306 µS/cm. The hydrochemical signature from a public supply well in the same rock type in the nearby Cloyne GWB is demonstrated in an expanded Durov plot in Figure 1 below.
Groundwater Flow Paths		The pure limestone bedrock has no intergranular permeability. Groundwater flows in the many faults and joints, enlarged by karstification. Past depression of the sea level enabled karstification at depth, which further enhances the permeability. Due to the high frequency of fissures in this region, overall groundwater flow is thought to be diffuse in nature, although solutionally enlarged conduits and cave systems do occur. Groundwater flow occurs in an upper shallow highly karstified weathered zone in which groundwater moves quickly in rapid response to recharge. Below this is a deeper zone where there are two components to groundwater flow: interconnected, solutionally enlarged conduits and cave systems that are controlled by structural deformation, and a more dispersed slow groundwater flow component in smaller fractures and joints outside the larger conduits. The water table is generally within 10 m of the surface, and groundwater is generally unconfined. The highly permeable aquifer supports a regional scale flow system. Groundwater flow paths can be up to several kilometres long, but may be significantly shorter where the water table is very close to the surface. Regional groundwater flow is away from the ridges to the north and south, towards the rivers draining the valley and to Lough Mahon in the east. The limestones in this body are frequently overlain by sand and gravel deposits which are in hydraulic continuity with the underlying bedrock and provide a permeable pathway for recharge to the karstic aquifer, and where saturated provide additional storage for the underlying bedrock aquifer.
Groundwater & Surface water interactions		The karstic system allows rapid interchanges of water between surface and underground. Swallowholes and caves receive surface water, and groundwater is discharged to surface as springs or as baseflow to rivers crossing the groundwater body. In this GWB, in addition to the general surface water interactions with the karstic aquifer, Cork Lough (001081) and the Douglas River Estuary (001046) are NHAs within this GWB which may be influenced by groundwater.

Conceptual model	• This GWB occupies the floor of an elongate east west trending valley extending west from Cork city. The body is generally flat to gently undulating (5-60 m OD), generally < 30 m OD in the east, 40-60 m OD west of Ovens. The River Lee joins the valley just west of Ballincollig and flows eastwards along the northern edge of the body, and its tributary the River Bride flows eastwards across the western half of the body. • The GWB is bounded to the east by the coast and Lough Mahon. To the south the boundary is the contact with the low permeability sandstones and mudstones of the Ballinhassig GWB. Along the northern side of the body, the contact between the pure unbedded limestones and the underlying mudstones and sandstones (as shown on the 1:100,000 GSI Bedrock map) occurs 400-800 m into the valley floor, beneath alluvium and deep sand and gravel deposits. The northern boundary of the body extends to the edge of the valley floor, thus some areas of low permeability mudstones and sandstones along the northern margin of the body are also included within the body. • The GWB is composed mainly of diffusely karstified, highly permeable pure limestones. To the north and south of the body are ridges of low permeability sandstones and mudstones. Overlying the bedrock in the GWB are glacial sand and gravel deposits. These vary in depth across the Lee and Bride Valley areas from several metres to approximately 40 m thick. The sand and gravel deposits provide a permeable pathway for recharge to the karstic aquifer and where saturated provide additional storage for the underlying bedrock aquifer. Along the northern boundary of the body these deposits overly the mapped contact between the pure unbedded limestones and the underlying mudstones and sandstones. The mudstones and sandstones that occur along the northern margin of the body are less productive than the overlying karstified limestones. • The pure unbedded limestones in the synclinal valleys of South Munster are generally intensely fractured and have high frequency jointing and their permeability has been enhanced by subsequent karstification. Karst features such as caves, swallowholes and other collapse features occur in this GWB. • Groundwater flows through faults and joints formed by deformation and subsequently enlarged by karstification. Most groundwater flow occurs in an upper shallow highly karstified weathered zone a few metres thick in which groundwater moves quickly in rapid response to recharge. Below this is a deeper zone where there are two components to groundwater flow. Groundwater flows through interconnected, solutionally enlarged conduits and cave systems that are controlled by structural deformation (influence of N-S jointing). In addition there is a more dispersed slow groundwater flow component in smaller fractures and joints outside the larger conduits. Generally this connected fractured zone extends to about 30 mbgl in pure limestones, however in the pure bedded limestones of the South Munster region, deep inflows from major zones of fissuring have been encountered to 40-50 mbgl. • Groundwater in this body is unconfined. The water table is generally less than 10 metres below the surface. Groundwater gradients will be flat in the permeable limestones (0.001-0.002). The highly permeable aquifer can support regional scale flow systems. Groundwater flow paths can be up to several kilometres long, but may be significantly shorter in areas where the water table is very close to the surface. Overall groundwater flow away from the ridges to the north and south, towards the rivers draining the valley and ultimately to Lough Mahon in the east. • Recharge to this GWB is both point and diffuse. The ridges to the north and south of this GWB (Ballinhassig GWB) provide runoff which recharges the limestone aquifer in the valley. Diffuse recharge will occur over the entire GWB. Swallowholes, collapse features provide the means for point recharge to the karstified aquifer. A relatively small volume of groundwater may cross as through-flow into this GWB from the adjacent low transmissivity GWBs. • Most of the GWB is of High Vulnerability. Many areas of Extreme Vulnerability occur in the east of the body where rock outcrop and shallow rock are common. In this highly karstified aquifer the underlying limestone will have a very irregular surface. Subsoil depths in this GWB can therefore be highly variable within short distances. • There is a high degree of interaction between surface water and groundwater in GWB underlain by karstified limestone.
Attachments	Hydrochemical Signature (Figure 1)
Instrumentation	**Stream gauges:** 19012, 19016*, 19049, 19050 **EPA Water Level Monitoring boreholes:** **EPA Representative Monitoring points:** Crookstown WS (COS 24) – in Gravels
Information Sources	Cronin C, Daly D, Meehan R, Johnston P (1997) *Dungarvan Public Supply Groundwater Source Protection Zones.* Geological Survey of Ireland. DELG/EPA/GSI (1999) *Groundwater Protection Schemes*. Department of the Environment and Local Government, Environmental Protection Agency & Geological Survey of Ireland. Farrington A (1959) The Lee Basin Part one: glaciation. Proc. R. Ir. Acad. 60B (3), 135-166. Kelly D, Wright G (2002) *Crookstown Water Supply -Groundwater Source Protection Zones.* Geological Survey of Ireland, 13pp. Sleeman A G, Pracht M (1994) *Geology of South Cork. A geological description of South Cork to accompany the Bedrock Geology 1 100,000 Map Series, Sheet 25*. Geological Survey of Ireland, 59pp Kelly D, Leader U, Wright G (2002) *South Cork Groundwater Protection Scheme*. Report to Cork County Council (South). Geological Survey of Ireland. Wright G, Gately C (2002) *Whitegate Regional WaterSupply Scheme (Dower Spring)*. Groundwater Source Protection Zones. Report to Cork County Council (South). Geological Survey of Ireland, 19pp. Wright G (1979) Groundwater in the South Munster Synclines. In: Hydrogeology in Ireland, Proceedings of a Hydrogeological Meeting and associated Field Trips held in the Republic of Ireland from 22 to 27 May, 1979. Published by the Irish National Committee of the International Hydrological Programme.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

Figure 1: Hydrochemical signature
(EPA Representative Monitoring)



Ballincollig GWB (For Reference)



List of Rock units in Ballincollig GWB

Rock unit name and code	Description	Rock unit group
Little Island Formation (LI)	Massive and crinoidal fine limestone	Dinantian Pure Unbedded Limestones
Cork Red Marble Formation (CK)	Red brecciated calcilutite limestone	Dinantian Pure Bedded Limestones
Waulsortian Limestones (WA)	Massive unbedded lime-mudstone	Dinantian Pure Unbedded Limestones
Ballysteen Formation (BA)	Fossiliferous dark-grey muddy limestone	Dinantian Lower Impure Limestones
Old Head Sandstone Formation (OH)	Flaser-bedded sandstone & minor mudstone	Dinantian Mudstones and Sandstones (Cork Group)
Cuskinny Member (Kncu)	Flaser-bedded sandstone & mudstone	Dinantian Mudstones and Sandstones (Cork Group)
Gyleen Formation (GY)	Sandstone with mudstone & siltstone	Devonian Old Red Sandstones

APPENDIX F

IRISH WATER RISK ASSESSMENT CORRESPONDENCE

From: [redacted]
Sent: Wednesday 19 February 2020 12:34
To: [redacted] (ESB Networks)
Cc: HQDWcompliance ; [redacted] ; [redacted]
Subject: RE: ESB enquiry regarding risk to water supply from cable fluid leaks

Dear [redacted]

Further to your query (within the attached email), we have examined the locations within your interactive map and cross referenced against the results from our regulatory monitoring programme for **Total Polyaromatic Hydrocarbons** (Total PAHs) and **Benzene**, from 2014 to date. Without knowing the exact chemical composition of the oil used to fill ESB cables, these are the closest parameters we can find from our monitoring programme that would be representative of potential oil contamination.

For the relevant supplies within the Greater Dublin Area, we have recorded zero exceedances of the parametric value (i.e. legally allowable limit) for Total PAHs (which is 0.1µg/L) and Benzene (which is 1µg/L) within this period. The same is true for the Cork City area.

A summary of these results are collated in the following table

Location Assessed	**Number of Samples tested for PAH**	**Number of exceedances for PAH**	**Number of Detections* for PAH**	**Number of Samples tested for Benzene**	**Number of exceedances for Benzene**	**Number of Detections* for Benzene**
Greater Dublin Area	981	0	15 (Range detected 0.01-0.04µg/L)	980	0	2 (Range detected 0.1-0.4µg/L)
Cork City	61	0	1 (Result: 0.02µg/L)	61	0	0

* **Detections** – where the result was above the limit of detection for the test in question, i.e. the test returned an actual concentration of the analyte

These results (which are from samples taken at the customer tap) would not indicate that leaks from oil filled cables have contaminated the drinking water supply for these areas, or at least to an extent where any contamination arising has resulted in a breach of the parametric value for PAHs and Benzene.

Notwithstanding what these results indicate, oil contamination in drinking water is a **serious public health matter**, and every effort should be made to ensure the likelihood of oil leaks from ESB cables coming into contact with water pipes is minimised to the **lowest possible extent**. Whilst our water mains are pressurised, should pressure levels drop for any reason (nearby burst for example),

contaminated groundwater could potentially infiltrate into our mains. Benzene in particular could also pose a risk to our PVC and Polyethylene pipes.

I trust this analysis and commentary is sufficient for your risk assessment.

Regards,

[redacted]
Drinking Water Compliance Lead
Environmental Regulation

Uisce Éireann
Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1
Irish Water
Colvill House, 24-26 Talbot Street, Dublin 1, Ireland

[redacted]