

Anne Maire Casey  
Electricity Supply Board  
One Dublin Airport Central  
Cloughran  
Co. Dublin

12 May 2021

**Your Reference**  
FFC-2021-A

**Our Reference**  
PR-427640\_ACM\_LT\_EN\_074\_2

## Re. Initial Preliminary Site Assessment, Cable Leak Ringsend - Poolbeg TF4

Dear Anne Marie,

AECOM Ireland Limited (AECOM) is pleased to present to Electricity Supply Board (ESB) this initial preliminary site environmental assessment of a cable fluid leak at Ringsend – Poolbeg TF4 circuit (the site).

### 1. Background

ESB Networks (ESBN) notified ESB of a cable fluid leak from an ESBN underground cable at the Ringsend - Poolbeg circuit on 24 January 2021. It is understood that the leak volume was 160 litres of cable fluid. The cable fluid composition is understood to be Linear Alky Benzene (CAS 67774-74-7). The actual leak location on the circuit is not known. The Ringsend – Poolbeg TF4 circuit (Figure 1) is a 110 kV cable, 1.4 km in length and was installed in 1983.



**Figure 1 – Site Location**

## 2. Objective

The objective of this work was to complete a site inspection and develop an initial preliminary environmental site assessment (PSA), i.e. identify potential risks to receptors from the cable fluid leak.

Once further information is provided on the leak, an updated PSA can be developed.

## 3. Scope of work

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

- A desktop review of publicly available information regarding the site's environmental setting and sensitivity, including:
  - Geological Survey of Ireland (GSI) Groundwater Public Viewer Maps (<https://dcentr.maps.arcgis.com/apps/MapSeries>), accessed 28 April 2021;
  - EPA Geoportal Site (<https://gis.epa.ie/EPAMaps>), accessed 28 April 2021;
  - EPA Incidents Database (<https://www.epa.ie/newsandevents/incidents/recent/>), accessed 28 April 2021;
  - Ordnance Survey of Ireland (OSI) (<http://geohive.ie>), accessed 28 April 2021;
  - Office of Public Works (OPW) Flood Maps (<http://www.floodinfo.ie>), accessed 28 April 2021;
  - National Parks and Wildlife Service (NPWS) (<http://webgis.npws.ie/npwsviewer/>), accessed 28 April 2021;
  - National Waste Collection Permit Office (NWCPO) (<http://www.nwcpo.ie/>) accessed 28 April 2021;
- A site walkover by AECOM staff (completed on 28 January 2021);
- A review of information provided by ESB; and
- Initial preliminary conceptual site model.

## 4. Environmental Setting

### 4.1 Topography

The site is located on the Poolbeg peninsula, approximately 4.5 km east of Dublin city centre. The Poolbeg peninsula was constructed on reclaimed lands consisting of sand dredged from Dublin Bay. The topography of the site and the surrounding area is generally flat c. 3 m to 6 m above Ordnance Datum (OD) (above Mean Sea Level at Malin Head, Co. Donegal).

### 4.2 Geology

According to the GSI spatial resources viewer, sub soils beneath site have not been mapped, however, made ground ("Urban" quaternary sediments) is indicated to the north of the site on Poolbeg peninsula and is likely to be present beneath the site, given the history of reclamation in this area. The GSI spatial resources viewer shows the bedrock beneath the site comprises dark limestone and shale of the Lucan Formation.

### 4.3 Hydrology

No surface waters are present within the Poolbeg site.

The site and surrounding area lie within the Liffey and Dublin Bay catchment. Dublin Bay is located south and east of the site and the Lower Liffey Estuary is north of the site. The 2013 – 2018 status of the Lower Liffey Estuary is classified as *Good* and *At Risk* in accordance with the Water Framework Directive, while Dublin Bay is classified as having *Good* status and *Not at Risk*.

The site is not within a low, medium or high probability (annual exceedance probability (AEP) of 0.1%, 0.5% or 10%) coastal or fluvial flood extent. No historical flood events have been recorded on the site or the immediate surrounding area according to the OPW flood maps. The closest recorded historical flood event was at Bath Avenue, Sandymount, Dublin 4 on 24 October 2011, c. 3 km southwest of the site.

#### 4.4 Hydrogeology

The GSI spatial resources viewer shows that the Lucan Formation is classified as *LI – locally important aquifer, which is moderately productive in local zones*. However, the bedrock beneath the site is not mapped as an aquifer, possibly given the coastal setting it is expected that groundwater in the bedrock would be brackish. The reclaimed sediments are also not classified as a gravel aquifer and groundwater in the reclaimed sediments is also expected to be brackish.

Groundwater vulnerability at the site has not been classified as the reclaimed sediments and bedrock are not classified as aquifers. Groundwater vulnerability 0.18 km north of the site is classified as *Low*.

The site is mapped as being within the Dublin Groundwater Body (IE\_EA\_G\_008) whose status under the Water Framework Directive (WFD, 2013 to 2018) is classified as *Good* and *Not at Risk*.

There are no *Groundwater Protection Areas* within a 2 km radius of the site for either public water supplies or group water schemes. A search of the GSI well database identified no groundwater wells within the immediate vicinity of the site itself. There are four wells within a 2 km radius of the site:

- Well 2923SEW036 is located c. 1.6 km northwest of the site, on the northern side of Dublin Port by the Tolka Estuary. This well was drilled to a depth of 6.2 m bgl in 1995; the use is unknown;
- Well 2923SEW014 is located c. 1.8 km west of the site, on Barrow Street. This well was drilled to a depth of 9.8 m bgl in 1938; the use is industrial;
- Well 2923SEW037 and 2923SEW038 are located c. 1.4 km southwest of the site, in Lansdowne. The wells were drilled to a depth of 7.6 m and 7.5 m bgl in 1989; their use is unknown.

It should be noted that there is no requirement to register abstraction wells with the GSI and there may be unregistered wells in the vicinity of the site. Since November 2018, it is required to register wells with abstraction rates above 25 m<sup>3</sup>/d with the EPA; the register of wells with abstractions above 25 m<sup>3</sup>/d has yet to be published.

Groundwater flow across the site is expected to be tidally driven given that it is surrounded – on three side by Dublin Bay and the Liffey Estuary.

#### 4.5 Natural Habitats and Protected Species

A review of designated sites, considered nationally and internationally protected, found that the lands on which the site is located have no formal designations. The closest designated sites are the South Dublin Bay Special Protected Area (SPA), River Tolka Estuary SPA, South Dublin Bay Proposed Natural Heritage Area (pNHA) and South Dublin Bay Special Area of Conservation (SAC), located immediately south and east the site.

#### 4.6 Regulatory Database Search

#### 4.7 National Waste Collection Permit Office

The National Waste Collection Permit Office (NWCPO) website was reviewed to identify authorised waste facilities within the jurisdiction of Dublin City Council that are also near the site. The NWCPO website indicated that there is one waste facility within a 2 km radius of the site as summarised in Table below.

**Table 1. Dublin City Council Permitted Waste Facilities within 2 km of the Site**

Authorisation Number	Facility Name	Location	Waste Activity
WFP-DC-10-0020-02	Everyday Waste and Skip Hire	84e Pigeon House Road, Ringsend, Dublin 4	Paper, cardboard, plastic, wooden, metallic and mixed packaging, end-of-life tyres, alkaline batteries (except 16 06 03), other batteries and accumulators, concrete, bricks

#### 4.8 EPA Licensing

The EPA database of waste licences was consulted which identified no waste facilities within a 2 km radius of the site.

#### 4.9 EPA IE and IPC licensing

The EPA database of Industrial Emissions (IE) and Integrated Pollution Control (IPC) licences was consulted which identified seven IE and two IPC licences within a 2 km of the site. The table below provides further details.

**Table 2. EPA IE and IPC Facilities within 2 km of the Site**

IE Register Number	Facility Name	Location	Distance to Site	Activity
P0577-03, IE, Licensed	Electricity Supply Board (Poolbeg)	Pigeon House Road, Ringsend, Dublin	Onsite	Energy
P0579-03, IE, Licensed	Electricity Supply Board (North Wall)	North Wall, Dublin	1.5 km northwest	Energy
W0036-02, IE, Licensed	Indaver Ireland Limited	Tolka Quay Road, Dublin	1.5 km north-west	Waste
P1022-02, IE, Licensed	Dublin Port Company	Port Centre, Alexandra Road, Dublin	1 km northeast	Waste
P1002, IE, Licensed	The Hammond Lane Metal Company Limited	Pigeon House Road, Dublin	0.4 km north	Waste
P0486-02, IE, Licensed	Synergen Power Limited	Dublin Bay Power Plant, Pigeon House Road, Ringsend, Dublin	0.15 km north	Energy
W0232-01, IE, Licensed	Dublin Waste to Energy Limited	Pigeon House Road, Poolbeg Peninsula, Dublin	0.15 km north	Waste
P0086-01, IE, Licensed	Irish Tar and Bitumen Suppliers	Alexandra Road, Dublin 1	1.2 km north	Chemicals
P0164-01, IE, Surrendered	Becbay Limited	South Bank Road, Ringsend, Dublin	0.5 km west	Mineral Fibres and Glass

#### 4.10 Environmental Sensitivity

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

- South Dublin Bay SPA;
- River Tolka Estuary SPA;
- South Dublin Bay pNHA; and
- South Dublin Bay SAC.

#### 4.11 Site Description & Walkover

The site is located on the Poolbeg peninsula and consists of 1.4 km 110 kv cable (Ringsend – Poolbeg TF4 circuit). As the leak location is unknown, the site visit consisted of walkover of accessible areas along the cable route.

No evidence of impact from the cable fluid release was noted during the site walkover.

#### 4.12 Surrounding Land Use

Land use in the immediate vicinity of the site is industrial, as summarised in Table 3.

**Table 3. Adjacent Land Use**

Direction	Description
North	The norther boundary of the site includes Ringsend Waste Water Treatment Works, Covanta Waste to Energy facility, Dublin Bay Power Plant and numerous industrial sites (including Hammond Lane metal recycling, Kilsaran Concrete, the ED&F Man cane molasses depot, and several shipping container yards). The northern border of the Poolbeg site is bound by the Lower Liffey Estuary, with ferry terminals associated with Dublin Port located across the estuary at a distance of 0.6 km north from the site.
East	The site is bound by ESB Poolbeg Generating Station to the east. Beyond this, is the National Oil Reserve Agency (NORA) fuel storage facility, Shelley Banks Beach and South Wall extending into Dublin Bay.
South	The south of the site includes shipping container yards, parking, disused land and South Dublin Bay. The southeast of the site is bound by a natural reserve. The closest residential receptors are located approximately 0.6 km south (Beach Road) of the site.
West	The west of the site is bound by shipping container yards, a closed landfill and the site of a historical glass bottle factory, which has now been demolished. The closest residential receptors are located approximately 0.6 km west (Pine Road) of the site.

## 5. Preliminary Conceptual Site Model

An initial preliminary Conceptual Site Model (CSM) has been developed to identify potential contaminant sources, contaminant migration pathways and potential receptors associated with the cable fluid leak. Once further information is provided on the leak, an updated CSM will be developed.

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

- A **source** – a substance that is in, on or under the land and has the potential to cause harm or pollution to environmental receptors including human health, groundwater and/or surface water;
- A **receptor** – in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body; and
- A **pathway** – a route or means by which a receptor can be exposed to, or affected by, a contaminant.

Each of these elements can exist independently, but they create a risk only where they are linked together, so that a particular contaminant affects a particular receptor through a particular pathway. This kind of linked combination of contaminant–pathway–receptor is described as a pollutant linkage. The preliminary CSM was developed to describe viable source–pathway–receptor (SPR) linkages for the site, which are presented in Table 6 below.

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

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

### 5.1 Potential Source

ESB Networks has confirmed that the cable fluid type was LAB. Details on the physical, chemical and toxicity properties of this fluid in provided Appendix B. To summarise, underground leakage of LABs is not likely to lead to significant issues from dissolved hydrocarbons or vapours. The main concern from LABs is the potential for them to migrate and spread as a light non aqueous liquid (LNAPL), downwards through unsaturated soil and then laterally in the vicinity of the groundwater table. The extent of LNAPL migration will depend on the properties of the surrounding soil and on the saturation and pressure distribution within the LNAPL. These in turn would depend on the quantity of cable fluid lost and the timescale over which the leakage occurred.

### 5.2 Receptors

#### 5.2.1 Human Health

The site and surrounding area are in industrial/commercial use. There are no residential areas immediately adjacent to the site; the closest being residential receptors are located 0.6 km to the west and south of the site. The most sensitive on-site human health receptor is, therefore, considered to be industrial/commercial site users.

It should be noted that this assessment does not address potential risks during construction works to construction workers. It is expected that such construction stage risks will be suitably mitigated with the implementation of robust environmental control measures (i.e. dust suppression, noise management, etc.) and the use of appropriate personal protective equipment by construction workers. Further comment on the risks to construction personnel during the construction phase is beyond the scope of this report.

#### 5.2.2 Waters

Table 4 identifies potential waters receptors given the environmental setting of the site.

**Table 4. Waters Receptors**

Waters Receptor	Present	Potable Supply	Description / Comment
Groundwater abstraction within 500 m of the site.	No	No	No known groundwater abstraction in vicinity of site, unlikely to be any developed given the site's coastal setting and brackish / saline groundwater.
Surface water body within 500 m of the site in direct hydraulic connection with groundwater from the site.	Yes	No	The site is surrounded on three sides by surface water. The River Liffey Estuary to the north, which is brackish; Dublin Bay to the south and east, which is saline. Although it is noted that Dublin Bay is classified as a SPA, SAC and pNHA.
Groundwater in bedrock beneath the site.	Yes	No	Bedrock is likely present at depths and is likely to be brackish / saline given the coastal setting.
Groundwater in superficial deposits beneath the site.	Yes	No	No known groundwater abstraction in vicinity of site, unlikely to be any developed given the site's coastal setting and brackish / saline groundwater.

Dublin Bay and the River Liffey Estuary are considered to be the most sensitive water receptors in the vicinity of the site. Given the industrial site setting and saline nature of groundwater, it is considered unlikely to be suitable for drinking water or for groundwater fed terrestrial ecosystems.

### 5.3 Potential Pathways

The potential exposure pathways are outlined in Table 5.

**Table 5. Potential Pathways**

Receptors	Pathway
Human health receptors in an industrial scenario	1. Soil and dust ingestion from near surface soils.
	2. Dermal contact with near surface soils.
	3. Inhalation of fugitive dust from near surface soils.
	4. Inhalation of vapours.
Waters receptors	5. Leaching of contaminants from soil into perched groundwater followed by vertical migration.
	6. Lateral migration of impacted groundwater.
	7. Horizontal groundwater migration to nearby surface waters.

### 5.4 Source-Pathway-Receptor Linkages

The preliminary CSM detailing the source-pathway-receptor linkages is presented in Table 6.

**Table 6. Preliminary Conceptual Site Model**

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
LAB	Inhalation of vapours which have migrated from the ground to above ground buildings.	Site users in an industrial/commercial scenario.	Mild	Low Likelihood	Low	The volume of the leak and low vapour pressure of LABs limits the potential for exposure via inhalation, and this is not expected to be a significant exposure route at normal temperatures. Due to the distance from the site (0.6 km), residential receptors are not considered at risk in this scenario.
	Soil and dust ingestion from near surface soils. Dermal contact with near surface soils. Inhalation of fugitive dust from near surface soils.	Site users in an industrial/commercial scenario.	Minor	Unlikely	Very Low	Typically, fluid filled cables are installed in trenches approximately 1.2 m deep. Given the likely depth to the cable, surface soils are unlikely to be affected and exposure via these pathways is not considered likely.
	Migration of ground gas generated from the degradation of the cable fluid to above ground buildings.	Site users in an industrial/commercial scenario.	Severe	Unlikely	Low	If a significant source of LAB NAPL is present on groundwater, there is potential for ground gas to be generated from degradation processes, so included within the CSM. <b>Owing to the potential impact to human health, the hazard automatically is assigned a “Severe” i.e. short-term acute risk</b> (as opposed to chronic, which would be a Medium category). However, given the volume of the leak and the likely linear dispersion of cable fluid along the cable route (as opposed to a traditional tank leak causing a concentrated plume), the likelihood of ground gas being generated in significant quantities at the site to cause harm is considered <b>Unlikely</b> (i.e. the circumstances under which harm would occur are improbable). Taking into consideration these two components (Unlikely and Severe), the CIRA guidance defaults to a <b>Low/Medium risk</b> . The guidance does, however, acknowledge that the level of technical uncertainty for Phase 1 assessments is inherently high and this brings conservatism to the assessment. Therefore, given the volume of the leak and the circumstances under which harm would occur are improbable, the potential risk is considered in the low range of the risk level, and further assessment is not considered warranted.
	Permeation of LAB NAPL through plastic water supply pipes.	Site users in an industrial/commercial scenario.	Medium	Unlikely	Low	Public water mains are likely to be present in the vicinity of the leak, servicing commercial properties have the potential to be impacted. However, the WHO drinking water guideline (DWG) for the relevant aromatic fraction <sup>1</sup> is 0.09 mg/l and as the solubility limit of LAB is 0.041 mg/L (OECD) i.e. less than the DWG, LAB cannot dissolve into the water supply above this level. Furthermore, water will be moving rapidly in the pipe making it unlikely to reach the solubility limit.
	Migration of potential contaminants along preferential flow pathways such as underground services and permeable backfill around the electricity cable and via groundwater.	Nearby surface water bodies including the Dublin Bay and the River Liffey Estuary.	Medium	Low to Unlikely	Low/ Moderate Low	The Ringsend – Poolbeg TF4 circuit is 1.4 km in length, and the distance from surface water receptors is generally 250 m, with the exception of the eastern portion which is located adjacent to Dublin Bay. However, it is unlikely that the leak the immediate area of the bay given no evidence of impact was observed along the shoreline was noted that during the site walkover. The potential hazard severity is consider medium given the protected status of the surface water receptor; however, the probability of risk is unlikely given the average distance to the Bay, the volume of the leak (160L) and the rapid degradation of LAB in waters (Appendix B), i.e. pollutant linkage may be present, but the circumstances under which harm would occur are improbable.

<sup>1</sup> Petroleum Products in Drinking-water, Background document for development of WHO Guidelines for Drinking-water Quality, 2008

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
	Leaching from soil to groundwater. Vertical and horizontal migration of contaminants through groundwater.	Groundwater in superficial deposits beneath the site.	Mild	Low Likelihood	Low	No known groundwater abstraction in vicinity of site, unlikely to be any developed given the site's coastal setting and brackish / saline groundwater. The solubility of LAB is low; therefore it is considered that the potential for dissolved phase impact from the presence of NAPL is considered to be low.
		Groundwater in limestone bedrock aquifer beneath the site.	Mild	Low Likelihood	Low	Bedrock beneath the site is not mapped as an aquifer, given the coastal setting it is expected that groundwater in the bedrock would be brackish. Based on this, and given the volume of the release, the potential impact is considered low.

## 6. Conclusion

AECOM completed an initial Preliminary Site Assessment of the site (the Ringsend – Poolbeg TF4 circuit) located on Poolbeg peninsula. The objective of the PSA was to identify potential human health and environmental risks that may be associated with a fluid leak from an unknown location at the site.

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

- South Dublin Bay SPA, River Tolka Estuary SPA, South Dublin Bay pNHA and South Dublin Bay SAC, all located immediately south and east the site.

It is estimated that 160 litres of cable fluid (Linear Alkyl Benzene (T 3788)) was released. Due to its high biodegradability, it is considered that LABs are of less concern for adverse environmental impact than other hydrocarbon fluids.

The preliminary CSM developed for the site looked at potential source-pathway-receptor linkages identified during the assessment works.

The Ringsend – Poolbeg TF4 circuit is 1.4 km in length, and the distance from the surface water receptor ranges from immediately adjacent to the cable approximately to 250 m. Therefore, depending on the location of the leak this risk ranges from **Low** to **Low/Moderate**. This also considers the volume of the leak. It is noted that during the site walkover no evidence of impact was observed along the Dublin bay shoreline.

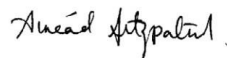
The leak should continue to be monitored and once further information on the leak location is provided, the PSA and preliminary CSM can be updated and recommendations for further investigation can be provided, if required.

Please do not hesitate to contact the undersigned with any queries.

Yours sincerely,



Bernice Cahill  
Associate Director  
AECOM Ireland Limited  
T: +353 87 299 5902  
E: bernice.cahill@AECOM.com



Sinead Fitzpatrick  
Technical Director  
AECOM Ireland Limited  
T: +353 86 4079549  
E: sinead.fitzpatrick@aecom.com

Inc.

Appendix A – Qualitative Risk Assessment Methodology

Appendix B – Physical, Chemical and Toxicity properties of LAB

© 2021 AECOM Ireland Limited. All Rights Reserved.

This document has been prepared by AECOM Ireland Limited (“AECOM”) for sole use of our client (the “Client”) in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client. Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.

## Appendix A - Qualitative Risk Assessment Methodology

A qualitative risk assessment has been carried out by assessing the severity of the potential consequence, taking into account both the potential severity of the hazard and the sensitivity of the target, based on the categories given in Table A.1 below.

**Table A.1 Potential Hazard Severity Definition**

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

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given in Table A.2 below.

**Table A.2 Probability of Risk Definition**

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

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

**Table A.3 Level of Risk for Potential Hazard Definition**

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

A description of the levels of risk outlined in Table A.3 is provided in the following table:

**Table A.4 Description of the Classified Risks and Likely Action Required**

Level of Risk	Description
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in substantial liability. Urgent investigation and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required and remedial works may be necessary in the short term and are likely over the long term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild, if realised.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.

**Level of Risk** **Description**

---

Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.
---------------	---

---

## Appendix B - Physical, Chemical and Toxicity properties of LAB

It is assumed, based on records provided to AECOM by ESB, that the fluid lost was 'T 3788' manufactured by H&R ESP Ltd of Milton Keynes in the UK. T 3788 is a low viscosity blend of linear alkyl benzenes (LABs), CAS # 67774-74-7.

### B.1 Physical and Chemical Properties

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

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

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

Table 5 summarises the basic physical and chemical properties of LABs.

**Table B.1 Linear Alkyl Benzene Physical and Chemical Properties**

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

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

### B.2 Degradation

The OECD SIDS (2002) review concluded that LABs undergo "rapid primary biodegradation in natural waters and complete mineralisation by micro-organisms under aerobic conditions". A measured half-life in water of four to nine days was reported. Microorganisms in sewage sludge and soil were reported to rapidly and completely biodegrade LABs. Anaerobic biodegradation was inferred to occur, but at a slow rate.

Degradation in soil is expected to occur but to be slower than in surface water due to the much slower mixing and the limited availability of oxygen. Where oxygen is available, aerobic degradation would occur at the fringes of a body of LNAPL in the soil/groundwater, producing elevated carbon dioxide levels in the soil and potentially elevated alkalinity in the groundwater.

In the absence of oxygen, anaerobic degradation may occur by methanogenesis or by reduction of sulphate, nitrate, ferric iron (Fe<sup>3+</sup>) and manganese (Mn<sup>3+</sup>). These processes could lead to reducing conditions in the groundwater, with depleted concentrations of sulphate (SO<sub>4</sub><sup>-</sup>) and nitrate (NO<sub>3</sub><sup>-</sup>) and increased concentrations of dissolved methane (CH<sub>4</sub>), ferrous iron (Fe<sup>2+</sup>) and dissolved manganese (Mn<sup>2+</sup>). Such conditions would be expected to occur close to the

LNAPL body and locally downgradient. With increased distance from the LNAPL, mixing with the surrounding groundwater and aeration from seasonal fluctuations and groundwater recharge would gradually allow ambient (most likely oxidised) conditions to be re-established.

### B.3 Toxicity

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

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

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

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