Appendices

APPENDIX 3.1 – COMAH LAND USE PLANNING ASSESSMENT OF DEVELOPMENT OF FORMER CONCORDE SITE AT NAAS ROAD, DUBLIN PREPARED BY AWN

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COMAH LAND USE PLANNING ASSESSMENT OF DEVELOPMENT OF FORMER CONCORDE SITE AT NAAS ROAD, DUBLIN

Technical Report Prepared For

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EXECUTIVE SUMMARY

A land use planning assessment was completed for a proposed mixed-use development at the former Concorde Industrial Estate site on the Naas Road, Dublin 12. The proposed development is located within the Consultation Distances surrounding the BOC Gases Ireland Upper Tier COMAH establishment and the Kayfoam Woolfson Lower Tier COMAH establishment.

The assessment was completed in accordance with the Policy and Approach of the Health and Safety Authority to COMAH Risk-based Land-use Planning (HSA, 2010).

Assessment of BOC Gases Ireland Major Accident Hazards

BOC Gases Ireland is located approximately 600 m from the proposed development. BOC Gases is engaged in the manufacturing of oxygen, nitrogen, argon and hydrogen and the storage of various other gases including toxic gases. The following major accident scenarios were assessed for land use planning purposes:

- Release and dispersion of toxic chlorine gas from 1 tonne tank;
- Reboiler explosion with overpressure consequences;
- Hydrogen Compressor Jet fire with thermal radiation consequences.

The assessment results are summarised as follows:

Scenario	Consequences	Frequency	Comments
Chlorine tank release	576 m to SLOT DTL following drum drop and release duration of 5 mins (Weather Category F2) 175 m to SLOT DTL following drum drop and release duration of 5 mins (Weather Category D5)	1.25E-04 /year	• The proposed development is located approximately 603 m from the location of the chlorine tank at BOC Gases Ireland; • Distance to toxic dose levels corresponding to SLOT DTL and 1% fatality outdoors for weather category F2 and D5 (effect height, 1.5 m) do not extend to the proposed development; • Toxic dose levels corresponding to SLOT DTL and 1% fatality outdoors for weather category D5 (effect height, 1.5 m) do not extend to the proposed development; • Toxic dose levels corresponding to SLOT DTL and 1% fatality indoors for weather categories F2 and D5 (effect height, 1.5 m) do not extend to the proposed development; • Individual risk of fatality contours do not extend to the proposed development.
	588 m to SLOT DTL following drum drop and release duration of 20 mins (Weather Category F2) 170 m to SLOT DTL following drum drop and release duration of 20 mins (Weather Category D5)	4.99E-04 /year	
	583 m to SLOT DTL following valve shear and release duration of 30 mins (Weather Category F2) 146 m to SLOT DTL following valve shear and release duration of 30 mins (Weather Category D5)	2.34E-03 /year	
ASU Reboiler Explosion	80 m to 1% mortality outdoors overpressure level 118 m to 1% mortality indoors in Category 2 structures (typical 4 storey office building) 205 m to 1% mortality indoors in Category 3 structure	1E-04 /year	Personnel outdoors and indoors at the proposed development are protected from an explosion involving the reboiler at the BOC Gases ASU Individual risk of fatality contours do not extend to the proposed development.

	(residential building)		
Hydrogen Jet fire	113 m to threshold of fatality thermal radiation level 104 m to 1% mortality outdoors thermal radiation level 96 m to thermal radiation level below which persons indoors are protected	5E-06 /year	Negligible consequences outdoors at proposed development. Persons indoors are protected at proposed development. Individual risk of fatality contours (as above) do not extend to the proposed development.

Assessment of Kayfoam Woolfson Major Accident Hazards

Kayfoam Woolfson is located approximately 960 m for the proposed development. Kayfoam Woolfson are involved in the manufacture of polyurethane foams for use in soft furnishings including mattresses and pillows. Kayfoam use toluene diisocyanate (TDI) in the manufacture of the polyurethane foams which is classified as an acute toxic category 1 via inhalation. TDI has a low vapour pressure (0.1 mmHg at 25 degC). When mixed with air the density was calculated to be 1.2253 kg/m^3. TNO Effects recommends the use of the neutral gas dispersion model where the density of the material is not more than 10% heavier than air (1.24 kg/m^3) therefore the neutral gas dispersion model in TNO Effects was used.

The following major accident scenarios were assessed for land use planning purposes:

- Major leak from bulk storage tank, pool formation within storage tank bund and evaporation and dispersion of TDI from the surface of the liquid pool;
- Catastrophic tank rupture with bund overtopping pool formation within and adjacent to bund and evaporation and dispersion of TDI from the surface of the liquid pool.

The following was concluded

- In the event of an accidental release of TDI into the largest bund, toxic dose outdoor corresponding to SLOT DTL effects and 1% probability of fatality (at the effect height considered, 1.5 m) are not reached. Fatalities are not expected to arise at the proposed development as a result of this scenario;
- In the event of a catastrophic rupture of the largest TDI tank, toxic dose outdoor corresponding to SLOT DTL effects and 1% probability of fatality (at the effect height considered, 1.5 m) are not reached. Fatalities are not expected to arise at the proposed development as a result of this scenario.

Cumulative Risk

The cumulative individual risk contours for the BOC Gases Ireland and Kayfoam Woolfson sites corresponding to the boundary of the inner, middle and outer land use planning zones are illustrated as follows.

It is noted that the 1 tonne chlorine tank release scenario provides the biggest contribution to the outer LUP zone. As outlined above, toxic dose levels corresponding to SLOT DTL and 1 % probability of fatality outdoor and indoor (weather category F2 and D5) do not extend to the proposed development.

It is concluded that the outer land use planning zone does not extend to the proposed development. Therefore, on the basis of individual risk, the BOC Gases Ireland Ltd and Kayfoam Woolfson Ltd. sites do not pose a constraint to the development of the former Concorde site.

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TABLES

FIGURES

1.0 INTRODUCTION

AWN Consulting Ltd. was requested by John Spain Associates to complete a land use planning assessment for a proposed mixed-use development at the former Concorde Industrial Estate site on the Naas Road, Dublin 12. The proposed development is located within the Consultation Distances surrounding the BOC Gases Ireland Upper Tier COMAH establishment and the Kayfoam Woolfson Lower Tier COMAH establishment.

This report outlines the following:

- Overview of proposed works and COMAH sites;
- Assessment methodology and criteria;
- Identification of major accident scenarios;
- Assessment of major accident hazards;
- Land Use Planning risk contours;
- Conclusions.

2.0 OVERVIEW OF PROPOSED WORKS AND COMAH SITES

2.1 Description of Development

It is proposed to construct an eight-storey mixed-use residential development at the former Concorde Industrial Estate site on the Naas Road, Dublin 12. The development will provide 492 residential accommodation across 7 floors, comprising:

- 104 no. studio apartments
- 136 no. 1 bed apartments
- 21 no. 2 bed (3p) apartments
- 231 no. 2 bed (4p) apartments

Commercial space including retail/crèche/office/enterprise space will be located at ground floor and first floor level of Block A overlooking the Naas Road. The site layout (ground floor) is illustrated in Figure 2-1.

The floor to ceiling height within the commercial spaces will allow a 2.7m clear space as per the residential spaces. Natural ventilation is provided in all habitable areas by means of openable windows. Ducts are provided from selected commercial units envisaged as having fume extract requirements to roof level. Figure 2-2 illustrates the proposed development elevation as seen from the West side (the side facing the Bluebell Industrial Estate).

The proposed development is located with the consultation distance for both BOC Gases Ireland Ltd. and Kayfoam Woolfson as set out is Schedule 8 of S.I. 600 of 2001 (Planning and Development Regulations, 2001). The locations of BOC Gases, Kayfoam and the proposed site are illustrated on Figure 2-3 below.

- Studios: 11
- One Bed Units: 12
- Two Bed (3P) Units: 1
- Two Bed (4P) Units: 17

Figure 2-1 Proposed Development Ground Floor Layout

Figure 2-2 Proposed Development Elevation -West

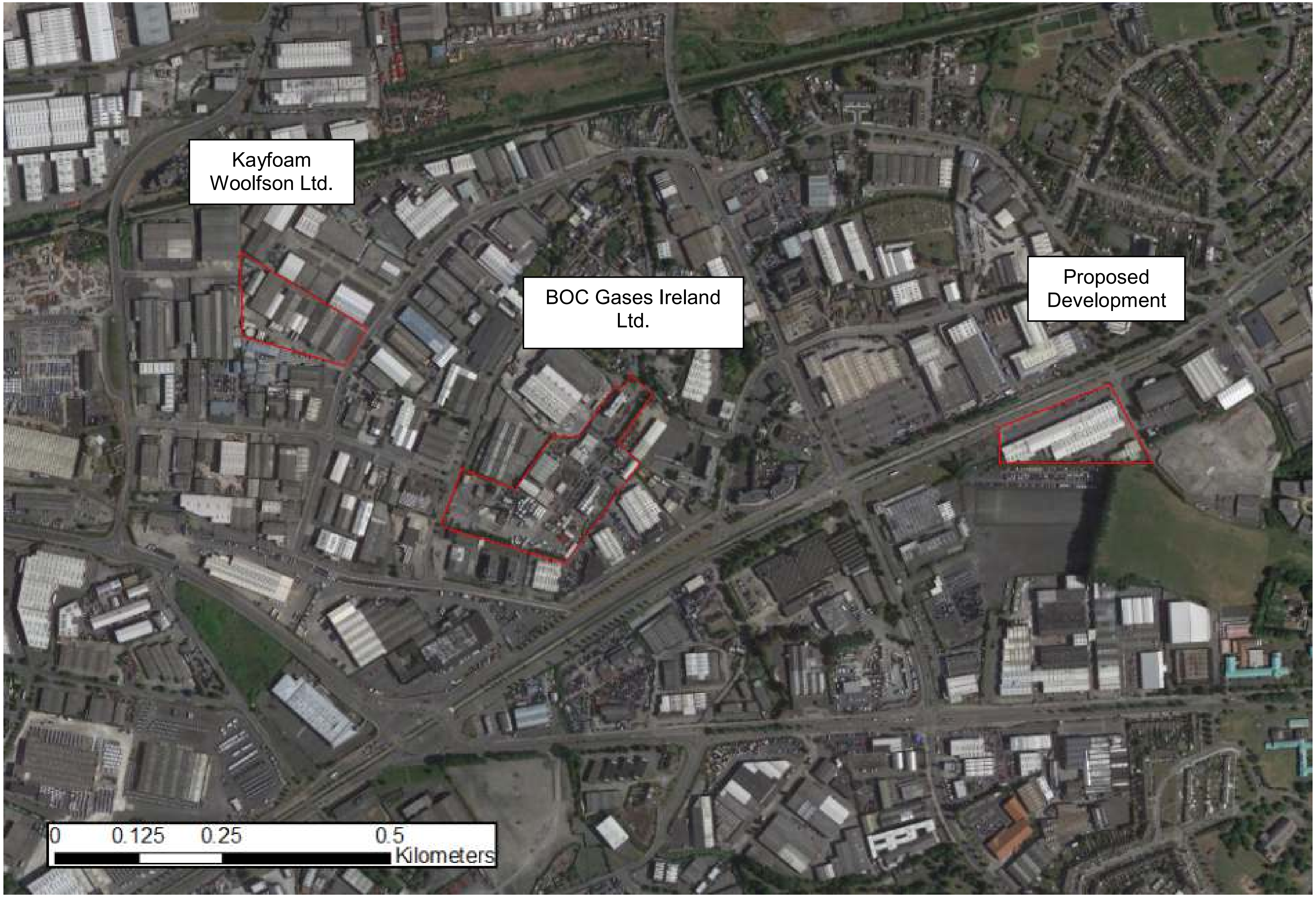


Figure 2-3 Development Location and Neighbouring Seveso Sites

2.2 BOC Gases Ireland Upper Tier COMAH Site

Information on BOC Gases Ireland Ltd. was obtained from the Health and Safety Authority (HSA) via a submission under the Access to Information on the Environment (AIE) Regulations.

BOC Gases Ireland Ltd. is located approximately 600 m from the proposed development in the Bluebell Industrial Estate, Bluebell, Dublin 12. BOC Gases Ireland is engaged in the manufacturing of oxygen, nitrogen, argon and hydrogen and the storage of various other gases including:

- Phosphine
- Acetylene
- Ethylene oxide
- Chlorine
- Hydrogen chloride
- Nitrous gas
- Anhydrous ammonia
- Tungsten hexafluoride
- Silane.

The quantities of dangerous substances on site as notified to the HSA are detailed in Table 2.1 below.

Dangerous substance	Maximum Inventory (tonnes)	Physical Form	Vessel type	Restrictive Flow Orifice (RFO) (mm)	Storage Pressure
Phosphine	0.465	Gas	Cylinder	3	4088.6 kPa
Acetylene	11	Gas	Cylinder	Not available	Not available
Oxygen	379	Liquid	Bulk Storage Vessels	Not available	Not available
Ethylene Oxide	5	Gas	Not available	Not available	Not available
Chlorine	9.1	Gas	B cylinders and Tank	7 (Tank) 3 (cylinder)	580 kPa (Tank)
Hydrogen chloride	25	Liquified Gas	Isotainer and Y cylinders	12.7 (ISO) 3 (cylinder	4200 kPa
Nitrous oxide	42.5	Gas	Isotrailer	12.7	160 barg
Anhydrous Ammonia	33.85	Gas	Isotainer and Y cylinders	12.7 (ISO) 3 (cylinder	7.9 barg (ISO)
Tungsten hexafluoride	2.83	Gas	Cylinder	Not available	Not available
Silane	5.6	Gas	Isotainer	12.7	66 barg

Table 2-1 BOC Gases Ireland Notified Substances

Liquified oxygen is produced on site at the Air Separation Unit (ASU) and stored in bulk storage vessels. Hydrogen is produced on site at the electrolytic Hydrogen Plant and is filled into cylinders in compressed form.

Table 2-2 provides information on the classification, hazard statements of products stored at BOC Gases Ireland Ltd.

Figure 2-4 illustrates the location of Hazardous installations on site at BOC Gases as notified to the HSA.

Substance	CAS #	COMAH Classification	Hazard Statements	Hazard
Hydrogen	1333-74-0	Flam. gas. Cat.1	H220	Extremely Flammable Gas
Phosphine	7803-51-2	Flam. Gas Cat.1 Acute Tox. Cat.1 Aquatic Acute Cat.1	H220 H330 H400	Extremely flammable gas Fatal if inhaled Very toxic to aquatic life
Acetylene	74-86-2	Flam. gas. Cat.1	H220	Extremely Flammable Gas
Oxygen	7782-44-7	Ox. Gas Cat.1	H270	May cause or intensity fire
Ethylene Oxide	75-21-8	Flam. Gas Cat.1 Acute Tox. Cat.3	H220 H331	Extremely flammable gas Toxic if inhaled
Chlorine	7782-50-5	Oxidising Gas Cat. 1 Acute Tox. Cat. 1 Aquatic Acute Cat.1	H270 H330 H400	May cause or intensity fire Fatal if inhaled Very toxic to aquatic life
Hydrogen chloride	7647-01-0	Acute Tox. (Inhalation - gas) Cat. 3	H331	Toxic if inhaled
Nitrous oxide	10024-97-2	Ox. gas Cat. 1	H270	May cause or intensity fire
Anhydrous Ammonia	7664-41-7	Flam. gas Cat. 2 Acute Tox. (Inhalation - gas) Cat. 3 Aquatic Acute Cat. 1 Aquatic Chronic Cat. 2	H221 H331 H400 H411	Flammable gas. Toxic if inhaled Very toxic to aquatic life Toxic to aquatic life with long lasting effects
Tungsten hexafluoride	7783-82-6	Acute Tox. 1	H330	Fatal if inhaled
Silane	7803-62-5	Flam. gas Cat. 1	H220	Extremely flammable gas

Table 2-2 Classification and Hazards of Products Stored at BOC Gases Ireland

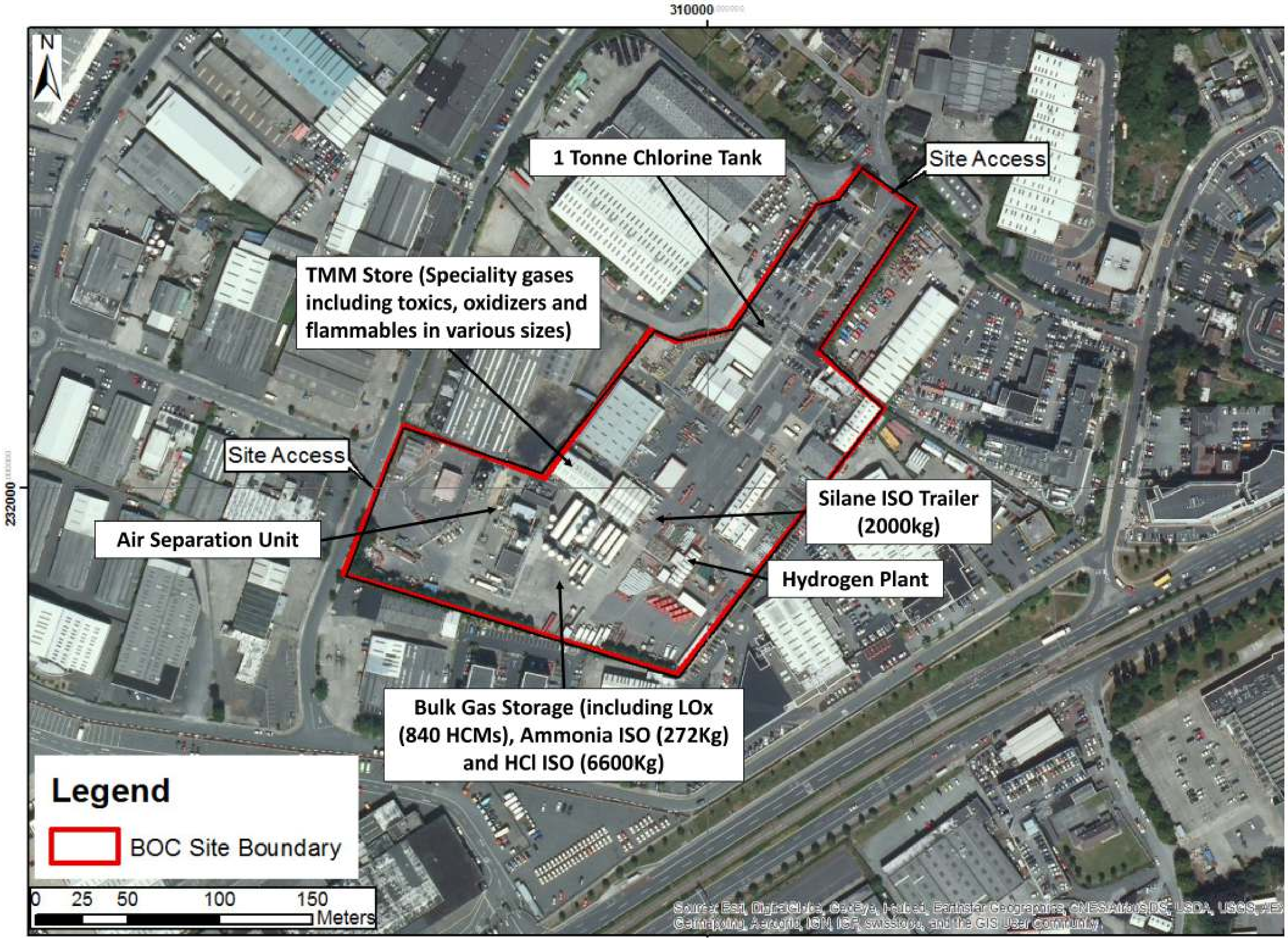


Figure 2-4 BOC Site Layout

2.3 Kayfoam Woolfson Lower Tier COMAH Site

Information on Kayfoam Woolfson Ltd. was obtained from the HSA via a submission under the Access to Information on the Environment (AIE) Regulations.

Kayfoam Woolfson is located on Bluebell Avenue in the Bluebell Industrial Estate, Dublin 12 approximately 960 m from the proposed development and is engaged in the manufacture of polyurethane foams for use in soft furnishings including mattresses and pillows.

Details of the dangerous substances stored on site as notified to the HSA are detailed in Table 2-3 below.

Dangerous substance	Maximum Inventory (tonnes)	Physical Form	Storage
2,4 Toluene diisocyanate;	85	Liquid	Indoor Bunded Tank
Diesel	1.8	Liquid	Indoor Bunded Tanks
Gas Oil	5	Liquid	Indoor Bunded Tanks

Table 2-3 Kayfoam Notified Substances

Table 2-4 provides information on the classification, hazard statements of the notified substances stored at Kayfoam Woolfson Ltd.

Substance	CAS #	COMAH Classification	Hazard Statements	Hazard
2,4 Toluene diisocyanate;	584-84-9	Acute Tox., Inhalation Cat. 1	H330	Fatal if inhaled
Diesel -DERV	68334-30-5	Flam. Liq. Cat.3 Aquatic Chronic Cat.2	H226 H411	Flammable Liquid and Vapour Toxic to aquatic life with long lasting effects
Gas Oil	68334-30-5	Flam. Liq. Cat.3 Aquatic Chronic Cat.2	H226 H411	Flammable Liquid and Vapour Toxic to aquatic life with long lasting effects

Table 2-4 Classification and Hazards of Substances Stored at Kayfoam Woolfson.

3.0 ASSESSMENT METHODOLOGY AND CRITERIA

3.1 Introduction

Trevor Kletz in his seminal work on the subject stated that the essential elements of quantitative risk assessment (QRA) are:

(i) how often is a Major Accident Hazard (MAH) likely to occur and
(ii) Consequence Analysis – what is the impact of the incident (Kletz, 1999)

Kletz also commented that another way of expressing this method of QRA is:

- How often?
- How big?
- So what?

The "how often?" question is generally answered by using frequency analysis techniques such as Event Tree Analysis (ETA) and Fault Tree Analysis (FTA), as described in the TNO Red Book (CPR 12E) (Committee for Prevention of Disasters, 1997). In the current assessment, conservative frequency data specified by the HSA for land use planning purposes in *Policy and Approach of the Health and Safety Authority to COMAH Risk-based Land-use Planning* (HSA, 2010) are applied to representative worst case major accident scenarios at the BOC Gases Ireland Bluebell and Kayfoam Woolfson sites.

The 'how big' element of the QRA was conducted following methodologies specified in the HSA's COMAH Land-Use Planning document (HSA, 2010) for estimating the consequences of fire and explosion scenarios. Where computer models were used, PHAST Version 8.11 and TNO Effects Version 10.1.9 modelling software were used. Risk contours were generated using TNO Riskcurves Version 10.1.9.

The "so what" element is perhaps the most contentious issue associated with QRA, as one is essentially asking what is an acceptable level of risk, in this case risk of fatality, posed by a facility. Individual and societal risk is quantified using TNO Riskcurves modelling software. The acceptability of the level of risk of fatality is assessed with reference to published acceptability criteria.

The Health and Safety Authority (HSA) in Ireland has specified the following tolerability criteria for individual risk of fatality at properties/developments neighbouring COMAH establishments:

- 5E-06 per year at non-residential type developments
- 1E-06 per year at residential type properties

In the UK, the following annual individual risk of fatality criteria apply to members of the public (Trbojevic, 2005):

10^{-4}	Intolerable limit for members of the public;
10^{-5}	Risk has to be reduced to the level As Low As Reasonably Practicable (ALARP);
3×10^{-6}	LUP limit of acceptability;
10^{-6}	Broadly acceptable level of risk
10^{-7}	Negligible level of risk

The UK HSE generally uses a three tier framework for risk tolerability (UK HSE, 2001):

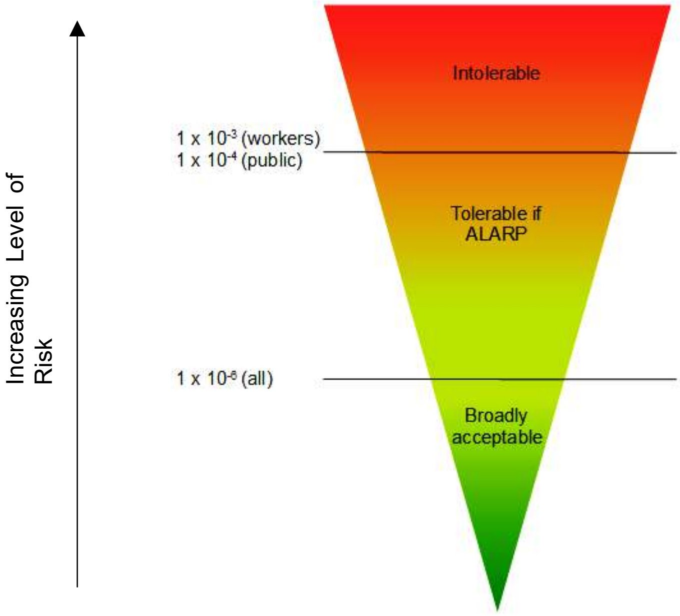


Figure 3-1 Risk Tolerability Criteria

The recommended upper risk of fatality bound for employees is set at 1 x 10^{-3}/year. The Chemical Industries Association (CIA, 2003) suggests that to allow only for the major hazard aspects of an employee's job, the upper bound should be reduced by a factor of 10 and thus be set at 1 x 10^{-4}/year for employees.

3.2 Land Use Planning and Risk Assessment

The Seveso III Directive (2012/18/EU) requires Member States to apply land-use or other relevant policies to ensure that appropriate distances are maintained between residential areas, areas of substantial public use and the environment, including areas of particular natural interest and sensitivity and hazardous establishments. For existing establishments, Member States are required to implement, if necessary, additional technical measures so that the risk to persons or the environment is maintained at an acceptable level.

The HSA is the Competent Authority in Ireland as defined by 2015 COMAH Regulations which implement the Seveso III Directive. The HSA is responsible for ensuring that the impacts of facilities which fall within the remit of this legislation are taken into account with respect to land use planning. This is achieved through the provision of technical advice to planning authorities.

A risk-based approach to land use planning near hazardous installations has been adopted by the HSA and is set out in the guidance document *Policy and Approach to COMAH Risk-based Land-use Planning* (HSA, 2010). This approach involves delineating three zones for land use planning guidance purposes, based on the potential risk of fatality from major accident scenarios resulting in damaging levels of thermal radiation (e.g. from pool fires), overpressure (e.g. from vapour cloud explosions) and toxic gas concentrations (e.g. from an uncontrolled toxic gas release).

The HSA has defined the boundaries of the Inner, Middle and Outer Land Use Planning (LUP) zones as:

10^{-5}/year	Risk of fatality for Inner Zone (Zone 1) boundary
10^{-6}/year	Risk of fatality for Middle Zone (Zone 2) boundary
10^{-7}/year	Risk of fatality for Outer Zone (Zone 3) boundary

The process for determining the distances to the boundaries of the inner, middle and outer zones for a Seveso establishment is outlined as follows:

- Determine the consequences of major accident scenarios using the modelling methodologies described in the HSA LUP Policy/Approach Document (HSA, 2010);
- Determine the severity (probability of fatality) using the probit functions specified by the HSA;
- Determine the frequency of the accident (probability of event) using data specified by the HSA; and
- Calculate the individual risk of fatality as follows:

  Risk = Frequency x Severity

The 2010 HSA Risk-Based LUP Policy/Approach document provides guidance on the type of development appropriate to the inner, middle and outer LUP zones. The advice for each zone is based on the UK Health and Safety Executive (HSE) PADHI (Planning Advice for Developments near Hazardous Installations) methodology. The PADHI methodology sets four levels of sensitivity, with sensitivity increasing from 1 to 4, to describe the development types in the vicinity of a COMAH establishment.

The Sensitivity Levels used in PADHI are based on a rationale which allows progressively more severe restrictions to be imposed as the sensitivity of the proposed development increases. The sensitivity levels are:

Level 1	Based on normal working population;
Level 2	Based on the general public – at home and involved in normal activities;
Level 3	Based on vulnerable members of the public (children, those with mobility difficulties or those unable to recognise physical danger); and
Level 4	Large examples of Level 3 and large outdoor examples of Level 2 and Institutional Accommodation.

Table 3-1 details the matrix that is used by the HSA to advise on suitable development for technical LUP purposes:

Level of Sensitivity	Inner Zone (Zone 1)	Middle Zone (Zone 2)	Outer Zone (Zone 3)
Level 1	✓	✓	✓
Level 2	✗	✓	✓
Level 3	✗	✗	✓
Level 4	✗	✗	✗

Table 3-1 LUP Matrix

3.3 Land Use Planning and Societal Risk

Vrijling and van Gelder (2004) have defined Societal Risk as:

"the relation between frequency and the number of people suffering from a specified level of harm in a given population from the realisation of specified hazards"

An important distinction in Societal Risk assessment is the number of persons that may be affected by off-site impacts, such as people with restricted mobility or children that may be affected by the need to rapidly evacuate a significant number of people from an area.

It is therefore prudent, when considering the Societal Risk Impacts of a development, to consider the nature and extent of a population which could be located in the vicinity of establishments with major accident hazard potential, or if adjacent lands are not already developed, to consider the nature and extent of a population which should be permitted to be located in this area.

It is recognised that it is not necessary to restrict all access by people to such lands, but it is considered prudent to restrict the number and type of persons which could be impacted.

The HSA LUP Policy and Approach document (HSA, 2010) recommends that for some types of development, particularly those involving large numbers of people, it is likely that the deciding factor from the point of view of land use planning is the societal risk, i.e. the risk of large numbers of people being affected in a single accident.

The HSA specifies the following societal risk criteria:

- Upper societal risk criterion value of 1 in 5000 for 50 fatalities (planning authority should advise against permitting the development)
- Broadly acceptable region of 1 in 100,000 for 10 fatalities (planning authority should not advise against permitting the development)
- Significant risk regions between these two values (planning authority should be advised of HSA approach to Risk-based Land Use Planning)

3.4 Consequence Modelling

The impacts of physical effects were determined by modelling accident scenarios in accordance with guidelines set out in the HSA COMAH Land Use Planning Policy document (HSA, 2010). Where computer models were used, TNO Effects Version 10.1.9 and DNV Phast Version 8.11 consequence modelling software were used.

Physical consequences from major accident scenarios associated with the proposed development relate to:

BOC Gases Ireland MAHs:

- Gas cylinder valve shear resulting in dispersion of toxic gas;
- ASU Reboiler explosion;
- Jet fire

Kayfoam Woolfson Ltd.

- Tank leak and dispersion of toxic vapour from pool.

3.4.1 Toxic Gas Exposure Criteria

The toxicity expressed by a given substance in the air is influenced by two factors, the concentration in the air (c) and the duration of exposure (t). A functional relationship between c and t can be developed, such that the end product of this relationship is a constant:

$$f(c,t) = \text{constant}$$

This constant is known as the Toxic Load and is calculated as follows:

$$\text{Toxic Load} = C^n.t$$

The UK Health and Safety Executive have set out Specified Level of Toxicity (SLOT) Dangerous Toxic Load (DTL) values. The UK HSE has defined land use planning SLOT as:

- Severe distress to almost everyone in the area;
- Substantial fraction of exposed population requiring medical attention;
- Some people seriously injured, requiring prolonged treatment;
- Highly susceptible people possibly being killed.

These criteria are fairly broad in scope, reflecting the fact that:

- There is likely to be considerable variability in the responses of different individuals affected by a major accident;
- There may be pockets of high and low concentrations of a toxic substance in the toxic cloud release, so that not everyone will get exactly the same degree of exposure; and
- The available toxicity data are not usually adequate for predicting precise dose-response effects.

The SLOT DTL value approximately equates to the toxic load which would give rise to 1% fatality. The UK HSE has also assigned Significant Likelihood of Death (SLOD) Dangerous Toxic Load (DTL) values to toxic substances. The SLOD DTL value equates to the toxic load which would give rise to a likely fatality of 50%.

The SLOT DTL and SLOD DTL values for the toxic materials assessed in this study are detailed as follows:

Substance	CAS No.	'n' value	SLOT DTL ppm^n.min	SLOD DTL ppm^n.min
Chlorine	7782-50-5	2	1.08×10^5	4.84×10^5
2,4 Toluene diisocyanate;	584-84-9	1	176	480

Table 3-2 SLOT DTL and SLOD DTL Values

3.4.1.1 Toxic Effects to Persons Outdoors

The HSA's LUP Policy and Approach Document (HSA 2010) sets out criteria for assessing the effects of a toxic gas release on persons outdoors, persons indoors and with respect to property damage.

For persons outdoors, the risk of fatality due to exposure to a toxic substance is calculated using probit equations in the form of:

$$Probit = a + b\ ln\ (C^n.t)$$

where a, b and n are constants and $(C^n.t)$ represents the toxic load.

A Probit (Probability Unit) function is used to convert the probability of an event occurring to percentage certainty that an event will occur. The probit variable is related to probability as follows (CCPS, 2000):

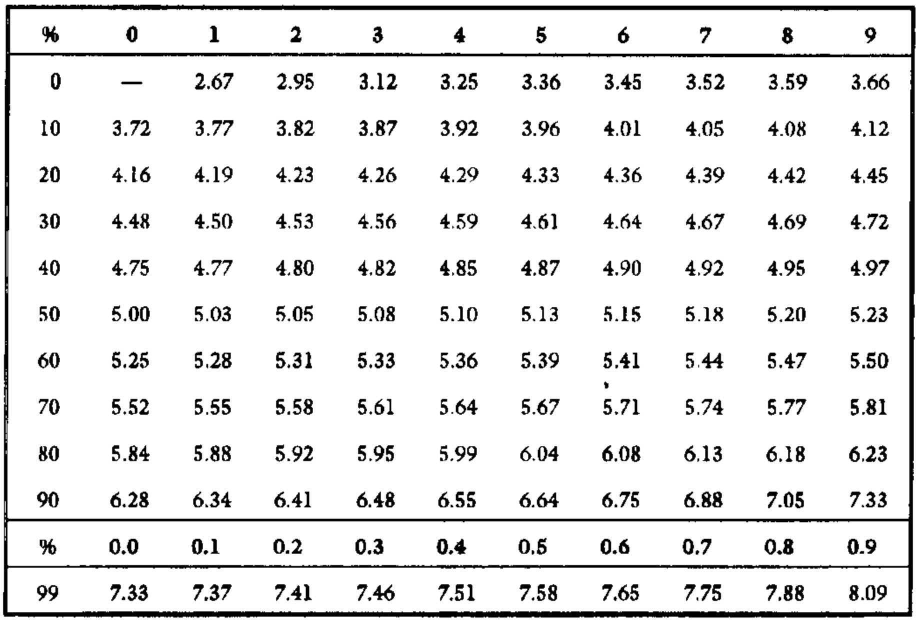
$$P = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Y-5} \exp\left(-\frac{u^2}{2}\right) du \qquad \textbf{(Equation 1)}$$

where P is the probability of percentage, Y is the probit variable, and u is an integration variable. The probit variable is normally distributed and has a mean value of 5 and a standard deviation of 1.

The Probit to percentage conversion equation is (CCPS, 2000):

$$P = 50\left[1 + \frac{Y-5}{|Y-5|} erf\left(\frac{|Y-5|}{\sqrt{2}}\right)\right] \qquad \textbf{(Equation 2)}$$

The relationship between Probit and percentage certainty is presented in the Table 3-3 (CCPS, 2000):



%	0	1	2	3	4	5	6	7	8	9
0	—	2.67	2.95	3.12	3.25	3.36	3.45	3.52	3.59	3.66
10	3.72	3.77	3.82	3.87	3.92	3.96	4.01	4.05	4.08	4.12
20	4.16	4.19	4.23	4.26	4.29	4.33	4.36	4.39	4.42	4.45
30	4.48	4.50	4.53	4.56	4.59	4.61	4.64	4.67	4.69	4.72
40	4.75	4.77	4.80	4.82	4.85	4.87	4.90	4.92	4.95	4.97
50	5.00	5.03	5.05	5.08	5.10	5.13	5.15	5.18	5.20	5.23
60	5.25	5.28	5.31	5.33	5.36	5.39	5.41	5.44	5.47	5.50
70	5.52	5.55	5.58	5.61	5.64	5.67	5.71	5.74	5.77	5.81
80	5.84	5.88	5.92	5.95	5.99	6.04	6.08	6.13	6.18	6.23
90	6.28	6.34	6.41	6.48	6.55	6.64	6.75	6.88	7.05	7.33
%	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
99	7.33	7.37	7.41	7.46	7.51	7.58	7.65	7.75	7.88	8.09

Table 3-3 Conversion from Probits to Percentage

The HSA recommends that probits be selected from the most well established sources:

- TNO (Dutch technical research organisation);
- AIChE (American Institute of Chemical Engineers); or
- HSE (UK Health and Safety Executive).

3.4.1.2 Persons Indoors

The risk to persons indoors from a toxic vapour cloud depends on the effective ventilation rate of the building, which may depend on the wind speed. Air change rates of 2.5 and 2 changes per hour are typically assumed for D5 and F2 conditions. The impact of a toxic release on an indoor population can be assessed using the same probit equations but it is necessary to modify the effective concentration and duration of exposure to take account of infiltration into the building.

3.4.2 Thermal Radiation Criteria

Fire scenarios have the potential to create hazardous heat fluxes. Therefore, thermal radiation on exposed skin poses a risk of fatality. Potential consequences of damaging radiant heat flux and direct flame impingement are categorised in Table 3-4 (HSA, 2010, CCPS, 2000, EI, 2007 and McGrattan et al, 2000).

Thermal Flux (kW/m^2)	Consequences
1 – 1.5	Sunburn
5 – 6	Personnel injured (burns) if they are wearing normal clothing and do not escape quickly
8 – 12	Fire escalation if long exposure and no protection
32 – 37.5	Fire escalation if no protection (consider flame impingement)
31.5	US DHUD, limit value to which buildings can be exposed
37.5	Process equipment can be impacted, AIChE/CCPS
Up to 350	In flame. Steel structures can fail within several minutes if unprotected or not cooled.

Table 3-4 Heat Flux Consequences

In relation to persons indoors, the HSA have specified the thermal radiation consequence criteria (from an outdoor fire) detailed in Table 3-5 (HSA, 2010).

Thermal Flux (kW/m^2)	Consequences
> 25.6	Building conservatively assumed to catch fire quickly and so 100% fatality probability
12.7 – 25.6	People are assumed to escape outdoors, and so have a risk of fatality corresponding to that outdoors
< 12.7	People are assumed to be protected, so 0% fatality probability

Table 3-5 Heat Flux Consequences Indoors

Thermal Dose Unit (TDU) is used to measure exposure to thermal radiation. It is a function of intensity (power per unit area) and exposure time:

$$\text{Thermal Dose} = I^{1.33}\ t \qquad \text{(Equation 3)}$$

where the Thermal Dose Units (TDUs) are (kW/m^2)$^{4/3}$.s, I is thermal radiation intensity (kW/m^2) and t is exposure duration (s).

The HSA recommends that the Eisenberg probit function (HSA, 2010) is used to determine probability of fatality to persons outdoors from thermal radiation as follows:

$$\text{Probit} = -14.9 + 2.56 \ln (I^{1.33}\ t) \qquad \text{(Equation 4)}$$

I	Thermal radiation intensity (kW/m^2)
t	exposure duration (s)

For long duration fires, such as pool fires, it is generally reasonable to assume an effective exposure duration of 75 seconds to take account of the time required to escape. With respect to exposure to thermal radiation outdoors, the Eisenberg probit relationship implies:

- 1% fatality – 966 TDUs (6.8 kW/m^2 for 75 s exposure duration) (Dangerous Dose)
- 10% fatality – 1452 TDUs (9.23 kW/m^2 for 75 s exposure duration)
- 50% fatality – 2387 TDUs (13.4 kW/m^2 for 75 s exposure duration)

3.4.3 Overpressure Criteria

Explosions scenarios can result in damaging overpressures, especially when flammable vapour/air mixtures are ignited in a congested area. Table 3-6 describes blast damage for various overpressure levels (Mannan, 2012).

Side-on Overpressure (mbar)	Description of Damage
1.5	Annoying noise
2	Occasional breaking of large window panes already under strain
3	Loud noise; sonic boom glass failure
7	Breakage of small windows under strain
10	Threshold for glass breakage
20	"Safe distance", probability of 0.95 of no serious damage beyond this value; some damage to house ceilings; 10% window glass broken
30	Limited minor structural damage
35 – 70	Large and small windows usually shattered; occasional damage to window frames
>35	Damage level for "Light Damage"
50	Minor damage to house structures
80	Partial demolition of houses, made uninhabitable
70 - 150	Corrugated asbestos shattered. Corrugated steel or aluminium panels fastenings fail, followed by buckling; wood panel (standard housing) fastenings fail; panels blown in
100	Steel frame of clad building slightly distorted
150	Partial collapse of walls and roofs of houses
150-200	Concrete or cinderblock walls, not reinforced, shattered
>170	Damage level for "Moderate Damage"
180	Lower limit of serious structural damage 50% destruction of brickwork of houses
200	Heavy machines in industrial buildings suffered little damage; steel frame building distorted and pulled away from foundations
200 – 280	Frameless, self-framing steel panel building demolished; rupture of oil storage tanks
300	Cladding of light industrial buildings ruptured
350	Wooden utility poles snapped; tall hydraulic press in building slightly damaged
350 – 500	Nearly complete destruction of houses
>350	Damage level for "Severe Damage"
500	Loaded tank car overturned
500 – 550	Unreinforced brick panels, 25 - 35 cm thick, fail by shearing or flexure
600	Loaded train boxcars completely demolished
700	Probable total destruction of buildings; heavy machine tools moved and badly damaged

Table 3-6 Blast Damage

Lees' Loss Prevention also gives the following damage criteria for process vessels (Mannan, 2012):

Peak Overpressure (mbar)	Description of Damage
	Steel floating roof petroleum tank
240	20% damage
1,380	99% damage
	Vertical cylindrical steel pressure vessel
830	20% damage
965	99% damage
	Spherical steel petroleum tank
550	20% damage
1100	99% damage

Table 3-7 Process Vessel Blast Damage

There are a number of modes of explosion injury including eardrum rupture, lung haemorrhage, whole body displacement injury, missile injury, burns and toxic exposure. Table 3-8 describes injury criteria from blast overpressure including probability of eardrum rupture and probability of fatality due to lung haemorrhage.

Probability of Eardrum Rupture (%)	Peak overpressure (mbar)
1 (threshold)	165
10	194
50	435
90	840
Probability of Fatality due to Lung Haemorrhage (%)	Peak overpressure (mbar)
1 (threshold)	1000
10	1200
50	1400
90	1750

Table 3-8 Injury Criteria from Explosion Overpressure

The HSA recommends that the Hurst, Nussey and Pape probit function (HSA, 2010) is used to determine probability of fatality to persons outdoors from overpressure as follows:

$$\text{Probit} = 1.47 + 1.35\ln P \qquad \text{(Equation 5)}$$

P Blast overpressure (psi)

The Hurst, Nussey and Pape probit relationship implies:

- 1% fatality – 168 mbar (Dangerous Dose)
- 10% fatality – 365 mbar
- 50% fatality – 942 mbar

The HSA uses relationships published by the Chemical Industries Association (CIA) to determine the probability of fatality for building occupants exposed to blast overpressure. The CIA has developed relationships for 4 categories of buildings (CIA, 2010):

- category 1: hardened structure building (special construction, no windows);

- category 2: typical office block (four storey, concrete frame and roof, brick block wall panels);
- category 3: typical domestic dwelling (two storey, brick walls, timber floors); and
- category 4: 'portacabin' type timber construction, single storey.

The CIA relationships imply the overpressure levels corresponding to probabilities of fatality of 1%, 10% and 50% detailed in Table 3-9**.**

Probability of fatality	Overpressure Level, mbar			
	Category 1	Category 2	Category 3	Category 4
1% fatality (dangerous dose)	435	100	50	50
10% fatality	519	183	139	115
50% fatality	590	284	300	242

Table 3-9 Blast Overpressure Consequences Indoors

The UK HSE Contract Research Report 151/1997 (prepared by WS Atkins) contains building vulnerability Pressure-Impulse (PI) diagrams for various different building types. These data are the basis for the CIA overpressure vulnerability relationships detailed in Table 3-9 above.

3.5 Modelling Parameters

3.5.1 Weather Conditions

Weather conditions at the time of a major-accident have a significant impact on the consequences of the event. Typically, high wind speeds slightly increase the impact of fires, particularly pool fires.

Atmospheric Stability Class and Wind Speed

In order to adequately assess the consequences of a major-accident, weather conditions must be selected that represent the weather experienced at the site. The standard atmospheric stability classes are listed in Table 3-10**.**

A-G Stability	Conditions	Typically observed during
A	Very unstable – Sunny with light winds	Day-time
B	Unstable – Less sunny or more windy than A	Day-time
C	Moderately unstable – Very windy/sunny or overcast/light wind	Day-time
D	Neutral – little sun and high wind or overcast/windy night	Day or Night-time
E	Moderately stable – Less overcast and less windy than D	Night-time
F	Stable – Night with moderate clouds and light/moderate winds	Night-time
G	Very Stable – Possibly Fog	Night-time

Table 3-10 Atmospheric Stability Classes

The following Pasquill stability/wind speed pairs are used for consequence modelling:

- average weather conditions are represented by stability category D and a wind speed of 5 m/s, i.e. Category D5;
- worst case conditions for toxic dispersion are represented by stability category F and a wind speed of 2 m/s, i.e. Category F2;

Wind Direction

The nearest weather station to the BOC Gases Ireland and Kayfoam Woolfson sites at which hourly wind speed and direction measurements are taken is at Casement Aerodrome. Figure 3-2 illustrates a wind rose based on hourly wind speed and direction data for Casement Aerodrome (1988 – 2018). Data was obtained from the Met Eireann website. It can be seen that the prevailing wind direction is approximately from the south west (220 °).

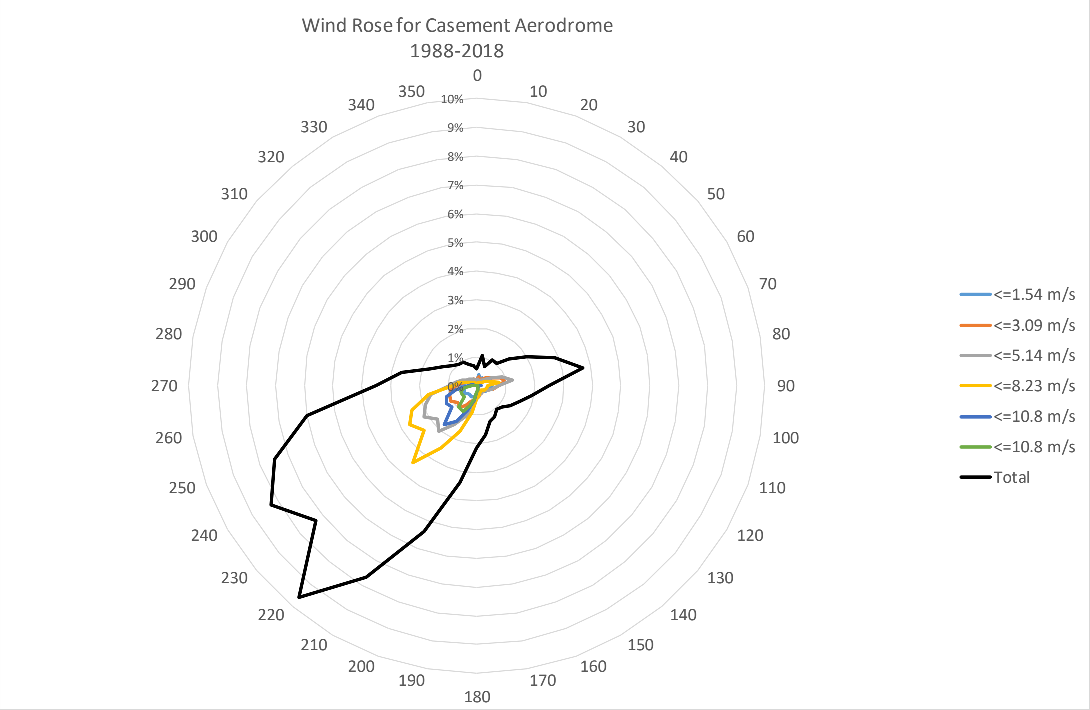


Figure 3-2 Wind Rose Casement Aerodrome Weather Station 1988 - 2018

Ambient Temperature

The ambient and surface temperature conditions significantly impact the results of the consequence modelling. Typically, atmospheric temperatures in the Bluebell area range from -4.7°C to 31°C through the year.

According to the weather data recorded between 1981 and 2010 at Casement Aerodrome, the average atmospheric temperature observed is 9.7°C. Therefore, an ambient temperature of 10°C has been selected to represent typical temperature conditions at the site.

Ambient Humidity

Weather data for Casement Aerodrome, monthly and annual mean and extreme values datasheet supplied by Met Éireann, indicates a mean morning (09:00 UTC) relative humidity of 83.6% and a mean afternoon (15:00 UTC) humidity of 73.8%. For this assessment, a representative ambient humidity of 80% has been assumed.

3.5.2 Surface Roughness

Surface roughness describes the roughness of the surface over which the cloud is dispersing. Typical values for the surface roughness are as follows (DNV PHAST Technical Reference Documentation):

Roughness length	Description
0.0002 m	Open water, at least 5 km
0.005 m	Mud flats, snow, no vegetation
0.03 m	Open flat terrain, grass, few isolated objects
0.1 m	Low crops, occasional large obstacles, x/h > 20
0.25 m	High crops, scattered large objects, 15 < x/h < 20
0.5 m	Parkland, bushes, numerous obstacles, x/h < 15
1.0 m	Regular large obstacles coverage (suburb, forest)
3.0 m	City centre with high and low rise buildings

Table 3-11 Surface Roughness

The BOC and Kayfoam establishments are in an industrial estate in the suburbs of Dublin. A surface roughness length of 1.0 m has been selected for this study.

3.6 Individual Risk Assessment Methodology

TNO Riskcurves Version 10.1.9 modelling software is used in this assessment to calculate individual risk of fatality contours and risk based land use planning zones associated with major accident scenarios.

3.7 Societal Risk Assessment Methodology

Societal Risk Index

The HSA in their COMAH land use planning guidance document (HSA, 2010) recommends that the Societal Risk Index is used as an initial screening tool in relation to societal risk to new developments in the vicinity of existing establishments.

The Societal Risk Index (SRI) is calculated using the following equation:

$$SRI = \frac{P \times R \times T}{A}$$

P	population factor, defined as $(n + n^2)/2$
n	number of persons at the development
R	average estimated level of individual risk in cpm
T	proportion of time development is occupied by n persons
A	area of the development in hectares

The HSA Policy and Approach Document does not prescribe acceptability criteria for the SRI, however Hirst and Carter (Hirst and Carter, 2000) state that the significant case for societal risk is set at SRI = 2500, based on UK HSE criteria.

4.0 IDENTIFICATION OF MAJOR ACCIDENT HAZARDS

A major accident is defined in the 2015 COMAH Regulations as:

> *"an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by these Regulations, and leading to serious danger to human health or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances"*

4.1 BOC Gases Ireland MAH Scenarios

As described in Section 2.2 above, BOC Gases are engaged in the manufacture of oxygen, nitrogen, argon and hydrogen and the storage of various toxic gases.

The Information for Land-Use Planning provided in Section 4 of the 2018 notification submission for BOC Gases Ireland provides the major accident scenarios arising at the BOC Gases Bluebell site.

Major Accidents with Toxic Dispersion Consequences

LUP 1 of the BOC notification describes the storage of toxic gas drums and cylinders on site including the storage of a 1 tonne chlorine tank.

The risk associated with the storage of the tonne chlorine tanks at the Bluebell site have been chosen as the representative toxic release scenario for the BOC Gases Ireland Bluebell site for the following reasons:

- As illustrated in Figure 2-4, the chlorine tank is closest hazardous installation involving toxic gas to the proposed development;
- The chlorine release consequence modelling results reported in the Consequence Assessment in Section 2 of the BOC Safety Report (obtained by AIE request submitted to the HSA) resulted in the greatest distances to toxic endpoints.

The HSA's LUP Policy and Approach Document (HSA 2010) provides the following representative scenario for a chlorine drum store:

Scenario	Description	Release Rate	Release duration (mins)	Likelihood (cpm)
1	Drum drop (large 13 mm hole in drum)	2.84 kg/s	5	1.2 per drum movement
2	Drum drop (small 7 mm hole in drum)	0.7 kg/s	20	4.8 per drum movement
3	Valve damage (shearing liquid valve	0.45 kg/s	30	22.5 per drum movement

Table 4-1 1 Tonne Chlorine Tank Representative Scenarios (HSA 2010)

Major Accidents with Overpressure Consequences

The Air Separation Unit on site is a process unit in which air is separated into its component gases (Nitrogen and Oxygen) by distillation at low temperatures and comprises distillation columns, heat exchangers and adsorbers. Hydrocarbon build-up within the reboiler unit (e.g. due to dry boiling) can lead to an explosion hazard.

An ASU reboiler explosion has been chosen to represent the worst case major accident scenario with overpressure consequences on site at BOC Gases Ireland Bluebell based on the results reported in the consequence assessment in Section 2 of the BOC Safety Report.

Major Accidents with Thermal Radiation Consequences

Hydrogen is produced on site at the electrolytic Hydrogen Plant and is filled into cylinders in compressed form. The potential for a jet fire from the hydrogen compressor is assessed as part of this LUP study.

4.2 Kayfoam Woolfson MAH Scenarios

As described in Section 2.3 above, Kayfoam Woolfson are involved in the manufacture of polyurethane foams for use in soft furnishings including mattresses and pillows.

Storage of Toxic Liquid in Bulk Tanks

Kayfoam use toluene diisocyanate (TDI) in the manufacture of the polyurethane foams which is classified as an acute toxic category 1 via inhalation.

TDI is stored indoors in 6 no. bulk tanks. The tanks are located within 3 no. internal bunds. The tank and bund dimensions are outlined below:

Bund	Bund dimensions (m)	Bund Volume (m3)	No. of Tanks	Tank 1 dimensions	Tank 2 dimensions	Tank 3 dimensions
A	7.65 x ~6.6 x 1.05	44.5	3	T1 r=1.04; H=3.812	T2 r=1.05; H=3.825	T4 r=1.05; H=3.826
B	2.82 x 6.33 x 1.32	23.9	2	T3 r=1.05; H= 4.445	T65 T1 r=1.05; H=4.443	-
C	3.25 x 2.88 x 1.92	17.9	1	T65 T2 r=0.98; H=4.2	-	-

Table 4-2 Toluene Diisocyanate Tank and Bund Dimensions

The TDI is delivered to the site via a specified route approximately once a week.

The HSA's LUP Policy and Approach Document (HSA 2010) specifies the following scenarios for sites storing toxic liquids in atmospheric bulk tanks:

- Major failure leading to the bund area being covered (frequency 1E-04/year per vessel);
- Catastrophic failure leading to larger spillage (frequency 1E-05 per year per vessel);
- Failure during road tanker on/off loading (frequency 3E-07 per operation).

TDI is stored indoors within 3 no. bunds at the Kayfoam Woolfson site. Information on the ventilation rates within the site building is unavailable therefore the toxic dispersion scenarios will be modelled as outdoor releases. Consequently, the following scenarios are considered to be representative of the major accidents at the Kayfoam site:

- Major leak from bulk storage tank, pool formation within storage tank bund and evaporation and dispersion of TDI from the surface of the liquid pool;
- Catastrophic tank rupture with bund overtopping pool formation within and adjacent to bund and evaporation and dispersion of TDI from the surface of the liquid pool.

Storage of Class III Petroleum Products

Kayfoam store Class III petroleum products (Diesel (Derv) and gas oil) on site for the purpose of fuelling forklift trucks, cars and the back-up power for the sprinkler system.
Diesel and Gas oil are stored at atmospheric temperature and pressure in 3 no. tanks across 2 no. bunds. The tank and bund dimensions are outlined below:

Bund	Bund dimensions (m)	No of tanks in bund	Contents of 1st Tank	Dimensions of 1st Tank	Contents of 2nd Tank	Dimension of 2nd Tank
1	3 x 2.05 x 1.5	2	Gas Oil	2.3 x 1.1 x 1.25	Derv	2.3 x 0.75 x 1.25
2	1 x 1.49	1	Gas Oil	2.5 x 0.75 x 1.4	-	-

Table 4-3 Class III Petroleum Products Tank and Bund Dimensions

The HSA's LUP Policy and Approach Document (HSA 2010) advise the following with respect to Class III petroleum products:

"Provided there are no other flammable substances on site or in the vicinity close enough to initiate a major accident on the site and it is clear that any credible spill will remain on site, the probability of a Class III Fire should not be considered credible."

The storage tanks are located indoors at the Kayfoam site and there are no other flammable substances on site therefore a fire involving the diesel and fuel oil at Kayfoam is not considered in this assessment.

5.0 ASSESSMENT OF BOC GASES IRELAND MAJOR ACCIDENT HAZARDS

5.1 Release and Dispersion of Toxic Chlorine Gas

The following representative release scenarios for the 1 tonne chlorine tank at BOC Gases Ireland were assessed using DNV Phast Version 8.11:

- Drum drop (large 13 mm hole in drum) (Duration 5 minutes)
- Drum drop (small 7 mm hole in drum) (Duration 20minutes)
- Valve damage (shearing liquid valve) (Duration 30 minutes)

Table 5-1 details probit equations that have been published for chlorine.

Substance	Publisher	A	B	n	Unit	Time	Reference
Chlorine	TNO	-4.86	0.5	2.75	ppm	Minutes	Phast Modelling Software
Chlorine	AICHE	-8.29	0.92	2	ppm	Minutes	AICHE Guidelines for CPQRA

Table 5-1 Chlorine Probits

5.1.1 Toxic Dispersion Model Inputs

Model inputs are detailed in Table 5-2 below.

Parameter	Details	Source/Assumption
Scenario	Leak model	Release of Cl_2 from 1 tonne tank
Material	Chlorine	-
Tank Inventory	1 tonne	BOC Gases Ireland
Temperature of substance	Ambient	BOC Gases Ireland
Pressure	5.8 barg	BOC Gases Ireland
Hole diameter	13mm 7mm	HSA Large hole following drum drop. BOC Gases Ireland (diameter of restricted flow orifice)
Release duration	5 min 20 min 30 min	Recommended by HSA
Release Direction	Horizontal	Worst case assumption
Wind speed	2 m/s, 5 m/s	Recommended by HSA as worst case modelling conditions
Pasquill Stability Factor	D, F	
Atmospheric temperature	10 degC	Met Éireann average measured at Casement Aerodrome Synoptic Station (1988 -2018)

Table 5-2 Chlorine Dispersion: Model Inputs

Phast Version 8.11 predicts the following release rates for the 5 min, 20 min and 30 min release durations respectively:

Drum drop (large 13 mm hole in drum) (Duration 5 minutes)	3.33 kg/s
Drum drop (small 7 mm hole in drum) (Duration 20minutes)	0.83 kg/s
Valve damage (shearing liquid valve) (Duration 30 minutes)	0.56 kg/s

5.1.2 Toxic Gas Dispersion Consequence Results

Table 5-3 details the distances to the SLOT DTL and SLOD DTL outdoors, and the distances to toxic doses outdoors corresponding to 1% and 50% probability of fatality outdoors for the TNO Probit equations (at 1.5 m above ground level).

Toxic Dose	n	Toxic Dose	Category D5		Category F2	
			Distance (m)	Width	Distance (m)	Width
		ppm^n.min	Outdoors	m	Outdoors	m
Release through 13 mm hole for 5 minutes						
SLOT DTL	2	1.08E05	175	30	576	91
SLOD DTL	2	4.84E05	106	23	303	74
1% Fatality – TNO Probit	2.75	3.16E06	179	31	539	93
50% Fatality – TNO Probit	2.75	3.32E08	59	15	110	50
Release through 7 mm hole for 20 minutes release						
SLOT DTL	2	1.08E05	170	22	588	75
SLOD DTL	2	4.84E05	105	18	318	63
1% Fatality – TNO Probit	2.75	3.16E06	147	22	539	73
50% Fatality – TNO Probit	2.75	3.32E08	49	11	111	41
Valve shear release for 30 minutes						
SLOT DTL	2	1.08E05	146	20	583	66
SLOD DTL	2	4.84E05	92	16	316	55
1% Fatality – TNO Probit	2.75	3.16E06	148	19	518	66
50% Fatality – TNO Probit	2.75	3.32E08	49	10	109	38

Table 5-3 Chlorine Drum Release Scenarios: Distance to Toxic Endpoints Outdoors

Figure 5-1 and Figure 5-2 illustrate contours corresponding to the SLOT and SLOD DTL outdoors (at effect height 1.5 m) following a chlorine drum drop for weather category F2 and D5 respectively. The shape of the contour is shown for the prevailing wind direction as well as the total effect zone taking account of all possible wind directions.

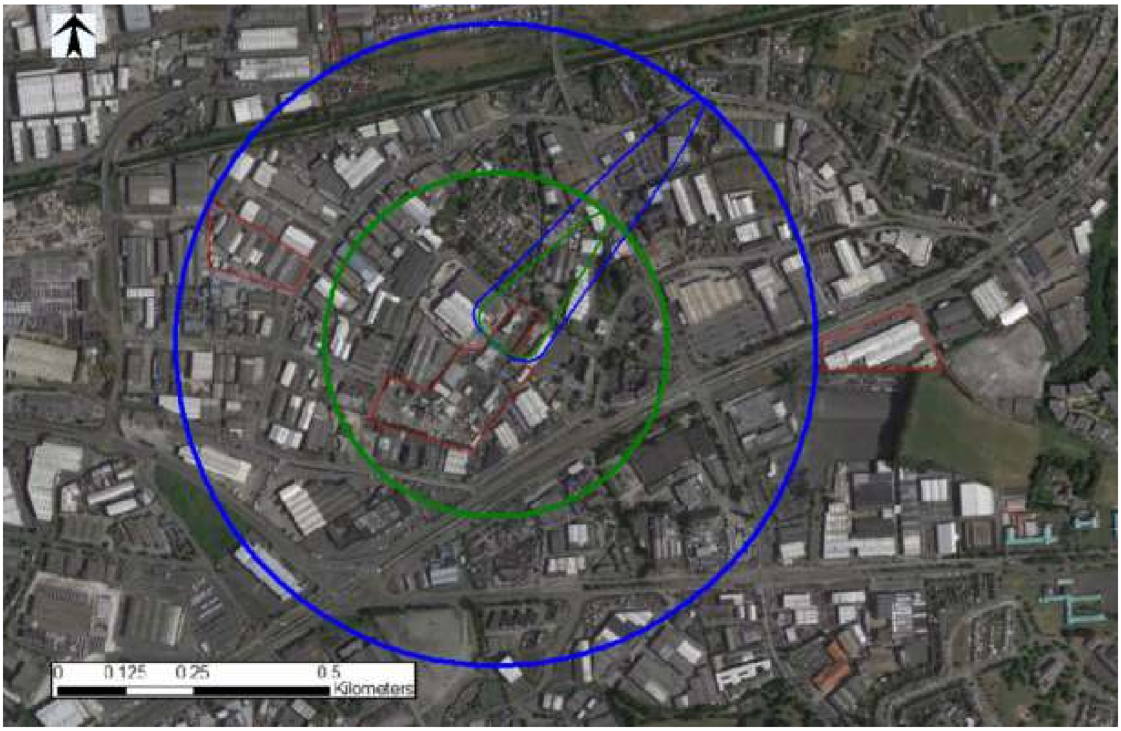


Figure 5-1 Chlorine Drum Drop 20 min release: SLOT and SLOD DTL Outdoor Contours (Category F2)

― SLOT DTL Contour	― SLOD DTL Contour
━ SLOT DTL Effect Zone	━ SLOD DTL Effect Zone

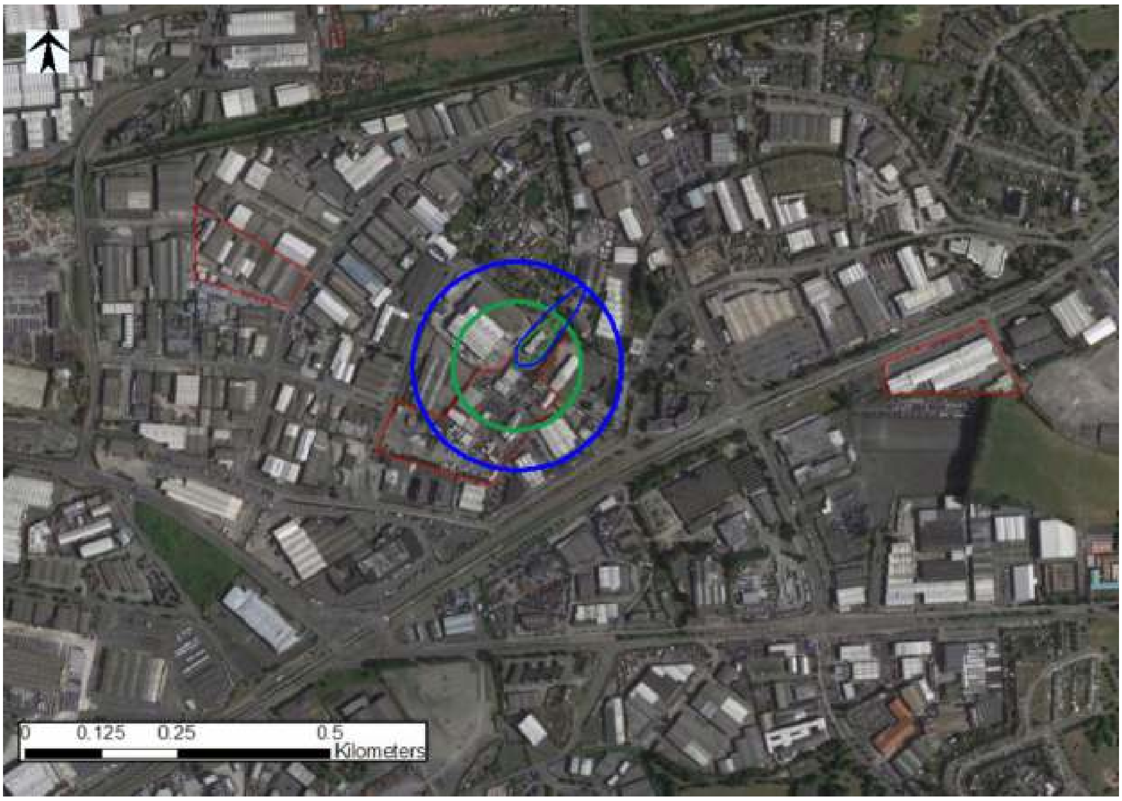


Figure 5-2 Chlorine Drum Drop 5 min release: SLOT and SLOD DTL Outdoor Contours (Category D5)

― SLOT DTL Contour	― SLOD DTL Contour
━ SLOT DTL Effect Zone	━ SLOD DTL Effect Zone

As illustrated, the toxic dose levels corresponding to the SLOT DTL outdoor hazard range from a release from a 1 tonne chlorine drum (weather category F2) do not extend to the proposed development.

As illustrated in Figure 5-2, the toxic dose levels corresponding to the SLOT DTL outdoor contours for weather category D5 (representing daytime weather conditions) does not extend to the proposed development.

The commercial units on the ground and first floors of the proposed development are not expected be occupied outside normal working hours (8am – 8pm). The commercial units on the ground floor and first floor units will have natural ventilation provided via openable windows.

Figure 5-3 and Figure 5-4 below illustrate toxic dose indoors at ground level (effect height 1.5 m) vs distance for the release scenario for Weather Category F2 and D5 respectively.

Figure 5-5 and Figure 5-6 below illustrate probability of fatality indoors at ground level (effect height 1.5 m) vs distance for the release scenario for Weather Category F2 and D5 respectively.

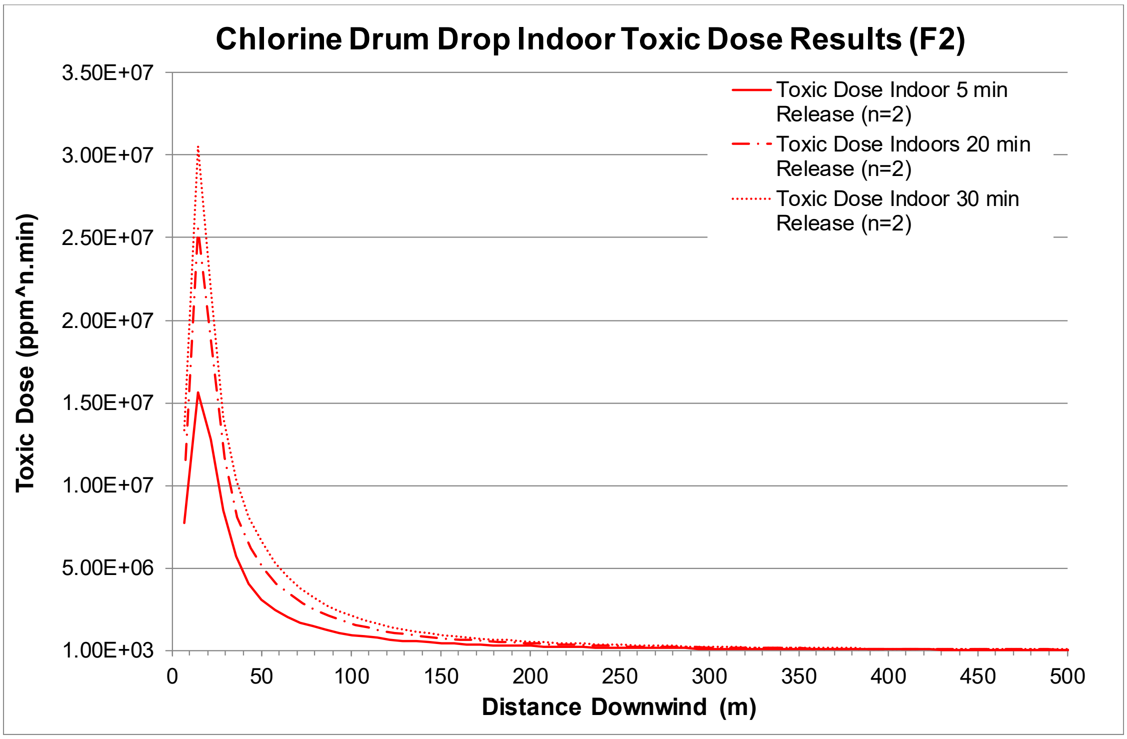


Figure 5-3 Chlorine Drum Toxic Release: Toxic Dose Indoor vs Distance Weather Category F2 (effect height 1.5 m)

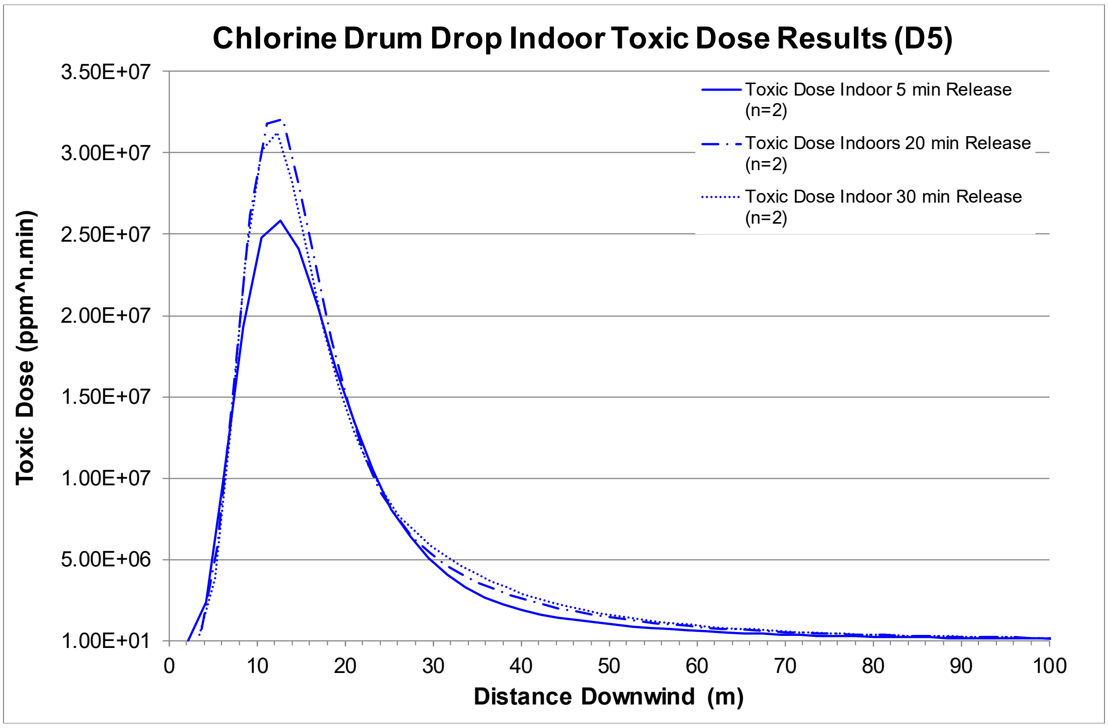


Figure 5-4 Chlorine Drum Toxic Release: Toxic Dose Indoor vs Distance Weather Category D5 (effect height 1.5 m)

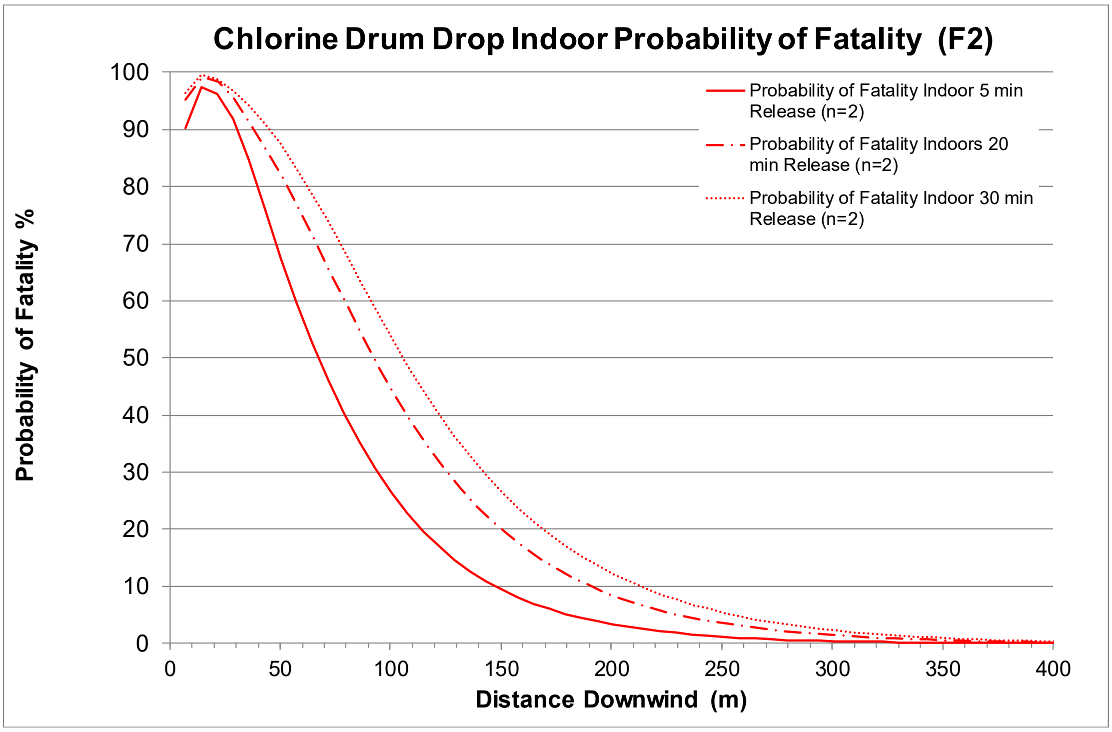


Figure 5-5 Chlorine Drum Toxic Release: Probability of Fatality Indoor vs Distance Weather Category F2 (effect height 1.5 m)

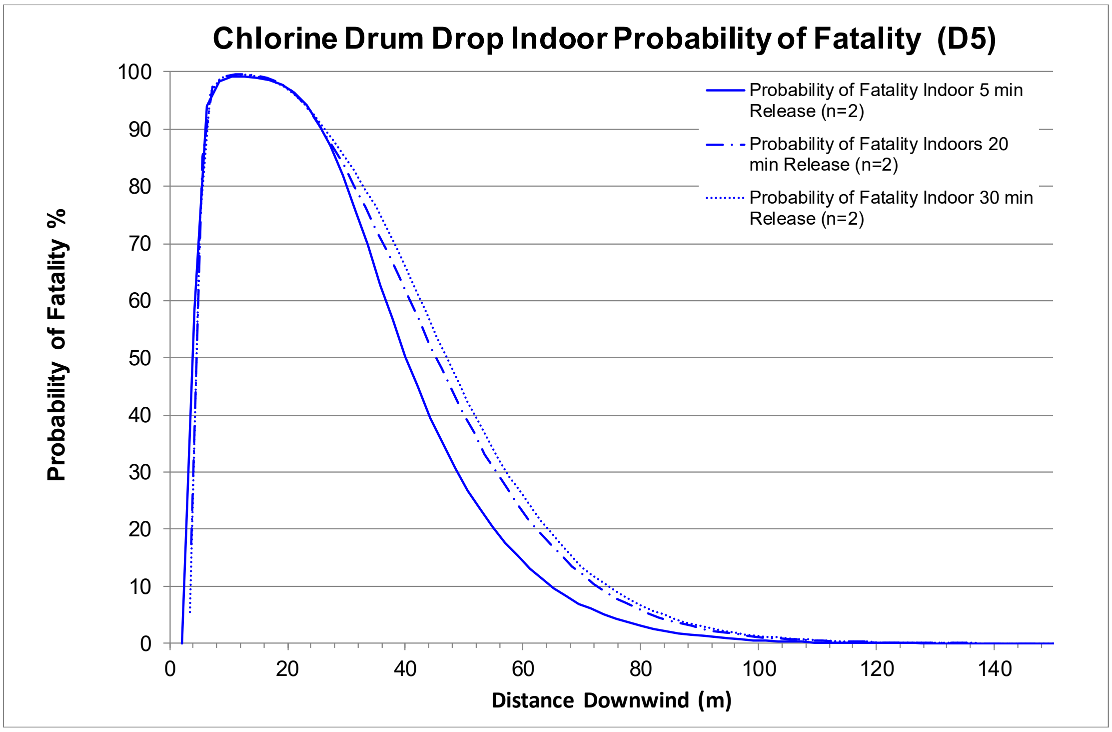


Figure 5-6 Chlorine Drum Toxic Release: Probability of Fatality Indoor vs Distance Weather Category D5 (effect height 1.5 m)

Toxic consequences observed indoors at ground floor (effect height 1.5 m) and first floor levels (effect height 6 m) of the proposed development are summarised in Table 5-4 below:

Building	Air Intake Height	Distance to air intake	Toxic Consequences
Ground Floor Units	40.5 m O.D. 1.5 m above release	Approximately 600 m	< 0.01% lethality Negligible
First Floor Commercial and Residential Units	46.53 m O.D. 6 m above release	Approximately 600 m	< 0.01% lethality Negligible

Table 5-4 Toxic Consequences Indoors at the Proposed Development

In the event of a release of chlorine gas from the 1 tonne drum at BOC Gases Ireland the following is concluded:

- Toxic dose levels corresponding to 1% fatality outdoors for weather category F2 (night time weather conditions) (effect height, 1.5 m) do not extend to the proposed development;
- Toxic dose levels corresponding to 1% fatality outdoors for weather category D5 (representing daytime weather conditions) (effect height, 1.5 m) do not extend to the proposed development;
- Toxic dose levels corresponding to 1% fatality indoors (effect height, 1.5 m) for weather categories F2 and D5 do not extend to the proposed development;
- Persons indoors and outdoors are protected.

5.1.3 Chlorine Release Frequency

The HSA's Land use Planning document (HSA, 2010) recommends the following frequencies for a release of chlorine from a 1 tonne drum:

Drum drop (large 13 mm hole in drum)	1.2 cpm per drum movement
Drum drop (small 7 mm hole in drum)	4.8 cpm per drum movement
Valve damage (shearing liquid valve)	22.5 cpm per drum movement

BOC Gases Ireland store 1 no. 1 tonne chlorine drum on site at a time. It is assumed that one drum of chlorine is sold per week, and that there are 2 no. movements per drum representing loading and unloading of the drum on site.
The frequencies used in the risk analysis are therefore:

Drum drop (large 13 mm hole in drum)	1.25E-04/year
Drum drop (small 7 mm hole in drum)	4.99E-04/year
Valve damage (shearing liquid valve)	2.34E-03/year

5.1.4 Chlorine Drum Individual Risk Contours

Individual risk contours were modelled using TNO Riskcurves Version 10.1.9 modelling software. The inputs to the model include consequence results (in Section 5.1.2), event frequency and wind speed and direction frequency data for Casement Aerodrome weather station (see Section 3.5). The Hurst Nussey Pape probit function is used to determine vulnerability from toxic dispersion results.

Figure 5-7 illustrates the cumulative individual risk of fatality contours for the chlorine release events.

Figure 5-7 Chlorine Drum: Individual Risk of Fatality Contours

5.2 ASU Reboiler

A reboiler explosion scenario involving a mixture of hydrocarbon and oxygen was identified as a potential major accident hazard at the ASU at BOC Gases Ireland.

5.2.1 Reboiler Explosion Model Inputs

Section 4 of the 2016 Notification document for BOC Gases Ireland provides a TNT equivalent mass of 6700 kg for assessing a hydrocarbon/oxygen mixture explosion on site. This value was used in the TNO Effects Version 10.1.9 Explosion Model (TNT Equivalency Model).

5.2.2 Reboiler Explosion Overpressure Consequences

Figure 5-8 illustrates the level of overpressure with distance following an explosion at the ASU reboiler.

Table 5-5 presents distances to overpressure levels associated with specified levels of probability of fatality to persons outdoors and to persons indoors in Category 2 (office type) buildings, Category 3 buildings (residential dwellings) and Category 4 buildings (Portacabins).

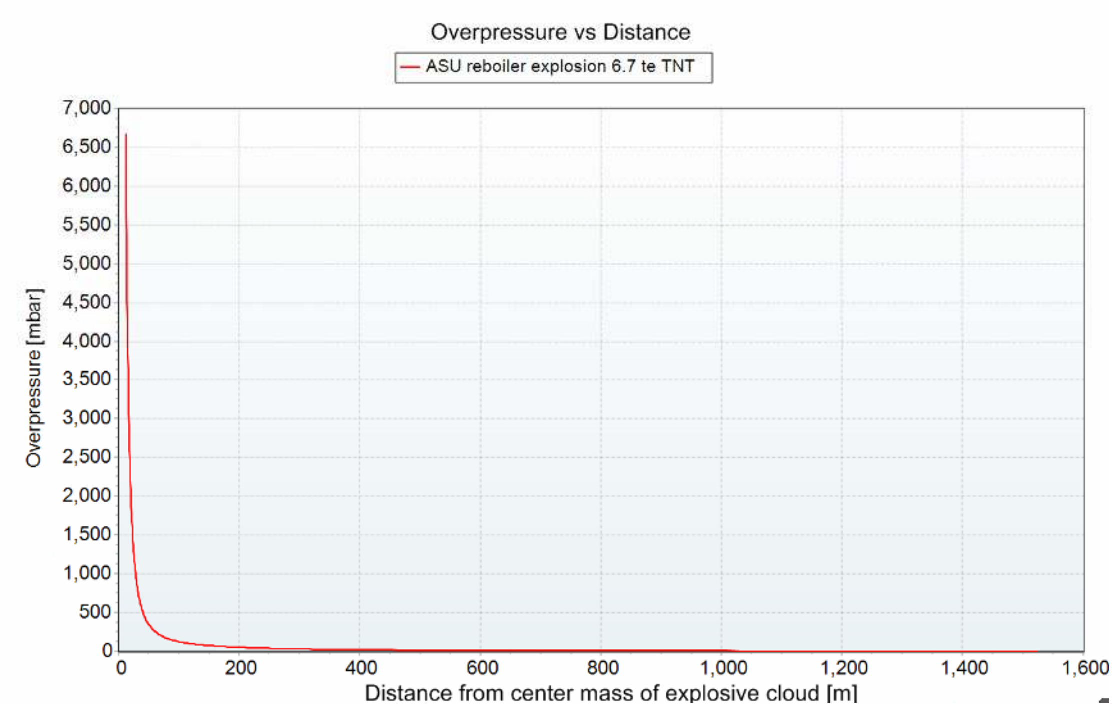


Figure 5-8 Reboiler Explosion: Overpressure vs. Distance

Probability of fatality	Persons outdoors	
	Overpressure level	Distance
	mbar	(m)
1%	168	80
10%	365	48
50%	942	29
Probability of fatality	Persons indoors: Category 2 (typical office block)	
	Overpressure level	Distance
	mbar	(m)
1%	100	118
10%	183	76
50%	284	56
Probability of fatality	Persons indoors: Category 3 (residential dwellings)	
	Overpressure level	Distance
	mbar	(m)
1%	50	205
10%	139	92
50%	300	54
Probability of fatality	Persons indoors: Category 4 (Portacabins)	
	Overpressure level	Distance
	mbar	(m)
1%	50	205
10%	115	106
50%	242	62

Table 5-5 Reboiler Explosion: Calculated Distances at Specified Overpressure Levels

5.2.3 Probability of Fatality from Reboiler Explosion

The probability of fatality outdoors from the overpressure consequences following a reboiler explosion at BOC Gases Ireland is calculated using the Hurst Nussey Pape Probit Equation. The probability of fatality indoors from the overpressure consequences of an explosion was determined using the CIA relationships (CIA, 2010) for different building types. The risk of fatality is the product of the probability of fatality and the likelihood of the event.

The probability of fatality with distance outdoors and indoors for the ASU reboiler explosion scenario is illustrated on Figure 5-9.

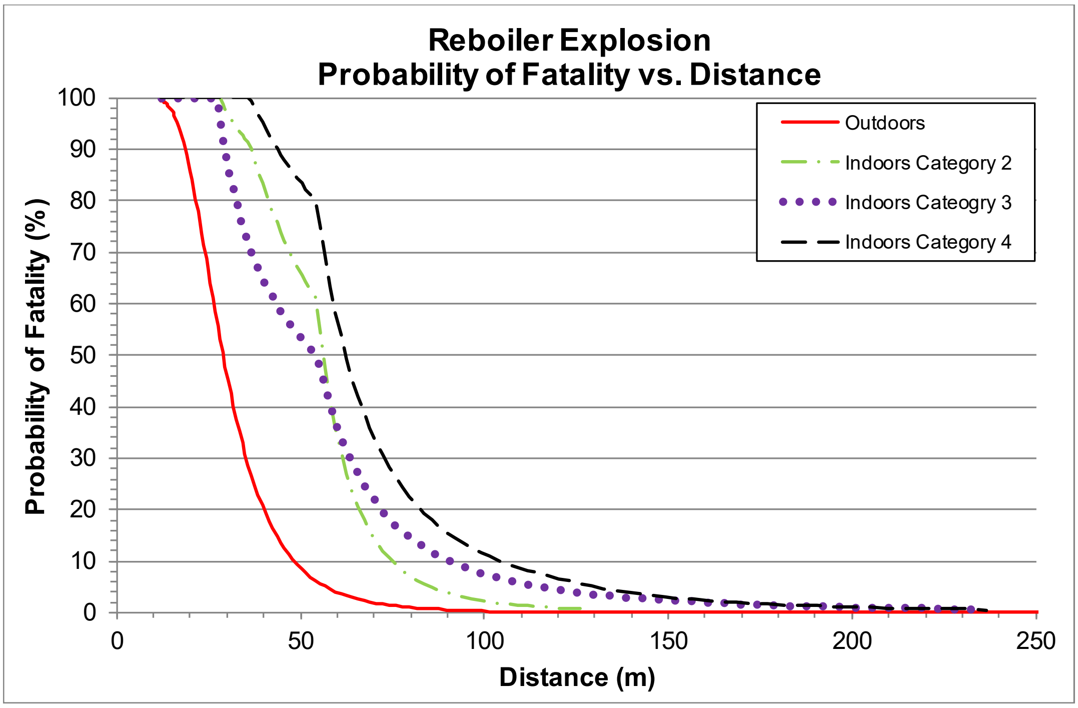


Figure 5-9 Reboiler Explosion: Probability of Fatality vs. Distance

The distance to the overpressure level corresponding to 1% mortality outdoors is 80 m, 1% mortality indoors in Category 2 type structures (representative of office building at ground floor and first floor levels of the proposed development) is 118 m and 1% mortality indoors in residential dwellings is 205 m. These contours are illustrated on Figure 5-10.

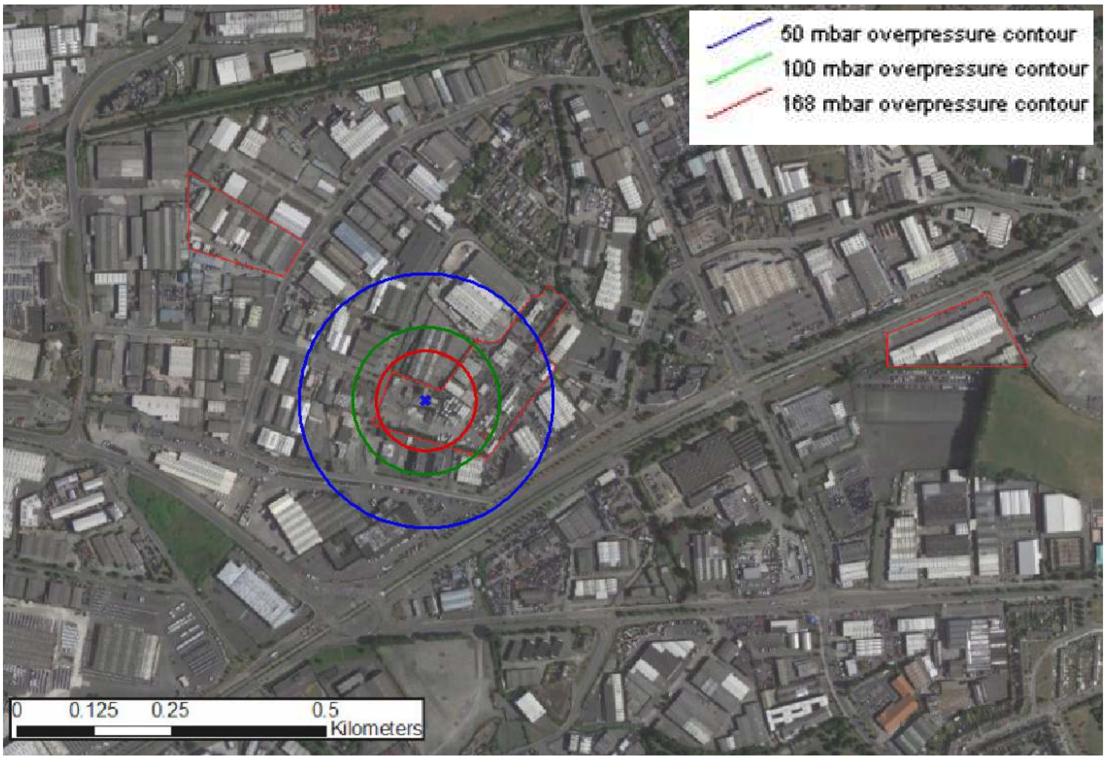


Figure 5-10 Reboiler Explosion: Overpressure Contours

It is concluded that the personnel outdoors and indoors at the proposed development are protected from an explosion involving the reboiler at the BOC Gases ASU.

5.2.4 Reboiler Explosion Frequency

The HSA's LUP Policy and Approach Document (HSA 2010) specifies a conservative frequency of 1E-04/year when assessing an explosion in a process area.

5.2.5 Reboiler Explosion Individual Risk Contours

Figure 5-11 illustrates the cumulative individual risk of fatality contours for the chlorine release events.

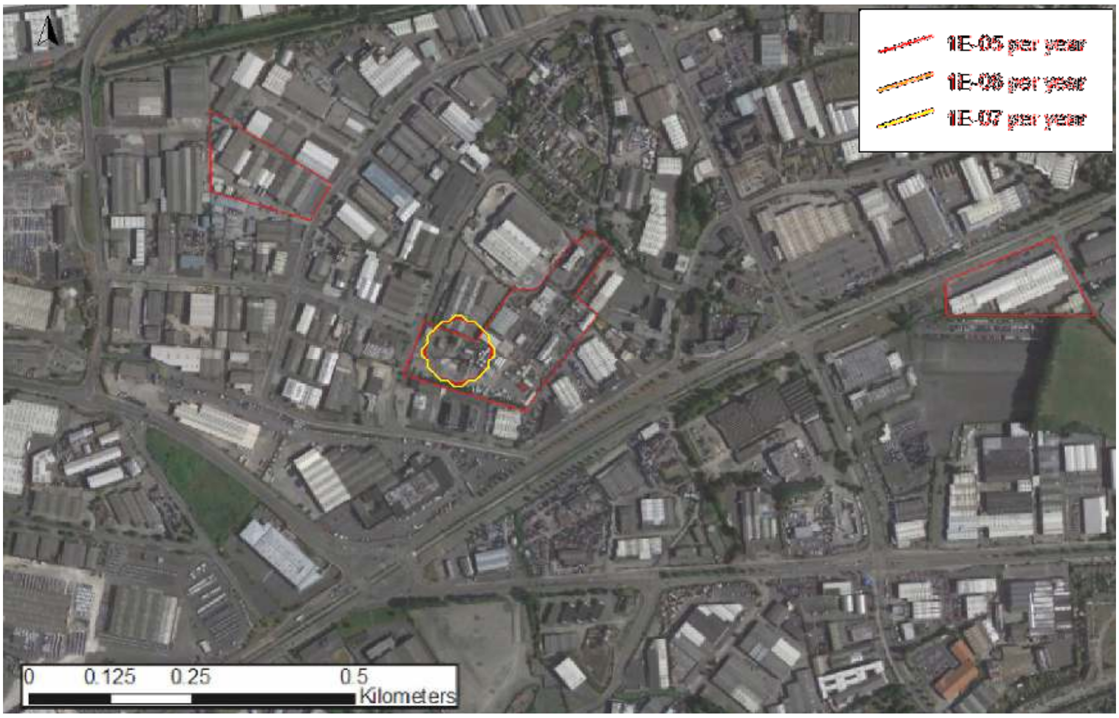


Figure 5-11 Reboiler Explosion: Individual Risk of Fatality Contours

5.3 Hydrogen Jet Fire

As discussed in Section 4.0 above, hydrogen is produced on site at the electrolytic Hydrogen Plant and is filled into cylinders in compressed form. The potential for a jet fire from the hydrogen compressor is assessed herein.

5.3.1 Hydrogen Jet fire Model Inputs

TNO Effects Version 10.9.1 was used to model a leak and jet fire involving the hydrogen compressor. Section 4 of the 2016 Notification document for BOC Gases Ireland provides the following modelling parameters for a loss of containment of hydrogen:

Volume of material	0.5 m^3
Vessel Pressure	20101 kPa
Orifice diameter	0.05 m

Receiver height was specified as 1.5 m. As per HSA policy (HSA, 2010), calculations were undertaken for 5 m/s wind speed and radiation levels are calculated in the downwind direction. Thermal dose and probability of fatality is based on a 75 s exposure duration.

5.3.2 Hydrogen Jet Fire Thermal Radiation Consequences

Table 5-6 presents the jet fire model outputs.

Parameter	Units	Category D5
Flame Emissive Power	kW/m^2	71
Jet Velocity	m/s	2437.9
Frustrum Lift Off Height	m	15
Frustrum Length	m	62
Frustrum Base Width	m	1.1018
Frustrum Tip Width	m	20.02

Table 5-6 Hydrogen Leak and Jet Fire Model Outputs

Thermal radiation vs. distance is illustrated on Figure 5-12 below:

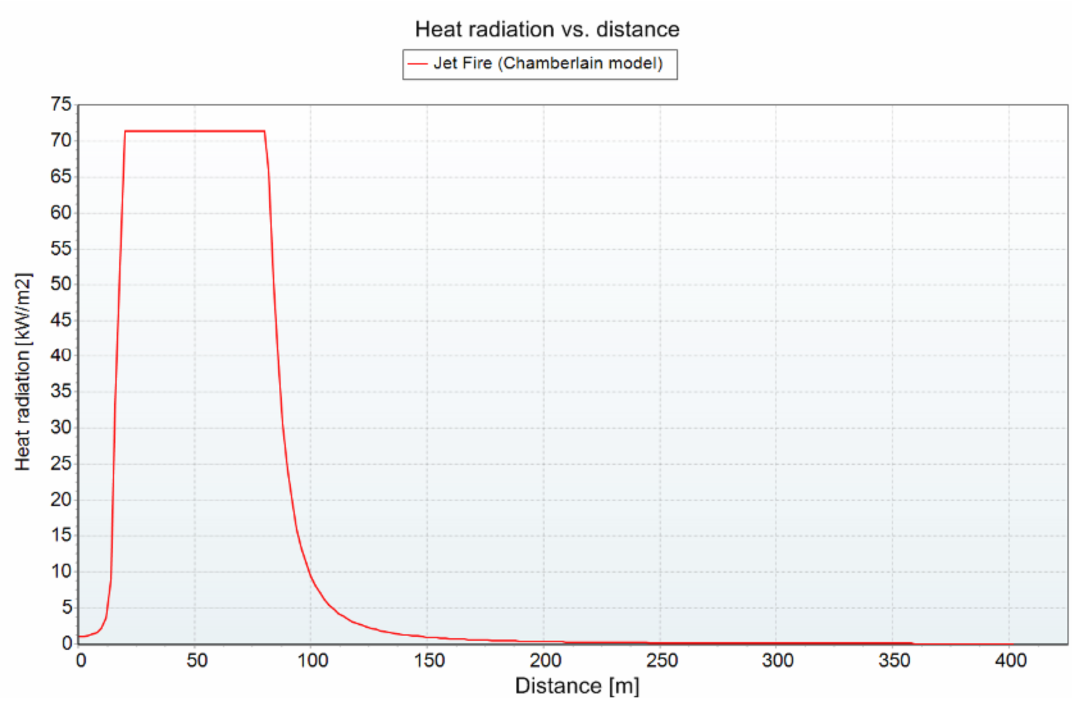


Figure 5-12 Hydrogen Jet Fire: Thermal Radiation vs. Distance

Thermal radiation results are summarised as follows:

Thermal radiation level, kW/m^2	Thermal dose units based on 75 s exposure duration, T (k/m^2)$^{4/3}$.s	Consequences	Distance (m)
4.1	490	Threshold of fatality	113
6.8	960	1% mortality outdoors	104
12.7	2204	Persons indoors protected	96
25.6	5598	100% fatality indoors	90

Table 5-7 Hydrogen Jet Fire: Thermal Radiation Results

The worst case contours are illustrated on the following figures:

- Figure 5-13 threshold of fatality outdoors contour (4.1 kW/m^2)

- Figure 5-14 persons protected indoors contour (12.7 kW/m^2)

The shape of the thermal radiation contour is illustrated for the prevailing wind direction (220 deg) as well as the effect zone which takes account of all possible wind directions.

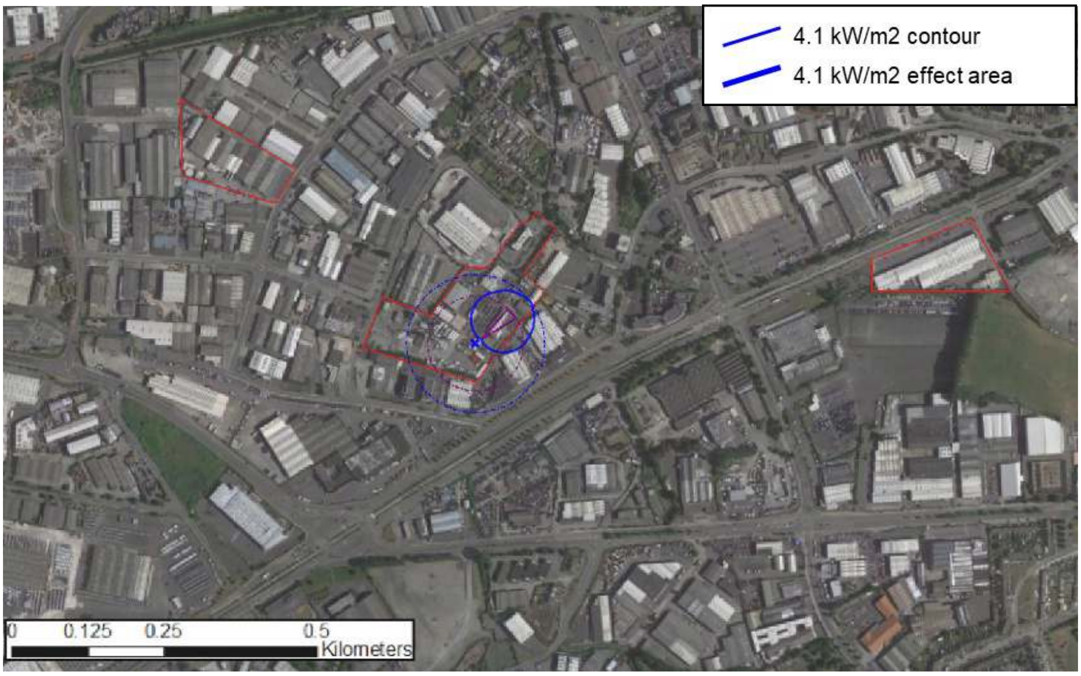


Figure 5-13 Hydrogen Jet Fire: Threshold of Fatality Outdoors Contour

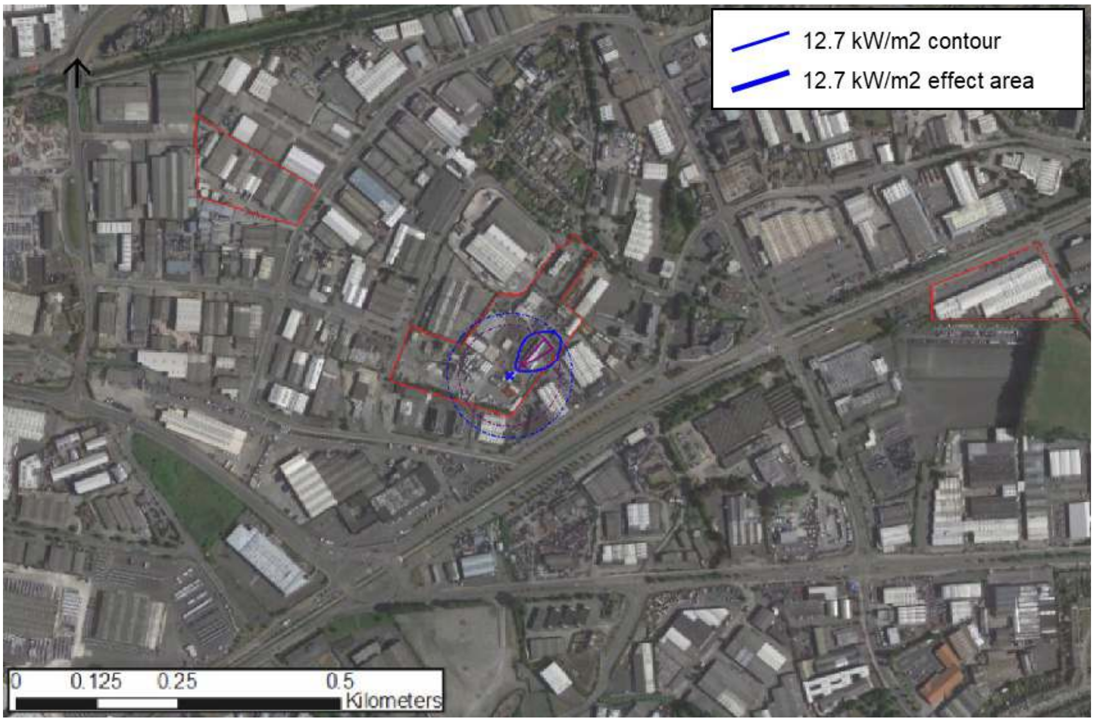


Figure 5-14 Hydrogen Jet Fire: Persons Protected Indoors Contour

The following is concluded:

- The thermal radiation level corresponding to the threshold of fatality does not reach the proposed development, persons outdoors at this location would not be exposed to harmful levels of thermal radiation;
- The thermal radiation level below which persons in indoor locations are protected does not extend to the proposed development, persons indoors at this location are protected from the thermal radiation consequences of an uncontained jet fire at the BOC Gases Hydrogen Plant.

5.3.3 Hydrogen Jet Fire Frequency

The HSA's Land Use Planning document (HSA, 2010) does not recommend a frequency for a gas leak from a pressurised vessel however the UK HSE Planning Case Assessment Guide Chapter 6K specifies a failure rate of 5E-06/year for a release through a 50 mm diameter hole in a pressure vessel.

5.3.4 Hydrogen Jet Fire Individual Risk Contours

Individual risk contours were modelled using TNO Riskcurves Version 10.1 modelling software. The inputs to the model include consequence results (in Section 5.3), event frequency (5E-06 per year) and wind speed and direction frequency data for Casement Aerodrome weather station (see Section 3.5). The Hurst Nussey Pape probit function is used to determine vulnerability from thermal radiation results.

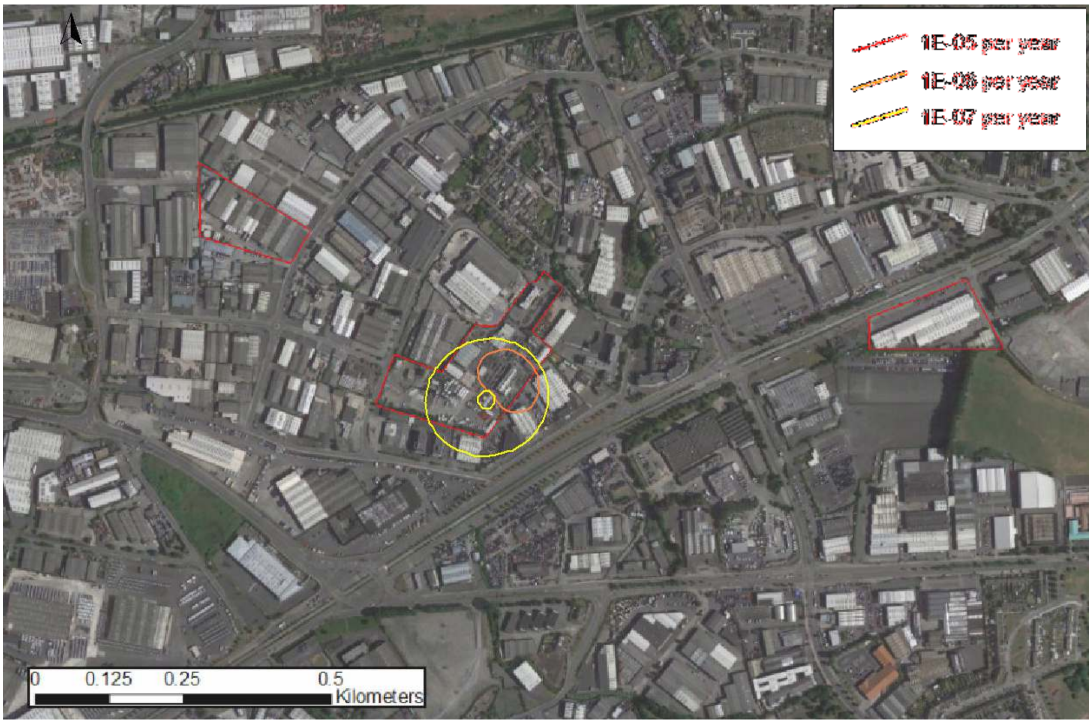


Figure 5-15 Hydrogen Jet Fire: Individual Risk of Fatality Contours

5.4 Cumulative Individual Risk of Fatality from BOC Gases Ireland

Individual risk of fatality contours have been calculated for a representative set of major accident hazard scenarios associated with BOC Gases Ireland. Individual risk of fatality contours (corresponding to the boundaries of the inner, middle and outer risk based land use planning zones) are illustrated on as follows.

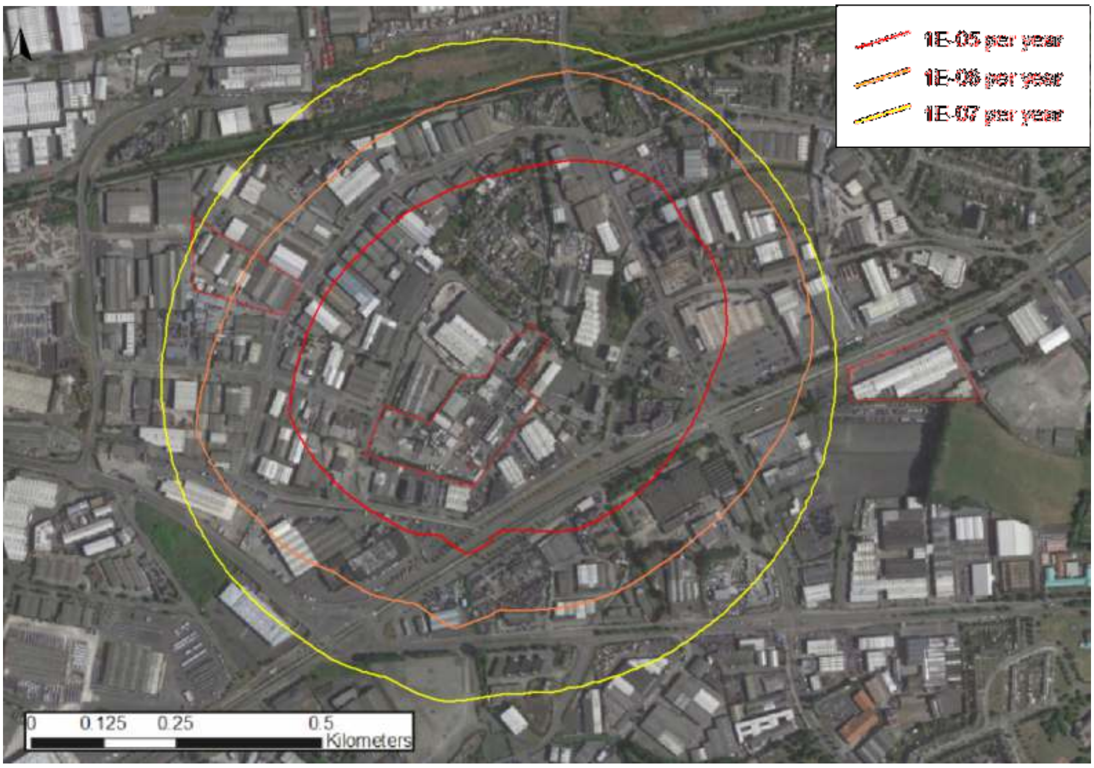


Figure 5-16 Cumulative Risk Arising from BOC Gases Ireland

As illustrated above, the individual risk of fatality contours corresponding to the boundaries of the inner, middle and outer risk based land use planning zones do not extend to the proposed development. The individual level of risk observed at the proposed development is negligible.

6.0 ASSESSMENT OF KAYFOAM WOOLFSON MAJOR ACCIDENT HAZARDS

As outlined in Section 4.2, the following major accidents scenarios were identified for the Kayfoam Woolfson site due to the storage of toluene diisocyanate (TDI) in atmospheric bulk tanks:

- Major leak from bulk storage tank, pool formation within storage tank bund and evaporation and dispersion of TDI from the surface of the liquid pool;
- Catastrophic tank rupture with bund overtopping pool formation within and adjacent to bund and evaporation and dispersion of TDI from the surface of the liquid pool.

Table 6-1 details the proposed probit equation published for TDI.

Substance	Publisher	A	B	n	Unit	Time	Reference
Toluene diisocyanate	RIVM (Netherlands National Institute for Public Health and the Environment)	-7.84	1	2	Mg/m^3	Minutes	https://www.rivm.nl/tolueendiisocyanaat

Table 6-1 Toluene diisocyanate Probit

6.1 Major Leak of TDI from Bulk Storage Tank

6.1.1 Toxic Dispersion Model Inputs

It is assumed that a major leak occurs from the largest TDI storage tank (capacity 15.4 m^3) resulting in the formation of a pool of liquid TDI within the bund, and evaporation and dispersion of TDI vapour from the surface of the liquid pool.

The TNO Effects Version 10.1.9 pool evaporation and dense gas dispersion models were used to model the evaporation and dispersion TDI vapour from the surface of a pool of liquid following this accident scenario. The pool evaporation model inputs are detailed in Table 6-2.

Parameter	Details	Units	Source/Assumption
Material	Toluene Diisocyanate	-	-
Pool size	50.4	m^2	Area of largest bund
Volume of TDI	15.4	m^3	Volume of largest tank

Table 6-2 Toluene Diisocyanate Pool Evaporation and Dispersion: Model Inputs

TNO Effects predicts an evaporation rate from the pool of TDI of 1.24E-05 kg/s and a density of 1.225 kg/m^3 after mixing with air. TNO Effects recommends the use of the neutral gas dispersion model where the density of the material is not more than 10% heavier than air (1.24 kg/m^3).

6.1.2 Toxic Gas Dispersion Results

The neutral gas dispersion model in TNO Effects Version 10.1.9 modelling software was used to model the dispersion of TDI vapour as it evaporates from the surface of the spilled liquid.

Figure 6-1 illustrates the toxic dose vs. distance downwind for weather categories D5 and F2 (Probit n=1 and n=2).

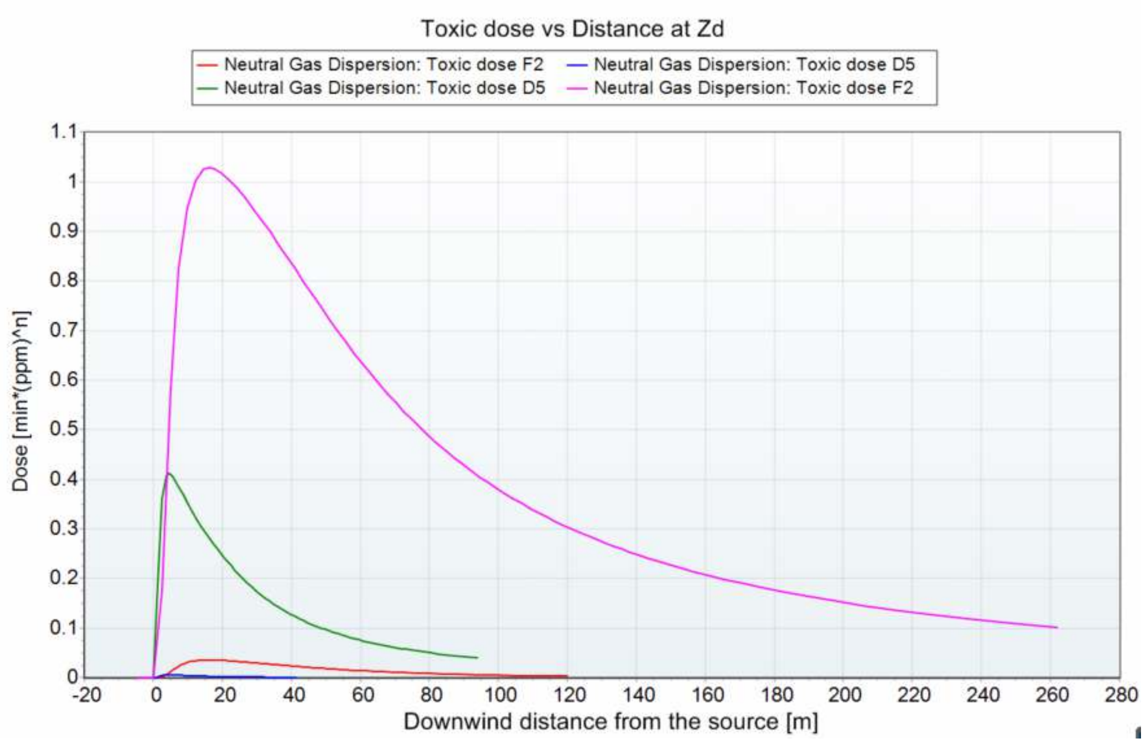


Figure 6-1 TDI Tank Leak: Toxic Dose vs. Distance Downwind

Table 6-3 details the distances to the SLOT DTL and SLOD DTL outdoors, and the distances to toxic doses outdoors corresponding to 1% and 50% probability of fatality outdoors (at 1.5 m AGL).

Toxic Dose	n	Toxic Dose	Category D5		Category F2	
		ppm^n.min	Distance (m)	Contour Dimensions	Distance (m)	Contour Dimensions
SLOT DTL	1	176	Not reached	-	Not reached	-
SLOD DTL	1	480	Not reached	-	Not reached	-
1% Fatality – RIVM Probit	2	2.12E+04	Not reached	-	Not reached	-
50% Fatality – RIVM Probit	2	2.18E+05	Not reached	-	Not reached	-

Table 6-3 TDI Tank Leak: Distances to Toxic Dose Endpoints Outdoors

It can be seen from the toxic dose results presented above that in the event of an accidental release of TDI into the bund outdoor toxic consequences (at the effect height considered, 1.5 m) are less than those associated with SLOT effects and 1% probability of fatality. Fatalities outdoors are not expected to arise at the proposed development as a result of this scenario.

6.1.3 Frequency of TDI Tank Spill

The risk of fatality arising from a major accident scenario is the product of the probability of event and probability of fatality.

The HSA Land Use Planning Guidance (HSA, 2010) recommends a frequency value of 1 x 10^{-4} per year per vessel for a major spill from a bulk storage tank leading to a bund area being covered. There are 6 No. TDI indoor tanks at the Kayfoam Woolfson site therefore a frequency value of 6 x 10^{-4} /year is used.

6.2 Catastrophic Tank Rupture

It is assumed that the largest TDI storage tank ruptures catastrophically resulting in 50% of the contents overtopping the bund. The consequences and level of individual risk of fatality from the evaporation and dispersion of TDI vapour from the surface of a liquid pool are investigated herein.

6.2.1 Model Inputs

The TNO Effects Version 10.1.9 pool evaporation and neutral gas dispersion models were used to model the evaporation and dispersion TDI vapour from the surface of a pool of liquid following this accident scenario.

It is assumed that 50% of the released liquid will overtop the bund (based on HSA COMAH LUP Guidance, 2010). The worst case event is taken to be a circular pool located adjacent to the storage bund (i.e. due to bund overtopping or bund failure).

The radius (R) of the pool is taken to be given by:

$R = 6.85\ V^{0.44537}$

with R in metres and V (volume of liquid in pool) in cubic metres, subject to a maximum diameter of 100 m (which occurs when V = 87 m^3), which should not normally be exceeded (unless there are special circumstances).

The discharge model inputs are detailed in Table 6-4.

Parameter	Details	Units	Source/Assumption
Material	TDI	-	-
Volume	15.4	m^3	Volume of largest TDI Tank
Pool size	959	m^2	Size of bund plus area occupied by overtopped fraction of released material (908 m^2)

Table 6-4 TDI Tank Catastrophic Rupture: Model Inputs

6.2.2 Toxic Gas Dispersion Consequences

Figure 6-2 illustrates the toxic dose vs. distance downwind for weather categories D5 and F2 (Probit n=1 and n=2).

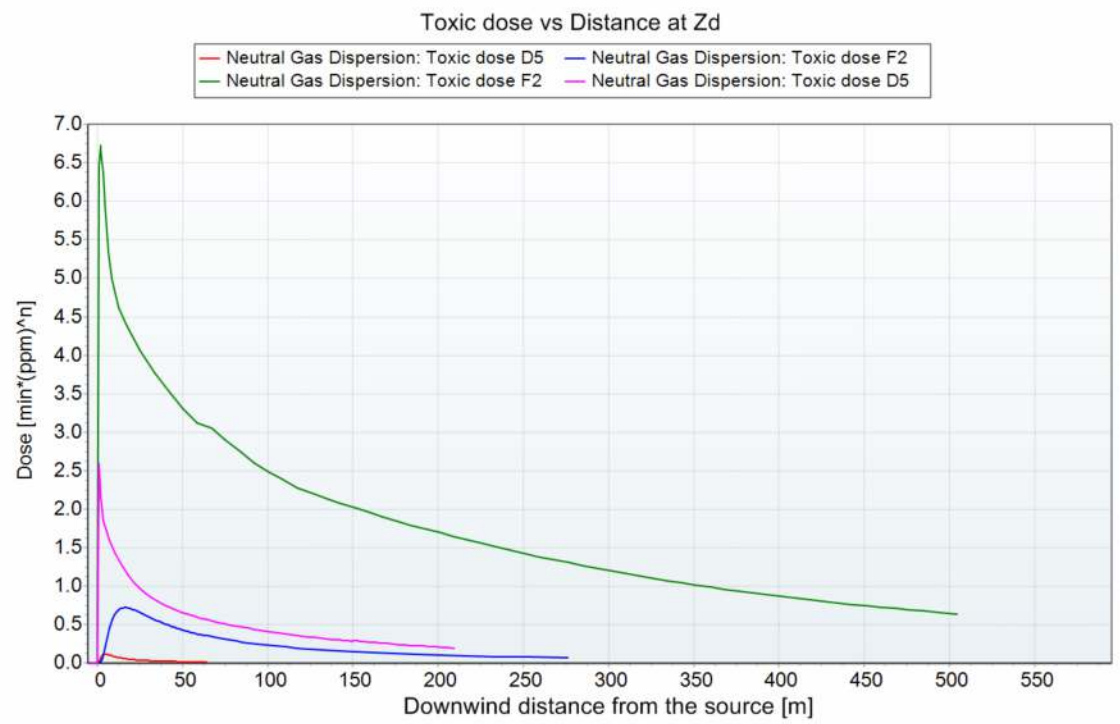


Figure 6-2 TDI Tank Catastrophic Rupture: Toxic Dose vs. Distance Downwind

Table 6-5 details the distances to the SLOT DTL and SLOD DTL outdoors, and the distances to toxic doses outdoors corresponding to 1% and 50% probability of fatality outdoors (at 1.5 m AGL) following a catastrophic rupture of the largest TDI tank.

Toxic Dose	n	Toxic Dose	Category D5		Category F2	
		ppm^n.min	Distance (m)	Contour Dimensions	Distance (m)	Contour Dimensions
SLOT DTL	1	176	Not reached	-	Not reached	-
SLOD DTL	1	480	Not reached	-	Not reached	-
1% Fatality – RIVM Probit	2	2.12E+04	Not reached	-	Not reached	-
50% Fatality – RIVM Probit	2	2.18E+05	Not reached	-	Not reached	-

Table 6-5 TDI Tank Catastrophic Rupture: Distances to Toxic Dose Endpoints Outdoors

It can be seen from the toxic dose results presented above that in the event of a catastrophic rupture of the largest TDI tank outdoor toxic consequences (at the effect height considered, 1.5 m) are less than those associated with SLOT effects and 1% probability of fatality. Fatalities outdoors are not expected to arise at the proposed development as a result of this scenario.

6.2.3 Frequency of TDI Tank Rupture

The risk of fatality arising from a major accident scenario is the product of the probability of event and probability of fatality.

The HSA Land Use Planning Guidance (HSA, 2010) recommends a frequency value of 1 x 10^{-5} per year per vessel for catastrophic failure from a bulk storage tank leading to a larger spill. There are 6 No. TDI indoor tanks at the Kayfoam Woolfson site therefore a frequency value of 6 x 10^{-5} /year is used.

7.0 LAND USE PLANNING RISK CONTOURS

The cumulative individual risk contours for the BOC Gases Ireland Ltd. and Kayfoam Woolfson sites were modelled using Riskcurves Version 10.1.9 and are illustrated on Figure 7-1.

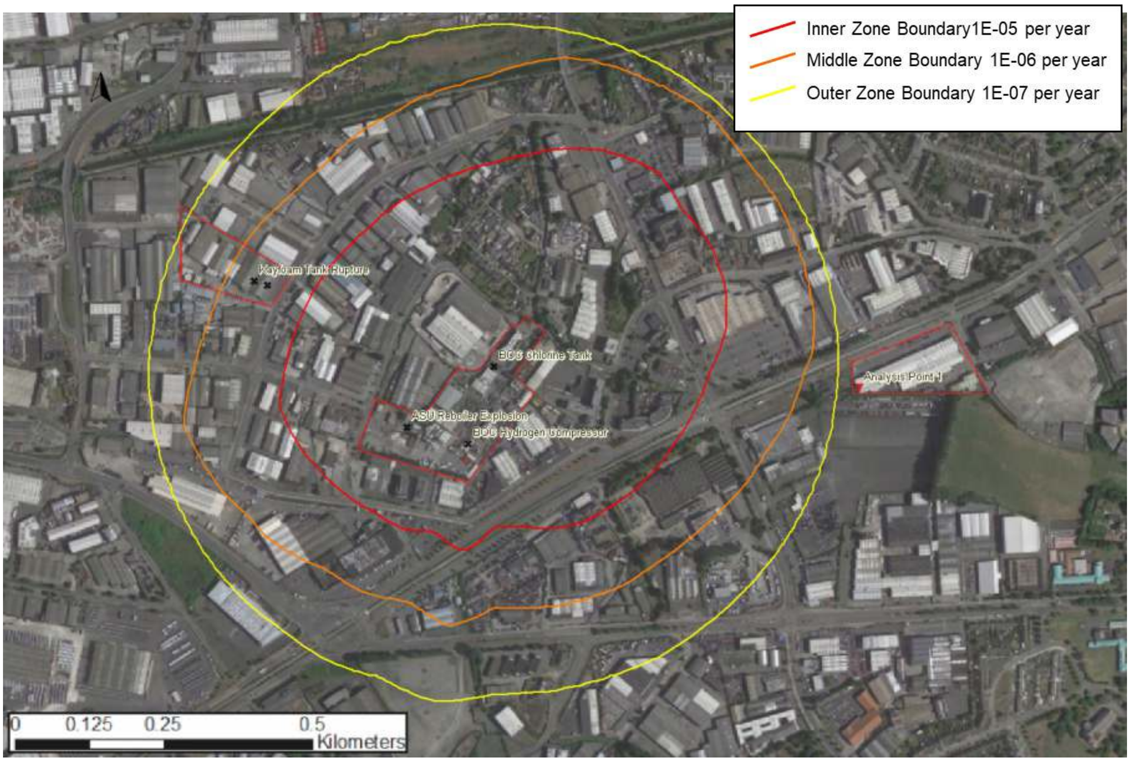


Figure 7-1 Individual Risk of Fatality Contours for BOC Gases Ireland and Kayfoam Woolfson

It is noted that the 1 tonne chlorine tank release scenario provides the biggest contribution to the outer LUP zone.

In the event of a release of chlorine gas from the 1 tonne drum at BOC Gases Ireland the following is concluded as discussed in Section 5.1.2 above:

- Toxic dose levels corresponding to 1% fatality outdoors for weather category F2 (night time weather conditions) (effect height, 1.5 m) do not extend to the proposed development;
- Toxic dose levels corresponding to 1% fatality outdoors for weather category D5 (representing daytime weather conditions) (effect height, 1.5 m) do not extend to the proposed development;
- Toxic dose levels corresponding to 1% fatality indoors (effect height, 1.5 m) for weather categories F2 and D5 do not extend to the proposed development;
- Persons indoors and outdoors during the daytime hours are protected (represented by weather category D5).

It is concluded that the outer land use planning zone does not extend to the proposed development. Therefore, on the basis of individual risk, the BOC Gases Ireland Ltd and Kayfoam Woolfson Ltd. sites do not pose a constraint to the development of the former Concorde site.

8.0 CONCLUSION

A land use planning assessment was completed addressing potential constraints posed by the BOC Gases Ireland Upper Tier COMAH establishment and the Kayfoam Woolfson Lower Tier COMAH establishment to the development of the former Concorde Industrial Estate site on the Naas Road, Dublin 12.

The assessment was completed in accordance with the Policy and Approach of the Health and Safety Authority to COMAH Risk-based Land-use Planning (HSA, 2010).

Assessment of BOC Gases Ireland Major Accident Hazards

BOC Gases Ireland is engaged in the manufacturing of oxygen, nitrogen, argon and hydrogen and the storage of various other gases including toxic gases. The following major accident scenarios were assessed for land use planning purposes:

- Release and dispersion of toxic chlorine gas from 1 tonne tank
- Reboiler explosion with overpressure consequences
- Hydrogen Compressor Jet fire

The assessment results are summarised as follows:

Scenario	Consequences	Frequency	Comments
Chlorine tank release	576 m to SLOT DTL following drum drop and release duration of 5 mins (Weather Category F2) 175 m to SLOT DTL following drum drop and release duration of 5 mins (Weather Category D5)	1.25E-04 /year	• The proposed development is located approximately 603 m from the location of the chlorine tank at BOC Gases Ireland; • Distance to toxic dose levels corresponding to SLOT DTL and 1% fatality outdoors for weather category F2 and D5 (effect height, 1.5 m) do not extend to the proposed development; • Toxic dose levels corresponding to SLOT DTL and 1% fatality outdoors for weather category D5 (effect height, 1.5 m) do not extend to the proposed development; • Toxic dose levels corresponding to SLOT DTL and 1% fatality indoors for weather categories F2 and D5 (effect height, 1.5 m) do not extend to the proposed development; • Individual risk of fatality contours do not extend to the proposed development.
	588 m to SLOT DTL following drum drop and release duration of 20 mins (Weather Category F2) 170 m to SLOT DTL following drum drop and release duration of 20 mins (Weather Category D5)	4.99E-04 /year	
	583 m to SLOT DTL following valve shear and release duration of 30 mins (Weather Category F2) 146 m to SLOT DTL following valve shear and release duration of 30 mins (Weather Category D5)	2.34E-03 /year	
ASU Reboiler Explosion	80 m to 1% mortality outdoors overpressure level 118 m to 1% mortality indoors in Category 2 structures (typical 4 storey office building) 205 m to 1% mortality indoors in Category 3 structure (residential building)	1E-04 /year	Personnel outdoors and indoors at the proposed development are protected from an explosion involving the reboiler at the BOC Gases ASU Individual risk of fatality contours (as above) do not extend to the proposed development

Hydrogen Jet fire	113 m to threshold of fatality thermal radiation level 104 m to 1% mortality outdoors thermal radiation level 96 m to thermal radiation level below which persons indoors are protected	5E-06 /year	Negligible consequences outdoors at proposed development Persons indoors are protected at proposed development Individual risk of fatality contours (as above) do not extend to the proposed development

Assessment of Kayfoam Woolfson Major Accident Hazards

Kayfoam Woolfson are involved in the manufacture of polyurethane foams for use in soft furnishings including mattresses and pillows.

Kayfoam use toluene diisocyanate (TDI) in the manufacture of the polyurethane foams which is classified as an acute toxic category 1 via inhalation. TDI has a very low vapour pressure (0.1 mmHg at 25 degC). When mixed with air the density was calculated to be 1.2253 kg/m^3. TNO Effects recommends the use of the neutral gas dispersion model where the density of the material is not more than 10% heavier than air (1.24 kg/m^3) therefore the neutral gas dispersion model in TNO Effects was used.

The following major accident scenarios were assessed for land use planning purposes:

- Major leak from bulk storage tank, pool formation within storage tank bund and evaporation and dispersion of TDI from the surface of the liquid pool;
- Catastrophic tank rupture with bund overtopping pool formation within and adjacent to bund and evaporation and dispersion of TDI from the surface of the liquid pool.

The following was concluded:

- In the event of an accidental release of TDI into the largest bund, toxic dose outdoor corresponding to SLOT DTL effects and 1% probability of fatality (at the effect height considered, 1.5 m) are not reached. Fatalities outdoors are not expected to arise at the proposed development as a result of this scenario;
- In the event of a catastrophic rupture of the largest TDI tank, toxic dose outdoor corresponding to SLOT DTL effects and 1% probability of fatality (at the effect height considered, 1.5 m) are not reached. Fatalities outdoors are not expected to arise at the proposed development as a result of this scenario.

Cumulative Risk

The cumulative individual risk contours for the BOC Gases Ireland and Kayfoam Woolfson sites corresponding to the boundary of the inner, middle and outer land use planning zones are illustrated as follows.

It is noted that the 1 tonne chlorine tank release scenario provides the biggest contribution to the outer LUP zone. As outlined above, toxic dose levels corresponding to SLOT DTL and 1 % probability of fatality outdoor and indoor (weather category F2 and D5) do not extend to the proposed development.

It is concluded that the outer land use planning zone does not extend to the proposed development. Therefore, on the basis of individual risk, the BOC Gases Ireland Ltd and Kayfoam Woolfson Ltd. sites do not pose a constraint to the development of the former Concorde site.

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END OF REPORT

APPENDIX 4.1 RMP SITES WITHIN THE SURROUNDING AREA

SMR No.	DU018-034
RMP Status	RMP
Townland	Bluebell/Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	710674/732306
Classification	Bridge
Dist. from development	c. 170m north
Description	No information available
Reference	www.archaeology.ie/ SMR file

SMR No.	DU018-033001/2
RMP Status	RMP
Townland	Bluebell
Parish	Drimnagh
Barony	Uppercross
I.T.M.	710527/732373
Classification	Church and Graveyard
Dist. from development	c. 285m north-northwest
Description	No information available
Reference	www.archaeology.ie/ SMR file

SMR No.	DU018-035
RMP Status	RMP
Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	711129/731964
Classification	Water mill - unclassified
Dist. from development	c. 290m southeast
Description	No information available
Reference	www.archaeology.ie/ SMR file

SMR No.	DU018-036
RMP Status	RMP
Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	711056/731833
Classification	Castle - Anglo-Norman masonry castle
Dist. from development	c. 300m southeast
Description	Now located on the grounds of the Christian Brother's monastery and school or the Long Mile Road, this castle is associated with the Barnewall family from the 13th to the early 17th century (Ball 1899, 95-6; Ball 1906, 125-132; Mc Dix 1897, 49-50: Anon 1914, 780). A rectangular moat (L 61m, W 45m) crossed by a stone-arched bridge (1780) on the E side leads onto a three-storey oblong tower incorporating a segmental-arched gateway. It has a projecting stair turret on the S side, lit by slit loops and a flattened arched ope with chamfered jambs The main chambers of the gate tower are lit by later inserted windows. The gate tower adjoins the S end of a great hall of 14th-16th-century date. This rises to two storeys over a vaulted basement and is entered from the courtyard by an

	outer staircase. This building has been considerably altered. The N wing rises t two storeys and is of probable 17th century date. An isolated NE tower may be part of the early defences of the castle. Limited excavations in 1992 and 1993 a the NW of the castle within the area enclosed by the moat revealed a stone-filled pit which contained 13th-15th century pottery and a drilled roof slate (Mullins 1993, 14; Mullins 1994, 13).
Reference	www.archaeology.ie/ SMR file

APPENDIX 4.2 RPS/NIAH SITES WITHIN THE SURROUNDING AREA

RPS No.	-
NIAH Ref.	50080437
Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	710850/732270
Classification	Lansdowne House
Dist. fr development	c. 115m northeast
Description	Description Detached square-plan three-bay two-storey house, built 1952, with quadrant-pro entrance bay to south-east corner of front (south) elevation. Flat roof w oversailing timber eaves. Painted concrete block walls with brown brick pli course. Square-headed window openings with timber-framed casement windo and concrete sills. Curved strip window to first floor of entrance bay and glass blc window to ground floor. Double-height wrap-around corner window to stair hall south-east corner. Some replacement uPVC windows. Square-headed dc opening to front and rear elevations, having replacement timber panelled do Painted brick boundary wall and replacement corrugated-iron gates to north to C Naas Road. Appraisal Lansdowne House is a remarkably complete and well-preserved example of r twentieth-century residential architecture, and the flat roof, quadrant entrance b and double-height corner stair windows are of particular interest. The house w designed by its owner, Jack Moran, who was a Commandant Engineer, and t house was built by direct labour. Lansdowne House is so called after t Lansdowne Valley, in which it lies. The house was formerly entered from south-e from the Naas Road, but is now accessed from the rear on the Old Naas Road.
Categories special interest	Architectural
Rating	Regional
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

RPS No.	5793
NIAH Ref.	-
Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	710878/732265
Classification	Naisetra House
Dist. fr development	c. 125m northeast
Description	No information available
Categories special interest	-
Rating	-
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

RPS No.	835

NIAH Ref.	50080436
Townland	Bluebell
Parish	Drimnagh
Barony	Uppercross
I.T.M.	710840/732359
Classification	Our Lady of the Wayside
Dist. fr development	c. 195m north
Description	Description Freestanding double-height red brick Roman Catholic church, built 1968, havi apse to north with conical roof, lean-to side aisles with flat-roofed confessio projections to east and west elevations, entrance front to south elevation, squa plan five-stage bell-tower to north-east corner, and flat-roofed sacristy to w elevation of chancel. Pitched slate roof to nave having masonry coping, eav course, cross finial and cast-iron rainwater goods. Pyramidal slate roof to bell tow having metal cross finial. Red brick walls laid in English garden wall bond o chamfered masonry plinth. Paired round-arched windows with cut maso surrounds to east and west elevations, having leaded stained glass. Rose wind in recessed blind arch to entrance bay, having cut and carved masonry tracery a surround. Round-arched windows to front elevation, apse and tower, havi masonry surrounds. Round-arched windows to sacristy, in pairs and tripl Unglazed arcades to belfry. Round-headed door openings with carved maso dressings and timber panelled doors, some leaded overlights and cut granite ste Interior with altar to north having carved marble altar. Gallery over main entran having timber panelled half-glazed double-leaf doors with leaded overligh Coffered ceilings, barrel-vaulted over side aisles. Arcades to side aisles, havi marble-clad octagonal piers. Timber panelled recessed confessionals and carv timber pews. Set in own grounds, bounded by red brick plinth walls with st railings, steel entrance gates and red brick piers. Located to north of Blueb Avenue, to east of junction with Naas Road. Appraisal The Church of Our Lady of the Wayside demonstrates the confidence of the Rom Catholic Church and its importance as a patron in the mid-twentieth century. T church is very similar in style to the Roman Catholic Church of the Assumption Walkinstown, dated 1954. The parish of Bluebell was established in 1967, and C Lady of the Wayside was constructed in anticipation of the development of la housing estates at Bluebell. Much of the land was later rezoned for industrial u and the church's capacity exceeded its congregational requirements. Though t building follows a traditional plan and form, this church displays features a materials, such as the flat roofs and red brick walls, which are typical of twentie century church design. Its height and form make it a notable landmark in the ar and is visible from the Naas Road to the east. In active use by the local commur it plays an important role in the area. The colourful stained-glass windows add the artistic interest and enliven the interior.
Categories special interest	Architectural, Artistic, Social
Rating	Regional
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

RPS No.	4832
NIAH Ref.	50080447
Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	711053/731824

Classification	Drimnagh Castle – Moat
Dist. fr development	c. 290-340m southeast
Description	Description Rectangular-plan moat, built c.1400, repaired c.1990, forming protective defer around Drimnagh Castle grounds. Entrance bridge spanning moat, built c.17 replacing earlier drawbridge structure. Castellated walls of the castle and ya constructed from local calp limestone and featuring battered buttresses. Sto platform east of the undercroft allowing access to moat via stone steps. Ea twentieth-century castellated walls, built c.1904, having openings with br detailing and pediments, enclosing coach house to south. Steel bridge spanni moat leading to coach house from Drimnagh Castle school grounds. Fed by t Bluebell stream, enclosing castle, courtyard, gardens, stable buildings, work ya and coach house. Draining into Lansdowne Valley via sluice gate. Appraisal In 1215 Hugh De Berneval, or Barnewall, acquired the lands of Drimnagh, Kimma and Terenure and began construction of fortifications on this site. The earliest pa of the castle date to the late fourteenth century and the moat was designed as defensive measure to minimise the risk of enemy invasion, protecting people a animals within its enclosure. An extensive renovation and reconstruction of t castle and demesne began in 1986 and included repair works to the moat and wa Drimnagh Castle is reputedly the only medieval castle in Ireland to retain its flood moat.
Categories special interest	Architectural, Archaeological, Historical, Technical
Rating	National
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

RPS No.	4832
NIAH Ref.	50080448
Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	711053/731824
Classification	Drimnagh Castle – Bridge
Dist. fr development	c. 290-340m southeast
Description	Description Single-arch bridge, built c.1780, renovated c.1990, spanning moat at cas entrance to east elevation and abutting castle tower. Rubble calp limestone wa with round arch having dressed limestone voussoirs and castellated parape Earthen finish to path. Bridge partially reconstructed to north wall, remnants render finish to south wall. Appraisal A traditionally constructed bridge in unrefined locally-sourced stone resulting in appealing textured visual effect. This eighteenth-century stone bridge replaced earlier drawbridge structure. The moat was designed as a defensive measure minimise the risk of enemy invasion, protecting people and animals within enclosure. The replacement of the drawbridge with a stone bridge in the eightee century signifies a change in attitude to defence at the castle.
Categories special interest	Architectural, Technical
Rating	Regional
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

RPS No.	4832
NIAH Ref.	50080450
Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	711053/731824
Classification	Drimnagh Castle – Garden
Dist. fr development	c. 290-340m southeast
Description	Description Rectangular walled garden, laid out c.1900, comprising rubble calp limestone wa to north and east, planted boundary to south and west. Square-profile pier to nor west corner, recent double-leaf gates to east wall, flanked by square-profile pie Remodelled c.1990, with formal planting. Remains of square-plan single-bay tov to paddock to north. Situated to east of central courtyard. Appraisal Walled gardens were an essential feature of country houses, providing fr vegetables and herbs for the kitchen. The shelter provided by the high walls allow the cultivation of a wide variety of plants, including vulnerable fruit trees. It w recently remodelled in the style of a seventeenth-century formal parterre gard providing an unusual contrast to the simple walls which are built of local undress calp limestone, like the other castle elements.
Categories special interest	Architectural, Historical
Rating	Regional
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

RPS No.	4832
NIAH Ref.	50080451
Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	711053/731824
Classification	Drimnagh Castle – Museum/Gallery
Dist. fr development	c. 290-340m southeast
Description	Description Freestanding rectangular-plan multiple-bay three-storey castle, built c.14 consisting of undercroft, great hall and gallery, with square-plan four-sta sixteenth century keep to south. Site enclosed by moat. Partly rebuilt and renovat c.1985. Replacement oak truss pitched slate roof over Great Hall, hipped to nor having shaped stone parapet, fumerelle and brick chimney to north gab Replacement hipped slate roof over tower, having castellated parapet with sto battlements and brick chimney to south elevation. Billeted stone moulding to ba of parapet of main block. Cut stone string course to tower. Reconstructed wind openings to main block and tower, featuring cut limestone surrounds, havi replacement cut and carved tracery and leaded glass. Square-headed openings great hall, east and west elevations, openings to east having brick pediment. Pair round-headed lancet windows to tower, east and west elevations, lower pair havi brick pediment. Loop windows to tower, south elevation. Entrance to inner courtya via integral arch through tower. Lowered pointed arch entrance opening undercroft having limestone voussoirs and replacement timber door. First fl

	gabled stone entrance porch and steps-built c.1780 allowing access from courtya to great hall. Fourteenth-century undercroft having vaulted ceiling with remains wicker centering, embrasure windows, sixteenth-century hearth, smoker and ba marie. Stone staircases to south and north-east allow access to great hall, havi seventeenth-century hearth and reconstructed oak truss roof and gallery. Sixteen century tower features lookout turrets to the south and west. Appraisal Drimnagh Castle was occupied to 1954, making it one of the oldest occupi buildings in the country. It is also one of very few medieval structures to still ha its enclosing moat. Its current form results from multi-period construction, begun the acquisition of the lands by Hugh De Berneval in 1215. The earlier wor including the undercroft, and the tower built by the Loftus family in the seventeen century, are typical of the need for defence at the time, while the later works su as the entrance bridge and walled garden are a physical reminder of the increas peace and prosperity of the country in the eighteenth century. As Dublin c expanded, the castle became part of the new suburbs of Drimnagh a Walkinstown, providing an interesting contrast to the twentieth-century school b on the grounds c.1960, and a notable reminder of Drimnagh's rural and histori past. Extensively renovated by a local community project, the castle nonethele retains much significant early fabric. (http://www.drimnaghcastle.org/)
Categories special interest	Architectural, Archaeological, Historical, Technical
Rating	National
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

RPS No.	4832
NIAH Ref.	50080464
Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	711053/731824
Classification	Drimnagh Castle – Barn
Dist. fr development	c. 290-340m southeast
Description	Description Detached rectangular-plan five-bay two-storey former barn and stable buildin built c.1650, with eighteenth-century and early twentieth-century alterations, havi first floor bridge connection to Drimnagh Castle Great Hall to east elevatio Currently in use as office and workshop. Pitched slate roof, hipped to east end, w yellow brick chimneystack having clay chimney pots, castellated parapet havi circular opening, and cast-iron rainwater goods. Rubble calp limestone wa Square-headed window openings with chamfered granite sills to front (south) a west elevations, yellow brick block-and-start surrounds having pediments, and s over-six pane timber sash windows. Pair of segmental-headed window openin flanking main entrance having six-over-six pane timber sash windows with marg sashes. Square-headed window openings to rear elevation, blocked. Loop windo to with chamfered surrounds to both elevations of bridge to Great Hall. Squa headed door openings to front elevation, having yellow brick block-and-st surrounds with pediments and replacement timber doors, opening to east havi nosed granite steps and metal handrails, leading to raised podium on external sto staircase to the Great Hall. Square-headed door opening under bridge, having c limestone surround and double-leaf timber panelled doors. Square-headed do openings to rear elevation, blocked. Located within the grounds of Drimnagh Cast west of the main castle building, having courtyard to south, walled garden to we and paddock to north.

	Appraisal The current form of Drimnagh Castle results from multi-phase construction, beg by the acquisition of the lands by Hugh De Berneval in 1215. The barn, or stal buildings, date from the seventeenth century, when the Loftus family owned of t castle. Further works were carried out in the eighteenth century, including t addition of the external stairway from the courtyard to the Great Hall. The brid connection from the barn may also date from this period. The castle was acquir by the Hatch family c.1904. Among the works executed by the Hatch family was t reconstruction of the barn to form stable buildings. Extensively renovated by community project in the 1980s following dereliction, the barn nonetheless reta much significant early fabric, including extensive use of local calp limestone.
Categories special interest	Architectural, Archaeological, Historical
Rating	National
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

RPS No.	5794
NIAH Ref.	50080435
Townland	Bluebell
Parish	Drimnagh
Barony	Uppercross
I.T.M.	710517/732396
Classification	Bluebell Cemetery, Mediaeval church ruin, graveyard, and surrounding ring fort
Dist. fr development	c. 310m north-northwest
Description	Description Enclosed irregular-plan graveyard, consisting of early graveyard with thirteen century church to south, extended to north 1905. Roofless ruinous remains medieval rubble limestone church, having surviving gable, rubble stone wa square-headed window opening with chamfered reveals and rubble stone vousso to interior, pointed arch door opening with rubble stone voussoirs. Poured concre paths to later graveyard, converging in centre with limestone shaft. Rock-fac rusticated circular-profile limestone shaft, having cross motif and string courses, s on octagonal-profile plinth. Rubble limestone boundary walls with gateway to sou east corner, having square-profile tooled limestone piers with double-leaf cast-ir gates, giving onto laneway to south to Old Naas Road. Rendered gate piers w cast-iron posts to south end of lane. Appraisal The church appears to have been in use in 1547 at the time of the dissolution Saint Patrick's Cathedral. The earliest known gravestone dates to 1713. Church Ireland burials took place from 1742 to 2001, and the graveyard was extended the north as far as the Camac River in 1905. The early graveyard is shown in t 1844 Ordnance Survey map. Church is noted as being in ruins on the 19 Ordnance Survey map. This site attests to the long-standing ecclesiasti presence in the locality, and is of significant importance in the social history of t area. The once rural area of Bluebell was developed by Dublin City Corporati from the 1960s, and the cemetery is now surrounded by industrial estates.
Categories special interest	Architectural, Archaeological, Historical, Social
Rating	Regional
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

RPS No.	5792
NIAH Ref.	50080484

Townland	Drimnagh
Parish	Drimnagh
Barony	Uppercross
I.T.M.	710337/731897
Classification	Mercedes Benz Factory/Office, Volkswagen premises, front range of buildings only
Dist. fr development	c. 320m southwest
Description	Description Detached thirty-nine-bay double-height factory, built c.1950, comprising cent square-plan tower with stepped corners flanked by projecting five-bay blocks w curved corners, in turn flanked by fourteen-bay blocks. Attached saw tooth roof block to south, and attached saw tooth roofed block to east. Flat roof with red br parapet having ceramic copings. Red brick parapet with ceramic string course a digital clocks to tower, topped by rotating Mercedes symbol. Red brick walls lai English garden wall bond, with ceramic tiled pilasters flanking openings, having til lintels and sills. Metal fittings to openings, many recently replaced and with rec curved glazing to entrance. Various related buildings to south. Rendered bound plinths and piers with cast-metal railings and gates. Appraisal Though now somewhat hidden from view by vegetation, the imposing to continues to make an eye-catching contribution to the streetscape and it brings vertical contrast to the building's long, horizontal form. Executed in crisp red bri the ceramic detailing adds definition, colour and textural interest to this carefu detailed building. Though some fittings have been replaced, original metal windo can be seen in the tower and parts of the projecting curved bays. A fine example modern architecture, it may have been commissioned by Burtons, before being s to Mercedes Benz.
Categories special interest	Architectural
Rating	Regional
Reference	www.buildingsofireland.ie/ Dublin City Development Plan 2016-2022

APPENDIX 4.3 STRAY FINDS WITHIN THE SURROUNDING AREA

Information on artefact finds from the study area in County Dublin has been recorded by the National Museum of Ireland since the late 18th century. Location information relating to these finds is important in establishing prehistoric and historic activity in the study area.

A review of the topographical files for the study area revealed that there have not been any stray finds recorded.

APPENDIX 4.4 LEGISLATION PROTECTING THE ARCHAEOLOGICAL RESOURCE

Protection of Cultural Heritage

The cultural heritage in Ireland is safeguarded through national and international policy designed to secure the protection of the cultural heritage resource to the fullest possible extent (Department of Arts, Heritage, Gaeltacht and the Islands 1999, 35). This is undertaken in accordance with the provisions of the *European Convention on the Protection of the Archaeological Heritage* (Valletta Convention), ratified by Ireland in 1997.

The Archaeological Resource

The *National Monuments Act 1930 to 2014* and relevant provisions of the *National Cultural Institutions Act 1997* are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. A National Monument is described as ‘a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto’ (National Monuments Act 1930 Section 2). A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places, and the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

Ownership and Guardianship of National monuments

The Minister may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Register of Historic Monuments

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the register is illegal without the permission of the Minister. Two months’ notice in writing is required prior to any work being undertaken on or in the vicinity of a registered monument. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Preservation Orders and Temporary Preservation Orders

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Record of Monuments and Places

Section 12(1) of the 1994 Act requires the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for the Department of Culture, Heritage and the Gaeltacht) to establish and maintain a record of monuments and places where the Minister believes that such monuments exist. The record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the state. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994. All recorded monuments on the proposed development site are represented on the accompanying maps.

Section 12(3) of the 1994 Act provides that 'where the owner or occupier (other than the Minister for Arts, Heritage, Gaeltacht and the Islands) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage, Gaeltacht and the Islands to carry out work and shall not, except in case of urgent necessity and with the consent of the Minister, commence the work until two months after giving of notice'.

Under the National Monuments (Amendment) Act 2004, anyone who demolishes or in any way interferes with a recorded site is liable to a fine not exceeding €3,000 or imprisonment for up to 6 months. On summary conviction and on conviction of indictment, a fine not exceeding €10,000 or imprisonment for up to 5 years is the penalty. In addition, they are liable for costs for the repair of the damage caused.

In addition to this, under the *European Communities (Environmental Impact Assessment) Regulations 1989,* Environmental Impact Statements (EIS) are required for various classes and sizes of development project to assess the impact the proposed development will have on the existing environment, which includes the cultural, archaeological and built heritage resources. These document's recommendations are typically incorporated into the conditions under which the proposed development must proceed, and thus offer an additional layer of protection for monuments which have not been listed on the RMP.

The Planning and Development Act 2000

Under planning legislation, each local authority is obliged to draw up a Development Plan setting out their aims and policies with regard to the growth of the area over a five-year period. They cover a range of issues including archaeology and built heritage, setting out their policies and objectives with regard to the protection and enhancement of both. These policies can vary from county to county. The Planning and Development Act 2000 recognises that proper planning and sustainable development includes the protection of the archaeological heritage. Conditions relating to archaeology may be attached to individual planning permissions.

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It is the policy of Dublin City Council:

CHC9:

- To protect and preserve National Monuments.
- To protect archaeological material in situ by ensuring that only minimal impact on archaeological layers is allowed, by way of the re-use of buildings, light buildings, foundation design or the omission of basements in the Zones of Archaeological Interest.
- That where preservation in situ is not feasible, sites of archaeological interest shall be subject to 'preservation by record' according to best practice in advance of re-development.
- That sites within Zones of Archaeological Interest will be subject to consultation with the City Archaeologist and archaeological assessment prior to a planning application being lodged.
- That the National Monuments Service will be consulted in assessing proposals for development which relate to Monuments and Zones of Archaeological Interest.
- To preserve known burial grounds and disused historic graveyards, where appropriate, to ensure that human remain are re-interred, except where otherwise agreed with the National Museum of Ireland.
- That in evaluating proposals for development in the vicinity of the surviving sections of the city wall that due recognition be given to their national significance and their special character.

- To have regard to the Shipwreck inventory maintained by the DAHG. Proposed developments that may have potential to impact on riverine, inter-tidal and sub-tidal environments shall be subject to an underwater archaeological assessment in advance of works.
- To have regard to DAHG policy documents and guidelines relating to archaeology

It is an objective of Dublin City Council:

CHCO10:

- To implement the archaeological actions of the Dublin City Heritage Plan 2002–2006 in light of the Dublin City Heritage Plan Review 2012.
- To prepare and implement conservation plans for National Monuments and Monuments in DCC care (City Walls, St Luke's Church, St James's Graveyard, St Thomas's Abbey, St Canice's Graveyard etc).
- To maintain, develop and promote the Dublin City Archaeological Archive (DCAA) at Pearse Street Library and Archives.
- To ensure the public dissemination of the findings of licensed archaeological activity in Dublin through the Dublin County Archaeology GIS.
- To develop a long-term management plan to promote the conservation, management and interpretation of archaeological sites and monuments and to identify areas for strategic research.
- To have regard to the city's industrial heritage and Dublin City Industrial Heritage Record (DCIHR) in the preparation of Local Area Plans (LAPs) and the assessment of planning applications and to publish the DCIHR online. To review the DCIHR in accordance with Ministerial recommendations arising from the national Inventory of Architectural Heritage (NIAH) survey of Dublin City and in accordance with the Strategic Approach set out in Section 11.1.4 of this chapter.
- To promote awareness of, and access to, the city's archaeological inheritance and foster high-quality public archaeology.
- To promote archaeological best practice in Dublin city.
- To promote the awareness of the international significance of Viking Dublin and to support post-excavation research into the Wood Quay excavations 1962 – 1981.
- To develop a strategy for the former Civic Museum collection and for other collections of civic interest and importance.
- To investigate the potential for the erection of Columbarium Walls.
- To support the implementation of the Kilmainham Mill Conservation Plan.
- Dublin City Council will seek to work with Diageo to undertake a more comprehensive industrial heritage survey of the constituent historic buildings within the Guinness Brewery complex at St James's Gate.
- To implement and promote The Dublin Principles (ICOMOS, 2011) as guiding principles to assist in the documentation, protection, conservation and appreciation of industrial heritage as part of the heritage of Dublin and Ireland.
- To continue to implement actions of the St Luke's Conservation Plan on the basis of funds available to conserve the monument, recover the graveyard, provide visitor access, improve visual amenity and secure an appropriate new use.

APPENDIX 4.5 LEGISLATION PROTECTING THE ARCHITECTURAL RESOURCE

The main laws protecting the built heritage are the *Architectural Heritage (National Inventory) and National Monuments (Miscellaneous Provisions) Act 1999* and the *Local Government (Planning and Development) Acts 1963–1999*, which has now been superseded by the *Planning and Development Act, 2000*. The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The background to this legislation derives from Article 2 of the 1985 Convention for the Protection of Architectural Heritage (Granada Convention). This states that:

For the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member state will undertake to maintain inventories of that architectural heritage.

The National Inventory of Architectural Heritage (NIAH) was established in 1990 to fulfil Ireland's obligation under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architecture of Ireland (NIAH Handbook 2005:2). As inclusion in the inventory does not provide statutory protection, the survey information is used in conjunction with the *Architectural Heritage Protection Guidelines for Planning Authorities* to advise local authorities on compilation of a Record of Protected Structures as required by the *Planning and Development Act, 2000*.

Protection under the Record of Protected Structures and County Development Plan

Structures of architectural, cultural, social, scientific, historical, technical or archaeological interest can be protected under the Planning and Development Act, 2000, where the conditions relating to the protection of the architectural heritage are set out in Part IV of the act. This act superseded the Local Government (Planning and Development) Act, 1999, and came into force on 1st January 2000.

The act provides for the inclusion of Protected Structures into the planning authorities' development plans and sets out statutory regulations regarding works affecting such structures. Under new legislation, no distinction is made between buildings formerly classified under development plans as List 1 and List 2. Such buildings are now all regarded as 'Protected Structures' and enjoy equal statutory protection. Under the act the entire structure is protected, including a structure's interior, exterior, attendant grounds and also any structures within the attendant grounds.

The act defines a Protected Structure as (a) a structure, or (b) a specified part of a structure which is included in a Record of Protected Structures (RPS), and, where that record so indicates, includes any specified feature which is in the attendant grounds of the structure and which would not otherwise be included in this definition. Protection of the structure, or part thereof, includes conservation, preservation, and improvement compatible with maintaining its character and interest. Part IV of the act deals with architectural heritage, and Section 57 deals specifically with works affecting the character of Protected Structures or proposed Protected Structures and states that no works should materially affect the character of the structure or any element of the structure that contributes to its special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. The act does not provide specific criteria for assigning a special interest to a structure. However, the National Inventory of Architectural Heritage (NIAH) offers guidelines to its field workers as to how to designate a building with a special interest, which are not mutually exclusive. This offers guidance by example rather than by definition:

Archaeological

It is to be noted that the NIAH is biased towards post-1700 structures. Structures that have archaeological features may be recorded, providing the archaeological features are incorporated within post-1700 elements. Industrial fabric is considered to have technical significance, and should only be attributed archaeological significance if the structure has pre-1700 features.

Architectural

A structure may be considered of special architectural interest under the following criteria:

- Good quality or well executed architectural design
- The work of a known and distinguished architect, engineer, designer, craftsman
- A structure that makes a positive contribution to a setting, such as a streetscape or rural setting
- Modest or vernacular structures may be considered to be of architectural interest, as they are part of the history of the built heritage of Ireland.
- Well-designed decorative features, externally and/or internally

Historical

A structure may be considered of special historical interest under the following criteria:

- A significant historical event associated with the structure
- An association with a significant historical figure
- Has a known interesting and/or unusual change of use, e.g. a former workhouse now in use as a hotel
- A memorial to a historical event.

Technical

A structure may be considered of special technical interest under the following criteria:

- Incorporates building materials of particular interest, i.e. the materials or the technology used for construction
- It is the work of a known or distinguished engineer
- Incorporates innovative engineering design, e.g. bridges, canals or mill weirs
- A structure which has an architectural interest may also merit a technical interest due to the structural techniques used in its construction, e.g. a curvilinear glasshouse, early use of concrete, cast-iron prefabrication.
- Mechanical fixtures relating to a structure may be considered of technical significance.

Cultural

A structure may be considered of special cultural interest under the following criteria:

- An association with a known fictitious character or event, e.g. Sandycove Martello Tower, which featured in Ulysses.
- Other structure that illustrate the development of society, such as early schoolhouses, swimming baths or printworks.

Scientific

A structure may be considered of special scientific interest under the following criteria:

- A structure or place which is considered to be an extraordinary or pioneering scientific or technical achievement in the Irish context, e.g. Mizen Head Bridge, Birr Telescope.

Social

A structure may be considered of special social interest under the following criteria:

- A focal point of spiritual, political, national or other cultural sentiment to a group of people, e.g. a place of worship, a meeting point, assembly rooms.
- Developed or constructed by a community or organisation, e.g. the construction of the railways or the building of a church through the patronage of the local community
- Illustrates a particular lifestyle, philosophy, or social condition of the past, e.g. the hierarchical accommodation in a country house, philanthropic housing, vernacular structures.

Artistic
A structure may be considered of special artistic interest under the following criteria:

- Work of a skilled craftsman or artist, e.g. plasterwork, wrought-iron work, carved elements or details, stained glass, stations of the cross.
- Well-designed mass-produced structures or elements may also be considered of artistic interest.

(From the NIAH Handbook 2003 & 2005 pages 15–20)

The Local Authority has the power to order conservation and restoration works to be undertaken by the owner of the protected structure if it considers the building to need repair. Similarly, an owner or developer must make a written request to the Local Authority to carry out any works on a protected structure and its environs, which will be reviewed within three months of application. Failure to do so may result in prosecution.

Dublin City Development Plan 2016-2022

It is the policy of Dublin City Council:

CHC1: To seek the preservation of the built heritage of the city that makes a positive contribution to the character, appearance and quality of local streetscapes and the sustainable development of the city.

CHC2: To ensure that the special interest of protected structures is protected. Development will conserve and enhance Protected Structures and their curtilage and will:

(a) Protect or, where appropriate, restore form, features and fabric which contribute to the special interest
(b) Incorporate high standards of craftsmanship and relate sensitively to the scale, proportions, design, period and architectural detail of the original building, using traditional materials in most circumstances
(c) Be highly sensitive to the historic fabric and special interest of the interior, including its plan form, hierarchy of spaces, structure and architectural detail, fixtures and fittings and materials
(d) Not cause harm to the curtilage of the structure; therefore, the design, form, scale, height, proportions, siting and materials of new development should relate to and complement the special character of the protected structure
(e) Protect architectural items of interest from damage or theft while buildings are empty or during course of works
(f) Have regard to ecological considerations for example, protection of species such as bats.

Changes of use of protected structures, which will have no detrimental impact on the special interest and are compatible with their future long-term conservation, will be promoted.

CHC3: To identify and protect exceptional buildings of the late twentieth century; to categorise, prioritise and, where appropriate, add to the RPS. Dublin City Council will produce guidelines and offer advice for protection and appropriate refurbishment.

It is the objective of Dublin City Council:

CHCO1: To undertake a survey and review of the Record of Protected Structures (RPS) within the identified phase 1 priority areas (as set out in Section 11.1.4: The Strategic Approach) of special historic and architectural interest, as part of the ongoing strategic management of the RPS.

CHCO3: To review and consider the recommendations of the National Inventory of Architectural Heritage as part of the conservation strategy to review the Record of Protected Structures and to designate Architectural Conservation Areas within the identified phase 1 priority areas (as set out in Section 11.1.4: The Strategic Approach) of special historic and architectural interest. Consideration will also be given to the inclusion of industrial heritage structures of special interest.

CHCO4: To review the zoning objectives and the red-lined hatched conservation designations as part of the conservation strategy to review the Record of Protected Structures and to designate Architectural Conservation Areas within the identified phase 1 priority areas (as set out in Section 11.1.4: The Strategic Approach) of special historic and architectural interest. Consideration will also be given to the inclusion of industrial heritage structures of special interest.

CHCO5: To continue the compilation of the database of the Record of Protected Structures and Architectural Conservation Areas.

CHCO6: To provide guidance for owners of protected structures or historic buildings on upgrading for energy efficiency and to promote the principles of sustainable building design in conservation.

CHCO7: To maintain a register of Buildings at Risk in which protected structures at risk from neglect or wilful damage will be entered and actions may be taken to ensure their survival.

CHCO8: To prepare schemes for Areas of Special Planning Control, where deemed desirable and appropriate, having regard to statutory needs of the city.

APPENDIX 4.6 IMPACT ASSESSMENT AND THE CULTURAL HERITAGE RESOURCE

Potential Impacts on Archaeological and Historical Remains

Impacts are defined as 'the degree of change in an environment resulting from a development' (Environmental Protection Agency 2003: 31). They are described as profound, significant or slight impacts on archaeological remains. They may be negative, positive or neutral, direct, indirect or cumulative, temporary or permanent.

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological and historical resources potentially affected. Development can affect the archaeological and historical resource of a given landscape in a number of ways.

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape.

- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery; disturbance by vehicles working in unsuitable conditions; or burial of sites, limiting accessibility for future archaeological investigation.

- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or longer-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits.

- Visual impacts on the historic landscape sometimes arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic monuments and historic landscape elements as well as their visual amenity value.

- Landscape measures such as tree planting can damage sub-surface archaeological features, due to topsoil stripping and through the root action of trees and shrubs as they grow.

- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluviums or peat deposits.

- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, and service trenches.

Although not widely appreciated, positive impacts can accrue from developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments, and the increased level of knowledge of a site or historic landscape as a result of archaeological assessment and fieldwork.

Predicted Impacts

The severity of a given level of land-take or visual intrusion varies with the type of monument, site or landscape features and its existing environment. Severity of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;

- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected;

- Assessment of the levels of noise, visual and hydrological impacts, either in general or site-specific terms, as may be provided by other specialists.

APPENDIX 4.7 MITIGATION MEASURES AND THE CULTURAL HERITAGE RESOURCE

Potential Mitigation Strategies for Cultural Heritage Remains

Mitigation is defined as features of the design or other measures of the proposed development that can be adopted to avoid, prevent, reduce or offset negative effects.

The best opportunities for avoiding damage to archaeological remains or intrusion on their setting and amenity arise when the site options for the development are being considered. Damage to the archaeological resource immediately adjacent to developments may be prevented by the selection of appropriate construction methods. Reducing adverse effects can be achieved by good design, for example by screening historic buildings or upstanding archaeological monuments or by burying archaeological sites undisturbed rather than destroying them. Offsetting adverse effects is probably best illustrated by the full investigation and recording of archaeological sites that cannot be preserved in situ.

Definition of Mitigation Strategies

Archaeological Resource

The ideal mitigation for all archaeological sites is preservation in situ. This is not always a practical solution, however. Therefore, a series of recommendations are offered to provide ameliorative measures where avoidance and preservation in situ are not possible.

Full Archaeological Excavation can be defined as ‘a programme of controlled, intrusive fieldwork with defined research objectives which examines, records and interprets archaeological deposits, features and structures and, as appropriate, retrieves artefacts, ecofacts and other remains within a specified area or site on land, inter-tidal zone or underwater. The records made and objects gathered during fieldwork are studied and the results of that study published in detail appropriate to the project design’ (CIfA 2014a).

Archaeological Test Trenching can be defined as ‘a limited programme of intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site on land, inter-tidal zone or underwater. If such archaeological remains are present field evaluation defines their character, extent, quality and preservation, and enables an assessment of their worth in a local, regional, national or international context as appropriate’ (CIfA 2014b).

Archaeological Monitoring can be defined as ‘a formal programme of observation and investigation conducted during any operation carried out for non-archaeological reasons. This will be within a specified area or site on land, inter-tidal zone or underwater, where there is a possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive (CIfA 2014c).

Underwater Archaeological Assessment consists of a programme of works carried out by a specialist underwater archaeologist, which can involve wade surveys, metal detection surveys and the excavation of test pits within the sea or riverbed. These assessments are able to access and assess the potential of an underwater environment to a much higher degree than terrestrial based assessments.

Architectural Resource

The architectural resource is generally subject to a greater degree of change than archaeological sites, as structures may survive for many years but their usage may change continually. This can be reflected in the fabric of the building, with the addition and removal of doors, windows and extensions. Due to their often more visible presence within the landscape than archaeological sites, the removal of such structures can sometimes leave a discernible ‘gap’ with the cultural identity of a population. However, a number of mitigation measures are available to ensure a record is made of any structure that is deemed to be of special interest, which may be removed or altered as part of a proposed development.

Conservation Assessment consists of a detailed study of the history of a building and can include the surveying of elevations to define the exact condition of the structure. These assessments are carried out by Conservation Architects and would commonly be carried out in association with proposed alterations or renovations on a Recorded Structure.

Building Survey may involve making an accurate record of elevations (internal and external), internal floor plans and external sections. This is carried out using an EDM (Electronic Distance Measurer) and GPS technology to create scaled drawings that provide a full record of the appearance of a building at the time of the survey.

Historic Building Assessment is generally specific to one building, which may have historic significance, but is not a Protected Structure or listed within the NIAH. A full historical background for the structure is researched and the site is visited to assess the standing remains and make a record of any architectural features of special interest. These assessments can also be carried out in conjunction with a building survey.

Written and Photographic record provides a basic record of features such as stone walls, which may have a small amount of cultural heritage importance and are recorded for prosperity. Dimensions of the feature are recorded with a written description and photographs as well as some cartographic reference, which may help to date a feature.

APPENDIX 7.1 SITE INVESTIGATIONS REPORT

Concorde Residential Development – Ground Investigation

Client: Silvermount Ltd.

Client's Representative: Barrett Mahony Consulting Engineers

Report No.: 18-1234

Date: December 2018

Status: Final for Issue

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</table>

The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015, Code of practice for site investigations.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

Laboratory testing was conducted in accordance with:

British Standards Institute BS 1377:1990 parts 2, 4, 5, 7 and 9

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015, The Code of Practice for Site Investigation.

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler)
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler)
P	Nominal 100mm diameter undisturbed piston sample
B	Bulk disturbed sample
LB	Large bulk disturbed sample
D	Small disturbed sample
C	Core sub-sample (displayed in the Field Records column on the logs)
L	Liner sample from dynamic sampled borehole
W	Water sample
ES / EW	Soil sample for environmental testing / Water sample for environmental testing
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained)
SPT (c)	Standard penetration test using 60 degree solid cone
x,x/x,x,x,x	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length. The length achieved is stated (mm) for any test increment less than 75mm
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm)
N=X/Z	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm)
V VR	Shear vane test (borehole) Hand vane test (trial pit) Shear strength stated in kPa V: undisturbed vane shear strength VR: remoulded vane shear strength
dd/mm/yy: 1.0 dd/mm/yy: dry	Date & water level at the borehole depth at the end of shift and the start of the following shift
▽	Water strike: initial depth of strike
▼	Water strike: depth water rose to
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.
(xxx/xxx/xxx)	Spacing between discontinuities (minimum/average/maximum).

Concorde Residential Development

1 AUTHORITY

On the instructions of Barrett Mahony Consulting Engineers Consulting Engineers, (“the Client’s Representative”), acting on the behalf of Silvermount Ltd. (“the Client”), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed residential development.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results.

All information given in this report is based upon the ground conditions encountered during the site investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client’s Representative in response to a particular set of instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client’s Representative, included boreholes, soil and rock sampling, in-situ and laboratory testing, and the preparation of a factual report on the findings.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were on the site of the existing Concorde Industrial Estate, on the Naas Road, Dublin 12. The site is bounded by the Naas Road to the north, industrial units to the east and a car showroom to the south.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 7th and 16th November 2018, comprised:

- Four light cable percussion boreholes, two of which were completed by rotary drilling methods;
- four boreholes by dynamic (windowless) sampling methods;
- a standpipe installation in two boreholes;
- two dynamic probes; and
- an infiltration test performed in two boreholes.

The exploratory holes and in-situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plan in Appendix A.

4.2 Boreholes

A total of eight boreholes were put down in a minimum diameter of 150mm through soils and rock strata to their completion depths by a combination of methods, including light percussion boring using a Dando Terrier rig, light cable percussion boring using a Dando 2500 rig, and rotary drilling by a Comacchio 205 tracked rotary drilling rigs.

The borehole logs state the methodology and plant used for each location, as well as the appropriate depth ranges.

A summary of the boreholes, subdivided by category in accordance with the methods employed for their completion, is presented in the following sub-sections.

Appendix B presents the borehole logs.

4.2.1 Light cable percussion boreholes

Two boreholes (BH02-BH03) were put down to completion in minimum 200mm diameter using a Dando 2500 light cable percussion boring rig. All boreholes were terminated on encountering virtual refusal on obstructions or in stiff deposits above their scheduled depth.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Environmental samples were taken at standard intervals within the overburden.

Standard penetration tests were carried out in accordance with BS EN 22476-3: 2005 at standard depth intervals using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix G.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

Where water was added to assist with boring, a note has been added to the log to account for same.

Appendix B presents the borehole logs.

4.2.2 Boreholes by combined percussion boring and rotary follow-on drilling

Two boreholes (BH01-BH03A) were put down by a combination of light cable percussion boring and rotary follow-on drilling techniques with core recovery in bedrock. Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to completion/bedrock. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Environmental samples were taken at standard intervals within the overburden.

Standard penetration tests were carried out in accordance with BS EN 22476-3: 2005 at standard depth intervals throughout the overburden using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix G.

Where coring was carried out within bedrock strata, conventional coring methods were used with a metric T2-101 core barrel, which produced core of nominal 84mm diameter, and was placed in triple channel wooden core boxes.

The core was subsequently photographed and examined by a qualified and experienced Engineering Geologist, thus enabling the production of an engineering log in accordance with *BS 5930: 2015: Code of practice for ground investigations*.

Appendix B presents the borehole logs, with core photographs presented in Appendix C.

4.2.3 Dynamic sampled boreholes

Four boreholes (WS01-WS04) were put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig. The boreholes were put down initially in 150mm diameter, reducing in diameter with depth as required, down to 50mm by use of the smallest sampler.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down clear of services or subsurface obstructions. The boreholes were taken to depths ranging between 2.80m and 3.00m where they were terminated at their scheduled depths, or else they were terminated on encountering virtual refusal on obstructions above this depth.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Environmental samples were taken at standard intervals throughout the overburden.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded. Details of the water strikes are presented on the individual borehole logs.

Appendix B presents the borehole logs.

4.3 Dynamic probes

Two dynamic probes were conducted as a follow on from boreholes WS01 – WS02 using the DPSHB method as described in BS EN ISO 22476-2: 2005. The method entails a 63.5kg hammer falling 0.75m onto a 50.5mm diameter cone with an apex angle of 90°.

Appendix B provides the dynamic probe logs on the sheet following the relevant borehole log in the form of plots, against depth, of the number of blows per 100mm penetration.

4.4 Standpipe installations

A groundwater monitoring standpipe was installed in boreholes BH01 and BH03A.

Details of the installations, including the depth range of the response zone, are provided in Appendix B on the individual borehole logs.

4.5 Infiltration tests

An infiltration/soakaway test was carried out in two boreholes (WS01- WS02) in accordance with BRE Digest 365 - Soakaways (BRE, 2016).

Appendix D presents the results and analysis of the infiltration test. The absence of the outflow from the borehole precluded calculation of infiltration coefficients.

4.6 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R6 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish National Grid) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these as-built positions.

4.7 Groundwater monitoring

Following completion of site works, groundwater monitoring was conducted on two rounds. Ground water monitoring was carried out using a water interface probe.

Details of groundwater and gas monitoring are presented in the Table 2 Section 6.3 of this report.

5 LABORATORY WORK

Upon their receipt in the laboratory, all disturbed samples were carefully examined and accurately described, and their descriptions incorporated into the borehole logs.

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- **soil chemistry:** pH and water soluble sulphate content

Laboratory testing of soils samples was carried out in accordance with British Standards Institute: *BS 1377, Methods of test for soils for civil engineering purposes; Part 1 (2016), and Parts 2-9 (1990).*

The test results are presented in Appendix E.

5.2 Environmental laboratory testing of soils

Environmental testing was conducted on selected environmental soil samples by Chemtest at its laboratory in Newmarket, Suffolk.

Testing was carried out according to Suite I of Engineer's Ireland Specification for Ground Investigation which includes testing for the following determinants:

- Metals
- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- Cyanides
- Asbestos screen
- pH.

Waste acceptance criteria (WAC) testing was carried out on eight samples.

Results of environmental laboratory testing are presented in Appendix H.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise Glacial Till. These deposits are underlain by limestones and shales of the Lucan Formation.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Paved surface:** all boreholes encountered macadam surfacing ranging in thickness between 50 – 150mm. Additionally concrete was encountered in BH01 and BH02 with a thickness of 300 – 350mm.

- **Made Ground (sub-base):** WS02 – WS04 encountered 200 – 850mm of subangular fine to coarse gravel.

- **Made Ground (fill):** reworked sandy gravelly clay fill/gravelly sand/sandy gravel encountered in WS01 and WS04, extending to a depth of 2.50m in both boreholes.

- **Glacial Till:** sandy gravelly clay/silt, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth. Encountered to a maximum depth of 10.00m in BH01. Note, however that this was the maximum extent of the borehole. Therefore, the extent of this strata was unable to be determined at this location.

- **Bedrock (Limestone):** Rockhead was encountered at a depth of 8.50m in BH03A.

6.3 Groundwater

Groundwater was encountered during percussion boring as groundwater strikes as shown in Table 1 below.

Table 1: Groundwater strikes encountered during ground investigation

GI Ref.	Water Level (mbgl)	Comments
BH03A	8.20	No rise after 20 mins
WS04	1.20	Rose to 1.10 after 20 mins

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Groundwater was not noted during drilling at any of the other borehole locations. However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out any/additional groundwater strikes and the possibility of encountering groundwater during excavation works should not be ruled out.

It should be noted that any groundwater strikes within bedrock may have been masked by the fluid used as the drilling flush medium.

Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 2.

Table 2: Groundwater monitoring (mbgl)

GI Ref.	BH01	BH03A
27/11/2018	2.38	2.45
11/12/2018	2.10	2.48

Seasonal variation in groundwater levels should also be factored into design considerations, and continued monitoring of the two installed standpipes will give an indication of the seasonal variation in groundwater level.

7 REFERENCES

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

BS 5930: 2015: Code of practice for ground investigations. British Standards Institution.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description.

BS EN ISO 14688-2:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.

BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.

Building Research Establishment (2007), BRE Digest 365: Soakaways.

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLANS

CAUSEWAY GEOTECH

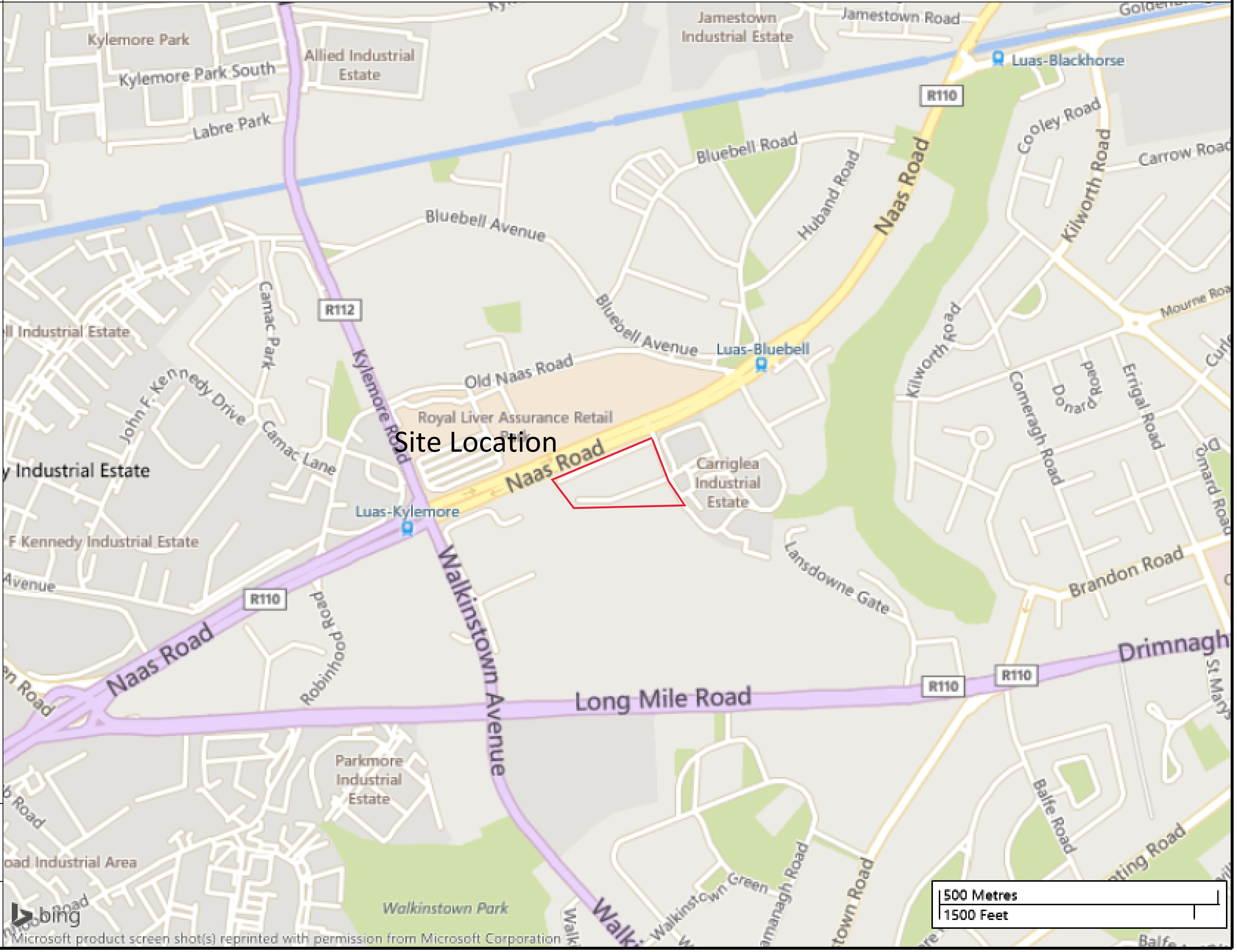
Project No.: 18-1234

Project Name: Concorde Residential Development

Client: Silvermount Ltd.

Client's Representative: Barrett Mahony Consulting Engineers

Legend Key



Title:
Site Location Plan

Last Revised:	**Scale:**
12/12/2018	1:10000

CAUSEWAY GEOTECH

Project No.: 18-1234

Project Name: Concorde Residential Development

Client: Silvermount Ltd.

Client's Representative: Barrett Mahony Consulting Engineers

Legend Key

●	Locations By Type - CP
●	Locations By Type - CP+RC

Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation

Title:

Exploratory Hole Location Plan

Last Revised:	**Scale:**
12/12/2018	1:1000

CAUSEWAY
GEOTECH

APPENDIX B

BOREHOLE AND DYNAMIC PROBE LOGS

CAUSEWAY GEOTECH

Project No.: 18-1234

Project Name: Concorde Residential Development

Borehole No.: BH01

Sheet 1 of 1

Coordinates:
310710.97 E
232051.31 N

Client: Silvermount Ltd.

Client's Representative: Barrett Mahony Consulting Engineers

Ground Level: 39.78 mOD

Dates: 07/11/2018 - 12/11/2018

Scale: 1:50

Driller: RN+KW

Logger: SR+GH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2500	0.00	2.40
Rotary Drilling	Comacchio 205	2.40	8.50
Rotary Coring	Comacchio 205	8.50	10.00

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
					39.68	(0.10) 0.10		BITMAC		
					39.58	(0.10) 0.20 (0.20)		CONCRETE		
0.40 - 1.40	B1				39.38	0.40		Concrete with boulders		
	D2							Firm becoming stiff brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular		
0.50	ES5									
						(1.00)				
1.00	ES6									
1.20 - 1.65	SPT (S) N=18	1.20		N=18 (2,3/3,5,4,6)						
1.40 - 2.00	B3				38.38	1.40		Stiff becoming very stiff dark grey slightly sandy slightly gravelly CLAY . Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		
	B4									
						(1.00)				
2.00 - 2.40	B7 D8									
						2.40				
2.00 - 2.38	SPT (S)	2.00		N=50 (4,5/50 for 225mm)	37.38			Very stiff dark grey sandy gravelly CLAY with low cobble and boulder content. (Driller's description)		
		2.00	Dry	07-11-2018						
		2.00	Dry	08-11-2018						
2.40 - 2.42	SPT (S)	2.40		N=50 (25 for 10mm/50 for 5mm)						
		2.50	Dry	08-11-2018						
		2.50	Dry	12-11-2018						
4.00 - 4.02	SPT (S)	4.00	Dry	N=50 (15 for 10mm/50 for 10mm)						
						(6.10)				
7.00 - 7.22	SPT (S)	7.00	Dry	N=50 (25 for 75mm/50 for 150mm)						
					31.28	8.50		Stiff black slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of predominately limestone. Cobbles are subrounded.		
	85					(1.50)				
10.00					29.78	10.00		End of Borehole at 10.00m		
				12-11-2018						
	TCR	SCR	RQD	FI						

Remarks
Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Terminated at scheduled depth.

Core Barrel T2101

Flush Type Polymer

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

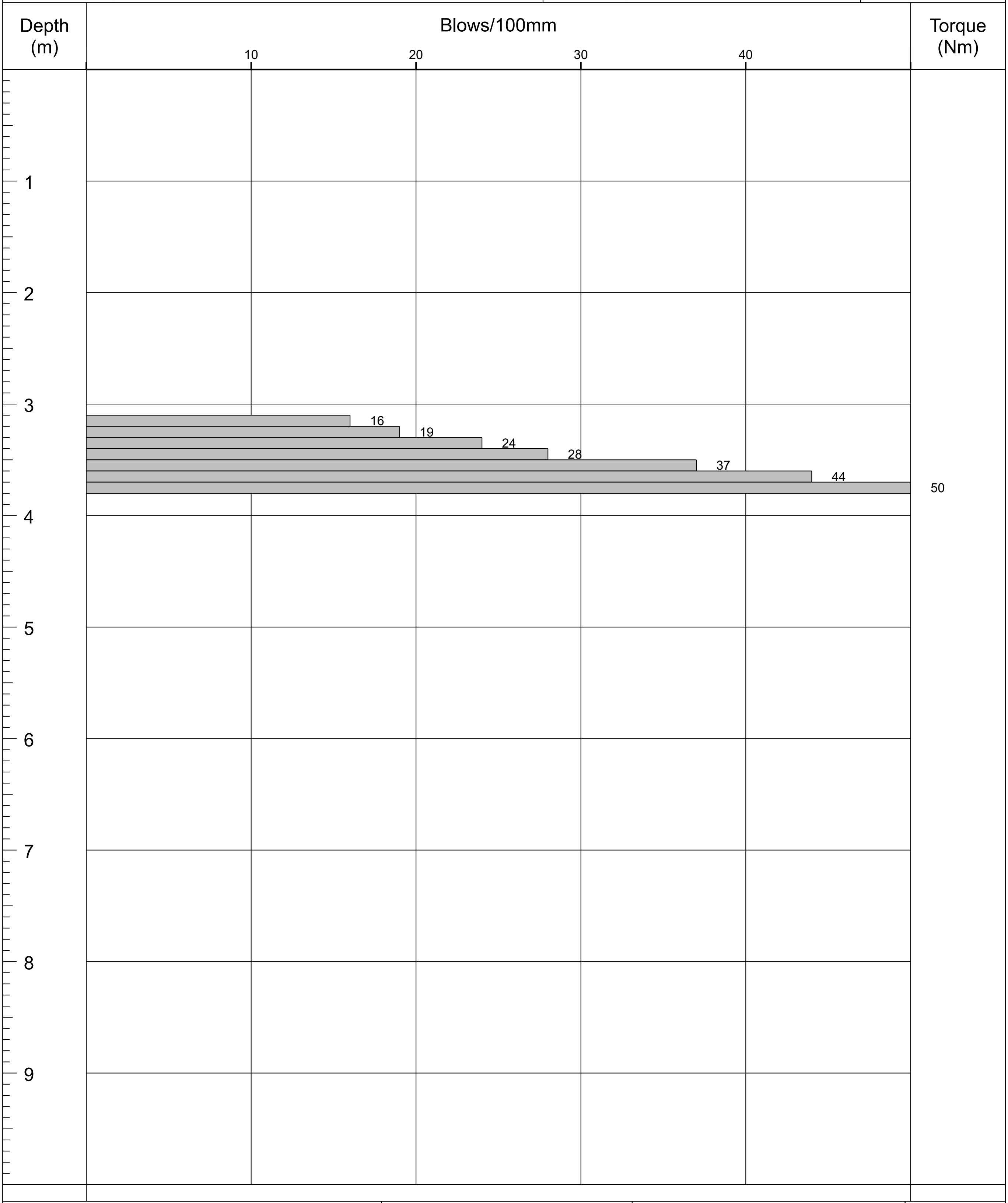
Water Added		Casing Details	
From (m)	To (m)	To (m)	Diam (mm)
1.20	2.40	2.50	200
8.50	10.00	10.00	200

CAUSEWAY GEOTECH

Probe Log

Probe No:
DPWS01
Sheet 1 of 1

Project Name: Concorde Residential Development	**Project No.** 18-1234	**Co-ords:**		**Hole Type:** DP
Client: Silvermount Ltd.		**Level:**		**Scale:** 1:50
Client's Rep: Barrett Mahony Consulting Engineers		**Date:** 15/11/2018		**Operator:** JC



Remarks:	Fall Height	750	Cone Base Diameter	
	Hammer Wt	64	Final Depth	3.70
	Probe Type	DPSH-B		

AGS

CAUSEWAY GEOTECH

Project No.: 18-1234	**Project Name:** Concorde Residential Development				**Borehole No.:** **BH02**	
Coordinates: 310858.48 E 232117.42 N	**Client:** Silvermount Ltd.				Sheet 1 of 1	
	Client's Representative: Barrett Mahony Consulting Engineers				**Scale:** 1:50	
Ground Level: 39.68 mOD	**Dates:** 08/11/2018 - 08/11/2018				**Driller:** RN **Logger:** SR	

Method	**Plant Used**	**Top**	**Base**
Cable Percussion	Dando 2500	0.00	2.40

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
					39.63	0.05 (0.05)		BITMAC		
						(0.35)		CONCRETE with rebar		
					39.28	0.40		Stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
0.50	ES5									
0.50 - 1.00	B1 D2									
1.00	ES6									
1.00 - 2.00	B3 D4									
1.20 - 1.65	SPT (C) N=16	1.20	Dry	N=16 (2,3/3,4,4,5)		(2.00)				
2.00	ES7									
2.00 - 2.19	SPT (C)	2.00	Dry	N=50 (6,8/50 for 40mm)						
2.15 - 2.21	SPT (C)	2.15	Dry	N=50 (25 for 25mm/50 for 35mm)	37.28	2.40		End of Borehole at 2.40m		
		2.20	Dry	08-11-2018						
		2.20	Dry	13-11-2018						
		~~8.50~~	~~5.00~~	~~13-11-2018~~						

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Terminated in stiff deposits.

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Water Added

From (m)	To (m)
1.20	2.20
8.50	10.00

Casing Details

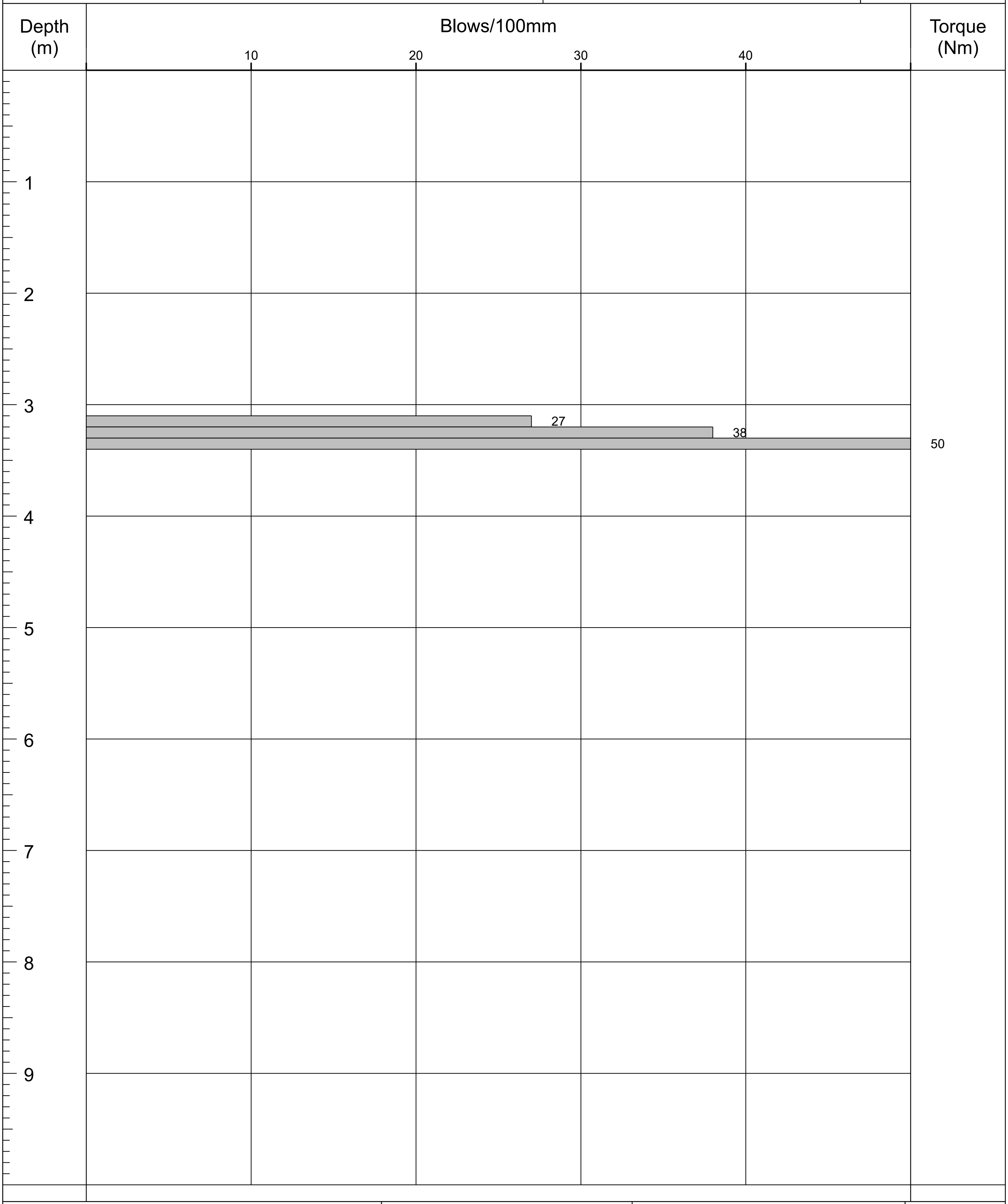
To (m)	Diam (mm)
2.20	200

Chiselling Details

From (m)	To (m)	Time (hh:mm)
2.15	2.20	01:00

Probe Log

Project Name: Concorde Residential Development	**Project No.** 18-1234	**Co-ords:**	**Probe No:** DPWS02 Sheet 1 of 1 **Hole Type:** DP
Client: Silvermount Ltd.		**Level:**	**Scale:** 1:50
Client's Rep: Barrett Mahony Consulting Engineers		**Date:** 15/11/2018	**Operator:** JC



Remarks:	Fall Height	750	Cone Base Diameter	
	Hammer Wt	64	Final Depth	3.30
	Probe Type	DPSH-B		

Project No.: 18-1234	**Project Name:** Concorde Residential Development		**Borehole No.:** **BH03**
Coordinates: 310905.50 E 232026.76 N	**Client:** Silvermount Ltd.		Sheet 1 of 1
	Client's Representative: Barrett Mahony Consulting Engineers		**Scale:** 1:50 **Driller:** RN
Ground Level: 39.08 mOD	**Dates:** 09/11/2018 - 09/11/2018		**Logger:** SR

Method	**Plant Used**	**Top**	**Base**
Cable Percussion	Dando 2500	0.00	0.50

Depth (m)	**Sample / Tests**	**Casing Depth (m)**	**Water Depth (m)**	**Field Records**	**Level (mOD)**	**Depth (m) (Thickness)**	**Legend**	**Description**	**Water**	**Backfill**
					38.98	(0.10) 0.10	▒	BITMAC		
						(0.40)	▨	MADE GROUND: Construction fill with cobbles, boulders and fragments of plastic		
					38.58	0.50		End of Borehole at 0.50m		

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0

Remarks
Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Terminated on concrete obstruction. Moved to rebore position BH03A.

Core Barrel	**Water Strikes**				**Chiselling Details**		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)

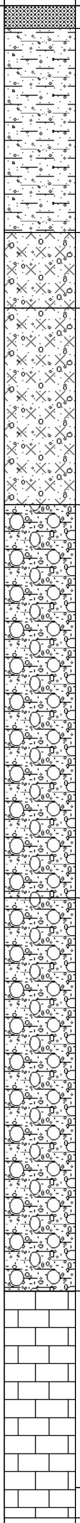
Flush Type	**Water Added**		**Casing Details**	
	From (m)	To (m)	To (m)	Diam (mm)

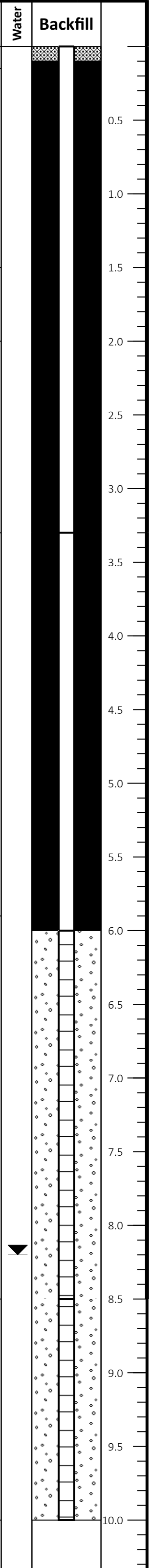
CAUSEWAY GEOTECH

Project No.: 18-1234	**Project Name:** Concorde Residential Development		**Borehole No.:** **BH03A**
Coordinates: 310904.66 E 232032.84 N	**Client:** Silvermount Ltd.		Sheet 1 of 1
	Client's Representative: Barrett Mahony Consulting Engineers		**Scale:** 1:50 **Driller:** RN+KW
Ground Level: 39.22 mOD	**Dates:** 09/11/2018 - 12/11/2018		**Logger:** SR+GH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2500	0.00	3.30
Rotary Drilling	Comacchio 205	3.30	8.50
Rotary Coring	Comacchio 205	8.50	10.00

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
0.10 - 0.50	B7 D8				39.07	(0.15) 0.15	BITMAC
0.50 0.50 - 1.50	ES1 B9 D10						Firm becoming stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
1.00	ES2					(1.35)	
1.20 - 1.65	SPT (S) N=16	1.20 1.20 1.20	Dry Dry Dry	N=16 (,3/5,4,3,4) 09-11-2018 12-11-2018	37.72	1.50	Stiff grey slightly sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular
1.50 - 2.00	B11 D12					(0.50)	
2.00 2.00 - 3.00	ES3 B13 D14				37.22	2.00	Stiff becoming very stiff grey slightly sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular
2.00 - 2.45	SPT (S) N=20	2.00	Dry	N=20 (2,3/4,4,7,5)		(1.30)	
3.00 3.00 - 3.30	ES4 B15					3.30	
	D16 SPT (S)	3.00	Dry	N=50 (4,7/50 for 155mm)	35.92		Very stiff brown sandy gravelly CLAY with medium cobble content (Driller's description)
3.30 - 3.34	SPT (S)	3.30 3.30	Dry Dry	N=50 (25 for 20mm/50 for 15mm) 12-11-2018			
4.00 - 4.45	SPT (S) N=37	4.00	Dry	N=37 (8,8/8,10,10,9)		(2.60)	
5.50 - 5.95	SPT (S) N=38	5.50	Dry	N=38 (10,8/8,9,9,12)			
					33.32	5.90	Very stiff dark grey sandy gravelly CLAY with high cobble and boulder content (Driller's description)
7.00 - 7.02	SPT (S)	7.00	Dry	N=50 (25 for 10mm/ 50 for 10mm)		(2.60)	
					30.72	8.50	Medium strong black argillaceous LIMESTONE. Partially weathered: slightly reduced strength, closer fracture spacing. Discontinuities: 1. 10 to 20 degree closely spaced fractures (40/90/170) undulating, rough. 2. 70 to 90 degree closely spaced joint, undulating, rough. *8.50m: Some clay infill*
	100					(1.50)	*9.80m: Some clay infill*
10.00					29.22	10.00	End of Borehole at 10.00m
	TCR	SCR	RQD	FI			





Remarks
Hand dug inspection pit excavated to 1.20m.

Terminated at scheduled depth.

Core Barrel	**Water Strikes**				**Chiselling Details**		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
T2101	8.20		20	8.20	3.30	3.30	01:00

Flush Type	**Water Added**		**Casing Details**	
	From (m)	To (m)	To (m)	Diam (mm)
Polymer	1.20	3.30	3.30 10.00	200 200

CAUSEWAY GEOTECH

Project No.: 18-1234	**Project Name:** Concorde Residential Development		**Borehole No.:** WS01
Coordinates: 310751.01 E 232088.12 N	**Client:** Silvermount Ltd.		Sheet 1 of 1
	Client's Representative: Barrett Mahony Consulting Engineers		**Scale:** 1:50
Ground Level: 40.58 mOD	**Dates:** 15/11/2018 - 15/11/2018		**Driller:** JC
			Logger: SR

Method	**Plant Used**	**Top**	**Base**
Light Percussion	Dando Terrier	0.00	3.00

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.00 - 0.20	B1					(0.20)		MADE GROUND: Grey angular to subangular fine to coarse GRAVEL		
0.20 - 1.70	B2				40.38	0.20		MADE GROUND: Soft locally firm brown sandy gravelly CLAY with low cobble content. Sand is fine. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
0.50	ES5									
1.00	ES6					(1.50)				
1.70 - 2.50	B3				38.88	1.70		MADE GROUND: Brown slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine to medium		
2.00	ES7					(0.80)				
2.50 - 3.00	B4				38.08	2.50		Stiff dark grey slightly sandy gravelly silty CLAY. Sand is fine. Gravel is subangular to subrounded fine to coarse		
						(0.50)				
3.00	ES8				37.58	3.00		End of Borehole at 3.00m		
		2.00	Dry	15-11-2018						

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Borehole continued by dynamic probing.

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)

Casing Details

To (m)	Diam (mm)
2.00	150

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Light Percussion	Dando Terrier	0.00	3.00

Project No.: 18-1234

Project Name: Concorde Residential Development

Borehole No.: WS02

Sheet 1 of 1

Coordinates:
310798.13 E
232102.33 N

Client: Silvermount Ltd.

Client's Representative: Barrett Mahony Consulting Engineers

Scale: 1:50

Driller: JC

Ground Level: 39.67 mOD

Dates: 15/11/2018 - 15/11/2018

Logger: SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.15 - 0.60	B2				39.52	(0.15) 0.15	▨	MADE GROUND: BITMAC		■
0.50	ES1					(0.45)	▨	MADE GROUND: Grey angular to subangular fine to coarse GRAVEL		■
0.60 - 1.00	B3				39.07	0.60 (0.40)	▨	MADE GROUND: Brown silty sandy subangular to subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded		■
1.00 1.00 - 1.90	ES4 B5				38.67	1.00 (0.90)	▨	Stiff brown sandy gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to coarse		■
1.90 - 3.00 2.00	B6 ES7				37.77	1.90 (1.10)	▨	Stiff dark grey slightly sandy silty gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to coarse		■
3.00	ES8				36.67	3.00		End of Borehole at 3.00m		
		2.00	Dry	15-11-2018						

Remarks
Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Borehole continued by dynamic probing.

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

From (m)	To (m)

Casing Details

To (m)	Diam (mm)
2.00	150

CAUSEWAY GEOTECH	**Project No.:** 18-1234	**Project Name:** Concorde Residential Development		**Borehole No.:** **WS03**
	Coordinates: 310754.08 E 232021.47 N	**Client:** Silvermount Ltd.		Sheet 1 of 1
		Client's Representative: Barrett Mahony Consulting Engineers		**Scale:** 1:50
	Ground Level: 40.11 mOD	**Dates:** 15/11/2018 - 15/11/2018		**Driller:** JC **Logger:** SR

Method	Plant Used	Top	Base
Light Percussion	Dando Terrier	0.00	2.80

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						(0.15)	▒	MADE GROUND: BITMAC		■
0.15 - 0.35	B1				39.96	0.15 (0.20)	▨	MADE GROUND: Grey angular to subangular fine to coarse GRAVEL		■
0.35 - 1.70 0.50	B3 ES2				39.76	0.35	▦	Stiff brown sandy gravelly CLAY with low cobble content. Sand is fine. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		■
1.00	ES5					(1.35)	▦			■
1.70 - 2.80	B4				38.41	1.70	▦	Stiff dark grey slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		■
2.00	ES6					(1.10)	▦			■
2.80	ES7				37.31	2.80		End of Borehole at 2.80m		
			Dry	15-11-2018						

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Terminated at scheduled depth.

Water Strikes				Chiselling Details		
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)

Water Added		Casing Details	
From (m)	To (m)	To (m)	Diam (mm)

CAUSEWAY GEOTECH	**Project No.:** 18-1234	**Project Name:** Concorde Residential Development	**Borehole No.:** **WS04**
	Coordinates: 310831.15 E 232026.86 N	**Client:** Silvermount Ltd.	Sheet 1 of 1
		Client's Representative: Barrett Mahony Consulting Engineers	**Scale:** 1:50 **Driller:** JC
	Ground Level: 39.73 mOD	**Dates:** 16/11/2018 - 16/11/2018	**Logger:** SR

Method	Plant Used	Top	Base
Light Percussion	Dando Terrier	0.00	3.00

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.15 - 0.40	B1				39.58	(0.15) 0.15		MADE GROUND: BITMAC		
						(0.25)		MADE GROUND: Grey angular to subangular fine to coarse GRAVEL		
					39.33	0.40				
0.50	ES2					(0.20)		MADE GROUND: Firm brown sandy gravelly CLAY with low cobble content. Sand is fine. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded		
0.60 - 2.50	B3				39.13	0.60		Brown sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.		
1.00	ES4								▼ ▽	
				Water Strike at 1.20m						
						(1.90)				
2.00	ES5									
					37.23	2.50		Soft locally firm grey sandy gravelly CLAY. Sand is fine. Gravel is subangular to subrounded fine to coarse		
						(0.50)				
3.00	ES6				36.73	3.00		End of Borehole at 3.00m		
			1.00	16-11-2018						

Remarks
Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.
Not enough sample to carry out B or D samples below 0.60m.

Terminated at scheduled depth.

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.20		20	1.10

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Water Added

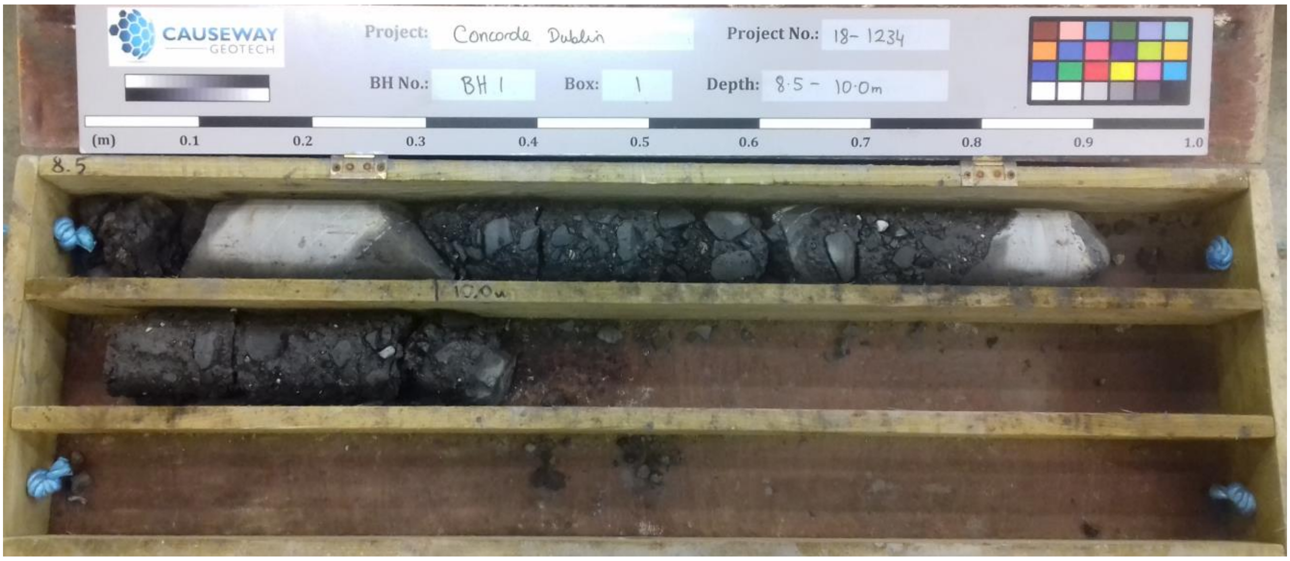
From (m)	To (m)

Casing Details

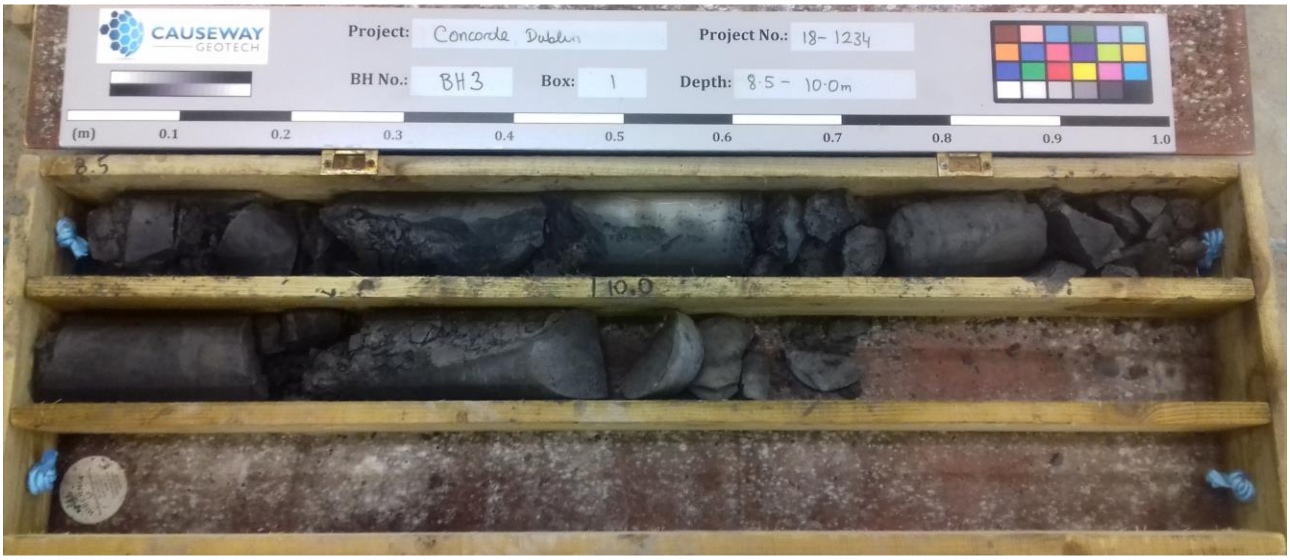
To (m)	Diam (mm)

APPENDIX C

CORE PHOTOGRAPHS



BH01 Box 1 8.5 – 10.0m



BH03 Box 1 8.5 – 10.0m

APPENDIX D

INFILTRATION TEST RESULTS

Soakaway Infiltration Test

Project No.: 18-1234
Site: Concorde, Naas Road
Test Location: WS01
Test Date: 15 November 2018

Borehole diameter	0.125	m
Cross sectional Area	0.01	m^2
Soakage Top depth	2.00	mbgl
Soakage Bottom depth	3.00	mbgl
Soakage Length	1.00	m
Saoakge medium	Boulder Clay	

depth to groundwater before adding water (m) = Dry

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

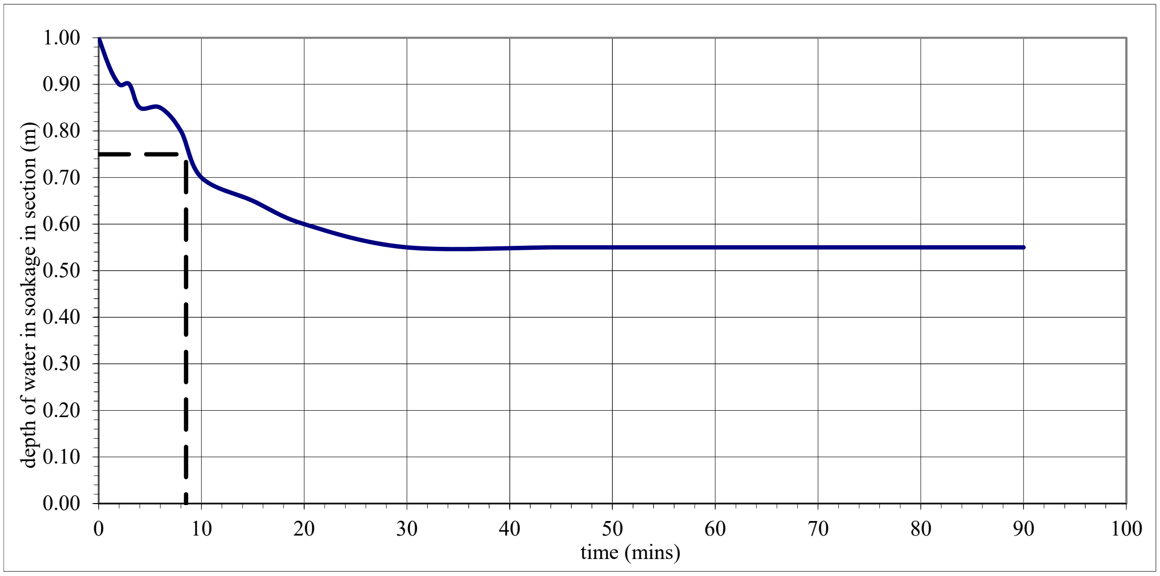
time (mins)	depth to water surface (m)	depth of water in soakage section (m)
0	2.00	1.00
1	2.06	0.94
2	2.10	0.90
3	2.10	0.90
4	2.15	0.85
6	2.15	0.85
8	2.20	0.80
10	2.30	0.70
15	2.35	0.65
20	2.40	0.60
30	2.45	0.55
45	2.45	0.55
60	2.45	0.55
75	2.45	0.55
90	2.45	0.55

From graph below:
test start - 75% depth at
0.75 m water depth
time is 8.5 minutes

test end - 25% depth at
0.25 m water depth
time is not determined

infiltration rate (q) is very low

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
8.5	0.25	0.75					



Soakaway Infiltration Test

Project No.: 18-1234
Site: Concorde, Naas Road
Test Location: WS02
Test Date: 15 November 2018

Borehole diameter 0.125 m
Cross sectional Area 0.01 m^2
Soakage Top depth 2.00 mbgl
Soakage Bottom depth 3.00 mbgl
Soakage Length 1.00 m
Saoakge medium Boulder Clay

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

depth to groundwater before adding water (m) = Dry

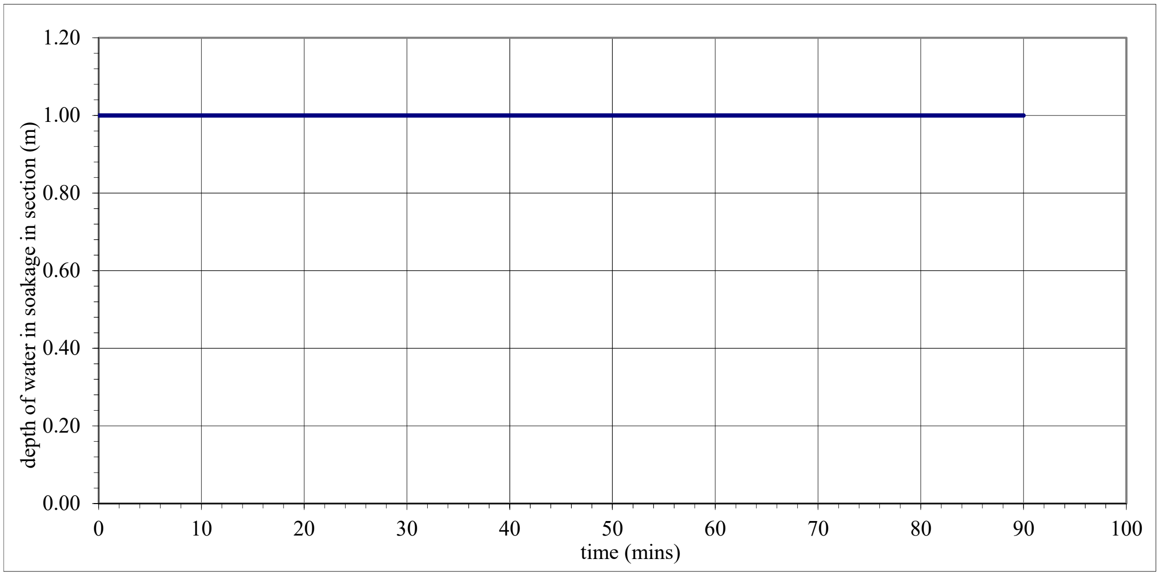
time (mins)	depth to water surface (m)	depth of water in soakage section (m)
0	2.00	1.00
1	2.00	1.00
2	2.00	1.00
3	2.00	1.00
4	2.00	1.00
6	2.00	1.00
8	2.00	1.00
10	2.00	1.00
15	2.00	1.00
20	2.00	1.00
30	2.00	1.00
45	2.00	1.00
60	2.00	1.00
75	2.00	1.00
90	2.00	1.00

From graph below:
test start - 75% depth at
0.75 m water depth
time is not determined

test end - 25% depth at
0.25 m water depth
time is not determined

infiltration rate (q) is very low

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)



APPENDIX E

GEOTECHNICAL LABORATORY TEST RESULTS

10122

+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

Project Name:	Concorde Residential Development
Project No.:	18-1234
Client:	Barrett Mahony Consulting Engineers
Date:	11/12/18

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s).

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days from the above date after which they will be appropriately disposed of unless we receive written instructions to the contrary prior to that date.

We trust our report meets with your approval but if you have any queries or require additional information, please do not hesitate to contact the undersigned.

Approved Signatory

Stephen Watson

Stephen Watson
Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

Project Name: Concorde Residential Development

Report Reference: Soil Schedule 1

The table below details the tests carried out, the specifications used, and the number of tests included in this report.

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	10
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	7
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	7
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	7

SUB-CONTRACTED TESTS

In agreement with Client, the following tests were conducted by an approved sub-contractor. All sub-contracting laboratories used are UKAS accredited.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Pro Soils Limited *(UKAS 2183)*	pH Value of Soil		3
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	Sulphate Content water extract		3

Summary of Classification Test Results

Project No.

18-1234

Project Name

Concorde Residential Development

Hole No.	Sample				Soil Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type										
BH01	1	0.40		B	Brown slightly sandy gravelly silty CLAY with some cobbles.			8.2	62	29 -1pt	16	13		CL
BH01	3	1.40		B	Dark grey slightly sandy gravelly silty CLAY.			9.8						
BH01	7	2.00		B	Dark grey sandy gravelly silty CLAY.			15.0	57	29 -1pt	15	14		CL
BH02	1	0.50		B	Brown sandy gravelly silty CLAY.			14.0	60	29 -1pt	17	12		CL
BH02	3	1.00		B	Brown sandy gravelly silty CLAY.			14.0	68	31 -1pt	17	14		CL
BH03A	7	0.10		B	Brown sandy gravelly silty CLAY.			15.0	49	37 -1pt	22	15		CI
BH03A	8	0.10		D	Brown sandy gravelly silty CLAY.			19.0						
BH03A	11	1.50		B	Grey slightly sandy gravelly clayey SILT.			18.0	56	43 -1pt	28	15		MI
BH03A	14	2.00		D	Grey slightly sandy gravelly clayey SILT.			28.0						
BH03A	15	3.00		B	Grey slightly sandy gravelly SILT/CLAY.			15.0	54	46 -1pt	27	19		MI/CI

All tests performed in accordance with BS1377:1990 unless specified otherwise

LAB 01R Version 4

Key

Density test

Linear measurement unless :

wd - water displacement

wi - immersion in water

Liquid Limit

4pt cone unless :

cas - Casagrande method

1pt - single point test

Particle density

sp - small pyknometer

gj - gas jar

Date Printed

12/11/2018 00:00

Approved By

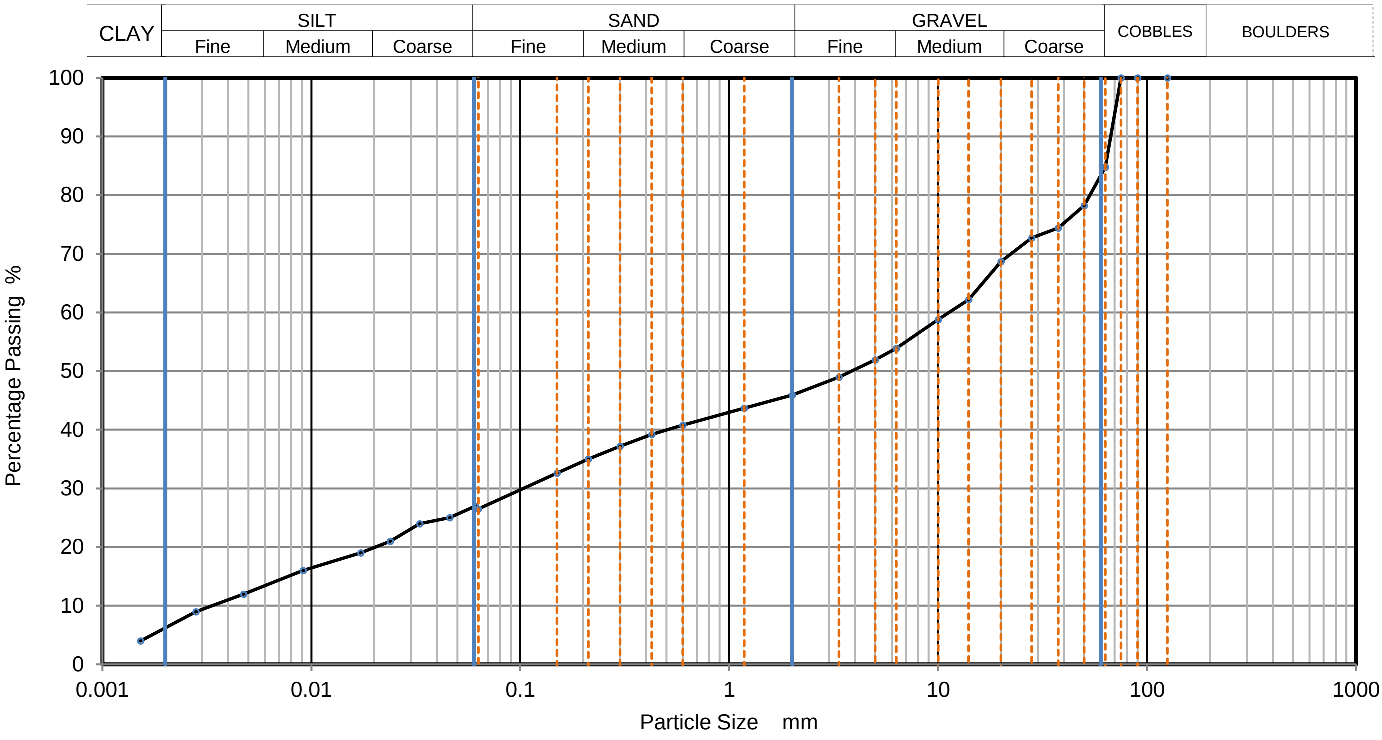
Stephen.Watson

10122

CAUSEWAY GEOTECH

PARTICLE SIZE DISTRIBUTION

Job Ref			**18-1234**
Borehole/Pit No.			BH01
Site Name	Concorde Residential Development	Sample No.	1
Soil Description	Brown slightly sandy gravelly silty CLAY with some cobbles.	Depth, m	0.40
Specimen Reference	6	Specimen Depth	0.4 m
Sample Type			B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus2018111912



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0609	27
90	100	0.0460	25
75	100	0.0330	24
63	85	0.0239	21
50	78	0.0172	19
37.5	74	0.0091	16
28	73	0.0047	12
20	69	0.0028	9
14	62	0.0015	4
10	59		
6.3	54		
5	52		
3.35	49		
2	46		
1.18	44		
0.6	41	Particle density	(assumed)
0.425	39	2.65	Mg/m3
0.3	37		
0.212	35		
0.15	33		
0.063	27		

Dry Mass of sample, g	11633

Sample Proportions	% dry mass
Cobbles	15
Gravel	39
Sand	19
Silt	21
Clay	6

Grading Analysis		
D100	mm	
D60	mm	11.3
D30	mm	0.104
D10	mm	0.00363
Uniformity Coefficient		3100
Curvature Coefficient		0.26

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved
Stephen.Watson

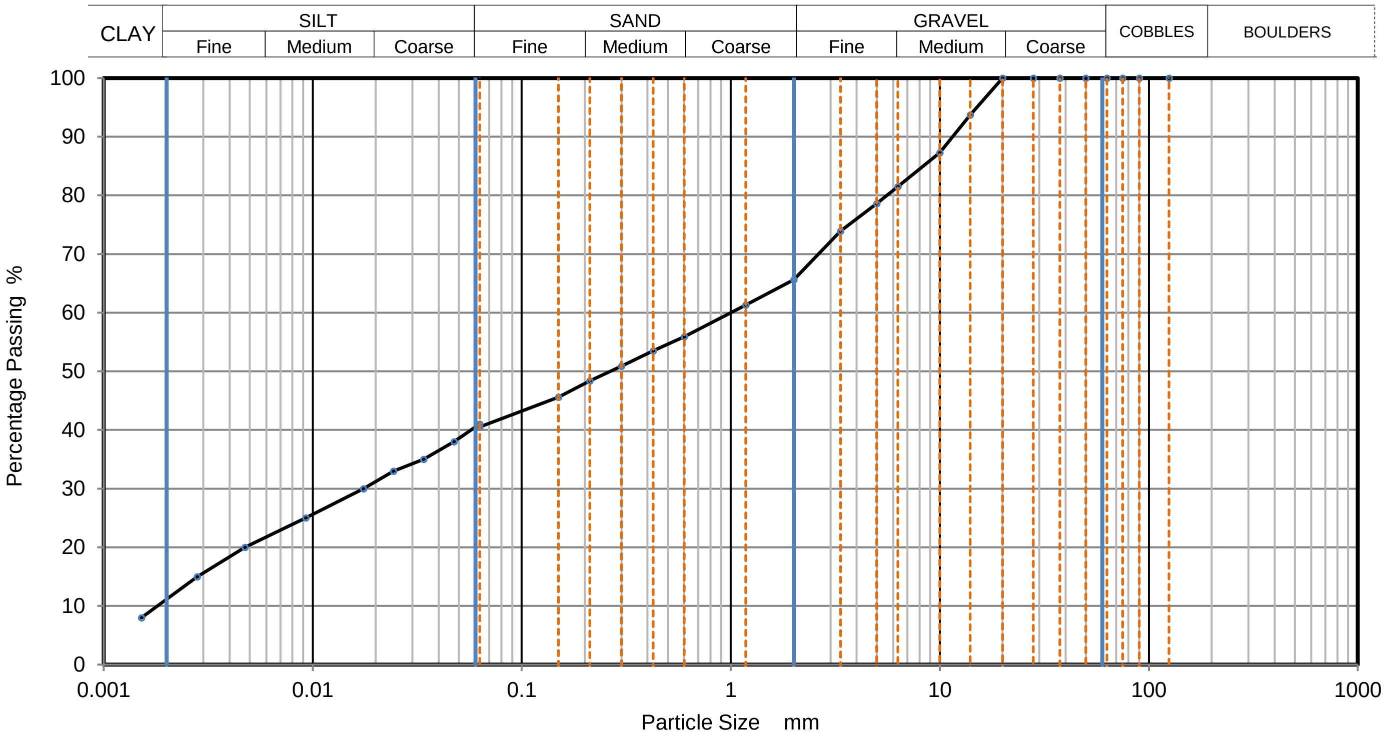
LAB 05R Version 4

UKAS TESTING

10122

PARTICLE SIZE DISTRIBUTION

		Job Ref	**18-1234**
		Borehole/Pit No.	BH01
Site Name	Concorde Residential Development	Sample No.	7
Soil Description	Dark grey sandy gravelly silty CLAY.	Depth, m	2.00
Specimen Reference	6 Specimen Depth 2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus2018111914



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0628	41
90	100	0.0474	38
75	100	0.0340	35
63	100	0.0244	33
50	100	0.0175	30
37.5	100	0.0093	25
28	100	0.0047	20
20	100	0.0028	15
14	94	0.0015	8
10	87		
6.3	82		
5	79		
3.35	74		
2	66		
1.18	61		
0.6	56	Particle density	(assumed)
0.425	54	2.65	Mg/m3
0.3	51		
0.212	48		
0.15	46		
0.063	41		

Dry Mass of sample, g	560

Sample Proportions	% dry mass
Cobbles	0
Gravel	34
Sand	25
Silt	29
Clay	11

Grading Analysis		
D100	mm	
D60	mm	1
D30	mm	0.0171
D10	mm	0.00179
Uniformity Coefficient		560
Curvature Coefficient		0.16

Remarks

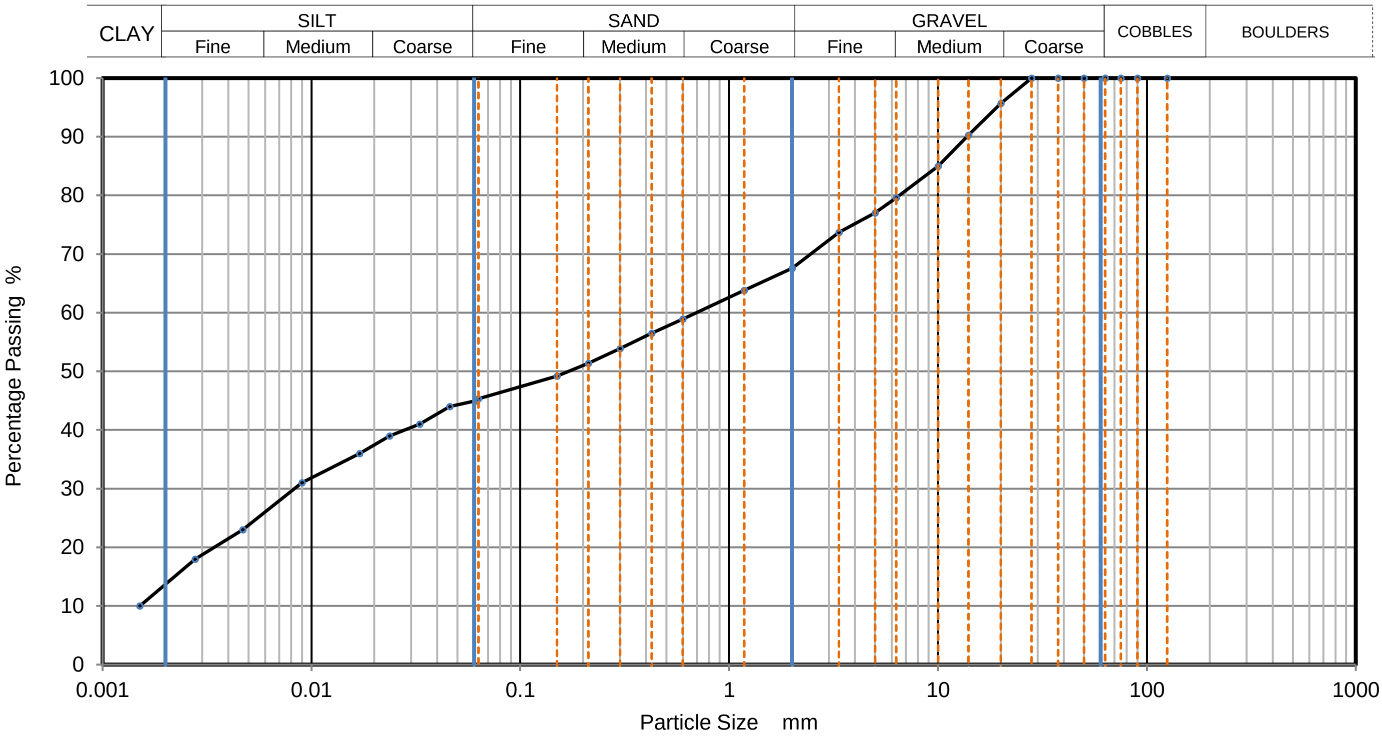
Preparation and testing in accordance with BS1377 unless noted below

Approved
Stephen.Watson

UKAS TESTING
10122

PARTICLE SIZE DISTRIBUTION

				Job Ref	**18-1234**
				Borehole/Pit No.	BH02
Site Name	Concorde Residential Development			Sample No.	1
Soil Description	Brown sandy gravelly silty CLAY.			Depth, m	0.50
Specimen Reference	6	Specimen Depth	0.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018111915



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0614	45
90	100	0.0460	44
75	100	0.0330	41
63	100	0.0237	39
50	100	0.0170	36
37.5	100	0.0090	31
28	100	0.0047	23
20	96	0.0028	18
14	90	0.0015	10
10	85		
6.3	80		
5	77		
3.35	74		
2	68		
1.18	64		
0.6	59	Particle density	(assumed)
0.425	57	2.65	Mg/m3
0.3	54		
0.212	51		
0.15	49		
0.063	45		

Dry Mass of sample, g	605

Sample Proportions	% dry mass
Cobbles	0
Gravel	32
Sand	22
Silt	32
Clay	13

Grading Analysis		
D100	mm	
D60	mm	0.695
D30	mm	0.00843
D10	mm	0.00154
Uniformity Coefficient		450
Curvature Coefficient		0.066

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved	
Stephen.Watson	

UKAS TESTING
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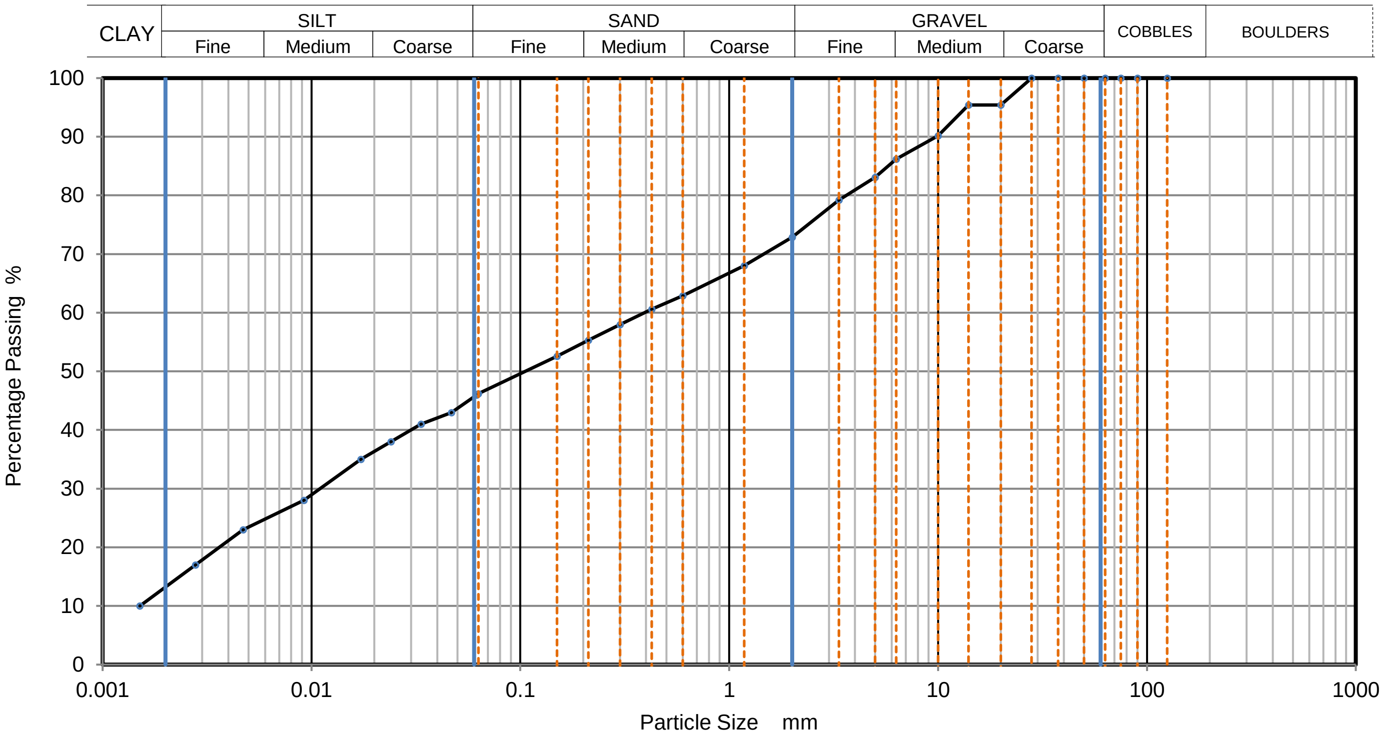
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**	Job Ref	**18-1234**
		Borehole/Pit No.	BH02
Site Name	Concorde Residential Development	Sample No.	3
Soil Description	Brown sandy gravelly silty CLAY.	Depth, m	1.00
Specimen Reference	6 Specimen Depth 1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus2018111916



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0619	46
90	100	0.0467	43
75	100	0.0335	41
63	100	0.0240	38
50	100	0.0172	35
37.5	100	0.0092	28
28	100	0.0047	23
20	95	0.0028	17
14	95	0.0015	10
10	90		
6.3	86		
5	83		
3.35	79		
2	73		
1.18	68		
0.6	63	Particle density	(assumed)
0.425	61	2.65	Mg/m3
0.3	58		
0.212	55		
0.15	53		
0.063	46		

Dry Mass of sample, g	941

Sample Proportions	% dry mass
Cobbles	0
Gravel	27
Sand	27
Silt	33
Clay	13

Grading Analysis	
D100 mm	
D60 mm	0.394
D30 mm	0.0108
D10 mm	
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

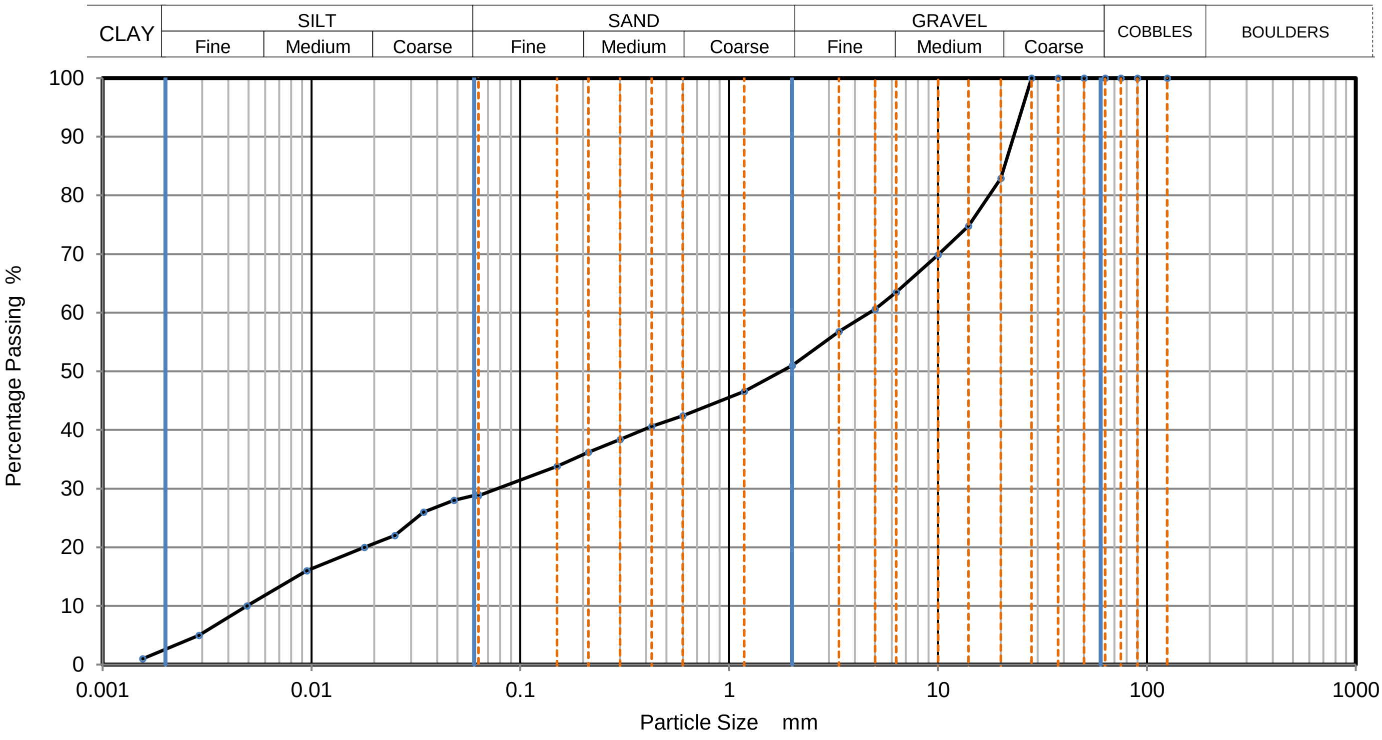
UKAS TESTING

10122

Approved
Stephen.Watson

PARTICLE SIZE DISTRIBUTION

		Job Ref	**18-1234**
		Borehole/Pit No.	BH03A
Site Name	Concorde Residential Development	Sample No.	7
Soil Description	Brown sandy gravelly silty CLAY.	Depth, m	0.10
Specimen Reference	6 / Specimen Depth / 0.1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus2018111917



Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	29
90	100	0.0481	28
75	100	0.0345	26
63	100	0.0250	22
50	100	0.0179	20
37.5	100	0.0095	16
28	100	0.0049	10
20	83	0.0029	5
14	75	0.0016	1
10	70		
6.3	64		
5	61		
3.35	57		
2	51		
1.18	47		
0.6	42	Particle density	(assumed)
0.425	41	2.65	Mg/m3
0.3	38		
0.212	36		
0.15	34		
0.063	29		

Dry Mass of sample, g	2129

Sample Proportions	% dry mass
Cobbles	0
Gravel	49
Sand	22
Silt	26
Clay	3

Grading Analysis		
D100	mm	
D60	mm	4.7
D30	mm	0.0777
D10	mm	0.00516
Uniformity Coefficient		910
Curvature Coefficient		0.25

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved
Stephen.Watson

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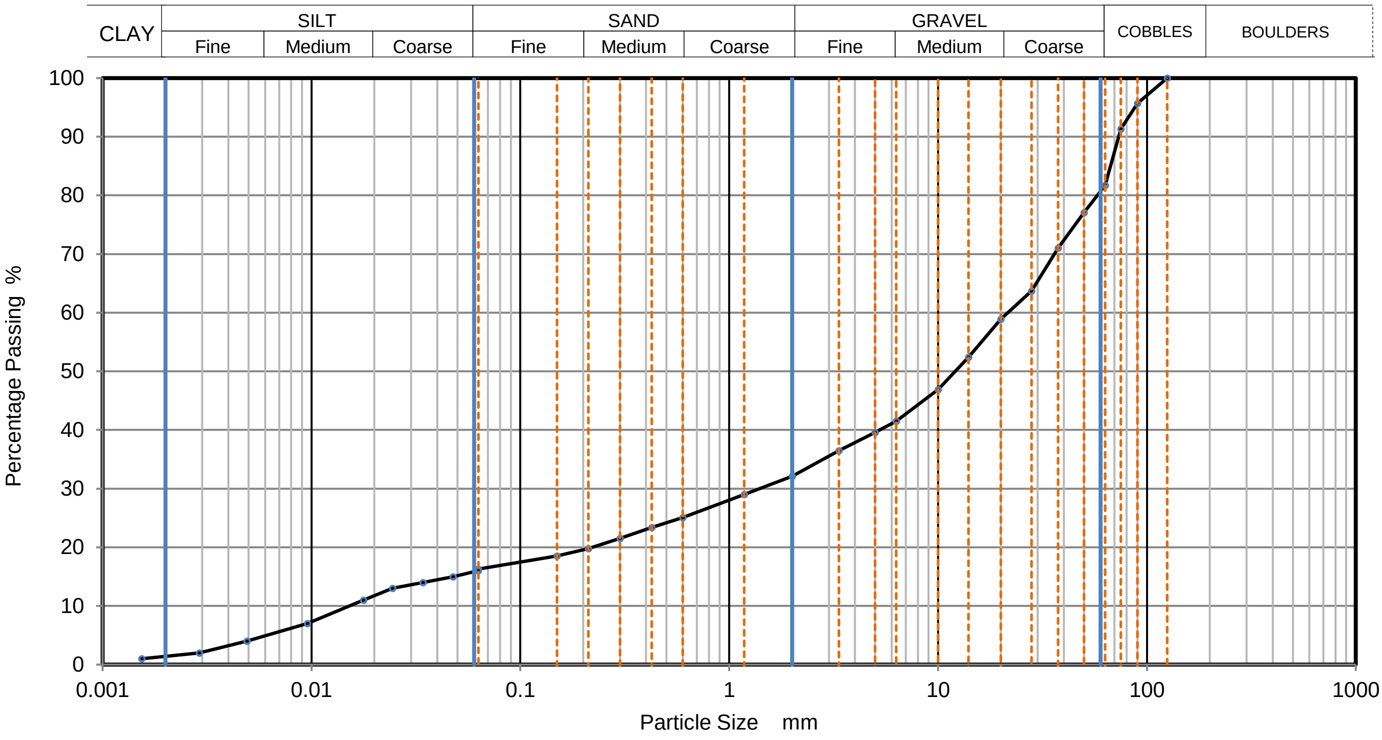
UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**	Job Ref	**18-1234**
		Borehole/Pit No.	BH03A
Site Name	Concorde Residential Development	Sample No.	11
Soil Description	Grey slightly sandy gravelly clayey SILT.	Depth, m	1.50
Specimen Reference	6 Specimen Depth 1.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	Caus2018111919



Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	16
90	96	0.0476	15
75	91	0.0341	14
63	82	0.0245	13
50	77	0.0177	11
37.5	71	0.0096	7
28	64	0.0049	4
20	59	0.0029	2
14	52	0.0015	1
10	47		
6.3	42		
5	40		
3.35	37		
2	32		
1.18	29		
0.6	25	Particle density	(assumed)
0.425	23	2.65	Mg/m3
0.3	22		
0.212	20		
0.15	19		
0.063	16		

Dry Mass of sample, g	10045

Sample Proportions	% dry mass
Cobbles	18
Gravel	50
Sand	16
Silt	15
Clay	1

Grading Analysis		
D100	mm	125
D60	mm	21.6
D30	mm	1.4
D10	mm	0.0157
Uniformity Coefficient		1400
Curvature Coefficient		5.8

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved
Stephen.Watson

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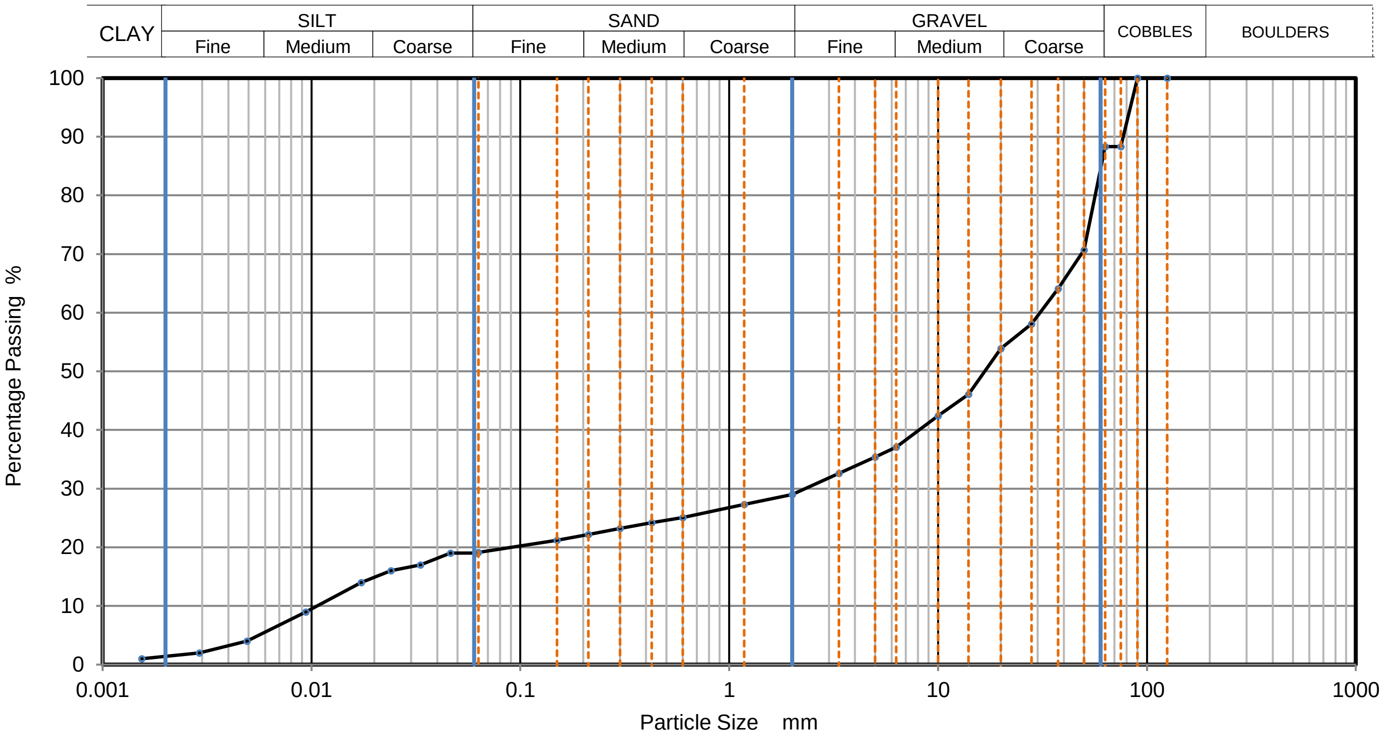
PARTICLE SIZE DISTRIBUTION

				Job Ref	**18-1234**
				Borehole/Pit No.	BH03A
Site Name	Concorde Residential Development			Sample No.	15
Soil Description	Grey slightly sandy gravelly SILT/CLAY.			Depth, m	3.00
Specimen Reference	6	Specimen Depth	3 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018111921



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0618	19
90	100	0.0463	19
75	88	0.0332	17
63	88	0.0240	16
50	71	0.0173	14
37.5	64	0.0094	9
28	58	0.0049	4
20	54	0.0029	2
14	46	0.0015	1
10	42		
6.3	37		
5	35		
3.35	33		
2	29		
1.18	27		
0.6	25	Particle density	(assumed)
0.425	24	2.65	Mg/m3
0.3	23		
0.212	22		
0.15	21		
0.063	19		

Dry Mass of sample, g	9981

Sample Proportions	% dry mass
Cobbles	12
Gravel	59
Sand	10
Silt	18
Clay	1

Grading Analysis		
D100	mm	
D60	mm	30.8
D30	mm	2.32
D10	mm	0.0106
Uniformity Coefficient		2900
Curvature Coefficient		16

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved
Stephen.Watson

LAB 05R Version 4

10122

UKAS
TESTING
2183

The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.: 18-37527-1

Initial Date of Issue: 03-Dec-2018

Client Causeway Geotech Ltd

Client Address:
8 Drumahiskey Road
Balnamore
Ballymoney
County Antrim
BT53 7QL

Contact(s):
Carin Cornwall
Ciaran Doherty
Colm Hurley
Darren O'Mahony
Gabriella Horan
John Cameron
Lucy Newland
Matthew Gilbert
Neil Haggan
Paul Dunlop
Paul McNamara
Sean Ross
Sean Toomey
Stephen Watson
Stuart Abraham

Project 18-1234 Concorde Residential Development

Quotation No.:

Date Received: 29-Nov-2018

Order No.:

Date Instructed: 29-Nov-2018

No. of Samples: 3

Turnaround (Wkdays): 3

Results Due: 03-Dec-2018

Date Approved: 03-Dec-2018

Approved By:

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 18-1234 Concorde Residential Development

Client: Causeway Geotech Ltd				**Chemtest Job No.:**	18-37527	18-37527	18-37527
Quotation No.:				**Chemtest Sample ID.:**	732979	732980	732981
Order No.:				Client Sample Ref.:	8	4	12
				Sample Location:	BH01	BH02	BH03A
				Sample Type:	SOIL	SOIL	SOIL
				Top Depth (m):	2	1	1.5
				Date Sampled:	28-Nov-2018	28-Nov-2018	28-Nov-2018
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Moisture	N	2030	%	0.020	11	12	24
pH	U	2010		N/A	8.3	8.6	7.9
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.13	< 0.010	0.45

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

CAUSEWAY
GEOTECH

APPENDIX F

ENVIRONMENTAL LABORATORY TEST RESULTS

UKAS
TESTING
2183

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	18-35678-1		
Initial Date of Issue:	23-Nov-2018		
Client	Causeway Geotech Ltd		
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL		
Contact(s):	Carin Cornwall Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Lucy Peaker Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Sean Ross Stephen Franey Stephen Watson Stuart Abraham Lucy Newland		
Project	18-1234 Concorde Dublin		
Quotation No.:	Q18-13245	**Date Received:**	13-Nov-2018
Order No.:		**Date Instructed:**	16-Nov-2018
No. of Samples:	3		
Turnaround (Wkdays):	4	**Results Due:**	21-Nov-2018
Date Approved:	23-Nov-2018		
Approved By:			
Details:	Martin Dyer, Laboratory Manager		

Project: 18-1234 Concorde Dublin

Client: Causeway Geotech Ltd	**Chemtest Job No.:**				18-35678	18-35678	18-35678
Quotation No.: Q18-13245	**Chemtest Sample ID.:**				724616	724619	724621
Order No.:	Client Sample Ref.:				ES1	ES1	ES3
	Sample Location:				BH1	BH2	BH2
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				0.5	0.5	2.0
	Date Sampled:				07-Nov-2018	08-Nov-2018	08-Nov-2018
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	11	12	11
pH	U	2010		N/A	8.8	8.5	8.5
Arsenic	U	2450	mg/kg	1.0	17	17	19
Barium	U	2450	mg/kg	10	69	52	96
Cadmium	U	2450	mg/kg	0.10	1.9	2.4	2.5
Chromium	U	2450	mg/kg	1.0	12	14	14
Molybdenum	U	2450	mg/kg	2.0	4.8	4.3	5.0
Antimony	N	2450	mg/kg	2.0	< 2.0	< 2.0	< 2.0
Copper	U	2450	mg/kg	0.50	21	28	33
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	39	51	53
Lead	U	2450	mg/kg	0.50	23	17	23
Selenium	U	2450	mg/kg	0.20	0.70	0.71	1.5
Zinc	U	2450	mg/kg	0.50	65	87	95
Chromium (Trivalent)	N	2490	mg/kg	1.0	12	14	14
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Total Organic Carbon	U	2625	%	0.20	0.74	0.89	0.39
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0

Results - Soil

Project: 18-1234 Concorde Dublin

Client: Causeway Geotech Ltd	**Chemtest Job No.:**				18-35678	18-35678	18-35678
Quotation No.: Q18-13245	**Chemtest Sample ID.:**				724616	724619	724621
Order No.:	Client Sample Ref.:				ES1	ES1	ES3
	Sample Location:				BH1	BH2	BH2
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				0.5	0.5	2.0
	Date Sampled:				07-Nov-2018	08-Nov-2018	08-Nov-2018
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	N	2815	mg/kg	0.10	< 0.10	< 0.10	< 0.10

Chemtest
The right chemistry to deliver results

Results - Single Stage WAC

Project: 18-1234 Concorde Dublin

Chemtest Job No:	18-35678				**Landfilll Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	724616						
Sample Ref:	ES1				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:							
Sample Location:	BH1						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	07-Nov-2018						
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.74	3	5	6
Loss On Ignition	2610	U	%	2.2	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0 < 2.0	100	--	--
pH	2010	U		8.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.038	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	0.0013	< 0.050	0.5	2	25
Barium	1450	U	0.0019	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	0.0013	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0078	0.078	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	2.9	29	800	15000	25000
Fluoride	1220	U	0.12	1.2	10	150	500
Sulphate	1220	U	5.2	52	1000	20000	50000
Total Dissolved Solids	1020	N	44	440	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	13	130	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	11

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 18-1234 Concorde Dublin

Chemtest Job No:	18-35678				**Landfill Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	724619						
Sample Ref:	ES1				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:							
Sample Location:	BH2						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	08-Nov-2018						
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.89	3	5	6
Loss On Ignition	2610	U	%	2.5	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0 < 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.072	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0014	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0012	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	4.3	43	800	15000	25000
Fluoride	1220	U	0.13	1.3	10	150	500
Sulphate	1220	U	4.4	44	1000	20000	50000
Total Dissolved Solids	1020	N	46	460	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	8.4	84	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	12

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 18-1234 Concorde Dublin

Chemtest Job No:	18-35678				**Landfilll Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	724621						
Sample Ref:	ES3						
Sample ID:							
Sample Location:	BH2						
Top Depth(m):	2.0						
Bottom Depth(m):							
Sampling Date:	08-Nov-2018						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	0.39	3	5	6
Loss On Ignition	2610	U	%	2.3	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0 < 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.062	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0027	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0020	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	3.4	34	800	15000	25000
Fluoride	1220	U	0.12	1.2	10	150	500
Sulphate	1220	U	4.6	46	1000	20000	50000
Total Dissolved Solids	1020	N	48	470	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	6.6	66	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	11

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.: 18-36454-1

Initial Date of Issue: 29-Nov-2018

Client Causeway Geotech Ltd

Client Address:
8 Drumahiskey Road
Balnamore
Ballymoney
County Antrim
BT53 7QL

Contact(s):
Carin Cornwall
Colm Hurley
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Gabriella Horan
John Cameron
Lucy Newland
Matthew Gilbert
Neil Haggan
Paul Dunlop
Paul McNamara
Sean Ross
Stephen Franey
Stephen Watson
Stuart Abraham

Project 18-1234 Concorde Dublin

Quotation No.: Q18-13245 **Date Received:** 20-Nov-2018

Order No.: **Date Instructed:** 22-Nov-2018

No. of Samples: 5

Turnaround (Wkdays): 4 **Results Due:** 27-Nov-2018

Date Approved: 29-Nov-2018

Approved By:

Details: Martin Dyer, Laboratory Manager

Results - Soil

Project: 18-1234 Concorde Dublin

Client: Causeway Geotech Ltd	**Chemtest Job No.:**				18-36454	18-36454	18-36454	18-36454	18-36454
Quotation No.: Q18-13245	**Chemtest Sample ID.:**				728229	728231	728233	728238	728242
Order No.:	Client Sample Ref.:				ES1	ES3	ES1	ES2	ES2
	Sample Location:				WS01	WS01	WS02	WS03	WS04
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	2.0	0.5	1.0	1.0
	Date Sampled:				15-Nov-2018	15-Nov-2018	15-Nov-2018	15-Nov-2018	16-Nov-2018
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
ACM Type	U	2192		N/A	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	20	9.3	5.0	11	4.3
pH	U	2010		N/A	7.8	8.5	9.3	8.6	9.0
Arsenic	U	2450	mg/kg	1.0	21	17	20	19	13
Barium	U	2450	mg/kg	10	92	84	75	90	36
Cadmium	U	2450	mg/kg	0.10	1.9	2.1	0.37	2.2	0.71
Chromium	U	2450	mg/kg	1.0	21	19	13	17	8.5
Molybdenum	U	2450	mg/kg	2.0	2.7	3.2	< 2.0	4.1	< 2.0
Antimony	N	2450	mg/kg	2.0	2.6	< 2.0	< 2.0	< 2.0	< 2.0
Copper	U	2450	mg/kg	0.50	41	27	16	33	8.0
Mercury	U	2450	mg/kg	0.10	0.46	< 0.10	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	53	53	18	59	19
Lead	U	2450	mg/kg	0.50	89	19	6.5	18	12
Selenium	U	2450	mg/kg	0.20	0.84	0.55	0.55	2.1	< 0.20
Zinc	U	2450	mg/kg	0.50	140	82	36	76	28
Chromium (Trivalent)	N	2490	mg/kg	1.0	21	19	13	17	8.5
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Organic Carbon	U	2625	%	0.20	4.4	1.0	5.0	0.68	2.1
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	80	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	80	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	250	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	250	< 5.0	< 5.0

Results - Soil

Project: 18-1234 Concorde Dublin

Client: Causeway Geotech Ltd	**Chemtest Job No.:**				18-36454	18-36454	18-36454	18-36454	18-36454
Quotation No.: Q18-13245	**Chemtest Sample ID.:**				728229	728231	728233	728238	728242
Order No.:	Client Sample Ref.:				ES1	ES3	ES1	ES2	ES2
	Sample Location:				WS01	WS01	WS02	WS03	WS04
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	2.0	0.5	1.0	1.0
	Date Sampled:				15-Nov-2018	15-Nov-2018	15-Nov-2018	15-Nov-2018	16-Nov-2018
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	330	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	0.54	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	0.16	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	0.16	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	N	2815	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Single Stage WAC

Project: 18-1234 Concorde Dublin

Chemtest Job No:	18-36454				**Landfilll Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	728229						
Sample Ref:	ES1						
Sample ID:							
Sample Location:	WS01						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	15-Nov-2018						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	4.4	3	5	6
Loss On Ignition	2610	U	%	8.5	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0 < 2.0	100	--	--
pH	2010	U		7.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.039	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0030	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0032	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	2.1	21	800	15000	25000
Fluoride	1220	U	0.53	5.3	10	150	500
Sulphate	1220	U	14	140	1000	20000	50000
Total Dissolved Solids	1020	N	140	1400	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	27	270	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	20

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 18-1234 Concorde Dublin

Chemtest Job No:	18-36454				**Landfill Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	728231						
Sample Ref:	ES3				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:							
Sample Location:	WS01						
Top Depth(m):	2.0						
Bottom Depth(m):							
Sampling Date:	15-Nov-2018						
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	1.0	3	5	6
Loss On Ignition	2610	U	%	2.0	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0 < 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.078	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0041	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0096	0.096	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	1.3	13	800	15000	25000
Fluoride	1220	U	0.23	2.3	10	150	500
Sulphate	1220	U	14	140	1000	20000	50000
Total Dissolved Solids	1020	N	85	840	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	11	110	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	9.3

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 18-1234 Concorde Dublin

Chemtest Job No: 18-36454
Chemtest Sample ID: 728233
Sample Ref: ES1
Sample ID:
Sample Location: WS02
Top Depth(m): 0.5
Bottom Depth(m):
Sampling Date: 15-Nov-2018

					Landfill Waste Acceptance Criteria Limits		
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	5.0	3	5	6
Loss On Ignition	2610	U	%	0.94	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	310	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0 < 2.0	100	--	--
pH	2010	U		9.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.69	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.025	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	0.0011	0.011	0.01	0.2	2
Molybdenum	1450	U	0.0094	0.094	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	0.0016	0.016	0.1	0.5	7
Zinc	1450	U	0.0025	< 0.50	4	50	200
Chloride	1220	U	5.7	57	800	15000	25000
Fluoride	1220	U	0.61	6.1	10	150	500
Sulphate	1220	U	170	1700	1000	20000	50000
Total Dissolved Solids	1020	N	270	2700	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	8.1	81	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	5.0

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

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Results - Single Stage WAC

Project: 18-1234 Concorde Dublin

Chemtest Job No:	18-36454				**Landflll Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	728238						
Sample Ref:	ES2				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:							
Sample Location:	WS03						
Top Depth(m):	1.0						
Bottom Depth(m):							
Sampling Date:	15-Nov-2018						
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.68	3	5	6
Loss On Ignition	2610	U	%	2.1	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0 < 2.0	100	--	--
pH	2010	U		8.6	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.31	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0048	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.015	0.15	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	1.9	19	800	15000	25000
Fluoride	1220	U	0.26	2.6	10	150	500
Sulphate	1220	U	6.4	64	1000	20000	50000
Total Dissolved Solids	1020	N	85	840	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	12	120	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	11

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 18-1234 Concorde Dublin

Chemtest Job No: 18-36454
Chemtest Sample ID: 728242
Sample Ref: ES2
Sample ID:
Sample Location: WS04
Top Depth(m): 1.0
Bottom Depth(m):
Sampling Date: 16-Nov-2018

					Landfill Waste Acceptance Criteria Limits		
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	2.1	3	5	6
Loss On Ignition	2610	U	%	1.0	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0 < 2.0	100	--	--
pH	2010	U		9.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.36	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0025	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	0.0079	0.079	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.012	0.12	0.5	10	30
Nickel	1450	U	0.0019	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	6.9	69	800	15000	25000
Fluoride	1220	U	0.47	4.7	10	150	500
Sulphate	1220	U	8.1	81	1000	20000	50000
Total Dissolved Solids	1020	N	78	780	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	10	100	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	4.3

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

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Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

CAUSEWAY
GEOTECH

APPENDIX G

SPT HAMMER ENERGY MEASUREMENT REPORT

Southern Testing
Environmental & Geotechnical

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Neil Burrows
Southern Testing Laboratories
Unit 11
Charlwoods Road
East Grinstead
RH19 2HU

SPT Hammer Ref:	NT5.
Test Date:	14/04/2018
Report Date:	15/04/2018
File Name:	NT5..spt
Test Operator:	CAUSEWAY

Instrumented Rod Data

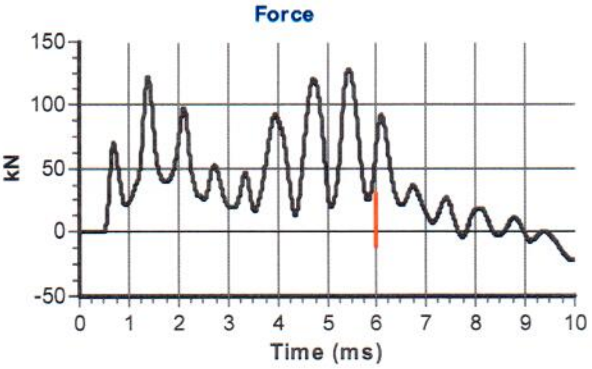
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

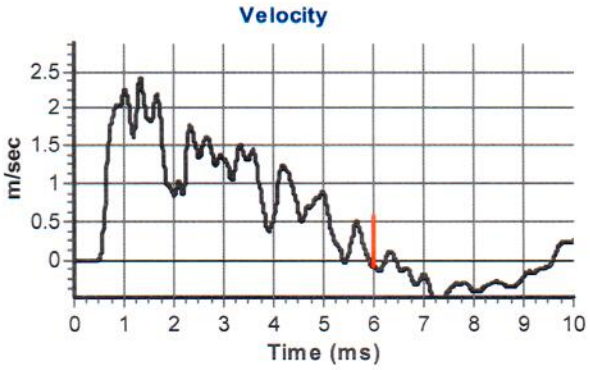
SPT Hammer Information

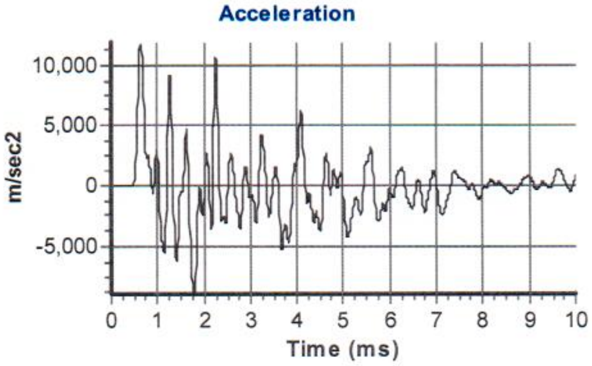
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.5

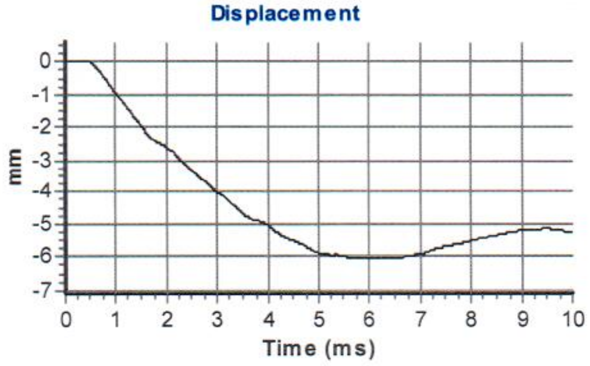
Comments / Location

Causeway Yard









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	299
Energy Ratio E_r (%):	**63**

NPBurrows

Signed: N P Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months

Southern Testing
Environmental & Geotechnical

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Neil Burrows
Southern Testing Laboratories
Unit 11
Charlwoods Road
East Grinstead
RH19 2HU

SPT Hammer Ref: NT4
Test Date: 14/04/2018
Report Date: 15/04/2018
File Name: NT4.spt
Test Operator: CAUSEWAY

Instrumented Rod Data

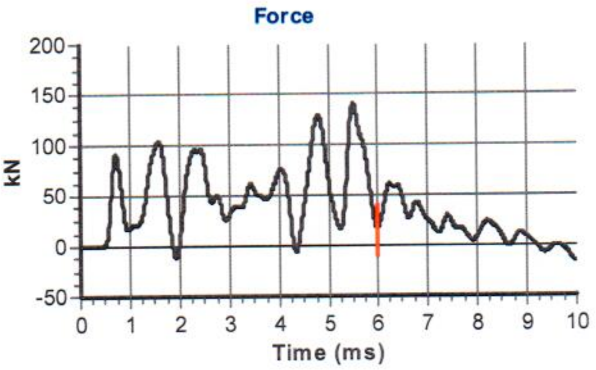
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.0
Assumed Modulus E_a (GPa): 200
Accelerometer No.1: 6458
Accelerometer No.2: 9607

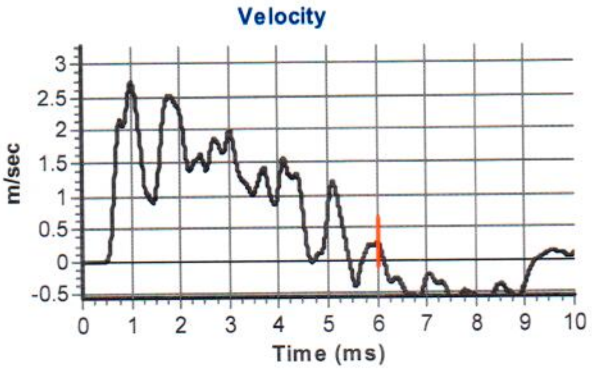
SPT Hammer Information

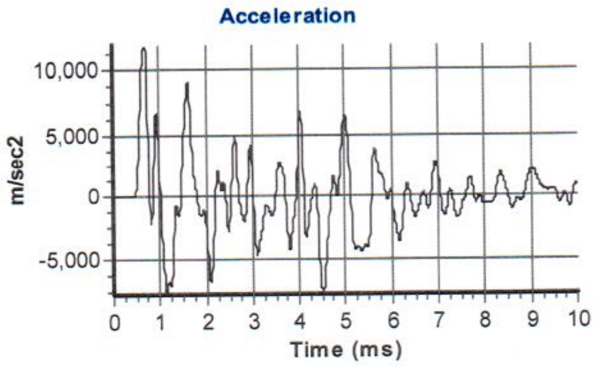
Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.5

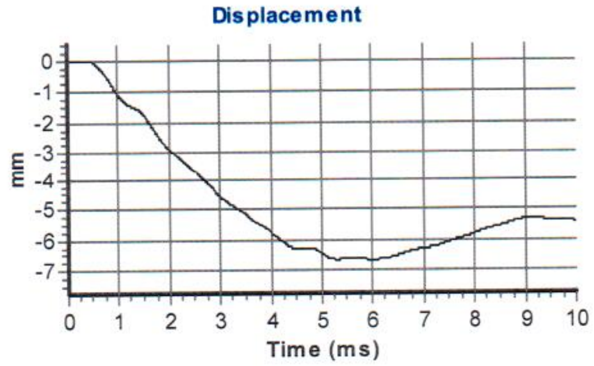
Comments / Location

Causeway Yard









Calculations

Area of Rod A (mm2): 905
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 307

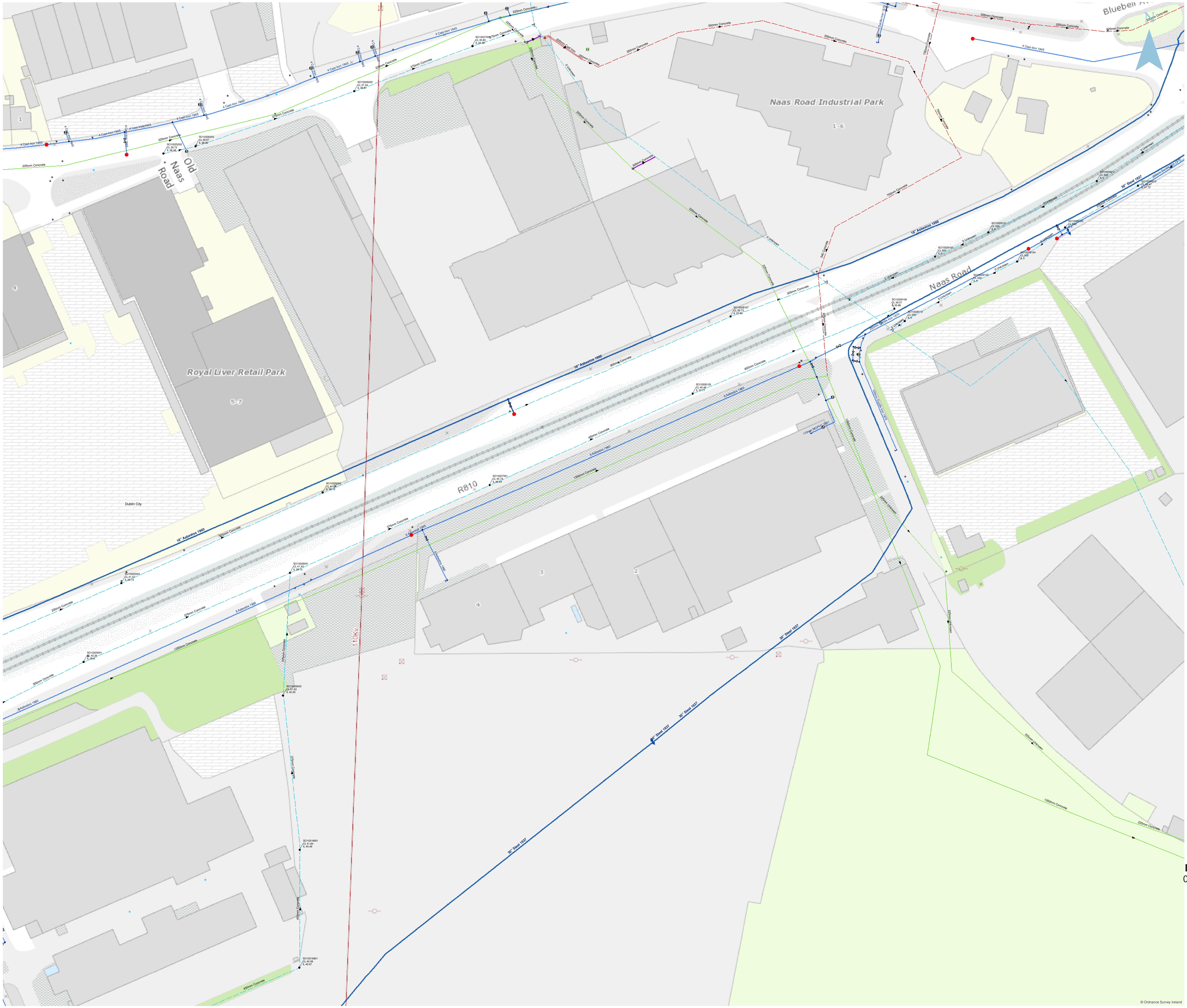
Energy Ratio E_r (%): 65

NPBurrows

Signed: N P Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months

APPENDIX 8.1 - PUBLIC WATER MAIN MAP NEAR THE SITE



UISCE
ÉIREANN : IRISH
WATER

Legend

Ⓜ Unknown Meter ; Other Meter

⋈ Sluice Valve Open

◆◆ Double Air Control Valve

Water Hydrants

Hydrant Function

● Fire Hydrant

⋈ Telemetry Kiosk

⊔ Cap

• Other Fittings

Water Distribution Mains

Owned By

— Distribution Water Main

— Trunk Water Main

Sewer Discharge Points

Discharge Type

○ Other; Unknown

▲ Pump Station

—▸— Gravity - Combined

—▸— Gravity - Foul

—▸— Gravity - Overflow

═▸═ Pumping - Foul

Storm Manholes

Manhole Type

• Standard

Storm Discharge Points

Discharge Type

→ Outfall

—▸— Surface Gravity Mains

1:500 at A0

Last edited:
12/06/2018

Metres

0 25 50 100

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2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water.
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Service connection pipes are not generally shown but their presence should be anticipated.

APPENDIX 8.2 – HR WALLINGFORD CALCULATION OUTPUTS

HR Wallingford
Working with water

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	pilar rojo
Site name:	concorde
Site location:	concorde

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance “Preliminary rainfall runoff management for developments”, W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	53.32758° N
Longitude:	6.3372° W
Reference:	6448778
Date:	2018-10-15T10:04:43

Methodology	IH124

Site characteristics

Total site area (ha)	1.83

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	2	3
HOST class	---	---
SPR/SPRHOST	0.3	0.37

Hydrological characteristics

	Default	Edited
SAAR (mm)	907	907
Hydrological region	12	12
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.13	2.13
Growth curve factor: 100 year	2.61	2.61

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	4.52	7.12
1 in 1 year (l/s)	3.84	6.05
1 in 30 years (l/s)	9.62	15.16
1 in 100 years (l/s)	11.79	18.58

APPENDIX 9.1 - AMBIENT AIR QUALITY STANDARDS

National standards for ambient air pollutants in Ireland have generally ensued from Council Directives enacted in the EU (& previously the EC & EEC). The initial interest in ambient air pollution legislation in the EU dates from the early 1980s and was in response to the most serious pollutant problems at that time which was the issue of acid rain. As a result of this sulphur dioxide, and later nitrogen dioxide, were both the focus of EU legislation. Linked to the acid rain problem was urban smog associated with fuel burning for space heating purposes. Also apparent at this time were the problems caused by leaded petrol and EU legislation was introduced to deal with this problem in the early 1980s.

In recent years the EU has focused on defining a basis strategy across the EU in relation to ambient air quality. In 1996, a Framework Directive, Council Directive 96/62/EC, on ambient air quality assessment and management was enacted. The aims of the Directive are fourfold. Firstly, the Directive's aim is to establish objectives for ambient air quality designed to avoid harmful effects to health. Secondly, the Directive aims to assess ambient air quality on the basis of common methods and criteria throughout the EU. Additionally, it is aimed to make information on air quality available to the public via alert thresholds and fourthly, it aims to maintain air quality where it is good and improve it in other cases.

As part of these measures to improve air quality, the European Commission has adopted proposals for daughter legislation under Directive 96/62/EC. The first of these directives to be enacted, Council Directive 1999/30/EC, has been passed into Irish Law as S.I. No 271 of 2002 (Air Quality Standards Regulations 2002), and has set limit values which came into operation on 17th June 2002. The Air Quality Standards Regulations 2002 detail margins of tolerance, which are trigger levels for certain types of action in the period leading to the attainment date. The margin of tolerance varies from 60% for lead, to 30% for 24-hour limit value for PM_{10}, 40% for the hourly and annual limit value for NO_2 and 26% for hourly SO_2 limit values. The margin of tolerance commenced from June 2002, and started to reduce from 1 January 2003 and every 12 months thereafter by equal annual percentages to reach 0% by the attainment date. A second daughter directive, EU Council Directive 2000/69/EC, has published limit values for both carbon monoxide and benzene in ambient air. This has also been passed into Irish Law under the Air Quality Standards Regulations 2002.

The most recent EU Council Directive on ambient air quality was published on the 11/06/08 which has been transposed into Irish Law as S.I. 180 of 2011. Council Directive 2008/50/EC combines the previous Air Quality Framework Directive and its subsequent daughter directives. Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$. The margins of tolerance specific to each pollutant were also slightly adjusted from previous directives. In regards to existing ambient air quality standards, it is not proposed to modify the standards but to strengthen existing provisions to ensure that non-compliances are removed. In addition, new ambient standards for $PM_{2.5}$ are included in Directive 2008/50/EC. The approach for $PM_{2.5}$ was to establish a target value of 25 µg/m^3, as an annual average (to be attained everywhere by 2010) and a limit value of 25 µg/m^3, as an annual average (to be attained everywhere by 2015), coupled with a target to reduce human exposure generally to $PM_{2.5}$ between 2010 and 2020. This exposure reduction target will range from 0% (for $PM_{2.5}$ concentrations of less than 8.5 µg/m^3 to 20% of the average exposure indicator (AEI) for concentrations of between 18 - 22 µg/m^3). Where the AEI is currently greater than 22 µg/m^3 all appropriate measures should be employed to reduce this level to 18 µg/m^3 by 2020. The AEI is based on measurements taken in urban background locations averaged over a three year period from 2008 - 2010 and again from 2018-2020. Additionally, an exposure concentration obligation of 20 µg/m^3 was set to be complied with by 2015 again based on the AEI.

Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions. The Alert Threshold is defined in Council Directive 96/62/EC as "a level beyond which there is a risk to human health from brief exposure and at which immediate steps shall be taken as laid down in Directive 96/62/EC". These steps include undertaking to ensure that the necessary steps are taken to inform the public (e.g. by means of radio, television and the press).

The Margin of Tolerance is defined in Council Directive 96/62/EC as a concentration which is higher than the limit value when legislation comes into force. It decreases to meet the limit value by the attainment date. The Upper Assessment Threshold is defined in Council Directive 96/62/EC as a concentration above which high quality measurement is mandatory. Data from measurement may be supplemented by information from other sources, including air quality modelling.

An annual average limit for both NO_X (NO and NO_2) is applicable for the protection of vegetation in highly rural areas away from major sources of NO_X such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex VI of EU Directive 1999/30/EC identifies that monitoring to demonstrate compliance with the NO_X limit for the protection of vegetation should be carried out distances greater than:

- 5 km from the nearest motorway or dual carriageway
- 5 km from the nearest major industrial installation
- 20 km from a major urban conurbation
- As a guideline, a monitoring station should be indicative of approximately 1000 km^2 of surrounding area.

Under the terms of EU Framework Directive on Ambient Air Quality (96/62/EC), geographical areas within member states have been classified in terms of zones. The zones have been defined in order to meet the criteria for air quality monitoring, assessment and management as described in the Framework Directive and Daughter Directives. Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The Zones were defined based on among other things, population and existing ambient air quality.

EU Council Directive 96/62/EC on ambient air quality and assessment has been adopted into Irish Legislation (S.I. No. 33 of 1999). The act has designated the Environmental Protection Agency (EPA) as the competent authority responsible for the implementation of the Directive and for assessing ambient air quality in the State. Other commonly referenced ambient air quality standards include the World Health Organisation. The WHO guidelines differ from air quality standards in that they are primarily set to protect public health from the effects of air pollution. Air quality standards, however, are air quality guidelines recommended by governments, for which additional factors, such as socio-economic factors, may be considered.

Air Dispersion Modelling

The inputs to the DMRB model consist of information on road layouts, receptor locations, annual average daily traffic movements, annual average traffic speeds and background concentrations(15). Using this input data the model predicts ambient ground level concentrations at the worst-case sensitive receptor using generic meteorological data.

The DMRB has recently undergone an extensive validation exercise (UK DEFRA, 2016a) as part of the UK's Review and Assessment Process to designate areas as Air Quality Management Areas (AQMAs). The validation exercise was carried out at 12 monitoring sites within the UK DEFRAs national air quality monitoring network. The validation exercise was carried out for NO_X, NO_2 and PM_{10}, and included urban background and kerbside/roadside locations, "open" and "confined" settings and a variety of geographical locations (UK DEFRA, 2016a).

In relation to NO_2, the model generally over-predicts concentrations, with a greater degree of over-prediction at “open” site locations. The performance of the model with respect to NO_2 mirrors that of NO_X showing that the over-prediction is due to NO_X calculations rather than the NO_X:NO_2 conversion. Within most urban situations, the model overestimates annual mean NO_2 concentrations by between 0 to 40% at confined locations and by 20% to 60% at open locations. The performance is considered comparable with that of sophisticated dispersion models when applied to situations where specific local validation corrections have not been carried out.

The model also tends to over-predict $PM_{10.}$ Within most urban situations, the model will over-estimate annual mean PM_{10} concentrations by between 20% to 40%. The performance is comparable to more sophisticated models, which, if not validated locally, can be expected to predict concentrations within the range of ±50%.

Thus, the validation exercise has confirmed that the model is a useful screening tool for the Second Stage Review and Assessment, for which a conservative approach is applicable (UK DEFRA, 2016a).

APPENDIX 9.2 - TRANSPORT INFRASTRUCTURE IRELAND SIGNIFICANCE CRITERIA

Magnitude of Change	**Annual Mean NO_2 / PM_{10}**	**No. days with PM_{10} concentration > 50 µg/m^3**	**Annual Mean $PM_{2.5}$**
Large	Increase / decrease ≥4 µg/m^3	Increase / decrease >4 days	Increase / decrease ≥2.5 µg/m^3
Medium	Increase / decrease 2 - <4 µg/m^3	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 µg/m^3
Small	Increase / decrease 0.4 - <2 µg/m^3	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 µg/m^3
Imperceptible	Increase / decrease <0.4 µg/m^3	Increase / decrease <1 day	Increase / decrease <0.25 µg/m^3

Table A1: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Absolute Concentration in Relation to Objective/Limit Value	**Change in Concentration** [Note 1]		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥40 µg/m^3 of NO_2 or PM_{10}) (≥25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

[Note 1] Well Below Standard = <75% of limit value.

Table A2: Air Quality Impact Significance Criteria For Annual Mean NO_2 and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration Note 1		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

Note 1 Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible

Table A3: Air Quality Impact Significance Criteria For Changes to Number of Days with PM_{10} Concentration Greater than 50 $\mu g/m^3$ at a Receptor

APPENDIX 9.3 – DUST MINIMISATION PLAN

A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of any dust produced will be deposited close to the potential source and any impacts from dust deposition will typically be within two hundred metres of the construction area.

In order to ensure mitigation of the effects of dust nuisance, a series of measures will be implemented. Site roads shall be regularly cleaned and maintained as appropriate, dry sweeping of large areas should be avoided. Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic only. Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions.

Prior to demolition blocks should be soft striped inside buildings (retaining walls and windows in the rest of the building where possible, to provide a screen against dust). During the demolition process explosive blasting should be avoided, water suppression should be used, preferably with a hand held spray. Only the use of cutting, grinding or sawing equipment fitted or used in conjunction with a suitable dust suppression technique such as water sprays/local extraction should be used. Drop heights from conveyors, loading shovels, hoppers and other loading equipment should be minimised, if necessary fine water sprays should be employed.

Vehicles using site roads shall have their speeds restricted where there is a potential for dust generation. Vehicles delivering material with dust potential to an off-site location shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust. Access gates to be located at least 10m from receptors where possible.

Vehicles exiting the site shall make use of a wheel wash facility where appropriate, prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads. Public roads outside the site shall be regularly inspected for cleanliness and cleaned as necessary. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions. Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. Record should be kept of all inspections of the haul routes and any subsequent action in a site log book.

Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind. Sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place. Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods, activities such as scabbling should be avoided. Bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.

At all times, the procedures put in place will be strictly monitored and assessed by the contractor. In the event of dust nuisance occurring outside the site boundary, satisfactory procedures will be implemented to rectify the problem. Dust monitoring should be put in place to ensure dust mitigation measures are controlling emissions. Dust monitoring should be conducted using the Bergerhoff method in accordance with the requirements of the German Standard VDI 2119. The Bergerhoff Gauge consists of a collecting vessel and a stand with a protecting gauge. The collecting vessel is secured to the stand with the opening of the collecting vessel located approximately 2m above ground level. The TA Luft limit value is 350 mg/(m^2*day) during the monitoring period between 28-32 days.

The Dust Minimisation Plan shall be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures. The name and contact details of a person to contact regarding air quality and dust issues should be displayed on the site boundary, this notice board should also include head/regional office contact details. Community engagement before works commence on site should be put in place, including a communications plan. All dust and air quality complaints should be recorded and causes identified, along with the measures taken to reduce emissions. This complaints log should be available for viewing by the local authority, if requested. Daily on and off site inspections should occur for nuisance dust and compliance with the dust management plan. This should include regular dust soiling checks of surfaces such as street furniture, windows, and cars within 100m of the site boundary. Cleaning should be provided if necessary.

APPENDIX 11.1 - TRAFFIC ASSESSMENT

Proposed mixed use, commercial and residential development, Concorde Industrial Estate, Naas Road, Walkinstown, Dublin 12

Traffic Assessment

Client: Development Ocht Limited

Barrett Mahony Consulting Engineers

Dr Martin Rogers
Transport Planning Professional

December 2018

CONTENTS

FIGURES

APPENDIX 1 – TRICS Data

1 BACKGROUND TO PROJECT

It is proposed to construct a mixed use, commercial and residential development on lands within the Concorde Industrial Estate, Naas Road, Walkinstown, Dublin 12

Site location and site layout maps are contained within Figure 1.

Barrett Mahony Consulting Engineers have been appointed by Development Ocht Limited to assess the impact of traffic generated by the proposed development on the local road network.

The development is predominantly residential, and will comprise the construction of 492 No. apartment units.

For the purposes of this traffic assessment, the commercial / mixed use component of the proposed development will be assumed to consist of the following:

- 347 m^2 GFA crèche
- 723 m^2 GFA office space
- 1410 m^2 GFA retail space
- 518 m^2 medical practice

A total car parking provision of 200 No. spaces is planned for the residential element and 38 No. spaces for the commercial / mixed use component.

It is assumed that the development will be fully operational by 2021.

The traffic impact of the proposed development comprises the assessment of its impact on the four following major junctions in the vicinity:

- Naas Road Kylemore Road / Walkinstown Avenue signalised junction (Site No. 1);
- Naas Road / Concorde Industrial Estate signalised junction (Site No. 2);
- Walkinstown Road / Long Mile Road signalised junction (Site No. 3);
- Davitt Road / Tyrconnelll Road / Naas Road signalised junction (Site No. 4).

The location of these surveys are detailed within Figure 2.

Traffic surveys were carried out at the above 4 No. locations on Thursday 18th October 2018.

The traffic assessment within this report will analyse the existing flows on all major links and at the above 4 critical junctions, detail the existing level of operational efficiency at each location, and will also assess the impact that the flows predicted to be generated by the proposal will have on these operational efficiencies.

The analysis within this report is undertaken on the basis of zero growth in network traffic over the period 2018 to 2040 period, consistent with the 'low growth' assumption of 0% for Dublin city as detailed within the 2011 NRA document 'Project Appraisal Guidelines: Unit 5.5 Link-based traffic growth forecasting'.

Section 2 provides details of the receiving environment.

Section 3 details the traffic predicted to be generated by the proposed development. Traffic generated by the planned development in Muirfield Drive is also taken into consideration

Section 4 details the need for a traffic assessment based on the criteria within the 2014 Traffic and Transport Assessment Guidelines.

Section 5 provides an analysis of the post-development of major links and junctions in the vicinity of the proposed development.

Section 6 makes some concluding comments regarding the sustainability of the proposed project in traffic impact terms.

2 THE RECEIVING ENVIRONMENT

The site is located within an urban road network, with the links adjacent to the site carrying significant volumes of traffic into and out of the central business area within Dublin city.

A traffic survey was carried out on Thursday October 18th 2018 over a 12-hour period between 0700 and 1900 at the 4 No. stated junctions.

Junctions outside these 4 No. junctions are not considered of significant relevance as generated traffic will have significantly dissipated by the time it will have reached this wider network

The surveys, combined with the trip generation estimates, indicate that the weekday morning peak occurs between 0800 and 0900 with the evening peak occurring between 1600 and 1700 - these were observed to be the timeframes during which the major links in the vicinity of the subject site will be assumed to be most heavily loaded. The following analysis is based on these peak periods.

The morning and evening peak hour flows incident at the 4 No. junctions were as follows:

Naas Road Kylemore Road / Walkinstown Avenue signalised junction
AM peak hour - 3271 passenger car units
PM peak hour - 3200 passenger car units

Naas Road / Concorde Industrial Estate signalised junction
AM peak hour - 1833 passenger car units
PM peak hour - 1816 passenger car units

Walkinstown Road / Long Mile Road signalised junction
AM peak hour - 3407 passenger car units
PM peak hour - 3071 passenger car units

Davitt Road / Tyrconnelll Road / Naas Road signalised junction
AM peak hour - 2089 passenger car units
PM peak hour - 1997 passenger car units

The results of these surveys are detailed for the morning and evening peak hours in Figures 3 and 4 respectively.

It should be noted that, relative to the surveys completed in 2015 for the Muirfield Drive site, at the Naas Road and Concorde junctions, flows have increased marginally in the morning peak (+4%) and decreased by approximately the same quantity during the evening peak (-4%). At the Davitt Road junction, incident volumes were down by 7% in the morning peak hour and virtually identical within the evening peak hour. At the Long Mile Road junction, flows were down by an average of 5% over both peaks.

The Design Manual for Roads and Bridges document 'TA 79/99 – Traffic Capacity of Urban Roads' provides information on the capacity of urban roads based on classification and road width.

Based on this design standard, the following hourly capacities are assumed the major road links in the vicinity of the subject site:

- Davitt Road - 1020 vehicles/hour
- Naas Road - 1260 vehicles/hour
- Kylemore Road - 1550 vehicles/hour
- Walkinstown Avenue - 1620 vehicles/hour
- Long Mile Road - 1470 vehicles/hour

The above capacities are approximate, given the variability in road widths along their entire length and the difficulty in accurate classification in all cases.

Using both the above estimated capacities and the peak hour link flows for the above link roads, Tables 2-1 and 2-2 contains the existing ratio of flow to capacity for each of the above 5 No. links for the morning and evening peak hours respectively:

Link	Link capacity (vehicles/hr)	AM Peak flow (veh/hr)	Ratio of flow to capacity (RFC)
Davitt Road	1020	648	0.64
Naas Road	1260	1038	0.82
Kylemore Road	1550	727	0.47
Walkinstown Ave	1620	890	0.55
Long Mile Road	1470	1084	0.74

Table 2-1: Existing RFC's on major links in vicinity of proposed development for AM peak hour

Link	Link capacity (vehicles/hr)	PM Peak flow (veh/hr)	Ratio of flow to capacity (RFC)
Davitt Road	1020	687	0.67
Naas Road	1260	1109	0.88
Kylemore Road	1550	676	0.44
Walkinstown Ave	1620	874	0.54
Long Mile Road	1470	999	0.68

Table 2-2: Existing RFC's on major links in vicinity of proposed development for PM peak hour

As detailed above within Tables 2-1 and 2-2, the major links in the vicinity of the proposed development are operating at between 44% and 88% of their estimated capacity, with the Naas Road and Long Mile Road links the most heavily loaded.

3 TRIP GENERATION, DISTRIBUTION AND ASSIGNMENT ANALYSIS FOR PROPOSED DEVELOPMENT

3.1 INTRODUCTION

The traffic impact of the proposed development is derived by assessing the trips generated by the proposal and, taking the day of opening flows on the network, gauging the extent to which the superimposed flows from the proposed development will affect the efficiency of future network flows, particularly their impact on both link flows generally and on the operational efficiency of the 4 No. signalised junctions in its vicinity.

3.2 TRIPS GENERATED BY THE RESIDENTIAL COMPONENT OF THE PROPOSED DEVELOPMENT

It is proposed to construct 492 No apartment units.

TRICS typically gives the following weekday morning and evening peak trip rates for apartments using Irish sites only:

		Weekday AM		Weekday PM	
		IN	OUT	IN	OUT
Apartments	Trips/Unit	0.044	0.186	0.157	0.062

Table 3-1: Peak hour trip rates for apartments within development site

The above TRICS trip rates give rise to the following weekday morning and evening peak trip rates for apartments:

		Weekday AM		Weekday PM	
	Units (No.)	IN	OUT	IN	OUT
Apartments	492	22	92	77	31

Table 3-2: Peak hour flows generated by proposed apartments within development site

3.3 TRIPS GENERATED BY THE COMMERCIAL / MIXED USE COMPONENT OF THE PROPOSED DEVELOPMENT

As stated above, for the purposes of trip generation analysis, the commercial / mixed use component of the proposed development will be assumed to consist of the following:

- 347 m^2 GFA crèche
- 723 m^2 GFA office space
- 1410 m^2 GFA retail space
- 518 m^2 medical practice

TRICS typically gives the following weekday morning and evening peak trip rates for the crèche component:

		Weekday AM		Weekday PM	
		IN	OUT	IN	OUT
Crèche	Trips/100m^2 GFA	3.5	3.3	1.57	1.49

Table 3-3: Peak hour trip rates for crèche component within development site

The above TRICS trip rates give rise to the following weekday morning and evening peak trip rates for the crèche component:

		Weekday AM		Weekday PM	
	GFA (m^2)	IN	OUT	IN	OUT

Crèche	347	12	11	5	5

Table 3-4: Peak hour flows generated for crèche component within development site

TRICS typically gives the following weekday morning and weekday evening peak trip rates for community centre / healthcare developments:

		Weekday AM		Weekday PM	
		IN	OUT	IN	OUT
Office	Trips/100 m^2 GFA	1.1	0.26	0.35	1.14

Table 3-5: Typical peak hour trip rates for car showroom component within development site

The above TRICS trip rates give rise to the following weekday morning and evening peak trip rates for the car showroom component:

		Weekday AM		Weekday PM	
	GFA m^2	IN	OUT	IN	OUT
Office	723	8	2	3	8

Table 3-6: Peak hour flows generated by car showroom component within development site

TRICS typically gives the following weekday morning and weekday evening peak trip rates for local shop developments:

		Weekday AM		Weekday PM	
		IN	OUT	IN	OUT
Retail space	Trips/100 m^2 GFA	3.3	2.9	4.1	4.6

Table 3-7: Typical peak hour trip rates for pharmacy component within development site

The above TRICS trip rates give rise to the following weekday morning and evening peak trip rates for the pharmacy component:

		Weekday AM		Weekday PM	
	GFA m^2	IN	OUT	IN	OUT
Retail space	1410	47	41	58	65

Table 3-8: Peak hour flows generated by car showroom component within development site

TRICS typically gives the following weekday morning and weekday evening peak trip rates for medical centre developments:

		Weekday AM		Weekday PM	
		IN	OUT	IN	OUT
Medical centre / GP	Trips/100 m^2 GFA	2.77	1.19	1.36	2.1

Table 3-9: Typical peak hour trip rates for medical centre component within development site

The above TRICS trip rates give rise to the following weekday morning and evening peak trip rates for the medical centre component:

		Weekday AM		Weekday PM	
	GFA m^2	IN	OUT	IN	OUT
Medical centre / GP	518	14	6	7	11

Table 3-10: Peak hour flows generated by car showroom component within development site

The following are the combined flows generated by the commercial / mixed use component within the subject site for the morning and evening peak:

	Weekday AM		Weekday PM	
	IN	OUT	IN	OUT
Crèche	12	11	5	5
Office	8	2	3	8
Shop space	47	41	58	65
Medical practice	14	6	7	11
Total generated flows	81	60	73	89

Table 3-11: Total flows generated by the commercial / mixed use component of the proposed development

It would be reasonable to assume that a significant proportion of the above trips will be generated by the occupants of the proposed residential component.

This report will assume that up to 25% of the trips detailed within Table 3-11 are generated by the residential component as detailed within Table 3-2, with a further 20%, on average, applied to take account of trips already present on the network (pass-by / diverted trips) and thus not new, additional trips.

Thus, Table 3-12 below details the total flows predicted to be generated by the total proposed development:

	Weekday AM		Weekday PM	
	IN	OUT	IN	OUT
Residential component	22	92	77	31
Commercial / mixed use component	40	35	45	45
Total generated flows	62	127	122	76

Table 3-12: Total flows generated by the commercial / mixed use component of the proposed development

In summary, the proposed development will generate 2 outgoing and 1 incoming trips per minute during the morning peak, with the reverse applying during the evening peak.

In reality, this analysis is overly conservative. In terms of the residential component, the low parking provision will result in generated volumes significantly lower than those predicted within this report. For the commercial / mixed use component, in reality, the vast majority of the generated trips, in all probability greater than the 20% allowed for within this report, are not new trips but will result from vehicles already on the network, i.e. pass-by / diverted trips.

In reality, the generated trips could be significantly less than 50% of the volumes indicated within Table 3-12.

3.4 TRIPS GENERATED BY ADJACENT PERMITTED DEVELOPMENT ON MUIRFIELD DRIVE

The 2015 traffic assessment for the proposed Muirfield Drive development estimated the following generated traffic for the proposed mixed use development:

<u>AM Peak hour:</u>

11 No. vehicles entering, 74 No. vehicles departing

<u>PM peak hour:</u>

39 No. vehicles entering, 14 No. vehicles exiting

These volumes will be added to the development flows estimated for the proposed development at the Concorde site.

3.5 ESIMATION OF TOTAL GENERATED FLOWS ALLOWED FOR WITHIN THE TRAFFIC ASSESSMENT

By combining the estimated traffic generation flows for the proposed development with the flows estimated to be generated by the adjacent Muirfield Drive site, the following morning and evening peak hour trips are derived:

	Weekday AM		Weekday PM	
	IN	OUT	IN	OUT
Concorde site	62	127	122	76
Muirfield site	11	74	39	14
Total volumes	73	201	161	90

Table 3-13: Total flows generated by the commercial / mixed use component of the proposed development

3.6 TRIP DISTRIBUTION

In relation to the distribution of the flows into and out of the proposed roundabout junction at the development entrance, based on existing flows within the general network, the following is assumed:

<u>Morning peak hour</u>

Arrivals

50% of generated flows will arrive from the Naas Road signalised intersection (73 × 0.5 = 36 pcu), with 50% arriving from the Davit Road / Tyrconnell Road junction, (73 × 0.5 = 36 pcu).

The traffic arriving from Davitt Road / Tyrconnell Road is split 50:50 (36 × 0.5 = 18 pcu)

The traffic arriving from Naas Road will be predominantly via Naas Road west (90% = 36 × 0.9 = 32 pcu), with 10% arriving via the Long Mile Road junction (10% = 36 × 0.1 = 4 pcu).

Departures

50% of generated flows will depart towards the Naas Road signalised intersection (201 × 0.5 = 100 pcu), with 50% departing to the Davit Road / Tyrconnell Road junction, (201 × 0.5 = 100 pcu).

The traffic departing to Davitt Road / Tyrconnell Road is split 50:50 (100 × 0.5 = 50 pcu)

The traffic departing to Naas Road will predominantly exit via Naas Road west (90% = 100 × 0.9 = 90 pcu), with 10% exiting via the Long Mile Road junction (10% = 100 × 0.1 = 10 pcu).

<u>Evening peak hour</u>

Arrivals

60% of generated flows will arrive from the Naas Road signalised intersection (161 × 0.6 = 96 pcu), with 40% arriving from the Davit Road / Tyrconnell Road junction, (161 × 0.4 = 64 pcu).

The traffic arriving from Davitt Road / Tyrconnell Road is split 50:50 (64 × 0.5 = 32 pcu)

The traffic arriving from Naas Road will be predominantly via Naas Road west (90% = 96 × 0.9 = 86 pcu), with 10% arriving via the Long Mile Road junction (10% = 96 × 0.1 = 10 pcu).

Departures
50% of generated flows will depart towards the Naas Road signalised intersection (90 × 0.5 = 45 pcu), with 50% departing to the Davit Road / Tyrconnell Road junction, (90 × 0.5 = 45 pcu).

The traffic departing to Davitt Road / Tyrconnell Road is split 50:50 (45 × 0.5 = 22 pcu)

The traffic departing to Naas Road will predominantly exit via Naas Road west (90% = 45 × 0.9 = 40 pcu), with 10% exiting via the Long Mile Road junction (10% = 45 × 0.1 = 5 pcu).

These generated flows and their distribution are detailed for the morning and evening peak hours in Figures 5 and 6 respectively.

3.7 TRIP ASSIGNMENT

The Do-Something scenario for the year of opening is obtained by combining Figures 3 and 5 for the morning peak hour, and Figures 4 and 6 for the evening peak hour.

4 REQUIREMENT FOR A TRAFFIC ASSESSMENT

The 2014 Traffic and Transport Assessment Guidelines requires the impact of the additional traffic volumes on the critical nearby junctions to be assessed in detail if:

- Development flows exceed 10% of existing turning movements at the two relevant junctions;
- Development flows exceed 5% of turning movements if the location has the potential to become congested.

It can be seen from the October 2018 traffic surveys undertaken at 4 No. major junctions in the vicinity of the subject site for the morning and evening peak hours respectively that the incident development flows (including those for the proposed Muirfield Drive project) on each junction as a percentage of total incident flows are as follows:

AM Peak
Naas Road Kylemore Road / Walkinstown Avenue signalised junction
AM peak hour 2-way flow on network - 3271 pcu
AM peak hour 2-way incident generated flows – 136 pcu = 4% increase in network flow

Naas Road / Concorde Industrial Estate signalised junction
AM peak hour 2-way flow on network - 1833 pcu
AM peak hour 2-way incident generated flows - 230 pcu = 12% increase in network flow

Walkinstown Road / Long Mile Road signalised junction
AM peak hour 2-way flow on network - 3407 pcu
AM peak hour 2-way incident generated flows - 14 pcu = 0.4% increase in network flow

Davitt Road / Tyrconnelll Road / Naas Road signalised junction
AM peak hour 2-way flow on network - 2089 pcu
AM peak hour 2-way incident generated flows - 136 pcu = 6% increase in network flow

PM Peak

Naas Road Kylemore Road / Walkinstown Avenue signalised junction
PM peak hour 2-way flow on network - 3200 pcu
PM peak hour 2-way incident generated flows – 141 pcu = 4% increase in network flow

Naas Road / Concorde Industrial Estate signalised junction
PM peak hour 2-way flow on network - 1816 pcu
PM peak hour 2-way incident generated flows - 228 pcu = 12% increase in network flow

Walkinstown Road / Long Mile Road signalised junction
PM peak hour 2-way flow on network - 3071 pcu
PM peak hour 2-way incident generated flows - 15 pcu = 0.5% increase in network flow

Davitt Road / Tyrconnelll Road / Naas Road signalised junction
PM peak hour 2-way flow on network - 1997 pcu
PM peak hour 2-way incident generated flows - 108 pcu = 5% increase in network flow

Given that all three junctions are significantly congested at peak times, and as a result assuming that the 5% threshold applies, then the 2014 Guidelines would require analysis of the traffic impact of the proposal at the development entrance (site No. 2) where increase are in the order of 12%. At the two other junctions on the Naas Road (Site Nos. 1 and 4), the need for an assessment is marginal, as increases are in the 4% to 6% range. Given flow patterns within the network, with generated traffic predicted to enter and exit in a predominantly east-west direction, the impact of the proposal on the Long Mile Road junction (Site No. 3) is very low level.

Furthermore, it must be noted that the trip generation forecasts within this report are very robust and conservative. If trip generation rates for the residential component were reduced to reflect the low parking provision at the subject site, and if trip generation rates for the commercial / mixed use component were reduced to reflect the fact that a significant proportion of these trips, greater than the 15% allowed for within this analysis, are already on the network (pass-by / diverted trips), then Site Nos 1 and 4 would not meet the 5% threshold.

5 TRAFFIC IMPACT ASSESSMENT OF PROPOSED DEVELOPMENT ON LOCAL ROAD NETWORK

5.1 INTRODUCTION

This section analyses the impact of the proposed development on link capacities of Davitt Road, Naas Road, Kylemore Road, Walkinstown Avenue and Long Mile Road.

This section also assesses the impact of the proposed development on the following 4 No. junctions:

- Naas Road Kylemore Road / Walkinstown Avenue signalised junction
- Naas Road / Concorde Industrial Estate signalised junction
- Walkinstown Road / Long Mile Road signalised junction
- Davitt Road / Tyrconnelll Road / Naas Road signalised junction

For the junction analysis, 4 No. scenarios are evaluated:

- Existing flows (AM and PM peak)
- 2021 flows with development in place (AM and PM peak)

The OSCADY programme was used to model the incident peak-hour lows at the signalised junctions.

5.2 LINK CAPACITIES WITH PROPOSED DEVELOPMENT IN PLACE

Using the hourly capacities assumed for the major road links within section 2 of this report for the vicinity of the subject site:

- Davitt Road - 1020 vehicles/hour
- Naas Road - 1260 vehicles/hour
- Kylemore Road - 1550 vehicles/hour
- Walkinstown Avenue - 1620 vehicles/hour
- Long Mile Road - 1470 vehicles/hour

And combining the network flows detailed within section 2 with the development flows as estimated within section 3, Tables 4-1 and 4-2 contain the post development ratios of flow to capacity for each of the above 5 No. links for the morning and evening peak hours respectively:

Link	Link capacity (vehicles/hr)	AM Peak flow (veh/hr)	Ratio of flow to capacity (RFC)
Davitt Road	1020	666	0.65
Naas Road	1260	1106	0.88
Kylemore Road	1550	727	0.47
Walkinstown Ave	1620	894	0.55
Long Mile Road	1470	1084	0.74

Table 5-1: Post development RFC's on major links in0 vicinity of proposed development for AM peak hour

Link	Link capacity (vehicles/hr)	PM Peak flow (veh/hr)	Ratio of flow to capacity (RFC)
Davitt Road	1020	719	0.70
Naas Road	1260	1165	0.92
Kylemore Road	1550	676	0.44
Walkinstown Ave	1620	884	0.55
Long Mile Road	1470	999	0.68

Table 5-2: Post development RFC's on major links in vicinity of proposed development for PM peak hour

As detailed above within Tables 5-1 and 4-2, the major links in the vicinity of the proposed development will operate at between 44% and 92% of their estimated capacity with all accounted for developments in place.

The maximum RFC has thus increased by a maximum of 4% on the existing levels, emphasising the low impact of the proposed development on the local road network. RFC's along Davitt Road are increased by 2% on average over both peak, Naas Road by an average of 5% over both peaks and Walkinstown Avenue by, on average over both peaks, less than 1%.

The proposed development is predicted to have no perceptible impact on the Kylemore Road and Long Mile Road links.

5.3 ANALYSIS OF NAAS ROAD/ KYLEMORE ROAD / WALKINSTOWN AVENUE SIGNALISED JUNCTION

5.3.1 Geometric parameters

For the junction in question, the following geometric characteristics apply:

Kylemore Road (Arm A)
3 No. lanes, inside lane for left-turning traffic only, outside lane and inner lane for straight-ahead only, all assumed to be 3.0 metres wide.

Naas Road East (Arm B)
4 No. lanes, inside lane for left-turning traffic only, outside lane for right-turning, and two inner lanes for straight-ahead only, all assumed to be 3.0 metres wide.

Walkinstown Avenue (Arm C)
2 No. lanes, outside lane for right-turning and straight-ahead traffic, inside lane for straight-ahead and left-turning, both assumed to be 3.0 metres wide.

Naas Road West (Arm D)
3 No. lanes, inside lane for left-turning traffic only, outside lane for right-turning, and inner lane for straight-ahead only, all assumed to be 3.0 metres wide.

5.3.2 Signal timings and phasing

A basic 3-phase signal cycle is in place at the junction, as observed within the October 2018 survey, configured as follows:

Phase 1
All northbound and southbound traffic (Arms A and C) from Kylemore Road and Walkinstown Avenue approaches have priority. All other traffic is stopped

Phase 2
All eastbound and westbound straight-ahead and left-turning traffic (Arms B and D) from Naas Road (east and west) approaches have priority. All other traffic is stopped.

Phase 3
All eastbound and westbound right-turning traffic (Arms B and D) from Naas Road (east and west) approaches have priority. All other traffic is stopped.

Times allocated to each phase will vary. However, in general, based on the observations during the traffic survey in October 2018, the following timings have been used for the morning and evening peaks within this analysis:

Morning Peak
Phase 1: 30 seconds
Phase 2: 80 seconds
Phase 3: 15 seconds

Total cycle time = 140 seconds, including an Intergreen Period set at 5 seconds for each of the 3 phases – total intergreen = 15 seconds)

Evening Peak
Phase 1: 45 seconds
Phase 2: 27 seconds
Phase 3: 15 seconds
Total cycle time = 102 seconds, including an Intergreen Period set at 5 seconds for each of the 3 phases – total intergreen = 15 seconds)

While this set of timings would appear upon inspection not to be optimised, the above timings have been used within this report to mirror the existing reality as closely as possible.

5.3.3 Analysis of existing AM and PM peak hour flows

Tables 5-3 and 5-4 immediately below detail the flows, capacities, RFC's and queue lengths for the existing morning and evening peaks:

	Morning peak hour 2018 (existing flows)			
0800-0815	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.64	5.52	0.12	2
Kylemore Rd straight	10.09	15.41	0.66	10
Naas Rd (E) left-turning	2.43	14.29	0.17	3
Naas Rd (E) straight	14.21	39.88	0.36	7
Naas Rd (E) right-turning	0.69	3.11	0.22	2
Walkinstown Av left-str-right	10.60	10.41	1.01	15
Naas Rd (W) left-turning	3.05	14.29	0.21	3
Naas Rd (W) straight	13.16	19.94	0.66	14
Naas Rd (W) right-turning	2.86	3.11	0.92	9
0815-0830	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.28	5.52	0.06	1
Kylemore Rd straight	9.05	15.41	0.67	9
Naas Rd (E) left-turning	1.83	14.29	0.26	2
Naas Rd (E) straight	13.78	39.88	0.37	7
Naas Rd (E) right-turning	1.00	3.11	0.12	2
Walkinstown Av left-str-right	10.60	9.78	1.00	21
Naas Rd (W) left-turning	2.38	14.29	0.16	3
Naas Rd (W) straight	10.47	19.94	0.56	11
Naas Rd (W) right-turning	3.01	3.11	0.94	11
0830-0845	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.32	5.52	0.06	1
Kylemore Rd straight	10.28	15.41	0.67	10
Naas Rd (E) left-turning	3.76	14.29	0.26	4
Naas Rd (E) straight	14.66	39.88	0.37	8
Naas Rd (E) right-turning	0.38	3.11	0.12	1
Walkinstown Av left-str-right	10.40	10.34	1.00	23
Naas Rd (W) left-turning	2.28	14.29	0.16	3
Naas Rd (W) straight	11.06	19.94	0.56	12
Naas Rd (W) right-turning	2.93	3.11	0.94	12
0845-0900	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.61	5.52	0.11	2
Kylemore Rd straight	8.12	15.41	0.53	8
Naas Rd (E) left-turning	1.97	14.29	0.14	2
Naas Rd (E) straight	12.79	39.88	0.32	7
Naas Rd (E) right-turning	1.64	3.11	0.53	4
Walkinstown Av left-str-right	10.40	9.98	1.04	26
Naas Rd (W) left-turning	1.95	14.29	0.14	2
Naas Rd (W) straight	10.74	19.94	0.54	11
Naas Rd (W) right-turning	3.58	3.11	1.15	20

Table 5-3: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday morning peak hour for existing 2018 flows

	Evening peak hour 2018 (existing flows)			
1600-1615	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.48	11.19	0.04	1
Kylemore Rd straight	11.46	31.23	0.37	6
Naas Rd (E) left-turning	1.06	6.86	0.16	2
Naas Rd (E) straight	15.96	19.14	0.83	11
Naas Rd (E) right-turning	0.71	4.26	0.17	1
Walkinstown Av left-str-right	10.53	21.28	0.50	5
Naas Rd (W) left-turning	1.99	6.86	0.29	3
Naas Rd (W) straight	9.29	9.57	0.97	19
Naas Rd (W) right-turning	1.99	4.26	0.47	4
1615-1630	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.36	11.19	0.03	1
Kylemore Rd straight	11.70	31.23	0.38	6
Naas Rd (E) left-turning	1.77	6.86	0.26	3
Naas Rd (E) straight	17.70	19.14	0.93	14
Naas Rd (E) right-turning	0.20	4.26	0.05	1
Walkinstown Av left-str-right	8.73	21.17	0.41	5
Naas Rd (W) left-turning	2.62	6.86	0.38	4
Naas Rd (W) straight	11.32	9.57	1.18	46
Naas Rd (W) right-turning	2.46	4.26	0.58	4
1630-1645	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.63	11.19	0.06	1
Kylemore Rd straight	12.03	31.23	0.39	6
Naas Rd (E) left-turning	1.47	6.86	0.22	2
Naas Rd (E) straight	16.38	19.14	0.86	12
Naas Rd (E) right-turning	0.55	4.26	0.13	1
Walkinstown Av left-str-right	10.13	20.53	0.49	5
Naas Rd (W) left-turning	1.63	6.86	0.24	2
Naas Rd (W) straight	8.65	9.57	0.90	35
Naas Rd (W) right-turning	2.26	4.26	0.53	4
1645-1700	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.48	11.19	0.04	1
Kylemore Rd straight	11.58	31.23	0.37	6
Naas Rd (E) left-turning	1.45	6.86	0.21	2
Naas Rd (E) straight	15.96	19.14	0.83	12
Naas Rd (E) right-turning	0.73	4.26	0.17	2
Walkinstown Av left-str-right	8.67	22.02	0.39	5
Naas Rd (W) left-turning	1.83	6.86	0.27	3
Naas Rd (W) straight	9.85	9.57	1.03	40
Naas Rd (W) right-turning	2.39	4.26	0.56	4

Table 5-4: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday evening peak hour for existing 2018 flows

It can be seen that the junction is quite heavily loaded within both the morning and evening peaks, with the Naas Road (West) link most heavily loaded during both peaks.

Queuing is significant on all approaches, most significantly on the Naas Road (West) approach)

5.3.4 Analysis of 2021 AM and PM peak hour flows with development in place (Do-something scenarios)

Tables 5-5 and 5-6 immediately below detail the flows, capacities, RFC's and queue lengths for the 2021 morning and evening peaks with the development in place (year of opening with development in place):

	Morning peak hour 2021 (development in place)			
0800-0815	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.64	5.52	0.12	2
Kylemore Rd straight	10.09	15.41	0.66	10
Naas Rd (E) left-turning	2.53	14.29	0.18	3
Naas Rd (E) straight	14.81	39.88	0.37	8
Naas Rd (E) right-turning	0.72	3.11	0.23	2
Walkinstown Av left-str-right	10.73	10.10	1.06	17
Naas Rd (W) left-turning	2.87	14.29	0.20	3
Naas Rd (W) straight	14.53	19.94	0.73	16
Naas Rd (W) right-turning	3.07	3.11	0.99	11
0815-0830	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.28	5.52	0.05	1
Kylemore Rd straight	9.05	15.41	0.59	9
Naas Rd (E) left-turning	1.91	14.29	0.13	2
Naas Rd (E) straight	14.39	39.88	0.36	8
Naas Rd (E) right-turning	1.04	3.11	0.34	3
Walkinstown Av left-str-right	10.73	9.51	1.12	26
Naas Rd (W) left-turning	2.42	14.29	0.17	3
Naas Rd (W) straight	11.91	19.94	0.60	13
Naas Rd (W) right-turning	2.94	3.11	0.95	12
0830-0845	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.32	5.52	0.06	1
Kylemore Rd straight	10.28	15.41	0.67	10
Naas Rd (E) left-turning	3.71	14.29	0.26	4
Naas Rd (E) straight	15.24	39.88	0.38	8
Naas Rd (E) right-turning	0.59	3.11	0.19	2
Walkinstown Av left-str-right	10.40	10.03	1.04	30
Naas Rd (W) left-turning	2.44	14.29	0.17	3
Naas Rd (W) straight	13.30	19.94	0.67	14
Naas Rd (W) right-turning	3.00	3.11	0.96	13
0845-0900	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.61	5.52	0.11	2
Kylemore Rd straight	8.12	15.41	0.53	8
Naas Rd (E) left-turning	2.06	14.29	0.14	2
Naas Rd (E) straight	13.54	39.88	0.34	7
Naas Rd (E) right-turning	1.54	3.11	0.50	4
Walkinstown Av left-str-right	10.53	9.76	1.08	35
Naas Rd (W) left-turning	1.95	14.29	0.14	2
Naas Rd (W) straight	12.06	19.94	0.61	13
Naas Rd (W) right-turning	3.72	3.11	1.20	23

Table 5-5: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday morning peak hour for 2021 flows with development in place

	Evening peak hour 2021 (development in place)			
1600-1615	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.84	11.19	0.08	1
Kylemore Rd straight	11.10	31.23	0.36	6
Naas Rd (E) left-turning	1.16	6.86	0.17	2
Naas Rd (E) straight	17.46	19.14	0.91	13
Naas Rd (E) right-turning	0.78	4.26	0.18	2
Walkinstown Av left-str-right	10.60	21.53	0.49	5
Naas Rd (W) left-turning	2.07	6.86	0.30	3
Naas Rd (W) straight	9.94	9.57	1.04	24
Naas Rd (W) right-turning	1.79	4.26	0.42	3
1615-1630	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.36	11.19	0.03	1
Kylemore Rd straight	11.70	31.23	0.38	6
Naas Rd (E) left-turning	1.92	6.86	0.28	3
Naas Rd (E) straight	19.20	19.14	1.00	19
Naas Rd (E) right-turning	0.21	4.26	0.05	1
Walkinstown Av left-str-right	8.80	20.88	0.42	5
Naas Rd (W) left-turning	2.71	6.86	0.40	4
Naas Rd (W) straight	11.68	9.57	1.22	56
Naas Rd (W) right-turning	2.54	4.26	0.60	5
1630-1645	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.63	11.19	0.06	1
Kylemore Rd straight	12.03	31.23	0.39	6
Naas Rd (E) left-turning	1.61	6.86	0.23	2
Naas Rd (E) straight	17.86	19.14	0.93	17
Naas Rd (E) right-turning	0.60	4.26	0.14	1
Walkinstown Av left-str-right	10.20	20.24	0.50	5
Naas Rd (W) left-turning	1.57	6.86	0.23	2
Naas Rd (W) straight	9.15	9.57	0.96	51
Naas Rd (W) right-turning	2.35	4.26	0.55	4
1645-1700	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Kylemore Rd left-turning	0.48	11.19	0.04	1
Kylemore Rd straight	11.58	31.23	0.37	6
Naas Rd (E) left-turning	1.58	6.86	0.23	2
Naas Rd (E) straight	17.42	19.14	0.91	14
Naas Rd (E) right-turning	0.79	4.26	0.19	2
Walkinstown Av left-str-right	8.73	22.02	0.40	5
Naas Rd (W) left-turning	1.75	6.86	0.26	3
Naas Rd (W) straight	10.37	9.57	1.08	64
Naas Rd (W) right-turning	2.48	4.26	0.58	4

Table 5-6: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday evening peak hour for 2021 flows with development in place

It can be seen that, with the development in place, the junction remains quite heavily loaded within both the morning and evening peaks, with the Naas Road (West) link remaining the most heavily loaded during both peaks.

Queuing remains significant on all approaches, most significantly on the Naas Road (West) approach) where queuing has increased most.

5.4 ANALYSIS OF NAAS ROAD / CONCORDE INDUSTRIAL ESTATE SIGNALISED JUNCTION

5.4.1 Geometric parameters

For the junction in question, the following geometric characteristics apply:

Naas Road (East) (Arm A)
3 No. lanes, inside lane for left-turning traffic only, outside lane for right-turning only, and inner lane for straight-ahead only, all assumed to be 3.0 metres wide.

Concorde Industrial Estate (Arm B)
2 No. lanes, inside lane for left-turning traffic only, outside lane for right-turning, both assumed to be 2.25 metres wide.

Naas Road (West) (Arm C)
2 No. lanes, outside lane for right-turning only, inside lane for straight-ahead only, both assumed to be 3.0 metres wide.

5.4.2 Signal timings and phasing

A basic 3-phase signal cycle is in place at the junction, as observed within the October 2018 survey, configured as follows:

Phase 1
All eastbound and westbound straight-ahead and left-turning traffic movements (Arms A and C) from Naas Road (E) and (W) have priority. All other traffic is stopped.

Phase 2
Eastbound straight-ahead and right-turning traffic (Arm C) from Naas Road (W) approach have priority. All other traffic is stopped.

Phase 3
All outbound exiting movements from Concorde Industrial estate have priority (Arm B). All other traffic is stopped.

A vehicle actuated intersection has been assumed, with a maximum cycle time of 120 seconds

5.4.3 Analysis of existing AM and PM peak hour flows

Tables 5-7 and 5-8 immediately below detail the flows, capacities, RFC's and queue lengths for the existing morning and evening peaks:

	Morning peak hour 2018 (existing flows)			
0800-0815	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.00	19.23	0.00	0
Naas Rd (E) straight	17.33	53.75	0.32	4
Concorde left + right-turning	0.07	1.40	0.05	1
Naas Rd (W) straight	14.47	27.59	0.52	4
Naas Rd (W) right-turning	0.00	1.39	0.00	0
0815-0830	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.00	19.23	0.00	0
Naas Rd (E) straight	16.40	53.75	0.31	4
Concorde left + right-turning	0.33	1.40	0.24	1
Naas Rd (W) straight	11.96	27.59	0.43	3
Naas Rd (W) right-turning	0.37	1.39	0.27	1
0830-0845	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.00	19.23	0.00	0
Naas Rd (E) straight	18.80	53.75	0.35	4
Concorde left + right-turning	0.07	1.40	0.05	1
Naas Rd (W) straight	12.42	27.59	0.45	3
Naas Rd (W) right-turning	0.52	1.39	0.37	2
0845-0900	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.33	17.59	0.02	1
Naas Rd (E) straight	16.33	49.17	0.33	4
Concorde left + right-turning	0.20	1.76	0.11	1
Naas Rd (W) straight	11.65	26.69	0.44	3
Naas Rd (W) right-turning	1.01	2.22	0.46	2

Table 5-7: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday morning peak hour for existing 2018 flows

	Evening peak hour 2018 (existing flows)			
1600-1615	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.36	19.23	0.02	1
Naas Rd (E) straight	17.51	53.75	0.33	4
Concorde left + right-turning	0.2	1.27	0.16	1
Naas Rd (W) straight	11.48	27.59	0.42	3
Naas Rd (W) right-turning	0.12	1.39	0.08	1
1615-1630	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.20	19.23	0.01	1
Naas Rd (E) straight	19.47	53.75	0.36	4
Concorde left + right-turning	0.27	1.27	0.21	1
Naas Rd (W) straight	12.41	27.59	0.45	3
Naas Rd (W) right-turning	0.25	1.39	0.18	1
1630-1645	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.00	7.96	0.00	1
Naas Rd (E) straight	18.20	53.75	0.34	4
Concorde left + right-turning	0.20	1.27	0.16	1
Naas Rd (W) straight	10.78	27.59	0.39	3
Naas Rd (W) right-turning	0.22	1.39	0.16	1
1645-1600	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.00	18.24	0.00	0
Naas Rd (E) straight	17.53	50.99	0.34	4
Concorde left + right-turning	0.60	1.54	0.39	2
Naas Rd (W) straight	10.88	26.85	0.41	3
Naas Rd (W) right-turning	0.45	1.69	0.27	1

Table 5-8: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday evening peak hour for existing 2018 flows

It can be seen that the junction is not heavily loaded within both the morning and evening peaks, as traffic exiting the industrial estate is very at very low levels.

Queuing is low on all approaches.

5.4.4 Analysis of 2021 AM and PM peak hour flows with development in place (Do-something scenarios)

Tables 5-9 and 5-10 immediately below detail the flows, capacities, RFC's and queue lengths for the 2021 morning and evening peaks with the development in place (year of opening with development in place):

	Morning peak hour 2021 (development in place)			
0800-0815	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.55	15.31	0.04	1
Naas Rd (E) straight	17.91	43.33	0.41	4
Concorde left-turning	1.14	2.34	0.49	2
Concorde right-turning	1.06	2.52	0.42	2
Naas Rd (W) straight	14.46	24.66	0.59	4
Naas Rd (W) right-turning	0.60	2.56	0.24	1
0815-0830	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.53	14.53	0.04	0
Naas Rd (E) straight	17.01	41.13	0.41	4
Concorde left-turning	1.34	2.57	0.52	2
Concorde right-turning	1.06	2.76	0.38	2
Naas Rd (W) straight	12.55	24.07	0.52	4
Naas Rd (W) right-turning	0.39	2.78	0.14	1
0830-0845	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.60	14.74	0.04	1
Naas Rd (E) straight	19.34	41.73	0.46	4
Concorde left-turning	1.14	2.49	0.46	2
Concorde right-turning	1.06	2.68	0.39	2
Naas Rd (W) straight	12.45	24.24	0.51	4
Naas Rd (W) right-turning	1.08	2.73	0.40	2
0845-0900	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.89	13.41	0.07	1
Naas Rd (E) straight	16.91	37.96	0.45	4
Concorde left-turning	1.14	2.86	0.40	2
Concorde right-turning	1.19	3.08	0.39	2
Naas Rd (W) straight	11.81	23.24	0.51	3
Naas Rd (W) right-turning	1.46	3.12	0.47	2

Table 5-9: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday morning peak hour for 2021 with development in place

	Evening peak hour 2021 (development in place)			
1600-1615	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	1.13	14.96	0.08	1
Naas Rd (E) straight	17.67	41.83	0.42	4
Concorde left-turning	0.84	2.43	0.34	1
Concorde right-turning	0.63	2.62	0.24	1
Naas Rd (W) straight	11.88	24.40	0.49	3
Naas Rd (W) right-turning	1.32	2.66	0.50	2
1615-1630	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	1.03	15.12	0.07	1
Naas Rd (E) straight	19.57	42.26	0.46	4
Concorde left-turning	0.90	2.36	0.38	1
Concorde right-turning	0.63	2.55	0.25	1
Naas Rd (W) straight	12.84	24.59	0.52	4
Naas Rd (W) right-turning	1.43	2.69	0.53	2
1630-1645	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.77	14.85	0.05	0
Naas Rd (E) straight	18.37	41.50	0.44	4
Concorde left-turning	0.84	2.47	0.34	1
Concorde right-turning	0.63	2.65	0.24	1
Naas Rd (W) straight	11.21	24.32	0.46	3
Naas Rd (W) right-turning	1.39	2.70	0.51	2
1645-1600	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Naas Rd (E) left-turning	0.74	13.46	0.06	1
Naas Rd (E) straight	17.73	37.63	0.47	4
Concorde left-turning	1.23	2.83	0.44	2
Concorde right-turning	0.63	3.05	0.21	1
Naas Rd (W) straight	11.21	23.32	0.48	3
Naas Rd (W) right-turning	1.39	3.15	0.53	2

Table 5-10: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday evening peak hour for 2021 with development in place

It can be seen that the junction remains lightly loaded within both the morning and evening peaks, with the generated traffic increasing queues marginally.

The junction is predicted to operate efficiently at all times with the development in place.

5.5 ANALYSIS OF WALKINSTOWN ROAD / LONG MILE ROAD SIGNALISED JUNCTION

5.5.1 Geometric parameters

For the junction in question, the following geometric characteristics apply:

Walkinstown Avenue North (Arm A)
3 No. lanes, inside lane for left-turning traffic only, outside lane for right-turn only and inner lane for straight-ahead only, all assumed to be 3.0 metres wide.

Long Mile Road East (Arm B)
3 No. lanes, inside lane for left-turning traffic only, outside lane for right-turning, and inner lane for straight-ahead only, all assumed to be 3.0 metres wide.

Walkinstown Avenue South (Arm C)
2 No. lanes, outside lane for right-turning and straight-ahead traffic, inside lane for straight-ahead and left-turning, both assumed to be 3.0 metres wide.

Long Mile Road West (Arm D)
3 No. lanes, inside lane for left-turning traffic only, outside lane for right-turning only, and inner lane for straight-ahead only, all assumed to be 3.0 metres wide.

5.5.2 Signal timings and phasing

A basic 4-phase signal cycle is in place at the junction, as observed within the October 2018 survey, configured as follows:

Phase 1
All southbound traffic (Arm A) from Walkinstown Avenue (N) has priority. All other traffic is stopped

Phase 2
All unopposed straight-ahead and left-turning northbound and southbound traffic (Arms A and C) along Walkinstown Avenue (north and south) approaches have priority. All other traffic is stopped

Phase 3
All eastbound and westbound straight-ahead and left-turning traffic (Arms B and D) from Long Mile Road (east and west) approaches have priority. All other traffic is stopped.

Phase 3
All eastbound and westbound right-turning traffic (Arms B and D) from the Long Mile Road (east and west) approaches have priority. All other traffic is stopped.

Times allocated to each phase will vary. However, in general, based on the observations during the traffic survey in October 2018, the following timings have been used for the morning and evening peaks within this analysis:

Morning and Evening Peaks
Phase 1: 15 seconds
Phase 2: 35 seconds
Phase 3: 45 seconds

Phase 4: 20 seconds

Total cycle time = 135 seconds, including an Intergreen Period set at 5 seconds for each of the 4 phases – total intergreen = 20 seconds)

While this set of timings would appear upon inspection not to be optimised, the above timings have been used within this report to mirror the existing reality as closely as possible.

5.5.3 Analysis of existing AM and PM peak hour flows

Tables 5-11 and 5-12 immediately below detail the flows, capacities, RFC's and queue lengths for the existing morning and evening peaks:

	Morning peak hour 2018 (existing flows)			
0800-0815	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	4.65	10.28	0.45	7
Walkinstown Ave (N) straight	6.69	14.33	0.47	9
Walkinstown Ave (N) left-turning	3.20	3.22	0.99	11
Long Mile Rd (E) left-turning	1.06	8.46	0.13	2
Long Mile Rd (E) straight	10.74	11.80	0.91	20
Long Mile Rd (E) right-turning	3.33	4.20	0.79	8
Walkinstown Ave (S) left-str-right	10.93	14.19	0.77	10
Long Mile Rd (W) left-turning	1.85	8.46	0.22	3
Long Mile Rd (W) straight	8.58	11.80	0.81	17
Long Mile Rd (W) right-turning	5.38	4.20	1.28	28
0815-0830	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	4.99	10.28	0.49	7
Walkinstown Ave (N) straight	5.36	14.33	0.37	8
Walkinstown Ave (N) left-turning	2.12	3.22	0.66	5
Long Mile Rd (E) left-turning	0.48	8.46	0.06	1
Long Mile Rd (E) straight	13.22	11.80	1.12	45
Long Mile Rd (E) right-turning	2.23	4.20	0.53	5
Walkinstown Ave (S) left-str-right	9.87	14.20	0.70	9
Long Mile Rd (W) left-turning	1.75	8.46	0.21	3
Long Mile Rd (W) straight	11.57	11.80	0.98	26
Long Mile Rd (W) right-turning	4.21	4.20	1.00	29
0830-0845	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	5.97	10.28	0.58	8
Walkinstown Ave (N) straight	6.45	14.33	0.45	9
Walkinstown Ave (N) left-turning	3.71	3.22	1.15	17
Long Mile Rd (E) left-turning	0.86	8.46	0.10	2
Long Mile Rd (E) straight	10.84	11.80	0.92	35
Long Mile Rd (E) right-turning	2.57	4.20	0.61	6
Walkinstown Ave (S) left-str-right	10.73	12.40	0.87	11
Long Mile Rd (W) left-turning	1.79	8.46	0.21	3
Long Mile Rd (W) straight	11.43	11.80	0.97	27
Long Mile Rd (W) right-turning	4.65	4.20	1.11	36
0845-0900	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	4.68	10.28	0.46	7
Walkinstown Ave (N) straight	5.20	14.33	0.36	7
Walkinstown Ave (N) left-turning	3.12	3.22	0.97	17
Long Mile Rd (E) left-turning	0.79	8.46	0.09	2
Long Mile Rd (E) straight	11.85	11.80	1.00	38
Long Mile Rd (E) right-turning	3.16	4.20	0.75	8
Walkinstown Ave (S) left-str-right	10.13	13.92	0.73	9
Long Mile Rd (W) left-turning	3.84	8.46	0.45	6
Long Mile Rd (W) straight	8.64	11.80	0.73	14
Long Mile Rd (W) right-turning	3.52	4.20	0.84	27

Table 5-11: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday morning peak hour for existing 2018 flows

	Evening peak hour 2018 (existing flows)			
1600-1615	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	2.42	10.28	0.24	4
Walkinstown Ave (N) straight	5.65	14.33	0.39	8
Walkinstown Ave (N) left-turning	3.46	3.22	1.08	14
Long Mile Rd (E) left-turning	1.55	8.46	0.18	3
Long Mile Rd (E) straight	11.74	11.80	0.99	27
Long Mile Rd (E) right-turning	3.97	4.20	0.95	12
Walkinstown Ave (S) left-str-right	8.33	12.74	0.65	8
Long Mile Rd (W) left-turning	2.90	8.46	0.34	5
Long Mile Rd (W) straight	8.70	11.80	0.74	14
Long Mile Rd (W) right-turning	3.66	4.20	0.87	10
1615-1630	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	4.38	10.28	0.43	6
Walkinstown Ave (N) straight	6.28	14.33	0.44	9
Walkinstown Ave (N) left-turning	3.94	3.22	1.22	25
Long Mile Rd (E) left-turning	1.43	8.46	0.17	3
Long Mile Rd (E) straight	9.62	11.80	0.82	17
Long Mile Rd (E) right-turning	1.95	4.20	0.47	4
Walkinstown Ave (S) left-str-right	8.80	11.94	0.74	8
Long Mile Rd (W) left-turning	2.17	8.46	0.26	4
Long Mile Rd (W) straight	10.17	11.80	0.86	18
Long Mile Rd (W) right-turning	4.33	4.20	1.03	16
1630-1645	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	2.73	10.28	0.27	4
Walkinstown Ave (N) straight	7.02	14.33	0.49	10
Walkinstown Ave (N) left-turning	3.25	3.22	1.01	26
Long Mile Rd (E) left-turning	1.40	8.46	0.17	3
Long Mile Rd (E) straight	5.70	11.80	0.49	9
Long Mile Rd (E) right-turning	2.90	4.20	0.69	7
Walkinstown Ave (S) left-str-right	7.27	12.80	0.57	7
Long Mile Rd (W) left-turning	3.49	8.46	0.41	6
Long Mile Rd (W) straight	9.08	11.80	0.77	15
Long Mile Rd (W) right-turning	4.89	4.20	1.17	27
1645-1700	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	3.71	10.28	0.36	5
Walkinstown Ave (N) straight	7.70	14.33	0.54	11
Walkinstown Ave (N) left-turning	2.85	3.22	0.89	22
Long Mile Rd (E) left-turning	1.91	8.46	0.23	3
Long Mile Rd (E) straight	5.19	11.80	0.44	8
Long Mile Rd (E) right-turning	3.50	4.20	0.84	9
Walkinstown Ave (S) left-str-right	9.53	11.46	0.83	9
Long Mile Rd (W) left-turning	2.75	8.46	0.33	5
Long Mile Rd (W) straight	10.84	11.80	0.92	21
Long Mile Rd (W) right-turning	3.61	4.20	0.86	20

Table 5-12: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday evening peak hour for existing 2018 flows

It can be seen that the junction is heavily loaded within both the morning and evening peaks.

Queuing is significant on all approaches.

5.5.4 Analysis of 2021 AM and PM peak hour flows with development in place (Do-something scenarios)

Tables 5-13 and 5-14 immediately below detail the flows, capacities, RFC's and queue lengths for the 2021 morning and evening peaks with the development in place (year of opening with development in place):

	Morning peak hour 2021 (development in place)			
0800-0815	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	4.71	10.28	0.46	7
Walkinstown Ave (N) straight	6.78	14.33	0.47	10
Walkinstown Ave (N) left-turning	3.24	3.22	1.00	12
Long Mile Rd (E) left-turning	1.06	8.46	0.13	2
Long Mile Rd (E) straight	10.74	11.80	0.91	20
Long Mile Rd (E) right-turning	3.33	4.20	0.79	8
Walkinstown Ave (S) left-str-right	11.00	14.19	0.78	10
Long Mile Rd (W) left-turning	1.85	8.46	0.22	3
Long Mile Rd (W) straight	9.58	11.80	0.81	17
Long Mile Rd (W) right-turning	5.38	4.20	1.28	28
0815-0830	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	5.07	10.28	0.49	7
Walkinstown Ave (N) straight	5.45	14.33	0.38	8
Walkinstown Ave (N) left-turning	2.15	3.22	0.67	6
Long Mile Rd (E) left-turning	0.48	8.46	0.06	1
Long Mile Rd (E) straight	13.22	11.80	1.12	45
Long Mile Rd (E) right-turning	2.23	4.20	0.53	5
Walkinstown Ave (S) left-str-right	9.93	14.20	0.70	9
Long Mile Rd (W) left-turning	1.75	8.46	0.21	3
Long Mile Rd (W) straight	11.57	11.80	0.98	26
Long Mile Rd (W) right-turning	4.21	4.20	1.00	29
0830-0845	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	6.02	10.28	0.59	9
Walkinstown Ave (N) straight	6.51	14.33	0.45	9
Walkinstown Ave (N) left-turning	3.74	3.22	1.16	17
Long Mile Rd (E) left-turning	0.86	8.46	0.10	2
Long Mile Rd (E) straight	10.84	11.80	0.92	35
Long Mile Rd (E) right-turning	2.57	4.20	0.61	6
Walkinstown Ave (S) left-str-right	10.80	12.40	0.87	11
Long Mile Rd (W) left-turning	1.79	8.46	0.21	3
Long Mile Rd (W) straight	11.43	11.80	0.97	27
Long Mile Rd (W) right-turning	4.65	4.20	1.11	36
0845-0900	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	4.73	10.28	0.46	7
Walkinstown Ave (N) straight	5.25	14.33	0.37	7
Walkinstown Ave (N) left-turning	3.15	3.22	0.98	18
Long Mile Rd (E) left-turning	0.79	8.46	0.09	2
Long Mile Rd (E) straight	11.85	11.80	1.00	38
Long Mile Rd (E) right-turning	3.16	4.20	0.75	8
Walkinstown Ave (S) left-str-right	10.20	13.92	0.73	9
Long Mile Rd (W) left-turning	3.84	8.46	0.45	6
Long Mile Rd (W) straight	8.64	11.80	0.73	14
Long Mile Rd (W) right-turning	3.52	4.20	0.84	27

Table 5-13: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday morning peak hour for 2021 flows with development in place

	Evening peak hour 2021 (development in place)			
1600-1615	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	2.45	10.28	0.24	4
Walkinstown Ave (N) straight	5.72	14.33	0.40	8
Walkinstown Ave (N) left-turning	3.50	3.22	1.09	14
Long Mile Rd (E) left-turning	1.55	8.46	0.18	3
Long Mile Rd (E) straight	11.74	11.80	0.99	27
Long Mile Rd (E) right-turning	3.97	4.20	0.95	12
Walkinstown Ave (S) left-str-right	8.53	12.74	0.67	8
Long Mile Rd (W) left-turning	2.90	8.46	0.34	5
Long Mile Rd (W) straight	8.70	11.80	0.74	14
Long Mile Rd (W) right-turning	3.66	4.20	0.87	10
1615-1630	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	4.40	10.28	0.43	6
Walkinstown Ave (N) straight	6.31	14.33	0.44	9
Walkinstown Ave (N) left-turning	3.96	3.22	1.23	26
Long Mile Rd (E) left-turning	1.43	8.46	0.17	3
Long Mile Rd (E) straight	9.62	11.80	0.82	17
Long Mile Rd (E) right-turning	1.95	4.20	0.47	4
Walkinstown Ave (S) left-str-right	9.00	11.94	0.76	9
Long Mile Rd (W) left-turning	2.17	8.46	0.26	4
Long Mile Rd (W) straight	10.17	11.80	0.86	18
Long Mile Rd (W) right-turning	4.33	4.20	1.03	16
1630-1645	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	2.74	10.28	0.27	4
Walkinstown Ave (N) straight	7.06	14.33	0.49	10
Walkinstown Ave (N) left-turning	3.27	3.22	1.01	27
Long Mile Rd (E) left-turning	1.40	8.46	0.17	3
Long Mile Rd (E) straight	5.70	11.80	0.49	9
Long Mile Rd (E) right-turning	2.90	4.20	0.69	7
Walkinstown Ave (S) left-str-right	7.47	12.80	0.58	7
Long Mile Rd (W) left-turning	3.49	8.46	0.41	6
Long Mile Rd (W) straight	9.08	11.80	0.77	15
Long Mile Rd (W) right-turning	4.89	4.20	1.17	27
1645-1700	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Walkinstown Ave (N) left-turning	3.73	10.28	0.36	5
Walkinstown Ave (N) straight	7.74	14.33	0.54	11
Walkinstown Ave (N) left-turning	2.87	3.22	0.89	23
Long Mile Rd (E) left-turning	1.91	8.46	0.23	3
Long Mile Rd (E) straight	5.19	11.80	0.44	8
Long Mile Rd (E) right-turning	3.50	4.20	0.83	9
Walkinstown Ave (S) left-str-right	9.67	11.46	0.85	10
Long Mile Rd (W) left-turning	2.75	8.46	0.33	5
Long Mile Rd (W) straight	10.84	11.80	0.92	21
Long Mile Rd (W) right-turning	3.61	4.20	0.86	20

Table 5-14: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday evening peak hour for 2021 flows with development in place

It can be seen that, with the development in place, the junction remains heavily loaded within both the morning and evening peaks, however, the increases in RFC's and queuing is imperceptible given the very small increases in incident flow due to development volumes.

Queuing, however, remains significant on all approaches.

5.6 ANALYSIS OF DAVITT ROAD / TYRCONNELLL ROAD / NAAS ROAD SIGNALISED JUNCTION

5.6.1 Geometric parameters

For the junction in question, the following geometric characteristics apply:

Tyrconnell Road (Arm A)

2 No. lanes, inside lane for left-turning traffic only, outside lane for right-turning only, and inner lane for straight-ahead only, all assumed to be 3.0 metres wide.

Davitt Road (Arm B)

2 No. lanes, inside lane for left-turning traffic only, outside lane for right-turning, both assumed to be 2.25 metres wide.

Naas Road (Arm C)

2 No. lanes, outside lane for right-turning only, inside lane for straight-ahead only, both assumed to be 3.0 metres wide.

5.6.2 Signal timings and phasing

The sequencing at this junction is quite erratic. There is a basic 3-phase cycle, but it is interspersed by a combination on three other phases which, at peak times, would appear to occur quite randomly.

In order to allow the junction to be modelled, the basic 3-phase sequence was used in combination with a fourth phase which caters only for LUAS movement, during which, effectively, very little vehicular movement takes place.

The results for the existing situation using this 4-phase cycle provided queue lengths reasonably similar to those observed during the site survey.

The basic 4-phase signal cycle assumed for the junction is thus as follows:

Phase 1
All traffic movements exiting Davitt Road (Arm B) onto Naas Road / Tyrconnell Road have priority. All other traffic is stopped.

Phase 2

All left-turning movements exiting Davitt Road (Arm A) and all right-turning movements exiting Naas Road (Arm C) have priority. All other movements are stopped.

Phase 3

All traffic movements exiting Tyrconnell Road (Arm A) onto Naas Road / Davitt Road have priority, along with straight-ahead traffic exiting Naas Road (Arm C) onto Tyrconnell Road. All other traffic is stopped.

Phase 4

No traffic movement takes place

The following timings have been used for the morning and evening peaks within this analysis:

Morning Peak
Phase 1: 15 seconds
Phase 2: 35 seconds
Phase 3: 35 seconds
Phase 4: 20 seconds

Total cycle time = 125 seconds, including an Intergreen Period set at 5 seconds for each of the 4 phases – total intergreen = 20 seconds)

Evening Peak
Phase 1: 15 seconds
Phase 2: 35 seconds
Phase 3: 30 seconds
Phase 4: 20 seconds

Total cycle time = 120 seconds, including an Intergreen Period set at 5 seconds for each of the 4 phases – total intergreen = 20 seconds)

5.6.3 Analysis of existing AM and PM peak hour flows

Tables 5-15 and 5-16 immediately below detail the flows, capacities, RFC's and queue lengths for the existing morning and evening peaks:

	Morning peak hour 2018 (existing flows)			
0800-0815	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	1.25	6.69	0.19	2
Tyrconnell Rd (E) straight	10.15	9.36	1.08	31
Davitt Rd left -turning	8.37	10.52	0.80	12
Davitt Rd right -turning	1.36	3.08	0.44	3
Naas Rd straight	9.33	8.70	1.07	28
Naas Rd right-turning	4.81	7.20	0.67	8
0815-0830	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	2.13	6.69	0.32	4
Tyrconnell Rd (E) straight	8.53	9.36	0.91	23
Davitt Rd left -turning	8.55	10.52	0.81	12
Davitt Rd right -turning	2.85	3.08	0.93	9
Naas Rd straight	7.85	8.70	0.90	20
Naas Rd right-turning	4.42	7.20	0.61	8
0830-0845	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	1.37	6.69	0.21	3
Tyrconnell Rd (E) straight	7.76	9.36	0.83	15
Davitt Rd left -turning	8.71	10.52	0.83	13
Davitt Rd right -turning	2.75	3.08	0.89	9
Naas Rd straight	8.30	8.70	0.95	21
Naas Rd right-turning	5.30	7.20	0.74	10
0845-0900	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	1.94	6.69	0.29	3
Tyrconnell Rd (E) straight	8.26	9.36	0.88	16
Davitt Rd left -turning	8.80	10.52	0.84	13
Davitt Rd right -turning	1.80	3.08	0.58	4
Naas Rd straight	9.26	8.70	1.06	32
Naas Rd right-turning	5.67	7.20	0.79	11

Table 5-15: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday morning peak hour for existing 2018 flows

	Evening peak hour 2018 (existing flows)			
1600-1615	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	0.91	6.28	0.14	2
Tyrconnell Rd (E) straight	9.16	8.77	1.04	25
Davitt Rd left -turning	9.24	11.26	0.82	12
Davitt Rd right -turning	1.89	3.53	0.54	4
Naas Rd straight	7.82	8.16	0.96	18
Naas Rd right-turning	3.85	7.82	0.49	6
1615-1630	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	1.35	6.28	0.22	2
Tyrconnell Rd (E) straight	9.05	8.77	1.03	31
Davitt Rd left -turning	8.60	11.26	0.76	11
Davitt Rd right -turning	1.40	3.53	0.40	3
Naas Rd straight	8.75	8.16	1.07	29
Naas Rd right-turning	4.31	7.82	0.55	7
1630-1645	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	1.53	6.28	0.24	3
Tyrconnell Rd (E) straight	10.21	8.77	1.16	53
Davitt Rd left -turning	8.75	11.26	0.78	11
Davitt Rd right -turning	1.92	3.53	0.54	4
Naas Rd straight	5.80	8.16	0.71	12
Naas Rd right-turning	3.26	7.82	0.42	5
1645-1700	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** **(-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	1.50	6.28	0.24	3
Tyrconnell Rd (E) straight	6.83	8.77	0.78	26
Davitt Rd left –turning	11.25	11.26	1.00	22
Davitt Rd right –turning	2.81	3.53	0.80	7
Naas Rd straight	8.36	8.16	1.03	22
Naas Rd right-turning	4.70	7.82	0.60	8

Table 5-16: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday evening peak hour for existing 2018 flows

At present, all approaches operate at close to capacity if not in excess of it during both peak hours.

Queuing is significant during both peak periods.

5.6.4 Analysis of 2021 AM and PM peak hour flows with development in place (Do-something scenarios)

Tables 5-17 and 5-18 immediately below detail the flows, capacities, RFC's and queue lengths for the 2021 morning and evening peaks with the development in place (year of opening with development in place):

	Morning peak hour 2021 (development in place)			
0800-0815	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	1.75	6.69	0.26	3
Tyrconnell Rd (E) straight	10.78	9.36	1.15	39
Davitt Rd left -turning	9.37	10.52	0.89	15
Davitt Rd right -turning	2.49	3.08	0.81	7
Naas Rd straight	9.43	8.70	1.08	29
Naas Rd right-turning	5.30	7.20	0.74	10
0815-0830	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	2.71	6.69	0.41	5
Tyrconnell Rd (E) straight	9.09	9.36	0.97	39
Davitt Rd left -turning	9.61	10.52	0.91	16
Davitt Rd right -turning	3.92	3.08	1.27	21
Naas Rd straight	7.98	8.70	0.92	22
Naas Rd right-turning	4.89	7.20	0.68	9
0830-0845	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	1.85	6.69	0.28	3
Tyrconnell Rd (E) straight	8.42	9.36	0.90	28
Davitt Rd left -turning	9.74	10.52	0.93	17
Davitt Rd right -turning	3.79	3.08	1.23	32
Naas Rd straight	8.38	8.70	0.96	23
Naas Rd right-turning	5.82	7.20	0.81	11
0845-0900	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC (-)**	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	2.49	6.69	0.37	4
Tyrconnell Rd (E) straight	8.84	9.36	0.95	27
Davitt Rd left -turning	9.75	10.52	0.93	18
Davitt Rd right -turning	2.91	3.08	0.94	31
Naas Rd straight	9.32	8.70	1.07	34
Naas Rd right-turning	6.21	7.20	0.86	12

Table 5-17: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday morning peak hour for 2021 flows with the development in place

	Evening peak hour 2021 (development in place)			
1600-1615	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	1.76	6.28	0.28	3
Tyrconnell Rd (E) straight	9.24	8.77	1.05	26
Davitt Rd left -turning	9.80	11.26	0.87	14
Davitt Rd right -turning	2.60	3.53	0.74	6
Naas Rd straight	6.90	8.16	0.85	13
Naas Rd right-turning	6.37	7.82	0.81	11
1615-1630	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	2.27	6.28	0.36	4
Tyrconnell Rd (E) straight	9.07	8.77	1.03	32
Davitt Rd left -turning	9.24	11.26	0.82	13
Davitt Rd right -turning	2.03	3.53	0.57	4
Naas Rd straight	9.24	8.16	1.13	33
Naas Rd right-turning	5.43	7.82	0.69	9
1630-1645	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	2.28	6.28	0.36	4
Tyrconnell Rd (E) straight	10.39	8.77	1.18	57
Davitt Rd left -turning	9.43	11.26	0.84	13
Davitt Rd right -turning	2.51	3.53	0.71	6
Naas Rd straight	6.19	8.16	0.76	13
Naas Rd right-turning	4.48	7.82	0.57	7
1645-1700	**Flow** (veh/min)	**Cap.** (veh/min)	**RFC** (-)	**Max queue** (veh/lane)
Tyrconnell Rd (E) left-turning	2.32	6.28	0.37	4
Tyrconnell Rd (E) straight	6.95	8.77	0.79	31
Davitt Rd left –turning	11.81	11.26	1.05	28
Davitt Rd right –turning	3.53	3.53	1.00	12
Naas Rd straight	8.80	8.16	1.08	27
Naas Rd right-turning	5.87	7.82	0.75	10

Table 5-18: Ratios of flow to capacity and queue lengths for each 15-minute interval during the weekday evening peak hour for 2021 flows with the development in place

On the day of opening of the proposed development in 2021, all approaches will continue to operate at close to capacity if not in excess of it during both peak hours.

While queuing remains significant during both peak periods, the increases resulting from the predicted development flows are not significant (the predicted development flows amount to a 2-way flow of approximately 2 vehicles per minute during both peaks).

6 OVERALL CONCLUSIONS REGARDING SUSTAINABILITY OF PROPOSED MIXED USE, COMMERCIAL AND RESIDENTIAL DEVELOPMENT IN TRANSPORTATION TERMS

This report demonstrates that the existing road network in the vicinity of the proposed development is busy and congested at peak times.

It is demonstrated that the volume of trips predicted to be generated by the proposal will be at low levels, and will not have a significant impact on major road junctions adjacent to the subject site.

The congested nature of the network, and the proximity of the LUAS Red line are significant arguments for a low provision of car parking at the subject site for the residential component of the proposed development. Technical support for these arguments are contained within other submitted documents.

In relation to the mixed use and commercial component of the proposed development, as stated earlier within this report, it is highly likely that trips attracted to these facilities are not new trips but already exist on the network. Entering and exiting trips in this case will thus be pass-by trips by commuters availing of these facilities before they complete their onward journey. The actual proportion of pass-by trips is probably far greater than assumed within this report.

In relation to the residential component of the proposed development, the low parking provision will result in high public transport and soft mode usage by residents at peak times on the network. Mobility measures outlined within the accompanying Parking and Mobility Report will help ensure the promotion of more sustainable modes of transport for residents at the subject site.

In overall terms, therefore, based on the analysis within this report, and given the mitigating facts listed immediately above, it is predicted that the proposal will have limited impact in transportation terms, and will constitute a wholly sustainable development.

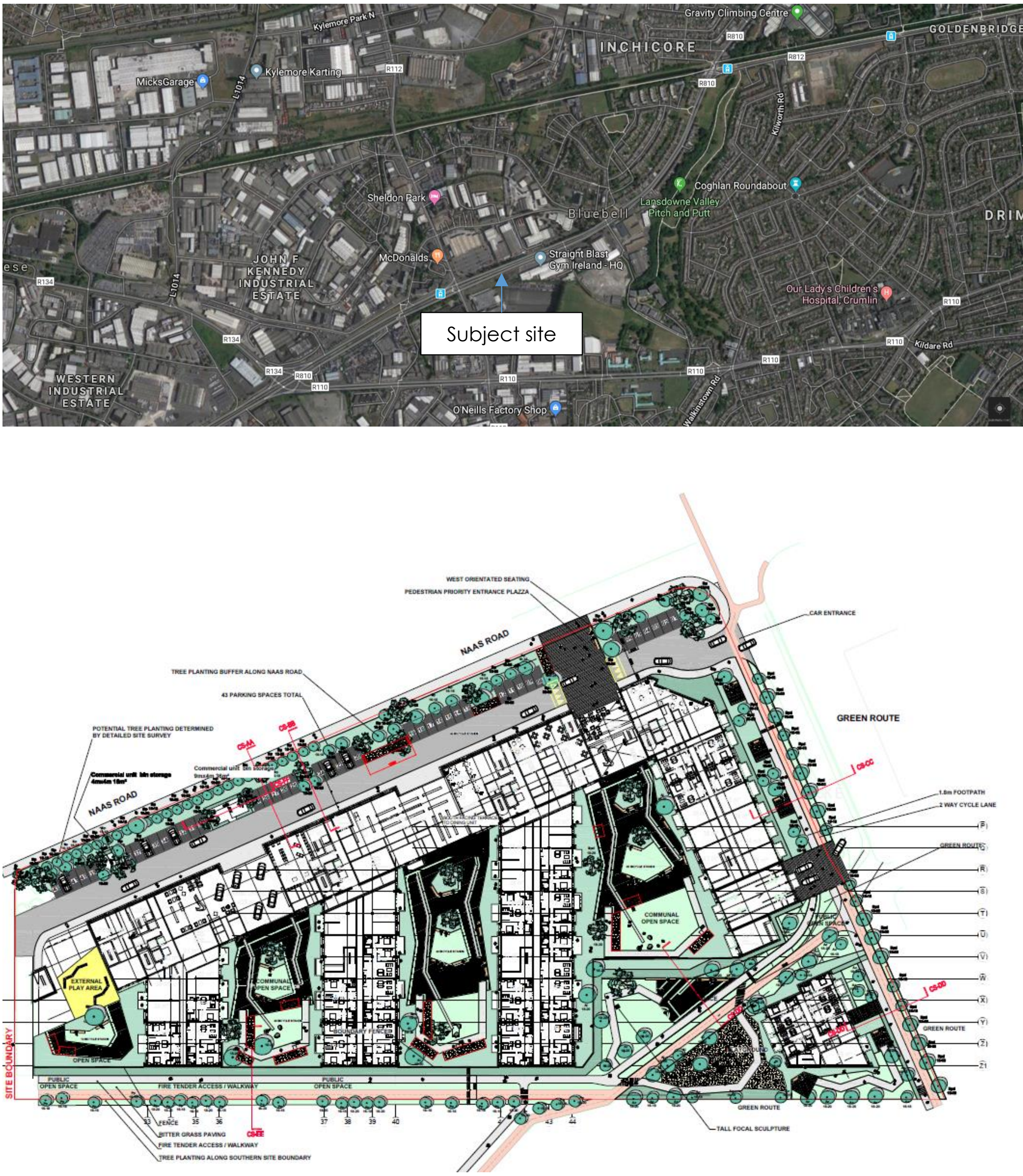


Figure 1: Site location and site layout for proposed development

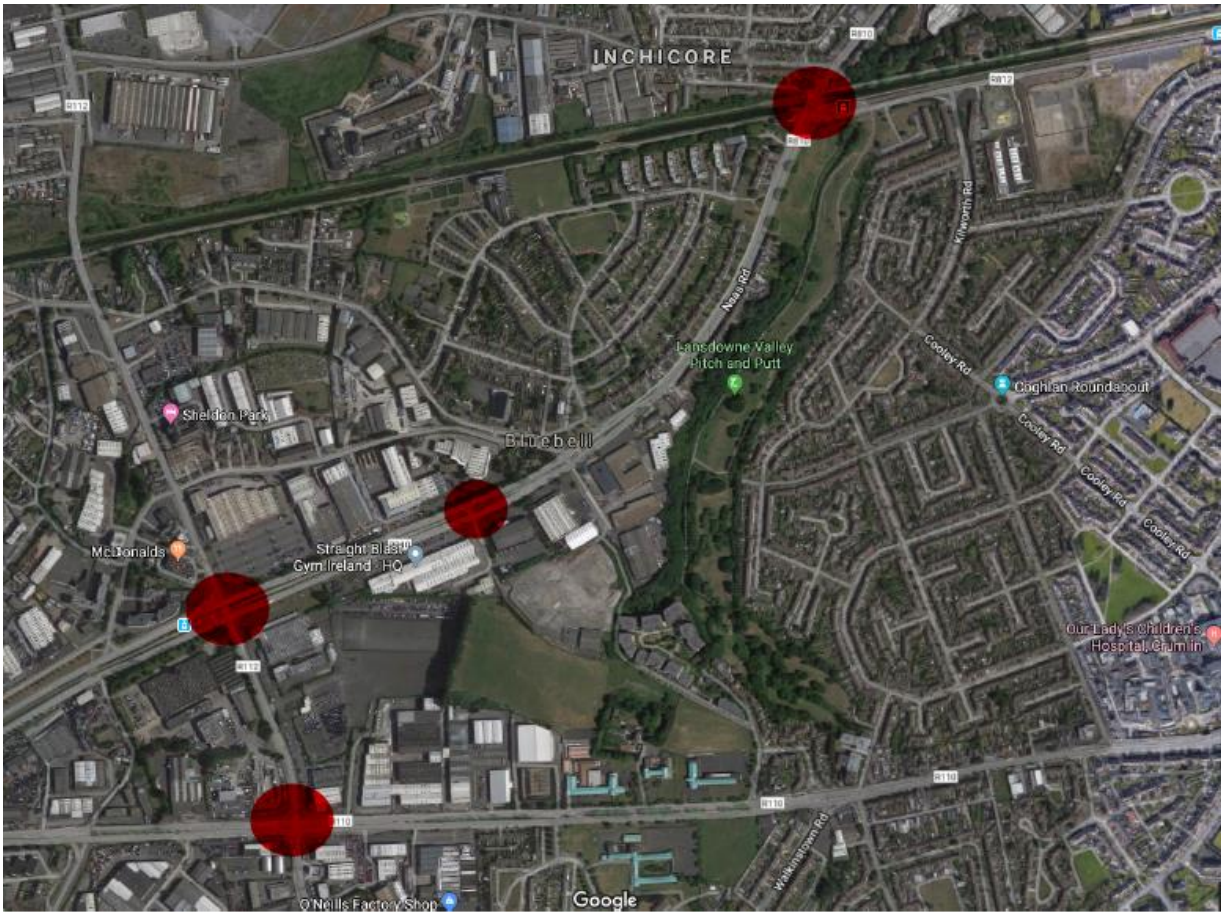


Figure 2: Location of traffic surveys

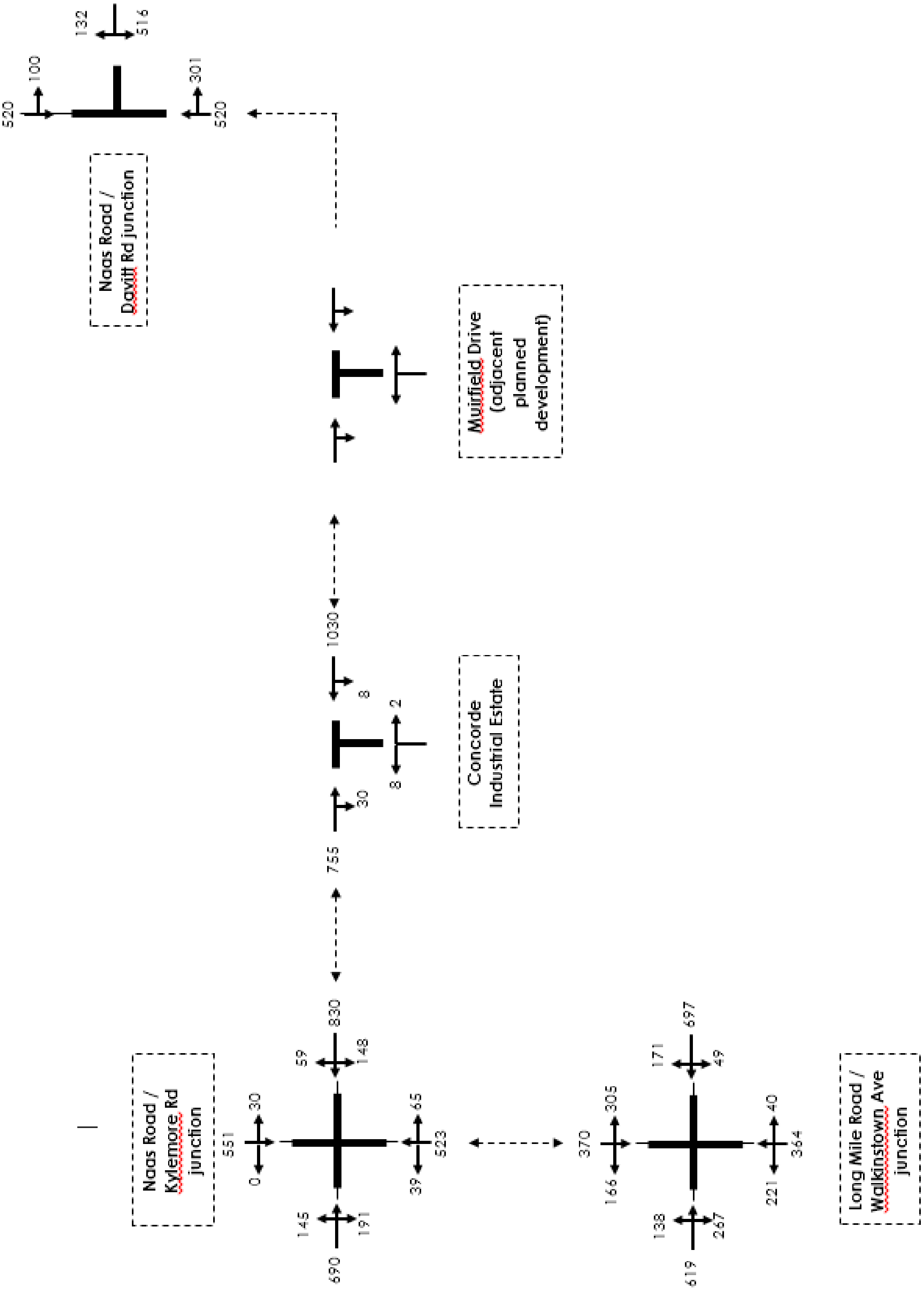


Figure 3: Existing AM Peak Flows (also assumed as 2021 opening day flows without development in place)

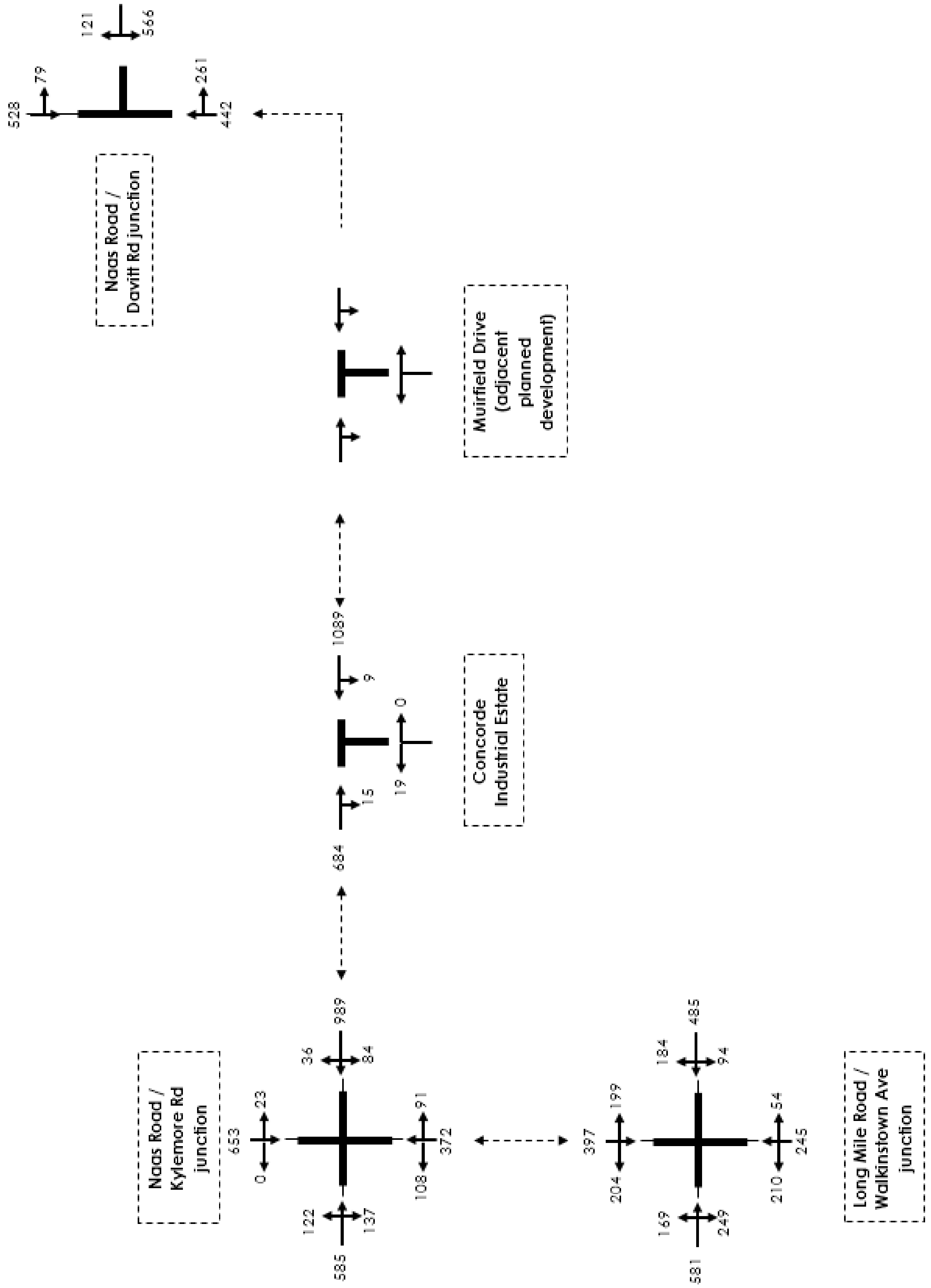


Figure 4: Existing PM Peak Flows (also assumed as 2021 opening day flows without development in place)

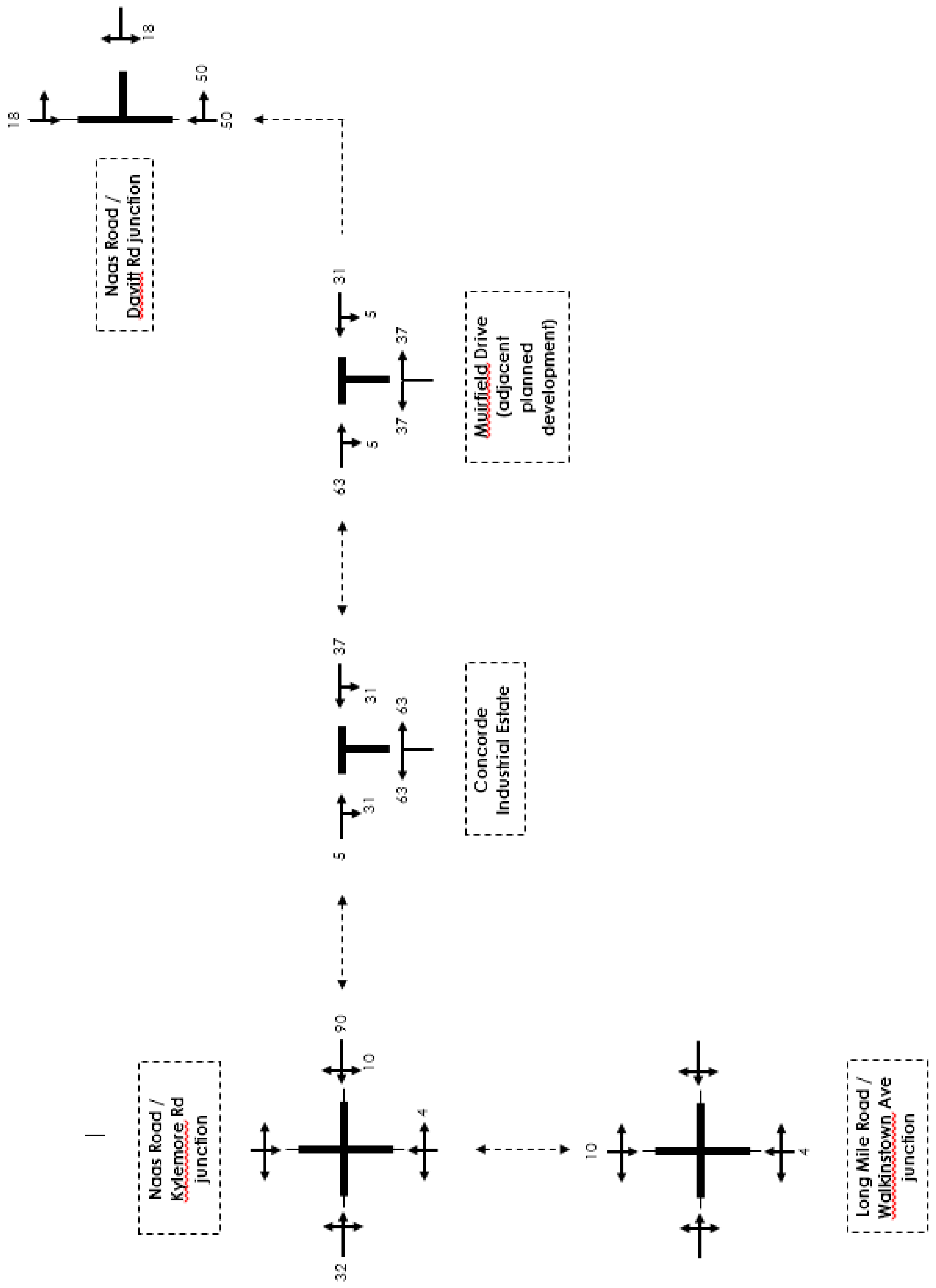


Figure 5: AM peak generated flows from Concorde site plus adjacent Muirfield Drive site

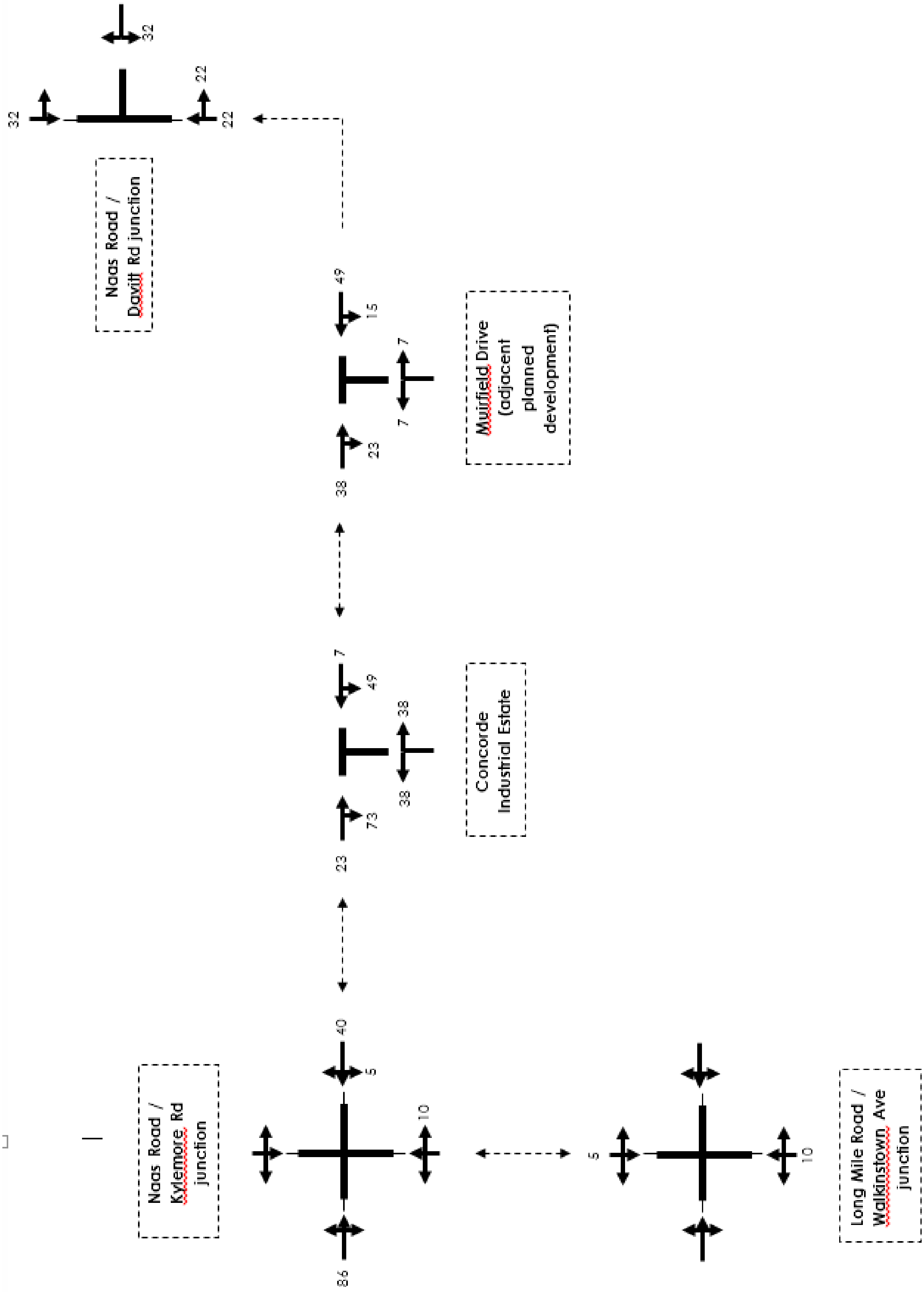


Figure 6: PM peak generated flows from Concorde site plus adjacent Muirfield Drive site

APPENDIX 1

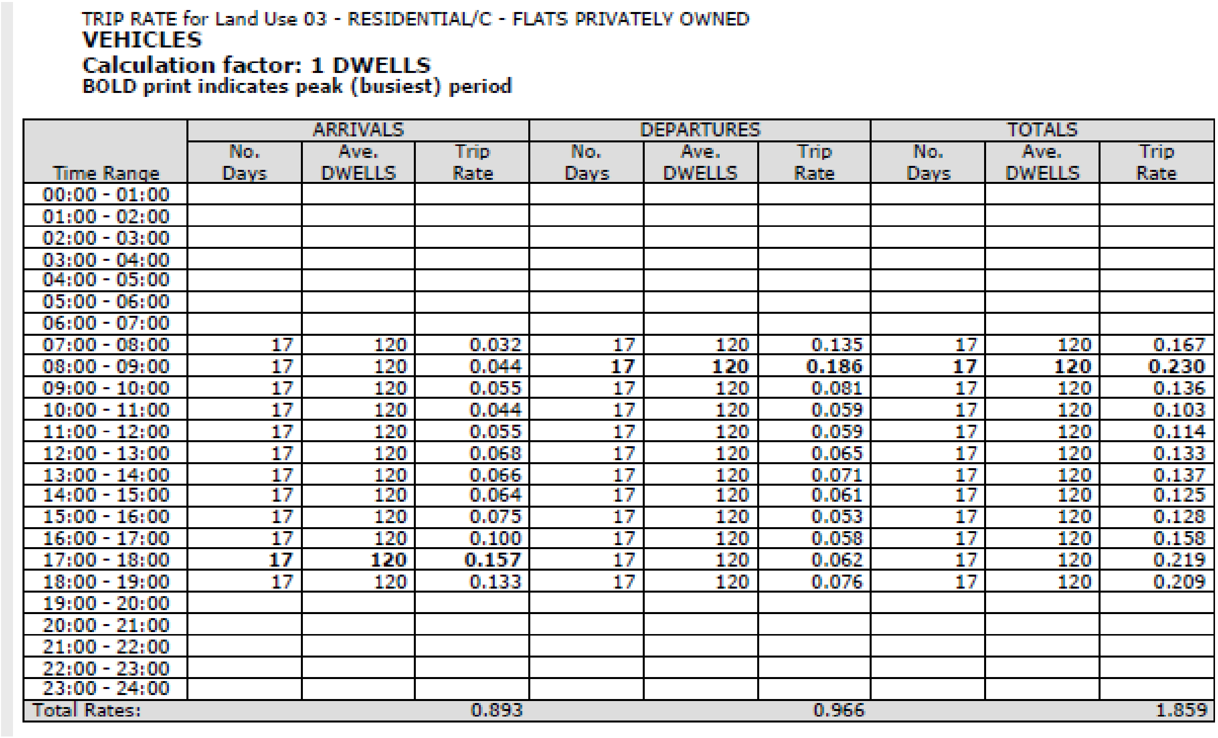
TRICS Data

TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 03 - RESIDENTIAL
Category : C - FLATS PRIVATELY OWNED
VEHICLES

Selected regions and areas:

02	**SOUTH EAST**		
	ES	EAST SUSSEX	1 days
	EX	ESSEX	1 days
	HC	HAMPSHIRE	1 days
04	**EAST ANGLIA**		
	CA	CAMBRIDGESHIRE	1 days
	NF	NORFOLK	1 days
	SF	SUFFOLK	1 days
05	**EAST MIDLANDS**		
	NT	NOTTINGHAMSHIRE	1 days
06	**WEST MIDLANDS**		
	WM	WEST MIDLANDS	1 days
08	**NORTH WEST**		
	GM	GREATER MANCHESTER	1 days
09	**NORTH**		
	TV	TEES VALLEY	1 days
11	**SCOTLAND**		
	SR	STIRLING	1 days
13	**MUNSTER**		
	WA	WATERFORD	1 days
14	**LEINSTER**		
	LU	LOUTH	1 days
15	**GREATER DUBLIN**		
	DL	DUBLIN	4 days



TRIP RATE for Land Use 03 - RESIDENTIAL/C - FLATS PRIVATELY OWNED
VEHICLES
Calculation factor: 1 DWELLS
BOLD print indicates peak (busiest) period

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. DWELLS	Trip Rate	No. Days	Ave. DWELLS	Trip Rate	No. Days	Ave. DWELLS	Trip Rate
00:00 - 01:00									
01:00 - 02:00									
02:00 - 03:00									
03:00 - 04:00									
04:00 - 05:00									
05:00 - 06:00									
06:00 - 07:00									
07:00 - 08:00	17	120	0.032	17	120	0.135	17	120	0.167
08:00 - 09:00	17	120	0.044	**17**	**120**	**0.186**	**17**	**120**	**0.230**
09:00 - 10:00	17	120	0.055	17	120	0.081	17	120	0.136
10:00 - 11:00	17	120	0.044	17	120	0.059	17	120	0.103
11:00 - 12:00	17	120	0.055	17	120	0.059	17	120	0.114
12:00 - 13:00	17	120	0.068	17	120	0.065	17	120	0.133
13:00 - 14:00	17	120	0.066	17	120	0.071	17	120	0.137
14:00 - 15:00	17	120	0.064	17	120	0.061	17	120	0.125
15:00 - 16:00	17	120	0.075	17	120	0.053	17	120	0.128
16:00 - 17:00	17	120	0.100	17	120	0.058	17	120	0.158
17:00 - 18:00	**17**	**120**	**0.157**	17	120	0.062	17	120	0.219
18:00 - 19:00	17	120	0.133	17	120	0.076	17	120	0.209
19:00 - 20:00									
20:00 - 21:00									
21:00 - 22:00									
22:00 - 23:00									
23:00 - 24:00									
Total Rates:			0.893			0.966			1.859

TRIP RATE CALCULATION SELECTION PARAMETERS:

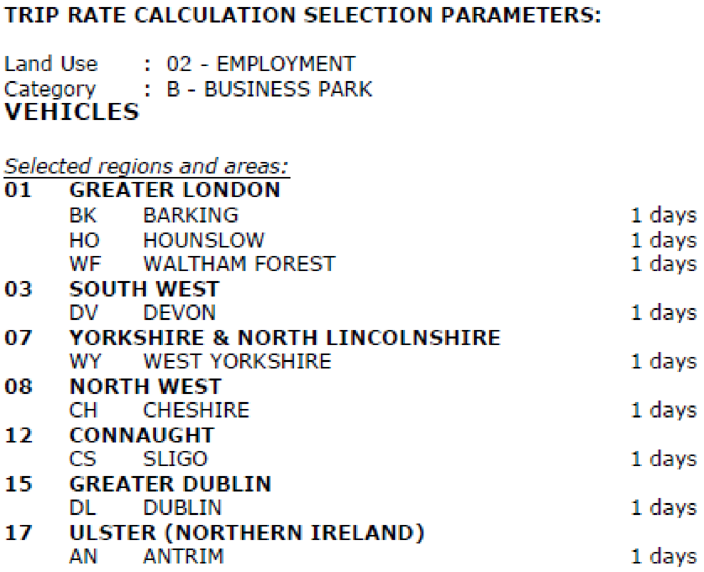
Land Use : 02 - EMPLOYMENT
Category : B - BUSINESS PARK

VEHICLES

Selected regions and areas:

01	**GREATER LONDON**		
	BK	BARKING	1 days
	HO	HOUNSLOW	1 days
	WF	WALTHAM FOREST	1 days
03	**SOUTH WEST**		
	DV	DEVON	1 days
07	**YORKSHIRE & NORTH LINCOLNSHIRE**		
	WY	WEST YORKSHIRE	1 days
08	**NORTH WEST**		
	CH	CHESHIRE	1 days
12	**CONNAUGHT**		
	CS	SLIGO	1 days
15	**GREATER DUBLIN**		
	DL	DUBLIN	1 days
17	**ULSTER (NORTHERN IRELAND)**		
	AN	ANTRIM	1 days

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate
00:00 - 00:30									
00:30 - 01:00									
01:00 - 01:30									
01:30 - 02:00									
02:00 - 02:30									
02:30 - 03:00									
03:00 - 03:30									
03:30 - 04:00									
04:00 - 04:30									
04:30 - 05:00									
05:00 - 05:30									
05:30 - 06:00									
06:00 - 06:30									
06:30 - 07:00									
07:00 - 07:30	9	1910	0.227	9	1910	0.058	9	1910	0.285
07:30 - 08:00	9	1910	0.279	9	1910	0.047	9	1910	0.326
08:00 - 08:30	9	1910	0.337	9	1910	0.076	9	1910	0.413
08:30 - 09:00	9	1910	0.535	9	1910	0.105	9	1910	0.640
09:00 - 09:30	**9**	**1910**	**0.634**	9	1910	0.157	9	1910	0.791
09:30 - 10:00	9	1910	0.459	9	1910	0.221	9	1910	0.680
10:00 - 10:30	9	1910	0.343	9	1910	0.221	9	1910	0.564
10:30 - 11:00	9	1910	0.250	9	1910	0.204	9	1910	0.454
11:00 - 11:30	9	1910	0.233	9	1910	0.198	9	1910	0.431
11:30 - 12:00	9	1910	0.268	9	1910	0.209	9	1910	0.477
12:00 - 12:30	9	1910	0.169	9	1910	0.326	9	1910	0.495
12:30 - 13:00	9	1910	0.273	9	1910	0.273	9	1910	0.546
13:00 - 13:30	9	1910	0.268	9	1910	0.308	9	1910	0.576
13:30 - 14:00	9	1910	0.308	9	1910	0.244	9	1910	0.552
14:00 - 14:30	9	1910	0.297	9	1910	0.285	9	1910	0.582
14:30 - 15:00	9	1910	0.250	9	1910	0.326	9	1910	0.576
15:00 - 15:30	9	1910	0.198	9	1910	0.238	9	1910	0.436
15:30 - 16:00	9	1910	0.279	9	1910	0.297	9	1910	0.576
16:00 - 16:30	9	1910	0.221	9	1910	0.459	9	1910	0.680
16:30 - 17:00	9	1910	0.204	9	1910	0.384	9	1910	0.588
17:00 - 17:30	9	1910	0.151	**9**	**1910**	**0.762**	**9**	**1910**	**0.913**
17:30 - 18:00	9	1910	0.134	9	1910	0.529	9	1910	0.663
18:00 - 18:30	9	1910	0.111	9	1910	0.209	9	1910	0.320
18:30 - 19:00	9	1910	0.064	9	1910	0.238	9	1910	0.302
19:00 - 19:30									
19:30 - 20:00									
20:00 - 20:30									
20:30 - 21:00									
21:00 - 21:30									
21:30 - 22:00									
22:00 - 22:30									
22:30 - 23:00									
23:00 - 23:30									
23:30 - 24:00									
Total Rates:			6.492			6.374			12.866

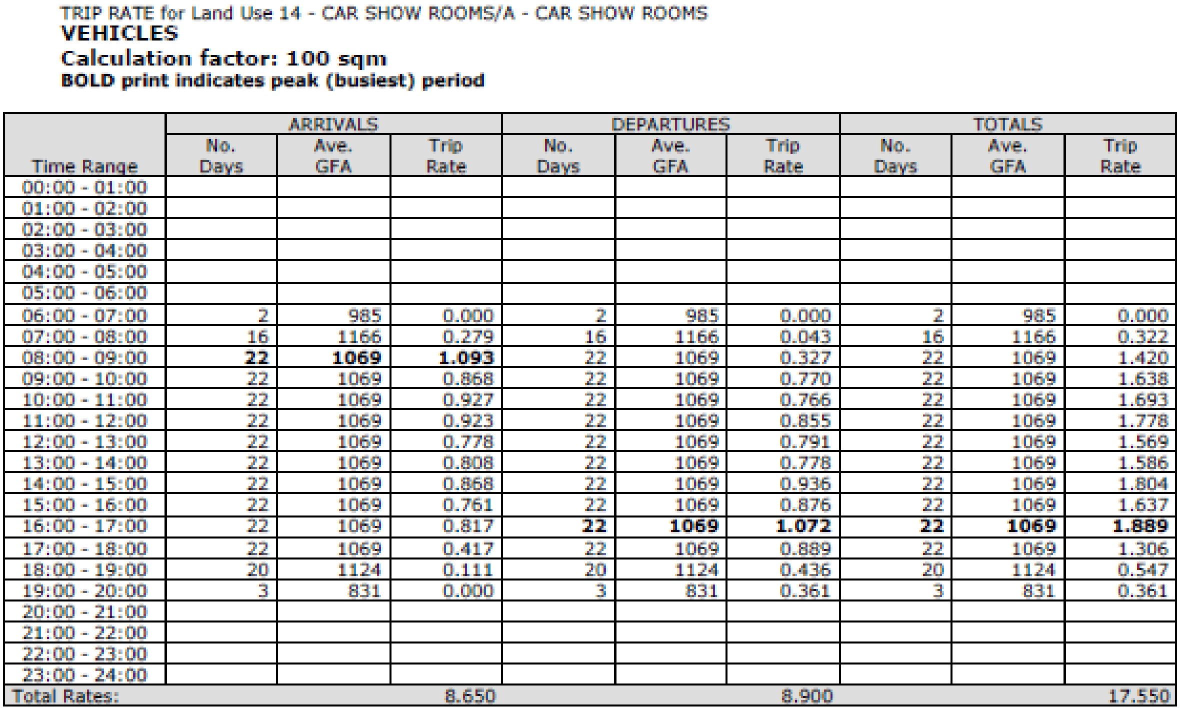


TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 02 - EMPLOYMENT
Category : B - BUSINESS PARK
VEHICLES

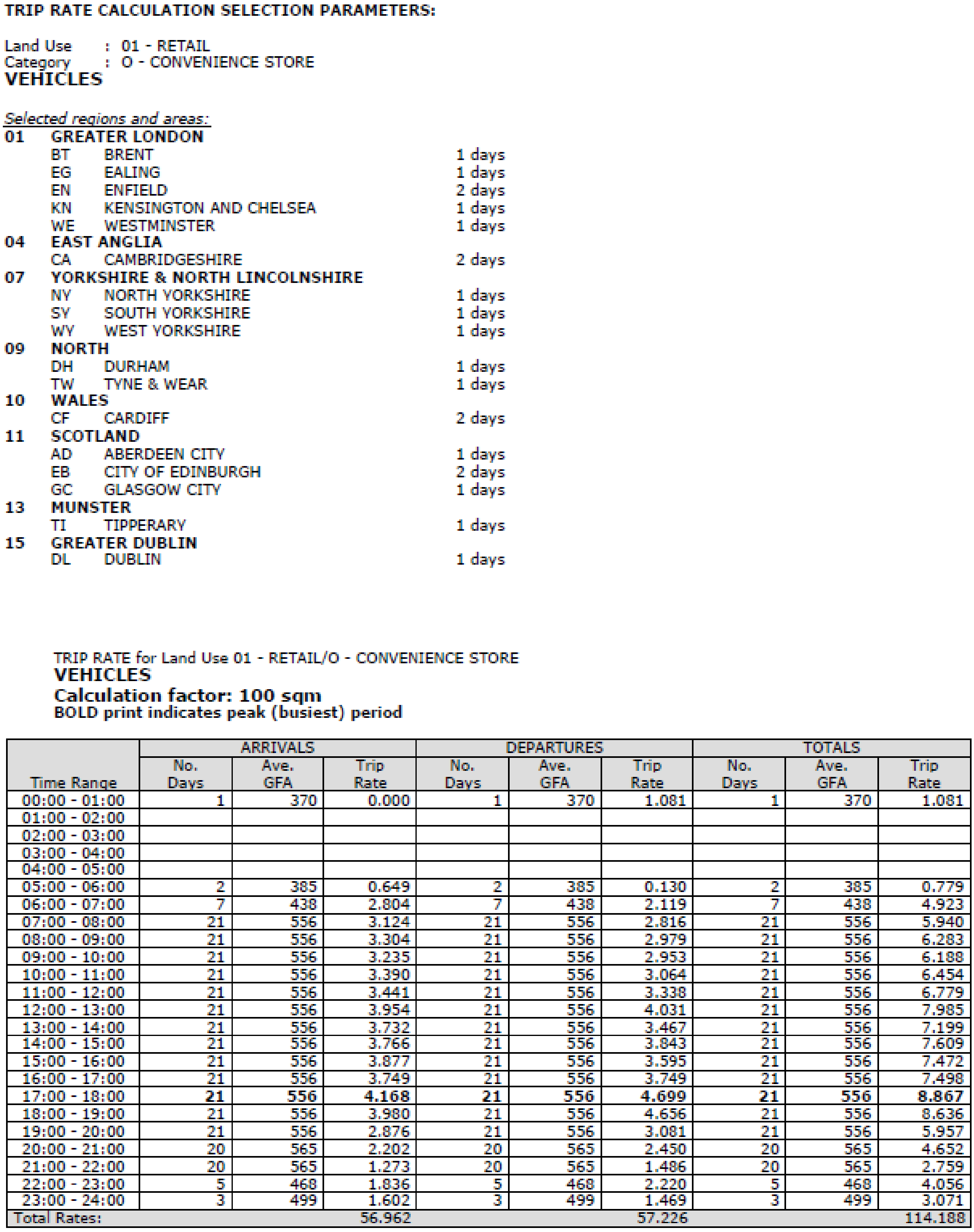
Selected regions and areas:

01	**GREATER LONDON**		
	BK	BARKING	1 days
	HO	HOUNSLOW	1 days
	WF	WALTHAM FOREST	1 days
03	**SOUTH WEST**		
	DV	DEVON	1 days
07	**YORKSHIRE & NORTH LINCOLNSHIRE**		
	WY	WEST YORKSHIRE	1 days
08	**NORTH WEST**		
	CH	CHESHIRE	1 days
12	**CONNAUGHT**		
	CS	SLIGO	1 days
15	**GREATER DUBLIN**		
	DL	DUBLIN	1 days
17	**ULSTER (NORTHERN IRELAND)**		
	AN	ANTRIM	1 days



TRIP RATE for Land Use 14 - CAR SHOW ROOMS/A - CAR SHOW ROOMS
VEHICLES
Calculation factor: 100 sqm
BOLD print indicates peak (busiest) period

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate
00:00 - 01:00									
01:00 - 02:00									
02:00 - 03:00									
03:00 - 04:00									
04:00 - 05:00									
05:00 - 06:00									
06:00 - 07:00	2	985	0.000	2	985	0.000	2	985	0.000
07:00 - 08:00	16	1166	0.279	16	1166	0.043	16	1166	0.322
08:00 - 09:00	**22**	**1069**	**1.093**	22	1069	0.327	22	1069	1.420
09:00 - 10:00	22	1069	0.868	22	1069	0.770	22	1069	1.638
10:00 - 11:00	22	1069	0.927	22	1069	0.766	22	1069	1.693
11:00 - 12:00	22	1069	0.923	22	1069	0.855	22	1069	1.778
12:00 - 13:00	22	1069	0.778	22	1069	0.791	22	1069	1.569
13:00 - 14:00	22	1069	0.808	22	1069	0.778	22	1069	1.586
14:00 - 15:00	22	1069	0.868	22	1069	0.936	22	1069	1.804
15:00 - 16:00	22	1069	0.761	22	1069	0.876	22	1069	1.637
16:00 - 17:00	22	1069	0.817	**22**	**1069**	**1.072**	**22**	**1069**	**1.889**
17:00 - 18:00	22	1069	0.417	22	1069	0.889	22	1069	1.306
18:00 - 19:00	20	1124	0.111	20	1124	0.436	20	1124	0.547
19:00 - 20:00	3	831	0.000	3	831	0.361	3	831	0.361
20:00 - 21:00									
21:00 - 22:00									
22:00 - 23:00									
23:00 - 24:00									
Total Rates:			8.650			8.900			17.550



TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 01 - RETAIL
Category : O - CONVENIENCE STORE

VEHICLES

Selected regions and areas:

01	**GREATER LONDON**		
	BT	BRENT	1 days
	EG	EALING	1 days
	EN	ENFIELD	2 days
	KN	KENSINGTON AND CHELSEA	1 days
	WE	WESTMINSTER	1 days
04	**EAST ANGLIA**		
	CA	CAMBRIDGESHIRE	2 days
07	**YORKSHIRE & NORTH LINCOLNSHIRE**		
	NY	NORTH YORKSHIRE	1 days
	SY	SOUTH YORKSHIRE	1 days
	WY	WEST YORKSHIRE	1 days
09	**NORTH**		
	DH	DURHAM	1 days
	TW	TYNE & WEAR	1 days
10	**WALES**		
	CF	CARDIFF	2 days
11	**SCOTLAND**		
	AD	ABERDEEN CITY	1 days
	EB	CITY OF EDINBURGH	2 days
	GC	GLASGOW CITY	1 days
13	**MUNSTER**		
	TI	TIPPERARY	1 days
15	**GREATER DUBLIN**		
	DL	DUBLIN	1 days

TRIP RATE for Land Use 01 - RETAIL/O - CONVENIENCE STORE

VEHICLES

Calculation factor: 100 sqm

BOLD print indicates peak (busiest) period

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate
00:00 - 01:00	1	370	0.000	1	370	1.081	1	370	1.081
01:00 - 02:00									
02:00 - 03:00									
03:00 - 04:00									
04:00 - 05:00									
05:00 - 06:00	2	385	0.649	2	385	0.130	2	385	0.779
06:00 - 07:00	7	438	2.804	7	438	2.119	7	438	4.923
07:00 - 08:00	21	556	3.124	21	556	2.816	21	556	5.940
08:00 - 09:00	21	556	3.304	21	556	2.979	21	556	6.283
09:00 - 10:00	21	556	3.235	21	556	2.953	21	556	6.188
10:00 - 11:00	21	556	3.390	21	556	3.064	21	556	6.454
11:00 - 12:00	21	556	3.441	21	556	3.338	21	556	6.779
12:00 - 13:00	21	556	3.954	21	556	4.031	21	556	7.985
13:00 - 14:00	21	556	3.732	21	556	3.467	21	556	7.199
14:00 - 15:00	21	556	3.766	21	556	3.843	21	556	7.609
15:00 - 16:00	21	556	3.877	21	556	3.595	21	556	7.472
16:00 - 17:00	21	556	3.749	21	556	3.749	21	556	7.498
17:00 - 18:00	**21**	**556**	**4.168**	**21**	**556**	**4.699**	**21**	**556**	**8.867**
18:00 - 19:00	21	556	3.980	21	556	4.656	21	556	8.636
19:00 - 20:00	21	556	2.876	21	556	3.081	21	556	5.957
20:00 - 21:00	20	565	2.202	20	565	2.450	20	565	4.652
21:00 - 22:00	20	565	1.273	20	565	1.486	20	565	2.759
22:00 - 23:00	5	468	1.836	5	468	2.220	5	468	4.056
23:00 - 24:00	3	499	1.602	3	499	1.469	3	499	3.071
Total Rates:			56.962			57.226			114.188

TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 06 - HOTEL, FOOD & DRINK
Category : C - PUB/RESTAURANT

VEHICLES

Selected regions and areas:

01	**GREATER LONDON**		
	CI	CITY OF LONDON	1 days
	HG	HARINGEY	1 days
	IS	ISLINGTON	2 days
	LB	LAMBETH	1 days
	WH	WANDSWORTH	1 days
02	**SOUTH EAST**		
	BF	BRACKNELL FOREST	1 days
03	**SOUTH WEST**		
	BR	BRISTOL CITY	1 days
04	**EAST ANGLIA**		
	SF	SUFFOLK	1 days
06	**WEST MIDLANDS**		
	WK	WARWICKSHIRE	1 days
	WO	WORCESTERSHIRE	1 days
08	**NORTH WEST**		
	CH	CHESHIRE	1 days
	LC	LANCASHIRE	2 days
10	**WALES**		
	SW	SWANSEA	1 days
11	**SCOTLAND**		
	AG	ANGUS	1 days
13	**MUNSTER**		
	TI	TIPPERARY	1 days
15	**GREATER DUBLIN**		
	DL	DUBLIN	1 days

TRIP RATE for Land Use 06 - HOTEL, FOOD & DRINK/C - PUB/RESTAURANT

VEHICLES

Calculation factor: 100 sqm

BOLD print indicates peak (busiest) period

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate
00:00 - 01:00									
01:00 - 02:00									
02:00 - 03:00									
03:00 - 04:00									
04:00 - 05:00									
05:00 - 06:00									
06:00 - 07:00									
07:00 - 08:00	1	600	0.000	1	600	0.000	1	600	0.000
08:00 - 09:00	1	600	0.000	1	600	0.000	1	600	0.000
09:00 - 10:00	1	600	0.000	1	600	0.000	1	600	0.000
10:00 - 11:00	16	559	0.369	16	559	0.224	16	559	0.593
11:00 - 12:00	16	559	0.660	16	559	0.369	16	559	1.029
12:00 - 13:00	**18**	**559**	**1.590**	18	559	0.676	18	559	2.266
13:00 - 14:00	18	559	1.352	18	559	1.083	18	559	2.435
14:00 - 15:00	18	559	0.785	18	559	0.775	18	559	1.560
15:00 - 16:00	18	559	0.855	18	559	0.775	18	559	1.630
16:00 - 17:00	18	559	0.646	18	559	0.656	18	559	1.302
17:00 - 18:00	18	559	0.984	18	559	0.567	18	559	1.551
18:00 - 19:00	18	559	1.531	18	559	1.541	18	559	3.072
19:00 - 20:00	18	559	1.481	**18**	**559**	**1.759**	**18**	**559**	**3.240**
20:00 - 21:00	18	559	1.282	18	559	1.560	18	559	2.842
21:00 - 22:00	18	559	0.726	18	559	1.133	18	559	1.859
22:00 - 23:00	18	559	0.567	18	559	1.173	18	559	1.740
23:00 - 24:00	17	545	0.389	17	545	0.972	17	545	1.361
Total Rates:			13.217			13.263			26.480

TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 07 - LEISURE
Category : K - FITNESS CLUB (PRIVATE)

VEHICLES

Selected regions and areas:

01	**GREATER LONDON**		
	BT	BRENT	1 days
	EN	ENFIELD	1 days
	HG	HARINGEY	1 days
	HK	HACKNEY	1 days
	IS	ISLINGTON	1 days
02	**SOUTH EAST**		
	ES	EAST SUSSEX	1 days
05	**EAST MIDLANDS**		
	NR	NORTHAMPTONSHIRE	1 days
07	**YORKSHIRE & NORTH LINCOLNSHIRE**		
	NY	NORTH YORKSHIRE	1 days
	WY	WEST YORKSHIRE	1 days
09	**NORTH**		
	CB	CUMBRIA	1 days
	TW	TYNE & WEAR	1 days
10	**WALES**		
	PS	POWYS	1 days

TRIP RATE for Land Use 07 - LEISURE/K - FITNESS CLUB (PRIVATE)

VEHICLES

Calculation factor: 100 sqm

BOLD print indicates peak (busiest) period

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate
00:00 - 01:00									
01:00 - 02:00									
02:00 - 03:00									
03:00 - 04:00									
04:00 - 05:00									
05:00 - 06:00	1	1570	0.000	1	1570	0.000	1	1570	0.000
06:00 - 07:00	12	1224	0.831	12	1224	0.191	12	1224	1.022
07:00 - 08:00	12	1224	0.511	12	1224	0.586	12	1224	1.097
08:00 - 09:00	12	1224	0.463	12	1224	0.504	12	1224	0.967
09:00 - 10:00	12	1224	0.960	12	1224	0.470	12	1224	1.430
10:00 - 11:00	12	1224	0.722	12	1224	0.647	12	1224	1.369
11:00 - 12:00	12	1224	0.518	12	1224	0.661	12	1224	1.179
12:00 - 13:00	12	1224	0.681	12	1224	0.681	12	1224	1.362
13:00 - 14:00	12	1224	0.538	12	1224	0.647	12	1224	1.185
14:00 - 15:00	12	1224	0.647	12	1224	0.538	12	1224	1.185
15:00 - 16:00	12	1224	0.620	12	1224	0.654	12	1224	1.274
16:00 - 17:00	12	1224	0.960	12	1224	0.811	12	1224	1.771
17:00 - 18:00	**12**	**1224**	**1.389**	12	1224	0.845	12	1224	2.234
18:00 - 19:00	12	1224	1.219	**12**	**1224**	**1.396**	**12**	**1224**	**2.615**
19:00 - 20:00	12	1224	0.994	12	1224	1.383	12	1224	2.377
20:00 - 21:00	12	1224	0.484	12	1224	1.137	12	1224	1.621
21:00 - 22:00	12	1224	0.129	12	1224	0.463	12	1224	0.592
22:00 - 23:00	3	851	0.078	3	851	0.274	3	851	0.352
23:00 - 24:00									
Total Rates:			11.744			11.888			23.632

TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 05 - HEALTH
Category : G - GP SURGERIES
VEHICLES

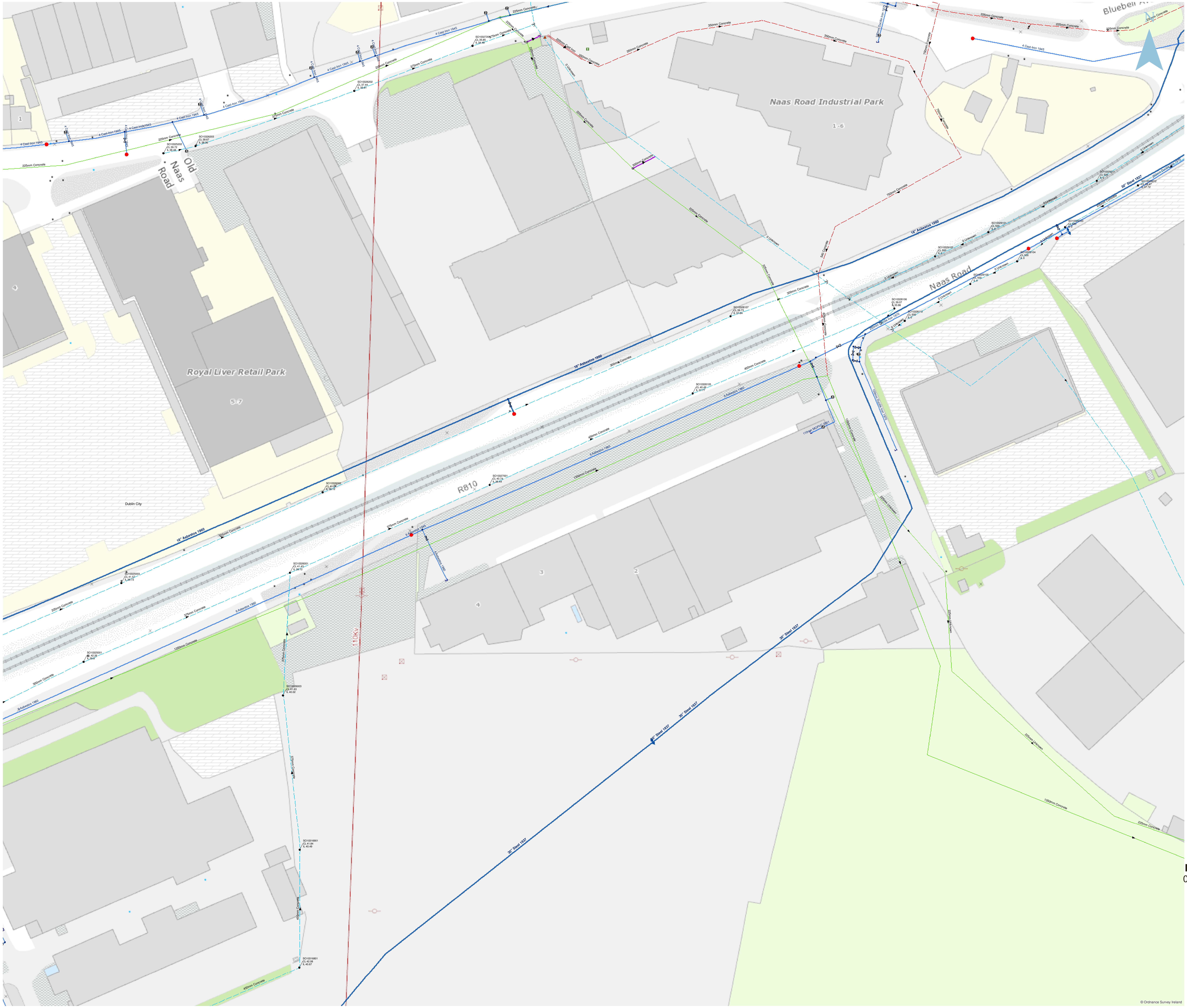
Selected regions and areas:

01	**GREATER LONDON**		
	WH	WANDSWORTH	1 days
02	**SOUTH EAST**		
	BU	BUCKINGHAMSHIRE	1 days
	SC	SURREY	1 days
03	**SOUTH WEST**		
	GS	GLOUCESTERSHIRE	1 days
	SM	SOMERSET	1 days
04	**EAST ANGLIA**		
	NF	NORFOLK	1 days
05	**EAST MIDLANDS**		
	LN	LINCOLNSHIRE	1 days
	NT	NOTTINGHAMSHIRE	1 days
06	**WEST MIDLANDS**		
	WK	WARWICKSHIRE	1 days
07	**YORKSHIRE & NORTH LINCOLNSHIRE**		
	NY	NORTH YORKSHIRE	2 days
	WY	WEST YORKSHIRE	1 days
08	**NORTH WEST**		
	CH	CHESHIRE	1 days
09	**NORTH**		
	TW	TYNE & WEAR	1 days
10	**WALES**		
	CF	CARDIFF	3 days
11	**SCOTLAND**		
	DU	DUNDEE CITY	1 days
12	**CONNAUGHT**		
	RO	ROSCOMMON	1 days
14	**LEINSTER**		
	CC	CARLOW	1 days
	WC	WICKLOW	1 days
15	**GREATER DUBLIN**		
	DL	DUBLIN	1 days
17	**ULSTER (NORTHERN IRELAND)**		
	AN	ANTRIM	1 days
	DE	DERRY	1 days

TRIP RATE for Land Use 05 - HEALTH/G - GP SURGERIES
VEHICLES
Calculation factor: 100 sqm
BOLD print indicates peak (busiest) period

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate	No. Days	Ave. GFA	Trip Rate
00:00 - 01:00									
01:00 - 02:00									
02:00 - 03:00									
03:00 - 04:00									
04:00 - 05:00									
05:00 - 06:00									
06:00 - 07:00									
07:00 - 08:00	22	848	0.649	22	848	0.129	22	848	0.778
08:00 - 09:00	24	813	2.771	24	813	1.199	24	813	3.970
09:00 - 10:00	**24**	**813**	**3.243**	24	813	2.684	24	813	5.927
10:00 - 11:00	24	813	3.222	**24**	**813**	**3.320**	**24**	**813**	**6.542**
11:00 - 12:00	24	813	2.720	24	813	3.028	24	813	5.748
12:00 - 13:00	24	813	2.228	24	813	2.684	24	813	4.912
13:00 - 14:00	24	813	1.445	24	813	1.511	24	813	2.956
14:00 - 15:00	24	813	2.828	24	813	2.500	24	813	5.328
15:00 - 16:00	24	813	2.725	24	813	2.741	24	813	5.466
16:00 - 17:00	24	813	2.285	24	813	2.684	24	813	4.969
17:00 - 18:00	24	813	1.363	24	813	2.111	24	813	3.474
18:00 - 19:00	23	831	0.241	23	831	0.963	23	831	1.204
19:00 - 20:00									
20:00 - 21:00									
21:00 - 22:00									
22:00 - 23:00									
23:00 - 24:00									
Total Rates:			25.720			25.554			51.274

APPENDIX 11.2– IRISH WATER MAIN MAP



UISCE
ÉIREANN : IRISH
WATER

Legend

- Ⓜ Unknown Meter ; Other Meter
- ⋈ Sluice Valve Open
- ◆◆ Double Air Control Valve

Water Hydrants

Hydrant Function

- ● Fire Hydrant
- ⧗ Telemetry Kiosk
- ⊔ Cap
- • Other Fittings

Water Distribution Mains

Owned By

- ― Distribution Water Main
- ━ Trunk Water Main

Sewer Discharge Points

Discharge Type

- ○ Other; Unknown
- ▲ Pump Station
- ―▶― Gravity - Combined
- - ▶ - Gravity - Foul
- ―▶― Gravity - Overflow
- ═▶═ Pumping - Foul

Storm Manholes

Manhole Type

- • Standard

Storm Discharge Points

Discharge Type

- ⇥ Outfall
- - ▶ - Surface Gravity Mains

1:500 at A0

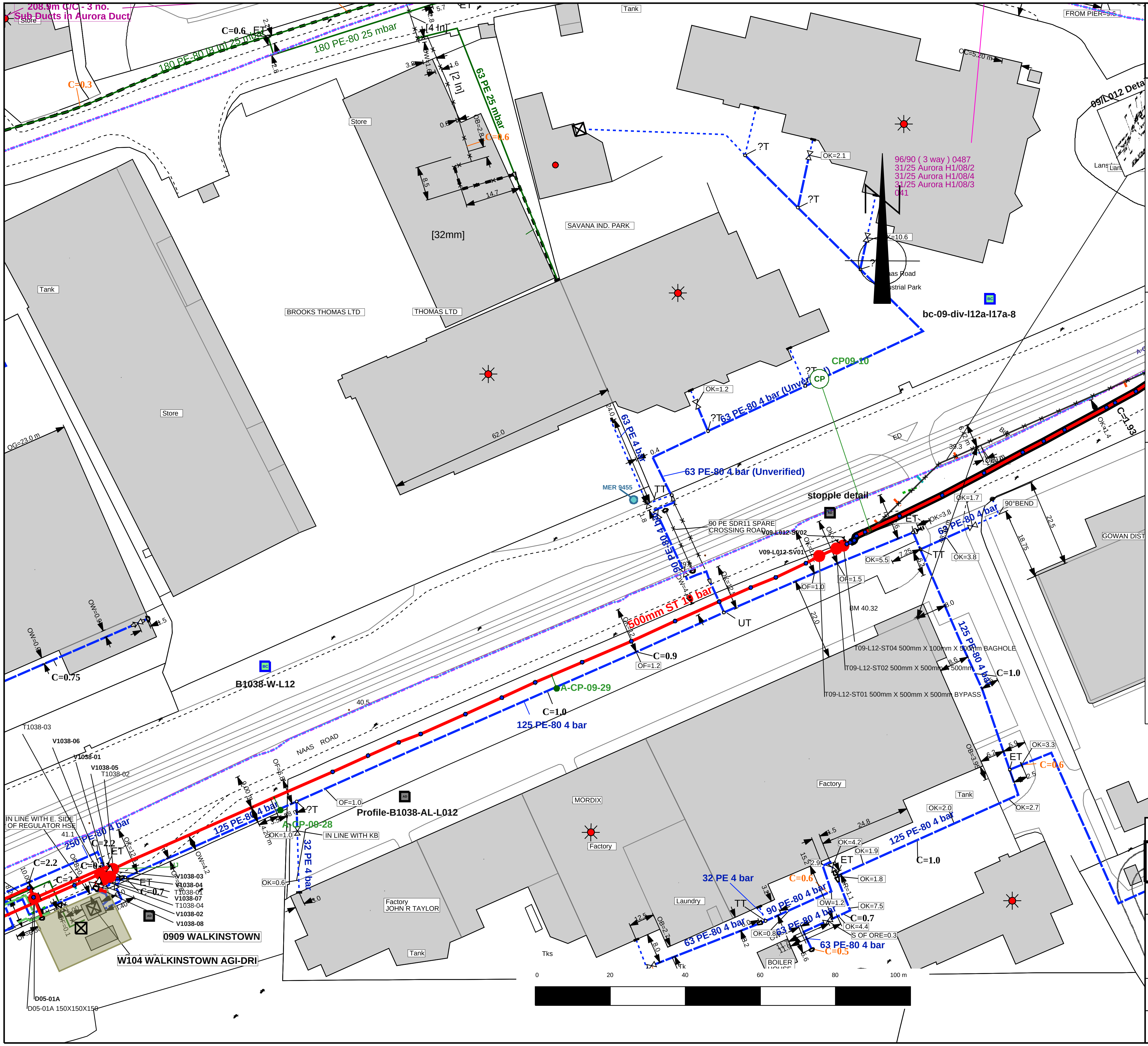
Last edited:
12/06/2018

Metres

0 25 50 100

2. Whilst every care has been taken in its compilation, Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water.
Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

APPENDIX 11.3– GAS NETWORK LAYOUT MAP



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Important Safety Notice:

Damage to gas pipelines can result in serious injury or death. Gas network information is provided as a general guide. The exact location and depth of medium or low pressure distribution gas pipes must be verified on site by carrying out necessary investigations, including, for example, hand digging trial holes along the route of the pipe. Service pipes are not generally shown but their presence should always be anticipated.

High pressure transmission pipelines are shown in red. If a transmission pipeline is identified within 10m of any intended excavations then work must not proceed before GNI has been consulted. The true location and depth of a transmission pipeline must be verified on site by a representative of GNI. Contact can be made through 1850 427 747.

All work in the vicinity of the gas network must be completed in accordance with the current edition of the Health & Safety Authority publication, Code of Practice For Avoiding Danger From Underground Services which is available from the Health and Safety Authority (1890 289 389) or can be downloaded at www.hsa.ie.

Legal Notice:

Gas Networks Ireland (GNI) and its affiliates, accept no responsibility for the accuracy of any information contained in this document including data concerning location and technical designation of the gas distribution and transmission network (the Information). The Information should not be relied on for accurate distance or depth of cover measurements.

Any representations and warranties, express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect or consequential loss, arising out of or in connection with the use or re-use of the Information.

Pipelines

- 🟥 Transmission Pipe (As-laid)
- ▬ Transmission Heavy Wall Pipe
- ▬ Transmission Pipe (Construction)
- ✕ Transmission Pipe (Decommissioned)

Fittings

- ▽ Bend
- ● Cover
- D Dome End
- N2 Nitrogen Fill Point
- o—o Pipe Support
- AMP DM M4P PM RMP Pipeline Marker Post
- ▶ Port
- ▭ Protection
- ◁ Reducer
- ● Tee
- I Transition
- Open ⋈ Closed ⧓ Valve
- | Weld

Cathodic Protection

- ACDD CP AC Discharge
- ●— CP Anode
- — CP Cable
- ▬ CP High Voltage Earthing
- ✚ CP Insulation Joint
- ⬡ CP Lug
- TR Station CP Transformer Rectifier
- CP CP Marker

Miscellaneous

- ▪ Landowner Boundary
- ▬ Townland Boundary
- ▬ Crossing Intersection (Road)
- ▬ Land Drain
- ▬ Electrical Utility
- ▪ Water Utility
- ▬ Telecom Utility
- ▬ Foul Water
- ▬ Duct
- ● Archaeological Site
- ▭ Ground Condition
- ☒ Installation (Location)
- ▭ Installation (Coverage)
- AD Associated Drawing File
- BC Associated Drawing File (Bar Chart)
- Customer
- LS Leak Survey (1 Month)
- LS Leak Survey (1 Year)
- ★ Incident
- ⬢ Data Capture Problem Point
- ▽ Trigonometric Control Point

Design Department - CORK

Gas Networks Ireland

GAS TRANSMISSION NETWORK INFORMATION

Issue:	H O'B - GNI/DLE/4596		
Location:	Naas Road		
Plot Date:	08/06/18	Contact:	021-453 4562
Plotted by:	D O'S	Scale:	1:1000

APPENDIX 11.4 – ESB NETWORK LAYOUT MAP

ESB Networks

TITLE: 20180613-064_A3

COLOUR CODE:

- BLACK - 38KV & HIGHER VOLTAGE OVERHEAD LINES
- GREEN - MV(10KV/20KV) OVERHEAD LINES
- BLUE - LV (400V/230V) OVERHEAD LINES
- CYAN - 38KV & HIGHER VOLTAGE UNDERGROUND CABLE ROUTES
- RED - MV/LV (10KV/20KV/400V/230V) UNDERGROUND CABLE ROUTES

DATE: 13-Jun-2018

** SCALE: 1:1250

** SCALE WHEN PRINTED ON AN A3 PAGE
XY COORDINATES DISPLAYED IN IRISH GRID COORDINATE SYSTEM

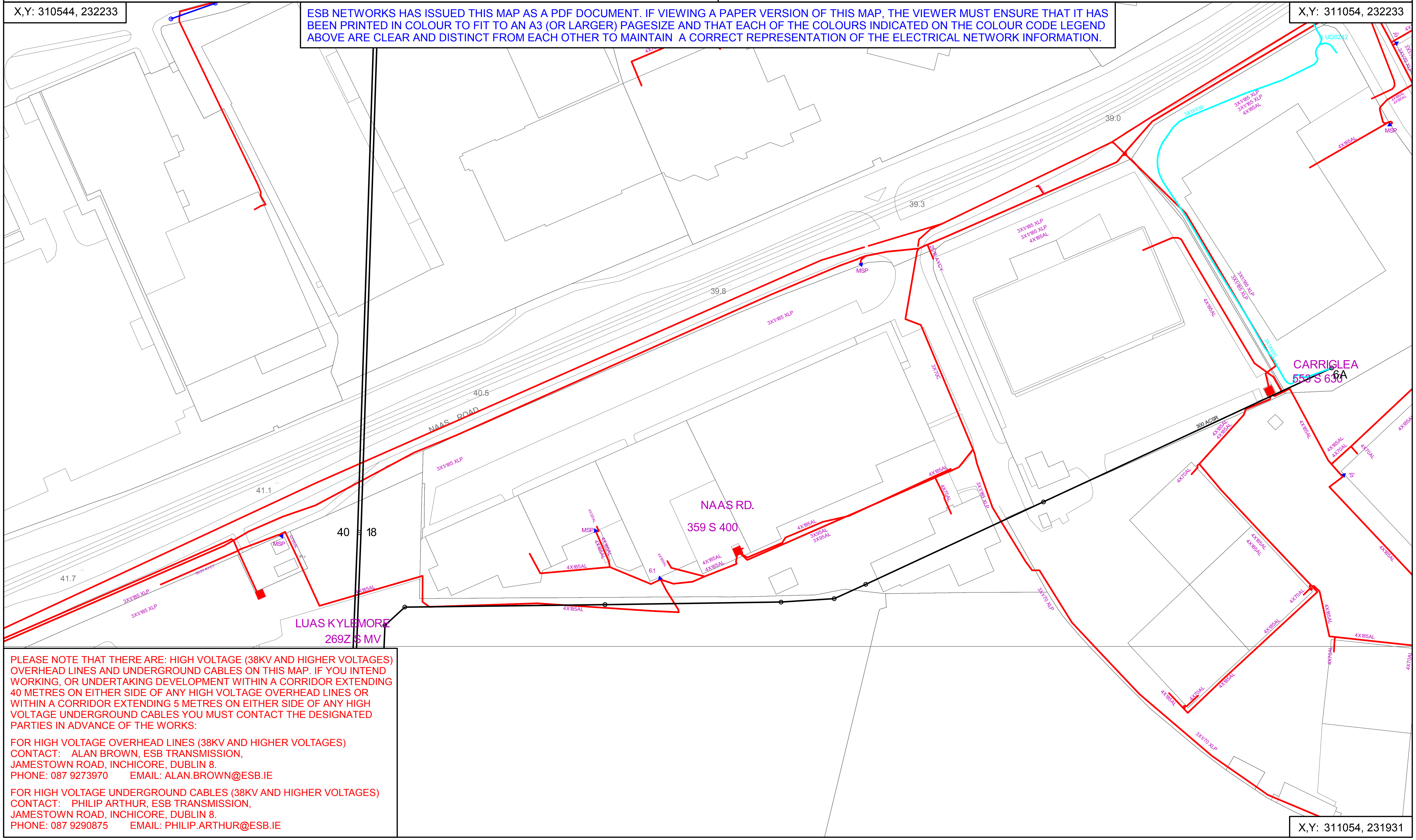
WARNING

THIS MAP INDICATES THE APPROXIMATE LOCATION OF ESB TRANSMISSION (400KV, 220KV, 110KV, 38KV) AND DISTRIBUTION (20KV, 10KV, 230V/400V) UNDERGROUND CABLES AND OVERHEAD LINES IN THE GENERAL AREA OF THE PROPOSED WORKS. ESB NETWORKS TAKES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE MAP. IT IS THE USER'S RESPONSIBILITY TO INDEPENDENTLY VERIFY THE INFORMATION AND THE LOCATION OF UNDERGROUND CABLES AND OVERHEAD LINES. LOW VOLTAGE (230V/400V) SERVICE CABLES (E.G. HOUSE SERVICES, FACTORY/SHOP SERVICES, PUBLIC LIGHTING LAMP SERVICES, ETC) ARE NOT INCLUDED BUT THEIR PRESENCE SHOULD BE ANTICIPATED. THE DEPTHS OF UNDERGROUND CABLES MUST NEVER BE ASSUMED. ADDITIONAL MORE DETAILED INFORMATION IS AVAILABLE FOR HIGH VOLTAGE TRANSMISSION UNDERGROUND CABLES (38KV, 110KV, 220KV, 400KV) FROM THE LOCAL ESB NETWORKS TRANSMISSION REPRESENTATIVE - SEE ATTACHED LIST FOR CONTACT DETAILS OR CALL 1850 372 757. NO WORK SHOULD BE CARRIED OUT IN THE VICINITY OF 38KV OR HIGHER VOLTAGE UNDERGROUND CABLES WITHOUT PRIOR CONSULTATION WITH ESB NETWORKS. BEFORE ANY MECHANICAL EXCAVATION IS UNDERTAKEN, THE ACTUAL LOCATION OF ALL UNDERGROUND ELECTRICITY CABLES MUST BE ESTABLISHED AND VERIFIED ON THE SITE USING: (A) UP-TO-DATE MAP RECORDS; (B) CABLE LOCATER EQUIPMENT OPERATED IN BOTH POWER AND RADIO MODES; (C) CAREFUL HAND DIGGING OF TRIAL HOLES USING 'SAFE DIGGING PRACTICE'. REFER ALSO TO 'HSA CODE OF PRACTICE FOR AVOIDING DANGER FROM UNDERGROUND SERVICES'. ESB TAKES NO RESPONSIBILITY FOR AND SHALL BEAR NO LIABILITY, HOWSOEVER ARISING, IN RELATION TO ANY DAMAGE, INJURY/DEATH OR LOSS OF SUPPLY AS A RESULT OF DAMAGE OR INTERFERENCE WITH ITS NETWORKS.

X,Y: 310544, 232233

ESB NETWORKS HAS ISSUED THIS MAP AS A PDF DOCUMENT. IF VIEWING A PAPER VERSION OF THIS MAP, THE VIEWER MUST ENSURE THAT IT HAS BEEN PRINTED IN COLOUR TO FIT TO AN A3 (OR LARGER) PAGESIZE AND THAT EACH OF THE COLOURS INDICATED ON THE COLOUR CODE LEGEND ABOVE ARE CLEAR AND DISTINCT FROM EACH OTHER TO MAINTAIN A CORRECT REPRESENTATION OF THE ELECTRICAL NETWORK INFORMATION.

X,Y: 311054, 232233



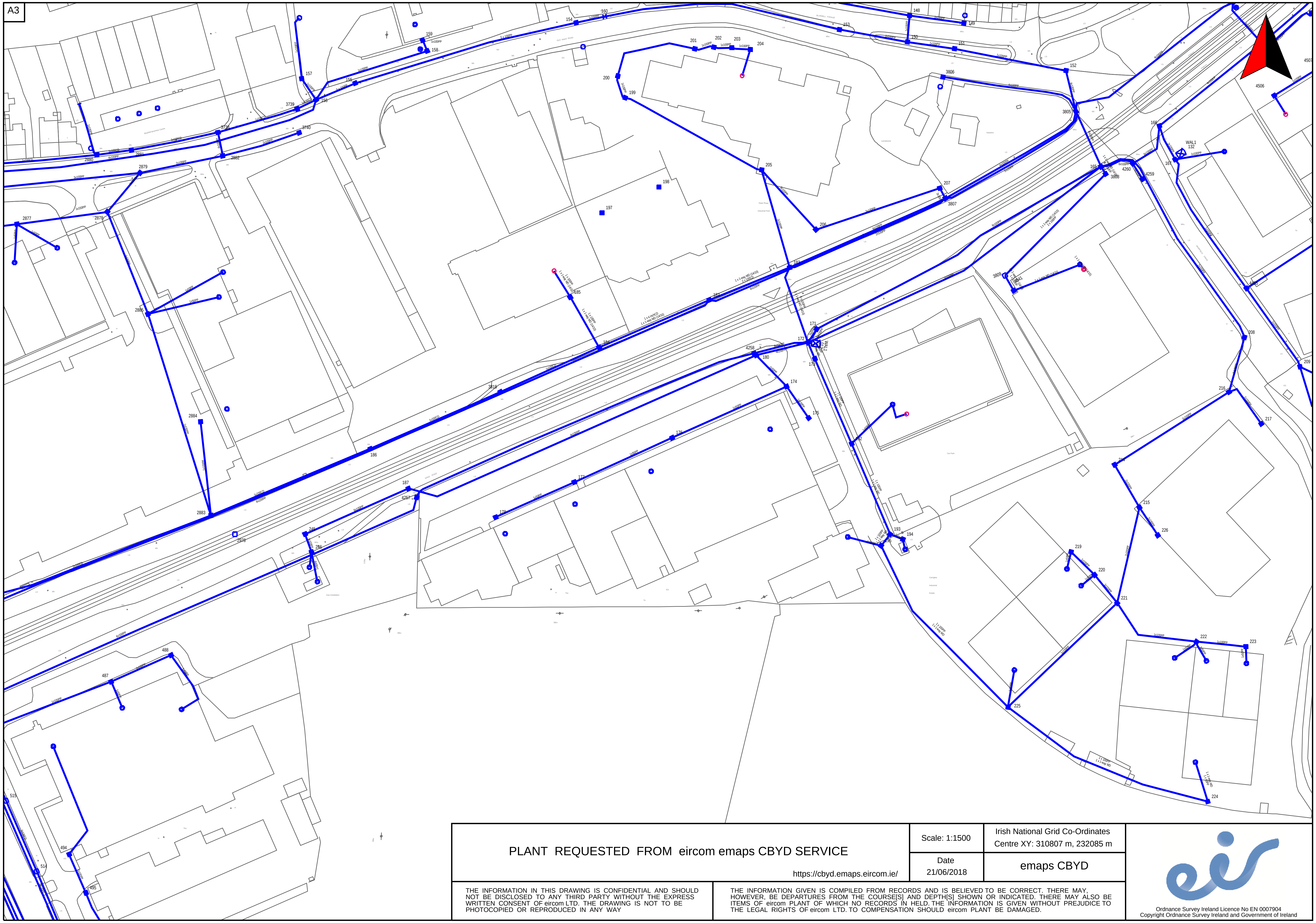
PLEASE NOTE THAT THERE ARE: HIGH VOLTAGE (38KV AND HIGHER VOLTAGES) OVERHEAD LINES AND UNDERGROUND CABLES ON THIS MAP. IF YOU INTEND WORKING, OR UNDERTAKING DEVELOPMENT WITHIN A CORRIDOR EXTENDING 40 METRES ON EITHER SIDE OF ANY HIGH VOLTAGE OVERHEAD LINES OR WITHIN A CORRIDOR EXTENDING 5 METRES ON EITHER SIDE OF ANY HIGH VOLTAGE UNDERGROUND CABLES YOU MUST CONTACT THE DESIGNATED PARTIES IN ADVANCE OF THE WORKS:

FOR HIGH VOLTAGE OVERHEAD LINES (38KV AND HIGHER VOLTAGES)
CONTACT: ALAN BROWN, ESB TRANSMISSION,
JAMESTOWN ROAD, INCHICORE, DUBLIN 8.
PHONE: 087 9273970 EMAIL: ALAN.BROWN@ESB.IE

FOR HIGH VOLTAGE UNDERGROUND CABLES (38KV AND HIGHER VOLTAGES)
CONTACT: PHILIP ARTHUR, ESB TRANSMISSION,
JAMESTOWN ROAD, INCHICORE, DUBLIN 8.
PHONE: 087 9290875 EMAIL: PHILIP.ARTHUR@ESB.IE

X,Y: 311054, 231931

APPENDIX 11.5 – EIR LAYOUT MAP



PLANT REQUESTED FROM eircom emaps CBYD SERVICE

https://cbyd.emaps.eircom.ie/

Scale: 1:1500

Irish National Grid Co-Ordinates
Centre XY: 310807 m, 232085 m

Date
21/06/2018

emaps CBYD

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12.1 WASTE MANAGEMENT PLAN

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Clonshaugh Business & Technology Park,
Dublin 17, Ireland.

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F: + 353 1 847 4257
E: info@awnconsulting.com
W: www.awnconsulting.com

OPERATIONAL WASTE MANAGEMENT PLAN FOR A PROPOSED MIXED-USE DEVELOPMENT

AT

THE CONCORDE INDUSTRIAL ESTATE, NAAS ROAD, DUBLIN 12

Report Prepared For

Development Ocht Ltd.

Report Prepared By

Chonaill Bradley, Senior Environmental Consultant

Our Reference

CB/18/10599WMR01

Date of Issue

16 April 2019

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Registered in Ireland No. 319812
Directors: F Callaghan, C Dilworth,
T Donnelly, E Porter
Associate Director: D Kelly

Document History

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Record of Approval

Details	Written by	Approved by
Signature		Elaine Neary
Name	Chonaill Bradley	Elaine Neary
Title	Senior Environmental Consultant	Associate
Date	16 April 2019	16 April 2019

CONTENTS

1.0 INTRODUCTION

AWN Consulting Ltd. (AWN) has prepared this Operational Waste Management Plan (OWMP) on behalf of Development Ocht Ltd., for submission to An Bord Pleanála (ABP) for a proposed development comprising of a mix of residential and retail units. The total gross site area comprises 1.8 hectares and is a brownfield site located adjacent to the southern side of the Naas Road (R810), Dublin 12.

This OWMP has been prepared to ensure that the management of waste during the operational phase of the proposed development is undertaken in accordance with the current legal and industry standards including, the *Waste Management Act 1996 – 2011* as amended and associated Regulations [1], *Protection of the Environment Act 2003* as amended [2], *Litter Pollution Act 2003* as amended [3], the *'Eastern-Midlands Region (EMR) Waste Management Plan 2015 – 2021'* [4] and Dublin City Council (DCC) *Bye-Laws for the Storage, Presentation and Collection of Household and Commercial Waste (2013)* [5] *and* the draft DCC '*Dublin City Council (Storage, Presentation and Segregation of Household and Commercial Waste) Bye-Laws' (2018)* [6]*.* In particular, this OWMP aims to provide a robust strategy for storing, handling, collection and transport of the wastes generated at site.

In addition, the following guidelines were consulted for healthcare specific waste management practice:

- Health Service Executive (HSE), *Waste Management Awareness Handbook* (2011) [7]; and
- HSE and Department of Health and Children (DOHC), *Healthcare Risk Waste Management: Segregation, Packaging and Storage Guidelines for Healthcare Risk Waste, 4th Edition* (2010) [8].

This OWMP aims to ensure maximum recycling, reuse and recovery of waste with diversion from landfill, wherever possible. The OWMP also seeks to provide guidance on the appropriate collection and transport of waste to prevent issues associated with litter or more serious environmental pollution (e.g. contamination of soil or water resources). The plan estimates the type and quantity of waste to be generated from the proposed development during the operational phase and provides a strategy for managing the different waste streams.

At present, there are no specific guidelines in Ireland for the preparation of OWMPs. Therefore, in preparing this document, consideration has been given to the requirements of national and regional waste policy, legislation and other guidelines.

2.0 OVERVIEW OF WASTEMANAGEMENT IN IRELAND

2.1 National Level

The Government issued a policy statement in September 1998 titled as *'Changing Our Ways'* [9] which identified objectives for the prevention, minimisation, reuse, recycling, recovery and disposal of waste in Ireland. A heavy emphasis was placed on reducing reliance on landfill and finding alternative methods for managing waste. Amongst other things, Changing Our Ways stated a target of at least 35% recycling of municipal (i.e. household, commercial and non-process industrial) waste.

A further policy document *'Preventing and Recycling Waste – Delivering Change'* was published in 2002 [10]. This document proposed a number of programmes to increase recycling of waste and allow diversion from landfill. The need for waste minimisation at source was considered a priority.

This view was also supported by a review of sustainable development policy in Ireland and achievements to date, which was conducted in 2002, entitled *'Making Irelands Development Sustainable – Review, Assessment and Future Action'* [11]. This document also stressed the need to break the link between economic growth and waste generation, again through waste minimisation and reuse of discarded material.

In order to establish the progress of the Government policy document *Changing Our Ways*, a review document was published in April 2004 entitled *'Taking Stock and Moving Forward'* [12]. Covering the period 1998 – 2003, the aim of this document was to assess progress to date with regard to waste management in Ireland, to consider developments since the policy framework and the local authority waste management plans were put in place, and to identify measures that could be undertaken to further support progress towards the objectives outlined in *Changing Our Ways*.

In particular, *Taking Stock and Moving Forward* noted a significant increase in the amount of waste being brought to local authority landfills. The report noted that one of the significant challenges in the coming years was the extension of the dry recyclable collection services.

The most recent policy document was published in July 2012 titled *'A Resource Opportunity'* [13]. The policy document stresses the environmental and economic benefits of better waste management, particularly in relation to waste prevention. The document sets out a number of actions, including the following:

- A move away from landfill and replacement through prevention, reuse, recycling and recovery.
- A Brown Bin roll-out diverting 'organic waste' towards more productive uses.
- Introducing a new regulatory regime for the existing side-by-side competition model within the household waste collection market.
- New Service Standards to ensure that consumers receive higher customer service standards from their operator.
- Placing responsibility on householders to prove they use an authorised waste collection service.
- The establishment of a team of Waste Enforcement Officers for cases relating to serious criminal activity will be prioritised.
- Reducing red tape for industry to identify and reduce any unnecessary administrative burdens on the waste management industry.
- A review of the producer responsibility model will be initiated to assess and evaluate the operation of the model in Ireland.
- Significant reduction of Waste Management Planning Regions from ten to three.

While *A Resource Opportunity* covers the period to 2020, it is subject to a mid-term review in 2016 to ensure that the measures are set out properly and to provide an opportunity for additional measures to be adopted in the event of inadequate performance. In early 2016, the Department of the Environment, Community and Local Government invited comments from interested parties on the discussion paper 'Exporting a Resource Opportunity'. While the EPA have issued a response to the consultation, an updated policy document has not yet been published.

Since 1998, the Environmental Protection Agency (EPA) has produced periodic *'National Waste (Database) Reports'* [14] detailing among other things estimates for household and commercial (municipal) waste generation in Ireland and the level of recycling, recovery and disposal of these materials. The 2016 National Waste Statistics, which is the most recent study published, reported the following key statistics for 2016:

- **Generated –** Ireland produced 2,763,166 t of municipal waste in 2016, this is a six percent increase since 2014. This means that each person living in Ireland generated 580kg of municipal waste in 2016;
- **Managed –** Waste collected and treated by the waste industry. In 2016, a total of 2,718,298 t of municipal waste was managed;
- **Unmanaged –**Waste that is not collected or brought to a waste facility and is therefore likely to cause pollution in the environment because it is burned, buried or dumped. The EPA estimates that 44,868 t was unmanaged in 2016;
- **Recovered –** the amount of waste recycled, used as a fuel in incinerators, or used to cover landfilled waste. In 2016, almost three quarters (74%) of municipal waste was recovered, this is a decrease from 79% in 2014;
- **Recycled –** the waste broken down and used to make new items. Recycling also includes the breakdown of food and garden waste to make compost. The recycling rate in 2016 was 41%, the same as 2014; and
- **Disposed –** the waste landfilled or burned in incinerators without energy recovery. Just over a quarter (26%) of municipal waste was landfilled in 2016).

2.2 Regional Level

The proposed development is located in the Local Authority area of Dublin City Council (DCC).

The *EMR Waste Management Plan 2015 – 2021* is the regional waste management plan for the DCC area which was published in May 2015.

The regional plan sets out the following strategic targets for waste management in the region that are relevant to the proposed development:

- Achieve a recycling rate of 50% of managed municipal waste by 2020; and
- Reduce to 0% the direct disposal of unprocessed residual municipal waste to landfill (from 2016 onwards) in favour of higher value pre-treatment processes and indigenous recovery practices.

Municipal landfill charges in Ireland are based on the weight of waste disposed. In the Leinster Region, charges are approximately €130-150 per tonne of waste which includes a €75 per tonne landfill levy introduced under the *Waste Management (Landfill Levy) (Amendment) Regulations 2013.*

The *Dublin City Development Plan 2016 – 2022* [15] sets out a number of policies and objectives for Dublin City in line with the objectives of the regional waste management plan. The plan identifies a need to further reduce the role of landfilling in favour of higher value recovery options.

Waste policies and objectives with a particular relevance to this development are:

<u>Policies:</u>

- *SI19: To support the principles of good waste management and the implementation of best international practice in relation to waste management in order for Dublin city and the region to become self-reliant in terms of waste management.*
- *SI20: To prevent and minimise waste and to encourage and support material sorting and recycling.*
- *SI21: To minimise the amount of waste which cannot be prevented and ensure it is managed and treated without causing environmental pollution.*
- *SI22: To ensure that effect is given as far as possible to the "polluter pays" principle.*

Objectives:

- *SIO16: To require the provision of adequately-sized-recycling facilities in new commercial and large-scale residential developments, where appropriate.*
- *SIO18: To implement the current Litter Management Plan through enforcement of the litter laws, street cleaning and education and awareness campaigns.*
- *SIO19: To implement the Eastern-Midlands Waste Management Plan 2015 - 2021 and achieve the plan targets and objectives.*

2.3 Legislative Requirements

The primary legislative instruments that govern waste management in Ireland and applicable to the project are:

- Waste Management Act 1996 (No. 10 of 1996) as amended 2001 (No. 36 of 2001), 2003 (No. 27 of 2003) and 2011 (No 20 of 2011). Sub-ordinate and associated legislation include:
    - European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011) as amended
    - Waste Management (Collection Permit) Regulations 2007 (S.I. No. 820 of 2007) as amended
    - Waste Management (Facility Permit and Registration) Regulation 2007 (S.I No. 821 of 2007) as amended
    - Waste Management (Licensing) Regulations 2000 (S.I No. 185 of 2000) as amended
    - European Union (Packaging) Regulations 2014 (S.I. No. 282 of 2014) as amended.
    - Waste Management (Planning) Regulations 1997 (S.I. No. 137 of 1997) as amended
    - Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015)
    - European Communities (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014)
    - Waste Management (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended
    - Waste Management (Food Waste) Regulations 2009 (S.I. No. 508 of 2009) as amended
    - European Union (Household Food Waste and Bio-waste) Regulations 2015 (S.I. No. 191 of 2015)
    - Waste Management (Hazardous Waste) Regulations 1998 (S.I. No. 163 of 1998) as amended
    - Waste Management (Shipments of Waste) Regulations 2007 (S.I. No. 419 of 2007) as amended
    - *European Communities (Transfrontier Shipment of Waste) Regulations 1994 (SI 121 of 1994)*
    - European Union (Properties of Waste Which Render it Hazardous) Regulations 2015 (S.I. No. 233 of 2015) as amended
- Environmental Protection Act 1992 (S.I. No. 7 of 1992) as amended;
- Litter Pollution Act 1997 (Act No. 12 of 1997) as amended and
- Planning and Development Act 2000 (S.I. No. 30 of 2000) as amended [16]

These Acts and subordinate Regulations enable the transposition of relevant European Union Policy and Directives into Irish law.

One of the guiding principles of European waste legislation, which has in turn been incorporated into the *Waste Management Act 1996 - 2011* and subsequent Irish legislation, is the principle of *"Duty of Care"*. This implies that the waste producer is responsible for waste from the time it is generated through until its legal disposal (including its method of disposal.) As it is not practical in most cases for the waste producer to physically transfer all waste from where it is produced to the final disposal area, waste contractors will be employed to physically transport waste to the final waste disposal site.

It is therefore imperative that the residents, tenants and proposed facilities management company undertake on-site management of waste in accordance with all legal requirements and employ suitably permitted/licenced contractors to undertake off-site management of their waste in accordance with all legal requirements. This includes the requirement that a waste contactor handle, transport and reuse/recover/recycle/dispose of waste in a manner that ensures that no adverse environmental impacts occur as a result of any of these activities.

A collection permit to transport waste must be held by each waste contractor which is issued by the National Waste Collection Permit Office (NWCPO). Waste receiving facilities must also be appropriately permitted or licensed. Operators of such facilities cannot receive any waste, unless in possession of a Certificate of Registration (COR) or waste permit granted by the relevant Local Authority under the *Waste Management (Facility Permit & Registration) Regulations 2007* as amended or a waste or IED (Industrial Emissions Directive) licence granted by the EPA. The COR/permit/licence held will specify the type and quantity of waste able to be received, stored, sorted, recycled, recovered and/or disposed of at the specified site.

2.3.1 Dublin City Council Waste Bye-Laws

Bye-Laws for the *Storage, Presentation and Collection of Household and Commercial Waste* were brought into force by DCC in May 2013. The Bye-Laws set a number of enforceable requirements on waste holders with regard to storage, separation and presentation of waste within the DCC functional area. Key requirements under these Bye-Laws of relevance to the proposed development include the following:

- A holder shall maintain all waste containers in such condition and state of repair so that the waste placed therein shall not be a source of nuisance, litter or odours and so that the waste may be conveniently collected;
- A holder shall separate at source such recyclable waste as prescribed by the approved waste collector employed by the holder and this fraction of waste shall be stored separately by the holder in a waste container;
- A management company shall ensure that adequate numbers of waste containers are available for use by holders in a multi-unit development;
- The management company of a multi-unit development and its managing agent shall ensure that adequate access and egress is available for the collection of waste from that multi-unit development; and
- Outside the Central Commercial District (CCD) collections are only to take place between 6am and 9pm Monday to Friday. This is restricted to 8am to 8pm on weekends and bank holidays. Waste is not to be presented for collection before 6pm on the day before collection. The proposed development is located outside of the CCD and must comply with these time restrictions.

The full text of the DCC Waste Bye-Laws is available from the DCC website.

2.3.2 Dublin City Council Draft Waste Bye-Laws

The DCC "Dublin City Council (Storage, Presentation and Segregation of Household and Commercial Waste) Bye-Laws (2018)" were released for consultation on the 30th of July 2018. These bye-laws will repeal the current '*Bye-Laws for the Storage, Presentation and Collection of Household and Commercial'*. The Draft Bye-Laws set a number of enforceable requirements on waste holders with regard to storage, separation and presentation of waste within the DCC functional area. Key requirements under these Draft Bye-Laws of relevance to the proposed development include the following

- Kerbside waste presented for collection shall not be presented for collection earlier than 5.00 pm on the day immediately preceding the designated waste collection day;
- All containers used for the presentation of kerbside waste and any uncollected waste shall be removed from any roadway, footway, footpath or any other public place no later than 10:00am on the day following the designated waste collection day, unless an alternative arrangement has been approved in accordance with bye-law 2.3;
- Documentation, including receipts, is obtained and retained for a period of no less than one year to provide proof that any waste removed from the premises has been managed in a manner that conforms to these bye-laws, to the Waste Management Act and, where such legislation is applicable to that person, to the European Union (Household Food Waste and Bio-Waste) Regulations 2015; and
- Adequate access and egress onto and from the premises by waste collection vehicles is maintained.

The full text of the Draft Waste Bye-Laws is available from the DCC website.

2.4 Regional Waste Management Service Providers and Facilities

Various contractors offer waste collection services for the residential and commercial sectors in the DCC region. Details of waste collection permits (granted, pending and withdrawn) for the region are available from the NWCPO.

As outlined in the regional waste management plan, there is a decreasing number of landfills available in the region. Only three municipal solid waste landfills remain operational and are all operated by the private sector. There are a number of other licensed and permitted facilities in operation in the region including waste transfer stations, hazardous waste facilities and integrated waste management facilities. There are two existing thermal treatment facilities, one in Duleek, Co. Meath and a second facility in Poolbeg in Dublin.

The Ballymount Civic Amenity Site is located c.1.9km to the south west of the development, which can be utilised by the residents of the development for certain household waste streams. The amenity site can accept paper, cans, cardboard, tetra pak, plastics, textiles and glass. There is also a bottle and textile bank located c. 550m to the north west of the development at the Cottage Inn.

A copy of all CORs and waste permits issued by the Local Authorities are available from the NWCPO website and all waste/IE licenses issued are available from the EPA.

3.0 DESCRIPTION OF THE PROJECT

3.1 Location, Size and Scale of the Development

The proposed development comprises of the demolition of the existing single storey industrial building (5,810 sq.m.) on the site and the construction of a “Build to Rent” Residential and commercial development on lands at Concorde Industrial Estate (1.88ha), Naas Road, Dublin 12.

The proposed development comprises of 492 no. residential units comprising of 104 no. studios, 136 no. 1 beds and 252 no. 2 beds. The proposed development includes the provision of communal residential facilities such as concierge, resident lounge, shared winter gardens, shared work space, meeting rooms, events spaces and external residential courtyards and all associated resident support facilities to accompany the "Build to Rent" development.

The development also includes the provision of 3,347 sq.m. commercial uses comprising of retail, café, restaurant, medical centre, car showroom, and creche. The proposed development also accommodates 200 no. car parking spaces at basement level and 43 no. at surface level, 276 no. cycle parking spaces at basement level and 264 no. cycle spaces at surface level, plant rooms, refuse storage, public open space, landscaping, SUDS drainage, and all associated site development works necessary to facilitate the development.

3.2 Typical Waste Categories

The typical non-hazardous and hazardous wastes that will be generated at the proposed development will include the following:

- Dry Mixed Recyclables (DMR) - includes waste paper (including newspapers, magazines, brochures, catalogues, leaflets), cardboard and plastic packaging, metal cans, plastic bottles, aluminium cans, tins and Tetra Pak cartons;
- Organic waste – food waste and green waste generated from internal plants/flowers;
- Glass; and
- Mixed Non-Recyclable (MNR)/General Waste.

In addition to the typical waste materials that will be generated at the development on a daily basis, there will be some additional waste types generated in small quantities which will need to be managed separately including:

- Green/garden waste may be generated from internal plants or external landscaping;
- Batteries (both hazardous and non-hazardous);
- Waste electrical and electronic equipment (WEEE) (both hazardous and non-hazardous);
- Printer cartridges/toners;
- Chemicals (paints, adhesives, resins, detergents, etc.) ;
- Light bulbs (Fluorescent Tubes, Long Life, LED and Lilament bulbs);
- Textiles (rags);
- Waste cooking oil (if any generated by the residents or commercial tenants);
- Furniture (and from time to time other bulky wastes); and
- Abandoned bicycles. Bicycle parking areas are planned for the development. As happens in other developments, residents and tenants sometimes abandon faulty or unused bicycles and it can be difficult to determine their ownership. However, it is proposed that these bicycles would be donated to charity so they are unlikely to become a waste

Wastes should be segregated into the above waste types to ensure compliance with waste legislation and guidance while maximising the re-use, recycling and recovery of waste with diversion from landfill wherever possible.

3.2.1 Healthcare Waste

Healthcare waste is defined in the HSE and DOHC *Healthcare Risk Waste Management* publication as *"solid or liquid waste arising from healthcare"*. Waste materials generated will fall into two main categories, namely healthcare non-risk waste (i.e. non-clinical healthcare waste) and healthcare risk waste (hazardous) as illustrated in Figure 3.1. Hazardous waste has been further subdivided in this plan into non-clinical hazardous waste and clinical/risk waste.

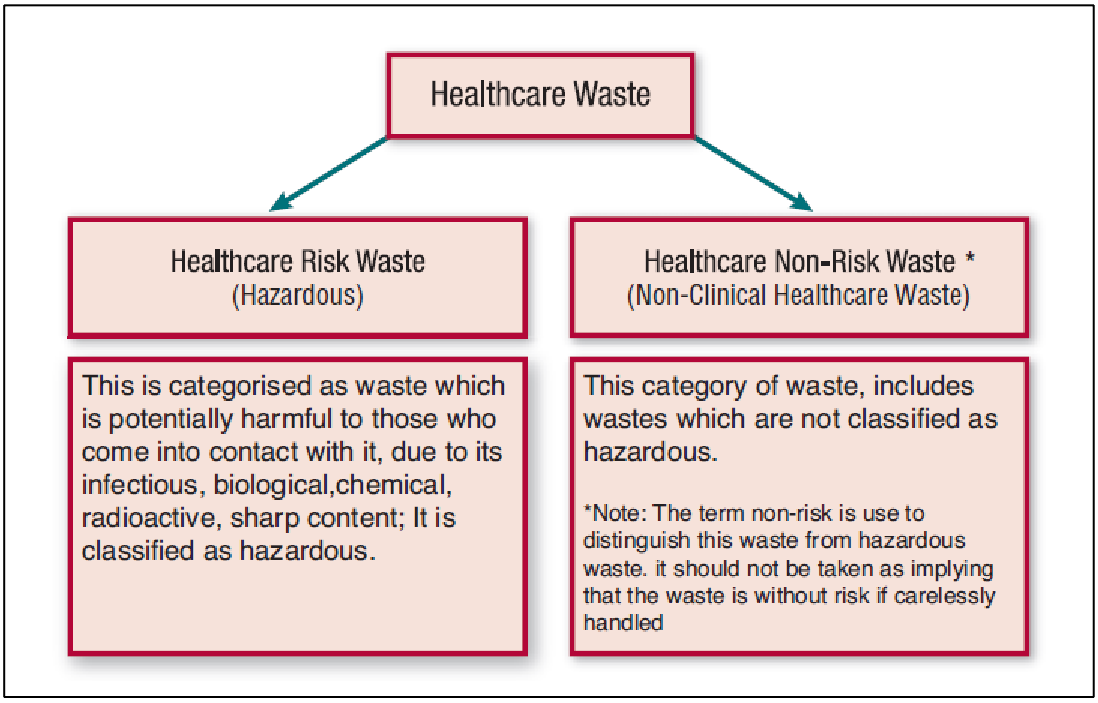


Figure 3.1 Healthcare Waste Categories (Source: HSE, *Waste Management Awareness Handbook* (2001)

3.2.2 Non-Risk/Non-Clinical Non-Hazardous Waste

The typical non-risk/non-clinical non-hazardous waste streams that will be generated will include the following typical waste categories:

- Dry Mixed Recyclables (DMR) – includes cardboard, non-confidential paper, newspaper, leaflets plastic packaging and bottles, aluminium cans, tins and Tetra Pak cartons;
- Confidential paper;
- Mixed Non-Recyclable /General Waste (MNR);
- Organic (food/catering) waste; and
- Glass.

In addition to the typical non-risk/non-clinical non-hazardous waste materials that will be generated on a daily basis, there will be some additional wastes generated on a regular basis that will need to be managed separately including:

- Green/garden waste from landscaping activities;
- Textiles;
- Batteries (non-hazardous) *note: hazardous batteries may also be generated which are referred to in Section 3.2.2*;
- Waste electrical and electronic equipment (WEEE) including computers, printers and other ICT equipment (non-hazardous) *note: WEEE containing hazardous components may also be generated which are referred to in Section 3.2.2*; and
- Furniture (and from time to time other bulky wastes).

3.2.3 Non-Clinical Hazardous Waste

The typical non-clinical hazardous waste streams that will be generated will include the following:

- Printer/toner cartridges;

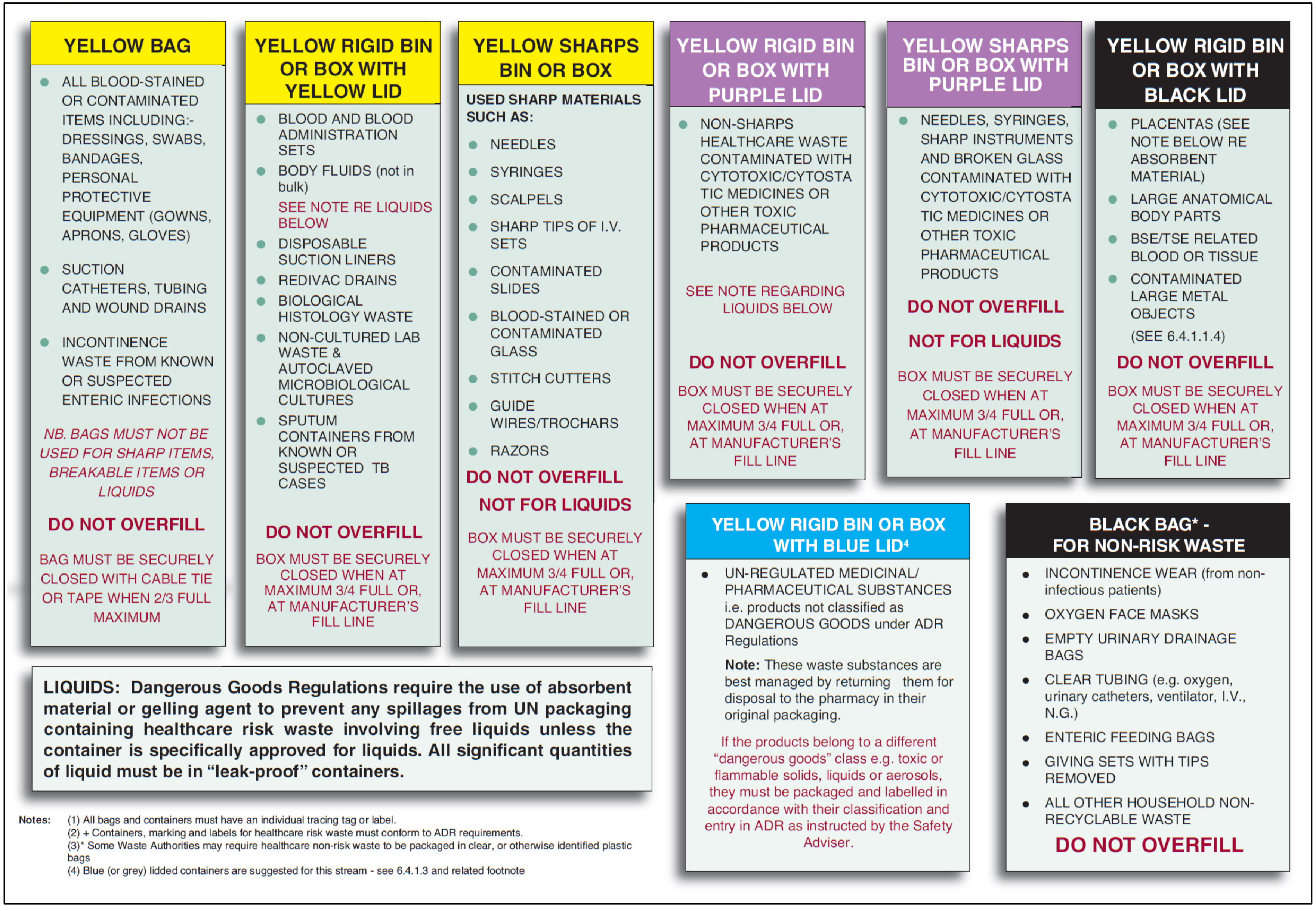
- Batteries (hazardous) *note: non-hazardous batteries may also be generated which are referred to in Section 3.2.1*;
- Waste electrical and electronic equipment (WEEE) including computers, printers and other ICT equipment (containing hazardous components) *note: WEEE not containing hazardous components may also be generated which are referred to in Section 3.2.1*;
- Cleaning chemicals (solvents, pesticides, paints, adhesives, resins, detergents, etc.); and
- Fluorescent bulb tubes and other mercury containing waste.

3.2.4 Healthcare Risk Waste (Hazardous)

Healthcare risk waste will be generated from doctor surgeries, consulting rooms, treatment rooms. Figure 3.2 over shows the classification and colour coding of healthcare risk waste as presented in the HSE guidance document.

Not all of the waste types listed in Figure 3.2 will be generated at the care centre as the centre will provide primary care services only and will not carry out significant surgical procedures or cancer care services.

The healthcare risk waste generated at the care centre will comprise waste disposed of in yellow bags (such as dressings, swabs, bandages, gloves etc.) and yellow sharps buckets (for waste such as needles, syringes, razors, stitch cutters etc.).



YELLOW BAG

- ALL BLOOD-STAINED OR CONTAMINATED ITEMS INCLUDING:- DRESSINGS, SWABS, BANDAGES, PERSONAL PROTECTIVE EQUIPMENT (GOWNS, APRONS, GLOVES)
- SUCTION CATHETERS, TUBING AND WOUND DRAINS
- INCONTINENCE WASTE FROM KNOWN OR SUSPECTED ENTERIC INFECTIONS

NB. BAGS MUST NOT BE USED FOR SHARP ITEMS, BREAKABLE ITEMS OR LIQUIDS

DO NOT OVERFILL

BAG MUST BE SECURELY CLOSED WITH CABLE TIE OR TAPE WHEN 2/3 FULL MAXIMUM

YELLOW RIGID BIN OR BOX WITH YELLOW LID

- BLOOD AND BLOOD ADMINISTRATION SETS
- BODY FLUIDS (not in bulk)
  SEE NOTE RE LIQUIDS BELOW
- DISPOSABLE SUCTION LINERS
- REDIVAC DRAINS
- BIOLOGICAL HISTOLOGY WASTE
- NON-CULTURED LAB WASTE & AUTOCLAVED MICROBIOLOGICAL CULTURES
- SPUTUM CONTAINERS FROM KNOWN OR SUSPECTED TB CASES

DO NOT OVERFILL

BOX MUST BE SECURELY CLOSED WHEN AT MAXIMUM 3/4 FULL OR, AT MANUFACTURER'S FILL LINE

YELLOW SHARPS BIN OR BOX

USED SHARP MATERIALS SUCH AS:

- NEEDLES
- SYRINGES
- SCALPELS
- SHARP TIPS OF I.V. SETS
- CONTAMINATED SLIDES
- BLOOD-STAINED OR CONTAMINATED GLASS
- STITCH CUTTERS
- GUIDE WIRES/TROCHARS
- RAZORS

DO NOT OVERFILL

NOT FOR LIQUIDS

BOX MUST BE SECURELY CLOSED WHEN AT MAXIMUM 3/4 FULL OR, AT MANUFACTURER'S FILL LINE

YELLOW RIGID BIN OR BOX WITH PURPLE LID

- NON-SHARPS HEALTHCARE WASTE CONTAMINATED WITH CYTOTOXIC/CYTOSTATIC MEDICINES OR OTHER TOXIC PHARMACEUTICAL PRODUCTS

SEE NOTE REGARDING LIQUIDS BELOW

DO NOT OVERFILL

BOX MUST BE SECURELY CLOSED WHEN AT MAXIMUM 3/4 FULL OR, AT MANUFACTURER'S FILL LINE

YELLOW SHARPS BIN OR BOX WITH PURPLE LID

- NEEDLES, SYRINGES, SHARP INSTRUMENTS AND BROKEN GLASS CONTAMINATED WITH CYTOTOXIC/CYTOSTATIC MEDICINES OR OTHER TOXIC PHARMACEUTICAL PRODUCTS

DO NOT OVERFILL

NOT FOR LIQUIDS

BOX MUST BE SECURELY CLOSED WHEN AT MAXIMUM 3/4 FULL OR, AT MANUFACTURER'S FILL LINE

YELLOW RIGID BIN OR BOX WITH BLACK LID

- PLACENTAS (SEE NOTE BELOW RE ABSORBENT MATERIAL)
- LARGE ANATOMICAL BODY PARTS
- BSE/TSE RELATED BLOOD OR TISSUE
- CONTAMINATED LARGE METAL OBJECTS
  (SEE 6.4.1.1.4)

DO NOT OVERFILL

BOX MUST BE SECURELY CLOSED WHEN AT MAXIMUM 3/4 FULL OR, AT MANUFACTURER'S FILL LINE

LIQUIDS: Dangerous Goods Regulations require the use of absorbent material or gelling agent to prevent any spillages from UN packaging containing healthcare risk waste involving free liquids unless the container is specifically approved for liquids. All significant quantities of liquid must be in "leak-proof" containers.

YELLOW RIGID BIN OR BOX WITH BLUE LID⁴

- UN-REGULATED MEDICINAL/ PHARMACEUTICAL SUBSTANCES i.e. products not classified as DANGEROUS GOODS under ADR Regulations

Note: These waste substances are best managed by returning them for disposal to the pharmacy in their original packaging.

If the products belong to a different "dangerous goods" class e.g. toxic or flammable solids, liquids or aerosols, they must be packaged and labelled in accordance with their classification and entry in ADR as instructed by the Safety Adviser.

BLACK BAG* - FOR NON-RISK WASTE

- INCONTINENCE WEAR (from non-infectious patients)
- OXYGEN FACE MASKS
- EMPTY URINARY DRAINAGE BAGS
- CLEAR TUBING (e.g. oxygen, urinary catheters, ventilator, I.V., N.G.)
- ENTERIC FEEDING BAGS
- GIVING SETS WITH TIPS REMOVED
- ALL OTHER HOUSEHOLD NON-RECYCLABLE WASTE

DO NOT OVERFILL

Notes:
(1) All bags and containers must have an individual tracing tag or label.
(2) + Containers, marking and labels for healthcare risk waste must conform to ADR requirements.
(3)* Some Waste Authorities may require healthcare non-risk waste to be packaged in clear, or otherwise identified plastic bags
(4) Blue (or grey) lidded containers are suggested for this stream - see 6.4.1.3 and related footnote

Figure 3.2 Segregation of Healthcare Risk Waste (Source: HSE and DOHC, *Healthcare Risk Waste Management* (2010) and HSE, *Waste Management Awareness Handbook* (2011))

3.3 European Waste Codes

In 1994, the *European Waste Catalogue* [17] and *Hazardous Waste List* [18] were published by the European Commission. In 2002, the EPA published a document titled the *European Waste Catalogue and Hazardous Waste List* [19], which was a condensed version of the original two documents and their subsequent amendments. This document has recently been replaced by the EPA '*Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous'* [20] which became valid from the 1st June 2015. This waste classification system applies across the EU and is the basis for all national and international waste reporting, such as those associated with waste collection permits, COR's, permits and licences and EPA National Waste Database.

Under the classification system, different types of wastes are fully defined by a code. The List of Waste (LoW) code (also referred to as European Waste Code or EWC) for typical waste materials expected to be generated during the operation of the proposed development are provided in Table 3.1 below

Waste Material	LoW/EWC Code
Paper and Cardboard	20 01 01
Plastics	20 01 39
Metals	20 01 40
Mixed Non-Recyclable Waste	20 03 01
Glass	20 01 02
Biodegradable Kitchen Waste	20 01 08
Oils and Fats	20 01 25
Textiles	20 01 11
Batteries and Accumulators*	20 01 33* - 34
Printer Toner/Cartridges*	20 01 27* - 28
Green Waste	20 02 01
WEEE*	20 01 35*-36
Chemicals (solvents, pesticides, paints & adhesives, detergents, etc.) *	20 01 13*/19*/27*/28/29*30
Fluorescent tubes and other mercury containing waste*	20 01 21*
Bulky Wastes	20 03 07
Healthcare wastes (wastes from natal care, diagnosis, treatment or prevention of disease in humans, includes non-hazardous and hazardous wastes) *	18 01*

* *Individual waste type may contain hazardous materials*

Table 3.1 Typical Waste Types Generated and LoW Codes

4.0 ESTIMATED WASTE ARISINGS

A waste generation model (WGM) developed by AWN, has been used to predict waste types, weights and volumes arising from operations within the proposed development. The WGM incorporates building area and use and combines these with other data including Irish and US EPA waste generation rates.

The estimated quantum/volume of waste that will be generated from the residential units has been determined based on the predicted occupancy of the units.

The waste generation for the retail, café, restaurant, medical, crèche and office units is based on waste generation rates per m^2 floor area for the proposed area uses.

The estimated waste generation for the development for the main waste types is presented in Table 4.1 and 4.2.

Waste type	Waste Volume (m^3/week)		
	Residential (Combined)	Retail/Café/ Restaurant Units (Combined)	Crèche Unit
Organic Waste	7.02	0.77	0.03
DMR	51.44	7.34	1.37
Glass	1.36	0.30	0.01
MNR	28.51	4.32	0.61
Total	**88.32**	**12.73**	**2.02**

Table 4.1 Estimated waste generation for the proposed development for the main waste types

Waste type	Waste Volume (m^3/week)	
	Offices (Combined)	Medical Unit
Organic Waste	0.04	0.06
Paper (Confidential)	0.71	0.53
Healthcare Risk Waste	-	0.15
DMR	1.63	1.29
Glass	0.01	0.01
MNR	0.88	0.56
Total	**3.31**	**2.59**

Table 4.2 Estimated waste generation for the proposed development for the main waste types

The BS5906:2005 Waste Management in Buildings – Code of Practice [21] was considered in the estimations of the waste arising. It has been assumed that the retail, café, restaurant, and residential units will generate similar waste volumes over a seven-day period, while the office, medical and crèche units will operate over a five-day period. It is anticipated that the conservative estimation of waste quantities from the residents will be sufficient to cover the small quantities likely to be generated in the community facilities on a weekly basis.

5.0 WASTE STORAGE AND COLLECTION

This section provides information on how waste generated within the development will be stored and how the waste will be collected from the development. This has been prepared with due consideration of the proposed site layout as well as best practice standards, local and national waste management requirements including those of DCC. In particular, consideration has been given to the following documents:

- BS 5906:2005 Waste Management in Buildings – Code of Practice;
- EMR Waste Management Plan 2015 – 2021;
- Dublin City Council Development Plan 2016 – 2022 (Appendix 10);
- DCC, Bye-Laws for the Storage, Presentation and Collection of Household and Commercial Waste (2013)*;*
- Draft DCC Dublin City Council (Storage, Presentation and Segregation of Household and Commercial Waste) Bye-Laws (2018);
- HSE, Waste Management Awareness Handbook;
- HSE and DOHC, Healthcare Risk Waste Management: Segregation, Packaging and Storage Guidelines for Healthcare Risk Waste; and
- DoEHLG, Sustainable Urban Housing: Design Standards for New Apartments, Guidelines for Planning Authorities (2018) [22].

Two dedicated communal Waste Storage Area (WSA) have been allocated within the development design for the residential units, these shared WSAs are located on basement level of the development. Three shared WSAs have been allocated for the commercial units at ground level of the development. All WSAs can be viewed on the drawings submitted with the planning application. A clinical WSA will be allocated within the medical unit by the medical unit tenants.

Using the estimated waste generation volumes in Table 4.1 and 4.2, the waste receptacle requirements for MNR, DMR, organic waste and glass have been established for the WSAs. These are presented in Table 5.1.

Area/Use	Bins Required			
	MNR*	DMR**	Organic	Glass
Residential	26 x 1100L	47 x 1100L	30 x 240L	12 x 120L
Commercial	7 x 1100L	12 x 1100L	4 x 240L	3 x 120L

*Note: * = Mixed Non-Recyclables*
*** = Dry Mixed Recyclables*

Table 5.1 *Waste storage requirements for the proposed development*

The waste receptacle requirements have been established from distribution of the total weekly waste generation estimate into the holding capacity of each receptacle type.

Waste storage receptacles as per Table 5.1 above (or similar appropriate approved containers) will be provided by the facilities management company in the residential WSAs.

Using the receptacles outlined in Table 5.1 residential DMR and MNR will be collected on a four times per week basis, while organic waste and glass will be collected on a weekly basis. Commercial DMR, MNR, organic waste and glass will be collected on a weekly basis.

As outlined in the current Dublin City Development Plan, it is preferable to use 1,100 litre wheelie bins for waste storage, where practical. However, in the case of organic and glass waste, it is considered more suitable to use smaller waste receptacles due to the weight of bins when filled with organic and glass waste. The use of 240 & 120 litre bins as recommended in Table 5.1 will reduce the manual handling impacts on the facilities management personnel and waste contractor employees.

The types of bins used will vary in size, design and colour dependent on the appointed waste contractor. However, examples of typical receptacles to be provided in the WSAs are shown in Figure 5.1. All waste receptacles used will comply with the IS EN 840 2012 standard for performance requirements of mobile waste containers, where appropriate.

Figure 5.1 *Typical waste receptacles of varying size (240L and 1100L)*

5.1 Waste Storage – Residential Units

Residents will be required to segregate waste into the following main waste streams:

- DMR;
- MNR;
- Organic waste; and
- Glass;

Residents will be required to take their segregated waste materials to one of the two designated residential WSAs at basement level and dispose of their segregated waste into the appropriate bins or compactors.

Each bin/container in the WSAs will be clearly labelled and colour coded to avoid cross contamination of the different waste streams. Signage will be posted above or on the bins to show exactly which waste types can be placed in each bin.

Access to the residential WSAs will be restricted to authorised residents, facilities management and waste contractors by means of a key or electronic fob access. Bins will be taken from the WSAs directly to a temporary storage and collection area, to the south of the carpark entrance.

Other waste materials such as textiles, batteries, printer toner/cartridges and WEEE may be generated infrequently by the residents. Residents will be required to identify suitable temporary storage areas for these waste items within their own units and dispose of them appropriately. Further details on additional waste types can be found in Section 5.6.

5.2 Waste Storage –Offices

The office tenants will be required to segregate waste within the development into the following main waste types:

- DMR;
- MNR;
- Paper (confidential);
- Organic waste; and
- Glass.

Personnel nominated by the office tenant(s) will empty the bins in the Area Waste Station (AWS), as required, and bring the segregated waste using trolleys/carts/bins to one of the three commercial WSAs located on ground level.

The offices will be occupied by multiple tenants. It is recommended that the office tenants implement the ‘binless office’ concept where employees do not have bins located under desks and instead bring their waste to AWSs located strategically on the office floors, at print stations/rooms and at any micro kitchens or tea stations which may be provided within the tenants office space. Experience has shown that the maximum travel distance should be no more than 15m from the employee’s desk to the AWS. This ‘best in class’ concept achieves maximum segregation of waste in an office setting.

Typically, an AWS would include a bin for DMR and a bin for MNR. It is recommended that a confidential paper bin with a locked lid/door should also be provided for at each AWS and/or adjacent to photocopy/printing stations, as required. In addition, it is recommended that organic and glass bins should be provided at any micro kitchens or tea stations, where appropriate.

A printer cartridge/toner bin should be provided at the print/copy stations, where appropriate.

It is recommended that all bins/containers should be clearly labelled, and colour coded to avoid cross contamination of the different waste streams. Signage should be posted on or above the bins to show which wastes can be put in each bin.

The binless office concept, in addition to assisting in maximising recycling rates and minimising associated landfill disposal costs, also has the advantage of substantially reducing cleaning costs, as cleaners visit only the AWSs on each floor, as opposed to each desk.

If a canteen/restaurant is provided within any of the office spaces or for the office spaces, this will generate additional waste volumes on a daily basis, primarily organic waste from food preparation/leftovers and possibly waste cooking oil and waste sludge from grease traps. A kitchen is also likely to generate extra packaging waste material such as cardboard and plastic from decanting of goods received. The waste figures in Table 4.1 do not include an allowance for a canteen in either offices.

Suppliers for the tenants should be requested by the tenants to make deliveries in reusable containers, minimize packaging and/or to remove any packaging after delivery where possible, to reduce waste generated by the development.

It is proposed that confidential paper waste will be managed separately to non-confidential paper waste. Tenants will be required to engage with an appropriately permitted/licenced confidential waste management contractor for collection and shredding of confidential paper. It is anticipated that tenants will place locked confidential waste paper bins as required throughout their office areas. The confidential waste company will typically collect bins directly from the office areas, under agreement with the tenant, and bring the locked bin or bags of confidential waste via the lifts to their collection truck. It is envisaged that confidential paper waste will be shredded on-site in the dedicated collection truck.

Access to the commercial WSAs will be restricted to authorised tenants, facilities management and waste contractors by means of a key or electronic fob access. Bins will be taken from the WSA directly to a temporary storage and collection area, to the south of the carpark entrance.

Other waste materials such as textiles, batteries, printer toner/cartridges and WEEE will be generated less frequently. Tenants will be required to identify suitable temporary storage areas for these waste items within their own units and dispose of them appropriately. Facilties management may arrange collection depending on the agreement. Further details on additional waste types can be found in Section 5.6.

5.3 Waste Storage – Retail/Café/Restaurant/Crèche Units

The retail/café/restaurant/crèche units will be required to segregate waste within the development into the following main waste types:

- DMR;
- MNR;
- Organic waste; and
- Glass.

The tenants will bring the segregated waste materials to one of the three commercial WSAs located on ground level.

Suppliers for the tenants should be requested by the tenants to make deliveries in reusable containers, minimize packaging or to remove any packaging after delivery where possible, to reduce waste generated by the development.

Any kitchens in the units will contribute a significant portion of the volume of waste generated on a daily basis, and as such it is important that adequate provision is made for the storage and transfer of waste from these areas to the WSA.

It is anticipated that waste will be generated in kitchens throughout the day, primarily at the following locations:

- Food Storage Areas (i.e. cold stores, dry store, freezer stores and stores for decanting of deliveries);
- Meat Preparation Area;
- Vegetable Preparation Area;
- Cooking Area;
- Dish-wash and Glass-wash Area; and
- Bar Area.

Small bins will be placed adjacent to each of these areas for temporary storage of waste generated during the day. Waste will then be transferred from each of these areas to the appropriate WSA and placed into the segregated bins as detailed in Table 5.1.

All bins/containers in the tenant’s areas as well as in the WSAs will be clearly labelled and colour coded to avoid cross contamination of the different waste streams. Signage will be posted above or on the bins to show exactly which wastes can be put in each.

The commercial WSAs are located on ground level at the rear of the commercial units and will be shared by all commercial tenants of the development.

Other waste materials such as batteries, WEEE and printer toner/cartridges will be generated less frequently. . Tenants will be required to identify suitable temporary storage areas for these waste items within their own units and dispose of them appropriately. Facilties management may arrange collection depending on the agreement. Further details on additional waste types can be found in Section 5.6.

5.4 Waste Storage – Medical

Waste will be generated from a wide variety of activities throughout the proposed care centre building. Healthcare risk wastes will typically be generated in the doctor surgeries, consulting rooms and treatment rooms. DMR and MNR waste will be generated throughout the building. Confidential and non-confidential paper waste will mainly be generated in offices and staff workstations.

There will be no public food service area or food preparation carried out in the building. Small quantities of organic (food) waste will be generated from staff lunches, micro kitchen areas and food brought into the building.

Appropriate colour coded, labelled and secured receptacles will be required for healthcare risk waste generated in the building as set out in the HSE, *Waste Management Awareness Handbook* (and illustrated in Figure 3.2). The required healthcare risk waste receptacles will be:

- Yellow bags (stored in rigid bins e.g. 60L pedal bin)
- Yellow rigid buckets with yellow lid

These waste receptacles will be stored in designated treatment rooms, doctor surgeries, consulting rooms and treatment rooms areas. Facilities or cleaning staff will transfer the risk waste bags/buckets on a regular basis to a dedicated clinical waste room on the lower ground floor level of the building. This room will have 1 no. 240 litre yellow clinical waste bin and 1 no. roll cages.

In addition, clinical waste bags and sharps buckets may be temporarily transferred to utility stores located across the unit during the day prior to transfer to the clinical waste room. Where required, these temporary storage locations should have 60/80 litre pedal bins for yellow risk waste bags and shelf storage for sharps buckets. Facilities or cleaning staff will transfer this waste to the dedicated Clinical Waste Room on a daily basis.

Non-risk waste receptacles for DMR and MNR will be strategically positioned in the treatment rooms, consulting rooms and offices as necessary.

Where suitable, it is proposed that office and work station areas will utilise area waste stations (AWSs) for non-risk waste streams as opposed to using individual receptacles at desks. AWSs should be conveniently located within 10-15m of workstations, where possible, and would typically include:

- 1 no. 60/80 litre receptacle for dry mixed recyclables;
- 1 no. 60/80 litre receptacle for mixed non-recyclables; and
- 1 no. 60/80 litre receptacle for confidential paper.

In addition, smaller bins or caddies for organic and glass waste should be located in the micro kitchen areas. In addition, smaller bins or caddies for organic and glass waste should be located in the micro kitchen areas. Containers for storage of waste electrical and electronic equipment (WEEE), waste batteries and light bulbs may also be provided in an internal non-risk waste storage area. Tenants will be required to identify suitable temporary storage areas for these waste items within their own units and dispose of them appropriately.

Facilities or cleaning staff will empty the internal waste bins on a regular basis and transfer the waste to the commercial WSAs on ground level.

5.5 Waste Collection

There are numerous private contractors that provide waste collection services in the Dublin City area. All waste contractors servicing the proposed development must hold a valid waste collection permit for the specific waste types collected. All waste collected must be transported to registered/permitted/licensed facilities only.

All waste requiring collection by the appointed waste contractor will be collected from the WSAs by facility management or the waste contractor (depending on the agreement) and taken from the WSAs directly to a temporary storage and collection area, to the south of the carpark entrance. A towing device will be used to relocate waste receptacles from the basement level to ground level. The WSAs and collection point can be viewed on drawings submitted with the planning application.

The facility management or waste contractor will ensure that empty bins are promptly returned to the WSAs after collection/emptying.

It is recommended that bin collection times/days are staggered to reduce the number of bins required to be emptied at once and the time the waste vehicle is onsite. This will be determined during the process of appointment of a waste contractor.

5.6 Additional Waste Materials

In addition to the typical waste materials that are generated on a daily basis, there will be some additional waste types generated from time to time that will need to be managed separately. A non-exhaustive list is presented below.

In addition to the typical waste materials that are generated on a daily basis, there will be some additional waste types generated from time to time that will need to be managed separately. A non-exhaustive list is presented below.

Green waste

Green waste may be generated from external landscaping and internal plants/flowers. Green waste generated from landscaping of external areas will be removed by external landscape contractors. Green waste generated from gardens internal plants/flowers can be placed in the organic waste bins.

Batteries

A take-back service for waste batteries and accumulators (e.g. rechargeable batteries) is in place in order to comply with the Waste Management Batteries and Accumulators Regulations 2014 as amended. In accordance with these regulations consumers are able to bring their waste batteries to their local civic amenity centre or can return them free of charge to retailers which supply the equivalent type of battery, regardless of whether or not the batteries were purchased at the retail outlet and regardless of whether or not the person depositing the waste battery purchases any product or products from the retail outlet.

The commercial tenants cannot use the civic amenity centre. They must segregate their waste batteries and either avail of the take-back service provided by retailers or arrange for recycling/recovery of their waste batteries by a suiltably permited/licenced contractor. Facilties management may arrange collection depending on the agreement.

Waste Electrical and Electronic Equipment (WEEE)

The *WEEE Directive 2002/96/EC* and associated Waste Management (WEEE) Regulations have been enacted to ensure a high level of recycling of electronic and electrical equipment. In accordance with the regulations, consumers can bring their waste electrical and electronic equipment to their local recycling centre. In addition consumers can bring back WEEE within 15 days to retailers when they purchase new equipment on a like for like basis. Retailers are also obliged to collect WEEE within 15 days of delivery of a new item, provided the item is disconnected from all mains, does not pose a health and safety risk and is readily available for collection.

As noted above, the commercial tenants cannot use the civic amenity centre. They must segregate their WEEE and either avail of the take-back/collection service provided by retailers or arrange for recycling/recovery of their WEEE by a suiltably permited/licenced contractor. Facilties management may arrange collection depending on the agreement.

Printer Cartridge/Toners

It is recommended that a printer cartridge/toner bin is provided in the commercial units, where appropriate. The commercial tenants tenants will be required to store this waste within their unit and arrange for return to retailers or collection by an authorised waste contractor, as required.

Waste printer cartridge/toners generated by residents can usually be returned to the supplier free of charge or can be brought to a civic amenity centre.

Chemicals (solvents, paints, adhesives, resins, detergents etc)
Chemicals (such as solvents, paints etc) are largely generated from building maintenance works. Such works are usually completed by external contractors who are responsible for the off-site removal and appropriate recovery/recycling/disposal of any waste materials generated.
Any waste cleaning products or waste packaging from cleaning products generated in the commercial units that is classed as hazardous (if they arise) will be appropriately stored within the tenants own space. Facilties management may arrange collection depending on the agreement.

Any waste cleaning products or waste packaging from cleaning products that are classed as hazardous (if they arise) generated by the residents should be brought to a civic amenity centre.

Light Bulbs (Fluorescent Tubes, Long Life, LED and Lilament bulbs)
Waste light bulbs may be generated by lighting at the commercial tenants. It is anticipated that commercial tenants will be responsible for the off-site removal and appropriate recovery/disposal of these wastes. Facilties management may arrange collection depending on the agreement.

Light bulbs generated by residents should be taken to the nearest civic amenity centre for appropriate storage and recovery/disposal.

Textiles
Where possible, waste textiles should be recycled or donated to a charity organisation for reuse.

Waste Cooking Oil
If the commercial tenants use cooking oil, waste cooking oil will need to be stored within the unit on a bunded area or spill pallet and regular collections by a dedicated waste contractor will need to be organised as required. It is envisaged that canteen/restaurant units in the tower block offices and some retail units will generate waste cooking oil.

If the residents generate waste cooking oil, this can be brought to a civic amenity centre.

Furniture (and other bulky wastes)
Furniture and other bulky waste items (such as carpet etc.) may occasionally be generated by the commercial tenants. The collection of bulky waste will be arranged as required by the tenant. If residents wish to dispose of furniture, this can be brought a civic amenity centre.

Abandoned Bicycles
Bicycle parking areas are planned for the development. As happens in other developments, residents and tenants sometimes abandon faulty or unused bicycles and it can be difficult to determine their ownership. Abandoned bicycles should be donated to charity if they arise

5.7 Waste Storage Area Design

The WSAs should be designed and fitted-out to meet the requirements of relevant design standards, including:

- Be fitted with a non-slip floor surface;
- Provide ventilation to reduce the potential for generation of odours with a recommended 6-10 air changes per hour for a mechanical system for internal WSAs;

- Provide suitable lighting – a minimum Lux rating of 220 is recommended;
- Be easily accessible for people with limited mobility;
- Be restricted to access by nominated personnel only;
- Be supplied with hot or cold water for disinfection and washing of bins;
- Be fitted with suitable power supply for power washers;
- Have a sloped floor to a central foul drain for bins washing run-off;
- Have appropriate signage placed above and on bins indicating correct use;
- Have access for potential control of vermin, if required; and
- Be fitted with CCTV for monitoring.

The facilities company will be required to maintain the waste storage areas in good condition as required by the DCC Waste Bye-Laws.

6.0 CONCLUSIONS

In summary, this OWMP presents a waste strategy that addresses all legal requirements, waste policies and best practice guidelines and demonstrates that the required storage areas have been incorporated into the design of the development.

Implementation of this OWMP will ensure a high level of recycling, reuse and recovery at the development. All recyclable materials will be segregated at source to reduce waste contractor costs and ensure maximum diversion of materials from landfill, thus achieving the targets set out in the *EMR Waste Management Plan 2015 – 2021*.

Adherence to this plan will also ensure that waste management at the development is carried out in accordance with the requirements of the *DCC Waste Bye-Laws and Draft DCC Waste Bye-Laws.*

The waste strategy presented in this document will provide sufficient storage capacity for the estimated quantity of segregated waste. The designated area for waste storage will provide sufficient room for the required receptacles in accordance with the details of this strategy.

7.0 REFERENCES

1. Waste Management Act 1996 (S.I. No. 10 of 1996) as amended 2001 (S.I. No. 36 of 2001), 2003 (S.I. No. 27 of 2003) and 2011 (S.I. No. 20 of 2011). Sub-ordinate and associated legislation include:
    - European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011) as amended
    - Waste Management (Collection Permit) Regulations 2007 (S.I. No. 820 of 2007) as amended
    - Waste Management (Facility Permit and Registration) Regulations 2007 (S.I No. 821 of 2007) as amended
    - Waste Management (Licensing) Regulations 2000 (S.I No. 185 of 2000) as amended
    - European Union (Packaging) Regulations 2014 (S.I. No. 282 of 2014)
    - Waste Management (Planning) Regulations 1997 (S.I. No. 137 of 1997)
    - Waste Management (Landfill Levy) Regulations 2015 (S.I. No. 189 of 2015)
    - European Communities (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014)
    - Waste Management (Batteries and Accumulators) Regulations 2014 (S.I. No. 283 of 2014) as amended
    - Waste Management (Food Waste) Regulations 2009 (S.I. No. 508 of 2009) as amended 2015 (S.I. No. 190 of 2015)
    - European Union (Household Food Waste and Bio-waste) Regulations 2015 (S.I. No. 191 of 2015)
    - Waste Management (Hazardous Waste) Regulations 1998 (S.I. No. 163 of 1998) as amended 2000 (S.I. No. 73 of 2000)
    - Waste Management (Shipments of Waste) Regulations 2007 (S.I. No. 419 of 2007) as amended
    - *European Communities (Transfrontier Shipment of Waste) Regulations 1994 (SI 121 of 1994)*
    - European Union (Properties of Waste which Render it Hazardous) Regulations 2015 (S.I. No. 233 of 2015)
2. Environmental Protection Act 1992 (Act No. 7 of 1992) as amended;
3. Litter Pollution Act 1997 (Act No. 12 of 1997) as amended;
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15. DCC*, Dublin City Development Plan 2016 – 2022* (2016)
16. Planning and Development Act 2000 (S.I. No. 30 of 2000) as amended 2010 (S.I. No. 30 of 2010) and 2015 (S.I. No. 310 of 2015).

17. European Waste Catalogue - Council Decision 94/3/EC (as per Council Directive 75/442/EC).
18. Hazardous Waste List - Council Decision 94/904/EC (as per Council Directive 91/689/EEC).
19. EPA, *European Waste Catalogue and Hazardous Waste List* (2002)
20. EPA, *Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous* (2015)
21. BS 5906:2005 Waste Management in Buildings – Code of Practice.
22. DoEHLG, Sustainable Urban Housing: Design Standards for New Apartments, Guidelines for Planning Authorities (2018).