Volume III - Appendices to Environmental Impact Assessment Report

Proposed Residential Development

Lands West of Old Belgard Road and North, South & West of Cookstown Road, Cookstown Industrial Estate, Tallaght, Dublin 24

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APPENDIX 4.1 Appendix 4 (Social Infrastructure Audit) to the Tallaght Town Centre Local Area Plan 2020

Comhairle Contae
Átha Cliath Theas
South Dublin County Council

Tallaght Town Centre
Local Area Plan 2020

Appendix 4
Social Infrastructure
Audit

Appendix 4

Appendix 4: Social Infrastructure Audit

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A4.1 Introduction

A4.1.1 Purpose

The following Social Infrastructure Audit (SIA) was prepared by South Dublin County Council (SDCC) for the purposes of informing the preparation of the Tallaght Town Centre Local Area Plan 2020–2026 (LAP).

The function of the SIA is to examine and analyse the availability and capacity of existing social infrastructure facilities in Tallaght, and to determine future requirements, and make recommendations based on anticipated settlement growth. This report is a statement of the outcome of the SIA.

Social Infrastructure relates to the provision of services and facilities which are essential for health, wellbeing and social development of a town/place. Social infrastructure facilities include for example, education, health services such as schools, surgeries and community specific services, as well as areas which can offer active sports and passive recreational activities. In addition to the actual activity and function, 'social infrastructure' facilities can provide an invisible platform of community and social interaction which some residents may rely upon for personal well-being. The provision of the requisite levels of social infrastructure within Tallaght is therefore important and vital to support the existing and planned residential base in both physical facilities and for social engagement.

The extent of the study area is shown in Figure 1. Figure 1 illustrates the SDCC County Development Plan 2016–2022 (CDP) Core Strategy Boundary for 'Tallaght'. The study area is defined by the LAP boundary located in the middle and identifies each individual neighbourhood.

A4.1.2 Policy Context

The assessment of 'social infrastructure' has been considered in the context of the spatial development objectives for Tallaght Town Centre set out in statutory policy documents at national, regional and local level.

The National Planning Framework (NPF) is the Government's high-level strategic plan for shaping the future growth and development of our country out to the year 2040. It recognises the importance of quality of life and notes that how future development in Ireland is planned will continue to be a significant determinant of people's quality of life. National Policy Objective 33 seeks to "prioritise the provision of new homes at locations that can support sustainable development and at an appropriate scale of provision relative to location".

The 'Regional and Economic Spatial Strategy' (RSES) prepared for the Eastern & Midland Region promotes and supports the strategic function of Tallaght as one of several highly urbanised settlements within the Dublin Metropolitan Area (DMA) with strong connectivity and synergy with Dublin City. The strategy recognises that Tallaght, through its identification within a 'Strategic Development Corridor', will play a contributory role in supporting future residential and employment services for the DMA.

In addition, the Metropolitan Area Strategy (MASP) set out in the RSES supports ongoing collaboration with regional stakeholders to ensure that social infrastructure such as education, health and community facilities are provided in tandem with the development of strategic development areas, and in particular to ensure that opportunities for social as well as physical regeneration are realised. There are a number of regional policy objectives (RPO's) within the RSES which support the provision of and access to social infrastructure, including RPO 9.13, which ensure that new social infrastructure developments are accessible and inclusive for a range of users, and RPO 9.19, which states that the Eastern and Midland Regional Assembly (EMRA) shall work collaboratively with stakeholders including the wide range of service providers through the Local Economic and Community Plans (LECP) to effectively plan for social infrastructure needs.

The importance of Tallaght at a County level is emphasised in the SDCC CDP, where Tallaght is designated as a 'Metropolitan Consolidation Town' whose function is to play a key role in creating a strong active urban place with strong transport links supporting a long term growth, which could see Tallaght expanding to a population of up to 100,000 people in a planned and phased manner. This assessment is guided by demographic projections adopted by SDCC, which anticipates housing unit growth of 3,715[1] as per the CDP. However, in the longer term, over a period of up to 20 years, it is envisaged to deliver between 8,410 to 11,090 new homes, achieving a population of up to 34,000 people within the LAP lands.

A4.1.3 Methodology

The SIA was conducted using desktop research, as well as incorporating data previously logged and mapped by SDCC. The SIA assessment comprises 3 parts: Assessment of the Existing Situation and Infrastructure Provision; Future Demand Analysis; and Social Infrastructure Recommendations.

1. *Existing Infrastructure Provision*
   The 'baseline' assessment was derived from; desk-top examination of available information and use of digital mapping techniques to identify spatial relationships between community infrastructure and population catchment. This assessment included the identification and catalogue of existing community infrastructure features (including where relevant, their capacity) under a number of predefined themes including: Education/Training, Childcare, Health, Sports/Recreation and Open Space, Social/Community Services, Arts & Culture, Faith, and other features.
2. *Future Demands Analysis*
   Consideration of existing infrastructure provision relative to the existing and planned population and best practice provision.
3. *Recommendations*
   Recommendations for future social infrastructure provision which can be taken into consideration by SDCC in the preparation of the LAP, and, in the assessment of other social and community programmes.

The strategy recognises that Tallaght, through its identification within a 'Strategic Development Corridor', will play a contributory role in supporting future residential and employment services for the DMA.

1 South Dublin County Council County Development Plan 2016–2020, Section 1 'Introduction and Core Strategy' – Table 1.8 Tallaght Available Regen Housing Capacity (2,271) plus Table 1.9 Tallaght New Regen Housing Capacity (1,444) = 3,715 (Tallaght Regen Housing Capacity up 2022) minus 5412 = 1697 (Remaining 'infill' for Tallaght Area up to 2022)

St Marys School

Figure A4.1: Study Area in relation to SDCC County Development Plan 2016-2022 (CDP) Core Strategy Boundary for 'Tallaght'.

A4.2 Existing Social Infrastructure Provision

The SIA assessed the existing social infrastructure within the Tallaght LAP lands and analysed the future demand for additional social infrastructure under the following headings:

- **A.** Education/Training
- **B.** Childcare
- **C.** Health
- **D.** Sports/Recreation and Open Space
- **E.** Social/Community Services
- **F.** Arts & Culture
- **G.** Faith, and
- **H.** Other features

A. Education/Training

Existing:

Schools

Name and address	Enrolled
1 no. primary school – St. Mary's National School, Greenhills Road, Tallaght, D24.	Boys: 167 Girls: 170
1 no. post-primary school – Old Bawn Community School, Old Bawn, Tallaght, D24.	Boys: 455 Girls: 457
1 no. third level institution – Technological University Dublin/ Tallaght Campus (TUD/TC), Blessington Rd, Tallaght, D24.	Student population: approx. 4,000
1 no. further education and training institution – Solas, DDLETB Tallaght Training Centre, Cookstown Rd, Tallaght, D24.	

It must also be noted that the following primary schools **lie immediately adjacent** to the boundary of the LAP lands:

Name and address	Enrolled	Location relative to LAP boundary
Sacred Heart Senior National School, Killinarden Tallaght D24.	Boys: 127 Girls: 148	South-west
Scoil Aenghusa Junior National School, Castle Park, Tymon North, D24.	Boys: 115 Girls: 117	East
Scoil Aonghusa Senior National School, Castle Park, Tymon North, D24.	Boys: 97 Girls: 121	East
St Roses Special School, Castle Park, Tymon North, D24.	Boys: 39 Girls: 24	East
St. Dominics National School, Mountain Park, Tallaght, D24.	Boys: 188 Girls: 175	South-east

The DoES is monitoring the demand for and provision of schools in the LAP area on an ongoing basis and SDCC will continue to consult and liaise with the DoES in this regard.

Furthermore, there are 14 additional primary schools and 3 additional post-primary schools that are within walking distance from various locations within the LAP lands. According to the Department of Education and Skills (DoES), the majority of these schools are not running at full capacity.

Training Facilities

Name and address
Tallaght Academy of Languages – TAL, 2a, Riverside Business Park, Whitestown Rd, Whitestown Industrial Estate, D24.
Tallaght Youthreach, Whitestown Road, Whitestown Industrial Estate, D24.
Priory Youthreach, Greenhills Rd, Tallaght, D24.

Demand Analysis:
The provision of primary and secondary school facilities in Ireland is determined on an area specific basis by the DoES, having regard to available school capacity, demographic projections, an analysis of child benefit records, and local GIS travel pattern modelling.

SDCC, in conjunction with the DoES and in accordance with Policy C9 (a) and Policy C9 (b) of the CDP, have identified a brownfield site within the LAP lands (between Fourth Avenue and Belgard Square North) for the future provision of 1 no. new post-primary school. Potential primary school sites are currently being investigated and will be agreed between SDCC and the DoES to meet the demands of a growing population.

The DoES is monitoring the demand for and provision of schools in the LAP area on an ongoing basis and SDCC will continue to consult and liaise with the DoES in this regard.

B. Childcare

Existing:

Creches

Name and address	Capacity
Startright Greenhills (Dublin West St. Mary's Creche), Greenhills Road, Tallaght, D24.	80
Nurture Childcare AMNCH, Tallaght Hospital, D24.	46
Oakview, TU Campus, Greenhills Road, Tallaght, D24.	60
Oakview Village Tallaght, County Hall, Belgard Square North, Tallaght, D24.	53
Once Upon a Time, Arena, Kiltipper Rd, Whitestown, Tallaght, D24.	72
Little Fairies Creche and Montessori, Belgard Square North, Cookstown, D24.	105 altogether – 3 babies, 10 wobblers, 12 toddlers, 42 ECCE morning, 22 ECCE afternoon, 16 full-time afternoons
Little Ladybird Creche, Montessori & Preschool, 1 Main Rd, Tallaght, D24.	40
Laugh and Learn, Block H, Gleann na hEorna, Cookstown Way, Tallaght, D24.	22

Demand Analysis:
The minimum figure for child places is derived from ensuring a space for the anticipated children in the 3-4 age range within the population of the LAP. It is considered that a proportion of children will not use childcare, will access childcare outside the site (adjacent to workplace etc) or will be minded in the home environment by family members.

C. Health

Existing:

Description	Name and address
1 no. Hospital	1. Tallaght University Hospital
2 no. GP Surgeries	1. Birchview Surgery, Kilnamanagh/Tymon Primary Care Centre Airton, Greenhills Rd, Tallaght, D24. (3 no. GPs practising) 2. APCC Talacare, Russell Centre, Tallaght Cross West, Tallaght, D24. (5 no. GPs practising)
1 no. Adult Mental Health Clinic	1. Tallaght Adult Mental Health Services, Sheaf House, Exchange Hall, Belgard Square North, Cookstown, D24.
1 no. Child and Adolescent Mental Health Clinic	1. Lucena Clinic, Exchange Hall, Belgard Square, North Tallaght, D24.
1 no. Primary Care Centre (includes GP practice, 1 no. pharmacy, 1 no. out-of-hours GP service, and other HSE services (i.e. Health Centre)	1. APCC Talacare, Russell Centre, Tallaght Cross West, Tallaght, D24.
8 no. Pharmacies	1. Hickeys Pharmacy, The Square Shopping Centre, Oldbawn, Tallaght, D24. 2. Health Express, 120 & 121, The Square Shopping Centre, Tallaght, D24. 3. Boots, 319, The Square, Oldbawn, Tallaght, D24. 4. Superdrug, Unit 106, The Square Shopping Centre, Tallaght, D24. 5. McCabes Pharmacy, Lidl Complex, Main St, Tallaght, D24. 6. Lloyds Pharmacy, Main St, Tallaght, D24. 7. Tesco, The Square, Tallaght, D.24. 8. Tallaght Cross Pharmacy, APCC Talacare, Russell Centre, Tallaght Cross West, Tallaght, D24.
3 no. Dental Surgeries	1. Smiles Dental, Unit 3B, Belgard Square W, Tallaght, D24. 2. Priory Dentists, 5 Main St, Tallaght, D24. 3. The Square Dental Practice, 3rd Level, Medical Centre, The Square Shopping Centre, Tallaght, D24.
3 no. Opticians	1. Specsavers, Unit 15, Level 3 The Square, Tallaght, D24. 2. Vision Express, 204 The Square, Tallaght, D24. 3. Dixon Hempenstall Opticians & Hearing Aid Centre, 17 The Square, D24.
Other	1. Affidea Ireland (minor injuries & illnesses walk-in clinics), Unit D1 Tallaght Cross East, D24. 2. Saint John of God Liffey Services, Unit 15, Block A Gleann na hEorna, Cookstown Way, Whitestown, Springfield, Tallaght, D24.

It must also be noted that:

- there are **no nursing homes** within the LAP lands;
- the GP surgery *Tallaght Medical Practice, 1 Alderwood Park, Springfield, D24 (4 no. GPs practising)* **lies immediately adjacent** to the western boundary of the LAP lands; and
- the pharmacy *ODC Chemists, 6 Kilnamanagh Shopping Centre, Mayberry Rd, Kilnamanagh, D24* **lies immediately adjacent** to the northern boundary of the LAP lands.

Demand Analysis:
There are no national standards for health provision in Ireland relating to the provision of primary care facilities, residential care facilities or the number GPs practising per head of population.

The Health Service Executive (HSE) estimates that a typical primary care centre can serve a population of between 10,000–20,000 people. With regard to GPs, in 2016 there were 8,514 actively practising GPs registered in Ireland[2]. At the time Ireland had a population of 4,761,865[3]. This amounts to a GP to population ratio of 1.79 per 1,000 population. According to the data collected here, Tallaght town centre currently has a GP to population ratio of 1.93 per 1,000 population (this includes the GPs practising at Tallaght Medical Practice immediately adjacent to but outside of the LAP lands) and the requirement of GPs is met.

In light of the above, and in the event that the maximum level of projected population growth occurs in Tallaght town centre, in the long-term a second primary care centre may be required in Tallaght. Furthermore and, at the very least, to maintain the 2016 average national ratio of 1.79 GPs per 1,000 population, it is envisaged that in such a scenario Tallaght town centre would require approx. 50 additional GPs to those currently practising in the area (in 2040), which could amount to a further 13 no. GP surgeries, given that the local average number of GPs per surgery in the area is 4.

In addition, Ireland has an ageing population. By 2036, the most conservative estimate is that Ireland is likely to have a national population of 5.33million[4]. The HSE states that by the same year over 1.13 million Irish people will be aged 65+ and that 45,000 of those people will require long stay residential care beds[5].

Based on the above figures, it is projected that if Tallaght Town Centre reaches a population of c.34,000 by 2040 then approx. 7,208 of the resident population will be aged 65+. A total of 1,417 of those people could require long-term residential care beds, such as those provided by nursing homes or alternatives such as community nursing unit facilities (which include residential care places in various settings (e.g. sheltered housing, home care and use of telecare). In addition, the HSE predicts that by 2036, 8.5 rehabilitation/assessment/respite beds per 1,000 65+ population will be required[6], which would amount to approx. 61 short term residential care beds being required by residents of Tallaght town centre. While these projections exceed the timescale of the current Tallaght LAP, the long-term provision of residential care and/or community nursing in Tallaght will undoubtedly need to be addressed as the population of the town grows.

Provision of health facilities and GP surgeries are a matter for the HSE, however the LAP endeavours to facilitate the provision of such facilities in development proposals in consultation with the HSE in tandem with growing population.

The Health Service Executive (HSE) estimates that a typical primary care centre can serve a population of between 10,000–20,000 people.

2 Source: https://ec.europa.eu/eurostat/statistics-explained/pdfscache/37382.pdf
3 Source: https://www.cso.ie/en/media/csoie/newsevents/documents/pressreleases/2017/prCensussummarypart1.pdf
4 Source: https://www.cso.ie/en/csolatestnews/pressreleases/2019pressreleases/pressstatementregionalpopulationprojections2017-2036/
5 Source: https://health.gov.ie/wp-content/uploads/2015/12/2015-07-30-DoH-Nursing-Homes-Study-Final-Report.pdf
6 Source: ibid.

Bancroft Park

D. Sports/Recreation and Open Space

Existing:

An improved network of streets and permeable neighbourhoods is envisaged within the plan area with a particular emphasis on regeneration and population growth within the neighbourhoods of Cookstown, Town Centre and Broomhill.

Sports

Description	Name and address
1 no. Soccer Stadium	1. Tallaght Stadium, Whitestown Way, Oldbawn, D24. Total area of playing pitch: 10,530 sqm/1.05Ha
2 no. Soccer Clubs	1. Shamrock Rovers Football Club, Tallaght Stadium, Whitestown Way, Oldbawn, D24. 2. St. Maelruans Football Club (ADDRESS IS OUTSIDE LAP BOUNDARY – 609 VIRGINIA HEIGHTS, COOKSTOWN – BUT THE PITCHES THEY PLAY ON ARE IN SEAN WALSH PARK (Total area of pitches= approx. 5971 sqm/0.59Ha AND BANCROFT PARK (Total area of pitches = approx. 8983sqm/0.9Ha)
11 no. All-weather Pitches	1. Astro Park Tallaght, Greenhills Rd, Tallaght, D24. (fee-paying) Total area: approx. 8,248 sqm/0.82Ha
2 no. Playgrounds	1. Oopsadaisy's Playground, The Square Shopping Centre, Tallaght, D24. Total area: approx. 205.92 sqm/0.02Ha 2. Watergate Playground, Sean Walsh Park, Oldbawn, Tallaght, D24. Total area: approx. 1,590 sqm/0.16Ha
1 no. 400m Outdoor Athletics Track	1. Tallaght Athletics Club, Bancroft Park, Greenhills Rd, Tallaght, D24.
2 no. Gymnastics Clubs	1. Excellence Sports Academy Gymnastics Club, Unit 65, Fourth Avenue, Cookstown Industrial Estate, Belgard Road, D24. 2. Phoenix Gymnastics Club, Unit 1, Broomhill Terrace, D24.
1 no. Dance Academy	1. South Dublin Dance Academy, Tallaght Enterprise Centre, Main Rd, Tallaght, D24.
2 no. Swimming Pools but NO PUBLICLY-OWNED SWIMMING POOLS	1. Westpark Fitness Gym, Greenhills Road, Tallaght, D24. 2. Club Vitae Health and Fitness Club, Maldron Hotel, Whitestown Way, Tallaght, D24.

It must also be noted that there are **no GAA Clubs** within the LAP lands. However, *Croi Ro Naofa GAA Club, Killinarden Park, Killinarden, Tallaght, D24* **lies immediately adjacent** to the south-western boundary of the LAP lands.

Existing:

Open Space

Description/Location	Total Area (Hectares)
2 no. Neighbourhood Parks	1. Sean Walsh Park. Total area: approx. 300,000sqm/30Ha 2. Bancroft Park (majority but not entirety of Bancroft Park included in LAP lands). Total area in LAP lands: approx. 135,326 sqm/13.5Ha
Rest of LAP Lands	Urban Squares, spaces and Pocket Parks. Total approx: 10.6ha

Demand Analysis:
In policy terms, standards relating to quality, quantity and accessibility of open space is a matter for local determination. Fields in Trust[7] (FIT) are a UK organisation who establish general benchmarks for the provision of open space. While these are formed on the basis of survey returns in England, they are often used as a starting point in which to examine local standards. They establish a standard of 1.6 hectares (4 acres) per 1,000 people for all outdoor space in urban areas and 0.8 hectares (2 acres) for children's play. Within this, it is acknowledged that the term 'urban area' is very broad and not readily transferrable to all areas.

A total of 43.5[8] hectares within the LAP boundary make up the main parkland and green infrastructure spaces within the LAP area, which equates to a per 1000 standard of c.4 hectares. The extent of open space areas provided in Seán Walsh Park and Bancroft Park, however, serve not only the existing population of the LAP lands, but the wider residential population of Tallaght.

It is considered, however, that the achievement of the FIT standard could be difficult within a very urban metropolitan environment[9] such as the LAP lands. Where constraints inhibit the delivery of quantity standards, the overall quality and accessibility of open space and facilities should be very high. The Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas (2009) outline, that where appropriate, local plans should have regard to a wider network of spaces which may serve a development area. This allows for a more flexible approach to open space provision, including the location of playing pitches and larger recreation spaces in wider accessible areas.

The LAP can be divided into 8 distinct but interlinked neighbourhoods comprising of Cookstown, Broomhill, Greenhills, The Centre, Technological University Dublin/ Tallaght Campus (TUD/TC), the Village Centre, Sean Walsh Park area and Whitestown. An improved network of streets and permeable neighbourhoods is envisaged within the plan area with a particular emphasis on regeneration and population growth within the neighbourhoods of Cookstown, Town Centre and Broomhill.

Each of these three neighbourhoods are identified as having the capability of delivering the majority of the long term population growth for the LAP up to 2040 and while the large parkland areas at Bancroft and Sean Walsh park are capable of serving part of the open space requirements of this projected population, the plan will require new sports and recreation spaces, pocket parks and amenity green spaces to be provided. It is also required that any proposed future development complies with a requirement to provide at least 10% of a site area as public open space.

In this regard, the SIA has identified that there is a requirement for new Sports, Recreation and Open space facilities to be provided in order to meet the future population need. Applying a holistic approach to future provision and taking into consideration the close proximity of each of these neighbourhoods, the plan recognises that there will be some neighbourhood crossover in regard to the provision of particular playing pitches and outdoor sports areas, however the overall quantum of space delivered should be capable of meeting the overall envisaged demand for such facilities, which will be provided in tandem with population growth. In this regard, the recommendations of the World Health Organisation (WHO) that a minimum of 9sqm[10] of green open space be provided per person should be applied.

7 Formerly the National Playing Field's Association.
8 Note this figure excludes existing urban squares and relates to the parklands and green infrastructure only.
9 The Greater London Authority deem that this general standard is not applicable in very urban metropolitan areas.
10 World Health Organization (WHO) 2009. Urban planning and Human health in the European City, Report to the World Health Organisation, International Society of City and Regional Planners (ISOCARP)

E. Social/Community Services

Existing:

Description	Name and address
6 no. Youth Services	1. Belgard Youth and Community Centre, Old Belgard Rd, Tallaght, D24. 2. Tallaght Youth Service, Main Rd, Tallaght, D24. 3. Tallaght Youth Theatre (BASED AT CIVIC THEATRE) 4. 24th Tallaght Dublin Scout Group Hall, Old Blessington Rd, Tallaght, D24. 5. Foróige Office Tallaght, Tallaght Youth Service, Main Road, Tallaght, D24. 6. Foróige The Biq Picture Youth Service, Belgard Square East, Tallaght, D24.
8 no. Community Services	1. County Library, Library Square, Tallaght, D24. 2. Citizens Information Centre, Hainault House, The Square, Tallaght, D24. 3. Tallaght MABS, Hainault House, The Square, Tallaght, D24. 4. The Priory, Main Street, Tallaght, D24. 5. St. Maelruan's Church Hall, Tallaght, D24. 6. Cheeverstown Hub, Unit 6, Block 2, High Street, Tallaght, D24. 7. Tallaght Drug and Alcohol Local Task Force, South Dublin County Partnership Block 3, County Hall, Belgard Square North, Tallaght, D24. 8. Beechpark Service, Bryan S. Ryan Building, Main Road, Tallaght, D24.
2 no. Services for Older People	1. Trustus, Whitestown Way, Tallaght, D24. 2. Trustus, Main Street, Tallaght, D24.
8 no. Education/training and Employment Services	1. EVE New Horizon, 44 Broomhill Cl, Airton Rd, Tallaght, D24. 2. National Learning Network Centre, Unit 77, Broomhill Rd, Tymon North, D24. 3. South Dublin Local Enterprise Office, South Dublin County Council, County Hall, Tallaght, D24. 4. Partas, 24 Main Rd, Tallaght, D24. 5. Tallaght Centre For the Unemployed, St Dominic's Hall, Main St., Tallaght, D24. 6. Threshold Training Network, Tallaght Enterprise Centre, Unit 17-19, Main Rd, Tallaght, D24. 7. DSP Training Centre, Cookstown Industrial Estate, Tallaght, D24. 8. Tallaght Adult Education Services, The Enterprise Centre (rear of Bryan S. Ryan), 24 Main Road, Tallaght, D24.
Other	1. Tallaght District Court, 2 Westpark, Tallaght, D24. 2. Tallaght Garda Station, Belgard Road East, Tallaght, D24.

It must also be noted that:

- the I*ntercultural Drop-In Centre, R113, Tallaght, D24* **lies immediately adjacent** to the south-eastern boundary of the LAP lands; and
- SDCC have approved a Part 8 application to develop an older person's residential development comprising of a total of 81 no. units at Sean Walsh Park, Whitestown Way, Tallaght, D24 (planning application reference number: SD188/0008).

Demand Analysis:

There are no national standards for the provision of social or community services. However, good neighbourhood planning can be achieved by following the recommendation of 0.3 community facilities per 1,000 population[11]. It must be borne in mind, though, that this guiding standard is quite crude as it does not distinguish between the various kinds of facilities, measuring only their quantity. Nevertheless, applying this benchmark indicates that Tallaght currently has a ratio of 4.18 facilities per 1,000 population. This suggests that

11 See: Barton et al. (2010). Shaping Neighbourhoods: For Local Health and Global Sustainability 2nd Edition. London: Routledge.

St Marks Community Centre

Tallaght is currently very well served with community services and facilities and that no additional community or social services will be required to facilitate a population of 34,000. However, without doubt the populations of the surrounding residential suburban areas make use of many of these facilities also and, even if the quantity of services does not increase, the capacity and, potentially, the variety of them may have to, regardless of the benchmark guide quoted above.

F. Arts & Culture

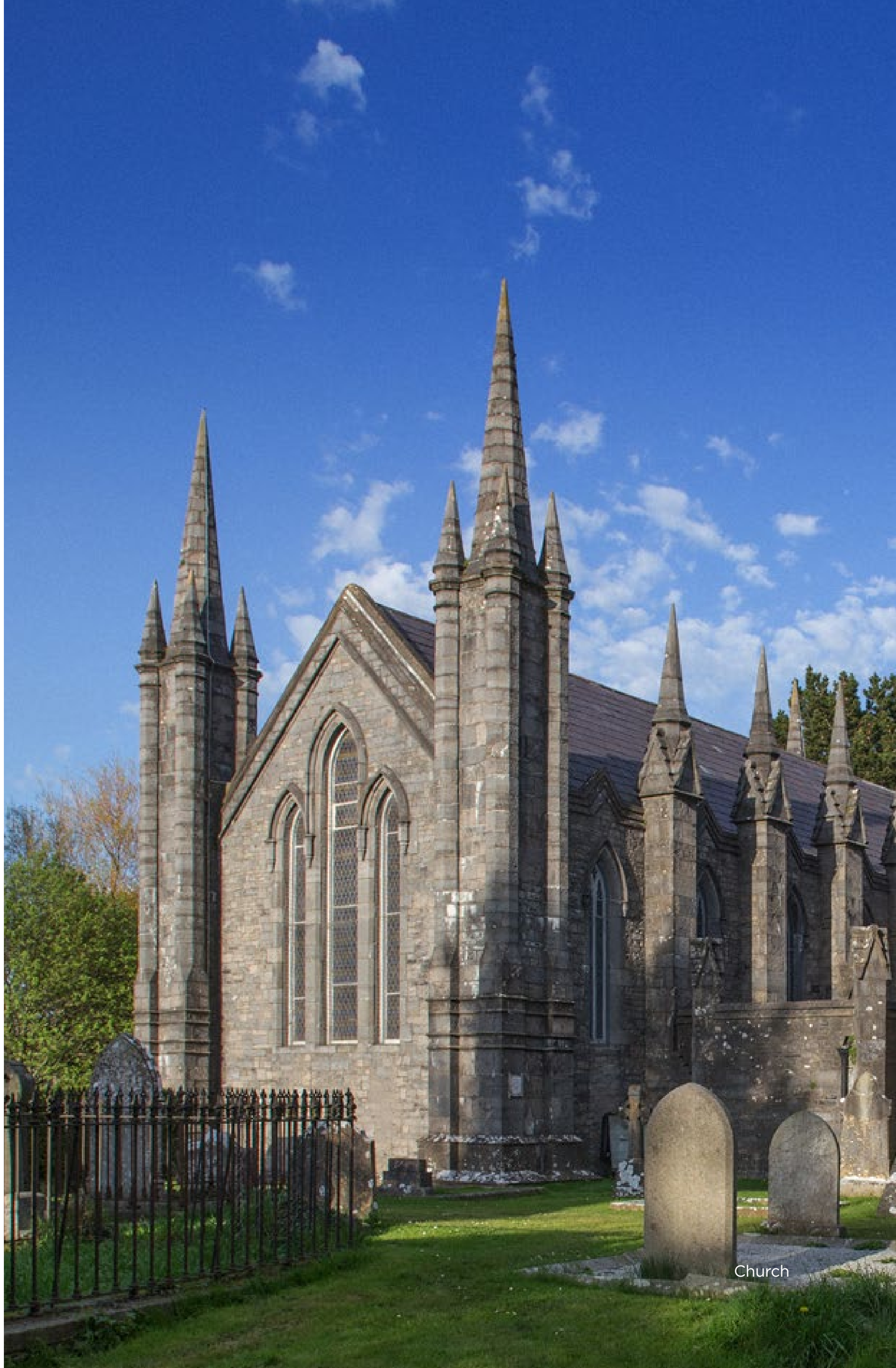
Existing:

Description	Name and address
3 no. Civic Arts and Culture Facilities	1. Civic Theatre, Belgard Square East, Tallaght, D24. 2. Rua Red, South Dublin Arts Centre, Blessington Rd, Tallaght, D24. 3. IMC Tallaght Movie Theatre, The Square Shopping Centre, Oldbawn, D24.
1 no. Music Facility	1. Music Generation South Dublin, c/o South Dublin County Library, Unit 1, The Square Industrial Complex, Tallaght, D24.

It must also be noted that *In Tune Music Academy, The Stonehouse Building, Old Blessington Rd, Whitestown, D24* **lies immediately adjacent** to the western boundary of the LAP lands.

Demand Analysis:

The provision of arts and cultural facilities and services typically relates to the spend per capita in the given area. As there is no record of such spending in the Tallaght area, it is not possible to project how many arts and cultural services would need to be provided for an increase in population of the area.



Church

The Square SC

G. Faith

Existing:

Description	Name and address
5 no. Centres of Worship (in locations zoned Objective TC and Objective VC)	1. 1 no. Roman Catholic church – St. Mary's Priory, Main St, Tallaght Village, D24. 2. 1 no. Church of Ireland church - Saint Maelruain's Church of Ireland, 24 Main St, Tallaght, D24. 3. Oratory of the Holy Family, The Square, Tallaght, D24. 4. Lifegate Bible Baptist Church, 3 Main St, Tallaght, D24. 5. Polski KoĐciół ZielonoĐwiĐtkowy w Dublinie (Polish Pentecostal Church in Dublin), Glashaus Hotel, Belgard Square W, Tallaght, D24.
4 no. Centres of Worship (in locations zoned Objective EE and Objective REGEN)	1. Christ Apostelic Church, Unit 15B Cookstown Business Centre, Belgard Road Tallaght, D24. 2. Word Of Life Church Ireland, Greenhills Business Pk 14a, D24. 3. The Evangelical Church of Reconciliation, A12 Cookstown Industrial Estate, D24. 4. The Redeemed Christian Church of God (RCCG) Joseph's Palace Dublin, 34 Airton Terrace, Airton Rd, Tallaght, D24.
1 no. Cemeteries	1. St. Maelruain's Church Cemetery, Old Blessington Road, Tallaght, D24.

Demand Analysis:
There are no known national or other benchmarking standards for providing this category of social infrastructure.

H. Other Facilities including Neighbourhood Centres

Existing:

Description	Name and address
2 no. Neighbourhood Centres	1. The Square Shopping Centre 2. Main Street and Old Bawn Road, Tallaght Village
1 no. Other	1. ALDI Convenience Store, Belgard Rd, Tallaght, D24 (zoned Objective REGEN).

It must also be noted that *Kilnamanagh Shopping Centre, Mayberry Road, Tallaght, D24* **lies immediately adjacent** to the northern boundary of the LAP lands.

Demand Analysis:
There are no national or other standards regarding the provision of neighbourhood centres.


Walkable Neighbourhood

A4.3 Recommendations

The Social Infrastructure Audit (SIA) has identified certain specific requirements for future provision of community infrastructure facilities for the LAP area. These requirements are based on current and anticipated population growth, with forecasts in the SDCC CDP Core Strategy of an additional 3,715-5,412 residential units by 2022, with long term projection of up to 8,410 to 11,090 units by 2040. This assessment will inform the future spatial development objectives for the LAP area and in this regard makes a number of recommendations[12]. Lead agents for the delivery of related actions have been identified where possible.

Fundamentally, when recommending social infrastructure, it is vital that there is equitable access for all members of the new and existing community. Conditions therefore include:

- that facilities and services are adaptable to changing demographic/social needs (flexibility in terms of scope and scale);
- there is sufficient capacity to meet needs;
- they are located within 10–15 min walk of the majority of homes;
- access is legible and perceived as safe;
- there are no physical barriers preventing access (busy roads, etc.);
- facilities/services are affordable;
- they can be accessed when required; and
- there are appropriate long-term governance arrangements in place (such as financial management structures) so that facilities and services are adequately maintained.

Given the overall size and nature of the LAP lands, it is considered reasonable that social infrastructure provision in high density areas are more relaxed and flexible, are multipurpose or co-location community hubs, where possible which are strategically located, and have good access to transport. Furthermore, it is noted that the neighbourhoods within the LAP area are located in close proximity to each other and the wider area to enable facilities serve a wider population than their immediate area. Planning for Walking (CIHT,

12 Recommendations are based on projections up to 2040 where a high range unit and population projection of 12,700 units 38,188ppl is envisaged.

Each of the neighbourhoods in the LAP plan area are within walking distance of an adjacent neighbourhood or lands located immediately outside the LAP boundary.

2015) provides the following guidance on walking distances "Most people will only walk if their destination is less than a mile away. Land use patterns most conducive to walking are thus mixed in use and resemble patchworks of "walkable neighbourhoods", with a typical catchment of around 800m, or a 10 minute walk" (CIHT, 2015, p.29).[13] Each of the neighbourhoods in the LAP plan area are within walking distance of an adjacent neighbourhood or lands located immediately outside the LAP boundary. Moreover, the LAP seeks to promote a permeable and connected urban structure that integrates movement, through the development of a framework of routes and spaces that promote place-making and movement by different modes of transport, while connecting Tallaght Town Centre with existing communities. Based on the above, it is a recommended that the development of social infrastructure facilities to meet identified requirements be pursued on this basis.

A. Education/Training

The requirement for possibly 2/3no. additional primary school and 1 no. post primary school has been identified. SDCC, in conjunction with the DoES and in accordance with Policy C9 (a) and Policy C9 (b) of the CDP, have identified a brownfield site within the LAP lands (between Fourth Avenue and Belgard Square North) for the future provision of 1 no. new post-primary school. Potential primary school sites are currently being investigated and will be agreed between SDCC and the DoES to meet the demands of a growing population.

A second new primary school may also be provided for within the LAP lands at a later date. The locational decisions for new school infrastructure, and future landuse zoning objectives, should seek to complement existing school provision by addressing the identified deficiency of existing primary school 'coverage' and school's should be provided in locations responsive to the school age dynamic (10 minute walktime) as well as areas identified for future urban/ neighbourhood expansion.

It is noted that educational investment should be viewed as a leading catalyst for positive renewal, rather than a service that follows demographic trends. The DoES is monitoring the demand for and provision of schools in the LAP area on an ongoing basis and SDCC will continue to consult and liaise with the DoES in this regard. With respect to education/training, the lead agent for delivery in this regard is both the Department of Education and Skills (DoEs) and South Dublin County Council (SDCC).

Technological University Dublin/ Tallaght Campus (TUD/TC) is an important education anchor located in the heart of Tallaght. In addition, there are a number of training centres with strong links to community education programmes. Applied learning from this successful model of joint institutional and community working should be integrated into the development of future education initiatives.

B. Childcare

The minimum figure for child places is derived from ensuring a space for the anticipated children in the 3-4 age range within the population of the LAP. All new residential developments and particularly those in excess of a 10-minute walk-time from existing childcare facilities with sufficient capacity to accommodate that development, will be required to comply with the minimum childcare standards and the provision of childcare facilities as part of specific developments. In addition, it is recommended that a policy is included in the LAP where future residential developments must justify how childcare provision have been met (i.e. existing capacity) in instances where childcare facilities are omitted from a scheme. With respect to childcare, the lead agent for delivery in this regard is developer led.

13 Chartered Institute of Highways & Transportation (2015) Planning for Walking, London: Chartered Institution of Highways & Transportation.


Tallaght IT

C. Health

Following a review of the current baseline data, it is considered that there are adequate health services and provisions in place for the lifetime of the LAP. However, based on the demand analysis and long term projected growth, up to 50 additional GP's may be required (up to 2040).
This may be in the form of an additional Primary Care Centre and larger surgeries. In addition, the long-term provision of residential care and/or community nursing in Tallaght will need to be addressed as the population of the town grows.

It is recommended that the Planning Authority should liaise with the HSE to ensure that the scope of services provided are adequate to meet identified local service gaps and that it is sufficiently resourced to cater for the future needs of the projected population in the area. The potential need for additional GP services to serve the LAP area should be kept under review, having regard to the roll out of the LAP. With respect to health, the lead agents for delivery will consist of developers, the Health Service Executive (HSE) and South Dublin County Council (SDCC).

D. Sports/Recreation and Open Space

The World Health Organisation (WHO) recommends that a minimum of 9sqm of green open space be provided per person should be applied. In line with this minimum recommendation the LAP area with a long-term projected population of 34,000 in 2040, would require a minimum of 306,000 (30.6ha) of green open space within the overall plan area. At present and within the LAP area, Sean Walsh Park and Bancroft Park provide for a total of 43.5ha of green open space. While these significant green open space areas fall within the LAP boundary, it would be disingenuous to assume that these existing facilities would cater for the projected new population alone, given these existing facilities serve a much wider population catchment within the Tallaght area. In this regard, it is considered reasonable to take into consideration that only 50% of the area of each of these parks would be included in the calculations for green open space within the LAP Area up to 2040.

In order to achieve the acceptable minimum provision of open space for the long term development of the LAP lands an open space strategy should be included in the LAP which sets out requirements for the delivery of a network of public spaces and a requirement for on site delivery of public open space in tandem with the development.

The delivery of open space areas should be carried out in a phased manner. The purpose of phasing is to ensure that infrastructure, facilities and amenities are provided together with new residential development. The phasing schedule should be based on the premise that the number of dwellings which may be permitted in each phase of development is dependent on the provision of a pre-determined amount of infrastructure, facilities and amenities to serve each phase. To ensure flexibility, the delivery of open space should be linked to the provision of housing in that neighbourhood or local area. In addition and in accordance with the provisions of Section 49 of the Planning and Development Act 2000 (as amended), it is recommended that a Supplementary Development Contribution Scheme be investigated for the Plan area to provide for the delivery of strategic open space, which could support the delivery of the required social infrastructure as identified in this SIA, where developments cannot provide the same.

Furthermore, it is recommended that a provision be made for flexible sports and play spaces, with the shared use of facilities prioritised. Opportunities for more intensive use of schools, clubs and public sports facilities should be examined, as well as the flexible use of community floorspace.

A high-quality innovative approach to public realm befitting the heritage, culture and economic standing of the LAP area is required. It is recommended that a public realm strategy is completed that includes engagement with local community stakeholders to foster an inclusive and positive approach to meeting local needs. It should explore opportunities to better integrate the concept of play into public space, contributing to the development of family-based community.

E. Social/Community Services

The future development needs of community centres in the area should be supported in recognition of the pivotal role they play in identifying and addressing social issues locally. While the analysis notes that Tallaght is currently very well served with community services and facilities and that no additional community or social services will be required to facilitate a population of 34,000, it is considered that even if the quantity of services does not increase, the capacity and variety of such services may need to be further augmented. In this regard, it is recommended that the LAP allow for the provision of an additional 2 no. community services within the Tallaght LAP lands in order to satisfy population increases and changing demographics over the long term. The location of such future community services should be provided relative to the location of target user groups and their level of accessibility, insofar as practical to address current dissatisfaction with locations.

Furthermore, it is recommended that support be given to the established Age Friendly community facilities, and in particular, to ensure that the needs of the elderly are appropriately considered in relation to the continued development of the LAP area.

F. Arts & Culture

While no benchmark exists for such a service, it is considered that support should be given to maintaining the existing concentration of a shared community space/creative venues in Tallaght Town Centre. It is considered important for young people to progress the development of youth arts and assist in the addressing any issues of social

Bancroft Park

Brookfield Community Centre

integration. In addition, it is recommended that provision for small galleries and flexible studio spaces in the area should be investigated.

G. Faith

The LAP area is well served and there are currently no plans for future facilities. The provision of future services in this respect will be monitored through the lifetime of the plan. It is recommended to support the continued use of the Priory.

H. Other Facilities including Neighbourhood Centres

The demand and need for additional neighbourhood centres / local retail services is determined in the LAP.

In addition to the above specific social infrastructure requirements and given the high density nature of the study area, this assessment recommends the following practices in the provision of social infrastructure consistent with best practice and the sustainable and effective use of resources:

Co-location: Co-location and clustering of complementary community services thus facilitating coordination, convenience and access for service users;

Multi-purpose and multi-function: Facilities and spaces should offer flexible and diverse space and uses over a range of times to maximise efficiency, utilisation and adaptability of physical assets;

Place making and community identity: Promotion and encouragement of community facilities that create a sense of place and identity, that have a civic quality, and level of amenity that can foster community ownership and offer a focus to support community engagement;

Partnership: Encourage delivery of infrastructure services and facilities through partnerships between different bodies for maximum efficiency and co-ordination; and

Community Asset Management: For the local authority to maintain and enhance their strategic role in co-ordination and engagement between different service providers to ascertain up-to-date information on community infrastructure and facilities for the benefit of the community and service providers.

Conclusions

Social & community infrastructure is essential to achieving a balanced approach to sustainable local communities and it is of critical importance to the economic as well as social development of a town/ place. This study examined the current context with respect to social infrastructure facilities in the LAP area and to determine future requirements based on projected population growth. The findings highlight the presence of some excellent social infrastructure facilities in the LAP area, as well as a number of key challenges and opportunities that will influence the delivery of future improvements.

The role of social infrastructure in integrating new and existing communities in the LAP area is critical. A mix of uses will provide opportunities for community activity and places for people to meet and connect. Local facilities within easy walking distance are supported and promoted in order to facilitate community cohesion, as well as to reduce transport requirements and meet stringent carbon dioxide reduction targets. Continuity of public realm and interconnected neighbourhoods ensure people can easily access facilities and services they need by walking or cycling. With higher density living in urban areas, co-housing and living with extended family, or in multiple family units is commonplace, therefore there is a much greater demand for highly flexible, multi-use facilities within communities. A flexible approach to developed floorspace, as well as the capacity to retrofit existing community facilities, is also important to address changing demographics and evolving community needs.

The study will function as an important evidence base for the Tallaght Town Centre Local Area Plan 2020-2026. In essence, the provision of social infrastructure in the LAP area is fundamentally about making the most of and developing the local network of assets, be they facilities, services or the programmes that bring this together.

Comhairle Contae
Átha Cliath Theas
South Dublin County Council

APPENDIX 4.2 Generic Quantitative Risk Assessment, prepared by RSK Ireland Ltd

Absolute Limousines Ltd and Boherkill Property Development Ltd

Generic Quantitative Risk Assessment

Belgard Circle K, Belgard Road, Tallaght, County Dublin

602923-R01 (01)

FINAL

NOVEMBER 2020

EXECUTIVE SUMMARY

RSK Ireland Limited (RSK) was commissioned by Absolute Limousines Ltd and Boherkill Property Development Ltd to carry out a Generic Quantitative Risk Assessment (GQRA) at the Belgard Circle K, Belgard Road, Tallaght, County Dublin (the site). The purpose of the GQRA was to establish the contamination status of the soil and groundwater underlying the site and identify any potentially significant risks to human health and / or the water environment.

A desk-based study revealed the site history was of agricultural use in the earliest maps dating from 1837-1842 and 1888-1913; was developed for industrial/commercial use by 1995; and the site was developed as a fuel station by 2000. The desk-based study identified a predominately industrial surrounding land use with several IPPC licensed facilities within 1 km of the site. A locally important aquifer lies below the site and two surface water features are located within 1 km of the site.

An environmental site assessment was completed. A total of five boreholes (MW101 to MW105) were drilled at the site on the 25th and 26th May 2020. All five boreholes were completed as gas and groundwater monitoring wells. Soil samples were collected during drilling, selected soil samples were submitted to a UKAS accredited laboratory (ALS) for chemical analysis for potential contaminants of concern (COC). Four gas monitoring visits and one groundwater sampling visit were completed at the site. Groundwater samples were submitted to a UKAS accredited laboratory (ALS) for chemical analysis for potential contaminants of concern (COC).

Following the completion of the environmental site assessment works and receipt of laboratory analytical results, a GQRA was completed to assess risks to human health and the water environment at the site.

The soil GACs for protection of human health with regards to a residential without home grown produce land use scenario were not exceeded in any of the soil samples analysed. The laboratory analysis of groundwater samples reported that there are no concentrations of contaminants that exceeds the adopted GrAC for human health.

As noted in section 6.2.1, the groundwater GACs for the protection of environmental waters were exceeded in MW104 and MW105 for MTBE indicating the potentially complete pollutant linkage to the locally important aquifer, the groundwater abstraction or the surface waters.

It is considered unlikely that MTBE concentrations will adversely impact the surface waters within 1 km of the site. This is due to lack of direct hydraulic connectivity and the processes of dispersion and degradation of dissolved contaminants which will occur between the site and the receptor.

It is also considered unlikely that contaminant concentrations encountered in shallow groundwater will adversely impact groundwater in the locally important aquifer beneath the site. Quaternary deposits underlying the site, comprising stiff clays, which were encountered during the investigation, will act as a barrier and retard downward migration of dissolved phase contaminants.

RSK does not consider that the contaminant concentrations identified in groundwater pose a significant risk to Human Health as none of the GACs have been exceeded.

Following four rounds of gas monitoring, a maximum GSV of 0.0009 l/hr was recorded. This GSV would initially classify the site as Characteristic Situation 1 (CS1) - **VERY LOW RISK**.
This classification determines that special gas protection measures would not be required within the proposed buildings.

RSK GENERAL NOTES

Project No.: 602923 – R01 (01)

Title: Generic Quantitative Risk Assessment – Belgard Circle K, Belgard road, Tallaght, County Dublin.

Client: Absolute Limousines Ltd and Boherkill Property Development Ltd

Date: 5th November 2020

Office: Dublin

Status: **FINAL**

Author	Brian Cronin	Technical reviewer	Paul Feely
Signature		Signature	
Date:	5th August 2020	Date:	5th August 2020

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1 INTRODUCTION

RSK Ireland Limited (RSK) was commissioned by Absolute Limousines Ltd and Boherkill Property Development Ltd to carry out a Generic Quantitative Risk Assessment (GQRA) at the Belgard Circle K, Belgard Road, Tallaght, County Dublin (the site). A site location map is presented in Figure 1. The purpose of the GQRA was to establish the contamination status of the soil, groundwater and ground gas underlying the site and to identify any potentially significant risks to human health and / or the water environment.

The following report has been prepared specifically and solely for the above noted project. Initial sections of the report describe the site. The subsequent part of the report contains a description of the ground conditions encountered, a summary of the investigation findings, a GQRA, conclusions and recommendations.

All plans, tables, field records and borehole logs relating to this investigation are either given within the text of the report or presented in the appendices. This report is subject to RSK's Service Constraints provided in Appendix A.

1.1 Scope of work

The scope of work for the GQRA included the following:

- Review of desk-based information.
- Field programme including drilling of five boreholes, installation of five monitoring wells, soil and groundwater sampling, laboratory chemical analysis and ground gas monitoring.
- Comparison of laboratory soil and groundwater results to in-house derived screening values for human health for residential land use.
- Comparison of laboratory groundwater results to selected guidance values for the Water Environment for residential land use.
- Comparison of gas monitoring results to selected guidance values.
- Provision of a GQRA report summarising the findings of the desk study, field and laboratory programmes and GQRA screening of laboratory results.

1.2 Limitations

The comments given in this report and the opinions expressed are based on the information reviewed. However, there may be conditions pertaining at the site that have not been disclosed by the investigation and therefore could not be taken into account. Groundwater levels may fluctuate seasonally and at times be significantly different than those recorded. In addition, Made Ground can vary in thickness and nature over short distances and may be significantly different within areas not subject to the intrusive investigation.

This report is subject to the RSK Ireland Limited service constraints given in Appendix A.

2 SITE DESCRIPTION

The site is located in Tallaght, County Dublin, on the Belgard Road, at grid reference O 08514 28741. The site covers an area of approximately 2,800 m^2. The site elevation s approximately 100 m above the Ordnance Datum with site topography observed to be flat. The site location is shown in Figure 1.

At the time of the assessment, the site was comprised of an operational fuel station and two car dealerships. The fuel station includes a fuelling forecourt constructed of reinforced concrete slab with four pump islands dispensing petrol and diesel. The forecourt is enclosed by a perforated drainage channel and sheltered with a canopy. Drainage from the forecourt is to a hydrocarbon interceptor. There is also a car wash slab approximately 5 m west of the forecourt which drains to a separate wash interceptor.

Petrol and diesel are stored in an underground tank farm below the forecourt, immediately east of the pump islands. The tanks are filled via off-set fill points located immediately east of the tank farm. The unground tank farm is vented to a vapour collection manifold in the eastern corner of the forecourt. There is a solid fuels store and a bottled gas cage in the western corner of the site.

There are four underground storage tanks (USTs) in the underground tank farm. The third tank is split into two equal volumes. Details of the underground tank farm are given in Table 2-1.

The surface of the site generally consists of tarmac and concrete. The site topography was observed to be flat. The site location is presented in Figure 1.

Table 2-1 Storage Tank Details

Tank No.	Grade	Capacity (litres)	Age	Construction	Fill Method
1 (UST)	Diesel	20,500	Unknown	Unknown	Off-set
2 (UST)	Diesel	20,500	Unknown	Unknown	Off-set
3 (split UST)	Petrol	10,200 x 2	Unknown	Unknown	Off-set
4 (UST)	Petrol	20,500	Unknown	Unknown	Off-set

The two car dealerships on the site are located immediately southeast of the fuel station. The car dealerships comprise office space, an indoor car showroom and approximately 700 m^2 of outdoor parking space.

2.1 Surrounding Land-use

Land use surrounding the site is predominately commercial and industrial in nature. The Old Belgard Road runs adjacent to the site on the northeast side of the site. Immediately northwest of the site is a large commercial building comprising office space for legal and financial firms.

Approximately 40 m north of the site is a Renault car dealership. To the east, beyond Old Belgard Road there is a number of commercial units including a garage, located approximately 30 m from the site. Immediately south of the site is a car park, with warehousing beyond, located approximately 60 m from the site. Immediately west of the site is a variety of commercial and industrial units which comprise the Cookstown Industrial estate.

3 DESK STUDY REVIEW

The desk study review is detailed in the following section and summarises information obtained from the following sources:

- Geological Survey of Ireland (GSI) online mapping at: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 ;
- Environmental Protection Agency (EPA) maps at https://gis.epa.ie/EPAMaps/ ;
- Ordinance Survey of Ireland (OSI) database located at http://map.geohive.ie/mapviewer.html ;
- Office of Public Works (OPW) interactive flood maps at http://www.floodmaps.ie/ ;
- The Water Framework Directive (WFD) Water Maps available at http://www.wfdireland.ie/maps.html ;
- National Parks and Wildlife Service NPWS mapping located at http://webgis.npws.ie/npwsviewer/.

3.1 Previous Site Operations

A review of the site history was undertaken by assessing the available historical maps and aerial photos available from the ordinance survey of Ireland (OSI) Geohive public viewer.

The earliest available online OSI map dating from 1837-1842 (Figure 3) shows that the site is agricultural land. The surrounding land use is predominately agricultural with a small number of residential dwellings in the area. There is a road immediately east of the site, running northwest to southeast, in the location of the current Old Belgard Road.

The OSI online map from 1888-1913 (Figure 4) shows the site and surrounding land largely unchanged. The surrounding land is still agricultural in use.

The OSI aerial photos from 1995 to 2012 have also been reviewed. The resolution of the photography is poor, it is difficult to identify building or property use.

In the 1995 aerial photograph, the site broadly appears to resemble it's current-day layout with the main retail building in place. However, there is no fuel station forecourt or canopy. The surrounding land has been developed for commercial and industrial use. The buildings and infrastructure in the surrounding area resemble the current-day layout.

The aerial photograph from 2000 shows the site as fully developed to its current state with a fuel station courtyard and canopy. The surrounding land remains relatively unchanged since the 1995 aerial photograph and resembles the current-day layout.

3.2 Geology

Information from the Geological Survey of Ireland (GSI) online mapping public viewer indicates that the solid geology underlying the site comprises dark grey limestone and shale of the Lucan formation, as shown in Figure 3.1 below.

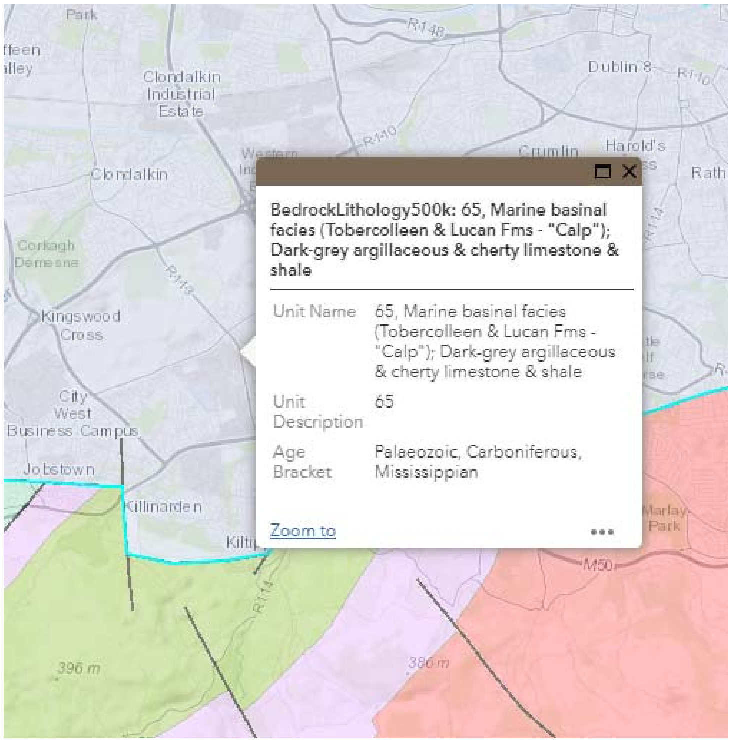


Figure 3.1 Bedrock Geology Underlying Site

According to the EPA, the superficial geology underlying is described as made ground which in turn overlies till derived from limestone.

The GSI has published borehole and trial pit records on-line. There are three borehole locations within a 2 km radius of the site. However, the GSI have been unable to locate the borehole logs for these locations.

3.3 Hydrogeology

3.3.1 Aquifer characteristics

Information from the GSI Groundwater public viewer website indicates that the underlying bedrock is categorised as a locally important aquifer, that is an aquifer which is moderately productive only in local zones. It is anticipated that perched groundwater may be encountered in more permeable horizons within any made ground and superficial deposits.

Groundwater vulnerability is classified as high at the site (see Figure 3.2 below). The EPA has categorised the groundwater body as not at risk. Water framework directive (WFD) monitoring (2010-2015) ranks the water quality as good.

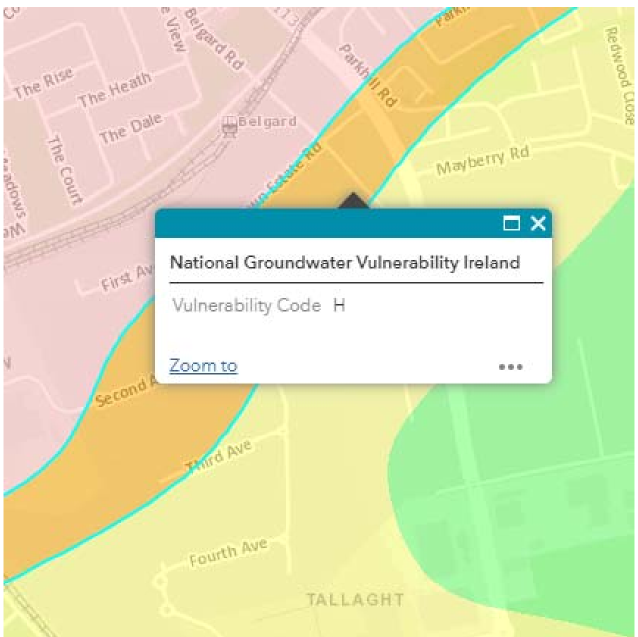


Figure 3.2 Groundwater Vulnerability at the Site

3.3.2 Groundwater abstractions

The GSI public viewer indicates that the closest groundwater abstraction is located approximately 500 m south of the site. The well use is described as industrial use. Yields are 513 m^3/day. The site is not located in a source protection area. According to the GSI map viewer, there are no other groundwater abstraction points within 1 km of the site.

3.4 Hydrology

3.4.1 Surface watercourses

EPA mapping has been reviewed to identify potential receptor surface watercourses. The nearest surface watercourse is the Tymon River located approximately 700 m to the southeast of the site. The River Poddle is located approximately 1 km to the south of the site. The EPA indicate that water quality as reported in the River Waterbody WFD Status (2010 – 2015) is "poor" at the River Poddle.

3.4.2 River Basin Management Plan

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

The waterbody area underlying the site is the Camac Lower, its ecological status is described as "bad".

3.4.3 Site Drainage

The surface of the site is constructed of reinforced concrete slab and tarmacadam.

From the on-site visual inspection and the review of site drawings, drainage from the fuel dispensing areas is to a hydrocarbon interceptor via a drainage channel which runs the perimeter of the forecourt. The outflow from the interceptor is expected to be to the municipal drainage network on Old Belgard Road.

Drainage from the tarmacadam area in front of the car dealers appears to be to a local on-site network and out to the municipal drainage network on Old Belgard Road.

3.4.4 Flood Risk

The Office of Public works (OPW) interactive flood maps have no record of a flood event occurring within 1 km of the site.

A review of the site was undertaken by assessing the available flood event maps provided by the OPW.

There is no flood risk map available for the site.

3.5 EPA Licensed IPPC / Waste Facilities / Section 4 Discharges

Information from the EPA website indicates that there are three IPPC licensed facilities within 1 km of the site. Approximately 200 m southwest of the site is Print and Display Ltd which operates a business of printing for commercial clients, offering vinyl wall graphics, vehicle branding and other large-scale visual advertising formats. INX International Ink Company Ltd are located approximately 600 m southwest of the site. Microprint and Bimeda Animal Health Ltd are located approximately 700 m southeast of the site.

There are three licensed waste facilities within 1 km of the site. Tonge Industries Ltd is located approximately 300 m west of the site and holds an active waste license. Starrus Eco Holdings Ltd are located approximately 500 m southwest of the site and hold an active waste license. Guardian Environmental Services Ltd are located approximately 700 m southwest of the site and have surrendered their waste license.

There are no section 4 discharges located within 1 km of the site.

3.6 Sensitive land uses

A 2km buffer zone for sensitive land uses has been used as RSK considers it reasonable to assume that significant impact to receptors is unlikely where surface water or groundwater migration is a potential pathway at this distance.

A search carried out using the National Parks and Wildlife Service website for the presence of any designated sites did not identify any sites within 2km of the subject site.

3.7 Local Authority Information

RSK have requested information from South Dublin County Council on 1st July 2020 regarding any pertinent environmental issues that they are aware of on or adjacent to the subject site, however no response was issued from the Council at the time of reporting.

4 FIELDWORK

4.1 Borehole Drilling & Monitoring Well Installation

A total of five boreholes (MW101 to MW105) were drilled on the 25th and 26th May 2020 using a Dando Terrier tracked window sampling drilling rig. Boreholes were advanced to a maximum depth of 4.6 mbgl. Drill cuttings were logged, groundwater conditions were noted, and representative soil samples collected by the supervising engineer. The locations of the boreholes are shown on Figure 2.

All five boreholes were completed as groundwater and ground gas monitoring wells by installing a 50mm internal diameter (ID) uPVC screen and casing. The 50mm ID screen and casings were installed to the base of each borehole as groundwater monitoring wells. The borehole annulus was backfilled with 6mm to 10mm graded gravels with a bentonite seal placed above the filter pack to prevent any downward migration of surface water. The well was finished with lockable steel cover flush with the ground surface. The wells were then purged and left to allow equilibration of groundwater levels.

Details of the monitoring well construction are presented on the borehole logs in Appendix B.

4.2 Soil Sampling

During borehole drilling soil samples were screened for visual and olfactory signs of contamination. Selected soil samples were submitted to a UKAS accredited laboratory (ALS) for chemical analysis for potential contaminants of concern (COC).

4.3 Ground Gas Monitoring

Four rounds of ground gas monitoring were undertaken on all five installed monitoring wells. The ground gas monitoring rounds were undertaken on the 5th, 9th, 12th and 15th June 2020.

The monitoring was undertaken using a GFM436 Portable Gas Analyser. Ground gases within the well head were pumped at a steady rate into the analyser and concentrations of methane (CH4) carbon dioxide (CO2), oxygen (O2), carbon monoxide (CO) and Lower Explosive Limit (LEL) were recorded at set intervals over a 10-minute period.

In addition, the atmospheric pressure before and during monitoring, together with the weather conditions, was recorded. The wells were also assessed for potential ground gas flow rates.

4.4 Groundwater Sampling

Following installation, all five groundwater monitoring wells were gauged for depth to water and the presence of light non-aqueous phase liquid (LNAPL), using an electronic interface probe on 5th, 9th, 12th and 15th June 2020.

Groundwater samples were retrieved from the newly installed monitoring wells using a USEPA-approved ‘Low-Flow’ purging and sampling methodology on 9th June 2020. The low-flow method relies on moving groundwater through the well screen at approximately the same rate as it flows through the geological formation. This results in a significant reduction in the volume of water extracted before sampling and significantly reduces the amount of disturbance of the water in the monitoring well during purging and sampling. Drawdown levels in the monitoring well and water quality indicator parameters (pH, temperature, electrical conductivity, redox potential and dissolved oxygen) are monitored during low-flow purging and sampling, with stabilisation indicating that purging is complete, and sampling can begin. As the flow rate used for purging is, in most cases, the same or only slightly higher than the flow rate used for sampling, and because purging and sampling are conducted as one continuous operation in the field, the process is referred to as Low-Flow Purging and Sampling. Low flow sampling forms can be provided upon request.

Samples were retrieved from MW102, MW103, MW104 and MW105. It should be noted that a sample was not retrieved from MW101 as it was found to be dry.

Samples were collected in containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation prior to transportation to ALS in Hawarden under chain of custody documentation.

4.6 Laboratory Testing

Seven selected soil samples were analysed for a suite of parameters which consisted of: total petroleum hydrocarbons (TPH) split into aliphatic and aromatic carbon bands; benzene, toluene, ethyl-benzene and xylene (BTEX), methyl tert-butyl ether (MTBE); total organic carbon (TOC); polycyclic aromatic hydrocarbons (PAH); volatile organic compounds (VOC); metals; and asbestos.

Groundwater samples collected during the groundwater monitoring event were analysed for a suite of parameters, which consisted of: TPH split into aliphatic and aromatic carbon bands; BTEX; MTBE and PAH.

5 RESULTS OF THE INVESTIGATION

5.1 Fieldwork

The following sections present the results of the intrusive investigation. Descriptions of the strata encountered, together with well design and groundwater conditions are given in borehole logs presented in Appendix B.

5.2 Encountered Ground Conditions

The site investigation identified Made Ground to a maximum depth of 1.0 mbgl in MW103. The made ground was found to be quite variable but generally comprised: concrete slab or tarmac on engineered gravel fill, overlying a slightly sandy, gravelly clay fill.

The made ground was generally underlain by till comprising stiff, gravelly clay with cobbles and boulders.

5.3 Ground Gas

The results have been assessed in accordance with the guidance provided in *CIRIA Report C665: Assessing risks posed by hazardous ground gases to buildings* (Wilson et al., 2007). In the assessment of risks posed by hazardous ground gases and selection of appropriate mitigation measures, CIRIA C665 identifies two types of development termed;

- Situation A (modified Wilson and Card method), appropriate to all development excluding traditional low-rise construction, and
- Situation B (National House-Building Council, NHBC) only appropriate to traditional low-rise construction with ventilated sub-floor voids.

Both methods are based on calculations of the limiting borehole gas volume flow for methane and carbon dioxide, renamed as the gas screening value (GSV). The GSV (litres of gas per hour) is calculated by multiplying borehole flow rate (litres per hour) and gas concentration (percent by volume).

In both situations, it is important to note that the GSV is a guideline value and not an absolute threshold. The GSV may be exceeded in certain circumstances, if the site conceptual model indicates it is safe to do so. Similarly, consideration of additional factors such as very high concentrations of carbon dioxide, should lead to consideration of the need to increase the Characteristic Situation.

The proposed development plan will comprise a residential building adjacent to an operational fuel station; the ground gas regime at the site will therefore be calculated using Situation A.

Situation A relates to all development types except low-rise housing and, by combining the qualitative assessment of risk with the gas monitoring results, provides a semi-quantitative estimate of risk for a site. The method is based on that proposed by Wilson and Card (1999), which was a development of a method proposed in CIRIA report 149 (Card, 1995). The method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flow for methane and carbon dioxide. Having calculated the worst case GSVs for methane and carbon dioxide, the Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

The GSV calculations are included in Table 5-1 below. The results of the gas monitoring are included as Appendix E.

Table 5-1: Summary of GSV Calculations

Date	Max. CH_4 (%)	Max. $C0_2$ (%)	Max Flow Rate (l/hr)	GSV CH_4	GSV $C0_2$
05/06/2020	0.1*	0.9	0.1*	0.0001	0.0009
09/06/2020	0.1*	0.9	0.1*	0.0001	0.0009
12/06/2020	0.1*	0.8	0.1	0.0001	0.0008
15/06/2020	0.1*	0.7	0.1*	0.0001	0.0007
Note: * no detection – limit of detection used					

As shown in Table 5-1 above, a maximum carbon dioxide concentration of 0.9% was recorded during the gas monitoring rounds. There was no detection of methane in any monitoring well over the four monitoring rounds. A maximum steady state flow of <0.1 l/hr was recorded during the monitoring rounds.

Following four rounds of gas monitoring, a maximum GSV of 0.0009 l/hr was recorded. this GSV would initially classify the site as Characteristic Situation 1 (CS1) - **VERY LOW RISK**.

This classification determines that special gas protection measures would not be required within the proposed buildings.

5.3 Groundwater Gauging

The results of the groundwater gauging exercise indicated the likely presence of a continuous groundwater table within the overburden soils encountered beneath the site.

Groundwater monitoring wells were surveyed to a site temporary datum to allow the estimation of groundwater flow. The water level in the continuous groundwater table ranged from 97.723 mSTD (MW102 on 09/06/2020) to 97.835 mSTD (MW105 on 09/06/2020). It has been estimated that the groundwater underlying the site is flowing in a south-westerly direction as shown in Figure 3. The groundwater levels for the groundwater monitoring wells are shown in Table 5-2 below.

Table 5-2: Groundwater gauging results

Location	Top of Casing (mSTD)	Depth to Product (mTOC)	Depth to Water (mTOC)	Water Table Elevation (mSTD)
MW101	100	-	DRY	-
MW102	99.816	-	2.093	97.723
MW103	99.798	-	2.073	97.725
MW104	99.699	-	1.926	97.773
MW105	99.710	-	1.875	97.835
DRY – No groundwater encountered in monitoring well during monitoring round				

5.4 Soil Analytical Results

A summary of the concentrations of contaminants reported by the laboratory analysis of selected soil samples are presented in Tables 5-3 to 5-5. The laboratory report is presented within Appendix C.

Table 5-3: TPH, BTEX and MTBE Soil Analytical Results (mg/kg)

Location	**MW101**	MW102	MW102	MW103	**MW104**	**MW104**	**MW105**	GAC Human Health – Residential (mg/kg) *
Depth (m)	2.0-3.0	1.0-2.0	4.0-6.0	1.0-2.0	1.0-2.0	3.0-3.6	2.0-3.0	
Aliphatics C5-C6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	42
Aliphatics C6-C8	<0.01	<0.01	0.024	<0.01	<0.01	0.013	0.013	100
Aliphatics C8-C10	<0.01	<0.01	<0.01	0.152	<0.01	<0.01	0.252	27
Aliphatics C10-C12	<1	<1	<1	<1	<1	<1	<1	130 *(48)*
Aliphatics C12-C16	<1	<1	<1	<1	<1	<1	<1	1,100 *(24)*
Aliphatics C16-C35	<1	<1	<1	<1	<1	<1	<1	65,000 *(8)*
Aliphatics C35-C44	<1	<1	<1	<1	<1	<1	<1	65,000 *(8)*
Aromatics C8-C10	<1	<1	<1	<1	<1	<1	<1	47
Aromatics C10-C12	<1	<1	<1	<1	<1	<1	<1	300
Aromatics C12-C16	<1	<1	<1	<1	<1	<1	<1	1,800 *(169)*
Aromatics C16-C21	<1	<1	<1	<1	<1	<1	<1	1,900
Aromatics C21-C35	<1	<1	<1	2.88	<1	<1	<1	1,900
Aromatics C35-C44	<1	<1	<1	<1	<1	<1	<1	1,900
Benzene	<0.18	<0.18	<0.18	<0.18	<1.8	<0.18	<0.18	0.9
Toluene	<0.14	<0.14	<0.14	<0.14	<1.4	<0.14	<0.14	900 *(869)*
Ethylbenzene	<0.08	<0.08	<0.08	<0.08	<0.8	<0.08	<0.08	80
Xylene	<0.4	<0.4	<0.4	<0.4	<4.0	<0.4	<0.4	80
MTBE	<0.2	<0.2	<0.2	<0.2	<2.0	<0.2	<0.2	100

- Results in bold indicate an exceedance

* GAC for soil with soil organic matter (SOM) content of 1% used. GAC is for residential without home grown produce.

Figures in brackets – RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the GAC with the corresponding solubility or vapour saturation limits given in brackets.

Table 5-4: PAH Soil Analytical Results (mg/kg)

Location	**MW101**	MW102	MW102	MW103	**MW104**	**MW104**	**MW105**	GAC Human Health – Residential (mg/kg) *
Depth (m)	2.0-3.0	1.0-2.0	4.0-6.0	1.0-2.0	1.0-2.0	3.0-3.6	2.0-3.0	
Naphthalene	<0.009	<0.009	<0.009	<0.009	<0.009	0.014	0.015	23
Acenaphthylene	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	6,600 (86)
Acenaphthene	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	6,600 (57)
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2,800 (31)
Phenanthrene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	1,300 (36)
Anthracene	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	31,000 (1.17)
Fluoranthene	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	2,800 (31)
Pyrene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	3,700
Benzo(a)anthracene	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	11.0
Chrysene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	30
Benzo(b)fluoranthene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	4.0
Benzo(k)fluoranthene	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	106
Benzo(a)pyrene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	5.3
Indeno(123cd)pyrene	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	45
Dibenzo(ah)anthracen	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	0.31
Benzo(ghi)perylene	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	355

- Results in bold indicate an exceedance

* GAC for soil with soil organic matter (SOM) content of 1% used. GAC is for residential without home grown produce.

Figures in brackets – RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the GAC with the corresponding solubility or vapour saturation limits given in brackets.

Table 5-5: Metals Soil Analytical Results (mg/kg)

Location	MW101	MW102	MW102	MW103	MW104	MW104	MW105	GAC Human Health – Residential (mg/kg) *
Depth (m)	2.0-3.0	1.0-2.0	4.0-6.0	1.0-2.0	1.0-2.0	3.0-3.6	2.0-3.0	
Arsenic	9.72	8.01	9.33	8.68	8	9.56	6.48	40
Cadmium	1.23	1.05	1.2	1.18	1.07	1.03	0.799	149
Chromium	11.2	9.64	11.5	6.3	6.34	9.64	9.25	21
Copper	15.4	12.9	15	13.8	12.9	13.1	9.57	7,100
Lead	25.7	16.7	20.9	16.1	15.7	17.1	11.9	310
Mercury	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	56
Nickel	29.3	23.8	27.6	23.5	22.5	22.7	17.3	180
Selenium	1.16	<1	1.39	1.27	1.2	1.06	1.25	430
Zinc	88.7	74.9	86.5	67.3	66	66.4	51.7	40,000

- Results in bold indicate an exceedance

* GAC for soil with soil organic matter (SOM) content of 1% used. GAC is for residential without home grown produce.

Figures in brackets – RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the GAC with the corresponding solubility or vapour saturation limits given in brackets.

5.5 Groundwater Analytical Results

The results of the laboratory analysis of the six groundwater samples taken during the groundwater monitoring round are presented in Tables 5-6 and 5-7. The groundwater human health GrACs for a sandy loam and groundwater depth of 0.65 m are used to screen the results. The GrACs for a groundwater depth of 0.65 m has been conservatively used to account for the possibility that the groundwater elevation may fluctuate seasonally. The results of the groundwater laboratory analysis are included in Appendix D.

Table 5-6: TPH, BTEX and MTBE Groundwater Analytical Results and GrACs (mg/l)

Location	MW102	MW103	MW104	MW105	GAC Human Health – Residential (mg/L)	GAC – Protection of Water Environment (mg/L)
Ali C5-C6	<0.01	<0.01	<0.01	<0.01	26.56	***
Ali C6-C8	<0.01	<0.01	<0.01	<0.01	5.37[#]	***
Ali C8-C10	<0.01	<0.01	<0.01	<0.01	0.427[#]	***
Ali C10-C12	<0.01	<0.01	<0.01	<0.01	0.0339[#]	***
Ali C12-C16	<0.01	<0.01	<0.01	<0.01	0.0008[#**]	***
Ali C16-C21	<0.01	<0.01	<0.01	<0.01	*	***
Ali C21-C35	<0.01	<0.01	<0.01	<0.01	*	***
Aro C8-C10	<0.01	<0.01	<0.01	<0.01	25.73[#]	***
Aro C10-C12	<0.01	<0.01	<0.01	<0.01	245[#]	***
Aro C12-C16	<0.01	<0.01	<0.01	<0.01	5.75[#]	***
Aro C16-C21	<0.01	<0.01	<0.01	<0.01	*	***
Aro C21-C35	<0.01	<0.01	<0.01	<0.01	*	***
Total TPH	<0.01	<0.01	<0.01	<0.01	*	0.0075[(1)**]
Benzene	<0.007	<0.007	<0.007	<0.007	2.9	0.00075[(1)**]
Toluene	<0.004	<0.004	<0.004	<0.004	590[#]	0.0525[(1)**]
Ethylbenzene	<0.005	<0.005	<0.005	<0.005	156.38	0.01[(2)]
Total Xylene	<0.011	<0.011	<0.011	<0.011	144.25	0.01[(2)]
MTBE	<0.003	0.004	0.098	0.118	945.7	0.01[(2)]

Where values are in **bold** they have exceeded the GAC for Human Health

Where values are underlined the have exceeded the GAC for Environmental Waters

(1) S.I. 366 European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016

(2) EPA Interim Report Towards Setting Guideline values for the Protection of Groundwater in Ireland 2003

GrAC is set at the limit of solubility as calculated GrAC exceeds the solubility limit for the pure compound in water.

* GAC not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data

** GAC is set below the LMDL. Where the analysis indicates concentrations below the LMDL a non-exceedance of the criteria will be inferred.

*** No GAC available in legislation or guidance.

Table 5-7: PAH Groundwater Analytical Results and GrACs (µg/l)

Location	MW102	MW103	MW104	MW105	GAC Human Health – Residential (µg/L)	GAC – Protection of Water Environment ((µ (µg/L)
Naphthalene	<0.01	<0.01	<0.01	<0.01	19,000#	1.0(2)
Acenaphthylene	<0.005	<0.005	<0.005	<0.005	7,950#	***
Acenaphthene	<0.005	<0.005	<0.005	<0.005	4,100#	***
Fluorene	<0.005	<0.005	<0.005	<0.005	*	***
Phenanthrene	<0.005	<0.005	<0.005	<0.005	*	***
Anthracene	<0.005	<0.005	<0.005	<0.005	*	10,000(2)
Fluoranthene	<0.005	<0.005	<0.005	0.00506	*	1.0(2)
Pyrene	0.0091	0.00711	0.00577	0.00735	*	***
Benzo(a)anthracene	<0.005	<0.005	<0.005	<0.005	*	***
Chrysene	<0.005	<0.005	<0.005	<0.005	*	***
Benzo(b)fluoranthene	<0.005	<0.005	<0.005	<0.005	*	0.5(2)
Benzo(k)fluoranthene	<0.005	<0.005	<0.005	<0.005	*	0.05(2)
Benzo(a)pyrene	<0.002	<0.002	<0.002	<0.002	*	0.0075(1) **
Indeno(123cd)pyrene	<0.005	<0.005	<0.005	<0.005	*	0.05(2)
Dibenzo(ah)anthracene	<0.005	<0.005	<0.005	<0.005	*	***
Benzo(ghi)perylene	<0.005	<0.005	<0.005	<0.005	*	0.05(2)
Total PAH	<0.082	<0.082	<0.082	<0.082	n/a	0.075(1) **

Where values are in **bold** they have exceeded the GAC for Human Health

Where values are underlined the have exceeded the GAC for Environmental Waters

(1) S.I. 366 European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016

(2) EPA Interim Report Towards Setting Guideline values for the Protection of Groundwater in Ireland 2003

GrAC is set at the limit of solubility as calculated GrAC exceeds the solubility limit for the pure compound in water.

* GAC not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data

** GAC is set below the LMDL. Where the analysis indicates concentrations below the LMDL a non-exceedance of the criteria will be inferred.

*** No GAC available in legislation or guidance.

6 GENERIC QUANTIATIVE RISK ASSESSMENT

6.1 Human Health

6.1.1 Soil

The soil results have been conservatively compared to GACs derived by RSK for a residential use without homegrown produce. The GACs are protective of human health in a residential use without homegrown produce, reflective of the proposed development adjacent to the fuel station. The most conservative screening criteria with the assumed Soil Organic Matter (SOM) of 1% have been applied to the site. The screening values for human health and their derivation are included in Appendix F.

The laboratory analysis of selected soil samples collected by RSK reported that there are no concentrations of contaminants that exceed the adopted GAC for human health.

6.1.2 Groundwater

The groundwater results have been compared to GrACs derived by RSK for a residential use. The screening values for human health and their derivation are included in Appendix G. The GrACs for sandy loam and a groundwater depth of 0.65m were used. The shallow groundwater depth is conservatively assumed to allow for seasonal fluctuations in the groundwater level.

The laboratory analysis of groundwater samples collected by RSK reported that there are no concentrations of contaminants that exceed the adopted GAC for human health.

6.2 Water Environment

6.2.1 Groundwater

Where available Irish Environmental Quality Standard (EQS) values have been used which have been obtained from Statutory Instrument No. 366 '*European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016'*. These values have been supplemented by the Irish interim values presented in the EPA report '*Interim Report Towards Setting Guideline Values for the Protection of Groundwater in Ireland'* dated 2003.

Concentrations were reported in monitoring wells at levels which exceeded the GACs for the protection of the water environment as follows;

- **MTBE;**
    - MW104 and MW105

All other results were reported at concentrations which did not exceed the GACs for the protection of the water environment.

6.3 Summary of Pollutant Linkages

Table 6-1 records the potential pollutant linkages that have been identified at the site. Justifications for the identification of a potential pollutant linkage together with the likelihood are also discussed in Table 6-1.

Please note that construction and maintenance workers have not been identified in the conceptual model as receptors because risks are considered to be managed through health and safety procedures as required in the Safety, Health and Welfare at Work (Construction) Regulations 2013.

Table 6-1: Summary of Pollutant Linkages

Source	Pathway	Receptor	Linkage?
Metals, PAH, BTEX, MTBE and TPH in soil	Direct Contact	Future Site Workers and Users	**Incomplete.** The GACs protective of human health have not been exceeded. The majority of the site is covered in hard standing.
		Off-site workers and residents	**Incomplete.** The GACs protective of human health have not been exceeded. The majority of the site is covered in hard standing.
	Leaching	Groundwater	**Incomplete**. Site covered in hardstanding and therefore no viable pathway exists. No significant contaminant concentrations have been identified in soils during the investigation. Additionally, no significant contaminant concentrations have been identified in the groundwater during the investigation indicating there are no COCs leaching from the soils.
	Vapour migration along fill, services and permeable strata	Future site users	**Incomplete.** The GACs protective of human health have not been exceeded, additionally the majority of the site is covered hard standing.
		Off-site workers and residents	
Metals, PAH, BTEX, MTBE and TPH in groundwater	Direct contact and ingestion	Site workers	**Incomplete.** The GACs protective of human health have not been exceeded, additionally the majority of the site is covered hard standing.
		Site users	
		Off-site residents	
	Migration	Locally important aquifer/abstraction well 500 m to the south	**Incomplete**. MTBE results have exceeded the GAC's for environmental waters in MW104 and MW105. However, it is considered unlikely that contaminant concentrations encountered in shallow groundwater will adversely impact groundwater in the locally important aquifer beneath the site. Quaternary deposits underlying the site, described as till which were encountered during the investigation, will act as a barrier and retard downward migration of contaminants. It is considered that there are no significant risks to the abstraction well as the GACs for environmental waters were not exceeded in MW102 and MW103 which are hydraulically downgradient of MW104 and MW105. This indicates that groundwater flowing off-site is not exceeding the GACs. Additionally, contaminant concentrations in shallow groundwater are unlikely to impact the underlying locally important aquifer as mentioned above, therefore RSK considers it unlikely that there is a viable pathway to the receptor.
		Tymon River 700m to the south east/ River Poddle 1 km to the south.	**Incomplete.** MTBE results have exceeded the GAC's for environmental waters in MW104 and MW105 for environmental waters. Given the distance to the receptors, it is considered unlikely that contaminant concentrations encountered in shallow groundwater on-site will adversely impact either the Tymon or the Poddle given the processes of dispersion and degradation that will occur between site and the receptors.
	Vapour migration along fill, services and permeable strata	Future site workers and users	**Incomplete.** The GACs protective of human health have not been exceeded. No significant contamination encountered during site investigation.
		Off-site workers and residents	**Incomplete. T**he GACs protective of human health have not been exceeded. No significant contamination encountered during site investigation.

Based upon the above information no potentially complete pollution linkages have been identified at the site.

8 CONCLUSIONS

Following the completion of the environmental site assessment works and receipt of laboratory analytical results, a GQRA was completed to assess risks to human health at the site with regards to a residential use without homegrown produce.

The laboratory analysis of selected soil samples reported that there are no concentrations of contaminants that exceeds the adopted GAC for human health.

The laboratory analysis of groundwater samples reported that there are no concentrations of contaminants that exceeds the adopted GrAC for human health.

As noted in section 6.2.1, the groundwater GACs for the protection of environmental waters were exceeded in MW104 and MW105 indicating the presence of potentially complete pollutant linkages to surface waters and the underlying locally important aquifer. Given the distance to the surface water receptors, it is considered unlikely that contaminant concentrations encountered in shallow groundwater on-site will adversely impact the Tymon River approximately 700 m to the southeast or the River Poddle river approximately 1 km to the south. This is due to lack of direct hydraulic connectivity and the processes of dispersion and contaminant degradation which will occur between the site and the receptor.

It is also considered unlikely that contaminant concentrations encountered in shallow groundwater will adversely impact groundwater in the locally important aquifer beneath the site. Quaternary deposits underlying the site, till comprising stiff clays, which was encountered during the investigation, will act as a barrier and retard downward migration of dissolved phase contaminants.

Following four rounds of gas monitoring, a maximum GSV of 0.0009 l/hr was recorded. this GSV would initially classify the site as Characteristic Situation 1 (CS1) - **VERY LOW RISK**.
This classification determines that special gas protection measures would not be required within the proposed buildings.

Taking into account the results of the laboratory analysis of soil and groundwater samples retrieved during the recent GQRA works, Belgard Circle K, Belgard Road, Tallaght, County Dublin is not considered to pose a significant risk to human health or to the water environment.

FIGURES

Prepared For: Absolute Limousines Ltd and Boherkill Property Development Ltd

Project: Cookstown Industrial Estate

Drawing Title: Figure 1 Site Location

Source: Google
Date: August 2020

N

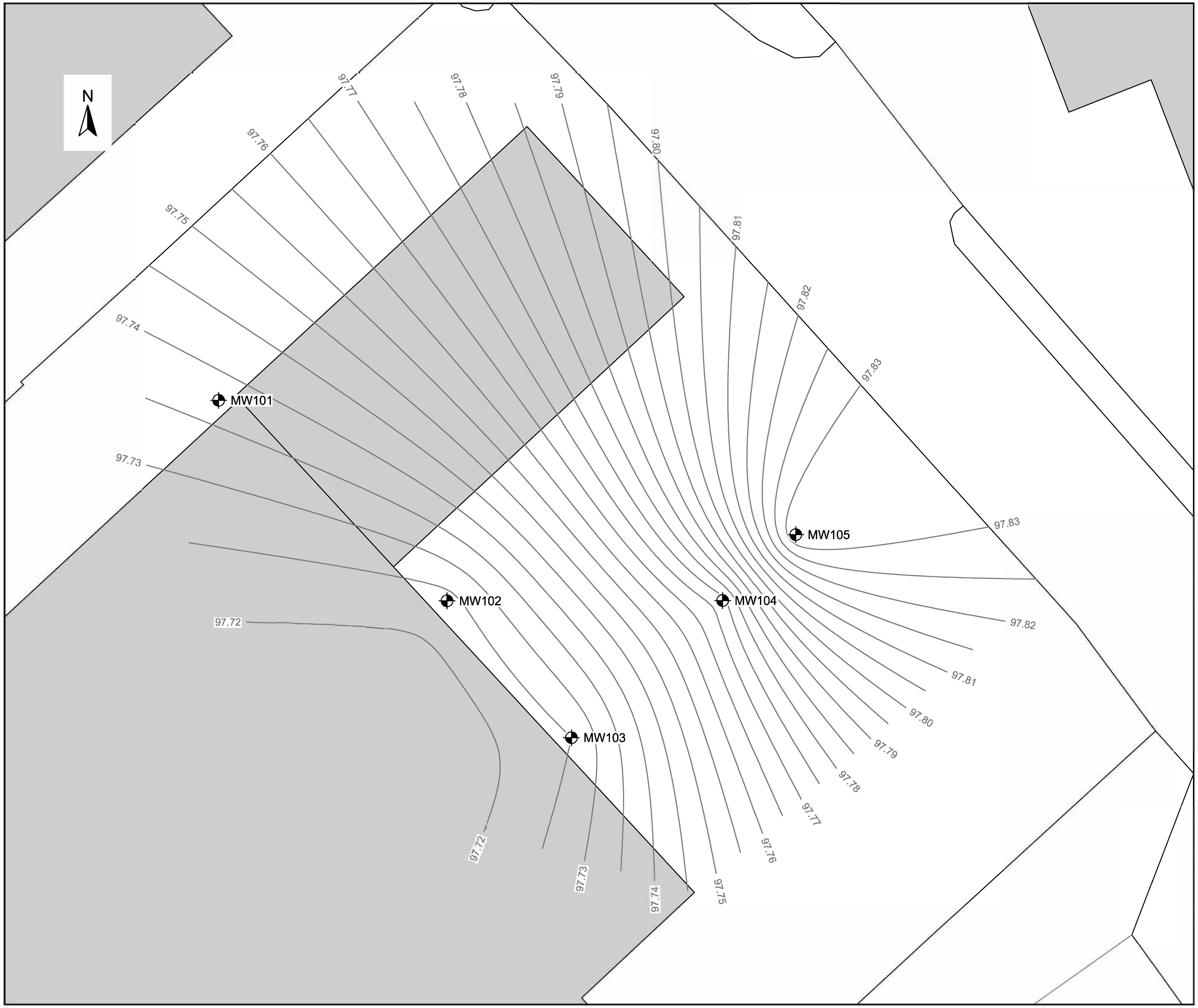
Prepared For: Absolute Limousines Ltd and Boherkill Property Development Ltd

Project: Cookstown Industrial Estate

Drawing Title: Figure 2 Monitoring Well Location Plan

RSK

Source: Google
Date: March 2020



LEGEND

Monitoring Well Location

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
00	07.07.20	-	MW	BC	-

The Old School,
Stillhouse Lane,
Bedminster,
Bristol,
BS3 4EB

Tel: +44 (0)117 947 1006
Email: info@rsk.co.uk
Web: www.rsk.co.uk

Client: Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd

Project Title: Cookstown Ind Estate

Drawing Title: Piezometric Plan

Drawn	Date	Checked	Date	Approved	Date
MW	07.07.20	BC	07.07.20	-	-

Dimensions	Scale	Original Size
m	1:250	A3

Project Number	Drawing Number
602923	Figure 2

Drawing File	Rev
602923 - Fig 2 - rev 00 - PP	00

APPENDIX A

Service Constraints

RSK IRELAND LIMITED
SERVICE CONSTRAINTS

1. This report and the Environmental Site Assessment carried out in connection with the report (together the "Services") were compiled and carried out by RSK Ireland Ltd (RSK) for Absolute Limousines Ltd and Boherkill Property Development Ltd (the "client") in accordance with the terms of a contract between RSK and the "client" dated November 2019. The Services were per formed by RSK with the skill and care ordinarily exercised by a reasonable Environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed in writing the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information], and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

APPENDIX B

Borehole Logs

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Cookstown Industrial Estate SI	Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd	BH101

Contract Ref:	Start: 25.05.20	Ground Level:	Co-ordinates:	Sheet:
602923	End: 25.05.20	---	---	1 of 1

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
	0.00-1.00	1	D				MADE GROUND: Tarmacadam.	0.15	
							MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.35	
							Brown very sandy gravelly CLAY. Gravel is angular.	(0.65) 1.00	
	1.00-2.00	2	D				Brown hard to stiff slightly sandy gravelly CLAY with occasional boulder fragments and cobbles. Gravel is small to medium and angular. Sand is fine.	(2.00) 3.00	
	2.00-3.00	3	D						
	3.00-3.40	4	D				Brown hard to stiff gravelly CLAY with assumed black boulder and fragments of grey granite. Gravel is small to medium and angular.	(0.40) 3.40	
							Borehole refused on boulder at 3.40m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 3.40m depth on completion. Response zone 2.50m to 3.40m depth.

All dimensions in metres | Scale: 1:25

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	Dando Terrier	Groundcheck	RMurphy	

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Cookstown Industrial Estate SI	**Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd**	**BH102**

Contract Ref:	Start:	End:	Ground Level:	Co-ordinates:	Sheet:
602923	**25.05.20**	**25.05.20**	**---**	**---**	**1** of **2**

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
							MADE GROUND: Black tarmacadam.	0.10	
							MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.30	
							MADE GROUND: Brown very sandy gravelly CLAY. Gravel is small to medium and subangular to angular. Clay is soft with fragments of hardcore gravel.	(0.60) 0.90	
							Light brown slightly sandy gravelly CLAY. Gravel is small to medium and subangular to angular.	(1.10) 2.00	
							Hard/stiff light brown slightly sandy gravelly CLAY. Gravel is small to medium and subangular to angular with black boulders (assumed boulder clay).	(2.60)	

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 4.60m depth on completion. Response zone 2.50m to 4.60m depth.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**Groundcheck**	**RMurphy**	

AGS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Cookstown Industrial Estate SI	Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd	BH102

Contract Ref:	Start: 25.05.20	Ground Level:	Co-ordinates:	Sheet:
602923	End: 25.05.20	---	---	2 of 2

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
								4.60	
							Borehole refused on boulder at 4.60m depth.		

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

All dimensions in metres

Scale: 1:25

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	Dando Terrier	Groundcheck	RMurphy	

AGS

WINDOW SAMPLE LOG

Contract: Cookstown Industrial Estate SI		Client: Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd		Window Sample: BH103
Contract Ref: 602923	Start: 25.05.20 End: 25.05.20	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
							MADE GROUND: Black tarmac.	0.10	
							MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.30	
							MADE GROUND: Brownish black sandy CLAY with medium to large boulders. Sand is fine.	0.50	
							MADE GROUND: Brown slightly sandy gravelly CLAY. Gravel is small to medium and subangular to angular with small to medium cobbles.	(0.50) 1.00	
							Light brown very sandy gravelly CLAY. Gravel is small to medium and subangular to angular with cobbles.	(1.00) 2.00	
							Light brown sandy gravelly CLAY. Sand is fine. Gravel is small to medium and subangular with black boulders (assumed boulder clay).	(1.80) 3.80	
							Borehole refused on boulder at 3.80m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 3.80m depth on completion. Response zone 2.50m to 3.80m depth.

All dimensions in metres | Scale: 1:25

Method Used: Tracked window sampling	Plant Used: Dando Terrier	Drilled By: Groundcheck	Logged By: RMurphy	Checked By:

AGS

WINDOW SAMPLE LOG

Contract: Cookstown Industrial Estate SI	Client: Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd	Window Sample: BH104
Contract Ref: 602923	Start: 25.05.20 End: 25.05.20 / Ground Level: --- / Co-ordinates: ---	Sheet: 1 of 1

Window Run	Depth	No	Type	Results	Water	Description of Strata	Depth (Thickness)
						MADE GROUND: Black tarmac.	0.10
						MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.30
						Light brown soft very sandy gravelly CLAY. Gravel is small to medium. Sand is fine.	(0.60) 0.90
						Hard/stiff light brown very sandy gravelly soft CLAY with boulders (assumed boulder clay). Gravel is small to medium. Sand is fine.	(2.70) 3.60
						Borehole refused on boulder at 3.60m depth.	

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 3.60m depth on completion. Response zone 2.50m to 3.60m depth.

All dimensions in metres | Scale: 1:25

Method Used: Tracked window sampling	Plant Used: Dando Terrier	Drilled By: Groundcheck	Logged By: RMurphy	Checked By:

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Cookstown Industrial Estate SI	Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd	BH105

Contract Ref:	Start: 26.05.20	Ground Level:	Co-ordinates:	Sheet:
602923	End: 26.05.20	---	---	1 of 1

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
							MADE GROUND: Black tarmac.	0.16	
							MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.30	
							Brown very sandy gravelly CLAY. Gravel is small to medium and subangular with boulders/cobbles. . . . from 0.90m depth contains boulders (assumed boulder clay). . . . slightly damp between 3.00m and 4.00m depth.	(4.00) 4.30	
							Borehole refused on boulder at 4.30m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 4.30m depth on completion. Response zone 2.50m to 4.30m depth.

All dimensions in metres | Scale: 1:25

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	Dando Terrier	Groundcheck	RMurphy	

AGS

APPENDIX C

Soil Laboratory Certificates of Analysis

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

RSK Group Plc
Unit B
Bluebell Business Centre
Old Naas Road
Dublin
Dublin 12

Attention: Paul Feely

CERTIFICATE OF ANALYSIS

Date of report Generation:	23 June 2020
Customer:	RSK Group Plc
Sample Delivery Group (SDG):	200528-125
Your Reference:	602923
Location:	Cookstown Industrial Estate
Report No:	556226

We received 22 samples on Thursday May 28, 2020 and 7 of these samples were scheduled for analysis which was completed on Tuesday June 23, 2020. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan
Operations Manager

1291

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
22217042	BH101		0.00 - 1.00	25/05/2020
22217043	BH101		1.00 - 2.00	25/05/2020
22217044	BH101		2.00 - 3.00	25/05/2020
22217045	BH101		3.00 - 3.40	25/05/2020
22217046	BH102		0.00 - 1.00	25/05/2020
22217048	BH102		1.00 - 2.00	25/05/2020
22217050	BH102		2.00 - 3.00	25/05/2020
22217052	BH102		3.00 - 4.00	25/05/2020
22217053	BH102		4.00 - 4.60	25/05/2020
22217055	BH103		0.00 - 1.00	25/05/2020
22217056	BH103		1.00 - 2.00	25/05/2020
22217057	BH103		2.00 - 3.00	25/05/2020
22217058	BH103		3.00 - 3.80	25/05/2020
22217059	BH104		0.00 - 1.00	26/05/2020
22217060	BH104		1.00 - 2.00	26/05/2020
22217061	BH104		2.00 - 3.00	26/05/2020
22217062	BH104		3.00 - 3.60	26/05/2020
22217063	BH105		0.00 - 1.00	26/05/2020
22217064	BH105		1.00 - 2.00	26/05/2020
22217065	BH105		2.00 - 3.00	26/05/2020
22217068	BH105		3.00 - 4.00	26/05/2020
22217069	BH105		4.00 - 4.30	26/05/2020

Maximum Sample/Coolbox Temperature (°C) : **14.2**

ISO5667-3 Water quality - Sampling - Part3 -
During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			22217044			22217048			22217053			22217056			22217060			22217062			22217065	
Customer Sample Reference			BH101			BH102			BH102			BH103			BH104			BH104			BH105	
AGS Reference																						
Depth (m)			2.00 - 3.00			1.00 - 2.00			4.00 - 4.60			1.00 - 2.00			1.00 - 2.00			3.00 - 3.60			2.00 - 3.00	
Container			1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)
Sample Type			S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Asbestos ID in Solid Samples	All	NDPs: 0 Tests: 7	X			X			X			X			X			X			X	
EPH CWG GC (S)	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
GRO by GC-FID (S)	All	NDPs: 0 Tests: 7			X			X			X			X			X			X		
Metals in solid samples by OES	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
PAH by GCMS	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
pH	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
Sample description	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
Total Organic Carbon	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
TPH CWG GC (S)	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
VOC MS (S)	All	NDPs: 0 Tests: 7			X			X			X			X			X			X		

22217065	BH105		2.00 - 3.00	60g VOC (ALE215)	S						X														X

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Inclusions	Inclusions 2
22217044	BH101	2.00 - 3.00	Dark Brown	Sandy Loam	Stones	Vegetation
22217048	BH102	1.00 - 2.00	Dark Brown	Clay Loam	Stones	None
22217053	BH102	4.00 - 4.60	Dark Brown	Clay Loam	Stones	None
22217056	BH103	1.00 - 2.00	Dark Brown	Clay Loam	Stones	None
22217060	BH104	1.00 - 2.00	Dark Brown	Sandy Loam	Stones	Vegetation
22217062	BH104	3.00 - 3.60	Dark Brown	Loamy Sand	Stones	Vegetation
22217065	BH105	2.00 - 3.00	Dark Brown	Sand	Stones	None

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Validated

CERTIFICATE OF ANALYSIS

SDG: 200528-125 **Client Reference:** 602923 **Report Number:** 556226
Location: Cookstown Industrial Estat **Order Number:** P2021703 **Superseded Report:**

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Customer Sample Ref.			BH101	BH102	BH102	BH103	BH104	BH104
Depth (m)			2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60
Sample Type			Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Date Sampled			25/05/2020	25/05/2020	25/05/2020	25/05/2020	26/05/2020	26/05/2020
Sampled Time			.	.	.	.	.	.
Date Received			28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
SDG Ref			200528-125	200528-125	200528-125	200528-125	200528-125	200528-125
Lab Sample No.(s)			22217044	22217048	22217053	22217056	22217060	22217062
AGS Reference								
Component	**LOD/Units**	**Method**						
Moisture Content Ratio (% of as received sample)	%	PM024	8	7.7	7.7	9.6	10	8.6
Organic Carbon, Total	<0.2 %	TM132	<0.2 M	<0.2 M	<0.2 M	0.216 M	<0.2 M	<0.2 M
pH	1 pH Units	TM133	8.75 M	8.83 M	8.83 M	8.93 M	8.74 M	9.41 M
Arsenic	<0.6 mg/kg	TM181	9.72 M	8.01 M	9.33 M	8.68 M	8 M	9.56 M
Cadmium	<0.02 mg/kg	TM181	1.23 M	1.05 M	1.2 M	1.18 M	1.07 M	1.03 M
Chromium	<0.9 mg/kg	TM181	11.2 M	9.64 M	11.5 M	6.3 M	6.34 M	9.64 M
Copper	<1.4 mg/kg	TM181	15.4 M	12.9 M	15 M	13.8 M	12.9 M	13.1 M
Lead	<0.7 mg/kg	TM181	25.7 M	16.7 M	20.9 M	16.1 M	15.7 M	17.1 M
Mercury	<0.14 mg/kg	TM181	<0.14 M	<0.14 M	<0.14 M	<0.14 M	<0.14 M	<0.14 M
Nickel	<0.2 mg/kg	TM181	29.3 M	23.8 M	27.6 M	23.5 M	22.5 M	22.7 M
Selenium	<1 mg/kg	TM181	1.16 #	<1 #	1.39 #	1.27 #	1.2 #	1.06 #
Zinc	<1.9 mg/kg	TM181	88.7 M	74.9 M	86.5 M	67.3 M	66 M	66.4 M

Validated

CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

		Customer Sample Ref.	BH105
		Depth (m)	2.00 - 3.00
		Sample Type	Soil/Solid (S)
		Date Sampled	26/05/2020
		Sampled Time	.
		Date Received	28/05/2020
		SDG Ref	200528-125
		Lab Sample No.(s)	22217065
		AGS Reference	
Component	**LOD/Units**	**Method**	
Moisture Content Ratio (% of as received sample)	%	PM024	6
Organic Carbon, Total	<0.2 %	TM132	<0.2 M
pH	1 pH Units	TM133	10.6 M
Arsenic	<0.6 mg/kg	TM181	6.48 M
Cadmium	<0.02 mg/kg	TM181	0.799 M
Chromium	<0.9 mg/kg	TM181	9.25 M
Copper	<1.4 mg/kg	TM181	9.57 M
Lead	<0.7 mg/kg	TM181	11.9 M
Mercury	<0.14 mg/kg	TM181	<0.14 M
Nickel	<0.2 mg/kg	TM181	17.3 M
Selenium	<1 mg/kg	TM181	1.25 #
Zinc	<1.9 mg/kg	TM181	51.7 M

Validated

CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

PAH by GCMS

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	BH101	BH102	BH102	BH103	BH104	BH104
Customer Sample Ref.			BH101	BH102	BH102	BH103	BH104	BH104
Depth (m)			2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60
Sample Type			Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Date Sampled			25/05/2020	25/05/2020	25/05/2020	25/05/2020	26/05/2020	26/05/2020
Sampled Time			.	.	.	.	.	.
Date Received			28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
SDG Ref			200528-125	200528-125	200528-125	200528-125	200528-125	200528-125
Lab Sample No.(s)			22217044	22217048	22217053	22217056	22217060	22217062
AGS Reference								
Naphthalene-d8 % recovery**	%	TM218	89	89.2	93	88.5	88.7	88
Acenaphthene-d10 % recovery**	%	TM218	90.6	88.6	88.4	88.3	87.8	89.6
Phenanthrene-d10 % recovery**	%	TM218	90.7	88.6	82.8	89	88.2	91.2
Chrysene-d12 % recovery**	%	TM218	88.8	84.6	71	90.2	89.4	93.7
Perylene-d12 % recovery**	%	TM218	85.9	80.6	70.3	87.9	88	89.6
Naphthalene	<9 µg/kg	TM218	<9 M	<9 M	<9 M	<9 M	<9 M	14 M
Acenaphthylene	<12 µg/kg	TM218	<12 M	<12 M	<12 M	<12 M	<12 M	<12 M
Acenaphthene	<8 µg/kg	TM218	<8 M	<8 M	<8 M	<8 M	<8 M	<8 M
Fluorene	<10 µg/kg	TM218	<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Phenanthrene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Anthracene	<16 µg/kg	TM218	<16 M	<16 M	<16 M	<16 M	<16 M	<16 M
Fluoranthene	<17 µg/kg	TM218	<17 M	<17 M	<17 M	<17 M	<17 M	<17 M
Pyrene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Benz(a)anthracene	<14 µg/kg	TM218	<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
Chrysene	<10 µg/kg	TM218	<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Benzo(b)fluoranthene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Benzo(k)fluoranthene	<14 µg/kg	TM218	<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
Benzo(a)pyrene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218	<18 M	<18 M	<18 M	<18 M	<18 M	<18 M
Dibenzo(a,h)anthracene	<23 µg/kg	TM218	<23 M	<23 M	<23 M	<23 M	<23 M	<23 M
Benzo(g,h,i)perylene	<24 µg/kg	TM218	<24 M	<24 M	<24 M	<24 M	<24 M	<24 M
PAH, Total Detected USEPA 16	<118 µg/kg	TM218	<118	<118	<118	<118	<118	<118

CERTIFICATE OF ANALYSIS

Validated

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

PAH by GCMS

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

		Customer Sample Ref.	BH105
		Depth (m)	2.00 - 3.00
		Sample Type	Soil/Solid (S)
		Date Sampled	26/05/2020
		Sampled Time	.
		Date Received	28/05/2020
		SDG Ref	200528-125
		Lab Sample No.(s)	22217065
		AGS Reference	
Component	**LOD/Units**	**Method**	
Naphthalene-d8 % recovery**	%	TM218	88.6
Acenaphthene-d10 % recovery**	%	TM218	90.7
Phenanthrene-d10 % recovery**	%	TM218	91.3
Chrysene-d12 % recovery**	%	TM218	85.4
Perylene-d12 % recovery**	%	TM218	80.7
Naphthalene	<9 µg/kg	TM218	15 M
Acenaphthylene	<12 µg/kg	TM218	<12 M
Acenaphthene	<8 µg/kg	TM218	<8 M
Fluorene	<10 µg/kg	TM218	<10 M
Phenanthrene	<15 µg/kg	TM218	<15 M
Anthracene	<16 µg/kg	TM218	<16 M
Fluoranthene	<17 µg/kg	TM218	<17 M
Pyrene	<15 µg/kg	TM218	<15 M
Benz(a)anthracene	<14 µg/kg	TM218	<14 M
Chrysene	<10 µg/kg	TM218	<10 M
Benzo(b)fluoranthene	<15 µg/kg	TM218	<15 M
Benzo(k)fluoranthene	<14 µg/kg	TM218	<14 M
Benzo(a)pyrene	<15 µg/kg	TM218	<15 M
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218	<18 M
Dibenzo(a,h)anthracene	<23 µg/kg	TM218	<23 M
Benzo(g,h,i)perylene	<24 µg/kg	TM218	<24 M
PAH, Total Detected USEPA 16	<118 µg/kg	TM218	<118

CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

TPH CWG (S)

Results Legend
- # ISO17025 accredited.
- M *m*CERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-3+§@ Sample deviation (see appendix)

		Customer Sample Ref.	BH101	BH102	BH102	BH103	BH104	BH104
		Depth (m)	2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60
		Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
		Date Sampled	25/05/2020	25/05/2020	25/05/2020	25/05/2020	26/05/2020	26/05/2020
		Sampled Time	.	.	.	.	.	.
		Date Received	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
		SDG Ref	200528-125	200528-125	200528-125	200528-125	200528-125	200528-125
		Lab Sample No.(s)	22217044	22217048	22217053	22217056	22217060	22217062
		AGS Reference						
Component	**LOD/Units**	**Method**						
GRO Surrogate % recovery**	%	TM089	94.4	98.5	102	127	96.6	94.3
Aliphatics >C5-C6	<10 µg/kg	TM089	<10	<10	<10	<10	<10	<10
Aliphatics >C6-C8	<10 µg/kg	TM089	<10	<10	23.8	<10	<10	13.1
Aliphatics >C8-C10	<10 µg/kg	TM089	<10	<10	186	<10	<10	25.2
Aliphatics >C10-C12	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aliphatics >C12-C16	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aliphatics >C16-C21	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aliphatics >C21-C35	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aliphatics >C35-C44	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Total Aliphatics >C10-C44	<5000 µg/kg	TM414	<5000	<5000	<5000	<5000	<5000	<5000
Total Aliphatics & Aromatics >C10-C44	<10000 µg/kg	TM414	<10000	<10000	<10000	<10000	<10000	<10000
Aromatics >EC5-EC7	<10 µg/kg	TM089	<10	<10	<10	<10	<10	<10
Aromatics >EC7-EC8	<10 µg/kg	TM089	<10	<10	<10	<10	<10	<10
Aromatics >EC8-EC10	<10 µg/kg	TM089	<10	<10	125	<10	<10	16.4
Aromatics > EC10-EC12	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aromatics > EC12-EC16	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aromatics > EC16-EC21	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aromatics > EC21-EC35	<1000 µg/kg	TM414	<1000	<1000	<1000	2880	<1000	<1000
Aromatics >EC35-EC44	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aromatics > EC40-EC44	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Total Aromatics > EC10-EC44	<5000 µg/kg	TM414	<5000	<5000	<5000	<5000	<5000	<5000
Total Aliphatics & Aromatics >C5-C44	<10000 µg/kg	TM414	<10000	<10000	<10000	<10000	<10000	<10000
Total Aliphatics >C5-C10	<50 µg/kg	TM089	<50	<50	210	<50	<50	<50
Total Aromatics >EC5-EC10	<50 µg/kg	TM089	<50	<50	125	<50	<50	<50
GRO >C5-C10	<20 µg/kg	TM089	<20	<20	335	<20	<20	<20

CERTIFICATE OF ANALYSIS

Validated

SDG:	200528-125	Client Reference:	602923	Report Number:	556226
Location:	Cookstown Industrial Estat	Order Number:	P2021703	Superseded Report:	

TPH CWG (S)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Customer Sample Ref.	BH105		
Depth (m)	2.00 - 3.00		
Sample Type	Soil/Solid (S)		
Date Sampled	26/05/2020		
Sampled Time	.		
Date Received	28/05/2020		
SDG Ref	200528-125		
Lab Sample No.(s)	22217065		
AGS Reference			

Component	LOD/Units	Method	BH105					
GRO Surrogate % recovery**	%	TM089	101					
Aliphatics >C5-C6	<10 µg/kg	TM089	<10					
Aliphatics >C6-C8	<10 µg/kg	TM089	12.8					
Aliphatics >C8-C10	<10 µg/kg	TM089	68.1					
Aliphatics >C10-C12	<1000 µg/kg	TM414	<1000					
Aliphatics >C12-C16	<1000 µg/kg	TM414	<1000					
Aliphatics >C16-C21	<1000 µg/kg	TM414	<1000					
Aliphatics >C21-C35	<1000 µg/kg	TM414	<1000					
Aliphatics >C35-C44	<1000 µg/kg	TM414	<1000					
Total Aliphatics >C10-C44	<5000 µg/kg	TM414	<5000					
Total Aliphatics & Aromatics >C10-C44	<10000 µg/kg	TM414	<10000					
Aromatics >EC5-EC7	<10 µg/kg	TM089	<10					
Aromatics >EC7-EC8	<10 µg/kg	TM089	<10					
Aromatics >EC8-EC10	<10 µg/kg	TM089	44.7					
Aromatics > EC10-EC12	<1000 µg/kg	TM414	<1000					
Aromatics > EC12-EC16	<1000 µg/kg	TM414	<1000					
Aromatics > EC16-EC21	<1000 µg/kg	TM414	<1000					
Aromatics > EC21-EC35	<1000 µg/kg	TM414	<1000					
Aromatics >EC35-EC44	<1000 µg/kg	TM414	<1000					
Aromatics > EC40-EC44	<1000 µg/kg	TM414	<1000					
Total Aromatics > EC10-EC44	<5000 µg/kg	TM414	<5000					
Total Aliphatics & Aromatics >C5-C44	<10000 µg/kg	TM414	<10000					
Total Aliphatics >C5-C10	<50 µg/kg	TM089	80.9					
Total Aromatics >EC5-EC10	<50 µg/kg	TM089	<50					
GRO >C5-C10	<20 µg/kg	TM089	80.9					

VOC MS (S)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	BH101	BH102	BH102	BH103	BH104	BH104
Depth (m)			2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60
Sample Type			Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Date Sampled			25/05/2020	25/05/2020	25/05/2020	25/05/2020	26/05/2020	26/05/2020
Sampled Time			.	.	.	.	.	.
Date Received			28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
SDG Ref			200528-125	200528-125	200528-125	200528-125	200528-125	200528-125
Lab Sample No.(s)			22217044	22217048	22217053	22217056	22217060	22217062
AGS Reference								
Dibromofluoromethane**	%	TM116	114	124	118	111	110	111
Toluene-d8**	%	TM116	99.4	100	99.9	100	100	101
4-Bromofluorobenzene**	%	TM116	96.6	96.5	99	98.5	95.7	99
Methyl Tertiary Butyl Ether	<10 µg/kg	TM116	<200 M	<200 M	<200 M	<200 M	<2000 M	<200 M
Benzene	<9 µg/kg	TM116	<180 M	<180 M	<180 M	<180 M	<1800 M	<180 M
Toluene	<7 µg/kg	TM116	<140 M	<140 M	<140 M	<140 M	<1400 M	<140 M
Ethylbenzene	<4 µg/kg	TM116	<80 M	<80 M	<80 M	<80 M	<800 M	<80 M
p/m-Xylene	<10 µg/kg	TM116	<200 #	<200 #	<200 #	<200 #	<2000 #	<200 #
o-Xylene	<10 µg/kg	TM116	<200 M	<200 M	<200 M	<200 M	<2000 M	<200 M
Sum of Detected Xylenes	<0.02 mg/kg	TM116	<0.4	<0.4	<0.4	<0.4	<4	<0.4
Sum of BTEX	<40 µg/kg	TM116	<800	<800	<800	<800	<8000	<800

Validated

CERTIFICATE OF ANALYSIS

SDG:	200528-125	Client Reference:	602923	Report Number:	556226
Location:	Cookstown Industrial Estat	Order Number:	P2021703	Superseded Report:	

VOC MS (S)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Customer Sample Ref.	BH105	
Depth (m)	2.00 - 3.00	
Sample Type	Soil/Solid (S)	
Date Sampled	26/05/2020	
Sampled Time	.	
Date Received	28/05/2020	
SDG Ref	200528-125	
Lab Sample No.(s)	22217065	
AGS Reference		

Component	LOD/Units	Method	BH105					
Dibromofluoromethane**	%	TM116	111					
Toluene-d8**	%	TM116	101					
4-Bromofluorobenzene**	%	TM116	96.7					
Methyl Tertiary Butyl Ether	<10 µg/kg	TM116	<200 M					
Benzene	<9 µg/kg	TM116	<180 M					
Toluene	<7 µg/kg	TM116	<140 M					
Ethylbenzene	<4 µg/kg	TM116	<80 M					
p/m-Xylene	<10 µg/kg	TM116	<200 #					
o-Xylene	<10 µg/kg	TM116	<200 M					
Sum of Detected Xylenes	<0.02 mg/kg	TM116	<0.4					
Sum of BTEX	<40 µg/kg	TM116	<800					

Asbestos Identification - Solid Samples

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
*	Subcontracted test.
(F)	Trigger breach confirmed
1-5&♦§@	Sample deviation (see appendix)

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH101 2.00 - 3.00 SOLID 25/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217044 TM048	04/06/2020	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH102 1.00 - 2.00 SOLID 25/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217048 TM048	04/06/2020	Marcin Magdziarek	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH102 4.00 - 4.60 SOLID 25/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217053 TM048	04/06/2020	Marcin Magdziarek	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH103 1.00 - 2.00 SOLID 25/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217056 TM048	04/06/20	Eva Guerra	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH104 1.00 - 2.00 SOLID 26/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217060 TM048	04/06/2020	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH104 3.00 - 3.60 SOLID 26/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217062 TM048	04/06/2020	Marcin Magdziarek	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH105 2.00 - 3.00 SOLID 26/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217065 TM048	04/06/2020	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected

Table of Results - Appendix

Method No	Reference	Description
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) by Headspace GC-FID (C4-C12)
TM116	Modified: US EPA Method 8260, 8120, 8020, 624, 610 & 602	Determination of Volatile Organic Compounds by Headspace / GC-MS
TM132	In - house Method	ELTRA CS800 Operators Guide
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES
TM218	Shaker extraction - EPA method 3546.	The determination of PAH in soil samples by GC-MS
TM414	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GCxGC-FID

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Test Completion Dates

Lab Sample No(s)	22217044	22217048	22217053	22217056	22217060	22217062	22217065
Customer Sample Ref.	BH101	BH102	BH102	BH103	BH104	BH104	BH105
AGS Ref.							
Depth	2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60	2.00 - 3.00
Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Asbestos ID in Solid Samples	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020
EPH CWG GC (S)	23-Jun-2020	22-Jun-2020	22-Jun-2020	22-Jun-2020	23-Jun-2020	23-Jun-2020	22-Jun-2020
GRO by GC-FID (S)	03-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	03-Jun-2020	03-Jun-2020	04-Jun-2020
Metals in solid samples by OES	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020
PAH by GCMS	02-Jun-2020	02-Jun-2020	03-Jun-2020	02-Jun-2020	02-Jun-2020	02-Jun-2020	02-Jun-2020
pH	04-Jun-2020	01-Jun-2020	01-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	01-Jun-2020
Sample description	30-May-2020	30-May-2020	30-May-2020	29-May-2020	30-May-2020	30-May-2020	30-May-2020
Total Organic Carbon	04-Jun-2020	04-Jun-2020	04-Jun-2020	03-Jun-2020	04-Jun-2020	05-Jun-2020	04-Jun-2020
TPH CWG GC (S)	23-Jun-2020	22-Jun-2020	22-Jun-2020	22-Jun-2020	23-Jun-2020	23-Jun-2020	22-Jun-2020
VOC MS (S)	03-Jun-2020	04-Jun-2020	04-Jun-2020	03-Jun-2020	04-Jun-2020	03-Jun-2020	03-Jun-2020

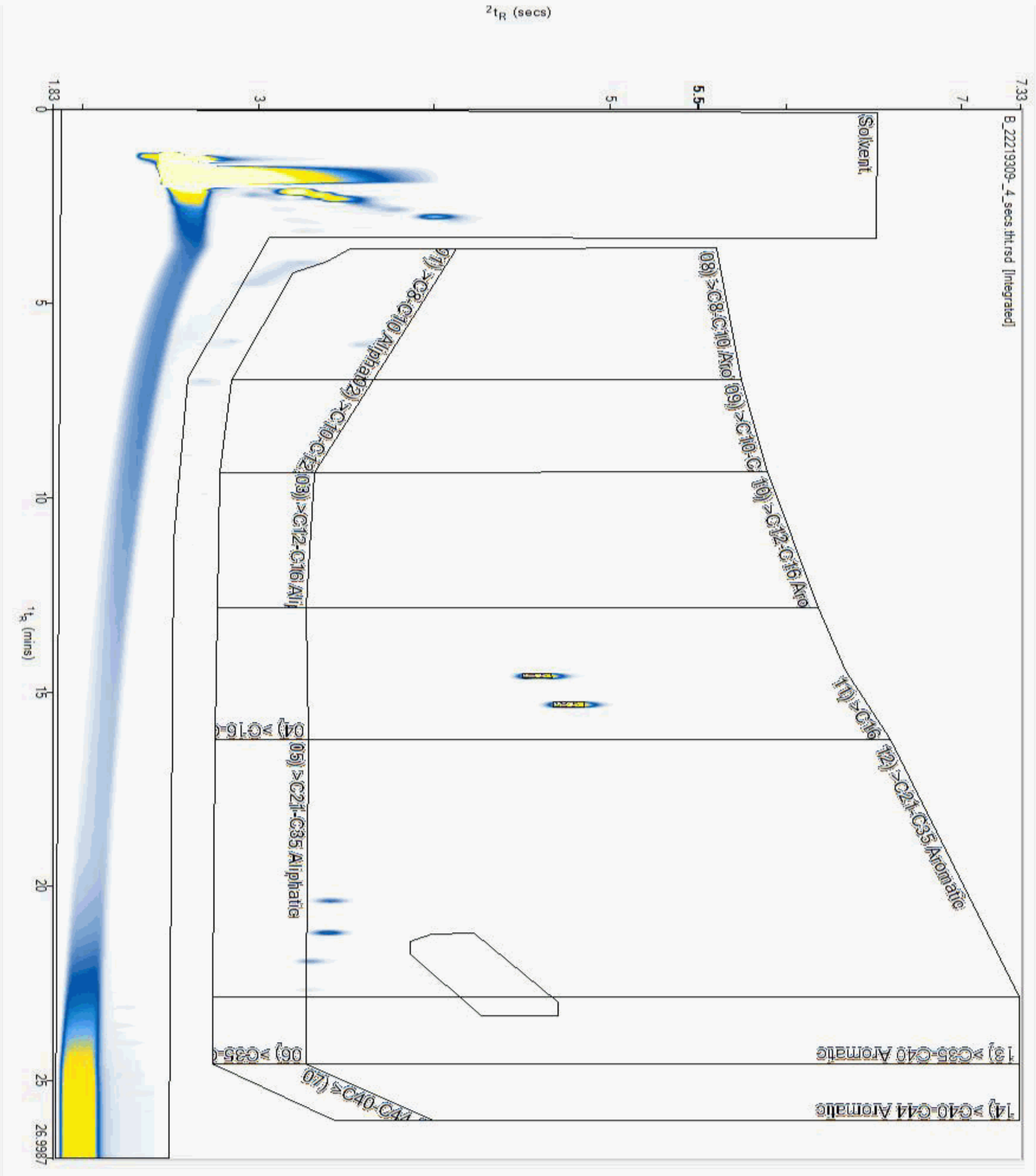
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	EPH CWG GC (S)	**Sample No :**	22219309	**Depth :**	1.00 - 2.00
		Sample ID :	BH103		

```
  ChromSpace LIMS export
 Current batch
Sample Identity:  B_22219309-_4_secs.tht
Date Acquired   :  21/06/20 05:13:28
Units           :  ppm
Dilution        :  0
CF              :
Multiplier      :
```



CERTIFICATE OF ANALYSIS

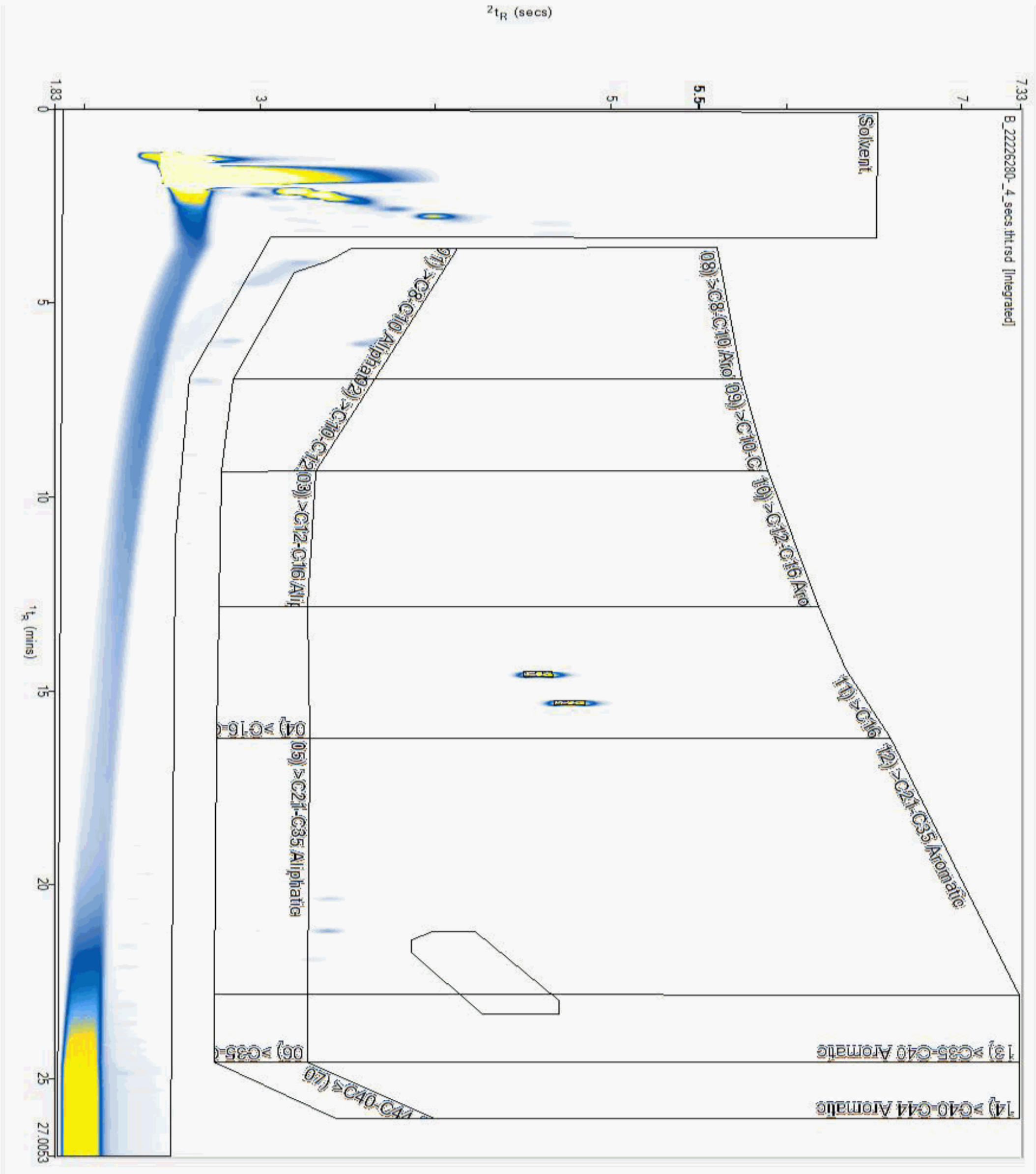
SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG GC (S) **Sample No :** 22226280 **Depth :** 1.00 - 2.00

Sample ID : BH102

```
  ChromSpace LIMS export
  Current batch
Sample Identity:  B_22226280-_4_secs.tht
Date Acquired  :  21/06/20 06:24:09
Units          :  ppm
Dilution       :  0
CF             :
Multiplier     :
```



Validated

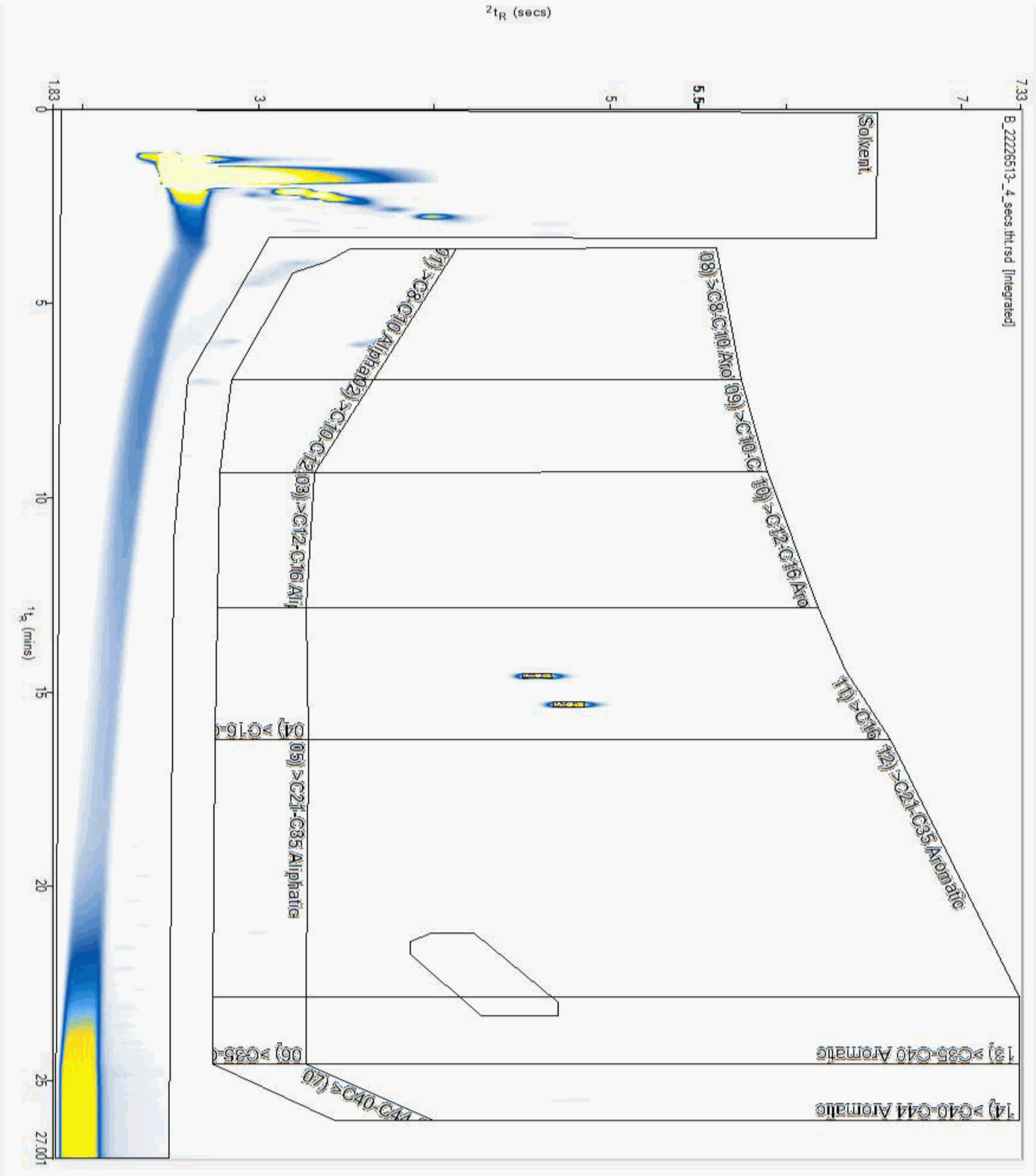
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	EPH CWG GC (S)	**Sample No :**	22226513	**Depth :**	4.00 - 4.60
		Sample ID :	BH102		

```
 ChromSpace LIMS export
  Current batch
Sample Identity:  B_22226513-_4_secs.tht
Date Acquired   :  21/06/20 05:53:32
Units           :  ppm
Dilution        :  0
CF              :
Multiplier      :
```



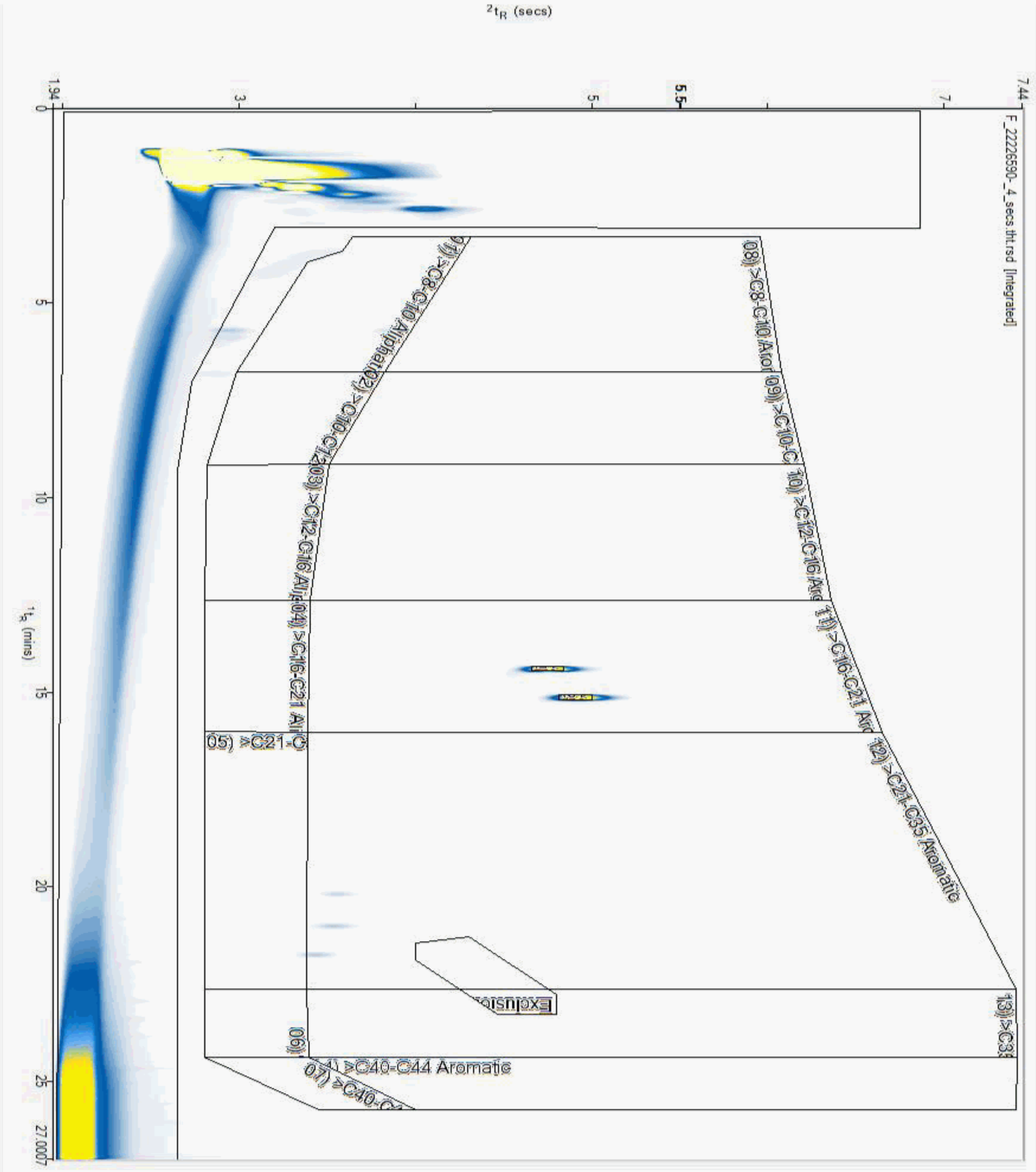
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG GC (S) **Sample No :** 22226590 **Depth :** 2.00 - 3.00
Sample ID : BH101

```
ChromSpace LIMS export
Current batch
Sample Identity:  F_22226590-_4_secs.tht
Date Acquired  :  22/06/20 09:13:20
Units          :  ppm
Dilution       :  0
CF             :
Multiplier     :
```



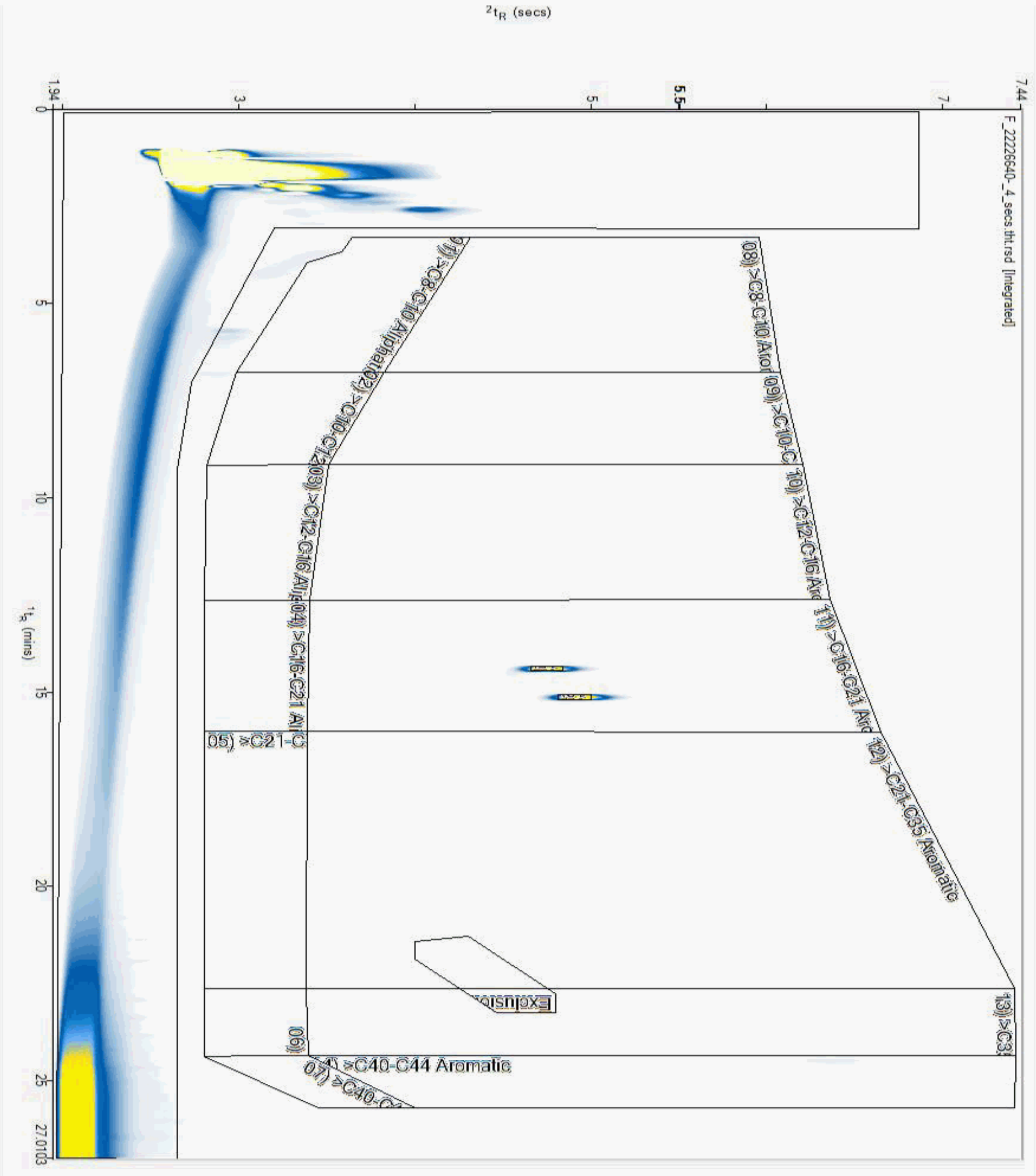
Chromatogram

Analysis: EPH CWG GC (S)

Sample No : 22226640
Sample ID : BH104

Depth : 3.00 - 3.60

```
ChromSpace LIMS export
Current batch
Sample Identity:  F_22226640-_4_secs.tht
Date Acquired   :  22/06/20 07:38:43
Units           :  ppm
Dilution        :  0
CF              :
Multiplier      :
```



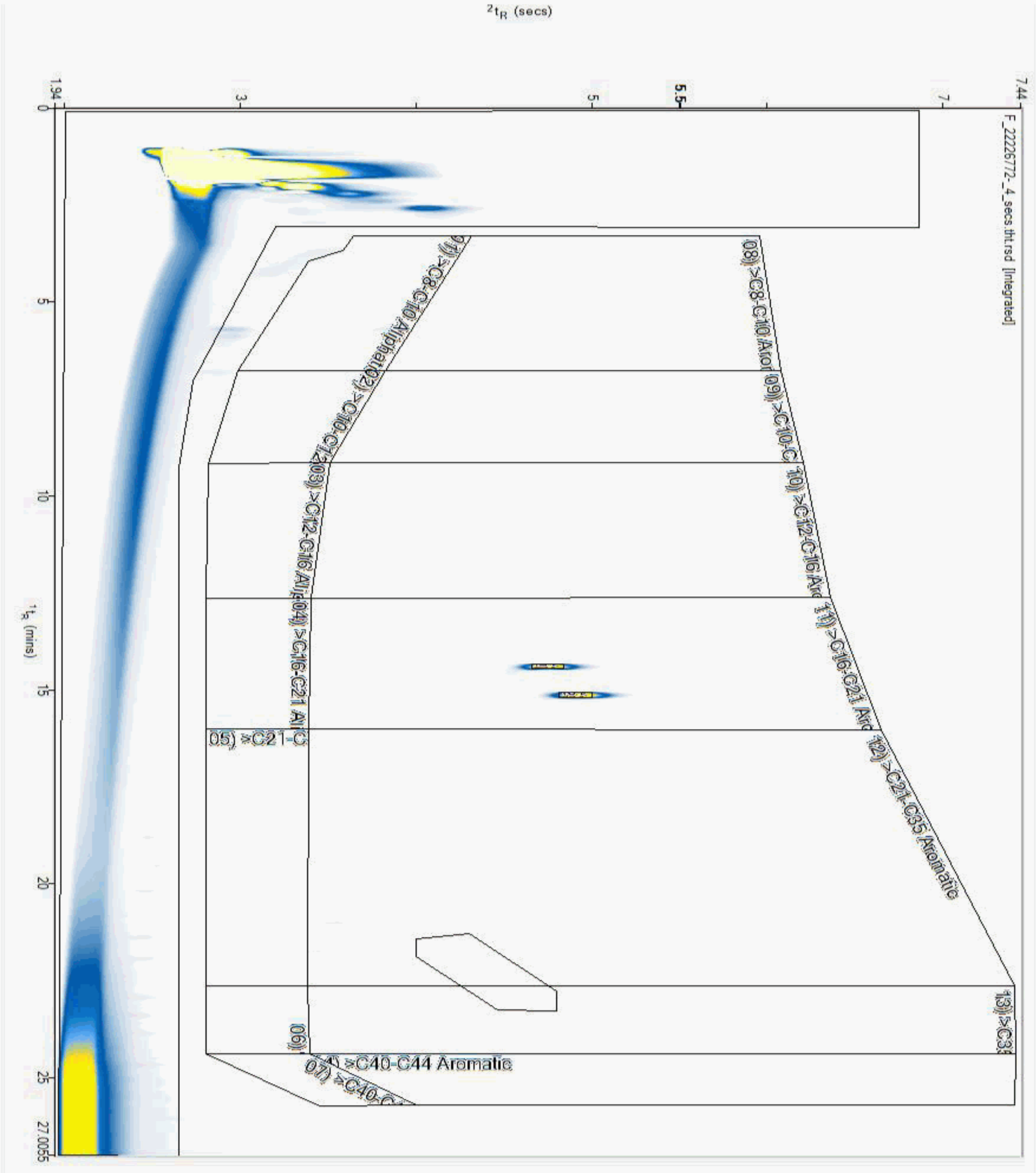
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	EPH CWG GC (S)	**Sample No :**	22226772	**Depth :**	1.00 - 2.00
		Sample ID :	BH104		

```
  ChromSpace LIMS export
    Current batch
Sample Identity:   F_22226772-_4_secs.tht
Date Acquired   :  22/06/20 08:10:16
Units           :  ppm
Dilution        :  0
CF              :
Multiplier      :
```



Validated

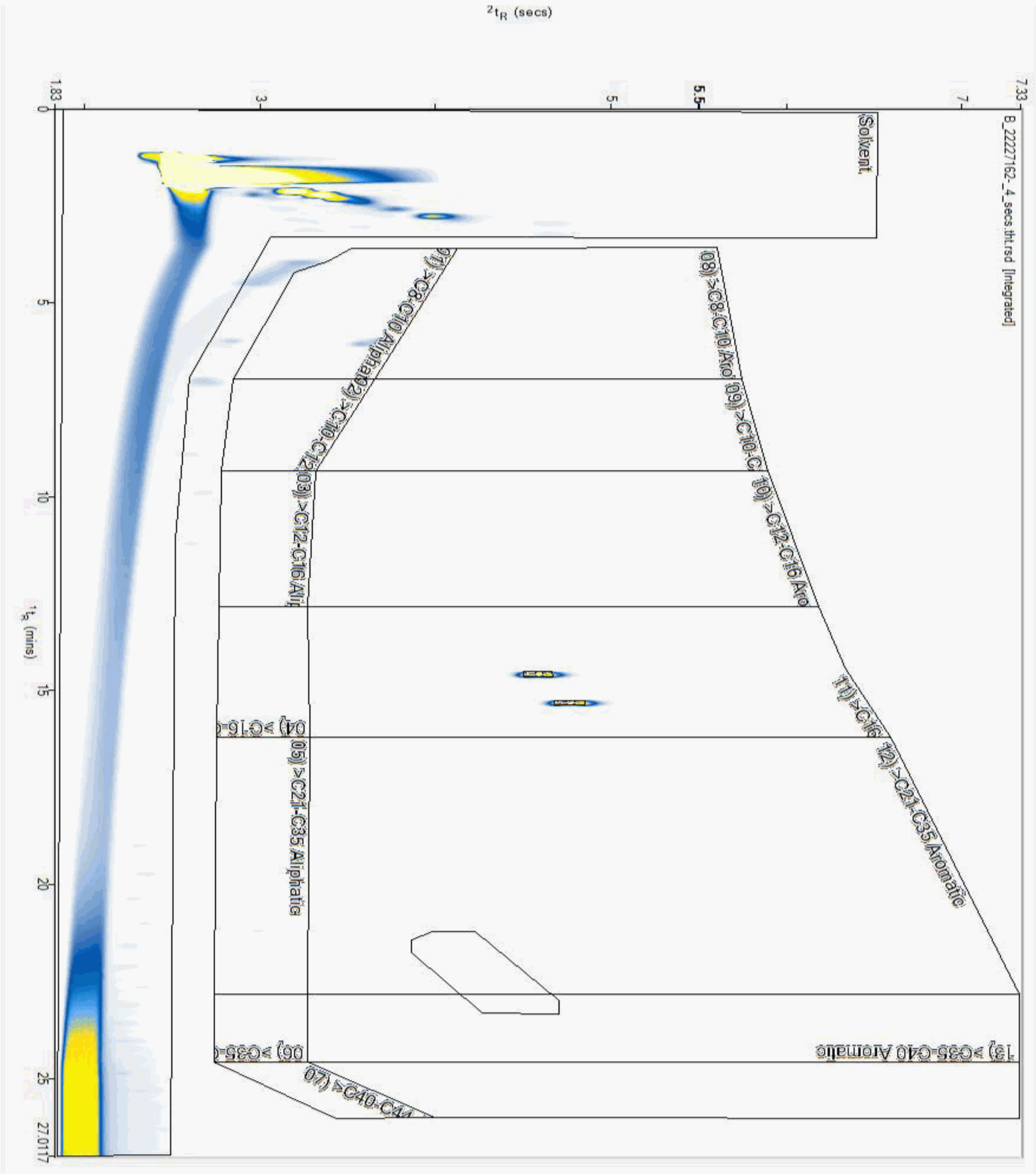
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	EPH CWG GC (S)	**Sample No :**	22227162	**Depth :**	2.00 - 3.00
		Sample ID :	BH105		

```
   ChromSpace LIMS export
  Current batch
Sample Identity:  B_22227162-_4_secs.tht
Date Acquired  :  21/06/20 07:25:18
Units          :  ppm
Dilution       :  0
CF             :
Multiplier     :
```

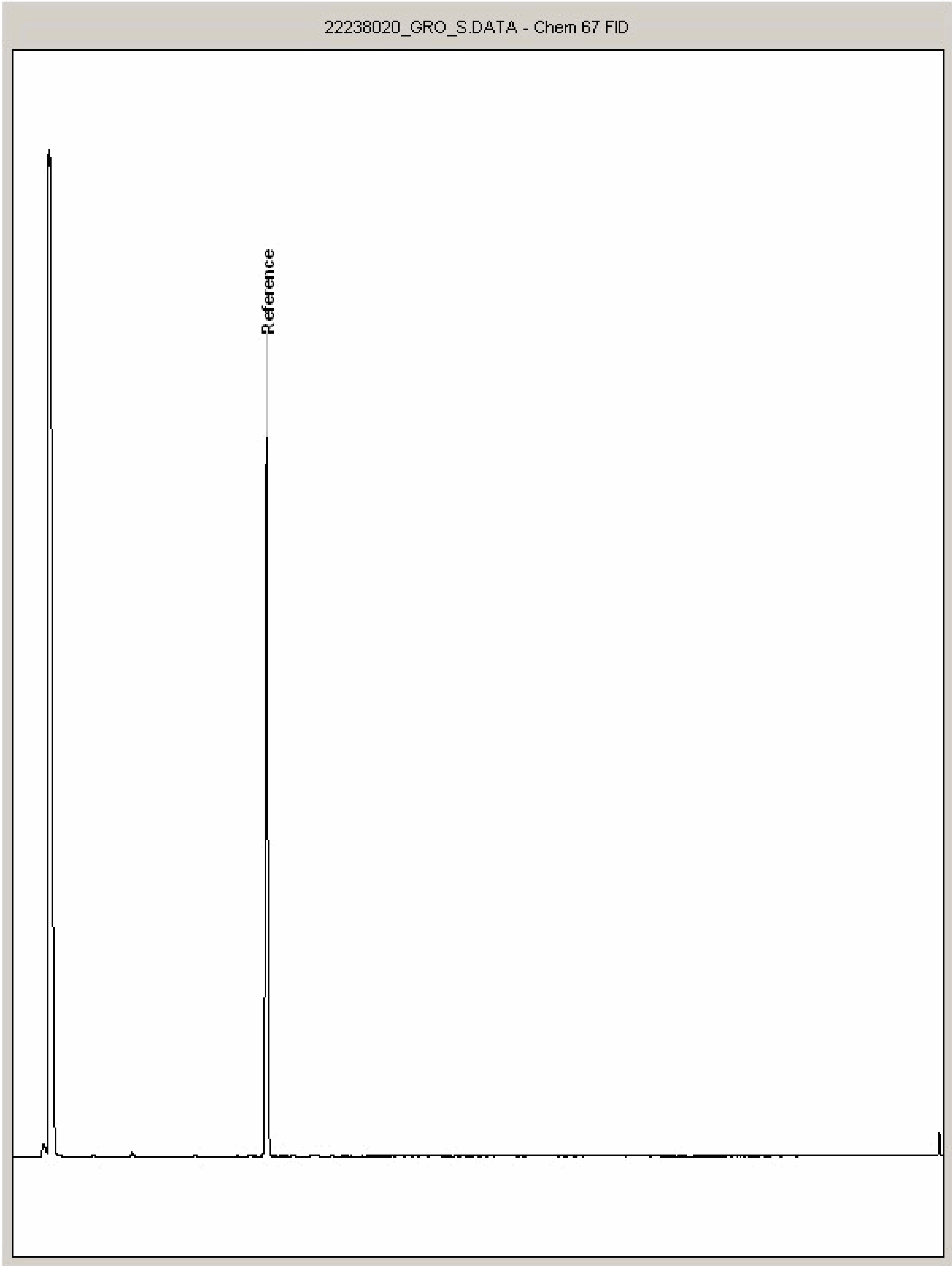


CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S) **Sample No :** 22238020 **Depth :** 1.00 - 2.00
Sample ID : BH104



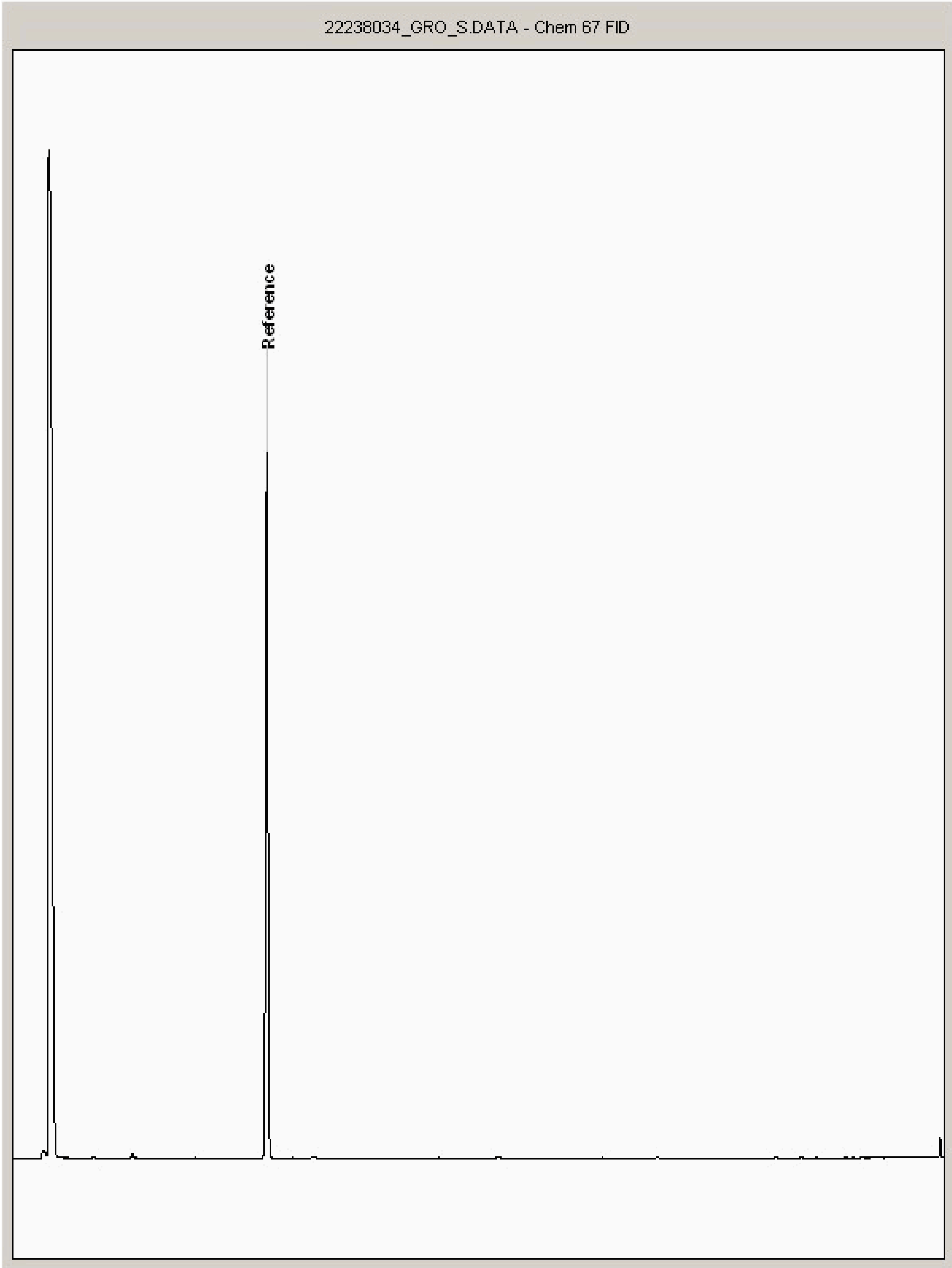
SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 22238034
Sample ID : BH101

Depth : 2.00 - 3.00

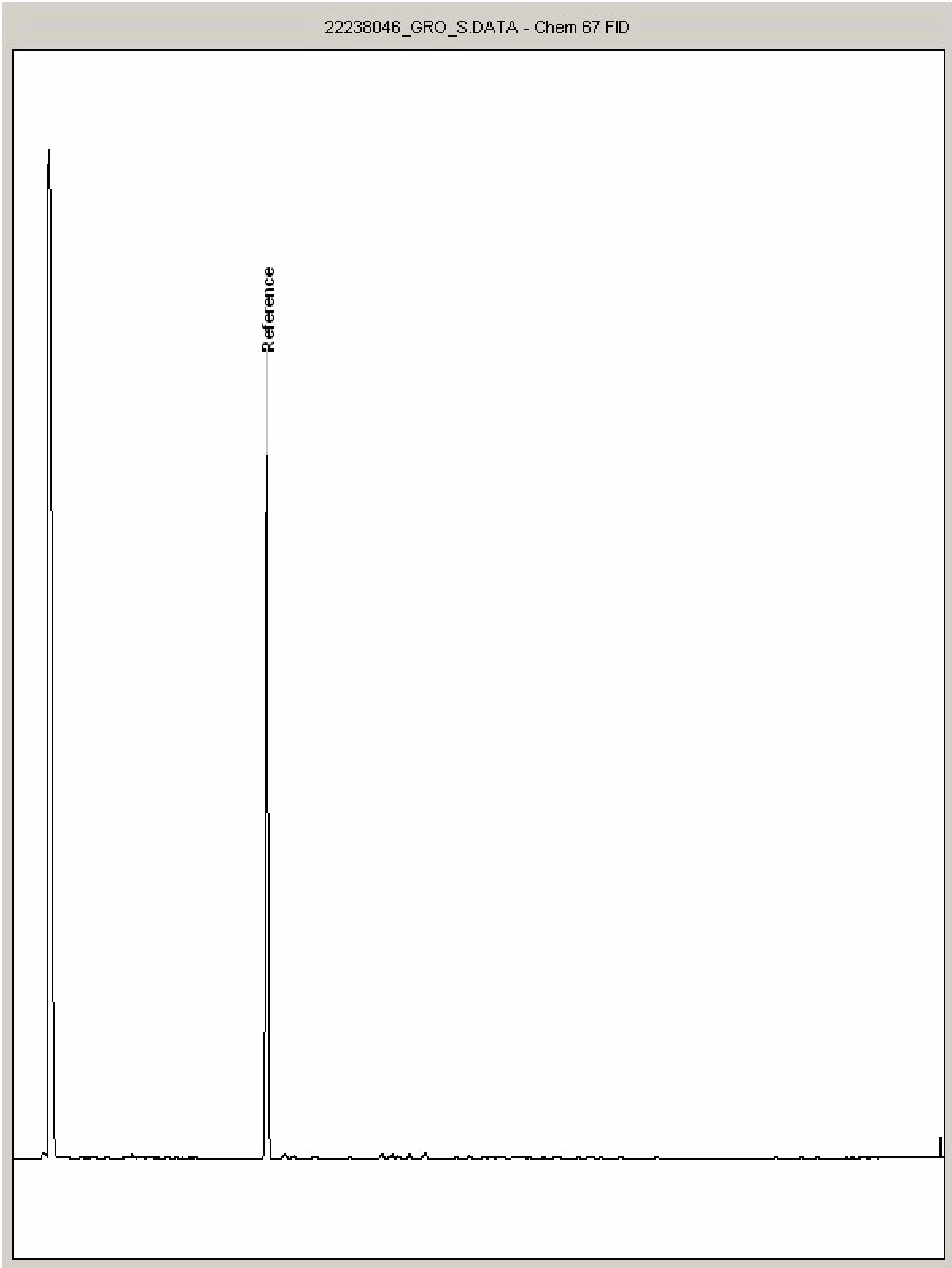


CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

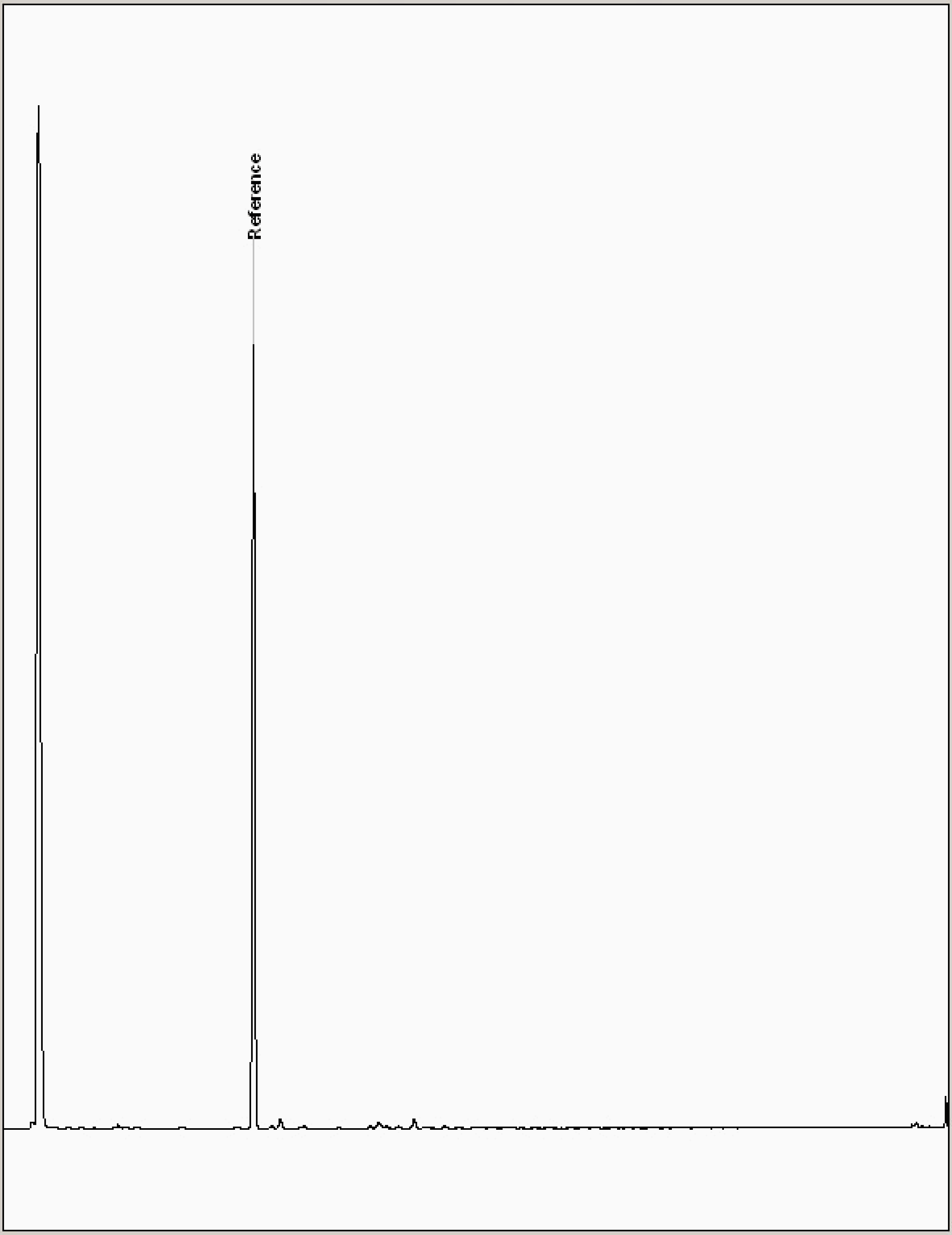
Analysis:	GRO by GC-FID (S)	**Sample No :**	22238046	**Depth :**	3.00 - 3.60
		Sample ID :	BH104		



Chromatogram

Analysis:	GRO by GC-FID (S)	**Sample No :**	22238166	**Depth :**	2.00 - 3.00
		Sample ID :	BH105		

22238166_GRO_S.DATA - HP6850 Signal 1



Validated

CERTIFICATE OF ANALYSIS

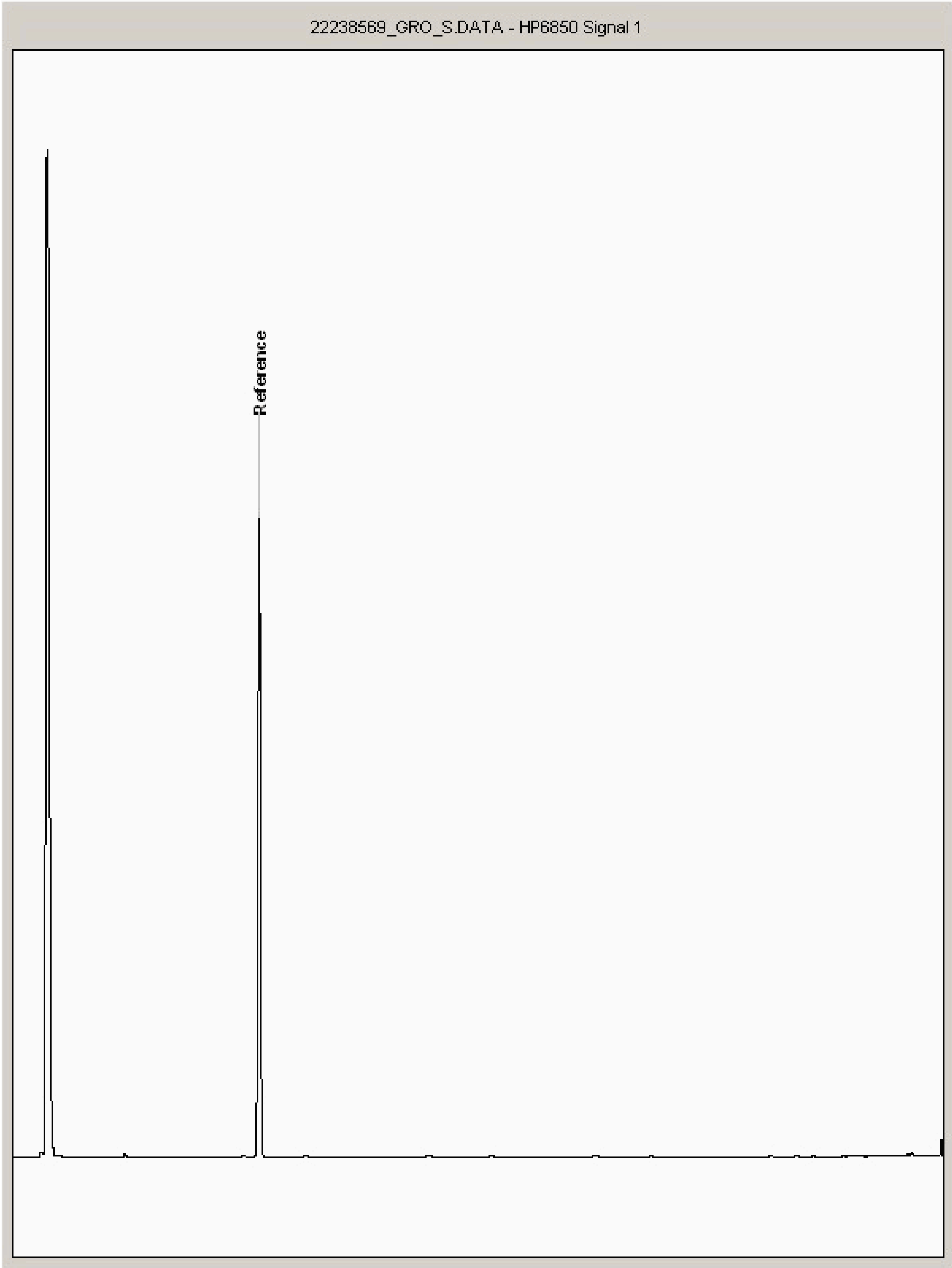
SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

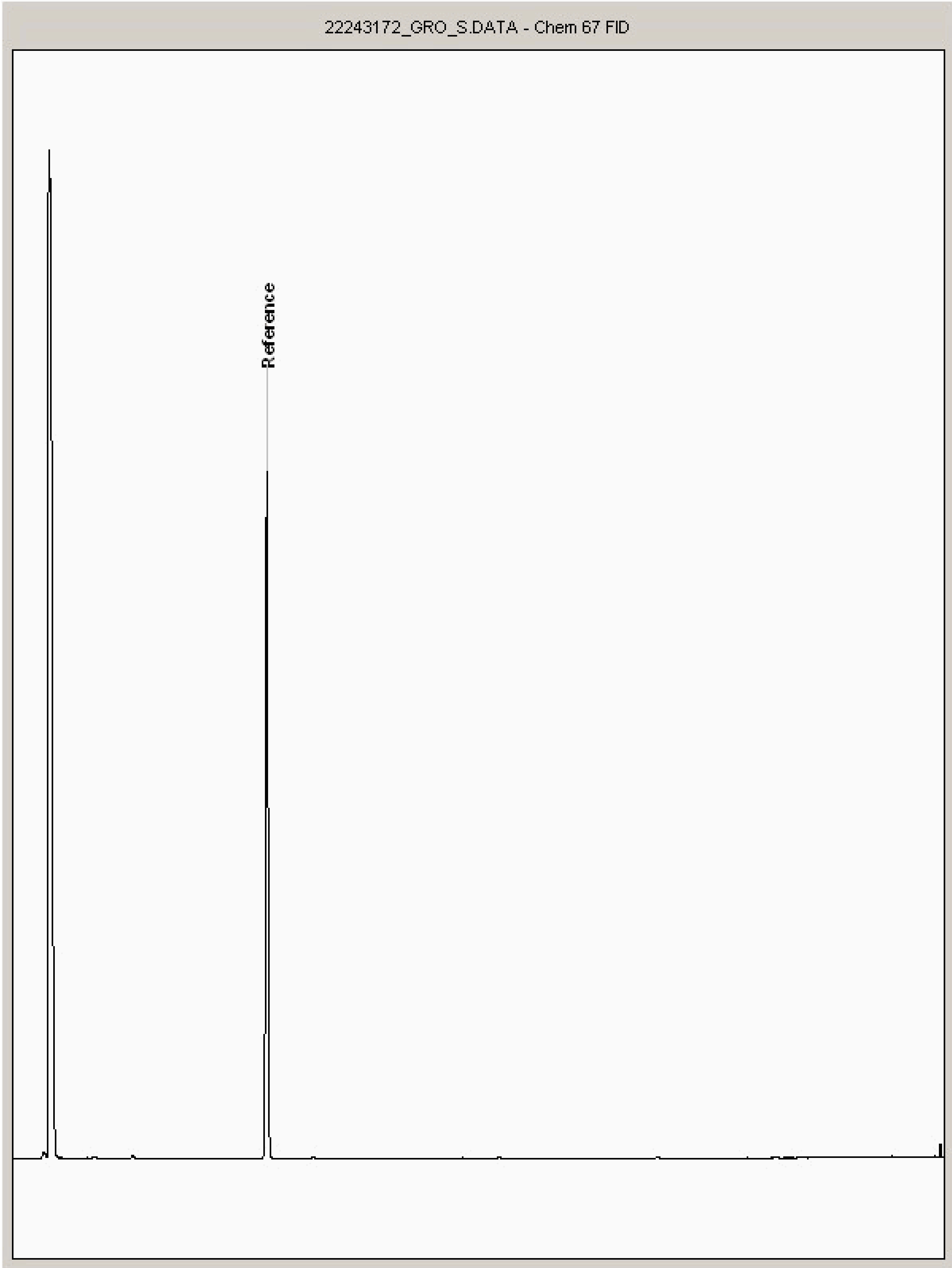
Sample No : 22238569
Sample ID : BH103

Depth : 1.00 - 2.00



Chromatogram

Analysis:	GRO by GC-FID (S)	**Sample No :**	22243172	**Depth :**	1.00 - 2.00
		Sample ID :	BH102		

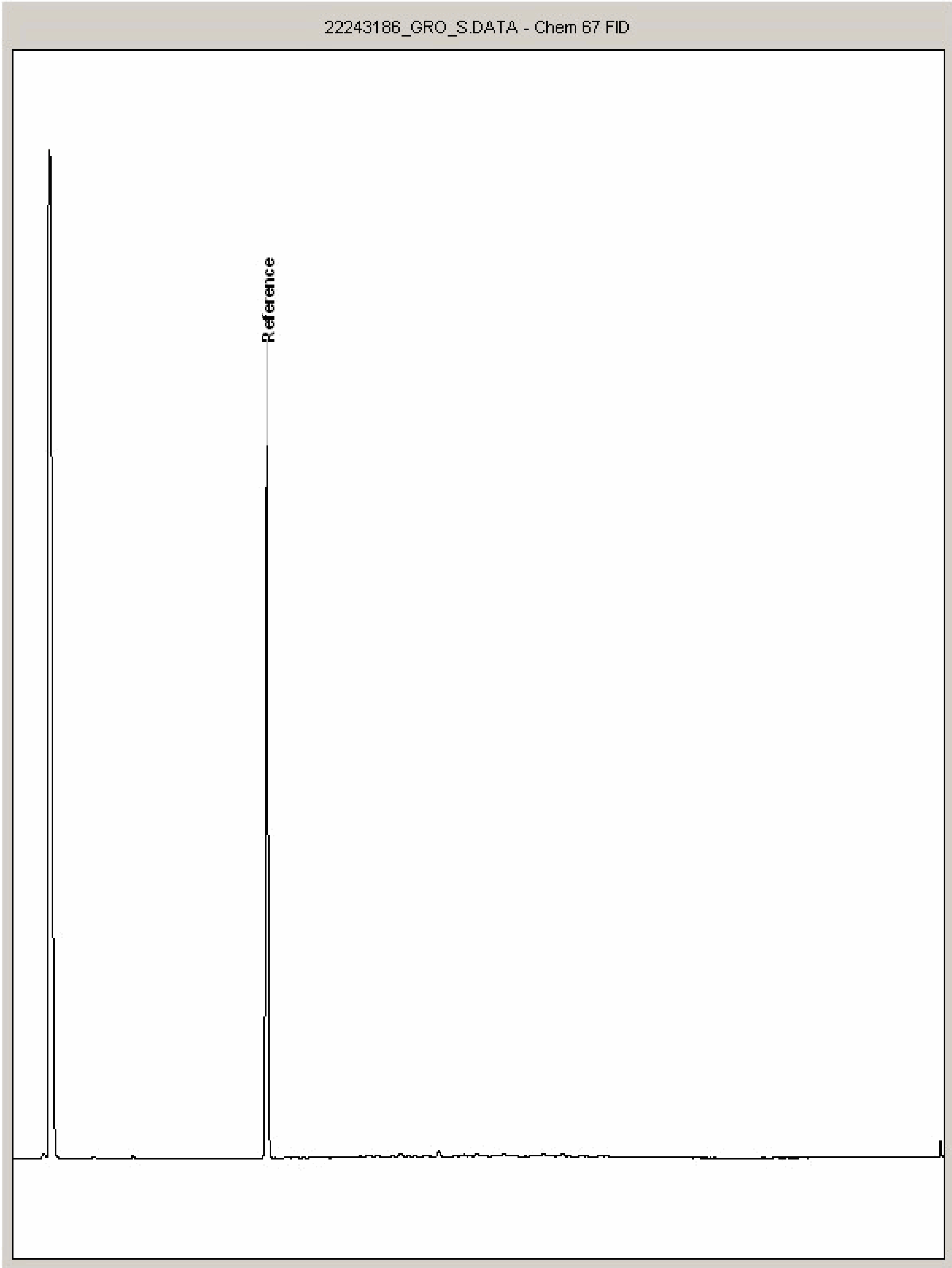


CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	GRO by GC-FID (S)	**Sample No :**	22243186	**Depth :**	4.00 - 4.60
		Sample ID :	BH102		



Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

18. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**

19. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 μm diameter, longer than 5 μm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.
Standing Committee of Analysts, *The Quantification of Asbestos in Soil (2017).*

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

APPENDIX D

Groundwater Laboratory Certificates of Analysis

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

RSK Group Plc
Unit B
Bluebell Business Centre
Old Naas Road
Dublin
Dublin 12

Attention: Paul Feely

CERTIFICATE OF ANALYSIS

Date of report Generation:	18 June 2020
Customer:	RSK Group Plc
Sample Delivery Group (SDG):	200611-61
Your Reference:	Cookstown S.I.: 602923
Location:	Cookstown, Belgard, Dublin
Report No:	555761

We received 4 samples on Thursday June 11, 2020 and 4 of these samples were scheduled for analysis which was completed on Thursday June 18, 2020. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan
Operations Manager

1291

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
22288308	MW102			09/06/2020
22288309	MW103			09/06/2020
22288311	MW104			09/06/2020
22288312	MW105			09/06/2020

Maximum Sample/Coolbox Temperature (°C) : **12.8**

ISO5667-3 Water quality - Sampling - Part3 -
During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			22288308		22288309		22288311		22288312	
Customer Sample Reference			MW102		MW103		MW104		MW105	
AGS Reference										
Depth (m)										
Container			0.5l glass bottle (ALE227)	Vial (ALE297)	0.5l glass bottle (ALE227)	Vial (ALE297)	0.5l glass bottle (ALE227)	Vial (ALE297)	0.5l glass bottle (ALE227)	Vial (ALE297)
Sample Type			GW	GW	GW	GW	GW	GW	GW	GW
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 4	X		X		X		X	
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 4	X		X		X		X	
GRO by GC-FID (W)	All	NDPs: 0 Tests: 4		X		X		X		X
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 4	X		X		X		X	
pH Value	All	NDPs: 0 Tests: 4	X		X		X		X	
TPH CWG (W)	All	NDPs: 0 Tests: 4	X		X		X		X	

CERTIFICATE OF ANALYSIS

SDG: 200611-61 **Client Reference:** Cookstown S.I.: 602923 **Report Number:** 555761
Location: Cookstown, Belgard, Dubli **Order Number:** P2021703 **Superseded Report:**

Results Legend		Customer Sample Ref.	MW102	MW103	MW104	MW105		
#	ISO17025 accredited.							
M	mCERTS accredited.							
aq	Aqueous / settled sample.	Depth (m)	.	.	.	.		
diss.filt	Dissolved / filtered sample.	Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)		
tot.unfilt	Total / unfiltered sample.	Date Sampled	09/06/2020	09/06/2020	09/06/2020	09/06/2020		
*	Subcontracted - refer to subcontractor report for accreditation status.	Sampled Time	.	.	.	.		
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery	Date Received	11/06/2020	11/06/2020	11/06/2020	11/06/2020		
		SDG Ref	200611-61	200611-61	200611-61	200611-61		
		Lab Sample No.(s)	22288308	22288309	22288311	22288312		
(F)	Trigger breach confirmed	AGS Reference						
1-3+§@	Sample deviation (see appendix)							

Component	LOD/Units	Method	MW102	MW103	MW104	MW105		
pH	<1 pH Units	TM256	7.67 #	7.54 #	8.02 #	8.33 #		

PAH Spec MS - Aqueous (W)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	MW102	MW103	MW104	MW105		
Customer Sample Ref.			MW102	MW103	MW104	MW105		
Depth (m)			.	.	.	.		
Sample Type			Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)		
Date Sampled			09/06/2020	09/06/2020	09/06/2020	09/06/2020		
Sampled Time			.	.	.	.		
Date Received			11/06/2020	11/06/2020	11/06/2020	11/06/2020		
SDG Ref			200611-61	200611-61	200611-61	200611-61		
Lab Sample No.(s)			22288308	22288309	22288311	22288312		
AGS Reference								
Naphthalene (aq)	<0.01 µg/l	TM178	<0.01 #	<0.01 #	<0.01 #	<0.01 #		
Acenaphthene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Acenaphthylene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Fluoranthene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	0.00506 #		
Anthracene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Phenanthrene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Fluorene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Chrysene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Pyrene (aq)	<0.005 µg/l	TM178	0.0091 #	0.00711 #	0.00577 #	0.00735 #		
Benzo(a)anthracene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Benzo(b)fluoranthene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Benzo(k)fluoranthene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Benzo(a)pyrene (aq)	<0.002 µg/l	TM178	<0.002 #	<0.002 #	<0.002 #	<0.002 #		
Dibenzo(a,h)anthracene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Benzo(g,h,i)perylene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Indeno(1,2,3-cd)pyrene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
PAH, Total Detected USEPA 16 (aq)	<0.082 µg/l	TM178	<0.082 #	<0.082 #	<0.082 #	<0.082 #		

CERTIFICATE OF ANALYSIS

Validated

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

TPH CWG (W)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

		Customer Sample Ref.	MW102	MW103	MW104	MW105
		Depth (m)	.	.	.	.
		Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
		Date Sampled	09/06/2020	09/06/2020	09/06/2020	09/06/2020
		Sampled Time	.	.	.	.
		Date Received	11/06/2020	11/06/2020	11/06/2020	11/06/2020
		SDG Ref	200611-61	200611-61	200611-61	200611-61
		Lab Sample No.(s)	22288308	22288309	22288311	22288312
		AGS Reference				
Component	**LOD/Units**	**Method**				
GRO Surrogate % recovery**	%	TM245	95	95	92	103
GRO >C5-C12	<50 µg/l	TM245	<50 #	<50 #	98 #	128 #
Methyl tertiary butyl ether (MTBE)	<3 µg/l	TM245	<3 #	4 #	98 #	118 #
Benzene	<7 µg/l	TM245	<7 #	<7 #	<7 #	<7 #
Toluene	<4 µg/l	TM245	<4 #	<4 #	<4 #	<4 #
Ethylbenzene	<5 µg/l	TM245	<5 #	<5 #	<5 #	<5 #
m,p-Xylene	<8 µg/l	TM245	<8 #	<8 #	<8 #	<8 #
o-Xylene	<3 µg/l	TM245	<3 #	<3 #	<3 #	<3 #
Sum of detected Xylenes	<11 µg/l	TM245	<11	<11	<11	<11
Sum of detected BTEX	<28 µg/l	TM245	<28	<28	<28	<28
Aliphatics >C5-C6	<10 µg/l	TM245	<10	<10	<10	<10
Aliphatics >C6-C8	<10 µg/l	TM245	<10	<10	<10	<10
Aliphatics >C8-C10	<10 µg/l	TM245	<10	<10	<10	<10
Aliphatics >C10-C12	<10 µg/l	TM245	<10	<10	<10	<10
Aliphatics >C12-C16 (aq)	<10 µg/l	TM174	<10	<10	<10	<10
Aliphatics >C16-C21 (aq)	<10 µg/l	TM174	<10	<10	<10	<10
Aliphatics >C21-C35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10
Total Aliphatics >C12-C35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10
Aromatics >EC5-EC7	<10 µg/l	TM245	<10	<10	<10	<10
Aromatics >EC7-EC8	<10 µg/l	TM245	<10	<10	<10	<10
Aromatics >EC8-EC10	<10 µg/l	TM245	<10	<10	<10	<10
Aromatics >EC10-EC12	<10 µg/l	TM245	<10	<10	<10	<10
Aromatics >EC12-EC16 (aq)	<10 µg/l	TM174	<10	<10	<10	<10
Aromatics >EC16-EC21 (aq)	<10 µg/l	TM174	<10	<10	<10	<10
Aromatics >EC21-EC35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10
Total Aromatics >EC12-EC35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10
Total Aliphatics & Aromatics >C5-35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10
Aliphatics >C16-C35 Aqueous	<10 µg/l	TM174	<10	<10	<10	<10

Table of Results - Appendix

Method No	Reference	Description
TM174	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters
TM245	By GC-FID	Determination of GRO by Headspace in waters
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Test Completion Dates

Lab Sample No(s)	22288308	22288309	22288311	22288312
Customer Sample Ref.	MW102	MW103	MW104	MW105
AGS Ref.				
Depth				
Type	Ground Water	Ground Water	Ground Water	Ground Water
EPH CWG (Aliphatic) Aqueous GC (W)	18-Jun-2020	18-Jun-2020	18-Jun-2020	18-Jun-2020
EPH CWG (Aromatic) Aqueous GC (W)	18-Jun-2020	18-Jun-2020	18-Jun-2020	18-Jun-2020
GRO by GC-FID (W)	17-Jun-2020	17-Jun-2020	17-Jun-2020	17-Jun-2020
PAH Spec MS - Aqueous (W)	17-Jun-2020	17-Jun-2020	17-Jun-2020	17-Jun-2020
pH Value	18-Jun-2020	18-Jun-2020	18-Jun-2020	18-Jun-2020
TPH CWG (W)	18-Jun-2020	18-Jun-2020	18-Jun-2020	18-Jun-2020

CERTIFICATE OF ANALYSIS

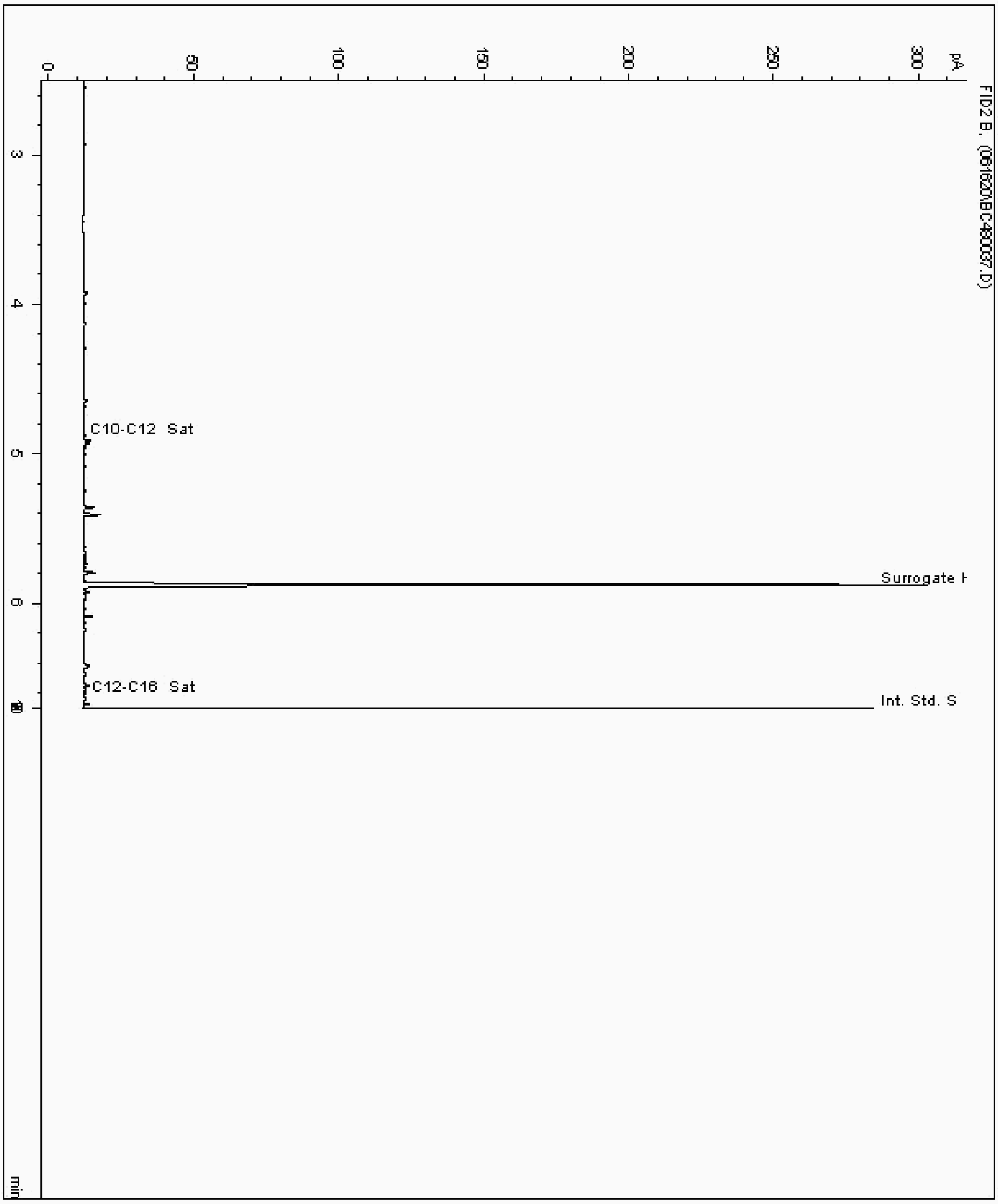
SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) Aqueous GC (W) **Sample No :** 22294089 **Depth :**
Sample ID : MW102

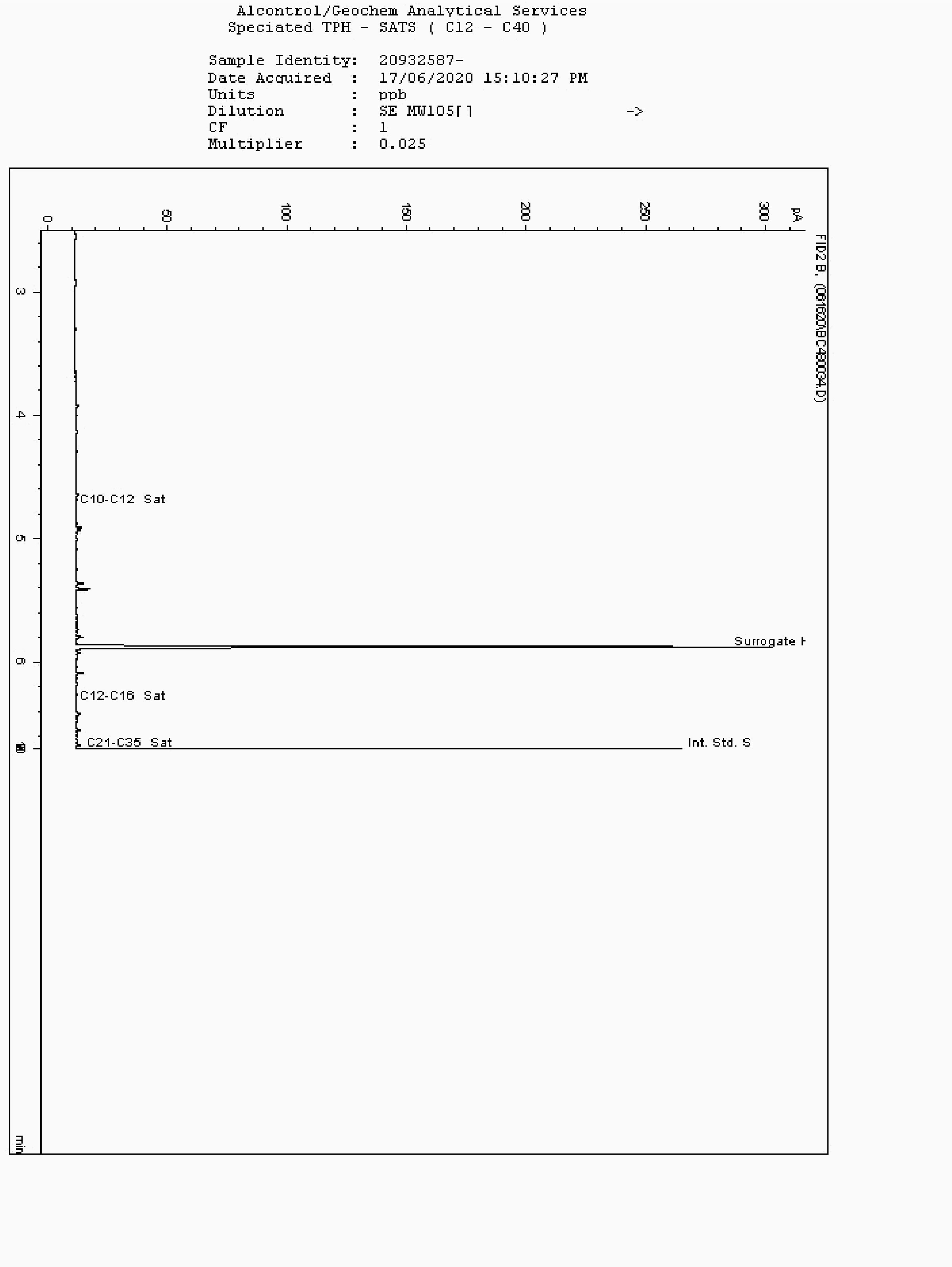
```
Alcontrol/Geochem Analytical Services
Speciated TPH - SATS ( C12 - C40 )

Sample Identity:  20932562-
Date Acquired  :  17/06/2020 16:20:13 PM
Units          :  ppb
Dilution       :  SE MW102[]            ->
CF             :  1
Multiplier     :  0.025
```



Chromatogram

Analysis: EPH CWG (Aliphatic) Aqueous GC (W) **Sample No :** 22294092 **Depth :**
Sample ID : MW105

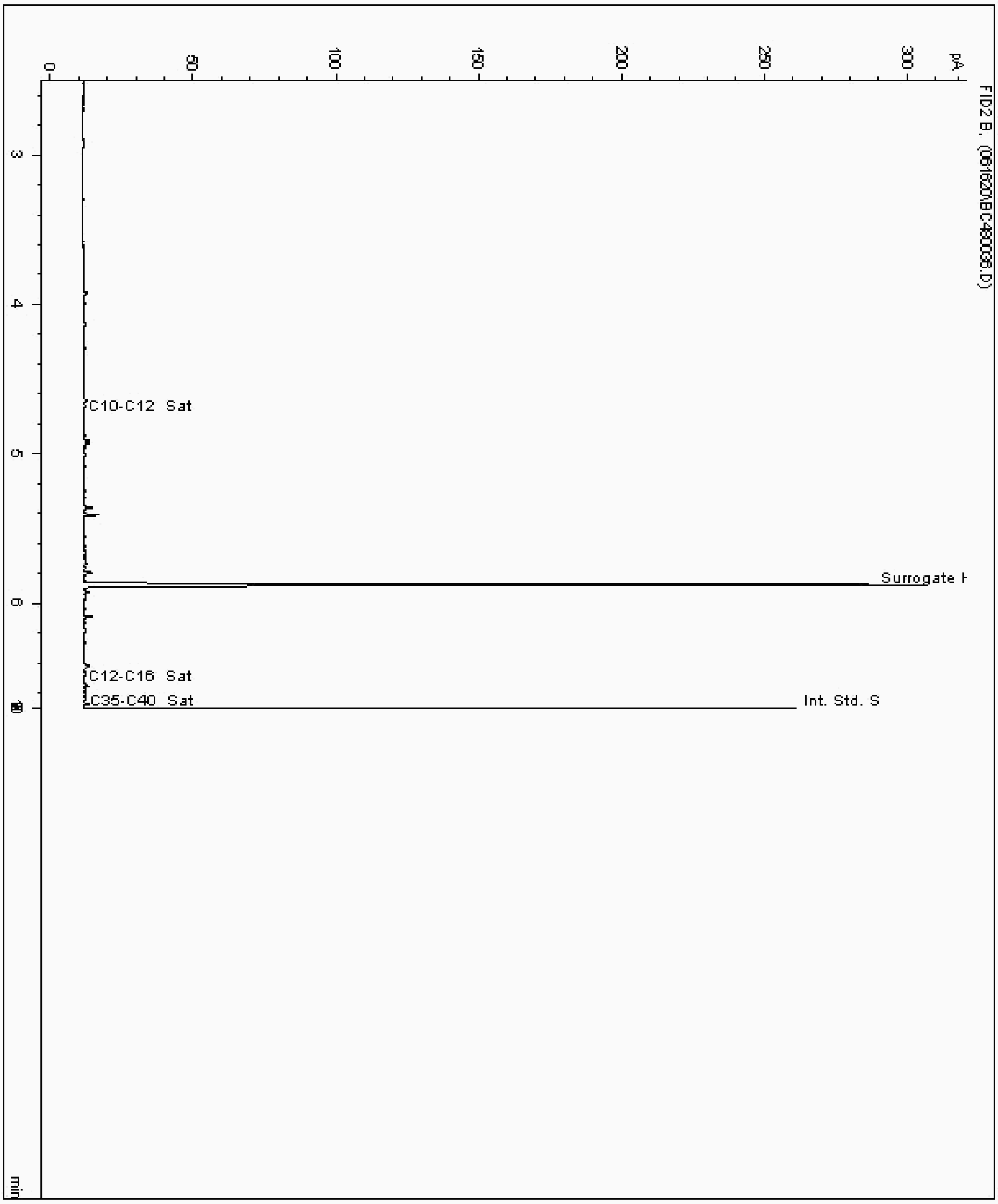


Chromatogram

Analysis: EPH CWG (Aliphatic) Aqueous GC (W) **Sample No :** 22294101 **Depth :**
Sample ID : MW103

```
Alcontrol/Geochem Analytical Services
Speciated TPH - SATS ( C12 - C40 )

Sample Identity:  20932569-
Date Acquired  :  17/06/2020 15:56:45 PM
Units          :  ppb
Dilution       :  SE MW103[]          ->
CF             :  1
Multiplier     :  0.025
```



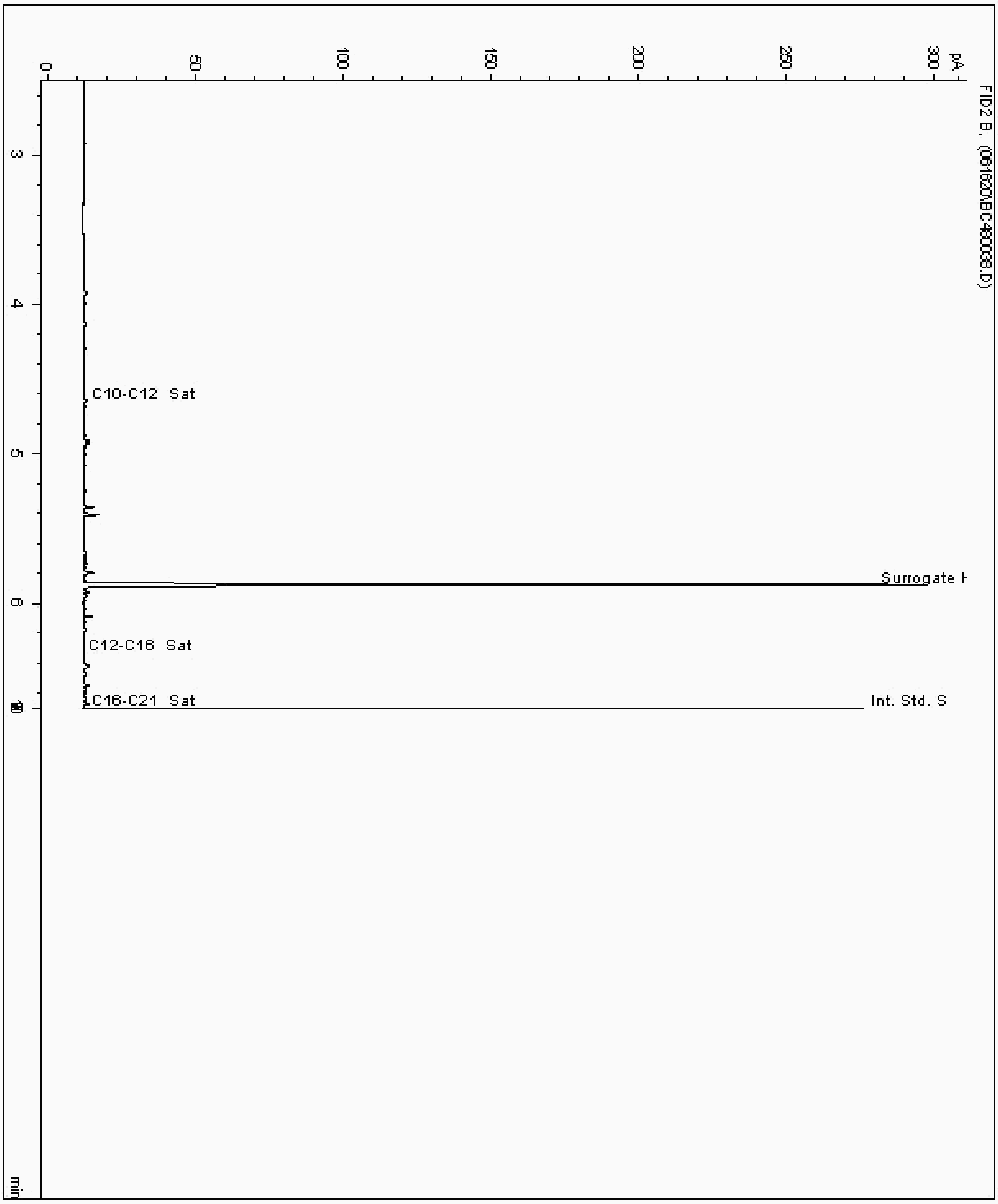
Chromatogram

Analysis: EPH CWG (Aliphatic) Aqueous GC (W) **Sample No :** 22294178 **Depth :**

Sample ID : MW104

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 20932576-
Date Acquired : 17/06/2020 16:43:32 PM
Units : ppb
Dilution : SE MW104[] ->
CF : 1
Multiplier : 0.025

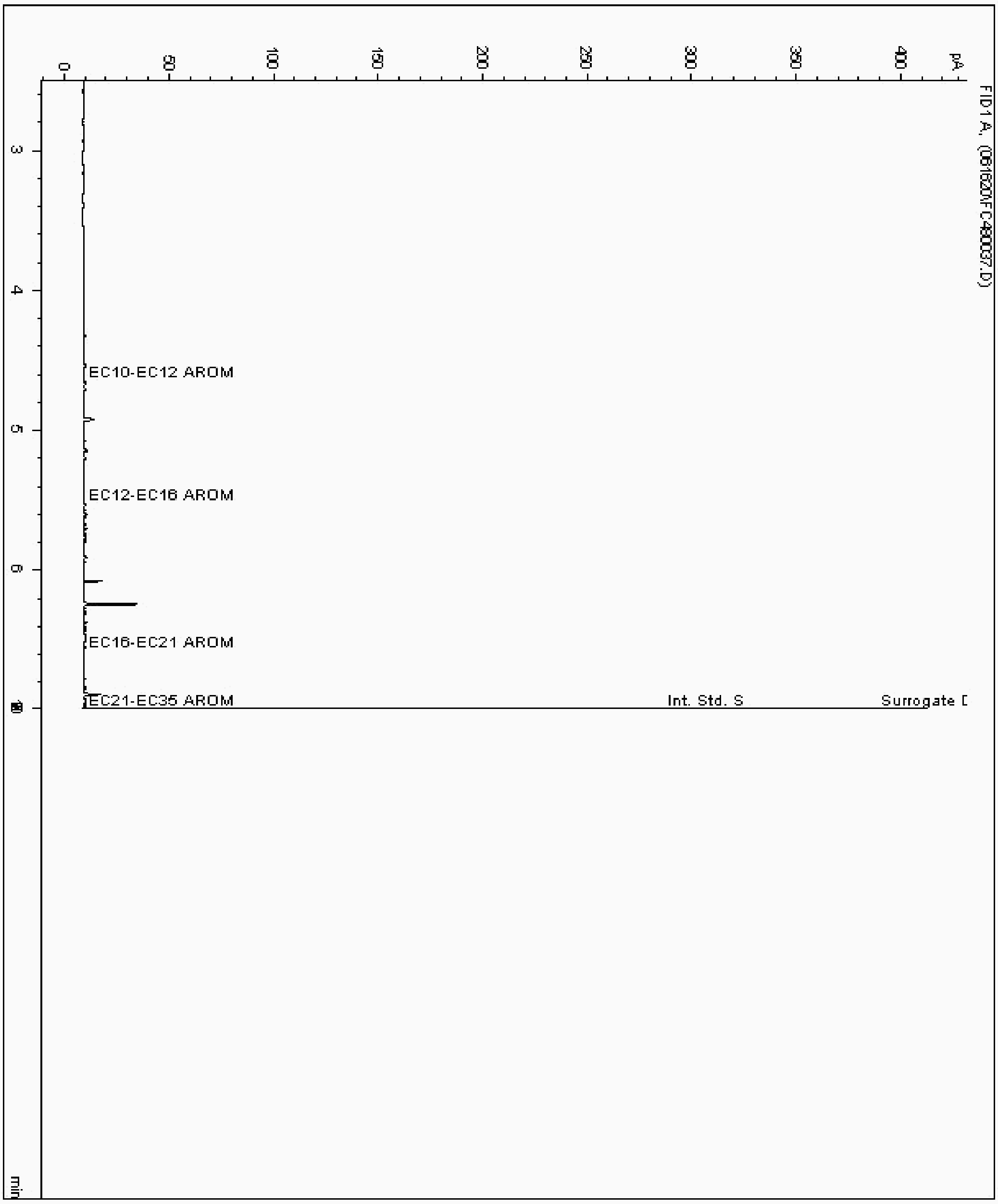


Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W) **Sample No :** 22294089 **Depth :**
Sample ID : MW102

```
Alcontrol/Geochem Analytical Services
Speciated TPH - AROM ( C12 - C40 )

Sample Identity:  20932563-
Date Acquired   :  17/06/2020 16:20:13 PM
Units           :  ppb
Dilution        :  SE MW102[]              ->
CF              :  1
Multiplier      :  0.025
```



CERTIFICATE OF ANALYSIS

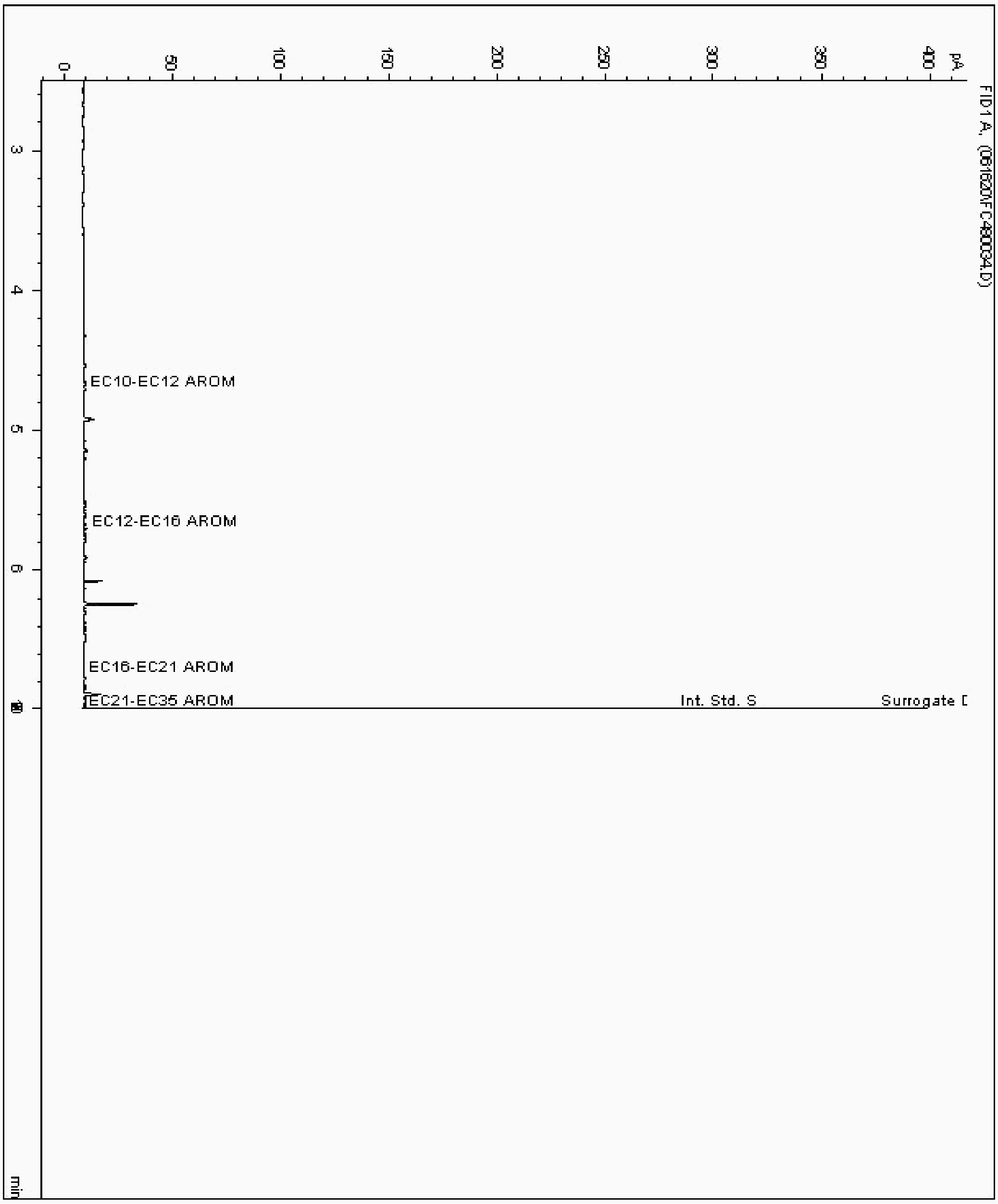
SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W) **Sample No :** 22294092 **Depth :**
Sample ID : MW105

```
Alcontrol/Geochem Analytical Services
Speciated TPH - AROM ( C12 - C40 )

Sample Identity:  20932588-
Date Acquired  :  17/06/2020 15:10:27 PM
Units          :  ppb
Dilution       :  SE MW105[]          ->
CF             :  1
Multiplier     :  0.025
```



CERTIFICATE OF ANALYSIS

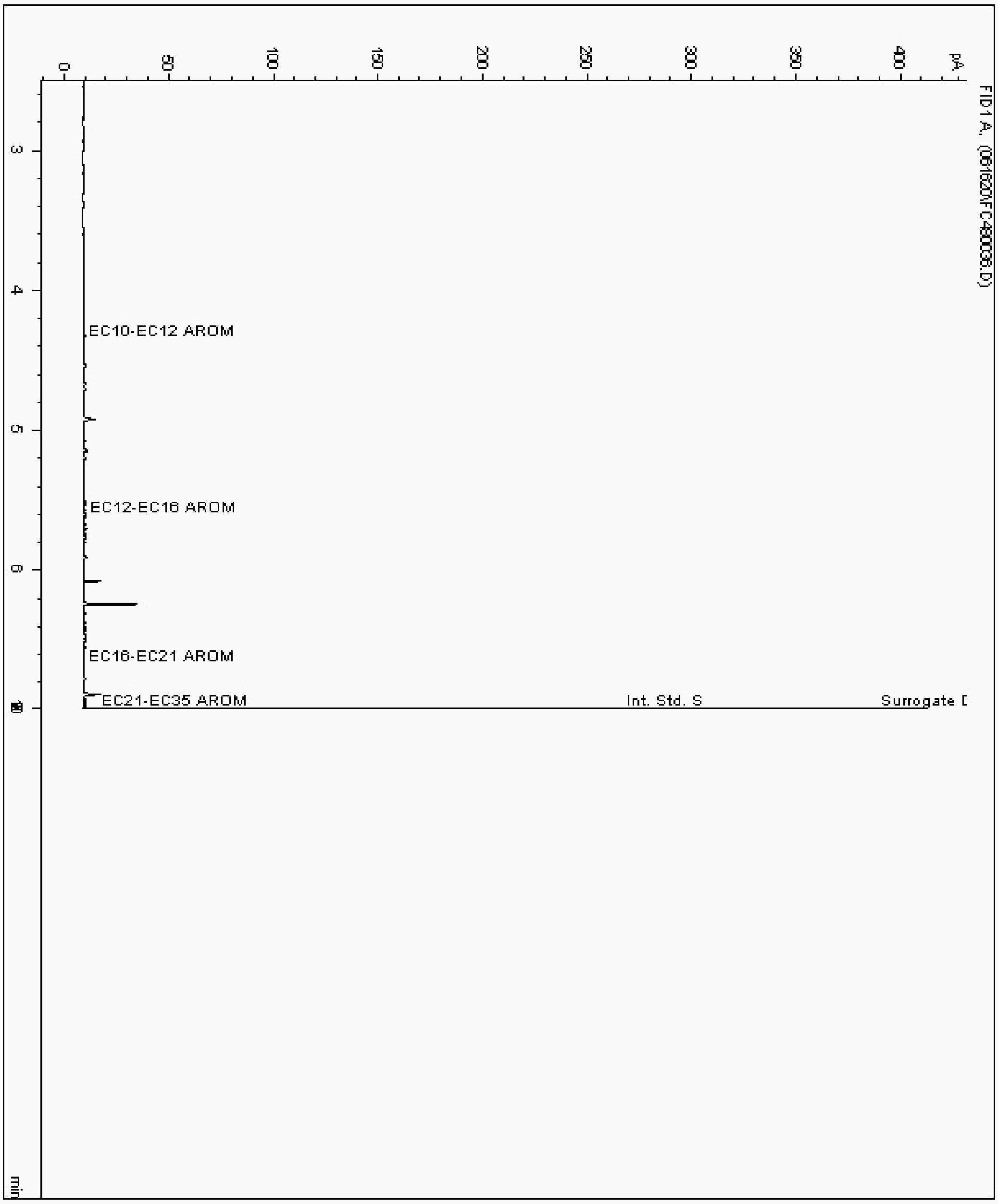
SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W) **Sample No :** 22294101 **Depth :**
Sample ID : MW103

```
Alcontrol/Geochem Analytical Services
Speciated TPH - AROM ( C12 - C40 )

Sample Identity:  20932570-
Date Acquired  :  17/06/2020 15:56:45 PM
Units          :  ppb
Dilution       :  SE MW103[]            ->
CF             :  1
Multiplier     :  0.025
```



CERTIFICATE OF ANALYSIS

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

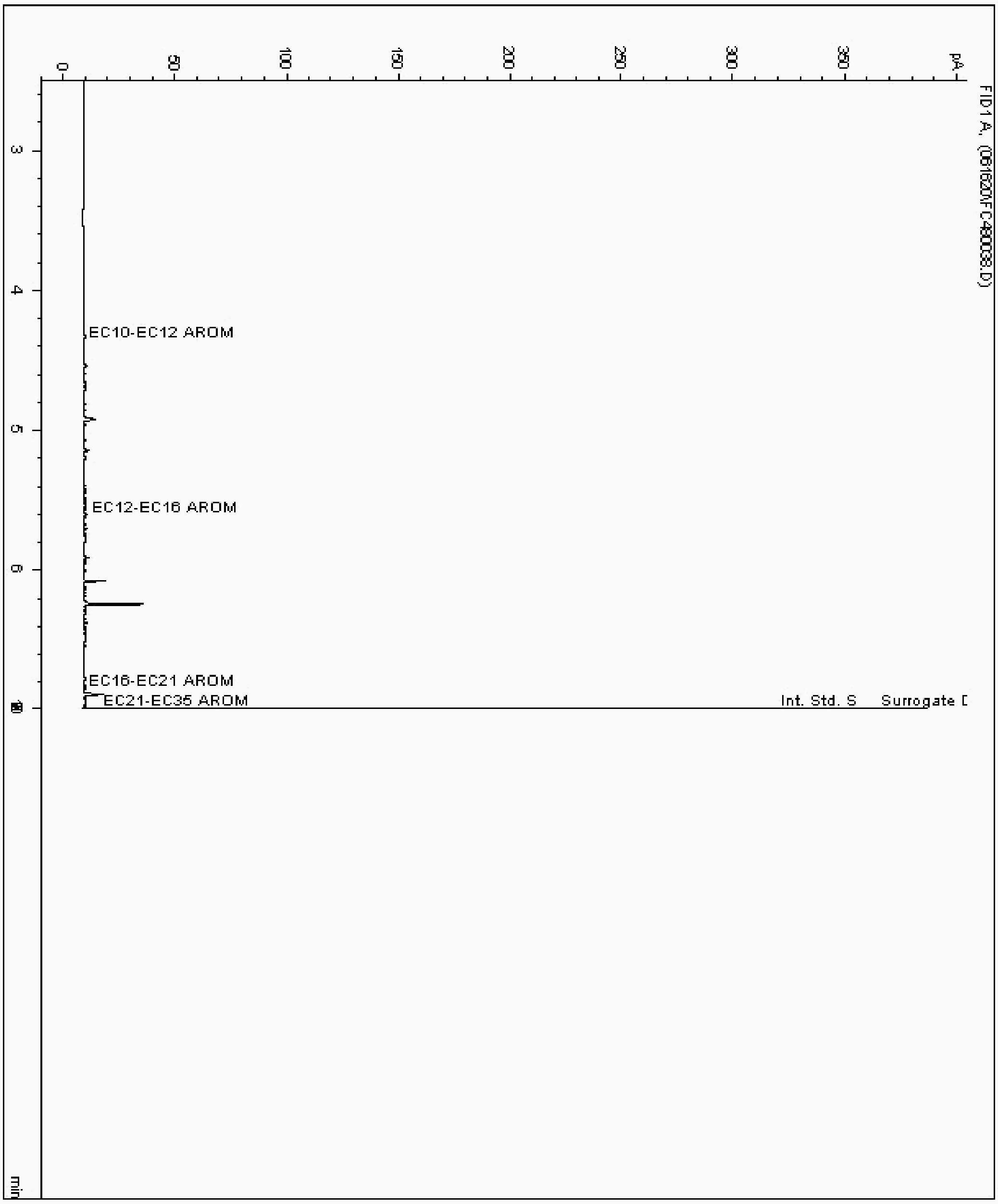
Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W) **Sample No :** 22294178 **Depth :**

Sample ID : MW104

```
Alcontrol/Geochem Analytical Services
Speciated TPH - AROM ( C12 - C40 )

Sample Identity:  20932577-
Date Acquired  :  17/06/2020 16:43:32 PM
Units          :  ppb
Dilution       :  SE MW104[]          ->
CF             :  1
Multiplier     :  0.025
```

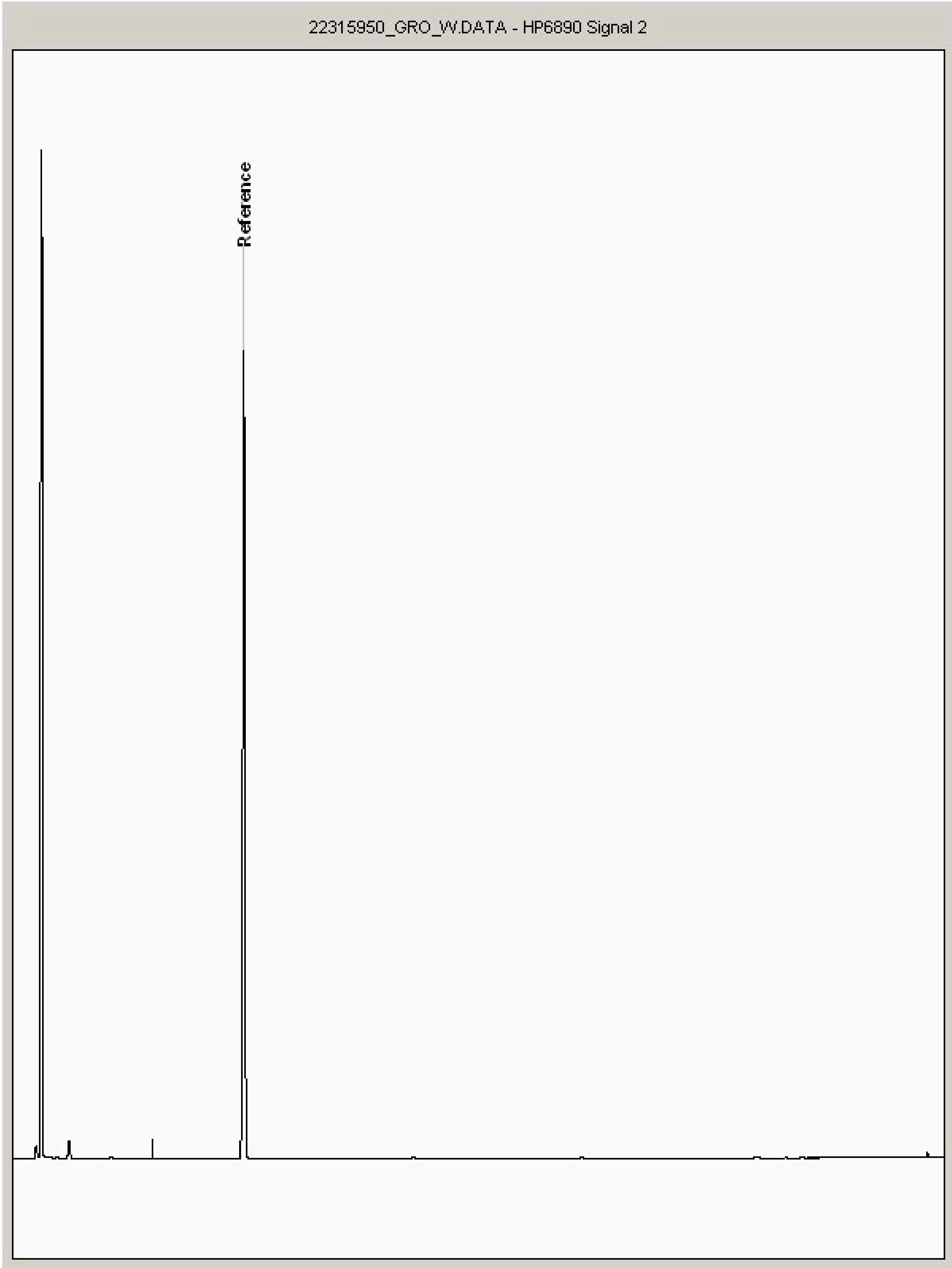


Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 22315950
Sample ID : MW105

Depth :

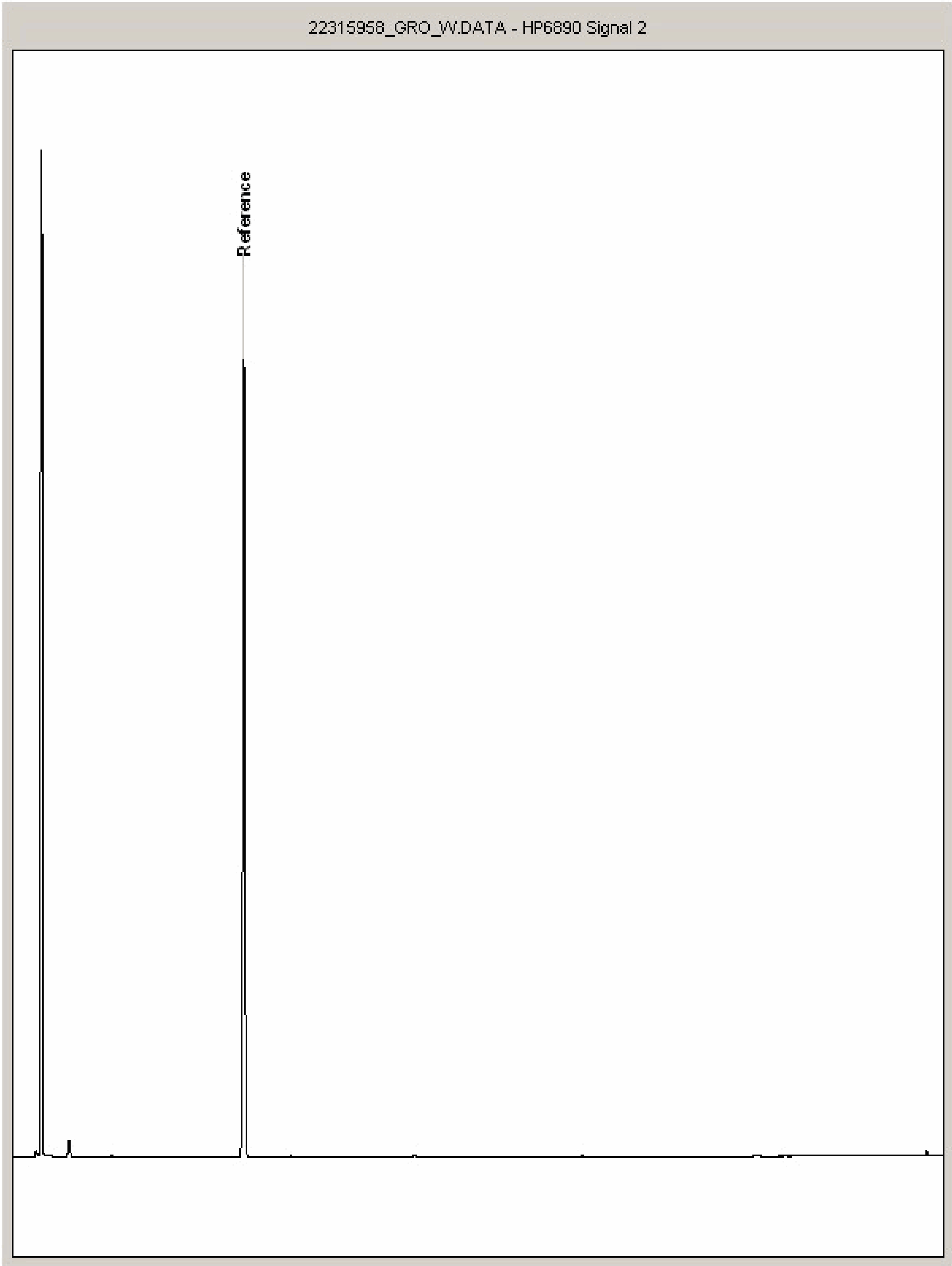


CERTIFICATE OF ANALYSIS

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

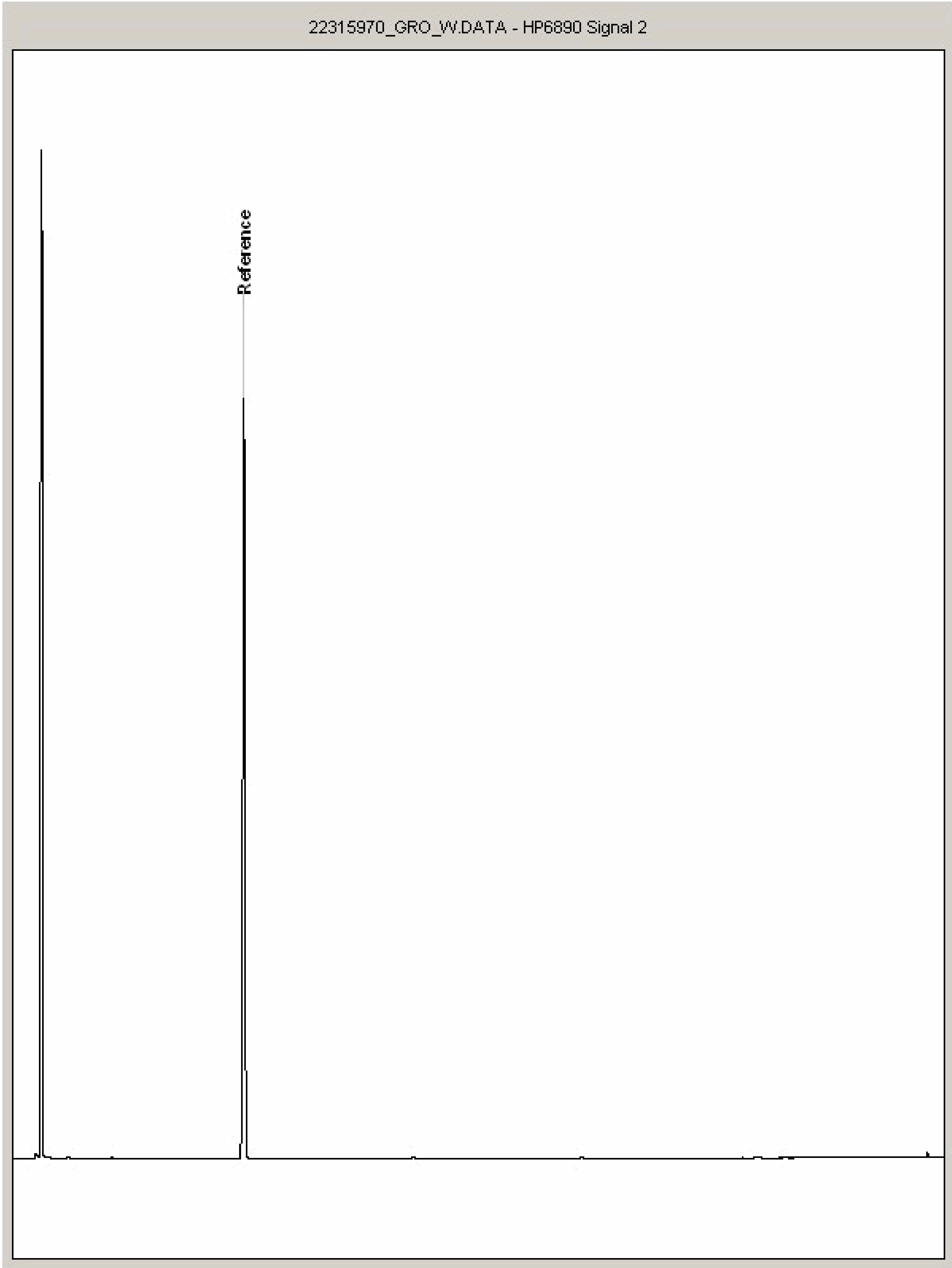
Chromatogram

Analysis:	GRO by GC-FID (W)	**Sample No :**	22315958	**Depth :**	
		Sample ID :	MW104		



Chromatogram

Analysis:	GRO by GC-FID (W)	**Sample No :**	22315970	**Depth :**	
		Sample ID :	MW103		



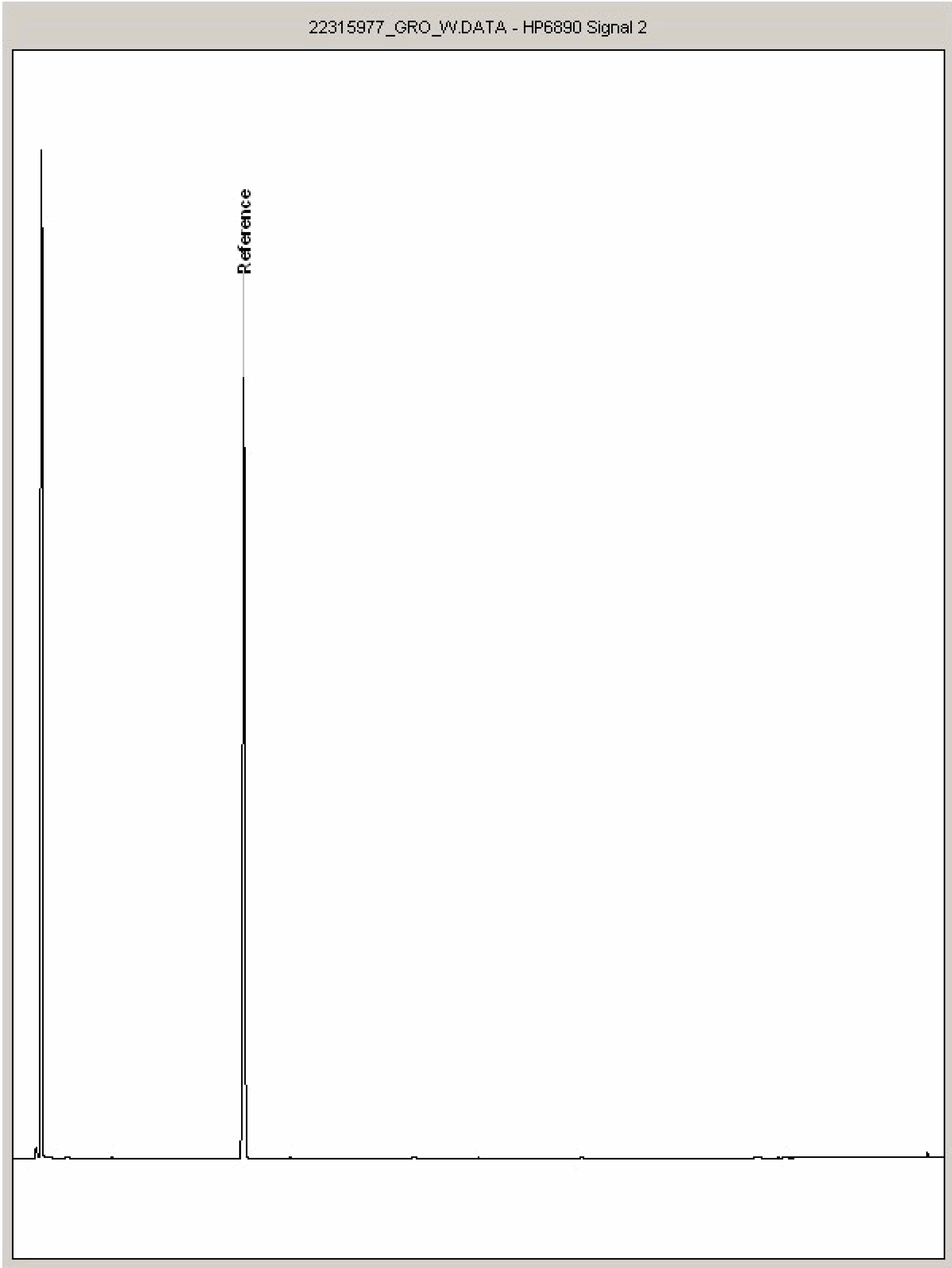
CERTIFICATE OF ANALYSIS

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (W) **Sample No :** 22315977 **Depth :**

Sample ID : MW102



Appendix General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

18. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**

19. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 μm diameter, longer than 5 μm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.
Standing Committee of Analysts, *The Quantification of Asbestos in Soil (2017).*

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

APPENDIX E

Ground Gas Monitoring Results

GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good Condition	Air Temperature: 12°C °C; Weather: DRY; Ground Conditions: WET; Wind: NONE / LIGHT / MEDIUM / STRONG	Weather:	GFM Series	1TS04ATG X23415X	✓
Exploratory Position ID: BH101	Monitoring Round Number: 1		Tidal State: (if applicable) n/a; High / Low / Rising / Falling		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)	Test Number: 1		

Test Sequence	Time of Monitoring 14:15 (hh:mm)	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
1 minute						
Stage 1 gas flow - Initial	14:25	00	0	988	0	Observations: None.
Stage 1 gas flow - Steady State	14:26	00	0	988	0	

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
14:28	0	0.0	0.7	19.5	0	0	LLL	1.0
+	15	0.0	0.7	18.1	0	0	LLL	1.0
+	30	0.0	0.7	17.9	0	0	LLL	1.0
+	60	0.0	0.7	17.9	0	0	LLL	1.0
+	90	-0.1	0.7	17.9	0	0	LLL	0.9
+	120	-0.1	0.7	17.9	0	0	LLL	0.9
+	180	-0.1	0.7	17.9	0	0	LLL	0.9
+	240	-0.1	0.7	18.0	0	0	LLL	0.9
+	300	-0.1	0.7	18.0	0	0	LLL	0.9
+	360	-0.1	0.7	18.0	0	0	LLL	0.9
+	420	-0.1	0.7	18.1	0	0	LLL	1.0
+	480	-0.1	0.7	18.1	0	0	LLL	1.0
+	540	-0.1	0.7	18.0	0	0	LLL	0.9
14:38	600	-0.1	0.7	18.0	0	0	LLL	0.9

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: DRY (m)	Time: 14 : 44	LNAPL Top (from datum): n/a (m)
Depth (from datum) to well base: 3.216 (m)		DNAPL Top (from datum): n/a (m)
Hole Purged: Yes / No	Purge Start: DRY	
Purge Volume: (ltrs) DRY	Purge End: DRY	

Post Testing Remarks: none

Samples Taken: Yes / No		Gas / Water	
Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK

Contract Name: Cookstown S.I	Contract Ref: 602923	Data Collected By: RM
Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 1 of 5	Checked: TBC

TPF210 Issue 1

GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 1.00m	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good Condition	Air Temperature: 12°C °C Weather: DRY Ground Conditions: WET Wind: NONE / LIGHT / MEDIUM / STRONG	Weather:	GFM Series	"Same as"	✓
Exploratory Position ID: BH102			Tidal State: (if applicable) n/a High / Low / Rising / Falling		
Install Type: SINGLE / DOUBLE	Monitoring Round Number: 1		Test Number: 1		
Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)				

Test Sequence 1 minute	Time of Monitoring 15:06 hh:mm	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
Stage 1 gas flow - Initial	15:06	00	0.6	988	0	Observations:
Stage 1 gas flow - Steady State	15:07	06	0.0	988	0	None.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
15:09	0	0.0	0.6	18.5	0	0	LLL	1.0
+	15	-0.1	0.4	18.8	0	0	LLL	1.0
+	30	0.0	0.3	19.4	0	0	LLL	1.0
+	60	-0.0	0.3	19.9	0	0	LLL	1.0
+	90	0.0	0.1	20.1	0	0	LLL	1.0
+	120	0.0	0.1	20.4	0	0	LLL	1.0
+	180	0.0	0	20.6	0	0	LLL	1.0
+	240	0.0	0	20.6	0	0	LLL	1.0
+	300	0.0	0	20.7	0	0	LLL	1.0
+	360	-0.1	0	20.7	0	0	LLL	1.0
+	420	-0.1	0	20.6	0	0	LLL	1.0
+	480	-0.1	0	20.7	0	0	LLL	1.0
+	540	-0.1	0	20.7	0	0	LLL	1.0
15:19	600	-0.1	0	20.7	0	0	LLL	1.0

STAGE 3 WATER LEVEL OBSERVATION

Depth (from datum) to water: DRY (m)	Time: 15 : 22	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 4.550 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: DRY		
Purge Volume: (ltrs) DRY	Purge End: DRY		

Post Testing Remarks:

Small amount of wet viscous clay detected at base of BH. would not be sampled.

Samples Taken: Yes / No			Gas / Water
Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK	Contract Name: COOKSTOWN S.T.	Contract Ref: 602913	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 2 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good Condition	Air Temperature: 12 °C; Weather: DRY; ~~Ground Conditions~~: DRY; Wind: NONE / LIGHT / MEDIUM / STRONG	Weather:	GEM series	Same GS	✓
Exploratory Position ID: BH103	Monitoring Round Number: 1		Tidal State: (if applicable) n/a; High / Low / Rising / Falling; Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence	Time of Monitoring (hh:mm)	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
1 minute	15:25					
Stage 1 gas flow - Initial	15:25	00	0.0	988	0	Observations:
Stage 1 gas flow - Steady State	15:26	00	0.0	988	0	none.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring (hh:mm)	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
15:27	0	-0.1	0.0	20.2	0	0	LLL	0.9
+	15	-0.1	0.0	20.8	0	0	LLL	0.9
+	30	-0.1	0.0	20.8	0	0	LLL	0.9
+	60	-0.1	0.0	20.7	0	0	LLL	0.9
+	90	-0.1	0.0	20.7	0	0	LLL	0.9
+	120	-0.1	0.0	20.7	0	0	LLL	0.9
+	180	-0.1	0.0	20.7	0	0	LLL	0.9
+	240	-0.1	0.0	20.7	0	0	LLL	0.9
+	300	-0.1	0.0	20.7	0	0	LLL	0.9
+	360	-0.1	0.0	20.7	0	0	LLL	0.9
+	420	-0.1	0.0	20.7	0	0	LLL	0.9
+	480	-0.1	0.0	20.7	0	0	LLL	0.9
+	540	-0.1	0.0	20.7	0	0	LLL	0.9
15:37	600	-0.1	0.0	20.7	0	0	LLL	0.9

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: DRY (m)	Time: 15:28	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 3.74 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: DRY		
Purge Volume: (ltrs) DRY	Purge End: DRY		

Post Testing Remarks: none.

Samples Taken: Yes / No		Gas / Water	
Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK			
	Contract Name: Cookstown S.I.	Contract Ref: 602923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURRAY	Page: 3 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 1.00	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good Condition	Air Temperature: 12 °C	Weather:	GEM Series	Same	✓
	Weather: DRY				
	Ground Conditions: DRY				
	Wind: NONE / LIGHT / MEDIUM / STRONG		Tidal State: (if applicable) n/a		
Exploratory Position ID: BH104			High / Low / Rising / Falling		
	Monitoring Round Number: 1		Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence: 1 minute	Time of Monitoring hh:mm	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
Stage 1 gas flow - Initial	15:56	00	0	987	0	Observations:
Stage 1 gas flow - Steady State	15:57	00	0	987	0	none

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	LEL (%)	PID (ppm)
15:58	0	0.0	0.0	20.2	0	0	LLL	0.9
+	15	0.1	0.5	20.1	0	0	LLL	0.9
+	30	0.1	0.5	20.2	0	0	LLL	0.9
+	60	-0.1	0.5	20.1	0	0	LLL	0.9
+	90	-0.1	0.5	20.0	0	0	LLL	0.9
+	120	-0.1	0.6	20.0	0	0	LLL	0.9
+	180	"	"	"	"	"	"	"
+	240	"	"	19.9	"	"	"	"
+	300	"	"	"	"	"	"	"
+	360	"	0.5	"	"	"	"	"
+	420	"	0.6	"	"	"	"	"
+	480	"	0.6	"	"	"	"	"
+	540	"	"	"	"	"	"	"
16:08	600	"	"	"	"	"	"	"

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: DRY (m)	Time: 16:10	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 3.980 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: DRY		
Purge Volume: (ltrs) DRY	Purge End: DRY		

Post Testing Remarks: none

Samples Taken: Yes / No		Gas / Water	
Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK	Contract Name: COOKSTOWN S.I	Contract Ref: 602923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURRAY	Page: 4 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) ...	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good Condition	Air Temperature: 12 °C Weather: DRY Ground Conditions: Dry Wind: NONE / LIGHT / MEDIUM / STRONG	Weather:	GEM SERIES	Same	✓
Exploratory Position ID: BH105	Monitoring Round Number: 1		Tidal State: (if applicable) High / Low / Rising / Falling		
			Test Number: 1		

Install Type: SINGLE / DOUBLE — Pipe Ref: 1) Shallow 2) Deep — Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)

Test Sequence	Time of Monitoring (hh:mm)	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)
1 minute	16:15				
Stage 1 gas flow - Initial	16:15	00	0.0	988	0
Stage 1 gas flow - Steady State	16:16	60	0.0	988	0

Gas tap: SINGLE / DOUBLE

Observations: none.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
16:17	0	-0.0	0.5	20.1	0	0	LLL	0.9
↓	15	-0.1	0.7	19.9	0	0	LLL	0.9
↓	30	-0.0	0.8	19.9	0	0	LLL	0.9
↓	60	-0.0	0.8	19.7	0	0	LLL	0.9
↓	90	-0.1	0.8	19.6	0	0	LLL	0.9
↓	120	-0.1	0.8	19.6	0	0	LLL	0.9
↓	180	-0.1	0.6	19.6	0	0	LLL	0.9
↓	240	-0.1	0.9	19.5	0	0	LLL	1.0
↓	300	-0.1	0.9	19.1	0	0	LLL	1.0
↓	360	〃	〃	〃	〃	〃	〃	〃
↓	420	〃	〃	〃	〃	〃	〃	〃
↓	480	〃	〃	〃	〃	〃	〃	〃
↓	540	〃	〃	〃	〃	〃	〃	〃
16:27	600	〃	〃	〃	〃	〃	〃	〃

STAGE 3 WATER LEVEL OBSERVATION

Depth (from datum) to water: 2.045 (m)	Time: 16:30	LNAPL Top (from datum): n/a	(m)
Depth (from datum) to well base: 4.270 (m)		DNAPL Top (from datum): n/a	(m)
Hole Purged: Yes / No	Purge Start: n/a		
Purge Volume: (ltrs) 3 X Well Volume	Purge End: n/a		

Post Testing Remarks:

none.

will sample on ROUND 2

Samples Taken: Yes / No — Gas / Water

Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK	Contract Name: Cookstown S.T.	Contract Ref: 603923
	Project Manager / Engineer: PAUL FEELY / RYAN MURRAY	Page: 5 of 5
	Data Collected By: RM	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 01/06/20	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good	Air Temperature: 14 °C	Weather:	GFM Series	Dublin	✓
	Weather: DRY				
	Ground Conditions: DRY				
Exploratory Position ID: BH101/MW101	Wind: NONE / LIGHT / MEDIUM / STRONG		Tidal State: (if applicable) High / Low / Rising / Falling		
	Monitoring Round Number: 2		Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence	Time of Monitoring 11:13am		Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
1 minute	hh:mm	sec				
Stage 1 gas flow - Initial	11:13	00	-0.3	1009	-5	Observations:
Stage 1 gas flow - Steady State	11:14	00	-1.0	1008	-8	NONE

STAGE 2 GAS CONCENTRATION READINGS	Time of Monitoring hh:mm	sec	Methane (%/vol) CH_4	Carbon Dioxide (%/vol) CO_2	Oxygen (%/vol) O_2	Hydrogen Sulphide (ppm) H_2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
	11:15	0	-0.3	0.1	20.1	0	0	LLL	0.8
		15	-0.3	0.4	19.9	0	0	LLL	0.8
		30	-0.3	0.5	19.6	0	0	LLL	0.8
		60	-0.3	0.5	19.5	0	0	LLL	0.8
		90	-0.3	0.5	19.4	0	0	LLL	0.8
		120	-0.3	0.5	19.4	0	0	LLL	0.8
		180	-0.3	0.5	19.4	0	0	LLL	0.8
		240	-0.3	0.5	19.4	0	0	LLL	0.8
		300	-0.3	0.5	19.4	0	0	LLL	0.8
		360	-0.3	0.5	19.4	0	0	LLL	0.8
		420							
		480							
		540							
	11:25	600							

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: DRY (m)	Time: 11:26	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 3.200 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: n/a		
Purge Volume: (ltrs) n/a	Purge End: n/a		

Post Testing Remarks: NONE

Samples Taken: Yes / No — Gas / Water N/A

Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK	Contract Name: Cookstown S.T.	Contract Ref: 602923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 1 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 09/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good	Air Temperature: 14 °C	Weather:	GFM Series	Dublin	✓
	Weather: DRY				
	Ground Conditions: DRY				
	Wind: NONE / LIGHT / MEDIUM / STRONG				
Exploratory Position ID: BH102 / MW102			Tidal State: (if applicable)		
			High / Low / Rising / Falling		
	Monitoring Round Number: 2		Test Number: 1		

Install Type: SINGLE / DOUBLE | Pipe Ref: 1) Shallow 2) Deep | Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)

Test Sequence	Time of Monitoring hh:mm	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
1 minute	11:32					Observations:
Stage 1 gas flow - Initial	11:33	00	-0.3	1009	1	
Stage 1 gas flow - Steady State	11:34	00	0.0	1009	0	NONE.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
11:35	0	-0.2	0.5	19.9	0	0	<	0.8
	15	-0.3	0.4	20.3	0	0	<	0.8
	30	-0.3	0.4	20.3	0	0	<	0.8
	60	-0.3	0.4	20.3	0	0	<	0.8
	90	-0.3	0.4	20.3	0	0	<	0.8
	120	-0.3	0.4	20.3	0	0	<	0.8
	180	-0.3	0.4	20.3	0	0	<	0.8
	240	-0.3	0.5	20.3	0	0	<	0.8
	300	-0.3	0.5	20.3	0	0	<	0.8
	360							
	420		ALL THE SAME.					
	480							
	540							
11:45	600							

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: 2.305 (m)	Time: 11:46	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 4.560 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: 11:47		
Purge Volume: (ltrs) n/a	Purge End: SEE GW DATA SHEET		

Post Testing Remarks: NONE.

Samples Taken: Yes / No | Gas / Water

Depth (from datum)	Sample Ref	Type	Container
		EW / G	
	SEE GW DATA SHEET		

RSK	Contract Name: Cookstown S.I.	Contract Ref: 602923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 2 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 09/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	
Pre-Testing Remarks: GOOD	Air Temperature: 15 °C	Weather:	
	Weather: DRY		
	Ground Conditions: DRY		
	Wind: NONE / LIGHT / MEDIUM / STRONG		
Exploratory Position ID: BH103 / MW103	Monitoring Round Number: 2		

Device	Serial Number	Daily Check
GEM series	Dublin	Ox ✓

Tidal State: (if applicable) High / Low / Rising / Falling

Test Number: 1

Install Type: SINGLE / DOUBLE | Pipe Ref: 1) Shallow 2) Deep | Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)

Test Sequence	Time of Monitoring 13:30 (hh:mm)	(sec)	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)
1 minute					
Stage 1 gas flow - Initial	13:30	0:0	0.0	1008	0
Stage 1 gas flow - Steady State	13:30	0:0	0.0	1008	0

Gas tap: SINGLE / DOUBLE

Observations: NONE.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm)	LEL (%)	PID (ppm)
13:32	0	-0.3	0.3	19.8	0	0	LL	0.8
"	15	-0.3	0.7	20.1	0	0	LL	0.8
"	30	-0.3	0.8	19.8	0	0	LL	0.9
"	60	-0.2	0.8	19.7	0	0	"	0.9
"	90	-0.2	0.8	19.7	0	0	"	0.9
"	120	-0.3	0.8	19.7	"	"	"	"
"	180	-0.3	0.9	19.6	"	"	"	"
"	240	-0.3	0.9	19.6	"	"	"	"
"	300	-0.3	0.9	19.7	"	"	"	"
"	360	-0.3	0.8	19.7	"	"	"	0.8
"	420	"	"	19.8	"	"	"	"
"	480	"	"	"	"	"	"	"
"	540	"	"	"	"	"	"	"
13:42	600	"	"	"	"	"	"	"

STAGE 3 WATER LEVEL OBSERVATION

Depth (from datum) to water: 2.242 (m)	Time: 13 : 44	LNAPL Top (from datum): n/a	(m)
Depth (from datum) to well base: 3.770 (m)		DNAPL Top (from datum): n/a	(m)
Hole Purged: Yes / No	Purge Start: 13 : 45		
Purge Volume: (ltrs) n/a	Purge End: SEE GW Sheet		

Post Testing Remarks: NONE.

Samples Taken: Yes / No | Gas / Water

Depth (from datum)	Sample Ref	Type	Container
		EW / G	
	SEE GW DATA SHEET		

RSK	Contract Name: Coolstown S.I	Contract Ref: 602923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 3 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 09/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device: GEM Series / Serial Number: DUBLIN / Daily Check: OK ✓
Pre-Testing Remarks: GOOD.	Air Temperature: 19 °C; Weather: DRY; Ground Conditions: DRY; Wind: NONE / LIGHT / MEDIUM / STRONG		Weather:
Exploratory Position ID: MW104	Monitoring Round Number: 2		Tidal State: (if applicable) High / Low / Rising / Falling; Test Number: 1
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)	

Test Sequence: 1 minute	Time of Monitoring 14:36 (hh:mm)	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
Stage 1 gas flow - Initial	14:37	06	0.0	1008	0	Observations:
Stage 1 gas flow - Steady State	14:38	00	0.0	1008	0	WONG

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH_4	Carbon Dioxide (%/vol) CO_2	Oxygen (%/vol) O_2	Hydrogen Sulphide (ppm) H_2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
14:39	0	-0.3	0.7	19.9	0	0	LLL	0.8
"	15	-0.3	0.6	20.1	0	0	LLL	0.8
"	30	-0.3	0.6	20.0	0	0	LLL	0.8
"	60	-0.3	0.6	19.9	0	0	LLL	0.8
"	90	-0.3	0.6	19.8	0	0	LLL	0.8
"	120	-0.3	0.6	19.8	0	0	LLL	0.8
"	180	-0.3	0.6	19.8	0	0	LLL	0.8
"	240	-0.3	0.6	19.8	0	0	LLL	0.8
"	300	-0.3	0.6	19.9	0	0	LLL	0.8
"	360							
"	420							
"	480							
"	540							
14:49	600							

STAGE 3 WATER LEVEL OBSERVATION

Depth (from datum) to water: 2.085 (m)	Time: 14:50	LNAPL Top (from datum): n/a (m)
Depth (from datum) to well base: 3.47 (m)		DNAPL Top (from datum): n/a (m)
Hole Purged: Yes / No	Purge Start: 14:5	
Purge Volume: (ltrs) n/a	Purge End: SEE GW DATA SHEET	

Post Testing Remarks: NONE.

Samples Taken: Yes / No — Gas / Water

Depth (from datum)	Sample Ref	Type	Container
		EW / G	
	SEE GW DATA SHEET		

RSK	Contract Name: COOKSTOWN S.I	Contract Ref: 602923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 4 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: MW105	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device C	Serial Number	Daily Check
Pre-Testing Remarks: GOOD.	Air Temperature: 15 °C Weather:		GEM Series	DUBLIN	02 ✓
	Weather: DRY				
	Ground Conditions: DRY				
	Wind: NONE / LIGHT / MEDIUM / STRONG		Tidal State: (if applicable) High / Low / Rising / Falling		
Exploratory Position ID: MW105	Monitoring Round Number: 2		Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence	Time of Monitoring hh:mm	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
1 minute	15:29					Observations:
Stage 1 gas flow - Initial	15:30	06	0	1009	0	
Stage 1 gas flow - Steady State	15:31	06	0	1008	0	NONE

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
15:32	0	-0.2	0.5	19.8	0	0	LLL	0.9
"	15	-0.2	0.1	20.7	0	0	LLL	0.9
"	30	-0.3	0.0	20.7	0	0	LLL	0.9
"	60	-0.3	0.0	20.6	0	0	LLL	0.8
"	90	-0.3	0.0	20.6	0	0	LLL	0.8
"	120	-0.3	0.0	20.6	"	"	"	"
"	180	-0.3	0.0	20.6	"	"	"	"
"	240	-0.3	0.0	20.6	"	"	"	"
"	300	"	"	"	"	"	"	"
"	360	"	"	"	"	"	"	"
"	420	"	"	"	"	"	"	"
"	480	"	"	"	"	"	"	"
"	540	"	"	"	"	"	"	"
15:42	600	"	"	"	"	"	"	"

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: 2.061 (m)	Time: 15:43	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 4.295 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: 15:44		
Purge Volume: (ltrs) n/a	Purge End: SEE GW DATA SHEET		

Post Testing Remarks: NONE

Samples Taken: Yes / No Gas / Water

Depth (from datum)	Sample Ref	Type EW / G	Container
	SEE GW DATA SHEET		

RSK	Contract Name: COOKSTOWN S.I.	Contract Ref: 602923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 5 of 5	Checked: TBC

GAS MONITORING FIELD SHEET

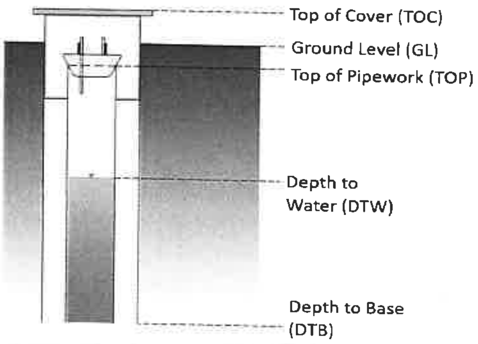
Monitoring Date:	12/06/2021	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	100mm
Pre-Testing Remarks:		Air Temperature: °C	12°C	Device:	GFM Series
Good Condition well leveled		Weather:	DRY	Serial Number:	DUBLIN OFFICE
		Ground Conditions:	DRY	Daily Check:	✓ Flow
		Wind: NONE / LIGHT / MEDIUM / STRONG		STRONG	
		Tidal State: (if applicable) High / Low / Rising / Falling		LOW - 998mb	
Exploratory Position ID:	MW101	Monitoring Round Number:	3	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE GAS BUNG
Time Start (hh:mm)	11:42	11:46	998	0.0	Observations (e.g. on-site activities):	BUSY PETROL STATION
Time End (hh:mm)	11:45	11:56				

Stage 1 Flow Readings: Time of flow monitoring (sec)	Stage 1 Flow Readings: Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0	0							
10	0	15	-0.2	0.8	18.8	0	0	<<<	0.9
15	0	30	-0.2	0.8	18.4	0	0	<<<	0.9
20	0	60	-0.2	0.8	18.3	0	0	<<<	0.9
25	0	90	-0.2	0.8	18.3	0	0	<<<	0.9
30	0	120	-0.2	0.8	18.3	0	0	<<<	0.9
40	0	180	-0.2	0.8	18.3	0	0	<<<	0.9
50	0	240	-0.2	0.8	18.3	0	0	<<<	0.9
60	0	300	-0.2	0.8	18.3	0	0	<<<	0.9
90	0	360	-0.2	0.8	18.3	0	0	<<<	0.9
120	0	420	-0.2	0.8	18.3	0	0	<<<	0.9
150	0	480	-0.2	0.8	18.3	0	0	<<<	0.9
180	0	540	-0.2	0.8	18.3	0	0	<<<	0.9
		600	-0.2	0.8	18.3	0	0	<<<	0.9
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION					
Depth (from datum) to water (DTW): (m)	DRY	Time:	11:57	LNAPL Top (from datum) (m):	n/a
Depth (from datum) to well base (DTB): (m)	3.171	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE - DRY	



Post testing remarks:		
NONE	Samples Taken: Yes / No	NO
	Sample Media: Gas/Water	n/a
	Gas Cannister Start (mb)	n/a
	Gas Cannister End (mb)	n/a
	Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK

Contract Name:	Cookstown S.I.	Data Collected By:	BRIAN C.
Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
Contract Ref:	602923	Page number:	115

GAS MONITORING FIELD SHEET

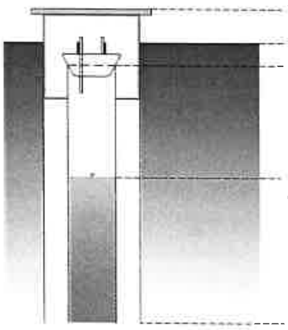
Monitoring Date:	12/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):		100mm	
Pre-Testing Remarks:			Air Temperature: °C	14°C	Device:	GFM Series	
Good Condition			Weather:	DRY	Serial Number:	DUBLIN	
			Ground Conditions:	DR	Daily Check:	✓	
			Wind: NONE / LIGHT / MEDIUM / STRONG		MEDIUM		
			Tidal State: (if applicable) High / Low / Rising / Falling		LOW		
Exploratory Position ID:	MW10R		Monitoring Round Number:	3	Test Number:	1	
Install Type: SINGLE / DOUBLE	SINGLE		Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm	

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	12:08	12:10	997	0	Observations (e.g. on-site activities):	BUSY PETROL STATION
Time End (hh:mm)	12:09	12:20				

Stage 1 Flow Readings Time of flow monitoring (sec)	Stage 1 Flow Readings Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0	0	-0.2	0.3	20.2	0	0.0	LLL	0.9
10	0	15	-0.2	0.3	20.4	0	0	"	0.9
15	0	30	-0.2	0.3	20.4	0	0	"	0.9
20	0	60	-0.2	0.3	20.2	0	0	"	0.9
25	0	90	-0.2	0.3	20.2	0	0	"	0.9
30	0	120	-0.3	0.3	20.2	0	0	"	0.9
40	0	180	-0.2	0.3	20.2	0	0	"	"
50	0	240	-0.2	0.3	20.2	0	0	"	"
60	0	300	"	"	"	"	"	"	"
90	0	360	"	"	"	"	"	"	"
120	0	420	"	"	"	"	"	"	"
150	0	480	"	"	"	"	"	"	"
180	0	540	"	"	"	"	"	"	"
		600	"	"	"	"	"	"	"
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION					
	Depth (from datum) to water (DTW): (m)	2.093	Time: 12:20	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	4.575	Purge Start: n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	NO	Purge End: n/a	Water Observations:	n/a
	Purge Volume: (ltrs) n/a		Post-Purge (DTW) (m) n/a		



Post testing remarks: NONE.

Samples Taken: Yes / No	NO
Sample Media: Gas/Water	n/a
Gas Cannister Start (mb)	n/a
Gas Cannister End (mb)	n/a
Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK			
Contract Name:	Coolstown S.I	Data Collected By:	RYAN
Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
Contract Ref:	602973	Page number:	2/5

GAS MONITORING FIELD SHEET

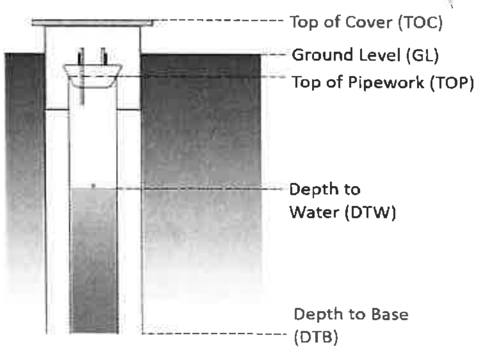
Monitoring Date:	12/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	0.15mm
Pre-Testing Remarks:		Air Temperature: °C	12°C	Device:	GFM
Good Condition		Weather:	OVERCAST	Serial Number:	DUBLIN OFFICE
		Ground Conditions:		Daily Check:	✓
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT	
		Tidal State: (if applicable) High / Low / Rising / Falling		LOW + FALLING	
Exploratory Position ID:	MW103	Monitoring Round Number:	3/5	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50 mm

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	12:34	13:38	997	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	12:37	13:48			NONE	

Stage 1 Flow Readings	Stage 1 Flow Readings	Stage 2 Gas Monitoring:	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
Time of flow monitoring (sec)	Flow Reading (l/hr)	Time of gas monitoring (sec)							
5	0.0	0	-0.2	0.8	19.3	0	0	<<<	0.9
10	0.0	15	-0.2	0.8	19.8	0	0	<<<	0.9
15	0.0	30	-0.2	0.8	19.6	0	0	<<<	0.9
20	0.0	60	-0.2	0.8	19.5	0	0	<<<	0.9
25	0.0	90	-0.2	0.8	19.5	0	0	<<<	0.9
30	0.0	120	-0.2	0.8	19.5	0	0	<<<	0.9
40	0.0	180	-0.2	0.8	19.5	0	0	<<<	0.9
50	0.0	240	-0.2	0.8	19.5	0	0	<<<	0.9
60	0.0	300							
90	0.0	360							
120	0.0	420							
150	0.0	480							
180	0.0	540							
		600							
Stage 1 gas flow - Peak (l/h)	0.0								
Stage 1 gas flow - Steady State (l/h)	0.0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	2.073	Time:	12:52	LNAPL Top (from datum) (m):	N/A
	Depth (from datum) to well base (DTB): (m)	3.728	Purge Start:	N/A	DNAPL Top (from datum) (m):	N/A
	Hole Purged: Yes / No	NO	Purge End:	N/A	Water Observations:	
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	N/A	NONE	



Post testing remarks:		
NONE	Samples Taken: Yes / No	NO
	Sample Media: Gas/Water	n/a
	Gas Cannister Start (mb)	n/a
	Gas Cannister End (mb)	n/a
	Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK				
	Contract Name:	Cookstown S.I	Data Collected By:	RYAN
	Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
	Contract Ref:	607923	Page number:	4/5

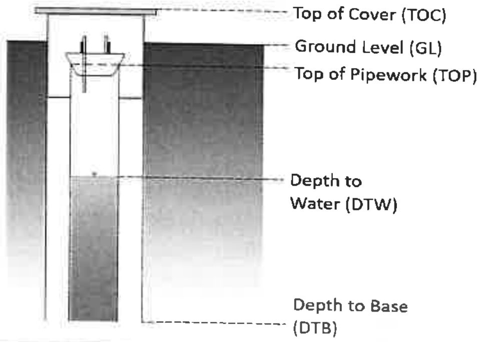
GAS MONITORING FIELD SHEET

Monitoring Date:	12/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	0.15m		
Pre-Testing Remarks:		Air Temperature: °C	12°C	Device:	GFM series		
Good Condition		Weather:	OVERCAST	Serial Number:	Dublin Office		
		Ground Conditions:		Daily Check:	✓		
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT			
		Tidal State: (if applicable) High / Low / Rising / Falling		Low + Falling			
Exploratory Position ID:	MW104	Monitoring Round Number:	3/4	Test Number:	1		
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50		

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE			
					SINGLE			
Time Start (hh:mm)	12:55	12:59	997	0	Observations (e.g. on-site activities):			
Time End (hh:mm)	12:58	13:09			none			
Stage 1 Flow Readings	**Stage 1** Flow Readings	**Stage 2** Gas Monitoring:	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
Time of flow monitoring (sec)	Flow Reading (l/hr)	Time of gas monitoring (sec)							
5	0.0	0	-0.2	0.8	19.4	0	0	<<<	0.9
10	0.0	15	-0.2	0.6	19.9	0	0	<<<	0.9
15	0.0	30	-0.2	0.6	19.7	0	0	<<<	0.9
20	0.0	60	-0.2	0.6	19.6	0	0	<<<	0.9
25	0.0	90	-0.2	0.6	19.6	0	0	<<<	0.9
30	0.0	120	-0.2	0.6	19.6	0	0	<<<	0.9
40	0.0	180	-0.2	0.6	19.6	0	0	<<<	0.9
50	0.0	240	-0.2	0.6	19.5	0	0	<<<	0.9
60	0.0	300	-0.2	0.6	19.6	0	0	<<<	0.9
90	0.0	360	-0.2	0.6	19.5	0	0	<<<	0.9
120	0.0	420	-0.2	0.6	19.5	0	0	<<<	0.9
150	0.0	480	-0.2	0.6	19.5	0	0	<<<	0.9
180	0.0	540	-0.2	0.6	19.5	0	0	<<<	0.9
		600	-0.2	0.6	19.5	0	0	<<<	0.9
Stage 1 gas flow - Peak (l/h)	0.0								
Stage 1 gas flow - Steady State (l/h)	0.0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION	Depth (from datum) to water (DTW): (m)	1.926	Time:	13:13	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	3.470	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:	Samples Taken: Yes / No	NO		
NONE	Sample Media: Gas/Water	N/A		
	Gas Cannister Start (mb)	N/A		
	Gas Cannister End (mb)	n/a		
	Gas Cannister Duration (mins)	n/a		
	Depth (from datum)	Sample Ref	Type (EW / G)	Container
		NONE		

Contract Name:	Cookstown S.I.	Data Collected By:	RYAN
Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
Contract Ref:	602973	Page number:	4/5

GAS MONITORING FIELD SHEET

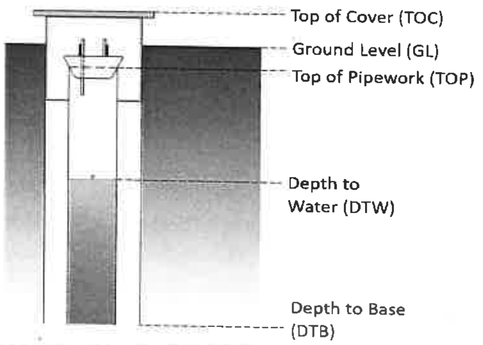
Monitoring Date:	12/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	0.20 m
Pre-Testing Remarks:		Air Temperature: °C	12°C	Device:	GFM Series
Good Condition		Weather:	OVERCAST	Serial Number:	DUBLIN OFFICE
		Ground Conditions:	DRY	Daily Check:	✓
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT	
		Tidal State: (if applicable) High / Low / Rising / Falling		LOW + FALLING	
Exploratory Position ID:	MW105	Monitoring Round Number:	3/4	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	13:13	13:17	997	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	13:16	13:27			NONE.	

Stage 1 Flow Readings Time of flow monitoring (sec)	Stage 1 Flow Readings Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0.0	0	-0.2	0.6	19.5	0	0	<<<	0.9
10	0.0	15	-0.2	0.3	20.3	0	0	<<<	0.9
15	0.0	30	-0.2	0.3	20.2	0	0	<<<	0.9
20	0.0	60	-0.2	0.3	20.1	0	0	<<<	0.9
25	0.0	90	-0.2	0.3	20.0	0	0	<<<	0.9
30	0.0	120	-0.2	0.3	20.0	0	0	<<<	0.9
40	0.0	180	-0.2	0.3	20.0	0	0	<<<	0.9
50	0.0	240	-0.2	0.3	20.0	0	0	<<<	0.9
60	0.0	300	-0.2	0.3	20.0	0	0	<<<	0.9
90	0.0	360	-0.2	0.3	20.0	0	0	<<<	0.9
120	0.0	420	-0.2	0.3	20.0	0	0	<<<	0.9
150	0.0	480	-0.2	0.3	20.0	0	0	<<<	0.9
180	0.0	540	-0.2	0.3	20.0	0	0	<<<	0.9
		600	-0.2	0.3	20.0	0	0	<<<	0.9
Stage 1 gas flow - Peak (l/h)	0.0								
Stage 1 gas flow - Steady State (l/h)	0.0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	1.875	Time:	13:38	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	3.105	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:	Samples Taken: Yes / No	NO		
NONE	Sample Media: Gas/Water	n/a		
	Gas Cannister Start (mb)	n/a		
	Gas Cannister End (mb)	n/a		
	Gas Cannister Duration (mins)	n/a		
	Depth (from datum)	Sample Ref	Type (EW / G)	Container
		NONE		

RSK	Contract Name:	Cookstown S.I.	Data Collected By:	RYAN
	Project Manager / Engineer:	PAUL FEEL	Checked:	TBC
	Contract Ref:	602925	Page number:	5/5

GAS MONITORING FIELD SHEET

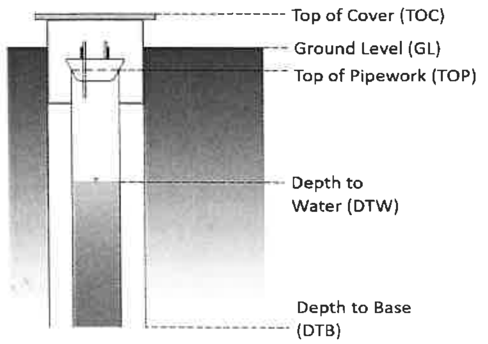
Monitoring Date:	15/06/2021	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m): 100mm	100mm
Pre-Testing Remarks:		Air Temperature: °C	16	Device:	DUBLIN
GOOD		Weather:	DRY	Serial Number:	GFM SERIES
		Ground Conditions:	DRY	Daily Check:	✓
		Wind: NONE / LIGHT / MEDIUM / STRONG		NONE	
		Tidal State: (if applicable) High / Low / Rising / Falling	HIGH	HIGH	
Exploratory Position ID:	MW101	Monitoring Round Number:	4/4	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	14:22	14:24	1004	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	14:23	14:34			NONE	

Stage 1 Flow Readings	Stage 1 Flow Readings	Stage 2 Gas Monitoring:	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
Time of flow monitoring (sec)	Flow Reading (l/hr)	Time of gas monitoring (sec)							
5	0	0	-0.1	0.3	20.8	0	0	LLL	0.9
10	0	15	-0.1	0.3	20.7	"	"	"	0.9
15	0	30	-0.1	0.4	20.5	"	"	"	0.9
20	0	60	-0.1	0.4	20.2	"	"	"	0.9
25	0	90	-0.1	0.4	20.1	"	"	"	0.9
30	0	120	-0.1	0.5	20.1	"	"	"	0.9
40	0	180	-0.1	0.5	20.1	"	"	"	0.9
50	0	240	-0.1	0.5	20.1	"	"	"	0.9
60	0	300	"	"	"	"	"	"	"
90	0	360	"	"	"	"	"	"	"
120	0	420	"	"	"	"	"	"	"
150	0	480	"	"	"	"	"	"	"
180	0	540	"	"	"	"	"	"	"
		600	"	"	"	"	"	"	"

Stage 1 gas flow - Peak (l/h)	0	**Note:** Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.
Stage 1 gas flow - Steady State (l/h)	0	

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	DRY	Time:	n/a	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	3.220	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
	Purge Volume: (ltrs)	N/A	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:	Samples Taken: Yes / No	NO		
NONE	Sample Media: Gas/Water	n/a		
	Gas Cannister Start (mb)	n/a		
	Gas Cannister End (mb)	n/a		
	Gas Cannister Duration (mins)	n/a		
	Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE			

RSK	Contract Name:	COOKSTOWN S.I	Data Collected By:	RYAN
	Project Manager / Engineer:	PAUL REILLY	Checked:	TBC
	Contract Ref:	602973	Page number:	1/5

GAS MONITORING FIELD SHEET

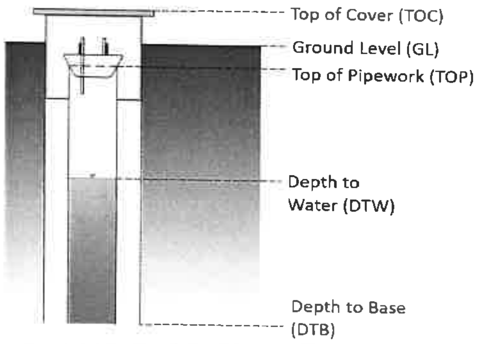
Monitoring Date:	15/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):		100mm
Pre-Testing Remarks:		Air Temperature: °C	15	Device:	GFM Series	
Good		Weather:	DRY	Serial Number:	DUBLIN OFFICE	
		Ground Conditions:	DRY	Daily Check:	✓	
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT		
		Tidal State: (if applicable) High / Low / Rising / Falling		HIGH		
Exploratory Position ID:	MW102	Monitoring Round Number:	4/4	Test Number:	1	
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm	

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	14:46	14:48	1003	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	14:47	14:58			NONE	

Stage 1 Flow Readings	Stage 1 Flow Readings	Stage 2 Gas Monitoring:	Methane	Carbon Dioxide	Oxygen	Carbon monoxide	Hydrogen sulphide	LEL	PID
Time of flow monitoring (sec)	Flow Reading (l/hr)	Time of gas monitoring (sec)	(%/vol)	(%/vol)	(%/vol)	(ppm)	(ppm)	(%)	(ppm)
5	0	0	-0.1	0.4	20.7	0	0	LLL	0.9
10	0	15	-0.1	0.3	20.8	〃	〃	LLL	0.9
15	0	30	-0.1	0.3	20.9	〃	〃	LLL	0.9
20	0	60	-0.1	0.3	20.9	〃	〃	〃	〃
25	0	90	〃	〃	20.9	〃	〃	〃	〃
30	0	120	〃	〃	20.8	〃	〃	〃	〃
40	0	180	〃	〃	20.7	〃	〃	〃	〃
50	0	240	〃	〃	〃	〃	〃	〃	〃
60	0	300	〃	〃	〃	〃	〃	〃	〃
90	0	360	〃	0.4	〃	〃	〃	〃	〃
120	0	420	〃	〃	〃	〃	〃	〃	〃
150	0	480	〃	0.3	〃	〃	〃	〃	〃
180	0	540	〃	〃	〃	〃	〃	〃	〃
		600	〃	〃	〃	〃	〃	〃	〃
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION					
Depth (from datum) to water (DTW): (m)	2.032	Time:	n/a	LNAPL Top (from datum) (m):	n/a
Depth (from datum) to well base (DTB): (m)	4.600	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	none	



Post testing remarks:	Samples Taken: Yes / No	NO		
NONE	Sample Media: Gas/Water	n/a		
	Gas Cannister Start (mb)	n/a		
	Gas Cannister End (mb)	n/a		
	Gas Cannister Duration (mins)	n/a		
	Depth (from datum)	Sample Ref	Type (EW / G)	Container
		NONE		

RSK	Contract Name:	COOKSTOWN S.I.	Data Collected By:	RYAN
	Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
	Contract Ref:	602923	Page number:	5/5

GAS MONITORING FIELD SHEET

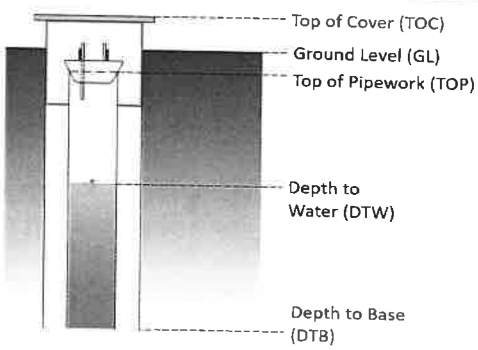
Monitoring Date:	13/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	100mm
Pre-Testing Remarks:	Good	Air Temperature: °C	16	Device:	GFM Series
		Weather:	DRY	Serial Number:	DUBLIN
		Ground Conditions:	DRY	Daily Check:	✓
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT	
		Tidal State: (if applicable) High / Low / Rising / Falling		HIGH	
Exploratory Position ID:	MW03	Monitoring Round Number:	8/14	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	14:54	14:56	1003	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	14:55	15:06			NONE	

Stage 1 Flow Readings	Stage 1 Flow Readings	Stage 2 Gas Monitoring:	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
Time of flow monitoring (sec)	Flow Reading (l/hr)	Time of gas monitoring (sec)							
5	0	0	0.6	0.3	20.3	0	0	<LL	0.9
10	0	15	0	0.6	20.4	〃	〃	〃	〃
15	0	30	0	0.7	20.3	〃	〃	〃	〃
20	0	60	0	0.7	20.2	〃	〃	〃	〃
25	0	90	0	0.7	20.1	〃	〃	〃	〃
30	0	120	0	0.7	20.1	〃	〃	〃	〃
40	0	180	0	〃	〃	〃	〃	〃	〃
50	0	240	0	〃	〃	〃	〃	〃	〃
60	0	300	0	〃	〃	〃	〃	〃	〃
90	0	360	0	〃	〃	〃	〃	〃	〃
120	0	420	0	〃	〃	〃	〃	〃	〃
150	0	480	0	〃	〃	〃	〃	〃	〃
180	0	540	0	〃	〃	〃	〃	〃	〃
		600	0	〃	〃	〃	〃	〃	〃
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	1.960	Time:	n/a	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	3.760	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:	
NONE	

Samples Taken: Yes / No	NO
Sample Media: Gas/Water	n/a
Gas Cannister Start (mb)	n/a
Gas Cannister End (mb)	n/a
Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK

Contract Name:	COOKSTOWN ST	Data Collected By:	RYAN
Project Manager / Engineer:	PAUL FEELY	Checked:	TRC
Contract Ref:	660923	Page number:	8/15

GAS MONITORING FIELD SHEET

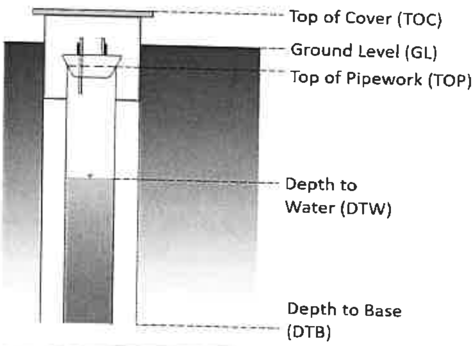
Monitoring Date:	15/06/2020	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	60mm
Pre-Testing Remarks:		Air Temperature: °C	17°C	Device:	GFM Series
Good		Weather:	DRY	Serial Number:	DUBLIN OFFICE
		Ground Conditions:	DRY	Daily Check:	✓
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT	
		Tidal State: (if applicable) High / Low / Rising / Falling		HIGH	
Exploratory Position ID:	MW1d	Monitoring Round Number:	414	Test Number:	1
Install Type: SINGLE / DOUBLE		Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	15:14	15:16	1005	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	15:15	15:17			NONE	

Stage 1 Flow Readings Time of flow monitoring (sec)	Stage 1 Flow Readings Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0	0	0	0.6	20.3	0	0	LLL	0.9
10	0	15	0	0.6	20.4	0	0	LLL	0.9
15	0	30	0	0.6	20.2	0	0	LLL	0.9
20	0	60	0	0.6	20.1	-10	"	"	"
25	0	90	0	"	20.0	-10	"	"	"
30	0	120	0	"	"	0	"	"	"
40	0	180	"	"	"	"	"	"	"
50	0	240	"	"	"	"	"	"	"
60	0	300	"	"	"	"	"	"	"
90	0	360	"	"	"	"	"	"	"
120	0	420	"	"	"	"	"	"	"
150	0	480	"	"	"	"	"	"	"
180	0	540	"	"	"	"	"	"	"
		600	"	"	"	"	"	"	"
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	1.834	Time:	n/a	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	3.500	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	no	Purge End:	n/a	Water Observations:	
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:				
NONE	Samples Taken: Yes / No	NO		
	Sample Media: Gas/Water	n/a		
	Gas Cannister Start (mb)	n/a		
	Gas Cannister End (mb)	n/a		
	Gas Cannister Duration (mins)	n/a		
	Depth (from datum)	Sample Ref	Type (EW / G)	Container
		NONE		

RSK				
	Contract Name:	COOKSTOWN ST	Data Collected By:	RYAN
	Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
	Contract Ref:	602973	Page number:	45

GAS MONITORING FIELD SHEET

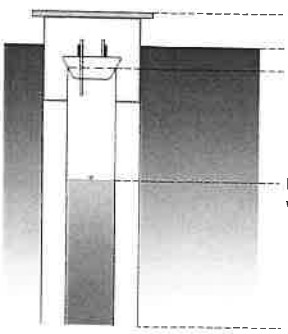
Monitoring Date:	15/08/2026	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	100mm
Pre-Testing Remarks:		Air Temperature: °C	17°C	Device:	GFM Series
GOOD.		Weather:	DRY	Serial Number:	DUBLIN
		Ground Conditions:	DRY	Daily Check:	
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT	
		Tidal State: (if applicable) High / Low / Rising / Falling		HIGH	
Exploratory Position ID:	MW105	Monitoring Round Number:	414	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	15:24	15:26	1003	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	15:25	15:36			NONE	

Stage 1 Flow Readings	Stage 1 Flow Readings	Stage 2 Gas Monitoring:	Methane	Carbon Dioxide	Oxygen	Carbon monoxide	Hydrogen sulphide	LEL	PID
Time of flow monitoring (sec)	Flow Reading (l/hr)	Time of gas monitoring (sec)	(%/vol)	(%/vol)	(%/vol)	(ppm)	(ppm)	(%)	(ppm)
5	0	0	0	0.4	20.2	0	0	LLL	1.0
10	0	15	0	0.3	20.2	"	"	"	"
15	0	30	0	0.3	20.3	"	"	"	"
20	0	60	0	0.3	20.3	"	"	"	"
25	0	90	0	0.3	20.2	"	"	"	"
30	0	120	0	"	20.2	"	"	"	"
40	0	180	0	"	20.1	"	"	"	"
50	0	240	0	"	"	"	"	"	"
60	0	300	0	"	"	"	"	"	"
90	0	360	0	"	"	"	"	"	"
120	0	420	0	"	"	"	"	"	"
150	0	480	0	"	"	"	"	"	"
180	0	540	0	"	"	"	"	"	"
		600	0	"	"	"	"		"
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION					
Depth (from datum) to water (DTW): (m)	1.822	Time:	n/a	LNAPL Top (from datum) (m):	n/a
Depth (from datum) to well base (DTB): (m)	4.295	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:	Samples Taken: Yes / No	NO		
NONE	Sample Media: Gas/Water	n/a		
	Gas Cannister Start (mb)	n/a		
	Gas Cannister End (mb)	n/a		
	Gas Cannister Duration (mins)	n/a		
	Depth (from datum)	Sample Ref	Type (EW / G)	Container
		NONE		

RSK				
	Contract Name:	COOKSTOWN ST	Data Collected By:	RYAN
	Project Manager / Engineer:	PAUL FEELY	Checked:	TRC
	Contract Ref:	602973	Page number:	5/5

APPENDIX F

Generic Assessment Criteria for a Residential Without Home Produce Site Use

Generic assessment criteria for human health: residential scenario without home-grown produce

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009(1). RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009(2). RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)(3,4), as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)(5) used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010(3)). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report(3) and associated appendices(6), and adopts them as GAC for these six substances.

For all other substances the C4SL exposure modifications relevant for residential without home-grown produce end use have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) and reducing exposure frequency for dermal contact outdoors.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015(7) or by the USEPA(14), where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.071, supporting EA guidance(5,8,9) and revised exposure scenarios published for the C4SL(3). The SAC are also termed GAC.

Conceptual model

In accordance with SR3(5), the residential without home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In accordance with Box 3.1 of SR3(5), the pathways considered for production of the SAC in the residential without home-grown produce scenario are

- direct soil and dust ingestion in areas of soft landscaping
- dermal contact with soil and indoor dust

- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium[1], the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh}, are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[9]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[9]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[9]:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[9], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[9], which explains how to calculate an effective assessment criterion manually.

SR3[5] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7(10), the EA TOX(1) reports, the C4SL SP1010 project report and associated appendices(3,6), the 2015 LQM/CIEH report(7) or the USEPA IRIS database(14). Where a C4SL has been published, the RSK GAC have duplicated the C4SL published values using all input parameters within the SP1010 final project report(3) and associated appendices(6), and has adopted them as GAC for these six substances. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report(11).

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the residential without home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. SR3(5) notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3(3), with a dust loading factor detailed in Section 9.3 of SR3(5). The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3(5). This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

Summary of modifications to the default CLEA SR3(5) input parameters for residential without home-grown produce

In summary, the RSK GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3(5). Modifications to the default SR3(5) exposure scenarios based on the C4SL exposure scenarios(3) are presented in Table 2 below.

The final selected GAC are presented by pathway in Table 3 and the combined GAC in Table 4.

Figure 1: Conceptual model for CLEA residential scenario without home-grown produce

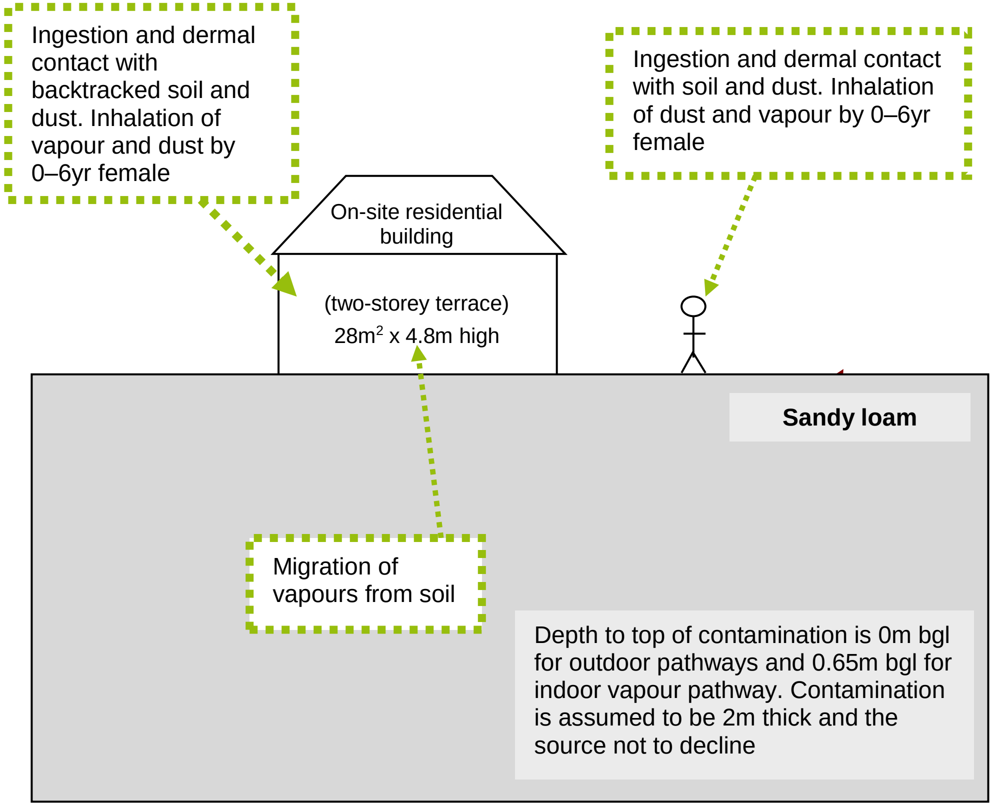


Table 1: Exposure assessment parameters for residential scenario without home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential without home-grown produce	Chosen land use
Receptor	Female child	Key generic assumption given in Box 3.1, SR3[(5)]
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3[(5)]. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3)[(5)]
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3)[(5)]
Start age class (AC)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3[(5)]
End AC	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[(13)]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential without home-grown produce – modified receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
Soil to skin adherence factor – (outdoor)	mg soil/cm^2 skin	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010[3]					
Inhalation rate	m^3 day^{-1}	5.4	8.0	8.9	10.1	10.1	10.1
Justification		Mean value USEPA, 2011[12]; Table 3.2, SP1010[3]					
Notes: For **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI_{oral} and TDI_{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3[1], Science Report SC050021/Cadmium SGV[1] and the project report SP1010[3] for more information.							

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR
Barium	(b)	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR
Beryllium		1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR
Boron		1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR
Cadmium	(a)	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR
Chromium (III) - trivalent	(c)	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR
Chromium (VI) - hexavalent	(a,d)	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR
Copper		1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR
Lead	(a)	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	NR	2.41E-01	NR	4.31E+00	NR	5.74E-01	NR	1.07E+01	NR	1.25E+00	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR
Methyl Mercury (Hg^{4+})		1.80E+01	1.87E+01	9.16E+00	7.33E+01	1.80E+01	3.62E+01	1.20E+01	1.42E+02	1.80E+01	7.68E+01	1.46E+01	3.04E+02
Nickel	(d)	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR
Selenium	(b)	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR
Vanadium		1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR
Zinc	(b)	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR
Cyanide (free)		4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR
Volatile Organic Compounds													
Benzene	(a)	7.36E+01	9.01E-01	8.90E-01	1.22E+03	7.36E+01	1.68E+00	1.64E+00	2.26E+03	7.36E+01	3.48E+00	3.33E+00	4.71E+03
Toluene		2.87E+04	9.08E+02	8.80E+02	8.69E+02	2.87E+04	2.00E+03	1.87E+03	1.92E+03	2.87E+04	4.55E+03	3.93E+03	4.36E+03
Ethylbenzene		1.29E+04	8.34E+01	8.29E+01	5.18E+02	1.29E+04	1.96E+02	1.93E+02	1.22E+03	1.29E+04	4.58E+02	4.42E+02	2.84E+03
Xylene - m		2.32E+04	8.25E+01	8.22E+01	6.25E+02	2.32E+04	1.95E+02	1.93E+02	1.47E+03	2.32E+04	4.56E+02	4.47E+02	3.46E+03
Xylene - o		2.32E+04	8.87E+01	8.83E+01	4.78E+02	2.32E+04	2.08E+02	2.06E+02	1.12E+03	2.32E+04	4.86E+02	4.76E+02	2.62E+03
Xylene - p		2.32E+04	7.93E+01	7.90E+01	5.76E+02	2.32E+04	1.86E+02	1.85E+02	1.35E+03	2.32E+04	4.36E+02	4.28E+02	3.17E+03
Total xylene		2.32E+04	7.93E+01	7.90E+01	6.25E+02	2.32E+04	1.86E+02	1.85E+02	1.47E+03	2.32E+04	4.36E+02	4.28E+02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		3.87E+04	1.04E+02	1.04E+02	2.04E+04	3.87E+04	1.69E+02	1.69E+02	3.31E+04	3.87E+04	3.21E+02	3.19E+02	6.27E+04
Trichloroethene		6.45E+01	1.72E-02	1.72E-02	1.54E+03	6.45E+01	3.59E-02	3.59E-02	3.22E+03	6.45E+01	7.98E-02	7.97E-02	7.14E+03
Tetrachloroethene		7.13E+02	1.79E-01	1.79E-01	4.24E+02	7.13E+02	4.02E-01	4.02E-01	9.51E+02	7.13E+02	9.21E-01	9.20E-01	2.18E+03
1,1,1-Trichloroethane		7.74E+04	9.01E+00	9.01E+00	1.43E+03	7.74E+04	1.84E+01	1.84E+01	2.92E+03	7.74E+04	4.04E+01	4.04E+01	6.39E+03
1,1,1,2 Tetrachloroethane		7.34E+02	1.54E+00	1.53E+00	2.60E+03	7.34E+02	3.56E+00	3.55E+00	6.02E+03	7.34E+02	8.29E+00	8.20E+00	1.40E+04
1,1,2,2-Tetrachloroethane		7.34E+02	3.92E+00	3.90E+00	2.67E+03	7.34E+02	8.04E+00	7.95E+00	5.46E+03	7.34E+02	1.76E+01	1.72E+01	1.20E+04
Carbon Tetrachloride		5.15E+02	2.58E-02	2.58E-02	1.52E+03	5.15E+02	5.65E-02	5.64E-02	3.32E+03	5.15E+02	1.28E-01	1.28E-01	7.54E+03
1,2-Dichloroethane		1.55E+01	9.20E-03	9.20E-03	3.41E+03	1.55E+01	1.33E-02	1.33E-02	4.91E+03	1.55E+01	2.28E-02	2.27E-02	8.43E+03
Vinyl Chloride		1.81E+00	7.73E-04	7.73E-04	1.36E+03	1.81E+00	1.00E-03	9.99E-04	1.76E+03	1.81E+00	1.53E-03	1.53E-03	2.69E+03
1,2,4-Trimethylbenzene		NR	5.58E+00	NR	4.74E+02	NR	1.29E+01	NR	1.16E+03	NR	2.69E+01	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds													
Acenaphthene		7.64E+03	4.86E+04	6.60E+03	5.70E+01	7.64E+03	1.18E+05	7.17E+03	1.41E+02	7.64E+03	2.68E+05	7.43E+03	3.36E+02
Acenaphthylene		7.65E+03	4.59E+04	6.55E+03	8.61E+01	7.65E+03	1.11E+05	7.15E+03	2.12E+02	7.65E+03	2.53E+05	7.42E+03	5.06E+02
Anthracene		3.82E+04	1.53E+05	3.06E+04	1.17E+00	3.82E+04	3.77E+05	3.47E+04	2.91E+00	3.82E+04	8.76E+05	3.66E+04	6.96E+00
Benzo(a)anthracene		1.98E+01	2.47E+01	1.10E+01	1.71E+00	1.98E+01	4.37E+01	1.36E+01	4.28E+00	1.98E+01	6.26E+01	1.50E+01	1.03E+01
Benzo(a)pyrene	(a)	5.34E+00	3.51E+01	NR	9.11E-01	5.34E+00	3.77E+01	NR	2.28E+00	5.34E+00	3.89E+01	NR	5.46E+00
Benzo(b)fluoranthene		4.97E+00	1.93E+01	3.95E+00	1.22E+00	4.97E+00	2.13E+01	4.03E+00	3.04E+00	4.97E+00	2.22E+01	4.06E+00	7.29E+00
Benzo(g,h,i)perylene		4.38E+02	1.87E+03	3.55E+02	1.54E-02	4.38E+02	1.94E+03	3.58E+02	3.85E-02	4.38E+02	1.97E+03	3.59E+02	9.23E-02
Benzo(k)fluoranthene		1.31E+02	5.41E+02	1.06E+02	6.87E-01	1.31E+02	5.76E+02	1.07E+02	1.72E+00	1.31E+02	5.91E+02	1.07E+02	4.12E+00
Chrysene		3.95E+01	1.19E+02	2.97E+01	4.40E-01	3.95E+01	1.49E+02	3.12E+01	1.10E+00	3.95E+01	1.66E+02	3.19E+01	2.64E+00
Dibenzo(a,h)anthracene		3.95E-01	1.45E+00	3.10E-01	3.93E-03	3.95E-01	1.64E+00	3.18E-01	9.82E-03	3.95E-01	1.74E+00	3.22E-01	2.36E-02
Fluoranthene		1.59E+03	3.83E+04	1.53E+03	1.89E+01	1.59E+03	8.87E+04	1.56E+03	4.73E+01	1.59E+03	1.83E+05	1.58E+03	1.13E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Fluorene		5.09E+03	6.20E+03	2.80E+03	3.09E+01	5.09E+03	1.53E+04	3.82E+03	7.65E+01	5.09E+03	3.62E+04	4.47E+03	1.83E+02
Indeno(1,2,3-cd)pyrene		5.65E+01	2.12E+02	4.46E+01	6.13E-02	5.65E+01	2.38E+02	4.56E+01	1.53E-01	5.65E+01	2.50E+02	4.60E+01	3.68E-01
Naphthalene		2.50E+03	2.33E+01	2.31E+01	7.64E+01	2.50E+03	5.58E+01	5.46E+01	1.83E+02	2.50E+03	1.31E+02	1.25E+02	4.32E+02
Phenanthrene		1.58E+03	7.17E+03	1.30E+03	3.60E+01	1.58E+03	1.76E+04	1.45E+03	8.96E+01	1.58E+03	4.07E+04	1.52E+03	2.14E+02
Pyrene		3.82E+03	8.79E+04	3.66E+03	2.20E+00	3.82E+03	2.04E+05	3.75E+03	5.49E+00	3.82E+03	4.23E+05	3.79E+03	1.32E+01
Phenol		6.48E+04	4.58E+02	4.55E+02	2.42E+04	6.48E+04	6.95E+02	6.88E+02	3.81E+04	6.48E+04	1.19E+03	1.17E+03	7.03E+04
Total Petroleum Hydrocarbons													
Aliphatic hydrocarbons EC_5-EC_6		3.23E+05	4.24E+01	4.24E+01	3.04E+02	3.23E+05	7.79E+01	7.79E+01	5.58E+02	3.23E+05	1.61E+02	1.61E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		3.23E+05	1.04E+02	1.04E+02	1.44E+02	3.23E+05	2.31E+02	2.31E+02	3.22E+02	3.23E+05	5.29E+02	5.29E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		6.45E+03	2.68E+01	2.68E+01	7.77E+01	6.45E+03	6.55E+01	6.53E+01	1.90E+02	6.45E+03	1.56E+02	1.55E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		6.45E+03	1.33E+02	1.32E+02	4.75E+01	6.45E+03	3.31E+02	3.27E+02	1.18E+02	6.45E+03	7.93E+02	7.67E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		6.45E+03	1.11E+03	1.06E+03	2.37E+01	6.45E+03	2.78E+03	2.42E+03	5.91E+01	6.45E+03	6.67E+03	4.37E+03	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC_8-EC_{10}		2.58E+03	4.74E+01	4.72E+01	6.13E+02	2.58E+03	1.16E+02	1.15E+02	1.50E+03	2.58E+03	2.77E+02	2.69E+02	3.58E+03
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.58E+03	2.58E+02	2.52E+02	3.64E+02	2.58E+03	6.39E+02	5.94E+02	8.99E+02	2.58E+03	1.52E+03	1.24E+03	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		2.58E+03	2.85E+03	1.80E+03	1.69E+02	2.58E+03	7.07E+03	2.30E+03	4.19E+02	2.58E+03	1.68E+04	2.48E+03	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(b)	1.86E+03	NR	NR	5.37E+01	1.90E+03	NR	NR	1.34E+02	1.92E+03	NR	NR	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.

Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for boron and selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 4
Human health generic assessment criteria for residential without home-grown produce

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	40	40	40
Barium	1,300	1,300	1,300
Beryllium	1.7	1.7	1.7
Boron	11,000	11,000	11,000
Cadmium	149	149	149
Chromium (III) - trivalent	910	910	910
Chromium (VI) - hexavalent	21	21	21
Copper	7,100	7,100	7,100
Lead	310	310	310
Elemental Mercury (Hg^0)	0.2	0.6	1.2
Inorganic Mercury (Hg^{2+})	56	56	56
Methyl Mercury (Hg^{4+})	9	12	15
Nickel	180	180	180
Selenium	430	430	430
Vanadium	1,200	1,200	1,200
Zinc	40,000	40,000	40,000
Cyanide (free)	40	40	40
Volatile Organic Compounds			
Benzene	0.9	1.6	3.3
Toluene	900 (869)	1,900	3,900
Ethylbenzene	80	190	440
Xylene - m	80	190	450
Xylene - o	90	210	480
Xylene - p	80	180	430
Total xylene	80	180	430
Methyl tertiary-Butyl ether (MTBE)	100	170	320
Trichloroethene	0.02	0.04	0.08
Tetrachloroethene	0.2	0.4	0.9
1,1,1-Trichloroethane	9.0	18.4	40.4
1,1,1,2 Tetrachloroethane	1.5	3.5	8.2
1,1,2,2-Tetrachloroethane	3.9	8.0	17.2
Carbon Tetrachloride	0.026	0.056	0.128
1,2-Dichloroethane	0.009	0.013	0.023
Vinyl Chloride	0.0008	0.0010	0.0015
1,2,4-Trimethylbenzene	5.6	12.9	26.9
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	6,600 (57)	7,200	7,400
Acenaphthylene	6,600 (86)	7,200	7,400
Anthracene	31,000 (1.17)	35,000	37,000
Benzo(a)anthracene	11.0	13.6	15.0
Benzo(a)pyrene	5.3	5.3	5.3
Benzo(b)fluoranthene	4.0	4.0	4.1
Benzo(g,h,i)perylene	355	358	359
Benzo(k)fluoranthene	106	107	107
Chrysene	30	31	32
Dibenzo(a,h)anthracene	0.31	0.32	0.32
Fluoranthene	1,500	1,600	1,600
Fluorene	2,800 (31)	3,800 (77)	4,500 (183)
Indeno(1,2,3-cd)pyrene	45	46	46
Naphthalene	23	55	125
Phenanthrene	1,300 (36)	1,450	1,520
Pyrene	3,700	3,800	3,800
Phenol	440*	688	1,170
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	42	78	161
Aliphatic hydrocarbons >EC_6-EC_8	100	230	530
Aliphatic hydrocarbons >EC_8-EC_{10}	27	65	155
Aliphatic hydrocarbons >EC_{10}-EC_{12}	130 (48)	330 (118)	770 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	1,100 (24)	2,400 (59)	4,400 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	65,000 (8)	92,000 (21)	111,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	65,000 (8)	92,000 (21)	111,000
Aromatic hydrocarbons >EC_8-EC_{10}	47	115	269
Aromatic hydrocarbons >EC_{10}-EC_{12}	300	600	1,200
Aromatic hydrocarbons >EC_{12}-EC_{16}	1,800 (169)	2,300 (419)	2,500
Aromatic hydrocarbons >EC_{16}-EC_{21}	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{21}-EC_{35}	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{35}-EC_{44}	1,900	1,900	1,900
Minerals			
Asbestos	Stage 1 test – No asbestos detected with ID; Stage 2 test - <0.001% dry weight (exceedance of either equates to an exceedance of the GAC)[1]		

Notes:
'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.
NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used
EC - equivalent carbon. SAC - soil assessment criteria.
[1] LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS)
RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.

APPENDIX G

Generic groundwater assessment criteria for human health:

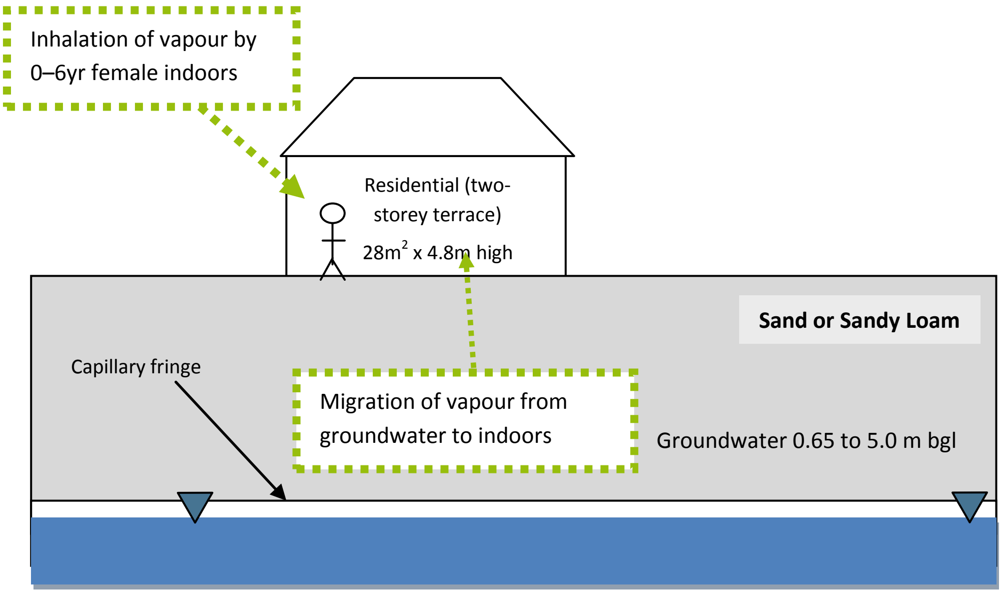
residential scenario

Generic groundwater assessment criteria (GrAC) for human health: residential scenario (child receptor)

Background

Volatile organic compounds (VOC) in groundwater have the potential to pose risks to residential site end users via indoor and outdoor inhalation exposure. Due to significant dilution effects in outdoor air, inhalation risk is dominated by indoor exposure. The GrAC conceptual site model (CSM) is shown in Figure 1 (not to scale).

Figure 1: GrAC conceptual model for a generic residential scenario



RSK GrAC derivation

Model selection

The Society for Brownfield Risk Assessment (SoBRA) published a set of generic assessment criteria for assessing vapour risk to human health from volatile contaminants in groundwater in February 2017[(1)]. The criteria were developed for a list of common VOC using the Environment Agency Contaminated Land Exposure Assessment (CLEA) tool[(2)] based on a sand soil type and a groundwater depth of 0.65 m below foundation base level. The CLEA tool is not designed to directly model VOC in groundwater and the SoBRA generic criteria are recognised as being conservative since calculations in CLEA are based on three-phase partitioning in the unsaturated zone between soil, soil vapour and soil moisture, with the latter taken by SoBRA as a groundwater equivalent. This method does not take account of the presence of a semi-saturated capillary fringe above the water table, which will serve to provide some mitigation to vertical soil vapour migration.

RSK GrAC are calculated using the RBCA Toolkit for Chemical Releases (version 2.6) with the Johnson and Ettinger model, based on the CSM in Figure 1 for a small terrace house (as defined in SR3[(3)], Table 4.21) and which allows consideration of a capillary fringe. The capillary fringe is the subsurface layer in which groundwater seeps up from a water table by capillary action to partially fill soil pores.

The RBCA model was used in preference to the Environment Agency Contaminated Land Exposure Assessment (CLEA) tool(2), as the CLEA tool is not designed to directly model VOC in groundwater and does not take account of the presence of a capillary zone.

Conceptual model

In accordance with SR3(3), the residential scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario.

The pollutant linkage considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents while indoors. Figure 1 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution of VOC in outdoor air. RBCA does not take direct account of the presence of VOC from non-aqueous phase chemicals but highlights when the assessment criterion exceeds the solubility limit of the pure compound.

Input selection – chemical and toxicological parameters

Key parameters used in the RBCA model are listed and justified in Table 1. The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7(2), the EA TOX(5) reports, and published by Nathanial et al.,(6), as appropriate. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report(7).

The toxicological input parameters are associated with minimal risk, rather than low risk.

For petroleum hydrocarbon fractions, aromatic hydrocarbons C5–C8 were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

For the GrAC, the Health Criteria Values (HCV) used in the modelling were derived using the toxicological data for the Soil Assessment Criteria, amended as follows:

- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3(3)) and breathing 8.77m^3 (average daily inhalation rate for a 0-6yr old female in accordance with SP1010 final project report for the C4SL (Table 3.2(8)) and USEPA data(9)
- Background inhalation (mean daily intake (MDI)) for a child (Age Classes 1-6)
- Residential amendments to the MDI for younger age groups following Table 3.4 and Section 3.4.1 of SR2(10),; amended to reflect average daily inhalation rates in accordance with SP1010 final project report for the C4SL (Table 3.2(8)) and USEPA data(9). Correction factors are presented in Table 1.

Table 1: Correction factors used to adjust adult MDI to younger age groups

Age Class	Body weight (kg)[1]	Inhalation rate (m^3/day)[2]	Correction factor for inhalation MDI[3]
1	5.6	5.4	0.34
2	9.8	8	0.51
3	12.7	8.9	0.57
4	15.1	10.1	0.64
5	16.9	10.1	0.64
6	19.7	10.1	0.64
17	70	15.7	-
Mean (AC1-6)	**13.3**	**8.8**	**0.56**

Notes
[1] Body weight from CLEA v1.071
[2] Inhalation rate from Table 3.2 of the SP1010 final project report for the C4SL(8)
[3] Inhalation correction factors are the ratio of the average male and female inhalation rates for each age class to the adult rate at age class 17 (age 16–59 years) and are based on the rates used by the Category 4 Screening Levels to derive the C4SLs(8),following the methodology in SR2(10).

The amended HCV used in the derivation of the RSK GrAC are presented in Table 2.

Note on Trimethylbenzenes

For trimethylbenzenes the CL:AIRE report(7) based background inhalation from non-soil sources (MDI) on a Dutch study from 1985, which is reported to have identified an average daily dose of 1,2,4-trimethylbenzene of 86 ug d^{-1} (1,3,5-trimethylbenzene was 20.5 ug d^{-1}). This dose value was based on the upper end of the identified concentration range of 1,2,4-trimethylbenzene (2.46 – 5.66 ug m^{-3}) and was used to calculate an a MDI of 1.23 ug kg^{-1} bw d^{-1} for a 70 kg adult breathing 20 m^3 of air daily.

The approach recommended in SR2(10), and also adopted for the C4SLs(8), for non-carcinogenic (threshold) compounds such as trimethylbenzenes is to subtract the MDI from the tolerable daily intake (TDI) to obtain a tolerable daily intake from soil (TDSI) in units of ug kg^{-1} bw d^{-1}. For 1,2,4-trimethylbenzene, the adult MDI from the Dutch study used in the CL:AIRE report(7) (1.23 ug kg^{-1} bw d^{-1}) is a significant proportion of the TDI (2.0 ug kg^{-1} bw d^{-1}), resulting in a low TDSI (1.0 ug kg^{-1} bw d^{-1}) when the 50% rule is applied (i.e. TDSI = TDI * 0.5 when MDI is high relative to TDI). This TDSI equates to an Inhalation Reference Concentration (or modified Health Criteria Value) for adults of 3.4 ug m^{-3} (70 kg adult breathing 15.7 m^3 d^{-1}).

By comparison the adult inhalation modified HCV for benzene is 6.2 ug m^{-3}, which is proven human carcinogen (non-threshold compound).

Table 2: Amended Health Criteria Values

VOC / SVOC	Modified HCV (mg/m^3) Child (Residential)
MTBE	1.0803
Benzene	0.0021
Toluene	2.1164
Ethylbenzene	0.1113
Xylenes	0.0834
Trimethybenzenes	0.0026
TPH_Aliph EC5-EC6	3.7913
TPH_Aliph >EC6-EC8	3.7913
TPH_Aliph >EC8-EC10	0.2199
TPH_Aliph >EC10-EC12	0.2199
TPH_Aliph >EC12-EC16	0.2199
TPH_Arom >EC8-EC10	0.0455
TPH_Arom >EC10-EC12	0.0455
TPH_Arom >EC12-EC16	0.0455
Acenaphthene	0.0910
Acenaphthylene	0.0910
Naphthalene	0.0011
Vinyl chloride	0.0005
Dichloroethane-1,2	0.0002
Tetrachloroethene	0.0083
Carbon tetrachloride	0.0025
Trichloroethane-1,1,1	0.9099
Trichloroethene	0.0009
Tetrachloroethane 1,1,2,2 & 1,1,1,2	0.0086
1,1,2-Trichloroethane	0.0073
1,1-dichloroethene	0.0864
Chloroethane	4.3318
Chloromethane	0.0039
Dichloromethane	0.1781

The MDI for 1,2,4-trimethylbenzene is considered by RSK to be overly conservative for the following reasons:

- The Dutch 1985 study is dated and air quality has improved since this time
- The maximum value in the range (5.66 ug m^{-3}) was used in calculating the MDI
- Experience has shown that trimethylbenzenes often appear to drive inhalation risks to a greater extent than benzene, even though the latter is carcinogenic and more volatile.

As an alternative to the 1985 Dutch study, RSK have obtained automated roadside air quality monitoring data for the UK from www.uk-air.defra.gov.uk/. The average concentration of 1,2,4-trimethylbenzene measured during 2015 at Eltham, south-east London (urban) was 0.309 ug m^{-3}, significantly lower than that identified in the Dutch study and used by CL:AIRE[7] for calculation of a MDI. Whilst an average concentration of 1,2,4-trimethylbenzene in UK urban and rural areas is likely to be significantly below 0.0.309 ug m^{-3}, this value is considered to be suitably conservative for the calculation of a modified HCV for trimethylbenzenes in the UK.

On this basis, the HCV for 1,2,4-trimethylbenzene for adults and children was calculated as 8.5 ug m^{-3} (0.0085 mg m^{-3}) and 2.6 ug m^{-3} (0.0026 mg m^{-3}), respectively (see Table 3). Due to the paucity of toxicological data for 1,2,3-trimethylbenzene and 1,3,5-trimethylbenzene the modified HCV for 1,2,4-trimethylbenzene is considered suitable for assessing total trimethylbenzenes.

Note on aqueous solubility and the RSK GrAC

Where the modelled assessment criteria, or the modelled assessment criteria with the correction factor applied to those contaminants specified below, exceeds the aqueous solubility limit the assessment criteria defaults to this concentration and consequently the GrAC is set at the limit of solubility. These assessment criteria are shaded in red in Table 4.

The theoretical aqueous solubility is the maximum amount of a single chemical that will dissolve in pure water at a specified temperature. Above this concentration, the chemical will exist in the non-aqueous phase (i.e. in its natural physical form as a solid, liquid (NAPL) or gas). If the contaminant, based on its toxicity, is not considered to pose a risk to human health at the aqueous solubility concentration then the contaminant can be considered not to pose a risk to human health. Where the GrAC is set at the aqueous solubility limit (shaded in red on Table 4), this is not a risk based assessment criteria but is indicative of the maximum amount of chemical that would be found dissolved in the water. Therefore an exceedance of the RSK GrAC set at the aqueous solubility limit is <u>not</u> indicative that there may be potential risks to human health. It should be noted that for certain contaminants (e.g. the lighter petroleum hydrocarbon fractions) the aqueous solubility is very low and may be at, or below, the laboratory method detection limit. It should also be noted that non-aqueous phase may exist where concentrations of individual compounds are well below their solubility limits where they are part of a mixture, in accordance with Raoult's Law.

Input selection - physical parameters

For the residential scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab as detailed in Table 3. Environment Agency document SR3[3] notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GrACs are the default CLEA v1.071 inputs presented in Table 3.3 of SR3[3].

The RSK GrAC have been calculated for both Sand and Sandy Loam soils. The soil parameters used in the derivation of the RSK GrAC are those presented in Table 3.1 of SR3[3].

The RSK GrAC have been derived for groundwater depths of 0.65 m, 1.5 m, 2.5 m and 5.0 m below ground level, incorporating a capillary fringe (see Table 4).

Input selection - attenuation factors

In line with recommendations provided in Environment Agency SR3[3] a sub-surface to indoor attenuation factor of 10 has been applied to certain RBCA derived 'site-specific target levels'. SR3[3] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase petroleum hydrocarbons by using partition coefficients are at least a factor of ten higher than those likely to be measured on-site. This difference is likely to be due to a number of factors, however aerobic biodegradation in the unsaturated zone is believed to be largely responsible. RSK has therefore applied this attenuation factor to all volatile petroleum hydrocarbon fractions (including BTEX, tri-methylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene). No such attenuation factors have been applied to other non-hydrocarbon chemical species, including chlorinated hydrocarbons or fuel oxygenates such as MtBE.

Convective (volumetric) air flow through foundation cracks (Q_{soil}) is a sensitive parameter in the calculation of GrAC and has been calculated within RBCA on a soil-specific basis for Sand and Sandy Loam in a residential exposure scenario (see Table 3). This approach is less conservative than using the default Q_{soil} value recommended in SR3[(3)] for a Sandy Loam (25 cm^3 s^{-1}) and used in the CLEA model (version 1.071) for Sandy Loam (and Sand) soils (25 cm^3 s^{-1}) in a residential scenario.

Table 3: Residential scenario – RBCA inputs

Parameter	Unit	Value	Justification
Receptor – female child			
Averaging time	Years	6	From Box 3.1, SR3[3]
Receptor weight	kg	13.3	Average of CLEA 0-6 year old female data, Table 4.6, SR3[3]
Exposure duration	Years	6	From Box 3.1, report , SR3[3]
Exposure frequency	Days yr^{-1}	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
Soil type – sand			
Total porosity	-	0.54	CLEA value for sand. Parameters for sand from Table 4.4, SR3[3]. Volumetric water content in the vadose zone is a highly sensitive parameter within the model and potentially highly variable in the field.
Volumetric water content – unsaturated (vadose) zone	-	0.24	
Volumetric air content - unsaturated (vadose) zone	-	0.30	
Dry bulk density	g cm^{-3} or kg L^{-1}	1.18	
Volumetric water content – capillary zone	-	0.35	Calculated using SR3 Equation 4.1. Value taken as the average moisture content calculated for suction heads (cm H_2O); 0 (i.e. saturated), 10, 20, 30, 40, 50 (i.e. unsaturated soil at field capacity). This is a highly sensitive parameter within the model.
Volumetric air content - capillary zone	-	0.19	Calculated from total porosity and volumetric water content of capillary zone. This is a highly sensitive parameter within the model.
Vertical hydraulic conductivity	cm d^{-1}	636	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3] equivalent to 7.36 E-03 cm s^{-1}
Vapour permeability	m^2	7.54 E-12	Calculated for sand using equations in Appendix 1, SR3[3]
Capillary zone thickness	m	0.25	Taken from C W Fetter, Applied Hydrogeology 4th Ed, 1994[11] and R Heath, Basic groundwater hydrology 1992[12] for a medium sand
Fraction organic carbon	%	0.0058	Equivalent to SOM = 1%. Note that GrAC are independent on FOC/SOM content since partitioning is assumed to be between aqueous and vapour phases only
Soil type – sandy loam			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[3]. Volumetric water content in the vadose zone is a highly sensitive parameter within the model and potentially highly variable in the field.
Volumetric water content – unsaturated (vadose) zone	-	0.33	
Volumetric air content - unsaturated (vadose) zone	-	0.20	
Dry bulk density	g cm^{-3} or kg/L	1.21	
Volumetric water content – capillary zone	-	0.42	Calculated using SR3 Equation 4.1[3]. Value taken as the average moisture content calculated for suction heads (cm H_2O); 0 (i.e. saturated), 10, 20, 30, 40, 50 (i.e. unsaturated soil at field capacity). This is a highly sensitive parameter within the model.
Volumetric air content - capillary zone	-	0.11	Calculated from total porosity and volumetric water content of capillary zone. This is a highly sensitive parameter within the model.

Parameter	Unit	Value	Justification
Vertical hydraulic conductivity	cm d^{-1}	308	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3] equivalent to 3.56E-3 cm s^{-1}
Vapour permeability	m^2	3.05 E-12	Calculated for sandy loam using equations in Appendix 1, SR3[3]
Capillary zone thickness	m	0.4	Taken from R Heath, Basic Groundwater Hydrology 1992[12] for a fine sand. Note: C W Fetter, Applied Hydrogeology 4th Ed, 1994[11] value for fine sand is 0.5 m
Fraction organic carbon	%	0.0058	Equivalent to SOM = 1%. Note that GrAC are independent on FOC/SOM content since partitioning is assumed to be between aqueous and vapour phases only
Building – small terrace house			
Building volume/area ratio	m	4.8	Table 3.3, SR3[3]
Foundation area	m^2	28	
Foundation perimeter	m	21.16	Calculated using Equation A2 in SR3[3], which assumes the building to be of square proportions.
Building air exchange rate	d^{-1}	12	Table 3.3, SR3[3] Building air exchange rate equivalent to 1.4 E-04 s^{-1}
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.00151	Calculated from floor crack area of 423cm^2 and building footprint of 28m^2 in Table 4.21, SR3[3]
Volumetric water content of cracks	-	0.24 / 0.33	For sand / sandy loam, assumed equal to underlying soil type in assumption that cracks become filled with unsaturated zone soil over time. Parameters for sand and sandy loam from Table 4.4, SR3[3]
Volumetric air content of cracks	-	0.30 / 0.20	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3[3] Equivalent to 31 g/cm/s^2
Convective air flow through cracks (Q_{soil}) - Sand	$m^3\ s^{-1}$	3.4 E-05	Soil-specific calculated parameter in RBCA equivalent (and cross checked) with equations A1, A2, A3, A8, A9 in SR3[3]. Equivalent to **34 $cm^3\ s^{-1}$**
Convective air flow through cracks (Q_{soil}) – Sandy Loam	$m^3\ s^{-1}$	1.4 E-05	Soil-specific calculated parameter in RBCA equivalent (and cross checked) with equations A1, A2, A3, A8, A9 in SR3[3]. Equivalent to **14 $cm^3\ s^{-1}$**

RSK GrAC derivation outputs

The RSK GrACs are presented in Table 4.

Within the RSK GrAC the following should be noted:

- GrAC do not take account of outdoor inhalation exposure to VOC, which is considered to contribute minimally to overall inhalation exposure
- GrAC do not take account of other exposure routes potentially relevant to VOC in shallow groundwater such as direct contact or root uptake
- No biodegradation is assumed to occur in the unsaturated zone. Where aerobic conditions on site are known to exist the GrAC for hydrocarbons may therefore be conservative
- GrAC do not take account of preferential flow into buildings such as through unsealed service entries. In such circumstances GrAC may not be appropriate for use
- GrAC are based on a soil vapour intrusion CSM and are not appropriate for use when the foundation is in direct contact with contaminated groundwater

- GrAC assume that the capillary fringe is un-contaminated with VOC, which is unlikely, particularly where groundwater levels are variable
- GrAC set at the theoretical aqueous solubility limit are not considered to pose a risk to human health
- GrAC do not take into account the interaction between contaminants and the influence this may have on the theoretical aqueous solubility
- GrACs are only applicable to dissolved phase contaminants where the modelled assessment criteria is below the aqueous solubility limits

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	Table 4: RSK GrAC (ug/l)								
	RESIDENTIAL								
	SAND					SANDY LOAM			
GW Depth (m)	0.65	1.5	2.5	5		0.65	1.5	2.5	5
Metals									
Elemental mercury	2.5	3.6	5.0	8.4		14.3	18.5	23.4	35.8
Methyl mercury	21550	27220	33880	50540		46300	48510	51110	57610
Volatile Organic Compounds									
Benzene	470	670	900	1490		2900	3640	4510	6680
Toluene	515140	590000	590000	590000		590000	590000	590000	590000
Ethylbenzene	24300	35190	48000	80020		156380	180000	180000	180000
Xylene - m	22610	32750	44670	74480		144250	181800	200000	200000
Xylene - o	27570	39950	54500	90900		174260	173000	173000	173000
Xylene - p	23640	34230	46700	77860		150470	189710	200000	200000
Total xylene	22610	32750	44670	74480		144250	173000	173000	173000
Methyl tertiary-Butyl ether (MTBE)	185010	267500	364520	607070		945700	1245710	1598660	2481040
Trichloroethene	13	18	25	41		82	100	130	190
Tetrachloroethene	80	120	160	260		520	650	810	1200
1,1,1-Trichloroethane	7110	10230	13910	23090		46230	57820	71450	105540
1,1,1,2 Tetrachloroethane	550	800	1100	1830		3330	4250	5330	8040
1,1,2,2-Tetrachloroethane	3620	5320	7320	12320		14600	20600	27650	45290
Carbon Tetrachloride	12	17	24	39		79	98	120	180
1,2-Dichloroethane	20	28	38	63		100	140	170	260
Vinyl Chloride	1.3	1.8	2.4	4.0		8	10	12	18
1,2,4-Trimethylbenzene	980	1430	1960	3270		6240	7900	9850	14720
Semi-Volatile Organic Compounds									
Acenaphthene	4100	4100	4100	4100		4100	4100	4100	4100
Acenapththylene	7950	7950	7950	7950		7950	7950	7950	7950
Naphthalene	5100	7530	10380	17510		19000	19000	19000	19000
Petroleum Hydrocarbons									
Aliphatic hydrocarbons EC5-EC6	4170	5900	7930	13020		26560	32990	35900	35900
Aliphatic hydrocarbons >EC6-EC8	3210	4540	5370	5370		5370	5370	5370	5370
Aliphatic hydrocarbons >EC8-EC10	120	170	230	380		427	427	427	427
Aliphatic hydrocarbons >EC10-EC12	33.9	33.9	33.9	33.9		33.9	33.9	33.9	33.9
Aliphatic hydrocarbons >EC12-EC16	0.759	0.759	0.759	0.759		0.759	0.759	0.759	0.759
Aromatic hydrocarbons >EC8-EC10	4150	5870	7900	12960		25730	32120	39630	58400
Aromatic hydrocarbons >EC10-EC12	14480	20510	24500	24500		245000	245000	245000	245000
Aromatic hydrocarbons >EC12-EC16	5750	5750	5750	5750		5750	5750	5750	5750

Notes:

Values less than 100 have not been rounded up or down; values greater than 100 have been rounded to the nearest 10.

Highlighted values exceed solubility limit for the pure compound in water (aqueous solubility); GrAC defaults to the limit of solubility.

No vadose zone biodegradation considered

Sub-surface to indoor air correction factor of 10 applied to all petroleum (non-chlorinated) hydrocarbons

All GrAC are for 1% SOM (0.0058 FOC)

APPENDIX 4.3 Code of Practice for Avoiding Danger from Overhead Electricity Lines

ESB NETWORKS

Code of Practice for Avoiding Danger from Overhead Electricity Lines

HEALTH AND SAFETY AUTHORITY

May 2019

Plain English Approved by NALA

Code of Practice for Avoiding Danger from Overhead Electricity Lines

Second Edition – May 2019

This Code of Practice comes into effect on the 1 May 2019.

Notice of the publication was published in the Iris Oifigiúil on the 2 April 2019.

This new Code of Practice for Avoiding Danger from Overhead Electricity Lines revokes and replaces the previous Code (issued 2008), in accordance with the Safety, Health and Welfare at Work Act 2005.

Available to download from:
HSA website: hsa.ie
ESB Networks website: esbnetworks.ie
Email: esbnetworks@esb.ie
Phone 1850 372 757
Emergency contact number: 1850 372 999

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Terms used in this Code of Practice

A number of key terms appear in this Code of Practice. If you see a word in **red**, it is defined in this section.

Competent person: In brief, this is a person who has the training, knowledge and experience appropriate to the work they are undertaking. Legislation defines a Competent person as "Competent person: A person is deemed to be a competent person where, having regard to the task he or she is required to perform and taking account of the size or hazards (or both of them) of the undertaking or establishment in which he or she undertakes work, the person possesses sufficient training, experience and knowledge appropriate to the nature of the work to be undertaken".

Exclusion zone: An exclusion zone is a region around a live overhead electricity line which must never be breached in order to avoid electrical arcing or flashover. Figure 4 shows an example of the exclusion zone around the three overhead electricity lines on a single pole.

Hazard zone: The hazard zone is a lateral area near an overhead electricity line which must normally be isolated from the work site by physical barriers. This minimises the risk of accidental contact or near contact with the overhead line by plant, equipment, scaffolding or other materials. Figure 2 shows an example of the hazard zone near an overhead electricity line.

Other useful terms explained

HV: Higher Voltage

kV: kiloVolt

LV: Low Voltage

Overhead line: means any electric line suspended above ground carrying or intended to carry electrical energy at a voltage exceeding 80 volts to earth.

1 About this Code of Practice

1 About this Code of Practice

1.1 Who this Code of Practice is for

This Code of Practice (COP) provides practical guidance to **Clients, Designers, Planners, Project Supervisors Design Process** (PSDP), **Project Supervisors Construction Stage** (PSCS), **Contractors, Safety Representatives** and any personnel who are involved in carrying out work where they are at risk from overhead electricity lines. It also applies to employers and employees at risk from the hazards of electricity from overhead electricity lines. This COP also gives practical advice to plant and machinery drivers and operators to avoid coming into contact with overhead electricity lines.

This Code of Practice (COP) was first published in 2008. ESB Networks, with the assistance of the Health and Safety Authority, published this edition in 2019.

1.2 Purpose of this Code of Practice

The purpose of this COP is to improve the level of safety while working near overhead electricity lines. It provides guidance to assist personnel working near overhead electricity lines to manage risk and avoid dangers from electric shock and electrocution.

This COP does not address safety issues for underground electricity cables or other underground services.

To deal with underground services, including buried electrical cables, the Health and Safety Authority has published a separate COP titled Code of Practice for Avoiding Danger from Underground Services.

1.3 The Code of Practice and the law

The Safety, Health and Welfare at Work (Construction) Regulations set statutory requirements which must be observed during the planning and implementation stages of construction projects.

This COP will help you comply with these regulations.

This COP is a joint initiative between ESB Networks and the Health and Safety Authority. This Code of Practice has been approved by the Health and Safety Authority in line with Section 60 of the Safety, Health and Welfare at Work Act 2005.

Accidents with overhead electricity lines may result in criminal prosecutions against individuals and/or companies. If you or your company are taken to court, compliance or non-compliance with the guidelines in this COP may be permitted as evidence in the case.

The requirements of this COP are without prejudice to the general obligations placed on employers and others by the current Safety Health and Welfare at Work Act 2005, Construction Regulations 2013 and General Application Regulations 2007 and amendments and other relevant legislation. This means that employers must comply with the COP and all relevant legislation.

1.4 Activities that this Code of Practice (COP) will guide you on

This COP gives recommendations and practical guidance on working safely near overhead lines. The COP primarily covers construction activities such as:

- working on building and construction sites
- construction work on farms and in forests
- constructing and resurfacing roadways and roads
- constructing railways or navigable waterways
- using cranes and mobile elevated work platforms (MEWPs)
- using concrete-placing booms and pumps
- using lorry-mounted cranes and other high-reach plant
- using tracked and wheeled excavation equipment
- transporting high loads by road, rail or navigable waterway
- handling long lengths of material
- dumping spoil
- storing, loading and unloading materials
- other construction activities

1.5 Activities excluded from this Code of Practice

This COP does not cover:

- general agricultural, general forestry, vegetation management or hedge-cutting activities;
- competent persons (as defined in definitions on page 7) permitted by the network owner/operator to work on or near the electricity network.

For codes of practice that cover general agricultural and forestry activities, visit hsa.ie.

2 Dangers of working close to overhead electricity lines

2 Dangers of working close to overhead electricity lines

2.1 Dangers of overhead electricity lines

People are killed and injured each year by accidental contact or near contact with overhead electricity lines. Most of these accidents involve:

- cranes or excavators;
- tipping trucks or truck mounted cranes;
- mobile extendable machinery;
- equipment such as scaffolding, gutters, long-handled concrete floats or ladders; or
- guiding a section of metal shuttering into position using a crane.

Electric shock can cause burns and damage to the heart which can be fatal.

Applying the methods and procedures in this COP will help eliminate these accidents.

Electrical utilities worldwide typically use bare conductors for overhead electricity lines. When you find covered conductors, this covering is usually for mechanical protection of the overhead line and is not rated as insulation. This means that covered conductors must be treated with the same precautions as bare conductors. This applies to all voltage levels.

2.2 Risk of electricity arcing (or jumping) from overhead electricity lines

For overhead electricity lines, there is a risk of electrical arcing even if a person or object does not actually come in direct contact with an exposed live part. Arcing occurs when electrical current jumps across an air gap and flows through the gap from the source of electrical power to another object or body nearby. The size of the gap that electrical current can jump depends on many factors. The most relevant factors are:

- the voltage of the source of electrical energy;
- the level of moisture and other impurities in the air gap; and
- the nature of the object or body at the non-energised side of the gap and how well it is insulated from earth.

This COP advises on the dimensions of the exclusion zone for different voltages. Always contact the network owner/operator for confirmation of the actual voltage levels for specific overhead electricity lines.

2.3 Range of voltages of overhead electricity lines

The range of voltages of overhead electricity lines on ESB Networks distribution and transmission systems varies from 230 volts to 400,000 volts.

Figure 1: The path of electrical current flowing to earth for a truck in contact or near contact with overhead lines

2.4 Definitions

2.4.1 Hazard zone

The hazard zone is a lateral area near an overhead electricity line which must normally be isolated from the work site by physical barriers. This minimises the risk of accidental contact or near contact with the overhead line by plant and machinery, equipment, scaffolding or other materials. See Figure 2. The dimensions of the hazard zone are related to the voltage of the overhead line. For the dimensions of the hazard zone (A) see Table 1.

Figure 2: Hazard zone

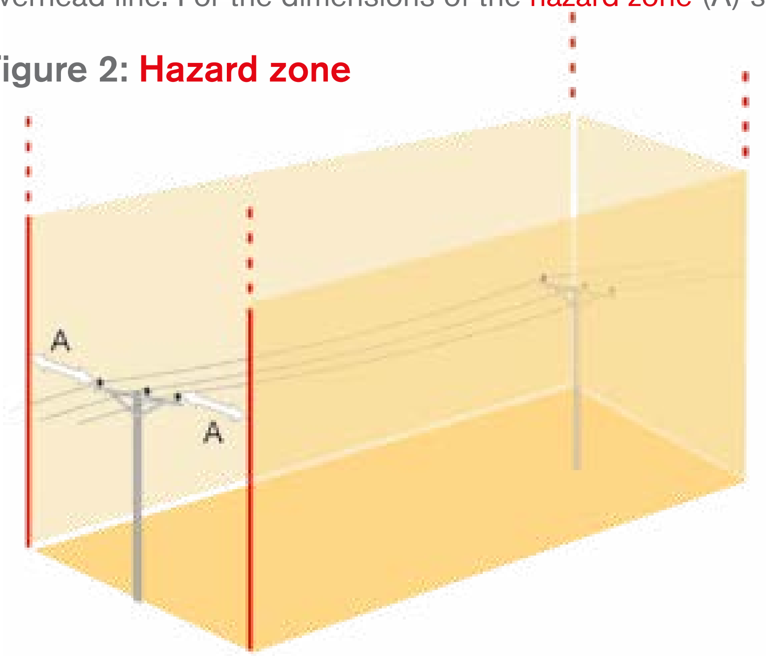
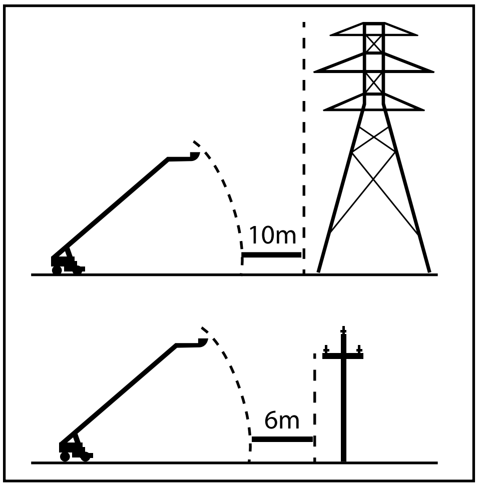


Table 1: Hazard zone minimum distances

Nominal phase-to-phase voltage of overhead line	Minimum horizontal distance (A) in metres
LV, 10kV, 20kV and 38kV	6.0
110kV, 220kV, 400kV (and other voltages in this range)	10.0

Figure 3: Plant and machinery minimum safe distance



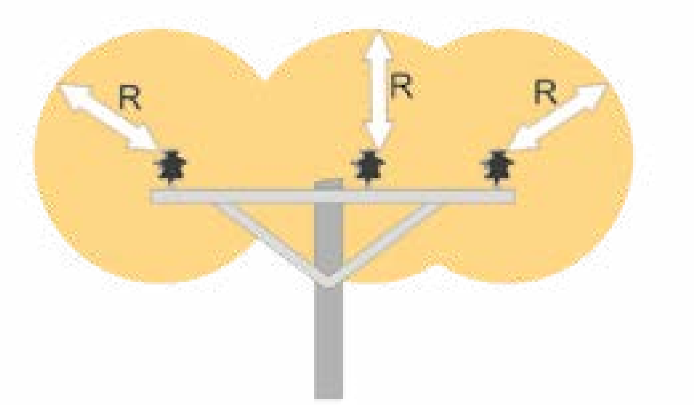
The diagram illustrates the two minimum safe distances

- 10m plus falling distance of fully extended boom (for 110kV and above)
- 6m plus falling distance of fully extended boom (for LV, 10kV, 20kV and 38kV)

2.4.2 Exclusion zone

An exclusion zone is a region around a live overhead electricity line which must never be breached in order to avoid electrical arcing or flashover. Figure 4 is an illustration of the exclusion zone around the three overhead electricity lines on a single pole.

Figure 4: Exclusion zone



For the dimensions of R, see Table 2 below

The dimension R of the exclusion zone is determined by the operating voltage of the overhead electricity line. The exclusion zones for operating plant and machinery and materials are specified in Table 2.

Table 2: Exclusion zones in metres (which must NEVER be breached)

Nominal phase-to-phase voltage of overhead line	Exclusion zone (R) in metres
Insulated LV conductors. (insulation to be verified in all cases by network owner/ operator before any work starts)	1.0
Un-insulated LV conductors	3.0
10kV, 20kV and 38kV	3.0
110kV	4.5
220kV	6.0
400kV	8.0

2.4.3 No-tip zone

A no-tip zone is the area that no part of a tipped truck or other raised equipment must enter. A no-tip zone applies to road strengthening and resurfacing works such as tarring and chipping existing roads. See chapter 9 for more details.

2.4.4 Crossing point

A crossing point is a defined, protected corridor that crosses under an overhead electricity line. Crossing points are created by installing:

- goalpost-style height-restricting barriers; and
- warning signs for overhead lines at entrances and exits of the crossing point.

The purpose of a crossing point is to:

- limit the location and the height of plant and machinery that can cross under the line; and
- alert drivers and plant operators to the hazard of the overhead line before they cross under it. Figure 7 in section 7.2 illustrates a crossing point.

2.4.5 Voltage levels

There are two levels of voltage.

Low voltage is any voltage **less than or equal to:**

- 1,000 volts (1kV) alternating current (AC);
- 1,500 volts direct current (DC).

Higher voltage is any voltage **greater than:**

- 1,000 volts (1kV) alternating current (AC);
- 1,500 volts direct current (DC).

NOTE: ESB Networks uses voltage terms such as LV, 10kV, 20kV, 38kV, 110kV, 220kV and 400kV to describe the different operating voltages of overhead electricity lines.

2.4.6 Particular risks

A particular risk is a situation that involves serious safety risks, which are referred to in the Safety Health and Welfare at Work (Construction) Regulations, such as working near high voltage electricity lines.

3 Role of the Client

3 Role of the Client

3.1 Introduction

A Client is a person or organisation for whom a construction project is carried out. Under the Safety, Health and Welfare at Work (Construction) Regulations, the Client, where required, must appoint a Project Supervisor Design Process (PSDP) and a Project Supervisor Construction Stage (PSCS) to manage health and safety for the design and construction of the project.

Clients have a legal duty to reasonably satisfy themselves that the project supervisors they appoint are competent and will allocate sufficient resources to the project to comply with their legal safety and health obligations. Clients also have legal duties in relation to Designers and Contractors. For further information, see Clients in Construction Best Practice Guidance available from hsa.ie.

Am I a Client?

You are a Client if you:

- commission the building of a house or apartment or a scheme of housing;
- commission the construction or renovation or the maintenance of farm buildings;
- extend or carry out repair and maintenance work on commercial or domestic premises such as shops, supermarkets, houses, cottages or apartments;
- build, extend or refurbish **any** type of structure including roads, motorways, railways, waterways, electricity networks or telecommunications networks.

If you commission work to be carried out on your home, you are a Client. You are subject to all the legal requirements that any other Client is subject to.

For further information, see HSA Guide for Homeowners available from hsa.ie.

3.2 Information from Clients

When a Client or a Client's agent appoints a PSDP and PSCS, they must:

- give the PSDP and PSCS any information about overhead electricy lines that they already have, making sure this information is as up to date as possible; and
- give the PSDP and PSCS any safety files that are relevant to the work.

3.3 Notifying the Health and Safety Authority (HSA)

If construction work is due to last more than 30 working days or 500 person days, a Client must notify the Health and Safety Authority that they are appointing a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS).

When a Client appoints a PSDP, they should submit an AF1 form at the beginning of the detailed design process. You can download an AF1 form from hsa.ie.

When a Client appoints a PSCS, they should submit an AF1 form before the construction begins. The PSCS has a duty to notify the HSA before construction work starts using the AF2 form. You can download forms from hsa.ie.

3.4 Looking after health and safety

A Client must cooperate with the PSDP and PSCS to make sure that the project complies with all health and safety requirements. This is particularly important in relation to timescales. A Client must agree to a timescale that can be achieved without compromising health and safety.

A Client is responsible for including a preliminary safety and health plan with any request for tenders for a PSCS. This preliminary safety and health plan is prepared by the PSDP.

3.5 Required alterations or diversions

In some projects, overhead electricity lines might have to be diverted or undergrounded to reduce risk in line with the Principles of Prevention that are listed in the Safety, Health and Welfare at Work Act (Annex 1). The Designer, Client or PSDP shall consult with the network owner/operator before works start, who shall advise the best course of action to reduce as far as practicable the hazard relating to the overhead line. This may require the overhead line to be diverted or undergrounded. The Client may be requested to pay for some **or** all of this work before the project commences.

4 Design process: roles and activities

4 Design process: roles and activities

4.1 Definition of Designer

Design means preparing drawings, design details, specifications and bills of quantities for commercial and domestic construction. A **Designer** is any person who is involved in the type of design work listed above.

4.2 The Project Supervisor Design Process (PSDP)

When there is a PSDP appointed, the Project Supervisor for Design Process (PSDP) is responsible for coordinating Designers.

The PSDP may issue directions to Designers or Contractors or others.

For further information, see the document Clients in Construction Best Practice Guidance available from hsa.ie.

The PSDP must:

- prepare a written preliminary safety and health plan;
- organise co-operation among Designers; and
- coordinate the work of Designers to ensure compliance:
  - with the Principles of Prevention (Annex 1); and
  - when there are unforeseen circumstances that result in a change to the design of a project, work with the Designers on safety, health and welfare implications that result from a change to the design;
- prepare a safety file for the completed project and give it to the Client.

4.3 Contents of the preliminary safety and health plan

The preliminary safety and health plan must contain:

- an overall description of the project;
- the proposed timescale;
- appropriate information about other work on site; and
- details of any work that will involve particular risks such as working near overhead electricity lines.

For information about the voltage of overhead lines, contact network owner/operator.

4.4 Overhead electricity lines as a design issue

The PSDP/Designer is initially responsible for coordinating design in relation to overhead electricity lines. PSDP/Designers should contact the network owner/operator for up-to-date information.

4.5 Using plans and site visits during design

Designers must contact the relevant network owner/operator to obtain up to-date maps and records of all overhead electricity lines so they can assess the risks early in the design process. Annex 5 explains how to get copies of maps.

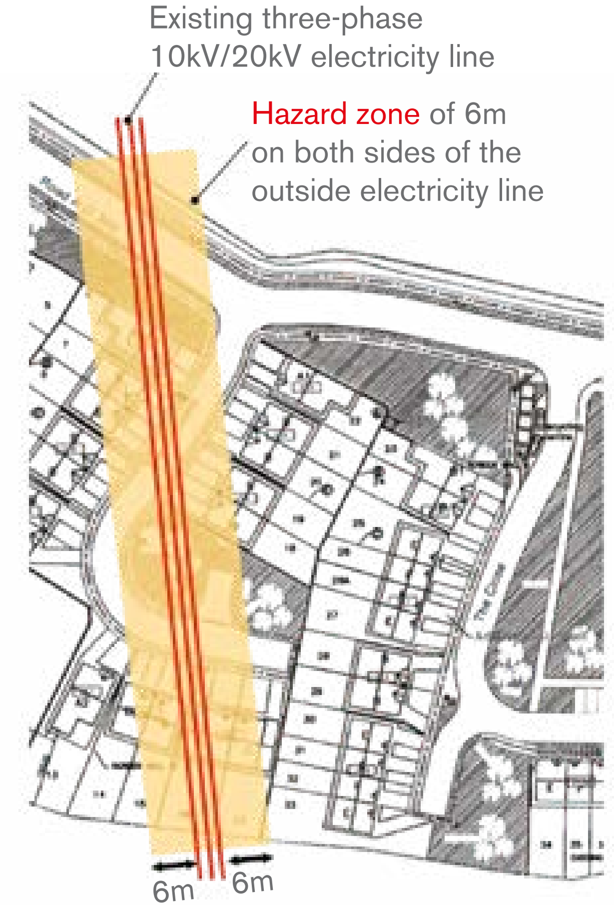
Designers should inspect the site to assess the situation in relation to overhead lines and consult with the PSDP to determine which design options to apply.

If overhead lines are present on site and if these lines will have an adverse effect on safety during construction, the PSDP/Designer should make sure the network owner/operator is contacted to formulate risk control measures to prevent accidental contact or near contact with the overhead lines during construction.

In consultation with the network owner/operator, adopt some or all of these risk control measures to reduce risk as much as possible.

- Divert lines early or, where possible, put them underground.
- Agree with the network owner/operator on power outages at critical points in project.
- Use barriers, bunting, height-restricting goalposts, warning signs and lighting while the electricity lines are still in place.

Figure 5: Overhead lines with a hazard zone overlaid on a map of a proposed development



4.6 Coordinating the design of temporary works

The PSDP is responsible for coordinating the design of temporary works on site. For overhead electricity lines, temporary works will generally involve putting up barriers, bunting, height-restricting goalposts, warning signs and lighting where plant and machinery or vehicles may cross under lines. Other structures such as physical barriers might also be installed to prevent unsafe activity in hazard zones.

Identifying these issues early in the design process and planning for them is key to controlling hazards. Arrangements should be in place before any construction work is undertaken.

Remember that installing a temporary structure in the vicinity of the hazard zone is also a risk that needs to be managed and installed without risk to individuals.

Design drawings for temporary works should include:

- the routes of overhead lines that:
  - cross over the site;
  - cross over the access route to the site;
  - are next to the site boundary;
- the voltage of the overhead lines;
- the hazard zones (Table 1); and
- the level of construction works that may be permitted in hazard zones while the lines are still present and energised, provided the safety of site personnel, visitors and the general public is assured.

The PSDP and Designers should take into account any additional work that may be required, including:

- building roadways;
- excavation work that may be required to put overhead lines underground;
- the potential impact of any excavations or other site works on the integrity and stability of the overhead line support structures, including stay wires; and
- the effect of changing site levels on existing clearances.

All temporary works should be carried out by a competent Designer and where required coordinated by the PSDP.

5 Construction stage: roles and activities

5 Construction stage: roles and activities

5.1 Project Supervisor Construction Stage (PSCS)

These are the key responsibilities of the PSCS.

- Manage and co-ordinate health and safety matters during the construction stage.
- Develop the safety and health plan for the construction stage.
- Facilitate safe access to the site.
- Coordinate the overall implementation of safe working procedures.
- Work with Contractors and the network owner/operator to make sure the level of risk is as low as possible.
- Apply the Principles of Prevention, which are listed in Annex 1. Consider the planning of the work to facilitate line removal or diversion as early as possible, including:
    - installing underground ducts early;
    - laying kerbs, footpaths and roadways; and
    - facilitating the positioning of items such as mini-pillars.

If lines have not been diverted use other methods to minimise the danger.
Examples may include:

- arranging for the switching out and earthing of the line(s);
- using barriers, bunting, height-restricting goalposts, warning signs and lighting; or
- in certain limited cases, using a competent dedicated observer, electromechanical limiting devices, or both.

Make sure barriers, bunting, goalposts, warning signs and lighting are maintained in good working order and are installed in accordance with chapter 7 of this COP. Also, see Form OHL1 in Annex 2.

5.2 The Contractor

These are the key responsibilities of the Contractor.

- Cooperate with the PSCS.
- Cooperate with other Contractors on health and safety.
- Work with the network owner/operator to make sure the level of risk is as low as possible.
- Supply accurate information in a timely manner to the PSDP to allow for the preparation of the Safety File.
- Supply accurate as-built drawings of underground cable ducts showing the location, depth and size of ducts to allow for the safe undergrounding of overhead electricity lines on site where applicable.
- Maintain the specific aspects of the safe systems of work, as described in this COP, and take direction from the PSCS, who has a statutory right to issue directions.
- Carry out site-specific risk assessments.
- Make sure that employees have adequate training.
- Make sure that any plant or machinery is, so far as is reasonably practical, safe and does not pose a risk to safety or health.
- Put in place measures to ensure that the health and safety of personnel are not adversely affected by the work they are doing.

By the nature of their work, some Contractors have a higher risk exposure from contact or near contact with electricity lines. These include:

- ground workers;
- road workers;
- piling contractors;
- plant drivers or operators;
- guttering installers;
- scaffolders; and
- roofers.

The Contractor is responsible for making sure all health and safety precautions are in place to protect these workers.

5.3 Employees and others at work

These are the responsibilities of workers on site.

- Follow the safe systems of work used on site.
- Take reasonable care to protect their own safety and the safety of others who might be affected by their actions.
- Report immediately any defects in health and safety that might endanger anyone in the workplace such as missing signage, broken barriers or goalposts or plant and machinery coming near to overhead lines.
- Avoid any behaviour likely to endanger health and safety on site.
- Avoid alcohol or any other intoxicant which might place them or their colleagues at risk.
- Attend health and safety training and assessments that are required by their employers and update training requirements as necessary.
- Never intentionally or accidentally cause plant, equipment or construction materials to enter the exclusion zone.

6 Consulting and working with ESB Networks

6 Consulting and working with ESB Networks

6.1 Consultation

You need to contact ESB Networks at the planning stage of work to get maps and records for existing overhead electricity lines running:

- over the site;
- near the site boundaries; or
- over access roads to the site.

Contact details are in Annex 5.

ESB Networks will work with you to determine the best approach to minimising the hazard and risk. Options may include:

- switching out and earthing lines;
- putting lines underground;
- diverting lines; or
- implementing other measures such as physical barriers, which are covered in chapter 7.

Contacting ESB Networks or any other network owner/operator is the responsibility of the Client/PSDP and Designer and must be done at the earliest stages of planning and design. It is the responsibility of the PSCS/Contractor to contact the network owner/operator at the construction stage.

As soon as hazards from overhead electricity lines are identified, contact ESB Networks for information.

6.2 Diverting lines or putting lines underground

The PSDP in conjunction with the Designer(s) should identify the hazards and manage the risks associated with the presence of overhead electricity lines on site. This includes the preservation of safety zone clearances. Diverting overhead lines or putting them underground are options to consider.

If the work near a line does not involve building permanent structures above ground, diverting a line may not be appropriate.

If there is no alternative route for a line, it will not be possible to divert it. In general, lines with voltages of 110kV, 220kV and 400kV cannot be diverted. In these cases, the Designer must design a safe system of work that minimises the hazard without diverting lines. The PSDP should coordinate the work of the Designer(s) to ensure that this occurs.

It is critical to contact ESB Networks as soon as possible because of the time it takes to apply for and get a line diverted.

- Diverting lines involves serving wayleaves and balancing workload. This can take several months.
- Diverting higher voltage lines involves applying for planning permission, serving wayleaves and balancing workload. This can take a year or more.

6.3 Switching out and earthing overhead lines

In some cases, switching out and earthing overhead lines may be the best approach to reducing the hazard.

In general, switching out and earthing lines is possible only for a few hours at a time. It may not be possible to switch out lines if work will take longer than that or if certain customers require an uninterrupted power supply.

If ESB Networks agree that switching out and earthing is appropriate, they will agree with you when the lines will be switched out. This will depend on local electricity demand, the feasibility of changing the electricity networks and informing customers of an outage.

Before starting work, you must wait for ESB Networks to notify you that the line is switched out and earthed. **Do not begin works until you receive** notification from ESB Networks.

The Contractor doing the work must be contactable at all times during the switch out in case ESB Networks need to switch the line back on.

6.4 Getting copies of maps and records

Maps and records can help you verify the location and voltage of overhead lines. Contact ESB Networks on 1850 928 960 to request maps and records. Contact information is in Annex 5.

When applying for overhead maps or records, you should include:

- a reference map of the area where work is to take place;
- a contact name and phone number; and
- the email address where the information is to be sent.

ESB Networks will send maps to you by email within 10 days in PDF format.

If you frequently need electricity maps and records and you are a licensed holder of electronic Ordnance Survey map data, you can register with ESB Networks for access to an electronic version of the electricity networks map and records.You can email your request including your site map to dig@esb.ie.

Call 1850 928 960
or +353 (0) 1 858 2060
or
Fax +353 (0)1 638 8169

Alternatively, you can make a postal request to:

Central Site
ESB Networks
St Margaret's Road
Finglas
Dublin 11
Ireland
D11 X3W7

6.5 Applying to alter or divert overhead electricity lines

When applying to alter or divert existing overhead electricity lines, send:

- a written request; and
- a copy of a site plan showing any proposed developments.

Send the application to:

ESB Customer Service Bureau, PO Box 29, Garrycastle, Athlone, Co. Westmeath.

6.6 Requesting information and assistance

For general information or advice on dealing with overhead electricity line conflicts:

- call 1850 372 757
- email esbnetworks@esb.ie

Your request will be forwarded to the local contact person for your area who will get back to you.

6.7 Contacting ESB Networks in an emergency

Emergency Contact No.
24 Hour/7 Day Service

1850 372 999

7 Construction sites where an overhead electricity line presents a hazard

7 Construction sites where an overhead electricity line presents a hazard

When overhead electricity lines present a hazard, the preferred choice is to switch out or divert the lines before site works begin.

If the lines cannot be switched out or diverted (see section 6.2), the nature of the work and the voltage at a site will determine the protective measures that are required. In all cases, you must establish a hazard zone. Determine the voltage during the planning stage and before any works begin. The voltage will affect the size of the hazard zone and the placement of barriers.

Most sites can be categorised in one of three categories.

7.1 Sites where there will be no work or plant passing in or under the hazard zone

7.2 Sites where plant will pass under a live overhead line

7.3 Sites where work will be carried out in the hazard zone

7.1 Sites where there will be no work or plant passing in or under the hazard zone

7.1.1 Set up barriers

On sites where machinery or plant may accidentally enter the hazard zone, you must erect a barrier on the work side (outside the edge of the hazard zone) at the correct distance from the line. **See Figure 6.**

Table 3: Minimum horizontal distances for barriers from the nearest conductor/overhead line on plan (hazard zone)

Nominal phase-to-phase voltage of overhead line	Minimum horizontal distance (A) in metres
LV, 10kV, 20kV and 38kV	6.0
110kV, 220kV, 400kV (and other voltages in this range)	10.0

7.1.2 Barrier materials (bunting, uprights and goalposts)

Use strong and sturdy, non-conducting and clearly visible materials.
See Figure 6.

7.1.3 Visibility equipment

Put standard electricity hazard warning signs along the route at intervals of 20 metres or less.
See Figure 6.

7.1.4 Prevent breaches of the hazard zone

Make sure that safe systems of work are in use for all plant and equipment.
Anything being used, moved or handled outside the hazard zone must not cross the barriers and breach the zone, for example when installing guttering, handling roofing timbers or erecting scaffolding.

7.1.5 Create task-specific risk assessments and work method statements

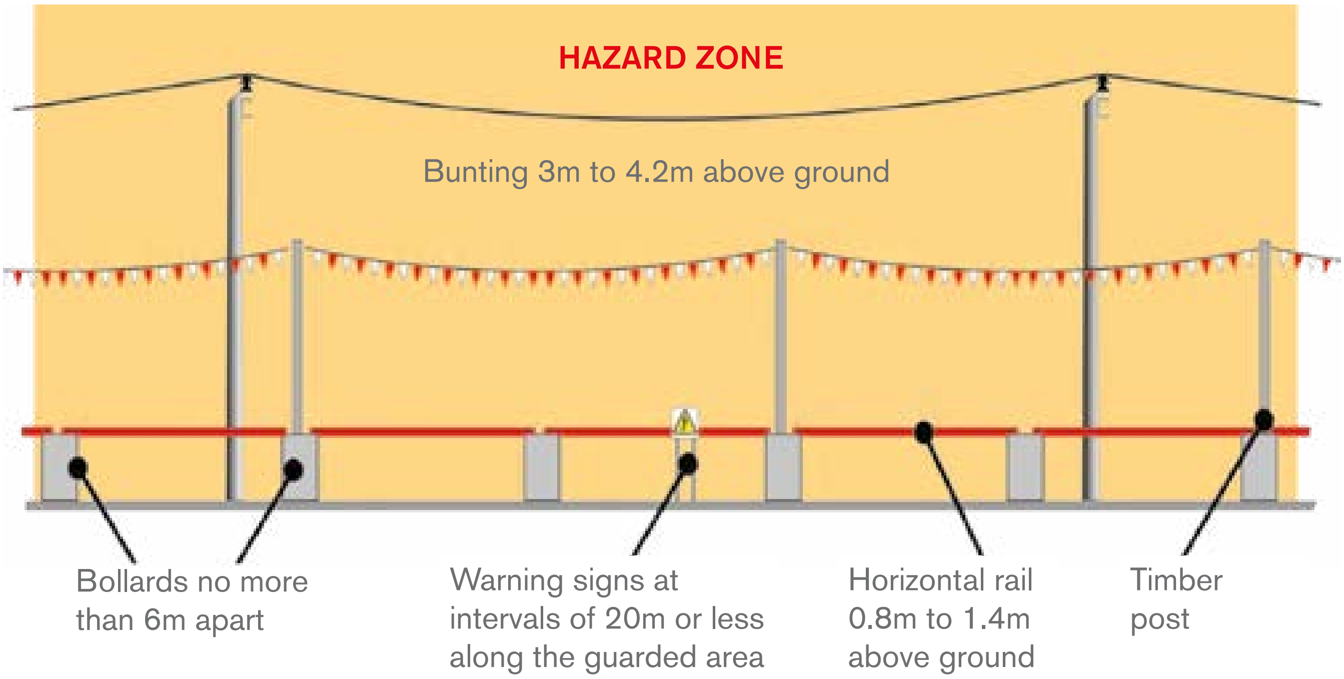
If machinery, ladders, scaffolding or other equipment are being used outside the hazard zone and this equipment could fall or otherwise inadvertently breach the relevant exclusion zone, create a task-specific risk assessment and work method statement. Outline the control measures to be used to eliminate this risk.

Make sure this risk assessment and method statement are available on site at all stages of construction.

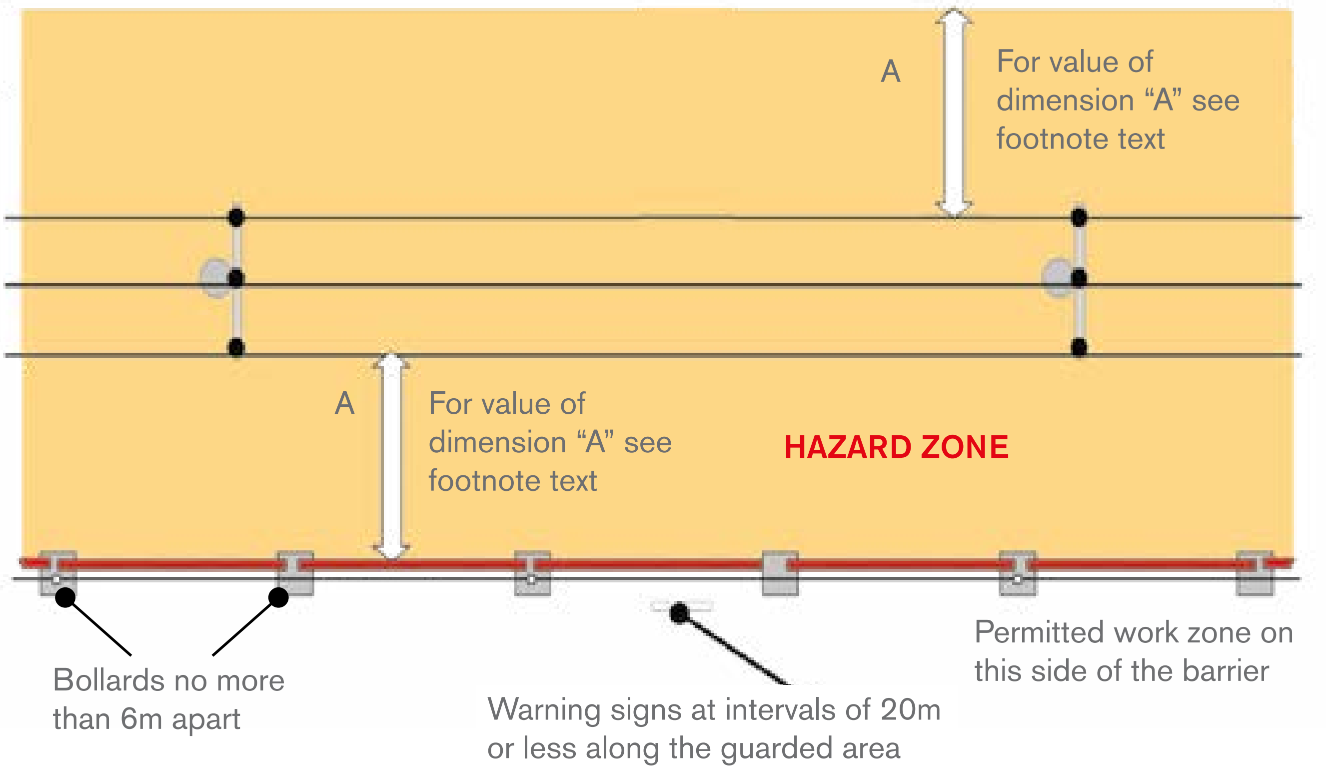
For information on the area required for exclusion zones, see section 2.4.2 and section 8.

Figure 6: Elevation and plan for a site where plant and machinery **will not** pass under electricity lines

Elevation



Plan



Dimension A = Minimum distance of **6m** for LV, 10kV, 20kV and 38kV
Dimension A = Minimum of **10m** for 110kV 220kV, 400kV (and other voltages in this range)

7.2 Sites where plant will pass under a live overhead line

When you need to move plant and machinery under a live overhead electricity line, you must create crossing points.

To create crossing points, erect height-restricting goalposts. These must be made from rigid, non-conducting, clearly visible material at the entrance to the crossing point on each side of the line.

Figure 7 shows the correct design of a crossing point.

Table 4: Specifications for crossing points

Location	Outside the hazard zone and in line with the protection barriers.
Maximum height	4.2 metres measured relative to ground level of the original site. This must be implemented by the dutyholder or responsible person.
Maximum width	9 metres. Crossings should be as narrow as is practical and safe. 9 metres is a maximum width.

Place this equipment along the crossing point.

- Suitable rigid barriers 0.8 to 1.4 metres in height on both sides of the crossing point corridor to prevent deviation from the corridor
- Two warning signs near the goalposts at each entrance at spacings of 20 metres or less along the barriers

Where possible, select locations for crossing points that are closer to the supporting poles or towers rather than to the middle of the overhead line span. This will give greater clearances at the crossing points and reduce the variations in clearances.

Do not erect bunting along the sides of the passageway. This may compromise safety clearances where the bunting crosses under the electricity line.

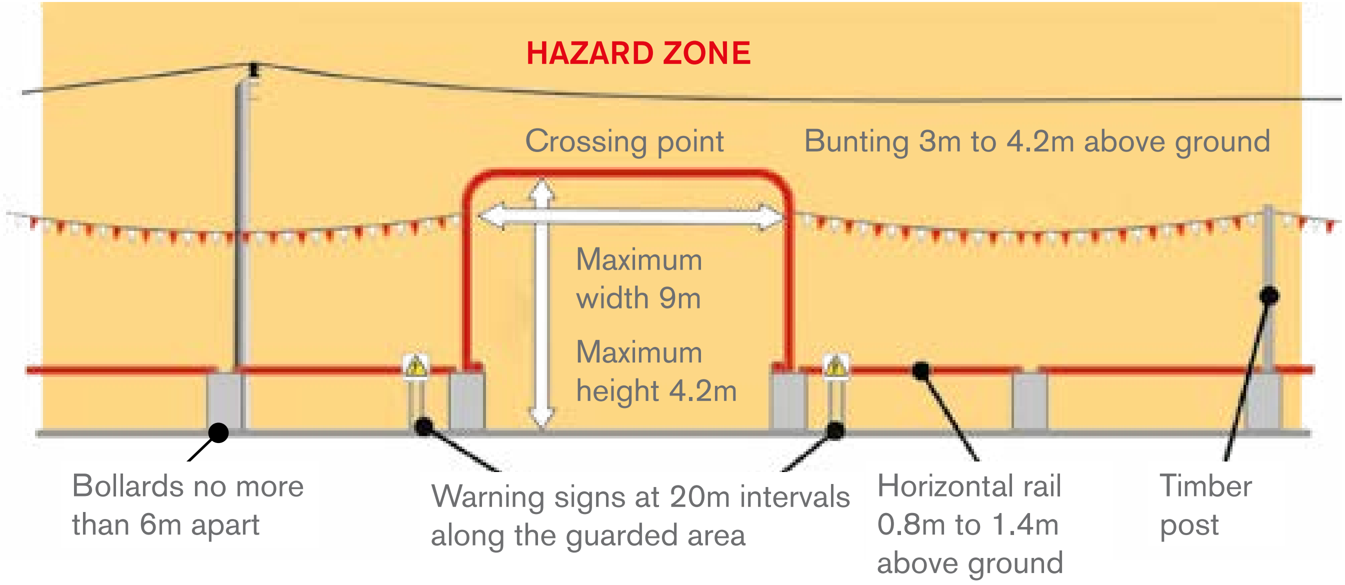
The clearances for overhead electricity lines can vary from time to time based on changing conditions such as:

- external physical loading conditions such as wind, ice or snow loading;
- changes in ambient temperature;
- variations in the amount of electrical current flowing in the line. This will cause variations in the temperature of the line conductors, which will cause variations in the line sags and ground clearances;
- other factors such as damaged poles, staywires or crossarms;
- any changes in ground levels close to the line.

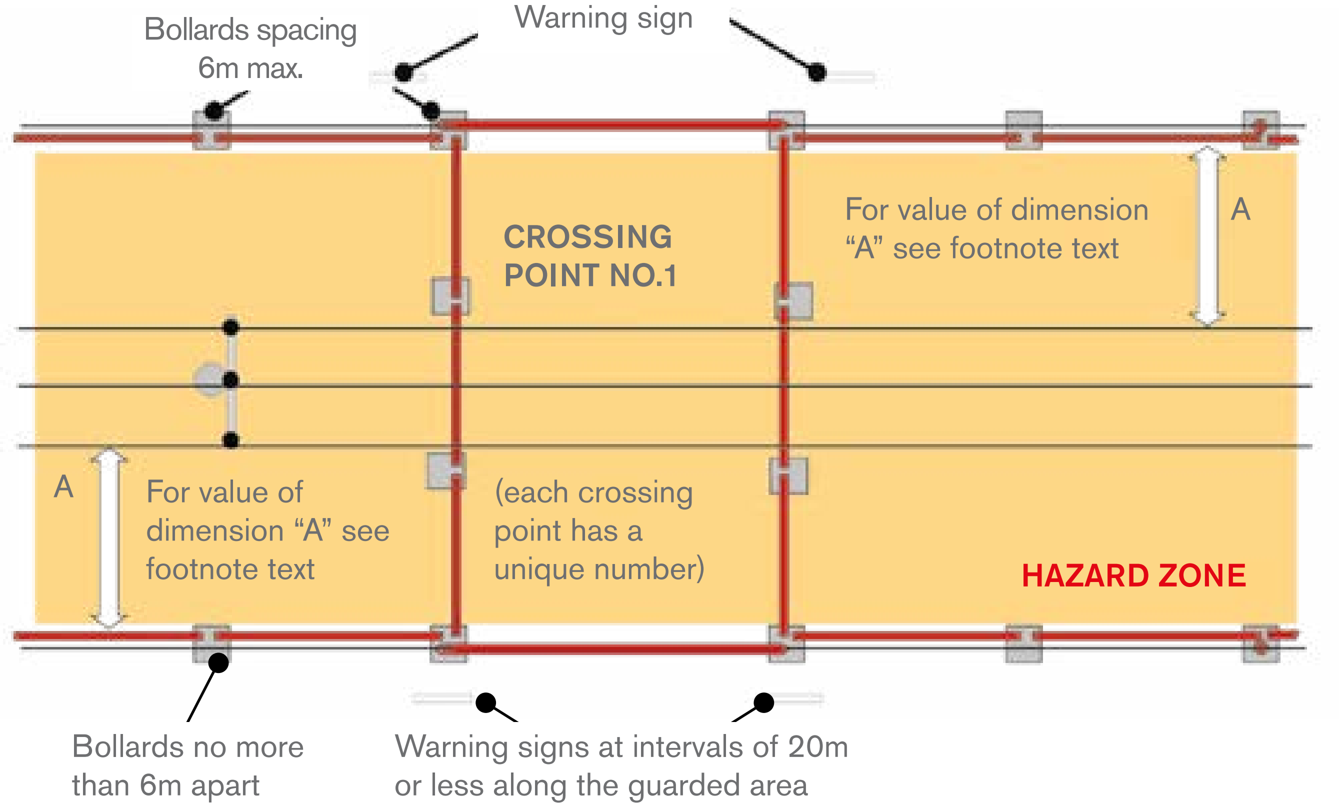
Figure 7: Elevation and plan for a site where plant and machinery will pass under electricity lines

At the crossing point, the maximum height of the crossbar must not exceed 4.2 metres except where this has been specifically approved by ESB Networks for that particular crossing location. This height must be measured relative to the original ground levels.

Elevation



Plan



Dimension A = **6m** minimum for LV, 10kV, 20kV, 38kV
Dimension A = **10m** minimum for 110kV, 220kV, 400kV (and other voltages in this range)

7.3 Sites where work will be carried out in the hazard zone

In certain very limited circumstances, work in the hazard zone of live overhead electricity lines, including the use of specified equipment, may be permitted.

In all cases, before work begins, you must:

- verify the line voltage with the network owner/operator;
- determine the hazard zone; and
- determine the exclusion zone.

> Do not dig or pour foundations for buildings within the hazard zone until lines that are to be diverted or put underground have been removed or disconnected.
>
> Digging or pouring foundations is specifically excluded from the classification of work permitted under 7.3.1 and 7.3.2 below.

7.3.1 Work that does not require consultation with the network owner/operator

If works do not involve plant and machinery, equipment or activities that could breach the exclusion zone (Table 2), you do not have to further consult with the network owner/operator after you have verified the voltage, as outlined above. If in doubt about anything, consult with network owner/operator. However, the PSCS and Contractor are responsible for safely managing the work.

Depending on the equipment and the height of the line, such work may include the use of:

- a bulldozer;
- small front tipping dumpers; or
- mini diggers.

A site-specific risk assessment and work method statement must be prepared before deciding what work can be done in the hazard zone. The risk assessment and work method statement **must** cover the following:

- the height of the line, taking into account any possible sag;
- the maximum potential height that the equipment can reach, ignoring any mechanical, electronic or electromechanical height limiters that may be fitted to the equipment;
- the possible effect of varying or changing ground levels within the hazard zone on the height of the line;
- the possible effect of works on support structures such as poles, towers, stay wires and other structures. The stability and integrity of these support structures are key to the safe operation of the overhead line infrastructure.

The work must be planned in order that it does not affect the structural integrity of the poles or towers supporting the electricity lines.

To access the hazard zone for this specific work, the barriers around the hazard zone may have to be temporarily removed. These barriers **must** be put back as soon as possible to prevent other vehicles or plant accessing the hazard zone.

7.3.2 Work that requires consultation with the network owner/operator

In **extremely limited circumstances**, work that could **accidentally** breach the exclusion zone can go ahead if:

- the network owner/operator is consulted before works begin;
- there is a comprehensive, detailed safe system of work in place; and
- when it is appropriate to de-energise the network, the work does not begin until **after** the network owner/operator switches out and earths the line.

It is not always possible to switch out or divert lines to permit work that could accidentally breach the exclusion zone.

Where work is permitted that could accidentally breach the exclusion zone, the following minimum precautions apply:

- Prepare a written risk assessment and work method statement in consultation with the people who will be doing the work. See 7.4 for factors to include in the risk assessment and method statement.
- Establish and use a daily permit-to-work system.

- Use only equipment that has certified operational limiters installed to prevent any part of the equipment breaching the exclusion zone.
- In the risk assessment, specify the limits to which the equipment can operate.
- On site, ensure only a competent person sets and fixes these limits and that the limits are verified by testing.
- Establish on-site management systems to make sure limits cannot be tampered with.
- Put in place a competent dedicated observer for plant and equipment. The dedicated observer must be able to communicate with the machine operator at all times and must not do any other work while work in the hazard zone is in progress.

7.4 Possible special arrangements for some low-voltage (LV) overhead lines

For LV overhead lines, to facilitate certain work within the hazard zone, especially in urban environments, it may be possible for ESB Networks to:

- replace bare conductors with insulated bundled conductors; or
- temporarily insulate the conductors by applying approved temporary shrouding and other protection to the conductors.

In these situations, you must consult with the network owner/operator to agree:

- site specific arrangements; and
- control measures for each individual conflict.

If LV overhead line conductors have been temporarily shrouded or appear to be insulated, this **does not** mean that they are safe to touch. The effectiveness of shrouding or insulation will depend on conditions such as the prevailing weather conditions.

If this insulation appears to be damaged or dislodged, stop all work within 3 metres of the damaged area and notify the network owner/operator immediately.

Implement all control measures that are specified by the network owner/operator and make all relevant employees and subcontractors aware of the safety requirements.

7.5 Maintain barriers and warning notices

The PSCS must put in place a care and maintenance system to make sure that barriers, bunting, warning signs, goalposts and lighting are in place and effective throughout the works. This system must include:

- daily visual checks of protective measures, the behaviour of site personnel and the operation of plant and machinery that is close to overhead lines;
- weekly recorded checks of protective measures; and
- a follow-up process for all protective measures and works to make sure defects are notified to the responsible person and corrected without delay.

See Annex 2 for Form OHL1, which is the recommended form.

8 Operating high-reach plant near overhead electricity lines

8 Operating high-reach plant near overhead electricity lines

8.1 Introduction

Using cranes, mobile elevated work platforms (MEWPs) and other high-reach plant near overhead electricity lines is hazardous and there have been many deaths associated with this equipment. Construction plant and/or materials being lifted or moved must never breach the exclusion zone at any stage. You must carefully manage works so they are safe.

8.2 Safe system of work

This chapter outlines a safe system of work that you can use for minimising the risk from using high-reach plant. Where it may not be practical to use the system described here, use an alternative safe system which offers the equivalent level of protection.

Examples of high-reach plant include:

- concrete-placing booms;
- mobile elevated work platforms (MEWPs); and
- lorry-mounted cranes and other high-reach plant.

The safe system of work should include the following:

- qualified, competent supervisors;
- written risk assessment and work method statement;
- effective controls for preventing contact or near contact with overhead lines; and
- effective communication.

8.3 Planning for high-reach plant

8.3.1 Identify overhead electricity lines before works begin

Before cranes, high-reach plant and equipment are used on site, assess the proximity of overhead electricity lines and determine the location and area of hazard zones.

The area of a hazard zone is related to the voltage of the overhead electricity lines, so the voltage of overhead lines must be identified. To do this, contact ESB Networks for assistance or get maps and records from ESB Networks Central Site. Contact details are in Annex 5.

Always treat overhead electricity lines as live unless ESB Networks has confirmed that they are switched out and earthed.

8.3.2 Assess the risks

Consider the factors listed here when you assess the risks and establish the safe work method. This list is not exhaustive. You may also have to consider other factors.

- **The type of crane or high-reach plant**

Different types of plant have different characteristics and operating methods. This means that safety requirements vary.

- **Load measurements**

Consider the weight, size, shape and surface area of the load. In particular, consider how the load will move as a result of the surface area facing the wind.

- **Overhead line span and support structures**

Wind can cause line conductors to swing sideways, which reduces clearances. The ambient temperature and the electrical loading can cause lines to sag, which also reduces clearances. These effects can be significant and are greatest on long spans and at the mid-span position.

- **Nature of the load**

The materials in a load and the way it is secured may cause movement during an operation. This movement may accidentally breach the exclusion zone.

- **Terrain, ground and surface**

Consider the surface that the plant is placed on. Is the surface likely to change or move? This can cause plant and equipment to move toward overhead lines or into the exclusion zone.

- **Visibility, light and weather**

Visibility, light levels and weather conditions all affect the operation of plant and how the load behaves.

- **Competent workers**

Ensure workers are competent and hold valid CSCS (Construction Skills Certification Scheme) cards where required by legislation.

Incorporate this information into your risk assessment and work method statement.

8.3.3 Position plant at a safe distance

When determining the safest position for cranes and high-reach plant, evaluate the maximum extended and falling distance of the plant and the voltage of the line. Then place the plant farther than its maximum extended and falling distance from the nearest point of the hazard zone for the particular voltage of overhead electricity line. See section 2.4.1 for hazard zone definition and dimensions.

Incorporate this information into your risk assessment and work method statement.

8.3.4 What to do if you cannot comply with 8.3.3

If it is not possible to achieve the recommended hazard zone clearances, you must make every effort during planning to re-design the set up and operation of plant and its load so that the exclusion zone cannot be breached.

If you cannot meet the requirements in 8.3.3, you must either contact the network owner/operator to discuss the feasibility of having the line switched out and earthed **or** use an alternative safe system of work. For example, choosing different plant or a limiter on long-reach plant. See section 8.5.

In certain limited circumstances, it may be necessary to set up and operate the crane or high-reach plant closer to the overhead electricity line. In this situation, the hazard zone might be breached during set up or operation. This means there must be a higher degree of safety management. In this situation, you must:

- consult with ESB Networks about the works;
- implement the special precautions in section 8.5; and
- observe the critical safety requirements for exclusion zones. These are specified in section 8.4.

Incorporate this information into your risk assessment and work method statement.

8.4 Critical safety requirements for exclusion zones

A person must not operate a crane or any other plant or equipment in a way that breaches the exclusion zone(s) as specified in section 2.4.2. This includes:

- any part of the crane or plant or the load being moved;
- a person operating or working on a mobile elevated work platform (MEWP);
- any hand tools or other equipment held by any person involved with the operation.

8.5 Special precautions when the hazard zone may be breached

When there is no option but to set up high-reach plant where the hazard zone may be breached and the overhead electricity lines cannot be switched out and earthed, you must take these special precautions. These include but are not limited to:

- completing a written risk assessment and work method statement specifically for the high-reach plant. Detail the controls you will put in place to make sure that the plant does not breach the exclusion zone;
- setting up a daily permit-to-work system. This is the responsibility of the Contractor;
- putting in place a competent dedicated observer for each item of plant. Section 8.5.1 explains this;
- setting up warning devices, limiting devices or both to notify the operator of any potential breach of the exclusion zone;
- limiting and controlling the personnel in contact with the high-reach plant or load. Section 8.5.2 explains how to do this.

8.5.1 Using dedicated observers

There are special provisions that apply where a dedicated observer is required.

An operator's employer or a self-employed operator is responsible for appointing a dedicated observer.

If a dedicated observer is required, the **operator must not operate high-reach plant** without a dedicated observer.

The dedicated observer must:

- warn the operator if any part of the crane, plant or load is about to enter the exclusion zone;
- be competent, that is, appropriately trained;
- be fully aware of the boundaries of the exclusion zone and have an appropriate means of preventing encroachment, such as by placing appropriate markers in a safe position which the dedicated observer and the operator can easily see;
- be able to instantly communicate effectively with the operator of the crane or plant at all times and use specialist equipment to communicate if necessary;
- be satisfied that there is adequate visibility or adequate lighting provided to perform their role;
- be satisfied that there is adequate visibility and be aware of blind spots, obstructions and lighting conditions; and
- wear eye protection to reduce glare, if necessary.

Dedicated observers must not:

- perform any other duty while acting as a dedicated observer;
- observe more than one item of high-reach plant at a time; or
- be in the basket of a MEWP that they are observing.

8.5.2 Personnel near to high-reach plant when in operation or being moved

In the hazard zone, only authorised personnel should be near or on high-reach plant. All other personnel must keep clear of high-reach plant when it is being moved or is in operation.

Only two types of personnel are permitted to touch high-reach plant or its load when it is being moved: operators and appropriately trained personnel who are essential to the operation.

Operators may be near to the plant or load when:

- they are in the cabin, not standing on the ground beside the high-reach plant; or
- they are using **radio-operated** remote control and standing well clear of the plant. Remote control with directly connected control leads are not permitted.

Appropriately trained personnel who may touch the high-reach plant, its attachments or its load include:

- slingers;
- signallers; and
- workers helping to set up the plant.

Personnel using guide ropes who are in direct or continuous contact with plant must not be in the hazard zone.

If personnel must make contact with the high-reach plant or its load, they should verify that all parts of the plant, load and slinging gear are outside the exclusion zone.

To control load movement, they must use non-conductive objects such as appropriately insulated poles, guide ropes or, where practical, insulated crane hooks.

The insulation must be effective against the maximum voltage of an overhead electricity line. The employer or self-employed operator is responsible for making sure the insulation meets international standards.

8.6 General good practice guidelines for operating high-reach plant

- Always assume that overhead electricity lines are live unless ESB Networks has verified that they are switched out and earthed.
- Operate high-reach plant at a slower than normal rate when it is near overhead electricity lines.
- Exercise caution when travelling over uneven ground that could cause a crane or other high-reach plant to weave or jolt close to overhead electricity lines.
- Keep all personnel well away from high-reach plant that is close to overhead electricity lines.
- Be careful near long spans of overhead electricity lines. Wind can cause significant sway in the conductors and reduce the clearance between the plant and the line.
- Transport long objects horizontally and below shoulder level near overhead lines.
- Know what emergency procedures to follow if there is contact with a live overhead electricity line. See Annex 5 for details.

9 Road strengthening and resurfacing works

9 Road strengthening and resurfacing works

9.1 Introduction

This chapter covers road strengthening and resurfacing works only. It does not cover new road construction.

Use this safe system of work for most road strengthening and resurfacing works. In situations where it may not be practical to use the system described here, use an alternative safe system which provides an equivalent level of protection.

Whatever system you use, you should:

- prepare a written risk assessment and work method statement;
- put in place effective controls for preventing contact or near contact with overhead lines; and
- evaluate whether it would be best to switch out and earth a line before work begins.

9.2 Procedure for roads that are crossed by overhead electricity lines: recommended safe system of work

9.2.1 Minimum safety controls

When road strengthening and resurfacing works take place near overhead electricity lines, a **no-tip zone must** be established. Minimum safety requirements:

- a survey before works start; and
- appointment of a competent person to:
  - control work near the lines and in crossing or conflict locations; and
  - communicate directly with operators of machinery and plant in or near the no-tip zone;
- a no-tip zone must have the following minimum horizontal distances from the nearest live overhead electricity lines as measured in plan view.

3 metres for lines with voltages up to 38kV*
4.5 metres for lines with voltages at 110kV
6 metres for lines with voltages at 220kV
8 metres for lines with voltages at 400kV

*These are illustrated in Figures 8, 8a and 8b of this Code of Practice.

9.2.2 Actions to take before works begin

- Survey all overhead electricity lines.
- Contact ESB Networks on 1850 928 960 to request maps and records. Further contact information is in Annex 5.
- Assign a unique identification number to each place where an overhead line crosses the road.
- On the road and using indelible (permanent) paint:
    - mark the boundaries of each no-tip zone; and
    - label each no-tip zone with its identification number.

9.2.3 Actions to take during works

Every day, the person in control of the site must make sure that safety measures are in place.

- On the day works begin, verify the survey is complete and markings are in place.
- Every day on site, fill in an Electrical Hazard Risk Assessment (EHRA) for each crossing and conflict. The EHRA template is in Annex 3.
- Make sure that warning signs are in place at the entrance and exits of the no-tip zone. For visual guidance on placing these signs, see Figure 8.
- Audit site safety [frequency is determined by the nature, scale and complexity of the works]. A template for a safety audit form is in Annex 4.

9.2.4 Operating plant and machinery safely in the no-tip zone

9.2.4.1 Operating a tipper truck

> Ensure a safe system of work is in place at all times and that the tipper truck is in good working order and on safe level ground. Be aware that tipper trucks may overturn. Maintain a safe distance from the truck.

When the tipper truck reaches the beginning of the no-tip zone lower the skip completely.

Move forward until the rear of the truck has passed far enough beyond the exit that no part of the skip will be in the no-tip zone when it is tipped. Allow enough space between the exit and the truck to permit a paver or chip spreader to be filled safely.

Do not reverse into the no-tip zone with the skip raised.

9.2.4.2 Filling a paver

Ensure the paver is moved beyond the exit point to ensure that there is sufficient clearance from the no-tip zone, while the tipper truck is carrying out the loading process.

To reduce hazards while filling pavers, consider using low equipment such as a front-tipping dumper instead of a tipper truck.

For visual guidance on using pavers, see Figures 8, 8a and 8b.

9.2.4.3 Filling a chipping spreader

Ensure the chipping spreader is moved beyond the exit point to ensure that there is sufficient clearance from the no-tip zone while the tripper truck is carrying out the loading process.

The chipping spreader should be reversed or towed backwards through the no-tip zone.

9.2.4.4 Using a planer or other elevated equipment

At all times, make sure that **no part** of the planer or other equipment **or any person** positioned on the equipment **is more than 4.2 metres above the road surface** while in the no-tip zone.

9.2.5 Alternative safe systems of work

If the safe system of work outlined earlier is not practical, you should use a system that includes risk control measures, such as goalposts, that are at least equivalent to the measures described above.

9.2.5.1 Using goal posts

Goal posts are required to restrict the height of plant passing close to or underneath live overhead electricity lines.

The maximum height of the goal posts must not be more than 4.2 metres above the original road surface level unless it has been specifically determined that a greater height is permissible for the specific crossing or conflict.

The maximum height for goal posts takes into account:

- the minimum height of the overhead electricity line; and
- the appropriate radial exclusion zone clearance for the voltage of the line involved.

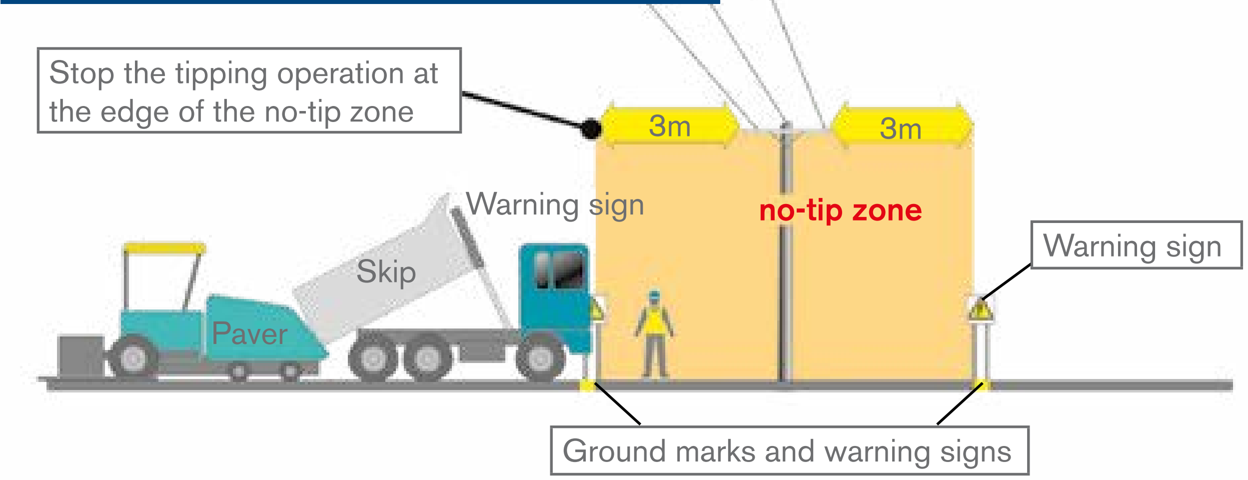
Refer to section 2.4.2 for information on exclusion zones.

You must assess and control the risks when erecting and removing goal posts.
Goalposts must be suitably erected and maintained for the duration of the works.

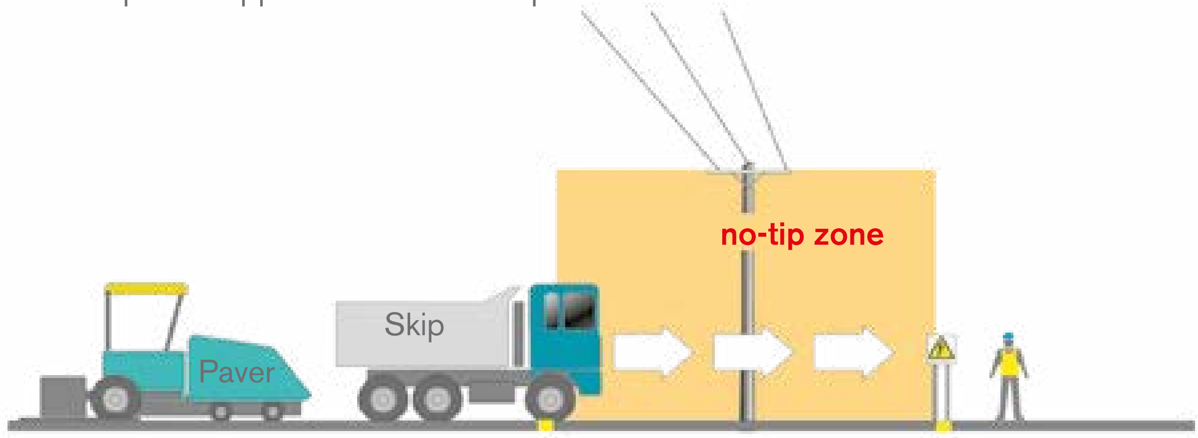

HIAB 200 C

Figure 8: Safe system of work when the crossing angle is at 90 degrees to the road

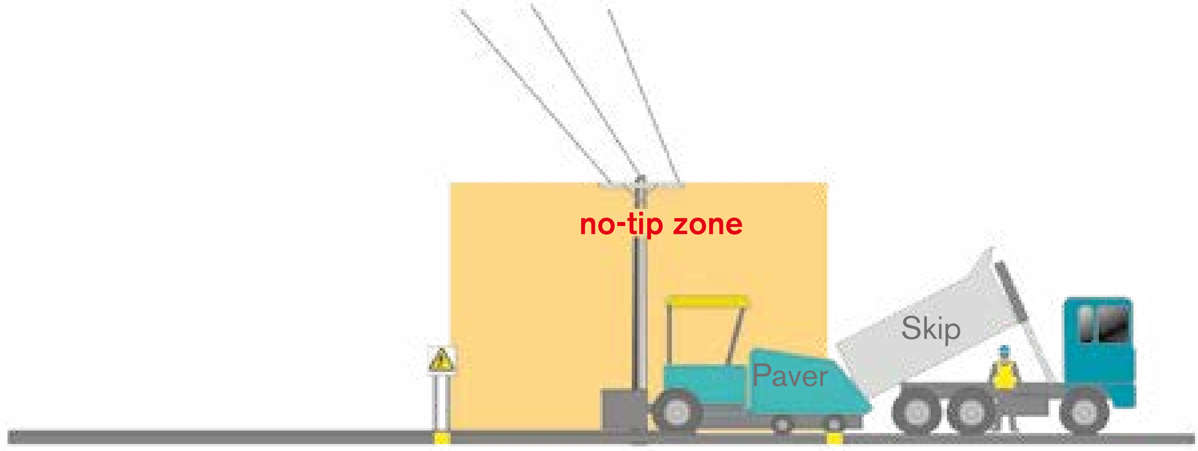
Illustrations for voltages up to 38kV only.
See Table 5 for clearance details for no-tip zones.



1. Load the paver hopper outside the no-tip zone.



2. Fully lower the skip on the tipper truck, and any other elevated plant, such as a planer. before passing through the no-tip zone.



3. Continue normal operation when the tipper truck or other elevated plant is completely clear of the no-tip zone.

Figure 8a: Safe system of work when the crossing angle is equal to or greater than 45 degrees to the road

Illustrations for voltages up to 38kV only.
See Table 5 for clearance details for no-tip zones.

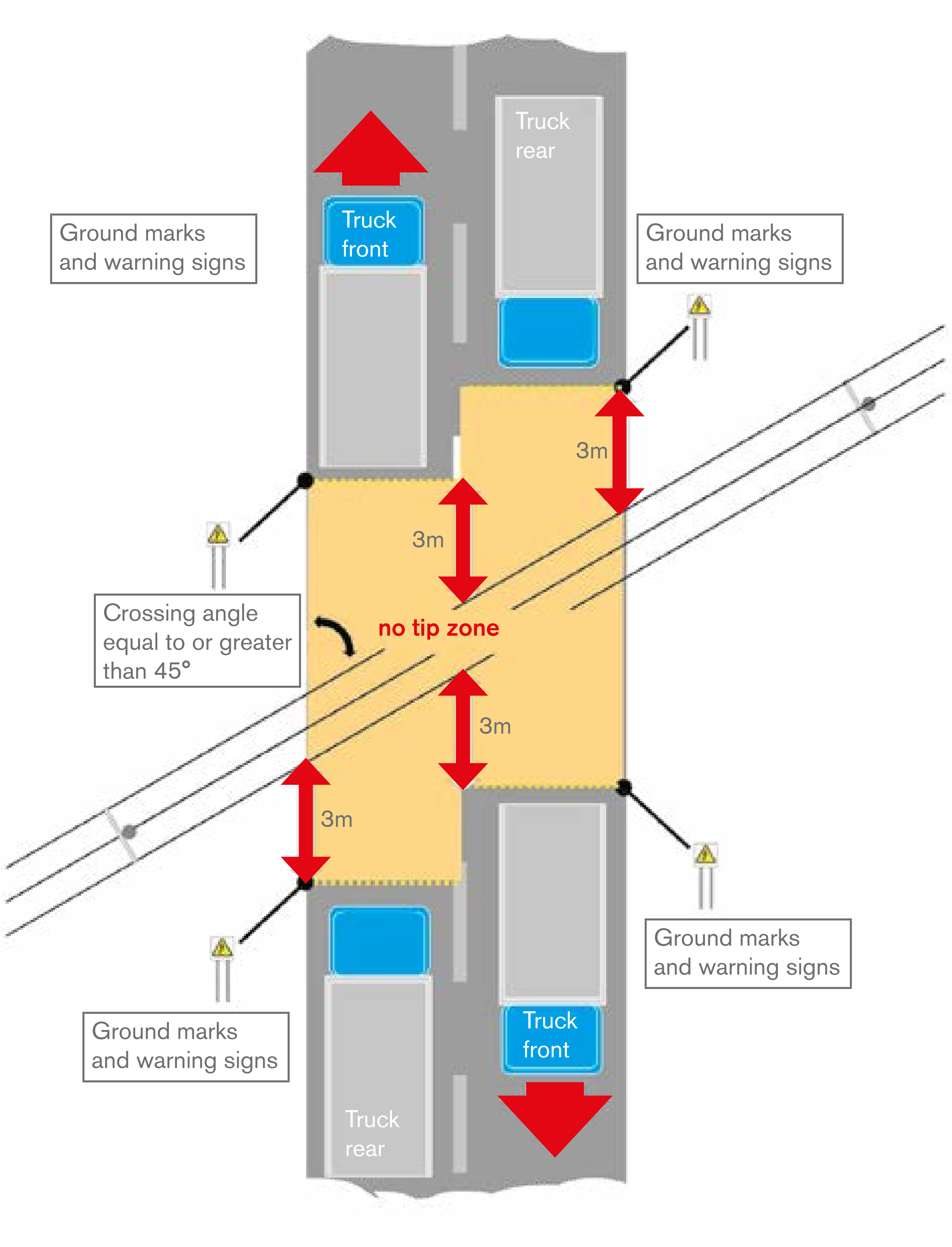
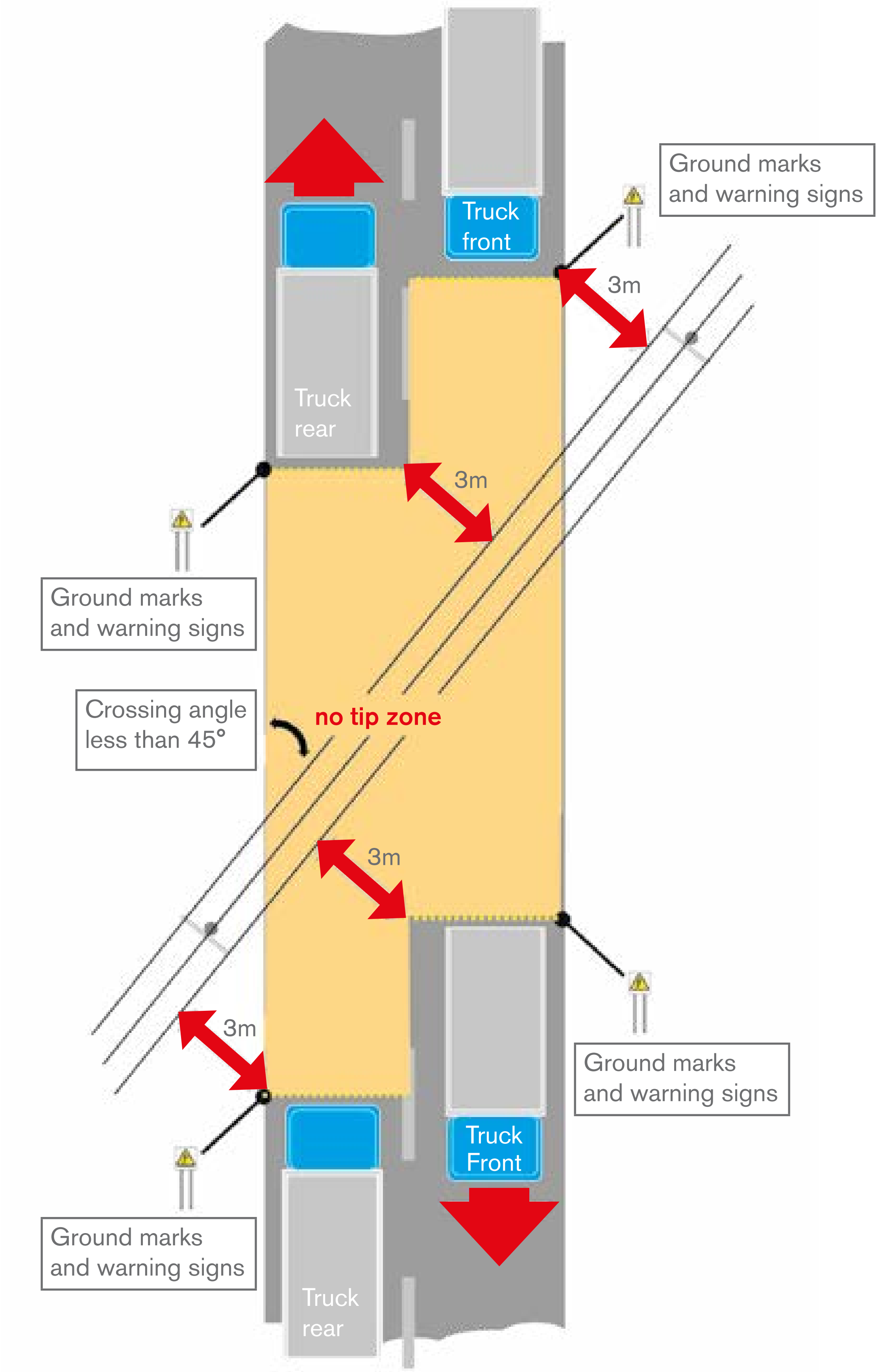


Figure 8b: Safe system of work for road resurfacing when the crossing angle is less than 45 degrees to the road

Illustrations for voltages up to 38kV only.
See Table 5 for clearance details for no-tip zones.



9.3 Procedure where overhead electricity lines approach close to or are parallel to the roadway

Some overhead electricity lines may not cross roadways, but they may approach close to or run parallel to the roadway for a section of the road.

The preliminary site survey must identify locations where overhead electricity lines could present a hazard to tipping trucks, taking into account:

- the route of the resurfacing works;
- the camber of the road;
- the presence or use of lay-bys;
- material storage dumps; and
- any other relevant factors.

If the risk assessment identifies a risk of accidental contact or near contact, **apply appropriate additional controls in addition to the controls listed in section 9.2.**

To work out the clearance that must be maintained, determine the operating voltages of the overhead electricity lines. This must be done at the planning stage and before any work starts.

Consult maps and records to determine voltages, or contact ESB Networks. See Annex 5 for contact information.

For this type of work, the minimum clearance for the relevant voltage is the **minimum horizontal clearance as measured on plan view between the skip of the tipper truck and the nearest overhead line conductor.**

9.3.1 Minimum clearances for different overhead line voltages

For road strengthening or resurfacing works where overhead electricity lines approach close to and/or run parallel to the roadway, use the clearances in Table 5.

Table 5: No-tip zone: minimum lateral clearance from the nearest point of the skip of a truck as measured horizontally on plan view

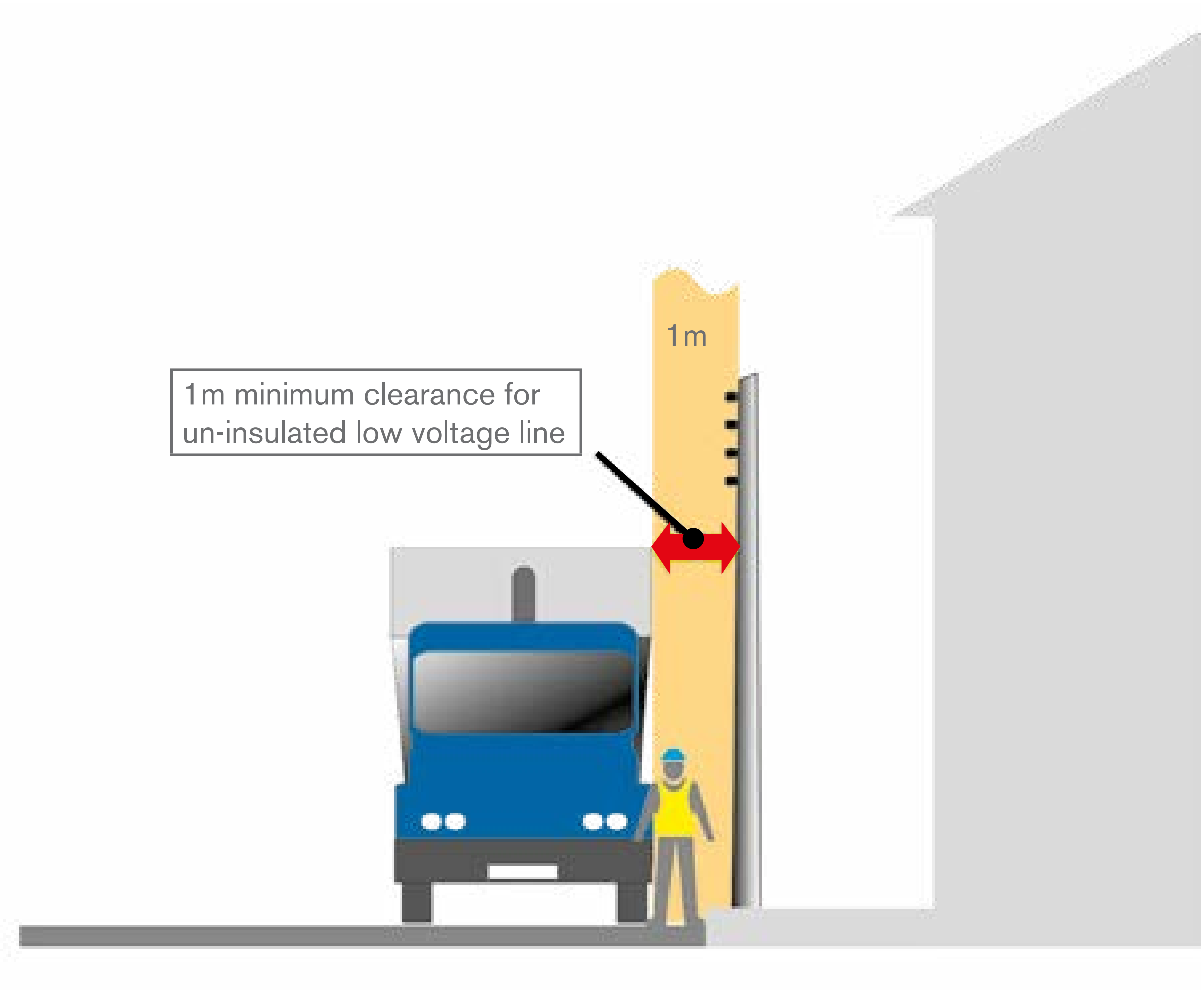
Nominal phase-to-phase voltage of overhead line	Minimum lateral clearance in metres
LV conductors	1.0
10kV, 20kV and 38kV	3.0
110kV	4.5
220kV	6.0
400kV	8.0

If the risk assessment identifies that the relevant minimum clearances cannot be achieved at all times, **use an alternative safe method.** Some alternative methods are:

- using a low-level front-tipping dumper to transport the road materials to the paver or spreader;
- using combination spreader units; and
- using height-limiting control measures in conjunction with a competent dedicated observer.

In certain limited situations, it may be necessary to have an electricity line switched out and earthed before proceeding with the work.

Figure 9: Road resurfacing parallel or near an un-insulated low voltage line



10 Installing overhead services for telecommunications

10 Installing overhead services for telecommunications

10.1 Introduction

Work on overhead telecommunication networks involves installing equipment on poles and structures which can be close to overhead electricity lines.

Where possible, work on these telecommunication networks must be planned and carried out to make sure that the exclusion zone is not breached.

The safest way to achieve this is to ensure that where possible work is carried out outside of the hazard zone.

Where telecommunications work is carried out inside the hazard or exclusion zone, this must be on the basis of a pre-existing agreement with the network owner/operator.

10.2 Scope

This section identifies what must be done to be able to work safely on overhead telecommunication networks where an overhead electricity line presents a hazard.

These requirements are additional to the more general requirements, specified elsewhere in this Code of Practice, including section 7 and section 8. This section does not cover activities relating to attaching communication networks on electrical networks as provided for in SI 391 of 2016 European Union (Reduction of Cost of Deploying High-Speed Public Communications Networks) Regulations. These are subject to compliance with separate requirements.

10.3 Roles and responsibilities

Telecommunications asset owners and/or operators must ensure compliance with this Code of Practice and/or with other requirements as agreed with the network owner/operator.

10.4 Safety management requirements

The telecommunications asset owner/ operator must put procedures and processes in place to manage the risks associated with carrying out telecommunications work close to overhead electricity lines. **The exclusion zone must not be breached – unless it is done based on a pre-existing agreement with the network owner/operator.**

10.4.1 Work outside the hazard zone

Where possible, work must be carried out outside of the hazard zone. Where you need to operate plant near live overhead electricity networks, you must:

- plan and assess the likely risks; and
- make sure that the appropriate controls and method statements are in place.

These measures will ensure that the exclusion zone cannot be breached.

10.4.2 Work inside the hazard zone

Where the work takes place inside the hazard zone, additional controls must be put in place to prevent inadvertent breaching of the exclusion zone.

10.4.3 Work inside the exclusion zone

In limited circumstances, work inside the exclusion zone can go ahead if:

- there is agreement with the network owner/operator; and
- there is a detailed safe system of work in place.

10.5 Communications and work management

The telecommunications asset owner/ operator must put in place effective work management and communications arrangements to facilitate:

- the safe working of the electricity network system by ESB Networks;
- the safety of all personnel;
- the safety of members of the public.

11 Transporting high loads by road

11 Transporting high loads by road

11.1 Introduction

When moving high loads, implement appropriate control measures to address the electrical and physical hazards of overhead electricity lines.

Electrical hazards arise from the risk of a high load contacting live electricity lines or coming close enough to cause electricity to flashover from live electricity lines.

Physical hazards arise from electricity lines, but also from obstacles such as telecommunications lines, trees and bridges.

11.2 Definition of a high load

As specified in the Road Traffic (Construction And Use Of Vehicles) (Amendment) Regulations 2003 to 2017, a high load is any load that is more than 4.65 metres high at its highest point. This height is measured vertically from a flat horizontal surface where the loaded transporting vehicle is parked.

ESB Networks standard clearances for electricity lines on designated local high load routes that cross public roads are designed to enable loads up to 4.65 metres high to pass safely. It is the responsibility of high load transporters to plan and implement a safe system of work.

For loads greater than 4.65 metres high, you **must** consult ESB Networks well before the proposed transportation date.

11.3 Planning for the transport of high loads

Before transporting a high load, you must consult ESB Networks on 1850 372 757 to discuss transportation and to agree control measures.

Voltage determines the minimum safe clearance required between the nearest point of any load and a live electricity line. This minimum safe clearance can vary substantially across the possible range of voltages – public roads are crossed by overhead lines ranging from 230 volts to 400,000 volts.

To determine the control measures required for a high load, ESB Networks will have to individually assess each overhead line crossing on the proposed route. In some cases, no specific control measures beyond this assessment may be required. In general, control measures may vary from having to arrange for ESB Networks to supervise load transport to switching out and earthing lines or, in more extreme cases, making arrangements for raising the height of the lines before the load is transported.

11.4 Information required by ESB Networks

When you contact ESB Networks about transporting a high load, provide this information.

- a clearly marked road map that shows:
  - the planned route for the load;
  - planned deviations to avoid other hazards such as bridges;
  - the starting and finishing locations of the journey;
- accurate detailed dimensions of the load including maximum height and width;
- the name and contact details of the road transport operator;
- the planned schedule for transporting the load including:
  - dates and times;
  - stopover arrangements; and
  - whether more than one load is involved.

11.5 Responsibilities of the road transport operator

A road transport operator must:

- notify ESB Networks of its intention to move a high load under or close to ESB Networks overhead electricity lines or equipment;
- provide accurate information on the high load to ESB Networks;
- comply with all precautions and control measures advised by ESB Networks;
- comply with all directions given by any ESB Networks staff that escort the high load.

11.6 Additional requirements and recommendations

You may be required to apply to other statutory or public bodies for a permit to transport a high load before you transport the load.

The definition of high loads in section 11.2 relates to safe passage under ESB Networks overhead electricity lines **only**. When you apply to other statutory or public bodies for permission or approval to move a high load, the height definition may be different to the one used in this Code of Practice.

12 Emergency procedures

12 Emergency procedures

These are designed to reduce the risk of injury and death if there is accidental contact with electricity networks.

Emergencies include:

- fallen or low conductors
- conductors in contact with a vehicle or machine
- fire
- electric shock
- an injury/casualty on site
- road accident
- damage to overhead lines, underground cables or other electrical plant

If you are unsure of the voltage of overhead lines, treat them as if they are high voltage. Remember, low voltage (LV) is less than or equal to 1000 volts (1.0kV). Higher Voltage (HV) is more than 1000 volts (1.0kV).

Emergency
Contact No.
24 Hour /
7 Day Service

1850 372 999

Case 1: An electricity line is on the ground or conductors are low or fallen

- **Stop work**, remain calm and stay away.
- Keep everyone away from live conductors.
- Do not allow yourself or others to come into contact with a person who is in contact with live conductors.
- Contact the ESB Networks emergency service at 1850 372 999 to get the network disconnected.
- Do not leave the site unattended. Remain on site until ESB Networks staff arrive.
- Do not approach conductors until ESB Networks confirm it is safe.

Case 2: A machine, truck or high-lift plant is in contact with an overhead line

There are three scenarios in this case.

- The machine is 'operable'.
- The machine is 'not-operable'. There is no immediate risk from fire or other hazards.
- The machine is 'not-operable'. There is an immediate risk from fire or other hazards.

Case 2(a): Machine is operable

- **Stop work**, remain calm and stay in the cab.
- Instruct everyone outside the vehicle not to approach it or to make contact with it.
- Disengage from the line.

- Lower the plant.
- **Slowly** drive well clear of the line only if this does not risk breaking the conductor or dragging it to the ground.
- Contact ESB Networks emergency service at 1850 372 999 to get the network disconnected.
- Do not leave the cab until ESB Networks confirm it is safe.
- Do not leave the site unattended. Remain on site until ESB Networks staff arrive.
- After the emergency has ended, check vehicles for damage before using them again.

Case 2(b): Machine is not operable. No immediate risk from fire or other hazard

- **Stop work**, remain calm and stay in the cab.
- Instruct everyone outside the vehicle not to approach it or to make contact with it.
- Contact ESB Networks emergency number at 1850 372 999 to get the network disconnected.
- Do not leave the cab until ESB Networks confirm it is safe.
- Do not leave the site unattended. Remain on site until ESB Networks staff arrive.
- After the emergency has ended, check vehicles for damage before using them again.

Case 2(c): Machine is not operable. Is at risk from fire or other hazard.

- **Stop work** and remain calm.
- Instruct everyone outside the vehicle not to approach it or to make contact with it.
- Jump clear of the machine or plant.
- Land with your feet as close together as possible to minimise the possibility of electric shock.
- Avoid placing your hands on the ground.
- Avoid making contact with any part of the vehicle when you are on the ground.
- Shuffle away from the vehicle. Take half steps only or hop with both your feet together. Avoid taking full steps or spreading your feet in any direction.
- When you are clear of the vehicle, machine or plant, continue to treat the conductors and vehicles as if they are live.
- Maintain a safe distance from the vehicle and never attempt to re-enter the vehicle. Ensure no one approaches the vehicle.
- Contact ESB Networks Emergency Service at 1850 372 999 to request disconnection of the network.
- Do not leave the site unattended. Remain on site until ESB Networks staff arrive.
- After the emergency has ended, check vehicles for damage before using them again.

Figure 10: If you accidentally come in contact with an overhead electricity line.

Jump clear of the machine or plant

Land with your feet as close together as possible

Shuffle away from the vehicle. Take half steps only or hop with both feet together to minimise the possibility of electric shock

Correct method for exiting a vehicle when there is a risk of fire or other hazard

Emergency Contact No.
24 Hour/7 Day Service

1850 372 999

ANNEXES

Annex 1: Principles of Prevention

Schedule 3 to the Safety, Health and Welfare at Work Act 2005 lists the General Principles of Prevention of accidents and ill-health in the workplace. The Principles of Prevention are a hierarchy of control methods for risk elimination and risk reduction.

The General Principles of Prevention are set out in descending order of preference.

1. The avoidance of risks.

2. The evaluation of unavoidable risks.

3. The combating of risks at source.

4. The adaptation of work to the individual, especially as regards the design of places of work, the choice of work equipment and the choice of systems of work, with a view, in particular, to alleviating monotonous work and work at a predetermined work rate and to reducing the effect of this work on health.

5. The adaptation of the place of work to technical progress.

6. The replacement of dangerous articles, substances or systems of work by safe or less dangerous articles, substances or systems of work.

7. The giving of priority to collective protective measures over individual protective measures.

8. The development of an adequate prevention policy in relation to safety, health and welfare at work, which takes account of technology, organisation of work, working conditions, social factors and the influence of factors related to the working environment.

9. The giving of appropriate training and instructions to employees.

The employer, employee, PSDP, Designer, PSCS and Contractors are responsible for implementing these principles.

Further details in relation to applying the Principles of Prevention can be found at hsa.ie.

Annex 2: Form OHL1

Protective measures: safety check for barriers, goalposts, warning signs, bunting and other protection (example)

Recommended weekly safety check for overhead line protection				Site: ABCD at Newtown Road PSCS: Joe Bloggs	
Date and time	**Inspected by**	**Location and crossing ID**	**Protection type**	**Comment**	**Action**
1 May 2016 11.00am	**J Smith** Safety Officer	Grid 3-5, A-B	Bunting	Bunting damaged at the north side of the ESB line	Reported to J Murphy, site engineer at 13.00, 1 May 2016
"	"	"	Goalposts	In order	Reported to J Murphy, site engineer at 13.00, 1 May 2016
"	"	"	Traffic barriers	In order	No action
"	"	"	Signage	In order	No action
"	"	Grid 6-12, A-B	Bunting	In order	No action
		"	Goalposts	Not applicable	Not applicable
"	"	"	Traffic barriers	4 traffic barriers removed at the south side of the line	Reported to J Murphy, site engineer at 13.00, 1 May 2016
"	"	"	Signage	In order	No action

Every day, check the condition and placement of protective measures.

Once a week, fill in a copy of OHL1 or a similar form and file it in your safety file.

Annex 2: Form OHL1

Protective measures: safety check for barriers, goalposts, warning signs, bunting and other protection (template)

Recommended weekly safety check for overhead line protection				Site: ABCD at Newtown Road PSCS: Joe Bloggs	
Date and time	Inspected by	Location and crossing ID	Protection type	Comment	Action

Every day, check the condition and placement of protective measures.

Once a week, fill in a copy of OHL1 or a similar form and file it in your safety file.

Annex 3: Electrical Hazard Risk Assessment form: EHRA (template)

On-site Electrical Hazard Risk Assessment form: EHRA

Fill in this form when you are resurfacing or strengthening roads near live overhead electricity lines or equipment.

Every day on site, fill in an Electrical Hazard Risk Assessment form (EHRA) for each crossing and conflict.

Name of contract: ______________________________

Road number and section number : ______________________________

Conflict identification number					
Specify the **voltage** of electricity lines that cross, run parallel to or closely approach a road (LV; 10/20/38kV; 110kV; 220kV; 400kV)					
Are the crew familiar with chapter 9 of the Code of Practice for Avoiding Danger from Overhead Electricity Lines?(LV; 10/20/38kV; 110kV; 220kV; 400kV)	Y / N*	Y / N*	Y / N*	Y / N*	Y / N*
Are the **extremities of the no-tip zone** established and marked out on site?	Y / N*	Y / N*	Y / N*	Y / N*	Y / N*
Are **warning signs** erected at both entry and exit of **no-tip zone**?	Y / N*	Y / N*	Y / N*	Y / N*	Y / N*
Has a person been **appointed to control work** at the overhead line crossing or conflict location?	Y / N*	Y / N*	Y / N*	Y / N*	Y / N*
Has a **procedure for safe working** at the overhead line crossing or conflict location been decided by the person in charge (PIC)?	Y / N*	Y / N*	Y / N*	Y / N*	Y / N*
Do all staff understand the **proposed safe work method statement** and agree that work can proceed safely with the networks **live**?	Y / N*	Y / N*	Y / N*	Y / N*	Y / N*

Signed by person in charge: ______________________________ Date: ______________

Agreed by crew (Circle one): Yes / No*   ESB Emergency Phone: 1850 372 999

*If the answer to any of these questions is **no**, appropriate action **must** be taken to address the issue before working at that location.

Annex 4: Road resurfacing safety audit form (template)

Contractor:		Audit Date:
Work location:		Auditor(s):
Description of work:		Names of crew members:
Issue	**Status**	**Comments**
Does the crew have a copy of the preliminary survey or pre-work planning assessment?	Y / N*	
Has an electrical hazard risk assessment (EHRA) been completed for all relevant crossings and conflicts?	Y / N*	
Is the crew familiar with EHRA requirements?	Y / N*	
Are no-tip zones established, marked on site and being complied with?	Y / N*	
Are there warning signs at crossing and conflict locations?	Y / N*	
Is there an appointed person controlling work at crossing and conflict locations?	Y / N*	
Are crew members trained for the tasks they are completing?	Y / N*	
Is the crew working in line with the appropriate method statement?	Y / N*	
Has the crew got the ESB Networks Emergency contact number? (1850 372 999)	Y / N*	
Commendable safe actions		
Deviations observed		
Suggestions taken and items for follow up		

Signed by person in charge: ______________________________ Date: ______________

Signed by auditor: ______________________________________ Date: ______________

Annex 5: Contacting ESB Networks

For all emergencies, including contact with overhead electricity lines, call 1850 372 999

ESB Networks General queries:	1850 372 757

Use this general number to find out about:

- new electricity connections;
- increased capacity;
- transporting high loads;
- voltage enquiries; and
- safety and technical queries.

Website esbnetworks.ie

To get electricity line maps or records

Email: dig@esb.ie

Phone: 1850 928 960
+353 1 858 2060

This service operates Monday to Friday only.

Fax us at: 01 638 8169

Write to us at: ESB Networks Central Site
St Margaret's Road
Finglas
Dublin 11
D11 X3W7

To get copies of free safety material

Email us at: esbnetworks@esb.ie

Phone: 1850 372 757

Visit: esb.ie/esbnetworks

Annex 6: Other useful contacts

Gas Networks Ireland

24 Hour Emergency Service:	1850 20 50 50
Gas Networks Ireland 'Dial Before You Dig':	1850 427 747
Gas Networks Ireland Transmission Enquiries:	021 453 4 562

Email: dig@gasnetworks.ie

EIR

'Click Before You Dig'

http://support.eir.ie/article/clickbeforeyoudig

Eir Home: 1800 773 729

Annex 7: Changes to the Code of Practice

This document updates the 2008 version of the Code of Practice for Avoiding Danger from Overhead Electricity Lines. The main changes are:

- improved readability using NALA Plain English guidelines;
- increased use of bullet pointing;
- early introduction of definitions for 'Competent Person', 'Exclusion Zone', 'Hazard Zone' and 'Overhead Line' and explanations of abbreviations such as HV, LV and kV;
- use of the term 'network owner/operator' rather than 'ESB Networks' to reflect the possibility of different network owner/operators in the future;
- early introduction of what the COP does and doesn't cover, specifically the exclusion from the code of workers competent to deal with the hazards of electricity. (Concern had been expressed that the 2008 version of the COP could be interpreted as placing an impediment on competent workers coming within 6 metres of an overhead line, even if adequate safety precautions were in place);
- explanation of the use of bare and insulated overhead lines and the need for similar levels of caution in both cases;
- use of more Irish and up-to-date photos and graphics to illustrate the messages contained in the COP;
- updating the responsibilities of the client in accordance with the 2013 Safety Health and Welfare at Work (Construction) Regulations;
- inclusion of additional information on notifying the HSA about construction activities;
- removal of inconsistencies between the COP and the HSA's 'Guidelines on the Procurement, Design and Management Requirements of the Safety Health and Welfare at Work (Construction) Regulations 2013';
- inclusion of emergency procedures and up-to-date illustrations in the body of the COP (rather than in an annex);
- updated contact information in Annex 5 and Annex 6;
- a bibliography after Annex 7;
- technical updates and references to current legislation;

- colour-coding of sections for ease of use;
- figures and tables – they are now cross-referenced throughout the document for ease of use.

Other useful codes of practice and guidelines

Guidelines for Safe Working Near Overhead Lines in Agriculture (HSA)

Irish Forestry Safety Guide (IFSG) 804 (HSA)

Code of Practice for Avoiding Danger from Underground Services (HSA)

Summary of Key Duties under the Procurement, Design and Site Management Requirements of the Safety Health and Welfare at Work (Construction) Regulations, 2013 (HSA)

Guidelines on the Procurement, Design and Management Requirements of the Safety Health and Welfare at Work (Construction) Regulations 2013 (Updated) (HSA)

Guide for Homeowners. Getting Construction Work Done Safely (HSA)

Mobile Elevated Work Platforms (MEWPs) Guidance on Safe Operating Procedures (HSA)

ARE YOU SURE IT'S SAFE?

- Always ask yourself the question, are you sure it's safe?
- When working outdoors, watch out for overhead electricity lines and underground cables.
- Remember, electricity is there for the good of everyone but can be dangerous and cause serious injury, or worse.
- Stay safe, stay clear of the electricity network.

For emergencies call
1850 372 999

Follow us on twitter
@ESBNetworks

Website
esbnetworks.ie

Notes

Notes

Stock No 9803203-3

APPENDIX 6.1 Generic Quantitative Risk Assessment, prepared by RSK Ireland Ltd

Absolute Limousines Ltd and Boherkill Property Development Ltd

Generic Quantitative Risk Assessment

Belgard Circle K, Belgard Road, Tallaght, County Dublin

602923-R01 (01)

FINAL

NOVEMBER 2020

EXECUTIVE SUMMARY

RSK Ireland Limited (RSK) was commissioned by Absolute Limousines Ltd and Boherkill Property Development Ltd to carry out a Generic Quantitative Risk Assessment (GQRA) at the Belgard Circle K, Belgard Road, Tallaght, County Dublin (the site). The purpose of the GQRA was to establish the contamination status of the soil and groundwater underlying the site and identify any potentially significant risks to human health and / or the water environment.

A desk-based study revealed the site history was of agricultural use in the earliest maps dating from 1837-1842 and 1888-1913; was developed for industrial/commercial use by 1995; and the site was developed as a fuel station by 2000. The desk-based study identified a predominately industrial surrounding land use with several IPPC licensed facilities within 1 km of the site. A locally important aquifer lies below the site and two surface water features are located within 1 km of the site.

An environmental site assessment was completed. A total of five boreholes (MW101 to MW105) were drilled at the site on the 25th and 26th May 2020. All five boreholes were completed as gas and groundwater monitoring wells. Soil samples were collected during drilling, selected soil samples were submitted to a UKAS accredited laboratory (ALS) for chemical analysis for potential contaminants of concern (COC). Four gas monitoring visits and one groundwater sampling visit were completed at the site. Groundwater samples were submitted to a UKAS accredited laboratory (ALS) for chemical analysis for potential contaminants of concern (COC).

Following the completion of the environmental site assessment works and receipt of laboratory analytical results, a GQRA was completed to assess risks to human health and the water environment at the site.

The soil GACs for protection of human health with regards to a residential without home grown produce land use scenario were not exceeded in any of the soil samples analysed. The laboratory analysis of groundwater samples reported that there are no concentrations of contaminants that exceeds the adopted GrAC for human health.

As noted in section 6.2.1, the groundwater GACs for the protection of environmental waters were exceeded in MW104 and MW105 for MTBE indicating the potentially complete pollutant linkage to the locally important aquifer, the groundwater abstraction or the surface waters.

It is considered unlikely that MTBE concentrations will adversely impact the surface waters within 1 km of the site. This is due to lack of direct hydraulic connectivity and the processes of dispersion and degradation of dissolved contaminants which will occur between the site and the receptor.

It is also considered unlikely that contaminant concentrations encountered in shallow groundwater will adversely impact groundwater in the locally important aquifer beneath the site. Quaternary deposits underlying the site, comprising stiff clays, which were encountered during the investigation, will act as a barrier and retard downward migration of dissolved phase contaminants.

RSK does not consider that the contaminant concentrations identified in groundwater pose a significant risk to Human Health as none of the GACs have been exceeded.

Following four rounds of gas monitoring, a maximum GSV of 0.0009 l/hr was recorded. This GSV would initially classify the site as Characteristic Situation 1 (CS1) - **VERY LOW RISK**.
This classification determines that special gas protection measures would not be required within the proposed buildings.

RSK GENERAL NOTES

Project No.: 602923 – R01 (01)

Title: Generic Quantitative Risk Assessment – Belgard Circle K, Belgard road, Tallaght, County Dublin.

Client: Absolute Limousines Ltd and Boherkill Property Development Ltd

Date: 5th November 2020

Office: Dublin

Status: **FINAL**

Author	Brian Cronin	Technical reviewer	Paul Feely
Signature		Signature	
Date:	5th August 2020	Date:	5th August 2020

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1 INTRODUCTION

RSK Ireland Limited (RSK) was commissioned by Absolute Limousines Ltd and Boherkill Property Development Ltd to carry out a Generic Quantitative Risk Assessment (GQRA) at the Belgard Circle K, Belgard Road, Tallaght, County Dublin (the site). A site location map is presented in Figure 1. The purpose of the GQRA was to establish the contamination status of the soil, groundwater and ground gas underlying the site and to identify any potentially significant risks to human health and / or the water environment.

The following report has been prepared specifically and solely for the above noted project. Initial sections of the report describe the site. The subsequent part of the report contains a description of the ground conditions encountered, a summary of the investigation findings, a GQRA, conclusions and recommendations.

All plans, tables, field records and borehole logs relating to this investigation are either given within the text of the report or presented in the appendices. This report is subject to RSK's Service Constraints provided in Appendix A.

1.1 Scope of work

The scope of work for the GQRA included the following:

- Review of desk-based information.
- Field programme including drilling of five boreholes, installation of five monitoring wells, soil and groundwater sampling, laboratory chemical analysis and ground gas monitoring.
- Comparison of laboratory soil and groundwater results to in-house derived screening values for human health for residential land use.
- Comparison of laboratory groundwater results to selected guidance values for the Water Environment for residential land use.
- Comparison of gas monitoring results to selected guidance values.
- Provision of a GQRA report summarising the findings of the desk study, field and laboratory programmes and GQRA screening of laboratory results.

1.2 Limitations

The comments given in this report and the opinions expressed are based on the information reviewed. However, there may be conditions pertaining at the site that have not been disclosed by the investigation and therefore could not be taken into account. Groundwater levels may fluctuate seasonally and at times be significantly different than those recorded. In addition, Made Ground can vary in thickness and nature over short distances and may be significantly different within areas not subject to the intrusive investigation.

This report is subject to the RSK Ireland Limited service constraints given in Appendix A.

2 SITE DESCRIPTION

The site is located in Tallaght, County Dublin, on the Belgard Road, at grid reference O 08514 28741. The site covers an area of approximately 2,800 m^2. The site elevation s approximately 100 m above the Ordnance Datum with site topography observed to be flat. The site location is shown in Figure 1.

At the time of the assessment, the site was comprised of an operational fuel station and two car dealerships. The fuel station includes a fuelling forecourt constructed of reinforced concrete slab with four pump islands dispensing petrol and diesel. The forecourt is enclosed by a perforated drainage channel and sheltered with a canopy. Drainage from the forecourt is to a hydrocarbon interceptor. There is also a car wash slab approximately 5 m west of the forecourt which drains to a separate wash interceptor.

Petrol and diesel are stored in an underground tank farm below the forecourt, immediately east of the pump islands. The tanks are filled via off-set fill points located immediately east of the tank farm. The unground tank farm is vented to a vapour collection manifold in the eastern corner of the forecourt. There is a solid fuels store and a bottled gas cage in the western corner of the site.

There are four underground storage tanks (USTs) in the underground tank farm. The third tank is split into two equal volumes. Details of the underground tank farm are given in Table 2-1.

The surface of the site generally consists of tarmac and concrete. The site topography was observed to be flat. The site location is presented in Figure 1.

Table 2-1 Storage Tank Details

Tank No.	Grade	Capacity (litres)	Age	Construction	Fill Method
1 (UST)	Diesel	20,500	Unknown	Unknown	Off-set
2 (UST)	Diesel	20,500	Unknown	Unknown	Off-set
3 (split UST)	Petrol	10,200 x 2	Unknown	Unknown	Off-set
4 (UST)	Petrol	20,500	Unknown	Unknown	Off-set

The two car dealerships on the site are located immediately southeast of the fuel station. The car dealerships comprise office space, an indoor car showroom and approximately 700 m^2 of outdoor parking space.

2.1 Surrounding Land-use

Land use surrounding the site is predominately commercial and industrial in nature. The Old Belgard Road runs adjacent to the site on the northeast side of the site. Immediately northwest of the site is a large commercial building comprising office space for legal and financial firms.

Approximately 40 m north of the site is a Renault car dealership. To the east, beyond Old Belgard Road there is a number of commercial units including a garage, located approximately 30 m from the site. Immediately south of the site is a car park, with warehousing beyond, located approximately 60 m from the site. Immediately west of the site is a variety of commercial and industrial units which comprise the Cookstown Industrial estate.

3 DESK STUDY REVIEW

The desk study review is detailed in the following section and summarises information obtained from the following sources:

- Geological Survey of Ireland (GSI) online mapping at: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 ;
- Environmental Protection Agency (EPA) maps at https://gis.epa.ie/EPAMaps/ ;
- Ordinance Survey of Ireland (OSI) database located at http://map.geohive.ie/mapviewer.html ;
- Office of Public Works (OPW) interactive flood maps at http://www.floodmaps.ie/ ;
- The Water Framework Directive (WFD) Water Maps available at http://www.wfdireland.ie/maps.html ;
- National Parks and Wildlife Service NPWS mapping located at http://webgis.npws.ie/npwsviewer/.

3.1 Previous Site Operations

A review of the site history was undertaken by assessing the available historical maps and aerial photos available from the ordinance survey of Ireland (OSI) Geohive public viewer.

The earliest available online OSI map dating from 1837-1842 (Figure 3) shows that the site is agricultural land. The surrounding land use is predominately agricultural with a small number of residential dwellings in the area. There is a road immediately east of the site, running northwest to southeast, in the location of the current Old Belgard Road.

The OSI online map from 1888-1913 (Figure 4) shows the site and surrounding land largely unchanged. The surrounding land is still agricultural in use.

The OSI aerial photos from 1995 to 2012 have also been reviewed. The resolution of the photography is poor, it is difficult to identify building or property use.

In the 1995 aerial photograph, the site broadly appears to resemble it's current-day layout with the main retail building in place. However, there is no fuel station forecourt or canopy. The surrounding land has been developed for commercial and industrial use. The buildings and infrastructure in the surrounding area resemble the current-day layout.

The aerial photograph from 2000 shows the site as fully developed to its current state with a fuel station courtyard and canopy. The surrounding land remains relatively unchanged since the 1995 aerial photograph and resembles the current-day layout.

3.2 Geology

Information from the Geological Survey of Ireland (GSI) online mapping public viewer indicates that the solid geology underlying the site comprises dark grey limestone and shale of the Lucan formation, as shown in Figure 3.1 below.

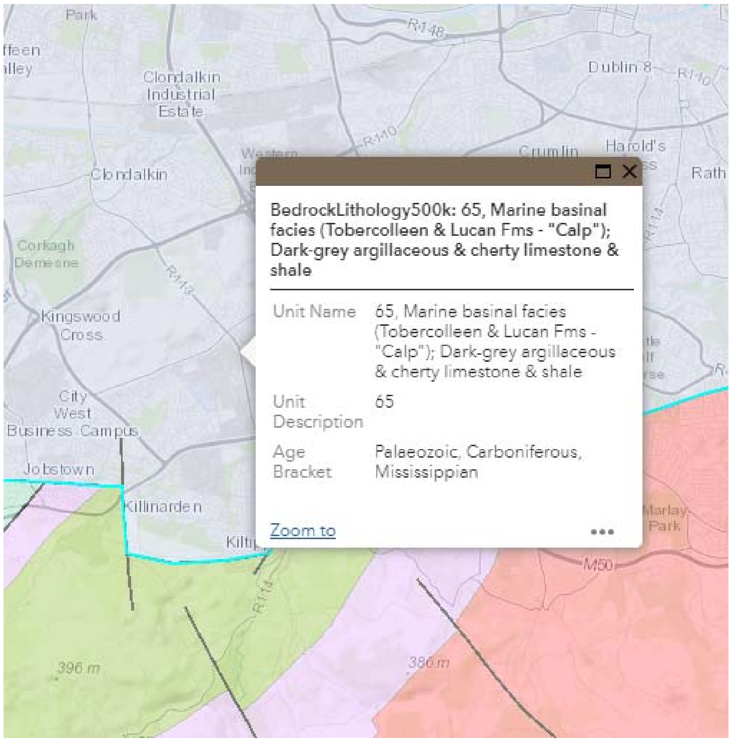


Figure 3.1 Bedrock Geology Underlying Site

According to the EPA, the superficial geology underlying is described as made ground which in turn overlies till derived from limestone.

The GSI has published borehole and trial pit records on-line. There are three borehole locations within a 2 km radius of the site. However, the GSI have been unable to locate the borehole logs for these locations.

3.3 Hydrogeology

3.3.1 Aquifer characteristics

Information from the GSI Groundwater public viewer website indicates that the underlying bedrock is categorised as a locally important aquifer, that is an aquifer which is moderately productive only in local zones. It is anticipated that perched groundwater may be encountered in more permeable horizons within any made ground and superficial deposits.

Groundwater vulnerability is classified as high at the site (see Figure 3.2 below). The EPA has categorised the groundwater body as not at risk. Water framework directive (WFD) monitoring (2010-2015) ranks the water quality as good.

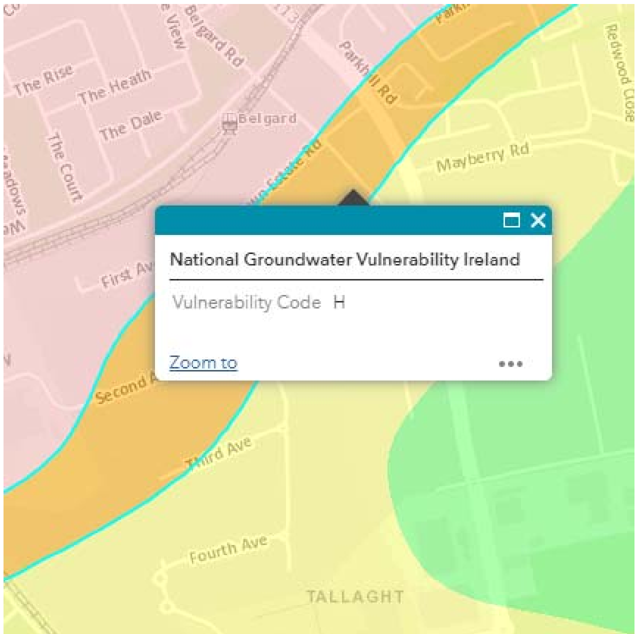


Figure 3.2 Groundwater Vulnerability at the Site

3.3.2 Groundwater abstractions

The GSI public viewer indicates that the closest groundwater abstraction is located approximately 500 m south of the site. The well use is described as industrial use. Yields are 513 m^3/day. The site is not located in a source protection area. According to the GSI map viewer, there are no other groundwater abstraction points within 1 km of the site.

3.4 Hydrology

3.4.1 Surface watercourses

EPA mapping has been reviewed to identify potential receptor surface watercourses. The nearest surface watercourse is the Tymon River located approximately 700 m to the southeast of the site. The River Poddle is located approximately 1 km to the south of the site. The EPA indicate that water quality as reported in the River Waterbody WFD Status (2010 – 2015) is “poor” at the River Poddle.

3.4.2 River Basin Management Plan

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

The waterbody area underlying the site is the Camac Lower, its ecological status is described as “bad”.

3.4.3 Site Drainage

The surface of the site is constructed of reinforced concrete slab and tarmacadam.

From the on-site visual inspection and the review of site drawings, drainage from the fuel dispensing areas is to a hydrocarbon interceptor via a drainage channel which runs the perimeter of the forecourt. The outflow from the interceptor is expected to be to the municipal drainage network on Old Belgard Road.

Drainage from the tarmacadam area in front of the car dealers appears to be to a local on-site network and out to the municipal drainage network on Old Belgard Road.

3.4.4 Flood Risk

The Office of Public works (OPW) interactive flood maps have no record of a flood event occurring within 1 km of the site.

A review of the site was undertaken by assessing the available flood event maps provided by the OPW.

There is no flood risk map available for the site.

3.5 EPA Licensed IPPC / Waste Facilities / Section 4 Discharges

Information from the EPA website indicates that there are three IPPC licensed facilities within 1 km of the site. Approximately 200 m southwest of the site is Print and Display Ltd which operates a business of printing for commercial clients, offering vinyl wall graphics, vehicle branding and other large-scale visual advertising formats. INX International Ink Company Ltd are located approximately 600 m southwest of the site. Microprint and Bimeda Animal Health Ltd are located approximately 700 m southeast of the site.

There are three licensed waste facilities within 1 km of the site. Tonge Industries Ltd is located approximately 300 m west of the site and holds an active waste license. Starrus Eco Holdings Ltd are located approximately 500 m southwest of the site and hold an active waste license. Guardian Environmental Services Ltd are located approximately 700 m southwest of the site and have surrendered their waste license.

There are no section 4 discharges located within 1 km of the site.

3.6 Sensitive land uses

A 2km buffer zone for sensitive land uses has been used as RSK considers it reasonable to assume that significant impact to receptors is unlikely where surface water or groundwater migration is a potential pathway at this distance.

A search carried out using the National Parks and Wildlife Service website for the presence of any designated sites did not identify any sites within 2km of the subject site.

3.7 Local Authority Information

RSK have requested information from South Dublin County Council on 1st July 2020 regarding any pertinent environmental issues that they are aware of on or adjacent to the subject site, however no response was issued from the Council at the time of reporting.

4 FIELDWORK

4.1 Borehole Drilling & Monitoring Well Installation

A total of five boreholes (MW101 to MW105) were drilled on the 25th and 26th May 2020 using a Dando Terrier tracked window sampling drilling rig. Boreholes were advanced to a maximum depth of 4.6 mbgl. Drill cuttings were logged, groundwater conditions were noted, and representative soil samples collected by the supervising engineer. The locations of the boreholes are shown on Figure 2.

All five boreholes were completed as groundwater and ground gas monitoring wells by installing a 50mm internal diameter (ID) uPVC screen and casing. The 50mm ID screen and casings were installed to the base of each borehole as groundwater monitoring wells. The borehole annulus was backfilled with 6mm to 10mm graded gravels with a bentonite seal placed above the filter pack to prevent any downward migration of surface water. The well was finished with lockable steel cover flush with the ground surface. The wells were then purged and left to allow equilibration of groundwater levels.

Details of the monitoring well construction are presented on the borehole logs in Appendix B.

4.2 Soil Sampling

During borehole drilling soil samples were screened for visual and olfactory signs of contamination. Selected soil samples were submitted to a UKAS accredited laboratory (ALS) for chemical analysis for potential contaminants of concern (COC).

4.3 Ground Gas Monitoring

Four rounds of ground gas monitoring were undertaken on all five installed monitoring wells. The ground gas monitoring rounds were undertaken on the 5th, 9th, 12th and 15th June 2020.

The monitoring was undertaken using a GFM436 Portable Gas Analyser. Ground gases within the well head were pumped at a steady rate into the analyser and concentrations of methane (CH4) carbon dioxide (CO2), oxygen (O2), carbon monoxide (CO) and Lower Explosive Limit (LEL) were recorded at set intervals over a 10-minute period.

In addition, the atmospheric pressure before and during monitoring, together with the weather conditions, was recorded. The wells were also assessed for potential ground gas flow rates.

4.4 Groundwater Sampling

Following installation, all five groundwater monitoring wells were gauged for depth to water and the presence of light non-aqueous phase liquid (LNAPL), using an electronic interface probe on 5th, 9th, 12th and 15th June 2020.

Groundwater samples were retrieved from the newly installed monitoring wells using a USEPA-approved ‘Low-Flow’ purging and sampling methodology on 9th June 2020. The low-flow method relies on moving groundwater through the well screen at approximately the same rate as it flows through the geological formation. This results in a significant reduction in the volume of water extracted before sampling and significantly reduces the amount of disturbance of the water in the monitoring well during purging and sampling. Drawdown levels in the monitoring well and water quality indicator parameters (pH, temperature, electrical conductivity, redox potential and dissolved oxygen) are monitored during low-flow purging and sampling, with stabilisation indicating that purging is complete, and sampling can begin. As the flow rate used for purging is, in most cases, the same or only slightly higher than the flow rate used for sampling, and because purging and sampling are conducted as one continuous operation in the field, the process is referred to as Low-Flow Purging and Sampling. Low flow sampling forms can be provided upon request.

Samples were retrieved from MW102, MW103, MW104 and MW105. It should be noted that a sample was not retrieved from MW101 as it was found to be dry.

Samples were collected in containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation prior to transportation to ALS in Hawarden under chain of custody documentation.

4.6 Laboratory Testing

Seven selected soil samples were analysed for a suite of parameters which consisted of: total petroleum hydrocarbons (TPH) split into aliphatic and aromatic carbon bands; benzene, toluene, ethyl-benzene and xylene (BTEX), methyl tert-butyl ether (MTBE); total organic carbon (TOC); polycyclic aromatic hydrocarbons (PAH); volatile organic compounds (VOC); metals; and asbestos.

Groundwater samples collected during the groundwater monitoring event were analysed for a suite of parameters, which consisted of: TPH split into aliphatic and aromatic carbon bands; BTEX; MTBE and PAH.

5 RESULTS OF THE INVESTIGATION

5.1 Fieldwork

The following sections present the results of the intrusive investigation. Descriptions of the strata encountered, together with well design and groundwater conditions are given in borehole logs presented in Appendix B.

5.2 Encountered Ground Conditions

The site investigation identified Made Ground to a maximum depth of 1.0 mbgl in MW103. The made ground was found to be quite variable but generally comprised: concrete slab or tarmac on engineered gravel fill, overlying a slightly sandy, gravelly clay fill.

The made ground was generally underlain by till comprising stiff, gravelly clay with cobbles and boulders.

5.3 Ground Gas

The results have been assessed in accordance with the guidance provided in *CIRIA Report C665: Assessing risks posed by hazardous ground gases to buildings* (Wilson et al., 2007). In the assessment of risks posed by hazardous ground gases and selection of appropriate mitigation measures, CIRIA C665 identifies two types of development termed;

- Situation A (modified Wilson and Card method), appropriate to all development excluding traditional low-rise construction, and
- Situation B (National House-Building Council, NHBC) only appropriate to traditional low-rise construction with ventilated sub-floor voids.

Both methods are based on calculations of the limiting borehole gas volume flow for methane and carbon dioxide, renamed as the gas screening value (GSV). The GSV (litres of gas per hour) is calculated by multiplying borehole flow rate (litres per hour) and gas concentration (percent by volume).

In both situations, it is important to note that the GSV is a guideline value and not an absolute threshold. The GSV may be exceeded in certain circumstances, if the site conceptual model indicates it is safe to do so. Similarly, consideration of additional factors such as very high concentrations of carbon dioxide, should lead to consideration of the need to increase the Characteristic Situation.

The proposed development plan will comprise a residential building adjacent to an operational fuel station; the ground gas regime at the site will therefore be calculated using Situation A.

Situation A relates to all development types except low-rise housing and, by combining the qualitative assessment of risk with the gas monitoring results, provides a semi-quantitative estimate of risk for a site. The method is based on that proposed by Wilson and Card (1999), which was a development of a method proposed in CIRIA report 149 (Card, 1995). The method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flow for methane and carbon dioxide. Having calculated the worst case GSVs for methane and carbon dioxide, the Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

The GSV calculations are included in Table 5-1 below. The results of the gas monitoring are included as Appendix E.

Table 5-1: Summary of GSV Calculations

Date	Max. CH_4 (%)	Max. $C0_2$ (%)	Max Flow Rate (l/hr)	GSV CH_4	GSV $C0_2$
05/06/2020	0.1*	0.9	0.1*	0.0001	0.0009
09/06/2020	0.1*	0.9	0.1*	0.0001	0.0009
12/06/2020	0.1*	0.8	0.1	0.0001	0.0008
15/06/2020	0.1*	0.7	0.1*	0.0001	0.0007
Note: * no detection – limit of detection used					

As shown in Table 5-1 above, a maximum carbon dioxide concentration of 0.9% was recorded during the gas monitoring rounds. There was no detection of methane in any monitoring well over the four monitoring rounds. A maximum steady state flow of <0.1 l/hr was recorded during the monitoring rounds.

Following four rounds of gas monitoring, a maximum GSV of 0.0009 l/hr was recorded. this GSV would initially classify the site as Characteristic Situation 1 (CS1) - **VERY LOW RISK**.

This classification determines that special gas protection measures would not be required within the proposed buildings.

5.3 Groundwater Gauging

The results of the groundwater gauging exercise indicated the likely presence of a continuous groundwater table within the overburden soils encountered beneath the site.

Groundwater monitoring wells were surveyed to a site temporary datum to allow the estimation of groundwater flow. The water level in the continuous groundwater table ranged from 97.723 mSTD (MW102 on 09/06/2020) to 97.835 mSTD (MW105 on 09/06/2020). It has been estimated that the groundwater underlying the site is flowing in a south-westerly direction as shown in Figure 3. The groundwater levels for the groundwater monitoring wells are shown in Table 5-2 below.

Table 5-2: Groundwater gauging results

Location	Top of Casing (mSTD)	Depth to Product (mTOC)	Depth to Water (mTOC)	Water Table Elevation (mSTD)
MW101	100	-	DRY	-
MW102	99.816	-	2.093	97.723
MW103	99.798	-	2.073	97.725
MW104	99.699	-	1.926	97.773
MW105	99.710	-	1.875	97.835
DRY – No groundwater encountered in monitoring well during monitoring round				

5.4 Soil Analytical Results

A summary of the concentrations of contaminants reported by the laboratory analysis of selected soil samples are presented in Tables 5-3 to 5-5. The laboratory report is presented within Appendix C.

Table 5-3: TPH, BTEX and MTBE Soil Analytical Results (mg/kg)

Location	MW101	MW102	MW102	MW103	MW104	MW104	MW105	GAC Human Health – Residential (mg/kg) *
Depth (m)	2.0-3.0	1.0-2.0	4.0-6.0	1.0-2.0	1.0-2.0	3.0-3.6	2.0-3.0	
Aliphatics C5-C6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	42
Aliphatics C6-C8	<0.01	<0.01	0.024	<0.01	<0.01	0.013	0.013	100
Aliphatics C8-C10	<0.01	<0.01	<0.01	0.152	<0.01	<0.01	0.252	27
Aliphatics C10-C12	<1	<1	<1	<1	<1	<1	<1	130 *(48)*
Aliphatics C12-C16	<1	<1	<1	<1	<1	<1	<1	1,100 *(24)*
Aliphatics C16-C35	<1	<1	<1	<1	<1	<1	<1	65,000 *(8)*
Aliphatics C35-C44	<1	<1	<1	<1	<1	<1	<1	65,000 *(8)*
Aromatics C8-C10	<1	<1	<1	<1	<1	<1	<1	47
Aromatics C10-C12	<1	<1	<1	<1	<1	<1	<1	300
Aromatics C12-C16	<1	<1	<1	<1	<1	<1	<1	1,800 *(169)*
Aromatics C16-C21	<1	<1	<1	<1	<1	<1	<1	1,900
Aromatics C21-C35	<1	<1	<1	2.88	<1	<1	<1	1,900
Aromatics C35-C44	<1	<1	<1	<1	<1	<1	<1	1,900
Benzene	<0.18	<0.18	<0.18	<0.18	<1.8	<0.18	<0.18	0.9
Toluene	<0.14	<0.14	<0.14	<0.14	<1.4	<0.14	<0.14	900 *(869)*
Ethylbenzene	<0.08	<0.08	<0.08	<0.08	<0.8	<0.08	<0.08	80
Xylene	<0.4	<0.4	<0.4	<0.4	<4.0	<0.4	<0.4	80
MTBE	<0.2	<0.2	<0.2	<0.2	<2.0	<0.2	<0.2	100

- Results in bold indicate an exceedance

* GAC for soil with soil organic matter (SOM) content of 1% used. GAC is for residential without home grown produce.

Figures in brackets – RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the GAC with the corresponding solubility or vapour saturation limits given in brackets.

Table 5-4: PAH Soil Analytical Results (mg/kg)

Location	MW101	MW102	MW102	MW103	MW104	MW104	MW105	GAC Human Health – Residential (mg/kg) *
Depth (m)	2.0-3.0	1.0-2.0	4.0-6.0	1.0-2.0	1.0-2.0	3.0-3.6	2.0-3.0	
Naphthalene	<0.009	<0.009	<0.009	<0.009	<0.009	0.014	0.015	23
Acenaphthylene	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	6,600 (86)
Acenaphthene	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	6,600 (57)
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2,800 (31)
Phenanthrene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	1,300 (36)
Anthracene	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	31,000 (1.17)
Fluoranthene	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	2,800 (31)
Pyrene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	3,700
Benzo(a)anthracene	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	11.0
Chrysene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	30
Benzo(b)fluoranthene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	4.0
Benzo(k)fluoranthene	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	106
Benzo(a)pyrene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	5.3
Indeno(123cd)pyrene	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	45
Dibenzo(ah)anthracen	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	0.31
Benzo(ghi)perylene	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	355

- Results in bold indicate an exceedance

* GAC for soil with soil organic matter (SOM) content of 1% used. GAC is for residential without home grown produce.

Figures in brackets – RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the GAC with the corresponding solubility or vapour saturation limits given in brackets.

Table 5-5: Metals Soil Analytical Results (mg/kg)

Location	MW101	MW102	MW102	MW103	MW104	MW104	MW105	GAC Human Health – Residential (mg/kg) *
Depth (m)	2.0-3.0	1.0-2.0	4.0-6.0	1.0-2.0	1.0-2.0	3.0-3.6	2.0-3.0	
Arsenic	9.72	8.01	9.33	8.68	8	9.56	6.48	40
Cadmium	1.23	1.05	1.2	1.18	1.07	1.03	0.799	149
Chromium	11.2	9.64	11.5	6.3	6.34	9.64	9.25	21
Copper	15.4	12.9	15	13.8	12.9	13.1	9.57	7,100
Lead	25.7	16.7	20.9	16.1	15.7	17.1	11.9	310
Mercury	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	56
Nickel	29.3	23.8	27.6	23.5	22.5	22.7	17.3	180
Selenium	1.16	<1	1.39	1.27	1.2	1.06	1.25	430
Zinc	88.7	74.9	86.5	67.3	66	66.4	51.7	40,000

- Results in bold indicate an exceedance

* GAC for soil with soil organic matter (SOM) content of 1% used. GAC is for residential without home grown produce.

Figures in brackets – RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the GAC with the corresponding solubility or vapour saturation limits given in brackets.

5.5 Groundwater Analytical Results

The results of the laboratory analysis of the six groundwater samples taken during the groundwater monitoring round are presented in Tables 5-6 and 5-7. The groundwater human health GrACs for a sandy loam and groundwater depth of 0.65 m are used to screen the results. The GrACs for a groundwater depth of 0.65 m has been conservatively used to account for the possibility that the groundwater elevation may fluctuate seasonally. The results of the groundwater laboratory analysis are included in Appendix D.

Table 5-6: TPH, BTEX and MTBE Groundwater Analytical Results and GrACs (mg/l)

Location	MW102	MW103	MW104	MW105	GAC Human Health – Residential (mg/L)	GAC – Protection of Water Environment (mg/L)
Ali C5-C6	<0.01	<0.01	<0.01	<0.01	26.56	***
Ali C6-C8	<0.01	<0.01	<0.01	<0.01	5.37[#]	***
Ali C8-C10	<0.01	<0.01	<0.01	<0.01	0.427[#]	***
Ali C10-C12	<0.01	<0.01	<0.01	<0.01	0.0339[#]	***
Ali C12-C16	<0.01	<0.01	<0.01	<0.01	0.0008[#**]	***
Ali C16-C21	<0.01	<0.01	<0.01	<0.01	*	***
Ali C21-C35	<0.01	<0.01	<0.01	<0.01	*	***
Aro C8-C10	<0.01	<0.01	<0.01	<0.01	25.73[#]	***
Aro C10-C12	<0.01	<0.01	<0.01	<0.01	245[#]	***
Aro C12-C16	<0.01	<0.01	<0.01	<0.01	5.75[#]	***
Aro C16-C21	<0.01	<0.01	<0.01	<0.01	*	***
Aro C21-C35	<0.01	<0.01	<0.01	<0.01	*	***
Total TPH	<0.01	<0.01	<0.01	<0.01	*	0.0075[(1)**]
Benzene	<0.007	<0.007	<0.007	<0.007	2.9	0.00075[(1)**]
Toluene	<0.004	<0.004	<0.004	<0.004	590[#]	0.0525[(1)**]
Ethylbenzene	<0.005	<0.005	<0.005	<0.005	156.38	0.01[(2)]
Total Xylene	<0.011	<0.011	<0.011	<0.011	144.25	0.01[(2)]
MTBE	<0.003	0.004	0.098	0.118	945.7	0.01[(2)]

Where values are in **bold** they have exceeded the GAC for Human Health

Where values are underlined the have exceeded the GAC for Environmental Waters

(1) S.I. 366 European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016

(2) EPA Interim Report Towards Setting Guideline values for the Protection of Groundwater in Ireland 2003

GrAC is set at the limit of solubility as calculated GrAC exceeds the solubility limit for the pure compound in water.

* GAC not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data

** GAC is set below the LMDL. Where the analysis indicates concentrations below the LMDL a non-exceedance of the criteria will be inferred.

*** No GAC available in legislation or guidance.

Table 5-7: PAH Groundwater Analytical Results and GrACs (µg/l)

Location	MW102	MW103	MW104	MW105	GAC Human Health – Residential (µg/L)	GAC – Protection of Water Environment ((µ (µg/L)
Naphthalene	<0.01	<0.01	<0.01	<0.01	19,000#	1.0(2)
Acenaphthylene	<0.005	<0.005	<0.005	<0.005	7,950#	***
Acenaphthene	<0.005	<0.005	<0.005	<0.005	4,100#	***
Fluorene	<0.005	<0.005	<0.005	<0.005	*	***
Phenanthrene	<0.005	<0.005	<0.005	<0.005	*	***
Anthracene	<0.005	<0.005	<0.005	<0.005	*	10,000(2)
Fluoranthene	<0.005	<0.005	<0.005	0.00506	*	1.0(2)
Pyrene	0.0091	0.00711	0.00577	0.00735	*	***
Benzo(a)anthracene	<0.005	<0.005	<0.005	<0.005	*	***
Chrysene	<0.005	<0.005	<0.005	<0.005	*	***
Benzo(b)fluoranthene	<0.005	<0.005	<0.005	<0.005	*	0.5(2)
Benzo(k)fluoranthene	<0.005	<0.005	<0.005	<0.005	*	0.05(2)
Benzo(a)pyrene	<0.002	<0.002	<0.002	<0.002	*	0.0075(1) **
Indeno(123cd)pyrene	<0.005	<0.005	<0.005	<0.005	*	0.05(2)
Dibenzo(ah)anthracene	<0.005	<0.005	<0.005	<0.005	*	***
Benzo(ghi)perylene	<0.005	<0.005	<0.005	<0.005	*	0.05(2)
Total PAH	<0.082	<0.082	<0.082	<0.082	n/a	0.075(1) **

Where values are in **bold** they have exceeded the GAC for Human Health

Where values are <u>underlined</u> the have exceeded the GAC for Environmental Waters

(1) S.I. 366 European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016

(2) EPA Interim Report Towards Setting Guideline values for the Protection of Groundwater in Ireland 2003

GrAC is set at the limit of solubility as calculated GrAC exceeds the solubility limit for the pure compound in water.

* GAC not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data

** GAC is set below the LMDL. Where the analysis indicates concentrations below the LMDL a non-exceedance of the criteria will be inferred.

*** No GAC available in legislation or guidance.

6 GENERIC QUANTIATIVE RISK ASSESSMENT

6.1 Human Health

6.1.1 Soil

The soil results have been conservatively compared to GACs derived by RSK for a residential use without homegrown produce. The GACs are protective of human health in a residential use without homegrown produce, reflective of the proposed development adjacent to the fuel station. The most conservative screening criteria with the assumed Soil Organic Matter (SOM) of 1% have been applied to the site. The screening values for human health and their derivation are included in Appendix F.

The laboratory analysis of selected soil samples collected by RSK reported that there are no concentrations of contaminants that exceed the adopted GAC for human health.

6.1.2 Groundwater

The groundwater results have been compared to GrACs derived by RSK for a residential use. The screening values for human health and their derivation are included in Appendix G. The GrACs for sandy loam and a groundwater depth of 0.65m were used. The shallow groundwater depth is conservatively assumed to allow for seasonal fluctuations in the groundwater level.

The laboratory analysis of groundwater samples collected by RSK reported that there are no concentrations of contaminants that exceed the adopted GAC for human health.

6.2 Water Environment

6.2.1 Groundwater

Where available Irish Environmental Quality Standard (EQS) values have been used which have been obtained from Statutory Instrument No. 366 '*European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016'*. These values have been supplemented by the Irish interim values presented in the EPA report '*Interim Report Towards Setting Guideline Values for the Protection of Groundwater in Ireland'* dated 2003.

Concentrations were reported in monitoring wells at levels which exceeded the GACs for the protection of the water environment as follows;

- **MTBE;**
  - MW104 and MW105

All other results were reported at concentrations which did not exceed the GACs for the protection of the water environment.

6.3 Summary of Pollutant Linkages

Table 6-1 records the potential pollutant linkages that have been identified at the site. Justifications for the identification of a potential pollutant linkage together with the likelihood are also discussed in Table 6-1.

Please note that construction and maintenance workers have not been identified in the conceptual model as receptors because risks are considered to be managed through health and safety procedures as required in the Safety, Health and Welfare at Work (Construction) Regulations 2013.

Table 6-1: Summary of Pollutant Linkages

Source	Pathway	Receptor	Linkage?
Metals, PAH, BTEX, MTBE and TPH in soil	Direct Contact	Future Site Workers and Users	**Incomplete.** The GACs protective of human health have not been exceeded. The majority of the site is covered in hard standing.
		Off-site workers and residents	**Incomplete.** The GACs protective of human health have not been exceeded. The majority of the site is covered in hard standing.
	Leaching	Groundwater	**Incomplete**. Site covered in hardstanding and therefore no viable pathway exists. No significant contaminant concentrations have been identified in soils during the investigation. Additionally, no significant contaminant concentrations have been identified in the groundwater during the investigation indicating there are no COCs leaching from the soils.
	Vapour migration along fill, services and permeable strata	Future site users	**Incomplete.** The GACs protective of human health have not been exceeded, additionally the majority of the site is covered hard standing.
		Off-site workers and residents	
Metals, PAH, BTEX, MTBE and TPH in groundwater	Direct contact and ingestion	Site workers	**Incomplete.** The GACs protective of human health have not been exceeded, additionally the majority of the site is covered hard standing.
		Site users	
		Off-site residents	
	Migration	Locally important aquifer/abstraction well 500 m to the south	**Incomplete**. MTBE results have exceeded the GAC's for environmental waters in MW104 and MW105. However, it is considered unlikely that contaminant concentrations encountered in shallow groundwater will adversely impact groundwater in the locally important aquifer beneath the site. Quaternary deposits underlying the site, described as till which were encountered during the investigation, will act as a barrier and retard downward migration of contaminants. It is considered that there are no significant risks to the abstraction well as the GACs for environmental waters were not exceeded in MW102 and MW103 which are hydraulically downgradient of MW104 and MW105. This indicates that groundwater flowing off-site is not exceeding the GACs. Additionally, contaminant concentrations in shallow groundwater are unlikely to impact the underlying locally important aquifer as mentioned above, therefore RSK considers it unlikely that there is a viable pathway to the receptor.
		Tymon River 700m to the south east/ River Poddle 1 km to the south.	**Incomplete.** MTBE results have exceeded the GAC's for environmental waters in MW104 and MW105 for environmental waters. Given the distance to the receptors, it is considered unlikely that contaminant concentrations encountered in shallow groundwater on-site will adversely impact either the Tymon or the Poddle given the processes of dispersion and degradation that will occur between site and the receptors.
	Vapour migration along fill, services and permeable strata	Future site workers and users	**Incomplete.** The GACs protective of human health have not been exceeded. No significant contamination encountered during site investigation.
		Off-site workers and residents	**Incomplete. T**he GACs protective of human health have not been exceeded. No significant contamination encountered during site investigation.

Based upon the above information no potentially complete pollution linkages have been identified at the site.

8 CONCLUSIONS

Following the completion of the environmental site assessment works and receipt of laboratory analytical results, a GQRA was completed to assess risks to human health at the site with regards to a residential use without homegrown produce.

The laboratory analysis of selected soil samples reported that there are no concentrations of contaminants that exceeds the adopted GAC for human health.

The laboratory analysis of groundwater samples reported that there are no concentrations of contaminants that exceeds the adopted GrAC for human health.

As noted in section 6.2.1, the groundwater GACs for the protection of environmental waters were exceeded in MW104 and MW105 indicating the presence of potentially complete pollutant linkages to surface waters and the underlying locally important aquifer. Given the distance to the surface water receptors, it is considered unlikely that contaminant concentrations encountered in shallow groundwater on-site will adversely impact the Tymon River approximately 700 m to the southeast or the River Poddle river approximately 1 km to the south. This is due to lack of direct hydraulic connectivity and the processes of dispersion and contaminant degradation which will occur between the site and the receptor.

It is also considered unlikely that contaminant concentrations encountered in shallow groundwater will adversely impact groundwater in the locally important aquifer beneath the site. Quaternary deposits underlying the site, till comprising stiff clays, which was encountered during the investigation, will act as a barrier and retard downward migration of dissolved phase contaminants.

Following four rounds of gas monitoring, a maximum GSV of 0.0009 l/hr was recorded. this GSV would initially classify the site as Characteristic Situation 1 (CS1) - **VERY LOW RISK**.
This classification determines that special gas protection measures would not be required within the proposed buildings.

Taking into account the results of the laboratory analysis of soil and groundwater samples retrieved during the recent GQRA works, Belgard Circle K, Belgard Road, Tallaght, County Dublin is not considered to pose a significant risk to human health or to the water environment.

FIGURES

Prepared For: Absolute Limousines Ltd and Boherkill Property Development Ltd

Project: Cookstown Industrial Estate

Drawing Title: Figure 1 Site Location

Source: Google
Date: August 2020

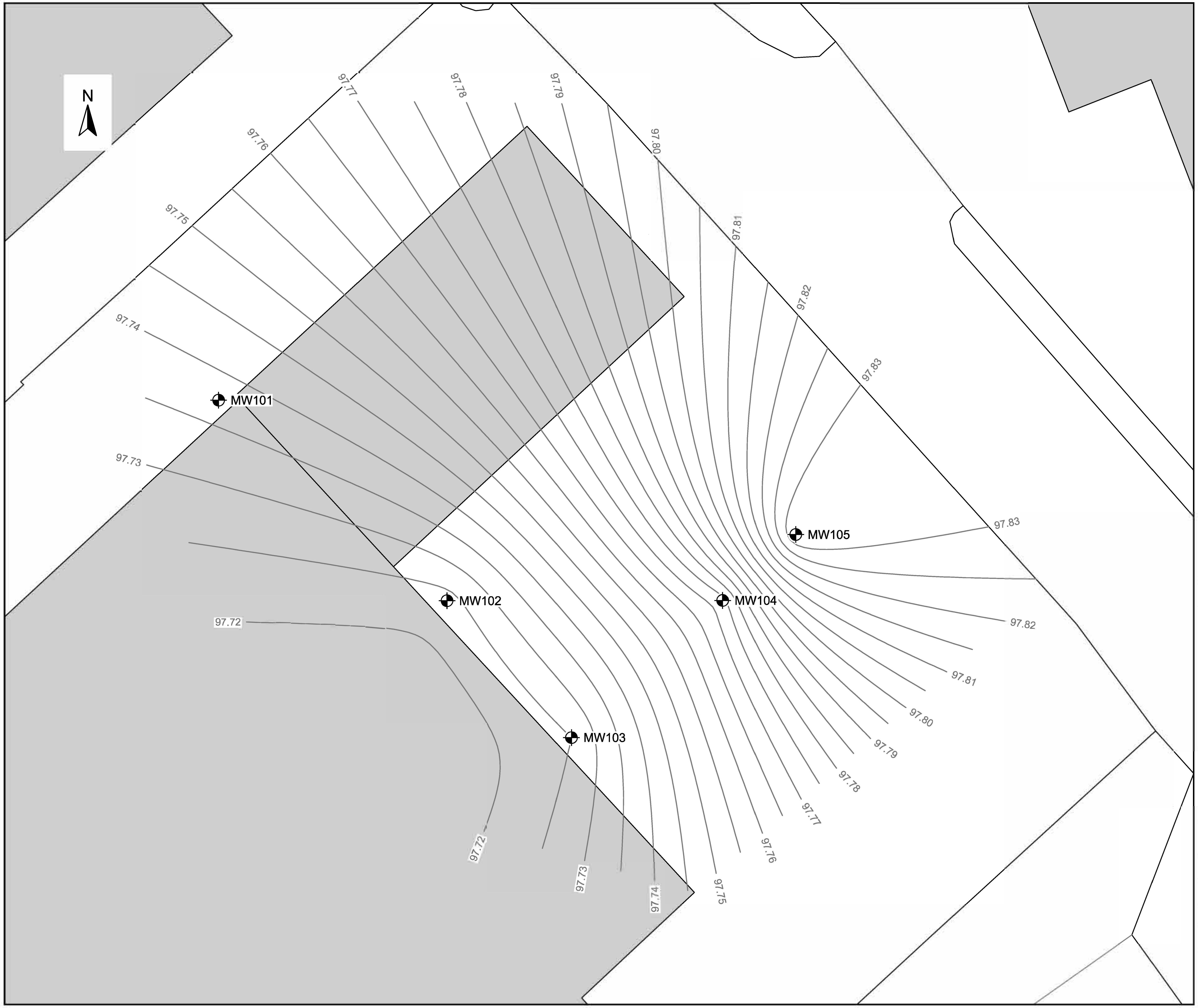
Prepared For: Absolute Limousines Ltd and Boherkill Property Development Ltd

Project: Cookstown Industrial Estate

Drawing Title: Figure 2 Monitoring Well Location Plan

RSK

Source: Google
Date: March 2020



LEGEND

Monitoring Well Location

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
00	07.07.20	-	MW	BC	-

RSK

The Old School,
Stillhouse Lane,
Bedminster,
Bristol,
BS3 4EB

Tel: +44 (0)117 947 1006
Email: info@rsk.co.uk
Web: www.rsk.co.uk

Client: Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd

Project Title: Cookstown Ind Estate

Drawing Title: Piezometric Plan

Drawn	Date	Checked	Date	Approved	Date
MW	07.07.20	BC	07.07.20	-	-

Dimensions	Scale	Original Size
m	1:250	A3

Project Number: 602923
Drawing Number: Figure 2
Drawing File: 602923 - Fig 2 - rev 00 - PP
Rev: 00

0 2 4 6 8 10m

APPENDIX A

Service Constraints

RSK IRELAND LIMITED
SERVICE CONSTRAINTS

1. This report and the Environmental Site Assessment carried out in connection with the report (together the "Services") were compiled and carried out by RSK Ireland Ltd (RSK) for Absolute Limousines Ltd and Boherkill Property Development Ltd (the "client") in accordance with the terms of a contract between RSK and the "client" dated November 2019. The Services were per formed by RSK with the skill and care ordinarily exercised by a reasonable Environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed in writing the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information], and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

APPENDIX B

Borehole Logs

WINDOW SAMPLE LOG

Contract: Cookstown Industrial Estate SI		Client: Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd		Window Sample: BH101
Contract Ref: 602923	Start: 25.05.20 End: 25.05.20	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Window Run	Depth	No	Type	Results	Water	Description of Strata	Depth (Thickness)
	0.00-1.00	1	D			MADE GROUND: Tarmacadam.	0.15
						MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.35
						Brown very sandy gravelly CLAY. Gravel is angular.	(0.65) 1.00
	1.00-2.00	2	D			Brown hard to stiff slightly sandy gravelly CLAY with occasional boulder fragments and cobbles. Gravel is small to medium and angular. Sand is fine.	(2.00) 3.00
	2.00-3.00	3	D				
	3.00-3.40	4	D			Brown hard to stiff gravelly CLAY with assumed black boulder and fragments of grey granite. Gravel is small to medium and angular.	(0.40) 3.40
						Borehole refused on boulder at 3.40m depth.	

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 3.40m depth on completion. Response zone 2.50m to 3.40m depth.

All dimensions in metres | Scale: 1:25

Method Used: Tracked window sampling | Plant Used: Dando Terrier | Drilled By: Groundcheck | Logged By: RMurphy | Checked By:

WINDOW SAMPLE LOG

Contract: Cookstown Industrial Estate SI	Client: Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd	Window Sample: BH102
Contract Ref: 602923	Start: 25.05.20 End: 25.05.20	Ground Level: ---
Co-ordinates: ---		Sheet: 1 of 2

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
							MADE GROUND: Black tarmacadam.	0.10	
							MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.30	
							MADE GROUND: Brown very sandy gravelly CLAY. Gravel is small to medium and subangular to angular. Clay is soft with fragments of hardcore gravel.	(0.60) 0.90	
							Light brown slightly sandy gravelly CLAY. Gravel is small to medium and subangular to angular.	(1.10) 2.00	
							Hard/stiff light brown slightly sandy gravelly CLAY. Gravel is small to medium and subangular to angular with black boulders (assumed boulder clay).	(2.60)	

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 4.60m depth on completion. Response zone 2.50m to 4.60m depth.

All dimensions in metres | Scale: 1:25

Method Used: Tracked window sampling	Plant Used: Dando Terrier	Drilled By: Groundcheck	Logged By: RMurphy	Checked By:

WINDOW SAMPLE LOG

Contract: Cookstown Industrial Estate SI	Client: Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd	Window Sample: BH102
Contract Ref: 602923	Start: 25.05.20 End: 25.05.20	Ground Level: ---	Co-ordinates: ---	Sheet: 2 of 2

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
								4.60	
							Borehole refused on boulder at 4.60m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

All dimensions in metres | Scale: 1:25

Method Used: Tracked window sampling	Plant Used: Dando Terrier	Drilled By: Groundcheck	Logged By: RMurphy	Checked By:

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Cookstown Industrial Estate SI	**Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd**	**BH103**

Contract Ref:	Start / End	Ground Level:	Co-ordinates:	Sheet:
602923	Start: **25.05.20** End: **25.05.20**	**---**	**---**	**1** of **1**

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
							MADE GROUND: Black tarmac.	0.10	
							MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.30	
							MADE GROUND: Brownish black sandy CLAY with medium to large boulders. Sand is fine.	0.50	
							MADE GROUND: Brown slightly sandy gravelly CLAY. Gravel is small to medium and subangular to angular with small to medium cobbles.	(0.50) 1.00	
							Light brown very sandy gravelly CLAY. Gravel is small to medium and subangular to angular with cobbles.	(1.00) 2.00	
							Light brown sandy gravelly CLAY. Sand is fine. Gravel is small to medium and subangular with black boulders (assumed boulder clay).	(1.80) 3.80	
							Borehole refused on boulder at 3.80m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 3.80m depth on completion. Response zone 2.50m to 3.80m depth.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Dando Terrier**	**Groundcheck**	**RMurphy**	

AGS

WINDOW SAMPLE LOG

Contract: Cookstown Industrial Estate SI	Client: Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd	Window Sample: BH104
Contract Ref: 602923	Start: 25.05.20 End: 25.05.20	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
							MADE GROUND: Black tarmac.	0.10	
							MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.30	
							Light brown soft very sandy gravelly CLAY. Gravel is small to medium. Sand is fine.	(0.60) 0.90	
							Hard/stiff light brown very sandy gravelly soft CLAY with boulders (assumed boulder clay). Gravel is small to medium. Sand is fine.	(2.70) 3.60	
							Borehole refused on boulder at 3.60m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 3.60m depth on completion. Response zone 2.50m to 3.60m depth.

All dimensions in metres | Scale: 1:25

Method Used: Tracked window sampling	Plant Used: Dando Terrier	Drilled By: Groundcheck	Logged By: RMurphy	Checked By:

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Cookstown Industrial Estate SI	Absolute Limousines Ltd and Boherkill Prop. Dev. Ltd	BH105

Contract Ref:	Start: 26.05.20	Ground Level:	Co-ordinates:	Sheet:
602923	End: 26.05.20	---	---	1 of 1

Progress: Window Run	Samples / Tests: Depth	No	Type	Results	Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
							MADE GROUND: Black tarmac.	0.16	
							MADE GROUND: Gravel fill. Gravel is small to medium and angular.	0.30	
							Brown very sandy gravelly CLAY. Gravel is small to medium and subangular with boulders/cobbles. . . . from 0.90m depth contains boulders (assumed boulder clay). . . . slightly damp between 3.00m and 4.00m depth.	(4.00) 4.30	
							Borehole refused on boulder at 4.30m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Inspection pit hand dug to 1.00m depth.
2. No groundwater encountered.
3. No visual or olfactory evidence of contamination.
4. 50mm diameter gas/groundwater monitoring well complete with flush protective cover installed to 4.30m depth on completion. Response zone 2.50m to 4.30m depth.

All dimensions in metres | Scale: 1:25

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	Dando Terrier	Groundcheck	RMurphy	

AGS

APPENDIX C

Soil Laboratory Certificates of Analysis

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

RSK Group Plc
Unit B
Bluebell Business Centre
Old Naas Road
Dublin
Dublin 12

Attention: Paul Feely

CERTIFICATE OF ANALYSIS

Date of report Generation:	23 June 2020
Customer:	RSK Group Plc
Sample Delivery Group (SDG):	200528-125
Your Reference:	602923
Location:	Cookstown Industrial Estate
Report No:	556226

We received 22 samples on Thursday May 28, 2020 and 7 of these samples were scheduled for analysis which was completed on Tuesday June 23, 2020. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan
Operations Manager

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
22217042	BH101		0.00 - 1.00	25/05/2020
22217043	BH101		1.00 - 2.00	25/05/2020
22217044	BH101		2.00 - 3.00	25/05/2020
22217045	BH101		3.00 - 3.40	25/05/2020
22217046	BH102		0.00 - 1.00	25/05/2020
22217048	BH102		1.00 - 2.00	25/05/2020
22217050	BH102		2.00 - 3.00	25/05/2020
22217052	BH102		3.00 - 4.00	25/05/2020
22217053	BH102		4.00 - 4.60	25/05/2020
22217055	BH103		0.00 - 1.00	25/05/2020
22217056	BH103		1.00 - 2.00	25/05/2020
22217057	BH103		2.00 - 3.00	25/05/2020
22217058	BH103		3.00 - 3.80	25/05/2020
22217059	BH104		0.00 - 1.00	26/05/2020
22217060	BH104		1.00 - 2.00	26/05/2020
22217061	BH104		2.00 - 3.00	26/05/2020
22217062	BH104		3.00 - 3.60	26/05/2020
22217063	BH105		0.00 - 1.00	26/05/2020
22217064	BH105		1.00 - 2.00	26/05/2020
22217065	BH105		2.00 - 3.00	26/05/2020
22217068	BH105		3.00 - 4.00	26/05/2020
22217069	BH105		4.00 - 4.30	26/05/2020

Maximum Sample/Coolbox Temperature (°C) : **14.2**

ISO5667-3 Water quality - Sampling - Part3 -
During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

Validated

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Results Legend

- X Test
- N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			22217044			22217048			22217053			22217056			22217060			22217062			22217065	
Customer Sample Reference			BH101			BH102			BH102			BH103			BH104			BH104			BH105	
AGS Reference																						
Depth (m)			2.00 - 3.00			1.00 - 2.00			4.00 - 4.60			1.00 - 2.00			1.00 - 2.00			3.00 - 3.60			2.00 - 3.00	
Container			1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)	60g VOC (ALE215)	1kg TUB	250g Amber Jar (ALE210)
Sample Type			S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Asbestos ID in Solid Samples	All	NDPs: 0 Tests: 7	X			X			X			X			X			X			X	
EPH CWG GC (S)	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
GRO by GC-FID (S)	All	NDPs: 0 Tests: 7			X			X			X			X			X			X		
Metals in solid samples by OES	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
PAH by GCMS	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
pH	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
Sample description	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
Total Organic Carbon	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
TPH CWG GC (S)	All	NDPs: 0 Tests: 7		X			X			X			X			X			X			X
VOC MS (S)	All	NDPs: 0 Tests: 7			X			X			X			X			X			X		

22217065	BH105		2.00 - 3.00	60g VOC (ALE215)	S						X														X

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Inclusions	Inclusions 2
22217044	BH101	2.00 - 3.00	Dark Brown	Sandy Loam	Stones	Vegetation
22217048	BH102	1.00 - 2.00	Dark Brown	Clay Loam	Stones	None
22217053	BH102	4.00 - 4.60	Dark Brown	Clay Loam	Stones	None
22217056	BH103	1.00 - 2.00	Dark Brown	Clay Loam	Stones	None
22217060	BH104	1.00 - 2.00	Dark Brown	Sandy Loam	Stones	Vegetation
22217062	BH104	3.00 - 3.60	Dark Brown	Loamy Sand	Stones	Vegetation
22217065	BH105	2.00 - 3.00	Dark Brown	Sand	Stones	None

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Validated

CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	BH101	BH102	BH102	BH103	BH104	BH104
		Customer Sample Ref.	BH101	BH102	BH102	BH103	BH104	BH104
		Depth (m)	2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60
		Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
		Date Sampled	25/05/2020	25/05/2020	25/05/2020	25/05/2020	26/05/2020	26/05/2020
		Sampled Time	.	.	.	.	.	.
		Date Received	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
		SDG Ref	200528-125	200528-125	200528-125	200528-125	200528-125	200528-125
		Lab Sample No.(s)	22217044	22217048	22217053	22217056	22217060	22217062
		AGS Reference						
Moisture Content Ratio (% of as received sample)	%	PM024	8	7.7	7.7	9.6	10	8.6
Organic Carbon, Total	<0.2 %	TM132	<0.2 M	<0.2 M	<0.2 M	0.216 M	<0.2 M	<0.2 M
pH	1 pH Units	TM133	8.75 M	8.83 M	8.83 M	8.93 M	8.74 M	9.41 M
Arsenic	<0.6 mg/kg	TM181	9.72 M	8.01 M	9.33 M	8.68 M	8 M	9.56 M
Cadmium	<0.02 mg/kg	TM181	1.23 M	1.05 M	1.2 M	1.18 M	1.07 M	1.03 M
Chromium	<0.9 mg/kg	TM181	11.2 M	9.64 M	11.5 M	6.3 M	6.34 M	9.64 M
Copper	<1.4 mg/kg	TM181	15.4 M	12.9 M	15 M	13.8 M	12.9 M	13.1 M
Lead	<0.7 mg/kg	TM181	25.7 M	16.7 M	20.9 M	16.1 M	15.7 M	17.1 M
Mercury	<0.14 mg/kg	TM181	<0.14 M	<0.14 M	<0.14 M	<0.14 M	<0.14 M	<0.14 M
Nickel	<0.2 mg/kg	TM181	29.3 M	23.8 M	27.6 M	23.5 M	22.5 M	22.7 M
Selenium	<1 mg/kg	TM181	1.16 #	<1 #	1.39 #	1.27 #	1.2 #	1.06 #
Zinc	<1.9 mg/kg	TM181	88.7 M	74.9 M	86.5 M	67.3 M	66 M	66.4 M

CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Results Legend	
#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Customer Sample Ref.	BH105	
Depth (m)	2.00 - 3.00	
Sample Type	Soil/Solid (S)	
Date Sampled	26/05/2020	
Sampled Time	.	
Date Received	28/05/2020	
SDG Ref	200528-125	
Lab Sample No.(s)	22217065	
AGS Reference		

Component	LOD/Units	Method	BH105						
Moisture Content Ratio (% of as received sample)	%	PM024	6						
Organic Carbon, Total	<0.2 %	TM132	<0.2 M						
pH	1 pH Units	TM133	10.6 M						
Arsenic	<0.6 mg/kg	TM181	6.48 M						
Cadmium	<0.02 mg/kg	TM181	0.799 M						
Chromium	<0.9 mg/kg	TM181	9.25 M						
Copper	<1.4 mg/kg	TM181	9.57 M						
Lead	<0.7 mg/kg	TM181	11.9 M						
Mercury	<0.14 mg/kg	TM181	<0.14 M						
Nickel	<0.2 mg/kg	TM181	17.3 M						
Selenium	<1 mg/kg	TM181	1.25 #						
Zinc	<1.9 mg/kg	TM181	51.7 M						

Validated

CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

PAH by GCMS

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3♦§@	Sample deviation (see appendix)

Component	LOD/Units	Method	BH101	BH102	BH102	BH103	BH104	BH104
Customer Sample Ref.			BH101	BH102	BH102	BH103	BH104	BH104
Depth (m)			2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60
Sample Type			Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Date Sampled			25/05/2020	25/05/2020	25/05/2020	25/05/2020	26/05/2020	26/05/2020
Sampled Time			.	.	.	.	.	.
Date Received			28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
SDG Ref			200528-125	200528-125	200528-125	200528-125	200528-125	200528-125
Lab Sample No.(s)			22217044	22217048	22217053	22217056	22217060	22217062
AGS Reference								
Naphthalene-d8 % recovery**	%	TM218	89	89.2	93	88.5	88.7	88
Acenaphthene-d10 % recovery**	%	TM218	90.6	88.6	88.4	88.3	87.8	89.6
Phenanthrene-d10 % recovery**	%	TM218	90.7	88.6	82.8	89	88.2	91.2
Chrysene-d12 % recovery**	%	TM218	88.8	84.6	71	90.2	89.4	93.7
Perylene-d12 % recovery**	%	TM218	85.9	80.6	70.3	87.9	88	89.6
Naphthalene	<9 µg/kg	TM218	<9 M	<9 M	<9 M	<9 M	<9 M	14 M
Acenaphthylene	<12 µg/kg	TM218	<12 M	<12 M	<12 M	<12 M	<12 M	<12 M
Acenaphthene	<8 µg/kg	TM218	<8 M	<8 M	<8 M	<8 M	<8 M	<8 M
Fluorene	<10 µg/kg	TM218	<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Phenanthrene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Anthracene	<16 µg/kg	TM218	<16 M	<16 M	<16 M	<16 M	<16 M	<16 M
Fluoranthene	<17 µg/kg	TM218	<17 M	<17 M	<17 M	<17 M	<17 M	<17 M
Pyrene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Benz(a)anthracene	<14 µg/kg	TM218	<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
Chrysene	<10 µg/kg	TM218	<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Benzo(b)fluoranthene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Benzo(k)fluoranthene	<14 µg/kg	TM218	<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
Benzo(a)pyrene	<15 µg/kg	TM218	<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218	<18 M	<18 M	<18 M	<18 M	<18 M	<18 M
Dibenzo(a,h)anthracene	<23 µg/kg	TM218	<23 M	<23 M	<23 M	<23 M	<23 M	<23 M
Benzo(g,h,i)perylene	<24 µg/kg	TM218	<24 M	<24 M	<24 M	<24 M	<24 M	<24 M
PAH, Total Detected USEPA 16	<118 µg/kg	TM218	<118	<118	<118	<118	<118	<118

CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

PAH by GCMS

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	BH105					
		Customer Sample Ref.	BH105					
		Depth (m)	2.00 - 3.00					
		Sample Type	Soil/Solid (S)					
		Date Sampled	26/05/2020					
		Sampled Time	.					
		Date Received	28/05/2020					
		SDG Ref	200528-125					
		Lab Sample No.(s)	22217065					
		AGS Reference						
Naphthalene-d8 % recovery**	%	TM218	88.6					
Acenaphthene-d10 % recovery**	%	TM218	90.7					
Phenanthrene-d10 % recovery**	%	TM218	91.3					
Chrysene-d12 % recovery**	%	TM218	85.4					
Perylene-d12 % recovery**	%	TM218	80.7					
Naphthalene	<9 µg/kg	TM218	15 M					
Acenaphthylene	<12 µg/kg	TM218	<12 M					
Acenaphthene	<8 µg/kg	TM218	<8 M					
Fluorene	<10 µg/kg	TM218	<10 M					
Phenanthrene	<15 µg/kg	TM218	<15 M					
Anthracene	<16 µg/kg	TM218	<16 M					
Fluoranthene	<17 µg/kg	TM218	<17 M					
Pyrene	<15 µg/kg	TM218	<15 M					
Benz(a)anthracene	<14 µg/kg	TM218	<14 M					
Chrysene	<10 µg/kg	TM218	<10 M					
Benzo(b)fluoranthene	<15 µg/kg	TM218	<15 M					
Benzo(k)fluoranthene	<14 µg/kg	TM218	<14 M					
Benzo(a)pyrene	<15 µg/kg	TM218	<15 M					
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218	<18 M					
Dibenzo(a,h)anthracene	<23 µg/kg	TM218	<23 M					
Benzo(g,h,i)perylene	<24 µg/kg	TM218	<24 M					
PAH, Total Detected USEPA 16	<118 µg/kg	TM218	<118					

TPH CWG (S)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	BH101	BH102	BH102	BH103	BH104	BH104
Customer Sample Ref.			BH101	BH102	BH102	BH103	BH104	BH104
Depth (m)			2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60
Sample Type			Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Date Sampled			25/05/2020	25/05/2020	25/05/2020	25/05/2020	26/05/2020	26/05/2020
Sampled Time			.	.	.	.	.	.
Date Received			28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
SDG Ref			200528-125	200528-125	200528-125	200528-125	200528-125	200528-125
Lab Sample No.(s)			22217044	22217048	22217053	22217056	22217060	22217062
AGS Reference								
GRO Surrogate % recovery**	%	TM089	94.4	98.5	102	127	96.6	94.3
Aliphatics >C5-C6	<10 µg/kg	TM089	<10	<10	<10	<10	<10	<10
Aliphatics >C6-C8	<10 µg/kg	TM089	<10	<10	23.8	<10	<10	13.1
Aliphatics >C8-C10	<10 µg/kg	TM089	<10	<10	186	<10	<10	25.2
Aliphatics >C10-C12	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aliphatics >C12-C16	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aliphatics >C16-C21	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aliphatics >C21-C35	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aliphatics >C35-C44	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Total Aliphatics >C10-C44	<5000 µg/kg	TM414	<5000	<5000	<5000	<5000	<5000	<5000
Total Aliphatics & Aromatics >C10-C44	<10000 µg/kg	TM414	<10000	<10000	<10000	<10000	<10000	<10000
Aromatics >EC5-EC7	<10 µg/kg	TM089	<10	<10	<10	<10	<10	<10
Aromatics >EC7-EC8	<10 µg/kg	TM089	<10	<10	<10	<10	<10	<10
Aromatics >EC8-EC10	<10 µg/kg	TM089	<10	<10	125	<10	<10	16.4
Aromatics > EC10-EC12	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aromatics > EC12-EC16	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aromatics > EC16-EC21	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aromatics > EC21-EC35	<1000 µg/kg	TM414	<1000	<1000	<1000	2880	<1000	<1000
Aromatics >EC35-EC44	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Aromatics > EC40-EC44	<1000 µg/kg	TM414	<1000	<1000	<1000	<1000	<1000	<1000
Total Aromatics > EC10-EC44	<5000 µg/kg	TM414	<5000	<5000	<5000	<5000	<5000	<5000
Total Aliphatics & Aromatics >C5-C44	<10000 µg/kg	TM414	<10000	<10000	<10000	<10000	<10000	<10000
Total Aliphatics >C5-C10	<50 µg/kg	TM089	<50	<50	210	<50	<50	<50
Total Aromatics >EC5-EC10	<50 µg/kg	TM089	<50	<50	125	<50	<50	<50
GRO >C5-C10	<20 µg/kg	TM089	<20	<20	335	<20	<20	<20

CERTIFICATE OF ANALYSIS

SDG:	200528-125	Client Reference:	602923	Report Number:	556226
Location:	Cookstown Industrial Estat	Order Number:	P2021703	Superseded Report:	

TPH CWG (S)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

		Customer Sample Ref.	BH105					
		Depth (m)	2.00 - 3.00					
		Sample Type	Soil/Solid (S)					
		Date Sampled	26/05/2020					
		Sampled Time	.					
		Date Received	28/05/2020					
		SDG Ref	200528-125					
		Lab Sample No.(s)	22217065					
		AGS Reference						
Component	**LOD/Units**	**Method**						
GRO Surrogate % recovery**	%	TM089	101					
Aliphatics >C5-C6	<10 µg/kg	TM089	<10					
Aliphatics >C6-C8	<10 µg/kg	TM089	12.8					
Aliphatics >C8-C10	<10 µg/kg	TM089	68.1					
Aliphatics >C10-C12	<1000 µg/kg	TM414	<1000					
Aliphatics >C12-C16	<1000 µg/kg	TM414	<1000					
Aliphatics >C16-C21	<1000 µg/kg	TM414	<1000					
Aliphatics >C21-C35	<1000 µg/kg	TM414	<1000					
Aliphatics >C35-C44	<1000 µg/kg	TM414	<1000					
Total Aliphatics >C10-C44	<5000 µg/kg	TM414	<5000					
Total Aliphatics & Aromatics >C10-C44	<10000 µg/kg	TM414	<10000					
Aromatics >EC5-EC7	<10 µg/kg	TM089	<10					
Aromatics >EC7-EC8	<10 µg/kg	TM089	<10					
Aromatics >EC8-EC10	<10 µg/kg	TM089	44.7					
Aromatics > EC10-EC12	<1000 µg/kg	TM414	<1000					
Aromatics > EC12-EC16	<1000 µg/kg	TM414	<1000					
Aromatics > EC16-EC21	<1000 µg/kg	TM414	<1000					
Aromatics > EC21-EC35	<1000 µg/kg	TM414	<1000					
Aromatics >EC35-EC44	<1000 µg/kg	TM414	<1000					
Aromatics > EC40-EC44	<1000 µg/kg	TM414	<1000					
Total Aromatics > EC10-EC44	<5000 µg/kg	TM414	<5000					
Total Aliphatics & Aromatics >C5-C44	<10000 µg/kg	TM414	<10000					
Total Aliphatics >C5-C10	<50 µg/kg	TM089	80.9					
Total Aromatics >EC5-EC10	<50 µg/kg	TM089	<50					
GRO >C5-C10	<20 µg/kg	TM089	80.9					

CERTIFICATE OF ANALYSIS

Validated

SDG:	200528-125	Client Reference:	602923	Report Number:	556226
Location:	Cookstown Industrial Estat	Order Number:	P2021703	Superseded Report:	

VOC MS (S)

Results Legend

- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-3+§@ Sample deviation (see appendix)

Component	LOD/Units	Method	BH101	BH102	BH102	BH103	BH104	BH104
Depth (m)			2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60
Sample Type			Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Date Sampled			25/05/2020	25/05/2020	25/05/2020	25/05/2020	26/05/2020	26/05/2020
Sampled Time			.	.	.	.	.	.
Date Received			28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
SDG Ref			200528-125	200528-125	200528-125	200528-125	200528-125	200528-125
Lab Sample No.(s)			22217044	22217048	22217053	22217056	22217060	22217062
AGS Reference								
Dibromofluoromethane**	%	TM116	114	124	118	111	110	111
Toluene-d8**	%	TM116	99.4	100	99.9	100	100	101
4-Bromofluorobenzene**	%	TM116	96.6	96.5	99	98.5	95.7	99
Methyl Tertiary Butyl Ether	<10 µg/kg	TM116	<200 M	<200 M	<200 M	<200 M	<2000 M	<200 M
Benzene	<9 µg/kg	TM116	<180 M	<180 M	<180 M	<180 M	<1800 M	<180 M
Toluene	<7 µg/kg	TM116	<140 M	<140 M	<140 M	<140 M	<1400 M	<140 M
Ethylbenzene	<4 µg/kg	TM116	<80 M	<80 M	<80 M	<80 M	<800 M	<80 M
p/m-Xylene	<10 µg/kg	TM116	<200 #	<200 #	<200 #	<200 #	<2000 #	<200 #
o-Xylene	<10 µg/kg	TM116	<200 M	<200 M	<200 M	<200 M	<2000 M	<200 M
Sum of Detected Xylenes	<0.02 mg/kg	TM116	<0.4	<0.4	<0.4	<0.4	<4	<0.4
Sum of BTEX	<40 µg/kg	TM116	<800	<800	<800	<800	<8000	<800

CERTIFICATE OF ANALYSIS

Validated

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

VOC MS (S)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

		Customer Sample Ref.	BH105					
		Depth (m)	2.00 - 3.00					
		Sample Type	Soil/Solid (S)					
		Date Sampled	26/05/2020					
		Sampled Time	.					
		Date Received	28/05/2020					
		SDG Ref	200528-125					
		Lab Sample No.(s)	22217065					
		AGS Reference						
Component	**LOD/Units**	**Method**						
Dibromofluoromethane**	%	TM116	111					
Toluene-d8**	%	TM116	101					
4-Bromofluorobenzene**	%	TM116	96.7					
Methyl Tertiary Butyl Ether	<10 µg/kg	TM116	<200 M					
Benzene	<9 µg/kg	TM116	<180 M					
Toluene	<7 µg/kg	TM116	<140 M					
Ethylbenzene	<4 µg/kg	TM116	<80 M					
p/m-Xylene	<10 µg/kg	TM116	<200 #					
o-Xylene	<10 µg/kg	TM116	<200 M					
Sum of Detected Xylenes	<0.02 mg/kg	TM116	<0.4					
Sum of BTEX	<40 µg/kg	TM116	<800					

Asbestos Identification - Solid Samples

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
*	Subcontracted test.
(F)	Trigger breach confirmed
1-5&♦§@	Sample deviation (see appendix)

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH101 2.00 - 3.00 SOLID 25/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217044 TM048	04/06/2020	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH102 1.00 - 2.00 SOLID 25/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217048 TM048	04/06/2020	Marcin Magdziarek	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH102 4.00 - 4.60 SOLID 25/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217053 TM048	04/06/2020	Marcin Magdziarek	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH103 1.00 - 2.00 SOLID 25/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217056 TM048	04/06/20	Eva Guerra	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH104 1.00 - 2.00 SOLID 26/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217060 TM048	04/06/2020	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH104 3.00 - 3.60 SOLID 26/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217062 TM048	04/06/2020	Marcin Magdziarek	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH105 2.00 - 3.00 SOLID 26/05/2020 00:00:00 28/05/2020 10:00:00 200528-125 22217065 TM048	04/06/2020	Christian Hallam	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected

Table of Results - Appendix

Method No	Reference	Description
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) by Headspace GC-FID (C4-C12)
TM116	Modified: US EPA Method 8260, 8120, 8020, 624, 610 & 602	Determination of Volatile Organic Compounds by Headspace / GC-MS
TM132	In - house Method	ELTRA CS800 Operators Guide
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES
TM218	Shaker extraction - EPA method 3546.	The determination of PAH in soil samples by GC-MS
TM414	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GCxGC-FID

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

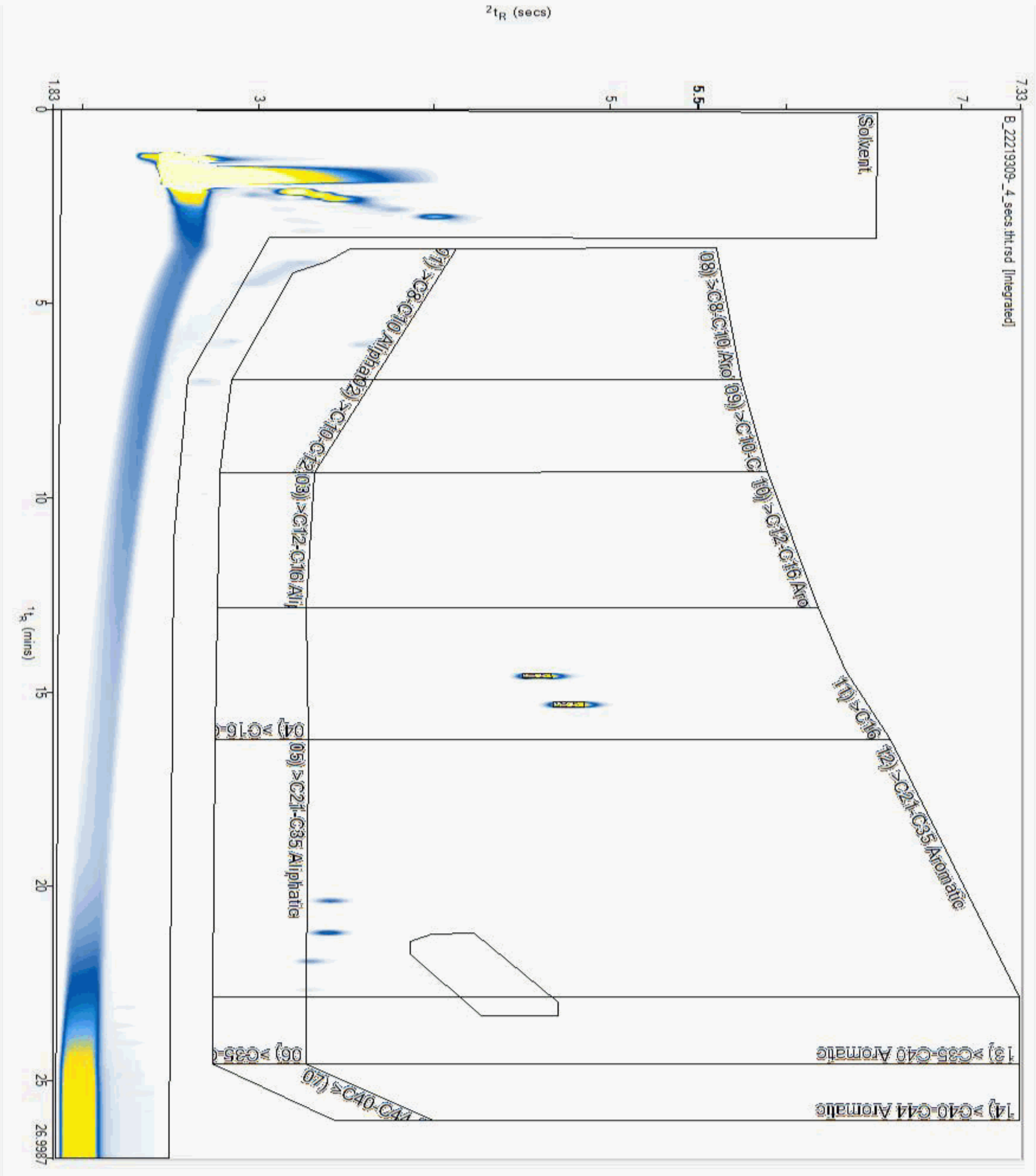
Test Completion Dates

Lab Sample No(s)	22217044	22217048	22217053	22217056	22217060	22217062	22217065
Customer Sample Ref.	BH101	BH102	BH102	BH103	BH104	BH104	BH105
AGS Ref.							
Depth	2.00 - 3.00	1.00 - 2.00	4.00 - 4.60	1.00 - 2.00	1.00 - 2.00	3.00 - 3.60	2.00 - 3.00
Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Asbestos ID in Solid Samples	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020
EPH CWG GC (S)	23-Jun-2020	22-Jun-2020	22-Jun-2020	22-Jun-2020	23-Jun-2020	23-Jun-2020	22-Jun-2020
GRO by GC-FID (S)	03-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	03-Jun-2020	03-Jun-2020	04-Jun-2020
Metals in solid samples by OES	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020
PAH by GCMS	02-Jun-2020	02-Jun-2020	03-Jun-2020	02-Jun-2020	02-Jun-2020	02-Jun-2020	02-Jun-2020
pH	04-Jun-2020	01-Jun-2020	01-Jun-2020	04-Jun-2020	04-Jun-2020	04-Jun-2020	01-Jun-2020
Sample description	30-May-2020	30-May-2020	30-May-2020	29-May-2020	30-May-2020	30-May-2020	30-May-2020
Total Organic Carbon	04-Jun-2020	04-Jun-2020	04-Jun-2020	03-Jun-2020	04-Jun-2020	05-Jun-2020	04-Jun-2020
TPH CWG GC (S)	23-Jun-2020	22-Jun-2020	22-Jun-2020	22-Jun-2020	23-Jun-2020	23-Jun-2020	22-Jun-2020
VOC MS (S)	03-Jun-2020	04-Jun-2020	04-Jun-2020	03-Jun-2020	04-Jun-2020	03-Jun-2020	03-Jun-2020

Chromatogram

Analysis: EPH CWG GC (S) **Sample No :** 22219309 **Depth :** 1.00 - 2.00
Sample ID : BH103

```
ChromSpace LIMS export
Current batch
Sample Identity:  B_22219309-_4_secs.tht
Date Acquired  :  21/06/20 05:13:28
Units          :  ppm
Dilution       :  0
CF             :
Multiplier     :
```

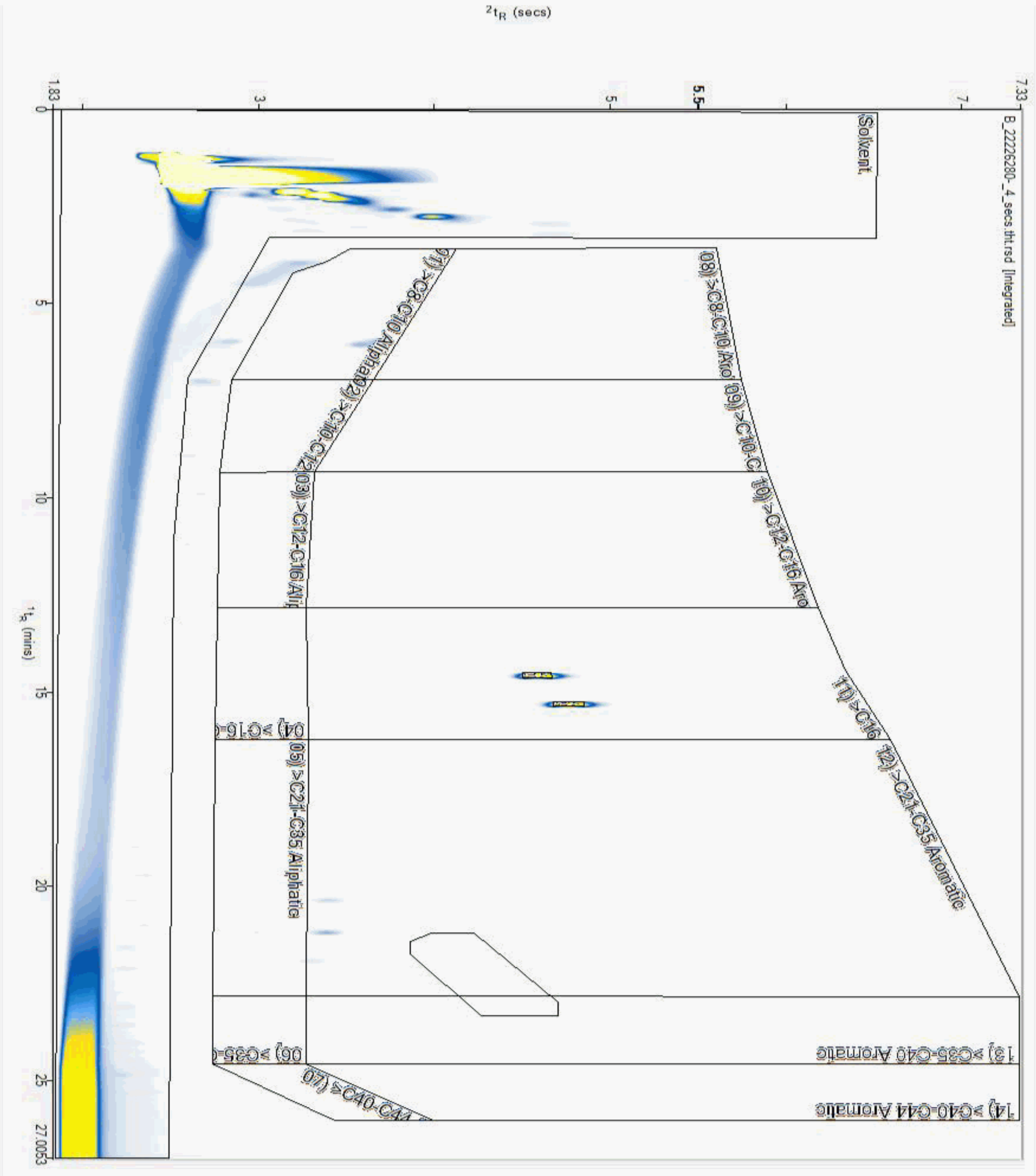


Chromatogram

Analysis: EPH CWG GC (S) **Sample No :** 22226280 **Depth :** 1.00 - 2.00

Sample ID : BH102

```
  ChromSpace LIMS export
 Current batch
Sample Identity:  B_22226280-_4_secs.tht
Date Acquired  :  21/06/20 06:24:09
Units          :  ppm
Dilution       :  0
CF             :
Multiplier     :
```



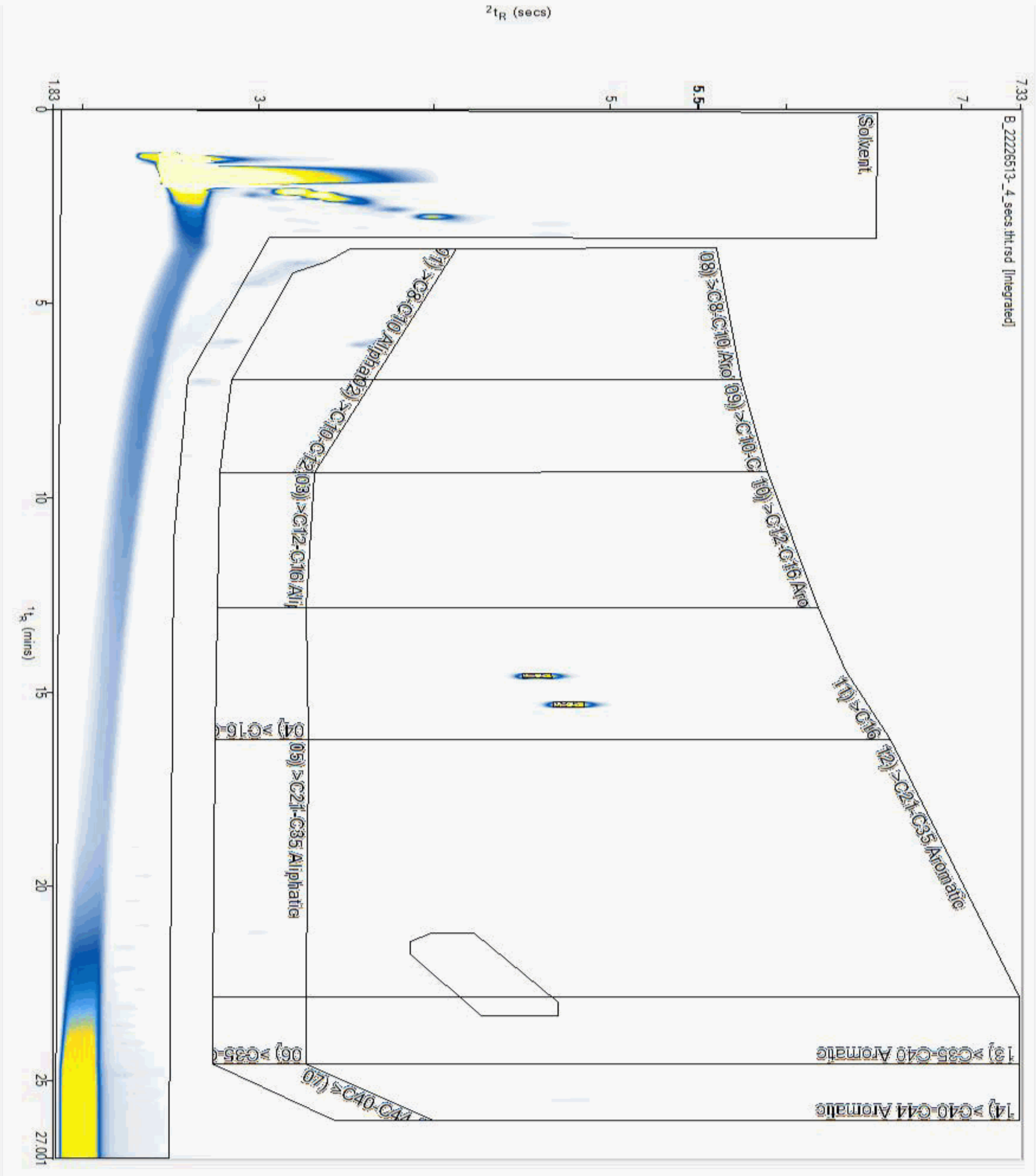
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	EPH CWG GC (S)	**Sample No :**	22226513	**Depth :**	4.00 - 4.60
		Sample ID :	BH102		

```
  ChromSpace LIMS export
 Current batch
Sample Identity:  B_22226513-_4_secs.tht
Date Acquired  :  21/06/20 05:53:32
Units          :  ppm
Dilution       :  0
CF             :
Multiplier     :
```



Validated

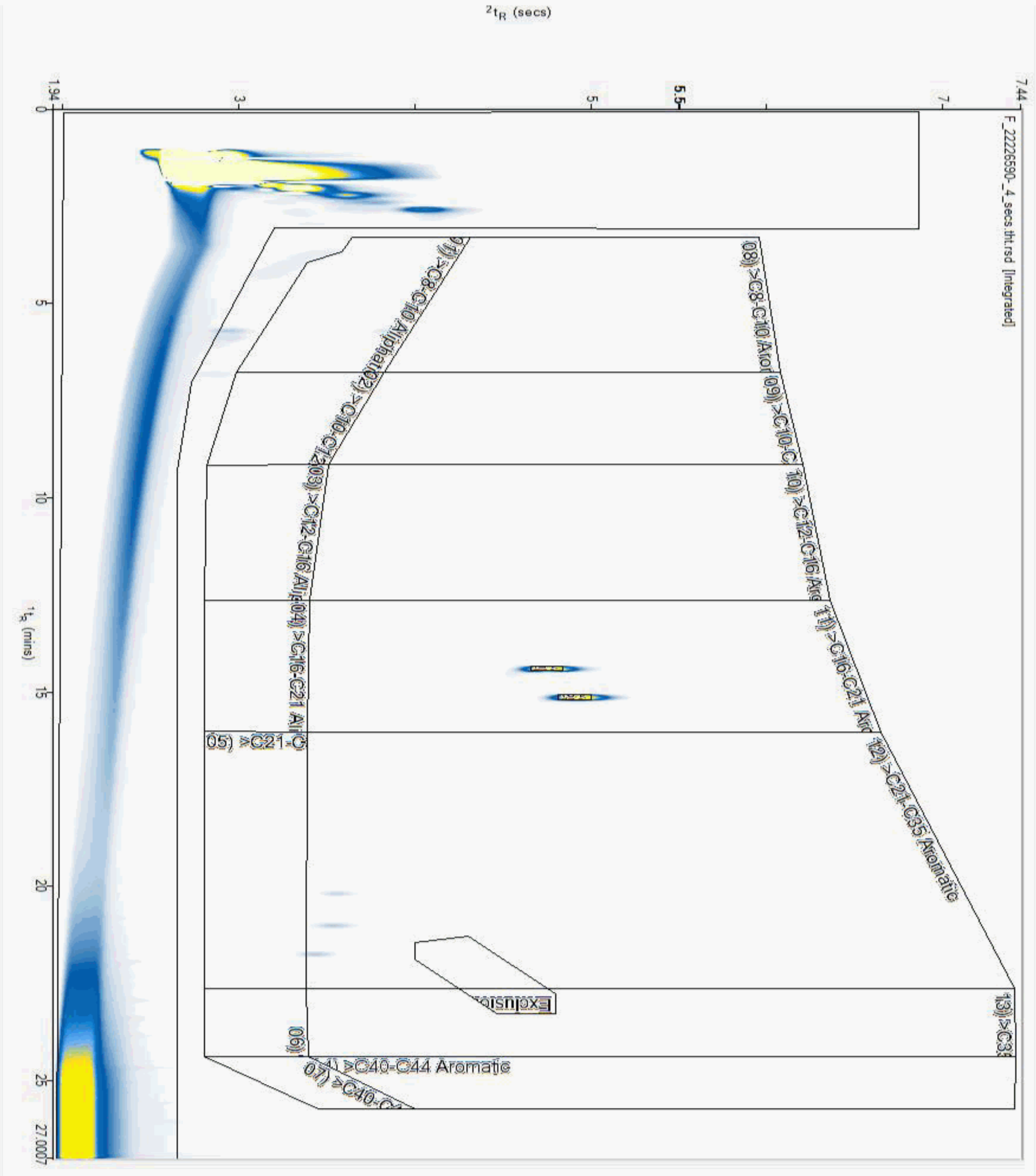
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	EPH CWG GC (S)	**Sample No :**	22226590	**Depth :**	2.00 - 3.00
		Sample ID :	BH101		

```
ChromSpace LIMS export
Current batch
Sample Identity:  F_22226590-_4_secs.tht
Date Acquired   :  22/06/20 09:13:20
Units           :  ppm
Dilution        :  0
CF              :
Multiplier      :
```



Validated

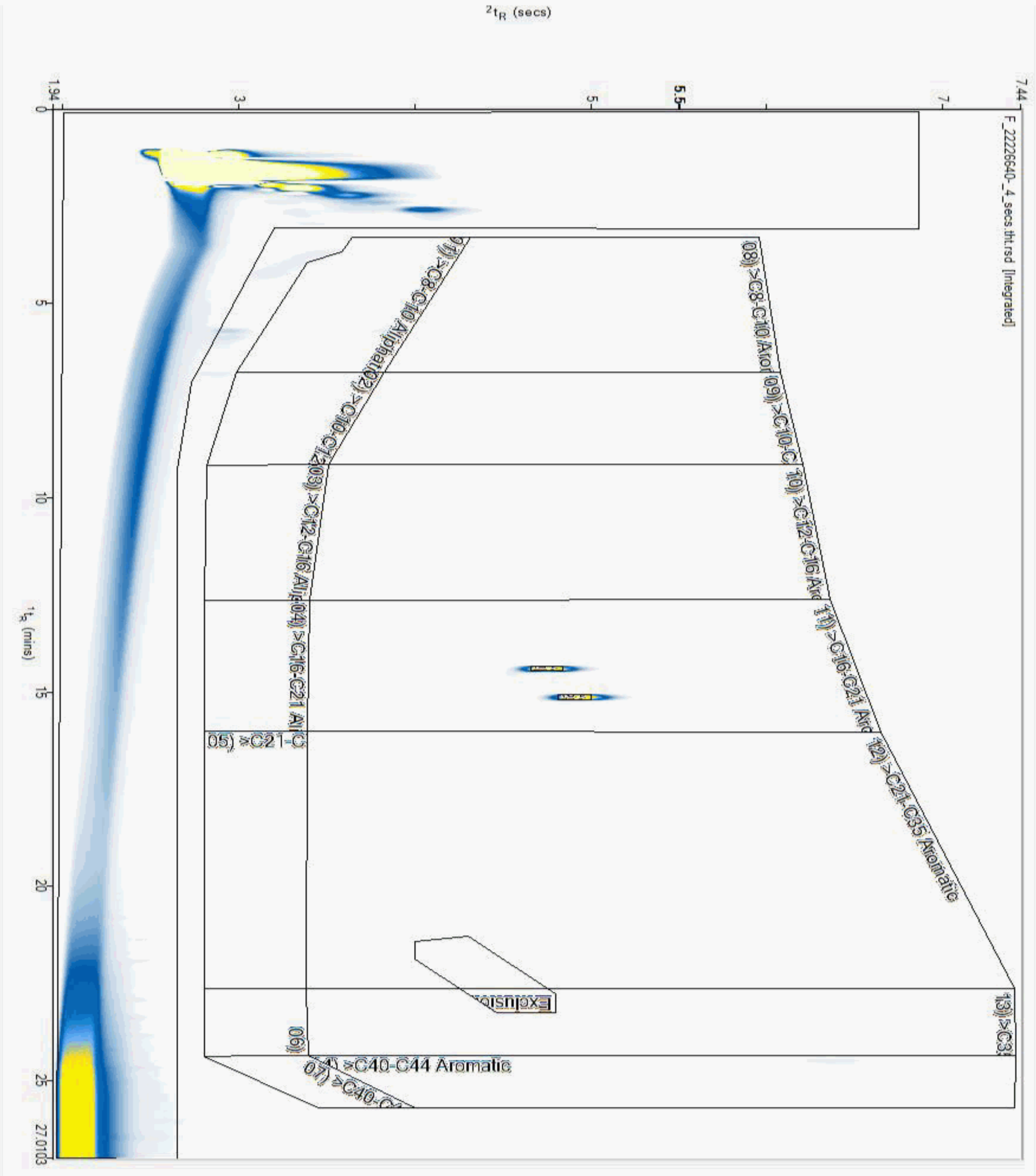
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG GC (S) **Sample No :** 22226640 **Depth :** 3.00 - 3.60
Sample ID : BH104

```
   ChromSpace LIMS export
  Current batch
Sample Identity:  F_22226640-_4_secs.tht
Date Acquired  :  22/06/20 07:38:43
Units          :  ppm
Dilution       :  0
CF             :
Multiplier     :
```



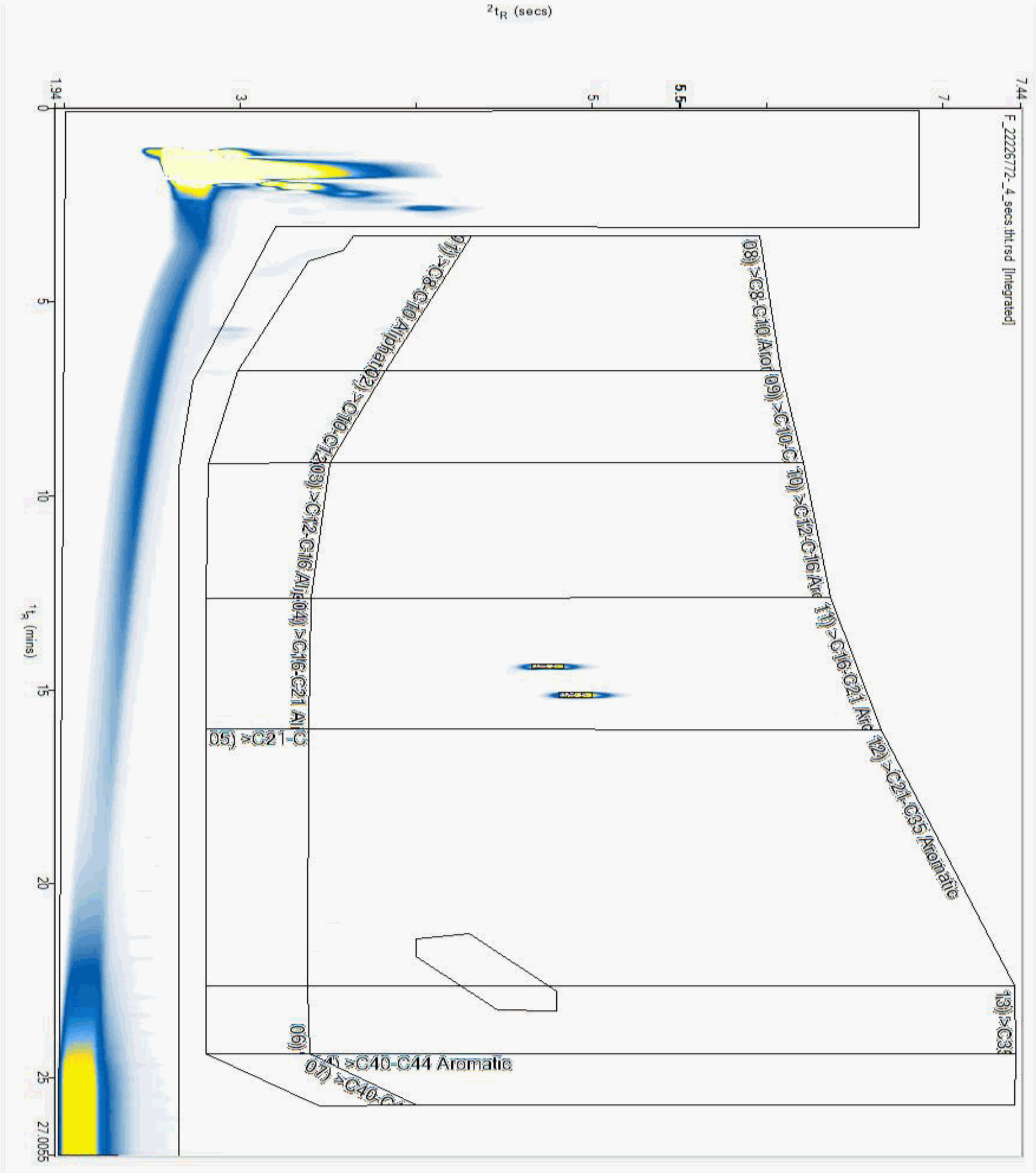
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	EPH CWG GC (S)	**Sample No :**	22226772	**Depth :**	1.00 - 2.00
		Sample ID :	BH104		

```
  ChromSpace LIMS export
  Current batch
Sample Identity:  F_22226772-_4_secs.tht
Date Acquired   :  22/06/20 08:10:16
Units           :  ppm
Dilution        :  0
CF              :
Multiplier      :
```



Validated

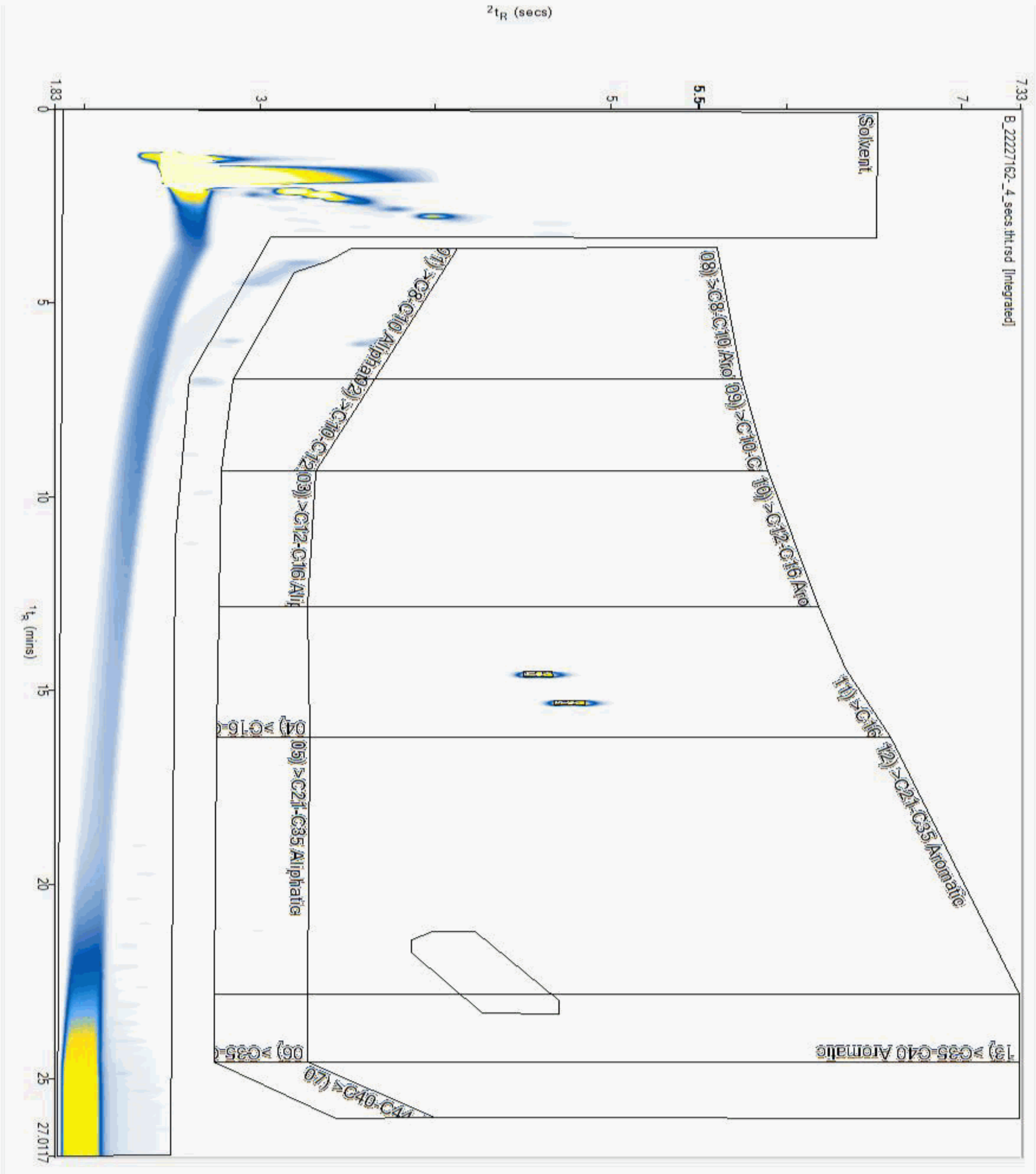
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	EPH CWG GC (S)	**Sample No :**	22227162	**Depth :**	2.00 - 3.00
		Sample ID :	BH105		

```
  ChromSpace LIMS export
 Current batch
Sample Identity:  B_22227162-_4_secs.tht
Date Acquired  :  21/06/20 07:25:18
Units          :  ppm
Dilution       :  0
CF             :
Multiplier     :
```

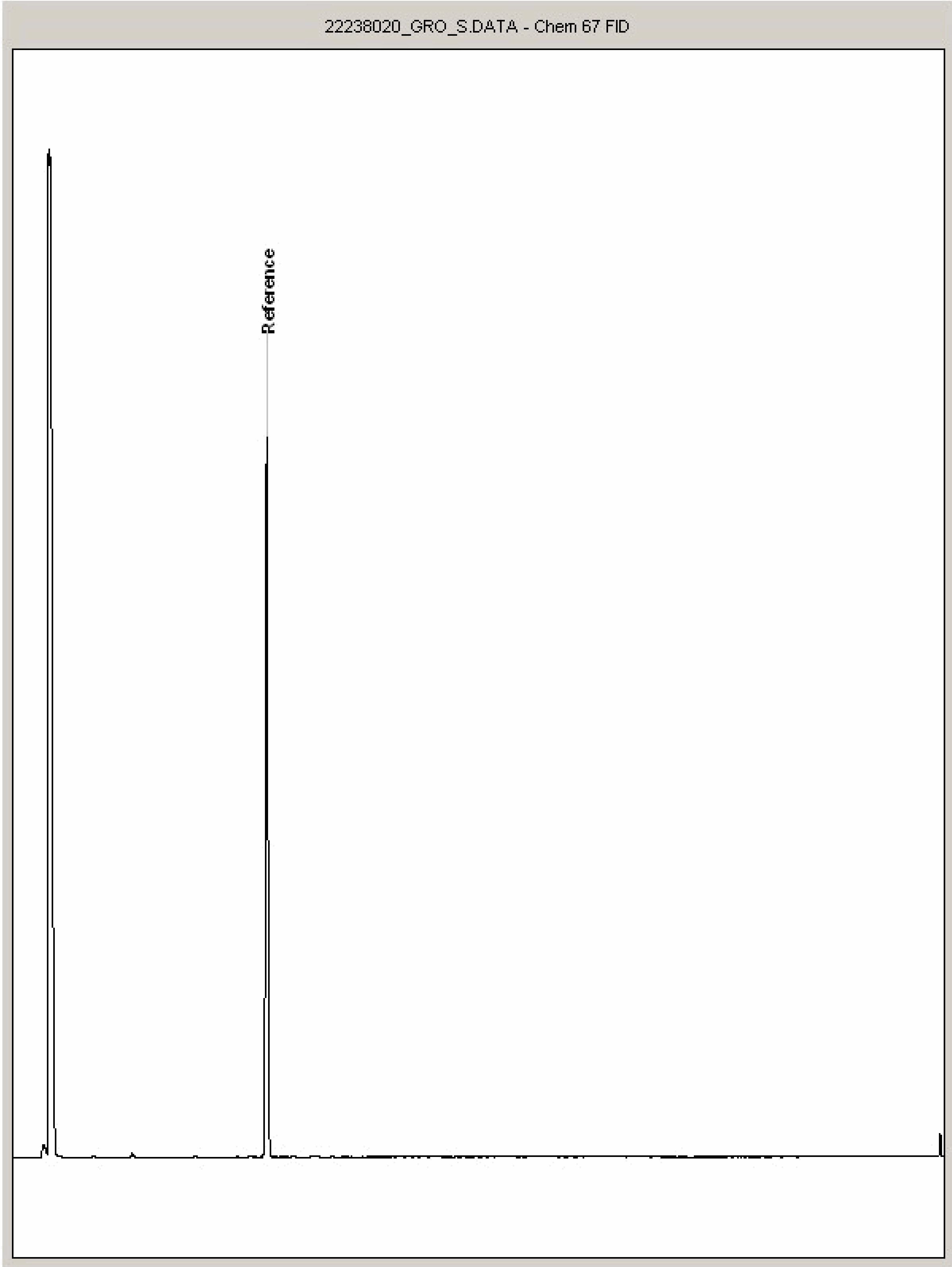


Chromatogram

Analysis: GRO by GC-FID (S)

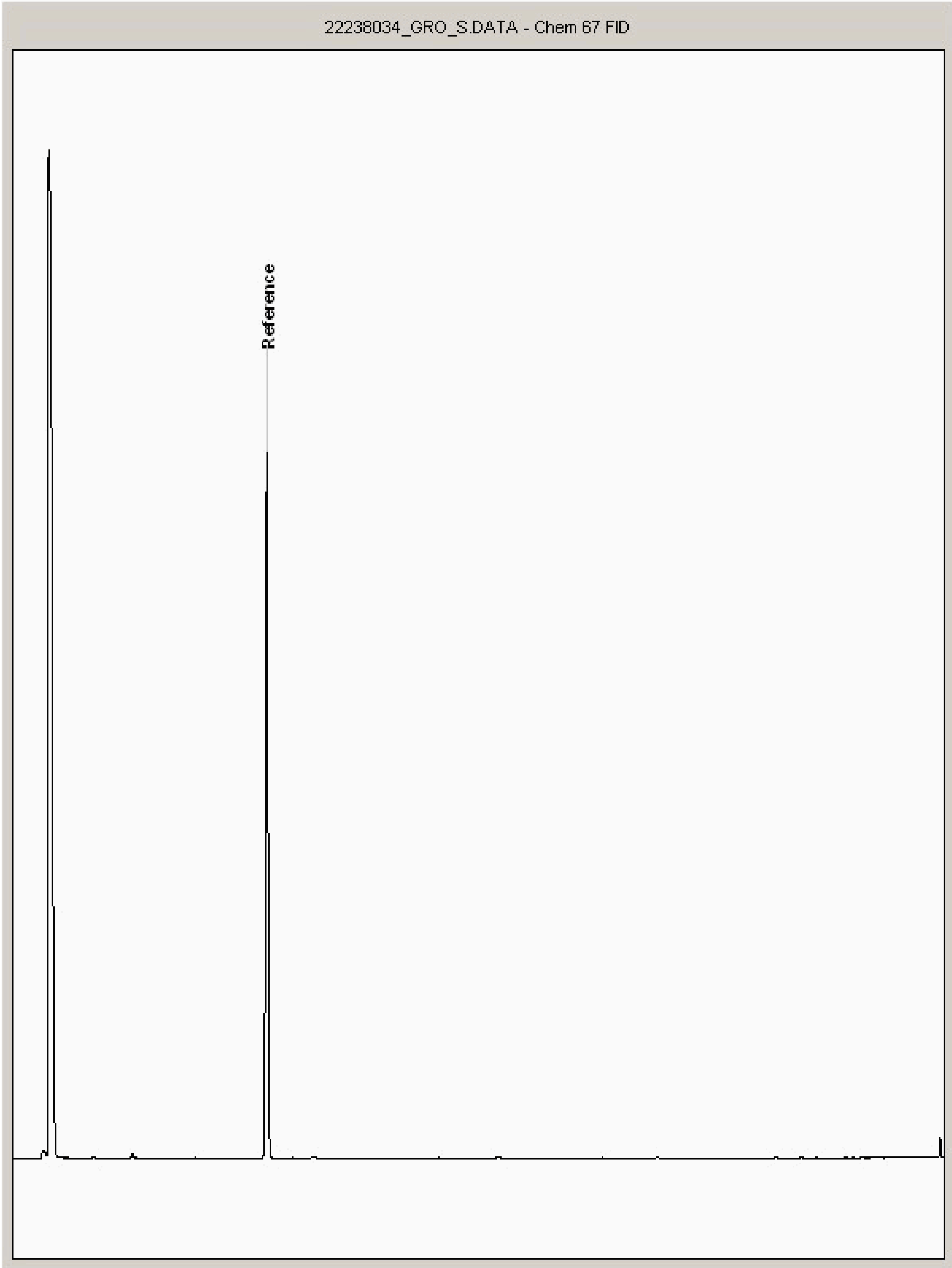
Sample No : 22238020
Sample ID : BH104

Depth : 1.00 - 2.00



Chromatogram

Analysis:	GRO by GC-FID (S)	**Sample No :**	22238034	**Depth :**	2.00 - 3.00
		Sample ID :	BH101		



CERTIFICATE OF ANALYSIS

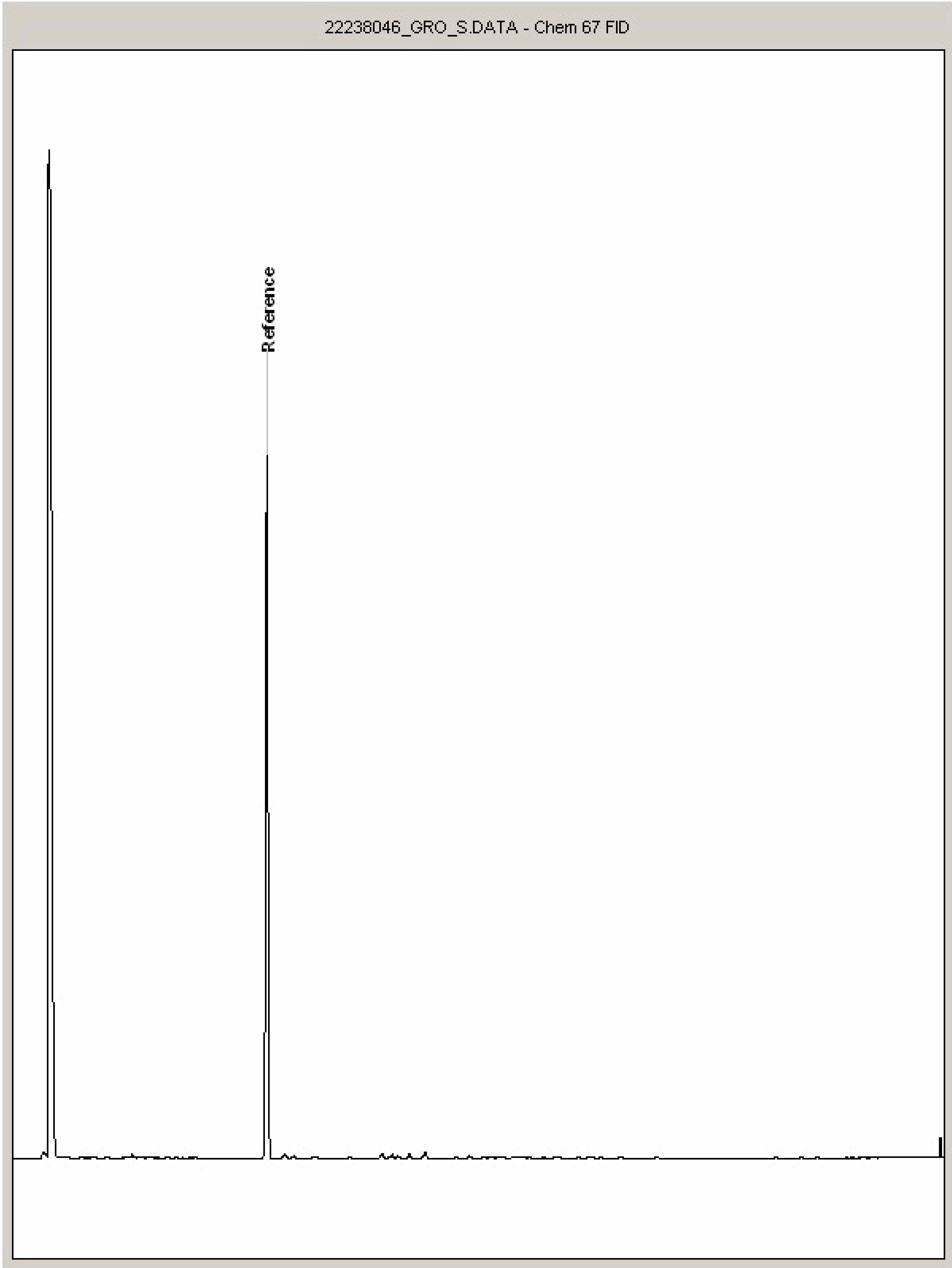
SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 22238046
Sample ID : BH104

Depth : 3.00 - 3.60



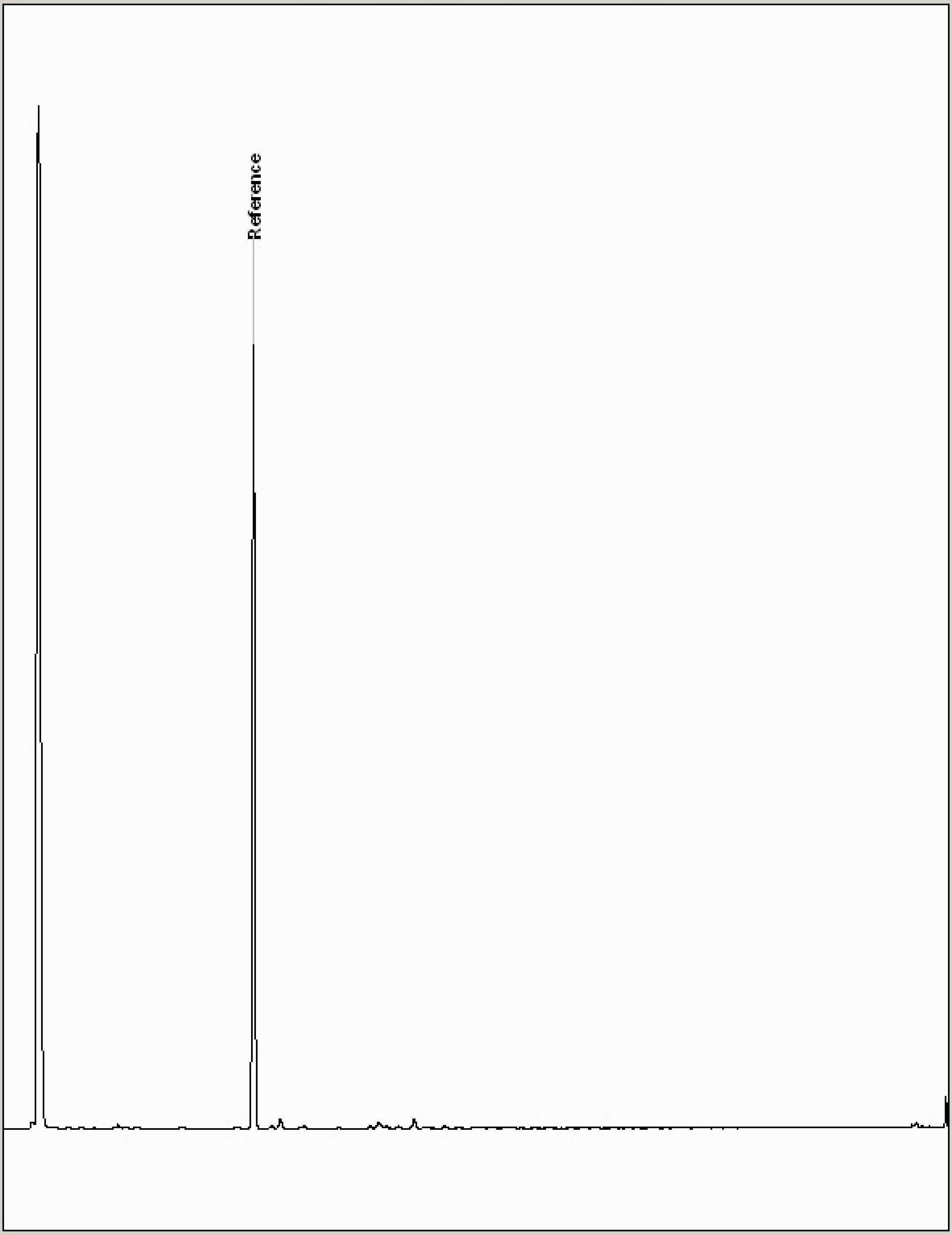
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	GRO by GC-FID (S)	**Sample No :**	22238166	**Depth :**	2.00 - 3.00
		Sample ID :	BH105		

22238166_GRO_S.DATA - HP6850 Signal 1



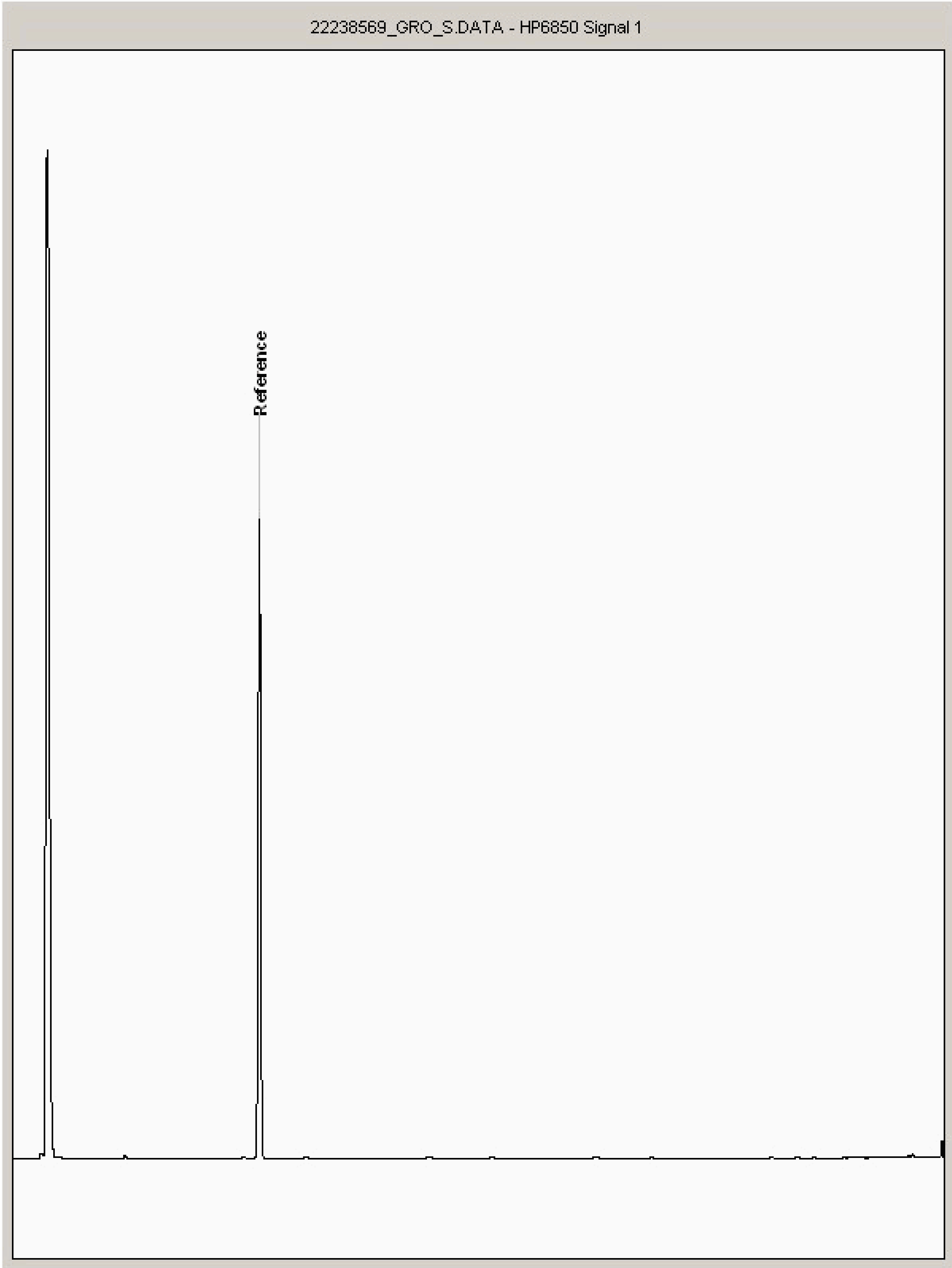
Validated

CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	GRO by GC-FID (S)	**Sample No :**	22238569	**Depth :**	1.00 - 2.00
		Sample ID :	BH103		

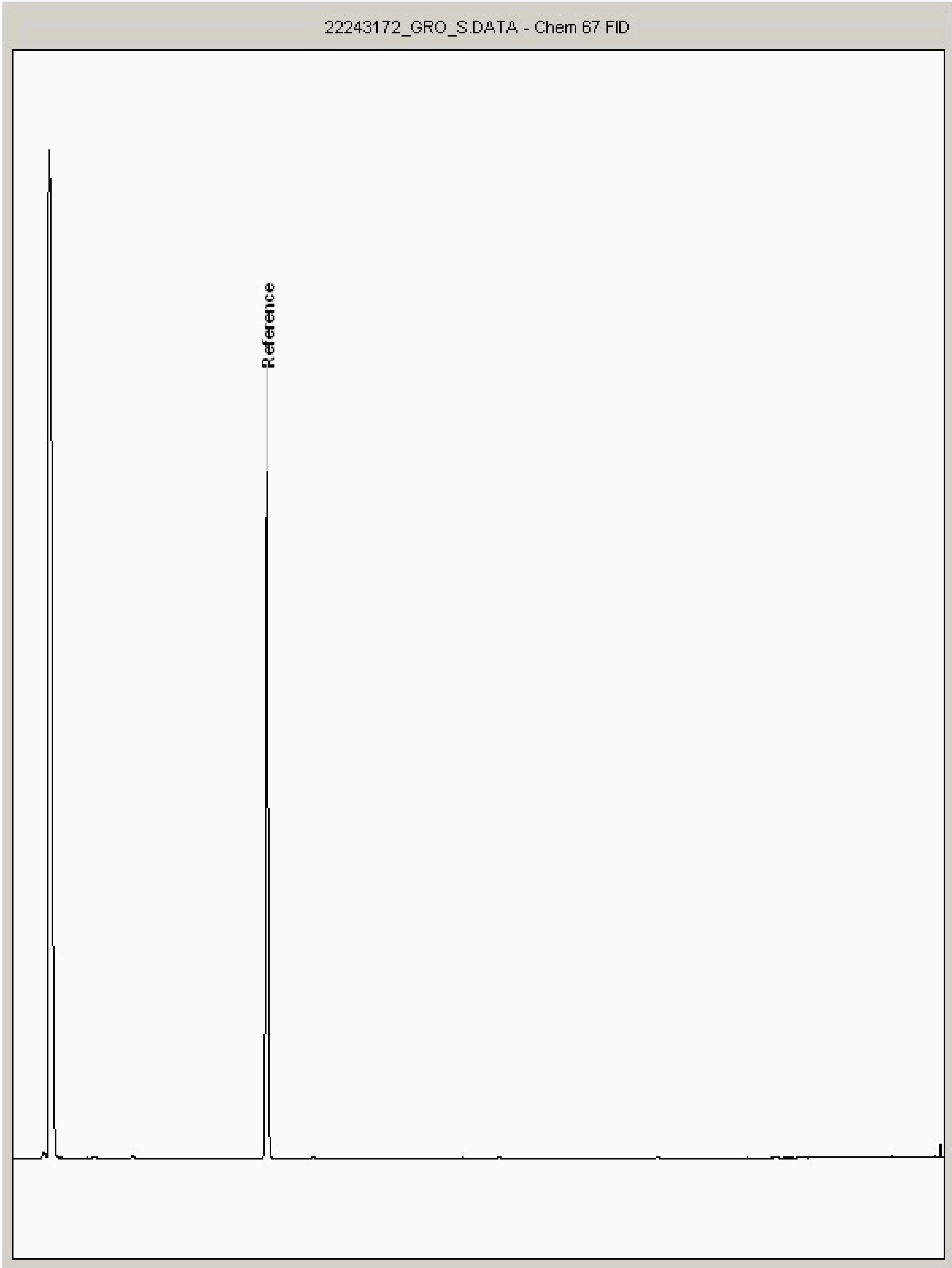


Validated

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	GRO by GC-FID (S)	**Sample No :**	22243172	**Depth :**	1.00 - 2.00
		Sample ID :	BH102		



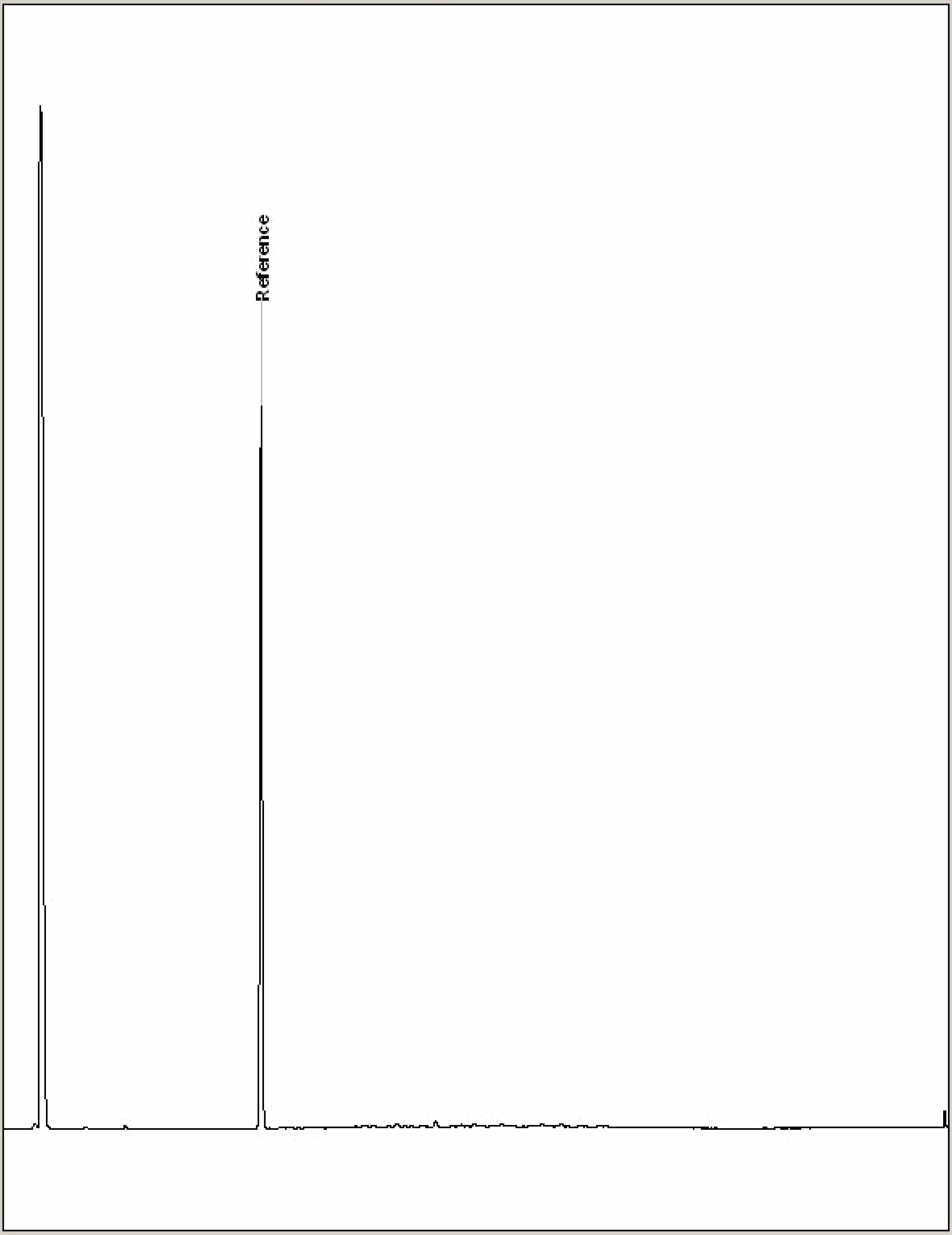
CERTIFICATE OF ANALYSIS

SDG:	200528-125	**Client Reference:**	602923	**Report Number:**	556226
Location:	Cookstown Industrial Estat	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis:	GRO by GC-FID (S)	**Sample No :**	22243186	**Depth :**	4.00 - 4.60
		Sample ID :	BH102		

22243186_GRO_S.DATA - Chem 67 FID



Appendix General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

18. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**

19. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of

<u>Identification of Asbestos in Bulk Materials & Soils</u>

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

<u>Visual Estimation Of Fibre Content</u>

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

<u>Respirable Fibres</u>

Respirable fibres are defined as fibres of <3 μm diameter, longer than 5 μm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.
Standing Committee of Analysts, *The Quantification of Asbestos in Soil (2017).*

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

APPENDIX D

Groundwater Laboratory Certificates of Analysis

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

RSK Group Plc
Unit B
Bluebell Business Centre
Old Naas Road
Dublin
Dublin 12

Attention: Paul Feely

CERTIFICATE OF ANALYSIS

Date of report Generation:	18 June 2020
Customer:	RSK Group Plc
Sample Delivery Group (SDG):	200611-61
Your Reference:	Cookstown S.I.: 602923
Location:	Cookstown, Belgard, Dublin
Report No:	555761

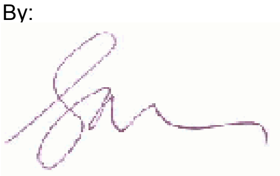
We received 4 samples on Thursday June 11, 2020 and 4 of these samples were scheduled for analysis which was completed on Thursday June 18, 2020. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:



Sonia McWhan
Operations Manager

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
22288308	MW102			09/06/2020
22288309	MW103			09/06/2020
22288311	MW104			09/06/2020
22288312	MW105			09/06/2020

Maximum Sample/Coolbox Temperature (°C) : **12.8**

ISO5667-3 Water quality - Sampling - Part3 -
During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Results Legend

- X Test
- N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			22288308		22288309		22288311		22288312	
Customer Sample Reference			MW102		MW103		MW104		MW105	
AGS Reference										
Depth (m)										
Container			0.5l glass bottle (ALE227)	Vial (ALE297)	0.5l glass bottle (ALE227)	Vial (ALE297)	0.5l glass bottle (ALE227)	Vial (ALE297)	0.5l glass bottle (ALE227)	Vial (ALE297)
Sample Type			GW	GW	GW	GW	GW	GW	GW	GW
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 4	X		X		X		X	
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 4	X		X		X		X	
GRO by GC-FID (W)	All	NDPs: 0 Tests: 4		X		X		X		X
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 4	X		X		X		X	
pH Value	All	NDPs: 0 Tests: 4	X		X		X		X	
TPH CWG (W)	All	NDPs: 0 Tests: 4	X		X		X		X	

Validated

CERTIFICATE OF ANALYSIS

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

		Customer Sample Ref.	MW102	MW103	MW104	MW105		
		Depth (m)	.	.	.	.		
		Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)		
		Date Sampled	09/06/2020	09/06/2020	09/06/2020	09/06/2020		
		Sampled Time	.	.	.	.		
		Date Received	11/06/2020	11/06/2020	11/06/2020	11/06/2020		
		SDG Ref	200611-61	200611-61	200611-61	200611-61		
		Lab Sample No.(s)	22288308	22288309	22288311	22288312		
		AGS Reference						
Component	**LOD/Units**	**Method**						
pH	<1 pH Units	TM256	7.67 #	7.54 #	8.02 #	8.33 #		

CERTIFICATE OF ANALYSIS

Validated

SDG:	200611-61	Client Reference:	Cookstown S.I.: 602923	Report Number:	555761
Location:	Cookstown, Belgard, Dubli	Order Number:	P2021703	Superseded Report:	

PAH Spec MS - Aqueous (W)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

		Customer Sample Ref.	MW102	MW103	MW104	MW105		
		Depth (m)	.	.	.	.		
		Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)		
		Date Sampled	09/06/2020	09/06/2020	09/06/2020	09/06/2020		
		Sampled Time	.	.	.	.		
		Date Received	11/06/2020	11/06/2020	11/06/2020	11/06/2020		
		SDG Ref	200611-61	200611-61	200611-61	200611-61		
		Lab Sample No.(s)	22288308	22288309	22288311	22288312		
		AGS Reference						
Component	**LOD/Units**	**Method**						
Naphthalene (aq)	<0.01 µg/l	TM178	<0.01 #	<0.01 #	<0.01 #	<0.01 #		
Acenaphthene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Acenaphthylene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Fluoranthene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	0.00506 #		
Anthracene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Phenanthrene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Fluorene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Chrysene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Pyrene (aq)	<0.005 µg/l	TM178	0.0091 #	0.00711 #	0.00577 #	0.00735 #		
Benzo(a)anthracene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Benzo(b)fluoranthene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Benzo(k)fluoranthene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Benzo(a)pyrene (aq)	<0.002 µg/l	TM178	<0.002 #	<0.002 #	<0.002 #	<0.002 #		
Dibenzo(a,h)anthracene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Benzo(g,h,i)perylene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
Indeno(1,2,3-cd)pyrene (aq)	<0.005 µg/l	TM178	<0.005 #	<0.005 #	<0.005 #	<0.005 #		
PAH, Total Detected USEPA 16 (aq)	<0.082 µg/l	TM178	<0.082 #	<0.082 #	<0.082 #	<0.082 #		

CERTIFICATE OF ANALYSIS

Validated

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

TPH CWG (W)

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-3+§@	Sample deviation (see appendix)

Customer Sample Ref.	MW102	MW103	MW104	MW105		
Depth (m)	.	.	.	.		
Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)		
Date Sampled	09/06/2020	09/06/2020	09/06/2020	09/06/2020		
Sampled Time	.	.	.	.		
Date Received	11/06/2020	11/06/2020	11/06/2020	11/06/2020		
SDG Ref	200611-61	200611-61	200611-61	200611-61		
Lab Sample No.(s)	22288308	22288309	22288311	22288312		
AGS Reference						

Component	LOD/Units	Method	MW102	MW103	MW104	MW105		
GRO Surrogate % recovery**	%	TM245	95	95	92	103		
GRO >C5-C12	<50 µg/l	TM245	<50 #	<50 #	98 #	128 #		
Methyl tertiary butyl ether (MTBE)	<3 µg/l	TM245	<3 #	4 #	98 #	118 #		
Benzene	<7 µg/l	TM245	<7 #	<7 #	<7 #	<7 #		
Toluene	<4 µg/l	TM245	<4 #	<4 #	<4 #	<4 #		
Ethylbenzene	<5 µg/l	TM245	<5 #	<5 #	<5 #	<5 #		
m,p-Xylene	<8 µg/l	TM245	<8 #	<8 #	<8 #	<8 #		
o-Xylene	<3 µg/l	TM245	<3 #	<3 #	<3 #	<3 #		
Sum of detected Xylenes	<11 µg/l	TM245	<11	<11	<11	<11		
Sum of detected BTEX	<28 µg/l	TM245	<28	<28	<28	<28		
Aliphatics >C5-C6	<10 µg/l	TM245	<10	<10	<10	<10		
Aliphatics >C6-C8	<10 µg/l	TM245	<10	<10	<10	<10		
Aliphatics >C8-C10	<10 µg/l	TM245	<10	<10	<10	<10		
Aliphatics >C10-C12	<10 µg/l	TM245	<10	<10	<10	<10		
Aliphatics >C12-C16 (aq)	<10 µg/l	TM174	<10	<10	<10	<10		
Aliphatics >C16-C21 (aq)	<10 µg/l	TM174	<10	<10	<10	<10		
Aliphatics >C21-C35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10		
Total Aliphatics >C12-C35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10		
Aromatics >EC5-EC7	<10 µg/l	TM245	<10	<10	<10	<10		
Aromatics >EC7-EC8	<10 µg/l	TM245	<10	<10	<10	<10		
Aromatics >EC8-EC10	<10 µg/l	TM245	<10	<10	<10	<10		
Aromatics >EC10-EC12	<10 µg/l	TM245	<10	<10	<10	<10		
Aromatics >EC12-EC16 (aq)	<10 µg/l	TM174	<10	<10	<10	<10		
Aromatics >EC16-EC21 (aq)	<10 µg/l	TM174	<10	<10	<10	<10		
Aromatics >EC21-EC35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10		
Total Aromatics >EC12-EC35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10		
Total Aliphatics & Aromatics >C5-35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10		
Aliphatics >C16-C35 Aqueous	<10 µg/l	TM174	<10	<10	<10	<10		

Table of Results - Appendix

Method No	Reference	Description
TM174	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters
TM245	By GC-FID	Determination of GRO by Headspace in waters
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Test Completion Dates

Lab Sample No(s)	22288308	22288309	22288311	22288312
Customer Sample Ref.	MW102	MW103	MW104	MW105
AGS Ref.				
Depth				
Type	Ground Water	Ground Water	Ground Water	Ground Water
EPH CWG (Aliphatic) Aqueous GC (W)	18-Jun-2020	18-Jun-2020	18-Jun-2020	18-Jun-2020
EPH CWG (Aromatic) Aqueous GC (W)	18-Jun-2020	18-Jun-2020	18-Jun-2020	18-Jun-2020
GRO by GC-FID (W)	17-Jun-2020	17-Jun-2020	17-Jun-2020	17-Jun-2020
PAH Spec MS - Aqueous (W)	17-Jun-2020	17-Jun-2020	17-Jun-2020	17-Jun-2020
pH Value	18-Jun-2020	18-Jun-2020	18-Jun-2020	18-Jun-2020
TPH CWG (W)	18-Jun-2020	18-Jun-2020	18-Jun-2020	18-Jun-2020

CERTIFICATE OF ANALYSIS

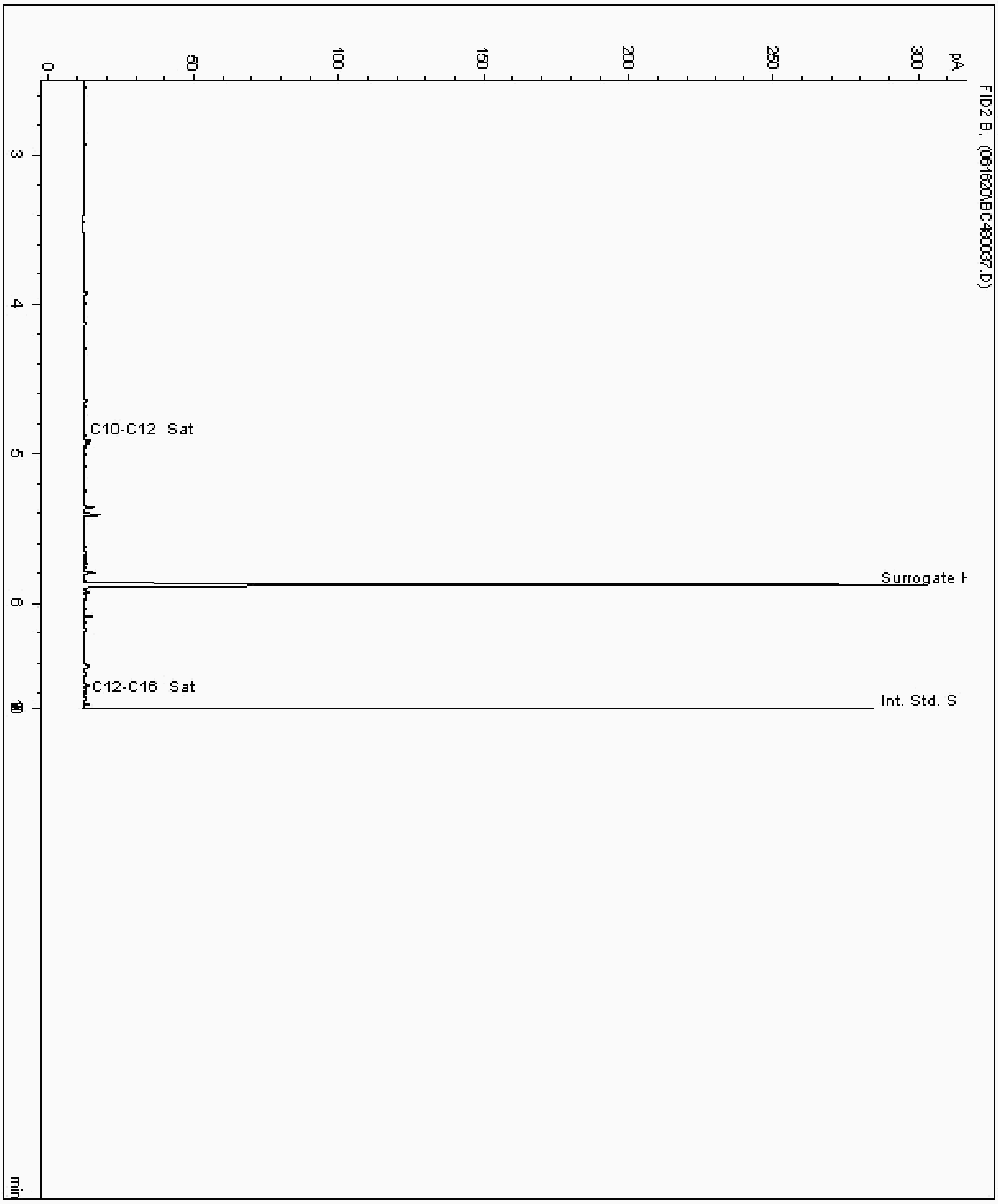
SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) Aqueous GC (W) **Sample No :** 22294089 **Depth :**
Sample ID : MW102

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 20932562-
Date Acquired : 17/06/2020 16:20:13 PM
Units : ppb
Dilution : SE MW102[] ->
CF : 1
Multiplier : 0.025

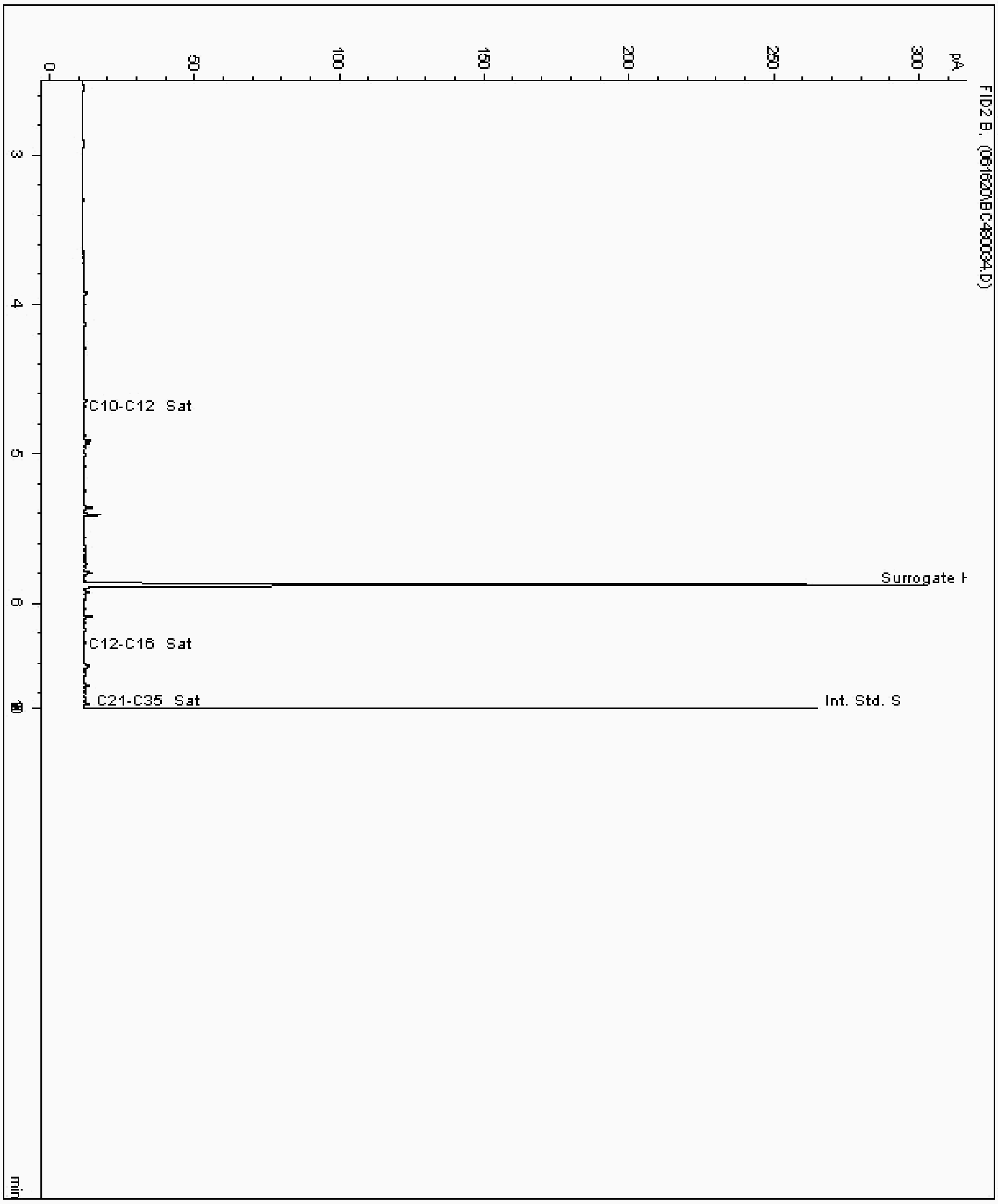


Chromatogram

Analysis: EPH CWG (Aliphatic) Aqueous GC (W) **Sample No :** 22294092 **Depth :**
Sample ID : MW105

```
Alcontrol/Geochem Analytical Services
Speciated TPH - SATS ( C12 - C40 )

Sample Identity:  20932587-
Date Acquired  :  17/06/2020 15:10:27 PM
Units          :  ppb
Dilution       :  SE MW105[]          ->
CF             :  1
Multiplier     :  0.025
```



CERTIFICATE OF ANALYSIS

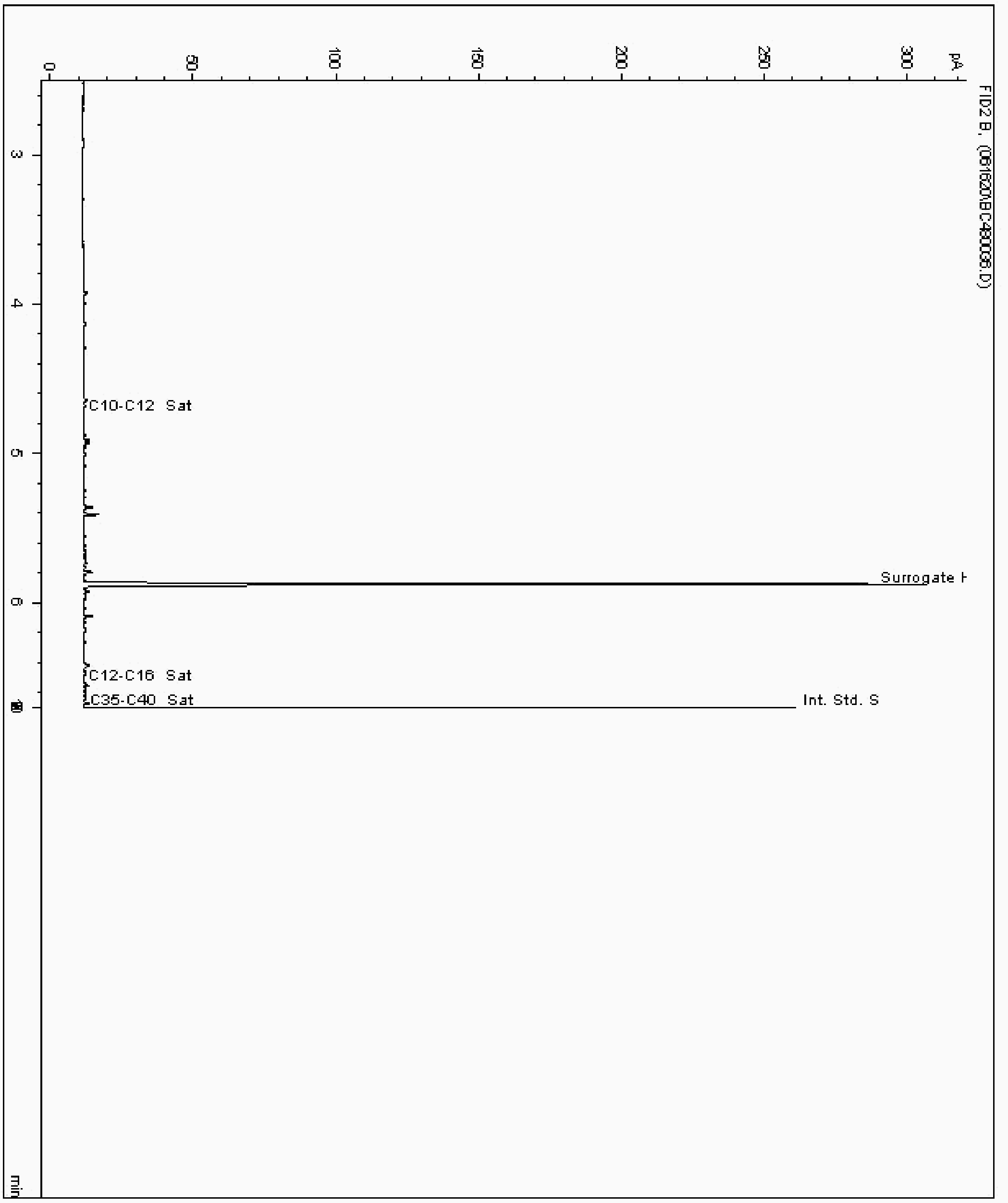
SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) Aqueous GC (W) **Sample No :** 22294101 **Depth :**
Sample ID : MW103

```
Alcontrol/Geochem Analytical Services
Speciated TPH - SATS ( C12 - C40 )

Sample Identity:  20932569-
Date Acquired  :  17/06/2020 15:56:45 PM
Units          :  ppb
Dilution       :  SE MW103[]            ->
CF             :  1
Multiplier     :  0.025
```

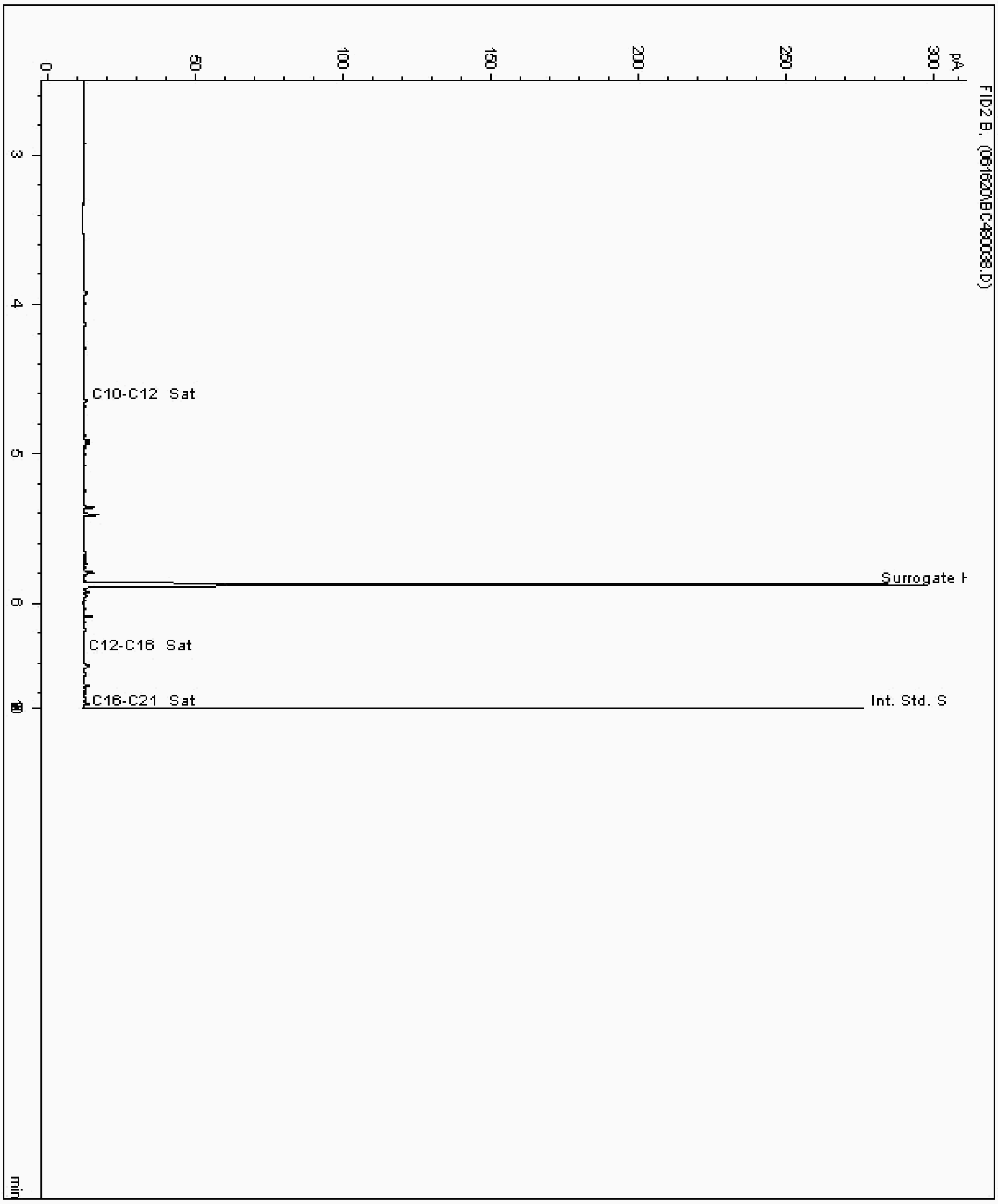


Chromatogram

Analysis: EPH CWG (Aliphatic) Aqueous GC (W) **Sample No :** 22294178 **Depth :**
Sample ID : MW104

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 20932576-
Date Acquired : 17/06/2020 16:43:32 PM
Units : ppb
Dilution : SE MW104[] ->
CF : 1
Multiplier : 0.025

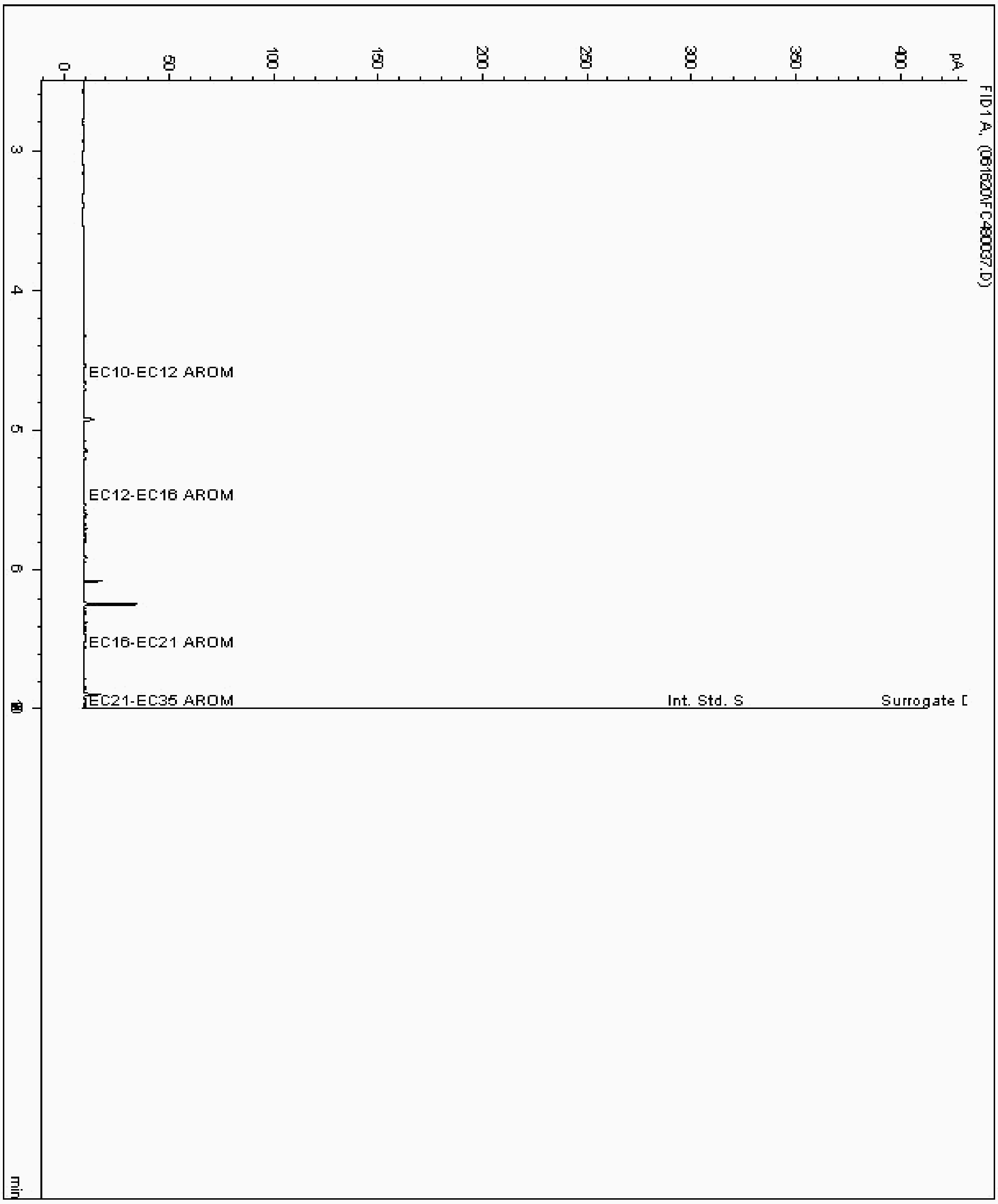


Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W) **Sample No :** 22294089 **Depth :**
Sample ID : MW102

```
Alcontrol/Geochem Analytical Services
Speciated TPH - AROM ( C12 - C40 )

Sample Identity:  20932563-
Date Acquired   :  17/06/2020 16:20:13 PM
Units           :  ppb
Dilution        :  SE MW102[]              ->
CF              :  1
Multiplier      :  0.025
```



CERTIFICATE OF ANALYSIS

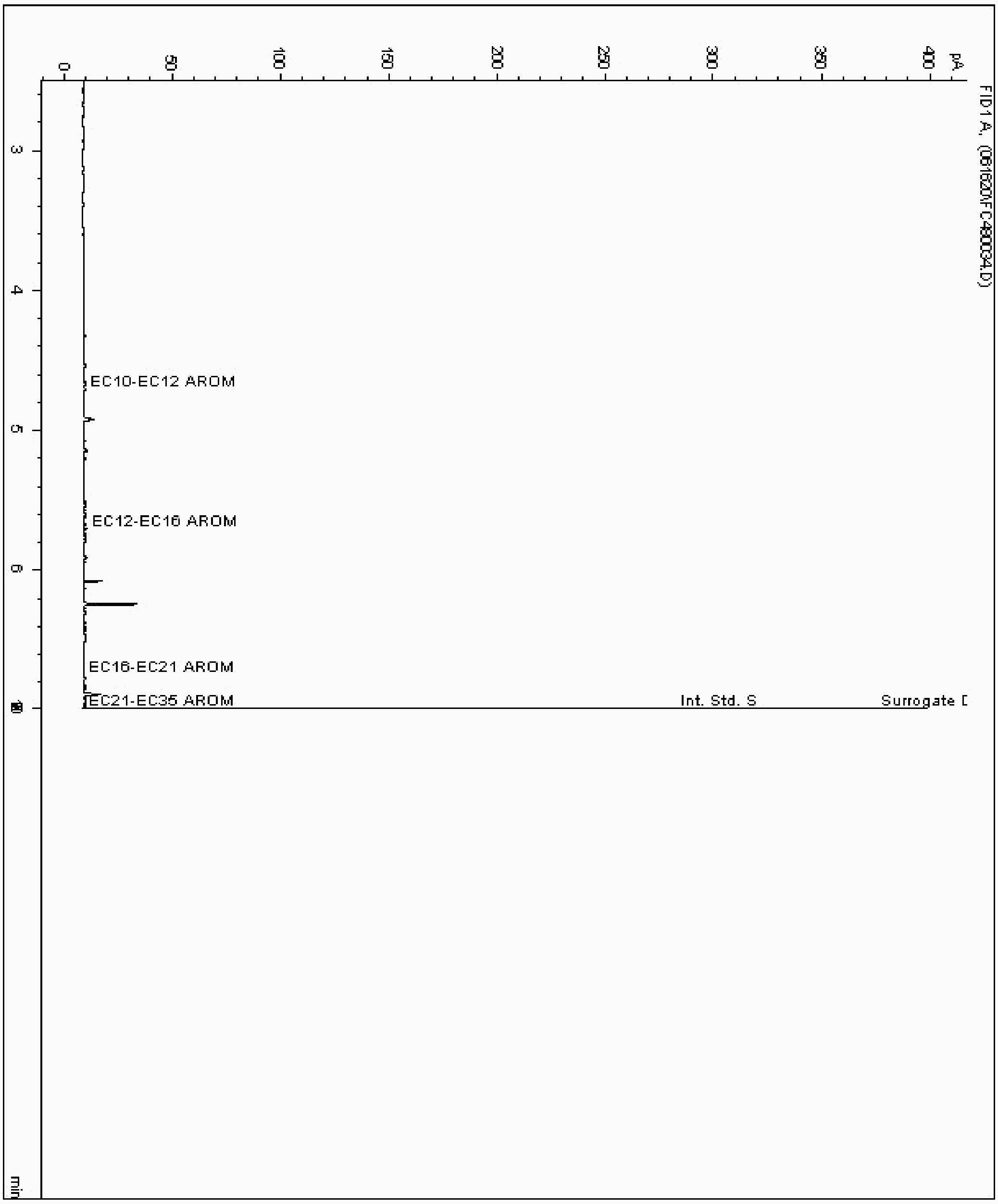
SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W) **Sample No :** 22294092 **Depth :**
Sample ID : MW105

```
Alcontrol/Geochem Analytical Services
Speciated TPH - AROM ( C12 - C40 )

Sample Identity:  20932588-
Date Acquired   :  17/06/2020 15:10:27 PM
Units           :  ppb
Dilution        :  SE MW105[]          ->
CF              :  1
Multiplier      :  0.025
```



CERTIFICATE OF ANALYSIS

Validated

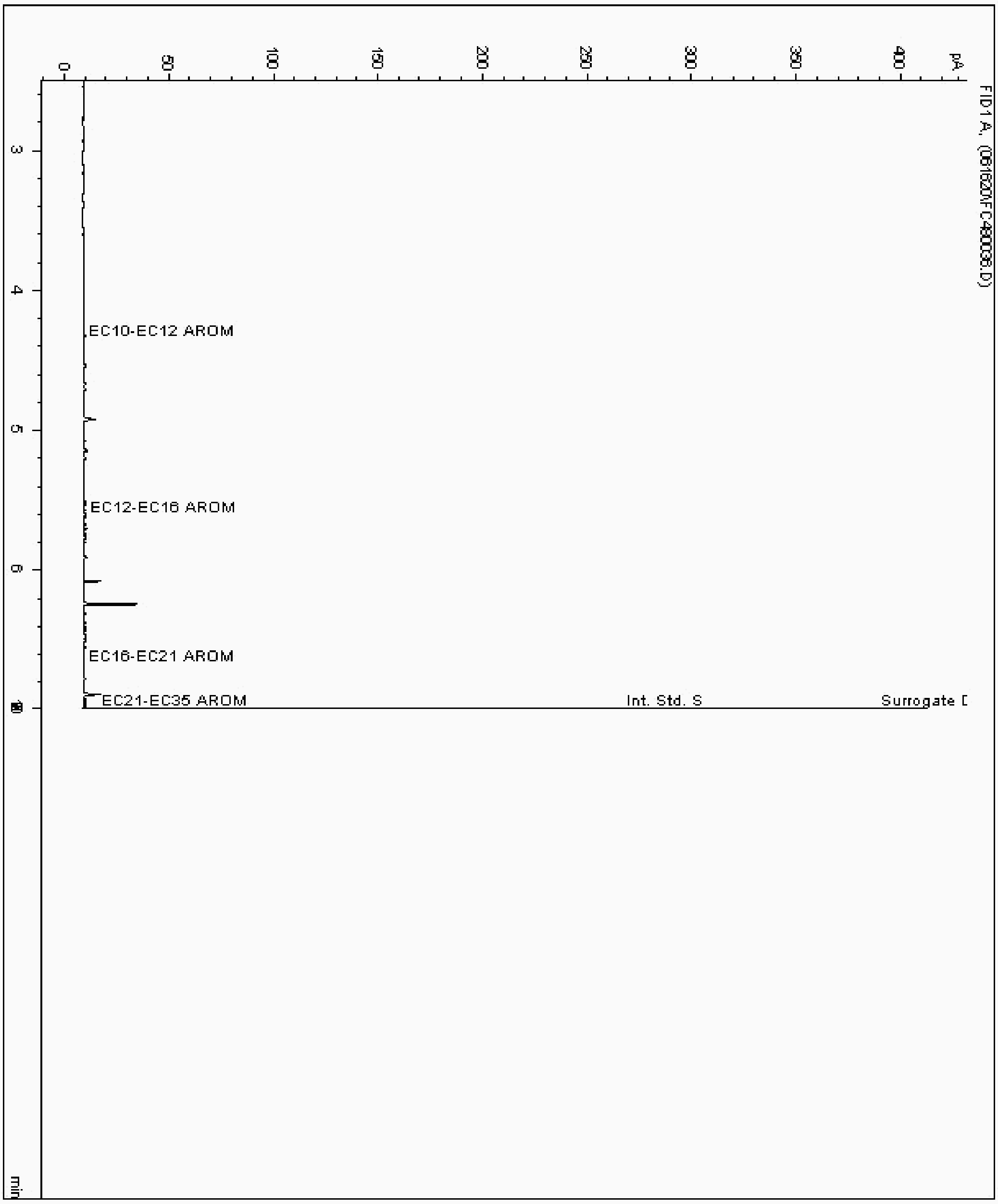
SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W) **Sample No :** 22294101 **Depth :**
Sample ID : MW103

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 20932570-
Date Acquired : 17/06/2020 15:56:45 PM
Units : ppb
Dilution : SE MW103[] ->
CF : 1
Multiplier : 0.025



CERTIFICATE OF ANALYSIS

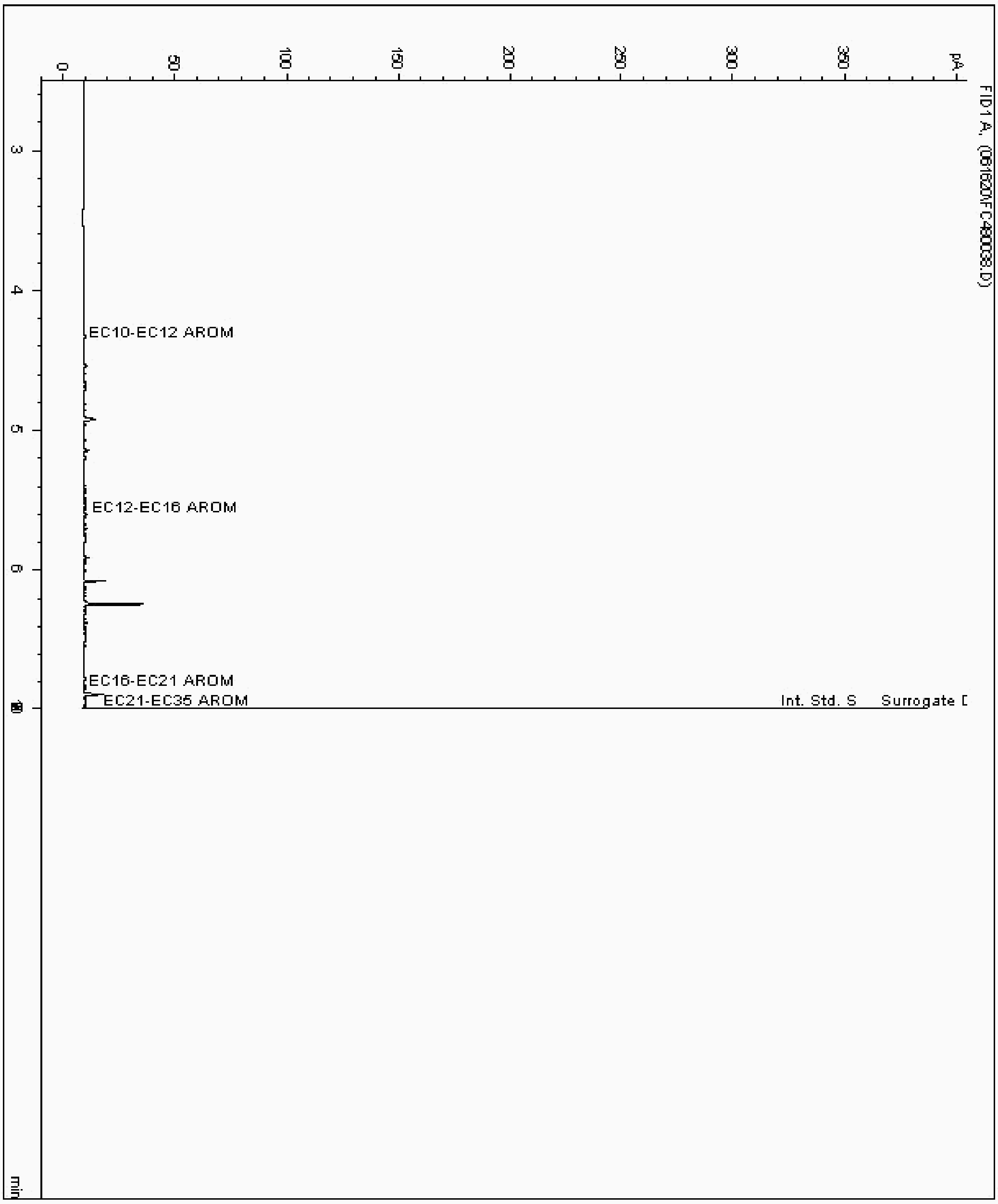
SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W) **Sample No :** 22294178 **Depth :**
Sample ID : MW104

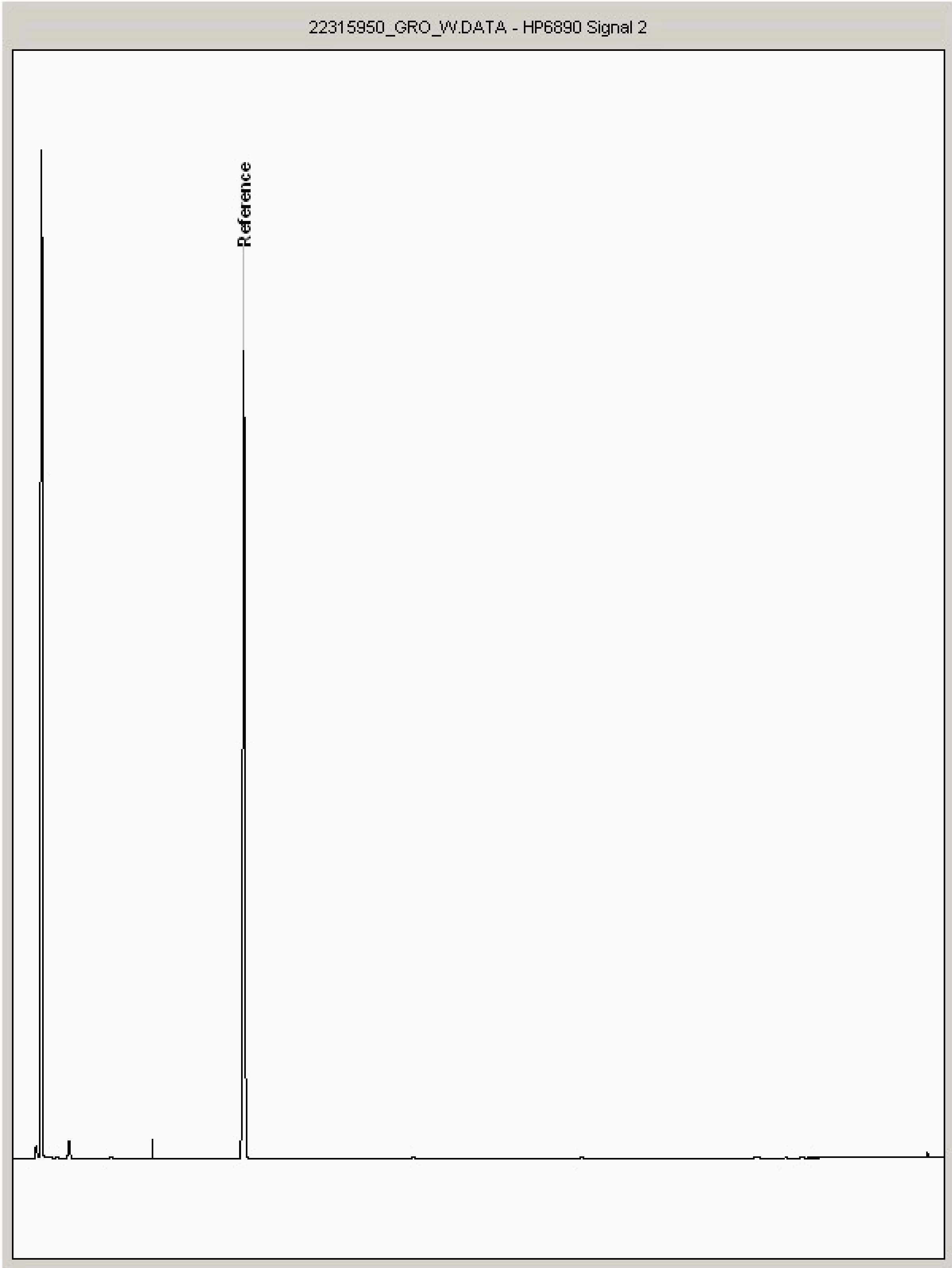
```
Alcontrol/Geochem Analytical Services
Speciated TPH - AROM ( C12 - C40 )

Sample Identity:  20932577-
Date Acquired  :  17/06/2020 16:43:32 PM
Units          :  ppb
Dilution       :  SE MW104[]          ->
CF             :  1
Multiplier     :  0.025
```



Chromatogram

Analysis: GRO by GC-FID (W) **Sample No :** 22315950 **Depth :**
Sample ID : MW105



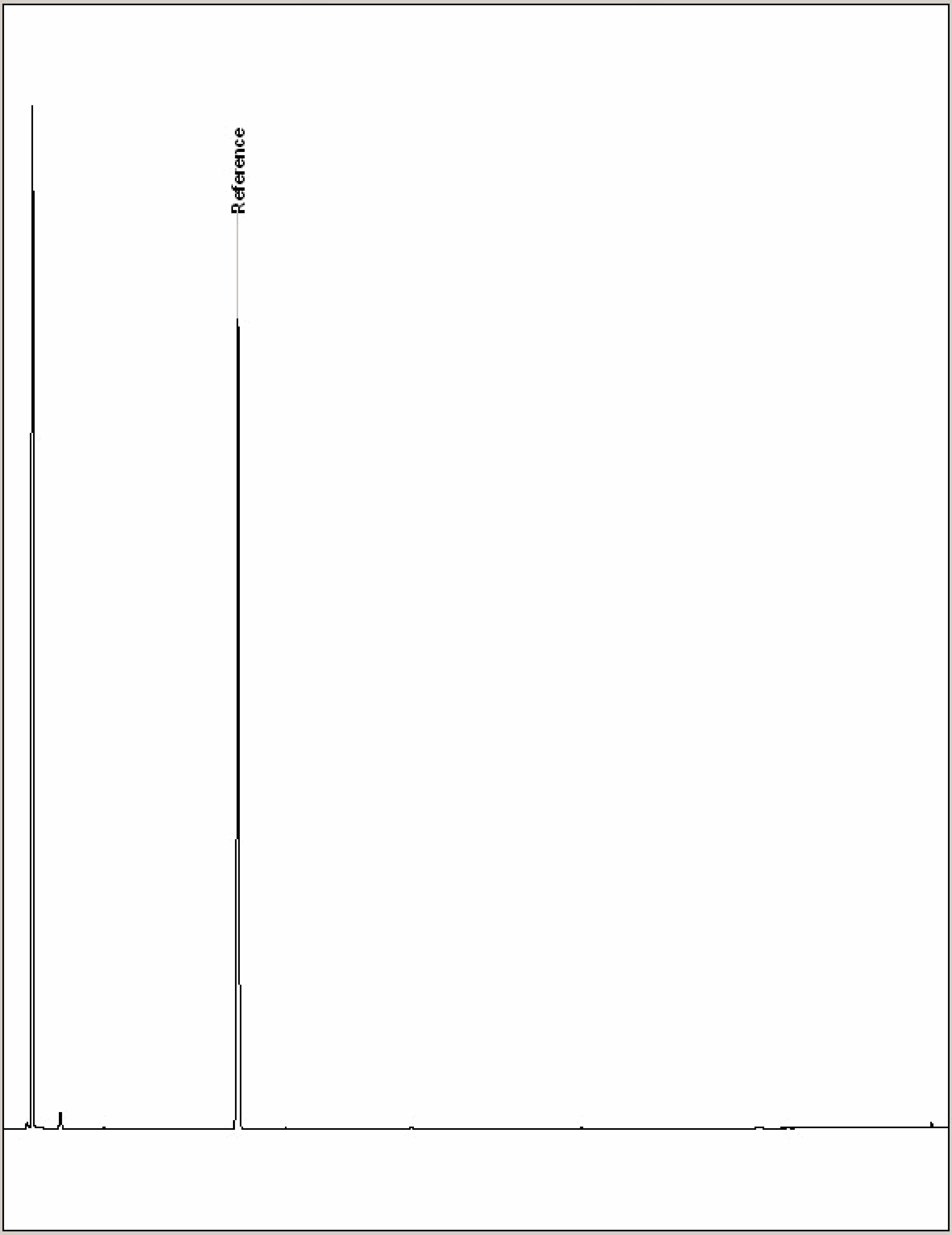
CERTIFICATE OF ANALYSIS

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

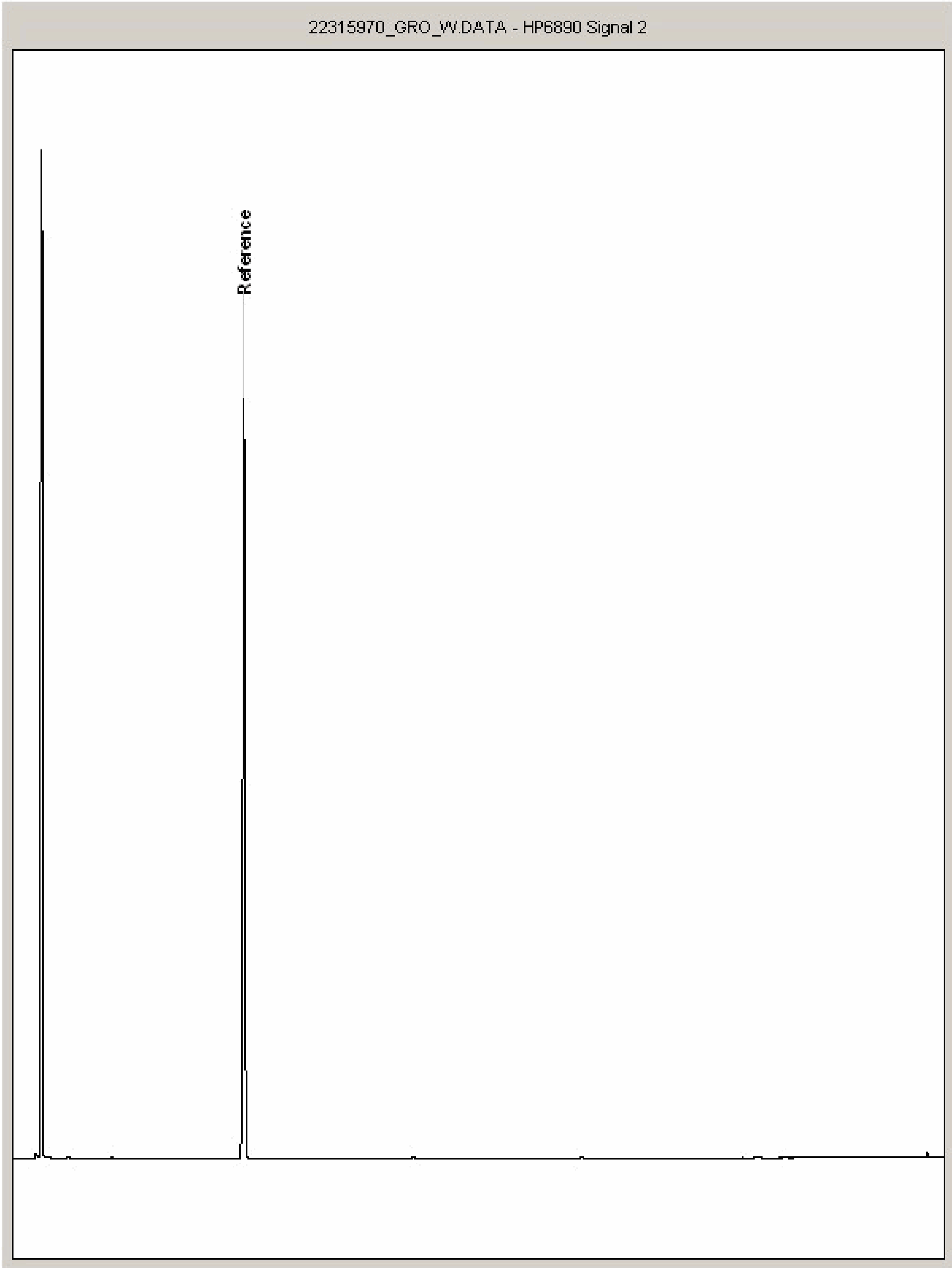
Analysis: GRO by GC-FID (W)	**Sample No :**	22315958	**Depth :**	
	Sample ID :	MW104		

22315958_GRO_W.DATA - HP6890 Signal 2



Chromatogram

Analysis:	GRO by GC-FID (W)	**Sample No :**	22315970	**Depth :**	
		Sample ID :	MW103		



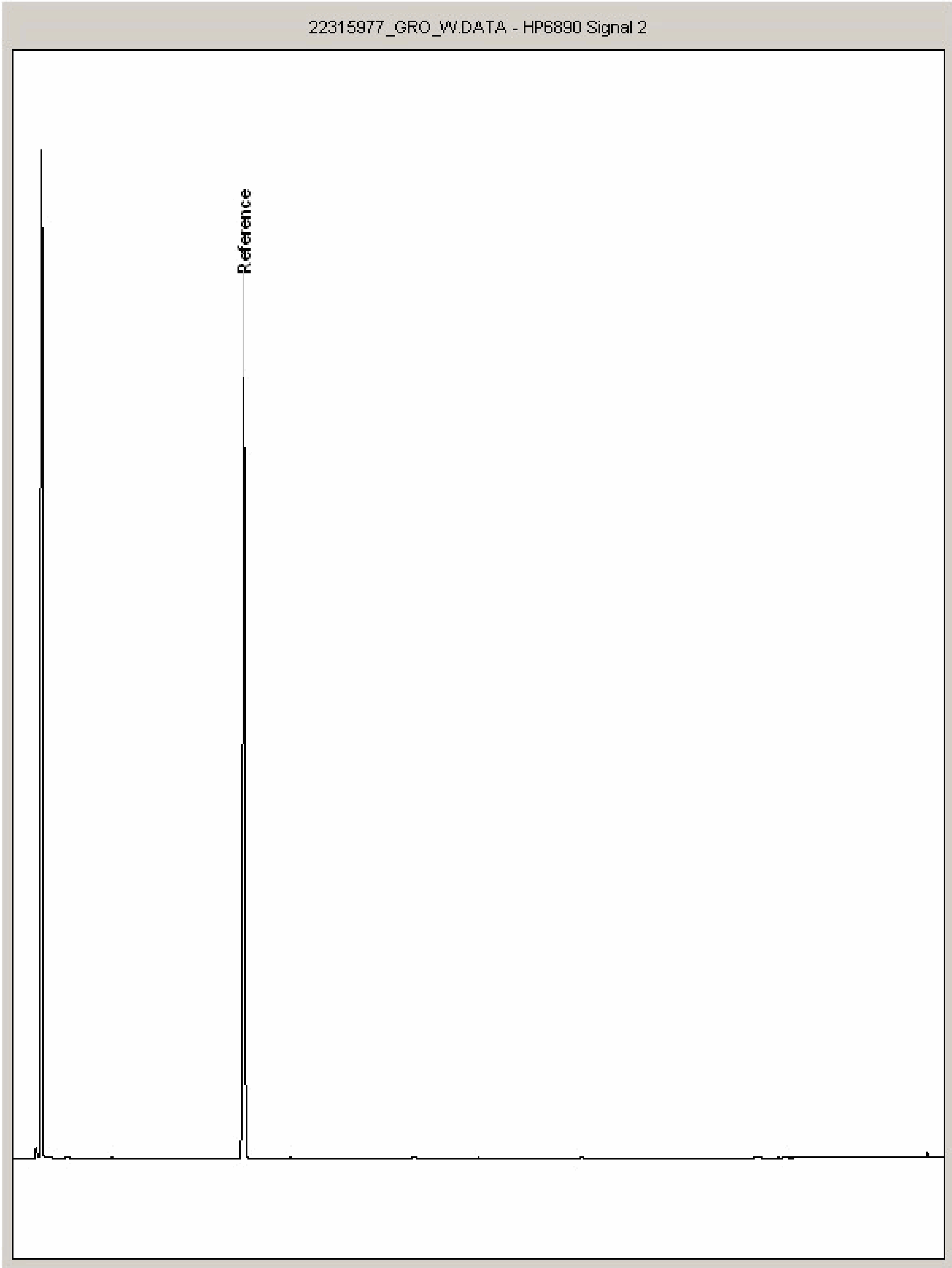
Validated

CERTIFICATE OF ANALYSIS

SDG:	200611-61	**Client Reference:**	Cookstown S.I.: 602923	**Report Number:**	555761
Location:	Cookstown, Belgard, Dubli	**Order Number:**	P2021703	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (W) **Sample No :** 22315977 **Depth :**
Sample ID : MW102



Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

18. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**

19. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.
Standing Committee of Analysts, *The Quantification of Asbestos in Soil (2017).*

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

APPENDIX E

Ground Gas Monitoring Results

GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	
Pre-Testing Remarks: Good Condition	Air Temperature: 12°C °C	Weather:	
	Weather: DRY		
	Ground Conditions: WET		
	Wind: NONE / LIGHT / MEDIUM / STRONG		
Exploratory Position ID: BH101	Monitoring Round Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)	

Device	Serial Number	Daily Check
GFM Series	15504A16	✓
	X23415 X	

Tidal State: (if applicable) n/a
High / Low / Rising / Falling
Test Number: 1

Test Sequence	Time of Monitoring 14:15		Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)
1 minute	hh:mm	sec			
Stage 1 gas flow - Initial	14:25	00	0	988	0
Stage 1 gas flow - Steady State	14:26	00	0	988	0

Gas tap: SINGLE / DOUBLE

Observations: none.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH_4	Carbon Dioxide (%/vol) CO_2	Oxygen (%/vol) O_2	Hydrogen Sulphide (ppm) H_2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
14:28	0	0.0	0.7	19.5	0	0	LLL	1.0
+	15	0.0	0.7	18.1	0	0	LLL	1.0
+	30	0.0	0.7	17.9	0	0	LLL	1.0
+	60	0.0	0.7	17.9	0	0	LLL	1.0
+	90	-0.1	0.7	17.9	0	0	LLL	0.9
+	120	-0.1	0.7	17.9	0	0	LLL	0.9
+	180	-0.1	0.7	17.9	0	0	LLL	0.9
+	240	-0.1	0.7	18.0	0	0	LLL	0.9
+	300	-0.1	0.7	18.0	0	0	LLL	0.9
+	360	-0.1	0.7	18.0	0	0	LLL	0.9
+	420	-0.1	0.7	18.1	0	0	LLL	1.0
+	480	-0.1	0.7	18.1	0	0	LLL	1.0
+	540	-0.1	0.7	18.0	0	0	LLL	0.9
14:38	600	-0.1	0.7	18.0	0	0	LLL	0.9

STAGE 3 WATER LEVEL OBSERVATION			
	Depth (from datum) to water: DRY (m)	Time: 14 : 44	LNAPL Top (from datum): n/a (m)
	Depth (from datum) to well base: 3.216 (m)		DNAPL Top (from datum): n/a (m)
	Hole Purged: Yes / No	Purge Start: DRY	
	Purge Volume: (ltrs) DRY	Purge End: DRY	

Post Testing Remarks:

none

Samples Taken: Yes / No — Gas / Water

Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK

Contract Name: Cookstown S.I	Contract Ref: 602923	Data Collected By: RM
Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 1 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100m	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good Condition	Air Temperature: 12 °C °C	Weather:	GFM Series	Same as ↑	✓
	Weather: DRY				
	Ground Conditions: WET				
Exploratory Position ID: BH102	Wind: NONE / LIGHT / MEDIUM / STRONG				
			Tidal State: (if applicable) n/a		
	Monitoring Round Number: 1		High / Low / Rising / Falling		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep		Test Number: 1		
		Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence: 1 minute	Time of Monitoring 15:06 (hh:mm)	(sec)	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
Stage 1 gas flow - Initial	15:06	00	0.6	988	0	Observations: none.
Stage 1 gas flow - Steady State	15:07	06	0.0	988	0	

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
15:09	0	0.0	0.6	18.5	0	0	LLL	1.0
+	15	-0.1	0.4	18.8	0	0	LLL	1.0
+	30	0.0	0.3	19.4	0	0	LLL	1.0
+	60	-0.0	0.3	19.9	0	0	LLL	1.0
+	90	0.0	0.1	20.1	0	0	LLL	1.0
+	120	0.0	0.1	20.4	0	0	LLL	1.0
+	180	0.0	0	20.6	0	0	LLL	1.0
+	240	0.0	0	20.6	0	0	LLL	1.0
+	300	0.0	0	20.7	0	0	LLL	1.0
+	360	-0.1	0	20.7	0	0	LLL	1.0
+	420	-0.1	0	20.6	0	0	LLL	1.0
+	480	-0.1	0	20.7	0	0	LLL	1.0
+	540	-0.1	0	20.7	0	0	LLL	1.0
15:19	600	-0.1	0	20.7	0	0	LLL	1.0

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: Dry (m)	Time: 15 : 22	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 4.550 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: DRY		
Purge Volume: (ltrs) DRY	Purge End: DRY		

Post Testing Remarks:

Small amount of wet viscous clay detected at base of BH. would not be sampled.

Samples Taken: Yes / No		Gas / Water	
Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK

Contract Name: COOKSTOWN S.T.	Contract Ref: 602913	Data Collected By: RM
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GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good Condition	Air Temperature: 12 °C	Weather:	GEM series	Same as	✓
	Weather: DRY				
	Ground Conditions: DRY				
	Wind: NONE / LIGHT / MEDIUM / STRONG		Tidal State: (if applicable) n/a		
Exploratory Position ID: BH103			High / Low / Rising / Falling		
	Monitoring Round Number: 1		Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence: 1 minute	Time of Monitoring 15:25 (hh:mm)	(sec)	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
Stage 1 gas flow - Initial	15:25	00	0.0	988	0	Observations:
Stage 1 gas flow - Steady State	15:26	00	0.0	988	0	none.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring (hh:mm)	(sec)	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
15:27	0	0.1	0.0	20.2	0	0	LLL	0.9
+	15	-0.1	0.0	20.8	0	0	LLL	0.9
+	30	-0.1	0.0	20.8	0	0	LLL	0.9
+	60	-0.1	0.0	20.7	0	0	LLL	0.9
+	90	-0.1	0.0	20.7	0	0	LLL	0.9
+	120	-0.1	0.0	20.7	0	0	LLL	0.9
+	180	-0.1	0.0	20.7	0	0	LLL	0.9
+	240	-0.1	0.0	20.7	0	0	LLL	0.9
+	300	-0.1	0.0	20.7	0	0	LLL	0.9
+	360	-0.1	0.0	20.7	0	0	LLL	0.9
+	420	-0.1	0.0	20.7	0	0	LLL	0.9
+	480	-0.1	0.0	20.7	0	0	LLL	0.9
+	540	-0.1	0.0	20.7	0	0	LLL	0.9
15:37	600	-0.1	0.0	20.7	0	0	LLL	0.9

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: DRY (m)	Time: 15:28	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 3.74 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: DRY		
Purge Volume: (ltrs) DRY	Purge End: DRY		

Post Testing Remarks:	Samples Taken: Yes / No		Gas / Water	
none.	Depth (from datum)	Sample Ref	Type	Container
			EW / G	

RSK	Contract Name: Cookstown S.I.	Contract Ref: 602923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY/RYAN MURRAY	Page: of 3/5	Checked: TBC

GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 1.00	Device	Serial Number	Daily Check

Pre-Testing Remarks: Good Condition

Air Temperature: 12 °C
Weather: DRY
Ground Conditions: DRY
Wind: NONE / LIGHT / MEDIUM / STRONG

Device	Serial Number	Daily Check
Weather: GEM Series	Same	✓

Tidal State: (if applicable) n/a
High / Low / Rising / Falling

Exploratory Position ID: BH104

Monitoring Round Number: 1

Test Number: 1

Install Type: SINGLE / DOUBLE | Pipe Ref: 1) Shallow 2) Deep | Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)

Test Sequence	Time of Monitoring hh:mm	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)
1 minute					
Stage 1 gas flow - Initial	15:56	00	0	987	0
Stage 1 gas flow - Steady State	15:57	00	0	987	0

Gas tap: SINGLE / DOUBLE

Observations: none

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	LEL (%)	PID (ppm)
15:58	0	0.0	0.0	20.2	0	0	LLL	0.9
+	15	0.1	0.5	20.1	0	0	LLL	0.9
+	30	0.1	0.5	20.2	0	0	LLL	0.9
+	60	-0.1	0.5	20.1	0	0	LLL	0.9
+	90	-0.1	0.5	20.0	0	0	LLL	0.9
+	120	-0.1	0.6	20.0	0	0	LLL	0.9
+	180	"	"	"	"	"	"	"
+	240	"	"	19.9	"	"	"	"
+	300	"	"	"	"	"	"	"
+	360	"	0.5	"	"	"	"	"
+	420	"	0.6	"	"	"	"	"
+	480	"	0.6	"	"	"	"	"
+	540	"	"	"	"	"	"	"
16:08	600	"	"	"	"	"	"	"

STAGE 3 WATER LEVEL OBSERVATION

Depth (from datum) to water: DRY (m)	Time: 16:10	LNAPL Top (from datum): n/a	(m)
Depth (from datum) to well base: 3.980 (m)		DNAPL Top (from datum): n/a	(m)
Hole Purged: Yes / No	Purge Start: DRY		
Purge Volume: (ltrs) DRY	Purge End: DRY		

Post Testing Remarks: none

Samples Taken: Yes / No | Gas / Water

Depth (from datum)	Sample Ref	Type	Container
		EW / G	

Contract Name:	Contract Ref:	Data Collected By:
COOKSTOWN S.I	602923	RM
Project Manager / Engineer: PAUL FEELY / RYAN MURRAY	Page: 4 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 05/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m)	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good Condition	Air Temperature: 12 °C Weather: DRY Ground Conditions: DRY Wind: NONE / LIGHT / MEDIUM / STRONG		GEM SERIES	Same	✓
Exploratory Position ID: BH105	Monitoring Round Number: 1		Tidal State: (if applicable) High / Low / Rising / Falling Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence: 1 minute	Time of Monitoring 16:15 (hh:mm)	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
Stage 1 gas flow - Initial	16:15	00	0.0	988	0	Observations:
Stage 1 gas flow - Steady State	16:16	60	0.0	988	0	none.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
16:17	0	-0.0	0.5	20.1	0	0	LLL	0.9
↓	15	-0.1	0.7	19.9	0	0	LLL	0.9
↓	30	-0.1	0.8	19.9	0	0	LLL	0.9
↓	60	-0.0	0.8	19.7	0	0	LLL	0.9
↓	90	-0.1	0.8	19.6	0	0	LLL	0.9
↓	120	-0.1	0.8	19.6	0	0	LLL	0.9
↓	180	-0.1	0.6	19.6	0	0	LLL	0.9
↓	240	-0.	0.9	19.5	0	0	LLL	1.0
↓	300	-0.1	0.9	19.5	0	0	LLL	1.0
↓	360	"	"	"	"	"	"	"
↓	420	"	"	"	"	"	"	"
↓	480	"	"	"	"	"	"	"
↓	540	"	"	"	"	"	"	"
16:27	600	"	"	"	"	"	"	"

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: 2.045 (m)	Time: 16:30	LNAPL Top (from datum): n/a (m)
Depth (from datum) to well base: 4.270 (m)		DNAPL Top (from datum): n/a (m)
Hole Purged: Yes / No	Purge Start: n/a	
Purge Volume: (ltrs) 3 X well volume	Purge End: n/a	

Post Testing Remarks:

none.

will sample on ROUND 2

Samples Taken: Yes / No		Gas / Water	
Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK	Contract Name: Cookstown S.T.	Contract Ref: 602923	Data Collected By: RM
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GAS MONITORING FIELD SHEET

Monitoring Date: 01/06/20	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good	Air Temperature: 14 °C Weather: DRY Ground Conditions: DRY	Weather:	GFM Series	Dublin	✓
Exploratory Position ID: BH101/MW101	Wind: NONE / LIGHT / MEDIUM / STRONG		Tidal State: (if applicable) High / Low / Rising / Falling		
	Monitoring Round Number: 2		Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence: 1 minute	Time of Monitoring 11:13am (hh:mm)	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
Stage 1 gas flow - Initial	11:13	00	-0.3	1009	-5	Observations: NONE
Stage 1 gas flow - Steady State	11:14	00	-1.0	1008	-8	

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
11:15	0	-0.3	0.1	20.1	0	0	LLL	0.8
	15	-0.3	0.4	19.9	0	0	LLL	0.8
	30	-0.3	0.5	19.6	0	0	LLL	0.8
	60	-0.3	0.5	19.5	0	0	LLL	0.8
	90	-0.3	0.5	19.4	0	0	LLL	0.8
	120	-0.3	0.5	19.4	0	0	LLL	0.8
	180	-0.3	0.5	19.4	0	0	LLL	0.8
	240	-0.3	0.5	19.4	0	0	LLL	0.8
	300	-0.3	0.5	19.4	0	0	LLL	0.8
	360	-0.3	0.5	19.4	0	0	LLL	0.8
	420							
	480							
	540							
11:25	600							

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: DRY (m)	Time: 11 : 26	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 3.200 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: n/a		
Purge Volume: (ltrs) n/a	Purge End: n/a		

Post Testing Remarks: NONE

Samples Taken: Yes / No — Gas / Water N/A

Depth (from datum)	Sample Ref	Type	Container
		EW / G	

RSK

Contract Name: Cookstown S.T.	Contract Ref: 602923	Data Collected By: RM
Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 1 of 5	Checked: TBC

GAS MONITORING FIELD SHEET

Monitoring Date: 09/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device	Serial Number	Daily Check
Pre-Testing Remarks: Good	Air Temperature: 14 °C; Weather: DRY; Ground Conditions: DRY; Wind: NONE / LIGHT / MEDIUM / STRONG	Weather:	GFM series	Dublin	✓
Exploratory Position ID: BH102 / MW102	Monitoring Round Number: 2		Tidal State: (if applicable) High / Low / Rising / Falling; Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence	Time of Monitoring (hh:mm)	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
1 minute	11:32					Observations:
Stage 1 gas flow - Initial	11:33	00	-0.3	1009	1	
Stage 1 gas flow - Steady State	11:34	00	0.0	1009	0	NONE.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring (hh:mm)	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
11:35	0	-0.2	0.5	19.9	0	0	<	0.8
	15	-0.3	0.4	20.3	0	0	<	0.8
	30	-0.3	0.4	20.3	0	0	<	0.8
	60	-0.3	0.4	20.3	0	0	<	0.8
	90	-0.3	0.4	20.3	0	0	<	0.8
	120	-0.3	0.4	20.3	0	0	<	0.8
	180	-0.3	0.4	20.3	0	0	<	0.8
	240	-0.3	0.5	20.3	0	0	<	0.8
	300	-0.3	0.5	20.3	0	0	<	0.8
	360							
	420							
	480		ALL THE SAME.					
	540							
11:45	600							

STAGE 3 WATER LEVEL OBSERVATION			
	Depth (from datum) to water: 2.305 (m)	Time: 11 : 46	LNAPL Top (from datum): n/a (m)
	Depth (from datum) to well base: 4.560 (m)		DNAPL Top (from datum): n/a (m)
	Hole Purged: Yes / No	Purge Start: 11 : 47	
	Purge Volume: (ltrs) n/a	Purge End: SEE GW DATA SHEET	

Post Testing Remarks: NONE.

Samples Taken: Yes / No — Gas / Water

Depth (from datum)	Sample Ref	Type	Container
		EW / G	
	SEE GW DATA SHEET		

RSK

Contract Name: Cookstown S.I.	Contract Ref: 602923	Data Collected By: RM
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TPF210 Issue 1

GAS MONITORING FIELD SHEET

Monitoring Date: 09/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device	Serial Number	Daily Check
Pre-Testing Remarks: GOOD	Air Temperature: 15 °C	Weather:	GEM seter	Dublin	Ox ✓
	Weather: DRY				
	Ground Conditions: DRY				
	Wind: NONE / LIGHT / MEDIUM / STRONG				
Exploratory Position ID: BH103 / MW107			Tidal State: (if applicable) High / Low / Rising / Falling		
	Monitoring Round Number: 2		Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence: 1 minute	Time of Monitoring 13:30 hh:mm	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
Stage 1 gas flow - Initial	13:30	0:0	0.0	1008	0	Observations:
Stage 1 gas flow - Steady State	13:30	0:0	0.0	1008	0	NONE.

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm)	LEL (%)	PID (ppm)
13:32	0	-0.3	0.3	19.8	0	0	LL	0.8
"	15	-0.3	0.7	20.1	0	0	LL	0.8
"	30	-0.3	0.8	19.8	0	0	LL	0.9
"	60	-0.2	0.8	19.7	0	0	"	0.9
"	90	-0.2	0.8	19.7	0	0	"	0.9
"	120	-0.3	0.8	19.7	0	0	"	0.9
"	180	-0.3	0.9	19.6	"	"	"	"
"	240	-0.3	0.9	19.6	"	"	"	"
"	300	-0.3	0.9	19.7	"	"	"	"
"	360	-0.3	0.8	19.7	"	"	"	0.8
"	420	"	"	19.8	"	"	"	"
"	480	"	"	"	"	"	"	"
"	540	"	"	"	"	"	"	"
13:42	600	"	"	"	"	"	"	"

STAGE 3 WATER LEVEL OBSERVATION			
Depth (from datum) to water: 2.242 (m)	Time: 13 : 44	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 3.770 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: 13 : 45		
Purge Volume: (ltrs) n/a	Purge End: SEE GW Sheet		

Post Testing Remarks: NONE.

Samples Taken: Yes / No		Gas / Water	
Depth (from datum)	Sample Ref	Type EW / G	Container
	SEE GW DATA SHEET		

RSK	Contract Name: Coolstown S.I	Contract Ref: 603923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 3 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: 09/06/2020	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device	Serial Number	Daily Check
Pre-Testing Remarks: GOOD.	Air Temperature: 19 °C Weather: DRY Ground Conditions: DRY Wind: NONE / LIGHT / MEDIUM / STRONG		GEM Series	DUBLIN	OK ✓
Exploratory Position ID: MW104	Monitoring Round Number: 2		Tidal State: (if applicable) High / Low / Rising / Falling Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence: 1 minute	Time of Monitoring 14:36 (hh:mm)	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)
Stage 1 gas flow - Initial	14:37	00	0.0	1008	0
Stage 1 gas flow - Steady State	14:38	00	0.0	1008	0

Gas tap: SINGLE / DOUBLE

Observations: WONG

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring (hh:mm)	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
14:39	0	-0.3	0.7	19.9	0	0	LLL	0.8
" "	15	-0.3	0.6	20.1	0	0	LLL	0.8
" "	30	-0.3	0.6	20.0	0	0	LLL	0.8
" "	60	-0.3	0.6	19.9	0	0	LLL	0.8
"	90	-0.3	0.6	19.8	0	0	LLL	0.8
"	120	-0.3	0.6	19.8	0	0	LLL	0.8
"	180	-0.3	0.6	19.8	0	0	LLL	0.8
"	240	-0.3	0.6	19.8	0	0	LLL	0.8
"	300	-0.3	0.6	19.9	0	0	LLL	0.8
"	360							
"	420							
"	480							
"	540							
14:49	600							

STAGE 3 WATER LEVEL OBSERVATION

Depth (from datum) to water: 2.085 (m)	Time: 14:50	LNAPL Top (from datum): n/a (m)	
Depth (from datum) to well base: 3.47 (m)		DNAPL Top (from datum): n/a (m)	
Hole Purged: Yes / No	Purge Start: 14:5		
Purge Volume: (ltrs) n/a	Purge End: SEE GW DATA SHEET		

Post Testing Remarks: NONE.

Samples Taken: Yes / No — Gas / Water

Depth (from datum)	Sample Ref	Type	Container
		EW / G	
	SEE GW DATA SHEET		

RSK

Contract Name: COOKSTOWN S.I	Contract Ref: 602923	Data Collected By: RM
Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 4 of 5	Checked: TBC

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GAS MONITORING FIELD SHEET

Monitoring Date: MW105	Measurement datum: GL / Top of pipe / Other TOC	Offset to GL (m) 100mm	Device C	Serial Number	Daily Check
Pre-Testing Remarks: GOOD.	Air Temperature: 15 °C Weather: DRY Ground Conditions: DRY Wind: NONE / LIGHT / MEDIUM / STRONG		Weather: GEM Series	DUBLIN	02 ✓
Exploratory Position ID: MW105	Monitoring Round Number: 2		Tidal State: (if applicable) High / Low / Rising / Falling; Test Number: 1		
Install Type: SINGLE / DOUBLE	Pipe Ref: 1) Shallow 2) Deep	Pipe Diameter: 19mm / 40mm / 50mm / Other (mm)			

Test Sequence	Time of Monitoring 15:29 hh:mm	sec	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE
1 minute						
Stage 1 gas flow - Initial	15:30	06	0	1009	0	Observations:
Stage 1 gas flow - Steady State	15.31	06	0	1008	0	NONE

STAGE 2 GAS CONCENTRATION READINGS

Time of Monitoring hh:mm	sec	Methane (%/vol) CH4	Carbon Dioxide (%/vol) CO2	Oxygen (%/vol) O2	Hydrogen Sulphide (ppm) H2S	Carbon Monoxide (ppm) CO	LEL (%)	PID (ppm)
15:32	0	-0.2	0.5	19.8	0	0	LLL	0.9
"	15	-0.2	0.1	20.7	0	0	LLL	0.9
"	30	-0.3	0.0	20.7	0	0	LLL	0.9
"	60	-0.3	0.0	20.6	0	0	LLL	0.8
"	90	-0.3	0.0	20.6	0	0	LLL	0.8
"	120	-0.3	0.0	20.6	"	"	"	"
"	180	-0.3	0.0	20.6	"	"	"	"
"	240	-0.3	0.0	20.6	"	"	"	"
"	300	"	"	"	"	"	"	"
"	360	"	"	"	"	"	"	"
"	420	"	"	"	"	"	"	"
"	480	"	"	"	"	"	"	"
"	540	"	"	"	"	"	"	"
15:42	600	"	"	"	"	"	"	"

STAGE 3 WATER LEVEL OBSERVATION			
	Depth (from datum) to water: 2.061 (m)	Time: 15:43	LNAPL Top (from datum): n/a (m)
	Depth (from datum) to well base: 4.295 (m)		DNAPL Top (from datum): n/a (m)
	Hole Purged: Yes / No	Purge Start: 15:44	
	Purge Volume: (ltrs) n/a	Purge End: SEE GW DATA SHEET	

Post Testing Remarks:

NONE

Samples Taken: Yes / No Gas / Water

Depth (from datum)	Sample Ref	Type	Container
		EW / G	
	SEE GW DATA SHEET		

RSK	Contract Name: COOKSTOWN S.I.	Contract Ref: 602923	Data Collected By: RM
	Project Manager / Engineer: PAUL FEELY / RYAN MURPHY	Page: 5 of 15	Checked: TBC

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Template release: 26/04/2018 10:57:20

Template ID: E - FB - GAS MONITORING RSK - V03

GAS MONITORING FIELD SHEET

Monitoring Date:	12/06/202	Measurement datum: TOC / GL / TOP / Other	TOC
Offset to GL (m):	100mm		
Pre-Testing Remarks:	Good Condition well leveled		
Air Temperature: °C	12°C	Device:	GFM Series
Weather:	DRY	Serial Number:	DUBLIN OFFICE
Ground Conditions:	DRY	Daily Check:	✓ flow
Wind: NONE / LIGHT / MEDIUM / STRONG	STRONG		
Tidal State: (if applicable) High / Low / Rising / Falling	LOW - 998mb		
Exploratory Position ID:	MW101	Monitoring Round Number:	3
Test Number:	1		
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW
Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm		

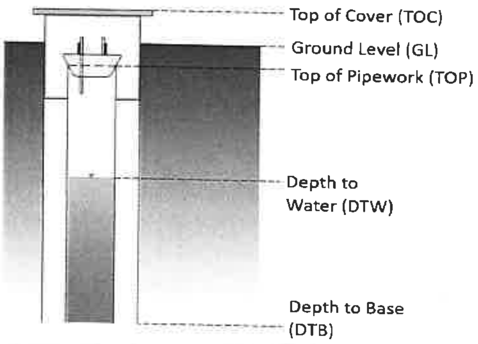
Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE GAS BUNG
Time Start (hh:mm)	11.42	11:46	998	0.0	Observations (e.g. on-site activities):	BUSY PETROL STATION
Time End (hh:mm)	11:45	11:56				

Stage 1 Flow Readings Time of flow monitoring (sec)	Stage 1 Flow Readings Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0	0			1s				
10	0	15	-0.2	0.8	18.8	0	0	<<<	0.9
15	0	30	-0.2	0.8	18.4	0	0	<<<	0.9
20	0	60	-0.2	0.8	18.3	0	0	<<<	0.9
25	0	90	-0.2	0.8	18.3	0	0	<<<	0.9
30	0	120	-0.2	0.8	18.3	0	0	<<<	0.9
40	0	180	-0.2	0.8	18.3	0	0	<<<	0.9
50	0	240	-0.2	0.8	18.3	0	0	<<<	0.9
60	0	300	-0.2	0.8	18.3	0	0	<<<	0.9
90	0	360	-0.2	0.8	18.3	0	0	<<<	0.9
120	0	420	-0.2	0.8	18.3	0	0	<<<	0.9
150	0	480	-0.2	0.8	18.3	0	0	<<<	0.9
180	0	540	-0.2	0.8	18.3	0	0	<<<	0.9
		600	-0.2	0.8	18.3	0	0	<<<	0.9
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION

Depth (from datum) to water (DTW): (m)	DRY	Time:	11:57	LNAPL Top (from datum) (m):	n/a
Depth (from datum) to well base (DTB): (m)	3.171	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	NONE - DRY
Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a		



Post testing remarks:	NONE	Samples Taken: Yes / No	NO
		Sample Media: Gas/Water	n/a
		Gas Cannister Start (mb)	n/a
		Gas Cannister End (mb)	n/a
		Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK

Contract Name:	Cookstown S.I	Data Collected By:	BRIAN C.
Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
Contract Ref:	602923	Page number:	115

GAS MONITORING FIELD SHEET

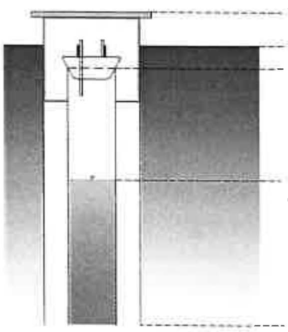
Monitoring Date:	12/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):		100mm	
Pre-Testing Remarks:		Air Temperature: °C	14°C	Device:	GFM Series		
Good Condition		Weather:	DRY	Serial Number:	DUBLIN		
		Ground Conditions:	DR	Daily Check:	✓		
		Wind: NONE / LIGHT / MEDIUM / STRONG		MEDIUM			
		Tidal State: (if applicable) High / Low / Rising / Falling		LOW			
Exploratory Position ID:	MW102	Monitoring Round Number:	3	Test Number:	1		
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)		50mm	

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	12:08	12:10	997	0	Observations (e.g. on-site activities):	BUSY PETROL STATION
Time End (hh:mm)	12:09	12:20				

Stage 1 Flow Readings Time of flow monitoring (sec)	Stage 1 Flow Readings Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0	0	-0.2	0.3	20.2	0	0	LLL	0.9
10	0	15	-0.2	0.3	20.4	0	0	"	0.9
15	0	30	-0.2	0.3	20.4	0	0	"	0.9
20	0	60	-0.2	0.3	20.2	0	0	"	0.9
25	0	90	-0.2	0.3	20.2	0	0	"	0.9
30	0	120	-0.3	0.3	20.2	0	0	"	0.9
40	0	180	-0.2	0.3	20.2	0	0	"	"
50	0	240	-0.2	0.3	20.2	0	0	"	"
60	0	300	"	"	"	"	"	"	"
90	0	360	"	"	"	"	"	"	
120	0	420	"	"	"	"	"	"	"
150	0	480	"	"	"	"	"	"	"
180	0	540	"	"	"	"	"	"	"
		600	"	"	"	"	"	"	"

Stage 1 gas flow - Peak (l/h)	0	Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.
Stage 1 gas flow - Steady State (l/h)	0	

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	2.093	Time:	12:20	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	4.575	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	n/a
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a		



Post testing remarks:	Samples Taken: Yes / No	NO
NONE.	Sample Media: Gas/Water	n/a
	Gas Cannister Start (mb)	n/a
	Gas Cannister End (mb)	n/a
	Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK	Contract Name:	Coolstown S.I	Data Collected By:	RYAN
	Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
	Contract Ref:	602973	Page number:	2/5

GAS MONITORING FIELD SHEET

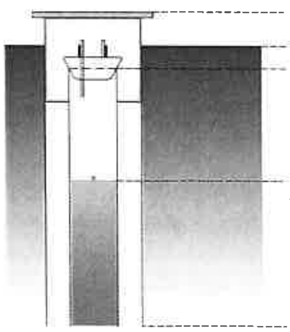
Monitoring Date:	12/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	0.15mm
Pre-Testing Remarks:		Air Temperature: °C	12°C	Device:	GFM
Good Condition		Weather:	OVERCAST	Serial Number:	DUBLIN OFFICE
		Ground Conditions:		Daily Check:	✓
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT	
		Tidal State: (if applicable) High / Low / Rising / Falling		LOW + FALLING	
Exploratory Position ID:	MW103	Monitoring Round Number:	3/5	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50 mm

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	12:34	13:38	997	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	12:37	13:48			NONE	

Stage 1 Flow Readings	Stage 1 Flow Readings	Stage 2 Gas Monitoring:	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
Time of flow monitoring (sec)	Flow Reading (l/hr)	Time of gas monitoring (sec)							
5	0.0	0	-0.2	0.8	19.3	0	0	<<<	0.9
10	0.0	15	-0.2	0.8	19.8	0	0	<<<	0.9
15	0.0	30	-0.2	0.8	19.6	0	0	<<<	0.9
20	0.0	60	-0.2	0.8	19.5	0	0	<<<	0.9
25	0.0	90	-0.2	0.8	19.5	0	0	<<<	0.9
30	0.0	120	-0.2	0.8	19.5	0	0	<<<	0.9
40	0.0	180	-0.2	0.8	19.5	0	0	<<<	0.9
50	0.0	240	-0.2	0.8	19.5	0	0	<<<	0.9
60	0.0	300	"	"	"	"	"	"	"
90	0.0	360	"	"	"	"	"	"	"
120	0.0	420	"	"	"	"	"	"	"
150	0.0	480	"	"	"	"	"	"	"
180	0.0	540	"	"	"	"	"	"	"
		600	"	"	"	"	"	"	"

Stage 1 gas flow - Peak (l/h)	0.0	**Note:** Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.
Stage 1 gas flow - Steady State (l/h)	0.0	

STAGE 3 WATER LEVEL OBSERVATION					
Depth (from datum) to water (DTW): (m)	2.073	Time:	12:52	LNAPL Top (from datum) (m):	N/A
Depth (from datum) to well base (DTB): (m)	3.728	Purge Start:	N/A	DNAPL Top (from datum) (m):	N/A
Hole Purged: Yes / No	NO	Purge End:	N/A	Water Observations:	
Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	N/A	NONE	



Post testing remarks:		
NONE	Samples Taken: Yes / No	NO
	Sample Media: Gas/Water	n/a
	Gas Cannister Start (mb)	n/a
	Gas Cannister End (mb)	n/a
	Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK	Contract Name: Cookstown S.I	Data Collected By:	RYAN
	Project Manager / Engineer: PAUL FEELY	Checked:	TBC
	Contract Ref: 607923	Page number:	4/5

GAS MONITORING FIELD SHEET

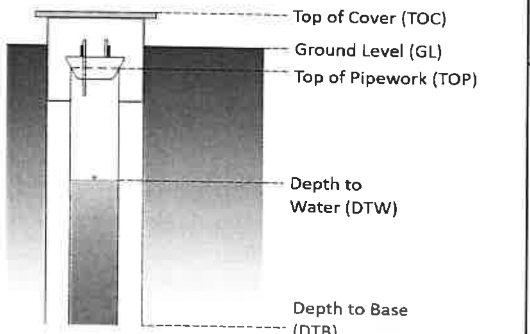
Monitoring Date:	12/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	0.15m
Pre-Testing Remarks:		Air Temperature: °C	12°C	Device:	GFM Series
Good Condition		Weather:	Overcast	Serial Number:	Dublin Office
		Ground Conditions:		Daily Check:	✓
		Wind: NONE / LIGHT / MEDIUM / STRONG			LIGHT
		Tidal State: (if applicable) High / Low / Rising / Falling			Low + Falling
Exploratory Position ID:	MW104	Monitoring Round Number:	3/4	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	12:55	12:59	997	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	12:58	13:09			None	

Stage 1 Flow Readings: Time of flow monitoring (sec)	Stage 1 Flow Readings: Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0.0	0	-0.2	0.8	19.4	0	0	<<<	0.9
10	0.0	15	-0.2	0.6	19.9	0	0	<<<	0.9
15	0.0	30	-0.2	0.6	19.7	0	0	<<<	0.9
20	0.0	60	-0.2	0.6	19.6	0	0	<<<	0.9
25	0.0	90	-0.2	0.6	19.6	0	0	<<<	0.9
30	0.0	120	-0.2	0.6	19.6	0	0	<<<	0.9
40	0.0	180	-0.2	0.6	19.6	0	0	<<<	0.9
50	0.0	240	-0.2	0.6	19.5	0	0	<<<	0.9
60	0.0	300	-0.2	0.6	19.6	0	0	<<<	0.9
90	0.0	360	-0.2	0.6	19.5	0	0	<<<	0.9
120	0.0	420	-0.2	0.6	19.5	0	0	<<<	0.9
150	0.0	480	-0.2	0.6	19.5	0	0	<<<	0.9
180	0.0	540	-0.2	0.6	19.5	0	0	<<<	0.9
		600	-0.2	0.6	19.5	0	0	<<<	0.9
Stage 1 gas flow - Peak (l/h)	0.0								
Stage 1 gas flow - Steady State (l/h)	0.0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION					
Depth (from datum) to water (DTW): (m)	1.926	Time:	13:13	LNAPL Top (from datum) (m):	n/a
Depth (from datum) to well base (DTB): (m)	3.470	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
Hole Purged: Yes / No	No	Purge End:	n/a	Water Observations:	
Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a		NONE



Post testing remarks:	Samples Taken: Yes / No	NO
NONE	Sample Media: Gas/Water	N/A
	Gas Cannister Start (mb)	N/A
	Gas Cannister End (mb)	n/a
	Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	None		

Contract Name:	Cookstown S.I.	Data Collected By:	Ryan
Project Manager / Engineer:	Paul Feely	Checked:	TBC
Contract Ref:	602973	Page number:	4/5

GAS MONITORING FIELD SHEET

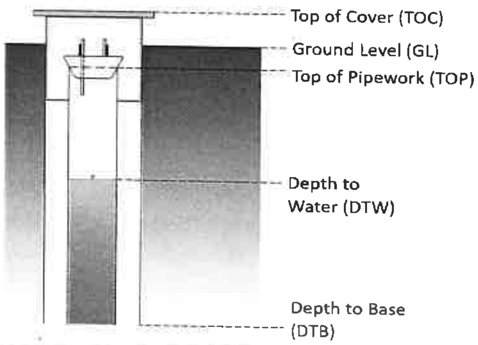
Monitoring Date:	12/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	0.20 m
Pre-Testing Remarks: Good Condition		Air Temperature: °C	12°C	Device:	GFM Series
		Weather:	OVERCAST	Serial Number:	DUBLIN OFFICE
		Ground Conditions:	DRY	Daily Check:	✓
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT	
		Tidal State: (if applicable) High / Low / Rising / Falling		LOW + FALLING	
Exploratory Position ID:	MW105	Monitoring Round Number:	3/4	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	13:13	13:17	997	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	13:16	13:27			NONE.	

Stage 1 Flow Readings Time of flow monitoring (sec)	Stage 1 Flow Readings Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0.0	0	-0.2	0.6	19.5	0	0	<LL	0.9
10	0.0	15	-0.2	0.3	20.3	0	0	<LL	0.9
15	0.0	30	-0.2	0.3	20.2	0	0	<LL	0.9
20	0.0	60	-0.2	0.3	20.1	0	0	<LL	0.9
25	0.0	90	-0.2	0.3	20.0	0	0	<LL	0.9
30	0.0	120	-0.2	0.3	20.0	0	0	<LL	0.9
40	0.0	180	-0.2	0.3	20.0	0	0	<LL	0.9
50	0.0	240	-0.2	0.3	20.0	0	0	<LL	0.9
60	0.0	300	-0.2	0.3	20.0	0	0	<LL	0.9
90	0.0	360	-0.2	0.3	20.0	0	0	<LL	0.9
120	0.0	420	-0.2	0.3	20.0	0	0	<LL	0.9
150	0.0	480	-0.2	0.3	20.0	0	0	<LL	0.9
180	0.0	540	-0.2	0.3	20.0	0	0	<LL	0.9
		600	-0.2	0.3	20.0	0	0	<LL	0.9
Stage 1 gas flow - Peak (l/h)	0.0								
Stage 1 gas flow - Steady State (l/h)	0.0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	1.875	Time:	13:38	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	3.105	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:		
NONE	Samples Taken: Yes / No	NO
	Sample Media: Gas/Water	n/a
	Gas Cannister Start (mb)	n/a
	Gas Cannister End (mb)	n/a
	Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK

Contract Name:	Cookstown S.I.	Data Collected By:	RYAN
Project Manager / Engineer:	PAUL FEEL	Checked:	TBC
Contract Ref:	602925	Page number:	5/5

GAS MONITORING FIELD SHEET

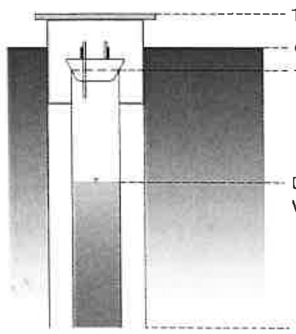
Monitoring Date:	15/06/2021	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	100mm	100mm	
Pre-Testing Remarks:		Air Temperature: °C	16	Device:	DUBLIN		
GOOD		Weather:	DRY	Serial Number:	GFM SERIES		
		Ground Conditions:	DRY	Daily Check:	✓		
		Wind: NONE / LIGHT / MEDIUM / STRONG		NONE			
		Tidal State: (if applicable) High / Low / Rising / Falling	HIGH	HIGH			
Exploratory Position ID:	MW101	Monitoring Round Number:	4/4	Test Number:	1		
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm		

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	14:22	14:24	1004	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	14:23	14:34			NONE	

Stage 1 Flow Readings Time of flow monitoring (sec)	Stage 1 Flow Readings Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0	0	-0.1	0.3	20.8	0	0	LLL	0.9
10	0	15	-0.1	0.3	20.7	"	"	"	0.9
15	0	30	-0.1	0.4	20.5	"	"	"	0.9
20	0	60	-0.1	0.4	20.2	"	"	"	0.9
25	0	90	-0.1	0.4	20.1	"	"	"	0.9
30	0	120	-0.1	0.5	20.1	"	"	"	0.9
40	0	180	-0.1	0.5	20.1	"	"	"	0.9
50	0	240	-0.1	0.5	20.1	"	"	"	0.9
60	0	300	"	"	"	"	"	"	"
90	0	360	"	"	"	"	"	"	"
120	0	420	"	"	"	"	"	"	"
150	0	480	"	"	"	"	"	"	"
180	0	540	"	"	"	"	"	"	"
		600	"	"	"	"	"	"	"
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION					
Depth (from datum) to water (DTW): (m)	DRY	Time:	n/a	LNAPL Top (from datum) (m):	n/a
Depth (from datum) to well base (DTB): (m)	3.220	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
Purge Volume: (ltrs)	N/A	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:				
NONE	Samples Taken: Yes / No	NO		
	Sample Media: Gas/Water	n/a		
	Gas Cannister Start (mb)	n/a		
	Gas Cannister End (mb)	n/a		
	Gas Cannister Duration (mins)	n/a		
	Depth (from datum)	Sample Ref	Type (EW / G)	Container
		NONE		

RSK	Contract Name:	COOKSTOWN S.I	Data Collected By:	RYAN
	Project Manager / Engineer:	PAUL FEELY	Checked:	TRC
	Contract Ref:	602973	Page number:	1/5

GAS MONITORING FIELD SHEET

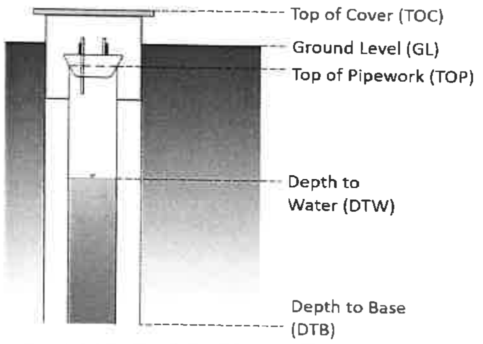
Monitoring Date:	15/06/20	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):		100mm	
Pre-Testing Remarks:		Air Temperature: °C	15	Device:	GFM Series		
Good		Weather:	DRY	Serial Number:	DUBLIN OFFICE		
		Ground Conditions:	DRY	Daily Check:	✓		
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT			
		Tidal State: (if applicable) High / Low / Rising / Falling		HIGH			
Exploratory Position ID:	MW102	Monitoring Round Number:	4/4	Test Number:	1		
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm		

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	14:46	14:48	1003	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	14:47	14:58			NONE	

Stage 1 Flow Readings: Time of flow monitoring (sec)	Stage 1 Flow Readings: Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0	0	-0.1	0.4	20.7	0	0	LLL	0.9
10	0	15	-0.1	0.3	20.8	"	"	LLL	0.9
15	0	30	-0.1	0.3	20.9	"	"	LLL	0.9
20	0	60	-0.1	0.3	20.9	"	"	"	"
25	0	90	"	"	20.9	"	"	"	"
30	0	120	"	"	20.8	"	"	"	"
40	0	180	"	"	20.7	"	"	"	"
50	0	240	"	"	"	"	"	"	"
60	0	300	"	"	"	"	"	"	"
90	0	360	"	0.4	"	"	"	"	"
120	0	420	"	"	"	"	"	"	"
150	0	480	"	0.3	"	"	"	"	"
180	0	540	"	"	"	"	"	"	"
		600	"	"		"	"	"	"
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	2.032	Time:	n/a	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	4.600	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	none	



Post testing remarks:	Samples Taken: Yes / No	NO		
NONE	Sample Media: Gas/Water	n/a		
	Gas Cannister Start (mb)	n/a		
	Gas Cannister End (mb)	n/a		
	Gas Cannister Duration (mins)	n/a		
	Depth (from datum)	Sample Ref	Type (EW / G)	Container
		NONE		

RSK	Contract Name:	COOKSTOWN S.I.	Data Collected By:	RYAN
	Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
	Contract Ref:	602923	Page number:	5/5

GAS MONITORING FIELD SHEET

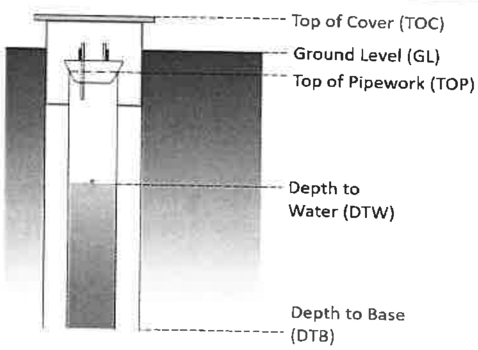
Monitoring Date: 13/06/20[illegible]	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	100 mm	
Pre-Testing Remarks:	Air Temperature: °C	16	Device:	GFM Series	
Good	Weather:	DRY	Serial Number:	DUBLIN	
	Ground Conditions:	DRY	Daily Check:	✓	
	Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT		
	Tidal State: (if applicable) High / Low / Rising / Falling		HIGH		
Exploratory Position ID: MW03	Monitoring Round Number:	8/4	Test Number:	1	
Install Type: SINGLE / DOUBLE: SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm	

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	14:54	14:56	1003	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	14:55	15:06			NONE	

Stage 1 Flow Readings Time of flow monitoring (sec)	Stage 1 Flow Readings Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0	0	0.6	0.3	20.3	0	0	<LL	0.9
10	0	15	0	0.6	20.4	"	"	"	"
15	0	30	0	0.7	20.3	"	"	"	"
20	0	60	0	0.7	20.2	"	"	"	"
25	0	90	0	0.7	20.1	"	"	"	"
30	0	120	0	0.7	20.1	"	"	"	"
40	0	180	0	"	"	"	"	"	"
50	0	240	0	"	"	"	"	"	"
60	0	300	0	"	"	"	"	"	"
90	0	360	0	"	"	"	"	"	"
120	0	420	0	"	"	"	"	"	"
150	0	480	0	"	"	"	"	"	"
180	0	540	0	"	"	"	"	"	"
		600	0	"	"	"	"	"	"
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION					
Depth (from datum) to water (DTW): (m)	1.960	Time:	n/a	LNAPL Top (from datum) (m):	n/a
Depth (from datum) to well base (DTB): (m)	3.760	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:				
NONE	Samples Taken: Yes / No	NO		
	Sample Media: Gas/Water	n/a		
	Gas Cannister Start (mb)	n/a		
	Gas Cannister End (mb)	n/a		
	Gas Cannister Duration (mins)	n/a		
	Depth (from datum)	Sample Ref	Type (EW / G)	Container
		NONE		

Contract Name:	COOKSTOWN ST	Data Collected By:	RYAN
Project Manager / Engineer:	PAUL FEELY	Checked:	TBC
Contract Ref:	602923	Page number:	8/5

GAS MONITORING FIELD SHEET

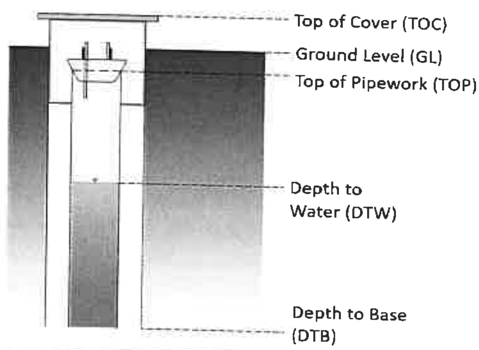
Monitoring Date:	15/06/2020	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	60mm
Pre-Testing Remarks: Good		Air Temperature: °C	17°C	Device:	GFM Series
		Weather:	DRY	Serial Number:	DUBLIN OFFICE
		Ground Conditions:	DRY	Daily Check:	✓
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT	
		Tidal State: (if applicable) High / Low / Rising / Falling		HIGH	
Exploratory Position ID:	MW04	Monitoring Round Number:	414	Test Number:	1
Install Type: SINGLE / DOUBLE		Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	15:14	15:16	1005	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	15:15	15:17			NONE	

Stage 1 Flow Readings Time of flow monitoring (sec)	Stage 1 Flow Readings Flow Reading (l/hr)	Stage 2 Gas Monitoring: Time of gas monitoring (sec)	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
5	0	0	0	0.6	20.3	0	0	LLL	0.9
10	0	15	0	0.6	20.4	0	0	LLL	0.9
15	0	30	0	0.6	20.2	0	0	LLL	0.9
20	0	60	0	0.6	20.1	-10	"	"	"
25	0	90	0	"	20.0	-10	"	"	"
30	0	120	0	"	"	0	"	"	"
40	0	180	"	"	"	"	"	"	"
50	0	240	"	"	"	"	"	"	"
60	0	300	"	"	"	"	"	"	"
90	0	360	"	"	"	"	"	"	"
120	0	420	"	"	"	"	"	"	"
150	0	480	"	"	"	"	"	"	"
180	0	540	"	"	"	"	"	"	"
		600	"	"	"	"	"	"	"
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	1.834	Time:	n/a	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	3.500	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	no	Purge End:	n/a	Water Observations:	
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:	Samples Taken: Yes / No	NO
NONE	Sample Media: Gas/Water	n/a
	Gas Cannister Start (mb)	n/a
	Gas Cannister End (mb)	n/a
	Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK

Contract Name:	COOKSTOWN ST	Data Collected By:	RYAN
Project Manager / Engineer:	PAUL EFELY	Checked:	TBC
Contract Ref:	602992 3	Page number:	45

GAS MONITORING FIELD SHEET

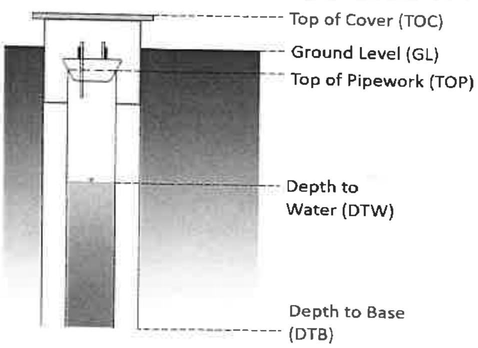
Monitoring Date:	15/08/2026	Measurement datum: TOC / GL / TOP / Other	TOC	Offset to GL (m):	100mm
Pre-Testing Remarks:		Air Temperature: °C	17°C	Device:	GFM Series
GOOD.		Weather:	DRY	Serial Number:	DUBLIN
		Ground Conditions:	DRY	Daily Check:	
		Wind: NONE / LIGHT / MEDIUM / STRONG		LIGHT	
		Tidal State: (if applicable) High / Low / Rising / Falling		HIGH	
Exploratory Position ID:	MW105	Monitoring Round Number:	414	Test Number:	1
Install Type: SINGLE / DOUBLE	SINGLE	Pipe Ref: 1) Shallow 2) Deep	SHALLOW	Pipe Diameter: 19mm/ 40mm / 50mm / Other (mm)	50mm

Time of Monitoring (hh:mm)	Flow readings	Gas readings	Atmospheric Pressure (mb)	Differential Pressure (mb)	Gas tap: SINGLE / DOUBLE	SINGLE
Time Start (hh:mm)	15:24	15:26	1003	0	Observations (e.g. on-site activities):	
Time End (hh:mm)	15:25	15:36			NONE	

Stage 1 Flow Readings	Stage 1 Flow Readings	Stage 2 Gas Monitoring:	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	Carbon monoxide (ppm)	Hydrogen sulphide (ppm)	LEL (%)	PID (ppm)
Time of flow monitoring (sec)	Flow Reading (l/hr)	Time of gas monitoring (sec)							
5	0	0	0	0.4	20.2	0	0	LLL	1.0
10	0	15	0	0.3	20.2	"	"	"	"
15	0	30	0	0.3	20.3	"	"	"	"
20	0	60	0	0.3	20.3	"	"	"	"
25	0	90	0	0.3	20.2	"	"	"	"
30	0	120	0	"	20.2	"	"	"	"
40	0	180	0	"	20.1	"	"	"	"
50	0	240	0	"	"	"	"	"	"
60	0	300	0	"	"	"	"	"	"
90	0	360	0	"	"	"	"	"	"
120	0	420	0	"	"	"	"	"	"
150	0	480	0	"	"	"	"	"	"
180	0	540	0	"	"	"	"	"	"
		600	0	"	"	"	"	"	"
Stage 1 gas flow - Peak (l/h)	0								
Stage 1 gas flow - Steady State (l/h)	0								

Note: Flow should be recorded at 5 second intervals up to 30 seconds, 10 second intervals to 2 minutes and 30 second intervals up to 3 minutes or until steady-state readings are obtained. Typically, steady state conditions occur within 30 seconds to a minute. The differential pressure reading (in Pa) should also be recorded during this period.

STAGE 3 WATER LEVEL OBSERVATION						
	Depth (from datum) to water (DTW): (m)	1.822	Time:	n/a	LNAPL Top (from datum) (m):	n/a
	Depth (from datum) to well base (DTB): (m)	4.295	Purge Start:	n/a	DNAPL Top (from datum) (m):	n/a
	Hole Purged: Yes / No	NO	Purge End:	n/a	Water Observations:	
	Purge Volume: (ltrs)	n/a	Post-Purge (DTW) (m)	n/a	NONE	



Post testing remarks:	Samples Taken: Yes / No	NO
NONE	Sample Media: Gas/Water	n/a
	Gas Cannister Start (mb)	n/a
	Gas Cannister End (mb)	n/a
	Gas Cannister Duration (mins)	n/a

Depth (from datum)	Sample Ref	Type (EW / G)	Container
	NONE		

RSK				
Contract Name:	COOKSTOWN ST		Data Collected By:	RYAN
Project Manager / Engineer:		PAUL FEELY	Checked:	TRC
Contract Ref:	602973		Page number:	5/5

APPENDIX F

Generic Assessment Criteria for a Residential Without Home Produce Site Use

Generic assessment criteria for human health: residential scenario without home-grown produce

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009[1]. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009[2]. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)[3,4], as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)[5] used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010[3]). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and adopts them as GAC for these six substances.

For all other substances the C4SL exposure modifications relevant for residential without home-grown produce end use have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) and reducing exposure frequency for dermal contact outdoors.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015[7] or by the USEPA[14], where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.071, supporting EA guidance[5,8,9] and revised exposure scenarios published for the C4SL[3]. The SAC are also termed GAC.

Conceptual model

In accordance with SR3[5], the residential without home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In accordance with Box 3.1 of SR3[5], the pathways considered for production of the SAC in the residential without home-grown produce scenario are

- direct soil and dust ingestion in areas of soft landscaping
- dermal contact with soil and indoor dust

- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium[(1)], the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh}, are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[(9)]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[(9)]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[(9)]:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[(9)], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[(9)], which explains how to calculate an effective assessment criterion manually.

SR3[(5)] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[10], the EA TOX[1] reports, the C4SL SP1010 project report and associated appendices[3,6], the 2015 LQM/CIEH report[7] or the USEPA IRIS database[14]. Where a C4SL has been published, the RSK GAC have duplicated the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and has adopted them as GAC for these six substances. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[11].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the residential without home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. SR3[5] notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3[3], with a dust loading factor detailed in Section 9.3 of SR3[5]. The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3[5]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

Summary of modifications to the default CLEA SR3[5] input parameters for residential without home-grown produce

In summary, the RSK GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3[5]. Modifications to the default SR3[5] exposure scenarios based on the C4SL exposure scenarios[3] are presented in Table 2 below.

The final selected GAC are presented by pathway in Table 3 and the combined GAC in Table 4.

Figure 1: Conceptual model for CLEA residential scenario without home-grown produce

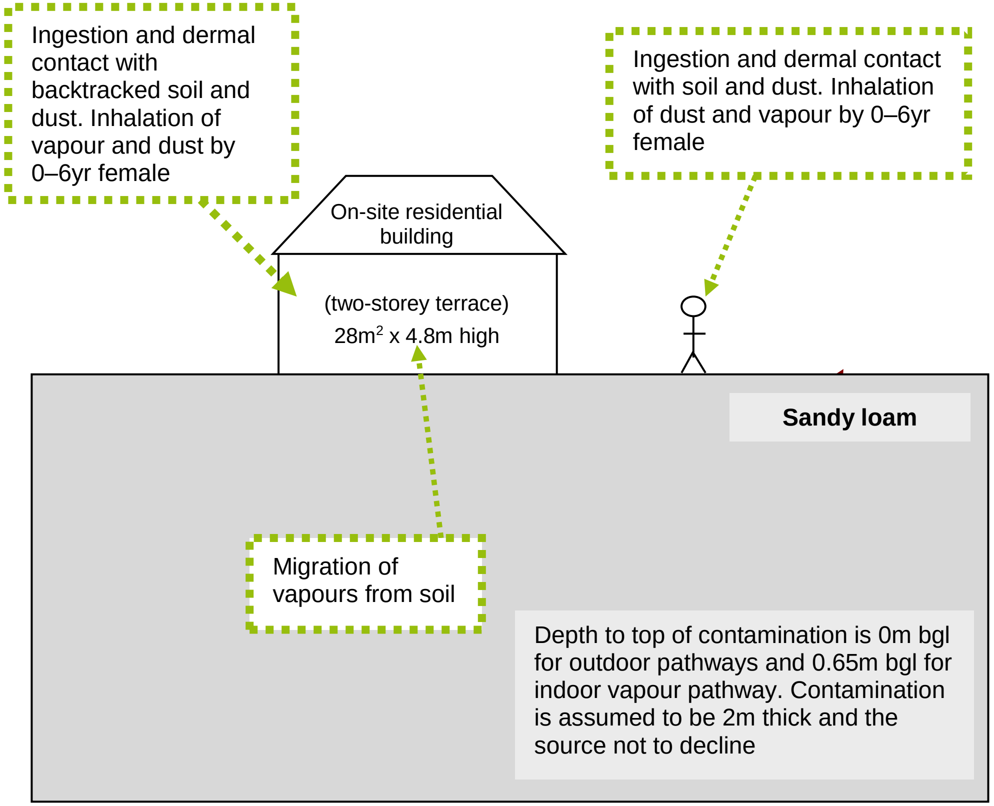


Table 1: Exposure assessment parameters for residential scenario without home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential without home-grown produce	Chosen land use
Receptor	Female child	Key generic assumption given in Box 3.1, SR3[(5)]
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3[(5)]. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3)[(5)]
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3)[(5)]
Start age class (AC)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3[(5)]
End AC	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[(13)]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential without home-grown produce – modified receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
Soil to skin adherence factor – (outdoor)	mg soil/cm^2 skin	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010[3]					
Inhalation rate	m^3 day^{-1}	5.4	8.0	8.9	10.1	10.1	10.1
Justification		Mean value USEPA, 2011[12]; Table 3.2, SP1010[3]					

Notes: For **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI_{oral} and TDI_{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3[1], Science Report SC050021/Cadmium SGV[1] and the project report SP1010[3] for more information.

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR
Barium	(b)	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR
Beryllium		1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR
Boron		1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR
Cadmium	(a)	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR
Chromium (III) - trivalent	(c)	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR
Chromium (VI) - hexavalent	(a,d)	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR
Copper		1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR
Lead	(a)	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	NR	2.41E-01	NR	4.31E+00	NR	5.74E-01	NR	1.07E+01	NR	1.25E+00	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR
Methyl Mercury (Hg^{4+})		1.80E+01	1.87E+01	9.16E+00	7.33E+01	1.80E+01	3.62E+01	1.20E+01	1.42E+02	1.80E+01	7.68E+01	1.46E+01	3.04E+02
Nickel	(d)	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR
Selenium	(b)	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR
Vanadium		1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR
Zinc	(b)	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR
Cyanide (free)		4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR
Volatile Organic Compounds													
Benzene	(a)	7.36E+01	9.01E-01	8.90E-01	1.22E+03	7.36E+01	1.68E+00	1.64E+00	2.26E+03	7.36E+01	3.48E+00	3.33E+00	4.71E+03
Toluene		2.87E+04	9.08E+02	8.80E+02	8.69E+02	2.87E+04	2.00E+03	1.87E+03	1.92E+03	2.87E+04	4.55E+03	3.93E+03	4.36E+03
Ethylbenzene		1.29E+04	8.34E+01	8.29E+01	5.18E+02	1.29E+04	1.96E+02	1.93E+02	1.22E+03	1.29E+04	4.58E+02	4.42E+02	2.84E+03
Xylene - m		2.32E+04	8.25E+01	8.22E+01	6.25E+02	2.32E+04	1.95E+02	1.93E+02	1.47E+03	2.32E+04	4.56E+02	4.47E+02	3.46E+03
Xylene - o		2.32E+04	8.87E+01	8.83E+01	4.78E+02	2.32E+04	2.08E+02	2.06E+02	1.12E+03	2.32E+04	4.86E+02	4.76E+02	2.62E+03
Xylene - p		2.32E+04	7.93E+01	7.90E+01	5.76E+02	2.32E+04	1.86E+02	1.85E+02	1.35E+03	2.32E+04	4.36E+02	4.28E+02	3.17E+03
Total xylene		2.32E+04	7.93E+01	7.90E+01	6.25E+02	2.32E+04	1.86E+02	1.85E+02	1.47E+03	2.32E+04	4.36E+02	4.28E+02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		3.87E+04	1.04E+02	1.04E+02	2.04E+04	3.87E+04	1.69E+02	1.69E+02	3.31E+04	3.87E+04	3.21E+02	3.19E+02	6.27E+04
Trichloroethene		6.45E+01	1.72E-02	1.72E-02	1.54E+03	6.45E+01	3.59E-02	3.59E-02	3.22E+03	6.45E+01	7.98E-02	7.97E-02	7.14E+03
Tetrachloroethene		7.13E+02	1.79E-01	1.79E-01	4.24E+02	7.13E+02	4.02E-01	4.02E-01	9.51E+02	7.13E+02	9.21E-01	9.20E-01	2.18E+03
1,1,1-Trichloroethane		7.74E+04	9.01E+00	9.01E+00	1.43E+03	7.74E+04	1.84E+01	1.84E+01	2.92E+03	7.74E+04	4.04E+01	4.04E+01	6.39E+03
1,1,1,2 Tetrachloroethane		7.34E+02	1.54E+00	1.53E+00	2.60E+03	7.34E+02	3.56E+00	3.55E+00	6.02E+03	7.34E+02	8.29E+00	8.20E+00	1.40E+04
1,1,2,2-Tetrachloroethane		7.34E+02	3.92E+00	3.90E+00	2.67E+03	7.34E+02	8.04E+00	7.95E+00	5.46E+03	7.34E+02	1.76E+01	1.72E+01	1.20E+04
Carbon Tetrachloride		5.15E+02	2.58E-02	2.58E-02	1.52E+03	5.15E+02	5.65E-02	5.64E-02	3.32E+03	5.15E+02	1.28E-01	1.28E-01	7.54E+03
1,2-Dichloroethane		1.55E+01	9.20E-03	9.20E-03	3.41E+03	1.55E+01	1.33E-02	1.33E-02	4.91E+03	1.55E+01	2.28E-02	2.27E-02	8.43E+03
Vinyl Chloride		1.81E+00	7.73E-04	7.73E-04	1.36E+03	1.81E+00	1.00E-03	9.99E-04	1.76E+03	1.81E+00	1.53E-03	1.53E-03	2.69E+03
1,2,4-Trimethylbenzene		NR	5.58E+00	NR	4.74E+02	NR	1.29E+01	NR	1.16E+03	NR	2.69E+01	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds													
Acenaphthene		7.64E+03	4.86E+04	6.60E+03	5.70E+01	7.64E+03	1.18E+05	7.17E+03	1.41E+02	7.64E+03	2.68E+05	7.43E+03	3.36E+02
Acenaphthylene		7.65E+03	4.59E+04	6.55E+03	8.61E+01	7.65E+03	1.11E+05	7.15E+03	2.12E+02	7.65E+03	2.53E+05	7.42E+03	5.06E+02
Anthracene		3.82E+04	1.53E+05	3.06E+04	1.17E+00	3.82E+04	3.77E+05	3.47E+04	2.91E+00	3.82E+04	8.76E+05	3.66E+04	6.96E+00
Benzo(a)anthracene		1.98E+01	2.47E+01	1.10E+01	1.71E+00	1.98E+01	4.37E+01	1.36E+01	4.28E+00	1.98E+01	6.26E+01	1.50E+01	1.03E+01
Benzo(a)pyrene	(a)	5.34E+00	3.51E+01	NR	9.11E-01	5.34E+00	3.77E+01	NR	2.28E+00	5.34E+00	3.89E+01	NR	5.46E+00
Benzo(b)fluoranthene		4.97E+00	1.93E+01	3.95E+00	1.22E+00	4.97E+00	2.13E+01	4.03E+00	3.04E+00	4.97E+00	2.22E+01	4.06E+00	7.29E+00
Benzo(g,h,i)perylene		4.38E+02	1.87E+03	3.55E+02	1.54E-02	4.38E+02	1.94E+03	3.58E+02	3.85E-02	4.38E+02	1.97E+03	3.59E+02	9.23E-02
Benzo(k)fluoranthene		1.31E+02	5.41E+02	1.06E+02	6.87E-01	1.31E+02	5.76E+02	1.07E+02	1.72E+00	1.31E+02	5.91E+02	1.07E+02	4.12E+00
Chrysene		3.95E+01	1.19E+02	2.97E+01	4.40E-01	3.95E+01	1.49E+02	3.12E+01	1.10E+00	3.95E+01	1.66E+02	3.19E+01	2.64E+00
Dibenzo(a,h)anthracene		3.95E-01	1.45E+00	3.10E-01	3.93E-03	3.95E-01	1.64E+00	3.18E-01	9.82E-03	3.95E-01	1.74E+00	3.22E-01	2.36E-02
Fluoranthene		1.59E+03	3.83E+04	1.53E+03	1.89E+01	1.59E+03	8.87E+04	1.56E+03	4.73E+01	1.59E+03	1.83E+05	1.58E+03	1.13E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	**Notes**	**SAC Appropriate to Pathway SOM 1% (mg/kg)**			**Soil Saturation Limit (mg/kg)**	**SAC Appropriate to Pathway SOM 2.5% (mg/kg)**			**Soil Saturation Limit (mg/kg)**	**SAC Appropriate to Pathway SOM 6% (mg/kg)**			**Soil Saturation Limit (mg/kg)**
		Oral	**Inhalation**	**Combined**		**Oral**	**Inhalation**	**Combined**		**Oral**	**Inhalation**	**Combined**	
Fluorene		5.09E+03	6.20E+03	2.80E+03	3.09E+01	5.09E+03	1.53E+04	3.82E+03	7.65E+01	5.09E+03	3.62E+04	4.47E+03	1.83E+02
Indeno(1,2,3-cd)pyrene		5.65E+01	2.12E+02	4.46E+01	6.13E-02	5.65E+01	2.38E+02	4.56E+01	1.53E-01	5.65E+01	2.50E+02	4.60E+01	3.68E-01
Naphthalene		2.50E+03	2.33E+01	2.31E+01	7.64E+01	2.50E+03	5.58E+01	5.46E+01	1.83E+02	2.50E+03	1.31E+02	1.25E+02	4.32E+02
Phenanthrene		1.58E+03	7.17E+03	1.30E+03	3.60E+01	1.58E+03	1.76E+04	1.45E+03	8.96E+01	1.58E+03	4.07E+04	1.52E+03	2.14E+02
Pyrene		3.82E+03	8.79E+04	3.66E+03	2.20E+00	3.82E+03	2.04E+05	3.75E+03	5.49E+00	3.82E+03	4.23E+05	3.79E+03	1.32E+01
Phenol		6.48E+04	4.58E+02	4.55E+02	2.42E+04	6.48E+04	6.95E+02	6.88E+02	3.81E+04	6.48E+04	1.19E+03	1.17E+03	7.03E+04
Total Petroleum Hydrocarbons													
Aliphatic hydrocarbons EC_5-EC_6		3.23E+05	4.24E+01	4.24E+01	3.04E+02	3.23E+05	7.79E+01	7.79E+01	5.58E+02	3.23E+05	1.61E+02	1.61E+02	1.15E+03
Aliphatic hydrocarbons $>EC_6$-EC_8		3.23E+05	1.04E+02	1.04E+02	1.44E+02	3.23E+05	2.31E+02	2.31E+02	3.22E+02	3.23E+05	5.29E+02	5.29E+02	7.36E+02
Aliphatic hydrocarbons $>EC_8$-EC_{10}		6.45E+03	2.68E+01	2.68E+01	7.77E+01	6.45E+03	6.55E+01	6.53E+01	1.90E+02	6.45E+03	1.56E+02	1.55E+02	4.51E+02
Aliphatic hydrocarbons $>EC_{10}$-EC_{12}		6.45E+03	1.33E+02	1.32E+02	4.75E+01	6.45E+03	3.31E+02	3.27E+02	1.18E+02	6.45E+03	7.93E+02	7.67E+02	2.83E+02
Aliphatic hydrocarbons $>EC_{12}$-EC_{16}		6.45E+03	1.11E+03	1.06E+03	2.37E+01	6.45E+03	2.78E+03	2.42E+03	5.91E+01	6.45E+03	6.67E+03	4.37E+03	1.42E+02
Aliphatic hydrocarbons $>EC_{16}$-EC_{35}	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons $>EC_{35}$-EC_{44}	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aromatic hydrocarbons $>EC_8$-EC_{10}		2.58E+03	4.74E+01	4.72E+01	6.13E+02	2.58E+03	1.16E+02	1.15E+02	1.50E+03	2.58E+03	2.77E+02	2.69E+02	3.58E+03
Aromatic hydrocarbons $>EC_{10}$-EC_{12}		2.58E+03	2.58E+02	2.52E+02	3.64E+02	2.58E+03	6.39E+02	5.94E+02	8.99E+02	2.58E+03	1.52E+03	1.24E+03	2.15E+03
Aromatic hydrocarbons $>EC_{12}$-EC_{16}		2.58E+03	2.85E+03	1.80E+03	1.69E+02	2.58E+03	7.07E+03	2.30E+03	4.19E+02	2.58E+03	1.68E+04	2.48E+03	1.00E+03
Aromatic hydrocarbons $>EC_{16}$-EC_{21}	(b)	1.86E+03	NR	NR	5.37E+01	1.90E+03	NR	NR	1.34E+02	1.92E+03	NR	NR	3.21E+02
Aromatic hydrocarbons $>EC_{21}$-EC_{35}	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01
Aromatic hydrocarbons $>EC_{35}$-EC_{44}	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.

Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for boron and selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 4
Human health generic assessment criteria for residential without home-grown produce

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	40	40	40
Barium	1,300	1,300	1,300
Beryllium	1.7	1.7	1.7
Boron	11,000	11,000	11,000
Cadmium	149	149	149
Chromium (III) - trivalent	910	910	910
Chromium (VI) - hexavalent	21	21	21
Copper	7,100	7,100	7,100
Lead	310	310	310
Elemental Mercury (Hg^0)	0.2	0.6	1.2
Inorganic Mercury (Hg^{2+})	56	56	56
Methyl Mercury (Hg^{4+})	9	12	15
Nickel	180	180	180
Selenium	430	430	430
Vanadium	1,200	1,200	1,200
Zinc	40,000	40,000	40,000
Cyanide (free)	40	40	40
Volatile Organic Compounds			
Benzene	0.9	1.6	3.3
Toluene	900 (869)	1,900	3,900
Ethylbenzene	80	190	440
Xylene - m	80	190	450
Xylene - o	90	210	480
Xylene - p	80	180	430
Total xylene	80	180	430
Methyl tertiary-Butyl ether (MTBE)	100	170	320
Trichloroethene	0.02	0.04	0.08
Tetrachloroethene	0.2	0.4	0.9
1,1,1-Trichloroethane	9.0	18.4	40.4
1,1,1,2 Tetrachloroethane	1.5	3.5	8.2
1,1,2,2-Tetrachloroethane	3.9	8.0	17.2
Carbon Tetrachloride	0.026	0.056	0.128
1,2-Dichloroethane	0.009	0.013	0.023
Vinyl Chloride	0.0008	0.0010	0.0015
1,2,4-Trimethylbenzene	5.6	12.9	26.9
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	6,600 (57)	7,200	7,400
Acenaphthylene	6,600 (86)	7,200	7,400
Anthracene	31,000 (1.17)	35,000	37,000
Benzo(a)anthracene	11.0	13.6	15.0
Benzo(a)pyrene	5.3	5.3	5.3
Benzo(b)fluoranthene	4.0	4.0	4.1
Benzo(g,h,i)perylene	355	358	359
Benzo(k)fluoranthene	106	107	107
Chrysene	30	31	32
Dibenzo(a,h)anthracene	0.31	0.32	0.32
Fluoranthene	1,500	1,600	1,600
Fluorene	2,800 (31)	3,800 (77)	4,500 (183)
Indeno(1,2,3-cd)pyrene	45	46	46
Naphthalene	23	55	125
Phenanthrene	1,300 (36)	1,450	1,520
Pyrene	3,700	3,800	3,800
Phenol	440*	688	1,170
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	42	78	161
Aliphatic hydrocarbons >EC_6-EC_8	100	230	530
Aliphatic hydrocarbons >EC_8-EC_{10}	27	65	155
Aliphatic hydrocarbons >EC_{10}-EC_{12}	130 (48)	330 (118)	770 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	1,100 (24)	2,400 (59)	4,400 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	65,000 (8)	92,000 (21)	111,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	65,000 (8)	92,000 (21)	111,000
Aromatic hydrocarbons >EC_8-EC_{10}	47	115	269
Aromatic hydrocarbons >EC_{10}-EC_{12}	300	600	1,200
Aromatic hydrocarbons >EC_{12}-EC_{16}	1,800 (169)	2,300 (419)	2,500
Aromatic hydrocarbons >EC_{16}-EC_{21}	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{21}-EC_{35}	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{35}-EC_{44}	1,900	1,900	1,900
Minerals			
Asbestos	Stage 1 test – No asbestos detected with ID; Stage 2 test - <0.001% dry weight (exceedance of either equates to an exceedance of the GAC)[1]		

Notes:
'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.
NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used
EC - equivalent carbon. SAC - soil assessment criteria.
[1] LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS)
RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.

APPENDIX G

Generic groundwater assessment criteria for human health:

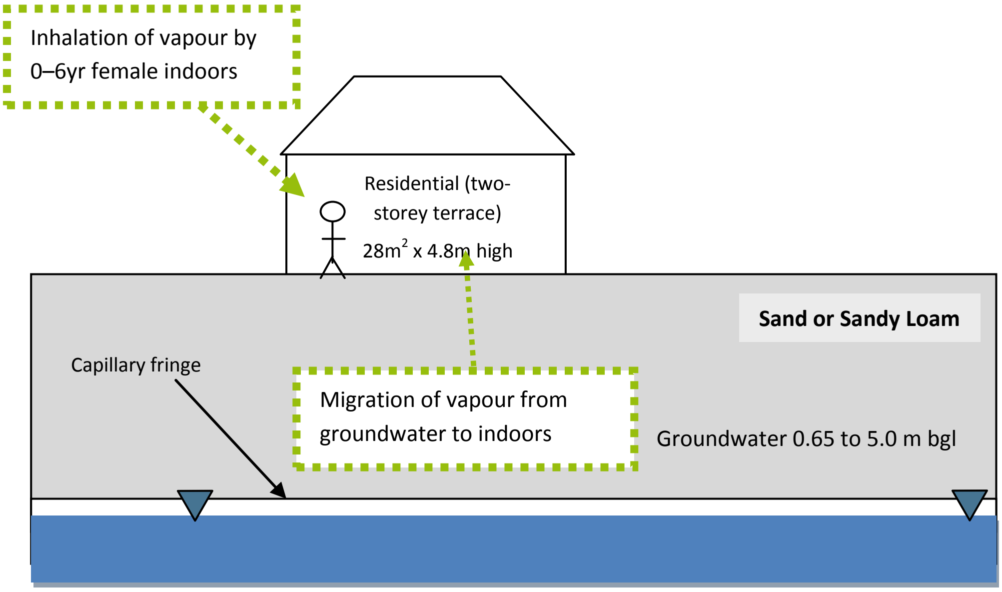
residential scenario

Generic groundwater assessment criteria (GrAC) for human health: residential scenario (child receptor)

Background

Volatile organic compounds (VOC) in groundwater have the potential to pose risks to residential site end users via indoor and outdoor inhalation exposure. Due to significant dilution effects in outdoor air, inhalation risk is dominated by indoor exposure. The GrAC conceptual site model (CSM) is shown in Figure 1 (not to scale).

Figure 1: GrAC conceptual model for a generic residential scenario



RSK GrAC derivation

Model selection

The Society for Brownfield Risk Assessment (SoBRA) published a set of generic assessment criteria for assessing vapour risk to human health from volatile contaminants in groundwater in February 2017[(1)]. The criteria were developed for a list of common VOC using the Environment Agency Contaminated Land Exposure Assessment (CLEA) tool[(2)] based on a sand soil type and a groundwater depth of 0.65 m below foundation base level. The CLEA tool is not designed to directly model VOC in groundwater and the SoBRA generic criteria are recognised as being conservative since calculations in CLEA are based on three-phase partitioning in the unsaturated zone between soil, soil vapour and soil moisture, with the latter taken by SoBRA as a groundwater equivalent. This method does not take account of the presence of a semi-saturated capillary fringe above the water table, which will serve to provide some mitigation to vertical soil vapour migration.

RSK GrAC are calculated using the RBCA Toolkit for Chemical Releases (version 2.6) with the Johnson and Ettinger model, based on the CSM in Figure 1 for a small terrace house (as defined in SR3[(3)], Table 4.21) and which allows consideration of a capillary fringe. The capillary fringe is the subsurface layer in which groundwater seeps up from a water table by capillary action to partially fill soil pores.

The RBCA model was used in preference to the Environment Agency Contaminated Land Exposure Assessment (CLEA) tool(2), as the CLEA tool is not designed to directly model VOC in groundwater and does not take account of the presence of a capillary zone.

Conceptual model

In accordance with SR3(3), the residential scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario.

The pollutant linkage considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents while indoors. Figure 1 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution of VOC in outdoor air. RBCA does not take direct account of the presence of VOC from non-aqueous phase chemicals but highlights when the assessment criterion exceeds the solubility limit of the pure compound.

Input selection – chemical and toxicological parameters

Key parameters used in the RBCA model are listed and justified in Table 1. The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7(2), the EA TOX(5) reports, and published by Nathanial et al.,(6), as appropriate. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report(7).

The toxicological input parameters are associated with minimal risk, rather than low risk.

For petroleum hydrocarbon fractions, aromatic hydrocarbons C5–C8 were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

For the GrAC, the Health Criteria Values (HCV) used in the modelling were derived using the toxicological data for the Soil Assessment Criteria, amended as follows:

- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3(3)) and breathing 8.77m^3 (average daily inhalation rate for a 0-6yr old female in accordance with SP1010 final project report for the C4SL (Table 3.2(8)) and USEPA data(9)
- Background inhalation (mean daily intake (MDI)) for a child (Age Classes 1-6)
- Residential amendments to the MDI for younger age groups following Table 3.4 and Section 3.4.1 of SR2(10),; amended to reflect average daily inhalation rates in accordance with SP1010 final project report for the C4SL (Table 3.2(8)) and USEPA data(9). Correction factors are presented in Table 1.

Table 1: Correction factors used to adjust adult MDI to younger age groups

Age Class	Body weight (kg)[1]	Inhalation rate (m^3/day)[2]	Correction factor for inhalation MDI[3]
1	5.6	5.4	0.34
2	9.8	8	0.51
3	12.7	8.9	0.57
4	15.1	10.1	0.64
5	16.9	10.1	0.64
6	19.7	10.1	0.64
17	70	15.7	-
Mean (AC1-6)	**13.3**	**8.8**	**0.56**

Notes
[1] Body weight from CLEA v1.071
[2] Inhalation rate from Table 3.2 of the SP1010 final project report for the C4SL(8)
[3] Inhalation correction factors are the ratio of the average male and female inhalation rates for each age class to the adult rate at age class 17 (age 16–59 years) and are based on the rates used by the Category 4 Screening Levels to derive the C4SLs(8),following the methodology in SR2(10).

The amended HCV used in the derivation of the RSK GrAC are presented in Table 2.

Note on Trimethylbenzenes

For trimethylbenzenes the CL:AIRE report(7) based background inhalation from non-soil sources (MDI) on a Dutch study from 1985, which is reported to have identified an average daily dose of 1,2,4-trimethylbenzene of 86 ug d^{-1} (1,3,5-trimethylbenzene was 20.5 ug d^{-1}). This dose value was based on the upper end of the identified concentration range of 1,2,4-trimethylbenzene (2.46 – 5.66 ug m^{-3}) and was used to calculate an a MDI of 1.23 ug kg^{-1} bw d^{-1} for a 70 kg adult breathing 20 m^3 of air daily.

The approach recommended in SR2(10), and also adopted for the C4SLs(8), for non-carcinogenic (threshold) compounds such as trimethylbenzenes is to subtract the MDI from the tolerable daily intake (TDI) to obtain a tolerable daily intake from soil (TDSI) in units of ug kg^{-1} bw d^{-1}. For 1,2,4-trimethylbenzene, the adult MDI from the Dutch study used in the CL:AIRE report(7) (1.23 ug kg^{-1} bw d^{-1}) is a significant proportion of the TDI (2.0 ug kg^{-1} bw d^{-1}), resulting in a low TDSI (1.0 ug kg^{-1} bw d^{-1}) when the 50% rule is applied (i.e. TDSI = TDI * 0.5 when MDI is high relative to TDI). This TDSI equates to an Inhalation Reference Concentration (or modified Health Criteria Value) for adults of 3.4 ug m^{-3} (70 kg adult breathing 15.7 m^3 d^{-1}).

By comparison the adult inhalation modified HCV for benzene is 6.2 ug m^{-3}, which is proven human carcinogen (non-threshold compound).

Table 2: Amended Health Criteria Values

VOC / SVOC	Modified HCV (mg/m^3) Child (Residential)
MTBE	1.0803
Benzene	0.0021
Toluene	2.1164
Ethylbenzene	0.1113
Xylenes	0.0834
Trimethybenzenes	0.0026
TPH_Aliph EC5-EC6	3.7913
TPH_Aliph >EC6-EC8	3.7913
TPH_Aliph >EC8-EC10	0.2199
TPH_Aliph >EC10-EC12	0.2199
TPH_Aliph >EC12-EC16	0.2199
TPH_Arom >EC8-EC10	0.0455
TPH_Arom >EC10-EC12	0.0455
TPH_Arom >EC12-EC16	0.0455
Acenaphthene	0.0910
Acenaphthylene	0.0910
Naphthalene	0.0011
Vinyl chloride	0.0005
Dichloroethane-1,2	0.0002
Tetrachloroethene	0.0083
Carbon tetrachloride	0.0025
Trichloroethane-1,1,1	0.9099
Trichloroethene	0.0009
Tetrachloroethane 1,1,2,2 & 1,1,1,2	0.0086
1,1,2-Trichloroethane	0.0073
1,1-dichloroethene	0.0864
Chloroethane	4.3318
Chloromethane	0.0039
Dichloromethane	0.1781

The MDI for 1,2,4-trimethylbenzene is considered by RSK to be overly conservative for the following reasons:

- The Dutch 1985 study is dated and air quality has improved since this time
- The maximum value in the range (5.66 ug m^{-3}) was used in calculating the MDI
- Experience has shown that trimethylbenzenes often appear to drive inhalation risks to a greater extent than benzene, even though the latter is carcinogenic and more volatile.

As an alternative to the 1985 Dutch study, RSK have obtained automated roadside air quality monitoring data for the UK from www.uk-air.defra.gov.uk/. The average concentration of 1,2,4-trimethylbenzene measured during 2015 at Eltham, south-east London (urban) was 0.309 ug m^{-3}, significantly lower than that identified in the Dutch study and used by CL:AIRE(7) for calculation of a MDI. Whilst an average concentration of 1,2,4-trimethylbenzene in UK urban and rural areas is likely to be significantly below 0.0.309 ug m^{-3}, this value is considered to be suitably conservative for the calculation of a modified HCV for trimethylbenzenes in the UK.

On this basis, the HCV for 1,2,4-trimethylbenzene for adults and children was calculated as 8.5 ug m^{-3} (0.0085 mg m^{-3}) and 2.6 ug m^{-3} (0.0026 mg m^{-3}), respectively (see Table 3). Due to the paucity of toxicological data for 1,2,3-trimethylbenzene and 1,3,5-trimethylbenzene the modified HCV for 1,2,4-trimethylbenzene is considered suitable for assessing total trimethylbenzenes.

Note on aqueous solubility and the RSK GrAC

Where the modelled assessment criteria, or the modelled assessment criteria with the correction factor applied to those contaminants specified below, exceeds the aqueous solubility limit the assessment criteria defaults to this concentration and consequently the GrAC is set at the limit of solubility. These assessment criteria are shaded in red in Table 4.

The theoretical aqueous solubility is the maximum amount of a single chemical that will dissolve in pure water at a specified temperature. Above this concentration, the chemical will exist in the non-aqueous phase (i.e. in its natural physical form as a solid, liquid (NAPL) or gas). If the contaminant, based on its toxicity, is not considered to pose a risk to human health at the aqueous solubility concentration then the contaminant can be considered not to pose a risk to human health. Where the GrAC is set at the aqueous solubility limit (shaded in red on Table 4), this is not a risk based assessment criteria but is indicative of the maximum amount of chemical that would be found dissolved in the water. Therefore an exceedance of the RSK GrAC set at the aqueous solubility limit is <u>not</u> indicative that there may be potential risks to human health. It should be noted that for certain contaminants (e.g. the lighter petroleum hydrocarbon fractions) the aqueous solubility is very low and may be at, or below, the laboratory method detection limit. It should also be noted that non-aqueous phase may exist where concentrations of individual compounds are well below their solubility limits where they are part of a mixture, in accordance with Raoult's Law.

Input selection - physical parameters

For the residential scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab as detailed in Table 3. Environment Agency document SR3(3) notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GrACs are the default CLEA v1.071 inputs presented in Table 3.3 of SR3(3).

The RSK GrAC have been calculated for both Sand and Sandy Loam soils. The soil parameters used in the derivation of the RSK GrAC are those presented in Table 3.1 of SR3(3).

The RSK GrAC have been derived for groundwater depths of 0.65 m, 1.5 m, 2.5 m and 5.0 m below ground level, incorporating a capillary fringe (see Table 4).

Input selection - attenuation factors

In line with recommendations provided in Environment Agency SR3(3) a sub-surface to indoor attenuation factor of 10 has been applied to certain RBCA derived 'site-specific target levels'. SR3(3) states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase petroleum hydrocarbons by using partition coefficients are at least a factor of ten higher than those likely to be measured on-site. This difference is likely to be due to a number of factors, however aerobic biodegradation in the unsaturated zone is believed to be largely responsible. RSK has therefore applied this attenuation factor to all volatile petroleum hydrocarbon fractions (including BTEX, tri-methylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene). No such attenuation factors have been applied to other non-hydrocarbon chemical species, including chlorinated hydrocarbons or fuel oxygenates such as MtBE.

Convective (volumetric) air flow through foundation cracks (Q_{soil}) is a sensitive parameter in the calculation of GrAC and has been calculated within RBCA on a soil-specific basis for Sand and Sandy Loam in a residential exposure scenario (see Table 3). This approach is less conservative than using the default Q_{soil} value recommended in SR3[(3)] for a Sandy Loam (25 cm^3 s^{-1}) and used in the CLEA model (version 1.071) for Sandy Loam (and Sand) soils (25 cm^3 s^{-1}) in a residential scenario.

Table 3: Residential scenario – RBCA inputs

Parameter	Unit	Value	Justification
Receptor – female child			
Averaging time	Years	6	From Box 3.1, SR3[3]
Receptor weight	kg	13.3	Average of CLEA 0-6 year old female data, Table 4.6, SR3[3]
Exposure duration	Years	6	From Box 3.1, report , SR3[3]
Exposure frequency	Days yr^{-1}	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
Soil type – sand			
Total porosity	-	0.54	CLEA value for sand. Parameters for sand from Table 4.4, SR3[3]. Volumetric water content in the vadose zone is a highly sensitive parameter within the model and potentially highly variable in the field.
Volumetric water content – unsaturated (vadose) zone	-	0.24	
Volumetric air content - unsaturated (vadose) zone	-	0.30	
Dry bulk density	g cm^{-3} or kg L^{-1}	1.18	
Volumetric water content – capillary zone	-	0.35	Calculated using SR3 Equation 4.1. Value taken as the average moisture content calculated for suction heads (cm H_2O); 0 (i.e. saturated), 10, 20, 30, 40, 50 (i.e. unsaturated soil at field capacity). This is a highly sensitive parameter within the model.
Volumetric air content - capillary zone	-	0.19	Calculated from total porosity and volumetric water content of capillary zone. This is a highly sensitive parameter within the model.
Vertical hydraulic conductivity	cm d^{-1}	636	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3] equivalent to 7.36 E-03 cm s^{-1}
Vapour permeability	m^2	7.54 E-12	Calculated for sand using equations in Appendix 1, SR3[3]
Capillary zone thickness	m	0.25	Taken from C W Fetter, Applied Hydrogeology 4th Ed, 1994[11] and R Heath, Basic groundwater hydrology 1992[12] for a medium sand
Fraction organic carbon	%	0.0058	Equivalent to SOM = 1%. Note that GrAC are independent on FOC/SOM content since partitioning is assumed to be between aqueous and vapour phases only
Soil type – sandy loam			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[3]. Volumetric water content in the vadose zone is a highly sensitive parameter within the model and potentially highly variable in the field.
Volumetric water content – unsaturated (vadose) zone	-	0.33	
Volumetric air content - unsaturated (vadose) zone	-	0.20	
Dry bulk density	g cm^{-3} or kg/L	1.21	
Volumetric water content – capillary zone	-	0.42	Calculated using SR3 Equation 4.1[3]. Value taken as the average moisture content calculated for suction heads (cm H_2O); 0 (i.e. saturated), 10, 20, 30, 40, 50 (i.e. unsaturated soil at field capacity). This is a highly sensitive parameter within the model.
Volumetric air content - capillary zone	-	0.11	Calculated from total porosity and volumetric water content of capillary zone. This is a highly sensitive parameter within the model.

Parameter	Unit	Value	Justification
Vertical hydraulic conductivity	cm d^{-1}	308	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3(3) equivalent to 3.56E-3 cm s^{-1}
Vapour permeability	m^2	3.05 E-12	Calculated for sandy loam using equations in Appendix 1, SR3(3)
Capillary zone thickness	m	0.4	Taken from R Heath, Basic Groundwater Hydrology 1992(12) for a fine sand. Note: C W Fetter, Applied Hydrogeology 4th Ed, 1994(11) value for fine sand is 0.5 m
Fraction organic carbon	%	0.0058	Equivalent to SOM = 1%. Note that GrAC are independent on FOC/SOM content since partitioning is assumed to be between aqueous and vapour phases only
Building – small terrace house			
Building volume/area ratio	m	4.8	Table 3.3, SR3(3)
Foundation area	m^2	28	
Foundation perimeter	m	21.16	Calculated using Equation A2 in SR3(3), which assumes the building to be of square proportions.
Building air exchange rate	d^{-1}	12	Table 3.3, SR3(3) Building air exchange rate equivalent to 1.4 E-04 s^{-1}
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.00151	Calculated from floor crack area of 423cm^2 and building footprint of 28m^2 in Table 4.21, SR3(3)
Volumetric water content of cracks	-	0.24 / 0.33	For sand / sandy loam, assumed equal to underlying soil type in assumption that cracks become filled with unsaturated zone soil over time. Parameters for sand and sandy loam from Table 4.4, SR3(3)
Volumetric air content of cracks	-	0.30 / 0.20	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3(3) Equivalent to 31 g/cm/s^2
Convective air flow through cracks (Q_{soil}) - Sand	m^3 s^{-1}	3.4 E-05	Soil-specific calculated parameter in RBCA equivalent (and cross checked) with equations A1, A2, A3, A8, A9 in SR3(3). Equivalent to **34 cm^3 s^{-1}**
Convective air flow through cracks (Q_{soil}) – Sandy Loam	m^3 s^{-1}	1.4 E-05	Soil-specific calculated parameter in RBCA equivalent (and cross checked) with equations A1, A2, A3, A8, A9 in SR3(3). Equivalent to **14 cm^3 s^{-1}**

RSK GrAC derivation outputs

The RSK GrACs are presented in Table 4.

Within the RSK GrAC the following should be noted:

- GrAC do not take account of outdoor inhalation exposure to VOC, which is considered to contribute minimally to overall inhalation exposure
- GrAC do not take account of other exposure routes potentially relevant to VOC in shallow groundwater such as direct contact or root uptake
- No biodegradation is assumed to occur in the unsaturated zone. Where aerobic conditions on site are known to exist the GrAC for hydrocarbons may therefore be conservative
- GrAC do not take account of preferential flow into buildings such as through unsealed service entries. In such circumstances GrAC may not be appropriate for use
- GrAC are based on a soil vapour intrusion CSM and are not appropriate for use when the foundation is in direct contact with contaminated groundwater

- GrAC assume that the capillary fringe is un-contaminated with VOC, which is unlikely, particularly where groundwater levels are variable
- GrAC set at the theoretical aqueous solubility limit are not considered to pose a risk to human health
- GrAC do not take into account the interaction between contaminants and the influence this may have on the theoretical aqueous solubility
- GrACs are only applicable to dissolved phase contaminants where the modelled assessment criteria is below the aqueous solubility limits

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	Table 4: RSK GrAC (ug/l)								
	RESIDENTIAL								
	SAND					SANDY LOAM			
GW Depth (m)	**0.65**	**1.5**	**2.5**	**5**		**0.65**	**1.5**	**2.5**	**5**
Metals									
Elemental mercury	2.5	3.6	5.0	8.4		14.3	18.5	23.4	35.8
Methyl mercury	21550	27220	33880	50540		46300	48510	51110	57610
Volatile Organic Compounds									
Benzene	470	670	900	1490		2900	3640	4510	6680
Toluene	515140	590000	590000	590000		590000	590000	590000	590000
Ethylbenzene	24300	35190	48000	80020		156380	180000	180000	180000
Xylene - m	22610	32750	44670	74480		144250	181800	200000	200000
Xylene - o	27570	39950	54500	90900		174260	173000	173000	173000
Xylene - p	23640	34230	46700	77860		150470	189710	200000	200000
Total xylene	22610	32750	44670	74480		144250	173000	173000	173000
Methyl tertiary-Butyl ether (MTBE)	185010	267500	364520	607070		945700	1245710	1598660	2481040
Trichloroethene	13	18	25	41		82	100	130	190
Tetrachloroethene	80	120	160	260		520	650	810	1200
1,1,1-Trichloroethane	7110	10230	13910	23090		46230	57820	71450	105540
1,1,1,2 Tetrachloroethane	550	800	1100	1830		3330	4250	5330	8040
1,1,2,2-Tetrachloroethane	3620	5320	7320	12320		14600	20600	27650	45290
Carbon Tetrachloride	12	17	24	39		79	98	120	180
1,2-Dichloroethane	20	28	38	63		100	140	170	260
Vinyl Chloride	1.3	1.8	2.4	4.0		8	10	12	18
1,2,4-Trimethylbenzene	980	1430	1960	3270		6240	7900	9850	14720
Semi-Volatile Organic Compounds									
Acenaphthene	4100	4100	4100	4100		4100	4100	4100	4100
Acenapththylene	7950	7950	7950	7950		7950	7950	7950	7950
Naphthalene	5100	7530	10380	17510		19000	19000	19000	19000
Petroleum Hydrocarbons									
Aliphatic hydrocarbons EC5-EC6	4170	5900	7930	13020		26560	32990	35900	35900
Aliphatic hydrocarbons >EC6-EC8	3210	4540	5370	5370		5370	5370	5370	5370
Aliphatic hydrocarbons >EC8-EC10	120	170	230	380		427	427	427	427
Aliphatic hydrocarbons >EC10-EC12	33.9	33.9	33.9	33.9		33.9	33.9	33.9	33.9
Aliphatic hydrocarbons >EC12-EC16	0.759	0.759	0.759	0.759		0.759	0.759	0.759	0.759
Aromatic hydrocarbons >EC8-EC10	4150	5870	7900	12960		25730	32120	39630	58400
Aromatic hydrocarbons >EC10-EC12	14480	20510	24500	24500		245000	245000	245000	245000
Aromatic hydrocarbons >EC12-EC16	5750	5750	5750	5750		5750	5750	5750	5750

Notes:

Values less than 100 have not been rounded up or down; values greater than 100 have been rounded to the nearest 10.

Highlighted values exceed solubility limit for the pure compound in water (aqueous solubility); GrAC defaults to the limit of solubility.

No vadose zone biodegradation considered

Sub-surface to indoor air correction factor of 10 applied to all petroleum (non-chlorinated) hydrocarbons

All GrAC are for 1% SOM (0.0058 FOC)

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) (see Table 9.1). 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. Council Directive 1999/30/EC, as relating to limit values for sulphur dioxide, nitrogen dioxide, lead and particulate matter, is detailed in Table 9.1. 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.

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 A9.2.1 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 A9.2.2 Air Quality Impact Significance Criteria For Annual Mean Nitrogen Dioxide and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

APPENDIX 9.3

Dust Management Plan

The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland, the UK (IAQM (2014), The Scottish Office (1996), UK Office of Deputy Prime Minister (2002) and BRE (2003)) and the USA (USEPA (1997)).

Site Management

The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design and effective control strategies.
At the construction planning stage, the siting of activities and storage piles will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance (see Figure 9.1 for the windrose for Casement Aerodrome). As the prevailing wind is predominantly westerly to south-westerly, locating construction compounds and storage piles downwind (to the east) of sensitive receptors will minimise the potential for dust nuisance to occur at sensitive receptors.

Good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or quickly implementing effective control measures before the potential for nuisance occurs. When rainfall is greater than 0.2mm/day, dust generation is generally suppressed (UK Office of Deputy Prime Minister (2002), BRE (2003)). The potential for significant dust generation is also reliant on threshold wind speeds of greater than 10 m/s (19.4 knots) (at 7m above ground) to release loose material from storage piles and other exposed materials (USEPA, 1986). Particular care should be taken during periods of high winds (gales) as these are periods where the potential for significant dust emissions are highest. The prevailing meteorological conditions in the vicinity of the site are favourable in general for the suppression of dust for a significant period of the year. Nevertheless, there will be infrequent periods were care will be needed to ensure that dust nuisance does not occur. The following measures shall be taken in order to avoid dust nuisance occurring under unfavourable meteorological conditions:

- The Principal Contractor or equivalent must monitor the contractors' performance to ensure that the proposed mitigation measures are implemented and that dust impacts and nuisance are minimised;
- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions;
- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details;
- It is recommended that community engagement be undertaken before works commence on site explaining the nature and duration of the works to local residents and businesses;
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out;
- It is the responsibility of the contractor at all times to demonstrate full compliance with the dust control conditions herein;
- At all times, the procedures put in place will be strictly monitored and assessed.

The dust minimisation measures shall be reviewed at regular intervals during the works 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. In the event of dust nuisance occurring outside the site boundary, site activities will be reviewed and satisfactory procedures implemented to rectify the problem. Specific dust control measures to be employed are described below.

Site Roads / Haulage Routes

Movement of construction trucks along site roads (particularly unpaved roads) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80% (UK Office of Deputy Prime Minister, 2002).

- A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles using unpaved site roads;
- Access gates to the site shall be located at least 10m from sensitive receptors where possible;
- Bowsers or suitable watering equipment will be available during periods of dry weather throughout the construction period. Research has found that watering can reduce dust emissions by 50% (USEPA, 1997). Watering shall be conducted during sustained dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use;
- Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.

Land Clearing / Earth Moving

Land clearing / earth-moving works during periods of high winds and dry weather conditions can be a significant source of dust.

- During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust;
- During periods of very high winds (gales), activities likely to generate significant dust emissions should be postponed until the gale has subsided.

Storage Piles

The location and moisture content of storage piles are important factors which determine their potential for dust emissions.

- Overburden material will be protected from exposure to wind by storing the material in sheltered regions of the site. Where possible storage piles should be located downwind of sensitive receptors;
- Regular watering will take place to ensure the moisture content is high enough to increase the stability of the soil and thus suppress dust. The regular watering of stockpiles has been found to have an 80% control efficiency (UK Office of Deputy Prime Minister, 2002);
- Where feasible, hoarding will be erected around site boundaries to reduce visual impact. This will also have an added benefit of preventing larger particles from impacting on nearby sensitive receptors.

Site Traffic on Public Roads

Spillage and blow-off of debris, aggregates and fine material onto public roads should be reduced to a minimum by employing the following measures:

- Vehicles delivering or collecting material with potential for dust emissions shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- At the main site traffic exits, a wheel wash facility shall be installed if feasible. All trucks leaving the site must pass through the wheel wash. In addition, public roads outside the site shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary.

Summary of Dust Mitigation Measures

The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory performance of the contractor. The key features with respect to control of dust will be:

- The specification of a site policy on dust and the identification of the site management responsibilities for dust issues;
- The development of a documented system for managing site practices with regard to dust control;
- The development of a means by which the performance of the dust minimisation plan can be regularly monitored and assessed; and
- The specification of effective measures to deal with any complaints received.

APPENDIX 10.1 Transportation Assessment Report, prepared by NRB Consulting Engineers

NRB consulting engineers

"Transportation Assessment Report"

including....

Stage 1 Road Safety Audit,
Preliminary Travel Plan, and
DMURS Statement of Consistency

For

Proposed Residential Development(s)

At

Lands West of Old Belgard Road and North, South & West of Cookstown Road, Cookstown Industrial Estate, Tallaght, Dublin 24.

SUBMISSION ISSUE

Apollo Buildings, Dundrum Road, Dundrum, Dublin 14
Tel/fax: +353 1 292 1941, E-mail: info@nrb.ie, Web: www.nrb.ie

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Appendices......

EXECUTIVE SUMMARY

NRB Consulting Engineers Ltd were appointed to address the Traffic/Transportation issues associated with a planning application for a mixed use residential apartment development on zoned development lands within Cookstown Industrial Estate.

The site was previously used for industrial and employment purposes. In this regard, the site has long established traffic and trip generation characteristics, which are most likely to have been significantly greater than the now proposed use.

Being located in the heart of Tallaght and within a 10-15 minute walk of The Square and other local large employment centres such as Tallaght Hospital and TU Dublin Campus, the site is ideally placed to take advantage of, and contribute to, non-car modes of travel.

This Transportation Assessment (TA) has been prepared to address any Traffic/Transportation issues associated with the proposal, and specifically the capacity of the existing road network. The report takes account of the Tallaght LAP transport policy & mobility policy context provisions which seek to change the nature of the networks in the area.

An independent Road Safety Audit of the Layout & Design has been undertaken and is included as ***Appendix G*** to this Report.

The Report has been prepared in accordance with the TII's Traffic & Transportation Assessment Guidelines, and addresses the worst case traffic impact of the proposal. This TA addresses the adequacy of the existing and improved local road network to safely and appropriately accommodate the worst case vehicular demands with the development fully occupied, taking account of the existing transportation demands locally. (The Report contains a dedicated ***Section 5.0*** that addresses the specific issues mentioned within Item 2 of the ABP Opinion of 29/April '20).

Comprehensive classified turning movement surveys of the existing affected roads and junctions were carried out during the weekday AM and PM Peak Hours prior to the Covid19 Pandemic. These formed the basis of the study. The analysis includes the effects of the existing traffic on the local roads and assesses the impact during the traditional peak commuter peaks periods.

The Transportation Assessment confirms that the improved road network and the access junctions are more than adequate to accommodate the worst case traffic associated with the development. The assessment also confirms that the construction and full occupation of the scheme will have a negligible impact upon the operation of the adjacent road network.

The Report includes within its recommendations the upgrade/conversion of the existing Industrial Estate Roundabouts to Traffic Signal Control, a form of Road Junction Control which is considered more appropriate for a town centre environment, and the layout and design reflects this. All of the roads and junctions within the Red Line of the application are being upgraded to reflect the new residential status of the area, compliant with the requirements of DMURS are reflecting the planning policies of the Local Area Plan, in addition to other recommendations contained herein (including within the Appendices).

In terms of number of transport alternatives easily available to Residents, it is considered that the proposed development is very highly sustainable indeed, in terms of public and alternative transport accessibility. The proximity of the development to existing public transport services means that all residents will have viable alternatives to the private car for accessing the site and will not be reliant upon the car as a primary mode of travel.

Direct and high quality pedestrian linkages are provided between the sites and the existing pedestrian & cycling facilities on the surrounding road network. The lower provision of car parking will act as a demand management measure, ensuring that the development is accessed in the most sustainable manner, being almost predominantly reliant on non-car modes of travel.

The layout of the proposed development seeks to maximise permeability and enhances legibility, and the design of appropriately sized blocks actively contributes to a highly permeable and accessible community for both pedestrians and cyclists.

The Traffic/Transportation/Roads related issues raised in the ABP Opinion, Item #2, have been addressed herein, with the references summarised by way of a specific additional Chapter 5.

We also conclude that there are no adverse traffic/transportation capacity or operational safety issues associated with the construction and occupation of the proposed residential apartment developments (including the associated ancillary commercial uses).

1. INTRODUCTION

1.1 This Transportation Assessment (TA) has been prepared by NRB Consulting Engineers Ltd and addresses the Traffic / Transportation issues arising from the proposal to construct and occupy a total of 1,104 apartments/duplexes & the ancillary commercial elements, on the zoned sites at Cookstown, Tallaght.

1.2 The proposed development, a high density apartment/residential scheme with ancillary small commercial uses should be considered in the context of its location within the heart of Tallaght Town Centre. A site location plan is included below as ***Figure 1.1***;

Figure 1.1 - Site Location in Heart of Tallaght

1.3 In describing the Receiving Environment and the Proposed Future Environment, this report addresses the following aspects of the proposed development:

- Relative Small Scale of the development **in Traffic terms** (conscious of the long established use and nature of the established site),
- Location of the development within the heart of the Town Centre in close proximity to high quality Public Transport Links,

- Traffic & Transportation impact,
- Capacity of the proposed vehicular accesses to accommodate the worst-case development traffic flows,
- Capacity of the Existing Road Network,
- Adequacy and safety of the existing roads and junctions locally, within the area of influence (with the replacement of roundabouts with Traffic Signal Control).
- Strategic Road improvements that will significantly further reduce impact and increase local permeability (including the construction of the now proposed local roads infrastructure and the Part 8 N-S Link connecting Cookstown Industrial Estate Road through to Belgard Square North, and also the 3rd party Proposal to construct an E-W Link Road through to Belgard Road adjacent B&Q).
- The Upgrade of the existing Industrial Estate Roundabouts to Traffic Signal Control incorporating controlled dedicated pedestrian crossing facilitates - which is considered more appropriate in a Town Centre Environment.

1.4 Recommendations contained within this Transportation Assessment are based on the following sources of information and industry-standard practices; -

- The TII Traffic & Transport Assessment Guidelines,
- Design Manual for Urban Roads and Streets,
- Recent Weekday AM and PM Peak Classified Turning Movements Traffic Survey Data commissioned,
- TII Design Guidance,
- Transportation Planning Policy provisions of the SDCC Development Plan & the Tallaght Local Are Plan (LAP),
- Our experience in assessing the impact of Developments of this Nature, and
- Site Visits and Observations.

1.5 The Report has been prepared in accordance with the requirements of the TII's Traffic & Transport Assessment Guidelines. These are the professional Guidelines used to assess the impact of developments on public roads.

1.6 An independent Stage 1 Road Safety Audit of the Roads and Layout, together with the associated Designer Feedback form is included as ***Appendix G*** to this Report.

2. EXISTING CONDITIONS, DEVELOPMENT PROPOSALS & PARKING

2.1 The subject development sites are located on lands within Cookstown Industrial Estate, as illustrated above as ***Figure 1.1*** and an illustration of the elements of the development is extracted from the Architects Plans and is included below are ***Figure 2.1***

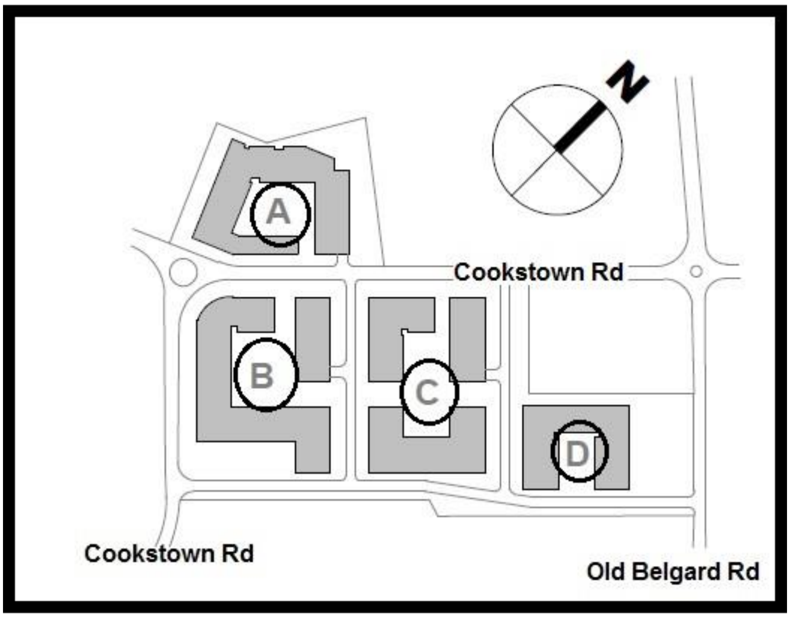


Figure 2.1 - Block Layout Plan

2.2 The content of the individual Blocks is as set out on the detailed Architectural Schedule of Accommodation, but in terms of Traffic/Transportation Assessment it is summarised below as ***Table 2.1*** for convenience.

Table 2.1; - Summary - Development Content by Block for Transportation Assessment Purposes

Block (Ref Fig 2.1)	*No.*
Block A	• 260 Apartments/Duplex Units, • Ancillary Residential Amenity Space, • Under-croft with 72 Car Parking Spaces & Cycle Parking
Block B	• 342 Apartments Units, • Ancillary Residential Amenity Space, • Ancillary Communal Space for Residents, • 285m^2 GFA Commercial Space, • Under-croft with 53 Car Parking Spaces & Cycle Parking
Block C	• 350 Apartments Units, • Ancillary Residential Amenity Space, • Ancillary Communal Crèche Space (272m^2 GFA), • Under-croft with 42 Car Parking Spaces & Cycle Parking
Block D	• 152 Apartments Units, • Ancillary Residential Amenity Space, • 1,500m2 GFA Local Office Space, • 477m^2 GFA Commercial Space • Under-croft with 51 Car Parking Spaces & Cycle Parking • Existing Garage & Forecourt

2.3 Based on the summary as set out above, the entire site has a total of 1,104 Apartments set out in individual blocks with streets and infrastructure arranged in traditional N-S and E-W blocks, consistent with the Local Area Plan, and as illustrated in the Layout drawings included as ***Appendix A.***

2.4 The development includes copious secure bicycle parking, limited car parking & refuse management/residential storage areas within the dedicated areas. Car Parking Quantum is addressed further within the Parking Section of the Report below. Importantly, it is proposed to remove and reconstruct the existing industrial estate roads consistent with the best practice design requirements of a residential urban area, removing and replacing the existing Industrial-type roads and road infrastructure.

2.5 The site is within the long-established Cookstown Industrial Estate, which clearly is Commercial/Industrial in nature, and this being addressed as part of the planning application. The sites are currently accessed by vehicular traffic by way of Belgard Road, Old Belgard Road, and Cookstown Estate Road.

2.6 Cookstown Road is a single carriageway 2-way road, currently subject to a 50kph speed restriction and is relatively lightly trafficked. It runs in a E-W orientation through the site (as an extension to First Avenue), and extends along the western boundary of the site where it is oriented in a N-S direction. The Traffic survey indicated that the road carries a weekday AM Peak Hour 2-Way traffic flow of approximately 600 Passenger Car Units (PCUs) and a 2-way flow of 590 PCUs in the PM Peak Hour. In these terms, the road is considered moderately trafficked in terms of its link carrying capacity.

2.7 First Ave consists of a single carriageway 2-way road, running generally in an E-W orientation, located west of the development sites. It too is subject to a 50kph speed limit, and has pedestrian footpaths along its length. The Traffic Survey indicated that the First Ave to the west carries a weekday AM Peak Hour traffic flow of approximately 190 PCUs, and a traffic flow of approximately 140 PCUs in the PM Peak Hour. In these terms, the road is considered very lightly trafficked in terms of its link carrying capacity

2.8 So, in general terms, the roads within Cookstown Industrial Estate are demonstrably lightly trafficked by vehicles currently. Out-with the Estate, Cookstown Road meets Old Belgard Road in the form of a medium ICD at-grade roundabout. Old Belgard Road is also a single carriageway road with footpaths along both sides. It is however moderately trafficked in terms of hourly volume of flow, with a weekday AM Peak Hour traffic flow of approximately 880 PCUs, and a traffic flow of approximately 800 PCUs in the PM Peak Hour.

2.9 Belgard Rd runs parallel to Old Belgard Rd and is linked to Old Belgard Rd in several locations along its length, making the sites permeable for traffic from the east. Belgard Road is also a 2 lane dual-carriageway type road with footpaths along both sides, generally meeting all intersecting streets by way of at-grade traffic signal controlled junctions. Belgard Road is, by contrast, quite heavily trafficked in terms of hourly volume of flow, with a weekday AM Peak Hour traffic flow of approximately 1,830 PCUs, and a traffic flow of approximately 2,100 PCUs in the PM Peak Hour

2.10 A review of the Road Safety Authority (RSA) on-line database of reported road traffic accidents confirms that there have been no relevant accidents on the adjacent affected roads during the reported period 2005 to date, that are considered relevant or which will be affected by the proposed development. An extract from the RSA Database is included below as ***Figure 2.2***

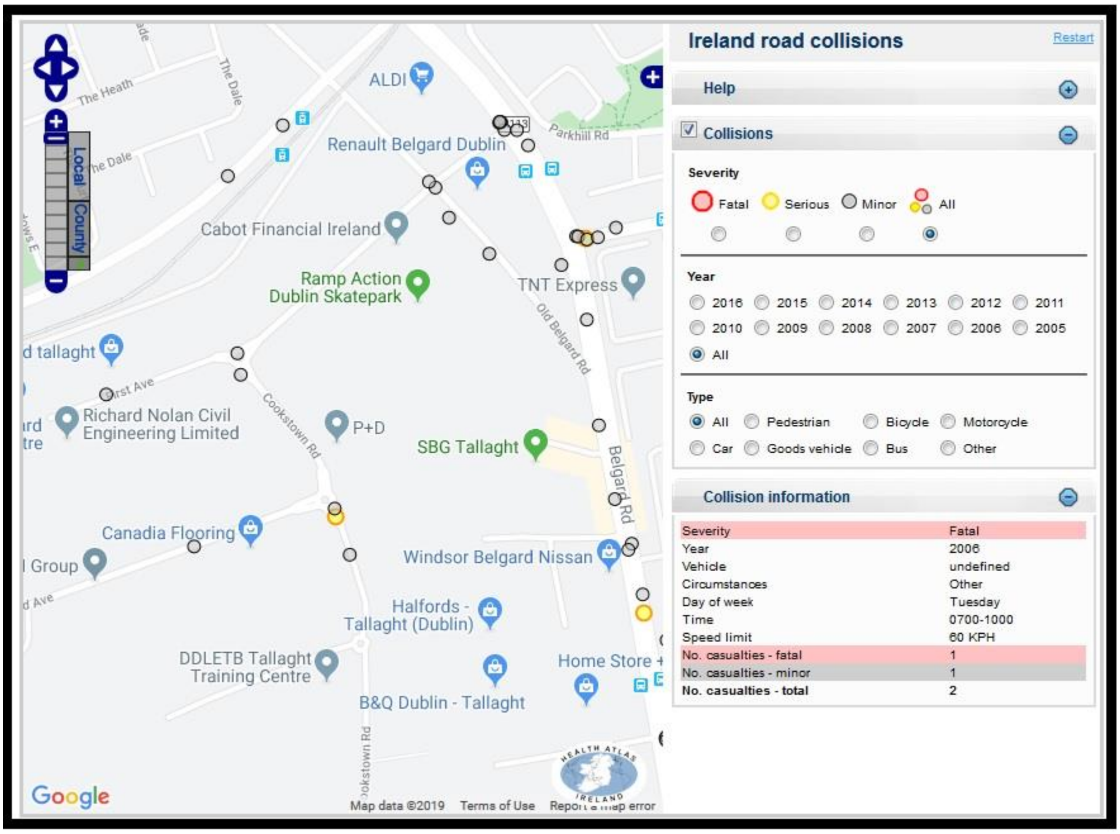


Figure 2.2 - RSA Accident Data Extract

Road Improvements and Plans

2.11 There are planned road improvements as part of this application, included as works within the red line, that will improve accessibility and increase local road permeability of the subject sites. The accessibility/permeability will be enhanced for all transport modes, with the removal of the inappropriate infrastructure and the replacement with modern residential-type infrastructure. The proposed altered internal roads will in particular increase accessibility to established public transport services and community facilities. The roadworks included in the application include; -

- The replacement & re-construction of Cookstown E-W road, along the northern extremity of the site,
- The replacement & re-construction of Cookstown N-S road, along the western boundary of the site,
- The replacement of 2 traditional Industrial Estate Roundabouts with at grade traffic signal controlled crossings (including pedestrian/cyclists priority within the sequence of the signals),
- The creation of a hight quality pedestrian route and link to the Belgard LUAS,
- New roads and links internally within the site, and
- All roads, footpaths, crossings, cyclists facilities and infrastructure constructed to standards that are consistent with a modern residential area.

2.12 The improved roads include the SDCC Part 8 construction of the N-S Link Road connecting Cookstown Industrial Estate Road through to Belgard Square North and also the 3rd party Proposal to construct an E-W Link Road through to Belgard Road, through lands known as the "Belgard Gardens Site" adjacent B&Q at Belgard Retail Park.

2.13 Given that the delivery of these two road projects are outside the control of the applicant, the beneficial effects of these links has not been included within this assessment. This is considered a robust approach, as it serves to concentrate traffic on and within the existing established road network. However, it is proposed to remove and reconstruct the existing industrial estate roads within the Red Line of the application as set out above, consistent with the best practice design requirements of a residential urban area providing safe and appropriate transportation linkages locally.

2.14 The 2 locally affected at Grade Roundabouts which are modelled as such herein are to be replaced by traffic signal controlled junctions, as this form of junction control is more appropriate for urban and residential environments.

Car Parking and Bicycle Parking Quantum & Justification

2.15 We have reviewed the **car parking** provision in terms of the maximum requirements of the SDCC Development Plan 2016-2022, for the entire development. The site is interpreted as being within SDCC Zone 2, with the resulting breakdowns provided herein for each individual Block below as ***Table 2.2, Table 2.3, Table 2.4*** and ***Table 2.5***; -

Table 2.2; - Car Parking Requirements as per SDCC Development Plan - BLOCK A

BLOCK	*Element*	*No.*	*SDCC Max Rate*	*Requires Max No.*
A	3 Bed+ Apartments	8	1.25/Unit	10
	2 Bed Apartments	137	1/unit	137
	1 Bed/Studio Apartments	115	0.75/unit	86
	Ancillary/Support Units	NA	NA	NA
	Block A Total Maximum Parking Required Under SDCC Plan			***233***

2.16 The under-croft for Site A has a provision of 72 spaces, including mobility-impaired parking spaces and this meets the MAXIMUM requirements of the SDCC Development Plan as set out above in ***Table 2.2*** above, being 30% of the maximum parking number allowed.

Table 2.3; - Car Parking Requirements as per SDCC Development Plan - BLOCK B

BLOCK	*Element*	*No.*	*SDCC Max Rate*	*Requires Max No.*
B	3 Bed+ Apartments	12	1.25/Unit	15
	2 Bed Apartments	150	1/unit	150
	1 Bed/Studio Apartments	180	0.75/unit	135
	Ancillary/Support Units	NA	NA	NA
	Block B Total Maximum Parking Required Under SDCC Plan			***300***

2.17 The under-croft for Site B has a provision of 57 spaces, including mobility-impaired parking spaces and this meets the MAXIMUM requirements of the SDCC Development Plan as set out above in ***Table 2.3*** above being 19% of the maximum parking number allowed.

Table 2.4; - Car Parking Requirements as per SDCC Development Plan - BLOCK C

BLOCK	*Element*	*No.*	*SDCC Max Rate*	*Requires Max No.*
C	3 Bed+ Apartments	25	1.25/Unit	31
	2 Bed Apartments	102	1/unit	102
	1 Bed/Studio Apartments	223	0.75/unit	167
	Ancillary/Support Units	NA	NA	NA
	Block C Total Maximum Parking Required Under SDCC Plan			***300***

2.18 The under-croft for Site C has a provision of 42 spaces, including mobility-impaired parking spaces and this meets the MAXIMUM requirements of the SDCC Development

Plan as set out above in ***Table 2.4*** above being 14% of the maximum parking number allowed.

Table 2.5; - Car Parking Requirements as per SDCC Development Plan - BLOCK D

BLOCK	***Element***	***No.***	***SDCC Max Rate***	***Requires Max No.***
D	3 Bed+ Apartments	0	1.25/Unit	0
	2 Bed Apartments	63	1/unit	63
	1 Bed/Studio Apartments	89	0.75/unit	67
	1,500m^2 Office	NA	1/75m^2	20
	477m^2 Commercial Unit	NA	1/25m^2	19
	Block D Total Maximum Parking Required Under SDCC Plan			***169***

2.19 The under-croft for Site D has a provision of 30 spaces (including those allocated to Offices), including mobility-impaired parking spaces and this meets the MAXIMUM requirements of the SDCC Development Plan as set out above in ***Table 2.5*** above being 18% of the maximum parking number allowed.

2.20 It is also noted that there are a significant number of on-street and surface parking spaces provided within the new street design along each of the new streets, adjacent Blocks A, B, C and D - these on street spaces are consistent with the recommendations of DMURS. **There are a total of 131 Spaces provided on-street, that are not reflected in the above calculations.** These spaces will facilitate short stay and visitor use, as well as facilitating set down and pick up, and taxi use, in addition to contributing to the streetscape wholly consistent with DMURS (which recommends street activity to promote lower ambient traffic speeds). The total car parking provision is 332 spaces, representing a parking ratio of 0.3 per unit.

2.21 The requirement for bicycle parking has also been assessed in accordance with the ***SDCC Development Plan*** and this is included below as ***Table 2.6*** to ***Table 2.9***

Table 2.6; - Block A - Min Bicycle Parking as per SDCC Development Plan -

Element	***SDCC Max Parking Rate***		***Requires***	
	Long Term	Short Stay	Long Stay	Short Stay
260 Apartments	1/5 units	1/10 units	52	26
Total Min Cycle Parking Required Under SDCC Plan			***78***	

Table 2.7; - Block B - Min Bicycle Parking as per SDCC Development Plan -

Element	***SDCC Max Parking Rate***		***Requires***	
	Long Term	Short Stay	Long Stay	Short Stay
342 Apartments	1/5 units	1/10 units	68	34
Total Min Cycle Parking Required Under SDCC Plan			***102***	

Table 2.8; - Block C - Min Bicycle Parking as per SDCC Development Plan -

Element	***SDCC Max Parking Rate***		***Requires***	
	Long Term	Short Stay	Long Stay	Short Stay
350 Apartments	1/5 units	1/10 units	70	35
Total Min Cycle Parking Required Under SDCC Plan			***105***	

Table 2.9; - Block D - Min Bicycle Parking for Apartments as per SDCC Development Plan -

Element	***SDCC Max Parking Rate***		***Requires***	
	Long Term	Short Stay	Long Stay	Short Stay
152 Apartments	1/5 units	1/10 units	30	15
Total Min Cycle Parking Required Under SDCC Plan			***45***	

2.22 Notwithstanding the Bicycle Parking & Storage requirements of the SDCC Development Plan, as illustrated above, cycle storage facilities are generally being provided to meet the more onerous requirements of The Department of Housing Planning & Local Government "***Sustainable Urban Housing Design Standards for New Apartments***" to meet the satisfaction of An Bord Pleanála.

2.23 In this regard, we set out below a schedule illustrating the current Bicycle Parking Provision at each of the Blocks, as ***Table 2.10.*** We believe that the bicycle parking provision is adequate to accommodate the worst case demands of the scheme.

Table 2.10; - Bicycle Parking Provided Per-Block & Total (With Bed Spaces illustrated)

Block Ref Fig 1.2	***At-Grade Visitor Cycle Parking Around Site***	***Bedrooms Per Block***	***Residential Cycle Spaces Required..***	***Total Residential Cycle Parking Provided***
Block A	***Refer Below***	**413**	**413**	**540**
Block B	***Refer Below***	**516**	**516**	**336**
Block C	***Refer Below***	**502**	**502**	**336**
Block D	***Refer Below***	**215**	**215**	**252**
Visitor Parking Assessment		**1 per 2 Units**		
Visitor Cycle Spaces		**552 Suggested**	**396 visitor spaces are provided at-Grade**	
Total Bicycle Parking Provided (for 1,104 Apartments with 1,646 Bedrooms Total)			**1,860**	

Discussion/Justification - Car Parking

2.24 Approximately c 30% of the maximum Development Plan Parking Maximum Standards are being provided within the parking areas associated with each block. In terms of the "***Sustainable Urban Housing Design Standards for New Apartments***" and the requirement for private car parking spaces, we include below as ***Table 2.11*** an illustration of the Parking Ratio for each individual Block, for ease of reference by ABP.

Table 2.11; - Car Parking Provision & Ratio Provided Per-Block

Block (Ref Fig 1.2)	***No Apts***	***No. Parking Spaces***	***Parking Ratio***
Block A	**260**	**72**	**0.28**
Block B	**342**	**57**	**0.17**
Block C	**350**	**42**	**0.12**
Block D	**152**	**30***	**0.20**
Total	**1,104**	**201**	**-----**

* ***For Residential Elements***

2.25 If however the 131 No. on-street parking spaces are also included, there are 332 car parking spaces provided **representing a parking ratio overall of 0.3**. The Number of Parking Spaces provided for each block is considered to be appropriate for the development, consistent with other sustainable similarly ideally located developments of this nature. In this case the reduced parking provision is considered appropriate in light of the location of the proposed development immediately adjacent high quality public transport (and in consideration of the provisions of the SDCC Development Plan being "Maximum" standards).

2.26 There is also a commitment to provide a 'Hub' with a total of 16 Go-Car car share spaces within the scheme. The letter of intent with regard to this element is included herein within ***Appendix A***. The generous provision of Go-Car spaces provides ready-access to vehicles for residents in the event of requiring same.

2.27 The development is not a fully traditional residential apartment development. There are elements of 'Build-to-Rent' and, in this regard, the Car Parking requirements are fundamentally different, with anticipated lower car ownership and dependency for this nature of scheme. Given the low number of spaces provided (effectively visitor/mobility impaired parking, 16 No Go-Car Spaces & set down provision), the entire scheme will be actively marketed and promoted as a "***Reduced Car Dependency***" scheme and this will be communicated from the outset as part of sales and marketing. The development will also be managed on an on-going basis to ensure that the Reduced Car Dependency nature of the development is continually promoted and enhanced.

2.28 The National Standard, The Department of Housing Planning & Local Government "***Sustainable Urban Housing Design Standards for New Apartments***" sets out the parking requirements based on locational characteristics of any development and states (Paragraph 4.18); -

Car Parking

The Quantum of Car parking or the requirement for any such provision for apartment developments will vary having regard to the types of location in cities and towns that may be suitable for apartment development, broadly based on proximity and accessibility criteria.

2.29 It then goes on to identify the locational characteristics and features that warrant a reduction or elimination in provision of private car parking spaces (Paragraph 4.19) ;-

Central and/or Accessible Urban Locations

In larger scale and higher density developments, comprising wholly of apartments in more central locations that are well served by public transport, the default policy is for car parking provision to be minimised, substantially reduced or wholly eliminated in certain circumstances. The policies above would be particularly applicable in highly accessible areas such as in or adjoining city cores or at a confluence of public transport systems such as rail and bus stations located in close proximity.

2.30 In terms of the stated Policy, the subject site meets all the requirements for significantly reducing or eliminating the provision of Private Car Parking, under the headings; -

High Density Development	✓
Comprising Wholly of Apartments	✓
Central Location	✓
Well Served by Public Transport	✓
Rail/Bus in Close Proximity	✓

2.31 In these terms the proposed subject development meets all the necessary requirements for significantly reduced car parking provision, in this case c. 20% of the SDCC Max Car Parking requirement.

2.32 The National Apartment Guidance states (Paragraph 4.23); -

For all types of location, where it is sought to eliminate or reduce car parking provision, it is necessary to ensure, where possible, the provision of an appropriate number of drop off, service, visitor parking spaces and parking for the mobility impaired. Provision is also to be made for alternative mobility solutions including facilities for car sharing club

vehicles and cycle parking and secure storage. It is also a requirement to demonstrate specific measures that enable car parking provision to be reduced or avoided.

2.33 Conscious that the scheme is intended to be actively marketed as Reduced Car Dependency, the layout has been designed with the above issues in mind and the drawings clearly show the required features; -

Drop Off Spaces	✓
Apartment Servicing Areas/Spaces	✓
Dedicated Visitor Parking Spaces	✓
Mobility Impaired Spaces	✓
"Go-Car" Spaces	✓
Cycle Parking & Cycle Storage	✓

2.34 In terms of ***specific measures*** to enable car parking provision to be reduced to the level proposed, in this case the specific measures are; -

- The Active Management and Marketing of the Development from the outset as Reduced Car Dependency',

- Very Limited Dedicated Car Parking is intended to be provided to Residents or will any be attached to any rental properties (and same will be Specified in associated Rental Agreements),

- The Location within walking distance of all South Dublin amenities (eg The Square and SDCC HQ, Tallaght Hospital etc) and schools,

- Associated Employment Opportunities locally (*Based on the CSO Census Data, in 2016 there were 2,958 commuters who lived in the Electoral Division of Tallaght - Springfield but worked elsewhere. There were 8,874 commuters who travelled in to this electoral division to work. This resulted in a net in-flow of 5,916 commuters. This indicates that the locality has significant employment opportunities, and these are continually improving*),

- Proximity to the LUAS being served by the LUAS Red Line 'on the doorstep' of the sites,

- Very easy walk distance from the Dublin Bus Terminus at *The Square* (from where 7 high frequency services currently operate)

- 16 No. Dedicated "Go Car" spaces/cars provided within the development,

- Copious Cycle Parking and Cycle Storage (Refer Above),

- On site Security and Management by permanent staff and CCTV that will ensure the car parking areas are monitored and policed, with a clamping system in operation, so that the car parking restrictions are closely controlled and enforced.

3. TRIP GENERATION, ASSIGNMENT & DISTRIBUTION

3.1 The Trip Rate Information Computer System (TRICS) database is used to ascertain vehicular trip generation associated with the use of any particular site. This represents industry standard practice for Transportation Assessments in Ireland.

3.2 In this case the worst case assessment is based on TRICS, and a robust and onerous assessment has been undertaken in order to ensure that we thoroughly assess the impact, in terms of stress-testing the access junctions and the road capacity impact of the scheme. In this case the assessment has not considered the beneficial diluting effect of the proposed road improvements, apart from the recommended upgrade of the adjacent roundabouts to traffic signal control, and this therefore represents a robust assessment of impact as traffic generated is assumed to be concentrated within the existing network rather than within a more permeable network as planned by SDCC.

3.3 The Trip Rates applied in this case for each individual Block are as summarised below as ***Table 3.1, Table 3.2, Table 3.3 and Table 3.4*** and are as individually broken down and extracted from the relevant TRICS Database within Appendix B and Appendix C herewith

Table 3.1; - TRICS Data Summary, Worst Case Traffic Generation BLOCK A

Network Period	PCU Arrivals	PCU Departures	Total 2-Way Traffic
Weekday AM Peak Hr	15	51	66
Weekday PM Peak Hr	47	22	69

Table 3.2; - TRICS Data Summary, Worst Case Traffic Generation BLOCK B

Network Period	PCU Arrivals	PCU Departures	Total 2-Way Traffic
Weekday AM Peak Hr	38	84	122
Weekday PM Peak Hr	86	57	143

Table 3.3; - TRICS Data Summary, Worst Case Traffic Generation BLOCK C

Network Period	PCU Arrivals	PCU Departures	Total 2-Way Traffic
Weekday AM Peak Hr	29	77	106
Weekday PM Peak Hr	70	38	108

Table 3.4; - TRICS Data Summary, Worst Case Net Traffic Generation BLOCK D

Network Period	PCU Arrivals	PCU Departures	Total 2-Way Traffic
Weekday AM Peak Hr	39	40	79
Weekday PM Peak Hr	40	44	84

3.4 We have included herein as ***Appendix B*** the TRICS data output for the individual elements upon which the above are based, conscious of course that the majority if not all elements of the development will be for the use of local residents and do not therefore generate external traffic movements.

Assignment/Distribution - Future Year Traffic

3.5 We have used hand assignment techniques based on common-sense origin destination traffic patterns, with the worst case traffic assigned to the roads. We have assumed that 100% of the traffic will have the proposed individual under-croft development vehicular access as origin/destination during the peak hours, as it is considered that this methodology will result in the most onerous assessment of the impact on the adjacent roads.

3.6 The standard methodology applied was to firstly ascertain the base background traffic conditions for both the weekday AM and weekday PM Commuter Peak periods. We then used the TII Project Appraisal Guidelines (Unit 5.5 Link-Based Traffic Growth forecasting) to establish opening/occupation year 2025 and design year 2040 traffic conditions on the local road network.

3.7 The worst case traffic based on the content of the above tables was then applied in order to establish Opening Year and Design Year Traffic Conditions. This is all included in the calculations included herein as ***Appendix C***.

3.8 It should be noted that we have selected an opening year of 2025 as being reasonable and appropriate, in terms of full occupation - However, varying the opening year and design year by 1-3 years will have no significant impact upon the conclusions of the study.

4. TRAFFIC IMPACT - TRAFFIC CAPACITY RESULTS

4.1 The Institution of Highways and Transportation (IHT) Guidelines for Traffic Impact Assessment and the TII Traffic and Transport Assessment Guidelines sets out a mechanism for assessment of developments of this nature and determining whether further assessment is indeed required. This industry standard process requires a **Threshold Assessment** of the impact on the local roads to be provided in order to determine whether further more detailed modelling and assessment of particular critical junctions is necessary.

4.2 The professional guidance referenced above sets out specific increases in traffic volume associated with new development, which, if breeched, requires further detailed analysis to be undertaken. The recommendation is that, if the expected increase is 5% or greater, then further analysis is warranted in circumstances where junctions are within but are nearing capacity. It should be noted that the observed and surveyed traffic on the affected roads within the Industrial Estate are considered very low, and in this regard the addition of new traffic has a more onerous net effect (in simple terms, with low levels of existing traffic the net effect of increased traffic is greatly exacerbated).

4.3 In this regard, it is anticipated that the addition of the proposed development, to long established roads in the area will in reality not result in any significant level of increase in traffic capacity issues arising on the local roads, with all anticipated traffic increases being below the Industry-Standard levels above which further assessment is required. This is particularly the case in terms of impact upon for example Belgard Road Traffic conditions, as evidenced from the Threshold Assessment included below.

4.4 In the case of the subject site, in the context of its former industrial uses, given the previous established volume and nature of the traffic associated with these industrial uses it is expected that the conversion to local residential uses will see a significant improvement in traffic conditions for all transport modes.

4.5 It should also be noted that the proposed road improvements described above will in time further reduce traffic impact by dispersing and diluting the effect of any additional development related traffic volumes. In addition, under Assessment Guidance, any requirement to consider the effect of other committed or planned development would have the effect of further increasing base/background traffic conditions and would have the knock-on effect of reducing the net impact of the subject development traffic.

4.6 We have undertaken the detailed assessment of the impact of the proposed development (Reference ***Appendix C*** herewith), and this confirms the Threshold Impact of locally affected junctions as set out below as ***Table 4.1***.

Table 4.1; - Threshold Assessment of Junction Impact - TII Guidelines

Relevant Junction	AM Peak (%)	PM Peak (%)	Comment
Internal Estate Junctions	N/A	N/A	ALL Key Junctions Assessed Below
Cookstown Rd/Belgard Rd	4.52%	4.07%	Sub 5% Threshold - No Assessment Reqd
R838/Belgard Rd	1.34%	1.18%	Sub 5% Threshold - No Assessment Reqd
R383/Old Belgard Rd	2.96%	4.77%	Sub 5% Threshold - No Assessment Reqd
Cookstown Rd/Old Belgard Rd	14.3%	16.8%	Exceeds 5% - Junction Assessed

<u>Internal Roundabout at First Ave/Cookstown Estate Rd</u>

4.7 We have used the TII-approved computer simulation model ARCADY (Assessment of Roundabout Capacity and Delay) to assess the capacity queues and delay at the existing junction and in order to confirm that adequate reserve capacity exists in order to accommodate the proposed development traffic. The results of the modelling are summarised as ***Table 4.2***, with the entire models included herein as ***Appendix D***.

Table 4.2; - ARCADY Summary Results First Ave/Cookstown Estate Roundabout

Modelled Scenario	Period Mean Max Q (PCUs)	Period Max RFC
2025 Opening Year AM Peak	<1	0.43
2025 Opening Year PM Peak	<1	0.3
2040 Design Year AM Peak	<1	0.47
2040 Design Year PM Peak	<1	0.33

4.8 The results confirm that the existing junction, in its current form, is way more than adequate to accommodate the worst case traffic conditions associated with the entire of the proposed development, with all RFCs way below 100% (and indeed all are below the Industry Standard recommended Max RFC of 0.85).

4.9 However, it is accepted that a roundabout may not constitute the most appropriate form of junction within what is to become a residential estate, with the associated increased pedestrian and cyclist movements, and we believe that the existing roundabout may be best replaced with a simple Signal Controlled T-Junction (subject to agreement with SDCC). However, the modelling confirms existing adequacy.

Cookstown Estate Rd/New E-W Street - Worst Case T Junction

4.10 We have undertaken an assessment of the capacity queues and delays at the proposed priority controlled junction using the TII-approved simulation model PiCADY (Priority Intersection capacity and Delay). The output of the assessment is included herein as ***Appendix E***, and is summarised below as ***Table 4.3***.

Table 4.3; - PiCADY Summary Results New E-W Street/Cookstown Estate Rd Junction

Modelled Scenario	Period Mean Max Q (PCUs)	Period Max RFC
2025 Opening Year AM Peak	<1	0.24
2025 Opening Year PM Peak	<1	0.13
2040 Design Year AM Peak	<1	0.25
2040 Design Year PM Peak	<1	0.14

4.11 All Results Above are well below the theoretical maximum accepted RFC of 0.85 and therefore no capacity problems are anticipated at the Junction.

4.12 It should be noted that the **anticipated traffic flows at this junction are significantly greater than any of the other priority controlled T Junctions on the local network**, including all of the accesses to the proposed under-crofts and development accesses - in these terms the analysis provides evidence and assurance that there will be no capacity related issues whatsoever arising at other proposed network junctions.

Roundabout at Old Belgard Rd/Cookstown Estate Rd

4.13 We have also again used the TII-approved computer simulation model ARCADY (Assessment of Roundabout Capacity and Delay) to assess the capacity queues and delay at the existing junction and in order to confirm that adequate reserve capacity exists in order to accommodate the proposed development traffic. The results of the modelling are summarised as ***Table 4.4***, with the entire models included herein as ***Appendix F.***

Table 4.4; - ARCADY Summary Results Old Belgard Rd/Cookstown Estate Roundabout

Modelled Scenario	**Period Mean Max Q (PCUs)**	**Period Max RFC**
2025 Opening Year AM Peak	4	0.84
2025 Opening Year PM Peak	2	0.57
2040 Design Year AM Peak	8	0.91
2040 Design Year PM Peak	2	0.61

4.14 The assessment demonstrates that the roundabout has adequate capacity to accommodate the worst case development traffic right up to the Design Year 2040, with all RFCs being within 100% (and only marginally above the industry recommended level of 85% in 2040) . It should be noted that ARCADY is a macro-simulation modelling tool, which relies on free flow for exiting traffic on downstream links, and other variables which can affect junction operation. In this regard, whilst the junction model demonstrates adequate capacity it is understood that there are other external capacity constraints that can affect operation, and this is most likely the case here.

4.15 In this case therefore it is accepted that a roundabout may not constitute the most appropriate form of junction as one of the main points of vehicular access to what is to become a residential estate, given the associated increased pedestrian and cyclist movements. We therefore believe that the existing roundabout may well be best replaced with a simple 4-arm Signal Controlled 'Crossroads' Junction (subject to agreement with SDCC), consistent with other junctions on Belgard Rd. Alternatively, it could be combined with off-set dedicated controlled pedestrian crossings. Any redesign of the junction that may be deemed necessary will be agreed with officials in SDCC.

4.16 The analysis undertaken confirms that there is adequate capacity in the existing and proposed junctions to accommodate the worst case traffic projections without any concerns arising in terms of traffic congestion or indeed Traffic Safety.

5. RESPONSE TO ITEM #2 OF ABP OPINION OF 29 APRIL 2020

5.1 This Section of the Transportation Assessment Report addresses the specific issues raised within Section 2 of the ABP Opinion dated 29th April 2020, which is reproduced below as ***Figure 5.1.***

> **2.** Further consideration of the documentation as it relates to access to the proposed development and to the streets in and around the site. The documentation should demonstrate whether the street network would provide adequate access for pedestrians and other road uses from the proposed development to public transport facilities, places of employment and commercial and social services, having regard to the principles and detailed requirements for urban streets set out in DMURS. In particular the documentation should clarify whether and how any new pedestrian access would be provided to the Luas stop at Belgard and whether and how the existing roads in the industrial estate would be altered to make them suitable to serve urban residential development. If separate cycle facilities are proposed the documentation should demonstrate whether they would comply with the National Cycle Manual and provide proper priority for cyclists over vehicles exiting from minor roads at junctions. The documentation should also provide a rationale for the proposed provision of parking for cars and bicycles.

Figure 5.1 – Extract ABP Opinion, Item #2

In particular it is noted that possibly the most appropriate response to the Item 2 cn be found in Appendix H (beginning at page 132) and in Appendix I (beginning at page 154) of the Transport Assessment document which in turn is part of Appendix 10.1 of the EIAR.

5.2 In terms of ***'The documentation should demonstrate whether the street network would provide adequate access for pedestrians and other road users from the proposed development to public transport facilities, places of employment and commercial and social services, having regard to the principles and detailed requirements for urban streets set out in DMURS'***, the best reference to where this is addressed is within ***Appendix I*** of this Report, and we highlight the following;

- The design of the local replacement streets within the Red Line have been carefully undertaken, so as to be fully consistent with DMURS, and a DMURS Statement of Consistency is included herein as Appendix I,

- The DMURS Statement of Consistency states; - “*The proposed layout strategy seeks to maximise connectivity between key local destinations through the provision of a high level of permeability and legibility for all journeys, particularly for sustainable forms of travel (cycling and walking). The proposed residential scheme delivers greater mode and route choices along direct, attractive and safe linkages to local amenities and schools/service destinations through replacement of the existing industrial estate roads with modern streets”*
- The DMURS Statement of Consistency goes on to state; “*High Quality Connections between the proposed development and the employment areas and facilities within Tallaght, are provided”*
- The Independent Safety Audit included as ***Appendix G*** included a review of accessibility for cyclists, pedestrians and mobility impaired users and all of the issues raised by the Audit Team are incorporated.

5.3 In terms of ***‘The documentation should clarify whether and how any new pedestrian access would be provided to the LUAS Stop at Belgard and whether and how the existing roads in the industrial estate would be altered to make them suitable to serve urban residential development’*** we highlight the following; -

- The planning application includes for the construction of a dedicated link to the Belgard LUAS Stop, and a letter of consent from the landowner (in this case Dublin City Council) has been received and is included as part of the planning application,

- All of the existing Industrial Estate roads & associated junctions within the red line of the planning application are being replaced with modern residential estate quality links and infrastructure, and **Section 2.11** of this Report states; -

  There are planned road improvements as part of this application, included as works within the red line, that will improve accessibility and increase local road permeability of the subject sites. The accessibility/permeability will be enhanced for all transport modes, with the removal of the inappropriate infrastructure and the replacement with modern residential-type infrastructure. The proposed altered internal roads will in particular increase accessibility to established public transport services and community facilities. The roadworks included in the application include; -

- *The replacement & re-construction of Cookstown E-W road, along the northern extremity of the site,*
- *The replacement & re-construction of Cookstown N-S road, along the western boundary of the site,*
- *The replacement of 2 traditional Industrial Estate Roundabouts with at grade traffic signal controlled crossings (including pedestrian/cyclists priority within the sequence of the signals),*
- *The creation of a hight quality pedestrian route and link to the Belgard LUAS,*
- *New roads and links internally within the site, and*

All roads, footpaths, crossings, cyclists facilities and infrastructure constructed to standards that are consistent with a modern residential area.

5.4 In terms of ***'If separate cyclist facilities are proposed, the documentation should demonstrate whether they would comply with The National Cycle Manual and provide proper priority for cyclists over vehicles existing from minor roads at junctions'*** we highlight the following;

- Proposed Cycle facilities on the Larger Public Roads are compliant with the National Cycle Manual (NCM) (NCM pages 12 & 83), with advance cycle facilities and Toucan type crossings incorporated into all signal controlled junctions. Internally, for the minor streets, the cyclists infrastructure is also consistent with the NCM (Pages 54 & 55).

- Pedestrian and cyclist priority at minor roads, and associated traffic calming, is achieved through the use of raised platforms which afford priority to pedestrians and cyclists.

5.5 In terms of ***'The documentation should also provide a rationale for the proposed provision of parking for cars and bicycles'***, we highlight the following;

- A comprehensive rationale supporting the provision of Bicycle Parking & Car Parking numbers is set out in this Report (Paragraph 2.15 to 2.34 inclusive).

6. CONCLUSIONS

6.1 This Transportation Assessment Report assesses the traffic & transportation impact of the proposal to construct and occupy a large residential apartment development on lands west of Old Belgard Rd, North, South & West of Cookstown Rd within Cookstown Ind Est, Tallaght, D24. The proposed development comprises distinct blocks, with a greatly improved street network as illustrated on the enclosed plans.

6.2 The scheme design reflects the Transportation Planning Policy provisions of the SDCC Development Plan & the Tallaght Local Are Plan (LAP)

6.3 This Report has been prepared in accordance with the TIIs Traffic & Transport Assessment Guidelines, and is based on industry standard high Trip Generation Rates, in order to provide an onerous and robust assessment of the impact of the proposed development.

6.4 The analysis includes the effects of the existing traffic on the local roads and is based on a comprehensive classified vehicle turning movement survey undertaken for the purposes of this study, prior to the Covid 19 Pandemic Emergency. The assessment does not include the further beneficial effects associated with the proposals to improve accessibility and reduce impact through the provision of new road links to the subject lands. It is proposed to remove and reconstruct the existing industrial estate roads within the Red Line of the application, consistent with the best practice design requirements for a residential urban area providing safe and appropriate transportation linkages locally, changing the nature and form of the existing 'industrial streets'.

6.5 The proposed development site is ideally located within the heart of Tallaght Town Centre, and will therefore benefit from access to non-car modes of travel.

6.6 Car and Bicycle Parking is being provided generally in compliance with the requirements of the SDCC Development Plan and The Department of Housing Planning & Local Government "***Sustainable Urban Housing Design Standards for New Apartments***". Following our review of the provision we consider the number of car and bicycle parking spaces provided to be adequate and appropriate

6.7 An independent Stage 1 Road Safety Audit of the layout and the road network is included as ***Appendix G***. A preliminary Mobility Management Plan (aka Travel Plan) has been prepared to underscore the multi-modal accessibility of the site and is included as ***Appendix H***. A review of the design in accordance with the requirements of DMURS is completed & the resulting *Statement of Consistency* is included as ***Appendix I***.

6.8 This report demonstrates that the proposed Development will have a negligible impact upon the established local traffic conditions and can easily be accommodated on the road network without any capacity or road safety concerns arising.

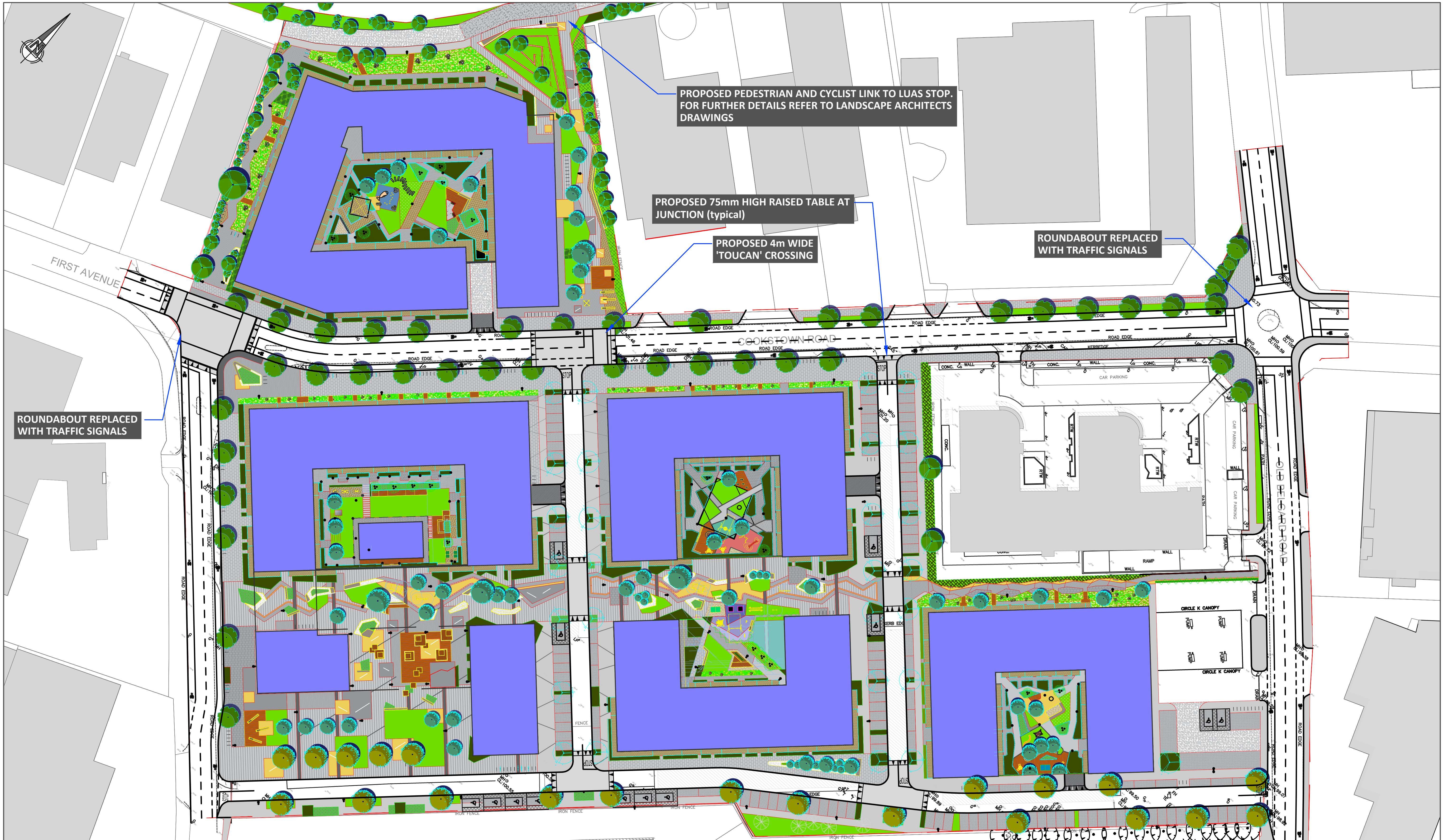
6.9 It is considered that there are no significant Operational Traffic Safety or Road Capacity issues that prevent a positive determination of the application by An Bord Pleanála.

APPENDICES - CONTENT

A	Proposed Development – Layout, Roads Arrangement & Access. Go-Car Letter of Intent/Commitment.
B	TRICS Trip Generation Output (Apartments, Shops, Offices, PFS)
C	Traffic Surveys, Trip Distribution & Network Traffic Flow Diagrams
D	ARCADY Junction Simulation Model Output - Cookstown Rd/1st Ave R'Abt
E	PiCADY Junction Model Output - Cookstown Rd/New E-W Street
F	ARCADY Junction Simulation Model Output - Old Belgard Rd/1st Ave R'Abt
G	Independent Stage 1 Road Safety Audit & Designer Feedback Form
H	Preliminary Mobility Management Plan (Travel Plan)
I	DMURS Statement of Consistency

APPENDIX A

Proposed Development -
Layout, Roads Arrangement & Access.
Go-Car Letter of Intent/Committment



NRB Consulting Engineers Ltd recommend that Road and land ownership boundaries are verified through Legal & Land searches by the Client.

This drawing is based upon CSR drawing 16408-2-100LMP, received 02/12/20. NRB Consulting Engineers Ltd shall not be liable for any inaccuracies or deficiencies.

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Registered in Ireland No. 491679

NRB consulting engineers

Client

Project: Lands west of Old Belgard Road and north, south and west of Cookstown Road, Cookstown Ind Est

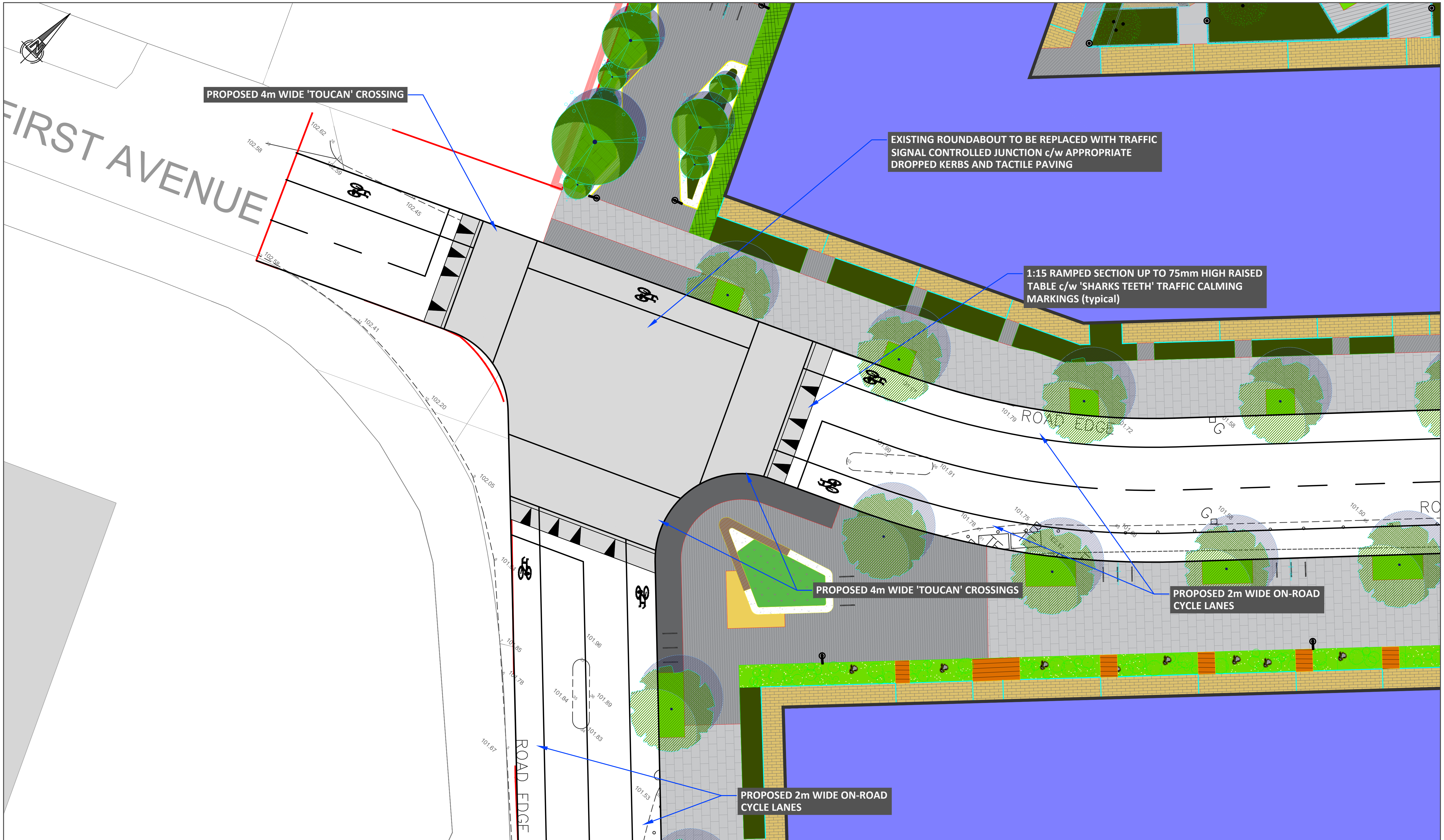
Title: Proposed Development Layout

Project No.	Drawing No.
19-036	NRB-TA-001

Drawn	Checked	Approved
PB	ER 07/12/20	ER 07/12/20

Date	Scale @ A3	Rev
30-Nov-20	1:1000	

Purpose of Issue: ☐ Draft ☐ As Built ☐ Information ☐ Tender ☐ Approval ☐ Construction



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Client

Project No. 19-036

Drawing No. NRB-TA-002

Project: Lands west of Old Belgard Road and north, south and west of Cookstown Road, Cookstown Ind Est

Drawn: PB

Checked: ER 30/11/20

Approved: ER 30/11/20

Title: Proposed Traffic Sgnals Layout at Junction of Cookstown Road and First Avenue

Date: 30-Nov-20

Scale @ A3: 1:250

Rev

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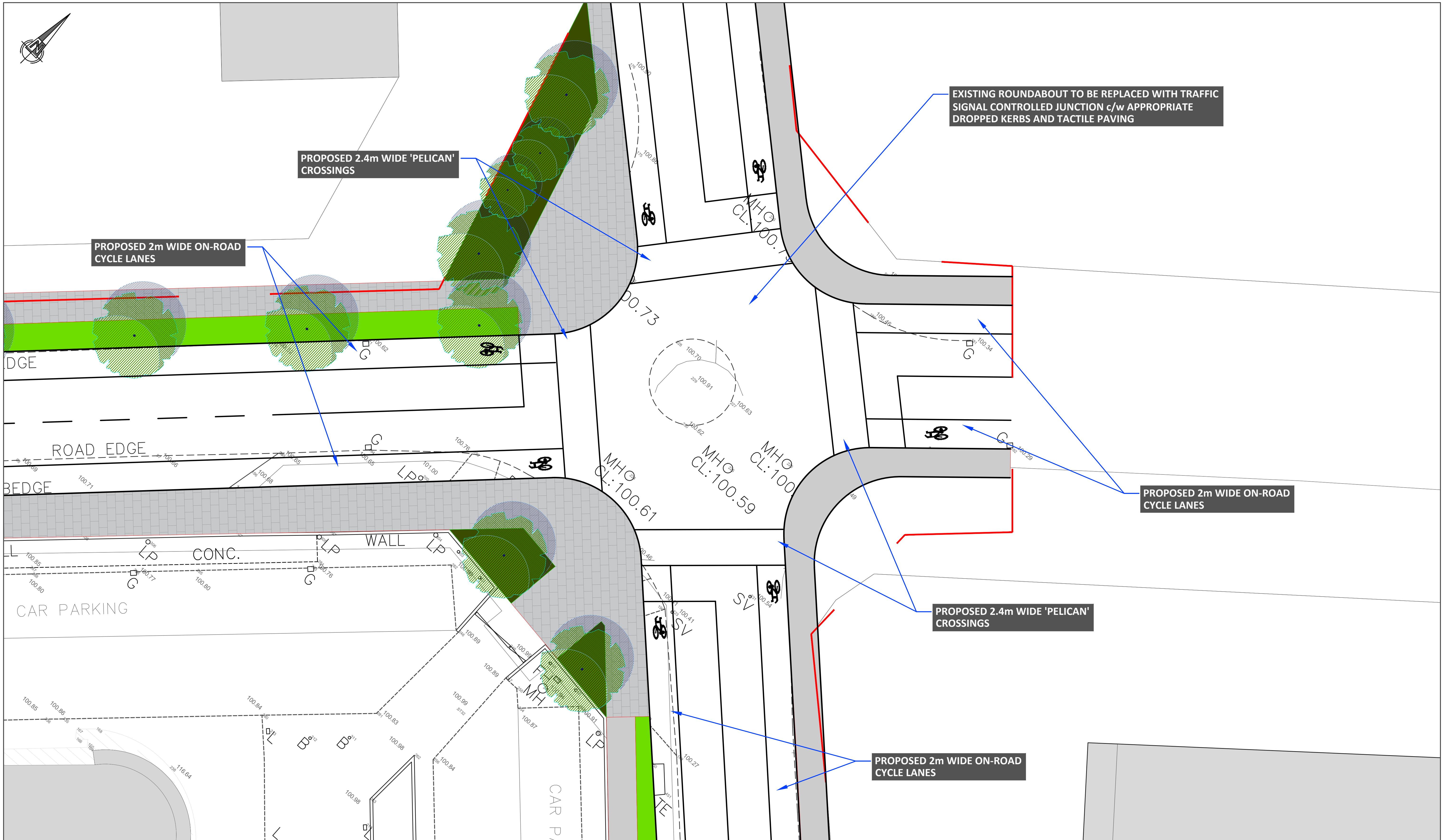
Purpose of Issue
- [ ] Draft
- [ ] As Built
- [ ] Information
- [ ] Tender
- [ ] Approval
- [ ] Construction



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NRB consulting engineers

Client	
Project	Lands west of Old Belgard Road and north, south and west of Cookstown Road, Cookstown Ind Est
Title	Proposed Traffic Sgnals Layout at Junction of Cookstown Road and Old Belgard Road

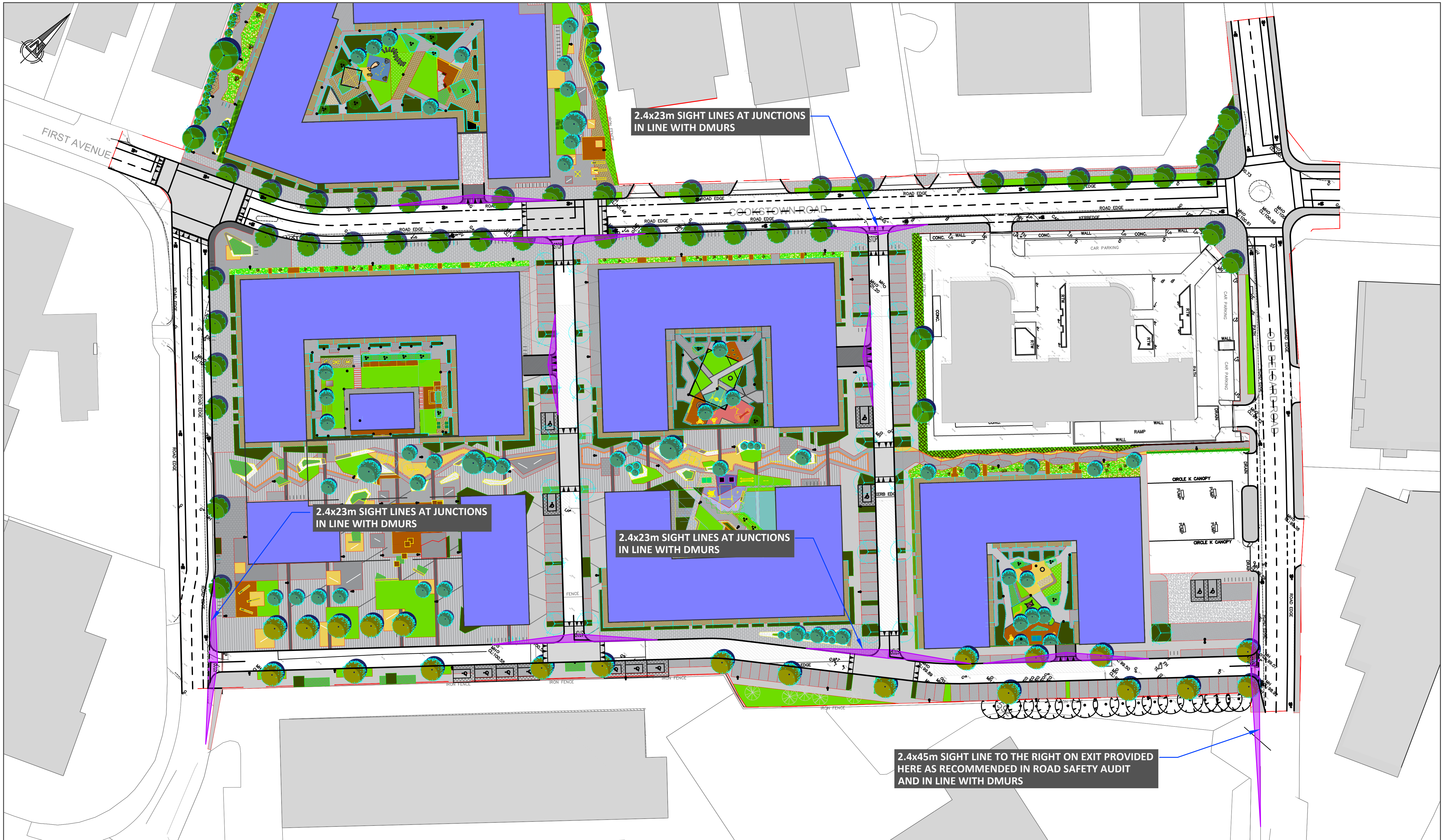
NRB Consulting Engineers Ltd accept no responsibility for any unauthorised amendments to this drawing. Only figured dimensions to be worked to.

Project No.	Drawing No.
19-036	NRB-TA-003

Drawn	Checked	Approved
PB	ER 30/11/20	ER 30/11/20

Date	Scale @ A3	Rev
30-Nov-20	1:250	

Purpose of Issue: ☐ Draft ☐ As Built ☐ Information ☐ Tender ☐ Approval ☐ Construction



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Client

Project: Lands west of Old Belgard Road and north, south and west of Cookstown Road, Cookstown Ind Est

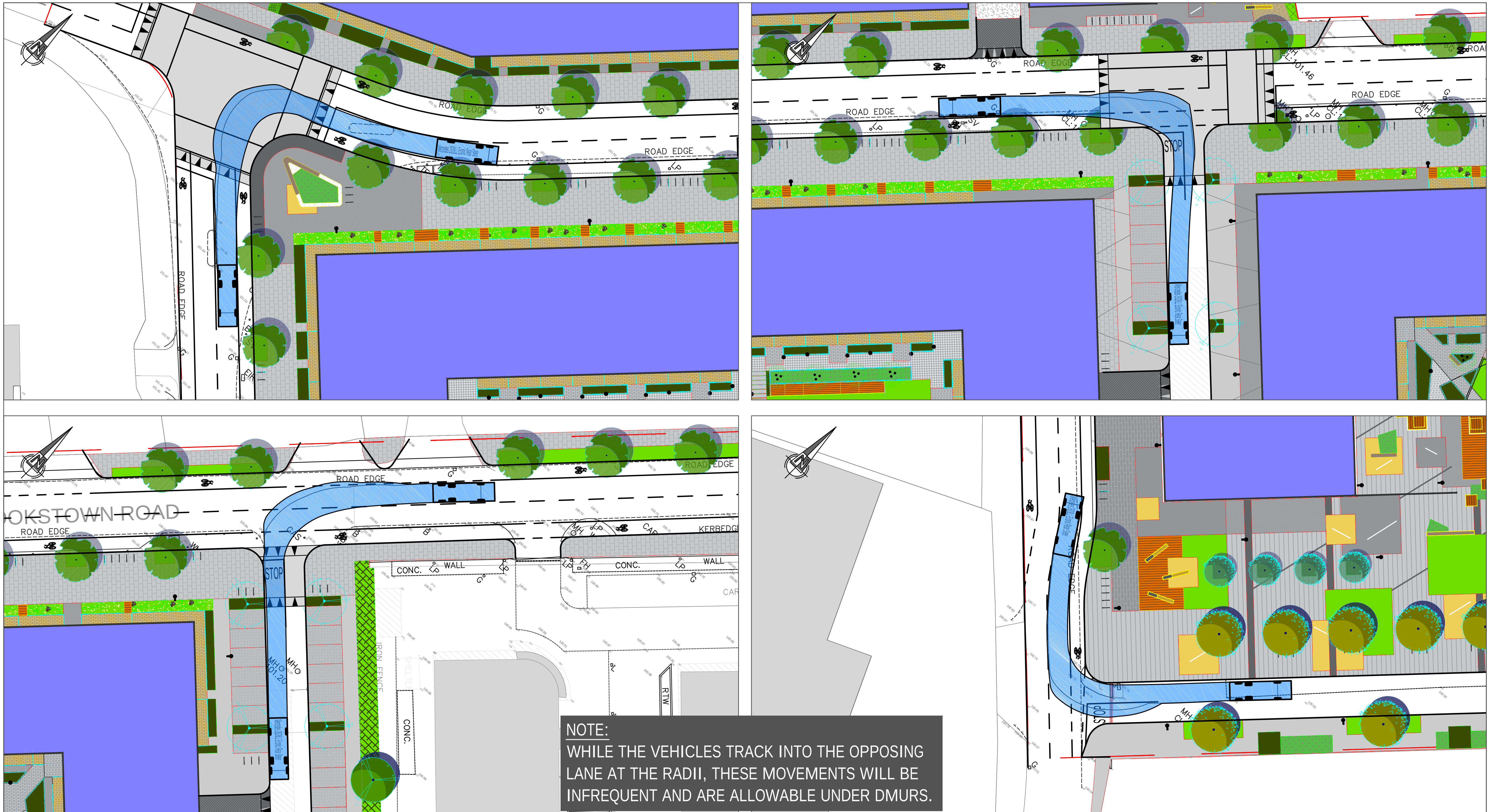
Title: Proposed Development Junction Sightlines

Project No.	Drawing No.
19-036	NRB-TA-004

Drawn	Checked	Approved
PB	ER 07/12/20	ER 07/12/20

Date	Scale @ A3	Rev
7-Dec-20	1:1000	

Purpose of Issue: ☐ Draft ☐ As Built ☐ Information ☐ Tender ☐ Approval ☐ Construction



VARIOUS AUTOTRACKS OF A REFUSE VEHICLE AT THE PROPOSED DEVELOPMENT

VARIOUS AUTOTRACKS OF A REFUSE VEHICLE AT THE PROPOSED DEVELOPMENT

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NRB consulting engineers

Client

Project: Lands west of Old Belgard Road and north, south and west of Cookstown Road, Cookstown Ind Est

Title: Various AutoTRACKs of a Refuse Vehicle at the Proposed Development (1 of 2)

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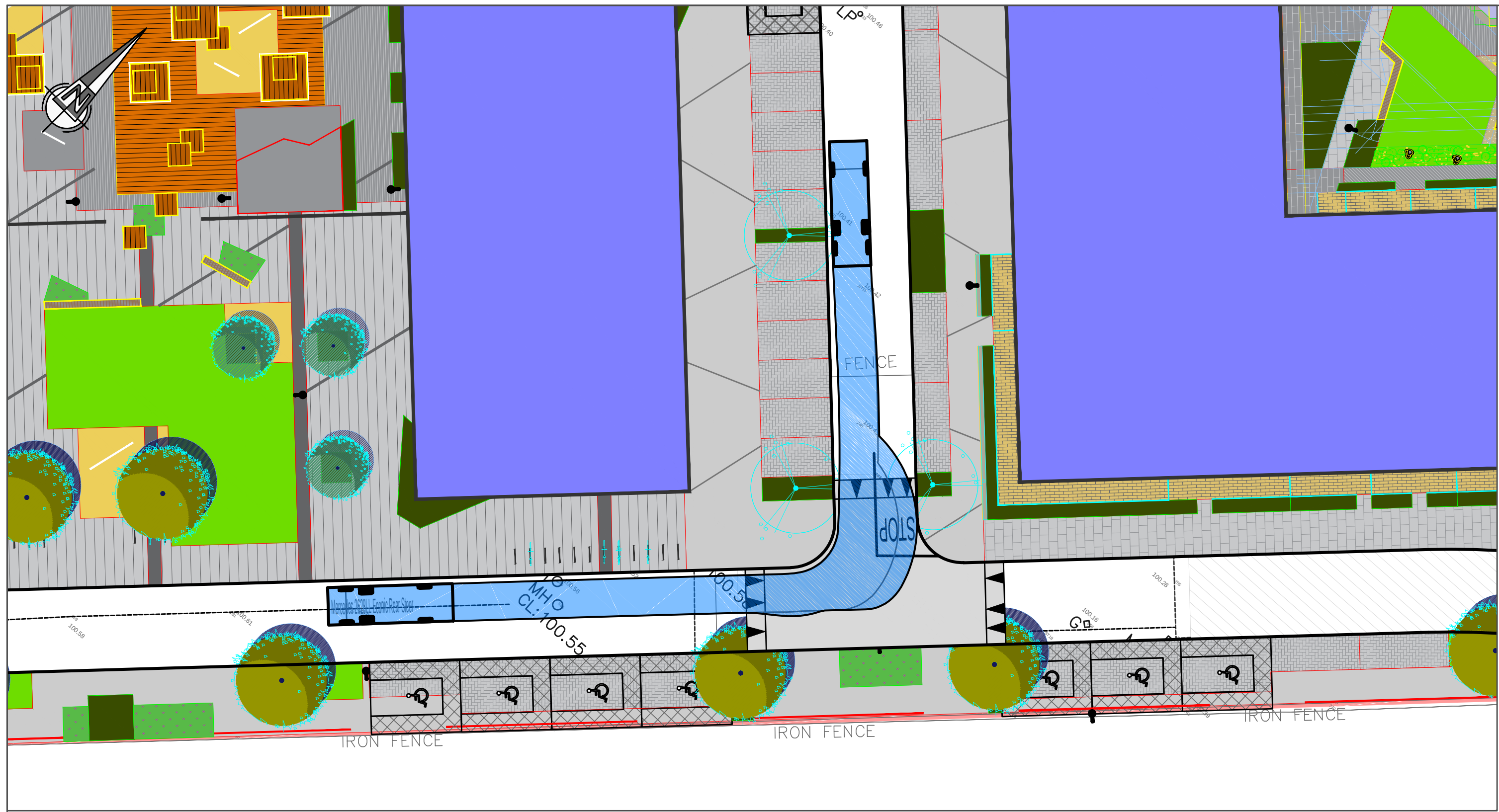
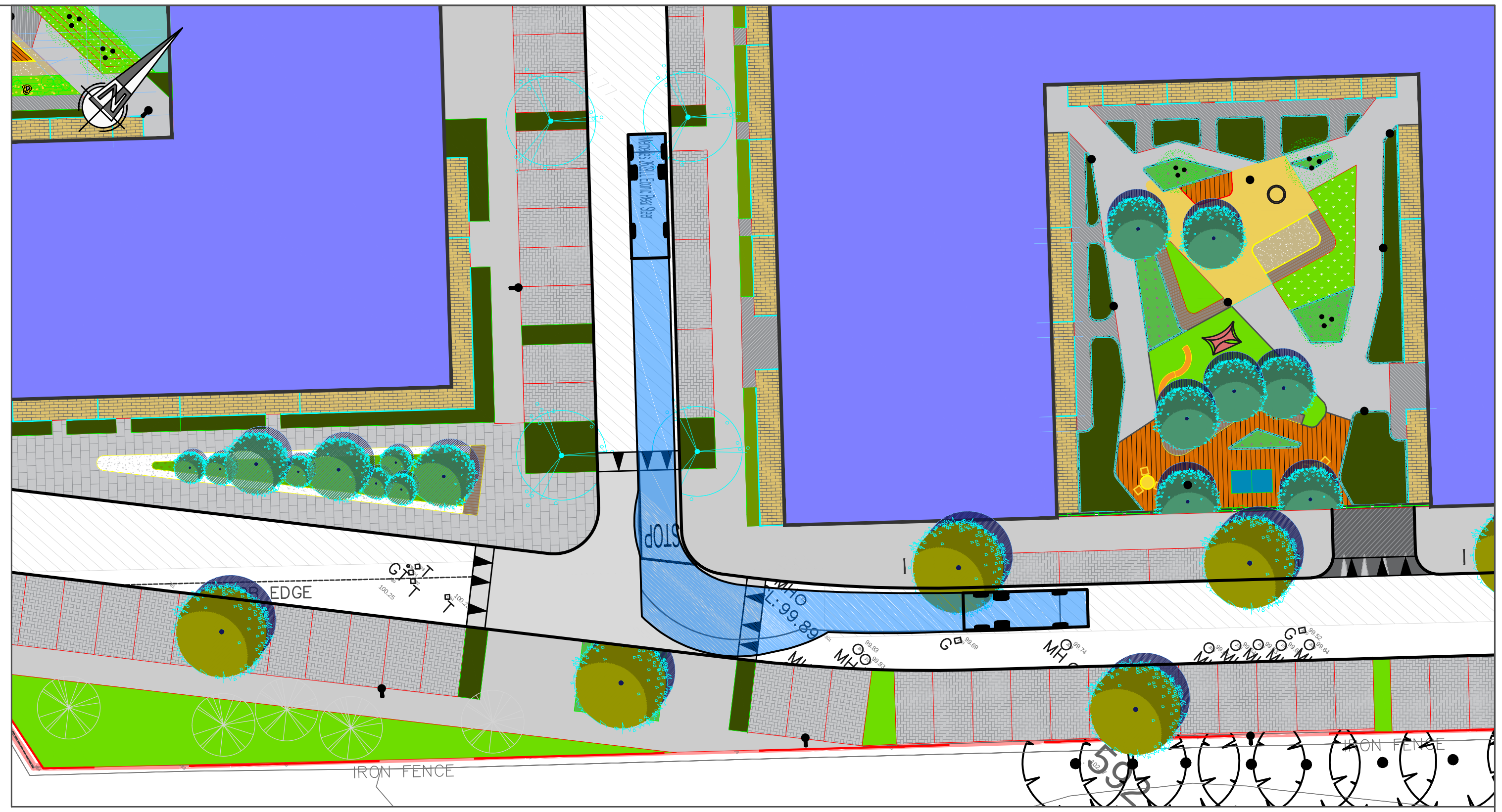
Project No.	Drawing No.
19-036	NRB-TA-005

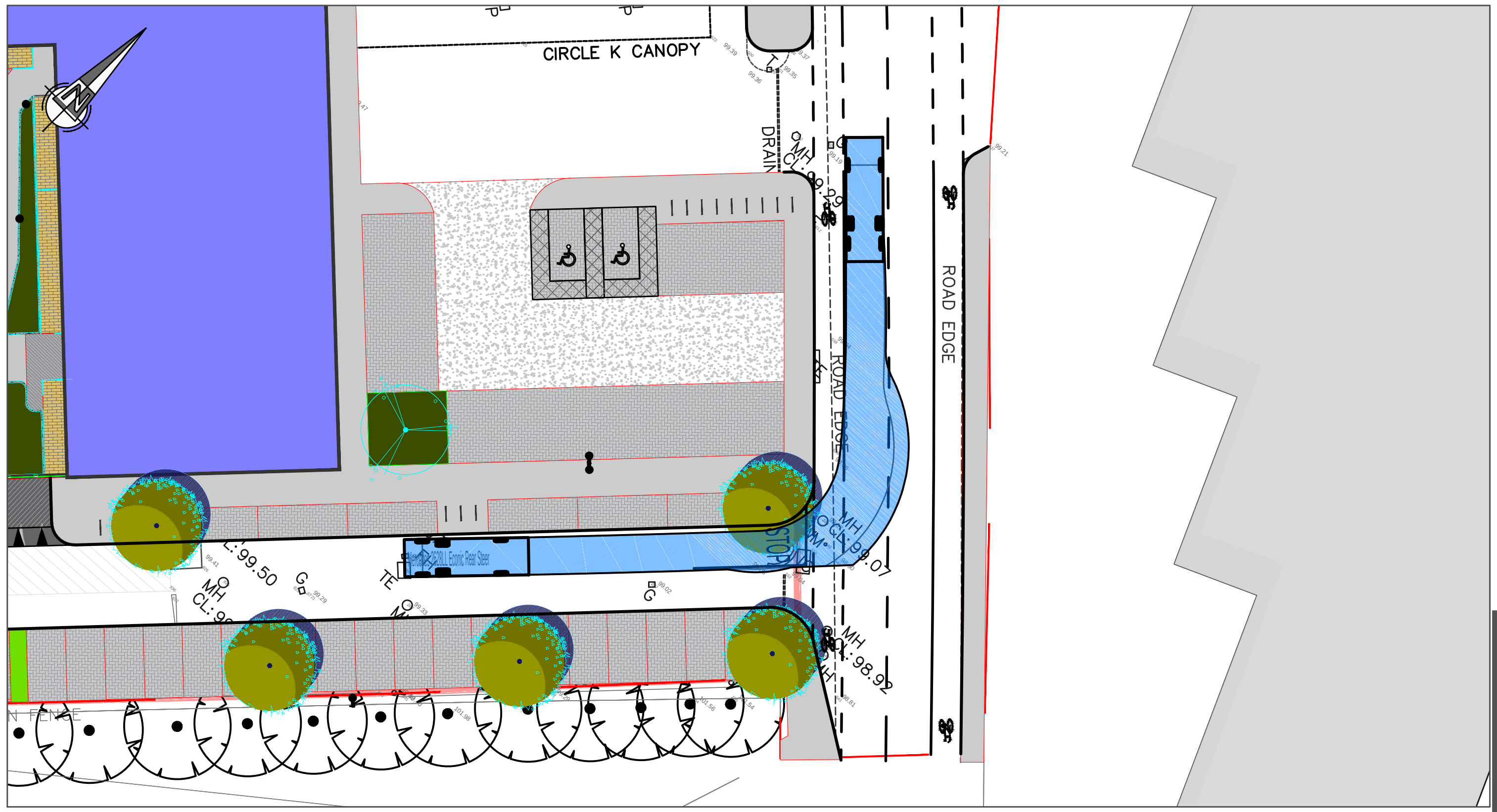
Drawn	Checked	Approved
PB	ER 07/12/20	ER 07/12/20

Date	Scale @ A3	Rev
7-Dec-20	1:500	

Purpose of Issue: ☐ Draft ☐ As Built ☐ Information ☐ Tender ☐ Approval ☐ Construction







NOTE:
WHILE THE VEHICLES TRACK INTO THE OPPOSING LANE AT THE RADII, THESE MOVEMENTS WILL BE INFREQUENT AND ARE ALLOWABLE UNDER DMURS.

VARIOUS AUTOTRACKS OF A REFUSE VEHICLE AT THE PROPOSED DEVELOPMENT

NRB Consulting Engineers Ltd recommend that Road and land ownership boundaries are verified through Legal & Land searches by the Client.

This drawing is based upon CSR drawing 16408-2-100LMP, received 02/12/20. NRB Consulting Engineers Ltd shall not be liable for any inaccuracies or deficiencies.

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NRB consulting engineers

Client

Project: Lands west of Old Belgard Road and north, south and west of Cookstown Road, Cookstown Ind Est

Title: Various AutoTRACKs of a Refuse Vehicle at the Proposed Development (2 of 2)

Project No.	Drawing No.
19-036	NRB-TA-006

Drawn	Checked	Approved
PB	ER 07/12/20	ER 07/12/20

Date	Scale @ A3	Rev
7-Dec-20	1:500	

Purpose of Issue: ☐ Draft ☐ As Built ☐ Information ☐ Tender ☐ Approval ☐ Construction

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Registered in Ireland No. 491679

NRB consulting engineers

Client

Project: Lands west of Old Belgard Road and north, south and west of Cookstown Road, Cookstown Ind Est

Title: Illustration of Parking Allocations

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Project No.	Drawing No.
19-036	NRB-TA-007

Drawn	Checked	Approved
PB	ER 07/12/20	ER 07/12/20

Date	Scale @ A3	Rev
7-Dec-20	1:1000	

Purpose of Issue: ☐ Draft ☐ As Built ☐ Information ☐ Tender ☐ Approval ☐ Construction

HWP,
Unit 1B Cookstown Industrial Estate,
Tallaght,
Dublin 24

Dublin, 21st October 2020

To Whom It May Concern,

This is a letter to confirm that GoCar intends to provide 16 shared car club vehicles in the proposed PRS Scheme at Cookstown Castle, Cookstown, Tallaght, Dublin 24. The scheme is set to comprise 1,104 apartments. GoCar representatives have discussed the project with representatives of NRB Consulting Engineers who are the Engineers for the Project and are excited to provide a car sharing service at this location.

It is understood that these vehicles will be exclusively used by residents of the development. GoCar will work with the eventual managers of the scheme to promote the service as an alternative to private cars.

GoCar is Ireland's leading car sharing service with over 60,000 members and over 800 cars and vans on fleet. Each GoCar which is placed in a community has the potential to replace the journeys of up to 15 private cars. The Department of Housing's Design Standards for New Apartments - Guidelines for Planning Authorities 2018 outline: "For all types of location, where it is sought to eliminate or reduce car parking provision, it is necessary to ensure... provision is also to be made for alternative mobility solutions including facilities for car sharing club vehicles."

Carsharing is a sustainable service. By allowing multiple people to use the same vehicle at different times, car sharing reduces car ownership, car dependency, congestion, noise and air pollution. It frees up land which would otherwise be used for additional parking spaces. Most GoCar users only use a car when necessary, and walk and use public transport more often than car owners.

By having GoCar car club vehicles in a development such as this, residents will have access to pay-as-you-go driving, in close proximity to their homes, which will increase usership of the service.

I trust that this information is satisfactory. For any queries, please do not hesitate to contact me.

Rob Kearns
Head of
Growth
GoCar Carsharing
Limited M: 083 822 3924
E: rob.kearns@gocar.ie

APPENDIX B

TRICS Trip Generation Output
(Apartments, Shops, Offices, PFS)

Calculation Reference: AUDIT-160301-200624-0613

TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 03 - RESIDENTIAL
Category : C - FLATS PRIVATELY OWNED
VEHICLES

Selected regions and areas:

02	SOUTH EAST		
	BD	BEDFORDSHIRE	3 days
	ES	EAST SUSSEX	1 days
	EX	ESSEX	2 days
	HC	HAMPSHIRE	1 days
03	SOUTH WEST		
	DC	DORSET	1 days
	DV	DEVON	1 days
04	EAST ANGLIA		
	CA	CAMBRIDGESHIRE	1 days
	NF	NORFOLK	1 days
	SF	SUFFOLK	2 days
05	EAST MIDLANDS		
	DS	DERBYSHIRE	1 days
	NT	NOTTINGHAMSHIRE	2 days
06	WEST MIDLANDS		
	WM	WEST MIDLANDS	1 days
07	YORKSHIRE & NORTH LINCOLNSHIRE		
	RI	EAST RIDING OF YORKSHIRE	1 days
08	NORTH WEST		
	MS	MERSEYSIDE	2 days
09	NORTH		
	CB	CUMBRIA	3 days
10	WALES		
	CO	CONWY	1 days
11	SCOTLAND		
	EB	CITY OF EDINBURGH	1 days
	SA	SOUTH AYRSHIRE	1 days
	SR	STIRLING	2 days
12	CONNAUGHT		
	GA	GALWAY	1 days
13	MUNSTER		
	WA	WATERFORD	1 days
14	LEINSTER		
	LU	LOUTH	3 days
15	GREATER DUBLIN		
	DL	DUBLIN	6 days
16	ULSTER (REPUBLIC OF IRELAND)		
	MG	MONAGHAN	1 days
17	ULSTER (NORTHERN IRELAND)		
	AN	ANTRIM	1 days

This section displays the number of survey days per TRICS® sub-region in the selected set

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	41	59	0.048	41	59	0.165	41	59	0.213
08:00 - 09:00	41	59	0.057	41	59	**0.198**	41	59	0.255
09:00 - 10:00	41	59	0.071	41	59	0.098	41	59	0.169
10:00 - 11:00	41	59	0.061	41	59	0.082	41	59	0.143
11:00 - 12:00	41	59	0.067	41	59	0.082	41	59	0.149
12:00 - 13:00	41	59	0.093	41	59	0.089	41	59	0.182
13:00 - 14:00	41	59	0.076	41	59	0.087	41	59	0.163
14:00 - 15:00	41	59	0.081	41	59	0.078	41	59	0.159
15:00 - 16:00	41	59	0.099	41	59	0.066	41	59	0.165
16:00 - 17:00	41	59	0.121	41	59	0.080	41	59	0.201
17:00 - 18:00	**41**	**59**	**0.179**	41	59	0.086	41	59	0.265
18:00 - 19:00	41	59	0.178	41	59	0.098	**41**	**59**	**0.276**
19:00 - 20:00									
20:00 - 21:00									
21:00 - 22:00									
22:00 - 23:00									
23:00 - 24:00									
Total Rates:			1.131			1.209			2.340

This section displays the trip rate results based on the selected set of surveys and the selected count type (shown just above the table). It is split by three main columns, representing arrivals trips, departures trips, and total trips (arrivals plus departures). Within each of these main columns are three sub-columns. These display the number of survey days where count data is included (per time period), the average value of the selected trip rate calculation parameter (per time period), and the trip rate result (per time period). Total trip rates (the sum of the column) are also displayed at the foot of the table.

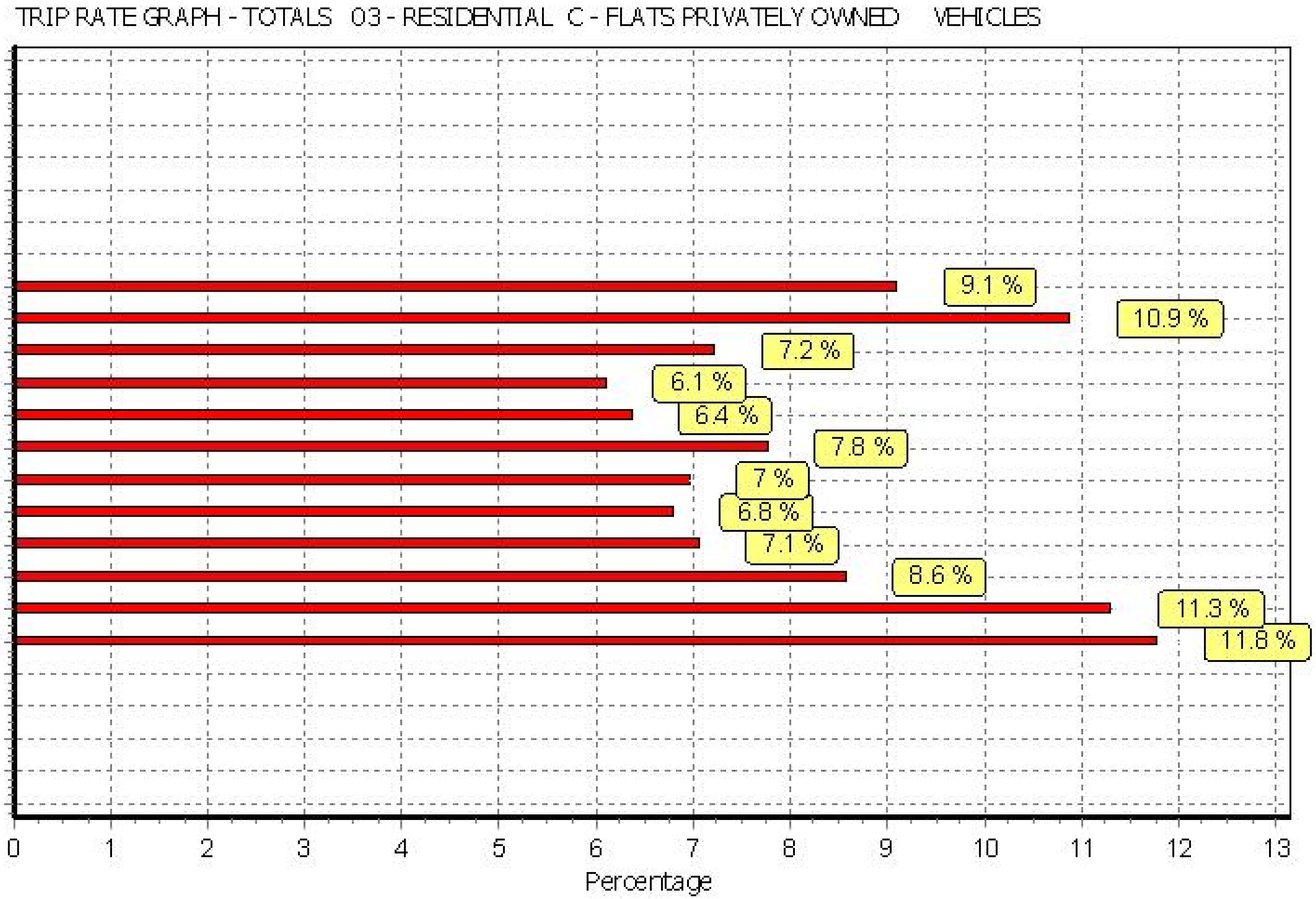
*To obtain a trip rate, the average (mean) trip rate parameter value (TRP) is first calculated for all selected survey days that have count data available for the stated time period. The average (mean) number of arrivals, departures or totals (whichever applies) is also calculated (COUNT) for all selected survey days that have count data available for the stated time period. Then, the average count is divided by the average trip rate parameter value, and multiplied by the stated calculation factor (shown just above the table and abbreviated here as FACT). So, the method is: COUNT/TRP*FACT. Trip rates are then rounded to 3 decimal places.*

Parameter summary

Trip rate parameter range selected:	6 - 184 (units:)
Survey date date range:	01/01/12 - 25/09/19
Number of weekdays (Monday-Friday):	41
Number of Saturdays:	0
Number of Sundays:	0
Surveys automatically removed from selection:	0
Surveys manually removed from selection:	0

This section displays a quick summary of some of the data filtering selections made by the TRICS® user. The trip rate calculation parameter range of all selected surveys is displayed first, followed by the range of minimum and maximum survey dates selected by the user. Then, the total number of selected weekdays and weekend days in the selected set of surveys are show. Finally, the number of survey days that have been manually removed from the selected set outside of the standard filtering procedure are displayed.

TIME	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	0.213	9.1
08:00-09:00	0.255	10.9
09:00-10:00	0.169	7.2
10:00-11:00	0.143	6.1
11:00-12:00	0.149	6.4
12:00-13:00	0.182	7.8
13:00-14:00	0.163	7.0
14:00-15:00	0.159	6.8
15:00-16:00	0.165	7.1
16:00-17:00	0.201	8.6
17:00-18:00	0.265	11.3
18:00-19:00	0.276	11.8
19:00-20:00		
20:00-21:00		
21:00-22:00		
22:00-23:00		
23:00-24:00		



This graph is a visual representation of the trip rate calculation results screen. The same time periods and trip rates are displayed, but in addition there is an additional column showing the percentage of the total trip rate by individual time period, allowing peak periods to be easily identified through observation. Note that the type of count and the selected direction is shown at the top of the graph.

TRIP RATE for Land Use 03 - RESIDENTIAL/C - FLATS PRIVATELY OWNED
CYCLISTS
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	41	59	0.003	41	59	0.010	41	59	0.013
08:00 - 09:00	41	59	0.003	**41**	**59**	**0.015**	**41**	**59**	**0.018**
09:00 - 10:00	41	59	0.003	41	59	0.004	41	59	0.007
10:00 - 11:00	41	59	0.002	41	59	0.004	41	59	0.006
11:00 - 12:00	41	59	0.005	41	59	0.003	41	59	0.008
12:00 - 13:00	41	59	0.003	41	59	0.002	41	59	0.005
13:00 - 14:00	41	59	0.002	41	59	0.002	41	59	0.004
14:00 - 15:00	41	59	0.003	41	59	0.002	41	59	0.005
15:00 - 16:00	41	59	0.004	41	59	0.003	41	59	0.007
16:00 - 17:00	41	59	0.003	41	59	0.002	41	59	0.005
17:00 - 18:00	**41**	**59**	**0.009**	41	59	0.005	41	59	0.014
18:00 - 19:00	41	59	0.007	41	59	0.002	41	59	0.009
19:00 - 20:00									
20:00 - 21:00									
21:00 - 22:00									
22:00 - 23:00									
23:00 - 24:00									
Total Rates:			0.047			0.054			0.101

This section displays the trip rate results based on the selected set of surveys and the selected count type (shown just above the table). It is split by three main columns, representing arrivals trips, departures trips, and total trips (arrivals plus departures). Within each of these main columns are three sub-columns. These display the number of survey days where count data is included (per time period), the average value of the selected trip rate calculation parameter (per time period), and the trip rate result (per time period). Total trip rates (the sum of the column) are also displayed at the foot of the table.

*To obtain a trip rate, the average (mean) trip rate parameter value (TRP) is first calculated for all selected survey days that have count data available for the stated time period. The average (mean) number of arrivals, departures or totals (whichever applies) is also calculated (COUNT) for all selected survey days that have count data available for the stated time period. Then, the average count is divided by the average trip rate parameter value, and multiplied by the stated calculation factor (shown just above the table and abbreviated here as FACT). So, the method is: COUNT/TRP*FACT. Trip rates are then rounded to 3 decimal places.*

TIME	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	0.013	12.9
08:00-09:00	0.018	17.8
09:00-10:00	0.007	6.9
10:00-11:00	0.006	5.9
11:00-12:00	0.008	7.9
12:00-13:00	0.005	5.0
13:00-14:00	0.004	4.0
14:00-15:00	0.005	5.0
15:00-16:00	0.007	6.9
16:00-17:00	0.005	5.0
17:00-18:00	0.014	13.9
18:00-19:00	0.009	8.9
19:00-20:00		
20:00-21:00		
21:00-22:00		
22:00-23:00		
23:00-24:00		

This graph is a visual representation of the trip rate calculation results screen. The same time periods and trip rates are displayed, but in addition there is an additional column showing the percentage of the total trip rate by individual time period, allowing peak periods to be easily identified through observation. Note that the type of count and the selected direction is shown at the top of the graph.

Calculation Reference: AUDIT-160301-191211-1248

TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 02 - EMPLOYMENT
Category : A - OFFICE
VEHICLES

Selected regions and areas:

03	SOUTH WEST		
	BR	BRISTOL CITY	1 days
	DC	DORSET	1 days
	WL	WILTSHIRE	1 days
04	EAST ANGLIA		
	CA	CAMBRIDGESHIRE	3 days
	NF	NORFOLK	2 days
	SF	SUFFOLK	1 days
05	EAST MIDLANDS		
	LE	LEICESTERSHIRE	1 days
06	WEST MIDLANDS		
	WK	WARWICKSHIRE	1 days
	WM	WEST MIDLANDS	1 days
	WO	WORCESTERSHIRE	2 days
07	YORKSHIRE & NORTH LINCOLNSHIRE		
	NY	NORTH YORKSHIRE	2 days
	WY	WEST YORKSHIRE	2 days
08	NORTH WEST		
	GM	GREATER MANCHESTER	3 days
	LC	LANCASHIRE	1 days
	MS	MERSEYSIDE	1 days
09	NORTH		
	CB	CUMBRIA	1 days
	DH	DURHAM	2 days
	TV	TEES VALLEY	1 days
	TW	TYNE & WEAR	2 days
10	WALES		
	CO	CONWY	1 days
	MT	MERTHYR TYDFIL	1 days
	PS	POWYS	1 days
	SW	SWANSEA	2 days
11	SCOTLAND		
	DU	DUNDEE CITY	1 days
	EB	CITY OF EDINBURGH	1 days
12	CONNAUGHT		
	CS	SLIGO	1 days
	RO	ROSCOMMON	1 days
13	MUNSTER		
	CR	CORK	1 days
15	GREATER DUBLIN		
	DL	DUBLIN	3 days
16	ULSTER (REPUBLIC OF IRELAND)		
	MG	MONAGHAN	2 days
17	ULSTER (NORTHERN IRELAND)		
	AN	ANTRIM	2 days

This section displays the number of survey days per TRICS® sub-region in the selected set

TRIP RATE for Land Use 02 - EMPLOYMENT/A - OFFICE
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 - 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	44	4575	0.108	44	4575	0.012	44	4575	0.120
07:30 - 08:00	44	4575	0.376	44	4575	0.061	44	4575	0.437
08:00 - 08:30	46	4389	0.561	46	4389	0.067	46	4389	0.628
08:30 - 09:00	**46**	**4389**	**0.650**	46	4389	0.106	**46**	**4389**	**0.756**
09:00 - 09:30	46	4389	0.499	46	4389	0.100	46	4389	0.599
09:30 - 10:00	46	4389	0.298	46	4389	0.135	46	4389	0.433
10:00 - 10:30	46	4389	0.189	46	4389	0.125	46	4389	0.314
10:30 - 11:00	46	4389	0.163	46	4389	0.105	46	4389	0.268
11:00 - 11:30	46	4389	0.138	46	4389	0.127	46	4389	0.265
11:30 - 12:00	46	4389	0.128	46	4389	0.118	46	4389	0.246
12:00 - 12:30	46	4389	0.132	46	4389	0.159	46	4389	0.291
12:30 - 13:00	46	4389	0.169	46	4389	0.208	46	4389	0.377
13:00 - 13:30	46	4389	0.183	46	4389	0.191	46	4389	0.374
13:30 - 14:00	46	4389	0.195	46	4389	0.153	46	4389	0.348
14:00 - 14:30	46	4389	0.167	46	4389	0.119	46	4389	0.286
14:30 - 15:00	46	4389	0.125	46	4389	0.155	46	4389	0.280
15:00 - 15:30	46	4389	0.095	46	4389	0.149	46	4389	0.244
15:30 - 16:00	46	4389	0.077	46	4389	0.170	46	4389	0.247
16:00 - 16:30	46	4389	0.087	46	4389	0.351	46	4389	0.438
16:30 - 17:00	46	4389	0.091	46	4389	0.387	46	4389	0.478
17:00 - 17:30	46	4389	0.073	**46**	**4389**	**0.632**	46	4389	0.705
17:30 - 18:00	46	4389	0.052	46	4389	0.386	46	4389	0.438
18:00 - 18:30	43	4653	0.028	43	4653	0.304	43	4653	0.332
18:30 - 19:00	42	4754	0.014	42	4754	0.123	42	4754	0.137
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:			4.598			4.443			9.041

This section displays the trip rate results based on the selected set of surveys and the selected count type (shown just above the table). It is split by three main columns, representing arrivals trips, departures trips, and total trips (arrivals plus departures). Within each of these main columns are three sub-columns. These display the number of survey days where count data is included (per time period), the average value of the selected trip rate calculation parameter (per time period), and the trip rate result (per time period). Total trip rates (the sum of the column) are also displayed at the foot of the table.

*To obtain a trip rate, the average (mean) trip rate parameter value (TRP) is first calculated for all selected survey days that have count data available for the stated time period. The average (mean) number of arrivals, departures or totals (whichever applies) is also calculated (COUNT) for all selected survey days that have count data available for the stated time period. Then, the average count is divided by the average trip rate parameter value, and multiplied by the stated calculation factor (shown just above the table and abbreviated here as FACT). So, the method is: COUNT/TRP*FACT. Trip rates are then rounded to 3 decimal places.*

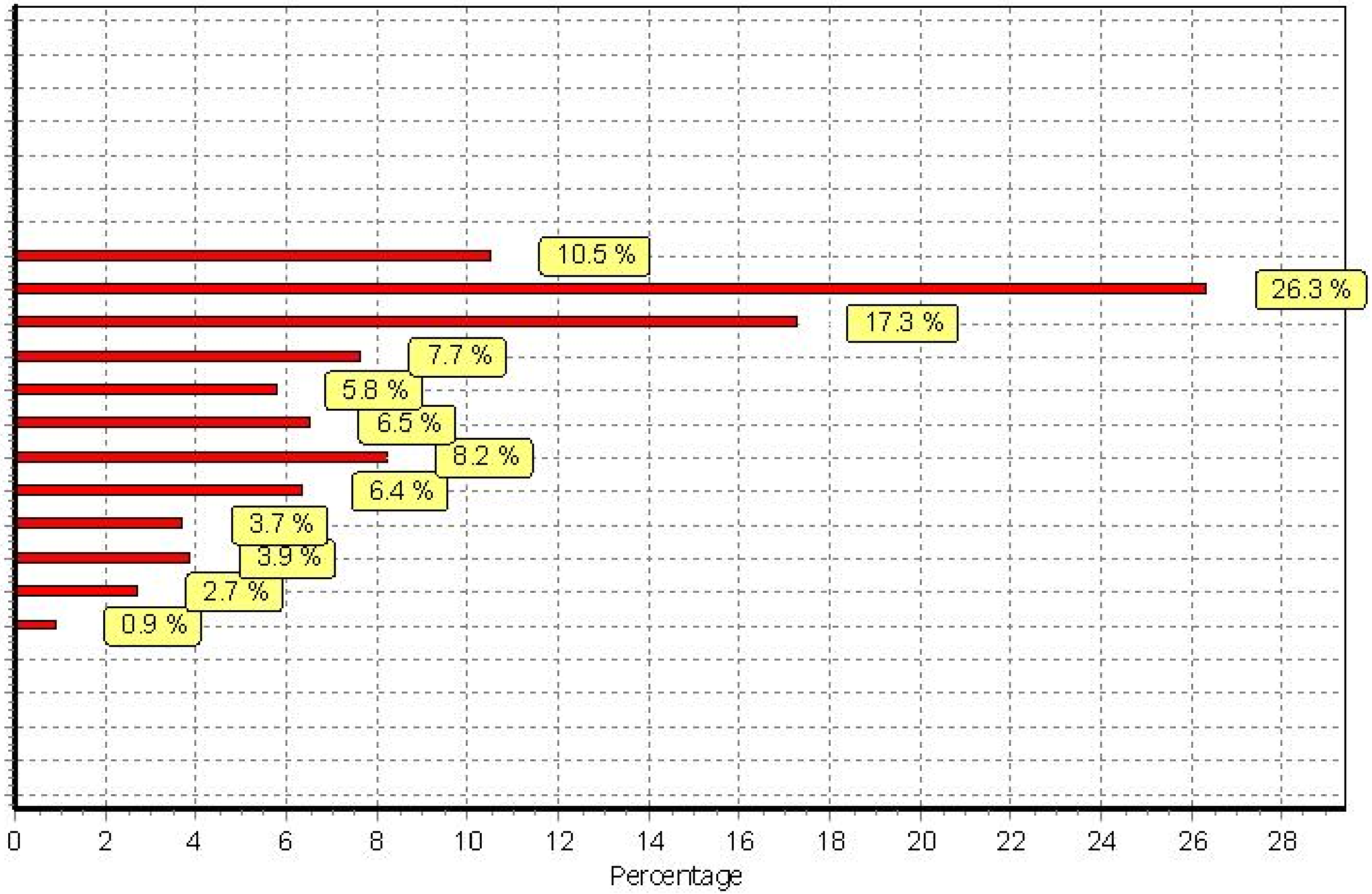
Parameter summary

Trip rate parameter range selected:	178 - 22657 (units: sqm)
Survey date date range:	01/01/11 - 14/03/19
Number of weekdays (Monday-Friday):	46
Number of Saturdays:	0
Number of Sundays:	0
Surveys automatically removed from selection:	1
Surveys manually removed from selection:	0

This section displays a quick summary of some of the data filtering selections made by the TRICS® user. The trip rate calculation parameter range of all selected surveys is displayed first, followed by the range of minimum and maximum survey dates selected by the user. Then, the total number of selected weekdays and weekend days in the selected set of surveys are show. Finally, the number of survey days that have been manually removed from the selected set outside of the standard filtering procedure are displayed.

TRIP RATE GRAPH - ARRIVALS 02 - EMPLOYMENT A - OFFICE VEHICLES

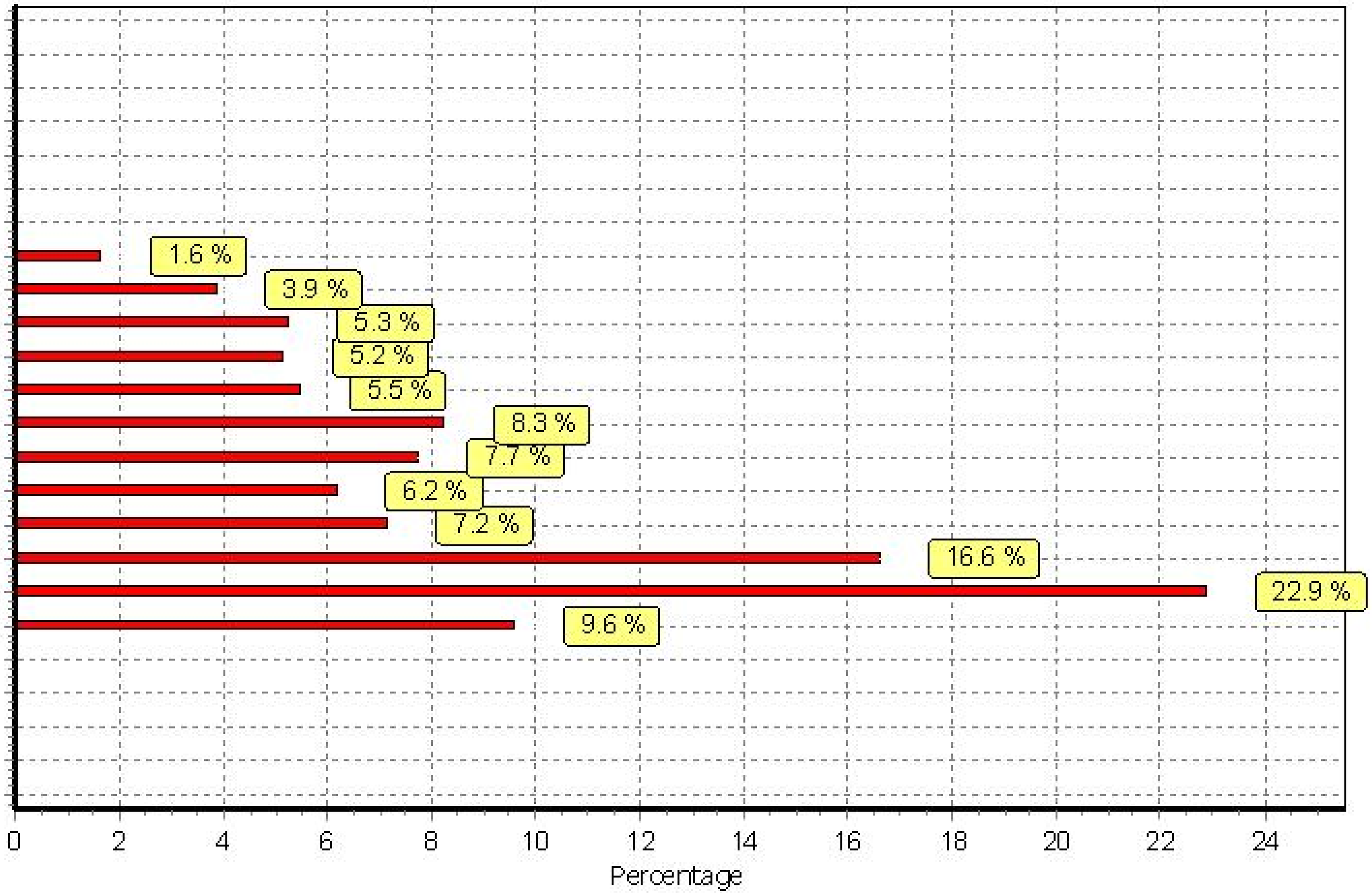
TIME	RATE	%
00:00-01:00		
01:00-02:00		
02:00-03:00		
03:00-04:00		
04:00-05:00		
05:00-06:00		
06:00-07:00		
07:00-08:00	0.484	10.5
08:00-09:00	1.211	26.3
09:00-10:00	0.797	17.3
10:00-11:00	0.352	7.7
11:00-12:00	0.266	5.8
12:00-13:00	0.301	6.5
13:00-14:00	0.378	8.2
14:00-15:00	0.292	6.4
15:00-16:00	0.172	3.7
16:00-17:00	0.178	3.9
17:00-18:00	0.125	2.7
18:00-19:00	0.042	0.9
19:00-20:00		
20:00-21:00		
21:00-22:00		
22:00-23:00		
23:00-24:00		



This graph is a visual representation of the trip rate calculation results screen. The same time periods and trip rates are displayed, but in addition there is an additional column showing the percentage of the total trip rate by individual time period, allowing peak periods to be easily identified through observation. Note that the type of count and the selected direction is shown at the top of the graph.

TRIP RATE GRAPH - DEPARTURES 02 - EMPLOYMENT A - OFFICE VEHICLES

TIME	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	0.073	1.6
08:00-09:00	0.173	3.9
09:00-10:00	0.235	5.3
10:00-11:00	0.230	5.2
11:00-12:00	0.245	5.5
12:00-13:00	0.367	8.3
13:00-14:00	0.344	7.7
14:00-15:00	0.274	6.2
15:00-16:00	0.319	7.2
16:00-17:00	0.738	16.6
17:00-18:00	1.018	22.9
18:00-19:00	0.427	9.6
19:00-20:00		
20:00-21:00		
21:00-22:00		
22:00-23:00		
23:00-24:00		



This graph is a visual representation of the trip rate calculation results screen. The same time periods and trip rates are displayed, but in addition there is an additional column showing the percentage of the total trip rate by individual time period, allowing peak periods to be easily identified through observation. Note that the type of count and the selected direction is shown at the top of the graph.

Calculation Reference: AUDIT-160301-191211-1221

TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 13 - PETROL FILLING STATIONS
Category : A - PETROL FILLING STATIONS
VEHICLES

Selected regions and areas:

03	SOUTH WEST		
	DV	DEVON	1 days
04	EAST ANGLIA		
	CA	CAMBRIDGESHIRE	1 days
05	EAST MIDLANDS		
	LE	LEICESTERSHIRE	1 days
06	WEST MIDLANDS		
	SH	SHROPSHIRE	1 days
	WM	WEST MIDLANDS	2 days
08	NORTH WEST		
	LC	LANCASHIRE	1 days
09	NORTH		
	NB	NORTHUMBERLAND	1 days
10	WALES		
	CP	CAERPHILLY	1 days
11	SCOTLAND		
	EB	CITY OF EDINBURGH	1 days
	FA	FALKIRK	1 days
13	MUNSTER		
	CR	CORK	2 days
14	LEINSTER		
	LU	LOUTH	1 days
15	GREATER DUBLIN		
	DL	DUBLIN	1 days
16	ULSTER (REPUBLIC OF IRELAND)		
	MG	MONAGHAN	1 days

This section displays the number of survey days per TRICS® sub-region in the selected set

LIST OF SITES relevant to selection parameters

1 CA-13-A-04 BP CAMBRIDGESHIRE
CHERRY HINTON ROAD
CAMBRIDGE
CAMBRIDGE
Suburban Area (PPS6 Out of Centre)
Residential Zone
Total Filling bays: 8
Survey date: WEDNESDAY 19/10/11 Survey Type: MANUAL

2 CP-13-A-01 TEXACO CAERPHILLY
NANTGARW ROAD
CAERPHILLY

Suburban Area (PPS6 Out of Centre)
Industrial Zone
Total Filling bays: 8
Survey date: TUESDAY 17/07/12 Survey Type: MANUAL

3 CR-13-A-01 TOPAZ CORK
VICARS ROAD
CORK

Suburban Area (PPS6 Out of Centre)
Industrial Zone
Total Filling bays: 10
Survey date: THURSDAY 13/12/12 Survey Type: MANUAL

4 CR-13-A-02 APPLEGREEN CORK
NORTH RING ROAD
CORK

Edge of Town
Residential Zone
Total Filling bays: 8
Survey date: FRIDAY 23/03/18 Survey Type: MANUAL

5 DL-13-A-03 APPLEGREEN DUBLIN
CLONSKEAGH ROAD
DUBLIN
CLONSKEAGH
Neighbourhood Centre (PPS6 Local Centre)
No Sub Category
Total Filling bays: 8
Survey date: THURSDAY 12/09/13 Survey Type: MANUAL

6 DV-13-A-03 GULF DEVON
MAIN ROAD
EXETER
PINHOE
Edge of Town
Residential Zone
Total Filling bays: 4
Survey date: THURSDAY 28/11/13 Survey Type: MANUAL

7 EB-13-A-02 SHELL CITY OF EDINBURGH
1 STENHOUSE ROAD
EDINBURGH

Suburban Area (PPS6 Out of Centre)
Residential Zone
Total Filling bays: 8
Survey date: FRIDAY 06/05/11 Survey Type: MANUAL

8 FA-13-A-02 MURCO FALKIRK
A801
FALKIRK
MADDISTON
Free Standing (PPS6 Out of Town)
Out of Town
Total Filling bays: 12
Survey date: MONDAY 03/06/13 Survey Type: MANUAL

9 LC-13-A-01 MURCO LANCASHIRE
VICTORIA ROAD
PRESTON
WALTON LE DALE
Edge of Town Centre
Built-Up Zone
Total Filling bays: 8
Survey date: MONDAY 14/05/12 Survey Type: MANUAL

LIST OF SITES relevant to selection parameters (Cont.)

10 LE-13-A-03 TOTAL LEICESTERSHIRE
GLENFIELD ROAD
LEICESTER

Suburban Area (PPS6 Out of Centre)
Residential Zone
Total Filling bays: 8
Survey date: THURSDAY 27/09/12 Survey Type: MANUAL

11 LU-13-A-01 BURMAH LOUTH
DUBLIN ROAD
DUNDALK

Suburban Area (PPS6 Out of Centre)
Residential Zone
Total Filling bays: 6
Survey date: THURSDAY 29/11/12 Survey Type: MANUAL

12 MG-13-A-01 G&G EMYVALE MONAGHAN
MAIN STREET
EMYVALE

Neighbourhood Centre (PPS6 Local Centre)
Village
Total Filling bays: 4
Survey date: WEDNESDAY 25/09/13 Survey Type: MANUAL

13 NB-13-A-03 BP NORTHUMBERLAND
BURRADON ROAD
NEAR CRAMLINGTON
ANNITSFORD
Edge of Town
Residential Zone
Total Filling bays: 11
Survey date: THURSDAY 22/11/12 Survey Type: MANUAL

14 SH-13-A-01 LOCAL SHROPSHIRE
THE MOUNT
SHREWSBURY
FRANKWELL
Edge of Town
Residential Zone
Total Filling bays: 4
Survey date: FRIDAY 30/05/14 Survey Type: MANUAL

15 WM-13-A-03 TOTAL WEST MIDLANDS
CHESTER ROAD
BIRMINGHAM
CASTLE BROMWICH
Edge of Town
Residential Zone
Total Filling bays: 8
Survey date: TUESDAY 18/10/11 Survey Type: MANUAL

16 WM-13-A-04 SHELL WEST MIDLANDS
STATION ROAD
BIRMINGHAM
STECHFORD
Suburban Area (PPS6 Out of Centre)
No Sub Category
Total Filling bays: 8
Survey date: TUESDAY 23/10/12 Survey Type: MANUAL

This section provides a list of all survey sites and days in the selected set. For each individual survey site, it displays a unique site reference code and site address, the selected trip rate calculation parameter and its value, the day of the week and date of each survey, and whether the survey was a manual classified count or an ATC count.

TRIP RATE for Land Use 13 - PETROL FILLING STATIONS/A - PETROL FILLING STATIONS
VEHICLES
Calculation factor: 1 BAYS
BOLD print indicates peak (busiest) period

	ARRIVALS			DEPARTURES			TOTALS		
Time Range	No. Days	Ave. BAYS	Trip Rate	No. Days	Ave. BAYS	Trip Rate	No. Days	Ave. BAYS	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	10	8	3.551	10	8	3.244	10	8	6.795
07:00 - 08:00	16	8	5.390	16	8	5.130	16	8	10.520
08:00 - 09:00	16	8	5.764	16	8	5.878	16	8	11.642
09:00 - 10:00	16	8	5.911	16	8	5.854	16	8	11.765
10:00 - 11:00	16	8	5.659	16	8	5.504	16	8	11.163
11:00 - 12:00	16	8	5.366	16	8	5.285	16	8	10.651
12:00 - 13:00	16	8	5.780	16	8	5.797	16	8	11.577
13:00 - 14:00	16	8	5.390	16	8	5.415	16	8	10.805
14:00 - 15:00	16	8	5.756	16	8	5.894	16	8	11.650
15:00 - 16:00	**16**	**8**	**6.065**	16	8	5.789	16	8	11.854
16:00 - 17:00	16	8	6.049	**16**	**8**	**6.293**	**16**	**8**	**12.342**
17:00 - 18:00	16	8	5.829	16	8	5.894	16	8	11.723
18:00 - 19:00	16	8	5.585	16	8	5.634	16	8	11.219
19:00 - 20:00	13	8	5.098	13	8	5.402	13	8	10.500
20:00 - 21:00	13	8	4.069	13	8	4.147	13	8	8.216
21:00 - 22:00	13	8	3.314	13	8	3.373	13	8	6.687
22:00 - 23:00									
23:00 - 24:00									
Total Rates:			84.576			84.533			169.109

This section displays the trip rate results based on the selected set of surveys and the selected count type (shown just above the table). It is split by three main columns, representing arrivals trips, departures trips, and total trips (arrivals plus departures). Within each of these main columns are three sub-columns. These display the number of survey days where count data is included (per time period), the average value of the selected trip rate calculation parameter (per time period), and the trip rate result (per time period). Total trip rates (the sum of the column) are also displayed at the foot of the table.

*To obtain a trip rate, the average (mean) trip rate parameter value (TRP) is first calculated for all selected survey days that have count data available for the stated time period. The average (mean) number of arrivals, departures or totals (whichever applies) is also calculated (COUNT) for all selected survey days that have count data available for the stated time period. Then, the average count is divided by the average trip rate parameter value, and multiplied by the stated calculation factor (shown just above the table and abbreviated here as FACT). So, the method is: COUNT/TRP*FACT. Trip rates are then rounded to 3 decimal places.*

Parameter summary

Trip rate parameter range selected:	4 - 12 (units:)
Survey date date range:	01/01/11 - 14/07/18
Number of weekdays (Monday-Friday):	16
Number of Saturdays:	0
Number of Sundays:	0
Surveys automatically removed from selection:	0
Surveys manually removed from selection:	0

This section displays a quick summary of some of the data filtering selections made by the TRICS® user. The trip rate calculation parameter range of all selected surveys is displayed first, followed by the range of minimum and maximum survey dates selected by the user. Then, the total number of selected weekdays and weekend days in the selected set of surveys are show. Finally, the number of survey days that have been manually removed from the selected set outside of the standard filtering procedure are displayed.

Calculation Reference: AUDIT-160301-191211-1204

TRIP RATE CALCULATION SELECTION PARAMETERS:

Land Use : 01 - RETAIL
Category : I - SHOPPING CENTRE - LOCAL SHOPS
VEHICLES

Selected regions and areas:

03	SOUTH WEST		
	BR	BRISTOL CITY	1 days
	DV	DEVON	1 days
04	EAST ANGLIA		
	CA	CAMBRIDGESHIRE	1 days
05	EAST MIDLANDS		
	LE	LEICESTERSHIRE	1 days
06	WEST MIDLANDS		
	SH	SHROPSHIRE	1 days
	WM	WEST MIDLANDS	1 days
	WO	WORCESTERSHIRE	1 days
08	NORTH WEST		
	CH	CHESHIRE	2 days
	LC	LANCASHIRE	1 days
09	NORTH		
	TV	TEES VALLEY	2 days
	TW	TYNE & WEAR	2 days
11	SCOTLAND		
	SR	STIRLING	1 days
13	MUNSTER		
	CR	CORK	1 days
15	GREATER DUBLIN		
	DL	DUBLIN	2 days
16	ULSTER (REPUBLIC OF IRELAND)		
	DN	DONEGAL	1 days
17	ULSTER (NORTHERN IRELAND)		
	DE	DERRY	2 days
	DO	DOWN	1 days

This section displays the number of survey days per TRICS® sub-region in the selected set

TRIP RATE for Land Use 01 - RETAIL/I - SHOPPING CENTRE - LOCAL SHOPS
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	1	540	1.296	1	540	1.296	1	540	2.592
07:00 - 08:00	22	1238	2.417	22	1238	2.156	22	1238	4.573
08:00 - 09:00	22	1238	2.949	22	1238	2.619	22	1238	5.568
09:00 - 10:00	22	1238	3.732	22	1238	3.203	22	1238	6.935
10:00 - 11:00	22	1238	3.684	22	1238	3.412	22	1238	7.096
11:00 - 12:00	22	1238	3.857	22	1238	4.007	22	1238	7.864
12:00 - 13:00	**22**	**1238**	**4.742**	**22**	**1238**	**4.577**	**22**	**1238**	**9.319**
13:00 - 14:00	22	1238	4.202	22	1238	4.239	22	1238	8.441
14:00 - 15:00	22	1238	3.864	22	1238	3.919	22	1238	7.783
15:00 - 16:00	22	1238	3.769	22	1238	3.893	22	1238	7.662
16:00 - 17:00	22	1238	4.125	22	1238	3.971	22	1238	8.096
17:00 - 18:00	22	1238	4.007	22	1238	4.345	22	1238	8.352
18:00 - 19:00	22	1238	3.893	22	1238	4.125	22	1238	8.018
19:00 - 20:00	19	1221	4.025	19	1221	4.059	19	1221	8.084
20:00 - 21:00	19	1221	3.197	19	1221	3.370	19	1221	6.567
21:00 - 22:00	15	1034	3.313	15	1034	3.732	15	1034	7.045
22:00 - 23:00									
23:00 - 24:00									
Total Rates:			57.072			56.923			113.995

This section displays the trip rate results based on the selected set of surveys and the selected count type (shown just above the table). It is split by three main columns, representing arrivals trips, departures trips, and total trips (arrivals plus departures). Within each of these main columns are three sub-columns. These display the number of survey days where count data is included (per time period), the average value of the selected trip rate calculation parameter (per time period), and the trip rate result (per time period). Total trip rates (the sum of the column) are also displayed at the foot of the table.

*To obtain a trip rate, the average (mean) trip rate parameter value (TRP) is first calculated for all selected survey days that have count data available for the stated time period. The average (mean) number of arrivals, departures or totals (whichever applies) is also calculated (COUNT) for all selected survey days that have count data available for the stated time period. Then, the average count is divided by the average trip rate parameter value, and multiplied by the stated calculation factor (shown just above the table and abbreviated here as FACT). So, the method is: COUNT/TRP*FACT. Trip rates are then rounded to 3 decimal places.*

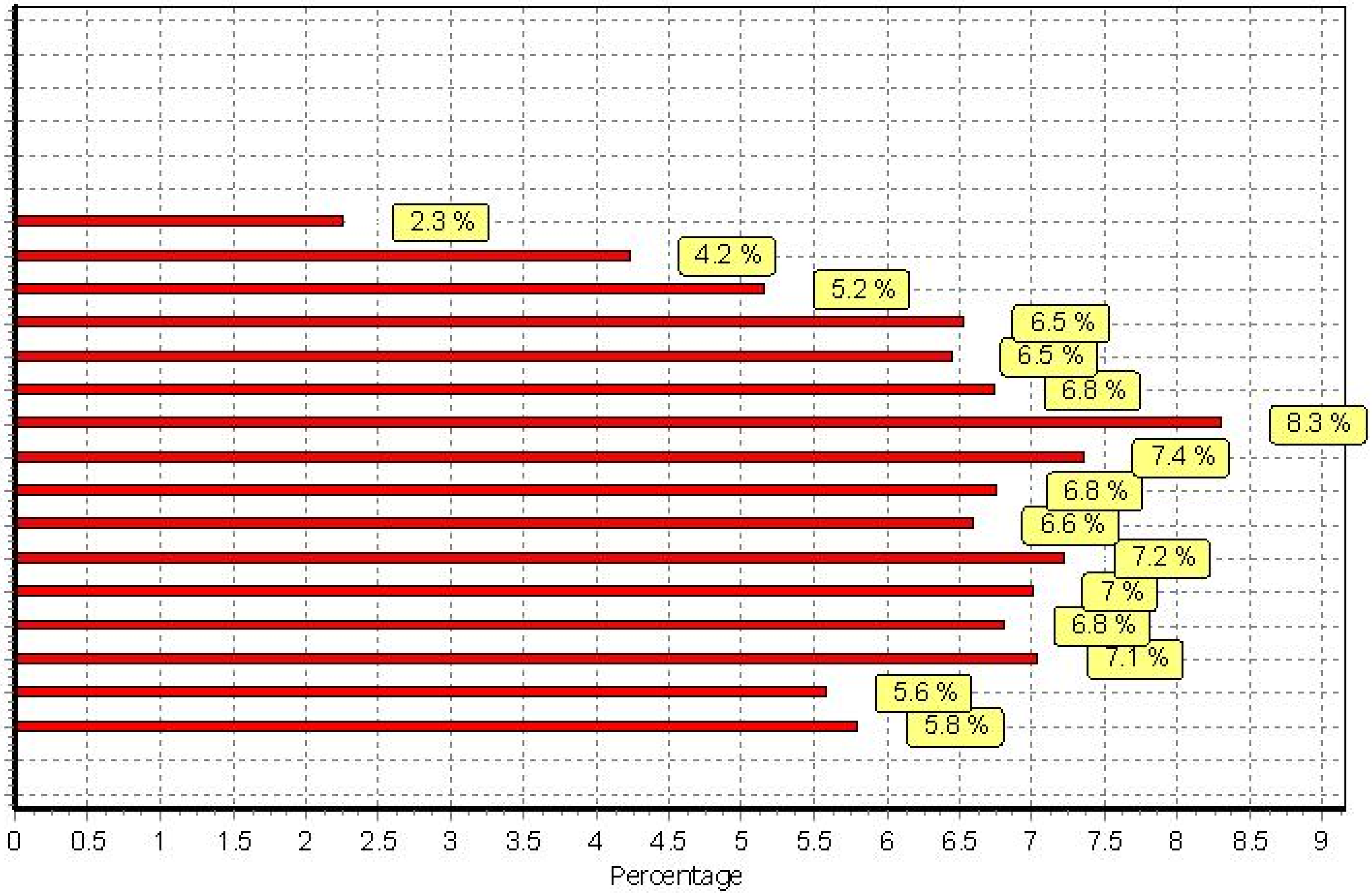
Parameter summary

Trip rate parameter range selected:	260 - 4052 (units: sqm)
Survey date date range:	01/01/11 - 24/05/19
Number of weekdays (Monday-Friday):	22
Number of Saturdays:	0
Number of Sundays:	0
Surveys automatically removed from selection:	1
Surveys manually removed from selection:	0

This section displays a quick summary of some of the data filtering selections made by the TRICS® user. The trip rate calculation parameter range of all selected surveys is displayed first, followed by the range of minimum and maximum survey dates selected by the user. Then, the total number of selected weekdays and weekend days in the selected set of surveys are show. Finally, the number of survey days that have been manually removed from the selected set outside of the standard filtering procedure are displayed.

TRIP RATE GRAPH - ARRIVALS 01 - RETAIL I - SHOPPING CENTRE - LOCAL SHOPS VEHICLES

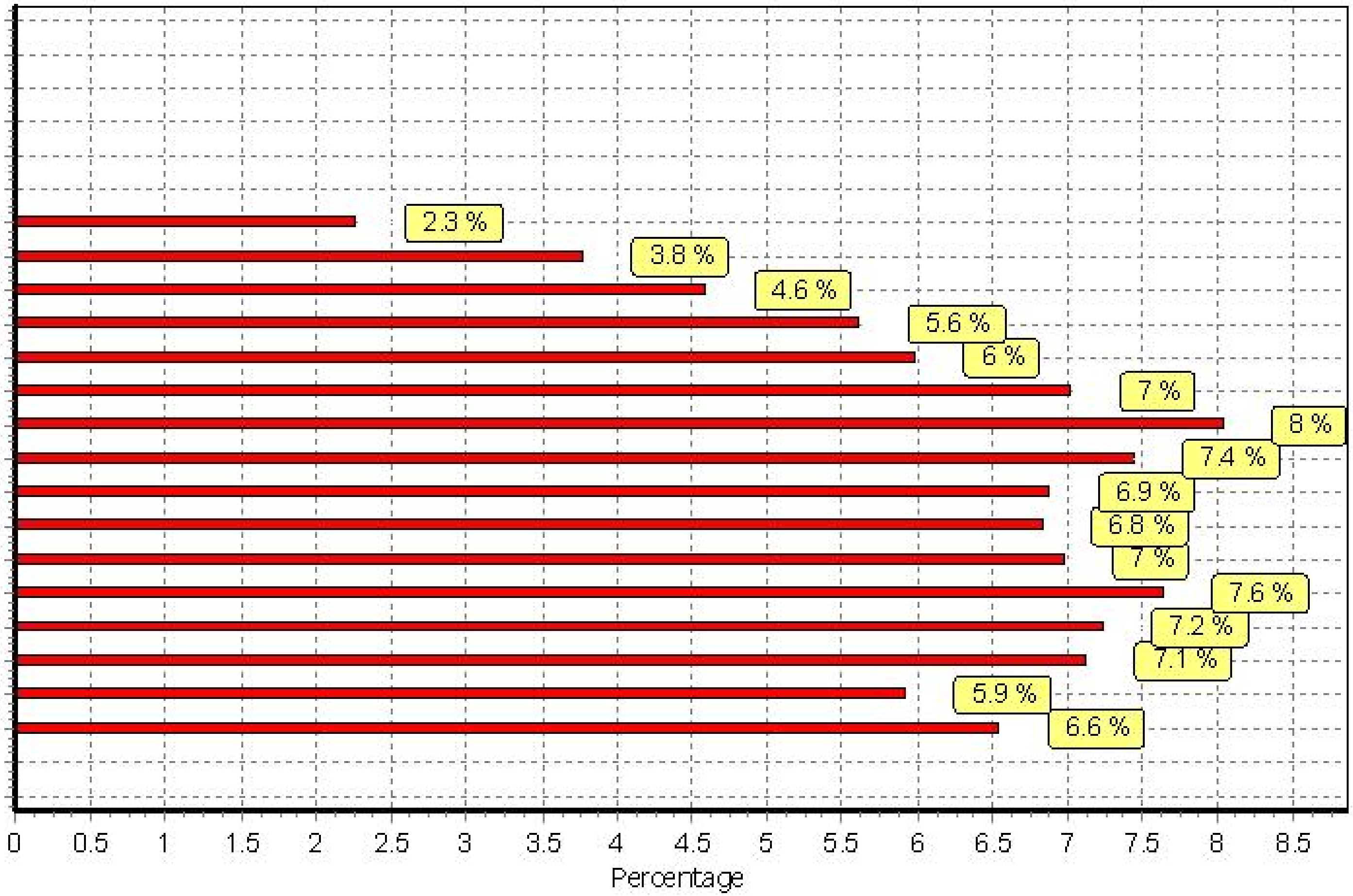
TIME	RATE	%
00:00-01:00		
01:00-02:00		
02:00-03:00		
03:00-04:00		
04:00-05:00		
05:00-06:00		
06:00-07:00	1.296	2.3
07:00-08:00	2.417	4.2
08:00-09:00	2.949	5.2
09:00-10:00	3.732	6.5
10:00-11:00	3.684	6.5
11:00-12:00	3.857	6.8
12:00-13:00	4.742	8.3
13:00-14:00	4.202	7.4
14:00-15:00	3.864	6.8
15:00-16:00	3.769	6.6
16:00-17:00	4.125	7.2
17:00-18:00	4.007	7.0
18:00-19:00	3.893	6.8
19:00-20:00	4.025	7.1
20:00-21:00	3.197	5.6
21:00-22:00	3.313	5.8
22:00-23:00		
23:00-24:00		



This graph is a visual representation of the trip rate calculation results screen. The same time periods and trip rates are displayed, but in addition there is an additional column showing the percentage of the total trip rate by individual time period, allowing peak periods to be easily identified through observation. Note that the type of count and the selected direction is shown at the top of the graph.

TRIP RATE GRAPH - DEPARTURES 01 - RETAIL I - SHOPPING CENTRE - LOCAL SHOPS VEHICLES

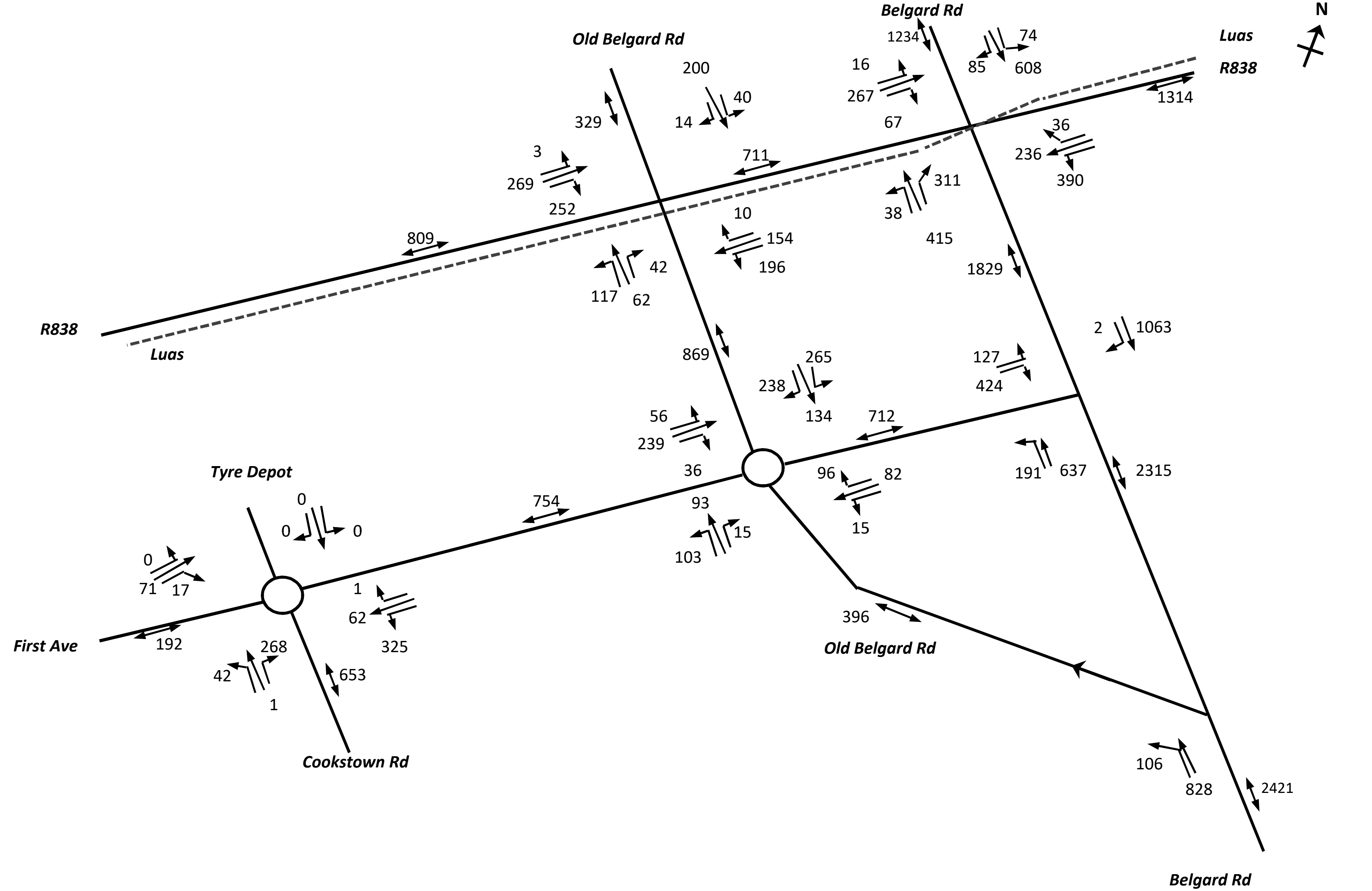
TIME	RATE	%
00:00-01:00		
01:00-02:00		
02:00-03:00		
03:00-04:00		
04:00-05:00		
05:00-06:00		
06:00-07:00	1.296	2.3
07:00-08:00	2.156	3.8
08:00-09:00	2.619	4.6
09:00-10:00	3.203	5.6
10:00-11:00	3.412	6.0
11:00-12:00	4.007	7.0
12:00-13:00	4.577	8.0
13:00-14:00	4.239	7.4
14:00-15:00	3.919	6.9
15:00-16:00	3.893	6.8
16:00-17:00	3.971	7.0
17:00-18:00	4.345	7.6
18:00-19:00	4.125	7.2
19:00-20:00	4.059	7.1
20:00-21:00	3.370	5.9
21:00-22:00	3.732	6.6
22:00-23:00		
23:00-24:00		



This graph is a visual representation of the trip rate calculation results screen. The same time periods and trip rates are displayed, but in addition there is an additional column showing the percentage of the total trip rate by individual time period, allowing peak periods to be easily identified through observation. Note that the type of count and the selected direction is shown at the top of the graph.

APPENDIX C

Traffic Surveys, Trip Distribution & Network Traffic Flow Projections & Diagrams

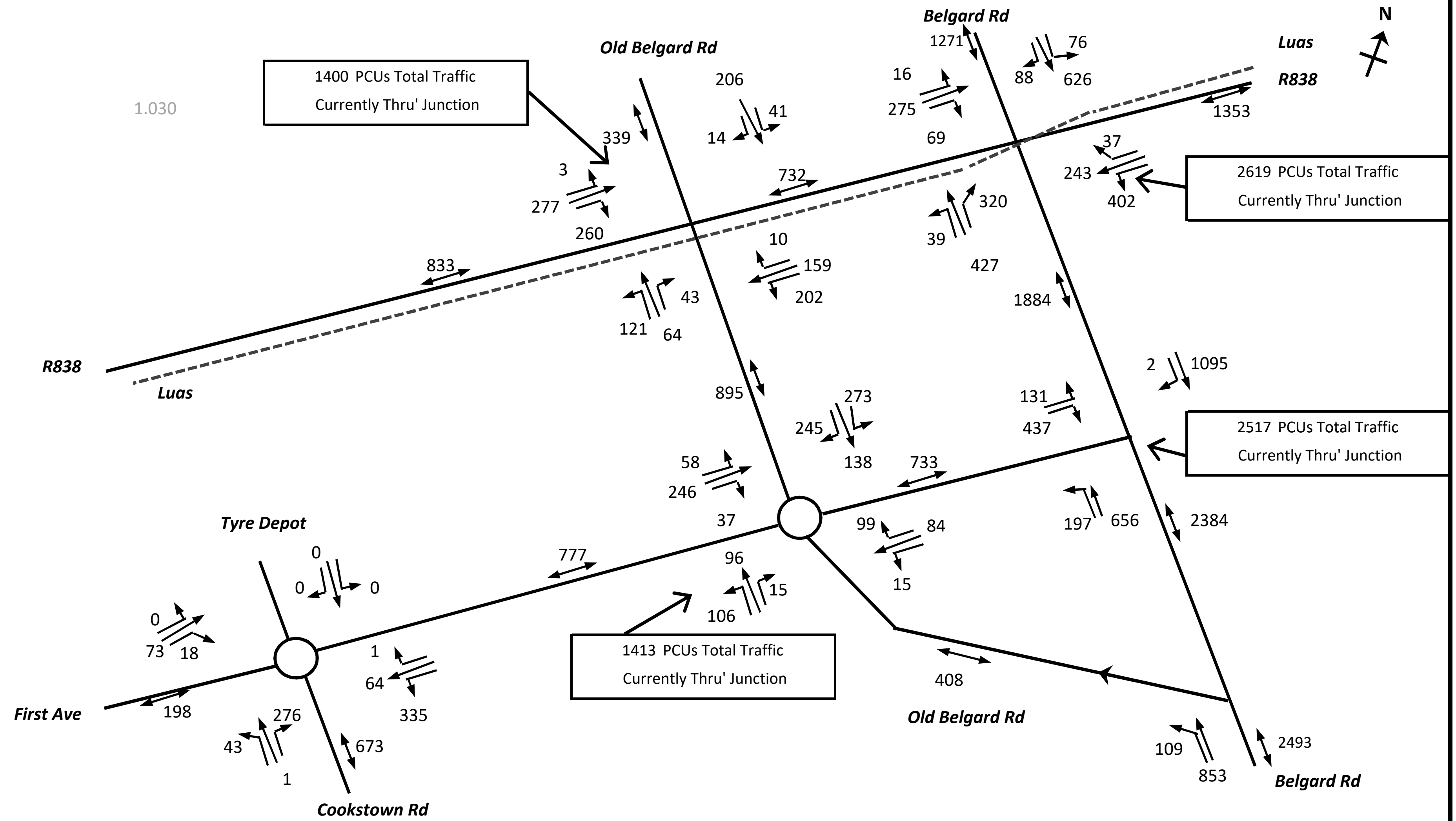


AS SURVEYED TRAFFIC FLOWS 2019 - WEEKDAY AM PEAK 8-9AM (PCUs)

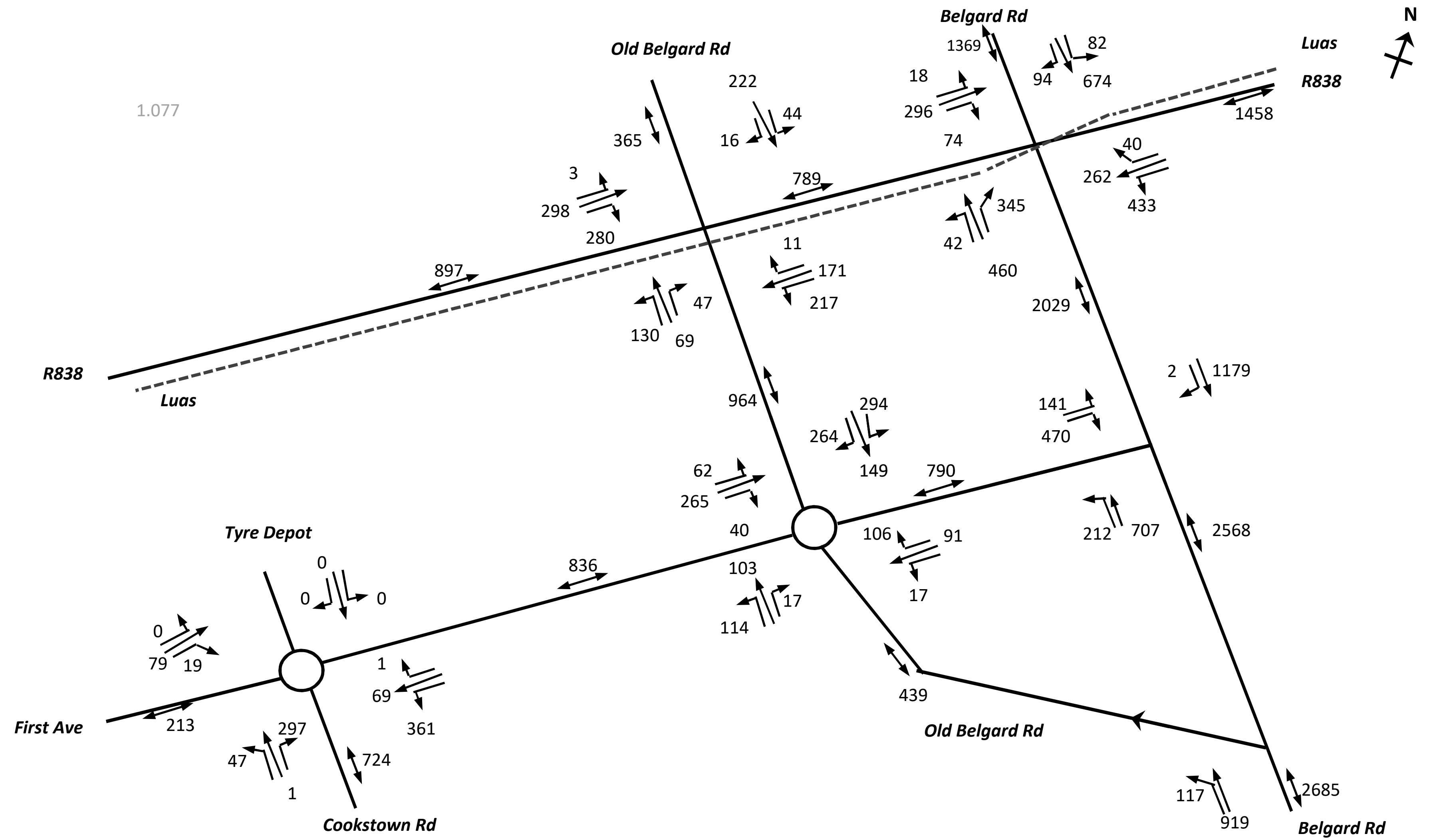
TII PE-PAG-02017 Project Appraisal Guidelines for National Roads Unit 5.3 (Travel Demand Projections, Table 5.3.2: Link-Based Growth Rates: Annual Growth Factors) SDCC

2019 to 2025 = 1.030

2025 to 2040 = 1.077



Projected Weekday AM Peak Hour Traffic Volumes (8-9am)
SELECTED OPENING YEAR 2025 - WITHOUT NEW DEVELOPMENT (PCUs).



Projected Weekday AM Peak Hour Traffic Volumes (8-9am)
SELECTED DESIGN YEAR 2040 (OPENING YEAR +15) - WITHOUT NEW DEVELOPMENT (PCUs).

TRICS Traffic Generation Assessment - BLOCK A

260 APARTMENTS/DUPLEX					
260 No Apts	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per Unit	Total	Per Unit	Total	
AM Peak Hr 8-9am	0.057	15	0.198	51	66
PM Peak Hr 5-6pm	0.179	47	0.086	22	69

BLOCK A TOTAL

TRICS Traffic Generation Assessment - BLOCK B

342 APARTMENTS					
342 No Apts	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per Unit	Total	Per Unit	Total	
AM Peak Hr 8-9am	0.057	19	0.198	68	87
PM Peak Hr 5-6pm	0.179	61	0.086	29	91

285m2 Commercial/Retail					
285 m2 Retail	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per 100m2	Total	Per 100m2	Total	
AM Peak Hr 8-9am	2.949	8	2.619	7	16
PM Peak Hr 5-6pm	4.007	11	4.345	12	24

Total Traffic Generated - BLOCK B			
Network Period	Car Arrivals	Car Departures	2-Way Traffic Tot
AM Peak Hr 8-9am	27	75	102
PM Peak Hr 5-6pm	72	41	113

BLOCK B TOTAL

TRICS Traffic Generation Assessment - BLOCK C

350 APARTMENTS					
350 No Apts	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per Unit	Total	Per Unit	Total	
AM Peak Hr 8-9am	0.057	20	0.198	69	89
PM Peak Hr 5-6pm	0.179	63	0.086	30	93

272m2 CRECHE					
272 m2 Creche	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per 100m2	Total	Per 100m2	Total	
AM Peak Hr 8-9am	3.270	9	2.513	7	16
PM Peak Hr 5-6pm	2.326	6	2.842	8	14

Total Traffic Generated - BLOCK C			
Network Period	Car Arrivals	Car Departures	2-Way Traffic Tot
AM Peak Hr 8-9am	29	76	105
PM Peak Hr 5-6pm	69	38	107

BLOCK C TOTAL

TRICS Traffic Generation Assessment - BLOCK D - NET ADDITIONAL TRAFFIC

152 APARTMENTS					
152 No Apts	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per Unit	Total	Per Unit	Total	
AM Peak Hr 8-9am	0.057	9	0.198	30	39
PM Peak Hr 5-6pm	0.179	27	0.086	13	41

1,500m2 OFFICES					
1500 m2 Office	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per 100m2	Total	Per 100m2	Total	
AM Peak Hr 8-9am	1.211	18	0.173	3	20
PM Peak Hr 5-6pm	0.125	2	1.018	15	17

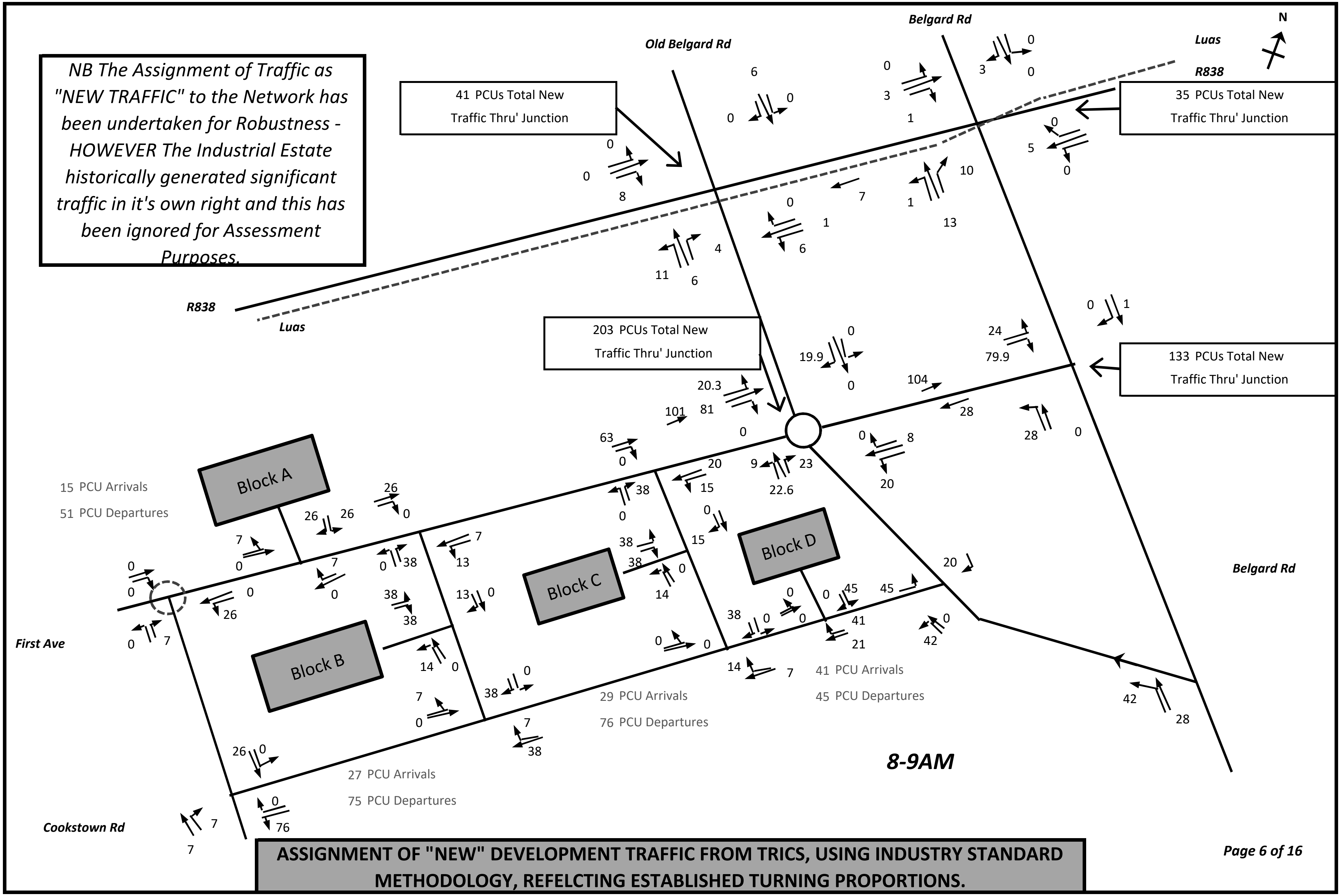
477m2 Commercial/Retail					
477 m2 Retail	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per 100m2	Total	Per 100m2	Total	
AM Peak Hr 8-9am	2.949	14	2.619	12	27
PM Peak Hr 5-6pm	4.007	19	4.345	21	40

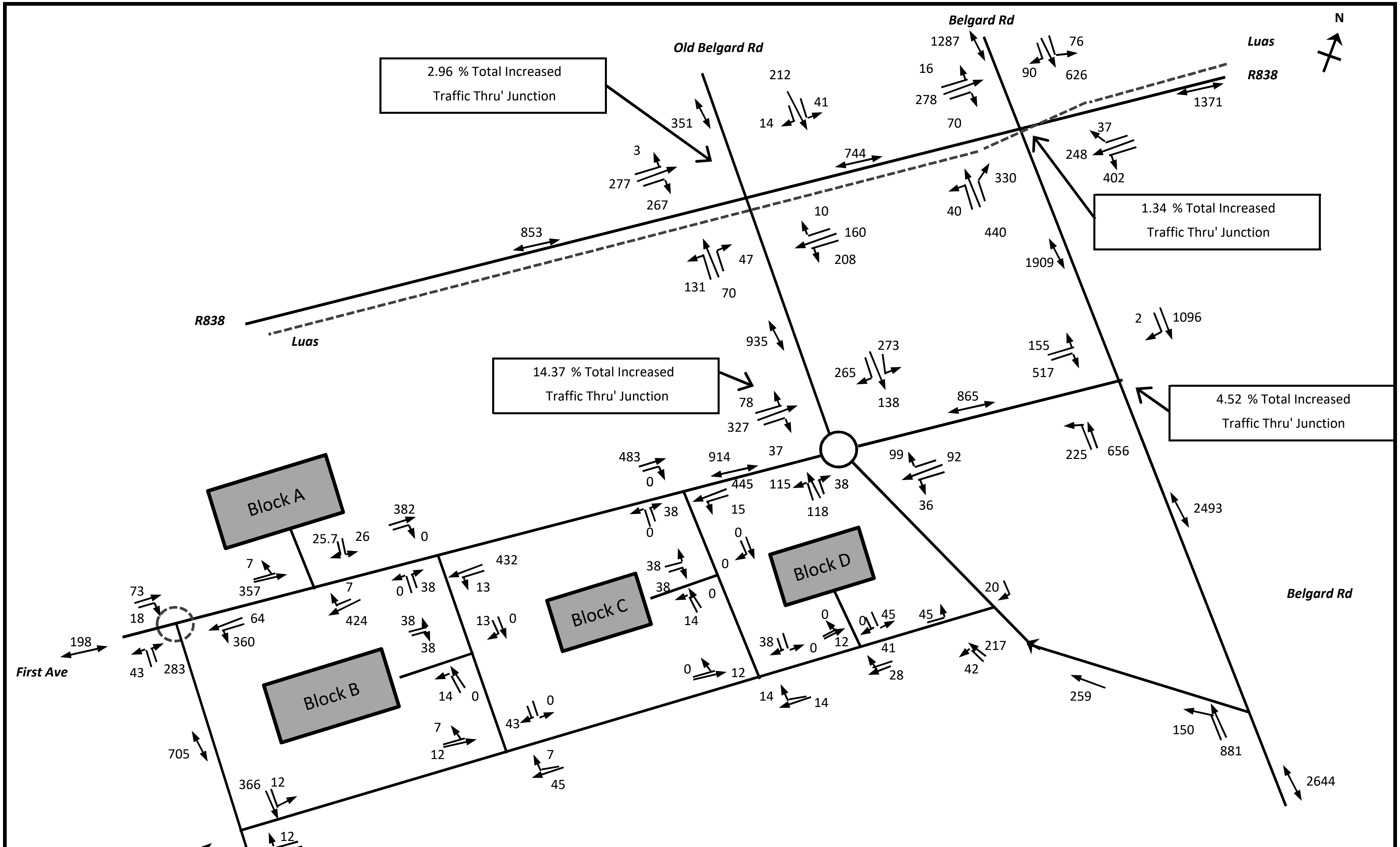
Total NET ADDITIONAL Traffic Generated - BLOCK D			
Network Period	Car Arrivals	Car Departures	2-Way Traffic Tot
AM Peak Hr 8-9am	41	45	86
PM Peak Hr 5-6pm	48	49	97

For Info - Traffic Already Being Generated by an 8-Stand PFS

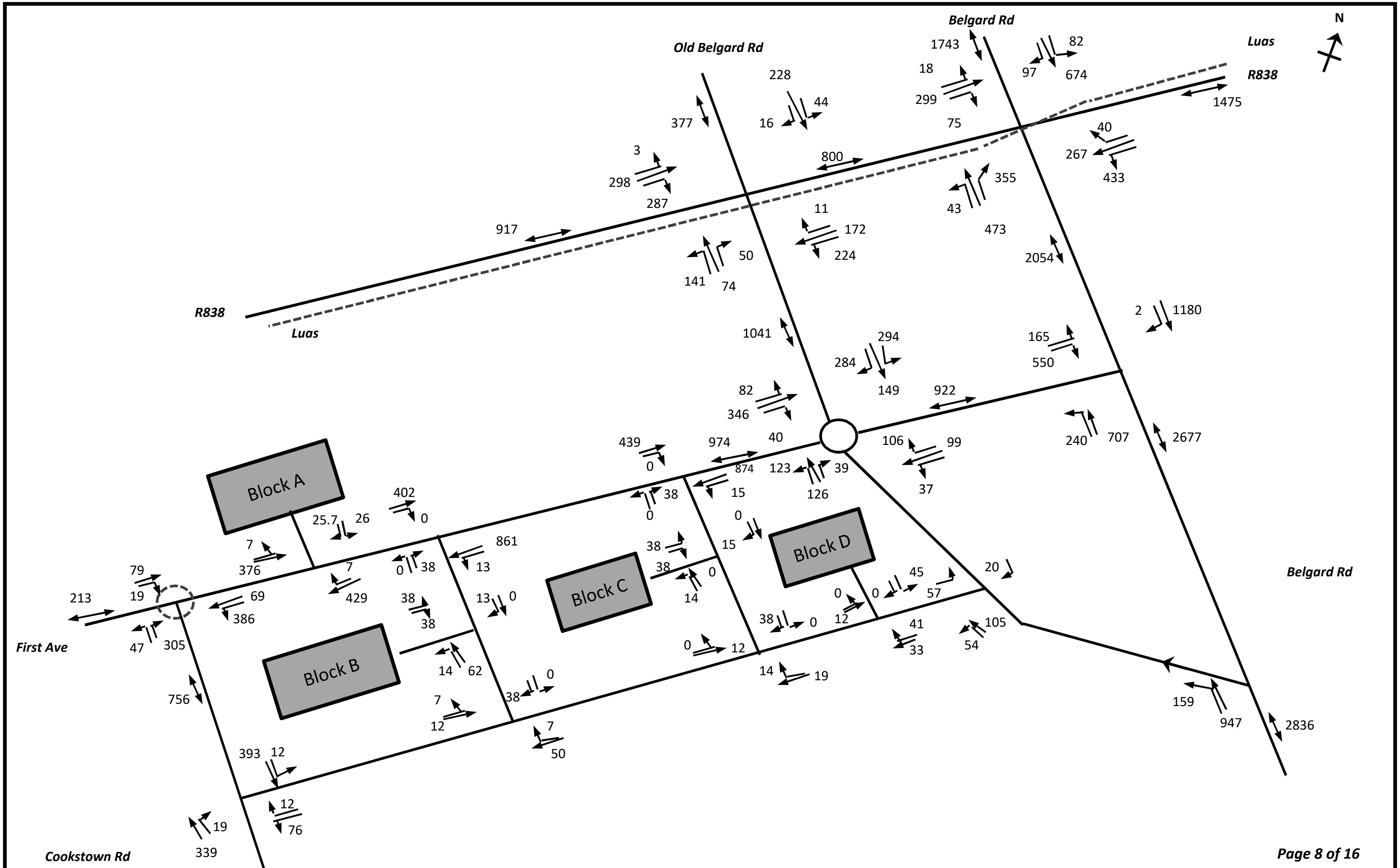
Petrol Filling Station & Ancillary Shop/Kiosk Unit					
8 Stand PFS	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	per Stand	Total	per Stand	Total	
AM Peak Hr 8-9am	5.764	46	5.874	47	93
PM Peak Hr 5-6pm	5.829	47	5.894	47	94

Note - The Filling Station is Being Replaced and it's Traffic is alredy established and included in the Traffic Surveys of the Existing Network that have been completed, so adding in Traffic associated with a Replacement PFS and Kiosk in not appropriate.

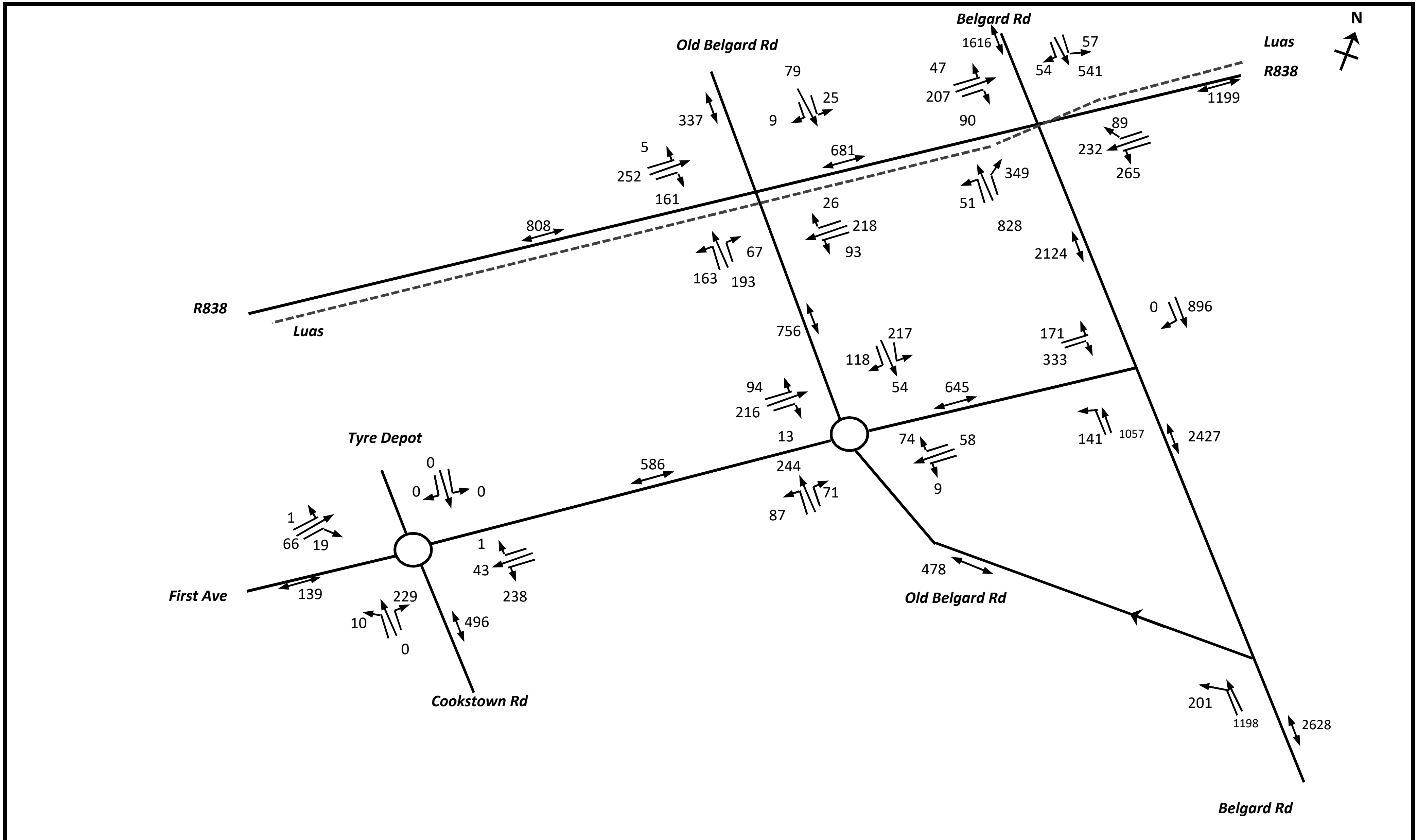

NB The Assignment of Traffic as "NEW TRAFFIC" to the Network has been undertaken for Robustness - HOWEVER The Industrial Estate historically generated significant traffic in it's own right and this has been ignored for Assessment Purposes.
41 PCUs Total New Traffic Thru' Junction
35 PCUs Total New Traffic Thru' Junction
203 PCUs Total New Traffic Thru' Junction
133 PCUs Total New Traffic Thru' Junction
Old Belgard Rd
Belgard Rd
Luas
R838
N
R838
Luas
Block A
Block B
Block C
Block D
15 PCU Arrivals
51 PCU Departures
27 PCU Arrivals
75 PCU Departures
29 PCU Arrivals
76 PCU Departures
41 PCU Arrivals
45 PCU Departures
First Ave
Cookstown Rd
Belgard Rd
8-9AM
Page 6 of 16
ASSIGNMENT OF "NEW" DEVELOPMENT TRAFFIC FROM TRICS, USING INDUSTRY STANDARD METHODOLOGY, REFELCTING ESTABLISHED TURNING PROPORTIONS.



Projected Weekday AM Peak Hour Traffic Volumes (8-9am)
SELECTED OPENING YEAR 2025 - WITH DEVELOPMENT OPEN & OCCUPIED (PCUs).



Projected Weekday AM Peak Hour Traffic Volumes (8-9am) DESIGN YEAR 2040
(OPENING YEAR+15) - WITH DEVELOPMENT OPEN & OCCUPIED (PCUs).

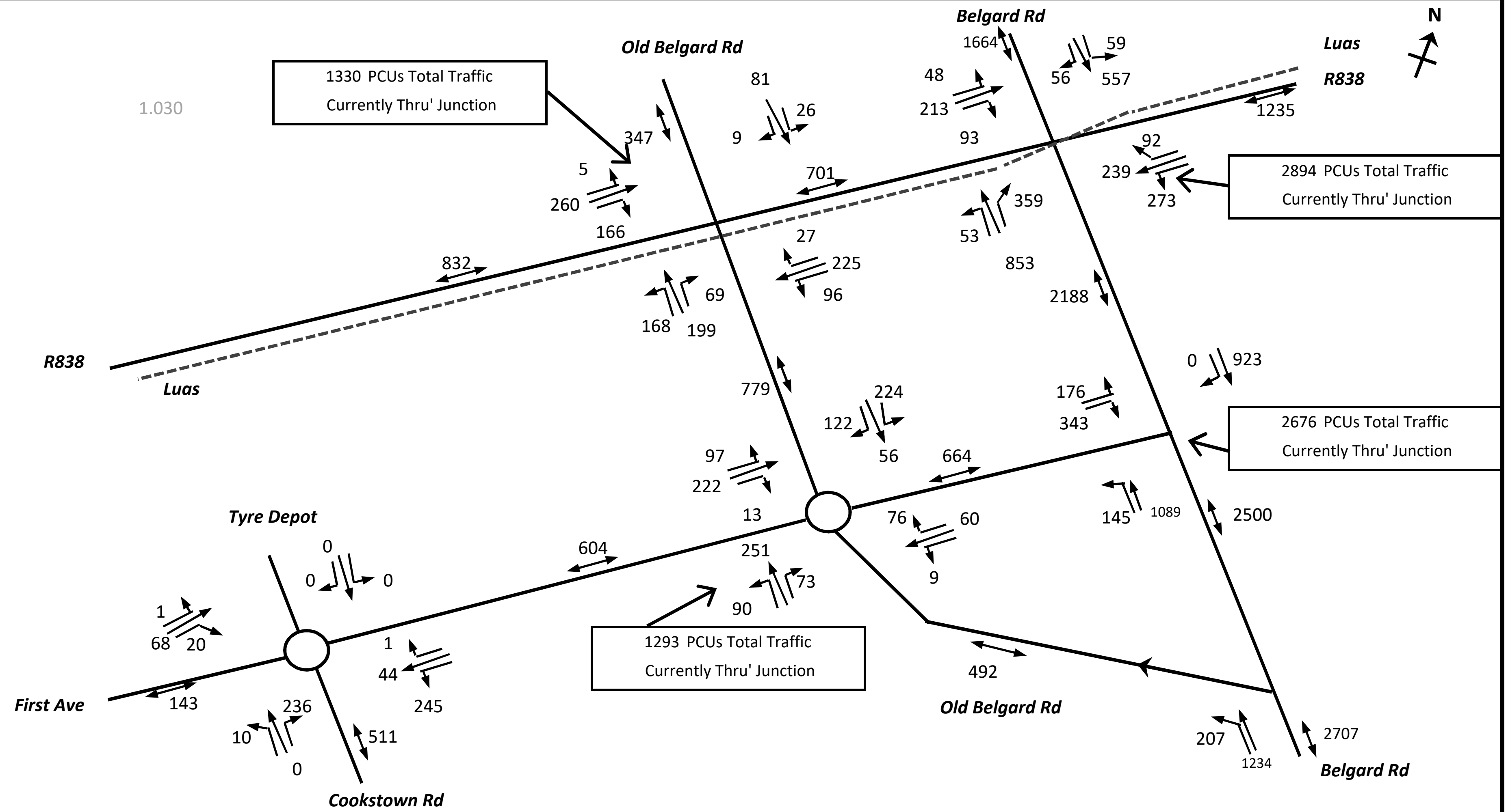


AS SURVEYED TRAFFIC FLOWS 2019 - WEEKDAY PM PEAK 5-6PM (PCUs)

TII PE-PAG-02017 Project Appraisal Guidelines for National Roads Unit 5.3 (Travel Demand Projections, Table 5.3.2: Link-Based Growth Rates: Annual Growth Factors) SDCC

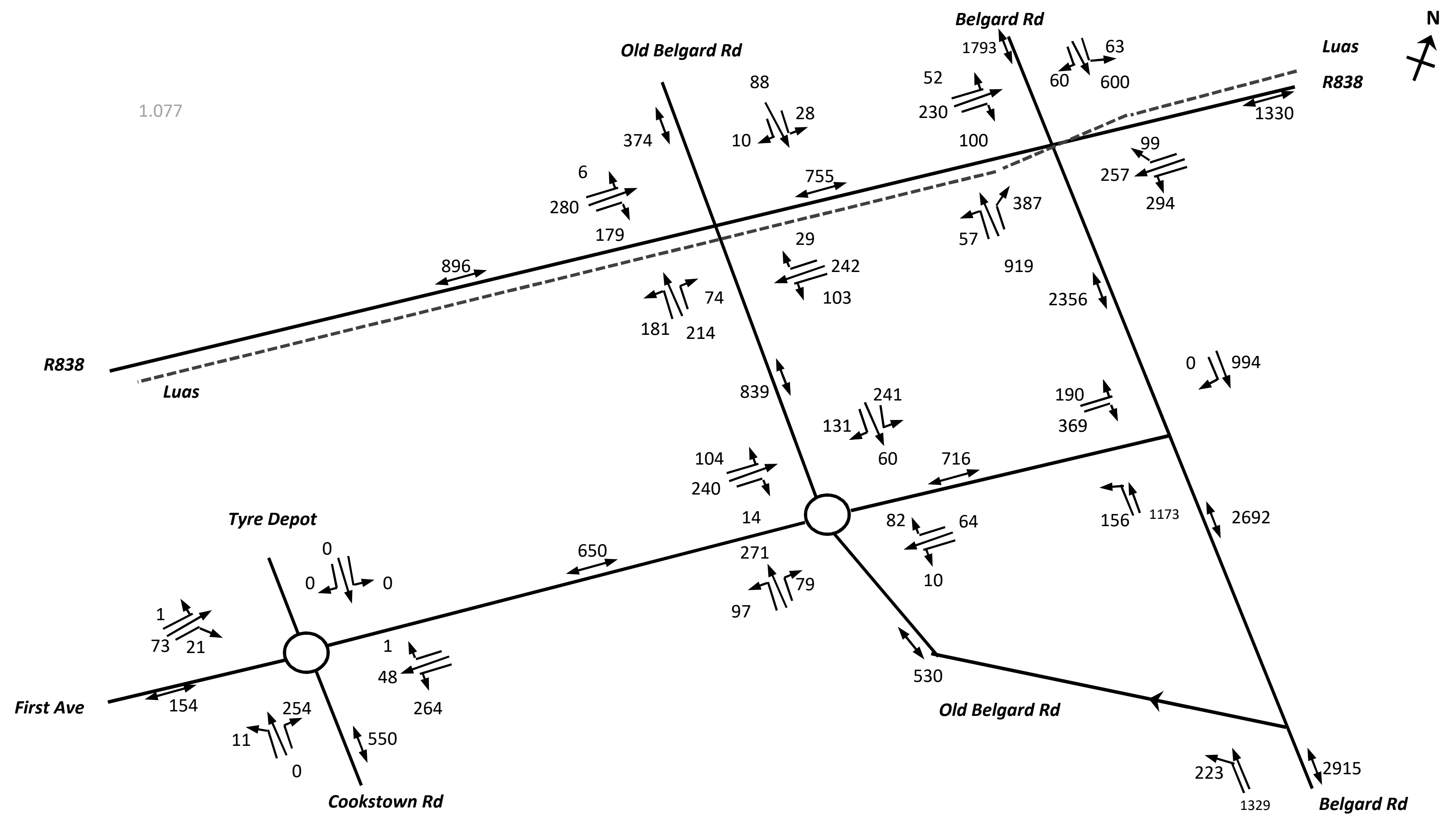
2019 to 2025 = 1.030

2025 to 2040 = 1.077



Projected Weekday PM Peak Hour Traffic Volumes (5-6pm)
SELECTED OPENING YEAR 2025 - WITHOUT NEW DEVELOPMENT (PCUs).

Page 10 of 16



Projected Weekday PM Peak Hour Traffic Volumes (5-6pm)
SELECTED DESIGN YEAR 2040 (OPENING YEAR +15) - WITHOUT NEW DEVELOPMENT (PCUs).

TRICS Traffic Generation Assessment - BLOCK A

260 APARTMENTS/DUPLEX					
260 No Apts	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per Unit	Total	Per Unit	Total	
AM Peak Hr 8-9am	0.057	15	0.198	51	66
PM Peak Hr 5-6pm	0.179	47	0.086	22	69

BLOCK A TOTAL

TRICS Traffic Generation Assessment - BLOCK B

342 APARTMENTS					
342 No Apts	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per Unit	Total	Per Unit	Total	
AM Peak Hr 8-9am	0.057	19	0.198	68	87
PM Peak Hr 5-6pm	0.179	61	0.086	29	91

285m2 Commercial/Retail					
285 m2 Retail	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per 100m2	Total	Per 100m2	Total	
AM Peak Hr 8-9am	2.949	8	2.619	7	16
PM Peak Hr 5-6pm	4.007	11	4.345	12	24

Total Traffic Generated - BLOCK B			
Network Period	Car Arrivals	Car Departures	2-Way Traffic Tot
AM Peak Hr 8-9am	27	75	102
PM Peak Hr 5-6pm	72	41	113

BLOCK B TOTAL

TRICS Traffic Generation Assessment - BLOCK C

350 APARTMENTS					
350 No Apts	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per Unit	Total	Per Unit	Total	
AM Peak Hr 8-9am	0.057	20	0.198	69	89
PM Peak Hr 5-6pm	0.179	63	0.086	30	93

272 m2 CRECHE					
272 m2 Creche	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per 100m2	Total	Per 100m2	Total	
AM Peak Hr 8-9am	3.270	9	2.513	7	16
PM Peak Hr 5-6pm	2.326	6	2.842	8	14

Total Traffic Generated - BLOCK C			
Network Period	Car Arrivals	Car Departures	2-Way Traffic Tot
AM Peak Hr 8-9am	29	76	105
PM Peak Hr 5-6pm	69	38	107

BLOCK C TOTAL

TRICS Traffic Generation Assessment - BLOCK D - NET ADDITIONAL TRAFFIC

152 APARTMENTS					
152 No Apts	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per Unit	Total	Per Unit	Total	
AM Peak Hr 8-9am	0.057	9	0.198	30	39
PM Peak Hr 5-6pm	0.179	27	0.086	13	41

1,500m2 OFFICES					
1500 m2 Office	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per 100m2	Total	Per 100m2	Total	
AM Peak Hr 8-9am	1.211	18	0.173	3	20
PM Peak Hr 5-6pm	0.125	2	1.018	15	17

477m2 Commercial/Retail					
477 m2 Retail	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	Per 100m2	Total	Per 100m2	Total	
AM Peak Hr 8-9am	2.949	14	2.619	12	27
PM Peak Hr 5-6pm	4.007	19	4.345	21	40

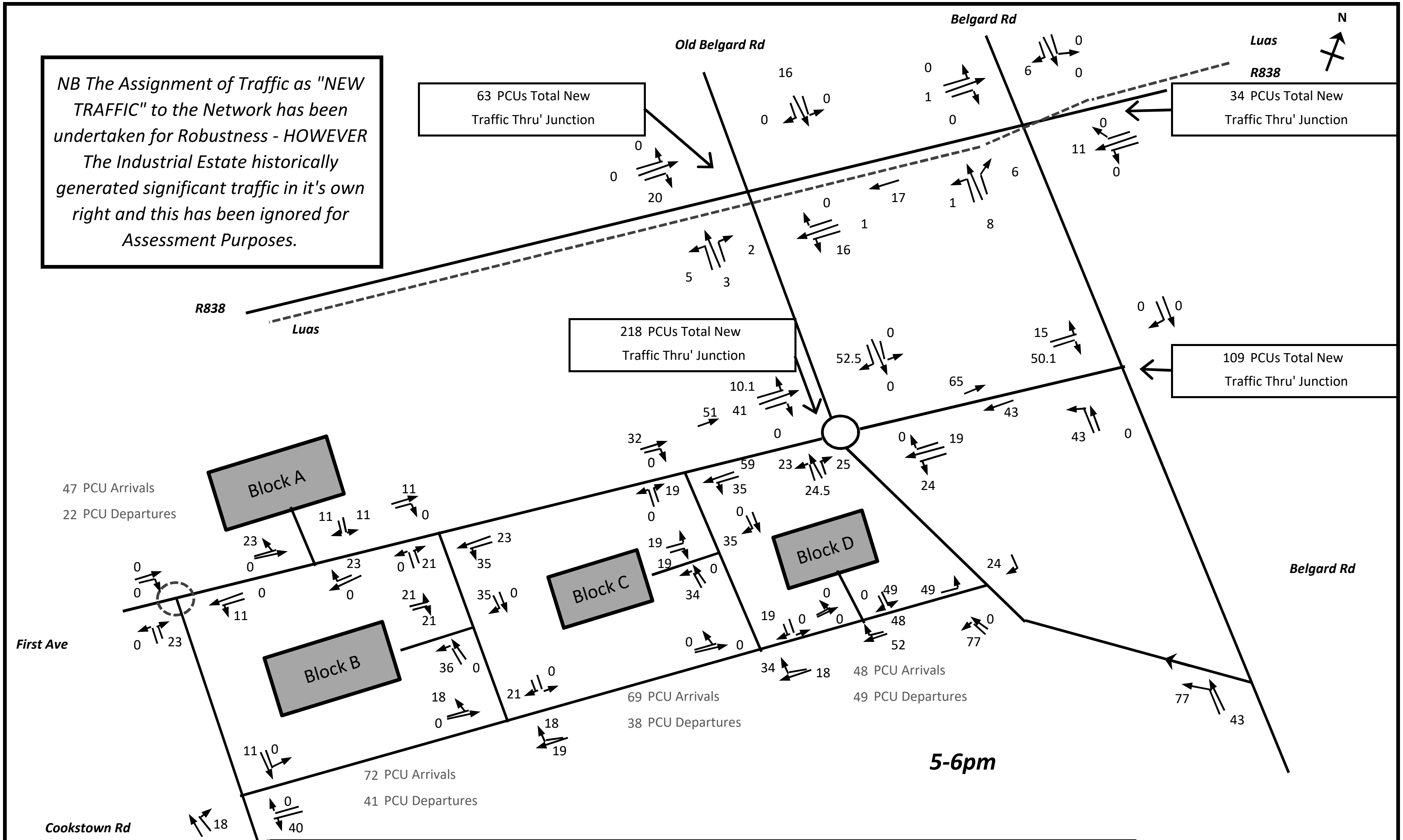
Total NET ADDITIONAL Traffic Generated - BLOCK D			
Network Period	Car Arrivals	Car Departures	2-Way Traffic Tot
AM Peak Hr 8-9am	41	45	86
PM Peak Hr 5-6pm	48	49	97

For Info - Traffic <u>Already Being Generated</u> by an 8-Stand PFS

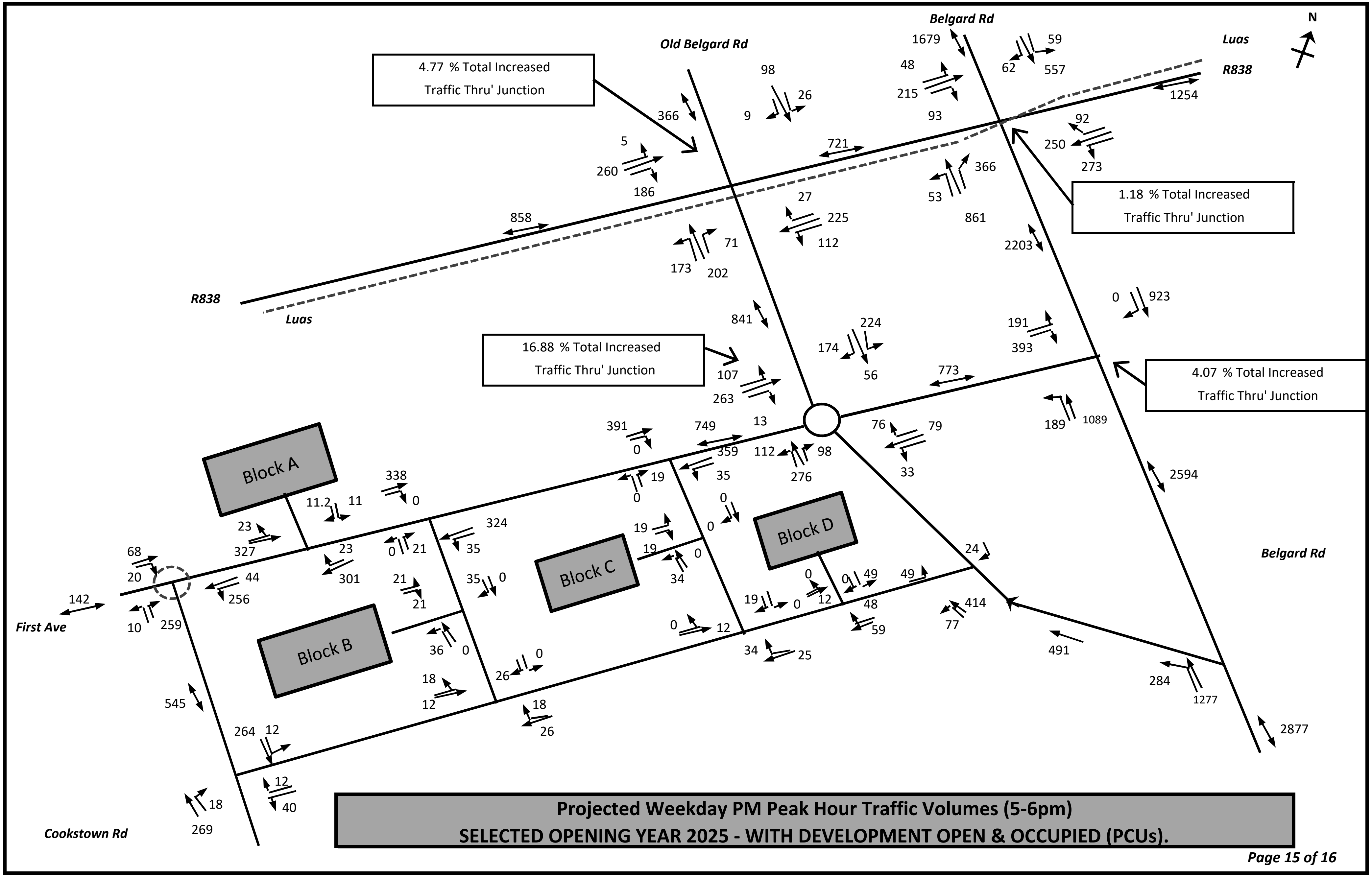
Petrol Filling Station & Ancillary Shop/Kiosk Unit					
8 Stand PFS	Car Arrivals		Car Departures		Total 2-Way Traffic
Network Period	per Stand	Total	per Stand	Total	
AM Peak Hr 8-9am	5.764	46	5.874	47	93
PM Peak Hr 5-6pm	5.829	47	5.894	47	94

Note - The Filling Station is Being Replaced and it's Traffic is alredy established and included in the Traffic Surveys of the Existing Network that have been completed, so adding in Traffic associated with a Replacement PFS and Kiosk in not appropriate.

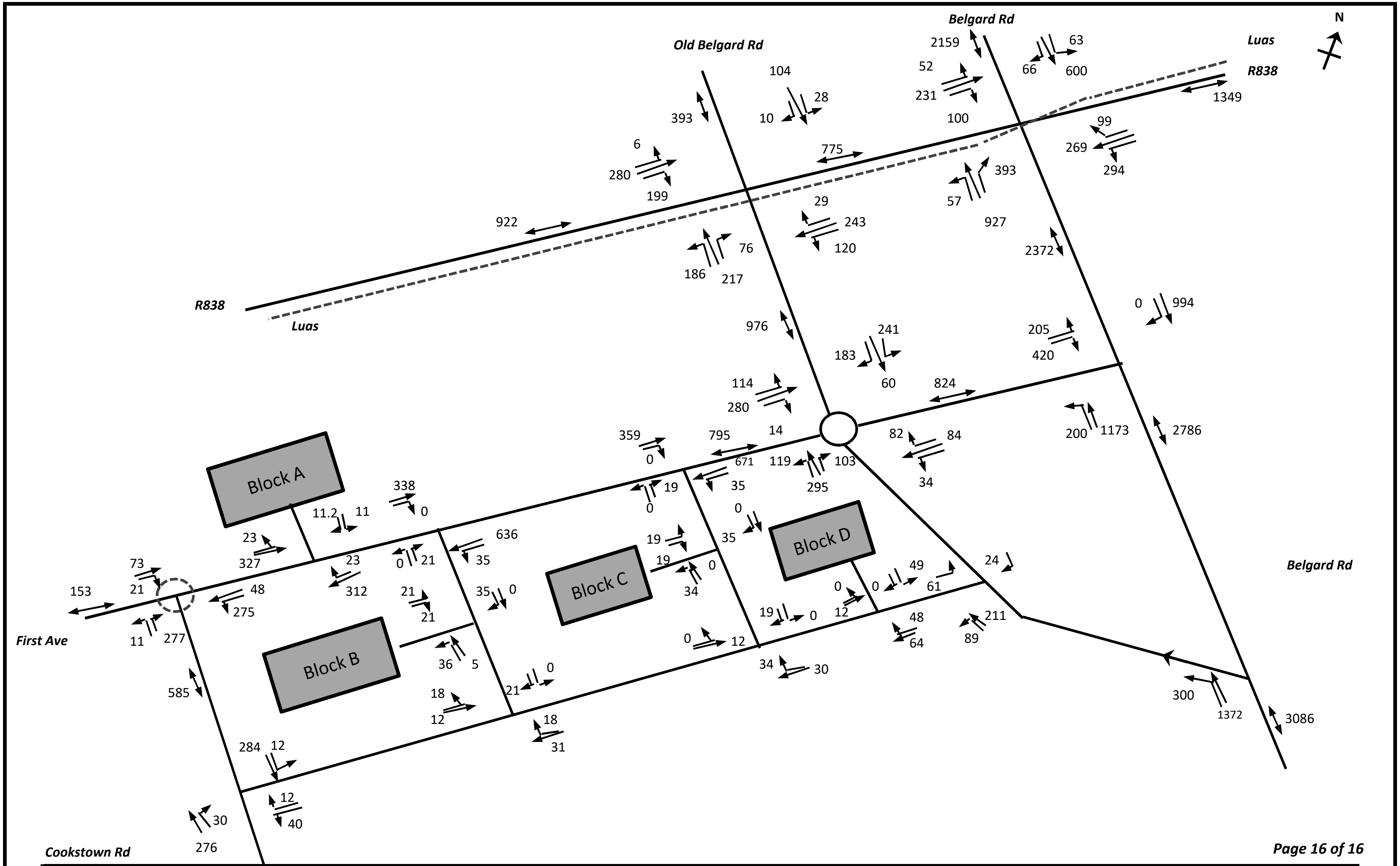
NB The Assignment of Traffic as "NEW TRAFFIC" to the Network has been undertaken for Robustness - HOWEVER The Industrial Estate historically generated significant traffic in it's own right and this has been ignored for Assessment Purposes.



ASSIGNMENT OF "NEW" DEVELOPMENT TRAFFIC FROM TRICS, USING INDUSTRY STANDARD METHODOLOGY, REFELCTING ESTABLISHED TURNING PROPORTIONS.



Belgard Rd
Old Belgard Rd
Luas
R838
N
4.77 % Total Increased
Traffic Thru' Junction
1.18 % Total Increased
Traffic Thru' Junction
16.88 % Total Increased
Traffic Thru' Junction
4.07 % Total Increased
Traffic Thru' Junction
Block A
Block B
Block C
Block D
First Ave
Cookstown Rd
Belgard Rd
Projected Weekday PM Peak Hour Traffic Volumes (5-6pm)
SELECTED OPENING YEAR 2025 - WITH DEVELOPMENT OPEN & OCCUPIED (PCUs).
Page 15 of 16



Projected Weekday PM Peak Hour Traffic Volumes (5-6pm) DESIGN YEAR 2040 (OPENING YEAR+15) - WITH DEVELOPMENT OPEN & OCCUPIED (PCUs).

APPENDIX D

ARCADY Junction Simulation Model Output
Cookstown Rd/1st Ave Roundabout

Existing Roundabout at Cookstown Estate Rd/1st Avenue
Summary ARCADY Results in Order as included herein
(Robust & Worst Case)

Modelled Scenario	Period Mean Max Q (PCUs)	Period Max RFC
2025 Opening Year AM Peak	<1	0.43
2025 Opening Year PM Peak	<1	0.3
2040 Design Year AM Peak	<1	0.47
2040 Design Year PM Peak	<1	0.33

<u>All Results Above are well below the recommended RFC of 0.85 (85% Capacity) and therefore no problems whatsoever are anticipated at the Existing Roundabout in terms of Capacity or excessive vehicle Queues</u>

<u>ACCEPTING that it is possible that SDCC may want to see this Roundabout altered to Traffic Signal Control, which is considered a more appropriate junction form in an Urban Residential Environment. Traffic Signals are easily Accommodated.</u>

*<u>**NB** Any Small Changes to Selected Opening Year 2025 or Design Year 2040 will have no significant implications in terms of the conclusions of the Study.</u>*

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.0.1.4646 []

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758 email: software@trl.co.uk Web: http://www.trlsoftware.co.uk

Filename: 2025 AM PM.j9
Path: N:\01 Projects\2019\19-036 Cookstown Phase 3\Calculations\Ctwn Rd 1st Ave ARCADYS
Report generation date: 12/12/2019 17:41:00

»2025, AM
»2025, PM

Summary of junction performance

	AM				PM			
	Q (PCU)	Delay (s)	RFC	LOS	Q (PCU)	Delay (s)	RFC	LOS
	2025							
Arm 1	0.8	5.93	0.43	A	0.4	4.83	0.30	A
Arm 2	0.5	5.21	0.34	A	0.4	4.73	0.28	A
Arm 3	0.1	4.41	0.11	A	0.1	4.33	0.10	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of Av. delay per arriving vehicle.

File summary

File Description

Title	(untitled)
Location	
Site number	
Date	12/12/2019
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	NRB-004\Eoin
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Av. delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Q Percentiles	Calculate residual capacity	RFC Threshold	Av. Delay threshold (s)	Q threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2025	AM	ONE HOUR	07:45	09:15	15
D2	2025	PM	ONE HOUR	16:45	18:15	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2025, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Junction Delay (s)	Junction LOS
1	1st Avs Ctwn Roundabout	Standard Roundabout	5.49	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
1	1st Ave East	
2	Cookstown Rd S	
3	1st Ave West	

Roundabout Geometry

Arm	V (m)	E (m)	l' (m)	R (m)	D (m)	PHI (deg)	Exit only
1	3.00	3.60	10.0	12.0	30.0	12.0	
2	3.00	3.60	10.0	12.0	30.0	12.0	
3	3.00	3.60	10.0	12.0	30.0	12.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
1	0.543	1093
2	0.543	1093
3	0.543	1093

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2025	AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
1		✓	426	100.000
2		✓	325	100.000
3		✓	91	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	362	64
	2	282	0	43
	3	73	18	0

Vehicle Mix

HV %s

		To		
		1	2	3
From	1	0	1	1
	2	1	0	1
	3	1	1	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
1	0.43	5.93	0.8	A
2	0.34	5.21	0.5	A
3	0.11	4.41	0.1	A

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	321	13	1086	0.295	319	0.4	4.731	A
2	245	48	1067	0.229	243	0.3	4.408	A
3	69	211	978	0.070	68	0.1	3.993	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	383	16	1084	0.353	382	0.5	5.176	A
2	292	57	1062	0.275	292	0.4	4.718	A
3	82	253	956	0.086	82	0.1	4.160	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	469	20	1082	0.433	468	0.8	5.910	A
2	358	70	1055	0.339	357	0.5	5.211	A
3	100	310	925	0.108	100	0.1	4.408	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	469	20	1082	0.433	469	0.8	5.926	A
2	358	70	1055	0.339	358	0.5	5.215	A
3	100	310	925	0.108	100	0.1	4.409	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	383	16	1084	0.353	384	0.6	5.197	A
2	292	58	1062	0.275	293	0.4	4.731	A
3	82	254	955	0.086	82	0.1	4.164	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	321	14	1086	0.295	321	0.4	4.760	A
2	245	48	1067	0.229	245	0.3	4.424	A
3	69	213	978	0.070	69	0.1	3.999	A

2025, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Junction Delay (s)	Junction LOS
1	1st Avs Ctwn Roundabout	Standard Roundabout	4.72	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2025	PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
1		✓	299	100.000
2		✓	271	100.000
3		✓	88	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	255	44
	2	261	0	10
	3	68	20	0

Vehicle Mix

HV %s

		To		
		1	2	3
From	1	0	1	1
	2	1	0	1
	3	1	1	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
1	0.30	4.83	0.4	A
2	0.28	4.73	0.4	A
3	0.10	4.33	0.1	A

Main Results for each time segment

16:45 - 17:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	225	15	1085	0.207	224	0.3	4.217	A
2	204	33	1075	0.190	203	0.2	4.164	A
3	66	196	987	0.067	66	0.1	3.947	A

17:00 - 17:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	269	18	1083	0.248	269	0.3	4.461	A
2	244	40	1072	0.227	243	0.3	4.388	A
3	79	234	966	0.082	79	0.1	4.099	A

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	329	22	1081	0.304	329	0.4	4.830	A
2	298	48	1067	0.280	298	0.4	4.726	A
3	97	287	937	0.103	97	0.1	4.325	A

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	329	22	1081	0.304	329	0.4	4.834	A
2	298	48	1067	0.280	298	0.4	4.730	A
3	97	287	937	0.103	97	0.1	4.326	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	269	18	1083	0.248	269	0.3	4.469	A
2	244	40	1072	0.227	244	0.3	4.396	A
3	79	235	966	0.082	79	0.1	4.103	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	225	15	1085	0.207	225	0.3	4.232	A
2	204	33	1075	0.190	204	0.2	4.177	A
3	66	197	986	0.067	66	0.1	3.953	A

Junctions 9

ARCADY 9 - Roundabout Module

Filename: 2040 AM PM.j9
Path: N:\01 Projects\2019\19-036 Cookstown Phase 3\Calculations\Ctwn Rd 1st Ave ARCADYS
Report generation date: 12/12/2019 17:44:22

Summary of junction performance

	AM				PM			
	Q (PCU)	Delay (s)	RFC	LOS	Q (PCU)	Delay (s)	RFC	LOS
	2040							
Arm 1	0.9	6.28	0.47	A	0.5	5.01	0.33	A
Arm 2	0.6	5.46	0.37	A	0.4	4.89	0.30	A
Arm 3	0.1	4.52	0.12	A	0.1	4.42	0.11	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of Av. delay per arriving vehicle.

File summary

File Description

Title	(untitled)
Location	
Site number	
Date	12/12/2019
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	NRB-004\Eoin
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Av. delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Q Percentiles	Calculate residual capacity	RFC Threshold	Av. Delay threshold (s)	Q threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2040	AM	ONE HOUR	07:45	09:15	15
D2	2040	PM	ONE HOUR	16:45	18:15	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2040, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Junction Delay (s)	Junction LOS
1	1st Avs Ctwn Roundabout	Standard Roundabout	5.77	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
1	1st Ave East	
2	Cookstown Rd S	
3	1st Ave West	

Roundabout Geometry

Arm	V (m)	E (m)	l' (m)	R (m)	D (m)	PHI (deg)	Exit only
1	3.00	3.60	10.0	12.0	30.0	12.0	
2	3.00	3.60	10.0	12.0	30.0	12.0	
3	3.00	3.60	10.0	12.0	30.0	12.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
1	0.543	1093
2	0.543	1093
3	0.543	1093

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2040	AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
1		✓	457	100.000
2		✓	351	100.000
3		✓	98	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	388	69
	2	304	0	47
	3	79	19	0

Vehicle Mix

HV %s

		To		
		1	2	3
From	1	0	1	1
	2	1	0	1
	3	1	1	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
1	0.47	6.28	0.9	A
2	0.37	5.46	0.6	A
3	0.12	4.52	0.1	A

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	344	14	1085	0.317	342	0.5	4.880	A
2	264	52	1065	0.248	263	0.3	4.525	A
3	74	228	970	0.076	73	0.1	4.057	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	411	17	1084	0.379	410	0.6	5.392	A
2	316	62	1060	0.298	315	0.4	4.882	A
3	88	273	945	0.093	88	0.1	4.242	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	503	21	1082	0.465	502	0.9	6.260	A
2	386	76	1052	0.367	386	0.6	5.453	A
3	108	334	912	0.118	108	0.1	4.522	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	503	21	1082	0.465	503	0.9	6.282	A
2	386	76	1052	0.367	386	0.6	5.462	A
3	108	335	911	0.118	108	0.1	4.524	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	411	17	1084	0.379	412	0.6	5.419	A
2	316	62	1059	0.298	316	0.4	4.897	A
3	88	274	945	0.093	88	0.1	4.246	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	344	14	1085	0.317	345	0.5	4.911	A
2	264	52	1065	0.248	265	0.3	4.546	A
3	74	229	969	0.076	74	0.1	4.063	A

2040, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Junction Delay (s)	Junction LOS
1	1st Avs Ctwn Roundabout	Standard Roundabout	4.88	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2040	PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
1		✓	322	100.000
2		✓	291	100.000
3		✓	94	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	274	48
	2	280	0	11
	3	73	21	0

Vehicle Mix

HV %s

		To		
		1	2	3
From	1	0	1	1
	2	1	0	1
	3	1	1	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
1	0.33	5.01	0.5	A
2	0.30	4.89	0.4	A
3	0.11	4.42	0.1	A

Main Results for each time segment

16:45 - 17:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	242	16	1085	0.224	241	0.3	4.306	A
2	219	36	1074	0.204	218	0.3	4.244	A
3	71	210	979	0.072	70	0.1	4.000	A

17:00 - 17:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	289	19	1083	0.267	289	0.4	4.577	A
2	262	43	1070	0.245	261	0.3	4.496	A
3	85	251	957	0.088	84	0.1	4.168	A

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	355	23	1081	0.328	354	0.5	5.000	A
2	320	53	1065	0.301	320	0.4	4.881	A
3	103	308	926	0.112	103	0.1	4.420	A

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	355	23	1081	0.328	355	0.5	5.006	A
2	320	53	1065	0.301	320	0.4	4.885	A
3	103	308	926	0.112	103	0.1	4.421	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	289	19	1083	0.267	290	0.4	4.589	A
2	262	43	1070	0.245	262	0.3	4.503	A
3	85	252	956	0.088	85	0.1	4.171	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	242	16	1085	0.224	243	0.3	4.320	A
2	219	36	1074	0.204	219	0.3	4.257	A
3	71	211	979	0.072	71	0.1	4.007	A

NRB consulting engineers

APPENDIX E

PiCADY Junction Model Output
Cookstown Rd/New E-W Street

Proposed Priority Controlled Junction at E-W Street
Summary PiCADY Results in Order as included herein
(Robust & Worst Case)

Modelled Scenario	Period Mean Max Q (PCUs)	Period Max RFC
2025 Opening Year AM Peak	<1	0.24
2025 Opening Year PM Peak	<1	0.13
2040 Design Year AM Peak	<1	0.25
2040 Design Year PM Peak	<1	0.14

All Results Above are well below the Recommended RFC of 0.85 (85% Capacity), and therefore no problems whatsoever are anticipated at the Proposed Site Access in terms of Capacity or excessive vehicle Queues - This is unsurprising in light of the very low volumes of anticipated traffic.

***NB** Any Small Changes to Selected Opening Year 2025 or Design Year 2040 will have no significant implications in terms of the conclusions of the Study.*

Junctions 9

PICADY 9 - Priority Intersection Module

Version: 9.0.1.4646 []

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758 email: software@trl.co.uk Web: http://www.trlsoftware.co.uk

Filename: 2025 AM PM.j9
Path: N:\01 Projects\2019\19-036 Cookstown Phase 3\Calculations\Ctwn Rd New EW Street PICADYS
Report generation date: 12/12/2019 17:10:10

»2025, AM
»2025, PM

Summary of junction performance

	AM				PM			
	Q (PCU)	Delay (s)	RFC	LOS	Q (PCU)	Delay (s)	RFC	LOS
	2025							
Stream B-AC	0.3	10.53	0.24	B	0.1	9.03	0.13	A
Stream C-AB	0.0	5.36	0.03	A	0.0	5.46	0.03	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of Av. delay per arriving vehicle.

File summary

File Description

Title	(untitled)
Location	
Site number	
Date	12/12/2019
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	NRB-004\Eoin
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Av. delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Q Percentiles	Calculate residual capacity	RFC Threshold	Av. Delay threshold (s)	Q threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2025	AM	ONE HOUR	07:45	09:15	15
D2	2025	PM	ONE HOUR	15:45	17:15	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2025, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Major road direction	Junction Delay (s)	Junction LOS
1	C'twn Rd/EW Street Junc (Worst Case)	T-Junction	Two-way	1.41	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description	Arm type
A	Cookstown Rd N		Major
B	New EW Street		Minor
C	Cookstown Rd S		Major

Major Arm Geometry

Arm	Width of carriageway (m)	Has kerbed central reserve	Has right turn bay	Visibility for right turn (m)	Blocks?	Blocking queue (PCU)
C	6.00			0.0	✓	0.00

Geometries for Arm C are measured opposite Arm B. Geometries for Arm A (if relevant) are measured opposite Arm D.

Minor Arm Geometry

Arm	Minor arm type	Lane width (m)	Visibility to left (m)	Visibility to right (m)
B	One lane	2.20	0	0

Slope / Intercept / Capacity

Priority Intersection Slopes and Intercepts

Junction	Stream	Intercept (PCU/hr)	Slope for A-B	Slope for A-C	Slope for C-A	Slope for C-B
1	B-A	440	0.080	0.202	0.127	0.289
1	B-C	574	0.088	0.222	-	-
1	C-B	574	0.222	0.222	-	-

The slopes and intercepts shown above do NOT include any corrections or adjustments.

Streams may be combined, in which case capacity will be adjusted.

Values are shown for the first time segment only; they may differ for subsequent time segments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2025	AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
A		✓	379	100.000
B		✓	100	100.000
C		✓	336	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A	B	C
From	A	0	12	367
	B	12	0	88
	C	326	10	0

Vehicle Mix

HV %s

		To		
		A	B	C
From	A	0	0	1
	B	0	0	0
	C	1	0	0

Results

Results Summary for whole modelled period

Stream	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
B-AC	0.24	10.53	0.3	B
C-AB	0.03	5.36	0.0	A
C-A				
A-B				
A-C				

Main Results for each time segment

07:45 - 08:00

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	75	485	0.155	75	0.2	8.763	A
C-AB	12	686	0.017	12	0.0	5.354	A
C-A	241			241			
A-B	9			9			
A-C	276			276			

08:00 - 08:15

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	90	471	0.191	90	0.2	9.434	A
C-AB	15	710	0.022	15	0.0	5.200	A
C-A	287			287			
A-B	11			11			
A-C	330			330			

08:15 - 08:30

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	110	452	0.244	110	0.3	10.505	B
C-AB	21	744	0.029	21	0.0	5.002	A
C-A	349			349			
A-B	13			13			
A-C	404			404			

08:30 - 08:45

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	110	452	0.244	110	0.3	10.526	B
C-AB	21	744	0.029	21	0.0	5.006	A
C-A	349			349			
A-B	13			13			
A-C	404			404			

08:45 - 09:00

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	90	471	0.191	90	0.2	9.461	A
C-AB	15	710	0.022	15	0.0	5.206	A
C-A	287			287			
A-B	11			11			
A-C	330			330			

09:00 - 09:15

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	75	485	0.155	75	0.2	8.803	A
C-AB	12	686	0.017	12	0.0	5.359	A
C-A	241			241			
A-B	9			9			
A-C	276			276			

2025, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Major road direction	Junction Delay (s)	Junction LOS
1	C'twn Rd/EW Street Junc (Worst Case)	T-Junction	Two-way	0.91	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2025	PM	ONE HOUR	15:45	17:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
A		✓	274	100.000
B		✓	52	100.000
C		✓	282	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A	B	C
From	A	0	12	262
	B	12	0	40
	C	272	10	0

Vehicle Mix

HV %s

		To		
		A	B	C
From	A	0	0	1
	B	0	0	0
	C	1	0	0

Results

Results Summary for whole modelled period

Stream	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
B-AC	0.13	9.03	0.1	A
C-AB	0.03	5.46	0.0	A
C-A				
A-B				
A-C				

Main Results for each time segment

15:45 - 16:00

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	39	482	0.081	39	0.1	8.115	A
C-AB	11	673	0.016	11	0.0	5.454	A
C-A	201			201			
A-B	9			9			
A-C	197			197			

16:00 - 16:15

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	47	471	0.099	47	0.1	8.482	A
C-AB	14	693	0.020	14	0.0	5.316	A
C-A	240			240			
A-B	11			11			
A-C	236			236			

16:15 - 16:30

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	57	456	0.126	57	0.1	9.024	A
C-AB	19	722	0.026	19	0.0	5.138	A
C-A	292			292			
A-B	13			13			
A-C	288			288			

16:30 - 16:45

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	57	456	0.126	57	0.1	9.029	A
C-AB	19	722	0.026	19	0.0	5.140	A
C-A	292			292			
A-B	13			13			
A-C	288			288			

16:45 - 17:00

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	47	471	0.099	47	0.1	8.492	A
C-AB	14	693	0.020	14	0.0	5.322	A
C-A	240			240			
A-B	11			11			
A-C	236			236			

17:00 - 17:15

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	39	482	0.081	39	0.1	8.138	A
C-AB	11	673	0.016	11	0.0	5.458	A
C-A	201			201			
A-B	9			9			
A-C	197			197			

Junctions 9

PICADY 9 - Priority Intersection Module

Filename: 2040 AM PM.j9
Path: N:\01 Projects\2019\19-036 Cookstown Phase 3\Calculations\Ctwn Rd New EW Street PICADYS
Report generation date: 12/12/2019 17:28:10

Summary of junction performance

	AM				PM			
	Q (PCU)	Delay (s)	RFC	LOS	Q (PCU)	Delay (s)	RFC	LOS
	2040							
Stream B-AC	0.3	10.78	0.25	B	0.1	9.30	0.13	A
Stream C-AB	0.1	5.44	0.06	A	0.3	5.89	0.14	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of Av. delay per arriving vehicle.

File summary

File Description

Title	(untitled)
Location	
Site number	
Date	12/12/2019
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	NRB-004\Eoin
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Av. delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Q Percentiles	Calculate residual capacity	RFC Threshold	Av. Delay threshold (s)	Q threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2040	AM	ONE HOUR	07:45	09:15	15
D2	2040	PM	ONE HOUR	15:45	17:15	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2040, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Major road direction	Junction Delay (s)	Junction LOS
1	C'twn Rd/EW Street Junc (Worst Case)	T-Junction	Two-way	1.47	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description	Arm type
A	Cookstown Rd N		Major
B	New EW Street		Minor
C	Cookstown Rd S		Major

Major Arm Geometry

Arm	Width of carriageway (m)	Has kerbed central reserve	Has right turn bay	Visibility for right turn (m)	Blocks?	Blocking queue (PCU)
C	6.00			0.0	✓	0.00

Geometries for Arm C are measured opposite Arm B. Geometries for Arm A (if relevant) are measured opposite Arm D.

Minor Arm Geometry

Arm	Minor arm type	Lane width (m)	Visibility to left (m)	Visibility to right (m)
B	One lane	2.20	0	0

Slope / Intercept / Capacity

Priority Intersection Slopes and Intercepts

Junction	Stream	Intercept (PCU/hr)	Slope for A-B	Slope for A-C	Slope for C-A	Slope for C-B
1	B-A	440	0.080	0.202	0.127	0.289
1	B-C	574	0.088	0.222	-	-
1	C-B	574	0.222	0.222	-	-

The slopes and intercepts shown above do NOT include any corrections or adjustments.

Streams may be combined, in which case capacity will be adjusted.

Values are shown for the first time segment only; they may differ for subsequent time segments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2040	AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
A		✓	407	100.000
B		✓	100	100.000
C		✓	358	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A	B	C
From	A	0	12	395
	B	12	0	88
	C	338	20	0

Vehicle Mix

HV %s

		To		
		A	B	C
From	A	0	0	1
	B	0	0	0
	C	1	0	0

Results

Results Summary for whole modelled period

Stream	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
B-AC	0.25	10.78	0.3	B
C-AB	0.06	5.44	0.1	A
C-A				
A-B				
A-C				

Main Results for each time segment

07:45 - 08:00

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	75	479	0.157	75	0.2	8.879	A
C-AB	24	689	0.035	24	0.0	5.431	A
C-A	246			246			
A-B	9			9			
A-C	297			297			

08:00 - 08:15

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	90	465	0.194	90	0.2	9.601	A
C-AB	31	713	0.044	31	0.1	5.299	A
C-A	290			290			
A-B	11			11			
A-C	355			355			

08:15 - 08:30

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	110	444	0.248	110	0.3	10.761	B
C-AB	44	748	0.059	44	0.1	5.135	A
C-A	350			350			
A-B	13			13			
A-C	435			435			

08:30 - 08:45

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	110	444	0.248	110	0.3	10.785	B
C-AB	44	749	0.059	44	0.1	5.138	A
C-A	350			350			
A-B	13			13			
A-C	435			435			

08:45 - 09:00

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	90	465	0.194	90	0.2	9.627	A
C-AB	31	713	0.044	32	0.1	5.308	A
C-A	290			290			
A-B	11			11			
A-C	355			355			

09:00 - 09:15

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	75	479	0.157	76	0.2	8.921	A
C-AB	24	689	0.035	24	0.0	5.439	A
C-A	246			246			
A-B	9			9			
A-C	297			297			

2040, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Major road direction	Junction Delay (s)	Junction LOS
1	C'twn Rd/EW Street Junc (Worst Case)	T-Junction	Two-way	1.46	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2040	PM	ONE HOUR	15:45	17:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
A		✓	295	100.000
B		✓	52	100.000
C		✓	333	100.000

Origin-Destination Data

Demand (PCU/hr)

		To		
		A	B	C
From	A	0	12	283
	B	12	0	40
	C	279	54	0

Vehicle Mix

HV %s

		To		
		A	B	C
From	A	0	0	1
	B	0	0	0
	C	1	0	0

Results

Results Summary for whole modelled period

Stream	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
B-AC	0.13	9.30	0.1	A
C-AB	0.14	5.89	0.3	A
C-A				
A-B				
A-C				

Main Results for each time segment

15:45 - 16:00

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	39	474	0.083	39	0.1	8.262	A
C-AB	59	673	0.088	58	0.1	5.870	A
C-A	192			192			
A-B	9			9			
A-C	213			213			

16:00 - 16:15

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	47	462	0.101	47	0.1	8.672	A
C-AB	76	694	0.110	76	0.2	5.848	A
C-A	223			223			
A-B	11			11			
A-C	254			254			

16:15 - 16:30

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	57	444	0.129	57	0.1	9.297	A
C-AB	104	723	0.143	103	0.3	5.835	A
C-A	263			263			
A-B	13			13			
A-C	312			312			

16:30 - 16:45

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	57	444	0.129	57	0.1	9.303	A
C-AB	104	724	0.143	104	0.3	5.840	A
C-A	263			263			
A-B	13			13			
A-C	312			312			

16:45 - 17:00

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	47	462	0.101	47	0.1	8.682	A
C-AB	76	694	0.110	77	0.2	5.862	A
C-A	223			223			
A-B	11			11			
A-C	254			254			

17:00 - 17:15

Stream	Total Demand (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
B-AC	39	474	0.083	39	0.1	8.281	A
C-AB	59	674	0.088	60	0.2	5.887	A
C-A	191			191			
A-B	9			9			
A-C	213			213			

APPENDIX F

ARCADY Junction Simulation Model Output

Old Belgard Rd/1st Ave R'Abt

Existing Roundabout at 1st Avenue/Old Belgard Rd
Summary ARCADY Results in Order as included herein
(Robust & Worst Case)

Modelled Scenario	Period Mean Max Q (PCUs)	Period Max RFC
2025 Opening Year AM Peak	4	0.84
2025 Opening Year PM Peak	2	0.57
2040 Design Year AM Peak	8	0.91
2040 Design Year PM Peak	2	0.61

All Results Above are within the recommended RFC of 0.85 (85% Capacity) during Opening Year 2025 and below 100% (Capacity) in the Design Year 2040 - therefore The Junction is approaching Capacity in 2040, considered as a stand-alone junction.

ACCEPTING that it is possible that SDCC may also want to see this Roundabout altered to Traffic Signal Control, which is considered a more appropriate junction form in an Urban Residential Environment. Traffic Signals are easily Accommodated.

__NB__ Any Small Changes to Selected Opening Year 2025 or Design Year 2040 will have no significant implications in terms of the conclusions of the Study.

Junctions 9

ARCADY 9 - Roundabout Module

Filename: 2025 AM PM.j9
Path: G:\Shared drives\Server\01 Projects\2019\19-036 Cookstown Phase 3\Calculations\1st Ave Old Belgadr ARCADYS
Report generation date: 07/09/2020 16:53:21

»2025, AM
»2025, PM

Summary of junction performance

	AM				PM			
	Q (PCU)	Delay (s)	RFC	LOS	Q (PCU)	Delay (s)	RFC	LOS
	2025							
Arm 1	0.4	5.90	0.29	A	0.3	4.68	0.21	A
Arm 2	0.5	6.52	0.35	A	1.3	9.15	0.57	A
Arm 3	1.0	7.42	0.50	A	1.0	8.31	0.49	A
Arm 4	4.8	24.56	0.84	C	1.2	8.97	0.55	A

Values shown are the highest values encountered over all time segments. Delay is the maximum value of Av. delay per arriving vehicle.

File summary

File Description

Title	(untitled)
Location	
Site number	
Date	12/12/2019
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	NRB-004\Eoin
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Av. delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Q Percentiles	Calculate residual capacity	RFC Threshold	Av. Delay threshold (s)	Q threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2025	AM	ONE HOUR	07:45	09:15	15
D2	2025	PM	ONE HOUR	16:45	18:15	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2025, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Junction Delay (s)	Junction LOS
1	1st Ave Old Belgard Rndab	Standard Roundabout	14.23	B

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
1	Link to Belgard Rd	
2	Old Belgard Rd S	
3	1st Ave Arm	
4	Old Belgard Rd N	

Roundabout Geometry

Arm	V (m)	E (m)	l' (m)	R (m)	D (m)	PHI (deg)	Exit only
1	3.00	3.70	15.0	12.0	35.0	11.0	
2	3.00	3.70	15.0	12.0	35.0	11.0	
3	3.00	3.70	15.0	12.0	35.0	11.0	
4	3.00	3.70	15.0	12.0	35.0	11.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
1	0.546	1130
2	0.546	1130
3	0.546	1130
4	0.546	1130

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2025	AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
1		✓	227	100.000
2		✓	271	100.000
3		✓	442	100.000
4		✓	676	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	36	92	99
	2	38	0	115	118
	3	327	37	0	78
	4	273	138	265	0

Vehicle Mix

HV %s

		To			
		1	2	3	4
From	1	0	1	1	1
	2	1	0	1	1
	3	1	1	0	1
	4	1	1	1	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
1	0.29	5.90	0.4	A
2	0.35	6.52	0.5	A
3	0.50	7.42	1.0	A
4	0.84	24.56	4.8	C

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	171	328	951	0.180	170	0.2	4.654	A
2	204	341	944	0.216	203	0.3	4.901	A
3	333	191	1026	0.324	331	0.5	5.217	A
4	509	301	966	0.527	505	1.1	7.813	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	204	394	915	0.223	204	0.3	5.113	A
2	244	409	907	0.269	243	0.4	5.477	A
3	397	229	1005	0.395	397	0.7	5.971	A
4	608	361	933	0.651	605	1.8	10.983	B

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	250	478	869	0.288	249	0.4	5.866	A
2	298	497	858	0.348	298	0.5	6.478	A
3	487	280	977	0.498	485	1.0	7.374	A
4	744	441	889	0.837	733	4.5	21.995	C

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	250	484	866	0.289	250	0.4	5.903	A
2	298	502	856	0.349	298	0.5	6.519	A
3	487	281	977	0.498	487	1.0	7.419	A
4	744	443	888	0.838	743	4.8	24.559	C

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	204	403	910	0.224	205	0.3	5.158	A
2	244	415	903	0.270	244	0.4	5.523	A
3	397	230	1004	0.396	399	0.7	6.014	A
4	608	363	932	0.652	619	2.0	12.026	B

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	171	333	948	0.180	171	0.2	4.682	A
2	204	345	942	0.217	204	0.3	4.936	A
3	333	192	1025	0.325	333	0.5	5.263	A
4	509	303	964	0.528	512	1.1	8.097	A

2025, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Junction Delay (s)	Junction LOS
1	1st Ave Old Belgard Rndab	Standard Roundabout	8.33	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2025	PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
1		✓	188	100.000
2		✓	486	100.000
3		✓	383	100.000
4		✓	454	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	33	79	76
	2	98	0	112	276
	3	263	13	0	107
	4	224	56	174	0

Vehicle Mix

HV %s

		To			
		1	2	3	4
From	1	0	1	1	1
	2	1	0	1	1
	3	1	1	0	1
	4	1	1	1	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
1	0.21	4.68	0.3	A
2	0.57	9.15	1.3	A
3	0.49	8.31	1.0	A
4	0.55	8.97	1.2	A

Main Results for each time segment

16:45 - 17:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	142	182	1031	0.137	141	0.2	4.084	A
2	366	246	995	0.368	364	0.6	5.734	A
3	288	337	946	0.305	287	0.4	5.499	A
4	342	280	977	0.350	340	0.5	5.684	A

17:00 - 17:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	169	218	1011	0.167	169	0.2	4.316	A
2	437	295	969	0.451	436	0.8	6.812	A
3	344	404	909	0.379	344	0.6	6.418	A
4	408	336	947	0.431	407	0.8	6.729	A

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	207	267	984	0.210	207	0.3	4.675	A
2	535	361	933	0.574	533	1.3	9.053	A
3	422	494	860	0.490	420	1.0	8.238	A
4	500	410	906	0.552	498	1.2	8.875	A

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	207	268	984	0.210	207	0.3	4.679	A
2	535	362	932	0.574	535	1.3	9.152	A
3	422	495	859	0.491	422	1.0	8.305	A
4	500	412	905	0.552	500	1.2	8.969	A

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	169	219	1010	0.167	169	0.2	4.325	A
2	437	297	968	0.451	439	0.8	6.898	A
3	344	406	908	0.379	346	0.6	6.482	A
4	408	338	946	0.432	410	0.8	6.810	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	142	183	1030	0.137	142	0.2	4.094	A
2	366	248	994	0.368	367	0.6	5.804	A
3	288	340	944	0.305	289	0.4	5.553	A
4	342	282	976	0.350	343	0.5	5.750	A

Junctions 9

ARCADY 9 - Roundabout Module

Filename: 2040 AM PM.j9
Path: G:\Shared drives\Server\01 Projects\2019\19-036 Cookstown Phase 3\Calculations\1st Ave Old Belgadr ARCADYS
Report generation date: 07/09/2020 16:55:55

»2040, AM
»2040, PM

Summary of junction performance

	AM				PM			
	Q (PCU)	Delay (s)	RFC	LOS	Q (PCU)	Delay (s)	RFC	LOS
	2040							
Arm 1	0.5	6.26	0.31	A	0.3	4.79	0.21	A
Arm 2	0.6	6.99	0.38	A	1.5	9.95	0.60	A
Arm 3	1.1	8.05	0.53	A	1.1	8.92	0.52	A
Arm 4	8.7	41.85	0.92	E	1.6	10.33	0.61	B

Values shown are the highest values encountered over all time segments. Delay is the maximum value of Av. delay per arriving vehicle.

File summary

File Description

Title	(untitled)
Location	
Site number	
Date	12/12/2019
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	NRB-004\Eoin
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Av. delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Q Percentiles	Calculate residual capacity	RFC Threshold	Av. Delay threshold (s)	Q threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2040	AM	ONE HOUR	07:45	09:15	15
D2	2040	PM	ONE HOUR	16:45	18:15	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2040, AM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Junction Delay (s)	Junction LOS
1	1st Ave Old Belgard Rndab	Standard Roundabout	21.87	C

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Arms

Arms

Arm	Name	Description
1	Link to Belgard Rd	
2	Old Belgard Rd S	
3	1st Ave Arm	
4	Old Belgard Rd N	

Roundabout Geometry

Arm	V (m)	E (m)	l' (m)	R (m)	D (m)	PHI (deg)	Exit only
1	3.00	3.70	15.0	12.0	35.0	11.0	
2	3.00	3.70	15.0	12.0	35.0	11.0	
3	3.00	3.70	15.0	12.0	35.0	11.0	
4	3.00	3.70	15.0	12.0	35.0	11.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
1	0.546	1130
2	0.546	1130
3	0.546	1130
4	0.546	1130

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2040	AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
1		✓	242	100.000
2		✓	288	100.000
3		✓	468	100.000
4		✓	727	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	37	99	106
	2	39	0	123	126
	3	346	40	0	82
	4	294	149	284	0

Vehicle Mix

HV %s

		To			
		1	2	3	4
From	1	0	1	1	1
	2	1	0	1	1
	3	1	1	0	1
	4	1	1	1	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
1	0.31	6.26	0.5	A
2	0.38	6.99	0.6	A
3	0.53	8.05	1.1	A
4	0.92	41.85	8.7	E

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	182	353	937	0.194	181	0.2	4.803	A
2	217	365	930	0.233	216	0.3	5.078	A
3	352	203	1019	0.346	350	0.5	5.436	A
4	547	318	956	0.572	542	1.3	8.672	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	218	423	899	0.242	217	0.3	5.330	A
2	259	438	891	0.291	258	0.4	5.746	A
3	421	243	997	0.422	420	0.7	6.290	A
4	654	381	922	0.709	649	2.3	13.155	B

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	266	508	852	0.313	266	0.5	6.195	A
2	317	530	841	0.377	316	0.6	6.926	A
3	515	298	967	0.533	514	1.1	7.985	A
4	800	467	875	0.915	780	7.5	32.657	D

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	266	518	847	0.315	266	0.5	6.262	A
2	317	537	837	0.379	317	0.6	6.994	A
3	515	298	967	0.533	515	1.1	8.047	A
4	800	468	874	0.915	796	8.7	41.847	E

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	218	440	890	0.245	218	0.3	5.417	A
2	259	450	884	0.293	260	0.4	5.826	A
3	421	244	997	0.422	422	0.7	6.350	A
4	654	383	921	0.710	678	2.6	16.322	C

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	182	359	934	0.195	183	0.2	4.841	A
2	217	370	928	0.234	217	0.3	5.122	A
3	352	204	1018	0.346	353	0.5	5.472	A
4	547	321	955	0.573	552	1.4	9.136	A

2040, PM

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction Type	Junction Delay (s)	Junction LOS
1	1st Ave Old Belgard Rndab	Standard Roundabout	9.20	A

Junction Network Options

Driving side	Lighting
Left	Normal/unknown

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2040	PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Av. Demand (PCU/hr)	Scaling Factor (%)
1		✓	187	100.000
2		✓	497	100.000
3		✓	407	100.000
4		✓	502	100.000

Origin-Destination Data

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	18	87	82
	2	82	0	123	292
	3	279	14	0	114
	4	241	68	193	0

Vehicle Mix

HV %s

		To			
		1	2	3	4
From	1	0	1	1	1
	2	1	0	1	1
	3	1	1	0	1
	4	1	1	1	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max delay (s)	Max Q (PCU)	Max LOS
1	0.21	4.79	0.3	A
2	0.60	9.95	1.5	A
3	0.52	8.92	1.1	A
4	0.61	10.33	1.6	B

Main Results for each time segment

16:45 - 17:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	141	206	1018	0.138	140	0.2	4.141	A
2	374	271	982	0.381	372	0.6	5.934	A
3	306	341	944	0.325	304	0.5	5.672	A
4	378	281	977	0.387	375	0.6	6.021	A

17:00 - 17:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	168	247	995	0.169	168	0.2	4.393	A
2	447	325	953	0.469	446	0.9	7.160	A
3	366	409	907	0.404	365	0.7	6.706	A
4	451	336	946	0.477	450	0.9	7.313	A

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	206	301	965	0.213	206	0.3	4.785	A
2	547	397	913	0.599	545	1.5	9.813	A
3	448	500	857	0.523	446	1.1	8.826	A
4	553	411	905	0.611	550	1.5	10.164	B

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	206	303	965	0.213	206	0.3	4.791	A
2	547	399	912	0.600	547	1.5	9.951	A
3	448	502	856	0.524	448	1.1	8.915	A
4	553	413	904	0.611	553	1.6	10.326	B

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	168	249	994	0.169	168	0.2	4.405	A
2	447	327	952	0.470	449	0.9	7.272	A
3	366	412	905	0.404	368	0.7	6.783	A
4	451	339	945	0.478	454	0.9	7.441	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	LOS
1	141	208	1017	0.138	141	0.2	4.154	A
2	374	273	981	0.382	375	0.6	6.017	A
3	306	344	942	0.325	307	0.5	5.737	A
4	378	283	975	0.387	379	0.6	6.111	A

APPENDIX G

Independent Stage 1 Road Safety Audit
& Designer Feedback Form

Title: **STAGE 1 ROAD SAFETY AUDIT**

For;

Proposed Residential Development at Lands West of Old Belgard road and North, South & West of Cookstown Road, Cookstown Industrial Estate, Tallaght, Dublin 24.

Client: **NRB Consulting Engineers**

Date: **September 2020**

Report reference: **0857R01**

VERSION: **FINAL**

Prepared By:

Bruton Consulting Engineers Ltd

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BRUTON CONSULTING ENGINEERS

CONTENTS SHEET

Contents

1.0 Introduction

This report was prepared in response to a request from Mr. Paul Burke, NRB Consulting Engineers, for a Stage 1 Road Safety Audit of the proposed residential development at West of Old Belgard Road and North, South & West of Cookstown Road, Cookstown Industrial Estate, Tallaght, Dublin 24.

The Road Safety Audit Team comprised of;

Team Leader:	**Norman Bruton**, BE CEng FIEI, Cert Comp RSA.
	TII Auditor Approval no. NB 168446
Team Member:	**Owen O'Reilly**, B.SC. Eng Dip Struct. Eng NCEA Civil Dip Civil. Eng CEng MIEI
	TII Auditor Approval no. OO1291756

The Road Safety Audit comprised an examination of the drawings and a site visit, together on the 4th September 2020.

The weather at the time of the site visit was dry and the road surface was dry.

This Stage 1 Road Safety Audit has been carried out in accordance with the requirements of TII Publication Number GE-STY-01024, dated December 2017.

The scheme has been examined and this report compiled in respect of the consideration of those matters that have an adverse effect on road safety. It has not been examined or verified for compliance with any other standards or criteria.

The problems identified in this report are considered to require action in order to improve the safety of the scheme for road users.

If any of the recommendations within this safety audit report are not accepted, a written response is required, stating reasons for non-acceptance. Comments made within the report under the heading of Observation are intended to be for information only. Written responses to Observations are not required.

A location map showing where each problem occurs is provided in **Appendix A.**

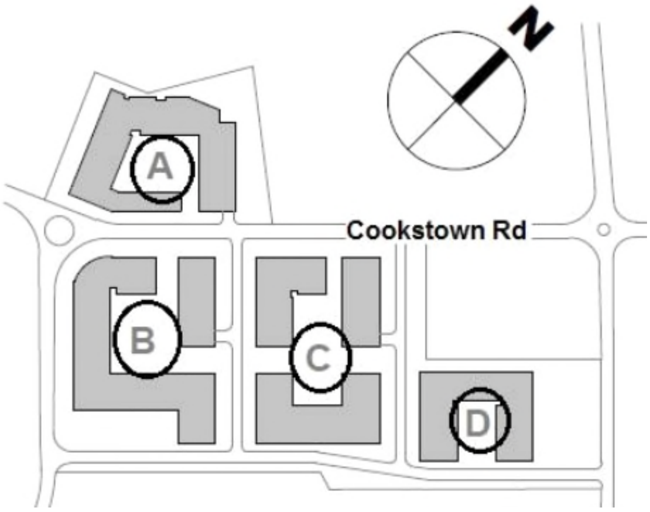
A list of the documents provided to the Audit Team is provided in **Appendix B.**

The feedback form for the Design Team Leader to complete is provided in **Appendix C.**

2.0 Background

It is proposed to construct a high density mixed use residential apartment development with some ancillary commercial uses on the existing commercial/industrial lands between Old Belgard Road and Cookstown Road.

The development will consist of four blocks. The development content for each block is outlined in the table below which has been extracted from the Draft Traffic and Transport Assessment report prepared by NRB Consulting Engineers.



Block A	• 260 Apartments/Duplex Units, • Ancillary Residential Amenity Space, • Under-croft with 72 Car Parking Spaces & Cycle Parking
Block B	• 339 Apartments Units, • Ancillary Residential Amenity Space, • Ancillary Communal Gym Space for Residents, • 641m^2 GFA Retail/Shop at GF Level, • Under-croft with 58 Car Parking Spaces & Cycle Parking
Block C	• 353 Apartments Units, • Ancillary Residential Amenity Space, • Ancillary Communal Crèche Space (272m^2 GFA), • Under-croft with 39 Car Parking Spaces & Cycle Parking
Block D	• 153 Apartments Units, • Ancillary Residential Amenity Space, • 1,922m2 GFA Local Office Space, • 249m^2 GFA Commercial Space • Possible Replacement Garage & Forecourt

A pedestrian link will be provided to Belgard Luas Station.

The Cookstown Industrial Estate is becoming a residential area on a phased basis based on a number of planning applications and based on promotion in the South Dublin Development Plan for the regeneration of older industrial estates along the Luas Corridor.

At the time of the site visit the Belgard Square North – Cookstown Industrial Estate Link Road was under construction. (The same Audit Team, carried out the Stage 1 and Stage 2 RSAs for that scheme.)

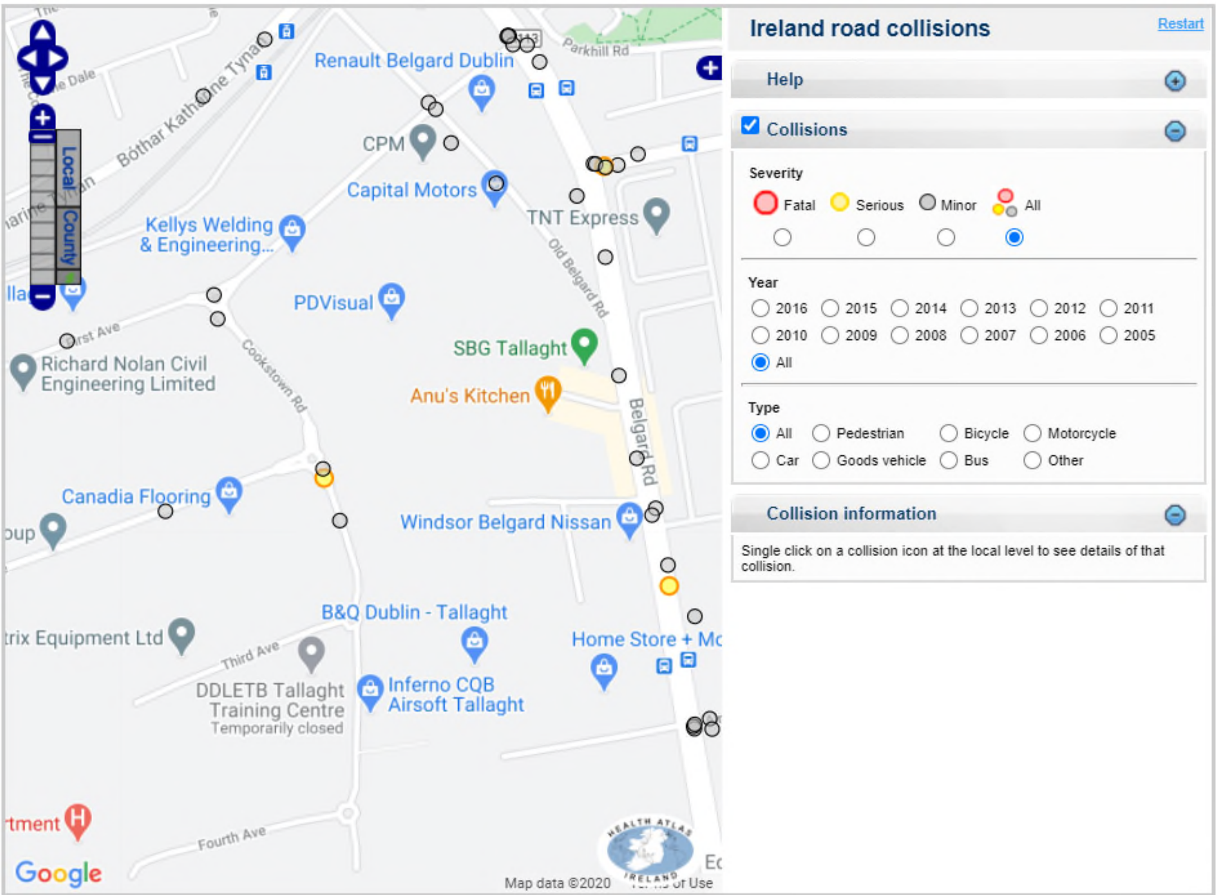
There are high containment kerbs throughout the existing Cookstown Industrial Estate roads which have a dual role of protecting vulnerable road users on the footpaths from errant vehicles and to prevent parking at inappropriate locations. There kerbs will be removed and replaced with standard height (125mm high kerbs)

The speed limit is 50km/hr.

The site location map is shown below.

Image Courtesy of openstreetmap.org

The Road Safety Authority's website www.rsa.ie shows that there have been six minor injury collisions recorded along the roads surrounding the site within the 12 year period 2005 to 2016. One collision on Old Belgard Road involved a pedestrian, another on the same road involved a cyclist. The other 4 collisions involved cars.



3.0 Main Report

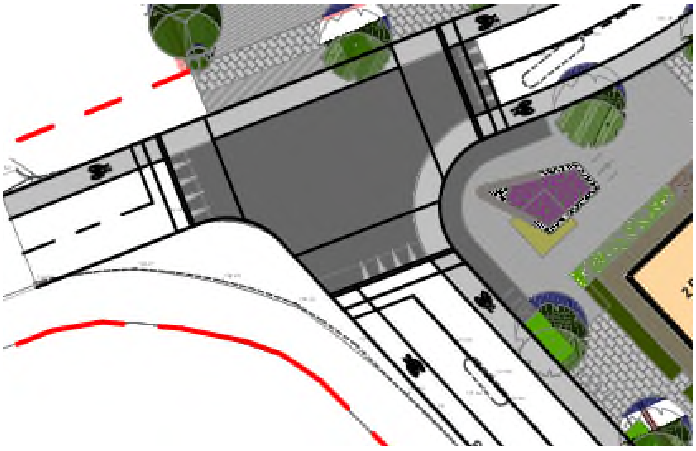
3.1 Problem

Location

Drawing Xref roads 06-08-20

Problem

The regeneration of Cookstown Industrial Estate as a whole may take several years and involve many phases. During this period there will be a shift from industrial traffic to residential traffic including pedestrians and cyclists. The percentage of heavy goods vehicles will be high at first and will decrease as time goes on, subject to the regeneration taking place. There is a risk that during the early stages that the roads network will be redeveloped in line with DMURS but will not be able to cater for heavy goods vehicles turning movements, interaction with cyclists etc. which can result in high severity collisions if they occur.



Recommendation

It is recommended that a routing plan for heavy goods vehicles be developed and signed to remove those vehicles that do not need local access from using the portion of Cookstown Road and Old Belgard Road associated with this development. Temporary layouts at the signalised junctions may be required to facilitate the swept path of heavy goods vehicles. Cyclists in particular should not have to share a space with left turning heavy goods vehicles.

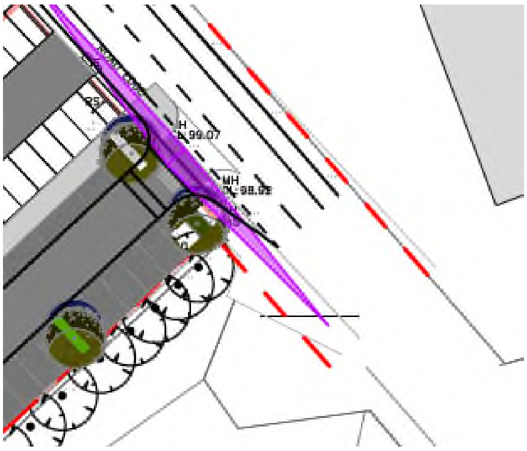
3.2 Problem

Location

Drawing Xref roads 06-08-20

Problem

The speed of vehicles observed travelling northbound on the Old Belgard road appeared to be generally in excess of 50km/hr. This may be due to the slip road type junction off the R113. If the visibility provided to the right for drivers exiting the new road to the south of the site is not sufficient then collisions could occur between exiting vehicles and through traffic.



Recommendation

It is recommended that traffic calming measures are provided to slow northbound traffic on approach to the new junction.

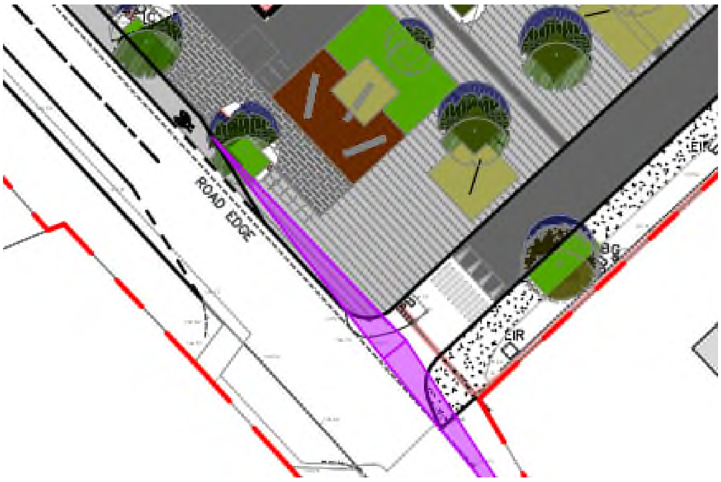
3.3 Problem

Location

Drawing Xref roads 06-08-20

Problem

The proposed cycle track on Cookstown Road terminates before the new southern junction of the site. Cyclists have to merge with general traffic possibly for a short distance before entering the new junction or continuing their journey southbound towards Belgard Square. The lack of cycle facilities at the new junction could lead to collisions between cyclists and turning traffic.



Recommendation

It is recommended that the cycle lane is extended beyond the junction and terminated at a suitable location south of the junction where it can be continued by a subsequent phase of construction without leaving a pinch-point in the future.

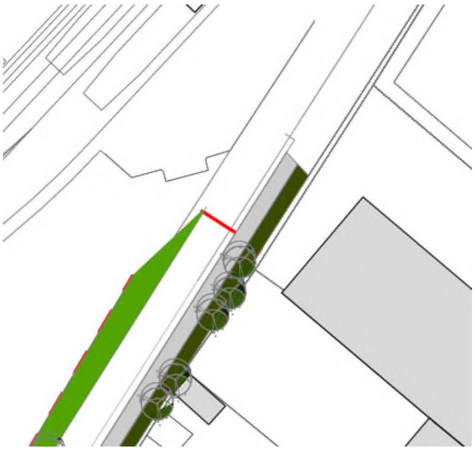
3.4 Problem

Location

Drawing Xref roads 06-08-20

Problem

There is a proposed pedestrian link from Block A to Belgard Luas Station. It was observed during the site visit that there is no access to the station from that end. There is a risk that pedestrians will climb over the railings and fall as they attempt to get to the platforms via the shortest route.



Recommendation

It is recommended that a new access to the station be provided through consultation with TII.

3.5 Problem

Location

Drawing Xref roads 06-08-20

Problem

It is anticipated that there will be a high pedestrian demand across Cookstown Road at the northern side of the site to access the pedestrian link to Belgard Luas station. This may include the mobility impaired such as blind or partially sighted individuals and may also include school children. Without a dedicated crossing point there is a risk of collisions between pedestrians and general traffic.

Recommendation

It is recommended that a controlled pedestrian/toucan crossing be provided at the desire line across Cookstown Road.

4.0 Observations

4.1 Observation

Vertical alignment, drainage, or cross sectional details were not provided to the Audit Team. The drawing was also not scaled and carriageway. Footpath and cycle track/lane dimensions were not provided.

4.2 Observation

Swept paths for HGV, refuse trucks and fire tenders were not provided.

4.3 Observation

Adequate lighting will be needed for the Luas pedestrian link to provide security and safety for users.

5.0 Audit Statement

We certify that we have examined the site and the information provided. The examination has been carried out with the sole purpose of identifying any aspects of the design which could be added, removed or modified in order to improve the safety of the scheme.

The problems identified have been noted in this report together with associated safety improvement suggestions which we would recommend should be studied for implementation. The audit has been carried out by the persons named below who have not been involved in any design work on this scheme as a member of the Design Team.

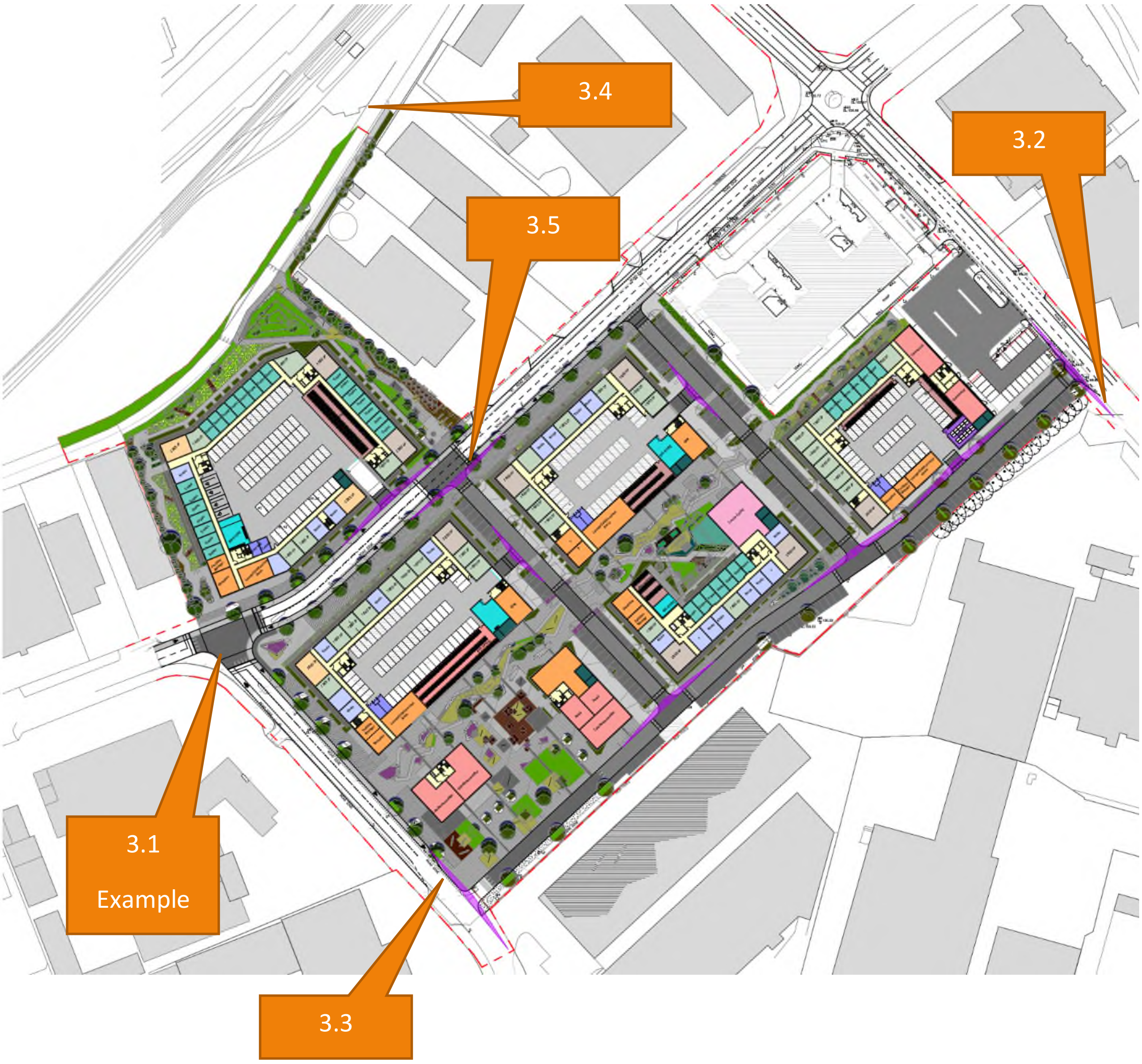
Norman Bruton **Signed:** Norman Bruton

(Audit Team Leader) **Dated: 24/9/2020**

Owen O'Reilly **Signed:** Owen O'Reilly

(Audit Team Member) **Dated: 24/9/2020**

Appendix A – Problem Location Map



Appendix B

Information Supplied to the Audit Team

- Drawing Xref roads 06-08-20

Background Information Supplied to the Audit Team

- Draft TTA, NRB August 2020

Appendix C

Feedback Form

BRUTON CONSULTING ENGINEERS

SAFETY AUDIT FORM – FEEDBACK ON AUDIT REPORT

Scheme: Cookstown Ind Estate

Stage: 1 Road Safety Audit

Date Audit (Site Visit) Completed: 4th September 2020

Paragraph No. in Safety Audit Report	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Alternative measures (describe)	Alternative measures accepted by Auditors (Yes/No)
3.1	Y	Y – The progress of Cookstown regeneration and associated reduction in HGVs to be reviewed at detailed design and construction stage in consultation with SDCC. Road works are designed in accordance with DMURS for this application. A routing plan can be developed through consultation with SDCC as there are other accesses to the estate. Temporary layouts to give more room for HGVs at signals can be developed at detailed design stage in consultation with SDCC if required.		
3.2	Y	Y – sightline is adequate and in accordance DMURS. Traffic calming speed reduction ramp added.		
3.3	Y	Y – Advisory cycle lane extended past the development where it can be continued by a subsequent development of adjacent 3rd party lands.		
3.4	Y	Y – Exact form of pedestrian access to LUAS platform through the railing to be agreed through consultation with relevant parties		
3.5	Y	Y – Controlled Toucan Crossing added as recommended.		

Observations:

4.1 Cycle tracks and footpaths are 2m each in width. All other relevant details (drainage, public lighting etc.) will be provided a detailed design stage.

4.2 Tracks for refuse vehicles and HGV's now attached.

4.3 Noted, and will be provided at detailed design stage.

Signed………………………………… **Date** 24/09/20
Design Team Leader

Signed………………………………… **Date**…………………… 24/9/2020
Audit Team Leader

Signed………………………………… **Date**…………………… 24/9/2020
Employer

APPENDIX H

Preliminary Planning Stage Mobility Management Plan (Travel Plan)

NRB consulting engineers

Preliminary

Travel Plan

(Mobility Management Plan)

Appendix H

For

Multiple Block Residential Apartment Development

on

Lands West of Old Belgard Road and North, South & West of Cookstown Road, Cookstown Industrial Estate, Tallaght, Dublin 24.

SUBMISSION ISSUE

Apollo Buildings, Dundrum Road, Dundrum, Dublin 14.
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Registered in Ireland No. 491679

Contents

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1.0 INTRODUCTION

Preamble….

1.1 NRB Consulting Engineers have been commissioned to prepare a Preliminary Travel Plan in support of an application for the redevelopment of the subject lands within Cookstown Industrial Estate, Tallaght, in order to explain the applicants commitment to the promotion of more sustainable and cost effective travel habits among the end occupiers/residents of the scheme. This report has been prepared conscious of Transportation Planning Policy provisions of the SDCC Development Plan & the Tallaght Local Are Plan (LAP). Pre-Planning discussion and consultation with SDCC Officials in terms of the Local Area Plan requirements have informed the content of this preliminary Mobility Management Plan.

1.2 This document has been subsequently reviewed conscious of the content of the ABP Opinion (Item #2) with Mobility Management Features that support high density residential development added following input from ABP and SDCC Officials (such as the commitment to 16 Go Car Spaces, and the link to Belgard LUAS added, for example).

What is a Travel Plan?

1.3 Originally and elsewhere called Mobility Management Plans (MMPs), they originated in the United States and the Netherlands in the late 1980s. In the US, employers over a certain size (generally over 100 employees) were required to implement 'Trip Reduction Plans' in order to reduce single-occupancy car commuting trips, and to increase car occupancy.

1.4 A MMP or Travel Plan (TP) consists of a package of measures put in place by an organisation to encourage and support more sustainable travel patterns among staff and other visitors. Such a plan usually concentrates on staff commuting patterns. In essence, a TP is useful not only to reduce the attractiveness of private car use, but also for the ability to promote and support the use of more sustainable transport modes such as walking, cycling, shared transport and mass transit such as buses and trains.

Aims and Objectives of this Travel Plan

1.5 The package generally includes measures to promote and improve the attractiveness of using public transport, cycling, walking, car sharing, flexible working or a combination of these as alternatives to single-occupancy car journeys to work. A TP can consider all travel associated with the residential or work site, including business travel, fleet management, customer access and deliveries. It should be considered as a dynamic process where a package of measures and campaigns are identified, piloted and monitored on an on-going basis. This MMP recognises the fact that, for some people, car use is often essential as part of the home to work commute, as the work commute is often combined with other important trips, for example having to drop children to school or crèche on the way.

1.6 The changes which are being sought as part of any plan may be as simple as car sharing one-day per week, or walking on Wednesdays, or taking the bus on days which do not conflict with other commitments, leisure or work activities.

1.7 It is envisaged that once in place, the Travel Plan will enable the following benefits to be realised for the Development:

- Reduced residential car parking demand and reduced congestion on the local road network due to lower demand for private transport and/or more efficient use of private motor vehicles,
- Improved safety for cyclists and pedestrians,
- Direct financial savings for those taking part in the developed initiatives, through higher than average vehicle occupancy rates,
- A reduction in car parking and car set-down demand, resulting in improved operational efficiency and safety for all,
- Improved social networking between all those participating in the shared initiatives,
- Improved environmental consideration and performance,
- Improved public image for the development, which sets an example to the broader community and may lead to residents making better travel decisions in the future,
- Improved health and well-being for those using active non-car transport modes,
- On-going liaison with the Local Authority and public transport providers to maintain, improve, and support transportation services to and from the site,
- Improved attractiveness of the development to prospective residents,
- Optimal levels of safety for all staff and visitors.

Methodology

1.8 As part of this Travel Plan, reference has been made to the following documents:

- Your Step By Step Guide To Travel Plans (NTA 2012);
- Achieving Effective Workplace Travel Plans (NTA 2011);
- Traffic and Transport Assessment Guidelines (TII);
- Traffic Management Guidelines (DoELG, 2003);
- Mobility Management Plans – DTO Advice Note (DTO, 2002);
- The Route to Sustainable Commuting (DTO 2001);
- Smarter Travel: A Sustainable Transport Future (DOT)

1.9 Consultation with key stakeholders is an essential part of any Travel plan. As discussed below, as part of the operational phase of this development, a Travel Plan Coordinator Role will be appointed from with the Management Company. Following on, once occupied, Residents will be asked to complete detailed questionnaires on essential data in relation to their existing travel patterns. This information will be used to inform the ongoing implementation, monitoring and review of the plan for this development.

1.10 This information has been used herein as the basis for the assessment, conclusions and recommendations.

2.0 ACCESS TO THE SITE - BY MODE

2.1 The development consists of the construction of 1,104 apartments, in a series of traditional blocks, on appropriately zoned sites at Cookstown Industrial Estate, Dublin 24. A location plan is shown below as ***Figure 2.1***.

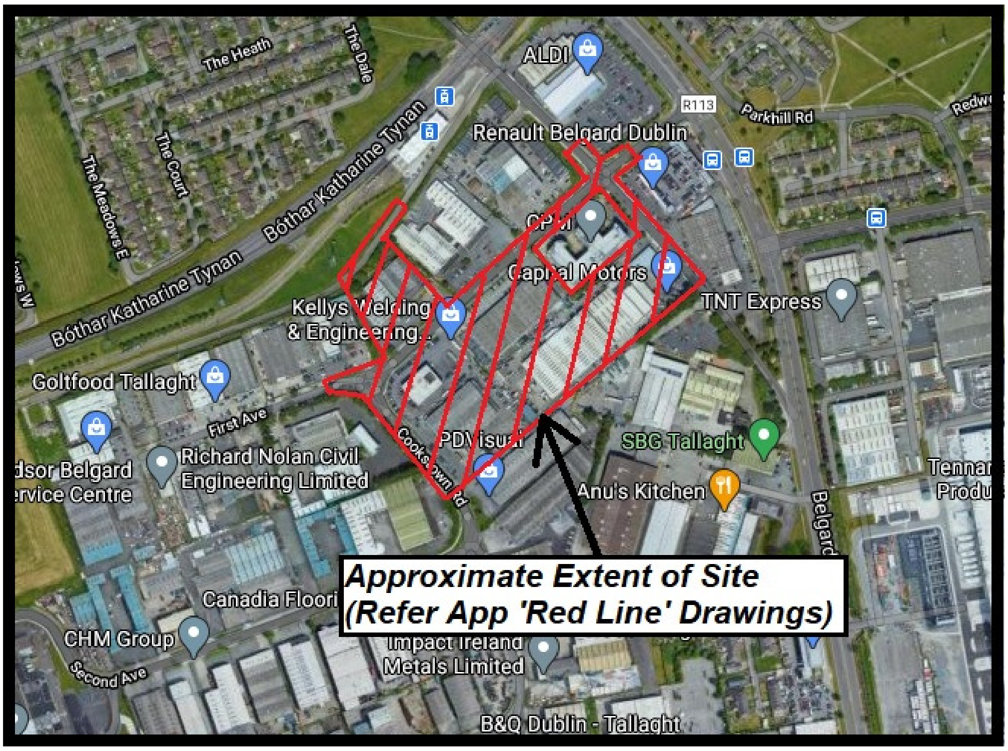

Figure 2.1 – Site(s) Location Map

2.2 The entire of the proposed Residential Development is of the highest quality with attractive living and leisure spaces incorporated into the Masterplan.

2.3 It is essential for the successful Travel Planning to concentrate on journeys associated with work and school commuting patterns. These are the groups which can most practically be encouraged to use modes of transport other than the car. The Tallaght LAP seeks to create a vibrant living residential area and the content and provisions of the MMP support this.

2.4 Notwithstanding this, the development is located in the heart of Tallaght and is in very close proximity to the range of public and alternative transport services in Tallaght, and in particular is immediately adjacent the LUAS, with a new pedestrian link provided.

Pedestrian and Cycling Facilities

2.5 The National Transport Authority (NTA) has surveyed the cycle facilities for the Greater Dublin Area (GDA) as part of the GDA Cycle Network Plan. An extract from this plan showing the facilities is included herein as ***Appendix A***.

2.6 The use and viability of the local services will be enhanced through the encouragement of the use of bicycles and through the demand measurement control of car parking provision.

2.7 Dockless Bicycles, known locally as 'Bleeper Bikes' have been operating in South Dublin County Council since 2017. Similar to the popular Dublin Bikes scheme, the Dockless Bikes initiative provides an accessible, short term bike rental scheme across the area which will help to encourage and facilitate a positive shift to cycling as an alternative to the private car.

2.8 The basis for these schemes is that they have access to rental bikes stored on public cycle parking stands and can return them to other approved public locations for a small fee. This has an advantage over the Dublin bike scheme as it does not require dedicated docking stations to be constructed. It also avoids the frustration and queues which can occur when waiting for a bike to become available and being returned to an empty docking station.

2.9 There are a number of locations permitted to drop off and collect dockless bikes in Tallaght, including many within a short walking distance of the subject sites.

2.10 The key to cycle accessibility is convenient safe links, with secure and carefully sited cycle parking. Cycling is ideal for shorter journeys. A significant amount of work has been carried out in the provision of facilities for Cyclists in SDCC (more that 200km of cycle facilities have been provided to date, and work is ongoing on the N81 and along the Dodder Riverbank to provide improved cycling access to Tallaght generally). The SDCC Development Plan & Tallaght LAP Strategies are to promote cycling and walking in the area and the development complies with these objectives.

2.11 The existing Cycle Infrastructure, which is being continually improved is identified in ***Figure 2.2*** below:

Figure 2.2 Existing Cycle Infrastructure

2.12 The enclosed GDA Cycle Network Plan sets out the proposals for improvements to the existing Cycle Network Plan locally. These are highlighted in ***Figure 2.3*** below

Figure 2.3 - Future Cycle Network

2.13 It is clear that it is proposed that the sites will be bounded by primary, secondary and feeder routes, bordering the development sites directly, thereby creating a high quality network of cycle routes throughout the local area - which will in turn connect to a comprehensive plan for the GDA outside of Tallaght.

2.14 The introduction of Toucan crossing facilities for cyclists at all Traffic Signal Controlled junctions within Tallaght, a scheme which is being rolled out, will further enhance cyclist accessibility and permeability. This will be further enhanced by the planned modernisation of the roads serving the sites within the red line of the application.

2.15 At present, pedestrian/cycle traffic at/to the existing sites are served by an extensive network of high quality footpaths and cycle lanes, outside of Cookstown Estate. The development includes sensible and simple at grade links to these facilities which are immediately adjacent the development.

2.16 The location of the proposed development is ideal in terms of encouraging walking. The proximity to Tallaght IT and Tallaght University Hospital means that walking will be an attractive alternative option for the vast majority of residents. In addition, being located in the heart of Tallaght a short distance from every day services such as Tallaght Town Centre ("The Square") reduces the need to travel and will assist in encouraging walking.

2.17 The SDCC, and National Objective, is to cultivate a walking and cycling culture, through the implementation of appropriate infrastructure and promotional measures, which positively encourages all members of the community to walk or cycle at all life stages and abilities, using modes of sustainable transport that delivers environmental, health and economic benefits to both the individual and the community. This is compliant with the objectives of both the SDCC Development Plan and the Tallaght LAP.

2.18 To help meet the target set in Ireland's first National Cycle Policy Framework launched in April 2009 (that 10% of all journeys will be by bike by 2020), the following will assist:

- Improve cycling conditions on primary cycle routes in the area as per the enclosed details,
- Develop new cycle route/ greenways through parks and open spaces,
- Improve connectivity/permeability from cycle routes to key destinations,
- Provide 30kph zones within residential areas and other suitable locations,
- Provide new secure cycle parking,
- Continue cycle training in schools,
- Ensure that cycling is a key element of all development (which has clearly been incorporated in this case) and
- Monitor trends in cycle numbers using cycle counter data.

2.19 The local infrastructure plans support the 19 specific objectives in the National Cycle Policy Framework. The proposed residential development on the subject sites, through good design, will assist in the promotion of cycling as a primary mode of travel.

2.20 For journeys greater than 8km, it is recognised that a modal shift to cycling could be achievable for some, but not all, and options such as public transport and car sharing should be considered. Journeys up to 8km could be undertaken by bicycle and journeys up to 3-4km could be undertaken by walking or cycling.

Cycle Parking

2.21 The Residential Apartment Guidelines recommends a significantly higher cycle parking requirement that that contained in the SDCC Development Plan. The Guidelines recommend 1 cycle parking stand per Bed-Space, plus 1 spaces per 2 units for visitors – the provision here is consistent with the Apartment Guidelines and is discussed in greater detail in the main body of the TA Report (Paragraphs 2.23 & 2.24).

2.22 It is expected that a very significant number of residents will be willing to cycle to work or to school, if safe links and secure parking are in place, and that is reflected in the provision of large number of dedicated cycle parking spaces over and above the SDCC Cycle Policy requirements and in line with new national Design Standards for Apartments. Once occupied, advice can be provided on routes by the appointed Travel Plan Coordinator, possibly with the help of a bicycle user group. This can be further facilitated in consultation with SDCC, as the ongoing provision of cycle facilities as set out above is fully implemented.

2.23 It is acknowledged that cyclists need to be confident that their cycles will not be tampered with while they are in storage. With this in mind, it is proposed to install the cycle parking with racks which allow both frame and wheels to be secured, and this has been included. These cycle racks are located in an active, well lit & security monitored place or where they can be seen by a security guard, either directly, or by closed circuit television.

Bus Provision

2.24 There are a number of Dublin Bus Stops operating locally, with the closest main stops (or Terminus Points) being located on Belgard square North and Belgard Road. There are several main routes within a 10 minute walk distance of the site and these are detailed in ***Figure 2.4*** below.

Route	***Description***
27	Clare Hall – Jobstown
49	Pearse Street – Tallaght (The Square)
54a	Pearse St. – Ellensborough / Kiltipper Way
56a	Ringsend Rd. – Tallaght (The Square)
65	Poolbeg St. – Blessington / Ballymore
75	The Square Tallaght – Dun Laoghaire
76	Chapelizod – Tallaght (The Square)
76a	Blanchardstown Centre – Tallaght (The Square)
77a	Ringsend Rd. – Citywest

Figure 2.4 - Bus Services within a 10 Minute Walk

2.25 All of the Dublin Bus routes currently passing the development are operated using new low-floor wheelchair accessible city buses. Detail of routes, timetables and fares are provided on www.dublinbus.ie, on the Dublin Bus App, and on the Transport for Ireland National Journey Planner App.

2.26 An additional Map showing the core Dublin Bus routes is included herein as an Appendix.

2.27 The proposed improved CORE Radial Routes which affect the subject development site are as follows:

- Tallaght-Walkinstown-Crumlin (Radial),

- Tallaght-Rathfarnham-Terenure (Radial),
- Dundrum/UCD - Tallaght (Orbital)

Mainline Bus Services Linking Tallaght

2.28 Bus Éireann also has a stop on Belgard Square which is served by Route No 132, linking Dublin Connolly with Bunclody in Co Wexford. Busarus is also accessible via the LUAS Red Line which is on the doorstep. The site is therefore highly accessible to a wide range of national mainline rail services serving all destinations around Ireland, and of course linking to Dublin Airport.

2.29 The ***Airport Hopper*** Tallaght Mini Bus Service operates between The Square Tallaght Town Centre and Dublin Airport, on an approximate hourly basis over the course of the working day.

2.30 Maps and Tables showing Bus Services are included herein and all are easily accessible via Service Provider Apps.

LUAS

2.31 The LUAS Red Line stops (Cookstown & Belgard) are immediately beside the site and high quality improved pedestrian links are provided. LUAS has become a highly successful travel mode linking Tallaght with local areas and onwards to the city centre. It is a semi-segregated light rail tram service operating at street level but generally gets priority over motorised vehicles at junctions. A map extract from the LUAS website, showing the complete network, is included below as ***Figure 2.5***

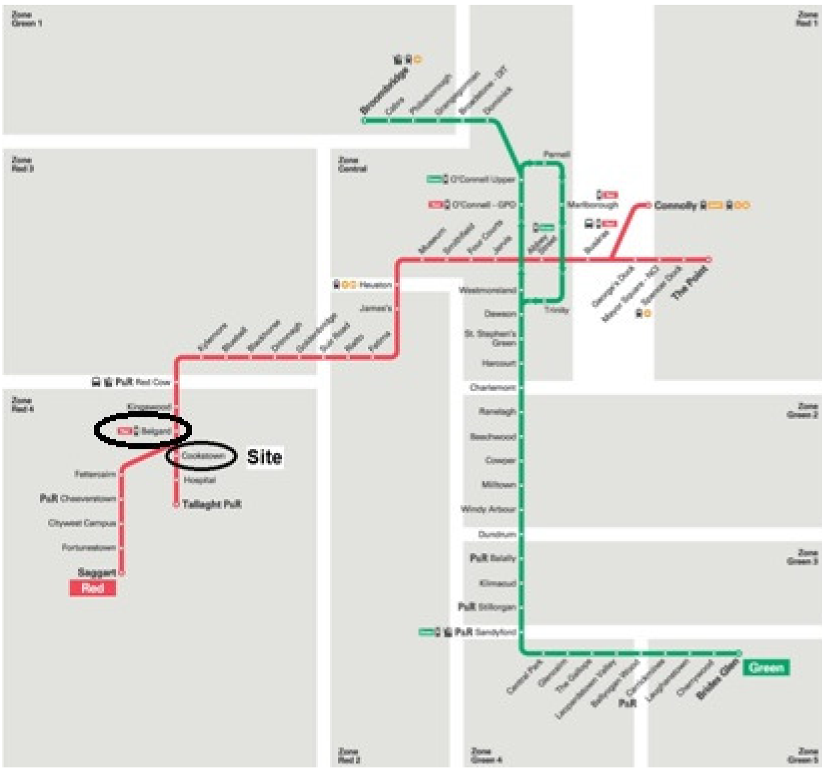

Figure 2.5 - LUAS Services

2.32 The LUAS Red Line serving the site provides a regular service between the 3 Arena/Connolly Station and Tallaght/Saggart with intermediate stops at key locations including Busarus, Heuston Station, Red Cow and City West. The normal day to day operating times are 05:30-24:00

2.33 The recently extended Green Line now provides a good degree of connectivity with the Red Line and their respective stops intersecting at O'Connell Street and Abbey Street. The Green Line provides a service between Sandyford and Broombridge with intermediate stops at St Stephens Green, Westmoreland, Cabra, Phibsborough and Broadstone DIT.

2.34 LUAS runs on a frequency of service which changes depending upon the time of day to adequately cater for demand. The service frequencies for the Local Services are detailed below as ***Figure 2.6***:

Tallaght - Eastbound Towards Connolly or The Point

Monday - Friday	Min	Avg	Max
05:30-07:00	10	14	20
07:00-10:00	3	8	10
10:00-16:00	9	9	10
16:00-19:00	9	9	10
19:00-00:00	6	10	15

Saturday	Min	Avg	Max
06:30-10:00	12	15	20
10:00-16:00	12	12	13
16:00-19:00	10	11	13
19:00-00:00	3	11	15

Sunday & Bank Holidays	Min	Avg	Max
07:00-12:00	10	13	20
12:00-19:00	10	10	11
19:00-23:00	10	11	12

Figure 2.6 - LUAS Service Frequencies

2.35 The LUAS provides excellent connectivity with other rail and DART services including both intercity, commuter and DART services operating out of Heuston Station and Connolly Station - both of which are served by the Red Line LUAS.

2.36 LUAS has the ability to deliver significant increased capacity through a combination of longer carriages/trains and increased frequency of service.

2.37 In terms of number of transport alternatives easily available to Residents, it is considered that the proposed development is very highly sustainable indeed, in terms of public and alternative transport accessibility. The proximity of the development to existing public transport services means that all residents will have viable alternatives to the private car for accessing the site and will not be reliant upon the car as a primary mode of travel.

2.38 Direct and high quality pedestrian linkages are provided between the sites and the existing pedestrian facilities on the surrounding road network. The entrances to the sites will be well lit, so that people can feel secure in using the facilities.

2.39 Public transport maps and timetables can be provided in prominent locations on the sites and the information will be kept up to date by the appointed Travel Plan Coordinator, a role for the Management Company.

2.40 Working Residents are generally now offered the opportunity to purchase public transport commuter tickets under the current ‘Employer Pass’ and ‘TaxSaver’ programmes, by individual Employers. Under these schemes the employer applies to Iarnród Éireann / Bus Éireann for tax free public transport tickets for their employees as an incentive for them to use public transport to travel to work.

2.41 With this in mind, the main focus of this Travel Plan will be to promote and support the use of alternative modes to the private car.

Car Parking

2.42 There are a reduced number of under-croft private car parking spaces provided for, including Go Car, Residential Spaces, mobility impaired and visitor parking. The limited car parking is considered appropriate in light of the location of the proposed development immediately adjacent high quality public transport, the inclusion of on-site services, and in consideration of the provisions of the SDCC Development Plan being "Maximum" standards. The development is also not a traditional residential apartment development, and in this regard the Car Parking requirements are fundamentally different, with anticipated lower car ownership and dependency for this nature of scheme. Given the low number of spaces provided (effectively managed residential spaces, visitor/mobility impaired parking, Go-Car and set down), the entire scheme will be actively marketed and promoted as a "Reduced Car Dependency" scheme and this will be communicated from the outset as part of sales and marketing. The development will also be managed on an on-going basis by the appointed Development Management Company to ensure that the reduced car dependency nature of the development is continually promoted and enhanced.

2.43 Details of the justification of the parking provision are set out in the main body of the Transportation Assessment Report. However, it is clear that the lower provision of car parking will act as a demand management measure, ensuring that the development is accessed in the most sustainable manner, being almost predominantly reliant on non-car modes of travel.

2.44 If considered appropriate, as part of a working MMP, additional priority spaces will in future be allocated to car-sharing workers when they travel together, with 10 'Go-Car' currently planned. These are some of the most accessible spaces and are clearly visible to other car park users. It is acknowledged that this may require some level of ‘policing’.

Electric Vehicle Charging

2.45 The car parking spaces will be designed so that they can easily be upgraded to allow conversion for Electric Vehicles. The entire car park of the subject scheme can be ducted to accept cabling to serve a charging point for every car space. Conduits can be run on the walls or underground, and charging points can also be retro-mounted. Where residents request a charging point to be installed, the relevant charging point can be pre-wired back to their home electricity meter in the designated meter location. The socket point will have a lockable cover on it so that only that resident may use the power point. This provision around the parking area allows future charging points to be installed at any of the car parking spaces with minimum works as and when required.

3.0 COLLECTION OF BASELINE INFORMATION

Possible Travel Pattern Questionnaires

3.1 The Redevelopment is a proposed high quality residential development in the centre of Tallaght. The development has capacity for in excess of 2,000 people when fully occupied (1,641 bedrooms in the 1,104 apartments).

3.2 Once occupied, and when the Travel Plan Coordinator is appointed, the occupiers of the proposed development will be encouraged to continually monitor the Travel Plan initiatives in order to maximise on their success.

3.3 Shortly after occupation of the new development, a detailed travel-questionnaire will likely be complied and distributed to Residents for completion. The aim of the travel questionnaire will be to establish travel patterns between work and home and school travel demand. The information gathered from this survey will be used to inform the further development of the Travel Plan.

3.4 The Baseline Survey information will also allow the Travel Plan Coordinator for the development to set realistic modal-split targets for the development.

3.5 It is anticipated that, given the very-much town centre location and good transport links at this development, combined with the reduced and managed levels of car parking on site, there will be a high percentage of use via public and alternative transport. The Travel Plan will need to maintain this positive modal split and improve it, where possible. It is informative to note that the "Smarter Travel: A Sustainable Transport Future" (DOT) Objective for 2020 is to achieve a reduced work related commuting by car modal share of 65% to 45%.

3.6 The Travel Plan is not seeking a radical change in terms of a modal shift; it is recognised that the use of the car is often essential for many users. Instead, the Plan seeks small but consistent increments of change in our approach to, and the use of, alternatives to the car.

4.0 THE TRAVEL PLAN

4.1 The successful implementation of a Travel Plan will ensure that, in-so-far-as-possible, the impacts of this traffic are reduced and minimised where practical, while providing a number of environmental and economic advantages detailed below.

4.2 The following sub-sections detail the available initiatives which will serve to better manage travel demand, and therefore the traffic impact of work-related journeys, focused on the movement of residents during peak times.

Walking

Walking - Key Information	
Approx Zone of Influence	3.5km
Percentage of Residents working in area of influence	TBC in each survey when occupied
Percentage of Residents interested in Walking	TBC in each survey when occupied

Table 4.1 – Key Information: Walking

4.4 There are many local, global, and personal benefits to walking to work, a few of which are listed following:

- **W** - Wake Up! - Studies have shown that people who walk to work are more awake and find it easier to concentrate.
- **A** - Always one step ahead - Walking makes people more aware of road safety issues and helps them develop stronger personal safety skills.
- **L** - Less congestion - If you leave the car at home and walk, there are fewer cars on the road which makes it safer for those who walk and cycle.
- **K** - Kinder to the environment - By leaving the car at home you are reducing the amount of CO 2 produced and helping to reduce the effects of climate change and air pollution.
- **I** - Interpersonal skills - Walking to work or school can be a great way to meet other walkers, share the experience, and develop personal skills.
- **N** - New adventures - Walking to work or school is a great way to learn about your local environment and community. It’s also a fun way to learn about the weather, landscape, and local ecosystems.
- **G** - Get fit and stay active - Walking to and from work or school helps people incorporate physical activity into their daily routines. Research shows that regular physical activity can benefit your body and mind.

4.5 Most adults will consider walking a maximum of 3.5 km (Approx 30/40 minutes) to work. Residents working within a 3.5 km radius of the site will be encouraged to walk to work as often as their schedule permits. Similarly school trips can be encouraged on foot.

4.6 The following initiatives and incentives can be used to encourage walking to work or school:

- Take part in a 'Pedometer Challenge' which is organised through the Irish Heart Foundation or Smarter Travel Workplaces;
- Organise special events such as a 'Walk to work/school on Wednesdays' where participants are rewarded for their participation;;
- Keep umbrellas in public areas on a deposit system for use when raining;
- Display Smarter Travel Workplaces Accessibility Walking maps on notice boards areas so Residents can plan journeys;
- Organise lunch time or afternoon walks as part of a health and well-being programme;
- Highlight the direct savings gained due to reduced use of private vehicles.

Cycling

Cycling – Key Information	
Approx. zone of influence	10km
Percentage of Residents Surveyed known to Work within the area of influence	TBC in each survey when occupied
Percentage of Residents interested in cycling	TBC in each survey when occupied

Table 4.2 : Key Information - Cycling

4.7 Research suggests that cycling is a viable mode of transport for people who live up to 10 km from work or school.

4.8 Cycling is a great way to travel. It helps foster independence, raises awareness of road safety, and helps the environment.

4.9 Some positive aspects of cycling to work or school are listed following:

- **C** - Cycling is fun! - Cycling is a great form of transport but it's also a great recreational activity. Cycling is a skill that stays with you for life and it's a fantastic way to explore your local community.
- **Y** - You save time & money - cycling to work reduces the need to travel by car thus reducing fuel costs and freeing up road space for more cyclists;
- **C** - Confidence building - travelling to work as an independent cyclist can give

people increased confidence proving beneficial in all aspects of life;

- **L** - Less congestion - If you leave the car at home and cycle to work there are fewer cars on the road which makes it safer for those who cycle and walk to work or school;
- **I** - Interpersonal skills - Cycling to work or to school can be a great way to meet other cyclists and share the experience;
- **N** - New adventures - Cycling to work or school is a great way to learn about your local environment and community. It helps people to understand where they live and how their actions affect their local environment;
- **G** - Get fit and stay active - cycling to and from work or school helps people incorporate physical activity into their daily routines. Research shows that regular physical activity can benefit your body and mind.

4.10 The provision of enhanced and attractive cycle parking facilities at the site will clearly play a critical role in promoting journeys by bicycle.

4.11 The following initiatives and incentives can be used to encourage cycling to work and school:

- New cycle parking installed within the development, secure and well lit;
- It will publicise cycle parking availability by way of signage and on notice boards;
- It will display maps on notice boards areas so people can plan journeys;
- The development can provide free cycle accessories (panniers, lights, visi-vests, helmets) in periodic draws for cyclists,
- The Travel Plan Coordinator can organise cycle training sessions on site on the rules of the road and the specific risks associated with the locality;
- The Travel Plan Coordinator can invite bike suppliers on site for a ‘Green Day’ or ‘Green Week’ so that people can try bikes before buying;
- The Travel Plan Coordinator can set up a Bicycle User Group (BUG) to promote cycling;
- The Travel Plan Coordinator can highlight the direct savings gained due to reduced use of private vehicles;
- The Travel Plan Coordinator can encourage residents to take part in National Bike Week, see www.bikeweek.ie.

Public Transport

Public Transport – Key Information	
Approx. zone of influence	All Residents
Percentage of Residents in area of influence	100%
Percentage of Residents using Public Transport	TBC in each survey when occupied

Table 4.3: Key Information: Public Transport

4.12 There are many benefits to taking public transport, some of which include:

- Personal Opportunities – Public transportation provides personal mobility and freedom;
- Saving fuel – Every full standard bus can take more than 50 cars off the road, resulting in fuel savings from reduced congestion;
- Reducing congestion – The more people who travel to work or to school on public transport, especially during peak periods, the less people travelling by private car;
- Saving money – Taking public transport to and from work or school is a lot cheaper than travelling by car and saves the cost of buying, maintaining and running a vehicle;
- Reducing fuel consumption – A full standard bus uses significantly less fuel per passenger than the average car;
- Reducing carbon footprint – Public transport is at least twice as energy efficient as private cars. Buses produce less than half the CO_2 emissions per passenger kilometre compared to cars and a full bus produces 377 times less carbon monoxide than a full car;
- Get fit and stay active - Walking to and from work or school to public transport helps people incorporate physical activity into their daily routines. Research shows that regular physical activity can benefit your body and mind.
- Less stress – Using public transport can be less stressful than driving yourself, allowing you to relax, read, or listen to music.

4.13 The following initiatives and incentives can be used by the Development Management Company at Occupation Stage to encourage people to take public transport:

- Publicise Employee Tax Saver Commuter tickets, which offer savings to employers in PSRI per ticket sold and significant savings to employees in marginal tax rate and levies on the price of their ticket;
- Encourage public transport use for travel by promoting smart cards, advertising the availability of these tickets to Residents;
- Publicise the availability of Real Time Information. Real Time Information shows when your bus is due to arrive at your bus stop so you can plan your journey more accurately;
- Provide maps of local bus routes and the nearest bus stops, LUAS Timetables and Frequencies, and the length of time it takes to walk to them;
- Contact local providers about issues such as location of existing and new bus stops, timing of routes, or where you have market information about a potential new route.

Go-Car/Car Sharing

Car Sharing – Key Information	
Approx. zone of influence	All Residents
Percentage of Residents in area of influence	100%
Percentage of Residents Car Sharing	TBC in each survey when occupied

Table 4.4: Key Information - Go-Car/Car Sharing

4.14 Every day thousands of commuters drive to work or to school on the same routes to the same destinations, at the same time as their colleagues. By car sharing just once a week, a commuter's fuel costs can be reduced by 20%, and in a similar fashion, the demand for work place parking can be reduced by 20%. If every single-occupancy driver carried another driver, there would be 50% less cars on the road at peak times.

4.15 Although use of the car to get to work or to school is essential for a large proportion of people, car sharing schemes have the potential to deliver a significant reduction in private vehicle trips by promoting higher than average occupancy rates for each vehicle.

4.16 A locally run car sharing scheme relies on a database containing workplace information, working hours, and peoples preferences such as gender/driver/passenger and their preferred route to and from work. This will be incorporated into the role for the Development Management Co.

4.17 The car-sharing database can be a map showing where Residents work, a database of car-sharers' details hosted on an organisations intranet site, or an on map-based matching website.

4.18 Car sharing often happens informally, however some participants often prefer a formal scheme such as a go Car facility which will normally generate a higher take-up for car sharing, and more efficiency in terms of increased occupancy rates. Car sharing is much easier promoted within a community such as is proposed here, and will be done by the Development Management Co.

4.19 Encouraging more Residents to share car journeys to work rather than driving alone as well as encouraging more to set up and take part in car sharing/pooling would prove a very effective means of reducing daily car trips to and from the site.

4.20 The following initiatives and incentives can be used to encourage car sharing:

- Provide incentives to sign up to a car sharing scheme with preferential parking spaces in the most convenient location;
- Draw up a car-sharing policy for how the scheme will operate, and issue car-

sharing permits to those qualifying to use the car-sharing spaces;

- Highlight to drivers that they do not have to share with a person that doesn't suit them – allow choice based on gender, route, smoking or non-smoking;
- Clarify the financial implications of the scheme – those accepting a lift could contribute towards fuel costs.
- Use existing online databases for car sharing. For example, the development could set up its own private car sharing site using www.carsharing.ie.
- Allocate parking spaces for use solely by car sharers, for example near to building entrances.

Action Plan Summary Table

4.25 The Summary Action Plan is described in the Table below. Modal Split Targets will be determined following on from the first Residential survey shortly after full occupation, typically within the first six months. This will be part of the role of the Travel Plan Coordinator, within the remit of the Development Management Company. This will show existing travel patterns with realistic targets set to improve the modal split of Residents.

	Initiative	Impact on Delivery	Difficulty Delivering	Current Modal Split	Target MS
Residents Initiatives	Walking	Medium	Low	TBC	TBC
	Cycling	Medium	Medium	TBC	TBC
	Public Transport	High	Low	TBC	TBC
	Other	Medium	Medium	TBC	TBC
	Car - Sharing	Medium	Medium	TBC	TBC
	Cars - 1 Passenger Only	High - Negative	High	TBC	TBC
Promoting the TP	Marketing the Plan	High	Low	Driven By TP Coordinator	
	Measuring Success	High	Medium	Annual Surveys	

Action Plan Summary Table

5.0 IMPLEMENTING THE PLAN

Background

5.1 Setting realistic targets and a sustained approach to the promotion of the Travel Plan is important if the measures are to be successful. The objectives and benefits of the Plan will be made clear and broadcast during the full lifecycle of the Plan.

5.2 The implementation of a successful Travel plan will require the upfront investment of resources. As well as reviewing objectives and initiatives regularly, it is equally important to measure results. This provides an indication of any Plan's success, and ensures that the targets remain realistic.

The Travel Plan Coordinator

5.4 The key objective of this Travel Plan is to ensure that the traffic impacts and car usage associated with the operation of Redevelopment are minimised. Achieving this objective will result in a wide array of benefits for the development and its stakeholders.

5.5 To ensure the plan is effective it is essential for a Travel Plan Coordinator to be appointed for the Development upon 100% occupation.

5.6 It is envisaged that the Coordinator will work closely with residents to enthusiastically promote and market the Travel Plan. As Residents will be the focus of the plan; their involvement must be sought from the outset.

5.7 To support the Travel Plan Coordinator's efforts, the Management Company must ensure that they have sufficient time to carry out their duties. In addition, it is essential that the powers of decision making are bestowed upon him/her, along with a suitable budget and programme for implementation.

Promoting the Travel Plan

5.9 Active promotion and marketing is needed if the Travel Plan is to have a positive impact on stakeholder travel patterns to and from the site.

5.10 All marketing initiatives should be focused on areas where there is willingness to change. Such information has been extracted from the questionnaires and has been described in Section 3 of this Plan.

- **Identify the Aim** – e.g. to reduce low occupancy car commuting, school, and business travel & to promote active travel, public transport & alternatives to travelling by car.
- **Brand the Plan** – as part of communicating the Travel Plan, visually brand all work relating to it with a consistent look, slogan, identity or logo.

- **Identify the Target Audience** – 'segment the audience' (e.g. shift workers, school travel, sedentary workers, people travelling long/ short distances, mode used, members of a walking club or green team) so you can target the message and events towards these different groups.

5.11 As part of the marketing process, the Travel Plan coordinator can personalise a plan for the Development, drawing attention to the benefits of participation and support for its implementation.

5.12 The Coordinator can identify communication tools and networks used by the different audiences in the Residences, and use these to communicate about travel.

5.13 Promotional material regardless of its quality is only as good as its distribution network; material incentives assist greatly in introducing people to alternative modes of commuting.

5.14 The plan should not be anti-car - it should be about promoting equity among modes and offering choice and accessibility.

5.15 The Coordinator can promote positive messages associated with a plan, for example, reduced tax/PRSI payments, getting fit and active, reducing congestion, reducing CO_2 emissions and so on, and encourage people to start small – changing one day per week for example, to explore their options.

5.16 Marketing drives which feature individual Residents who have reduced their car use can carry a strong message. This will serve to raise not only the profile of the Plan, but also send a clear message in relation to the Residents commitment to the Plan.

6.0 CONCLUSIONS

6.1 The development forming the subject of this application accords with the principles of sustainable development, being located within an established town centre within clear and easy access to alternative modes of travel, and with very little car parking provided acting as a further demand management measure . The Management Company, once the development is occupied, will utilise pragmatic measures that encourage safe and viable alternatives to the private car for accessing the development.

6.2 Good Travel Planning is not a one-off event, it is instead an on-going iterative process requiring continued effort. This Preliminary report assists these efforts by forming an outline framework and providing guidance for its success. Monitoring and reviewing the initiatives set out within the plan will form a far greater part of the Final Travel Plan itself.

6.3 The key to the Plans success will be the appointment of a ***Travel Plan Coordinator*** for the development, once occupied, a role which will be part of the Development Management Company responsibilities. They will be vested with total responsibility for implementing the plan. They should be granted the authority and time to execute the Plan, and be provided with sufficient resources to realise the Plans success.

6.4 As Residents are the focus of the plan; their involvement should be sought from the outset following occupation. To this end, the Plan Coordinator should be assisted and supported by the Management Company and Residents. This will serve to spread the work load, and also give the Residents a valuable input into the operation of the Plan.

6.5 Successful Travel Plans require extensive marketing **and** regular review. The measures set out in the Action Plan Summary Table (Chapter 4) should form the basis of a sound, realistic Plan and should be clearly set out and be fully transparent to all users.

6.6 Residents also have an essential responsibility in terms of co-operating with, and taking an active part in the plan. They are, after all, the plan's primary focus.

6.7 It is recommended that the Final Travel Plan be set in motion at full occupation. The plan should evolve and develop with the development, taking into account changing Residents and their travel preferences and needs.

6.8 Annual reviews of the Plan should include a full stakeholder survey, providing valuable information for target setting and marketing target groups. It is emphasised that failing to meet initial targets should not be seen as failure, as the preliminary 12 to 18 months of the plan should be viewed as a calibration exercise for target setting.

NRB consulting engineers

Preliminary

Travel Plan

(Mobility Management Plan)

Appendix H

For

Multiple Block Residential Apartment Development

on

Lands West of Old Belgard Road and North, South & West of Cookstown Road, Cookstown Industrial Estate, Tallaght, Dublin 24.

SUBMISSION ISSUE

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Registered in Ireland No. 491679

Contents

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1.0 INTRODUCTION

Preamble….

1.1 NRB Consulting Engineers have been commissioned to prepare a Preliminary Travel Plan in support of an application for the redevelopment of the subject lands within Cookstown Industrial Estate, Tallaght, in order to explain the applicants commitment to the promotion of more sustainable and cost effective travel habits among the end occupiers/residents of the scheme. This report has been prepared conscious of Transportation Planning Policy provisions of the SDCC Development Plan & the Tallaght Local Are Plan (LAP). Pre-Planning discussion and consultation with SDCC Officials in terms of the Local Area Plan requirements have informed the content of this preliminary Mobility Management Plan.

1.2 This document has been subsequently reviewed conscious of the content of the ABP Opinion (Item #2) with Mobility Management Features that support high density residential development added following input from ABP and SDCC Officials (such as the commitment to 16 Go Car Spaces, and the link to Belgard LUAS added, for example).

What is a Travel Plan?

1.3 Originally and elsewhere called Mobility Management Plans (MMPs), they originated in the United States and the Netherlands in the late 1980s. In the US, employers over a certain size (generally over 100 employees) were required to implement 'Trip Reduction Plans' in order to reduce single-occupancy car commuting trips, and to increase car occupancy.

1.4 A MMP or Travel Plan (TP) consists of a package of measures put in place by an organisation to encourage and support more sustainable travel patterns among staff and other visitors. Such a plan usually concentrates on staff commuting patterns. In essence, a TP is useful not only to reduce the attractiveness of private car use, but also for the ability to promote and support the use of more sustainable transport modes such as walking, cycling, shared transport and mass transit such as buses and trains.

Aims and Objectives of this Travel Plan

1.5 The package generally includes measures to promote and improve the attractiveness of using public transport, cycling, walking, car sharing, flexible working or a combination of these as alternatives to single-occupancy car journeys to work. A TP can consider all travel associated with the residential or work site, including business travel, fleet management, customer access and deliveries. It should be considered as a dynamic process where a package of measures and campaigns are identified, piloted and monitored on an on-going basis. This MMP recognises the fact that, for some people, car use is often essential as part of the home to work commute, as the work commute is often combined with other important trips, for example having to drop children to school or crèche on the way.

1.6 The changes which are being sought as part of any plan may be as simple as car sharing one-day per week, or walking on Wednesdays, or taking the bus on days which do not conflict with other commitments, leisure or work activities.

1.7 It is envisaged that once in place, the Travel Plan will enable the following benefits to be realised for the Development:

- Reduced residential car parking demand and reduced congestion on the local road network due to lower demand for private transport and/or more efficient use of private motor vehicles,
- Improved safety for cyclists and pedestrians,
- Direct financial savings for those taking part in the developed initiatives, through higher than average vehicle occupancy rates,
- A reduction in car parking and car set-down demand, resulting in improved operational efficiency and safety for all,
- Improved social networking between all those participating in the shared initiatives,
- Improved environmental consideration and performance,
- Improved public image for the development, which sets an example to the broader community and may lead to residents making better travel decisions in the future,
- Improved health and well-being for those using active non-car transport modes,
- On-going liaison with the Local Authority and public transport providers to maintain, improve, and support transportation services to and from the site,
- Improved attractiveness of the development to prospective residents,
- Optimal levels of safety for all staff and visitors.

Methodology

1.8 As part of this Travel Plan, reference has been made to the following documents:

- Your Step By Step Guide To Travel Plans (NTA 2012);
- Achieving Effective Workplace Travel Plans (NTA 2011);
- Traffic and Transport Assessment Guidelines (TII);
- Traffic Management Guidelines (DoELG, 2003);
- Mobility Management Plans – DTO Advice Note (DTO, 2002);
- The Route to Sustainable Commuting (DTO 2001);
- Smarter Travel: A Sustainable Transport Future (DOT)

1.9 Consultation with key stakeholders is an essential part of any Travel plan. As discussed below, as part of the operational phase of this development, a Travel Plan Coordinator Role will be appointed from with the Management Company. Following on, once occupied, Residents will be asked to complete detailed questionnaires on essential data in relation to their existing travel patterns. This information will be used to inform the ongoing implementation, monitoring and review of the plan for this development.

1.10 This information has been used herein as the basis for the assessment, conclusions and recommendations.

2.0 ACCESS TO THE SITE - BY MODE

2.1 The development consists of the construction of 1,104 apartments, in a series of traditional blocks, on appropriately zoned sites at Cookstown Industrial Estate, Dublin 24. A location plan is shown below as ***Figure 2.1***.

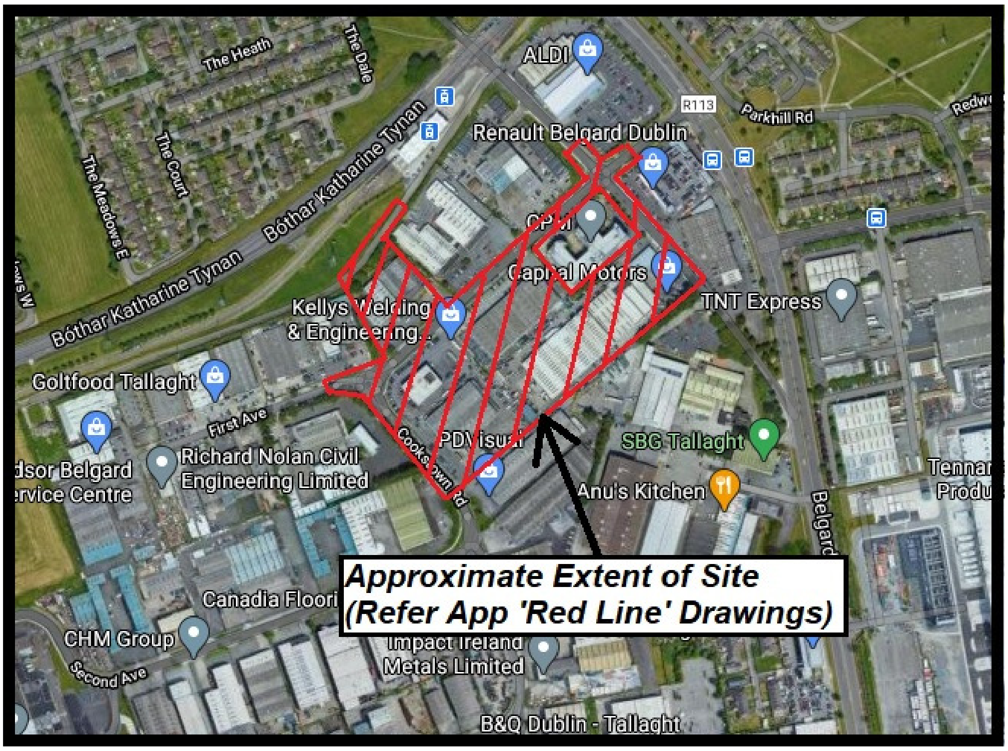


Figure 2.1 – Site(s) Location Map

2.2 The entire of the proposed Residential Development is of the highest quality with attractive living and leisure spaces incorporated into the Masterplan.

2.3 It is essential for the successful Travel Planning to concentrate on journeys associated with work and school commuting patterns. These are the groups which can most practically be encouraged to use modes of transport other than the car. The Tallaght LAP seeks to create a vibrant living residential area and the content and provisions of the MMP support this.

2.4 Notwithstanding this, the development is located in the heart of Tallaght and is in very close proximity to the range of public and alternative transport services in Tallaght, and in particular is immediately adjacent the LUAS, with a new pedestrian link provided.

Pedestrian and Cycling Facilities

2.5 The National Transport Authority (NTA) has surveyed the cycle facilities for the Greater Dublin Area (GDA) as part of the GDA Cycle Network Plan. An extract from this plan showing the facilities is included herein as ***Appendix A***.

2.6 The use and viability of the local services will be enhanced through the encouragement of the use of bicycles and through the demand measurement control of car parking provision.

2.7 Dockless Bicycles, known locally as 'Bleeper Bikes' have been operating in South Dublin County Council since 2017. Similar to the popular Dublin Bikes scheme, the Dockless Bikes initiative provides an accessible, short term bike rental scheme across the area which will help to encourage and facilitate a positive shift to cycling as an alternative to the private car.

2.8 The basis for these schemes is that they have access to rental bikes stored on public cycle parking stands and can return them to other approved public locations for a small fee. This has an advantage over the Dublin bike scheme as it does not require dedicated docking stations to be constructed. It also avoids the frustration and queues which can occur when waiting for a bike to become available and being returned to an empty docking station.

2.9 There are a number of locations permitted to drop off and collect dockless bikes in Tallaght, including many within a short walking distance of the subject sites.

2.10 The key to cycle accessibility is convenient safe links, with secure and carefully sited cycle parking. Cycling is ideal for shorter journeys. A significant amount of work has been carried out in the provision of facilities for Cyclists in SDCC (more that 200km of cycle facilities have been provided to date, and work is ongoing on the N81 and along the Dodder Riverbank to provide improved cycling access to Tallaght generally). The SDCC Development Plan & Tallaght LAP Strategies are to promote cycling and walking in the area and the development complies with these objectives.

2.11 The existing Cycle Infrastructure, which is being continually improved is identified in ***Figure 2.2*** below:

Figure 2.2 Existing Cycle Infrastructure

2.12 The enclosed GDA Cycle Network Plan sets out the proposals for improvements to the existing Cycle Network Plan locally. These are highlighted in ***Figure 2.3*** below

Figure 2.3 - Future Cycle Network

2.13 It is clear that it is proposed that the sites will be bounded by primary, secondary and feeder routes, bordering the development sites directly, thereby creating a high quality network of cycle routes throughout the local area - which will in turn connect to a comprehensive plan for the GDA outside of Tallaght.

2.14 The introduction of Toucan crossing facilities for cyclists at all Traffic Signal Controlled junctions within Tallaght, a scheme which is being rolled out, will further enhance cyclist accessibility and permeability. This will be further enhanced by the planned modernisation of the roads serving the sites within the red line of the application.

2.15 At present, pedestrian/cycle traffic at/to the existing sites are served by an extensive network of high quality footpaths and cycle lanes, outside of Cookstown Estate. The development includes sensible and simple at grade links to these facilities which are immediately adjacent the development.

2.16 The location of the proposed development is ideal in terms of encouraging walking. The proximity to Tallaght IT and Tallaght University Hospital means that walking will be an attractive alternative option for the vast majority of residents. In addition, being located in the heart of Tallaght a short distance from every day services such as Tallaght Town Centre ("The Square") reduces the need to travel and will assist in encouraging walking.

2.17 The SDCC, and National Objective, is to cultivate a walking and cycling culture, through the implementation of appropriate infrastructure and promotional measures, which positively encourages all members of the community to walk or cycle at all life stages and abilities, using modes of sustainable transport that delivers environmental, health and economic benefits to both the individual and the community. This is compliant with the objectives of both the SDCC Development Plan and the Tallaght LAP.

2.18 To help meet the target set in Ireland's first National Cycle Policy Framework launched in April 2009 (that 10% of all journeys will be by bike by 2020), the following will assist:

- Improve cycling conditions on primary cycle routes in the area as per the enclosed details,
- Develop new cycle route/ greenways through parks and open spaces,
- Improve connectivity/permeability from cycle routes to key destinations,
- Provide 30kph zones within residential areas and other suitable locations,
- Provide new secure cycle parking,
- Continue cycle training in schools,
- Ensure that cycling is a key element of all development (which has clearly been incorporated in this case) and
- Monitor trends in cycle numbers using cycle counter data.

2.19 The local infrastructure plans support the 19 specific objectives in the National Cycle Policy Framework. The proposed residential development on the subject sites, through good design, will assist in the promotion of cycling as a primary mode of travel.

2.20 For journeys greater than 8km, it is recognised that a modal shift to cycling could be achievable for some, but not all, and options such as public transport and car sharing should be considered. Journeys up to 8km could be undertaken by bicycle and journeys up to 3-4km could be undertaken by walking or cycling.

Cycle Parking

2.21 The Residential Apartment Guidelines recommends a significantly higher cycle parking requirement that that contained in the SDCC Development Plan. The Guidelines recommend 1 cycle parking stand per Bed-Space, plus 1 spaces per 2 units for visitors – the provision here is consistent with the Apartment Guidelines and is discussed in greater detail in the main body of the TA Report (Paragraphs 2.23 & 2.24).

2.22 It is expected that a very significant number of residents will be willing to cycle to work or to school, if safe links and secure parking are in place, and that is reflected in the provision of large number of dedicated cycle parking spaces over and above the SDCC Cycle Policy requirements and in line with new national Design Standards for Apartments. Once occupied, advice can be provided on routes by the appointed Travel Plan Coordinator, possibly with the help of a bicycle user group. This can be further facilitated in consultation with SDCC, as the ongoing provision of cycle facilities as set out above is fully implemented.

2.23 It is acknowledged that cyclists need to be confident that their cycles will not be tampered with while they are in storage. With this in mind, it is proposed to install the cycle parking with racks which allow both frame and wheels to be secured, and this has been included. These cycle racks are located in an active, well lit & security monitored place or where they can be seen by a security guard, either directly, or by closed circuit television.

Bus Provision

2.24 There are a number of Dublin Bus Stops operating locally, with the closest main stops (or Terminus Points) being located on Belgard square North and Belgard Road. There are several main routes within a 10 minute walk distance of the site and these are detailed in ***Figure 2.4*** below.

Route	***Description***
27	Clare Hall – Jobstown
49	Pearse Street – Tallaght (The Square)
54a	Pearse St. – Ellensborough / Kiltipper Way
56a	Ringsend Rd. – Tallaght (The Square)
65	Poolbeg St. – Blessington / Ballymore
75	The Square Tallaght – Dun Laoghaire
76	Chapelizod – Tallaght (The Square)
76a	Blanchardstown Centre – Tallaght (The Square)
77a	Ringsend Rd. – Citywest

Figure 2.4 - Bus Services within a 10 Minute Walk

2.25 All of the Dublin Bus routes currently passing the development are operated using new low-floor wheelchair accessible city buses. Detail of routes, timetables and fares are provided on www.dublinbus.ie, on the Dublin Bus App, and on the Transport for Ireland National Journey Planner App.

2.26 An additional Map showing the core Dublin Bus routes is included herein as an Appendix.

2.27 The proposed improved CORE Radial Routes which affect the subject development site are as follows:

- Tallaght-Walkinstown-Crumlin (Radial),

- Tallaght-Rathfarnham-Terenure (Radial),
- Dundrum/UCD - Tallaght (Orbital)

Mainline Bus Services Linking Tallaght

2.28 Bus Éireann also has a stop on Belgard Square which is served by Route No 132, linking Dublin Connolly with Bunclody in Co Wexford. Busarus is also accessible via the LUAS Red Line which is on the doorstep. The site is therefore highly accessible to a wide range of national mainline rail services serving all destinations around Ireland, and of course linking to Dublin Airport.

2.29 The ***Airport Hopper*** Tallaght Mini Bus Service operates between The Square Tallaght Town Centre and Dublin Airport, on an approximate hourly basis over the course of the working day.

2.30 Maps and Tables showing Bus Services are included herein and all are easily accessible via Service Provider Apps.

LUAS

2.31 The LUAS Red Line stops (Cookstown & Belgard) are immediately beside the site and high quality improved pedestrian links are provided. LUAS has become a highly successful travel mode linking Tallaght with local areas and onwards to the city centre. It is a semi-segregated light rail tram service operating at street level but generally gets priority over motorised vehicles at junctions. A map extract from the LUAS website, showing the complete network, is included below as ***Figure 2.5***

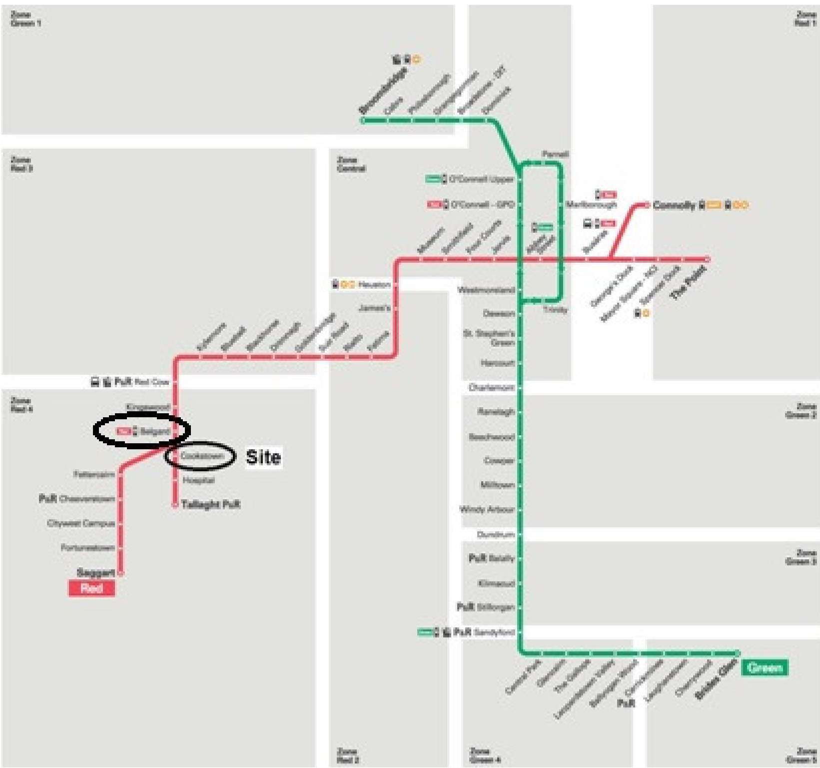


Figure 2.5 - LUAS Services

2.32 The LUAS Red Line serving the site provides a regular service between the 3 Arena/Connolly Station and Tallaght/Saggart with intermediate stops at key locations including Busarus, Heuston Station, Red Cow and City West. The normal day to day operating times are 05:30-24:00

2.33 The recently extended Green Line now provides a good degree of connectivity with the Red Line and their respective stops intersecting at O'Connell Street and Abbey Street. The Green Line provides a service between Sandyford and Broombridge with intermediate stops at St Stephens Green, Westmoreland, Cabra, Phibsborough and Broadstone DIT.

2.34 LUAS runs on a frequency of service which changes depending upon the time of day to adequately cater for demand. The service frequencies for the Local Services are detailed below as ***Figure 2.6***:

Tallaght - Eastbound Towards Connolly or The Point

Monday - Friday	Min	Avg	Max
05:30-07:00	10	14	20
07:00-10:00	3	8	10
10:00-16:00	9	9	10
16:00-19:00	9	9	10
19:00-00:00	6	10	15

Saturday	Min	Avg	Max
06:30-10:00	12	15	20
10:00-16:00	12	12	13
16:00-19:00	10	11	13
19:00-00:00	3	11	15

Sunday & Bank Holidays	Min	Avg	Max
07:00-12:00	10	13	20
12:00-19:00	10	10	11
19:00-23:00	10	11	12

Figure 2.6 - LUAS Service Frequencies

2.35 The LUAS provides excellent connectivity with other rail and DART services including both intercity, commuter and DART services operating out of Heuston Station and Connolly Station - both of which are served by the Red Line LUAS.

2.36 LUAS has the ability to deliver significant increased capacity through a combination of longer carriages/trains and increased frequency of service.

2.37 In terms of number of transport alternatives easily available to Residents, it is considered that the proposed development is very highly sustainable indeed, in terms of public and alternative transport accessibility. The proximity of the development to existing public transport services means that all residents will have viable alternatives to the private car for accessing the site and will not be reliant upon the car as a primary mode of travel.

2.38 Direct and high quality pedestrian linkages are provided between the sites and the existing pedestrian facilities on the surrounding road network. The entrances to the sites will be well lit, so that people can feel secure in using the facilities.

2.39 Public transport maps and timetables can be provided in prominent locations on the sites and the information will be kept up to date by the appointed Travel Plan Coordinator, a role for the Management Company.

2.40 Working Residents are generally now offered the opportunity to purchase public transport commuter tickets under the current 'Employer Pass' and 'TaxSaver' programmes, by individual Employers. Under these schemes the employer applies to Iarnród Éireann / Bus Éireann for tax free public transport tickets for their employees as an incentive for them to use public transport to travel to work.

2.41 With this in mind, the main focus of this Travel Plan will be to promote and support the use of alternative modes to the private car.

Car Parking

2.42 There are a reduced number of under-croft private car parking spaces provided for, including Go Car, Residential Spaces, mobility impaired and visitor parking. The limited car parking is considered appropriate in light of the location of the proposed development immediately adjacent high quality public transport, the inclusion of on-site services, and in consideration of the provisions of the SDCC Development Plan being "Maximum" standards. The development is also not a traditional residential apartment development, and in this regard the Car Parking requirements are fundamentally different, with anticipated lower car ownership and dependency for this nature of scheme. Given the low number of spaces provided (effectively managed residential spaces, visitor/mobility impaired parking, Go-Car and set down), the entire scheme will be actively marketed and promoted as a "Reduced Car Dependency" scheme and this will be communicated from the outset as part of sales and marketing. The development will also be managed on an on-going basis by the appointed Development Management Company to ensure that the reduced car dependency nature of the development is continually promoted and enhanced.

2.43 Details of the justification of the parking provision are set out in the main body of the Transportation Assessment Report. However, it is clear that the lower provision of car parking will act as a demand management measure, ensuring that the development is accessed in the most sustainable manner, being almost predominantly reliant on non-car modes of travel.

2.44 If considered appropriate, as part of a working MMP, additional priority spaces will in future be allocated to car-sharing workers when they travel together, with 10 'Go-Car' currently planned. These are some of the most accessible spaces and are clearly visible to other car park users. It is acknowledged that this may require some level of 'policing'.

Electric Vehicle Charging

2.45 The car parking spaces will be designed so that they can easily be upgraded to allow conversion for Electric Vehicles. The entire car park of the subject scheme can be ducted to accept cabling to serve a charging point for every car space. Conduits can be run on the walls or underground, and charging points can also be retro-mounted. Where residents request a charging point to be installed, the relevant charging point can be pre-wired back to their home electricity meter in the designated meter location. The socket point will have a lockable cover on it so that only that resident may use the power point. This provision around the parking area allows future charging points to be installed at any of the car parking spaces with minimum works as and when required.

3.0 COLLECTION OF BASELINE INFORMATION

Possible Travel Pattern Questionnaires

3.1 The Redevelopment is a proposed high quality residential development in the centre of Tallaght. The development has capacity for in excess of 2,000 people when fully occupied (1,641 bedrooms in the 1,104 apartments).

3.2 Once occupied, and when the Travel Plan Coordinator is appointed, the occupiers of the proposed development will be encouraged to continually monitor the Travel Plan initiatives in order to maximise on their success.

3.3 Shortly after occupation of the new development, a detailed travel-questionnaire will likely be complied and distributed to Residents for completion. The aim of the travel questionnaire will be to establish travel patterns between work and home and school travel demand. The information gathered from this survey will be used to inform the further development of the Travel Plan.

3.4 The Baseline Survey information will also allow the Travel Plan Coordinator for the development to set realistic modal-split targets for the development.

3.5 It is anticipated that, given the very-much town centre location and good transport links at this development, combined with the reduced and managed levels of car parking on site, there will be a high percentage of use via public and alternative transport. The Travel Plan will need to maintain this positive modal split and improve it, where possible. It is informative to note that the "Smarter Travel: A Sustainable Transport Future" (DOT) Objective for 2020 is to achieve a reduced work related commuting by car modal share of 65% to 45%.

3.6 The Travel Plan is not seeking a radical change in terms of a modal shift; it is recognised that the use of the car is often essential for many users. Instead, the Plan seeks small but consistent increments of change in our approach to, and the use of, alternatives to the car.

4.0 THE TRAVEL PLAN

4.1 The successful implementation of a Travel Plan will ensure that, in-so-far-as-possible, the impacts of this traffic are reduced and minimised where practical, while providing a number of environmental and economic advantages detailed below.

4.2 The following sub-sections detail the available initiatives which will serve to better manage travel demand, and therefore the traffic impact of work-related journeys, focused on the movement of residents during peak times.

Walking

Walking - Key Information	
Approx Zone of Influence	3.5km
Percentage of Residents working in area of influence	TBC in each survey when occupied
Percentage of Residents interested in Walking	TBC in each survey when occupied

Table 4.1 – Key Information: Walking

4.4 There are many local, global, and personal benefits to walking to work, a few of which are listed following:

- **W** - Wake Up! - Studies have shown that people who walk to work are more awake and find it easier to concentrate.
- **A** - Always one step ahead - Walking makes people more aware of road safety issues and helps them develop stronger personal safety skills.
- **L** - Less congestion - If you leave the car at home and walk, there are fewer cars on the road which makes it safer for those who walk and cycle.
- **K** - Kinder to the environment - By leaving the car at home you are reducing the amount of CO 2 produced and helping to reduce the effects of climate change and air pollution.
- **I** - Interpersonal skills - Walking to work or school can be a great way to meet other walkers, share the experience, and develop personal skills.
- **N** - New adventures - Walking to work or school is a great way to learn about your local environment and community. It's also a fun way to learn about the weather, landscape, and local ecosystems.
- **G** - Get fit and stay active - Walking to and from work or school helps people incorporate physical activity into their daily routines. Research shows that regular physical activity can benefit your body and mind.

4.5 Most adults will consider walking a maximum of 3.5 km (Approx 30/40 minutes) to work. Residents working within a 3.5 km radius of the site will be encouraged to walk to work as often as their schedule permits. Similarly school trips can be encouraged on foot.

4.6 The following initiatives and incentives can be used to encourage walking to work or school:

- Take part in a 'Pedometer Challenge' which is organised through the Irish Heart Foundation or Smarter Travel Workplaces;
- Organise special events such as a 'Walk to work/school on Wednesdays' where participants are rewarded for their participation;;
- Keep umbrellas in public areas on a deposit system for use when raining;
- Display Smarter Travel Workplaces Accessibility Walking maps on notice boards areas so Residents can plan journeys;
- Organise lunch time or afternoon walks as part of a health and well-being programme;
- Highlight the direct savings gained due to reduced use of private vehicles.

Cycling

Cycling – Key Information	
Approx. zone of influence	10km
Percentage of Residents Surveyed known to Work within the area of influence	TBC in each survey when occupied
Percentage of Residents interested in cycling	TBC in each survey when occupied

Table 4.2 : Key Information - Cycling

4.7 Research suggests that cycling is a viable mode of transport for people who live up to 10 km from work or school.

4.8 Cycling is a great way to travel. It helps foster independence, raises awareness of road safety, and helps the environment.

4.9 Some positive aspects of cycling to work or school are listed following:

- **C** - Cycling is fun! - Cycling is a great form of transport but it's also a great recreational activity. Cycling is a skill that stays with you for life and it's a fantastic way to explore your local community.
- **Y** - You save time & money - cycling to work reduces the need to travel by car thus reducing fuel costs and freeing up road space for more cyclists;
- **C** - Confidence building - travelling to work as an independent cyclist can give

people increased confidence proving beneficial in all aspects of life;

- **L** - Less congestion - If you leave the car at home and cycle to work there are fewer cars on the road which makes it safer for those who cycle and walk to work or school;
- **I** - Interpersonal skills - Cycling to work or to school can be a great way to meet other cyclists and share the experience;
- **N** - New adventures - Cycling to work or school is a great way to learn about your local environment and community. It helps people to understand where they live and how their actions affect their local environment;
- **G** - Get fit and stay active - cycling to and from work or school helps people incorporate physical activity into their daily routines. Research shows that regular physical activity can benefit your body and mind.

4.10 The provision of enhanced and attractive cycle parking facilities at the site will clearly play a critical role in promoting journeys by bicycle.

4.11 The following initiatives and incentives can be used to encourage cycling to work and school:

- New cycle parking installed within the development, secure and well lit;
- It will publicise cycle parking availability by way of signage and on notice boards;
- It will display maps on notice boards areas so people can plan journeys;
- The development can provide free cycle accessories (panniers, lights, visi-vests, helmets) in periodic draws for cyclists,
- The Travel Plan Coordinator can organise cycle training sessions on site on the rules of the road and the specific risks associated with the locality;
- The Travel Plan Coordinator can invite bike suppliers on site for a ‘Green Day’ or ‘Green Week’ so that people can try bikes before buying;
- The Travel Plan Coordinator can set up a Bicycle User Group (BUG) to promote cycling;
- The Travel Plan Coordinator can highlight the direct savings gained due to reduced use of private vehicles;
- The Travel Plan Coordinator can encourage residents to take part in National Bike Week, see www.bikeweek.ie.

Public Transport

Public Transport – Key Information	
Approx. zone of influence	All Residents
Percentage of Residents in area of influence	100%
Percentage of Residents using Public Transport	TBC in each survey when occupied

Table 4.3: Key Information: Public Transport

4.12 There are many benefits to taking public transport, some of which include:

- Personal Opportunities – Public transportation provides personal mobility and freedom;
- Saving fuel – Every full standard bus can take more than 50 cars off the road, resulting in fuel savings from reduced congestion;
- Reducing congestion – The more people who travel to work or to school on public transport, especially during peak periods, the less people travelling by private car;
- Saving money – Taking public transport to and from work or school is a lot cheaper than travelling by car and saves the cost of buying, maintaining and running a vehicle;
- Reducing fuel consumption – A full standard bus uses significantly less fuel per passenger than the average car;
- Reducing carbon footprint – Public transport is at least twice as energy efficient as private cars. Buses produce less than half the CO_2 emissions per passenger kilometre compared to cars and a full bus produces 377 times less carbon monoxide than a full car;
- Get fit and stay active - Walking to and from work or school to public transport helps people incorporate physical activity into their daily routines. Research shows that regular physical activity can benefit your body and mind.
- Less stress – Using public transport can be less stressful than driving yourself, allowing you to relax, read, or listen to music.

4.13 The following initiatives and incentives can be used by the Development Management Company at Occupation Stage to encourage people to take public transport:

- Publicise Employee Tax Saver Commuter tickets, which offer savings to employers in PSRI per ticket sold and significant savings to employees in marginal tax rate and levies on the price of their ticket;
- Encourage public transport use for travel by promoting smart cards, advertising the availability of these tickets to Residents;
- Publicise the availability of Real Time Information. Real Time Information shows when your bus is due to arrive at your bus stop so you can plan your journey more accurately;
- Provide maps of local bus routes and the nearest bus stops, LUAS Timetables and Frequencies, and the length of time it takes to walk to them;
- Contact local providers about issues such as location of existing and new bus stops, timing of routes, or where you have market information about a potential new route.

Go-Car/Car Sharing

Car Sharing – Key Information	
Approx. zone of influence	All Residents
Percentage of Residents in area of influence	100%
Percentage of Residents Car Sharing	TBC in each survey when occupied

Table 4.4: Key Information - Go-Car/Car Sharing

4.14 Every day thousands of commuters drive to work or to school on the same routes to the same destinations, at the same time as their colleagues. By car sharing just once a week, a commuter’s fuel costs can be reduced by 20%, and in a similar fashion, the demand for work place parking can be reduced by 20%. If every single-occupancy driver carried another driver, there would be 50% less cars on the road at peak times.

4.15 Although use of the car to get to work or to school is essential for a large proportion of people, car sharing schemes have the potential to deliver a significant reduction in private vehicle trips by promoting higher than average occupancy rates for each vehicle.

4.16 A locally run car sharing scheme relies on a database containing workplace information, working hours, and peoples preferences such as gender/driver/passenger and their preferred route to and from work. This will be incorporated into the role for the Development Management Co.

4.17 The car-sharing database can be a map showing where Residents work, a database of car-sharers’ details hosted on an organisations intranet site, or an on map-based matching website.

4.18 Car sharing often happens informally, however some participants often prefer a formal scheme such as a go Car facility which will normally generate a higher take-up for car sharing, and more efficiency in terms of increased occupancy rates. Car sharing is much easier promoted within a community such as is proposed here, and will be done by the Development Management Co.

4.19 Encouraging more Residents to share car journeys to work rather than driving alone as well as encouraging more to set up and take part in car sharing/pooling would prove a very effective means of reducing daily car trips to and from the site.

4.20 The following initiatives and incentives can be used to encourage car sharing:

- Provide incentives to sign up to a car sharing scheme with preferential parking spaces in the most convenient location;
- Draw up a car-sharing policy for how the scheme will operate, and issue car-

sharing permits to those qualifying to use the car-sharing spaces;

- Highlight to drivers that they do not have to share with a person that doesn't suit them – allow choice based on gender, route, smoking or non-smoking;
- Clarify the financial implications of the scheme – those accepting a lift could contribute towards fuel costs.
- Use existing online databases for car sharing. For example, the development could set up its own private car sharing site using www.carsharing.ie.
- Allocate parking spaces for use solely by car sharers, for example near to building entrances.

Action Plan Summary Table

4.25 The Summary Action Plan is described in the Table below. Modal Split Targets will be determined following on from the first Residential survey shortly after full occupation, typically within the first six months. This will be part of the role of the Travel Plan Coordinator, within the remit of the Development Management Company. This will show existing travel patterns with realistic targets set to improve the modal split of Residents.

	Initiative	Impact on Delivery	Difficulty Delivering	Current Modal Split	Target MS
Residents Initiatives	Walking	Medium	Low	TBC	TBC
	Cycling	Medium	Medium	TBC	TBC
	Public Transport	High	Low	TBC	TBC
	Other	Medium	Medium	TBC	TBC
	Car - Sharing	Medium	Medium	TBC	TBC
	Cars - 1 Passenger Only	High - Negative	High	TBC	TBC
Promoting the TP	Marketing the Plan	High	Low	Driven By TP Coordinator	
	Measuring Success	High	Medium	Annual Surveys	

Action Plan Summary Table

5.0 IMPLEMENTING THE PLAN

Background

5.1 Setting realistic targets and a sustained approach to the promotion of the Travel Plan is important if the measures are to be successful. The objectives and benefits of the Plan will be made clear and broadcast during the full lifecycle of the Plan.

5.2 The implementation of a successful Travel plan will require the upfront investment of resources. As well as reviewing objectives and initiatives regularly, it is equally important to measure results. This provides an indication of any Plan's success, and ensures that the targets remain realistic.

The Travel Plan Coordinator

5.4 The key objective of this Travel Plan is to ensure that the traffic impacts and car usage associated with the operation of Redevelopment are minimised. Achieving this objective will result in a wide array of benefits for the development and its stakeholders.

5.5 To ensure the plan is effective it is essential for a Travel Plan Coordinator to be appointed for the Development upon 100% occupation.

5.6 It is envisaged that the Coordinator will work closely with residents to enthusiastically promote and market the Travel Plan. As Residents will be the focus of the plan; their involvement must be sought from the outset.

5.7 To support the Travel Plan Coordinator's efforts, the Management Company must ensure that they have sufficient time to carry out their duties. In addition, it is essential that the powers of decision making are bestowed upon him/her, along with a suitable budget and programme for implementation.

Promoting the Travel Plan

5.9 Active promotion and marketing is needed if the Travel Plan is to have a positive impact on stakeholder travel patterns to and from the site.

5.10 All marketing initiatives should be focused on areas where there is willingness to change. Such information has been extracted from the questionnaires and has been described in Section 3 of this Plan.

- **Identify the Aim** – e.g. to reduce low occupancy car commuting, school, and business travel & to promote active travel, public transport & alternatives to travelling by car.
- **Brand the Plan** – as part of communicating the Travel Plan, visually brand all work relating to it with a consistent look, slogan, identity or logo.

- **Identify the Target Audience** – 'segment the audience' (e.g. shift workers, school travel, sedentary workers, people travelling long/ short distances, mode used, members of a walking club or green team) so you can target the message and events towards these different groups.

5.11 As part of the marketing process, the Travel Plan coordinator can personalise a plan for the Development, drawing attention to the benefits of participation and support for its implementation.

5.12 The Coordinator can identify communication tools and networks used by the different audiences in the Residences, and use these to communicate about travel.

5.13 Promotional material regardless of its quality is only as good as its distribution network; material incentives assist greatly in introducing people to alternative modes of commuting.

5.14 The plan should not be anti-car - it should be about promoting equity among modes and offering choice and accessibility.

5.15 The Coordinator can promote positive messages associated with a plan, for example, reduced tax/PRSI payments, getting fit and active, reducing congestion, reducing CO2 emissions and so on, and encourage people to start small – changing one day per week for example, to explore their options.

5.16 Marketing drives which feature individual Residents who have reduced their car use can carry a strong message. This will serve to raise not only the profile of the Plan, but also send a clear message in relation to the Residents commitment to the Plan.

6.0 CONCLUSIONS

6.1 The development forming the subject of this application accords with the principles of sustainable development, being located within an established town centre within clear and easy access to alternative modes of travel, and with very little car parking provided acting as a further demand management measure . The Management Company, once the development is occupied, will utilise pragmatic measures that encourage safe and viable alternatives to the private car for accessing the development.

6.2 Good Travel Planning is not a one-off event, it is instead an on-going iterative process requiring continued effort. This Preliminary report assists these efforts by forming an outline framework and providing guidance for its success. Monitoring and reviewing the initiatives set out within the plan will form a far greater part of the Final Travel Plan itself.

6.3 The key to the Plans success will be the appointment of a ***Travel Plan Coordinator*** for the development, once occupied, a role which will be part of the Development Management Company responsibilities. They will be vested with total responsibility for implementing the plan. They should be granted the authority and time to execute the Plan, and be provided with sufficient resources to realise the Plans success.

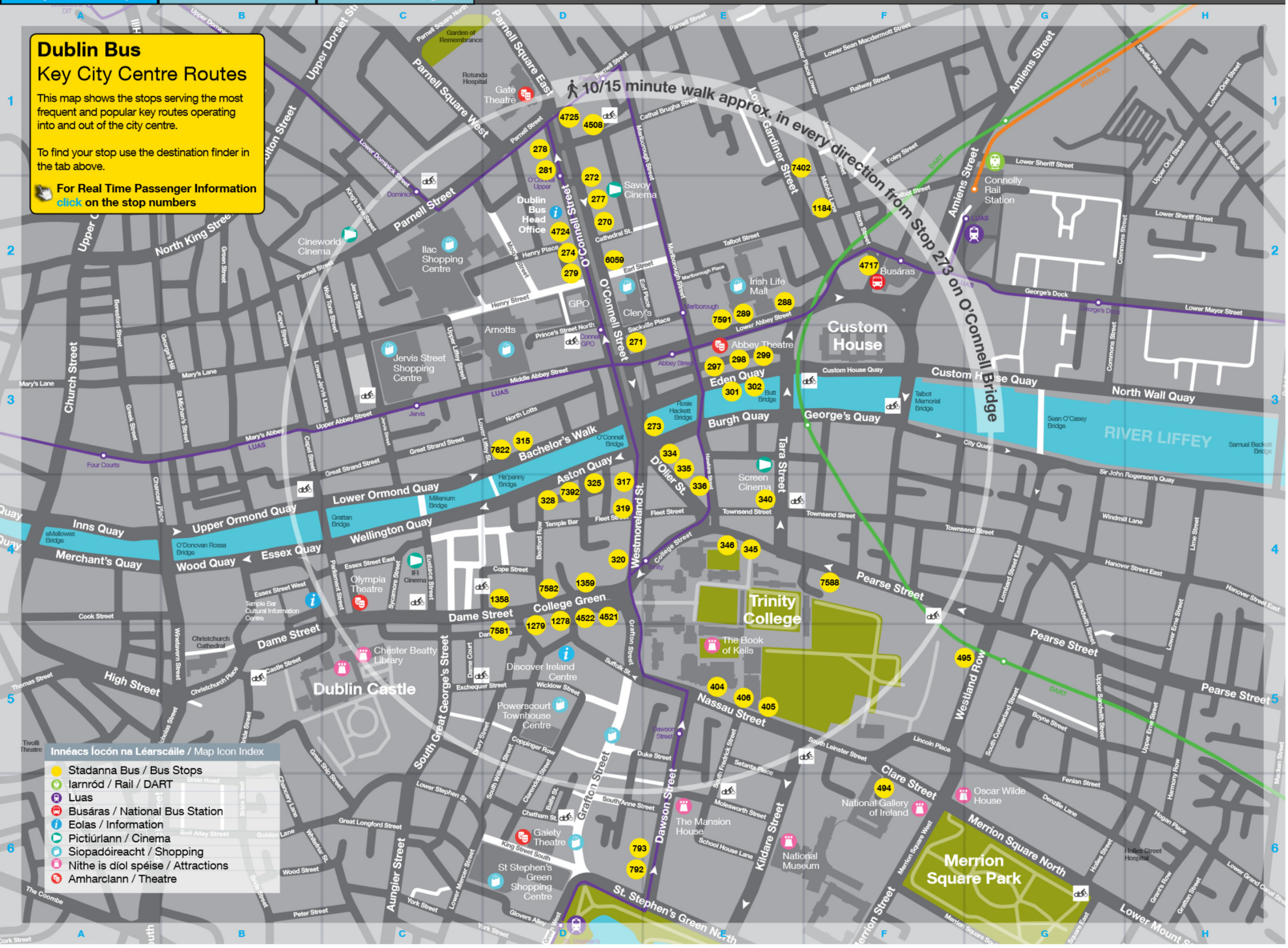
6.4 As Residents are the focus of the plan; their involvement should be sought from the outset following occupation. To this end, the Plan Coordinator should be assisted and supported by the Management Company and Residents. This will serve to spread the work load, and also give the Residents a valuable input into the operation of the Plan.

6.5 Successful Travel Plans require extensive marketing **<u>and</u>** regular review. The measures set out in the Action Plan Summary Table (Chapter 4) should form the basis of a sound, realistic Plan and should be clearly set out and be fully transparent to all users.

6.6 Residents also have an essential responsibility in terms of co-operating with, and taking an active part in the plan. They are, after all, the plan's primary focus.

6.7 It is recommended that the Final Travel Plan be set in motion at full occupation. The plan should evolve and develop with the development, taking into account changing Residents and their travel preferences and needs.

6.8 Annual reviews of the Plan should include a full stakeholder survey, providing valuable information for target setting and marketing target groups. It is emphasised that failing to meet initial targets should not be seen as failure, as the preliminary 12 to 18 months of the plan should be viewed as a calibration exercise for target setting.


Dublin Bus
Key City Centre Routes
This map shows the stops serving the most frequent and popular key routes operating into and out of the city centre.
To find your stop use the destination finder in the tab above.
For Real Time Passenger Information click on the stop numbers
10/15 minute walk approx. in every direction from Stop 273 on O'Connell Bridge
Innéacs Íocón na Léarscáile / Map Icon Index
Stadanna Bus / Bus Stops
Iarnród / Rail / DART
Luas
Busáras / National Bus Station
Eolas / Information
Pictiúrlann / Cinema
Siopadóireacht / Shopping
Nithe is díol spéise / Attractions
Amharclann / Theatre
Custom House
Trinity College
Dublin Castle
Merrion Square Park
RIVER LIFFEY
O'Connell Street
O'Connell Bridge
Parnell Square East
Parnell Square West
Parnell Street
North King Street
Church Street
Inns Quay
Merchant's Quay
Wood Quay
Essex Quay
Upper Ormond Quay
Lower Ormond Quay
Wellington Quay
Bachelor's Walk
Aston Quay
Eden Quay
Burgh Quay
George's Quay
Custom House Quay
North Wall Quay
Westmoreland St.
D'Olier St.
Tara Street
Pearse Street
Nassau Street
Clare Street
Merrion Square North
Dame Street
College Green
High Street
Dawson Street
Grafton Street
Kildare Street
Westland Row
Amiens Street
Gardiner Street
St. Stephen's Green North
South Great George's Street
Aungier Street
Dublin Bus Head Office
GPO
Busáras
Connolly Rail Station
Ilac Shopping Centre
Jervis Street Shopping Centre
Arnotts
Savoy Cinema
Cineworld Cinema
Gate Theatre
Abbey Theatre
Irish Life Mall
Screen Cinema
Olympia Theatre
IFI Cinema
Chester Beatty Library
Discover Ireland Centre
Powerscourt Townhouse Centre
Gaiety Theatre
St Stephen's Green Shopping Centre
The Book of Kells
The Mansion House
National Gallery of Ireland
National Museum
Oscar Wilde House
4725
4508
278
281
272
277
270
4724
274
279
6059
271
7591
289
288
7402
1184
4717
297
298
299
301
302
273
315
7622
334
335
336
340
317
325
7392
328
319
320
346
345
7588
1359
7582
1358
1279
1278
4522
4521
7581
404
406
405
495
494
793
792

Dublin Bus
Key City Centre Routes

Use the index and grid reference to find the right stop on the city centre map.

The stop number shown on the map also appears on the top of the bus stop to help you find your stop more easily.

For Real Time Passenger Information click on the stop numbers

For Timetable Information click the Bus Route numbers

Route Destination	Bus Route	Stop Number	Grid Ref
Ballsbridge/RDS	4, 7, 7a	4725	D1
	4, 7, 7a	273	E3
	4, 7, 7a	405	E5
Ballyfermot	40	270	D2
	40	335	E3
	40	4521	D4
Blackrock	4, 7, 7a	4725	D1
	4, 7, 7a	273	E3
	4, 7, 7a	405	E5
Blanchardstown - Shopping Centre	39/a	793	D6
	39/a	7588	F4
	39/a	328	D4
Blanchardstown - Village	38/a, 39	793	D6
	39	7588	F4
	38/a	274	D2
	39	328	D4
Botanic Gardens	83	1359	D4
	83, 155	319	D4
Bray Main Street	145	7622	D3
	145, 155	334	E3
	145, 155	406	E5
Celbridge	67	346	E4
	67	317	D4
Charlestown S.C.	9	1359	D4
	9, 40	319	D4
	9	281	D1
	40	1358	D4
	40	279	D2
Citywest Business Pk.	77a	4522	D4
Clondalkin Village	13	270	D2
	13	335	E3
	13	4521	D4
Clonskeagh	11	271	D3
	11	404	E5
Clontarf	130	7591	E2
Coolock	15	7582	D4
	15	299	E3
	27	1358	D4
	27	298	E3
Coombe Hospital	27, 151	302	E3
	27, 77a, 151	4522	D4
Croke Park & Museum	11	793	D6
	13, 16	1359	D4
	11, 16	320	D4
	1, 13	319	D4
	1, 11, 16	278	D1
DCU	9, 13	1359	D4
	9, 13, 155	319	D4
	4, 9, 13 , 155	281	D1
	11	793	D6
	11	278	D1
Donnybrook	39a	315	D3
	46a, 145, 155	334	E3
	39a	335	E3
	39a	404	E5
	39a, 155	6059	D3
	46a, 145, 155	406	E5
Dublin Airport	16, 747	1359	D4
	16	320	D4
	16	278	D1
	41	288	E2
	747, 757	4717	G3
	747	4724	D2
	747	4508	D1
	747	7402	E1
	757	494	F6
	757	495	F5
	757	7588	G7
Dublin Zoo	46a	792	D6
	46a	320	D4
	46a	274	D2
Dún Laoghaire	7, 7a	4725	D1
	7, 7a	273	E3
	7, 7a	405	E5
	46a	6059	D2
	46a	334	E3
	46a	406	E5
Dundrum	14	301	E3
	14	336	E4
	14	7581	D5
Fairview	14, 15	7582	D4
	15	299	E3
	27	1358	D4
	27	298	E3
	130	7591	E2
Finglas Village	40	1358	D4
	40	319	D4
	40	279	D2
Glasnevin Cemetery	40	1358	D4
	40	319	D4
	40	279	D2
	140	7582	D4
	140	274	D2
Guinness Storehouse	13, 40	270	D2
	13, 123, 40	335	E3
	13, 40	4521	D4
	123	272	D2
	123	1278	D4
Harold's Cross	9	277	D2
	9	336	E4
	9	1278	D4
	16	270	D2
	16	336	E4
	16	1279	D5
Heuston Rail Station	25/a/b/d, 66/a/b, 67	346	E4
	66/a/b, 67	317	D4
	25/a/b/d	7392	D4
	145	792	D6
	145	7588	F4
	145	325	D4
Howth Summit	31/a	289	E2
Howth Village	31/a	289	E2
IKEA	140	7582	D4
	140	319	D4
	140	274	D2
	155	792	D6
	155	319	D4
	155	281	D2
Kimmage	83	315	D3
	9, 83	336	E4
	83	1279	D5
Leeson Street	11	271	D3
	11	404	E5
	46a, 155	6059	D2
	46a, 145, 155	334	E3
	46a, 145, 155	406	E5
Liffey Valley S.C.	40	270	D2
	40	335	E3
	40	4521	D5
Lucan (Esker Church)	25a	346	E4
	25a	7392	D4
Lucan Village	25, 66/a/b, 67	346	E4
	66/a/b, 67	317	D4
	25	7392	D4
Malahide Road	42	1184	F2
Malahide Village	42	1184	F2
Marino	123	1359	D4
	123	274	D2
	123	4508	D1
Mater Hospital	38/a/b	793	D6
	38/a/b	274	D2
	46a	792	D6
	46a	320	D4
	46a	274	D2
Mater Hospital (Private)	11	793	D6
	11, 16	320	D4
	1, 13, 40	319	D4
	1, 11, 16	278	D1
	13, 16	1359	D4
	13	281	D2
	40	1358	D4
	40	279	D2
Maynooth Village	66	346	E4
	66	317	D4
Merrion Square	4, 7, 7a	4725	D1
	4, 7, 7a	273	E3
	4, 7, 7a	405	E5
	25/a/b/d, 66/a/b, 67	315	D3
	25/a/b/d, 66/a/b, 67	406	E5
Naas Road	13	270	D2
	13	335	E3
	13	4521	D4
Navan Road	38/a/b, 39/a	793	D6
	39/a	7588	F4
	38/a/b	274	D2
	39/a	328	D4
North Circular Road	46a	792	D6
	46a	320	D4
	46a	274	D2
Ongar	39/a	793	D6
	39/a	7588	F4
	39/a	328	D4
Our Lady's Children's Hospital, Crumlin	27, 151	302	E3
	27, 77a, 151	4522	D4
	123	272	D2
	123	335	E3
	123	1278	D4
Phibsboro	9	1359	D4
	9, 83, 140, 155	319	D4
	4, 9, 155	281	D1
	140	7582	D4
	140	274	D2
Ranelagh	11	271	D3
	11	404	E5
Rathfarnham	16	270	D2
	16	336	E4
	16	1279	D5
Rathgar	14, 15	301	E3
	14	336	E4
	14, 15	7581	D5
Rathmines	14, 15	301	E3
	83/a	315	D3
	14, 83	336	E4
	14, 15, 140	7581	D5
	140	6059	D2
	140	334	E3
Ringsend	1	271	D3
	1, 77a	340	E4
Santry	16	1359	D7
	16	320	D4
	1	319	D4
	1, 16	278	D1
	41/c	288	E2
South Circular Road	9	277	D2
	9	336	E4
Stillorgan Village	46a, 155	6059	D2
	46a, 145, 155	334	E3
	46a, 145, 155	406	E5
	145	7622	D3
Swords Village	41/c	288	E2
Tallaght Village	27	302	E3
	27	4522	D4
Templeogue	15	301	E3
	15	7581	D5
Terenure Village	15	301	E3
	15	7581	D5
	16	270	D2
	16	336	E4
The 3Arena	151	7622	D3
	151	297	E3
The Square Tallaght	27	302	E3
	27	4522	D4
UCD Belfield	39a	315	D3
	39a	335	E3
	39a	404	E5
Walkinstown Cross	27	302	E3
	27, 77a	4522	D4

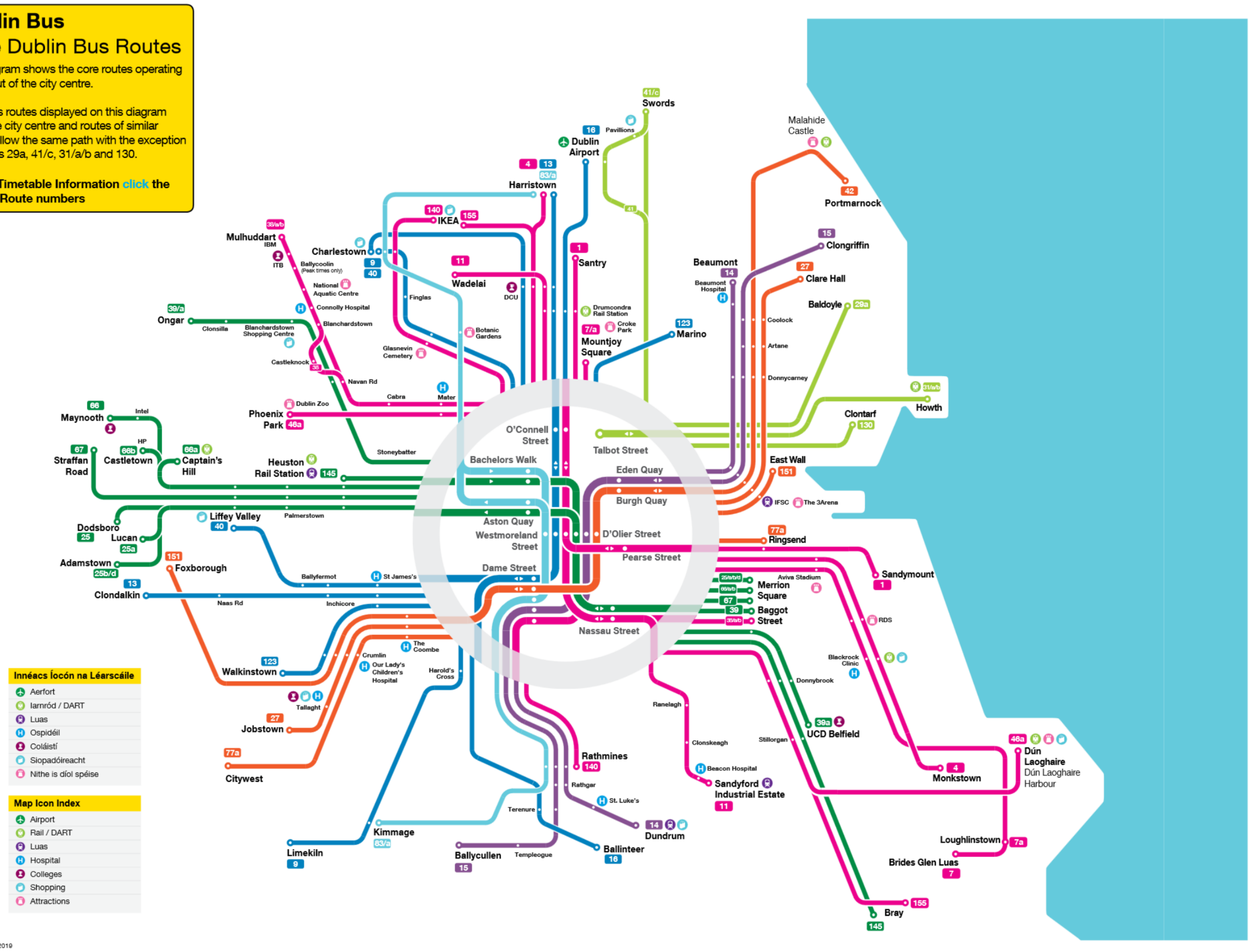
Dublin Bus

Core Dublin Bus Routes

This diagram shows the core routes operating in and out of the city centre.

Most bus routes displayed on this diagram cross the city centre and routes of similar colour follow the same path with the exception of Routes 29a, 41/c, 31/a/b and 130.

For Timetable Information click the Bus Route numbers



Operative Date: October 2019

APPENDIX I

DMURS
Statement of Consistency

consulting engineers

NRB

DMURS Design Statement

Technical Note

(Appendix I)

for

Proposed Residential Development(s)

on

Lands West of Old Belgard Road and North, South & West of Cookstown Road, Cookstown Industrial Estate, Tallaght, Dublin 24

SUBMISSION ISSUE

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1.0 INTRODUCTION

1.1 It is NRB's opinion that the proposed Residential Development Layout and associated roads are consistent with both the principles and guidance outlined within the *Design Manual for Urban Roads and Streets* (DMURS) 2013, as amended in 2019. The scheme proposals are the outcome of an integrated design approach, in which the evolution of the development design incorporated various mitigation measures and development proposals in response to a series of consultations with SDCC and ABP. This approach seeks to implement a sustainable community connected by well-designed links, layout and accesses - which combined to deliver attractive, convenient and safe slow mode access to this residential development, in addition to promoting modal shift and viable alternatives to car based journeys. The resultant proposed Cookstown Castle Development provides for an enhanced high quality and easily accessible sustainable community based neighbourhood.

1.2 The following section discusses design features which are incorporated within the proposed residential scheme with the objective of delivering a design that is consistent with the principles of DMURS.

2.0 DESIGN ATTRIBUTES

2.1 The proposed layout strategy seeks to maximise connectivity between key local destinations through the provision of a high level of permeability and legibility for all journeys, particularly for sustainable forms of travel (cycling and walking). The proposed residential scheme delivers greater mode and route choices along direct, attractive and safe linkages to local amenities and schools/service destinations through replacement of the existing industrial estate roads with modern streets.

2.2 High Quality Connections between the proposed development and the employment areas and facilities within Tallaght, are provided. The layout itself has been designed to deliver a hierarchy which provide safe access within / across the proposed new residential community, linking the site and community with the established network. Vehicular access to the car parking is separate from the pedestrian accesses to the development and has been designed with safety in mind, conscious that an independent Road Safety Audit was also undertaken, reinforcing safety features.

2.3 As part of the development, the access facilities are to address the different levels of motorised traffic whilst optimising access to/from the proposed development via alternative transport for higher number of pedestrians and cyclists. The design philosophy has sought to emphasise the context / place status of the scheme in terms of level of connectivity provided, quality of the proposed design, provision of enhanced accommodation for pedestrian / cyclists activity and vulnerable users requirements whilst ensuring appropriate 'transition' solutions for conflicting mobility movements as recommended in DMURS and the Tallaght LAP, particularly at street junctions.

2.4 The layout of the proposed development seeks to maximise permeability and enhances legibility, and the design of appropriately sized blocks actively contributes to a highly permeable and accessible community for both pedestrians and cyclists.

2.5 The proposed layout seeks to successfully create an appropriate balance between the functional requirements of different network users whilst enhancing the 'sense of place'. Design attributes of the proposed layout which contribute to achieving this ***DMURS objective*** include:

a) Vehicular access to the development car parks is separate from the pedestrian accesses to the development and the open space.

b) Through the provision of separate vehicle accesses onto the local streets, the plan offers a well-connected but permeable network,

c) Under ***Section 3.4.1 Vehicle Permeability***, DMURS states that 'Permeable layouts provide more frequent junctions which have a traffic-calming effect as drivers slow and show greater levels of caution' - in this regard the form of streets and road layout in the proposed Cookstown Castle Development conform with DMURS and the Tallaght LAP.

d) DMURS also goes on to state that 'Designers may be concerned that more permeable street layouts will result in a higher rate of collisions. However, research has shown that there is no significant difference in the collision risk attributable to more permeable street layouts in urban areas and that more frequent and less busy junctions need not lead to higher numbers of accidents.'

e) The proposed design deliberately seeks to specify minimal signage and line markings along the internal layout, with such treatments used sensitively throughout and predominately at key nodes and 'transition' areas.

f) Footpaths not less than 1.8m (2.0m or wider) will be provided throughout the scheme with connections and tie-ins to existing external pedestrian networks.

g) Appropriate clear unobstructed visibility splays, as per DMURS requirements, will be maintained at the site access junctions to the external road network and at all public road junctions.

h) Well designed and frequent pedestrian crossing facilities will be provided along key travel desire lines throughout the emerging Area in addition to those located at street nodes. All courtesy crossings will be provided with either dropped kerbs thereby allowing pedestrians to informally assert a degree of priority. The separation of vehicular access to the development from the pedestrian accesses to the development aid in this aspect of the layout.

i) Along the more heavily trafficked routes, formal signalised controlled crossings can be provided at junctions for the benefit of both pedestrians and cyclists. These will connect with the Pedestrian, Cyclists and Bus Stop facilities adjacent the subject site. Raised platforms are proposed at all intersections, which serve to reduce traffic speed and aid the safe prioritised passage of pedestrians and vulnerable road users. In addition, it may be considered appropriate to replace existing roundabout controlled junctions with signal controlled junctions, and this strategy would be consistent with DMURS.

j) All informal pedestrian crossing facilities will be at least 2.0m wide, whilst all controlled pedestrian crossings will be a minimum of 2.4m wide.

k) With the objective of encouraging low vehicle speeds and maximising pedestrian safety and convenience, corner radii will be 6m where swept path analysis permits and will incorporate further reduced radii where feasible in line with DMURS guidance.

l) Internally within the development, where carriageway kerb are required, heights will be typically 75-80mm in accordance with the objectives of DMURS.

m) Within the development, as required, cyclists will share the space with other street users as per the NCM guidance for such situations and best practice. The proposed Cycle facilities on the Larger Public Roads are compliant with the National Cycle Manual (NCM) (NCM pages 12 & 83), with advance cycle facilities and Toucan type crossings incorporated into all signal controlled junctions. Internally, for the minor streets, the cyclists infrastructure is also consistent with the NCM (Pages 54 & 55)

n) Any required street signage and road markings will be in accordance with the Department of Transport Traffic Signs Manual, and the location and form will be agreed in advance with South Dublin County Council (conscious of DMURS recommendations on the minimisation of signage / reduction of street clutter).

APPENDIX 11.1 Summary of Relevant Legislation

National Monuments (Amendment) Act (1930-2014)

All archaeological sites have the full protection of the national monuments legislation (Principal Act 1930; Amendments 1954, 1987, 1994, 2004 and 2014). In the 1987 Amendment of Section 2 of the Principal Act (1930), the definition of a national monument is specified as:

> *any artificial or partly artificial building, structure or erection or group of such buildings, structures or erections;*
> *any artificial cave, stone or natural product, whether forming part of the ground, that has been artificially carved, sculptured or worked upon or which (where it does not form part of the place where it is) appears to have been purposely put or arranged in position;*
> *any, or any part of any, prehistoric or ancient tomb, grave or burial deposit, or*
> *(ii) ritual, industrial or habitation site*
> *and*
> *any place comprising the remains or traces of any such building, structure or erection, any cave, stone or natural product or any such tomb, grave, burial deposit or ritual, industrial or habitation site...*

Under Section 14 of the Principal Act (1930):

It shall be unlawful...

> *to demolish or remove wholly or in part or to disfigure, deface, alter, or in any manner injure or interfere with any such national monument without or otherwise than in accordance with the consent hereinafter mentioned (a licence issued by the Office of Public Works National Monuments Branch),*
> or
> *to excavate, dig, plough or otherwise disturb the ground within, around, or in the proximity to any such national monument without or otherwise than in accordance...*

Under Amendment to Section 23 of the Principal Act (1930),

> *A person who finds an archaeological object shall, within four days after the finding, make a report of it to a member of the Garda Síochána...or the Director of the National Museum...*

The latter is of relevance to any finds made during a watching brief.

In the 1994 Amendment of Section 12 of the Principal Act (1930), all the sites and 'places' recorded by the Sites and Monuments Record of the Office of Public Works are provided with a new status in law. This new status provides a level of protection to the listed sites that is equivalent to that accorded to 'registered' sites [Section 8(1), National Monuments Amendment Act 1954] as follows:

The Commissioners shall establish and maintain a record of monuments and places where they believe there are monuments and the record shall be comprised of a list of monuments and such places and a map or maps showing each monument and such place in respect of each county in the State.

The Commissioners shall cause to be exhibited in a prescribed manner in each county the list and map or maps of the county drawn up and publish in a prescribed manner information about when and where the lists and maps may be consulted.

In addition, when the owner or occupier (not being the Commissioners) of a monument or place which has been recorded, or any person proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such monument or place, he shall give notice in writing of his proposal to carry out the work to the Commissioners and shall not, except in the case of urgent necessity and with the consent of the Commissioners, commence the work for a period of two months after having given the notice.

Under the National Monuments Amendment Act (2004), the Minister of Environment, Heritage and Local Government will issue directions relating to archaeological works and will be advised by the National Monuments Section and the National Museum of Ireland. The Act sets out the circumstances whereby the Minister of Environment, Heritage and Local Government may grant consent (i.e. In respect of a national monument of which the Minister or a local authority are the owners or the guardians or in respect of which a preservation order is in force) or issue directions (i.e. in relation to approved road developments—being road development approved under either or both sections 49 and 51 of the Roads Act 1993).

14A. (1) The consent of the Minister under section 14 of this Act and any further consent or licence under any other provision of the National Monuments Acts 1930 to 2004 shall not be required where the works involved are connected with an approved road development.

14A. (2) Any works of an archaeological nature that are carried out in respect of an approved road development shall be carried out in accordance with the directions of the Minister, which directions shall be issued following consultation by the minister with the Director of the National Museum of Ireland.

14A (4) Where a national monument has been discovered to which subsection (3) of this section relates, then the road authority carrying out the road development shall report the discovery to the Minister subject to subsection (7) of this section, and pending any directions by the minister under paragraph (d) of this subsection, no works which would interfere with the monument shall be carried out, except works urgently required to secure its preservation carried out in accordance with such measures as may be specified by the Minister

The Minister will consult with the Director of the National Museum of Ireland for a period not longer than 14 days before issuing further directions in relation to the national monument.

The Minister will not be restricted to archaeological considerations alone, but will also consider the wider public interest.

Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 1999.

This Act provides for the establishment of a national inventory of architectural heritage and historic monuments.

Section 1 of the act defines “architectural heritage” as:-

- *(a) all structures and buildings together with their settings and attendant grounds, fixtures and fittings,*
- *(b) groups of such structures and buildings, and,*
- (c) *sites which are of architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest*.

Section 2 of the Act states that the Minister (for Arts, Heritage, Gaeltacht and the Islands) shall establish the NIAH, determining its form and content, defining the categories of architectural heritage, and specifying to which category each entry belongs. The information contained within the inventory will be made available to planning authorities, having regard to the security and privacy of both property and persons involved.

Section 3 of the Act states that the minister may appoint officers, who may in turn request access to premises listed in the inventory from the occupiers of these buildings. The officer is required to inform the occupier of the building why entry is necessary, and in the event of a refusal, can apply for a warrant to enter the premises.

Section 4 of the Act states that obstruction of an officer or a refusal to comply with requirements of entry will result in the owner or occupier being guilty of an offence.

Section 5 of the Act states that sanitary authorities who carry out works on a monument covered by this Act will as far as possible preserve the monument with the proviso that its condition is not a danger to any person or property, and that the sanitation authority will inform the Minister that the works have been carried out.

The provisions in the Act are in addition to and not a substitution for provisions of the National Monument Act (1930–94), and the protection of monuments in the National Monuments Act is extended to the monuments covered by the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act (1999).

Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 2000 and the Local Government (Planning and Development) Act 2000

The Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act provides for the establishment of a national inventory of architectural heritage and historic monuments.

Section 1 of the act defines “architectural heritage” as:

(a) all structures and buildings together with their settings and attendant grounds, fixtures and fittings,
(b) groups of such structures and buildings, and,
(c) sites, which are of architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest.

The Local Government (Planning and Development) Act, 1999, which came into force on 1st January 2000, provides for the inclusion of protected structures into the planning authorities’ development plans and sets out statutory regulations regarding works affecting such structures, thereby giving greater statutory protection to buildings. All structures listed in the development plan are now referred to as Protected Structures and enjoy equal statutory protection. Under the 1999 Act the entire structure is protected, including a structures interior, exterior, the land lying within the curtilage of the protected structure and other structures within that curtilage. This Act was subsequently repealed and replaced by the Planning and Development Act, 2000, where the conditions relating to the protection of architectural heritage are set out in Part IV of the Act.

The main features of the 2000 Act are:

a) planning authorities have a clear obligation to create a record of protected structures (RPS) which includes all structures or parts of structures in their functional areas which, in their opinion, are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. This record forms part of a planning authority’s development plan.
b) planning authorities are also obliged to preserve the character of places and townscapes which are of special architectural, historic, archaeological, artistic, cultural, scientific, social or technical interest or that contribute to the appreciation of protected structures, by designating them architectural conservation areas (ACAs) in their development plan.
c) development plans must include objectives for the protection of such structures and the preservation of the character of such areas to ensure proper and sustainable planning and development.
d) new responsibilities are given to the owners and occupiers of protected structures to maintain them and planning authorities have additional powers to ensure that buildings are not endangered either directly or through neglect.5 Financial assistance, in the form of conservation grants, is available from planning authorities to assist in this process.
e) the owner or occupier of a protected structure may seek a declaration from the relevant planning authority to determine the works to the structure that would materially affect its character and therefore require planning permission, and those works which may be carried out as exempted development.
f) where a structure is protected, the protection includes the structure, its interior and the land within its curtilage and other structures within that curtilage (including their interiors) and all fixtures and features which form part of the interior or exterior of all these structures. All works which would materially affect the character of a protected structure, or a proposed protected structure, will require planning permission.

APPENDIX 11.2 Glossary of Impact Assessment

Significance Criteria (NRA Guidelines 2006)

The significance criteria can be used to evaluate the significance of an archaeological site, monument or complex. It should not, however, be regarded as definitive, rather it is an indicator which contributes to a wider judgment based on the individual circumstances of a feature. Different archaeological heritage asset types lend themselves more easily to assessment and it should be borne in mind that this can create a bias in the record, for example an upstanding stone monument such as a fortified house is easier to examine with a view to significance than a degraded enclosure site.

Criteria	Explanation
Existing Status	The level of protection associated with an archaeological site / monument is an important consideration.
Condition /Preservation	The survival of a monument's archaeological potential both above and below ground is an important consideration and should be assessed in relation to its present condition and surviving features. Well-preserved sites should be highighted, this assessment can only be based on a field inspection.
Documentation /Historical Significance	The significance of a monument may be enhanced by the existence of records of previous investigations or contemporary documentation supported by written evidence or historic maps. Sites with a definite historical association or an example of a notable event or person should be highlighted.
Group Value	The value of a single monument may be greatly enhanced by its association with related contemporary monuments or with monuments from different periods indicating an extended time presence in any specific area. In some cases it may be preferable to protect the complete group, including associated and adjacent land, rather than to protect isolated monuments within that group.
Rarity	The rarity of some monument types can be a central factor affecting response strategies for development, whatever the condition of the individual feature. It is important to recognise sites that have a limited distribution.
Visibility in the Landscape	Monuments that are highly visible in the landscape have a heightened physical presence. The inter-visibility between monuments may also be explored in this category.
Fragility/ Vulnerability	It is important to assess the level of threat to archaeological monuments from erosion, natural degradation, agricultural activity, land clearance, neglect, careless treatment or development. The nature of the archaeological evidence cannot always be specified precisely but it may still be possible to document reasons to justify the significance of the feature. This category relates to the probability of monuments producing material of archaeological significance as a result of future investigative work.
Amenity Value	Regard should be taken of the existing and potential amenity value of a monument.

Table 11.1 Significance Criteria, NRA Guidelines 2006 (Archaeological Heritage)

Determining Significance of Architectural Heritage Assets

The significance of perceived impact on structures and sites of architectural merit is determined by a combination of the architectural heritage importance of the structure and the degree of impact. In each case the structure is given a rating as to its importance and, if higher than "Record only", the nature of its special interest is given. The rating definitions are in accordance with those given by the National Inventory of Architectural Heritage (NIAH):

- *International:* Structures or sites of sufficient architectural heritage importance to be considered in an international context. Examples include St Fin Barre's Cathedral, Cork. These are exceptional structures that can be compared to and contrasted with the finest architectural heritage in other countries.
- *National:* Structures or sites that make a significant contribution to the architectural heritage of Ireland. These are structures and sites that are considered to be of great architectural heritage

significance in an Irish context. Examples include Ardnacrusha Power Station, Co. Clare; the Ford Factory, Cork; Carroll's Factory, Dundalk; Lismore Castle, Co. Waterford; Sligo Courthouse, Sligo; and Emo Court, Co. Laois.
- *Regional:* Structures or sites that make a significant contribution to the architectural heritage within their region or area. They also stand in comparison with similar structures or sites in other regions or areas within Ireland. Examples would include many Georgian terraces; Nenagh Courthouse, Co. Tipperary; or the Bailey Lighthouse, Howth. Increasingly, structures that need to be protected include structures or sites that make a significant contribution to the architectural heritage within their own locality. Examples of these would include modest terraces and timber shop fronts.
- *Local:* These are structures or sites of some vintage that make a contribution to the architectural heritage but may not merit being placed in the RPS separately. Such structures may have lost much of their original fabric.
- *Record only:* These are structures or sites that are not deemed to have sufficient presence or inherent architectural or other importance at the time of recording to warrant a higher rating. It is acknowledged, however, that they might be considered further at a future time.

Where the rating is deemed to be higher than “Record only” the category of special interest is noted. It should be noted that the term “special architectural interest” applies only in the context of this assessment of architectural heritage and does not imply that those buildings and other structures that are not considered to be of special architectural interest are in any way inferior or are of lower value.

The special interest is based on the categories set down in the Planning and Development Act, 2000. While that Act gives no criteria for assigning a special interest to a structure, the National Inventory of Architectural Heritage (NIAH) offers guidelines to its field-workers. This offers guidance by example rather than by definition, and is the system adopted for the present assessment. There are eight categories set down in the Act, viz. archaeological, architectural, historical, technical, cultural, scientific, social and artistic, and the NIAH guidance for each is as follows:

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:-

- An aspiration of aesthetic appeal to its design.
- Good quality or well executed architectural design
- The work of a known and distinguished architect, engineer, designer, craftsman
- 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
- 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 where there is an association with a known fictitious character or event, e.g., Sandycove Martello Tower which featured in Ulysses.

Scientific

A structure may be considered of special scientific interest where it 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.
- In the evaluation of the special interest of a structure it is possible for the structure to have a special interest under more than one of the above categories.

Assessment of Material Assets, as Defined by the EPA (2002)

Context Describe the location and extent of the asset. Does it extend beyond the site boundary?

Character Describe the nature and use of the asset. It is exploited, used or accessible? Is it renewable or non-renewable and if so, over what period?

Significance Describe the significance of the asset. Is the material asset unique, scarce or common in the region? Is its use controlled by known plans, priorities or policies? What trends are evident or may reasonably be inferred?

Sensitivity Describe the changes in the existing environment which could limit the access to, or the use of, the material asset.

Glossary of Impacts as defined by the NRA Guidelines 2006, with reference to the EPA (2002 & 2017)

Impacts are generally categorised as either being a direct impact, an indirect impact or as having no predicted impact. A glossary of impacts as defined by the EPA are as follows: -

- A **direct impact** occurs when a cultural heritage asset is located within the proposed development area and entails the removal of part, or the entire asset
- **Indirect impacts** may be caused due to the close proximity of a development to a cultural heritage asset. Mitigation strategies and knowledge of detail design can often ameliorate any adverse indirect impact. Indirect impacts may include severance of linked features, degradation of setting and amenity or provide a visual intrusion.
- **No predicted impact** occurs when the proposed development does not adversely or positively affect a cultural heritage asset.

The impacts of the proposed scheme on the cultural heritage environment are first assessed in terms of their quality i.e. positive, negative, neutral (or direct and indirect):

Negative Impact	A change that will detract from or permanently remove a cultural heritage asset from the landscape.
Neutral Impact	A change that does not affect the cultural heritage asset.
Positive Impact	A change that improves or enhances the setting of a cultural heritage asset.

Duration of Impacts:

Temporary Impact	Impact lasting for one year or less.
Short-term Impacts	Impact lasting one to seven years.
Medium-term Impact	Impact lasting seven to fifteen years.
Long-term Impact	Impact lasting fifteen to sixty years.
Permanent Impact	Impact lasting over sixty years.

Types of Impacts:

Cumulative Impact	The addition of many small impacts to create one larger, more significant, impact.
Do Nothing Impact	The environment as it would be in the future should no development of any kind be carried out.
Indeterminable Impact	When the full consequences of a change in the environment cannot be described.
Irreversible Impact	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
Residual Impact	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
'*Worst case' Impact*	The impacts arising from a development in the case where mitigation measures substantially fail.

Magnitude of Impact

Extent – size, scale and spatial distributions of the effect
Duration – period of time over which the effect will occur
Frequency – how often the effect will occur
Context – how will the extent, duration and frequency contrast with the accepted baseline conditions.

Magnitude of Impact	Criteria
Very High	Applies where mitigation would be unlikely to remove adverse effects. Reserved for adverse, negative effects only. These effects arise where a cultural heritage asset is completely and irreversibly destroyed by a proposed development.
High	An impact which, by its magnitude, duration or intensity alters an important aspect of the environment. An impact like this would be where part of a cultural heritage asset would be permanently impacted upon leading to a loss of character, integrity and data about the archaeological / cultural heritage feature/site.
Medium	A moderate direct impact arises where a change to the site is proposed which though noticeable is not such that the archaeological / cultural heritage integrity of the site is compromised and which is reversible. This arises where an archaeological / cultural heritage feature can be incorporated into a modern day development without damage and that all procedures used to facilitate this are reversible.
Low	An impact which causes changes in the character of the environment which are not significant or profound and do not directly impact or affect an archaeological / cultural heritage feature, site or monument.
Negligible	An impact capable of measurement but without noticeable consequences.
No change	No change to the asset or setting

Table 11.2 Magnitude Criteria

Sensitivity Criteria

An evaluation of the sensitivity / value of sites and features is based on the extent to which assets contribute to the archaeological or built heritage character, though their individual or group qualities, either directly or potentially and guided by legislation, national policies, acknowledged standards, designations and criteria. The table below presents the scale of sensitivity / value together with criteria.

Sensitivity / Value	Criteria
Very High	Sites of international significance: World Heritage Sites National Monuments Protected Structures of international and national importance Designed landscapes and gardens of national importance Assets of acknowledged international importance or that can contribute significantly to international and national research objectives
High	RMP / SMR sites Designated assets that contribute to regional research objectives Protected Structures of regional importance Architectural Conservation Areas
Medium	Recently / newly identified archaeological sites (not yet included on the SMR / RMP; the importance of the resource has yet to be fully ascertained) Undesignated assets that contribute to regional research objectives NIAH Building Survey and Garden Survey Sites
Low	Undesignated Sites of local importance (e.g. townland / field boundaries) Assets compromised by poor preservation and/or poor survival of contextual associations

Sensitivity / Value	Criteria
	Assets of limited value but with the potential to contribute to local research objectives (e.g. potential buried foundations associated with features / structures shown the 1st edition OS six-inch mapping) Historic townscapes or built up areas of limited historic integrity in their building or their settings
Negligible	Assets with very little or no surviving archaeological interest. Buildings of no architectural or historic note
Unknown	The nature of the resource has yet to be fully ascertained, e.g. sites or areas of specific archaeological potential, greenfield areas or riverine / stream / coastal environs with inherent archaeological potential. Structures with potential historic significance (possibly hidden or inaccessible).

Table 11.3 Sensitivity Criteria

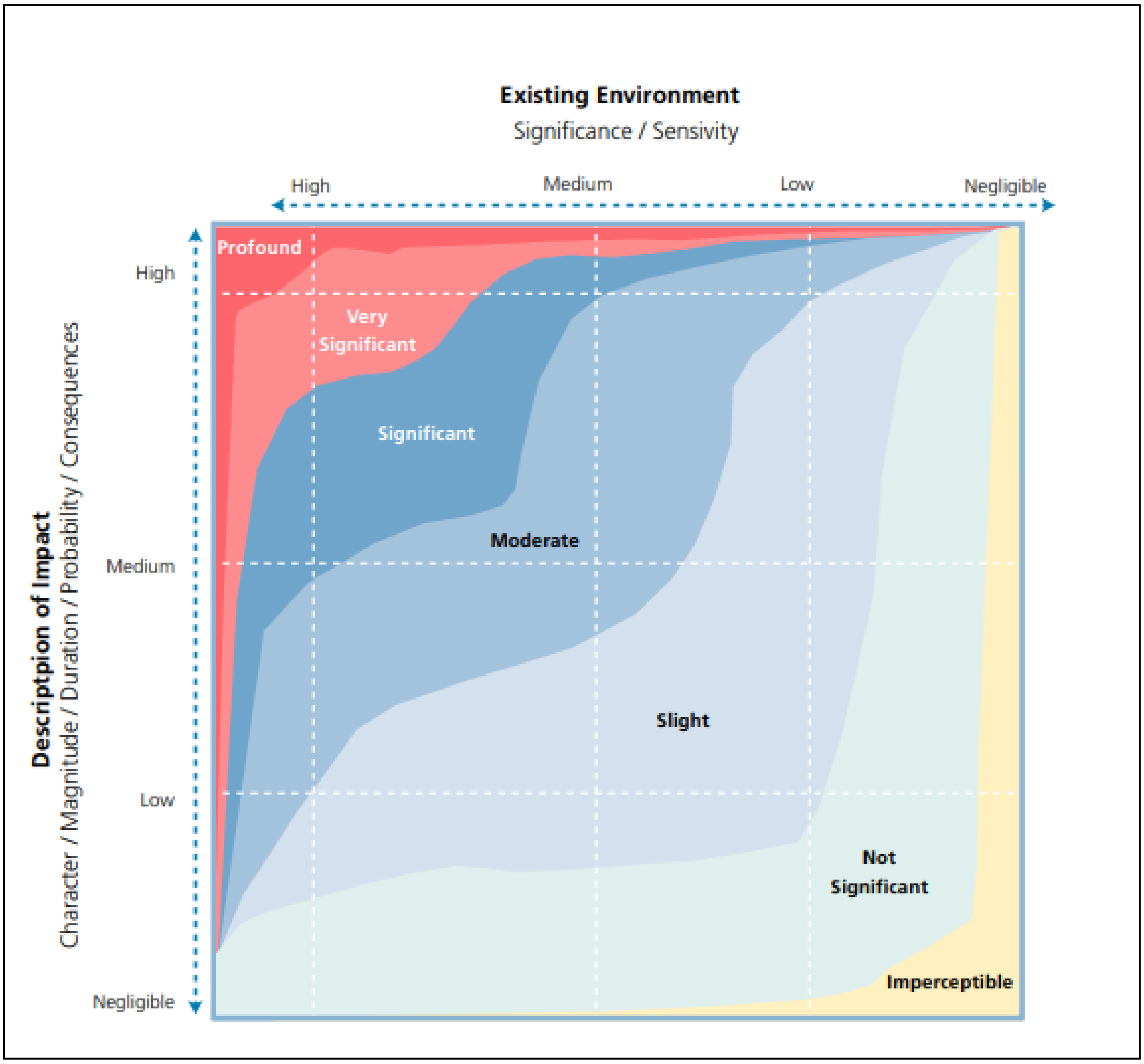
Criteria for Assessment of Impact Significance

Using both the sensitivity of the heritage asset and the magnitude of impact, the impact significance is established (Table 6).

The Draft EPA Revised Guidelines on Information to be contained within an EIS (September 2015) has also added the following levels of significance of effect (as per figure below):

Significance of Effect	Description
Very Significant	An impact which by its character, magnitude, duration or intensity significantly alters the majority of a sensitive aspect of the environment, for example in this case a monument
Not Significant	An effect which causes noticeable changes in the character of the environment but without noticeable consequences.

Table 11.4 Significance of Effects (EPA draft 2015)



Source: Draft EPA Revised Guidelines on Information to be contained within Environmental Impact Assessment Reports (August 2017), p.53