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Report for:

CIRC Management LLP

Care Home Development at Lower Teddington Road and Station Road, Hampton Wick

Air Quality Assessment

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1. INTRODUCTION

ACCON UK Limited (ACCON) has been commissioned by CIRC Management LLP to undertake an Air Quality Assessment to support a planning application for the Proposed Care Home Development at 12-14 Station Road, Hampton Wick and the refurbishment and renovation of Nos 13, 19-33 at Lower Teddington Road, Hampton Wick.

The proposal consists of 28 units at 12-14 Station Road, Hampton Wick and the refurbishment and renovation of Nos 13, 19-33 at Lower Teddington Road, Hampton Wick. The proposed development is located within the administrative boundary of London Borough of Richmond upon Thames (LB Richmond) and is within the Richmond Air Quality Management Area (AQMA), which has been declared for exceedances of both NO_2 and PM_{10} annual mean objective limits since December 2000.

This assessment has been completed in order to determine whether the proposed development achieves compliance against the National Air Quality Objectives (NAQOs), along with National and Local Planning Policy. The assessment has been undertaken in accordance with the Department for Environment, Food and Rural Affairs' (DEFRA) current Technical Guidance on Local Air Quality Management (LAQM.TG16.)[1] and covers the effects of local air quality on the development.

The report assesses the overall pollutant concentrations of nitrogen dioxide (NO_2) and particulates (PM_{10} and $PM_{2.5}$) at the proposed development site and at nearby existing sensitive receptors. A glossary of terms is detailed in **Appendix 1** and the location of the site is shown in **Section 3.1**. The development plan for the site with development receptor locations is identified in **Appendix 5. Appendix 4** identifies nearby sensitive receptor locations, modelled to assess the impacts of additional traffic emissions associated with the operation of the development. It is estimated that the proposed development would be completed and occupied by 2020, subject to receiving planning approval.

The potential air quality constraints on the development and air quality impacts of the development have been assessed on the basis of the findings of detailed dispersion modelling using Breeze Roads GIS Pro Version 5.1.8, which has been undertaken in the context of relevant NAQOs, emission limit values and relevant guidance.

[1] DEFRA, Local Air Quality Management Technical Guidance 2016.

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2. AIR POLLUTION POLICY CONTEXT

2.1. Introduction

In the UK at the present time, emissions from road transport account for a substantial proportion of national air pollutant emissions. Road transport currently contributes almost 22% of national carbon dioxide emissions[2]. Whilst the UK is set to meet its international commitments on carbon dioxide emission reductions, the transport sector carbon dioxide emissions are continuing to grow.

The number of licensed vehicles in Great Britain in 2016 was 37.1 million, an increase of 41% from 1994[3], with 83.1% of these being cars. Between 1994 and 2014, there was a substantial increase in the number of diesel cars on the road from 7.4% to 36.2%. Of the 2,274,550 new car registrations in 2015, 51.3% of the vehicles were diesel, 45.7% were petrol with 3% used alternative fuels[4].

It is evident that continued growth in private car ownership and usage will continue to result in a further deterioration of air quality in urban areas and increasing emissions of greenhouse gases. Whilst current technological improvements extended the reduction in emissions to approximately 2010, additional measures are now required in order to prevent re-growth of emissions, both to meet ambient air quality targets in urban areas and to offer an alternative to the car for urban journeys. Consequently, where new development can be located in relatively close proximity to public transport and local services, a contribution to the UK's target of reducing emissions will have been made.

2.2. Legislation

In 1997, the United Kingdom National Air Quality Strategy (NAQS)[5] was published and this document set out an analysis of the magnitude and potential health and environmental problems associated with air pollutant emissions, particularly those emanating from road traffic.

The strategy proposed a schedule of air quality objectives, which were to be met for various pollutants in the years up to 2005. In setting these objectives, due account was taken of health and socio-economic cost-benefit factors, together with consideration of the practical and pragmatic aspects of whether targets would be achievable. Whilst it was identified in the Strategy that the objectives for benzene, butadiene, lead and carbon monoxide could be achieved as a result of improvement measures already put in place, complying with targets for NO_2 and PM_{10} would be more difficult. In considering what additional measures would have to be introduced to counter these apparent shortfalls, the Government voiced the following thought: "*changes in planning and transport policies (are needed) which would reduce the need to travel and reliance on the car*". With regard to the necessity for encouraging a shift away from private car usage, the Strategy commented, in terms of the new package approach to transport funding, "*As a general rule, traffic demand* management *and restraint measures should be included and this, together with proposals to promote and enhance other modes of transport, should aim to achieve modal shifts away from the private car*".

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[2] Environmental Protection UK. (2010 Update, Published 2017). Car Pollution. Available from www.environmental-protection.org.uk
[3] Department for Transport. (2016). Provisional Road Traffic Estimates, Great Britain: October 2015 - September 2016 Summary
[4] Society of Motor Manufacturers and Traders (2016). Car Registrations October 2016 Overview. Available from www.smmt.co.uk
[5] DEFRA. The National Air Quality Strategy 1997 (1997).

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The White Paper on Integrated Transport (July 1998) proposed a range of measures at both national and local level to address issues of congestion and environmental effects. During the consultation process in 1997, the environmental issue most frequently cited by responses was air quality and it is therefore clear that this problem is uppermost in the mind of the public. The implementation of measures to relieve congestion in urban areas, by means of improvements in provision of public transport and encouragement of a modal shift, will also benefit urban air quality.

A review of the UK Air Quality Strategy was undertaken in 1998 and a consultation document was published in January 1999, outlining proposals for amending the Strategy. In August 1999, in response to the consultation, the Government then published an Air Quality Strategy for England, Scotland, Wales and Northern Ireland. The Air Quality Regulations (England) 2000 enacted in April 2000, and the Air Quality (England) (Amendment) Regulations 2002 gave legal force to the air quality standards set out in the Strategy. A new strategy was released in July 2007 with various amendments to the air quality objectives. The proposals, in brief, consisted of recommendations to adopt the provisions of the EU Air Quality Daughter Directives.

Schedule 2 of the Air Quality Standards Regulations 2010[6] implements a limit value for $PM_{2.5}$ to be achieved by 2015, although they are yet to come into force and only apply to England. The Air Quality Standards (AQS) included in the Air Quality Standards Regulations 2010 are set out in **Appendix 2**.

The 'standards' are set at concentrations below which health effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of a particular pollutant.

The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of the costs, benefits, feasibility and practicality of achieving the standards. The objectives are prescribed within The Air Quality (England) Regulations 2000 (Stationery Office, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (Stationery Office, 2002) (termed the 'Regulations'). Air Quality Objectives included in the Regulations and current legislation (CAFE Directive) which are relevant to the current study (NO_2 and PM_{10}) are outlined in **Appendix 2**.

The Air Quality Objectives only apply where members of the public are likely to be regularly present for the averaging time of the objective (i.e. where people will be exposed to pollutants). The annual mean objectives apply to all locations where members of the public might be regularly exposed; these include building façades of residential properties[7], schools, hospitals and care homes. The 24-hour mean objective applies to all locations where the annual mean objective would apply, together with hotels and gardens of residential properties. The 1-hour mean objective also applies at these locations as well as at any outdoor location where a member of the public might reasonably be expected to stay for 1-hour or more, such as shopping streets, parks and sports grounds, as well as bus stations and railway stations that are not fully enclosed.

Measurements across the UK have shown that the 1-hour mean NO_2 objective is unlikely to be exceeded unless the annual mean NO_2 concentration is greater than 60µg/m^3 [8]. Thus, exceedances

[6] HMSO, (2010). The Air Quality Standards Regulations 2010. Statutory Instrument 1001.
[7] Such locations should represent parts of the garden where relevant public exposure is likely, for example where there are seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.

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of 60µg/m^3 as an annual mean NO_2 concentration are used as an indicator of potential exceedances of the 1-hour mean NO_2 objective.

Similarly, studies have also established a relationship between the annual mean PM_{10} concentration and number of exceedances of the 24-hour mean objective: those areas where the annual mean concentrations are greater than 32µg/m^3 were demonstrated to be at risk of exceeding the 24-hour mean objective. Thus, exceedances of 32µg/m^3 as an annual mean PM_{10} concentration are used as an indicator of potential exceedances of the 24-hour mean PM_{10} objective.

The Draft Clean Air Strategy 2018[9] was released for consultation in summer 2017 and is still under review. Once published it will supersede the policies featured in The National Air Quality Strategy 1997 and is currently a material consideration in planning and transport policy. The strategy mainly deals with how to improve air quality in England but also discusses air quality policy in the devolved administrations. In comparison with the previous strategy it has a more joined-up approach, incorporating transport, domestic, industrial and agricultural emission reduction policies with a combined focus on both ambient and indoor air quality. The plan also has an emphasis on the proposal to use Clean Air Zones (CAZs) and the ULEZ (in London) to quickly bring highly polluted urban centres below the legal limits. Some of the key policies in the plan are a renewed consideration of under-used Smoke Control Areas due to the growth of highly polluting domestic wood burning stoves, new best practices being incorporated into the agricultural sector to reduce ammonia emissions (and their associated secondary particulates) and with a policy to prohibit the sale of new petrol and diesel car by 2040. However, air quality objective limits outlined in the document are largely unchanged from the previous strategy.

2.3. Planning Policy

2.3.1. National Planning Policy Framework

The National Planning Policy Framework[10] was published in July 2018 and *"sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced"*. Air quality policy is discussed in Paragraph 181, which states:

> *"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan"*

[8] DEFRA, 2007. Analysis of the Relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites, 2003. Laxen and Mariner.
[9] DEFRA, Draft Clean Air Strategy 2018
[10] Ministry of Housing, Communities and Local Government, National Planning Policy Framework, July 2018

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2.3.2. National Planning Practice Guidance

Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impacts in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife).

When deciding whether air quality is relevant to a planning application, considerations could include whether the development would:

- Significantly affect traffic in the immediate vicinity of the proposed development site or further afield. This could be by generating or increasing traffic congestion; significantly changing traffic volumes, vehicle speed or both; or significantly altering the traffic composition on local roads.
- Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality.
- Give rise to potentially unacceptable impact (such as dust) during construction for nearby sensitive locations.

Mitigation options where necessary will be locationally specific, will depend on the proposed development and should be proportionate to the likely impact. It is important therefore that local planning authorities work with applicants to consider appropriate mitigation so as to ensure the new development is appropriate for its location and unacceptable risks are prevented. Planning conditions and obligations can be used to secure mitigation where the relevant tests are met.

Examples of mitigation include:

- The design and layout of development to increase separation distances from sources of air pollution;
- Using green infrastructure, in particular trees, to absorb dust and other pollutants;
- Means of ventilation;
- Promoting infrastructure to promote modes of transport with low impact on air quality;
- Controlling dust and emissions from construction, operation and demolition; and
- Contributing funding to measures, including those identified in air quality action plans and low emission strategies, designed to offset the impact on air quality arising from new development.

2.3.3. London Borough of Richmond upon Thames Local Plan

The London Borough of Richmond Upon Thames Core Strategy[11], which was adopted in April 2009 sets out the key planning policies which will, within the broader context of the London Plan, determine the future development of Richmond upon Thames over the next 15 years. The Core Strategy has three core values that guide its policies:

- *'A Sustainable Future'*
- *'Protecting Local Character'*

[11] Medway Council, Medway Local Plan, May 2003

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- *“‘Meeting People’s Needs’*

The Borough’s Local Development Framework Vision focuses on sustainable future where:

> *“The Borough will play its part in minimising climate change, maintaining finite resources and reducing adverse environmental impacts of any development. Buildings will be constructed in a sustainable way, energy use minimised and renewable energy maximised, to move towards carbon neutrality. The need for travel will be minimised and non-car based travel will increase, contributing to reducing congestion and improving air quality.”*

LB Richmond also has a Local Plan from July 2018 which will cover development in the area until 2033. To deliver the Local Plan's vision, strategic objectives will need to be achieved. In the Air Quality context, it is stated:

> *“Reduce or mitigate environmental impacts and pollution levels (such as air, noise, light, odour, fumes water and soil) and encourage improvements in air quality, particularly along major roads and areas that already exceed acceptable air quality standards.”*

The plan also contains a policy on Local Environmental Impacts, Pollution and Land Contamination (paragraph 4.10) and the council’s approach to the policy is as follows:

> *“The Council promotes good air quality design and new technologies. Developers should secure at least 'Emissions Neutral' development. To consider the impact of introducing new developments in areas already subject to poor air quality, the following will be required:*
>
> 1. *an air quality impact assessment, including where necessary, modelled data;*
> 2. *mitigation measures to reduce the development's impact upon air quality, including the type of equipment installed, thermal insulation and ducting abatement technology;*
> 3. *measures to protect the occupiers of new developments from existing sources;*
> 4. *strict mitigation for developments to be used by sensitive receptors such as schools, hospitals and care homes in areas of existing poor air quality; this also applies to proposals close to developments used by sensitive receptors.”*

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3. SITE DESCRIPTION AND BASELINE CONDITIONS

3.1. Site Description

The Proposed Care Home Developments are located to the west of Lower Teddington Road, Hampton Wick and approximately 50 metres easterly from Seymour Road. The site is located within the Richmond AQMA which has been declared for exceedances of both NO_2 and PM_{10} annual mean objective limit since December 2000.

The location and the red line boundary of the site are detailed below in **Figure 3.1**.

Figure 3.1: Site Location Plan

3.2. Air Quality Review and Assessment

As previously indicated, Local Authorities have been required to carry out a review of local air quality within their boundaries to assess areas that may fail to achieve the limit values. Where these objectives are unlikely to be achieved, local authorities must designate these areas as AQMA's and prepare a written action plan to achieve the AQS's.

The review of air quality takes on several prescribed stages, of which each stage is reported. LB Richmond's Air Quality Annual Status Report 2018[12] provides the most recent air quality monitoring results for the Borough (2018). Details of the monitoring data used for model verification purposes is provided in **Section 3.3.**

3.3. Local Air Quality Monitoring

The London Borough of Richmond upon Thames (LB Richmond) monitors local air quality through a diffusion tube monitoring network. The monitoring sites chosen for verification of the air quality modelling were the diffusion tubes:

[12] London Borough of Richmond Upon Thames, 2018 Air Quality Annual Status Report (ASR) for 2017

- 6, located at Kingston Road, Teddington (near. Woffington Close)
- 45, located at 154 High St, Teddington

The 2017 annual mean NO_2 concentrations for the monitoring sites are shown in **Table 3.1** below. The annual mean NO_2 NAQO was not exceeded at any of the monitoring sites.

Table 3.1: Local Monitoring Data Suitable for Model Verification

Monitor Site Number	Distance to nearest Kerb (m)	Grid Reference		2017 Annual Mean NO_2 (µg/m^3)	2017 Data Capture (%)
		X	Y		
6	0.7	517,266	170,031	30.0	100
45	0.5	516,383	171,154	35.0	100

3.4. Identification of Relevant Receptors

To assess the potential air quality constraints on the development site, sensitive receptor locations were modelled at key locations on the boundaries of the proposed residential development. Development receptors were modelled at the ground floor. Higher floors were not modelled as the general trend for pollutant concentrations is to reduce with increasing height, therefore it was only deemed necessary to model them at the ground floor.

To determine if there is likely to be any air quality impacts from the development on nearby existing sensitive receptors, existing receptors (ER) have been identified in the local surrounding area. These were modelled at the ground floor at 1.5 metres. **Appendices 4** and **5** identify the ER and DR locations.

3.5. Background Concentration of Air Pollutants

Background concentrations of air pollutants for the modelling were obtained from the pollutant concentration maps which were updated by DEFRA in November 2017. These updated maps are based on monitoring and meteorological data for 2015. **Table 3.2** identifies the pollutant concentrations at the diffusion tubes and the proposed development site. The estimated background concentrations for annual mean NO_2 and PM_{10} used in the assessment are below the annual mean objective limit of 40µg/m^3 in 2017 and 2020.

Table 3.2: Background Concentrations of Pollutants

Location and Year	NO_x µg/m^3	NO_2 µg/m^3	PM_{10} µg/m^3	$PM_{2.5}$ µg/m^3
2017- Verification for 6 (517,500,170,500)	28.3	19.6	14.7	9.7
2017- Verification for 45 (516,500,171,500)	29.7	20.4	15.0	9.8
2020- Proposed Development Site (517,500, 169,500)	33.4	22.6	15.2	10.0

Note: In 2020 the ratio between PM_{10} and $PM_{2.5}$ at the proposed development and at the Existing Receptors (…) is 0.65, at the Existing Receptors (…) is ….

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4. METHODOLOGY AND ASSESSMENT CRITERIA

4.1. Methodology

In the UK, DEFRA provides guidance on the most appropriate methods to estimate pollutant concentrations for use in Local Air Quality Management (LAQM). DEFRA regularly updates its Technical Guidance, with the latest LAQM Technical Guidance (TG16) published in April 2016. The methodology in LAQM.TG16. directs air quality professionals to a number of tools published by DEFRA to predict and manage air quality. For example, it is necessary to use the updated NO_x to NO_2 calculator to derive NO_2 concentrations from the NO_x outputs from Breeze Roads modelling. This is because NO_2 concentrations within the model are otherwise predicted using the CALINE4 NO_x to NO_2 conversion methodology, which should not be used within the model as current evidence shows that the proportion of primary NO_2 in vehicle exhausts has increased since the model was developed, which would affect the relationship between NO_x and NO_2 at roadside locations.

In order to determine the extent to which air quality issues will affect the development of the site, the study has considered the following:

- Any air quality measurements carried out in the area near the proposed development; and
- The most recent Air Quality Review and Assessment Reports from LB Richmond.

4.2. Breeze Roads Modelling of Pollutant Concentrations

Dispersion modelling has been undertaken using Breeze Roads to determine air quality concentrations across the site. Breeze Roads is an air dispersion modelling software suite that predicts air quality impacts of carbon monoxide (CO), nitrogen dioxide, particulate matter (PM), and other inert pollutant concentrations from moving and idling motor vehicles at or alongside roadways and roadway intersections.

Breeze Roads can be used in conjunction with the MOBILE5, EMFAC emission models or other emissions data, to demonstrate compliance with the UK's National Air Quality Strategy. Breeze Roads predicts air pollutant concentrations near highways and arterial streets due to emissions from motor vehicles operating under free-flow conditions and idling vehicles. In addition, 1-hour and running 8-hour averages of CO or 24-hour and annual block averages of PM_{10} can be calculated.

4.3. Model Set-up Parameters

The most recent Emissions Factor Toolkit (EFT, version 8.0.1, December 2017) issued by DEFRA was used to derive emissions factors (in grams per kilometre) for vehicle movements along roads incorporated into the model. This version of the EFT includes updates to COPERT NOx and PM_{10} emissions factors for road traffic which are taken from the European Environment Agency EEA COPERT 5 emissions calculation tool, including new EURO 6 subcategories.

There have also been updated to the vehicle fleet and age information. Version 8.0.1 of the EFT was produced by DEFRA in response to changes in 'real world' vehicle emissions. As such, it has been assumed that the EFT produces reliable emission factors which are suitable for dispersion modelling as it is the most up-to-date tool provided by DEFRA. 2017 meteorological data from Heathrow has been used in the modelling. Additionally, it should be noted that there has recently been a marked downturn in the sales of diesel cars such that the EFT, which includes the vehicle fleet mix, may have an unrealistically high %age of diesel cars such that any modelling is likely to be an over prediction and a worst-case scenario.

4.4. Local Air Quality Management Technical Guidance (2016) Recommendations

The Local Air Quality Management Technical Guidance (TG.16) has made recommendations of where the AQS should and should not be applied, as summarised in **Table 4.1**.

As it is not always possible to be prescriptive in this matter, Local Authorities may apply local knowledge and judgement when considering the application of the AQS. The examples given in **Table 4.1** are not intended to be a comprehensive list.

Table 4.1: Examples of Where AQS Should Be Applied

Averaging Period	AQS Should Apply	AQS Should Not Apply
Annual Mean	All locations where members of the public might be regularly exposed. Building facades of: • Residential properties • Schools • Hospitals • Care homes etc.	Building facades of offices or other places of work where members of the public do not have regular access. • Hotels, unless people live there as their permanent residence. • Residential gardens • Kerbside sites or any other location where public exposure is expected to be short term.
24-hour and 8-hour mean	All locations where the annual mean objective would apply. • Hotels • Residential gardens	Kerbside sites or any other location where public exposure is expected to be short term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. • Kerbside sites (e.g. pavements of busy shopping streets) • Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might spend one hour or more. • Any outdoor locations where members of the public might spend one hour or longer.	Kerbside sites where the public would not be expected to have regular access.
15-min mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	

4.5. Applying the AQS to this Development

As this planning appeal includes residential properties and the assessment of existing sensitive receptors, the AQS calendar year limit value will be applied. As such, annual mean objectives will be considered.

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4.6. Assessment Criteria

A detailed assessment was considered appropriate for this proposed development with model results being verified against local monitoring data. This was undertaken using the detailed dispersion model Breeze Roads.

For the purposes of this assessment, the limit values assigned to individual pollutants as set out in the Air Quality Standards Regulations 2010 form the basis of the air quality assessment. The limit values are based on an assessment of the effects of each pollutant on public health. Therefore, they are a good indicator in assessing whether, under normal circumstances, the air quality in the vicinity of a development is likely to be detrimental to human health.

4.7. Operation Phase

The main pollutants of concern are generally considered to be NO_2 and PM_{10} for road traffic. The Breeze Roads methodology has been used for this assessment to predict the constraints on development and also to predict the impacts of any additional traffic generated from the development on surrounding sensitive receptors.

For the assessment, the following scenarios were considered:

- 2017 Model Verification;
- 2020 Opening Year Without Development; and
- 2020 Opening Year With Development.

4.8. Traffic Data

The Breeze Roads prediction model requires the user to provide various input data, including the Annual Average Hourly Traffic (AAHT) flow, the number of heavy-duty vehicles (HDVs), the distance of the road centreline from the receptors and vehicle speeds.

The traffic information is detailed in **Table 4.2** and **Table 4.3** below for the verification and assessment scenarios. For the verification scenario traffic flow and vehicle split data were obtained from the Department for Transport (DfT). Vehicle speeds were estimated based on local speed limits and traffic conditions and were reduced near junctions and crossings to replicate queuing traffic. These monitoring locations were chosen for verification purposes as they are amongst the closest to the Proposed Development and were selected after careful consideration of the available traffic data in the area. Where the location of diffusion tubes could not be accurately determined, they were not utilised for the verification assessment despite their proximity to the Proposed Development.

The DfT currently provides traffic data for 2017.

Table 4.2: 2017 Traffic Flow Data for Verification

Monitoring Site	Road Section	AAHT	Speed (km/h)	HDV%
6	Upper Teddington	645	25	4.3
	Upper Teddington, Junction with Normansfield Avenue	645	20	4.3
	Upper Teddington (Bus Stop)	645	15	4.3

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Monitoring Site	Road Section	AAHT	Speed (km/h)	HDV%
45	High Street	443	30	7
	High Street (Bus Stop)	443	25	7

Note: This is a non-exhaustive summary of the road sections modelled and includes the sections that are likely to contribute the greatest emissions to the development receptors.

Table 4.3 identifies the estimated 2020 AAHT traffic flows for roads near to the proposed development (for use in the constraints and impacts modelling). For the "without development" scenario, 2017 traffic flows of the nearby roads were obtained from the Department for Transport and these were scaled to the occupation date for development (2020) using a LB Richmond specific traffic growth factor of YYYYY obtained from TEMPro. The Lower Teddington Road and Station Road Traffic Flows for 2018 were obtained from the Traffic Consultants[13] and were scaled to the occupation date for development (2020) using a LB Richmond specific traffic growth factor of 1.0479 obtained from TEMPro. The "with development" scenario took account of the air quality impacts as a result of the likely traffic impacts of the proposed development. It is noted that the Transport Statement identifies a small reduction in generated traffic when compared to the existing situation. The combined daily trips expected to be generated by the development is XXX vehicles. The traffic generation figure for all of the development was combined with the 2020 baseline flows to produce the total traffic flows used in the "with development" scenario. Vehicle speeds were estimated based on local speed limits and traffic conditions and were reduced near junctions and crossings to replicate queuing traffic.

Table 4.3: 2020 Opening Year Traffic Flow Data TO BE COMPLETED

Model scenarios	Road Section	AAHT	Speed (km/h)	HGV (%)
Opening Year Without Development				
Opening Year With Development				

Note: This is a non-exhaustive summary of the road sections modelled and includes the sections that are most likely to contribute the greatest emissions to the development receptors.

[13] Paul Mew Associates (2018), Transport Statement, Lower Teddington and Station Road, Kingston Upon Thames

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4.9. Validation and Verification of the Model

Model validation undertaken by the software developer will not have been carried out in the vicinity of the site being considered in this assessment. As a result, it is necessary to perform a comparison of the modelled results with local monitoring data at suitable locations. This verification process aims to minimise model uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results. The verification was carried out in accordance with LAQM.TG16. Suitable monitoring data for the purpose of verification is available for concentrations of NO_2 and PM_{10} at the monitoring positions detailed in **Section 3.3**.

The verification exercise resulted in an average difference for the NO_x contribution between the modelled and monitored NO_x roads of -68.25%, which indicates that the model is significantly under-predicting. When the monitored and modelled results are compared as recommended in LAQM.TG16 the road NO_X adjustment factor is **3.362** (as identified in **Table 4.4**). This factor was applied to all modelled NO_x results prior to calculating modelled NO_2 using the NO_x to NO_2 calculator. In the absence of appropriate PM_{10} monitoring within close proximity to the site, the NO_x adjustment factor has also been applied to the PM_{10} modelled concentrations, in accordance with the guidance provided in LAQM.TG16.

Table 4.4: NO_2 Annual Mean Verification for 2017

Monitoring Position	Monitored		Modelled		% Difference (NO_2 Total) Before Adjustment	% Difference (NO_2 Total) After Adjustment	Road NO_X Factor
	Road NO_2 µg/m³	Road NO_X[14] µg/m³	Road NO_2 µg/m³	Road NO_X µg/m³			
6	30.0	21.9	2.59	5.2	-26.1	-6.7	**3.362**
45	35.0	31.6	6.1	12.6	-24.2	13.0	

Typically, with smaller datasets, the root mean square error (RMSE) is the important statistic and the verification process resulted in an RMSE below the target value of <4 µg/m³, where the concentration may be near the AQO, as identified in **Table 4.5**. Therefore, there is a high level of confidence in the verification process.

Table 4.5: Summary of the Statistics Used to Assess Model Uncertainty

Statistical Parameter	Value	Description
Correlation Coefficient	1.000	Used to measure the linear relationship between predicted and observed data. The ideal value (an absolute relationship) is 1.
Root Mean Square Error (RMSE)	3.5	RMSE defines the average error/uncertainty of the model verification and is in the same units as the model outputs (µg/m³). Values should be <10µg/m³ or ideally <4µg/m³ where concentrations are near the AQO. The ideal value is 0µg/m³.
Fractional Bias	0.0	Identifies if the model shows a systematic tendency to over/under predict concentrations. The ideal value is 0 and range between +/- 2. Negative values suggest an over prediction whilst positive values suggest under prediction.

[14] Obtained from NO_X to NO_2 Calculator Spreadsheet available from www.laqm.Defra.gov.uk

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4.10. Assessment of $PM_{2.5}$

The 2007 Air Quality Strategy introduced a new exposure reduction regime for $PM_{2.5}$, tiny particles associated with respiratory and cardio-vascular illness and mortality which have no known safe limit for human exposure. The new regime will attempt to reduce the exposure of all urban dwellers, alongside the existing method of reducing hotspots of PM exposure. $PM_{2.5}$ typically makes up two thirds of PM_{10} emissions and concentrations. However, objectives for $PM_{2.5}$ (as shown in **Table 4.6**) are not currently incorporated into Local Air Quality Management regulations, therefore there is no statutory obligation to review and assess air quality against them.

Table 4.6: National Exposure Reduction Target, Target Value and Limit Value for $PM_{2.5}$

Time Period	Objective/Obligation	To be achieved by
Annual mean	Target value of 25µg/m^3	2010
Annual mean	Limit value of 25µg/m^3	2015
Annual mean	Stage 2 indicative limit value of 20µg/m^3	2020
3 year Average Exposure Indicator (AEI)[a]	Exposure reduction target relative to the AEI depending on the 2010 value of the 3 year AEI (ranging from a 0% to a 20% reduction)	2020
3 year Average Exposure Indicator (AEI)[a]	Exposure concentration obligation of 20µg/m^3 (of vegetation)	2015

[a] The 3 year running mean of AEI is calculated from the $PM_{2.5}$ concentration averaged across all urban background monitoring locations in the UK e.g. the AEI for 2010 is the mean concentration measured over 2008, 2009 and 2010.

Presently, Breeze Roads does not predict the concentration of $PM_{2.5}$ as part of the methodology, therefore, the future concentration of $PM_{2.5}$ will be calculated using the typical ratio between the background concentrations of PM_{10} and $PM_{2.5}$ for the opening year of development. This predicted concentration will then be compared against the annual mean Objective Limit value of 25µg/m^3.

5. IMPACTS AND CONSTRAINTS OF AIR QUALITY

5.1. Air Quality Impact of Development Traffic - Acceptability Criteria

It is common in the UK to use the Environmental Protection UK's (EPUK) Guidance[15] on Air Quality Assessments for Planning Applications to assess the impact of a development. This advises that an air quality assessment will be required where the development is anticipated to give rise to significant changes in air quality. There will also be a need to assess air quality implications of a development where a significant change in relevant exposure is anticipated. A full air quality assessment should normally be undertaken where proposals give rise to significant changes in traffic flows, typically a change in annual average daily traffic (AADT) of 100 LDV flows in or adjacent to an AQMA or 500 LDV flows elsewhere. Other changes caused by a development such as a major new junction, significant road realignment or a substantial increase in HDV traffic may also warrant a full impact assessment.

5.2. Air Quality Impacts

In January 2017, Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) updated their guidance on "Land-Use Planning and Development Control: Planning for Air Quality". The guidance provides a methodology for determining the impacts of increased pollutant concentrations at sensitive receptor locations resulting from emission sources such as the generation of traffic from development sites.

To characterise the impacts of the proposed development on local air quality, predictions of air pollutant concentrations have been made for the operational year of 2020 using the Breeze Roads dispersion model.

Table 5.1: Impacts of Pollutant Concentrations as a result of the Development

Long-Term Average Concentration in Assessment Year	% Change in Concentration relative to the Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial
The AQAL is the Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level'				

5.3. Air Quality Impact of Development Traffic - Assessment TO BE COMPLETELY REVISED

The proposed residential development will result in XXX additional AADT vehicle movements onto the local road network. Sensitive receptors were modelled at the façades of existing properties near the proposed development. These existing sensitive receptor locations are identified in **Appendix 4** and the modelled predicted NO_2 and particulate matter pollutant concentrations at these existing receptors are identified in **Tables 5.2** and **5.4**.

[15] Environmental Protection UK and IAQM (2017) – Land-Use Planning and Development Control: Planning for Air Quality

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5.4. Predicted Constraints on Development

In order to characterise the air quality at the proposed development, predictions of air pollutant concentrations have been carried out for the occupation year of 2020 using the Breeze Roads dispersion model and UK emission factors. The results of the predictions which include the road NO_X adjustment factor (**Table 4.4**) can be identified in **Tables 5.3** and **5.5**.

5.5. 2020 Pollutant Concentrations TO BE COMPLETELY REVISED

5.5.1. 2020 Annual Mean NO_2 Concentrations- Existing Receptors

Table 5.2 identifies the modelled NO_2 concentrations at existing receptors in 2020 both with the development completed and fully occupied and without the development. All impacts are classified based on the criteria found in **Table 5.1**. All the receptors experience changes that are classified as negligible, whilst the largest impact experienced was an increase of 0.3µg/m^3 at ER3. Where differences in pollutant concentrations are identified in **Table 5.1** for the same primary road this is due to the distance of the sensitive receptor from the kerbside of the road.

All of the pollutant concentrations will remain significantly below the annual NO_2 AQO. In respect of the NO_2 1-hour AQO, there is only a risk that the NO_2 1-hour objective (200µg/m^3) could be exceeded at local sensitive receptors if the annual mean NO_2 concentration is greater than 60µg/m^3. Therefore, exceedances of NO_2 1-hour AQO would not be expected in 2020 as the worst-case annual mean predicted concentration is 20.2µg/m^3 (ER3).

Table 5.2: Modelled 2020 NO_2 Concentrations – Existing Receptors

Receptor	Floor	Air Quality Objective (µg/m^3)	Without Development Total NO_2 (µg/m^3)	With Development Total NO_2 (µg/m^3)	Change in Concentration (µg/m3)	Impact Descriptor
ER1	Ground	40				
ER2		40				
ER3		40				
ER4		40				
ER5		40				

5.5.2. Air Quality Constraints- 2020 Annual Mean NO_2 Concentrations

Table 5.3 identifies the modelled NO_2 concentrations at development receptors in 2020. As the planning application was in outline only, the development receptors have been modelled on the boundary of the site, approximately five metres from the kerbside, as a worst-case. At the development site, the worst-case annual mean predicted concentration is 13.3µg/m^3 at both DR1 and DR2. Therefore, exceedances of the NO_2 1-hour AQO in 2020, would not be expected.

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Table 5.3: Modelled 2020 NO_2 Concentrations – Development Receptors

Receptor	Floor	Air Quality Objective (µg/m³)	NO_2 Road Contribution (µg/m³)	Total NO_2 (µg/m³)
DR1	Ground	40		
DR2				
DR3				
DR4				
DR5				

5.5.3. 2020 Annual Mean Particulate Matter Concentrations- Existing Receptors

Table 5.4 identifies the modelled PM_{10} and $PM_{2.5}$ concentrations in 2020 both with and without the development completed and fully operational. The highest predicted annual mean PM_{10} concentration with and without the development is 14.8µg/m³ at ER1. The highest predicted annual mean $PM_{2.5}$ concentration with and without the development is 10.1µg/m³ at ER1. The greatest change in PM_{10} concentration is 0.1µg/m³.

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Table 5.4 Modelled 2020 PM10 and PM2.5 Concentrations – Existing Receptors

Receptor	Total PM_{10} Without Development µg/m³ (Days >50 µg/m³)	Total PM_{10} With Development µg/m³ (Days >50 µg/m³) [16]	Change in PM_{10} (µg/m3)	Total $PM_{2.5}$ Without Development µg/m³	Total $PM_{2.5}$ With Development µg/m³	Change in $PM_{2.5}$ (µg/m3)
ER1						
ER2						
ER3						
ER4						
ER5						

5.5.4. Air Quality Constraints – 2020 Annual Mean Particulate Matter Concentrations

Table 5.5 identifies the modelled PM_{10} concentrations in 2020. Modelled PM_{10} and $PM_{2.5}$ concentrations are ... and ... at both development receptors, respectively.

Table 5.5: Modelled 2020 PM_{10} and $PM_{2.5}$ Concentrations – Development Receptors

Receptor	Floor	PM_{10} Air Quality Objective (µg/m³)	Total PM_{10} µg/m³ (Days >50 µg/m³) [17]	$PM_{2.5}$ Air Quality Objective (µg/m³)	Total $PM_{2.5}$ µg/m³
DR1	Ground	40			
DR2		40			
DR3		40			
DR4		40			

[16] Not to be exceeded more than 35 times a year.
[17] Not to be exceeded more than 35 times a year.

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6. MITIGATION

6.1. Operation Phase TO BE COMPLETELY REVISED

As identified by the constraints assessment, there are no exceedances of the NAQO's for NO_2, PM_{10} or $PM_{2.5}$ at any of the proposed development receptors for the projected completion year of 2020. The highest modelled NO_2 concentration and PM_{10} concentration at sensitive development receptors are 13.3µg/m^3 and 13.8µg/m^3 respectively which are below the annual mean NO_2 and PM_{10} objective values of 40µg/m^3.

As identified by the impact assessment, there are no exceedances of the NAQO's for, PM_{10} or $PM_{2.5}$ at any of the existing sensitive receptors.

The highest expected increase in NO_2 concentrations at an existing receptor with the development in place is 0.3µg/m^3 at ER3. Of these existing receptors, the highest resultant NO_2 pollutant concentration was at ER3 with a concentration of 20.2µg/m^3.

The highest expected increase in PM_{10} concentrations at an existing receptor with the development in place is 0.1µg/m^3. Of these existing receptors, the highest resultant PM_{10} pollutant concentration was at ER1 with a concentration of 14.8µg/m^3.

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7. CONCLUSIONS SUBJECT TO CHANGE

During the operation phase, the Breeze Roads modelling predicts that there will be no exceedances of the nitrogen dioxide or particulate matter objectives at the sensitive development receptors on the proposed development site.

The modelling also predicts that there will be negligible increases in nitrogen dioxide and particulate matter at existing sensitive receptors as a result of the proposed development and that pollutant concentrations will remain significantly below the air quality objective levels.

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APPENDICES

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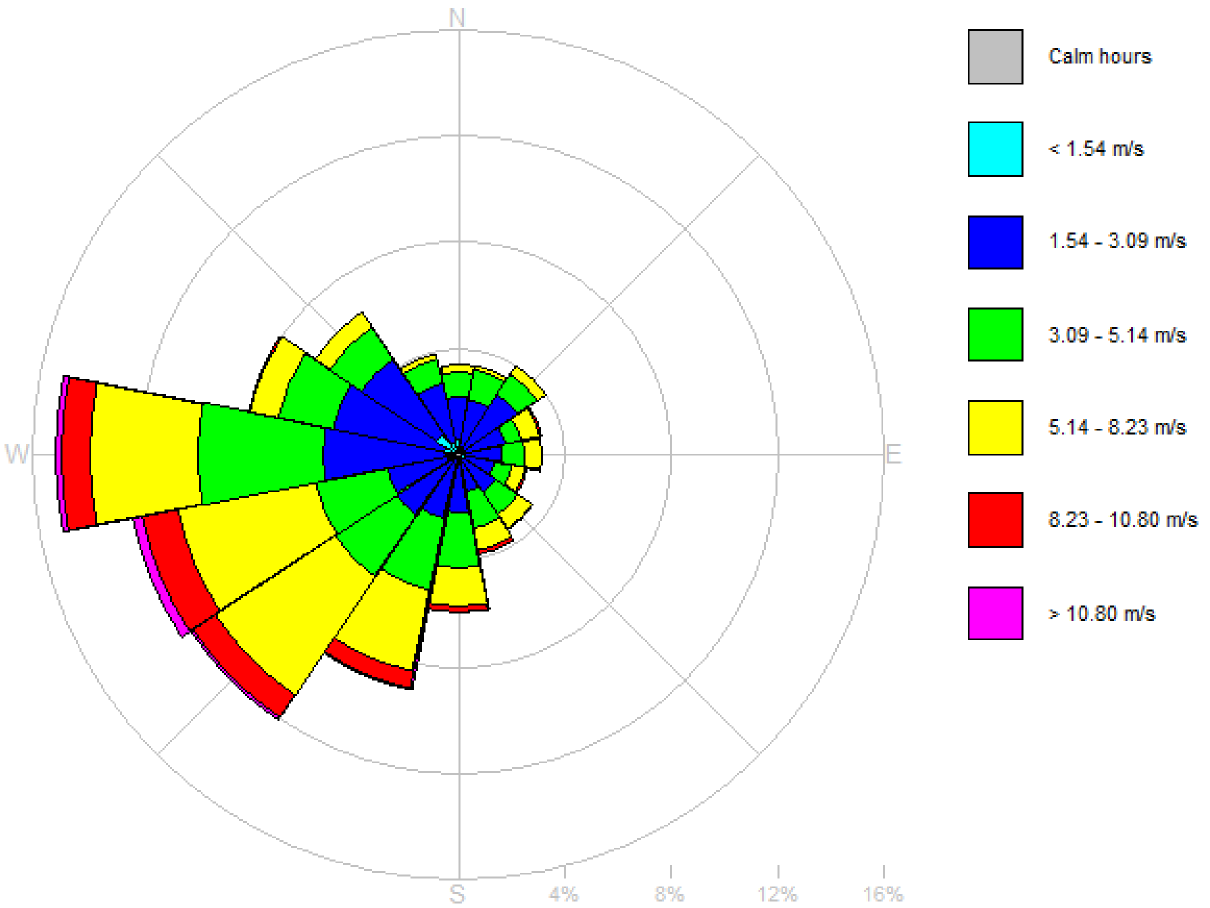
Appendix 1: Glossary of Terms

AADT	Annual Average Daily Traffic
AAHT	Annual Average Hourly Traffic
AQMA	Air Quality Management Area -An area that a local authority has designated for action, based upon predicted exceedances of Air Quality Objectives.
AQS/ NAQOs	Air Quality Standard/ National Air Quality Objectives - The concentrations of pollutants in the atmosphere, which can broadly be taken to achieve a certain level of environmental quality. The standards are based on assessment of the effects of each pollutant on human health including the effects on sensitive sub groups.
AURN	Automatic Urban and Rural Network Air Quality Monitoring Site.
Calendar Year	The average of the concentrations measured for each pollutant for one year. In the case of the AQS this is for a calendar year.
Concentration	The amount of a (polluting) substance in a volume (of air), typically expressed as a mass of pollutant per unit volume of air (for example, micrograms per cubic metre, $\mu g/m^3$) or a volume of gaseous pollutant per unit volume of air (parts per million, ppm).
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emissions Factor Toolkit
Exceedance	A period of time where the concentration of a pollutant is greater than the appropriate Air Quality Objective.
HDV	Heavy Duty Vehicle
HGV	Heavy Goods Vehicle
LAQM	Local Air Quality Management
Nitrogen Oxides	Nitric oxide (NO) is mainly derived from road transport emissions and other combustion processes such as the electricity supply industry. NO is not considered to be harmful to health. However, once released to the atmosphere, NO is usually very rapidly oxidised to nitrogen dioxide (NO_2), which is harmful to health. NO_2 and NO are both oxides of nitrogen and together are referred to as nitrogen oxides (NO_x).
PM_{10}/$PM_{2.5}$	Fine Particles are composed of a wide range of materials arising from a variety of sources including combustion sources (mainly road traffic), and coarse particles, suspended soils and dust from construction work. Particles are measured in a number of different size fractions according to their mean aerodynamic diameter. Most monitoring is currently focused on PM_{10} (less than 10 microns in aero-dynamic diameter), but the finer fractions such as $PM_{2.5}$ (less than 2.5 microns in aero-dynamic diameter) is becoming of increasing interest in terms of health effects.
TEMPro	TEMPro is software produced by the DfT to calculate the expected growth of traffic by year on roads throughout the country. The factor varies depending on the region and type of road.
$\mu g/m^3$	Micrograms per cubic metre of air - A measure of concentration in terms of mass per unit volume. A concentration of $1\mu g/m^3$ means that one cubic metre of air contains one microgram (millionth of a gram) of pollution.

Appendix 2: Air Quality Standards

Pollutant	Averaging Period	Limit Value	Margin of Tolerance
Benzene	Calendar Year	5µg/m^3	
Carbon Monoxide	Maximum daily running 8 Hour Mean	10mg/m^3	
Lead	Calendar Year	0.5µg/m^3	100%
Nitrogen Dioxide	One Hour	200µg/m^3 Not to be exceeded more than 18 times per year	
	Calendar Year	40µg/m^3	
Particulates (PM_{10})	One day	50µg/m^3 Not to be exceeded more than 35 times per year	50%
	Calendar Year	40µg/m^3	20%
Particulates ($PM_{2.5}$)	Calendar Year	25µg/m^3	20%
Sulphur Dioxide	One Hour	350µg/m^3 Not to be exceeded more than 24 times per calendar year	150µg/m^3
	One Day	150µg/m^3 Not to be exceeded more than 3 times per calendar year	

Appendix 3: 2017 Heathrow Airport Wind Rose



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Appendix 4: Proposed Development - Nearby Existing Receptor Locations

LEGEND

- ● Existing Receptor Location
- **ER1** Existing Receptor Number
- — Site Boundary

Client: CIRC Management LLP		Proposed Development - Nearby Existing Receptors		Design:	NG	accon UK ENVIRONMENTAL CONSULTANTS
				Drawn:	NG	
Rev: A	Description: FINAL	Rev: A		Checked:	GP	*Appendix 4*
				Approved:	GP	Scale: On Map

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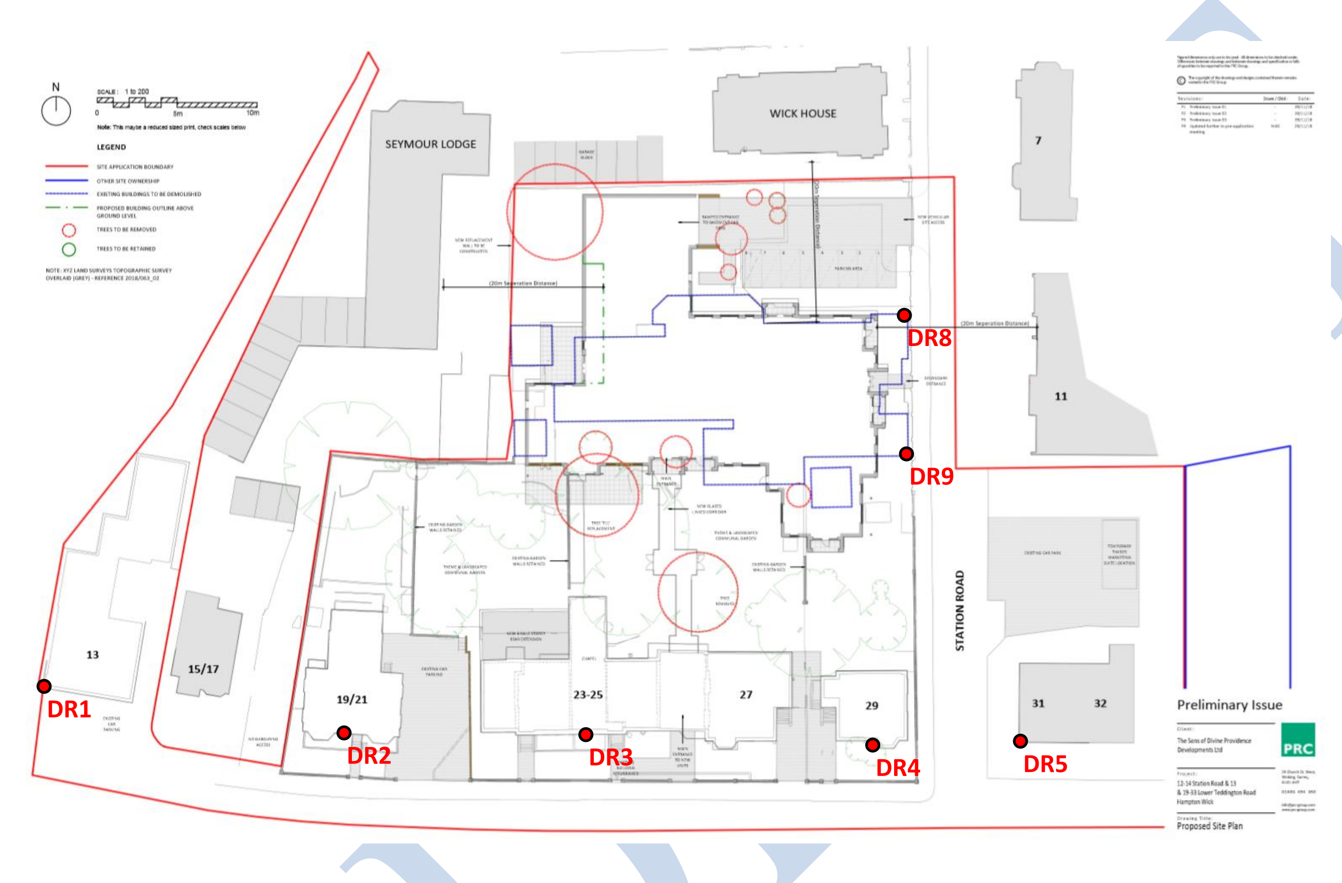
Appendix 5: Proposed Development - Development Receptor Locations



LEGEND

- Development Receptor Location
- DR1 — Development Receptor Number
- Site Application Boundary

Client: CIRC Management LLP		Description: Proposed Development – Development Receptors		Design:	PRC	accon UK ENVIRONMENTAL CONSULTANTS
				Drawn:	NG	
Rev: A	Description: FINAL	Rev: A		Checked:	GP	*Appendix 5*
				Approved:	GP	Scale: On Plan

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