



32 Lawn Road, Camden

Planning Application by Fairview Estates (Housing) Ltd

Air Quality Impact Assessment for Combined Heat and Power Plant

October 2014






Fairview NEW HOMES Ltd.






The Airshed

Specialist Environmental Consultancy for
Air Quality, Odour and
Environmental Noise

Air Quality Impact Assessment Combined Heat and Power Plant for Proposed Housing Fairview New Homes Lawn Road Camden

Prepared by
The Airshed, 5 Lauder Place, East Linton
East Lothian EH40 3DB
Tel. 01620 860 529
mail@theairshed.com
www.theairshed.com

Record of changes

Version	Date	Change
1	28th October 2014	1st Draft for internal review
2	29th October 2014	For client review

Executive Summary

Fairview New Homes Ltd is seeking planning permission from the London Borough of Camden (LBC) to redevelop a site at 32 Lawn Road, Camden, London NW3 AXE. The application proposes the demolition of existing buildings and the erection of 73 new residential units within a single building up to 22m in height. The scheme incudes an energy centre which will include a gas fired CHP system with a single XRG20 LoadTracker unit and four gas fired boilers. The emissions from the CHP and boiler plant will be released from 5 separate flues terminating 1m above roof level on the tallest part of the new building at a height of 23m above ground level. The nearest opening windows in the new building will be at a height of ~21m. The Airshed has been appointed by Fairview to assess whether the emissions from the combustion sources are likely to affect occupants of the proposed building. The only pollutant likely to have any adverse significance on sensitive receptors is Nitrogen Oxide (NO_2).

The site is located within a large urban area with mixed residential and commercial uses. The nearest existing dwellings are the flats in a 15 storey tower block to the north-east, 5 storey flats in Lawn Road to the west and five storey flats to the south in Garnet Road/Upper Park Road. The receptors in the 15 storey block will overlook the proposed development and will also have some potential to be affected due to the relative height of the proposed release.

Air quality impacts have been predicted using the dispersion model ADMS 5 and 5 years of hourly sequential meteorological data. The emission rates are based on emission factors provided by the equipment suppliers. The assessment is based on the assumption that all combustion units operate at full output at all times.

NO_x air pollution has been predicted around the proposed building using a high definition grid at all floor levels. The assessment also includes a sensitivity analysis for meteorological variability, surface roughness effects and receptor height. The worst case factors have been used in the assessment. Impacts have been assessed in accordance with the framework published in EPUK 2010.

The emissions of combustion pollutants are predicted to comply with all relevant air quality standards. The greatest impact on residents of the proposed building is predicted to be on residents living on the top floor. These impacts are likely to be of negligible significance.

The worst case impact offsite is predicted to be at the nearest 15 storey tower block to the north-east where the increase in the annual mean NO_2 is of negligible significance.

Contents

FIGURES

TABLES

APPENDICES

Acronyms

ADMS 5	Air Dispersion Modelling System Version 5
AQIA	Air Quality Impact Assessment
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
CERC	Cambridge Environmental Research Consultants
CFD	Computational Fluid Dynamics
CHP	Combined Heat and Power
CO	Carbon Monoxide
^{o}C	Degrees Centigrade
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency for England and Wales
EAL	Environmental Assessment Levels
EQS	Environmental Quality Standards
g/s	grams per second
H1	Horizontal Guidance Note 1
HSE	Health and Safety Executive (UK)
IPPC	Integrated Pollution Prevention & Control Directive
K	degrees Kelvin
kW	kiloWatt
m/s	metres per second
m^3/s	cubic metres per second
mg/m^3	milligrammes per cubic metre(10^{-3})
MWe	Mega Watts (electrical)
MWt	Mega Watts (thermal)
ng/m^3	nanogrammes per cubic metre (10^{-9})
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
O_2	Oxygen
OS	Ordnance Survey (UK)
PM_{10}	Particles with aerodynamic diameter less than 10 microns
$PM_{2.5}$	Particles with aerodynamic diameter less than 2.5 microns
SO_2	Sulphur Dioxide
ug/m^3	microgrammes per cubic metre (10^{-6})

Prediction is very difficult, especially about the future.

Niels Bohr, Danish physicist (1885 - 1962)

1.0 INTRODUCTION

Background to Report

1.1. Fairview New Homes Ltd, 50 Lancaster Road, Enfield, Middlesex EN2 0BY is seeking planning permission from the London Borough of Camden (LBC) to redevelop a site at 32 Lawn Road, Camden, London NW3 AXE. [See Figure 1 attached]

1.2. The application proposes the demolition of existing buildings and the erection of 73 new residential units within a single building up to 22m in height. The redevelopment includes a proposed combined heat and power (CHP) scheme for the new housing, to be located in a plant room at ground floor level.

1.3. The proposed energy centre will include a gas fired CHP system with a single XRG20 LoadTracker unit rated at 45 kW. The scheme also proposes four conventional 127 kW gas fired boilers. The emissions from the CHP and boiler plant will be released from 5 separate flues terminating 1m above roof level on the tallest part of the new building at a height of 23m above ground level. The nearest opening windows in the new building are at a height of ~21m.

1.4. The Airshed has been appointed by Fairview to assess whether the emissions from the combustion sources are likely to affect occupants of the proposed building.

1.5. The site is located within a large urban area with predominantly residential use. The nearest existing dwellings are the flats in two 15 storey buildings to the north-east and west, 5 storey flats in Lawn Road to the west and five storey flats to the south in Garnet Road/Upper Park Road. The receptors in the two 15 storey blocks which will overlook the proposed development also have some potential to be affected due to the relative height of the proposed release.

Scope of Air Quality Impact Assessment

1.6. This assessment considers the potential adverse air quality impacts from the proposed new CHP system. This study is intended to help determine the likely effect of buildings on plume dispersion and to determine the stack height required to ensure effective dispersion of residual pollutants. The only pollutant likely to have any adverse significance on sensitive receptors is Nitrogen Dioxide (NO_2).

1.7. The atmospheric dispersion model used in this study, ADMS 5, has been widely validated. Experience has shown that ADMS 5 is conservative, so that the model will tend to over-predict, provided the source estimates are accurate.

1.8. The assessment considers the effects of these emissions on sensitive receptors in terms of air quality standards. The results from the AQIA are relevant when considering human health impacts.

1.9. This assessment is only concerned with the air quality impacts from the proposed CHP system and boiler plant. The impacts of development road traffic have not been considered further.

1.10. The assessment ignores any adverse impacts likely to arise during the construction project.

Report Structure

1.11. Section 2 discusses relevant planning policy, air quality standards, and UK and European Regulations and Guidance relating to air quality assessment criteria.

1.12. Section 3 describes the pollutant emission rates for the proposed operation. The section also discusses the baseline air quality conditions around the proposed installation, taking account of the character of the emissions.

1.13. Section 4 sets out the reasons for the approach to assessment and details the assumptions made in the dispersion model.

1.14. The results and significance of the model Sensitivity Analysis and the overall results of the dispersion model are presented in Section 5.

1.15. The proposed mitigation measures are outlined in Section 6.

1.16. The significance of the residual emissions is presented in Section 7.

2.0 RELEVANT LEGISLATION AND STANDARDS

Introduction to Section 2

2.1. This section discusses relevant planning policy, air quality standards, and Guidance relating to the proposed installation.

Air Quality Standards

2.2. EC Council Directive 96/62/EC on ambient air quality assessment and management (The Air Quality Framework Directive) established a framework through which the European Union will agree limit or target values for air pollutants. The limits within the EC Directive were implemented by The Air Quality Limit Value Regulations. EC Council Directive 2008/50/EC consolidated earlier air quality directives. The Limit Value Regulations set air quality standards for a range of air pollutants including Nitrogen Dioxide (NO_2). The UK Government has published an Air Quality Strategy[1] which sets out how the Government proposes to fulfil the UK's obligations under the Air Quality Directive.

2.3. The Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland sets out the policy, targets and objectives for air pollutants. The Technical Guidance to local authorities for the review and assessment of air quality was updated in February 2009.[2] This Guidance TG(09) sets out the methods to be used to determine if air quality objectives are likely to be achieved.

Air Quality Management Areas

2.4. Where the air quality objectives are likely to be exceeded then the relevant local authority must declare an Air Quality Management Area (AQMA). The proposed development is within the London Borough of Camden. The Borough has declared the entire borough area[3] as an Air Quality Management Area due to concerns that levels of NO_2 and particles as PM_{10} may exceed EC Limit Values. This assessment takes the review and assessment findings for the London Borough of Camden into account.[4]

Air Quality Guidance

2.5. DEFRA has published Guidance relating to emissions from medium scale combustion plant (20 – 50 MW). The proposed plant falls well below this threshold and is therefore not subject to the requirements of the Environmental Permitting Regulations. The process emissions are therefore regulated under the Clean Air Act. There is some non-statutory Guidance[5] that local authorities may choose to take into account when considering proposals for new CHP plant, which is relevant to this

[1] DEFRA July 2007. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland Vols 1 & 2.
[2] DEFRA 2009. Review and Assessment Technical Guidance TG(09)
[3] http://uk-air.defra.gov.uk/aqma/details?aqma_id=205
[4] London Borough of Camden April 2012. Air Quality and Screening Assessment
[5] Environmental Protection UK February 2012. Combined Heat and Power: Air Quality Guidance for Local Authorities

proposal. This Guidance covers CHP systems in the 50 kW – 20 MW[6] range and cites emission factors for natural gas fired CHP plant ranging from 200 – 22,000 mg/kWh. This assessment relies on emission factors provided by equipment suppliers.

Sensitive Receptors – Human Exposure

2.6. According to the Guidance in TG(09) referred to above, air quality objectives should apply to all locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant objective. Thus short-term standards such as the 1 hour objective for NO_2 should apply to footpaths and other areas which may be frequented by the public even for a short period of time. Longer term objectives such as the 24 hour or annual mean should apply at houses or other locations which the public can be expected to occupy on a continuous basis. These objectives do not apply to exposure at the workplace, e.g. the roof of the proposed building.

Ecological Receptors

2.7. This assessment assumes that the EC ecological Limit Values for SO_2 and NO_x do not apply within the study area. This is based on paragraph 10 of 2008/50/EC[7] which states that compliance with critical levels for the protection of vegetation should focus on places away from built-up areas.

Assessment Criteria

2.8. The assessment levels used for this report are set out in Table 2.1 below. These are based on EC Limit Values.

Table 2.1 – Environmental Assessment Levels - Air Quality

Pollutant	EAL	Time Average	Justification
Nitrogen Dioxide	200 ug/m^3	1 hour 99.8%ile	EC Limit Values
	40 ug/m^3	Annual mean	

2.9. The assessment criteria are summarised in Table 2.2 below. This is based on the assessment framework derived from the EPUK Air Quality Guidelines.[7] Although the EPUK assessment framework is mainly focused on transport sources, this framework has been adopted in this assessment as most local authorities are familiar with its approach.

Table 2.2 – Definition of Impact Magnitude

Magnitude of Change	Annual Mean
Imperceptible	Increase / decrease <1%
Small	Increase / decrease 1 - 5%
Medium	Increase / decrease 5 - 10%
Large	Increase / decrease >10%

Units = For NO_2 %changes in annual mean pollutant concentration compared to European Limit Value *(from Table 4 EPUK 2010[8]).*

[6] All energy values quoted here refer to net rated thermal input
[7] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0050:EN:NOT
[8] Environmental Protection UK 2010 Development Control – Planning for Air Quality (2010 Update)

3.0 BASELINE AIR QUALITY AND PROCESS EMISSION INVENTORY

Emission Inventory for the AQIA

3.1 The emission rates are based on emission factors provided by Fairview New Homes Ltd to The Airshed. The emissions from the process are based on a design for the CHP plant provided by the preferred suppliers with a NO_x emission rate of 6.58 g/s.[9] Each 127kW boiler unit has a reported emission factor of 39 mg/kWh.[10] The emissions are summarised in Table 3.1 below.

Table 3.1 – Summary of Emissions

Source	mg/kWh	kW	mg/m^3	g/s
CHP plant	-	45	100	0.002
Single Gas fired boiler unit	39	507	-	0.001

3.2 A single combustion Scenario has been considered for the proposed operation. Details are presented in Table 3.2 at the end of the text. This Scenario is based on the design assumption that all combustion plant will operate at 100% capacity throughout the year.

Baseline Air Quality

3.3 Estimates of background pollution of Oxides of Nitrogen have been obtained from the DEFRA sponsored air quality archive.[11] The data in Table 3.3 below includes the estimated background concentration within 1km of the proposed installation, within the study area centred on OS x 527500; y 185500. Based on these published values the background annual mean NO_2 is ~31 ug/m^3 in the year 2014.

Table 3.3 - Annual Mean Air Quality ug/m^3 Near Proposed Installation 2014

N **OS x**	**OS y**	**NO_x**	**NO_2**
527500	185500	49.5	30.7

Cumulative Impacts

3.4. This assessment assumes that emissions from all existing processes and operations are included within the background estimates within the study area.

[9] FLUE SYSTEM FOR LOADTRACKER CHP XRGI 6 / XRGI 9 / XRGI 15G / XRGI 20G Operating on natural gas
[10] MHS Ultramax Thison L2
[11] http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2011

4.0 DISPERSION MODELLING

Introduction to Section 4

4.1. This Section sets out the reasons for the approach to assessment and details the assumptions made in the dispersion modelling.

Justification for Approach

4.2. The likely impact from process emissions may be estimated using an appropriate atmospheric dispersion model and reliable emission estimates. The emissions from the process are based on a simple emission factor and estimates of maximum heat use provided by Fairview and their agents and suppliers. These emission factors have not been independently verified by The Airshed. The emissions will be tested as part of the commissioning process so that a reasonable degree of confidence can be attached to the emission estimates, provided the emission rates do not exceed the modelled values.

4.3. The objective of the dispersion modelling assessment is to predict the likely effect of the prevailing climate, local surface conditions and the new buildings on plume behaviour; and to predict the likely worst case concentrations at the nearest sensitive receptors within the new building and at existing receptors nearby. These predictions may be used to help determine the flue height required to ensure effective dispersion of residual pollution.

- The pattern of pollutant dispersion may be estimated using several years of historical meteorological data from a representative site.
- Air quality impacts are assessed against Air Quality Limit Values.
- The emission of oxides of Nitrogen are based on the information provided the client. The emission factor calculations have not been verified by The Airshed.

4.4. The assessment ignores the impacts from process upsets, fluctuations and accidents. This is contingent on a programme of planned preventative maintenance being implemented to ensure that the risk of unplanned emissions is minimised. The measures intended to prevent or minimise unplanned emissions are discussed in Section 6.

Approach to Modelling Uncertainty

4.5. Environment Agency policy statement[12] refers to the Royal Meteorological Society Guidelines on Dispersion Modelling. According to this Guidance dispersion modelling studies should include a Sensitivity Analysis for model inputs, to provide an estimate of the possible errors in the predictions. The Sensitivity Analysis is discussed in more detail in Section 5. The Environment Agency has also published requirements for dispersion modelling.[13] This includes advice on the Agency's

[12] Environment Agency, undated. Policy Statement EAS/2007/1/1
[13] Environment Agency, undated. Air Dispersion Modelling Report Requirements (for detailed dispersion

requirements for reporting. These Guidance documents have been taken into account in the assessment.

4.6. A widely recognised mathematical model, ADMS 5, has been used to predict how emissions will be dispersed taking account of: the source conditions (either by emission factors or the flow rate and pollutant concentration); release conditions (efflux velocity and temperature); meteorological conditions from a representative site (in this case near ground measurements at Heathrow supplied by the Met. Office); and surface conditions (surface roughness).

4.7. The model used, ADMS 5, has been developed specifically for industrial point sources. The model is widely used in the UK for environmental assessment and is generally considered by UK environmental agencies to be suitable for air quality impact assessment subject to its proper use.

4.8. Potential difficulties and limitations in this type of study when applied to air quality impact assessments include:

- Lack of good information about the risk to human health from process emissions. This assessment relies on the statutory Limit Values and objectives that are based on extensive epidemiological data;
- Uncertainties in baseline conditions. The baseline estimates used are based on current DEFRA estimates;
- Errors in source terms used to estimate emissions. Emission rates are based on supplier estimates;[14]
- Errors inherent in the dispersion model used. The model is considered to be suitable for use in this application and has been widely validated for industrial point sources; and
- Errors introduced by the model user due to the use of inappropriate or unrepresentative input values such as meteorological data or surface roughness values. A Sensitivity Analysis has been conducted to take these potential errors into account. The significance of these factors is discussed in Section 5. In general the approach used in this assessment has been to include worst case factors for dispersion.

4.9 This assessment presents a detailed account of the modelling process and considers the model sensitivity to the main user inputs. An inventory of the models runs for this project is presented in Table 4.1. [See Table at end of text, before the Figures].

Dispersion Modelling

4.10 The transport and transformation of a pollutant in the boundary layer can be predicted with a reasonable degree of confidence using an appropriate mathematical model. The model used for this exercise is ADMS 5. This mathematical model enables the calculation of multiple sources and

modelling).

[14] The exact emission rates from the process obviously can not be determined until the process is built, operating and tested. The emission rates will be tested as part of the process commissioning.

includes an algorithm for assessing flow around buildings that may cause entrainment. The principal factors affecting the concentration of a pollutant are:

- source characteristics including source strength, height of discharge, density, and temperature of the release;
- prevailing atmospheric conditions including wind speed, wind direction, cloud cover, precipitation, ambient temperature and the depth of the boundary layer[15]; and
- adjacent buildings and local surface conditions.

These factors can be assigned numerical values and the resultant downwind concentrations of pollutants may be predicted.

4.11 The model description is published in the user guide for ADMS 5.[16] The model was originally developed as a research project jointly funded by HSE, the Meteorological Office and Her Majesty's Industrial Inspectorate of Pollution. The model is routinely used by UK environment agencies.[17]

Model Parameters

4.12 The temperature and efflux velocity of the flue gases are based on typical conditions. The emissions from the combustion process are summarised in Table 4.2 in accordance with the requirements of H1 and Environment Agency Guidelines.[18] [See Table 3.2 at end of text].

Table 4.2 - Summary of Modelled Conditions

Parameter	CHP Plant	Boiler No. 1 of 4
OS x	527552.52	527552.32
OS y	185359.66	185359.39
Stack height	23m	23m
Pollutant emission rate	NO_x 0.002 (g/s)	NO_x 0.001 (g/s)
Exit diameter	0.080 (m)	0.200 (m)
Exit temperature	120 (^oC)	120 (^oC)
Efflux velocity (actual)	12.4 (m/s)	8.0 (m/s)
Volumetric flow rate (actual)	0.062 (m^3/s)	0.251 (m^3/s)

Source Condition, Location and Height

4.13 The sources have been considered as continuous, steady state point source releases, at maximum load. The locations of the flues are shown in Figure 2. The height of the release was initially assumed to be 23m above ground, based on the planning drawings. The proposed building

[15] The boundary layer is the layer of the atmosphere near the surface of the planet that is affected by mechanical turbulence from surface friction and convective turbulence through local surface heating.
[16] CERC 2012. ADMS-5, The Multiple Source Air Dispersion Model. CERC, Cambridge.
[17] Details of model validation studies are available at http://www.cerc.co.uk/software/publications.htm

and stack locations were obtained from the site planning drawings and the OS map base at 1:1250 scale.

Surface Roughness

4.14 The surface roughness conditions at the site have been assumed to be typical of a large urban area with surface roughness of 1.5m. This value has been used across the domain. The effects of surface roughness are discussed in the Sensitivity Analysis.

Meteorological Data

4.15 The selection of suitable meteorological data needs to be conducted with care. The main limiting factor for suitable meteorological data is continuous observations of cloud cover, used in the model to determine atmospheric stability.

4.16 The Met Office operates a site at Heathrow, 22km to the south-west of the site. Five years of hourly sequential meteorological data (2003 - 2007 inclusive) have been used to predict the dispersion around the site. Heathrow is likely to be reasonably representative of the study area. The worst case one year in five has been used in the assessment. A summary of the meteorological data is presented in Appendix 1.

Building Effects

4.17 The dispersion model used can take account of the effects of re-circulating flow or downwash effects caused by buildings near the point of release. Building effects have been considered. The building has been simplified into eight cuboid shapes. Details of the buildings used in the model are listed in Table 4.3 at the end of the text.

Terrain Effects

4.18 The proposed site is located on relatively level ground with slopes < 1:10 and where terrain effects are unlikely to have any effect on air flow and dispersion. Terrain effects have therefore been ignored.

Time Averaging and Percentiles

4.19 The averaging time for NO_2 is based on a 1 hour average. The 1 hour 97.79%ile has been calculated for NO_2.

Grid Resolution and Receptors

4.20 The annual mean NO_x has been predicted over the study area for 3621 grid points based on a grid 51 by 71 covering the study area at intervals of 1m. The extent of the prediction grid is shown in Appendix 1. An additional 15 fixed receptor points were located at ground level to the east and west of the main building to assist with the model sensitivity analysis. These receptor locations were selected after preliminary model runs indicated that these locations would represent worst case ground level concentrations. The receptor locations used in the model sensitivity analysis are shown in Figure 3.

Removal Effects

4.21 Atmospheric chemistry and photo-lytic reactions have been ignored in the dispersion modelling. An allowance has been made for typical NO_x:NO_2 chemistry in the overall assessment, based on the Environment Agency's empirical factors.[18]

Overview of the Modelling Process

4.22 Details of the ADMS dispersion model runs are presented in Table 4.1. [See table at end of text].

[18] http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

5.0 IMPACT ASSESSMENT RESULTS

Model Sensitivity Analysis

5.1. It is a requirement of the Royal Meteorological Society Guidelines on Dispersion Modelling[19&20] that this type of study should include a Sensitivity Analysis for model inputs, to provide an estimate of the possible errors in the predictions. The potential errors in predictions and limits to the dispersion model were outlined in Section 4.

5.2. The Sensitivity Analysis conducted for this study considers the likely variability and errors arising from meteorological data, surface roughness and receptor height. The detailed model outputs are presented in Appendix 2.

5.3. The predictions take account of the worst case dispersion conditions, so there are no significant residual uncertainties in the model predictions that remain unquantified.

5.4. The Environment Agency's method for assessing model uncertainty indicates that confidence in the model is medium, due to the effects of buildings on dispersion.[21] The main issue for air quality is likely to be the impact on the annual mean NO_2. The discussion in the Sensitivity Analysis below therefore is focused on this parameter.

Sensitivity Analysis – Meteorological Data

5.5. The model Sensitivity Analysis indicates that the predicted annual mean results vary marginally with the year of hourly sequential meteorological data used to predict dispersion. Based on 5 years of data (Heathrow 2003 – 2007), the highest predicted annual mean ranges by a factor of up to ~5% over the five years of data considered.[22] The highest levels of NO_x are predicted to occur to the east of the proposed buildings. The worst case predicted annual mean level of NO_x at ground level is 0.82 ug/m^3 when the historical meteorological data for 2004 is used. The results for this assessment are presented in detail within Appendix 2.

Sensitivity Analysis – Surface Roughness

5.6. The model runs were initially conducted assuming a surface roughness of 1.5m, typically the upper end of the values used in ADMS to model surface roughness in cities and large urban areas. The dispersion model has been run using surface roughness values of 0.5m, 1.0m, 1.5m and

[19] Royal Meteorological Society May 1995. Policy Statement Atmospheric Dispersion Modelling Guidelines on the justification of choice and use of models and the communication and reporting of results

[20] ADMLC 2004. Guidelines for the Preparation of Dispersion Modelling Assessments for Compliance with Regulatory Requirements – an Update to the 1995 Royal Meteorological Society Guidance.

[21] Ji Ping Shi and Betty Ng; 2004. Risk based pragmatic approach to address model uncertainty. Air Quality Modelling and Assessment Unit The Environment Agency 29 Newport Road Cardiff CF24 0TP. Paper Given At NSCA Seminar.

[22] Where the maximum predicted annual mean concentration in the five years considered is expressed as a ratio of the lowest reported annual mean for the same five years.

2.0m across the domain to represent the conceivable range of roughness conditions within the study area.

5.7. This parameter has a significant effect on predicted air pollutant concentrations. The worst case annual mean value is predicted using an assumed surface roughness value of 2.0m and this has been adopted for the assessment. In general, long-term air concentrations increase with roughness length. As a precautionary measure a surface roughness of 2.0m has been assumed across the domain. The results for this assessment are presented in detail within Appendix 2.

Sensitivity Analysis – Receptor Height

5.8. The model runs have been conducted for all floor levels within the proposed building. The results are plotted in Figures 4.1 – 4.8 based on a prediction grid at 1m grid resolution These contour plots indicate that, even at top floor level (at a height of 21m above ground level), the predicted annual mean NO_x at the most exposed elevation is less than 1ug/m^3. The predicted NO_x concentrations at ground level (0m) are also <1ug/m^3.

Results

5.9. The results for NO_x predictions are summarised in Table 5.1 below. These have been converted into equivalent NO_2 values and are reported in Table 5.2 below. The NO_x:NO_2 conversion factors are based on the typical EA method used for combustion sources. The annual mean predictions are based on the worst case dispersion conditions for surface roughness and meteorological variability. The criteria used to assess the significance of these predictions were presented earlier in Table 2.2. The overall predicted concentration of NO_2 is summarised in Table 5.2 below. This relates to impacts on receptors within the proposed new building.

Table 5.1 - Summary of Predicted NO_x at new building

Pollutant	Baseline	Process Contribution	With Installation
NO_x 1 hour 99.79%ile*	99.0	2.3	101.3
NO_x annual mean	49.5	0.9	50.4

Table 5.2 - Summary of Predicted NO_2 at new building

Pollutant	Baseline	With Installation	EAL
NO_2 1 hour 99.79%ile*	61.4	62.2*	200
NO_2 annual mean	30.7	31.3*	40

N.B. all units are ug/m^3

* assumes NO_x:NO_2 conversion as per EA conversion factors

5.10. The emissions of combustion pollutants are predicted to comply with all relevant air quality standards. The greatest impact is predicted to be on residents living on the top floor. The installation of the proposed CHP and boiler units is predicted to increase the annual mean NO_2 by <2% compared to an imagined baseline where the buildings are constructed, without the gas fired CHP and boiler units.

5.11. The predicted change in NO_2 is a small increase of negligible significance in terms of the EPUK framework, where the change is expressed as a percentage of the EAL.

5.12. Existing sensitive residential receptors living in the adjacent tower block to the north-east are predicted to be exposed to an increase of 0.8ug/m^3 in the annual mean NO_2 at a height of 24m above ground This is a small increase of negligible significance in terms of the assessment criteria in Table 2.2.

6.0 PROPOSED MITIGATION MEASURES

Operational Impacts

6.1 The following measures are proposed to prevent or minimise impacts on air pollution:

- Low NO_x burners shall be selected for the CHP and boiler units to reduce emissions.
- The release of emissions shall be from flues 23m above ground level, at least 1m above the highest point of the roof.
- The emissions shall be discharged with an efflux velocity not less than 8m/s, when operating under maximum load conditions.
- The process shall be monitored by an independent testing agency at commissioning stage to validate the model assumptions.
- Supervisory staff shall be trained to ensure that the installation is operated within specification.
- All process operations shall be subject to routine planned preventative maintenance.

7.0 EVALUATION OF IMPACTS

7.1 Baseline air quality around the proposed installation is likely to be within European Limit Values and UK air quality objectives. However the entire Borough has been declared a Local Air Quality Management Area due to concerns about annual mean PM_{10} and NO_2.

7.2 The main concern is likely to be the impact on the statutory EC annual mean Limit Value of 40ug/m^3 for NO_2, where the existing baseline is ~31ug/m^3.

7.3 The greatest predicted impact at any receptor within the proposed new building is predicted to add <1ug/m^3 NO_2 to the annual mean. This is a small increase of negligible significance in terms of the EPUK 2010 assessment framework.

7.4 The proposed CHP and boiler plant is predicted to cause a small increase in the annual mean NO_2 at the nearest existing residential receptors. This is of negligible significance.

Tables

Emission Inventory
CHP Lawn Road
Scenario - Project Description - October 2014

Item	description	internal stack diameter [4]	internal stack area	efflux velocity at stack conditions [5]	Temperature in stack [6]	volume of release (actual) [7]	Moisture actual [8]	O_2 actual [9]	correction for temperature	correction for moisture	correction for O_2	volume of dry air for single XRGI 20G	volume of release at 273K, dry. 5%O_2 [11]	mass exhaust gas flow	pollutant	Emission factor [12]	total thermal input [13]	Pollutant Concentration 273K 5% O_2 (dry gas) [14]	pollutant emission rate [15]
	CHP and boiler system [1]	(m)	m^2	m/s	K	m^3/s	%	%				m^3/s	m^3/s	kg/s		mg/kWh	kW	mg/m^3	g/s
1	CHP plant [2]	0.080	0.005	12.4	393	0.062	10.0	5.0	1.44	1.11	1.00	0.039	0.019	0.023	NO_x	-	45	100	0.002
2	Gas fired boiler unit - one of four [3]	0.200	0.031	8.0	393	0.251										39	127		0.001

Notes

1 This assumes one LoadTracker CHP and four TH-L120 boilers
2 Emissions from LoadTracker unit only where total NOx emission is reported to be 6.58 g/hr
3 Based on emission factor for gas fired boiler MHS Ultramax Thison L2
4 Based on email from Allyson Spratt Fairview New Homes dated 23 October 2014
5 CHP calculated by Airshed based on gas flows. Boilers efflux based on email from Allyson Spratt Fairview New Homes dated 23 October 2015
6 Exhaust temperature based on conservative assumption
7 Volume of stack gases adjusted for actual conditions (moisture, temperature and oxygen)
8 Moisture content based on Airshed assumption
9 Oxygen content in emission tests reported value
10 The supplier estimates the flow of dry gas from the 70.24 kg/hr dry gas per 45kW Tracker uni
11 The volume of gases has been corrected for 5% to correspond with the reported emission concentration
12 Emission factor for four gas boilers as provided by MHS Boilers
13 Each gas fired boiler (MHS Boilers) is 126.8kW gross
14 Based on flow rate and emission concentraton at reference conditions (5% oxygen 273K dry gas) for a XRGI 20
15 Total emission rates based on full load conditions.

Run		File Name		Met Data	Surface roughness (m)	receptor height (m)	objective
run01	1	heathrow 2003	.apl	Heathrow 2003			
	2	heathrow 2004	.apl	Heathrow 2004			
	3	heathrow 2005	.apl	Heathrow 2005			
	4	heathrow 2006	.apl	Heathrow 2006			to determine the significance of the effects of meteorological
	5	heathrow 2007	.apl	Heathrow 2007	2.0	0	variability
run02	6	rough 0.5m	.apl		0.5		
	7	rough 1m	.apl		1.0		
	8	rough 1-5m	.apl		1.5		to determine the significance of surface roughness on predicted
	9	rough 2m	.apl	Heathrow 2004	2.0	0	dispersion
run03	10	Scenario 1	.apl			0	
	11					3	
	12					6	
	13					9	
	14					12	
	15					15	
	16					18	
	17			Heathrow 2003	2.0	21	to determine the effect of receptor height on dispersion

	top block mid	top block south	top block north	six storey	east tower	south block	south west block	stair tower
Centre X	527552.1	527554.4	527558.2	527557.8	527579.5	527565.0	527548.4	527550.2
Centre Y	185359.7	185359.7	185380.1	185352.5	185348.9	185346.6	185344.0	185375.5
Height	22.0	22.0	22.0	19.0	19.0	16.0	16.0	25.0
Length	13.2	7.1	18.4	7.8	6.4	8.0	10.0	5.3
Width	23.3	10.8	12.5	6.8	13.8	23.2	16.2	2.9
Angle to North	105.9	168.6	22.7	349.1	80.0	170.0	259.8	114.8

Figures

AS 0444 Lawn Road AQIA 23 October 2014

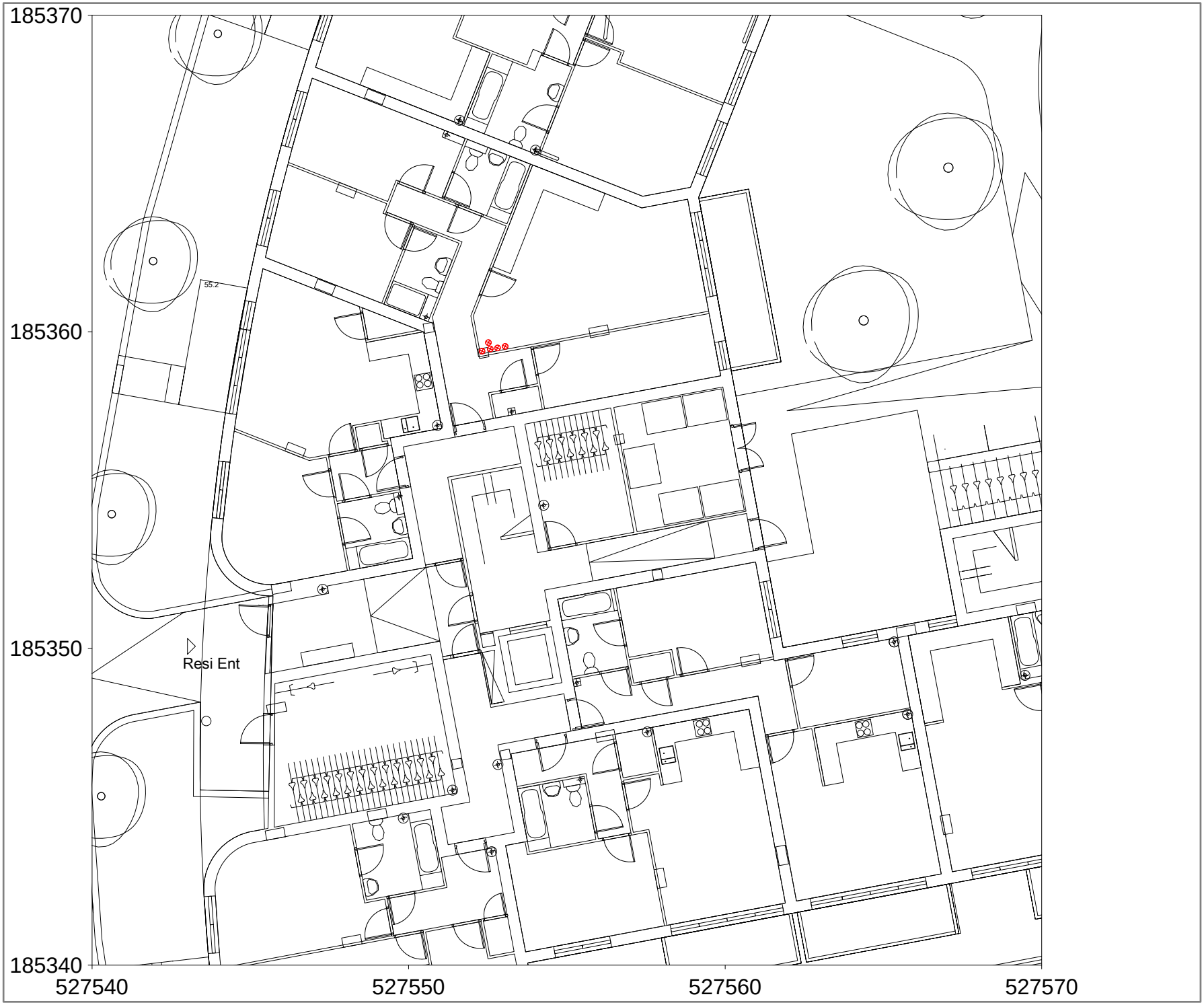
Fairview NEW HOMES Ltd.

Site Location

indicative planning boundary

Figure 1

The Airshed



AS 0444 Lawn Road AQIA 23 October 2014

Fairview NEW HOMES Ltd.

Site Location

proposed flue

Figure 2

The Airshed

AS 0444 Lawn Road AQIA 27 October 2014

Fairview NEW HOMES Ltd.

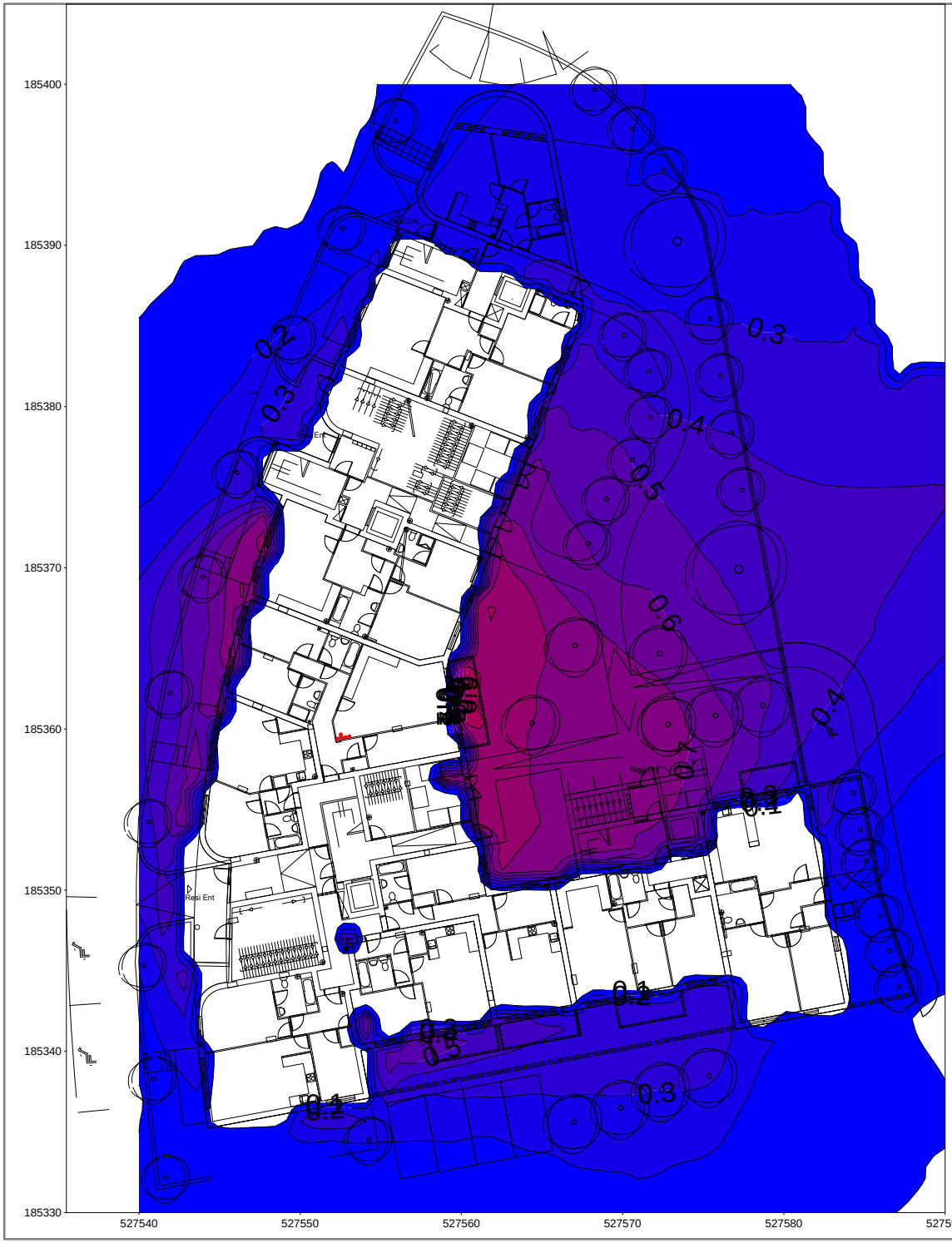
Model Layout

building considered in dispersion model

receptor used for model sensitivity analysis

Figure 3

The Airshed



AS 0444 Lawn Road AQIA 23 October 2014

Fairview NEW HOMES Ltd.

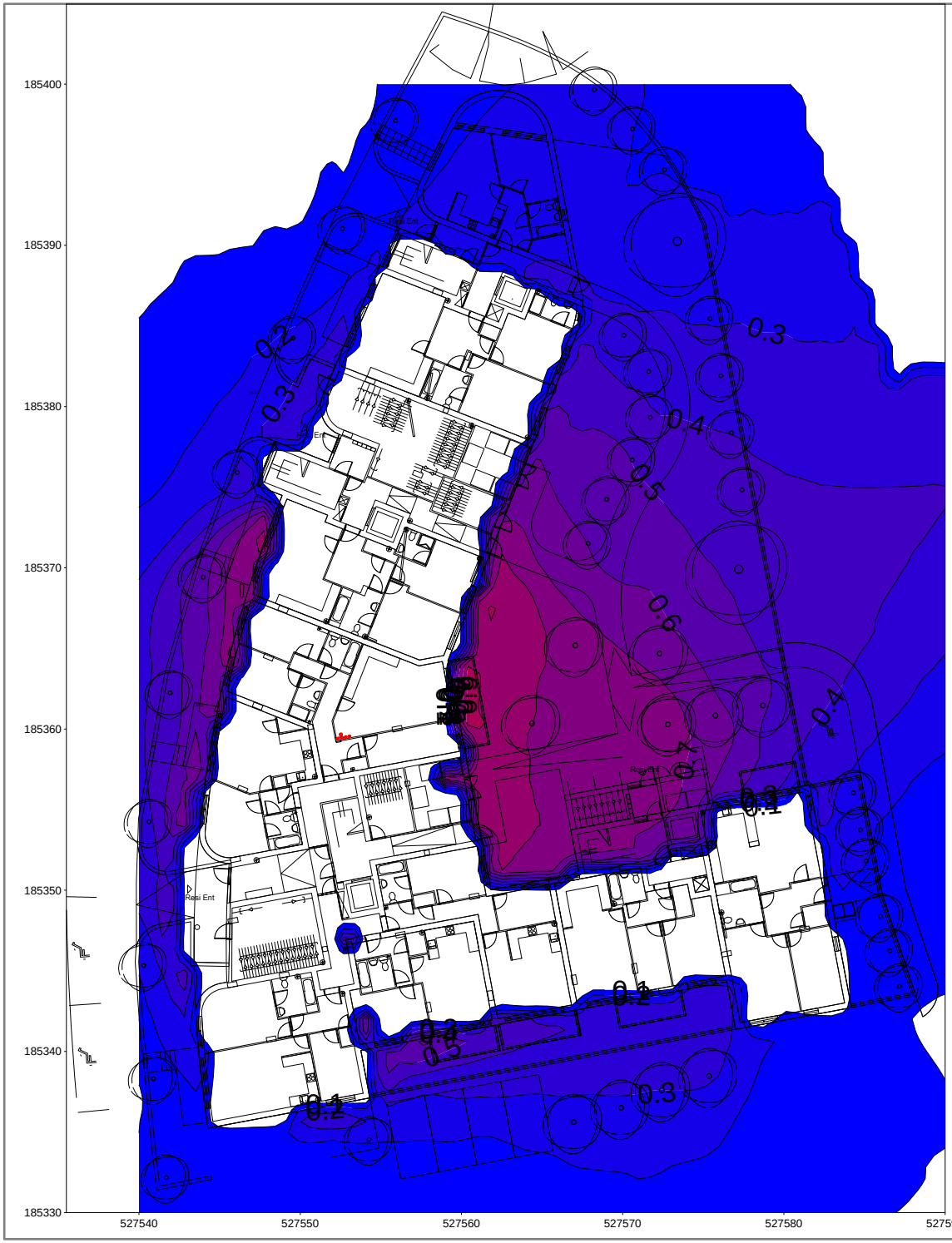
Ground Level

ADMS 5
Scenario 1
45 kW CHP LoadTracker
500 kW gas boilers
steady state sources
Stacks 23m
Main Building - 22m top block mid
Model Scenario 1.apl
Met data Heathrow 2004
Surface roughness 2.0m
Building Effects on
ignores NOx : NO2 chemistry
Terrain effects off
Prediction Grid 1m
Receptor Height 0m
Averaging period 1 hour
Background ignored
Benchmark 40 ug/m3
Units ug/m3 NOx
1 hour annual mean

1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Figure 4.1

The Airshed



AS 0444 Lawn Road AQIA 23 October 2014

Fairview NEW HOMES Ltd.

ground floor

ADMS 5
Scenario 1
45 kW CHP LoadTracker
500 kW gas boilers
steady state sources
Stacks 23m
Main Building - 22m top block mid
Model Scenario 1.apl
Met data Heathrow 2004
Surface roughness 2.0m
Building Effects on
ignores NOx : NO2 chemistry
Terrain effects off
Prediction Grid 1m
Receptor Height 3m
Averaging period 1 hour
Background ignored
Benchmark 40 ug/m3
Units ug/m3 NOx
1 hour annual mean

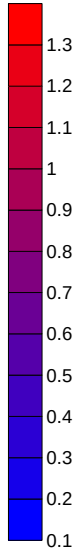
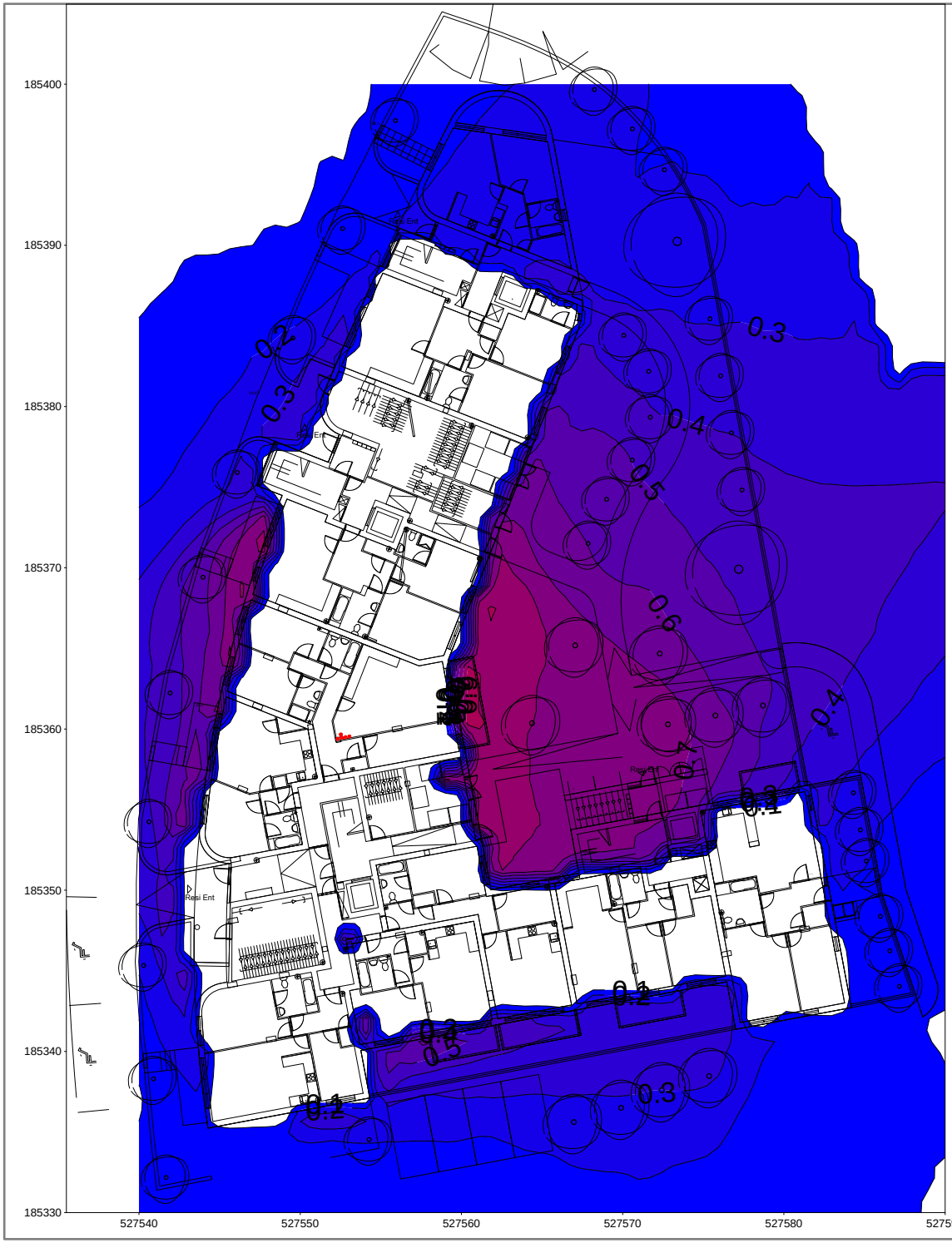


Figure 4.2

The Airshed



AS 0444 Lawn Road AQIA 23 October 2014

Fairview NEW HOMES Ltd.

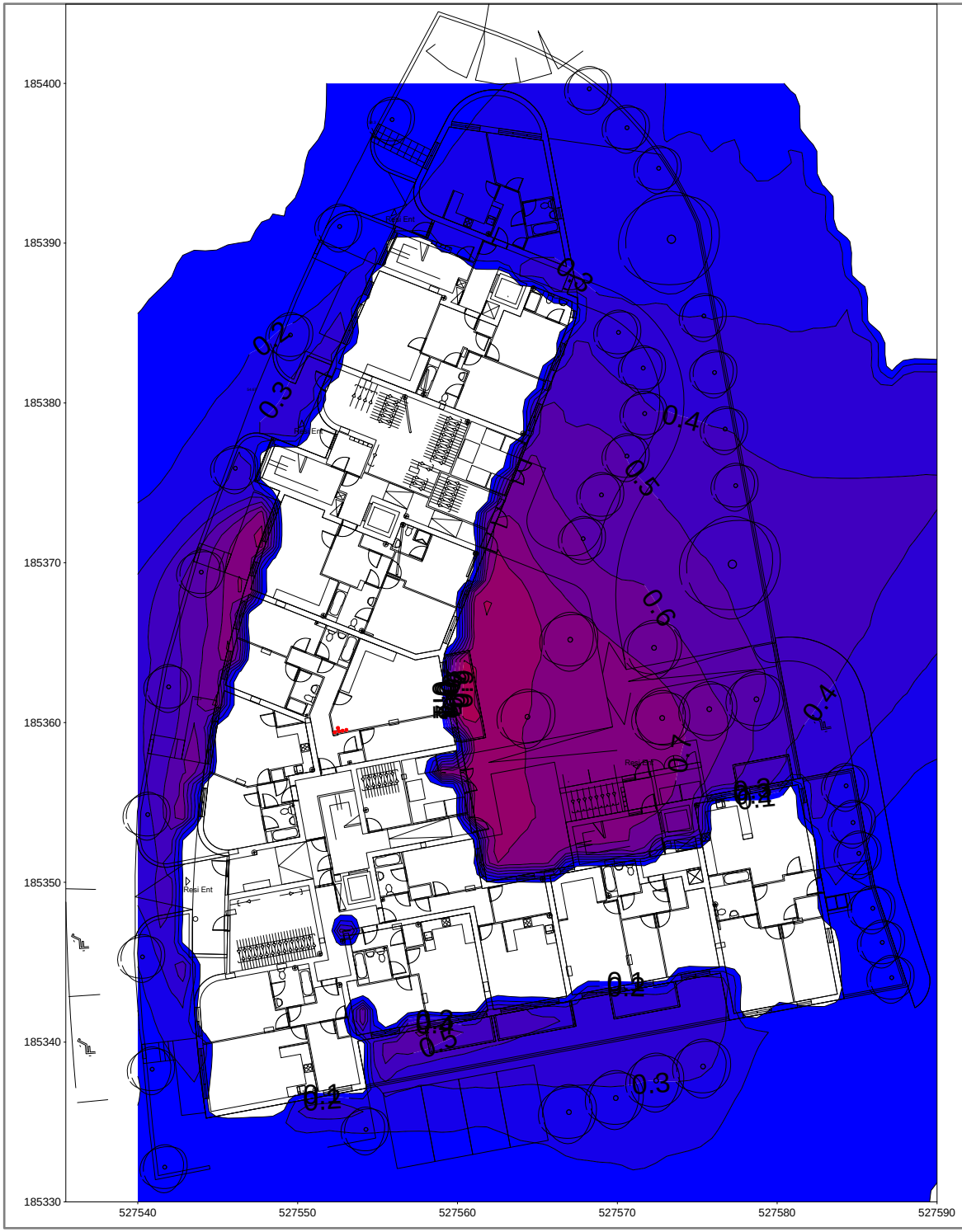
first floor

ADMS 5
Scenario 1
45 kW CHP LoadTracker
500 kW gas boilers
steady state sources
Stacks 23m
Main Building - 22m top block mid
Model Scenario 1.apl
Met data Heathrow 2004
Surface roughness 2.0m
Building Effects on
ignores NOx : NO2 chemistry
Terrain effects off
Prediction Grid 1m
Receptor Height 6m
Averaging period 1 hour
Background ignored
Benchmark 40 ug/m3
Units ug/m3 NOx
1 hour annual mean

1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Figure 4.3

The Airshed



AS 0444 Lawn Road AQIA 23 October 2014

Fairview NEW HOMES Ltd.

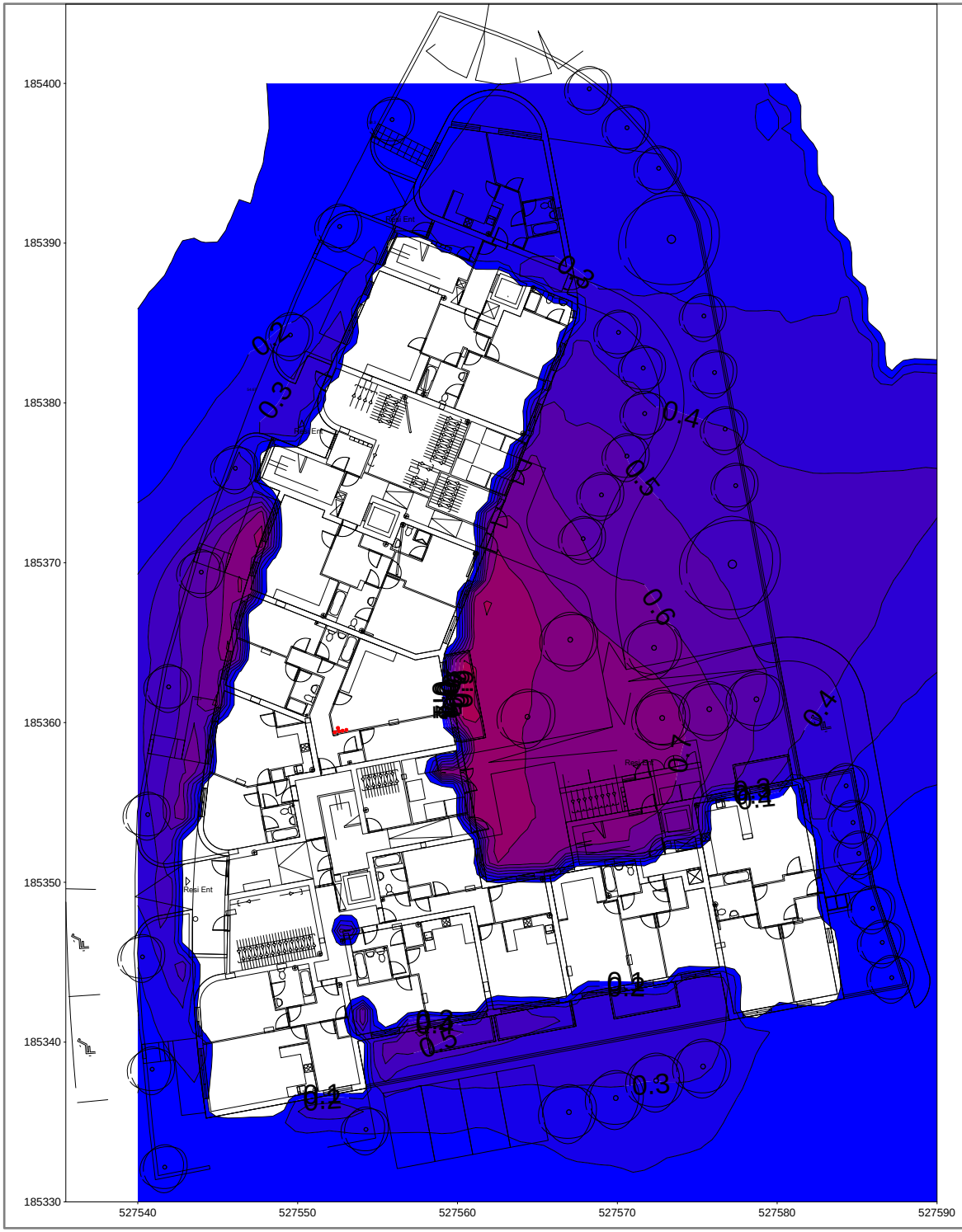
second floor

ADMS 5
Scenario 1
45 kW CHP LoadTracker
500 kW gas boilers
steady state sources
Stacks 23m
Main Building - 22m top block mid
Model Scenario 1.apl
Met data Heathrow 2004
Surface roughness 2.0m
Building Effects on
ignores NOx : NO2 chemistry
Terrain effects off
Prediction Grid 1m
Receptor Height 9m
Averaging period 1 hour
Background ignored
Benchmark 40 ug/m3
Units ug/m3 NOx
1 hour annual mean

1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Figure 4.4

The Airshed



AS 0444 Lawn Road AQIA 23 October 2014

Fairview NEW HOMES Ltd.

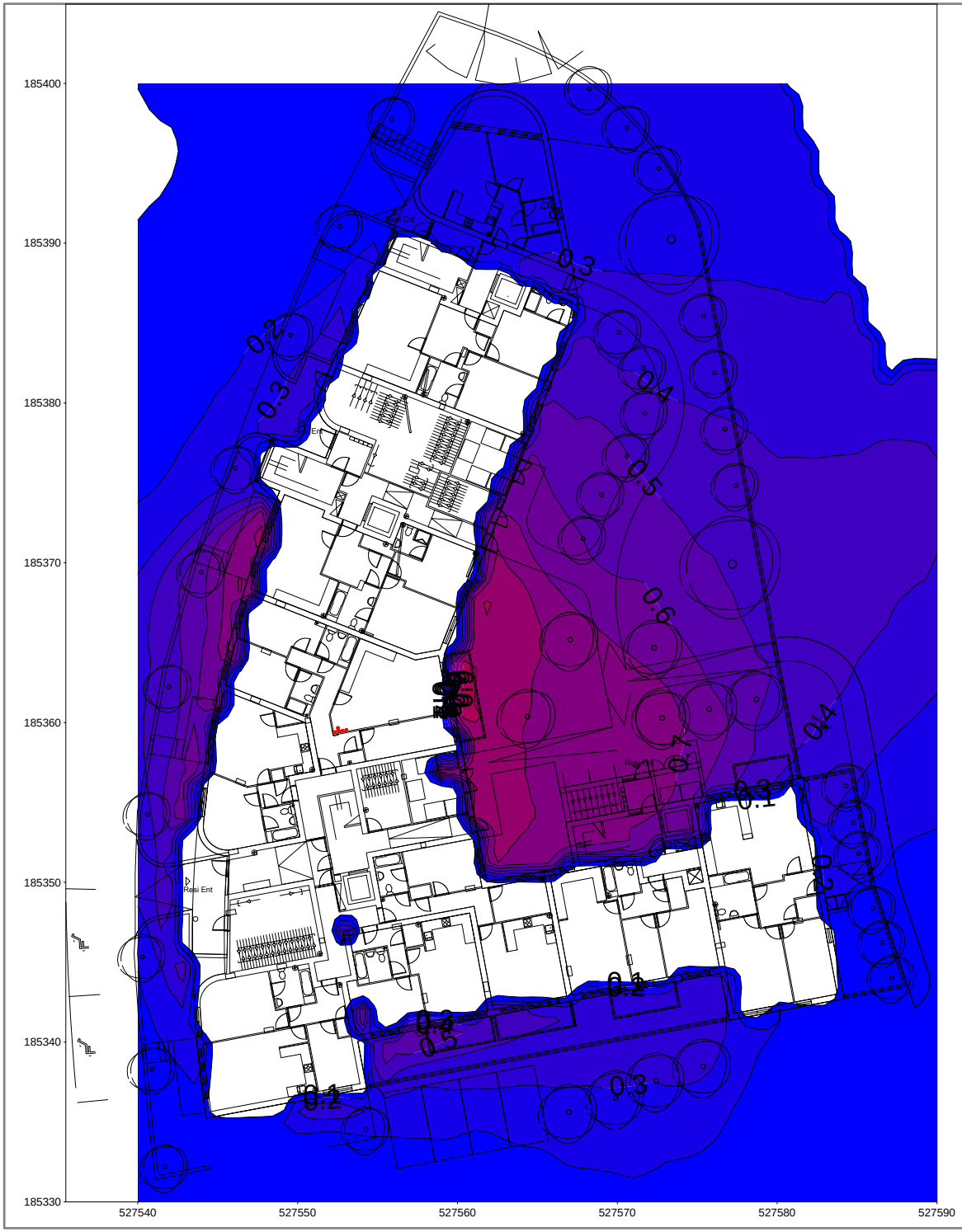
third floor

ADMS 5
Scenario 1
45 kW CHP LoadTracker
500 kW gas boilers
steady state sources
Stacks 23m
Main Building - 22m top block mid
Model Scenario 1.apl
Met data Heathrow 2004
Surface roughness 2.0m
Building Effects on
ignores NOx : NO2 chemistry
Terrain effects off
Prediction Grid 1m
Receptor Height 12m
Averaging period 1 hour
Background ignored
Benchmark 40 ug/m3
Units ug/m3 NOx
1 hour annual mean

1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Figure 4.5

The Airshed



AS 0444 Lawn Road AQIA 23 October 2014

Fairview NEW HOMES Ltd.

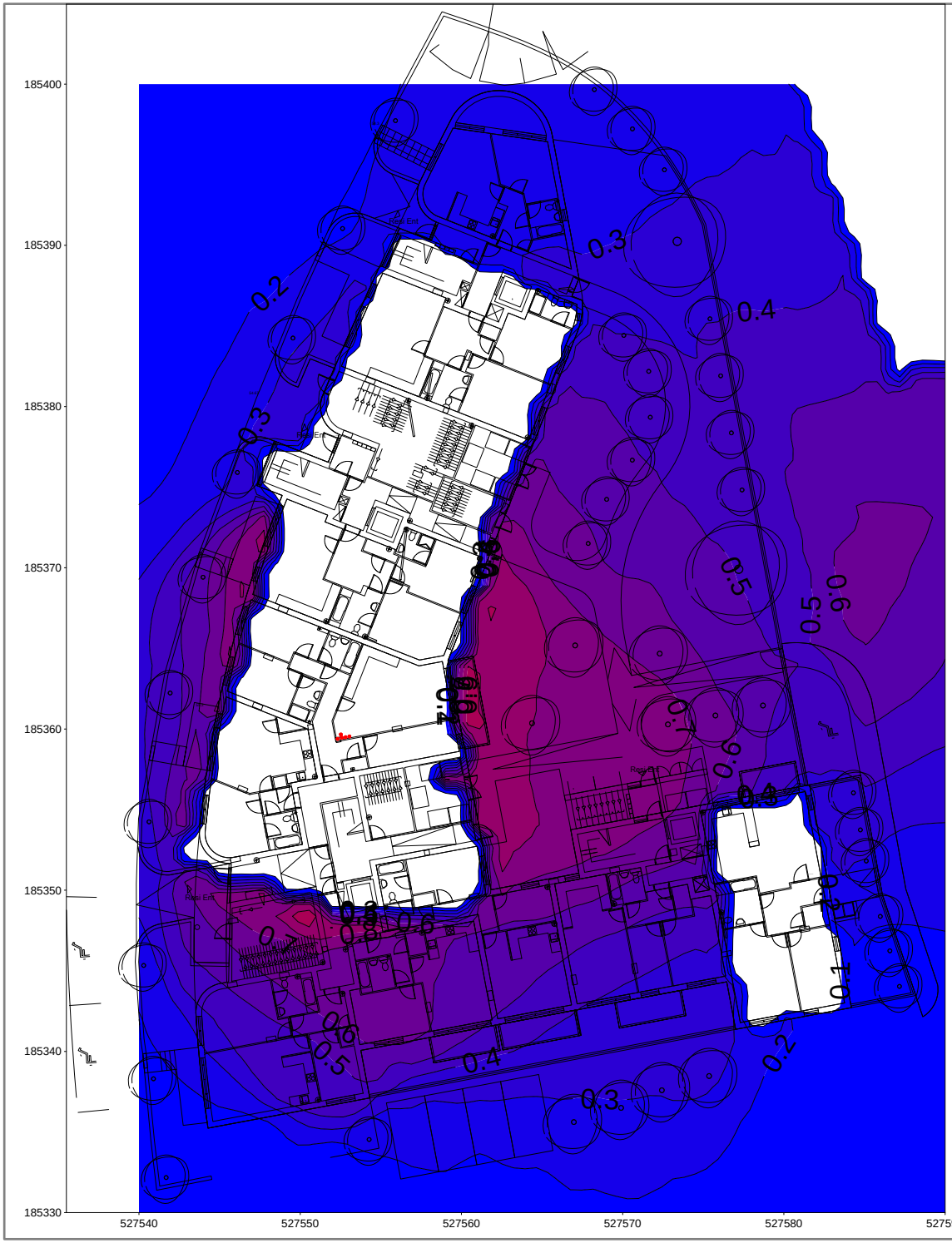
forth floor

ADMS 5
Scenario 1
45 kW CHP LoadTracker
500 kW gas boilers
steady state sources
Stacks 23m
Main Building - 22m top block mid
Model Scenario 1.apl
Met data Heathrow 2004
Surface roughness 2.0m
Building Effects on
ignores NOx : NO2 chemistry
Terrain effects off
Prediction Grid 1m
Receptor Height 15m
Averaging period 1 hour
Background ignored
Benchmark 40 ug/m3
Units ug/m3 NOx
1 hour annual mean

1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Figure 4.6

The Airshed



AS 0444 Lawn Road AQIA 23 October 2014

Fairview NEW HOMES Ltd.

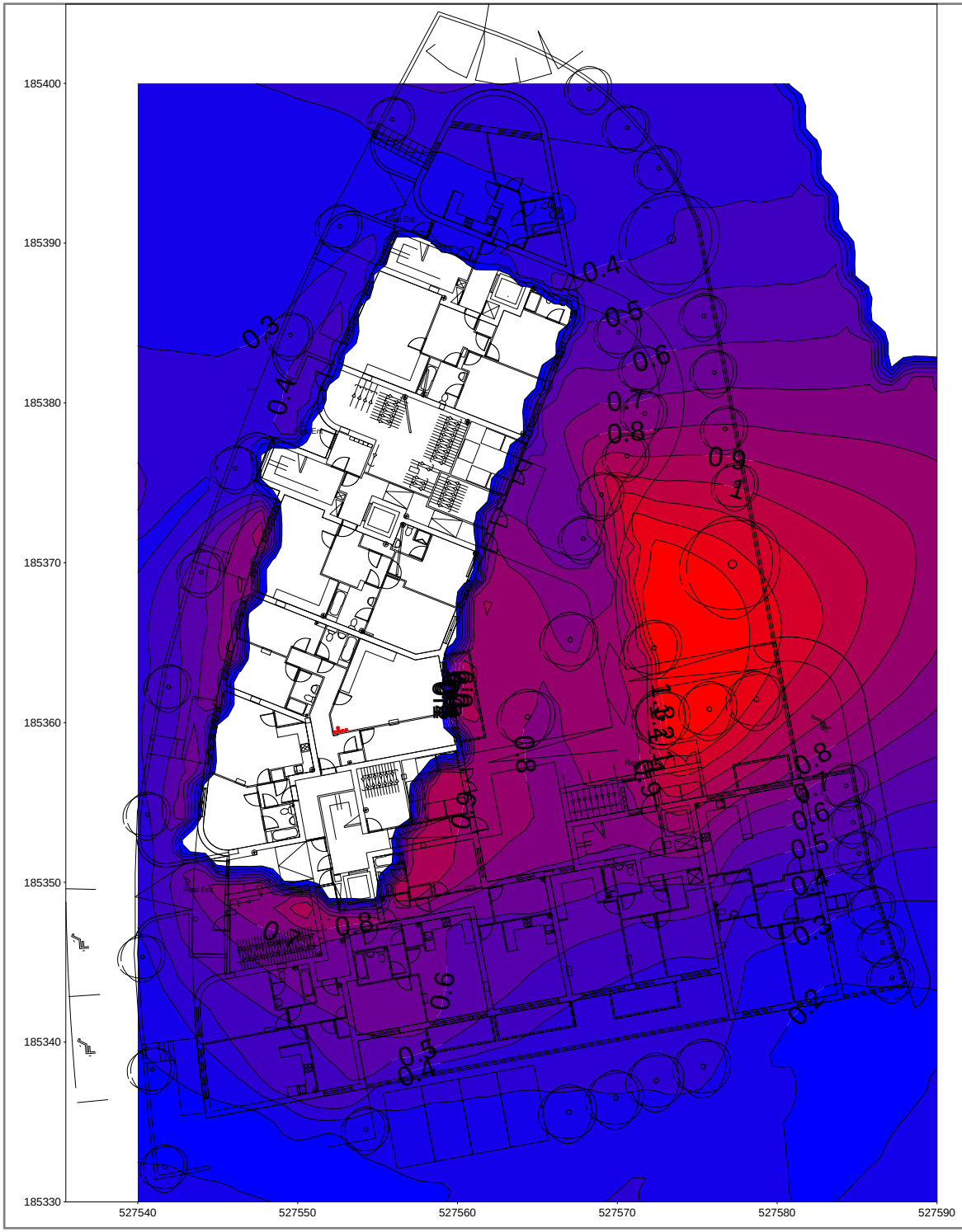
fifth floor

ADMS 5
Scenario 1
45 kW CHP LoadTracker
500 kW gas boilers
steady state sources
Stacks 23m
Main Building - 22m top block mid
Model Scenario 1.apl
Met data Heathrow 2004
Surface roughness 2.0m
Building Effects on
ignores NOx : NO2 chemistry
Terrain effects off
Prediction Grid 1m
Receptor Height 18m
Averaging period 1 hour
Background ignored
Benchmark 40 ug/m3
Units ug/m3 NOx
1 hour annual mean

1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Figure 4.7

The Airshed



AS 0444 Lawn Road AQIA 23 October 2014

Fairview NEW HOMES Ltd.

sixth floor

ADMS 5
Scenario 1
45 kW CHP LoadTracker
500 kW gas boilers
steady state sources
Stacks 23m
Main Building - 22m top block mid
Model Scenario 1.apl
Met data Heathrow 2004
Surface roughness 2.0m
Building Effects on
ignores NOx : NO2 chemistry
Terrain effects off
Prediction Grid 1m
Receptor Height 21m
Averaging period 1 hour
Background ignored
Benchmark 40 ug/m3
Units ug/m3 NOx
1 hour annual mean

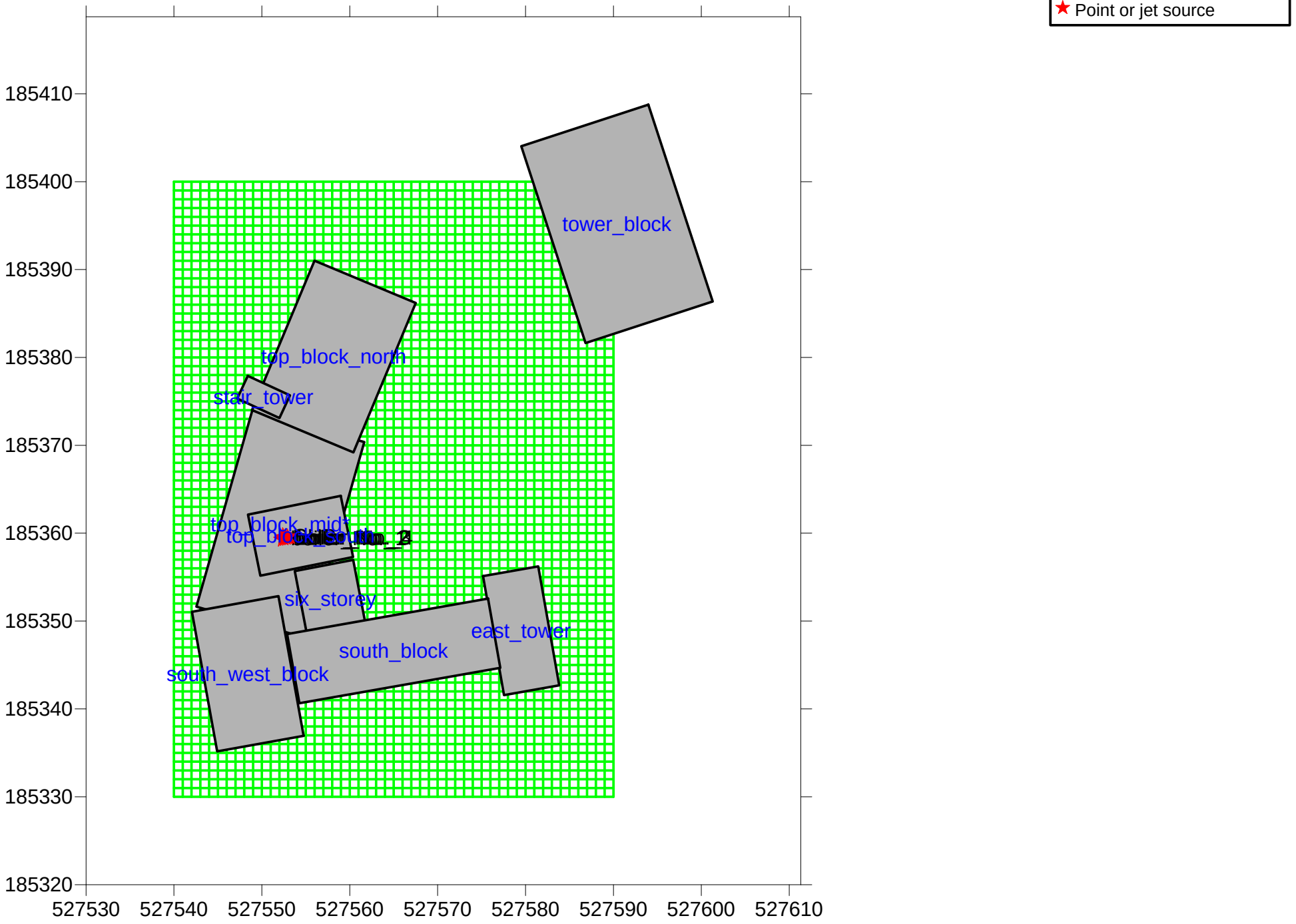
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Figure 4.8

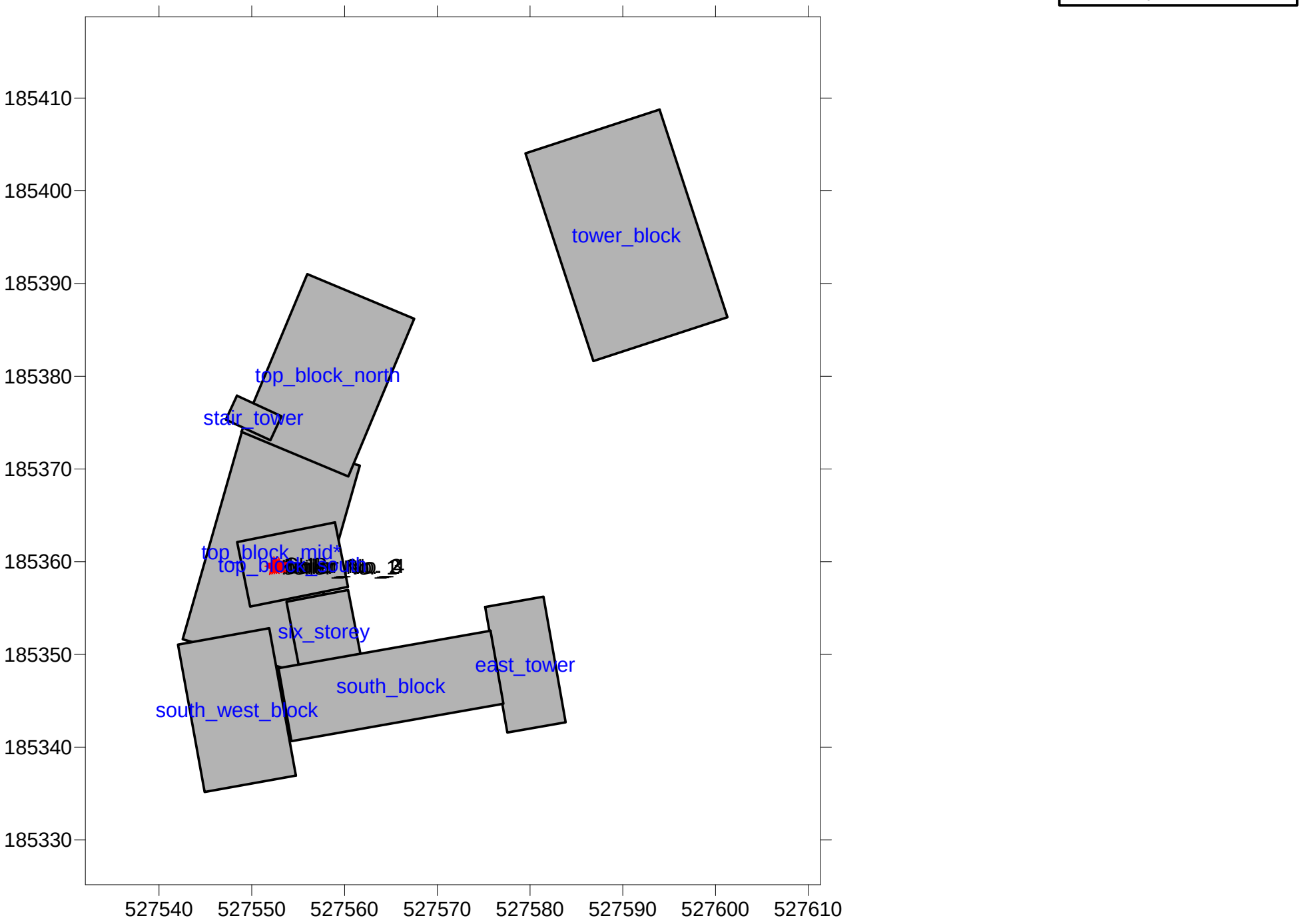
The Airshed

Appendix 1 – ADMS Model Inputs

Visualisation of ADMS input
P:\AS 0444 Lawn Road AQIA\model runs rev01\Scenario 1.APL



Visualisation of ADMS input
P:\AS 0444 Lawn Road AQIA\model runs rev01\Scenario 1.APL



Appendix 2 – ADMS Model Outputs

			model sensitivity analysis - met. data					model sensitivity analysis - surface roughness			
Receptor	X(m)	Y(m)	2003	2004	2005	2006	2007	0.5m	1.0m	1.5m	2.0m
W1	527541.8	185350.2	0.49	0.38	0.41	0.44	0.39	0.31	0.35	0.38	0.42
W2	527542.6	185354.0	0.70	0.57	0.64	0.65	0.58	0.47	0.54	0.57	0.64
W3	527543.6	185357.2	0.72	0.59	0.66	0.66	0.60	0.49	0.55	0.59	0.65
W4	527544.7	185360.6	0.75	0.64	0.71	0.72	0.65	0.53	0.60	0.64	0.72
W5	527545.6	185364.1	0.75	0.67	0.69	0.74	0.66	0.55	0.63	0.67	0.74
W6	527546.6	185367.5	0.78	0.73	0.71	0.76	0.70	0.59	0.68	0.73	0.81
W7	527547.6	185370.8	0.77	0.72	0.70	0.75	0.68	0.58	0.67	0.72	0.80
W8	527547.9	185374.4	0.35	0.32	0.36	0.36	0.33	0.27	0.30	0.32	0.36
E1	527562.3	185351.2	0.67	0.70	0.70	0.69	0.66	0.57	0.65	0.70	0.78
E2	527561.5	185353.8	0.74	0.77	0.76	0.76	0.72	0.63	0.72	0.77	0.84
E3	527561.1	185357.3	0.76	0.80	0.79	0.79	0.77	0.65	0.75	0.80	0.88
E4	527559.9	185361.2	0.78	0.82	0.81	0.81	0.80	0.68	0.77	0.82	0.90
E5	527560.6	185364.1	0.74	0.81	0.80	0.79	0.78	0.67	0.76	0.81	0.89
E6	527561.3	185367.3	0.72	0.79	0.79	0.75	0.77	0.65	0.75	0.79	0.88
E7	527562.2	185369.8	0.70	0.78	0.77	0.74	0.76	0.64	0.73	0.78	0.86
Scenario 1 annual mean NOx		**max**	**0.78**	**0.82**	**0.81**	**0.81**	**0.80**	**0.68**	**0.77**	**0.82**	**0.90**

Receptor	X(m)	Y(m)	Z(m)	LTConc|ug/m3|NOx|<All sources>|-|1hr	P 99.80|ug/m3|NOx|<All sources>|-|1hr
W1	527541.8	185350.2	0	0.49	2.2
W2	527542.6	185354.0	0	0.70	2.2
W3	527543.6	185357.2	0	0.72	2.2
W4	527544.7	185360.6	0	0.75	2.2
W5	527545.6	185364.1	0	0.75	2.3
W6	527546.6	185367.5	0	0.78	2.3
W7	527547.6	185370.8	0	0.77	2.3
W8	527547.9	185374.4	0	0.35	2.2
E1	527562.3	185351.2	0	0.67	2.3
E2	527561.5	185353.8	0	0.74	2.3
E3	527561.1	185357.3	0	0.76	2.2
E4	527559.9	185361.2	0	0.78	2.2
E5	527560.6	185364.1	0	0.74	2.2
E6	527561.3	185367.3	0	0.72	2.2
E7	527562.2	185369.8	0	0.70	2.2
			max	**0.78**	**2.3**

Scenario 1
heathrow 2003
surface roughness 1.5m

Receptor	X(m)	Y(m)	Z(m)	LTConc|ug/m3|NOx|<All sources>|-|1hr	P 99.80|ug/m3|NOx|<All sources>|-|1hr
W1	527541.8	185350.2	0	0.38	2.1
W2	527542.6	185354.0	0	0.57	2.2
W3	527543.6	185357.2	0	0.59	2.2
W4	527544.7	185360.6	0	0.64	2.2
W5	527545.6	185364.1	0	0.67	2.2
W6	527546.6	185367.5	0	0.73	2.3
W7	527547.6	185370.8	0	0.72	2.3
W8	527547.9	185374.4	0	0.32	2.1
E1	527562.3	185351.2	0	0.70	2.2
E2	527561.5	185353.8	0	0.77	2.2
E3	527561.1	185357.3	0	0.80	2.2
E4	527559.9	185361.2	0	0.82	2.2
E5	527560.6	185364.1	0	0.81	2.2
E6	527561.3	185367.3	0	0.79	2.2
E7	527562.2	185369.8	0	0.78	2.2
			max	**0.82**	**2.3**

Scenario 1
heathrow 2004
surface roughness 1.5m

Receptor	X(m)	Y(m)	Z(m)	LTConc|ug/m3|NOx|<All sources>|-|1hr	P 99.80|ug/m3|NOx|<All sources>|-|1hr
W1	527541.8	185350.2	0	0.41	2.2
W2	527542.6	185354.0	0	0.64	2.2
W3	527543.6	185357.2	0	0.66	2.2
W4	527544.7	185360.6	0	0.71	2.2
W5	527545.6	185364.1	0	0.69	2.2
W6	527546.6	185367.5	0	0.71	2.2
W7	527547.6	185370.8	0	0.70	2.2
W8	527547.9	185374.4	0	0.36	2.1
E1	527562.3	185351.2	0	0.70	2.2
E2	527561.5	185353.8	0	0.76	2.2
E3	527561.1	185357.3	0	0.79	2.2
E4	527559.9	185361.2	0	0.81	2.2
E5	527560.6	185364.1	0	0.80	2.2
E6	527561.3	185367.3	0	0.79	2.2
E7	527562.2	185369.8	0	0.77	2.2
			max	**0.81**	**2.2**

Scenario 1
heathrow 2005
surface roughness 1.5m

Receptor	X(m)	Y(m)	Z(m)	LTConc|ug/m3|NOx|<All sources>|-|1hr	P 99.80|ug/m3|NOx|<All sources>|-|1hr
W1	527541.8	185350.2	0	0.44	2.1
W2	527542.6	185354.0	0	0.65	2.1
W3	527543.6	185357.2	0	0.66	2.1
W4	527544.7	185360.6	0	0.72	2.2
W5	527545.6	185364.1	0	0.74	2.2
W6	527546.6	185367.5	0	0.76	2.2
W7	527547.6	185370.8	0	0.75	2.2
W8	527547.9	185374.4	0	0.36	1.9
E1	527562.3	185351.2	0	0.69	2.2
E2	527561.5	185353.8	0	0.76	2.2
E3	527561.1	185357.3	0	0.79	2.2
E4	527559.9	185361.2	0	0.81	2.2
E5	527560.6	185364.1	0	0.79	2.2
E6	527561.3	185367.3	0	0.75	2.2
E7	527562.2	185369.8	0	0.74	2.2
			max	**0.81**	**2.2**

Scenario 1
heathrow 2006
surface roughness 1.5m

Receptor	X(m)	Y(m)	Z(m)	LTConc|ug/m3|NOx|<All sources>|-|1hr	P 99.80|ug/m3|NOx|<All sources>|-|1hr
W1	527541.8	185350.2	0	0.39	2.1
W2	527542.6	185354.0	0	0.58	2.2
W3	527543.6	185357.2	0	0.60	2.2
W4	527544.7	185360.6	0	0.65	2.2
W5	527545.6	185364.1	0	0.66	2.2
W6	527546.6	185367.5	0	0.70	2.2
W7	527547.6	185370.8	0	0.68	2.2
W8	527547.9	185374.4	0	0.33	2.0
E1	527562.3	185351.2	0	0.66	2.2
E2	527561.5	185353.8	0	0.72	2.2
E3	527561.1	185357.3	0	0.77	2.2
E4	527559.9	185361.2	0	0.80	2.2
E5	527560.6	185364.1	0	0.78	2.2
E6	527561.3	185367.3	0	0.77	2.2
E7	527562.2	185369.8	0	0.76	2.2
			max	**0.80**	**2.2**

Scenario 1
heathrow 2007
surface roughness 1.5m

Receptor	X(m)	Y(m)	Z(m)	LTConc|ug/m3|NOx|<All sources>|-|1hr	P 99.80|ug/m3|NOx|<All sources>|-|1hr
W1	527541.8	185350.2	0	0.31	2.0
W2	527542.6	185354.0	0	0.47	2.0
W3	527543.6	185357.2	0	0.49	2.0
W4	527544.7	185360.6	0	0.53	2.0
W5	527545.6	185364.1	0	0.55	2.1
W6	527546.6	185367.5	0	0.59	2.1
W7	527547.6	185370.8	0	0.58	2.1
W8	527547.9	185374.4	0	0.27	1.9
E1	527562.3	185351.2	0	0.57	2.1
E2	527561.5	185353.8	0	0.63	2.1
E3	527561.1	185357.3	0	0.65	2.1
E4	527559.9	185361.2	0	0.68	2.1
E5	527560.6	185364.1	0	0.67	2.1
E6	527561.3	185367.3	0	0.65	2.1
E7	527562.2	185369.8	0	0.64	2.1
			max	**0.68**	**2.1**

Scenario 1
heathrow 2004
surface roughness 0.5m

Receptor	X(m)	Y(m)	Z(m)	LTConc|ug/m3|NOx|<All sources>|-|1hr	P 99.80|ug/m3|NOx|<All sources>|-|1hr
W1	527541.8	185350.2	0	0.35	2.1
W2	527542.6	185354.0	0	0.54	2.1
W3	527543.6	185357.2	0	0.55	2.1
W4	527544.7	185360.6	0	0.60	2.1
W5	527545.6	185364.1	0	0.63	2.2
W6	527546.6	185367.5	0	0.68	2.2
W7	527547.6	185370.8	0	0.67	2.2
W8	527547.9	185374.4	0	0.30	1.9
E1	527562.3	185351.2	0	0.65	2.2
E2	527561.5	185353.8	0	0.72	2.2
E3	527561.1	185357.3	0	0.75	2.2
E4	527559.9	185361.2	0	0.77	2.2
E5	527560.6	185364.1	0	0.76	2.2
E6	527561.3	185367.3	0	0.75	2.2
E7	527562.2	185369.8	0	0.73	2.2
			max	**0.77**	**2.2**

Scenario 1
heathrow 2004
surface roughness 1.0m

Receptor	X(m)	Y(m)	Z(m)	LTConc|ug/m3|NOx|<All sources>|-|1hr	P 99.80|ug/m3|NOx|<All sources>|-|1hr
W1	527541.8	185350.2	0	0.38	2.1
W2	527542.6	185354.0	0	0.57	2.2
W3	527543.6	185357.2	0	0.59	2.2
W4	527544.7	185360.6	0	0.64	2.2
W5	527545.6	185364.1	0	0.67	2.2
W6	527546.6	185367.5	0	0.73	2.3
W7	527547.6	185370.8	0	0.72	2.3
W8	527547.9	185374.4	0	0.32	2.1
E1	527562.3	185351.2	0	0.70	2.2
E2	527561.5	185353.8	0	0.77	2.2
E3	527561.1	185357.3	0	0.80	2.2
E4	527559.9	185361.2	0	0.82	2.2
E5	527560.6	185364.1	0	0.81	2.2
E6	527561.3	185367.3	0	0.79	2.2
E7	527562.2	185369.8	0	0.78	2.2
			max	**0.82**	**2.3**

Scenario 1
heathrow 2004
surface roughness 1.5m

Receptor	X(m)	Y(m)	Z(m)	LTConc|ug/m3|NOx|<All sources>|-|1hr	P 99.80|ug/m3|NOx|<All sources>|-|1hr
W1	527541.8	185350.2	0	0.42	2.2
W2	527542.6	185354.0	0	0.64	2.2
W3	527543.6	185357.2	0	0.65	2.2
W4	527544.7	185360.6	0	0.72	2.2
W5	527545.6	185364.1	0	0.74	2.2
W6	527546.6	185367.5	0	0.81	2.2
W7	527547.6	185370.8	0	0.80	2.2
W8	527547.9	185374.4	0	0.36	2.1
E1	527562.3	185351.2	0	0.78	2.2
E2	527561.5	185353.8	0	0.84	2.2
E3	527561.1	185357.3	0	0.88	2.2
E4	527559.9	185361.2	0	0.90	2.2
E5	527560.6	185364.1	0	0.89	2.2
E6	527561.3	185367.3	0	0.88	2.2
E7	527562.2	185369.8	0	0.86	2.2
			max	**0.90**	**2.2**

Scenario 1
heathrow 2004
surface roughness 2.0m

Fairview
NEW HOMES Ltd.