CCWEL: Roseburn Terrace

Air Quality Modelling Report

City of Edinburgh Council

60564045/AQ/02

Quality information

Prepared by	Verified by	Approved by
Elisa Uginet Graduate Air Quality Consultant	Garry Gray Technical Director -Air Quality	Tom Stenhouse Technical Director -Air Quality
Fergus Boughton Principal Air quality Consultant		

Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	08/10/2019		Y	Tom Stenhouse	Technical Director
2	14/10/2019		Y	Tom Stenhouse	Technical Director

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Prepared for:

City of Edinburgh Council

Prepared by:

AECOM
2 City Walk
Leeds
United Kingdom

T: +44 (113) 204 5000
aecom.com

Table of Contents

Tables

1. Introduction

Introduction

1.1 This air quality modelling report has been prepared in support of ongoing engagement with stakeholders that have expressed an interest in the changes in exposure to air pollutants that are likely to occur as a direct result of the proposed Roseburn Terrace improvement scheme. The scheme involves improving pedestrian crossings, adding buffers (cycle lane and loading bay) between pedestrians and traffic and managing queues with some changes in the road use and the traffic light patterns. The site is situated in the west of Edinburgh city centre.

1.2 This report focusses on exposure of people to nitrogen dioxide and particulate matter (PM_{10} size fraction) during the morning and afternoon rush hour periods, but also considers the likely changes to daily and annual mean concentrations.

1.3 This work sits outside of the normal impact assessment methodologies used to consider changes in air quality, because the likely changes are too subtle to be demonstrated by the methods set out in technical guidance documents, such as the Design Manual for Roads and Bridges. This report is not intended to be a formal impact assessment but presents detailed information relating the magnitude of air pollutant concentration changes that would occur due to the scheme and supporting explanation to set the findings into context. The methods used are set out in sufficient detail to be understandable by a technically competent person, but the remainder of the document has been drafted with the intention of being accessible by a lay audience.

1.4 The report illustrates the pattern of exposure to nitrogen dioxide and PM_{10} with the current road configuration and traffic flows as they were in 2016. 2016 is the reference year of the existing baseline traffic model. The report then considers how the proposed scheme of improvements to the road would alter the pattern of exposure, if the volume and mix of traffic remained unchanged. Finally, the magnitude of air pollutant concentrations is considered for the proposed scheme in the scheme year of opening (assumed 2021).

Scope of Work

1.5 Stakeholders have raised questions that relate to the exposure of people to changes in the concentration of the air pollutants nitrogen dioxide and particulate matter. In this study particulate matter is represented by the size fraction PM_{10}.

1.6 The study has quantified the magnitude of short term concentrations of nitrogen dioxide and PM_{10} for three distinct model scenarios:

- **Baseline 2016 Scenario**: This scenario is based on traffic as experienced in 2016 on Roseburn Terrace, using meteorological data from 2017.
- **With Scheme 2016 Scenario**: This scenario includes changes to the layout of the road and traffic resulting from the scheme as it would be in 2016, using meteorological data from 2017.
- **With Scheme 2021 Scenario**: This scenario represents the opening year (2021) including the same changes to road layout due to the Proposed Development as the With Scheme 2016 scenario, using meteorological data from 2017.

1.7 The magnitude of short term concentrations is modelled and presented for a range of point receptors at building facades and council measurement locations, with additional graphic plots to illustrate the changes between scenarios.

2. Planning Policy and Legislation

European Legislation

2.1 European Union (EU) air quality legislation is provided within Directive 2008/50/EC (EU, 2008), which came into force on 11th June 2008. This Directive consolidated previous legislation which was designed to deal with specific pollutants in a consistent manner and provided new air quality objectives for particulate matter with an aerodynamic diameter of less than 2.5 µm ($PM_{2.5}$). The consolidated Directives include:

- Directive 99/30/EC (EU, 1999) - the First Air Quality "Daughter" Directive - sets ambient Air Quality Limit Values (AQLVs) for NO_2, oxides of nitrogen (NO_x), sulphur dioxide, lead and particulate matter with an aerodynamic diameter of less than 10 µm (PM_{10});
- Directive 2000/69/EC (EU, 2000) - the Second Air Quality "Daughter" Directive - sets ambient AQLVs for benzene and carbon monoxide; and
- Directive 2002/3/EC (EU, 2002)) - the Third Air Quality "Daughter" Directive - seeks to establish long term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

2.2 Directive 2008/50/EC (Council of European Communities, 2008) is currently transposed into UK legislation by the Air Quality Standards Regulations 2010 (Scottish Government, 2010) which came into force on the 11th June 2010. These limit values are binding on the UK and have been set with the aim of avoiding, preventing or reducing harmful effects on human health and on the environment.

National Legislation

2.3 The objectives adopted in Scotland are laid out in the Air Quality (Scotland) Regulations 2000 (Scottish Government, 2000), Air Quality (Scotland) Amendment Regulations 2002 (Scottish Government, 2002) and the Air Quality (Scotland) Amendment Regulations 2016 (draft) (Scottish Government, 2016). Table 1 provides a summary table for current Air Quality Objectives in Scotland concerning pollutants considered within this study.

Table 1: Current Air Quality Objectives in Scotland

Pollutant	Concentration ($\mu g/m^3$)	Measured as	Permitted exceedances of objective value
Nitrogen Dioxide, NO_2	200	1-hour mean	Not to be exceeded more than 18 times a year
	40	Annual mean	None
Particulates, PM_{10}	50	24-hour mean	Not to be exceeded more than 7 time per year
	18	Annual mean	None

2.4 The key issue in this study is the change in exposure that people would experience on a timescale of the rush hour periods when emissions are at the highest rates. The hourly objective value for nitrogen dioxide is useful as a point of reference. The short term PM_{10} objective value is for a 24 hour mean and as with annual mean values, is less useful in understanding short term changes in exposure to variable emissions because the low emission periods at other times of day mask the exposure experienced during periods of high emissions. The PM_{10} values have been reported as hourly maximum values and the associated implications for the annual values made qualitatively.

3. Assessment Methodology

3.1 This section details the methods used to illustrate the likely potential changes in air pollutant concentrations that would result from the planned scheme. The approach used has been to use detailed traffic modelling and instantaneous emissions tools to provide high resolution data of the location of emissions with the study area. Dispersion modelling, using ADMS and taking account of the 'street canyon' setting, has been used to calculate how those emissions would disperse and dilute as the wind carries them away from the road.

3.2 The study area is roughly defined by a 200m perimeter each side of the A8 at Roseburn Terrace, between the junctions with Roseburn Gardens and Roseburn Street.

Method for Calculation of Road Traffic Emissions

3.3 The incomplete combustion of fuel in vehicle engines results in the presence of hydrocarbons (HC) such as benzene and 1,3-butadiene, and sulphur dioxide (SO_2), carbon monoxide (CO) and PM_{10} (aerodynamic diameter less than 10 µm) in exhaust emissions. Better emission control technology and fuel specifications are expected to reduce emissions per vehicle in future years.

3.4 At the high temperatures and pressures found within vehicle engines, some of the nitrogen in air and fuel is oxidised to form oxides of nitrogen (NO_X), mainly in the form of nitric oxide (NO); which is then converted to NO_2 in the atmosphere. The presence of NO_2 in the atmosphere is associated with adverse effects on human health. Vehicle emissions can also result in the exposure at sensitive receptors to concentrations of PM_{10} and $PM_{2.5}$.

3.5 This assessment used VISSIM microsimulation traffic model to model emissions for three distinct model scenarios and two time frames representing am and pm rush hour (peak) periods:

- **Baseline 2016 Scenario**: This scenario is based on traffic as experienced in 2016 on Roseburn Terrace, using meteorological data from 2017.
- **With Scheme 2016 Scenario**: This scenario includes changes to the layout of the road and traffic resulting from the scheme as it would be in 2016, using meteorological data from 2017.
- **With Scheme 2021 Scenario**: This scenario represents the opening year (2021) including the same changes to road layout due to the Proposed Development as the With Scheme 2016 scenario, using meteorological data from 2017.

3.6 The dispersion modelling has used emission rates from instantaneous emissions modelling for AM and PM Peak. Base VISSIM models and traffic flows for the assessment were provided by City of Edinburgh Council (CEC), calibrated and validated to a base year of 2016 in previous modelling undertaken by Jacobs. Additional 2021 'Opening Year' traffic flows were estimated using growth factors extracted from TEMPro (however it should be noted that this does represent a very cautious approach; traffic in Edinburgh, and on this road in particular, is going down over time).

3.7 Modelling was undertaken for the AM Peak (08:00 – 09:00) and PM Peak (17:00 – 18:00); each model includes a 15 minute warm-up period prior to collection of results. Car, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV) traffic matrices were provided.

3.8 The hourly emission rates from EnViVer were used to represent longer peak periods (7:00 to 10:00 for the AM and 17:00 to 19:00 for the PM) in the ADMS model, to increase the number of hours modelled, allowing a greater range of meteorological conditions to be modelled.

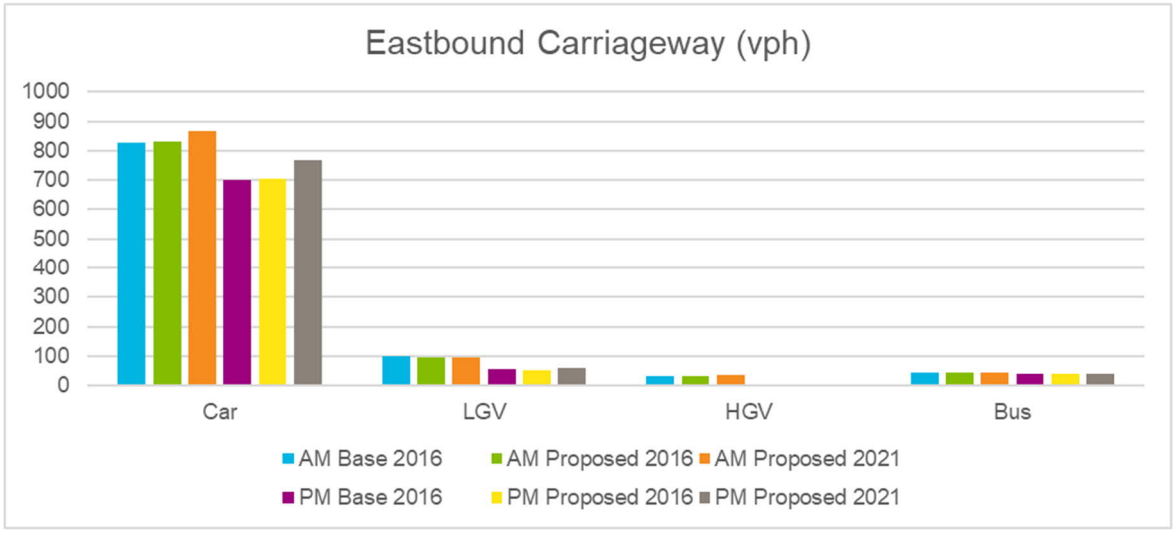
3.9 Link Flows have been extracted from the VISSIM models to assess the vehicle throughput in each scenario. This information is illustrated in Figure 1.

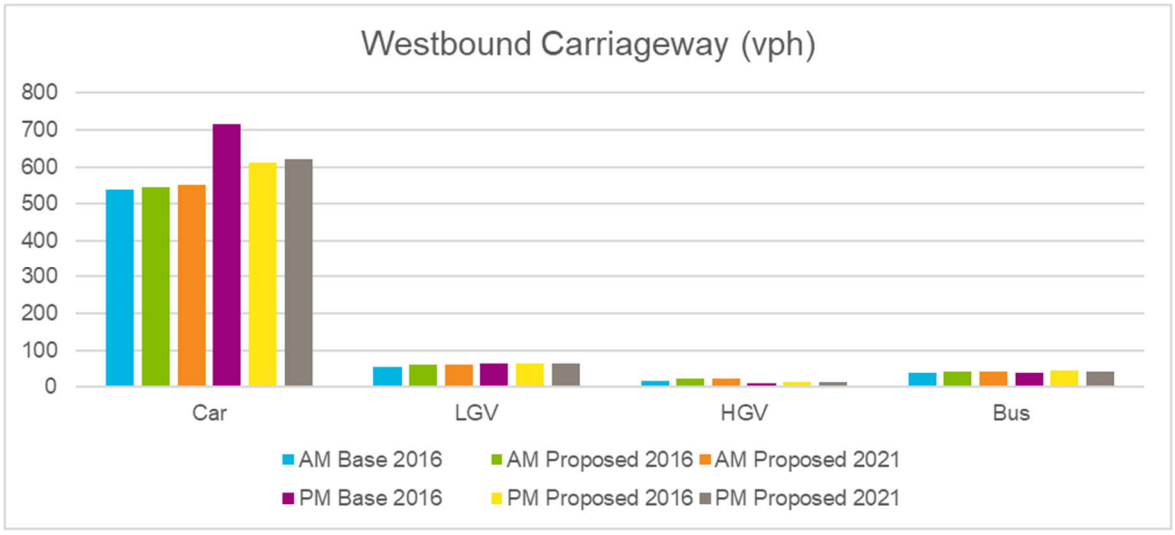
3.10 The eastbound carriageway shows the approximately 8% increase in PM peak traffic flow between 2016 and 2021 is accommodated by the traffic signals, with a slightly lower increase accommodated in the busier AM peak movement.

3.11 On the westbound carriageway, the increase in traffic flow between 2016 and 2021 is less pronounced due to the proposed traffic signal gating strategy to reduce westbound queuing on Roseburn Terrace. This proposed gating strategy is also responsible for the reduced westbound throughput in the PM peak, when compared to the PM Base traffic flow.

3.12 As mentioned above it should be noted that assuming an increase in traffic between 2016 and 2021 does represent a very cautious approach; traffic in Edinburgh, and on this road in particular, is going down over time.

Figure 1: Summary of Relative Traffic Flows Across All VISSIM Scenarios





vph = vehicles per hour

3.13 The petrol/diesel data split used within this assessment for the baseline and with scheme scenarios are presented in Appendix A of this report.

3.14 VISSIM outputs were post-processed using bespoke Python scripts and EnViVer instantaneous emissions software to estimate the NOx and PM_{10} emissions rate data in g/km/hr, for the peak hour traffic flows on Roseburn Terrace. This modelling used custom 2016 and 2021 fleet profiles which were developed in EnViVer to capture the differences in emission rates for different types and ages of vehicle under the predicted

driving conditions. The resolution of the emission rate data was at 5m increments for each lane.

3.15 The emissions rate data for the one hour duration am and pm peak periods reported from the emission calculations, where used in the dispersion model stage to represent a peak periods of 3 hours duration in the morning and 2 hours duration in the afternoon, so as to maximise the variability of meteorological conditions considered.

Model Output Locations

3.16 Air pollutant concentrations have been quantified by the model at two City of Edinburgh council nitrogen dioxide sampling sites and at the façade of buildings fronting onto Roseburn Terrace.

3.17 Each receptor represents a façade on a building, in each case a ground floor location is selected at a height of 1.5m. Additional receptor points have been included directly above the ground floor receptor location, at 4.5 m above street level.

3.18 Model outputs for 30 receptor points have been produced, as listed in Table 2 and displayed in Figures 3 to 7.

Table 2: Selected Model Output Locations

ID	Receptor Description	OS Grid Reference		Height (m)
		X	Y	
R1	Commercial property	323043.2	673171.6	1.5
R2	Commercial property	323032.8	673175.26	1.5
R3	Commercial property	323016.4	673179.9	1.5
R4	Commercial property	323002.9	673184.4	1.5
R5	Commercial property	322991.6	673187.9	1.5
R6	Commercial property	322978.7	673192.1	1.5
R7	Commercial property	322964.7	673196.7	1.5
R8	Commercial property	322951.1	673201.1	1.5
R9	Commercial property	322937.0	673205.7	1.5
R10	Commercial property	322927.6	673207.8	1.5
R11	Residential property	322901.4	673208.1	1.5
R12	Residential property	322963.6	673230.4	1.5
R13	Commercial property	322969.9	673214.1	1.5
R14	Commercial property	322981.9	673209.7	1.5
R15	Commercial property	322995.9	673204.6	1.5
R16	Commercial property	323011.2	673198.8	1.5
R1_b	Residential property	323043.2	673171.6	4.5
R2_b	Residential property	323032.8	673175.2	4.5
R3_b	Residential property	323016.4	673179.9	4.5
R4_b	Residential property	323002.9	673184.4	4.5
R5_b	Residential property	322991.6	673187.9	4.5
R6_b	Residential property	322978.7	673192.1	4.5
R7_b	Residential property	322964.7	673196.8	4.5
R8_b	Residential property	322951.1	673201.1	4.5
R9_b	Residential property	322937.0	673205.7	4.5
R10_b	Residential property	322927.6	673207.8	4.5

ID	Receptor Description	OS Grid Reference		Height (m)
		X	Y	
R13_b	Residential property	322969.9	673214.1	4.5
R14_b	Residential property	322981.9	673209.7	4.5
R15_b	Residential property	322995.9	673204.6	4.5
R16_b	Residential property	323011.2	673198.8	4.5
22a	City of Edinburgh Council Sampling Site	322984.0	673189.0	1.5
23	City of Edinburgh Council Sampling Site	323007.3	673198.2	1.5

Dispersion Modelling

3.19 The ADMS dispersion model input data and general model conditions used in the assessment for the Proposed Development are provided in Table 3.

Table 3: General ADMS Roads Model Conditions

Variables	ADMS Roads Model Input
Surface roughness at source	1.5m
Minimum Monin-Obukhov length for stable conditions	30m
Terrain types	Flat
Street Canyons	Advanced
Receptor locations	See Table 2: Selected Model Output Locations
Emissions	NO_x, PM_{10}
Emission factors	From EnViVer
Meteorological data	1 year (2017) hourly sequential data from Edinburgh Airport meteorological station
Emission profiles	Hourly profiles used to represent AM peak queues between 7am and 10am Hourly profiles used to represent AM peak queues between 5pm and 7pm
Model output	99.79th percentile 1h NO_x concentrations 98th percentile 24h PM_{10} concentrations

Dispersion Modelling Scenarios

3.20 Dispersion modelling scenarios considered within the assessment of impacts on air quality due to the Proposed Development include:

- Baseline 2016 Scenario: This scenario models the dispersion of emissions from the existing road network. This scenario has used Defra's project pollutant background concentration for the reference year of 2017 (the first year of the current projects) and 2017 meteorological data. Local emissions modelled for periods 7am to 10am and 5pm to 7pm.
- With Scheme 2016 Scenario: This scenario models the dispersion of emissions from the Site in the year 2016 with the scheme in place. This scenario has used 2017 backgrounds and 2017 meteorological data. Local emissions modelled for periods 7am to 10am and 5pm to 7pm.
- With Scheme 2021 Scenario: This scenario models the dispersion of emissions from the Site in the year 2021 with the scheme in place. This scenario has used 2017 backgrounds and 2017 meteorological data. The use of 2017 background data is a

conservative approach, as the background concentrations are expected to decrease in the future. Local emissions modelled for periods 7am to 10am and 5pm to 7pm.

Meteorological Data

3.21 One year (2017) of hourly sequential observation data from Edinburgh Airport meteorological station has been used in this assessment. The station is located approximately 8 km West of the Proposed Development and experiences meteorological conditions that are considered to be representative of those experienced in the Roseburn Terrace area.

3.22 The year 2017 had been chosen as it is a typical year and has been used in recent air quality assessments by City of Edinburgh. It represents a known dataset, with no missing data issues.

3.23 The wind rose presented in Figure 2 indicates that the predominant wind direction is from the West South-West.

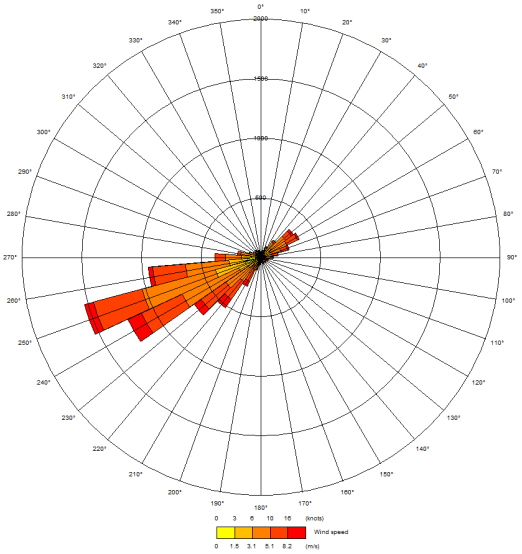


Figure 2: 2017 wind rose from Edinburgh Airport meteorological station

Background Data

3.24 Background concentration data for PM_{10} have been sourced from Defra Background Maps and are presented in Table 4. 2017 background concentrations have been used for the all scenarios, as a conservative estimate of future reductions in background contributions to total pollutant concentrations on Roseburn Terrace.

Table 4: Defra Predicted Background Annual Mean PM_{10} Concentrations

Grid Square		PM_{10} 2017 Background Concentrations (µg/m^3)
322500	673500	10.7
323500	673500	11.1

3.25 Defra background concentrations include contributions from a variety of sources, including roads, rail and industry. As this assessment has a very limited spatial coverage of the road network, a conservative approach has been taken by not removing any sources from the Defra background values for PM_{10}. To provide a conservative approach, no improvement in background concentrations over time has been assumed by using the 2017 concentrations for all future scenario predictions.

3.26 For the NO_2 background concentration, a background diffusion tube located within the study area of the scheme has been used for all the scenarios, providing a conservative approach by assuming no decrease in the background concentration over time. The value used for all receptor locations is 17 µg/m^3.

Road Traffic Emissions NO_X to NO_2 Conversion

3.27 For the conversion of short-term predictions, a 35% conversion from predicted roadside NOx to NO_2 is assumed to calculate the local contribution, and twice the annual mean background NO_2 concentration added to calculate a total concentration value.

PM_{10} Model Outputs to Final Results Conversion

3.28 From the PM_{10} model outputs, twice the annual mean background PM_{10} concentration is added to the local contribution to calculate the total concentration value.

4. Existing Conditions

4.1 Roseburn Terrace is located in Edinburgh's Central AQMA for nitrogen dioxide. However, data for sampling locations 22a and 23 on Roseburn Terrace confirms that façade corrected annual mean concentrations of nitrogen dioxide have been below the objective value of 40 µg/m^3 since 2011. This means the air quality in the study area is currently in compliance with air quality standards.

4.2 There is no measurement data for hourly mean concentrations of nitrogen dioxide concentrations in Roseburn Terrace, but annual concentrations are well below 50 µg/m^3 and so it can be presumed with confidence that the hourly mean objective value is also achieved at building facades.

4.3 There is no measurement data available for PM_{10} concentrations within Roseburn Terrace.

Baseline 2016 Scenario

4.4 1-hour mean concentrations of NO_2 and PM_{10} for the Baseline 2016 scenario have been predicted at all locations specified in Table 2 and the results are reported in Table 5.

4.5 The results confirm that hourly mean concentrations of nitrogen dioxide at the façade of buildings in Roseburn Terrace are well below the air quality objective value of 200 µg/m^3. There are hotspots at the eastern end of Roseburn Terrace, as represented by receptors R2 to R7 on the southern side and R16 on the northern side of the street.

4.6 Figure 3 provides an illustration of the pattern of hourly mean nitrogen dioxide concentrations along Roseburn Terrace for the Baseline 2016 scenario and includes the locations that concentrations have been calculated for within Table 5. The pattern of emissions from local road vehicles increasing concentrations on the southern side of the street is consistent with measurement data for sampling locations 22a and 23. The plot also confirm the location of sampling location 22a as being in a position that is representative of the highest value to the north of the street.

4.7 The hourly maximum concentrations of PM_{10} are low and at many receptors the value of the maximum hourly concentration is lower than the air quality objective for a 24 hour mean concentration.

Table 5: Baseline 2016 Scenario

Receptor ID	Nitrogen dioxide 1-hour mean 99.79th percentile (µg/m3)	PM_{10} 1-hour max (µg/m^3)
R1	55.3	27.6
R2	82.2	35.5
R3	81.7	29.9
R4	176.6	66.2
R5	121.4	44.1
R6	74.9	37.8
R7	74.0	39.3
R8	65.6	31.8
R9	81.9	32.7
R10	47.2	25.8
R11	42.8	24.6
R12	57.4	28.7

Receptor ID	Nitrogen dioxide 1-hour mean 99.79th percentile (µg/m3)	PM_{10} 1-hour max (µg/m^3)
R13	85.1	32.3
R14	134.2	53.1
R15	141.4	54.4
R16	156.8	61.2
R1_b	49.4	26.4
R2_b	69.2	32.2
R3_b	73.6	27.5
R4_b	147.2	59.0
R5_b	111.1	41.6
R6_b	66.0	35.0
R7_b	64.8	35.7
R8_b	58.2	29.6
R9_b	74.9	31.3
R10_b	44.0	24.9
R13_b	71.0	29.6
R14_b	121.1	49.7
R15_b	128.4	50.6
R16_b	141.8	56.7
R22a	43.1	24.3
R23	193.2	70.3

LEGEND

Receptors

Nitrogen dioxide
1-hour mean
99.79th percentile
(µg/m^3)

- < 2
- 2 - 10
- 10 - 20
- 20 - 100
- > 100

Client:	City of Edinburgh
Project:	CCWEL Roseburn Terrace
Title:	Baseline 2016 Scenario Model Results

12 Regan Way
Chetwynd Business Park
Chilwell
Nottingham
NG9 6RZ

Tel: +44 (0) 115 907 7000
Fax: +44 (0) 115 907 7001
www.aecom.com

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Figure 3 — A3

5. With Scheme Conditions

With Scheme 2016 Scenario

5.1 Table 6 presents NO_2 and PM_{10} short-term concentrations at receptor locations during the weekday rush hour periods and the change in the local road contribution to total air pollutant concentrations that can be attributed to the scheme.

Table 6: Summary of the change in air quality with the scheme.

Receptor ID	Nitrogen Dioxide		PM_{10}	
	1-hour mean 99.79th percentile (µg/m3)	Change in local contribution relative to the baseline (µg/m3)	1-hour max (µg/m3)	Change in local contribution relative to the baseline (µg/m3)
R1	50.0	-5.4	27.4	-0.2
R2	73.5	-8.7	35.6	0.1
R3	63.4	-18.3	29.9	0.0
R4	144.4	-32.1	58.4	-7.8
R5	79.7	-41.6	39.2	-5.0
R6	71.7	-3.2	37.0	-0.8
R7	75.2	1.1	38.0	-1.3
R8	68.1	2.5	32.1	0.4
R9	72.7	-9.2	31.5	-1.2
R10	52.6	5.4	25.6	-0.2
R11	48.2	5.4	24.8	0.2
R12	54.7	-2.7	27.7	-0.9
R13	70.3	-14.8	31.0	-1.3
R14	95.4	-38.8	47.1	-6.1
R15	99.8	-41.6	48.2	-6.1
R16	130.2	-26.6	52.7	-8.6
R1_b	46.8	-2.6	25.9	-0.5
R2_b	63.1	-6.1	32.2	0.1
R3_b	58.8	-14.8	27.6	0.1
R4_b	122.8	-24.3	52.2	-6.8
R5_b	74.6	-36.5	37.3	-4.4
R6_b	64.0	-2.0	34.0	-1.0
R7_b	66.7	1.9	34.7	-1.0
R8_b	61.4	3.2	29.9	0.3
R9_b	67.1	-7.9	30.2	-1.1
R10_b	47.5	3.5	24.8	-0.2
R13_b	60.8	-10.3	28.7	-0.9
R14_b	89.5	-31.6	45.0	-4.6
R15_b	93.2	-35.2	46.0	-4.6
R16_b	119.1	-22.7	49.7	-7.0
R22a	41.8	-1.3	24.1	-0.3
R23	167.4	-25.8	64.7	-5.5

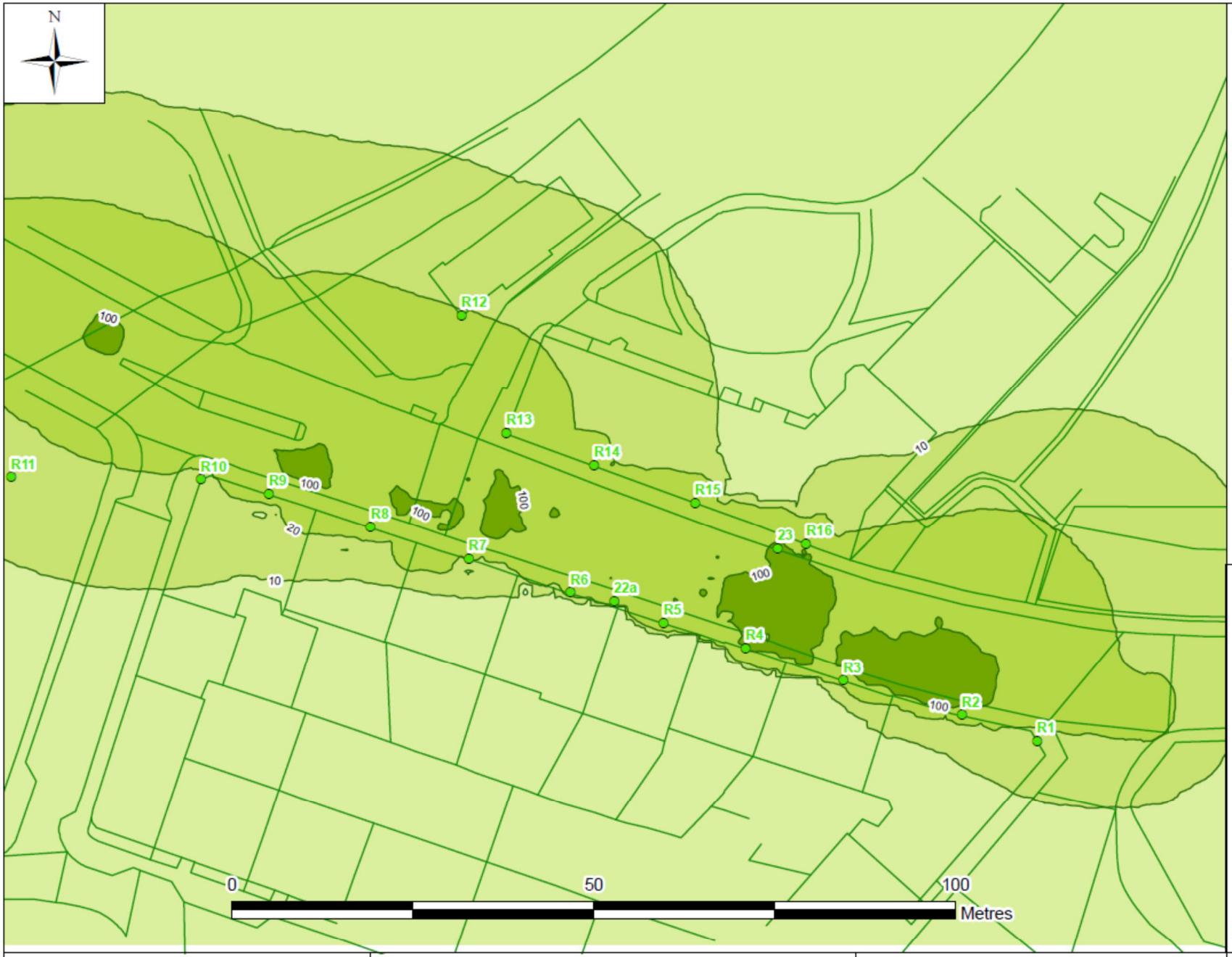
5.2 The with scheme 2016 scenario results are mostly beneficial and represent reductions in the hourly mean concentration of nitrogen dioxide and particulate matter at locations between the kerbside and building facades on Roseburn Terrace, compared to the baseline 2016 scenario. There are some locations that would experience a slight worsening due to the increase volumes of traffic flowing through previously less congested sections of the road.

5.3 Figure 4 illustrates the hourly mean concentration of nitrogen dioxide during peak traffic periods and the change in the pattern of the local contribution to total concentrations within the Roseburn Terrace is illustrated in Figure 5.

5.4 The scale of the changes to hourly mean nitrogen dioxide concentrations range from a maximum worsening at R12 and R13 at ground floor level, of +5 µg/m^3, to an improvement of -41 µg/m^3 at R5 and R15. None of the increases introduce a risk of the hourly mean air quality objective value not being achieved and overall represent a situation were the margin of achievement of the annual mean objective value would also improve.

5.5 The change in hourly concentrations of particulate matter (PM_{10}) is mainly so small as to represent no change, but there are some improvements of up to -8 µg/m^3. Overall the results would equate to a slight improvement in the 24 hour mean and annual concentration of PM_{10}.

5.6 During peak periods the reduction in short term concentrations of both nitrogen dioxide and PM_{10} illustrated at locations beyond Roseburn Terrace represent a contribution to reducing the background concentration of these pollutants, which is in the order to 1 µg/m^3 to 2 µg/m^3.



LEGEND

Receptors

Nitrogen dioxide
1-hour mean
99.79th percentile
(µg/m^3)

- < 2
- 2 - 10
- 10 - 20
- 20 - 100
- > 100

Client:	City of Edinburgh
Project:	CCWEL Roseburn Terrace
Title:	With Scheme 2016 Scenario Model Results

AECOM
12 Regan Way
Chetwynd Business Park
Chilwell
Nottingham
NG9 6RZ
Tel: +44 (0) 115 907 7000
Fax: +44 (0) 115 907 7001
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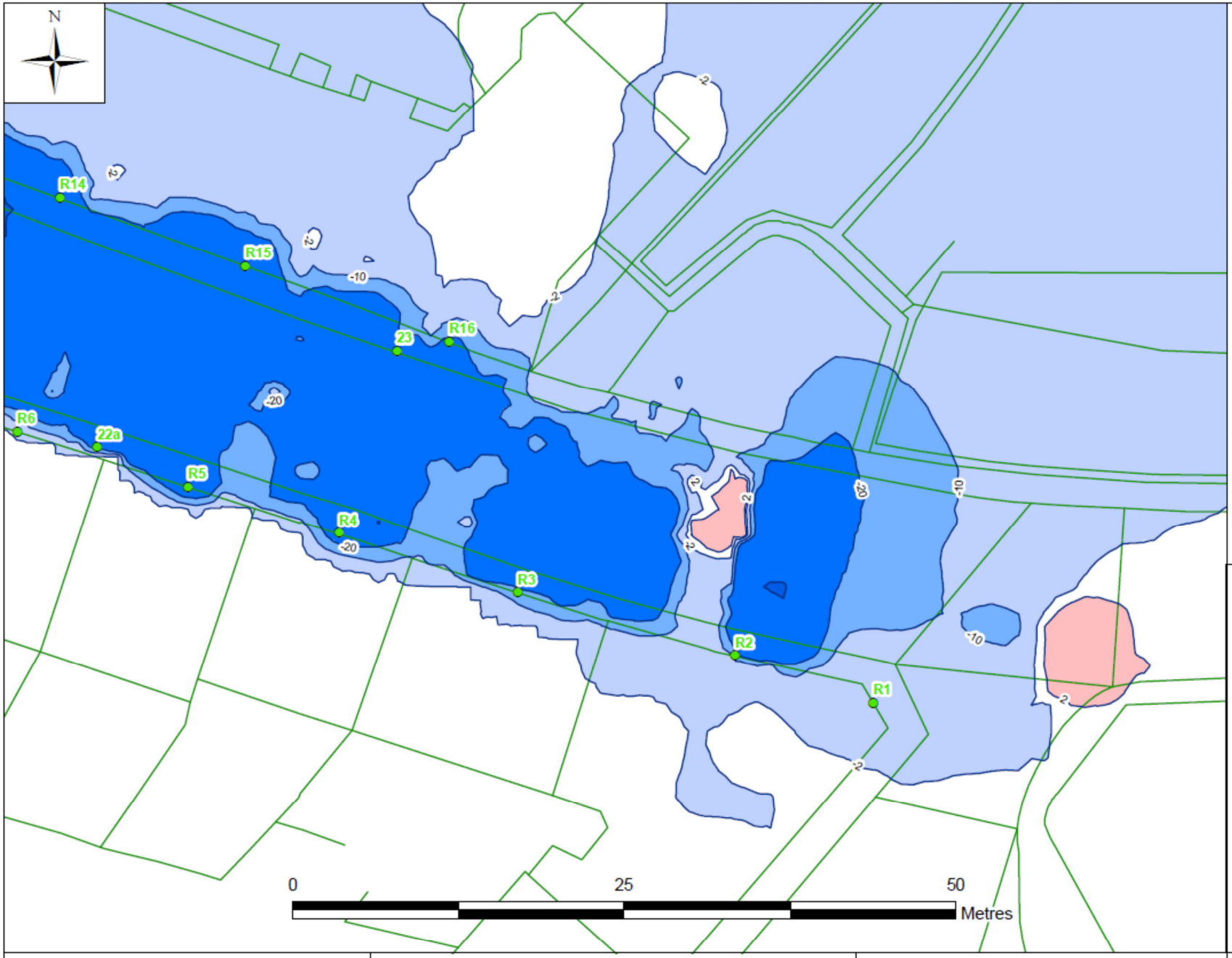
Figure 4 — A3



LEGEND

Receptors

Nitrogen dioxide
1-hour mean
99.79th percentile
(µg/m^3)

- < -100
- -100 to -20
- -20 to -10
- -10 to -2
- -2 to 2
- 2 to 10
- 10 to 20
- > 20

Client:	City of Edinburgh
Project:	CCWEL Roseburn Terrace
Title:	Effect of Scheme (Change in Nitrogen Dioxide), 2016 Model Results

AECOM
12 Regan Way
Chetwynd Business Park
Chilwell
Nottingham
NG9 6RZ
Tel: +44 (0) 115 907 7000
Fax: +44 (0) 115 907 7001
www.aecom.com

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Date:	11/10/2019	Scale at A3:	1:300

Figure 5 — A3

With Scheme 2021 Scenario

5.7 Table 7 presents NO_2 and PM_{10} short-term concentrations at receptor locations and the change in concentration with respect to the "2016 With Scheme" scenario, with the Proposed Development in operation.

Table 7: 2021 With Scheme Scenario.

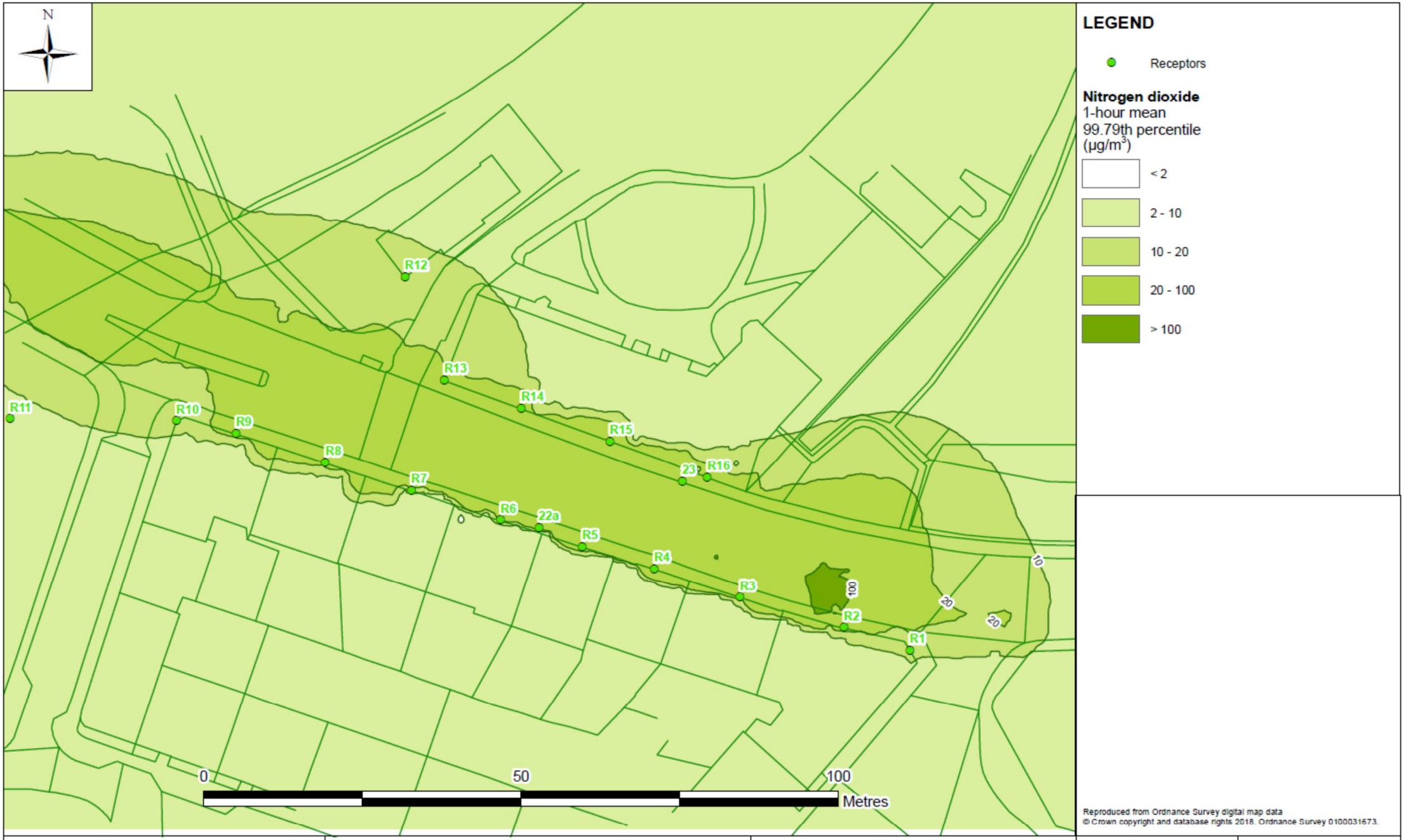
Receptor ID	NO_2 1-hour mean 99.79th percentile ($\mu g/m^3$)	Change in NO_2 with respect to 2016 ($\mu g/m^3$)	PM_{10} 1-hour max ($\mu g/m^3$)	Change in PM_{10} with respect to 2016 ($\mu g/m^3$)
R1	44.5	-5.4	26.3	-1.0
R2	58.1	-15.5	32.7	-2.9
R3	54.9	-8.5	28.6	-1.3
R4	104.1	-40.3	51.9	-6.6
R5	67.4	-12.3	36.8	-2.3
R6	58.9	-12.8	34.2	-2.8
R7	59.4	-15.8	35.1	-2.9
R8	53.2	-15.0	30.0	-2.2
R9	57.8	-14.9	29.6	-1.9
R10	45.1	-7.6	24.8	-0.7
R11	42.4	-5.8	24.2	-0.6
R12	46.7	-8.0	26.5	-1.2
R13	55.5	-14.8	29.3	-1.7
R14	73.8	-21.6	42.1	-5.0
R15	79.8	-19.9	43.8	-4.5
R16	95.5	-34.8	46.7	-6.0
R1_b	42.7	-4.2	25.2	-0.7
R2_b	51.8	-11.3	30.1	-2.2
R3_b	51.3	-7.4	26.9	-0.7
R4_b	91.9	-31.0	47.1	-5.1
R5_b	63.8	-10.8	35.4	-1.9
R6_b	53.6	-10.4	31.9	-2.1
R7_b	54.7	-12.0	32.6	-2.1
R8_b	49.1	-12.3	28.2	-1.7
R9_b	54.3	-12.7	28.6	-1.6
R10_b	41.9	-5.6	24.2	-0.6
R13_b	49.9	-10.9	27.4	-1.3
R14_b	70.2	-19.3	40.6	-4.4
R15_b	75.4	-17.8	42.1	-3.9
R16_b	89.4	-29.7	44.6	-5.1
R22a	39.0	-2.8	23.7	-0.4
R23	117.0	-50.5	55.9	-8.9

5.8 The year of opening scenario with the scheme in place results in improvements in short term concentrations at all receptors compared to the baseline 2016 scenario. This is in

part due to the scheme and in part to the reduction in emissions per vehicle that is progressively occurring within the vehicle fleet over time.

5.9 The reduction of hourly mean concentrations of nitrogen dioxide are illustrated in Figure 6 and this is especially evident at locations within the road carriageway themselves. There is a corresponding reduction in concentrations at the building facades.

5.10 In the year of opening all the receptors experience short term and long term concentrations of nitrogen dioxide and particulate matter that are below the objective value and will do so by a larger margin than is currently observed in the data for City of Edinburgh sampling locations 22a and 23.



Client:	City of Edinburgh
Project:	CCWEL Roseburn Terrace
Title:	With Scheme 2021 Scenario Model Results

12 Regan Way
Chetwynd Business Park
Chilwell
Nottingham
NG9 6RZ

Tel: +44 (0) 115 907 7000
Fax: +44 (0) 115 907 7001
www.aecom.com

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Figure 6 — A3

Appendix A Traffic Data

	Cars		
	% Petrol	% Diesel	% Electric
2021	50.50%	49.12%	0.38%
2016	54.95%	44.94%	0.12%

	LGV		
	% Petrol	% Diesel	% Electric
2021	2.05%	97.47%	0.48%
2016	3.40%	96.35%	0.25%

	HGV		
	% Petrol	% Diesel	% Electric
2021		100.00%	
2016		100.00%	

	Bus		
	% Petrol	% Diesel	% Electric
2021		100.00%	
2016		100.00%	