Berryden Corridor Improvements

Air Quality Assessment

Aberdeen City Council

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Quality information

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1. Introduction

AECOM was commissioned to prepare an air quality assessment for the completion of the Berryden Road dualling project in Aberdeen.

The Project involves construction of a new road between St Machar Drive roundabout (A96 Great Northern Road / A978 St Machar Drive) and the Berryden Road roundabout, on predominantly brownfield land, and widening of the existing single carriageway between the B986 Skene Square / Maberly Street junction and Berryden Road roundabout.

The route is adjacent to numerous residential and commercial properties, as well as a school and hospital. The route is indicated in Appendix A.

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2. Legislation and Policy

2.1 European Air Quality Directives

The Air Quality Framework Directive (96/62/EC) on ambient air quality assessment and management defines the policy framework for 12 air pollutants known to have a harmful effect on human health and the environment. Ambient concentration limit values for the specific pollutants are set through a series of Daughter Directives.

Following the Daughter Directives, Council Directive 2008/50/EC on ambient air quality and cleaner air for Europe came into force in 2008 and was transposed into national legislation in 2010 (The Air Quality (Scotland) Regulations 2010 (Defra, 2010)). It consolidated existing air quality legislation and made provisions for Member States to postpone limit value attainment deadlines and allow an exemption from the obligation to limit values for certain pollutants, subject to strict conditions and assessment by the European Commission (EC).

2.2 National Air Quality Legislation

The provisions of Part IV of the Environment Act 1995 establish a national framework for air quality management, which requires all Local Authorities to conduct local air quality reviews. Section 82(1) of the Act requires these reviews to include an assessment of the current air quality in the area and the predicted air quality in future years. Should the reviews indicate that the objectives prescribed in the UK Air Quality Strategy (AQS) (Defra, 2011) and the Air Quality (Scotland) Regulations 2010 (Defra, 2010) (henceforth referred to as the "Air Quality Regulations") will not be met, the Local Authority is required to designate an Air Quality Management Area (AQMA). Action must then be taken at a local level to ensure that air quality in the area improves.

The UK AQS (AQS) (Defra, 2011) identifies nine ambient air pollutants that have the potential to cause harm to human health. These pollutants are associated with local air quality problems, with the exception of ozone, which is instead considered to be a regional problem. Similarly, the Air Quality Regulations set objectives, but for just seven of the pollutants that are associated with local air quality. These objectives aim to reduce the health effects of the pollutants to negligible levels.

The air quality objectives and limit values currently applicable to the UK can be split into two groups. Each has a different legal status and is therefore handled differently within the framework of UK air quality policy. These are:

- UK air quality objectives set down in regulations for the purposes of local air quality management; and
- European Union (EU) limit values transcribed into UK legislation for which compliance is mandatory.

2.2.1 Pollutants of Concern

2.2.1.1 Nitrogen Dioxide

The Government and the Devolved Administrations adopted two Air Quality Objectives for nitrogen dioxide (NO_2) which were to be achieved by the end of 2005. In 2010, mandatory EU air quality limit values on pollutant concentrations were to apply in the UK, although it continues to be breached in locations throughout the UK. The EU limit values for NO_2 in relation to human health are the same as the national objectives (Defra, 2011):

- An annual mean concentration of 40 µg/m^3 (microgrammes per meter cubed); and
- An hourly mean concentration of 200 µg/m^3, to be exceeded no more than 18 times per year (99.79th percentile).

In practice, meeting the annual mean objective has been and is expected to be considerably more demanding than achieving the 1-hour objective. The annual mean objective of 40 µg/m^3 is currently widely exceeded at roadside sites throughout the UK, with exceedances also reported at urban background locations in major conurbations. Exceedances are associated almost exclusively with road emissions.

There is considerable year-to-year variation in the number of exceedances of the hourly objective, driven by meteorological conditions which give rise to winter episodes of poor dispersion and summer oxidant episodes. Analysis of the relationship between 1-hour and annual mean NO_2 concentrations at roadside and kerbside monitoring sites indicate that exceedances of the 1-hour objective are unlikely where the annual mean is below 60 µg/m^3 (Defra, 2016).

2.2.1.2 Particulate Matter

Particulate matter is composed of a wide range of materials arising from a variety of sources. Particulate matter is typically assessed as total suspended particulates or as a mass size fraction.

This assessment considers the annual mean and daily mean air quality objectives, as specified in the AQS for England, Scotland, Wales and Northern Ireland (Defra, 2011). Two objectives have been adopted in Scotland for PM_{10} (fine particulate matter), which were to be achieved by the end of 2004:

- An annual mean concentration of 18 µg/m^3 (gravimetric); and
- A 24-hour mean concentration of 50 µg/m^3 (gravimetric) to be exceeded no more than 7 times per year.

One objective has been adopted in Scotland for $PM_{2.5}$, of an annual mean concentration of 10 µg/m^3 (gravimetric) to be achieved by 2020.

Both short-term and long-term exposure to ambient levels of particulate matter is consistently associated with respiratory and cardiovascular illness and mortality as well as other ill-health effects. Particles of less than 10 micrometres (µm) in diameter have the greatest likelihood of reaching the thoracic region of the respiratory tract.

It is not currently possible to discern a threshold concentration below which there are no effects on the whole population's health. Reviews by World Health Organisation and the Committee on the Medical Effects of Air Pollutants (COMEAP, 1998) have suggested exposure to a finer fraction of particles ($PM_{2.5}$, which typically make up around two thirds of PM_{10} emissions and concentrations) give a stronger association with the observed ill health effects, but also warn that there is evidence that the coarse fraction (between PM_{10} – $PM_{2.5}$) also has some effects on health.

2.2.1.3 Construction Dust

Dust is defined as all particulate matter up to 75 µm in diameter and comprising both suspended and deposited dust, whereas PM_{10} is a mass fraction of airborne particles of diameter of 10 µm or less. The health effects associated with dust include eye, nose and throat irritation in addition to the nuisance caused by deposition on cars, windows and property. Dust and PM_{10} emissions arise from a number of sources, so construction activities and emissions from vehicles associated with the development should be considered.

2.2.2 Scotland's Third National Planning Framework (NPF3)

Scotland's Third National Planning Framework was published in June 2014 and brings together the Scottish Government's plans and strategies in economic development, regeneration, energy, environment, climate change, transport and digital infrastructure to provide a coherent vision of how Scotland should evolve over the next 20 to 30 years.

With regard to the proposed project, a number of potential local air quality and emissions effects were recognised by the Framework:

- Air quality impacts arising from increased transport movements;
- Localised impacts arising from housing development;
- Environmental impacts arising from transport infrastructure enhancements;
- Localised impacts arising from improved gateways; and
- Climate change impacts from improved global connectivity.

2.2.3 Scottish Planning Policy (SPP)

The purpose of the Scottish Planning Policy (June 2014) is to set out national planning policies which reflect Scottish Ministers' priorities for operation of the planning system and for the development and use of land. The NPF3 and the SPP share a vision for the planning system in Scotland:

> *'We live in a Scotland with a growing, low-carbon economy with progressively narrowing disparities in well-being and opportunity. It is growth that can be achieved whilst reducing emissions and which respects the quality of environment, place and life which makes our country so special. It is growth which increases solidarity – reducing inequalities between our regions. We live in sustainable, well-designed places and*

homes which meet our needs. We enjoy excellent transport and digital connections, internally and with the rest of the world.'

In terms of air quality, the SPP states that:

- *This SPP introduces a presumption in favour of development that contributes to sustainable development. This means that policies and decisions should be guided by principles, including:*
  - *Avoiding over-development, protecting the amenity of new and existing development and considering the implications of development for water, air and soil quality.*
- *Local development plans should safeguard all workable mineral resources which are of economic or conservation value and ensure that those are not sterilised by other development. Plans should set out the factors that specific proposals will need to address, including:*
  - *Disturbance, disruption and noise, blasting and vibration, and potential pollution of land, air and water.*

2.2.4 Scottish Low Emission Strategy

The Low Emission Strategy for Scotland (Scottish Government, 2015) outlines a framework and accompanying air quality modelling methodology for implementing Low Emission Zones (LEZ).

The purpose of the Low Emission Strategy is intended to '*draw together the various policies being implemented and developed across a range of central and local government portfolios which have the potential to improve air quality, and present these within a coherent overall framework, setting a new refocused agenda for action. The Strategy sets out the contribution that better air quality can make to sustainable economic growth and quality of life for the citizens of Scotland.*'

2.2.5 Building Scotland's Low Emission Zones, Consultation 2017

Transport Scotland has opened a consultation regarding how to effectively deliver a national approach to the implementation of Low Emission Zones (LEZ), whereby coordinated standards would apply to a number of Scottish cities, including Aberdeen.

The consultation focuses on the use of LEZs to improve air quality, and also to improve road network operations and tackle congestion, support modal shift to active travel and public transport, support climate change mitigation and support improving town and city spaces.

2.3 Local Planning Policy

2.3.1 Aberdeen City Council Air Quality Action Plan (AQAP), 2011

The Aberdeen City Council (ACC) Air Quality Action Plan (AQAP) was published in 2011 for the three AQMAs across the City. Within the AQAP, actions have been proposed to improve air quality within the AQMAs, the majority of which are concerned with reducing the effect of transport emissions. The actions are categorised as follows:

- Actions which aim to encourage a modal shift in vehicle use to more sustainable modes of transport and to influence travel choices;
- Actions to encourage the use of vehicles with lower emissions and cleaner vehicles;
- Actions which will improve road infrastructure;
- Actions which will improve traffic management;
- Actions concerning planning and policies; and
- Actions involving non-transport measures.

The Berryden Corridor improvements, the subject of this air quality assessment, are Action 3.2c in the AQAP and are intended to improve the flow of traffic to and from the City from the north. The AQAP acknowledges the possibility that this may bring traffic closer to certain properties but that the air quality impacts were predicted to be neutral.

2.3.2 Aberdeen City Council Local Development Plan

The second Local Development Plan was adopted on 20th January 2017 and replaced the 2012 Plan; this had not been published at the time of writing this report in October 2017. The Local Development Plan is a vital document which shapes the future of Aberdeen and influences significant public and private investment in homes, businesses, shops, infrastructure and facilities.

Numerous Policy Options to protect air quality, including:

- *AQ1 Air Quality. Resists proposals that result in deterioration in air quality unless appropriate mitigation measures are implemented. Also sets out criteria for when Air Quality Assessments will be required to be provided through the planning application process. This policy has a positive impact on air quality as its main aim is to enhance the existing air quality situation across the city and within the three declared Air Quality Management Areas (AQMAs). This policy also has a positive impact on climatic factors and human health through the promotion of improved air quality across the city.*
- *SG Air Quality. Sets out criteria for when Air Quality Assessments will be required to be provided through the planning application process. This policy has a positive impact on air quality as its main aim is to enhance the existing air quality situation across the city and within the three declared Air Quality Management Areas (AQMAs). This policy also has a positive impact on climatic factors and human health through the promotion of improved air quality across the city.*

2.3.3 Aberdeen City Council Supplementary Planning Guidance

The ACC Supplementary Planning Guidance (SPG) document (ACC, 2017) provides guidance on the way in which air quality is coordinated through planning. The guidance provides a structure for:

- The policy framework;
- To highlight developments where air quality may be a material consideration;
- To identify development proposals that will require an air quality assessment;
- To provide guidance on the process of air quality assessment; and
- To set out the Council's approach to the use of planning conditions and S75 agreements in respect of air quality.

This assessment is written with consideration to the requirements of the SPG.

The second Local Development Plan incorporates Land Use Policies & Supplementary Guidance Options that:

> *Policy sets out expected developer contributions towards infrastructure requirements. New developments are required to demonstrate that sufficient measures have been taken to minimise traffic generation and promote sustainable and active travel.*
>
> *This section now includes a presumption against developments which may have a detrimental impact on air quality without mitigation*

2.4 Assessment Guidance

The assessment has been undertaken with reference to the following guidance documents:

- IAQM (2014) Guidance on the Assessment of Dust from Demolition and Construction;
- EPUK (2010) Development Control: Planning for Air Quality;
- EPUK / IAQM (2017) Land-Use Planning & Development Control: Planning for Air Quality;
- Aberdeen City Council (2017) Supplementary Planning Guidance: Air Quality; and

In 2010, the EPUK published the Development Control: Planning for Air Quality guidance document. In 2017, the EPUK / IAQM jointly published updated guidance for development control (Land-Use Planning & Development Control: Planning for Air Quality) with more stringent assessment criteria than the 2010 document.

3. Assessment Methodology

3.1 Scope of Assessment

The potential for air quality impacts have been considered for two distinct phases:

- The 'construction' phase: during which the greatest impact is expected to be from dust; and
- The 'operational' phase: when the impacts will be primarily associated with vehicle emissions.

During the construction phase of the proposed development, there is the potential for construction activities to generate fugitive emissions of particulate matter (dust and PM_{10}). There is the risk of such emissions giving rise to significant adverse effects on amenity or health at receptors located within 350 m of the source of emissions (IAQM, 2014) unless appropriate mitigation measures are adopted. There are receptors located within 20 m of the site boundary and therefore an assessment of the significance of effects from fugitive emissions of dust and PM_{10} from the site has been undertaken. The assessment includes the consideration of the risk of adverse effects associated with the potential track-out of material at receptors located within 50 m of roads extending up to 500 m from the site's access points.

The potential for changes to long term and short term mean concentrations of nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) as a result of predicted changes in road traffic movements on the local road network have been considered specifically for the following scenarios:

The following scenarios were assessed:

- 2015 baseline;
- 2020 DM and 2035 DM (Do-Minimum, without the Development); and
- 2020 DS and 2035 DS (Do-Something, with the Development operational).

The nearest air quality sensitive designated ecological sites located in the vicinity of the proposed development are the Scotstown Moor and Nigg Bay Sites of Special Scientific Interest (SSSI), approximately 3 km northeast and 3.6 km southeast of the works, respectively. The southern end of the proposed development is also 1.5 km from the River Dee, a Special Area of Conservation (SAC). These areas are beyond the range where potentially significant air quality impacts are likely. Therefore, it is considered highly unlikely that the proposed works could emit dust emissions or contribute to pollutant concentrations with the potential to significantly affect the nearest ecological receptor sites. The risk to such sites is not considered further in this assessment.

3.2 Consultation

The Aberdeen City Council air quality officer was contacted to discuss the proposed project, the potential local air quality effects, modelling methodology and assessment procedures.

It was agreed that the most recent version (2017) of the IAQM / EPUK assessment guidance would be used to determine the potential local air quality effects.

3.3 Construction Phase

The impacts associated with the construction phase of the proposed development have been qualitatively assessed with reference to the IAQM published 'Guidance on the assessment of dust from demolition and construction' (IAQM, 2014).

According to the IAQM, the main air quality impacts that may arise during construction activities are:

- Dust deposition, resulting in the soiling of surfaces;
- Visible dust plumes, which are evidence of dust emissions;
- Elevated PM_{10} concentrations, as a result of dust generating activities on site; and
- An increase in concentration of airborne particles and NO_2 due to exhaust emissions from diesel powered vehicles and equipment on site and vehicles accessing the site.

Activities on construction sites are classified into four types to reflect their different potential impacts:

- Demolition;
- Earthworks;
- Construction; and
- Track-out (the transportation of dust and dirt from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network).

The following steps, as defined by the IAQM, were followed:

- STEP 1 Screen the requirement for a detailed assessment. Human and ecological receptors were identified and distance to the site and construction routes were determined;
- STEP 2 Assess the risk of dust impacts. The potential risk of dust impacts occurring for each activity was determined, based on the magnitude of the potential dust emissions and the sensitivity of the area;
- STEP 3 Identify the need for site-specific mitigation. Based on the risk of impacts occurring, site specific mitigation measures were determined; and
- STEP 4 Define impacts and their significance. The significance of the potential residual dust impacts (taking mitigation into account) for each activity was determined.

The IAQM (2017) air quality assessment guidance states that need for detailed road traffic assessment, due to construction phase vehicle movements, should be screened against set criteria.

The construction phase of the Proposed Development is likely to lead to a small increase in the number of vehicles on the local highway network, for the duration of the construction works only. EPUK (2010) set out criteria to establish the need for an air quality assessment for the construction phase of a development as being:

> *"Large, long-term construction sites that would generate large HGV flows (>200 per day) over a period of a year or more."*

The construction work would be phased and it is considered unlikely that this development would lead to this number of vehicle movements, and the additional number of vehicle movements is not considered to be high enough to have the potential to cause a significant adverse effect at any local air quality sensitive receptor. Therefore, construction phase road traffic emissions are not considered further as the potential effect on local air quality sensitive receptors is not considered to be significant.

3.4 Operational Phase

During operation, the proposed development has the potential to change vehicle movements on the surrounding road network. An increase in vehicle emissions can increase the exposure at sensitive receptors to concentrations of NO_2 and particulate matter (PM_{10} and $PM_{2.5}$). This assessment quantifies the concentration of the pollutants most commonly associated with vehicle emissions at the worst affected receptor locations. Concentrations for both Do-Minimum and Do-Something scenarios have been predicted using applicable modelling techniques. The magnitude of change as a result of the change in vehicle movements due to the project will be used to identify the potential for road traffic emissions to cause a significant effect at sensitive receptors.

This assessment follows current guidance for the determination of baseline pollutant concentrations and uses emissions factors for road traffic from the Emissions Factors Toolkit, EFT 7.0 (Defra, 2016).

The magnitude of road traffic emissions for the baseline and with project scenarios are calculated from traffic flow data. The assessment considers the operational phase impact of road traffic emissions at receptors adjacent to roads in the vicinity of the proposed development.

The meteorological data was recorded in 2016 and correlated with the most recent period of monitoring recorded in 2016. The base year emissions were modelled as 2015, as these data were also used for the future (2020) scenario and would lead to a more cautious approach.

3.4.1 Road Traffic Emissions Modelling

This assessment has used the latest version of dispersion model software 'ADMS-Roads' (v4.1) to quantify pollution levels at selected receptors. ADMS-Roads is a modern dispersion model that has an extensive published track record of use in the UK for the assessment of local air quality impacts, including model validation and verification studies (CERC, 2014). The emission factors applied to the model were derived from the UK Emission Factor Toolkit v7.0.

3.4.1.1 Sensitivity Testing

The air quality emission model uses data published by Defra that estimates emissions from the UK vehicle fleet, and the reduction in emissions that are expected to occur with increasingly stringent legislation and new technologies. However, there has been some uncertainty in recent years regarding the effects of Euro emission standards, whereby engines have been tuned for test cycles that do not reflect real-life uses, and so the anticipated improvements have not been fully realised in all situations.

Due to the uncertainty in the rate of year-on-year improvements in vehicle emissions technology, an assumption has been made that there are no improvements in vehicle emissions between 2015 and 2020. Whilst this may over-predict the future pollutant concentrations, it was considered to be an appropriate means of ensuring that the potential effects were not under estimated.

Similarly, it was assumed that there are no improvements in vehicle emissions between 2020 and 2035. However, making projections this far into the future is highly uncertain, and although results for this future scenario have been presented in this report, it is not possible to apply a high confidence to the results.

3.4.2 Conversion of NO_x to NO_2

The proportion of NO_2 in NO_x varies greatly with location and time according to a number of factors including the amount of oxidant available and the distance from the emission source. NO_x concentrations are expected to decline in future years due to falling emissions, therefore NO_2 concentration will not be limited as much by ozone and consequently it is likely that the NO_2/NO_x ratio will in the future increase. In addition, a trend has been noted in recent years whereby roadside NO_2 concentrations have been increasing at certain roadside monitoring sites, despite emissions of NO_x falling. The direct NO_2 phenomenon is having an increasingly marked effect at many urban locations throughout the UK and must be considered when undertaking modelling studies.

In this study modelled NO_X values were converted to NO_2 using the 'NO_X to NO_2' calculator, released in June 2014, and available at the Air Quality Archive (AQA, 2014). The year and region for which the modelling has been undertaken are specified and local factors, such as an appropriate factor of NO_X emitted as NO_2, are used in the calculation.

3.4.3 Traffic Data

Traffic data was provided by Systra in the form of the 24 hour annual average daily traffic (AADT) flows, including separate flows for HDVs (vehicles > 3.5 tonnes, including buses), and speeds for each link section

The modelled roads include the Berryden corridor, as well as other major roads including the city centre AQMA. The traffic data used in the assessment is summarised in Appendix D.

The traffic flows are predicted to increase on the majority of roads due to the proposed Project going ahead, and would also increase in the future scenarios either with, or without, the proposed Project.

The baseline scenario included the impacts of transport projects that are now operational:

- Diamond Bridge;
- Bedford Road bus gate;
- Partially segregated left turn from King George VI Bridge to West Tullos Road; and
- A96 to Aberdeen Airport Link Road.

The 2020 Do-Minimum Scenario included the following projects, as well as population/ employment growth:

- Local access arrangements to access new development sites;
- Broad Street Restrictions (Bus only between Queens Street and Upper Kirkgate);
- A90 Balmedie to Tipperty dual carriageway;
- Aberdeen Western Peripheral Route (AWPR) – including A96-to-Aberdeen Airport Link Road arrangements;

- A90 (Schoolhill) & A96 (Chapelbrae) Park & Ride sites with associated bus services;
- Aberdeen-Inverness Rail Service Improvements, including a new station at Kintore; and
- Haudagain Roundabout improvement Project – including new link road.

Do-Minimum Scenario 2035 includes of population / employment growth and routing impacts covering the following Projects:

- City Centre masterplan Projects,
- Bus only roads on sections of Guild Street, Market Street, Bridge Street;
- Gyratory system between South College Street and North Esplanade West;
- Union Street bus and taxi only between Market Street and Bridge Street;
- Schoolhill road closure;
- Rose Street road closure (southern end); and
- Langstane Place road closure.

3.4.4 Receptors

Air quality sensitive receptors susceptible to changes in air quality typically include residential properties, schools, care homes, hospitals and designated ecological sites.

The annual mean pollutant concentrations were predicted at all sensitive receptors within 30m of the modelled roads, as this was considered to include the extent where air quality effects may occur. This was used to determine the number of properties and the magnitude of the change in pollutant concentrations resultant from the proposed project.

The pollutant concentrations were predicted at the centre of every sensitive receptor. Whilst this did not indicate the maximum concentration at each location, it did provide the greatest geographic range for the model. In addition, a number of locations that correlated with ACC monitoring sites were modelled at the facades where the greatest impacts were identified.

The modelled receptor locations are shown in Appendix B, Figure 2.

3.4.5 Meteorological Data

The meteorological dataset used in the assessment was recorded in 2016 at the meteorological station at Aberdeen Dyce Airport, located approximately 15 kilometres to the north-west of the study site. The meteorological site is considered to be representative of regional meteorological conditions and sufficient to satisfy the requirements of this assessment.

3.4.6 Model Verification

When using modelling techniques to predict concentrations, it is necessary to make a comparison between the modelling results and the monitoring data at the same locations, to ensure that the model is reproducing actual observations. The accuracy of the future year modelling results are relative to the accuracy of the base year results, therefore greater confidence can be placed in the future year concentrations if good agreement is found for the base year.

Modelling results are subject to systematic and random error; systematic error arises due model formulations and random errors to variable factors, such as uncertainty in the traffic data and the composition of the vehicle fleet, and uncertainty in the meteorological dataset. This can be addressed and, if necessary, adjusted for by comparison with monitoring data.

A verification adjustment of 2.39 was calculated for NO_X and 2.62 for PM_{10}. The calculations are provided in Appendix E.

3.5 Significance Criteria

3.5.1 Construction Phase

Step 4 of the construction phase assessment methodology defines the significance of the potential residual effect, i.e. after mitigation dust impacts.

It is typically accepted that significant construction emissions can be effectively controlled, and so the dust assessment methodology and definition of effects outlined in Appendix C were used to inform the mitigation controls that should be implemented.

3.5.2 Operational Phase

For road traffic emissions, the change in pollutant concentrations, with respect to the baseline concentrations, has been described at receptors that are representative of exposure to impacts on local air quality within the study area. Pollutant concentrations in the modelled scenarios are predicted and this is used to identify the risk of the Air Quality Objective values being exceeded in each scenario.

For consideration of a change in annual mean concentrations of a given magnitude, the EPUK / IAQM (2017) have jointly published recommendations for describing the effects of such impacts at individual receptors, as set out in Table 1.

Table 1. Effects Descriptors at Individual Receptors – Annual Mean NO_2

Annual Mean Pollutant Concentration at Receptor in Assessment Year ($\mu g/m^3$)	Change in Annual Mean Concentration of NO_2 ($\mu g/m^3$)				
	< 0.2	0.2 – 0.6	0.6 – 2.2	2.2 - 4	> 4
≤30.2	Negligible	Negligible	Negligible	Slight	Moderate
30.2 – 37.8	Negligible	Negligible	Slight	Moderate	Moderate
37.8 – 41.0	Negligible	Slight	Moderate	Moderate	Substantial
41.0 – 43.8	Negligible	Moderate	Moderate	Substantial	Substantial
≥43.8	Negligible	Moderate	Substantial	Substantial	Substantial

Table 2. Effects Descriptors at Individual Receptors – Annual Mean PM_{10}

Annual Mean Pollutant Concentration at Receptor in Assessment Year ($\mu g/m^3$)	Change in Annual Mean Concentration of NO_2 ($\mu g/m^3$)				
	< 0.1	0.1 – 0.3	0.3 – 1	1 – 1.8	> 1.8
≤13.6	Negligible	Negligible	Negligible	Slight	Moderate
13.6 – 17	Negligible	Negligible	Slight	Moderate	Moderate
17 – 18.5	Negligible	Slight	Moderate	Moderate	Substantial
18.5 – 19.7	Negligible	Moderate	Moderate	Substantial	Substantial
≥19.7	Negligible	Moderate	Substantial	Substantial	Substantial

The EPUK / IAQM (2017) guidance includes seven explanatory notes to accompany the terminology for the effect descriptors. In particular, it is noted that the descriptors are for individual receptors only and that overall significance is determined using professional judgement. Additionally, it is noted that it is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the objective value. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the objective value, rather than being exactly equal to it.

A change in predicted annual mean concentrations of NO_2 or PM_{10} of less than 0.5% is considered to be so small as to be negligible. A change (impact) that is negligible, given normal bounds of variation, would not be capable of having a direct effect on local air quality that could be considered to be significant.

The EPUK / IAQM guidance indicates that it is the intention of the effect descriptors for smaller changes in pollutant concentrations to capture the potential risk associated with cumulative development. Changes of 1% of a relevant Air Quality Objective could, under the EPUK / IAQM guidance, result in slight to moderate air quality effects at individual receptors. In practice this assessment inherently considers cumulative impacts through the use of traffic data, Defra background concentrations and predictions at committed developments. Therefore, it is considered highly unlikely that significant air quality impacts could occur with the development for changes in concentrations of 1%.

Additionally, the EPUK / IAQM guidance also includes the potential for sight to substantial air quality effects as a result of changes in pollutant concentrations between 2 and 5% of relevant Air Quality Objectives. In practice, changes in concentration of this magnitude, and in particular changes at the lower end of this band are likely to be very difficult to distinguish through any post operational monitoring regime due to the number of sources of NO_2 in an urban environment and the inter annual effects of varying meteorological conditions. Changes in concentration of more than 5% (the two highest bands) are considered to be of a magnitude which is far more likely to be discernible and as such carry additional weight within the overall evaluation of significance for air quality.

3.5.3 Overall Determination of Significance

The significance of all the reported impacts is then considered for the development in overall terms. The potential for the development to contribute to or interfere with the successful implementation of policies and strategies for the management of local air quality are considered if relevant, but the principal focus is any change in the likelihood of future achievement of the Air Quality Objective values for the following pollutants:

- Annual mean nitrogen dioxide (NO_2) concentration of 40 $\mu g/m^3$;
- 1-hour mean NO_2 concentration of 200 $\mu g/m^3$ not to be exceeded on more than 18 times per year;
- Annual mean particulate matter (PM_{10}) concentration of 18 $\mu g/m^3$;
- 24-hour mean PM_{10} concentration of 50 $\mu g/m^3$ not to be exceeded on more than 7 days per year; and
- Annual mean fine particulate matter ($PM_{2.5}$) concentrations of 10 $\mu g/m^3$ to be achieved by 2020.

The achievements of local authority goals for local air quality management are directly linked to the achievement of the Air Quality Objective Values described above and as such this assessment focuses on the likelihood of future achievement of the Air Quality Objective Values.

In terms of the significance of the consequences of any adverse impacts, an effect is reported as being either 'not significant' or as being 'significant'. If the overall effect of the development on local air quality or on amenity is found to be 'moderate' or 'substantial' this is deemed to be 'significant'. Effects found to be 'minor' are considered to be 'not significant', although they may be a matter of local concern. 'Negligible' effects are considered to be 'not significant'.

4. Baseline Air Quality

4.1 Local Air Quality Management

Aberdeen City Council (ACC) undertakes air quality Review and Assessment in accordance with the Local Air Quality Management (LAQM) regime. ACC has declared several AQMAs due to poor air quality; formulated an Air Quality Action Plan (AQAP) to address air quality issues; implemented actions within the plan; and undertaken various studies, both pollutant monitoring and desk based, to better understand the issues.

4.1.1 Air Quality Management Areas

Three AQMAs have been declared in Aberdeen for both annual mean NO_2 and PM_{10} based on monitoring and modelling work, which revealed that national air quality objectives and statutory European limits were either not being met, or were unlikely to be met in these areas. ACC undertakes monitoring of the main local air pollutants associated with urban areas: nitrogen oxides (NO_X; consisting of nitrogen oxide (NO) and nitrogen dioxide (NO_2)) and fine particulate matter (PM_{10}).

The air quality problem in Aberdeen is predominantly a result of emissions from road vehicles, as is the case elsewhere in the UK, which is reflected in the locations declared as AQMAs:

- City Centre, declared for annual mean and 1-hour NO_2 objective. It includes Union Street, Market Street, Virginia Street, Commerce Street, and parts of Holburn Street, Guild Street and King Street, Victoria Road to the junction with Sinclair Road, Bridge Street and West North Street to the junction with Littlejohn Street.
- Anderson Drive, incorporating the whole of Anderson Drive, the area around the Haudagain roundabout, and Auchmill Road to the junction with Howes Road.
- Wellington Road, incorporating the Queen Elizabeth II Bridge to Balnagask Road.

4.1.2 Air Quality Action Plan

ACC published an Air Quality Action Plan (AQAP) in 2006, which was updated and revised in 2011. The AQAP is focussed predominantly on controlling emissions from road vehicles, as this is the major source of pollution in the City as a whole, although it includes other measures such as ‘Measure 6.4’; to investigate initiatives to improve air quality in the environs of the harbour.

A source apportionment study was undertaken and presented in the revised AQAP. It determined that in 2010 road traffic contributed approximately 82% of NO_X and 48% of PM_{10}, where Heavy Goods Vehicles (HGVs) were the most significant source of NO_X. Cars and taxis were predicted to contribute the majority of the local PM_{10}, whilst the background sources contributed 52%.

Within the AQMA, concentrations in excess of 40 $\mu g/m^3$ for NO_2 and in excess of 18 $\mu g/m^3$ for PM_{10} were predicted at the majority of the receptors. By 2016, exceedances, or ‘near’ exceedances of the annual mean objective, were still predicted at most receptors within the AQMA. It was concluded that there is a likelihood of the 1-hour NO_2 objective being exceeded at locations within the existing AQMA. However, by 2012 and beyond, exceedances were considered to be less likely, although it was recognised that modelled predictions of decreasing NO_2 concentrations in future years should be treated with caution as roadside concentrations nationwide have not been dropping as forecast. In the most polluted areas, traffic emission reductions of the order of 50-75% would be required for compliance with the mandatory NO_2 annual mean limit value.

4.2 Pollutant Monitoring

4.2.1 Continuous Monitoring

ACC operates 6 continuous analysers which monitor NO_2 and PM_{10}, shown in Appendix B, Figure 2. The nearest continuous monitoring location to the southern end of the proposed Project is CM2, on Union Street, which is a roadside site located approximately 700 m to the south of the proposed development boundary.

Annual mean NO_2 concentrations, shown in Table 2, exceeded the objective of 40 $\mu g/m^3$ between 2014 and 2016 at the roadside station near the southern end of the proposed development (Union Street). The most recent annual mean was 43 $\mu g/m^3$, with no exceedances of the 1 hour mean (200 $\mu g/m^3$) recorded.

The concentration of PM_{10} was close to the annual mean objective at Union Street in 2014 and 2015, whilst $PM_{2.5}$ also exceeded the objective in 2015.

Table 3. Continuous Monitoring

ID	Location	Classification	Annual Mean NO_2 (Hourly Means > 200 µg/m^3 in brackets)			Annual Mean PM_{10} (24-Hour Means > 50 µg/m^3 in brackets)			Annual Mean $PM_{2.5}$		
			2014	2015	2016	2014	2015	2016	2014	2015	2016
CM1	Errol Place	Background	21	23 (1)	21	15	12 (4)	12	10	8	5
CM2	Union Street	Roadside	**47**	**46** (3)	**43**	**18**	17 (4)	13	-	**11**	7
CM3	Market Street	Roadside	**40**	36	35 (1)	**26 (22)**	**19 (12)**	12 (1)	-	**11**	6
CM4	Anderson Drive	Roadside	26	22	21	15	13 (2)	12	-	-	-
CM5	Wellington Road	Roadside	**48**	**40**	**46** (11)	**21** (2)	**20 (16)**	16 (2)	-	-	-
CM6	King Street	Roadside	27	28	28	**19** (5)	17 **(8)**	16 (1)	-	-	-

Note: Bold type denotes an exceedance of the relevant objective

4.2.2 Passive Monitoring

ACC currently operates an extensive network of 56 passive diffusion tubes across the City. The annual mean NO_2 concentrations recorded at the monitoring locations nearest to the site are provided Table 4, with their locations illustrated in Appendix B, Figure 2.

Diffusion tubes DT61 and DT63 were established in 2015 in the vicinity of the proposed route of the project to inform this study. Annual mean NO_2 concentrations exceeded the objective value at Skene Square, although DT48 was a more distant diffusion tube 50 m west of the existing carriageway.

It should be noted that DT 64 is currently designated as Urban Background but will be closer to the proposed realigned carriageway.

Table 4. Passive Monitoring, NO_2 Concentrations

ID	Location	Classification	Distance from Existing Carriageway	Within AQMA?	Annual Mean NO_2 (µg/m^3)					
					2011	2012	2013	2014	2015	2016
DT48	139 Gt. Northern Road	Roadside	50 m	No	n/a	n/a	25.9	23.2	23.2	18.9
DT61	21 Skene Square	Roadside	Within site boundary	No	n/a	n/a	n/a	n/a	35.9	**40.3**
DT63	93 Berryden Road	Roadside	Within site boundary	No	n/a	n/a	n/a	n/a	26.0	23.0
DT62	35 Chestnut Row	Background	150 m	No	n/a	n/a	n/a	n/a	14.5	14.4
DT64	102 Picktillum Place	Background	Within site boundary	No	n/a	n/a	n/a	n/a	16.9	16.9

Note: Exceedances of the NO_2 annual mean objective of 40 µg/m^3 are shown in **bold**.
Source: Aberdeen City Council (2016)

4.3 Background Concentrations

A large number of sources of air pollutants exist which individually may not be significant, but collectively, over a large area, need to be considered.

4.3.1 Monitored Data

ACC undertakes monitoring at three background locations; one continuous monitoring site and two passive diffusion tubes. The annual mean NO_2 concentrations recorded at these sites are provided in Table 5.

LAQM.TG(16) (Defra, 2016) defines a background site as 'a location distanced from sources and therefore broadly representative of city-wide background conditions'.

Diffusion tubes DT62 and DT64 were established in 2015 in the vicinity of the proposed route to inform this study. Annual mean NO_3 concentrations were below the objective value, as were those from the continuous monitoring station. Concentrations at the latter were relatively stable between 2011 and 2015, ranging from 20-23 µg/m^3.

Table 5. Monitored Background NO_2 Concentrations

ID	Location	Classification	Type	Within AQMA?	Annual Mean NO_2 (µg/m^3)					
					2011	2012	2013	2014	2015	2016
CM1	Errol Place	Background	Continuous	No	23	21	20	21	23	21
DT62	35 Chestnut Row	Urban Background	Diffusion Tube	No	n/a	n/a	n/a	n/a	14.5	14.4
DT64	102 Picktillum Place	Urban Background	Diffusion Tube	No	n/a	n/a	n/a	n/a	16.9	16.9

Source: Aberdeen City Council (2017)

The annual mean PM_{10} concentrations recorded at the continuous monitoring site are provided in Table 6. Concentrations did not exceed the annual mean objective, varying from 12-15 µg/m^3 between 2011 and 2015; the most recent value recorded was 12 µg/m^3.

Table 6. Monitored Background PM_{10} Concentrations

ID	Location	Classification	Type	Within AQMA?	Annual Mean NO_2 (µg/m^3)					
					2011	2012	2013	2014	2015	2016
CM1	Errol Place	Background	Continuous	No	14	12	13	15	12	12

Source: Aberdeen City Council (2017)

4.3.2 Defra Modelled Data

Background pollutant concentrations have been obtained from the Defra LAQM website (Defra, 2017), where estimates are available with a spatial resolution of one square kilometre (km), and divided between several source categories. The 1 km squares within the model domain were identified, and adjusted background concentrations of NO_X, NO_2, PM_{10} and $PM_{2.5}$ were determined according to the technical guidance, LAQM.TG(16) (Defra, 2016) to remove the modelled pollutant sectors (i.e. the modelled road emission sources). The concentrations calculated by the model due to vehicle emissions can then be added to these background concentrations to give the total predicted concentration at a receptor.

The estimated annual mean pollutant concentrations centred on the grid-square encompassing the north and south sections of the Berryden Road are provided in Table 7 for the modelled base year, and the future year of 2020. Concentrations are generally predicted to be lower in the future due to more stringent legislation and improved emissions technology.

The modelled background concentrations are similar to those recorded at the background diffusion tubes. Therefore, as the background concentrations vary across the city, it was considered to be appropriate to use the Defra background concentrations encompassing each modelled receptor location used in the study.

To ensure the assessment was conservative, the 2015 baseline concentrations were used in the 2020 future year scenarios, and the 2020 concentrations were used in the 2035 future scenarios.

Table 7. Modelled Background Concentrations at Berryden Road

Pollutant	North Section				South Section			
	2016		2020		2016		2020	
	Total	Adjusted	Total	Adjusted	Total	Adjusted	Total	Adjusted
NO_X	23.9	19.8	19.8	17.1	29.5	22.6	24.4	19.7
NO_2	16.7	14.1	14.1	12.3	20.0	15.8	17.0	14.0
PM_{10}	12.5	12.0	12.2	11.7	13.0	12.1	12.6	11.8
$PM_{2.5}$	8.5	8.1	8.1	7.8	9.0	8.3	8.5	8.0

5. Predicted Effects

5.1 Construction Phase

As discussed in the assessment methodology, a four step process was followed to determine the risk of potential impacts during the construction phase. Further details can be found in Appendix C.

5.1.1 STEP 1: Screen the Requirement for a more Detailed Assessment

Screening criteria specify an assessment is required if there is:

- a ‘human receptor’ within 350 m of the boundary of the site or within 50 m of the route used by construction vehicles (up to 500 m from the site entrance); or
- a ‘ecological receptor’ within 50 m of the site boundary or within 50 m of the route used by construction vehicles (up to 500 m from the site entrance).

There are numerous residential and commercial properties within a 350 m radius, as well as three schools. There are no ecological receptors within 50 m of the site boundary or the construction vehicle route. Taking the above into consideration, in accordance with the IAQM Guidance there is a need to proceed to a detailed assessment for the construction phase in order to define the most appropriate mitigation controls.

5.1.2 STEP 2: Assess the Risk of Dust Impacts

Step 2A – Define the Potential Dust Emission Magnitude

Demolition

The potential dust emission classification during the demolition works is dependent on (where relevant) the total building volume, construction material, whether on-site crushing and screening will take place and the types of demolition activities being undertaken.

It is anticipated that sections of the existing roads will be demolished, along with a small number of buildings. Therefore according to the IAQM Guidance (2014) the potential dust emission class should be classification as ‘**Large’**.

Earthworks

The works will likely include large areas of landscaping in preparation for changes to the road alignments. Earthworks will primarily involve excavating material, haulage, tipping and stockpiling, and the potential dust emission classification during the earthworks is dependent on the total site area, the soil type, number of heavy earth moving vehicles and amount of material moved. Therefore according to the IAQM Guidance (2014) the proposal is considered to have a ‘**Large’** magnitude of potential dust emissions during the earthworks.

Construction

The key issues when determining the potential dust emission magnitude during the construction phase includes the size of the construction areas, method of construction, materials and duration of build.

No buildings are proposed to be constructed, although construction works for the carriageway would be described as ‘**Medium’** potential dust generating potential in accordance with the criteria in the IAQM Guidance.

Track-out

Factors which determine the dust emission magnitude are vehicle size, vehicle speed, vehicle numbers, geology and duration. With regard to the criteria for the dust-generating potential of the surface material, the number of outward vehicle movements in any one day and the length of unpaved road, it is considered appropriate to classify the potential dust effects as ‘**Medium’**.

Step 2B – Define the Sensitivity of the Area

The following were taken into consideration when determining the sensitivity of the area to dust soiling and health impacts of PM_{10}.

- The site is located in close proximity to residential and commercial properties and therefore the receptor sensitivity is considered to be High;
- There are between 10 and 100 properties within 20 m of the works, although the individual construction activities will be undertaken in sections rather than across the route as a whole; and
- PM_{10} monitoring undertaken at nearby roadside (CM2 and CM6) continuous monitoring stations indicated that annual mean PM_{10} concentrations were between 16-18 µg/m^3 in 2015. The annual mean PM_{10} concentration at the nearest background continuous monitoring station was 12 µg/m^3 in 2015.

Taking the above into consideration the sensitivity of the area to dust soiling impacts is **High**, and **High** for human health impacts.

Step 2C – Define Risk of Impacts

Taking into consideration the conclusion from Steps 2A and 2B, the risk of dust impacts for each activity are provided in Table 8.

Table 8. Summary of Dust Risk

Source	Dust Soiling	Human Health
Demolition	High	High
Earthworks	High	High
Construction	Medium	Medium
Track-out	Medium	Medium

5.2 Operational Phase

5.2.1 NO_2

The annual mean concentration of NO_2 was predicted at receptor locations within 30m of roads affected by the proposed development. In addition, a number of individual locations were modelled at the building facades where the greatest impacts were identified, and which correlated with ACC monitoring sites.

The change was described in accordance with the IAQM / EPUK criteria, with regard to both the change in concentration resultant from the proposed project, and the total concentration compared to the annual mean objective.

The results in Table 8 indicate that the project would lead to more receptors experiencing adverse than beneficial effects in both 2020 and 2035. These results are also shown in Appendix F, Figures 5 to 8.

Table 9. Number of Properties Affected by Change in Annual Mean NO_2

Year	2020		2035	
Description of Change	Beneficial	Adverse	Beneficial	Adverse
Substantial	0	0	0	0
Moderate	4	29	0	9
Slight	12	31	0	30
Negligible	2013		2050	

The receptors and predicted annual mean concentrations where the change in concentration was described as greater than Negligible are shown in Table 10.

Table 10. Description of NO_2 Effects Greater than Negligible

Receptor ID	2016	2020 DM	2020 DS	Description	2035 DM	2035 DS	Description
1370	24.4	26.3	19.8	Moderate Beneficial			
1392	22.0	23.6	20.3	Slight Beneficial			
2193	17.5	17.7	21.9	Moderate Adverse	16.3	4	
3927	19.6	20.1	24.0	Moderate Adverse	18.7	4	
3928	19.1	19.5	22.6	Slight Adverse	17.8	4	
3929	18.6	18.9	21.5	Slight Adverse			
3930	18.3	18.6	20.7	Slight Adverse			
3944	18.8	19.0	23.0	Moderate Adverse	18.0	4	
3945	18.9	19.1	23.6	Moderate Adverse	18.4	4	
3946	18.6	18.7	22.3	Slight Adverse	17.6	4	
3947	18.3	18.4	21.5	Slight Adverse			
3951	18.7	18.7	21.9	Slight Adverse	17.3	4	
3962	19.7	19.6	22.7	Slight Adverse			
3997	21.1	21.0	18.6	Slight Beneficial			
4004	21.1	21.0	18.7	Slight Beneficial			
4012	21.4	21.2	18.9	Slight Beneficial			
4019	21.6	21.4	19.1	Slight Beneficial			
4027	22.0	21.8	19.4	Slight Beneficial			
4031	22.3	22.1	19.7	Slight Beneficial			
4039	22.9	22.9	20.6	Slight Beneficial			
4040	24.5	24.6	21.4	Slight Beneficial			
4041	27.2	27.3	22.2	Moderate Beneficial			
4264	19.3	19.0	22.8	Slight Adverse	18.6	4	
4288	29.1	28.7	33.5	Moderate Adverse	23.9	27.1	Slight Adverse
4289	26.1	25.9	29.2	Slight Adverse	21.5	23.8	Slight Adverse
4295	25.6	25.4	28.3	Slight Adverse			
4301	23.9	23.7	26.6	Slight Adverse			
4322	19.4	19.5	22.0	Slight Adverse			
4324	19.7	19.8	22.1	Slight Adverse			
4330	21.6	21.3	24.2	Slight Adverse			
4856	19.8	19.4	24.1	Moderate Adverse	15.9	19.0	Slight Adverse
4903	19.9	19.5	24.5	Moderate Adverse	16.0	19.3	Slight Adverse
6615	25.7	24.8	Demolished		22.1	Demolished	
6616	26.1	25.3	Demolished		22.5	Demolished	
6617	26.6	25.7	31.0	Moderate Adverse	23.0	26.6	Slight Adverse
6618	28.0	27.1	32.7	Moderate Adverse	24.3	28.0	Slight Adverse
6620	27.2	26.4	31.7	Moderate Adverse	23.8	27.3	Slight Adverse
6623	27.2	26.5	31.7	Moderate Adverse	24.0	27.5	Slight Adverse
7780	19.9	20.0	22.1	Slight Adverse			
12768	25.3	25.0	28.1	Slight Adverse			
16209	19.7	18.7	16.5	Slight Beneficial			

Receptor ID	2016	2020 DM	2020 DS	Description	2035 DM	2035 DS	Description
19808	23.2	22.9	25.1	Slight Adverse			
19819	23.9	23.6	26.3	Slight Adverse			
19829	22.4	22.1	24.4	Slight Adverse			
19835	23.5	23.0	26.6	Slight Adverse	20.6	23.1	Slight Adverse
19836	24.6	24.1	30.1	Moderate Adverse	21.3	25.3	Moderate Adverse
19837	27.1	26.3	Demolished		23.0	Demolished	
22270	21.4	22.3	25.2	Slight Adverse	16.4	19.4	Slight Adverse
22278	19.5	20.0	26.5	Moderate Adverse	15.4	20.3	Moderate Adverse
22284	18.5	18.9	26.5	Moderate Adverse	14.9	20.2	Moderate Adverse
22296	18.2	18.6	24.8	Moderate Adverse	14.7	19.2	Moderate Adverse
22299	18.1	18.5	25.9	Moderate Adverse	14.7	20.0	Moderate Adverse
22300	17.9	18.2	28.5	Moderate Adverse	14.6	21.5	Moderate Adverse
22309	18.2	18.7	25.9	Moderate Adverse	14.8	20.1	Moderate Adverse
22319	20.0	20.8	25.0	Moderate Adverse	15.7	20.0	Moderate Adverse
22330					16.6	18.8	Slight Adverse
22350	22.9	24.6	21.4	Slight Beneficial			
22360	24.4	26.5	20.6	Moderate Beneficial			
22368	23.7	25.6	20.0	Moderate Beneficial			
27536	16.2	16.4	19.0	Slight Adverse			
27542	16.0	16.1	19.6	Slight Adverse			
27548	15.8	16.0	20.7	Moderate Adverse	12.6	15.6	Slight Adverse
27556	17.3	17.4	23.0	Moderate Adverse	14.2	17.8	Slight Adverse
27564	17.1	17.3	23.0	Moderate Adverse	14.2	18.0	Slight Adverse
27572	17.1	17.3	23.1	Moderate Adverse	14.2	18.1	Slight Adverse
27578	17.2	17.4	23.1	Moderate Adverse	14.2	18.2	Slight Adverse
27586	17.4	17.6	23.3	Moderate Adverse	14.3	18.4	Moderate Adverse
28790	21.6	21.8	19.5	Slight Beneficial			
30955	29.8	29.5	32.7	Moderate Adverse	25.5	27.8	Slight Adverse
30964	27.8	27.4	29.6	Slight Adverse			
30970	28.9	28.4	29.8	Slight Adverse			
33850	28.9	28.7	32.1	Moderate Adverse	24.8	27.4	Slight Adverse
33851	28.1	27.9	31.3	Moderate Adverse	24.2	26.7	Slight Adverse
33852	26.8	26.6	30.3	Moderate Adverse	23.2	25.9	Slight Adverse
33853	23.3	23.0	25.4	Slight Adverse			
33856	25.0	24.7	28.2	Slight Adverse	21.8	24.1	Slight Adverse
33863	25.1	24.8	28.2	Slight Adverse			
33864	25.3	25.0	27.8	Slight Adverse			
41306	25.9	25.6	29.1	Slight Adverse	22.1	24.4	Slight Adverse
41314	24.7	24.4	26.8	Slight Adverse			

The detrimental effects were predicted at a number of locations near the route of Berryden Corridor; notably around the junction with Hutcheon Street, and the realigned section between Laurelwood Avenue and Clifton

Road. These impacts were due to the increased traffic flows and change in proximity to the carriageway realignment.

Beneficial changes were predicted where the Berryden Road carriageway would be realigned further from the receptor.

A number of buildings are likely to be demolished near the junction of Berryden Road and Hutcheon Street, and so these were not included in the Do-Something scenario results.

The increase in annual mean concentration in 2020 near the Berryden Road exceeded 4 $\mu g/m^3$ in several areas adjacent to the Berryden Road, whilst increases greater than 10 $\mu g/m^3$ were predicted near the realigned section at Ashgrove Road, near DT64 at the northern end of the Project. .

The significance of the impacts in 2035 was predicted to be lower than in 2020, due to lower overall pollutant concentrations. In addition, it should be recognised that the 2035 scenario was modelled using 2020 vehicle emission rates and background concentrations, which would be more cautious than may expected to occur, but would also minimise the likelihood of applying realistically optimistic assumptions. This approach means that both the total concentrations and the change resultant from the proposed Project are likely be over-predicted.

The annual mean objective was not predicted to be exceeded at any location outside the AQMA.

5.2.2 PM_{10} and $PM_{2.5}$

The annual mean concentration of PM_{10} was predicted at receptor locations within 30m of road affected by the proposed development. The change was described in accordance with the IAQM/EPUK criteria, with regard to both the change in concentration resultant from the proposed project, and the total concentration compared to the annual mean objective.

The results in Table 11 indicate that the project would lead to more detrimental than beneficial effects. Moderate detrimental effects due to increased annual mean PM_{10} concentrations were predicted in both 2020 and 2035. These results are also shown in Appendix F, Figures 9 to 12.

The highest predicted concentration in 2020 was 18 $\mu g/m^3$, and in 2035 it was 17.6 $\mu g/m^3$, and the annual mean objective was not predicted to be exceeded at any location.

The concentration of PM_{10} in 2020 and 2035 was predicted to be greater than the annual mean objective due to the background contribution. It was therefore considered that the description of impacts for PM_{10} should be applied to that for $PM_{2.5}$.

Table 11. Number of Properties Affected by Change in Annual Mean PM_{10}

Year	2020		2035	
Description of Change	Beneficial	Adverse	Beneficial	Adverse
Substantial	0	0	0	0
Moderate	0	5	0	6
Slight	1	39	0	30
Negligible	2044		2053	

The receptors and predicted annual mean concentrations where the change in concentration was described as greater than than Negligible are shown in Table 12.

Table 12. Description of PM_{10} Effects Greater than Negligible

Receptor ID	2016	2020 DM	2020 DS	Description	2035 DM	2035 DS	Description
1370	24.7	13.6	13.2	Slight Beneficial			
3927	24.7	13.1	13.7	Slight Adverse			
3928	24.7	13.0	13.5	Slight Adverse			
3944	24.7	13.0	13.6	Slight Adverse			

Receptor ID	2016	2020 DM	2020 DS	Description	2035 DM	2035 DS	Description
3945	24.7	13.0	13.7	Slight Adverse			
3962	24.7	13.1	13.5	Slight Adverse			
4264	24.7	13.1	13.5	Slight Adverse			
4288	25.6	14.6	15.3	Slight Adverse	14.5	15.2	Slight Adverse
4289	25.6	14.2	14.7	Slight Adverse	14.0	14.5	Slight Adverse
4295	25.6	14.2	14.6	Slight Adverse	13.9	14.4	Slight Adverse
4301	25.6	14.0	14.3	Slight Adverse	13.6	14.1	Slight Adverse
4330	24.7	13.3	13.7	Slight Adverse			
4856	24.7	13.1	13.7	Slight Adverse			
4903	24.7	13.1	13.7	Slight Adverse			
6615	25.6	14.1	Demolished		14.0	Demolished	
6616	25.6	14.1	Demolished		14.0	Demolished	
6617	25.6	14.2	14.8	Slight Adverse	14.1	14.9	Slight Adverse
6618	25.6	14.4	15.1	Slight Adverse	14.4	15.2	Slight Adverse
6620	25.6	14.3	14.9	Slight Adverse	14.3	15.1	Slight Adverse
6623	25.6	14.3	14.9	Slight Adverse	14.4	15.2	Slight Adverse
12764					14.1	14.4	Slight Adverse
12768	25.6	14.1	14.5	Slight Adverse	14.0	14.5	Slight Adverse
19808					13.9	14.2	Slight Adverse
19819	25.6	14.0	14.3	Slight Adverse	14.0	14.4	Slight Adverse
19829					13.7	14.0	Slight Adverse
19835	25.6	13.9	14.3	Slight Adverse	13.8	14.3	Slight Adverse
19836	25.6	14.0	14.8	Slight Adverse	13.9	14.8	Slight Adverse
19837	25.6	14.3	Demolished		14.3	Demolished	
22270	24.7	13.3	13.9	Slight Adverse	12.8	13.6	Slight Adverse
22278	24.7	13.1	14.1	Moderate Adverse	12.7	13.8	Moderate Adverse
22284	24.7	13.0	14.1	Moderate Adverse	12.6	13.8	Moderate Adverse
22296	24.7	12.9	13.8	Slight Adverse	12.6	13.6	Slight Adverse
22299	24.7	12.9	14.0	Moderate Adverse	12.6	13.8	Moderate Adverse
22300	24.7	12.9	14.3	Moderate Adverse	12.6	14.1	Moderate Adverse
22309	24.7	13.0	14.0	Moderate Adverse	12.6	13.8	Moderate Adverse
22319	24.7	13.1	13.9	Slight Adverse	12.7	13.8	
22330	24.7	13.3	13.7	Slight Adverse			
27556	24.7	12.9	13.6	Slight Adverse			
27564	24.7	12.8	13.6	Slight Adverse			
27572	24.7	12.8	13.6	Slight Adverse			
27578	24.7	12.8	13.6	Slight Adverse			
27586	24.7	12.9	13.7	Slight Adverse			
30955	25.6	14.7	15.1	Slight Adverse	14.7	15.3	Slight Adverse
30964					14.4	14.7	Slight Adverse
31494					14.2	14.5	Slight Adverse
33850	25.6	14.6	15.0	Slight Adverse	14.6	15.2	Slight Adverse

Receptor ID	2016	2020 DM	2020 DS	Description	2035 DM	2035 DS	Description
33851	25.6	14.5	14.9	Slight Adverse	14.4	15.0	Slight Adverse
33852	25.6	14.3	14.8	Slight Adverse	14.2	14.8	Slight Adverse
33853					13.7	14.0	Slight Adverse
33856	25.6	14.1	14.5	Slight Adverse	13.9	14.5	Slight Adverse
33863	25.6	14.1	14.5	Slight Adverse	13.9	14.5	Slight Adverse
33864	25.6	14.1	14.4	Slight Adverse	14.0	14.4	Slight Adverse
41306	25.6	14.2	14.7	Slight Adverse	14.1	14.6	Slight Adverse
41314	25.6	14.0	14.4	Slight Adverse	14.0	14.4	Slight Adverse
41322					13.8	14.1	Slight Adverse

6. Mitigation Measures

6.1 Construction Phase

6.1.1 Dust Control Mitigation

Determining site-specific mitigation measures corresponds to Step 3 of the assessment methodology (Section 3.2).

A number of mitigation measures can be adopted to reduce the production and/or dispersal of dust to lessen the nuisance and limit the human health impacts. Ideally dust should be controlled at the source as once airborne it is difficult to suppress. Appropriate mitigation measures are provided in the IAQM 'Guidance on the assessment of dust from demolition and construction' (IAQM, 2014).

According to the IAQM Guidance (IAQM, 2014), the dust risk for each of the activities determined in Step 2C should be used to define the appropriate site specific mitigation measures to be adopted. Mitigation measures for the earthworks, construction and track-out activities of the construction phase are provided in Table 13. Where a negligible risk of dust impacts was determined, no mitigation measures, beyond those required by legislation are required. However, mitigation measures may be applied as part of good practice.

Table 13. Dust Control Measures Specific to Construction Phase Activities

Activity	Possible Dust Control Methods
Demolition	• Ensure effective water suppression is used during demolition operations. Hand held water sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.
Earthworks	• Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable. • Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable. • Only remove the cover in small areas during work and not all at once.
Construction	• Avoid scrabbling (roughening of concrete surfaces). • Ensure sand and other aggregates are stored in bonded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place. • Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.

Activity	Possible Dust Control Methods
Track-out	• Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). • Avoid dry sweeping of large areas. • Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary ay material tracked out of the site. This may require the sweeper being continuously in use. • Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. • Record all inspections of haul routes and any subsequent action in a site log book. • Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.

As well as the mitigation measures listed for the specific earthworks, construction and track-out elements discussed, general mitigation measures are provided in Table 14, after taking into consideration the risk of dust impacts determined in Step 2C.

Table 14. Potential Site Operations and Possible Methods of Controlling Dust

Activity	Possible Dust Control Methods
Communication	• Develop and implement a stakeholder communications plan that includes community engagement before work commences on site. • Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. • Display the head or regional office contact information. • Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority.
Site Management	• Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner and record the measures taken. • Make the complaints log available to the local authority when asked. • Record any exceptional incidents that cause dust and/or air emissions, either on or off site and the action taken to resolve the situation in the log book
Monitoring	• Undertake daily on-site and off-site inspections, where receptors (including roads) are nearby, to monitor dust, record inspection results and make the log available to the local authority when asked. • Carry out regular site inspections, record inspection results and make an inspection log available to the local authority when asked. • Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
Preparing and maintaining the site	• Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible. • Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site. • Fully enclose site or specific operations where there is a high potential for

Activity	Possible Dust Control Methods
	dust production and the site is active for an extensive period. • Avoid site runoff of water or mud. • Keep site fencing, barriers and scaffolding clean using wet methods. • Remove materials that have the potential to produce dust from site as soon as possible. • Cover, seed or fence stockpiles to prevent wind whipping.
Operating vehicle/machinery and sustainable travel	• Ensure all vehicles switch off engines when stationary - no idling vehicles. • Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable. • Impose and signpost a maximum speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate). • Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
Operations	• Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays. • Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation. • Use enclosed chutes and conveyors and covered skips. • Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate. • Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
Waste Management	• Avoid bonfires and burning of waste materials.

6.1.2 Residual Effects

The impacts associated with the construction phase of the proposed development have been qualitatively assessed with reference to the Institute of Air Quality Management (IAQM) published draft ‘Guidance on the assessment of dust from demolition and construction’ (IAQM, 2014).

The IAQM guidance states that ‘in the case of demolition / construction it is assumed that mitigation (secured by planning conditions, legal requirements or required by regulations) will ensure that a potential significant adverse effect will not occur, so the residual effect will normally be ‘not significant’’.

Therefore, overall it is considered that the impacts during the construction phase will be of ‘**Negligible’** significance.

6.2 Operational Phase

The proposed project was predicted to lead to both beneficial and detrimental effects near the Berryden Road route corridor due to the changes in traffic flows, but predominantly due to proximity to the carriageway realignment. However, the proposed project was not predicted to lead to an exceedance of the annual mean objectives at any location outside the AQMA.

The effects of the proposed project are predominantly due to the realignment of the carriageway changing the proximity of the properties near the road. Therefore, whilst it is unlikely to be practical to introduce design changes, other localised measures that may reduce emissions should be investigated, such as alterations to the traffic light timing to reduce effects in the most sensitive locations, or variable speed limits during peak times.

However, as the proposed project will also affect a large extent of the local road network, mitigation controls would be most effective if they were coordinated with strategic plans, such as improvements to the bus fleet, and reducing road traffic in the city centre by increasing park and ride use. These mitigation controls may be implemented through the ACC Air Quality Action Plan, which includes aspirations to improve individual components of the vehicle fleet.

In addition, ACC is working closely with SEPA and Scottish Government to undertake feasibility studies for the implementation of a Low Emission Zone and supporting measures to actively promote the use of low emission vehicles in the city.

6.2.1 Residual Effects

The model used cautious input data to predict the pollutant concentrations in the future scenarios, so the actual effects will likely be of lesser significance. The it should be recognised that the model inputs for the 2020 scenario were modelled as 2015, and 2035 was modelled as 2020, which were both considered to be very cautious

In particular, it is not possible to confidently predict the emissions from the road fleet very far into the future, and so the results for the 2035 scenario should be treated cautiously. It is very likely that by 2035 the overall concentrations will be significantly lower than those predicted due to improvements to the transport fleet and the shift towards low and ultra-low emission vehicles. Therefore, the most significant local air quality effects were likely to occur in 2020.

Whilst discrete impacts were predicted occur in 2020 that were described as Moderate Adverse, there were also a number of locations where beneficial effects would occur.

Furthermore, the proposed project was not predicted to lead to an exceedance of the local air quality objectives outside of an AQMA. Therefore, the overall significance of the impacts due to the proposed project going ahead was described as Slight Adverse.

7. Summary

AECOM was commissioned to undertake a local air quality assessment for the Berryden Corridor improvements, which will involve construction of a new section of road and widening of existing single carriageway.

A qualitative construction phase assessment has been undertaken in accordance with the Institute of Air Quality Management (IAQM, 2014) 'Guidance on the assessment of dust from demolition and construction' to determine the potential dust and vehicle emission impacts. Taking into consideration the risk of potential impacts, appropriate mitigation measures were recommended.

The operational phase was assessed using detailed dispersion modelling to assess the impacts of the proposed project in 2020 and 2035. The significance of the resultant change in air quality was described in accordance with the EPUK / IAQM (2017) guidance.

7.1 Construction Phase

With regard to predicted impacts during the construction phase, the assessment concludes the following:

- The nearest receptors to the site are residential and commercial properties within 20 m of the proposed development. No ecological receptors are located within 50 m of the proposed site.
- Taking the above into consideration the sensitivity of the area was considered to be High for both dust soiling and human health impacts.
- The potential risk of dust effects was determined to be Large during demolition and earthworks, and Medium during construction works and due to track-out.
- Appropriate mitigation measures were recommended to effectively control the effects during the construction phase.
- Therefore, overall it is considered that the impacts during the construction phase will be of **Negligible** significance should the appropriate mitigation measures be employed.

7.2 Operational Phase

With regard to predicted impacts during the operational phase, the assessment concludes the following:

- The annual mean concentration of NO_2 was not predicted to be exceeded at any locations outwith the existing AQMA in 2020 or 2035.
- The annual mean concentration of PM_{10} was predicted to be close to the Scottish annual mean objective for PM_{10}, although it would be well below the EU limit value.
- The significance of the change in pollutant concentrations was described as Negligible at the majority of locations.
- Close to the proposed project the realignment of the carriageway was predicted to result in both Moderate Beneficial and Moderate Adverse effects for NO_2 in 2020. These changes were predominantly due to the change in proximity of the receptor locations resultant from the realignment:
  - In 2020, Slight and Moderate beneficial impacts were predicted where the Berryden Road carriageway would be realigned further from the receptor, and Slight and Moderate adverse effects were predicted where the Berryden Road carriageway would be realigned closer to the receptor.
  - In 2035, Slight and Moderate adverse effects were predicted to the east of Caroline Place and west of Skene Square.
- Close to the proposed project the realignment of the carriageway was predicted to result in similar effects for PM_{10}:
  - In 2020, Slight beneficial impacts were predicted at one location, whilst predominantly Slight and Moderate adverse effects were predicted where the Berryden Road carriageway would be realigned closer to the receptor.
  - In 2035, Slight and Moderate adverse effects were predicted to the east of Caroline Place and west of Skene Square.

- The effects on $PM_{2.5}$ were considered to be described as the same as for PM_{10}.
- However, the model approach was cautious, as the 2035 scenario was modelled as 2020, and 2020 was modelled as 2015. Therefore, the absolute predicted concentrations and changes in the future were likely to be over-estimated, and the overall descriptions of the effects in 2035 are likely to be significantly lower.

7.3 Conclusions

Whilst some discrete impacts will occur that were described as Moderate Adverse, there were also a number of locations where beneficial effects would occur, and the proposed project was not predicted to lead to an exceedance of the local air quality objectives outside of an AQMA. Therefore, the overall significance of the impacts due to the proposed project going ahead was described as Slight Adverse.

However, mitigation options should be investigated, where potential controls for the proposed project would necessarily rely upon coordination of strategic programmes to reduce emissions from the regional and city vehicle fleets, as well as local measures.

Strategic mitigation measures should specifically be coordinated through the ACC Air Quality Action Plan and the Low Emission Zone feasibility study, which would align controls and supporting measures with other Scottish cities.

In addition, local measures that may reduce emissions should be investigated, such as alterations to the traffic light timing to reduce effects in the most sensitive locations.

8. References

Aberdeen City Council (2011) Air Quality Action Plan.

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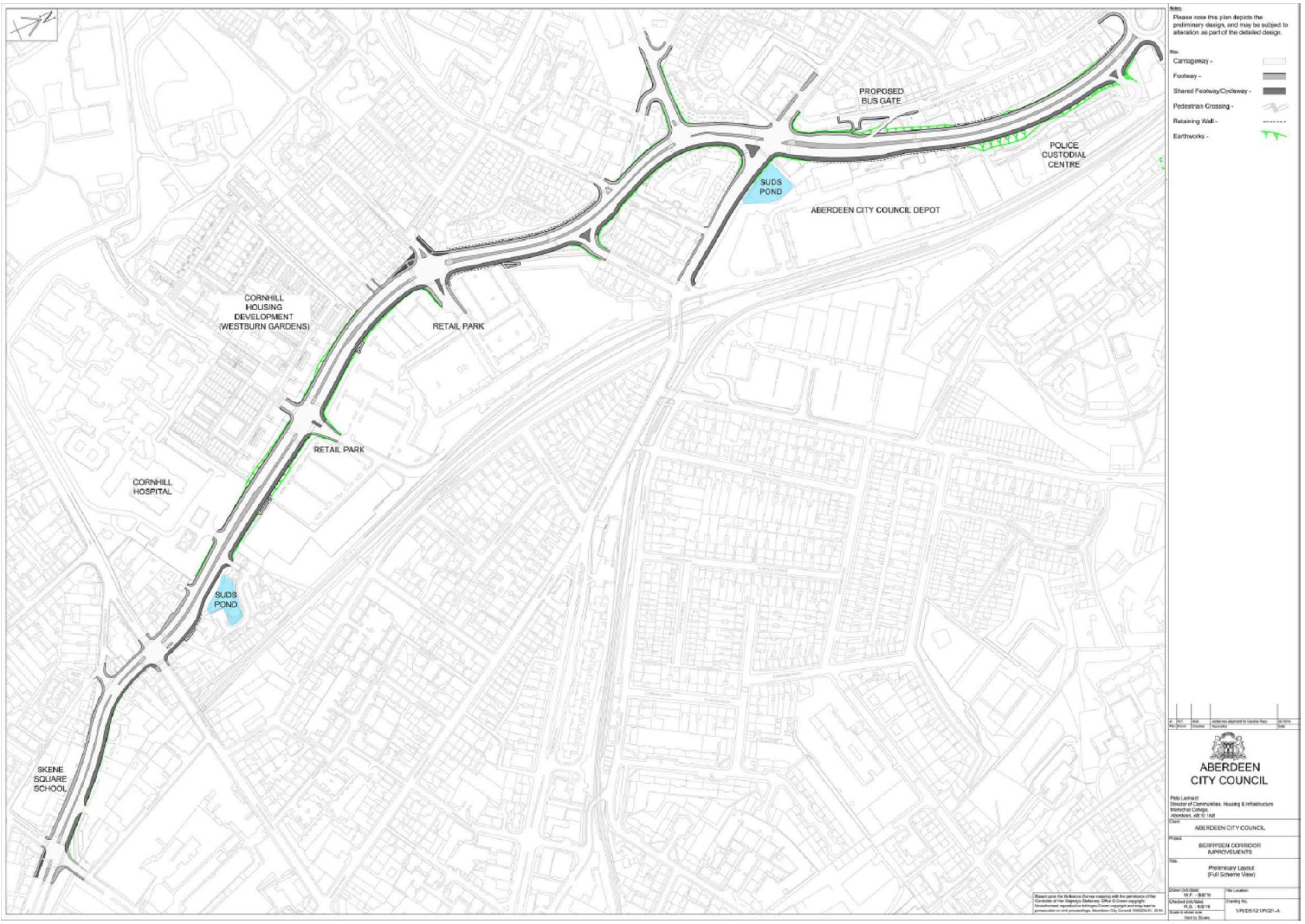
Institute of Air Quality Management (IAQM) (2014) Guidance on the assessment of dust from demolition and construction.

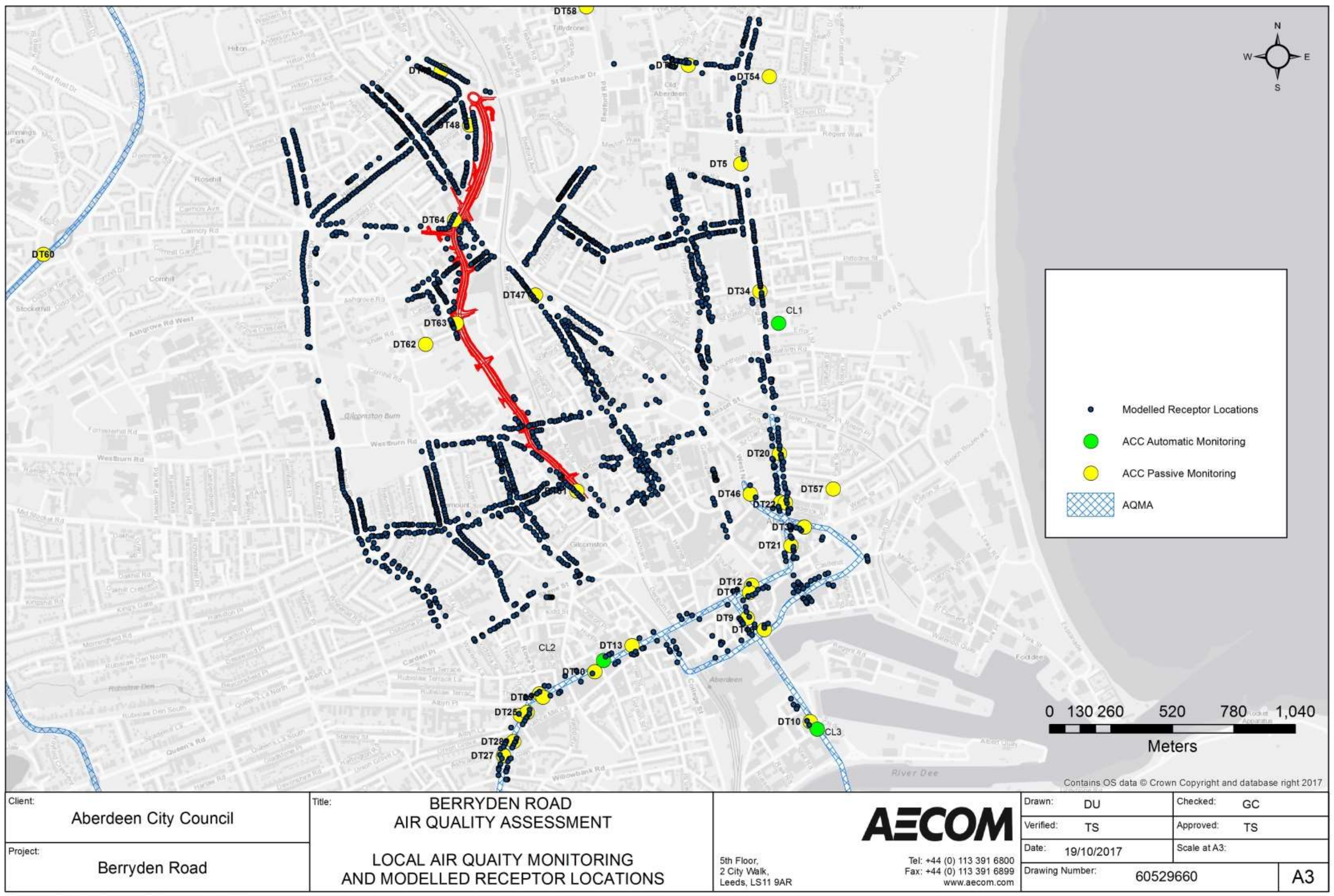
Appendix A Proposed Berryden Road Improvement Layout

Figure 1: Proposed Berryden Road Improvement Layout



Appendix B Local Air Quality Monitoring

Figure 2: Air Quality Monitoring Undertaken by Aberdeen City Council



Appendix C Dust Assessment Methodology

STEP 1: Screen the Requirement for a Detailed Assessment

Sensitive receptors were identified and the distance to the site and construction routes were determined according to the examples of sensitivity shown in Table 15. According to the IAQM, an assessment will normally be required where there are sensitive receptors within 350 m of the boundary of a site and/or within 50 m of route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance.

A human receptor, as considered within the IAQM guidance, is any location where a person or property may experience:

- The annoyance effects of airborne dust or dust soiling e.g. dwellings, industrial or commercial premises such as a vehicle showroom, food manufacturers, electronics manufacturers, amenity areas and horticultural operations; or
- Exposure to PM_{10} over a period relevant to the air quality objectives.

Ecological receptors within 50 m of the boundary of the site or routes used by construction vehicles on the public highway, up to 500 m from the site entrance, also need to be identified.

There are no ecological receptors which need to be considered as part of this assessment.

Table 15. Examples of Dust Sensitive Receptors

Sensitivity	Dust Soiling	Human Health	Ecological
High	– Dwellings – Museum and other culturally important collections, – Medium and long term car parks – Car showrooms	– Residential properties. – Hospitals, – Schools – Residential care homes	– - Locations with an international or national designation (e.g. SAC) and the designated features may be affected by dust soiling
Medium	– Parks – Places of work	– - Office and shop workers, but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	– - Locations with a national designation (e.g. SSSI) where the features may be affected by dust deposition
Low	– Playing fields – Farmland (unless commercially-sensitive horticultural) – Footpaths – Short term car parks – Roads	– Public footpaths – Playing fields – Parks – Shopping streets	– Locations with a local designation where the features may be affected by dust deposition local Nature Reserve with dust sensitive features.

SAC: Special Area of Conservation; SSSI: Site of Special Scientific Interest

STEP 2: Assess the Risk of Dust Impacts

The risk of dust arising in sufficient quantities to cause annoyance and/or health effects was determined for each activity (demolition, earthworks, construction works and track out), taking account of:

- The scale and nature of the works, which determines the potential dust emission magnitude (small, medium or large) (Step 2A); and
- The sensitivity of the area (low, medium or high) (Step 2B).

These factors were then combined to give the risk of dust effects with no mitigation applied, as Negligible, Low, Medium or High.

It should be noted that where detailed information was not available to inform the risk category, professional judgement and experience was used and a cautious approach adopted, in accordance with the guidance.

Step 2A – Define the Potential Dust Emission Magnitude

Demolition

The classifications in Table 13 are based on examples of suitable criteria, although factors such as seasonality, building type, duration and scale were also taken into consideration, where possible.

Table 16. Potential Demolition Works Dust Emission Classification

Potential Dust Emission Classes	Criteria
Large	– Large: Total building volume >50,000 m^3 – Potentially dusty construction material (e.g. concrete) – On-site crushing and screening – Demolition activities >20 m above ground level
Medium	– Total building volume 20,000 m^3 – 50,000 m^3 – Potentially dusty construction material – Demolition activities 10-20 m above ground level
Small	– Total building volume <20,000 m^3 – Construction material with low potential for dust release (e.g. metal – cladding or timber) – Demolition activities <10 m above ground – Demolition during wetter months

Earthworks

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. The classifications in Table 17 are based on examples of suitable criteria. Factors such as existing land use, topography, seasonality, duration and scale were also taken into consideration, where possible.

Table 17. Potential Earthworks Dust Emission Classification

Potential Dust Emission Classes	Criteria
Large	- Total site area: >10,000 m^2 – Potentially dusty soil type (e.g. clay) – >10 heavy earth moving vehicle active at any one time – Formation of bunds >8 m in height – Total material moved >100,000 tonnes
Medium	– Total site area: 2,500 - 10,000 m^2 – Moderately dusty soil type (e.g. silt) – 5 -10 heavy earth moving vehicle active at any one time – Formation of bunds 4 - 8 m in height – Total material moved 20,000 – 100,000 tonnes
Small	– Total site area: <2,500 m^2 – Soil type with large grain size (e.g. sand) – < 5 heavy earth moving vehicle active at any one time – Formation of bunds < 4 m in height – Total material moved <20,000 tonnes – Earthworks during wetter months

Construction

The key issues when determining the potential dust emission magnitude during the construction phase include the size of the building(s)/infrastructure, method of construction, construction materials and duration of build. The classifications in Table 18 are based on examples of suitable criteria. Factors such as seasonality, building type, duration and scale were also taken into consideration, where possible.

Table 18. Potential Construction Works Dust Emission Classification

Potential Dust Emission Classes	Criteria
Large	– Total building volume >100,000 m^3 – Piling, on site concrete batching, sandblasting
Medium	– Total building volume 25,000 – 100,000 m^3 – Potentially dusty construction material (e.g. concrete) – On-site concrete batching
Small	– Total building volume <25,000 m^3 – Construction material with low potential for dust release (e.g. metal cladding or timber)

Track-out

Track-out is the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the local road network. The classifications in Table 19 are based on examples of suitable criteria. Factors such as vehicle size, speed, numbers, geology and duration were also taken into consideration, where possible.

Table 19. Potential Track-out Dust Emission Classification

Potential Dust Emission Classes	Criteria
Large	– 50 HGV (>3.5t) outward movements in any one day – Potentially dusty surface material – Unpaved road length > 100 m
Medium	– 25 – 100 HGV (>3.5t) outward movements in any one day – Moderately dusty surface material – Unpaved road length 50 – 100 m
Small	– < 25 HGV (>3.5t) outward movements in any one day – Surface material with low potential for dust release – Unpaved road length < 50 m

Step 2B – Define the Sensitivity of the Area

The sensitivity of the area takes account of the following factors:

- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentrations; and
- Site specific factors, such as whether there are natural shelters, such as trees to reduce the risk of wind-blown dust.

The sensitivity of the area is determined separately for dust soiling impacts on people and properties (Table 20), human health impacts (Table 21).

Table 20. Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		< 20 m	< 50 m	< 100 m	< 350 m
High	>100	High	High	Medium	Low
Medium	10 – 100	High	Medium	Low	Low
Low	1 -10	Medium	Low	Low	Low

Table 21. Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number of Receptors	Distance from the Source (m)			
			< 20 m	< 50 m	< 100 m	< 350 m
High	> 18 µg/m^3	>100	High	High	High	Medium
		10 – 100	High	High	Medium	Low
		1 -10	High	Medium	Low	Low
	16 - 18 µg/m^3	>100	High	High	Medium	Low
		10 – 100	High	Medium	Low	Low
		1 -10	High	Medium	Low	Low
	14 - 16 µg/m^3	>100	High	Medium	Low	Low
		10 – 100	High	Medium	Low	Low
		1 -10	Medium	Low	Low	Low
	< 14 µg/m^3	>100	Medium	Low	Low	Low
		10 – 100	Low	Low	Low	Low
		1 -10	Low	Low	Low	Low
Medium	-	> 10	High	Medium	Low	Low
	-	1 -10	Medium	Low	Low	Low
Low	-	1 -10	Low	Low	Low	Low

Step 2C - Define the Risk of Impacts

The dust emission magnitude determined at Step 2A should be combined with the sensitivity of the area determined at Step 2B to determine the risk of effects with no mitigation applied (Table 22). This Step is undertaken for each activity undertaken on site.

Table 22. Risk of Dust Impacts

Activity	Sensitivity of Area	Dust Emission Classification		
		Large	Medium	Small
Earthworks	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Construction	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Track-out	High	High	Medium	Medium
	Medium	Medium	Low	Negligible
	Low	Low	Low	Negligible

STEP 3: Identify the need for Site-Specific Mitigation

Based on the risk of effects determined in Step 2C for each activity, appropriate site-specific mitigation measures were recommended. Appropriate mitigation measures are set out in the IAQM Guidance.

STEP 4: Define impacts and their significance

Finally the significance of the potential residual dust impacts, i.e. after mitigation, was determined. According to the IAQM Guidance the residual impacts assumes that all mitigation measures (recommended in Step 3) to avoid or reduce impacts are adhered to, and therefore the residual impacts should be considered to be ‘not significant’.

Appendix D Traffic Data

Table 23. Traffic Data Used in the Model

		AADT					HGV					Speed, km/hr				
Road	Dir.	Base	Do-Min		Do-Som		Base	Do-Min		Do-Som		Base	Do-Min		Do-Som	
		2015	2020	2035	2020	2035	2010	2020	2035	2020	2035	2010	2020	2035	2020	2035
Clifton Road	NB	606	706	756	711	819	15%	14%	13%	14%	16%	42	42	43	42	42
Clifton Road	SB	875	682	682	789	929	36%	19%	22%	21%	23%	33	32	31	31	31
A96(N)	NB	7519	6703	6703	8611	10289	7%	9%	8%	6%	6%	45	47	46	46	45
A96(N)	SB	9386	9299	9299	10221	12071	4%	6%	7%	5%	6%	42	42	40	41	39
Bedford Road	NB	2710	4601	4601	4647	6245	7%	5%	8%	6%	6%	41	41	40	41	40
Bedford Road	SB	3623	4339	4339	4323	5337	7%	7%	9%	7%	7%	30	30	29	30	29
Ashgrove Road	EB	608	876	876	680	1107	4%	3%	5%	3%	3%	28	26	27	28	28
Ashgrove Road	WB	590	816	816	322	318	5%	3%	4%	10%	6%	25	24	24	24	24
Westburn Drive	NB	4952	4926	4926	5181	7057	8%	8%	10%	8%	7%	35	35	34	35	35
Westburn Drive	SB	5704	5558	5558	5596	6616	8%	8%	10%	9%	8%	29	29	28	29	28
King Street	NB	12645	12937	12937	12849	12695	17%	19%	20%	20%	21%	36	33	33	33	34
King Street	SB	10834	11468	11468	11469	9750	16%	17%	18%	17%	22%	39	37	37	37	37
A96(S)	NB	2145	3704	3704	3855	6585	16%	14%	26%	14%	16%	48	46	39	46	39
A96(S)	SB	4139	4987	4987	5421	9238	10%	12%	18%	11%	10%	32	32	32	32	32
Back Hilton Road	EB	3297	3696	3696	3842	4067	16%	22%	22%	19%	16%	33	32	33	30	30
Back Hilton Road	WB	5562	6363	6363	4351	4240	13%	13%	15%	18%	19%	31	30	29	32	32
A944	EB	2687	3243	3243	3020	8458	8%	9%	19%	9%	8%	28	30	27	30	26
A944	WB	2491	2760	2760	3886	7762	7%	9%	16%	7%	6%	28	30	28	30	27
George Street	NB	1573	1743	1743	1708	3289	16%	20%	26%	20%	13%	24	24	25	23	25
George Street	SB	2917	2992	2992	3387	3267	16%	21%	20%	19%	18%	26	27	27	27	27

Road	Dir.	AADT					HGV					Speed, km/hr				
		Base	Do-Min		Do-Som		Base	Do-Min		Do-Som		Base	Do-Min		Do-Som	
		2015	2020	2035	2020	2035	2010	2020	2035	2020	2035	2010	2020	2035	2020	2035
Watson Street / Esslemont Avenue	NB	1216	1302	1302	1319	2913	11%	12%	15%	13%	7%	26	26	25	26	24
Watson Street / Esslemont Avenue	SB	1365	1421	1421	1533	2616	12%	12%	14%	12%	7%	23	23	23	23	24
Mount Street	NB	1318	1024	1024	979	2098	35%	34%	27%	36%	23%	26	26	26	26	26
Mount Street	SB	1575	1385	1385	2827	2744	22%	21%	17%	12%	10%	25	25	24	25	24
Bedford Place / Orchard Street	EB	1555	1663	1663	1682	2243	8%	8%	15%	8%	11%	27	27	27	27	27
Bedford Place / Orchard Street	WB	1850	2036	2036	2012	2766	8%	10%	12%	9%	9%	28	28	28	28	27
Spital	NB	2508	2987	2987	2655	4716	8%	9%	16%	10%	10%	32	32	29	32	30
Spital	SB	2754	2898	2898	2680	2006	8%	9%	9%	10%	13%	26	26	25	26	25
Mounthooly	NB	2655	3255	3255	2888	6480	6%	6%	16%	7%	8%	25	24	20	25	21
Mounthooly	SB	3739	4416	4416	4055	5372	6%	6%	8%	7%	6%	29	29	27	29	26
Skene Street	EB	4147	4720	4720	4907	5210	5%	6%	8%	6%	7%	25	24	22	24	22
Skene Street	WB	4880	4077	4077	4021	5016	8%	11%	13%	12%	11%	19	19	19	19	18
Albert Street / Craigie Loanings	NB	3973	3832	3832	3972	6259	7%	7%	10%	7%	5%	36	36	35	36	35
Albert Street/ Craigie Loanings	SB	4563	4307	4307	4256	5447	7%	7%	8%	7%	7%	36	36	35	36	35
Rosemount Place / Maberley Street / Spring Gardens	EB	3787	3867	3867	3063	4036	9%	9%	11%	11%	11%	29	29	27	29	27
Rosemount Place / Maberley Street / Spring Gardens	WB	3961	4415	4415	3573	4515	10%	9%	12%	11%	11%	25	25	25	25	25
Gallowgate	NB	3364	2473	2473	2817	1778	10%	11%	12%	10%	16%	34	34	21	35	20
Gallowgate	SB	3225	3548	3548	2597	3316	12%	8%	13%	11%	14%	29	29	33	29	33
St Machar Drive / Hilton Street	EB	5565	6402	6402	6181	8619	4%	4%	6%	5%	5%	30	29	27	29	27
St Machar Drive / Hilton Street	WB	6410	6607	6607	6628	8785	4%	5%	7%	5%	5%	31	30	27	30	27
Hilton Drive	NB	1644	1799	1799	1528	1559	12%	15%	18%	16%	18%	31	31	31	31	31
Hilton Drive	SB	1904	1820	1820	1744	1932	8%	14%	14%	14%	11%	34	33	34	34	33
Holburn Street CCAQMA	NB	6968	7600	7600	7788	6997	11%	12%	12%	11%	11%	28	27	28	27	28

Road	Dir.	AADT					HGV					Speed, km/hr				
		Base	Do-Min		Do-Som		Base	Do-Min		Do-Som		Base	Do-Min		Do-Som	
		2015	2020	2035	2020	2035	2010	2020	2035	2020	2035	2010	2020	2035	2020	2035
Holburn Street CCAQMA	SB	8928	9537	9537	9703	10091	9%	9%	9%	9%	9%	27	26	26	26	26
Union Street CCAQMA	NB	5858	5830	5830	5833	2177	34%	40%	19%	40%	51%	16	16	16	16	16
Union Street CCAQMA	SB	6582	7471	7471	7458	4091	25%	23%	12%	23%	23%	16	15	17	15	17
Victoria Road / Market Street CCAQMA	NB	13042	14513	14513	14637	13885	13%	15%	22%	15%	23%	32	30	31	30	31
Victoria Road / Market Street CCAQMA	SB	14646	15143	15143	15273	19164	11%	14%	21%	14%	17%	26	27	24	27	24
King Street CCAQMA	NB	9804	9869	9869	9908	8667	22%	26%	24%	26%	28%	33	31	32	31	32
King Street CCAQMA	SB	5813	6633	6633	6660	5636	32%	31%	29%	31%	35%	29	27	27	27	27
Guild Street CCAQMA	NB	3163	3027	3027	2600	0	23%	25%	0%	30%	0%	37	36	0	36	0
Guild Street CCAQMA	SB	15011	16231	16231	16347	1048	9%	10%	5%	9%	84%	48	43	38	43	38
Bridge Street CCAQMA	NB	14120	12902	12902	13039	15602	13%	16%	15%	16%	12%	47	48	15	48	16
Bridge Street CCAQMA	SB	963	1535	1535	1678	0	44%	32%	0%	33%	0%	17	16	0	16	0
Trinity Quay / Virginia Street CCAQMA	NB	14672	16552	16552	16275	17074	8%	8%	22%	8%	22%	34	32	28	32	27
Trinity Quay / Virginia Street CCAQMA	SB	13801	14532	14532	14719	17084	5%	6%	15%	6%	13%	36	36	36	36	36
Commerce Street / W N Street CCAQMA	NB	9437	10245	10245	10187	11561	6%	6%	26%	6%	23%	23	23	14	23	14
Commerce Street / W N Street CCAQMA	SB	8744	9421	9421	9858	11612	4%	6%	18%	5%	14%	19	20	18	20	18
Wapping Street CCAQMA	EB	14932	15464	15464	15290	13862	7%	8%	6%	8%	7%	27	27	18	26	18
Anderson Drive S-A93 AQMA	NB	13224	10989	10989	10932	11740	7%	8%	6%	8%	6%	50	50	50	50	50
Anderson Drive A93-S AQMA	SB	14794	12731	12731	12587	13425	10%	11%	12%	11%	11%	45	46	45	46	45
Anderson Drive A93-A944 AQMA	NB	16063	13891	13891	13798	15254	8%	8%	9%	8%	8%	49	49	49	49	49
Anderson Drive A944-A93 AQMA	SB	16213	13573	13573	13274	14896	9%	9%	11%	9%	10%	49	49	49	49	49
Anderson Drive A944-N AQMA	NB	20234	17846	17846	17519	19530	8%	8%	9%	8%	8%	45	44	42	43	42
Anderson Drive N-A944 AQMA	SB	17584	15418	15418	15166	17323	9%	10%	11%	10%	10%	42	42	41	42	41

Road	Dir.	AADT					HGV					Speed, km/hr				
		Base	Do-Min		Do-Som		Base	Do-Min		Do-Som		Base	Do-Min		Do-Som	
		2015	2020	2035	2020	2035	2010	2020	2035	2020	2035	2010	2020	2035	2020	2035
Berryden Corridor N	NB	6453	6110	6110	9401	11825	6%	8%	8%	6%	6%	28	29	28	38	37
Berryden Corridor N	SB	9536	9474	9474	11408	13987	4%	5%	7%	5%	6%	27	27	25	30	29
Berryden Corridor Mid	NB	4192	5000	5000	8299	9934	15%	15%	11%	9%	8%	15	14	14	26	26
Berryden Corridor Mid	SB	1037	907	907	8795	10107	35%	49%	58%	8%	8%	9	9	10	32	32
Berryden Corridor S	NB	7456	7943	7943	7975	8903	8%	9%	11%	9%	10%	29	28	27	31	32
Berryden Corridor S	SB	8847	8609	8609	9907	11302	8%	9%	10%	8%	9%	22	22	21	24	24
Denburn Road N	NB	8442	9301	9301	8762	14358	8%	8%	12%	9%	9%	23	24	17	26	26
Denburn Road N	SB	9558	9913	9913	10053	13639	7%	7%	10%	7%	7%	26	26	23	20	18
Denburn Road Mid	NB	12581	13048	13048	12244	17847	5%	6%	12%	6%	7%	39	39	30	32	28
Denburn Road Mid	SB	12071	12570	12570	11012	16397	6%	7%	13%	7%	10%	40	40	36	39	38
Denburn Road S	NB	9721	10564	10564	10728	17493	4%	5%	10%	4%	6%	46	46	45	46	45
Denburn Road S	SB	12766	13529	13529	12990	15604	4%	5%	7%	5%	6%	39	39	40	39	39
RB: A96 / A944 / Mounthooly	Circ	7053	8117	8117	7913	14925	10%	9%	16%	9%	9%	27	27	25	27	25
A96(mid)	NB	4822	4566	4566	4560	5476	11%	12%	14%	13%	12%	26	26	26	30	29
A96(mid)	SB	6704	6661	6661	5257	6955	8%	9%	11%	11%	11%	30	30	29	34	33
Belmont Road	NB	3805	3085	3085	63	21	2%	4%	11%	25%	98%	9	8	6	10	10
Belmont Road	SB	8740	8285	8285	1101	1264	6%	6%	5%	2%	16%	30	30	30	19	18

Source: Systra

Appendix E Model Verification Adjustment

The model was verified by comparison with NO_2 diffusion tubes operated by Aberdeen City Council (ACC) in 2016. The model under-estimated concentrations when compared to the monitoring data and so the modelled results for NO_2 and PM_{10} were adjusted in accordance with the procedure detailed in technical guidance LAQM.TG(16).

Table 24. Comparison of Modelled and Monitored NO_2 Concentrations, 2015

Monitoring Site	Monitor Type	Background NO_2	Monitored Total NO_2	Modelled Total NO_2	% Difference [(modelled-monitored)/monitored]
DT3	DT	10.2	24.3	19.4	-20%
DT5	DT	11.7	20.0	24.2	21%
DT9	DT	27.8	50.2	39.7	-21%
DT10	DT	27.3	54.1	37.5	-31%
DT11	DT	27.8	51.1	35.4	-31%
DT12	DT	27.8	48.9	35.4	-28%
DT13	DT	15.8	40.9	23.7	-42%
DT16	DT	27.8	43.8	38.2	-13%
DT17	DT	27.8	46.7	37.5	-20%
DT18	DT	16.5	48.5	20.3	-58%
DT19	DT	16.5	45.4	26.8	-41%
DT20	DT	27.8	32.1	34.6	8%
DT21	DT	27.8	44.1	36.9	-16%
DT22	DT	27.8	39.3	35.8	-9%
DT25	DT	16.5	42.8	21.9	-49%
DT27	DT	16.5	28.7	20.0	-30%
DT28	DT	16.5	34.9	21.6	-38%
DT29	DT	16.5	48.8	25.9	-47%
DT30	DT	16.5	46.5	24.8	-47%
DT33	DT	27.8	43.1	36.1	-16%
DT34	DT	15.8	28.7	21.1	-27%
DT46	DT	27.8	26.0	32.8	26%
DT47	DT	14.1	28.5	16.2	-43%
DT48	DT	11.5	18.9	14.9	-21%
DT49	DT	11.1	28.4	14.6	-49%
DT50	DT	11.7	18.3	14.2	-23%
DT54	DT	11.7	18.3	12.8	-30%
DT57	DT	27.8	29.9	29.2	-2%
DT58	DT	11.5	20.8	12.7	-39%
DT61	DT	15.8	40.3	23.7	-41%
DT62	DT	12.6	14.4	13.3	-8%
DT63	DT	14.1	23.0	19.9	-14%
DT64	DT	14.1	16.9	15.5	-8%
CL2	CA	16.5	43.0	25.4	-41%
CL4	CA	11.3	21.0	11.4	-46%
CL6	CA	11.7	28.0	19.1	-32%

Table 25. Comparison of Modelled and Monitored PM_{10} Concentrations, 2015

Monitoring Site	Monitor Type	Background PM_{10}	Monitored Total PM_{10}	Modelled Total PM_{10}	% Difference [(modelled-monitored)/monitored]
CL2	CA	13.3	13.0	14.0	7%
CL4	CA	12.1	12.0	12.2	1%
CL6	CA	12.1	16.0	13.0	-19%

An adjustment factors were calculated as follows:

$NO_{X\ [monitored,\ traffic\ contribution]} = NO_{X\ [monitored]} – NO_{X\ [background]}$

$NO_{X\ [modelled,\ traffic\ contribution]} = NO_{X\ [modelled]} – NO_{X\ [background]}$

Adjustment Factor = $NO_{X\ [monitored,\ traffic\ contribution]} / NO_{X\ [modelled,\ traffic\ contribution}$

An adjustment factor of **2.3865** was calculated for NO_X and **2.6225** for PM_{10}.

The adjustment factors were subsequently applied to the modelled NO_X concentrations and background NO_X added to give the adjusted NO_X concentrations (NO_X [model adjusted]) (Table 30):

$NO_{X\ [model\ adjusted,\ traffic\ contribution]} = NO_{X\ [modelled,\ traffic\ contribution]}$ x Adjustment Factor

$NO_{X\ [model\ adjusted]} = NO_{X\ [model\ adjusted,\ traffic\ contribution]} + NO_{X\ [background]}$

The adjusted NO_X concentrations were then converted to NO_2. using version 4.1 of the 'NO_2 to NO_X' calculator provided by the Air Quality Archive and in accordance with the technical guidance, LAQM.TG(16).

Table 26. Determination of Modelled and Monitored Road NO_2 and Modelled Road NO_X

ID	Monitored Total NO_2	Monitored Road NO_X	Background NO_2	Monitored Road Contribution NO_2 (total-background)	Monitored Road Contribution NO_X (total-background)	Modelled Road Contribution NO_X (excluding background)
DT3	24.3	27.6	10.2	14.1	27.6	17.5
DT5	20.0	15.9	11.7	8.3	15.9	
DT9	50.2	49.8	27.8	22.4	49.8	24.9
DT10	54.1	60.9	27.3	26.8	60.9	21.1
DT11	51.1	52.0	27.8	23.3	52.0	15.6
DT12	48.9	46.5	27.8	21.1	46.5	15.6
DT13	40.9	53.3	15.8	25.1	53.3	15.4
DT16	43.8	34.3	27.8	16.0	34.3	21.6
DT17	46.7	41.2	27.8	18.9	41.2	20.1
DT18	48.5	70.7	16.5	32.0	70.7	
DT19	45.4	62.8	16.5	28.9	62.8	
DT20	32.1	8.7	27.8	4.3	8.7	13.9
DT21	44.1	35.0	27.8	16.3	35.0	18.8
DT22	39.3	24.1	27.8	11.5	24.1	16.5
DT25	42.8	56.4	16.5	26.3	56.4	
DT27	28.7	24.3	16.5	12.2	24.3	
DT28	34.9	37.8	16.5	18.4	37.8	
DT29	48.8	71.5	16.5	32.3	71.5	
DT30	46.5	65.6	16.5	30.0	65.6	16.2
DT33	43.1	32.7	27.8	15.3	32.7	17.1

ID	Monitored Total NO_2	Monitored Road NO_X	Background NO_2	Monitored Road Contribution NO_2 (total-background)	Monitored Road Contribution NO_X (total-background)	Modelled Road Contribution NO_X (excluding background)
DT34	28.7	25.7	15.8	12.9	25.7	10.1
DT46	26.0	-3.6	27.8	-1.8	-3.6	
DT47	28.5	28.7	14.1	14.4	28.7	3.9
DT48	18.9	14.2	11.5	7.4	14.2	6.4
DT49	28.4	34.5	11.1	17.3	34.5	6.5
DT50	18.3	12.6	11.7	6.6	12.6	4.6
DT54	18.3	12.6	11.7	6.6	12.6	2.0
DT57	29.9	4.2	27.8	2.1	4.2	2.7
DT58	20.8	18.0	11.5	9.3	18.0	2.4
DT61	40.3	51.9	15.8	24.5	51.9	15.3
DT63	23.0	17.3	14.1	8.9	17.3	11.0
DT64	16.9	5.3	14.1	2.8	5.3	2.6
CL2	43.0	56.8	16.5	26.5	56.8	17.4
CL4	21.0	18.8	11.3	9.7	18.8	0.2
CL6	28.0	32.5	11.7	16.3	32.5	14.1

Table 27. Determination of Modelled and Monitored Road PM_{10} and Modelled Road PM_{10}

ID	Monitored Total PM_{10}	Monitored Road PM_{10}	Background PM_{10}	Monitored Road Contribution PM_{10} (total-background)	Modelled Road Contribution PM_{10} (excluding background)
CL2	13.0	-0.3	13.3	-0.3	0.7
CL4	12.0	-0.1	12.1	-0.1	0.0
CL6	16.0	3.9	12.1	3.9	0.9

Table 28. Determination of the Adjustment Factor and Total Adjusted NO_2

ID	Adjustment Factor for Modelled Road Contribution	Adjusted Modelled Road Contribution NO_X	Adjusted Modelled Total NO_2	Monitored Total NO_2	% Difference [(mod-mon)/mon]
DT3	1.5768	41.7	30.9	24.3	27%
DT9	1.9948	59.5	54.1	50.2	8%
DT10	2.8825	50.4	50.0	54.1	-8%
DT11	3.3400	37.2	45.0	51.1	-12%
DT12	2.9771	37.3	45.1	48.9	-8%
DT13	3.4554	36.8	33.8	40.9	-17%
DT16	1.5854	51.7	51.0	43.8	16%
DT17	2.0452	48.1	49.5	46.7	6%
DT20	0.6209	33.3	43.4	32.1	35%
DT21	1.8639	44.8	48.2	44.1	9%
DT22	1.4599	39.4	45.9	39.3	17%
DT30	4.0485	38.7	35.3	46.5	-24%
DT33	1.9094	40.9	46.6	43.1	8%
DT34	2.5417	24.1	28.0	28.7	-3%

ID	Adjustment Factor for Modelled Road Contribution	Adjusted Modelled Road Contribution NO_X	Adjusted Modelled Total NO_2	Monitored Total NO_2	% Difference [(mod-mon)/mon]
DT47	7.4175	9.2	19.0	28.5	-34%
DT48	2.2221	15.2	19.4	18.9	3%
DT49	5.2647	15.6	19.3	28.4	-32%
DT50	2.7238	11.0	17.5	18.3	-4%
DT54	6.3653	4.7	14.2	18.3	-22%
DT57	1.5295	6.5	31.1	29.9	4%
DT58	7.4926	5.7	14.5	20.8	-30%
DT61	3.3923	36.5	33.7	40.3	-17%
DT63	1.5644	26.3	27.4	23.0	19%
DT64	2.0256	6.2	14.1	16.9	-17%
CL2	3.2637	41.6	36.6	43.0	-15%
CL4	94.8840	0.5	11.5	21.0	-45%
CL6	2.2965	33.7	28.6	28.0	2%

Figure 3: Adjusted Modelled NO_2 Versus Monitored Concentrations

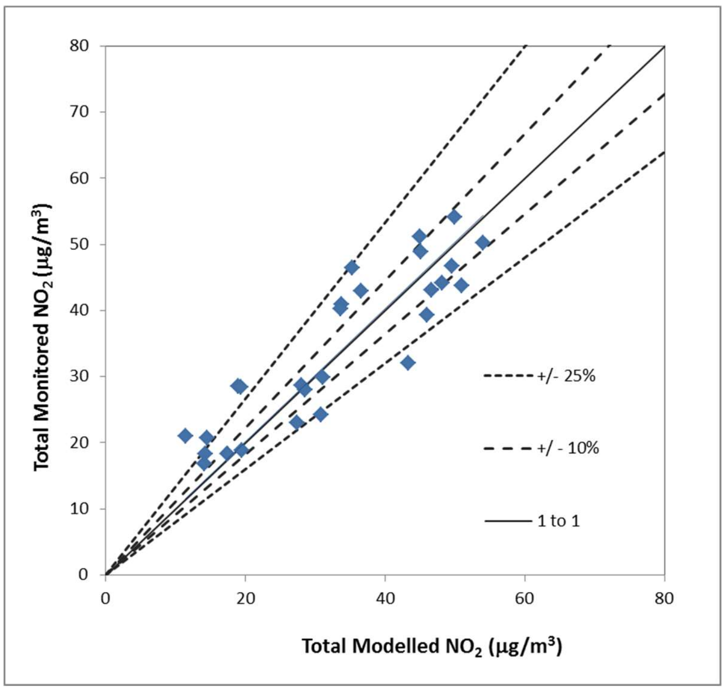
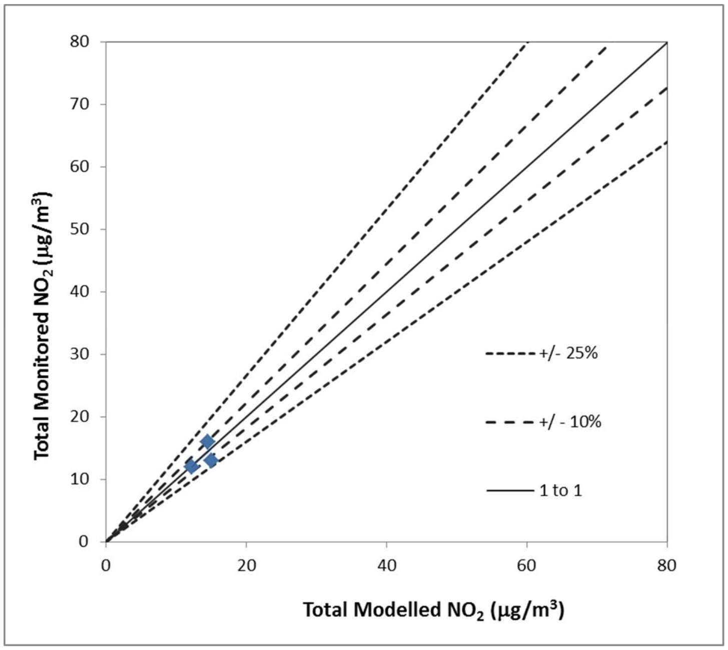


Table 29. Determination of the Adjustment Factor and Total Adjusted PM_{10}

ID	Adjustment Factor for Modelled Road Contribution	Adjusted Modelled Road Contribution PM_{10}	Adjusted Modelled Total PM_{10}	Monitored Total PM_{10}	% Difference [(mod-mon)/mon]
CL2	2.6225	1.7	15.0	13.0	16%
CL4	2.6225	0.0	12.2	12.0	1%
CL6	2.6225	2.3	14.5	16.0	-10%

Figure 4: Adjusted Modelled PM_{10} Versus Monitored Concentrations



The data in Table 30 indicate the statistical confidence attributed to the model. The data show that the verification significantly improves the accuracy of the model.

Table 30. Statistical Confidence

	Ideal Value	NO_2		PM_{10}	
		Unadjusted	Adjusted	Unadjusted	Adjusted
Correlation Coefficient	1	0.86	0.89	0.22	0.54
RMSE	0	10.79	6.08	1.81	1.48
Fractional Bias	1	-0.15	-0.41	-0.63	-0.68

Appendix F Plotted Results

Figure 5: Predicted Annual Mean NO_2 Concentrations, 2020, Do-Minimum Scenario

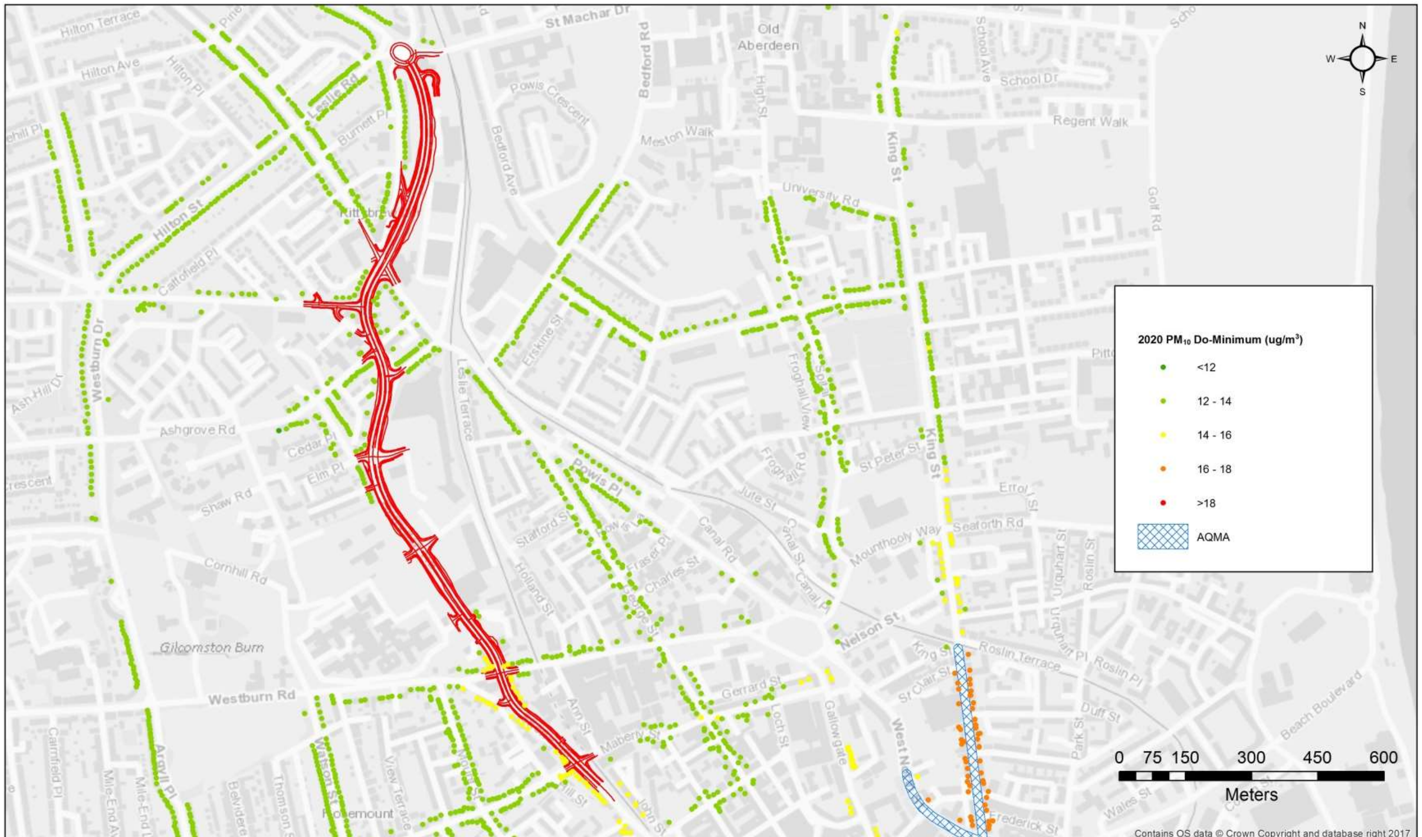
Figure 6: Predicted Annual Mean NO_2 Concentrations, 2020, Do-Something Scenario

Figure 7: Description of Change of Annual Mean NO_2 Concentrations, 2020

Figure 8: Description of Change of Annual Mean NO_2 Concentrations, 2035

Client: Aberdeen City Council	Title: BERRYDEN ROAD AIR QUALITY ASSESSMENT	AECOM	Drawn: DU / Checked: GC
			Verified: TS / Approved: TS
Project: Berryden Road	DESCRIPTION OF EFFECTS ANNUAL MEAN NO_2 2035	5th Floor, 2 City Walk, Leeds, LS11 9AR; Tel: +44 (0) 113 391 6800 Fax: +44 (0) 113 391 6899 www.aecom.com	Date: 19/10/2017 / Scale at A3:
			Drawing Number: 60529660 / A3

Figure 9: Predicted Annual Mean PM_{10} Concentrations, 2020, Do-Minimum Scenario



Client: Aberdeen City Council	Title: BERRYDEN ROAD AIR QUALITY ASSESSMENT PREDCITED ANNUAL MEAN PM_{10} CONCENTRATIONS DO-MINIMUM 2020	AECOM 5th Floor, 2 City Walk, Leeds, LS11 9AR Tel: +44 (0) 113 391 6800 Fax: +44 (0) 113 391 6899 www.aecom.com	Drawn: DU	Checked: GC
Project: Berryden Road			Verified: TS	Approved: TS
			Date: 19/10/2017	Scale at A3:
			Drawing Number: 60529660	A3

Figure 10: Predicted Annual Mean PM_{10} Concentrations, 2020, Do-Something Scenario

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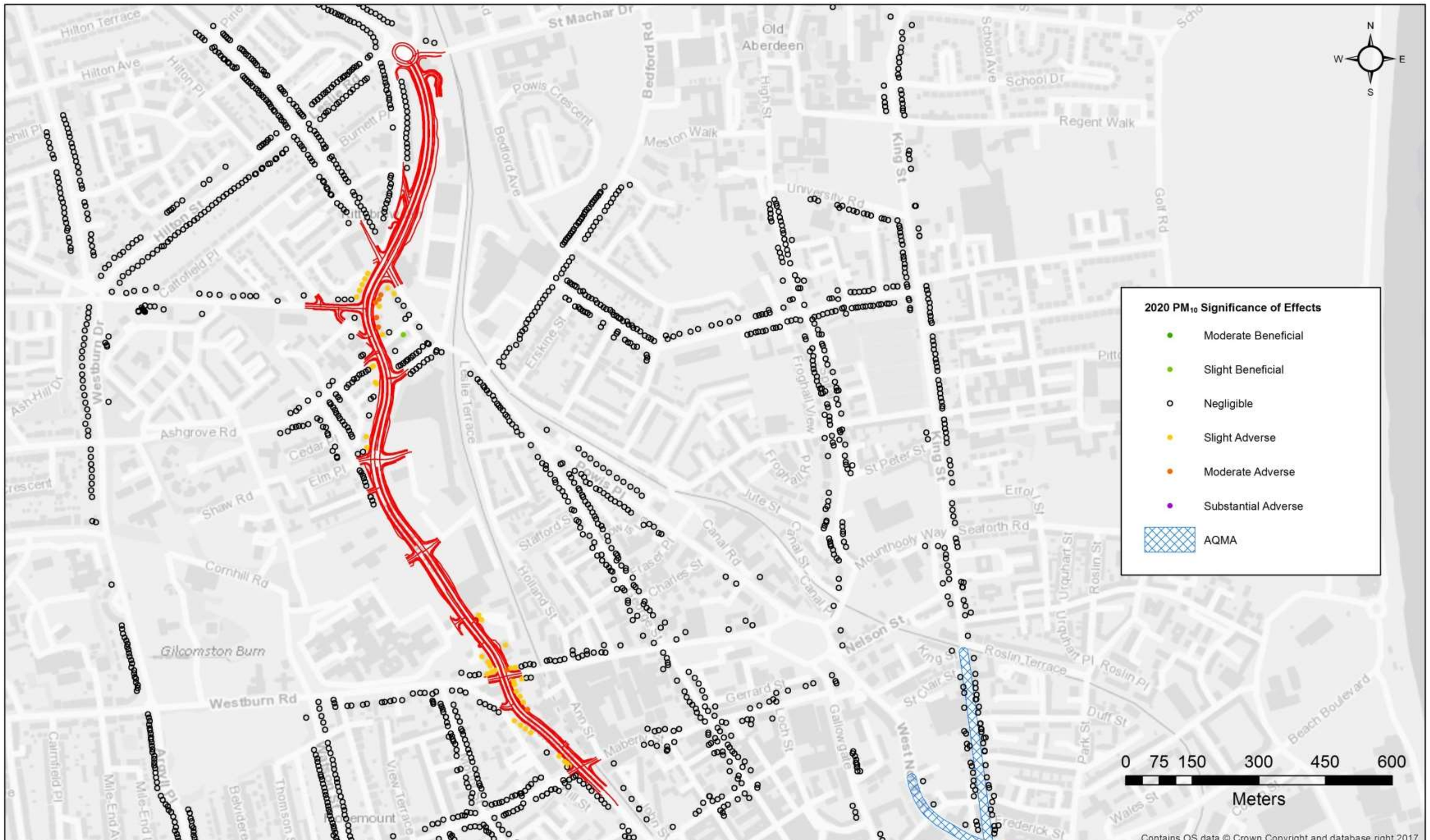
Figure 11: Description of Change of Annual Mean PM_{10} Concentrations, 2020



Client: Aberdeen City Council	Title: BERRYDEN ROAD AIR QUALITY ASSESSMENT	AECOM	Drawn: DU	Checked: GC
			Verified: TS	Approved: TS
Project: Berryden Road	DESCRIPTION OF EFFECTS ANNUAL MEAN PM_{10} 2020	5th Floor, 2 City Walk, Leeds, LS11 9AR; Tel: +44 (0) 113 391 6800 Fax: +44 (0) 113 391 6899 www.aecom.com	Date: 19/10/2017	Scale at A3:
			Drawing Number: 60529660	A3

Figure 12: Description of Change of Annual Mean PM_{10} Concentrations, 2035

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