Detailed Assessment of Musselburgh AQMA

East Lothian Council

Change list

Ver:	Date:	Description of the change	Reviewed	Approved by
P01	09/06/22	1ST Draft	EMP	JS
P02	06/09/22	Final FOR APPROVAL	EMP	JS
C01	08/09/22	FINAL APPROVED		COLIN CLARK

Sweco UK Limited Reg. No.: 2888385
Project Name: Detailed Assessment
Project Number: 65201802

Client: East Lothian Council
Ver: P02
Approved by JS
Date: 06/09/22
Author: MB
Document number 65201802
Document Reference: 65201802-SWE-XX-X-T-AQ-0001

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Executive Summary

Sweco UK Ltd was commissioned by East Lothian Council to prepare a Detailed Assessment for the proposed revocation of Musselburgh High Street AQMA in Musselburgh. The assessment has been undertaken to investigate the potential scale and extent of exceedances of the Scottish Air Quality Objectives (SAQOs) in the study area to determine whether the requirement for the AQMA remains valid or should be revoked.

The AQMA was declared in 2013 for exceedances of the annual mean NO_2 objective and encompassed the High Street between Bridge Street in the west and Newbigging Street in the east.

A Further Assessment completed in 2014 concluded that the AQMA boundary was appropriate and the requirement for the AQMA was still valid.

This Detailed Assessment report describes a dispersion modelling study of road traffic emissions in High Street in Musselburgh, East Lothian. The assessment has determined annual mean concentrations of NO_2 at this location.

A combination of the latest Council monitoring data and atmospheric dispersion modelling using AMDS-Roads have been used to conduct the study. The study utilises the latest available traffic and meteorological data for 2019.

The assessment has considered:

- The last 6 years of monitoring data
- 2019 traffic flow data, due to the pandemic it has not been possible to consider a more recent year due to changes in traffic patterns as a result of Covid-19 lockdown measures over the last 2 years. It has been considered that this would be worst case.
- Assessment of potential future emissions
    - Future with City of Edinburgh LEZ in operation.
    - Met sensitivity of 5 years of metrological conditions.
    - The potential impact from the Local Development Flow full build out. The potential increase in traffic volume required to result in exceedances of the NO_2 annual mean objective.

The report has indicated the following:

- Local diffusion tube monitoring has not recorded an exceedance in SAQO since 2016 where sites T6 and T31 measured 40 $\mu g/m^3$ and 43 $\mu g/m^3$, respectively.

- 103 sensitive receptors were identified across Musselburgh, all residential. This included receptors within the High Street AQMA placed at 4 m to represent the human exposure at the first-floor level on the High Street.
- The modelling did not predict any exceedances of the SAQOs for annual mean NO_2 at any of the sensitive receptors across the study area
- Modelling of the potential future impacts from the City of Edinburgh LEZ were also considered. This assumed all buses would be Euro 6. This resulted in a reduction of annual mean concentration of approximately 7 $\mu g/m^3$ in the High Street.

The review of monitoring data and dispersion modelling carried out to support this Detailed Assessment indicates that the NO_2 annual mean objective is no longer exceeded within the Musselburgh AQMA, or at any locations considered within the study area. Future development within Musselburgh and associated changes of traffic flows have also been considered. These have also concluded that there is little risk to the annual mean objective being exceeded in the future either as a result of met conditions or changing fleet composition as a result of the proposed City of Edinburgh LEZ.

It is, therefore, concluded that it is considered unlikely that the SAQ annual mean NO_2 objective will be exceeded in future years, thus the requirement for the AQMA no longer remains valid and can be revoked. It is recommended that the Council gives consideration to doing so under Section 83 (2) of the Environment Act 1995. It is further recommended that East Lothian Council continue to undertake monitoring within the AQMA to identify any changes in air quality concentrations as a precaution.

This report has been prepared for East Lothian Council by a third party. East Lothian Council accept and take ownership of its findings.

1.0 Introduction

The Environment Act 1995 and subsequent regulations required local authorities to assess compliance of air quality in their area with the standards and objectives set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 (AQS). The air quality standard and objectives are defined in the Air Quality (Scotland) Regulations 2000 and Air Quality (Scotland) Amendment Regulations 2002.

The process by which local authorities assess compliance with AQS objectives is known as Local Air Quality Management (LAQM). The LAQM process commenced in 1998, and since then East Lothian Council have regularly reviewed and assessed air quality within its boundaries. As part of that review and assessment the Council operates a monitoring network throughout its boundaries, targeting areas of anticipated poor air quality, and then reports on the results annually.

In 2012, East Lothian's air quality Annual Progress Report[1] indicated that nitrogen dioxide (NO_2) concentrations at various locations had exceeded, or were very close to, the Annual Mean Objective. This led to a Detailed Assessment in 2012. In 2013, exceedances at the High Street were confirmed in the following Air Quality Progress Report[2] for East Lothian Council and an order[3] declaring an Air Quality Management Area (AQMA) came into effect on 13 November 2013. The extent of the AQMA is shown in Figure 1.

A Further Assessment[4] was undertaken in 2014. As part of this work the Council extended their diffusion tube monitoring network to include 5 additional locations. These new locations were identified as potential hotspots within the AQMA because of the dispersion modelling completed as part of the 2012 Detailed Assessment.

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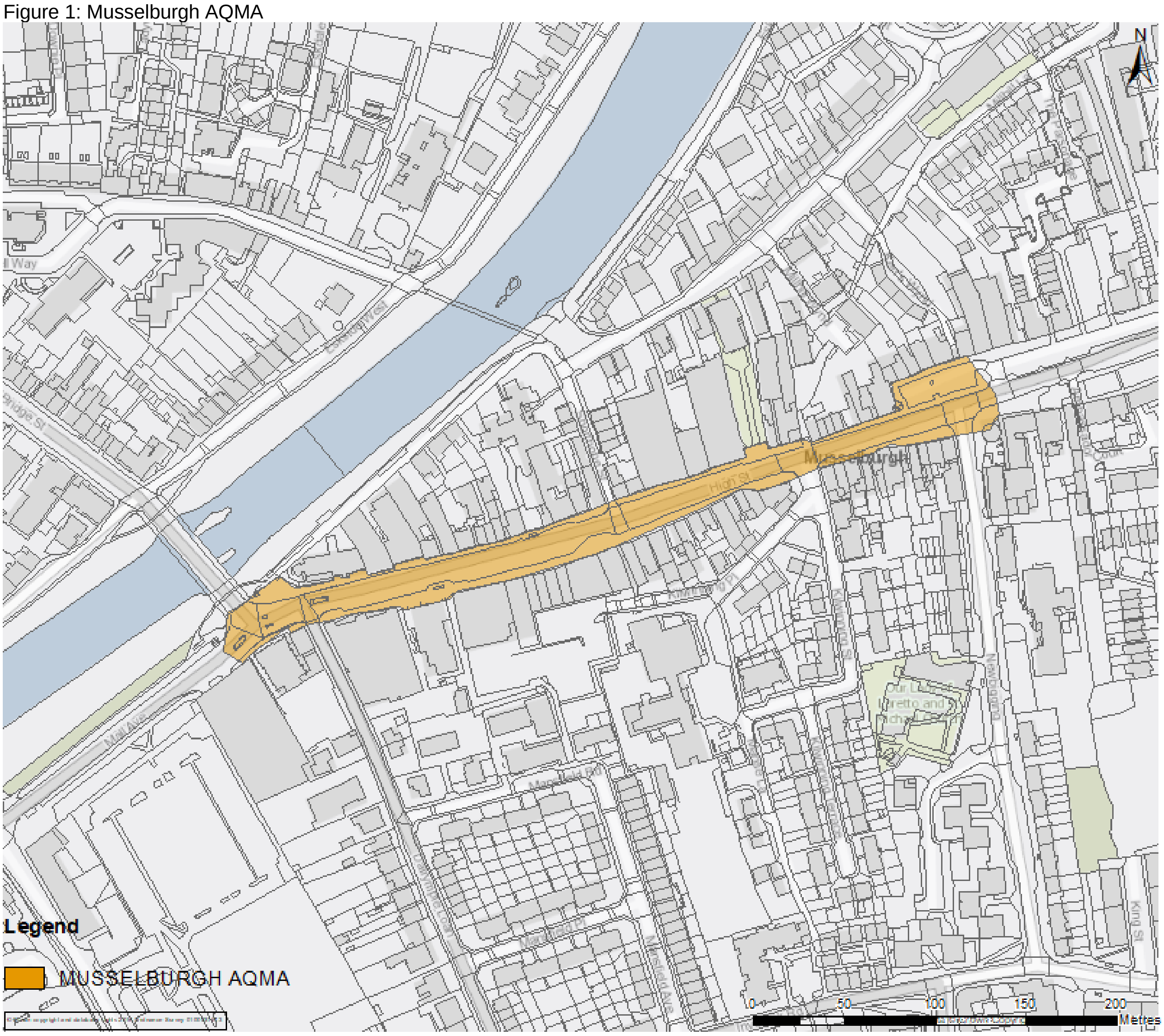
[1] Available at: https://www.eastlothian.gov.uk/downloads/file/23469/air_quality_progress_report_2012
[2] Available at: https://www.eastlothian.gov.uk/downloads/file/23468/air_quality_progress_report_2013
[3] Available at: https://www.eastlothian.gov.uk/downloads/file/23466/air_quality_management_area_order
[4] Available at: https://www.eastlothian.gov.uk/downloads/file/23471/air_quality_further_assessment_2014_-_further_assessment_of_air_quality_musselburgh

Figure 1: Musselburgh AQMA



The Musselburgh High Street AQMA covers the area around High Street (A199), Musselburgh from its junction with Newbigging and extending westwards to the junction with Bridge Street and Mall Avenue.

In 2017, the Musselburgh Air Quality Action Plan (AQAP)[5] was finalised by East Lothian Council. The aim of the AQAP was to reduce transport emissions of NOx in the AQMA by approximately 21% through the introduction of 13 measures that were classified by priority and timescale. These measures are outlined in Table 1.1 below.

[5] Available at: https://www.eastlothian.gov.uk/downloads/file/23473/air_quality_action_plan_2017

TABLE 1.1: SUMMARY OF THE ACTION PLAN FOR THE MUSSELBURGH HIGH ST AQMA

Priority	Measure No	Measure	Timescale
Strategic Measures			
A	1	Improving links with Local Transport Strategy	Ongoing
B	2	Improving links with Local Development Plan	Ongoing
Direct Measures			
C	9	AQMA Signage	Short Term
D	4	Enforcement of idling provisions of The Road Traffic (Vehicle Emission) (Fixed Penalty) (Scotland) Regulations 2003	Short Term
E	6	Eco Stars	Short-Medium Term
F	10	East Central Scotland Vehicle Emission Partnership	Ongoing
G	13	Provision of information regarding air quality and travel options	Ongoing
H	12	Promotion of alternative modes (cycling + walking)	Ongoing
I	11	Green Travel Plans for large institutions and businesses	Short-Medium Term
J	7	SCOOT – Split Cycle Offset Optimisation Technique	Ongoing
K	3	Bus stop relocations on High Street, Musselburgh	Short-Medium Term
L	8	Longer Trains and Platforms at Musselburgh Rail Station	Short-Medium Term
M	5	Electrification of Lothian Buses in Musselburgh	Short-Medium Term

NO_2 annual mean concentrations continued to exceed the NO_2 objective up to 2016. However, since 2016 the measured annual mean NO_2 concentrations have remained below the objective level, decreasing steadily following the introduction of the AQAP in 2017.

2.0 Policy Context

Scottish policy in relation to the LAQM process is set out in Local Air Quality Management LAQM TG (16)[6] and Policy Guidance (PG(S)(16))[7].

The policy guidance describes the air quality objectives to be applied in assessing air quality and the review and assessment process. The relevant aspects are described in Sections 2.1 and 2.2 below.

This guidance is intended to help local authorities with their local air quality management duties under Part IV of the Environment Act 1995. It sets out:

- The statutory background and the legislative framework within which local authorities have to work
- The principles behind reviews and assessments of air quality and the recommended steps that local authorities should take
- How local authorities should handle the designation of Air Quality Management Areas (AQMAs) and the drawing up and implementation of action plans
- Suggestions for taking forward the development of local air quality strategies
- Suggestions on how local authorities should consult and liaise with others
- The role of transport-related measures in improving air quality
- The general principles behind air quality and land use planning
- The effects of biomass on air quality
- The relationships between air quality and noise policy.

This guidance was issued by the Scottish Ministers under section 88(1) of the1995 Act. Local authorities should have regard to it when undertaking their local air quality management duties, as required under section 88(2) of the Act. The guidance should be taken into account by all local authority departments involved in local air quality management (LAQM), including environmental health, corporate services, planning, economic development and transport planning. The guidance complements the information and advice contained in Cleaner Air for Scotland 2 (CAFS2)[8], which was published in July 2021 which replaced the original strategy published in 2015.

2.1 National Legislation and Policy

2.1.1 Local Air Quality Management

Part IV of the Environment Act 1995[9], requires the UK Government to publish an Air Quality Strategy and local authorities to review, assess and manage air quality within their areas. This is known as Local Air Quality Management (LAQM)[10].

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[6] Available at: https://www.scottishairquality.scot/laqm/technical-guidance

[7] Available at: https://www.scottishairquality.scot/laqm/technical-guidance

[8] Available at: https://www.gov.scot/publications/cleaner-air-scotland-2-towards-better-place-everyone/

[9] Environment Act 1995.

[10] Local Air Quality Management Technical Guidance LAQM.TG (16). April 2016. Department for Environment, Food and Rural Affairs

The 2007 Air Quality Strategy[11] establishes the policy for ambient air quality in the UK. It includes the National Air Quality Objectives (AQOs) for the protection of human health and vegetation for 11 pollutants. Those AQOs included as part of LAQM are prescribed in the Air Quality (Scotland) Regulations 2000 and the Air Quality (Amendment) (Scotland) Regulations 2002. Table 2.1 presents the AQOs for Nitrogen dioxide (NO_2)

TABLE 2.1: RELEVANT OBJECTIVES SET OUT IN THE AIR QUALITY STRATEGY

Pollutant	Concentrations	Measured As
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times per year	One-hour mean
	40µg/m^3	Annual mean

The NAQOs apply to external air where there is relevant exposure to the public over the associated averaging periods within each objective. Guidance is provided within the Local Air Quality Management Technical Guidance 2016 (LAQM.TG (16)) issued for Local Authorities, on where the AQOs apply as detailed in Table 2.2. The objectives do not apply in workplace locations, to internal air or where people are unlikely to be regularly exposed (i.e. centre of roadways).

TABLE 2.2: LOCATIONS WHERE AIR QUALITY OBJECTIVES APPLY

Averaging Period	Objectives Should Apply at:	Objectives Should Generally Not Apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-hour mean and eight-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties*	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.

[11] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. 2007. Department for Environment, Food and Rural Affairs

Averaging Period	Objectives Should Apply at:	Objectives Should Generally Not Apply at:
One-hour mean	All locations where the annual mean and: 24 and eight-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably expect to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access.
15-min mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes.	
*** – Such locations should represent parts of the garden where relevant public exposure to pollutants is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure to pollutants would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.**		

2.2 Review and Assessment Process

The LAQM process requires that local authorities carry out regular reviews of air quality in the form of annual assessment reports. Where an assessment identifies that there is a risk that an air quality objective will be exceeded at a location with relevant public exposure then a Detailed Assessment is undertaken. Detailed assessments consider any risk of exceedance of an objective in greater depth in order to determine whether or not an exceedance is likely.

Where a likely exceedance of an objective is identified, the Council are required to declare an Air Quality Management Area (AQMA), a designated area in which the Council have an obligation to develop and implement an Air Quality Action Plan (AQAP) plan to improve air quality.

In designating an AQMA, policy guidance states:

‘air quality management areas must encompass all known and predicted areas of exceedance where there is relevant exposure’

Where, however, it is identified that air quality within an AQMA meets air quality objectives, then local authorities can amend or revoke an AQMA. Policy guidance states:

‘In order....to revoke an air quality management area the local authority is required to submit a Detailed Assessment clearly outlining the evidence for changes in the likelihood of exceedance of the objectives occurring and demonstrating the cause of these changes.’

‘where a local authority considers it necessary to amend or revoke an air quality management area.... (necessary to) consult all the relevant statutory consultees.... local authorities should

submit their reports for appraisal showing monitoring results and other evidence to justify their decision.'

To revoke an AQMA it is, therefore, necessary to demonstrate compliance with the NAQS objectives but also demonstrate or justify the cause for improvement in air quality.

2.3 Overview of the Assessment

Based on the continued measured compliance with NO_2 objectives since 2016 it is proposed to revoke the AQMA. This report forms a Detailed Assessment of NO_2 to identify whether the AQMA should be revoked.

The general approach taken in the assessment was:

- Collect and analyse recent traffic, monitoring, meteorological and background concentration data for use in a dispersion modelling study.
- Review historic measurement data and trends
- Use dispersion modelling to produce numerical predictions of annual mean NO_2
- Use dispersion modelling to produce contour plots showing the expected spatial variation of the annual mean concentrations of pollutants.
- Recommend if East Lothian Council should retain or revoke the Musselburgh AQMA within the study area.
- Assess the likelihood of exceedance of the NAQS objects in the future by considering differing meteorological conditions.

The modelling methodologies provided for Detailed Assessments are outlined in the Scottish Government and Defra Technical Guidance LAQM.TG(16) and were used throughout this study.

3.0 Information used to support this assessment

3.1 Maps

Ordnance Survey based GIS data of the model domain and a road alignment GIS dataset were used in the assessment.

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3.2 Road traffic data

The traffic data was provided by the transport consultant Systra in the form of a Paramics model. The data provided consisted of a GIS shapefile of the modelled road network and the corresponding traffic flows per road link.

The traffic flows were provided in an Average Annual Daily Traffic (AADT) format for the following vehicle categories: motorcycle, car, taxi, LGV, bus, rigid HGV and artic HGV. The traffic data also provided speeds in the form of kilometres per hour (kph). These speeds were used to assign the average speed for each modelled road link.

3.3 Vehicle emission factors

The Emissions Factors Toolkit (EFT V10.1 August 2020 release) was used in the modelling assessment to calculate pollutant emission factors for each modelled road link. This version of the EFT was the most recent release at the time of undertaking the assessment. It's unlikely that the change of version would result in a change of conclusions.

The input parameters for the EFT follows the 'Detailed Option 2' traffic format in Scotland for 2019. The selected pollutants included NO_x using the Air Quality Modelling (g/km/s) output.

3.4 Meteorological data

Meteorological data for 2019 measured at the Edinburgh Gogarbank site was used for the modelling assessment. The meteorological measurement site is located approximately 17km west of the study area.

Meteorological measurements are subject to their own uncertainty which will unavoidably carry forward into this assessment.

3.5 Background concentrations

The Scottish air quality background maps[12] were used to assess current background concentrations of NO_x and NO_2 in the vicinity of the site. This resource provides estimated annual mean background concentrations of key pollutants at a resolution of 1x1km for Scotland.

At the time of the assessment the most recent 2018 based background maps and associated tools had been published. The 2018 maps project background concentrations from a base year of 2018.

The 2019 projected mapped background concentrations from the grid squares within the study area are provided in Table 3.1.

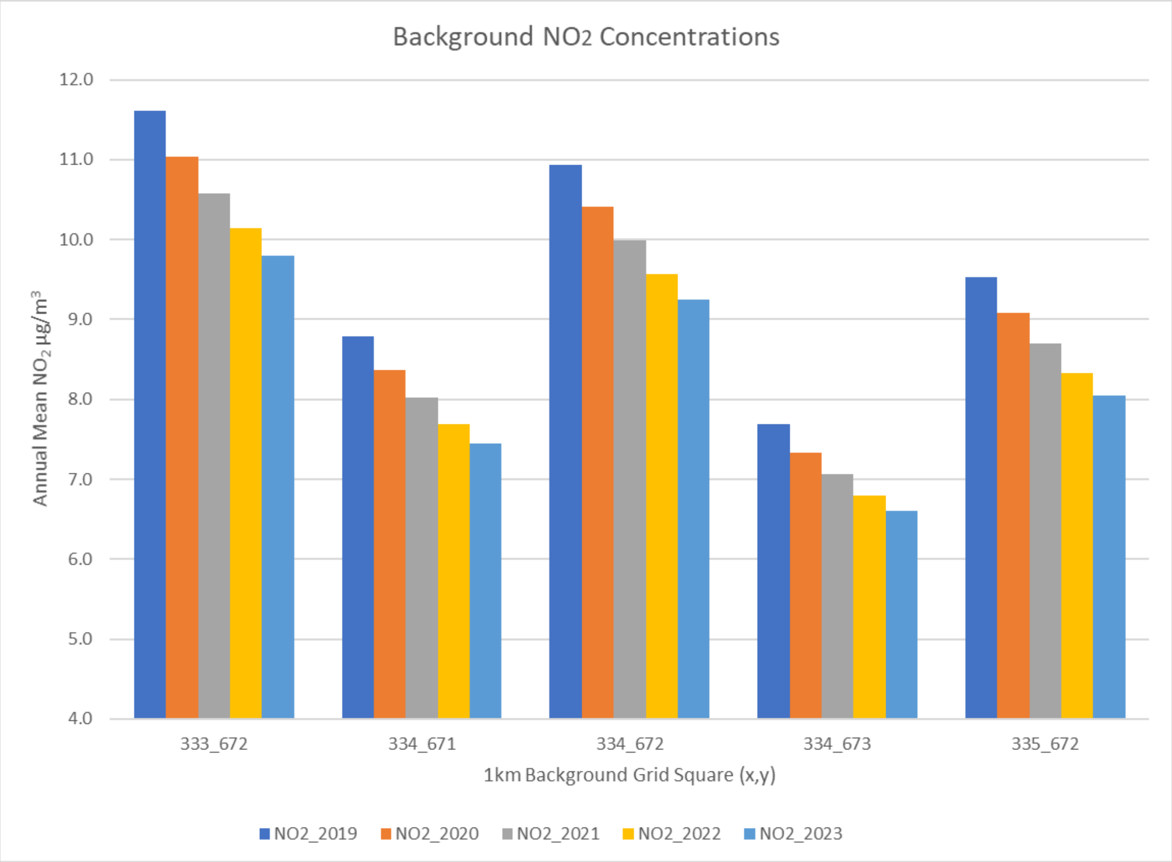
TABLE 3.1: 2019 ANNUAL MEAN BACKGROUND CONCENTRATIONS (µg/m³)

Grid Square	Background Concentrations (µg/m3)		
	Year	NOx	NO_2
333500_672500	2019	16.8	11.6
334500_671500	2019	12.6	8.8
334500_672500	2019	15.8	10.9
334500_673500	2019	10.9	7.7
335500_672500	2019	13.7	9.5

Background concentrations are predicted to decline in future years, the trend in background concentrations is presented in Chart 1. This clearly shows a downward trend in annual mean NO_2 since 2016.

[12] Scottish Air Quality, 2017, Background Maps, accessed at: http://www.scottishairquality.scot/data/mapping?view=data

Chart 1: NO_2 Background Concentrations 2019-2023



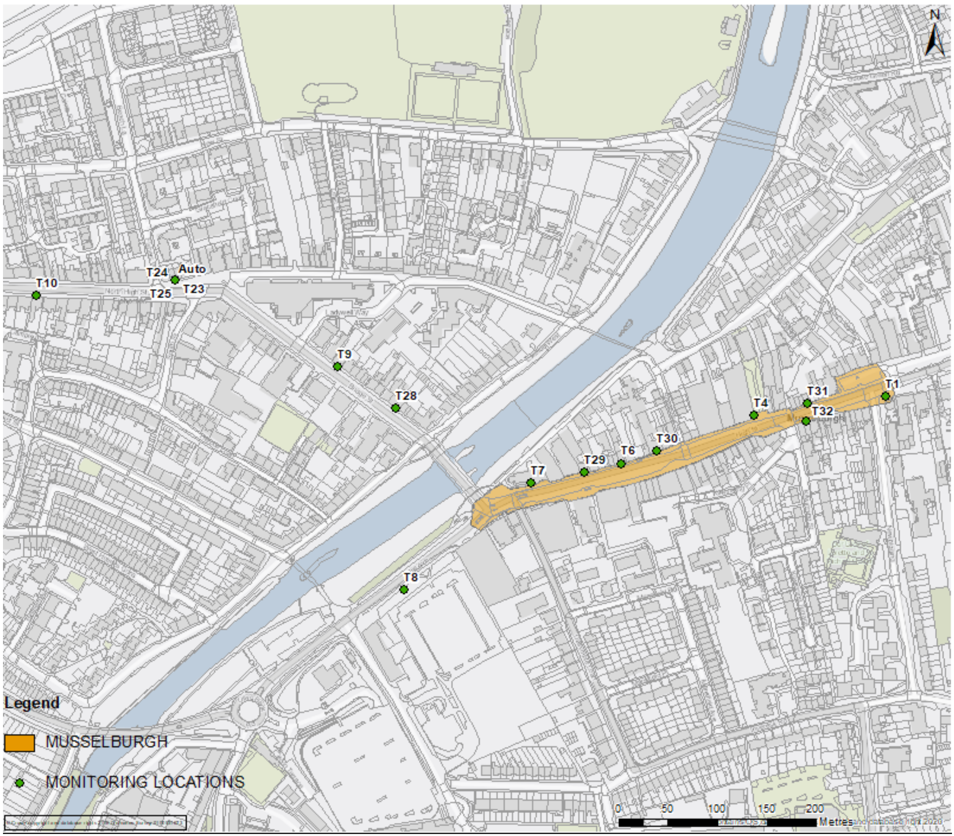
4.0 Monitoring Locations

The 2021 air quality Annual Progress Report (APR)[13] was published by East Lothian Council in January 2022. Full details of the QA/QC for all measurement data are provided in the latest APR. While annual mean concentrations measured during 2020 have been included these should be considered not representative of current air quality in the AQMA. These measurements have a degree of uncertainty as monitored during the pandemic when there were a number of Covid-19 Lockdown measures. Data capture during 2020 fell below the 75% requirements and therefore underwent annualization across all sites. Full details of this can be found in the 2021 Annual Progress Report. All LAQM reports published by East Lothian Council can be found at https://www.eastlothian.gov.uk/downloads/download/12756/air_quality_reports.

During 2019, nitrogen dioxide (NO_2) concentrations were measured using both automatic and diffusion tube monitoring techniques. East Lothian Council undertook automatic monitoring at 1 location and diffusion tube monitoring at 28 locations throughout the Council boundary.

17 of these monitoring locations are within the vicinity of the study area and are all roadside sites. All monitoring locations within the study area are presented in Figure 2.

Figure 2: Monitoring Locations



[13] Available at: https://www.eastlothian.gov.uk/downloads/download/12756/air_quality_reports

4.1 Monitoring Results

The automatic monitoring site on the High Street, Musselburgh has not shown any exceedance in annual mean NO_2 concentrations from 2015 to 2019, recording 20 µg/m^3 in 2019. The site uses a gas-phase chemiluminescence detection monitoring technique. Overall, concentrations have steadily declined since 2017.

In 2019, all diffusion tube monitoring locations measured annual mean NO_2 concentrations less than 40µg/m^3. The highest annual mean NO_2 concentrations in 2019 were recorded at roadside locations along the High Street (T6 and T31) with a concentration of 32 µg/m^3, which is below the AQO of 40µg/m^3. These sites are both located within the Musselburgh High Street AQMA and have both shown an overall decrease in NO_2 concentrations since 2015, this is shown in the trend graph in

The trend in annual mean concentrations from 2016 is presented in Chart 2 and clearly shows a downward trend from 2016.

Chart 2 No exceedances of the NO_2 annual mean have been measured since 2016.

It is important to note that there is a degree of uncertainty in diffusion tube monitoring data, largely due to the accuracy of results obtained which tend to be ±20% accurate.

Full details of the monitoring results located within the study area, ranging from 2016-2021 are provided in Table 4.1. The monitoring considered for model verification is discussed further in section 6.1.

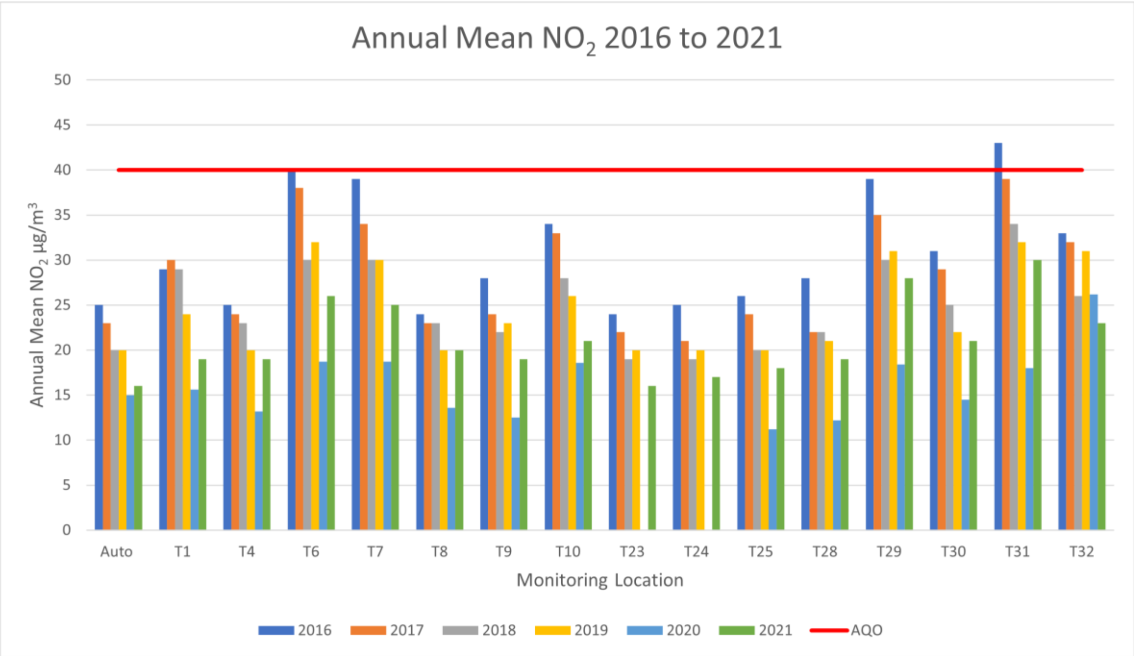
TABLE 4.1: NO_2 MONITORING RESULTS 2016-2021 (µg/m^3)

Site ID	Site Name	X	Y	In AQMA	2016	2017	2018	2019	2020	2021
Automatic Monitoring Locations										
NOx	Musselburgh North High Street	333941	672837	Yes	25	23	20	20	15	16
Non-automatic Monitoring Locations										
T1	Musselburgh - Jewbigging Junction	334659	672720	Yes	29	30	29	24	15.6	19
T4	Musselburgh - 87 High St	334526	672700	Yes	25	24	23	20	13.2	19
T6	Musselburgh - 147 High Street	334392	672652	Yes	40	38	30	32	18.7	26
T7	Musselburgh - 183 High St	334301	672632	No	39	34	30	30	18.7	25
T8	Musselburgh - Mall Av	334172	672524	No	24	23	23	20	13.6	20
T9	Musselburgh - 45 Bridge Street	334105	672750	No	28	24	22	23	12.5	19
T10	Musselburgh - 150 North High St	333800	672822	Yes	34	33	28	26	18.6	21

Site ID	Site Name	X	Y	In AQMA	2016	2017	2018	2019	2020	2021
T23	Musselburgh - Co-located 133 N High St	333941	672837	No	24	22	19	20	-	16
T24	Musselburgh - Co-located 133 N High St	333941	672837	No	25	21	19	20	-	17
T25	Musselburgh - Co-located 133 N High St	333941	672837	No	26	24	20	20	11.2	18
T28	Musselburgh - 15 Bridge Street	334164	672708	No	28	22	22	21	12.2	19
T29	Musselburgh - 167 High Street	334354	672643	Yes	39	35	30	31	18.4	28
T30	Musselburgh - 137 High Street	334427	672664	Yes	31	29	25	22	14.5	21
T31	Musselburgh - 69 High Street	334580	672713	Yes	43	39	34	32	18.0	30
T32	Musselburgh - 86 High Street	334578	672695	Yes	33	32	26	31	26.2	23

The trend in annual mean concentrations from 2016 is presented in Chart 2 and clearly shows a downward trend from 2016.

Chart 2: Trend Graph 2016 to 2021



5.0 Modelling Methodology

5.1 Modelling of Current Air Quality

Air quality concentrations have been modelled for a baseline year of 2019. The baseline model predicts NO_2 concentrations within the study area to determine the current air quality in Musselburgh.

5.2 Modelling of Future Air Quality

Consideration was also given to the proposed Edinburgh Low Emission Zone (LEZ). The proposed LEZ could impact on traffic movements through Musselburgh and therefore impact pollutant concentrations. The modelling of the proposed LEZ has involved consultation with SEPA and Edinburgh City Council on assumptions included within the modelling. The modelling of the LEZ has used the 2019 baseline model and applied a change in fleet composition to make all buses Euro VI.

5.3 Modelling Software

Annual mean concentrations of NO_2 during 2019 have been modelled within the study area using the atmospheric dispersion model ADMS Roads (version 5.0.0.1).

The model has been verified by comparison of the modelled predictions of road NOx with local monitoring results. The available roadside diffusion tube measurement within the study area (described in Section 4 above) were used to verify the annual mean road NOx model predictions.

Following initial comparison of the modelled concentrations with the available monitoring data, refinements were made to the model input to achieve the best possible agreement with the diffusion tube measurements. Further information on model verification is provided in Section 6.1 and Appendices

Appendix 1 – Model Verification.

A surface roughness of 1 m was used in the modelling to represent the urban conditions in the model domain. A limit for the Monin-Obukhov length of 30 m was applied to represent a large town.

The source-oriented grid option was used in ADMS-Roads, this option provides finer resolution of predicted pollutant concentrations along the roadside, with a wider grid being used to represent concentrations further away from the road, the resolution of which is dependent upon the total size of the domain being modelled. The predicted concentrations were interpolated to derive values between the grid points using the Spatial Analyst tool in the GIS software ArcMap 10.8.1. This allows contours showing the predicted spatial variation of pollutant concentrations to be produced and added to the digital base mapping.

It should be noted that any dispersion modelling study has a degree of uncertainty associated with it; all reasonable steps have been taken to reduce this where possible.

5.4 Treatment of modelled road NO_x contribution

It is necessary to convert the modelled road NOx concentrations to NO_2 for comparison with the relevant objectives.

The Defra NO_X/NO_2 Calculator was used to calculate NO_2 concentrations from the NO_X concentrations predicted by ADMS-Roads. The model requires input of the background NO_X, the modelled road contribution and accounts for the proportion of NOx released as primary NO_2. For the East Lothian Council area in 2019 with the “All other UK urban Traffic” option in the model, the NO_X/NO_2 model estimates that 28.9% of NO_X is emitted from local road vehicles as NO_2.

5.5 Validation of ADMS-Roads

Validation of the model is the process by which the model outputs are tested against monitoring results at a range of locations and the model is judged to be suitable for use in specific applications; this is usually conducted by the model developer.

CERC have carried out extensive validation of ADMS applications by comparing modelled results with standard field, laboratory and numerical data sets, participating in EU workshops on short range dispersion models, comparing data between UK M4 and M25 motorway field monitoring data, carrying out inter-comparison studies alongside other modelling solutions such as DMRB and CALINE4, and carrying out comparison studies with monitoring data collected in cities throughout the UK using the extensive number of studies carried out on behalf of local authorities and Defra.

5.6 Study Area

The study area comprises of sensitive receptors where the annual mean objective applies at many locations situated around Musselburgh. The study area including the roads modelled are presented in

Figure 3: Study Area

5.7 Receptor Locations

The model has been used to predict NO_2 annual mean concentrations at sensitive receptors within the study area. The receptors are located at the facade of buildings in the model domain where relevant exposure exists. The receptors have been modelled at 1.5 m to represent human exposure at the ground floor level and where appropriate 4m to represent human exposure at the first floor level. The locations of the selected receptors are presented in Table 5.1 and Figure 4.

TABLE 5.1: RECEPTOR LOCATIONS

Receptor ID	Type	Address	X	Y	Z
R1	Residential	9 New Street	333753	672971	1.5
R2	Residential	118 New Street	333794	672932	1.5
R3	Residential	5 Fishers Wynd	333930	672910	1.5
R4	Residential	138 North High Street	333829	672819	1.5

Receptor ID	Type	Address	X	Y	Z
R5	Residential	137 North High Street	333925	672848	1.5
R6	Residential	19 Millhill	334723	672985	1.5
R7	Residential	27 Linkfield Road	335189	672972	1.5
R8	Residential	3 Linkfield Road	335052	672991	1.5
R9	Residential	2 Balcarres Road	334794	673008	1.5
R10	School	2 Millhill	334719	672961	1.5
R11	Residential	Linkfield Road	335426	672961	1.5
R12	Residential	Linkfield Road	335359	672981	1.5
R13	Residential	8 James Street	334624	672940	1.5
R14	Residential	Linkfield Road	335512	672938	1.5
R15	Residential	27 Ashgrove Place	335498	672790	1.5
R16	Residential	5 Linkfield Road	334786	672795	1.5
R17	School	Linkfield Road	334911	672982	1.5
R18	School	Linkfield Road	334940	672873	1.5
R19	Residential	1 Kilwinning Street	334572	672681	1.5
R20	Residential	33 Kerr's Wynd	334594	672835	1.5
R21	Residential	124 High Street	334491	672664	1.5
R22	Residential	1 Shorthope Street	334452	672686	1.5
R23	Residential	91 Millhill	334495	672792	1.5
R24	Residential	New Street	334446	672966	1.5
R25	Residential	Eskside West	334238	672721	1.5
R26	Residential	163 North High Street	334345	672801	1.5
R27	Residential	New Street	334469	673008	1.5
R28	Residential	North High Street (Brunton Hall -	334215	672830	1.5
R29	Residential	1 New Street	334202	672967	1.5
R30	Residential	26 Bridge Street	334167	672681	1.5
R31	Residential	7 Links Street	334110	672891	1.5
R32	Residential	49 North High Street	334144	672845	1.5
R33	Residential	29 Eskside West	334121	672623	1.5
R34	School	17 Bridge Street	334155	672715	1.5
R35	Residential	1 Downie Place	334139	672956	1.5
R36	Residential	8 Hercus Loan	334084	672611	1.5
R37	Residential	22 Bridge Street	334029	672784	1.5
R38	Residential	Ladywell Way	334080	672801	1.5
R39	Residential	28 New Street	334051	672970	1.5
R40	Residential	93 North High Street	334050	672852	1.5
R41	Residential	76 New Street	333979	672970	1.5
R42	Residential	2 Links View	334012	673014	1.5
R43	Residential	47 Eskside West	334020	672539	1.5
R44	Residential	Lochend Road South	333697	672789	1.5
R45	Residential	10 New Street	333688	672954	1.5
R46	Residential	11 New Street	333671	672920	1.5
R47	Residential	51 Eskview Road	333667	672447	1.5
R48	Residential	202 New Street	333601	672922	1.5
R49	Residential	184 Market Street	333535	672805	1.5
R50	Residential	271 North High Street	333523	672844	1.5
R51	Residential	Harbour Road	333469	672900	1.5
R52	Residential	Edinburgh Road	333426	672826	1.5
R53	Residential	12 Newhailes Crescent	333337	672673	1.5
R54	Residential	Stoneyhill Drive	333269	672512	1.5

Receptor ID	Type	Address	X	Y	Z
R55	Residential	58 Campie Lane	333791	672724	1.5
R56	Residential	14 Campie Road	333794	672652	1.5
R57	Residential	12 Market Street	333921	672613	1.5
R58	Residential	3 Mall Avenue	334140	672490	1.5
R59	Residential	12 Mansfield Road	334363	672497	1.5
R60	Residential	1 Mansfield Place	334390	672434	1.5
R61	Residential	139 Inveresk Road	334603	672409	1.5
R62	Residential	8 Dalrymple Loan	334335	672475	1.5
R63	Residential	99 Dalrymple Loan	334327	672542	1.5
R64	Residential	99 Mansfield Avenue	334476	672401	1.5
R65	Residential	93 Inveresk Road	334423	672357	1.5
R66	Residential	96 Inveresk Road	334386	672317	1.5
R67	Residential	58 Inveresk Road	334244	672302	1.5
R68	Residential	1 Grove Street	334959	672426	1.5
R69	Residential	30 Rothesay Place	334859	672389	1.5
R70	Residential	2 Wanless Court	334793	672436	1.5
R71	Residential	Inveresk Village Road	334748	672009	1.5
R72	Residential	Inveresk Village Road	334808	671977	1.5
R73	Residential	6 King Street	334737	672445	1.5
R74	Residential	54 Newbigging	334644	672390	1.5
R75	Residential	42 Newbigging	334702	672423	1.5
R76	Residential	9 Newbigging	334647	672677	1.5
R77	Residential	107 Newbigging	334623	672337	1.5
R78	Residential	The Inveresk Estate	334656	672046	1.5
R79	Residential	45 Maitland Park Road	333117	672925	1.5
R80	Residential	6 Edinburgh Road	333177	672968	1.5
R81	Residential	56 Edinburgh Road	332976	673036	1.5
R82	Residential	62 Pinkie Road	335582	672585	1.5
R83	Residential	64 Pinkie Road	335492	672587	1.5
R84	Residential	92 Ashgrove	335468	672626	1.5
R85	Residential	8 Ashgrove View	335481	672646	1.5
R86	Residential	11 Windsor Park Terrace	335477	672729	1.5
R87	Residential	12 Pinkie Terrace	335456	672511	1.5
R88	Residential	2 Park Grove Place	335302	672483	1.5
R89	Residential	44 The Grove	335250	672492	1.5
R90	School	Pinkie Road	335231	672560	1.5
R91	Residential	5 Park Court	335086	672452	1.5
R92	Residential	Eskmills Road	333996	672308	1.5
R93	Residential	1 Eskview Road	333787	672356	1.5
R94	Residential	Campie Road	333815	672404	1.5
R95	Residential	24 Eskview Terrace	333761	672234	1.5
R96	Residential	2 Eskview Crescent	333682	672135	1.5
R97	Residential	2 Craighall Terrace	335578	672900	1.5
R98	Residential	2 Pittencrieff Court	335642	672909	1.5
R99	Residential	4 Beach Lane	333875	672988	1.5

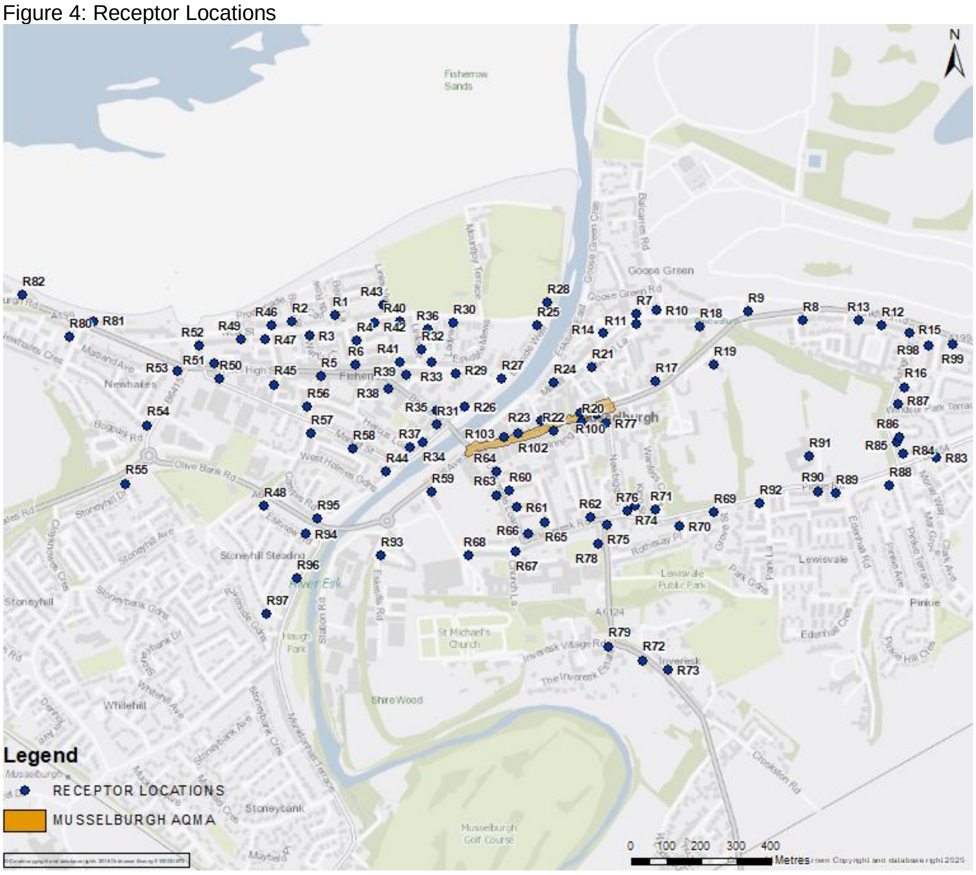
Additional receptors were also added to the model domain to further identify and determine the pollutant concentrations within the Musselburgh High Street AQMA. These receptors have been modelled at 4.0 m to represent human exposure at the first-floor level on the High Street.

Receptors R101, 102 and 103 have been chosen as their locations are within the current AQMA. These additional receptors are found below in Table 5.2.

TABLE 5.2: ADDITIONAL RECEPTORS ON HIGH STREET

Receptor ID	Type	Address	X	Y	Z
R100	Residential	68 HIGH STREET	334618	672705	4.0
R101	Residential	77 HIGH STREET	334570	672709	4.0
R102	Residential	143 HIGH STREET	334391	672652	4.0
R103	Residential	167 HIGH STREET	334353	672642	4.0

Figure 4: Receptor Locations



6.0 Current Air Quality

6.1 Verification of Model

Model verification is the comparison of modelled results with available local monitoring data. This identifies how well the model is performing. LAQM.TG (16) recommends making the adjustment to the road contribution of the pollutant only. The model is refined as part of the verification process to reduce uncertainties within the modelling.

The modelling results were verified against modelling locations: Automatic monitoring site (NOx), T1, T4, T6, T7, T8, T9, T10, T28, T29, T30, T31 and T32.

Following refinements to the model, the model verification process identified that an adjustment factor was required to bring the modelled concentrations in line with measured. An adjustment factor of 1.1618 was calculated and applied to the Road NOx for all modelled concentrations. Following adjustment, the adjusted road NO_x was then input into the Defra NO_x to NO_2 calculator. Full details of the model adjustment process are outlined in Table 6.1 and Table 6.2 below.

Model uncertainty can be estimated by calculating the root mean square error (RMSE). The RSME was 2.71 µg/m^3. This is well within the ideal model performance of 25 % ie an RMSE of 4 µg/m^3.

Verifying modelling data with diffusion tube data will always be subject to uncertainty due to the limitations in diffusion tube monitoring data, even automatic data has some uncertainties. The model results should be considered in this context. Further information on the verification process including the linear regression analysis is available in the Appendices. Appendix 1.

TABLE 6.1: PRE-ADJUSTMENT MODELLED VS MEASURED NO_2 CONCENTRATIONS 2019

Measuring Location	Measured (µg/m^3)	Modelled (µg/m^3)
NOx	20	16.8
T1	24	20.6
T4	20	19.7
T6	32	28.6
T7	30	23.1
T8	20	15.9
T9	23	18.5
T10	26	21.1
T28	21	18.7
T29	31	27.7
T30	22	23.7
T31	32	31.1
T32	31	31.4

TABLE 6.2: POST-ADJUSTMENT MODELLED VS MEASURES NO_2 CONCENTRATIONS 2019

Measuring Location	Measured (µg/m^3)	Modelled (µg/m^3)
NOx	20.0	17.9
T1	24.0	22.3

Measuring Location	Measured (µg/m^3)	Modelled (µg/m^3)
T4	20.0	21.3
T6	32.0	31.4
T7	30.0	25.2
T8	20.0	17.0
T9	23.0	19.9
T10	26.0	22.8
T28	21.0	20.2
T29	31.0	30.4
T30	22.0	25.9
T31	32.0	34.2
T32	31.0	34.6

6.2 Modelled Concentrations

Adjusted NO_2 annual mean concentrations at the specified receptors are presented within this section.

The annual mean concentrations for NO_2 were not predicted in excess of the annual mean objective at any location indicating that the requirement for the AQMA was no longer valid.

The highest receptor concentration for NO_2 was predicted at Receptor 101 (34.5 µg/m^3) at 77 High Street. Full receptor results can be found in Table 6.3 below.

TABLE 6.3: BASELINE MODELLED ANNUAL MEAN CONCENTRATIONS µg/m^3 FOR NO_2 AT SENSITIVE RECEPTORS 2019

Receptor	Address	NO_2 Annual Mean (µg/m^3)
R1	9 New Street	11.3
R2	118 New Street	11.6
R3	5 Fishers Wynd	11.9
R4	138 North High Street	16.0
R5	137 North High Street	15.9
R6	19 Millhill	11.8
R7	27 Linkfield Road	11.7
R8	3 Linkfield Road	16.7
R9	2 Balcarres Road	9.8
R10	2 Millhill	8.6
R11	Linkfield Road	11.3
R12	Linkfield Road	11.0
R13	8 James Street	10.1
R14	Linkfield Road	11.4
R15	27 Ashgrove Place	9.2
R16	5 Linkfield Road	15.4
R17	Linkfield Road	11.7
R18	Linkfield Road	12.2
R19	1 Kilwinning Street	17.2
R20	33 Kerr's Wynd	11.7
R21	124 High Street	19.5
R22	1 Shorthope Street	18.9
R23	91 Millhill	12.3

Receptor	Address	NO_2 Annual Mean ($\mu g/m^3$)
R24	New Street	10.1
R25	Eskside West	12.4
R26	163 North High Street	11.1
R27	New Street	9.5
R28	North High Street (Brunton Hall - Eskside West)	8.9
R29	1 New Street	10.1
R30	26 Bridge Street	15.9
R31	7 Links Street	10.8
R32	49 North High Street	11.3
R33	29 Eskside West	12.3
R34	17 Bridge Street	20.6
R35	1 Downie Place	10.2
R36	8 Hercus Loan	11.6
R37	22 Bridge Street	13.8
R38	Ladywell Way	13.9
R39	28 New Street	10.3
R40	93 North High Street	11.7
R41	76 New Street	10.8
R42	2 Links View	10.5
R43	47 Eskside West	9.5
R44	Lochend Road South	12.2
R45	10 New Street	11.6
R46	11 New Street	11.9
R47	51 Eskview Road	11.3
R48	202 New Street	12.0
R49	184 Market Street	13.8
R50	271 North High Street	22.7
R51	Harbour Road	13.9
R52	Edinburgh Road	21.0
R53	12 Newhailes Crescent	14.4
R54	Stoneyhill Drive	11.4
R55	58 Campie Lane	11.8
R56	14 Campie Road	11.4
R57	12 Market Street	10.9
R58	3 Mall Avenue	15.7
R59	12 Mansfield Road	12.5
R60	1 Mansfield Place	12.1
R61	139 Inveresk Road	15.6
R62	8 Dalrymple Loan	12.1
R63	99 Dalrymple Loan	16.3
R64	99 Mansfield Avenue	11.3
R65	93 Inveresk Road	14.0
R66	96 Inveresk Road	10.3
R67	58 Inveresk Road	11.0
R68	1 Grove Street	12.0
R69	30 Rothesay Place	10.9
R70	2 Wanless Court	13.0
R71	Inveresk Village Road	11.7
R72	Inveresk Village Road	11.7
R73	6 King Street	11.9

Receptor	Address	NO_2 Annual Mean (µg/m³)
R74	54 Newbigging	17.5
R75	42 Newbigging	21.1
R76	9 Newbigging	18.0
R77	107 Newbigging	11.4
R78	The Inveresk Estate	10.7
R79	45 Maitland Park Road	11.1
R80	6 Edinburgh Road	16.6
R81	56 Edinburgh Road	21.8
R82	62 Pinkie Road	13.9
R83	64 Pinkie Road	11.2
R84	92 Ashgrove	9.8
R85	8 Ashgrove View	9.5
R86	11 Windsor Park Terrace	9.3
R87	12 Pinkie Terrace	9.8
R88	2 Park Grove Place	10.2
R89	44 The Grove	11.7
R90	Pinkie Road	9.8
R91	5 Park Court	10.6
R92	Eskmills Road	9.5
R93	1 Eskview Road	12.1
R94	Campie Road	16.5
R95	24 Eskview Terrace	15.2
R96	2 Eskview Crescent	10.7
R97	2 Craighall Terrace	11.0
R98	2 Pittencrieff Court	11.1
R99	4 Beach Lane	9.6
R100	68 High Street	17.7
R101	77 High Street	34.5
R102	143 High Street	24.1
R103	167 High Street	24.1

6.3 Annual Mean NO_2 Contour Plot

The contour plot for annual mean NO_2 concentrations in 2019 for the modelled study area is presented in Figure 5.

The contour plot has shown that while there are locations within the High Street, the current AQMA, where the annual mean is greater than 40 µg/m³ these are within the centre of the road and not at the facade of sensitive receptors. Sensitive receptors within High Street are also mainly located at 1st floor height.

Figure 5 Modelled Annual mean NO_2 concentrations (µg/m^3)

7.0 Future Assessment

It is important when considering the revocation of an AQMA that due consideration is given to the potential air quality changes over the next 3 to 5 years. To better understand the potential changes in air quality this chapter discusses:

- Met Sensitivity
- The potential impact from the City of Edinburgh LEZ in 2023
- The LDP and estimated traffic growth

7.1 Met Sensitivity

Pollutant concentrations may vary significantly from one year to the next, due to the influence of meteorological conditions, and it is important that authorities avoid cycling between declaring, revoking and declaring again, due simply to these variations. Therefore, East Lothian Council have considered the potential effects on pollutant concentrations under 5 years of meteorological conditions. This should provide certainty that any future exceedances (that might occur in more adverse meteorological conditions are unlikely. This sensitivity analysis will show how sensitive the area is to the effects of the meteorological conditions.

The MET sensitivity results from 2015 to 2019 for NO_2 can be found in Appendix 2 – MET Sensitivity.

The results show that 2019 was identified as having the highest annual mean concentration for the largest proportion of receptors. There was only a slight variation is concentrations across the 5 year period.

As 2019 has the highest concentration for most receptors, it also proves that the model is predicting for a worst-case scenario. For the remaining years where 2019 does not have the highest concentration, the largest percentage increase in concentration is less than 1%

Therefore, we can be confident that the effects of meteorological conditions on this area is negligible and therefore unlikely to result in a breach of the annual mean objective in the future.

7.2 City of Edinburgh LEZ

The City of Edinburgh Council (CEC)will be introducing an LEZ that will be operational from 2023. The 1st phase of this will be to introduce the requirement for buses to be equivalent to Euro 6 or better to allow them to enter the LEZ. Both SEPA and CEC confirmed that the dispersion modelling undertaken for this LEZ had shown that buses travelling through the AQMA would all be travelling to and from CEC and through the LEZ so it was safe to assume that in 2023 all buses in Musselburgh will also be Euro 6.

Therefore, the assessment of the impact of the LEZ has been considered as a dispersion modelling scenario. Due to the uncertainties following the pandemic its unknown what traffic volume will be in 2023. therefore, as worst case this future assessment has considered the impact of the LEZ on the 2019 baseline study.

The results of this future assessment scenario have shown that annual mean concentrations for NO_2 would not be predicted to be in excess of their annual mean objective at any locations within the study area.

The highest annual mean concentration for NO_2 was predicted to occur at Receptor 101 (27.6 µg/m^3) located at 77 High Street. Full receptor results can be found in Table 7.1 below.

TABLE 7.1: LEZ MODELLED ANNUAL MEAN CONCENTRATIONS FOR NO_2 µg/m^3 AT SENSITIVE RECEPTORS 2019

Receptor	Address	NO_2 Annual Mean (µg/m)^3	Reduction in Concentrations Due To LEZ
R1	9 New Street	10.8	0.5
R2	118 New Street	11.1	0.5
R3	5 Fishers Wynd	11.6	0.3
R4	138 North High Street	14.4	1.6
R5	137 North High Street	14.6	1.3
R6	19 Millhill	11.6	0.2
R7	27 Linkfield Road	11.3	0.4
R8	3 Linkfield Road	16.1	0.6
R9	2 Balcarres Road	9.9	0.1
R10	2 Millhill	8.3	0.3
R11	Linkfield Road	11.2	0.1
R12	Linkfield Road	10.8	0.2
R13	8 James Street	9.5	0.6
R14	Linkfield Road	11.2	0.2
R15	27 Ashgrove Place	9.1	0.1
R16	5 Linkfield Road	14.7	0.7
R17	Linkfield Road	11.5	0.2
R18	Linkfield Road	12.0	0.2
R19	1 Kilwinning Street	15.3	1.9
R20	33 Kerr's Wynd	11.3	0.4
R21	124 High Street	16.4	3.1
R22	1 Shorthope Street	16.2	2.7
R23	91 Millhill	11.8	0.5
R24	New Street	9.6	0.5
R25	Eskside West	11.9	0.5
R26	163 North High Street	10.7	0.4
R27	New Street	9.6	0.1
R28	North High Street (Brunton Hall - Eskside West)	8.7	0.2
R29	1 New Street	9.9	0.2
R30	26 Bridge Street	14.2	1.7
R31	7 Links Street	10.8	0
R32	49 North High Street	11.2	0.1
R33	29 Eskside West	11.9	0.4
R34	17 Bridge Street	17.3	3.3
R35	1 Downie Place	10.0	0.2
R36	8 Hercus Loan	11.3	0.3
R37	22 Bridge Street	12.9	0.9
R38	Ladywell Way	13.3	0.6

Receptor	Address	NO_2 Annual Mean (µg/m)[3]	Reduction in Concentrations Due To LEZ
R39	28 New Street	10.1	0.2
R40	93 North High Street	11.3	0.4
R41	76 New Street	10.4	0.4
R42	2 Links View	10.6	0.1
R43	47 Eskside West	9.3	0.2
R44	Lochend Road South	11.8	0.4
R45	10 New Street	11.1	0.5
R46	11 New Street	11.2	0.7
R47	51 Eskview Road	11.1	0.2
R48	202 New Street	11.3	0.7
R49	184 Market Street	13.0	0.8
R50	271 North High Street	19.0	3.7
R51	Harbour Road	13.0	0.9
R52	Edinburgh Road	18.6	2.4
R53	12 Newhailes Crescent	13.9	0.5
R54	Stoneyhill Drive	11.2	0.2
R55	58 Campie Lane	11.7	0.1
R56	14 Campie Road	11.3	0.1
R57	12 Market Street	10.8	0.1
R58	3 Mall Avenue	14.7	1
R59	12 Mansfield Road	11.9	0.6
R60	1 Mansfield Place	11.7	0.4
R61	139 Inveresk Road	14.9	0.7
R62	8 Dalrymple Loan	11.6	0.5
R63	99 Dalrymple Loan	15.3	1
R64	99 Mansfield Avenue	11.1	0.2
R65	93 Inveresk Road	13.7	0.3
R66	96 Inveresk Road	10.2	0.1
R67	58 Inveresk Road	10.6	0.4
R68	1 Grove Street	11.3	0.7
R69	30 Rothesay Place	10.5	0.4
R70	2 Wanless Court	12.1	0.9
R71	Inveresk Village Road	11.5	0.2
R72	Inveresk Village Road	11.6	0.1
R73	6 King Street	10.7	1.2
R74	54 Newbigging	15.8	1.7
R75	42 Newbigging	17.2	3.9
R76	9 Newbigging	14.3	3.7
R77	107 Newbigging	11.0	0.4
R78	The Inveresk Estate	10.6	0.1
R79	45 Maitland Park Road	10.7	0.4
R80	6 Edinburgh Road	15.1	1.5
R81	56 Edinburgh Road	19.1	2.7
R82	62 Pinkie Road	12.8	1.1
R83	64 Pinkie Road	10.5	0.7
R84	92 Ashgrove	9.7	0.1
R85	8 Ashgrove View	9.4	0.1
R86	11 Windsor Park Terrace	9.3	0
R87	12 Pinkie Terrace	9.5	0.3

Receptor	Address	NO_2 Annual Mean (µg/m)[3]	Reduction in Concentrations Due To LEZ
R88	2 Park Grove Place	9.7	0.5
R89	44 The Grove	10.6	1.1
R90	Pinkie Road	9.4	0.4
R91	5 Park Court	10.1	0.5
R92	Eskmills Road	9.5	0
R93	1 Eskview Road	11.9	0.2
R94	Campie Road	15.6	0.9
R95	24 Eskview Terrace	14.5	0.7
R96	2 Eskview Crescent	10.5	0.2
R97	2 Craighall Terrace	10.9	0.1
R98	2 Pittencrieff Court	10.8	0.3
R99	4 Beach Lane	9.4	0.2
R100	68 High Street	15.3	2.4
R101	77 High Street	27.6	6.9
R102	143 High Street	19.4	4.7
R103	167 High Street	19.6	4.5

Therefore, the introduction of the LEZ would result in further improvements in air quality within the AQMA, and there would be no risk of the annual mean NO_2 objective being breached.

7.3 LDP and Traffic Growth

The Local Development Plan could result in a large change in traffic flow through the AQMA over its lifetime. Unfortunately, at the time of preparing the Detailed Assessment a full traffic model of the LDP had not been undertaken. Therefore, to aid East Lothian in managing the potential impact that these new and additional traffic flows could have some high-level calculations have been completed to determine the change in traffic flow required to result in an exceedance of the annual men NO_2 objective in the future.

This analysis showed that assuming buses remain at Euro 6 or better the traffic flow would need to increase by 13,800 vehicles to result in an exceedance of the objective, assuming the same mix as we have in 2019 and as a worst case with 2019 emissions profile.

As the flow in 2019 was approximately 17,000 vehicles an increase to a total flow of 30,000 vehicles could result in air quality concentrations increasing to levels close to or greater than 40 µg/m3. While this information is indicative it does highlight that a substantial increase in traffic flow would be required before there would be an exceedance of the air quality objective.

Having this information will allow the Council to monitor planning applications for changes in traffic flows within Musselburgh to check that a total flow of over 30,000 vehicles isn't exceeded.

The Transport Department of the Council have reviewed these projections. They have advised that an increase of this magnitude would render the network inoperable as it is already at 80% saturation. With future requirements to support a 20% reduction in journey lengths. They have also confirmed that Local Development Plan 1 and 2 are unlikely to generate this level of increase to traffic movements through Musselburgh High Street

8.0 Conclusions and Recommendations

Sweco UK Ltd was commissioned by East Lothian Council to prepare a Detailed Assessment to determine if the requirement for the Musselburgh AQMA remains valid or if it could be revoked.

The Musselburgh AQMA was declared in 2012 for exceedances of the annual mean NO_2 objective. Previous studies have shown that the predominant source of NO_2 was road traffic emissions.

A review of the monitoring data has shown that there is a downward trend in both background concentrations as well as measured concentrations within the AQMA.

A dispersion modelling study of road traffic emissions in Musselburgh, East Lothian has been conducted to determine the spatial extent of annual mean NO_2 concentrations. This has concluded that there are currently no locations within the study area that has an exceedance of the annual mean NO_2 objective. The highest concentrations remain within the current AQMA boundary but are now significantly below the 40µg/m^3 limit value.

In order to revoke the AQMA it is essential to have confidence in that measured NO_2 concentrations will not rise above the objective level again in coming years. Whilst this can never be determined with 100% certainty, local monitoring has shown that the annual mean concentration for NO_2 has stayed well below exceedance since 2016. The modelling has also predicted that the annual mean concentrations are to remain below exceedance levels in both the assessment or current air quality and future years where the Edinburgh LEZ will be in place. The LEZ will reduce concentration in the High Street by possibly as much as 7 µg/m^3.

It is, therefore, concluded that it is considered unlikely that the NAQS annual mean NO_2 objective will be exceeded in future years, thus the AQMA can be revoked. It is recommended that the Council gives consideration to doing so under Section 83 (2) of the Environment Act 1995.

As the monitoring has shown the current locations are in the hot spot locations it is recommended that the Council continue to monitor annual mean NO_2 in these locations as a precaution.

Figures

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4

Appendices

Appendix 1 – Model Verification

Verification is the process of comparing modelled results with the available local monitoring data. This identifies how accurate the modelled results are in comparison to monitored results and provides a clearer indication on how well the model is preforming. The process includes checking and refining model input data to better align modelled results with monitored results. Modelled results can be adjusted in accordance with LAQM TG(16) guidance.

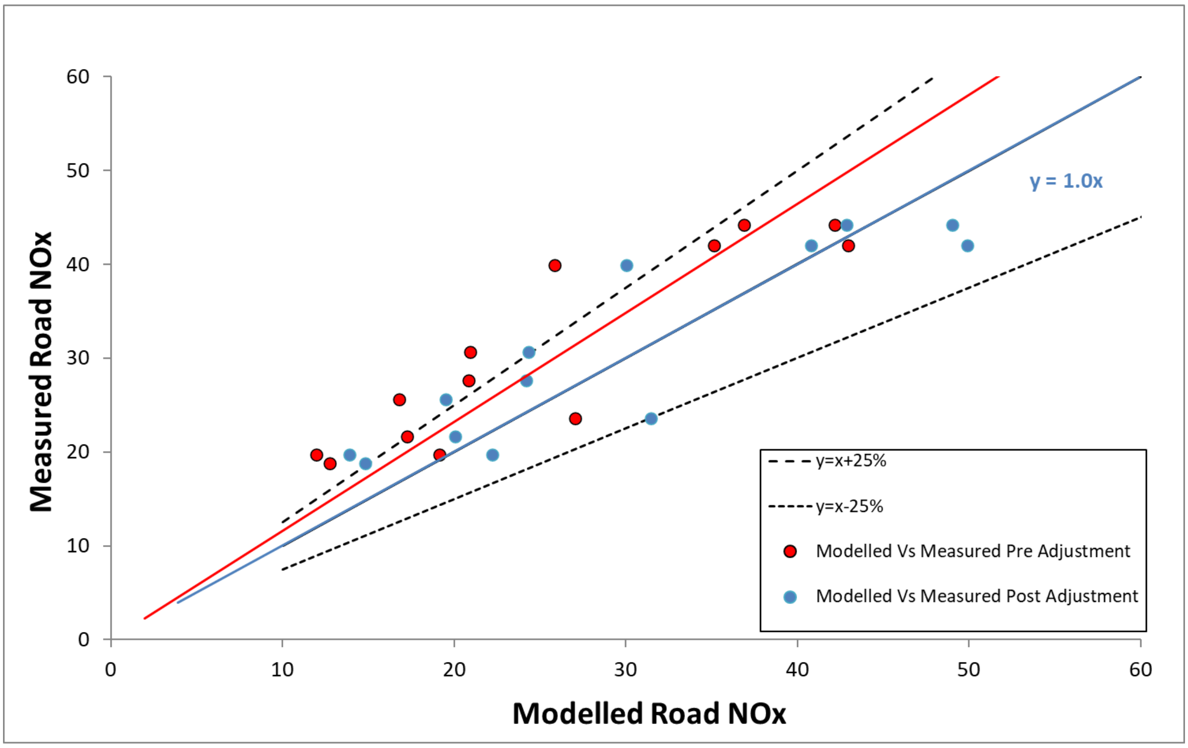
The model was verified using annual mean NO_2 measurements from automatic and diffusion tube monitoring sites located throughout the study area.

As stated in Chapter 6, the model was verified using annual mean NO_2 measurements from automatic and diffusion tube locations along the modelled road network.

Following refinements of the model, the modelled road contribution did not require an adjustment factor (1.1618) to bring the predicted NO_2 concentrations in line with the measured concentrations at diffusion tube locations mentioned above.

Linear regression determines the line of best fit for the modelled NO_x against monitored NO_x. the gradient of the best line of fit is then used as the adjustment factor. A linear regression plot comparing modelled and monitored Road NO_x concentrations before and after adjustment is presented in Figure A.1.

Figure A. 1 - Linear regression plot of modelled vs monitored NOx



The Root Mean Square Error (RMSE) is used to determine average error or uncertainty of the model. The units of RMSE are the same as the quantity being compared. If the RMSE value is higher than ±25% of the objective being assessed, then model inputs and verification should be reassessed for improvement. The RMSE for this study was 2.71 µg/m^3 after adjustment, which is in line with LAQM TG(16) guidelines (10% of the objective being assessed).

Appendix 2 – MET Sensitivity Results

TABLE A2.1: MET SENSITIVITY – NO_2

Receptor	Annual Mean Concentration (µg/m³)					Range + Standard Deviation	% Change from average
	2015	2016	2017	2018	2019		
R1	11.1	11.1	11.1	11.1	11.1	11.1 - 11.1 ± 0.03	0.00%
R2	11.3	11.4	11.3	11.3	11.4	11.3 - 11.4 ± 0.03	0.00%
R3	11.6	11.7	11.6	11.7	11.7	11.6 - 11.7 ± 0.05	0.00%
R4	11.9	12.0	11.9	12.0	12.0	11.9 - 12 ± 0.05	0.00%
R5	13.3	14.1	13.3	13.3	14.2	13.3 - 14.2 ± 0.45	0.00%
R6	15.6	16.0	15.7	15.7	16.0	15.6 - 16 ± 0.16	0.00%
R7	11.1	11.3	11.1	11.2	11.3	11.1 - 11.3 ± 0.08	0.09%
R8	10.6	10.9	10.7	10.7	11.0	10.6 - 11 ± 0.19	0.00%
R9	13.7	14.0	13.7	13.7	14.0	13.7 - 14 ± 0.17	0.07%
R10	9.1	9.3	9.1	9.1	9.2	9.1 - 9.3 ± 0.09	0.22%
R11	10.9	11.1	10.9	11.0	11.1	10.9 - 11.1 ± 0.08	0.00%
R12	10.3	10.7	10.3	10.4	10.7	10.3 - 10.7 ± 0.21	0.00%
R13	10.3	10.7	10.3	10.4	10.8	10.3 - 10.8 ± 0.22	0.00%
R14	11.2	11.3	11.2	11.2	11.3	11.2 - 11.3 ± 0.09	0.09%
R15	10.3	10.7	10.3	10.3	10.8	10.3 - 10.8 ± 0.24	0.00%
R16	9.3	9.4	9.3	9.4	9.4	9.3 - 9.4 ± 0.04	0.00%
R17	14.9	15.4	14.9	14.9	15.4	14.9 - 15.4 ± 0.29	0.00%
R18	11.3	11.6	11.3	11.4	11.6	11.3 - 11.6 ± 0.14	0.17%
R19	11.0	11.2	11.2	11.2	11.3	11 - 11.3 ± 0.09	0.00%
R20	16.3	17.3	16.5	16.6	17.6	16.3 - 17.6 ± 0.55	0.00%
R21	11.5	11.7	11.6	11.6	11.7	11.5 - 11.7 ± 0.08	0.00%
R22	15.7	16.7	15.9	16.0	17.0	15.7 - 17 ± 0.55	0.00%
R23	18.0	18.8	18.1	18.1	18.7	18 - 18.8 ± 0.37	0.21%
R24	11.9	12.1	11.9	11.9	12.1	11.9 - 12.1 ± 0.11	0.08%
R25	10.3	10.4	10.3	10.4	10.4	10.3 - 10.4 ± 0.03	0.00%
R26	12.3	12.6	12.4	12.4	12.6	12.3 - 12.6 ± 0.11	0.08%
R27	11.2	11.3	11.2	11.2	11.3	11.2 - 11.3 ± 0.07	0.09%
R28	8.2	8.2	8.2	8.2	8.2	8.2 - 8.2 ± 0.03	0.00%
R29	11.1	11.2	11.1	11.2	11.2	11.1 - 11.2 ± 0.06	0.00%
R30	10.4	10.4	10.4	10.4	10.5	10.4 - 10.5 ± 0.03	0.00%
R31	13.2	14.2	13.0	13.0	14.1	13 - 14.2 ± 0.6	0.64%
R32	11.0	11.1	11.0	11.1	11.1	11 - 11.1 ± 0.04	0.00%
R33	11.2	11.3	11.3	11.3	11.3	11.2 - 11.3 ± 0.05	0.00%
R34	11.8	12.3	11.6	11.7	12.2	11.6 - 12.3 ± 0.3	0.57%
R35	17.4	17.9	17.6	17.6	17.9	17.4 - 17.9 ± 0.19	0.00%
R36	10.5	10.6	10.5	10.6	10.6	10.5 - 10.6 ± 0.03	0.00%
R37	11.4	11.8	11.3	11.4	11.8	11.3 - 11.8 ± 0.24	0.60%
R38	12.0	12.7	11.9	11.9	12.7	11.9 - 12.7 ± 0.42	0.32%

Receptor	Annual Mean Concentration (µg/m³)					Range + Standard Deviation	% Change from average
	2015	2016	2017	2018	2019		
R39	12.5	12.6	12.5	12.6	12.7	12.5 - 12.7 ± 0.08	0.00%
R40	10.6	10.6	10.6	10.6	10.7	10.6 - 10.7 ± 0.04	0.00%
R41	11.8	12.0	11.9	11.9	12.0	11.8 - 12 ± 0.07	0.00%
R42	11.2	11.3	11.3	11.3	11.4	11.2 - 11.4 ± 0.05	0.00%
R43	8.5	8.5	8.5	8.5	8.5	8.5 - 8.5 ± 0.03	0.00%
R44	11.0	11.3	10.9	10.9	11.3	10.9 - 11.3 ± 0.2	0.35%
R45	12.0	12.5	12.0	12.0	12.5	12 - 12.5 ± 0.28	0.00%
R46	11.5	11.6	11.5	11.5	11.6	11.5 - 11.6 ± 0.04	0.00%
R47	11.9	12.0	11.9	11.9	12.0	11.9 - 12 ± 0.06	0.00%
R48	11.0	11.4	10.9	10.9	11.3	10.9 - 11.4 ± 0.22	0.35%
R49	12.0	12.1	12.1	12.1	12.2	12 - 12.2 ± 0.05	0.00%
R50	13.2	13.9	13.3	13.3	13.9	13.2 - 13.9 ± 0.35	0.00%
R51	17.9	18.4	18.0	18.1	18.4	17.9 - 18.4 ± 0.23	0.00%
R52	13.3	13.6	13.4	13.4	13.6	13.3 - 13.6 ± 0.11	0.00%
R53	16.3	18.0	15.9	15.9	17.9	15.9 - 18 ± 1.06	0.67%
R54	12.5	13.1	12.3	12.3	13.0	12.3 - 13.1 ± 0.39	0.46%
R55	11.1	11.4	11.1	11.1	11.4	11.1 - 11.4 ± 0.17	0.00%
R56	11.5	11.7	11.4	11.5	11.7	11.4 - 11.7 ± 0.14	0.17%
R57	11.0	11.3	11.0	11.1	11.2	11 - 11.3 ± 0.11	0.09%
R58	10.9	11.2	10.9	10.9	11.1	10.9 - 11.2 ± 0.14	0.36%
R59	13.3	13.7	13.5	13.5	13.9	13.3 - 13.9 ± 0.26	0.00%
R60	12.2	12.5	12.3	12.3	12.5	12.2 - 12.5 ± 0.14	0.00%
R61	11.8	12.1	11.9	11.9	12.1	11.8 - 12.1 ± 0.12	0.00%
R62	13.6	14.1	13.5	13.5	14.0	13.5 - 14.1 ± 0.29	0.43%
R63	11.4	11.9	11.3	11.4	11.9	11.3 - 11.9 ± 0.3	0.00%
R64	14.5	15.0	14.7	14.8	15.1	14.5 - 15.1 ± 0.25	0.00%
R65	11.3	11.6	11.3	11.3	11.5	11.3 - 11.6 ± 0.15	0.09%
R66	12.5	12.9	12.5	12.6	12.9	12.5 - 12.9 ± 0.21	0.15%
R67	10.2	10.5	10.2	10.2	10.5	10.2 - 10.5 ± 0.16	0.00%
R68	10.6	10.8	10.7	10.7	10.8	10.6 - 10.8 ± 0.09	0.00%
R69	12.1	12.6	12.2	12.2	12.7	12.1 - 12.7 ± 0.27	0.00%
R70	10.7	11.0	10.8	10.8	11.1	10.7 - 11.1 ± 0.15	0.00%
R71	12.9	13.1	12.9	13.0	13.2	12.9 - 13.2 ± 0.13	0.00%
R72	10.5	10.8	10.4	10.5	10.8	10.4 - 10.8 ± 0.2	0.00%
R73	9.3	9.4	9.4	9.5	9.5	9.3 - 9.5 ± 0.05	0.11%
R74	13.2	13.5	13.3	13.4	13.5	13.2 - 13.5 ± 0.12	0.00%
R75	15.6	16.4	15.8	15.9	16.6	15.6 - 16.6 ± 0.43	0.00%
R76	17.0	17.4	17.2	17.2	17.5	17 - 17.5 ± 0.22	0.00%
R77	14.9	16.1	14.7	14.7	16.2	14.7 - 16.2 ± 0.76	0.00%
R78	11.0	11.4	10.9	10.9	11.5	10.9 - 11.5 ± 0.28	0.00%
R79	10.2	10.5	10.1	10.2	10.5	10.1 - 10.5 ± 0.18	0.00%
R80	11.1	11.6	11.0	11.1	11.5	11 - 11.6 ± 0.25	0.17%
R81	15.2	15.4	15.3	15.3	15.4	15.2 - 15.4 ± 0.1	0.00%
R83	10.6	10.9	10.7	10.8	11.0	10.6 - 11 ± 0.16	0.00%

Receptor	Annual Mean Concentration (µg/m³)					Range + Standard Deviation	% Change from average
	2015	2016	2017	2018	2019		
R84	10.7	10.9	10.8	10.8	10.9	10.7 - 10.9 ± 0.09	0.00%
R85	9.9	10.0	9.9	9.9	10.0	9.9 - 10 ± 0.05	0.00%
R86	9.7	9.8	9.7	9.8	9.8	9.7 - 9.8 ± 0.05	0.00%
R87	9.4	9.5	9.4	9.5	9.5	9.4 - 9.5 ± 0.04	0.00%
R88	9.5	9.7	9.6	9.6	9.7	9.5 - 9.7 ± 0.09	0.00%
R89	10.0	10.3	10.0	10.0	10.3	10 - 10.3 ± 0.19	0.00%
R90	10.4	10.8	10.4	10.4	10.9	10.4 - 10.9 ± 0.25	0.00%
R91	9.6	9.7	9.6	9.6	9.7	9.6 - 9.7 ± 0.04	0.00%
R92	10.4	10.8	10.5	10.5	10.8	10.4 - 10.8 ± 0.19	0.00%
R93	10.7	10.9	10.7	10.8	11.0	10.7 - 11 ± 0.12	0.00%
R94	11.8	12.4	11.6	11.6	12.3	11.6 - 12.4 ± 0.37	0.57%
R95	15.2	15.7	15.2	15.2	15.6	15.2 - 15.7 ± 0.26	0.32%
R96	13.1	13.9	12.8	12.9	13.9	12.8 - 13.9 ± 0.53	0.51%
R98	9.7	9.9	9.7	9.7	9.9	9.7 - 9.9 ± 0.13	0.00%
R99	10.3	10.7	10.3	10.3	10.7	10.3 - 10.7 ± 0.25	0.00%

Appendix 3 – LDP Traffic Growth

The Road NOx and emissions rates for the highest predicted NO_2 annual mean concentration was used to estimate the level of Road NOx that would be required to result in an exceedance. The NOx to NO_2 calculator was used to calculate the Road NOx that would result in an NO_2 concentration of 41µg/m^3, the calculated Road NOx was 64.3 µg/m$^{3.}$

The traffic flow on the link adjacent to the highest receptor R101 was used to obtain the emission rate responsible for the Road NOx and the traffic flow that generated the emissions rate. These data were then used to calculate the increase in Road NOx that would be required and therefore the equivalent traffic flow increase.

Receptor	Traffic Flow	Road NOx (with LEZ)	Road NOx for exceedance	Factor required to adjust to exceedance
R101	16995	34.9	64.29	1.84

This factor was applied to the emissions as we know there is a direct relationship with the NOx emissions and the concentration.

As the Bus flow won't change its emissions are assumed to stay static and only the emission from the other vehicles would be assumed to increase. Therefore, the level of adjustment of the fleet (-buses) was estimated this gave an adjustment factor of 1.93. This was then applied to the traffic flow resulting in a combined traffic volume of 30,763.

Bus Emissions Rate	Rest of Traffic Flow emission Rate (a)	Total emissions Rate (b)	Adjusted emissions rate required (c)	Factor =(c-a)/b
0.0091	0.0897	0.0988	0.1822	1.93

Legend

Musselburgh AQMA

Rev.	Date	Amendment Details	Dr'n	Chk'	App'
P0	10/06/2022	FIRST ISSUE	MB	JS	JS

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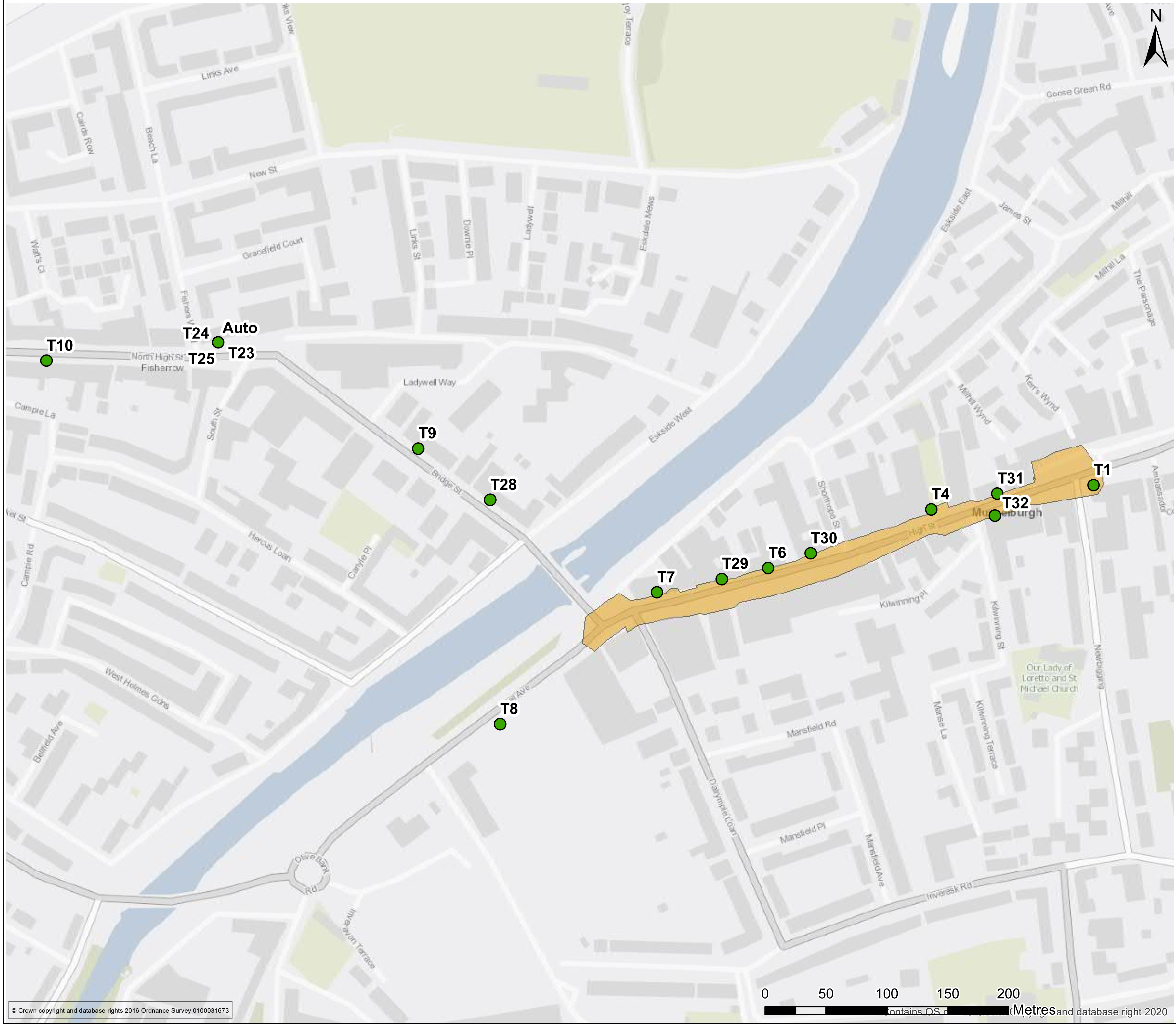
Drawing Title

FIGURE 1 - MUSSELBURGH AQMA

Status Desc.		Status	XX
Project No.	65201802	Scale	1:2,000
Drawing No.	65201802 - SWE - XX - XX - DR - J - FIGURE - 2	Sheet Size	A3



Legend

- Musselburgh AQMA
- Monitoring Locations

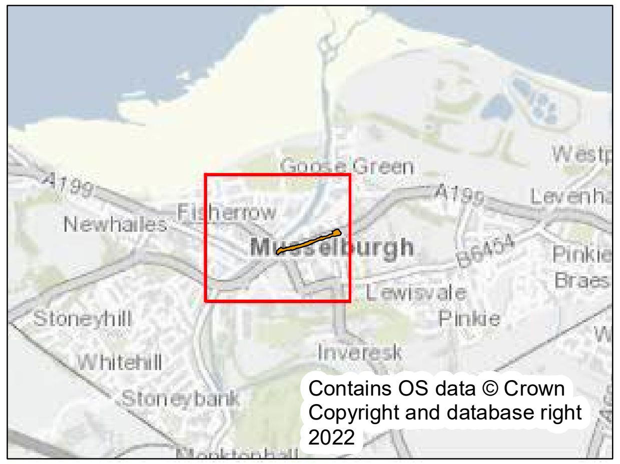


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FIGURE 2 - MONITORING LOCATIONS

Status Desc.		Status	XX
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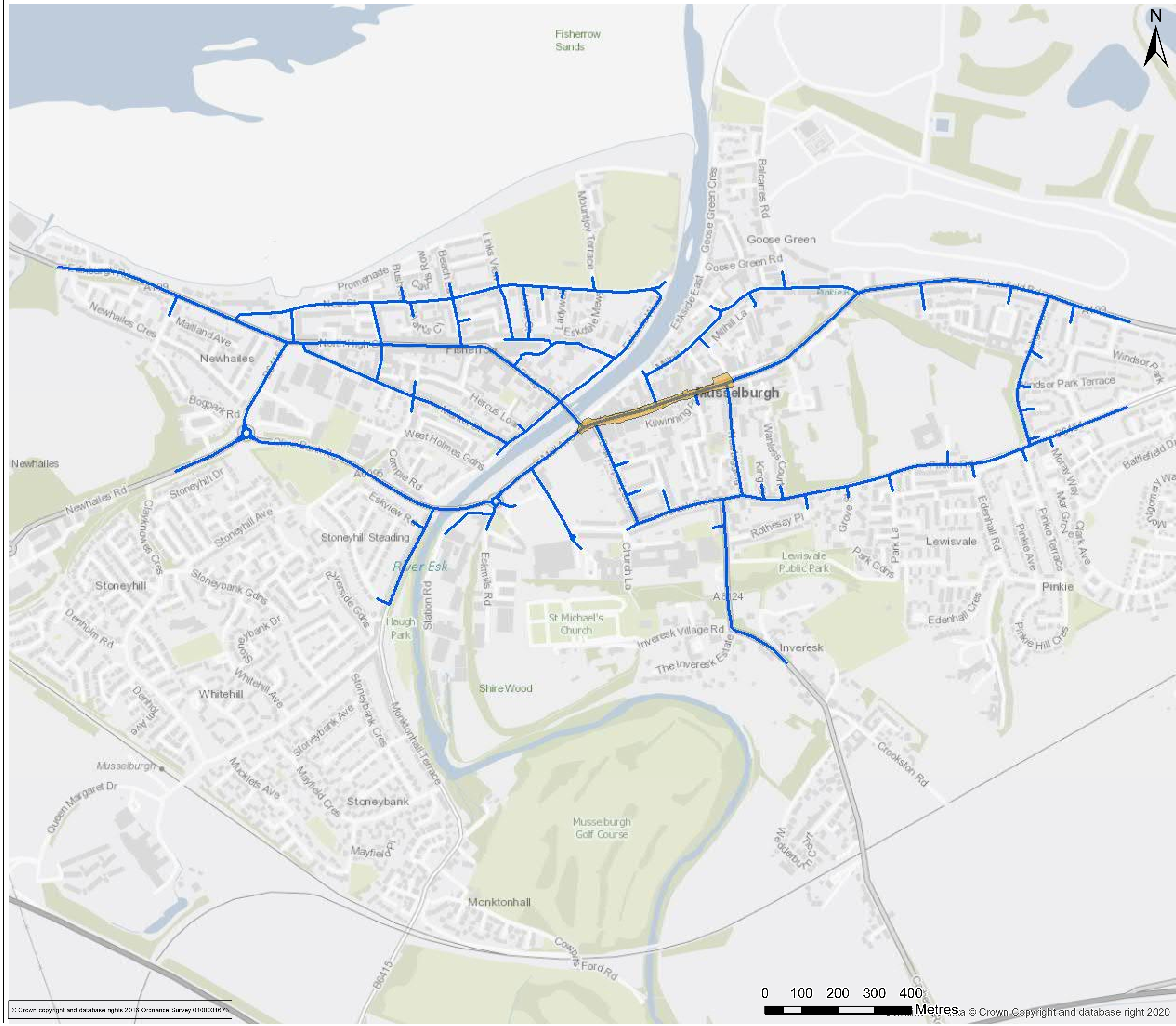
Drawing No.	65201802 - SWE - XX - XX - DR - J - FIGURE - 2	Sheet Size	A3



Legend

Study Area

Mussleburgh AQMA

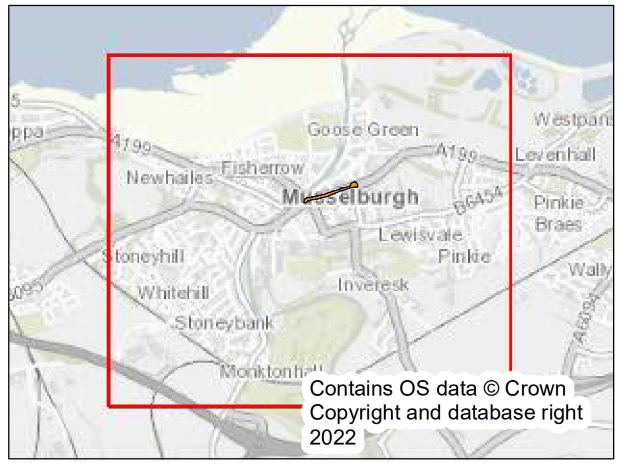


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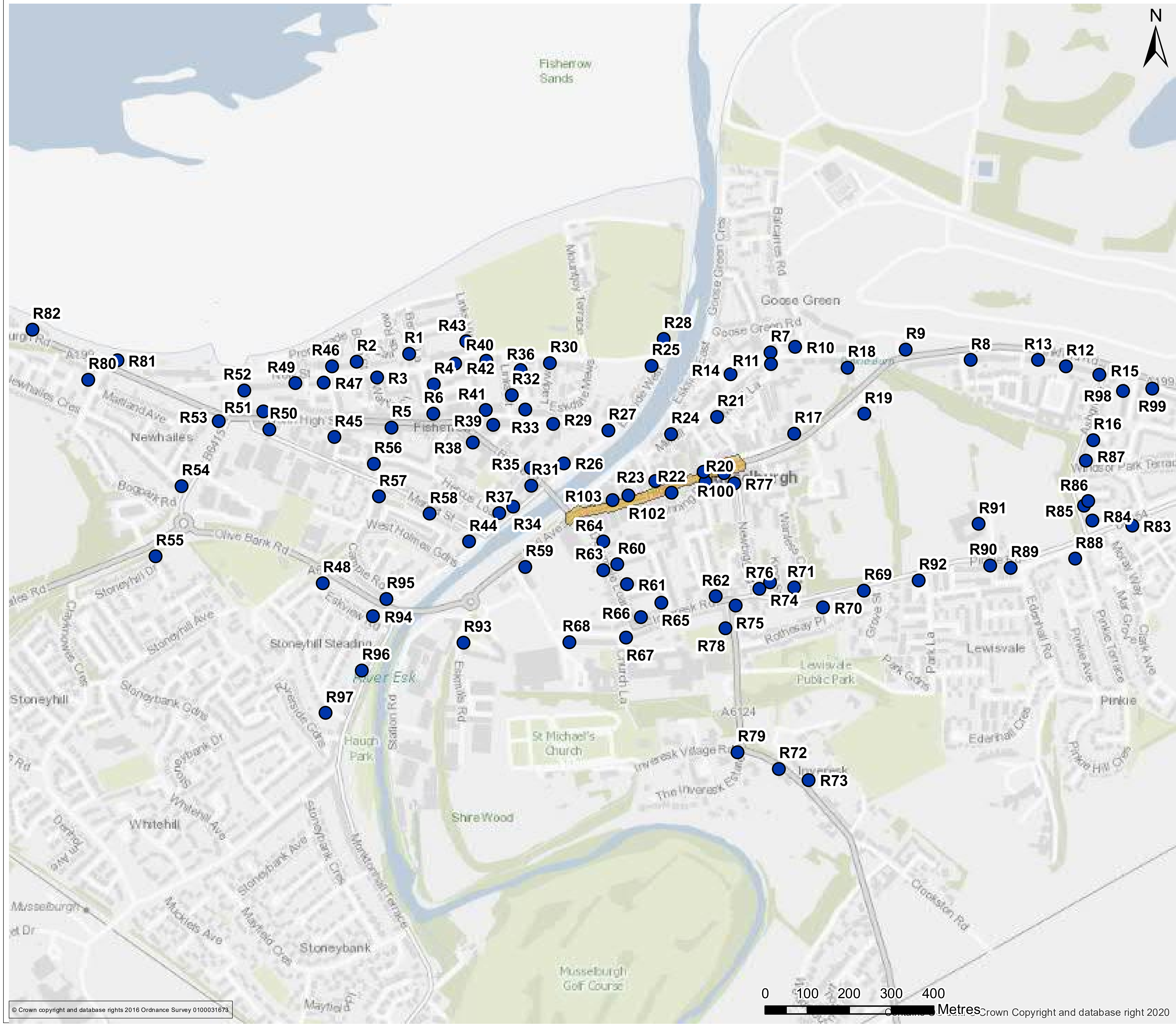
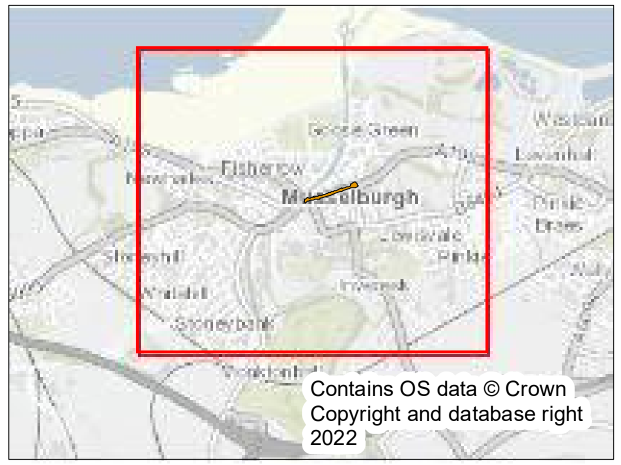
FIGURE 3 - STUDY AREA

Status Desc.		Status	XX
Project No.	65201802	Scale	1:10,000
Drawing No.	65201802 - SWE - XX - XX - DR - J - FIGURE - 2	Sheet Size	A3



Legend

- Receptor Locations
- Musselburgh AQMA



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P0	10/06/2022	FIRST ISSUE	MB	JS	JS

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FIGURE 4 - RECEPTOR LOCATIONS

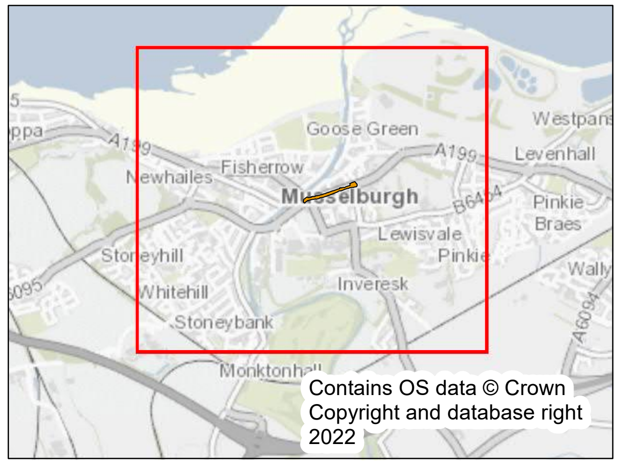
Status Desc.		Status	XX
Project No.	65201802	Scale	1:8,680
Drawing No.	65201802 - SWE - XX - XX - DR - J - FIGURE - 2	Sheet Size	A3

Legend

Musselburgh AQMA

Annual Mean NO_2 Concentrations

- 11 - 15
- 15 - 20
- 20 - 30
- 30 - 36
- 36 - 40
- 40 - 45



P0	14/06/2022	FIRST ISSUE	MB	JS	JS
Rev.	Date	Amendment Details	Dr'n	Chk'	App'

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FIGURE 5 - NO2 Annual Mean Concentrations

Status Desc.		Status	XX
Project No.	65201802	Scale	1:8,680
Drawing No.	65201802 - SWE - XX - XX - DR - J - FIGURE - 2	Sheet Size	A3