Background Concentration Maps

User Guide

November 2017
## Change Log

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Details of Changes Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>November 2017</td>
<td>Released with 2015 reference year background maps</td>
</tr>
</tbody>
</table>
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Introduction

This user guide has been compiled by Bureau Veritas in the role of Project Manager for the Local Air Quality Management (LAQM) Helpdesk.

Air pollution background concentration maps are published by Defra and the Devolved Administrations to assist local authorities in carrying out Review and Assessment of local air quality as part of their duties under the Environment Act 1995. The purpose of this user guide is to explain the background maps and the related tools that are available, and to provide guidance on their use. This user guide consolidates previously available information and guidance to local authorities on background concentration maps and supporting tools.

UK background maps are made available for a reference year and projected future years for a range of pollutants including oxides of nitrogen (NO\textsubscript{x}), nitrogen dioxide (NO\textsubscript{2}) and particulate matter (PM\textsubscript{10} and PM\textsubscript{2.5}). The Scottish Government publishes separate maps for use by Scottish authorities and these are also mentioned in this guide. Maps with Northern Ireland coordinate references are also available.

New background maps are released by Defra periodically due to updates to the underlying data, including emissions factors. Details on the supporting assumptions and input data are provided in this guide to aid understanding.

Local authorities should use the most up-to-date data and supporting tools made available, which have been updated for their use with the 2015 reference year maps.

For NO\textsubscript{x}, NO\textsubscript{2}, PM\textsubscript{10} and PM\textsubscript{2.5} the current reference year is 2015. For sulphur dioxide (SO\textsubscript{2}), benzene, carbon monoxide (CO) and 1,3-butadiene, the current reference year is 2001 as it has not been necessary to update the forecasts because ambient concentrations rarely exceed the Air Quality Strategy (AQS) objectives for these pollutants. For 2010 and 2011 reference years, correction factors are available to counter the effects of unusual meteorology on NO\textsubscript{2} (2010 only) and PM\textsubscript{10} (2011 only). This guide also details the historic versions of all maps that have been published.

A number of techniques and tools are available to support and help local authorities in their use of the background maps. The techniques that are detailed include:

- Removing the Influence of Unusual Pollution Years;
- NO\textsubscript{2} Adjustment for NO\textsubscript{x} Sector Removal;
- Using Background Maps to Adjust Monitoring Data;

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• Reference Year Queries and Data Availability; and

• Manipulation of Background Maps without GIS (Geographical Information System).

The tools are:

• NO$_x$ to NO$_2$ Calculator;

• NO$_2$ Adjustment for NO$_x$ Sector Removal Tool; and

• Year Adjustment Factors.

Further details on these are provided as part of this user guide.
Background Maps

About the Background Maps

Main Purpose

The main purpose of the background maps is to provide estimates of background concentrations for specific pollutants. These can then be used in air quality assessments to better understand the contribution of local sources to total pollutant concentrations. They provide information on how pollutant concentrations change over time and across a wide area. They also provide an estimated breakdown of the relative sources of pollution.

The maps allow for the assessment of new pollutant sources that are introduced into an area and the impact they may have upon local air quality.

Definition of Background Concentrations

The total concentration of a pollutant comprises those from explicit local emission sources such as, roads, chimney-stacks, etc., and those that are transported into an area by the wind from further away. If all the local sources were removed, all that would remain is that which comes in from further away; it is this component that is called ‘background’.

In many situations the background contribution may represent a significant or dominant proportion of the total pollutant concentration, so it is important that authorities give this careful consideration. A good understanding of background concentrations is important when completing air quality assessments as this in turn allows for a good understanding of local pollutant sources.

Data Content and Format

The following provides details on the data content of the background maps and the format in which the data are available.

Local Authorities

Background maps are available for each local authority in England, Wales, Scotland and Northern Ireland. It is possible to select the preferred pollutant and the year desired using the data selector drop-down on the background maps area of the UK-AIR website².

Mapped background concentrations for use in LAQM Review and Assessments undertaken by Scottish local authorities are available on the Scottish Air Quality website³. These maps

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² [https://uk-air.defra.gov.uk/data/laqm-background-home](https://uk-air.defra.gov.uk/data/laqm-background-home)
are available for NO$_x$, NO$_2$ and PM$_{10}$ only, together with a document setting out the methodology. Further detail on the differences between the background maps for Scotland provided on the UK-AIR website and those on the Scottish Air Quality website is provided on page 6.

**Pollutants**

The background maps contain estimates of pollutant concentrations based on an average over a year (annual average) for the following pollutants:

<table>
<thead>
<tr>
<th>Reference Year</th>
<th>2015</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO$_x$</td>
<td>SO$_2$</td>
</tr>
<tr>
<td></td>
<td>NO$_2$</td>
<td>CO</td>
</tr>
<tr>
<td></td>
<td>PM$_{10}$</td>
<td>benzene</td>
</tr>
<tr>
<td></td>
<td>PM$_{2.5}$</td>
<td>1,3-butadiene</td>
</tr>
</tbody>
</table>

**Spatial and Temporal Resolution**

The background pollutant concentration maps are presented in 1km x 1km grid squares across England, Wales, Scotland and Northern Ireland. The current version of the background maps (reference year 2015) contains estimates for NO$_x$, NO$_2$, PM$_{10}$ and PM$_{2.5}$ for the period 2015 through to 2030.

For SO$_2$, CO, benzene and 1,3-butadiene the data are available in the 2001 reference year maps for the years, 2001, 2003 and 2010. Year adjustment factors can be used to adjust this data. Further details showing how to do this can be found on page 20 of this user guide.

**Source Sectors**

The background map total concentrations for NO$_x$, PM$_{10}$ and PM$_{2.5}$ are made up of contributing source sectors. The source sectors include transport, industry and commercial. For the full list of sectors for each pollutant please see Appendix A: Background Maps Sectors.

Source sectors are also split into those emitted from within a grid square and those that enter the grid square from outside. In presenting the data in this way the individual sectors can be subtracted from the total background where a more detailed local assessment is to

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3 [http://www.scottishairquality.co.uk/data/mapping?view=data](http://www.scottishairquality.co.uk/data/mapping?view=data)
be carried out for that sector. This approach reduces the risk of double counting pollutant concentrations by avoiding the inclusion of both the estimated background component and the detailed sector component being evaluated.
What Maps are Available?

<table>
<thead>
<tr>
<th>Location</th>
<th>Available from</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK (including England, Wales Scotland and Northern Ireland)</td>
<td><a href="#">UK-AIR</a>²</td>
<td>UK background maps are available for NO(<em>x), NO(<em>2), PM(</em>{10}) and PM(</em>{2.5}). The modelling methodology is based on the UK Pollution Climate Mapping (PCM) approach, used to model the annual mean background and roadside concentrations for the UK as a whole.</td>
</tr>
<tr>
<td>Scotland</td>
<td><a href="#">Scottish Air Quality website</a>³</td>
<td>Scottish background maps are available for NO(_x), NO(<em>2) and PM(</em>{10}). The Scotland specific-model differs from the UK PCM model, only in that it uses Scottish monitoring data and Scottish meteorological data exclusively to model the annual mean background and roadside concentrations for Scotland.</td>
</tr>
</tbody>
</table>
| Northern Ireland | [UK-AIR](#)² | Northern Ireland background maps are available for NO\(_x\), NO\(_2\), PM\(_{10}\) and PM\(_{2.5}\). These files are based on the same information as those provided in the UK version which is based on grid squares from the Great Britain OS (GBOS), except they are calculated based on area weighted averages of the GBOS data.  

*Note: Some coastal grid squares are missing in this data set, or have much lower concentration values than adjacent squares as a result of the data conversion. Values for adjacent grid squares may be used if required.*

These data are likely to be appropriate for analyses in which the background concentrations will be combined with other geographical information on the Northern Ireland OS (NIOS) grid. |
How do I Access the Latest Maps?

UK (GBOS co-ordinates)

The current background concentration maps for the England, Wales, Scotland and Northern Ireland (2015 reference year) are available from UK-AIR\(^4\).

To get the background concentrations, use the drop down selectors to choose the Local Authority, Pollutant and Year required. Then click on the grey ‘Download CSV’ button.

Scotland (GBOS co-ordinates)

The current background concentration maps for Scotland (using a 2013 reference year), which incorporate Scotland specific-modelling, are available from the Scottish Air Quality website\(^3\).

To get the background concentrations use the drop down selectors to choose the Local Authority, Pollutant and Year required. Then click on the grey ‘Download CSV’ button.

A new link will be generated below the ‘Download CSV’ button called ‘Download selected CSV data’. Click this button to obtain the requested dataset, or right click and ‘Save link as’.

**IMPORTANT:** The current Scottish specific maps are based on a 2013 reference year. In the interim period whilst these are updated, users are advised to continue to use the 2013 reference year Scottish background maps for Scottish Local Authorities, in preference to the 2015 reference year UK-wide background maps.

**IMPORTANT:** Users should not use the Scottish specific maps with the NO₂ Adjustment for NOₓ Sector Removal Tool as the underlying assumptions vary between the two (see Supporting Tools and Processes for more information).

**Northern Ireland (NIOS co-ordinates)**

The current background concentration maps for Northern Ireland (2015 reference year) are available from [UK-AIR](#). A file is also available for each year between 2015 and 2030 covering all of Northern Ireland that provides the maps for Northern Ireland on the NIOS grid.

To get the background concentrations use the drop down selectors to choose the Pollutant and Year required. Then click on the grey ‘Download CSV’ button.

Note that all Northern Ireland local authority data are downloaded together.

**IMPORTANT:** Users should not use the Northern Ireland specific maps with NIOS co-ordinates with the NO₂ Adjustment for NOₓ Sector Removal Tool as the co-ordinate systems are incompatible (see Supporting Tools and Processes for more information).

**How do I Visualise the Latest Maps?**

Once downloaded from the relevant websites you may wish to review the background concentration map data visually. This is traditionally completed using a GIS. Where a GIS is not available, the background maps can be manipulated using the Excel function ‘pivot table’. Further details of this function are provided in Appendix B.
How are they Generated?

European Union directives on ambient air quality require member states, including the UK, to undertake air quality assessments, and to report the findings of these assessments to the European Commission on an annual basis.

As part of this reporting, background pollution maps at 1km x 1km resolution are modelled. These background pollution maps form the basis of the local authority background maps. The total modelled background concentrations are split by source sector and projected to future years to aid the LAQM process.
# Details of Available Historic Versions of the Background Maps

<table>
<thead>
<tr>
<th>Reference Year</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2015</strong> (Current Version for NOₓ, NO₂, PM₁₀ and PM₂.₅)</td>
<td>The 2015 reference year background maps are the most up-to-date version of the background maps for NOₓ, NO₂, PM₁₀ and PM₂.₅ and should be used for all new air quality assessments of these pollutants. Within these maps, background concentrations are available for 2015 to 2030. These 2015 reference year maps have been calibrated using 2015 monitoring and meteorological data.</td>
</tr>
<tr>
<td><strong>2013</strong></td>
<td>The 2013 reference year version of the background maps should not be used for new air quality assessments. These 2013 reference year maps are available for 2013 to 2030 and have been calibrated using 2013 monitoring and meteorological data.</td>
</tr>
<tr>
<td><strong>2011</strong></td>
<td>The 2011 reference year version of the background maps should not be used for new air quality assessments. These 2011 reference year maps are available for 2011 to 2030 and have been calibrated using 2011 monitoring and meteorological data.</td>
</tr>
<tr>
<td><strong>2010</strong></td>
<td>The 2010 reference year version of the background maps should not be used for new air quality assessments. The 2010 reference year maps are available for 2010 to 2030 and have been calibrated using 2010 monitoring and meteorological data.</td>
</tr>
<tr>
<td><strong>2008, 2006 and 2004</strong></td>
<td>Older versions of the background pollutant concentration maps exist with 2008, 2006 and 2004 reference years. These maps are no longer available for use in air quality assessment as they have been superseded by the current maps.</td>
</tr>
<tr>
<td><strong>2001</strong> (Current Version for SO₂, CO, benzene and 1,3-butadiene)</td>
<td>For new air quality assessments of SO₂, CO, benzene and 1,3-butadiene, the 2001 reference year background maps should be used (note, only for THESE pollutants). Within these maps background concentrations are available for 2001, 2003 and 2010. These 2001 reference year maps have been calibrated using 2001 monitoring and meteorological data.</td>
</tr>
</tbody>
</table>

Details of Current Background Maps

NO\textsubscript{x}, NO\textsubscript{2}, PM\textsubscript{10} and PM\textsubscript{2.5}

The 2015 reference year background maps are based on monitoring and meteorological data for 2015. They have been produced to incorporate more up to date information on emissions.

The methodology of the modelling used to create the background maps is consistent with that employed to support the development of the 2017 air quality plan\textsuperscript{5}. A full description of the reference year model for 2015 is provided in the technical report on UK supplementary assessment for 2015\textsuperscript{6}.

Emissions estimates based on the UK National Atmospheric Emissions Inventory 2014 (2015 for road transport emissions) are the main source of input data for the 2015 reference year background maps. The NAEI emissions mapping method is described elsewhere in detail in the NAEI UK Emissions Mapping Methodology Report\textsuperscript{7}. However, the following is provided by way of a brief summary of the key input data, assumptions and changes from the 2013 reference year background maps:

- The 2015 reference year background maps are based on ambient monitoring and meteorological data for 2015;
- The emissions projections for non-road traffic sources in the 2015 reference year background maps are based on Updated Energy Projections 2015\textsuperscript{8} from the Department for Business, Energy and Industrial Strategy (BEIS);
- The 2015 reference year background maps are based upon the updated COPERT 5 NO\textsubscript{x} and PM emission factors for road traffic\textsuperscript{9}, as taken from the European Environment Agency (EEA) COPERT 5 emission calculation tool\textsuperscript{10} (first released September 2016), including Euro 6 subcategories. The main revisions in comparison to the 2013 reference year background maps include a new set of Euro 6 NO\textsubscript{x} emissions factors for passenger cars and light goods vehicles (LGVs) and updated

\footnotesize


\textsuperscript{7} http://uk-air.defra.gov.uk/reports/cat07/1710261436_Methodology_for_NAEI_2017.pdf

\textsuperscript{8} https://www.gov.uk/government/collections/energy-and-emissions-projections

\textsuperscript{9} The accompanying report “Methodology for the calculation of exhaust emissions – SNAPs 070100-070500, NFRs 1A3bi-iv” is available here: http://emisia.com/products/copert/documentation

\textsuperscript{10} http://emisia.com/products/copert/copert-5
NO\textsubscript{x} emission factors for Euro 5 LGVs. The emission factors for HGVs, buses and motorcycles have also been updated;

- Outside of London, the 2015 reference year background maps are based on a set of traffic activity projections from the Department for Transport (DfT) (RTF 2015)\textsuperscript{11}; and

- Within London, the 2015 reference year background maps are based on bespoke vehicle fleet information for London provided by Transport for London (TfL), developed as part of the London Atmospheric Emissions Inventory (LAEI) 2013 update\textsuperscript{12}. The 2015 reference year background maps are inclusive of the impact from 2020 onwards of the Ultra-Low Emission Zone (ULEZ) in central London - users no longer need to adjust the data to account for the ULEZ.

For NO\textsubscript{x}, NO\textsubscript{2}, PM\textsubscript{10} and PM\textsubscript{2.5} the most current version of the background maps (i.e. 2015) should be used.

**SO\textsubscript{2}, CO, Benzene and 1,3-Butadiene**

Background maps for SO\textsubscript{2}, CO, benzene and 1,3-butadiene are based on the 2001 reference year. Only data for these pollutants contained within the 2001 reference year background maps should be used.

\begin{footnotesize}
\textsuperscript{12} http://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory-2013
\end{footnotesize}
Supporting Tools and Processes

The tools listed below may be required to support the use of the air pollution background concentration maps in air quality assessment. When undertaking an assessment, please ensure to use the tools that correspond with the version of the background concentration maps being used.

**IMPORTANT:** If and when previous reference year background maps are being used (i.e. 2013 and previous years) the corresponding version of the Supporting Tools should also be used. If not publically available, these can be requested from the LAQM Helpdesk.

For further details on how use these tools, please refer to the relevant section within this user guide.
NO$_2$ Adjustment for NO$_x$ Sector Removal

The background maps for NO$_x$ concentrations are split into source sectors. When removing sectors from the background NO$_2$ concentrations to avoid double counting in the modelling process, it is necessary to adjust the NO$_2$ concentrations in proportion to the reductions in NO$_x$ as a result of removing the specific source sector(s).

The latest version of the tool (Version 6.0), which replaces Version 5.1, can be downloaded from the LAQM website$^{13}$.

**IMPORTANT:** This tool should only be used with the UK-wide GBOS co-ordinate background maps, and not with either the Scottish specific or the NIOS co-ordinate background maps. This tool is presently not compatible with these two data sets.

A worked example covering the application of the NO$_2$ Adjustment for NO$_x$ Sector Removal Tool is presented below.

**Worked Example: Removing Road Traffic Sectors from NO$_x$ and NO$_2$ Background Maps**

The procedure for removing road traffic sectors from the mapped background NO$_x$ and NO$_2$ concentrations to avoid the issue of double counting in the modelling process is undertaken as follows:

**Step 1:**

Enter the background year required (2015 - 2030).

**Step 2:**

Enter the information from the background maps. Concentrations are in µg/m$^3$.

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Step 3:

Enter NO\textsubscript{x} concentration (\(\mu g/m^3\)) to be removed. This concentration should either be input into the ‘Road’ or ‘Non-Road’ box depending on the source type. In this example, the source sector that is to be removed from the maps is “Primary A road in”. The original mapped NO\textsubscript{x} “Primary A road in” source contribution is 12.95\(\mu g/m^3\).

Step 4:

Run the NO\textsubscript{2} Adjustment for NO\textsubscript{x} Sector Removal Tool by clicking on the ‘Run Tool’ button, to obtain revised mapped background NO\textsubscript{x} and NO\textsubscript{2} concentrations following sector removal. In this example the revised total NO\textsubscript{2} is 42.06\(\mu g/m^3\).
NO\textsubscript{x} to NO\textsubscript{2} Calculator

This calculator allows local authorities to derive NO\textsubscript{2} from NO\textsubscript{x} wherever NO\textsubscript{x} is predicted by modelling emissions from roads. The calculator can also be used to calculate the road component of NO\textsubscript{x} from roadside NO\textsubscript{2} diffusion tube measurements.

The latest version of the tool (Version 6.1), which replaces Version 5.1, includes updated estimates of regional concentrations of NO\textsubscript{x}, NO\textsubscript{2} and O\textsubscript{3} above the surface layer, and fractions of vehicle NO\textsubscript{x} emissions emitted directly as NO\textsubscript{2} (f-NO\textsubscript{2}) from the NAEI, consistent with the 2017 NO\textsubscript{2} Air Quality Plan\textsuperscript{5}. It also provides the ability to include user defined f-NO\textsubscript{2} values (e.g. those estimated by the Primary NO\textsubscript{2} Fraction Advanced Option of the Emissions Factors Toolkit EFT v8), in place of the provided default values.

Version 6.1 of the tool should only be used with the 2015 reference year background map concentrations and the EFT v8, and can be used for years 2015 to 2030.

The latest version of the tool can be downloaded from the [LAQM website]\textsuperscript{14}.

General Inputs:

\begin{itemize}
  \item [1] Specify year of modelling assessment or monitoring
    \begin{itemize}
      \item Use the scroll bar to scroll the year up or down
      \begin{itemize}
        \item 2015
      \end{itemize}
    \end{itemize}
  \item [2] Specify the local authority
    \begin{itemize}
      \item Use the combobox to select your local authority
      \begin{itemize}
        \item Southwark
      \end{itemize}
    \end{itemize}
  \item [3] Estimated regional concentrations above the surface layer
    \begin{itemize}
      \item Ozone 50.3 \textmu{g} m\textsuperscript{-3}
      \item Oxides of nitrogen 28.2 \textmu{g} m\textsuperscript{-3} as NO\textsubscript{2}
      \item Nitrogen dioxide 19.5 \textmu{g} m\textsuperscript{-3}
    \end{itemize}
  \item [4] Specify the traffic mix
    \begin{itemize}
      \item Use the combobox to select your traffic mix
      \begin{itemize}
        \item All UK traffic
      \end{itemize}
    \end{itemize}
  \item Fraction NO\textsubscript{x} emitted from local road vehicles as NO\textsubscript{2}
    \begin{itemize}
      \item 0.269751
    \end{itemize}
  \item Regional fraction NO\textsubscript{x} emitted as NO\textsubscript{2}
    \begin{itemize}
      \item 0.269751
    \end{itemize}
\end{itemize}

\textsuperscript{14} [http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc](http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc)
1. Specify the year of the modeling assessment or diffusion tube measurements.

2. Select the local authority: the spreadsheet will provide an estimate of the regional O₃, NOₓ and NO₂ concentrations above the surface layer. These provide information about the amount of oxidant available in the atmosphere.

3. Specifying a representative traffic mix: the spreadsheet will estimate the fraction of vehicle NOₓ emissions emitted as NO₂ (f-NO₂).

The traffic mix dropdown box contains six options:

- All UK traffic;
- All London traffic;
- All other urban UK traffic;
- All non-urban UK traffic;
- Buses outside London; and
- Buses in London.

The descriptors “urban” and “non-urban” are based upon the DfT’s definition: an urban road is a road within an urban area with a population of 10,000 or more. However, traffic on motorways within urban areas, including London, should be considered separately. It is also recognized that study areas (and roads) which cross more than one area definition are difficult to include. The following is advised:

- “All UK traffic” should only be used if none of the other options given below are suitable for your data.
- “All London traffic” can be used anywhere in London except adjacent to motorways or where buses dominate the vehicle fleet.
- “All other urban UK traffic” is an average of all urban roads outside of London, excluding motorways in urban areas. If your receptors or diffusion tubes are in an urban area and not near to motorways, you can use this option.
- “All non-urban UK traffic” gives a national average of traffic on non-urban roads and all motorways. If your receptors or diffusion tubes are outside of urban areas or near to any motorway, even in urban areas, you can use this option.
- “Buses outside London” can be used outside London where buses dominate your local fleet.
- “Buses in London” can be used inside London where buses dominate your local fleet.
In some situations you may have sufficiently detailed information to calculate your own “f-NO\textsubscript{2}” value. The EFT v8 now provides an estimate the Primary Fraction of NO\textsubscript{2} (f-NO\textsubscript{2}) using the Primary NO\textsubscript{2} Fraction Advanced Option - f-NO\textsubscript{2} values are provided at the individual link level and also as a weighted average according to the contribution each vehicle type makes to total NO\textsubscript{x} emissions from traffic associated with all links entered as input in to the EFT. The f-NO\textsubscript{2} values for each vehicle type that are employed as part of the calculation are consistent with those applied on the NAEI.

When you enter user defined f-NO\textsubscript{2} values directly into the calculator, you do not need to specify a traffic mix under “General Inputs”.

NO\textsubscript{x} to NO\textsubscript{2} Tab:

1) Confirm that the General inputs spreadsheet has been completed.

2) Type in:
   - A Receptor ID and its Easting and Northing (Optional);
   - The modelled contribution from roads to oxides of nitrogen concentrations (Road increment NO\textsubscript{x}); and
   - The local background concentration as NO\textsubscript{2} (2 decimal places). You may alternatively enter the local background as NO\textsubscript{x}, as the calculations are faster if you input background NO\textsubscript{x}, rather than background NO\textsubscript{2}. Leave the redundant background NO\textsubscript{x} or NO\textsubscript{2} columns blank as appropriate.

3) The default set-up is to use the fraction of oxides emitted as NO\textsubscript{2} from the General Inputs spreadsheet. We recommend a majority of users therefore leave the “Fraction emitted as NO\textsubscript{2}” column empty to use the default set up. However, you can overwrite the defaults by typing appropriate values (0-1) into this column. The f-NO\textsubscript{2} tab provides additional values.

4) Click the ‘Run NO\textsubscript{x} to NO\textsubscript{2}’ button to run the tool, which will then calculate:
   - The total nitrogen dioxide concentration at the receptor (Total NO\textsubscript{2}); and
   - The incremental contribution to nitrogen dioxide concentrations from the road vehicle emissions (Road NO\textsubscript{2}).

5) An example of indicative inputs and output results is provided below (note these values are for the purposes of this example only):
6) Click on the ‘Clear spreadsheet’ button to clear the spreadsheet to run new results.

Diffusion Tubes Tab:

1) Confirm that the General inputs spreadsheet has been completed.

2) Type in:
   • The site identifier (Site ID) [Optional];
   • The nitrogen dioxide concentration measured by the diffusion tube (Diffusion tube NO$_2$); and
   • The local background concentration as NO$_2$. You may alternatively enter the local background as NO$_x$. Leave the redundant background NO$_x$ or NO$_2$ columns blank as appropriate.

3) Hit the ‘Run’ button to run the tool. The tool will calculate the incremental contribution to oxides of nitrogen concentrations from the road vehicle emissions (Road NO$_x$).

4) See below an example of indicative results (note these values are for the purposes of this example only):

4) Hit the ‘Clear’ button to clear the spreadsheet and run new inputs.
Year Adjustment Factors

Year adjustment factors are not required for 2015 reference year background maps because maps are available for all years 2015-2030.

The Year Adjustment Factors published in the 2003 Technical Guidance LAQM TG(03) may still be used for projecting 2001-based background concentrations of carbon monoxide, benzene and 1,3-butadiene ONLY. These are available in the 2001 Year Adjustment Factors Spreadsheet\textsuperscript{15}.

Users are reminded that the factors applied to forecasting measured annual mean roadside NO\textsubscript{2} and PM\textsubscript{10} concentrations to future years differ to those discussed above. Further information is available on the LAQM website\textsuperscript{16}.

\textsuperscript{15} https://laqm.defra.gov.uk/documents/yearfactorslaqm2001.xls

\textsuperscript{16} https://laqm.defra.gov.uk/tools-monitoring-data/year-adjustment-factors.html
Using Background Maps to Adjust Monitoring Data

**NO\textsubscript{x}, NO\textsubscript{2}, PM\textsubscript{10} and PM\textsubscript{2.5}**

The most up-to-date background maps can be used to adjust annual mean background monitoring data values for NO\textsubscript{x}, NO\textsubscript{2}, PM\textsubscript{10} and PM\textsubscript{2.5} to a different year, as explained in paragraph 7.72 on page 7-25 of [LAQM.TG(16)]\textsuperscript{17}.

**SO\textsubscript{2}, CO, Benzene and 1,3-Butadiene**

For all pollutants, projection should be made forwards from the nearest background map year available to the relevant year. For SO\textsubscript{2}, Year Adjustment Factors are not provided as it is considered that, away from specific locations near industrial sources or areas of high domestic coal burning, that SO\textsubscript{2} background concentrations would change very little, i.e. the factor would be close to 1.

Year Adjustment Factors for CO, benzene and 1,3-butadiene can be found in the [2001 Year Adjustment Factors Spreadsheet]\textsuperscript{18}. If using these factors, the following guidance on the Use of Projection Factors for Background and Roadside Pollutant Concentrations should be adopted.

Users undertaking LAQM Review and Assessments for SO\textsubscript{2}, benzene, CO or 1,3-butadiene are advised to first contact the [LAQM Helpdesk]\textsuperscript{19} to seek the latest advice before proceeding with the assessment.

**Benzene:**

- Year 2011 to 2025: Use the mapped 2010 concentrations and relevant factors for the following year.

**CO:**

- Year 2002 to 2025: Use the mapped 2001 concentration and relevant factors for following years.

**1,3-Butadiene:**

- Years 2004 to 2025: Use the mapped 2003 concentrations and relevant factors for following years.

\textsuperscript{17} https://laqm.defra.gov.uk/technical-guidance/

\textsuperscript{18} https://laqm.defra.gov.uk/documents/yearfactorslaqm2001.xls

\textsuperscript{19} https://laqm.defra.gov.uk/helpdesks.html
For years after 2025, as a conservative approach it is advised that the 2025 background concentrations of benzene, CO or 1,3-butadiene for 2025 are adopted.
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,3-Butadiene</td>
<td>1,3-Butadiene is a VOC emitted into the atmosphere principally from fuel combustion of petrol and diesel vehicles. 1,3-butadiene is also an important chemical in certain industrial processes, particularly the manufacture of synthetic rubber.</td>
</tr>
<tr>
<td>AURN</td>
<td>Automatic Urban and Rural Network</td>
</tr>
<tr>
<td>Benzene</td>
<td>Benzene is a volatile organic compound (VOC) which is a minor constituent of petrol. The main sources of benzene in the atmosphere in Europe are the distribution and combustion of petrol. Of these, combustion by petrol vehicles is the single biggest source (70% of total).</td>
</tr>
<tr>
<td>CO</td>
<td>Carbon monoxide (CO) is a colourless, odourless poisonous gas produced by incomplete, or inefficient, combustion of fuel. It is predominantly produced by road transport, in particular petrol-engine vehicles.</td>
</tr>
<tr>
<td>DfT</td>
<td>Department for Transport</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information System</td>
</tr>
<tr>
<td>HGV</td>
<td>Heavy Goods Vehicles</td>
</tr>
<tr>
<td>HDV</td>
<td>Heavy Duty Vehicles. It encompasses Rigid and Artic Heavy Goods Vehicles and Buses/Coaches</td>
</tr>
<tr>
<td>LAQM</td>
<td>Local Air Quality Management</td>
</tr>
<tr>
<td>LDV</td>
<td>Light Duty Vehicles. It encompasses cars, taxis (black cabs London), and vans</td>
</tr>
<tr>
<td>LGV</td>
<td>Light Goods Vehicles</td>
</tr>
<tr>
<td>Local pollutant sources</td>
<td>Emissions from sources such as roads, chimney-stacks, etc.</td>
</tr>
<tr>
<td>NAEI</td>
<td>National Atmospheric Emissions Inventory</td>
</tr>
<tr>
<td>NO₂</td>
<td>Nitric oxide (NO) is mainly derived from road transport emissions and other combustion processes such as the electricity supply industry. NO is not considered to be harmful to health. However, once released to the atmosphere, NO is usually very rapidly oxidized, mainly by ozone (O₃), to nitrogen dioxide (NO₂), which can be harmful to health</td>
</tr>
<tr>
<td>NOₓ</td>
<td>NO₂ and NO are both oxides of nitrogen and together are referred to as nitrogen oxides (NOₓ)</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>Particulate Matter less than 10µm in aerodynamic diameter</td>
</tr>
<tr>
<td>PM₂,₅</td>
<td>Particulate Matter less than 2.5µm in aerodynamic diameter</td>
</tr>
<tr>
<td>SO₂</td>
<td>Produced when a material, or fuel, containing sulphur is burned. Globally, much of the sulphur dioxide (SO₂) in the atmosphere comes from natural sources, but in the UK the predominant source are power stations burning fossil fuels, principally coal and heavy oils. Widespread domestic use of coal can also lead to high local concentrations of SO₂.</td>
</tr>
<tr>
<td>Source sectors</td>
<td>Emissions from sectors such as industrial processes, combustion, transport and residential and commercial combustion</td>
</tr>
</tbody>
</table>
Local Air Quality Management Helpdesk

This Helpdesk has been set up on behalf of Defra and the Devolved Administrations to offer assistance to local authorities in managing air pollution in their area. The Helpdesk provides:

- answers to local authorities’ questions on air quality monitoring, modelling and emissions inventories;

- information and guidance to assist local authorities in carrying out the LAQM Review and Assessment process required under Part IV of the Environment Act 1995; and

- information and guidance to assist local authorities in preparing and implementing Air Quality Action Plans for improvement of local air quality.

Contact details for the LAQM Helpdesk can be found at: https://laqm.defra.gov.uk/helpdesks.html.
Appendices

Appendix A: Background Maps Sectors

<table>
<thead>
<tr>
<th>Header</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local_Auth_Code</td>
<td>Unique code for each local authority</td>
</tr>
<tr>
<td>X</td>
<td>Easting of centre of grid square (meters)</td>
</tr>
<tr>
<td>Y</td>
<td>Northing of centre of grid square (meters)</td>
</tr>
<tr>
<td>Geo_area</td>
<td>Unique code for each DA, inner and outer London</td>
</tr>
<tr>
<td>EU_zone_agglom</td>
<td>Unique code for each EU reporting zone and agglomeration</td>
</tr>
<tr>
<td>Total_NOX</td>
<td>Total concentration (sum of all sectors)</td>
</tr>
<tr>
<td>Motorway_in</td>
<td>Motorway in square sources</td>
</tr>
<tr>
<td>Motorway_out</td>
<td>Motorways out square sources</td>
</tr>
<tr>
<td>Trunk_A_Rd_in</td>
<td>Trunk A roads in square sources</td>
</tr>
<tr>
<td>Trunk_A_Rd_out</td>
<td>Trunk A roads out square sources</td>
</tr>
<tr>
<td>Primary_A_Rd_in</td>
<td>Primary A roads in square sources</td>
</tr>
<tr>
<td>Primary_A_Rd_out</td>
<td>Primary A roads out square sources</td>
</tr>
<tr>
<td>Minor_Rd+Cold_Start_in</td>
<td>Minor roads and cold start in square sources</td>
</tr>
<tr>
<td>Minor_Rd+Cold_Start_out</td>
<td>Minor roads and cold start out square sources</td>
</tr>
<tr>
<td>Industry_in</td>
<td>Industry area in square sources (combustion in industry, energy production, extraction of fossil fuel and waste)</td>
</tr>
<tr>
<td>Header</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Industry_out</td>
<td>Industry area out square sources (combustion in industry, energy production, extraction of fossil fuel and waste)</td>
</tr>
<tr>
<td>Domestic_in</td>
<td>Domestic, institutional and commercial space heating in square sources</td>
</tr>
<tr>
<td>Domestic_out</td>
<td>Domestic, institutional and commercial space heating out square sources</td>
</tr>
<tr>
<td>Aircraft_in</td>
<td>Aircraft in square sources</td>
</tr>
<tr>
<td>Aircraft_out</td>
<td>Aircraft out square sources</td>
</tr>
<tr>
<td>Rail_in</td>
<td>Rail in square sources</td>
</tr>
<tr>
<td>Rail_out</td>
<td>Rail out square sources</td>
</tr>
<tr>
<td>Other_in</td>
<td>Other in square sources (ships, off-road and other emissions)</td>
</tr>
<tr>
<td>Other_out</td>
<td>Other out square sources (ships, off-road and other emissions)</td>
</tr>
<tr>
<td>Point_Sources</td>
<td>Point sources</td>
</tr>
<tr>
<td>Rural</td>
<td>Regional rural concentration</td>
</tr>
<tr>
<td>Header</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Local_Auth_Code</td>
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</tr>
<tr>
<td>X</td>
<td>Easting of centre of grid square (meters)</td>
</tr>
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<td>Y</td>
<td>Northing of centre of grid square (meters)</td>
</tr>
<tr>
<td>Geo_area</td>
<td>Unique code for each DA, inner and outer London</td>
</tr>
<tr>
<td>EU_zone_agglom</td>
<td>Unique code for each EU reporting zone and agglomeration</td>
</tr>
<tr>
<td>Total_PM10</td>
<td>Total concentration (sum of all sectors)</td>
</tr>
<tr>
<td>Motorway_in</td>
<td>Motorway in square sources</td>
</tr>
<tr>
<td>Motorway_out</td>
<td>Motorways out square sources</td>
</tr>
<tr>
<td>Trunk_A_Rd_in</td>
<td>Trunk A roads in square sources</td>
</tr>
<tr>
<td>Trunk_A_Rd_out</td>
<td>Trunk A roads out square sources</td>
</tr>
<tr>
<td>Primary_A_Rd_in</td>
<td>Primary A roads in square sources</td>
</tr>
<tr>
<td>Primary_A_Rd_out</td>
<td>Primary A roads out square sources</td>
</tr>
<tr>
<td>Minor_Rd+Cold_Start_in</td>
<td>Minor roads and cold start in square sources</td>
</tr>
<tr>
<td>Minor_Rd+Cold_Start_out</td>
<td>Minor roads and cold start out square sources</td>
</tr>
<tr>
<td>Brake+Tyre_in</td>
<td>Brake and Tyre wear emissions in square sources</td>
</tr>
<tr>
<td>Brake+Tyre_out</td>
<td>Brake and Tyre wear emissions out square sources</td>
</tr>
<tr>
<td>Road_Abrasion_in</td>
<td>Road Abrasion emissions in square sources</td>
</tr>
<tr>
<td>Road_Abrasion_out</td>
<td>Road Abrasion emissions out square sources</td>
</tr>
<tr>
<td>Sectors</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------------------------------------------</td>
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<tr>
<td>Industry_in</td>
<td>Industry area in square sources (agriculture, combustion in industry, construction, energy production, extraction of fossil fuel, processes in industry, quarries, solvents and waste)</td>
</tr>
<tr>
<td>Industry_out</td>
<td>Industry area out square sources (agriculture, combustion in industry, construction, energy production, extraction of fossil fuel, processes in industry, quarries, solvents and waste)</td>
</tr>
<tr>
<td>Domestic_in</td>
<td>Domestic, institutional and commercial space heating in square sources</td>
</tr>
<tr>
<td>Domestic_out</td>
<td>Domestic, institutional and commercial space heating out square sources</td>
</tr>
<tr>
<td>Rail_in</td>
<td>Rail in square sources</td>
</tr>
<tr>
<td>Rail_out</td>
<td>Rail out square sources</td>
</tr>
<tr>
<td>Other_in</td>
<td>Other in square sources (aircraft, ships, off-road and other emissions)</td>
</tr>
<tr>
<td>Other_out</td>
<td>Other out square sources (aircraft, ships, off-road and other emissions)</td>
</tr>
<tr>
<td>PM_secondary</td>
<td>Secondary PM (inorganic and organic)</td>
</tr>
<tr>
<td>Residual+Salt</td>
<td>Sea salt, calcium and iron rich dusts and regional primary PM and residual non-characterised sources (residual is 1.0μg m⁻³)</td>
</tr>
<tr>
<td>Point_Sources</td>
<td>Point sources</td>
</tr>
<tr>
<td>Header</td>
<td>Description</td>
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</tr>
<tr>
<td>EU_zone_agglom</td>
<td>Unique code for each EU reporting zone and agglomeration</td>
</tr>
<tr>
<td>Total_PM2.5</td>
<td>Total concentration (sum of all sectors)</td>
</tr>
<tr>
<td>Motorway_in</td>
<td>Motorway in square sources</td>
</tr>
<tr>
<td>Motorway_out</td>
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<tr>
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<td>Road Abrasion emissions in square sources</td>
</tr>
<tr>
<td>Road_Abrasion_out</td>
<td>Road Abrasion emissions out square sources</td>
</tr>
<tr>
<td>Background Maps Headers and Sectors – PM$_{2.5}$</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Industry_in</strong></td>
<td>Industry area in square sources (agriculture, combustion in industry, construction, energy production, extraction of fossil fuel, processes in industry, quarries, solvents and waste)</td>
</tr>
<tr>
<td><strong>Industry_out</strong></td>
<td>Industry area out square sources (agriculture, combustion in industry, construction, energy production, extraction of fossil fuel, processes in industry, quarries, solvents and waste)</td>
</tr>
<tr>
<td><strong>Domestic_in</strong></td>
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<td>Domestic, institutional and commercial space heating out square sources</td>
</tr>
<tr>
<td><strong>Rail_in</strong></td>
<td>Rail in square sources</td>
</tr>
<tr>
<td><strong>Rail_out</strong></td>
<td>Rail out square sources</td>
</tr>
<tr>
<td><strong>Other_in</strong></td>
<td>Other in square sources (aircraft, ships, off-road and other emissions)</td>
</tr>
<tr>
<td><strong>Other_out</strong></td>
<td>Other out square sources (aircraft, ships, off-road and other emissions)</td>
</tr>
<tr>
<td><strong>PM_secondary</strong></td>
<td>Secondary PM (inorganic and organic)</td>
</tr>
<tr>
<td><strong>Residual+Salt</strong></td>
<td>Sea salt, calcium and iron rich dusts and regional primary PM and residual non-characterised sources (residual is 1.0µg m$^{-3}$)</td>
</tr>
<tr>
<td><strong>Point_Sources</strong></td>
<td>Point sources</td>
</tr>
</tbody>
</table>
Appendix B: Manipulation of Maps without a GIS

The background pollution concentration maps can be manipulated using the Excel function ‘pivot table’ to allow the visualisation of grid squares without the use of a GIS.

The below instructions provide details for how to ‘map’ background pollutant concentrations by grid square using Excel 2010.

1. Download the background concentrations.
2. Save the file and open in Excel.
3. Select a cell within the data.
4. On the ribbon toolbar go to ‘Insert’ then ‘Tables - PivotTable’ then ‘Insert Pivot table’.
5. Ensure the ‘Table/Range’ and ‘Location’ information is correct on the ‘Create PivotTable’ screen and select ‘OK’.
6. Using the ‘PivotTable Field List’, drag the ‘X’ field into the field area marked ‘Column Labels’.
7. Using the ‘PivotTable Field List’, drag the ‘Y’ field into the field area marked ‘Row Labels’.
8. On the ‘Row Labels’ dropdown filter list, select ‘Sort Largest to Smallest’.
9. Drag the required field for the data you want to map, e.g. Total_NO2_2015, into the field area marked ‘Values’.
10. The data should be presented in a grid, as it would be on a map, with values for each 1km x 1km grid square.
11. This process can be repeated for each pollutant and year that needs to be visualised. Go back to the data sheet and repeat steps 3 to 10.
Appendix C: Historic Information Regarding Background Maps

The 2015 reference year background maps should be used for all new air quality assessments. Previous versions may be useful to review historic assessment predictions.

2013 Reference Year Background Maps

The 2013 reference year background maps are based on monitoring and meteorological data for 2013. They have been produced to incorporate more up to date information on emissions from Euro 5 and Euro 6 vehicles.

The main changes from the 2011 reference year maps are as follows:

- The 2013 maps are based on ambient monitoring and meteorological data for 2013;
- The projections use new NO\textsubscript{x} and PM emission factor assumptions for Euro 5 and 6 vehicles, based on the European Environment Agency (EEA) COPERT 4v11 emission calculation tool; and
- Updated fleet composition data, accounting for updates to traffic and fleet projections in London, based on information provided by Transport for London (TfL).

2011 Reference Year Background Maps

The 2011 reference year background maps are based on monitoring and meteorological data for 2011. They have been produced in order to avoid the inclusion of the impact of the unusually cold weather in 2010 on the projections of NO\textsubscript{x} and NO\textsubscript{2} and to incorporate more up to date information on emissions from Euro 5 and Euro 6 light duty vehicles.

The likely overestimation was due to the high NO\textsubscript{x} and NO\textsubscript{2} concentrations recorded in 2010, the reference year the previous set of maps were produced from. The 2011 background maps are available with sector detail for NO\textsubscript{x}, PM\textsubscript{10} and PM\textsubscript{2.5} from 2011 to 2030.

The main changes from the 2010 reference year maps are as follows:

- The 2011 maps are based on ambient monitoring and meteorological data for 2011;
- The 2011 maps are based on the assumptions underlying the latest (base 2013) NO\textsubscript{x} emissions projections for road transport;
- The projections use new NO\textsubscript{x} emission factor assumptions for Euro 5 and 6 diesel cars and LGV based on COPERT 4 v10.0;
- The maps are based on new assumptions for the Department of Transport, based on updated Road Transport Forecasts (RS 2013); and
• In London, specific information from TfL (2013) on the projected bus and taxi fleets have been considered.

2010 Reference Year Background Maps

The 2010 reference year background maps are based on monitoring and meteorological data for 2010. The emissions inventory data used in the modelling of the background concentrations was taken from the NAEI for 2009, with emission estimates for area and point sources scaled forward from 2009 to 2010.

The dispersion modelling required in producing the maps was completed using ADMS 4.2. UK national network monitoring data has been used to calibrate the background and roadside models.

The main changes from previous reference year maps are as follows:

• The revised maps incorporate new information on the age distribution of vehicles and emissions factors for NO\textsubscript{x} for road vehicles;

• Improved spatial resolution of underlying information on regional oxidant (OX) concentrations used with the 2010 maps;

• The revised maps for particulate matter incorporate updated information on secondary inorganic aerosols and proportions of PM\textsubscript{2.5} and PM\textsubscript{10}; and

• Measured concentrations in 2010 at AURN background stations were higher in 2010 than in 2008 and this is reflected in the 2010 reference maps.

2008 Reference Year Background Maps

Background concentrations were available for NO\textsubscript{x}, NO\textsubscript{2}, PM\textsubscript{10} and PM\textsubscript{2.5} from 2008 to 2020 and calibrated using 2008 monitoring and meteorological data.

The background maps were calculated using the 2007 NAEI and associated projections, incorporating UEP37 energy projections current road traffic emission factors. Euro 5 and Euro 6 measures for LDVs and Euro VI measures for HDV are included in the projections.

The main changes observed between the 2008 and 2006 background maps are as follows:

• NO\textsubscript{2}: The 2008 maps show higher concentrations in much of Scotland, Northern Ireland and the west of Wales, but much of England the predicted concentrations are lower. The majority of urban areas show significantly higher background concentrations;

• NO\textsubscript{x}: Across the majority of the country the background concentrations are higher; and
• PM$_{10}$: Clear difference in emissions between the east and the west of the UK, with concentrations in the east higher and the west lower.

2006 Reference Year Background Maps

Background concentrations were available for NO$_x$, NO$_2$, PM$_{10}$ and PM$_{2.5}$ from 2006 to 2020 and calibrated using 2006 monitoring and meteorological data.

Background maps calculated using the 2005 NAEI and associated projections, incorporating UEP30 energy projections current road traffic emission factors. Euro 5 and Euro 6 measures for LDVs and Euro VI measures for HDV are included in the projections.

2004 Reference Year Background Maps

Background concentrations were available for NO$_x$, NO$_2$, and PM$_{10}$ from 2004, 2005 and 2010 and calibrated using 2004 monitoring and meteorological data.

Background maps calculated using the 2003 NAEI and associated projections, incorporating UEP12 energy projections current road traffic emission factors. Euro 4 and Euro 5 measures are included in the baseline.
Removing the Influence of Unusual Pollution Years

When using the 2011 Reference Year Background Maps – Particulate Matter

There are indications from national monitoring data that 2011 was an unusually high year for PM\(_{10}\) and PM\(_{2.5}\). Therefore, scaling factors have been derived to calculate a more typical case estimate for projections calculated from a reference year of 2011 for these pollutants.

A single factor of 0.91 for PM\(_{10}\) and PM\(_{2.5}\) has been derived by comparing measured concentrations in 2011 with those for 2008, 2009, 2010 and 2012.

**Worked Example: Removing the Influence of Unusual PM\(_{10}\) from the 2011 Reference Year Background Maps**

1. Download the PM\(_{10}\) or PM\(_{2.5}\) data for the year required (2011-2030).

2. Take the Total PM\(_{10}\) from the data spreadsheet (in this case 24.39 µg/m\(^3\)) and apply the scaling factor of 0.91. This will then give you the corrected Total PM\(_{10}\) for the year required.

\[
24.39 \text{ µg/m}^3 \times 0.91 = 22.19 \text{ µg/m}^3 \text{ (Corrected Total PM}_{10}\text{ to 2 decimal places)}
\]

Additionally, you may find it necessary to remove a PM\(_{10}\) sector source. In this example, the source sectors that are to be removed from the maps are “Primary A Rd in” and “Primary A Rd out”. The original mapped PM\(_{10}\) contribution from “Primary A Rd in” is 0.18 µg/m\(^3\) and for “Primary A Rd out” is 0.37 µg/m\(^3\).

To remove these sectors from the scaled map, the sum of these sector contribution also needs to be multiplied by 0.91, and then subtracted from the already corrected Total PM\(_{10}\) (i.e. 22.19 µg/m\(^3\) as derived above):
22.19 µg/m$^3$ – (0.91 x (0.18 µg/m$^3$ + 0.37 µg/m$^3$)) = 21.69 µg/m$^3$ (Corrected Sector Removed PM$_{10}$ to 2 decimal places)

**When using the 2010 Reference Year Background Maps – Nitrogen Dioxide**

It is widely recognised that concentrations of NO$_2$ were generally elevated in 2010 compared to more recent years. Analysis across the AURN suggests that NO$_x$ concentrations were, on average 15% higher in 2010 than other recent years. Corresponding NO$_2$ concentrations have been estimated to be around 10% higher in 2010.

However, concentrations vary across various monitoring station types with Urban Industrial, Suburban and Urban Background, and Urban Traffic stations tending to be higher in 2010, whereas Rural Background stations tended to have lower NO$_x$/NO$_2$ concentrations in 2010.

As the 2010 reference year background maps are based on and validated using 2010 monitoring data, the effect of the higher concentrations in 2010 mean that projected background concentrations for NO$_x$/NO$_2$ may be higher than expected.

To allow results which are more characteristic of a typical year, you may wish to consider removing the influence of projecting from the 2010 year from the background maps by scaling them. This can be completed using the 2010 reference year NO$_2$ Adjustment for NO$_x$ Sector Removal Tool, **Version 3.1**\(^\text{20}\).

You should assess the type of area being considered when scaling background maps as the method is unlikely to be suitable to use in areas representing rural background locations as it may result in underestimation of background concentrations.

\(^{20}\) [http://laqm.defra.gov.uk/documents/NO2-Background-Sector-Toolv3.1.xls](http://laqm.defra.gov.uk/documents/NO2-Background-Sector-Toolv3.1.xls)
Worked Example: Removing the Influence of Unusual NO2 from the 2010 Reference Year Background Maps

The background maps for NOx concentrations are split into source sectors. When removing sectors from the background NOx concentrations to avoid double counting in the modelling process, it is necessary to adjust the NO2 concentrations in proportion to the reductions in NOx as a result of removing the specific source sector(s).

The relationship between NO2 and NOx is not linear, therefore the adjustment is not straightforward and as such the relevant NO2 Adjustment for NOx Sector Removal Tool should be used.

The NO2 Adjustment for NOx Sector Removal Tool uses an equation taken from the report on ‘UK modelling under the Air Quality Directive (2008/50/EC) for 2010 covering the following air quality pollutants: SO2, NOx, NO2, PM10, PM2.5, lead, benzene, CO and ozone’.

The NO2 Adjustment for NOx Sector Removal Tool uses the same area specific regional oxidant and f-NO2 values used in the background concentration mapping process to produce a background NO2 value corresponding to the NOx value when either a ‘road’ or ‘non-road’ NOx source has been removed.

It is therefore important to avoid producing invalid results that you ensure to:

1) use the correct reference year background maps;
2) enter the correct coordinates for background information being processed; and
3) use the correct NO2 Adjustment for NOx Sector Removal Tool for the reference year used.

The NO2 Adjustment for NOx Sector Removal Tool – 2010 Reference Year (version 3.1) uses the following equation:

\[
A = (f_{NO2} \times B + OX) \times (-2.423 \times 10^{-13} \times B^6 + 1.607 \times 10^{-10} \times B^5 - 4.329 \times 10^{-8} \times B^4 + 6.132 \times 10^{-6} \times B^3 - 5.020 \times 10^{-4} \times B^2 + 2.593 \times 10^{-2} \times B) \times ((0.001 \times C) + 1.0126)
\]

Where:

A = NO2 concentration in ppb;
B = NOx concentration in ppb;
OX = regional oxidant concentration in ppb;
C = NOx concentration in µg/m³.

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Step 1:

Using values taken from the 2010 reference year background maps enter all details in Steps 1 and 2 of the NO₂ Adjustment for NOₓ Sector Removal Tool as in standard operation. Grid square coordinates from the national background maps should be entered, however the tool will estimate the nearest grid square for the coordinates provided (so these must be correct).

Please remember to ensure the correct year is chosen (2010-2030).

Step 2:

Remove 15% of the background NOₓ using the ‘NOₓ to be removed’ box in Step 3 of the NO₂ Adjustment for NOₓ Sector Removal Tool. This can be carried out in the NO₂ Adjustment for NOₓ Sector Removal Tool by multiplying both the Sum of NOₓ Roads (45.7 µg/m³) and the Sum of NOₓ Non-Road Sectors (41.4 µg/m³) by 0.15.

Step 3:

Run the NO₂ Adjustment for NOₓ Sector Removal Tool to produce an NO₂ value (40.5 µg/m³) corresponding to the 15% reduction in NOₓ.