High Lane Residents Association

Response to Consultation
Revised Draft Greater Manchester Spatial Framework, January 2019

Appendix 3

Air Quality and Traffic in High Lane

A Review of Local Data
in the context of the public consultation on the
Revised Draft (January 2019) of the
Greater Manchester Spatial Framework (GMSF)

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Contents

1. Introduction

Air quality modelling, submitted in 2013 as part of the planning application for the A6MARR (the extended A555 which opened in October 2018), predicted that in the road's opening year (which, at the time, was expected to be 2017), the annual mean concentration of NO_2 (nitrogen dioxide) in places such as High Lane would exceed the limit of 40 µg/m^3 — breaching the Air Quality Standards Regulations 2010. In fact, even without the A6MARR, the modelling predicted that the limit in High Lane near the A6 would be exceeded, and this was later confirmed by measurements in 2014 (see Section 3).

2. NO_2 Modelling Associated with the A6MARR Project (2013)

Figure 8.9 (on page 9 of these Figures) associated with Appendix 8 of the Environmental Statement of the A6MARR Planning Application shows the locations of the predicted exceedances: various points along A6 in High Lane, such as near the bridge over the Middlewood Way, both sides of the junction with Windlehurst Road and both sides of the junction with Andrew Lane. Figure 8.10 (on page 10 of Figures for Appendix 8 document) shows the predicted changes directly attributable to the A6MARR by comparing "without" to "with" the new road. Of the 24 locations shown in High Lane, 22 were **increases** (6 more than 4 µg/m^3 [the highest category], 14 between 2 and 4 µg/m^3, 3 between 0.4 and 2 µg/m^3) and 1 was a slight decrease of less than 0.4 µg/m^3 (near the junction with Windlehurst Road), where all the values relate to the annual mean concentration of NO_2.

In contrast, on the Hazel Grove side along the A6, the overwhelming majority of points on map show decreases of at least 4 µg/m^3.

3. NO_2 Measurements Associated with the A6MARR Project (2014)

In August 2014, a six-month air quality measurement programme began in High Lane (and elsewhere locally) to obtain an indication of the concentration levels of **nitrogen dioxide** near parts of the A6. The aim was to establish a baseline figure prior to the opening of the A6MARR.

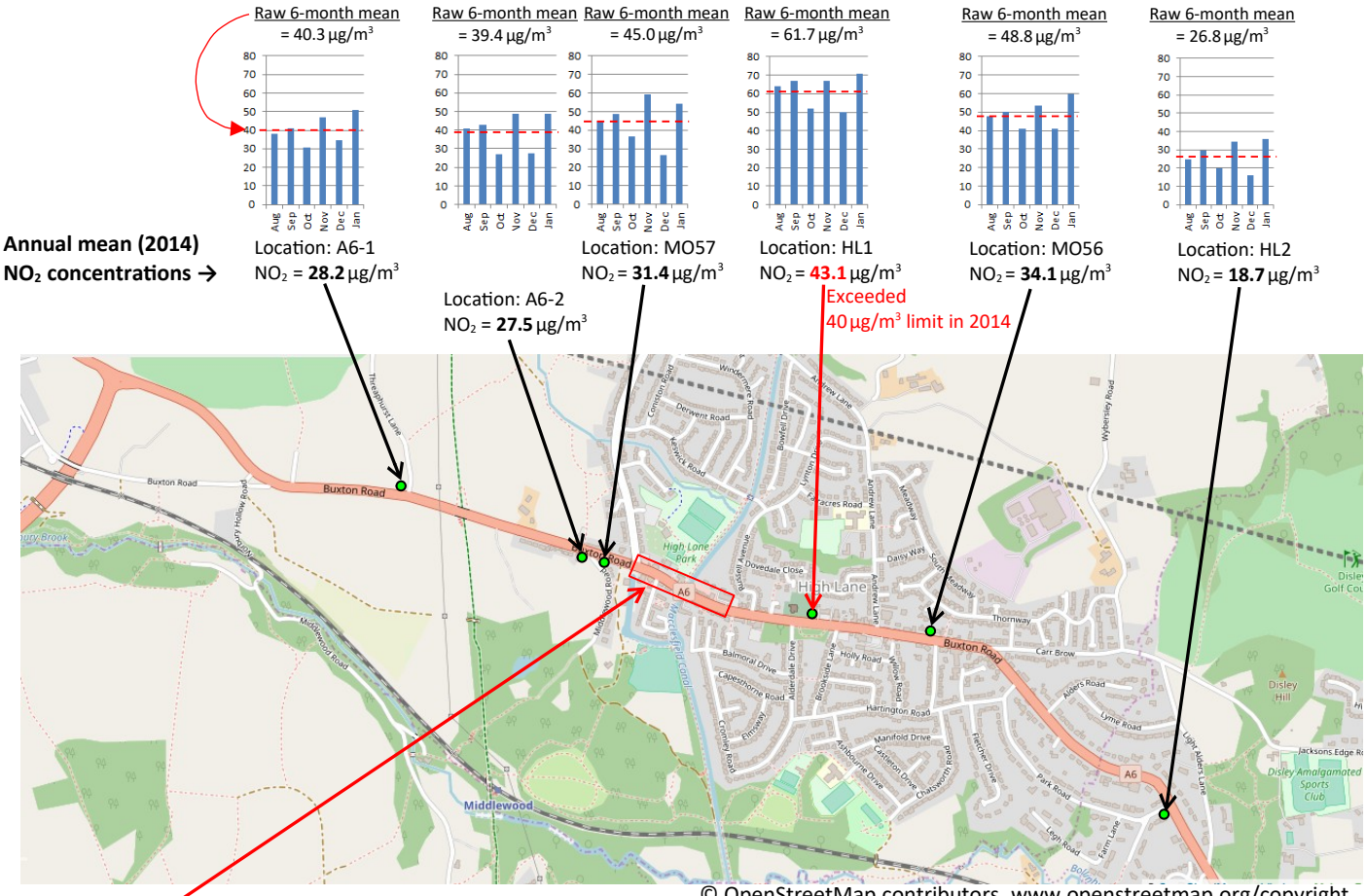

Figure 1 — Measurements of NO_2 in High Lane in 2014.

Also, see https://mappinggm.org.uk/clean-air-plan/?lyrs=gm_boundaries#os_maps_light/18/53.36507/-2.07588 for details (e.g. locations of high NO_2 concentrations) of modelling published by TfGM, which predicts exceedance of the 40 µg/m^3 legal limit (annual mean NO_2) in High Lane in 2021 (no other years published).

The results[1] described in the report, of relevance to High Lane, are shown on the map above. The measurement process involved installing a pair of passive NO_2 diffusion tubes at each site (typically by attaching to a lamp post) and replacing them monthly to send to a laboratory to obtain raw measurements of the concentration of NO_2 which were then averaged across the pair and bias-adjusted to calibrate them to a local continuous "reference method" analyser (the one on the A6 near Stepping Hill hospital) using a further co-located pair of diffusion tubes, and then each site's 6 monthly readings were seasonally adjusted to obtain a single figure per site for the whole year. These are shown on the above map for 2014 at each of the four sites along the A6 in High Lane, plus two further sites just outside the boundaries. The diffusion tubes were installed in pairs at each site to increase the quality of the data recorded and to help maximise the overall data capture, which was fortunately 100% at all the above sites, i.e. no missing months.

4. NO_2 Modelling Published by TfGM (2017)

Modelling published in 2017 by Transport for Greater Manchester shows the predicted areas of high concentrations of NO_2 in 2021. This is available to view in the GM Clean Air Plan area of the Mapping GM website, https://mappinggm.org.uk/clean-air-plan/?lyrs=gm_boundaries#os_maps_light/18/53.36507/-2.07588. It shows that part of the A6 near the centre of High Lane is still predicted to exceed the legal limit (40 µg/m^3 annual mean concentration of NO_2) in High Lane in 2021.

5. Background Information on Air Quality

The Air Quality Standards Regulations 2010 (a transposition of European Directive 2008/50/EC into national legislation) identifies the following air pollutants:

- **Nitrogen dioxide** (NO_2)
- **Particulate matter** (defined in the Regulations as including $PM_{2.5}$ and PM_{10})
- Sulphur dioxide (SO_2)
- Oxides of nitrogen (NO_x) (defined in the Regulations as NO + NO_2)
- Benzene (C_6H_6)
- Carbon monoxide (CO)
- Metallic (Lead (Pb), Arsenic (As), Cadmium (Cd) and Nickel (Ni))
- Benzo[a]pyrene ($C_{20}H_{12}$) or other polycyclic aromatic hydrocarbons (PAHs)
- Ozone (O_3)

and defines the corresponding maximum concentration limits that are [ideally] not to be exceeded.

The Greater Manchester Air Quality Action Plan (2016-2021) states that

> *The two pollutants of most concern for the majority of areas of the UK where air quality is a problem are **nitrogen dioxide** (NO_2) and **particulate matter** (PM), derived from gasoline. Road vehicles are the predominant sources.*

The limits for these pollutants, according to the above Regulations, are:

NO_2	
Concentration averaged during 1 calendar **year** period	**40** µg/m^3
Concentration averaged during 1 **hour** period	**200** µg/m^3 (maximum of **18** exceedances per calendar year)

PM_{10}	
Concentration averaged during 1 calendar **year** period	**40** µg/m^3
Concentration averaged during 1 **day** period	**50** µg/m^3 (maximum of **35** exceedances per calendar year)

$PM_{2.5}$	
Concentration averaged during 1 calendar **year** period	**25** µg/m^3

[1] ATKINS, *A6MARR Monitoring and Evaluation Baseline Report: Appendix J. Pre-Construction Air Quality Monitoring Report*, Version 2.6, April 2016, pp. 1-29 of PDF, http://www.semmms.info/wp-content/uploads/A6MARR_BaselineReport_Final_appendixes_JtoLonly.pdf

The Greater Manchester Air Quality Action Plan (2016-2021)[2] recognises that Greater Manchester urban area represents one of the 38 **non-compliant zones** in the UK, due to exceedances of the annual mean NO_2 limit value of 40 µg/m^3.

The Air Quality Expert Group explains[3] that **nitrogen dioxide** (NO_2) is released into the atmosphere when fuels are burned (e.g. petrol or diesel in a vehicle engine, or natural gas in a domestic central-heating boiler or power station). There is evidence that high levels of NO_2 can inflame the airways in our lungs and, over a long period of time, affect how well our lungs work. People with asthma are particularly affected.

The Air Quality Expert Group explains[4,5] that **particulate matter** is a term used to describe condensed-phase (solid or liquid) particles, suspended in the atmosphere, of various sizes that range from a few nanometres in diameter (about the size of a virus) to around 100 micrometres (100 µm, about the thickness of a human hair). The components of particulate matter may be directly emitted into the atmosphere (**primary components**) or formed by the reaction of atmospheric gases (**secondary components**) and include:

- Sodium chloride (e.g. from sea salt)
- Elemental carbon (black carbon (soot) e.g. from the combustion of fossil fuels such as coal, natural gas and oil (diesel and petrol) and biomass fuels such as wood chips
- Trace metals (present at very low concentrations) including lead, cadmium, nickel, chromium, zinc and manganese. Generated by metallurgical processes (e.g. steel making) or by impurities found in or additives mixed into fuels used by industry, or by mechanical abrasion processes (e.g. during vehicle motion and brake and tyre wear).
- Mineral components (e.g. in coarse dusts from quarrying, construction and demolition work and from wind-driven dusts), including aluminium, silicon, iron and calcium.
- Pollen
- Soil particles
- Sulphates (e.g. from the oxidation of sulphur dioxide (SO_2) in the atmosphere to form sulphuric acid, which can react with ammonia (NH_3) to give ammonium sulphate)
- Nitrates (e.g. from the oxidation of NO_x in the atmosphere to form nitric acid, which can react with NH_3 to give ammonium nitrate. Also present as sodium nitrate)
- Organic carbon. Primary organic carbon comes from traffic or industrial combustion sources; secondary organic carbon comes from the oxidation of volatile organic compounds (VOCs). There may be several hundred individual components.

Measurements of the concentration of particulate matter in air are made by recording the mass of particulate matter in one cubic metre of air, using the units micrograms per cubic metre, **µg/m^3**.

Particulate matter is classified according to its size. The size of 10 µm corresponds to thoracic particles, i.e. the size of inhaled particles that penetrate beyond the larynx, whereas 2.5 µm was chosen because of its significance for the penetration of human lungs. So **PM_{10}**, for example, comprises — to a good approximation — particles that are less than or equal to 10 µm in diameter; similarly, **$PM_{2.5}$** comprises particles that are less than or equal to 2.5 µm in diameter. From these definitions, it is clear that $PM_{2.5}$ is a subset of PM_{10}, but the available evidence[6] suggests that it is $PM_{2.5}$ (**fine particles**) that is the main cause of the harmful effects of particulate matter, compared to **coarse particles**, $PM_{2.5\text{-}10}$, although there is still some debate as to whether it is actually the **ultrafine** fraction of $PM_{2.5}$ (i.e. $PM_{0.1}$ or indeed a non-mass metric, such as the total number of particles per unit volume) that is primarily responsible for the effects.

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[2] TRANSPORT FOR GREATER MANCHESTER / GREATER MANCHESTER COMBINED AUTHORITY, *Greater Manchester Air Quality Action Plan 2016-2021*, 2016, p.15, https://www.manchester.gov.uk/download/downloads/id/24676/greater_manchester_air_quality_action_plan_2016.pdf

[3] AIR QUALITY EXPERT GROUP, *Nitrogen Dioxide in the United Kingdom: Summary*, 2004, Department for the Environment, Food and Rural Affairs, https://uk-air.defra.gov.uk/assets/documents/reports/aqeg/nd-summary.pdf

[4] AIR QUALITY EXPERT GROUP, *Particulate Matter in the United Kingdom: Summary*, 2005, Department for the Environment, Food and Rural Affairs, https://uk-air.defra.gov.uk/assets/documents/reports/aqeg/pm-summary.pdf

[5] AIR QUALITY EXPERT GROUP, *Fine Particulate Matter ($PM_{2.5}$) in the United Kingdom*, 2012, Department for the Environment, Food and Rural Affairs, https://uk-air.defra.gov.uk/assets/documents/reports/cat11/1212141150_AQEG_Fine_Particulate_Matter_in_the_UK.pdf

The harmful effects of atmospheric particulate matter upon human health are well recognised and quantified, and include[6]: premature mortality, hospital admissions, allergic reactions, lung dysfunction and cardiovascular diseases.

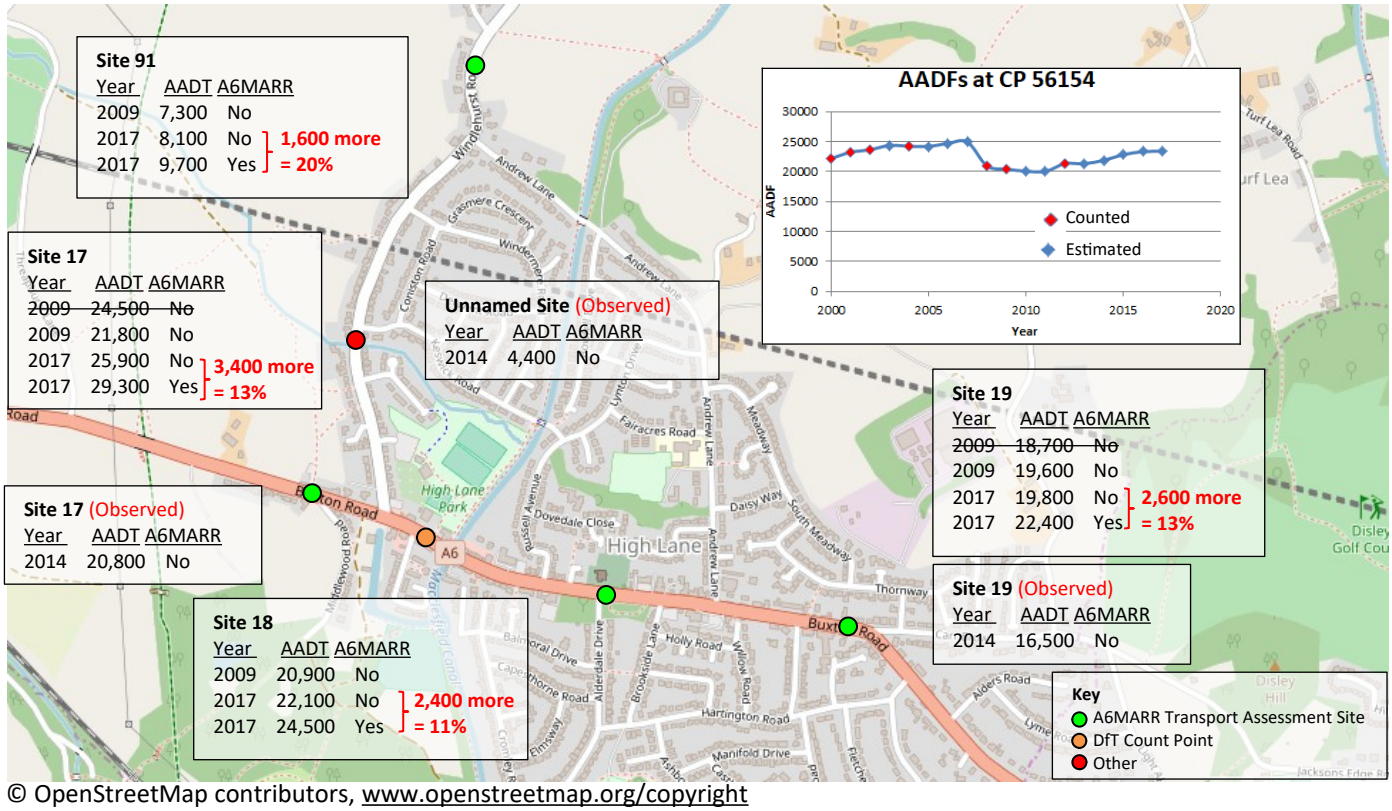
6. Traffic Modelling Associated with the A6MARR Project (2013)

Figure 9.6 (on p. 173) of the Transport Assessment of the A6MARR Planning Application shows a comparison of the Annual Average Daily Traffic (AADT — essentially the **total number of vehicles** (both directions) **per day** passing a given point, averaged over a one year period) at various locations for the "base year" of 2009 and the predicted AADTs in the assumed "opening year" of 2017, both without and with the A6MARR. The latter figures shown on the map on that page include, despite the lack of mention in the Key, a set of Enhanced Mitigation Measures (aimed at limiting the negative effects of the A6MARR). This is confirmed by an addendum (in the form of a table of figures) that was omitted from the original Transport Assessment.

I have shown these figures on the maps below, together with some observed AADT figures[7] (provided by SMBC) from a two-week automatic traffic count study in September / October 2014, the raw data from which was adjusted by seasonality factors to obtain the annualised daily totals.

Although the figures published in the Transport Assessment were used for the Public Inquiry, further modelling work was undertaken in preparation for the Full Approval of the Business Case. This led to some adjustments of the base year (2009) figures. I obtained these updated figures from SMBC in September 2015 and have shown the revised figured on the map below, together with the original figures crossed out.

Finally, the map also shows the Department for Transport's AADF figures at Count Point 56154[8], which I have plotted as a graph. (Annual Average Daily Flow is a term that I believe is used interchangeably with AADT.) The data includes mixtures of actual counts and estimated counts; all the estimated counts are estimated using the previous year's AADF.



© OpenStreetMap contributors, www.openstreetmap.org/copyright

Figure 2 — Traffic Counts in High Lane in 2000-2017: Modelled and Observed

[6] *Ibid.*, p.9 (p.20 of PDF)

[7] The 2014 figure for Site 17 was amended by SMBC from their original 21,200 to remove some spurious data from the raw count data, following advice from TfGM.

[8] Available to download from http://api.dft.gov.uk/v3/trafficcounts/countpoint/id/56154.csv

It is plainly obvious that all the modelled AADT figures are higher (by between 11 to 20%) in High Lane when the A6MARR is taken into account.

In fact, the maps[9] of the predicted morning and evening peak congestion post-A6MARR clearly show that High Lane and Handforth were the only areas with increased[10] traffic and delays in both periods — everywhere else either improves or stays the same. (Disley and an area near Manchester Airport were predicted to be worse in the morning peak only.)

The Transport Assessment of the A6MARR Planning Application says, in section 9.21 (p. 158 of the PDF),

> *The nature of the A6 through High Lane and Disley means that it is **neither possible nor desirable** to significantly increase network capacity along this corridor.*

This builds on a study (circa 1988) by the Department of Transport into a Disley and High Lane Bypass of the A6 which explains the need for such a bypass [although it was never constructed] in its public consultation document[11]:

> *By the mid-1990s, traffic on the A6 **will exceed** the **practical capacity** of the road, creating a severe environmental impact on the local communities and causing delay and frustration to motorists.*

In this context — no Disley and High Lane Bypass, but increased traffic on the A6 through High Lane as a result of the A6MARR and the recent housing developments nearby to the east (in East Cheshire and High Peak)[12], the A6 in High Lane being a road that is already heavily congested and expected to continue to breach air quality limits for NO_2 — I leave it to the reader's imagination what the effect will be of the GMSF's[13] proposed addition of 500 new dwellings on green belt land[14] in High Lane that will feed into the A6 using access points on both the north and south of the village.

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[9] ATKINS LIMITED, *A6 to Manchester Airport Relief Road: Transport Assessment*, 1007/6.15.2/183, October 2013, Figs. 9.4, 9.5, pp.168-169, http://a6marr.stockport.gov.uk/746597/760095/760276

[10] For these maps, the thresholds were a change in traffic of at least 5% and a change in overall junction delay of at least 15 seconds.

[11] Department of Transport, A6 Study: Disley and High Lane Bypass Public Consultation, n.d. (but mentions exhibitions in January 1988 in the future tense, so probably dated January 1988 or December 1987).

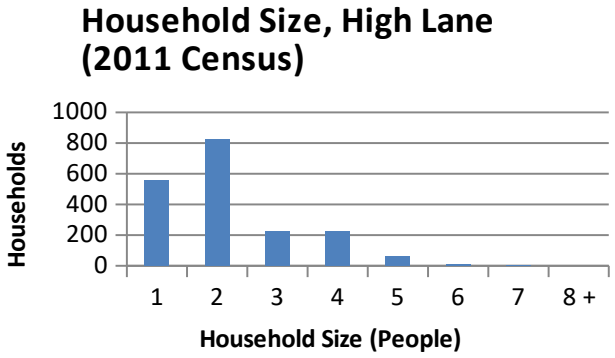
[12] For example, **97** dwellings in New Mills (decision imminent on planning application), **37** dwellings in New Mills, **107** dwellings in Whaley Bridge, **105** dwellings (Long Lane) in Chapel-en-le-Frith, **47** dwellings (Manchester Rd) in Chapel-en-le-Frith, **122** dwellings (phase 1) in Disley, **39** dwellings (phase 2) in Disley, **91** dwellings (phase 1) in Chinley, **62** dwellings (phase 2) in Chinley, **108** dwellings (north of Dinting Rd) in Glossop, **96** dwellings (Charlestown) in Glossop, http://planning.highpeak.gov.uk/portal/servlets/ApplicationSearchServlet?PKID=219108, http://planning.highpeak.gov.uk/portal/servlets/ApplicationSearchServlet?PKID=210350, http://planning.highpeak.gov.uk/portal/servlets/AttachmentShowServlet?ImageName=421938, http://planning.highpeak.gov.uk/portal/servlets/ApplicationSearchServlet?PKID=211408 http://planning.highpeak.gov.uk/portal/servlets/ApplicationSearchServlet?PKID=207208, http://planning.cheshireeast.gov.uk/applicationdetails.aspx?pr=14/4172M, http://planning.cheshireeast.gov.uk/applicationdetails.aspx?pr=13/2765M, http://planning.highpeak.gov.uk/portal/servlets/ApplicationSearchServlet?PKID=154664, http://planning.highpeak.gov.uk/portal/servlets/ApplicationSearchServlet?PKID=208246, http://planning.highpeak.gov.uk/portal/servlets/ApplicationSearchServlet?PKID=216913, http://planning.highpeak.gov.uk/portal/servlets/ApplicationSearchServlet?PKID=210787

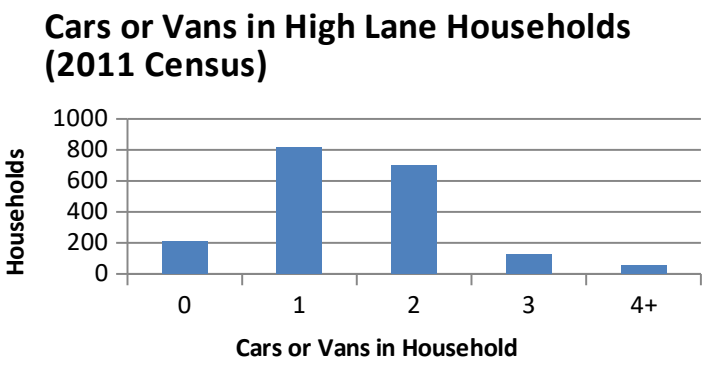
[13] GREATER MANCHESTER COMBINED AUTHORITY, *Greater Manchester's Plan for Homes, Jobs and the Environment: Greater Manchester Spatial Framework*, Revised Draft, January 2019, pp.360-362 (pp. 367-369 of PDF), https://www.greatermanchester-ca.gov.uk/media/1710/gm_plan_for_homes_jobs_and_the_environment_1101-web.pdf

[14] SMBC, Interactive Map of with layers for Air Quality Management Areas, Green Belt Areas and Smoke Control Areas, https://www.stockport.gov.uk/pollution/environmental-protection-act

7. High Lane Census Data (2011)

Using statistics from the 2011 Census[15] for High Lane, at an average of 2.2 people per household, and 1.5 cars or vans per household, 500 more homes would be likely to mean an additional population of 1100 and 750 more cars or vans. Note that households in High Lane have more than the national average number of cars or vans, presumably because of the relatively rural location and poor public transport infrastructure. (The average for England is 1.2 cars or vans per household.)





8. Further High Lane Statistics

It is apparent that some incorrect "facts" about High Lane continue to circulate on many websites and in social media. One of the most widely quoted of these is that High Lane has a population of 5852. However, the 2011 Census data shows that for High Lane's three Lower Layer Super Output Areas (Stockport 038B, Stockport 038C and Stockport 038D) the total was **4196** — a difference of 1656!

I think if the point about proportionality of development is being made (i.e. 500 new dwellings for a village whose population was only 4196 in 2011), it does not help the argument to use an over-inflated population figure to begin with.

The following figures give an indication of the population in High Lane over the last two decades or so:

4184 in mid-2017 (the latest available estimate[16] from the ONS)
4196 in 2011 from dataset KS101EW (Usual resident population) of the 2011 Census
4349 in 2001 from dataset KS001 (Usual resident population) of the 2001 Census

For the record, the 2011 Census (e.g. dataset QS402EW) shows there were a total of **1904 households** living in High Lane in 2011.

Another incorrect "fact" that has propagated around the Internet is that High Lane covers an area of 261 square miles! Surely even a moment's thought is enough to realise that this is preposterous? The true figure, closer to **1.3 square miles**, can be seen by looking at High Lane's three Lower Layer Super Output Areas[17,18,19].

9. Miscellaneous

9.1 Effect of Trees on Pollution

It is well known that plants remove CO_2 from the air via photosynthesis and that in general, trees, being large, can process significantly more than smaller plants. But what about other air pollutants — do trees help?

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[15] OFFICE FOR NATIONAL STATISTICS, *2011 UK Census*, https://www.nomisweb.co.uk/census/2011 using datasets QS406UK (Household Size) and QS416UK (Cars or Vans in Households) for High Lane LLSOAs: Stockport 038B, Stockport 038C and Stockport 038D.

[16] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/lowersuperoutputareamidyearpopulationestimates

[17] http://statistics.data.gov.uk/doc/statistical-geography/E01005906

[18] http://statistics.data.gov.uk/doc/statistical-geography/E01005907

[19] http://statistics.data.gov.uk/doc/statistical-geography/E01005913

Defra published research[20] by the [then[21]] Highways Agency into the effectiveness of tree planting on reducing pollution levels. It concluded that the predominant effect was one of changing air-flow patterns to enhance turbulence and thereby encourage atmospheric mixing of pollutants, and that any similar physical obstacle would produce similar results, but it was thought unlikely that this alone would be sufficient in general to lead to the achievement of air quality objectives.

9.2 Overestimated Non-Traffic Sources of Air Pollution?

Following the publication of the government's Clean Air Strategy 2019 paper[22], news headlines appeared claiming that wood-burning stoves were now responsible for 38% of the UK's $PM_{2.5}$ emissions. This seemed such a large percentage that it was investigated further by the BBC Radio 4 statistics programme *More or Less*, broadcast on 8th February 2019.[23]

It found that the 38% figure was based on survey of UK homes to assess the extent of wood burning taking place combined with data from the National Atmospheric Emissions Inventory. But it seems that a worst-case scenario (of most of the stoves in use being the old-fashioned, high polluting varieties) had been assumed to produce the 38% figure, with an associated uncertainty level in the results of about a **factor of ten**!

Rather than using an indirect method (like surveys), the programme continued, it is also possible to make direct measurements, and by analysing the physical and chemical properties of the $PM_{2.5}$ samples collected, it is possible to attribute the proportion originating from wood-burning stoves. The results varied from location to location, of course, but the wood-burning percentages were found to be between 6 to 9% in urban areas and between 4 to 6% in rural areas.[24] Furthermore, it was added that, if anything, these measurements have been trending slightly downwards over time.

However, these directly measured figures include *all* sources of $PM_{2.5}$, including from natural processes (e.g. from sea salt) as well as from overseas sources (carried in the air to the UK), whereas the survey-based ones were based on UK anthropogenic emissions only. Hence it is not possible to make a direct comparison of the figures.

Nevertheless, with such a high level of uncertainty, the 38% figure in the paper should be treated with a good deal of caution.

[20] DEPARTMENT FOR ENVIRONMENT, FOOD & RURAL AFFAIRS, *How effective are acoustic screening or tree planting alongside busy roads in reducing pollution at adjacent residential areas?*, 1st March 2010, https://laqm.defra.gov.uk/laqm-faqs/faq41.html

[21] https://www.gov.uk/government/organisations/highways-england/about

[22] DEPARTMENT FOR ENVIRONMENT, FOOD & RURAL AFFAIRS, *Clean Air Strategy 2019*, 13th January 2019, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf

[23] HARFORD, T. *et al.*, *More or Less: Teen Suicide; Brexit Business Moves; Wood-Burner Pollution*, BBC Radio 4, 8th February 2019, Item starting at 18 minutes, 22 seconds, https://www.bbc.co.uk/programmes/p070d4xz

[24] Reported on the programme by Dr Gary Fuller of King's College London.

10. Useful Links

- **AQE** (Air Quality England)
  - **Hazel Grove Air Pollution Data**
    Current hourly (and historical) measurements of NO_2 and PM_{10} concentrations

- **Clean Air Greater Manchester** (previously Great Air Manchester)
  - **Map of Roads predicted to breach legal limits for NO_2 beyond 2020**
    Includes A6 in High Lane
  - **Latest Air Quality Information**
    Current hourly (and historical) measurements of NO_2 and PM_{10} concentrations

- **EEA (European Environment Agency): Latest Air Quality Data**

- **Environmental Noise Directive Mapping Agglomerations, England**
  Interactive map of agglomerations, e.g. Greater Manchester Urban Area Agglomeration

- **UK AIR** (includes air pollution forecast)
  - **Air Pollution Glossary**
  - **Interactive Monitoring Network Map**

- **UK NAEI** (National Atmospheric Emissions Inventory)
  - **Interactive Map**

11. Key Documents

- *Air Quality Plan for Tackling Roadside Nitrogen Dioxide Concentrations in Greater Manchester Urban Area (UK003)*, July 2017. Note that High Lane is outside this area.

- *Greater Manchester Air Quality Action Plan (2016-2021)*

- *Greater Manchester Clean Air Plan Overview*, January 2019

- *The Air Quality Standards Regulations 2010*

- *UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations*, July 2017

Also a list of specialised publications relating to air quality can be seen at **Air Quality Expert Group**

Appendix 1 - Measurement of Particulate Matter

The legislation[25] categorises particulate matter according to its size, measured in terms of its ability to pass through a size-selective inlet as defined in the reference method (specific to the size category) for sampling and measurement with a 50% efficiency cut-off at the specified aerodynamic diameter. For PM_{10}, the reference method is described in European Standard EN 12341; for $PM_{2.5}$, it is EN 14907. The form of the size-selection curve is illustrated below[26] to help explain the meaning of "50% efficiency cut-off".

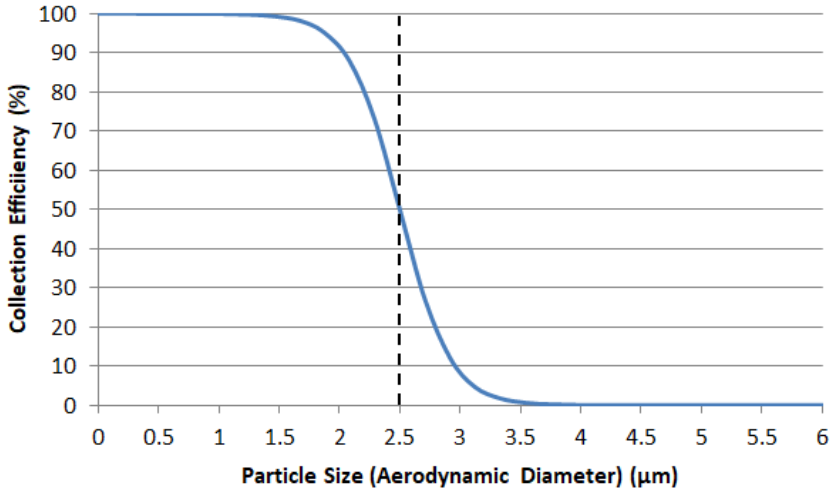

Figure 3 — Indicative Size-Selection Curve for a $PM_{2.5}$ Inlet

The graph shows that, as with most measurements, there is an associated tolerance band around the nominal value. So, for example, a $PM_{2.5}$ selection inlet may include a small percentage of particulates that have a diameter *greater than* 2.5 µm, but it may also fail to include *all* of the particulates less than 2.5 µm. For this reason, $PM_{2.5}$, for example, can be said to comprise — to a good approximation — particles that are less than or equal to 2.5 µm in diameter.

[25] GOV.UK, *The Air Quality Standards Regulations 2010*, http://www.legislation.gov.uk/uksi/2010/1001/pdfs/uksi_20101001_en.pdf

[26] AIR QUALITY EXPERT GROUP, *Fine Particulate Matter ($PM_{2.5}$) in the United Kingdom*, 2012,, *op. cit.*, Figure 2.1, p.20 = p.31 of PDF