Detailed Assessment for Chesterfield Borough Council

In fulfillment of Part IV of the Environment Act 1995
Local Air Quality Management

March, 2013

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Executive Summary

Targeted monitoring of road vehicle related Nitrogen Dioxide has been measured at four separate locations within the Chesterfield BC area. This is due to elevated levels being measured in 2010, and reported in the subsequent Progress Report, submitted in September 2011. The areas are:

i) Sheffield Road, Whittington Moor (in the vicinity of the new road junction leading to the football stadium and supermarket development).
ii) Whittington Hill, Old Whittington.
iii) Church Street, Brimington.
iv) Duke Street, Staveley.

The monitoring was undertaken between September 2011 and September 2012, using diffusion tubes at each of the sites, with the results of the monitoring being validated in-house by comparison with the ratified data from the AURN affiliated roadside monitoring equipment on Chatsworth Road. This found that the results obtained by the diffusion tubes were subject to a bias factor of 0.73.

The results of the monitoring are as follows:

Sheffield Road: 35.15 µg/m^3
Whittington Hill: 28.29 µg/m^3
Church Street: 39.35 µg/m^3
Duke Street: 31.88 µg/m^3

None of the locations were found to be in breach of the Air Quality Standard, which is an annual mean level of 40 µg/m^3 .

No Air Quality Management Areas are being declared.

Targeted monitoring will continue at both of the Sheffield Road and Church Street areas, in light of the higher levels in these locations. The monitoring has reverted to a single diffusion tube on both Whittington Hill, and Duke Street.

We have raised the issue of traffic pollution with the Highways Authority for this area (in this case Derbyshire County Council), with the intention of pressing for changes in traffic management across the borough, in order to ensure there is no decline in air quality, in the same way as we would if an AQMA had been declared.

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1. Introduction

As part of the ongoing requirement to assess air quality across the borough of Chesterfield, the 2011 Progress Report highlighted four areas where air quality may breach the Air Quality Standard. As such there is the requirement to carry out Detailed Assessments for the pollutants in question (in each of these instances, Nitrogen Dioxide), and to assess the likely sources of the pollutant. In each location the only realistic source of the nitrogen dioxide is from traffic and, in particular, restricted traffic flows in locations where the adjacent housing fronts directly onto the pavement. In the locations where the Detailed Assessments confirm that the Air Quality Standard is breached, we have the duty to declare an Air Quality Management Area, to include the affected properties, and to seek methods of improving air quality in the affected areas.

2. National Perspective

Air Quality Objectives

The air quality objectives applicable to LAQM **in England** are set out in the Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043), and are shown in Table 1.1. This table shows the objectives in units of micrograms per cubic metre $\mu g/m^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Table 2.1 Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	5.00 $\mu g/m^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

3. Background to AQ Monitoring in Chesterfield

The previous work carried out in fulfilment of the requirements of Air Quality Review and Assessment are summarised in Table 3.1, below, and continued overleaf:

Table 3.1 Summary of Previous Review and Assessments

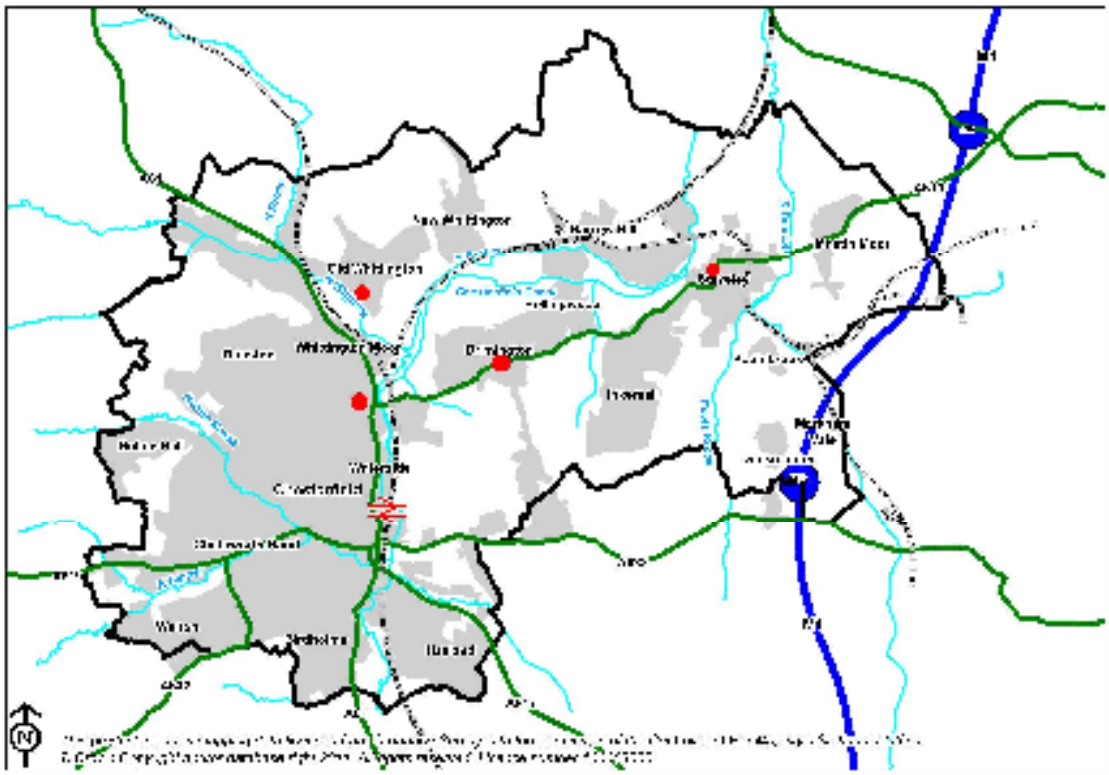
Date	Report Title	Conclusions and recommendations
2003	Update & Screening Assessment	Nitrogen Dioxide and PM_{10} were at risk of exceeding the health-based objectives. This led to a Detailed Assessment of these pollutants being conducted in 2004
2004	Detailed Assessment	No immediate action necessary, but Nitrogen Dioxide and PM_{10} should remain under close review. Improvements in air quality monitoring across the borough were also recommended
2005	Progress Report	Monitoring data highlighted a risk of exceedence of the Air Quality Nitrogen Dioxide Objectives on Derby Road. However, the data capture was not of sufficient accuracy for immediate action to be taken. Recommendations were made to improve the air quality monitoring strategy.
2006	Update & Screening Assessment	Monitoring data highlighted three locations showing exceedence of the annual Nitrogen Dioxide Air Quality Objective. These were Chatsworth Road (A619) and Derby Road (A61 South) and Chesterfield Road, Staveley (A619). Recommendation was made to complete a Detailed Assessment for these areas
2007	Detailed Assessment	Modelled data confirmed that Chatsworth Road (A619) and Derby Road (A61 South) and Chesterfield Road, Staveley (A619). showed exceedence of the annual Nitrogen Dioxide Air Quality Objective. Proposal was made to declare a ribbon AQMA, the proposed boundary of which would be based on a contour produced by the ADMS model, and incorporated areas of the borough predicted as having average annual NO_2 levels in excess of 36 µg/m^3.
2008	Progress Report	Recommendation to improve data capture, relocation of background monitoring site and relocation of some diffusion tubes to increase accuracy of results. Better working with planning department on major developments and improving the Authority's air quality web pages.
2009	Update & Screening Assessment	Monitoring data highlighted two further areas (both lying outside of the boundary for the proposed AQMA) showing elevated levels of Nitrogen Dioxide and possible exceedence of the annual Nitrogen Dioxide Air Quality Objective. These areas were Whittington Hill and Compton Street. Recommendation to produce detailed assessments for both areas.

2010	Progress Report	None of the air quality objectives were exceeded in 2009 and it was decided to withdraw the proposals for the declaration of an AQMA. It was recommended to continue to monitor air quality at all of the hot spots previously identified. In addition, the Council is reviewing the monitoring locations to ensure that a comprehensive monitoring data set is obtained and can be used to assess air quality within the Borough with confidence.
2010	Detailed Assessment and Source apportionment	Detailed assessment based on dispersion modelling of the most heavily trafficked areas within the Borough including Whittington Hill and Compton Street. Both monitoring and modelling indicated no exceedences of any of the objectives in 2009. Elevated levels were however found at a few locations and recommendations were made to continue to monitor trends throughout the Borough and especially at these locations.
2011	Progress Report (revised)	Monitoring data highlighted four areas showing elevated levels of Nitrogen Dioxide and possible exceedence of the annual Nitrogen Dioxide Air Quality Objective. These areas were Whittington Hill; Sheffield Road; Duke Street, Staveley; and Church Street, Brimington. Recommendation to produce Detailed Assessments for these areas.
2012	Update & Screening Assessment	Monitoring Data indicates that NO_2 levels have decreased across the borough as a whole, and as a result the four areas highlighted above are revised to a single site. However, the ongoing Detailed Assessments are continuing
2013	Detailed Assessment	This report

4. Locations

Four locations in the borough have been highlighted as possible traffic pollution hotspots with elevated levels of NO_2. The locations within the borough are shown in red, on the map, below:

Figure 4.1 Locations of Detailed Assessment Areas



Further details on each of the locations of the Detailed Assessments are given overleaf:

4.1 Sheffield Road, Whittington Moor

The new Proact Stadium football ground, on Sheffield Road was opened in 2010 and forms part of a larger redevelopment of the site previously occupied by the DemaGlass glassworks factory. Although the football stadium was viewed as being the major development on the site, its impact has been overshadowed by the opening of a Tesco supermarket on an adjacent plot. Traffic modelling, submitted as part of the planning application process, indicated that the increased traffic levels would not have a sufficiently adverse effect to breach the Air Quality Objective at the most directly affected dwellings on Sheffield Road and the Lockoford Lane/James Street junction. This assessment, which found that the development would have a minimal adverse effect, was approved by external contractors employed by the authority. However, the modelling was carried out using emission factors which are now regarded as not sufficiently accurate and monitoring has indicated that breaches of the Air Quality Objective may in fact be occurring, at properties on Sheffield Road. The inclusion of a traffic light controlled vehicle junction adjacent to the affected housing façade serves to restrict the previously free flow of traffic.

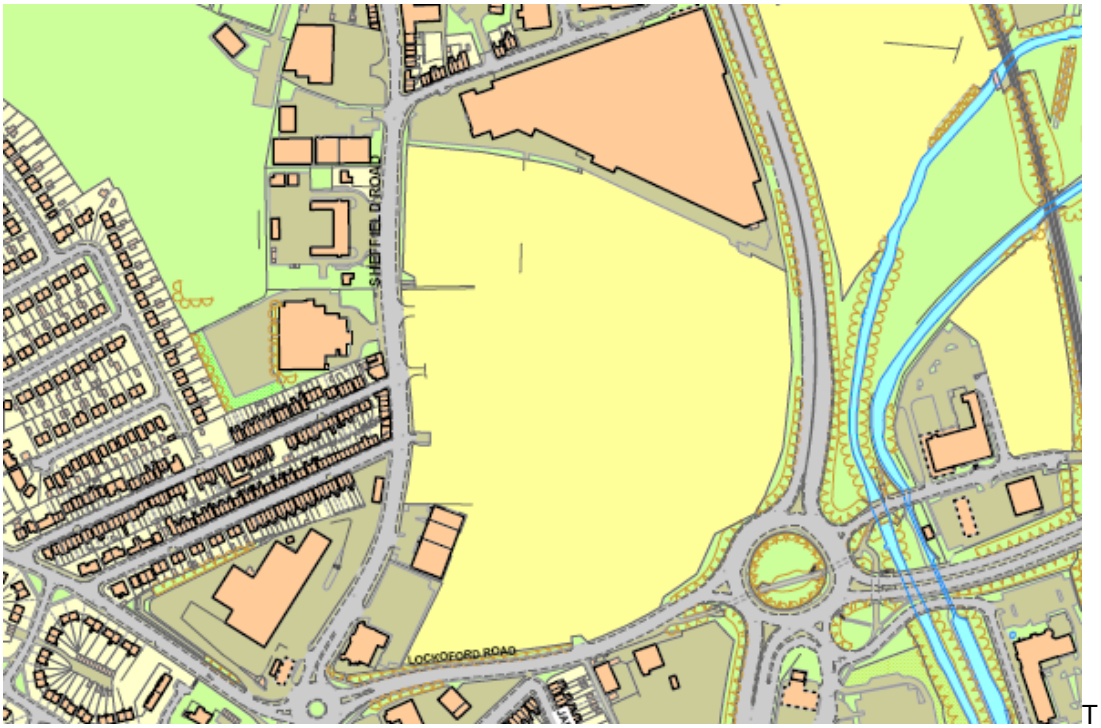
The photograph, below, shows the previous road setup and the affected terraced row of shops and houses. The existing gate to the right of the picture has now been widened and is one of the access roads to the Tesco supermarket on the former DemaGlass glassworks site. The blue awnings which can be seen near the middle of the frame are adjacent to a second gate (located at the far end of the awnings) which has also been widened and this is now a vehicle access to the new Proact football stadium.

Figure 4.1.1 Original Road Layout on Sheffield Road

Picture Courtesy of Google Maps Streetview

The map, over leaf, shows the original road layout

Figure 4.1.2 Original Road Layout



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The following pictures show the now traffic light controlled junction, and the widened access road to the right, and the close proximity to the row of houses shown above. Note: the pictures used to assemble the mosaics were taken when vehicles were not in shot to avoid "ghosting" of vehicle images in the final panorama.

The first mosaic approximates the view shown in Figure 4.1.1

Figure 4.1.3 Revised Road on Sheffield Road

The second mosaic picture faces the affected row of houses, and approximates the view from the gate shown to the right of the Figure 4.1.1.

Figure 4.1.4 Revised Road Layout Facing Affected Facade

The picture, below, is a panoramic mosaic showing the whole of the junction and the surrounding area (including the Tesco supermarket, set back at the far right of the frame). Due to the wide angle “fish-eye” effect, the main Sheffield Road enters the picture in mid-left, and recedes from view in mid-frame.

Figure 4.1.5 Panorama of Revised Road Layout

These, and further pictures, are shown at a larger size in Appendix 6.

Sheffield Road is a busy road and the traffic controlled junction serves to impede the flow of traffic, directly in front of the row of houses shown in the pictures above.

Figure 4.1.6 Queuing Traffic on Sheffield Road

Figure 4.1.7, overleaf, is a cropped view of the development site, with Sheffield Road running across the top of the picture (from upper left to the upper middle of the frame, where it leaves the shot), and part of the affected terrace of housing can be seen in the upper left corner of the picture. The new junction is out of the frame just above centre left. The large building in the foreground is the supermarket, with the Proact stadium behind.

Figure 4.1.7 The New Supermarket and Football Ground

Picture Courtesy of Robb McGann, Robinson Steel Structures

The following map shows the revised road layout, serving the football stadium, and the supermarket:

Figure 4.1.8 Revised Road Layout

4.2 Whittington Hill, Old Whittington

At Whittington Hill, it appears that the increased levels of NO_2 concentrations arise because engines of HGVs and buses tend to be working very hard as they travel up the relatively steep hill and, since there is only one lane of traffic in both directions, all other vehicles are forced to follow at the same speed. The result is that emissions rates are at their highest over this section of the road. The road has an increased number of HGVs than may normally be expected on a road in such a location due to the presence of the industrial estate at Station's Lane, at the far side of a housing estate over the brow of the hill. This problem is exacerbated due to an increase in gradient halfway up the hill. The effect of this is that heavy vehicles lose momentum and are forced to change down a gear at this point, slowing traffic along the length of the road. Some buses turn off the road onto Holland Road, at the T-junction shown in the middle of the picture, below. The panoramic mosaic shows the roadway and the adjacent housing, the change in gradient is approximately at the centre of the picture. Note: the pictures used to assemble the mosaic were taken when vehicles were not in shot to avoid "ghosting" of vehicle images in the final panorama.

Figure 4.2.1 Whittington Hill

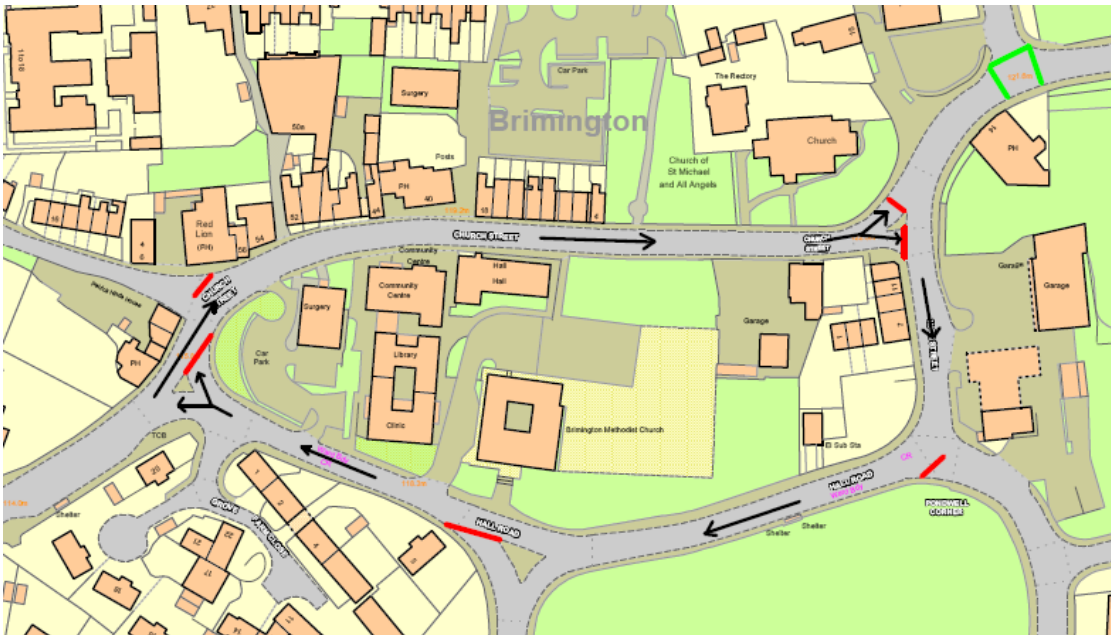
This picture, and further pictures, are shown at a larger size in Appendix 7.

Whilst the increase in gradient would be likely to have an adverse effect upon ambient air quality, this is greatly eased by the fact that the adjacent housing is set further back from the roadway as the hill is climbed. Due to the age of the housing built along this stretch of road, this greatly advantageous fact cannot have been planned but is nonetheless fortuitous.

4.3 Church Street, Brimington

The A619 trunk road linking the north side of Chesterfield to the M1 passes through Brimington. This road originally ran as a two way road through the centre of the old village but had been supplemented by a second carriageway which skirts the original buildings, and the effect of this is that a one way system is now in place. The diagram, below, shows the traffic flows around the system. The black arrows show the direction of traffic flow, the red lines are uncontrolled traffic junctions where traffic can filter onto the system when able, the green lines in the upper right show the location of a nearby traffic light controlled junction which may, in times of high traffic loading cause tail backs into the one way system sufficiently to reach the row of houses, approximately 130m back down the roadway. The whole of the area is on a gentle incline, sloping upwards from West to East.

Figure 4.3.1 Road Layout, and Traffic Flow, at Brimington



Where the road is not marked with an arrow, two way traffic flows are allowed.

The affected row of terraced houses are located on the north side of the one way system, adjacent to the church.

Figure 4.3.2 Affected Façade at Church Street, Brimington

As can clearly be seen, the houses face directly onto the street. There may also be a minor canyon effect due to the Church Hall on the opposite side of the roadway, as shown more clearly in the picture overleaf, from the opposite side of the road.

Figure 4.3.3 Carriageway at Church Street, Brimington

On street parking serves to restrict the effective road width, but also acts to move the traffic away from the affected façade.

These, and further pictures, are shown at a larger size in Appendix 4.

4.4 Duke Street, Staveley

The A619 trunk road linking the north side of Chesterfield to the M1 passes through Staveley, closely by-passing the heart of the village. The figure below shows the road layout, the main road passing from lower left to upper right, passing to the south and east of the old village, and the affected housing façade is highlighted in red.

Figure 4.4.1 Road Layout at Duke Street, Staveley

The pictures, below, show the roadway and the affected row of terraced houses and shops. The road is on a slight incline, with a roundabout at the junction on the brow of the hill (this is at the northern end of the row of houses highlight in the map above, and to the right of the picture below). The road is generally free flowing, with only the single pedestrian controlled crossing to change the flow. However, as the road is the only practical link to the M1 motorway, it is prone to severe congestion backing up from the entry to the motorway if there are traffic problems on that major route.

The picture below shows the affected road of houses from the south end, and also shows the pedestrian crossing.

Figure 4.4.2 Affected Façade at Duke Street, Staveley

The second picture shows the same stretch of road from the north, with the affected row of housing to the left of the picture.

Figure 4.4.3 Northern Section of Façade and Carriageway

These, and further pictures, are shown at a larger size in Appendix 5.

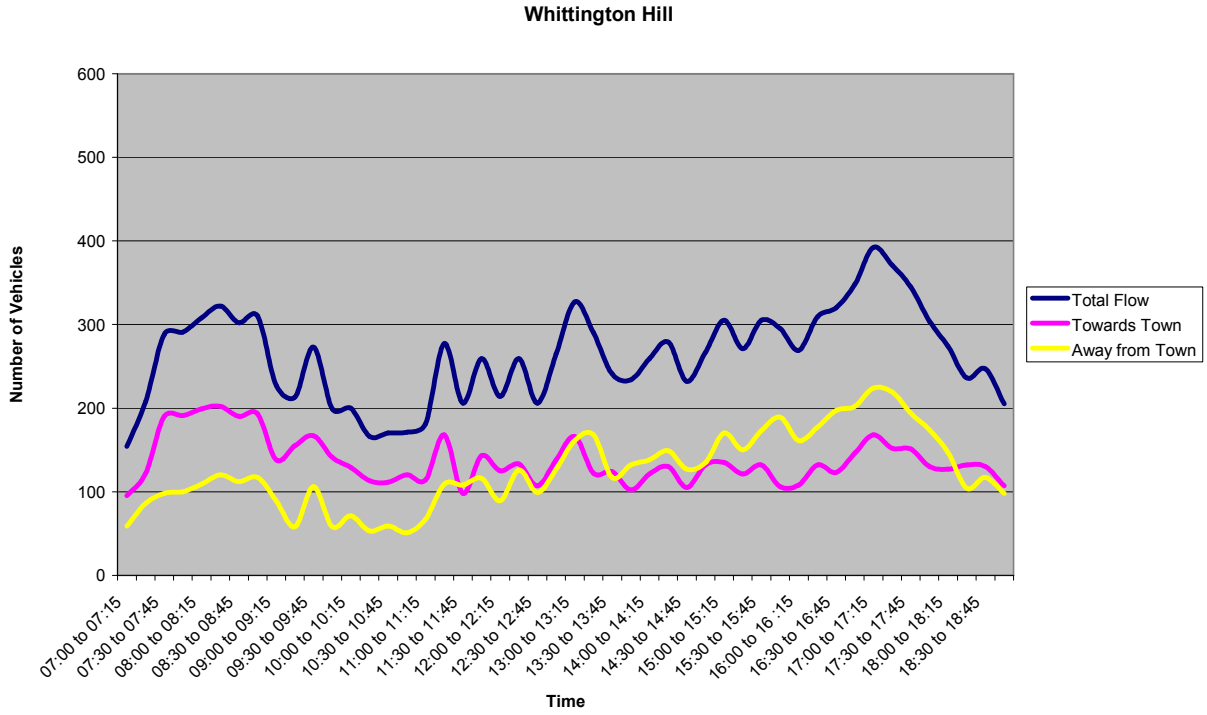
5. Monitoring

5.1 Traffic Count

A brief traffic counting exercise was carried out between 4th and 8th July 2011, as part of a modelling validation exercise. Four sites were chosen, and two of these sites (Whittington Hill, Old Whittington; and Church Street, Brimington) are locations where we have subsequently undertaken Detailed Assessments. A summary of the relevant traffic count data obtained is given below:

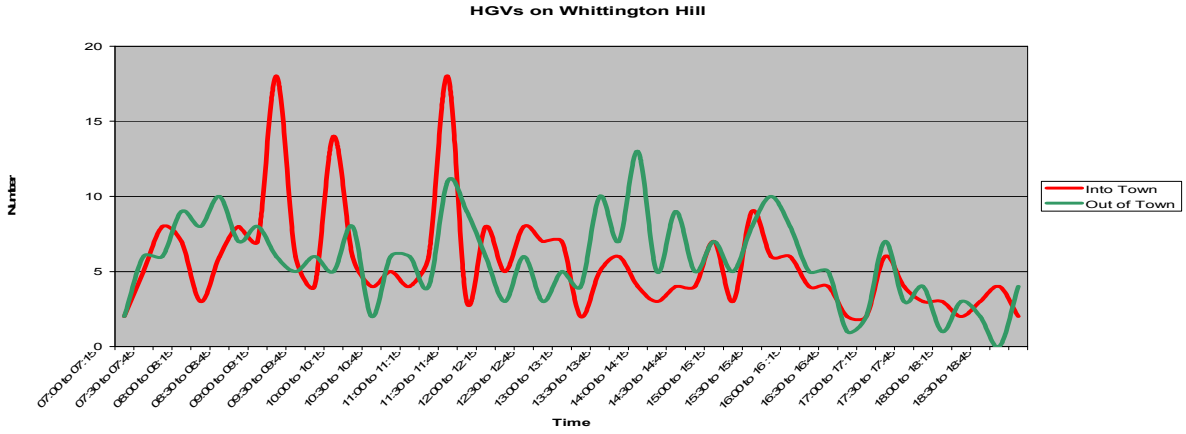
Whittington Hill had a total vehicle flow of 12594 with the busiest period between 17:00 and 17:15, with 379 vehicles. Note how the direction of traffic flow reverses from early afternoon, in the morning most flow is into town (downhill) and from the afternoon it changes to out of town (uphill).

Figure 5.1.1 Traffic Flow on Whittington Hill



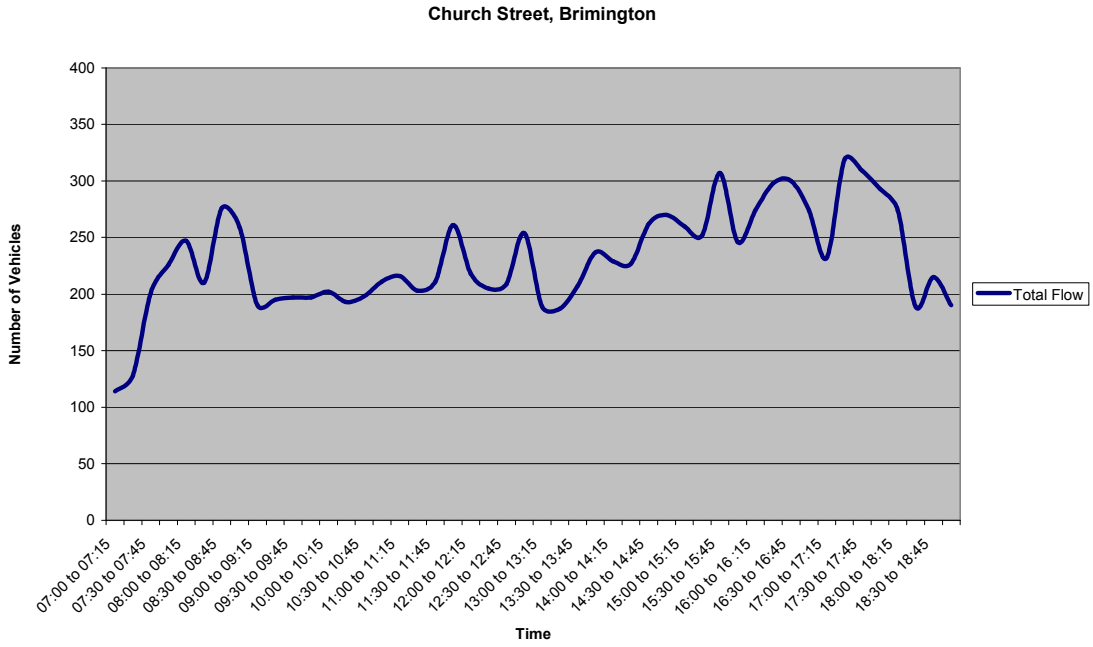
The related number of lorries and buses on the road is shown below:

Figure 5.1.2 Variation in HGV flows on Whittington Hill



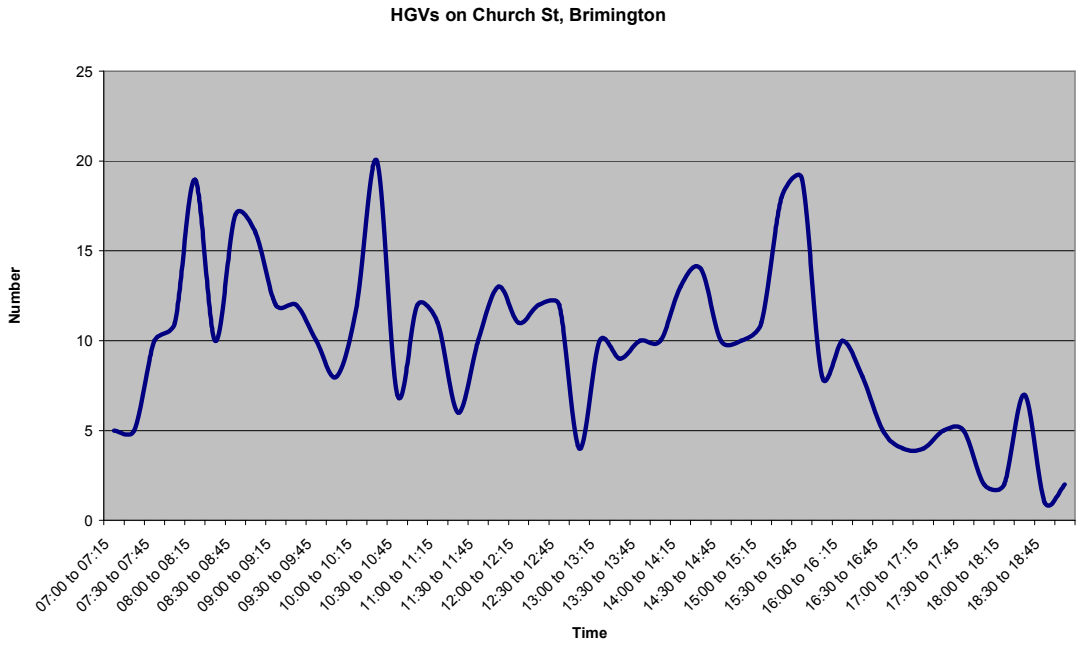
Church Street at Brimington (on the one-way system) had a peak flow at between 17:15 and 17:30, with 314 vehicles. The total vehicle flow at that site was 11061.

Figure 5.1.3 Traffic Flow on Church Street, Brimington



The related number of lorries and buses on the road is shown below:

Figure 5.1.4 Variation in HGV flows on Church Street, Brimington



In both locations it is noted that the number of HGVs appear to decline gradually through the day. This may confirm the anecdotal evidence that many haulage journeys are carried out on the motorway network in the night, and enter the domestic road system during the mornings.

Whilst much informative and interesting data was obtained by the traffic monitoring (particularly with regard to the impact of local topography on traffic speeds and engine

performance, on Whittington Hill), it must be tempered by the fact that the data is in the form of a "snap-shot" from a single day. Caution must be taken in assessing the validity of attempting to extrapolate the data over extended time periods. More accurate, and statistically valid, data can only be obtained by a full traffic counting survey, of the type routinely undertaken by the local highways authority (in this case Derbyshire County Council). Data has been supplied by that authority for the roads in question (from the existing data archive), but as the locations of the counts did not precisely match the Detailed Assessment locations we have regarded them as informative additional information which broadly verifies the in-house traffic counts.

5.2 Automatic Monitoring

Chesterfield Borough Council sought to source, install and operate a NOx monitor in the vicinity of Sheffield Road, where a possible breach of the Air Quality Objective may be found to be occurring. We sought, and obtained permission from Chesterfield Football Club, based at the Pronet stadium, but have been unable to source a suitable monitor. The result of this is that monitoring has been carried out solely by the use of NOx monitoring tubes, and the results obtained have been subject to bias adjustment by comparison with one of the AURN affiliated sites which are operated within the Borough. This exercise is addressed in Appendix 1.

5.3 Non-Automatic Monitoring

NO_2 diffusion tubes are used across the Borough, in order to assess the wider exposure to NO_2. During 2011, the location of the diffusion tubes was rationalised in order to provide a more targeted programme of monitoring, in support of the ongoing Detailed Assessments. This involved removing the sites where the NO_2 level is routinely well below the target level (ie less than 30 $\mu g/m^3$), and relocating the tubes to the sites where the existing tubes show results at the target level. The co-located tubes on the Automatic Site at Queens Park Annex have not been moved.

The locations of the tubes in the Detailed Assessment areas are shown in Table 5.3.1 overleaf:

Table 5.3.1 Locations of NOx tubes

Tube Number	Site Name	Site Type	O/S Grid Reference	Distance to kerb of nearest road	Relevant Exposure
3	376 Sheffield Road	Urban roadside	438291 373006	1m	Façade
40	380 Sheffield Road	Urban roadside	438290 373014	1m	Façade
31	386 Sheffield Road	Urban roadside	438289 373028	1m	Façade
4	390 Sheffield Road	Urban roadside	438284 373057	1m	Façade
28	Patrick Hinds House, Church St	Urban roadside	440323 373482	1m	Façade
6	6 Church Street	Urban roadside	440440 373514	1m	Façade
38	14 Church Street	Urban roadside	440421 373515	1m	Façade
37	50 Church Street	Urban roadside	440361 373513	1m	Façade
10	7 High Street	Urban roadside	440531 373484	1m	Façade
13	14a Church Street	Urban roadside	443450 374817	1m	Façade
21	39 Duke Street	Urban roadside	443447 374711	1m	Façade
33	55 Duke Street	Urban roadside	443452 374762	1m	Façade
7	63/65 Duke Street	Urban roadside	443454 374781	1m	Façade
26	37 Whittington Hill	Urban roadside	438323 374540	2m	Façade
11	42, Whittington Hill	Urban roadside	438307 374560	2m	Façade
25	62 Whittington Hill	Urban roadside	438294 374497	3m	Façade
36	65 Whittington Hill	Urban background	438304 374457	6m	Façade
23	78 Whittington Hill	Urban roadside	438285 374446	2m	Façade

Appendix 3 shows the locations of the NOx diffusion tube monitoring in the Detailed Assessment areas. The red dots show the locations of the tubes which have not been altered. The green dots are the revised locations allowing the Detailed Assessments to be undertaken.

6. Monitoring Results

6.1 Results

The table, overleaf, gives a summary of the results of the annual monitoring at each of the detailed assessment areas. The table shows the data capture rate for each site. The table is then split, showing the annual and monthly bias factor adjusted values for each site. It is further split, with all data included, and with low data capture site excluded. Any site with less than 75% data capture rate is excluded. In each case, using the annual bias factor gives a higher result than the monthly bias factor, and excluding low data capture rate data gives a higher result than including all data. The final result for each Detailed Assessment area (ie using the annual bias factor, and excluding low capture rate data) is displayed in bold.

Table 6.1 Results (all monitoring data expressed in µg/m^3)

Monitoring Site		All Data					Low Capture Rate Data Excluded			
		Monthly Bias factor		**Annual Bias factor**			**Monthly Bias factor**		**Annual Bias factor**	
	Data capture %	Annual Mean	Area Mean	Annual Mean	Area Mean		Annual Mean	Area Mean	Annual Mean	Area Mean
376 Sheffield Rd	83	34.81		35.84			34.81		35.84	
390 Sheffield Rd	100	29.28		29.44			29.28		29.44	
386 Sheffield Road	75	34.92		36.01			34.92		36.01	
380 Sheffield Road	100	39.15	34.54	39.30	35.15		39.15	34.54	39.30	**35.15**
6 Church St, Brimington	100	41.57		41.98			41.57		41.98	
50 Church St, Brimington	66	33.86		35.86			Data excluded due to low capture rate			
14 Church St, Brimington	92	43.71		44.20			43.71		44.20	
Patrick Hinds House, Brimington	92	32.24		32.19			32.24		32.19	
7 High St, Brimington	92	38.1	37.90	39.02	38.65		38.1	38.91	39.02	**39.35**
65 Duke St, Staveley	92	33.87		34.44			33.87		34.44	
39 Duke St, Staveley	25	28.19		28.23			Data excluded due to low capture rate			
55 Duke Street, Staveley	100	35.13		35.28			35.13		35.28	
14a Church St, Staveley	100	25.78	30.74	25.92	30.97		25.78	31.59	25.92	**31.88**
42, Whittington Hill	92	33.79		34.18			33.79		34.18	
78 Whittington Hill	92	29.84		30.06			29.84		30.06	
62 Whittington Hill	100	27.87		28.23			27.87		28.23	
37 Whittington Hill	92	23.29		23.29			23.29		23.29	
65 Whittington Hill	75	25.92	28.14	25.71	28.29		25.92	28.14	25.71	**28.29**

6.2 Modelling Results

Modelling has not been carried out, as previous modelling exercises in the areas concerned have asserted that there is no likelihood of the Air Quality Objective being breached. As such we have concerns over the validity of the models which are currently commercially available.

6.3 Discussion of Results

The general trend of improving air quality appears to be continuing from the poor air quality in 2010, driven by the abnormal weather patterns which drew air from central Europe, for extended periods in the year. This appears to be borne out by looking at the longer term trends for the original NOx tubes in each of the Detailed Assessment Areas:

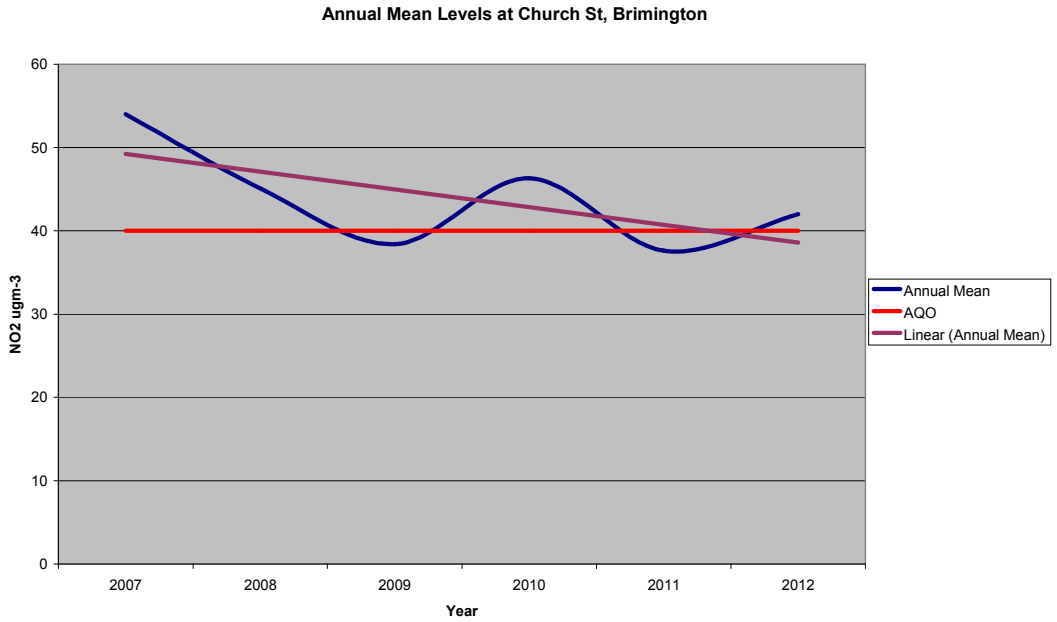
Table 6.3.1 Comparison of Annual Results

Location	2009	2010	2011	2012*
Sheffield Road	-	**45.2**	**42.3**	39.3
Whittington Hill	32.8	**45**	37.1	34.2
Church Street	38.4	**46.3**	37.6	**42.0**
Duke Street	35.7	**44.4**	31.7	34.4

* The data for 2012 is not the full calendar year, as the ratified data from the AURN sites is not yet available. This result is the data for the 12 months of this report, and as such duplicates the last four months of the previous year's data.

We are concerned about the fluctuating levels at Church Street, Brimington, where the level varies above and below the Objective. Monitoring has been carried out at a single location since 2007, this being the NOx tube at 14 Church Street. Figure 6.3.1, below, shows the changes in annual mean over time, in comparison with the Objective:

Figure 6.3.1 Trendline of Annual Mean NOx levels at Church St, Brimington



A trendline has also been plotted onto the graph, and clearly shows a general downward trend in the level, in this area. Given this fluctuation and the long term trend we are unable to conclude that an ongoing breach of the Air Quality Objective is occurring in this Detailed Assessment area. As such, we believe that it would be precipitous to proceed along the route of formally declaring an AQMA when the fluctuating levels may well continue as before,

displaying a downward trend but with peaks and troughs in the annual level. As can be seen by looking at the summary of actions in Table 3.1, this was the case between 2007 and 2010, where a proposed ribbon AQMA was scrapped as the monitoring did not substantiate a need, but only after a great deal of increasingly scarce resources had been allocated to the task.

The current intensified monitoring will continue in this area, in order to ensure that any reversal in the current trend is swiftly identified. In practice, this will mirror the work required in undertaking a Further Assessment.

Whilst we are taking a cautious approach with regard to formally declaring an AQMA, we have raised the issue of traffic pollution with the Highways Authority for this area (in this case Derbyshire County Council), with the intention of pressing for changes in traffic management in this area, in the same way as we would if an AQMA had been declared. Having discussed this with them, at an informal level, as the preliminary results of this monitoring exercise were being calculated (ie before the bias factors could be calculated, following ratification of the AURN site results for the same period), we are confident that this aim is shared by both authorities.

7. Conclusions

Overall, **none** of the Detailed Assessments has **demonstrated an ongoing breach** of the Air Quality Standard for Nitrogen Dioxide, as such Chesterfield Borough Council **will not be declaring Air Quality Management Areas** in any of the assessment sites.

8. Proposed actions

Whilst there is no breach of the Air Quality Objective, and as such no duty to declare an AQMA, it is noted that the overall level at Church Street, Brimington is close to breaching the Objective, and that two individual exposure sites in the assessment area have exceeded the Objective. In light of this, the current monitoring regime will continue in this area. Similarly, the results at Sheffield Road, while not breaching the Standard, are close to the level and monitoring will continue, unaltered, in this area.

Enhanced monitoring at both Whittington Hill and Duke Street, Staveley, ceased with effect from January 2013. In both locations, monitoring has reverted to a single tube, at the most elevated location over the Detailed Assessment period. This will allow the extra tubes to be relocated to more appropriate sites, as mentioned in the 2012 USA report.

The informal discussions with Derbyshire County Council Traffic Management team will continue in a more formalised manner, to address the ongoing issue of traffic congestion, both across the Borough as a whole, but more particularly along the A619 (part of which is Church Street, Brimington, and also Duke Street, Staveley), in order to ensure the continued downward trend of vehicle derived air pollution.

9. References

NO2 Diffusion Tubes for LAQM: Guidance for Local Authorities NETCEN, 2006

Diffusion Tubes for Ambient NO2 Monitoring: Practical Guidance NETCEN, 2008

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DEFRA, 2011

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Local Air Quality Management Technical Guidance LAQM.TG (09) DEFRA, 2009

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A Brief Survey of Traffic Flows at Key Locations in Chesterfield Enstec Services Ltd, 2011

The Relation Between Diffusion Tube Bias and Distance From the Road
Air Quality Consultants Ltd, 2006

Brimington – Staveley By-pass, a Non-Technical Summary of the Environmental Statement
Derbyshire County Council. 1995

Appendices

Appendix 1: QA/QC
Appendix 2: Data Capture Rate
Appendix 3: NOx diffusion tube locations in Detailed Assessment Areas
Appendix 4: Panoramic Mosaics of Church Street, Brimington
Appendix 5: Panoramic Mosaics of Duke Street, Staveley
Appendix 6: Panoramic Mosaics of Sheffield Road, Whittington Moor
Appendix 7: Panoramic Mosaics of Whittington Hill

Appendix 1: QA/QC

Bias factor calculation and verification

The results obtained by the use of diffusion tubes is subject to a bias factor which is calculated locally by comparison with the results obtained by the affiliated AURN monitoring site on Chatsworth Road. This site is used as it is more comparable to the detailed assessment locations than the site in Queens Park (which is located at a sports field).

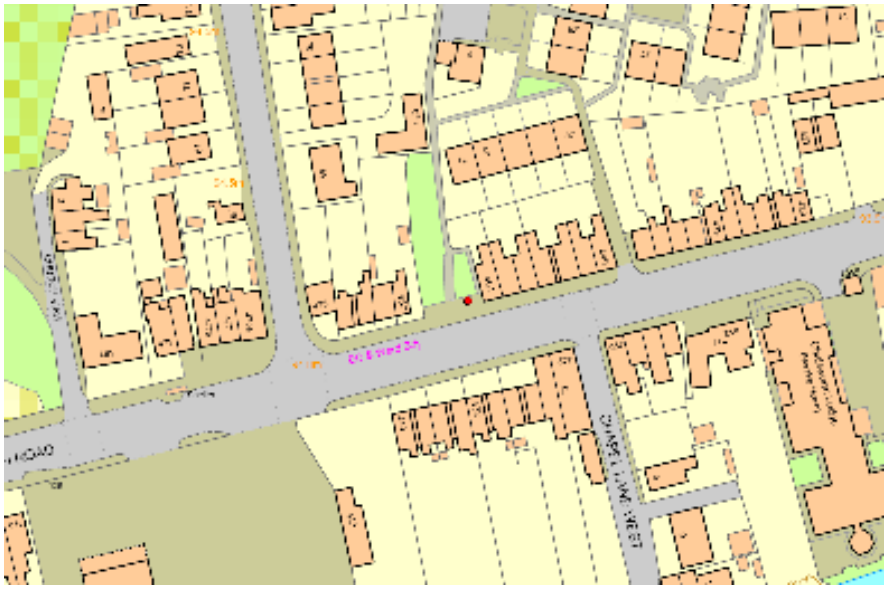
Chesterfield Borough Council operates two automatic monitoring sites, affiliated to the national AURN network. The details of the sites and the monitoring being undertaken at each location are given below in Table AP1.1:

Table AP1.1: Detail of Automatic Monitoring Site

Site Name	Site Type	OS Grid Ref		Pollutants Monitored	Monitoring Technique
Chatsworth Road	Roadside (but reclassified as an Urban background)	436349 E	370657 N	NOx PM_{10} $PM_{2.5}$ Benzene Aldehyde	Chemi-luminescent FDMS FDMS Pumped Tubes Pumped Filter
Site Name	**In AQMA?**	**Relevant Exposure?** (Y/N with distance (m) to relevant exposure)		**Distance to kerb of nearest road** (N/A if not applicable)	**Does this location represent worst-case exposure?**
Chatsworth Road	N	Y (1m)		4.5m	Yes

The map, below, shows the locations of the two automatic monitoring stations operated by Chesterfield Borough Council.

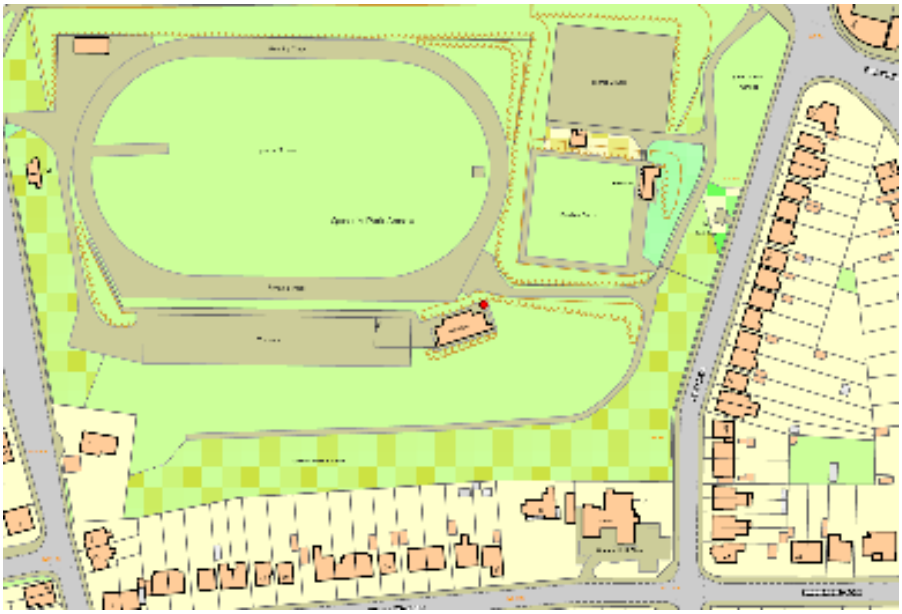
Figure AP1.1 Location of Chatsworth Road Automatic Monitoring Site



Note: For data handling and data download purposes, this site is referred to as Chesterfield Roadside, by both Bureau Veritas and DEFRA.

This site, formerly classified as a Roadside site, has been reclassified as an Urban Background site due to the distance between the sample inlet and the nearest kerbside. This site is indicative of public exposure for dwellings in urban locations.

Figure AP1.2 Location of Queens Park Annex Automatic Monitoring Site



Note: For data handling and data download purposes, this site is referred to as Chesterfield, by both Bureau Veritas and DEFRA.

This site is classified as an Urban Background site, and is indicative of the diffusion tubes in locations set away from main roads.

As is readily apparent from looking at the location maps, the Chesterfield Roadside site, on Chatsworth Road, is most appropriate for bias factor calculation. This is discussed further below.

The use of the co-located diffusion tubes on the AURN monitoring station allows a locally derived bias factor to be calculated. The annual factor for the period September 2011 to August 2012 is **0.73**, this is comparable with the factors applied over the previous seven years.

Figure AP1.3 Ricardo-AEA standard Bias factor calculation output

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	31/08/2011	28/09/2011	23.0	24.0	23.0	23	0.6	2	1.4	15.40	100	Good	Good
2	28/09/2011	01/11/2011	29.0	30.0	30.0	30	0.6	2	1.4	21.70	99.7	Good	Good
3	01/11/2011	30/11/2011	39.0	36.0	39.0	38	1.7	5	4.3	30.60	100	Good	Good
4	30/11/2011	04/01/2012	25.0	27.0	26.0	26	1.0	4	2.5	22.30	99.5	Good	Good
5	04/01/2012	01/02/2012	30.0	31.0	33.0	31	1.5	5	3.8	24.30	98.1	Good	Good
6	01/02/2012	29/02/2012	35.0	34.0	34.0	34	0.6	2	1.4	24.00	95.8	Good	Good
7	29/02/2012	28/03/2012	30.0	36.0	37.0	34	3.8	11	9.4	24.30	95.5	Good	Good
8	28/03/2012	25/04/2012	28.0	27.0	27.0	27	0.6	2	1.4	18.00	95.1	Good	Good
9	25/04/2012	30/05/2012	24.0	23.0	22.0	23	1.0	4	2.5	17.60	90.9	Good	Good
10	30/05/2012	27/06/2012	24.0	22.0	23.0	23	1.0	4	2.5	15.20	90.6	Good	Good
11	27/06/2012	01/08/2012	19.0	21.0	20.0	20	1.0	5	2.5	15.26	97.5	Good	Good
12	01/08/2012	29/08/2012	22.0	24.0	23.0	23	1.0	4	2.5	14.13	99.7	Good	Good
13													
												Overall survey -->	Good precision	Good Overall DC

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

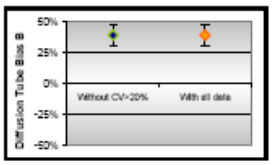
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Chatsworth Road

Precision: 12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.73 (0.69 - 0.78)
Bias B	37% (29% - 46%)
Diffusion Tubes Mean:	28 μgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	20 μgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	20 (19 - 22) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.73 (0.69 - 0.78)
Bias B	37% (29% - 46%)
Diffusion Tubes Mean:	28 μgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	20 μgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	20 (19 - 22) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

In addition to calculating a single annual bias factor, the data has been further adjusted using a bias factor for each month, in order to discover any unacceptable variations in data validity. This has also allowed a variance to be calculated for each month in comparison with the annual bias factor. The result of this exercise is shown below:

The monthly bias factors are as follows:

Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
0.66	*0.73*	*0.81*	*0.86*	*0.78*	*0.70*	*0.71*	*0.66*	*0.77*	*0.66*	*0.76*	*0.61*

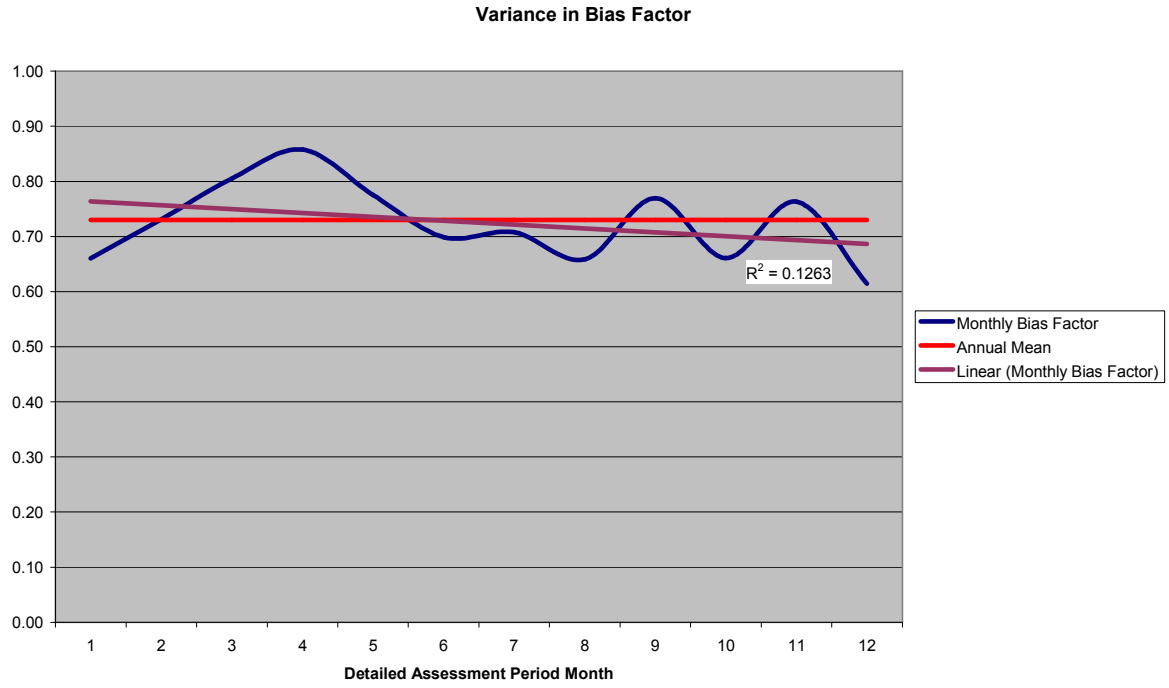
Comparing the monthly factor to the annual bias factor allows a monthly variance between both bias factors to be calculated, and this has been expressed as a percentage from the annual factor:

Sep	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*
-9.95	*0.20*	*10.31*	*17.49*	*6.24*	*-4.24*	*-3.05*	*-9.79*	*5.42*	*-9.47*	*4.52*	*-15.84*

Overall the positive and negative variations from the annual bias factor cancel out but analysis of the variations allows an assessment of the variance where lower data capture has resulted from missing NOx sample tubes, and in these instances the overall Detailed Assessment area statistical calculations will be carried out with any suspect data included, and removed, and the “worst case” results used.

The bias factor data has been plotted on a graph allowing the monthly and annual bias factors to be compared. This is achieved by plotting a linear regression line through the monthly data and calculating the R-squared value.

Figure AP1.4 Variation in Bias Factor



As can clearly be seen, the regression line and the annual mean are closely related. The R-squared value of the monthly bias factor data is low, indicating that the data is of low variability throughout the year.

We are confident that the locally calculated annual bias factor is statistically viable.

Appendix 2: Data Capture Rate

The capture rate for the automatic monitor at Chatsworth Road is **96.9**%.

The capture rate for the diffusion tubes at each site is shown in Table AP2.1below:

Table AP2.1 Data Capture Rates

Location	Data capture %
376 Sheffield Rd	***83***
390 Sheffield Rd	***100***
386 Sheffield Road	***75***
380 Sheffield Road	***100***
6 Church St, Brimington	***100***
50 Church St, Brimington	***66***
14 Church St, Brimington	***92***
Patrick Hinds House, Brimington	***92***
7 High St, Brimington	
65 Duke St, Staveley	***92***
39 Duke St, Staveley	***25***
55 Duke Street, Staveley	***100***
14a Church St, Staveley	***100***
42, Whittington Hill	***92***
78 Whittington Hill	***92***
62 Whittington Hill	***100***
37 Whittington Hill	***92***
65 Whittington Hill	***75***

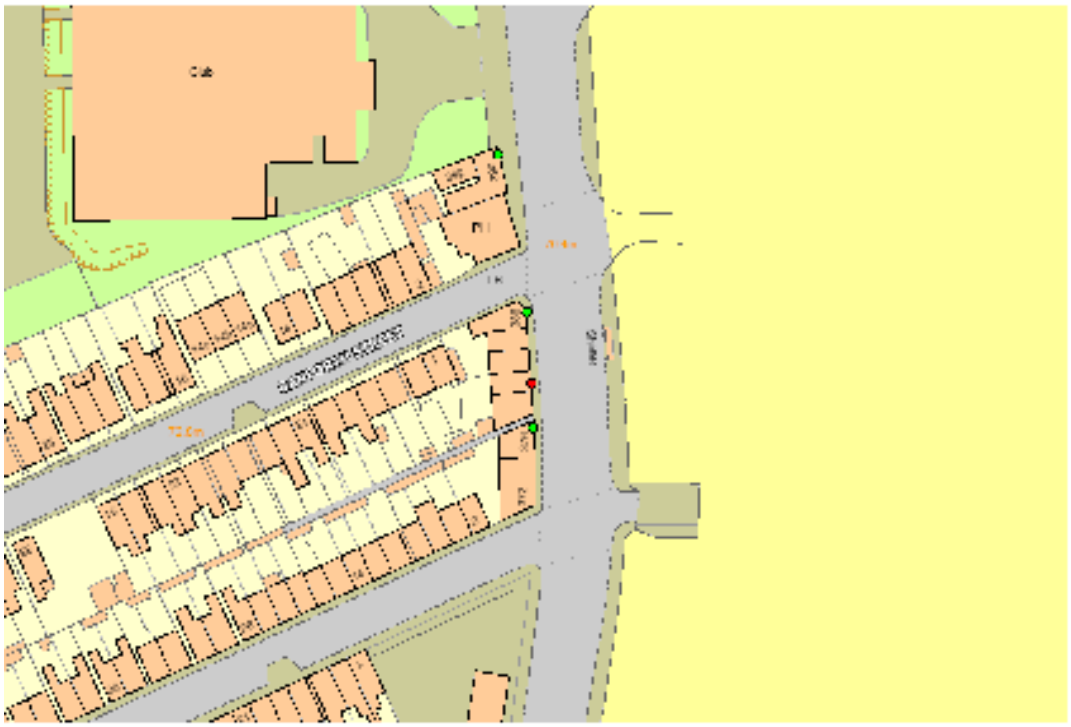
Low data capture at a single site in both the Church St, Brimington area and the Duke St, Staveley area have meant that two calculations have been carried out for these locations (one with all data included and one with the poor data rate sites excluded), in both instances the "worst case" result is used for the final assessment.

Appendix 3 NOx diffusion tube locations in Detailed Assessment Areas

Sheffield Road

The red dots show the locations of the tubes which have not been altered. The green dots are the revised locations allowing the ongoing Detailed Assessments to be undertaken.

Figure AP3.1 Sheffield Road Sites



The location of the new football ground and supermarket development is denoted by the yellow sector of the map, and is shown again in an update to the area mapping in the figure overleaf:

Figure AP3.2 Sheffield Road Sites

Whittington Hill

The red dots show the locations of the tubes which have not been altered. The green dots are the revised locations allowing the ongoing Detailed Assessments to be undertaken.

Figure AP3.3 Whittington Hill Sites

Church St, Brimington

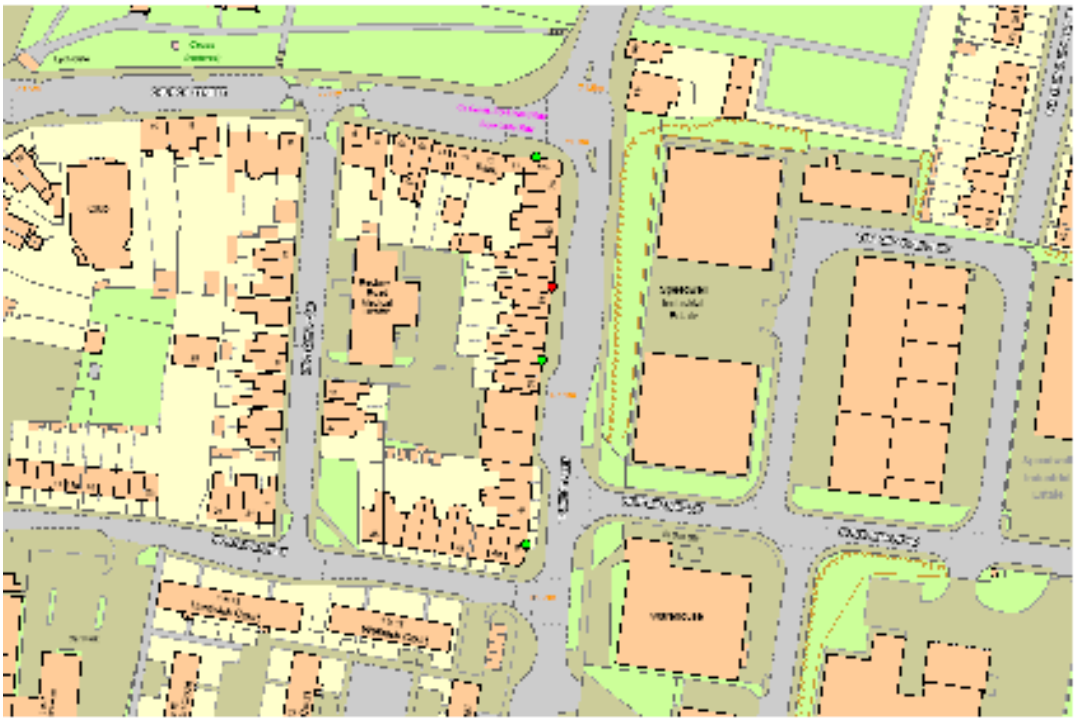
The red dots show the locations of the tubes which have not been altered. The green dots are the revised locations allowing the ongoing Detailed Assessments to be undertaken.

Figure AP3.4 Church Street, Brimington Sites

Duke Street, Staveley

The red dots show the locations of the tubes which have not been altered. The green dots are the revised locations allowing the ongoing Detailed Assessments to be undertaken.

Figure AP3.5 Duke Street, Staveley Sites



Appendix 4

Panoramic Mosaics of Church Street, Brimington

Panorama 1

Panorama 2

Panorama 3

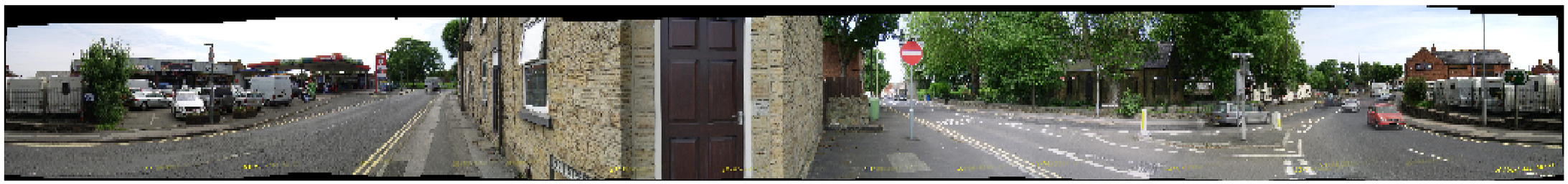
Panorama 4

Panorama 5

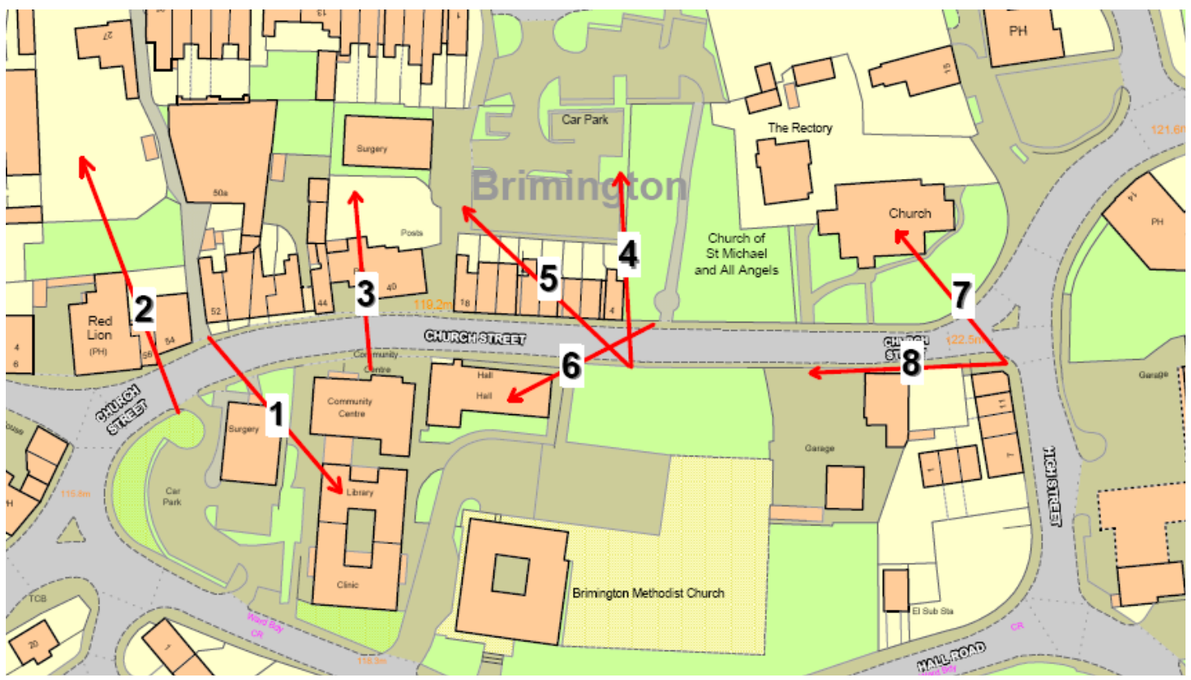
Panorama 6

Panorama 7

Panorama 8



Key to Panorama Directions (the numbered arrows show the direction of the centre of each panorama mosaic)



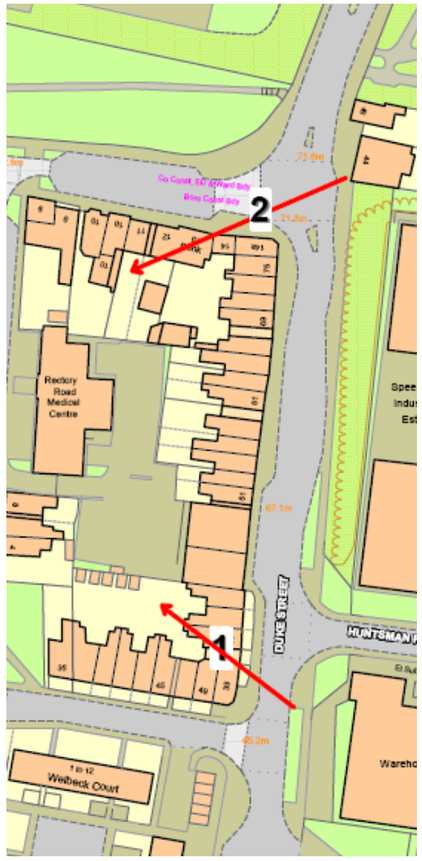
Appendix 5

Panoramic Mosaics of Duke Street, Staveley

Panorama 1

Panorama 2

Key to Panorama Directions (the numbered arrows show the direction of the centre of each panorama mosaic)



Appendix 6

Panoramic Mosaics of Sheffield Road, Whittington Moor

Panorama 1

Panorama 2

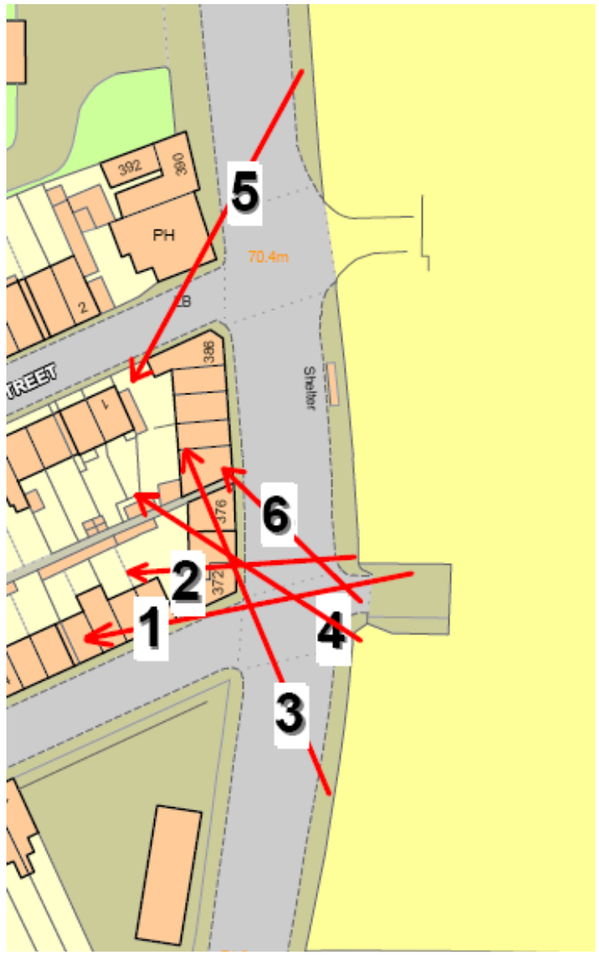
Panorama 3

Panorama 4

Panorama 5

Panorama 6

Key to Panorama Directions (the numbered arrows show the direction of the centre of each panorama mosaic)



Appendix 7

Panoramic Mosaics of Whittington Hill, Old Whittington

Panorama 1

Panorama 2

Panorama 3

Panorama 4

Panorama 5

Key to Panorama Directions (the numbered arrows show the direction of the centre of each panorama mosaic)