

AIR QUALITY WORKING GROUP(AQWG) REPORT – Jan 2020

The Christleton and Littleton Air Quality Working Group.

CHRISTLETON

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1-SUMMARY

CWac's fixed monitor measurements indicate that the WHO and UK limit for NO₂ of 40ug/m³ have been exceeded in three out of five consecutive years on the A41 and for two consecutive years on the A51.

From August through to November a Christleton volunteer has monitored air quality from the A51 through the centre of Christleton to the A41 using a handheld Plume device which measures Nitrogen Dioxide(NO₂), 10micron particles(PM₁₀) and 2.5micron particles(PM_{2.5}). Although these Plume devices have indicated that NO₂ concentrations are at or below the NO₂ limit at all locations from the A41 to the A51 they have revealed that PM₁₀ and PM_{2.5} concentrations are at or well above the PM₁₀ and PM_{2.5} limits at peak times at four hotspots.

- **The centre of the village**
- **The centre of the village down Pepper St, the A41 cycle path and across the Hamburger**
- **Littleton A51 junction to VX Golf Club**
- **Little Heath Road to the A51**

All of these locations are routes to schools for schoolchildren

Data gathered indicates that NO₂ and PM₁₀ concentrations are almost wholly traffic related whilst PM_{2.5} concentrations are 30/40% traffic related and 60/70% are from a wide range of other sources.

As exposure to PM₁₀ and PM_{2.5} levels, above the WHO and DEFRA limits, has serious long term health implications these results are being shared with CWAC who will be asked to support:

- Continuous monitoring of PM₁₀ and PM_{2.5} as well as NO₂
- Actions based on an inevitable reduction in DEFRA limits for PM₁₀ and particularly PM_{2.5} particles
- Air Quality Management Area(AQMA) status for the A41 and A51
- Air Quality Management Plans for the A41 and A51
- Signage to direct traffic via the M56/M6 rather than down the A41 and A51
- Increased priority for building of a link road to bypass Littleton
- Creation of additional lane from the A41 directly on to A55 with no lights
- Create an additional lane from the Hamburger to the A41.
- Improvements in control of the Hamburger to reduce queueing on the A41
- A delay in the upgrade to the A51 until sufficient NO₂ and PMs measurements have provided a clear understanding of the effect of increased traffic flows on air quality
- Essential improvements to the A51 roundabout including switching off of the internal lights
- Plans to reduce traffic flow through the centre of Christleton
- Park and Stride
- Alternative cyclist and pedestrian routes to school

The levels of pollution identified in this report from the A41 through Christleton Village centre to the A51 is comparable to larger urban locations like Bolton, Bournemouth, Leicester, Edinburgh, Manchester, Newcastle, Liverpool, Bristol to name just a few of over seventy locations throughout the UK.

Failure to take these Christleton and Littleton actions will result in fine particles continuing to penetrate deep into the lungs and cardiovascular system of children with long term health consequences.

2-AIR QUALITY CONCENTRATION LIMITS

About 4 million people die globally each year as a result of outdoor exposure to particulate air pollution. In Europe, 520 000 excess deaths a year were attributed to air pollution in 2017. In the UK 40 000 deaths a year are attributed to air pollution with London alone contributing 10 000 deaths. These deaths are mainly due to exposure to nitrogen dioxide (NO₂) and particulate matter (PM).

As a result there is an increasing focus on:

- NO₂ – Nitrogen Dioxide
- PM₁₀ – Particle size less than 10u
- PM_{2.5} –Particle size less than 2.5u

Concentration limits are progressively dropping but there are some differences between the World Health Organisation(WHO), US(EPA) and EU/UK(Defra) limits:

		All concentrations in ug/m ³		
		WHO	US	EU and UK(DEFRA) used by CWAC
NO ₂	annual mean	40	100	40
	1 hr mean	200		200(no more than 18 times/year in UK)
PM 10	annual mean	20	50	40(18 in Scotland)
	24 hour mean	50	150	50(no more than 35times/year in UK)(7 times/year in Scotland)
PM 2.5	annual mean	10	12	25(12 in Scotland)
	24 hour mean	25	35	

- Attachment 1 – NO₂ extract from WHO air quality guidelines
- Attachment 2 – PMs extract from WHO air quality guidelines
- Attachment 3 - National air quality objectives and European Directive limits – DEFRA

NO₂ has been identified as contributing to respiratory and cardiovascular illness. If you live alongside very busy roads, and your health is good, the levels of NO₂ are unlikely to have any short-term health effects. The long-term effects however can result in a gradual deterioration in the health of people who are already suffering from respiratory problems, and an increased susceptibility to respiratory infections amongst healthy individuals.

There is an increasing concern about particulate matter (PM) which is a mixture of solid and liquid particles with aerodynamic diameter smaller than 2.5um (PM_{2.5}) and between 2.5 and 10um (PM_{10-2.5}), respectively known as fine and coarse particles. PM_{2.5} particles are smaller than PM_{10-2.5} particles. These PM_{2.5} particles are the most dangerous form of air pollution as their microscopic size and larger surface area to volume ratio allows them to carry more toxic pollutants deep into the lungs where they enter the bloodstream.

The EU and UK PM_{2.5} annual mean limit of 25ug/m³ is out of step with both the WHO and US limits of 10/12ug/m³ and will almost certainly be reduced as recent studies have shown positive associations between short term exposure to PM_{2.5} and risk of hospital admission from septicemia, fluid/electrolyte disorders, acute and unspecified renal failure, cardiovascular/respiratory diseases, Parkinson's disease, diabetes, phlebitis, thrombophlebitis and thromboembolism etc etc

- Attachment 4 – Short term exposure to fine particulate matter PM_{2.5}

We have concluded that planned actions in response to PM_{2.5} measurements should anticipate the inevitable reduction in the PM 2.5 annual limit from 25ug/m³(EU/UK) to 10ug/m³(WHO/US).

3-CWAC MONITORING OF NO2 ONLY

All annual means are extracted from the CWAC 2017/2018 reports for the locations listed:

A51	TA	2017	47.4
		2018	44.5
Centre of Village	VRC	2018	19.6
A41	W23	2017	29.2
		2018	33.1
	CM	2017	30.8
		2018	33.9
	CP3	2017	31.9
		2018	31.3
	MCC	2014	41.8
		2015	38.1
		2016	44.5
		2017	40
		2018	38

The A51 and A41 NO2 levels measured by CWAC are generally near or above the WHO and DEFRA annual limits

As you can see TA on the A51, which is currently outside the AQMA, has an NO2 of 44.5ug/m3 in 2018 whereas Chester City Centre has an average of 32.3 ug/m3 with a range of 25.2 to 45.7ug/m3. The extended AQMA into Boughton has an average of 36.1ug/m3 with a range of 25 - 47.6 and the entire AQMA has an average of 35.69ug/m3. The measurements at TA on the A51 are higher than 91% of all readings inside the Chester AQMA zone and the measurements at MCC on the A41 are higher than 77% of all readings inside the Chester AQMA zone.

It is difficult to understand why the A41 and A51 are not inside the Chester AQMA

- Attachment 12 - Extent of existing Chester AQMA

4-PLUME DEVICES TO DATE AND CALIBRATIONS

Whereas the CWaC fixed monitors measure long term levels of NO2 alone, the Plume measurement devices are capable of continuous readout of NO2, PM2.5 and PM10. The first device was purchased by a Christleton resident (Plume 1) and the second and third devices by Littleton residents (Plume 2,3) and a fourth device by a Chester resident (Plume 4).

Measurements have been mainly taken using Plume1 from the beginning of August to the end of the year.

The plume devices employ nano technology based upon semi-conducting metal oxides for NO2 and laser light scattering for particulates whereas the national monitors employ chemiluminescence for NO2 and thermogravimetric measurement for particulates. Papers comparing the two conclude they give virtually identical results given frequent cleaning and filter changes for static monitors and regular calibration for static monitors and Plumes.

The Plume devices have been calibrated successfully against static monitors at Boughton for NO2 and Wrexham for NO2, PM10 and PM2.5 and are sufficiently accurate to identify hotspots requiring continuous monitoring to compare with the above limits.

		FIXED	PLUME 1	PLUME 2
Boughton Aug 28 th	NO2	22.5	18	
Wrexham Oct 20 th	NO2	6	6	
	PM2.5	13	11.4	
Wrexham Nov 16	PM2.5	5.8	3.4	3.2
	PM10	7.5	11	4.9

Wrexham measures particulates every 12 minutes but only reports an hourly average. The Plume devices measure and report every minute so comparing the static monitors when they are both dynamically changing is difficult. For example the above Plume measurement of 3.4 for PM2.5 has a 1.4-5.3 dynamic spread.

A statistical analysis of the Plume measurements indicates a 95% confidence level of alignment with the static monitors. A simpler observation to date is that most Plume measurements are conservatively lower than the static monitors which are themselves heavily dependent for accuracy on frequent cleaning and filter changes.

5-PLUME MEASUREMENTS BY LOCATION

Plume 1 has taken 27 sets of measurements for approximately an hour on each occasion in locations from the A41 through to the A51 and four hotspots identified – the centre of the village, centre of Village down Pepper St to Hamburger, Littleton A51 junction to VX Golf Club and return and Little Heath Road to A51.

- Attachment 5 - Air Quality measurements Aug 1 to Nov 24 2019

These measurements have been compared with the above concentration limits for the four hotspots and plotted on a map of Christleton and Littleton.

- Attachment 6 – Comparison of measurements with concentration limits
- Attachment 7 – Map location of Hotspots

5.1-CENTRE OF VILLAGE.

- 16X1 hour sessions covering 0800 to 1700 Aug 1 – Nov 24.
- NO2 from 0 to 74ug/m3 – generally below the WHO annual/24hour limits of 40/200ug/m3.
- PM10 from 8 to 85ug/m3 – average is around the WHO 24hour limit of 20ug/m3.
- PM2.5 from 2 to 64ug/m3 – average is around the WHO annual limit of 10ug/m3 with many peaks above but the average is below the DEFRA limit of 25ug/m3.

5.2-CENTRE OF VILLAGE DOWN PEPPER ST TO HAMBURGER.

- 7 sessions covering school runs 0745-0845 and 1450-1600.
- NO2 from 2 to 48ug/m3 – generally below the WHO annual/24hour limits of 40/200ug/m3 with peaks above at the Hamburger.
- PM10 from 8 to 79 – peaking above the WHO/DEFRA annual limits of 20/40ug/m3 from the end of Pepper St, along the A41 cycle track and across the Hamburger pedestrian crossing.
- PM2.5 from 2.5 to 64 – peaking at several times the WHO/DEFRA annual limits of 10/25ug/m3 from the end of Pepper St, along the A41 cycle track and across the Hamburger pedestrian crossing.

5.3-LITTLETON A51 JUNCTION TO VX GOLF CLUB & RETURN

- 1X1hour session 1400 to 1500 – a Saturday.
- NO2 from 2 to 24ug/m3 – less than WHO/DEFRA annual limit of 40ug/m3.
- PM10 from 27 to 46ug/m3 – peaks at above the WHO/DEFRA annual limits of 20/40ug/m3 but less than the 24hour mean of 50ug/m3.
- PM2.5 from 14 to 39ug/m3 – peaks at several times the WHO/DEFRA annual limits of 10/25ug/m3.

5.4-LITTLETON LANE/THE BYE PASS TO A51

- 1X1hour sessions covering 1530 to 1730 – school run – stream of slow moving traffic.
- NO2 from 0 to 10ug/m3 – peaks arriving at A51 but none on A51 as flow into Chester swift.
- PM10 from 0 to 30ug/m3 – peaks generally lower than WHO/DEFRA annual limits of 20/40ug/m3.
- PM2.5 from 0 to 40ug/m3 – highest on Littleton Lane in slow moving traffic – higher than WHO/DEFRA annual limits of 10/25ug/m3.

Limited monitoring outside schools to date – further resources needed from the village and/or schools

5.5-GENERAL OBSERVATIONS

CWAC are only measuring NO2 but PM10 and PM2.5 appear to be the more significant issue

Measurements to date indicate:

NO2 concentrations are below the WHO/DEFRA limits for all areas measured to date except the Hamburger
PM10 and PM2.5 concentrations are around or above the WHO/DEFRA limits for certain times at:

- **The centre of the village**
- **The centre of the village down Pepper St, the A41 cycle path and across the Hamburger**
- **Littleton A51 junction to VX Golf Club**
- **Little Heath Road to the A51**

We have the most measurements in the centre of the Village

- Attachment 8 - Centre of Village NO2, PM10, PM2.5 concentrations for 50 to 600 v/hour traffic

These measurements have been graphed in Attachment 8 and are summarised here

ug/m3	Annual limits				
	50v/hr	600v/hr	Av of 16	WHO	EU/UK
NO2	8	27	16.0	40	40
PM10	18	32	23.7	20	40
PM2.5	7	11.5	9.0	10	25

- NO2 is not a reliable marker for PM10 and PM2.5
- NO2 and PM10 concentrations increase significantly with traffic volume
- PM 2.5 concentrations are less sensitive to traffic volume
- PM10 and PM2.5 levels are at the WHO limits but below the EU/UK limits in the centre of the village

Increased gaps between cars reduces concentrations as vortex are set up between each car
Increased vehicular speed reduces concentrations but increased volume increases concentrations
Significant increases in PM2.5 are expected as we move into the increased use of fossil fuels/gas/oil for heating in December and January.

There are multiple rural, domestic heating and industrial sources for PM2.5 in major UK urban locations. If you believe the published UK seasonal variations in major UK urban locations there would appear to be no short term actions that can reduce concentrations of PM2.5 to below 10ug/m3. However our measurements indicate that the background PM2.5 concentrations in the Christleton and Littleton area are lower than 10ug/m3 and action now will prevent the long term inevitable health effects for the young and elderly.

- Attachment 9 – Executive summary of DEFRA PM2.5 document
- Attachment 10 - Sources of PM2.5
- Attachment 11 – PM2.5 seasonal variations

6-ACTIONS REQUIRED - REVIEWED AND ADDED TO BY TWG

6.1-CENTRE OF VILLAGE

Christleton Traffic Working Group(TWG) recommendations to reduce congestion

- Reduction in gridlocks through Hbarring of driveways to protect driveway passing places.
- Removal of pinch point opposite ROB.
- Park and Stride to reduce school drop off and pick up traffic.
- Gateways and chicanes on Little Heath Road, Plough Lane and Birch Heath Lane to reduce traffic volume.

Additional recommendations to further reduce congestion and improve air quality

- Sealed surfaces that do not abrade and hold particles – sets or the modern equivalent of cobbles.
- Total change in atmosphere and improvement in appearance of centre of Village so as to discourage all vehicles other than the absolute necessary from accessing Village Road (Civic Architect).
- Reconsider eliminating or reducing flow off the A41 down Rowton Bridge Road.
- Signage to direct traffic via M56/M6 rather than down the A41 and A51.
- Increase priority for building of link road to bypass Littleton
- Provision of car park adjacent to village centre

6.2-CENTRE OF VILLAGE DOWN PEPPER ST TO HAMBURGER

Reduce queueing on A41 to/from Hamburger by:

- Creation of additional lane with no lights from A41 directly on to A55.
- Create additional lane from Hamburger on to A41.
- Optimising computer operation of Hamburger to reduce A41 queue lengths.
- Consider alternative cyclist and pedestrian routes to school.

6.3-LITTLETON A51 JUNCTION TO VX GOLF CLUB & RETURN

- Delay upgrade to A51 until sufficient NO2 and PMs measurements/modelling to understand the air quality impact of increased traffic flows.
- Switch off A51 roundabout internal lights to ease congestion.

6.4-LITTLETON LANE/THE BYE PASS TO A51

- Reduce traffic flows into and out of Village so as to reduce congestion on LHR.
- Total change in atmosphere in the centre of Village so as to discourage vehicles from accessing the centre of the village via LHR.

6.5-CWAC ACTION REQUIRED FOR HOTSPOTS

Continuous monitoring of PM10 and PM2.5 as well as NO2

Air Quality Management Area(AQMA) status consideration for the A41 and A51

Air Quality Management Plans for the A41 and A451

6.6-FAILURE TO TAKE ACTION IS NOT AN OPTION

The levels of pollution identified in this report from the A41 through Christleton Village centre to the A51 is comparable to larger urban locations like Bolton, Bournemouth, Leicester, Edinburgh, Manchester, Newcastle, Liverpool, Bristol to name just a few of over seventy locations throughout the UK.

Failure to take these actions in Christleton and Littleton will result in fine particles penetrating deep into the lungs and cardiovascular system of young children with the long term consequences of strokes, heart disease, lung cancer, asthma and respiratory infections to name just a few.

Legal action against local authorities that have failed to take action is now more commonplace.

7-ATTACHMENTS

- 1 – NO2 extract from WHO air quality guidelines
- 2 – PMs extract from WHO air quality guidelines
- 3 – DEFRA National air quality objectives and EU directive limit and target values
- 4 – Short term exposure to fine particulate matter PM2.5
- 5 - Air Quality measurements-Aug 1-Nov 24 2019
- 6-Comparison of measurements with concentration limits
- 7-Map location of Hotspots
- 8-Centre of Village NO2, PM10, PM2.5 concentrations for 50 to 600 v/hour traffic volumes
- 9-Executive summary of PM2.5 document
- 10-Sources of PM2.5
- 11-PM2.5 seasonal variations
- 12-Extent of existing Chester AQMA