Cheshire West and Chester Council Thornton le Moors Air Quality Action Plan (Draft)

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

Revised 2023

Cheshire West and Chester

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Report Reference number	AQAP Thornton
Published	October 2017
Revised	December 2023

Executive Summary

This Air Quality Action Plan (AQAP) has been produced as part of our statutory duties required by the Local Air Quality Management framework. It comprises a review of the measures detailed within the Thornton le Moors AQAP up to and including 2022, assesses the relative success of the measures to improve air quality within the Thornton le Moors Air Quality Management Area (AQMA) and sets out our priorities up to 2027. In setting out our priorities we take into account progress made on the implementation and delivery of the Action Plan up to 2022 in order to ensure compliance with the national air quality objectives.

Air pollution is associated with a number of adverse health impacts and affects the most vulnerable in society: children and older people, and those with heart and lung conditions. Sulphur dioxide (SO_2), which is the pollutant of concern in the Thornton le Moors AQMA, is a respiratory irritant that can cause constriction of the airways. People with asthma are considered to be particularly sensitive and health effects can occur very rapidly, making short-term exposure to peak concentrations important.

The annual health cost to society of the impacts of air pollution in the UK is significant[1]. Cheshire West and Chester Council is committed to reducing the exposure of people in the borough to poor air quality in order to improve health.

The Thornton le Moors AQMA was declared in 2016 in response to measured and modelled exceedances of the 15-minute objective for SO_2 in residential areas and public open spaces. The cause of the exceedances is industrial, predominantly related to refinery emissions, although it is recognised that Essar Oil (UK) Ltd. is compliant with its permit conditions set by the Environment Agency (EA).

We have developed actions that can be considered under two broad topics:

- Environmental permits
- Public information

The aim of this AQAP is to address the exceedances of the short-term objective for SO_2. Our secondary priority is to provide accurate and timely information on local air quality to local residents and industry.

[1] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

In this AQAP we outline how we, the Environment Agency and Essar Oil (UK) Ltd. plan to effectively tackle air quality issues within our control in Thornton le Moors. However, as a local authority, we recognise that there are a large number of air quality policy areas that are outside of our influence (such as industrial emissions standards set in permitting regulations), but for which we may have useful evidence, and so we will continue to work with regional and central government on policies and issues beyond Cheshire West and Chester's direct influence.

Responsibilities and Commitment

This AQAP was prepared by the Regulatory Services department of Cheshire West and Chester Council with the support and agreement of the Environment Agency and Essar Oil (UK) Ltd.

This AQAP has been approved by:

Maria Byrne
Director of Environment and Communities
Cheshire West and Chester Council

This AQAP will be subject to an annual review, appraisal of progress and reporting to the Council's air quality steering group. Progress each year will be reported in the Annual Status Reports (ASRs) produced by Cheshire West and Chester Council, as part of our statutory Local Air Quality Management duties.

If you have any comments on this AQAP please send them to:

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Table of Contents

List of Tables

List of Figures

1. Introduction

This report reviews the actions that Cheshire West and Chester Council, Essar Oil (UK) Ltd. and the Environment Agency took between 2017 and 2022 in the delivery of the action plan to reduce SO_2 concentrations and exposure to SO_2; thereby positively impacting on the health and quality of life of residents and visitors to the Thornton le Moors Air Quality Management Area (AQMA). It also sets out the priorities for the period up to and including 2027 based on the progress and relative success of the measures implemented to date.

It has been developed in recognition of the legal requirement on the local authority to work towards national Air Quality Strategy (AQS) objectives under Part IV of the Environment Act 1995 and relevant regulations made under that part and to meet the requirements of the Local Air Quality Management (LAQM) statutory process.

Local authorities are obliged to regularly review and assess the AQS pollutants at locations at which members of the public may be present for the prescribed averaging period. Notwithstanding the regulatory role of the authority, air pollution from a broad range of sources including industry, commerce, transport and housing should be assessed.

Where, as an outcome of the LAQM process, it is anticipated that a statutory objective may not be met at a particular location the local authority must declare an AQMA and then prepare an Air Quality Action Plan (AQAP) setting out how the authority intends to improve air quality within the AQMA.

The Thornton le Moors AQMA was declared in September 2016 because of measured exceedances of the 15-minute objective for sulphur dioxide primarily arising from an industrial source.

This AQAP will be reviewed every five years at the latest and progress on measures set out within this plan will be reported on annually in Cheshire West and Chester Council's air quality Annual Status Report (ASR).

2. Summary of current air quality in Cheshire West and Chester

2.1 Air quality management area

Nationally, three air quality objectives for SO_2 have been set for the protection of public health (Table 1). The Thornton le Moors AQMA (Figure 1) was declared on 29th September 2016 due to monitored and modelled exceedances of the 15-minute mean sulphur dioxide (SO_2) objective of 266 micrograms per cubic metre ($\mu g/m^3$). This objective permits no more than 35 exceedances per year.

Table 1 – Air quality objectives for SO_2 in England.

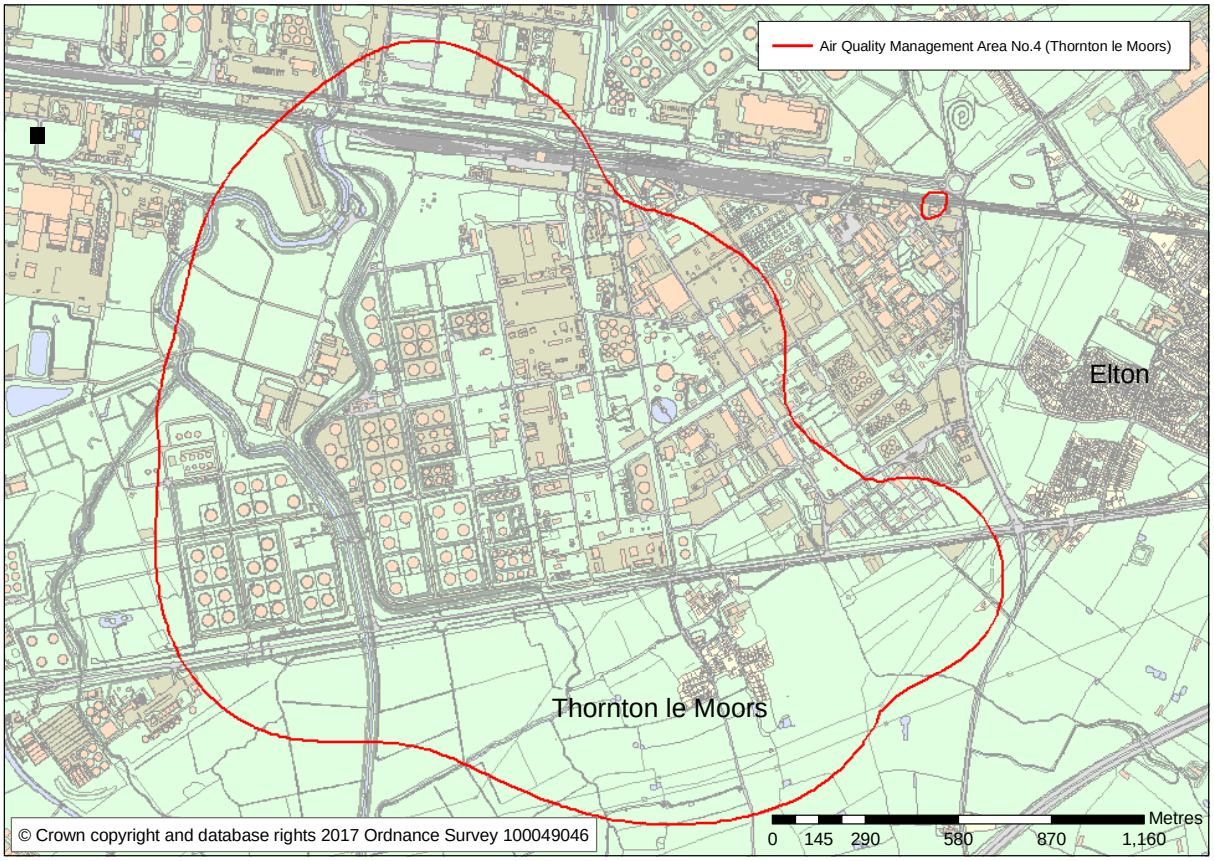
Pollutant	**Air quality objective**	
	Concentration	**Measured as**
Sulphur dioxide (SO_2)	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean
	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean
	125 $\mu g/m^3$, not to be exceeded more than three times a year	24-hour mean

The AQMA encompasses all residential properties in the village of Thornton le Moors, along with two travellers' sites and a single, isolated house. The population living within the AQMA is estimated to be around 220. As the objective applies at locations where members of the public might reasonably be exposed to SO_2 in excess of 266$\mu g/m^3$ for a period of 15 minutes, the AQMA also includes a number of public open spaces such as footpaths, roads and the rectory playing fields.

The AQMA was declared on the basis of modelling undertaken as part of a detailed assessment in 2016[2], which was undertaken following measured exceedances of the 15-minute mean objective at real-time monitoring stations in Thornton le Moors. The detailed assessment confirmed that the cause of short-term exceedances in Thornton le Moors is industrial stack emissions on the oil refinery complex to the north of the village. Figure 6 (appendix D) shows a SO_2 contour plot predicted by the dispersion modelling study.

[2] Cambridge Environmental Research Consultants. Dispersion modelling of SO_2 emissions from Stanlow Refinery, Cheshire, 2016.

Figure 1 – Location and extent of the Thornton le Moors AQMA

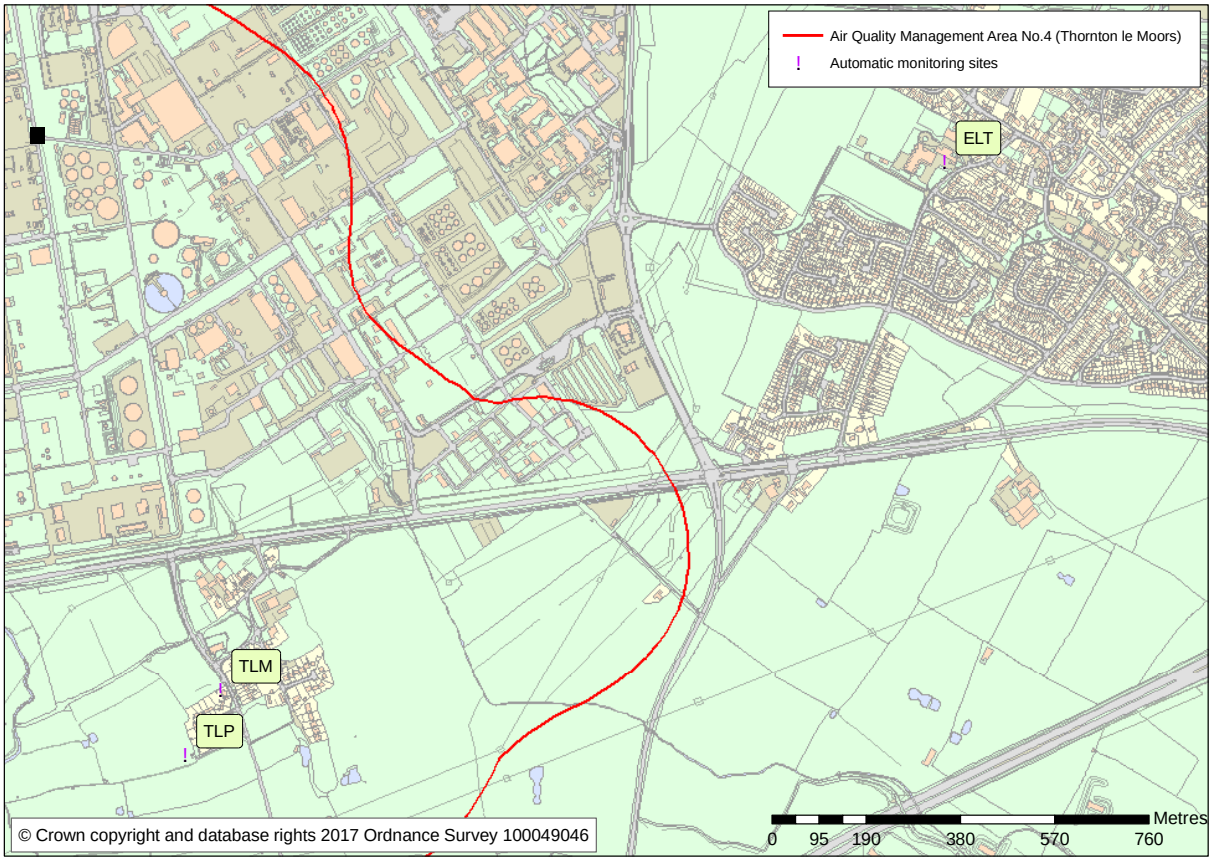


Map showing the extent of the air quality management area in Thornton le Moors encapsulating the entire village of Thornton le Moors, the caravan sites located between Cryers Lane and Pool Lane on the A5117, almost the whole of the Essar Refinery and a small area of the Chester University Campus.

2.2 Air quality monitoring

Cheshire West and Chester Council has been monitoring SO_2 in Thornton le Moors in real-time since the summer of 2013. Figure 2 below shows the locations of automatic monitoring stations in the vicinity of the AQMA. Monitoring at station TLM ceased in February 2015 because of extensive refurbishment works at the village hall, and the analyser relocated to newly-established monitoring station, TLP, some 150m away on Park Road. The monitoring network was expanded in June 2015 with the addition of station ELT (approximately 800m east of the AQMA) on School Lane in Elton. Both SO_2 analysers at TLP and ELT remain in continual operation. In addition to SO_2, TLP is equipped to monitor nitrogen dioxide, particulates and meteorological parameters. Details of real-time monitoring stations are shown in Table 7 (Appendix C).

Figure 2 – Location of automatic monitoring sites close to AQMA



Map showing the location of monitoring points TLM and TLP in the village of Thornton le Moors, and ELT in the village of Elton in relation to the AQMA

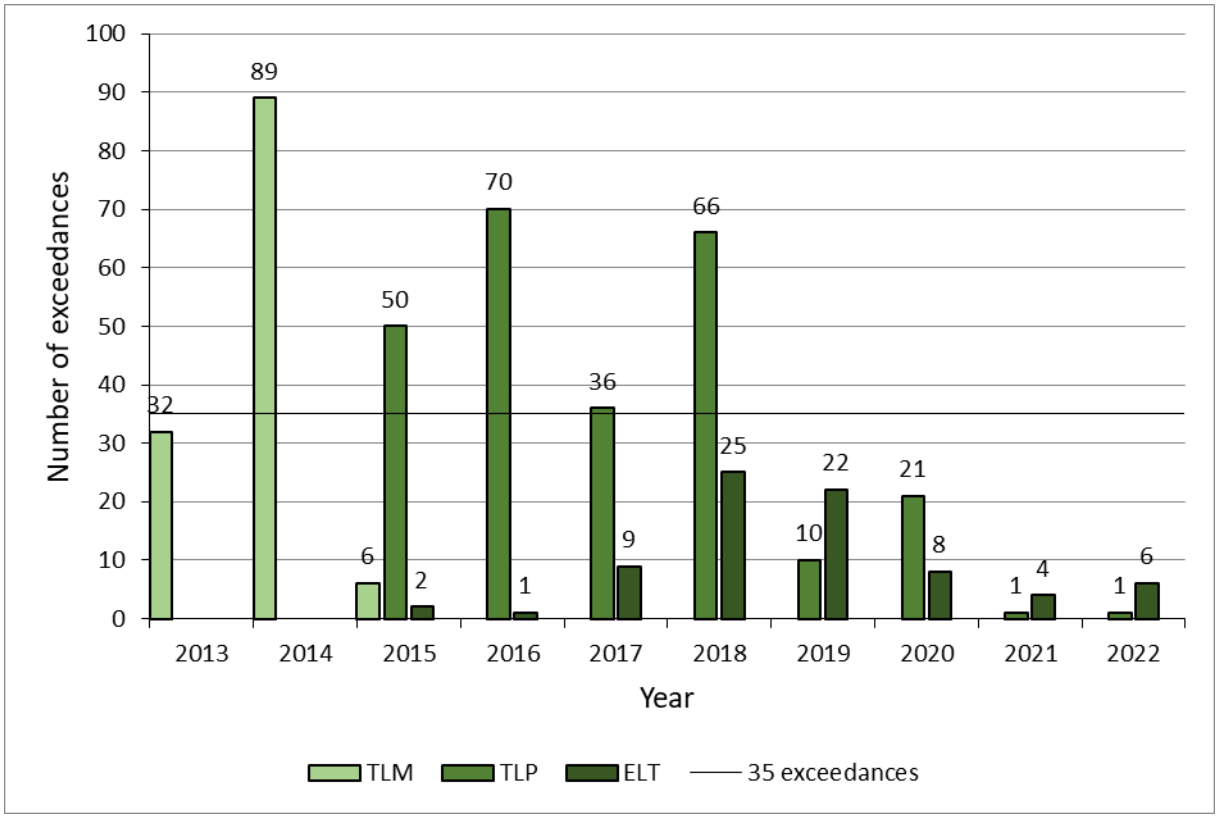
A summary of local monitoring results for the period 2013 to 2022 is presented in Table 8 (Appendix C). The results show that:

- The 15-minute mean objective was exceeded in Thornton le Moors during each full calendar year of monitoring between 2014 and 2018 (note: for 2013, monitoring did not commence until the end of June). In 2014 there were 89 exceedances (Figure 3), which is 54 more than the 35 permitted, spread across 24 days of the year (Table 9).
- The 15-minute mean objective has not been exceeded at Elton.
- The 15-minute mean objective has not been exceeded since 2018.
- The annual objective has not been exceeded at any location.
- The 24-hour mean objective (125μg/m^3) objective has not been exceeded at any location.

- The AQMA is therefore based on the 15-minute average and it has not been necessary for the declaration to apply to other averaging periods.

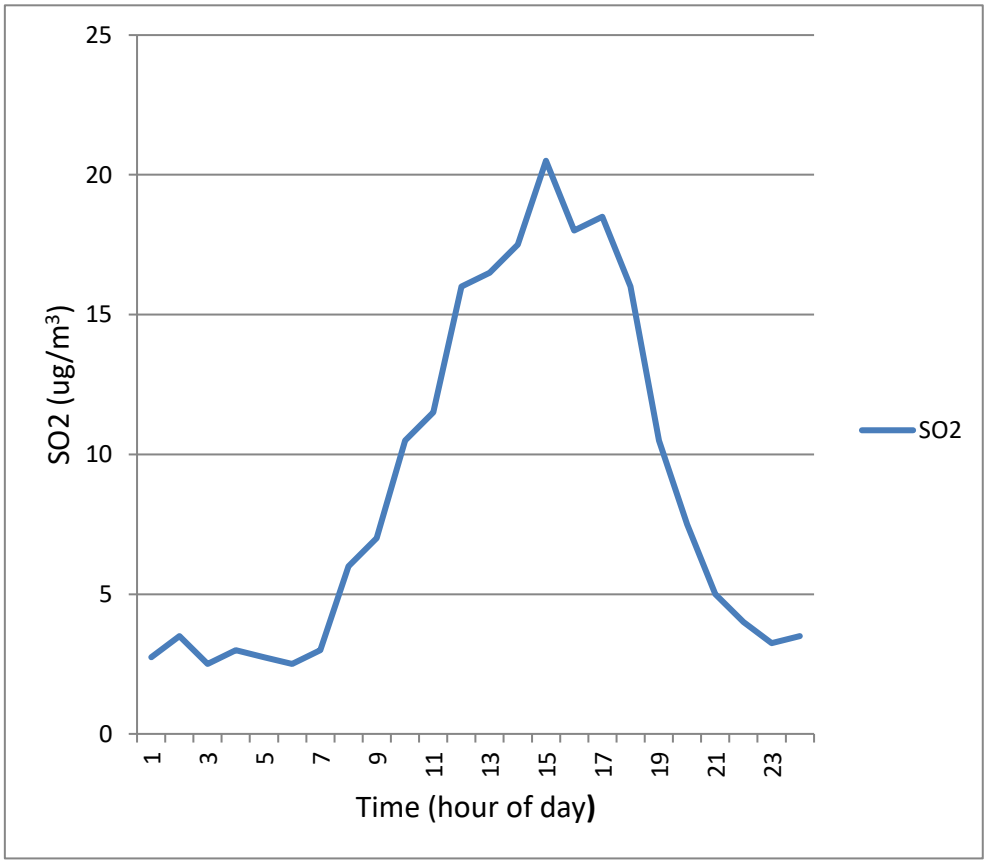
Further details of the monitoring and assessment of local SO_2 are presented in the Council's annual LAQM reports which are available here: www.cheshirewestandchester.gov.uk/aqmanagement

Figure 3 – Annual numbers of exceedances of the 15-minute objective



As the emissions causing SO_2 exceedances come from tall point sources, grounding of the stack plumes is strongly dependent on local weather conditions. Monitoring results show that exceedances of the 15-min objective are more likely during the daytime in the summer months and that most exceedances have tended to occur between 9am and 5pm (Figure 4). There is a greater probability of exceedances occurring during north-westerly winds with wind speeds of between 5 and 10 metres per second and where the air temperature is greater than 10^{o}C (with increased probability of exceedance at temperatures of 15 to 20^{o}C); these conditions tend to be convective.

Figure 4 – Temporal variations in monitored SO_2 in Thornton le Moors



3. Cheshire West and Chester Council's air quality priorities

3.1 Public health context

Sulphur dioxide (SO_2) is a gas that is formed by the combustion of fossil fuels that contain sulphur. The main sources in the UK are heavy oils and coal used in industrial plant, oil refining processes, coal fired power stations, domestic coal fires and oil fired central heating.

SO_2 is a respiratory irritant and may cause breathing difficulties in asthma sufferers at high concentrations. Health effects can occur very rapidly, making short-term exposure to peak concentrations important. Three objectives (with averaging periods of 15-minutes, 1-hour and 24 hours) have been set to minimise the health effects on vulnerable groups.

The local Director of Public Health and Public Health England have issued the following advice pertinent to SO_2: People in good health are unlikely to experience any short-term health effects related to the current levels of air pollution in the borough. However people with pre-existing lung or heart conditions, asthma or other bronchial conditions are more likely to be affected by elevated levels of outdoor air pollution. Sulphur dioxide may irritate the nose, throat and airways and can cause coughing, wheezing, shortness of breath, or a tight feeling around the chest. The effects of sulphur dioxide are felt very quickly and people at risk of developing symptoms would feel the worst effects in 10 or 15 minutes after breathing it in. The effects do not last once the pollution event has moved away in the wind. People with long-term health conditions should follow their doctor's usual advice about exercising and managing their conditions.

With regards to the exceedances of the air quality standards at Thornton le Moors, the air quality standards have been set with health effects in mind. They have been specified at levels below which there are believed to be no measurable health effects in the main population. The 15-minute air quality objective of 266$\mu g/m^3$ has been exceeded more times than the permitted allowances (35 allowed per year) and Cheshire West and Chester Council has recommended measures to reduce this. Most of the sulphur dioxide exceedances of the 15-minute average have occurred at

levels that reflect the ‘moderate’ air pollution banding of the Defra (Department for Environment, Food and Rural Affairs) Daily Air Quality Index (DAQI) (Table 2). At these concentrations, people with asthma and other lung problems in particular may experience symptoms. Fewer exceedances have occurred at the ‘high’ DAQI banding or the ‘very high’ banding. At these concentrations people with asthma may need to use their reliever inhaler more often. Older people may also be affected and the general population may experience discomfort such as irritation and cough.

Table 2 – Daily air quality index – recommended actions and advice

Air Pollution Banding	**Value**	**Accompanying health messages for at-risk individuals***	**Accompanying health messages for the general population**
Low	1-3	Enjoy your usual outdoor activities.	Enjoy your usual outdoor activities.
Moderate	4-6	Adults and children with lung problems, and adults with heart problems, who experience symptoms, should consider reducing strenuous physical activity, particularly outdoors.	Enjoy your usual outdoor activities.
High	7-9	Adults and children with lung problems, and adults with heart problems, should reduce strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their reliever inhaler more often. Older people should also reduce physical exertion	Enjoy your usual outdoor activities.
Very High	10	Adults and children with lung problems, and adults with heart problems, should reduce strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their reliever inhaler more often. Older people should also reduce	Reduce physical exertion, particularly outdoors, especially if you experience symptoms such as cough or sore throat.

*Adults and children with heart or lung problems are at greater risk of symptoms. Follow your doctor's usual advice about exercising and managing your condition. It is possible that very sensitive individuals may experience health effects even on Low air pollution days. Anyone experiencing symptoms should follow the guidance provided in the table.

3.2 Planning and policy context

The Cheshire West and Chester Local Plan Strategic Policies document provides the overall vision, strategic objectives, spatial strategy and strategic planning policies for the borough to 2030.

STRAT 1 Sustainable development states that proposals should:

- Provide for mixed-use developments which seek to provide access to homes, employment, retail, leisure, sport and other facilities, promoting healthy and inclusive communities whilst reducing the need to travel;
- Locate new housing, with good accessibility to existing or proposed local shops, community facilities and primary schools and with good connections to public transport; and
- Support regeneration in the most deprived areas of the borough and ensure those reliant on non-car modes of transport can access jobs and services.

STRAT 10 Transport and accessibility states that:

- In order to minimise the need for travel, proposals for new development should be located so as they are accessible to local services and facilities by a range of transport modes;
- New development will be required to demonstrate that appropriate provision is made for access to public transport and other alternative means of transport to the car;
- Proposals should seek to maximise use of sustainable (low carbon) modes of transport, by incorporating high quality facilities for pedestrians, cyclists and public transport and where appropriate charging points for electric vehicles; and
- Proposals for new industrial and warehousing development should maximise opportunities to transport products by non-road modes of transport. Sites alongside the Manchester Ship Canal, Weaver Navigation and rail network may be particularly suitable for freight use and these opportunities should be integrated into development proposals where feasible. Existing or potential freight movement opportunities will be safeguarded from development which could preclude continued or future freight use.

SOC 5 Health and well-being states that proposals will be supported that:

- promote safe and accessible environments and developments with good access by walking, cycling and public transport; and
- Development that gives rise to significant adverse impacts on health and quality of life (e.g. soil, noise, water, air or light pollution, and land instability, etc.) including residential amenity, will not be allowed.

The Local Plan (part two) will set out the non-strategic allocations and detailed policies, following on from the strategic framework set out in the Local Plan (part one). When adopted both documents will constitute the statutory development plan for Cheshire West and Chester and will replace all former Local Plans. It is proposed that Local Plan (part two) is submitted to Secretary of State for examination in 2017 Local Plan (part two) offers an opportunity to include policies specifically related to air quality in planning considerations.

Low Emission Strategy

In addition to the above the council is also working on a Low Emission Strategy that will be published early in 2018. The strategy takes a long-term integrated approach to air quality allowing us to identify priority areas in order to reduce emissions throughout the borough including Thornton le Moors. The strategy will identify key actions which can be developed in more detail and may be incorporated into this AQAP.

Climate Emergency Response Plan

The Council has worked with and engaged a range of partners, climate experts, community groups and businesses to understand the challenges and opportunities the Climate Emergency presents for our area. The Climate Emergency Response Plan which focuses on the borough wide response to the climate crisis. The Climate Emergency response plan sets out the scale of the challenge that we face, as a borough, to achieve carbon neutrality by 2045. The plan is guided by scientific evidence on the current state of emissions in west Cheshire and the engagement and intervention planning undertaken since the Climate Emergency was declared in May 2019. It outlines the action required to achieve carbon neutrality, and how the delivery of these actions will be tracked.

Electric vehicle charging infrastructure strategy.

Transport is the second highest carbon emitting sector in the borough, and the highest nationally. Decarbonising transport is essential to achieving net zero. Nationally, road emissions account for over 90% of transport emissions and the majority of these road-based emissions are from private cars.

The Council's aim for the Cheshire West and Chester Electric Vehicle Charging Infrastructure Strategy is to provide a sustainable electric vehicle charging infrastructure network that supports journeys across the borough, is easy to use, is inclusive and accessible for all, and offers good value for money to both for the Council and network users. Additionally it will contribute to a broader 'net zero' transport network which delivers healthier communities while supporting inclusive economic growth.

3.2.1 Environmental permitting

The Environment Agency (EA) has responsibility for regulating emissions from large industrial installations through environmental permits. As such, Cheshire West and Chester Council has no regulatory control over the operation of Essar's Stanlow refinery.

Essar operate the refinery under an environmental permit issued and regulated by the Environment Agency. The permit places emission limits on Essar for a range of pollutants including SO_2. These legally defined emission limits have not been breached by Essar.

The EA has provided the following explanatory information regarding their role in air quality:

The EA has a number of duties related to air quality. They ensure that the industrial facilities they regulate comply with the Environmental Permitting Regulations (EPR), thus contributing to compliance with:

- UK requirements such as the UK Air Quality Strategy, the Countryside and Rights of Way Act and the Natural Environment and Rural Communities Act

- EU requirements on the UK such as Air Quality Directives, Habitats Directive, the National Emissions Ceiling Directive and the Industrial Emissions Directive.

EU Ambient Air Quality Directive and 4th Air Quality Daughter Directive (AQDD)

If the emissions from an installation alone could lead to a breach of an EU air quality (AQ) limit value then the EA must include permit conditions to prevent this. However, it has been found that the more common circumstance is that where an EU AQ limit value is breached, it is mainly a result of emissions from non-Agency regulated sources e.g. traffic. Under these circumstances the EA have to take a view on what level of reduction should be borne by the installation.

The EA will investigate what improvements can be made if it is found that a regulated installation is projected to contribute significantly to the breach of an EU AQ limit value. In simple terms, limit values now only apply at locations where there is relevant public exposure. The Environment Agency must set more stringent emission limits or other controls than would be the case under Best Available Techniques (BAT), or appropriate measures for waste operations, if they are needed to achieve compliance with an EU limit value where the installation is making a significant contribution.

Similarly, if the EA finds that an installation is contributing significantly to the breach of an EU AQ target value, they will investigate what improvements can be made within BAT or appropriate measures and require the operator to implement these. But this may not completely remove the exceedence of the target value or in the timescale required by the 4th AQDD.

The Environmental Permitting Regulations require that the EA sets emission limit values or such other conditions in permits for industrial installations as may be required to ensure compliance with EU AQ limit values[3], even if these are more stringent than would be associated with the application of best available techniques (BAT) for installations specified under the Industrial Emissions Directive (IED). The 4th AQDD does not require permit conditions to go beyond BAT to achieve its target values.

[3] EU limit values for SO_2 are a 1-hour mean of 350μg/m^3 and a 24-hour mean of 125μg/m^3. These are identical to the hourly and daily UK standards for SO_2. The UK 15-minute standard, however, has no equivalent EU limit value.

The UK Air Quality Strategy (AQS)

The EA will investigate what improvements can be made if an installation they regulate is contributing significantly to the breach of a national objective or is projected to do so. The AQS indicates that it does not expect the EA will generally set permit conditions going beyond the application of BAT in order to achieve a national objective. This is reflected in the EPR Guidance. But if a national objective is likely to be breached then permit conditions may need to be more demanding than those normally associated with BAT.

The Environment Act 1995 requires that the EA "has to have regard to the AQS in discharging its pollution control functions" and is particularly relevant to the EPR permits under which they regulate installations and waste facilities. Broadly, the AQS requires that for installations subject to the IED, the Environment Agency should base EPR permit conditions on the application of BAT in order to meet national air quality objectives.

Local Air Quality Management

The EA is committed to working with local authorities and to plays its part fully in LAQM. The EA have found that several regulated sectors have a potential to affect air quality significantly. Some individual installations in these sectors have already been found to contribute significantly. The EA have been working with local authorities for some time to implement the necessary improvements. EA-regulated installations may be covered by freestanding AQAPs or ones which are transport-related and incorporated into Local Transport Plans. The EA provides information which relates to:

- the current releases from the installation(s);
- any assessments on the effect of the releases from the installation(s) on local air quality;
- any plans already in place which will deliver future improvements for local air quality;
- any equipment or operational changes which could deliver improvements for local air quality.

The EA agrees improvements with local authorities for installations that contribute significantly to breaches of an AQS objective. These improvements will be incorporated into the permit or action plan for the installation.

The 1995 Environment Act requires the EA to have regard to the Government's AQS and so there is a need to ensure that the installations and waste facilities regulated under the Environmental Permitting Regulations do not cause air quality problems or make existing ones worse.

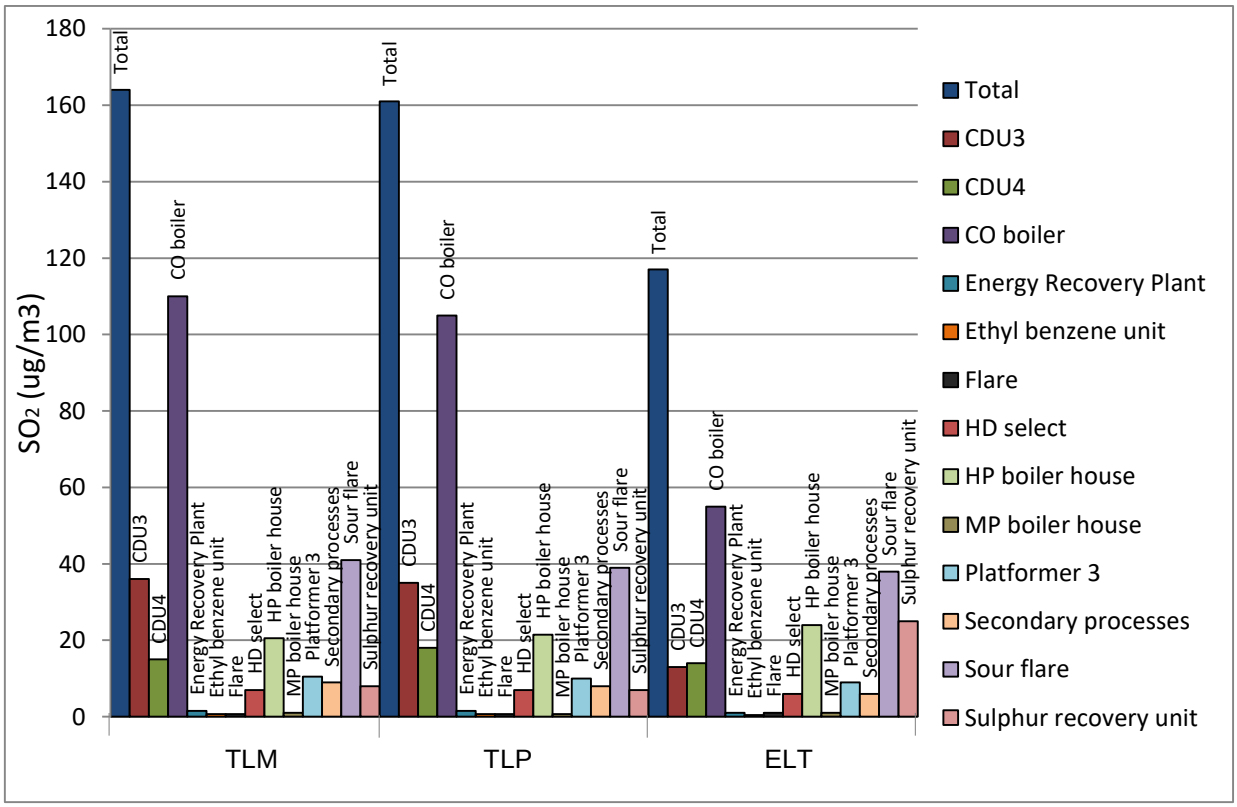
3.3 Source apportionment

The AQAP measures presented in this report are intended to be targeted towards the predominant sources of emissions within the Thornton le Moors area.

Away from industrial sources, concentrations of SO_2 in the region are typically very low: in Frodsham, for example, the urban background annual average is 2-3$\mu g/m^3$.

Modelling of refinery emissions was carried out by Cambridge Environmental Research Consultants (CERC) in 2016 on behalf of Cheshire West and Chester Council using data provided by Essar. This included a source apportionment exercise. A range of 12 potential sources of SO_2 on the refinery site were modelled, the relative contributions of which are shown in Figure 5 below. Exceedances of the 15-minute mean objective are inherently episodic, with a strong directional component, so the relative contributions of different sources will vary dependent on the meteorological conditions prevailing at the time. Therefore, the 99.9th percentile value for all sources will not be the sum of contributions from each individual source. It is clear, however, that the percentage source contributions to ambient SO_2 in the AQMA are dominated by emissions from the CO boiler stack serving the catalytic cracker unit. This was confirmed in a subsequent modelling study commissioned by Essar, again undertaken by CERC. Measures with an emphasis on reducing emissions from the CO boiler are therefore likely to deliver the greatest benefits. Of the remainder, the sour flare and CD3 stack are the most significant sources of SO_2 in the local area.

Figure 5 – 99.9th percentiles of modelled 15-minute mean SO_2 concentrations by source



3.4 Required reduction in emissions

With reference to section 2.2 above, the combined effects of refinery emissions and particular meteorological conditions can result in short-term episodes of elevated SO_2 in Thornton le Moors.

Monitoring shows that the number of exceedances recorded varies from year to year. In 2014 89 exceedances of the 15-minute mean were recorded at the TLM site, which is 54 greater than the 35 permitted by the national objective. During 2015 there were six exceedances at TLM prior to relocation of the analyser to the TLP site, at which there were 50 exceedances. In 2016 there were 70 15-minute mean exceedances at the TLP monitoring station.

Taking the result at TLP for 2014 as a worst case (both in terms of the number of exceedances recorded and the former site's proximity to the predicted area of maximum impact), a 61% reduction in the number of exceedances would be required to achieve the national objective.

Sensitivity tests carried out as part of CERC's supplementary detailed modelling study showed that a reduction in SO_2 emissions from the CO boiler of the order of 40%, in conjunction with reduction of fugitive emissions, would be likely to reduce the number of exceedances to below the 35 permitted.

3.5 Key priorities

As shown in 3.3 above the main cause of SO_2 exceedances in the AQMA is the stack which serves the catalytic cracker unit. Reducing the impact of SO_2 emissions from this source, therefore, will be key to achieving the national objective within the village of Thornton le Moors of no more than 35 exceedances of 266 $\mu g/m^3$. Other stacks, on the refinery site contribute to the measured exceedances so it would be beneficial to achieve reductions of emissions for the permitted process as a whole. The key priorities have been identified:

- Priority 1 – Reduce emissions of SO_2 from the catalytic cracking unit
- Priority 2 – Reduce overall emissions of SO_2 from the refinery
- Priority 3 – Provide real-time ambient monitoring data to site operator in a timely manner

4. Review on progress of Key Priorities to 2022.

Three key priorities were identified for implementation to 2022:

- Priority 1 – Reduce emissions of SO_2 from the catalytic cracking unit
- Priority 2 – Reduce overall emissions of SO_2 from the refinery
- Priority 3 – Provide real-time ambient monitoring data to site operator in a timely manner

This section reviews progress made on delivering these priorities.

4.1 Reduction of SO_2 emissions from catalytic cracker stack.

In June 2017 Essar commenced the trial of injecting of DeSOx additive into the catalytic cracker unit, served by the CO Boiler stack. It is important to note that the catalytic cracker is at the heart of any refinery operation and the cost of a cracker unit is priced in billions of pounds. Consequently in order to protect the asset, maintain product quality and achieve the desired result of the effective reduction of SOx emissions, it was necessary to introduce the additive slowly, only increasing the dosage over time following analysis of data. At a number of stages the trial was paused to allow technical improvements to be made or else to facilitate learning. It was not until October 2020 that consistent SOx reductions were achieved.

It is noted in Figure 3 that the number of exceedances were lower in 2019 and 2020 than the previous 5 years of monitoring, and whilst there were fewer than 35 exceedances required to breach the objective nonetheless there were still 22 and 21 exceedances of the objective value respectively. Since October 2020 and consistent dosing with the additive, there has been a marked reduction in the number of exceedances of the 15-minute objective value with just one recorded at TLP in 2021, 2022 and 2023 (as of December).

Dosing now forms part of standard operational procedures for the catalytic cracker unit.

4.2 Reduction of overall emissions of SO_2 from the refinery.

Reducing overall sulphur emissions from the refinery is an important secondary measure. Essar targeted the key areas as follows

1. Scheduling maintenance/repair on sulphur critical plant to suit the weather:

   Maintenance and planned plant downtime have been scheduled as much as possible to be undertaken when weather conditions are unlikely to result in an exceedance of the 15-minute objective. Essar uses meteorological data to plan maintenance activities of this type to minimise impact on neighbouring populations. Data from local air quality monitors forms part of the site daily monitoring, prompting response if elevated readings are detected.

2. Isolation of the sulphur recovery units to allow independent operations:

   Essar operate two high efficiency sulphur recovery units (SRU). The original design and configuration did not allow each SRU to be isolated individually. Essar implemented a project to install isolation for each unit to further increase reliability. This project was completed on target in Q1 of 2018 and prior to completion both desulphurisation units had to be taken offline together for maintenance. The units now operate independently significantly reducing the time that the plant operates without at least one being operational and consequently reducing the number and duration of flaring events.

3. Fuel gas desulphurisation:

   The refinery uses refinery fuel gas (RFG) as a fuel for combustion plants. Essar are invested in additional treatment (fuel gas desulphurisation) for the RFG system. This project, which was implemented in Q1 2018, complements the introduction of a natural gas supply to the refinery, which supplies the boilers. The expected impact of these improvements is to reduce background levels of SO_2.

4. Reduce fugitive emissions:

   Fugitive emissions from plant contribute a negligible amount to emissions from the site. However Essar continues to maintain, replace and re-life critical pieces of equipment to maintain the integrity of the plant and minimise leaks and seeps.

4.3 Provide real-time ambient monitoring data to site operator in a timely manner.

An automated notification system was setup in 2021 to provide email notifications when real-time monitoring results at TLP and ELT exceeded 200µg/m^3. This system was superseded in January 2023 when the Council's new air quality monitoring website went live allowing free access to all to real-time monitoring data. Essar can view live data and consider appropriate courses of action available should SO_2 levels at TLP approach the objective limit.

5. Revision of the Thornton le Moors AQAP

According to the Detailed Assessment, as illustrated in Figure 5 above, only the significant reduction of SO_2 emissions from the CO Boiler serving the catalytic cracker unit was likely to deliver more than a negligible effect at TLP. Since consistent dosing with the DeSOx additive commenced in October 2020 to achieve this aim, exceedances of the 15-minute objective value at TLP have only been recorded on one occasion in 2021, 2022 and 2023 (as of December). Exceedances at ELT have also reduced compared to 2018 when there were 25 exceedances and 2019 when there were 22 exceedances but overall monitoring results at ELT confirm the Detailed Assessment conclusion that this receptor is less directly influenced by CO Boiler and flaring and other refinery sources play a greater role in exceedances recorded here.

It is recognised by both Essar and the Environment Agency that dosing with DeSOx additive represents Best Available Techniques for the refinery process and as such Essar are obliged to continue indefinitely under the Environmental Permitting Regulations.

As of the end of December 2023, assuming there are no exceedances recorded during December, a 5 years period will have elapsed since the objective was last exceeded in 2018. Technical Guidance (TG22) paragraph 3.57 states:

“there should not be any declared AQMAs for which compliance with the relevant objective has been achieved for a consecutive five-year period”.

The Council acknowledge this requirement and will undertake detailed modelling in early 2024 to update the original 2016 detailed modelling and confirm whether the objective is likely to be exceeded anywhere within the AQMA taking into account reduced SOx emissions from the CO Boiler stack.

The Council is conscious that the 2014 model identifies areas in and around the former monitoring site of TLM as the area most likely to experience exceedances. Where as the current monitoring location, TLP, is predicted to experience fewer such exceedances. Accordingly it is necessary to rerun the model to confirm whether exceedances remain likely or not and whether the AQMA should be revoked or the boundaries varied.

The key priorities for 2023 to 2027 therefore remain unchanged with the added commitment to undertake detailed monitoring in early 2024 to determine whether the AQMA can be revoked or the boundaries varied.

Table 3 below shows the updated Thornton le Moors AQAP measures. It contains:

- a list of the actions that form part of the plan
- the responsible organisations which will deliver this action
- estimated cost of implementing each action
- expected benefit in terms of pollutant emission and/or concentration reduction
- the timescale for implementation
- how progress will be monitored

An additional measure has been included to undertake further detailed modelling in 2024.

Regular annual updates on implementation of these measures are documented in the Council's ASRs. Copies can be accessed on the Cheshire West and Chester Council (CWAC) website at: www.cheshirewestandchester.gov.uk/aqmanagement

Table 3 – Air quality action plan measures

Measure	Measure title	EU category	EU classification	Lead authority	Planning phase	Implementation phase	Key performance indicator	Target pollution reduction in the AQMA	Progress to date	Estimated completion date	Comments
1	Remove sulphur compounds in process	Environmental permits	Measures to reduce pollution through IPPC permits going beyond BAT	Essar	2017	2017 onwards	SO_2 measured at catalytic cracker stack	Reduction in 15-min exceedances to less than 35 per year. Potential air quality benefit is thought to be medium (in the range of 25-40%)	Trial in progress	Completed 2020	Essar routinely dose to minimise SOx emissions.
2	Schedule maintenance / repair on sulphur critical plant to suit the weather	Environmental permits	Other	Essar	Ongoing	Ongoing	SO_2 measured at local AQ monitoring stations	Negligible	Measure in use	Ongoing	Essar uses weather data to plan activities. Essar uses real time AQ monitoring data to respond rapidly to spikes.
3	Isolation of sulphur recovery units to allow independent operation	Environmental permits	Other	Essar	2017	Q1 2018	Sour gas flaring	Negligible	To be installed in 2018 turnaround (TA)	Completed Q1 2018	This allows one SRU to be shut down for maintenance while keeping the other online.
4	Fuel gas scrubbing and fuel substitution	Environmental permits	Other	Essar	2017	Q1 2018	Sulphur content in refinery fuel gas	Negligible	To be installed in 2018 TA	Completed Q1 2018	Essar are investing in additional fuel gas desulphurisation. Nat gas supply to boilers has already been introduced.
5	Address fugitive emissions	Environmental permits	Other	Essar	Ongoing	Ongoing	SO_2 measured at local AQ monitoring stations	Negligible	Medium pressure (MP) superheater to be replaced in 2018 TA	Completed / Ongoing	Fugitive emissions are addressed as they are identified, e.g. MP superheater will be replaced as it is approaching end of life.
6	Air quality monitoring	Public information	Via the internet	CWAC	Ongoing	Ongoing	Real-time data published on website	Nil	Ongoing	Completed Q1 2023 / Ongoing	Results published on CWAC website, updated hourly

Measure	Measure title	EU category	EU classification	Lead authority	Planning phase	Implementation phase	Key performance indicator	Target pollution reduction in the AQMA	Progress to date	Estimated completion date	Comments
7	Real-time data provision to operator (with trigger capability)	Public information	Via the internet / other	CWAC / Essar	Q3 2017	October – December 2017	Establishment of data sharing	Negligible	Trial from June to August 2017	Completed 2021 /Ongoing	Trial completed. Supports measure 2 above
8	Air quality monitoring expansion	Public information	Other	CWAC	Q1 2018	To be confirmed (TBC)		Nil	Nil	Completed 2018 – no additional suitable sites identified.	Suitable site(s) to be explored
9	Development of dispersion calendar	Environmental Permits	Other	EA	2017	2018	Pollution calendar published	Negligible	Fine resolution meteorology data purchased	Not implemented on cost benefit basis.	Additional modelling to characterise meteorological conditions during pollution episodes. Supports measure 2 above.
10	Undertake further detailed modelling	Public information	Other	CWAC	Q1 2024	Q1 / Q2 2024	Publishment of report.	Nil	Nil	Q2 2024	Results will confirm whether AQMA can be revoked.

6. Development and implementation of the Thornton le Moors AQAP

6.1 Consultation and stakeholder engagement

In developing / updating this AQAP, we intend to work with other local authorities, agencies, businesses and the local community to improve local air quality. Schedule 11 of the Environment Act 1995 requires local authorities to consult the bodies listed in **Error! Reference source not found.**. In addition, we have undertaken the following stakeholder engagement:

- Council website
- Email
- Press releases
- Letters to residents within the AQMA
- Communication with local councillors and member of parliament
- Attendance at Parish Council meetings
- Letters to local GP surgeries
- Meetings with Essar and the Environment Agency

Table 4 – Consultation to be undertaken

Yes / No	**Consultee**
Yes	the Secretary of State
Yes	the Environment Agency
No	the highways authority
Yes	other public authorities as appropriate, such as public health officials
Yes	local residents
Yes	local business bodies and other organisations as appropriate
Yes	local councillors
Yes	local Member of Parliament
Yes	Parish Council

To date, no formal consultation has been undertaken as the action plan is currently being finalised. When this is complete, however, consultation on the draft will be undertaken and the responses to our consultation stakeholder engagement will be provided in Appendix A.

Appendix A: Response to consultation

Table 5 – Summary of responses to consultation and engagement on the AQAP

Consultee	**Category**	**Response**
To be completed	To be completed	To be completed

Appendix B: Reasons for not pursuing action plan measures

Table 6 – Action plan measures not pursued and the reasons for that decision

Action category	**Action description**	**Reason action is not being pursued (including stakeholder views)**
Environmental Permits	Raise stack heights	Extension of the existing stack is not technically feasible. Construction of a replacement stack in a different location would have a significant impact on the operation of the unit. This option is therefore considered to be unfeasible.
Environmental Permits	Improve sulphur recovery rates and efficiencies	Efficiency is already high. The sulphur recovery units perform better than the applicable BAT requirements.
Environmental Permits	Alter fuel burning profiles in response to real-time ambient monitoring	The principal source of SO_2 exceedances is the CO boiler which does not burn fuels from the refinery mains. The quantity of sulphur reaching the CO Boiler is dependent on the sulphur content of the crude oil being processed at the time. This cannot be altered in a timescale short enough to respond to real-time ambient monitoring.
Environmental Permits	Alter fuel burning profiles in response to weather data	The principal source of SO_2 exceedances is the CO boiler which does not burn fuels from the refinery mains. The quantity of sulphur reaching the CO boiler is dependent on the sulphur content of the crude oil being processed at the time. This cannot be altered in a timescale short enough to respond to changes in the weather.

Appendix C: Monitoring results

Table 7 – Details of SO_2 monitoring sites

Location / ID	Site type	Grid reference		Monitoring technique	In AQMA?	Relevant exposure? distance (m)	Worst-case location?	Start date	End date
		Easting	Northing						
Thornton le Moors (TLM)	Industrial	344174	374461	UV-fluorescence	Yes	Yes (20)	Yes	Jun-13	Feb-15
Thornton le Moors (TLP)	Industrial	344103	374330	UV-fluorescence	Yes	Yes (38)	No	Feb-15	Current
Elton (ELT)	Industrial	345642	375522	UV-fluorescence	No	Yes (0)	Yes	Jun-15	Current

Table 8 – SO_2 monitoring results

Location / ID	Site type	In AQMA?	Air quality criteria	Number of exceedances of the objectives.				
				2013	**2014**	**2015**	**2016**	**2017**
Thornton le Moors (TLM)	Industrial	Yes	15-minute standard (266μg/m^3)	32	**89**	6	n/m	n/m
			1-hour standard (350μg/m^3)	1	4	0	n/m	n/m
			24-hour standard (125μg/m^3)	0	0	0	n/m	n/m
Thornton le Moors (TLP)	Industrial	Yes	15-minute standard (266μg/m^3)	n/m	n/m	**50**	**70**	**36**
			1-hour standard (350μg/m^3)	n/m	n/m	4	4	1
			24-hour standard (125μg/m^3)	n/m	n/m	0	1	0
Elton (ELT)	Industrial	No	15-minute standard (266μg/m^3)	n/m	n/m	2	1	9
			1-hour standard (350μg/m^3)	n/m	n/m	0	0	0
			24-hour standard (125μg/m^3)	n/m	n/m	0	0	0

Location / ID	Site type	In AQMA?	Air quality criteria	Number of exceedances of the objectives.				
				2018	**2019**	**2020**	**2021**	**2022**
Thornton le Moors (TLM)	Industrial	Yes	15-minute standard (266μg/m^3)	n/m	n/m	n/m	n/m	n/m
			1-hour standard (350μg/m^3)	n/m	n/m	n/m	n/m	n/m
			24-hour standard (125μg/m^3)	n/m	n/m	n/m	n/m	n/m
Thornton le Moors (TLP)	Industrial	Yes	15-minute standard (266μg/m^3)	**66**	10	21	1	1
			1-hour standard (350μg/m^3)	0	0	0	0	0
			24-hour standard (125μg/m^3)	0	0	0	0	0
Elton (ELT)	Industrial	No	15-minute standard (266μg/m^3)	25	22	8	4	6
			1-hour standard (350μg/m^3)	4	1	0	0	0
			24-hour standard (125μg/m^3)	0	0	0	0	0

Notes: exceedances of the SO_2 objectives shown in **bold** (15-minute mean = 35 allowed per year, hourly mean = 24/year, 24-hour mean = three/year)

(1) Where the period of valid data capture was less than 85%, the relevant percentiles (μg/m^3) are provided in brackets. Percentiles are: 15-minutes = 99.9th; 1-hour = 99.7th; 24-hour = 99.2nd.

(2) n/m = no monitoring conducted

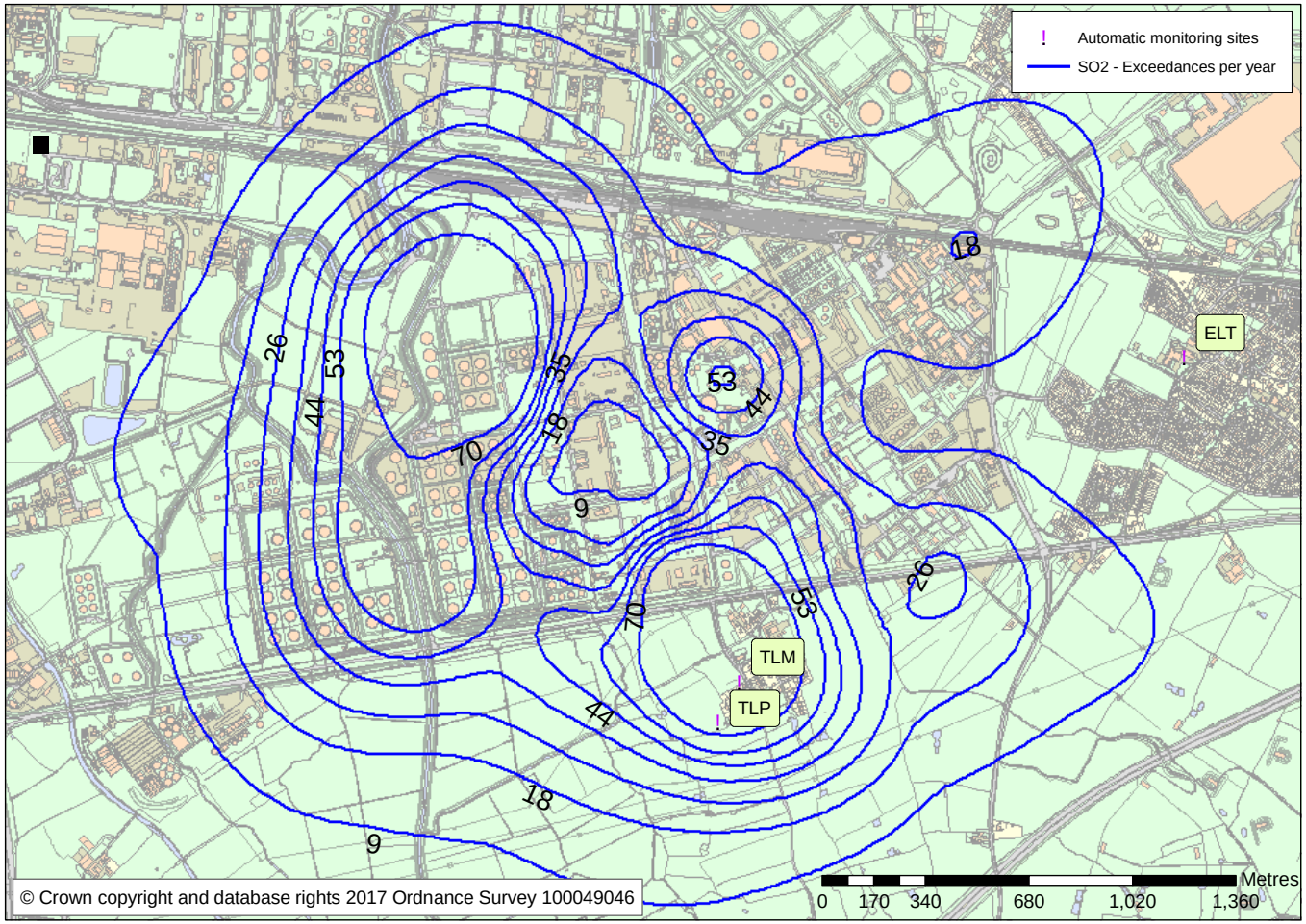
Table 9 – Annual counts of days on which SO_2 exceedances occurred

Site	SO_2 objective	Number of days per year on which exceedances were recorded									
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TLM	15-minute	11	24	3	n/m	n/m	n/m	n/m	n/m	n/m	n/m
	1-hour	1	4	0							
	24-hour	0	0	0							
TLP	15-minute	n/m	n/m	15	17	14	14	6	6	1	1
	1-hour			3	4	1	0	0	0	0	0
	24-hour			0	1	0	0	0	0	0	0
ELT	15-minute	n/m	n/m	2	1	3	1	4	3	2	3
	1-hour			0	0	0	1	1	0	0	0
	24-hour			0	0	0	0	0	0	0	0

(1) n/m = no monitoring conducted

Appendix D: Detailed dispersion modelling

Figure 6 – Modelled maximum SO_2 exceedances per year, 2013 - 2015



Map showing modelled contours of likely number of exceedances of the sulphur dioxide 15 minute air quality objective

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values'
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
AQS	Air Quality Strategy
ASR	Air quality Annual Status Report
BAT	Best available techniques
CCU	Catalytic cracker unit
CERC	Cambridge Environmental Research Consultants
CWAC	Cheshire West and Chester Council
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EPR	Environmental Permitting Regulations
EU	European Union
IED	Industrial Emissions Directive
LAQM	Local Air Quality Management
SO_2	Sulphur dioxide
SOx	Oxides of sulphur
TA	Turnaround – periodic large scale essential maintenance

References

Cambridge Environmental Research Consultants (CERC). Dispersion modelling of SO_2 emissions from Stanlow Refinery, Cheshire, 2016

Cheshire West and Chester Council. Annual Status Report, 2016

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