URN: 21-019

Subject: Air Quality Status Report

Report to: Environment Committee 25th November 2021

Report by: James Wilson – Head of Environmental Services

SUBJECT MATTER

This report details Great Yarmouth's 2020 Air Quality Annual Status Report. This is an annual report to Government on the state of local air quality in the Borough.

RECOMMENDATIONS

That Members:

- Notes the Air Quality Status Report 2020 and its contents.

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1. Introduction

1.1. Great Yarmouth Borough Council must report annually on the status of the air quality in the Borough, as required by Part IV of the Environment Act 1995. The reporting format follows a standard national template.

2. The 2020 Report

2.1. Overall, this Air Quality Annual Status Report has not revealed any exceedance of air quality standards and has not predicted any likely exceedance over the next 12 months.

3. Recommendations

3.1. That the committee notes the Air Quality Status Report 2020 and its contents.

4. Background papers

4.1. Appendix 1 2020 Air Quality Annual Status Report (ASR)

Area for consideration	Comment
Monitoring Officer Consultation:	None
Section 151 Officer Consultation:	None

Existing Council Policies:	none
Financial Implications (including VAT and tax):	None
Legal Implications (including human rights):	None
Risk Implications:	None
Equality Issues/EQIA assessment:	None
Crime & Disorder:	None
Every Child Matters:	None

2020 Air Quality Annual Status Report (ASR)

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

October 2021

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Report Reference number	GYBC/ASR/2020

Executive Summary: Air Quality in Our Area

Overall, this Air Quality Annual Status Report has not revealed any exceedance of air quality standards and has not predicted any likely exceedance over the next 12 months.

The Port is increasingly handling work related to North Sea offshore wind turbine construction and maintenance, and oil rig decommissioning. The Outer Harbour remains in use for general bulk cargo and there are no plans to set up a container terminal. The detailed assessment in 2010 recommended a watching brief and that position remains the same.

The Local Enterprise Zone for the South Denes peninsula, plus the Local Development Order covering this area, and small parts of Southtown and Gorleston, is expected to attract new industry over the coming years with its relaxation of planning standards. Close liaison between Environmental Services and Planning departments is taking place to give early identification of new business that may impact on local air quality. Work has commenced on construction of the new hotel and commercial development on the Yarmouth south beach seafront (known as the Edge).

Construction work at several large residential developments and the enterprise zone in Bradwell and South Gorleston are progressing, and the associated A47 (A12) – A143 link road (assessed as unlikely to have adverse impacts) is now in use.

The dualling of the A47 between Acle and Great Yarmouth has no firm timescale for construction yet, with Highways England suggesting that it would not happen for another decade, despite the A47 Alliance is applying for funding for it as a priority project with the 2020-25 period. The Great Yarmouth Third River Crossing (GYTRC) (between Southtown and the South Denes Peninsula) construction has now started and is schedules for completion in 2023. The GYTRC and highway changes mean that the NO_2 diffusion tube locations need to be reviewed for 2022.

Highways England have improved a number of A47 junctions in Great Yarmouth. The Harfrey's Roundabout where the proposed GYTRC would join the A47, is scheduled for improvement. Together the GYTRC and A47 junction improvements have the potential to significantly improve connectivity between the LDO / Enterprise Zone including port of Great Yarmouth, and the strategic road network.

The Council's state-of-the-art automatic monitoring station (which is of an AURN and airport standard) has provided real-time monitoring data for since 2018, including (crucially for LAQM) PM_{10}, $PM_{2.5}$, and NO_2.

A detailed assessment is not required for any pollutants and the Council will progress to the next Annual Status Report in 2021.

Air Quality in Great Yarmouth

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues, because areas with poor air quality are also often the less affluent areas[1,2].

The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[3].

Great Yarmouth Borough Council's area is situated in the south east corner of Norfolk. It covers the area from Hopton-on-Sea in the south to Winterton-on-Sea in the north, a coastline of some 24 miles. The southern boundary follows the County boundary with Suffolk. To the west and north, the Borough is bounded by rivers of the Norfolk Broads including the Yare, Waveney, Bure and Thurne.

A mixed urban/rural area, the population of approximately 98,000 is concentrated in the urban centres of Great Yarmouth, Gorleston, Bradwell and Caister-on-Sea, with smaller communities in Hopton-on-Sea, Hemsby, Martham, Ormesby and Winterton on-Sea. In summer, the population doubles. The geology is gently undulating in the east on glacial tills with flat marshland adjacent to the Broadland rivers. The River Yare is the principal river of Broadland and this discharges to the North Sea at Great Yarmouth, forming a long narrow port area. There are a number of Sites of Special Scientific Interest and Breydon Water is considered an important international site with a RAMSAR designation.

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[1] Environmental equity, air quality, socioeconomic status and respiratory health, 2010
[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006
[3] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

Most land use outside the built-up urban areas is given over to farming. This is predominantly arable farming although there are grazing marshes on the river flood plains. Large areas adjacent to the coast are used in conjunction with tourism which is one of the main industries. The Port is the principal UK base for the Southern North Sea offshore oil and gas industry, as well as becoming established as a centre for the construction and maintenance of offshore wind farms in the North Sea.

The key pollutants of concern locally continue to be Nitrogen Oxides and particulates primarily from traffic and industrial emissions.

GYBC plays an active part in the Norfolk LAQM sub-group of all district Councils, and Norfolk County Council Highways and Public Health. The Environment Agency and the University of East Anglia unfortunately no longer attend the group, though their participation in the past was valuable, and would be welcomed again.

Actions to Improve Air Quality

The Borough does not have any Air Quality Management Areas, and so there is no specific action plan to improve air quality. However, the Council has taken a number of measures forward over recent years (see section 2) to improve air quality, and to reduce the exposure of the public to adverse air quality.

Conclusions and Priorities

Following the Council's former air quality monitoring station site in Gorleston being decommissioned in late 2016, the Council's new, state-of-the-art replacement monitoring station was installed in December 2017 in South Denes, monitoring a wider range of pollutants (including PM_{10} $PM_{2.5}$ and NO_2), and providing a local bias adjustment factor for the NO_2 diffusion tubes – the location of these will be reviewed for 2022, due to the GYTRC and A47 changes.

This updated monitoring programme, will provide data for future vital decisions around transport, infrastructure, business, and housing development for the Borough.

Given the current levels of pollutants measured, a detailed assessment is not required for any pollutants and the Council will progress to the next Annual Status Report in 2021.

Local Engagement and How to get Involved

If people would like to find out more about air quality, and how they can contribute to improving it in their area, these links can provide further information:

- Defra's – UK Government – UK-Air website: https://uk-air.defra.gov.uk/

- Great Yarmouth Borough Council's real-time air quality (and meteorology) monitoring data: http://www.ukairquality.net/

- Sustrans' 'CleanSpace' sustainable transport and air quality movement: http://www.sustrans.org.uk/what-you-can-do/use-your-car-less/join-air-quality-movement - the Council has bought some of the CleanSpace Tags mentioned on this site, for residents and staff in urban areas to trial. Please contact the report's author or your Neighbourhood Manager for more information. Media enquiries should be directed to the Council's Communications & Press Officer;

- 'Air Pollution' website – college/university level: http://www.air-quality.org.uk/index.php

- BBC 'Bitesize' – GCSE air quality: http://www.bbc.co.uk/schools/gcsebitesize/science/21c/air_quality/

- 'Clean Air Kids' – air quality website for children aged 5-11: http://www.clean-air-kids.org.uk/index.html

- Evolution of WHO air quality guidelines: past, present and future (2017) – report on the World Health Organisation's evolving advice: http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2017/evolution-of-who-air-quality-guidelines-past,-present-and-future-2017

Please note that Great Yarmouth Borough Council does not have any control over the content of the above websites, and is not responsible for their content, which it does not necessarily endorse.

Table of Contents

1 Local Air Quality Management

This report provides an overview of air quality in the Borough of Great Yarmouth during 2019. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by Great Yarmouth Borough Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England can be found in Table E.1 in Appendix E.

2   Actions to Improve Air Quality

2.1   Air Quality Management Areas

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority must prepare an Air Quality Action Plan (AQAP) within 12-18 months setting out measures it intends to put in place in pursuit of compliance with the objectives.

Great Yarmouth Borough Council currently does not have any AQMAs. For reference, a map of Great Yarmouth Borough Council's monitoring locations is available in Appendix D.

☒ **Great Yarmouth Borough Council confirm the information on UK-Air regarding their AQMA(s) is up to date**

2.2 Progress and Impact of Measures to address Air Quality in the Borough of Great Yarmouth

Defra's last appraisal of the 2018 ASR concluded *"On the basis of the evidence provided by the Local Authority the conclusions reached are acceptable for all sources and pollutants.*

The next step for Great Yarmouth Borough Council is to submit their next Annual Status Report in 2019."

There appears to have been a technical issue with the 2019 ASR submission, as neither the ASR or the appraisal were showing. The ASR has now been resubmitted.

Great Yarmouth Borough Council has taken forward a number of direct measures during the current reporting year of 2020 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.1.

Key completed measures are:

- Secure bikes stores installed at multiple Council Offices;

- Installation of rapid electric vehicle charging point in Council car park; and,

- Bin lorry route optimisation.

Great Yarmouth Borough Council expects the following measures to be completed over the course of the next reporting year:

- Removal of unnecessary streetlights; and,

- Installation of 16 fast electric vehicle charging points over 8 Council car parks.

Table 2.1 – Progress on Measures to Improve Air Quality

Measure No.	Measure	EU Category	EU Classification	Date Measure Introduced	Organisations involved	Funding Source	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
1	Payment of cycling allowance to Council staff	Alternatives to private vehicle use	Other	Ongoing	GYBC	GYBC	Reduction in car mileage & take-up of scheme	N/A	Implemented	Ongoing	Small impact
2	Work bike scheme	Alternatives to private vehicle use	Other	Ongoing	GYBC	GYBC	Reduction in car mileage & take-up of scheme	N/A	Implemented	Ongoing	Bikes regularly used by staff
3	Replacement of streetlights with energy efficient units	Policy Guidance and Development Control	Low Emissions Strategy	Ongoing	GYBC	GYBC	Reduction in energy bill	N/A	Planned long term replacement scheme	Ongoing	Reduced energy bills for the Council
4	Establishment of county wide air quality group	Policy Guidance and Development Control	Regional Groups Co-ordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality	Ongoing	Joint partnership	Joint partnership	Better air quality & public health in Norfolk	N/A	Implemented	Ongoing	Shared ideas & feeding into County Council policies on transportation, public health & air quality
5	Promotion of town walks	Promoting Travel Alternatives	Promotion of walking	Ongoing	GYBC	GYBC	Reduction in vehicle use in town	N/A	Implemented	Ongoing	Reduction in vehicle use
6	Carbon reduction and fuel poverty	Policy Guidance and Development Control	Other policy	Ongoing	GYBC	GYBC	Reduction in energy bills	N/A	Implemented	Ongoing	Reduction in energy bills for householders
7	Leisure centre replacement	Policy Guidance and Development Control	Low Emissions Strategy	2022	GYBC	GYBC	Reduction in emissions to air & energy bill	N/A	Preparation Phase	2022	Air source heat pumps, solar panels, CHP, heat recovery, highly efficient and insulated, so EPC A
8	Introduction and improvement of safe cycle route between train station and town centre	Promoting Travel Alternatives	Promotion of cycling	Completed	Norfolk County Council	Norfolk County Council	Reduction in vehicle use in town	N/A	Planning phase	Completed	Reduction in vehicle emissions
9	Introduction and improvement of safe walking route between train station and town centre	Promoting Travel Alternatives	Promotion of walking	Completed	Norfolk County Council	Norfolk County Council	Reduction in vehicle use in town	N/A	Planning phase	Completed	Reduction in vehicle emissions
10	Removal of unnecessary streetlights	Policy Guidance and Development Control	Other policy	2021	GYB Services	GYB Services	Reduction in energy bill	N/A	Implemented	2021	Reduced energy bills for the Council

11	Establishment of joint working with Director of Public Health, GYBC & county wide air quality group	Policy Guidance and Development Control	Regional Groups Co-ordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality	Ongoing	Joint partnership	Joint partnership	Better air quality & public health in Norfolk	N/A	Implemented	Ongoing	Shared ideas & feeding into County Council policies on transportation, air quality & public health
12	Construction of third road river crossing in Great Yarmouth	Transport Planning and Infrastructure	Other	2023	Norfolk County Council	Norfolk County Council	Reduction in vehicle use in town & better air quality	N/A	Preparation Phase	2023	The County and the Borough Councils are working on the business case
13	Procurement of electric vehicles for multiple Council Services	Vehicle Fleet Efficiency		2022	GYBC	GYBC	Reduction in Council vehicle emissions	N/A	Planning phase	2022	Was originally just Environmental Services, but extended to other services
14	Procurement of electric pool car for Council Staff use	Alternatives to private vehicle use	Other	2022	GYBC	GYBC	Reduction in Council vehicle emissions	N/A	Planning phase	2022	This replaces the unleaded petrol fuelled pool car
15	Secure bikes stores installed at multiple Council Offices	Alternatives to private vehicle use	Other	Completed	GYBC	GYBC	Reduction in car mileage & usage of bike stores	N/A	Implemented	Completed	Enhanced secure bike storage at the Town Hall/Grey Friars House and The Conge
16	Provision of pool bikes for Council Staff use	Alternatives to private vehicle use	Other	2022	GYBC	GYBC	Reduction in car mileage & usage of pool bikes	N/A	Planning phase	2022	Will facilitate cycling rather than car use for visits within the urban area, where staff have not cycled to work
17	Installation of rapid electric vehicle charging point in Council car park	Promoting Low Emission Transport		Completed	GYBC & Highways England	GYBC & Highways England	Reduction in vehicle emissions & usage	N/A	Implemented	Completed	20-30 minutes rapid electric vehicle charging point installed as part of A14 trunk road network
18	Installation of 16 fast electric vehicle charging points over 8 Council car parks	Promoting Low Emission Transport		2021	GYBC	GYBC	Reduction in vehicle emissions & usage	N/A	Planning phase	2021	3-4 hours fast electric vehicle charging points are proposed
19	Procurement of mobile AQ monitoring units	Other	Other	2022	GYBC	GYBC	Real time measurement of air quality when required around the Borough	N/A	Planning phase	2022	To be calibrated against AQMS and deployed in district
20	Proposed 'Bike to Work Day' for 'Clean Air Day'	Alternatives to private vehicle use	Other	2022	GYBC & Norfolk County Council	GYBC & Norfolk County Council	Reduction in car mileage & participation	N/A	Planning phase	2022	Proposed to be in conjunction with NCC Pushing Ahead cycling project if DfT funding continues
21	Bin lorry route optimisation	Vehicle Fleet Efficiency		Completed	GYB Services	GYB Services	Reduction in fleet mileage and delay in procurement of additional bin lorry	N/A	Planning phase	Completed	GYB Services to utilise route optimisation software

22	Carbon reduction plan and carbon footprinting for Council	Other	Other	2022	GYBC	GYBC	Metrics on Council emissions to air, and reduction in these	N/A	Planning phase	2022	Scope to be defined, mapped and audited against
23	Installation and operation of new AQMS of airport/AURN specification	Other	Other	Complete	GYBC	GYBC	Real time measurement of air quality and production of bias adjustment factor for diffusion tubes	N/A	Implemented	Complete	New AQMS operating to over 99% data capture
24	New Local Plan for Planning Development Control	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	2022	GYBC	GYBC	Implementation of new Local Plan	N/A	Planning phase	2022	Implementation after consultations and revisions

2.3 PM$_{2.5}$ – Local Authority Approach to Reducing Emissions and/or Concentrations

As detailed in Policy Guidance LAQM.PG16 (Chapter 7), local authorities are expected to work towards reducing emissions and/or concentrations of PM$_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5µm or less). There is clear evidence that PM$_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

Great Yarmouth Borough Council is taking the following measures to address PM$_{2.5}$:

- In December 2017, following a capital procurement exercise, Great Yarmouth Borough Council had an Air Monitors AQMS installed, with a FIDAS for monitoring PM$_{2.5}$ (plus PM$_{10}$, and theoretically any other particle size class), and a Thermo NO$_x$ analyser, which basically brought the Council's real-time air quality monitoring into parity with AQMS used for monitoring airports, or being introduced into the national AURN network. This means that within the Borough of Great Yarmouth, we are more aware what concentrations our residents and visitors are exposed to. Another advantage of this high specification AQMS, is that it is highly suitable for enabling the calibration of portable real-time air quality monitors, meaning that Great Yarmouth Borough Council, our partner authorities within the Norfolk LAQM sub-group, or one of the neighbouring Suffolk LAs could co-locate portable monitors with the Council's AQMS, and so calibrate them for increased accuracy in the field;

- To this end, a capital procurement bid has been made for two portable Air Quality Monitoring Stations, which could potentially measure PM$_{2.5}$, PM$_{10}$, O$_3$, NO$_2$, temperature and humidity. If successful, these portable AQMS could be used to monitor PM$_{2.5}$ throughout the Borough, at sites proposed for allocation in the emerging local plan, or where planning applications have been made;

- The Council is working through the Norfolk Environmental Protection Group's (NEPG) Air Quality Sub-Group, to ensure regular two-way engagement with representatives of Public Health England, and the Director of Public Health at Norfolk County Council;

- The Council will also be meeting and working with the Director of Public Health's Office to help imbed air quality within their work, their Joint Strategic

Needs Assessment, to ensure that it is discussed at the Norfolk Health and Wellbeing Board, and to ideally provide data to improve the Public Health Outcomes Framework indicator 3.01 'Fraction of mortality attributable to particulate air pollution' estimate. The Council's new AQMS and proposed Micro AQMS will directly support this through the provision of accurate $PM_{2.5}$ data;

- The Council has direct dialogue with Officers of Norfolk County Council Highways, and also through the NEPG Air Quality Subgroup, on proposed significant changes to highways and traffic flows in the Borough, when possible improvements to $PM_{2.5}$ exposure will also be considered;

- Also, the Council's measures from section 2.2 and 'Table 2.2 – Progress on Measures to Improve Air Quality' above, also contribute to reducing $PM_{2.5}$ emissions and/or exposure;

- The Council's programme to encourage active travel, exercise, healthy choices, and avoidance of areas of poor air quality by residents and staff within the urban areas will continue.

3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

This section sets out what monitoring has taken place and how it compares with objectives.

Great Yarmouth Borough Council undertook automatic (continuous) monitoring at nitrogen dioxide, particulate matter, and ozone at one site in South Denes, Great Yarmouth during 2019. Table A.1 in Appendix A shows the details of this site and the former site in Gorleston. NB. Local authorities do not have to report annually on the following pollutants: 1,3 butadiene, benzene, carbon monoxide and lead, unless local circumstances indicate there is a problem. National monitoring results are available at https://uk-air.defra.gov.uk/interactive-map

The Council's continuous monitoring data can be accessed at http://www.ukairquality.net/

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

3.1.2 Non-Automatic Monitoring Sites

Great Yarmouth Borough Council undertook non-automatic (passive) monitoring of NO_2 at one site during 2019. Table A.2 in Appendix A shows the details of this site, and the former site which provided data for 2015-2016 in this report.

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on Quality Assurance/Quality Control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (e.g. "annualisation" and/or distance correction), are included in Appendix C.

3.2   Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias[4], "annualisation" (where the data capture falls below 75%), and distance correction[5]. Further details on adjustments are provided in Appendix C.

3.2.1   Nitrogen Dioxide (NO₂)

Table A.3 in Appendix A compares the ratified and adjusted monitored NO_2 annual mean concentrations for the past 5 years with the air quality objective of 40µg/m³.

For diffusion tubes, the full 2019 dataset of monthly mean values is provided in Appendix B. All tube results have been bias adjusted, though only four could be distance corrected, as the background 2018 Defra background levels (there is not more recent modelling) were too high for the tool to produce outputs, including for the Urban Background AQMS in South Denes.

Table A.4 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m³, not to be exceeded more than 18 times per year.

There were no exceedances of either the annual, or hourly air quality objectives here, with an improving trend (over 5 years) for the annual mean objective, and the hourly objective unchanged at 0 exceedances.

3.2.2   Particulate Matter (PM₁₀)

Table A.5 in Appendix A compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past 5 years with the air quality objective of 40µg/m³.

Table A.6 in Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for the past 5 years with the air quality objective of 50µg/m³, not to be exceeded more than 35 times per year.

There were 12 exceedances of the 24 hour mean air quality objective here, and none for the annual objective, with the measured level being 21 µg/m³. Both of these are an increase compared to the decreasing trend of levels measured in Gorleston during 2015-2016. The Defra 2018 PM_{10} background map (there is not more recent modelling) level for the area was 14.8µg/m³, and so the measured level was higher

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[4] https://laqm.defra.gov.uk/bias-adjustment-factors/bias-adjustment.html
[5] Fall-off with distance correction criteria is provided in paragraph 7.77, LAQM.TG(16)

than predicted. We will review the levels in future to discern whether this site can be considered as Urban Background.

3.2.3   Particulate Matter (PM$_{2.5}$)

Table A.7 in Appendix A presents the ratified and adjusted monitored PM$_{2.5}$ annual mean concentrations for the past 5 years.

The measured PM$_{2.5}$ was 12μg/m^3, the same as in 2018, which was the first year that the Council had the capacity to measure PM$_{2.5}$ and so it is not possible to discern any trend yet with respect to the measured 12μg/m^3. The Defra PM$_{2.5}$ 2018 background map (there is not more recent modelling) level for the area was 10.0μg/m^3, and so the measured level was broadly as predicted.

Appendix A: Monitoring Results

Table A.1 - Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Inlet Height (m)
CM1	Maltings House, Gorleston	Urban background	652498	305600	PM10	NO	BAM	5	25	3
					O3	NO	UV Photometer			
					NO2	NO	Chemiluminescent			
CM2	Fenner Road	Urban Background	652983	305658	PM10	NO	Optical	145	6	2.5
					PM2.5	NO	Optical			
					NO2	NO	Chemiluminescent			

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property).

(2) N/A if not applicable

Table A.2 – Details of Non-Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube collocated with a Continuous Analyser?	Height (m)
DT1	12 Bridge Road	Roadside	652054	308187	NO2	NO	0	4	NO	3
DT2	44 North Quay	Roadside	652079	307828	NO2	NO	0	2	NO	2.5
DT3	60 North Quay (upper)	Roadside	652105	307664	NO2	NO	0	1	NO	3
DT5	110 South Quay	Roadside	652518	306863	NO2	NO	0	6	NO	3
DT6	9 Southgates Road	Roadside	652569	306536	NO2	NO	0	3	NO	3
DT7	41 Southgates Road	Roadside	652611	306224	NO2	NO	0	2	NO	3
DT4	Southtown Road Junction	Roadside	652045	307417	NO2	NO	0	2	NO	3
DT8	Maltings House, Gorleston	Urban Background	652496	305605	NO2	NO	5	26	YES	2.5
DT8	Maltings House, Gorleston	Urban Background	652496	305605	NO2	NO	5	26	YES	2.5
DT8	Maltings House, Gorleston	Urban Background	652496	305605	NO2	NO	5	26	YES	2.5
DT9	81 North Quay	Roadside	652069	307871	NO2	NO	0	3	NO	3
DT10	1 South Quay	Roadside	652321	307321	NO2	NO	0	3	NO	1.5
DT11	25 South Quay	Roadside	652421	307184	NO2	NO	0	4	NO	2
DT12	Pasteur Road	Roadside	651993	307370	NO2	NO	14.5	9	NO	1.5
DT8	Fenner Road	Urban Background	652983	305658	NO2	NO	145	6	YES	2.5

DT8	Fenner Road	Urban Background	652983	305658	NO2	NO	145	6	YES	2.5
DT8	Fenner Road	Urban Background	652983	305658	NO2	NO	145	6	YES	2.5

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property).

(2) N/A if not applicable.

Table A.3 – Annual Mean NO₂ Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO$_2$ Annual Mean Concentration (μg/m^3) [3] [4]				
							2015	2016	2017	2018	2019
CM1	652498	305600	Urban Background	Automatic	N/A	N/A	16.8	14.5	N/A	N/A	N/A
CM2	652983	305658	Urban Background	Automatic	99.91	99.91	N/A	N/A	N/A	15	15
DT1	652054	308187	Roadside	Diffusion Tube	91.67	91.67	21.9	21.1	25.6	22.5	17.09
DT2	652079	307828	Roadside	Diffusion Tube	83.33	83.33	22.5	21.2	20.9	19.4	14.78
DT3	652105	307664	Roadside	Diffusion Tube	100	100	25.4	24.4	21.8	22.2	16.90
DT5	652518	306863	Roadside	Diffusion Tube	100	100	23.8	22.9	21.7	18.9	14.35
DT6	652569	306536	Roadside	Diffusion Tube	100	100	24.4	22.2	22.3	19.8	15.02
DT7	652611	306224	Roadside	Diffusion Tube	100	100	20.9	20.3	19	18.1	13.78
DT4	652045	307417	Roadside	Diffusion Tube	100	100	37.4	33.2	36.7	30.3	23.04
DT8	652496	305605	Urban Background	Diffusion Tube	N/A	N/A	16	17.7	16.7	N/A	N/A
DT8	652496	305605	Urban Background	Diffusion Tube	N/A	N/A	16.3	17.7	16.2	N/A	N/A
DT8	652496	305605	Urban Background	Diffusion Tube	N/A	N/A	15.7	17.1	16.3	N/A	N/A
DT9	652069	307871	Roadside	Diffusion Tube	100	100	19.9	18.5	18.8	17.0	12.93
DT10	652321	307321	Roadside	Diffusion Tube	100	100	32.8	33.7	33.2	29.8	22.65

DT11	652421	307184	Roadside	Diffusion Tube	100	100	31.6	27.4	27.9	21.6	16.42
DT12	651993	307370	Roadside	Diffusion Tube	91.67	91.67	N/A	24.9	23.3	21.0	15.93
DT8	652983	305658	Urban Background	Diffusion Tube	100	100	N/A	N/A	N/A	14.0	10.64
DT8	652983	305658	Urban Background	Diffusion Tube	100	100	N/A	N/A	N/A	14.0	10.66
DT8	652983	305658	Urban Background	Diffusion Tube	100	100	N/A	N/A	N/A	13.6	10.32

☒ **Diffusion tube data has been bias corrected**

☒ **Annualisation has been conducted where data capture is <75%**

☒ **Reported concentrations are those at the location of the monitoring site (bias adjusted and annualised, as required), i.e. prior to any fall-off with distance adjustment**

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) Means for diffusion tubes have been corrected for bias. All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

(4) Concentrations are those at the location of monitoring and not those following any fall-off with distance adjustment.

Table A.4 – 1-Hour Mean NO₂ Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2019 (%) [2]	NO₂ 1-Hour Means > 200µg/m³ [3]				
							2015	2016	2017	2018	2019
CM1	652498	305600	Urban Background	Automatic	N/A	N/A	0	0 (80.5)	N/A	N/A	N/A
CM2	652983	305658	Urban Background	Automatic	99.91	99.91	N/A	N/A	N/A	0	0

Notes:

Exceedances of the NO₂ 1-hour mean objective (200µg/m³ not to be exceeded more than 18 times/year) are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.

Table A.5 – Annual Mean PM$_{10}$ Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2019 (%) [2]	PM$_{10}$ Annual Mean Concentration (µg/m^3) [3]				
						2015	2016	2017	2018	2019
CM1	652498	305600	Urban Background	N/A	N/A	16.8	15.5	N/A	N/A	N/A
CM2	652983	305658	Urban Background	91.50%	91.50%	N/A	N/A	N/A	20	21

☒ **Annualisation has been conducted where data capture is <75%**

Notes:

Exceedances of the PM$_{10}$ annual mean objective of 40µg/m^3 are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16, valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Table A.6 – 24-Hour Mean PM$_{10}$ Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2019 (%) [2]	PM$_{10}$ 24-Hour Means > 50µg/m^3 [3]				
						2015	2016	2017	2018	2019
CM1	652498	305600	Urban Background	N/A	N/A	0	0 (14.9)	N/A	N/A	N/A
CM2	652983	305658	Urban Background	91.50%	91.50%	N/A	N/A	N/A	10	12

Notes:

Exceedances of the PM$_{10}$ 24-hour mean objective (50µg/m^3 not to be exceeded more than 35 times/year) are shown in **bold.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

Table A.7 – PM$_{2.5}$ Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2019 (%) [2]	PM$_{2.5}$ Annual Mean Concentration (µg/m^3) [3]				
						2015	2016	2017	2018	2019
CM2	652983	305658	Urban Background	91.50%	91.50%	N/A	N/A	N/A	12	12

☒ **Annualisation has been conducted where data capture is <75%**

Notes:

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16, valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Appendix B: Full Monthly Diffusion Tube Results for 2019

Table B.1 - NO₂ Monthly Diffusion Tube Results - 2019

| Site ID | X OS Grid Ref (Easting) | Y OS Grid Ref (Northing) | NO₂ Mean Concentrations (µg/m³) | | | | | | | | | | | | Annual Mean | | |
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Raw Data	Bias Adjusted (0.76) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
DT1	652054	308187	32.25	38.19	24.75	18.43	18.31	20.74	22.36	N/A	22.56	25.60	29.50	30.30	25.73	19.55	19.6
DT2	652079	307828	30.26	36.82	24.36	26.24	22.38	N/A	N/A	24.28	22.83	21.00	29.30	18.70	25.62	19.47	
DT3	652105	307664	26.6	37.87	24.35	26.11	27.13	24.77	25.67	26.48	23.94	24.30	28.30	21.90	26.45	20.10	
DT5	652518	306863	25.35	29.18	22.95	27.94	26.32	26.39	21.63	23.40	26.80	20.10	25.40	22.50	24.83	18.87	
DT6	652569	306536	26.86	34.06	25.21	20.09	22.93	23.78	24.03	25.39	23.83	26.20	28.70	19.60	25.06	19.04	
DT7	652611	306224	27.09	31.29	20.58	14.75	22.7	22.93	21.36	21.36	20.16	21.70	27.60	19.10	22.55	17.14	
DT4	652045	307417	47.89	48.03	44.75	31.11	45.46	39.2	37.41	42.21	39.04	31.10	40.00	39.80	40.50	30.78	30.8
DT9	652069	307871	26.88	32.3	20.91	19.78	16.93	17.65	17.32	17.93	17.10	13.40	26.00	17.50	20.31	15.43	
DT10	652321	307321	38.48	37.48	35.35	39.71	41.77	41.65	40.28	33.62	35.57	35.30	37.40	26.80	36.95	28.08	28.1
DT11	652421	307184	35.44	36.8	27.14	29.35	29.49	23.96	29.36	24.18	30.69	25.30	31.50	26.30	29.13	22.14	
DT12	651993	307370	25.04	34.39	25.57	N/A	20.74	24.34	14.82	25.13	23.51	22.50	31.60	18.30	24.18	18.37	18.1
DT8	652983	305658	26.90	27.59	19.82	12.30	13.51	14.19	15.80	15.85	16.57	18.23	25.03	19.32	18.76	14.26	
DT8	652983	305658	30.49	30.00	20.35	15.13	14.89	15.06	15.73	16.92	13.81	17.58	25.56	20.26	19.65	14.93	
DT8	652983	305658	30.59	32.56	22.86	16.45	13.62	14.59	16.19	16.41	17.29	17.26	24.35	20.77	20.25	15.39	

☒ **Local bias adjustment factor used**

☒ **National bias adjustment factor used**

☒ **Annualisation has been conducted where data capture is <75%**

☒ **Where applicable, data has been distance corrected for relevant exposure in the final column**

Notes:

Exceedances of the NO$_2$ annual mean objective of 40μg/m^3 are shown in **bold**.

NO$_2$ annual means exceeding 60μg/m^3, indicating a potential exceedance of the NO$_2$ 1-hour mean objective are shown in **bold and underlined.**

(1) See Appendix C for details on bias adjustment and annualisation.

(2) Distance corrected to nearest relevant public exposure.

Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC

QA/QC of Diffusion Tube Monitoring

The diffusion tubes are supplied by Gradko Environmental, part of Gradko International Ltd. They consist of 20% TEA (Triethanolamine) in deionised water. Once received by post the tubes are stored in a refrigerator until required. Once the tubes have been placed in their holders, the end caps are removed, and the tubes exposed for a month. At the end of the period the tubes are recapped and retrieved and stored in the refrigerator until returned by post to the laboratory for analysis. A travel blank is used. This travels everywhere with the exposed tubes but is not itself exposed. It is stored in the refrigerator and sent for analysis with the exposed tubes. Its purpose is to check on contamination of the tubes.

Gradko International is accredited by UKAS for the analysis of NO_2. Gradko also take part in the AIR NO_2 Proficiency Testing Scheme on a quarterly basis. Their AIR results over the previous four rounds of testing covering January to November 2019, gave 100% laboratory performance in terms of the accuracy and precision of results during three rounds, and 75% during one round (Summary of Laboratory Performance in AIR NO2 Proficiency Testing Scheme (January 2019 – October 2020).

Diffusion Tube Bias Adjustment Factors

The National bias adjustment factor for the period was 0.91 (Spreadsheet Version Number: 9/21)

Factor from Local Co-location Studies

The Borough Council has co-located three diffusion tubes with its continuous air quality monitors. The site is set up as an urban background site, to give continuity to the Council's previous urban background site. From the co-location study the local bias adjustment factor derived is 0.76 for 12 months of data, as detailed in Figure C.1 below.
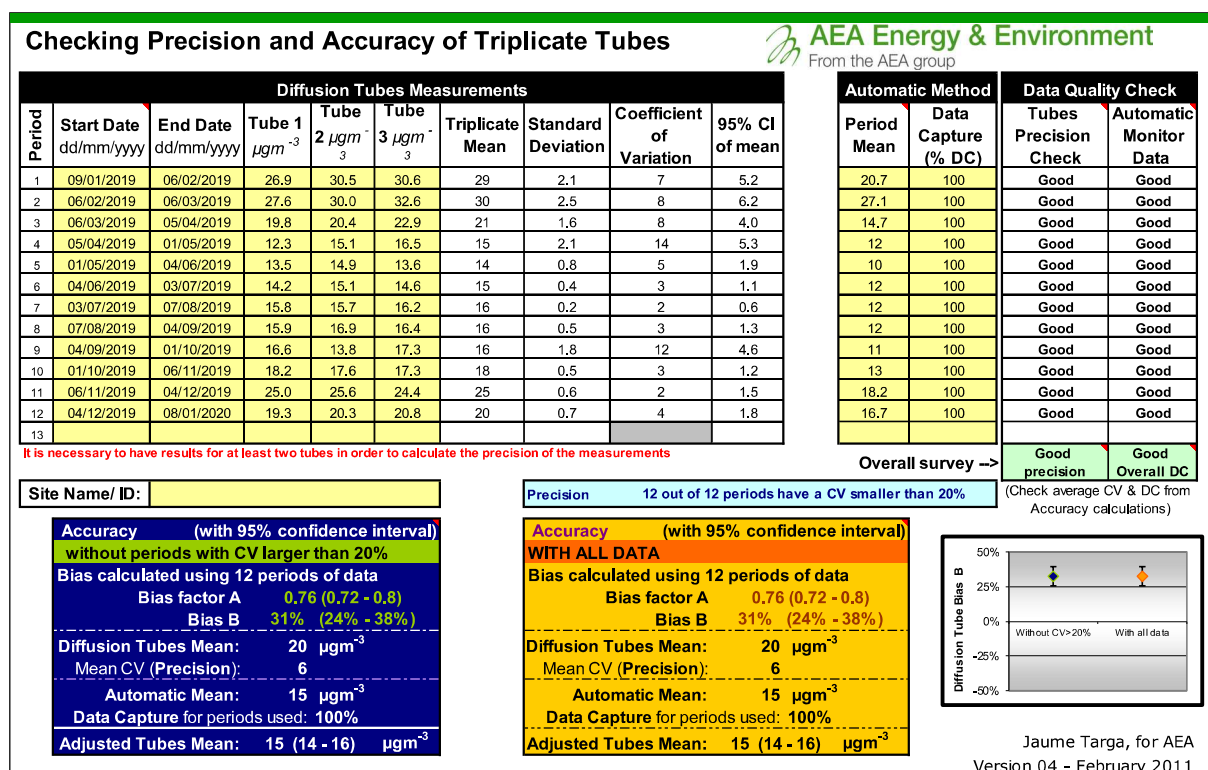
Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

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	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
										Automatic Method		**Data Quality Check**	
1	09/01/2019	06/02/2019	26.9	30.5	30.6	29	2.1	7	5.2	20.7	100	Good	Good
2	06/02/2019	06/03/2019	27.6	30.0	32.6	30	2.5	8	6.2	27.1	100	Good	Good
3	06/03/2019	05/04/2019	19.8	20.4	22.9	21	1.6	8	4.0	14.7	100	Good	Good
4	05/04/2019	01/05/2019	12.3	15.1	16.5	15	2.1	14	5.3	12	100	Good	Good
5	01/05/2019	04/06/2019	13.5	14.9	13.6	14	0.8	5	1.9	10	100	Good	Good
6	04/06/2019	03/07/2019	14.2	15.1	14.6	15	0.4	3	1.1	12	100	Good	Good
7	03/07/2019	07/08/2019	15.8	15.7	16.2	16	0.2	2	0.6	12	100	Good	Good
8	07/08/2019	04/09/2019	15.9	16.9	16.4	16	0.5	3	1.3	12	100	Good	Good
9	04/09/2019	01/10/2019	16.6	13.8	17.3	16	1.8	12	4.6	11	100	Good	Good
10	01/10/2019	06/11/2019	18.2	17.6	17.3	18	0.5	3	1.2	13	100	Good	Good
11	06/11/2019	04/12/2019	25.0	25.6	24.4	25	0.6	2	1.5	18.2	100	Good	Good
12	04/12/2019	08/01/2020	19.3	20.3	20.8	20	0.7	4	1.8	16.7	100	Good	Good
13													

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

Overall survey --> **Good precision** | **Good Overall DC**

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:

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 0.76 (0.72 - 0.8)
Bias B 31% (24% - 38%)

Diffusion Tubes Mean: 20 μgm^{-3}
Mean CV (**Precision**): 6

Automatic Mean: 15 μgm^{-3}
Data Capture for periods used: 100%

Adjusted Tubes Mean: 15 (14 - 16) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.76 (0.72 - 0.8)
Bias B 31% (24% - 38%)

Diffusion Tubes Mean: 20 μgm^{-3}
Mean CV (**Precision**): 6

Automatic Mean: 15 μgm^{-3}
Data Capture for periods used: 100%

Adjusted Tubes Mean: 15 (14 - 16) μgm^{-3}

Jaume Targa, for AEA
Version 04 – February 2011

Figure C.1 Derivation of Local Bias Adjustment Figure

Discussion of Choice of Factor to Use

The Borough Council has used the local bias adjustment figure of 0.76 as the bias adjustment factor. The national factor for 2019 is reasonably similar, and also less than 1. There is a preference to use a local factor due to the following:

- The co-location of triplicate tubes alongside the continuous monitoring site;
- There is greater than 9 months of data; and,
- It is considered the local bias adjustment factors will be most representative of the local conditions – particularly as the national bias adjustment factor is composed of many different site types, and length of studies.

Distance Correction of Bias adjusted Diffusion Tube Data

The Council has attempted to distance correct the annual bias adjusted diffusion tube data, using Bureau Veritas' 'NO$_2$ Fall off with Distance from Road Calculator v4.2' spreadsheet. However, this was only possible with two tubes, as the background levels were too high on the Defra 2019 NO$_2$ maps.

QA/QC of automatic monitoring

The automatic monitors are maintained in accordance with the manufacturer's recommendations. The Council has a maintenance contract with Acoem UK (formerly Air Monitors Ltd.) who also supplied the new AQMS to the Council. The site is routinely

visited by Acoem UK every six months for routine maintenance and the contract allows for a 48hour response to emergency call out situations.

Automatic calibrations of the NO2 analyser are carried out daily. BOC specialist calibration gases are used to obtain span values and instrumental drift is accounted for during the processing of the data. Data processing and handling is provided by Ricardo Energy & Environment undertakes both the data management and 6-monthly AQMS QA/QC services for the Council, which is recommended as best practice by Defra in LAQM TG (16). The AQMS completes regular automated calibrations to the Fidas 200 (with WS600 MET Station) particulate monitor, and Thermo Model 42i Chemiluminescent $NO-NO_2-NO_x$ Analyser. Inlet filter changes are also carried out by the Council's contractors. Council Officers undertake periodic checks of the site, and also visit when potential issues are reported by Ricardo Energy & Environment. It should be noted that the Council's AQMS is to a similar specification used to monitor UK airports, and within the national AURN AQ monitoring network.

All site visits are recorded in the site log and describe adjustments, repairs, problems encountered etc. following scheduled service visits reports are issued by the engineers.

Appendix D: Map(s) of Monitoring Locations and AQMAs

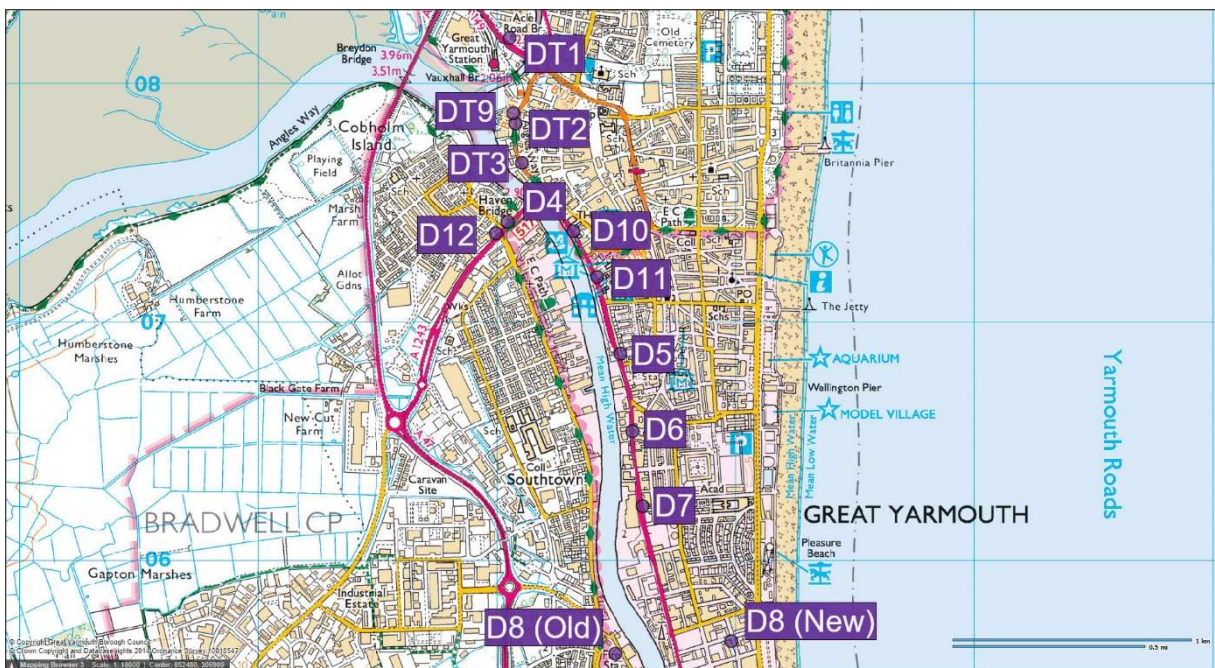**Figure D.1 Location of the Automatic Air Quality Monitoring Station**

Figure D.2 Map(s) of Non-Automatic Monitoring Sites

Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England

Pollutant	Air Quality Objective[6]	
	Concentration	**Measured as**
Nitrogen Dioxide (NO$_2$)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	40 µg/m^3	Annual mean
Particulate Matter (PM$_{10}$)	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
	40 µg/m^3	Annual mean
Sulphur Dioxide (SO$_2$)	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

[6] The units are in microgrammes of pollutant per cubic metre of air (µg/m^3).

Glossary of Terms

Abbreviation	Description
AIR	Independent analytical proficiency-testing scheme by LGC Ltd. and the Health and Safety Laboratory (HSL)
ASR	Annual Status Report (on air quality)
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
AQMS	Air Quality Monitoring Station (real-time monitoring)
ASR	Air quality Annual Status Report
AURN	Automatic Urban and Rural Network (Defra's national automatic monitoring network)
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
EU	European Union
FDMS	Filter Dynamics Measurement System
FIDAS	Real-time optic particulate monitor for AQMS
GYBC	Great Yarmouth Borough Council
GYB Services	Great Yarmouth Borough Services
GYTRC	Great Yarmouth Third River Crossing
LAQM	Local Air Quality Management
NCC	Norfolk County Council

NEPG	Norfolk Environmental Protection Group
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10μm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5μm or less
QA/QC	Quality Assurance and Quality Control
RAMSAR	The Convention on Wetlands, called the Ramsar Convention, is the intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources
SO_2	Sulphur Dioxide
TEA	Triethanolamine: the reagent used in diffusion tubes as an absorbent for ambient NO2

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