Falkirk Council

Proposal for the Revocation of the Grangemouth Air Quality Management Area (AQMA)

In fulfillment of Section 83(2)of the Environment Act 1995 – Local Air Quality Management

2023

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Executive Summary

An Air Quality Management Area (AQMA) encompassing a section of Grangemouth was declared in 2005 due to exceedances of the sulphur dioxide (SO_2) 15-minute mean national air quality strategy (NAQS) objective.

Measured SO_2 concentrations in Grangemouth have declined over recent years and become regularly compliant with the NAQS objective for ten years (since 2012). Section 4 "AQMA" of Part IV of the Environment Act 1995[1] states:

"There are no set criteria on which an AQMA amendment or revocation decision will be based, and the Scottish Government considers each request on a case-by-case basis. A minimum requirement however will normally be **at least three consecutive years** where the NAQS objectives of concern are being achieved and where monitoring data demonstrates that further exceedances of the objectives are unlikely to occur."

On this basis, **Falkirk Council are proposing to revoke the Grangemouth AQMA (SO_2 15-min mean)**. This proposed revocation report and an associated Detailed Assessment[2] aims to provide evidence that will assist Falkirk Council in doing so following public consultation.

This proposal includes the following elements:

- Background and history of the Grangemouth AQMA;
- Description of local SO_2 pollution sources;
- Monitoring equipment used;
- A review of measured SO_2 concentrations;
- Conclusions and recommendations.

Detailed dispersion modelling of current and future SO_2 concentrations with associated meteorological conditions in Grangemouth are included in the Detailed Assessment[1].

[1] https://www.gov.scot/publications/local-air-quality-management-policy-guidance/pages/4/
[2] https://www.falkirk.gov.uk/services/environment/environmental-policy/air-quality/

There were eleven SO_2 (15-min mean) NAQS objective exceedances recorded at three Grangemouth monitoring sites over the last eighteen years. No further NAQS objective exceedances have been recorded since 2012. These results demonstrate that the SO_2 (15-min mean) concentrations recorded in the past ten years (since 2012) have complied with the NAQS objective. Falkirk Council expects continued compliance of the SO_2 (15-min mean) NAQS objective in future years.

Revoking an AQMA is an indication that there has been an improvement in air quality within that designated area over a period of time. This improvement has public health benefits through the achievement and the on-going work of the relevant, agreed Air Quality Action Plan (AQAP) measures and other associated improvements in industrial processes and utilisation of cleaner fuels / technologies.

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1. Background

1.1 Introduction

Falkirk Council has been working to improve air quality and public health for many years. The Council has a responsibility to comply with legislation and policy regulations when managing local air quality. The Council completes its Local Air Quality Management (LAQM) duties by managing an extensive air quality monitoring network, assessing collected data and reporting on areas of existing or anticipated poor air quality - declared via AQMAs.

1.2 Legislation and Policy

European Legislation

The European Union (EU) has published a Directive on Ambient Air Quality Assessment and Management[3] which came into force in September 1996. This Directive was intended as a strategic framework for tackling air quality consistently, through setting European-wide air quality limit values in a series of daughter directives, superseding and extending European legislation. The first four daughter directives were placed into national legislation. A new EU air quality directive[4] came into force in June 2008 and was transposed into The Air Quality Standards Regulations[5] in Scotland, Wales, Northern Ireland and England in June 2010.

National Legislation

The Environment Act 1995[6] (UK Government) required the preparation of a NAQS setting Air Quality Objectives (AQOs) for specified pollutants and outlining measures to be adopted by local authorities through the system of LAQM and by others to work in pursuit of the achievement of these objectives. The NAQS was published in 1997 and subsequently reviewed and revised in 2000, and an addendum to the Strategy published in 2002. The current Strategy[7] was published in July 2007.

The Air Quality Standards (AQS) are set for the purpose of protecting human health, vegetation, and ecosystems from certain harmful atmospheric pollutants. The Scottish air quality standards take account of the EU objective values and are either effectively

[3] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A31996L0062
[4] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A32008L0050
[5] https://www.legislation.gov.uk/uksi/2010/1001/contents/made
[6] https://www.legislation.gov.uk/ukpga/1995/25/contents
[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69336/pb12654-air-quality-strategy-vol1-070712.pdf

identical, or more stringent. LAQM Technical Guidance TG22[8] provides advice on where the AQS for pollutants considered in this study apply. These are summarised in Table 1.

Table 1 – Examples of Where the AQS Apply

Averaging Period	Standards Should Apply to	Standards Should Generally Not Apply to
24-hour mean and 8-hour mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless used as a permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-hour mean and 8-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be shorter than either the 24- or 8-hour relevant mean.
1-hour mean	All locations where the annual mean and 24- and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably expect to spend one hour or longer.which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably expect to spend one hour or longer.	Kerbside sites where the public would not be expected to have regular access.
15-min mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	

Cleaner Air for Scotland

The Scottish Government's Cleaner Air for Scotland (CAFS) Strategy - The Road to a Healthier Future[9] is a national strategy that sets out how the Scottish Government will deliver its commitment to further improving air quality to protect health.

The CAFS strategy aims to help the Scottish Government achieve the ambitious goal "to have the best air quality in Europe". A National Modelling Framework (NMF) and

[8] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf
[9] https://www.gov.scot/publications/cleaner-air-scotland-road-healthier-future/

National Low Emission Framework (NLEF) are being developed to provide the tools and mechanisms to improve national air quality.

Cleaner Air for Scotland 2 (CAFS2) - Towards a Better Place for Everyone[10] is Scotland's second air quality strategy. CAFS2 sets out how the Scottish Government and its partner organisations propose to further reduce air pollution to protect human health and fulfil Scotland's legal responsibilities over the period from 2021 to 2026. A series of actions across a range of policy areas are outlined within the strategy.

Local Air Quality Management

The AQOs which are relevant to LAQM in Scotland and have been set into regulations, namely the Air Quality (Scotland) Regulations 2000[11], the Air Quality (Scotland) Amendment Regulations 2002[12] and the Air Quality (Scotland) Amendment Regulations 2016[13].

AQMA revocation information can be found in Section 4 "AQMA" of Part IV of the Environment Act 1995 LAQM: Policy Guidance which states:

"Local authorities are able to amend or revoke an existing AQMA order at any time as set out under section 83(2) of the 1995 Act. Where an authority considers it necessary to do this, the Scottish Government expects the authority to consult SEPA and all other statutory consultees, businesses, members of the public and other interested parties in the vicinity of the AQMA. All available supporting information to justify the amendment or revocation should be provided to the Scottish Government before any changes take effect (and this should take the form of a revocation proposal report – as outlined below). A local authority may submit a proposal to amend or revoke an existing AQMA order at any time."

LAQM Technical Guidance TG22[14] requires that a decision to amend or revoke an AQMA should only be taken "In most cases the decision to amend or revoke an AQMA should only be taken following a detailed study, to be appended to the ASR/APR as additional supporting technical information. A modelling study may allow compliance to be assessed over a wider geographical area than when compared to monitoring alone. This should set out in detail all the available information used to reach the decision, with the same degree of confidence as was provided for the original

[10] https://www.gov.scot/publications/cleaner-air-scotland-2-towards-better-place-everyone/
[11] https://www.legislation.gov.uk/ssi/2000/97/made
[12] https://www.legislation.gov.uk/ssi/2002/297/contents/made
[13] https://www.legislation.gov.uk/sdsi/2016/9780111030837/contents
[14] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

declaration." as displayed in this report. An associated Detailed Assessment report has been completed by consultants Sweco to support the revocation of the Grangemouth AQMA.

1.3 Summary of Proposal

One of the Falkirk Council areas which had historic, poor air quality was Grangemouth. Its town centre and nearby residential areas are located adjacent to a large industrial petrochemical area and international shipping container port. The geographical location and transport infrastructure (nearby the Forth estuary and the M9 motorway) enables Grangemouth to be advantageous for these national and economically significant industries. These areas are shown in Map 1.Grangemouth Layout in Appendix A.

The Grangemouth Air Quality Action Plan (AQAP)[15] was completed by consultants BMT Cordah and published in July 2007. The AQAP Section 2 (p.4) states:

"Up to 2004, the number of measured exceedances of the SO_2 NAQS (15-min) objective appeared to be reducing year on year. In the period following the completion of the Detailed Assessment a number of exceedances of the objective were measured. Analysis of the meteorological conditions at the time of the exceedances and through discussions with Ineos (formerly BP) identified that some of the measured exceedances were directly attributable to events on the Ineos site. Following discussions with SEPA and the Scottish Executive (now the Scottish Government) it was determined that an AQMA should be declared as a precautionary measure for the area covering residential properties within Grangemouth, due to historical exceedances of the 15-min mean NAQS objective for SO_2."

[15] https://www.falkirk.gov.uk/services/environment/environmental-policy/air-quality/docs/air-quality/00%202007%20Grangemouth%20Air%20Quality%20Action%20Plan.pdf?v=202308290912

2. Description of the Grangemouth AQMA

2.1 Pollutant

The World Health Organisation (WHO) description[16] of pollutant SO_2:

"SO_2 is a colourless gas that is readily soluble in water. It is predominantly derived from the combustion of fossil fuels for domestic heating, industries and power generation."

2.2.Time Intervals

The AQS[17] are recorded concentrations (of a pollutant) over a given period, which are considered to be acceptable in terms of what is scientifically known about the effects on health and the environment. They can also be used as a benchmark to indicate whether air pollution is getting better or worse.

An exceedance is a period of time (defined for each standard) where the concentration is higher than that set out in the AQS. The Grangemouth AQMA relevant AQS are shown in Table 2.

Table 2: SO_2 AQS

Pollutant	Concentration	Measured As	To Be Achieved By
Sulphur Dioxide (SO_2)	266 µg/m^3, not to be exceeded more than 35 times a year	15 minute average	31st December 2005

2.3 Date AQMA Declared

The AQMA was declared by Falkirk Council on 1st November 2005. The AQMA has been active for 18 years at the time this report was published. The original Falkirk Council AQMA Declaration Order and associated map can be shown in Appendix B.

2.4 Description and Extent of the Grangemouth AQMA Boundary

The area shown inside the solid black line on Figure 1 Grangemouth AQMA Boundary below is the designated AQMA area. This designated area incorporates the Grangemouth oil terminal, the extensive petrochemical complex, the international shipping port / docks, several chemical manufacturing sites and adjacent town centre / residential areas. The area generally covers the Grangemouth town centre to the

[16] https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/types-of-pollutants
[17] https://www.scottishairquality.scot/air-quality/standards

Forth estuary port area and extends south to the M9 motorway. Figures 2 and 3 display the petrochemical area and international shipping port respectively.

Figure 1 – Grangemouth AQMA

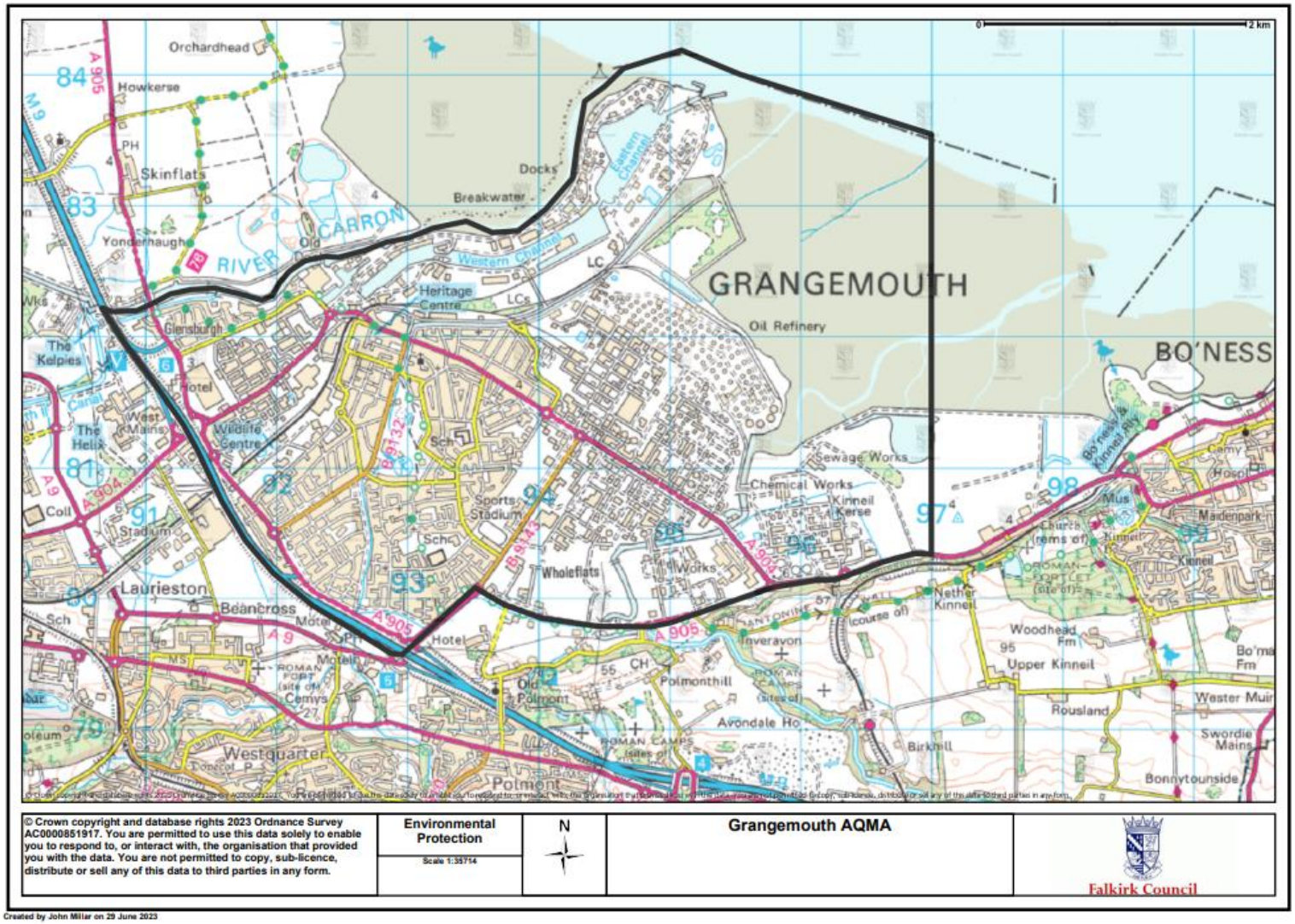


Figure 2 – Grangemouth Petrochemical Area

Figure 3 – Grangemouth International Port

3. Historical Grangemouth LAQM Reports / Assessments

There have been many air quality related reports completed before and during the AQMA designation in Grangemouth, these are summarised and listed below.

1. 2003 LAQM Updating and Screening Assessment (U&SA) – Available on Request

The LAQM U&SA report was completed by BMT Cordah for Falkirk Council in July 2003 which states within Section 7.9 Conclusion:

"Based on the Review and Assessment work carried out to date, current emissions levels from the main industrial operators and the recent monitoring data, it has been identified that there is a high probability of the SO_2 objectives being exceeded within the Falkirk Council area. A Detailed Assessment (DA) for SO_2 is therefore required for Falkirk Council."

2. 2004 Supplementary Report to DA - Available on Request

Following the recommendations stated in the 2003 U&SA report above, Falkirk Council completed a Supplementary Report to DA in November 2004. The studies completed by BMT Cordah were: 1 Review of (SO_2) exceedance data, 2. Modelling study of SO_2 sources, and 3. Emissions inventory. The 2004 report concludes:

"Despite the levels of SO_2 which have been recorded at Inchyra Park during 2004, the predictions based upon the known reductions in SO_2 emission rates from BP Grangemouth and improvements in management control over SO_2 emissions from the power stations and refinery indicate that the AQS objectives will be met by the relevant dates; there is therefore no need to declare an AQMA."

3. 2005 Grangemouth AQMA Declared

Following Falkirk Council committee meetings and an external consultation process, the Grangemouth AQMA Declaration Order was published on 24th October 2005 and can be shown in Appendix B. The Declaration Order states:

"The (Grangemouth) Designated Area is designated in relation to a likely breach of the SO_2 (15-min mean) objective as specified in the Air Quality (Scotland) Regulations 2000."

The Grangemouth AQMA became active on 1st November 2005.

4. 2007 Grangemouth AQMA Further Assessment - Available on Request

After the Grangemouth AQMA was declared in 2005, the Grangemouth AQMA Further Assessment (FA) report was developed by BMT Cordah for Falkirk Council on 18th May 2007. The FA contained: 1. Review of SO_2 data, 2. Emissions inventory and 3. Atmospheric dispersion modelling including source apportionment. The FA concludes: "The emission inventory has indicated that the greatest contributor to annual SO_2 emissions in the Falkirk Council area was Ineos. The SO_2 emissions from shipping and from domestic / commercial sources were also greater than those from smaller industrial emitters. It is intended that monitoring of SO_2 concentrations within the Grangemouth AQMA is maintained and an AQMA action plan be drawn up to target improved monitoring and communication between industrial operators, SEPA and Falkirk Council."

5. 2007 Grangemouth AQMA Action Plan

The Grangemouth AQMA Action Plan was completed by BMT Cordah for Falkirk Council on 31st July 2007. The AQAP outlined local and national policy developments relating to the National Emissions Ceilings and Large Combustion Plant Directives (LCPD), the Ineos Pollution Prevention and Control (PPC) environmental permit, the site sulphur reduction plan and agreed AQAP measures.

6. 2010 Grangemouth AQMA - Further Assessment

Air quality data recorded from three Grangemouth automatic monitoring stations indicated an increase in ambient SO_2 concentrations since 2005. This study was undertaken to provide further analysis to establish any identifiable cause. The 2010 FA report consisted of two stages:

1. Evidence based study to analyse monitoring data in relation to meteorological data during the periods of SO_2 exceedances; and

2. Dispersion modelling study of emissions from Grangemouth industrial operators and Longannet (coal fired) power station during exceedance periods.

The FA concludes:

“Considering the meteorological analysis, the modelling study, and the fact that Ineos are frequently operating normally during pollution episodes, it would appear likely that the main cause of the 15-min mean exceedances is the combined effect of all sources within Ineos. Overall, the (Grangemouth) area should remain designated as an AQMA. Considering the extent of the predicted exceedances, it is concluded that the current boundary of the AQMA is appropriate and does not need adjustment.”

7. 2014 Grangemouth Tail Gas Study

The Grangemouth Tail Gas Study was completed by Golder Associates on behalf of Falkirk Council in July 2014. In response to the AQMA declaration, a working group of key stakeholders including Falkirk Council, SEPA, the Scottish Government and the petrochemical plant operators (Ineos and Petroineos) was formed to implement an action plan of measures to improve local air quality. Petroineos, in discussion with SEPA brought forward proposals to install Tail Gas Treatment (TGT) de-sulphurisation plant technology to reduce emissions of SO_2 from its site. The Tail Gas Study was undertaken to understand the effect of the proposed TGT installation on local SO_2 emissions.

The study concludes:

“Modelling predictions of 2013 without the TGT indicates that the 15-min mean objective would continue to be breached based on projected emissions data. Modelling predictions of 2013 with the TGT installation indicates that the number of exceedances of the 15-min mean objective would reduce markedly. Predicted concentrations at Grangemouth AURN and Moray would continue to be in excess of the objective level, however the number of predicted exceedances would be below that allowed under the objective. No exceedances are predicted at Grangemouth MC. Overall, maximum concentrations are predicted to reduce markedly as a result of the TGT introduction.”

8. 2020 Grangemouth Emissions Study

An extensive air quality modelling study was undertaken by consultants Sweco on behalf of Falkirk Council in 2020 to identify and assess the major sources of (industrial

and traffic) emissions within the Grangemouth area as no AQMA-related emissions assessment had been completed since 2014.

The study considers multiple pollutants such as SO_2, nitrogen dioxide (NO_2) and particulates (PM_{10}+$PM_{2.5}$). The study includes baseline air quality, road traffic emissions assessment, industrial emissions assessment, source apportionment and utilises emissions modelling to predict future emissions at local receptors. The fundamental concept was that this study could be updated in future (and expanded for any additional sources) which would be advantageous to understanding current and future emissions in Grangemouth.

4. Description of Local Pollution Sources

The 2010 Grangemouth FA[18] and the 2020 Grangemouth Emissions Study[19] assesses the main sources of SO_2 in Grangemouth. Over time, these sources may have changed / been modified, improved efficiency or have been decommissioned / mothballed.

The main SO_2 source list can be shown below in Table 3: Grangemouth SO_2 Sources. Please note that, this is not a definitive list of *all* SO_2 sources in the Grangemouth area, it is describing the main contributor sources to historical poor air quality.

The Scottish Environment Protection Agency (SEPA) is the regulator for industrial operators through managing environmental permits such as Pollution Prevention and Control (PPC). More information on how SEPA regulates industry in Grangemouth can be found here:

https://www.sepa.org.uk/regulations/air/air-quality/grangemouth/

The major Grangemouth industrial operators map can be shown in Appendix A: Maps, 2. Major Industrial Operators.

[18] https://www.falkirk.gov.uk/services/environment/environmental-policy/air-quality/docs/air-quality/00%202010%20Grangemouth%20AQMA%20Further%20Assessment.pdf?v=202309151334
[19] https://www.falkirk.gov.uk/services/environment/environmental-policy/air-quality/docs/air-quality/12%20Grangemouth%20Emissions%20Study%202020.pdf?v=202103021416

Table 3: Grangemouth SO_2 Sources

Grangemouth Major SO_2 Source Summary			
Operator	**Group Type**	**Source**	**Still Operating in 2023?**
BP (Now INEOS FPS)	BP (Now INEOS FPS)	BP A17	Y
Calachem	Boilers	BB02 / BB03 / BB05	Y
Engie	Boilers	Cochrane	Y
		Nebraska 1+2	Y
INEOS Chemicals	None	Boilers	Y
		Flares	Y
INEOS Infrastructure	Boilers	P / ST8	Y
		Boiler 9 / 10	Y
		Boiler 11	N
		Boiler 12	N
		Boiler 13	N
		Boiler 14	Y
		Boiler 15	Y
	CHP		Y
Petroineos	Flares	No 1 Flare	Y
		No. 2 Flare	Y (spare)
		No. 3 Flare	Y
	CDU3	CDU3 / DHT3	Y
	VDU / HCU	VDU / HCU	Y
	H / Unit	H / Unit	Y
	SRU Units	SRU 5 Tall Stack	Y
		SRU 6 Tall Stack	Y
Petroineos	FCCU Unit	FCCU	N
	All Petroineos Sources	1CDUB1	N (mothballed)
		CRU-Main	Y
		CRU 1st Interheater	Y
		Hydrofiner	Y
		H / Unit	Y
		SRU 5 Tall Stack	Y
		SRU 6 Tall Stack	Y
		1 CDUB1A	N (mothballed)
		CDU2 / DHT2	Y
		CDU3 / DHT3	Y
		VDU / HCU	Y
		FCCU	N
		HCU Mild Column Reboiler	Y
Scottish Power	Longannet Coal Fired Station (Decommissioned in 2016)	Longannet 1	N
		Longannet 2	N
		Longannet 3	N
		Longannet 4	N

Acronym	Full Description
CDU	Crude Distillation Unit
CHP	Combined Heat and Power
CRU	Catalytic Reformer Unit
DHT	Distillate Hydrotreater
FCCU	Fluidised Catalytic Cracking Unit
H / Unit	Hydrogen Unit
HCU	Hydrocracker
P / ST8	Boiler 8
SRU	Sulphur Recovery Units
VDU	Vacuum Distillation Unit
1CDUB1	Crude Distillation Unit 1B

4.1 Changes to Local Pollution Sources

The following organisations have provided the following Grangemouth SO_2 emission related information over recent years.

Industrial Operator: Ineos (Refinery, Petrochemicals and Power Station from 2005)

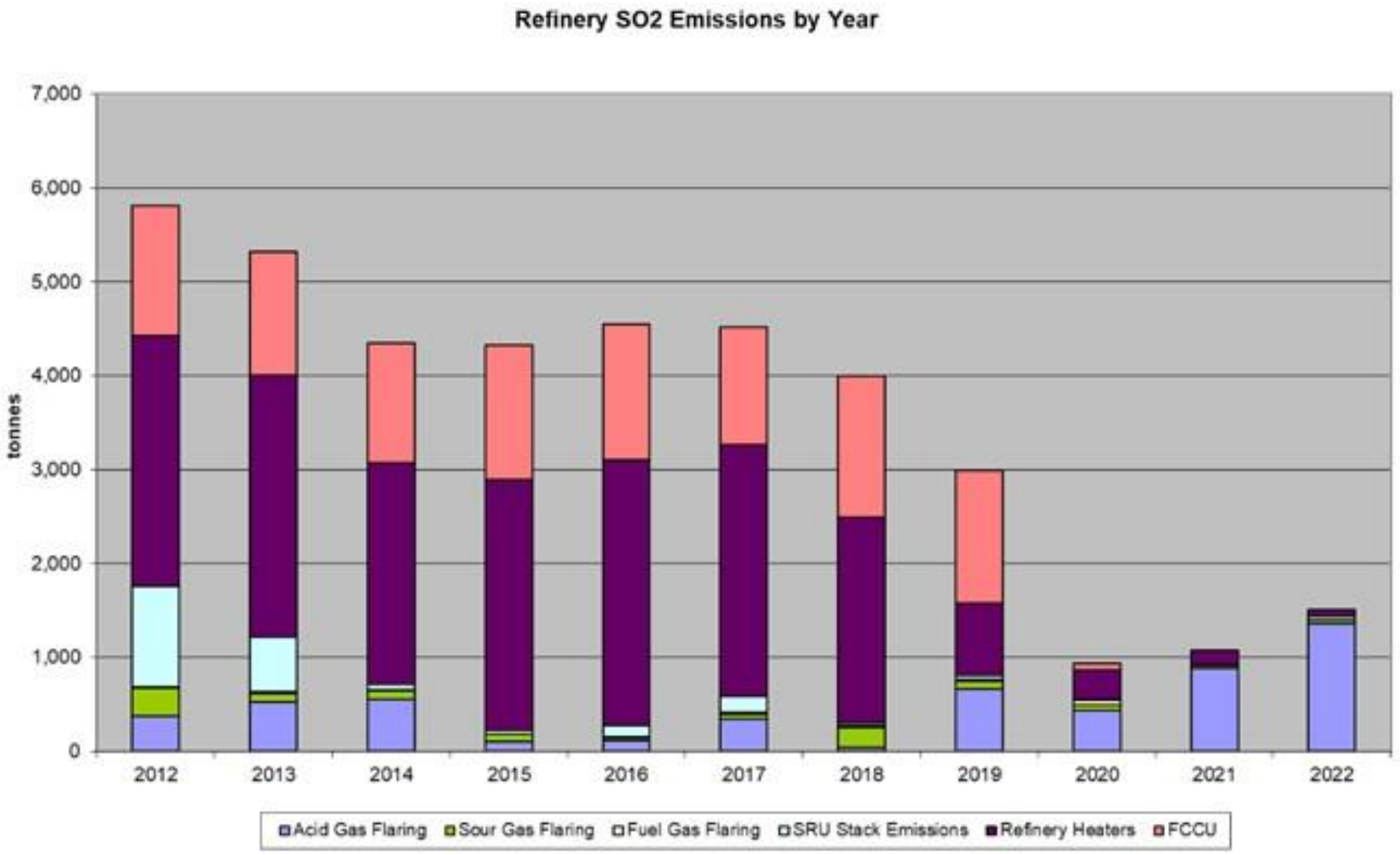
"In 2004, discussions between Falkirk Council and (then) BP identified a route to providing a way forward to reduce the SO_2 emissions for the installation. These planned measures were the result of numerous teams reviewing the sites operations and possible minimisation/mitigating options. One comprehensive piece of work that greatly assisted with this drive and direction was a detailed assessment of the SO_2 sources using air dispersion modelling. This was undertaken internally within BP/Ineos. The dedicated resource reviewed many scenarios of the sites operations to fully understand the SO_2 sources and build a comprehensive picture of the mechanics of both refinery and the power station to provide the best approach in reducing SO_2 emissions and their impact on the local environment. Through this the SO_2 sources were categorised into their contribution to the overall SO_2 emission of the installation and then these were further interrogated to provide a way forward where some could be improved through fuel switching, process operational changes and retrofitting.

1. Recommissioning of the Fluidised Catalytic Cracking Unit (FCCU) and installation of a new sulphur recovery unit (SRU). The latter leading to negation of any incremental SO_2 emissions from the reinstatement of the FCCU, through improvements in flaring reduction and increasing the reliability and availability of this equipment;
2. Under normal operations the modelling determined that fuel oil could be replaced with fuel gas in the power station and this could be achieved by Dec 2003 without detailed study work or retrofitting, thus reducing SO_2 emissions almost immediately.
3. The modelling also identified the Sulphur Recovery unit improvements and retrofitting option of Tail Gas Treatment.
4. Reformation of the CRU fired heater leading to a reduction in SO_2 emissions was also identified and undertaken.
5. In addition to the above where possible, the Grangemouth refinery purchased feedstock with low sulphur content. The purchasing policy has a direct effect on reducing sulphur emissions but also has an effect on operational costs.

Industrial Operator: Petroineos (Grangemouth Refinery – 2011 onwards)

"Over the years, Petroineos have invested and taken action to reduce sulphur dioxide emissions from the Refinery. There are also two further improvements planned for 2024/5 as detailed below."

Year of Improvement	Project	Colour of Bar in Graph
2013	Tail Gas Unit commissioned	Pale blue
2015	Sulphur Recovery Unit reliability improvements	Purplish blue
2018 2019	Fuel Gas Conversion Projects on three major heaters, resulting in elimination of fuel oil burning from Refinery.	Dark Purple
2020	Fluidised Catalytic Cracker Unit decommissioned. The FCCU was the unit with the largest single contribution to SO2 emissions. It was not economic to fund environmental improvements.	Pink
2020	Crude Distillation Unit 1 decommissioned. This reduced the nameplate throughput of the Refinery and eliminated all liquid fuel burning. This dual impact reduced SO2 emissions	Dark Purple
2024	Fuel Gas Sweetening Project to be commissioned to minimise the concentration of sulphur dioxide created by burning fuel gas	Dark Purple
2024/5	Sulphur Recovery Unit Turndown Project commissioning. On occasion, the closure of the FCCU in 2020 has resulted in the sulphur recovery units not being able to operate because there is insufficient quantity of sulphur requiring removal from gaseous streams	Purplish blue


Refinery SO2 Emissions by Year
tonnes
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Acid Gas Flaring
Sour Gas Flaring
Fuel Gas Flaring
SRU Stack Emissions
Refinery Heaters
FCCU

Environmental Regulator: SEPA

"SO_2 emissions from the Petroineos Refinery have undergone a significant downward trend over recent years following the Tail Gas Treatment unit upgrade in 2013, flaring reductions in 2017 and large gas conversion projects in 2018 and 2019 respectively. Emissions then fell further following the restructuring of the site in 2021. The oil refinery is a very complex and highly integrated site, which requires careful planning and checks during the implementation of any change, so SEPA have been working constantly over this time to ensure that the upgrades were implemented as soon as possible. Further improvements are due in early 2024 and discussions are underway to improve the reliability of the sulphur abatement system to ensure that levels remain low in the future."

"The reduction in flaring was achieved through a programme of improved reliability maintenance targeting key risk areas, such as compressors. The conversion from mixed gas and oil to gas only firing took place over two years, with upgrades to the burner system on Crude Unit 3 completed in 2018, followed by Crude Unit 2 and the Vacuum Distillation Unit in 2019. Crude Unit 1 is currently mothballed but would use gas only if reinstated."

Local Authority: Falkirk Council

Historically and in general, elevated levels of SO_2 have been recorded in Grangemouth during periods of industrial maintenance with subsequent flaring when strong onshore winds (direction from northeast to southwest) and higher ambient temperatures are prevalent. Elevated levels of SO_2 have frequently been recorded during the spring and summer months when these conditions are generally more common and industrial maintenance activities are often undertaken.

5. Implemented AQAP Measures

The agreed Grangemouth AQAP measures below are detailed in the 2007 Grangemouth AQMA Action Plan[20].

AQAP Measure 1

"The Integrated Pollution Prevention and Control (IPPC) regulatory regime requires that SEPA ensure that industrial operators adopt Best Available Techniques (BAT) to minimise emissions from regulated sites."

"Falkirk Council will provide SEPA with sufficient information on ambient measured SO_2 concentrations (and other pollutant concentrations) to adequately regulate emissions from industrial operators. Falkirk Council has developed an air quality website to which SEPA will have a privileged level of access through password control."

Achieved: The previously established Falkirk Council air quality website has subsequently been replaced by the Air Quality in Scotland website which provides all of Falkirk Council's live and historical air quality data.

AQAP Measure 2

"It is proposed that a working group is setup comprising officers from both SEPA and Falkirk Council. The working group will meet on a regular basis (bi-annually) to monitor air quality issues within the AQMA. Where appropriate, the working group can also meet on an ad-hoc basis. In particular, the working group should evaluate any measured pollution episodes or changes to plant, processes or emission profiles from industrial sites in the Grangemouth area."

Achieved: Falkirk Council has established a working group and provides SO_2 exceedance reports, weather and industrial plant related information on a monthly basis via email. SEPA and industrial operators are included in this group and are regular contributors. An example of a Falkirk Council monthly exceedance report is shown in Appendix C: Monthly SO_2 Working Group Report Example.

[20] https://www.falkirk.gov.uk/services/environment/environmental-policy/air-quality/docs/air-quality/00%202007%20Grangemouth%20Air%20Quality%20Action%20Plan.pdf?v=202308290912

AQAP Measure 3

"Historically, in the event of a pollution episode or measured exceedance of an NAQS objective at a monitoring station in Grangemouth, Falkirk Council officers have made contact with Ineos to notify them of the event and to ascertain any reason(s) for the high SO_2 concentrations. Falkirk Council therefore proposes to introduce a system whereby in the event of elevated SO_2 concentrations being measured at one of the Grangemouth monitoring stations a text alert message will be sent to the mobile phones of persons on a relevant working group contact list."

Achieved: A text alert system (direct from SO_2 analyser) had been established by Falkirk Council previously however, the Air Quality in Scotland website created the Know and Respond text / email alert system which is available for all to use and has replaced the Council system.

AQAP Measure 4

"The trend in measured concentrations and the inability of the modelling studies to replicate the measured concentrations means that the spatial extent of elevated SO_2 concentrations is not fully understood. Falkirk Council proposes to introduce additional monitoring within the AQMA including the new automatic monitoring station at Moray Primary School in Grangemouth."

Achieved: Falkirk Council installed the Grangemouth Moray fixed, automatic air quality station on 20th September 2006. The site, since installation, continually monitors SO_2 and nitrogen dioxide (NO_2). The location of the Grangemouth Moray site can be shown in Appendix A Map 5.

6. Monitoring Equipment

Falkirk Council monitors SO_2 and other pollutants at several locations throughout the Council area using automatic and manual sampling methods. The automatic monitoring data displayed below has been fully checked and ratified in accordance with the Scottish Air Quality Database Quality Assurance / Quality Control (QA/QC) process[21]. Full details of all monitoring undertaken by Falkirk Council can be found in the latest Annual Progress Report.

6.1 Automatic

Falkirk Council currently maintains and operates four automatic monitoring stations (with continuously monitoring, reference method SO_2 analysers) located within the Grangemouth AQMA as detailed in Table 4 below, these are: A8 Grangemouth Automatic Urban and Rural Network (AURN), A9 Grangemouth Moray, A10 Grangemouth Municipal Chambers, A11 Grangemouth Zetland Park and one nearby "Background" station, A3 Bo'ness. The locations of all automatic monitoring stations are displayed in Appendix A – Maps of Automatic Monitoring Locations.

Site information and live monitoring data from all Falkirk Council's network can be viewed using following link:

https://www.scottishairquality.scot/latest/summary

6.2 Non-Automatic

Falkirk Council deploys and utilises many non-automatic monitoring methods such as diffusion and benzene, toluene, ethylbenzene and xylenes (BTEX) post-mounted tubes across its region however none of these methods monitor SO_2 which is the focus of this AQMA revocation proposal so are not included.

[21] https://www.scottishairquality.scot/data/verification-ratification

The automatic, fixed air quality monitoring stations and associated equipment are displayed in Table 4.

Table 4: Automatic Stations

AQ Monitoring Site ID:		A3 Bo'ness	A8 Grangemouth AURN	A9 Grangemouth Moray	A10 Grangemouth Municipal Chambers	A11 Grangemouth Zetland Park
Site Type:		Urban Backround / Industrial	Urban Backround / Industrial	Urban Backround / Industrial	Urban Backround / Industrial	Urban Backround / Industrial
Address:		Bo'ness Town Hall, Stewart Avenue, EH51 0EF	Inchyra Park, Inchyra Place, Grangemouth, FK3 9EY	Abbotsgrange Early Learning and Childcare Centre, Oxgang Rd, Grangemouth, FK3 9DL	Grangemouth Municipal Chambers, Bo'ness Rd, FK3 8AF	Scottish Water facility, Zetland Park, Grangemouth, FK3 8JB
Easting / Northing:		299815 / 681481	293830 / 681022	293469 / 681321	292816 / 682009	292969 / 681106
Monitoring Equipment	SO_2	Horiba 360 APSA (2016)	Teledyne ML9850B (2000 - 24/04/19) Ecotech Serinus 50 (24/04/19 - 04/02/22)	Horiba APSA 360 (20/09/06 - 04/16)	Horiba 360 APSA (1997 - 02/17)	Horiba 360 APSA (05/05/15 -07/03/22)
		Horiba 370 APSA (06/16 - present)	API Teledyne T100 (04/02/22 - present)	Horiba APSA 370 (04/16 - present)	Horiba APSA 370 (02/17 - present)	API Teledyne T100 (07/03/22 - present)
Reference Method Monitoirng Technique	SO_2	Horiba 360 and 370 APSA: UV Fluorescence	Teledyne ML9850B: UV Fluorescence Ecotech Serinus 50: UV Fluorescence API Teledyne T100: UV Fluorescence	Horiba 360 and 370 APSA: UV Fluorescence		
Date Site Installed:		2003	2000	20/09/2006	1997	05/05/2015
Date Site Removed:		Still operational	Still operational	Still operational	Still operational	Still operational
Comments:		Considered a site for "background" SO_2 monitoring in comparison to the Grangemouth sites.	One of two Automatic Urban and Rural Network affiliated sites (including Grangemouth Moray)	AURN affiliated		

7. Monitoring Data

SO_2 15min Mean (>266µg/m^3) – Total Number of Annual Exceedances by Site (2004 - 2022)

The measured, total SO_2 (15-min) NAQS exceedances (over 266µg/^{3} not to be exceeded over 35 times) are presented in Table 5 below. The last time a NAQS objective exceedance was recorded in the Grangemouth area was in 2012 at sites A8 Grangemouth AURN (50 times), A9 Grangemouth Moray (92 times) and A10 Grangemouth MC (51 times). Since 2012, no other NAQS exceedance has been recorded and there has been a significant decline in overall total number of annual exceedances to date at all monitoring sites.

There were eleven SO_2 (15min mean) NAQS objective exceedances recorded at three Grangemouth sites (above) over the displayed, last eighteen-year period. No further NAQS objective exceedances were recorded since 2012.

The site with the overall highest exceedance total was the A9 Grangemouth Moray site with 114 times (>266µg/m^3) exceedances recorded in 2008. There were subsequent exceedances recorded at this site in the following years until the second highest exceedance of 92 times recorded in 2012. There were no other NAQS objective exceedances recorded after 2012 at any of the Grangemouth sites.

More recently in 2016, a relatively high exceedance total of 28 times was recorded at the A10 Grangemouth MC site, this was within the NAQS objective but was elevated in comparison to other Grangemouth monitoring sites in this year. Since 2016, the exceedance amounts have declined and remained low until present. **Most exceedances recorded can be attributable to episodes of industrial flaring.**

The sites with the lowest number of exceedances are A3 Bo'ness and A11 Grangemouth Zetland Park with no exceedances recorded from 2015 until present.

These results demonstrate that the SO_2 (15-min mean) concentrations for the past ten years (since 2012) have complied with the NAQS objective. Falkirk Council expects the SO_2 (15-min mean) exceedances to remain within the NAQS objective (35 times) for many years in the future due to the ongoing AQAP measures as part of a longer

term Falkirk Council Air Quality Strategy and industrial process improvements as detailed in Section 5 Implemented AQAP Measures.

Falkirk Council expects to publish a 5-year Air Quality Strategy in 2024 which will include all agreed and ongoing Grangemouth AQAP measures.

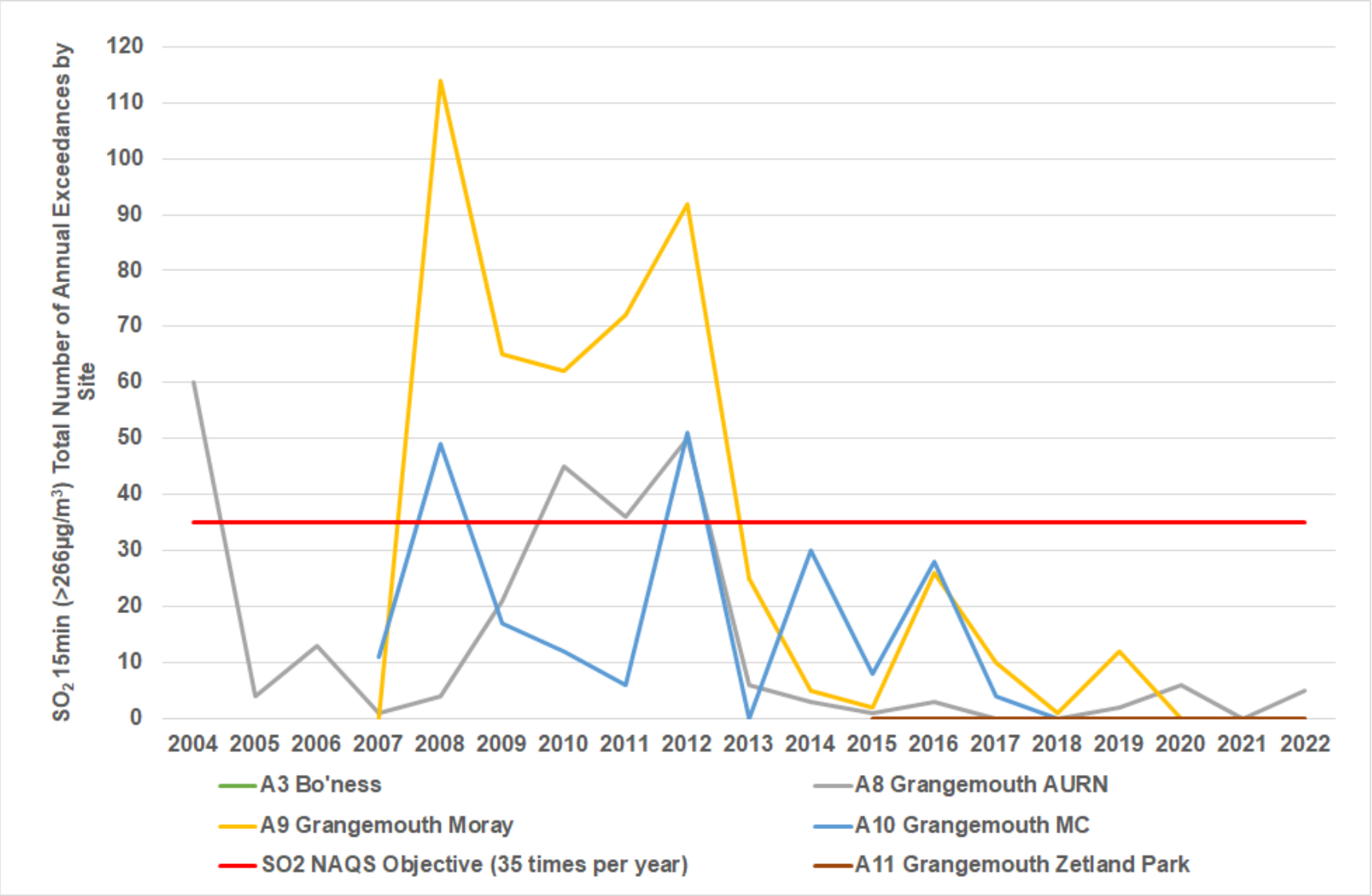
Table 5: SO_2 15min Mean (>266µg/m^3) – Total Number of Annual Exceedances by Site (2004 - 2022)

Site ID	Site Type	SO_2 15min Mean (>266µg/m^3) - Total Number of Annual Exceedances by Site																		
		Pre AQMA		AQMA Declared	AQMA Active															
		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	COVID-19 2020	COVID-19 2021	2022
A3	Bo'ness													0(1)	0	0	0	0	0	0
A8	Grangemouth AURN	**60**	4	13	1	4	21	**45**	**36**	**50**	6	3	1	3	0	0	2	6	0	5
A9	Grangemouth Moray				0	**114**	**65**	**62**	**72**	**92**	25	5	2	26	10	1	12	0	0	0
A10	Grangemouth MC				11(1)	**49**	17	12	6	**51**	0	30	8	28	4	0	0	0	0	0
A11	Grangemouth Zetland Park												0(1)	0	0	0	0	0	0	0

Notes: **Exceedances of the SO_2 (15min) NAQS objective of 266µg/m^3 over 35 times are shown in bold.**

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

Graph 1: Measured Automatic SO_2 15min Mean (>266µg/m^3) – Total Number of Annual Exceedances by Site (2004 - 2022)



8. Future AQMA Actions to be Retained

The Grangemouth AQMA actions that will be retained by Falkirk Council to provide essential air quality services within the Grangemouth area in future are:

1. Retain, maintain and operate all existing fixed, automatic monitoring stations within the Grangemouth area as specified in Section 5. Monitoring;
2. Providing monthly SO_2 exceedance reports to the existing formal working group (SEPA, industrial operators, Falkirk Council etc.). Recipients can be added or removed as necessary via a request to Falkirk Council Environmental Protection;
3. Continue to monitor local weather and provide data access to the Grangemouth working group partners. The monitoring equipment is located at the Grangemouth Zetland Park AQ site and will be operated / maintained by Falkirk Council to supplement the nearest Met Office weather station at Gogarbank, Edinburgh;
4. Exceedance notification and investigation with relevant organisations such as SEPA and industrial operators utilising text / email alerts from the Air Quality in Scotland website to continue as currently undertaken via the formal working group;
5. Publication of an updated Grangemouth Emissions Study on a regular basis (at least every five years) to quantify and take in account any new or changed emission source in the Grangemouth area.

Falkirk Council expects to publish a 5-year Air Quality Strategy in 2024 which will include all agreed and ongoing AQAP actions. The Falkirk Council Annual Progress Reports (APR)[22] will keep a record of achievements.

[22] https://www.falkirk.gov.uk/services/environment/environmental-policy/air-quality/

9. Conclusions and Recommendations

The Grangemouth AQMA was declared by Falkirk Council on the 1st November 2005 following exceedances of the SO_2 (15min mean) NAQS objective. Since the AQMA was declared, measured concentrations of SO_2 (using automatic monitoring methods) have gradually declined and have since become compliant with the NAQS objective consistently over the past ten years (since 2012).

The 2010 Grangemouth FA[23] assesses the main sources of SO_2 in Grangemouth. These are summarised in Section 4: Description of Local Pollution Sources. Historically, the petrochemical area has been responsible for the majority of SO_2 emissions sources in the Grangemouth area.

As a result of the achievement and on-going work of the AQAP measures (as described in the above Section 5) and other improvements in industrial processes and utilisation of cleaner fuels / technologies, Falkirk Council has demonstrated that the 15min mean concentrations of SO_2 complies with the relevant NAQS objective and that the Grangemouth AQMA should be revoked.

Please note that SO_2 exceedances may still be recorded in Grangemouth in certain conditions / scenarios. It is unlikely that the SO_2 NAQS objective will be exceeded in future years.

As stated within Section 4 “AQMA” of Part IV of the Environment Act 1995[24] states in relation to AQMA Revocation:
“Local authorities are able to amend or revoke an existing AQMA order at any time as set out under section 83(2) of the 1995 Act. Where an authority considers it necessary to do this, the Scottish Government expects the authority to consult SEPA and all other statutory consultees, businesses, members of the public and other interested parties in the vicinity of the AQMA. All available supporting information to justify the amendment or revocation should be provided to the Scottish Government before any changes take effect (and this should take the form of a revocation proposal report – as outlined below).

[23] https://www.falkirk.gov.uk/services/environment/environmental-policy/air-quality/docs/air-quality/00%202010%20Grangemouth%20AQMA%20Further%20Assessment.pdf?v=202309151334
[24] https://www.gov.scot/publications/local-air-quality-management-policy-guidance/pages/4/

A local authority may submit a proposal to amend or revoke an existing AQMA order at any time."

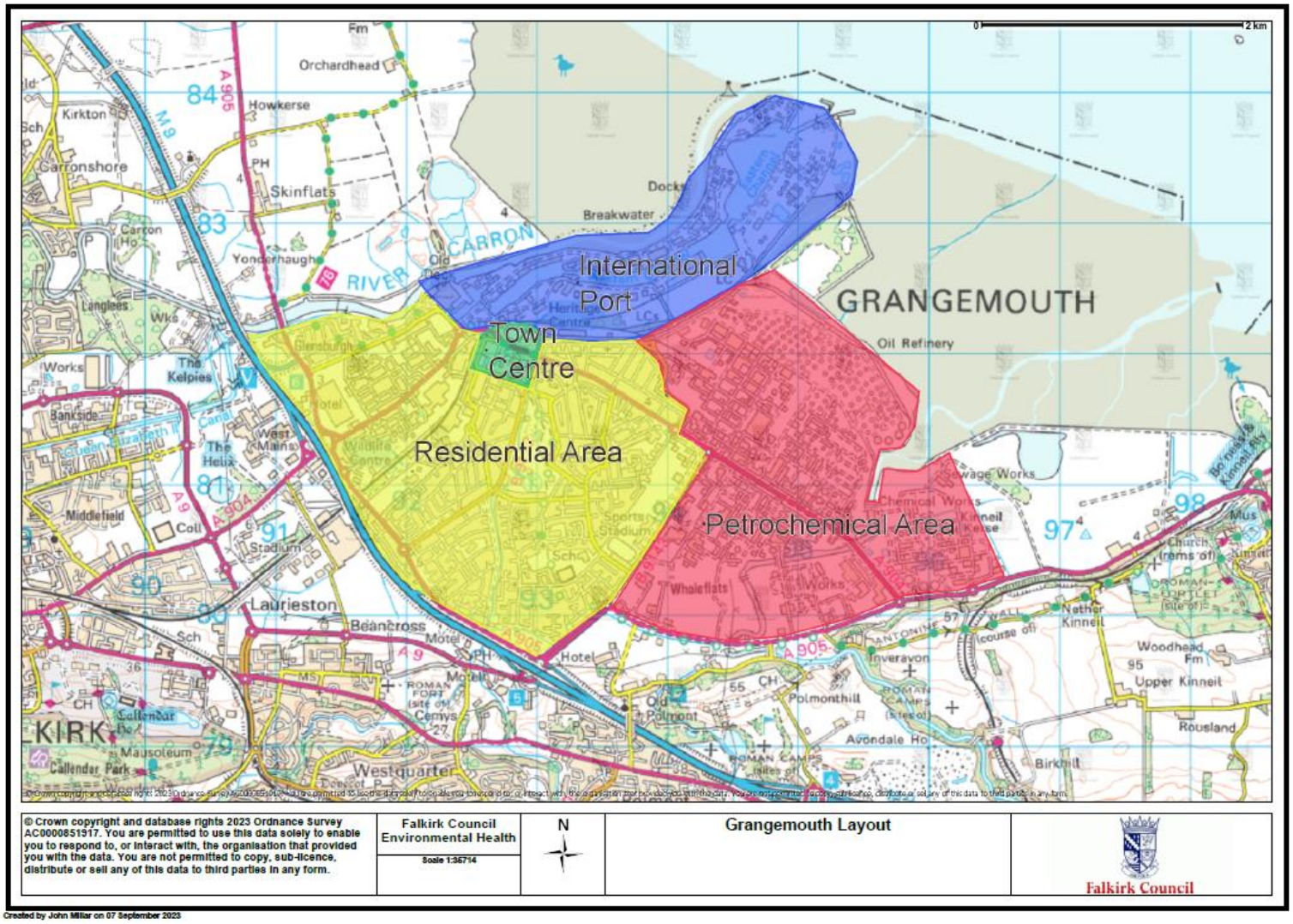
Falkirk Council will continue to have (automatic, reference method) SO_2 monitoring capabilities within the Grangemouth area for many years to come. It is anticipated that annual Scottish Government LAQM funding will continue to be provided for this. This will provide a valuable resource for public health resources into the future.

Falkirk Council is requesting the permission of the Scottish Government and Scottish Environment Protection Agency (SEPA) to revoke the Grangemouth AQMA for SO_2 (15-min mean). Pending permission approval, Falkirk Council will notify all other statutory consultees and publicise the revocation through local / social media, so the public and local businesses are fully aware of the situation.

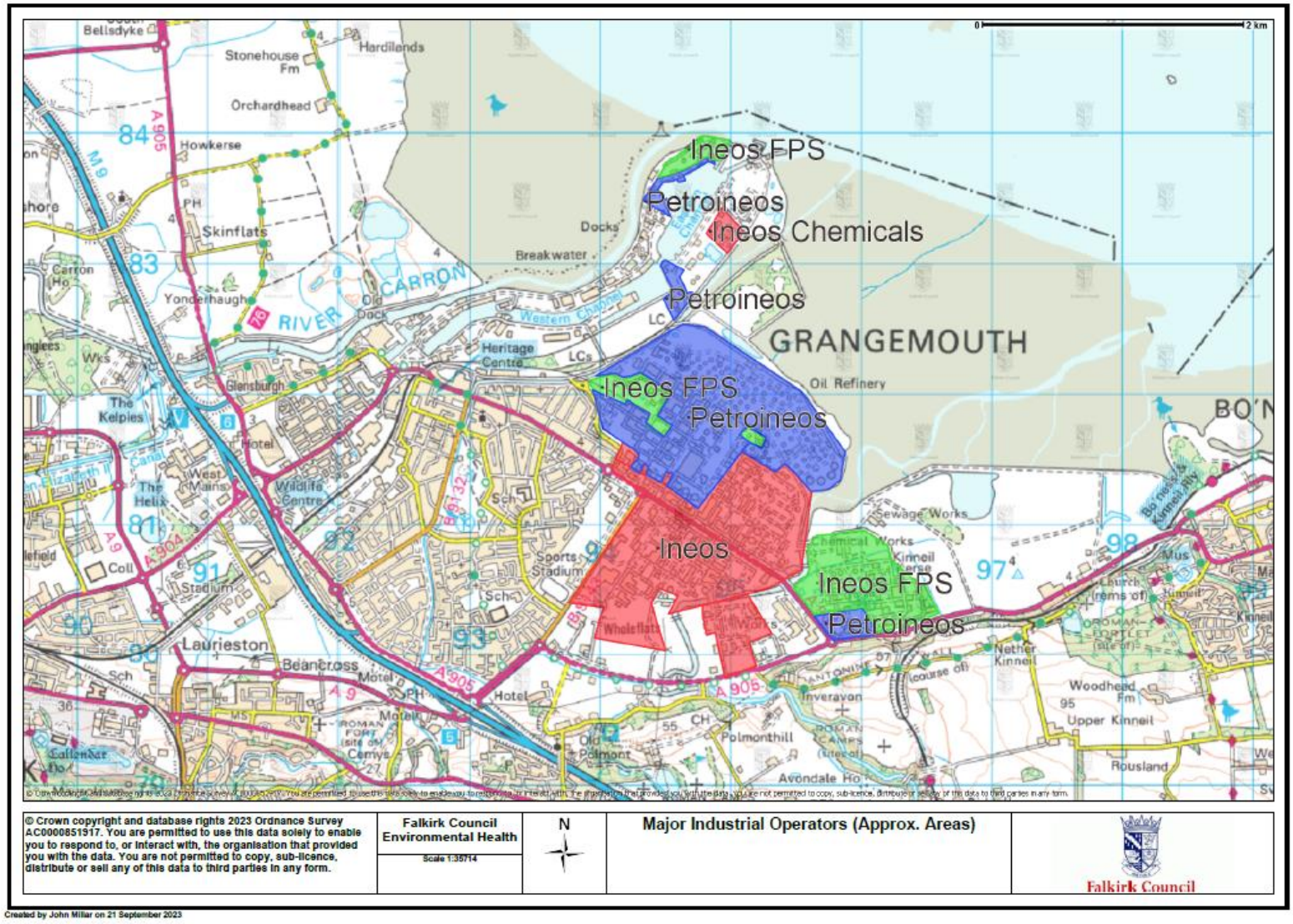
10. Acknowledgements

Falkirk Council gratefully acknowledges the support received from SEPA, Ineos, Petroineos, consultants Sweco and the Civil Air Support when completing this proposal report.

Appendix A – Maps
Map 1.Grangemouth Layout (Approximate areas)



Map 2. Major Industrial Operators (Approximate areas)



Maps of Automatic Monitoring Stations
Map 3: A3 Bo'ness

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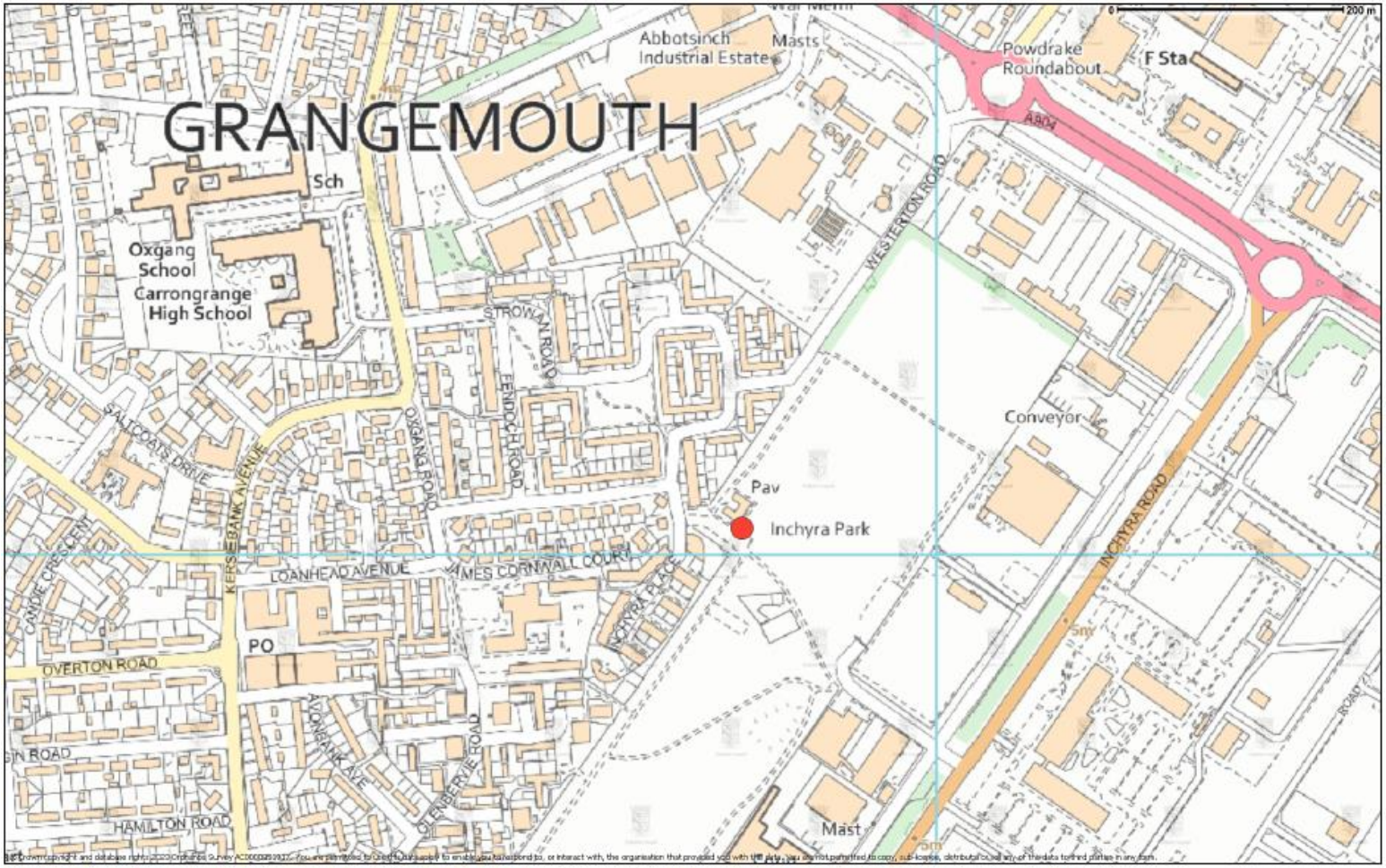
Map 4: A8 Grangemouth AURN



Falkirk Council Environmental Health

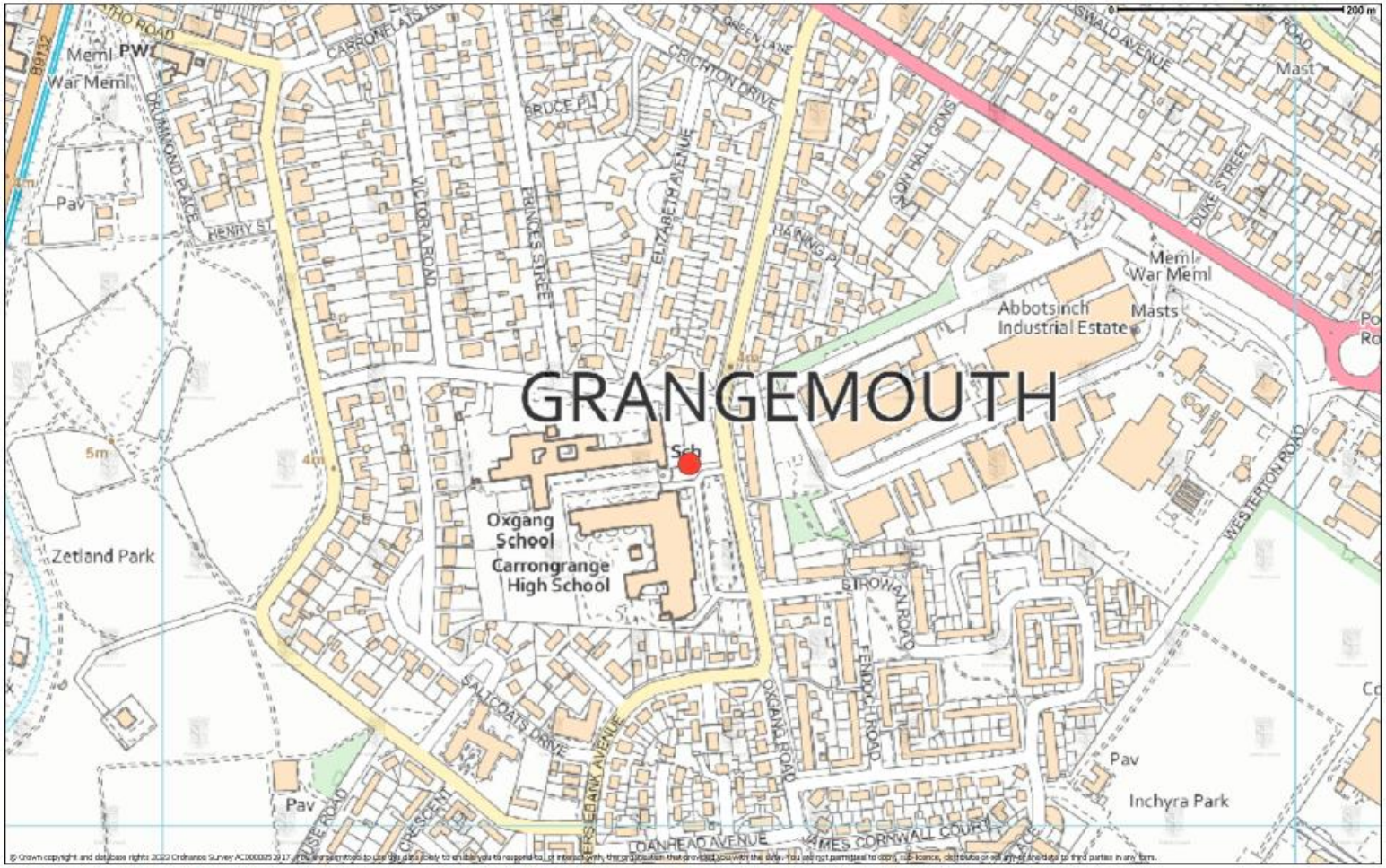
Scale 1:4536

N

A8 Grangemouth AURN Automatic AQ Station Location

Falkirk Council

Map 5: A9 Grangemouth Moray



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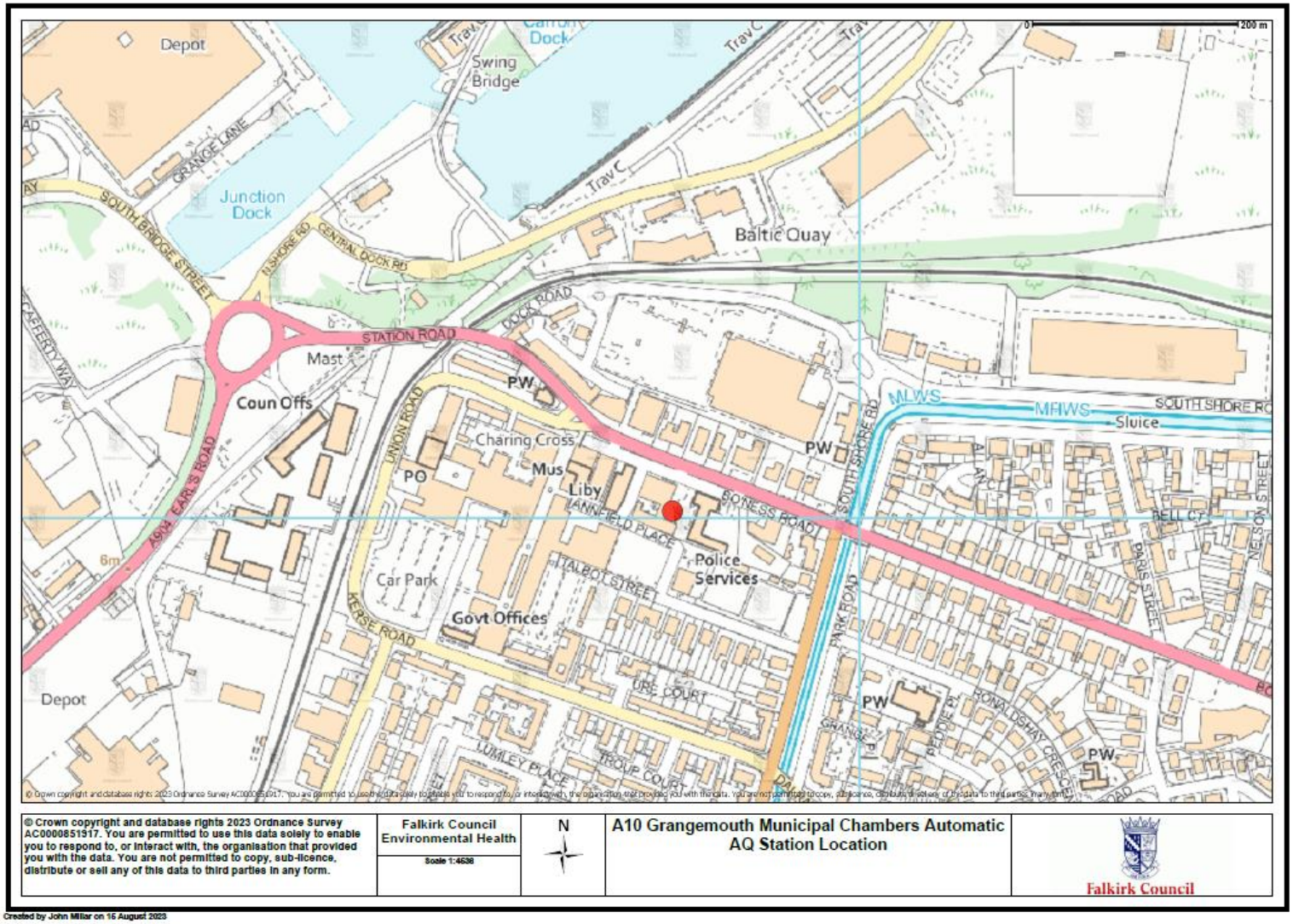
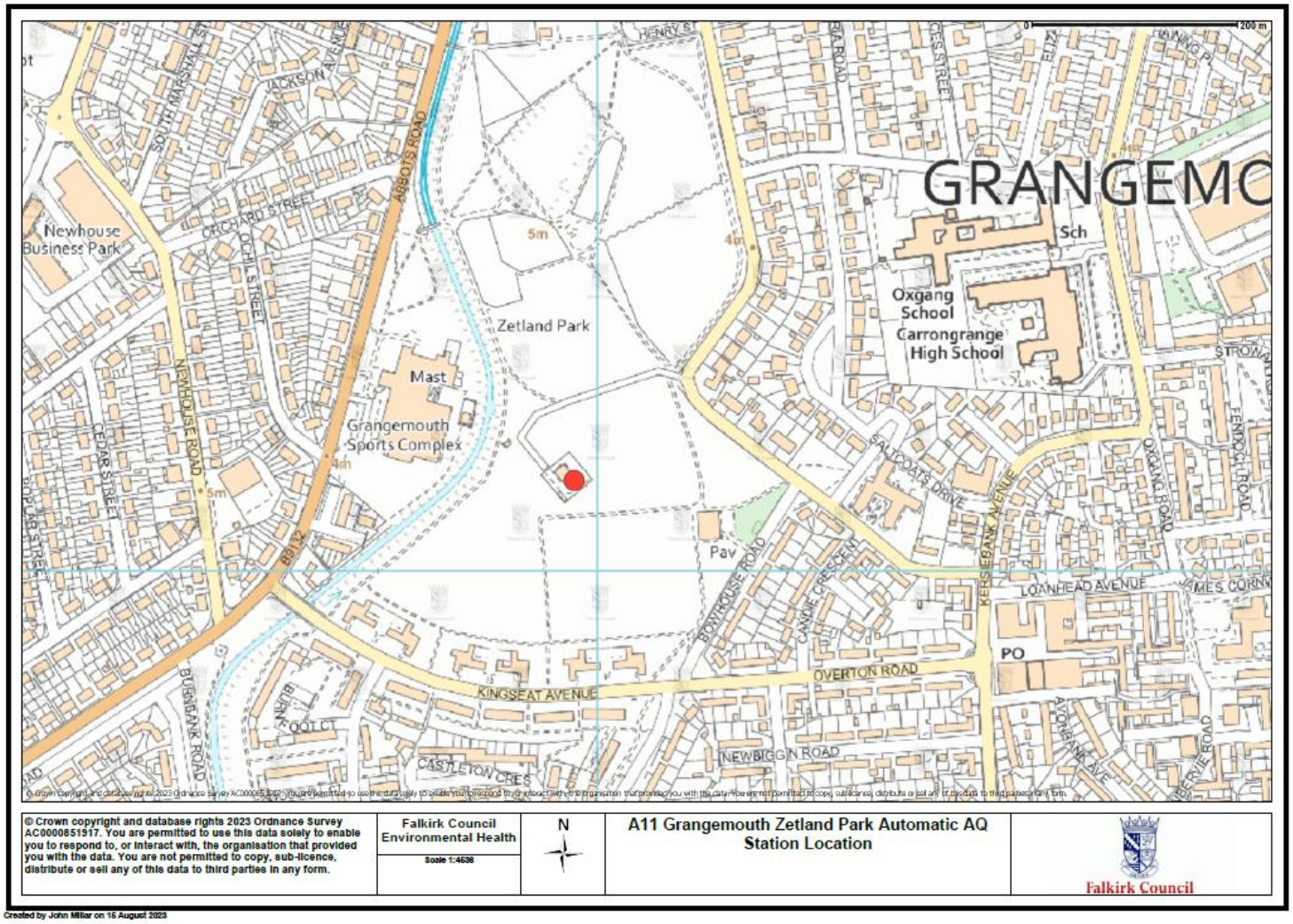
Map 6: A10 Grangemouth Municipal Chambers



A11 Grangemouth Zetland Park



Appendix B – Grangemouth AQMA Order

Environment Act 1995, Part IV, section 83(1)

Falkirk Council

Air Quality Management Area (No. 1) Order 2005

Falkirk Council, in exercise of the powers conferred upon it by section 83(1) of the Environment Act 1995, hereby makes the following Order.

This Order may be referred to as the Falkirk Council Air Quality Management Area (No. 1) Order 2005 and shall come into effect on 1 November 2005.

The area shown inside the solid black line on the map accompanying this Order is to be designated as an air quality management area ("the Designated Area"). The Designated Area incorporates the Grangemouth petrochemical complex and adjacent area. The map may be viewed at (i) the Council Offices, Municipal Buildings, Falkirk, (ii) Abbotsford House, David's Loan, Bainsford and (iii) Grangemouth Library, Bo'ness Road, Grangemouth.

The Designated Area is designated in relation to a likely breach of the sulphur dioxide (15 minute mean) objective as specified in the Air Quality (Scotland) Regulations 2000.

This Order shall remain in force until it is varied or revoked by a subsequent order.

The Common Seal of Falkirk Council
was hereto affixed on 24th October 2005 on behalf of Falkirk Council

.....

Acting Director of Law and Administration Services
Municipal Buildings
Falkirk

Grangemouth AQMA Map

Appendix C: Monthly SO_2 Working Group Report Example

Table 1: SO_2 Exceedances Summary December 2020

1st - 31st December 2020	Number of exceedances of SO_2 concentration value / limit value			Highest SO_2 Concentration ($\mu g/m^3$)			Data capture rate (%)	Date of last exceedance	Status
	15-minute	Hourly	Daily	15-minute	Hourly	Daily			
Grangemouth AURN	0	0	0	41	11.6	4.1	98	21/04/2020	Provisonal
Grangemouth Moray	0	0	0	18.4	8.6	2.9	98	29/04/2019	
Grangemouth Municipal Chambers	0	0	0	10.6	8.5	1.3	98	25/06/2019	
Grangemouth Zetland Park	0	0	0	7.2	3.4	0.7	99	none	
Falkirk Hope St	0	0	0	72.2	18.8	4	99	none	
Bo'ness	0	0	0	14.9	10.6	2.8	99	none	

Scottish SO_2 Air Quality Objectives		
Time period	Concentration ug/m3	No. of exceedances permitted
15-min	266	35
Hourly	350	24
Daily	125	3

Prepared by Falkirk Council

Table 2: Exceedances of the 15-Minute SO_2 Objective Concentration by Month

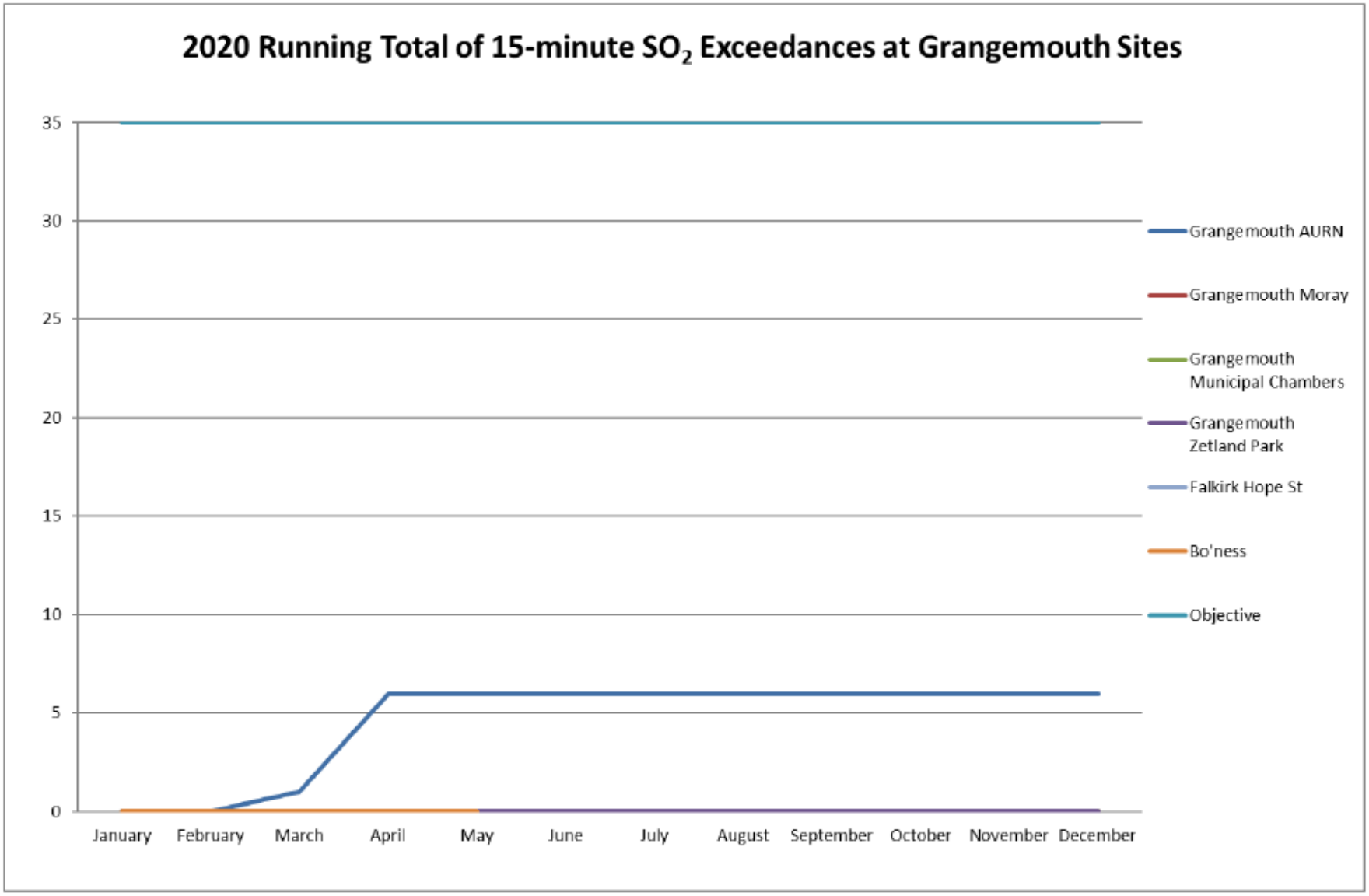
15-min SO_2 exceedances by month												
2020	January	February	March	April	May	June	July	August	September	October	November	December
Grangemouth AURN	0	0	1	5	0	0	0	0	0	0	0	0
Grangemouth Moray	0	0	0	0	0	0	0	0	0	0	0	0
Grangemouth Municipal Chambers	0	0	0	0	0	0	0	0	0	0	0	0
Grangemouth Zetland Park	0	0	0	0	0	0	0	0	0	0	0	0
Falkirk Hope St	0	0	0	0	0	0	0	0	0	0	0	0
Bo'ness	0	0	0	0	0	0	0	0	0	0	0	0

Table 3: Running Totals of the 15-Minute SO_2 Objective Concentration by Month

15-min SO_2 exceedances by month, running totals												
2020	January	February	March	April	May	June	July	August	September	October	November	December
Grangemouth AURN	0	0	1	6	6	6	6	6	6	6	6	6
Grangemouth Moray	0	0	0	0	0	0	0	0	0	0	0	0
Grangemouth Municipal Chambers	0	0	0	0	0	0	0	0	0	0	0	0
Grangemouth Zetland Park	0	0	0	0	0	0	0	0	0	0	0	0
Falkirk Hope St	0	0	0	0	0	0	0	0	0	0	0	0
Bo'ness	0	0	0	0	0	0	0	0	0	0	0	0

Table 4: Summary of SO_2 Exceedances at Grangemouth Sites

List of SO_2 exceedances		
All times GMT and all presented data is 'Provisional'		
Grangemouth AURN		
Date	Time	Conc. µg/m3
27/03/2020	21:45	321.2
09/04/2020	14:00	286
09/04/2020	16:00	371.7
18/04/2020	21:30	297.8
21/04/2020	03:45	288.7
21/04/2020	06:30	302



Prepared by Falkirk Council