# 07 July 2023

**Mossmorran & Braefoot Bay Independent Air Quality Expert Advisory Group**

2021 Annual Report

# Mossmorran & Braefoot Bay Independent Air Quality Expert Advisory Group

# We provide advice and recommendations to Fife Council regarding the monitoring of air emissions arising from the operations at the Mossmorran plants and the Braefoot Bay terminal facilities (operated by Shell UK Limited (Shell) and ExxonMobil Chemical Limited (ExxonMobil). We do this by independently reviewing air quality data collected from a number of sources as well as considering the potential impact that any major plant changes could have on air quality. We produce annual reports to present our findings of the review and any recommendations we may have.

# Following a review by Fife Council in 2020 (See section 1.2) the group was reconstituted as the Mossmorran and Braefoot Bay Expert Advisory Group on Air Quality. This report has been produced by the Expert Advisory Group.

# Related URLs:

# Fife Council Annual Air Quality Progress Report 2022

# <https://www.fife.gov.uk/__data/assets/pdf_file/0027/416457/Fife_Annual_Progress_Report_2022_Issue_2_Final_Updated_1.pdf>

# Scottish Environment Protection Agency (SEPA) Mossmorran Website

# <https://www.sepa.org.uk/regulations/air/air-quality/mossmorran-and-braefoot-bay-complexes>

# CONTENTS

[Key findings and recommendations 1](#_Toc125472588)

[1 Background 3](#_Toc125472589)

[1.1 What are the Mossmorran & Braefoot Bay terminal facilities? 3](#_Toc125472590)

[1.2 Who are the Mossmorran & Braefoot Bay Independent Air Quality Expert Advisory Group? 3](#_Toc125472591)

[1.3 Who pays for the AQ EAG’s work? 3](#_Toc125472592)

[1.4 What are the aims of the AQ EAG Annual Report? 4](#_Toc125472593)

[1.5 How does the AQ EAG undertake their role? 4](#_Toc125472594)

[1.6 How does the AQ EAG maintain their independence? 4](#_Toc125472595)

[1.7 What meetings did the AQ EAG particpate in during 2021? 5](#_Toc125472596)

[2 substantive changes in the facilities that may impact on local air quality 6](#_Toc125472597)

[2.1 What changes have been reported by the facilities that could impact on local air quality? 6](#_Toc125472598)

[2.2 What are the AQ EAG’s comments and recommendations (where relevant)? 6](#_Toc125472599)

[3 Air quality indicators reviewed 7](#_Toc125472600)

[3.1 What are the pollutants reviewed? 7](#_Toc125472601)

[3.2 How do we assess Air Quality? 8](#_Toc125472602)

[3.3 What data are reviewed and who provides this? 9](#_Toc125472603)

[3.4 Ozone – is this monitored and is it a concern? 10](#_Toc125472604)

[3.5 Who has a regulatory role in relation to the Mossmorran and Braefoot Bay facilities? 10](#_Toc125472605)

[4 flaring 13](#_Toc125472606)

[4.1 Why is flaring needed? 13](#_Toc125472607)

[4.2 What flaring took place during 2021? 13](#_Toc125472608)

[4.3 Are the quantities flared increasing over time? 15](#_Toc125472609)

[4.4 What additional actions occurred in 2021? 17](#_Toc125472610)

[4.5 What are the AQ EAG’s comments and recommendations (where relevant)? 17](#_Toc125472611)

[5 Emissions Data 18](#_Toc125472612)

[5.1 What are the emission data results for 2021? 18](#_Toc125472613)

[5.2 What are the AQ EAG’s comments and recommendations (where relevant)? 18](#_Toc125472614)

[6 air quality 21](#_Toc125472615)

[6.1 What are the results of the air quality data typically reviewed by the AQ EAG for 2021? 21](#_Toc125472616)

[6.2 SEPA air quality monitoring in 2021 – what did they do and what were the results? 22](#_Toc125472617)

[6.3 Has there been any air quality monitoring undertaken during flaring events? 25](#_Toc125472618)

[6.4 What impact do wind farms have on air quality? 25](#_Toc125472619)

[6.5 What are the AQ EAG’s comments and recommendations (where relevant)? 25](#_Toc125472620)

[7 Health effects 27](#_Toc125472621)

[7.1 Are people living near the facilities experiencing adverse health effects relating to their air quality? 27](#_Toc125472622)

[7.2 What are the AQ EAG’s comments and recommendations (where relevant)? 27](#_Toc125472623)

[8 CONCLUSIONS 28](#_Toc125472624)

[APPENDIX 1. ABBREVIATIONS 29](#_Toc125472625)

[APPENDIX 2. Glossary 31](#_Toc125472626)

[APPENDIX 3. Membership 32](#_Toc125472627)

# Key findings and recommendations

The Mossmorran & Braefoot Bay Expert Advisory Group on Air Quality (AQ EAG) advises Fife Council regarding the air quality monitoring and related health impacts arising from operations at the Mossmorran Complex and the Braefoot Bay Marine terminal facilities. Shell UK Limited (Shell) and ExxonMobil Chemical Limited (ExxonMobil) operate these facilities, which are named the Shell Fife Natural Gas Liquids (FNGL) Plant and the ExxonMobil Fife Ethylene Plant (FEP) in this report.

The AQ EAG reviews air quality data collected from various sources, including air monitoring data from Fife Council, SEPA, INEOS, and emissions monitoring by ExxonMobil and Shell, as required by their permit.

The AQ EAG also considers the potential impact that any major plant changes could have on air quality and liaises with representatives from community councils and the local health service.

Flaring, which is undertaken to protect the plant safety during planned and unplanned maintenance work, has been of concern to some in nearby communities. Both companies make efforts to minimise the flaring required.

Notifiable flaring events reported by Shell occurred in April, May, and June, while ExxonMobil reported events in February, April, June, and July. These events were associated with a periodic major cycle of investment in coordination with the pipeline system from the North Sea. Other planned activities such as maintenance also resulted in flaring. A plant process upset at ExxonMobil resulted in unplanned flaring in February, while other flaring events were generally due to maintenance and associated plant restart. Flaring may also occur at one facility if the other is unable to process and therefore there is no outlet for a product. Steps are taken to reduce the product before the flare is used.

Air monitoring by SEPA around the Mossmorran Complex, along with other sources of air quality data from Fife Council and INEOS did not indicate any adverse effects on air pollutants concentrations from the flaring events in 2021. There were four days where levels of particulate matter exceeded the 24-hour limits set by the Scottish Government, (air quality objectives permit up to seven exceedances in a year).

SEPA’s monitoring sites were chosen to reflect the location of residential communities, and included a downwind site, expected to represent the most impacted direction from the Mossmorran Complex.

The cyberattack on SEPA in December 2020 resulted in lost QA/QC (quality assurance/quality control) related data and for the first half of 2021 SEPA’s internal systems were not operational. Thus, SEPA’s air quality monitoring data for 2021 were presented in provisional form. Full QA/QC adjustment and ratification was not possible in 2021.

Air quality monitoring from Fife Council does not identify any adverse impact on local air quality, giving us confidence that there is no additional risk of exposure to higher levels of air pollution from the Mossmorran Complex.

Overall, based on the data available for 2021, emissions from the Shell and ExxonMobil plants at Mossmorran and Braefoot Bay has not resulted in exceedances of the Scottish air quality objectives, minimising risk to the health of members of the local community. The group recommends that the EAG continue to review information provided from Fife Council’s air quality network and data from SEPA’s local monitoring activities with respect to the Mossmorran Complex in future years.

Fife Council is required to periodically review and assess air quality in its area to ensure air quality standards and objectives for specific pollutants are not exceeded. For the Mossmorran Complex and Braefoot Bay terminal facilities, this process includes taking account of the Review Group findings. Both facilities are also regulated by the Health and Safety Executive (HSE), who ensure health and safety of site staff. The HSE also regulate issues concerning the health and safety of people on and off site under the Control of Major Accident Hazard Regulations 2015.

# Background

## What are the Mossmorran & Braefoot Bay terminal facilities?

Shell UK Limited (Shell) operates the Fife Natural Gas Liquids (FNGL) plant that extracts natural gasoline, ethane, propane and butane from natural gas liquids pumped from the St Fergus gas plant near Peterhead. The plant at Mossmorran comprises three identical process units that are fed directly from the pipeline. Large atmospheric pressure tanks store propane, butane and gasoline. Underground pipelines supply these products to the Braefoot Bay deep-water loading facility, where they are loaded on to tankers. These products are key raw materials for a range of everyday items. The Shell FNGL plant has continued to supply approximately 10% of the total volume of produced propane and butane to the adjacent Avanti Gas Road Loading Terminal. The neighbouring Fife Ethylene Plant (FEP) operated by ExxonMobil Chemical Limited (ExxonMobil) was the first plant to use natural gas liquids from the North Sea as feedstock. It takes the ethane gas, which would otherwise be left as a component of natural gas used in homes, processes and ‘cracks’ the molecules to create ethylene, a much higher value product used to manufacture many plastics. FEP is permitted to produce 820,000 tonnes of ethylene per year and is one of approximately 40 ethylene crackers within the whole of Europe.

## Who are the Mossmorran & Braefoot Bay Independent Air Quality Expert Advisory Group?

In 2020, at a meeting of the Environment and Protective Services Subcommittee of the Fife Council (17 September 2020), the recommendation was made that the Mossmorran and Braefoot Bay Community and Safety Liaison Committee would be the recognised forum for community oversight. This would be an umbrella committee where issues or concerns from the community could be raised. Three Expert Advisory Groups (EAGs) would be formed under this committee – one on air quality, one on noise, light and vibration, and one on communications. These groups would carry out tasks assigned by the Safety Liaison Committee. These tasks include the generation of this report, which is completed independently. The final report is then sent to the Safety Liaison Committee.

The AQ EAG replaces the Mossmorran & Braefoot Bay Independent Air Quality Monitoring Review Group (Review Group), formed to provide advice and recommendations to Fife Council regarding the monitoring of air emissions arising from the operations at the Mossmorran plants and the Braefoot Bay terminal facilities.

## Who pays for the AQ EAG’s work?

Since the Mossmorran and Braefoot Bay facilities were given planning permission in 1977, the operators of the complex have paid for the costs of a consultant to produce Annual Independent Air Quality Reports for the previous Review Group to consider. Despite the relevant planning records no longer being available, it is standard practice for Fife Council to request the developer to fund liaison groups and any reporting required for similar developments. The funding model shall therefore continue on this basis and be the subject of review by the EAG on Air Quality as appropriate.

This summary and the full report are independently developed by the Institute of Occupational Medicine (IOM) for the AQ EAG as required under the planning permits for FEP and FNGL, and financed by site operators. This summary has been approved by the Mossmorran and Braefoot Bay Community and Safety Liaison Committee’s Expert Advisory Group on Communications.

Fife Council covers costs of the administration of the Committee and constituent groups including the AQ EAG. Other members of the AQ EAG are employed and funded by the organisations they represent.

## What are the aims of the AQ EAG Annual Report?

The aims of this Annual Report are to:

* Outline any substantive changes in the facilities at Mossmorran and Braefoot Bay and any potential to impact on local air quality
* Describe any changes in air quality regulation and changes in knowledge on health effects of possible emissions from the plants
* Comment on the emissions from the facilities
* Summarise the available data on flaring
* Review other information about local air quality, including monitoring data from the area
* Detail any advice or recommendations the group proposes

A summary of relevant ongoing initiatives and plant updates that have occurred are also included.

## How does the AQ EAG undertake their role?

The constitution and terms of reference outlines the approach taken to the AQ EAG’s work. The terms of reference are under review.

## How does the AQ EAG maintain their independence?

The AQ EAG provides advice and recommendations to Fife Council. At each AQ EAG meeting, members are requested to declare any conflicts of interest. None were declared during the reporting period. Minutes are taken at each Review Group meeting, with copies of these being publicly available on the Fife Council website ([www.fife.gov.uk/airquality](http://www.fife.gov.uk/airquality)).

The AQ EAG has engaged IOM as an independent consultant to gather information, evaluate, and produce the air quality report. IOM works with the AQ EAG on the final content of the report. ExxonMobil and Shell provide information from their facilities and representatives from the operators attend AQ EAG meetings. The operators have the opportunity to provide comment on draft versions of the report. However, the AQ EAG reserves the right to take these comments into account (or otherwise) when finalising their report.

IOM declares that there were no conflicts of interest in the preparation of this report.

The responsibility for the content of the AQ EAG annual report lies solely with the AQ EAG.

## What meetings did the AQ EAG particpate in during 2021?

Table 1‑1 provides details of when the AQ EAG formally met during the calendar year 2021.

The minutes of these meetings are available on the Fife Council Air Quality website at https://www.fife.gov.uk/kb/docs/articles/environment2/environmental-health/mossmorran-and-braefoot-bay.

Table 1‑1: Schedule of meetings in 2021

|  |  |
| --- | --- |
| **Meeting** | **Date(s)** |
| Mossmorran and Braefoot Bay Expert Advisory Group - Air Quality - Meeting | 26th November 2021 |

# substantive changes in the facilities that may impact on local air quality

## What changes have been reported by the facilities that could impact on local air quality?

There were no major changes to the ExxonMobil FEP or Shell FNGL during 2021 that would be anticipated to adversely affect local air quality. Progress is being made on the elevated flare tip and enclosed ground flare at ExxonMobil FEP.

## What are the AQ EAG’s comments and recommendations (where relevant)?

The AQ EAG will continue to outline any substantive changes in the facilities at Mossmorran and Braefoot Bay and any potential they might have to impact on local air quality.

# Air quality indicators reviewed

## What are the pollutants reviewed?

Burning of fuel results in a number of pollutants released, which are described in this section. For more information on air pollutants, please see <http://www.scottishairquality.scot/air-quality/pollutants>. The pollutants described in this report are primarily of interest because of their potential to affect health. This report does not include greenhouse gas emissions, as those are primarily related to climate change.

Smoke (or soot) occurs when there is incomplete combustion (not enough oxygen to burn the fuel completely). Smoke is a collection of these tiny, unburned particles. Smoke has regulated consent limits during normal operation at the Mossmorran complex, measured as PM10.

*Particulate Matter (PM)*: is the term used to describe solid or liquid particles suspended in the atmosphere[[1]](#footnote-2). Particle size affects how deep a particle can penetrate into the lungs and be absorbed. Particles can be generated mechanically (e.g. dust from vehicle tyres driving over roads), through combustion (e.g. burning wood or fuel) or through chemical reactions. Particles may also be made up of or carry substances which can affect health.

* *PM10*: This is particulate matter with a diameter of less than 10 µm. PM10 are defined by international convention as being able to be deposited in the lung. Because it has the potential to cause effects on health, it is regulated in the UK and must meet a certain level. There are many sources, including road traffic, agriculture, industry and personal or household activities (e.g. domestic wood-burning, cooking).
* PM2.5: This is particulate matter with a diameter of less than 2.5 µm. These particles can penetrate even deeper into the lung than PM10. This is also sometimes called ‘fine particulate matter’ and has been associated with various health impacts, especially with regards to lung and heart health. Fine particles can cause inflammation and heart and lung diseases and impair lung development in children. In addition, fine particles may carry surface-absorbed carcinogenic compounds into the lungs. There are many sources, including road traffic, agriculture, industry and personal activities.

*Nitrogen dioxide (NO2):* This gas is produced by the reaction of oxygen and nitrogen during combustion. Vehicle emissions are a major source, especially in cities. Nitric oxide always occurs when NO2 is formed. The two gases together are known as oxides of nitrogen, sometimes described in shorthand form as NOx. NO2 may have adverse effects on the health of the lung. NO2 can irritate the lungs and lower resistance to respiratory infections such as influenza.

*Carbon monoxide (CO):* This is a colourless, odourless gas produced by incomplete, or inefficient, combustion of fuel. It is predominantly produced by road transport, in particular petrol-engine vehicles. CO prevents the normal transport of oxygen by the blood.

*Sulphur Oxides (SOx):*  Sulphur oxides are a group of chemicals that can be found in the air as gases and particles. SOx are produced when a fuel containing sulphur is burned. Sulphur dioxide (SO2) is the sulphur oxide which is of greatest concern to health. In the UK, the predominant source of SO2 is power stations burning fossil fuels, principally coal and heavy oils. Widespread domestic use of coal can also lead to high local concentrations of SO2. SO2 can cause irritation of the lungs and mucous membranes. Moderate concentrations of SO2 may result in a fall in lung function in asthmatics. Tightness in the chest and coughing occur at high levels, and lung function of asthmatics may be impaired to the extent that medical help is required. SO2 pollution is considered more harmful when particulate and other pollution concentrations are also high.

*Benzene:* This hydrocarbon is a minor component of petrol. Fuel distribution and car exhausts are the major contributors to benzene levels in the air, as well as industrial emissions. Benzene can also be produced from other sources of burning, such as fires and cigarette smoke. Benzene is no longer permitted to be used in consumer products. Benzene is a carcinogen, and air quality objectives are established to minimise this risk. Possible health effects that may result from long-term exposure to benzene include cancer, central nervous system disorders, liver and kidney damage, reproductive disorders, and birth defects.

*Volatile organic compounds (VOCs):* Carbon-based (or organic) chemicals that readily evaporate and are sometimes referred to as vapours. Many hydrocarbons, including benzene, butane, pentane and hexane are VOCs. Different VOCs are associated with different health effects, however, not all VOCs have known health effects.

## How do we assess Air Quality?

Air quality is measured by comparing against a range of health-effects based objectives. Objectives indicate the allowable exceedances of a standard. An air quality standard is the concentration recorded over a specified time period which are considered acceptable with respect to health. In Table 3‑1, the standard value is the ‘Limit concentration’ collected over the amount of time given in the ‘Time period’ column. The objectives are noted as the allowed number of exceedances in the ‘Limit concentration’ column. Further information on these can be found at <http://www.scottishairquality.scot/air-quality/standards>.

Table 3‑1: Air quality objectives in Scotland (from Summary of Objectives of the National Air Quality Strategy, <http://www.scottishairquality.scot/air-quality/standards>)

| **Pollutant** | **Limit concentration** | **Time period** |
| --- | --- | --- |
| PM10 | 50 µg m-3 (not to be exceeded more than 7 times a year) | 24 hour mean |
| 18 µg m-3 | Annual mean |
| PM2.5 | 10 µg m-3 | Annual mean |
| Nitrogen dioxide (NO2) | 200 µg m-3 (not to be exceeded more than 18 times a year) | 1 hour mean |
| 40 µg m-3 | Annual mean |
| Carbon monoxide (CO) | 10 mg m-3 | Running 8 hour mean |
| Sulphur dioxide (SO2) | 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 |
| Benzene | 3.25 µg m-3 | Running annual mean |
| 1,3-Butadiene | 2.25 µg m-3 | Running annual mean |
| VOCs | No specific limit |  |

To provide information and advice to groups who may be affected by air pollution, in the UK most air pollution information services use the index and banding system approved by the Committee on Medical Effects of Air Pollution Episodes[[2]](#footnote-3) (COMEAP) called the Daily Air Quality Index (DAQI). The system uses a 1-10 index divided into four bands to provide more detail about the health risks of air pollution levels in a simple way, similar to the sun (UV) index or pollen index.

* 1-3 (Low)
* 4-6 (Moderate)
* 7-9 (High)
* 10 (Very High)

Usually, the overall air pollution index for a site or region is calculated from the highest concentration of five pollutants:

* Nitrogen Dioxide
* Sulphur Dioxide
* Ozone
* PM2.5
* PM10

However, where only limited pollutant concentrations are available (e.g. if only PM monitoring is available) the concentration boundaries for individual pollutants (PM2.5 or PM10) have been used to generate a DAQI.

Further information on how to use the DAQI along with health messages for at-risk groups and the general population can be found at https://www.scottishairquality.scot/air-quality/daqi.

## What data are reviewed and who provides this?

Table 3‑2 provides a summary of the data typically considered and the providers of this information for the 2021 Annual Report.

Table 3‑2: Source of information considered by the Review Group

|  |  |
| --- | --- |
| **Data considered** | **Data provider** |
| Carbon monoxide (CO) emissions | Shell and ExxonMobil |
| Sulphur oxides (SOx) emissions | Shell and ExxonMobil |
| Nitrogen oxides (NOx) emissions | Shell and ExxonMobil |
| PM10 emissions | Shell and ExxonMobil |
| iso-butane, n-butane, iso-pentane, n-pentane, n-hexane, n-heptane, benzene, toluene, xylene and total hydrocarbons (C4-C10) | INEOS Forties Pipeline System (FPS) |
| Flaring events (tonnage) | Shell and ExxonMobil |
| Air quality monitoring | SEPA, Fife Council |

INEOS Forties Pipeline System (FPS) Ltd. provide data as they voluntarily commission the National Physical Laboratory (NPL) on an annual basis to monitor the ambient air hydrocarbon levels at 12 locations on the Forth Estuary coastline.

# In addition, Fife Council annually review and assess air quality in the Fife area and the Review Group consider Fife’s annual Air Quality Annual Progress Report[[3]](#footnote-4). The report provides the results of NO2, PM10 and PM2.5 monitoring undertaken at four automatic stations in Cupar, Kirkcaldy, Dunfermline and Rosyth and non-automatic monitoring using diffusion tubes at 42 sites. Pollution from road vehicle emissions is the key air quality issue in Fife, with nitrogen dioxide (NO2) and particulate matter (PM10) being the pollutants of concern. During 2021, Fife Council revoked the NO2 element of two air quality management areas (AQMAs) in the Fife area, one at Bonnygate, Cupar and the other in Appin Crescent, Dunfermline. They remain AQMA’s with respect to PM10, although levels of this pollutant are also being reduced4.

## Ozone – is this monitored and is it a concern?

Stakeholders have previously expressed concern about ozone.

Ozone (O3) is not emitted directly from any man-made source in any significant quantities. In the lower atmosphere, O3 is primarily formed by a complicated series of chemical reactions initiated by sunlight. These reactions can be summarised as the sunlight-initiated oxidation of VOCs in the presence of nitrogen oxides (NOx). The chemical reactions do not take place instantaneously, but can take hours or days, therefore ozone measured at a particular location may have arisen from VOC and NOx emissions many hundreds or even thousands of miles away. Ozone irritates the airways of the lungs, increasing the symptoms of those suffering from asthma and lung diseases[[4]](#footnote-5).

The AQ EAG does not receive any data pertaining to ozone as this is not routinely monitored by the facilities, INEOS FPS or Fife Council.

The AQ EAG will continue to review the need for monitoring of ozone. However, it is unlikely that emissions of NOx and VOCs arising from the operations at the Mossmorran plants and the Braefoot Bay terminal facilities would contribute to formation of ozone in the local area.

## Who has a regulatory role in relation to the Mossmorran and Braefoot Bay facilities?

The Mossmorran Complex and the Braefoot Bay Marine Terminal need to comply with a number of regulations which cover emissions that might affect air quality.

**Pollution Prevention and Control (Scotland) Regulations 2012 (‘the PPC Regulations’)**

Both sites at the Mossmorran Complex and ExxonMobil at Braefoot Bay are permitted by SEPA under the Pollution Prevention and Control (Scotland) Regulations 2012 (‘the PPC Regulations’).

The PPC Regulations focus on emissions from the facility and use of Best Available Techniques (‘BAT’) by the operator. They require the operator to operate their installation in such a way that (a) all the appropriate preventative measures are taken against pollution, in particular through application of the best available techniques, and (b) no significant pollution is caused.

Permit conditions including Emission Limit Values (ELVs) are set to reflect BAT and to protect the environment and public health. Such conditions are set following consultation with the Local Authority and the relevant Health Board to ensure that any air quality or public health aspects have been included. SEPA’s role thereafter is to ensure compliance with the permit conditions. Both Shell and ExxonMobil are required to provide monitoring data to demonstrate that ELVs are being met. Testing of emissions must conform to required standards and SEPA performs periodic compliance inspections to verify the quality and source of the data and can commission their own testing to verify results where required.

For airborne emissions from Mossmorran, the Shell and ExxonMobil permits require that the emissions from the stacks (or chimneys) from furnaces, boilers and gas turbines are tested and analysed. The results of the periodic analysis are checked against defined emission limits, and the results and outcomes are reported to SEPA. If the results are within the consented limits, it indicates the plant is operating as designed. SEPA periodically reviews the emission limits to ensure alignment with BAT as required by legislation. If an emission limit is exceeded the cause is investigated and follow-up initiated to prevent reoccurrence.

**Control of Major Accident Hazard Regulations 2015 (the COMAH Regulations)**

The Control of Major Accident Hazard Regulations 2015 (the COMAH Regulations) are regulated jointly by the Health and Safety Executive (HSE) and SEPA as the Competent Authority.

**Health and safety regulations**

These regulations apply to workplaces and are aimed at protecting the health of those on site, primarily workers.

**Local Air Quality**

Fife Council is required by Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents to undertake a review and assessment of local air quality in their area to ensure prescribed air quality objectives and standards for Scotland[[5]](#footnote-6) are not being exceeded.

**Statutory nuisance**

Fife Council is responsible for regulating statutory nuisance, including light (in practice, for odour and noise, where these are not covered by permit conditions enforced and issued by SEPA).

SEPA, Fife Council, NHS Fife and Public Health Scotland meet regularly and keep each other informed on what is happening at Mossmorran and share the results of air quality monitoring, including running joint working groups when required. This:

* Supports Fife Council Local Air Quality Reviews;
* Combined with sharing information on community health concerns, allows NHS Fife to assess and report on the health impacts of flaring.

# flaring

## Why is flaring needed?

The flares at the Mossmorran complex are part of the safety system. Because the gas is constantly flowing to the complex, it is necessary to send gas that is being sent to the site and cannot be processed to the flare for combustion. This might be due to scheduled maintenance requiring the plant to be ‘gas free’ prior to entry; or following an unplanned interruption in production. The flare systems include one 80-metre-high flare stack with up to three flare tips at Shell FNGL; one 100-metre-high flare at ExxonMobil FEP; and two ground flares operated by Shell FNGL, used by both sites as required.

The ground-level flares, owned and operated by Shell, are used in preference to the high-level flares to minimise noise and light impacts for local residents. However, it is not always possible to avoid use of the elevated flare, and this may occur if the ground flares are in use by the other operator or restricted in capacity relative to the amount of gas needed to be flared.

During flaring, excess gas is combined with steam and air before being burnt off. This is accepted as industry best practice, producing water vapour and CO2 when combustion is optimised. During a process upset, the ability to continue operating and the time it takes to start up and shut down are key elements that impact whether flaring occurs and for how long. Feed rates have to be managed through the whole supply network up to the offshore platforms in the North Sea, and upsets could have an impact on the natural gas supply for the whole of Scotland.

## What flaring took place during 2021?

In 2021, a number of planned and unplanned flaring events occurred at the Mossmorran Complex. Planned flaring events were primarily related to maintenance activities, while unplanned flaring was due to unexpected events.

ExxonMobil FEP reported a flaring event in February, resulting from a major compressor trip. Further elevated flaring occurred in April, June, and July. The plant was shut down for planned maintenance in April, and two restarts after planned maintenance in June and July resulted in use of the elevated flare. In addition, FEP uses the elevated flare if they are not able to access the ground flare at Shell FNGL or if the composition of the gas is not appropriate for use of the ground flare. These events are explained in further detail in Table 4‑1 and Table 4‑2.

Table 4‑1: Quantities flared by Shell FNGL in 2021. Purge gas is needed to prevent the creation of a potentially combustible mixture in the system and pilot gas is to provide a supply of fuel gas to keep the pilots lit.

| **Month** | **Ground Flaring (tonnes)**  **(inc. pilot & purge)** | **Elevated Flaring**  **(tonnes)** | **Total (Ground and Elevated)** | **Reason for significant flaring events** |
| --- | --- | --- | --- | --- |
| **(inc. pilot & purge)** | **(tonnes)** |
| **Jan** | 1.7 | 200.1 | 201.8 |  |
| **Feb** | 5.2 | 165.8 | 171.1 |  |
| **Mar** | 0.0 | 186.8 | 186.8 |  |
| **Apr** | 7.0 | 604.1 | 611.0 | Planned Total Plant Shut down for maintenance |
| **May** | - | 758.9 | 758.9 | Planned Total Plant Shut down for maintenance |
| **Jun** | - | 1184.4 | 1184.4 | Associated with neighbouring plant’s unavailability to accept reduced amount of ethane during total plant shutdown |
| **Jul** | - | 210.6 | 210.6 |  |
| **Aug** | - | 212.5 | 212.5 |  |
| **Sep** | - | 138.5 | 138.5 |  |
| **Oct** | 102.8 | 117.9 | 220.7 |  |
| **Nov** | 38.2 | 187.5 | 225.8 |  |
| **Dec** | 5.1 | 208.2 | 213.3 |  |
| **Total** | **160.0** | **4175.3** | **4335.3** |  |

Table 4‑2: Quantities flared by ExxonMobil FEP in 2021. Pilot gas is to provide a supply of fuel gas to keep the pilots lit.

| **Month** | **Ground Flaring (tonnes)**  **(inc. pilot & purge)** | **Elevated Flaring**  **(tonnes)**  **(inc. pilot & purge)** | **Total (Ground and Elevated)** | **Reasons for Significant Flaring Events** |
| --- | --- | --- | --- | --- |
| **Jan** | 729 | - | 729 |  |
| **Feb** | 637 | 36 | 673 | Plant process upset (trip of major compressor) resulted in use of flare system to combust gas until plant back online |
| **Mar** | 488 | - | 488 |  |
| **Apr** | 1,186 | 422 | 1,608 | Plant shutdown for planned maintenance event required use of elevated flare |
| **May** | 560 | - | 560 |  |
| **Jun** | 8,330 | - | 8,330 | Plant restart after planned maintenance event required use of elevated flare |
| **Jul** | 10,958 | 29 | 10,987 | Plant restart after planned maintenance event required use of elevated flare |
| **Aug** | 336 | - | 336 |  |
| **Sep** | 444 | 2 | 446 |  |
| **Oct** | 611 | 58 | 669 |  |
| **Nov** | 474 | 35 | 509 |  |
| **Dec** | 474 | 12 | 486 |  |
| **Total** | **25,226** | **595** | **25,821** |  |

## Are the quantities flared increasing over time?

Ground and elevated flare totals for both plants are shown in Figure 4‑1 and Figure 4‑2.

Figure ‑: Total quantities (tonnes) flared annually at Shell FNGL

Figure ‑: Total quantities flared annually at ExxonMobil FEP

The Shell FNGL flaring quantities were much higher than normal in 2019 (around 39,000 tonnes) due to the need for the plant to process more ethane than normal due to FEP’s shutdown over a six month period (Figure 4‑1). Levels in 2020 and 2021 decreased to be more in line with previous flaring quantities.

The overall trend at both facilities appears to be increasing slightly over time, but the levels are quite variable per year and future flaring quantities cannot be predicted from the existing trends over the past 15 years.

For more information on flaring from both facilities, Figure 4-3 and 4-4 show the split of total flaring quantities between base flaring (associated with normal operations) and event flaring (associated with events such as shutdown and start-up of equipment due to process upsets) as well as flaring due to events out with the operators’ control (e.g. storm-related power loss). Further information on the definitions can be found in APPENDIX 2. In 2019, a larger amount of event and external flaring occurred at both facilities, and was much reduced in the last two years. In 2021 flaring emissions were mostly attributable to planned events (e.g. due to maintenance).

The relative difference in flaring quantities between the two facilities may be explained by the difference in requirements to shut down for maintenance. ExxonMobil FEP has only one process line and therefore needs to shut down the facility for maintenance, resulting in the need to flare, while Shell FNGL has three lines, allowing them to perform maintenance without full facility shut-down. As shown in Table 4‑1 and Table 4‑2, larger quantities tend to be flared after plant restarts.

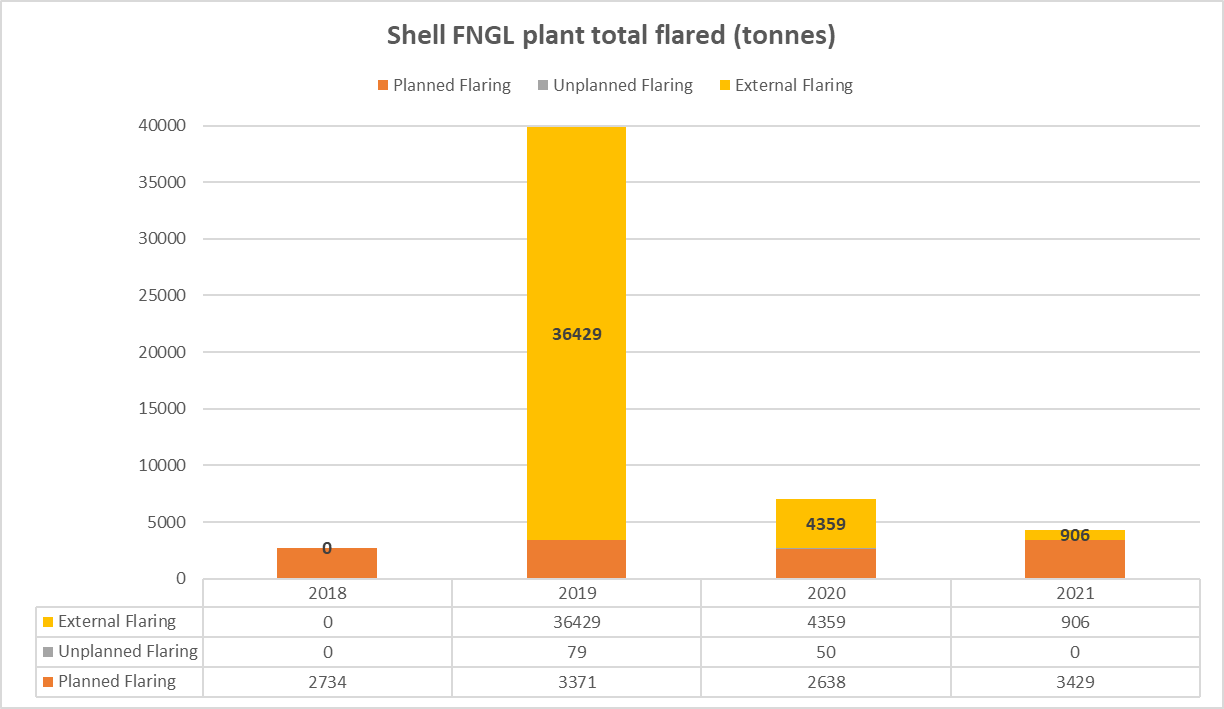


Figure ‑: Quantities flared by type of flaring at Shell FNGL (see Appendix 2 for flaring definitions specific to Shell FNGL)

Figure ‑: Quantities flared by type of flaring at ExxonMobil FEP (see Appendix 2 for flaring definitions specific to ExxonMobil FEP)

## What additional actions occurred in 2021?

Actions are underway at ExxonMobil and Shell to make improvements to their flaring systems. This includes installation of improved elevated flare tip and progressing the development and construction of the enclosed ground flare at ExxonMobil. Installation of an improved elevated flare tip at Shell and additional measures to prevent and, where that is not possible, minimise flaring.

## What are the AQ EAG’s comments and recommendations (where relevant)?

Flaring quantities appear to have a slight increasing trend from 2005 onwards at both FEP and FNGL, however, this did not result in any air quality standard exceedances (see Section 6). It is not clear whether the trend will continue into the future as the yearly fluctuation is variable.

# Emissions Data

## What are the emission data results for 2021?

The emissions monitoring measurements for 2021 submitted to SEPA are summarised for each regulated Shell FNGL and ExxonMobil FEP source at Mossmorran in Table 5‑1 (Shell FNGL), Table 5‑2, and Table 5‑3 (ExxonMobil FEP). The emission limit values (ELVs) set by SEPA for each emission source (see Section 3.5), are also shown. Emissions from the sources at the Mossmorran Complex described in this section are diluted in the air as they disperse away from the facilities. The air quality impacts measured in the surrounding areas are described in Section 6.

The emissions reported in this section are combustion related. Additional information on other types of emissions from Shell FNGL and ExxonMobil FEP can be found on the Scottish Pollution Release Inventory (SPRI) website[[6]](#footnote-7).

## What are the AQ EAG’s comments and recommendations (where relevant)?

In 2021 the emission monitoring results were within the limits set by SEPA. In the next sections, local air quality monitored in areas surrounding the Mossmorran Complex and any related health impacts will be discussed. The AQ EAG notes that the air quality results do not indicate that the emissions have led to levels of air pollutants nearby exceeding any health based objectives (see Section 6).

Table 5‑1: Emissions from Furnaces at Shell FNGL plant during 2021 (mg m-3 at 3% O2, 273 K dry). Readings are taken monthly and the mean, maximum and minimum are shown. Values below the detection limit of the measurement instrument are indicated as < detection limit value.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Furnace** | **CO Concentration (mg/m3)** | | | | **NOx Concentration (mg/m3)** | | | | **SO2 Concentration (mg/m3)** | | | |
| **ELV** | **Mean** | **Max.** | **Min.** | **ELV** | **Mean** | **Max.** | **Min.** | **ELV** | **Mean** | **Max.** | **Min.** |
| 1 | 100 | <6 | <6 | <6 | 150 | 108 | 196.6\* | 75 | 10 | <10 | <10 | <10 |
| 2 | 100 | <6 | <6 | <6 | 150 | 67 | 76 | 60 | 10 | <10 | <10 | <10 |
| 3 | 100 | 9 | 42 | <6 | 150 | 105 | 137 | 77 | 10 | <10 | <10 | <10 |

\*NOx limit exceedance, reported to SEPA in June 2021, was slightly higher than the compliance limit and second sample taken confirmed lowered emission concentration within emission limit value.

Table 5‑2: Emissions from Furnaces 1-7 and Gas Turbine Exhaust Stack at ExxonMobil FEP during 2021 (mg m-3 at 3% O2, 273 K Dry). The furnace exhaust readings are taken quarterly and the mean, maximum and minimum are shown. The gas turbine exhaust readings are taken monthly and the mean, maximum and minimum are shown. Values below the detection limit of the measurement instrument are indicated as < detection limit value.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CO\* Concentration (mg/m3)** | | | **NOx Concentration as NO2\*\* (mg/m3)** | | | **SO2\* Concentration (mg/m3)** | | |
|  | Average | Max | Min | Average | Max | Min | Average | Max | Min |
| **Furnace 1** | 3.2 | 12.8 | <3 | 266.5 | 300.0 | 240.4 | <14 | <14 | <14 |
| **Furnace 2** | 22.1 | 38.5 | 9.7 | 209.0 | 246.5 | 163.0 | 19.1 | 34.0 | <14 |
| **Furnace 3** | 3.2 | 12.7 | <3 | 289.8 | 348.9 | 251.4 | 3.5 | <14 | <14 |
| **Furnace 4** | 3.3 | 12.8 | <3 | 249.9 | 260.4 | 227.5 | <14 | <14 | <14 |
| **Furnace 5** | 6.7 | 6.7 | 6.7 | 241.5 | 241.5 | 241.5 | <14 | <14 | <14 |
| **Furnace 6** | 4.0 | 12.8 | <3 | 207.3 | 216.6 | 202.5 | 0.4 | <14 | <14 |
| **Furnace 7** | <3 | <3 | <3 | 265.7 | 271.8 | 247.3 | 1.1 | 4.5 | <14 |
| **Gas Turbine Stack** | 1.3 | 2.7 | <3 | 370.7 | 427.4 | 263.2 | 4.7 | 13.2 | 0.0 |

\*No limit: no emission limit applied by SEPA

\*\*Authorised PPP Emissions Limit is 350 mg m-3 for the furnaces and 550 mg m-3 for the gas turbine stack

Table 5‑3: Emissions from ExxonMobil Boilers at Mossmorran during 2021. Measured NOx, SOx and CO Values (mg m-3@ 3% O2, 273K Dry) from Boiler stacks A, B and C. Readings are taken every six months and averaged.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Boiler** | **CO Concentration**  **(mg m-3)** | | **NOx Concentration as NO2**  **(mg m-3)** | | | **SOx Concentration**  **(mg m-3)** | | | **PM10 Concentration**  **(mg m-3)** | | |
| **Authorised PPC Emissions Limit** | **Result** | **Authorised PPC/LCPD Emissions Limit** | **LCPD fuel weighted consent** | **Result** | **Authorised PPC/LCPD Emissions Limit** | **LCPD fuel weighted consent** | **Result** | **Authorised PPC/LCPD Emissions Limit** | **LCPD fuel weighted consent** | **Result** |
| A\* | 200 | 5.3 | Limit is fuel weighted (450 on liquid fuel, 300 on gas) | 300.0 | 99.9 | Limit is fuel weighted (350 on liquid fuel, 35 on gas). | n/a | 1.1 | Limit is fuel weighted (50 on liquid fuel, 5 on gas). | n/a | 0.2 |
| 1.0 | 300.0 | 113.0 | 35.0 | 0.7 | 5.0 | 1.3 |
| B | 200 | 3.5 | 300.0 | 91.6 | 35.0 | 0.6 | 5.0 | 0.3 |
| 0.8 | 383.5 | 70.1 | 210.4 | 8.0 | 30.1 | 1.2 |
| C | 200 | 3.0 | 300.0 | 106.7 | 35.0 | 0.6 | 5.0 | 0.2 |
| 2.5 | 300.0 | 99.9 | 35.0 | 0.3 | 5.0 | 0.8 |

# air quality

## What are the results of the air quality data typically reviewed by the AQ EAG for 2021?

The air quality data reviewed include Fife Council air quality monitoring data, hydrocarbon monitoring done voluntarily by INEOS along the coastline and monitoring around the Mossmorran Complex done by SEPA. The first two sources are discussed here and SEPA’s monitoring is described in the following section.

Fife Council’s Air Quality team did not identify any new issues in the vicinity of Mossmorran or Braefoot Bay in their 2022 Air Quality Annual Progress Report. None of the automatic monitoring sites at Cupar, Dunfermline, Kirkcaldy, and Rosyth reported exceedances of the annual mean air quality objectives for PM2.5, PM10 or NO2. Two Air Quality Management Areas (AQMAs) were declared in prior years for PM10 and NO2, however in 2021, the NO2 element was revoked, indicating that they have achieved their AQMAs objectives for this pollutant. There were no exceedances of the daily PM2.5 or PM10 objectives (see Table 3‑1) by the automatic monitoring stations. The AQMesh, also used in selected locations, is not certified under MCERTS or any other scheme for compliance monitoring and is used as indicative only.

PM2.5 and PM10 concentrations are greatly influenced by many non-local sources, compared to NO2. Particulate matter also has many natural sources (e.g. sea salt, pollen) along with man-made sources (e.g. vehicles, heating, industry), and can be formed due to chemical reactions in the air (e.g. due to emissions from agriculture).

Any air quality management areas (AQMAs) where greater control for PM10 or NO2 are needed are not associated with emissions from the facilities at Mossmorran or Braefoot Bay.

Road traffic is the main contributor to air quality issues in these areas. In addition to the automatic monitoring sites, Fife Council includes a network of NO2 diffusion tubes, primarily aimed at assessing traffic-related NO2.

INEOS FPS Ltd. commissioned the National Physical Laboratory (NPL) to monitor the ambient air hydrocarbon levels at 12 locations on the Forth Estuary coastline during 2021 (1st January 2021 to 31st December 2021). Nine locations on the Estuary North shore between North Queensferry and West Wemyss (including 4 locations between Dalgety Bay and Burntisland) were used, and 3 locations on the Estuary South shore between South Queensferry and Whitehouse Point were used. The ambient air samples were collected over 2 week periods using passive diffusion tubes. These samples were analysed for iso-butane, n-butane, iso-pentane, n-pentane, n-hexane, n-heptane, benzene, toluene, xylene and total hydrocarbons (C4-C10). These hydrocarbons may be emitted from a variety of sources around the Forth Estuary including INEOS operations at Hound Point Terminal, road traffic, and other industrial sites such as the operations of ExxonMobil and Shell at Braefoot Bay and Mossmorran. Monitored concentrations of propane, n-butane, iso-butane, n-pentane, hexane, heptane, octane, nonane, decane, propylene, toluene, o-xylene, m & p-xylene, styrene and total C4 to C10 hydrocarbons are measured by INEOS as part of their annual reporting requirements at Grangemouth and Hound Point.

* The results of this monitoring indicate that the average concentrations of benzene over the 12-month period had annual means at each location ranging from 0.1 to 0.4 parts per billion (ppb). This is below the current annual air quality (Scotland) objective of 1 ppb[[7]](#footnote-8).
* There are no Air Quality (Scotland) Strategy objectives for other hydrocarbons except for 1,3-butadiene. This compound was not specifically reported by INEOS.
* The substance present in the greatest concentrations at all locations was n-butane for which annual mean concentrations ranged from 1.3 to 9.3 ppb. Concentrations of n-heptane, toluene and xylene were all below the limit of detection (LOD) of <0.3ppb.
* Other annual mean concentrations (iso-butane, iso-pentane, n-pentane, n-hexane) range from <0.3 ppb to 3.6ppb.
* Annual mean total C4-C10 hydrocarbons concentrations range from <5-20 ppb.

The concentration levels of hydrocarbons reported by INEOS are unlikely to have health impacts, based on the available evidence. Air quality objectives are indicated for the hydrocarbons where a health risk standard has been defined, but these have not been exceeded.

## SEPA air quality monitoring in 2021 – what did they do and what were the results?

The locations of SEPA’s air monitoring equipment are shown in Figure 6‑1. SEPA undertook air quality monitoring throughout the year. During this time, automatic (i.e. continuous) monitoring for particulate matter (PM2.5 and PM10) and various combustion-related gases (CO, NO2, SO2) was done at Little Raith. Particulate matter was monitored at Lochgelly, Donibristle (from 1st April 2021), and Auchtertool (1st April – 4th November 2021). Instrument and power issues resulted in data gaps for Auchtertool at the end of 2021. No additional monitoring was done using diffusion tubes because in previous years these data did not indicate that NO2 or VOCs measured using these methods were near levels of concern.

Wind speed and direction was also continuously monitored over the measurement period at Lochgelly during the January to December 2021 period.

In 2021, SEPA’s systems were not operational for the first half of the year, due to the cyberattack in December 2020. Thus, data from SEPA’s Mossmorran and Braefoot Bay air quality report were not able to undergo the regular ratification procedure. While the gas analysers were QC checked fortnightly, the data could not be fully QA/QC’d. Normally, they would be changed out if the instruments’ drift exceeded acceptable levels or if the instrument had been deployed more than six months. However, due to COVID-19 restrictions, there were times when the analysers may not have been changed out at the appropriate time, resulting in some data gaps.

Similar issues with the cyberattack and other logistical challenges due to COVID-19 meant that the Little Raith particulate matter instrument was not able to be calibrated. The particulate matter instruments at Auchtertool and Donibristle are considered indicative instruments (i.e. not reference equivalents) and were calibrated. The instrument at Lochgelly is a reference equivalent but some of the QC and calibration data was lost due to either the cyberattack, or inability to visit due to COVID-19 restrictions. The air monitoring data for 2021 presented can therefore only be interpreted as indicative.

Map

Description automatically generated

Figure ‑: Map of SEPA monitoring sites for 2021 (from Air Quality Monitoring Mossmorran, January-December 2021, Draft version 30 September 2022)

The Daily Air Quality Index (DAQI) is used in reporting by SEPA for the continuously monitored pollutants, because the DAQI provides a way of indicating whether levels measured may pose a health risk (low, moderate, high, very high) and incorporate short-term standards. The DAQI is normally based on the highest concentration of these five pollutants – nitrogen dioxide, sulphur dioxide, ozone, PM2.5 and PM10, if available. In this case the DAQI is based the available pollutants measured. The DAQI’s moderate band generally begins at the short-term air quality standard levels, e.g. the 24-hour mean for PM10, one-hour mean for NO2 (see Table 3‑1 for complete details).

Particulate matter levels were mostly within the low band of the DAQI, with average PM10 at 8.8 µg m-3 and average PM2.5 at 6.3 µg m-3. These annual averages are similar to the levels measured at the four automatic monitoring stations in Fife[[8]](#footnote-9). The 24 hour average PM10 air quality objective concentration of 50 µg m-3 was exceeded three times at Little Raith Farm in 2021, on the 19, 26 and 27 January. However up to seven exceedances of the 24-hour mean are allowed annually as part of the Scottish air quality objective. The winds at the times of the three highest daily average PM10 concentrations were light with variable directions, and periods of calm conditions. These cannot be attributed to any specific source or direction from the monitoring site.

The measured daily average PM10 concentration exceeded 50 µg m-3 once during the monitoring at Donibristle in 2021. Seven exceedances are permitted in a year therefore this is not an exceedance of the air quality objective for PM10. The concentration measured on the 30 May was 689.3 µg m-3. The weather on the 30 May had predominantly light North Easterly winds. No evidence of long range events for 30 May and data compared with PM10 levels at local sites in Fife, Edinburgh St Leonards and Auchencorth Moss where PM10 levels were low. Low level flaring occurred on 30 May 2021 but are unlikely to be cause of the elevated PM10 levels as the flaring rate was low and likely due to routine maintenance on site. SEPA received no complaints on 30 May 2021 in relation to the flaring or visible black smoke or dust. Therefore the elevated particulate levels cannot be attributed to the complex on 30 May 2021.

The NO2 and SO2 data were all below annual mean air quality objectives as well as short-term objectives. Annual mean levels were similar to those found at Fife Council’s automatic air monitoring stations.

The continuous monitors used by SEPA are certified according to the Environment Agency’s Monitoring Certification Scheme (MCERTS). They are either equivalent methods for continuous ambient air-quality monitoring systems (CAMS), which means they can be used in compliance monitoring for UK objectives[[9]](#footnote-10), or indicative methods, which means they cannot be used in compliance monitoring but are officially recognised for trend analysis, source identification, or other similar types of analysis[[10]](#footnote-11). These certifications specify the testing conditions and objectives the instruments must meet compared to a reference monitor.

The automatic gas monitoring systems (NO2, SO2, CO) at Little Raith used equipment certified under MCERTS and the procedures for monitoring and data processing are based on the relevant BS EN standards.

The FIDAS at Lochgelly is a CAMS equivalent method, but the Turnkey Osiris (used at Auchertool and Donibristle) is certified as an ‘Indicative Ambient Particulate Monitor’ for PM10. Osiris PM2.5 data is not covered by MCERTS above 100 µg m-3, however values never reached this concentration.

The site at Little Raith has been identified as the primary downwind site and has the potential to be impacted the most by emissions from the Mossmorran Complex. It is expected that the air pollution measured at Little Raith would also be affected by farming activities, which can generate particulate matter. The other sites are considered to represent the community, and similarly would be influenced by nearby sources such as traffic.

## Has there been any air quality monitoring undertaken during flaring events?

The automatic monitors at Little Raith Farm were continuously operated throughout 2021, while the particulate matter monitors at Lochgelly and Donibristle operated throughout the year from 1 April. The Auchtertool site operated for a shorter period of time (April-November). These would have been operational during most of the reported flaring events. No additional monitoring was undertaken at other sites or for other pollutants during flaring events.

## What are the AQ EAG’s comments and recommendations (where relevant)?

Based on the available data, the ExxonMobil and Shell FNGL plants at the Mossmorran complex did not have adverse impacts on local air quality. The only short-term episodes of concern related to PM10 but these were within air quality objectives (i.e. number of exceedances were below requirements). These did not coincide with flaring activities and therefore are likely due to events unrelated to the plants at the Mossmorran complex.

Air quality monitoring by SEPA and the monitoring through Fife Council do not indicate any adverse effects on air quality in 2021 related to the Mossmorran Complex. Although the site likely contributes some amount to the air pollutant levels in the area, these are not easily distinguishable from other sources, either locally or through long-range transport from further away.

Existing monitoring data do not indicate an air quality problem overall, based on comparison with air quality objectives. Particulate matter was monitored in 2021 at four sites near the Complex. Any flaring events that did occur during the monitoring periods did not appear to have an adverse impact on local air quality. One site continuously also monitored NO2, CO, and SO2. The data for 2021 were not fully ratified, and therefore the data must be treated with more uncertainty than in previous years. Although there were four exceedances of the short-term (24-hour average) concentrations of PM10, the number of exceedances is still allowable under the Scottish Air Quality Objectives. Otherwise, the measured values do not indicate that there were large differences in air quality between 2021 and previous years. Data from previous monitoring during flaring do not indicate that concentrations of these gases in the community would have been raised to concerning levels.

Past reports of the Mossmorran & Braefoot Bay Independent Air Quality Expert Advisory Group (see 2020 and 2021 reports[[11]](#footnote-12)) have described studies done on the potential for wind farms in the area to impact local air quality related to emissions from the Mossmorran Complex. These studies found that wind turbines would have a relatively small and negligible impact on local air quality.

The monitoring stations and programme were chosen by SEPA to reflect community exposures and agreed with previous Review Group. The positions of the monitors were informed by community locations and air modelling predictions.

Air monitoring undertaken by SEPA are considered by the AQ EAG to be done to a rigorous standard, and any issues have been reported in SEPA’s reports in a transparent manner. As mentioned previously, the 2021 SEPA data are not ratified due to external circumstances adversely affecting their computer systems. Additionally, COVID-19 restrictions occasionally resulted in delays in changing gas analysers.

Stakeholder engagement activities were undertaken by SEPA around air quality, and use of additional monitors similar to those used by Fife Council are being considered to replace existing monitoring and provide additional feedback to the community on air quality. Continued engagement activities with the community to provide information about the relationship between emissions from the facilities and local air quality are recommended.

# Health effects

## Are people living near the facilities experiencing adverse health effects relating to their air quality?

NHS Fife are aware of concerns, expressed to SEPA by members of the public, about disturbing amounts of noise, bright light and occasional black smoke during flaring activity.

A report conducted by NHS Fife as of 2019 concluded that, the overall impact of flaring on people local to Mossmorran in recent years has not been acceptable and could plausibly affect health in the widest sense. NHS Fife would therefore recommend that every reasonable effort to be made to reduce the frequency, duration and intensity of these events.[[12]](#footnote-13)

However, NHS Fife has not received reports from health professionals of adverse community health effects attributed to either the normal operation of the Mossmorran plant or unplanned flaring events there. NHS Fife have no new evidence of an association between air pollution in the vicinity and cancer19. Local cancer rates have not been found to be higher than expected after taking account of deprivation as measured by the Scottish Index of Multiple Deprivation[[13]](#footnote-14).

## What are the AQ EAG’s comments and recommendations (where relevant)?

The AQ EAG understands through their discussions with stakeholders, that some people in the communities have concerns that their health may be adversely affected by the plant operations and flaring events.

Past community health concerns in the Mossmorran area have often focussed on cancer. In response to concerns about cancer clusters, NHS Fife have looked at cancer incidence on several occasions in the recent past. Each time, no evidence was found of cancer rates in the Mossmorran area that differ significantly from those elsewhere in Fife or Scotland, once the socio-economic profile of the areas is taken into account.

NHS Fife is committed to working with national agencies to explore evidence relating to health concerns that have been raised in the areas surrounding Mossmorran, should new evidence emerge.

# CONCLUSIONS

Flaring occurs as a safety mechanism for FEP and FNGL, and in 2021, both planned flaring (due to known maintenance) and unplanned flaring (due to unexpected circumstances) occurred.

Flaring emissions appear to have slightly increased over the last 15 years, although the amount of gas flared fluctuates from year-to-year. It is not clear that this trend will continue to the future. Events requiring FEP to shut down in the last two years may contribute to recent increases.

Air quality monitoring in the area does not indicate that air pollution in the region reached levels that would have been hazardous for the community.

It is considered that the emissions from the facilities at Mossmorran and Braefoot Bay did not result in air quality levels that pose a significant health risk to members of the local community.

1. ABBREVIATIONS

|  |  |
| --- | --- |
| µg m-3 | Microgram per cubic metre, mass concentration unit for particulates and gases. There are 1,000,000 micrograms in a gram. |
| mg m-3 | Milligram per cubic metre, mass concentration unit for particulates and gases. There are 1,000 micrograms in a gram. |
| µm | Micrometre (there are one million micrometres in a metre) |
| AQMAs | Air Quality Management Areas |
| AURN | Automatic Urban and Rural Network |
| BAT | Best Available Techniques |
| BTEX | Benzene, Toluene, Ethylbenzene and Xylene |
| CO | carbon monoxide |
| COMAH | Control of Major Accident Hazard |
| COMEAP | Committee on Medical Effects of Air Pollution Episodes |
| DAQI | Daily Air Quality Index |
| DEFRA | Department of environment, food and rural affairs |
| ELV | Emission Limit Value |
| ExxonMobil | ExxonMobil Chemical Limited |
| FEP | Fife Ethylene Plant - ExxonMobil Chemical Limited (ExxonMobil)’s production facility at Mossmorran |
| FNGL | Fife Natural Gas Liquids – comprises Shell UK Limited (Shell)’s production facility at Mossmorran for the fractionation of liquefied natural gas |
| FPS | Forties Pipeline System |
| HSE | Health and Safety Executive |
| IPPC | Integrated Pollution Prevention and Control |
| K | Kelvin, a unit of temperature. 273 K is approximately 0°C. 1 K = 1°C |
| MBBEAGAQ | Mossmorran and Braefoot Bay Expert Advisory Group on Air Quality |
| MBBIAQMRG | Mossmorran and Braefoot Bay Independent Air Quality Monitoring Review Group |
| MCERTS | Monitoring Certification Scheme |
| NO2 | Nitrogen dioxide |
| NOx | Nitrogen oxides |
| NPL | National Physical Laboratory |
| O3 | Ozone |
| PM | Particulate matter |
| PM10 | Air pollution particles that are approximately less than 10 μm in diameter |
| PM2.5 | Air pollution particles that are approximately less than 2.5 μm in diameter and are therefore a subset of PM10. |
| ppb | Parts per billion by volume, concentration unit for gases and vapours, equivalent to one cubic millimetre of gas mixed with one cubic metre of air. |
| PPC | Pollution Prevention and Control |
| ppm | Parts per million by volume, concentration unit for gases and vapours, equivalent to one cubic centimetre of gas in a cubic metre of air, 1ppm = 1,000 ppb. |
| Review Group | Mossmorran & Braefoot Bay Independent Air Quality Monitoring Review Group |
| SEPA | Scottish Environment Protection Agency |
| Shell | Shell UK Limited |
| SOx | Sulphur oxides |
| SO2 | Sulphur dioxide |
| TOR | Terms of reference |
| THCs | Total hydrocarbons |
| VOCs | Volatile organic compounds |

# 

1. Glossary

Air quality standard – the concentration recorded and averaged over a specified time period which is considered acceptable with respect to health.

Air quality objective - the allowable exceedances of a standard in a defined time period.

From ExxonMobil Permit, a “flaring event” is any flaring of hydrocarbon at a rate greater than 5t/h for longer than 30mins, to either the ground or elevated flare.

The following types of flaring are defined for ExxonMobil:

* Unplanned (also called event) Flaring – Unplanned flaring greater than 5 tonnes/hour to either the ground or elevated flare i.e. during a process upset
* Planned Flaring – Planned flaring greater than 5 tonnes/hour, for which SEPA & communities will have been given notice ahead of time. Planned flaring includes Base Flaring, which means <5 tonnes/hour flaring to either ground or elevated flare that is required for normal plant operation (purging of process equipment, use of safety facilities (pressure control valves etc.).
* External Flaring – Any planned/unplanned flaring due to factors outside FEPs control (i.e. – ethane from FNGL routed to ground flares during the FEP shutdown). However, this does not include flaring due to a process upset as a result of weather.

The following types of flaring are defined for Shell FNGL :

* Planned Flaring - Flaring to either ground or elevated flare that is required for normal plant operation (pilot gas for safe operation of flare tip, purging of process equipment, use of safety facilities etc.) and flaring required for larger maintenance/process activities, for which SEPA and communities are given notice ahead of time (planned plant start-up/shutdown etc.).
* Unplanned Flaring - Flaring due to unplanned changes in operations that require gas to be flared.
* External Flaring - Flaring (both planned/unplanned) due to events out with operator's control.

1. Membership

This Appendix contains information provided by Fife Council, membership as at December 2021.

| **Name** | **Designation/**  **Representing** | **Address** |
| --- | --- | --- |
| **A. MEMBERS** | |  |
| Kenny Bisset | Fife Council (Enterprise, Planning and Protective Services) | Enterprise, Planning and Protective Services, Glenrothes |
| Dr Miranda Loh | Institute of Occupational Medicine (IOM) | Research Avenue North, Riccarton, Edinburgh |
| Ian Brocklebank | Scottish Environment Protection Agency (SEPA) | Operations Technical Support Unit East, Scottish Environment Protection Agency, Edinburgh Office, Silvan House, 231 Corstorphine Road, Edinburgh, EH12 7AT |
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| Peter Franklin | Dalgety Bay & Hillend Community Council | Dalgety Bay |
| **B. BY INVITATION** | |  |
| Lynne Keavney | SEPA |  |
| David Fisher | SEPA |  |
| Richard Sinnott | SEPA |  |
| Peter Finney | SEPA |  |
| Ian Wager | SEPA |  |
| Cllr Linda Erskine | Lochgelly, Cardenden and Benarty Ward | Fife House, Glenrothes |
| Cllr Rosemary Liewald | Lochgelly, Cardenden and Benarty Ward | Fife House, Glenrothes |
| Cllr Mary Bain Lockhart | Lochgelly, Cardenden and Benarty Ward | Fife House, Glenrothes |
| Cllr Lea Mclelland | Lochgelly, Cardenden and Benarty Ward | Fife House, Glenrothes |
| Cllr Lesley Backhouse | Burntisland, Kinghorn and Western Kirkcaldy Ward | Fife House, Glenrothes |
| Cllr Julie MacDougall | Burntisland, Kinghorn and Western Kirkcaldy Ward | Fife House, Glenrothes |
| Cllr Kathleen Leslie | Burntisland, Kinghorn and Western Kirkcaldy Ward | Fife House, Glenrothes |
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| Cllr Dave Dempsey | Inverkeithing and Dalgety Bay Ward | Fife House, Glenrothes |
| Cllr Sarah Neal | Inverkeithing and Dalgety Bay Ward | Fife House, Glenrothes |
| Stephen Bygrave | Ineos Forties Pipeline Ltd | Hound Point |
| Rachel Morrell | Ineos Ltd | Grangemouth Petrochemical Complex |
| Iain Fleming | Auchtertool Community Council | Auchtertool |
| Tom Kinnaird | Benarty Community Council | Benarty |
| Alexander Macdonald | Burntisland Community Council | Burntisland |
| David A. Taylor | Cardenden & Kinglassie Community Council | Cardenden |
| Irene Burt | Cowdenbeath Community Council | Cowdenbeath |
| Fred Clarke | Kelty Community Council | Kelty |
| Raymond Wilson | Lochgelly Community Council | Lochgelly |
| Amelia Howie | Lumphinnans Community Council | Lumphinnans |
| Maureen Cuthbertson | Crossgates & Mossgreen Community Council | Crossgates (Inland) |
| William Dryburgh | Aberdour Community Council | Aberdour |

1. Air Quality (PM2.5 particulate air pollution) and Mortality in Scotland. : A Briefing Paper, HPS April 2014. http://www.documents.hps.scot.nhs.uk/environmental/briefing-notes/air-quality-and-mortality-2014-04.pdf [↑](#footnote-ref-2)
2. http://comeap.org.uk/ [↑](#footnote-ref-3)
3. https://www.fife.gov.uk/\_\_data/assets/pdf\_file/0027/416457/Fife\_Annual\_Progress\_Report\_2022\_Issue\_2\_Final\_Updated\_1.pdf [↑](#footnote-ref-4)
4. <http://www.scottishairquality.scot/air-quality/pollutants#ozone> [↑](#footnote-ref-5)
5. https://www.legislation.gov.uk/ukpga/1995/25/part/IV <http://www.scottishairquality.scot/air-quality/standards> [↑](#footnote-ref-6)
6. https://informatics.sepa.org.uk/SPRI/ [↑](#footnote-ref-7)
7. The air quality standard for benzene is reported here in ppb, rather than µg m-3 for comparability with the measured values. Both ppb and µg m-3 are measures of concentration, ppb is generally used for gas or vapours, and is a measure of volume of gas per volume of air. µg m-3 is a measure of mass of gas per volume of air. There is a conversion factor between the two units. [↑](#footnote-ref-8)
8. https://www.fife.gov.uk/\_\_data/assets/pdf\_file/0027/416457/Fife\_Annual\_Progress\_Report\_2022\_Issue\_2\_Final\_Updated\_1.pdf [↑](#footnote-ref-9)
9. <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/532491/LIT_7050.pdf>; also [↑](#footnote-ref-10)
10. https://uk-air.defra.gov.uk/assets/documents/reports/cat14/1101140842\_Assessment\_of\_UK\_AURN\_PM\_Equipment\_against\_2010\_GDE.pdf and https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\_data/file/642895/LIT\_7070.pdf [↑](#footnote-ref-11)
11. https://www.fife.gov.uk/kb/docs/articles/environment2/environmental-health/mossmorran-and-braefoot-bay [↑](#footnote-ref-12)
12. NHS Fife (2019) Reports of the health impact of Flaring at Mossmorran and Historical Cancer Incidence. Available from: [191030-nhs-fife-mossmorran-health-impact-summary-final.pdf (nhsfife.org)](https://www.nhsfife.org/media/32734/191030-nhs-fife-mossmorran-health-impact-summary-final.pdf) [↑](#footnote-ref-13)
13. For all cancers combined, the most deprived areas have incidence rates that are almost a third higher than the least deprived areas. <https://www.isdscotland.org/Health-Topics/Cancer/Publications/2019-04-30/2019-04-30-Cancer-Incidence-Report.pdf> (accessed 29/07/2019) [↑](#footnote-ref-14)