South Gloucestershire Council

A4174 Hambrook Air Quality Report

2019 – 2024 Monitoring Results

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Report Reference	A4174_Hambrook_2019_2024
Date	June 2026

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1 Introduction

1.1 Purpose of report

This report provides the results of the air quality monitoring between 2019 and 2024 for the A4174 Hambrook Air Quality scheme which was put in place to improve the roadside nitrogen dioxide (NO_2) levels and reviews the compliance of the results with the legal NO_2 annual mean limit value of 40 microgrammes per cubic metre ($\mu g/m^3$).

1.2 Background

1.2.1 Targeted Feasibility Study

Following the Government's UK Air Quality Plan[1] for nitrogen dioxide published in July 2017, South Gloucestershire Council (SGC) was mandated to undertake a Targeted Feasibility Study by the Government via a Ministerial Direction issued in March 2018. The study was required to identify actions that could be taken to reduce roadside NO_2 concentrations by the A4174 Ring Road between the A4017 Bromley Heath Road and M32 Motorway Junction 1 roundabouts to meet the annual mean NO_2 limit value (40 $\mu g/m^3$), as set out in the Air Quality Standards Regulations 2010, in the shortest time possible. The roadside NO_2 levels were identified as being above the annual mean limit value through a preceding national assessment of local authority roads.

The feasibility study concluded that it would be possible to bring forward compliance with the NO_2 limit value on this section of the A4174 if certain traffic management measures were put in place at the Hambrook junction. The measures aimed to reduce the length of time vehicles were stationary and allow the ring road traffic to flow more efficiently, thereby reducing traffic emissions and improving air quality. The outcome of the study was approved by the Joint Air Quality Unit (JAQU); a joint unit formed between the Department for Environment, Food and Rural Affairs (Defra) and the Department for Transport (DfT) to deliver the national nitrogen dioxide reduction strategies.

The South Gloucestershire study, along with the feasibility studies of all 33 mandated authorities in the "third wave" of Government air quality action, were used to develop the

[1] Air quality plan for nitrogen dioxide (NO_2) in UK (2017) - GOV.UK (www.gov.uk)

supplement[2] to the 2017 UK Air Quality Plan and were also published separately by Defra[3].

The council was subsequently legally directed through a further Ministerial Direction in October 2018 to implement the traffic management measures identified in the Feasibility Study.

1.2.2 Traffic measures implemented

The following traffic measures were implemented at the A4174 Hambrook junction in August 2019:

- Removal of the right turn onto the B4058 from the westbound carriageway of the A4174 ring road
- Removal of the straight on movement for the B4058 northbound from Frenchay
- Removal of the right turn from the B4058 from Frenchay onto the A4174
- Changing the westbound bus lane to an all-traffic lane on the A4174 through the junction to the M32 traffic signals.

A diagram showing the measures is also provided in Figure A.3 (Appendix A).

1.2.3 New and existing monitoring

New monitoring sites were set up by the roadside to assess the impact of the traffic restrictions at the junction on NO_2 concentrations along the A4174 ring road between the M32 Junction 1 and Bromley Heath roundabouts. This is because the NO_2 annual mean limit value set out in the Air Quality Standards Regulations 2010 applies where there is public access (with some exceptions), which includes the pedestrian and cycle paths by the roadside in this location. Details about this monitoring are provided in Section 2.

The new roadside monitoring sites were set up in addition to monitoring that has been undertaken for many years where people live near the A4174 at Hambrook in line with local air quality management (LAQM) requirements. However, the national air quality objectives, which form the basis of the LAQM framework, take “relevant exposure” into

[2] Supplement to the UK plan for tackling roadside nitrogen dioxide concentrations (publishing.service.gov.uk)

[3] Supplement to the UK plan for tackling roadside nitrogen dioxide concentrations: local authorities feasibility studies - Defra, UK

consideration with the objectives applying where people are regularly present for the averaging period of the objective. Relevant exposure for the national annual mean NO_2 objective, which is the same value (40 µg/m^3) as the annual mean limit value, generally relates to long-term exposure across the year, such as at the facades of residential properties and care homes but also applies to schools and hospitals.

The LAQM monitoring results show that the NO_2 levels are below the national air quality objective where people live near the A4174 at Hambrook. This is mainly because the houses are set back from the ring road and pollutant concentrations quickly drop off with increasing distance from the road. These results are reported in the SGC Air Quality Annual Status Reports (ASR) which are available on the council's Air Quality webpage[4].

The scheme monitoring results for 2019 – 2024 have not been reported in the council's Annual Status Reports as the scheme did not come under SGC's LAQM duties.

1.2.4 Assessment arrangements

The NO_2 monitoring data for the scheme was reported separately to JAQU for independent review. However, assessment of the scheme's effectiveness was delayed as it took longer than expected to obtain appropriate data due to the Covid-19 pandemic. This was because the monitoring data for 2020 and 2021 was not typical of normal conditions due to the reduced traffic levels, and therefore, was not considered to be representative of long-term trends in NO_2 concentrations. 2022 was the first year considered to be representative of "new normal" conditions following the pandemic.

JAQU confirmed that the council would need to demonstrate two consecutive calendar years of compliant data below the legal limit (40 µg/m^3) from 2022 onwards in order to be considered eligible to be released from the ministerial direction.

JAQU undertook assessments of the 2022, 2023 and 2024 monitoring data. This report should be read in conjunction with JAQU's Assessment Report of the 2022 and 2023 monitoring data and their subsequent Assessment Report of the 2024 data, which are available on SGC's Hambrook traffic lights webpage[5].

[4] https://beta.southglos.gov.uk/air-quality/

[5] https://www.southglos.gov.uk/hambrookchanges

2 Air Quality Monitoring

This section sets out the roadside nitrogen dioxide (NO_2) monitoring undertaken from 2019 to 2024 by the A4174 Ring Road between the A4017 Bromley Heath Road and M32 Motorway Junction 1 roundabouts. The monitoring results are compared with the annual mean limit value of 40 µg/m^3 and the trends are identified and discussed.

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Site

An SGC automatic (continuous) NO_2 monitoring site by the A4174 Ring Road (westbound) near Old Gloucester Road has been operational since April 2022. The high-resolution measurements are made using a chemiluminescence analyser, which is an accurate reference method for monitoring NO_2. The automatic data is ratified and processed in line with Defra Local Air Quality Management Technical Guidance (LAQM TG22)[6].

2.1.2 Non-Automatic Monitoring Sites

NO_2 concentrations have been monitored at ten SGC non-automatic sites along the A4174 Ring Road between the Bromley Heath and M32 Junction 1 roundabouts. The monitoring is carried out using three diffusion tubes at each site to improve accuracy. Diffusion tubes are passive samplers and consist of a small plastic tube containing a chemical reagent called triethanolamine (TEA) in the case of NO_2 monitoring. Eight of the triplicate diffusion tube sites were operational since 2019, and two additional sites were operational from 2022. One of the additional sites from 2022 (Site 191) is co-located by the automatic monitoring site.

The diffusion tubes at each site are exposed to ambient air for one month at a time, in line with the Defra Diffusion Tube Monitoring Calendar recommended exposure periods each year, before being sent to a laboratory for analysis. The monthly results are processed following Defra LAQM Technical Guidance (TG22) to produce an annual mean for the calendar year to compare with the annual mean limit value (40 µg/m^3).

[6] UK Regions (exc. London) Technical Guidance | LAQM

Defra also set up a triplicate diffusion tube monitoring site from 2021 on the westbound approach to the Hambrook crossroads as part of their UK Urban NO_2 monitoring network (UUNN)[7]. UUNN sites are focused in areas where local authorities are working with JAQU to reduce roadside NO_2 concentrations and the monitoring data is used to assess compliance against the annual mean NO_2 limit value.

A map showing the location of the automatic and diffusion tube monitoring sites is provided in Figure A.2 (Appendix A).

2.2 Monitoring Results and Trends

2.2.1 Automatic NO_2 Monitoring Results

The automatic monitoring results at the Hambrook A4174 site show the annual mean NO_2 concentrations have been below the limit value (40 µg/m^3) since the monitoring began in April 2022. Overall, there was a 32% decrease in annual mean NO_2 concentrations between 2022 (annualised mean 29.6 µg/m^3) and 2024 (20.2 µg/m^3) at this site.

The Stoke Gifford A4174 (near Coldharbour Lane) and Yate (Station Road) automatic monitoring sites in South Gloucestershire also showed reductions in annual mean NO_2 concentrations of 20% and 12% respectively between 2022 to 2024, demonstrating a wider downward trend in NO_2 levels across the district.

The automatic monitoring results for the Hambrook A4174 site (Site ID SG3) are provided in Table A.1 (Appendix A). The real-time automatic data is available on the Air Quality in the United Kingdom (ukairquality.net) website[8] for all three South Gloucestershire monitoring sites.

The trend in the annual mean NO_2 concentrations at the Hambrook automatic monitoring site is shown in Figure A.1 (Appendix A).

Further details about the SGC automatic sites are provided in the 2025 Air Quality Annual Status Report (ASR) available on the council website Air quality | BETA - South Gloucestershire Council.

[7] UK Urban NO_2 Network - DEFRA UK Air - GOV.UK

[8] Air Quality in the United Kingdom (ukairquality.net)

2.2.2 Non-Automatic (Diffusion Tube) NO_2 Monitoring Results

The diffusion tube monitoring results for the SGC A4174 roadside sites are presented in Table A.1 (Appendix A).

The SGC diffusion tube monitoring results showed that in **2019**, six of the monitoring sites exceeded the annual mean limit of 40 µg/m^3 (sites 177, 178, 179,182, 183 and 184). The highest concentration (49.9 µg/m^3) was monitored at site 177, followed by site 182 (44.7 µg/m^3). Both these sites are located on the westbound section between the Hambrook crossroads and the M32 junction, with site 177 located closest to the M32. There were no borderline "at risk" sites within 10% of the limit value (at 36 µg/m^3 or above) as the remaining two monitoring sites (175 and 176) were both below 36 µg/m^3. The traffic measures were in place from August 2019 onwards.

In **2020**, the annual mean NO_2 concentrations reduced by an average of 14.4% across the eight sites compared to 2019, which was most likely due to the impact of the Covid-19 pandemic travel restrictions. However, despite the reduced traffic levels, two sites (177 and 182) continued to exceed the annual mean limit, although to a lesser extent than in 2019. The annual mean NO_2 concentrations at site 177 reduced by 16.4% to 41.7 µg/m^3 and at site 182, the annual mean reduced by 6% to 42.0 µg/m^3 compared to 2019. There was one "at risk" site above 36 µg/m^3 (Site 184) with an annual mean of 37.3 µg/m^3.

In **2021**, the same two sites continued to exceed the annual mean limit with higher concentrations monitored at site 177 (43.0 µg/m^3) and site 182 (43.8 µg/m^3) than in 2020, although they were lower than the pre-Covid 2019 levels at these sites. Site 184 remained an "at risk" site with an annual mean of 39.1 µg/m^3. The annual mean NO_2 concentrations increased by an average of 2.6% across the eight monitoring sites as the Covid-19 restrictions eased and traffic levels increased.

In **2022**, annual mean exceedances were monitored at the same two sites but with only a marginal increase at site 177 to 43.3 µg/m^3 and a fall at site 182 to 42.4 µg/m^3. The other six monitoring sites remained compliant below 40 µg/m^3 but four were "at risk" sites above 36 µg/m^3 (Sites 178, 179, 183 and 184), although the JAQU Assessment Report covering the 2022 data did not specify site 179 as an "at risk" site. However, this does not change the overall conclusions of their report. Overall from 2019 to 2022, the annual mean concentrations reduced on average by 10.6% across the eight original monitoring sites despite traffic levels now surpassing pre-Covid levels.

In **2023**, all ten diffusion tube monitoring sites complied with the annual mean NO_2 limit value, with no sites exceeding 40 µg/m^3 for the first time. There were also no "at risk" sites within 10% of the limit value. The NO_2 annual mean concentrations across the ten SGC monitoring sites fell by an average of 23% compared with 2022. The highest annual mean NO_2 concentration was measured at site 177 (32.8 µg/m³), representing a 24% reduction (10.5 µg/m³) from 2022.

The 2023 annual mean NO_2 concentrations also decreased by an average of 20% compared to 2022 across the wider South Gloucestershire diffusion tube network, reflecting the decrease observed at the A4174 Hambrook diffusion tube sites.

In **2024**, there were no triplicate site results that exceeded the annual mean limit value or any "at risk" sites within 10% of the limit above 36 µg/m^3. This was the second consecutive year of monitoring results that achieved compliance. The highest annual mean of 31.4 µg/m^3 was measured at site 177. The annual mean NO_2 concentrations across the A4174 Hambrook triplicate diffusion tube monitoring sites decreased by an average of 4.7% from 2023 to 2024.

A 10% decrease in the NO_2 annual mean at the Hambrook A4174 automatic monitoring site from 2023 to 2024 (with the triplicate co-located tubes at the automatic monitoring site showing a 7% decrease) was also observed. The 2024 NO_2 annual mean also decreased by 6% compared to 2023 at the Stoke Gifford A4174 automatic monitoring site and by 7% at the Yate automatic monitoring site showing a wider downward trend in NO_2 levels across the district. These trends generally compare well with the trend observed across the national automatic urban and rural monitoring network (AURN) roadside sites where the average 2024 NO_2 annual mean concentration decreased by 6% from 2023 levels[9].

The Defra UUNN triplicate diffusion tube monitoring results are also included in Table A.1 (Appendix A). The results were below the annual mean limit value (40 µg/m^3) and the "at risk" level of 36 µg/m^3 in all years the site was operational. The highest annual mean concentration recorded at this site was 29 µg/m^3 in 2022. The annual mean concentration reduced by 21% from 2022 to 23 µg/m^3 in 2024.

[9] Summary - GOV.UK

The trends in annual mean NO_2 concentrations between 2019 and 2024 at the SGC A4174 Hambrook diffusion tube sites and the Defra UUNN monitoring site are shown in Figure A.1 (Appendix A).

Aside from the significant drop in concentrations in 2020 due to Covid-19 pandemic impacts, an overall downward trend in concentrations can be seen at all of the sites. The average reduction in annual mean NO_2 concentrations was 34% across the SGC A4174 Hambrook diffusion tube monitoring sites which were operational from 2019 to 2024. This mirrors the trend observed across the national AURN roadside sites where the average 2024 annual mean NO_2 concentration was also 34% lower than 2019 levels[10]. The largest observed decrease in NO_2 annual mean concentrations between 2019 and 2024 was 18.5 $\mu g/m^3$ at site 177, which represents a 37% reduction.

The reducing trend in NO_2 levels is likely due to a combination of factors, including changes in travel behaviour and patterns following the Covid-19 pandemic, along with improvements in the composition of the vehicle fleet as newer, cleaner vehicles, including electric vehicles, replaced older, more polluting vehicles. The scheme traffic management measures also likely contributed by reducing the length of time vehicles on the ring road were stationary at the junction due to the fewer permitted movements possible, thereby allowing traffic to flow as efficiently as possible along the ring road, reducing vehicle emissions.

Furthermore, the introduction of the Bristol Clean Air Zone (CAZ) in November 2022 is likely to have accelerated vehicle fleet improvements across the wider area and appears to have contributed to reduced NO_2 levels in South Gloucestershire from its first full year of operation in 2023. The effect is particularly relevant given the volume of commuter traffic between Bristol and South Gloucestershire, especially along the A4174 Hambrook section, which connects directly to the M32 at Junction 1.

As a general point, it should be noted that pollutant concentrations can also vary significantly from one year to the next due to the influence of meteorological conditions but the sustained overall downward trend in NO_2 concentrations provides more certainty that compliant levels will be maintained, despite rising traffic levels.

[10] Nitrogen dioxide (NO_2) - GOV.UK (www.gov.uk)

2.3 Joint Air Quality Unit Assessments

JAQU assessment of the effectiveness of the scheme was delayed due to the impact of the Covid-19 pandemic on traffic levels. This meant that the monitoring data for 2020 and 2021 was not typical and could not be considered representative of long-term trends in NO_2 concentrations. 2022 was the first year that was considered to be representative of post pandemic "new normal" conditions.

Two consecutive years of compliant data from 2022 onwards were required to demonstrate the roadside NO_2 levels had been successfully reduced and maintained below the legal annual mean limit value, in order to be considered eligible for release from the ministerial direction.

The automatic and diffusion tube monitoring data was submitted to JAQU for 2022 and 2023, and in November 2024, SGC received the JAQU 2022 & 2023 Assessment Report confirming that the 2023 data was compliant as there were no exceeding or "at risk" sites above 36 $\mu g/m^3$. However, because there were two exceeding sites in 2022, and also some "at risk" sites, another year of compliant data was needed to show NO_2 levels could be maintained below the legal annual mean limit value.

2024 monitoring data was submitted to JAQU in Spring 2025 and their subsequent assessment report confirmed the 2024 NO_2 data was compliant with no exceeding or "at risk" sites above 36 $\mu g/m^3$ and that SGC had successfully achieved two consecutive years of compliant data for 2023 and 2024.

Both the JAQU 2022 & 2023 Air Quality Assessment report and the subsequent 2024 Assessment report are available on SGC's Hambrook traffic lights[11] webpage.

2.4 Conclusions

A risk assessment by JAQU concluded that the risk of exceedance in future years is low. The main contributing factors to this are:

- There were no monitoring sites categorised as "exceeding" or "at risk" (within 10% of the limit value) in 2023 and 2024.

[11] https://www.southglos.gov.uk/hambrookchanges

- While traffic volumes are above pre-Covid levels, a “headroom analysis” (which looks at how much room there is before air quality limits might be exceeded) shows that, even if traffic continues to grow, the current fleet composition means it is unlikely to cause an exceedance. This is backed up by the ongoing average fall in NO_2 levels across South Gloucestershire, despite rising traffic levels.

Having achieved the required two consecutive years of compliant data, SGC were eligible to exit the Defra / DfT NO_2 programme and the council was formally released from the legal ministerial direction in March 2026.

The traffic measures put in place for the A4174 Hambrook Air Quality Scheme were subsequently removed on 27 April 2026 and the road and junction layout returned to how it was before August 2019. The westbound bus lane has also been reinstated through the junction. The reinstated traffic movements are shown in Figure A.4 (Appendix A).

2.5 Next Steps

South Gloucestershire Council will continue to monitor roadside NO_2 concentrations by the A4174 at Hambrook. Following the council’s exit from the NO_2 programme, the monitoring results will be assessed for compliance and reported as part of our statutory Local Air Quality Management duties going forward. The 2025 monitoring results will be reported in this year’s Air Quality Annual Status Report and is expected to be available later in 2026.

Further information about air quality in South Gloucestershire is available on the council website Air quality | BETA - South Gloucestershire Council.

Appendix A

Table A.1 – Annual Mean NO_2 Monitoring Results: A4174 Hambrook Automatic and Diffusion Tube Sites (µg/m^3)

Site ID	Site Name	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	2019	2020	2021	2022	2023	2024
175	Hambrook - A4174 Eastbound	363785	178537	34.9	29.6	28.9	30.5	22.7	22.4
176	Hambrook - A4174 Westbound by Bus layby	364243	178381	29.9	24.6	26.7	26.2	20.0	18.7
177	Hambrook - A4174 Westbound near M32 J1 lane sign	363705	178523	**49.9**	**41.7**	**43.0**	**43.3**	32.8	31.4
178	Hambrook - A4174 Eastbound by Winterbourne B4058 road sign	363897	178507	**41.8**	33.4	34.9	***36.8***	29.5	28.0
179	Hambrook - A4174 Eastbound bus layby by funeral directors	364004	178481	**42.6**	35.0	34.8	***36.1***	27.0	26.7
182	Hambrook - A4174 Westbound between Bristol Rd & Old Glos Rd	363805	178496	**44.7**	**42.0**	**43.8**	**42.4**	32.2	30.8
183	Hambrook - A4174 Eastbound by footpath Frome Valley Walkway	364290	178396	**41.2**	35.4	35.1	***36.8***	28.7	27.0
184	Hambrook - A4174 Westbound near Bromley Heath Viaduct	364598	178244	**41.1**	***37.3***	***39.1***	***39.5***	31.5	29.0
190	Hambrook - A4174 Westbound opposite funeral parlour	364031	178436	N/O	N/O	N/O	35.3	26.8	25.9
191	Hambrook - A4174/Old Gloucester Road AQMS Co-location	363773	178500	N/O	N/O	N/O	28.5	21.1	19.7
SGLO 001	Hambrook - A4174 Westbound opposite funeral parlour (Defra UUNN triplicate site)	364062	178429	N/O	N/O	28	29	25	23

Site ID	Site Name	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	2019	2020	2021	2022	2023	2024
SG3	Hambrook A4174 Old Gloucester Road (Automatic Monitor)	363772	178501	N/O	N/O	N/O	29.6	22.5	20.2

Notes:

Annual mean concentrations are presented in micrograms per cubic metre (µg/m^3).

Exceedances of the NO_2 Limit Value 40 µg/m^3 are shown in **bold**.

Borderline / "At Risk" results within 10% of NO_2 Limit Value 40 µg/m^3 (i.e. greater than 36 µg/m^3) are shown in ***bold italics***.

Diffusion tube annual means have been corrected for bias.

All means have been annualised if valid data capture for the full calendar year is less than 75%.

Concentrations are those at the monitoring location.

Each diffusion tube monitoring site is a triplicate site with three diffusion tubes.

UUNN – Defra UK Urban NO_2 Network of triplicate diffusion tube monitoring sites. UUNN annual means provided are as reported on Defra UK-AIR website[12].

N/O site not operational.

[12] Annual and Exceedance Statistics - DEFRA UK Air - GOV.UK

Figure A.1 – Trends in Annual Mean NO_2 concentrations at A4174 Hambrook Automatic and Diffusion Tube Monitoring Sites (µg/m^3)

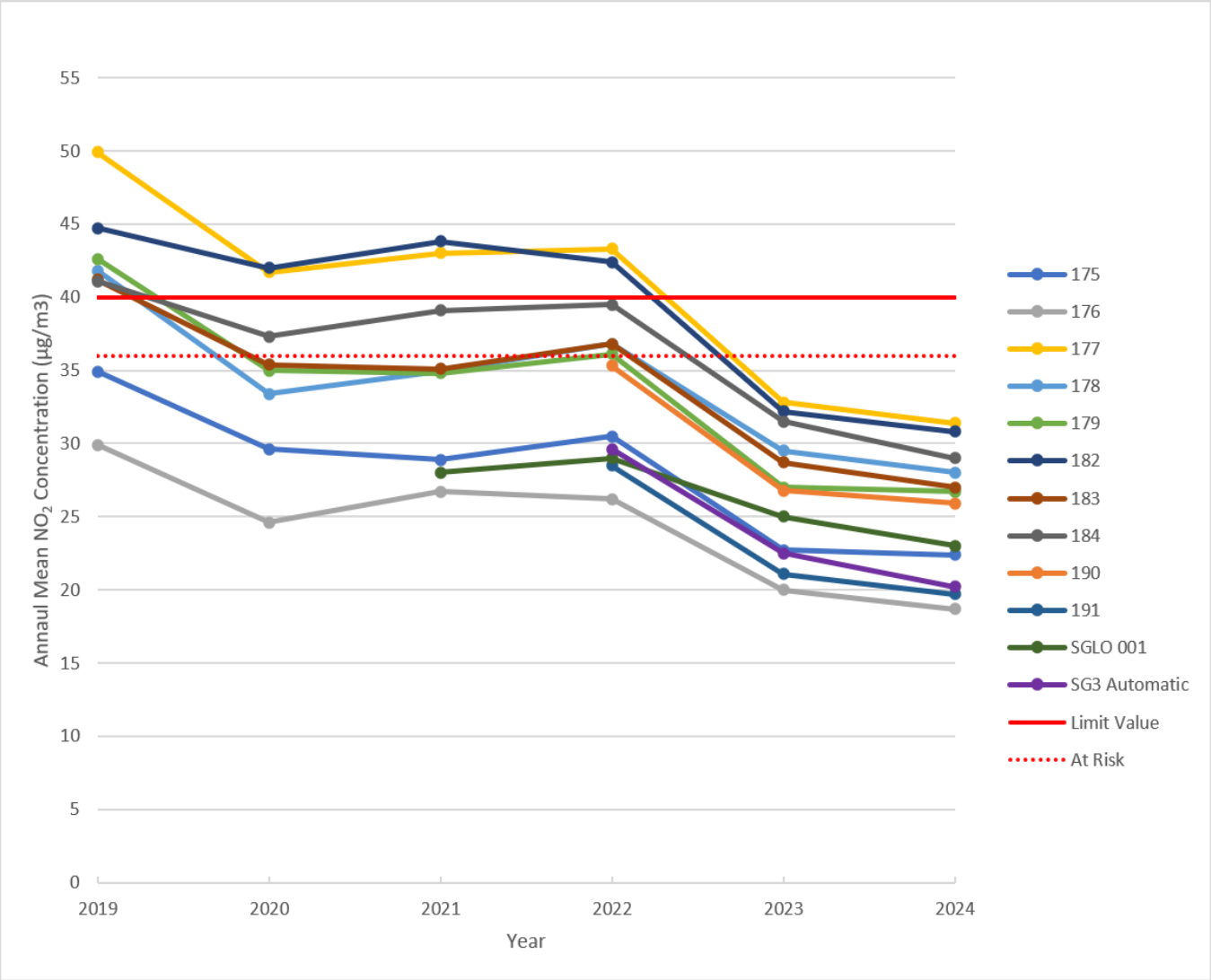


Figure A.2 – Map of A4174 Hambrook Automatic and Diffusion Tube Monitoring Sites

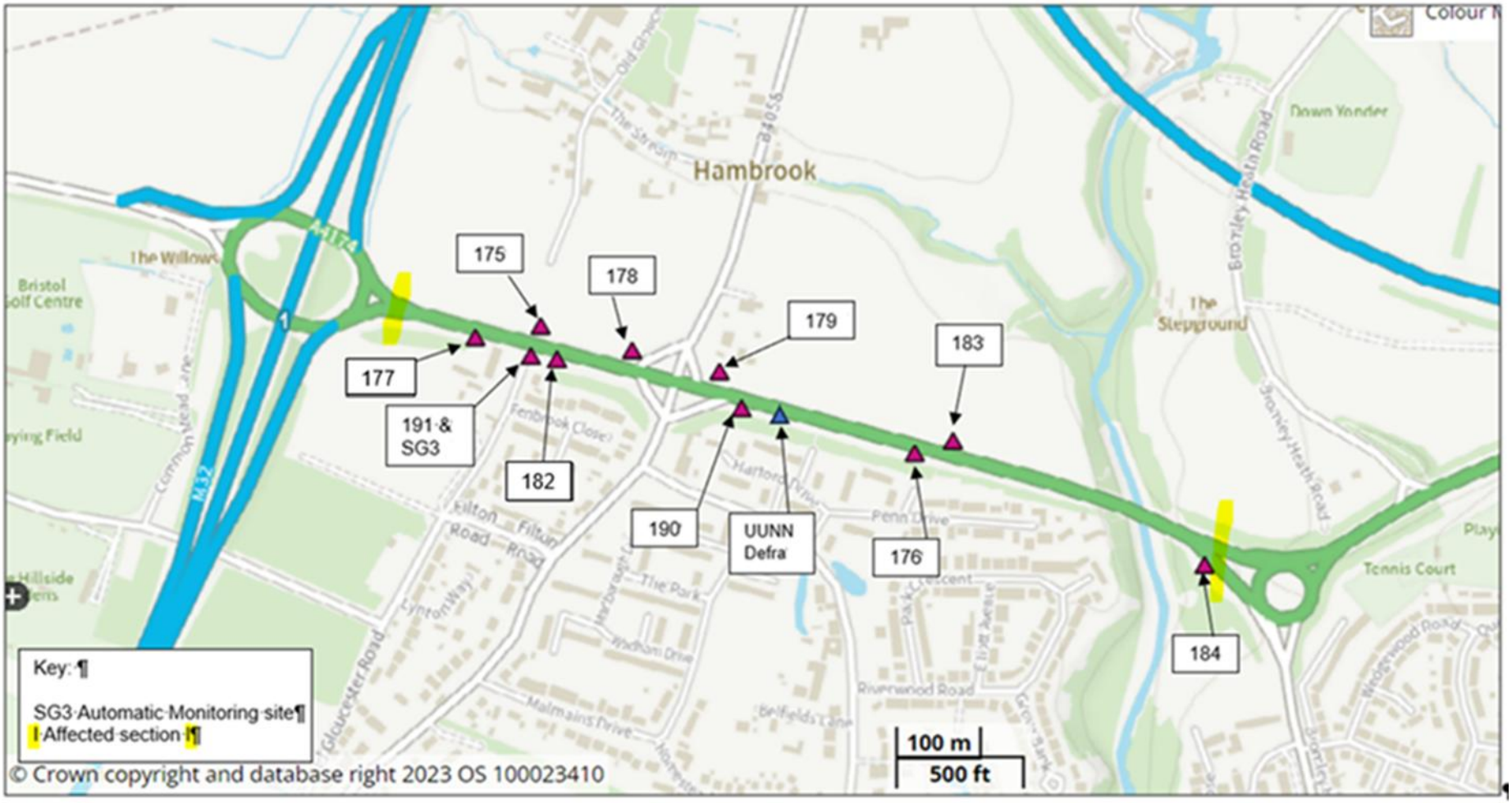


Figure A.3 – Traffic measures implemented at A4174 Hambrook Junction in 2019

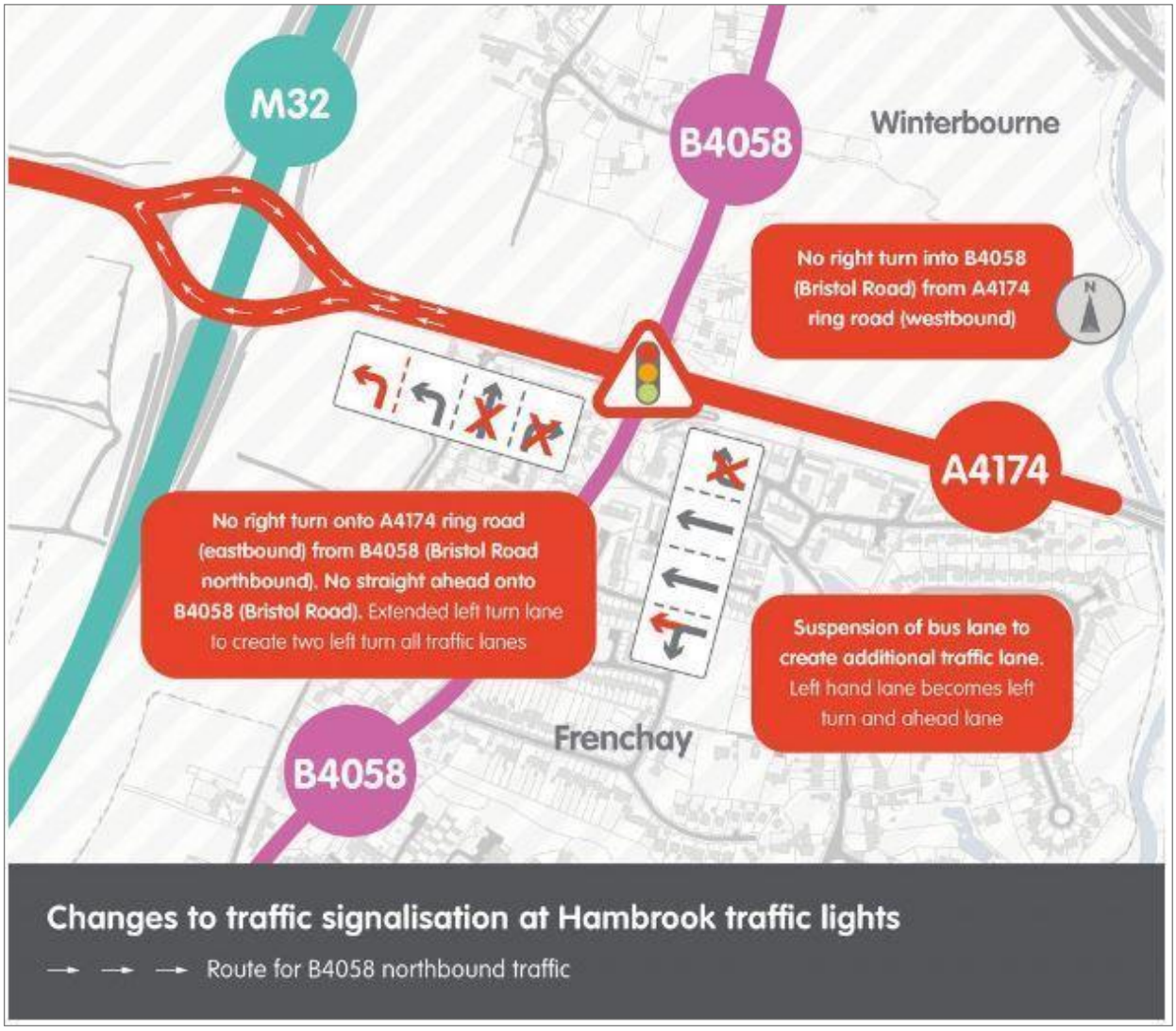
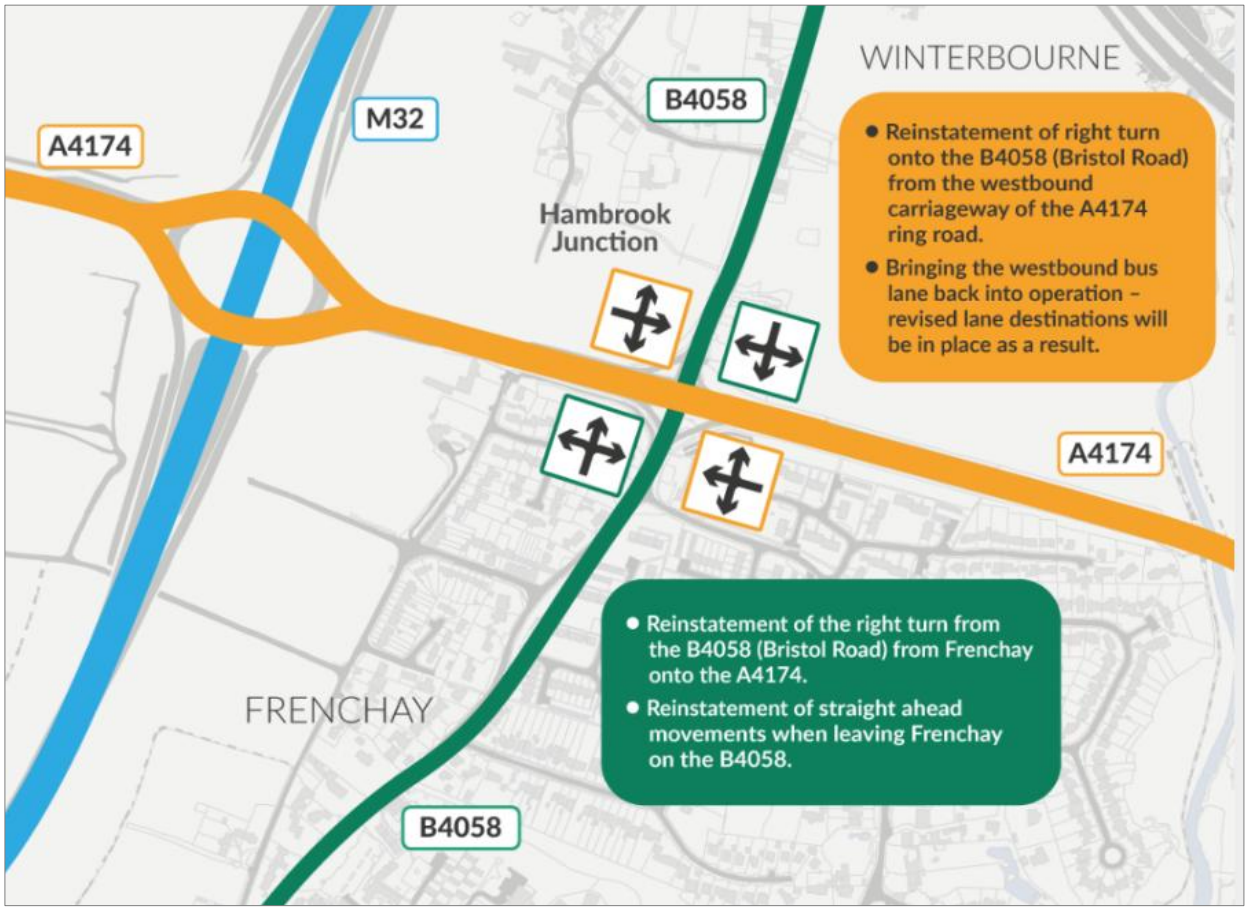


Figure A.4 – Reinstated traffic movements at A4174 Hambrook Junction in 2026



Glossary of Terms

Abbreviation	Description
ASR	Annual Status Report
AURN	Automatic Urban and Rural Network (National monitoring network)
CAZ	Clean Air Zone
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DT	Diffusion Tube
Exceedance	A period of time where the concentration of a pollutant is greater than the appropriate air quality limit value
JAQU	Joint Air Quality Unit between Defra and Department for Transport
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
SGC/SGDC	South Gloucestershire Council/ South Gloucestershire District Council
$\mu g/m^3$	Microgrammes per cubic metre
UUNN	Defra UK Urban NO_2 Network

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