## Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AQMA</td>
<td>Air Quality Management Area</td>
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<tr>
<td>AQAP</td>
<td>Air Quality Action Plan</td>
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<td>AQO</td>
<td>Air Quality Objective</td>
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<tr>
<td>BCC</td>
<td>Bristol City Council</td>
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<tr>
<td>CAZ</td>
<td>Clean Air Zone</td>
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<tr>
<td>Defra</td>
<td>Department for Environment, Food &amp; Rural Affairs</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>EV</td>
<td>Electric Vehicle</td>
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<tr>
<td>GBATS4M</td>
<td>Greater Bristol Area Transport Study v4M</td>
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<tr>
<td>GUL</td>
<td>Go Ultra Low</td>
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<tr>
<td>HE</td>
<td>Highways England</td>
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<tr>
<td>HGV</td>
<td>Heavy Goods Vehicle</td>
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<tr>
<td>JAQU</td>
<td>Joint Air Quality Unit</td>
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<tr>
<td>JLTP</td>
<td>Joint Local Transport Plan</td>
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<td>JTS</td>
<td>Joint Transport Study</td>
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<td>JSP</td>
<td>Joint Spatial Plan</td>
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<td>LEP</td>
<td>Local Enterprise Partnership</td>
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<td>LAQM</td>
<td>Local Air Quality Management</td>
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<td>LGV</td>
<td>Light Goods Vehicle</td>
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<tr>
<td>NAEI</td>
<td>National Atmospheric Emissions Inventory</td>
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<td>NOx</td>
<td>Nitrogen Oxides</td>
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<td>NO₂</td>
<td>Nitrogen Dioxide</td>
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<tr>
<td>OBC</td>
<td>Outline Business Case</td>
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<tr>
<td>PCM</td>
<td>Pollution Climate Mapping</td>
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<td>PHV</td>
<td>Private Hire Vehicle</td>
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<td>PM</td>
<td>Particulate Matter</td>
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<td>PT</td>
<td>Public Transport</td>
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<td>SEP</td>
<td>Strategic Economic Plan</td>
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<tr>
<td>SOC</td>
<td>Strategic Outline Case</td>
</tr>
<tr>
<td>ULEV</td>
<td>Ultra low emission vehicles</td>
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<tr>
<td>VDM</td>
<td>Variable demand model</td>
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<td>WECA</td>
<td>West of England Combined Authority</td>
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2. Strategic Case

2.1 Introduction

Building on the findings of the Strategic Outline Case (SOC), the purpose of the Strategic Case in this Outline Business Case (OBC) is to establish the reassessed case for change and preferred way forward by:

- Identifying Bristol City Council’s (BCC) statutory and regulatory air quality obligations;
- Presenting existing air quality conditions (including specific air quality problems arising from the aforementioned obligations, based on updated air quality and traffic modelling); and
- Outlining the desired goals of this intervention.

Within this context, and in accordance with the Inception package of JAQUs guidance, this Strategic Case considers the following:

- The strategic context, underpinned by European, national and local policies which are pertinent to the project;
- Presentation of the results of the more detailed baseline air quality and transport modelling using the agreed target determination values;
- Based on these findings, reconsideration of the strategic case put forward as part of the Strategic Outline Case; with the case for change and preferred way forward reassessed;
- More detailed understanding of the project’s benefits, risks, constraints and dependencies;
- Evidence of detailed stakeholder engagement; and
- Presentation of a detailed logic map or theory of change.

2.2 Air Quality: Background and Context

Poor air quality is the largest known environmental risk to public health in the UK and investing in cleaner air and doing more to tackle air pollution are priorities for the EU and UK governments as well as for BCC. To this end, legislative bodies at all levels are motivated to implement air quality standards to be achieved through actions and policies, with the health of local people at the heart of the measures implemented. As a result, this section presents some of the key policy drivers and legal obligations influencing EU and the UK Government policy for achieving air quality compliance.

2.2.1 European requirements

The UK Government has an obligation to achieve European Air Quality Limit Values (Directive 2008/50/EC, Annex III). The most relevant Limit Values relate to nitrogen dioxide (NO₂) and Particulate Matter smaller than 10 μm (PM_{10}) which must not exceed 40 μg/m³ as an annual mean (i.e. measured over a calendar year). The primary drivers for these ‘Limit Values’ are public health concerns associated with NO₂ and PM_{10}. Specific health impacts for these pollutants can be summarised as follows:

- NO₂: high concentrations can lead to inflammation of the airways. Long-term exposure can increase symptoms of bronchitis in asthmatic children and reduced lung development and function; and
- PM: Long-term exposure can increase risk of developing cardiovascular and respiratory diseases, including lung cancer. Research shows that particles with a diameter of 10 microns or smaller (PM_{10}), and especially particles with a diameter of 2.5 microns or smaller (PM_{2.5}) can be inhaled deep into the respiratory tract.

More generally, a range of other public health issues are linked to poor air quality, as detailed below. These issues are believed to affect at-risk groups such older people, children, people with pre-existing lung and heart conditions.

- Long-term exposure to air pollution is linked to chronic mortality;
- Long term exposure can also reduce life expectancy by increasing deaths from lung, heart, and circulatory conditions;
- Short term exposure can contribute to adverse health effects including exacerbation of asthma, effects on lung function and increases in hospital admissions; and
- Other adverse health effects including diabetes, cognitive decline and dementia, and effects on the unborn child are also linked to exposure.

In light of the public health issues outlined above, the UK government is legally responsible for ensuring that it complies with the provisions of the EU Air Quality Directives. The Government assesses air quality compliance with the European Directive in 43 areas across the country at single locations, using both monitoring and modelling. It uses Defra’s Pollution Climate Mapping (PCM) model to forecast exceedances, which is adjusted based on the monitored data. This is the approved means of reporting air quality information to assess legal compliance with the European legislation.

2.2.2 UK Government requirements

To meet UK Government regulations, local authorities must demonstrate that they are working towards the National Air Quality Objectives. The objective level for concentrations of NO\textsubscript{2} and PM\textsubscript{10} within the national legislation are the same as the European regulations (annual mean of 40 $\mu$g/m\textsuperscript{3}), but are applied and assessed differently. Air Quality Objectives only apply where people are exposed for the averaging period of the objective (i.e. for a year) and therefore compliance with air quality objectives is assessed most commonly at building facades (where people are regularly present) including around busy major junctions.

The Government’s Local Air Quality Management (LAQM) regime requires all local authorities to regularly review and assess whether Air Quality Objectives (AQOs) have been achieved at relevant locations. Where the assessment shows exceedances at relevant locations, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures in pursuit of the objectives.

2.2.3 Local Assessment

The results of the national modelling indicate widespread exceedances in NO\textsubscript{2} along several arterial routes into the city centre of Bristol, in particular the M32. It should be noted that monitoring locations are not necessarily at the same distance from the road as is assumed in the PCM model, and hence some differences would be expected between the PCM outputs and monitored exceedances. Monitoring locations largely represent relevant exposure where practical.

BCC collects NO\textsubscript{2} monitoring data using a combination of automatic (a series of reference method instruments approved for use by Defra) and non-automatic (passive diffusion tube) monitoring. The local monitoring data shows greater and more widespread exceedances than are indicated within the PCM model in Bristol. Figure 2-1 shows the PCM modelled concentrations in Bristol (required to meet European regulations), and the local monitoring data recorded by BCC (required to meet UK Government regulations) as recorded in 2015.

The UK Government’s latest air quality plan (July 2017) identifies that for the majority of non-complying zones, a network of Clean Air Zones is the most effective route to compliance of annual mean NO\textsubscript{2} with legal limits. Defra’s vision for Clean Air Zones is: “Clean Air Zones improve the urban environment to support public health

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and the local economy, making cities more attractive places to live, work, do business and spend leisure time. They support cities to grow and transition to a low emission economy thus ensuring these benefits are sustainable for the long term.” The UK government has discretionary powers to pass on their responsibility (and associated legal outcomes) to local authorities.

BCC was directed in July 2017 to produce a Local Clean Air Plan to address the air quality Limit Value exceedances within Bristol and achieve compliance with the NO₂ legal limit in the shortest possible time. There are both public health and regulatory imperatives for improving air quality in Bristol City.

Figure 2-1: Comparison of Annual Nitrogen Dioxide Concentrations Measured at Monitoring Sites in Bristol and Estimated by the PCM Model

2.2.4 Local Health Impacts

Bristol City Council’s 2019 Air Quality Annual Status Report states: *Air pollution has negative impacts on the health of people in Bristol, especially vulnerable members of the population. Evidence suggests that it can cause permanent lung damage in babies and young children and exacerbates lung and heart disease in older people. A recent report into the health effects of air pollution in Bristol concluded that around 300 premature deaths each year in the City of Bristol can be attributed to exposure to NO₂ and fine particulate matter (PM_{2.5}), with roughly an equal number attributable to both pollutants. This represents about 8.5% of deaths in the administrative area of Bristol being attributable to air pollution. This has an estimated cost to the NHS of £83m.*
2.3 Transport, Business and Air Quality: Policy Context

2.3.1 Policy Context

2.3.1.1 Links between Transport, Business and Air Quality

Transport is widely acknowledged as a key driver of air quality issues, with highway traffic problems such as congestion and fleet composition considered as a primary source of air pollution. For example, the Department for Environment, Food and Rural Affairs (DEFRA) have estimated that within areas of the UK that are exceeding NO₂ limits, 80% of the NOx emissions at these locations is due to transport, with diesel cars and vans being the largest source of emissions. The causal link between road transport and air quality is even more marked in Bristol City, given that 59% of locally controllable nitrogen dioxide within the City of Bristol is associated with local road traffic.

Further, despite the long-term shift towards less-polluting road vehicles, background traffic growth associated with economic development could delay the betterment of, or even worsen, traffic-related air quality issues. Therefore, even though the fleet composition may become more environmentally friendly over time, absolute growth of vehicle numbers on the network could suppress the air quality benefits that improved fleet composition would be expected to provide.

Growth in vehicular traffic is tied to economic development and growth. Within this context, it is critical to understand the interactions between transport, economic development and air quality policy.

2.3.1.2 Sub-regional Policy and Strategy

Bristol sits within a wider economic region known as the West of England (which includes Bath North East Somerset, Bristol, North Somerset and South Gloucestershire) and is part of the West of England Combined Local Authority known as WECA (which is formed of the above authorities minus North Somerset).

Air quality considerations need to be at the heart of transport and business planning policy and strategy at the sub-regional level if improvements are to be realised. The West of England LEP’s Strategic Economic Plan (2015-30) established the economic vision for the sub-region. This explicitly recognises the need to improve and protect air quality by aiming to achieve economic growth and development with no detriment to air quality.

The wider West of England local authorities is undertaking a programme of policy reform underpinned by the Joint Spatial Plan (JSP) and Joint Transport Study (JTS), although the current status of this Plan is uncertain. The JSP identifies the economic development and growth projections for the West of England, simultaneously identifying the need to improve air quality as a wider sustainability objective. The West of England is forecast to accommodate 105,500 new homes (at least 33,500 of which will be in Bristol) and 82,500 new jobs to 2036. This scale of development will not only increase traffic on the highway network, it will also increase the number of people likely to be subjected to any ongoing air quality issues in Bristol. The JTS recognises that poor air quality, caused by highway traffic, is a major challenge contributing to ill health and premature death. As a result, the JTS recommends an air quality objective under the social impacts theme (SH2), that seeks to address poor air quality generated by transport sources.

The Draft West of England Joint Local Transport Plan 4 (2019-36) has been prepared by WECA and the four West of England local authorities. It takes account of JSP and JTS recommendations and supports delivery of the more detailed interventions set out in local transport strategies across the region. One of the five objectives for the draft plan is to ‘address poor air quality and take action against climate change’. There are five outcomes associated with this objective that this plan is seeking to achieve, as follows:

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6 Item 2.9 [https://www.bristol.gov.uk/documents/20182/32675/Health+Impacts+of+Air+Pollution+in+Bristol+February+2017/4df2fce5-e2fc-4c22-b5c7-5e7a5ee56701](https://www.bristol.gov.uk/documents/20182/32675/Health+Impacts+of+Air+Pollution+in+Bristol+February+2017/4df2fce5-e2fc-4c22-b5c7-5e7a5ee56701)

7 Completion and adoption of the JSP has been delayed as a result of concerns expressed by the Inspectors at examination of proposals. Although it is as yet unclear what will need to be done in detail, the Inspectors suggested that fundamental changes should be made to the approach.
NOx, particulates and carbon emissions are reduced;

Air quality in the AQMAs is improved;

Air quality remains better than national standards outside the AQMAs;

The transport network is resilient and adaptable; and

Technological advances to improve air quality and monitoring are embraced.

Within the Local Connectivity section of the plan there is a policy to ‘support the identification and implementation of measures that will improve air quality’, which demonstrates the importance given to air quality in JLTP4. This section identifies three interventions, to:

- Support ongoing work to manage the impact of transport on air quality and climate change;
- Support ongoing work on Clear Air Zones and the UK Air Quality Plan; and
- Support work on Zero and Low Emission Vehicles.

As part of this, the authorities have committed to ‘support the preparation of Air Quality Action Plans and delivery of specific measures identified to improve air quality’.

The West of England was awarded £7m Go Ultra Low (GUL) Funding to spend over 5 years to promote the uptake of electric vehicles (EVs) across the region, following a Go Ultra Low West bid. As a result, EV purchases in the region will rise to 5,000 new registrations per year by 2020. The MetroBus project has also seen over 50 new ULEV buses brought into service within the West of England. The gas-powered vehicles are modern, low emission and expected to reduce carbon emissions and fuel consumption by 25 per cent, compared to a standard bus. The Clean Air Plan will be developed with the GUL project in mind, to avoid inclusion of measures which are already funded and/or progressing.

2.3.1.3 Local Policy and Strategy

BCC is responsible for the development of local policies and transport plans that support the delivery of both West of England and Bristol aims and policies. As a result, it is necessary to assess how the various options considered to improve the air quality in Bristol will align with and support the realisation of the strategic objectives within the policy documents. The key strategic themes and principles of the existing policies overlap with several of critical success factors used in the economic assessment, including those related to air quality improvements, benefits to the economy, social inclusion and public health benefits.

The Bristol City Council Corporate Strategy covers the period from 2017-2022 and sets out aims for the city to become ‘an affordable, low carbon, accessible, clean, efficient and reliable transport network to achieve a more competitive economy and better connected, more active and healthy communities’. This includes aims to ‘secure the best available technology and innovation for Bristol so that all buses and, over time, other vehicles, are not polluting the city or adding to global warming’. The Corporate Strategy outlines a number of actions that will help to achieve this objective. These include the development of an air quality action plan, encouraging bus operators to explore and invest in new fuel technologies, pursuing powers to introduce low emission or clean air zones and replacing the council’s fleet with low emission vans and cars when possible and appropriate. These are all supported by other regional and local policies.

A draft Bristol Transport Strategy8 was prepared in 2018 to fill the gap in transport policy for Bristol between the West of England level (JLTP4) and individual transport strategies, such as walking and cycling. The Transport Strategy was consulted on at the end of 2018 and is due to be adopted by Full Council later this year. The vision is for Bristol to be ‘a well-connected city that enables people to move around efficiently with increased transport options that are accessible and inclusive to all’. It focuses on how we can get people from all areas of the city to be able to access jobs, training, education and everyday facilities by many different transport options, such as buses, trains, cycling and walking. The aim is to reduce congestion and address wider challenges by exploring,

8 https://www.bristol.gov.uk/documents/20182/3641895/Bristol+Transport+Strategy+-+adopted+2019.pdf/383a996e-2219-dbbb-7c75-3a270bf026c-
enabling and delivering actions with our neighbouring councils and other groups and partners across the city. The Transport Strategy is supported by a number of mode specific plans that will support the wider air quality objective. This includes work on options for mass transit, park and ride and the development of a Parking Strategy. The Parking Strategy is based on a number of key objectives including the reduction of private car use, enhancement of the vitality of the city, encouraging alternative modes of travel and guiding appropriate scale, location and standards of all car parking within the city. These will all support the wider air quality objective.

The Bristol One City Plan outlines how the city will become an inclusive and sustainable city by 2050. The aim of the One City Plan is to bring together the ideas and goals of many stakeholders across Bristol and combine these into a focused long-term plan for the city. The vision is to make Bristol “a fair, healthy and sustainable city. A city of hope and aspiration, where everyone can share in its success”.

The Plan includes six priority themes that will be worked towards, including Connectivity; Economy; Health and Wellbeing; Homes and Communities; Learning and Skills. Goals for each decade will be set around these themes. Change will be promoted by facilitating participation in the Plan, creating more resilient public services by promoting shared agendas, and enabling the City Office to work as a hub to support and coordinate city resources. An updated version of the Plan will be published in January 2020 and will be refreshed each year.

The key strategic themes and principles of the existing strategy documents are set out in Table 2-1.
### Table 2-1: Objectives of policies relevant to Air Quality

<table>
<thead>
<tr>
<th>Policy</th>
<th>Objective</th>
<th>Economic</th>
<th>Environmental</th>
<th>Social</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEP</td>
<td>• Create the right conditions for business to thrive. Give confidence and certainty to our investors to attract and retain investment to stimulate and minimize growth.</td>
<td>• Create places where people want to live and work, through delivery of cultural infrastructure and essential infrastructure, including broadband, transport and housing to unlock suitable locations for economic growth.</td>
<td>• Shape the local workforce to provide people with skills that businesses need to succeed and that will provide them with job opportunities.</td>
<td>• Ensure all our communities share in the prosperity, health and well-being and reduce the inequality gap.</td>
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<tr>
<td></td>
<td>• Ensure a resilient economy, which operates within environmental limits. That is a low carbon and resource efficient economy, increases natural capital, and is proofed against future environmental, economic and social shocks.</td>
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</tr>
<tr>
<td>West of England Joint Transport Study</td>
<td>• Support economic growth</td>
<td>• Reduce carbon emissions;</td>
<td>• Contribute to better safety, health &amp; security;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improve quality of life and a healthy natural environment</td>
<td>• Promote accessibility.</td>
<td></td>
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</tr>
<tr>
<td>West of England Joint Spatial Plan</td>
<td>• To identify and meet the need for housing and accommodate the economic growth objectives of the LEP Strategic Economic Plan</td>
<td>• To protect and enhance the sub-region's diverse and high quality environment and ensuring resilience including through protection against flood risk</td>
<td>• To ensure that the JSP benefits all sections of our communities</td>
<td></td>
<td>• To ensure a spatial strategy where new development is properly aligned with infrastructure</td>
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<tr>
<td>Core Strategy</td>
<td>• To deliver a city with sustainable economic and housing growth</td>
<td>• A city which reduces its carbon emissions and addresses the challenges of climate change</td>
<td>• An accessible and digitally connected city with a transport system which meets its needs</td>
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<td></td>
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<td></td>
<td>• A safe and healthy city made up of thriving neighbourhoods with a high quality of life</td>
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<td></td>
<td></td>
<td></td>
<td>• A prosperous, cohesive and sustainable city, a regional capital which is a great place to live</td>
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</tbody>
</table>
### Table 2-1: Objectives of policies relevant to Air Quality

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<tr>
<th>Policy</th>
<th>Economic</th>
<th>Environmental</th>
<th>Social</th>
<th>Other</th>
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<tbody>
<tr>
<td>JLTP4</td>
<td>• Support sustainable and inclusive economic growth</td>
<td>• Address poor air quality and take action against climate change</td>
<td>• Enable equality and improve accessibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Create better places</td>
<td>• Contribute to better health, wellbeing, safety and security</td>
<td></td>
</tr>
<tr>
<td>Corporate Strategy</td>
<td></td>
<td>• Will put Bristol on course to be run entirely on clean energy by 2050 and introduce a safe, clean streets campaign</td>
<td>• Build 2,000 new homes (800 affordable) per year by 2020</td>
<td>• Will not impose future Residents’ Parking Schemes and will review existing schemes</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Deliver work experience and apprenticeships for every young person</td>
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<td></td>
<td>• Protect children’s centre services</td>
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<td>• Increase the number of school places and introduce a fairer admissions process</td>
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<td></td>
<td>• Will be a leading cultural city, making culture and sport accessible to all</td>
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<tr>
<td>Bristol Transport Strategy</td>
<td>• Support sustainable growth by enabling efficient movement of people and goods, reducing carbon emissions and embracing new technologies</td>
<td>• Provide transport improvements to accommodate increased demand from growth in housing, jobs &amp; regeneration on an already congested network with complex movements from within and outside the city boundary.</td>
<td>• Create better places that make better use of our streets and enable point to point journeys to be made efficiently.</td>
<td>• Enable reliable journeys by minimising the negative impacts of congestion and increasing network efficiency and resilience.</td>
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<td></td>
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<td>• Enable equality within an inclusive transport system that provides realistic transport options for all.</td>
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<td></td>
<td></td>
<td>• Create healthy places, promoting active transport, improving air quality, and implementing a safe systems approach to road safety.</td>
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</table>
## Table 2-1: Objectives of policies relevant to Air Quality

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<thead>
<tr>
<th>Policy</th>
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<th>Economic</th>
<th>Environmental</th>
<th>Social</th>
<th>Other</th>
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</thead>
<tbody>
<tr>
<td>Bristol Parking Strategy</td>
<td>• By 2050 everyone in Bristol will contribute to a sustainable, inclusive and growing economy from which all will benefit</td>
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<td></td>
<td>• Enhance the vitality of the city.</td>
<td>• Reduce unnecessary use of private cars especially in the city centre.</td>
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<td>• Encourage alternative modes of transport.</td>
<td>• Encourage alternative modes of transport.</td>
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<td></td>
<td>• Guide appropriate scale, location and standards for all private and public parking, including branding of all city parking</td>
<td>• Guide appropriate scale, location and standards for all private and public parking, including branding of all city parking</td>
</tr>
<tr>
<td>Bristol One City Plan</td>
<td>• By 2050 Bristol will be a sustainable city, with low impact on our planet and a healthy environment for all</td>
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<td></td>
<td>• By 2050 everyone will be well connected with digital services and transport that is efficient, sustainable and inclusive; supporting vibrant local neighbourhoods and a thriving city centre.</td>
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<td>• By 2050 everyone in Bristol will have the opportunity to live a life in which they are mentally and physically healthy</td>
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<td></td>
<td>• By 2050 everyone in Bristol will live in a home that meets their needs within a thriving and safe community</td>
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<td></td>
<td>• By 2050 everyone in Bristol will have the best start in life, gaining the support and skills they need to thrive and prosper in adulthood</td>
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2.4 Assessment of Baseline Air Quality and Transport Conditions

2.4.1.1 Overview of modelling work

In 2013, BCC commissioned CH2M (now Jacobs) to update the existing GBATS model, primarily to assess the MetroWest scheme. The updated model is called the GBATS4 Metro Model (GBATS4M). The GBATS4M model consists of:

- A Highway Assignment Model representing vehicle-based movements across the Greater Bristol area for a 2013 autumn weekday morning peak hour (08:00-09:00), an average inter-peak hour (10:00-16:00) and an evening peak hour (17:00-18:00);
- A Public Transport (PT) Assignment Model representing bus- and rail-based movements across the same area and time periods; and
- A five-stage multi-modal incremental Variable Demand Model (VDM) that forecasts changes in trip frequency and choice of main mode, time period of travel, destination, and sub-mode choice, in response to changes in generalised costs across the 12-hour period (07:00-19:00).

The air quality model base year is 2015 since the 2017 data was not available at the time the model was developed, and in 2016 there was a significant amount of disruption from roadworks in the city (related to the Metrobus scheme) which prevented some monitoring data from being collected and altered the typical travel patterns across the city.

As the GBATS4M model has a base year of 2013, a 2015 traffic model has been developed to support this by interpolating from the 2013 and 2021 models. It was therefore pragmatic to undertake disaggregation of the traffic model by vehicle compliance / fuel type in the 2015 model rather than 2013. The validation of the 2015 fleet composition will be reported within the T4 Transport Modelling Forecast Report appended to the OBC.

The options assessed in this Outline Business Case are found in Table 2-2.

Table 2-2: Summary of each scheme measures for each Option

<table>
<thead>
<tr>
<th>Option</th>
<th>Scheme Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>No CAP scheme implemented</td>
</tr>
<tr>
<td>Option 1</td>
<td>A CAZ C charging scheme for non-compliant buses, taxis, HGVs and LGVs.</td>
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<tr>
<td></td>
<td>A 24-hour a day seven days a week HGV weight restriction (3.5 tons) on some of the</td>
</tr>
<tr>
<td></td>
<td>most polluted routes: Rupert St, Baldwin Street, Park Row/Upper Maudlin Street,</td>
</tr>
<tr>
<td></td>
<td>Marlborough Street and Lewins Mead.</td>
</tr>
<tr>
<td></td>
<td>A diesel car ban on Upper Maudlin Street and Park Row running from St James Barton</td>
</tr>
<tr>
<td></td>
<td>roundabout to Park Street – not including James Barton roundabout itself. 7am-3pm,7</td>
</tr>
<tr>
<td></td>
<td>days a week (does not apply to taxis, private hire vehicles or emergency vehicles).</td>
</tr>
<tr>
<td></td>
<td>Bus and local traffic interventions in the most polluting areas; this includes a</td>
</tr>
<tr>
<td></td>
<td>Park and Ride on the M32, an inbound bus lane on the M32 from Junction 2 to Cabot</td>
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<tr>
<td></td>
<td>Circus car park, an inbound bus lane on Cumberland Road, and using existing traffic</td>
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<tr>
<td></td>
<td>signals to control the amount of traffic entering congested areas with poor air</td>
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<td></td>
<td>quality.</td>
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<tr>
<td>Option</td>
<td>Scheme Measures</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Option 2</td>
<td>Diesel ban over a small central area from 7am-3pm, 7-days per week. Taxis, private hire vehicles and emergency vehicles are exempted.</td>
</tr>
<tr>
<td>Medium CAZ D with new Option 1 components (Benchmark Option)</td>
<td>A CAZ D charging scheme for non-compliant cars, buses, taxis, HGVs and LGVs.</td>
</tr>
<tr>
<td></td>
<td>A 24-hour a day seven days a week HGV weight restriction (3.5 tons) on some of the most polluted routes: Rupert St, Baldwin Street, Park Row/Upper Maudlin Street, Marlborough Street and Lewins Mead.</td>
</tr>
<tr>
<td></td>
<td>A diesel car ban on Upper Maudlin Street and Park Row running from St James Barton roundabout to Park Street – not including James Barton roundabout itself. 7am-3pm, 7 days a week (does not apply to taxis, private hire vehicles or emergency vehicles).</td>
</tr>
<tr>
<td></td>
<td>Bus and local traffic interventions in the most polluting areas; this includes a Park and Ride on the M32, an inbound bus lane on the M32 from Junction 2 to Cabot Circus car park, an inbound bus lane on Cumberland Road, and using existing traffic signals to control the amount of traffic entering congested areas with poor air quality.</td>
</tr>
<tr>
<td></td>
<td>A scrappage scheme (up to £2,000) for private diesel cars.</td>
</tr>
<tr>
<td>Hybrid Option</td>
<td>A charging scheme for non-compliant buses, taxis, HGVs and LGVs.</td>
</tr>
<tr>
<td></td>
<td>A 24hr a day seven days a week HGV weight restriction (3.5 tons) on some of the most polluted routes: Rupert St, Baldwin Street, Park Row/Upper Maudlin Street, Marlborough Street and Lewins Mead</td>
</tr>
<tr>
<td></td>
<td>Bus and local traffic interventions in the most polluting areas; this includes a Park and Ride on the M32, an inbound bus lane on the M32 from Junction 2 to Cabot Circus car park, an inbound bus lane on Cumberland Road, and using existing traffic signals to control the amount of traffic entering congested areas with poor air quality.</td>
</tr>
<tr>
<td></td>
<td>A scrappage scheme (up to £2,000) for private diesel cars.</td>
</tr>
<tr>
<td></td>
<td>A diesel car ban over a specific small central area from 7am to 3pm, 7 days a week (does not apply to taxis, private hire vehicles or emergency vehicles).</td>
</tr>
</tbody>
</table>
2.4.2 Air Quality in Bristol

Section 2.2 establishes that the key drivers for improving air quality in BCC relate to public health and regulatory issues. Non-compliance with the EU’s Limit Values and the UK Governments AQOs for NO₂ represents a significant threat to public health and BCC legal and regulatory responsibilities. As such, it is essential that a robust understanding of the current and future, scale and extent of exceedances is established under the reference case, informed by baseline air quality modelling.

2.4.3 Monitoring data in Bristol

Air quality monitoring in Bristol is comprehensive and long standing. Bristol’s monitoring network is focused on NO₂ as the concentrations of this pollutant near busy roads exceed the health-based national Objectives and European Limit Values, though some data is available about particulate matter. The current air quality situation in Bristol is presented in the form of a map in Figure 2-2, showing measurements of nitrogen dioxide at locations within the city centre.

The Bristol City Council and Defra monitoring network in 2018 consisted of:

- 6 real time NO₂ monitors which provide continuous live data which is uploaded automatically to a public website: [https://opendata.bristol.gov.uk/pages/air-quality-dashboard-new/air-quality-now#air-quality-now](https://opendata.bristol.gov.uk/pages/air-quality-dashboard-new/air-quality-now#air-quality-now)
- 3 real time particulate monitors (1 x PM₂.₅ and 2 x PM₁₀)
- 128 NO₂ diffusion tubes (in 2018) which provide a monthly and annual concentration for this pollutant.

In BCC’s Annual Status Report for 2019, states that:

- Taking an average of all diffusion tube sites for which there is data since 2014 (74 in total) there has been an average of a 2.1μg/m³ reduction in annual NO₂ values over the period 2014-2018. When looking at the difference between 2018 data compared to 2017 at the 78 sites with data for both years, the average fall in NO₂ concentrations was -1.1 μg/m³. These monitoring sites are kerbside or roadside sites with the exception of one urban background site.
- Consideration of trends in NO₂ concentrations at a selection of kerb/roadside sites on the busiest road corridors throughout Bristol since 2010 show that a very similar pattern is observed in all parts of the city. Monitoring has shown consistent exceedence of the annual objectives for NO₂ at many locations. The red line at 40μg/m³ in Figure 2-3 represents the annual objective for nitrogen dioxide.

The city centre NO₂ measurements shown in Figure 2-3 are all above the Air Quality Objective. All these sites are at roadside locations, which is an indication of the source of the air quality problem. As is shown in Figure 2-2, many parts of Bristol, especially near busy roads and in the city centre, NO₂ exceeds legal national objectives and European Limit Values.
Figure 2-2: Annual mean NO₂ concentrations across the Bristol Urban Area in 2018 (taken from BCC’s Air Quality Annual Status Report, 2019)
2.4.4 Source Apportionment

There are many sources of NOx and PM10 in the UK, including, but not limited to, power stations, transport, domestic combustion (including wood burning stoves), agriculture and industrial processes. The National Atmospheric Emissions Inventory (NAEI) provides estimates of the amount of different pollutants that are emitted to the air each year from human activity in the UK. Road transport is the main contributor of emissions of nitrogen oxides (NOx), particularly at roadside locations, and therefore the predominant cause in locations where NO2 concentrations are not complying with Limit Values or Air Quality Objectives.

Nitrogen oxides is a generic term which includes both NO and NO2. According to NAEI estimates, around a third of the UK NOx emissions in 2015 arose from road transport, most of which came from diesel vehicles (NAEI, 2017)\(^9\). Some disparities exist due to the increase in the proportion of NOx emitted directly as NO2 (also known as primary NO2) from the exhausts of modern diesel vehicles, as a result of emission control systems that aim to reduce total NOx and particulate matter emissions. Contributions from transport to NOx emissions, in central Bristol will be higher than the UK as a whole. No other major sources of NOx (e.g. from energy production, domestic combustion or other industrial processes) have been identified within the Bristol area, and other sources of NOx are included in the background concentrations. Background concentrations are those measured well away from any significant sources of pollution, such as busy roads, railway lines or industrial sites with emissions to air, or modelled based on monitored background concentrations.

Emissions of NOx are a combination of nitrogen oxide (NO) and NO2 and are dependent on the type of vehicle (both in terms of size and age of the vehicle). Figure 2-4 shows the proportion of NOx emissions by the vehicle fleet in the centre of Bristol in 2021, calculated from the vehicle movements in the GBATS model, and the latest vehicle emission factors provided by Defra specifically for work contributing to the National Air Quality Plan. This shows that diesel vehicles contribute around 93% of the total.

2.4.4.1 Air Quality Model Specification

This section of the OBC discusses the results of the modelling without the CAP in place, in order to understand what level the problem would be in the future without any positive interventions. This forms part of a wider set of modelled scenarios which are described below for clarity.

2.4.4.2 Baseline Results – 2021

The predicted annual mean concentrations of nitrogen dioxide still shows 138 exceedances in 2021, as shown in Figure 2-5. The critical areas are predominately in the centre as shown in the more detailed plan on Figure 2-6.
Figure 2-5: Predicted NO₂ concentrations in 2021 (annual mean)
Figure 2-6: Predicted NO$_2$ concentrations in the 2021 Final Reference Case at PCM-equivalent receptor locations in the City Centre Focus Areas
2.4.5 AQMAs

BCC declared an AQMA in 2001 for NO2 and PM10. The boundary has been amended since but still covers the city centre and arterial routes. Approximately 100,000 people live within the AQMA and it also includes the central employment, leisure and shopping districts, major hospitals and dozens of schools. Therefore, many more than the 100,000 people who live within the AQMA are exposed to air pollution concentrations exceeding the Air Quality Objectives in their daily lives. The designation of an AQMA does not require that a Clean Air Zone be put in place; but it does require the local authority to take action to reduce levels of pollution. It should be noted that Bristol currently achieves the relevant Air Quality Objectives for PM10, although the AQMA remains as a precautionary measure.

There are also three small AQMAs in South Gloucestershire, in Kingswood/Warmley, Staple Hill and adjacent to the roundabout at Junction 17 of the M5. The breaches in these areas are not as significant as those within the BCC AQMA in central Bristol.

2.4.6 Summary of problems identified

In the case of air quality in Bristol, the current problem that needs to be addressed is the identified exceedance of the legal annual mean Limit Value for NO2. BCC has monitored and endeavored to address air quality in Bristol since 2002. Despite this, Bristol has ongoing exceedances of the legal limits for NO2 and these are predicted to continue until around 2030 without intervention.

The Pollution Climate Mapping (PCM) model (Base Year 2015) is a collection of models designed to fulfil part of the UK’s EU Directive (2008/50/EC) requirements to report on the concentrations of particular pollutants in the atmosphere in the context of the EU Limit Values. The PCM model predicted exceedances of the nitrogen dioxide (NO2) EU Limit Value (i.e. receptor locations alongside roads on the PCM network) within Bristol, including on Newfoundland Way. Local monitoring data provides evidence of more widespread NO2 exceedances within Bristol than was indicated within the PCM model. The results of the 2017 BCC NO2 monitoring for example, indicated several exceedances of the EU Limit Value, particularly in the city centre. The likely cause of the exceedances at these locations is a combination of the traffic mix (particularly diesel vehicles), road speed (i.e. slower speeds tending to increase emissions) and presence of canyons (generally tall buildings on either side of the road which prevent pollutants from dispersing as effectively as they would in an open area).

In the absence of suitably targeted interventions, the exceedances are expected to persist, meaning an improvement in public health will not be accelerated in Bristol. Therefore, BCC would fail to comply with its regulatory responsibilities as air quality problems continue.
2.5 Spending objectives and success factors

A robust case for change requires a thorough understanding of what the project is seeking to achieve. The objectives and success factors identified for the project need to be rooted in the local and strategic context (i.e. Section 2.2 and 2.3) and specific issues and problems identified (i.e. Section 2.4), which the project seeks to address.

Within this context, the primary spending objective of the Plan, in accordance with JAQU Options Appraisal Guidance and in line with the issues raised in the air quality background and context section above, is to deliver a scheme that leads to compliance with the EU’s mandatory NO2 concentration Limit Values in the shortest possible time and reduces human exposure most quickly.

A secondary spending objective is also proposed; to deliver a scheme which leads to compliance with the LAQM air quality objectives as set out in the Air Quality (England) Regulations (SI 2000/ 928 as amended). The difference between Limit Values and LAQM air quality objectives are set out in Section 2.2 of this document.

To support the realisation of the spending objectives documented above, a number of critical success factors (CSFs) were identified as part of the SOC process to appraise and refine the longlist of options into the shortlist of options considered at OBC stage. These CSFs can be differentiated into two groups, Primary and Secondary:

- **Primary CSF** – combining the primary and secondary spending objectives, the primary CSF seeks to deliver compliance with NO2 air quality Limit Values and Air Quality Objectives in the shortest possible timescales. At SOC stage, only those options that achieved this CSF (based on modelling available at that time) were shortlisted for further analysis; and
- **Secondary CSF** – related to the supplementary spending objectives listed above, the following secondary CSFs were used at SOC stage to undertake a comparative assessment of shortlisted options whilst recognising that the overriding test was delivery of compliance in accordance with the Primary CSF:
  - **Strategic**
    - Provide equity across different vehicle type and trip purpose; and
    - Compliance with Defra Draft CAZ framework, including minimum requirements.
  - **Economic**
    - Mitigate financial impact on low income households;
    - Improve health of low income households;
    - Maximise positive effects on the economy, whilst minimising any negative impacts and
    - Improve public health across Bristol.
  - **Commercial**
    - Delivery timescale risks of procurement.
  - **Financial**
    - Likelihood of revenue equating to implementation/operational costs;10
    - Upfront capital required for scheme; and
    - Risk of financial penalty to the Council/s.
  - **Management**
    - Public acceptability which could impact on the option’s deliverability;
    - Political acceptability which could impact on the option’s deliverability.

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10 Complying with the legal test which was set out by the High Court in November 2016 in R (ClientEarth) (NO2) V Secretary of State for Environment Food and Rural Affairs [2016] EWHC 2740 (Admin), only shortlisted options which achieve compliance with the NO2 Limit Value in the shortest possible time, are appraised across this criterion. The relevant analysis is presented in the Financial Case chapter.
2.6 Case for Change

The baseline assessment work shows that in 2021, with no Clean Air Zone intervention, there will be 138 locations that exceed the legal annual mean Limit Value for NO₂. Intervention is required to ensure compliance is achieved within the shortest possible time.

2.7 Optioneering Process

2.7.1 SOC Options Analysis

A key part of the Strategic Outline Case was the option assessment work. This comprised of developing a long list of schemes, and assessing them against an evaluation criteria, which resulted in a short list of schemes for assessment in this Outline Business Case.

The primary CSF were brought together with the other secondary CSFs to develop the evaluation criteria with which the options will be refined. The evaluation criteria are set out in Table 2-3.

Table 2-3: Summary of Evaluation Criteria

<table>
<thead>
<tr>
<th>Cases</th>
<th>ID</th>
<th>Evaluation Criteria</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic</td>
<td>1</td>
<td>Deliver compliance with NO₂ air quality Limit Values and Air Quality Objectives</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in the shortest possible timescales</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Provide equity across different vehicle types and trip purposes</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Compliance with the CAZ framework</td>
<td>High</td>
</tr>
<tr>
<td>Economic</td>
<td>4</td>
<td>Mitigate financial impact on low income households</td>
<td>Very High</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Improve health of low income households</td>
<td>Very High</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Economic effects</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Improve public health</td>
<td>Very High</td>
</tr>
<tr>
<td>Commercial</td>
<td>8</td>
<td>Delivery timescale risks of procurement</td>
<td>Low</td>
</tr>
<tr>
<td>Financial</td>
<td>9</td>
<td>Likelihood of revenue equating to implementation/operational costs</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Upfront capital required for scheme</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Risk of financial penalty to the Council/s</td>
<td>Low</td>
</tr>
<tr>
<td>Management</td>
<td>12</td>
<td>Public acceptability</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Political acceptability</td>
<td>Medium</td>
</tr>
</tbody>
</table>

The SOC recommended that the following Options were considered in the development of options for consideration in the OBC:

- **Option 1** – Benchmark option – medium area Class D charging zone. In line with JAQU’s’ Option Appraisal Guidance, the lowest class required to achieve compliance in the shortest possible timescales.
- **Option 2** – Package of non-charging interventions. Having reviewed the effectiveness of the non-charging measures, the single most effective measure would be the prohibition of diesel cars from polluted parts of the city, which has been assumed to be the small zone.
- **Option 3** – Medium area Class C charging option with complementary non-charging interventions – Class C CAZ at Medium geography level with the addition of complementary non-charging measures.
Strategic Case

- **Option 4** – Medium area Class D charging option with complementary non-charging interventions – Class D CAZ at Medium geography level.
- **Option 5** – Small area Class C charging option with complementary non-charging interventions – Class C CAZ at Small geography level, with the addition of non-charging measures.
- **Option 6** – Small area Class D charging option with complementary non-charging interventions – Class D CAZ at Small geography level, with the addition of the non-charging measures

Non-charging measures could include:
- Introduction and enforcement of anti-idling zones for buses in the city centre
- Increased Euro Standard requirements for taxis and private hire vehicles in licensing agreements
- Restrictions on goods vehicles movements in the City Centre and/or AQMA during peak hours

**2.7.2 Options Developed: OBC Consideration**

Following initial analysis, a further option of a Diesel car exclusion over a small area with bus and taxi fleet improvement to Euro 6 or better (Option 2c) was developed to improve compliance.

The results of the modelling showed that Options 4 and 2c were the better performing options in terms of NO₂ compliance. Further economic assessments were undertaken for each of the two options. The economic assessments concluded Option 4 would achieve compliance at all locations by 2027, with the exception of the north section of Upper Maudlin Street, which would be compliant by 2030. Comparatively, Option 2c was expected to achieve compliance at all locations by 2023, with the exception of the north section of Upper Maudlin Street which would be compliant only by 2024.

However, following consideration of these results, the it was decided that the impact of the identified options on lower income households was such that there was a need to identify further options which would meet the air quality obligations of the Council but avoid or reduce these impacts. Following this decision, the BCC Mayor and JAQU were in contact to resolve the issue of clean air and identify a way forward that would meet all priorities and aims.

**2.7.2.1 Development of Variant 1**

The priority of Variant 1 was to achieve compliance with the legal tests, however it also aimed to develop an option that targeted reduction of NO₂ from taxis, HGVs, LGVs, Buses/Coaches, since restrictions to these vehicle classes has less impact on lower income households than restrictions for cars. The BCC Mayor is keen to develop a sustainable scheme to achieve air quality compliance, and which is integrated into the other future vision, plans and projects currently being developed across the city, including the One City Plan.

Variant 1 includes the following measures:
- Fleet improvements to all buses to Euro 6 (this will also be in the reference case);
- All BCC taxis and private hire vehicles are upgraded to compliance (this will also be in the reference case);
- Increased use of Avonmouth freight consolidation site;
- Upgrade all BCC waste vehicles to Euro 6 or better – (it should be noted that this component was not modelled);
- Ban HGVs from NO₂ critical links;
- A car scrappage scheme;
- Bus and local traffic interventions in the most polluting areas; this includes a Park and Ride on the M32, an inbound bus lane on the M32 from Junction 2 to Cabot Circus car park, an inbound bus lane on
Cumberland Road, and using existing traffic signals to control the amount of traffic entering congested areas with poor air quality.

Modelling indicated that the Variant 1 option would achieve a compliance date of 2030 and the compliance was driven by compliance at Marlborough Street (i.e. this would be the location that meets compliance last). This compliance date is later than the Hybrid Option and New Benchmark Option (2027).

2.7.2.2 New Option 1

New Option 1 consisted of the following measures:

- A charging scheme for non-compliant buses, taxis, HGVs and LGVs (a Class “C” CAZ). This charge applies once a day regardless of how many times you go in or out of the medium zone.
  - Taxis, PHVs, LGVs £9.00
  - HGVs, Buses and Coaches £100.00
- A 24-hour a day seven days a week HGV weight restriction (3.5 tons) on some of the most polluted routes: Rupert St, Baldwin Street, Park Row/Upper Maudlin Street, Marlborough Street and Lewins Mead.
- A diesel car ban on Upper Maudlin Street and Park Row running from St James Barton roundabout to Park Street – not including James Barton roundabout itself. 7am-3pm, 7 days a week (does not apply to taxis, private hire vehicles or emergency vehicles).
- Bus and local traffic interventions in the most polluted areas; this includes a Park and Ride on the M32, an inbound bus lane on the M32 from Junction 2 to Cabot Circus car park, an inbound bus lane on Cumberland Road, and using existing traffic signals to control the amount of traffic entering congested areas with poor air quality.

The New Option 1 differs to Variant 1 in that Variant 1 does not include a charging zone, whereas Option 1 consists of a CAZ C zone.

2.7.2.3 New Option 2

This option refines the 24 hour car diesel ban option modelled in Step 1 and 2 (Option 2c) with an 8 hour restriction. This was modelled because the previous diesel ban option had the shortest compliance date. The option comprises a diesel car ban over a specific small central area from 7am to 3pm, 7 days a week (does not apply to taxis, private hire vehicles or emergency vehicles). The scheme could be complemented by mitigation schemes including a local scrappage scheme.

2.7.2.4 New Benchmark Option: Medium CAZ D with New Option 1 components (private cars charged)

This option represents the “benchmark” option, and includes:

- A charging scheme for non-compliant cars, buses, taxis, HGVs and LGVs (A Class “D” CAZ). This charge applies once a day regardless of how many times you go in or out of the medium zone.
- A 24-hour a day seven days a week HGV weight restriction (3.5 tons) on some of the most polluted routes: Rupert St, Baldwin Street, Park Row/Upper Maudlin Street, Marlborough Street and Lewins Mead.
- A diesel car ban on Upper Maudlin Street and Park Row running from St James Barton roundabout to Park Street – not including James Barton roundabout itself. 7am-3pm, 7 days a week (does not apply to taxis, private hire vehicles or emergency vehicles).
- Bus and local traffic interventions in the most polluting areas; this includes a Park and Ride on the M32, an inbound bus lane on the M32 from Junction 2 to Cabot Circus car park, an inbound bus lane on
Cumberland Road, and using existing traffic signals to control the amount of traffic entering congested areas with poor air quality.

- A scrappage scheme (up to £2,000) for private diesel cars. This would provide a grant towards a new vehicle or an alternative mode of transport. Vehicles belonging to residents in Bristol, Bath & North East Somerset, North Somerset and South Gloucestershire would be eligible – as long as their drive into work includes the Option 1 charging zone area or they live in the area.

2.7.2.5 Hybrid Option of New Option 1 and New Option 2

The Hybrid Option was developed in order to improve the year of compliance and offer the best solution to the air quality problems within the city. It was also a response to a number of comments within the consultation (July/August 2019), suggesting that combining Option 1 and 2 would provide a better solution to the city's air quality issues. The Hybrid Option that was developed includes:

- A charging scheme for non-compliant buses, taxis, HGVs and LGVs. This charge applies once a day regardless of how many times you go in or out of the medium zone.

- A 24hr a day seven days a week HGV weight restriction (3.5 tons) on some of the most polluted routes: Rupert St, Baldwin Street, Park Row/Upper Maudlin Street, Marlborough Street and Lewins Mead.

- Bus and local traffic interventions in the most polluting areas; this includes a Park and Ride on the M32, an inbound bus lane on the M32 from Junction 2 to Cabot Circus car park, an inbound bus lane on Cumberland Road, and using existing traffic signals to control the amount of traffic entering congested areas with poor air quality.

- A scrappage scheme (up to £2,000) for private diesel cars. This would provide a grant towards a new vehicle or an alternative mode of transport. Vehicles belonging to residents in Bristol, Bath & North East Somerset, North Somerset and South Gloucestershire would be eligible – as long as their drive into work includes the Option 1 charging zone area or they live in the area.

- A diesel car ban over a specific small central area from 7am to 3pm, 7 days a week (does not apply to taxis, private hire vehicles or emergency vehicles).

The assessment is reported in the transport and air quality modelling reports appended to the OBC (Appendix D OBC-18 and OBC-19, Appendix E OBC-23 and OBC-27) showed that the Hybrid Option and the New Benchmark Option are expected to achieve compliance by 2027. The Hybrid Option compliance date is driven by exceedences at only one location - Church Road whereas the New Benchmark Option compliance date is driven by three locations (Park Street, Marlborough Street and Church Road). For this reason, the BCC Project Board identified this option as the preferred option.

Following this work, a 2025 model scenario was developed, to provide more certainty of the compliance year. This work showed that compliance would be achieved by 2025 in the Hybrid scenario. This work is reported in the Church Road assessment and 2025 modelling report OBC-20 (Appendix D).

The technical assessment work for these options is set out in the Outline Business Case and supporting appendices. In addition, the OBC presents information about the economic assessment of options.

2.7.3 Confirmation of options to be assessed in this OBC

As a result of the option assessment work, the following measures were short listed:

- New Option 1 Clean Air Zone (Class C - private cars not charged)
- New Option 2 Diesel car ban over the small area
- New Benchmark Option: Medium CAZ D with New Option 1 components (private cars charged)
- Hybrid Option of New Option 1 and New Option Benefits, Risks, Constraints and Dependencies
The economic case sets out details of the air quality, transport and economic assessment work. This work shows that the Hybrid option of the preferred option. Information about the design of the Hybrid Option is presented in Appendix A to the Outline Business Case.

2.8 Benefits, Risks, Constraints & Dependencies

2.8.1 Benefits

The Clean Air Plan could provide benefits in the following areas:

- Public Health, including mortality rates caused to some extent by NO₂
- Transport (decongestion, journey times, accident rates)
- Financial revenue streams

2.8.1.1 Public health and the environment

The most substantial benefit of the Plan is an improvement in public health through a reduction in NO₂ concentrations. These benefits are associated with a reduction in both morbidity and mortality.

Reducing morbidity will lead to a reduction in public health expenditure and reducing mortality will lead to a reduction in the lost output and human costs.

The Full Business Case will include updating the assessment work undertaken which concluded that around 300 premature deaths each year in the City of Bristol can be attributed to exposure to NO₂ and fine particulate matter (PM₂.₅).

2.8.1.2 Transport

Road transport is responsible for the largest proportion of NO₂ concentrations in Bristol and hence the Plan will include measures to tackle this source and either reduce traffic volumes or reduce the emissions from this source. The proposed diesel car ban will combat a major source of pollution, while attempting to minimise impacts on vulnerable citizens.

The Plan also includes measures which increase travel by sustainable modes such as public transport, walking and cycling. An increase in use of these modes would produce health benefits through increased physical activity, resulting in reduced risk of premature death and reduced absenteeism from work. Further information on these measures can be found within the CAF Scheme Proposal, OBC-17 (Appendix C).

2.8.1.3 Financial Revenue Streams

The Hybrid options involves a charging element (for buses, coaches, taxis, LGVs and HGVs) and this could provide Bristol City Council with an ongoing additional revenue stream. Defra’s Clean Air Zone Framework (May 2017) prevents Local Authorities from setting a charge as a revenue raising measure, but any charging scheme will need to be set at a level to produce a change in behaviour. As a result, the Plan may produce revenue in excess of the operational costs of running the scheme. In accordance with the Transport Act 2000 this revenue should be re-invested to facilitate the achievement of local transport policies which aim to improve air quality and support the delivery of the ambitions of the Plan. In this way, the Plan may realise additional benefits through supporting further measures with any excess revenue. The anticipated revenue from the Plan has been calculated alongside the operational costs to understand the potential for excess revenue – see Financial Case for further details.
2.8.2 Risks

The Clean Air Plan has the following risks associated with it:

- Changes in carbon emissions
- Changes in particulate matter emissions
- Economic impacts
- Resource demand
- Impacts on vulnerable groups, particularly low income groups

2.8.2.1 Carbon

The Plan is focused on one pollutant; nitrogen dioxide. However, the main sources of nitrogen dioxide, vehicles, also produce other pollutants including carbon dioxide and particulate matter. There is a risk that the selected Plan could achieve compliance with the legal limit for NO2 concentrations, but simultaneously result in an increase in other harmful pollutants. Carbon dioxide is particularly relevant, since the growth in diesel vehicles (which produce high levels of NO2) is largely down to the promotion of their benefits in reducing carbon emissions. If there are restrictions on the use of diesel vehicles within the city, then this could result in a rise in the popularity of petrol vehicles. Some evidence suggests that petrol vehicles emit higher levels of CO2 than diesels (but lower NO2 levels). Therefore, the rise in the number of petrol vehicles within the city could increase the CO2 produced, which can contribute to global warming. The assessment shows that the preferred option, the Hybrid, provides greenhouse gases benefits. See Economic Case for further details.

2.8.2.2 Particulate Matter

In addition, there are Limit Values and Air Quality Objectives for particulate matter (PM), specifically PM10 and PM2.5 which will need consideration. Recent monitoring data has demonstrated that particulate matter emissions in Bristol have been under both Limit Values and Objectives for several years. It is not anticipated that the Plan will produce an increase in PM emissions due to the reduction in traffic levels and acceleration of fleet renewal, both of these measures will result in a reduction in PM. The impacts of PM10 are explored in the Distributional and Equalities Impact Assessment, Appendix H.

2.8.2.3 Economic impacts

The Plan will impact the local economy, as detailed in the Economic Case. A significant proportion of jobs in Bristol are located within the city centre where some of the most significant exceedances are located. It is therefore likely that the measures will be targeted at reducing emissions in the central area of Bristol, and depending on the measures selected could restrict access to the jobs or services within the same area. However, the CAP scheme would also include a number of mitigations to reduce any impacts of the scheme, including the economic effects. These are outlined within the CAF proposal, OBC-17 (Appendix C).

2.8.2.4 Resource Demand

This Plan is one of 15 similar plans being developed across the country within the same time frame. The objectives of all these plans are to achieve compliance with the NO2 Limit Values. It is therefore likely that similar schemes could be proposed in multiple locations, putting pressure on the market supply of particular items, such as Approved Enforcement Devices and compliant buses. BCC are already taking measures to avoid such a scenario, by engaging early with suppliers as part of the procurement strategy and ensuring that potential suppliers know the scale and scope of the BCC scheme.
2.8.2.5 Vulnerable Groups

There are specific risks that relate only to the implementation of a charging zone which may form part of the Plan. There is potential to disproportionately penalise vulnerable groups in society, depending on the geographic location, scale and the structure of vehicle compliance standards. In particular, it is appropriate to consider the differential impacts of the Plan on low income households since this is correlated to the likely public and political acceptance of the Plan. This assessment is set out in the Economic Impact Report.

2.8.3 Constraints

2.8.3.1 Legal

The most significant constraint on the Plan is the legal situation through which it has materialised. Specifically, the requirement for the UK Government to achieve compliance with the Limit Values in the shortest time possible, and only considering cost when comparing between two equally quick schemes. Specifically, in November 2016 the High Court found that ‘I reject any suggestion that the state can have any regard to cost in fixing the target date for compliance or in determining the route by which the compliance can be achieved where one route produces results quicker than another. In those respects, the determining consideration has to be the efficacy of the measure in question and not their cost. That, it seems to me, flows inevitably from the requirements in the Article to keep the exceedance period as short as possible’.

The Hybrid option has legal constraints associated with the enforcement of the scheme. The Council does not have the powers to enforce the HGV ban or diesel ban, and this currently must be undertaken by the police. The Council are working with DfT to gain the legal powers to do this.

2.8.3.2 Planning/Consenting

A local charging order is required to allow the development and operation of charging measures such as a CAZ. The primary factor for approval of a charging order is whether the local traffic authority is satisfied that the local charging scheme appears desirable, for the purpose of, directly or indirectly facilitating the achievement of local transport plan polices, of both the local traffic authority/charging authority and any combined authority within whose area the proposed order will take effect. Other factors that need to be satisfied prior to bringing a local charging order into effect include:

- An adequate consultation process; failure to consult to the required standard could be seen to be legally challengeable.
- Public Sector Equality Duty and possibly Human Rights Act issues will need to be carefully and demonstrably considered.

In addition to the charging order, Traffic Regulation Orders are required for:

- The small area car diesel ban; and
- HGV restrictions on Upper Maudlin Street.

It is noted that The Local Authorities' Traffic Orders (Procedure) (England and Wales) Regulations 1996 requires that a public inquiry shall be held if a valid objection is received to any TRO if its effect is to prohibit the loading or unloading of vehicles of any class in a road on any day of the week:

- at all times;
- before 07.00 hours;
- between 10.00 and 16.00 hours; or*

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iv. after 19.00 hours.

2.8.3.3 Resources

The Plan could necessitate significant recruitment to manage and operate any back-office and enforcement functions required to ensure successful delivery. This scale and form of staff resources required to deliver the Plan will vary depending on the management and operation processes selected. In the event that back office and enforcement functions are retained in-house, BCC could be required to recruit a large number of temporary and flexible staff, particularly to deal with contraventions. BCC could struggle to fill the specific roles created as a result of the Plan. At the same time, existing functions such as Human Resources, Property and IT may be exposed to considerable pressure to ensure that the recruitment process is adequately resourced. These issues have been considered by BCC within their procurement strategy and the Quantified Risk Assessment (QRA) process. Mitigating measures have been proposed to deal with such a scenario and to identify any issues at an early stage.

2.8.3.4 Social acceptability

Results from the Bristol City Council CAZ Consultation (July/August 2019) suggest that there is a reasonable level of public support for particularly Option 1, but also Option 2. Question 5 from the consultation questionnaire asked respondents to 'please tell us why you agree or disagree with each option'. Feedback from respondents on Option 1 (question 5a) found that 166 respondents (20%) provided comments suggesting that both Option 1 and 2 should be implemented. Feedback from respondents on Option 2 (question 5b) found that 184 respondents (20%) provided comments suggesting that both Option 1 and 2 should be implemented together.

Reasons for supporting a combination of both Option 1 and 2 included that this would have the greatest impact on air quality, that both options should be implemented to be ambitious and that a combination of both options would promote a natural shift away from private vehicle use, amongst other reasons.

In addition, more than two thirds of all respondents (69%; 3,414 respondents) agree or strongly agree that Option 1 is a good way to improve air quality (39% strongly agree and 32% agree). More than half of all respondents (55%; 2,717 respondents) agree or strongly agree that Option 2 is a good way to improve air quality (32% strongly agree and 23% agree).

Therefore, despite not being consulted on specifically within the questionnaire, a significant number of people made the suggestion that a combination of both options should be implemented. This is in addition to support that exists for the two options individually.

2.8.4 Dependencies

The Plan is dependent on the progression of other workstreams which may feed into the development of the schemes which form the final package of measures. Specifically, projects considering the most effective public transport priority schemes and walking/cycling schemes have recently been commissioned by WECA and will be relied upon by this Plan in order to meet the required timescales.

The delivery and success of the Plan is linked to a range of national, sub-regional and local stakeholders and statutory bodies, whose activities, programmes and policies could have significant implications on the transport and air quality context. Further, various agents hold a range of transport data (for example compliance, registration, taxi licensing, fleet databases) and air quality data (for example PCM/AQMA receptor information) that will be critical to ensuring the ongoing operation and monitoring of the Plan’s intervention measures. Therefore, close collaboration across various partners is essential to ensuring timely progress of the Plan.
2.8.4.1 Highways England

Concerning national stakeholders, Highways England (HE) currently manage and operate the M5 and M32, which provide links around and into Bristol. There are key exceedances of the NO\textsubscript{2} Limit Value on the M32. As such, the management of traffic along the M32 is likely to form a key part of the Plan and will require the involvement of Highways England to implement. The project manager, engineers and designers are already working closely with Highways England on this issue.

2.8.4.2 Low Emissions Vehicles

The Plan is also dependent on the ongoing nationwide roll-out and promotion of LEV uptake, by both the private and public sector. The opportunity for individuals to switch to new and used compliant vehicles is related to the availability of vehicles in the market, the provision of the appropriate infrastructure and facilities to support these type of vehicles, and promotional programmes and incentives to buy LEV. The West of England was awarded £7m Go Ultra Low (GUL) Funding to spend over 5 years to promote the uptake of electric vehicles (EVs) across the region, following a Go Ultra Low West bid. As a result, EV purchases in the region will rise to 5,000 new registrations per year by 2020. Go Ultra Low West has included initiatives such as installing over 120 new public charging points within the west of England, providing 50% match funding for charge points to be installed in businesses across the four WECA local authority areas and adding over 70 electric vehicles to local authority car fleets within the West of England\textsuperscript{12}.

2.8.4.3 West of England Combined Authorities

At a sub-regional and local level, the Plan is dependent on the progression of the West of England Combined Authority’s (WECA) existing and proposed major scheme intervention programme. A range of transport initiatives may contribute to an improvement in air quality in advance of, or alongside, the Plan. Therefore, this could have some influence over the ability to meet the required timescales or affect the overall outcome. The wider WECA programmes typically have longer timescales for delivery and implementation, meaning the overlap between the Plan and wider initiatives could be limited. However, this will need to be considered in the CAP.

Further, collaboration with WECA will be critical where the Plan is expected to interact with the (as yet not identified) Key Route Network. As such, discussion with WECA is ongoing to understand the interactions between the Plan and existing and future programmes undertaken by WECA.

2.8.4.4 Neighbouring Authorities

Neighbouring authorities including Wiltshire, B\&NES, South Gloucestershire, Somerset and, further afield, South Wales, are also closely related to development of the Plan, in light of travel to work patterns for employees working in Bristol.

B\&NES have been directed to implement a CAP as part of the UK Air Quality Plan alongside Bristol City Council. Therefore, there are some interdependencies and synergies between the two local authorities that may allow for joint market testing and procurement. Furthermore, the implementation of two Plans in close proximity may reduce the potential for displacement of traffic and economic activity from one affected area to another, as both local authorities are subject to similar measures.

Discussions are ongoing between BCC and neighbouring authorities are ongoing to better understand the interactions between the Plan and existing and future programmes undertaken by proximate authorities.

\textsuperscript{12} https://travelwest.info/drive/electric-vehicles/go-ultra-low-west
2.9 Stakeholder and Public Engagement

2.9.1 Communications Plan

The Bristol City Council Clean Air Zone Communications Plan seeks to provide an overview of activity undertaken to date and intended future focus of engagement with residents and city stakeholders during the upcoming stages of preparation, ahead of implementation of the traffic Clean Air Zone in March 2021.

Between 1 July and 12 August 2019, the council consulted on two options for a traffic Clean Air Zone which are designed to achieve compliance with legal NO₂ limits in the shortest possible time (further information on the two options can be found within Section 2.9.2). The options were:

- Option 1: Clean Air Zone (private cars not charged)
- Option 2: Diesel car ban

The consultation asked respondents how concerned they are about the health impacts of poor air quality in Bristol and it sought feedback from citizens, businesses and other stakeholders on the two options. The findings of this consultation are summarised within a Consultation report, which will be considered by Cabinet before they make a decision on a preferred Clean Air Zone option to present to government as part of an Outline Business Case.

Following the submission of the Outline Business Case (OBC) in November, the next stage of the project will be the Full Business Case (FBC). This stage will:

- Take forward a final scheme – the nature of which will be dependent on the OBC and the decision of Cabinet Members;
- Finalise proposals and clarify logistical details around the operation of the scheme (including costs)

It is unlikely during this stage that significant changes will be made to the scheme – though the traffic Clean Air Zone will continue to evolve based on stakeholder feedback. Stakeholder engagement will focus on raising awareness of air pollution and the proposed scheme, helping people to prepare for implementation and ensuring rules and laws are adhered to. Engagement and communication efforts will focus on groups who need support with transitioning. Face-to-face meetings and drop-in sessions will be provided, along with online and printed communications.

A Stakeholder summit will be run by BCC on Monday 18th November 2019.

A copy of the Communications Plan is presented in Appendix B to the OBC.

2.9.2 CAZ Consultation (July/August 2019)

Bristol City Council undertook a six-week consultation from 1st July to 12th August 2019 on options 1 and 2. Engagement as part of the consultation included:

- six drop-in sessions across the city
- Communications Toolkits distributed to partner organisations to help them publicise the consultation
- public events such as the Harbour Festival
- media engagement
- social media posts
• bus shelter and variable message road side advertisements.

Data was collected via online and paper copies of the questionnaire, interview surveys with under-represented groups, meetings with specific stakeholder groups and letters and emails received by the Council. As a result, the Council received 5,034 responses to the consultation. 70% of these responses were from within the BCC area, 7% were from South Gloucestershire, 3% were from North Somerset, and 1% were from Bath & North East Somerset (B&NES).

Respondents indicated a high level of concern about health impacts of air quality in the city, as can be seen in Figure 2-7, with over 60% of respondents expressing that they are very concerned. This high proportion of respondents in Bristol who are very concerned about health impacts, was reflected across all deprivation deciles.

Figure 2-7: Concern about health impacts of poor air quality

There was a high level of support for Option 1, with more than two thirds of all respondents (69%; 3,414 respondents) who agree or strongly agree that Option 1 is a good way to improve air quality (39% strongly agree and 32% agree). This is more than three times the 21% (1,018) of all respondents who disagree or strongly disagree. 11% (534 respondents) neither agree nor disagree.

More than half of all respondents (55%; 2,717 respondents) agree or strongly agree that Option 2 is a good way to improve air quality (32% strongly agree and 23% agree). This is more than one and a half times the 34% (1,702) of all respondents who disagree or strongly disagree. 11% (534 respondents) neither agree nor disagree (the same proportion as for Option 1).

Question 5 asked respondents to ‘please tell us why you agree or disagree with each option’. Feedback from respondents on Option 1 (question 5a) found that 41% of respondents provided reasons indicating support for Option 1, including that Option 1 targets the correct vehicles (56%), general support for Option 1 (14%), Option 1 will promote behavior change (13%), and Option 1 will have a positive impact on air quality (11%).

Feedback from respondents on Option 2 (question 5b) found that 29% of respondents outlined reasons for supporting Option 2 including that Option 2 targets the correct vehicles (47%), Option 2 will encourage behavior change (15%), Option 2 will improve air quality (14%) and general comments in support of Option 2 (11%).
Within Option 1, there was high levels of support (62% of respondents) that community and school transport vehicles for disabled people and their carers, should pay no CAZ charge. In addition, between 64-69% of respondents believed that HGVs, buses/coaches and LGVs for businesses based within the Option 1 zone, should pay the full charge, however this dropped to 42-46% for those businesses with low turnover.

Some of the most popular additional improvements and incentives to the Option 1 scheme included new/improved walking/cycle routes (50% of respondents), anti-idling zones for buses in the city centre (36%), traffic signal timings to minimise queues in areas with poor air quality (35%), improved public transport to hospitals on Upper Maudlin Street (34%), amongst other suggestions. For Option 2 the most popular additional improvements and incentives included new/improved cycle/walking routes (51% of respondents), subsidised bus travel for certain demographic or income groups (35%), improved public transport to the hospitals on Upper Maudlin Street (33%), traffic signals to minimise queues in areas with poor air quality (32%) and scrappage scheme for diesel cars (31%), amongst others.

Question 5 was a free-text question (‘Please tell us why you agree or disagree with each option’). Feedback from respondents on Option 1 (question 5a) found that 166 respondents (20%) provided comments suggesting that both Option 1 and 2 should be implemented. Feedback from respondents on Option 2 (question 5b) found that 184 respondents (20%) provided comments suggesting that both Option 1 and 2 should be implemented together.

Of the comments given in response to question 5a (regarding Option 1) 46% of respondents had reservations about Option 1, 41% had reasons for supporting Option 1, 26% offered alterations to the option and 22% gave alternative scheme suggestions. In response to question 5b (Option 2), 21% of respondents who answered this question had reservations about Option 2, 54% had reasons for supporting Option 2, 29% suggested alterations to this option and 26% gave alternative scheme suggestions.

Further details are available in the Consultation Report, appendix N to the OBC.

2.10 Logic Map

The logic map presented in Table 2-4 highlights the theory of change underpinning the Plan. It demonstrates how inputs (in the form of programme expenditure) generates outputs (in the form of activities and scheme elements delivered) which drive outcomes (in the form of behavioural, transport and economic changes) leading to impacts (long-term societal changes).
### Table 2-4: Logic Map

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
<th>Outcomes</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Implementation Fund</td>
<td>• Charging scheme for non-compliant buses, taxis, HGVs and LGVs.</td>
<td>• Behavioural change leading to:</td>
<td>• Improved air quality</td>
</tr>
<tr>
<td>• Clean Air Fund</td>
<td>• HGV weight restrictions on some of the most polluted routes within Bristol.</td>
<td>• Accelerated vehicle upgrading</td>
<td>• Increased physical activity</td>
</tr>
<tr>
<td>• Scheme Revenue</td>
<td>• Bus and local traffic interventions in the most polluting areas.</td>
<td>• Switch in preference for non-diesel cars and compliant buses/taxis/HGVs/LGVs</td>
<td>• Improved human health</td>
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<tr>
<td></td>
<td>• Scrappage scheme for diesel cars.</td>
<td>• Reduction in diesel cars and non-compliant vehicle fleet</td>
<td>• Loss of some economic activity</td>
</tr>
<tr>
<td></td>
<td>• A diesel car ban over a specific small central area from 7am-3pm (except for taxis, private hire vehicles and emergency vehicles)</td>
<td>• Increased mode share of public transport</td>
<td></td>
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<td></td>
<td></td>
<td>• Increased share of active travel modes</td>
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<td></td>
<td></td>
<td>• Diverted trips and trips avoiding the charging zone and diesel car ban zone</td>
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<td></td>
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<td>• Cancelled trips</td>
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<td></td>
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<td>• Implications of behavioural change:</td>
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<td></td>
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<td>• Cost of compliance</td>
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<td></td>
<td></td>
<td>• Reduction in local NO(_2) concentrations</td>
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<td>• Potential increase in CO(_2) concentrations</td>
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<td></td>
<td></td>
<td>• Changes to capacity of highway network across BCC</td>
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<td>• Changes to location of economic activity</td>
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<td></td>
<td></td>
<td>• Decrease in value of diesel cars and non-compliant vehicles in the local area</td>
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<td></td>
<td></td>
<td>• ‘Neutralised’ negative impacts on Small and Medium-sized Enterprises (SMEs) / micro businesses and disadvantaged groups</td>
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</table>

### 2.11 Conclusions

Evidence from local monitoring data indicates that there are widespread exceedances of the Limit Value and Air Quality Objective for NO\(_2\) across Bristol. Defra predicts that without further action exceedances will exist beyond 2020, but local assessments suggest that compliance would not naturally occur until 2030. Due to the forecast air quality exceedances Bristol City Council has been directed by the Minister to produce a Clean Air Plan to achieve air quality improvements in the shortest possible time.

The Clean Air Plan fits well with the objectives of existing policies in the region, including the JTS and JSP. The measures proposed within the Clean Air Plan are likely to be complimentary to existing policy objectives and to support wider transport initiatives. Bristol City Council is working closely with WECA to ensure that emerging policy also reflects the magnitude of the air quality problem and the urgent need to address it.

Any intervention will have impacts across the region which are both positive and negative. There are likely to be benefits to public health, and also possibly a reduction in congestion and the associated impacts. Conversely, there is a risk that the chosen measures could increase carbon or particulate matter emissions, or negatively impact the economy or vulnerable groups. In addition, the development of similar plans across the country could result in high demand for particular infrastructure or services, which the existing market cannot fulfil. The selection of measures to include within the Clean Air Plan will consider these risks and seek to mitigate them wherever possible whilst maximising the benefits.