MetroWest

Portishead Branch Line (MetroWest Phase 1)

TR040011

Applicant: North Somerset District Council
6.25, Environmental Statement, Volume 4, Appendix Series 7 Air Quality and Greenhouse Gases
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, regulation 5(2)(a)
Planning Act 2008

Author: CH2M
Revision: Version 2
Date: May 2020

NetworkRail | West of England Local Enterprise Partnership | West of England Combined Authority | HM Government | Bath & North East Somerset Council | Bristol City Council | North Somerset Council | South Gloucestershire Council | travelwest

Notice

Document history

Project	Portishead Branch Line (MetroWest Phase 1) Development Consent Order Scheme
Planning Inspectorate Scheme Reference	TR040011
Part and Application Document Reference	6, 6.25
Document title	Environmental Statement, Volume 4, Appendix 7.1 Construction Dust Assessment Appendix 7.2 Air Quality Modelling Methodology Appendix 7.3 Air Quality Model Verification, Appendix 7.4 Air Quality Modelling Results Appendix 7.5 Climate
Regulation Number	Regulation 5(2)(a)
Applicant	North Somerset District Council
Lead Author	KT at CH2M

Version	Date	Status of Version
01	08/11/19	Application Issue
02	28/05/20	Revised modelling to address comments by Bristol City Council in Appendices 7.2, 7.3 and 7.4. Update cross referencing in Appendix 7.5.

MetroWest+

Portishead Branch Line (MetroWest Phase 1)

TR040011

Applicant: North Somerset District Council
6.25, Environmental Statement, Volume 4, Appendix 7.1 Construction Dust Assessment
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, regulation 5(2)(a)
Planning Act 2008

Author: CH2M

NetworkRail | West of England Local Enterprise Partnership | West of England Combined Authority | HM Government | Bath & North East Somerset Council | Bristol City Council | North Somerset Council | South Gloucestershire Council | travelwest

Table of Contents

Tables

Abbreviations

AQMA	Air Quality Management Area
AQO	Air quality objective
AWT	Avon Wildlife Trust
BWNS	Bristol Wildlife Network Sites
DCO	Development Consent Order
ES	Environmental Statement
HDV	Heavy duty vehicle
IAQM	Institute of Air Quality Management
NCN	National cycle network
NNR	National Nature Reserve
NO_2	Nitrogen dioxide
NSIP	Nationally significant infrastructure project
NSWS	North Somerset Wildlife Site
PM_{10}	Particular matter smaller than 10µ diameter
RRV	Road rail vehicle
SAC	Special Area of Conservation
SNCI	Site of Nature Conservation Interest
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest

SECTION 1

Introduction

1.1.1 The air quality impacts of construction dust and vehicle emissions during the construction of the Portishead Branch Line (MetroWest Phase 1) Development Consent Order Scheme ("the DCO Scheme") have been considered following the Institute of Air Quality Management's *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014). Individual considerations for four construction activities are discussed in the guidance: demolition, earthworks, construction and track-out.

1.1.2 The aims of the assessment are to determine the risk of dust impacts from each construction activity and identify the level of mitigation required.

1.1.3 To allow mitigation measures to be applied to construction work in a coherent and consistent way, the DCO Scheme has been subdivided into areas of similar activity requiring similar intervention:

- Portishead station and surrounds
- Construction of the railway between Portishead and Portbury Junction along the disused line
- Construction of works along the operating railway between Portbury Junction and Ashton Junction.

1.1.4 Following the IAQM (2014) approach, the following steps are required:

- Estimate the magnitude of dust emissions based on the scale of the activity.
- Define the sensitivity of the area(s) surrounding the construction site to specific dust impacts - dust soiling of areas and property, human health and ecological impacts.
- Combine the magnitude of emissions and overall sensitivity of the area to the dust impacts to determine the overall risk of dust impacts.
- Specify an appropriate level of dust mitigation based on the risk assessment.

SECTION 2

Assessment Methodology

2.1 Magnitude of dust emissions

2.1.1 The dust emission magnitude is based on the scale of the anticipated works and is classified as Small, Medium, or Large. Dust emissions are defined according to the scale and nature of the work for each activity, as shown in Table 2.1 below.

Table 2.1: Quantitative Determination of the Magnitude of Dust Emissions for each of the Four Demolition and Construction Activities

Activity	Dust Emission Magnitude
Demolition	Large: Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level; Medium: Total building volume 20,000 m^3 to 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and Small: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10 m above ground, demolition during wetter months.
Earthworks	Large: Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes; Medium: Total site area 2,500 m^2 to 10,000 m^2, moderately, dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m - 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes; and Small: Total site area <2,500 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <20,000 tonnes, earthworks during wetter months.
Construction	Large: Total building volume >100,000 m^3, on site concrete, batching, sandblasting; Medium: Total building volume 25,000 m^3 to 100,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching; and Small: Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

Table 2.1: Quantitative Determination of the Magnitude of Dust Emissions for each of the Four Demolition and Construction Activities

Activity	Dust Emission Magnitude
Track-out	Large: >50 HDV (>3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m; Medium: 10-50 HDV (>3.5 t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m; and Small: <10 HDV (>3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m.

Source: Institute of Air Quality Management ("IAQM"), Guidance on the assessment of dust from demolition and construction, February 2014.

2.2 Sensitivity of Areas Affected by Construction Dust

2.2.1 The sensitivity of areas to different types of impacts from construction dust depends on a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM_{10} considered as part of the impact on human health, the local background concentration, and
- site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

2.2.2 The two types of sensitive receptors that may be impacted by dust from construction activities, as defined by IAQM (2014), are human and ecological. A receptor is defined as, "*A location that may be affected by dust emissions during demolition and construction. Human receptors include locations where people spend time and where property may be impacted by dust. Ecological receptors are habitats that might be sensitive to dust"* (Section 2 in IAQM 2014).

2.2.3 The guidance refers to human receptors as those properties that may be subject to adverse impacts of dust or PM_{10} over a time period relevant to the air quality objective. Specific properties include, dwellings, cultural heritage collections such as museums, and food manufacturers.

2.2.4 While consideration should be given to the number of human receptors, IAQM (2014) does not require precise counting but recommends that judgement is used to estimate the approximate number of receptors within distance bands. For example, a single dwelling is classified as one receptor, whereas a school counts as 100.

2.2.5 Ecological receptors comprise designated sites, habitats and plant assemblages susceptible to dust. Consideration may be given to sites designated at the European, national and local level.

2.2.6 The sensitivity of receptors is classified into High, Medium or Low. IAQM (2014) advises that there is no specific classification system for the sensitivity of receptors, but does provide guidelines as illustrated in Table 2.2.

Table 2.2: Definitions of Sensitivities of Receptors to Dust Impacts

Impact	Sensitivity	Types of Receptors
Sensitivities of people to dust soiling effects	High	Locations where people can expect a high level of amenity value. The appearance, aesthetics or value of a property would be diminished by soiling and the property would be occupied permanently or for extended periods. EG: residential property, museums, and other culturally important collections, car showrooms, and long term car parks.
	Medium	Locations where people can expect a reasonable level of amenity, but not reasonably expect to enjoy the same level of amenity as in their home; or where the appearance, aesthetics or value of the property could be diminished by soiling; or the occupants would not reasonably be expected to be present continuously or regularly for extended periods as part of the normal pattern of use of the land. EG: parks or places of work.
	Low	The enjoyment of the amenity would not reasonably be expected; or the property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern or use of the land. EG: playing fields, farmland (except commercially-sensitive horticulture), footpaths, short term car parks and roads.
Sensitivities of people to the health effects of PM10	High	Locations where members of the public are exposed over a time period relevant to the air quality objective ("AQO") for PM_{10}, e.g. 8 hrs / day for the 24-hr objective. EG: residential property, hospitals, schools, and residential care homes.

Table 2.2: Definitions of Sensitivities of Receptors to Dust Impacts

Impact	Sensitivity	Types of Receptors
	Medium	Locations where workers are exposed over a time period relevant to the air quality objective for PM_{10}. EG: office and shop workers, but excluding workers occupationally exposed to PM_{10} as protection is covered by Health and Safety at Work legislation.
	Low	Locations where human exposure is transient. EG: public footpaths, playing fields, parks and shopping streets.
Sensitivities of receptors to ecological effects	High	Internationally and nationally designated sites and designated features that may be affected by dust soiling; or a location where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List for Great Britain. EG: Special Area of Conservation (“SAC”), Special Protection Areas (“SPA”), Ramsar sites and Sites of Special Scientific Interest (“SSSI”) designated for dust-sensitive habitat or features.
	Medium	Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or locations with a national designation where the features may be affected by dust deposition. EG: SSSIs with dust sensitive features.
	Low	Locations with a local designation where the features may be affected by dust deposition. EG. A local Nature Reserve with dust sensitive features.

Source: Institute of Air Quality Management, Guidance on the assessment of dust from demolition and construction, February 2014.

2.2.7 The sensitivity of land and property to dust soiling is determined by: the sensitivity of the receptor, the number of receptors, and four distance bands from the source of construction dust, as shown in Table 2.3.

Table 2.3: Sensitivity of Areas to the Effects of Dust Soiling

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Source: Institute of Air Quality Management, Guidance on the assessment of dust from demolition and construction, February 2014.

2.2.8 The sensitivity of areas to human health impacts is determined by: the sensitivity of the receptor, the annual mean dust concentration as measured by PM_{10}, the number of receptors, and five distance bands from the construction source, as shown in Table 2.4.

2.2.9 Estimated PM_{10} concentrations for the study area were obtained using Defra background maps (https://uk-air.defra.gov.uk/data/laqm-background-home) for the base year of the DCO Scheme (2013); the base year pollutant concentrations are considered the worst case, assuming improvements in air quality following stricter regulation in the future. The values used for each part of the project are detailed in the sections below.

Table 2.4: Area Sensitivity to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentrations	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m^3	>100	High	Medium	Low	Low	Low

Table 2.4: Area Sensitivity to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentrations	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Source: Institute of Air Quality Management, Guidance on the assessment of dust from demolition and construction, February 2014.

2.2.10 The sensitivity of areas to the ecological impacts of construction dust is determined by: the receptor sensitivity, the number of receptors and two distance bands from the source of construction dust, as shown in Table 2.5.

2.2.11 Construction and demolition impacts on designated sites may include physical changes that can affect photosynthetic processes, or chemical changes to the soil that may lead to plant loss. Impacts are often reversible after the construction work ceases.

Table 2.5: Area Sensitivity to Ecological Impacts

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
	High	High
High	High	Medium
	Medium	Low
Medium	Medium	Low
Low	Low	Low

Source: Institute of Air Quality Management, Guidance on the assessment of dust from demolition and construction, February 2014.

2.3 Evaluation of the risk of dust impacts

2.3.1 The dust emissions magnitude and area sensitivities are combined in order to determine the overall risk of dust impacts with no applied mitigation, for each construction activity within each zone as shown in Table 2.6. The level of risk determined by this table determines the level of mitigation to be followed at the construction site.

Table 2.6: Risk of Impacts from each Activity

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks and Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Source: Institute of Air Quality Management, Guidance on the assessment of dust from demolition and construction, February 2014.

2.4 Emissions from Construction Vehicles

2.4.1 Emissions from construction vehicles also need to be considered as they are a potential source of both NO_2 and PM_{10}. According to the IAQM guidance, where high numbers of vehicle movements, especially lorries, are expected to be generated over a long period of time (i.e. one year or more) in the same location, the impact of construction phase traffic should be also considered and assessed using the same methodology described for operational impacts.

SECTION 3

Assessment of Potential Effects

3.1 Overview of the DCO Scheme

3.1.1 A detailed description of the DCO Scheme and the proposed construction methodology is provided in the Environmental Statement ("ES") Chapter 4 Description of the Proposed Works (DCO Document Reference 6.7).

3.1.2 The DCO Scheme comprises a 13.7 km section of railway. The works are subdivided into the Nationally Significant Infrastructure Project ("NSIP") works and the Associated Development works. The DCO Scheme Order limits identify the land-take required for the permanent works, temporary works and land rights needed to deliver the railway infrastructure, rail stations, car parks, pedestrian / cycle / highway infrastructure and maintenance compounds from Portishead to Ashton Junction in south Bristol.

3.1.3 The NSIP works comprises a 5.633 km section of the railway from a new station at Portishead to Portbury Dock Junction, connecting onto the existing Portbury Freight Line with a new junction (Pill Junction), near Pill Viaduct, and the slewing of the existing operational railway through Pill to accommodate the new line.

3.1.4 The Associated Development works comprise:

- a new railway station at Portishead;
- car parks, pedestrian / cycle / highway infrastructure at Portishead including re-alignment of Quays Avenue and a new pedestrian and cycle bridge near Trinity Primary School;
- re-opening the former Pill station (southern platform) including demolition of the existing station house for a new station forecourt; earthworks to the cutting slope, a new ramp and staircase from the entrance to the reconstructed southern platform, lighting and shelter on the southern platform, and an emergency refuge area; a separate main car park; and highway infrastructure;
- new permanent maintenance compounds from Portishead to Pill Junction;
- temporary construction compounds between Portishead and Ashton Junction;
- works to upgrade the existing Portbury Freight Line from Royal Portbury Dock to Ashton Junction, to enable operation of both passenger train and freight train services; and associated works to pedestrian / cycle / highway infrastructure including modifications to the national cycle network 26 ("NCN26");
- Ashton Vale level crossing will remain operation, and there will be no alternations to the level crossing itself, but the following works are proposed to reduce the highway traffic impact form the increased use of the level crossing:

- Extension of the left turn lane on Winterstoke Road,
- Optimisation of the Ashton Vale Road signals; and
- Provision of the pedestrian ramp from Ashton Vale Road to Ashton Road.

3.1.5 The construction dust assessment for the DCO Scheme is based on available information and does not include items for which the design is not yet complete or developed to a suitable level to provide more detailed information (e.g. the number and type of equipment, the number of heavy duty vehicles ("HDV") that will be used to transport materials and waste). The assessment is based on distance bands from the construction areas as specified in IAQM (2014) guidance. However, it excludes the construction compounds, on the assumption that the working surface will comprise hard core. Dust emissions from vehicle movements are typically only a concern on unpaved surfaces (IAQM, 2014).

3.1.6 In addition, Network Rail will undertake permitted development works which do not form part of the DCO Application, comprising:

- the Parson Street Junction upgrade (including signalling cabling/equipment to Ashton Junction) and Liberty Lane Sidings,
- Bedminster Down Relief Line (partial re-instatement),
- removal of interlock between existing signals at Holesmouth Junction on the Severn Beach line to allow for the increase in trains movements, and
- Bathampton Turnback.

3.1.7 The construction impacts of the permitted development works have not been considered in this assessment for the DCO Scheme.

3.1.8 Similar sections of the works are expected to require similar dust mitigation measures, so the DCO Scheme has been divided into sections based on the type of work being undertaken (station works or rail line), the setting (urban or rural) and status of the existing line (redundant or active). The selected sections are:

- Portishead Station and Surrounds
- Portishead to Portbury Junction, and
- Portbury Junction to Ashton Junction.

3.2 Portishead Station and Surrounds

The Proposed Construction Works

3.2.1 The works in Portishead include highway works to re-align Quays Avenue, construction of the new station and two car parks, construction of the railway line between the station and the outskirts of Portishead, a new pedestrian and cycle bridge over the railway, pedestrian and cycle links from the station into the town centre and landscaping works.

3.2.2 Early re-alignment of Quays Avenue would release land for a temporary construction compound within what will become the car park in front of the new station and provide access to the railway corridor to re-build the railway, the new pedestrian/cycle crossing near Trinity Primary School, and the new station.

3.2.3 The highway works involve removal of the black top, diversion of utility services, minimal earthworks, re-forming the carriageways, new line marking and kerbing. The construction of the railway will include removal of the existing rails, sleepers and ballast, diversion of utilities, construction of the pedestrian bridge, and re-laying new ballast, rails and sleepers. The construction of the new station will comprise piling, *in situ* and precast concrete works, erection of a steel framed structure and masonry walls for the main body of the building, and fittings.

Define the Potential Dust Emission Magnitude

3.2.4 An assessment of the expected magnitude of impact for dust emissions for each construction phase is provided below.

- **Demolition:** Information on the total volumes to be demolished is not available. Such activities are not expected to be very large as there are no structures, besides roads and the existing unused track, on the site of the future station. The volume to be demolished is assumed to be below 20,000 m^3. Dust emissions may arise from the removal of the existing disused track and the current road alignments i.e. the Quays Avenue-Phoenix Way roundabout, involving potentially dusty materials. In particular the roundabout will be relocated to make room for the new station. Although the total volume would suggest a low magnitude, the presence of dusty material means that the magnitude of dust emissions resulting from demolition has been classified as **medium**.
- **Earthworks:** The Portishead station construction site surface, including Quays Avenue and Phoenix Way roundabout and the associated construction compounds, is around 30,000 m^2. The surrounding soil type is assumed to be moderately dusty and excavation activities expected in the carpark and Trinity Primary School Bridge construction plans include the use of up to two 25 t excavators and two 2 0t bulldozers[1]. In addition, 5-10 heavy earth moving vehicles are assumed to be active during construction activities. The areas outside the protected vegetation zones will be de-vegetated to facilitate the works. Considering there is no available information relating to the total material, and following a conservative approach, the magnitude of dust emissions from earthworks is considered to be **large**.
- **Construction:** Construction of the new station, including new road alignments, and a car park, is a large portion of the overall activities that will take place at this site. The total building volume is expected to be well under 100,000 m^3. Specific information on the materials that will be used and on site construction activities are unknown at this stage. However, equipment to be used will include hammer rigs, cranes, bulldozers and rollers, all of which may create dust. Emissions from

[1] As reported in the Construction Plan Categorised List

activities carried out in the associated construction compounds are expected to be limited. Therefore the dust emissions magnitude for construction has been defined as **medium** based on the building volume.

- **Track-out:** The exact numbers of HDV movements from the construction site is unknown at this stage. Construction plans indicate that HDVs will be used often to transport materials, including earth, ballast, tarmac, station parts and fill for pedestrian and cycle bridge ramps, to/from the site and the temporary construction compounds in the station car park, at Sheepway and off the A369 Portbury Hundred. Following a conservative approach, an estimate of more than 50 outward movements of HDVs per day is assumed. The surface of the roads the HDVs travel on also influences the dust emissions magnitude of track-out activities. Assuming that movements will be on paved roads between the work site through Portishead to the main construction camp off the A369 Portbury Hundred, on unpaved roads within the work site as well as along the disused line, and the total HDV movement estimate, the dust emissions magnitude for track-out has been classified as **large**.

Define the Sensitivity of the Area

3.2.5 The majority of the receptors identified within each of the distance bands comprise residential dwellings, both individual homes and blocks of flats. There are a number of other properties where members of the public may be exposed for eight or more hours in a day. These include two supermarkets, a shopping centre, two hotels, a health centre, a nursing home, a leisure centre, and a number of offices and warehouses. Trinity Primary School is located within the 100 m band of the site, which according to IAQM (2014) counts as 100 additional receptors within that band. A map of the site with the five associated IAQM buffers is shown in the ES Volume 3, Figure 7.4 Sheet 1 (DCO Document Reference 6.24). The sensitivity of receptors for dust soiling and human health is considered to be **high** based on Table 2.2. There are no sensitive ecological receptors in proximity to the Portishead station construction site.

3.2.6 Table 3.1 provides an estimate of the number of receptors at five different distance bands from the construction site, and the sensitivity of areas for both dust soiling and health impacts assuming high sensitivity receptors (refer back to Tables 2.3 and 2.4).

3.2.7 According to Table 2.3, with 20 high sensitivity receptors within 20 m of the construction site the area sensitivity to the effects of dust soiling is **high**.

3.2.8 The average background PM_{10} concentration around Portishead station is 15 µg/m^3 based on Defra background maps. Exceedances of the 24-hour objective are unlikely at annual mean concentrations of less than 24 µg/m^3 (Defra, 2009)[2]. Table 2.4 shows that with an annual mean concentration of PM_{10} less than 24 µg/m^3 and the estimated numbers of receptors, the area sensitivity for human health is **low** for all distance bands.

[2] Defra, Local Air Quality Management - Technical Guidance LAQM.TG(09), February 2009.

Table 3.1: Area sensitivity to relevant construction impacts for Portishead station based on number of receptors and distance from the source

Distance from Source (m)	Approximate Number of Receptors	Area Sensitivity	
		Dust Soiling	Human Health
20	20	High	Low
50	60	Medium	Low
100	> 210	Low	Low
200	> 310	-	Low
350	> 410	Low	Low

3.2.9 The highest area sensitivity to dust soiling and human health (Table 2.6) was used to determine the overall sensitivity of the area to each of the four construction activities (Table 3.2). Overall the Portishead area is expected to have a high sensitivity to dust soiling and a low sensitivity to human health.

Table 3.2: Overall sensitivity of the potentially impacted area to dust soiling and human health

Potential Impact	Overall Sensitivity of the Potentially Impacted Area			
	Demolition	Earthworks	Construction	Track-out
Dust Soiling	High	High	High	High
Human Health	Low	Low	Low	Low

Define the Risk of Dust Impacts

3.2.10 Following IAQM guidance (2014), information sourced from the Construction Strategy (DCO Document Reference 5.4) and professional judgement have been used to estimate the dust emission magnitude for each activity (see paragraph 3.2.4). The emission magnitude was then combined with the overall sensitivity of the area (see paragraph 3.2.9) to classify the risk of impacts with no mitigation applied. Table 3.3 summarises the assessed dust risk for each activity.

Table 3.3: The overall risk of dust impacts for each of the construction activities

Potential Impact	Overall Risk of Dust Impacts			
	Demolition	Earthworks	Construction	Track-out
Dust Soiling	Medium Risk	High Risk	Medium Risk	High Risk
Human Health	Low Risk	Low Risk	Low Risk	Low Risk

3.2.11 The demolition works were estimated to result in medium magnitude of emissions, for high sensitivity area to dust soiling and a low sensitivity area for human health resulting in a **medium risk** for dust soiling and a **low risk** for human health without mitigation.

3.2.12 The earthworks were estimated to result in a large magnitude of emissions for high sensitivity area to dust soiling and a low sensitivity area for human health resulting in a **high risk** for dust soiling and a **low risk** for human health without mitigation.

3.2.13 The construction works were estimated to result in medium magnitude of emissions for high sensitivity area to dust soiling and a low sensitivity area for human health resulting in a **medium risk** for dust soiling and a **low risk** for human health without mitigation.

3.2.14 The track-out works were estimated to result in a large magnitude of emissions for high sensitivity area to dust soiling and a low sensitivity area for human health, resulting in a **high risk** for dust soiling and a **low risk** for human health without mitigation.

3.3 Portishead to Portbury Junction

The Proposed Construction Works

3.3.1 The section between Portishead and Portbury Junction largely covers the much of the NSIP works to remove some 4.762 km of the existing redundant track bed and build a new railway line through a predominantly rural landscape. The railway engineering works include:

- replace the track formation,
- repair or replace culverts,
- repair or replace bridges and other structural assets,
- minor earthworks and alterations to cuttings,
- install signalling, electrical and communication systems,
- install noise barrier(s),
- the relocation of Openreach cables and
- fencing.

3.3.2 Two principle temporary construction compounds are proposed, one located between the dis-used railway and the A369 Portbury Hundred near Sheepway and one by Lodway Farm to the west of Pill. A small construction compound will also be located at Sheepway on the north side of the disused corridor. There may also be access along the railway corridor to the temporary construction site at the proposed Portishead station car park.

3.3.3 It is proposed to implement one-way haulage routes to minimise the need for vegetation clearance within the railway corridor while providing sufficient space for construction and haulage. There are several options for the movement of old ballast from site to engineering trains which would carry the ballast to a Network Rail handling depot. These are discussed in the ES Chapter 4 Description of the Proposed Works (DCO Document Reference 6.7). The worse case scenario would be to remove the old ballast from the railway corridor and store it temporarily at the Portbury Hundred and Lodway construction compounds prior to onward disposal possibly via rail.

3.3.4 The timing of the works and the working front may vary along this section, depending on the works schedule, potentially affecting different receptors at different times.

Define the Potential Dust Emission Magnitude

3.3.5 An assessment of the expected magnitude of dust impact for each construction phase is provided below.

- **Demolition:** Works on this section of the DCO Scheme include replacing the disused track, culverts and where possible to repair rather than replace existing structures. Information on the total volumes to be demolished/removed is not available. Dust emissions may arise from the use of rail saws, road-rail vehicles ("RRV"), excavators, dumpers, HDVs and cranes. However, it is expected that such activities will be very minimal as most work will concern improvements to the railway line. Therefore the magnitude of dust emissions resulting from demolition is expected to be **small**.
- **Earthworks:** Major earthworks are not expected along this section of the line; however, replacing the existing disused track will include trackbed preparation activities. The soil type is unknown, but expected to be moderately dusty and the number of HDV movements is also unknown. Of most concern to dust impacts will be the excavation of the existing trackbed, which will include removing ballast, steel rail, vegetation, timber sleepers and general spoil. The quantities of materials to be excavated is estimated to be 15,000 m^3, which may bulk up on excavation to 20,000 m^3. Based on the presence of moderately dusty material and volume of material moved, the magnitude of dust emissions from earthworks is considered to be **medium**.
- **Construction**: The total building volume is expected to be well under 100,000 m^3. For the construction of formation and ballast and for the installation of new sleepers and permanent way, two main options have been considered:
  - Option 1 – using off-track plant along the track formation;
  - Option 2 – using off-track plant along temporary constructed haul road.

  The assessment has been based on Option 2, which is the most conservative option in terms of expected emissions to air. The dust emissions magnitude for construction has been defined as **large**.
- **Track-out**: Track-out could generate the greatest potential impact along this section of the DCO Scheme as all stages of construction activity will include the need for HDVs to haul various materials and wastes to and from the construction compounds. The number of HDV movements from the construction site is unknown at this stage, but it is assumed that, for a limited period of time, more than 50 outbound HDVs per day could occur. The haulage routes on the highway network are paved and will not result in significant emissions; however, there will be unpaved haul routes in rural areas and within the works site. Therefore, the dust

emissions magnitude for track-out has been classified as **large**. Different solutions have been proposed to remove contaminated ballast and formation but the difference in terms of potential associated emissions to air are small and do not affect the assessment.

Define the Sensitivity of the Area

3.3.6 This part of the DCO Scheme passes through the outskirts of Portishead and then through a rural area, with farm houses and cottages and small settlements, to the outskirts of Pill. A number of the rural dwellings are Grade II Listed Buildings. The disused railway passes a large industrial complex at Portbury Royal Dock as it approaches Pill, where there are extensive industrial and commercial buildings, and also large outdoor storage areas, currently principally used for the temporary storage of imported vehicles. The sensitivity of receptors to both dust soiling and human health is considered to be high (see Table 2.2).

3.3.7 There are three ecologically designated sites of international or national importance within 100 m of the DCO Scheme in the lower reaches of the River Avon in Pill.

- The internationally designated Severn Estuary Ramsar site is designated for its waders and waterfowl. Overwintering bird surveys in the vicinity of Pill found that there were very low numbers of birds in the designated area, which was attributed to the high levels of disturbance from the M5 traffic and dog walkers along the foreshore (see the ES, Appendix 9.3b, DCO Document Reference 6.25). The Report to Inform Habitats Regulations Assessment (see the ES, Appendix 9.12, DCO Document Reference 5.5) concluded that the DCO Scheme is not considered to have a significant impact on the integrity of the designated site. This designation is not considered further in the assessment of construction dust.
- The Severn Estuary SPA is designated for its over-wintering assemblage and numbers of various birds. As above, the overwintering bird survey and Habitats Regulations screening report conclude that the DCO Scheme will not significantly affect bird life or the integrity of the site. This designation is not considered further in the assessment of construction dust.
- The nationally designated Severn Estuary SSSI supports habitats for fens, marshes, swamps and neutral grasslands where designated features may be sensitive to dust impacts. This site is taken forward for the construction dust assessment and is classified as high sensitivity in accordance with the IAQM guidance (see Table 2.2).

3.3.8 There are eight local wildlife sites within 50 m of construction sites along the disused section of the railway line between Portishead and Pill, which are summarised in Table 3.4 below. These are accorded a low sensitivity value (see Table 2.2) and need not be considered further in the assessment.

3.3.9 A map of the construction site with the five associated IAQM buffers and construction sites is shown in the ES, Volume 3, Figure 7.4 Sheet 2 (DCO Document Reference 6.24).

Table 3.4: Local Wildlife Sites, SNCIs, and Nature Reserves within 50 m (ordered by distance from the Portishead to Pill disused line)

Designated site	Qualifying features	Distance
Portbury Wharf Nature Reserve North Somerset Wildlife Site ("NSWS") (Avon Wildlife Trust ("AWT") Nature Reserve from 2010-2015)	Marshy grassland, open water and associated habitats and species	0 m
Field east of M5 Motorway, Lodway NSWS	Marshy grassland and semi-improved neutral grassland	0 m
Drove Rhyne and adjacent fields NSWS	Swamp, standing water (ditches), and semi-improved neutral grassland	0 m
Fields between railway line and A369, Portbury NSWS	Species rich marshy grassland	0 m
Field east of Court House NSWS	Species rich unimproved neutral grassland	0 m
Priory Farm (AWT Nature Reserve)	Wetland with reed bed	0 m
Land adjacent to Severn Estuary SSSI (Portbury) NSWS	Species rich marshy grassland	12 m
Land adjacent to Severn Estuary SSSI (Portbury) NSWS	Species rich marshy grassland	27 m
Fields between A369 and M5 Motorway, Portbury NSWS	Species rich marshy grassland. Many breeding sedge warblers and reed warblers.	40 m
Fields on Caswell Moor NSWS	Swamp, standing water (ditches), and semi-improved neutral grassland	41 m

3.3.10 Table 3.5 below provides an estimate of the number of sensitive human receptors within the five IAQM distance bands around the construction site, and the sensitivity of areas for both dust soiling and health impacts assuming high sensitivity receptors (refer back to Tables 2.2 and 2.3). The majority of these receptors are within urban areas. However, the route also passes through less densely populated rural areas. It may be appropriate to adjust the required mitigation along the route, depending on the proximity of residential and educational land use.

3.3.11 Table 3.5 indicates that the area within 50 m of the site will be highly sensitive to dust soiling impacts from construction activities. Receptors within 100 m will have medium sensitivity and those farther away will have low sensitivity to dust soiling. As a result of the low background concentration of PM_{10} (approximately 16 µg/m^3 as an annual mean), the sensitivity of human health to PM_{10} effects is not as high, with only those areas within 20 m of the site showing a medium sensitivity; receptors more than 20 m have low sensitivity to human health impacts.

Table 3.5: Area sensitivity to relevant construction impacts for the Portishead Branch Line section based on number of receptors and distance from the source

Distance from Source (m)	Number of Receptors	Area Sensitivity	
		Dust Soiling	Human Health
20	130	High	Medium
50	200	High	Low
100	350	Medium	Low
200	760	-	Low
350	1650	Low	Low

3.3.12 There is one nationally designated site located near this section of the DCO Scheme, the Severn Estuary SSSI. Table 3.6 provides the area sensitivities to ecological impacts from construction. The Severn Estuary supports important terrestrial habitats which may be adversely affected by dust deposition and is classified as high sensitivity. The area sensitivity to ecological impacts is classified as medium because the designated site is more than 20 m but less than 50 m from the construction activity.

Table 3.6: The estimated area sensitivity of designated sites near the Portishead to Pill section of the DCO Scheme

Receptor (Sensitivity)	Distance from Site (m)	
	20	50
Severn Estuary SSSI (High)	-	Medium

3.3.13 The highest sensitivity to construction impacts was used to determine the overall sensitivity of the area for each of the four construction activities; the data are shown in Table 3.7. Overall the area is expected to have a high sensitivity to dust soiling and a medium sensitivity with respect to human health and ecological impacts.

Table 3.7: Area sensitivity to impacts of each construction activity.

Potential Impact	Overall Sensitivity of the potentially impacted area			
	Demolition	Earthworks	Construction	Track-out
Dust Soiling	High	High	High	High
Human Health	Medium	Medium	Medium	Medium
Ecological	Medium	Medium	Medium	Medium

Define the Risk of Dust Impacts

3.3.14 The IAQM guidance (2014) and professional judgement have been used to estimate the dust emission magnitude for each activity (see paragraph 3.3.5). The emission magnitude was then combined with the overall sensitivity of the area (see paragraph 3.3.13) to classify the risk of impacts with no mitigation applied. Table 3.8 summarises the assessed dust risk for each activity.

Table 3.8: Overall risk of dust impacts from each construction activity.

Potential Impact	Overall Risk of Dust Impacts			
	Demolition	**Earthworks**	**Construction**	**Track-out**
Dust Soiling	Medium Risk	Medium Risk	High Risk	High Risk
Human Health	Low Risk	Medium Risk	Medium Risk	Medium Risk
Ecological	Low Risk	Medium Risk	Medium Risk	Low Risk

3.3.15 The demolition works were estimated to result in small magnitude of emissions, for high sensitivity area to dust soiling, medium sensitivity area for human health and a medium sensitivity for ecology, resulting in a **medium risk** for dust soiling and **low risk** for human health and ecology without mitigation.

3.3.16 The earthworks were estimated to result in a medium magnitude of emissions for high sensitivity area to dust soiling, a medium sensitivity area for human health and a medium sensitivity for ecology, resulting in a **medium risk** for dust soiling, human health and ecology without mitigation.

3.3.17 The construction works were estimated to result in medium magnitude of emissions for high sensitivity area to dust soiling and a medium sensitivity area for human health and ecology, resulting in a **medium risk** for dust soiling, human health and ecology without mitigation.

3.3.18 The track-out works were estimated to result in a large magnitude of emissions for high sensitivity area to dust soiling and medium sensitivity area for human health and ecology, resulting in a **high risk** for dust soiling and a **medium risk** for human health and ecology without mitigation.

3.4 Portbury Junction to Ashton Junction

The Proposed Construction Works

3.4.1 This section of the DCO Scheme comprises the associated development works along the operational freight line between Pill and Ashton Junction, including a new station and car park in Pill, various works along the operational railway line, repair works to Pill Viaduct, strengthening works to the other bridges along the Avon Gorge, modifications to Quarry Bridge No. 2, modifications to Winterstoke Road, construction of a new pedestrian and cycle ramp from Ashton Vale Road to Ashton Road, and permanent closure of Barons Close pedestrian crossing.

3.4.2 The Avon Road Bridge will be demolished and rebuilt and the western embankments will be widened, steepened and strengthened to accommodate the new line to Portishead. If the works require a large crane to lift in loads for the bridge, it will also be necessary to demolish and subsequently restore part of a wall fronting a residential property in Pill and several garages.

3.4.3 The works for Pill station include the removal of the southern dis-used platform, earthworks to enlarge the existing cutting and construction of a retaining wall, to provide space for the new platform and ramp to the station forecourt. The station forecourt will be constructed on the site of the No. 7 Station Road, following the demolition of the property.

3.4.4 A car park will be also constructed near Pill station in the former railway goods yards. Main construction activities will be site clearance, land levelling, sub-base and surfacing with asphalt.

3.4.5 The railway works from Pill Junction to Clifton Junction will include:

- Minor alterations to the track, including vertical and horizontal alignment,
- replacing sleepers, ballast cleaning, and geotechnical works,
- repair and replacement of culverts,
- minor works to tunnels,
- repairing bridges and other structural assets,
- minor earthworks and alterations to cuttings and embankments,
- geotechnical works to stabilise the cliff faces in the Avon Gorge, including stone picking, rock bolting and the erection of three catch fences,
- installing signals,
- replacing the signalling and electrical systems,
- installing a train driver communication system,
- replacing fencing along the railway corridor and
- new maintenance access points to the railway.

3.4.6 A new power supply point (“PSP”) building is required and will be incorporated into the new maintenance compound next to Pill station car park.

3.4.7 A new vehicle maintenance road rail access point will be provided off Clanage Road to the Portishead Branch Line.

3.4.8 The signalling equipment of a half kilometre section of railway from Portbury Dock to Portbury Dock Junction will be replaced on the Bristol Port Company Land.

3.4.9 The only large construction compound will be located at Lodway on the west side of Pill, which was discussed in the previous section. Given the geographical constraints of much of the railway corridor through the Avon Gorge, there will be provision for access and welfare points at intervals through the gorge. The Clanage Road site will be used as a temporary construction compound. Much of the movement of materials and wastes will be via train, with minimal movement of HGVs.

3.4.10 General information from construction plans has been used to define the magnitude of various construction activities and, in some cases, assumptions have been made on the basis of previous experience on similar projects.

3.4.11 Construction works will take place over a wide area with smaller sections having more intense work. The impacts on receptors will vary temporally and spatially along the route. Most human receptors along this section are constrained to the areas in Pill and Bristol, at either end of this section, and the ecological receptors are mainly located in the Avon Gorge.

Define the Potential Dust Emission Magnitude

3.4.12 An assessment of the expected magnitude of dust impact for each construction phase is provided below.

- **Demolition:** Some demolition works are required along this section of the DCO Scheme. No. 7 Station Road will be demolished to create the new entrance to Pill Station and there will be demolition works associated with the reconstruction of the southern platform at Pill station and cutting slope. Avon Road Bridge will be demolished and rebuilt. As described above, it may be necessary to demolish a short section of property wall and several garages. Information on the exact volumes to be demolished is not available at this time. Considering that demolition activities 10-20 m above ground level will occur and following a conservative approach, the magnitude of dust emissions resulting from demolition is expected to be **medium**.
- **Earthworks**: This section of the DCO Scheme is extensive and the total work area is well over 100,000 m^2. Slope stabilisation works are required at the Avon Road embankment at Lodway in Pill, the southern cutting slope through Pill where the station will be located, and along Mount Pleasant on the east side of Pill Viaduct. Minor modifications to the railway alignment will require the lifting and replacement of the ballast and soil improvement works where the ground is not sufficiently compacted. These sections will be constructed using conventional methods. The soil type and ballast are expected to be moderately dusty. However, this material will be moved by train and not by HDVs. Information relating to the total material to be excavated is not available. Some slope stabilisation works will be required through the Avon Gorge on the slopes above the railway, from rock picking, to rock bolting and controlled removal of unstable blocks of stone downslope. In accordance with the IAQM guidance and following a conservative approach the magnitude of dust emissions from earthworks is considered to be **large**.
- **Construction**: Construction activities along this section of the DCO Scheme will include improvements to the existing line to accommodate an additional rail service, the construction of a new entrance to Pill station and platform (which will also include improvements to the existing track), and the reconstruction of Avon Road Bridge. Minor repairs are required for many of structures along the railway. There will be on-site concrete mixing as well. The total building volume is unknown, but it is

expected to be well under 100,000 m^3. Taking into account all of these factors, the dust emissions magnitude for construction has been defined as **medium**.

- **Track-out:** The number of HDV movements from the construction site is unknown. The haulage of materials to/from the site and related construction compounds has been considered. In addition, a large portion of this section is outside the urban areas of Pill and Bristol where roads or access to the site may be unpaved. It is expected that the majority of materials and waste will be transported by rail, reducing the number of HDVs required. The materials included in the haulage, such as ballast, are assumed to be moderately dusty and the number of HDV movements is expected to be less than 50 per day. The dust emissions magnitude for track-out has, therefore, been classified as **medium.**

Define the Sensitivity of the Area

3.4.13 This section of the route passes a large number of human and ecological receptors, with the human receptors located at Pill in the west and the outskirts of Bristol in the east, and passes through or alongside a number of ecological receptors in the rural section (see the ES, Volume 3, Figure 7.4 Sheets 3 to 5, DCO Document Reference 6.24).

3.4.14 Most human receptors are dwellings; however, there are three schools and a nursery as well as several workplaces within 350 m of the construction site. In addition, there are a number of locations where the public may be subject to exposure, including community centres, post offices, religious buildings and hotels. Overall the sensitivity of human receptors to dust soiling and health impacts is considered to be **high**.

3.4.15 The railway also passes through and close to important nature conservation sites designated at the European, national and local level.

3.4.16 There is one European designated site in this section, the Avon Gorge Woodlands SAC, which is traversed by the DCO Scheme. The SAC is designated for its woodland habitat and calcareous grasslands. The SAC designation is considered to be high sensitivity (see Table 2.2). The nationally designated Avon Gorge SSSI and Leigh Woods National Nature Reserve ("NNR"), also form part of the Avon Gorge Woodlands SAC. These designations are considered to be medium sensitivity (see Table 2.2).

3.4.17 Ashton Court SSSI lies about 70 m west of the site and supports invertebrate habitats. This SSSI is accorded medium sensitivity, but as there is already a high sensitivity receptor in the form of the Avon Gorge SAC and SSSI this site is not considered further.

3.4.18 The DCO Scheme also passes close to a number of local wildlife sites which are listed in Table 3.9. Local wildlife sites are accorded low sensitivity and are not considered further as the assessment is based on the highest value site.

Table 3.9: Bristol Wildlife Network Sites ("BWNS"), North Somerset Wildlife Sites ("NSWS") and Sites of Nature Conservation Interest ("SNCI") within 50 m of the DCO Scheme between Pill and Ashton Junction

Designated site	Qualifying features	Approximate distance
Bower Ashton Playing Fields BWNS	Amenity grassland	0 m
River Avon (part of) NSWS	Saltmarsh and saltmarsh influenced grassland	0 m
River Avon (part of) SNCI	Saltmarsh habitats	0 m
Avon Gorge and Leigh Woods NSWS	Extremely diverse area including endemic species	0 m
Bower Ashton Allotments BWNS	Allotments	0 m
Land between railway line and the River Avon BWNS	Allotments and amenity grassland with trees	0 m
White City Allotments BWNS	Allotments	0 m
Alderman Moore Allotments BWNS	Allotments and scrub	0 m
Bower Ashton Line BWNS	Linear scrub and hedgerow habitat	0 m
Railway line near Bedminster Down BWNS	Linear scrub and hedgerow habitats	0 m
Bower Ashton Mineral Railway (disused) SNCI	Scrub, ruderal communities and grassland	1 m
Parson Street station BWNS	Linear scrub and hedgerow habitat	16 m
Ashton Court Estate SNCI	A mosaic of habitats including ancient trees and areas of diverse grassland	20 m
Bedminster Down Allotments BWNS	Allotments	29 m

3.4.19 Table 3.10 provides the number of sensitive human receptors within the five IAQM (2014) distance bands. Based on Table 2.2 the sensitivity of the area to dust soiling, given the number of receptors in different distance bands falls from high to low.

3.4.20 The sensitivity of the areas to dust impacts on human health considers the background PM_{10} concentrations. The average background PM_{10} concentration for this section is approximately 16 ± 2.5 μg/m^3 according to Defra background maps. Exceedances of the 24-hour objective are unlikely at annual mean concentrations of less than 24 μg/m^3.

3.4.21 Table 3.10 indicates that the greatest level of sensitivity to dust soiling is high and the greatest sensitivity of human health to PM_{10} is medium.

Table 3.10: Area sensitivity to relevant construction impacts for the operational freight line Pill to Ashton Gate based on number of receptors and distance from the source

Distance from Source (m)	Number of Receptors	Area Sensitivity	
		Dust Soiling	Human Health
20	170	High	Medium
50	500	High	Low
100	980	Medium	Low
200	1,810	-	Low
350	3,650	Low	Low

3.4.22 Table 3.11 summarises the area sensitivities to ecological impacts from construction. Each designated site is home to important species and other features that may be adversely affected by dust deposition. The sensitivity of receptors to dust varied from high to low, based on the sensitivity of the receptor and distance from the DCO Scheme.

Table 3.11: Area sensitivity to ecological impacts

Receptor (Sensitivity)	Distance from Site (m)	
	20	50
Avon Gorge Woodlands SAC (high)	High	Medium
Avon Gorge SSSI (medium)	Medium	Low
Leigh Woods NNR (medium)	Medium	Low
Ashton Court SSSI (medium)	-	Low
Local wildlife sites	Low	Low

3.4.23 The highest sensitivity to construction impacts was used to determine the overall sensitivity of the area to each of the four construction activities as are shown in Table 3.12. Overall the area is expected to have a high sensitivity to dust soiling, a medium sensitivity to human health and a high sensitivity to ecological impacts.

Table 3.12: Area sensitivity to impacts from each construction activity.

Potential Impact	Overall Sensitivity of the potentially impacted area			
	Demolition	Earthworks	Construction	Track-out
Dust Soiling	High	High	High	High
Human Health	Medium	Medium	Medium	Medium
Ecological	High	High	High	High

Define the Risk of Dust Impacts

3.4.24 Following IAQM guidance (2014), professional judgement has been used to estimate the dust emission magnitude for each activity (see paragraph 3.4.12). The emission magnitude was then combined with the overall sensitivity of the area (see paragraph 3.4.23) to classify the risk of impacts with no mitigation applied. Table 3.13 summarises the assessed dust risk for each activity.

Table 3.13: Overall risk of dust impacts from each construction activity

Potential Impact	Overall Risk of Dust Impacts			
	Demolition	**Earthworks**	**Construction**	**Track-out**
Dust Soiling	Medium Risk	High Risk	Medium Risk	Medium Risk
Human Health	Low Risk	Medium Risk	Medium Risk	Low Risk
Ecological	Medium Risk	High Risk	Medium Risk	Medium Risk

3.4.25 The demolition works were estimated to result in medium magnitude of emissions, for high sensitivity area to dust soiling, medium sensitivity area for human health and a medium sensitivity for ecology, resulting in a **medium risk** for dust soiling, **low risk** for human health and **medium** risk for ecology without mitigation.

3.4.26 The earthworks were estimated to result in a large magnitude of emissions for high sensitivity area to dust soiling, a medium sensitivity area for human health and a high sensitivity for ecology, resulting in a **high risk** for dust soiling, **medium risk** for human health and **high risk** for ecology without mitigation.

3.4.27 The construction works were estimated to result in medium magnitude of emissions for high sensitivity area to dust soiling, medium sensitivity area for human health and high sensitivity for ecology, resulting in a **medium risk** for dust soiling, human health and ecology without mitigation.

3.4.28 The track-out works were estimated to result in a medium magnitude of emissions for high sensitivity area to dust soiling, medium sensitivity area for human health and high sensitivity for ecology, resulting in a **medium risk** for dust soiling, **low risk** for human health and **medium risk** for ecology without mitigation

3.5 Emission from Construction Vehicles

3.5.1 The construction of the DCO Scheme may also affect air quality due to tailpipe emissions from haulage vehicles. According to the IAQM guidance, where high numbers of vehicle movements, especially lorries, are expected to be generated over a long period of time (i.e. one year or more) in the same location, the impact of construction phase traffic should be also considered. The assessment should be carried out using the same methodology described for operational impacts. According to the criteria, an increase in HDVs of more than 100 per day when averaged over a full year, or 25 per day within or adjacent to an air quality management area (“AQMA”), would require further consideration.

3.5.2 The current construction programme assumes that construction would commence in spring 2022 with the scheme opening in winter 2023/24. More specific information is not available at this stage, but it is considered unlikely that there will be more than 100 HDVs movements per day in the same area for one year and therefore no further assessment of construction vehicles would be required.

3.6 Overall Impact from Construction Activities

3.6.1 Following IAQM guidance for the assessment of impacts associated with the different construction phases of the scheme, the significance of impact is considered to be large for dust soiling, medium for human health and large for ecological receptors. However, with appropriate mitigation measures, short-term impacts can be avoided. Further discussion of mitigation to manage construction dust are provided in the ES, Appendix 4.1 Code of Construction Practice (DCO Document Reference 8.15) and Appendix 4.2 Master Construction Environmental Management Plan (DCO Document Reference 8.14).

3.7 Residual Impacts from Construction Activities

3.7.1 The application of mitigation measures will significantly reduce the risks for impacts related to construction works. In particular, the significance of residual effects with mitigation measures in place, is predicted to be low.

SECTION 4
References

Institute of Air Quality Management (IAQM), February 2014. Guidance on the assessment of dust from demolition and construction.

MetroWest

Portishead Branch Line (MetroWest Phase 1)

TR040011

Applicant: North Somerset District Council
6.25, Environmental Statement, Volume 4, Appendix 7.2 Air Quality Modelling Methodology
The Infrastructure Planning (Applications: Prescribed Forms and Procedure)
Regulations 2009, regulation 5(2)(a)
Planning Act 2008

Author: CH2M

Table of Contents

Tables

Figures

Abbreviations

AADT	Annual Average Daily Traffic
BCC	Bristol City Council
DCO	Development Consent Order
DM	Do Minimum
DS	Do Something
EEA	European Environment Agency
EFT	Emission Factor Toolkit
ES	Environmental Statement
HDV	Heavy duty vehicles
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NSDC	North Somerset District Council
PM_{10}	Particulate matter with a diameter less than 10 µm

SECTION 1

Air Quality Modelling Methodology

1.1 Introduction

1.1.1 This Appendix describes the methodology used to assess air quality impacts arising from the Portishead Branch Line (MetroWest Phase 1) DCO Scheme ("the DCO Scheme"). The tools and models used were the most up to date available at the time the air quality assessment was carried out in March 2016.

1.1.2 Annual mean concentrations of nitrogen oxides ("NO_x") and particulate matter smaller than 10 microns in aerodynamic diameter ("PM_{10}") were predicted using the ADMS-Roads dispersion model (version 4.1). The model uses detailed traffic information for the local road network together with meteorological data to predict pollutant concentrations at specific locations specified by the user.

1.1.3 Air quality modelling was carried out using estimated traffic emissions in various emissions scenarios. The resulting air pollutant concentrations are compared against the Air Quality Strategy Objectives and are used to predict air quality impacts from the DCO Scheme.

1.2 Meteorological Data

1.2.1 The model was run using a full year of hourly sequential meteorological data for year 2015 from the meteorological station at Bristol Filton Aerodrome, which is less than 10 km to the north-east of the DCO Scheme. Data from this station were considered to be most representative of the meteorological conditions across the study area as it was the closest meteorological site to the DCO Scheme and had the most similar terrain to the study area considered in the air quality modelling.

1.2.2 The 2015 wind rose for Bristol Filton Aerodrome is shown in Figure 1.1. The predominant wind direction is westerly.

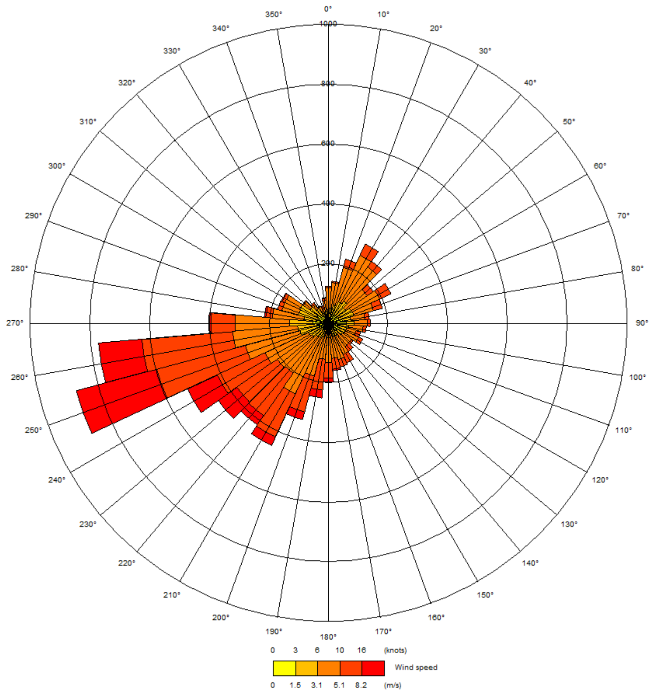

Figure 1.1: Year 2015 Wind Rose for Bristol Filton Airport

1.3 Study Area

1.3.1 The study area is described in Section 7.3 of the Environmental Statement ("ES") Chapter 7 Air Quality and Greenhouse Gases (DCO Document Reference 6.10). The transport assessment considered the whole Bristol City Council ("BCC") road network and the network in the north and east of North Somerset District Council ("NSDC"). The study area included roads that screened in against EPUK and IAQM criteria (around Portishead and adjacent to Parson Street, Bedminster and Bristol Temple Meads stations). For completeness, as well as selected receptors adjacent to the above roads, the modelling of receptors for the new passenger service between Portishead and Pill to account for all pollutant sources in the air quality modelling have also been included.

1.4 Traffic Data

1.4.1 Annual Average Daily Traffic ("AADT") flows, annual average vehicular speeds and proportion of Heavy Duty Vehicles ("HDV") on roads across the study area were based on traffic data reported in the ES, Appendix 16.1 Transport Assessment (DCO Document Reference 6.25).

1.5 Modelling Scenarios

1.5.1 The scenarios considered were:

- 2015 - Base Year;
- 2021 - Do-Minimum for the assumed Opening Year (without the DCO Scheme, no improvements along existing railway and no new rail service between Portishead and Bristol, including any committed development);
- 2021 - Do-Something for the assumed Opening Year (with the DCO Scheme, including any committed development).

1.5.2 Operational air quality impacts associated with changes in road traffic and the proposed changes to road access to the railway stations at Portishead and Pill were assessed for the study area defined in the ES Chapter 7.3 Air Quality and Greenhouse Gases (DCO Document Reference 6.10).

1.6 Background Concentrations

1.6.1 Background pollutant concentrations are spatially and temporally variable. Background NO_2 and PM_{10} concentrations representative of conditions in the study area have been established for the opening year scenario.

1.6.2 Background concentrations have been obtained from the Defra website[3] which provide predictions based on a grid at a resolution of 1 km^2 across the whole of the UK. The background concentrations used for the Base Year and Opening Year were based on the 2015 reference year background maps (published in November 2017). The background concentrations were compared against automatic background monitoring concentrations and it was determined that no adjustment was needed. Motorway, Trunk A Road and Primary A Road in-square road sector contributions were removed from the background totals based on a grid-by-grid review, applying professional judgement. Background NO_2 concentrations were adjusted following NOx sector removal using version 6.0 of the Defra NO_2 adjustment for NO_x Sector Removal tool.

1.7 NO_X to NO_2 Conversion Factors

1.7.1 Modelled diesel locomotive and road-traffic NO_2 were calculated from modelled NO_x concentrations using version 6.1 of the NO_x to NO_2 calculator. This calculator allows the derivation of NO_2 from NO_x wherever NO_x is predicted by modelling emissions from roads. The calculator can also be used to calculate the road component of NO_x from roadside NO_2 diffusion tube measurements.

1.8 Long Term Trend Gap Analysis

1.8.1 To correct for perceived over-optimism of vehicle fleet regeneration in the future year, a long term trend (LTT) gap analysis was applied to the background and road increment NO_2 concentrations, following DMRB Interim Advice Note 170/12. A Projected Base Year scenario was produced which applied Base Year traffic data with Opening Year vehicle emission rates and background concentrations. The trend in total NO_2 between the Base and Projected Base Year at each receptor is compared against Defra long term annual projection factors. This produced a gap adjustment factor, which was applied to the Opening Year DM and DS NO_2 concentrations at each receptor. The LTT adjustment resulted in either an increase or no change in the total NO_2 concentration at each receptor. The LTT adjustment was not applied to the rail contribution to the receptor NO_2 concentrations because the underlying rail emission rates were kept constant between the Base Year and Opening Year. The same approach was applied for modelled NO_x concentrations.

[3] https://laqm.defra.gov.uk/review-and-assessment/tools/tools.html,

1.9 Emission Inventory

Road Emissions

1.9.1 Vehicle emission factors for NO_x and PM_{10} for the Base Year (2015) and Opening Year (2021) have been derived from Emission Factor Toolkit ("EFT") version 8.0.1. NO_x emission factors are taken from the European Environment Agency ("EEA") COPERT 5 emission calculation tool, and take into account the real world emission performance of Euro 5 and 6 diesel cars. Vehicle emission factors for PM_{10} include emissions associated with brake and tyre wear. Vehicle fleets in v8.0.1 of the EFT were based on a 2015 reference year. All tools applied in the air quality assessment are compatible with the 2015 reference year fleets.

1.9.2 Version 8.0.1 of the EFT was applied in this assessment to allow compatibility with the 2015 Base Year. Defra released v9.0 of the EFT in May 2019, which applies 2017-projected vehicle fleets. Additional NOx emission rate calculations were estimated using the EFT v9.0 using the Opening Year traffic dataset in order to compare the influence of the updated fleets. This showed that Road NO_x emission rates calculated with v8.0.1 (this assessment) were within 1% of those calculated using v9.0 with the average differences over all links ranging between -3.5% and 2.2%. Therefore, given the relatively small margin of difference in NO_x emission rates compared to the latest tool, EFT v8.0.1 was considered to be sufficient for use in this assessment.

Railway Emissions

1.9.3 Railway emissions have been calculated for classes of trains that are considered representative for the base year and that are expected to be in service in the future. Class-specific emission factors have been sourced for passenger and freight trains from available previous studies (Hobson and Smith, 2001). An emission inventory has been produced considering the following three class of trains:

- Class 150 (two coaches);
- Class 166 (three coaches); and
- Class 66 (freight trains).

1.9.4 The emission factors for Class 150, Class 166 and Class 66 trains are shown in Table 1.1.

Table 1.1 Locomotive emission factors for NO_x, PM_{10} and CO_2. Sourced from Hobson and Smith (2001).

Locomotive	**Class 150**			**Class 166**			**Class 66 (Freight)**		
Pollutant	NO_x	PM_{10}	CO_2	NO_x	PM_{10}	CO_2	NO_x	PM_{10}	CO_2
Emission Factor (g/km)	32.6	1.1	3202	30.3	1.0	2979	120	2.9	19147

1.9.5 According to project information, the DCO Scheme is also expected to have Class 165 (two coaches) trains on service. Emissions factors associated with diesel locomotives Class 166 (three coaches) are higher than those estimated for locomotives Class 165. In the absence of more specific information regarding the ratio of Class 165 to Class 166 and following a conservative approach, the modelling exercise has been carried out assuming that all additional trains on service will be Class 166 (three coaches).

1.9.6 To represent the variability of emissions related to the number and type of trains in service on different lines, hourly emission profiles have been derived for each line considered, class of train and scenario. The time-varying emissions factor files were based on actual train time tables and preliminary scheme information. These have been incorporated into the ADMS model to represent railway-associated emissions from the existing and the future railway lines.

1.9.7 The modelling of local air quality impacts considered emissions from the DCO Scheme associated with trains idling while in the stations. Passenger trains approaching and stopping at Portishead Station were med to be limited to 6 minutes for the assessment but is is proposed that the dwell time will be around 3 minutes. The emissions associated with the 6 minute idling time contributed approximately 5% of the rail NO_x emissions at Portishead station. The associated effects on NO_2 and PM_{10} concentrations at receptors were negligible.

Regional Emissions

1.9.8 In addition to emission rates estimated for the local air quality assessment, the total annual emissions of NO_x, PM_{10} and CO_2 were calculated over a core and refined regional study area. The core regional study area was defined as the full traffic reliability area, as described in Section 7.3 of the ES Chapter 7 Air Quality and Greenhouse Gases (DCO Document Reference 6.10). The regional assessment considers road and rail emission sources and it should be noted that the study areas differ between the two transportation methods.

1.9.9 It has been agreed with BCC that regional emissions would only be reported for the Opening Year (2021) in the core assessment as a result of uncertainty in emission factors in future years beyond 2030. It should be noted that a year 2023 scenario is included in the refined estimates of the annual road emissions as described below. The regional emissions from road sources were calculated over the defined study area using the annual link emission function of the DEFRA Emission Factor Toolkit (version 8.0.1). The emission calculations take account of changes in the traffic data (daily flows, HDV and average speeds) between the Do Minimum (“DM”) and Do Something (“DS”) scenarios, as well as road link length.

1.9.10 Regional rail emissions were estimated based on emission factors for various locomotives operating 40 services per day between Portishead and Parson Street Station and onto Bristol Temple Meads. The rail emissions for each route section are calculated as the product of emission factors, the number of journeys and journey distance. Emissions were estimated for the rail component based on the assumption that the emission factors used in the models for passenger and freight trains do not change in future year scenarios. In accordance with the local air quality assessment, rail emission factors are applied from Hobson and Smith (2001). The regional emission calculations did not include train idling time. This was considered to be acceptable given that the influence of idling was found to be negligible in the local air quality assessment.

1.9.11 To complement the core regional emission calculations described above, the emission calculations have been further refined to isolate potential benefits arising specifically from the new Portishead to Bristol Temple Meads rail branch of the DCO Scheme. The refined rail emissions consider 40 services per day on just the new Portishead to Bristol Temple Meads line,. Refined rail emissions are calculated for a scenario using emission factors for existing diesel trains (Hobson and Smith, 2001) and for a further scenario that applies emission factors assuming a Class 165 HyDrive train is operated. The calculation with the Class 165 HyDrive emission factors is intended to indicate the emission changes that would accompany a switch from conventional diesel to hybrid propulsion units operating on the new rail line. In a final rail scenario, emissions are calculated with HyDrive emission factors reduced by 20% (i.e. a 20% improvement in fuel consumption and a 20% reduction in NOx and PM_{10} emission factors).

1.9.12 The refined regional emission calculations also apply a more specific approach for calculating road-based emissions from the new Portishead to Bristol Temple Meads line. The reduction in vehicle kilometres associated with the opening of the new rail line was calculated over Portishead and Pill using rail demand forecasts at rail stations in combination with journey distance and times extracted from the GBATS4 Saturn model. This produces the decrease in vehicle kilometres, apportioned into six average speed brackets. The annual emissions for a 1 km road with a default "Basic Split" fleet mix was calculated with each average speed using the EFT (2018, v8.0.1). A speed-weighted approach was then applied by multiplying the emissions for these 1 km sections of road by the number of vehicle kilometres in their respective speed brackets. The refined annual road emissions were calculated separately for year 2021 and year 2023 conditions, whereby the number of vehicle kilometres, average speeds and emission factors are varied. The vehicle kilometre and average speeds for 2023 were calculated by interpolating between modelled values for 2021 and 2036.

1.10 Air Quality Assumptions

1.10.1 Table 1.2 lists the assumptions that have been made in order to complete the assessment of construction and operational impacts on air quality for the Portishead Branch Line DCO Scheme from Portishead station to Ashton Junction.

Table 1.2: Construction and operational assumptions – DCO Scheme

Topic / Area	Assumption
Train types	Addition of diesel powered trains on three local train lines. All trains will be Class 166 with three carriages. These are the worst-case type of train in terms of available reported emission factors.
Operating times and number of trains	20 passenger trains in each direction per day (Monday - Saturday), with 10 passenger trains in each direction on Sundays. The number of freight trains using the line varies. No assumptions have been made with regard the number of freight trains as these are accounted for within the baseline measurements, and are not expected to be different in Opening Year.
Turnaround/dwell times	Trains approaching and stopping at Portishead Station were assumed to take 6 minutes in our assessment (although a dwell time of 3 minutes has been proposed). A 30 seconds dwelling time was assumed at Pill Station.
Long-term exposure to emissions	There are areas of potential long-term exposure within 30 m edge of the railway line in Portishead, Sheepway and Pill.
Changes in road traffic and railway station access routes	There will be operational air quality impacts associated with changes in road traffic and changes to road access the railway stations at Portishead and Pill. These have been considered and were scoped out against air quality screening criteria.
Opening year (Winter 2023/24)	Opening year (Winter 2023/24) is considered to be the worst-case future scenario for air quality. Air quality is expected to improve in future years due to more stringent emission controls on vehicles.
Decommissioning	No specific plans have been formulated for the decommissioning phase of the Portishead Branch Line. It is expected that the services will continue for as long as there is a business case for doing so. Bridges carrying highways over the DCO Scheme and public rights of way would continue to be maintained to standards appropriate for the public use – a result of obligations of NSDC as local highway authority.
Ongoing maintenance of railway line	Ongoing maintenance of cuttings and embankments will be required along operational railway line from the Port to the mainline.
Continuation of freight traffic	Operational railway between Royal Portbury Dock and Parson Street would remain open for freight traffic even if passenger services ceased.

Table 1.2: Construction and operational assumptions – DCO Scheme

Topic / Area	Assumption
Materials and waste haulage	Movement of materials and waste will be undertaken by rail as much as possible, reducing the number of haulage vehicles on the highway network. Given the good air quality along much of the DCO Scheme and the intention to minimise road haulage as far as possible, it is assumed at this stage that construction plant and traffic is unlikely to affect compliance with air quality objectives.
Hourly mean NO_2	Not modelled for the assessment. Concentrations are expected to meet the hourly objective at all receptors in Pill and Portishead, as annual mean concentrations are predicted to be less than 60 µg m^{-3} (Defra, 2018). Air quality impacts on the short-term objective are not expected to be significant.
Generation of dust	Some construction activities are likely to generate dust which have the potential to cause annoyance (e.g. discolouration of surfaces) at nearby properties if uncontrolled.

1.10.2 Table 1.3 shows the operational assumptions made for the areas outside the DCO application area.

Table 1.3: Operational assumptions – outside of DCO application area

Topic / Area	Assumption
Trains idling in Parsons Street, Bedminster, Avonmouth, Severn Beach and Bathampton.	Maximum time assumed in our air quality modelling that a passenger train would approach and stop at Parsons Street is 2 minutes and the engine would remain on during this time. A worst-case approach was applied based on available information, and based on the proximity of receptors. Passenger train approaches and stopping times were assumed to be similar at Bedminster, Avonmouth, Severn Beach and Bathampton. The nearest relevant exposure receptors at these stations and along these lines are setback further from the source of diesel locomotive emissions to lead to any significant effects, and as such Parson Street was assumed as a worst-case as receptors were identified within 20 m of this section of the branch line. No freight train idling was considered along the Bedminster Down Relief line, mainly due to the lack of information on how often this facility would be used. The background concentrations for the area were modelled to be low and there were not identified receptors within close proximity to the line to be significantly influenced by it and as such it was considered unlikely to lead to any significant effects.

1.11 References

Defra, 2018. Local Air Quality Management - Technical Guidance LAQM.TG(16).

Hobson, M., and Smith, A., 2001. Rail emission model. AEA Technology, Culham.

MetroWest

Portishead Branch Line (MetroWest Phase 1)

TR040011

Applicant: North Somerset District Council
6.25, Environmental Statement, Volume 4, Appendix 7.3 Air Quality Model Verification
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, regulation 5(2)(a)
Planning Act 2008

Author: CH2M

NetworkRail | West of England Local Enterprise Partnership | West of England Combined Authority | HM Government | Bath & North East Somerset Council | Bristol City Council | North Somerset Council | South Gloucestershire Council | travelwest

Table of Contents

Abbreviations

BCC	Bristol City Council
ES	Environmental Statement
NSDC	North Somerset District Council

SECTION 1

Air Quality Model Verification

1.1 Introduction

1.1.1 Prior to performing a rigorous assessment of air quality impacts at all identified sensitive receptors, it is necessary to verify modelling predictions against monitoring data within the study area. This process involves a comparison between predicted and measured road-traffic contributions to pollutant concentrations.

1.1.2 As outlined in Chapter 7 Air Quality and Greenhouse Gases (DCO Document Reference 6.10), Section 7.4 of the Environmental Statement ("ES"), North Somerset District Council ("NSDC") and Bristol City Council ("BCC") monitor NO_2 concentrations using automatic and diffusion tube monitoring. The ADMS-Roads model (v4.1) was used to predict Base Year (2015) total NO_2 concentrations at NSDC and BCC monitoring locations alongside or close to the defined study area.

1.2 Zoned Model Verification

1.2.1 Seven diffusion tube monitoring sites were used for the air quality model verification across NSDC and BCC. All of these sites had data capture greater than 90% in 2015. The locations of all air quality monitoring sites within 500 m of the study area are shown in Figure 7.2 Volume 3 of the ES (DCO Document Reference 6.24).

1.2.2 The initial modelled versus monitored results for total NO_2 concentrations at verification sites are presented in Table 1.1.

Table 1.1: Unadjusted Annual Mean Modelled and Monitored Total NO_2 Concentrations ($\mu g\ m^{-3}$) at Monitoring Sites

Site Id	Location	Measured NO_2	Unadjusted Modelled NO_2	% Difference Model vs Measured
BCC 99	Greville Smyth Park	28.7	20.8	-27.5%
BCC 419	Parson Street	53.6	34.7	-35.3%
NSC 2	Portbury (Priory Road)	23.0	16.8	-26.9%
BCC 473	B&G Snax West Street	49.6	24.1	-51.5%
BCC 474	Martial Arts West Street	38.5	19.4	-49.6%
BCC 215	Parson Street School	44.2	24.8	-43.8%
BCC 439	Parson Street School	41.0	24.8	-39.4%

1.2.3 Table 1.1 shows that total annual mean NO_2 concentrations are underpredicted at all verification sites. Modelled road/rail NO_x and measured road NO_x concentrations were compared to derive a verification factor to apply to the modelled results. The contribution of rail NOx at the verification receptors was considered to be marginal.

1.2.4 As a result of differences in the nature of the monitoring sites, the verification process was zoned to derive three verification adjustment factors. Generally, the initial step when testing modelling performance is to assume that a single adjustment factor will be derived. However, this assumes that the characteristic of the emissions inventory is spatially and diurnally homogeneous which in urban cases is generally the case. However, by further drilling down into emissions sources it is often found that characteristically these tend to differ where they should in theory be very similar. For example, a street where the effects of tall buildings trap emissions and hence the modelling may underpredict these effects at this location. The zones generalised for this assessment were:

- General road site sites (adjustment factor of 2.231), which applied to most modelled locations;
- West Street sites (adjustment factor of 7.252), which are subject to street canyon effects; and
- Bedminster Road near Parson Street School (adjustment factor of 3.421), which is subject to queues and vehicle acceleration events that weren't specifically characterised by the model approach.

1.2.5 Table 1.2 shows the monitoring sites used to derive the adjustment factor for each zone, in addition to a comparison of the adjusted modelled versus measured NO_2 concentrations at these sites. These sites are predominantly influenced by road traffic emissions with slight contributions from rail.

1.2.6 The adjustment factors were applied to the modelled road increment NO_x component only. This was because the verification adjustment factor was derived using roadside monitoring sites. At each receptor, the unadjusted modelled rail NO_x was then added to the adjusted modelled road NO_x and the background to yield a total NO_x concentration. After adjustment, the modelled NO_2 concentrations were within 25% of the measured concentrations at all verification sites, showing a reasonable correlation between the two sets of data. The verification resulted in a Root Mean Square Error (RMSE) value of 2.95 µg m^{-3}, showing that the average error in the adjusted model is acceptable based on Defra TG(16) guidance.

Table 1.2: Adjusted Annual Mean Modelled and Monitored Total NO_2 Concentrations ($\mu g\ m^{-3}$) at Monitoring Sites

Site Id	Location	Zone	Measured NO_2	Adjusted Modelled NO_2	% Difference Model vs Measured
BCC 99	Greville Smyth Park	1	28.7	23.8	-17.2%
BCC 419	Parson Street	1	53.6	53.1	-1.0%
NSC 2	Portbury (Priory Road)	1	23.0	21.5	-6.7%
BCC 473	B&G Snax West Street	2	49.6	44.9	-9.5%
BCC 474	Martial Arts West Street	2	38.5	40.7	5.6%
BCC 215	Parson Street School	3	44.2	41.6	-6.0%
BCC 439	Parson Street School	3	41.0	41.6	1.3%

1.2.7 Following Defra TG(16) guidance, the verification factors for road traffic NO_x were also applied to road traffic PM_{10} concentrations as there were no monitoring sites to verify road traffic PM_{10} concentrations in the study area. This is considered to be a worst-case approach.

1.3 References

1.3.1 Defra, 2016. Technical Guidance for Local Air Quality Management. TG(16)

MetroWest

Portishead Branch Line (MetroWest Phase 1)

TR040011

Applicant: North Somerset District Council
6.25, Environmental Statement, Volume 4, Appendix 7.4 Air Quality Modelling Results
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, regulation 5(2)(a)
Planning Act 2008

Author: CH2M

NetworkRail | West of England Local Enterprise Partnership | West of England Combined Authority | HM Government | Bath & North East Somerset Council | Bristol City Council | North Somerset Council | South Gloucestershire Council | travelwest

Table of Contents

Tables

Abbreviations

BCC	Bristol City Council
DM	Do Minimum
DS	Do Something
ES	Environmental Statement
NO_2	Nitrogen dioxide
NSDC	North Somerset District Council

SECTION 1

Air Quality Modelling Results

1.1 Receptor Modelled Results

1.1.1 This appendix presents the adjusted nitrogen dioxide ("NO_2") predicted concentrations at selected receptors in North Somerset District Council ("NSDC"), Bristol City Council ("BCC") and South Gloucestershire Council ("SGC") for the base case (2015) and Opening Year (2021) Do-Minimum (DM; without scheme) and Do-Something (DS; with scheme) scenarios.

1.1.2 The difference in the predictions for the Do-Minimum and Do-Something represent the impact of the Portishead Branch Line (MetroWest Phase 1) Development Consent Order Scheme ("the DCO Scheme") on air quality.

1.2 NSC Modelled Results

1.2.1 Table 1.1 below shows modelled concentrations at receptors in NSDC. No exceedances of the related air quality limit are predicted for any of the considered scenarios. The locations of the receptor sites are presented on Figure 7.3 in Volume 3 of the Environmental Statement ("ES") (DCO Document Reference 6.25).

Table 1.1: Annual Mean Modelled NO_2 Concentrations (µg m^{-3}) at Receptors in NSDC for the Base Year (2015) and the Year of Opening (2021) for the Do-Minimum (DM) and Do-Something (DS) Scenarios

ID	Type	Verification Zone	Base Year 2015	2021 Annual Mean NO_2 (µg m^{-3})			
				DM	DS	Impact (DS-DM)	Impact Magnitude
R1	Road	1	16.1	12.8	12.8	0	Negligible
R2	Road	1	18.6	15	15	0	Negligible
R3	Road&Rail	1	15.4	12.9	13	0.1	Negligible
R4	Road	1	20.6	16.6	16.6	0	Negligible
R5	Road&Rail	1	18.2	14.7	14.8	0.1	Negligible
R6	Road&Rail	1	16.5	13.6	13.6	0	Negligible
R7	Road	1	20.4	16.5	16.4	-0.1	Negligible
R8	Road	1	16.4	13.1	13	-0.1	Negligible
R9	Rail	1	15.3	12.8	13	0.2	Negligible
R10	Rail	1	15.1	12.7	12.9	0.2	Negligible
R11	Rail	1	15	12.6	12.7	0.1	Negligible
R12	Rail	1	14.9	12.5	12.8	0.3	Negligible
R13	Rail	1	13.6	11.5	11.8	0.3	Negligible

Table 1.1: Annual Mean Modelled NO_2 Concentrations (µg m^{-3}) at Receptors in NSDC for the Base Year (2015) and the Year of Opening (2021) for the Do-Minimum (DM) and Do-Something (DS) Scenarios

ID	Type	Verification Zone	Base Year 2015	2021 Annual Mean NO_2 (µg m^{-3})			
				DM	DS	Impact (DS-DM)	Impact Magnitude
R14	Rail	1	13.6	11.5	11.8	0.3	Negligible
R15	Road&Rail	1	13.8	11.6	11.7	0.1	Negligible
R16	Road&Rail	1	17.9	14.2	14.6	0.4	Negligible
R17	Rail	1	17.5	13.9	14.1	0.2	Negligible
R24	Rail	1	15.1	12.2	12.5	0.3	Negligible
R25	Rail	1	15.3	12.4	12.9	0.5	Negligible
R26	Rail	1	15.1	12.3	12.8	0.5	Negligible
R27	Rail	1	15.1	12.3	12.7	0.4	Negligible
R28	Rail	1	15	12.2	12.4	0.2	Negligible
R29	Rail	1	14.8	12	12.2	0.2	Negligible
R30	Rail	1	16.4	13	13.2	0.2	Negligible
R31	Rail	1	13.3	10.9	11.2	0.3	Negligible
R32	Rail	1	13.4	11	11.4	0.4	Negligible
R34	Ecological/ Road&Rail	1	20.4	16.6	16.6	0	Negligible
R35	Ecological/ Road&Rail	1	16.5	13.2	13.2	0	Negligible
R36	Ecological/ Road&Rail	1	14.5	11.5	11.5	0	Negligible
R37	Ecological/ Road&Rail	1	13.9	11	11	0	Negligible
R38	Ecological/ Road&Rail	1	13.6	10.8	10.8	0	Negligible
R39	Ecological/ Road&Rail	1	17.9	14.1	14.1	0	Negligible
R40	Ecological/ Road&Rail	1	18.1	14.3	14.3	0	Negligible
R41	Ecological/ Road&Rail	1	18.2	14.4	14.4	0	Negligible

Table 1.1: Annual Mean Modelled NO_2 Concentrations (µg m^{-3}) at Receptors in NSDC for the Base Year (2015) and the Year of Opening (2021) for the Do-Minimum (DM) and Do-Something (DS) Scenarios

ID	Type	Verification Zone	Base Year 2015	2021 Annual Mean NO_2 (µg m^{-3})			
				DM	DS	Impact (DS-DM)	Impact Magnitude
R42	Ecological/ Road&Rail	1	18.5	14.6	14.7	0.1	Negligible
R43	Ecological/ Road&Rail	1	18.9	14.9	15.1	0.2	Negligible

1.3 BCC Modelled Results

1.3.1 Table 1.2 below shows modelled concentrations at receptors in BCC.

Table 1.2: Annual Mean Modelled NO_2 Concentrations (µg m^{-3}) at Receptors in BCC for the Base Year (2015) and the Year of Opening (2021) for the Do-Minimum and Do-Something Scenarios

ID	Type	Verifica-tion Zone	Base Year 2015	2021 Annual Mean NO_2			
				DM	DS	Impact (DS-DM)	Impact Magnitude
R19	Rail	1	27.1	25.3	25.6	0.3	Negligible
R20	Rail	1	17	13.7	14	0.3	Negligible
R21	Rail	1	17	13.7	13.9	0.2	Negligible
R22	Rail	1	17.1	13.7	14.1	0.4	Negligible
R23	Rail	1	17.1	13.7	13.9	0.2	Negligible
R44	Road &Rail	1	19.6	15.7	15.9	0.2	Negligible
R45	Road &Rail	1	21	17	17.3	0.3	Negligible
R46	Road &Rail	1	19.3	15.4	15.7	0.3	Negligible
R47	Rail	1	16.8	13.2	13.4	0.2	Negligible
R48	Road &Rail	1	21.2	16.4	16.7	0.3	Negligible
R49	Road &Rail	1	30.3	22.8	23	0.2	Negligible
R50	Road &Rail	1	40.9	33.9	34.1	0.2	Negligible
R51	Road &Rail	1	41.1	33.6	33.8	0.2	Negligible
R52	Road &Rail	1	31	23.6	23.8	0.2	Negligible
R53	Road &Rail	1	36.8	27.3	27.5	0.2	Negligible
R54	Road &Rail	1	25.8	19.8	20.1	0.3	Negligible
R55	Road &Rail	1	25.5	19.5	19.7	0.2	Negligible

Table 1.2: Annual Mean Modelled NO_2 Concentrations (µg m^{-3}) at Receptors in BCC for the Base Year (2015) and the Year of Opening (2021) for the Do-Minimum and Do-Something Scenarios

ID	Type	Verifica-tion Zone	Base Year 2015	2021 Annual Mean NO_2			
				DM	DS	Impact (DS-DM)	Impact Magnitude
R56	Road &Rail	3	41.1	28.7	28.7	0	Negligible
R57	Rail	1	22.6	17.7	17.8	0.1	Negligible
R58	Rail	1	22.5	17.7	17.9	0.2	Negligible
R59	Rail	1	22.2	17.6	18	0.4	Negligible
R60	Road &Rail	1	25.1	19.9	20.1	0.2	Negligible
R61	Road &Rail	1	22.7	17.9	18	0.1	Negligible
R62	Road &Rail	2	48.4	36.5	36.4	-0.1	Negligible
R63	Road &Rail	2	44.5	34.4	34.3	-0.1	Negligible
R64	Road &Rail	2	41.7	32.3	32.2	-0.1	Negligible
R65	Road &Rail	2	40.6	31.7	31.5	-0.2	Negligible
R66	Road &Rail	2	43	33.5	33.4	-0.1	Negligible
R67	Road &Rail	1	36.8	27.2	27.2	0	Negligible
R68	Road &Rail	1	29.8	23.9	24	0.1	Negligible
R74	Rail	1	20.5	16.1	16.3	0.2	Negligible
R75	Rail	1	20.7	16.3	16.5	0.2	Negligible
R76	Road &Rail	1	26.8	20.8	21.1	0.3	Negligible
R77	Rail	1	20.3	16	16.2	0.2	Negligible
R78	Road &Rail	1	25.6	20.8	21	0.2	Negligible

Table 1.2: Annual Mean Modelled NO_2 Concentrations (µg m^{-3}) at Receptors in BCC for the Base Year (2015) and the Year of Opening (2021) for the Do-Minimum and Do-Something Scenarios

ID	Type	Verifica-tion Zone	Base Year 2015	2021 Annual Mean NO_2			
				DM	DS	Impact (DS-DM)	Impact Magnitude
R79	Road &Rail	1	24	19.4	19.4	0	Negligible
R80	Road &Rail	1	22.2	17.1	17.5	0.4	Negligible
R81	Road &Rail	1	19.9	15.4	15.8	0.4	Negligible
R82	Road &Rail	1	23.9	19.6	19.7	0.1	Negligible
R89	Road &Rail	1	30.5	23	23	0	Negligible
R90	Road &Rail	1	33.4	23.6	23.6	0	Negligible
R91	Road &Rail	1	30	21.7	21.8	0.1	Negligible
R92	Road &Rail	1	26.9	19.8	19.9	0.1	Negligible
R93	Road &Rail	1	25.1	18.7	18.8	0.1	Negligible
R94	Road &Rail	1	26.8	19.8	19.9	0.1	Negligible
R95	Road &Rail	1	23.9	18.8	18.9	0.1	Negligible
R96	Road	1	23.6	17.7	17.7	0	Negligible

1.4 SGC Modelled Results

1.4.1 Table 1.3 below shows modelled concentrations at receptors in SGC.

Table 1.3: Annual Mean Modelled NO_2 Concentrations (µg m^{-3}) at Receptors in SGC for the Base Year (2015) and the Year of Opening (2021) for the Do-Minimum and Do-Something Scenarios

ID	Type	Verifica-tion Zone	Base Year 2015	2021 Annual Mean NO_2			
				DM	DS	Impact (DS-DM)	Impact Magnitude
R33	Rail	1	27.1	25.3	25.6	0.3	Negligible

MetroWest+

Portishead Branch Line (MetroWest Phase 1)

TR040011

Applicant: North Somerset District Council
6.25, Environmental Statement, Volume 4, Appendix 7.5 Climate
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, regulation 5(2)(a)
Planning Act 2008

Author: CH2M

NetworkRail | West of England Local Enterprise Partnership | West of England Combined Authority | HM Government | Bath & North East Somerset Council | Bristol City Council | North Somerset Council | South Gloucestershire Council | travelwest

Table of Contents

Tables

Figures

SECTION 1

Climate

1.1 Introduction

1.1.1 This appendix presents the assessment of the impacts that the Portishead Branch Line (MetroWest Phase 1) Development Consent Order Scheme ("the DCO Scheme") may have on the Climate Change objectives highlighted within the Climate Change Act 2008 and addresses the requirement in The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 ("the EIA Regulations") to consider the impact of the scheme on climate and the vulnerability of the scheme to the effects of climate change.

1.1.2 The following sections highlight the key legislative frameworks, the methodology undertaken to assess potential impacts, a review of baseline conditions, identification of the potential impacts, measures incorporated into the scheme design, the assessment of effects, mitigation and enhancement, assessment assumptions and limitations, and summary.

1.1.3 The assessment of the effect of a project on climate change and the vulnerability of projects to climate change and natural hazards is a relatively new requirement of EIA. As such, the methodology for this type of work is emerging and the assessment presented here adopts a high level strategic approach.

1.2 Legislative and policy framework

International level

1.2.1 The Intergovernmental Panel on Climate Change (IPCC, 2014) states that *"Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks".* Greenhouse gas emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any greenhouse gas emissions or reduction from a project might be considered to be significant. All new embodied carbon emissions[1], arising from the use and consumption of material resources, are also likely to contribute to a significant negative environmental effect.

[1] The embodied carbon dioxide emissions of a material are the total carbon dioxide equivalent emissions released prior to leaving the factory gate. This would normally include extraction or harvesting, the manufacturing process and any pre-distribution transportation. However, it does not include the carbon dioxide emissions associated with transport from the factory gate to site, construction activities, maintenance or decommissioning. This boundary condition is known as 'cradle-to-gate'.

1.2.2 In 1997, the Kyoto Protocol to the United Nations Framework Convention on Climate Change ("UNFCC") was adopted as a means to provide legally binding limits on carbon emissions for 37 countries, which includes the United Kingdom. The Protocol committed signatories to reduce carbon emissions by an average of 5% below the 1990 levels during the first commitment period between 2008 and 2012; and by at least 18% below the 1990 levels during the second commitment period between 2013 and 2020.

1.2.3 In December 2015, the Paris Agreement, a global climate agreement, was adopted. The Agreement was ratified and entered into force in November 2016. The central aim of the Agreement is to strengthen the global response to climate change by limiting the global temperature increases, through setting a target of net zero global carbon emissions in the second half of this century.

National level

1.2.4 Under the Kyoto Protocol's second commitment period (2013 – 2020), the collective European Union ("EU") set a target to reduce carbon emissions by 20% relative to the 1990 levels. In 2014, the EU agreed collectively to reduce carbon emissions by at least 40% by 2030 compared to 1990 levels. This commitment was reaffirmed in the EU's Nationally Determined Contribution submitted as part of the Paris Agreement.

The Climate Change Act 2008

1.2.5 The Climate Change Act 2008 established a framework for the United Kingdom to achieve its long-term goals of reducing carbon emissions by at least 80% by 2050 relative to 1990 levels. An interim target of a 34% reduction from 1990 levels by 2020. To ensure that regular progress is made, the Climate Change Act 2008 established a system of carbon budgets.

1.2.6 The first three carbon budgets in the UK were announced in April 2009, covering the periods 2008–2012, 2013–2017 and 2018–2022. The budgets require emissions reductions of 23%, 29% and 35% respectively, below 1990 levels. In June 2011, the fourth Carbon Budget was announced, amounting to an emission cut of 50% on 1990 levels over the years 2023-2027. Therefore, it is important that impacts from transport schemes on greenhouse gas emissions are carefully considered.

Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

1.2.7 The EIA Regulations require the consideration of climate in the environmental assessment. Schedule 4 on the information to be included in the environmental statements includes under paragraph 4 a description of factors likely to be significantly affected by the development including climate greenhouse gas emissions and impact relevant to adaptation. Paragraph 5 goes on to require "*A description of the likely significant effects of the development on the environment resulting from …(f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change*."

1.2.8 The Environmental Statement for the DCO Scheme benefits from the transitional provisions in the EIA Regulations 2017 because the Scoping Opinion was sought and received in 2015 under the Infrastructure Planning

EIA Regulations 2009. The EIA Regulations 2009 only required consideration of climatic factors. However, the DCO Scheme is giving consideration to – and will seek to apply, where possible – the new EIA Regulations 2017.

National Adaptation Programme

1.2.9 The Climate Change Risk Assessment is a five-yearly assessment of all major risks and opportunities from Climate Change within the UK. The most recent assessment, published in 2016 outlined the main risks associated with Climate Change in the UK as the following six key areas:

- Flooding and coastal change risks to communities, businesses and infrastructure.
- Risks to health, well-being and productivity from higher temperatures.
- Risks of water deficits in public water supply, and for agriculture, energy generation and industry, with impacts on freshwater ecology.
- Risks to natural capital, including soils, coastal, marine and freshwater ecosystems, and biodiversity.
- Risks from climate-related impacts on domestic and international food production and trade.
- New and emerging pests and diseases, and non-native species, affecting people, plants and animals.

1.2.10 The National Adaptation Programme is the Government's strategy to address the main risks and opportunities identified in the risk assessment. The programme focuses on raising awareness of the need for climate change adaptation, increasing resilience to current climate extremes, taking timely action for long-lead time measures, and addressing major evidence gaps.

National Planning Statement for National Networks

1.2.11 The information presented in the National Planning Statement for National Networks ("NPSNN") paragraphs 5.16 - 5.19 relates to the Government's legally binding framework to cut greenhouse gas emissions by at least 80% by 2050. Although impacts of road developments on aggregate levels of emissions are likely to be small, carbon impacts must be considered as part of the appraisal of scheme options.

1.2.12 Paragraph 5.17 states that "*it is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets. However, for road projects applicants should provide evidence of the carbon impact of the project and an assessment against the Government's carbon budgets*."

1.2.13 The NPSNN further states in paragraph 5.18 that *"…any increase in carbon emissions is not a reason to refuse development consent, unless the increase in carbon emissions resulting from the proposed Option are so significant that it would have a material impact on the ability of Government to meet its carbon reduction targets"*.

National Planning Policy Framework

1.2.14 The National Planning Policy Framework ("NPPF") was published in March 2012 setting out the Government's planning policies for England. In paragraph 109 the Framework states that: *"The planning system should contribute to and enhance the natural and local environment by: … preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability".* There are national and local policies for the management, mitigation and adaptation to climate change.

1.2.15 The Framework prioritises addressing climate change impacts in the planning and decision-making process for major transport infrastructure projects and provides guidance on climate change allowances to be used in flood risk assessment. The Framework identifies how new developments must make allowances for climate change impacts to ensure no increased risk is placed on people and property.

Local Climate Change Management

1.2.16 As a means to monitor and promote the reduction of greenhouse gas emissions across the United Kingdom, in July 2011, the Department of Energy and Climate Change ("DECC") requested Local Authorities to report greenhouse gas emissions from their own estates and services using a standard methodology and format, in line with the United Kingdom Government's environmental reporting guidance[2].

1.3 Assessment methodology

Guidance and best practice

1.3.1 As noted in IEMA's *Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation*, (IEMA, 2015), until such time as there is a consolidated methodology or practice for climate change assessment, the scope of a climate change assessment should cover:

- identifying the emerging baseline, taking account of the influence of climate change (as above);
- identifying the potential impacts of the scheme during construction, operation and decommissioning;
- assessing the sensitivity of baseline receptors to climate change;
- assessing the scale of impact of the project in combination with climate change;
- assessing the significance of the combined impact;
- identifying mitigation measures and, where these do not result in acceptable residual impacts, refine the design and reassess the significance until the project achieves the minimum acceptable requirements; and

2 DECC, The Carbon Plan: Delivering our low carbon future, 2011

- developing a climate change adaptation plan.

1.3.2 In considering the elements of climate, professional judgements have been used to provide a qualitative description of the nature of impacts and, where appropriate, to describe the predicted change that the DCO Scheme will introduce in comparison with the baseline conditions.

Effects of the DCO Scheme on climate

1.3.3 In line with TAG Unit A3 Environmental Impact Appraisal (2015), Chapter 4 Greenhouse Gases (Department for Transport, 2015); and PAS 2080: 2016 Carbon management in infrastructure, the assessment of the effects of the DCO Scheme on climate includes:

- identification and assessment of greenhouse gases, and any other significant carbon emissions which will occur throughout the lifecycle of the project, their relative scale, in relation to the baseline and in comparison, to the UK emissions predictions; and
- identification of opportunities for mitigation.

Vulnerability of the DCO Scheme to climate change

1.3.4 The assessment of the vulnerability of the DCO Scheme to climate change identifies and assesses the rate of climate change, highlighting the potential extent of disruption which may occur throughout the lifecycle of the project.

1.3.5 The main risk for the DCO Scheme is the effect of changing flood risk as a result of changing rainfall patterns, sea level rise and increasing risk of tidal flooding. These issues have been assessed through coastal and fluvial modelling and are presented in the Environmental Statement, Appendix 17.1 Flood Risk Assessment (“FRA”) (DCO Document Reference 5.6).

Vulnerability of receptors

1.3.6 According to IEMA (2015), three levels of sensitivity can be used to describe the receptor vulnerability to climate change.

- High vulnerability – the receptor is directly dependent on existing and/or prevailing climatic factors, and reliant on these specific existing climate conditions continuing in future (e.g. river flows and ground water level); or only able to tolerate a very limited variation in climate conditions.
- Moderate vulnerability – the receptor is dependent on some climatic factors, but able to tolerate a range of conditions (e.g. a species which has a wide geographic range across the entire UK, but is not found in southern Spain).
- Low vulnerability – climatic factors have little influence on receptors (therefore, consider whether it is justifiable to assess such receptors further within the context of EIA – i.e. it is likely that such issues will have been excluded in scoping process).

Study area

1.3.7 The DCO Scheme is largely located within the administrative boundary of North Somerset District Council (“NSDC”) with a short section in Bristol City Council’s (“BCC”) jurisdiction. The DCO Scheme is part of the MetroWest

Phase 1 project, which also includes a half hourly service on the Severn Beach Line and a half hourly service for Keynsham, Oldfield Park stations on the Bath Spa line. MetroWest Phase 1 is being promoted by NSC and the West of England Combined Authorities ("WECA"), comprising BCC, South Gloucestershire Council ("SGC") and Bath and North-East Somerset Council ("B&NES").

1.3.8 As the DCO Scheme is highly interconnected with local railway services within Bristol and to Bath Spa and the wider railway network, climate impacts, in one section of a network, could have knock-on effects throughout the West of England region. Therefore, this climate assessment, associated with the DCO Scheme, has been undertaken at a regional level, highlighting key local level impacts where applicable.

1.4 Emerging baseline conditions

Climate

Current baseline

1.4.1 The climate in the greater Bristol area is classified as "Cfb" (Marine West Coast Climate) (Weatherbase), according to the Köppen Climate Classification system. This climate type is found on the west coast of continents in mid-latitudes and is characterised by an equitable temperate climate with cool winters, warm summers, few extremes in temperature and precipitation throughout the year.

1.4.2 The UK Climate Projection (UKCP18) is a Met Office Hadley Centre Climate Programme, which is supported by the Department of Business, Energy and Industrial Strategy ("BEIS") and the Department for Environment, Food and Rural Affairs ("Defra"). The UKCP18 platform presents the future climate projections within the UK. The aim of the platform is to provide information across the UK as to possible climate changes that can be expected in the future. UKCP18 was released in November 2018, replacing the previous UKCP09 projections. Over land, the projected trends of climate changes during the 21st century are similar to UKCP09, but with warmer, wetter winters and hotter, drier summers. Nevertheless, natural variations mean that the opposite may still occur.

1.4.3 The baseline period 1981-2010, was downloaded from the Met Office HadUK-Grid, which is a new UKCP18 collection of gridded climate variables derived from the network of UK land surface observations, at a spatial resolution of 12 km x 12 km[3]. The Met Office baseline data for average conditions in the England SW/Wales S region has been used to support the baseline[4]. The period 1981-2010 has been used to assess and identify possible trends in historical data (extracted from the most up to date datasets and time periods available).

---

3 Website accessed on the 10th of January 2019: http://catalogue.ceda.ac.uk/uuid/dc2ef1e4f10144f29591c21051d99d39

4 Website accessed on the 10th of January 2019: https://www.metoffice.gov.uk/climate/uk/summaries/datasets

1.4.4 The current climate and weather events experienced in the Bristol region are summarised as follows:

- Average annual temperature is 10.8°C and ranges from an average annual minimum and maximum temperature of 7.6 and 14°C. Summer and Winter average annual temperatures are summarised as:
  - A winter average temperature of 5.6°C;
  - A summer average temperature of 16.2°C;
- Average annual precipitation received for the Bristol area is 901 mm, with approximately 115 days in the year receiving more than 1 mm of precipitation in the England SW/Wales S region. Summer and Winter average annual precipitation is summarised as:
  - A winter average precipitation of 244 mm; and
  - A summer average precipitation of 198 mm.

Future baseline

1.4.5 This section provides a comparison between the current climate (described above) and the projected future conditions in and around the Bristol area. Due to uncertainties in predicting greenhouse gas emissions generated in the future, four Representative Concentration Pathway ("RCP") global emission scenarios have been developed, as presented in UKCP18. These scenarios provide a more detailed simulation of climate than the previous UKCP09 scenarios. RCP 2.6 assumes that annual greenhouse gas emissions peak between 2010–2020, with a substantial decline thereafter (1.6˚C increase by 2100 compared to pre-industrial period). RCP 4.5, emissions peak around 2040, then decline (2.4˚C increase by 2100 compared to pre-industrial period). RCP 6.0, emissions peak around 2080, then decline (2.8˚C increase by 2100 compared to pre-industrial period). RCP 8.5, emissions continue to grow unmitigated throughout the 21st century (4.3˚C by 2100 compared to the pre-industrial period).

1.4.6 Table 1.1 presents the projected climate changes for each emission scenario and for each 30-year period for the Bristol area (N 175347.25, E 356275.03), obtained from the UKCP18 projections for the 2020s, 2050s and 2080s[5]. These projected climate changes are based against the 1981-2010 baseline.

---

5 Future projection (2020s, 2050s and 2080s) are obtained from for probabilistic projections at 25 km x 25 km resolution over the period 1961-2100 (https://ukclimateprojections-ui.metoffice.gov.uk/products)

Table 1.1: Future climate projections under different emissions scenarios

Description	2020s (2010 – 2039)				2050s (2040 – 2069)				2080s (2070 – 2099)			
	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
Annual mean temperature	+0.73°C	+0.61°C	+0.58°C	+0.72°C	+1.09°C	+1.29°C	+1.21°C	+1.85°C	+1.24°C	+2.21°C	+2.54°C	+3.65°C
Winter mean temperature	+0.55°C	+0.57°C	+0.54°C	+0.65°C	+0.94°C	+1.21°C	+1.13°C	+1.67°C	+1.05°C	+1.82°C	+2.08°C	+3.02°C
Summer mean temperature	+1.04°C	+0.80°C	+0.77°C	+0.94°C	+1.54°C	+1.71°C	+1.60°C	+2.44°C	+1.85°C	+3.15°C	+3.58°C	+5.03°C
Annual mean precipitation	+0.44%	+0.59%	+0.57%	+0.58%	+0.58%	+0.54%	+0.53%	+0.62%	+1.64%	+1.87%	+1.87%	+2.01%
Winter mean precipitation	+5.14%	+5.04%	+4.82%	+5.73%	+7.94%	+8.83%	+8.35%	+12.38%	+9.94%	+15.80%	+17.68%	+24.57%
Summer mean precipitation	-7.6%	-8.24%	-7.98%	-9.20%	-16.73%	-19.13%	-18.52%	-24.15%	-21.47%	-26.48%	-29.54%	-38.58%
Source: UK Climate Projections Website												

1.4.1 Projections into the 2020s, 2050s and 2080s, for every greenhouse gas emission scenarios, indicate an increase in temperatures and precipitation within the Bristol area. Changes in temperatures indicate increases between 0.54 ˚C and 5.03 ˚C. Precipitation trends show that winter precipitation may increase by up to 24.57% during winter months, while rains may decrease during the summer, ranging between -7.6% and -28.58%.

1.4.2 It is important to take into account the uncertainty associated with the selected climate projections. Estimated ranges for future climate are conditioned on a set of modelling, statistical, and dataset choice assumptions with expert judgement playing a role in the various methodological and data choices. These UKCP18 projections do not capture all future outcomes and are estimates. However, they should be indicative of the overall magnitude of changes over the 21st Century.

Carbon dioxide

1.4.3 The National Atmospheric Emissions Inventory ("NAEI") provides an inventory of all emissions across the United Kingdom. As presented on the NAEI system, an estimate of the mass of CO_2 emitted (in kilotonnes ("Kt") for 2015) in Bristol, North Somerset and Bath and North-East Somerset areas is shown in Table 1.2. This shows that road transportation contributed about 30%, 46% and 31% to 2015 CO_2 emissions in the Bristol, North Somerset and B&NES areas respectively. By comparison, diesel trains emitted less than 1% CO_2 emissions in 2015.

Table 1.2: Bristol, North Somerset and B&NES CO_2 emissions for 2015 for different economic sectors

Economic Sector	CO_2 (Kt)		
	Bristol	North Somerset	B&NES
Industry & Commercial Electricity	396	135	128
Industry & Commercial Gas	145	39	61
Large Industrial Installations	1	5	0
Industrial & Commercial Other Fuels	37	67	31
Agricultural Combustion	1	14	13
Domestic Electricity	230	119	107
Domestic Gas	363	181	163
Domestic Other Fuels	14	18	21
Road Transport (A roads)	153	106	135
Road Transport (Motorways)	76	246	0
Road Transport (Minor roads)	298	178	110
Diesel Railways	6	7	6
Transport Other	4	14	1

Table 1.2: Bristol, North Somerset and B&NES CO_2 emissions for 2015 for different economic sectors

Economic Sector	CO_2 (Kt)		
	Bristol	North Somerset	B&NES
LULUCF Net Emissions	5	19	8
Total for all sectors	**1,729**	**1,149**	**783**

Source: National Atmospheric Emissions Inventory (2015)

Greenhouse Gas Emissions Reporting

1.4.4 According to the report *Adoption of a carbon dioxide reduction target for North Somerset*, (North Somerset Council, 2018) as part of their commitment to action on climate change, NSDC has adopted a local carbon reduction target. This target agreed across West of England local authorities is to reduce carbon emissions by 50% by 2035 from a 2014 baseline. This target is set out in the West of England Joint Spatial Plan (2017). According to NSDC's Annual Monitoring Report (2017), North Somerset has reduced their carbon emissions by 28.5% from 2005-2015.

1.4.5 According to BCC's Development Monitoring Report (2016), BCC has committed to reducing the city's CO_2 emissions by 40% and 80% by 2020 and 2050 respectively, from a 2005 baseline. In 2015, BCC updated their Climate and Energy Framework (2015), which proposed a new target of 50% reduction of CO_2 emissions by 2020. By 2014, total CO_2 emissions had reduced by 25% from 2005 levels (Bristol City Council, 2016).

1.4.6 At the time of carrying out this climate assessment, the most up-to-date information available within the public domain for CO_2 emissions in B&NES, was for the year 2013. According to B&NES Council's information on Climate Change Mitigation and Adaptation, in 2013, 895,000 tonnes of CO_2 was produced within the scope of influence of the Council. The majority (98%) of these emissions came from industry, transport and domestic activities. Some 2% of emissions were produced by direct activities of the Council (fleet, business travel, leisure services, street lighting, schools and offices). B&NES Council aims to limit the risk of severe climate change by reducing the area's greenhouse gas emissions and their reliance on fossil fuels. According to B&NES's Environmental Sustainability and Climate Change Strategy 2016-2010, they are committed to a carbon reduction target for the area of 45% by 2029. This target is in line with the West of England Joint Spatial Plan.

1.5 Potential Impacts During Construction, Operation and Decommissioning

1.5.1 Greenhouse gases released through direct fuel consumption and/or consumption of supplied electricity during the construction and operational phase of the DCO Scheme have the potential to contribute to greenhouse gas emissions and therefore potentially impact on climate and the Government's ability to meet their legally binding greenhouse gas reduction targets.

1.5.2 Future climate change trends, including increased maximum temperatures, increased rainfall during winter months, and increased frequencies of extreme events, could affect the resilience and vulnerability of the DCO Scheme. The FRA for the DCO Scheme assesses the impact of the scheme on drainage and future flood risk (see Environmental Statement Appendix 17.1, DCO Document Reference 5.6). Other matters, such as the effects of increasing temperature on railway infrastructure such as rails are matters for research and development at the corporate (rather than project) level within Network Rail.

1.5.3 The Environmental Statement Chapter 4 Description of the Proposed Works (DCO Document Reference 6.7) explains that consideration has been given to likely significant effects arising during the decommissioning phase. However, owing to the nature and life span of the proposed development, the regulated process of any closure in the future, which would be overseen by the Office of Rail and Road, and there being no reasonably foreseeable decommissioning proposals such that likely impacts could be identified and assessed, these effects are not considered further in this appendix.

1.6 Measures Adopted as Part of the DCO Scheme

1.6.1 A number of measures have been included as part of the DCO Scheme design in order to minimise certain environmental effects. These include:

- careful designing of the scheme to ensure key receptors are avoided where possible;
- construction adopting best practices techniques, which are outlined in the Code of Construction Practice ("CoCP") and presented in more detail in the Master Construction Environmental Management Plan ("CEMP"); and
- compliance with regulatory and legislative regimes as required by law.

1.6.2 The main measure adopted in the design of the DCO Scheme relevant for climate change is the design of highway, surface and railway drainage, which includes an allowance for climate change.

1.6.3 The drainage design strategy for the DCO Scheme is presented in *MetroWest Phase 1 Surface Water Drainage Strategy for Portishead and Pill Stations, haul roads and compounds* (DCO Document Reference 6.26).

1.6.4 The highway drainage design assumes a blanket worst-case scenario of 40% increase in rainfall due to climate change in the 1 in 30-year return period for a 60 year design life. The climate allowance of 40% is above the figures presented in Table 1.1 for the worst case 30-year timeframe (+12% winter mean precipitation) and the 80-year timeframe (+25% winter mean precipitation).

1.6.5 At Portishead Station, rainwater from the station and car park A will be discharged to the open drain known as The Cut by the Wessex Water pumping station. Stormwater from car park B will be discharged to a ditch along the southern boundary of the car park by Sainsbury's which drains to the Portbury Ditch. Highway drainage from the modified Quays Avenue, Pill car park, and highway modifications on Winterstoke Road will connect into the existing highway drainage.

1.6.6 There is limited scope to employ sustainable drainage systems ("SuDS") in Portishead and Pill, due to the poor ground conditions. The designs do consider the use of over-enlarged pipes to maintain existing runoff rates and highway drainage capacity.

1.6.7 The existing earth drainage ditches alongside the disused railway corridor will be cleaned out and re-formed as required. The culverts will be either restored or replaced on a like-for-like basis. It is currently envisaged that it will not be necessary to enlarge the existing culverts under the railway, but this will be confirmed during the detailed design phase.

1.6.8 At Pill Station, the drainage from the platform and track will be collected and discharged to a holding tank near the proposed new car park and discharged into the highway drainage.

1.6.9 Along the operational railway, the existing drainage system appears to function adequately. The track drainage is designed to accommodate a 25 year return period storm with a 20% uplift to allow for project future climate change.

1.6.10 The drainage designs will be agreed with the highways authority for connections to the existing highway drainage, the Environment Agency for new discharges to main rivers and the North Somerset Levels Inland Drainage Board for new discharges to other watercourses.

1.6.11 The Master CEMP requires the contractors to undertake a carbon assessment to identify ways that they can reduce their carbon footprint for the construction of the DCO Scheme.

1.7 Assessment of Effects

Effects of the DCO Scheme on Climate

1.7.1 The addition of diesel locomotives in the area will add to regional CO_2 emissions. However, the increase in emissions will be limited compared to total CO_2 emissions generated by the transport sector.

1.7.2 In IEMA's *Guide to assessing greenhouse gas emissions and evaluating their significance* (IEMA 2017) it is noted that greenhouse gas emissions from all projects contribute to climate change. The consequence of a changing climate has the potential to have knock-on environmental effects, therefore any greenhouse gas emissions or reductions from a project may be considered to be significant.

1.7.3 In principle, all greenhouse gas emissions should be considered when assessing the impact of a scheme. These include emissions resulting from the production of materials used in any infrastructure (known as embedded carbon), as well as those resulting from changes to the use of transport fuels.

1.7.4 Although carbon dioxide has a relatively low global warming potential compared to other greenhouse gases, it is the most abundant contributor. Therefore, the global warming potential of greenhouse gas emissions is measured in terms of the equivalent amount of CO_2 (referred as CO_2e) that would give rise to global warming.

Embodied carbon

1.7.5 An assessment of the embodied carbon emissions resulting from the construction of the DCO Scheme has been undertaken (Environmental Statement, Chapter 12 Materials and Waste, DCO Document Reference 6.15). The approach was based on WRAP resource efficiency (embodied carbon) benchmarks for completed new build and refurbishment infrastructure projects, given the lack of detailed information for the DCO Scheme about construction materials, waste generation, construction methods, energy use and fuel. These figures are summarised in Table 1.3 and provide an indicative worse case assessment of the magnitude of impact arisings from embodied carbon emissions during the construction of the DCO Scheme.

Table 1.3: Estimated embodied carbon impact of constructing the DCO Scheme

WRAP embodied carbon emissions benchmark and project type (50th percentile, median)	Number of benchmarked projects and benchmark robustness (high, medium, low)	Estimated total embodied carbon emissions (t)
42 tCO_2e / £100 k (new build and refurbishment infrastructure projects)	22 (High)	27,300

1.7.6 The Government has a legally binding framework to cut greenhouse gas emissions by at least 80% by 2050. Emission reductions will be delivered through a system of five year carbon budgets that set a trajectory to 2050:

- 1st carbon budget (2008 to 2012) of 3,018 $MtCO_2e$;
- 2nd carbon budget (2013 to 2017) of 2,782 $MtCO_2e$;
- 3rd carbon budget (2018 to 2022) of 2,544 $MtCO_2e$;
- 4th carbon budget (2023 to 2027) of 1,950 $MtCO_2e$; and
- 5th carbon budget (2028 to 2032) of 1,765 $MtCO_2e$.

1.7.7 The current construction programme is to start in spring 2022 and complete by winter 2023/24. Compared to the UK's 3rd carbon budget (2018 to 2022) of 2,544 MtCO2e and the 4th carbon budget (2023 to 2027) of 1,950 MtCO2e, the DCO Scheme's estimated embodied carbon emissions represents a very small proportion (< 0.001%) of the UK's 5-year Carbon Budget. Furthermore, the embodied carbon emissions associated with the

DCO Scheme's use of material resources will be largely regulated through the European Union's Emissions Trading Scheme ("ETS") (a Europe wide emissions cap and trade scheme with a decreasing 'cap' or limit over time) and other policy tools as part of the UK Climate Change Act 2008 target of reducing greenhouse gas emissions by at least 80% of 1990 levels by 2050 (this includes reducing emissions from the devolved administrations (Scotland, Wales and Northern Ireland). This means that, overall, most of the DCO Scheme's embodied carbon emissions are unlikely to contribute significantly to an increase in Europe-wide carbon emissions[1].

Greenhouse gases assessment

1.7.8 The Environmental Statement Chapter 7 Air Quality and Greenhouse Gases (DCO Document Reference 6.10) provides an assessment of predicted CO_2 emissions. The DCO Scheme is expected to lead to a negligible decrease in vehicle kilometres travelled across the road network and hence a negligible impact on CO_2 savings. Rail emissions associated with the DCO Scheme are expected to contribute to an increase in CO_2 emissions. As a result the net CO_2 emissions in the opening year of the DCO Scheme are predicted to increase overall by 942 tonnes/year compared with the do-something scenario. This is despite the DCO Scheme resulting in reductions in regional road CO_2 emissions of 266 tonnes/year. However, the magnitude of change is negligible on the national scale as it is only 0.003% of the total CO_2 emitted nationally from the transport sector, which is over 30,000 kilotonnes/year (NAEI, 2014).

1.7.9 A further refinement of regional emission estimates was undertaken to examine whether the benefits of the DCO Scheme may have been undervalued in the core assessment (see para 7.6.40. For the refinement, the net change in emissions was calculated as the difference between increases in rail emission from just the new Portishead to Temple Meads train service and decreases in road emissions that result from shifts in transport mode onto this proposed branch of the train line. The reduction in road emissions was calculated using a vehicle kilometres approach. Note that the recalculation includes years 2021 and 2023 the revised opening year. Using this approach and assuming existing diesel engines will be operated on the rail line in average running conditions, the net change in CO_2 emissions was +269 tonnes/year, for the year 2021. This approach therefore yields a smaller net increase (i.e. smaller disbenefit) in emissions than the core approach. The slightly smaller disbenefit was also estimated when assuming year 2023. Rail emissions increase as a result of the DCO Scheme. However, the implementation of modern technologies can reduce the magnitude of emission increases. If diesel engines for example were to be replaced with hybrid technologies in average running conditions, the proposed Portishead to Temple Meads rail branch results in greatly reduced net increases in CO_2 emissions of 117 tonnes/year, for year 2021. If an

[1] Carbon budgets are currently accounted on a 'net' basis, allowing for trading in the EU ETS. If the UK were to leave the ETS, as a result of leaving the European Union for example, an accounting adjustment would be required in order preserve the intent of the budgets. However, regardless of the accounting adjustment, the UK would need to continue the expansion of low-carbon power generation in order to meet its 2050 targets.

operational hybrid system led to a 20% improvement in efficiency through for example, regenerative breaking a net (road + rail) decrease in CO_2 emissions of 5.2 tonnes/year could be achieved in 2021. An improved net benefit of -27 tonnes/year is estimated for 2023.

Vulnerability of the DCO Scheme to Climate Change

Receptors and project vulnerability

1.7.10 According to IEMA (2015), receptors are described as being either highly sensitive, moderately sensitive or having a low sensitivity to climate change factors. Within the study area receptors include both residential areas and key ecological areas.

1.7.11 The trends highlighted in the Future Climate Baseline section indicate the possibility of increased extreme weather conditions that could be experienced in the region (i.e. possibility of flooding during winter months and drought during summer months).

1.7.12 Following guidance from IEMA (2015), receptors within the region are classified as moderately sensitive as they are expected to be affected by changes in climate however, are not considered to be dependent on specific climate conditions. In fact, receptors in the study area are currently subjected to a wide range of climatic variability throughout the year and may not be highly vulnerable to future temperature and rainfall projections presented in Table 1.1.

1.7.13 Notwithstanding the above, there some important ecological features in the study area, including sites of European, national and local importance, and protected species of flora and fauna, including rare species of flora. The ecological baseline and assessment of the impact of the DCO Scheme on habitats, flora and fauna are presented in the Environmental Statement, Chapter 9, Ecology and Biodiversity (DCO Document Reference 6.12).

1.7.14 The most important ecological site affected by the DCO Scheme is the Avon Gorge Woodlands Special Area of Conservation (“SAC”), which also includes the Avon Woods Site of Special Scientific Interest (“SSSI”) and Leigh Woods National Nature Reserve (“NNR”). The SAC is designated for its *Tilio-Acerion* woodland and *Festuco-Brometalia* grassland, and also supports 22 rare plants including endemic whitebeams, and protect fauna including bat, badger, dormice, reptiles, and otter. The biodiversity of the SAC is evolving due to the colonisation of invasive species shading out the rare Whitebeams and grasslands for which the site is designated, and the spread of *Chalara fraxinea* disease which is killing the ash trees.

1.7.15 In the longer term, the impact of changing climate on biodiversity and the spread of diseases is little understood. Changing climate is expected to result in changing patterns of biogeography with the migration of temperate species northwards and to higher elevations and replacement with species from milder climates. Changing climate and human activity may lead to the spread of diseases of flora and fauna. However, it is not possible to determine how these changes may affect specific protected sites and species within the study area.

1.7.16 In the short to medium term, the DCO Scheme offers an opportunity to improve the integrity and biodiversity of the Avon Gorge Woodlands

SAC/SSSI through management of Network Rail's estate, for example, removal of invasive species, planting out new Whitebeams grown on from seed collected from the woodlands, and specific mitigation measures for rare species. Further details are provided in the Environmental Statement, Volume 4, Appendix 9.11 Avon Gorge Woodlands Vegetation Management Plan (DCO Document Reference 8.12).

Drainage

1.7.17 The drainage design is conservative, based on higher rainfall intensities than those forecast in Table 1.1, and consequently is resilient to climate change for the next 30 years and beyond.

Flood Risk Assessment

1.7.18 The FRA has assessed flood risk to the DCO Scheme for the present day (2015) and future (2075 and 2115) scenarios. The assessment of flood risk has informed the DCO Scheme design and mitigation measures to ensure that it is safe from flooding during its lifetime (with appropriate mitigation) and does not increase flood risk elsewhere. Key flood risks have been identified and appropriate mitigations proposed. The assessment of flood risk has been informed by available information on flood risk (e.g. EA flood maps) and informed by hydraulic modelling undertaken as part of the FRA.

1.7.19 The FRA has been developed in consultation with the Environment Agency, North Somerset Levels Inland Drainage Board, NSDC and Bristol City Council.

1.7.20 The DCO Scheme is considered to pass the NPPF Sequential Test as there are no other feasible locations for the DCO Scheme.

1.7.21 The DCO Scheme is classified as *Essential Infrastructure* for national policy on flood risk. Elements of the scheme are within Flood Zones 3a and 3b. The DCO Scheme passes both limbs of the Exception Test, as required for *Essential Infrastructure* development within Flood Zones 3a and 3b. It has wider sustainability benefits to the community. It will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.

1.7.22 The lifetime of the DCO Scheme is assumed to be 60 years (2075 future scenario). Model simulations have also tested sensitivity to a 100 year future scenario (2115). Projected climate change and sea level rise during the life of the DCO Scheme are significant, with projected sea level rise of approximately 0.59 m between 1990 and 2075, and 1.14 m between 1990 and 2115, resulting in the largest impacts.

1.7.23 The DCO Scheme railway levels are generally slightly higher than existing levels, typically by between approximately 0 mm and 300 mm. However, to avoid impacts on flood risk elsewhere, existing railway levels will be retained in the River Avon tidal floodplain in the Bower Ashton area and Longmoor and Colliter's Brooks floodplain.

1.7.24 The most significant flood risk to the DCO Scheme is River Avon tidal flooding near Bower Ashton. For the present day (2015) scenario, modelling undertaken for the FRA indicates the DCO Scheme (i.e. post-development) would be flooded during tidal River Avon floods approximately once every 5 to 10 years for the current (2015) scenario and more frequently than once every year (at Bower Ashton) for the future (2075 and 2115) scenarios.

1.7.25 Coastal flood risk between Portishead and Pill is not significant for the present day (2015) and future (2075) scenarios, as modelling undertaken for this FRA indicates flooding of the DCO Scheme occurs less than once every 1000 years on average. Modelling indicates that for the future (2115) scenario the DCO Scheme will experience coastal flooding once every 200 to 1000 years on average.

1.7.26 Fluvial flood risk from Portbury Ditch, Drove Rhyne and Easton-in-Gordano Stream is not considered to be significant for the present day (2015) and future (2075 and 2115) scenarios.

1.7.27 For the present day (2015) scenario the DCO Scheme is outside of the Colliter's Brook and Longmoor/Ashton Brook 100-year return period flood extent, and within the 1000-year return period flood extent. For the future (2075 and 2115) scenarios the DCO Scheme is shown to be outside of the Colliter's Brook and Longmoor/Ashton Brook 50-year return period flood extent, and within the 75-year return period flood extent.

1.7.28 Portishead station and carpark are in the defended floodplain and so the impact of flooding on access and egress is considered insignificant for the present day (2015 and 2075) scenarios, for which the simulated 1000 year flood does not extend this far. For the future (2115) scenario, Portishead station and carparks, and the pedestrian crossing of Portbury Ditch (providing a pedestrian route from the station to Portishead) will be above the 200-year coastal flood level.

1.7.29 Pill station, car park and adjacent roads are several metres higher than River Avon flood levels and so access/egress is considered safe from River Avon tidal flooding.

1.7.30 The EA surface water flood map (https://flood-warning-information.service.gov.uk/long-term-flood-risk/map) indicates that there may be relatively small and localised areas in the vicinity of the DCO Scheme that could be vulnerable to surface water flooding during intense rainstorms. Surface water drainage of the railway and stations and car parks has been designed in consultation with the Environment Agency, North Somerset Levels Inland Drainage Board, NSDC and Bristol City Council, as appropriate, to ensure the DCO Scheme does not increase surface water flood risk elsewhere. The drainage of Portishead and Pill stations and car parks includes SuDS where appropriate.

1.7.31 All loss of floodplain storage by the DCO Scheme will be fully mitigated by providing floodplain compensation storage. The DCO Scheme design includes floodplain compensation to fully mitigate loss of Easton-in-Gordano Stream fluvial floodplain by localised ground lowering. The DCO Scheme design includes floodplain compensation within the proposed Clanage Road compound to fully mitigate displacement of floodplain storage by the Clanage Road compound access ramps.

1.7.32 A breach of the Sea Commissioner's Bank coastal flood defence during a tidal flood event would not affect the DCO Scheme for the present day (2015) scenario. The potential for a breach to impact the DCO Scheme increases for the future scenarios (2075 and 2115), due to projected future sea level rise. However, the impacts of a breach of the Sea Commissioner's bank on the DCO Scheme would be relatively minor even for the future (2115) scenario 200 year coastal event, and similar to the same event without a breach.

1.7.33 The inland flood bund coastal flood defence provided as part of a recent residential development on the outskirts of Portishead has an unresolved structural issue. The Environment Agency requires this to be resolved before adopting and maintaining the structure. The Environment Agency has recently agreed with a private developer actions required to resolve this structural issue. After these remedial works have been undertaken, the Environment Agency will adopt the defence for maintenance. There is likely to be a strategic response to manage future increased coastal flood risk between Portishead and Pill and the inland bund is likely to remain a component of the strategic coastal flood risk management infrastructure in the future.

1.7.34 Significant culverts under the railway will continue to be managed by the Environment Agency, North Somerset Levels Inland Drainage Board, NSDC, Network Rail and BCC as appropriate to minimise the risk of blocked culverts resulting in increased flooding locally during a flood event.

1.7.35 The DCO Scheme has been designed to result in no increase in flood risk elsewhere.

1.7.36 An Outline Flood Plan for the Operations Phase has been developed to support the DCO application (included in the Environmental Statement Appendix 17.1 FRA, DCO Document Reference 5.6). It provides an indication of the key issues required for consideration, and the general approach that will be taken, for flooding issues when the scheme is operational. Network Rail manages flood risk at a route level, producing Extreme Weather Plans (Network Rail Standard Maintenance Procedure NR/L3/TRK/1010) which incorporate flood responses across the route network. Once the DCO Scheme reaches the operational stage any relevant flood response issues pertaining to the line will fall under the auspices of the route-wide plan and any subsequent updates applied to it.

1.8 Mitigation and Adaptation

1.8.1 The IPCC Fifth Assessment Synthesis Report (IPCC, 2015) states that mitigation (i.e. reducing carbon emissions) and adaptation (i.e. responding to climate change impacts) are complementary approaches to reduce the risks associated with climate change over different timescales.

1.8.2 The resilience of the DCO Scheme will be determined by how the scheme design accounts for the projected impacts associated with climate changes (in accordance with the NPSNN paragraph 4.40 and the EIA Regulations).

Mitigation

1.8.3 Mitigation in the short and medium-term can reduce climate change impacts in the future. Benefits from adaptation however can be realised in the present and can aid in addressing future emerging risks associated with climate change.

1.8.4 At the Scheme level, there are limited opportunities for mitigation carbon emissions, for example through simple carbon footprinting techniques to identify opportunities to avoid, reduce, or substitute carbon emissions related to the construction of the DCO Scheme (e.g. through the exploration of alternative material specifications). The air quality assessment in the ES Chapter 7 (DCO Document Reference 6.10) demonstrates that the DCO Scheme is likely to result in a negligible rise in regional greenhouse gas emissions, as the modal switch from car trips to train is not sufficient to offset the increased emissions from the new train service.

1.8.5 Passenger services on the DCO Scheme will be powered by multiple diesel units for the hourly plus service. In the longer term, consideration may be given to provide a half hourly service. Implementation of a half hourly service requires extensive engineering works, at which point consideration may be given to electrifying the line. While this would remove local emissions from the combustion of hydrocarbons (diesel), the reduction of regional emissions would depend on the energy source for electricity production. The current DCO application does not include a half hourly service which would be consented under a separate application and require a separate business case.

1.8.6 The DCO Scheme forms a key part of the wider MetroWest strategic programme, to enhance the reach and the service frequency of the local rail network. The MetroWest programme (see Figure 1) comprises:

- MetroWest Phase 1 to enhance the Severn Beach Line and the Bath Spa to Bristol Line to operate a half hourly train service and re-open the Portishead Line with an hourly train service. Two new stations are proposed, at Portishead and Pill. The new train services will also service 16 existing stations.
- MetroWest Phase 2 to enhance the Yate to Bristol Line to operate half hourly train service and introduce an hourly train service on the Henbury line (freight only) to Bristol. Three new stations are proposed at Henbury, North Filton and Ashley Down. The new train services will also serve six existing stations.
- Specific station re-opening / new station projects, including Portway station and Charfield station.
- Further enhancements to service frequency for local rail lines (currently at the feasibility stage).

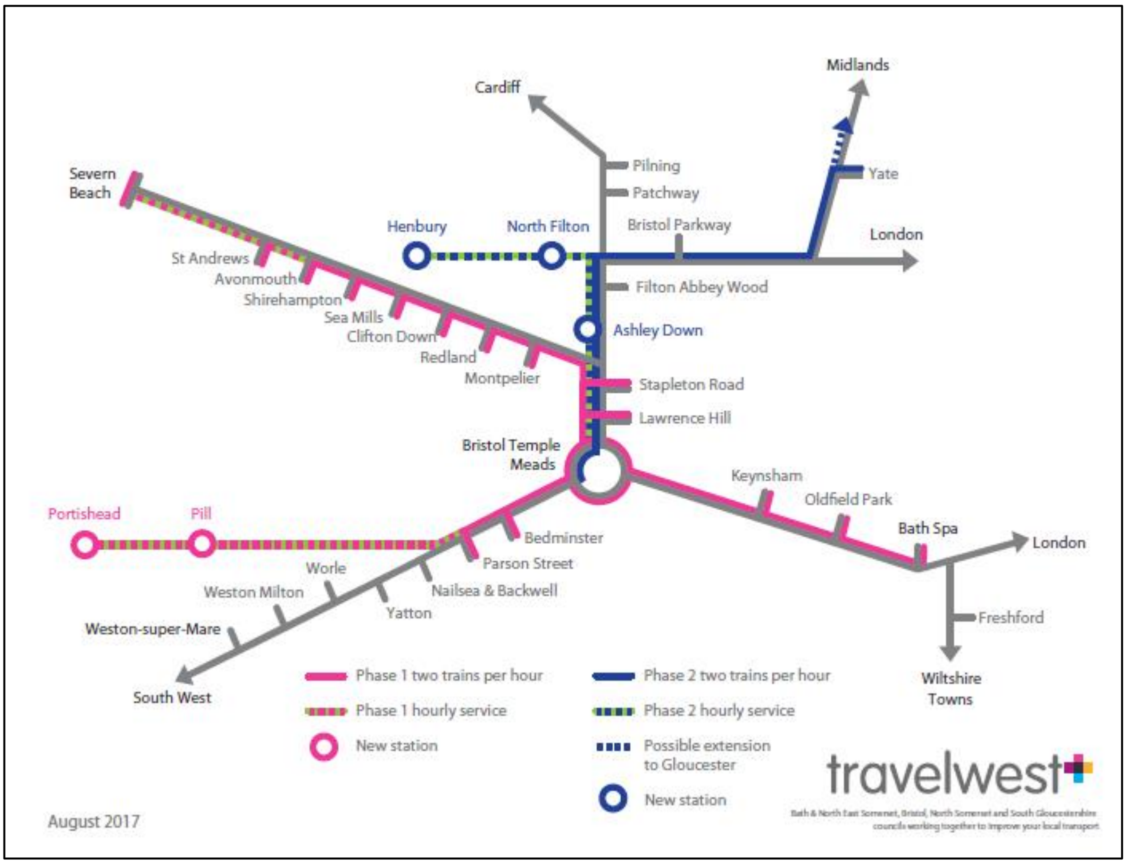

Figure 1 Diagrammatic Illustration of the MetroWest Programme

1.8.7 The first three projects of the MetroWest Programme (as above) are scheduled to be delivered by 2023 at an estimated cost of approximately £170M. The three projects will provide new/enhanced train services for about 500,000 people within 2 km of railway stations served by these improvements. The programme is expected to be expanded further as part of the key priorities of the five authorities in delivering the draft Joint Local Transport Plan 4 (“JLTP4”) for the period 2019 to 2036.

1.8.8 Specifically the draft JLTP4 Early Investment Schemes under development such as Stage C of MetroWest Phase 1 (a two trains per hour service on the Portishead Branch Line) and for a further new station to open at Ashton Gate on the Portishead Branch Line require the DCO Scheme to go ahead. These schemes would offer air quality benefits by allowing further modal shift from car to rail travel. 520 homes are proposed in the Ashton Gate area by Bristol Sport and a station at Ashton Gate would provide a sustainable travel solution into the centre of Bristol.

1.8.9 The DCO Scheme (being the major part of MetroWest Phase 1) will provide the foundation upon which the rest of the MetroWest programme will be rolled out. Consequently, the delivery of the DCO Scheme is strategically important for the five local authorities in delivering its transport policy and realising strategic objectives. Furthermore as the greenhouse gas emissions of the individual components of the projects within the programme are delivered and aggregated, the DCO Scheme will contribute to wider long term benefits.

1.8.10 Mitigation also involves the use of new technologies and renewable energies. The development of such mitigation lies with Network Rail and the train operating companies and as such is not available at the project level.

1.8.11 The UK railway industry has introduced a variety of measures to mitigate climate change. For example, Network Rail has developed and published climate change adaptation plans which prioritise the western route and identified investment in flooding, earth slips and wind resilience as 'high priority'[2]. It has also established a climate change resilience steering group to strengthen governance and adaptive capacity.

1.8.12 New technologies are emerging for low emission technology replacing conventional diesel-powered passenger trains. This technology is already beginning to come market as follows.

- Hybrid diesel / battery power systems reducing emissions by typically 20% compared to a standard EURO5 diesel powered new train, are now being offered to the market by Angel Trains and Porterbrook, as a conversion to existing diesel powered trains.
- Tri-mode diesel / battery / electric trains manufactured by Stadler provide both a greater reduction in emissions while offering greater operational capability. The actual reduction in emissions depends upon the length of overhead line electrification in operation on the train route. The Welsh Government has placed an order for these trains for South Wales Valleys.
- Hydrogen powered trains have been introduced into service in Germany, developed by Alston. Also Porterbrook are currently developing hydrogen power systems to convert existing diesel or electric trains. Hydrogen is used to generate electricity which powers the electric motors. The only by-product of hydrogen is water.

1.8.13 Without the DCO Scheme the trend of car dependency will continue. Car dependency is a major issue on the Portishead corridor with 71.9% of all journey to work by car/van, compared with 59.3% for the WoE and 57.0% for England. The DCO Scheme will assist the re-balancing of the local transport network, by addressing the very limited modal choice for the Portishead to Bristol corridor, which is reflected in the proportion of journeys to work taken by train. Just 1.0% of journeys to work on the Portishead corridor are by train, compared with 2.1% for the WoE and 5.3% for England.

1.8.14 The implementation of the DCO Scheme will assist the de-carbonisation of the local transport network as part of the medium to long term MetroWest Programme of investing in the local rail network, which forms a key foundation of the WoE's transport strategy, to achieve modal switch. Beyond the implementation of DCO Scheme local policy makers will have greater opportunity to implement more ambitious de-carbonisation / climate change policies, that target modal switch objectives, through some form of 'congestion charge' or 'road pricing' scheme. However, the pursuit of these

---

2 Network Rail, Climate Change Adaptation Report, 2015

more ambitious policies could not realistically be pursued for the Portishead to Bristol corridor without the implementation of the DCO Scheme.

Adaptation

1.8.15 The DCO Scheme as designed incorporates allowances for climate change through the highway and railway drainage and floodplain compensation. The DCO Scheme does not include works to existing or the construction of new flood defences. The principal response to flooding in the Bower Ashton area would be to suspend services until it is safe to resume them.

1.8.16 If the risk of flooding increases as predicted by the FRA modelling, it is worth considering that there is likely to be a strategic response to manage future increased coastal flood risk between Portishead and Pill and the city of Bristol to protect urban areas from increased flood risk, for example by constructing new flood defences. These works could also benefit the DCO Scheme, reducing the vulnerability of the DCO Scheme to the tidal flood risk in the Bower Ashton area. The FRA has not considered the consequences of new flood defences and at present there are no committed plans for new flood defences in the area.

1.9 Assessment Assumptions and Limitations

1.9.1 Due to the uncertainties that exist around the subject of climate change, there are limitations associated with predicting the impacts of climate change into the future, including:

- Uncertainty around climate change projections;
- Limited methodological guidance on how a climate change assessment should be carried out; and
- There is limited evidence relating to climate change impacts on infrastructure and environmental receptors, especially ecological receptors.

1.10 Summary

1.10.1 The DCO Scheme is anticipated to result in a small overall increase in CO_2e emissions within the region. The estimated total embodied carbon emissions that may be released during the construction of the DCO Scheme is estimated to be 27,300 tonnes, which represents <0.001% of the UK's Five Year Carbon Budget. In the first year of operation, the net increase in greenhouse gas emissions is estimated to be 942 tonnes per year which corresponds to 0.003% of the total CO_2 emitted nationally from the transport sector, which is over 30,000 kilotonnes/year (NAEI, 2014). The impact of the DCO Scheme on climate is therefore considered as negligible.

1.10.2 The railway industry is developing mitigation strategies to reduce carbon emissions from rail transportation through low emission technology.

1.10.3 The resilience of the DCO Scheme to projected climate change has been assessed in the FRA. This shows that most of the DCO Scheme is not vulnerable to future flood risk within the 60 year design life of the project, except for a short section in Bower Ashton where the railway crosses Flood Zone 3. This section is currently vulnerable to tidal flooding about once every five to ten years, reducing to more than once a year by 2075. Here, the main approach to flooding would be to suspend services until they are safe to resume.

1.10.4 Overall, it is considered that the DCO Scheme design and mitigation measures would ensure that it is safe from flooding during its lifetime (with appropriate mitigation) and does not increase flood risk elsewhere.

1.11 Abbreviations

B&NES	Bath and North East Somerset Council
BCC	Bristol City Council
BEIS	Department of Business, Energy and Industrial Strategy
CEMP	Construction Environmental Management Plan
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
CoCP	Code of Construction Practice
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
EIA	Environmental impact assessment
ES	Environmental Statement
EU	European Union
FRA	Flood risk assessment
IEMA	Institute of environmental Management and Assessment
IPCC	intergovernmental Panel on Climate Change
Kt	kilotonnes
NAEI	National Atmospheric Emissions Inventory
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NPSNN	National Policy Statement for National Networks
NSDC	North Somerset District Council
RCP	Representative Concentration Pathway
SAC	Special Area of Conservation
SGC	South Gloucestershire Council
SSSI	Site of Special Scientific Interest
SuDS	Sustainable drainage systems
UNFCC	United Nations Framework Convention on Climate Change
WECA	West of England Combined Authority

1.12 References

Bath & North-East Somerset Council. Climate Change and Adaptation. Accessed from: http://www.bathnes.gov.uk/services/your-council-and-democracy/local-research-and-statistics/wiki/climate-change-mitigation-and on: 19/02/2018

Bristol City Council, 2015. Our Resilient Future: A Framework for Climate and Energy Security.

Bristol City Council, 2016. Development Monitoring Report.

Department for Transport, 2014. National Policy Statement for National Networks.

Department for Transport, 2015. TAG Unit A3: Environmental Impact Appraisal

IPCC, 2013. Working Group/Contributions to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

IPCC, November 2014. Climate Change Synthesis Report,

IEMA, 2017. Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance.

IEMA, November 2015. Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation

National Atmospheric Emissions Inventory, 2015. Accessed from: http://naei.beis.gov.uk/ on: 07/02/2018

North Somerset Council, 2017. Annual Monitoring Report

North Somerset Council, 2018. Report to the Executive: Adoption of a carbon dioxide target for North Somerset

RSSB. Improving industry performance, Climate change adaptation. Accessed from: https://www.rssb.co.uk/improving-industry-performance/climate-change-adaptation on: 20/02/2018

Weatherbase. Accessed from: http://www.weatherbase.com/weather/weather-summary.php3?s=62730&cityname=Bristol%2C+England%2C+United+Kingdom&units= on: 07/02/2018

West of England, November 2017. Joint Spatial Plan Publication Document

UK Climate Projections. Accessed from: http://ukclimateprojections-ui.metoffice.gov.uk/ on: 07/02/2018