Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Environmental Statement

Volume 2

Chapter 18: Air Quality and Climate Change

June 2021

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Project No:	B27070CT
Document Title:	Proposed Bowland Section Environmental Statement Volume 2 Chapter 18: Air Quality and Climate Change
Document Ref.:	LCC_RVBC-BO-ES-018
Revision:	0
Date:	June 2021
Client Name:	United Utilities Water Ltd

Jacobs U.K. Limited

5 First Street
Manchester M15 4GU
United Kingdom
T +44 (0)161 235 6000
F +44 (0)161 235 6001
www.jacobs.com

Contents

18. Introduction

18.1 Introduction

1) This chapter presents an assessment of the likely significant effects of the Proposed Bowland Section on air quality. It also considers the climate change agenda in the context of estimated carbon emissions associated with construction of the Proposed Bowland Section, and explains outline options to mitigate these emissions.

2) This chapter begins by reviewing the legislation and planning policies relevant to air quality. The assessment area and methodology for the assessment are then outlined. The nature, value and sensitivity of the existing baseline environment are then identified before an assessment is made of the potential effects on the air quality for the Proposed Bowland Section. Mitigation measures have been proposed to avoid, reduce or offset any potential effects and these embedded and good practice mitigation measures have been taken into account in the assessment (see Section 18.4.4 and Chapter 3: Design Evolution and Development Description). Essential mitigation measures are further outlined in Section 18.7.

3) Construction-related carbon emissions and an outline of United Utilities' approach to carbon management on HARP are examined in Section 18.8, while Section 18.9 and Section 18.20 consider cumulative effects and provide concluding comments, respectively.

4) Schedule 4(5) of the EIA Regulations identify that EIAs should consider the impact of proposed developments on climate. Construction-related carbon emissions and an outline of United Utilities' approach to carbon management on HARP are therefore examined in Section 18.8. The vulnerability of the project to climate change-related risks is discussed in Chapter 15: Major Accidents. Section 18.9 and Section 18.20 consider cumulative effects and provide concluding comments, respectively.

5) Two air quality assessment areas were adopted for the purposes of this assessment, as follows:

- Local air quality up to 10 km from the assessed pollutant sources – relates to pollutants with the potential to affect human health and ecosystems at a local level, during the construction phase of the Proposed Bowland Section
- Dust emissions during the construction phase up to 350 m from construction areas. A site-specific assessment of the impacts of dust during construction has not been undertaken; instead a reasonable worst-case approach has been adopted to define the required level of dust mitigation measures needed to avoid likely significant effects.

6) Assessment areas were not required for the operational phase of the Proposed Bowland Section as there are no known sources of air pollution that would operate with the aqueduct in place that could impact on air quality.

7) This chapter is supported by the following technical appendices and figures:

- Appendix 18.1: Dispersion Model Input Parameters
- Appendix 18.2: Dispersion Modelling Results
- Figure 18.1: Modelled Generator Locations, Receptor Locations and Modelled Road Network

18.2 Scoping and Consultations

18.2.1 Scoping

8) An air quality chapter was included within the EIA Scoping Report[1] which was submitted to the relevant planning authorities for comment in October 2019 followed by a Scoping Addendum in February 2021[2]

[1] United Utilities (2019) Haweswater Aqueduct Resilience Programme, Proposed Bowland Section - EIA Scoping Report, October 2019.
[2] United Utilities (2021) Haweswater Aqueduct Resilience Programme, Proposed Bowland Section - EIA Scoping Report Addendum. February 2021.

that was required due to design changes and refinements. Each of the local planning authority's scoping opinions was informed by statutory consultee comments and the scope of this assessment is based on the scoping opinions. Relevant scoping comments and responses are outlined in Appendix 4.1.

18.2.2 Consultation

9) During the course of this assessment, consultation has taken place with relevant statutory and non-statutory consultees, stakeholders and third parties. This is summarised in Appendix 4.1.

18.3 Key Legislation and Guidance

10) Table 18.1 introduces relevant air quality legislation and key air quality-related strategies which are underpinned by legislation.

Table 18.1: Air Quality Key Legislation and Relevant Plans or Strategies

Applicable Legislation, Plans and Strategies	Description
Environment Protection Act 1990 Part III[3]	Provides statutory nuisance provisions for nuisance dust.
Environment Act 1995, Part IV[4]	Defines requirements for Local Air Quality Management (LAQM).
The Air Quality (England) Regulations 2000[5] and The Air Quality (England) (Amendment) Regulations 2002[6]	Legislates for the Air Quality Objectives (AQOs) for pollutants set out in the 2007 Air Quality Strategy.
The Air Quality Standards Regulations 2010/2016 (as amended)[7]	Transposes the air quality Limit Values set out in the European Union (EU) ambient air quality directive 2008/50/EC (European Commission, 2008) to UK law. Prior to Brexit, the UK Government was responsible to the European Commission (EC) for ensuring that it complied with the provisions of EU Directives.
The National Air Quality Strategy for England, Scotland, Wales and Northern Ireland, 2007[8]	Updates the 2000 Air Quality Strategy, and sets out how local air quality is managed, through the application of AQOs based on The Air Quality (England) Regulations 2000 and The Air Quality (England) (Amendment) Regulations 2002.
Clean Air Strategy 2019[9]	Sets out how different air pollutants are planned to be tackled going forward for both their impact on nature and humans.
National Air Pollution Control Programme[10]	The National Air Pollution Control Programme is a UK wide document. It sets out measures and technical analysis which demonstrates how legally binding 2020 and 2030 emission reduction commitments can be met across the UK.

[3] *Legislation.gov.uk* (2020) [Online] Available from: https://www.legislation.gov.uk/ukpga/1990/43/part/III [Accessed: March 2021]
[4] *Legislation.gov.uk* (2015) [Online] Available from: https://www.legislation.gov.uk/ukpga/1995/25/part/IV [Accessed: March 2021]
[5] *Legislation.gov.uk* (2000) [Online]Available from: https://www.legislation.gov.uk/uksi/2000/928/contents/made [Accessed: March 2021]
[6] *Legislation.gov.uk* (2002) [Online] Available from: https://www.legislation.gov.uk/uksi/2002/3043/contents/made [Accessed: March 2021]
[7] *Legislation.gov.uk* (2016) [Online] Available from: https://www.legislation.gov.uk/uksi/2016/1184/contents/made [Accessed: March 2021]
[8] Department for Environment, Food & Rural Affairs (2007) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland - Volume 1.* [Online] Available from: https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-1 [Accessed: October 2020]
[9] Department for Environment, Food and Rural Affairs, Ministry of Housing, Communities & Local Government, Department for Transport, Department of Health and Social Care, HM Treasury, and Department for Business, Energy & Industrial Strategy (2019) *Clean Air Strategy 2019* [Online] Available from: https://www.gov.uk/government/publications/clean-air-strategy-2019 [Accessed: March 2021]
[10] Department for Environment, Food & Rural Affairs, Welsh Government, The Scottish Government, and Department of Agriculture, Environment and Rural Affairs (Northern Ireland) (2019) *Air Quality: UK National Air Pollution Control Programme* [Online] Available from: https://www.gov.uk/government/publications/air-quality-uk-national-air-pollution-control-programme [Accessed: March 2021]

Applicable Legislation, Plans and Strategies	Description
The Conservation of Habitats and Species Regulations 2010 (as amended)[11]	The presence of protected habitats and ecosystems within the air quality assessment area introduces legislative requirements that must be taken into account in assessing air quality.

11) EU Directive 2008/50/EC Ambient Air Quality and Cleaner Air for Europe was published to consolidate previous EU Directives on ambient air quality. These EU Directives form the basis for UK air quality legislation via The Air Quality Standards Regulations 2010. Although published in 2007, the Air Quality Strategy is consistent with The Air Quality Standards Regulations 2010.

12) Prior to Brexit, the UK government was responsible to the European Commission (EC) for ensuring that it complied with the provisions of the EU Directive 2008/50/EC. Although this is no longer the case, The Air Quality Standards Regulations 2010 remain in force and compliance with the Limit Values within these regulations is still required. As noted in Table 18.1, on the UK government's behalf, the Department for Transport (DfT) and Department for Environment Food and Rural Affairs (Defra) had Public Service Agreements relating to EU Limit Values. The responsibility for compliance with the Limit Values in The Air Quality Standards Regulations 2010 remains with these bodies. The responsibilities of Local Authorities with respect to meeting air quality standards are not the same as the responsibilities of the UK government with regard to the Limit Values in The Air Quality Standards Regulations 2010. Local Authorities do have statutory duties for LAQM but are not obliged to ensure AQOs are met but are worked towards in the shortest practical time.

13) It is important to recognise the difference between the EU Limit Values (for which compliance is determined at a national level by government, but is often delegated to local authorities where there are potential exceedances) and the AQOs (for which compliance is determined at a local level by local authorities under the LAQM regime). Whilst the EU Limit Values and AQOs for the relevant pollutants (nitrogen dioxide (NO_2) and fine particulate matter with aerodynamic diameter of 10 microns or less (PM_{10})) may be set at the same concentration value (e.g. 40 $\mu g/m^3$, as an annual mean) the means of determining compliance are fundamentally different, and they must be considered separately.

14) Article 3 of the EU Directive (2008/50/EC) requires Member States to nominate the competent authority for the assessment of air quality (which in the UK is the Secretary of State for the Environment) and it may be interpreted that only the competent authority can determine compliance with the EU Limit Values. Compliance is initially determined via the national monitoring network and national model (the Pollution Climate Mapping (PCM) model), followed by more local scale modelling to assess actions to enable compliance, such as a Clean Air Zone. There are a number of important differences between this and the monitoring / modelling carried out by local authorities to determine compliance with the AQOs. Some of these differences are summarised in Table 18.2.

Table 18.2: Comparison Between National and Local Compliance Approaches

Factor	National Compliance	Local Compliance
Relevant exposure	EU Limit Values apply everywhere there is public access, within 15 m of the running lane / kerbside. However, paths running perpendicular to the road are excluded.	Annual mean AQOs only apply at locations where public exposure is relevant to the averaging period, e.g. at residential building façades.
Treatment of junctions	Monitoring is not carried out within 25 m of a junction and the same constraint is applied to the modelling.	Junctions are specifically considered in both monitoring and modelling.

[11] *Legislation.gov.uk* (2010) [Online] Available from: https://www.legislation.gov.uk/uksi/2010/490/contents/made [Accessed: March 2021]

Factor	National Compliance	Local Compliance
Microscale	Excludes micro-environments and focuses on locations representative of 100 m lengths of roads.	Focuses on 'hot-spot' locations.
Roadside	Modelled concentrations apply to a distance of 4 m from kerbside of the national road network. Local roads are excluded from the model.	Focus is on concentrations at the building façade, whatever distance from the kerb and alongside any road.
Monitoring	Restricted to monitoring stations in the national network, operated to meet the Data Quality Objectives of the EU Directive.	Principally based on local authority monitoring, including both automatic and passive diffusion samplers.

15) Because of these differences, there are many locations across the UK where the national compliance with the EU Limit Values, and local compliance with the AQOs, are not in agreement. For the purpose of this assessment, they are treated separately. This is consistent with the advice in the relevant Planning Practice Guidance.[12] Compliance with EU Limit Values are only considered where there is a potential impact on air quality from road traffic emissions, principally for NO_2, at locations which coincide with links in the PCM model, as other emission sources are more readily mitigated at source during the design.

18.3.1 Air Quality Objectives and Target Values

16) The air quality objectives applicable to LAQM in England are set out in The Air Quality (England) Regulations 2000 and subsequent 2002 amendment. The pollutants relevant to this assessment are sulphur dioxide (SO_2), oxides of nitrogen (NOx), NO_2, PM_{10}, fine particulate matter with aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$), carbon monoxide (CO) and ammonia (NH_3). The relevant AQOs are presented in Table 18.3. In addition, the Environment Agency (2016)[13] sets out in its online guidance a series of target values for the protection of human health and conservation areas, where these are not already covered by EU Limit Values or AQOs. These are known as Environmental Assessment Levels (EALs) and are also presented in Table 18.3.

Table 18.3: Air Quality Objectives (AQOs) / EU Limit Values / EALs

Pollutant	AQOs		Type
	Concentration	Pollutant	
NO_2 (for human health)	200 µg/m^3 not to be exceeded more than 18 times / year	1-hour mean (equivalent to the 99.79th percentile of 1-hour means)	AQO / EU Limit Value
	40 µg/m^3	Annual mean	AQO / EU Limit Value
NO_x (for vegetation and ecosystems)	30 µg/m^3	Annual mean	AQO / EU Limit Value
	75 µg/m^3	24-hour mean (maximum)	EAL
PM_{10} (for human health)	50 µg/m^3 not to be exceeded more than 35 times / year	24-hour mean (equivalent to the 90.4th percentile of the 24-hour means)	AQO / EU Limit Value

[12] Ministry of Housing, Communities & Local Government (2019) Planning practice guidance, Air Quality [Online] Available from: https://www.gov.uk/guidance/air-quality--3 [Accessed: March 2021]

[13] Environment Agency (2016) *Air emissions risk assessment for your environmental permit* Published 1 February 2016, updated 7 October 2020 [Online] Available from: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions [Accessed: March 2021]

Pollutant	AQOs		Type
	Concentration	Pollutant	
	40 µg/m^3	Annual mean	AQO / EU Limit Value
$PM_{2.5}$ (for human health)	25 µg/m^3	Annual mean (exposure reduction target)	AQO / EU Limit Value
CO (for human health)	10,000 µg/m^3	Maximum 8-hour running mean (100th percentile)	AQO / EU Limit Value
	30,000 µg/m^3	Maximum 1-hour mean (100th percentile)	EAL
SO_2 (for human health)	125 µg/m^3 not to be exceeded more than three times / year	24-hour mean (equivalent to the 99.18th percentile of the 24-hour means)	AQO / EU Limit Value
	350 µg/m^3 not to be exceeded more than 24 times / year	1-hour mean (equivalent to the 99.73rd percentile of the 1-hour means)	AQO / EU Limit Value
	266 µg/m^3 not to be exceeded more than 35 times / year	15-minute mean (equivalent to the 99.9th percentile of the 15-minute means)	AQO
SO_2 (for vegetation and ecosystems)	20 µg/m^3	Annual mean	AQO / EU Limit Value
	10 µg/m^3	Annual mean	EAL (where lichen or bryophytes are present)
NH_3 (for human health)	180 µg/m^3	Annual mean	EAL
	2,500 µg/m^3	Maximum 1-hour mean (100th percentile)	EAL
NH_3 (for vegetation and ecosystems)	3 µg/m^3	Annual mean	EAL
	1 µg/m^3	Annual mean	EAL (where lichen or bryophytes are present)

17) Parts of the UK are currently failing to meet the annual mean NO_2 AQO and EU Limit Values. The first Air Quality Plan[14] for NO_2 in the UK outlined how air quality would be improved by reducing NO_2 emissions in towns and cities. A revised UK Air Quality Plan was published by Defra and DfT (2017)[15] in July 2017, but the most recent ruling from the High Court in February 2018 (ClientEarth (No.3) versus SoSEFRA)[16] concluded that this plan is insufficient to bring compliance with the EU air quality Limit Values within the shortest timeframe possible. In May 2018, Defra released a consultation draft of the Clean Air Strategy 2018, outlining actions to tackle emissions from a range of pollutant sources. The consultation on this draft informed the final Clean Air Strategy[17] and National Air Pollution Control Programme[18] published in January 2019 and March 2019 respectively. The Environment Bill 2019-21

[14] Defra (2015) *Air quality in the UK: plan to reduce nitrogen dioxide emissions* December 2015.
[15] Defra & DfT (2017) *Air quality plan for nitrogen dioxide (NO2) in UK (2017)* [Online] Available from: https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017 [Accessed: March 2021]
[16] Royal Courts of Justice (2018) [Online] Available from: https://www.judiciary.gov.uk/wp-content/uploads/2018/02/clientearth-no3-final-judgmentdocx.pdf [Accessed: March 2021]
[17] Department for Environment, Food and Rural Affairs, Ministry of Housing, Communities & Local Government, Department for Transport, Department of Health and Social Care, HM Treasury, and Department for Business, Energy & Industrial Strategy (2019) *op. cit.*
[18] Department for Environment, Food & Rural Affairs, Welsh Government, Scottish Government, and Department of Agriculture, Environment and Rural Affairs (Northern Ireland) (2019) *op. cit.*

introduces some of these issues, but at the time of writing had only reached the report stage in the House of Commons on 26 January 2021.

18) National and Local Planning Policies are covered in Chapter 5: Planning Policy and Context.

18.4 Assessment Methodology and Assessment Criteria

19) The air quality assessment included consideration of the following aspects:

- Dust emissions generated by earthworks and construction-related activities during the construction phase
- Exhaust emissions of pollutants to air from road vehicles (e.g. cars, vans, buses and lorries) on the local road network during construction of the Proposed Bowland Section
- Exhaust emissions from electrical generation plant (i.e. diesel generators) during the construction phase.

18.4.1 Assessment Methodology

20) Reference has been made to national and local policy documents, national guidance and other relevant guidance and information in determining the assessment methodology and criteria to be used to assess the above aspects.

21) The assessment was undertaken in accordance with the assessment methodologies set out in the following guidance documents:

- Institute of Air Quality Management (IAQM) guidance[19] for assessing dust from demolition and construction (for the assessment of dust)
- Highways England: Design Manual for Roads and Bridges (DMRB) LA 105 – Air Quality[20] (for the assessment of road traffic emissions during construction and to inform the determination of significance of air quality effects). This also included use of the DMRB HA207/07[21] guidance to supplement the road traffic screening criteria
- Environment Agency guidance: Air emissions risk assessment for your environmental permit[22] (for the assessment of emissions from the diesel generators during construction). This was supplemented with specific aspects of the Environmental Protection UK (EPUK) and IAQM guidance[23] for describing the impacts and determination of significance of air quality effects in relation to short-term emissions.

22) The methodology was discussed with relevant stakeholders as outlined above in Section 18.2.2.

Construction Phase – Dust Emissions

23) Dust assessments for the environmental assessment of proposed developments in the UK are often undertaken using the methodology set out in the IAQM guidance[24] for the assessment of dust from demolition and construction. This approach identifies the level of risk associated with the proposed construction activities (from high risk to low risk / negligible) and sets the level of mitigation required to avoid a likely significant effect. The higher the risk determined for certain activities, the higher the level of dust mitigation, controls, monitoring and management which would need to be applied at the construction site.

[19] Institute of Air Quality Management (2016) *Guidance on the assessment of dust from demolition and construction* [Online] Available from: http://iaqm.co.uk/wp-content/uploads/guidance/iaqm_guidance_report_draft1.4.pdf [Accessed: March 2021]
[20] Highways England (2019), Design Manual for Roads and Bridges LA 105 Air Quality [Online] Available from: https://www.standardsforhighways.co.uk/dmrb/search/10191621-07df-44a3-892e-c1d5c7a28d90 [Accessed: March 2021]
[21] Highways England (2007) Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 Ha207/07 Air Quality.
[22] Environment Agency *(2016) op. cit.*
[23] Environmental Protection UK and Institute of Air Quality Management (2017), Land-Use Planning & Development Control: Planning For Air Quality, version 1.2 [Online] Available from: https://iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf [Accessed: March 2021]
[24] Institute of Air Quality Management (2016) *op. cit.*

24) Based on the proposed activities and volume of earthworks and material to be processed and transported in constructing the tunnels and associated site compounds and shafts, there is the potential for dust emissions to be generated by the Proposed Bowland Section and be dispersed off-site to nearby sensitive locations. Therefore, as a reasonable worst-case approach it was assumed that all construction activities were categorised as having a high risk of dust impacts prior to the application of any mitigation measures. Therefore, a site-specific dust assessment has not been undertaken. Appropriate good practice mitigation measures required to effectively control dust emissions from high-risk dust activities (as set out in the IAQM guidance)[25] have been included in the required Construction Code of Practice (CCoP). Construction dust is therefore not discussed further in this chapter other than in terms of the appropriate good practice mitigation measures proposed (see Section 18.4.4) and the conclusion on residual effects (see Section 18.7).

Construction Phase – Vehicle Emissions

25) The assessment of emissions of NOx / NO_2 and PM_{10} / $PM_{2.5}$ from construction vehicles used traffic data explained in Chapter 16: Transport Planning. The traffic data represents the average daily road traffic conditions and the following traffic data parameters were provided per road link:

- Annual Average Daily Traffic (AADT) (vehicles per day)
- Heavy Duty Vehicles (HDVs) percentage
- Daily average vehicle speed (kilometres per hour (kph)).

26) The assessment of construction vehicle emissions used construction phase traffic modelling data to determine the affected road network (ARN) based on DMRB LA 105[26] screening criteria, supplemented with the DMRB HA207/07[27] speed criteria. The ARN for road traffic emissions during the construction phase was determined by the change in traffic data between a Do Nothing scenario (DN) (i.e. without the Proposed Bowland Section in place and not including any committed developments), and a Do Something scenario (DS) (with the Proposed Bowland Section in place and including committed developments). These scenarios were modelled for the year with the highest anticipated construction traffic levels, which were compared against the following DMRB screening criteria for identifying the ARN:

- Daily traffic flows would change by 1,000 AADT or more
- HDV flows would change by 200 AADT or more
- Daily average speeds would change by 10 km/hour or more
- A change in carriageway alignment by 5 m.

27) A DMRB drop-off spreadsheet-based assessment (using the dispersion equation for predicting the traffic contributions to pollutant concentrations at different distances from the road (set out in Annex C paragraph C3.2 of the DMRB guidance (HA 207/07)) was then undertaken to determine the potential pollutant concentrations at the worse-case sensitive locations within 200 m from the construction phase ARN. Locations within 2 km of the on-site diesel generators and also close to the construction traffic routes or other non-ARN roads with available traffic modelling data (i.e. locations not close to the ARN) were also included within the assessment area to ensure the combined impact of both diesel generator and road traffic emissions was considered, especially at locations close to roads where the existing pollutant concentrations would be elevated. Further details of the assessment locations are provided in Section 18.4.2.

28) The drop-off spreadsheet assessment approach was considered appropriate for the Proposed Bowland Section, with consideration being given to the nature of the Proposed Bowland Section (generally an area of good air quality and relatively few sensitive locations or heavily populated areas).

[25] Institute of Air Quality Management (2016) *op. cit.*
[26] Highways England (2020) *op. cit.*
[27] Highways England (2007) *op. cit.*

29) As noted above, worst-case sensitive locations are required to be identified within 200 m of the ARN for assessment purposes. Other roadside locations were included in the assessment where these were close to routes proposed to be used by construction road traffic or close to other roads (where these locations were within 2 km of the diesel generators), regardless of whether the road links were part of the ARN. Where data were available in the traffic modelling outputs, other (non-affected) road link data within 200 m of selected locations were also included to provide a representative emission calculation.

30) In addition, the assessment area for road traffic was extended to include reasonable worst-case locations within 2 km of the diesel generators for those roads where traffic flows would increase due to the Proposed Bowland Section, or where locations are close to busy roads.

31) The Defra Emission Factor Toolkit version 10.1 was used to calculate the NOx, NO_2, PM_{10} and $PM_{2.5}$ emissions from road vehicles for all road links that are part of the assessment area. Emissions were then fed into the drop-off spreadsheet to calculate predicted ambient pollutant concentration contributions from the modelled traffic sources at the local air quality locations. The predicted NOx / NO_2 concentrations at ecological locations were also used to determine the nitrogen and acid deposition rates. The following scenarios were assessed:

- Baseline Year 2019
- Worst-Case Construction Year (2023) – without the Proposed Bowland Section or other committed development-related traffic growth (DN)
- Worst-Case Construction Year (2023) – with the Proposed Bowland Section being constructed (DS).

32) IAQM guidance [28] specifies the following in relation to the assessment of emissions to air from construction plant and machinery:

33) 'Experience of assessing the exhaust emissions from on-site plant (also known as Non-road Mobile Machinery or NRMM) and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed.'

34) Based on the relatively low number of diesel-powered plant and machinery items anticipated to operate simultaneously at each of the construction compounds, and low existing concentrations of pollutants in the vicinity of the compounds, the potential impact on local air quality at human and ecological locations in the vicinity of the sites would be imperceptible. Typical earth moving construction plant would be required for the earthworks associated with establishing the compounds over the period of several months. For the Proposed Bowland Section, particularly at the Newton-in-Bowland launch compound, this would include approximately 10 – 12 relatively small-sized excavators, two small dump trucks, a roller and other plant (such as a forklift, telehandler, concrete wagon and road sweeper). These works would then be followed by the portal construction for a period of approximately three months which would require up to four relatively small-sized excavators, breaker, concrete pump, spraying robot and conveyors. The general plant activity during the tunnel construction and management of material / waste arisings which comprises the longest period of activities (up to approximately five years) at the Newton-in-Bowland launch compound generally requires relatively small numbers of above ground plant items (e.g. five relatively small-sized excavators, five small to medium-sized dump trucks, roller, dozer, crane, telehandler, forklift, compressor, road sweeper and pumps). Some open-cut trenching works and pipework construction would be required towards the end of the main construction activity period once tunnelling has been completed, and would require up to five relatively small-sized excavators, four dump trucks, two rollers, a dozer and crawler crane for a period of approximately three months.

35) On this basis, and in line with the IAQM guidance, this aspect was screened out from requiring a detailed assessment, and the impact on air quality from construction plant and machinery emissions is considered to be imperceptible, resulting in a not significant effect.

[28] Institute of Air Quality Management (2016) *op. cit.*

Construction Phase– Diesel Generator Emissions

36) For the purposes of this assessment, it was assumed that most of the electrical power for on-site machinery, including the tunnel boring machines, would be provided by diesel generators. This is a reasonable worst-case assumption. The compounds included in the assessment were those containing generators of 250 kVa in size or larger.

37) The potential impacts of the operation of the diesel generators arise from stack emissions of combustion-derived pollutants. As diesel fuel is proposed, the pollutants considered in the assessment are NOx, NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$ and NH_3. The potential impacts were determined for the following aspects:

- The potential impact on human health due to emissions of NOx in the form of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$ and NH_3
- The potential impact on vegetation and ecosystems due to emissions of NOx, SO_2 and NH_3 and the associated nitrogen and acid deposition.

38) An industry-standard atmospheric dispersion model was used to model releases of the identified substances (the Atmospheric Dispersion Modelling System (ADMS) version 5.2 atmospheric dispersion model). The ADMS model predicts the dispersion of operational emissions from a specific source (e.g. an exhaust stack), and the subsequent concentrations over an identified area (e.g. a grid of points covering the site and surrounding area) or at specified points (e.g. nearby residential properties). The latest version (5.2.4) was used for the modelling.

39) The modelling assessment was undertaken in line with relevant guidance including the Environment Agency guidance for the assessment of industrial emissions.[29] Further details of the diesel generator emissions and dispersion modelling procedure is set out in Appendix 18.1. In summary, the emissions from the diesel generators were calculated based on the EU Stage V emission standards for non-road engines,[30] which were introduced in 2019 for all new diesel generators. The diesel generator locations and layout of the construction compounds were identified from the designs and were then fed into the ADMS model to calculate predicted ambient pollutant concentrations contributions from the modelled diesel generator sources at the local air quality locations using five years of meteorological data. This was undertaken for the worst-case construction year (2023) with the proposed Bowland section being constructed (DS).

40) As the construction sites would be operating in the order of years at high capacity / load during the construction phase, it was assumed for emission calculations that all generators were continuously operating at full load (i.e. 24 hours per day for 365 days per year). This enabled the worst-case annual pollutant emissions to be predicted and to capture the highest long-term and short-term pollutant concentrations that may occur at nearby sensitive locations. However, this level of operation would not occur in practice and is particularly overly-conservative at the Lower Houses reception site compound, where activities would be expected to peak for less than a whole year.

18.4.2 Sensitive Locations

Human Locations

41) For the local air quality assessment of emissions from road traffic and the diesel generators during the construction phase, selected human locations (within 200 m of the modelled road links and / or 2 km of the diesel generators) were identified using Ordnance Survey Address Base Plus data, and selected using professional judgement. The types of locations searched for within the assessment area include residential properties, schools, hospitals and care homes. Footpaths and other public locations where exposure would occur over shorter periods were also identified. Human sites have been modelled for

[29] Environment Agency (2016) *op. cit.*

[30] The European Parliament and the Council of the European Union (2016) Regulation (EU) 2016/1628 of the European Parliament and of the Council of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations (EU) No 1024/2012 and (EU) No 167/2013, and amending and repealing Directive 97/68/EC [Online] Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1628&from=EN [Accessed: March 2021]

NO_2 and PM_{10} / $PM_{2.5}$ for road traffic emissions, and for NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$ and NH_3 in respect of diesel generator emissions. The combined impact of the NO_2, PM_{10} and $PM_{2.5}$ concentrations at human locations due to emissions from road traffic and the diesel generators was used as the basis of the assessment for these pollutants.

42) Selected sensitive locations were those either closest to modelled roads, or representative of the anticipated maximum impacts of the Proposed Bowland Section diesel generators (or a combination of both sources) in that area. An additional location was included within the Clitheroe Air Quality Management Area (AQMA) to determine the potential impact of traffic flow changes within Clitheroe, where elevated NO_2 concentrations exist. All human locations are considered of equal value and sensitivity.

43) A total of 35 human health locations are included in the assessment, and are shown on Figure 18.1. Full details of the human locations are provided in Appendix 18.1.

Ecological Locations (Designated Sites)

44) The following site designations have been considered for the assessment:

- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Ramsar site
- Site of Special Scientific Interest (SSSI)
- National Nature Reserve (NNR)
- Local Nature Reserve (LNR)
- Local Wildlife Site (LWS), Biological Heritage Site (BHS) etc.
- Ancient woodland.

45) Designated sites contain features which may be sensitive to changes in air quality pollutant concentrations, either directly (on the primary habitat designated) or indirectly (i.e. on the habitat associated with a non-habitat designation, e.g. birds), and which could be adversely affected by the effect of an increase in air pollution on vegetation. The designated sites within 2 km (or 10 km for European sites, i.e. SAC, SPA and Ramsar sites) of the diesel generators are detailed in Section 18.5.3 and shown on Figure 18.1. The designated sites were agreed with the scheme ecologists. Locations representing each of the designated sites were identified and included in the models. Details of the ecological locations are set out in Appendix 18.1 and are also shown on Figure 18.1.

46) The concentrations of NOx, NO_2, SO_2 and NH_3 were modelled at each of the ecological locations. The predicted concentrations of these pollutants were also used to assess the potential impact from acid deposition and nutrient nitrogen deposition at the ecological locations.

Pollution Climate Mapping Locations

47) In accordance with DMRB LA 105, PCM locations (i.e. at 4 m from the roadside and at any public reportable location) for the EU Limit Value compliance assessment are required for modelling on any ARN road links within the PCM model. As there are no ARN road links which coincide with road links within the PCM model, no specific PCM locations were identified. As described in Section 18.5.2, the nearest PCM link is 10 km to the south-east of any of the Proposed Bowland Section compounds (Newton-in-Bowland compound). Therefore, the contribution to pollutant concentrations from diesel generator emissions, given the relatively small size and number of diesel generators, would be imperceptible and have no impact on compliance with the EU Limit Values at these PCM links.

18.4.3 Background Concentrations and Deposition

48) 'Background' air quality is a concept used to enable assessment of the effects of particular emissions sources, without the need for all sources in the area to be considered explicitly within the modelling. The

background concentrations are added to the predicted contributions (PCs) from the road traffic and diesel generator emissions modelling for each modelled location to derive the total pollution concentrations, referred to as the predicted environmental concentration (PEC).

49) Defra provides empirically derived national background maps, providing estimates of background pollutant concentrations on a 1 km x 1 km grid square resolution.[31] The data for NOx, NO_2, PM_{10} and $PM_{2.5}$ were obtained based on the 2018 base year maps from which future years are projected. For SO_2 and CO concentrations, the 2001-based background maps were used as more up-to-date versions were not available. For NH_3, the background concentrations were obtained from the Air Pollution Information System (APIS) website using the Site Relevant Critical Loads or Search by Location functions for each human and ecological location.[32] The background NH_3 concentrations are based on the three-year mean for the 2016 – 2018 period.

50) No sector removal or adjustment has been undertaken for background concentrations.

51) In line with the Environment Agency guidance,[33] the background concentrations for short-term concentrations (i.e. 15-minute, one-hour, eight-hour and 24-hour mean concentrations) were based on twice the annual mean background concentration to account for short-term variations.

52) Existing acid and nitrogen deposition rates were obtained from APIS.[34] These were selected for the assessed designated site at the modelled location and are representative of the deposition value for tall and short vegetation (i.e. depending on the vegetation types present at each of the designated sites as identified by the scheme ecologists). These were based on the latest existing deposition data available on the APIS website, using the three-year mean for the 2016 – 2018 period.

Prediction of Environmental Concentrations Including Adjustment for Long-term Trend in NOx and NO_2

53) As noted above, the PEC was produced by the addition of road traffic and diesel generator PCs (where applicable) to the background concentrations of NOx, PM_{10} and $PM_{2.5}$ for human and relevant ecological locations. The total NO_2 concentrations from road traffic, including the background NO_2 concentrations, were derived from the modelled NOx concentrations at locations located within 200 m of the modelled road links using the Defra NO_x to NO_2 calculator (v8.1).[35]

54) A further adjustment step for the modelled road traffic component was undertaken to account for the observed trends in ambient roadside NO_x and NO_2. In July 2011, Defra published a report[36] examining the long-term air quality trends in NO_x and NO_2 concentrations, which identified a clear decrease in NO_2 concentrations between 1996 and 2002. Thereafter NO_2 concentrations have stabilised with little to no reduction between 2004 and 2012. The consequence of the conclusions of Defra's advice on long-term trends is that there is a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality, built into the vehicle emission factors, the projected background maps and the NO_x and NO_2 calculator.

55) Highways England (DMRB LA 105)[37] has developed the gap analysis methodology to adjust model predictions, which uses the relationship between the base year vehicle emission rates and the opening year vehicle emission rates, and the measured trends in roadside air quality concentrations to uplift opening year predicted concentrations to align them better with the long-term trends of NO_x and NO_2.

56) The gap analysis methodology incorporates Euro 6/VI improvements. These projection factors are referred to as 'Long Term Trend Euro 6/VI (LTTE6)'. The LTTE6 factors take a precautionary approach to account for uncertainty associated with Euro 6/VI performance and fleet mix in the future, rather than

[31] Defra (2020) *Background Mapping data for local authorities*, Background Maps 2018 and 2001 [Online] Available from: https://uk-air.defra.gov.uk/data/laqm-background-home [Accessed: October 2020]
[32] Air Pollution Information System (2020) [Online] Available from: http://www.apis.ac.uk/ [Accessed: February 2021]
[33] Environment Agency (2016) *op. cit.*
[34] Air Pollution Information System (2020) *op. cit*.
[35] Defra (2020) NOx to NO2 Calculator, version 8.1, August 2020 [Online], Available from: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc [Accessed: March 2021]
[36] Defra (2011) Trends in NOx and NO2 emissions and ambient measurements in the UK [Online] Available from: https://uk-air.defra.gov.uk/assets/documents/reports/cat05/1108251149_110718_AQ0724_Final_report.pdf [Accessed: March 2021]
[37] Highways England (2019) *op. cit.*

assuming full reductions in emissions occur as predicted by Euro 6/VI, which has not been observed by air quality monitoring trends associated with recent Euro standards. This is implemented into LTTE6 by taking the midpoint between the measured trend predictions (which assume no improvement in emissions associated with Euro 6/VI) and predicted Euro 6/VI uptake and emission improvements.

57) On this basis, the LTTE6 projections are considered to be the most reasonable prediction of likely actual future NO_X and NO_2 concentrations, and have been used in the local air quality assessment for locations within 200 m of roads. The gap analysis is not applied to PM_{10} or $PM_{2.5}$ predictions.

58) For emissions from the diesel generators, the conversion of NOx to NO_2 was undertaken in line with the Environment Agency guidance[38] to determine the NO_2 PC and subsequently added to the total NO_2 concentration derived from the road traffic modelling described above, after application of the LTTE6. At locations greater than 200 m of the modelled road links, the NOx emissions from the diesel generators were converted to NO_2 in line with the Environment Agency guidance[39] and subsequently added to the background NO_2 concentration.

18.4.4 Embedded Mitigation and Good Practice

59) Embedded mitigation is inherent to the design, and good practice measures are standard industry methods and approaches used to manage commonly occurring environmental effects. The assessments presented in Section 18.6 of this chapter are made taking into account embedded mitigation and the implementation of good practice measures.

Embedded Mitigation

60) The design has sought to avoid impacts as part of the design process. Chapter 3: Design Evolution and Development Description explains the evolution of the design with input from the environmental team, including mitigation workshops and the use of GIS based constraints data.

Good Practice Measures

61) The good practice measures which would be required to control dust emissions would be agreed between the construction contractor and the relevant local authorities via the Construction Environmental Management Plan. These would be developed and informed by the 'highly recommended' mitigation measures set out in the IAQM guidance based on the requirements for a high-risk site, and where these are relevant to the types of construction activities and sites.[40]

62) The need for any additional topic-specific essential mitigation (generally for effects likely to be significant in the context of the EIA Regulations) identified as a result of the assessment in Section 18.6 is then set out separately in Section 18.7.

18.4.5 Assessment Criteria

Human Locations

63) The air quality assessment results have been used to identify locations in exceedance of the relevant AQOs / Limit Values, defined in Table 18.3, in either the DN or DS scenarios for construction. Only locations that are exceeding the relevant AQOs / EU Limit Values are considered in the judgement of significance in accordance with DMRB LA 105 for annual averages. The change in predicted concentrations have been calculated as the difference between DS and DN model results at these locations.

64) Where the difference in concentrations are less than or equal to 1 % of the AQO / Limit Value (e.g. less than or equal to 0.4 $\mu g/m^3$ for annual mean NO_2 and PM_{10} concentrations), then the change at these locations is considered to be imperceptible and can be scoped out of the judgement on significance.

[38] Environment Agency (2016) *op cit.*
[39] Environment Agency (2016) *ibid.*
[40] Institute of Air Quality Management (2016) *op. cit.*

65) In its DMRB LA 105 guidance, Highways England has developed a framework to provide guidance on the number of locations for each of the magnitude of change categories that might result in a significant effect in relation to annual mean concentrations.[41] These are guideline values only and are to be used to inform professional judgement on significant effects of the Proposed Bowland Section with regard to changes in annual mean concentrations of pollutants. These are provided in Table 18.4. Other pollutants with annual mean AQO, Limit Values or EALs (i.e. $PM_{2.5}$ and NH_3) were considered using the same approach, with the change in concentration factored on the same basis as for those set out in Table 18.4 for NO_2 and PM_{10} (i.e. small would be based on >1 %, medium based on >5 % and large based on >10 % of the relevant AQO, Limit Values or EAL for each pollutant).

66) A location with a predicted change in concentration greater than imperceptible (e.g. greater than a magnitude of 0.4 µg/m^3) is assigned to one of six categories (large, medium and small for either worsening or improvement) where there is a predicted AQO / Limit Value exceedance. If any exceedances are predicted, the number of locations in each category are compared to guideline ranges provided in DMRB LA 105.

- Where the number of locations falls below, or equal to, the lower value of the range in a given category, it is considered that the Proposed Bowland Section would not give rise to a significant effect
- Where values are equal to or greater than the upper limit of the range for a given category, it has been considered that the potential impact of the Proposed Bowland Section is likely to cause a significant effect
- Where values lie between the guideline ranges for a given category, further consideration based on a balanced judgement of the impacts across the whole assessment area has been undertaken, including consideration of both worsening and improvement (if applicable).

Table 18.4: Guideline to Number of Properties Constituting a Significant Effect (Annual Mean Concentrations)

Magnitude of Change in Annual Mean NO_2 or PM_{10} Concentration (µg/m^3)	Number of Locations where AQOs Already above Objective with:	
	Worsening or Creation of a New Exceedance	Improvement or the Removal of an Existing Exceedance
Large (>4 µg/m^3)	1 to 10	1 to 10
Medium (>2 µg/m^3)	10 to 30	10 to 30
Small (>0.4 µg/m^3)	30 to 60	30 to 60

67) The EPUK / IAQM guidance[42] recommends that, for determining the severity of an impact for short-term concentrations (i.e. 15-minute mean, one-hour mean, eight-hour mean and 24-hour mean concentrations), the background concentrations are less important and impacts should be described using peak concentrations from the modelled source(s). The guidance provides impact descriptors for predicted short-term concentrations, which are similar to the magnitude of change for long-term concentrations set out in Table 18.4. The impact descriptors for short-term changes in concentrations taken from the EPUK / IAQM guidance are set out in Table 18.5. These are used as the initial basis for judging the overall significance of the effects for changes in short-term concentrations at human locations which are made using professional judgement.

Table 18.5: Impact Descriptors for Individual Locations (Short-term Concentrations)

Percentage Change in Concentration Relative to AQO / Limit Value or EAL			
10 % or Less	11–20 %	21–50 %	>50 %
Negligible	Small	Medium	Large

[41] Highways England (2019) *op. cit.*
[42] Environmental Protection UK and Institute of Air Quality Management (2017) *op. cit.*

Percentage Change in Concentration Relative to AQO / Limit Value or EAL			
10 % or Less	11–20 %	21–50 %	>50 %
Notes: Table intended to be used by rounding the percentage change to whole numbers.			

68) The EPUK / IAQM guidance states that *'the reasons for reaching the conclusions on significance should be transparent and set out logically.'* The factors taken into consideration when judging the overall significance of changes in short-term pollutant concentrations include the following:

- Whether the Proposed Bowland Section causes an exceedance of a short-term AQO / Limit Value or EAL
- The number of properties or relevant exposure locations where exceedances are predicted and the impact descriptors (as set out in Table 18.5) at each of these locations
- The extent of the population exposure to the predicted changes (i.e. number of properties or locations affected by small, medium or large air quality impacts across the assessment area)
- The influence and validity of any assumptions adopted in undertaking the assessment; and the duration of the impacts.

69) As discussed in the EPUK / IAQM guidance, the judgement of a significant effect occurring for short-term concentrations would be based on the overall balance of impacts across the assessment area. It is more straightforward to conclude that the effect of the Proposed Bowland Section on air quality is not significant if all the impacts are described as negligible or small and there is no exceedance of the AQO / Limit Value or EAL. Similarly, if the majority of impacts are described as medium or large and there are exceedances, it is more straightforward to conclude that the Proposed Bowland Section leads to a significant air quality effect. It is more difficult to identify the significance of the air quality effects in the intermediate region where there is more uncertainty in the transition from not significant to significant.

Ecological Locations

70) The predicted concentrations of NOx, SO_2 and NH_3 were used to identify the potential for significant effects to occur in relation to the relevant AQOs and EALs for the protection of vegetation and ecosystems as set out in Table 18.3. With regard to nitrogen and acid deposition, critical loads for designated sites in the UK have been published by the Centre for Ecology and Hydrology and were obtained from the APIS website[43] following advice provided by the scheme ecologists. Critical loads are defined on the APIS website as:

'a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge'.

71) The full details of the critical loads adopted for each designated site are shown in Appendix 18.2 and the critical load values are also shown in the results tables in Section 18.6.1.

72) With regard to concentrations and deposition rates at designated sites, the Environment Agency guidance[44] states 'emissions can be described as insignificant (imperceptible) and no further assessment is required (including the need to calculate PECs) if:

- The short-term PC (i.e. the maximum 24-hour concentration) is less than 10 % of the short-term AQO/EAL for the protection of vegetation and ecosystems (the 'critical level'); or
- The long-term PC (i.e. the annual mean) is less than 1 % of the long-term critical level or critical load.'

73) Where the long-term PC is above 1 %, further consideration of existing background concentrations or deposition rates is required, and where the total concentration or deposition is less than 70 % of the

[43] UK Centre for Ecology and Hydrology (2020) *Air Pollution Information System* [Online] Available from: http://www.apis.ac.uk/ [Accessed: February 2021]
[44] Environment Agency (2016) *op. cit.*

critical level or critical load, calculated in combination with other committed projects or developments included within traffic data, the emission is not likely to have a significant effect.

74) Where the long-term PC is above 1 %, and the total concentration or deposition rate is greater than 70 % of the critical level or critical load, either alone or in combination with other committed projects or developments, then this may indicate a significant effect and further consideration is likely to be required.

75) Where the short-term PC is above 10 % of the critical level then an assessment would be made of the PEC and if the PEC exceeds the critical level it would be regarded as potentially significant and would require further consideration.

76) With regard to concentrations at other designated sites (e.g. ancient woods, local wildlife sites and national and local nature reserves), the Environment Agency guidance[45] states *'emissions can be described as insignificant (imperceptible) and no further assessment is required if:*

- The short-term PC is less than 100 % of the short-term critical level; or
- The long-term PC is less than 100 % of the long-term critical level/critical loads.'

77) Where the contribution is above 100 %, either alone or in combination with other committed projects or developments, then this may indicate a significant effect and further consideration is likely to be required.

78) For designated sites any impacts which could potentially lead to a significant effect will be passed to the scheme ecologists to determine their significance and where practicable, mitigation will be proposed.

18.4.6 Operation Phase Methodology

79) For the assessment of impacts during operation of the Proposed Bowland Section, the traffic data were screened in accordance with the criteria set out in DMRB LA 105[46] (refer to Section 18.4.1). No roads were found to meet the DMRB criteria and there are no other operational sources such as diesel generators. Therefore, further assessment of the operation phase was screened out and air quality impacts would be negligible.

18.4.7 Assumptions and Limitations

80) It should be emphasised that the air quality impact assessment and emission calculations are based on a series of computer models of future conditions. The process begins with the modelling of future traffic flows and determination of diesel generator specification, which are subject to their own inherent degree of uncertainty. The emissions are then calculated and the emission data are then fed into dispersion models and total concentrations derived to compare future air quality conditions both with and without the Proposed Bowland Section. The air quality models draw on a number of other trends and parameters that must be projected into the future. The modelling process includes atmospheric dispersion modelling, which provides an estimate of concentrations arising from input emissions and historical meteorological data.

81) As with any computer model that seeks to predict future conditions, there is uncertainty in the predictions made. Whilst being the best predictions available, elements of impact prediction such as the specific concentration of a given pollutant at a given location, or whether an exceedance of AQOs or EU Limit Values would or would not occur at a specific location, are not precise and are always subject to a margin of error. However, the assessment process is considered to be based on the most reasonable, robust and representative methodologies, taking advice from published guidance.

82) Sensitive locations have been determined using online mapping, e.g. Google Earth/Maps and also Ordnance Survey mapping data. There may in some cases be properties, such as those recently built, which are not yet present within these data sources.

[45] Environment Agency (2016) *op. cit.*
[46] Highways England (2019) *op. cit.*

83) For the modelling of emissions from the diesel generators, several conservative assumptions were adopted. These included assuming each generator was continuously operating at maximum load for the duration of each calendar year, even though this would not occur in practice. All emissions of particulates from the diesel generators were assumed to be in the PM_{10} and $PM_{2.5}$ size fraction. The generator results were based on the highest predicted concentrations obtained from any of the five years of meteorological data used for the modelling.

18.5 Baseline Conditions

84) This section details the air quality baseline for the assessment area and identifies locations included within the assessment. The Proposed Bowland Section extends across the local authorities of Lancaster City Council and Ribble Valley Borough Council.

85) Baseline data were collated from a variety of sources, including:

- LAQM reviews undertaken by local authorities, including local authority monitoring data
- PCM model outputs
- Designated sites information from Natural England and local authorities
- Background concentration maps produced by Defra and the Centre for Ecology and Hydrology.

18.5.1 Local Air Quality Management

86) Under Part IV of the Environment Act 1995, the UK government introduced LAQM, which placed duties on local authorities to undertake periodic reviews of air quality in their areas to assess present and likely future air quality against the AQOs. Where these objectives are not likely to be met, the local authority must designate an AQMA and produce an action plan for improvement in air quality.

Lancaster City Council

87) The Proposed Bowland Section, and the assessment area, is partly located within the jurisdiction of Lancaster City Council.

88) Lancaster City Council has declared three AQMAs due to exceedances of the annual mean NO_2 AQO from road traffic emissions. The AQMAs are located around the gyratory system in Lancaster city centre and at the main crossroad junctions in Carnforth and Galgate. All three AQMAs are located approximately 15 km to 20 km to the west and north-west of the nearest Proposed Bowland Section compound locations. The proposed construction traffic haul routes do not pass through any of the AQMAs. The nearest point of the construction traffic haul route is the junction of the A683 and the M6 which is approximately 2 km to the north-northeast of the City of Lancaster AQMA.

89) Continuous monitoring is undertaken at two roadside locations within the City of Lancaster AQMA. The annual mean and one-hour mean NO_2 concentrations measured at these locations are below the AQOs. The continuous monitoring data are shown in Table 18.6.

Table 18.6: Lancaster City Council Continuous Monitoring of NO_2 and PM_{10}: Annual Mean Concentrations ($\mu g/m^3$)

Station	E	N	Pollutant	2015	2016	2017	2018
AN1-Cable Street	347684	461963	NO2	-	-	39.6	34.0
AN2-Dalton Square	347852	461611	NO2	34.9	32.0	32.0	34.0
APM1-Cable Street	347684	461963	PM10	24.6	-	22.5	22.0

90) The council is also responsible for a NO_2 diffusion tube monitoring programme of 54 locations across its local authority area, principally focused around Lancaster, Carnforth, Galgate and Morecambe. The lowest recorded annual mean concentration in 2018 (the latest year of data available) was 14 $\mu g/m^3$, recorded at an urban background location in Lancaster (tube LC4). Exceedances of the annual mean

AQO of 40 µg/m^3 were recorded at six locations within the City of Lancaster AQMA (tubes LC1, LC10, LC11, J, LC19 and LC32), with concentrations ranging from 40 µg/m^3 to 55 µg/m^3. The nearest diffusion tubes to the construction traffic haul route are approximately 1.4 km to the south-west of the junction of the A683 and the M6 (tubes LC28 to LC30). These roadside locations adjacent to the A683 recorded annual mean NO_2 concentrations of 23 µg/m^3 to 28 µg/m^3 in 2018.

Ribble Valley Borough Council

91) The Proposed Bowland Section, and the assessment area, is partly located within the jurisdiction of Ribble Valley Borough Council.

92) Ribble Valley Borough Council has declared one AQMA (Whalley Road, Clitheroe AQMA 1) for annual mean NO_2 concentrations, which is located in the town centre of Clitheroe at the junction of Whalley Road and Greenacre Street.

93) There is currently no continuous monitoring undertaken within the borough. The council is responsible for a network of six passive diffusion tube monitoring locations. The NO_2 monitoring concentrations within the AQMA only are provided in Table 18.7. The concentrations recorded in the AQMA have been below the AQO of 40 µg/m^3 for the last four years of monitoring data. The other three diffusion tube locations are in Clitheroe and a location in Mellor Brook and are not representative of the air quality within the area surrounding the Proposed Bowland Section construction compounds. The urban background diffusion tube in Clitheroe (Site ID 1) recorded a concentration of 11 5 µg/m^3 in 2018.

94) There is currently no monitoring of particulate matter (PM_{10} or $PM_{2.5}$) undertaken by Ribble Valley Borough Council.

Table 18.7: Ribble Valley Borough Council Diffusion Tube Monitoring Data within AQMA: Annual Mean NO2 Concentrations (µg/m3)

Tube ID	Location	Type	E	N	2015	2016	2017	2018
2	Royal British Legion	Roadside	374234	441291	33.7	39.9	35.3	37.2
3	57 Whalley Road	Roadside	374213	441240	24.6	28.7	25.2	26.3
4	Greenacre Street	Roadside	374222	441315	33.2	36.6	33.8	32.2

18.5.2 Pollution Climate Mapping

95) The PCM model is run by Ricardo Energy & Environment on behalf of Defra, and is designed to fulfil part of the UK's EU Directive (2008/50/EC) requirements to report on the concentrations of pollutants in the atmosphere. Modelled PCM NO_2 concentrations are provided for a 2018 base year and projected to future years at representative roads throughout the UK.

96) Based on the required assessment area for the Proposed Bowland Section, the closest PCM links to the Proposed Bowland Section in the Defra PCM model are as follows:

- The A671 (Census ID 802077794), which is within the Clitheroe AQMA (i.e. approximately 10 km to the south-east of the closest compound (Newton-In-Bowland Compound)). The A671 has a modelled concentration of 17.6 µg/m^3 in 2019 and 14.3 µg/m^3 in 2023;
- The A683 (Census ID 802017403) which stops at the junction with the M6 motorway. This road has a modelled concentration of 28.2 µg/m^3 in 2019 and 21.5 µg/m^3 in 2023; and
- The A59 PCM link (Census ID 802077917), which is west of the southern-most haul route and has a modelled concentration of 25.6 µg/m^3 in 2019 and 20.4 µg/m^3 in 2023. The concentrations are well below the EU Limit Value of 40 µg/m^3.

97) There are no PCM links which require assessment as any road links close to the PCM links were not classed as part of the ARN.

18.5.3 Designated Biodiversity Sites

98) Designated biodiversity site information is published by Natural England and provided as GIS datasets. The information was utilised to identify ecological designated sites within 10 km of the on-site diesel generators for the Proposed Bowland Section compounds for European designated sites (e.g. SPAs, SACs and Ramsar sites), and within 2 km of the on-site diesel generators for national and local level designated sites. Those designated sites also within 200 m of the construction traffic route and within the above distances were also considered for determination of the potential combined impact from both source types. The designated sites identified are provided in Table 18.8.

Table 18.8: Identified Biodiversity Designated Sites

Designated Site Type	Level of Designation	Identified Designated Sites	Distance from Diesel Generators (Within)
SPAs	European	Bowland Fells	10 km
Ramsar	International	None	
SACs	European	Calf Hill and Cragg Woods North Pennine Dales Meadows	
SSSIs	National	Far Holme Meadow	2 km
NNR	National	None	2 km
LNR	Local	None	2 km
BHS	Local	Helks Wood Over Houses Great Wood Birkett Fell, Hodder Bank Fell and Mosswaite Fell Goodber Common (including Summersgill Fell and White Moss) Lower Helks Pastures Crag House Roadside Verges Ashnott Meadow Bonstone Brook Pastures Waddington Fell Road, Roadside Verges Gibb's Wood and Bonstone Wood Gamble Hole Farm Pasture Sugar Loaf Clerk Laithe Great Dunnow Hill Newton North Road Verges Newton West Road Verges Wray Wood Moor Pike Gill Wood Cowkins Coppice Hole House and Lower House Grasslands Meadows Adjoining Far Holme Meadow SSSI Well Beck Wood	2 km

Designated Site Type	Level of Designation	Identified Designated Sites	Distance from Diesel Generators (Within)
		New Barn Meadow, Low Gill Foss Bank Wood, High Lot Wood, Over Wood and Mosit Shoe Wood Cragg Wood, Holme Wood, Birks Wood and Park House Wood	
Ancient Woodland	Local	Scales Wood Ancient Woodland (ID 1102544) Ancient Woodland (ID 1413140) Cragg / Holme / Birks Woods Ancient Woodland (ID 1102542) Ancient Woodland (ID 1413137) Ancient Woodland (ID 1413135) Ancient Woodland (ID 1413132) Ancient Woodland (ID 1413134) Ancient Woodland (ID 1102554) Ancient Woodland (ID 1413131) Ancient Woodland (ID 1413130) Ancient Woodland (ID 1413128) Ancient Woodland (ID 1413126) Ancient Woodland (ID 1413125) Ancient Woodland (ID 1413123) Ancient Woodland (ID 1413120) Ancient Woodland (ID 1413096) Great Dunnow Wood Ancient Woodland (ID 1102670) Ashnott Wood Ancient Woodland (ID 1102518)	2 km

99) The existing nitrogen and acid deposition rates at each designated site are set out in Table 18.9.

Table 18.9: Existing Nitrogen and Acid Deposition at the Assessed Designated Sites

Ecological Location Reference	Designated Site	Vegetation Type (for Deposition Velocity)	Existing Nutrient N Deposition (kg N/ha/year)	Existing Acid Deposition (kEqH+/ha/year)	
				Nitrogen	Sulphur
H1	Scales Wood Ancient Woodland (ID 1102544)	Tall	36.4	2.60	0.29
H2	Ancient Woodland (ID 1413140)	Tall	36.4	2.60	0.29
H3	Cragg / Holme / Birks Woods Ancient Woodland (ID 1102542)	Tall	36.4	2.60	0.29
H4	Ancient Woodland (ID 1413137)	Tall	36.4	2.60	0.29

Ecological Location Reference	Designated Site	Vegetation Type (for Deposition Velocity)	Existing Nutrient N Deposition (kg N/ha/year)	Existing Acid Deposition (kEqH+/ha/year)	
				Nitrogen	Sulphur
H5	Ancient Woodland (ID 1413135)	Tall	36.4	2.60	0.29
H6	Ancient Woodland (ID 1413132)	Tall	36.4	2.60	0.29
H7	Ancient Woodland (ID 1413134)	Tall	36.4	2.60	0.29
H8	Far Holme Meadow SSSI	Tall	24.6	1.80	0.30
H9	Ancient Woodland (ID 1102554)	Tall	36.4	2.60	0.29
H10	Ancient Woodland (ID 1413131)	Tall	36.4	2.60	0.29
H11	Ancient Woodland (ID 1413130)	Tall	36.8	2.63	0.34
H12	Ancient Woodland (ID 1413128)	Tall	36.4	2.60	0.29
H13	Ancient Woodland (ID 1413126) and Helks Wood BHS	Tall	31.8	2.27	0.37
H14	Ancient Woodland (ID 1413125)	Tall	31.8	2.27	0.37
H15	Ancient Woodland (ID 1413123)	Tall	36.4	2.60	0.45
H16	Ancient Woodland (ID 1413120)	Tall	31.8	2.27	0.37
H17a	North Pennine Dales Meadows SAC	Short	26.6	1.90	0.33
H17b		Short	26.6	1.90	0.33
H17c		Short	26.6	1.90	0.33
H18	Ancient Woodland (ID 1413096)	Tall	35.1	2.51	0.43
H19	Great Dunnow Wood Ancient Woodland (ID 1102670)	Tall	37.2	2.66	0.38
H20a	Ashnott Wood Ancient Woodland (ID 1102518)	Tall	33.5	2.39	0.33
H20b		Tall	33.5	2.39	0.33
H20c		Tall	33.5	2.39	0.33
H21a	Over Houses Great Wood BHS	Tall	36.4	2.60	0.29
H21b	Over Houses Great Wood BHS and Ancient Woodland (ID 1413134)	Tall	36.4	2.60	0.29
H22a	Goodber Common (including Summersgill Fell and White Moss) BHS	Short	24.6	1.76	0.25
H22b		Short	22.8	1.63	0.31
H23	Lower Helks Pastures BHS	Short	24.6	1.76	0.25
H24	Calf Hill and Cragg Woods SAC	Tall	29.3	2.10	0.30
H25	Crag House Roadside Verges BHS	Short	23.4	1.67	0.28
H26	Ashnott Meadow BHS	Tall	35.3	2.52	0.36
H27	Bonstone Brook Pastures BHS	Short	23.4	1.67	0.28
H28a		Short	24.5	1.75	0.30

Ecological Location Reference	Designated Site	Vegetation Type (for Deposition Velocity)	Existing Nutrient N Deposition (kg N/ha/year)	Existing Acid Deposition (kEqH+/ha/year)	
				Nitrogen	Sulphur
H28b	Waddington Fell Road, Roadside Verges BHS	Short	24.5	1.75	0.3
H29a	Birkett Fell, Hodder Bank Fell and Mosswaite Fell BHS	Short	23.4	1.67	0.28
H29b		Short	23.4	1.67	0.28
H30a	Gibb's Wood and Bonstone Wood BHS	Tall	33.5	2.39	0.33
H30b		Tall	33.5	2.39	0.33
H31	Gamble Hole Farm Pasture BHS	Short	25.9	1.85	0.37
H32	Sugar Loaf BHS	Short	25.9	1.85	0.37
H33	Clerk Laithe BHS	Short	25.9	1.85	0.37
H34	Great Dunnow Hill BHS	Short	26.6	1.90	0.33
H35	Newton North Roadside Verges BHS	Short	25.9	1.85	0.37
H36	Newton West Roadside Verges BHS	Short	25.9	1.85	0.37
H37	Wray Wood Moor BHS	Short	24.6	1.76	0.25
H38	Pike Gill Wood (Including Willock Close Wood and High Grasses Wood) BHS	Tall	36.4	2.60	0.29
H39	Cowkins Coppice BHS and Cragg / Holme / Birks Wood (ID 1102542)	Tall	36.4	2.60	0.29
H40a	Hole House and Lower House Grasslands BHS	Short	24.6	1.76	0.25
H40b		Short	24.6	1.76	0.25
H40c		Short	24.6	1.76	0.25
H41a	Meadows Adjoining Far Holme Meadow SSSI BHS	Short	24.6	1.76	0.25
H41b		Short	24.6	1.76	0.25
H41c		Short	24.6	1.76	0.25
H42a	Well Beck Wood (Including Helks Home Wood and Middlefield Wood) BHS	Tall	31.8	2.27	0.37
H42b		Tall	31.8	2.27	0.37
H42c		Tall	31.8	2.27	0.37
H43	New Barn Meadow, Low Gill BHS	Short	25.8	1.84	0.3
H44	Foss Bank Wood, High Lot Wood, Over Wood and Mosit Shoe Wood BHS	Tall	36.8	2.63	0.34
H45	Bank Wood, High Lot Wood, Over Wood and Mosit Shoe Wood BHS	Tall	36.4	2.6	0.29
H46	Cragg Wood, Holme Wood, Birks Wood and Park House Wood BHS and Cragg/Holme/Birks Wood (ID 1102542)	Tall	36.4	2.6	0.29
H47a	Bowland Fells SPA / SSSI	Short	21.4	1.50	0.30

Ecological Location Reference	Designated Site	Vegetation Type (for Deposition Velocity)	Existing Nutrient N Deposition (kg N/ha/year)	Existing Acid Deposition (kEqH+/ha/year)	
				Nitrogen	Sulphur
H47b			23.8	1.70	0.30
H47c			23.8	1.70	0.30
H47d			28.0	2.00	0.40
H47e			25.1	1.80	0.30
H47f			25.1	1.80	0.30
H47g			25.1	1.80	0.30
H47h			27.3	2.00	0.40
H47i			27.3	2.00	0.40
H47j			27.3	2.00	0.40
H47k			27.7	2.00	0.40

18.5.4 Defra Background Mapping

100) The Defra mapped 1 km x 1 km grid background pollutant concentrations for 2019 and 2023 encompassing the Proposed Bowland Section and assessed locations are presented in Table 18.10. All background pollutant concentrations are well within the AQOs and EALs.

Table 18.10: Mapped Background Annual Mean Pollutant Concentrations Surrounding the Proposed Bowland Section and at Assessed Locations

Pollutant	2019 Background Concentration Range (µg/m^3)	2023 Background Concentration Range (µg/m^3)
NO_2	4.4 to 9.9	3.9 to 8.6
NO_X	5.4 to 13.0	4.7 to 11.2
PM_{10}	7.8 to 10.0	7.4 to 9.5
$PM_{2.5}$	5.4 to 6.9	5.1 to 6.5
SO_2	1.8 to 2.6	1.8 to 2.6
CO	78.1 to 85.2	80.3 to 87.5
NH_3*	1.1 to 2.1	1.1 to 2.1
Notes: * Information obtained from the APIS website (see Table 18.11).		

18.5.5 Information Sources

101) The assessment was undertaken with reference to the sources detailed in Table 18.11.

Table 18.11: Key Information Sources

Data Source	Reference
Lancaster City Council 2019 Air Quality Annual Status Report. This data source provided local authority monitoring and AQMA information.	https://www.lancaster.gov.uk/environmental-health/environmental-protection/air-quality/air-quality-reviews-and-assessments
Ribble Valley Borough Council 2019 Air Quality Annual Status Report. This data source provided local authority monitoring and AQMA information.	https://www.ribblevalley.gov.uk/downloads/file/12725/air_quality_annual_status_report_2019
Defra AQMA Maps. This data source provided spatial information regarding existing AQMAs.	https://uk-air.defra.gov.uk/aqma/maps
Defra background map concentration data for NOx, NO_2, PM_{10}, $PM_{2.5}$, CO and SO_2. This data source provided baseline background air quality pollutant concentration data.	http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html
Mapped concentration data for NH_3. This data source provided baseline background air quality NH_3 concentration data.	www.apis.ac.uk
Defra PCM data. This data source provides PCM link data.	https://uk-air.defra.gov.uk/library/no2ten/2020-no2-pm-projections-from-2018-data
Designated sites datasets. This data source provides spatial data for relevant ecological designated sites (SPAs, SACs, SSSI, Ramsar, NNRs, LNRs, BHSs, Ancient Woodland).	SPAs – https://data.gov.uk/dataset/174f4e23-acb6-4305-9365-1e33c8d0e455/special-protection-areas-england SACs – https://data.gov.uk/dataset/a85e64d9-d0f1-4500-9080-b0e29b81fbc8/special-areas-of-conservation-england SSSIs – https://data.gov.uk/dataset/5b632bd7-9838-4ef2-9101-ea9384421b0d/sites-of-special-scientific-interest-england Ramsars – https://data.gov.uk/dataset/67b4ef48-d0b2-4b6f-b659-4efa33469889/ramsar-england LNRs – https://data.gov.uk/dataset/acdf4a9e-a115-41fb-bbe9-603c819aa7f7/local-nature-reserves-england NNRs – https://data.gov.uk/dataset/30348208-fcf4-4419-a092-7de9e5d16e07/national-nature-reserve-nnr-areas-outside-sites-of-special-scientific-interest Ancient Woodland – https://data.gov.uk/dataset/9461f463-c363-4309-ae77-fdcd7e9df7d3/ancient-woodland-england BHSs -Lancashire Environmental Record Network (LERN)

18.6 Assessment of Likely Significant Effects

102) The following section describes the effects of the Proposed Bowland Section on air quality during the construction and operational phases.

18.6.1 Construction Phase

103) The potential air quality effects upon locations (human and ecological) during the construction phase have been assessed.

104) Potential adverse impacts on air quality during construction of the Proposed Bowland Section are summarised in Table 18.19 and discussed in the following sections.

Dust Emissions

105) The construction works were assumed to create a high risk of dust impacts (as a worse-case scenario) prior to the application of mitigation measures. An assessment of dust emission for the construction phase has therefore not been undertaken (see Section 18.4.1). Appropriate good practice mitigation measures required to control dust emissions from high-risk sites to a level that can be considered to be a not significant effect (in accordance with IAQM guidance)[47] have been specified in Section 18.4.4 and included in the CCoP).

Diesel Generator and Road Traffic Emissions

106) The results of the modelling of diesel generator emissions presented are the maximum modelled concentrations predicted at any of the 35 assessed human locations for the five years of meteorological data used in the assessment. The results of the dispersion modelling of the diesel generator emissions are set out in Table 18.12, which presents the following information:

- Environmental Quality Standard (EQS) (used to represent the relevant AQO or EAL for reporting purposes)
- Estimated annual mean background concentration (see Section 18.5.4)
- PC, the maximum modelled concentrations due to the emissions from the additional road traffic (annual mean only) and / or diesel generators
- PEC, the maximum modelled concentration (PC) combined with estimated background concentration
- PC and PEC as a percentage of the EQS.

107) The full results at assessed human locations are provided in Appendix 18.2.

Table 18.12: Construction Phase Modelling Results for Diesel Generator Emissions (Maximum at Human Locations)

Pollutant	Averaging Period	Location ID	EQS (µg/m^3)	Baseline Air Quality level* (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EQS (%)	PEC / EQS (%)
CO	Maximum 8-hour mean	R19	10,000	161	109	270	1.1 %	2.7%
	Maximum 1-hour mean	R35	30,000	161	810	972	2.7 %	3.2%
NO_2	Annual mean	R19	40	4.2	0.5	4.7	1.2 %	11.8 %

[47] Institute of Air Quality Management (2016) *op. cit.*

Pollutant	Averaging Period	Location ID	EQS (µg/m^3)	Baseline Air Quality level* (µg/m^3)	PC (µg/m^3)	PEC (µg/m^3)	PC / EQS (%)	PEC / EQS (%)
	1-hour mean (99.79th %ile)	R35	200	7.8	50.4	58.2	25.2 %	29.1 %
SO_2	24-hour mean (99.18th %ile)	R19	125	5.0	5.8	10.8	4.6 %	8.6 %
	1-hour mean (99.73rd %ile)	R35	350	5.0	77.9	82.9	22.2 %	23.7 %
	15-minute mean (99.9th %ile)	R35	266	5.0	81.8	86.9	30.8 %	32.7 %
PM_{10}	Annual mean	R19	40	7.6	0.03	7.6	0.1 %	19.1 %
	24-hour mean (90.41st %ile)	R19	50	15.2	0.1	15.3	0.2 %	30.6 %
$PM_{2.5}$	Annual mean	R19	25	5.1	0.03	5.1	0.1 %	20.5 %
NH_3	Annual mean	R19	180	1.2	0.1	1.3	0.1 %	0.7 %
	Maximum 1-hour mean	R19	2500	1.2	26.8	28.0	1.1 %	1.1 %

Notes:

* The baseline air quality level includes the contribution from roads where the location is also close to a road included within the road traffic emissions assessment (i.e. it represents the concentration for the DN scenario as discussed in Section 18.4.1).

108) The results for diesel generator emissions in Table 18.12 indicate that the predicted concentrations at human locations do not exceed any relevant long-term or short-term EQSs. While peak levels of most air pollutants were predicted to occur at residential property, R19, located approximately 140 m to the west of the planning application boundary, these were not significant, as discussed below.

109) The maximum PC for annual mean NO_2 is 0.47 µg/m^3, which is equivalent to 1.2 % of the relevant EQS. This contribution is greater than 1 % of the EQS and represents a small adverse impact. However, the PEC is considerably lower than the EQS and is therefore not considered significant.

110) For the assessment of one-hour mean (99.79th %ile) NO_2 concentrations, the maximum PC is more than 10 % of the short-term EQS at the highest location (a footpath location close to the Proposed Bowland Section launch compound). The maximum PC of 50.4 µg/m^3 represents a medium adverse impact. However, the PEC is well below the EQS at this nearby short-term exposure location. The maximum PC at any of the long-term exposure locations including residential properties is 7.8 µg/m^3 (3.9 % of the EQS) which is an imperceptible impact.

111) For annual mean PM_{10}, $PM_{2.5}$ and NH_3 concentrations, the respective PCs are less than 1 % of the relevant annual mean EQS at human locations and the respective impacts are therefore considered to be imperceptible.

112) For short-term PM_{10}, CO and NH_3 concentrations, the respective PCs are less than 10 % of the short-term EQS at human locations and the impacts can be described as imperceptible.

113) For the 24-hour mean SO_2 concentration, the maximum PC is less than 10 % of the relevant short-term EQSs at human locations and is an imperceptible impact. For one-hour mean and 15-minute mean SO_2

concentrations, the maximum PC is more than 10 % of the relevant short term EQS at human locations and is representative of a medium adverse impact. However, the respective PECs are well below the EQS.

114) The predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ were also assessed at those human locations which were also close to the road network where changes in vehicle movements would occur during the construction phase. The results are presented in Table 18.13 and show the individual change due to road traffic emissions and also the combined change which includes the contribution from diesel generator emissions. Locations R11, R13, R14 and R21 are next to a road link where the modelled change in traffic flows exceeds the criteria for identifying an affected road link (i.e. the change in HDVs is greater than 200 as an AADT). This is a section of the B6478 between the Proposed Bowland Section and Proposed Marl Hill Section and is shown as the ARN on Figure 18.1.

115) The results in Table 18.13 indicate that for those locations close to the road network and within the assessment area for diesel generator emissions, the additional contribution from road traffic emissions is imperceptible (a maximum of 0.1 $\mu g/m^3$). The largest combined impact is predicted at R19, where the total PC, from both generator and road traffic emissions, is 0.5 $\mu g/m^3$. This remains a small impact and the PEC of 4.7 $\mu g/m^3$ is well within the EQS of 40 $\mu g/m^3$. A location within the Whalley Road, Clitheroe AQMA 1 was specified in order to determine the potential increase in annual mean NO_2 concentrations due to the change in road traffic flows during the construction phase. This was included even though the change in flows is below the thresholds set out in the DMRB LA 105 guidance for identifying the ARN. The results in Table 18.13 indicate that the maximum increase of 0.1 $\mu g/m^3$ is imperceptible and would not impact on measures to reduce NO_2 concentrations within the AQMA.

116) As no ARN road links coincided with, or were close to, PCM links, no PCM locations or specific assessment was required with regard to road traffic emissions. Furthermore, the contribution from diesel generator emissions are only just above imperceptible at those locations closest to the construction compounds. At the nearest PCM locations to the Proposed Bowland Section, approximately 10 km to the south-east of the nearest compound (Newton-In-Bowland Compound), the PC would be imperceptible. On this basis, there would be no risk of non-compliance with the EU Limit Values at the nearest PCM locations.

117) The predicted concentrations of NOx, SO_2 and NH_3 at ecological locations resulting from diesel generator emissions are summarised in Table 18.14. The results focus on the European and nationally designated sites within the assessment area to determine the potential for significant effects at these sites of highest importance. Table 18.14 also provides the highest predicted concentrations at any of the locally designated sites (i.e. any of the BHSs or ancient woodlands within the assessment area) to determine the need to undertake further assessment work. The full detailed results are provided in Appendix 18.2. The results also include a contribution from the diesel generator emissions associated with the Proposed Marl Hill Section construction activities. The combined impacts were determined for the following ecological sites that are within the relevant assessment area for both sections:

- North Penning Dales Meadows SAC;
- Bowland Fells SPA and Bowland Fells SSSI;
- Ancient Woodland (ID 1413096);
- Great Dunnow Wood Ancient Woodland (ID 1102670);
- Ashnott Wood Ancient Woodland (ID 1102518);
- Crag House Roadside Verges BHS;
- Ashnott Meadow BHS;
- Bonstone Brook Pastures BHS;
- Waddington Fell Road, Roadside Verges BHS;
- Birkett Fell, Hodder Bank Fell and Mosswaite Fell BHS;
- Gibb's Wood and Bonstone Wood BHS;
- Gamble Hole Farm Pasture BHS;

- Newton North Roadside Verges BHS; and
- Newton West Roadside Verges BHS.

118) The assessment was initially based on the worst-case approach of assuming that each site contains lichens and bryophytes and requires the use of the more stringent critical levels for SO_2 and NH_3. Where this has indicated further consideration is required in accordance with the criteria set out in Section 18.4.5, the scheme ecologist has reviewed the ecological sites to determine the presence of lichens and bryophytes. This situation occurred for the North Pennine Dales Meadows SAC, Bowland Fells SPA / Bowland Fells SSSI and Far Holme Meadow SSSI in relation to NH_3 concentrations, and the critical level was subsequently altered to be representative of a site where lichens and bryophytes are not present (i.e. 3 µg/m^3 instead of 1 µg/m^3).

119) The results in Table 18.14 indicate that the predicted concentrations are all within the relevant criteria set out in Section 18.4.5 for identifying where further assessment is required by ecologists. Therefore, the predicted impacts are imperceptible. Seven of the designated ecological sites are also close to roads that would experience a change in traffic flows during the construction phase. The maximum additional contribution to predicted annual mean NOx concentrations at any of these sites due to road traffic emissions is 0.8 µg/m^3, which was predicted at location H31 (Gamble Hole Farm Pasture BHS). As can be seen from the results in Table 18.14, an additional 0.8 µg/m^3 would not alter the outcome of the assessment at any of the ecological sites and the combined impacts from diesel generator and road traffic emissions would remain imperceptible. The full results at these seven ecological sites are presented in Appendix 18.2.

Table 18.13: Construction Phase Modelling Results for Road Traffic and Diesel Generator Emissions (Maximum at Human Locations)

Location ID	Location Description	DN 2023 (Road Traffic) Concentration (µg/m^3)			DS 2023 (Road Traffic) Concentration (µg/m^3)			DS 2023 (Road Traffic and Diesel Generator) Concentration (µg/m^3)			Change in Concentration (DS-DN) (Road) (µg/m^3)			Change in Concentration (DS-DN) (Road & Generators) (µg/m^3)		
		NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
R2	High Park House Farm	4.2	7.6	5.1	4.3	7.6	5.1	4.3	7.6	5.1	0.0	0.0	0.0	0.1	0.0	0.0
R3	Lower House Farm	4.1	7.4	5.1	4.1	7.4	5.1	4.3	7.4	5.1	0.0	0.0	0.0	0.1	0.0	0.0
R8	Residential off Back Lane	4.1	7.7	5.2	4.1	7.7	5.2	4.3	7.7	5.2	0.0	0.0	0.0	0.3	0.0	0.0
R9	Hodder Croft	4.1	7.7	5.2	4.1	7.7	5.2	4.3	7.7	5.2	0.0	0.0	0.0	0.2	0.0	0.0
R10	Residential off Newton Rd	4.3	7.7	5.2	4.3	7.7	5.2	4.6	7.7	5.2	0.0	0.0	0.0	0.3	0.0	0.0
R11	Hill House Farm	5.0	7.7	5.2	5.2	7.8	5.3	5.3	7.8	5.3	0.1	0.1	0.1	0.2	0.1	0.0
R13	Slim Row Farm	5.0	7.7	5.2	5.1	7.8	5.3	5.2	7.8	5.3	0.1	0.1	0.1	0.2	0.1	0.0
R14	Wyndfell Farm	4.5	7.7	5.2	4.6	7.7	5.2	4.6	7.7	5.2	0.0	0.0	0.0	0.1	0.0	0.0
R19	Fober Farm	4.2	7.6	5.1	4.2	7.6	5.1	4.7	7.6	5.1	0.0	0.0	0.0	0.5	0.0	0.0
R21	Residential off Slaidburn Rd	4.8	7.7	5.2	4.9	7.7	5.2	5.0	7.7	5.2	0.1	0.0	0.0	0.2	0.0	0.0
Whalley Road, Clitheroe AQMA 1		15.2	10.5	7.1	15.3	10.5	7.1	-	-	-	0.1	0.0	0.0	-	-	-

Notes:
All numbers have been rounded to one decimal place.

Table 18.14: Construction Phase Modelling Results for Diesel Generator Emissions (Maximum at Ecological Locations)

Ecological Site	Location ID	Pollutant	Averaging Period	EQS ($\mu g/m^3$)	Baseline Air Quality Level ($\mu g/m^3$)	PC ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PC / EQS (%)	PEC / EQS (%)
Far Holme Meadow SSSI	H8	NOx	Annual mean	30	4.8	0.05	4.9	0.16 %	16.2 %
			24-hour mean (maximum)	75	9.6	0.40	10.0	0.53 %	13.4 %
		SO_2	Annual mean	10	1.8	0.04	1.8	0.39 %	18.1 %
		NH_3	Annual mean	3	2.1	0.01	2.1	0.44 %	70.1 %
North Pennine Dales Meadows SAC	H17a - H17c	NOx	Annual mean	30	4.8	0.11	4.9	0.38 %	16.4 %
			24-hour mean (maximum)	75	9.6	0.96	10.6	1.28 %	14.1 %
		SO_2	Annual mean	10	2.4	0.07	2.4	0.69 %	24.4 %
		NH_3	Annual mean	3	1.6	0.02	1.6	0.76 %	54.8 %
Crag Hill and Crag Woods SAC	H24	NOx	Annual mean	30	5.6	0.01	5.6	0.03 %	18.7 %
			24-hour mean (maximum)	75	11.2	0.19	11.4	0.26 %	15.2 %
		SO_2	Annual mean	10	2.0	0.01	2.0	0.06 %	20.2 %
		NH_3	Annual mean	1	1.3	0.00	1.3	0.19 %	128.2 %
Bowland Fells SPA and Bowland Fells SSSI	H47a – H47k	NOx	Annual mean	30	4.5	0.11	4.6	0.4 %	15.2 %
			24-hour mean (maximum)	75	8.9	1.32	10.2	1.8 %	13.7 %
		SO_2	Annual mean	10	2.3	0.06	2.4	0.6 %	23.9 %
		NH_3	Annual mean	3	1.0	0.02	1.0	0.7 %	33.7 %
Maximum local site	H36	NOx	Annual mean	30	5.3	4.6	9.9	15.2 %	33.0 %
			24-hour mean (maximum)	75	10.6	26.7	37.3	35.6 %	49.7 %
		SO_2	Annual mean	10	2.5	2.5	5.0	25.1 %	50.5 %
		NH_3	Annual mean	1	1.2	0.83	2.0	82.5 %	197.5 %

121) The rate of deposition of nitrogen containing species and acidic compounds has been estimated at the assessed designated sites. This allows the potential for adverse effects to be evaluated by comparison with critical loads for acid and nutrient nitrogen deposition. The assessment took account of emissions of NOx, SO_2 and NH_3 from the proposed diesel generators and also NOx emissions from road traffic at those eight designated sites close to roads expected to experience changes in traffic flows during construction.

122) The predicted nitrogen deposition at ecological locations resulting from diesel generator emissions is summarised in Table 18.15. As with ambient concentrations of pollutants, the results focus on the European and nationally designated sites within the assessment area and highest predicted nitrogen deposition at any of the locally designated sites to determine the need to undertake further assessment work. The full detailed deposition results are provided in Appendix 18.2. The results indicate that the critical loads are exceeded, and the predicted deposition rates from diesel generator emissions are above the relevant criteria set out in Section 18.4.5 for identifying where further assessment is required by ecologists (i.e. the PC was greater than 1 % of the critical load for European or nationally designated sites), at two European sites (North Pennine Dales Meadows SAC and Bowland Fells SPA and Bowland Fells SSSI). Therefore, nitrogen deposition at these two sites is considered further as part of the assessment presented in Chapter 9: Ecology. The criteria were not exceeded at the Far Holme Meadow SSSI (i.e. the PC was less than 1 % of the critical load) or any local sites (i.e. the PC was less than 100 % of the critical load). Therefore, the predicted impacts are imperceptible at the remaining sites and no further assessment is required.

123) The results for modelling of nitrogen deposition at the designated site also close to the road network are shown in Table 18.16. The maximum additional contribution to predicted nitrogen deposition at any of the designated sites is 0.066 kgN/ha/year (Gamble Hole Farm Pasture BHS). As can be seen from the results, the combined nitrogen deposition from diesel generator and road traffic emissions does not lead to the relevant criteria being exceeded. Therefore, the predicted impacts are imperceptible.

Table 18.15: Modelled Nitrogen Deposition at Designated Sites – Diesel Generator Emissions (Maximum at Ecological Locations)

Location ID	Ecological Site	Vegetation Type	Minimum Critical Load (CL)	Nitrogen Deposition (kgN/ha/year)				
				Existing Deposition (N)	PC	PEC	PC / CL (%)	PEC / CL (%)
H8	Far Holme Meadow SSSI	Tall	10	24.6	0.07	24.7	0.7 %	247 %
H17a-H17c	North Pennine Dales Meadows SAC	Short	10	26.6	0.13	26.7	1.3 %	267 %
H47a – H47k	Bowland Fells SPA and Bowland Fells SSSI	Short	10	27.7	0.12	27.8	1.2 %	278 %
H36	Maximum Local Site	Short	20	25.9	4.75	30.7	23.8 %	153 %

Table 18.16: Modelled Nitrogen Deposition at Designated Sites – Road Traffic and Diesel Generator Emissions (Maximum at Ecological Locations)

Location ID	Ecological Site	Vegetation Type	Minimum Critical Load (CL) (kgN/ha/year)	Nitrogen Deposition (kgN/ha/year)						
				Existing Deposition	Road PC	Road PEC	Road & Generator PC	Road & Generator PEC	Road & Generator PC / CL (%)	Road & Generator PEC / CL (%)
H3	Haw Wood BHS and Cragg / Holme / Birks Woods Ancient Woodland (ID 1102542)	Tall	10	36.4	0.003	36.4	0.17	36.6	1.7 %	366 %
		Tall	10	36.4	0.000	36.4	0.17	36.6	1.7 %	366 %
H39	Cowkins Coppice BHS and Cragg / Holme / Birks Wood (ID 1102542)	Tall	10	36.4	0.006	36.4	0.15	36.6	1.5 %	366 %
H46	Cragg Wood, Holme Wood, Birks Wood and Park House Wood BHS and Cragg / Holme / Birks Wood (ID 1102542)	Tall	10	36.4	0.006	36.4	0.14	36.5	1.4 %	365 %
H28a	Waddington Fell Road, Roadside Verges BHS	Short	20	24.5	0.019	24.5	0.33	24.8	1.6 %	124 %
H28b	Waddington Fell Road, Roadside Verges BHS	Short	20	24.5	0.019	24.5	0.34	24.8	1.7 %	124 %
H31	Gamble Hole Farm Pasture BHS	Short	15	25.9	0.066	26.0	1.67	27.6	11.1 %	184 %
H36	Newton West Roadside Verges BHS	Short	20	25.9	0.006	25.9	4.76	30.7	23.8 %	153 %
H38	Pike Gill Wood (Including Willock Close Wood and High Grasses Wood) BHS	Short	10	36.4	0.003	36.4	0.05	36.4	0.5 %	364 %

124) The predicted acid deposition at ecological locations resulting from diesel generator emissions is summarised in Table 18.17. The results indicate that, although the critical loads are exceeded at some of the sites, the predicted deposition rates are within the relevant criteria set out in Section 18.4.5 for identifying where further assessment is required by ecologists (i.e. the PC was less than 1 % of the critical load for European and nationally designated sites or less than 100 % of the critical load for local sites). The exception is for Far Holme Meadow SSSI and Bowland Fells SPA and Bowland Fells SSSI, where the PC is 1.6 % and 1.2 % of the critical load, respectively, and the PEC is greater than 100 % of the critical load. Therefore, the predicted impacts are imperceptible at all sites except at Far Holme Meadow SSSI and Bowland Fells SPA and Bowland Fells SSSI which are considered further as part of the assessment presented in Chapter 9: Ecology.

125) The maximum additional contribution to predicted acid deposition at any of the designated sites due to road traffic emissions was 0.0047 kEqH+/ha/year (Gamble Hole Farm Pasture BHS). As can be seen from the results in Table 18.18, the combined acid deposition from diesel generator and road traffic emissions does not lead to the relevant criteria being exceeded, and the combined impacts remain imperceptible.

Table 18.17: Modelled Acid Deposition at Designated Sites – Diesel Generator Emissions (Maximum at Ecological Locations)

Location ID.	Ecological Site	Vegetation Type	Critical Load (CL) (kEqH+/ha-year) (CLMaxN)	Acid Deposition (kEqH+/ha/year)					
				Existing Deposition (N)	Existing Deposition (S)	PC	PEC	PC / CL (%)	PEC / CL (%)
H8	Far Holme Meadow SSSI	Short	0.6	1.8	0.3	0.01	2.1	1.6 %	352 %
H17a-H17c	North Pennine Dales Meadows SAC	Short	2.1	1.9	0.3	0.017	2.2	0.8%	107%
H47a – H47k	Bowland Fells SPA and Bowland Fells SSSI	Short	1.4	2.0	0.4	0.016	2.4	1.2%	173%
H36	Maximum Local Site	Tall	5.1	1.9	0.3	0.62	2.8	12.3 %	56 %

Table 18.18: Modelled Acid Deposition at Designated Sites – Road Traffic and Diesel Generator Emissions (Maximum at Ecological Locations)

Location ID	Ecological Site	Vegetation Type	Critical Load (CL) (kEqH+/ha-year) (CLMaxN)	Acid Deposition (kEqH+/ha/year)							
				Existing Deposition (N)	Existing Deposition (S)	Road PC	Road PEC	Road & Generator PC	Road & Generator PEC	Road & Generator PC / CL (%)	Road & Generator PEC / CL (%)
H3	Haw Wood BHS and Cragg / Holme / Birks Woods Ancient Woodland (ID 1102542)	Tall	3.25	2.60	0.29	0.0002	2.89	0.03	2.92	0.8 %	90 %
		Tall	3.25	2.60	0.29	0.0000	2.89	0.03	2.92	0.8 %	90 %
H39	Cowkins Coppice BHS and Cragg / Holme / Birks Wood (ID 1102542)	Tall	3.26	2.60	0.29	0.0004	2.89	0.02	2.91	0.7 %	89 %
H46	Cragg Wood, Holme Wood, Birks Wood and Park House Wood BHS and Cragg/Holme/Birks Wood (ID 1102542)	Tall	3.26	2.60	0.29	0.0004	2.89	0.02	2.91	0.6 %	89 %
H28a	Waddington Fell Road, Roadside Verges BHS	Short	5.07	1.75	0.30	0.0013	2.05	0.04	2.09	0.8%	41%
H28b		Short	5.07	1.75	0.30	0.0013	2.05	0.04	2.09	0.9%	41%
H31	Gamble Hole Farm Pasture BHS	Short	Not sensitive	1.85	0.37	0.0047	2.22	0.21	2.43	N/A	
H36	Newton West Roadside Verges BHS	Short	5.07	1.85	0.37	0.0004	2.22	0.63	2.85	12.5%	56%
H38	Pike Gill Wood (Including Willock Close Wood and High Grasses Wood) BHS	Tall	3.25	2.60	0.29	0.0002	2.89	0.01	2.90	0.2 %	89 %

Summary of Construction Phase Effects

126) The summary of the potential air quality impacts during construction are presented in Table 18.19.

Table 18.19: Summary of Construction Phase Effects

Environmental / Community Asset	Value / Sensitivity	Effect	Nature of Effect	Magnitude	Significance of Effect (Pre-Essential Mitigation)
Human locations	N/A	Increase in pollutant concentrations (NO_2, PM_{10}, $PM_{2.5}$, CO, SO_2 and NH_3)	Adverse, temporary, short term	Imperceptible to medium	Not significant
	N/A	Increase in dust deposition and PM_{10} / $PM_{2.5}$ concentrations	Adverse, temporary, short term	N/A (assumed high risk)	Not significant (assumed good practice mitigation adopted as standard)
Ecological locations (except Far Holme Meadow SSSI, North Pennine Dales Meadows SAC and Bowland Fells SPA and Bowland Fells SSSI)	N/A	Increase in pollutant concentrations (NOx, SO_2 and NH_3)	Adverse, temporary, short term	Imperceptible	Not significant
	N/A	Increase in nitrogen and acid deposition	Adverse, temporary, short term	Imperceptible	Not significant
Ecological locations – Far Holme Meadow SSSI	N/A	Increase in pollutant concentrations (NOx, SO_2 and NH_3)	Adverse, temporary, short term	Imperceptible	Not significant
		Increase in nitrogen deposition	Adverse, temporary, short term	Imperceptible	Not significant
		Increase in acid deposition	Adverse, temporary, short term	Above imperceptible	See Chapter 9: Ecology
Ecological locations – North Pennine Dales Meadows SAC	N/A	Increase in pollutant concentrations (NOx, SO_2 and NH_3)	Adverse, temporary, short term	Imperceptible	Not significant
		Increase in nitrogen deposition	Adverse, temporary, short term	Above imperceptible	See Chapter 9: Ecology

Environmental / Community Asset	Value / Sensitivity	Effect	Nature of Effect	Magnitude	Significance of Effect (Pre-Essential Mitigation)
		Increase in acid deposition	Adverse, temporary, short term	Imperceptible	Not significant
Ecological locations – Bowland Fells SPA and Bowland Fells SSSI	N/A	Increase in pollutant concentrations (NOx, SO_2 and NH_3)	Adverse, temporary, short term	Imperceptible	Not significant
		Increase in nitrogen and acid deposition	Adverse, temporary, short term	Above imperceptible	See Chapter 9: Ecology

18.6.2 Operational Phase

127) The traffic flow data provided did not identify any roads that met the DMRB criteria for assessment, and there are no known operational sources of air pollution which would operate with the Proposed Bowland Section in place (the diesel generators would only operate during the construction phase of the Proposed Bowland Section). Therefore, further assessment of operational effects was screened out, and air quality effects are considered to be not significant.

18.7 Essential Mitigation and Residual Effects

128) As explained in Section 18.4.4, the assessment of effects in Section 18.6 takes into account the application of both embedded mitigation and good practice measures. This section identifies additional topic-specific essential mitigation identified through the assessment process, and then sets out the residual effects taking all three categories (embedded, good practice and essential) into account. The assessment indicates that essential mitigation is not required to further control dust or pollutant emissions during the construction phase.

129) With the implementation of appropriate good practice dust mitigation measures during the construction phase of the Proposed Bowland Section, no significant residual air quality effects are predicted with regard to dust emissions from the construction compounds.

130) The residual air quality effects with regard to diesel generator emissions and road traffic emissions during the construction phase would be not significant at all assessed human and ecological locations. The exception is for the predicted nitrogen and acid deposition at Far Holme Meadow SSSI, North Pennine Dales Meadows SAC and Bowland Fells SPA and Bowland Fells SSSI where a potentially significant effect has been identified that requires further consideration as part of the assessment undertaken in Chapter 9: Ecology.

131) No specific mitigation measures are required during the operational phase. Maintenance of the Proposed Bowland Section would be in accordance with relevant environmental good practice.

18.8 Climate Change

18.8.1 United Utilities and the Climate Change Agenda

132) Climate change and the resultant shifts in weather patterns have the potential to significantly impact United Utilities' operations when hazards such as droughts, floods, storms or heatwaves become more frequent and more intense. United Utilities has first-hand experience of the impacts of extreme weather events on its operations and customers; United Utilities knows it needs to adapt its service to a changing

climate, and has a part to play in mitigating climate change. At a corporate level, the company has developed a climate change mitigation strategy and made six pledges to reduce its carbon footprint.

18.8.2 HARP and the Climate Change Agenda

133) It has been previously stated in the ES that, once operational, HARP would transfer treated water from its source to supply points in Cumbria, Lancashire and Greater Manchester under the influence of gravity along its entire length. There would be no requirement for energy-consuming pumping plant or machinery under normal day-to-day operating conditions, and consequently there would be no significant carbon emissions associated with treated water supply. It is acknowledged, however, that HARP would give rise to direct and indirect carbon emissions associated with the enabling works, construction activities, materials usage, and commissioning of the infrastructure before it enters use. The main sources of carbon emissions would include transport and road haulage of surplus materials, the use of diesel generating sets at the construction compounds, and concrete and steel usage in the shafts and tunnel segments.

18.8.3 Estimate of Carbon Emissions

134) The assessment of carbon has considered the emissions from the following sources:

- Consumption of fuel in the diesel generators to power the Tunnel Boring Machines (TBMs)
- Consumption of fuel in the diesel powered generators at the reception compounds
- Emissions from the manufacture and transport to the construction site of concrete and steel to be used in the tunnel linings, tunnel grouting and steel connection sections
- Transport emissions to haul excess cut material from the tunnel excavations to landfill, and the process emissions from disposal at landfill.

135) Fuel consumption in the diesel generators to power the TBMs has been derived from work previously undertaken to determine total diesel consumption for the TBM usage throughout the relevant construction periods. Fuel consumption in the reception compounds is derived from generator output, usage patterns and programmed duration.

136) Due to the absence of design information on material quantities, the volume of concrete required for the tunnel lining and grouting elements has been estimated using known diameters, tunnel lengths and excavated volumes for each of the sections using TBMs. The quantity of steel for the connection tunnels has been estimated using known internal diameters and an example product specification for gravity composite reinforced water pipeline.

137) At the time of assessment, information on procurement of materials was unknown. Therefore, an assumptions on transport distance of 200 km has been applied due to the specialised specification of concrete required for the tunnel construction.

138) All transportation, waste and fuel emission factors have been sourced from BEIS emission factors 2020 and material emission factors have been sourced from the Inventory of Carbon Emissions (ICE) database v3.0.

139) The results of the carbon assessment are presented in Table 18.20.

Table 18.20: Carbon Assessment Results for the Proposed Bowland Section

Element	Emissions tCO_2e
Operation of diesel generators to power the TBMs (fuel burn)	24,291
Reception compounds (fuel burn)	6,259
Tunnel Concrete grouting	4,540
Tunnel Concrete lining and connections	22,320

Element	Emissions tCO_2e
Transport of Concrete to Site	6,396
Steel connections (incl transport)	290
Waste transport to landfill	5,214
Waste disposal of soil at landfill	7,105
Total	**76,415**

18.8.4 Mitigation

140) In order to mitigate potential carbon emissions and address the climate agenda, United Utilities would implement its climate change mitigation strategy. It is anticipated that the most effective intervention on HARP would be in the supply chain. United Utilities is therefore proposing to embed carbon and climate agenda-related requirements in the procurement process for consortia seeking to finance, design, build and maintain HARP. While still in development it is intended that these procurement requirements will be a mandatory part of the tendering process, and will be carried forward into the contract requirements for the newly-appointed consortia.

18.9 Cumulative Effects

141) The following section provides an overview of the potential cumulative effects from different proposed developments and land allocations, in combination with the Proposed Bowland Section (i.e. inter-project cumulative assessment). Data on proposed third party developments and land allocations contained in development plan documents were obtained from various sources, including local planning authority websites, online searches, and consultations with planning officers. Proposed development data were then reviewed with a view to identifying schemes or land allocations whose nature, scale and scope could potentially give rise to significant environmental effects when considered in combination with the likely effects arising from the Proposed Bowland Section.

142) Intra-project cumulative impacts i.e. two or more types of impact acting in combination on a given environmental receptor, property or community resource are considered in Chapter 14: Communities and Health.

143) The over-arching cumulative effects of the Proposed Programme of Works i.e. the five proposed replacement tunnel sections in combination, are considered in Volume 2 Chapter 19: Cumulative Effects. In addition Volume 2 Chapter 19 examines the cumulative effects associated with the outcomes from Volume 2 (delivery and operation of the main construction compounds, tunnel and construction traffic routes), Volume 5 (proposed off-site highways works and satellite compounds), and Volume 6 (Proposed Ribble Crossing).

144) Based on professional judgement, it was concluded that there are no proposed third party developments or land allocations in local development plan documents have been identified in the vicinity of the Proposed Bowland Section which would be any closer than those human locations already considered within the assessment. Road traffic from committed developments were also included within the traffic flow data used as the basis of the assessment of the DS scenario in comparison to the DN scenario. As no significant effects were identified within the assessment as presented in Section 18.6, there are no significant cumulative effects. Potential cumulative effects at the Far Holme Meadow SSSI are addressed in Chapter 9: Ecology.

18.9.1 Highways Works and Proposed Ribble Crossing

145) The potential for likely significant effects relating to the Proposed Bowland Section - off-site highways works and proposed Ribble Crossing is addressed in Volume 5 and Volume 6 respectively. Air quality was screened out of the environmental assessment reported in Volumes 5 and 6 on the basis that no likely significant air quality effects were identified. Climate change was also screened out of the reporting in Volume 5 on the basis that the off-site highways works comprise a minor element of the

overall construction effort in carbon balance terms, and therefore fall outside the scope of the carbon assessment.

18.10 Conclusion

146) This chapter of the ES considered the potential air quality impacts and residual effects associated with construction and operation at human and ecological locations in relation to the construction compounds, generator locations, and the construction haulage route, along the route of the Proposed Bowland Section.

147) Existing air quality was established using a combination of modelled background mapping and existing monitoring data recorded by local authorities. The assessment areas are predominantly rural with the main contributor to the regional background concentrations being local roads.

148) The chapter has included the assessment of the potential air quality impacts associated with emissions from diesel generators at the construction compounds required for construction of the Proposed Bowland Section. The assessment also included consideration of the impact of road traffic emissions due to the additional vehicle movements on the local road network during construction. The predicted impacts were assessed against the relevant air quality standards and guidelines for the protection of human health (referred to as EQSs) and protected designated ecological sites (referred to as critical levels and critical loads).

149) The detailed dispersion modelling results indicate that emissions to air from the diesel generators and additional road traffic are unlikely to result in any significant air quality effects at human locations or at the designated sites identified in the assessment. The exception is for acid deposition at Far Holme Meadow SSSI, nitrogen deposition at North Pennine Dales Meadows SAC, and nitrogen and acid deposition at Bowland Fells SPA and Bowland Fells SSSI where the PC is greater than 1 % of the critical load, and where the critical load is already exceeded due to existing deposition rates. The significance of the increase in nitrogen and acid deposition is assessed within Chapter 9: Ecology.

150) Appropriate good practice dust mitigation measures were identified to prevent significant effects occurring at off-site locations. Such measures are considered to be normal good practice that would be adopted by the contractor meeting the requirements of the air quality mitigation measures within the CCoP. These would also be agreed with the relevant local authorities prior to construction works commencing.

151) There are no operational sources of air emissions which would be of similar scale or duration as the construction works. These were scoped out of the assessment and the air quality effects would be not significant.

152) It is therefore concluded that the air quality effects associated with the construction and operation of the Proposed Bowland Section, when compared against human health criteria, would be not significant. The significance of effects with regard to the Far Holme Meadow SSSI, North Pennine Dales Meadows SAC and Bowland Fells SPA is reported in Chapter 9: Ecology.

18.11 Glossary and Key Terms

153) Key phrases and terms used within this technical chapter relating to Air Quality and Climate Change are defined within Appendix 1.2: Glossary and Key Terms.