Chapter 10

Air Quality

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10 AIR QUALITY

10.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) identifies, describes and presents an assessment of the likely significant effects of the proposed N2 Slane Bypass and Public Realm Enhancement Scheme (the 'Proposed Scheme') on Air Quality during both the construction and operational phases of the development. The assessment presented is informed by and should be read in conjunction with the following key chapters of the EIAR: **Chapter 4 – Description of the Proposed Scheme**, **Chapter 5 – Description of the Construction Phase** and the following topic-specific chapters:

- **Chapter 7 – Traffic and Transport:** Predicted traffic and mobility effects;
- **Chapter 15 – Biodiversity: Terrestrial Ecology:** Baseline descriptions and impact assessment related to the terrestrial aspects of biodiversity. This chapter also deals with species who rely on the aquatic environment, namely otter and kingfisher;
- **Chapter 16 – Biodiversity: Aquatic Ecology:** Baseline descriptions and impact assessment related to the aquatic ecology aspects of biodiversity;
- **Chapter 19 – Climate:** Baseline descriptions and impact assessment related to climate; and
- **Chapter 23 – Material Assets: Resource and Waste Management:** Baseline descriptions and impact assessment related to the management of waste and materials arising from the Proposed Scheme.

10.2 Methodology

The air quality impact assessment has followed the overall methodology and guidance relating to the EIA process and preparation as set out in **Chapter 1 – Introduction**.

Specifically in relation to the air quality impact assessment, the methodology adopted is based on Transport Infrastructure Ireland (TII) and World Health Organization (WHO) guidance; refer to **Section 10.2.1.3**.

The objectives of this assessment were to undertake the following:

- Determine baseline air quality within the study area;
- Identify human receptors where a potential significant change in NO_2, PM_{10} or $PM_{2.5}$ concentrations, due to the proposed national road scheme, may occur;
- Identify sensitive designated habitats where a potential significant change in NOx or ammonia concentrations, due to the proposed national road scheme, may occur;
- Identify human and sensitive designated habitats where there is risk of dust, emissions and traffic movement effects occurring during the construction phase; and
- Determine suitable mitigation measures to reduce significant air quality effects to an acceptable level.

The impact of the proposed road development on air quality has been assessed for both the construction and operational phases by considering the pollutant background concentrations, emissions from road traffic, potential for construction dust and emissions from construction traffic and machinery. Predicted concentrations have been compared to the relevant statutory limit values and the WHO guidelines for the protection of human health.

10.2.1 Legislation, Policy and Guidance

10.2.1.1 Legislation

Specific legislation relating to air quality which has been considered within this chapter of the EIAR includes:

- Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe;
- Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011) as amended;

- Ambient Air Quality Standards Regulations 2022 (S.I. No. 739 of 2022);
- Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants;
- Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC; and
- S.I. No. 232 of 2018 - European Union (National Emission Ceilings) Regulations 2018.

The details of the limit values expressed in this legislation is provided in **Section 10.2.5.1** (ambient air quality) and **Section 10.2.5.2** (national air quality).

10.2.1.2 Policy

On 12 May 2021, the European Commission (EC) adopted the EU Action Plan: 'Towards a Zero Pollution for Air, Water and Soil' which was a key deliverable of the European Green Deal. The relevant targets for 2030 of this plan to this assessment are listed as follows:

- Improving air quality to reduce the number of premature deaths caused by air pollution by 55%; and
- Reducing by 25% the EU ecosystems where air pollution threatens biodiversity.

Furthermore, as part of the European Green Deal, in October 2022 the EC proposed to revise the Ambient Air Quality Directives to align more closely with the recommendations of the World Health Organization (WHO). The purpose of this proposal is to:

- Put the EU on track to achieve zero pollution for air by 2050;
- Foresee a regular review of the air quality standards, in line with latest scientific evidence;
- Further improve the legal framework, providing more clarity on access to justice, damage redress, effective penalties, and better public information on air quality;
- Support local authorities in achieving cleaner air by strengthening air quality monitoring, modelling, and air quality plans; and
- Merge the current two Directives into one and streamlines provisions to clarify and simplify the rules.

Nationally, Project Ireland 2040 the National Planning Framework cite air quality as a National Policy Objective 64 as follows:

> *Improve air quality and help prevent people being exposed to unacceptable levels of pollution in our urban and rural areas through integrated land use and spatial planning that supports public transport, walking and cycling as more favourable modes of transport to the private car, the promotion of energy efficient buildings and homes, heating systems with zero local emissions, green infrastructure planning and innovative design solutions.*

In addition, the Clean Air Strategy for Ireland was published by the Department of the Environment, Climate and Communications (DECC) in April 2023 (DECC, 2023) with the following aims:

- To set the appropriate targets and limits to ensure continuous improvements in air quality across the country, to deliver health benefits for all;
- To ensure the integration of clean air considerations into policy development across Government;
- To increase the evidence base that will help us to continue to evolve our understanding of the sources of pollution and their impacts on health, in order to address them more effectively;
- To enhance regulation required to deliver improvements across all pollutants;
- To improve the effectiveness of our enforcement systems;
- To promote and increase awareness of the importance of clean air, and the links between cleaner air and better health; and
- To develop the additional targeted/specific policy measures as required to deal with national or local air quality issues.

Following the EU policy, the national strategy commits to setting more stringent legal limits for ambient air quality taking into full consideration the new WHO guideline limits and the proposal for a new EU Ambient Air Quality Directive with achievement of final WHO Guidelines Value by 2040. In addition, interim values are proposed for 2026 and 2030 to track progress to meeting the WHO Guidelines by 2040.

Locally, the Meath County Development Plan 2021-2027 notes that the Council's role in relation to air quality is to promote a reduction in air pollution, through the implementation of relevant legislation and through the provision of advice and guidance on best practice. Transport emissions, primarily from road transport, is acknowledged as one of the key air pollution challenges. The following policies are noted in relation to air quality:

- INF OBJ 71: *To continue to monitor air and noise quality results submitted from selected locations throughout the County in co-operation with the Health Service Executive and the Environmental Protection Agency*; and
- INF OBJ 72: *To support the collation or air quality and greenhouse gas monitoring data in support of a regional air quality and greenhouse gas emission inventory*.

10.2.1.3 Guidance

The assessment utilises the predictive approaches of the following TII guidance documents:

- TII Air Quality Assessment of Specified Infrastructure Projects – Overarching Technical Document PE-ENV-01106 (December 2022) (TII, 2022a);
- TII Air Quality Assessment of Proposed National Roads - Standard PE-ENV-01107 (December 2022) (TII, 2022b); and
- TII Road Emissions Model (REM): Model Development Report GE-ENV-01107 (December 2022) (TII, 2022c).

In addition, the following non-legislative guidance is applied to this assessment:

- World Health Organization (WHO) (2021). WHO global air quality guidelines: particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulphur dioxide and carbon monoxide;
- Institute of Air Quality Management (IAQM) (2014) Guidance on the assessment of dust from demolition and construction; and
- Technical Instructions on Air Quality Control – TA Luft, German Federal Ministry for Environment, Nature Conservation and Nuclear Safety, (July 2002).

10.2.2 Zone of Influence

The Institute of Air Quality Management (IAQM) '*Guidance on the assessment of dust from demolition and construction*' states that a dust assessment is typically required where there is:

- A 'human receptor' within:
  - 350 metres of the boundary of the site; or
  - 50 metres of the route(s) used by construction vehicles on the public highway, up to 500 metres from the site entrance(s).
- An 'ecological receptor' within:
  - 50 metres of the boundary of the site; or
  - 50 metres of the route(s) used by construction vehicles on the public highway, up to 500 metres from the site entrance(s).

To ensure a robust assessment and given the ecological sensitivities in the area, the zone of influence (ZoI) for the construction phase dust impacts is set at 500 metres from the temporary landtake boundary.

In terms of road traffic during the operational phase, the TII Air Quality Assessment of Proposed National Roads (Standard PE-ENV-01107) (TII, 2022b) state that 200 metres represents the distance within which detectable impacts of a road might be for worst case sensitive receptors.

The key residential and commercial receptors within 300 metres of the main alignment of the Proposed Scheme, the construction areas and the public realm and are displayed in **Figure 10.1**.

10.2.3 Sources of Information to inform the Assessment

10.2.3.1 Desktop Study

Table 10-1 outlines the existing publicly available datasets and information used to inform the air quality assessment that was collected through the detailed desktop review with supplementary information compiled from the EPA.[1]

Table 10-1: Summary of key desktop reports

Title	Source	Year
An Post GeoDirectory (Q1) 2023	Meath County Council (2023)	2023
Ireland's Air Pollutant Emissions 1990-2030	EPA (2022a)	2022
Air Quality in Ireland 2021 – Indicators of Air Quality	EPA (2022b)	2022
Air Quality Report 2021 – Supplemental information	EPA (2022c)	2022
Air Quality in Ireland 2020 – Indicators of Air Quality	EPA (2021a)	2021
Air Quality Report 2020 – Supplemental information	EPA (2021b)	2021
Air Quality in Ireland 2019 – Indicators of Air Quality	EPA (2020a)	2020
Air Quality Report 2019 - Supplemental information	EPA (2020b)	2020
Air Quality in Ireland 2018 – Indicators of Air Quality	EPA (2019a)	2019
Air Quality Report 2018 – Supplemental information	EPA (2019b)	2019
Air Quality in Ireland 2017 – Indicators of Air Quality	EPA (2018a)	2018
Air Quality Report 2017 – Supplemental information	EPA (2018b)	2018

10.2.3.2 Site Specific Surveys

In addition to the desktop studies undertaken, a series of site-specific baseline monitoring was undertaken to determine the local levels and spatial variation for baseline air quality within the Slane area. Monitoring of oxides of nitrogen (NO and NO_2, which when combined are referred to as 'NO_x') and aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes) was undertaken at five locations including areas both along the route of the proposed scheme and within the village of Slane. These pollutants are predominately derived from traffic pollution and provide a spatial representation of baseline air quality in the area.

The location of the site-specific surveys and the dates for the three-monthly surveys are outlined in **Table 10-2** and the locations are shown in **Figure 10.1**.

Table 10-2: Summary of site-specific survey data

Reference	Location	GPS Co-ordinates	Month 1	Month 2	Month 3
A1	N2 South – Bypass Start	53.6888792, -6.5413985	01/12/20 - 05/01/21	05/01/21 - 08/02/21	08/02/21 - 09/03/21
A2	Slane village Square	53.7088632, -6.5429107			
A3	N51 East Roundabout	53.7072968, -6.5254461			
A4	Tow Path opposite the Mill	53.7016265, -6.5389735			
A5	N2 North - Bypass End	53.7207330, -6.5256482			

[1] EPA Air Quality Data: https://airquality.ie/

10.2.3.3 TII Road Emissions Model

Emissions from road transport when the road is operational have been calculated using the TII Road Emissions Model (REM). The REM calculates road transport emissions integrating the traffic volumes/ speeds for light and heavy vehicles on the Proposed Scheme with Irish fleet composition information.

Traffic data has been compiled from **Chapter 7 – Traffic and Transportation** and covers the wider road network between the M1 (east), M50 (south), N3 (west) up to the Ardee area in the north. Emission changes from changes to traffic patterns as a result of traffic changes are quantified using the TII Road Emissions Model (REM). This tool includes the following traffic and fleet mix information:

- Traffic information from the TII National Transport Model which provides validated estimates of the volumes of light and heavy vehicles, and the speed at which they travel, on the National Roads Network.
- A Fleet Mix database developed by researchers in the Energy Policy and Modelling Group at University College Cork for cars based on economic projections, and for other light and heavy vehicles by AECOM. The Fleet Mix database is underpinned by the Central Statistics Office's goods vehicles registration data (both heavy and light goods vehicles).
- Emission Rate Database derived from the European Environment Agency's (EEA) COPERT Emissions Tool - the EU industry standard vehicle emissions calculator – published in the EMEP/EEA air pollutant emission inventory guidebook. These data were adjusted further using data published in the UK by DEFRA.

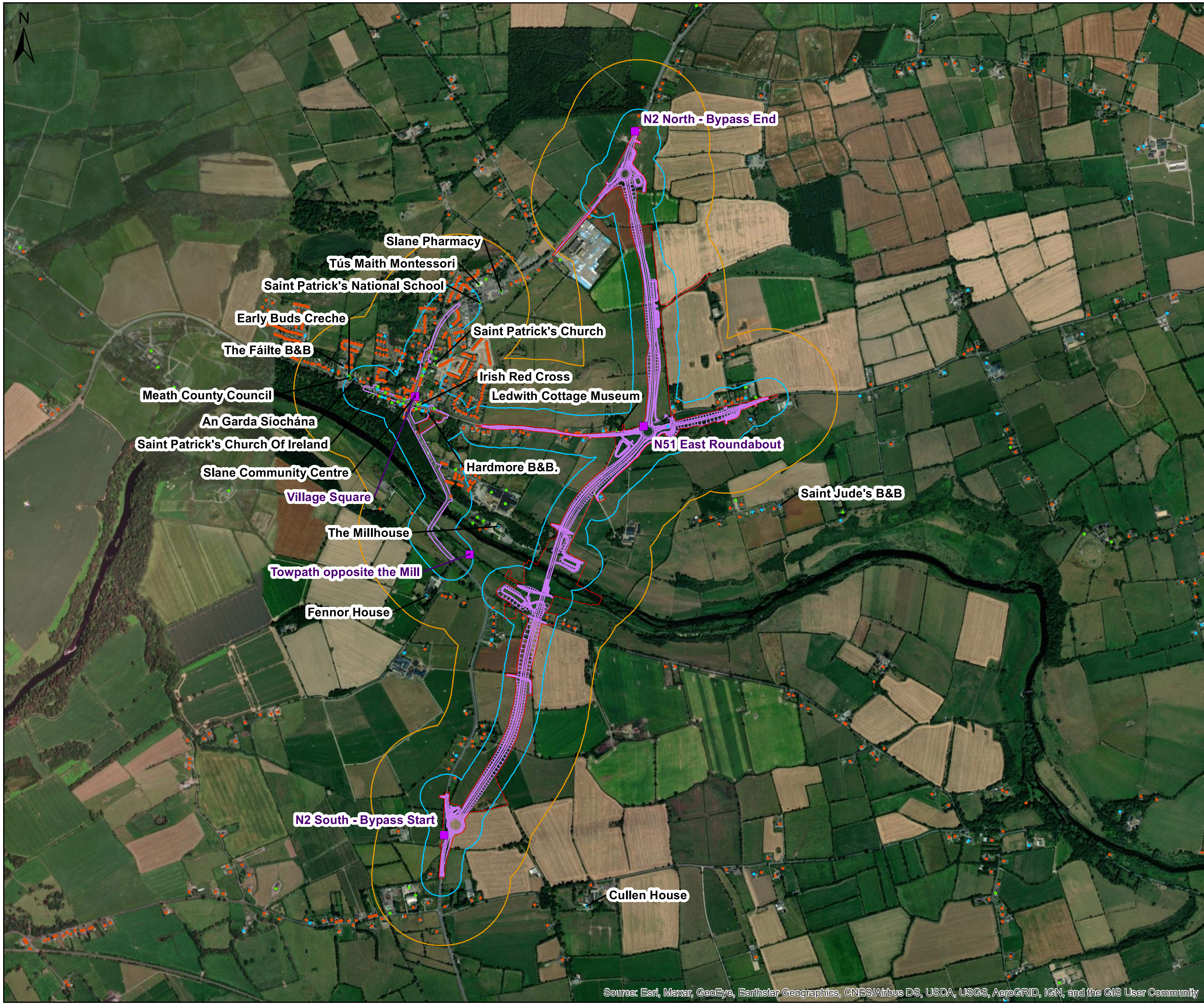
The REM calculates road transport emissions integrating traffic volumes/ speeds for light and heavy vehicles on the national road network with Irish fleet composition information.

The traffic data for the Proposed Scheme have been input to the model to generate vehicle emissions for total national emissions. The tool does this by multiplying together the classified vehicles in the default Fleet Mix Database with the speed-based emission rates in the specified Emissions Rate Database and the Proposed Scheme traffic flows.

Under EU and national policy on electric vehicles and fuel and engine technology, the proportions of the different vehicle classifications (EURO classification) will change over time because it is expected the fleet will move towards increased adoption of newer and relatively lower emission vehicles in the future, including greater uptake of hybrid (HEV), battery-electric (BEV) and alternative fuelled vehicles. The extent of this change is unknown, so the results are generated for three separate Fleet Databased scenarios within the REM model as follows:

- Business as Usual (BaU) scenario; i.e. excluding strategic policy interventions for reduction of CO_2, etc, and based on existing trends in vehicle purchasing and turnover of vehicles out of the vehicle fleet;
- Climate Action Plan (CAP) based on achieving increases in EVs including 151,000 passenger car EV and PHEVs by 2025 and 840,000 passenger car EV and PHEVs by 2030; and
- An intermediate case using linear extrapolation to a central value between BaU and CAP for each vehicle sub-classification.

The BaU represents a scenario whereby there is no progression in reducing the average tailpipe greenhouse gas emissions per vehicle while the CAP scenario assumes a full implementation of current CAP policy and targets. Results for all three scenarios are presented within this assessment.



Legend

Proposed Scheme

Proposed Scheme Boundary

100m Buffer

350m Buffer

Air Quality Monitoring Stations

GeoDirectory (Q1 2023)

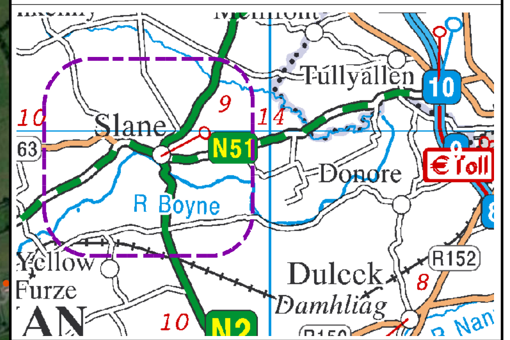
Residential

Commercial

Business

Data Source: An Post Geodirectory (Q1 2023) provided by Meath County Council.

0 0.2 0.4 0.8 Kilometres



Client

Meath County Council

N2 Slane Bypass and Public Realm Enhancement Scheme

Title

Figure 10.1

Air Quality Monitoring Locations & Key Receptors

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Issue Details

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10.2.4 Key Parameters for Assessment

The following aspects were considered in the assessment of potential effects of the Proposed Scheme on air quality:

Construction Phase

- Fugitive dust emissions at the sites and compounds of the Proposed Scheme during ground investigations, demolitions, excavations, construction and track-out of the Proposed Scheme;
- Plant emissions from diesel use on mobile and fixed plant engaged in the construction phase; and
- Road traffic emissions from transport of personnel and materials to and from site for consultation activities.

Operational Phase

- Road traffic emissions from traffic volumes using the scheme once operational – this parameter is assessed at national level, within the wider Slane area and also at local level for individual properties

10.2.5 Assessment Criteria and Significance

10.2.5.1 Ambient Air Quality Limits

In May 2008, all previous European Directives on air quality were replaced with a revised Directive on Ambient Air Quality and Cleaner Air for Europe (2008/50/EC) known as the CAFE Directive, which has been transposed into Irish Legislation through the Air Quality Standards Regulations (S.I. No. 180/2011). In Ireland, ambient air quality monitoring is carried out by the EPA in accordance with the requirements of the CAFE Directive. These air quality limits as specified in these regulations, are presented in **Table 10-3** and represent the main assessment criteria for the operational phase of the Proposed Scheme.

The CAFE Directive and the Air Quality Standards Regulations specify limit values in ambient air for sulphur dioxide (SO_2), lead (Pb), benzene (C_6H_6), particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2) and oxides of nitrogen (NO_x). These limits are mainly for the protection of human health and are largely based on review of epidemiological studies on the health impacts of these pollutants. In addition, there are limits that apply to the protection of the wider environment (ecosystems and vegetation).

Table 10-3: Limits as Specified in Air Quality Standards Regulations 2011 (S.I. 180 of 2011)

Pollutant	Criteria	Value
Nitrogen Dioxide	Hourly limit for protection of human health - not to be exceeded more than 18 times per year	200 µg/m^3 NO_2
	Annual limit for protection of human health	40 µg/m^3 NO_2
	Annual limit for protection of vegetation	30 µg/m^3 NO + NO_2
Benzene	Annual limit for protection of human health	5 µg/m^3
Carbon Monoxide	Maximum daily 8-hour running mean	10 mg/m^3
Lead	Annual limit for protection of human health	0.5 µg/m^3
Sulphur Dioxide	Hourly limit for protection of human health - not to be exceeded more than 24 times per year	350 µg/m^3
	Daily limit for protection of human health - not to be exceeded more than 3 times per year	125 µg/m^3
	Annual limit for protection of vegetation	20 µg/m^3
Particulate Matter PM_{10}	24-hour limit for protection of human health - not to be exceeded more than 35 times per year	50 µg/m^3 PM_{10}
	Annual limit for protection of human health	40 µg/m^3 PM_{10}
Particulate Matter $PM_{2.5}$	Annual target value for the protection of human health	20 µg/m^3 $PM_{2.5}$

In addition to the statutory limits for the protection of human health listed in Air Quality Standards Regulations (S.I. No. 180/2011), as amended, the WHO has published a set of air quality guidelines to offer quantitative health-based recommendations for air quality management. The WHO Guidelines are based on reducing the risk to human health and in some cases the levels differ from the EU statutory limits as these limits are based on balancing health risks with technological feasibility, economic considerations and various other political and social factors in the EU.

The most recent publication from the WHO was in 2021 and the WHO-recommended air quality guidelines (AQG) and interim targets are presented in **Table 10-4**. These guidelines are not legally binding standards; however, they do provide WHO Member States with an evidence-informed tool that they can use to inform legislation and policy. The levels are presented as an ultimate guideline as well as a series of interim targets which are proposed as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high. It is notable that the AQG recommended by the WHO are significantly lower than the Air Quality Standards Regulations (S.I. No. 180/2011, as amended) for key traffic pollutants such as NO_2 and PM_{10}.

In October 2022, the EC proposed to revise the Ambient Air Quality Directives (**Table 10-3**) to align more closely with the recommendations of the World Health Organization (**Table 10-4**). As such, this assessment employs the WHO guidelines as the appropriate assessment criteria for the protection of human health.

Table 10-4: WHO Recommended Air Quality Guideline (AQG) levels and interim targets (2021)

Pollutant	Averaging Time	Interim Target				AQG
		1	2	3	4	
$PM_{2.5}$ (µg/m^3)	Annual	35	25	15	10	**5**
	24-hour	75	50	37.5	25	**15**
PM_{10} (µg/m^3)	Annual	70	50	30	20	**15**
	24-hour	150	100	75	50	**45**
O_3 (µg/m^3)	Annual	100	70	–	–	**60**
	24-hour	160	120	-	–	**100**
NO_2 (µg/m^3)	Annual	40	30	20	–	**10**
	24-hour	120	50	–	–	**25**
SO_2 (µg/m^3)	24-hour	125	50	–	–	**40**
CO (mg/m^3)	24-hour	7	–	–	–	**4**

10.2.5.2 Combustion Gases / Particulates and National Air Quality Limits

Ireland is a party to the Convention on Long Range Transboundary Air Pollution (CLRTAP) under which certain transboundary air pollutants are controlled. For EU Member States, implementation of the Gothenburg Protocol (a daughter protocol of the CLRTAP) is achieved through limits set out in the National Emissions Ceilings Directive 2001/81/EC (NECD) which has been amended by Directive 2016/2284/EU.

The NECD sets national emission ceilings for key pollutants including particulate matter (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3) and Volatile Organic Compounds (VOCs). The aim of the Directive is to cut the negative impacts of air pollution on human health by almost half by 2030. Reducing levels of illness, including respiratory and cardiovascular diseases and premature death is the main priority.

Ireland's emissions ceilings under the first NEC Directive applied until December 2019 with reference to 2005 as the base year. Article 4(1) and Annex II of the revised directive then sets out new reduction commitments which apply from 2020 to 2029, and from 2030 onwards as shown in **Table 10-5**.

Table 10-5: Ireland's National Emissions Ceiling Directive 2020 and 2030 Targets

Pollutant	2010-20 Targets under 2001/81/EC (kilotonnes)	Targets under 2016/2284/EU (kilotonnes)	
		2020	2030
SO_2	42	25.574	10.960
NO_x	65	66.836	40.626
NMVOC	55	56.335	51.077
NH_3	116	112.066	107.539
$PM_{2.5}$	*N/A*	15.606	11.229

10.2.5.3 Impact Assessment Criteria for Human Receptors

The TII Guidance (PE-ENV-01106) states that the magnitude of change should be used to describe the quality of the effect as positive, negative or neutral using the criteria in **Table 10-6**. In addition, the impact descriptors in **Table 10-7** should be used to describe the impact at each receptor location, which takes into consideration the percentage change in concentration relative to the air quality standards of the pollutant. As noted, this assessment uses the WHO guidelines (**Table 10-4**) rather than the statutory limits as the relevant AQLV.

Table 10-6: TII Quality of Effect Criteria (TII, 2022a)

Quality of Effect	Description
Positive Effect	Where there is a decrease in annual mean concentration at a receptor which does not constitute a neutral effect.
Neutral Effect	Where there is a change in concentration at a receptor of: • 5% or less where the opening year, without the proposed scheme annual mean concentration is 75% or less of the standard; or • 1% or less where the opening year, without the proposed scheme annual mean concentration is 94% or less of the standard.
Negative Effect	Where there is an increase in annual mean concentration at a receptor which does not constitute a neutral effect.

Table 10-7: TII Impact Descriptors (TII, 2022a)

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Standard Value (AQLV)			
	1	2-5	6-10	>10
75% or less of AQLV	Neutral	Neutral	Slight	Moderate
76 – 94% of AQLV	Neutral	Slight	Moderate	Moderate
95 – 102% of AQLV	Slight	Moderate	Moderate	Substantial
103 – 109% of AQLV	Moderate	Moderate	Substantial	Substantial
110% or more of AQLV	Moderate	Substantial	Substantial	Substantial

10.2.5.4 Impact Assessment Criteria for Ecological Receptors

The impact of nitrogen deposition is also considered in the assessment at ecologically sensitive areas such as European or Nationally designated sites. The relevant assessment criteria employed in the TII guidance is summarised in **Table 10-8**, which is largely based around the critical loads for nitrogen.

Alkaline fens were identified as the qualifying interest for the SAC with sensitivity to nitrogen deposition. The '*Review and revision of empirical critical loads of nitrogen for Europe*' (German Environment Agency, 2022) provides a 2022 critical load for alkaline fens as the range 15-25 kg/ha/year. The potential for impact has been assessed as an interaction with the project ecologist (refer to **Chapter 15** of this EIAR and the NIS, that latter of which is available under separate cover as part of the planning documentation).

Table 10-8: TII Assessment Criteria for Sensitive Designated Habitats (TII, 2022a)

Description of Results	Significance
Total N deposition and acid deposition are more than 1% of the critical load	Discuss further with project biodiversity practitioners
The total N deposition and acid deposition are less than 1% of the critical load.	Not significant

10.2.5.5 Construction Dust

Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on. Due to the scale of the proposed Project construction sites are likely to be in operation for extended periods and therefore detailed consideration of potential dust impacts and how to mitigate impacts is required.

The criteria for appraisal of the magnitude of dust emissions is reviewed for each site compound area in the tables below under the headings of demolition, earthworks, construction and track-out based on a series of criteria set out by the IAQM. The risk of potential for dust impacts with respect to dust nuisance, human health and ecology are a function of magnitude of the dust generation at each construction site in combination with the sensitivity of the surrounding area as detailed in **Section 10.4.1.1**.

Demolition

Dust emission magnitude from demolition can be classified as small, medium or large and are described as follows:

- **Large:** Total building volume > 50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities > 20m above ground level;
- **Medium:** Total building volume 20,000m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10 m – 20 m above ground level; and
- **Small:** Total building volume 20,000 m^3, construction material with low potential for dust release, demolition activities < 10 m above ground, demolition occurring during wetter months.

Table 10-9: Risk of Dust Impacts – Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Earthworks

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. This may also involve levelling the site and landscaping. Dust emission magnitude from earthworks can be classified as small, medium or large and are described as follows:

- **Large:** Total site area > 10,000 m^2, potentially dusty soil type (e.g. clay which will be prone to suspension when dry due to small particle size), > 10 heavy earth moving vehicles active at any one time, formation of bunds > 8 m in height, total material moved > 100,000 tonnes;

- **Medium:** Total site area 2,500 m^2 – 10,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4m–8m in height, total material moved 20,000 – 100,000 tonnes; and
- **Small:** Total site area < 2,500 m^2, soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4 m in height, total material moved < 20,000 tonnes, earthworks during wetter months.

Table 10-10: Risk of Dust Impacts – Earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Construction

Dust emission magnitudes from construction can be classified as small, medium or large and are described as follows:

- **Large:** Total building volume > 100,000 m^3, on-site concrete batching, sandblasting;
- **Medium:** Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), on-site concrete batching; and
- **Small:** Total building volume < 25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

Table 10-11: Risk of Dust Impacts – Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Track-out

Factors which determine the dust emission magnitude are vehicle size, vehicle speed, vehicle numbers, geology and duration. Track-out refers to the dirt, mud, or other debris tracked or carried onto the public road network on the wheels of vehicles exiting construction sites. Dust emission magnitude from Track-out can be classified as small, medium or large and are described as follows:

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

Table 10-12: Risk of Dust Impacts – Track-out

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

10.2.6 Data Limitations

This Chapter of the EIAR has been prepared based upon the best available information and in accordance with current best practice and relevant guidelines.

Note that the site-specific baseline surveys were undertaken during the Covid-19 pandemic when there may have been alterations to existing traffic and residential/commercial occupancy patterns which may have altered the baseline. To resolve this matter, the baseline data has been suitably corrected based on analysis of the wider EPA network results for periods pre and during Covid.

There were no other technical difficulties or otherwise encountered in the preparation of this chapter of the EIAR.

10.3 Description of Existing Environment (Baseline Scenario)

10.3.1 Current Baseline Environment

10.3.1.1 National Emissions

The EPA prepares annual reports on the national emissions to comply with the annual reporting requirements of the Convention on Long Range Transboundary Air Pollution (CLRTAP) and the National Emissions Ceiling Directive (NECD). The 2021 report (Ireland's Air Pollutant Emissions 1990-2030, EPA, 2021b[2]) has been referenced to establish the national baseline of these pollutants which are summarised in **Table 10-13**. Note that the pollutants of relevance to this assessment are those that may be derived from road traffic emissions i.e. NO_x, $PM_{2.5}$ and non-methane volatile organic compounds (NMVOCs). While SO_2 (sulphur dioxide) and NH_3 (ammonia) are measured in the baseline these are not derived from road traffic and are not discussed further in this analysis.

Table 10-13: Ireland's National Emissions Ceiling Directive 2020 and 2030 Targets

Pollutant	2010-20 Targets under 2001/81/EC (kilotonnes)	Emissions Trends (kilotonnes)						Targets under 2016/2284/EU (kilotonnes)	
		2014	2015	2016	2017	2018	2019	2020	2030
SO_2	42	17.591	15.891	14.444	14.987	14.622	10.874	**25.574**	**10.960**
NO_x	65	108.199	107.468	110.176	108.167	107.954	98.031	**66.836**	**40.626**
NMVOC	55	108.013	108.543	109.798	114.852	115.094	113.747	**56.335**	**51.077**
NH_3	116	114.238	119.525	124.819	128.635	135.214	125.404	**112.066**	**107.539**
$PM_{2.5}$	*N/A*	13.848	13.818	13.094	12.989	13.561	11.790	**15.606**	**11.229**

Emissions of NO_x contribute to acidification of soils and surface waters, tropospheric ozone formation and nitrogen saturation in terrestrial ecosystems. Road transport is the primary source (40.6%) in Ireland. NO_x

[2] Ireland's Air Pollutant Emissions 2019 (1990-2030). Available at: https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-air-pollutant-emissions-2019-1990-2030.php

emissions have been consistently above the NEC, reflective of Ireland's ongoing challenge in complying with the ceiling. Progress in reducing emissions has been difficult, even with the large reductions in emissions from power stations in recent years.

NMVOCs are emitted as gases by a wide array of products including paints, paint strippers, glues, cleaning agents and adhesives. These compounds also arise as a product of incomplete combustion of fuels and, as such, are a component of vehicle exhaust emissions. They also arise from the storage of animal manures and fertilisers in agriculture, and from the food and drink industry. NMVOCs contribute to the formation of ground level (tropospheric) ozone, with some species such as benzene and 1,3 butadiene being directly hazardous to human health.[3] Transport emissions account for 4.9% of national total emissions of NMVOCs, arising mainly from exhaust and fugitive releases from gasoline vehicles.

Particulate matter (PM) is ubiquitous and there are many sources of dust including vehicle exhausts, surfaces such as soils and roads, industry emissions, construction activities as well as formation from reactions between different pollutant gases. PM_{10} (dust particles with a diameter less than 10 µg) is small enough to be inhaled into the lungs however fine particulate matter ($PM_{2.5}$, diameter less than 2.5 µg) is considered a better measure of anthropogenic sources of particulate matter. The main sources in Ireland are fossil fuel combustion in the commercial and residential sectors (54.9% of the national total), with the transport sector contributing 13.8%.

Ammonia (NH_3) emissions are associated with acid deposition/rain and the formation of secondary PM. The agriculture sector accounts for virtually all (99.4%) of ammonia emissions in Ireland. Grasslands ultimately receive the bulk of the 42 million tonnes (Mt) of animal manures (equivalent to 539,000 tonnes of nitrogen) produced annually in Ireland along with nitrogen fertilisers which amounted to 365,989 tonnes (as nutrient nitrogen) in 2019. A proportion of the nitrogen in these inputs is volatilised into the air as ammonia.

10.3.1.2 Ambient Air Quality

Under the Clean Air for Europe Directive (2008/50/EC), EU member states must designate 'zones' for the purpose of managing air quality. For Ireland, four zones were defined in the Air Quality Standards Regulations (S. I. No. 180 of 2011), as amended. The zones were amended on 1 January 2013 to take account of population counts from the 2011 CSO Census and to align with the coal restricted areas in the 2012 Regulations (S.I. No. 326 of 2012). The four zones and the main areas in each zone are defined as:

- **Zone A:** Dublin Conurbation;
- **Zone B:** Cork Conurbation;
- **Zone C:** Other cities and large towns comprising Galway, Limerick, Waterford, Clonmel, Kilkenny, Sligo, Drogheda, Wexford, Athlone, Ennis, Bray, Naas, Carlow, Tralee, Dundalk, Navan, Letterkenny, Celbridge, Newbridge, Mullingar, Balbriggan, Greystones, Leixlip and Portlaoise; and
- **Zone D:** Rural Ireland, i.e. the remainder of the State excluding Zones A, B and C.

The Proposed Scheme falls within the EPA air quality Zone D which covers rural Ireland. These rural areas generally have the lowest (i.e. best) background air quality in Ireland as these are located away from large towns and cities where residential heating and traffic sources lead to increased pollution levels. The EPA monitors pollutant levels for all pollutants listed in S.I. 180 of 2011, as amended, on a continuous basis at a series of monitoring stations around the country. Data has been compiled from the EPA database for Zone D to represent the rural background and to inform this assessment.

10.3.1.2.1 National Monitoring Data

The air quality in the area is best characterised by EPA Zone D data (Rural Ireland) and details of the most recent six years of EPA data published for the zone for each of the main traffic-based pollutants in the following sections. It is noted that the 2020 data presented relates to COVID-19 pandemic lock downs and restricted movements when baseline patterns of transport and residential occupancy were altered and as such, these 2020 baseline levels have been considered having regard to these limitations.

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[3] EEA (2015) Indicator Assessment: Non-methane volatile organic compounds (NMVOC) emissions. Available at: https://www.eea.europa.eu/data-and-maps/indicators/eea-32-non-methane-volatile-1/assessment-4 [Note: The EEA has discontinued this indicator]

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is classed as both a primary and a secondary pollutant. As a primary pollutant, NO_2 is emitted from all combustion processes (such as a gas/oil fired boiler or a car engine). The EPA report that in Ireland, the main source of NO_2 is from road transport. As a secondary pollutant NO_2 is derived from atmospheric reactions of pollutants that are themselves, derived mainly from traffic sources.

The levels of NO_2 and NO_x in Zone D for the period 2015 to 2021 are presented in **Table 10-14**. The average results shows the existing baseline levels in Zone D are currently below ambient air quality limit values and the WHO Guidelines. By extension, the levels of NO_2 in the vicinity of the proposed route are expected to be below these levels. This compliance level is to some extent a result of Ireland's location in western Europe where there is a strong prevailing westerly wind, high rainfall levels and low sunshine levels that allows for the rapid dispersion of pollutants and generally good air quality.

Table 10-14: Results of NO_2 and NO_x monitoring carried out by the EPA in Zone D

Year	Annual Mean NO_2 (µg/m^3)	Annual No. of NO_2 Values Exceeding Hourly Limit for Protection of Human Health >200 µg/m^3	Annual Mean NO_x (µg/m^3)
2015	5.5	0	6.2
2016	6.3	0	9.9
2017	4.4	0	5.7
2018	4.7	0	6.7
2019	5.7	0	7.8
2020	7.6	0	15.9
2021	7.5	0	14.2
Limit	**40 (Annual Limit for Protection of Human Health)**	**18 (No. of samples not to exceed the year)**	**30 (Annual limit for protection of vegetation)**
WHO Air Quality Guideline (AQG)	**10**	**–**	**–**

Source: *Air Quality in Ireland report 2021 (EPA, 2022).*

Particulate Matter

Particulate Matter (PM_{10} and $PM_{2.5}$) may be emitted as a primary pollutant from road vehicle exhausts as well as from the combustion of solid fuels (coal, peat, wood) and the EPA report that the main source (especially of the smaller and more dangerous $PM_{2.5}$ particles) is solid fuel burning for home heating.[4] In rural areas, sources will include solid fuel burning for space heating, road traffic, agricultural activities and natural processes such as sea salt aerosol. PM may also be formed as secondary pollutants from the condensation or reaction of chemical vapours in the atmosphere.

The levels of PM_{10} and $PM_{2.5}$ in Zone D for the period 2015 to 2021 are presented in **Table 10-15**. As with NO_x, the average results for PM_{10} and $PM_{2.5}$ show the existing baseline levels based on data from the EPA monitoring network are currently below ambient air quality limit values in Zone D and by extension the levels in the vicinity of the proposed route are also considered to be below and in compliance with the human health limits presented in **Table 10-3**. However, it is noted that the levels of PM_{10} are only marginally below the new WHO Guidelines in recent years and the levels of $PM_{2.5}$ are above the WHO Guideline for all years since 2015. As noted, the EPA record that the primary source of these emissions is from solid fuel burning for space heating and not from road traffic but road traffic (in particular diesel engines) is a source of fine particulate matter.

[4] Link: https://www.epa.ie/environment-and-you/air/air-pollutants/

Table 10-15: Results of PM_{10} and $PM_{2.5}$ monitoring carried out by the EPA in Zone D

Year	Annual Mean PM_{10} ($\mu g/m^3$)	Average no. of PM_{10} Values Exceeding 24 Hour Limit for Protection of Human Health >50 $\mu g/m^3$	Annual Mean $PM_{2.5}$ ($\mu g/m^3$)
2015	12.5	3	8
2016	11.8	2	9
2017	9.9	0.7	7.4
2018	11.8	0	9.4
2019	14.3	2.6	9.3
2020	11.2	1.0	7.8
2021	11.9	1.1	8.7
Limit	**40** **(Annual Limit for protection of human health)**	**35** **(No. of Samples not to exceed per year)**	**25** **(Annual target value for the protection of human health)**
WHO Air Quality Guideline (AQG)	**15**	**–**	**5**

Source: *Air Quality in Ireland report 2021 (EPA, 2022).*

Carbon Monoxide

Carbon monoxide (CO) is produced from the partial oxidation of carbon-containing compounds (i.e. organic fuels such as coal, oil, petrol, diesel, wood, etc.) during the combustion process. CO forms when there is not enough oxygen to produce carbon dioxide (CO_2) during combustion. As such, CO is a primary pollutant from all combustion process including vehicle exhausts, domestic heating, etc. The extent of CO emissions depends on the fuel type and the combustion conditions. Once inhaled, CO is quickly absorbed into the bloodstream from the lungs. Then it combines with haemoglobin in the blood to form carboxyhaemoglobin. This reduces the ability of the blood to carry oxygen around the body and it robs the heart, brain and other vital organs of oxygen. The EPA did not undertake CO monitoring within Zone D prior to 2020 so the levels recorded in Zone C for the years 2015 to 2019 are presented in **Table 10-16** with Zone D data reported for 2020 and 2021. The levels of CO are significantly lower, i.e. less than 10% of the limit value (refer to **Table 10-3**) as well as the WHO Guideline.

Table 10-16: Results of CO monitoring carried out by the EPA in Zone C and D

Year	Annual Mean CO (mg/m^3)
2015 (Zone C)	0.2
2016 (Zone C)	0.6
2017 (Zone C)	0.1
2018 (Zone C)	0.2
2019 (Zone C)	0.1
2020 (Zone D)	0.4
2021 (Zone D)	0.3
Limit	**10** **(8-hour limit for protection of human health)**
WHO Air Quality Guideline (AQG)	**4** **(24 hour mean for the protection of human health)**

Source: *Air Quality in Ireland report 2021 (EPA, 2022).*

Volatile Organic Compounds

Volatile organic compounds (VOC) such as benzene (a known human carcinogen) are emitted directly from petrol fuelled vehicles. Other VOCs are also emitted from petrol exhausts (toluene, ethylbenzene, xylenes). These compounds have varying sources and properties and only benzene has a limit for the protection of human health in the legislation (**Table 10-3**). For assessment, it is noted that like CO, the EPA does not undertake VOC monitoring in Zone D areas and hence the Zone C data has been presented to provide a conservative background for information purposes and is shown in **Table 10-17**. Overall, benzene levels are low and are well below the limit for the protection of human health (refer to **Table 10-3**). Levels of the other VOCs have also remained stable in past several years but there is no limit designated as the standard for the protection of human health.

Table 10-17: Results of VOC monitoring carried out by the EPA in Zone C (source: EPA)

Year	Annual Mean Benzene ($\mu g/m^3$)	Annual Mean Toluene ($\mu g/m^3$)	Annual Mean Ethylbenzene ($\mu g/m^3$)	Annual Mean m/p-Xylene ($\mu g/m^3$)	Annual Mean o-Xylene ($\mu g/m^3$)
2015	0.13	0.15	0	0.02	0.01
2016	0.45	0.50	0	0.39	0.10
2017	0.35	0.40	0.09	0.38	0.08
2018	0.18	0.25	0.09	0.12	0.21
2019	0.17	0.31	0.07	0.23	0.20
2020	0.04	0.07	0.06	0.09	0.10
2021	0.18	0.43	0.11	0.1	0.03
Limit	**5 (Annual limit for protection of human health)**	***N/A***	***N/A***	***N/A***	***N/A***

Source: *Air Quality in Ireland report 2021 (EPA, 2022).*

10.3.1.2.2 Site-specific Monitoring Data

In addition to the EPA national database, site specific baseline monitoring was undertaken for air quality within the Slane area. The location and methodology for the monitoring is described in **Section 10.2.3.2**. The baseline air quality data for NO, NO_2 and NO_x is presented in **Table 10-18**. The baseline data has been seasonally adjusted as per standard practice to allow for a representation of annual results. In addition, as the monitoring was undertaken during the Covid -19 pandemic, the baseline data has been adjusted based on the ratio between pre-Covid data (2019) and validated data recorded by the EPA during the site-specific monitoring event.

Table 10-18: Baseline Air Quality Data for Nitrogen Oxides

Monitoring Location *(see Figure 10.1)*	Month 1 ($\mu g/m^3$)			Month 2 ($\mu g/m^3$)			Month 3 ($\mu g/m^3$)		
	NO	NO_2	NO_x	NO	NO_2	NO_x	NO	NO_2	NO_x
A1	9.1	**11.6**	20.7	3.8	**12.4**	16.2	6.6	**14.4**	21.0
A2	41.9	**31.0**	72.8	40.7	**30.2**	70.9	24.8	**28.8**	53.6
A3	5.5	7.2	12.7	2.7	7.0	9.6	6.4	8.1	14.4
A4	5.1	6.5	11.6	5.6	7.0	12.6	4.1	7.0	11.1
A5	4.2	8.2	12.4	2.5	6.9	9.4	2.7	9.4	12.1
Limit	–	40	–	–	40	–	–	40	–
WHO Guideline	–	10	–	–	10	–	–	10	–

The baseline air quality assessment found that concentrations of NO, NO_2 and NO_x are elevated at monitoring location A2 within Slane village. While the levels of NO_2 in the village (range from 27.2 to 29.2

µg/m³ NO_2) do not exceed the annual limit for the protection of human health (40 µg/m³ NO_2) the baseline levels are well above the WHO Guideline for NO_2 (10 µg/m³ NO_2). It is likely that these elevated concentrations are a result of the levels of traffic congestion in the village (e.g. traffic lights, single lane bridge and two-way roads). All other locations outside of the village have NO_2 levels that are below the limit and WHO Guideline and are largely in line with the national Zone D baseline (refer to **Table 10-14**).

The NO_x concentrations at A2 were above the annual limit for protection of vegetation (30 µg/m³ NO + NO_2) at A2 which may have potential for baseline localised adverse impact on the River Boyne and River Blackwater Special Area of Conservation and Special Protection Area.

The baseline air quality data for benzene, toluene, ethylbenzene and xylene is displayed in **Table 10-19**. The levels of aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylene) in the area are low and similar to the national baseline presented in **Table 10-17** with no significant elevation of levels in the area.

Table 10-19: Baseline Air Quality Data for Aromatic Hydrocarbons

Monitoring Location *(see Figure 10.1)*	Month 1 (µg/m³)				Month 2 (µg/m³)				Month 3 (µg/m³)			
	B	T	E	X	B	T	E	X	B	T	E	X
A1	0.42	0.24	*ND*	0.56	0.53	0.33	*ND*	0.29	0.24	*ND*	*ND*	*ND*
A2	0.66	0.63	*ND*	0.87	0.38	0.24	*ND*	*ND*	0.42	0.31	*ND*	1.08
A3	0.47	0.28	*ND*	0.29	0.25	*ND*	*ND*	*ND*	0.27	*ND*	*ND*	*ND*
A4	0.39	0.24	*ND*	0.52	0.23	*ND*	*ND*	*ND*	0.31	*ND*	*ND*	0.30
A5	0.61	0.34	*ND*	*ND*	0.24	*ND*	*ND*	*ND*	0.54	0.33	*ND*	0.49

Key: *ND denotes 'Not Detected'. B: Benzene, T: Toluene, E: Ethylbenzene, and X: Xylenes.*

10.3.1.3 Mainline Bypass

As part of the site-specific monitoring (**Section 10.2.3.2**), air quality was monitored at location A1 (N2 South – start of the bypass in the south), A3 (N51 roundabout) and A5 (N2 North – end of the bypass in the north). These locations were chosen to relate to the proposed Mainline Bypass.

During the air quality monitoring, NO, NO_2 and NO_x concentrations at A1, A3 and A5 were similar to the national average for Zone D locations (Rural Ireland). Monitoring locations A1 and A5 were located along the existing N2, representative of the operational N2 traffic and air quality in that area. Monitoring location A3 was located on the existing N51 at the approximate location of the proposed N51/N2 roundabout. The air quality at this location was representative of traffic on the existing N51. The implementation of the proposed route will increase traffic adjacent to this monitoring location.

10.3.1.4 N51 Route Improvements

As part of the site-specific monitoring (**Section 10.2.3.2**), air quality was also monitored at A2 (Slane village) and A3 (N51 roundabout). These locations were chosen to relate to the proposed N51 Route Improvements.

During the site-specific air quality monitoring NO, NO_2 and NO_x concentrations at A3 were similar to the national average for Zone D locations (Rural Ireland). This monitoring location is located on the existing N51 at the approximate location of the proposed N51/N2 roundabout. The air quality was representative of traffic on the existing N51. The implementation of the proposed route will increase traffic adjacent to this monitoring location.

10.3.1.5 Slane Village Traffic Management Works and Public Realm Works

Site specific monitoring (**Section 10.2.3.2**) was also undertaken at A2 (Slane village) and A4 (Boyne Tow Path Walkway). These locations were chosen to relate to the Slane village Traffic Management Works and Public Realm Works.

The air quality monitoring at monitoring location A2 was undertaken within Slane village at the N2/N51 junction. This monitoring location was reflective of the current traffic and air quality data of the adjacent N2, the proposed route will divert the N2 traffic away from the Village and the N51 will become the main route in the Village. The baseline air quality monitoring found that concentrations of NO, NO_2 and NO_x were elevated at monitoring location A2. NO_x concentrations at A2 were above the annual limit for protection of vegetation (30 µg/m³ NO + NO_2) during the air quality monitoring. It is likely that these elevated concentrations are a result of high volumes of traffic build up in the town (e.g. traffic lights, single lane bridge and two-way roads) and slow moving, starting and stopping traffic.

During the air quality monitoring undertaken, NO, NO_2 and NO_x concentrations at A4 were similar to the national average for Zone D locations (Rural Ireland). This monitoring location was located on the Boyne Navigation towpath (known as the Ramparts Walk), south of the village.

10.3.1.6 Sensitive Receptors

The TII Guidelines state that sensitive receptor locations include residential housing, schools, hospitals, places of worship, sports centres and shopping areas i.e. locations where members of the public are likely to be regularly present. The GeoDirectory for the proposed bypass route and N51 improvements indicates that a total of 408 residential properties within 500m of the Proposed Scheme (i.e. the zone of influence for the construction stage). There are a total of 230 residential properties within 300 m of the Proposed Scheme (i.e. the zone of influence for the operation stage). The breakdown is summarised in **Table 10-20**.

Table 10-20: GeoDirectory Summary

Buffer Band	Count of All Property Types	Count of Residential Only
0-50 m	38	28
50-100 m	16	14
100-200 m	47	42
200-300 m	129	115
300-500 m	260	209

The GeoDirectory indicates that a total of 38 properties are located within 50 m from the centreline of the proposed bypass route and N51 road improvements (this is the distance within which the greatest air quality impacts will be experienced) with 28 of these properties being residential. Within 100 m, the number of properties rises to 54 in total with 42 of these properties being residential.

In addition to residential sensitivities, sensitive non-residential receptors in the wider area of the alignment were also reviewed. These include educational and care facilities and are listed in **Table 10-21**. It is noted that none of these sensitive receptors were located within 100 m of the proposed alignment but all are located within the Public Realm works or within 100 m of the works.

Table 10-21: Sensitive Receptors

Receptor Type	Receptor
Preschool/Creche	Tús Maith Montessori
	Early Buds Creche
National School	Saint Patrick's National School
Places of Worship	Saint Patrick's Church of Ireland
	Saint Patrick's Catholic Church
Health Centres / Care Homes	Slane Health Centre

In addition to the sensitive receptors identified above, the following ecological receptors were also noted in the area:

- River Boyne and River Blackwater SAC (Site Code: 002299) and SPA (Site Code: 004232) which will be crossed by the Proposed Scheme;
- Crewbane Marsh Proposed Natural Heritage Area [pNHA] (Site Code: 000553), east of the Proposed Scheme;
- Slane Riverbank pNHA (Site Code: 001591), south of Slane village;

- Boyne Woods pNHA (Site Code: 001592), south of Slane village; and
- Rossnaree Riverbank pNHA (Site Code: 001589), east of the Proposed Scheme.

Both human and natural receptors are addressed further in the assessment (**Section 10.4**).

10.3.1.7 Baseline Road Traffic Emissions from the Existing Road Network

Existing traffic data for the Proposed Scheme has been compiled from **Chapter 7** of the EIAR. The traffic model is a wide area model and covers the wider road network between the M1 (east), M50 (south), N3 (west) up to the Ardee area in the north. As such, the calculated emissions capture the macro-scale levels of pollutant emissions in the northeast of the country. Using the TII Road Emissions Model the estimated emissions for 2019 baseline traffic is presented in **Table 10-22.**

Table 10-22: 2019 Baseline Pollutant Emissions from Road Transport

Pollutant	Total Emissions (tonnes)
Oxides of Nitrogen (NO_x)	2,802
Particulate Matter PM_{10}	183
Particulate Matter $PM_{2.5}$	119

10.3.1.8 Sensitivity to Construction Dust

An appraisal has been carried out to assess sensitivity of receptors to dust soiling, health impacts and ecological impacts due to the construction phase in accordance with the IAQM Guidance. This appraisal reviews the sensitivity of the site's location with respect to dust nuisance, human health and ecological impacts and then calculates a risk of impact using the magnitude of site activities. Receptor sensitivity can be described as follows with respect to nuisance dust as per the IAQM Guidance:

- High sensitivity receptor with respect to dust nuisance – surrounding land where:
  - Users can reasonably expect enjoyment of a high level of amenity;
  - The appearance, aesthetics or value of their property would be diminished by soiling;
  - The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land; or
  - Examples include dwellings, museums and other culturally important collections, medium and long-term car parks.
- Medium sensitivity receptor with respect to dust nuisance – surrounding land where:
  - Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home;
  - The appearance, aesthetics or value of their property could be diminished by soiling;
  - The people or property would not reasonably be expected to be present continuously or regularly for extended periods as part of the normal pattern of use of the land; or
  - Indicative examples include parks and places of work.
- Low sensitivity receptor with respect to dust nuisance – surrounding land where:
  - The enjoyment of amenity would not reasonably be expected;
  - Property would not reasonably be expected to be diminished in appearance, aesthetics, or value by soiling;
  - There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land; or
  - Indicative examples include playing fields, farmland (unless commercially sensitive horticultural), footpaths, short term car parks and roads.

Receptor sensitivity can be described as follows with respect to human health as per the IAQM Guidance:

- High sensitivity receptor with respect to human health – surrounding land where:
  - Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day); or
  - Indicative examples include residential properties. Hospitals, schools, and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.
- Medium sensitivity receptor with respect to human health – surrounding land where:
  - Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, relevant location would be one where individuals may be exposed for eight hours or more in a day); or
  - Indicative examples include office and shop workers but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.
- Low sensitivity receptor with respect to human health – surrounding land where:
  - Locations where human exposure is transient; or
  - Indicative examples include public footpaths, playing fields, parks, and shopping streets.

Receptor sensitivity can be described as follows with respect to ecology as per the IAQM Guidance:

- High sensitivity receptor with respect to ecology – surrounding land where:
  - Locations with an international or national designation and the designated features may be affected by dust soiling; or
  - Indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.
- Medium sensitivity receptor with respect to ecology – surrounding land where:
  - Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or
  - Indicative example is a European or Nationally designated site with dust sensitive features.
- Low sensitivity receptor with respect to ecology – surrounding land where:
  - Locations with a local designation where the features may be affected by dust deposition; or
  - Indicative example is a local Nature Reserve with dust sensitive features.

Prior to assessing the impact from dust emissions, the sensitivity of the area must be established using the headings:

- Dust Soiling Effects on People and Property;
- Human Health Impacts; and
- Ecological Impacts.

The sensitivity of the area is considered as per the criteria outlined in the IAQM Guidance and as reproduced in **Table 10-23**, **Table 10-24** and **Table 10-25**.

In terms of the sensitivity of the area to dust soiling effects on people and property, the receptor sensitivity, number of receptors and their distance from the source are considered. Using these criteria as outlined in **Table 10-23**, the sensitivity of the area to dust soiling can be established.

Table 10-23: Sensitivity of the Area to Dust Soiling Effects on People and Property

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

The IAQM Guidance also outlines the criteria for assessing the human health impact from PM_{10} emissions from construction activities based on the current annual mean PM_{10} concentrations, receptor sensitivity and the number of receptors effected as per **Table 10-24**. The annual mean background PM_{10} concentration was reviewed in **Section 10.3.1.2.1**. This found concentrations to be significantly less than 24 µg/m^3 (**Table 10-15**) and this band of sensitivity is applied throughout this assessment.

Table 10-24: Sensitivity of the Area to Human Health Impacts

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

Dust deposition impacts on ecology can occur due to chemical or physical effects. This includes reduction in photosynthesis due to smothering from dust on the plants and chemical changes such as acidity to soils. Often impacts will be reversible once the works are completed and dust deposition ceases. The Proposed Scheme will traverse the River Boyne and River Blackwater SAC which is classed as a highly sensitive receptor. As shown in **Table 10-25** the worst-case sensitivity of the area to ecological impacts is considered 'high' under this guidance without adequate mitigation.

Table 10-25: Sensitivity of the Area to Ecological Impacts

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

An overall summary of the baseline area for construction to dust nuisance, human health and ecological impacts is shown in **Table 10-26**.

Table 10-26: Summary of Sensitivity of the Area to Dust

Location	Description of Works	Nuisance Sensitivity	Human Health Sensitivity	Ecology Sensitivity
Main N2 Alignment	Approximately 39 hectares (ha) of land permanently acquired for the construction of the proposed road development including demolition, earthworks, bridge construction, road construction, drainage, utilities and landscaping.	High	Medium	High
Main Compound	Contractor's compound, offices, welfare facilities, car parking. Material storage and laydown and maintenance of construction plant on an area of 0.45ha.	Medium	Low	Medium
Satellite Compound	Contractor's compound, offices, welfare facilities, car parking, vehicle washing facilities. No material storage.	Medium	Low	Medium
Southern Stockpile	To store topsoil (5,990m^3) and surplus rock (19,120m^3). Rock processing plant.	Medium	Low	Medium
Northern Stockpile (Topsoil)	To store topsoil (12,020m^3).	Low	Low	Medium
Northern Stockpile (Rock)	To store surplus rock than cannot be accommodated in the Southern Stockpile.	Low	Low	Medium
Public Realm	Activities will include the removal or existing road pavement and footpaths, utility diversion, installation of new road pavements and footpaths, and construction of an off-street car park. Equipment includes excavators, dumpers, planners, rollers and pavers.	High	Medium	Medium

10.3.2 Evolution of the Environment in the Absence of the Proposed Scheme

The likely evolution of the air quality baseline in future years in the absence of the Proposed Scheme, referred to as the 'Do-Nothing' Scenario, is presented within this section.

The baseline air quality trends shown for Ireland from 2009 to 2021 show a very slight gradual decline for all pollutants on an annual basis (some anomaly in 2020 and 2021 from Covid). NO_2 mean concentrations in Zone C and D have been below the EU Limit Level (40 µg/m^3). PM_{10} levels in Zones C and D have consistently been below the EU Limit and WHO Guideline since 2009 with the exception of Zone C in 2013 where the WHO Guideline (20 µg/m^3) was marginally exceeded (21 µg/m^3). PM_{10} levels are highest in towns and villages across Ireland due largely to the burning of solid fuel. $PM_{2.5}$ levels are generally highest in Zones C and D but since 2009 the levels are consistently below the EU limit value (20 µg/m^3) however often exceed the WHO Guideline Value (10 µg/m^3). According to the EPA, fine particulate matter levels are a concern countrywide.

The gradual decreases in pollutant trends are based on the implementation of a series of national and EU driven policies and legislation on emissions from road traffic, industrial emissions and space heating. The EPA has reported on the main challenges of reducing air pollution from key sources such as particulate matter emissions, mainly from solid fuel burning in the residential sector, and NO_x emissions from vehicles in the transport sector.

The Government's 'National Clean Air Strategy' for Ireland has proposed a series of measures for transport with a view to an irreversible shift to low-emission mobility. Among the measures considered in the strategy are taxation policy on fuel and vehicles, increasing the electrification of the national fleet, increased vehicle emissions standards, fuel standards and a move to more sustainable modes of transport, particularly in towns and cities.

The Department of Environment, Climate and Communications Climate Action Plan 2023 commits to achieving a net zero carbon energy systems objective nationally. Regarding transport, the following goals are defined for 2030:

- 50% increase in daily active travel journeys;
- 130% increase in daily public transport journeys;
- 25% reduction in daily car journeys;
- EV share of total private passenger car fleet to reach 30%;
- EV share of new private car registrations to reach 100%;
- 845,000 Private EVs on the road network;
- 20% EV share of total commercial LGV fleet;
- 95,000 commercial EVs; and
- 30% ZE share of new heavy duty commercial vehicle registrations.

Ongoing reductions in tailpipe emissions from the Auto Oil program (an EC Directorates General collective with the aim of establishing a consistent framework for assessment of different policy options related to the reduction of emissions and to provide a foundation for the transition towards longer term air quality studies covering all emission sources5) will lead to a continual reduction in emissions per fleet vehicle in Ireland as newer Euro 6/VI vehicle, hybrids and electric vehicles replace older vehicles. This decrease may be offset by the increased number of vehicles in the fleet and/or a reduction on the efficiency on the road network. Other policy instruments impacting transport emissions include the Biofuels Obligations Scheme and uptake of electric vehicles. Based on these trends, the transport sector is facing a challenge in achieving the emissions reductions set out in the National Policy Position.

Against this policy background and evolving baseline air quality trends, in the absence of the Proposed Scheme, the current road system in Slane village (N2 and N51) would remain in its current state with the volume of traffic steadily increasing. As discussed in **Section 10.3.1**, the baseline air quality at survey location A2 shows that there is an existing pollution problem in Slane resulting in elevated NO, NO_2 and NO_x. It is likely that these elevated concentrations are as a result of high volumes of traffic build up in the town (e.g. traffic lights, single lane bridge and two-way roads) and slow moving, starting and stopping traffic. In the absence of the Proposed Scheme, there would be little to no opportunity to improve air quality within the village by diverting and improving the current traffic flow from Slane village (and adjacent sensitive receptors) to the east via a bypass of the village. The traffic management measures along with the public realm enhancement proposals could not be implemented without the proposed bypass, and there would be less opportunity to link up safer active travel modes via the proposed pedestrian and cycle links.

[5] https://ec.europa.eu/environment/archives/autooil/index.htm

The traffic model for the Proposed Scheme predicts future traffic levels across the wider north east road network in the absence of the Proposed Scheme (i.e. the Do-Minimum scenarios). The predicted emissions for operational traffic under the following scenarios are presented in **Table 10-27**:

- 2026 Do-Minimum i.e. opening year without the Proposed Scheme in 2026; and
- 2041 Do-Minimum i.e. design year without the Proposed Scheme in 2041.

Results are presented for each of the three REM scenarios i.e. the Business as Usual scenario with no progression on climate policy, a Climate Action Plan scenario assuming full implementation, and an intermediate scenario.

The results showing varying results for each of the three pollutants considered as follows:

- For Oxides of Nitrogen (NO_x) there is a significant projected decrease in emissions in both future years for all three scenarios. This is largely as a result of the Auto Oil program measures to limit fuel and engine technology as well as the electrification of the fleet under CAP23 which has co-benefits for reducing NO_x;
- Particulate Matter PM_{10} shows no such reduction in 2026 with a marginal increase followed by a more significant increase in 2041 for all scenarios. The above policy measures are predicted to have limited impact on direct emissions of PM_{10} and the net impact is the increased number of vehicles on the current road network.
- Particulate Matter $PM_{2.5}$ does show a decrease in 2026 as a result of the policy intervention but this is more moderate than that for NO_x and then an increase is predicted ion 2041 when the growth in vehicle numbers becomes the dominate factor.

It should be noted that the REM model is highly conservative and typically overpredicts the traffic emissions to ensure a conservative analysis. The inherent conservatism in the REM model and the predictions should be viewed in this regard and predicted future increases in emissions are likely a worst-case scenario.

Table 10-27: Predicted Annual Pollutant Emissions from Road Transport in the absence of the Proposed Scheme

Pollutant	Scenario	BaU Scenario (tonnes)	Intermediate Scenario (tonnes)	CAP Scenario (tonnes)
Oxides of Nitrogen (NO_x)	Do-Minimum 2026	1,945	1,916	1,854
	Change relative to 2019 baseline (%)	**-31%**	**-32%**	**-34%**
	Do-Minimum 2041	1,089	857	671
	Change relative to 2019 baseline (%)	**-61%**	**-89%**	**-76%**
Particulate Matter PM_{10}	Do-Minimum 2026	186	186	186
	Change relative to 2019 baseline (%)	**+2%**	**+2%**	**+2%**
	Do-Minimum 2041	215	213	211
	Change relative to 2019 baseline (%)	**+17%**	**+16%**	**+15%**
Particulate Matter $PM_{2.5}$	Do-Minimum 2026	110	110	109
	Change relative to 2019 baseline (%)	**-8%**	**-8%**	**-8%**
	Do-Minimum 2041	125	122	121
	Change relative to 2019 baseline (%)	**+5%**	**+3%**	**+2%**

10.4 Description of Likely Significant Effects

Section 10.4.1 and **10.4.2** provide a description of the likely significant effects of the Proposed Scheme on air quality in cumulation with other existing development in the area. A description of the likely significant effects in cumulation with approved development i.e., development not yet built, is presented in **Section 10.4.3** based on the detailed methodology for the CIA included in **Chapter 25**.

The impact interactions between air quality and other environmental factors are identified and described in **Chapter 26** and assessed throughout **Sections 10.4.1** to **10.4.3**.

The following sections consider the potential impact of the Proposed Scheme on air quality during the construction and operational phases. The construction assessment considers potential impacts due to construction activities and construction-related traffic. The operational phase assesses the potential impact locally and regionally due to traffic emissions. The 'Do-Nothing' scenario outlining the likely evolution without the development has been presented in **Section 10.3.2**.

10.4.1 Construction Phase

10.4.1.1 Construction Dust

The greatest potential impact on air quality during the construction phase is from construction dust emissions, PM_{10} and $PM_{2.5}$ emissions and the potential for nuisance dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1- 75 µm), therefore includes both PM_{10} and $PM_{2.5}$. Deposition typically occurs in close proximity to each site and potential impacts generally occur within 350 m of the route used by construction vehicles on the public road, up to 500 m from the site entrance.

Large particle sizes (greater than 75 µm) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 µm are of interest as these can remain airborne for greater distances and give rise to the potential dust nuisance at the sensitive receptors.

This section of the chapter provides an overview of the typical activities that have potential for dust impacts during the construction phase of the Proposed Scheme. The potential for dust emissions due to construction can vary substantially day to day and are strongly influenced by the level of activity, the specific operations, and the prevailing meteorological conditions. While each individual site compound will differ, the processes that have the potential for the generation of construction dust will be similar. Further details on construction methods can be found in **Chapter 5** which contains an overview of the activities and methods that are anticipated to be used during construction and commissioning of the Proposed Scheme.

The following operations are the main dust generating sources or activities:

- Vegetation clearance – removes grass and other soil covering;
- Demolition – detailed demolition plans will be required to minimise dust generation;
- Movement of trucks along paved public roads – potential of track-out of dust on vehicle tyres from construction sites or resuspension of dust;
- Movement of trucks along unpaved haul roads (this will only be relevant for a number of sites) – potential for resuspension of dust as vehicles move around the site;
- Extraction of material – works will be broken down into different types however all will involve the movement of potentially dusty material which has the potential to generate dust;
- Processing of materials such as rock; and
- Stockpiling of material – stockpiles have the potential to generate dust due to dry material movement and wind erosion.

In order to determine the level of dust mitigation required during the proposed works, the potential dust emission magnitude (**Section 10.2.5.5**) for each dust generation at each site needs to be taken into account in conjunction with the previously established sensitivity of the area (**Section 10.3.1.8**). Using the appraisal criteria for the assessment of risk at sensitive receptors as detailed in **Section 10.4.1.1**, a summary of dust emission magnitudes from the main construction areas (as presented in **Figure 10.2**) is shown in **Table 10-28**.

The resultant requirement levels (i.e. high, medium or low levels of mitigation) for mitigation with respect to nuisance dust, health impacts and ecological impacts are shown in **Table 10-29** to **Table 10-32** and an overall summary provided in **Table 10-33**.

Table 10-28: Summary of Emission Magnitude

Location	Demolition	Earthworks	Construction	Track-out
Main N2 Alignment	Small	Large	Large	Large
Main Compound	Small	Medium	Medium	Medium
Satellite Compound	Small	Medium	Medium	Medium
Southern Stockpile	Small	Medium	Large	Large
Northern Stockpile (Topsoil)	Small	Medium	Large	Large
Northern Stockpile (Rock)	Small	Medium	Large	Large
Public Realm	Small	Medium	Large	Medium

Table 10-29: Summary of Demolition Risk to Define Site-Specific Mitigation

Location	Dust Nuisance Risk	Human Health Risk	Sensitive Ecology Risk
Main N2 Alignment	Low	Low	Low
Main Compound	Low	Negligible	Low
Satellite Compound	Low	Negligible	Low
Southern Stockpile	Low	Negligible	Low
Northern Stockpile (Topsoil)	Negligible	Negligible	Low
Northern Stockpile (Rock)	Negligible	Negligible	Low
Public Realm	Low	Low	Low

Table 10-30: Summary of Earthworks Risk to Define Site-Specific Mitigation

Location	Dust Nuisance Risk	Human Health Risk	Sensitive Ecology Risk
Main N2 Alignment	High	Medium	High
Main Compound	Medium	Low	Medium
Satellite Compound	Medium	Low	Medium
Southern Stockpile	Medium	Low	Medium
Northern Stockpile (Topsoil)	Low	Low	Medium
Northern Stockpile (Rock)	Low	Low	Medium
Public Realm	Medium	Medium	Medium

Table 10-31: Summary of Construction Risk to Define Site-Specific Mitigation

Location	Dust Nuisance Risk	Human Health Risk	Sensitive Ecology Risk
Main N2 Alignment	High	Medium	High
Main Compound	Low	Low	Low
Satellite Compound	Low	Low	Low
Southern Stockpile	Medium	Low	Medium
Northern Stockpile (Topsoil)	Low	Low	Medium
Northern Stockpile (Rock)	Low	Low	Medium
Public Realm	High	Medium	Medium

Table 10-32: Summary of Track-out Risk to Define Site-Specific Mitigation

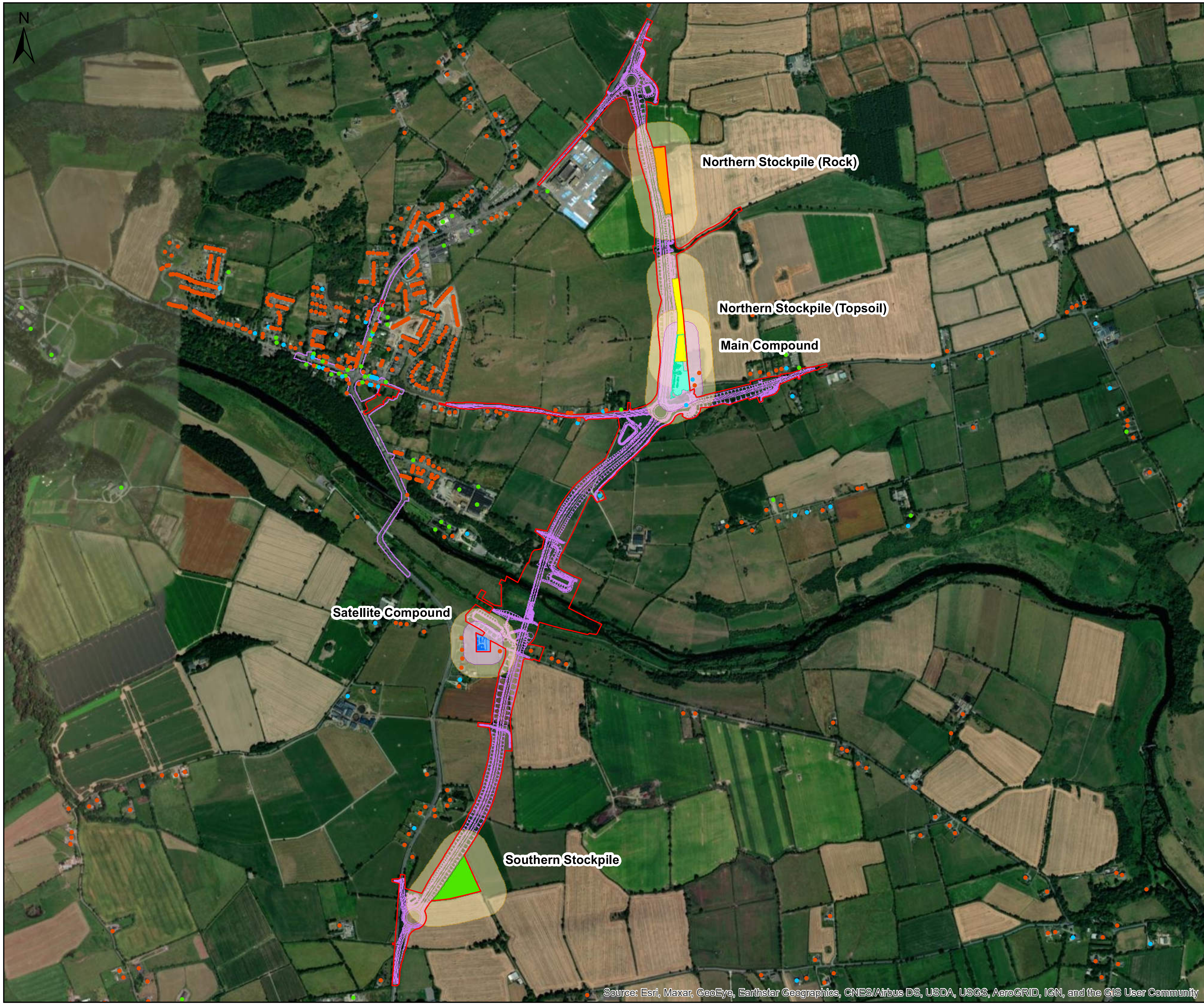
Location	Dust Nuisance Risk	Human Health Risk	Sensitive Ecology Risk
Main N2 Alignment	High	Medium	High
Main Compound	Medium	Low	Medium
Satellite Compound	Medium	Low	Medium
Southern Stockpile	Medium	Low	Medium
Northern Stockpile (Topsoil)	Low	Low	Medium
Northern Stockpile (Rock)	Low	Low	Medium
Public Realm	Medium	Medium	Medium

The risk of dust impacts arising from the Proposed Scheme are summarised in **Table 10-33**. The magnitude of risk determined is used to prescribe the level of site-specific mitigation required for each activity to prevent significant impacts occurring. The scale of the works on the main alignment constitute a high dust risk requiring mitigation while the proximity of the works on the Public Realm to sensitive receptors also classifies these works as high risk and requiring mitigation. All other compounds are medium risk but will require some levels of mitigation.

The impacts associated with construction phase dust emissions are considered short term **slight to moderate** adverse impacts without mitigation and therefore a series of best practice mitigation is presented in **Section 10.5.1.1**.

Table 10-33: Summary Overall Dust Impact Risk to Define Site-Specific Mitigation

Location	Worst Case Dust Risk
Main N2 Alignment	High
Main Compound	Medium
Satellite Compound	Medium
Southern Stockpile	Medium
Northern Stockpile (Topsoil)	Medium
Northern Stockpile (Rock)	Medium
Public Realm	High



Legend

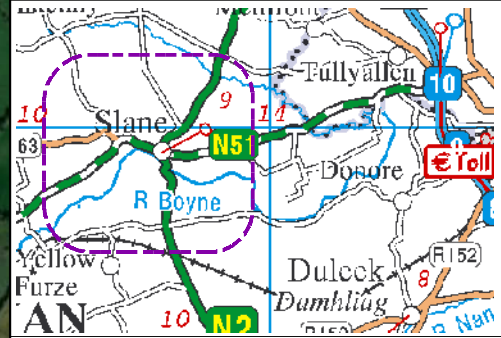
- Proposed Scheme Alignment
- Proposed Scheme Boundary
- Main Compound
- Satellite Compound
- Northern Stockpile (Rock)
- Northern Stockpile (Topsoil)
- Southern Stockpile
- 50m Buffer
- 100m buffer

GeoDirectory (Q1 2023)

- Residential
- Commercial
- Business

Data Source: An Post Geodirectory (Q1 2023) provided by Meath County Council.

0 0.125 0.25 0.5
Kilometres



Client
Meath County Council

N2 Slane Bypass and Public Realm Enhancement Scheme

Title
Figure 10.2

Construction Compound Locations

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Issue Details

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Status: A1	**Rev:** C01	**Model File Identifier:** MDT0806-RPS-01-N2-M2-C-XM1001 MDT0806-RPS-01-PR-M2-C-XR9000
Drawn: NR	**Date:** 24/05/2023	
Checked: PC	**Scale:** 1:14,000 (A3)	
Approved: NO'N	**Projection:** ITM	

NOTE:

10.4.1.2 Construction Traffic

A large quantity of earthworks material will be removed from the site and transported to a suitable location for recovery. In total, some 520,000m^3 of soil and stone is expected to be removed from the site (refer **Chapter 23 – Material Assets: Resource and Waste Management**). It is intended that this material will leave the site directly upon excavation to the appropriate infill area off-site in the greater Dublin area (Huntstown waste facility, Finglas). The predicted levels of construction traffic and the associated haul routes are presented in **Chapter 5 – Description of the Construction Phase**, **Section 5.5** (Traffic Impact During Construction).

Construction traffic can impact directly on local air quality generally and on any sensitive receptors that are located adjacent to the road networks being used during construction. The significance of air quality impacts due to vehicle emissions during the construction phase is dependent on the number of additional vehicle movements, the proportion of HGVs and the proximity of sensitive receptors to site access routes.

In terms of haul routes a series of six site access points have been identified where traffic will enter/exit the mainline works onto the public road network with the two main haul routes identified as follows:

- Earthworks trips from the southern end of the scheme will travel south on the N2 to access the Huntstown waste facility in Fingal (projected maximum of 268 HGV movements and 60 passenger car movements per day) – equating to a 5% increase on 2019 baseline traffic on this route.
- HGV traffic from the northern end if the scheme (north of the River Boyne) will be directed to travel on east on the N51 and M1/M50 to access the Huntstown waste facility (maximum of 275 HGV movements and 210 passenger car movements per day) – equating to a 10% increase on 2019 baseline traffic on this route.

Both haul routes will experience increased traffic levels as a result of construction and there is potential for sensitive receptors located along these routes to experience an air quality impact. The REM model has been employed to simulate the level of change in ambient air quality for receptors along the proposed haul routes.

In addition, some construction traffic will utilise the local Rossnaree Road from the section between the N2 to the proposed site accesses to the works to the south and to the River Boyne bridge construction site. As a worst-case scenario, some 310 HGVs and 90 passenger cars will utilise this section of the Rossnaree Road between the N2 and the site access points.

The impact of this construction traffic on the residential property located closest to each haul route (i.e. the worst affected receptor) is presented in **Table 10-34**. This worst affected receptor on each route will experience an increase in ambient air quality levels as a result of the construction traffic ranging from a 2% increase to a 9% increase. This data includes the current background levels in the area as well as the contribution from road traffic.

The results indicate that for the N2 Haul Route to the south, the baseline levels of air pollution at the worst affected property are well below all statutory guidelines. However, the baseline levels are only marginally below the WHO guidelines for NO_x (95%) and PM_{10} (93%) and above the guideline for $PM_{2.5}$ (184%) suggesting that this property is currently experiencing poor air quality.

With the additional construction traffic, the levels increase by 2-5% but remain well below the statutory limits for the protection of human health. As per the baseline, the levels with construction are only marginally below the WHO guidelines for NO_x (99%) and PM_{10} (94%) and above the guideline for $PM_{2.5}$ (187%) suggesting that this property will continue to experience poor air quality during the construction phase.

Using the descriptors in **Table 10-6** and

Table 10-7 the following classification of impact for this property may be established:

- For NO_x a 5% increase in levels with the long-term average concentration at 95 – 102% of AQLV (in this case using the WHO Guidelines), the impact is classed as moderate.
- For PM_{10} a 2% increase in levels with the long-term average concentration at 76 – 94% of AQLV (WHO Guidelines), the impact is classed as slight.
- For $PM_{2.5}$ a 3% increase in levels with the long-term average concentration already >110% of AQLV (WHO Guidelines), the impact is classed as substantial.

For the N51 Haul Route to the north towards the east of Slane, the predicted baseline levels are similar and while well below the statutory limits are only marginally below the WHO guidelines. However, baseline levels are lower than on the N2 haul route given the lower existing traffic volumes on the route. The baseline levels for NO_x (79%) and PM_{10} (88%) are below while the levels for $PM_{2.5}$ (175%) are above the guideline suggesting that this property is currently experiencing poor air quality.

With the additional construction traffic, the levels increase by 2-7% but remain well below the statutory limits for the protection of human health. As per the baseline, the levels with construction are marginally below the WHO guidelines for NO_x (86%) and PM_{10} (90%) and above the guideline for $PM_{2.5}$ (179%) suggesting that this property will continue to experience poor air quality during the construction phase.

Using the descriptors in **Table 10-6** and

Table 10-7 the following classification of impact for this property may be established:

- For NO_x an 11% increase in levels with the long-term average concentration at 76 – 94% of AQLV, the impact is classed as moderate.
- For PM_{10} a 2% increase in levels with the long-term average concentration at 76 – 94% of AQLV (WHO Guidelines), the impact is classed as slight.
- For $PM_{2.5}$ a 4% increase in levels with the long-term average concentration already >110% of AQLV (WHO Guidelines), the impact is classed as substantial.

Currently, the traffic on the Rossnaree Road is limited with a low resultant DM impact. With the additional construction traffic, the levels increase by 2-9% but remain well below the statutory limits for the protection of human health. The levels with construction are below the WHO guidelines for NO_x (71%) and PM_{10} (82%) and above the guideline for $PM_{2.5}$ (164%) suggesting that this property will continue to experience poor air quality during the construction phase.

Using the descriptors in **Table 10-6** and

Table 10-7 the following classification of impact for this property may be established:

- For NO_x an 9% increase in levels with the long-term average concentration at 75% or less of AQLV, the impact is classed as slight.
- For PM_{10} a 2% increase in levels with the long-term average concentration at 76 – 94% of AQLV (WHO Guidelines), the impact is classed as slight.
- For $PM_{2.5}$ a 4% increase in levels with the long-term average concentration already >110% of AQLV (WHO Guidelines), the impact is classed as substantial.

In summary, the baseline levels of air pollution from current road traffic on the proposed haul routes is high relative to the WHO guidelines and these levels will increase slightly with construction traffic. By employing the WHO Guidelines as the assessment criteria for construction traffic, the analysis indicates that the construction traffic will have an impact that ranges from slight (for PM_{10}) to moderate (for NO_x) to substantial (for $PM_{2.5}$) impact for the residential receptors closest to the haul routes.

Receptors located further way from the haul routes will experience impacts lower than those presented in **Table 10-34**.In summary, construction traffic is predicted to have a **moderate adverse** impact on air quality for the short-term duration of material haulage.

Table 10-34: Local Impact to Air Quality as a result of Construction Traffic

Property Group	Scenarios	Nitrogen Dioxide (µg/m³)	Particulate Matter µg/m³	
		Annual Average NO_2	Annual Average PM_{10}	Annual Average $PM_{2.5}$
Background		5	12	8
N2 Haul Route	2019 Baseline	9.45	13.89	9.22
	+ Construction Traffic	9.92	14.13	9.37
	% Change relative to AQLV	+5%	+2%	+3%
	Quality of Effect	Moderate	Slight	Substantial
N51 Haul Route	2019 Baseline	7.94	13.19	8.77
	+ Construction Traffic	8.60	13.47	8.95
	% Change relative to AQLV	+7%	+2%	+4%
	Quality of Effect	Moderate	Slight	Substantial
Rossnaree Road	2019 Baseline	6.11	12.05	8.03
	+ Construction Traffic	7.06	12.33	8.22
	% Change relative to AQLV	9%	2%	4%
	Quality of Effect	Slight	Slight	Substantial
Statutory Limits		40	40	25
WHO Guidelines		10	15	5
Positive	Neutral	Slight	Moderate	Substantial

10.4.1.3 Construction Plant Emissions

The full list of estimated plant for each of the phases on the mainline, main bridge over the Boyne, other overbridges and the public realm have been compiled in collaboration with the design team and the acoustics team.

Fuel efficiency data has been collated from plant specifications and industry standards. Normal working times will be 07.00 to 19.00 hours Monday to Friday and 08.00 to 16.30 hours on Saturdays (68.5 hours per week) and the total fuel use is assumed at 68.5 hours per week for the duration of the phase of works. Note that this is highly conservative as plant operation is more typically intermittent, but a conservative approach is adopted in line with the precautionary principle. Fuel use throughout is assumed to be diesel fuel and the total estimated use for the duration of the works is 2,199 m³.

Emissions to atmosphere from this diesel combustion have been quantified using the European Environment Agency EMEP/EEA air pollutant emission inventory guidebook 2019. Specifically, Section 1.A.4 on non-road mobile machinery has been employed to define the potential emissions and the results of this analysis are shown in **Table 10-35**. These figures represent the total emissions for the duration of the construction phase from diesel use across all aspects of the construction phase.

Table 10-35: Construction Plant Emissions

Pollutant	Total Emissions (tonnes)	Fraction of Irelands National Emissions Ceiling for 2030 (%)
Ammonia	0.01	0.00%
Non-Methane Volatile Organic Compounds	6.31	0.01%
Oxides of Nitrogen (NO_x)	60.99	0.15%
Particulate Matter PM_{10}	3.93	NA

Particulate Matter $PM_{2.5}$	3.93	0.04%
Total Suspended Particulates	3.93	NA

When the results of the construction phase are compared to the National Emissions Ceilings in **Table 10-5** (where ceilings exist for pollutants), the levels are negligible for ammonia and of the order of 0.01 to 0.15% for other pollutants. Oxides of Nitrogen represent the highest fraction of any pollutant but the levels are of minor significance when compared to the emissions ceilings.

As such, the emissions from diesel use during the construction phase are considered a **minor adverse in the shoer term**.

10.4.2 Operational Phase

The predicted traffic volumes are outlined in **Chapter 7 – Traffic and Transport**. The main impact activity is operational traffic and its potential to impact on individual properties, in the local area, nationally and identified sensitive ecosystems in the area.

10.4.2.1 Potential Air Quality Impact of Operational Phase (National Impact)

Road traffic predictions with the Proposed Scheme in operation have been modelled and are summarised in **Chapter 7**. These predicted changes in traffic have been employed to estimate the future generation of transport related national air pollutants. The predicted emissions for operational traffic under the following scenarios are presented in **Table 10-36**:

- 2026 Do-Something i.e. opening year with the Proposed Scheme in 2026; and
- 2041 Do-Something i.e. design year with the Proposed Scheme in 2041.

The results of both scenarios are presented for each of the three REM scenarios depending on climate policy intervention. Like the Do-Minimum Scenario (**Table 10-27**) the CAP Scenario is only marginally (2%) below the BaU scenario in 2026 but more significantly lower (15%) in 2026 with greater time for CAP implementation.

When the Do-Something predictions for each scenario in each year are compared with the corresponding Do-Minimum scenarios (**Table 10-27**) there is negligible change in total emissions. These results suggest that the Proposed Scheme will not increase or decrease traffic on the road network but will redistribute traffic around the network with no net change in impact over the Do-Minimum impact.

Employing the significance criteria in **Table 10-6**, this is considered a **neutral** impact to national air quality.

Table 10-36: Predicted Annual Pollutant Emissions from Road Transport from the Proposed Scheme

Pollutant	Scenario	BaU Scenario (tonnes)	Intermediate Scenario (tonnes)	CAP Scenario (tonnes)
Oxides of Nitrogen (NO_x)	Do-Something 2026	1,945	1,916	1,854
	Change relative to 2026DM (%)	**0%**	**0%**	**0%**
	Do-Something 2041	1,088	857	671
	Change relative to 2041DM (%)	**0%**	**0%**	**0%**
Particulate Matter PM_{10}	Do-Something 2026	186	186	186
	Change relative to 2026DM (%)	**0%**	**0%**	**0%**
	Do-Something 2041	215	213	211
	Change relative to 2041DM (%)	**0%**	**0%**	**0%**
Particulate Matter $PM_{2.5}$	Do-Something 2026	110	110	109
	Change relative to 2026DM (%)	**0%**	**0%**	**0%**
	Do-Something 2041	125	122	121
	Change relative to 2041DM (%)	**0%**	**0%**	**0%**

10.4.2.2 Index of Overall Change in Exposure

The index of Overall Change in Exposure is undertaken to compare the overall impact on people for each of the Do-Minimum and Do-Something options. The Index is based on identifying the number of sensitive receptor locations within 50 m of the carriageway for all road links with a significant change in traffic for each of the options.

Road traffic predictions with the Proposed Scheme in operation have been modelled and are summarised in **Chapter 7**. These predicted changes in traffic have been employed to estimate the change in the index of overall exposure to traffic pollution, i.e. whether the Proposed Scheme will have a net reduction or increase on the number of the population exposure to air pollution. The predicted emissions for operational traffic under the 2026 Do-Minimum and Do-Something scenarios are presented in **Table 10-37** for the Business as Usual emissions scenario.

The results indicate an overall negative NO_x index which represents a net reduction in the population exposure to road traffic pollution. In other words, by diverting the road traffic source away from the high population density area of Slane village, there is a net reduction in exposure to pollution which is positive for air quality.

Currently there are 98 properties within 50 m of the existing N2 alignment through Slane that are subject to road traffic pollution. With the Proposed Scheme in operation this will decrease to 14 between the same points resulting in a net benefit for 84 properties and a potential net adverse for 14 properties (addressed in **Section 10.4.2.3**).

Employing the significance criteria in **Table 10-6**, this overall reduction in exposure to road traffic is considered a **positive** impact to air quality pollution in the Slane area.

Table 10-37: Index of Overall Change in Exposure for NO_x in 2026

Link Name	Properties <50m	Link Length (km)	NO_x DM (kg/yr)	NO_x DS (kg/yr)	Change in Emissions (kg/yr)	Changes in NO_x Emission Rate (kg/km/yr)	NO_x Index
3124	0	0.276	3248	201	-3,047	-11,027	0
3126	4	0.290	3248	201	-3,047	-10,508	-42,028
3186	5	0.497	2168	163	-2,005	-4,034	-20,171
3187	4	0.363	2137	807	-1,330	-3,667	-14,656
3188	6	0.698	2137	2727	590	846	5,072
3236	3	0.399	2168	3311	1,143	2,865	8,594
3311	13	0.286	2336	163	-2,173	-7,609	-98,773
3312	0	0.413	2448	174	-2,274	-5,503	0
3313	12	0.142	2336	163	-2,173	-15,285	-183,634
3314	1	0.125	2353	807	-1,546	-12,400	-12,368
3315	7	0.205	2465	865	-1,600	-7,823	-54,634
3316	9	0.212	3388	900	-2,488	-11,738	-105,623
3317	1	0.142	3388	900	-2,488	-17,527	-17,521
3432	5	0.239	3172	180	-2,992	-12,498	-62,594
3454	3	0.195	3788	180	-3,608	-18,519	-55,508
3457	25	0.133	3788	672	-3,116	-23,470	-585,714
3226	0	1.275	0	3013	3,013	2,363	0
3227	5	2.228	0	3495	3,495	1,569	7,843
Total							-1,215,295

10.4.2.3 Potential Air Quality Impact of Operational Phase (Local Impact)

As noted in **Section 10.4.2.2**, there are 84 properties along the existing N2 that will experience a net reduction in road traffic pollution with the Proposed Scheme in operation. This is a direct result of reducing the circa 8,000 vehicles that pass through this route per day down to circa 2,000 vehicles per day.

Conversely, there are five properties located along the alignment of the Proposed Scheme that currently experience background levels of air quality with no direct impact from road traffic. These properties may potentially experience a net increase in air pollution levels as a result of the increased proximity to the new alignment.

There are a further nine properties located on the existing N2 to the south and north of the proposed roundabouts for the tie in of the Proposed Scheme alignment. These properties will continue to experience road traffic pollution as per the baseline but experience some level of change associated with traffic volumes and proximity to the road.

Finally, there are a series of sensitive receptors located along the existing N51 east and west of the roundabout for the proposed N2 alignment that may experience changes in traffic volumes and/or road alignment that may result in impacts to air quality.

The REM model has been employed to quantify these changes for each of the above receptor groups. Road traffic during the operational phase mainly relates to vehicles utilising the Proposed Scheme and these traffic volumes have been quantified in **Chapter 7 – Traffic and Transport**. This chapter also includes an assessment of the baseline levels of traffic on the existing road network. Projected traffic figures associated with the Proposed Scheme at key junctions and links as identified in the traffic and transport assessment were used to predict the concentrations of traffic-derived pollutants in baseline and future years. The REM model combines background concentrations of pollutants sourced from the EPA baseline data presented in the baseline description.

The parameters assessed were NO_2, PM_{10} and $PM_{2.5}$ which are the pollutants of most concern with regard to road traffic emissions and the WHO Guidelines. The potential impact on air quality is assessed for the design year (2041) for the following scenarios:

- 'Do-Minimum' (DM) – This scenario is taken to be the base year network with the addition of committed road schemes as follows:
  - The N52 is a national secondary road which forms an important cross-country route, connecting the Midlands area to the Dundalk and the main M1 route to Belfast. This scenario takes account of the N52 Ardee Bypass, which is an improvement to the strategic road network that is planned to be built by the opening year whether or not the Slane Bypass goes ahead. Therefore, changes have been addressed by adding the Ardee scheme to the Do-Minimum network analysis.
  - Improvements are ongoing to the N51 at Dunmoe, between Slane and Navan. Once this relatively minor on-line improvement scheme is completed, it is proposed to raise the speed limit on this section of the N51 from 80 km/h to 100 km/h.
- 'Do-Scheme' (DS) – The Do-Scheme scenario models the Proposed Scheme as a high-quality dual-carriageway road, with free-flow speeds of 100 km/h for all vehicles.

Pollutant concentrations have been provided at the worst-case receptors i.e. those properties that are closest to the affected links and likely to experience the worst case impacts. The receptor references applied for this analysis are analogous to those employed in **Chapter 9 – Noise and Vibration** and presented in **Figure 9.4**. The following receptors have been assessed using the REM tool:

- **R760** which is a residential property on the existing N2 to the south of Slane at McGruder's Cross. This receptor is chosen to represent the properties on the existing N2 alignment south of the offline section. These properties will continue to experience road traffic impacts under both DM and DS scenarios.
- **R731** which is a residential property on the existing N2 to the south of Slane north of the proposed offline alignment. This receptor is chosen to represent the properties on the existing N2 alignment north of the offline section. These properties should experience reduced road traffic impacts under DS scenario.
- **R988** which is a residential property on the existing N2 in Slane north of the bridge. This receptor is chosen to represent the properties on the existing N2 alignment south of the N51 in Slane. These properties should experience reduced road traffic impacts under DS scenario.

- **R899** which is a residential property on the existing N2 in Chapel Street in Slane north of the junction with the N51. This receptor is chosen to represent the properties on Chapel Street. These properties should experience reduced road traffic impacts under DS scenario.
- **R55** which is St Patricks National School. This property should experience reduced road traffic impacts under DS scenario.
- **R1050** which is a residential property on the existing N2 to the north of Slane. This receptor is chosen to represent the properties on the existing N2 alignment north of the offline section after the point where the alignment re-joins the existing N2. These properties will continue to experience road traffic impacts under both DM and DS scenarios.
- **R941** which is a residential property on the existing N51 east of the proposed junction with the N2 alignment. This receptor is chosen to represent the properties on the existing N51 alignment which will continue to experience impacts from the N51 as well as additional impact from the proposed N2.
- **R1064** which is a residential property on the existing N51 west of the junction with the proposed N2 alignment. This receptor is chosen to represent the properties on the existing N51 alignment which will continue to experience impacts from the N51 as well as additional impact from the proposed N2.
- **R696** which is a residential property on the Rossnaree Road which lies in close proximity to the proposed N2 alignment. This receptor is chosen to represent the properties on the Rosnaree Road which will experience impacts from the proposed N2 alignment.
- **R940** which is a residential property located away from all existing roads but adjacent to the alignment of the proposed N2 north of the Boyne and will experience impacts from the proposed N2 alignment.

The sensitive receptors are displayed in **Figure 10.3** and the results of the analyses for these receptors are presented in **Table 10-38** for NO_2, **Table 10-39** for PM_{10} and **Table 10-40** for $PM_{2.5}$. In all cases the % Change relative to the Air Quality Limit Values (AQLV) have been compared against the WHO guidelines (**Table 10-4**) rather that the statutory limits (**Table 10-3**) to ensure a robust assessment. The significance of the impact is then presented relative to the TII criteria in **Table 10-6** and

Table 10-7.

For NO_2 the data shows significant reductions in ambient air quality levels with the Do-Something scenario on the existing N2 to the north, south and through Slane village (R731, R988, R899 and R55). As noted there are 84 receptors within 50 m of this road that will experience these reductions and a net positive impact for air quality in the long-term.

The properties along the existing N2 north and south of the offline sections (R760 and R1050) will experience slight increases in levels of traffic pollution as a result of the Proposed Scheme given the slight increase in volumes of traffic on the road. These increases in air pollution levels are classed as neutral to slight adverse in the long-term.

Similarly, the properties along the existing N51 (R941 and R1064) will experience an increase in air pollution as a result of the proposed scheme and this ranges from a neutral to slight adverse impact in the long term.

For the two representative properties that are located close to the proposed N2 alignment, both properties are expected to experience increases in traffic pollution as a result of the scheme and this would be similar for all five properties located within 50 metres of the proposed alignment. These properties will experience a slight to moderate adverse impact in the long term from road traffic.

It is noted that for both the DM and DS scenarios, the levels of NO_2 are predicted to remain below both the WHO Guidelines and the current statutory limits for the protection of human health. This is true for each of the BaU, Intermediate and CAP scenarios and as expected, the CAP scenario presents the lowest emission future scenario.

For Particulate Matter PM_{10}, the levels show a largely identical trend to that for NO_2 with a positive impact for the properties within Slane village that benefit from the proposed offline sections. For the properties north/ south of the offline alignment, on the N51 and on the proposed offline section, the air quality impact is predicted to range from slight to moderate adverse in the long term. Again, levels remain below the current statutory limit and marginally below the WHO guideline for all 2041 scenarios.

For Particulate Matter $PM_{2.5}$, the background levels in the area are high (8 µg/m^3) which is above the WHO guideline (5 µg/m^3) and, as such, any significant increase is considered substantial. Like the other pollutants, the levels of $PM_{2.5}$ within Slane village will decrease with the Proposed Scheme while properties north/ south of the offline alignment, on the N51 and on the proposed offline section will experience an increase in levels. Given the high background, these increases are classed as substantial adverse in the long term.

In short, the proposed scheme will lead to a net positive long term air quality impact for circa 84 properties that are currently located within 50 m of the existing N2. For properties north/south of the offline alignment, on the N51 and on the proposed offline section the potential impact to air quality ranges from negligible to substantial depending on the receptor and pollutant.

Table 10-38: Local Impact to Air Quality as a result of Operational Traffic – Nitrogen Dioxide (NO_2) in 2041 Opening Year

Receptor	Business as Usual			Intermediate			Climate Action Plan		
	Do-Minimum	Do-Something	% Change relative to AQLV	Do-Minimum	Do-Something	% Change relative to AQLV	Do-Minimum	Do-Something	% Change relative to AQLV
Background					6				
R760	6.95	7.57	6%	6.77	7.28	5%	6.63	7.03	4%
R731	7.31	6.13	-12%	7.07	6.1	-10%	6.87	6.08	-8%
R988	8.29	6.17	-21%	7.90	6.12	-18%	7.59	6.09	-15%
R899	8.71	6.55	-22%	8.22	6.40	-18%	7.84	6.29	-16%
R55	7.33	6.35	-10%	7.09	6.27	-8%	6.91	6.20	-7%
R1050	7.00	7.32	3%	6.81	7.07	3%	6.66	6.87	2%
R941	7.11	7.38	3%	6.87	7.09	2%	6.69	6.85	2%
R1064	7.19	7.70	5%	6.92	7.38	5%	6.70	7.12	4%
R696	6.00	7.22	12%	6.00	6.98	10%	6.00	6.78	8%
R940	6.00	6.95	10%	6.00	6.76	8%	6.00	6.61	6%
Statutory Limit (Annual Limit for Protection of Human Health)					**40**				
WHO Air Quality Guideline (AQG)					**10**				
Positive	**Neutral**		**Slight**		**Moderate**		**Substantial**		

Table 10-39: Local Impact to Air Quality as a result of Operational Traffic – Particulate Matter PM_{10} in 2041 Opening Year

Receptor	Business as Usual			Intermediate			Climate Action Plan		
	Do-Minimum	Do-Something	% Change relative to AQLV	Do-Minimum	Do-Something	% Change relative to AQLV	Do-Minimum	Do-Something	% Change relative to AQLV
Background	12								
R760	13.62	14.51	6%	13.61	14.49	6%	13.61	14.48	6%
R731	14.24	12.13	-14%	14.23	12.13	-14%	14.22	12.13	-14%
R988	14.35	12.14	-15%	14.32	12.14	-15%	14.40	12.13	-15%
R899	14.73	12.41	-15%	14.69	12.40	-15%	14.66	12.39	-15%
R55	13.34	12.32	-7%	13.32	12.31	-7%	13.31	12.31	-7%
R1050	13.65	14.15	3%	13.68	14.14	3%	13.67	14.13	3%
R941	13.40	13.73	2%	13.38	13.71	2%	13.37	13.69	2%
R1064	13.39	14.42	7%	13.37	14.40	7%	13.36	14.39	7%
R696	12.00	13.80	12%	12.00	13.79	12%	12.00	13.79	12%
R940	12.00	13.40	9%	12.00	13.40	9%	12.00	13.39	9%
Statutory Limit (Annual Limit for Protection of Human Health)	**40**								
WHO Air Quality Guideline (AQG)	**15**								

Positive	Neutral	Slight	Moderate	Substantial

Table 10-40: Local Impact to Air Quality as a result of Operational Traffic – Particulate Matter $PM_{2.5}$ in 2041 Opening Year

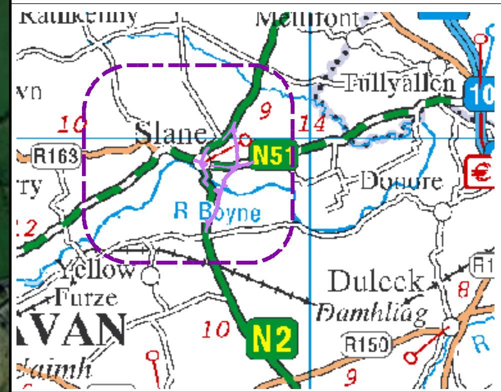
Receptor	Business as Usual			Intermediate			Climate Action Plan		
	Do-Minimum	Do-Something	% Change relative to AQLV	Do-Minimum	Do-Something	% Change relative to AQLV	Do-Minimum	Do-Something	% Change relative to AQLV
Background	8								
R760	8.92	9.44	10%	8.92	9.42	10%	8.91	9.41	10%
R731	9.28	8.08	-24%	9.27	8.08	-24%	9.26	8.08	-24%
R988	9.37	8.08	-26%	9.34	8.08	-25%	9.32	8.08	-25%
R899	9.60	8.25	-27%	9.56	8.24	-26%	9.53	8.23	-26%
R55	8.78	8.19	-12%	8.76	8.18	-12%	8.75	8.18	-11%
R1050	8.96	9.23	5%	8.95	9.22	5%	8.95	9.21	5%
R941	8.81	9.00	4%	8.79	8.98	4%	8.78	8.97	4%
R1064	8.81	9.40	12%	8.79	9.37	12%	8.78	9.36	12%
R696	8.00	9.03	21%	8.00	9.02	20%	8.00	9.02	20%
R940	8.00	8.80	16%	8.00	8.80	16%	8.00	8.79	16%
Statutory Limit (Annual Limit for Protection of Human Health)	**25**								
WHO Air Quality Guideline (AQG)	**5**								

Positive	Neutral	Slight	Moderate	Substantial

Legend

- Proposed Scheme
- Proposed Scheme Boundary
- Sensitive Receptors

0 0.125 0.25 0.5
Kilometres



Client

Meath County Council

N2 Slane Bypass and Public Realm Enhancement Scheme

Title

Figure 10.3

Sensitive Receptors

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Issue Details

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10.4.2.4 Impact on Sensitive Ecosystems

The principal pollutants of concern which originate from road developments are the NO_x in terms of impact on sensitive ecosystems. Nitrogen oxides may have a positive or negative impact by acting as a fertiliser or a phytotoxicant. Effects are mainly on vegetation growth, photosynthesis, and nitrogen assimilation or metabolism.

As outlined in **Section 10.3.1.6**, the proposed route traverses across the River Boyne and River Blackwater SAC and SPA and is adjacent to two proposed Natural Heritage Areas.

Alkaline fens were identified as the qualifying interest for the SAC with sensitivity to nitrogen deposition. The '*Review and revision of empirical critical loads of nitrogen for Europe*' (German Environment Agency, 2022) provides a 2022 critical load for alkaline fens as the range 15-25 kg/ha/year.

Given the ecological sensitivity of the ecosystems in the vicinity of the proposed route, a nitrogen deposition assessment was undertaken under the current road network and the proposed road network. Traffic data for the 2041 Business as Usual DM and DS scenarios were used to inform this assessment. **Table 10-41** presents the results in terms of nitrogen deposition on the Alkaline fens at River Boyne and River Blackwater SAC and at the proposed Natural Heritage Areas.

Table 10-41: Predictions of Nitrogen Deposition at Sensitive Ecosystems in 2041

Designated Site	Scenario	Road Nitrogen Dioxide (µg/m^3)	Nutrient Nitrogen Deposition (kg/ha/year)	Acid Deposition (kg/ha/year)
River Boyne and River Blackwater SPA/SAC	DM	2.31	0.32	0.02
	DS	2.50	0.35	0.03
	% of Critical Load (15kg/ha/year)		**0.3%**	
Boyne Woods pNHA	DM	2.31	0.67	0.05
	DS	0.26	0.08	0.01
	% of Critical Load (15kg/ha/year)		**-4.2%**	
Slane Riverbank pNHA	DM	2.31	0.32	0.02
	DS	0.17	0.02	0
	% of Critical Load (15kg/ha/year)		**-2.1%**	

Under the Do-Minimum scenario, the SAC/SPA continues to be crossed via the existing single lane bridge in Slane village whereas under the Do-Scheme scenario, a second bridge is provided to the east of the village to accommodate the new alignment. This results in a slight increase (0.04 kg/ha/year) in nutrient and acid deposition on the SAC/SPA and the on the Alkaline fens given the impact of both bridges combined.

This increase equates to 0.3% of the lower end of the range for Critical Load for Alkaline Fens (15 kg/ha/year). Employing the TII significance criteria in **Table 10-8**, once the total N deposition and acid deposition are less than 1% of the critical load, this not considered to be a significant impact on these ecological receptors. As such, the impact from traffic emissions on these ecological receptors is considered negligible.

There is a net decrease in emissions for the two proposed Natural Heritage Areas as the alignment moves traffic further from these ecological sites.

Further details of the predicted impacts to sensitive ecosystems are presented in **Chapter 15 – Biodiversity: Terrestrial Ecology** and **Chapter 16 – Biodiversity: Aquatic Ecology** of the EIAR.

10.4.3 Cumulative Impact

A cumulative impact assessment (CIA) has been undertaken to consider potential for cumulative impact of the Proposed Scheme with other approved development. The detailed methodology for the CIA is described in **Chapter 25 – Cumulative Effects**. The assessment has considered cumulative sources and impact pathways which could impact on air quality.

The projects listed in **Appendix 25.2** have been assessed. Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/ temporal scales involved. Projects were screened-in to the CIA where located within the zone of influence (ZoI) of the Proposed Scheme or where projects have the scope to potentially alter the traffic volumes and/or flows assessed in this chapter for determination of air quality impact. The projects that were screened-in to the Air Quality CIA are listed in **Table 10-42**.

Table 10-42: Projects Screened-in for Potential Cumulative Effects on Air Quality

Project Code	Project Location	Project Type	Potential for Cumulative Effect
PR 1	Stanley Hill, Slane, Co. Meath	Wastewater Treatment Tank	Potential pathway for air quality effects during construction phase – within 500 m of the ZoI for the Proposed Scheme
PR 2	Millhouse, Slane, Co. Meath	Restaurant	
PR 3	Ledwidge Hall, Drogheda Road, Slane, Co. Meath *(now constructed)*	Residential Development	
PR 4	Ledwidge Hall Green, Drogheda Road, Slane, Co. Meath *(now constructed)*	Residential Development	
PR 5	Former Parochial House, The Square, and adjacent Art Gallery, Main Street, Slane, Co. Meath	Commercial Building	
PR 6	Conyngham Arms Hotel, Main Street, Slane, Co. Meath	Hotel	
PR 12	Mullaghdillon, Slane, Co. Meath	Quarry	Potential – construction phase HGV movements
PR 13	Harlinstown, Slane, Co. Meath	Road Works	Potential – construction phase traffic disruption from the proposed road works
PR 55	N52 Ardee Bypass, Ardee, Co Louth	Road Works	Potential – proposed road scheme

For projects PR 1 to PR 6, to ensure a robust assessment, the ZoI for the construction phase dust impacts was set at 500 m from the temporary land take boundary of the Proposed Scheme. Each of these projects, while modest in scale, lie within the ZoI and therefore have potential for cumulative adverse dust impact during construction. Impacts may be increased dust if works are undertaken simultaneously or elongation of impact if works are undertaken concurrently along with the Proposed Scheme. However, with the proposed mitigation outlined for the Proposed Scheme, the potential for significant cumulative adverse dust effects are unlikely and not significant.

For PR 12, this project is located approx. 2.5 km from the Proposed Scheme and outside of the Proposed Scheme's dust ZoI. However, as the project lies to the north-east of Slane, traffic from this project will likely use the N2 and N51 as haul routes. Permission for the project is restricted to up to six truck movements per day (Condition 3) and expires in three years (Condition 2), so the project is likely to be closed before the Proposed Scheme is operational. Therefore there is no potential for cumulative adverse impact for air quality.

PR 13 comprises modest road works with potential for some traffic disruption caused by installation of underpass section of the project. However, this is considered short-term and not likely to cause significant adverse cumulative impact with the Proposed Scheme.

PR 55 lies approx. 15 km to the north of the Proposed Scheme and entails the construction of a single carriageway road for a distance of 4.5 km. During the operational phase, the routing of two national roads (N2 and N52) away from residential areas with both PR 55 and the Proposed Scheme will increased average speeds to reduce congestion, resulting in a net positive cumulative impact for air quality.

10.5 Mitigation Measures

10.5.1 Construction Phase

10.5.1.1 Construction Dust

Dust mitigation measures are based upon the industry guidelines in the Building Research Establishment (BRE) document entitled ‘Control of Dust from Construction and Demolition Activities’. Measures to be implemented on the Proposed Scheme to avoid, prevent or reduce and, if possible, offset likely significant adverse effects are as follows:

- A Dust Minimisation Plan shall be prepared by the contractor in advance of construction works commencing on-site. The Dust Minimisation Plan shall include details of a monitoring regime using standard Bergerhoff gauges (to VDI standard) at a series of locations that are identified based on potential risk of dust nuisance (see **Section 10.7.1** for further details of monitoring).
- The contractor shall be required to maintain monthly dust levels below the guideline of 350 mg/m^2/day (for non-hazardous dusts) as an annual average at sensitive receptors. Where dust levels are measured to be above this guideline the mitigation measures in the area will be reviewed and improved to ensure that dust deposition is reduced to below 350 mg/m^2/day.
- Site roads shall be regularly cleaned and maintained as appropriate. Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic only.
- Any site roads with the potential to give rise to dust shall be regularly watered, as appropriate, during dry and/or windy conditions (also applies to vehicles delivering material with dust potential).
- All vehicles exiting the site shall make use of a wheel wash facility prior to entering onto public roads, to ensure mud, dust and other materials are not tracked onto public roads.
- Wheel washes shall be self-contained systems that do not require discharge of the wastewater to water bodies.
- Public roads outside the site shall be regularly inspected for cleanliness and cleaned as necessary.
- The focus of the control procedures relating to emissions to air during earth moving and construction shall be to reduce the generation of airborne material.
- Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind.
- All rock processing, crushing and screening undertaken at the Southern Stockpile will be in accordance with the procedures presented in the UK Process Guidance Note 3/16(12) Statutory guidance for mobile crushing and screening.
- Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.
- All vehicles which present a risk of spillage of materials, while either delivering or removing materials, will be loaded in such a way as to prevent spillage on to the public road.
- All vehicles will be suitably maintained to ensure that emissions of engine generated pollutants is kept to a minimum.

With the implementation of the above measures and monitoring during construction, it is expected that the levels of dust generated will be minimal and are unlikely to cause an environmental nuisance.

10.5.1.2 Construction Traffic

Mitigation of road traffic emissions are mainly achieved through application of EU legislation which promotes improvements in fuel and engine technology resulting in a gradually reducing emissions per vehicle profile. The collection of EU Directives, known as the Auto Oil Programme, have outlined improved emission criteria which manufacturers are required to achieve from vehicles produced in the past and in future years. This is a trend which has been in operation for many years and is destined to continue in future years for both cars and heavy-duty vehicles.

The following additional mitigation is proposed in relation to construction traffic management for the proposed road development:

- A Traffic Management Plan shall be prepared by the contractor to deliver the mitigation measures outlined in **Chapters 5** and **7** of this EIAR on a location-specific basis by the appointed contractor(s) in advance of the works commencing on-site.
- A designated delivery route shall be used for all materials to/from the site for all drivers, as overseen by the PSCS to be appointed by MCC.
- The use of low emissions vehicles within the haulage fleet will be included within the Contract Documents.
- The use of private vehicles by construction staff to access the site will be minimised through the encouragement of use of public transport, encouragement of car sharing, and maximising use of local labour to reduce transport emissions. To implement this, the contractor shall prepare a Mobility Management Plan for site staff.

10.5.1.3 Construction Plant

To reduce emissions from compounds a mobile plant the following mitigation is recommended:

- For electricity generation at the construction compounds, hydrogen generators or electrified plant shall be utilised over traditional diesel generators. This should also apply to lower powered mobile plant as appropriate.
- A regular maintenance schedule for all construction plant machinery shall be undertaken to maintain optimum machinery efficiency.
- Engines will be turned off when machinery is not in use.

10.5.2 Operational Phase

As noted earlier in this chapter, reduction of road traffic emissions is mainly driven by legislation and improved criteria focussed on improvements in fuel and engine technology which in tuns results in a gradually reducing emissions profile. This is a trend which has been in operation for many years and is projected to continue in future years for both cars and heavy goods vehicles. The introduction of the National Car Test (NCT) and Commercial Vehicle Roadworthiness Test. (CVRT) in Ireland has also helped to reduce transport emissions by ensuring that all vehicles on Irish roads over four years old undergo an emissions test.

No scheme specific mitigation measures have been identified but emissions of pollutants from road traffic will be controlled by either controlling the number of road users or by controlling the flow of traffic. For the majority of vehicle-generated pollutants, emissions rise as speed drops, although the opposite is true at very high speeds (i.e. speeds greater than 120 km/h). Emissions also tend to be higher under stop-start conditions when compared with steady speed driving. The free flow of traffic on the proposed bypass, as well as giving priority to the east-west traffic through Slane village as part of the public realm enhancement proposals, would allow for the generation of lower concentrations of traffic-related pollutants due to more steady speed driving.

10.6 Residual Impacts

Residual impacts are assessed for the construction and operational phases of the proposed road development.

10.6.1 Construction Phase

With the implementation of the mitigation measures outlined in **Section 10.5.1** alongside monthly dust monitoring during the construction phase (see **Section 10.7.1**) the residual impact to the properties within 100 m of the proposed work areas (mainline works, construction compounds and stockpile areas) is predicted to be '**Slight Adverse**'. The residual impact on dwellings >100 m from the proposed works is considered '**Imperceptible**'.

Construction traffic on the proposed haul routes is predicted to have a '**Moderate Adverse**' impact on air quality for properties adjacent to the haul route for the short-term duration of material haulage.

The residual air quality impact from diesel use in mobile plant during the construction phase are considered a **'Minor Adverse'** impact in the short term.

10.6.2 Operational Phase

The proposed scheme will lead to a net '**Positive**' long term air quality impact for circa 84 properties that are currently located within 50 metres of the existing N2. For properties north/south of the offline alignment, on the N51 and on the proposed offline section the potential impact to air quality ranges from '**Negligible to Substantial Adverse**' depending on the receptor and pollutant.

10.7 Monitoring

10.7.1 Construction Phase

Monthly monitoring of dust deposition levels shall be undertaken by the contractor for the duration of construction for comparison with the guideline of 350 mg/m^2/day (for non-hazardous dusts). This monitoring shall be carried out at a minimum of three locations at each construction compound in each section and further monitoring locations at sensitive receptors around the proposed works. The additional locations will be at any residential receptor area within 100 m of the proposed works areas.

Where dust levels are measured to be above the guideline of 350 mg/m^2/day, the mitigation measures in the area shall be reviewed and improved to ensure that dust deposition is reduced to below 350 mg/m^2/day. Should high dust levels continue to occur following these improvements, the contractor shall provide alternative mitigation measures and/or will modify the construction works taking place.

10.7.2 Operational Phase

No operational phase monitoring is proposed.

10.8 Chapter References

DECC (2023) Clean Air Strategy for Ireland.

DEFRA (2012) Process Guidance Note 3/16(12) Statutory guidance for mobile crushing and screening.

EPA (2022a) Air Quality in Ireland 2021 – Indicators of Air Quality.

EPA (2022b) Air Quality Report 2021 – Supplemental information.

EPA (2021a) Ireland's Air Pollutant Emissions 1990-2030.

EPA (2021b) Air Quality in Ireland 2020 – Indicators of Air Quality.

EPA (2021c) Air Quality Report 2020 – Supplemental information.

EPA (2020a) Air Quality in Ireland 2019 – Indicators of Air Quality.

EPA (2020b) Air Quality in Ireland 2019 – Supplemental information.

EPA (2019a) Air Quality in Ireland 2018 – Indicators of Air Quality.

EPA (2019b) Air Quality in Ireland 2018 – Supplemental information.

EPA (2018a) Air Quality in Ireland 2017 – Indicators of Air Quality.

EPA (2018b) Air Quality in Ireland 2017 – Supplemental information.

EU Action Plan: 'Towards a Zero Pollution for Air, Water and Soil'.

European Environment Agency (2019). EMEP / EEA Air Pollutant Emission Inventory Guidebook 2019.

German Environment Agency (2022) Review and revision of empirical critical loads of nitrogen for Europe.

Government of Ireland (2023), Climate Action Plan. Changing Ireland for the better.

IAQM (2014) Guidance on the assessment of dust from demolition and construction.

TA Luft (2022) Technical Instructions on Air Quality Control. German Federal Ministry for Environment, Nature Conservation and Nuclear Safety, July 2002.

TII (2022a) Air Quality Assessment of Specified Infrastructure Projects – Overarching Technical Document PE-ENV-01106 (December 2022).

TII (2022b) Air Quality Assessment of Proposed National Roads – Standard PE-ENV-01107 (December 2022).

TII (2022c) Road Emissions Model (REM): Model Development Report GE-ENV-01107 (December 2022).

WHO (2021) WHO global air quality guidelines: particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulphur dioxide and carbon monoxide.